DATA *Nugget*

Changing Salinity to Chase Smelt

Featured laboratory: San Francisco Bay National Estuarine Research Reserve

Research Background:

Suisun Marsh is home to a critically endangered species of fish called the Delta Smelt. Delta smelt are considered an **indicator species** for the Sacramento-San Joaquin Delta, meaning that their presence (or absence) in this environment can tell scientists a lot about the health of the ecosystem. These fish are small and sensitive to changes in their habitat, such as water level and salinity (saltiness). The delta smelt's lifespan is only one year, so maintaining the health of its habitat throughout the year is very important for the future of the population.

Delta Smelt (Credit: Peterson, B. Moose U.S. Fish and Wildlife Service)

Salinity gates at Suisun Marsh (Credit: US Army Corps of Engineers)

Each year, the Department of Water Resources (DWR) alters Suisun Marsh to welcome migrating birds like ducks. To make the habitat more suitable for these birds, DWR open and close salinity gates at the mouth of the marsh. When the gates close, they block salty water from entering the marsh, but still allow fresh water to come in. This blockage typically occurs between October and May, and encourages the growth of invertebrates (bugs and worms) that the birds like to eat. Since the delta smelt is a freshwater fish that uses Suisun Marsh, DWR wants to study how to make the marsh more suitable for the smelt. They wondered, is there a way to make Suisun Marsh a better habitat for the Delta Smelt?

DWR decided to close the salinity gates in August, two months earlier than normal, to allow the marsh to fill with fresh water at the end of the summer. The National Estuarine Research Reserve (NERR) wondered how this will affect water quality in the marsh. A NERR System-wide monitoring program water quality station at Second Mallard Slough took data every 15 minutes during this time.

NERR Water Quality Station in Suisun Marsh (Credit: SF Bay NERR Staff)

Scientific Question: What effect will closing the salinity gates have on salinity in Suisun Marsh?

Scientific Data:

**Use the data below to answer the scientific question:**

| Date	Daily average salinity		Date	Daily average salinity
7/15/2018	6.08		7/31/2018	6.092
7/16/2018	6.025		8/1/2018	6.103
7/17/2018	5.934		8/2/2018	6.102
7/18/2018	5.895		8/3/2018	6.065
7/19/2018	5.896		8/4/2018	5.691
7/20/2018	5.829		8/5/2018	5.058
7/21/2018	5.938		8/6/2018	4.116
7/22/2018	5.899		8/7/2018	3.239
7/23/2018	5.995		8/8/2018	3.096
7/24/2018	5.968		8/9/2018	3.081
7/25/2018	6.024		8/10/2018	3.111
7/26/2018	6.072		8/11/2018	3.204
7/27/2018	6.129		8/12/2018	3.326
7/28/2018	6.178		8/13/2018	3.42
7/29/2018	6.124		8/14/2018	3.493
7/30/2018	6.141		8/15/2018	3.521

What data will you graph to answer the question?

Independent variable: _____

Dependent variable: _____

Draw your graph below: Identify any changes, trends, or differences you see in your graph. Draw arrows pointing out what you see, and write one sentence describing what you see next to each arrow.
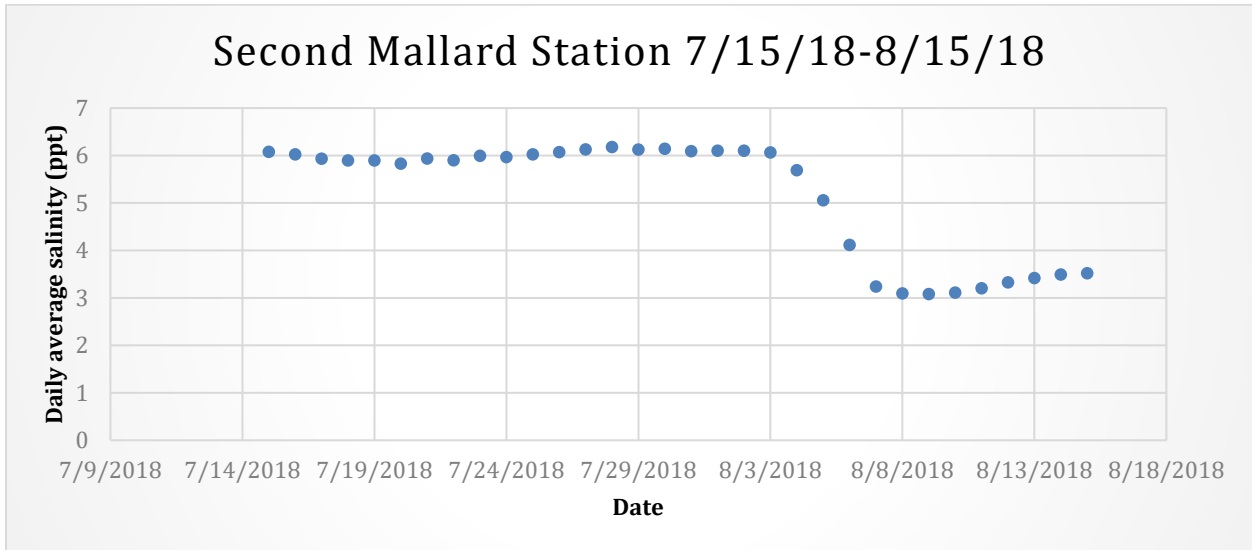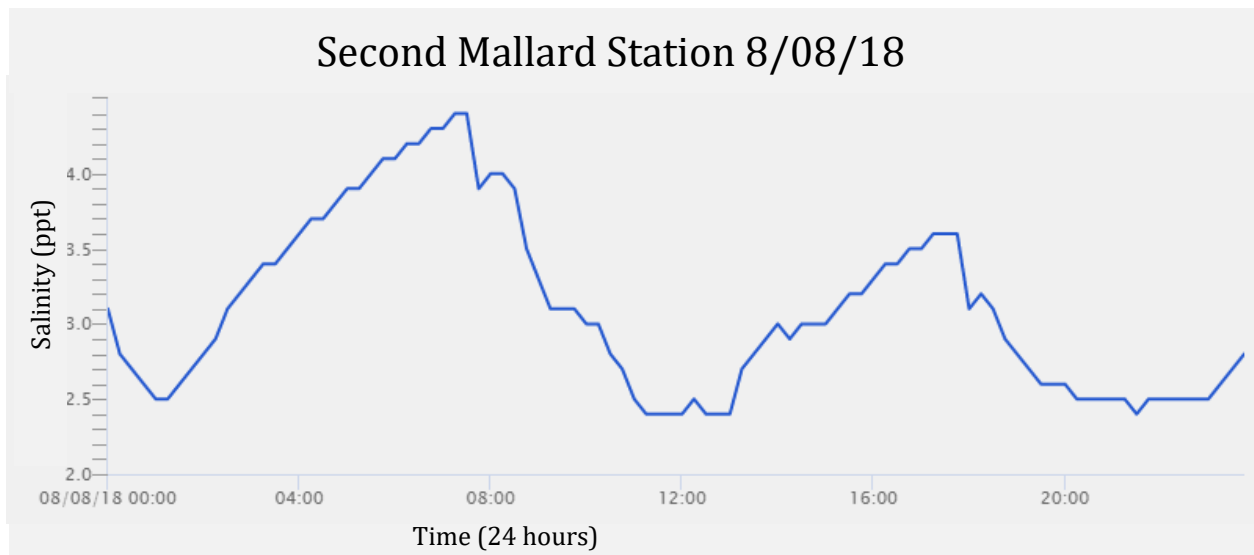

Graph 1: Graphed data using only daily average salinity.
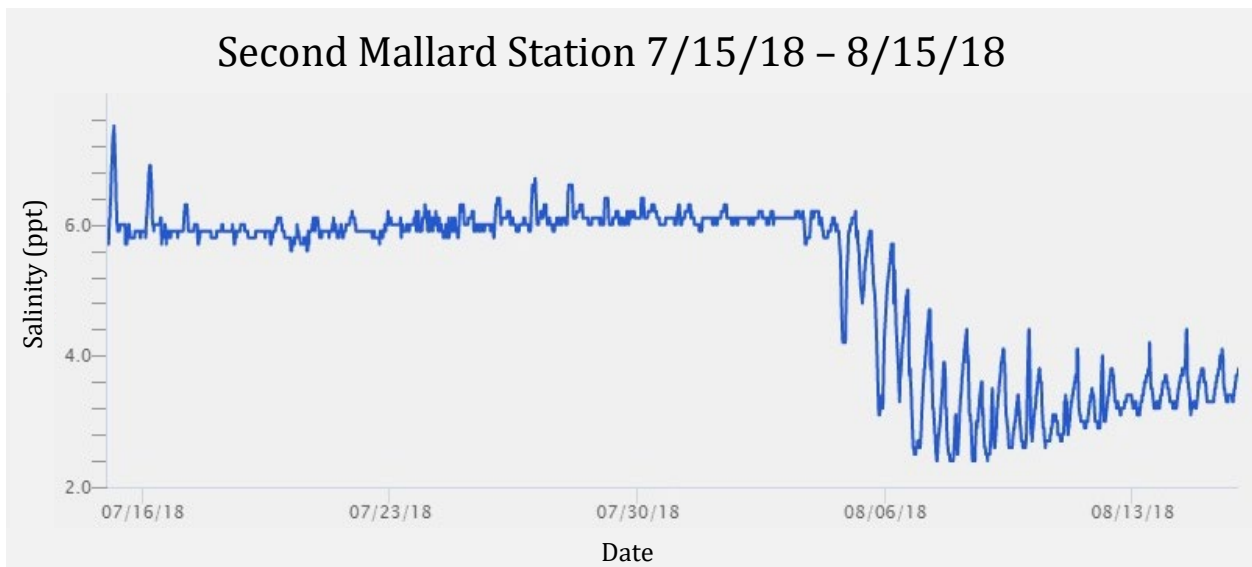
Graph 2: Graphed data using all available data points (every 15 minutes) from NERRSData.org

Second Mallard Station 7/17/18
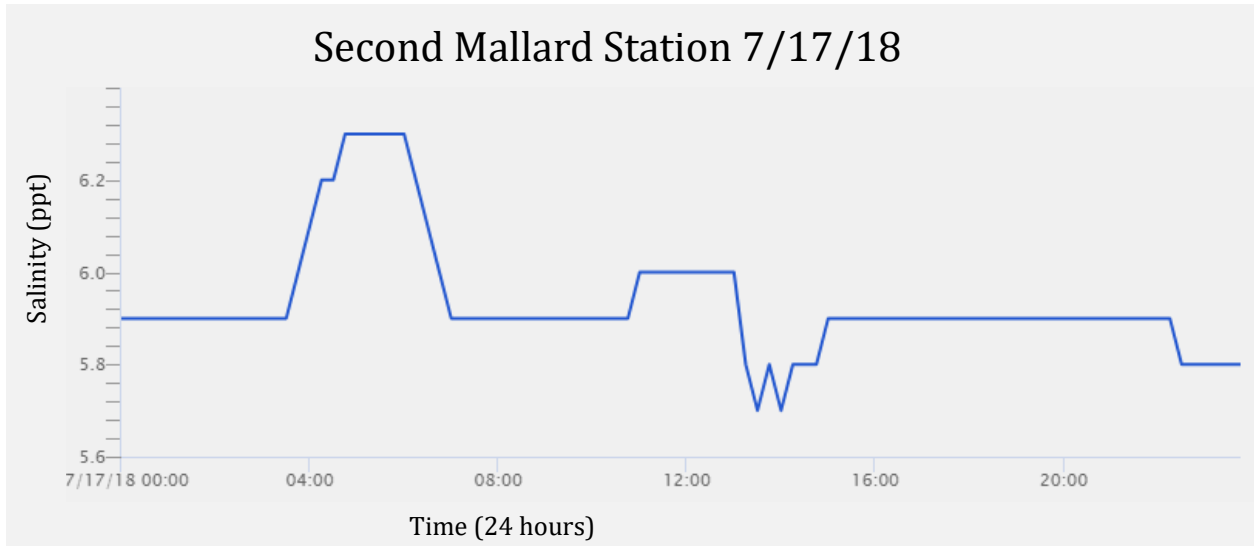
Graph 3: Graphed data using all available data points on July 17, 2018 (before gates were closed). From NERRSData.org

Second Mallard Station 8/08/18

Graph 4: Graphed data using all available data points on August 8, 2018 (after the gates were closed). From NERRSData.org

Interpret the data:

Make a claim that answers the scientific question.

Example Claim 1: Closing the salinity gates makes Second Mallard Station fresher (less salty).

Example Claim 2: Closing the salinity gates makes the salinity more variable at Second Mallard Station.

What evidence was used to write your claim? Reference specific parts of the table or graph.

Claim 1: The daily average salinity at Second Mallard Station decreased when the gates were closed. The data shows a high daily average of 6.178 ppt at the end of July, and a low daily average of 3.081 ppt on August 9th. We know that the gates were closed in August. The average of the salinities measured before August (July 15-July 31) is 6.012 ppt, while the average of the salinities measured in August (August 1-15) is 4.175 ppt.

Claim 2: Although the daily average salinity decreased at Second Mallard Station when the gates were closed, the salinity became much more variable throughout the day. In the first drop (around August 4th), the salinity drops from ~6ppt to ~4ppt. The Graph 2 shows that this trend continued when the gates were being operated. Graphs 3 and 4 demonstrate the difference in variability before and after the gates were closed. (Notice the difference in scale between Graph 3 and 4)

Explain your reasoning and why the evidence supports your claim. Connect the data back to what you learned about how the salinity gates operate.

Claim 1: The salinity at Second Mallard Point decreased because more fresh water was trapped in the marsh. When the salinity gates are operated, they allow fresh water to flood the marsh, which dilutes the salt concentration of the water.

Claim 2: The salinity at Second Mallard Point was more variable, meaning it experienced a greater change in salinity throughout the day. You can see in Graph 3 and 4 that the highs and lows in July vs August are very different. The difference in salinity between high and low in July is smaller than in August.

Your next steps as a scientist: Science is an ongoing process. What new question do you think should be investigated? What future data should be collected to answer your question?

What effect does salinity have on biodiversity of vegetation in Suisun Marsh?
What other water quality characteristics are affected by closing the gates?
What effect does variability in salinity have on vegetation in the marsh?
Does air temperature have an effect on water quality in the marsh?

What future data should be collected to answer your question?

Independent variable(s): _____

Dependent variable(s): _____

For each variable, explain why you included it and how it could be measured.

Vegetation diversity/abundance before and after the gates were closed
        Method: Vegetation surveys using quadrats around the marsh
Dissolved oxygen, turbidity before and after the gates were closed
        Method: Water sampling (collected by NERR SWMP)
Air temperature at the marsh between July 15 and August 15, 2018
        Method: Looking at weather records during the time period

What hypothesis are you testing in your experiment? A hypothesis is a proposed explanation for an observation, which can then be tested with experimentation or other types of studies.

I hypothesize that….
        Vegetation diversity or abundance will decrease when salinity levels are more variable
        Dissolved oxygen/turbidity will decrease/increase after the gates are closed
        Salinity will be higher when air temperature is higher (and vice versa)