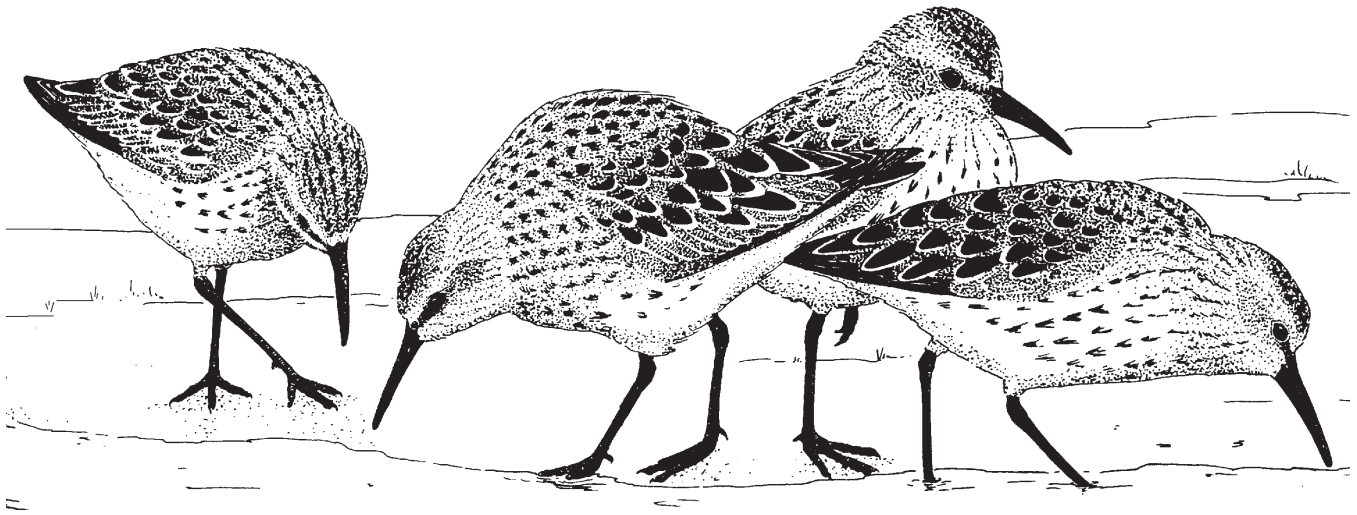


A Shorebird Primer for Educators

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What Makes a Bird a Shorebird?



“We are utterly convinced that shorebirds are among the most interesting, puzzling and challenging of all life forms. They offer a delightful spectacle—agile, exciting, unpredictable, beautiful, and tantalizing.”

—Des Thompson and Ingvar Byrkjedal, *Shorebirds*

Habitat

Birds of Open Land

Land and water—they are the two most basic geographic features of the Earth’s surface. What happens along the narrow lines where these two great bodies meet? This fragile strip, whether inland along the edge of a lake or river, or between ocean and the beach, contains some of the greatest variety of living organisms, or *biodiversity*, on our planet. The narrow strip where the two meet is called the *shore*. This part of the land is enriched by life-sustaining water, yet must also endure powerful daily and seasonal natural forces created by water. Water levels can change through natural events—such as periodic flooding, drought, evaporation, and fluctuation of tides, and through human-caused-mechanical release of water from dams or planned water drawdowns. These modifications of water level affect water properties such as salinity and other chemical composition. These, in turn, affect the plant and animals species that can live there.

Organisms that live in this precious environment are built to live in these variable conditions. *Shorebirds* are a group of birds

especially *adapted* to thrive in these areas. Rather than characterizing this group of birds as “shore-living,” they are more accurately described as “birds of open land” because of the wide range of places they are found. For example, shorebird habitat includes estuaries, mudflats, grasslands, tundra, alpine areas, and shorelines.

Migration

Most Shorebirds Migrate Long Distances

Each spring and fall, enormous flocks of shorebirds swarm along the coasts in great *migrations*. It is a thrilling sight when the shore comes alive with feeding birds, or a flock swiftly wheels and turns in flight. These flocks pulse to and fro with the cycles of the tides, and on a broader scale, with the cycles of the seasons. Shorebirds eat, breed, travel, and rest as a part of these cycles of nature.

Shorebirds are one of the most migratory groups of animals on the planet. Of the 51 species that breed in North America, 40 species (78 percent) spend the northern winter in countries other than the United States or Canada. In addition to Latin American and Caribbean



destinations, some shorebirds breeding in North America winter in Eastern Asia, Australia, Polynesia, and Northern Europe. For example, the Pacific-Golden Plover flies non-stop from Hawaii to Alaska in two or three days. That's 2400 miles! Other Pacific-Golden Plovers winter in Tahiti and fly non-stop to Alaska--a distance of 5000 miles! To accomplish these amazing migratory feats, all long-distance migratory shorebirds have long, pointy wings that allow them to fly fast and far and have the ability to store lots of fat to fuel their journeys.

Shorebirds Depend on Three Distinct Geographical Areas

Because most shorebirds are migratory, they need healthy habitat in at least three distinct geographic areas: northern breeding grounds, southern non-breeding grounds, and stopover sites scattered along their migration routes. Stopover habitats are crucial for shorebirds to rest and refuel during migration. For example, Sanderlings, cardinal-sized sandpipers, breed in northern Alaska and may spend their non-breeding season as far away as the southernmost tip of South America, in Tierra Del Fuego, Argentina. To successfully complete their migration, Sanderlings depend on numerous stopover sites along the Atlantic and Pacific Flyways.

They require tundra habitat for breeding, beaches and mudflats for stopover habitat, and beaches during the winter.

Not All Shorebirds Are Long-Distance Migrants!

Although shorebirds are generally known for long-distance migrations, some species migrate very short distances. In fact, not all shorebirds breed in the Arctic.

Long-billed Curlews, for example, nest on the interior grasslands of North America and spend the winters along the Gulf Coast of North America. A few shorebird species do not migrate at all. For example, the Wilson's Plover remains in Florida throughout the year, and the Black Oystercatcher remains on the Pacific Coast.

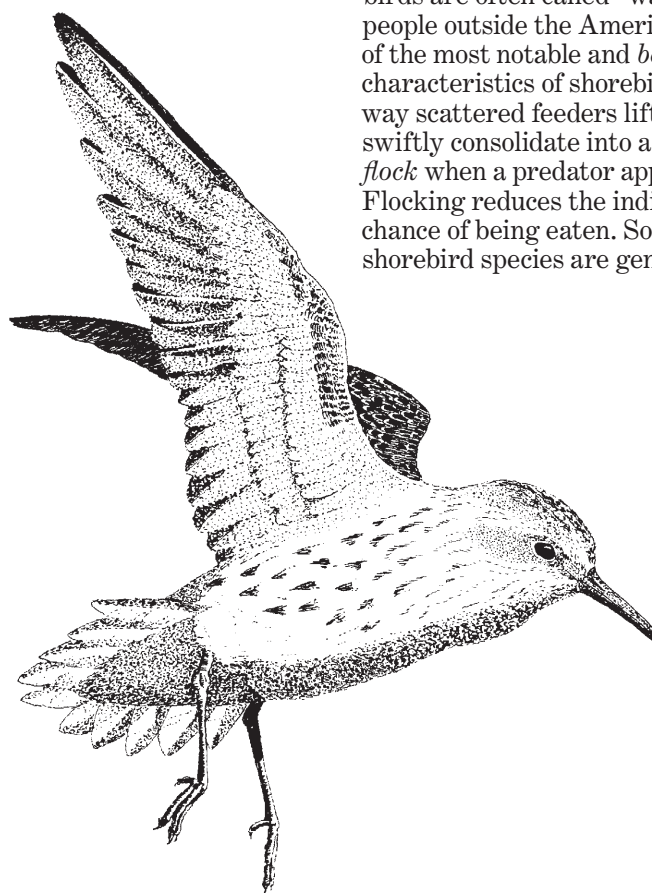
Shorebirds Are Unique in Form and Function

Shorebird families include the sandpipers, plovers, oystercatchers, snipes, and stilts, among others. Shorebirds share morphological and life history characteristics that set them apart from other birds. They are distinguished by their small-to-medium-sized, narrow, pointy bills, long legs, long pointy toes, long wings, and unique feeding

behaviors. They are different from many other groups of birds you may observe using the same habitats. For example, although found in coastal wetlands, herons, egrets, gulls, and pelicans are not true shorebirds. Upon closer examination, you will see they differ from shorebirds in their lifestyles (food, behavior, nesting, etc.) and in the way they look. Check out a bird identification guide to note their differences. To aid in your comparison of shorebirds to seabirds and wading birds see the chart in the Appendix.

Shorebirds Have Unique Feeding Behaviors

Because of their lifestyle of wading through water and mud to find food, particularly during their spectacular migrations, these small-to-medium-sized, long-legged birds are often called "waders" by people outside the Americas. One of the most notable and *behavioral* characteristics of shorebirds is the way scattered feeders lift off and swiftly consolidate into a graceful *flock* when a predator approaches. Flocking reduces the individual's chance of being eaten. Some shorebird species are generally



solitary, but most will readily join a flock in response to a *disturbance*. Mixed-species flocks are common, making bird-watching more interesting and challenging.

You can also recognize shorebirds by the way they search for food. Many shorebirds use their bills to *probe* the mud for tiny clams, snails, sand fleas, and worms. Those with short bills probe for animals living very near the surface. Shorebirds with longer bills can reach animals buried deeper in the mud. Oystercatchers, on the other hand, have strong, laterally-flattened, chisel-like bills. They use their bills to pry open, or sometimes crush, the oysters and clams they eat. Many shorebirds, particularly sandpipers, run up and down the beach, as if they are chasing the waves, as they pick tiny food items off the surface of the sand. Plovers are visual feeders, so they have large eyes to glean insects from the land's surface.

Shorebirds Are Known for Elaborate Behaviors and Displays

Besides their regular migrations, shorebird lifestyles include other highly developed rituals of behavior such as elaborate courtship and predator distraction displays. Most of us have never had the pleasure of witnessing these displays because many migratory shorebirds nest in remote Arctic areas of North America (the *NeArctic*), Northern Europe and Russia (*PaleArctic*), or in isolated grasslands.

During the breeding season, many shorebird pairs defend territories. Individuals of some species also defend mobile feeding territories, the area around their bodies as they forage. Another distinctive behavioral *adaptation* of shorebirds is their one-legged posture while roosting. Keeping

one leg and the bill tucked under the body feathers conserves heat. This is important in the often chilly, open areas of their habitat.

Shorebirds Contribute to a Healthy Ecosystem

Did you know that shorebirds contribute to a healthy *ecosystem*? Shorebird droppings, called *guano*, fertilize the mudflats where they feed and the water over which they fly. The guano helps microscopic plants, called *phytoplankton*, grow. This *phytoplankton* forms the base of the food chain for the ocean fish and other seafood we eat.

Shorebirds Are Indicators of Healthy Ecosystems

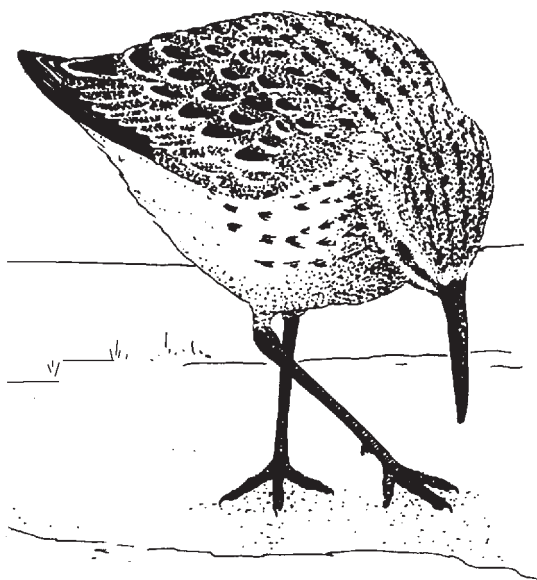
Shorebirds are also good indicators of ecosystem health. *Indicator species* tell biologists how they and other creatures in the habitat are doing. For instance, a change in the shorebird population could suggest a decline in their food resources or a problem with one of the *abiotic* (nonliving, such as water and soil) components of the ecosystem.

Shorebirds Are Part of the Earth's Vast Biodiversity

Shorebirds are also a part of our earth's *biodiversity*. Every day scientists make new discoveries about how species are connected to one another, including us. The survival of one species often depends upon the presence of another. The greater the biodiversity in an area, the more stable and healthy the animal and plant populations will be in order to survive tough times such as drought or disease.

To teach your students about the general characteristics of shorebirds, try these classroom activities found in the guide.

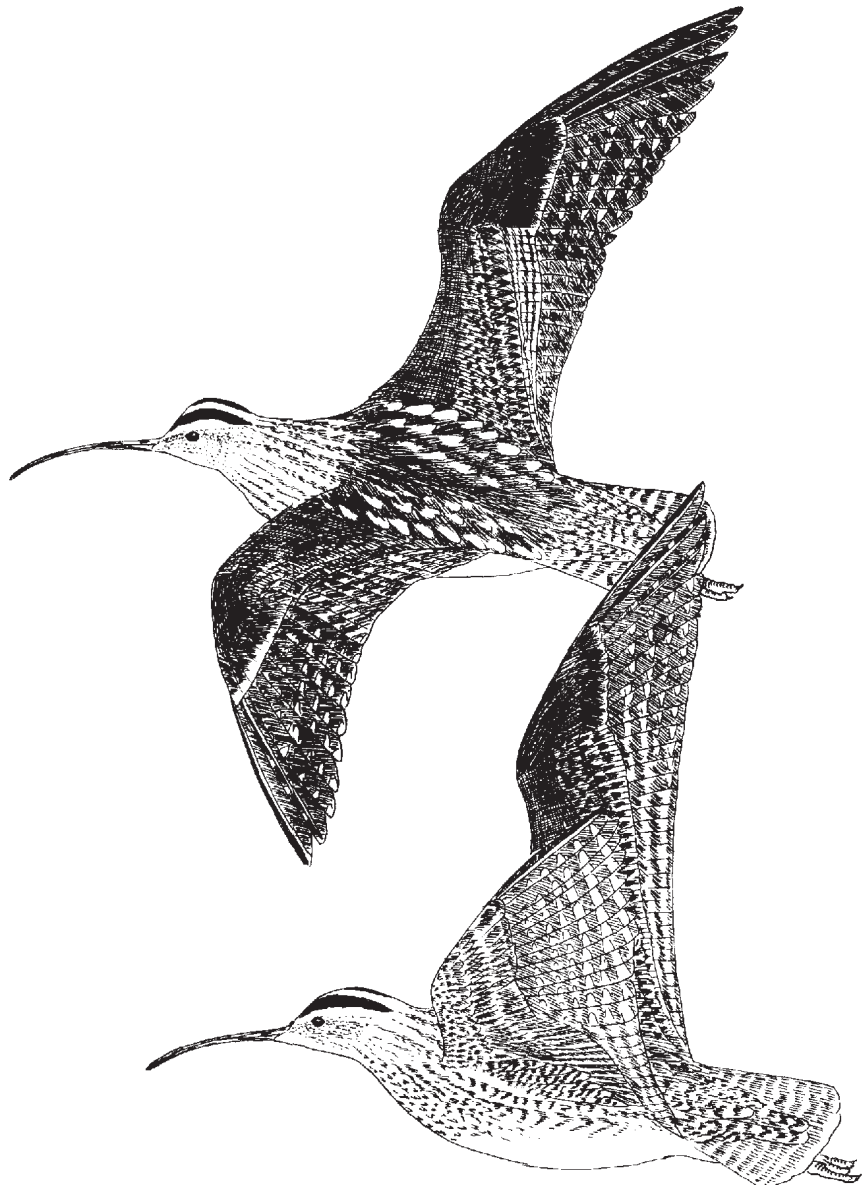
- **Shorebird Profiles**
- **Build a Shorebird**
- **Most Wanted: Shorebirds!**
- **A Year (a Day or a Week) in My Life as a Shorebird**
- **Get to Know Shorebirds Puppet Shows**



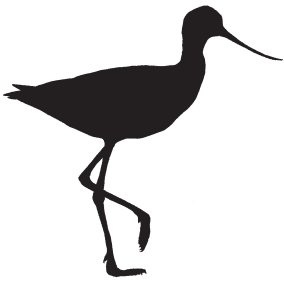
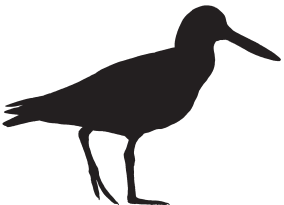
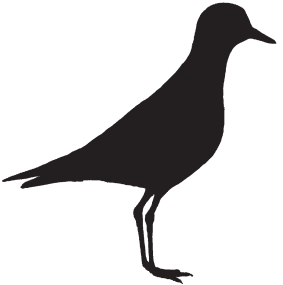
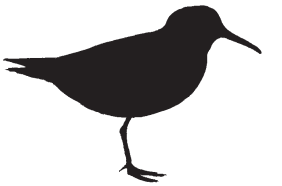
General Characteristics of Shorebirds

- Most shorebirds have long, wading legs and long, pointy toes.
- Most shorebirds have long, slender, probing beaks.
- Most shorebirds are ground-nesters.
- Many shorebirds migrate long distances.
- Most shorebirds have long, pointy wings.
- Most shorebirds depend on three distinct geographic areas: breeding grounds, non-breeding grounds, and migratory stopover sites.
- Many shorebirds have a system of elaborate courtship and distraction displays.
- Shorebirds feed on insects, mollusks, crustaceans, and other *invertebrate* animals.
- Many shorebirds are found on coastal and interior wetlands.
- Migratory shorebirds can store 50 percent to 100 percent of their body weight to fuel their long journeys.

NOTE: To compare shorebirds to seabirds (gulls, terns, pelicans) and wading birds (herons and egrets), see the [chart in the Appendix](#).



Shorebird Families Regularly Represented in North America

<p>Avocet and Stilts (<i>Recurvirostridae</i>) 2 species</p> <p>Sleek and graceful waders with long, slender bills and lanky legs. Only two representatives of this family are found in North America.</p> <p>The American Avocet is fairly common to shallow ponds, marshes and lakeshores. It is recognized by the way it sweeps its slightly upcurved bill from side to side through the water in search of food.</p> <p>The Black-necked Stilt is easily recognized by its long red or pink legs. It is generally found in the interior of North America.</p> <p>The subspecies Hawaiian Black-necked Stilt is only found in Hawaii. It is a non-migratory shorebird.</p> 	<p>Oystercatchers (<i>Haematopodidae</i>) 2 species</p> <p>These are chunky shorebirds of the coastline. They have strong, laterally flattened red-orange bills, which are used to pry open the shells of clams and oysters. They also probe in the sand for worms and crabs.</p> <p>Two species of oystercatchers are found in North America: the Black Oystercatcher (along the Pacific Coast) and the American Oystercatcher (along the Gulf and Atlantic coasts).</p> 	<p>Plovers (<i>Charadriidae</i>) 9 species</p> <p>These are compact birds with relatively short legs. They use their short, fairly thick bills to pick prey from the surface of the sand or mud. They are known for the way they feed in a step, step, stop pattern.</p> <p>Plovers are divided into two groups, the Ringed-plovers (which are the smaller plovers) and the Dark-bellied plovers. Nine species of plovers are found in North America.</p> 	<p>Sandpipers (<i>Scolopacidae</i>) 37 species</p> <p>The greatest majority (37 species) of North American shorebirds are sandpipers.</p> <p>Sandpipers vary greatly in size and shape. Generally, sandpipers are longer-billed and longer-legged than plovers. Unlike plovers, they walk continuously while feeding.</p> <p><i>Sandpipers Include</i> Typical Sandpipers (14) Snipes (1) Godwits (3) Curlews (4) Shanks (5) Yellowlegs (2) Turnstones (2) Phalaropes (3) Dowitchers (2) Woodcocks (1)</p> 
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How to Identify Shorebird Species

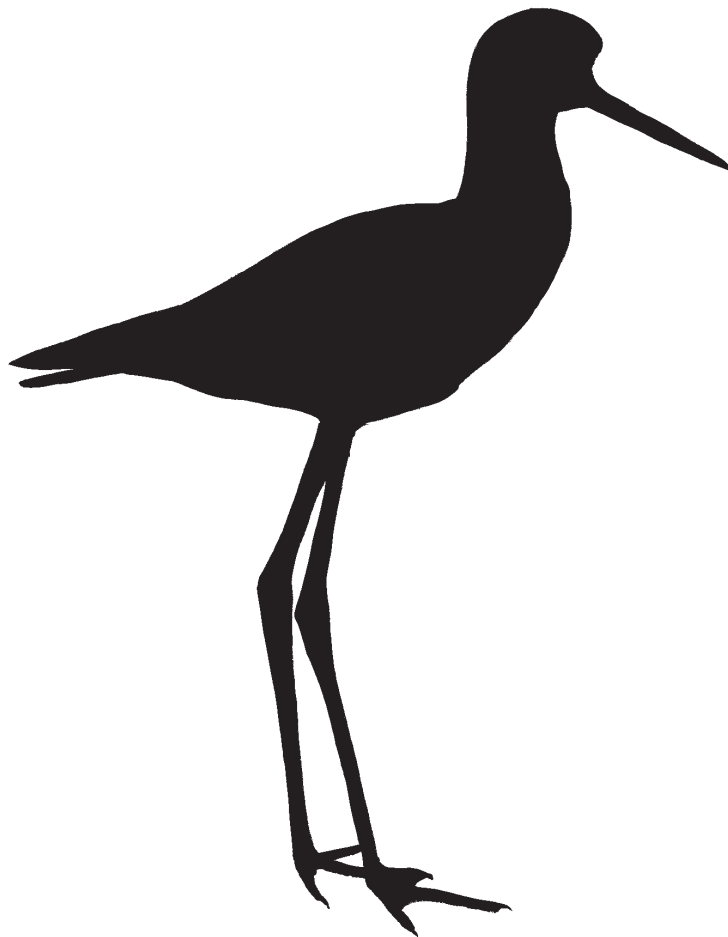
Shorebird Morphology

The term *morphology* refers to what an organism physically looks like. Shape, color, and size are all examples of morphology. Shorebirds are generally small-to-medium-sized birds. Many are chunky, some have a stately posture, while others are more hunched over like they have no necks. Perhaps one of their most striking physical traits is their long legs. Most have long, narrow, pointed *bills* to probe for food in the mud or water. Shorebirds have long, pointed wings and are strong, fast fliers.

Most shorebirds are speckled brown, rust, and white on the back. Some have white or black patches on the head, breast, or belly. The coloration of shorebirds might first seem rather ordinary. However, the value of their dull coloration becomes obvious the first time you see a beach with 10,000 legs! This coloration serves as *camouflage*. Their ability to blend in with the sandy, muddy, or grassy areas where they feed and nest protects them from predators like falcons, gulls, jaegers, and foxes.

Is It Necessary to Recognize Different Shorebird Species?

It is not necessary to identify individual shorebird species in order to learn about them! By knowing their basic characteristics, you will be able to pick shorebirds out of the bird crowd. Because of their camouflaged coloration and similarities among species, identifying individual species can be challenging. If you decide to take on the challenge, you have a greater chance of success by using a logical approach. On the next page are some tips on identifying shorebirds that not only will improve your chances of success, but also of having an enjoyable time in the process.



Tips on Identifying Shorebird Species

Tip 1. Become familiar with shorebird *anatomy*. This will help you to describe what you see and understand the descriptions found in bird field guides. Illustrations of shorebird anatomy, in flight and standing, can be found in the *Appendix*. This graphic can be used in the field or as an instructional overhead transparency in the classroom.

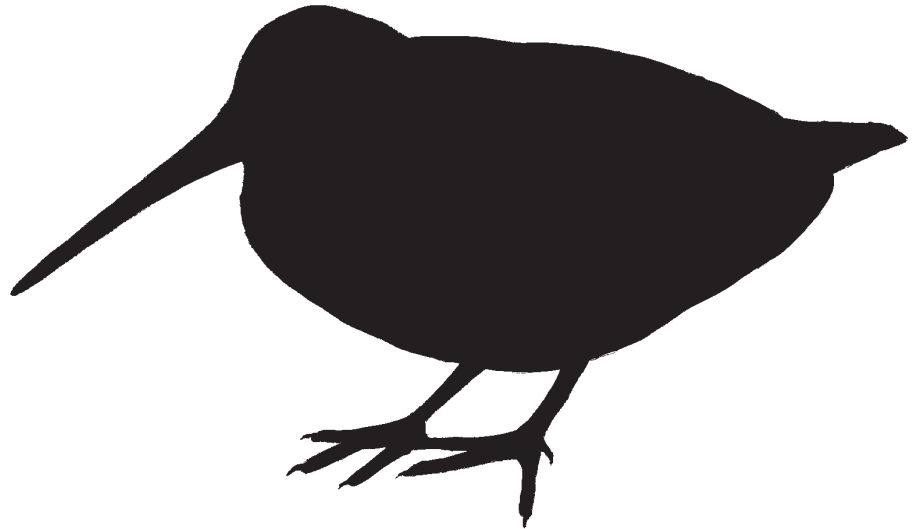
Tip 2. Obtain a field guide that shows breeding, non-breeding, and juvenal *plumages* and *range maps*. Plumages can change the birds' appearance from one season to the next. Range maps help predict what species you can expect in your area. Make sure it has clear photos or illustrations.

Tip 3. Practice using binoculars before going out to watch shorebirds. If you are taking students on a field trip to observe shorebirds, use the pre-trip activity *Using a Field Guide and Binoculars*, found in the educator's guide section *Field Trip Activities*.

Tip 4. Use a spotting scope as well as binoculars to watch shorebirds. Shorebirds often feed or rest in the same open area long enough to make setting up a spotting scope worthwhile. A spotting scope is easy to set up, has more powerful magnification than binoculars, and gives your arms a rest!

Tip 5. Start with easily recognized species common in your area. Study the birds in your field guide, making note of the species found in your area. Another quick way to identify common birds is to get a local bird list from a local or nearby bird-watching organization or from park, refuge, forest, or nature center staff.

Tip 6. Focus on learning just a few birds at a time to keep from becoming overwhelmed.



Tip 7. Do not try to identify a bird based on one characteristic alone. Since many shorebirds do not have readily distinctive plumage, especially in the winter, use body size and shape, and the comparative length of the bill, neck, and legs to help narrow down the possibilities. Here are some questions to ask yourself:

- Is it a small (sparrow-size), medium (mourning dove or robin-size) or large (crow or duck-size) shorebird?
- Is the silhouette like a plover, curlew, or other?
- Does the color of the feathers, also called *plumage*, have distinct white, rust, or black patches? Does the bird have spots or streaks on its breast?
- What color is the bird's *bill*? Is it longer or shorter than the length of its head? Is it straight or slightly curved up or down? Is the bill one color its entire length?
- What color are the legs? How long are the legs?
- When the bird is flying, can you see wing stripes or a distinct tail pattern?

■ How is the bird behaving? Is it picking up its food or probing below the surface for prey? Where is it located—in vegetation, water, or mud?

■ Is the bird you are observing alone, in a small group, or part of a large flock?

Tip 8. Join a natural history or birding club. The more time you spend in the field in the company of “experts,” the more quickly you will learn shorebird identification.

Tip 9. Start a shorebird field journal. Sketch pictures and write descriptions of the birds you see. Note how they behave, their location, and the season. Eventually you can start studying each species during different seasons, noting changes in their plumage. A variety of master journal pages are available to you in the Field Trip section.

Explore the World with Shorebirds! To practice shorebird identification skills with your students, try the pre-field trip activity *Using a Field Guide and Binoculars*. Follow it up with the activity *Sampling Local Shorebird Population* if you take a shorebird field trip.

Shorebirds Depend on a Chain of Healthy Habitats

Habitat Sweet Habitat!

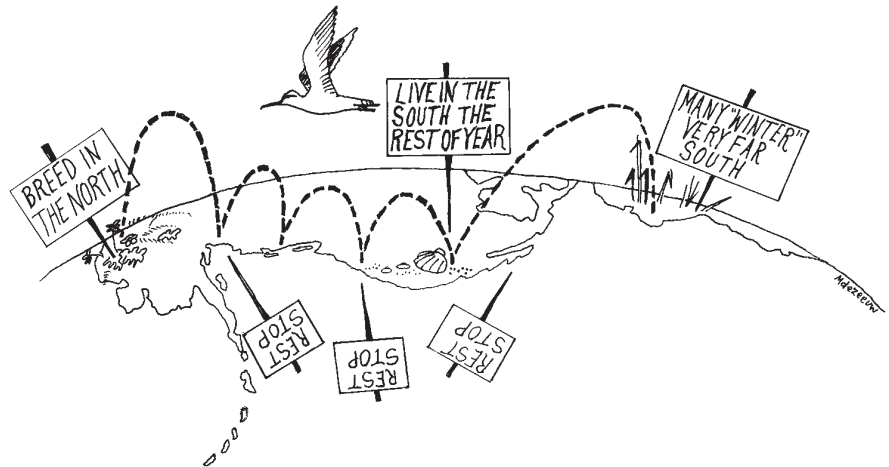
- Migratory shorebirds depend on at least three habitats for their survival: where they breed, where they winter, and migratory stopover sites in between.
- Habitat loss is the leading cause for declining animal populations, including shorebirds!
- White-rumped Sandpipers that breed in northern Canada and Alaska are also found in virtually every Latin American and Caribbean country during the rest of the year.
- Biologists estimate that five to eight million shorebirds rest and refuel at Alaska's Copper River Delta mudflats each spring. This makes it one of the most important stopovers in the world.

Healthy Habitat

Shorebirds, like all wildlife populations, rely on healthy habitat. This means that where they find food, water, and shelter is pollution-free and supports a food web rich in biological diversity. The greater the biodiversity in an area, the more stable and healthy the animal and plant populations will be in order to survive tough times such as drought or disease.

Birds of Open Space

In its most basic definition, shorebird *habitat* is open space. Open, in landscape terms, means without significant canopy cover (plants blocking the sky above). A few shorebird species live or *roost* in deciduous woodlands, but in general they are *adapted* to live on sandy or rocky *shores* and open grassy areas. For adult shorebirds, the *flock* supplies more shelter than the habitat. Individuals in the flock take shelter from wind behind each other. The bird at the end of the



flock, facing the wind, eventually hops to the back of the flock, forcing another to take its turn as windbreak.

Shorebird Habitats Many Shorebirds Rely on Wetlands

Wetlands are areas with soils that hold water and with plants and animals adapted to wet conditions on land. There are many different types of wetlands, including *estuaries, inland mudflats, tundra, river and stream corridors, potholes, playa lakes, salt and freshwater marshes*. Ocean shoreline habitats like *beaches, mudflats, and rocky-intertidal* areas can also be considered wetlands. For a more detailed description of these wetlands, see the Glossary or the Student Readings found in the Appendix.

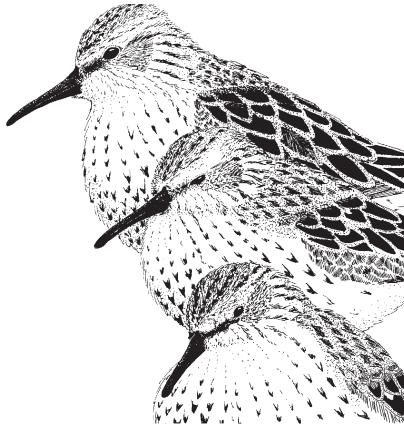
These areas all have in common water that pools on or near the surface and saturates the soil. How long and how wet an area stays depend on the type of soil, plants, and the slope of the land. Some kinds of wetlands dry up each year, but they are still wetlands. Remember: a sponge is still a sponge, even when it is dry. Many shorebirds, like Western Sandpipers, nest on upland tundra in the Arctic, a relatively dry type of habitat formed on *permafrost*.

This frozen ground does not allow rain or melting snow to drain, so pools of water abound.

The shallow water in wetlands provides for plant growth, allows penetration of light and warmth, and provides buoyancy and an abundance of food for young and adult shorebirds. Wetlands are an *invertebrate* soup of snails, worms, insect larvae, crabs, shrimp, and sand fleas (the staple of many shorebird diets).

Some Shorebirds Prefer Uplands

Shorebirds that do not need wetlands are found on grasslands. For example, Buff-breasted Sandpipers and Killdeer have adapted to live in open, short-grass habitats. Unlike most ground-nesting shorebirds, the American Woodcock prefers to nest in trees found near grassland habitat. These birds snatch bugs from the grass and the surface of the soil. Unfortunately, like wetlands, grasslands are being replaced with human development and agriculture. Because there are fewer short-grass prairies, these birds are now trying to use pastures, farm fields, gravel areas, golf courses, school grounds, and lawns for resting, feeding, and nesting. In these areas they face another set of hazards — poisoning



from lawn and agricultural pesticides and disturbance and destruction of nests by machinery and recreational vehicles. With a little awareness and some minor changes, shorebirds and people can share these habitats.

Most Shorebirds Depend on Habitat in Three Geographical Areas

Shorebirds may use three very different habitat types and geographic areas for breeding, resting during migration, and living the majority of the year. For instance, shorebirds that nest in the northern tundra may migrate

inland, stopping near ponds and spending the winter on southern *mudflats*.

During the *breeding season*, migratory shorebirds spend only two months each year nesting and raising their young in inland tundra, grassland, or on ocean, lake, or river beaches. During the *nonbreeding season*, they live in more southern areas at mudflats, estuaries, and beaches.

During migration, shorebirds depend on areas where they can stop to rest and feed. Shorebirds follow different paths during spring and fall migration, increasing the number of different places they may use throughout their journeys. These *stopover sites* tend to be small beaches, prairie potholes, inland lakes, and estuaries, areas where a stream or river drains into the sea. Some shorebird species stop in agricultural fields, short-grass prairies, and other open, dry areas. Stopover sites might be small but are full of food and support a concentration of thousands, or even millions, of shorebirds every spring and fall.

Shorebirds Use Traditional Sites

The migratory paths and stopover sites used by shorebirds year after year are considered traditional shorebird sites. When a large flock congregates at one stopover or nesting site, the entire group is extremely vulnerable. A storm, oil spill, or some other threat can mean disaster! Shorebirds do not have the time or energy to search for an alternative site. Each shorebird species has evolved over many generations into a design best suited to its habitat type. Good land stewardship by landowners, managers, and the public can help ensure that healthy habitats are available to migratory birds throughout their life cycles.

Explore the World with Shorebirds!

To teach your students about the habitats shorebirds need, try these classroom activities found in the guide:

- [Shorebird Food Webs](#)
- [Can't We Share?](#)
- [Wetland Metaphors](#)
- [Match the Habitat Cards](#)
- [Types of Habitat](#)
- [Map Your Habitats](#)
- [When the Grass Was Greener](#)

Some Shorebirds and the Habitats They Use

Sandy Beach

Wilson's Plover
Sanderlings
American Oystercatcher
Long-billed Curlew
Dunlin
Red Knot

Rocky-intertidal

Ruddy Turnstone
Black Oystercatcher

Tundra

Ruddy Turnstone
Buff-breasted Sandpiper
American Golden-Plover
Red Knot
White-rumped Sandpiper

Saltwater Marsh

Wilson's Phalarope
Greater Yellowlegs
Dunlin
Short-billed Dowitcher
Killdeer

Freshwater Marsh

Greater Yellowlegs
Dunlin
Short-billed Dowitcher
Killdeer
White-rumped Sandpiper

Grassland

Buff-breasted Sandpiper
American Golden-Plover
Long-billed Curlew
Mountain Plover
Killdeer

**See Appendix for full list*



Shorebirds Have Special Adaptations

“Each shorebird is a beautifully functioning organism, the parts finely tuned by natural selection to work together to adapt the bird to its environment.”

—Dennis Paulson, *Shorebirds of the Pacific Northwest*

Amazing Shorebird Designs!

- Up to 50 percent of a migrating sandpiper’s body weight is deposited as fat. This fat provides the energy for long-distance flight.
- Long, pointed wings enable some shorebirds to fly up to 50 miles per hour!
- Curlews and woodcocks have extremely sensitive bills. They are *tactile* feeders and can “feel” their prey deep in the mud, allowing them to find food they cannot see.
- Long-billed shorebirds probe in the mud, opening just the tip of their bills. This helps them pick out their food without getting a mouthful of mud in the process!
- Plovers are visual feeders and have large eyes so they can see their prey.

How Adaptations Evolve over Time

A group of *organisms* that can breed and produce fertile offspring is called a *species*. For example, bulldogs and collies belong to the same species (dog) because they can mate and produce puppies that will grow up and have their own puppies. Members of a species have similar *traits* or characteristics.

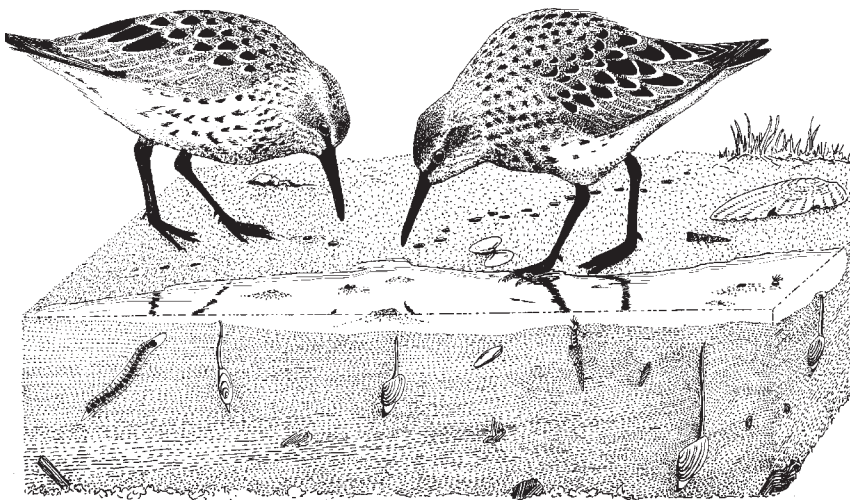
These traits are what help species use the resources found in their *habitat* to survive and reproduce. A trait can be physical or behavioral. If a trait gives a species an advantage in surviving to *breed* (flying faster than others, having better eyesite or coloration), it will be passed on from generation to generation through the species *DNA* or *genes*. This helpful trait, called an *adaptation*, enables the individual to out-compete others. The *Theory of Natural Selection* explains this process: those individuals of a species best suited to survive and reproduce in their environment will pass their genes to the next generation.

Physical Adaptations

Colored to Blend in with Their Surroundings

Shorebirds are designed, or *adapted*, to survive in open habitats. Their brown, rust, black, and white *plumage* makes them less conspicuous to predators. Their bi-coloration, dark on the back and lighter on the belly, further *camouflages* them from *predators*. Their light bellies blend in against the light sky when seen from below. When observed from above, by a falcon for example, their dark backs blend in with the beach or *mudflat* below. Have you ever seen a flock of brown sandpipers suddenly appear white as they turn together in the air and flash their undersides at you?

Shorebirds also have special adaptations to successfully nest



in open habitats. Most shorebirds lay three or four eggs in a nest on the ground. Nesting on the ground exposes the eggs and the incubating parent to many predators. The camouflage coloring of the adults, eggs, and chicks are physical adaptations to help keep them from being seen by predators. Additionally, the eggs are small and perfectly formed to fit tightly together so the parent can fully cover them.

Legs Designed for Wading and Walking on Mud

Shorebirds have long legs for wading. Their long toes give them the stability they need for their seemingly endless walking and running along the water's edge and in soft mud.

Bills Designed for Feeding and Preening

Their *bills* are highly adapted tools for finding food. Some species will probe for invertebrates in mud or water, poking their bills up and down in rapid succession like a sewing machine until they feel something to eat. Others have bills perfectly adapted to swishing through the water to filter food from the water column. Oystercatcher bills are able to pry mollusks from rocks, while turnstones use their bills to flip rocks and find food underneath. By closely observing bill length, shape, and how the bird uses it, you can separate shorebird species.

Not only used for finding food, bills are used for preening as well. A special *oil gland* located at the base of their tails helps to keep their feathers dry. The birds spread the oil from this gland with their bills or the backs of their heads when *preening* themselves. The oil repels water from the feathers, keeping them warm and dry.

Wings Designed for Distance and Speed

The long, pointed shape of a shorebird's wing is designed for flying long distances at fast speeds. Red Knots have been tracked flying over 40 mph. Other species have been clocked at 60 mph with good tail winds. Some shorebirds, like the America Black Oystercatchers, make short migrations, and their wings are not so long and pointed.

Behavioral Adaptations

Flocking for Protection

Shorebirds also have many *behavioral adaptations* that increase the odds they will survive from one season into the next. For example, they tend to lift off in unison from a beach or mudflat when they sense trouble. Traveling in huge migratory flocks is an adaptation to protect individual birds from predators. Just like a school of fish, these large flocks zig-zag back and forth to appear to be a much larger animal. In fact, even other bird species will join these

flocks to take advantage of this "safety in numbers" strategy.

Migrating to Favorable Habitat

Even migration itself is a behavioral adaptation. By nesting within the few months of Arctic summer, shorebirds take advantage of the abundant seasonal food sources of insects and the long daylight to feed. In the Arctic, the vast open space means there is little competition from other bird species, and it is a relatively predator-free environment, that is otherwise inhospitable most of the year.

Fooling Predators

Many shorebirds, like the common Killdeer, use *distraction displays* to protect their nests and chicks from predators. One such display is the "broken wing act." In this case, the shorebird parent, who is faster and less naïve when it comes to predator evasion, lures the predator away from its nest or young chicks by pretending to have a broken wing. The predator follows, thinking that it has found an easy meal, only to be disappointed. As soon as the predator gets close, the



Distraction Display

adult Killdeer flies away to safety. This distracts the predator from the nest or from slower moving, less experienced chicks.

Attracting a Mate

Perhaps some of the most interesting behavioral adaptations occur on shorebird breeding grounds. Generally, male shorebirds reach the Arctic nesting grounds first. They quickly establish *territories*. Once the females arrive, the males begin an elaborate system of *courtship displays*, which are adaptations to ensure they will attract females and increase their chances of *breeding*. These displays may include wing fluttering, tail cocking, nest scraping, and, of course, singing. For more details, read the *Elaborate Shorebird Mating Systems and Displays* section.

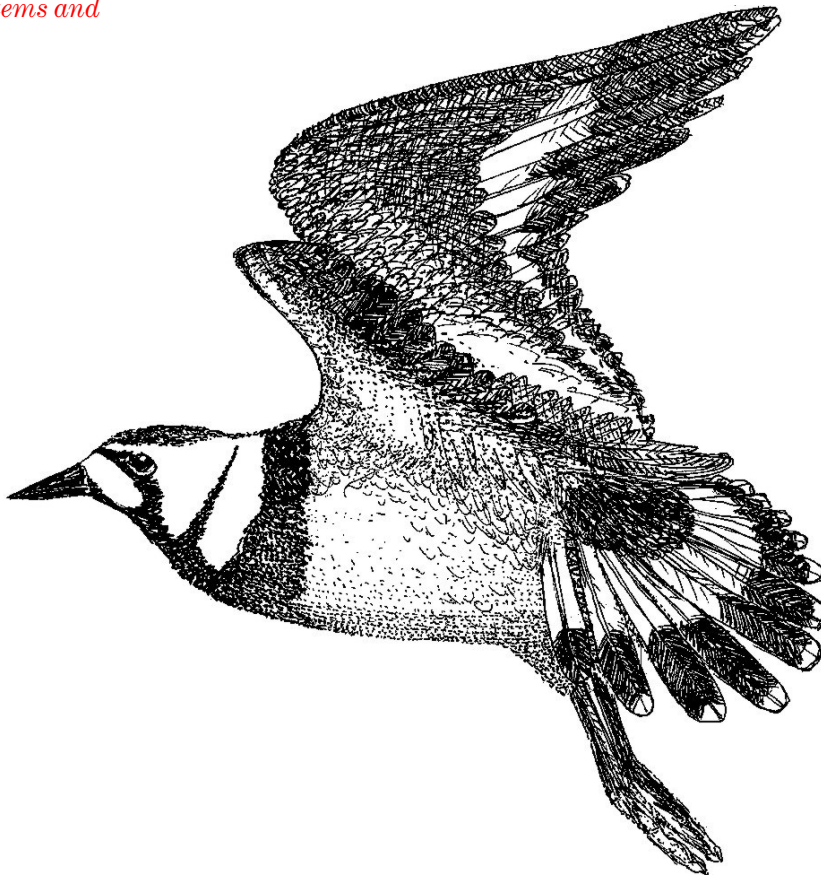
Raising Chicks

Another behavioral adaptation is seen in the rearing of chicks. In some species, the male is solely responsible for incubating the eggs and raising the chicks to fledgings. In others, both parents may care for the chicks together. How parents care for the chicks is specific to the species and an adaptation to the environmental conditions. Once shorebird chicks hatch, they quickly leave the nest. Chicks are able to feed on their own but depend on their parents for protection from weather and predators.

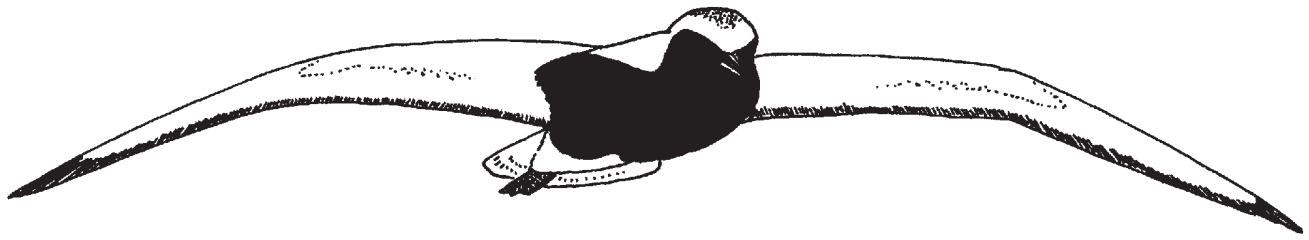
Explore the World with Shorebirds!

Help your students discover the amazing adaptations of shorebirds with these classroom activities

- [Build a Shorebird](#)
- [What Can I Eat with This Beak?](#)
- [Avian Olympics](#)



The Magnificent Shorebird Migration



Shorebirds Are Record Breakers!

■ *The Largest Congregation of Shorebirds*

Over one million shorebirds, mostly Western Sandpipers and Dunlins, have been recorded in a single spring day on Alaska's Copper River Delta. In fact, practically the entire North American population of Western Sandpipers stops there to rest and refuel on a diet that consists almost entirely of tiny clams!

■ *The Longest Nonstop Flyer*

Bar-tailed Godwits make the longest nonstop migration of any shorebird species traveling 6500 miles from Alaska to New Zealand, one way, without stopping.

■ *The Farthest Traveler*

Pectoral Sandpipers make the longest migratory flights of all birds! They winter in southern South America but breed as far North as Central Siberia.

■ *The Fastest Flyers*

When migrating with good tail winds, shorebirds can fly up to 60 miles per hour!

■ *Timed to Dine*

Eighty-percent of Red Knots in the Western Hemisphere time their arrival at the Delaware Bay, from the southern tip of Argentina, just in time to dine on millions of horseshoe crab eggs. The eggs have been stirred up to the beach surface by tides and the masses of egg-laying horseshoe crabs.

■ *Ravenous Eaters*

In order to gain enough weight to continue their migration to the Arctic, Sanderlings eat one horseshoe crab egg every 5 seconds for 14 hours each day until they have rested and fed enough to continue migrating.

The Mystery of Migration

Bird *migration*, the seasonal movement of birds from their *breeding grounds* to their *wintering grounds*, is perhaps one of the most spectacular, physically demanding, and mysterious wildlife events. We know that some birds are physically designed for long, rapid flight. There are a variety of remarkable migrating birds, including songbirds, waterfowl, and raptors. Arctic-nesting shorebirds are famous for their spectacular migrations, both because of the long distances they fly to extreme-north summer destinations and for the huge numbers of birds that concentrate at *stopover* sites along the way.

How and why do birds migrate? How do they find their way across such long distances? Why do they travel in swarms of hundreds of thousands of birds? How do they know when to leave for either their breeding or wintering areas? Although migration is still not fully understood by scientists, it is a strategy that has evolved over time as conditions in the Earth's geography and climate changed. One theory suggests that as the last Ice Age ended and northern areas began to experience warmer weather, short summers favored

insects because of their short life spans and rapid breeding cycles. Some birds moved north to take advantage of this abundant food source and because there were fewer species to compete for food. Soon *natural selection* took hold. The birds that were most *efficient* at migrating arrived at the breeding grounds first and were more likely to produce and raise young successfully. Do you know of other reasons (theories or stories) in your culture or science books to explain why birds migrate?

Although we may not know what first enticed birds to migrate, we do know that shorebirds still take advantage of abundant sources of invertebrate prey. Since the insects are only available as a food source during the Northern Hemisphere summers, the birds need to fly south again to find food for the rest of the year. This involves flying long distances over traditional routes (see Flyways section) and often across international boundaries. Shorebirds' habitat needs must be met within designated time periods and at specific sites.

A Note About Migration Terminology

■ In any discussion of globally-occurring animals like shorebirds, "spring" and "fall" are relative terms. We often use the terms "summer" and "breeding" to mean the same season, because the Arctic is experiencing summer when shorebirds are there to breed. Also, we tend to use the terms "nonbreeding" and "winter" interchangeably.



Migration Terminology Continued

- Remember that winter in the Northern Hemisphere (from November to March) is actually summer in the Southern Hemisphere. We might refer to those shorebirds which have migrated south of the equator for their “nonbreeding” months as “wintering” in, say, South America, but they are really experiencing another summer. While the equator divides two physical halves of the globe, because of the tilt of the Earth’s axis, it generally divides the seasons too.
- In North America, we generally refer to our seasons as “spring,” “summer,” “fall,” and “winter.” In other areas of the world, particularly those close to the equator, seasons may be divided differently, such as “rainy,” “dry,” or “monsoon.”

Timing of Migration

The shorebird migration season lasts a long time. Some individuals begin heading toward their breeding grounds as early as February. They fly just behind the 35 degree Fahrenheit *isotherm*, an imaginary moving line that represents air temperature at any one given time, stopping along the way to rest and refuel. This ensures that when the birds reach their nesting areas, the water and ground will not be frozen. This explains why peak migration dates may vary from year to year and emphasizes that shorebirds are affected by the weather.

Shorebirds do not migrate in family groups like geese, swans, or cranes. In both spring and fall migrations, there is often a difference in timing between the females and males. Adults leave the breeding grounds first during fall migration. Juveniles follow in an average of two weeks. This gives the chicks extra time to grow strong before migration and to fatten up without the added competition of the adults. Because of these trends, you can see that shorebird migration, as a whole, can cover a period of time between February and November.

Spring Migration Is a Rush to the Breeding Grounds

The tendency to *bottleneck* is most prominent in the spring when shorebirds are racing to reach their *breeding grounds*. To find mates successfully, an entire population needs to arrive within a few days of each other. The short Arctic summer compounds the rush, giving shorebirds only about two months to find a mate, establish a territory, lay eggs, and raise a family!

Fall Migration Is a More Leisurely Trip

Fall migration back to wintering areas occurs in waves from late June through November. The first to head south are usually failed breeders, those with no chicks to raise. Successful breeders may begin flying south by mid-July. Fall migrants also use stopover sites but are not concentrated in nearly the same numbers as in the spring, and they appear more spread out over time. They also use other wetlands as refueling stops, besides the main stopover sites. Without the rush to breed, the migratory pace to wintering grounds is relatively leisurely by comparison to spring migration.

Amazing Travelers

Biologists separate migratory shorebirds into three groups: long-distance migrants (those that fly more than 8000 miles one way); medium-distance migrants (those that fly 3500 – 7500 miles; and short-distance migrants (those that travel fewer than 3000 miles). As a group, shorebirds are among the world’s record holders for long-distance migration. The White-rumped Sandpiper is an example of a species found breeding in northern Alaska and living during the nonbreeding season in Tierra del Fuego (the most southern tip of South America). However, some shorebirds do not migrate all the way to the Arctic to nest. Several species, such as the Marbled Godwit, nest in the prairies of North Dakota and Saskatchewan while wintering along the Gulf Coast or in San Francisco Bay. The endangered Piping Plover winters in Florida, then migrates a short distance to breed along the Atlantic Coast from Georgia to Massachusetts. Some populations of other species have a very short migration distance. The Wilson’s Plover breeds and winters in Florida.

For those species that do migrate, enormous energy requirements are necessary for these biannual flights. Most individuals spend their time preparing for migration by feeding and storing fat reserves for their upcoming flight. Some shorebirds will gain half their weight or more in stored fat.

Flyways—Sky Paths

The migratory routes of birds, referred to as *flyways*, are not specific, narrow “highways.” Instead, they are general routes that most migrants tend to follow. Scientists have proposed that birds use the stars, the sun, and even the Earth’s magnetic field for guidance.

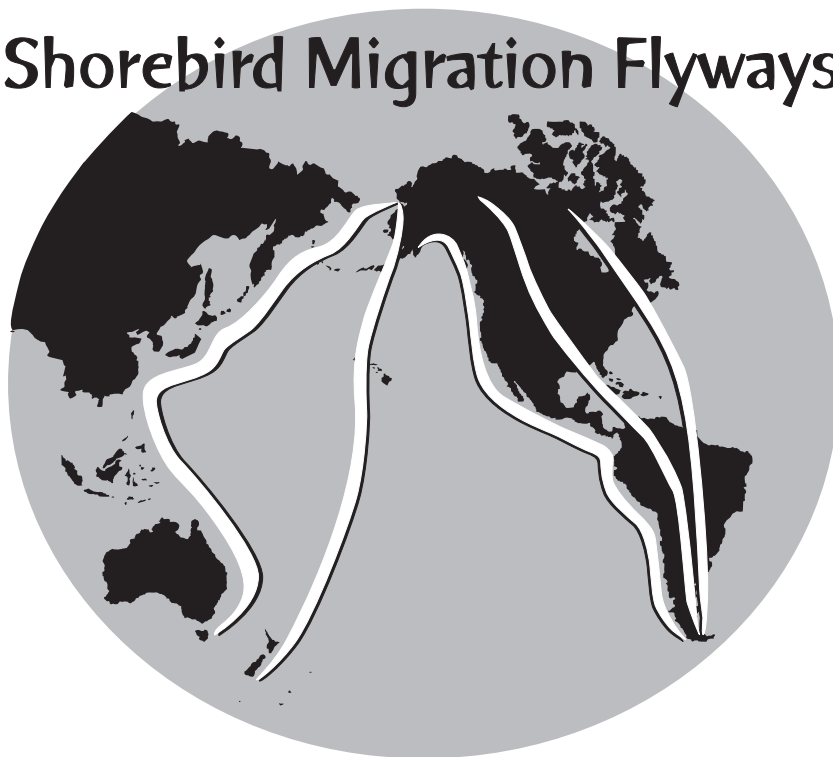
Many shorebirds follow coastlines. Two flyways, the *American Pacific* and the *American Atlantic*, follow the coasts of the North American continent. They extend from the Alaskan and Canadian Arctic, along the Pacific and Atlantic coasts to the southern tip of South America. In North America, shorebirds also migrate inland along the *American Central Flyway*.

Other shorebird migration routes that use the North American Arctic include the Central Pacific and the East Asian-Australasian Flyways. 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, along the east of the Asian continent, through countries such as Japan, China, and Korea, to the Russian and Alaskan Arctic.

Migrating Shorebirds Stop to Rest and Feed

Most migrating birds require the presence of *wetlands* in their breeding habitat and on their wintering grounds. These two regions are often thousands of miles apart. Shorebirds depend on wetlands in between for food and rest to reach their final destinations. Large numbers of

Shorebird Migration Flyways



migrating shorebirds will return to the same *stopover site* year after year. Termed *staging*, these large flocks of shorebirds will feed for several days or weeks in order to build up their energy reserves to continue their flight. Wetland *estuaries*, rich habitats where a source of freshwater meets the ocean, provide some of the most important shorebird *staging areas* in the world.

Arctic-nesting shorebirds are also famous for the huge numbers of birds that concentrate at stopover sites along the flyway. Since most Arctic-nesting shorebirds tend to use the same relatively

few stopover sites, a *bottleneck* results at these few vital wetlands. These critically important staging areas can host tens of thousands, even hundreds of thousands, of shorebirds at one time. In fact, five sites in North America support more than a million shorebirds each spring.

Shorebirds Congregate at Important Staging Areas!

- The Copper River Delta is thought to be the most heavily used stopover site for all Western Sandpipers along the *Pacific Flyway*. Shorebirds stop at this site because of the superabundance of crustaceans, mollusks, worms, and other energy-rich foods.
- Shepody Bay, in the Bay of Fundy, is another important shorebird site for at least 34 species of shorebirds that use the marshes and mudflats. About one million Semipalmated Sandpipers visit this stopover site along the *Atlantic Flyway* from mid-July to early September.
- Cheyenne Bottoms, considered the largest interior marsh in the United States, hosts as many as 45 to 90 percent of all our shorebird, duck, and geese species that stop to rest and feed during their migration along the *Central Flyway*.

Critical Staging Areas of North America

Pacific Flyway

Copper River Delta, Alaska
Kachemak Bay, Alaska
Mono Lake, California
Salton Sea, California
San Francisco Bay, California
Gray's Harbor, Washington
Great Salt Lake, Utah
Lahontan Valley, Nevada

Central Flyway

Cheyenne Bottoms, Kansas
Sand Lake, South Dakota
Quill Lake, Saskatchewan
Bolivar Flats, Texas
Quivira NWR, Kansas
Rainwater Basin, Nebraska
Horicon Marsh, Wisconsin

Atlantic Flyway

Delaware Bay, New Jersey,
Delaware, Maryland
Bay of Fundy, Canada
Maryland/Virginia Barrier
Islands
Cape Romain NWR, South
Carolina
Monomoy Island, Massachusetts

Migrating Shorebirds Are Extremely Vulnerable!

If a traditional stopover is lost to development or contaminated with pollution, the birds do not have the energy or the time to look for another suitable place to stop. Sometimes an entire population will move through a stopover site within a week or two. This makes shorebirds extremely vulnerable to habitat changes or loss. *One environmental disaster at a critical staging site could impact the survival of an entire species of shorebird!*

Explore the World with Shorebirds!

Discover the mysteries and challenges of migration through math, simulation games, and creative writing using these activities:

- [Migration Headache](#)
- [Migration Math Madness](#)
- [The Incredible Journey](#)
- [Precarious Paths](#)
- [Bird's-Eye View](#)

The Shorebird Flyways in Your Backyard

What is a Migration Flyway?

A migration flyway is an invisible “highway in the sky,” a general route birds follow as they fly from their breeding grounds in the north to more southern areas where they spend their winters.

How Did Scientists Determine Where the Flyways Are?

Biologists have determined migration routes through the use of radio telemetry and observation of banded and flagged birds. For some species, they can even tell where birds are from by bill length and coloration. Many shorebirds that have been banded have also been flagged. This is a band that sticks out from the side of the bird’s leg. Each country has an assigned color so biologists can determine where the birds have come from. For more information on the flagging program go to <http://www.mb.ec.gc.ca/nature/migratorybirds/paspl/dc29s01.en.html>.

Where Are These Flyways Located?

Scientists have grouped these flight paths into generalized flyways. When talking about migration flyways, biologists have most often referred to the routes of *waterfowl* that follow four fairly narrow migration paths through North America: the Pacific Flyway, the Central Flyway, the Mississippi Flyway, and the Atlantic Flyway.

Shorebird flyways are more general and tend to overlap. For this reason, *shorebird biologists have identified three broader shorebird flyways* within North America: the *American Pacific Flyway*, the *American Central Flyway* (which combines the Central and Mississippi flyways of songbirds and waterfowl), and the *American Atlantic Flyway*. Other shorebird migration routes that use the North American Arctic include the *Central Pacific* and the *East*

Shorebird Migration Flyways



Asian-Australasian Flyways. 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, along the east of the Asian continent through countries such as Japan, China, and Korea, to the Russian and Alaskan Arctic.

Flyway Names

You will notice that the flyways are named with “American” at the beginning. This is to clarify that these flyways are located in the Western Hemisphere. Without that clarification, people from other countries may look at this information and confuse these flyways with other regions of the globe. For example, if you take into account the entire globe, the

American Atlantic Flyway is really on the western side of the Atlantic Ocean and should be called the Western Atlantic Flyway. However, we felt that would confuse our primary audience which is in the United States. By adding “American” to Atlantic Flyway, people will understand that we are speaking of the Atlantic flyway in the Americas.

Interested in more information about the flyway in your backyard? The following pages describe the geographic zones and highlight exciting shorebird facts about the area where you live.

How Do Birds Find Their Way?

Birds probably use a variety of methods to navigate. Though scientists are not exactly sure how birds navigate along these routes,

there are several theories. Some think birds find their way using the stars as a guide. There is evidence that some large flocks of migrating birds have seemed to “lose their way” over large metropolitan areas where city lights brighten the sky and make the stars harder to see. Other scientists believe that birds migrate using an internal magnetic compass. This system guides the birds along the earth’s magnetic routes.

How Are Shorebirds Able to Migrate Such Long Distances?

Shorebirds have specific physical adaptations for long distance flight, including long, pointed wings and the ability to gain and store highly concentrated fat to fuel their journey. Some shorebirds can fly nonstop for thousands of miles to reach their migratory destinations. However, most shorebird species stop along the way to rest and feed. Stopover sites with abundant food sources have become traditional areas where hundreds of thousands of birds congregate during the migration season. Here they gorge themselves on nutrient-rich invertebrates to replenish the body fat that fuels the rest of their journey. These sites are vitally important to shorebird survival and breeding success.

Where Are Important Shorebird Stopover Sites Located?

Important stopover areas are located along each flyway. Some are famous, like the Copper River Delta in Alaska, for the hundreds of thousands of birds that stop each year; other sites are smaller but just as important. Today pollution, development, and agriculture expansion threaten to wipe out many shorebird stopover sites. The Western Reserve Network (WHSRN) is a multinational coalition of scientists and conservationists working together to identify important sites for protection. Sites nominated into the WHSRN network fall into one of three categories: Hemispheric Sites that host a minimum of 500,000 shorebirds annually, International Sites with a minimum of 100,000 shorebirds each year, and Regional Sites where at least 20,000 shorebirds migrate through annually. The network provides recognition and information for managing these sites. New sites are nominated each year. Of course there are many sites that have fewer than 20,000 birds. These sites are also very important for shorebirds and can be recognized through the National Audubon Society’s Important Bird Area (IBA) network (<http://www.audubon.org/bird/iba/>). Schools and communities can also nominate their towns as Shorebird Sister Cities through the Shorebird Sister Schools Program (<http://sssp.fws.gov>).

For answers to more questions commonly asked about shorebird migration and adaptations, please refer to the sections *The Magnificent Shorebird Migration* and *Shorebirds Have Special Adaptations* in the *Shorebird Primer*.

Explore the World with Shorebirds!

Have students identify the shorebird flyway(s) they live in. Use the WHSRN site listings found later in this section or log on to the WHSRN Web site (www.manomet.org/WHSRN/) to identify important shorebird stopover sites in their flyway. Then have your students mark them on a wall map of North America. Students can learn specific information about the site’s resources from the WHSRN Web site. Interested in knowing which shorebirds are found in your area? Refer to any of the field guides listed in the Appendix, or check out the *Shorebird Profiles* to learn more about birds specific to your flyway.



American Pacific Flyway

Route Description

The American Pacific Flyway generally follows the eastern Pacific coastline from the western Arctic, including Alaska and the Aleutian Islands, down the Rocky Mountain and Pacific coastal regions of Canada, the United States, and Mexico, to where it blends with other flyways in Central and South America. The extensive American Pacific flyway system is separated into four **geographic regions**: Alaska, the Northern Pacific, the Intermountain West, and the Southern Pacific Region.

A map of the **geographic regions** is in the U.S. Shorebird Conservation Plan located at <http://shorebirdplan.fws.gov>.

Facts About the Flyway

Alaskan Region

- Alaska's size and northerly position provide breeding habitat for more types of shorebirds than anywhere else in the United States.
- Of the 71 species which have occurred in this region, 37 breed here.
- Most Alaskan shorebirds migrate to southern areas of the United States and Mexico. About one third head to South America or Oceania (Australia and New Zealand).
- More than one million birds congregate at Alaskan staging sites. In the spring, as many as five to eight million shorebirds use the food resources of the famous Copper River Delta.

Northern Pacific Region

- Estuaries like Gray's Harbor, Willapa Bay, and Bandon Marsh support over 100,000 shorebirds during peak migration.
- Other important shorebird habitats, such as the Willamette Valley are a mix of wetlands and agriculture and are used extensively in winter by Dunlin and Wilson's Snipe.
- Of the 50 shorebird species that breed in the United States, 40 are found regularly in this region.
- Important habitats include coastal estuaries, sandy beaches, rocky shorelines, freshwater marshes, pastures, and agricultural lands.

Intermountain West Region (IMW)

- Eleven species of shorebirds breed and another 23 migrate regularly through this huge region that includes a variety of wetlands, from saline sinks to alpine streams.
- Up to 90 percent of the world's adult Wilson's Phalaropes molt and stage in the IMW hypersaline lakes prior to their trip to South America.
- Important habitats include large saline lakes, marshes, upland, agricultural fields, ephemeral wetlands, man-made impoundments, and riparian areas.

Southern Pacific Region

- Internationally and nationally significant numbers of Western Sandpipers, Snowy Plovers and Mountain Plovers are found here.
- Important habitats include tidal wetlands and marshes, salt ponds, seasonal wetlands, flooded agricultural lands, managed wetlands, and range and agricultural land.
- Twenty eight species of shorebirds spend the nonbreeding season here.

Shorebirds Most Characteristic of the American Pacific Flyway

With the exception of the Snowy Plover, the shorebirds on this list are common and can be observed by students. The list is also a "snapshot" of species diversity in the flyway, providing a variety of natural history stories to learn about. Shorebirds that are rare on this flyway are noted with an asterisk. Consider researching these shorebirds using this guide, the library, and the World Wide Web.

Western Sandpiper
Black-bellied Plover
Short-billed Dowitcher
Dunlin
Marbled Godwit
Black Oystercatcher
Black Turnstone
Long-billed Curlew
*Snowy Plover**
Black-necked Stilt

Shorebird Migration Flyways



Western Hemisphere Shorebird Reserve Network Sites on the American Pacific Flyway*

Refer to the Shorebirds Across the Americas poster included in your educator's binder or request a copy by sending an e-mail to sssp@fws.gov.

Hemispheric Sites

A minimum of 500,000 shorebirds use these sites each year.

United States

Copper River Delta, Alaska
Grays Harbor, Washington
Great Salt Lake, Utah
Lahontan Valley, Nevada
San Francisco Bay, California
Yukon Delta, Alaska

Argentina

Tierra del Fuego

International Sites

A minimum of 100,000 shorebirds use these sites each year.

United States

Kachemak Bay, Alaska
Grasslands, California
Humboldt Bay, California
Mono Lake, California

Mexico

Estero Rio Colorado
Guerrero Negro
Marismas Nacionales

Brazil

Argentina

Regional Sites

A minimum of 20,000 shorebirds use these sites each year.

United States

Elkhorn Slough, California
Kvichak Bay, Alaska
Nushagak Bay, Alaska
Sacramento Valley, California
San Diego Bay, California
South Salton Sea, California
Springfield Bottoms, Idaho
Yukon Delta, Alaska

* For a detailed description of these sites, please go to the WHSRN Web site at <http://www.manomet.org/WHSRN/> and click on the Shorebird Reserve Network button.



American Atlantic Flyway

Route Description

The American Atlantic Flyway extends from the offshore waters of the Atlantic Coast west to the Appalachian Mountains. Many birds using the American Atlantic Flyway start at the southern tip of South America or the coast of Chile and then move through the interior of South America (Argentina, Paraguay, Bolivia, Brazil, and Suriname) and across the Caribbean. They reach the United States touching Maryland, Virginia, and Delaware. From there they head to James Bay and Hudson Bay in Canada.

The Atlantic Flyway is divided into two geographic areas: the Northern Atlantic and the South East Coastal Plain/Caribbean.

A map of the geographic areas is in the U.S. Shorebird Conservation Plan located at <http://shorebirdplan.fws.gov>.

Facts About the Flyway

Northern Atlantic Region

- This is the most heavily populated area in the United States.
- Wetlands are affected by development. Still, beaches in this region are essential, high-quality habitat for shorebirds.
- This region is considered critical to the survival of Red Knots, Piping Plovers, and Whimbrels.
- The Delaware Bay was the first WHSRN site. It supports huge concentrations of spring migrants that feast on horseshoe crab eggs.

- There is good access to shorebird viewing opportunities. Large portions of publicly owned coastal habitat and strong state land use regulations have strengthened local support for shorebird conservation.

South East Coastal Plain/Caribbean Region

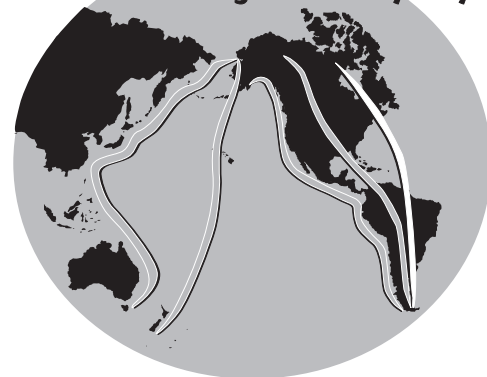
- This is an important area for breeding American Oystercatchers, Snowy Plovers, Wilson's Plovers, and Piping Plovers.
- Over five million shorebirds use the 50,000 acres of publicly managed wetlands in this region.

Shorebirds Most Characteristic of the American Atlantic Flyway

With the exception of the Piping Plover, shorebirds on this list are common and can be observed by students. The list is also a “snapshot” of species diversity in the flyway, providing a variety of natural history stories to learn about. Shorebirds that are rare on this flyway are noted with an asterisk. Consider having your students research these shorebirds using this guide, the library, and the World Wide Web.

Semipalmated Sandpiper
Purple Sandpiper
Red Knot
Willet
Ruddy Turnstone
Sanderling
Greater and Lesser Yellowlegs
American Oystercatcher
*Piping Plover**
Least Sandpiper

Shorebird Migration Flyways



Western Hemisphere Shorebird Reserve Network Sites on the American Atlantic Flyway*

Refer to the Shorebirds Across the Americas poster included in your educator's binder or request a copy by sending an e-mail to sssp@fws.gov.

Hemispheric Sites

A minimum of 500,000 shorebirds use these sites each year.

United States
Delaware Bay, Delaware, New Jersey,
Maryland

Canada
Bay of Fundy, Nova Scotia

Suriname
Bigi Pan
Coppename
Wia Wia

Brazil
Reentrancias/Maranhenses/
Maranhao

Argentina
Laguna Mar Chiquita
Tierra del Fuego

International Sites

A minimum of 100,000 shorebirds use these sites each year.

United States
Barrier Islands, Maryland and Virginia
Cape Romain, South Carolina

Brazil
Logoa de Peixe, Brazil
Argentina
Bahía de San Antonia Oeste

Regional Sites

A minimum of 20,000 shorebirds use these sites each year.

United States
Altamaha River Delta, Georgia
Edwin B. Forsythe, New Jersey
Monomoy Islands, Massachusetts

Peru
Paracas

* For a detailed description of these sites, please go to the WHSRN Web site at <http://www.manomet.org/WHSRN/> and click on the Shorebird Reserve Network button.

American Central Flyway

Route Description

The American Central Flyway covers a wide band of land that extends from the eastern edge of the Rocky Mountains, including the Midwest, the Mississippi River, and the Gulf of Mexico, to the western edge of the Appalachian Mountains.

There are four geographic regions within the Central Flyway: the Northern Plains and Prairie Potholes, the Central Plains and Playa Lakes, the Upper Mississippi Valley and Great Lakes, and the Lower Mississippi and Western Gulf Coast.

A map of the geographic areas is in the U.S. Shorebird Conservation Plan located at <http://shorebirdplan.fws.gov>.

Facts About the Flyway

Northern Plains/ Prairie Pothole Region

- This is one of the major migration routes of Western Hemisphere shorebirds. Thirteen species also breed here.
- It encompasses prairies, potholes, and badlands in all or part of seven states.
- There are constantly changing habitat conditions. Shorebirds here are opportunistic.
- Habitat in this area includes rolling hills of prairie grasses, temporary and semi-permanent wetlands, and agricultural fields.

Central Plains and Playa Lakes

- Three stopover sites in this region are part of WHRSN.
- This region supports a large percentage of the hemisphere's long-distance migrants, including the Stilt and White-rumped Sandpipers.

- Mosaics of temporary wetlands, like playa lakes, are extremely important to shorebirds but are unpredictable in their locations due to weather conditions and hydrological changes from human activities.
- Important habitats in this region include temporary wetlands, agricultural fields, short-grass prairies, freshwater marshes, and rivers.

Upper Mississippi Valley and the Great Lakes

- The region experiences dynamic climate changes and unpredictable habitat conditions.
- Thirty-two species of shorebirds occur in this region.
- Habitats in this region include managed and natural wetlands, river floodplains, lake shoreline, sand and gravel bars, reservoirs, and flooded agricultural fields.

Lower Mississippi and Western Gulf Coast

- A rich variety of shorebird habitats provides important areas for shorebirds in the United States.
- Five highly imperiled shorebirds—the Snowy Plover, Piping Plover, Mountain Plover, Eskimo Curlew, and Long-billed Curlew, have historically been or are presently found along the Gulf Coast.

Shorebirds Most Characteristic of the American Central Flyway

With the exception of the Buff-breasted Sandpiper, shorebirds on this list are common and are readily observed by students. The list is also a “snapshot” of species diversity in the flyway, providing a variety of natural history stories to learn about. Shorebirds that are rare on this flyway are noted with an asterisk. Consider having your students research these shorebirds using this guide, the library, and the World Wide Web.

White-rumped Sandpiper
American Golden-Plover
Long-billed Dowitcher
American Avocet
Upland Sandpiper
Hudsonian Godwit
Lesser Yellowlegs
*Buff-breasted Sandpiper**
Pectoral Sandpiper
Spotted Sandpiper

Shorebird Migration Flyways



The Western Hemisphere Shorebird Reserve Network Sites on the American Central Flyway*

Refer to the Shorebirds Across the Americas poster included in your educator's binder or request a copy by sending an e-mail to sssp@fws.gov.

Hemispheric Sites

A minimum of 500,000 shorebirds use these sites each year.

United States

Great Salt Lake, Utah
Cheyenne Bottoms, Kansas

Canada

Chaplin/Old Wives/Reed Lakes,
Saskatchewan

Brazil

Reentrancias/
Maranhenses/Maranhao

Argentina

Laguna Mar Chiquita
Tierra del Fuego

International Sites

A minimum of 100,000 shorebirds use these sites each year.

United States

Bolivar Flats, Texas
Brazoria NWR, Texas
Laguna Madre (bi-national), Texas and
Mexico

Mexico

Laguna Madre (bi-national),
Texas and Mexico

Canada

Quill Lakes, Saskatchewan

Regional Sites

A minimum of 20,000 shorebirds use these sites each year.

United States

Benton Lake NWR, Montana
Chautauqua NWR, Illinois
J. Clark Slayer NWR, North Dakota
Long Lake NWR, North Dakota
Quivira NWR, Kansas
Salt Plains NWR, Oklahoma
Swan Lake NWR, Illinois

Canada

Beaverhill Lake,
Saskatchewan
Last Mountain Lake,
Saskatchewan

Mexico

Playa Ceuta

Peru

Paracas

*For a detailed description of these sites, please go to the WHSRN Web site at <http://www.manomet.org/WHSRN/> and click on the Shorebird Reserve Network button.



East Asian-Australasian Flyway

Route Description

The East Asian-Australasian Flyway (EAA) stretches nearly pole to pole. Birds breed on the tundra inside the Arctic Circle in Alaska and Russia. Countries with important wintering and stopover sites include: Australia, New Zealand, Japan, China, Taiwan, the Koreas, Singapore, Malaysia, Indonesia, Philippines, Mongolia, Bangladesh, Vietnam, India, Papua New Guinea, Myanmar, and Thailand.

Facts About the Flyway

- The EAA Shorebird Site Network identifies some of the flyway's most important sites for shorebirds. As of July 2002, this network contained 31 sites in ten countries. Wildlife scientists estimate that about 400 sites in the EAA are critical to shorebirds.
- Wildlife scientists estimate at least four million migratory shorebirds use this flyway. Australia alone hosts at least two million shorebirds at some time during the year. More than 60 species of migratory shorebirds use the flyway.
- Wildlife scientists are concerned about the survival of 11 species of migratory shorebirds in this flyway. Some of the flyway's most threatened shorebirds include the Spoon-billed Sandpiper, Asian Painted Snipe, and Spotted Greenshank.
- Dunlins, Great Knots, and Bar-tailed Godwits are the most common birds in the flyway. The least common species are the Spoon-billed Sandpiper, Asian-painted Snipe, and Spotted Greenshank. Other shorebirds which occur in this flyway include the Red-necked Stint, Little and Long-toed Stints; Curlew, Marsh, Terek, and Broad-billed Sandpipers; Black-bellied, Kentish (snowy), Little-ringed and Mongolian Plovers; Eurasian and Far Eastern Curlews; Asian Dowitchers; Red Knots; Pied Avocets; Spotted Redshanks; Black-winged and Banded Stilts; Whimbrels; Pied and Sooty Oystercatchers; and Pheasant-tailed Jacanas.
- The greatest threats to shorebirds in the flyway come from loss and degradation of wetlands from agriculture, pollution, overfishing, logging, and soil erosion.
- Some of the most important shorebird sites along the flyway include China's Yellow Sea; the Yalu Jiang National Nature Reserve; Manko, on the island of Okinawa in Japan; and the Moroshechnaya River estuary in Russia.

Shorebirds Most Characteristic of the East Asian-Australasian Flyway

Most of the shorebirds on this list are common and can be observed by students. The list is also a "snapshot" of species diversity in the flyway, providing a variety of natural history stories to learn about. Shorebirds that are rare on this flyway are noted with an asterisk. Consider having your students research these shorebirds using this guide, the library, and the World Wide Web.

Little Curlew
Bar-tailed Godwit
Great Knot
Gray-tailed Tattler
Red-necked Stint
Sharp-tailed Sandpiper
Spoon-billed Sandpiper
Spotted Greenshank

Shorebird Migration Flyways



Central Pacific Flyway

Route Description

The Central Pacific Flyway includes New Zealand and hundreds of islands spread over thousands of miles in the Pacific Ocean. Some of the island groups include Hawaii, Guam and the Northern Mariana Islands, Phoenix Islands, Line Islands, and American Samoa. Most of the birds that use this flyway for migration or nonbreeding habitat fly to the Arctic or sub Arctic regions of North America and Asia to breed.

Facts About the Flyway

- The Hawaiian and Pacific/Remote Islands National Wildlife Refuges (NWR) play an important role in shorebird migration in the Central Pacific Flyway. Some of the refuges in this complex include Midway Atoll NWR, Kealia Pond NWR on Maui, James Campbell NWR, and Hanalei NWR on Kaua'i Island. Palmyra Atoll is another part of the Pacific/Remote Islands NWR Complex. This is a group of about 50 islands near the equator in the Line Islands.
- Guam and islands off the coasts of Micronesia and Tahiti are also important for shorebirds.
- This flyway is crucial for the Bristle-thighed Curlew, Pacific Golden-Plover, and Wandering Tattler which spend the nonbreeding season on the islands within this flyway.
- Shorebird species in this flyway perform incredible migratory journeys. Bar-tailed Godwits appear to make a nonstop 6500-mile flight Alaska to New Zealand in the fall. Bristle-thighed Curlews and Pacific Golden Plovers may fly over 3000 miles non-stop during both their fall and spring migrations.
- Hawaii is home to an endangered non-migratory shorebird, the Hawaiian Stilt. Native Hawaiians call this bird the 'Ae'o.
- Threats in this flyway include nonnative plants and animals, land development, wetland drainage, water pollution, and disturbance.
- Some species of migratory shorebirds in this flyway are also threatened by how little we know about them. For example, we could lose important habitats before we even know they are important.

Shorebirds Most Characteristic of the Central Pacific Flyway

With the exception of the Bristle-thighed Curlew, the shorebirds on this list are common and can be observed by students. The list is also a "snapshot" of species diversity in the flyway, providing a variety of natural history stories to learn about. Shorebirds that are rare on this flyway are noted with an asterisk. Consider having your students research these shorebirds using this guide, the library, and the World Wide Web.

Pacific Golden-Plover
Wandering Tattler
Bristle-thighed Curlew
Ruddy Turnstone

Shorebird Migration Flyways



Shorebird Nesting and Breeding

Stellar Performances!

- The male Pectoral Sandpiper draws the attention of females by pumping up a fat-filled breast sac, hooting, and making low-level flights over the tundra.
- The Wilson's (Common) Snipe's mating call is made with its tail feathers! The Snipes repeatedly flies high into the sky and then plunges straight toward earth before beating his wings to rise again. When he falls he holds his tail at an angle. The air rushing over his stiff feathers produces his unique "winnowing" or "bleating" mating call.
- The calcium content of the shells in a sandpiper clutch is greater than the calcium content of the female that laid the eggs.
- Some sandpipers in the Arctic eat lemming (a small mammal) teeth as a source of calcium for eggshell formation.
- Western Sandpipers weigh about 25 grams (less than one ounce). They lay four eggs, each weighing 7.5 grams-almost one-third of each female's body weight per egg!
- Black-bellied Plovers migrate thousands of miles yet often return to within 300 feet of the previous year's nest.

Shorebird Breeding

Shorebirds, like most vertebrates, breed only during one particular time of year. Shorebird breeding also depends on ritual behaviors. Most *breeding behaviors* occur within the *breeding season* and on the *breeding grounds*. Some shorebirds are very *site-faithful*, returning to the same breeding grounds, and sometimes the same territory, year after year. In fact, oystercatchers even use the same nests.

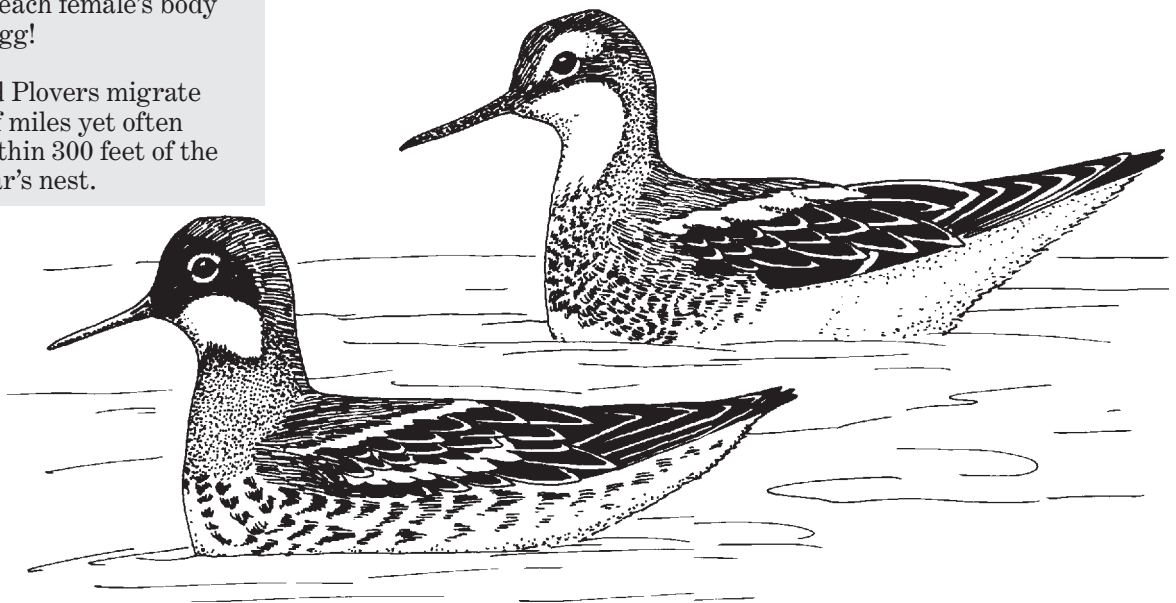
Male and Female Shorebirds Can Be Hard to Tell Apart

Most female and male shorebirds look the same in *breeding plumage*. There are some species, however, in which females are larger than males! In some species, the males have distinctly different patterns and colors from the females. In all three species of phalaropes, the female is more brightly colored than the male.

Most Shorebirds Are Ground-Nesters

Shorebirds generally nest on the ground. Most of these nests, called *scrapes*, are simple, shallow, saucer or cup-shaped structures. They may be lined with grass or lichen. Some are made entirely of pebbles and a few bits of shells.

You might ask "Why would ground-nesting shorebirds choose to build their nests in wetlands?" In fact, wetlands make a wonderful nursery habitat for many animals. Wetlands provide an abundance of plankton, plants, and invertebrate foods. The leaves, blades, and roots of wetland plants provide a substrate for tiny invertebrates and conceal baby shorebirds from predators. Despite the water in this habitat, shorebirds find a clump of grass or move to slightly higher ground within the wetland to nest. Some shorebird species will even rebuild their nests if they are flooded or destroyed.



Shorebirds Establish Breeding Territories

Although a population of shorebirds may nest in the same habitat, most are not colonial breeders like seabirds. Instead, most shorebirds stake out territories where they perform their breeding displays. Any intruder of the same species is greeted with vigorously territorial displays before the defending shorebird resorts to a chase or a fight.

Concealing the Nest Is Critical for Survival

Shorebirds depend on camouflage, a simple and shallow nest structure, and sometimes small nearby or overhanging plants to hide their nests. Their own cryptic coloration helps conceal their nests while they incubate. Birds that nest in trees are concealed by leaves and protected from ground predators by their height, but there are very few trees in areas where most shorebirds nest.

The Typical Shorebird Clutch

Shorebirds generally lay four buff-colored, speckled eggs that are pointed on one end, though some species lay only three eggs. Biologists think shorebird eggs are designed this way so they fit together in a pinwheel shape that keeps more of each egg's surface covered and warm during incubation.

Parental Roles Can Vary Greatly among Shorebird Species

Incubating the Eggs

Care of the eggs or brood is handled in different ways by different species. Most often both the male and female take turns incubating the eggs for about 24 days. Bar-tailed Godwit females, for example, incubate the eggs by day, and the males incubate them by night. Dunlins do just the opposite. In a few species only the female incubates the eggs. Occasionally the male takes on sole responsibility for incubating the *clutch*.

Caring for the Chicks

How shorebirds care for their chicks varies among species. Not all shorebird parents stay to care for their young. The female Black-bellied Plover deserts the chicks when they are only half-way to *fledging*, which is when they have all their flight feathers and are just beginning to fly. The Common Snipe pair divides its brood, and each parent cares for only some of the chicks. Chicks from unrelated groups of Least Sandpiper nests are moved to communal feeding grounds.

Shorebird chicks do not grow their flight feathers and begin to fly until they are about three or four weeks old. However, most are very *precocial* and begin to aggressively search for food only a day or two after hatching. During this time on the ground, chicks hide from predators by using their *cryptic coloration* to blend in with their surroundings and freeze in place when the parent makes an alarm call.

Exceptional Shorebird Parents

Some shorebird parents will go to great lengths to protect and train their offspring. For example, Short-billed Dowitcher males are believed to roll their eggs to a new nest if their original nest is threatened. Oystercatchers may feed their chicks for more than 100 days after hatching, teaching them how to pry open or crack oyster shells. Many shorebird parents use *distraction displays* to protect their offspring. The parent purposely draws the attention of an intruder with calls or exaggerated movements. The parent may pretend to drag a broken wing or tail, hoping the intruder will see the parent as easy, helpless prey and go after him or her instead of the eggs or chicks. The Killdeer is most well known for doing the broken-wing display to distract predators.

Shorebirds Have the Most Varied Mating System of All Birds

Shorebirds have a wide variety of *mating systems*, the roles taken on by breeding males and females. A shorebird's mating system refers to differences in the number of partners that the bird breeds with and the kind of social bond it forms with these mates.

Monogamy

Many shorebirds are *monogamous*, meaning that a female and male mate only with each other for one nesting season. Here both parents protect the nest. This arrangement greatly improves the chances of the chicks making it to adulthood. Dunlins, Western Sandpipers, Turnstones, Yellowlegs, Dowitchers, Godwits, and Red Knots are usually monogamous.

Polygamy

Other shorebirds are *polygamous*, breeding with more than one mate during a breeding season. Those that are *polyandrous*, like the Red-necked and Red Phalaropes, have one female forming *pair bonds* with two or more males in one summer. The females of these non-territorial little shorebirds are more brightly colored than males, and the females attract the opposite sex with special calls, flights, and postures. By contrast, White-rumped Sandpipers are *polygynous*, meaning that a male breeds with and defends more than one female and nest within his *territory*.

Promiscuity and Lekking

Some shorebirds are also *promiscuous*, breeding with more than one mate without forming pair bonds to help defend and protect the nest or raise the chicks. Female snipe, for example, are promiscuous at the beginning of the season, but when the nest site is chosen she forms a *pair bond* with one male for the rest of the season.

A promiscuous mating system includes *leks*, places where a group of males gather to make vigorous displays to attract females for the purpose of mating. *Lekking* often occurs at the same sites every year. Anywhere from two to 15 male Buff-breasted Sandpipers gather at dawn on broad upland tundra leks every year to engage in rituals of wing-stretching, waving and jumping. Imagine seeing the strange gathering of male sandpipers-glinting, white underwings waving in the low, bright light of an Arctic dawn. Researchers believe they choose to display at this time of day when the bright undersides of their wings are the showiest.

Elaborate and Complex Breeding Rituals

A *ritual* is a set of behaviors or activities that is performed in a particular way for a specific reason or occasion. A ritual may be as simple as always arranging food on a plate the same way or as elaborate as a traditional church wedding. People recognize, respond to, and expect certain rituals. What kinds of rituals do you have in your classroom?

Shorebirds, like people, also have developed a set of ritualized behaviors. As a matter of fact, shorebirds have evolved some of the most elaborate and complex breeding displays seen among all *orders* of birds. In most cases, these involve repeated, exaggerated movements and postures designed to draw the attention of the opposite sex. However, many displays are initiated to facilitate courtship and copulation, distract predators away from nests and chicks, and advertise breeding and nesting territory.

Upon arriving at the breeding grounds, territorial birds, usually males, advertise themselves or the territory they have staked out. To advertise they may make dramatic aerial and ground displays that include wing fluttering, tail cocking, nest scraping, and calls to attract a mate and potential competitors.

Courtship Displays and Nest building

Courtship rituals are specific to the species. The birds may respond to each other with bows, tail movements, calls, or the way they hold their bills. Behaviors of the courting pair may include neck preening and calls.

The courting ritual also often involves nest building. In some shorebird species, the female selects the nest site; in others, it is the male that makes the decision. Some shorebird pairs build the nest together, sometimes with separate tasks like selecting materials, building, and then lining. Many shorebirds build several scrapes before selecting one to lay their eggs in.

Explore the World with Shorebirds!

Discover the elaborate and complex breeding displays and nesting habits of shorebirds and the breeding challenges they face using these activities:

- Musical Nests
- Guard Your Nest
- Behave Yourself!
- It Is a Tough Life!
- Colorful Changes



Threats to Migrating Shorebirds

Shorebirds Face Almost Insurmountable Odds!

- Research shows a steep decline in the populations of several shorebird species, and it is suspected that many others have declining populations.
- Habitat loss is the number one reason for the decline of wildlife populations.
- Fifty-seven percent of *prairie potholes* of the American Great Plains are gone. Fifty percent of all wetlands across the United States have been drained for agriculture and urbanization.
- Sandpipers are genetically programmed to stop, rest, and replenish their energy in certain wetlands along the Pacific Coast from South America to Alaska. If one of these wetlands is lost to natural or human causes, sandpipers that depend on that area might not survive to migrate further.
- ATVs, Jet skis, and even more passive recreation like dog walking and jogging along our coastal beaches may chase shorebirds from critical wintering, breeding, and feeding areas.

What threats affect *migratory shorebirds* each year, even though their total population currently numbers more than 20 million? There are a variety of natural threats such as *predators*, weather, and disease. However, human-influenced changes are by far the most serious threats to shorebird survival today.

Vanishing Habitat

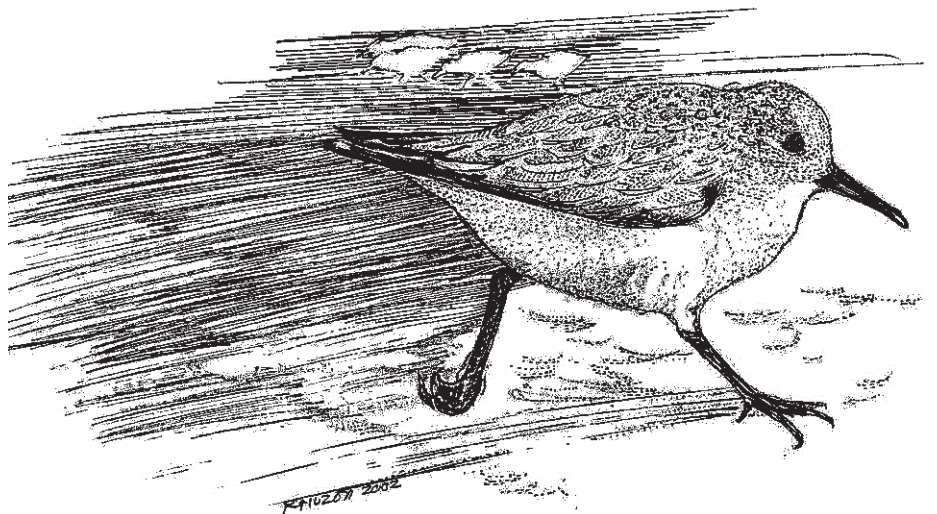
Today the primary threat to the survival of migratory birds is the disappearance and degradation of habitat. Many migrant shorebird populations are dependent for vital food and rest on the same wetlands, estuaries, and grasslands year after year. In some circumstances, if one of these stopover locations is lost, shorebirds may not stop nearby even if an alternate site exists. Instead, they fly on to the next stop, perhaps hundreds of miles away, without resting or feeding. Many birds may not survive.

In many situations the habitat is still there, but it has been degraded to the point that it is no longer healthy and cannot support the wildlife as it

did in its unspoiled state. Even if the habitat is not completely removed from the landscape, things such as disturbances from people, effects of nearby industry, and the increase of predators can make a habitat unhealthy for wildlife that depends on it. Urban sprawl and industry are reducing the availability of habitat. This type of development also reduces the quality of neighboring conservation lands because nonnative species, chemical pollutants, and an increase in predators associated with humans (dogs, cats, raccoons, rats) can be introduced.

Agriculture and Shorebird Habitat

Wetlands were historically drained or the water diverted for irrigation. Rivers have been dredged and diked for navigation and flood control. Prairies and “reclaimed” wetlands were quickly replaced by agriculture. Our modern system of agriculture, called *monoculture*, uses a piece of land for a single type of crop which effectively eliminates habitat and species diversity. The use of pesticides to control weeds and



insects on crop fields also is thought to have both direct and indirect effects on shorebirds. Food resources may be removed, causing the birds to starve. Chemicals may also accumulate within the birds' tissues, leading to deformities and poisoning. In places where agriculture and shorebirds attempt to coexist, eggs and young birds are often crushed by machinery.

Pollution Hurts Shorebirds and Their Invertebrate Foods

Many types of *pollution*, including *runoff*, *pesticides*, lead shot, acid rain and snow, may all be affecting shorebirds and the insects and fish they feed on.

An oil spill near coastal stopover areas, especially one timed with the peak of migration, would be a disaster to shorebirds. For example, Delaware Bay, a critical stopover site for 600,000 migrating shorebirds, is also the second largest petrochemical port in the eastern United States. A major oil spill would coat the feathers of shorebirds, making it impossible for them to fly or stay warm and dry. Birds that try to clean themselves and accidentally ingest oil would be poisoned. An oil spill would also kill horseshoe crabs and their eggs, a critical food source for the shorebirds that pass through the area.

Human Recreation Can Disturb Wintering and Feeding Shorebirds

Migrating shorebird populations are also threatened by disturbances at their stopover sites. If the disturbance is intense enough, migrating shorebirds will continue migrating without stopping at all. Without adequate refueling, individuals may not have enough energy to reach their breeding grounds and/or breed successfully.

Popular recreation activities like riding off-road vehicles on barrier beaches sometimes leave deep tire tracks in the sand or mud, trapping

newly hatched chicks. They also flush birds into the air at a time that is critical for the birds to rest and feed. Operating Jet skis and boats near shorebird wintering areas scares birds away.

Even more passive recreation can be a problem for shorebirds. Off-leash dog walking, kite flying, sunbathing, and surfing also chase birds from their choice feeding sites and cause them to use valuable energy in the process.

Shorebirds and Hunting

Historically, flocks of migrating shorebirds were highly vulnerable to shooting. Market shooting was a common occurrence in the Nineteenth century. Market shooters took advantage of the need for fresh meat in the urbanizing eastern United States. Shorebirds could be easily and economically harvested because they concentrated in huge flocks at predictable migratory staging areas, could be decoyed into shooting range, and would return back for wounded flock mates. Most species of shorebirds were hunted throughout the 1800s, some to the point of extinction.

The Arctic-breeding Red Knot, which migrates in massive flocks northward across the United States, was severely affected by market hunters in the 1800s. The *endangered* Eskimo Curlew, called the "doughbird," was hunted for food and sport until it reached the verge of extinction. Today, even if a few individuals are alive, their numbers may be so low that they may never be seen again. Even though regulations were passed to stop the killing of shorebirds, their low reproductive rate and highly social lifestyle have prevented their comeback.

Today in the United States, there are only two shorebird species (American Woodcock and Wilson's (common) Snipe) that have large enough

populations to support a regulated harvest season. *Subsistence* egg gathering by native indigenous people in the Arctic is still traditional practice that is allowed. Migrating shorebirds are still being hunted in many other countries today. Working with international, national, and regional communities is important to ensure that shorebirds are not overharvested.

The Spread of Exotic Species May Change Shorebird Habitat

Nonnative or exotic species are being introduced into wetlands. Sometimes these introduced species seriously alter the structure of the wetland by competing with native plants and animals. As healthy wetland habitat shrinks, shorebirds lose the feeding and resting sites they rely on. Consider these examples:

European Beach Grass

Introduced in 1898 to stabilize sand dunes, this grass has invaded the once bare beaches where Snowy Plovers prefer to nest. The grass also creates habitat for their predators near their remaining nesting sites.

Great Lakes Aliens

Many nonnative plants and animals have been introduced into the Great Lakes ecosystem, including the zebra mussel, spiny water flea, carp, and purple loosestrife. Little is known about how these exotic species may affect shorebirds that migrate through and breed in the Great Lakes. Biologists suspect that other exotic plants and nonnative invertebrates may have unpredictable effects on the shorebird food base.

Resource Management Sometimes Conflicts with Shorebirds

Many of our activities like mosquito-control programs, oyster-culture practices, and salt pond management can conflict with shorebird conservation.

In places where agriculture and shorebirds attempt to coexist, eggs and young birds are often crushed by harvest machinery. As many as 400-600 birds were killed in a 10-day mowing season in the hay fields of the Silvies Floodplain in Oregon. Without grasses to hide in, the chicks that escaped the machinery were caught quickly by predators.

Throughout Los Angeles County and parts of Orange County, California, entire beaches are raked daily or weekly to remove trash and tidal debris. This makes it impossible for Snowy Plovers to nest. Noisy and large, these machines can crush plover nests and chicks and scare the adults away. Beach raking also removes the kelp and driftwood that invertebrate foods live on.

Shorebirds and Deadly Diseases

Shorebirds are also susceptible to diseases. Most diseases are natural occurrences, but their effects on the bird population are dependent upon how many individuals are concentrated in the area at the time of the outbreak. Some of the diseases that may have a devastating effect on shorebirds include avian botulism and West Nile Virus.

Avian botulism outbreaks are common within the interior of North America during the summer and early fall when temperatures are warm and water conditions are low. A toxin is produced by a bacterium and is ingested by birds as they feed on invertebrates in infected waters. During late summer and fall, water resources are rare and migrating birds concentrate in the few areas where water does occur. Control of botulism outbreaks is difficult because there is still a lot to be learned about this disease. Land managers spend a lot of time and energy trying to avoid massive die-offs. Many critical shorebird staging

areas are known to have botulism outbreaks. Several thousands of shorebirds can be lost during severe outbreaks.

West Nile Virus is a blood-borne disease that can also affect humans. Birds can become ill and die if bitten by an infected mosquito. In northern latitudes, freezing winters that would stop the cycle of the disease kill adult mosquitoes; however, because of the migratory nature of many species of birds, they may harbor the virus throughout the winter and bring it back when they return. It is not known what the full impact of West Nile Virus will be on bird populations, but it too could become a threat to entire populations of shorebirds.

Predators Out of Balance

Shorebirds have few natural mammalian predators on their remote nesting grounds. Their cryptic coloration helps them hide from avian predators like *falcons* and *jaegers*. As Arctic nesting areas are developed, introduced predators may become an increased concern.

Shorebirds that nest, stop to rest and refuel, and winter on coastal beaches and mudflats near large population centers are vulnerable to predators. Many shorebird predators such as foxes, skunks, crows, gulls, rats, and raccoons are extremely successful at coexisting with people. Their population numbers have increased to the point that the delicate predator/prey relationship is out of balance. Normally predators would not impact the shorebird population. However, shorebirds that are already at a disadvantage due to other human-related threats become vulnerable to these predators, including people's pets—dogs and cats! Even if not actively hunted by these predators, the energy used by shorebirds to move out of their way can jeopardize their health.

Habitat: Valuable to People and Shorebirds

Wetlands are important habitats to people. They are a source of water for power, crop irrigation, transportation, drinking water, and recreation. More and more people are finding wetlands attractive home sites. Highway bridges span them, sewer plants are built near them, and ports are developed on them. Grasslands provide people with space and rich soil for farmers to raise cattle, horses, and crops like corn, soybeans, and sunflowers. They are also important places for our communities and for wildlife we like to observe and hunt.

As these vital habitats shrink, shorebirds and countless other animals and plants lose the habitats they rely on. We will lose the benefits of clean water, flood control, fishing areas, and beauty that wetlands provide. We lose the rich soil, vast space, and diversity of life in grasslands. Is it possible that people and shorebirds can survive, possibly even thrive, together using these habitats? Yes—with good land stewardship. The more we learn about these ecosystems and the intricate interactions among all the organisms living there, the better our chances of making good resource management decisions in the future!

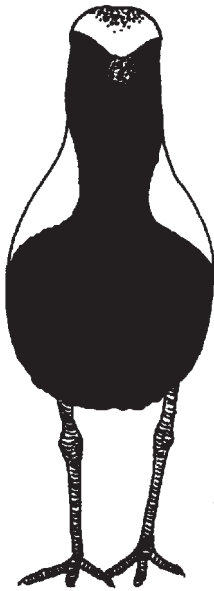
Explore the World with Shorebirds!

Let your students discover the threats shorebirds face in these simulation and critical thinking activities:

- **It Is a Tough Life!**
- **Migration Headache**
- **The Incredible Journey**
- **Shorebird Decision Dilemmas**
- **Guard Your Nest**
- **When the Grass Was Greener**



Shorebird Conservation



Shorebird Conservation Provides a Hopeful Future

- Over 20 million acres of shorebird habitat are part of the Western Hemisphere Shorebird Reserve Network (WHSRN). This voluntary consortium of over 240 organizations and agencies across the Americas is working together to protect and manage wetlands.
- The National Wildlife Refuge system, managed by the U.S. Fish and Wildlife Service, provides quality habitat for shorebird breeding, nesting, and wintering.
- Working with land managers and landowners, we are finding a way to manage for people and shorebirds.
- By managing habitat for shorebirds, numerous other species that depend on these ecosystems will benefit too.

Shorebird Conservation Is Very Challenging!

Land managers and biologists are faced with many tough questions that often have many possible answers, depending on an individual's perspective. Consider a private landowner who is trying to keep a family-owned ranching business alive. He or she will probably have different ideas and feelings about protecting shorebird habitat on land where his or her cattle grazes than a research biologist will. A community development committee elected to create jobs and attract tourist dollars into the community will probably have different coastal development priorities than a member of a bird-watching group.

Below are some of the difficult questions scientists are forced to answer when promoting or defending shorebird conservation. Which of these questions do think are easily answered?

How Can We Work to Protect Birds beyond Our Borders?

Perhaps one of the most significant conservation challenges is protecting species with long-distance migrations. The shorebirds that breed in North America migrate through or spend the nonbreeding season in no fewer than 41 nations! Protecting shorebirds involves cooperation and agreement among many different countries. Cultural differences, gaps in scientific understanding, and varying conservation ethics can create challenges to cooperation among countries.

How Can We Increase Our Own Shorebird Knowledge?

There is a need for more research and monitoring of many shorebird species. Biologists need more

information on baseline population numbers, an inventory of habitats used by shorebirds, and the development of long-term monitoring programs. Existing data suggest that populations of many shorebird species are already declining.

How Can We Reverse Past Population Declines?

Another significant conservation challenge is the low reproductive potential of shorebirds. The fact that most species lay a clutch of four or fewer eggs each season, with only a very few species re-nesting, makes it very difficult for biologists to reverse past population declines and increase shorebird numbers quickly.

How Can We Protect Shorebirds from Disasters?

The fact that shorebirds concentrate in such high numbers at migration stopover sites poses another challenge to biologists. Huge populations of shorebirds are vulnerable to any number of catastrophic environmental changes like weather events, oil spills, toxic chemical residues, habitat development, or human disturbances at many of these key sites.

How Might Climate Change Affect Shorebirds?

Climate change is possibly the least studied threat to shorebirds across all the flyways. Scientists suspect that global warming could change water levels along the coast and eliminate important shorebird habitat. Warmer winters might change the migration patterns of shorebirds, causing some to winter further north, bypassing the more southern conservation lands specifically set aside for them.

How Can We Help Private Landowners Save Important Habitat?

Much of the land used by shorebirds is privately owned. Several federal and most state natural resource agencies have programs to assist private landowners in managing wildlife and wildlife habitat on their property. These programs are limited in staff and funding.

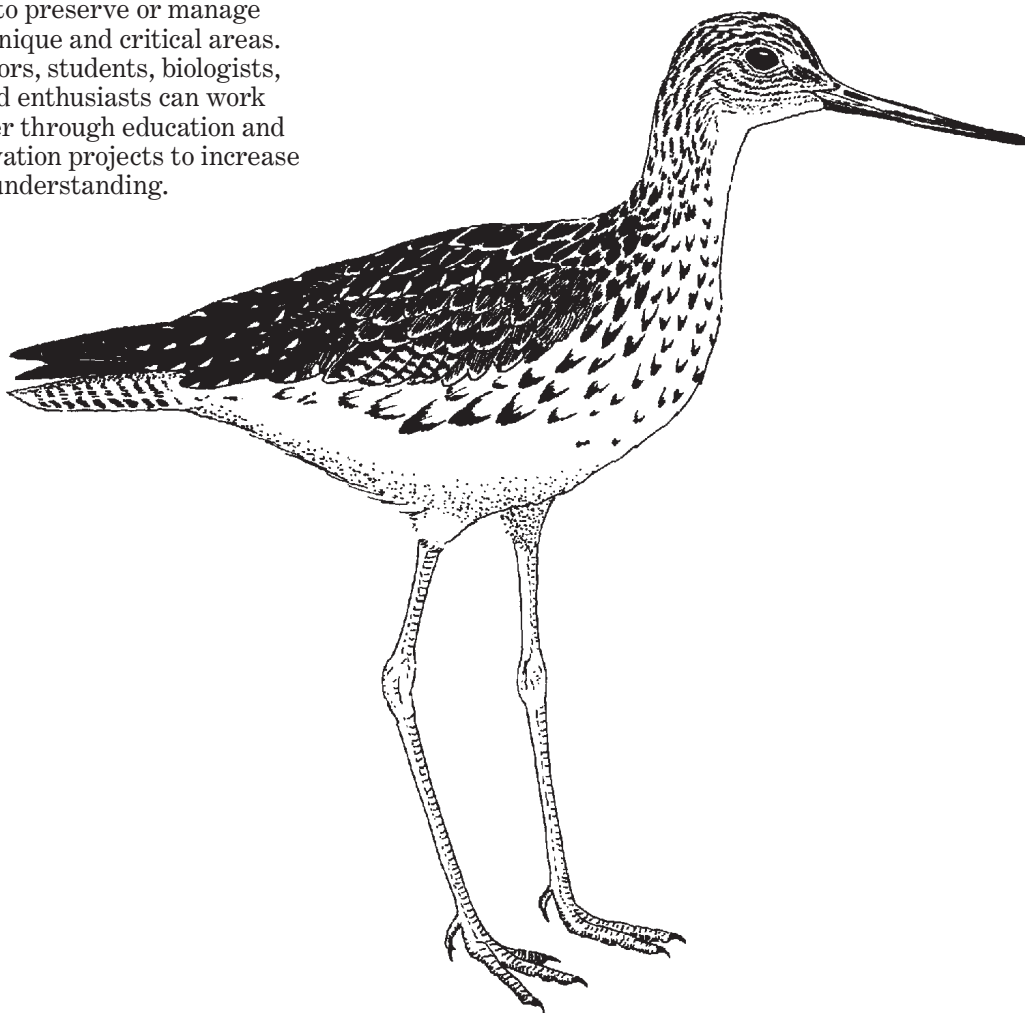
How Do We Increase Public Understanding?

Many people do not see wetlands and grasslands as important. They are not aware of the benefits that wetlands and grasslands provide them. Therefore, they do not see a need to preserve or manage these unique and critical areas. Educators, students, biologists, and bird enthusiasts can work together through education and conservation projects to increase public understanding.

National and International Partnership Programs Help

Thankfully, an increasing number of individuals and countries are recognizing these conservation challenges and the threat of habitat destruction all over the world. Many federal, state, indigenous, and private groups have purchased and protected millions of acres for local and migratory wildlife. There is a worldwide effort to identify critical staging areas and then to protect them. More studies are

conducted each year to answer questions about shorebird migration patterns, current population numbers, and habitat needs. Education programs, like the Shorebird Sister Schools Program, are teaching people about the value of wetlands and grasslands for shorebirds and all the other species that depend on these vital ecosystems. The following is a description of some of the most influential national and international partnership programs established to help protect shorebirds and their habitats.



■ *The National Wildlife Refuge System*

In the United States, the U.S. Fish and Wildlife Service has principal legal responsibility for managing 93 million acres for migratory wildlife at the federal level. There are more than 500 National Wildlife Refuges and Wetland Management Districts and most are considered important to shorebirds. Many refuges host huge flocks of shorebirds during some time of the year. To learn more about the National Wildlife Refuge System see its Web site at www.fws.gov

■ *The North American Bird Conservation Initiative (NABCI)*

NABCI is an agreement among organizations and agencies from Canada, Mexico, and the United States to facilitate the conservation of all native North American birds. Established in 1997, members of the NABCI subscribe to the motto “together we are stronger” and are sharing knowledge, experiences, and ideas to conserve birds and their critical habitats in North America. For more information on NABCI log on www.nabci.org.

■ *The United States Shorebird Conservation Plan*

This is a partnership effort of state and federal agencies, non-governmental conservation organizations, academic institutions, and individuals across the country committed to restoring and maintaining stable and self-sustaining populations of shorebirds in the United States and throughout the Western Hemisphere. This plan includes conservation goals for each region of the country, identifies conservation and research needs for critical habitats, and proposes education and outreach programs to increase public awareness of shorebirds and understanding

of the threats they face. The plans can be found at <http://shorebirdplan.fws.gov>.

■ *The North American Waterfowl Management Plan (NAWMP)*

MAWMP was originally designed to address the loss of waterfowl populations and habitat. Although international in scope, it depends on regional joint ventures to implement habitat and population goals. It has been successful in raising awareness of waterfowl conservation issues and protecting waterfowl habitat. Habitat joint ventures have been given the task of providing the framework to implement habitat goals from the other three bird group initiatives which include shorebirds. For more information log onto <http://northamerican.fws.gov/NAWMP/nawmphp.htm>.

■ *The Western Hemisphere Shorebird Reserve Network (WHSRN)*

This network brings together over 200 private and public organizations in seven countries working toward the conservation, restoration, and management of critical shorebird habitats throughout the Americas. Sites are recognized as significant to shorebirds when they fit one of three requirements: Regional Sites host at least 20,000 shorebirds; International Sites are used by at least 100,000 shorebirds; and Hemispheric Sites provide habitat to 500,000 or more shorebirds throughout the year. To date, WHSRN has over 50 wetland sites in seven countries that are critical links in a shorebird migration chain. For more information contact www.manomet.org.

■ *The Ramsar Convention on Wetlands*

This intergovernmental treaty signed in Ramsar, Iran, in 1971 was established to provide a framework for international cooperation for the conservation and wise use of wetlands and their resources. More than 122 countries from all regions of the world are now part of the convention. They meet every three years to discuss progress and wetland conservation. As part of membership, these countries agree to consider wetland conservation in their natural resource planning, promote wise use of wetlands in their countries, and establish nature reserves. They are also required to designate at least one site for inclusion on the “List of Wetlands of International Importance” based on criteria adopted under the convention. For more information go to <http://www.ramsar.org>.

■ *The International Shorebird Survey (ISS)*

ISS is a volunteer program organized by Manomet Center for Conservation Sciences. The purpose ISS is to collect information on shorebirds and the wetlands they use during migration. To date, more than 800 shorebird watchers have collected information from 1650 locations throughout the Western Hemisphere. Volunteers have added to our knowledge of migration routes, timing of peak migrations, trends in species declines, and locations of key stopover areas for shorebirds. The work of ISS volunteers has shown that many species of shorebirds concentrate at key staging areas to such a degree that their populations now depend on these critical sites. This led to the creation of the Western Hemisphere Shorebird

Reserve Network. To learn more about this important volunteer group, contact Manomet at <http://www.manomet.org>.

■ *Pan American Shorebird Program (PASP)*

This is an international program to promote conservation of and research on shorebirds in the Americas by coordinating shorebird color marking in the Americas and connecting observers of marked shorebirds with the banders of those birds. For more information go to <http://www.pnr-rpn.ec.gc.ca/nature/migratorybirds/pasp/index.en.html>

■ *The Shorebird Sister Schools Program (SSSP)*

The SSSP enables students to learn about shorebirds and their habitats, track migration, interact with shorebird biologists, and share their experiences with other “sister schools” shorebird enthusiasts around the world. Participation can include subscribing to the E-mail Network, viewing the World Wide Web site, and/or completing activities from the Grades 2-12 education guide *Explore the World with Shorebirds!* To learn more, visit the Web site at <http://sssp.fws.gov>.

Explore the World with Shorebirds!

If you would like to get your students thinking about their own conservation values get them and involved in shorebird education and conservation, try these activities:

- **What You Can Do for Shorebirds!**
- **Birding Code of Ethics**
- **Shorebird Values on the Line**
- **Shorebird Decision Dilemmas**
- **Shorebird News**
- **Shorebird Fair**
- **Shorebirds on Display**
- **Shorebird Wax Museum**
- **Shorebird Poetry**

You Can Help Shorebirds Too!

Learn about shorebirds.

The more you know about shorebirds, the more you will understand how you can help.

Never chase flocks of shorebirds.

Chasing shorebirds forces them to use up valuable energy and reduces the time they spend feeding and roosting.

Never let dogs chase shorebirds.

Choose to take your pets to an exercise area away from where shorebirds nest, rest, and feed. Always keep your pets on a leash.

Explain to others why it is so important not to disturb shorebirds.

Many people do not know that their actions hurt shorebirds. Share what you know with them so they can make better choices.

Become a shorebird observer.

Keep track of migrants coming through your local area. Help scientists identify critical staging areas for preservation. Submit your information to the ISS, c/o Manomet Bird Observatory, Box 1770, Manomet, MA 02345; Tel. 508/224 6521; Fax 508/224 9220.



Shorebird Research and Technology

Discovering More About Shorebirds Through Research

- New technology is allowing biologists to isolate stable isotopes in shorebird feathers and to trace what location the bird was in when it grew those feathers.
- Stable isotopes are helping to identify what shorebirds eat in specific areas and the importance of those types of food to shorebirds.
- Radio telemetry is helping biologists to determine the location of shorebirds most important habitat.

Scientists are still searching for answers to many questions about shorebirds. To discover what kind of birds live in a *habitat*, we can walk the area throughout the year and watch for different *species*. With a good field guide, binoculars, and lots of practice, we could identify all of the species that come to an area. But what about questions dealing with age, *survivorship*, *mortality*, or *behavior*? We can help birds best if we understand where they live, what they need, and where they travel.

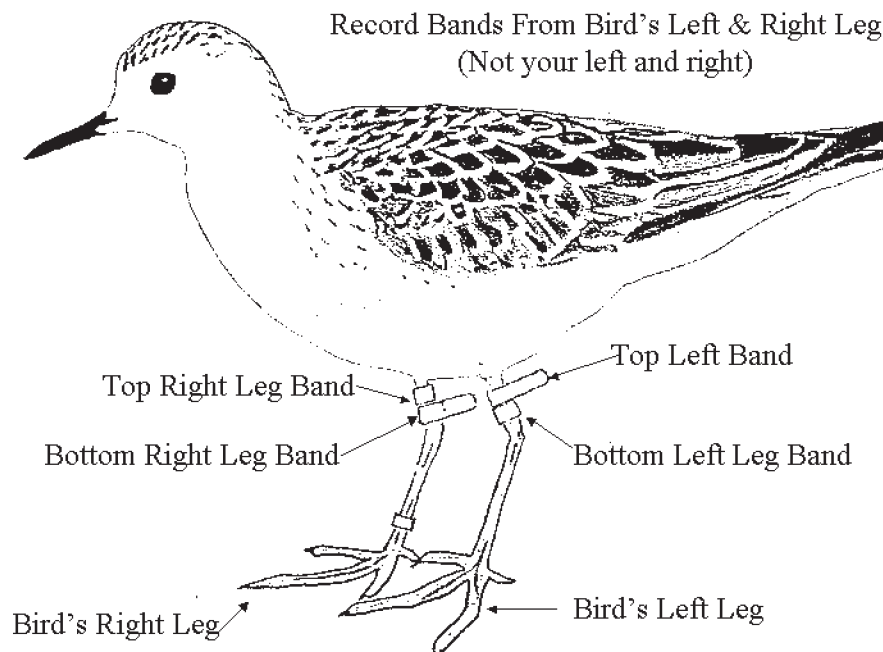
Often, in order to focus management efforts more clearly, researchers need to know where a specific bird population spends its entire year. Individual shorebirds, because of their migratory patterns, are difficult to track throughout the year. There is often a need to link

birds breeding in Siberia with those migrating through Missouri and wintering in Argentina. Because of this need, ornithologists use several methods such as banding and other forms of marking, radio and satellite telemetry, DNA testing, and, most recently, stable isotope analysis.

Bird Banding

Bird Banding helps to answer many of these questions. Marking birds for study has been done for more than 100 years—ever since John James Audubon captured an Eastern Phoebe in the 1850s, wrapped a small piece of silver wire around its leg, and determined that the same bird returned the following year.

Today, bird banding involves attaching a loose-fitting aluminum band around the bird's leg that is coded ahead of time with a unique



identification number. Also attached at times is a series of colored bracelets and flags that represent the country where the bird was banded, the banding year, and perhaps the age of the bird.

There are several ways to capture birds for banding:

1. Researchers can stretch a fine net called a *mist net* across an area where birds are likely to fly. Where and when the net is placed depends on the species and purpose. Once caught in the net, the bird is quickly and carefully untangled by the researcher who bands it, collects data on the species such as age, weight, and sex, then releases it.
2. Chicks can be banded before they leave the nest. By banding birds in the year they hatch and recording their annual return, researchers can see how long they live and if they are being replaced by a sufficient number of young. Shorebirds, unlike other bird species, are tolerant of humans handling their chicks.
3. *Cannon netting* involves using an electrical charge to catapult a net into the air over feeding shorebirds. This method is usually used in coastal areas where many birds can be captured quickly.

Because learning to handle birds properly requires special training, and to ensure that valuable information is not wasted or lost if birds are banded incorrectly, a special permit from the U.S. Fish and Wildlife Service is required for all birdbanding in the United States. Trained biologists handle birds carefully and keep stress to the birds to a minimum, ensuring that they are rarely injured.

Many birds that have been banded disappear and die without the researchers knowing where, when, or why. If you find a dead bird with a band, please report it to the appropriate agency.

To Report a Metal-Banded Bird

Notify your local state wildlife agency or the U.S. Fish and Wildlife Bird Banding Lab. Record the entire number on the band, the date you found the bird, the species (if you know it), and the exact location in which you found it.

Send this information along with the band, if possible, to:

Chief, Bird Banding Laboratory
Office of Migratory Bird Management
U.S. Fish and Wildlife Service
Laurel, MD 20810
Or call: 1 800/327 2263

To Report a Color-Banded or Flagged Bird

Describe each band: type (metal, color band, flag); colors (as exactly as possible—light green, dark blue); and location on bird (left or right leg, upper or lower leg, above or below other bands). Report if you are unsure of any bands or if you did not see all parts of both legs clearly. Please also report species, location of sighting, date, and any other information about behavior or other birds.

Mail shorebird color band sightings to:
PASP, Canadian Wildlife Service,
115 Perimeter Road,
Saskatoon, SK, S7N 0X4,
Canada

Or submit online at
<http://www.pnr-rpn.ec.gc.ca/nature/migratorybirds/pasp/index.en.html>

Radio Telemetry

Sometimes biologists will clip the feathers between a shorebird's shoulder blades and attach a small radio transmitter with glue. Each transmitter has a unique frequency like a radio station so that the biologist can use an antenna to "tune-in" to the banded bird. The transmitter does not injure the bird and eventually falls off; also the feathers grow back without affecting the bird's ability to fly. This technique allows scientists to study shorebirds in their natural habitats while performing their natural behaviors. They can learn what habitat the birds are using, how long they stay there, where they fly to next, and much more.

Satellite telemetry is a similar technology that uses satellites to track birds. Satellite transmitters have not been used on shorebirds because shorebirds are too small for these larger transmitters. Satellite technology is used more often with larger birds like swans. Also, satellite transmitters are more expensive than radio transmitters. Perhaps as technology improves, smaller, cheaper transmitters will be invented for use with shorebirds.

Stable Isotopes

Several species of shorebirds replace their flight feathers (wing and tail feathers) on their southern wintering grounds prior to beginning their northern migration during the spring. As the bird eats, traces of minerals and elements are deposited in the growing feather. Feathers grow quickly, and once they are fully grown, they are "lifeless." Because they do not change, elements are "stamped" into the feather. Stable isotopes are naturally occurring elements incorporated into an animal when

taken in by the foods the animal eats. The stable isotopes revealed in bird tissue reflect the same stable isotopes found in the bird's diet at its local habitat. By analyzing elements found in shorebird tissue, scientists may trace some birds to specific geographical locations. Collecting a feather from a shorebird caught at one site, analyzing it for stable isotopes, and comparing the results with stable isotopes from known geographic sites may allow a scientist to trace a bird to the general location where it grew the feather. This technology is relatively new and exciting to biologists because of its potential to link geographic areas used by shorebirds during migration, breeding, and wintering. To read more about stable isotopes in shorebirds, go to the following Web site: http://www.fort.usgs.gov/resources/spotlight/shorebird_isotopes/isotopes_home.asp

DNA Testing

DNA or genetic analysis is a powerful tool to assess whether shorebird populations and species are related. By taking a small sample of blood or tissue, scientists can learn about the evolutionary history of shorebirds in relation to other species and other groups of birds. This technique can also be used to compare different populations of the same species. For example, through DNA analyses scientists learned that the Piping Plovers wintering along the Gulf Coast of Mexico were actually two different subpopulations—genetically different within the species. They learned that one subpopulation breeds in the Great Lakes and the other along the Atlantic Coast. This can be very important for managing the species as a whole, as well as discovering different problems associated with each subpopulation.

Explore the World with Shorebirds!

Give your students the opportunity to collect shorebird data through simulations or by observing real shorebirds. Here are some research and technology activities:

- **Banded Birds**
- **You Be the Scientist**
- **Imaginary Mist Nets**
- **Shorebird Field Study (field trip)**
- **Bird Beans**
- **Mud Creatures Study**
- **Sampling Local Shorebird Populations (field trip)**
- **Shorebirds on the Web**

