

Migration and Migratory Stopover Sites

Concepts

- During each year of their lives, most shorebirds migrate between habitats located in different geographic areas.
- Shorebirds spend most of each year at their nonbreeding sites.
- Arctic-nesting shorebirds undertake some of the longest migrations of any animals.
- Migratory shorebirds depend on habitat in at least three areas: breeding, nonbreeding, and migratory stopover sites.
- Shorebirds concentrate in great numbers at their stopover sites.
- Because shorebirds fly together in large numbers, their populations are extremely vulnerable to threats along their migratory routes.
- Most important migratory stopovers are nutrient-rich habitats, like estuaries, that also provide resources desirable to humans, making them vulnerable to alteration, pollution, disturbance, and destruction.
- Shorebirds migrate between northern breeding areas and southern wintering areas to take advantage of seasonal food resources.

Activities

Migration Headache

*(lower elementary/
upper elementary)*

Students become “migrating shorebirds,” traveling between nesting and wintering habitats. Along their journeys they experience some of the threats affecting the survival of migratory shorebird populations.

Migration Math Madness

*(upper elementary school/
middle school)*

Students discover that shorebirds migrate long distances between their northern breeding grounds and southern breeding habitats, using five defined corridors or “highways” in the sky. By using the migration map provided, they measure and calculate the distances some shorebirds travel and come to understand why shorebirds must stop to feed and rest along the way.

The Incredible Journey

*(upper elementary school/
middle school)*

Through an active simulation game, students learn about the many threats shorebirds face on their migratory journeys.

Precarious Paths

(upper middle school/high school)

Students read clue cards to map the migration paths of their “mystery shorebirds.”

Bird's-eye View

(upper middle school/high school)

Students imagine that they are a migratory shorebird and design an illustration that conveys the length and difficulty of the trip, as well as the landmarks, habitats, and stopover sites they pass over along the way.



Migration Headache

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Grade Level: lower elementary, upper elementary/lower middle school

Duration: one 40-minute class period

Skills: vocabulary, discussion, comparison, observation, data collection and interpretation; using technology (with additional activity)

Subjects: science, language arts, math, and physical education; technology and social studies (geography) (with additional activity)

Concepts:

- During each year of their lives, most shorebirds migrate between habitats located in different geographic areas.
- Shorebirds migrate between northern breeding areas and southern wintering areas to take advantage of seasonal food resources.
- Arctic-nesting shorebirds undertake some of the longest migrations of any animals.
- Migratory shorebirds depend on habitat in at least three areas: breeding, nonbreeding, and migratory stopover sites.
- Because shorebirds fly together in large numbers their populations are extremely vulnerable to threats along their migratory routes.
- Most important migratory stopovers are nutrient-rich habitats, like estuaries, that also provide resources desirable to humans, making them

vulnerable to alteration, pollution, disturbance, and destruction.

Vocabulary

- migration
- limiting factor
- habitat
- habitat loss
- breeding areas
- nesting site
- nonbreeding site
- wintering area

Overview

Students become "migrating shorebirds," traveling between nesting and wintering habitats. Along their journeys they experience some of the threats that affect the survival of migratory shorebird populations.

Objectives

After this activity, students will be able to:

- Define the term migration.
- List three limiting factors that can affect the populations of migrating shorebirds.
- Classify these limiting factors as natural or human-caused.
- Predict the effects of habitat loss and degradation on populations of shorebirds.

Materials

- Large playing field or gymnasium
- Two paper plates for every three students (Clearly mark the plates, perhaps with a large X on one side, to differentiate top from bottom.)
- Additional plates based on one-fourth of the total number of plates from calculation above.
- *Factors Affecting Survival Cards* or *Habitat Scenarios* listed below
- Flip chart and several colored markers

Introduction

Migration is a challenging task for migratory shorebirds. For many species it involves flying tremendous distances, facing

difficult weather, and depending on stopover habitats and food resources that have been available for many generations.

There are approximately 49 different species of shorebirds throughout North America. Most of these shorebirds spend their summers at northern *breeding areas* in the United States and Canada and migrate to *wintering areas* in the southern United States, Central America, and South America. The White-rumped Sandpiper, for example, migrates each year from the Arctic Circle to the southernmost tip of South America and back, a round trip of 20,000 miles! However, not all shorebirds migrate such long distances. Some, like the American Avocet, breed in the northern part of the United States and winter in the southern part of the United States.

There is a wide variety of *limiting factors*, both natural and man-made, that affect whether or not these birds reach their nesting or wintering grounds. Understanding what these factors are and how they affect shorebird populations is the key to shorebird conservation.

To learn more about shorebird migration and threats to shorebird survival, read *Magnificent Shorebird Migration and Threats to Migrating Shorebirds* found in the *Shorebird Primer*.

Activity Preparation

1. Photocopy one set of the game cards (included in this activity) on cardstock paper. Each card lists one factor (from the table below) affecting shorebird survival on one side and the number of plates lost or gained as a result of this factor on the other side. *Additional Habitat Scenarios that may be used along with, or in place of, the*

Factors Affecting Shorebird Survival are provided; however, the additional habitat scenarios are not laid out as game cards.

2. Select an area about 20 meters (about 70 feet) in length (indoors or out) where the students can race back and forth.

Habitat Scenarios

Educators may want to photocopy these scenarios before beginning the activity.

These scenarios can be used during the activity to assist educators with the factors that may reduce or enhance a wetland habitat.

- A marsh has been dredged to allow a marina to be built. Remove one habitat (plate) from the stopover habitat.
- A landowner has agreed to reflood fields after harvesting, increasing acreage for wintering birds. Add one habitat (plate) to the wintering habitat.
- A joint federal and state wetland restoration project involve the removal of drain tiles, allowing

a former wetland to flood and return to its natural state. Add one habitat (plate) to the stopover habitat.

- A large increase in the number of cats, dogs, and raccoons has reduced the value of a marsh nesting area. Remove one habitat (plate) from the nesting habitat.
- Wintering habitat is reduced by the conversion of wetlands to cropland. Remove one habitat (plate) from the wintering habitat.
- New legislation restricts boat traffic on a number of lakes and large marshes, reducing the human disturbance to wildlife. Add one habitat (plate) to stopover habitat.
- Several years of sufficient rain and snow have replenished the water supply, thus increasing the food supply. Add one habitat (plate) to the nesting habitat.
- A timber company has agreed to preserve grassland with scattered wetlands in exchange for tax credits. Add one habitat (plate) to the stopover habitat.
- Wintering habitat is reduced

by the conversion of beach to condominiums. Remove one habitat (plate) from the wintering habitat.

Procedure

1. Select a large playing area about 70 feet in length. Place an equal number of bases in three areas on the playing field. (See illustration.) Choose the number of bases so that there is one base for each two or three students at each of the three areas on the field. Designate one of the end areas as the “wintering habitat,” the other end as the “nesting habitat,” and the area in the middle as “stopover habitat.”
2. Explain to the students that they are shorebirds and will migrate among these three areas at your signal. Tell the students that the bases represent suitable shorebird habitat such as wetlands and grasslands. At the end of each migration, the students will have to have one foot on a base in order to be

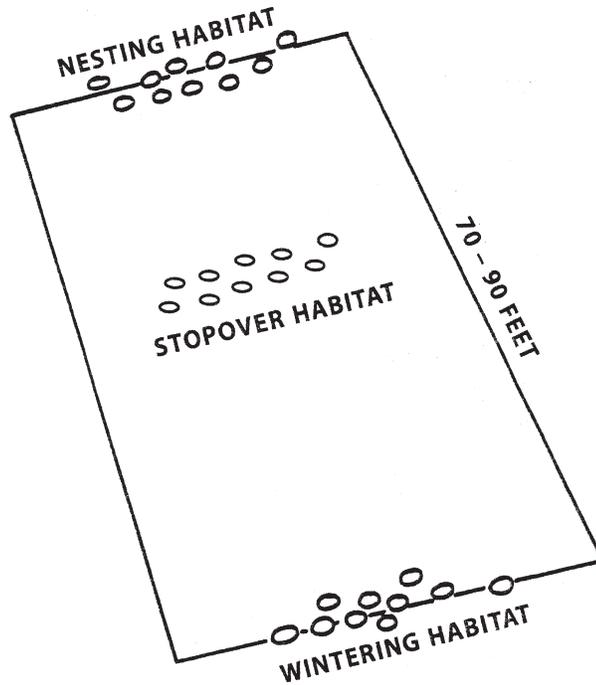
Factors Affecting Shorebird Survival

<i>Factors Reducing Survival</i>	<i>Number of plates lost*</i>	<i>Factors Favoring Survival</i>	<i>Number of plates gained*</i>
Urban expansion	5	Preservation of wetlands and grasslands	4
Wetland drainage	5	Dynamic balance with predators	4
Conversion of wetlands and grasslands to farmland	4	Improvement/addition of habitat	3
Pollution (e.g., oil or chemical spill or runoff)	3	Education about habitat for wildlife	3
Drought	3	Normal rainfall (i.e., neither drought nor flood)	2
Disturbance to resting and feeding shorebirds	2	Education about hunting	1
Pollution of food supply	1	Farm management for crops, cattle, and shorebirds	3
Illegal hunting	1		

* Number of plates lost/gained: These numbers are only suggestions and are not necessarily accurate or directly proportional to the size of the threat, percentage of change in survival, etc. This will vary between particular places or incidents.

allowed to continue (survive). Tell the students that only two (or three, as decided in Step 1) shorebirds can occupy a habitat (base) at one time. If they can not find a habitat that is not “filled,” that means they have not found any suitable habitat. They “die,” and have to move, at least temporarily, to the sidelines. During migration, the students may want to “flap their wings,” moving their arms like birds in flight.

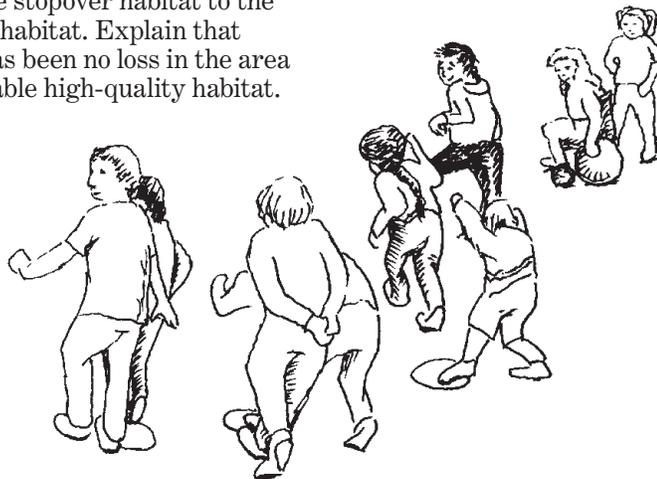
3. Explain to the students that many factors will limit the survival of populations of migrating shorebirds. Some involve changes in the wintering, stopover, and nesting habitats. There will be periods of time in which food, water, shelter, and space are suitably arranged to meet the habitat requirements of the birds. There will be other times when the habitat is stressed, with many factors limiting the potential for the birds' survival.



4. Begin the activity with all students at the wintering habitat. Announce the start of the first migration. Have the students migrate slowly until they become familiar with the process. Then they can speed up. On the first try, all the birds will successfully migrate to the stopover habitat.
5. Explain that most shorebirds need these areas to rest and eat before continuing the migratory journey. Then have them migrate from the stopover habitat to the nesting habitat. Explain that there has been no loss in the area of available high-quality habitat.

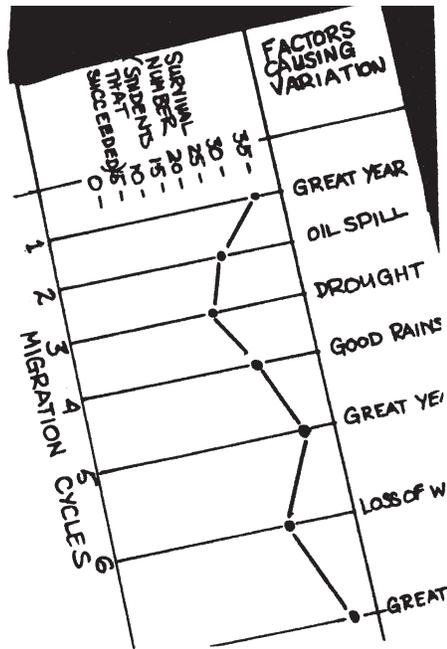
Thus, a successful nesting season is at hand.

6. Before the students migrate back “south,” turn over four plates in the breeding habitat. This represents a catastrophic loss. Tell the students that this is the result of a period of unusually heavy rain that flooded many of the nests. Instruct the students to migrate. This results in a large number of students waiting



on the sidelines to re-enter the nesting habitat. Tell the students that these birds died as a result of habitat loss. Remind any “deceased” birds that they will have a chance to get back into the activity. They can come back as surviving hatchlings when favorable conditions prevail and there is habitat available in the nesting ground.

7. Continue the migrations by reading the *Factors Affecting Survival Cards* or the *Habitat Scenarios*. Educators may want to appoint two students as monitors to remove and add bases (habitats) as required on the cards. Use your discretion to ensure that too many plates are not added or removed, and that “dead shorebirds” have an opportunity to re-enter the game.
8. Repeat the process for eight or ten migration cycles. Remember, overall the availability of suitable habitats for shorebirds are diminishing. The activity should end with fewer areas of available habitat than can accommodate all the birds. *The greatest long-term threat to the survival of populations of shorebirds is the loss and degradation of habitat.*
9. As you move through the game, chart the number of shorebirds that survive each round, using the flip chart and markers as shown below. Make a note on the chart indicating what caused serious shorebird deaths and what caused good breeding years for students to refer to later.



10. After the activity, ask the students to identify factors that caused shorebird populations to decline or increase. What are the short- and long-term effects of the decline or increase? Which factors reduced or enhanced the quality of the habitat? What are the benefits and liabilities related to these factors for the community?
 - Have students summarize what they have learned about the factors that affect shorebird migration.
 - Divide these factors into two lists-human-caused factors and environmental factors.
 - Compare similarities and differences among these limiting factors. Which pose the most significant long-term threat to shorebird survival?
 - What threats exist to your local shorebird habitat?
11. Have students study the graph you created during the game.
 - What were the causes of the biggest population declines?
 - Ask students to imagine how long these factors might affect a shorebird population (one breeding season, two....?).
 - Distinguish between catastrophic effects and gradual changes.

- What kinds of things can be done to protect and restore habitats for migrating bird populations? Discuss potential trade-offs related to any recommendations for humans and other organisms (including shorebirds).

Additional Activities



Cultural Connections

- Facilitate a student discussion about what might be the culturally-influenced viewpoints of the peoples' actions in the "Affecting Shorebird Survival" and "Habitat Scenarios" towards the environment.
- Have students research the impact of the Exxon Valdez oil spill on the local communities affected and on the shorebirds migrating through.

Research a Species of Shorebird

Conduct this activity again with each student representing a specific kind of shorebird.

Research Habitat Loss

Causes in Your Community

Explore the major factors affecting habitat loss and alteration-or gain and restoration-in your area. Research the causes for long-term habitat loss, as well as any major efforts underway to prevent these increasing losses. Find out how wetlands have changed or remained the same in your community throughout the past 100 years. Are there wetland regulations or zoning laws in your community?

Research Other Migratory Animals

What other animals migrate? Are the problems they face similar to those of migratory birds?

Research Laws Protecting Migratory Species

There are national laws and international treaties protecting migratory species. Find out about some of these. What is their history? Are they effective? Are there problems enforcing them? What migrating species, if any, are unprotected by such laws?

Track Shorebird Migration Around the World

Use the Shorebird Sister Schools Website at <http://sssp.fws.gov> to monitor shorebird migration throughout the world. Look at the reports scientists and students are posting. Look for sightings of shorebirds in your area. Post your own shorebird observations on the Web site too!



Urban Expansion



Lose Habitat for 15 Shorebirds (Remove 5 Plates)

Wetland Drainage



Lose Habitat for 15 Shorebirds (Remove 5 Plates)

Conversion of Wetlands and Grasslands to Farmland

Lose
Habitat for 12
Shorebirds
(Remove 4 Plates)

Pollution



Lose Habitat for 9 Shorebirds (Remove 3 Plates)

Drought



Lose Habitat for 9 Shorebirds (Remove 3 Plates)

Disturbance to Nesting and Feeding Shorebirds

**Lose
Habitat for 6
Shorebirds
(Remove 2 Plates)**

Food Supply Is Polluted

**Lose
Habitat for 3
Shorebirds
(Remove 1 Plate)**

Illegal Hunting



Lose
Habitat for 3
Shorebirds
(Remove 1 Plate)

Preservation of Wetlands and Grasslands

Gain

Habitat for 12

Shorebirds

(Add 4 Plates)

Dynamic Balance With Predators

Gain Habitat for 12 Shorebirds (Add 4 Plates)

Habitat Is Improved or Added

Gain Habitat for 9 Shorebirds (Add 3 Plates)

Education About Habitat for Wildlife

Gain Habitat for 9 Shorebirds (Add 3 Plates)

**Normal Rainfall
(neither drought nor
flood)**

Gain Habitat for 6 Shorebirds (Add 2 Plates)

Education

About

Hunting



Gain

Habitat for 3

Shorebirds

(Add 1 Plate)

Farm Management for Crops, Cattle, and Shorebirds

Gain Habitat for 9 Shorebirds (Add 3 Plates)

Migration Math Madness

Adapted with permission from "Seasonal Wetlands." Santa Clara Audubon Society. "Salt Marsh Manual: An Educator's Guide." San Francisco Bay National Wildlife Refuge.

Grade Level: upper elementary/middle school

Duration: one 30-minute class period

Skills: collection, comparison, and interpretation of data; using technology (with additional activity)

Subjects: science, math, and social studies; geography and technology (with additional activities)

Concepts:

- During each year of their lives, most shorebirds migrate between habitats located in different geographic areas.
- Shorebirds migrate between northern breeding areas and southern wintering areas to take advantage of seasonal food resources.
- Arctic-nesting shorebirds undertake some of the longest migrations of any animals.
- Migratory shorebirds depend on habitat in at least three areas: breeding, nonbreeding, and migratory stopover sites.
- Shorebirds concentrate in great numbers at their stopover sites.

Vocabulary

- Central Flyway
- Atlantic Flyway
- Pacific Flyway
- isotherm
- flyway
- stopover site
- wintering area
- nesting area
- wetland
- migration

Overview

Students discover that shorebirds migrate long distances between northern breeding grounds and southern breeding habitats, using

five corridors or “highways” in the sky. By using the migration map provided, they measure and calculate the distances some shorebirds travel and come to understand why shorebirds must stop to feed and rest along the way.

Objectives

After this activity, students will be able to:

- Define the term isotherm.
- Describe the routes of the shorebird flyways that run along or through the continental United States.
- Calculate the migration distances of two shorebirds.
- Explain why wetland stopover sites are critical to shorebird migration.

Materials

- Twenty-centimeters pieces of string (one per student or group)
- One set of *Migration Math Map Worksheets* and the *Migration Madness* reading for each student
- Pens or crayons for each student

Introduction

Shorebird *migration* is perhaps one of the most spectacular wildlife events known to biologists today. It is now thought that the seasonal movement of shorebirds, from their warm, winter habitat world to the brutal environment of the Arctic tundra, is an adaptation for survival. Their migration to the Arctic allows them to take advantage of the abundant, seasonal invertebrate food resources in an area of the world relatively low in predators and competitors. In addition, the vast open space of the Arctic provides much more habitat for breeding and nesting than their wintering area, and there are many more hours of daylight to feed.

There would have to be an advantage to shorebirds for them to expend so much energy. Consider

the American Golden-Plover that flies 4350 miles nonstop, twice each year, between South America and Northern Canada and the Alaskan tundra. Physical feats like this are common in the world of shorebirds. Pectoral Sandpipers winter in Southern South America but breed as far west as Central Siberia. Some plovers, curlews, and tattlers fly nonstop from Hawaii and other Pacific Islands to Alaska in two or three days, a distance of over 3500 miles!

To migrate successfully, many shorebirds stop to rest and feed along the way at wetlands and grasslands. These *stopover sites* provide critical food resources that give the birds energy to continue the race to their northern breeding grounds.

To learn more about shorebird migration, read *Magnificent Shorebird Migration* found in the *Shorebird Primer*.

Activity Preparation

1. Review the *Migration Math Map Worksheets* provided. Decide which flyway(s) you will emphasize. You may choose to have each student complete all three worksheets or divide the class into three groups, each focusing on a different flyway.
2. Make photocopies so each student has at least one activity sheet.
3. Make one photocopy of the *Migration Madness* reading for each student.

Procedure

1. Have your class review *Migration Madness*.
2. Pass out one piece of string 20 centimeters long to each student. Instruct the student to place the end of the string at the start of one of the migratory paths drawn on the map. He or she

should lay the string along the path so that it follows it exactly. At the end of the path, mark the string with a crayon or marker.

3. This string is now marked at the same length as the line on the map. Instruct the students to compare this piece or pieces of marked string with the mileage scale to estimate how many miles the bird traveled.
4. Ask the students to convert the mileage into kilometers. Remember that 1 mile = 1.609 km. If you start with kilometers (km), 1 km = 0.621 miles.
5. Repeat steps 2 and 3 for the other paths shown on the map. Students should write their answers in the spaces provided.
6. Now have them calculate how long it would take these birds to reach their nesting habitat at 40 miles per day, at 72 miles per day, at 150 miles per day.

Additional Activity

Geography Along the Flyway

As students plot the migration of the birds on the migration map, have them also include what countries the birds fly through.

World Migration Map

While Migration Math Madness focused on the three flyways in the Western Hemisphere, there are actually five shorebird flyways. The two additional flyways are in the Eastern Hemisphere, but some of the shorebirds in those flyways breed in the North American Arctic of Canada and Alaska. Introduce these additional flyways to your students by referring to the map in this activity and flyway descriptions located on the Shorebird Sister Schools Web site at <http://sssp.fws.gov>.

Have students work together to draw a world map on butcher paper. Hang up the map on a classroom wall. Next divide the students into five teams. Assign each team to one of the five flyways. Instruct each team to select three to five shorebirds that use the flyway it is assigned and then research the migration routes of each shorebird and add to the world map.

*Note: Students who study shorebirds in the Eastern Hemisphere will have to do additional Web searches for information on those species because they are not included in the Shorebird Profiles. A short list of species that use the East Asian-Australasian and Central Pacific Flyways can be found in the flyway section of *The Shorebird Primer*.

Ask them to write a short biography of the bird that includes the following and add it to the wall.

- a picture or drawing of the shorebird
- the distance they travel during migration
- the critical stopover sites they use along the way (if known)
- its food preferences
- the types of wetland habitat they use

Resources Students

Can Use Include:

- Bird identification guides recommended in the Appendix of this guide
- Shorebird Sister Schools Web site <http://sssp.fws.gov>; go to the “Flyways” link
- Prairies to Patagonia Web site <http://www.manomet.org/WHSRN/Prairies/index.htm>
- USGS Biogeographical Profiles <http://www.mesc.usgs.gov/products/pubs/555/555.asp> (then scroll down and click on “species profiles.”)

- Australasian Wader Study Group Web site <http://www.tasweb.com.au/awsg/index.htm>
- Birds of Australia Web site www.birdsaustralia.com.au
- Shorebird Education of Australia Web site <http://www.wetlands.org.au/shorebirds/>
- Japan’s Shorebird Education Project Web site <http://www.chidori.jp/education/>



Migration Madness

Migrating birds travel long distances between wintering and nesting areas. Most birds do not fly nonstop between these areas, although many are capable of doing so. Timing of the migration is related to seasonal temperature changes but is first triggered by changes in the amount of daylight.

During the spring, most birds do not *migrate* north faster than the 35°Fahrenheit (F) *isotherm* moves. This isotherm is an imaginary, moving line that represents air temperature at any one specific time. The area north of this line is cooler than 35°F, and the area south of it is warmer than 35°F. Migrating behind the isotherm ensures that when the birds reach their nesting areas, the water and ground will not be frozen.

In the fall, temperatures affect the amount of food available to shorebirds. Insects and plants die off in cooler temperatures, so the birds keep moving south to where warmer temperatures mean abundant food.

The migratory routes of birds, referred to as *flyways*, are not specific, narrow “highways,” but general routes that most migrants tend to follow. Most shorebird flyways follow the shoreline habitat the birds prefer.

- In North America shorebirds also migrate inland along the *Central Flyway* that follows freshwater river systems.
- Many other shorebirds migrate on the *Atlantic Flyway*, traveling from the southernmost tip of Argentina, along the American Atlantic Coast up to Canada.
- One of the major routes used by Alaskan Arctic-nesting shorebirds is the *Pacific Flyway*, a path between South or Central American wintering areas and nesting areas in the Arctic regions of Alaska and Canada.
- The *Central Pacific Flyway* extends across the ocean from New Zealand to Pacific islands like Hawaii and up through the Alaskan Arctic.
- The *East Asian–Australasian Flyway* runs from Australia to Japan, China, and Korea, and to the Russian and the Alaskan Arctic.

Wetland stopover sites are important to shorebirds because they provide areas to feed and rest along their migration routes. If a bird flies between Argentina and Alaska, it will cover between 7000 and 8000 air miles. Without local wetlands, many birds would not get enough food energy to make the entire trip.

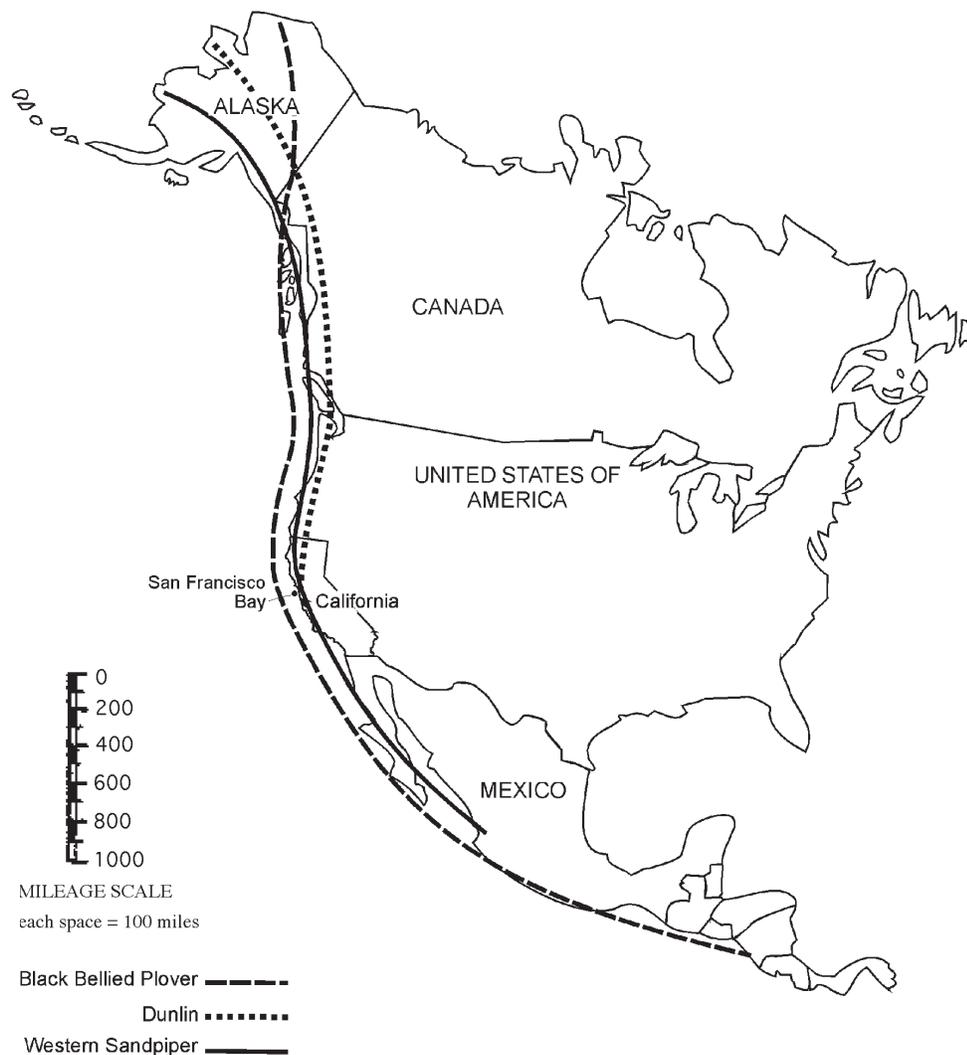
Birds, like fish, can move in three-dimensional space. This means that besides moving across the earth they also can change altitude. About 15 percent of shorebirds migrate at elevations below 10,000 feet. However, pilots have observed many shorebirds flying at about 29,000 feet!

As they get closer to their northern nesting grounds, shorebirds begin to fly faster. Weather and timing become critical factors in getting nests built and young raised in the short two to three months of Arctic summer. Otherwise, migrating shorebirds generally fly for a few hours, rest and feed for one to three days, and then continue. Birds migrating along the Central Flyway have been recorded flying 23 miles per day (mpd) up the Mississippi Valley, 40 mpd across southern Canada, 72 mpd to northern Canada, 116 mpd to Arctic Canada, and those going on to Alaska-150 mpd!

Shorebird Migration Map Pacific Flyway

Directions:

Measure and record the number of miles traveled by each bird.

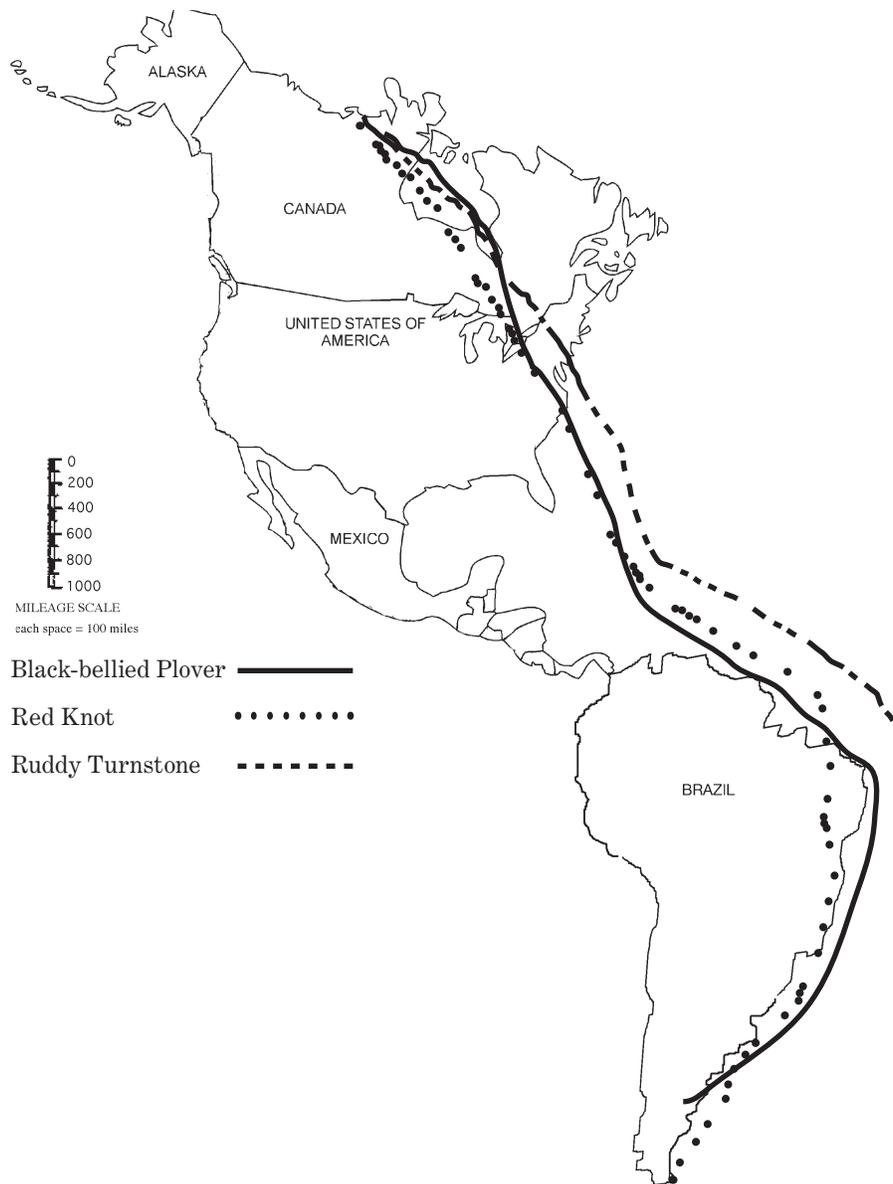


Pacific Flyway

	<i>Miles</i>	<i>Kilometers</i>
<i>Western Sandpiper</i>		
<i>Black-bellied Plover</i>		
<i>Dunlin</i>		

Shorebird Migration Map Atlantic Flyway

Directions:
Measure and record the number of miles traveled by each bird.

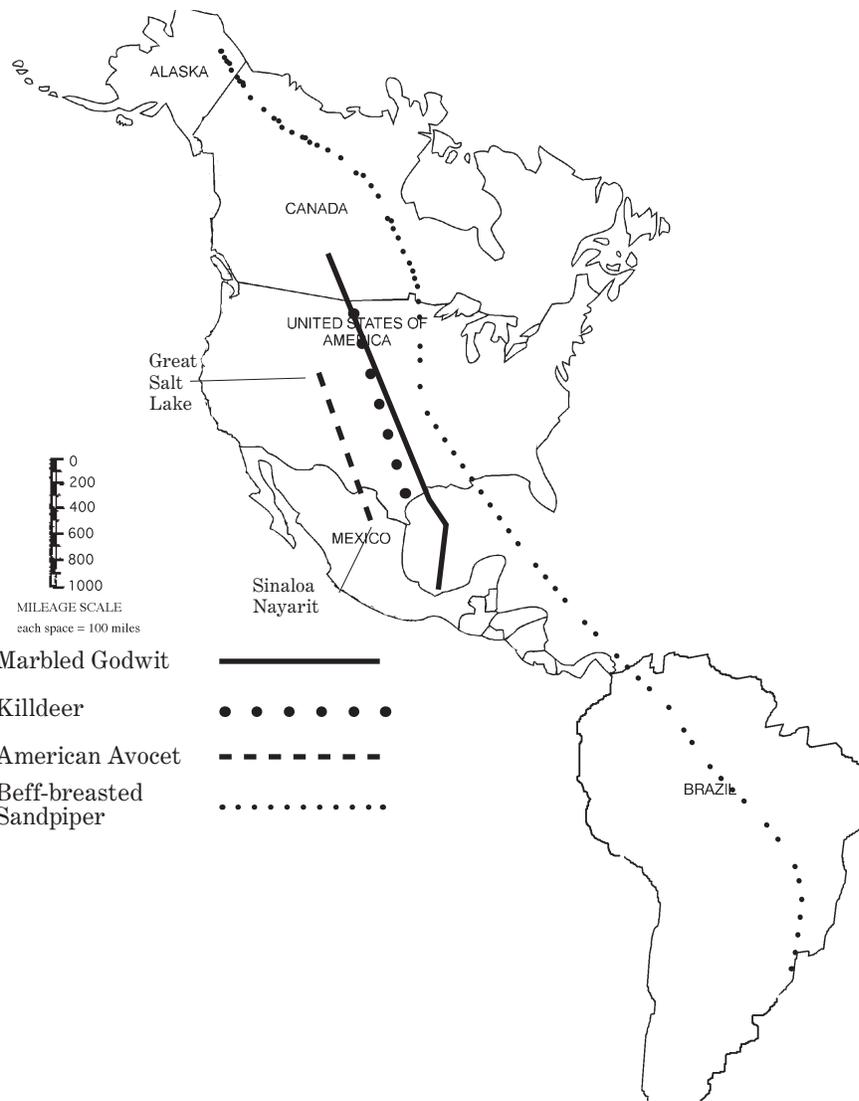


Atlantic Flyway

	<i>Miles</i>	<i>Kilometers</i>
<i>Black-bellied Plover</i>		
<i>Red Knot</i>		
<i>Ruddy Turnstone</i>		

Shorebird Migration Map Central Flyway

Directions:
Measure and record the number of miles traveled by each bird.



Central Flyway

	<i>Miles</i>	<i>Kilometers</i>
<i>Marbled Godwit</i>		
<i>Killdeer</i>		
<i>American Avocet</i>		
<i>Buff-breasted Sandpiper</i>		

The Incredible Journey

Adapted with permission from “Ecosystem Matters: Activity and Resource Guide for Environmental Educators,” Rocky Mountain Region of the USDA Forest Service.

Grade Level: upper elementary/
middle school

Duration: 1 hour to 1 hour and 30 minutes

Skills: comparison of similarities and differences, critical thinking, vocabulary, discussion, observation, and prediction; using technology (with additional activities)

Subjects: science, physical education, social studies, geography, history, and math; technology (with additional activities)

Overview

Through an active simulation game, students learn about the many threats shorebirds face on their migratory journeys.

Concepts:

- During each year of their lives, most shorebirds migrate between habitats located in different geographic areas.
- Arctic-nesting shorebirds undertake some of the longest migrations of any animals.
- Migratory shorebirds depend on at least three habitats: breeding, nonbreeding, and migratory stopover sites.
- Shorebirds concentrate in great numbers at their stopover sites.
- Because shorebirds fly together in large numbers, their populations are extremely vulnerable to threats along their migratory routes.
- Most important migratory stopovers are nutrient-rich habitat, like estuaries, which also provide resources desirable to humans, making them vulnerable to alteration, pollution, and destruction.

- Shorebirds migrate between northern breeding areas and southern wintering areas to take advantage of seasonal food resources.

Vocabulary

- aquatic habitat
- aquatic insects
- breeding grounds
- nonbreeding grounds
- body mass
- clutch
- fat loading
- fledging
- flyway
- foraging
- invertebrates
- juvenile
- migrate
- migration route
- nesting
- pesticide
- pothole
- predator
- probing
- shorebird
- species
- survivorship
- territory
- wetlands
- amphipods
- critical habitat
- Central Flyway
- Atlantic Flyway
- Pacific Flyway

Objectives

After this activity, students will be able to:

- List five characteristics unique to shorebirds.
- Locate the three main flyways in the United States.
- Name four hazards shorebirds encounter along their annual migrations.
- Explain why these birds migrate from the far north to the far south of the Western Hemisphere.
- Explain what “fat loading” is and why it is important to migrating shorebirds.

Materials

- Playing field or gymnasium
- Cones, string, rope, or hula hoops to mark breeding grounds, wintering grounds, and staging areas
- One classroom set of Northern, Southern and Staging Area Cards
- *Western Hemisphere Shorebird Reserve Network Poster* (included with the education guide)

Introduction

There are approximately 50 different species of shorebirds throughout North America. Most shorebirds spend their summers in the northern areas of the United States, Canada, and Alaska and *migrate* to southern United States, Central America, and South America to spend their winters where food is available. The White-rumped Sandpiper, for example, migrates each year from the Arctic Circle to the southernmost tip of South America and back, a round trip of 20,000 miles every year! However, not all shorebirds migrate such long distances. Some, like the American Avocet, breed in the north and winter in the southern part of the United States.

In North America, three primary flyways are heavily used as *migration routes*, connecting the shorebirds’ *breeding grounds* in the north to their *nonbreeding grounds* in the south. The *Pacific Flyway* follows the coast from Alaska to the southern part of South America. The *Atlantic Flyway* runs along the Atlantic Coast from northwestern Canada to the very southern tip of South America. The *Central Flyway* stretches from north central Canada, down through the center of the United States into northern South America. The activity focuses on the Central Flyway.



To learn more about the spectacular migrations of shorebirds, read *Magnificent Shorebird Migration* found in the *Shorebird Primer*. To learn more about the threats shorebirds face along the way, as well as the ongoing efforts to protect them and their critical habitats, read *Threats to Shorebirds*, also found in the *Shorebird Primer*.

Activity Preparation

1. Read the background information *Magnificent Shorebird Migration* found in the *Shorebird Primer*. It is essential to understanding this activity. Read through the game cards as well in order to be aware of the situations presented to the students.

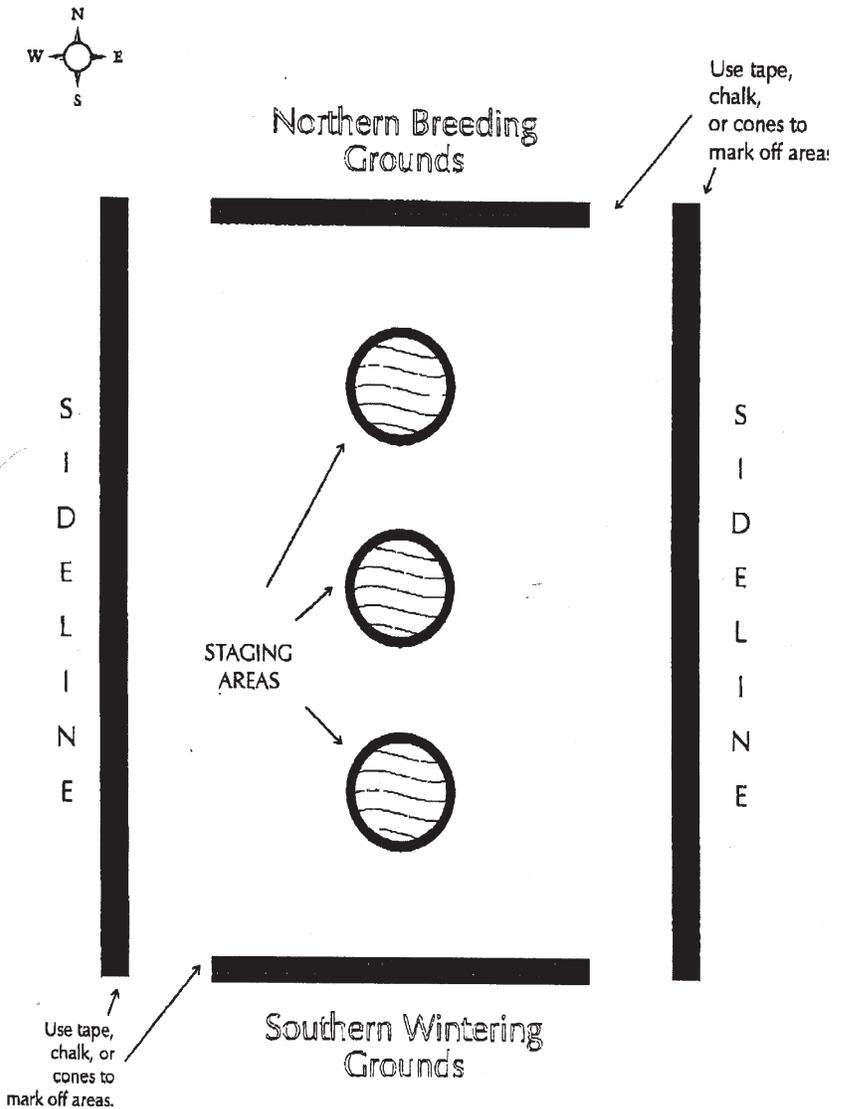
2. Photocopy and cut out the following game cards:
 10-Northern Cards
 10-Southern Cards
 14-Staging Area Cards

3. Set up your playing field according to the directions and diagram below.

■ Place a rope or other line across each end of the playing field and mark one end “the nonbreeding grounds” and the other “the breeding grounds.”

■ Place three circles in the playing field, using rope or hula hoops. The circles represent staging areas.

4. Disperse the Staging Area Cards evenly among the three staging circles. Spread the Northern Cards in the breeding area and the Southern Cards in the nonbreeding grounds.



Procedure

1. Talk briefly about *migration*, *staging areas*, *breeding grounds*, and *nonbreeding grounds*. Explain that students will be migrating shorebirds. Locate the three main flyways on a map of North and South America, using the *Western Hemisphere Shorebird Reserve Network Poster* with the education guide. For purposes of this game, players are to imagine they have migrated on the Central Flyway.

2. Explain how the game works.

- Each player must pick up one card at the wintering ground, each staging area, and the breeding ground.
- Players must follow the directions written on the cards and return the cards to the pile before they continue their migrations. For example, a card from the breeding grounds may instruct its holder to take a person who has been labeled “dead” by another card and return him or her into the game as a young bird.

- Any player who picks up a card indicating death of the bird must drop out of the game and stand along the sidelines until there is an opportunity to rejoin the game.
3. Select one or two players to represent the Peregrine Falcon and/or the Merlin as predators in flight. Their job is to tag students as they move among the staging areas. They must escort each tagged victim to the edge of the playing field before tagging another migrating student.
 4. As the players run to the other side of the playing field, they must stop at each of the staging areas to refuel (unless otherwise instructed). They collect one card at each staging area and follow the directions on the card.
 5. Players must make four complete migrations (from south to north and back to south). Each migration (in one direction) will begin with a signal from the teacher.
 6. Plot the survival rate of each migration. Discuss some of the following questions to identify what affected the survival rate.
 - What were some of the unexpected situations described on the cards? How did these things affect migration?
 - What events caused bird deaths? Which were “natural” and which were “human-caused?” List these on the chalkboard.
- Discuss the list of “human-caused” deaths and evaluate the pros and cons of each situation. How do people’s actions affect other animals and each other? (DDT is an insecticide used to protect crops from damaging pests. It has been outlawed in the United States for over 20 years. Scientists discovered that DDT can be passed on from one animal to another, poisoning all the organisms it comes in contact with.)
 - What are some of the weather changes shorebirds experience during their migration?

Additional Activities



Cultural Connections

- After the activity, lead a discussion with students discussing cultural beliefs about the environment and their influence on survival of shorebirds.
- Students can pretend to be shorebirds migrating from Paraguay to Nunavut, Canada. They can research Spanish and Inuit or French words, phrases, or sentences to speak to each other when they arrive in those countries—phrases such as “welcome,” “I am hungry,” and “be careful.” Students can also work with the school’s Spanish or French teacher to come up with words and sentences.

Prairie Pothole/Playa Lake History Lesson

Ask each student to search for ten facts regarding the formation and history of the Prairie Pothole or Playa Lake Region in the central United States. Have them share the information they discovered and then assemble a class report based on the facts they uncovered.

Local Shorebird Migration

Working in small groups and using the <http://sssp.fws.gov>, have your students research local shorebirds, including the migration routes they take and the places where they stop to rest and feed. Ask them to draw migration maps to plot known and possible stopover sites. Have them report on what they learned.

Local Shorebird Threats

Invite a state wildlife officer to speak to the class about what impacts the migratory birds in your community. Find out how students can help to lessen the effects of these impacts.

The Incredible Journey Game Cards

Ten - Northern Cards

(Make one photocopy.)

<p>NORTHERN CARD Bad news! Unusually bad weather has limited your feeding time. You are too weak to make it to the first staging area. You die and must go to the sideline.</p>	<p>NORTHERN CARD Severe weather in the Arctic tundra kept you from laying eggs. You have difficulty finding a sufficient supply of invertebrate prey (animals you eat). You struggle to keep up with the flock. Hop on one foot to your first staging area.</p>
<p>NORTHERN CARD Yeah! Good weather and only a few predators have made it a great nesting season. Pick two people from the sidelines to migrate with you.</p>	<p>NORTHERN CARD Lost wetlands on the way to your breeding grounds made you late and weak. You do not have time to reproduce. Craneflies and bloodworms are abundant so you double your weight. Begin your migration.</p>
<p>NORTHERN CARD Hurrah! It's been a warm, wet summer. There was an abundance of shoreflies and danceflies to feed on. Your nesting is successful. Take one person from the sidelines with you. Begin migration.</p>	<p>NORTHERN CARD Yikes! It's been a good year for weasels and a bad year for eggs. None of your young survive. Food was abundant. Begin migration.</p>
<p>NORTHERN CARD Great! You have successfully hatched and fledged one of your young. Pick one person to migrate with you.</p>	<p>NORTHERN CARD You are young and are not able to put on a sufficient fat load before migration begins. You are not so strong as the adults. Skip to the first staging area.</p>
<p>NORTHERN CARD Bummer! A large fox population this year has increased fatalities. You are eaten. Go to the sidelines.</p>	<p>NORTHERN CARD Yum! There is an abundance of amphipods and snails this year. You have easily doubled your body weight. You have had a successful nest. Take two people to migrate with you. Begin migrating!</p>

The Incredible Journey Game Cards

Ten – Southern Cards

(Make one photocopy.)

<p>SOUTHERN CARD Yippee! It's been a good winter! A new wetland reserve area has been added to your winter grounds. There was plenty of food. Fly to your first staging area.</p>	<p>SOUTHERN CARD Yuck! You are feeding on aquatic insects contaminated with DDT from the runoff of agricultural lands surrounding your wetland habitat. You become sick and die. Go to the sideline.</p>
<p>SOUTHERN CARD How disappointing! You have had a rough nine months at your wintering grounds. Part of the wetland you have always returned to has been drained, causing more birds to compete for less food. You are weak. Hop on one foot to the first staging area.</p>	<p>SOUTHERN CARD Bang! Hunting of shorebirds is still legal in South America. A hungry hunter shoots you. Go to the sideline.</p>
<p>SOUTHERN CARD Too bad! Agriculture is spreading on your wintering grounds and, as a result, so is DDT. You die from pesticide poisoning. Go to the sideline.</p>	<p>SOUTHERN CARD You're starving! Overcrowding due to the loss of wetlands has increased competition for what little food there is. You do not have an adequate fat load and your migration is difficult. You may skip to your first staging area.</p>
<p>SOUTHERN CARD Oh no! More wetlands have been drained and turned into agricultural areas. You are unable to find enough food and eventually die. Go to the sidelines.</p>	<p>SOUTHERN CARD Moo! The cattle industry is booming in South America. Your winter habitat is severely overgrazed, making it difficult to eat enough to put on an adequate fat load for migration. You must skip to your first staging area.</p>
<p>SOUTHERN CARD Worms! Oodles of freshwater worms! It's been a great winter with lots of food. You easily increase your body weight from 20 grams to 40 grams for the long migration to the Arctic tundra. Migrate to the first staging area.</p>	<p>SOUTHERN CARD Good news! Educating people about the need to preserve wetlands has paid off. More wetlands mean more food. You begin your next migration in good health.</p>

The Incredible Journey Game Cards

Fourteen – Staging Cards

(Make one photocopy.)

<p>STAGING AREA Bye, bye! You did not find enough food to replenish your fat load, and the flock you were traveling with has left without you. You must wait one turn to continue on with another flock.</p>	<p>STAGING AREA This is unnerving! You are on the perimeter (outer edge) of the flock and must constantly be on the look-out for predators. You do not eat enough to put on an adequate fat load. Hop to the next staging area.</p>
<p>STAGING AREA Gobble, gobble! You have had warm weather and abundant food at this staging area. You have easily increased your weight by 100%! Begin your migration again.</p>	<p>STAGING AREA Yikes! Your usual staging area has been drained for farming. You must scrounge to find enough food for the next leg of your journey. Hop on one foot to the next staging area.</p>
<p>STAGING AREA Bad stuff! You find that this staging area has been contaminated with pesticides from surrounding agricultural lands. You become ill and die. Go to the sideline.</p>	<p>STAGING AREA WHEEEEEEE! You've got a full stomach and a tail wind pushing you on to your next staging area. A predator can't even catch you! Arrive at your next staging area quickly and safely.</p>
<p>STAGING AREA Brrrr! Bad weather makes for a slow migration! Side step to your next staging area.</p>	<p>STAGING AREA Bad stuff! Bad weather makes for a slow migration! Side step to your next staging area.</p>
<p>STAGING AREA What? Your usual staging ground is swarming with people! A new recreation center has opened at your staging area. Being around so many people makes feeding difficult. You do not store enough energy. Walk to your next staging area.</p>	<p>STAGING AREA Hooray! The Western Hemisphere Shorebirds Reserve Network has done a great deal to preserve important shorebird sites along your migration route. You find a surplus of food and quickly refuel for your continued migration.</p>

The Incredible Journey Game Cards

Fourteen – Staging Cards

(continued)

(Make one photocopy.)

<p>STAGING AREA Gooley! You find one of your coastal staging areas covered in oil. You become covered with the thick goo and are unable to eat, fly, or maintain any body heat. You die. Go to the sideline.</p>	<p>STAGING AREA Ugh! You have run into a head wind (wind blowing against you) and you are burning up a lot of energy. Take two steps forward and one step back as you make your way along your migration.</p>
<p>STAGING AREA Whoopie! Education about wetlands has gained public support for the restoration of wetland areas. You have an abundance of snails and freshwater worms to feed on! You begin your migration in good health.</p>	<p>STAGING AREA ZAP! New radio towers have been built across your migration route. You are zapped and die. Go to the sideline.</p>
<p>STAGING AREA You find yourself feeding in the safety of the flock. Craneflies, danceflies, and shoreflies are abundant. You double your weight easily. Move on to the next staging area.</p>	

Precarious Paths

Adapted with permission from "New Jersey's Shorebirds: A Local and Global Perspective." New Jersey Audubon Society. 1998.

Grade Level: upper middle school/ high school

Duration: one class period

Skills: vocabulary, discussion, critical thinking, collection and interpretation of data, presentation, and comparison

Subjects: science, geography, and language arts; fine arts (with additional activity)

Concepts:

- During each year of their lives, most shorebirds migrate between habitats located in different geographic areas.
- Arctic-nesting shorebirds undertake some of the longest migrations of any animals.
- Shorebirds migrate between northern breeding areas and southern wintering areas to take advantage of seasonal food resources.
- Migratory shorebirds depend on at least three habitats: breeding, nonbreeding, and migratory stopover sites.
- Most migratory stopovers are nutrient-rich habitat, like estuaries, which also provide resources desirable to humans, making them vulnerable to alteration, pollution, disturbance, and destruction.

Vocabulary

- migration
- migration flyway
- Pacific Flyway
- Atlantic Flyway
- Central Flyway
- threat
- predator
- bird-banding
- stopover site
- distraction display
- incubate
- mate

Overview

Students read clue cards to map the migration paths of their “mystery shorebirds.”

Objectives

After this activity, students will be able to:

- Describe factors that affect shorebird migration.
- Label the three major migration routes of North American shorebirds.

Materials

- One copy for each student of the *Blank Western Hemisphere Map* measuring tool
- pencils or markers
- Copies of the *Shorebird Clue Cards* so each student has one to four cards
- Additional geography resources
- One overhead transparency of the *Western Hemisphere Migration Flyways Map*

Introduction

Shorebirds experience incredible *migration* journeys that follow the same general paths each year. Their migration is subject to weather, food availability, predators, changes in habitat, pollution, and other human-induced disturbances. Each species of shorebird has specific needs that dictate its selection of feeding, resting, and breeding sites.

For more specific information about shorebird migration, read *The Magnificent Shorebird Migration* and *Shorebirds Depend on a Chain of Healthy Wetlands* in the *Shorebird Primer*.

Activity Preparation

1. Photocopy the *Blank Western Hemisphere Map* so there is one for each student.
2. Make a transparency of the *Western Hemisphere Migration Flyways Map*

3. Decide which Shorebird Clue Cards you will use for the activity. Photocopy and cut the cards so each student will get between one to four cards.

Procedure

1. Pass out a *Western Hemisphere Map* to each student. Have the students identify the countries and bodies of water shown on the map by using additional geography resources.
2. Introduce the concept of migration flyways. Using the transparency of the *Western Hemisphere Migration Flyways Map*, show students the routes of the three flyways of North America. Ask each student to identify the flyway route of his or her shorebird.
 - Atlantic Flyway:** Red Knot and Ruddy Turnstone
 - Central Flyway:** Marbled Godwit
 - Pacific Flyway:** Western Sandpiper
3. Now that each student has identified the flyway his or her shorebird uses, have students work together to assemble a six-piece shorebird migration story. (Note: the Marbled Godwit has eight cards in the story.)
4. Once the teams are confident they have pieced their entire story puzzles together correctly, ask them to mark the bird's location on their migration maps. If a team's bird is not clearly following one of the three flyways, have the team check its story cards against the master. Once all the teams are done, have each one read its shorebird's migration account to the class. Have teams use the migration map as a visual aid.
5. Ask the students to use additional resources (bird books,

the Internet, the Audubon Society, or the *Shorebird Profiles* located in the *Appendix* of this education guide, etc.) to find out about their shorebird's life history. Have them prepare a written, oral, or visual presentation about the shorebird that includes the following:

- the bird's migration route
- what challenges (threats) the bird encountered
- whether or not the bird had chicks and if not, why and what it did instead

6. Discuss some of the following questions with the class.

- Why do different types of shorebirds use different migration routes? Why do some use different routes in the spring and fall?
- Why do they stop along the way? What would happen to these birds if pollution or development changed the stopover sites they depend on?
- How are the habitat requirements different and similar for each bird on both their breeding and nonbreeding territories?
- Which habitats are important for resting and feeding as the make their migration flights?

Additional Activities



Cultural Connections

- Students can write additional precarious paths clue cards that describe the interactions among the shorebirds and the cultural groups along their migration paths.
- Students can research the Exxon Valdez oil spill and how it impacted the communities along the coast and the birds.

Salt Clay Migration Map

Create either a classroom-sized map of the Western Hemisphere or have each student create his or her own map using the recipe below. After the clay has dried thoroughly, use acrylic paint to color the map in order to identify landforms. For example, paint the rivers and lakes blue, the mountain ranges brown, and the prairie areas light green. Then use pins and string to chart out the migration route of each of the shorebirds described in this activity. Include a picture of the birds and a short biography of each to display below the map. Give students the choice of also researching the migrations of other shorebirds and adding them to the map.

Salt Clay Map

2 cups flour
1 cup salt
1 tablespoon alum (You must include this!)
1 cup water

Stir ingredients and then knead until smooth and blended. Use a 12" x 18" board or heavy cardboard to hold an individual map. If making a classroom map, double or triple the recipe as needed.



Precarious Paths Clue Card Red Knot (Atlantic Flyway)

(Make one photocopy.)

<p>Precarious Paths Clue Card-Red Knot</p> <p><i>January 8th</i> There are thousands of us feeding on the sandy beaches and mud flats at the southern tip of South America in Tierra del Fuego. I spend most of the day feeding in the mussel beds, devouring young mussels. The rest of the time I roost and preen with the rest of the flock.</p>	<p>Precarious Paths Clue Card-Red Knot</p> <p><i>March 14th</i> I arrived on the central coast of Argentina to feed again on the invertebrates living in the mud of the immense tidal sand flat. I need to increase my body weight by 80 percent and to do that I eat a lot of the small snails found here.</p>
<p>Precarious Paths Clue Card-Red Knot</p> <p><i>May 19th</i> After a nonstop flight to the northern coast of South America, then across the ocean, I arrived on the sandy beaches and tidal flats of the Delaware Bay. There are about 50 to 100,000 of us here with tens of thousands of other shorebirds. We are all here for one reason: food! Horseshoe crab eggs galore! We eat and eat and eat...that is unless we are sleeping or trying to stay away from people and other animals.</p>	<p>Precarious Paths Clue Card-Red Knot</p> <p><i>May 31st</i> I weigh so much that I don't think I can lift off the ground, but late in the afternoon, the incoming tide pushes me and the flock higher up on the beach. We all move away from the advancing water, moving as one. Someone jumps a certain way and we are all up in the air, flying north, knowing that we will not stop until we fly over Hudson Bay and reach the Arctic tundra.</p>
<p>Precarious Paths Clue Card-Red Knot</p> <p><i>June 3rd</i> As we fly over the northern Canadian tundra pools and hummocks of the Melville Peninsula, I leave the flock and fly down to a barren area scattered with vegetation. It is here that I will find my mate and we will spend the next six weeks establishing a nest, incubating the eggs, and raising our young.</p>	<p>Precarious Paths Clue Card-Red Knot</p> <p><i>July 18th</i> Leaving our young behind, I make it to James Bay. This is my favorite spot on my southward migration. The tidal mud flats are full of clams. From here I will follow the west winds to the Atlantic coastline where I will feed almost constantly until late August. The best places to stop along the coast are national and state refuges, parks, and forests. By September I'll be ready for the nonstop, four-day flight over the ocean to Suriname. I'll rest and feed before my return flight to Tierra del Fuego, Argentina.</p>

Precarious Paths Clue Card Ruddy Turnstone (Atlantic Flyway)

(Make one photocopy.)

<p>Precarious Paths Clue Card-Ruddy Turnstone</p> <p><i>April 10th</i> I have been working my way northward for the past month or so, finding many sandy beaches and mud flats in coastal south Florida. Much of my time is spent looking for food by turning over stones and seaweed to look for and catch my preferred food – sand fleas. But I will eat anything I can scavenge, such as dead animals and bits of food left over from other animals feeding.</p>	<p>Precarious Paths Clue Card-Ruddy Turnstone</p> <p><i>May 16th</i> For the last couple of years, I stop along the Delaware Bay to gorge myself on horseshoe crab eggs. I feed a little differently than the other shorebirds that join me – I dig up the eggs that are right under the surface, while they pick the eggs up off the surface. I guess in this way I am making more eggs available to everyone.</p>
<p>Precarious Paths Clue Card-Ruddy Turnstone</p> <p><i>June 3rd</i> I thought I ate enough horseshoe crab eggs so I could fly directly to my breeding grounds, but I guess I didn't gain as much weight as usual. I stop at Churchill, on the Hudson Bay to feed along their jetties before continuing. I hope I will have enough time to select a mate and nest.</p>	<p>Precarious Paths Clue Card-Ruddy Turnstone</p> <p><i>June 16th</i> I arrive on the breeding grounds north of Hudson Bay and look for the location I have used in the past. The boulder on the tundra is an ideal place for me to perch and call and watch for predators. As I touch down, I am immediately assaulted by another Ruddy Turnstone, driving me out of range.</p>
<p>Precarious Paths Clue Card-Ruddy Turnstone</p> <p><i>July 8th</i> As much as I try, I am unable to find a suitable nest site and available mate. Leaving the breeding grounds early, I head south. Along the way I meet up with other Ruddy Turnstones and we form small flocks as we work our way down the Atlantic coastline, stopping at Parker River National Wildlife Refuge in Massachusetts, Pea Island National Wildlife Refuge in North Carolina, and Sapelo Island National Estuarine Reserve in Georgia.</p>	<p>Precarious Paths Clue Card-Ruddy Turnstone</p> <p><i>September 4th</i> After we depart from the national wildlife refuges and sanctuaries at the southern tip of Florida, our small flock arrives in northern Argentina. This is the same beach I started out at last season when I migrated north. We spend most of our time feeding and preening. I hope that next year I can make it back to the Arctic with plenty of energy and plenty of time to breed.</p>

Precarious Paths Clue Card Marbled Godwit (Central Flyway)

(Make one photocopy.)

<p>Precarious Paths Clue Card-Marbled Godwit</p> <p><i>April 15th</i> Well, I'm fattening up on worms and insect larvae in the mudflats of Humbolt Bay. I'll soon be ready for my journey to the Canadian grasslands to nest.</p>	<p>Precarious Paths Clue Card-Marbled Godwit</p> <p><i>April 30th</i> I made it to the Great Salt Lake. I'll rest and eat here for a couple of weeks before I continue my long flight. I will stop once more at Benton Lake, Montana before reaching the breeding grounds.</p>
<p>Precarious Paths Clue Card-Marbled Godwit</p> <p><i>June 4th</i> I've arrived at Quill Lakes in Saskatchewan, Canada. I quickly recognized my mate's call, the same male I have nested with for the past four years! We better hurry to choose a nest site and scrape a simple hollow in the grass so I can lay our eggs. We'll nest in the dry uplands of the grasslands not too far from the lake.</p>	<p>Precarious Paths Clue Card-Marbled Godwit</p> <p><i>June 15th</i> This morning I had a frightening experience! When I was searching for grubs and insect larvae in the grass, a man grabbed me! He put these funny-looking bands on my legs—a silver one, bright red and orange ones, and a white one with an end sticking out. These odd bands don't bother me when I walk or fly, but they sure do look funny. I wonder what they mean?</p>
<p>Precarious Paths Clue Card-Marbled Godwit</p> <p><i>June 30th</i> Our four spotted eggs hatched just when they were supposed to, about 24 days after I laid them. Our chicks are already pecking for insects in the grass. They surely are a hungry bunch!</p>	<p>Precarious Paths Clue Card-Marbled Godwit</p> <p><i>August 14th</i> It's time to head south again before winter blows in. It's lonely migrating all by myself, but it will be good to get to those wonderful sand crabs—a change from my summer diet in the grasslands.</p>
<p>Precarious Paths Clue Card-Marbled Godwit</p> <p><i>September 15th</i> I stop to rest and feed at Antelope Island State Park in the Great Salt Lake. It's a wonderful smorgasbord of food here! There's thousands of other birds here too!</p>	<p>Precarious Paths Clue Card-Marbled Godwit</p> <p><i>November 10th</i> I made it! I completed another successful flight down to Humbolt Bay, California. Many of us Marbled Godwits continue even farther south to Bodega Bay or to the west side of the Gulf of California. Me, I'm satisfied to stay here and spend the winter resting and eating.</p>

Precarious Paths Clue Card Western Sandpiper (Pacific Flyway)

(Make one photocopy.)

<p>Precarious Paths Clue Card-W.Sandpiper</p> <p><i>April 10th</i> Everyone's flocking up, getting ready for our long trip north to the breeding grounds. It's amazing having so many of us together at one time. We'd better hurry; we've got a long way to fly, starting way down here along the coast of Peru!</p>	<p>Precarious Paths Clue Card-W.Sandpiper</p> <p><i>April 20th</i> After stopping at several locations to rest and refuel, we've made it to the United States at the national wildlife refuges in San Diego Bay. We'll rest and refuel in the mudflats before heading to our next stop-- San Francisco Bay National Wildlife Refuge.</p>
<p>Precarious Paths Clue Card-W.Sandpiper</p> <p><i>May 10th</i> After leaving Oregon Island National Wildlife Refuge, we stopped at Nisqually National Wildlife Refuge before heading to the nutrient-rich Alaska coast!</p>	<p>Precarious Paths Clue Card-W.Sandpiper</p> <p><i>May 20th</i> I bet there are one million of us here at Alaska's Copper River Delta. This is a wonderful stopover site along our way north. The endless mudflats give me a chance to probe the mud for tiny clams, worms, and sand fleas until I replace some of the body fat I used getting here. I'm going to need the energy to make it all the way up into northwestern Alaska.</p>
<p>Precarious Paths Clue Card-W.Sandpiper</p> <p><i>June 1st</i> Looks like the males have beaten us here to the Alaskan Artic Tundra of the Arctic National Wildlife Refuge. Well, that's O.K. They've already selected nesting sites, so all I have to do is choose a mate and lay my eggs.</p>	<p>Precarious Paths Clue Card-W.Sandpiper</p> <p><i>June 10</i> I'm so glad that my mate and I take turns incubating the eggs. That gives me a chance to feast on the large numbers of insects that are hatching now. I'd better watch out while I'm feeding. The Arctic fox is always looking to make a meal out of us shorebirds!</p>

Precarious Paths Clue Card Western Sandpiper (Pacific Flyway)

(continued)

(Make one photocopy.)

<p>Precarious Paths Clue Card-W.Sandpiper</p> <p><i>June 24th</i> Here we go again! Those gulls are nasty predators and are after our chicks. Maybe I can distract them with the “broken wing act” while my mate leads our chicks to safety. Looks like they’ve seen this trick before and aren’t falling for it this time.</p>	<p>Precarious Paths Clue Card-W.Sandpiper</p> <p><i>July 18th</i> Having left the young behind, I fly to Kachemak Bay at the Alaska Maritime National Wildlife Refuge, then to Stikine River Delta along the Canadian coast. This is my favorite spot on my southward migration because of the abundance of clams in the tidal mudflats. Then I will travel along the coast line, stopping every couple hundred miles. We take our time getting home.</p>
<p>Precarious Paths Clue Card-W.Sandpiper</p> <p><i>August 30th</i> We have arrived at Marismas Nacionales near Tepic, Mexico. This is a great place to rest. In fact, some Western Sandpipers will stay here all winter. I will continue to Peru with one stop in Panama before arriving.</p>	<p>Precarious Paths Clue Card-W.Sandpiper</p> <p><i>August 15th</i> I’m glad to be back in Peru for the winter. I need a rest! Every year the trip gets harder for me. There are so many people along the coast who disturb me when I try to rest and feed along the way. Sometimes the food has a strange, unfamiliar taste that makes me feel weak. Well, at least I can rest here for a few months and regain my strength.</p>



MILEAGE SCALE
each space = 100 miles

*Map provided
by New Jersey
Audobon Society*

Bird's-eye View

Adapted with permission from Quinlan, "Alaska Wildlife Week."

Grade Level: upper middle school/ high school

Duration: several 30-minute class periods

Skills: visualization, communication, vocabulary, and discussion; using technology (with additional activities)

Subjects: science, social studies, geography, fine arts; language arts and technology (with additional activities)

Concepts:

- During each year of their lives, most shorebirds migrate between habitats located in different geographic areas.
- Arctic-nesting shorebirds undertake some of the longest migrations of any vertebrates.
- Migratory shorebirds depend on at least three habitats: breeding, nonbreeding, and migratory stopover sites.
- Some shorebirds concentrate in great numbers at their stopover sites.

Vocabulary

- migration
- stopover site
- geography
- climate
- breeding grounds
- landmarks
- habitat
- flock

Overview

Students imagine that they are migratory shorebirds and design an illustration that conveys the length and difficulty of the trip, as well as the landmarks, habitats, and stopover sites they pass over along their way.

Objectives

After this activity, students will be able to:

- List at least three important landmarks to a migrating shorebird.
- Write a paragraph describing the migration of one type of shorebird, including where it starts and ends its journey, where it stops to feed, what it eats along the way, and the important landmarks it passes.
- Translate the paragraph into a picture that depicts the migration of the same shorebird.

Materials

- A roll of butcher paper
- One large sheet of drawing paper per student
- Drawing materials like charcoal and colored pencils, markers, crayons, or paints
- Shorebird research materials, including the Shorebird Profiles (found in the Appendix) and an assortment of resource books (located in the Appendix)

Introduction

There are approximately 49 different species of shorebirds throughout North America. Most shorebirds spend their summers in the northern areas of the United States and Canada and *migrate* to the southern United States, Central America, and South America to spend their winters where food is available. The White-rumped Sandpiper, for example, migrates each year from the Arctic Circle to the southernmost tip of South America and back--a round trip of 20,000 miles every year! However, not all shorebirds migrate such long distances. Some, like the American Avocet, breed in the extreme north and winter in the southern part of the United States.

In North America, shorebirds use three primary *migration routes* (flyways) that connect their *breeding grounds* in the north to their *wintering grounds* in the south. Each of these flyways is characterized by unique physical features, wetland habitats, and stopover sites. To learn more about the spectacular migrations of shorebirds, read *Magnificent Shorebird Migration* found in the *Shorebird Primer*.

Procedure

1. Ask students to remember what the world looks like from the view of an airplane, the top of a tall building, or the ridge of a mountain. Have they ever looked down on the tops of trees, clouds, a river, or a coastline? What was the purpose of their journeys? Did they look forward with anticipation to the sight of their destination? Did they anticipate a change in climate and geography?
2. Ask them to imagine what the world looks like to a migrating shorebird in the spring or in the fall. How high does the shorebird fly? What kinds of landmarks might be important to a shorebird? What kind of weather would it have to endure? What would it see? Make a class list of the answers your students provide.

Possible responses: the shoreline; estuaries, river deltas, or other types of wetlands; receding ice or snow; other shorebirds flying, landing, feeding, or roosting together, perhaps in large flocks; treetops; the height of the tide; storms; clouds; warm sunshine; people with binoculars; towns and cities; bare plowed fields where there used to be a marsh

3. Ask the students to select a species of shorebird for this activity. Have them learn all they can about the bird they select. What does it eat? Where does it breed? What flyway does it take to its nonbreeding grounds? Where does it spend its winters?
4. Ask the students to draw or paint a picture of the world from the viewpoint of the migrating shorebird. Encourage them to accurately portray the habitat the bird might pass over, the length of the journey, the altitude the bird is flying, and the feel of the air.
5. Have them use the butcher paper to sketch a layout of their picture and practice drawing in aerial perspective. When they are satisfied with their mock-up, they can transfer their ideas onto the final drawing paper.

Additional Activities



Cultural Connection

Students add information related to the cultural groups along the shorebirds' migration routes.

Shorebird Migration Stories

Ask students to write a story describing their shorebird's migration to accompany their drawing. What did it see and hear along the way? Where did it stop to rest and feed? What was it like at this stopover site? How long was the journey? How did it feel to finally reach the breeding ground?

Shorebird Migration Play

As a cooperative project, have the class select one of the shorebird migration stories and turn it into a dramatic play. Divide the class into teams to prepare costumes, design the set, write the dialogue, and act out the parts. Videotape the production and design special invitations to a live performance.

