Mass Audubon
SALT MARSH SCIENCE PROJECT

An Inquiry based seasonal field science study.
By Elizabeth Duff 1998, Updated 2019
Including *Phragmites* Values
Study By: Kristen Grant, Robert Buchsbaum 1996

Contents

Outline

Stage 1. Introducing Salt Marshes and Mass Audubon Salt Marsh Science Project

1. Students will learn what values of salt marshes, and the threats to them, and how people are working to restore them.
   Methods: Salt Marsh Scavenger Hunt, Wetlands Restoration Video, Wetlands Metaphors activity. (Mass Audubon Education Coordinator is available to present this introduction.)
   Follow-up: Salt Marsh Science Slideshow.

2. Optional: Field Trip One: Salt Marsh Ecology: Mapping and Exploring the Salt Marsh.

Stage 2. Preparing for field research:

Students will learn the methods they will use in the field:

1. Use of the refractometer: What is salinity?
2. What is a transect, how do you do them accurately?
3. What plants grow on a salt marsh? How does one use an identification key to identify plants?

Stage 3. Field Research:

1. Vegetation transect.
2. Measure tides.
3. Do fish samples.
4. Measure salinity.
5. Optional: Bird observation, insect observation, macro-invertebrate observation, Soil sampling: comparing compaction and sedimentation.

Stage 4. Analysis and Discussion

1. Graphing results.
2. Summarizing results.
3. Asking questions, looking for patterns, suggesting possible extensions to the investigation.
4. Sharing information with other schools.

Stage 5. Designing and conducting further studies: (Owning the questions)

1. Discussing which questions are investigable.
2. Planning investigations: Writing methods down in a way that others could conduct the same study.
3. Acquiring materials for the study.
4. Conducting the study.
5. Graphing, summarizing, analyzing, discussing.

Stage 6

Communicating Results

1. Discuss ways of presenting the information to other interested people: Other students and schools, the people in your town, Mass Audubon. Imagine that you are presenting to a large roomful of people. What could you use to make your presentation visible, understandable, and interesting?
2. What are ways you can make this a quality presentation?
3. Design a presentation.
4. Present it! (Share information with your town, with newspapers, at a schools conference, on the internet)

Suggested Study Timeframe:

Fall: Pre-trip prep, and field trips, in class discussion and analysis. Compiling data, raising questions, asking advice from Mass Audubon. Etc.

Explanation: Vegetation data collected in September and October is most valuable. During this time, plants are at their height, at the end of their growing season. They are most easy to identify, as many have seed heads at that time. It is possible to collect vegetation data in November, but is much colder and more difficult.

Please check the tide charts when planning your trips. Salinity data that is collected at a spring tide, and at a neap tide is most valuable. A spring tide occurs around the time of the full moon, and the new moon. Look to see where the tide heights are highest. Plan to take your trip near that time. Neap tide is when the high tides are lowest. Check the tide heights for that event too.

Tide heights measured at spring tides are also most useful. This is also a good time, to mark with flags, where high tide reaches.

(If possible, weekly salinity data would be preferable.)

Winter: Creating/Adding to websites, communicating data, planning additional study, Presenting at March conference.

Spring: Investigating additional study based on investigating student's questions, based on their design.

Field Activities and Materials Lists

1. Salinity
    A. Materials Needed
    B. Pre-trip preparation
    C. Field methods
    D. Follow-up

2. Long-term vegetation surveys (vegetation transects)
    A. Materials Needed
    B. Pre-trip preparation
    C. Field methods
    D. Follow-up

3. Measuring student's impact
    A. Materials Needed
    B. Pre-trip preparation
    C. Field methods
    D. Follow-up

4. Fish sampling
    A. Materials Needed
    B. Pre-trip preparation
    C. Field methods
    D. Follow-up

5. Field Plant/animal interactions observations
    A. Materials Needed
    B. Pre-trip preparation
    C. Field methods
    D. Follow-up

6. Insect sampling
    A. Materials Needed
    B. Pre-trip preparation
    C. Field methods
    D. Follow-up

7. Pre-trip preparation sheets.
8. Field Data collection sheets.
9. In Class - Data analysis sheets.
10. How this connects with the Massachusetts State Curriculum Frameworks.
11. Background Information

Salinity

Objectives: To notice how salinity relates to the growth of *Phragmites*, and salt marsh plants. To notice how salinities change over time.

A. Materials:

Pre-trip classroom demonstration materials:

- Refractometer handout/or overhead
- 1-2 Refractometers
- Salt
- Eye dropper
- 500 ml graduated cylinders
- A large container
- A large mixing spoon
- Water
- Lens paper or dry towels
- Distilled water
- Optional: sea water

Field materials:

- 1-2 refractometers
- distilled water to calibrate the refractometers
- soft cloth
- 1-2 suction tubes
- At least 3 sets of wells made from PVC pipes (Shallow, medium, and deep= 1 set)
- Labeled film canisters

B. Pre-trip preparation:

A. Explain: What is salinity? (How salty the water is) (Compare the word salt to salinity.)

B. Using the refractometer hand-out, explain how a refractometer works, and how to read one. Show students that the scale reads from 0 at the bottom up to 100 at the top (Demonstrate the use of the refractometer). Use distilled water to make sure that your refractometer is calibrated accurately. Distilled water should register 0 $^{0}/_{00}$. If it does not register that level, use the calibration knob to calibrate the refractometer accurately. Measure the salinity of your tap water. Compare it to salinity of sea water or salt water that you mix.

C. Salinity is measured in parts per thousand. Optional: (You can demonstrate what this is, using salt, and measuring utensils, making a solution that is a 20 parts per thousand ($^{0}/_{00}$) (mix well) and then using the refractometer to measure it. If you are using tap water that you have measured the salinity of, ask students to figure out how much salt you would add to make it 20 parts per thousand. Teach students to write it 20 $^{0}/_{00}$ and to read the scale from the right side**.** Show students a diagram of the inside of the refractometer, and teach them to read from the right hand side of the refractometer.

D. Explain why we are measuring salinity: We think that *Phragmites* has trouble growing in highly salty water. It seems to prefer fresh or brackish water. (Fresh mixed with salt). We are measuring the salinity at different heights to see if salinity makes a difference to *Phragmites*, and at what depth. We think that *Phragmites* will not grow as tall where it is salty, and may not be able to grow at all.

Field Methods (Salinity):

1. Ask students to think, and make a prediction: Do you think the highest salinity will be in the shallow, medium, or deep well? Explain their reason why. Measure salinity. Was the prediction correct? What might explain this? (See background information)

- Remove the cover from the well.
- Insert the tubing of the syringe into the well pipe.
- Pull the syringe up until several millimeters of water are contained in the tube.
- Put the film canister at the bottom of the tubing and push the syringe down to release the sample into the canister.

2. Measure the salinity with the refractometer:

- A. Record the site on your data sheet.
- B. Open the sample and insert a clean glass dropper or other clean, suitable devise for taking a drop of water.
- C. Open the flap at the end of the refractometer and put on a drop of water.
- D. Close the flap tightly, put the eyepiece up to your eye and face into the light. Look for the vague line on the meter and gauge a reading. (Read the measurements from the right side. Be sure to notice which way the numbers are going. $^{0}/_{00}$ means parts per thousands, it does not mean percent, which is parts per hundred.) Double check the number with another person in your group. Make sure you agree on the number.
- E. Record your salinity measurement on the data sheet.
- F. After each use of the refractometer, wipe off the refractometer using a dry cloth or towel.

If you do not have immediate access to a refractometer at the site you are sampling from follow these procedures:

- If you are taking samples back to the school to read on another day: refrigerate your samples until you are able to take salinity readings.

- ALWAYS: On masking tape on each film canister; mark the date and location including the number of the well on each with permanent marker. Without this information, the salinity reading is not useful.
- Well numbers are as follows: Site 1 is located inside the *Phragmites* stand; these three wells are marked D=deep for the longest well; M=medium; S=Shallow. Corresponding canisters should be marked 1D, 1M, 1S.
- Site 2 is located in the transition zone. (2D , 2M, 2S)
- Site 3 is Located in the marsh grasses, with no *Phragmites.*

Follow-up: Share with your students the information/analysis that Mass Audubon Scientists have been making regarding their data. How does your data compare? What additional questions does this raise for your students? How does the height of the vegetation compare with the salinity?

Long-term Vegetation survey: Vegetation Transects:

A. Materials Needed: HOW TO SET UP TRANSECTS:

- 4 transect markers: 2 in the *Phragmites*; 2 in the marsh. (Set up transects so they run perpendicular to a ditch. Generally, 0 is in the *Phragmites*, and 25 is at the ditch.)
- 25 or more meter tape measure
- Tomato stake to secure end of measuring tape
- Data sheets
- Clip boards
- Pencils
- Vegetation Key
- Optional: Vegetation poster, Plant field guide.
- Meter stick for measuring height of vegetation.

B. Methods:

Pre-trip Preparation in the classroom:

1. Explain that we are recording the vegetation growing along a transect, and students will be studying this over time to notice patterns of vegetation growth. We are looking to see whether the *Phragmites* stand is growing larger, and replacing other salt marsh plants. If this is happening, we want to know how fast it is happening. Show students graphs made from your site in past years, graphs from other school sites, or graphs from Mass Audubon sites. Use Mass Audubon graphs to practice making predictions. Make predictions about vegetation on your site this year. (How tall do you think the tallest *Phragmites* will be? If you have data from last year: do you think there will be more *Phragmites*? How much more?) Notice the height of *Phragmites*, and make predictions regarding height as well.
2. Explain how to do a transect and practice in the classroom using books, pencils, paper, desks, students, instead of vegetation. (See attached sheet)
3. **Discuss the importance of minimizing impact on the salt marsh, particularly along the vegetation transect line**. Ask: What would happen to the plants if we walk on them? What should we do to help minimize impact on the salt marsh? (See attached sheets regarding impact.)
4. Plan a study method that will maximize accuracy and minimize impact: Do not have more than 10 students standing in one area at one time. Have different students double check each meter on the transect, to reassure accuracy.
5. Bring in samples of salt marsh plant to the classroom, and have students practice identifying them using the identification key.

C. Vegetation Transect Field Methods

- Remind students of the importance of not trampling the vegetation along the transect line.
- Remind students that the plant must be immediately below the measuring tape. If it is off to the side, it is not on the transect. This helps us collect **unbiased** data. (Explain what bias is. See attached sheet.)
- Roll out the measuring tape from one marker to the other.
- Along each meter of the transect, students should identify and record what plants are present. (If you have two classes of 25 students in the field, each pair of students could be responsible for one meter.) If you have fewer than 25 students, make sure all meters are covered. You could have students do 2 meters, so pairs could double check each other.
- Measure the two tallest plants on each meter. Record what type of plant they are.
- **(Optional Follow-up)**: If you may have your students draw a side view diagram of the transect using this information.
- Repeat this process on the second transect.

D. Follow-up:

1. Fill in the Vegetation Analysis Part 2 in order to:
    a. Compile and graph the data.
    b. If you have data from previous years, compare
2. Make predictions.
    a. Read the graph for information.
    b. Raise questions.
3. Write a summary of your findings.

Measuring student's impact

-1. **Materials:**
- Camera film
- Optional: Soil compaction tester

-2. **Methods: Pre-trip:**

A. Show students pictures of impacts on other sites. Explain and discuss ways a salt marsh can be impacted negatively, and positively (See attached sheet). Plan a way to study the site that minimizes impact. (Plan should include: Minimizing # of students in one area at one time, minimizing the amount of time students stand on the marsh, walking on wrack, limiting the area of the study site, standing on previously disturbed areas such as dirt mounds etc.)

B. Photograph the site before students walk on it.

-3. **Field Methods:**

a. Photograph site after students are done for the day.
b. Compare the two photographs. Make suggestions for the following year to minimize impact. (Are there areas you want to avoid to let vegetation recover, or to remain undisturbed?)
c. Optional: Measure the soil compaction using a soil compaction tester. Compare this to an area that students have not walked on. Compare it to a bare area that may be bare because of the weight of an ice flow from previous years.

Fish Sampling

Mass Audubon is investigating the length, volume and amount of fish upstream and downstream of a tidal restriction. We measure fish caught per hour, putting 2 fish traps upstream and 2 fish traps downstream of a tidal restriction, and leaving the traps in the water for 3 hours. We divide by three to find out how many fish were caught in one hour. If you put your fish traps out for a longer period of time, please divide by the appropriate number of hours to find out how many fish were caught per hour.

Our original hypothesis was: Fish are less abundant, smaller, and fewer species with an area that has been tidally restricted, compared to fish outside a tidal restriction. The data we have collected so far is leading us to change that hypothesis.

If your study area does not contain a tidal restriction, you can compare fish upstream and downstream, and develop your own hypotheses.

1. **Materials needed:**

- 4 minnow traps
- 4 trap markers
- One medium sized plastic container for each student participating in fish sampling
- Nets or 25 yogurt containers for dipping are also useful
- Data sheets
- 4 Graduated cylinders
- Pictures of salt marsh fish

2. **Methods:**

Pre-trip preparation:

- Put in the minnow traps at marked locations at least 3 hours before your visit. (Record the time.) If the ditch empties at low tide, be sure not to leave the trap out through low tide, which will kill the fish.
- Put the traps in on a high/falling tide and return to do your sampling well before the tide is at its lowest point.
- Draw on the map the locations of the fish traps.
- Show students a map of the study site, picturing where the traps are. Indicate which way water flows to the sea. Point out any possible tidal restrictions.
- Ask students to predict where the most fish will be, most kinds of fish, and biggest fish.
    - Ask them to write reasons for their predictions.

On the trip:

A. Ask students to predict how many fish they will find in the first fish trap they are working with. After they count the fish at this station, have them estimate how many they will find at the next site: Do they expect more or less upstream or downstream, inside or outside a tidal restriction?

- Half -fill the student's plastic containers with creek water.
- Pull the trap out of the creek and open it up. Scoop out some fish into one of each pairs containers to enable the group to count the species and the populations more quickly and easily. Students can count fish, from one container into the

other, and record their answers. **Remind students to treat fish respectfully. Fish need to be under water to breathe.**

- Record the names of each species sampled and the total number of individuals of each species on the data sheet. Have students total the number of fish.
- When your trip is completed, be sure to return fish gently to the ditch where they came from.
- If you have extra time: Encourage questioning and observation: Do you think there will be more fish at the next trap? Why? What do you think these fish eat? What might eat them? What questions are the students asking? What questions can you investigate further through observation or research? Pine Grove students want to know what killed the fish in their fish trap. They also think that the higher the tide, the fewer the fish in the trap. What is your data showing? What questions do you have that other schools could investigate?

Optional Observation:

Birds in Wetlands:

Materials: Plants in Wetlands Book, data sheets
How do birds interact with other species on the salt marsh?

Question to investigate:
Do certain bird species prefer to nest, feed, or rest in the typical salt marsh vegetation, or in the *Phragmites*?

Bird Methods:

1. Observe birds. Identify species if possible.
2. Record whether they are in salt marsh, in air, in *Phragmites*, on water etc.
3. Record what they are doing.
4. Record date, time, location, weather etc.
5. If possible: Notice what they are eating, and where they are nesting.

Plants in wetlands:

How do plants in a salt marsh interact with other plants, and with other living things?

Pre-trip prep: Show students the Plants in Wetlands Book by Charles Redington. Explain we will be collecting data to add to the book.

We need information regarding spiders, with many salt marsh plant, and little is known about Sea Lavender. Either of these things could be focal points for this observation:

Options:

A. Look for spiders on the salt marsh. When you find them, identify what plant(s) they are on, and what they are doing.
B. Look for Sea Lavender. Sit with a patch of Sea Lavender. Using a hand lens, observe whether there are any insects, spiders, snails etc. on it. Are there any bites taken out of the leaves? Is anything eating it, fertilizing the flower etc? What plant is it growing with? To help focus your students in their observation skills, have students draw a picture of the plant, and the patch of sea lavender, with the other plants it is growing with.

C. Observe any of the Salt Marsh plants in Redington books. Information regarding sea creatures such as snails, crabs etc. is not in the book. Any of this information would be useful.

Optional:

Insect Sampling

Note: Prior to sampling for insects, try to discover your students' feelings about killing the insects which are sampled. If the students have ethical issues with killing the insects, please do your best to release the insects to the field alive. If the students feel that the death of the insects will be necessary to ensure solid data collection, use a killing jar.

I. **Materials needed:**

- 1 insect net for each student participating in the insect sampling.
- 2 clear jars with lids for each student participating.
- Alcohol soaked cotton balls if you intend to kill the insects.
- Data sheets.

II. **Methods:**

- If you intend to kill the insects, put an alcohol soaked cotton ball in each jar. If you are trying to keep the insects alive, put nothing in the jar.
- Give each student a net and ask each to go into the *Phragmites* stand and take 5 random sweeps with the net.
- Ask students to come out of the *Phragmites* and enclose the net over the jar to put insects inside. Quickly close the lid on top.
- With a killing jar, label the jar with the date and site location. Basic identification can be done with field guides back in the classroom.
- If you are keeping the insects alive, ask the students to record very simple descriptions of the insects i.e. Very tiny, fly-like black, two wings or names they know i.e. mosquito. Also count and record total populations of each identified species. When this information is recorded, the insects can be released back into the *Phragmites*.
- Repeat the process in the open marsh.

Pre-Field Trip Resources

Introducing Salt Marshes: Wetland Restoration Video Handout

Name _____ Date

Directions: Find the answers to the following questions while watching the video:
Voices of the Great Marsh Video
https://www.youtube.com/watch?v=9zLkXx2NkcQ

1. What are 3 ways salt marshes are important to people and wildlife?

_____

_____

_____

2. What are three threats to salt marshes?

_____

_____

_____

3. What are things people can do to help protect and restore salt marshes?

_____

_____

_____

4. Explain three reasons why you think the salt marsh in your town is safe or threatened.

_____

_____

_____

FIELD DATA SHEET for IN-SCHOOL PRACTICE TRANSECT

LOCATION_____ Date _____ Class _____

Weather _____

Names _____ Teacher(s) _____

Directions: In the section highlighted on your paper, identify the item immediately below the measuring tape. If the item is to the left or the right of the tape measure, it is not on the transect. If you have a question, ask! Record on the sheet P for present, when an item is present. If an "other" item is present, record the name of the item, and mark P for present.

Distance	Desk	Rug	Paper	Pencil	other	other	other	other
along line								
0 to 1 meters								
1 to 2								
2 to 3								
3 to 4								
4 to 5								
5 to 6								
6 to 7								
7 to 8								
8 to 9								
9 to 10								
10 to 11								
11 to 12								

Measure the tallest items along your transect area. What are they?

Name of item_____ Height _____

Name of item _____ Height _____

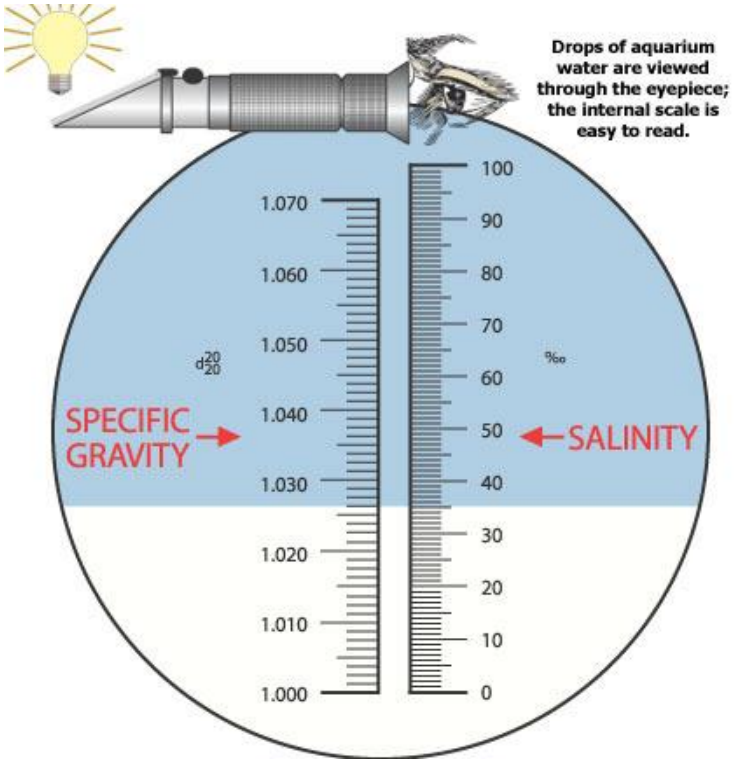
Individual Area surveyed:_____ meters

How to use a Refractometer

Salinity refractometer: An instrument for measuring how salty water is.

How refractometers work: "Refractometers are used to measure substances dissolved in water. The refractometer works using the principle of light refraction through liquids. As light passes from air into water it slows down, creating the phenomenon which gives a "bent" look to objects partially submerged in water. Simply put, the more dissolved solids in water, the slower light travels through it, and the more pronounced the "bending" effect on light. Refractometers use this principle to determine the amount of dissolved solids in water by passing light through ta sample and showing the refracted angle on a scale displayed within the refractometer's eyepiece. "(p. 268 Forestry Suppliers, Inc. Catalog 1997).

Salinity scale: displaying gravity on the left scale, and Parts per Thousand (ppt) ($^{0}/_{00}$) on the right scale.



What is the salinity of the water in this refractometer?

35 ppt.

Operating procedures:

1. Aim the front end of the refractometer toward a light source and rotate the eyepiece to obtain clearest focus.
2. Adjustment of the null (To calibrate your refractometer, so you know it is accurate, use distilled water, and adjust so it reads 0 ppt. Do this before you measure the salinity of other samples.
    A. Open the cover plate, and clean the prism with a soft cloth to avoid scratching the surface.
    B. Apply a few drops of pure distilled water on the prism platform.
    C. Close cover plate.
    D. Remove the rubber cap on the calibration screw and rotate the calibration screw so that the dark and light boundary line coincides exactly with the '0' line on the ppt scale.
3. Carefully dry the prism platform and cover and replace the rubber cap over the calibration screw.
4. Place a few drops of the test solution on the prism and close the cover plate so solution spreads evenly.
5. Aim the front end of the refractometer toward the light source and adjust the eyepiece for clearest focus of the boundary line between the light and dark hemispheres.

Precautions:

1. After use do not dip or run unit under water. Avoid letting water seep into internal section of refractometer.
2. Carefully clean the refractometer after each use with a soft cloth. Do not scratch prism surfaces.
3. Store unit in a dry, clean, and non-corrosive environment.
4. Avoid strong shock

Materials Checklist:

Introducing Salt Marsh Values:

Wetland Metaphor Items.

- sponge
- Pillow case
- pillow
- mixer or egg beater
- cradle
- sieve or strainer
- filter
- antacid
- cereal
- soap

Introducing Salt Marsh Science Study:

- Disk with floppy Shots slide show
- Computer

Salinity

Pre-trip classroom demonstration materials:

- Refractometer handout/or overhead.
- 1-2 Refractometers
- Salt
- Eye dropper
- 500 ml Graduated Cylinders
- A large Container
- A large mixing spoon, Water
- Lens paper or dry towels
- Distilled water
- Optional: sea water

Field materials:

- 1-2 refractometers
- distilled water to calibrate the refractometers
- Soft cloth
- 1-2 suction tubes
- At least 3 sets of wells made from pvc pipes (Shallow, medium, and deep= 1 set)
- Labeled film canisters

Long-term Vegetation Study: Vegetation Transects

- 4 transect markers: 2 in the *Phragmites*; 2 in the marsh.
- 25 or more meter tape measure
- Tomato stake to secure end of measuring tape.
- Data sheets
- Clip boards
- Pencils
- Vegetation Key
- Optional: Vegetation poster, Plant field guide.
- Meter stick for measuring height of vegetation.

Student's Impact Study:

- Camera
- Film.
- Optional: Soil compaction tester

Fish Sampling

- 4 minnow traps
- 4 trap markers
- One medium sized plastic container for each student participating in fish sampling.
- Nets or 25 yogurt containers for dipping are also useful.
- Data sheets.
- 4 Graduated cylinders
- Pictures of salt marsh fish.
- National Audubon Guide to New England

Plants in Wetlands/Birds in Wetlands

Plants in Wetlands Book

- data sheets
- optional: binoculars

Insect Sampling (Optional)

- Insect net for each student participating in the insect sampling.
- Clear jars with lids for each student participating.
- Alcohol soaked cotton balls if you intend to kill the insects.
- Data sheets.

Additional Field Materials:

- Cellular phone
- First Aid Kit

Background information:

TIDES

Tides fluctuate, according to the moon cycle, and the season. Tides are highest near a full moon and a new moon. They are highest in the fall. Tide charts record when the tide will be high, and low, and how many feet the tide will be. It takes 6 hours for the tide to go from high to low or low to high. Some areas of the marsh are flooded daily, while others are flooded bimonthly. Other areas are only rarely flooded, except during a huge storm, and a high tide. People have documented that that sea level is rising. Salt marshes can act as a cushion against rising sea level. In areas that tides are restricted, it takes longer for the tide to flow in, and it does not flow in completely, before the tide begins flowing out. See attached sheet for further information regarding tides.

Glossary:

Brackish: Salty water, that is less salty than sea water. (It is partly mixed with fresh water.)

Refractometer: An instrument that measures how salty water is.

Salinity: The saltiness of water measured in parts per thousand. (Abbreviated ppt or $^{0}/_{00}$)

Spring Tide: a tide of maximum range occurring at the new and full moon.

Quality Control: Scientific methods designed to ensure that data is as accurate as possible. Replication (having more than one person collect data from the same site is one way of doing this.

Salt Marsh Science: Field Guide and Data Book

Name: _____

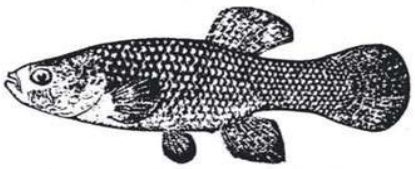
Team: _____

Location: _____

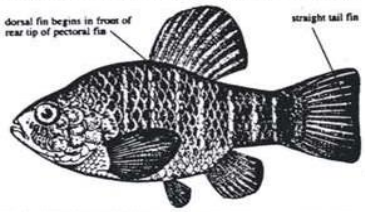
Date: _____

FISH OF THE ESTUARY

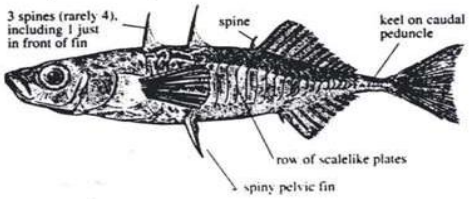
***FUNDULUS HETEROCLITUS*, Mummichog**
Max. 5-6 in.
Most are 3 ½ -4 in.



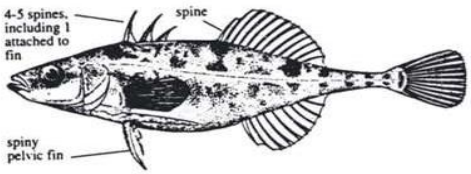
***CYPRINODON VARIEGATUS*, Sheepshead Minnow**
Max 3 in.



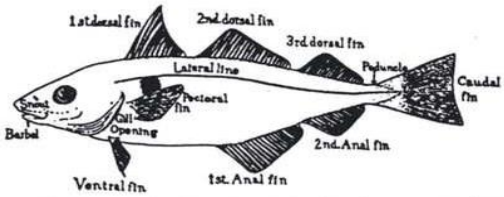
***GASTEROSTEUS ACULEATUS*, Three-spined stickleback**
Has 3 to 5 spines (note: there is also a Two-spined stickleback that has 5-6 bony plates).
Has many bony plates. (More than 6)
Max size 4 in.
Most < 3 in.



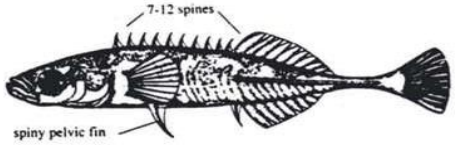
***APELTES QUADRACUS*, Four-spined stickleback**
Has 2 to 4 spines.
No bony plates.
1 ½ -2 ½ in.



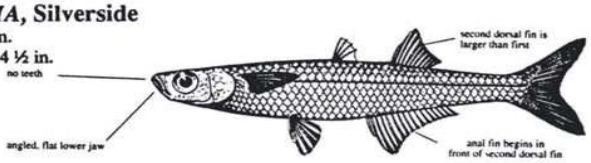
FISH DIAGRAM



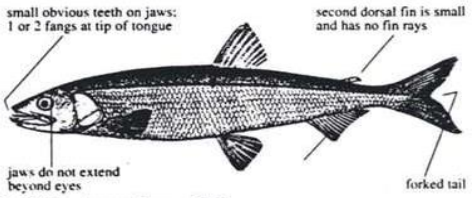
***PUNGITUS PUNGITUS*, Nine-spined stickleback**
Has 7 or more spines
Not more than 3 in.
Most are 2-2 ½ in.



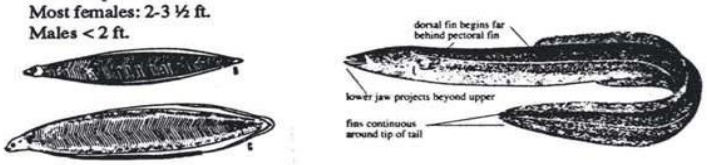
***MENIDIA*, Silverside**
Up to 5 ½ in.
Most are 4-4 ½ in.



***OSMERUS*, Smelt**
Max. 13-14 in.
Most 7-9 in.

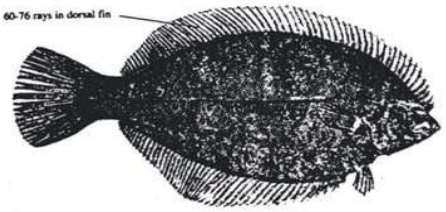


***ANGUILLA ROSTRATA*, American Eel**
Adults: up to 4 Ft.
Most females: 2-3 ½ ft.
Males < 2 ft.



***SYNGNATHUS*, Pipefish**
Max: 12 in.
Most are 4 to 8 in.

***PLEURONECTES AMERICANUS*, Winter Flounder**
Max. 23 inches
Most adults are 12-15 inches



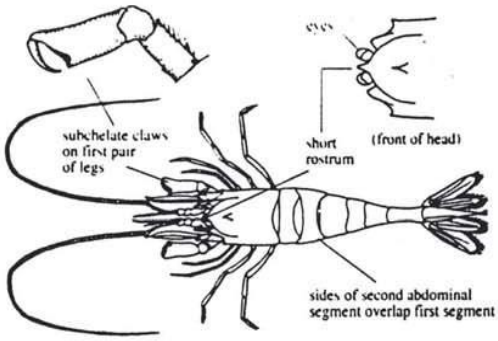
When identifying fish: Look at body shape, and presence and location of fins. For example, Smelt are easily identifiable from Silversides, when you notice that Silversides have two dorsal fins. (See fish diagram to learn fin names). Fish of the same species are often different sizes and colors. *Size and color are generally not good identifying features.*

If you are collecting fish in water of low salinity, you may catch fish not found on this chart. On your data form, you may simply label these "freshwater fish." If you have The National Audubon Society Field Guide To New England look in section on freshwater fish to identify other species.

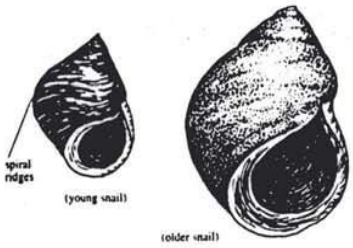
Shared with permission. **Credit: Fishes of the Gulf of Maine**

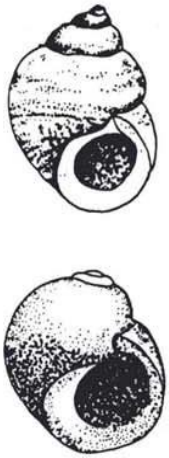
MARINE ANIMALS OF THE ESTUARY

***CRANGON SEPTEMSPINOSA*, Sand Shrimp**
< 6 cm.

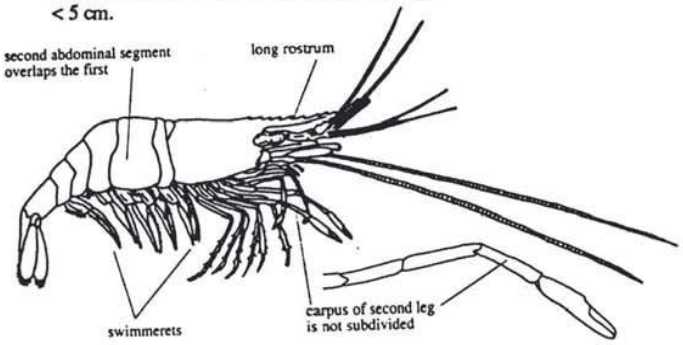


***LITTORINA*, Periwinkle**

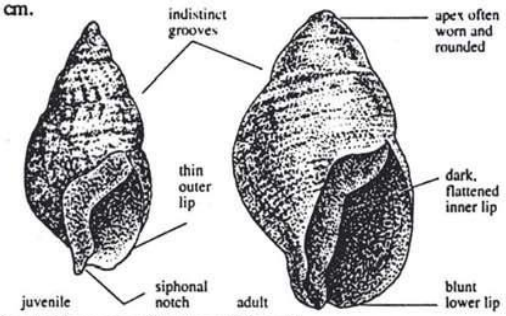




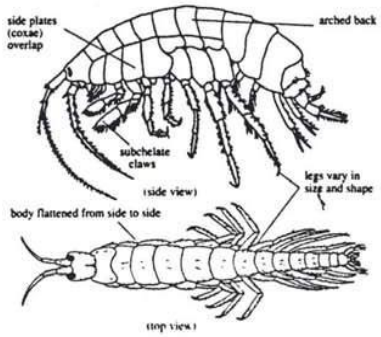
***PALAEMONETES* Grass Shrimp**
< 5 cm.



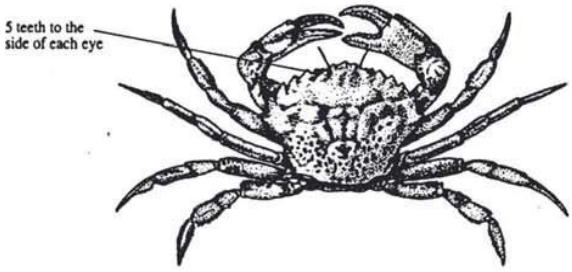
***ILYANASSA OBSOLETA*, Eastern Mud Snail**
< 2.5 cm.



Typical Gammarid Amphipod



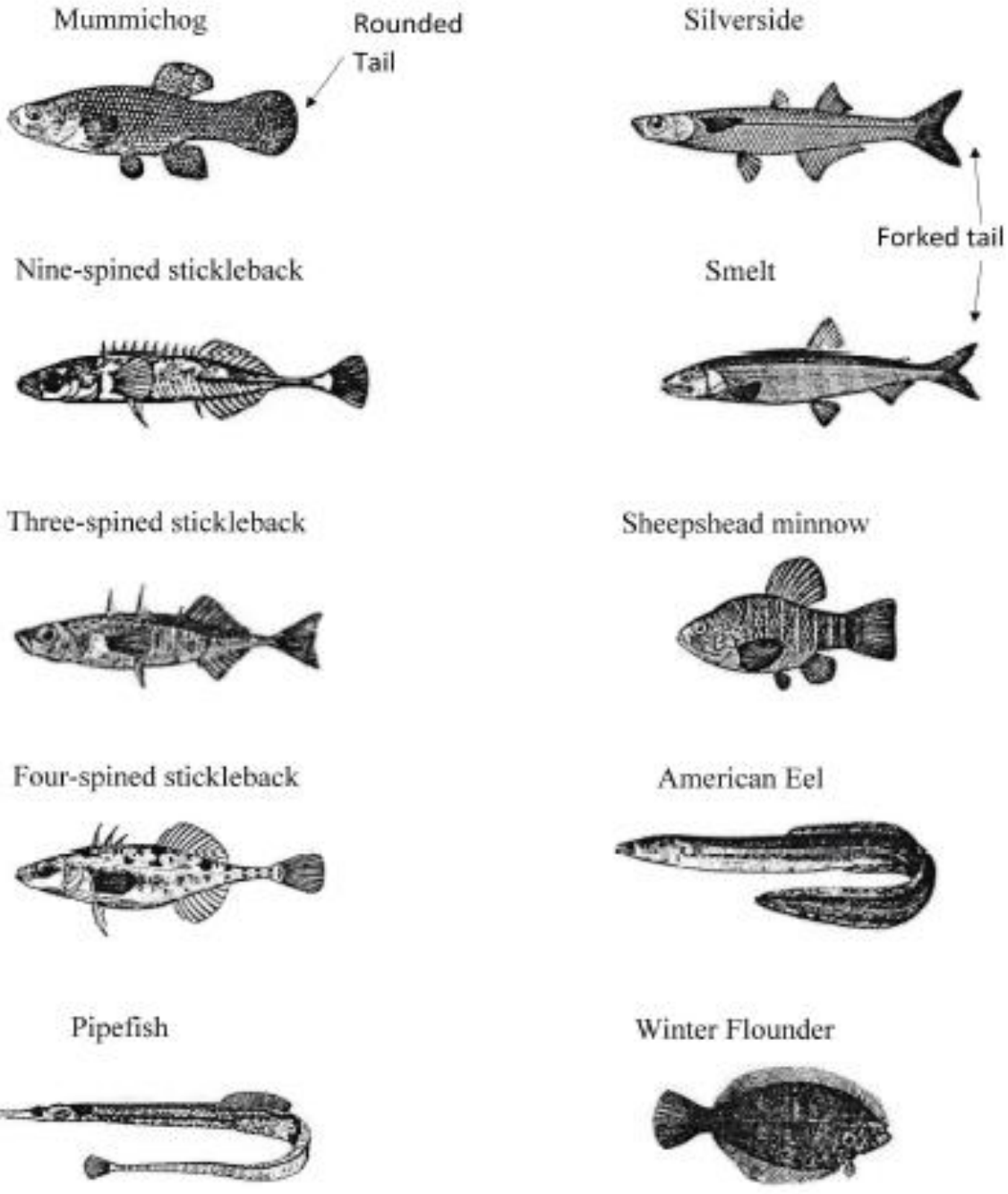
***CARCINUS MAENAS*, Green Crab**
shell width < 8 cm.



<u>When identifying animals</u>: Look at body shape. For example, Periwinkles are easily identifiable from Mud Snails, when you notice that Periwinkle shells are much more rounded than Mud Snail shells. Animals of the same species are often different sizes and colors. *Size and color are generally not good identifying features.*

If you are collecting animals in water of low salinity, you may catch animals not found on this chart. On your data form, you may simply label these "freshwater animal." If you have The National Audubon Society Field Guide To New England look in section on freshwater animals to identify other species.

FISH OF THE ESTUARY



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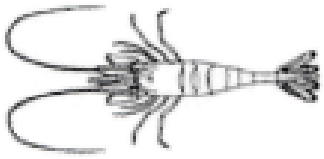
Credit: Fishes of the Gulf of Maine

MARINE ANIMALS OF THE ESTUARY

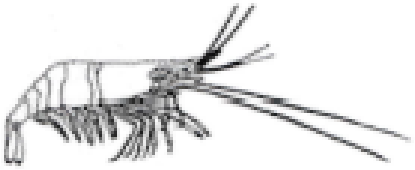
Sand Shrimp (sandy color)



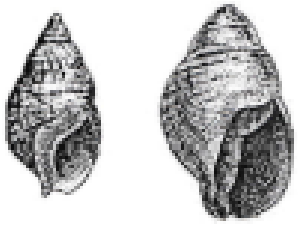
Periwinkle

Grass Shrimp (Glass Shrimp)

(clear color)

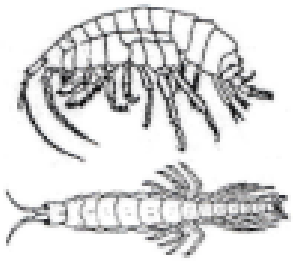


Eastern Mud Snail



Green Crab

Typical Gammarid Amphipod



When identifying animals: Look at body shape. For example, Periwinkles are easily identifiable from Mud Snails, when you notice that Periwinkle shells are much more rounded than Mud Snail shells. Animals of the same species are often different sizes and colors. *Size and color are generally NOT good identifying features.*

Shared with permission. **Credit: Fishes of the Gulf of Maine**

Mass Audubon

Plum Island Ecosystems Long Term Ecological Research

Common Plants of the Salt Marsh Identification Key

By Elizabeth Duff 1997

Please note: not all salt marsh plants are included in this key.
You may want to adapt this key, as you find additional species on your site

1a Plant has long grasslike leaves. (Leaves grow straight to a point.) 8
1b Leaves are not straight and grasslike, or plant does not have a recognizable leaf.....2

2a Plant is fleshy. (If you squeeze a leaf or segment, your fingers get wet from the stuff inside) 3
2b Plant is not fleshy. 4

3a Plant does not have an obvious leaf.....Common Glasswort (*Salicornia europea*)
3b Plant has numerous small leaves.....Sea blite (*Suaeda*)

4a Plant has a twig-like brown stem, and is a small shrub.....Marsh Elder (*Iva frutescens*)
4b Plant does not have a woody stem.....5

5a Leaves are triangular..... Orach (*Atriplex*)
5b Leaves are not triangular.....6

6a Plant grows straight with leaves growing along stem.....7

6b Leaves grow at the base of the plant. The top branches and grows many tiny lavender flowers.....Sea Lavender (*Limonium carolinianum*)

7a Plant grows single stem. Leaf is narrow, then widens, then narrows again to a rounded point. Plant grows golden yellow flowers in the fall. .....Seaside goldenrod .....(*Solidago sempervirens*)
7b Stems are single or forked. Leaf is straight and narrow, tapering to a point. Plant grows purple daisy-shaped flowers in the fall .... Aster (*Aster*)

8a Plant stem is triangular. The plant grows flowers that resemble miniature pine cones. .....Saltmarsh Bulrush (*Scripus*)
8b Stem is not triangular.....9

9a Leaves grow only from the base of the plant. 10
9b Leaves grow along the stem.....11

10a Leaf grows ¼ to ½ inch wide, and up to 6 feet high. Plant grows brown spikes at the top.....Narrow leaved cattail (*Typha angustifolia*)
10b Plant leaf is less than ¼ inch wide, and grows numerous small greenish flowers on a spike. Plant grows from 8-32 inches tall. Seaside Arrow Grass (*Triglochin maritimum*)

11a Plant has numerous leaves growing all the way up the stem.....12

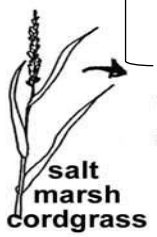
* 11b Plant has few leaves (4 or less) and/or leaves grow only part way up the stem.....13

*Please note: Salt marsh hay may have more than 4 leaves, but the leaves are widely spaced.

12 has 3 choices

12a Plant leaf is wide, greater than ½ inch. Stem is round and hollow. Plant grows a large silky plume at the top. Plant can be 6 ½- 14 feet high... Phragmites (*Phragmites australis*)

12b Plant leaf is narrow. (Less than 1/8 inch.) Plant has many leaves growing in two directions, like a lot of V's on the stem. Leaves are light green, and can be flattened out. ..... Spikegrass (*Distichlis spicata*)

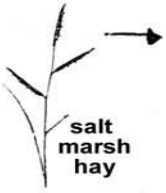


12c Plant leaf is about ¼- ½ inch wide. Plant grows 1-8 feet high. Plant grows tall close to water. Leaves are dark green or yellowish green Leaves feel rough. Plant flower and seeds grow hugging the center of the plant. Saltmarsh cordgrass (*Spartina alterniflora*)

13a Plant stem is, solid, and round. Flower/seed pods are round, and form from the side of the stem, rather than at the very end. .....Black Grass (*Juncus gerardi*)

13b Live plant stem is generally green and jointed. Plant flower and seeds grow on the very end of the stem..... 14

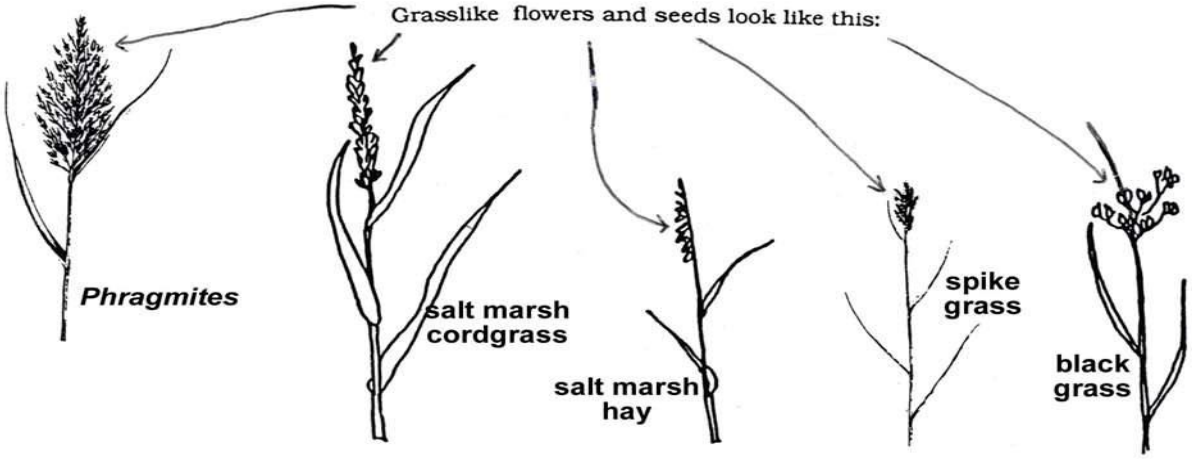
14a Plant leaf is about ¼- ½ inch wide. Plant grows 1-8 feet high. Plant grows tall close to water. Leaves are dark green or yellowish green Leaves feel rough. Plant flower and seeds grow hugging the center of the plant. Saltmarsh cordgrass (*Spartina alterniflora*)



14b Leaf is extremely skinny (It looks like it might fit through a needle eye.) Its sides curve inward. Plant flower and seeds grow on one side of a stalk, (like the teeth on a comb.) ....Saltmeadow cordgrass (*Spartina patens*)

Additional saltmarsh/brackish water plants not included in this key are: Purple loosestrife, marsh fern, silverweed, amaranth, and numerous upland grasses, and upland species.

Grasslike flowers and seeds look like this:



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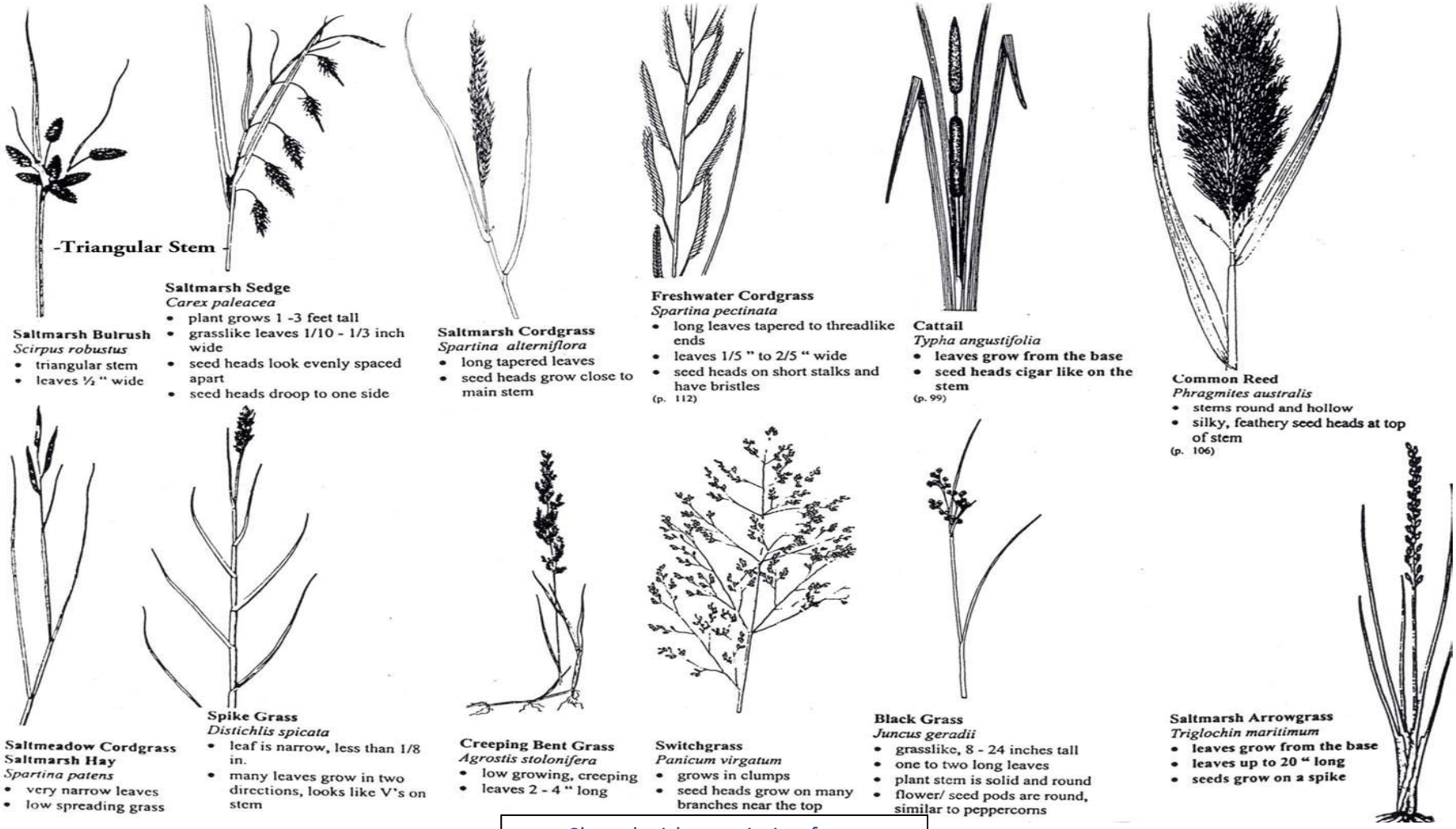

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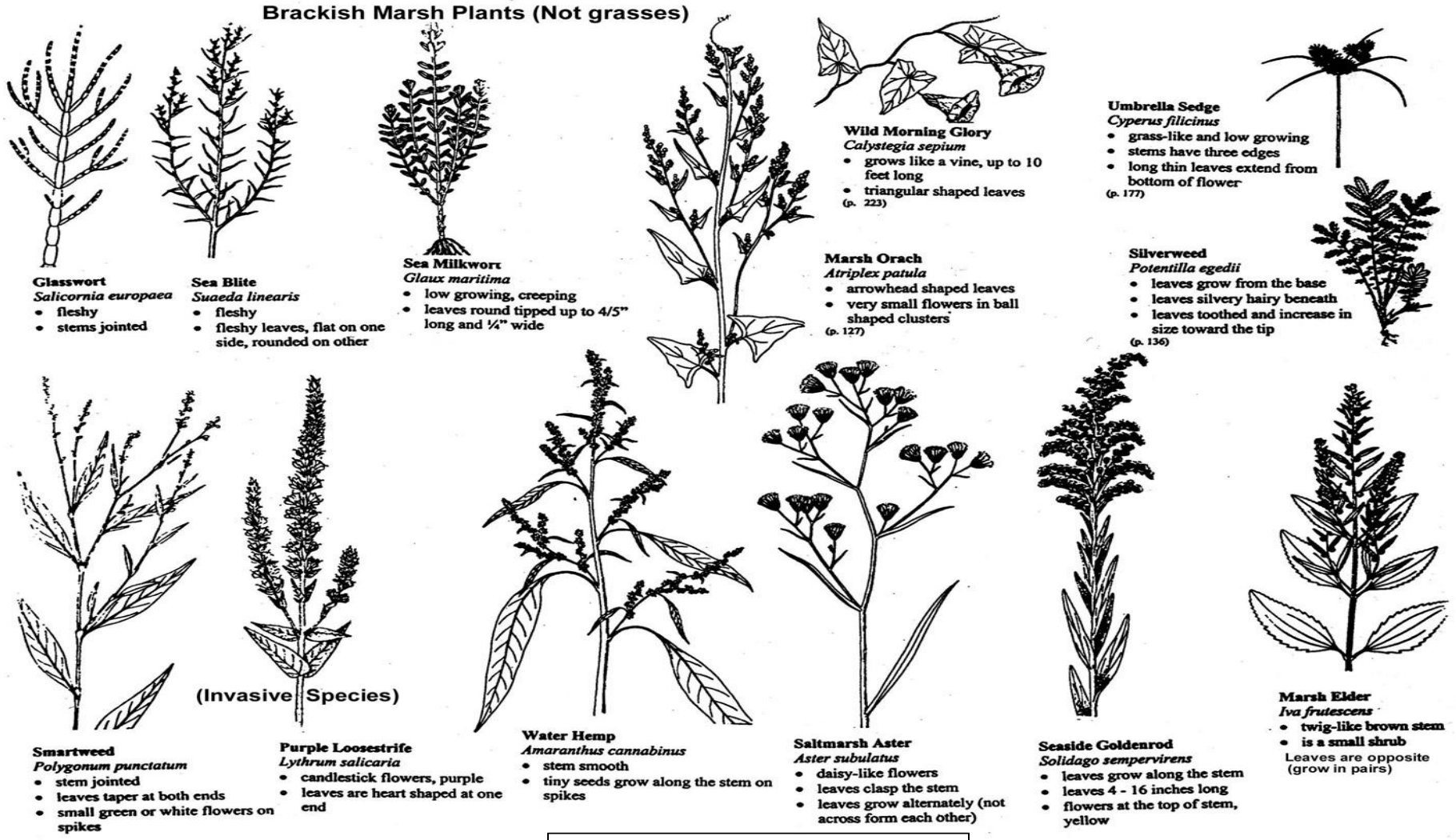

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Field Trip 1: Exploration
Salt Marsh Colors

Directions: Using colored pencils or crayons, draw the natural features of the area, capturing the different shades of color of the salt marsh. Add as much detail as possible: focusing on the different colors, rather than on every blade of grass. (Suggested time: 10-15 minutes)

Marsh Mapping: (Trip 1)

Directions: Record the following on your map:

Natural features:
-Different Vegetation types.
-Wildlife.
-Water

Human Impact:
-Houses, roads, parking lots
-Ditches, Culverts (Pipes)
-Litter

Create a key on your map to indicate what the symbols you are using mean.

Is this a Tidal Restriction?

Mass Audubon Scientists are studying marshes where there are tidal restrictions. Where the tide has been restricted, *Phragmites* often grows. If you discover a tidal restriction, you have found one clue explaining the growth of *Phragmites.*

Measure or estimate and record the channel width and the crossing width.
Channel Width Upstream _____ Downstream _____
Pipe or culvert width upstream _____ Downstream _____

Observe and record using the following Restriction Classification Scheme.

Classification	Channel Vs. Culvert Opening	Upstream	Downstream
1	River Width < Opening Width	1	1
2	River Width = Opening Width	2	2
3	River Width 1 to 2 x Opening Width	3	3
4	River Width 2.1 to 5 x Opening Width	4	4
5	River Width over 5x Opening Width	5	5
Classification	**Evidence of Flow Restriction/Erosion**		
1	Unrestricted/no pooling	1	1
2	Flow detained/slight erosion	2	2
3	Minor pooling/ erosion present	3	3
4	Significant pooling/significant erosion present	4	4
5	Major pooling/major erosion present	5	5

Definitions:

Erosion: Is the wearing a way of sediments. (If tidal flow is restricted by a culvert, the speed of the water can increase as it goes through the culvert. This can increase erosion, as the water comes through with great force, wearing away the banks.)

Pooling: A pool of water is standing water (as opposed to flowing water in a river.) Pooling occurs when a pipe is too small. The water stands still, unable to flow through.

	Vegetation Comparison		
1	Upstream = Downstream	1	1
2	Upstream slightly different than downstream	2	2
3	Upstream different than downstream	3	3
4	Upstream much different than downstream	4	4
5	Upstream completely different than downstream	5	5

Vegetation Comparison: When the tidal range is reduced, the upstream habitat may no longer be dominated by salt marsh grasses, but instead may contain less salt tolerant species such as Common Reed (*Phragmites australis*) or freshwater species such as cattails (*Typha sp.*) In extreme cases, the habitat may evolve into shrub or forested swamp, and the former wetland may be invaded by upland species.

Salt Marsh Observations:

Record your observations of the following feel free to make comparisons:

COLORS:

TEXTURES:

SHAPES:

SMELLS:

SOUNDS:

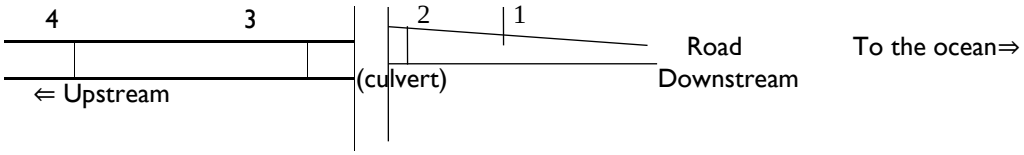
FEELINGS: (How does it feel to your feet, your skin, your emotions, etc.)

FISH DATA SHEET

Suggested App: Tide Charts Near me: https://play.google.com/store/apps/details?id=me.tidesnear.free&hl=en_US

Location: _____ **Date** _____ **Tide: Spring Neap**

Mass Audubon is studying to see if the size and species of fish differ upstream and downstream of a tidal restriction (an area where a small culvert prevents full tidal flow.)



If you are trapping fish upstream and downstream of a culvert, use the following labeling system:

1. Furthest downstream (closest to the ocean)
2. Downstream of a culvert
3. First trap upstream of a culvert
4. Furthest upstream of a culvert (Furthest away from the ocean.)

Predict: A. Will there be more fish upstream or downstream?

Explain your answer _____

Time trap set	Time Trap Pulled	Total Time	Fish trap #	What species are present?	How many of each	Total volume of each species	Average volume of one fish. (ml)
				Downstream			
Biggest	Mummichog		Trap 1				
Smallest	Mummichog						
Set	Pulled	Total					
			Trap 2				
Biggest	Mummichog						
Smallest	Mummichog						
Set	Pulled	Total		**Upstream**			
			Trap 3				
Biggest	Mummichog						
Smallest	Mummichog						
Set	Pulled	Total					
			Trap 4				
Biggest	Mummichog						
Smallest	Mummichog						

Follow-up Compile your data and do these additional computations:

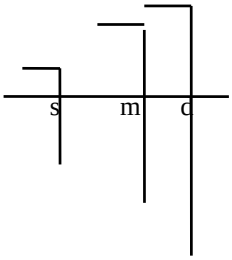
A. Find the total number of each species upstream vs downstream.

B. Where is there greater biodiversity? Upstream or downstream?

C. Find the average volume of mummichogs upstream vs. downstream.

D. In the classroom, graph your results.

SALINITY FIELD DATA SHEET



Shallow=5-20 cm
Medium=35-50 cm
Deep=65-80 cm

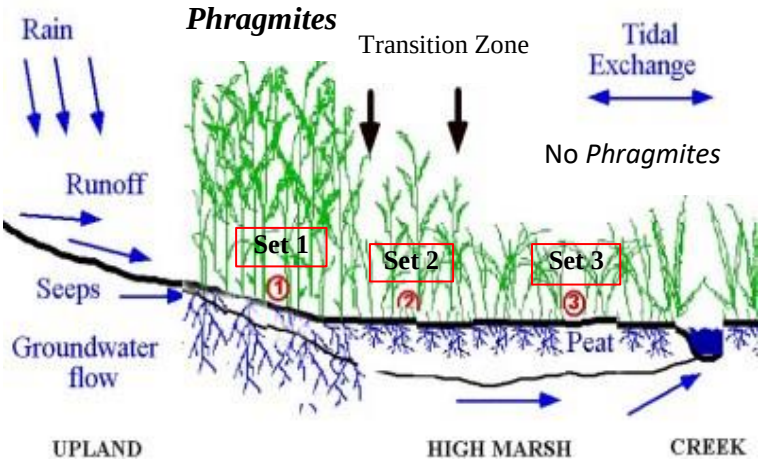
Date _____
Location: _____
Excel file name: _____well.xls
We do not know if shallow, medium, or deep water has the most impact on *Phragmites*. We are measuring salinities at different depths, and locations to see what impact it is having on the plant life.

1. **Make predictions:** Circle where do you think salinity will be greatest?
   Shallow Medium Deep

   Explain your prediction.

_____

_____



2. Wells are located at 3 different locations (See Diagram). Where do you think the greatest salinity levels will be found? (Circle one)

   1. In the *Phragmites* 2. In the transition zone 3. In the salt marsh grasses, with no *Phragmites*

3. Explain your predictions: Why do you think so?

_____

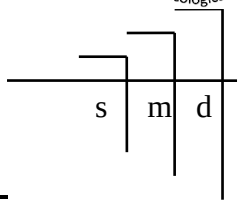
4. Measure salinity. Be sure to double check you are reading it accurately. Have members in your group double-check your answer.

	Transect 1		**Transect 2**
Set 1.1 (in *Phragmites*)	Shallow_____ Medium_____ Deep_____ Notes:	Set 1.2	Shallow_____ Medium_____ Deep_____ Notes:
Set 2.1 (transition)	Shallow_____ Medium_____ Deep_____ Notes:	2.2	Shallow_____ Medium_____ Deep_____ Notes:
Set 3.1 (no *Phragmites*)	Shallow_____ Medium_____ Deep_____ Notes:	3.2	Shallow_____ Medium_____ Deep_____ Notes:
	Transect 3		**Salinity: Background Information** Salinity is how salty the water is. The saltier the water is, the higher the salinity in parts per thousand. Something that is 20 grams salt out of a total of 1000 ml of water is written $20^0/_{00}$. We think that *Phragmites* has difficulty growing in high salinities (greater than $20^0/_{00}$) ($20^0/_{00}$ is the same as 2%).
Set 1.3	Shallow_____ Medium_____ Deep_____ Notes:		
Set 2.3	Shallow_____ Medium_____ Deep_____ Notes:		
Set 3.3	Shallow_____ Medium_____ Deep_____ Notes:		

SALINITY FIELD DATA SHEET

Date: _____

Location:_____



Shallow = 5-20 cm
Medium = 35-50 cm
Deep = 65-80 cm

Locate on the map which transect you are sampling. Record the number here. Transect # _____

1. **Make predictions:** Circle where do you think salinity will be greatest?
   Shallow Medium Deep

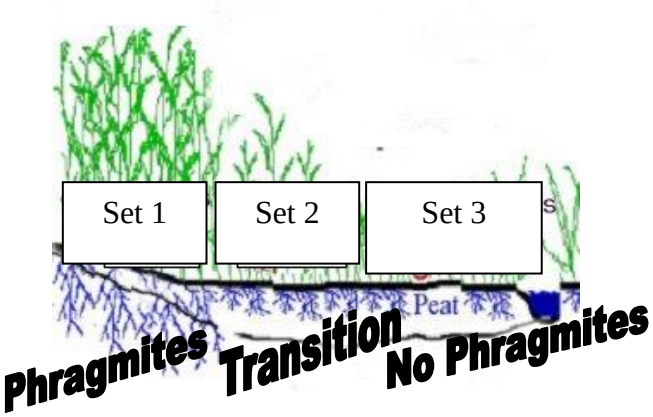
Explain your prediction. I think the _____ well will have the highest salinity because

_____

Salinity	**Transect Number_____**	**Notes**
Set 1 (In *Phragmites*)	Shallow _____ Medium _____ Deep _____	
Set 2 (transition)	Shallow _____ Medium _____ Deep _____	
Set 3 (No *Phragmites*)	Shallow _____ Medium _____ Deep _____	

2. Wells are located at 3 different locations. (See Diagram.) Where do you think the greatest salinity levels will be found? (Circle one)

Set 1. In the *Phragmites*. Set 2. Transition Set 3. In the salt marsh grasses with no *Phragmites*.



Explain your prediction. Why do you think so?
I think the set # _____ will have the highest salinity level because

_____

_____

3. Measure and record your answers above. Check the salinity scale. What category (or categories) is your salinity?

_____ Hyperhaline (Superhigh >35 ppt) _____Polyhaline (High 19-35 ppt) _____Mesohaline (Medium 5-18 ppt) _____Oligohaline (Low <5 ppt)_____ Fresh (0-.05 ppt)

4. Salt marsh scientists noticed that *Phragmites* has a hard time growing in salinity greater than 18 ppt. Is this trend supported at your site? What evidence can you give?

_____

Salinity Background Information: Salinity is how salty the water is. The saltier the water is, the higher the salinity. Most refractometers measure salinity in parts per thousand. Something that is 20 grams salt out of a total 1000 ml of water is written 20 $^{0}/_{00}$. We think that *Phragmites* has difficulty growing in high salinities (greater than 20 $^{0}/_{00}$) (20 $^{0}/_{00}$ is the same as 2 %.)

FIELD DATA SHEET for VEGETATION TRANSECT

LOCATION _____ Date _____ Teacher _____

Directions:

1. On your data sheet, circle the meter assigned to you. Record all of your data in that row.
2. Find your meter.
3. Look directly below the meter tape for plants.
4. Notice how many different plants are on your meter.
5. Identify each different kind of plant, using the identification key, pictures, or field guide.
6. If you have a question, ask!
7. Record on the sheet P for present in the row your meter is, when a plant is present.
8. If an "other" plant is present, record the name of the plant at the top of the column and mark P for present.
9. Measure the two tallest plants on your meter, record the type, and height in cm.
10. Give your group leader your data.

Distance	Height of tallest *Phragmites* on each meter.	Phragmites (*Phragmites australis*)	Saltmarsh cordgrass (*Spartina alterniflora*)	Saltmarsh Hay (*Spartina patens*)	spike grass (*Distichlis spicata*)	other	other	other	other	other	other
along line											
0 to 1											
1 to 2											
2 to 3											
3 to 4											
4 to 5											
5 to 6											
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19 to 20											
20 to 21											
21 to 22											
22 to 23											
23 to 24											
24 to 25											

We are particularly interested in the height of the following plants: *Phragmites*, purple loosestrife, cattail and salt marsh cordgrass. Please record the height of the tallest of these species on your transect.

FIELD DATA SHEET for VEGETATION Transect Teacher's Version

LOCATION _____ Date _____ Teacher _____

Directions:

1. On your data sheet, circle the meter assigned to you. Record all of your data in that row.
2. Find your meter.
3. Look directly below the meter tape for plants.
4. Notice how many different plants are on your meter.
5. Identify each different kind of plant, using the identification key, pictures, or field guide.
6. If you have a question, ask!
7. Record on the sheet P for present in the row your meter is, when a plant is present.
8. If an "other" plant is present, record the name of the plant at the top of the column, and mark P for present.
9. Measure the two tallest plants on your meter, record the type, and height in cm.
10. Give your group leader your data.

We are particularly interested in the height of the following plants: *Phragmites*, purple loosestrife, cattail and salt marsh cordgrass. Please record the height of the tallest of these species on your transect.

Distance	Height of tallest *Phragmites on each meter.*		Phragmites (*Phragmites australis*)		Salt marsh cordgrass (*Spartina Alterniflora*)		Saltmarsh Hay (*Spartina patens*)		Spike grass (*Distichlis spicata*)		other		other		other		other		other		other	
0 to 1																						
1 to 2																						
2 to 3																						
3 to 4																						
4 to 5																						
5 to 6																						
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17 to 18																						
18 to 19																						
19 to 20																						
20 to 21																						
21 to 22																						
22 to 23																						
23 to 24																						
24 to 25																						

If you are collecting data on more than one day, copy student's data into one column on one day, and the other column on the next, so you can compare. On the second day (or later) have student double-check any discrepancies.

Sample Sheet Filled in: FIELD DATA SHEET for VEGETATION TRANSECT

LOCATION _____ Date _____ Teacher _____

Directions:

1. On your data sheet, circle the meter assigned to you. Record all of your data in that row.
2. Find your meter.
3. Look directly below the meter tape for plants.
4. Notice how many different plants are on your meter.
5. Identify each different kind of plant, using the identification key, pictures, or field guide.
6. If you have a question, ask!
7. Record on the sheet P for present in the row your meter is, when a plant is present.
8. If an "other" plant is present, record the name of the plant at the top of the column, and mark P for present.
9. Measure the two tallest plants on your meter, record the type, and height in cm.
10. Give your group leader your data.

We are particularly interested in the height of the following plants: *Phragmites*, purple loosestrife, cattail and salt marsh cordgrass. Please record the height of the tallest of these species on your transect.

Distance along line	Height of tallest *Phragmites* on each meter	Phragmites (*Phragmites australis*)	Saltmarsh cordgrass (*Spartina alterniflora*)	Saltmarsh hay (*Spartina patens*)	Spike grass (*Distichlis spicata*)	Other Black grass	Other Glass-wort	Other Purple loose-strife	Other Sea lav-ender	Other
0 to 1	250	P						P 167		
1 to 2	244	P						P 165		
2 to 3	256	P						P 164		
3 to 4	225	P								
4 to 5	225	P								
5 to 6	220	P								
6 to 7	213	P		P						
7 to 8	200	P		P			P			
8 to 9				P			P			
9 to 10	175	P		P						
10 to 11				P					P	
11 to 12				P						
12 to13				P		P				
13 to 14				P		P				
14 to 15				P		P				
15 to 16				P						
16 to 17				P		P			P	
17 to 18				P		P				
18 to 19			P 33	P		P	P			
19 to 20			P34	P			P			
20 to 21			P 35	P						
21 to 22			P36	P						
22 to 23			P 37	P						
23 to 24			P 38	P						
24 to 25			P 39	P						

FIELD DATA SHEET for VEGETATION TRANSECT: Brackish Marsh

LOCATION _____ Date _____ Teacher _____

Questions: Is *Phragmites* spreading? Is the area that is a monoculture (where only *Phragmites* is growing) spreading? How fast? Is it growing tall and healthy or short and stunted? Did restoration efforts help? Compare your data to past years to notice. Directions:

1. Observe your plant sample closely. Be sure you know recognize the traits that are unique to your plant. Note how it looks both when in blossom (or with seed head) and without.
2. Look along the transect for your plant. If you do not see it immediately in a meter, pull aside other plants or wrack to look more closely. If you are in doubt ask for help!
3. Record a "P" in every meter that you find it.
4. Report your findings to your group leader. Make sure they record your data accurately.

5. If you are doing *Phragmites*, Make sure you measure the height in centimeters.
6. If you are doing some other plant, and it is the tallest plant on some meters, measure its height too.
7. If you have extra time, do another plant.

Distance along line	Ht. of tallest *Phragmites* (in cm.) (star which plant is tallest)	Phragmites (*Phragmites australis*)	Cattail (*Typha angustifolia*) **Please record Height.**	Creeping Bent Grass (*Agristus stolinifera*)	Goldenrod (*Solida go semperv irens*)	Silverweed (Potentila anserina)	Salt marsh Bulrush	Saltmarsh sedge	Saltmarsh Cord-grass (*Spartia alerniflora*)	other	other
0 to 1											
1 to 2											
2 to 3											
3 to 4											
4 to 5											
5 to 6											
6 to 7											
7 to 8											
8 to 9											
9 to 10											
10 to 11											
11 to 12											
12 to 13											
13 to 14											
14 to 15											
15 to 16											
16 to 17											
17 to 18											
18 to 19											
19 to 20											
20 to 21											
21 to 22											
22to 23											
23to 24											
24to 25											

We are particularly interested in the heights of: *Phragmites*, purple loosestrife, cattail, and saltmarsh cordgrass.

FIELD DATA SHEET for VEGETATION TRANSECT: Brackish Marsh Teacher's Version

LOCATION _____ Date _____ Teacher _____

Questions: Is *Phragmites* spreading? Is the area that is a monoculture (where only *Phragmites* is growing) spreading? How fast? Is it growing tall and healthy or short and stunted? Did restoration efforts help? Compare your data to past years to notice.

Teacher Directions:

- Make sure you are familiar with the plants and can help the students identify them accurately. Assign each pair one or two plants. (Assign similar plants to the same pair, pointing out differences, to avoid confusing one with the other.)
- Review the site prior to your visit, and bring in plant samples that you do not recognize to identify in advance.
- **Suggested book:** A Field Guide to Coastal Wetland Plants of the Northeastern United States by Ralph W. Tiner Jr.
- *Use the double columns to double check one group against another.* You want to compile one set of accurate data.
- Know your students. Who needs an "easy" plant? Who is attentive to details and will look hard for a rare one.

1. Observe your plant sample closely. Be sure you know recognize the traits that are unique to your plant. Note how it looks both when in blossom (or with seed head) and without.
2. Look along the transect for your plant. If you do not see it immediately in a meter, pull aside other plants or wrack to look more closely. If you are in doubt ask for help!
3. Record a "P" in every meter that you find it.
4. Report your findings to your group leader. Make sure they record your data accurately.
5. If you are doing *Phragmites*, make sure you measure the height in **centimeters.**

Distance	Height of tallest *Phragmites on each meter.*		Phragmites (*Phragmites australis*)		Salt marsh cordgrass (*Spartina Alterniflora*)		Saltmarsh Hay (*Spartina patens*)		spike grass (*Distichlis spicata*)		other		other		other		other		other		other	
0 to 1																						
1 to 2																						
2 to 3																						
3 to 4																						
4 to 5																						
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18 to 19																						
19 to 20																						
20 to 21																						
21 to 22																						
22 to 23																						
23 to 24																						
24 to 25																						

Remember: What is most important is we get the *Phragmites* data accurately. Double check that data yourself.

Bird and Vegetation Observations:

Mass Audubon and Dr. Charles Redington author of *Plants in Wetlands Redington Field Guide* are interested in knowing how birds interact with different plants (vegetation). Please observe how birds are using plants. Are they nesting in cattails and *Phragmites* in the cordgrasses, do they use blades of these grasses to make nests, are they resting on these plants. Do they use these plants to hide in?

If you have many species of birds that you are observing have people in your team choose different species to observe, so you can collect information on each species.

Type of Bird	How many do you see? (Keep a tally.)	What is it doing?	What type of plant is it using/on/near? (A short grass, Phragmites, upland)	What is it using the vegetation for? (Nesting, resting, hiding, eating etc.)

Invertebrates/Vegetation Study

Date _____

Many creatures live on the salt marsh. A closer look will help you observe them.
Using a hula hoop or rope to de-mark the area you are studying, count how many creatures you can find on the vegetation, on the surface of the marsh, and in the mud. You might find spiders, insects, snails, crabs and more!

ANIMALS

Draw and/or name what you see.	How many? (Keep a tally)	Where did you find it? (On the surface of the ground, in the mud, under water)	How is it interacting with plants? (Eating, walking on, resting, making a nest/web, hiding in, etc.)	What kind of plant is it using? (Please be as specific as you can.) (What kind of grass)

Additional Questions:

What additional scientific questions do you have? How could you investigate those questions? Think of at least 3 questions including:

A) A question you could research on the internet or elsewhere.

B) A question you could ask a professional scientist.

C) A question you can design a study to investigate.

D) Explain the method of your study (Use additional paper if necessary).

List 5 things that are good (+) and bad (-) about this salt marsh.

(+)	(-)
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.

Explain one of your (+) and one of your (-) answers.

(+):

(-):

Marsh Memories:

How has your knowledge and feelings about salt marshes changed?

I used to think salt marshes were .....

And now I know the salt marsh is.....

What actions do recommend to take to help improve and protect the salt marsh in your town?

a. _____

b. _____

c. _____

What additional questions would you like to investigate on the salt marsh?

a. _____

b. _____

c. _____

Post-trip activities:

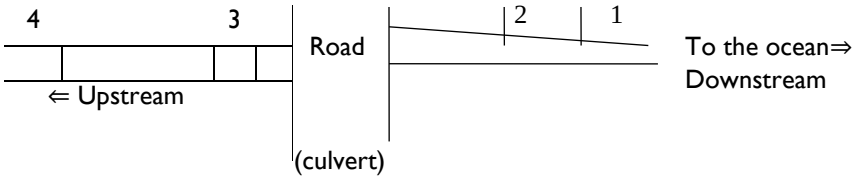
FISH: CLASS COMPARISON

Name: _____ Date: _____

Location: _____ Class:_____

Class comparison:

Write the number of fish present in each trap location:



Location	Trap 1		Trap 2		Trap 3		Trap 4.	
Fish Species	Number	Ave. Vol.	Number	Ave. Vol.	Number	Ave. Vol.	Number	Ave. Vol.
Mummichog								
Silverside								
3 Spined Stickleback								
4 Spined Stickleback								
9 Spined Stickleback								
Sand Shrimp								
Shore (grass) shrimp								
Eel								
Crab								
Other:								
Total # organisms								
Total Volume								
Total # of species								

1. Which trap had the most fish? _____
2. Which trap had the greatest average volume of fish? _____
3. Which trap had the greatest variety of species?
4. What are possible explanations for these results?

_____

_____

_____

_____

5. Design a graph that would be helpful in communicating your results. Graph this data.

Have students compile and discuss the data:

Vegetation:

1. Post all vegetation data on the board, and have students graph it, and answer the questions at the bottom of the vegetation analysis page. You may have students work individually, in pairs, or in groups.
2. Discuss their findings. Was the data collection accurate? (Did students collect the same information from the same sites?)
3. If you have data from a previous year: Is the *Phragmites* area growing? What are student's predictions for the future?
4. What more do students want to know?

Fish data:

1. Have students who have data from different fish traps post the information on the board.
2. Note which fish traps had the most fish. Discuss possible reasons why. List all hypotheses.
3. What is impacting your fish traps?

Salinity:

Notice patterns: Where was the salinity the highest? Lowest? What was the highest salinity in the *Phragmites* stand?

Tides:

Did the tide enter the transition zone (where there are mixed vegetation and *Phragmites*)? Did it enter the *Phragmites* stand? How high was the tide? Use the tide chart to figure out: how many days of the year have a tide that height or greater?

Summarize and share: Summarize and share what you are learning. Students may choose the best summaries to post to other schools. Use the graphs to help illustrate your points.

Additional Questions:

Discuss:

(Owning the questions)
What are additional questions that students have? Which questions can you answer through observation? Research using books, internet or interviews, or through further investigation.

Design a new study:
Decide which question(s) are ones students can investigate, and with them design a study to investigate that question. If you have questions about the design of your study, feel free to contact Liz Duff and Robert Buchsbaum, at Mass Audubon for advice.

Conduct your study.

Analyze your data: Summarize what you are finding.

Share your methods and results with others: Use email or the internet to let other schools know what you are studying. They may be able to help you collect data!

Optional Extensions:
(Useful for assessment)

A Plan out and create a slide show of your site.
Take photographs of your site. Get the photos on a hard drive and create a slide show of your site.

B. Make a field guide of the creatures and plants that you find on your site.

C. Make an identification key for identifying animals, or upland plant species on your site.

D. Design a poster or brochure explaining why this area is important to your town. Include historical uses, and current day uses. Explain possible threats to this habitat, and ways of protecting and restoring it.

E. Design a project of your own, get it Ok'd by your teacher, and do it!

Technology:

Teachers have found this project provides excellent reasons to integrate technology.

The following is a brainstorm created by Rockport teachers for creating a web site. Also enclosed is an assignment, using the internet for research purposes.

The Massachusetts Audubon Salt Marsh Science Web site provides an opportunity for you to learn more about Salt Marsh Science, to compare your data with data collected by other schools, and to link your web site too.

This web site includes a "Murder in the Tidepool" for your students to investigate, Upcoming Events, Data Summaries, Graphs, and Additional Resources.

CLASS VEGETATION ANALYSIS

Name: _____

Location: _____ Date data taken _____ Class _____

Make a graph showing the vegetation present along the total transect. Be sure to make a key for your graph.

Distance in M	01	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Phragmites																									
Cordgrass																									
Saltmarsh Hay																									
Spike Grass																									
Glasswort																									
Bulrush																									
wrack																									
Sea blite																									
Orach																									
Goldenrod																									
Other:																									

1. In how many meters is *Phragmites* present? _____
2. What percent of the total number of meters, is *Phragmites* present in? _____
3. Compare this graph with information collected last year, or to information from another school. How are they the same? How are they different?

_____

_____

4. We are investigating whether *Phragmites* is spreading, and how fast. What do you think the vegetation will look like next year? Use a code, or different color to draw in your prediction. Explain why you think it will look like that.

_____

_____

5. What are 2 questions you can answer from looking at this graph?

_____

_____

6. What more do you want to know, now that you have seen this information?

_____

_____

CLASS SUMMARIES

Summarize your findings:

See below for an example of a summary of the vegetation data.

Sample Vegetation Summary:

At the Rockport site, near route 127, Mass Audubon staff found 5 meters of *Phragmites* on their 25 meter vegetation transect. Twenty percent of the total transect had *Phragmites* present. The tallest *Phragmites* plants were 306 cm and 269 cm. Mass Audubon staff noticed three other grasses present, and two other herbaceous plants. Wrack was present along 9 meters (36%) of the transect. Cordgrass was present on 52% of the transect (13 meters) and saltmarsh hay was present on 92% of the transect (23 meters). Spike grass was present on 8 meters, or 32%.

Discussion: Because a ditch is present along this transect at 9-10 meters, bringing in water with high salinity, I expect that the *Phragmites* stand will not expand much further into the marsh, unless further sedimentation raises the elevation further. Nearby storm drains are access points for sedimentation (sand and dirt is pushed onto the marsh from the road), raising the elevation (height) of the marsh. This seems to cause favorable conditions for the growth of *Phragmites*. Questions to investigate include: How large an area did this increased sedimentation impact and how high has sedimentation raised the elevation? Taking soil cores to compare the sediments and measuring elevation on the marsh will help answer these questions.

Wrack is spread far along the transect. This may indicate that the tide flows into the *Phragmites* stand at least occasionally. Some wrack was just a few strands of grasses, others were large mats of mixed grasses. In the future, I want to record comments to indicate these differences. Large mats of wrack will kill vegetation underneath, if left there for long periods of time. This may lead to changes in vegetation over time.

1. Write paragraphs summarizing your fish data, vegetation data, and salinity data.

2 What patterns are you finding, through studying your data?

3 What additional questions do you have?

4 Which of these questions could you investigate, and how?

5 What interactions between plants and animals have you observed on the salt marsh?

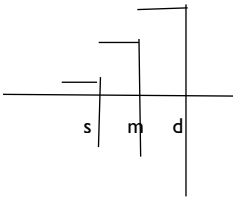
6 What special project would your school like to investigate, in addition to this study?

7 What questions do you want students in other schools to investigate with you?

When you have summarized the information, please send it to Mass Audubon. We will share it with other schools.

Spanish Data Sheets

HOJA DE DATOS DE CAMPO DE SALINIDAD



Fecha _____

No sabemos si el agua poco profunda, mediana o profunda tiene mayor impacto en la caña común. Estamos midiendo salinidades a profundidades y en ubicaciones diferentes para ver el impacto que tiene en la vida vegetal.

Piense en lo que sabe: ¿De dónde viene el agua salada? ¿De dónde viene el agua dulce?

1. **Haga predicciones:** Marque con un círculo donde piense que la salinidad sea mayor. Baja Mediana Mucha profundidad

Explique su predicción. _____
¿Hay algún momento del año que en que haría una predicción diferente?
En caso afirmativo, ¿cuándo? _____

2. Hay pozos ubicados en 5 puntos diferentes. (Consulte el diagrama.) ¿Dónde piensa que se encontrarán los niveles más altos de salinidad? (Marque una opción con un círculo)

1. En las cañas comunes 2. En la zona de transición 3. En los pastos de pantanos salados, donde no crece caña común
Explique sus predicciones: ¿Por qué piensa así?

_____

_____

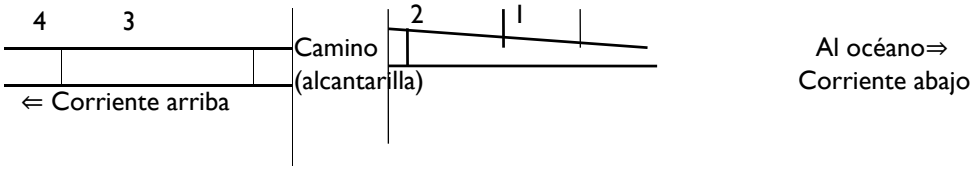
3. Mida la salinidad. Verifique si la lectura es correcta. Pida a los integrantes de su grupo que verifiquen su respuesta

Conjunto	**Transecto 1**		**Transecto 2**
Pozo 1.1 (en la caña común)	Baja_____ Mediana_____ Mucha profundidad_____	Conjunto 1.2	Baja_____ Mediana_____ Mucha profundidad_____
Pozo 2.1 (En la zona de transición)	Baja_____ Mediana_____ Mucha profundidad_____	2.2	Baja_____ Mediana_____ Mucha profundidad_____
Pozo 3.1 (En los pastos de pantanos salados)	Baja_____ Mediana_____ Mucha profundidad_____	3.2	Baja_____ Mediana_____ Mucha profundidad_____
Conjunto	**Transecto 3**		**Salinidad: Antecedentes:** La salinidad es el grado de sal que contiene el agua. Cuanto más salada sea el agua, más alta es la salinidad. La mayoría de los refractómetros miden la salinidad en partes por mil. Algo que contenga 20 gramos de sal en un total de 1000 ml de agua se representa así: 20 0/00. Pensamos que a la caña común le es difícil crecer con un alto grado de salinidad (mayor que 20 0/00) (20 0/00 es lo mismo que un 2 %. Si el refractómetro mide en partes por cien, o porcentajes, añada un cero a la medición para anotar partes por mil.
1.3	Baja_____ Mediana_____ Mucha profundidad_____		
2.3	Baja_____ Mediana_____ Mucha profundidad_____		
3.3	Baja_____ Mediana_____ Mucha profundidad_____		

DATOS DE PECES

Fecha:_____

Audubon de Massachusetts está estudiando para ver si el tamaño y la especie de los peces difiere corriente arriba y corriente abajo con respecto a la restricción de marea (una zona donde una pequeña alcantarilla impide el flujo normal de la marea.)



Si se capturan peces corriente arriba y corriente abajo de una alcantarilla, se utiliza el sistema de rotulación siguiente:
Corriente abajo más lejano (más cerca del océano)
Corriente abajo de una alcantarilla **(Si se cuenta con 3 trampas corriente abajo, rotúlelas 2 y 2.5 como se indica arriba.)**
Primero capture corriente arriba con respecto a la alcantarilla
Corriente arriba lo más alejado de una alcantarilla
Predicción: ¿Cuál trampa tendrá la mayor cantidad de peces?
¿Cuál trampa tendrá la mayor variedad de especies?
Explique sus respuestas.

_____

_____

Hora en que se colocó la trampa: _____ Número de horas _____
Hora en que se quitó la trampa: _____ Número promedio _____ de peces capturados por hora.

Trampa de peces núm.	Adivine cuántos peces habrá en la trampa.	¿Cuáles son las especies presentes?	¿Cuánt as de cada tipo?	Volumen total de cada especie (ml)	Volumen promedio de un pez. (ml)
1					
2					
3					
4					

¿Es esta una restricción de mareas?

Los científicos de Audubon de Massachusetts están estudiando pantanos donde hay restricciones de mareas. Donde se restringe la marea, a menudo crecen las cañas comunes. Si descubre una restricción de mareas, ha hallado una pista que explica el crecimiento de la caña común.

Definiciones:

Erosión: Es el desgaste de los sedimentos. (Si el flujo de mareas está restringido por una alcantarilla, la velocidad del agua puede aumentar al pasar por la alcantarilla. Esto puede aumentar la erosión, porque el agua pasa con gran fuerza, desgastando las orillas.)

Posas: Una posa es de agua estancada (al contrario del agua que fluye en un río). Las posas se forman cuando la tubería es muy pequeña. El agua se estanca y no puede correr.

Mida o estime y anote el ancho del canal y el ancho de cruce.
Ancho del canal corriente arriba _____ Corriente abajo _____

Clave de identificación de plantas comunes del pantano salado
Por Elizabeth Duff 1997

Sírvase observar: esta clave no incluye todas las plantas de pantanos salados.

Puede convenirle adaptar esta clave, al ir encontrando especies adicionales en el sitio

1a La planta tiene hojas largas como pasto. (Las hojas crecen rectas hasta ciertopunto.).....…8

1b Las hojas no son rectas ni similares al pasto; o la planta no tiene una hojareconocible.....2

2a La planta es carnosa, como una uva. (Si se aprieta una hoja o segmento, se mojan los dedos con lo que contiene)……...……..3

2b La planta no es carnosa. ……..……4

3a La planta no tiene una hoja obvia……Common Glasswort (*Salicornia europea*)

3b La planta tiene numerosas hojas pequeñas…….....…...Sea blite (*Suaeda*)

4a La planta tiene un tallo café como ramita y es un arbusto pequeño…...Marsh Elder (*Iva frutescens*)

4b La planta no tiene tallo como de madera.....……...5

5a Las hojas son triangulares.....…….....…….... Orach *(Atriplex*)

5b Las hojas no son triangulares.....…….....…….....6

6a La planta crece recta y le brotan hojas a lo largo del tallo.....…….....…….....7

6b Las hojas crecen en la base de la planta. La punta se bifurca y tiene muchas flores diminutas de lavanda…….....…Sea Lavender (*Limonium carolinianum*)

7a La planta crece con un solo tallo. La hoja es angosta, luego se ensancha, luego se estrecha de nuevo hasta formar una punta redonda. La planta tiene flores amarillas de tono dorado en el otoño. …….....Seaside goldenrod (*Solidago sempervirens*)

7b Los tallos son simples o bifurcados. La hoja es recta y estrecha, formando una punta. La planta tiene flores moradas con forma de margarita en el otoño ….....….. Aster (*Aster*)

8a El tallo de la planta es triangular. La planta tiene flores que se asemejan a conos de pino en miniatura. ….....……Saltmarsh Bulrush (*Scripus*)

8b El tallo no es triangular.....…….....…….....9

9a Las hojas crecen solamente desde la base de la planta. ……10

9b Las hojas crecen a lo largo del tallo.....…….....…….....…...……11

10a La hoja crece hasta un tamaño de ¼ a ½ pulgadas de ancho y la planta hasta 6 pies de alto. La planta tiene púas café en la punta…… …Narrow leaved cattail (*Typha angustifolia*) 10b La hoja de la planta es de menos de ¼ de pulgada de ancho y la planta tiene flores pequeñas verdosas en una púa. La planta crece entre 8-32 pulgadas de alto. Seaside Arrow Grass (*Triglochin maritimum*)

11a La planta tiene numerosas hojas que crecen por todo el tallo…….....……12

11b La planta tiene pocas hojas (4 o menos) y las hojas crecen solamente en parte del tallo..13

12a La hoja de la planta es ancha, de más de ½ pulgada. El tallo es redondo y hueco. La planta tiene una pluma grande y sedosa en la punta. La planta puede tener 6 ½- 14 pies de alto… Caña común (*Phragmites australis*)

12b La hoja de la planta es angosta. (Menos de 1/8 de pulgada.) La planta tiene muchas hojas que crecen en dos direcciones, como dispuestas en forma de V en el tallo. Las hojas son de color verde claro y pueden ser aplastadas. .... Spikegrass (*Distichlis spicata*)

12c La hoja de la planta es de aproximadamente ¼- ½ pulgada de ancho. La planta llega a 1-8 pies de alto. La plant crece alta cerca del agua. Las hojas son verde oscuro o verde amarillento y se sienten ásperas. Las flores y semillas de la planta crecen rodeando el centro

de la planta. .....Saltmarsh cordgrass (*Spartina alterniflora*)

13a El tallo de la planta es sólido y redondo. Las flores y vainas de semillas son redondas y se forman desde el costado del tallo en vez del extremo. ……..……Black Grass (*Juncus gerardi*)

13b El tallo de la planta viva es generalmente verde y unido, la flor de la planta y sus semillas

crecen en el extremo del tallo..... .....…….....…….....

14a La hoja de la planta es de aproximadamente ¼- ½ pulgada de ancho. La planta llega a 1-8 pies de alto. La planta crece alta cerca del agua. Las hojas son verde oscuro o verde amarillento y se sienten ásperas. Las flores y semillas de la planta crecen rodeando el centro de la planta..... Saltmarsh cordgrass (*Spartina alterniflora*)

14b La hoja es sumamente delgada (se ve como si pudiera enhebrar una aguja.) Los costados se curvan hacia adentro. Las flores y las semillas de la planta crecen en un lado del tallo (como los dientes de una peineta). ..... …….Saltmeadow cordgrass (*Spartina patens*) Las plantas acuáticas adicionales de pantanos salados y agua salobre que no se incluyen en esta clave son: Purple loosestrife, helecho de pantano, silverweed, amaranto y numerosos pastos de tierras altas así como especies de tierras altas.

HOJA DE DATOS DE CAMPO para CORTE TRANSVERSAL DE VEGETACIÓN

UBICACIÓN _____ Fecha _____ Maestro _____

Instrucciones:

1. En la hoja de datos, marque con un círculo el medidor que se le asignó. Anote todos los datos en esa fila.
2. Busque el medidor.
3. Mire directamente bajo la cinta medidora para las plantas.
4. Observe cuántas plantas diferentes hay en el medidor.
5. Identifique cada tipo distinto de planta, usando la clave de identificación, ilustraciones o guía de campo.
6. Si tiene alguna pregunta, ¡hágala!
7. Anote en la hoja P para indicar presente en la fila en que está el medidor ,cuando haya una planta presente.
8. Si hay otra planta presente, anote el nombre de la planta y marque P para indicar presente.
9. Mida las dos plantas más altas en el medidor, anote el tipo y la altura en cm.
10. Entregue al líder del grupo los datos.

Distancia	Mida las 2 plantas más altas a lo largo de su zona de corte transversal.	Caña común (*Phragmites australis*)	Saltmarsh cordgrass (*Spartina alterniflora)*	Saltmeadow cordgrass/ (Saltmarsh Hay) (*Spartina patens*)	spike grass (*Distichlis spicata*)	otro	otro	otro	otro	otro
a lo largo de la línea										
0 a 1										
1 a 2										
2 a 3										
3 a 4										
4 a 5										
5 a 6										
6 a 7										
7 a 8										
8 a 9										
9 a 10										
10 a 11										
11 a 12										
12 a 13										
13 a 14										
14 a 15										
15 a 16										
16 a 17										
17 a 18										
18 a 19										
19 a 20										
20 a 21										
21 a 22										
22 a 23										
23 a 24										
24 a 25										

Mida las 2 plantas más altas a lo largo de su zona de corte transversal. ¿Qué tipo de plantas son? Nombre de la planta _____ Altura _____ Nombre de la planta _____Altura _____

Observaciones de pájaros y vegetación:

Audubon de Massachusetts y el Dr. Charles Redington, autor de *Plants in Wetlands Redington Field Guide* (Guía de campo de las plantas en las tierras pantanosas de Redington) se interesan en saber cómo interactúan los pájaros con diferentes plantas (vegetación.) Observe cómo usan los pájaros las plantas. Anidan en *cattails* y caña común en los *cordgrasses*, usan hojas de estos pastos para formar nidos, descansan en estas plantas. ¿Usan plantas para ocultarse?

Si se están observando muchas especies de pájaros es mejor pedir a los integrantes de su grupo que elijan distintas especies para observar, para poder así recopilar información de cada especie.

Tipo de pájaro	¿Cuántos se ven? (Mantenga un recuento.)	¿Qué está haciendo?	¿Está usando, está encima o cerca de qué tipo de planta? (Un pasto corto, caña común, tierras altas)	¿Para qué está usando la vegetación? (Formar nidos, descansar, ocultarse, comer, alimentarse, etc.)

HOJA DE DATOS DE CAMPO DE LOS SUELOS (Actividad opcional)

Ubicación _____ Fecha _____

Muestra de suelos

1: en las cañas comunes

2: zona de transición (Donde crecen caña común y pasto de pantanos salados.)

3: en los pastos de pantanos salados

Use la sonda para tomar muestras en cada una de las tres ubicaciones marcadas con banderas anaranjadas y anote los resultados en la tabla siguiente.

Observaciones	Muestra 1 (caña)	Muestra 2 (trans.)	Muestra 3 (pantano)
Número de capas de suelo			
Color/es			
Olor			
Textura			
Presencia de organismos vivos			

Califique la composición de las muestras utilizando esta escala:

0 (nada) 1 Muy poco 2 (mediano) 3 Más de ½

	Muestra 1	Muestra 2	Muestra 3
Piedrecillas			
Arena			
Materia orgánica			
Cieno (tierra de partículas finas)			

Escriba un párrafo corto que describa la o las muestras de tierra

_____

_____

_____

_____

_____

_____

Estudios de invertebrados y vegetación

Fecha _____

Muchas criaturas viven en el pantano salado. Una mirada más de cerca le ayudará a observarlas. Usando un aro hula hoop o una cuerda marque el área en estudio, cuente cuántas criaturas encuentra en la vegetación, en la superficie del pantano y en el lodo. Pueden hallarse arañas, insectos, caracoles, cangrejos, etc.

ANIMALES

Dibuje o indique lo que vea.	¿Cuántos? (Mantenga un recuento)	¿Dónde se encontraba? (En la superficie, en el lodo, bajo el agua)	¿Cómo interactúa con las plantas? (Comiendo, caminando, descansando, haciendo un nido/tela, ocultándose, etc.)	¿Qué tipo de planta está usando? (Especifique lo más posible.) (Qué tipo de pasto)

Preguntas adicionales:

¿Qué preguntas científicas adicionales tiene? ¿Cómo se podrían investigar esas preguntas? Piense por lo menos en 3 preguntas como:

A) Una pregunta que pudiera investigar en Internet o en otra parte.

B) Una pregunta que pudiera hacer a un científico profesional.

C) Una pregunta que sirva para diseñar un estudio a investigar.

D) Explique el método del estudio. (Use papel adicional si es necesario.)

Indique 5 cosas que son buenas (+) y malas (-) sobre este pantano salado.

(+)	(-)
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.

Explique una de sus respuestas (+) y una de sus respuestas (-).

(+):

(-):

Recuerdos del pantano:

¿Cómo ha cambiado su conocimiento y pensamiento sobre los pantanos salados?

Antes pensaba que los pantanos salados eran .....

Y ahora sé que el pantano salado es.....

Qué acciones recomienda para mejorar y proteger el pantano salado en su ciudad.

a. _____

b. _____

c. _____

¿Qué preguntas adicionales le interesaría investigar en el pantano salado?

a. _____

b. _____

c. _____