



## SALT POND MIGRATION

**Overview:** In this activity, students will simulate a sandpiper migration between nesting and wintering habitats. Afterwards, students collect a sample of salt pond water and study the tiny animals the sandpipers are feeding on.

**Content Standards Correlations:** Science, p. 295

**Grades:** K-6

**Key Concepts:** Salt ponds around San Francisco Bay are human made habitats. These salt ponds provide an important stopover for migratory birds traveling on the Pacific flyway. The plants and animals living in the salt ponds are an important food source for migratory shorebirds and waterfowl.

**Objectives:**

Students will be able to:

- describe the food chain in a salt pond ecosystem
- describe the effects of habitat loss on migratory bird populations
- state one way to help protect migratory birds and their habitats

**Materials:**

**Provided by the Refuge:**

- two sets of 6 bases (wintering, wetland habitats and nesting habitats) set out one of each for every two students
- 12 dip nets
- 12 dipping containers
- 12 hand lenses
- 1 bird id. chart
- 1 food pyramid poster
- 1 brine shrimp fact sheet



*Male Brine Shrimp*

### TIME FRAME FOR CONDUCTING THIS ACTIVITY

**Recommended Time:** 30 minutes

**Introduction** (5 minutes)

- discuss migration and migratory birds, especially sandpipers

**Migration Simulation** (8 minutes)

- set up the playing field and discuss the object of the game
- play 4 to 6 rounds of the migration game, each time removing or adding bases from the wintering or nesting habitat.

**Discussion** (2 minutes)

- discuss ways to protect migratory birds

**Salt Pond Investigation** (7 minutes)

- discuss salt pond habitat
- discuss how to collect a sample
- hand out one dipping container and dip net to each student
- allow time for investigation at the salt pond

**Aquatic Life Study** (6 minutes)

- return to the levee with the samples and hand out one hand lens to each student
- discuss brine shrimp and brine flies

**Discussion** (2 minutes)

- relate the importance of salt pond life to migratory birds
- return samples to salt pond

### HOW THIS ACTIVITY RELATES TO THE REFUGE'S RESOURCES

**What are the Refuge's resources?**

- significant wildlife habitat
- endangered species
- migratory birds

**What makes it necessary to manage the resources?**

- Loss of wetlands result in a loss of wintering and nesting habitat for migratory birds.

**What can students do to help?**

Refuge staff conduct a Coast Clean-Up, but we need your help.

- Be responsible for your own trash
- Participate in a Coast Clean-Up
- Teach others what you have learned about habitats and migratory birds

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## SUPPORTING INFORMATION ABOUT THIS ACTIVITY

### Migratory Birds

- The Pacific Flyway is the West Coast's major migration route; it is used by migratory birds during their flights between breeding grounds in the north and wintering grounds in the south.
  - In the Spring, birds migrate to breeding grounds in the north where there is less competition for food and space and where the short summers promote huge insect blooms that provide ample quantities of food.
  - In the Fall, birds migrate to wintering grounds in the south, seeking better weather conditions and greater quantities of food than can be found in the northern hemisphere in winter.
  - Since these two regions are often thousands of miles apart, migratory birds need wetland habitats to provide them with food and rest in between.
  - The primary threats to migratory birds are the disappearance and degradation of wetlands.
    - Agriculture and industry are reducing the availability of natural wetlands.
    - Nonpoint source pollution, caused by pesticides, freeway runoff, and dumping in storm drains, has taken its toll.
    - Natural limiting factors also affect migratory birds; predators, weather, disease, fire, and drought take their toll.

### Salt Pond

- Salt ponds are human-made habitats, created for the production of salt.
- Historically, levees were built around the tidal salt marshes (the natural habitat), creating huge, shallow, swimming pool-like structures. The enclosed marshy areas were flooded with water from San Francisco Bay. The flooding drowned the plants and resulted in salt ponds.
- Today, Cargill Salt Company uses the ponds to harvest salt through the process of solar evaporation. Bay water is pumped through a series of ponds and after three years the concentration is high enough for salt crystals to form. The salt is then harvested, processed and sold.
- Salt ponds with varying salinities (amount of dissolved salts in the water) encompass the South Bay. In this very salty aquatic environment, only certain plants and animals can

survive.

- Plants in the salt pond are algae.
- Animals in the salt pond are: brine shrimp, brine flies, water boatmen, and small fish (such as three-spined stickleback).

### South Bay Salt Pond Restoration Project

- The South Bay Salt Pond Restoration Project is the largest tidal wetland project on the West Coast, and is happening right here in the South Bay.
- 15,100 acres were purchased from Cargill with the goal of restoring the salt ponds to a mix of wetland habitats, primarily tidal marsh. Tidal marsh serves many important functions, including contributing to a critical mosaic of habitats for fish, birds, and other species, providing flood control protection, and filtering toxic pollution and excess nutrient runoff.
- Many of the salt ponds will remain as managed ponds and be enhanced to maximize their use as feeding and resting habitat for migratory shorebirds and waterfowl traveling on the Pacific Flyway.

### Salt Pond Food Chain

- Food chains are sequences of organisms in which each member of the food chain feeds on the member below it.
- Food chains begin with a producer that makes energy from sunlight and nutrients.
- In the case of the salt pond food web, one food chain is:

**Sunlight & nutrients** —> **Algae** —>  
**Brine Shrimp** —> **Shorebirds**

### Brine Shrimp

*Female Brine Shrimp*

*Male Brine Shrimp*



- Brine shrimp are crustaceans, like crabs and lobsters, with an exoskeletons (a hard outer shell or skeleton). When their soft bodies grows too big for their outer shell, brine shrimp molt (shed the shell) and begin to grow a larger shell.

- Brine shrimp feed on algae (microscopic plants in the pond). Brine shrimp are eaten by water boatmen and shorebirds.
- A brine shrimp's gills are located on each of its 22 legs. Very salty water has less oxygen than fresh water. To store oxygen, a brine shrimp produces hemoglobin (same as in your blood), which makes it look reddish. Females are more commonly red due to the stress they are under while producing eggs.
- Mature female brine shrimp have egg sacs; male brine shrimp have claspers at their heads. For reproduction, the male uses its claspers to hold the female while he fertilizes the eggs in her egg sack.
- Brine shrimp can live for 2-3 months and eggs can develop when the female is 3 weeks old. Brine shrimp eggs can lie dormant for up to 13 years; dried-out eggs will hatch when water or wind carries the "beached" eggs into the water.

### Brine Flies

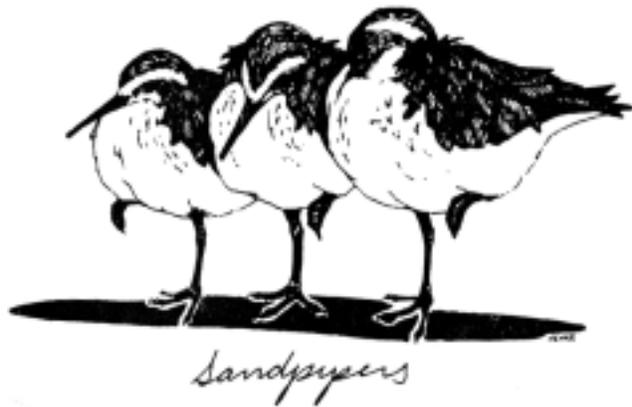
*Brine Fly Adult*



*Brine Fly Larva*



- Brine flies are insects found on the shores and waters of salt ponds. They are harmless to people and usually fly away when people approach the salt pond shore.
- Brine flies feed on algae by lapping it up with their mouth parts. Brine flies are eaten by shorebirds.
- After mating, females release their eggs underwater for several weeks. The eggs go through metamorphosis into adults. From the eggs hatch wormlike larvae that remain underwater for several weeks. The larvae molt (shed their skin) three times and then their outer skin hardens into a cocoon like form; the larvae are now pupae. After one to three weeks the pupae change into winged adults. Once at the surface, the winged adults emerge and begin their new lives.
- Brine fly adults die off in winter months, however dormant larvae and pupae sustain the population when they hatch in the spring.



### Sandpipers

- One of the most visible and abundant migratory shorebirds that winters in the wetlands of San Francisco Bay is the Western sandpiper. Huge flocks of them can be seen wheeling and diving in unison above the water.
- Sandpipers have relatively small eyes, and use their long bills to detect and capture prey that is beneath the water surface or buried in the mud.
  - Their slender, sensitive beaks are perfectly adapted for finding worms, crabs, shrimp, and other small crustaceans.
  - Their bills are so flexible that a bird can open the tip of its bill to grasp prey without opening the base of the bill.
- In spring sandpipers fly rapidly north to Alaska, where they breed and feed all summer.
- In late summer and fall, groups of sandpipers make a leisurely trip southward, departing at all different times.
- During the winter sandpipers can be found along the entire Pacific coast from Washington to South America.



**HOW TO LEAD THIS ACTIVITY BY FOLLOWING THE "DO, READ, ASK" TEACHING FORMAT**

**Introduction (5 minutes)**

**Read**

“In this activity we will be studying the importance of the salt pond habitat to migratory birds by becoming migrating sandpipers.”

**Ask**

**? What are migratory birds?** (Birds that spend summer in one habitat and winter in another.)

**Read**

- “The Pacific Flyway is the West coast’s major migration route. It’s almost like a highway in the sky. In the spring, birds migrate to breeding grounds in the north where there is less competition for food and space.
- In the fall, birds migrate to wintering grounds in the south, seeking better weather conditions.
- Since these two places are thousands of miles apart, migratory birds need wetland habitats to provide them with food and rest in between, just like when people take long vacations and need to stop in at fast food restaurants to feed and rest!”

**Ask**

**? What are some migratory birds that pass through the San Francisco Bay?** (Ducks, geese, terns, swallows, hummingbirds, and many shorebirds such as sandpipers.)

**Read**

“One of the most visible and abundant migratory shorebirds that winters in the San Francisco Bay habitats is the Western sandpiper. Huge flocks of them can be seen flying above the water.

- Sandpipers use their long bills to detect and capture prey that is beneath the water surface or buried in the mud. Their slender, sensitive beaks are perfectly adapted for finding worms, crabs, shrimp, and other small crustaceans.”

**Ask**

**? Can anyone guess where the Western sandpiper goes in the spring to nest?** (In spring they fly rapidly north to Alaska, where they breed and feed all summer.)

**Read**

“A major threat to migratory birds is the disappearance and pollution of wetlands, such as marshes, sloughs, and salt ponds. Pollution, caused by pesticides, freeway runoff, and dumping pollution in storm drains, is part of the problem.”

**Do**

- Choose the number of bases so you have one for every two students at each end of the playing field.
- One end is the San Francisco Bay Area (wintering habitat) and the other end is Alaska (nesting habitat).
- Make certain to include the “salt pond” and “salt marsh” bases in your selection for wintering habitats.

Place the bases in two areas on the playing field as shown below:

**Migration Simulation (8 minutes)**

**Read**

- “Many factors impact the survival of migrating birds. Some involve changes in the wintering and nesting habitats.
- There are times of abundant food and water, with

<b>San Francisco Bay Area</b>		<b>Alaska</b>
wintering: salt pond		nesting
wintering: salt marsh		nesting
wintering: mudflat	50-70 feet	nesting
wintering: slough		nesting
wintering: salt pond		nesting

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suitable shelter and space. At other times food or water is scarce. Sometimes the available habitat is reduced or polluted.

- Each base, at either end of the field, provides an area of suitable habitat for two birds.
- You are Western sandpipers starting in the San Francisco Bay Area, which is the wintering habitat. The other end, is your nesting habitat in Alaska.
- Remember, each base can only be used by two sandpipers.”

### **Do**

Have students go to the bases in their San Francisco Bay Area wintering habitat.

### **Read**

- "You are now wintering in the San Francisco Bay Area. There are different types of wetlands here. Look at the base to see the name of the wetland habitat you are standing on.
- When I give the signal, walk to a suitable habitat in your Alaska nesting area. Flap your wings to show you are flying swiftly to your destination. When you reach the base, you have migrated successfully."

### **Do**

Give the signal and have the students “migrate” to their Alaska habitat to nest. Everybody migrates successfully on the first try because there are an equal number of bases at each end.

### **Do**

To simulate habitat loss remove the salt marsh base from the wintering habitat.

### **Read**

- “A large salt marsh has been drained and used for building houses.
- When I give the signal, you must “fly” to a base in order to survive. You cannot go to a base if two sandpipers are already there.
- Anyone not finding a base is a dead bird and will have to sit on the side. You will have another chance to get back in the game as a newly hatched chick when conditions are more favorable. Until then, you will need to stand on the side and decompose.”

### **Do**

Give the signal for students to “migrate” to their wintering habitat in the San Francisco Bay Area. Two sandpipers will “die” because there is one less base.

### **Do**

Now, remove two bases from the nesting habitat.

### **Read**

“Two wetlands have been lost from the nesting habitat in Alaska. They have been contaminated by an oil spill. You have only a small amount of wetland left for the remaining sandpipers.”

### **Do**

Give the signal to migrate. Two more sandpipers will die.

### **Do**

Remove one base from the wintering habitat.

### **Read**

“A slough has been destroyed in the wintering habitat in the Bay Area. It has been polluted by pesticides and soapy water that people washed down the storm drain.”

### **Do**

Give the signal for students to “migrate” to their wintering habitat.

### **Do**

While you are still at the “Alaska” site, replace two bases to the nesting habitat to simulate an increase in habitat.

### **Read**

“Concerned citizens have learned about the value of wetlands. A large National Wildlife Refuge is created in Alaska to preserve wetlands.”

### **Do**

Give the signal for students to “migrate” to their nesting habitat.

### **Read**

- “Thanks to concerned citizens, there is more wetland habitat for the sandpipers. Conditions are favorable for a good breeding season.
- All “decomposing birds” may now reenter the game as newly hatched chicks.”

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**Ask**

**? What happened the last time you migrated to the San Francisco Bay?** (Birds died because there was not enough habitat.)

**? If wetland habitat is not restored in the Bay Area, what will happen when you migrate there?** (Many of the sandpipers will die again due to lack of suitable habitat.)

**Read**

“Luckily, people in the Bay area are helping the birds. Thousands of people stopped pouring pollutants down storm drains, and a new project here in the South Bay is restoring some salt ponds back to salt marshes. Because of these actions, more wetland habitat is suitable for migratory birds.”

**Do**

Replace the missing bases of the wintering habitat. Give the signal for students to “migrate” to their wintering habitat.

**Discussion** (2 minutes)

**Ask**

**? What are some causes of bird population decline from year to year?** (Natural disasters—drought, storms, disease; loss of habitat; predation by humans and wildlife.)

**? What human activities cause habitat loss and degradation for migratory birds?** (Draining and filling in wetlands for farm land, road construction, housing and business development, garbage dumps; dumping of pollutants, oil spills into waterways; tossing of trash into bays and salt ponds, like plastic containers, soda can holders, styrofoam peanuts, etc.)

**? What is one reason a wildlife refuge exists?** (To protect migratory birds; shorebirds and ducks.)

**? How are the salt ponds important to migratory birds?** (Salt ponds provide food, like brine shrimp, brine flies, and water boatmen, for migratory birds.)

**? How can you help protect habitat for shorebirds like the sandpiper?** (Be responsible for your own trash, participate in Coastal Clean-Up; stop putting pollutants down storm drains; educate others about the importance of wetlands; etc.)

**Read**

“Now that we have seen the importance of wetlands to migratory birds like the Western sandpiper, let’s

move to the salt pond and find out what makes it valuable to the birds as a feeding ground.”

**Salt Pond Investigation** (7 minutes)

**Do**

Focus the students attention on the salt pond. Discuss the habitat.

**Ask**

**? Are salt ponds natural or human-made habitats?** (Human-made.)

**Read**

- “Salt Ponds were created to produce salt. The salt company built levees around salt marshes and flooded the salt marsh with Bay water. The salt ponds produce salt using evaporation.
- The bay water evaporates and becomes saltier and saltier, as it is moved from one pond to the next. After about five years, it is moved to the last pond and is salty enough to harvest salt.”

**Ask**

**? What microscopic plants live in the salt pond?** (Single-celled algae.)

**? What animals can you see feeding on these small plants in the salt pond?** (Birds, such as shorebirds and ducks.)

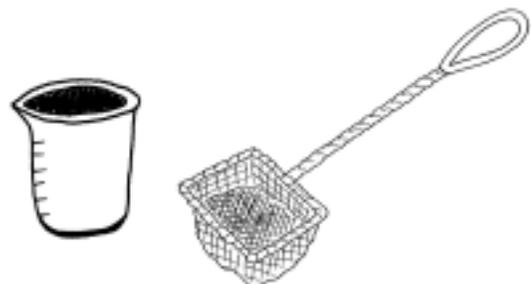
**Read**

“We are going to get a sample of salt pond water to investigate other creatures the birds are eating.”

**Read and Demonstrate**

(Hold up dipping container and dip net to demonstrate how to take a sample.)

- “To take an aquatic life sample, fill the dipping container with water.
- Run the dip net through the water, without hitting the muddy bottom of the salt pond.
- Turn the net upside down and empty it into the dipping container.”



**Do**

Hand out one dipping container and dip net to each student. Walk to the edge of the salt pond with the students. Allow ample time for investigation at the salt pond and collecting samples.

**Aquatic Life Study** (6 minutes)

**Do**

Instruct students to return to the levee with their samples. Collect nets and pass out hand lenses.

**Ask**

? **Do you see any brine shrimp in your sample? Can you describe them?** (Brine shrimp are crustaceans, like crabs and lobsters; they are usually pink or red, with many legs.)

? **Are you looking at a male or female brine shrimp?** (A mature female has a dark colored egg sack near the tail. A male has claspers on his head which are used to hold the female while fertilizing the eggs.)

? **Describe the way brine shrimp move.** (Brine shrimp move their legs continuously in order to circulate the water which contains oxygen over their gills and to draw algae toward them.)

? **Have you seen any brine flies? Can you describe brine flies?** (Brine flies are insects with 6 legs and a pair of wings. They are black. The brine fly larvae look like small worms.)

? **How do brine flies move?** (They walk on top of the water or fly.)

**Discussion** (2 minutes)

**Ask**

? **What plant is at the beginning of the salt pond food chain?** (Algae.)

? **What do you think brine shrimp and brine flies eat?** (Algae.)

? **What eats the brine shrimp?** (Small fish; shorebirds, such as black-necked stilts, avocets and sandpipers; and ducks.)

? **What do salt ponds provide migratory birds with?** (Provide food: algae, brine shrimp, brine flies, and small fish.)

**Read**

“It’s time to return our samples to the salt pond and hand in the equipment.”

**SALT POND FOOD WEB**

