

# Seabirds and Shorebirds of the Gulf of the Farallones

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## Table of Contents

Background Information	3
Glossary of Terms	10
Fact Sheets	11
Activities	15
Script for Slide Show	42
Books and Resources	47
Selected Web Sites	48

## Standards Covered at High School Level from Science Content Standards for California Public Schools

The Seabird and Shorebird unit will help your students achieve the following educational standards. These standards are from the Science Content Standards for California Public Schools. Performance standards, indicated by bullets after each content standard, are specific for each activity. We suggest using the fact sheets with the slide shows to emphasize key points and to provide students with written material for future reference. Words in italics are defined in the glossary.

### Slide Show and Fact Sheet

#### Biology/Life Sciences

6. Ecology. Stability in an ecosystem is a balance between competing effects. Students will:
- a. Know biodiversity is the sum total of different kinds of organisms and is affected by alterations of habitats.
  - b. Know how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.
- Students will understand how human activities affect seabird and shorebird populations.

## **Bird Watching Activity**

### Biology/Life Sciences

6. Ecology. Stability in an ecosystem is a balance between competing effects.

Students will:

- a. Know biodiversity is the sum total of different kinds of organisms and is affected by alterations of habitats.
  - b. Know how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.
- Students will observe the diversity of birds in an ecosystem and understand how human actions can affect bird populations.

## **Studying Albatross Migration Activity**

### Investigation and Experimentation

1. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations. Students will:

- b. Identify and communicate sources of unavoidable experimental error.
  - c. Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.
  - d. Formulate explanations by using logic and evidence.
  - g. Recognize the usefulness and limitations of models and theories as scientific representations of reality.
  - k. Recognize the cumulative nature of scientific evidence.
- Students will create graphs and interpret albatross migration using satellite tag data.

## **Shorebird Seasonal Abundance Activity**

### Biology/Life Sciences

6. Ecology. Stability in an ecosystem is a balance between competing effects. Students will:

- a. Know biodiversity is the sum total of different kinds of organisms and is affected by alterations of habitats.
  - b. Know how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.
- Students will create graphs to analyze seasonal abundance of shorebirds in the Sanctuary.

# Seabirds and Shorebirds

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When thinking of the marine environment, most people ignore an important group of animals – the birds. They may not live in the ocean water but marine birds depend on and are a part of the marine ecosystem. *Seabirds* spend their lives at sea except during breeding, and *shorebirds* tend to stick close to land, breeding and feeding in the varied habitats along the coast.

In the Gulf of the Farallones National Marine Sanctuary, seabirds and shorebirds make their home in and near the protected waters. They rely on this area for food and habitat. The productive waters of the Gulf of the Farallones attract birds and many other animals, and are driven by the coastal *upwelling* of nutrient rich water. (Learn more in the Oceanography of the Gulf of the Farallones Unit.)

Seldom seen by people, seabirds spend most of their lives at sea. They feed on *plankton* or fish at the surface or dive down to catch fish or squid. Most seabirds rest and sleep on the rolling waves, while some of the more coastal seabirds roost on land for a few hours per day. Some species travel thousands of miles each year, while others stay in the same area for most of their lives. More than 120 seabird species have been recorded in the Sanctuary. In the center of the Sanctuary are the Farallon Islands, where the largest breeding colony of seabirds in the contiguous United States and 30% of California's breeding seabirds can be found. The Islands are a National Wildlife Refuge managed by the U.S. Fish and Wildlife Service. Twelve species of seabirds and one shorebird, the Black Oystercatcher, breed on the Farallon Islands.

The common term “shorebird” encompasses any bird that relies on the shores and beaches for habitat to feed and nest. Over 160 species of shorebirds use the Sanctuary for shelter, food and/or as a *migration* corridor. Most species breed far to the north of San Francisco and migrate through the Sanctuary and San Francisco Bay on their way to their wintering grounds to the south. They stop in the Sanctuary to feed in the bays, estuaries, and mudflats along the coast. Several areas within the boundaries of the Sanctuary where shorebirds frequent are Bolinas Lagoon, Tomales Bay, Bodega Bay, Estero Americano, and Estero de San Antonio.

## Behavior and Morphology

From the shape of the beak to the webbing of the feet, these air-breathing, feather-covered vertebrates are highly specialized to make their living near or on the water. Their behaviors and physical *morphology* help them survive this unique environment. Built to fly with hollow bones and air sacs, some birds literally swim through the water. (Not all birds have hollow bones) Researchers study and compare the morphological traits and behaviors of birds to understand the birds themselves.

### *Beaks*

A bird's beak is more than just the opening to its mouth for feeding or communicating. Birds use their beaks to *preen* their feathers, build their nests, display courtship behaviors, and as a deadly weapon against predators.

Seabirds primarily feed on fish, plankton, and squid, although some feed on other seabird chicks! Seabird species coexist in the same ecosystem by having different feeding methods. Surface feeding birds such as skimmers and gulls have short sharp beaks to catch fish on the fly. Plunge-diving is a technique for catching highly mobile prey used by Brown Pelicans and terns. Cormorants are diving birds and have long hooked bills, which can hold slippery fish underwater. Other diving birds have grooved palates to hold on to fish. Common Murres have been recorded to dive down to 100 meters (300 feet). How do they do it? The diving birds have adaptations similar to diving marine mammals – another air-breathing vertebrate. They have a large blood volume and enhanced capacity of blood and muscle, which allows them to provide enough oxygen to their muscles while diving. Winged “pirates” such as jaegers steal food from other seabirds.

Shorebirds have long pointy beaks to probe into the sand, mud, or water to catch their prey. The shorebirds can be categorized into feeding strategy groups. The “probers” use long beaks, up to several inches, to unearth small crustaceans hidden within the sandy shores. Each species has a unique beak length, limiting

the depth at which food can be obtained. This *vertical division* in feeding strategy allows for the highest number of species to feed in the same area. A notable “prober”, the Long-billed Curlew has the longest beak of any shorebird, reaching up to 9 inches. Willets have comparatively short beaks and can probe into the sand to catch smaller worms and sand crabs. In contrast, the “gleaners” display a *horizontal division* where the different species are separated from each other based on their leg length. Short-legged gleaners like the Snowy Plover scurry along catching invertebrates on the surface of Sanctuary beaches. Longer-legged species like the Avocet are able to travel farther into the surf and feed on items inaccessible to fellow shorebirds.

There are many other species-unique feeding strategies of shorebirds, such as that of the Black Oystercatcher. They use a long, thick triangular beak to sever shells of mussels and clams. The appropriately named Turnstones wander beaches turning over beach debris in search of invertebrate species.

### *Wings*

Many seabirds have long, narrow and pointy shaped wings. The albatross has the longest wingspan, at more than 7 feet, using its wings like a sail to carry it along wind currents. You will seldom see an albatross flap its wings as it cruises the open ocean. The wings of a gull are broader and of medium length, a more all-purpose wing. Terns and jaegers, which dip and swoop down to the sea surface, have pointy wings. Common Murres and puffins, which usually make relatively short and direct flights, have much shorter and narrower wings.

Many shorebirds migrate truly great distances between their summer breeding grounds and winter feeding grounds. They are small birds that can travel at speeds of 50 miles per hour and travel for several days. The wing shape of most shorebirds is narrow and long for their long distance travels.

### *Feet and Legs*

Most seabirds have their legs set farther back on the body than land birds. In this arrangement, the legs are better for diving than for walking. Diving and wading birds also have webbed feet for swimming. The shearwaters, murres, and puffins use their wings to propel themselves through the water and use their webbed feet as stabilizers. Albatross have broad webbed toes that provide leverage as they push against the water. Cormorants use their webbed feet for propulsion and underwater fold their wings in to become more streamlined. Loons look awkward as they walk on land because their feet are so far back on their bodies.

Shorebirds have long legs and no webbing between the toes. These adaptations allow them to wade through the surf or in an estuary in search of food. The lengths of the legs vary depending on feeding strategy.

### *Physiological Traits*

Have you ever seen a gull with a runny nose? That is a healthy bird, although it might not seem so at first. Animals that eat salty fish and ingest seawater would have too much salt in their blood unless they didn't remove some of it. Marine birds have glands that extract excess salt from their blood. The glands are located in a shallow depression near the eye socket. In most marine birds, the excess salt is released through the nasal cavity. In pelicans and cormorants, salt is excreted into the roof of the mouth and drips off the beak.

Most seabirds have waterproof *plumage*. Using the oil from the uropygial gland found in birds, they keep their feathers clean and smooth by *preening*. Moving the oil from the gland at the base of the upper tail feathers, they use their bill to spread it around. Waterproof feathers keep the bird's body dry and are important insulation to maintain a warm body. A few exceptions to this rule are the cormorants and some terns. Cormorants lack the oil-producing gland that is responsible for the waterproofing of birds' feathers. This allows their feathers to become saturated with water, reducing buoyancy and permitting deeper dives. To maintain warmth, they have a waterproof body rather than waterproof plumage. You will often see cormorants drying their wings. Some terns also lack waterproof plumage and they survive by rarely touching the water and catching prey at or above the surface.

### Breeding Birds of the Farallon Islands

Common Murre  
Pigeon Guillemot  
Cassin's Auklet  
Rhinoceros Auklet  
Tufted Puffin  
Double-Crested Cormorant  
Pelagic Cormorant  
Brandt's Cormorant  
Western Gull  
Least Storm-Petrel  
Ashy Storm-Petrel  
Fork-tailed Storm-Petrel  
Black Oystercatcher

### Niche Categories and Taxonomic Classification

Living organisms are often categorized in different ways. Some birds are closely related *taxonomically* but have very different life styles or *niches*. The following descriptions use both niche and taxonomy to categorize the seabirds and shorebirds in the Gulf of the Farallones. The taxonomic categories are important, yet in an ecosystem approach to learning about marine birds the niche categories add more to the overall understanding of these animals. The Gulf of the Farallones National Marine Sanctuary protects many habitats for seabirds and shorebirds. The open ocean of the Gulf of the Farallones provides feeding grounds for the *aerialists* and open water swimmers. The coastal seabirds can be found several miles from the coast or living in Tomales Bay, Bolinas Lagoon, estuaries, and sandy beach habitats alongside the shorebirds.

*Open Water Swimmers and Aerialists: Gull, Tern, Skua, Jaeger, Murre, Guillemot, Murrelet, Auklet, Puffin, Phalarope*

While some of the order Charadriiformes inhabit coastal waters, the others are found out at sea. Gulls and terns are seldom found far from the coast, feeding on a variety of prey. Skuas, Jaegers, and Kittiwakes are better adapted to life at sea. Two species of Phalaropes found in Sanctuary waters distinguish themselves as being the only oceanic species in the same family as shorebirds. These examples illustrate that closely related species have different lifestyles.

Murres, Guillemots, Murrelets, Auklets, and Puffins belong to the Alcid Family and are highly adapted to life at sea. Many Alcids live a truly pelagic existence, residing on the ocean's surface except when rearing their young. Exemplified by the Common Murre, alcids look like feathered footballs with wings. Although their wings are rather small, massive breast muscles that account for more than one-third of the bird's weight propel Murres short distances in the air, or down deep in the water. Common Murres and Cassin's Auklets are the most abundant species on the Farallon Islands, with more than 150,000 Common Murres.

With adaptations that make them successful on land and at sea, there is little territory where gulls are not found. Unlike the other breeders of the Farallones, gulls have an extremely varied diet, often including garbage. The most prolific species, the Western Gull, has established itself in urban areas as well, feeding from garbage dumps and dumpsters. Gulls have less fluctuations in breeding success than the other twelve species on the Farallones, possibly because they are not directly linked to the success of a particular fish stock.

*Aerialists: Albatross, Fulmar, Petrel, Shearwater, Storm-Petrel*

The order Procellariiformes contains the seabirds best adapted to pelagic life. Distinguished by tubular nostrils that open externally into a hooked bill, this group is also called the tubenoses. Equipped with long,

powerful wings for extended flight and a salt gland for processing seawater, birds such as Albatrosses and Fulmars spend up to nine months at sea, taking to land only to rear their young. This order also changes seafood into an oil in their stomachs, which is regurgitated to feed their young. Chicks grow and survive on this high caloric oil with limited feedings (days or weeks between feedings). Also, it permits the adults to fly longer distances than they could if they had to carry food in their bills. Albatross have foraging ranges of over one thousand miles, spending the majority of the year in the open ocean. Black-footed Albatross fly to the Gulf of the Farallones to feed on the abundant food sources and return to their nests on the Northwestern Hawaiian Islands to feed their chicks. (Learn more about this in the Albatross Activity).

Despite their small size (sparrow-sized) and fragile appearance, storm-petrels get their name from their uncanny ability to survive the blunt-force of ocean storms. Most active at dawn and dusk, storm-petrels are known for their “dancing” behavior while feeding, dabbling their feet on the waters surface while hunting for crustaceans and squid.

#### *Aerialists and Coastal Seabirds: Tropicbird, Booby, Frigatebird, Pelican, Cormorant*

Birds in the order Pelecaniformes such as the Pelican, Frigatebird, and Tropicbird have some of the largest wings relative to body size. Another group of aerialists, long slender wings allow these species to effortlessly glide over the surface of the ocean. Pelecaniformes are all fish eating, relatively sedentary seabirds that make short trips compared to other seabirds and feed by diving and plunging.

The endangered California Brown Pelican is among the many non-breeding species found within the borders of the Gulf of the Farallones National Marine Sanctuary. They disperse from breeding areas from the south and feed in Sanctuary waters in late summer through early winter. The more commonly seen of the seabirds, the California Brown Pelican is one of the great recovery stories. Plagued by DDT, the pelican population was brought to the edge of extinction until the banning of the pesticide in 1972.

Cormorants are often seen on coastal rocks drying their wings, and are noteworthy for their long necks and thin beaks. One of the older bird families taxonomically speaking, cormorants can saturate their feathers with water and dive deeper than other seabirds to find fish. Three species of cormorants live in the Gulf of the Farallones and breed on the Farallon Islands. The Double-Crested Cormorant is commonly seen along the shore, flying with its neck crooked. Slightly larger and more uniformly dark is the Brandt’s Cormorant. Rarely seen near the shore, the Pelagic Cormorant is the thinnest of the three species.

#### *Coastal Seabirds: Loon, Grebe, and other Duck-like birds*

While not usually considered seabirds, many duck-like species belonging to three taxonomic orders are found in the Gulf of the Farallones feeding on the plentiful stocks of food. Loons are large aquatic birds found on the coastline. Known for their eerie wails and strange laughter, these birds are expert hunters of fish and crustaceans. They feed down to depths of 80 meters (240 feet), capturing fish with their strong dagger-like bills. Several species of loons spend time within the estuaries along California’s coast during the winter and others during their migration.

Grebes are usually found on the coastal shores of the Sanctuary, although they do form large groupings on the open ocean. Also fishing birds, grebes are somewhat limited in swimming power by their “lobed” feet (not fully webbed). Six species of Grebes make their winter home in the Sanctuary, including the Eared, Horned, and Western Grebes. These birds are excellent divers. They have been known to use their wings to “fly” underwater as they hunt for small fish.

More than twenty species of other duck-like birds inhabit the Gulf of the Farallones and surrounding waters, with many of them present year-round. The well-known Canada Goose is a seasonal visitor to the area along with the elegant Northern Pintail. Species display a great variation in color, size, shape, and feeding behavior. Some common feeding methods include dabbling for small invertebrates (Mallards), feeding on vegetation (Geese), and diving for fish (Mergansers & Scoters). Surf Scoters, an oceanic species of duck, migrate here during the winter and can be found in the swash zone along the shore, feeding on mussels and invertebrates.

### *Shorebirds: Heron, Egret, Bittern*

Seven species of Herons, Egrets, and Bitterns of the taxonomic family Ardeidae can be found in the Sanctuary's estuaries and near shore regions. These long-necked wading birds are found in wetlands and along shorelines. The Great Egret is easy to identify by its pure white body and long black legs and feet, and yellow bill. The smaller Snowy Egret is very similar in appearance, but its smaller size, yellow feet, and a black bill distinguish it from the Great Egret. Using dagger-like bills, these predatory birds spear frogs, fish, crayfish, and other small animals. Their migratory path stretches from southern Canada to Mexico, utilizing the rich feeding grounds of the Gulf of the Farallones National Marine Sanctuary as important resting areas.

### *Shorebirds: Plovers, Sandpipers, Stilts, and more*

The Charadriiformes order, which includes gulls and murre, also contains the "true" shorebirds (sandpipers, plovers, stilts, avocets, and turnstones). These shorebirds are known for their extraordinary feats of migration; some travel over 15,000 miles, fly 3-4 days nonstop, or fly at speeds exceeding 40 miles per hour. During the spring and fall, millions of migratory birds pass through the Sanctuary, San Francisco Bay and other bays and estuaries along the coast. The "*Pacific Flyway*" is one of four main routes birds travel through North America on annual migrations.

There are nearly forty members of the Sandpiper family that have been seen within the Sanctuary borders such as the elegant American Avocet, two species of Dowitcher, the Long-billed Curlew, eight species of Sandpipers, and the Black-necked Stilt. These species probe about the shores of the Sanctuary feeding on buried clams, worms, crustaceans, and small fish.

The Killdeer and the Snowy Plover are members of the Plover group, which feed by gleaning insects on the beach. These short-legged birds can be seen sparsely scattered along sandy beaches such as Ocean Beach and the Point Reyes beaches. Killdeer are best known for enacting an injury to lure predators away from their nests. Once an abundant species along the Pacific coast, the endangered Western Snowy Plover has declined to a point where its population size is so low that it is listed as a threatened species. Population estimates vary from 3,500 to 4,500.

### **Human Impact**

Birds, bird eggs, and mammals of the Gulf of the Farallones National Marine Sanctuary have been harvested since the arrival of the first Europeans in 1579. Since then, two seabird species, the Short-tailed Albatross and Marbled Murrelet, have been so adversely impacted they are currently on the endangered species list.

To the Ohlone, the San Francisco Native American people, the Farallon Islands were known as the "Islands of the Dead" and were never ventured to in life. After the Islands were discovered by newcomers, they were visited to fill ships with meat, fur, and eggs. These harvests were infrequent until 1811 when the first island outpost was established by Russian fur-trappers for regular harvest of bird and mammal products. The harsh conditions of the Farallones did not fair well with the settlers and they abandoned their settlement in 1838.

Local waters were once again regularly harvested in 1848 when gold was discovered in the hills of California. The exponential growth of San Francisco resulted in the enormous demand for food and supplies. Sanctuary waters seemed to hold an endless supply of fish, squid, crab, oysters, shrimp, and eggs. It was the eggs of the Common Murre that brought settlement back to the Islands. The Farallon Egg Company gathered more than 14 million Common Murre eggs in less than 40 years.

At the same time nationwide, millions of herons and egrets were being slaughtered annually for their feathers. Raiding nest colonies, entire populations of Great Blue Herons, Snowy Egrets, and Great Egrets were harvested for their elegant breeding plumage. It was this senseless slaughter that first provoked public environmental action. Protesting citizens banned the sale of plumes within the city of New York, founded the first Audubon Society, and paved the way for the Federal Migratory Bird Treaty Act (1918). The Migratory Bird Act made it unlawful to kill or possess any part, nest, or egg product of any native bird within the United States, Canada, Mexico, Japan, and Russia. On the coast of the Sanctuary, Audubon Canyon Ranch is a 2,000 acre preserve that still holds breeding sites for the once threatened Egret and Heron populations.

President Theodore Roosevelt protected the Farallon Islands as a preserve and refuge for seabirds and

marine mammals in 1909, one of the first National Wildlife Refuges (NWR) in the nation. The South Farallon Islands were added to the Refuge in 1969. The U.S. Fish and Wildlife Service currently manages the Farallon NWR as one of over 540 National Wildlife Refuges.

As the increase in human conquest of natural habitats continues, native bird species are on the decline; 33 bird species are listed as endangered or threatened in the state of California as of February 2003, with 227 birds listed worldwide. Birds can be an *indicator species* of the health of the environment, and through monitoring trends in their populations, researchers can monitor the environment. Travelling miles along the coast each day, shorebirds are specifically vulnerable to ecological disturbances such as oil spills, other toxic chemicals, habitat destruction, human disturbance, and the resulting declines within the food chain.

The presence of humans on and around the Gulf of the Farallones National Marine Sanctuary continues to affect nesting and migrant birds. Shipping, commercial fishing, and pollution have continued to be major concerns for the continued success of all local marine life. Although these species are able to survive the blunt force of the open ocean, they are no match for an oil spill. In 1984 the T/V *Puerto Rican* had two explosions on board and eventually broke apart, spilling 1.4 million gallons of oil and killing 6,000 birds. When oil comes into contact with birds' feathers their natural waterproofing breaks down, leaving seabirds vulnerable to hypothermia (see Oil Spill Unit to learn more). Through the extraordinary efforts of marine biologists the local breeding populations of several marine bird species, such as the Common Murre, have been nearly recovered to their former numbers.

Many resident seabirds, such as the Ashy Storm-petrel, are dependent on specific species of fish to feed themselves and their young. Constant variations in the fish populations, due to natural events and competition with local fishery industries, create great stress on the success rates of these vulnerable species. Fishery operations have also added to the mortality rate of seabirds, especially the Common Murre, who drown in *gill nets*. The decline in these birds eventually led to the banning of gill nets on the California coast.

Another threat to seabirds that may be surprising is light pollution. Some seabirds like petrels and auklets are nocturnal to avoid predators like gulls. Fishing vessels and other boats that leave deck lights illuminated at night attract petrels and auklets which become disoriented and crash into boats. Boats that illuminate seabird colonies disrupt breeding and can attract predatory gulls which kill smaller seabirds.

### The Common Murre Restoration Project

In 1986 the barge *Apex Houston* discharged 20,000 gallons of oil while in transit from San Francisco to Long Beach Harbor. The spill covered beaches from Point Reyes to Monterey with oil. 10,000 seabirds were killed, including 6,000 Common Murres. Several of the murre breeding sites were deserted, including Devil's Slide Rock.

In 1995 the U.S. Fish and Wildlife Service employed a technique called social attraction to reestablish the Common Murre colony on Devil's Slide Rock. Social attractants, including decoys of adult murres, decoys of murre chicks and eggs, CD players projecting amplified murre sounds (Murre's Greatest Hits!), and three-sided mirror boxes, were used to attract the highly colonial birds back to the rock.

The project has been incredibly successful, far exceeding expectations in its first and subsequent years. Within 24 hours of establishing the social attraction devices on the rock, birds began landing at the colony that had been abandoned for 10 years following the spill! The birds attended the rock regularly that year and fledged three chicks. The number of birds breeding on Devil's Slide Rock has increased each year, with 123 nesting pairs in 2002 and numbers continue to go up.

## How to Get Involved

The easiest way to see the various species that inhabit the Gulf of the Farallones National Marine Sanctuary is to take a *pelagic* seabird or wildlife trip, yet many of them can be seen from the coast at such locations as Point Reyes and Bodega Bay. Shorebirds can be easily observed by visiting local beaches. (See the Bird Watching Activity for more information).

Sanctuary Beach Watch volunteers monitor the coastline every two-to-four weeks for live and dead birds, and are often the first to detect oil along the coast. Through the Sanctuary's programs, and similar volunteer programs worldwide, the general public can expand their knowledge of the environment they live in, while helping to preserve and protect wildlife.

You can take steps in your everyday life to help protect birds:

- Join your local conservation organization
- Organize a beach cleanup
- Keep your dog on leash when at the beach
- Turn off unnecessary lighting on boats
- Dispose of plastic and trash in a recycling or trash bin
- Cut 6-pack plastic rings and dispose of properly.

## References

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# Glossary of Terms

## Seabirds and Shorebirds

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<i>Aerialist</i>	a bird that spends most of the time flying and soaring
<i>Biomagnification</i>	an increase in the concentration of a toxin from one trophic level to the next
<i>Gill net</i>	a fishing net set vertically in the water so that fish swimming into it are entangled in the mesh by their gills. Diving birds can become entangled and die by drowning.
<i>Horizontal division</i>	a feeding strategy where different species of shorebirds are competitively separated from each other based on their leg length
<i>Indicator species</i>	a species that can indicate the health of an ecosystem
<i>Migration</i>	a regular journey along a well-defined route, particularly those involving a return to breeding ground
<i>Morphology</i>	the structure and form of an organism
<i>Niche</i>	a specialization by a species to avoid competition and share resources; also can refer to the range of environmental space that a species occupies
<i>Pacific Flyway</i>	one of the four main routes which birds travel through North America on annual trips to their wintering grounds and summer breeding grounds
<i>Pelagic</i>	associated with the open water of the ocean
<i>Plankton</i>	drifting algae and animals that have no control over the direction that they travel; they are at the mercy of the currents
<i>Plumage</i>	feathers
<i>Preen</i>	to smooth, clean, or distribute water-proofing oil to feathers with the beak
<i>Seabirds</i>	birds that rely on the ocean for food and come to land only to breed
<i>Shorebirds</i>	birds that rely on shores and beaches for habitat, feeding, and nesting
<i>Taxonomy</i>	the systematic categorization and naming of organisms
<i>Upwelling</i>	a process that occurs when strong winds blow surface water away and deeper water comes up to the surface to replace it. This creates a highly productive biological community when the deeper water is nutrient rich.
<i>Vertical division</i>	a feeding strategy where different species of shorebirds are competitively separated from each other based on their beak length



# SEABIRDS OF THE GULF OF THE FARALLONES



Not many residents of San Francisco are aware that the largest and most diverse breeding colony of seabirds in the contiguous United States is within city limits. The Farallon Islands are located 27 miles west of the Golden Gate Bridge and act as a seasonal home to more than 300,000 nesting seabirds every year. Twelve species found breeding on the Islands belong to the highly adapted seabird group.

The Gulf of the Farallones National Marine Sanctuary, founded in 1981, protects over 1,000 square miles of one of the most productive regions in the Pacific Ocean including the water surrounding the Farallon Islands. The continual flow of cold, nutrient-rich waters provides a seemingly endless supply of food for all points on the food web. Each spring, the union of isolated island habitat and the wealth of food attracts hundreds of thousands of seabirds to the Sanctuary. Since 1972, more than 400 species of birds have been recorded on the rocks of the Farallon Islands and surrounding waters. The Farallon National Wildlife Refuge, managed by the US Fish and Wildlife Service, protects the islands themselves.



Photo by Dawn Breeset, PRBO

*Short-tailed Shearwater*

## CLASSIFICATION

Birds that spend their entire lives on or above the water and only come to land to breed are categorized as seabirds. The bills, body shapes, and wings vary from species to species. Most seabirds have webbed feet which are back towards the tail, the most efficient location for propelling the bird on and through the water. Grouped by their dependence on the ocean for habitat and/or as source of food, seabirds are not grouped by common relation. The many species of seabirds can be further divided by their niche into aerialists, open water swimmers, and coastal seabirds.

### AERIALISTS

The aerialists are primarily members of the orders *Pelecaniformes* and *Procellariiformes* such as the albatross, frigatebird, and pelican. Several species of albatross, including the Black-footed Albatross common in the Sanctuary, have wingspans exceeding 7 feet. Long, slender, and powerful wings allow

these birds long-distance and near-effortless flights extending to more than 2,400 kilometers. Birds such as albatross and fulmars spend up to nine months at sea, coming to land only to rear their young. They have salt glands that remove excess salt that they consume by drinking seawater and feeding.

Able to survive the most violent of ocean storms, storm-petrels are small nocturnal seabirds known for their dancing feeding behavior on the surface of the ocean. They dip their webbed feet in to catch their prey.

The California Brown Pelican is one of the great recovery stories for endangered species. Plagued by DDT, the pelican population was brought to the edge of extinction until the banning of the pesticide in 1972. Pelicans are abundant in the Sanctuary during the summer and fall, cruising over the breakers in a single file line.

### OPEN WATER SWIMMERS

The wings of open water swimmers are wide and allow the birds enhanced diving abilities. Most swimmers simply sit on the water's surface when they are not diving for food.

Murres, Guillemots, Murrelets, Auklets, and Puffins belong to the Alcid Family and are highly adapted to life at sea. Many Alcids live a truly pelagic existence, residing on the ocean's surface except when rearing their young. Common Murres and Cassin's Auklets are the most abundant species on the Farallon Islands, numbering in the tens of thousands. The Common Murre has been known to dive to depths of 192 meters.

More closely related to birds that feed on the shore, two species of Phalaropes distinguish themselves as being open-water seabirds. These small sandpipers spend 10 months of the year on the open waters, migrating through the Sanctuary and feeding at the ocean's surface.

### COASTAL SEABIRDS

Although they don't spend their lives at sea, many coastal seabirds are directly linked to the ocean through their food. Cormorants, gulls, terns, grebes, loons, and coastal ducks simply visit the ocean on feeding trips.

Cormorants are a very ancient species, reminiscent of the first aquatic birds. Lacking waterproofing of other seabirds, cormorants are able to saturate their feathers with water to allow them to dive to deeper depths. They can often be seen along the coastline, gathering in large numbers on craggy rocks, holding their wings open to dry.

#### BREEDING SEABIRDS OF THE FARALLON ISLANDS

Common Murre	Pigeon Guillemot
Cassin's Auklet	Rhinoceros Auklet
Tufted Puffin	Double-Crested Cormorant
Pelagic Cormorant	Brandt's Cormorant
Western Gull	Least Storm-Petrel
Ashy Storm-Petrel	Fork-tailed Storm-Petrel

Seldom found far from coastal waters, gulls and terns feed on a variety of prey. The most prolific species along the Pacific coast, the Western Gull has established itself in urban areas as well, feeding from garbage dumps and dumpsters.

Loons are large aquatic birds found on the rich coastline feeding on various fish species down to depths of 80 meters, capturing fish with their strong dagger-like bills. Grebes are usually found on the coastal shores of Sanctuary waters, although they do form large groupings on the open ocean. Also fishing birds, grebes are somewhat limited in swimming power by their "lobed" feet (not fully webbed).

## HISTORICAL PERSPECTIVE AND CURRENT STATUS

The Farallon Islands were untouched by the Native American Ohlones who regarded the islands as a place of the after-



Photo from Point Reyes Bird Observatory

*A Common Murre on the Farallon Islands during the summer.*

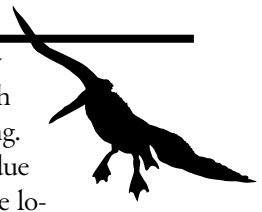
life. Seabirds and many other animals of the Gulf of the Farallones National Marine Sanctuary have been harvested since the first landing of Europeans in 1579. The abundant resources of sea lion meat, fur seal pelts, seabirds, and bird eggs were infrequently harvested until 1812 when a Russian settlement was founded on the Farallon Islands and lasted for 25 years. The exponential growth of San Francisco resulted in the enormous demand for

food and supplies. The Gulf of the Farallones waters provided an endless supply of fish, squid, crab, oysters, shrimp, and eggs. It was the eggs of the Common Murre that brought human settlement back to the Islands. Common Murre eggs were collected and shipped to the San Francisco markets which devastated the population of this seabird by removing more than 14 million eggs in only 40 years.

Human presence within the Gulf of the Farallones has decimated local seabird and wildlife populations through eggging, oil spills, seafood harvesting, and wildlife disturbance. The Common Murre population was brought down to less than one six-thousandth of its original size (6,000 individuals in the 1950s from a historical one million).

Oil spills are always a concern near San Francisco, one of the busiest ports in the Pacific. Oil spills are especially harmful to the open water swimmers which sit at the surface where the oil also floats. The oil spill from the barge *Apex Houston* in 1986 killed nearly 6,000 Common Murres. Upon contact with feathers, oil breaks down the natural waterproofing thus the crucial insulation that protects these birds from hypothermia is destroyed.

Many resident seabirds, such as the Ashy Storm-petrel, are dependent on certain fish species to feed themselves and their young. Constant variations in the fish populations due to natural events and competition with the local fishery industry create great stress on the success rates of these vulnerable species. Fishery operations have also added to the mortality rate of seabirds, especially the Common Murre, who drown in gill nets. The decline in these birds eventually led to the banning of drift nets on the California coast.



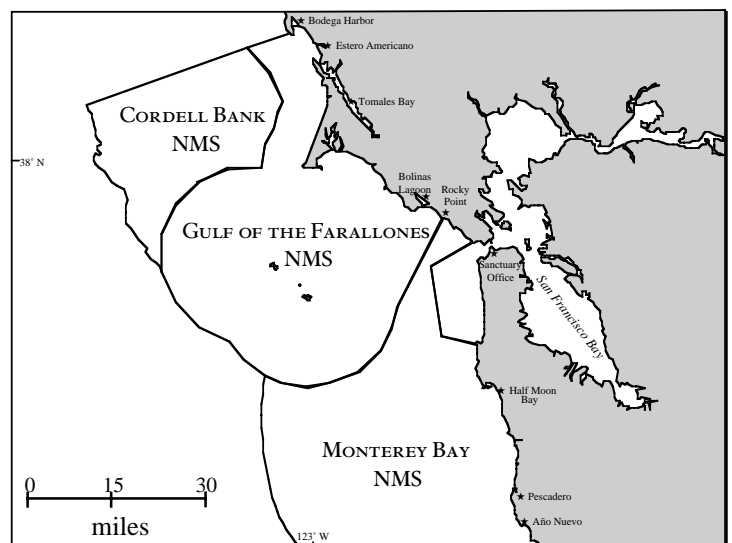
Many species harvested in this period have just begun to recover. Of the more than 120 seabird species recorded for all of the Sanctuary, two are currently on the endangered species list.

To see the many seabirds of the Gulf of the Farallones National Marine Sanctuary, take a pelagic seabird or wildlife boat trip or go to the coast. Point Reyes and Bodega Bay are wonderful areas to see seabirds close to shore or on their nesting rocks.

Sanctuary volunteers monitor the coastline for live and dead marine life, and they are often the first to detect oiled birds from an oil spill. Through the Sanctuary's Beach Watch program, the public can not only expand their knowledge of the marine environment, but can also help to preserve the wild places and wild things for generations to come.

*For more information on the Gulf of the Farallones National Marine Sanctuary, seabirds, or how to get involved contact:*

- Farallones Marine Sanctuary Association  
www.farallones.org or (415) 561 - 6625
- Gulf of the Farallones National Marine Sanctuary  
farallones.noaa.gov
- Point Reyes Bird Observatory  
www.prbo.org
- The Audubon Society  
www.audubon.org
- International Bird Rescue Research Center  
www.ibrrc.org





# SHOREBIRDS OF THE GULF OF THE FARALLONES



The Gulf of the Farallones National Marine Sanctuary holds crucial habitat for vast species of shorebirds. The term shorebird or “waders”, encompasses any bird that relies on beaches or wetlands for habitat to feed and nest. Approximately 80 of the more than 400 species of shorebirds are found within the Sanctuary’s boundaries. Easily recognizable members include the Great Blue Heron, the sandpipers, and the egrets. Within the Sanctuary, shorebirds can be seen at Bolinas Lagoon, Tomales Bay, Bodega Bay, Estero Americano, and Estero de San Antonio.

## CLASSIFICATION

Shorebirds belong to the second largest class of vertebrates, the Aves, with nearly 10,000 living species of birds. The order Charadriiformes contains the “true” shorebirds (sandpipers, plovers, stilts, avocets, oystercatchers, skimmers, turnstones, and phalaropes). Generally having long legs and beaks and no webbing between the toes, shorebirds are specifically adapted to their environment. There are many other shorebirds living within the Sanctuary that are not considered in the family of “true” shorebirds, including the egrets and duck-like birds with similar feeding strategies.

“True” shorebirds are known for their extraordinary feats of migration, as some travel over 15,000 miles, fly three to four days nonstop, or fly at speeds exceeding 40 miles per hour. During the spring and fall seasons, millions of migratory birds pass through the Bay Area on the “Pacific Flyway.” This is one of four main routes on which birds travel through North America on annual trips to and from their wintering grounds to the south.

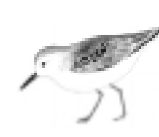


Marbled Godwit (*Limosa fedoa*)

Photo from GFNMS library



Willet



Western Sanderling



Marbled Godwit

## TRUE SHOREBIRDS

The Charadriiformes can be divided on a basis of feeding strategy by species that “probe,” those that “glean,” and those with species-specific feeding behaviors.

### Probers

Using long beaks reaching up to several inches, “probers” unearth small crustaceans hidden within the sand or mud. Each species has a unique beak length, limiting the depth at which food can be obtained. This vertical division in feeding strategy allows for the highest number of shorebird species to feed in the same area.

There are nearly 40 members of the Sandpiper family that have been seen within the Sanctuary, such as the elegant American Avocet, two species of dowitcher, eight species of sandpipers, and the Black-necked Stilt. These species probe about the shores feeding on buried clams, worms, crustaceans, and small fish. A notable “prober”, the Long-billed Curlew, has the longest beak of any shorebird, reaching up to nine inches.

### Gleaners

In contrast to the “probers,” the “gleaners” scurry along the beach feeding on invertebrates on the sand surface. The “gleaners” display a horizontal division of foraging, based on their leg length. The longer-legged species are able to travel farther into the surf and are able to feed on items inaccessible to other shorebirds. Sanderlings gather in large numbers to glean the beach. Once an abundant species along the Pacific coast, the Western Snowy Plover has declined to such a low population size that it is listed as threatened on the federal endangered species list. Another plover, the Killdeer, is best known for its screeching calls and enacting an injury to lure predators away from its nest.

### Species-unique strategies

There are many other feeding strategies of shorebirds, such as that of the Black Oystercatcher, which uses a long, thick triangular beak to sever open shells of mussels and clams. The Black Skimmer has a beak with a greatly enlarged lower half used to catch fish while flying just above the water’s surface. The appropriately named turnstones wander beaches turning over beach debris in search of invertebrate species to feed upon.



Photo by Jamie Hall

Snowy Egret (*Egretta thula*)

## OTHER SHOREBIRDS

Loons, grebes, herons, ducks, and rails are similar to “true” shorebirds, yet are classified in five other orders.

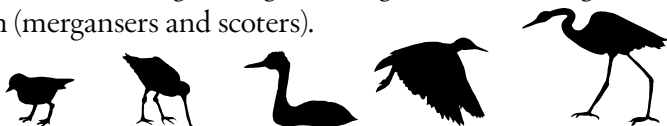
The Black Rail, listed as threatened on California’s endangered species list, can be found in Tomales Bay. Faced with rapidly diminishing habitat, rails are now rarely found in the salt marshes of bay and coastal communities.

Seven species of herons, egrets, and bitterns live in the Sanctuary. These long-necked wading birds are found in wetlands and along the shoreline. The Great Egret is identified by its white body, yellow beak, and long black legs; the Snowy Egret is very similar in appearance, with a smaller body size, black beak, and yellow feet. Using dagger-like bills, these predatory birds quickly snatch up frogs, fish, crayfish, and other small animals.

Six species of grebes make their winter home in the Sanctuary, including the Eared, Horned, and Western Grebes. These birds are excellent swimmers and divers. They have been known to use their wings to “fly” underwater as they hunt for small fish.

Four species of loons spend time within the estuaries along California during their migration. Known for their eerie wails and strange laughter, these birds are expert hunters of fish and crustaceans.

More than twenty species of duck-like birds inhabit the Gulf of the Farallones and surrounding waters, with many of them present year-round. The Canada Goose is a seasonal visitor to the area along with the elegant Northern Pintail. Diversity is quite strong in these duck-like birds, with species displaying great variation in color, size, shape, and feeding behavior. Some common feeding methods include dabbling for small invertebrates (mallards), feeding on vegetation (geese), and diving for fish (mergansers and scoters).



## CONSERVATION

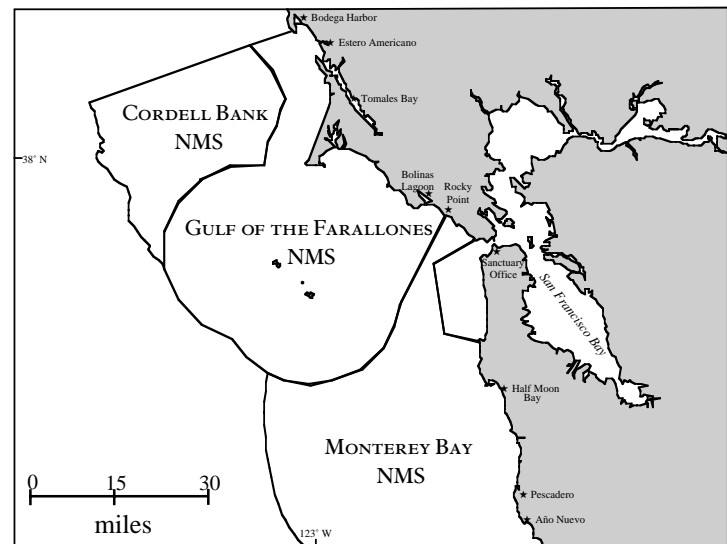
At the end of the 19th century, millions of herons and egrets were slaughtered annually for their elegant feathers used in the fashion industry. Their magnificent breeding plumage was worth more than their weight in gold. This harmful activity provoked the first public environmental action by banning the sale of plumes, followed by the foundation of the Audubon Society and passing the Federal Migratory Bird Treaty Act (1918).

As the increase in human coastal development continues, native bird species are on the decline; 33 bird species are listed as endangered or threatened in the state of California as of October 2001, with almost 250 birds listed worldwide. Traveling miles along the coast each day, shorebirds are specifically vulnerable to ecological disturbances such as oil spills, the presence of toxic chemicals, and the resulting declines within the food web.

Sanctuary volunteers monitor the coastline for live and dead marine life, and they are often the first to detect oiled birds from an oil spill. Through the Sanctuary’s Beach Watch program, the general public can not only expand their knowledge of the environment marine life live within, but can also help to preserve and protect it for future generations.

*For more information on the Gulf of the Farallones National Marine Sanctuary, shorebirds, or how to get involved contact:*

Gulf of the Farallones National Marine Sanctuary  
[farallones.noaa.gov](http://farallones.noaa.gov)  
 Farallones Marine Sanctuary Association  
[www.farallones.org](http://www.farallones.org) or (415) 561 - 6625  
 Point Reyes Bird Observatory  
[www.prbo.org](http://www.prbo.org)



# Seabird and Shorebird Activities

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## Bird Watching

### Objective

Your students will become in touch with nature by simply practicing the skills of observation, while learning about species identification and behavior in one habitat. The beauty of bird watching is that it can be done anywhere, for any amount of time.

### Materials and Supplies

Binoculars

Field guides and/or species identification cards

*Bird Watching Field Notes* worksheet

Clipboards/ Pencils

### Background

Birds are in the second largest class of vertebrates, *Aves*, with more than 10,000 species. Birds are an important group in the food web of many ecosystems. The Gulf of the Farallones National Marine Sanctuary is home to more than 300,000 breeding seabirds and provides crucial habitat for more than 80 species of shorebirds. Millions of migratory birds pass through the San Francisco Bay Area on the “Pacific Flyway.” This is one of four main routes on which birds travel through North America on annual trips to and from their wintering and breeding grounds.

Most people know more about bird identification than they realize. For example, you could probably identify different groups such as shorebirds and hawks. Bird identification is a skill that can be continuously improved over time. The key to correctly identifying a bird is to look at a combination of field marks (physical characteristics): size, shape, bill, tail, wings, and coloration. A bird’s behavior and habitat are sometimes just as important in identification.

*Size:* How large is the bird? Is it the size of a hummingbird or of an eagle?

*Shape:* Most birds have a shape characteristic of its family. Which group does it most closely resemble? Look not only at the shape of the body, but also look at the shape of the head.

*Bill:* The shape of a bird’s bill is specialized for feeding. Is it hooked like a bird of prey? Dagger-shaped like a tern? Long and narrow for digging into the beach like a shorebird?

*Tail:* What is the shape of its tail? Is it forked, square-tipped, notched, rounded, or pointed? Are there any patterns on the tail?

*Wings:* The shape of a bird’s wings, especially if it is flying overhead, can be useful in identification. Also, look for any distinct color patterns.

*Coloration:* The colors and pattern of a bird’s plumage (feathers) are also important to note. Keep in mind that males and females can look different. Many species change color during the breeding season and there are regional variations in color.

*Behavior:* Watching a bird’s actions can provide many clues to its identity. Look at social behaviors (flocking, courtship dances), as well as personality clues (is it shy and elusive or unconcerned with human

presence?). Have your students listen to song patterns, which are often species unique.

Flying: How does it fly? Does it dip up and down, or fly directly? Does it glide and soar? How does it beat its wings?

Feeding: Is the bird foraging for food on the ground? Diving into the water for its meal?

*Habitat/Range:* Each bird is specially adapted for a particular ecosystem. Where did you find the bird? In the treetops? In scrub brush on the ground? Gliding over the ocean? Wading in a lake? In addition, each species has a geographic range that it lives in or migrates through.

### Pre-activity

Students will get more out of this activity if they observe birds more than once. Assign each student to watch birds around their house and take notes for 20 minutes as homework. This will give students a chance to simply start watching birds. Then have each student share their experiences with the class.

### Activity

In the classroom, go over the basics of bird identification, and the different characteristics that the students should be looking for. Describe and show pictures of 10 species that you are likely to encounter in the field. Remember to talk about good wildlife viewing habits to avoid disturbing birds. Go over the “Walker’s Etiquette” with your students before going into the field.

You can take your students to one habitat or you can visit two different habitats to make comparisons. Pick a good time to go in the field, for example, during spring or fall migration, or if you are going to watch shorebirds, at a low tide. Then, go bird watching!

In the field, have your students record general information and sketch the birds on the *Bird Watching Field Notes* worksheet. Each student should choose 3-5 birds to watch and take detailed descriptions about their physical and behavioral characteristics. Use field guides or identification cards to identify the species.

Back in the classroom, have your students answer questions and draw conclusions from their field notes. Some topics of discussion could be: What can you tell about a bird’s food source and habitat from their physical characteristics? What are the key members of the food web of the ecosystem we visited? How would the seasonal distribution of birds be affected by climate change? What human activities could affect birds’ habitat?

### Recommended Field Guides

1. Field Guide to the Birds of North America, National Geographic, Geographic Society, 1999.
2. A Field Guide to Western Birds by Roger Tory Peterson, Houghton Mifflin Company, 1990.
3. National Audubon Society Field Guide to North American Birds (Western Region), by Miklos D. F. Udvardy, Alfred A. Knopf, Inc. 1994.
4. The Sibley Guide to Birds, by David Sibley. Alfred A. Knopf, Inc. 1994.

### Recommended Bird Watching Areas in the San Francisco Bay Area

Although you can watch birds outside your school, a field trip to a good bird viewing area might be more rewarding. Check out a beach or park near the school, or visit an area listed below.

The wetlands and coastal areas of the Gulf of the Farallones National Marine Sanctuary offer great seabird and shorebird viewing areas. These areas are listed from north to south along the coast. Please visit the “Explore” section on [www.farallones.org](http://www.farallones.org) for directions and more details about each site.

Bodega Bay  
Estero Americano  
Estero de San Antonio  
Bolinás Lagoon Nature Preserve  
Audubon Canyon Ranch  
Gazos Beach, Montara  
Pescadero Marsh

Point Reyes National Seashore is a premier bird viewing destination. Some good spots are McClures Beach, Abbott’s Lagoon, Limantour Estero Reserve, and Drake’s Bay. Visit [www.nps.gov/pore/](http://www.nps.gov/pore/) to find out more details. The Point Reyes Bird Observatory offers bird walks and other educational activities. For more information and for bird watching areas in Point Reyes, visit [www.prbo.org](http://www.prbo.org).

The Marin Headlands in the Golden Gate National Recreation Area has numerous trails through rolling hills and open space. Be sure to spend time at Rodeo Lagoon.

In the city of San Francisco, you can visit Golden Gate Park. Wooded areas are home to land birds, and waterfowl and gulls can be found in the park’s lakes. In the Presidio, Crissy Field Lagoon and Beach provide shorebird viewing. Along the west coast of the city, pelicans, cormorants, and gulls can be seen at the Cliff House and Ocean Beach.

South of San Francisco, you can see swallows and songbirds at the cliffs at Ft. Funston. Pillar Point and Pillar Harbor in the Half Moon Bay area are great spots to view coastal seabirds and shorebirds.

Inland, in the south Bay area, visit Don Edwards San Francisco Bay National Wildlife Refuge which has bay, marsh, pond, and mudflat habitats with over 280 bird species. For more information see <http://desfbay.fws.gov/>.

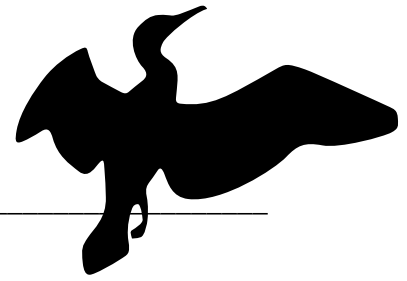
### Extensions

For more activities see:

[The Birdwatchers Activity Book](#) by Donald Heintzelman, Stackpole Books, 1983.

[The Sibley Guide to Bird Life and Behavior](#) by David Sibley, Knopf, 2001.

# Bird Watching Field Notes



## Observations taken at bird sighting location

Name of observer: \_\_\_\_\_

Date: \_\_\_\_\_ Time: \_\_\_\_\_

Location: \_\_\_\_\_

Habitat type: \_\_\_\_\_

General description of area: \_\_\_\_\_

Number of birds in area: \_\_\_\_\_

Are the birds in a group or singly?: \_\_\_\_\_

What are the birds doing? (wading, swimming, climbing, etc): \_\_\_\_\_

## Species Description

Size: \_\_\_\_\_

Shape: \_\_\_\_\_

Bill: \_\_\_\_\_

Tail: \_\_\_\_\_

Wings: \_\_\_\_\_

Coloration: \_\_\_\_\_

Behavior: \_\_\_\_\_

Name of Species: \_\_\_\_\_

## Sketch your bird

## Species Description

Size: \_\_\_\_\_

Shape: \_\_\_\_\_

Bill: \_\_\_\_\_

Tail: \_\_\_\_\_

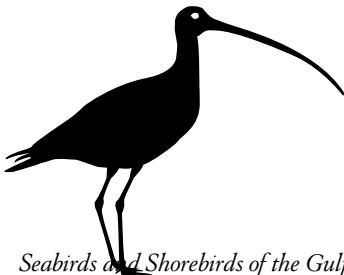
Wings: \_\_\_\_\_

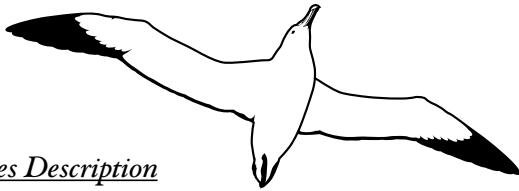
Coloration: \_\_\_\_\_

Behavior: \_\_\_\_\_

Name of Species: \_\_\_\_\_

## Sketch your bird





Species Description

Size: \_\_\_\_\_  
Shape: \_\_\_\_\_  
Bill: \_\_\_\_\_  
Tail: \_\_\_\_\_  
Wings: \_\_\_\_\_  
Coloration: \_\_\_\_\_  
Behavior: \_\_\_\_\_  
Name of Species: \_\_\_\_\_

Sketch your bird

Species Description

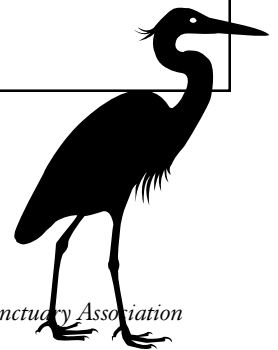
Size: \_\_\_\_\_  
Shape: \_\_\_\_\_  
Bill: \_\_\_\_\_  
Tail: \_\_\_\_\_  
Wings: \_\_\_\_\_  
Coloration: \_\_\_\_\_  
Behavior: \_\_\_\_\_  
Name of Species: \_\_\_\_\_

Sketch your bird

Species Description

Size: \_\_\_\_\_  
Shape: \_\_\_\_\_  
Bill: \_\_\_\_\_  
Tail: \_\_\_\_\_  
Wings: \_\_\_\_\_  
Coloration: \_\_\_\_\_  
Behavior: \_\_\_\_\_  
Name of Species: \_\_\_\_\_

Sketch your bird





## WALKER'S ETIQUETTE

Help Us Protect Birds, Seals, and Other Wildlife!

### WATCH QUIETLY

Restrain your impulse to get closer. Your best viewing is usually from further away and from a position of stillness. Use binoculars. As you pass, do not engage in any stalking activity, or attempt to approach animals undetected. You cannot get a good picture unless you have a 500 mm or more lens. If you get too close, wildlife will leave. If an animal reacts in any way to your presence, you are too close!

### APPROACH INDIRECTLY

Avoid a direct approach. Do not walk toward, through, or near wildlife or flocks of birds. Do not allow your dog to disturb wildlife. Keep dogs leashed and away from wildlife. Know your local area and hike only when you can least disturb wildlife.

### LEAVE ALONE

Do not handle or rescue young or adult wildlife that you believe may be abandoned or injured. When parents forage, they may naturally leave their young unattended. Your rescue may cause the youngster's death. Wild animals, even small ones, that are injured can bite or peck unexpectedly and cause injury. If you are concerned about any animal, call your local wildlife agency or animal control agency.

### KEEP AWAY

Maintain a sufficient distance so that animals do not feel threatened. When an animal's behavior changes because of your presence, you are creating a disturbance. Some wildlife can be disturbed at distances over 650 feet. Responsible visitors watch for changes in animal behavior to avoid disturbing them. Stay well away from wildlife habitat or places where they could be resting out of view.

### EXPLAIN EFFECTS

Tell other hikers about how they can help protect wildlife. Marine mammals and migratory birds are protected from harm, flushing, and harassment by the Marine Sanctuary Act, the Marine Mammal Protection Act, the Migratory Bird Treaty Act, and local laws. Continuing disturbances can result in areas being closed to hiking. Protect your camping and hiking privileges by helping educate less aware hikers.

### RETREAT

Certain animal behaviors indicate they are being disturbed; for example, seals lifting their heads or birds moving away or flapping their wings. When you observe these signs of stress, you should retreat from the area immediately to avoid prolonged stress on the animals.

[www.farallones.org](http://www.farallones.org)



# Studying Albatross Migration

## Objective

Students will investigate the migratory movements of a female Black-footed Albatross during its breeding season using telemetry tag data taken from a study in 1998. They will work with maps and draw conclusions from their interpretations.

## Materials and Supplies

Background Information on Albatross and Migration

Migration Data Table 1: Brooding Stage

Migration Data Table 2: Chick-rearing Stage

Mapping Albatross Migration Questions

Map 1: Hawaiian Islands

Map 2: North Eastern Pacific Ocean

Map 3: National Marine Sanctuaries along West Coast

## Background

The central coast of California is rich in marine life and a major destination feeding ground for many species of birds. Many shorebirds migrate along the coast foraging for food in the rich upwelling zones, while some pelagic seabirds migrate from as far away as the southern hemisphere and sub-tropical Pacific to feed in the California region.

Black-footed Albatross are a common pelagic species that visit the waters off the coast of California and Washington to feed. The California current that flows southward along the North American continent is a productive upwelling region. During the spring upwelling season, nutrients from the cold depths are brought to the surface and stimulate the food web, from microscopic phytoplankton to the great whales.

## Activity

1. Introduce students to Albatrosses and the study of their migration using background information.
2. Introduce students to the migration data tables and maps.  
Data Table 1 is data collected during the brooding part of the season.  
Data Table 2 is data collected during the chick-rearing period.  
Map 1 is of the Hawaiian Island region, focusing on the nesting island.  
Map 2 is the North Pacific Ocean. This map should be used to map the chick-rearing data set.
3. Using Map 3 (the west coast national marine sanctuaries map), have students label the Olympic Coast, Cordell Bank, Gulf of the Farallones, Monterey Bay, and Channel Islands National Marine Sanctuaries on Map 2 (North-Eastern Pacific Ocean). Instruct them to not write on the ocean part (if they do, the data points will be hard to see). Discuss what the National Marine Sanctuaries are.
4. Have students graph the location of each transmission and record the transmission number on their map. Plot the brooding data on Map 1. Plot the rearing data on Map 2. Have students connect the numbers sequentially to show the route of the Albatross.
5. When they have completed their maps, have students answer the questions on the Mapping Albatross Migration Questions handout. Have students refer to the graphs titled Figure 1 to answer some of the questions.

### Extensions

Have students research who manages the parts of the ocean, such as state waters, federal waters, and international waters. What types of regulations are in place for managing such a huge part of the planet? What are the laws in prohibiting the dumping of plastic? How do these laws affect wildlife species such as Albatrosses that travel or live far away from land?

Calculate flight distance using the flight distance calculator on the Albatross Project website:

<http://www.wfu.edu/albatross/gcircle/calcfull.html>

The albatross has an amazing digestive system that concentrates the fats and oils from their food. A food storing lab activity is on this website:

[http://www.wfu.edu/albatross/atwork/food\\_storing.htm](http://www.wfu.edu/albatross/atwork/food_storing.htm)

Satellite imagery from SeaWiFs provides maps of many oceanographic parameters. There are extensive teacher resources to use this imagery in your classroom. Have your students investigate the SeaWiFs satellite imagery at different times of year. When is chlorophyll abundant and how can you tell from the images? <http://seawifs.gsfc.nasa.gov/SEAWIFS/TEACHERS/>

The U.S. Fish and Wildlife Service protects atolls and islands in the Northwestern Hawaiian Islands where albatrosses breed. To learn about the islands and its inhabitants go to the website:

<http://www.midway.fws.gov> or <http://www.hawaiianatolls.org/>

The Albatross Project came out of Wake Forest University and was the inspiration for this activity. The project is no longer delivering data to classrooms, but has a multitude of activities and background information about albatross. <http://www.wfu.edu/albatross/>

Have your students research information on long-line fisheries and the affect on Albatross:

[www.eurocbc.or/page402.html](http://www.eurocbc.or/page402.html)

Write a report on the differences between Laysan and Black-footed Albatross.

[www.birdinghawaii.co.uk](http://www.birdinghawaii.co.uk)

Albatross Adaptations- have some fun with your students and “turn” a student into an Albatross using props to introduce students to their adaptations. (Salt extraction, food concentration, long stiff wings, webbed feet, strong olfactory sense, visual feeders, life long pair bond, etc.)

### Credits

Wake Forest University, Dave Anderson

Duke University, David Hyrenbach

Data points used in this activity are not exact, but estimated based on a map created from an albatross study completed in 1998. David Hyrenbach of Duke University generated the map. The project was funded by Wake Forest University and permission was given to use this information.

## Background Information on Albatross and Migration

There are 24 species of albatross, which are the largest of the Procellariiformes order, weighing up to 22 pounds. They are magnificent flyers, using their extremely long and narrow wings for extended flight. Albatrosses are pelagic, spending months at sea and taking to land only to breed on oceanic islands. These nesting sites can be far from optimal feeding areas, so albatrosses cover thousands of miles during one trip to find food. Their senses are adapted for life at sea.

### Procellariiformes

Albatrosses belong to the order Procellariiformes, which includes fulmars, shearwaters, gadfly petrels, and storm petrels. Tubular nostrils that open externally onto a hooked bill distinguish this order known as “tube-nosed swimmers”. They feed primarily from the surface on fish, squid, and other marine organisms. Procellariiformes process food into a concentrated energy source with a high caloric content. The high caloric content is necessary to sustain them on long migrations and to feed their young when they return.

### Migration

Albatrosses are able to fly long distances without using much energy because they use dynamic soaring, a technique where they use wind energy to ride currents without flapping their wings. Black-footed Albatrosses migrate throughout the North Pacific all year, ranging farthest north in the summer months and farthest south in the winter months. A navigational experiment with a Laysan Albatross holds the record for bird homing - the bird found its nest from 4,120 miles away. Black-footed Albatrosses are seen year-round off the California coast. They nest on the Northwest Hawaiian Islands, but continue to travel long distances to upwelling regions off California to feed.

### Upwelling

There are five National Marine Sanctuaries along the west coast of North America set aside to protect areas of biological and cultural significance. The west coast of North America is a very productive marine environment. The combination of oceanographic conditions, currents, and underwater topographic features support a diverse marine food web. The California current begins off of Washington State. It travels south and mixes in a transition zone off of southern California where warmer waters are moving north. This slow moving, broad current is associated with a process called upwelling. Upwelling is when colder, nutrient rich waters from the depths are brought to the surface where they “fertilize” the microscopic phytoplankton during the spring months of the year. The nutrients are from decomposed life and help to stimulate the food web starting with a growth spurt of phytoplankton. When the waters are teeming with life, massive amounts of krill, fish eggs, juvenile fish, gelatinous zooplankton and squid attract seabirds like the Black-footed Albatross to feed in this region.

### Reproduction

Albatrosses breed on remote islands far away from land, and almost always return to breed on the island on which they hatched. After fledging (leaving the nest and its dependence on its parents), they do not return to land for years, until reaching maturity. Albatrosses engage in courtship, which can last as long as two full years. Birds establish a pair bond with one other bird, which becomes their life long reproductive partner. The breeding season can last up to eight months and sometimes longer. During that time, the parents alternate foraging trips while the other cares for the bird on the nest. A lot of energy goes into raising an albatross chick. It is hypothesized that to ensure the highest percentage of success for a chick to survive and fledge, only one egg is laid per season. Brooding is the time period spent on an unhatched egg to 18 days after hatching. The time spent caring for the chick is known as rearing. This stage can last from 19-140 days after hatching. The mates may only see each other 8-10 days total out of the 8 months, not very romantic by any means!

## Studying migration

Until recently, marking birds with identifying bands was the only way to study bird migration. However, because of the low probability of bands being reported, large numbers of banded birds were required to gain a small amount of scattered information. Monitoring bird movements from the ground or by airplane using conventional telemetry transmitters was an improvement, but still presented logistical difficulties for studying long-range migration. The new satellite transmitters are more promising. They are small and lightweight enough to be carried by birds, and can show the entire annual movement of a bird. Tags are designed to be no more than 3% of the bird's body weight.

## Tagging and Satellites

In 1998 at Tern Island, Hawaii, Albatrosses were outfitted with satellite transmitters while at their nesting sites. Since these birds are best adapted for flight at sea and not walking on land, they were somewhat easy to catch. Each bird was carefully removed from the nest. While attaching the tag, the fertile egg was protected in the wraps of a towel, to protect it from the brutal heat of the sun and predators. Waterproof tape was attached between feathers that remain in their normal position, so the transmitter does not disturb the bird. The transmitter was attached to the tape with Teflon ribbon. The bird was then returned to the nest.

The tag itself is quite small and has an antenna outstretched, just a little bit shorter than a dollar bill. Satellites orbiting Earth locate the transmitters from space, and relay information to ground receiving stations. Scientists also use satellites to collect other information such as chlorophyll abundance and sea-surface temperature to help understand why Albatrosses and other marine migratory species go where they do. A high concentration of chlorophyll is a good sign that there is a lot of food in the water for animals to eat.



The transmitter that attaches to the wing of the Albatross is shorter than a dollar bill. Picture from <http://www.wfu.edu/albatross>

## Data from space

Scientists receive the transmitted data as a series of numbers, beginning with the tag, or ID number, for the bird. They also receive information on the date, time, and location of the bird's transmission. For example:

Bird	Date	Time	Lat (E/W)	Lon (N/S)
51C	5/5/98	14:39:08	24.435	163.734

Here you have the bird's ID (51C) and the date and time that satellites took the location, and the latitude and longitude of the locations. The time is recorded in Greenwich Mean Time, which is also Universal time. Greenwich Mean Time is used globally to avoid confusion amongst time zones.

Using the information provided by the satellite tags, researchers are able to track the movement of individual birds. This information provides insight into the life cycle and ecology of the Albatross. Using the data of location, sea surface temperature and chlorophyll abundance, scientists can learn about the types of habitats in which they prefer to feed.

### **Conservation**

Albatross populations have been in decline for a number of reasons. Many birds die because they have mistakenly eaten plastic. If a parent Albatross eats plastic on a foraging trip and returns to the nest to feed its chick, they regurgitate that plastic to their young. Eventually the plastic fills up the young Albatross' stomach and it dies of starvation or dehydration. Many skeletons of birds have been found with large amounts of plastic sitting where their stomachs used to be. Longline fisheries also pose a direct threat to Albatrosses and other pelagic species. Albatross are visual feeders and will go directly for baited longlines. If they get caught on the line, they will drown. The information gathered with the satellite tags may help better protect Albatrosses and other species at risk sharing these habitats.

## Migration Data Table 1: Brooding Stage (0-18 days after hatching)

Locations of a female Black-footed Albatross during brooding stage-1998

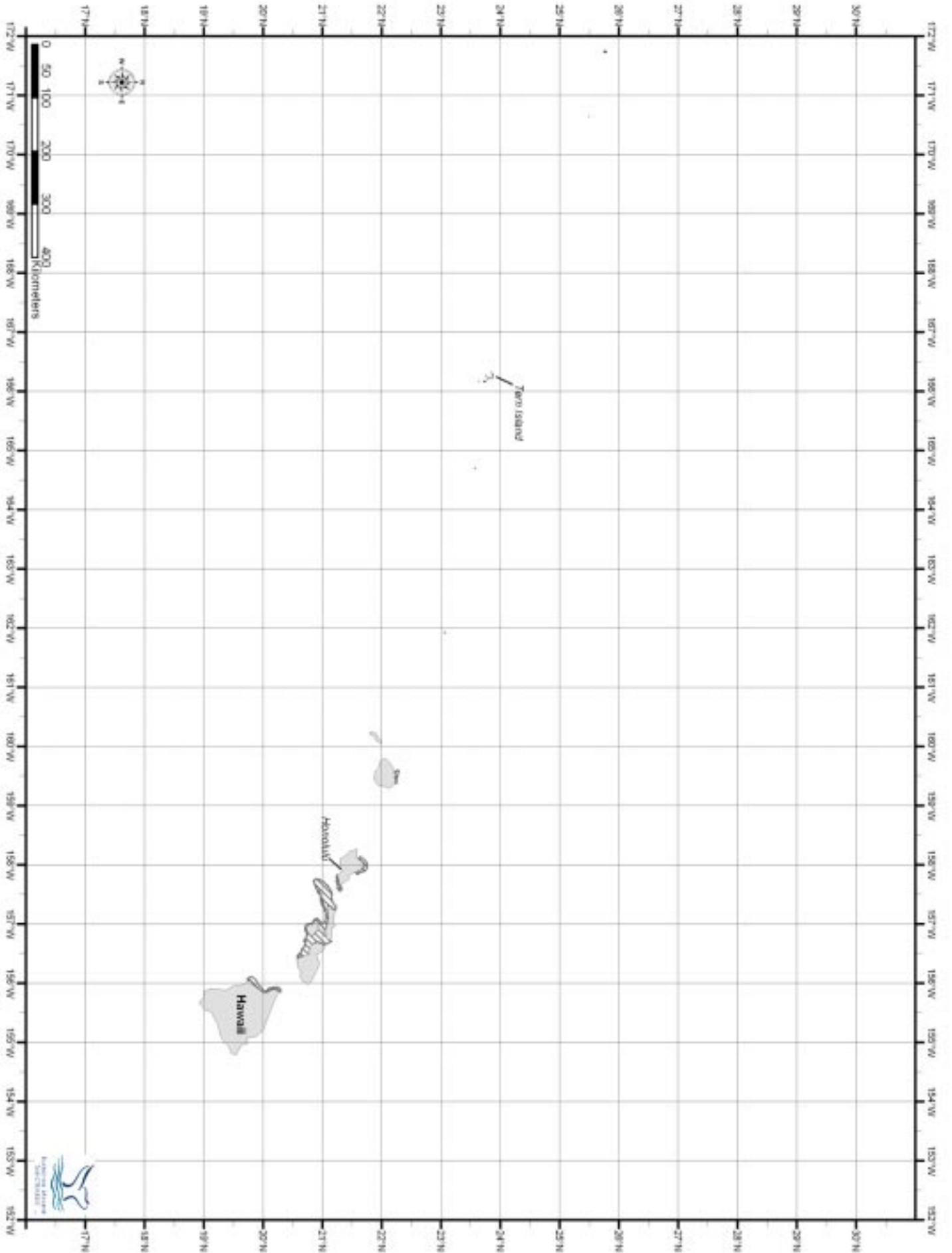
Transmission	Date	Longitude (E/W)	Latitude (N/S)
1	February 5	166.28	23.87
2	February 6	165.75	23.00
3	February 6	166.28	23.87
4	February 8	165.98	25.00
5	February 11	166.28	23.87
6	February 11	166.10	25.50
7	February 12	164.56	23.40
8	February 13	163.50	22.50
9	February 14	166.28	23.87

## Migration Data Table 2: Chick-Rearing Stage (19-140 days after hatching)

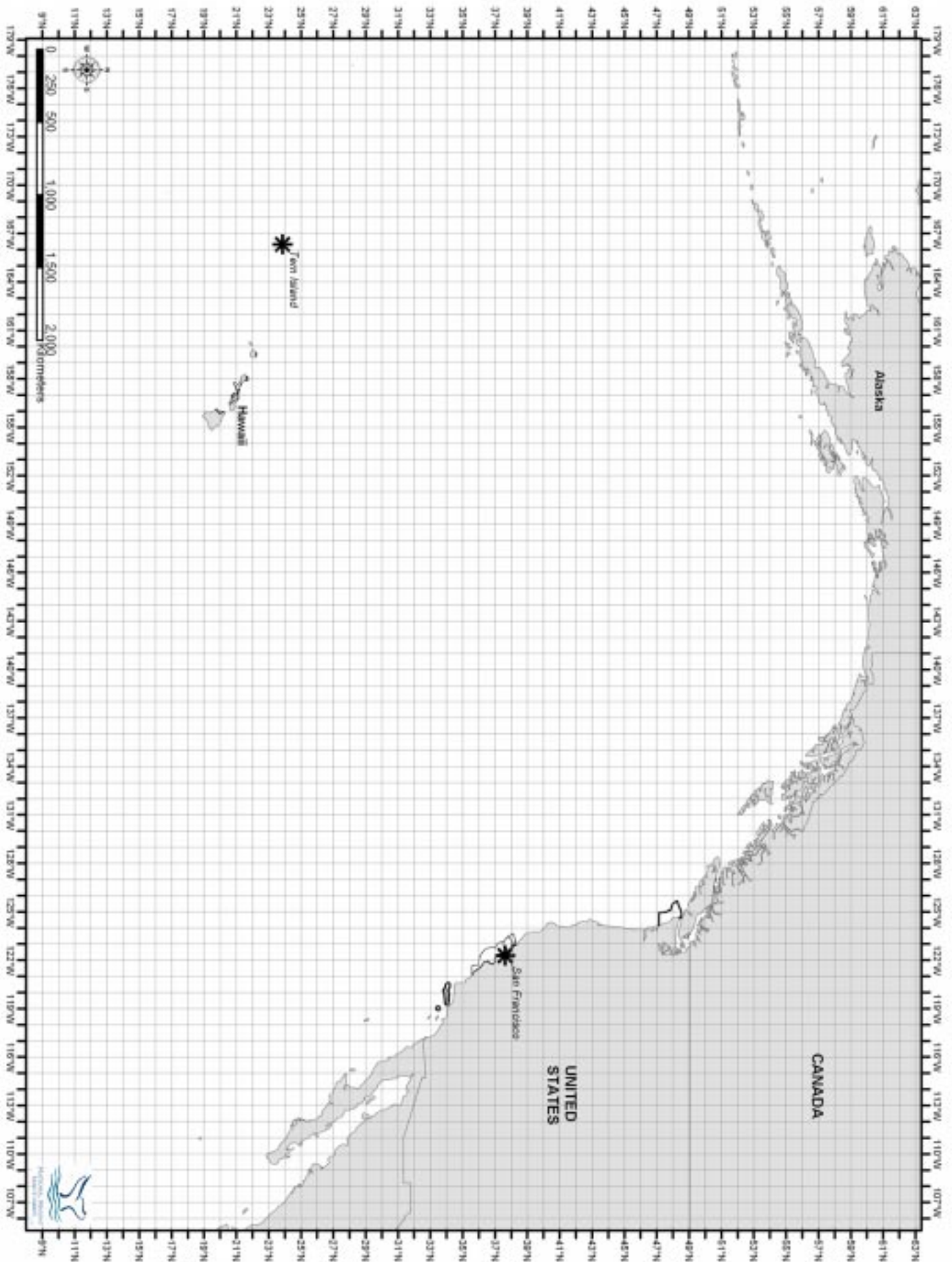
Location of a female Black-footed Albatross during chick-rearing stage-1998

Transmission	Date	Longitude (E/W)	Latitude (N/S)
10	February 25	168.72	29.10
11	February 28	146.23	38.00
12	March 2	132.45	43.75
13	March 7	126.35	43.26
14	March 10	126.00	46.00
15	March 13	125.25	39.87
16	March 16	123.45	35.24
17	March 19	132.93	32.76
18	March 22	146.58	27.85
19	March 25	166.28	23.87
20	March 27	165.23	27.45
21	March 29	167.98	33.27
22	April 1	169.57	26.56
23	April 2	166.28	23.87
24	April 5	155.00	32.00
25	April 8	145.60	34.90
26	April 9	131.98	45.71
27	April 11	127.35	41.69
28	April 14	123.25	37.50
29	April 17	133.29	30.60
30	April 20	142.84	28.12
31	April 22	146.21	31.39
32	April 23	150.16	28.38
33	April 24	166.28	23.87

# Map 1: Hawaiian Islands



Map 2: North Eastern Pacific Ocean



Map 3: National Marine Sanctuaries along West Coast



## Mapping Albatross Migration: Questions

1. Albatrosses spend 95% of their time at sea, coming to land only to nest in the sub-tropical Pacific. Describe 4 hazards an albatross may encounter either on shore or at sea. After listing your obstacles, classify the hazard as natural or human-influenced.

- |    |    |
|----|----|
| 1. | 3. |
| 2. | 4. |

2. Why do scientists want to know where Albatrosses go during the nesting season?

3. Describe the migration route for the female Black-footed Albatross, based on the maps you generated. Include the beginning and ending locations. How did it vary during the brooding and rearing stages?

4. Did the albatross in this study travel near or through any of the National Marine Sanctuaries?

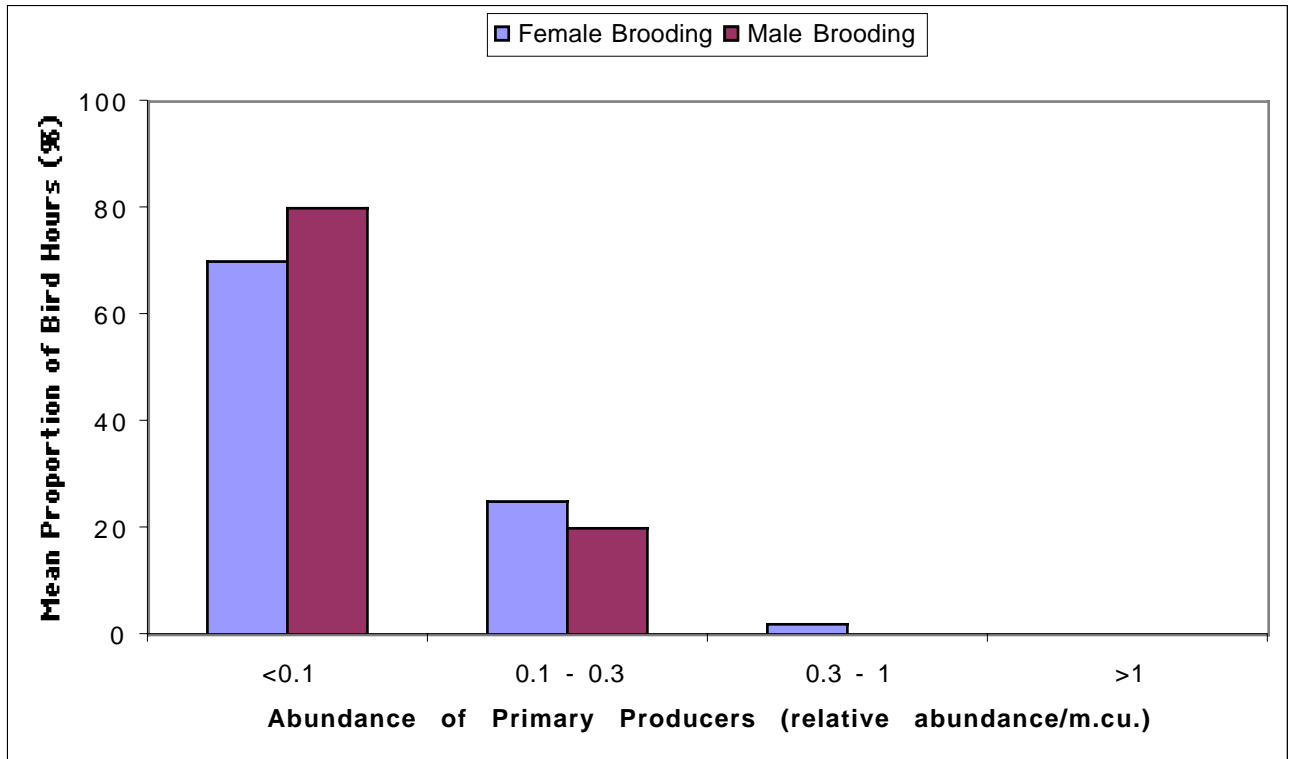
5. What role do National Marine Sanctuaries play in protecting all marine organisms?

6. Why are international treaties or agreements necessary to protect pelagic (open ocean) species such as the Black-footed Albatross?

7. In a few sentences, summarize what you have learned about satellite tracking programs and their importance to conservation efforts.



### Brooding Stages



### Rearing Stages

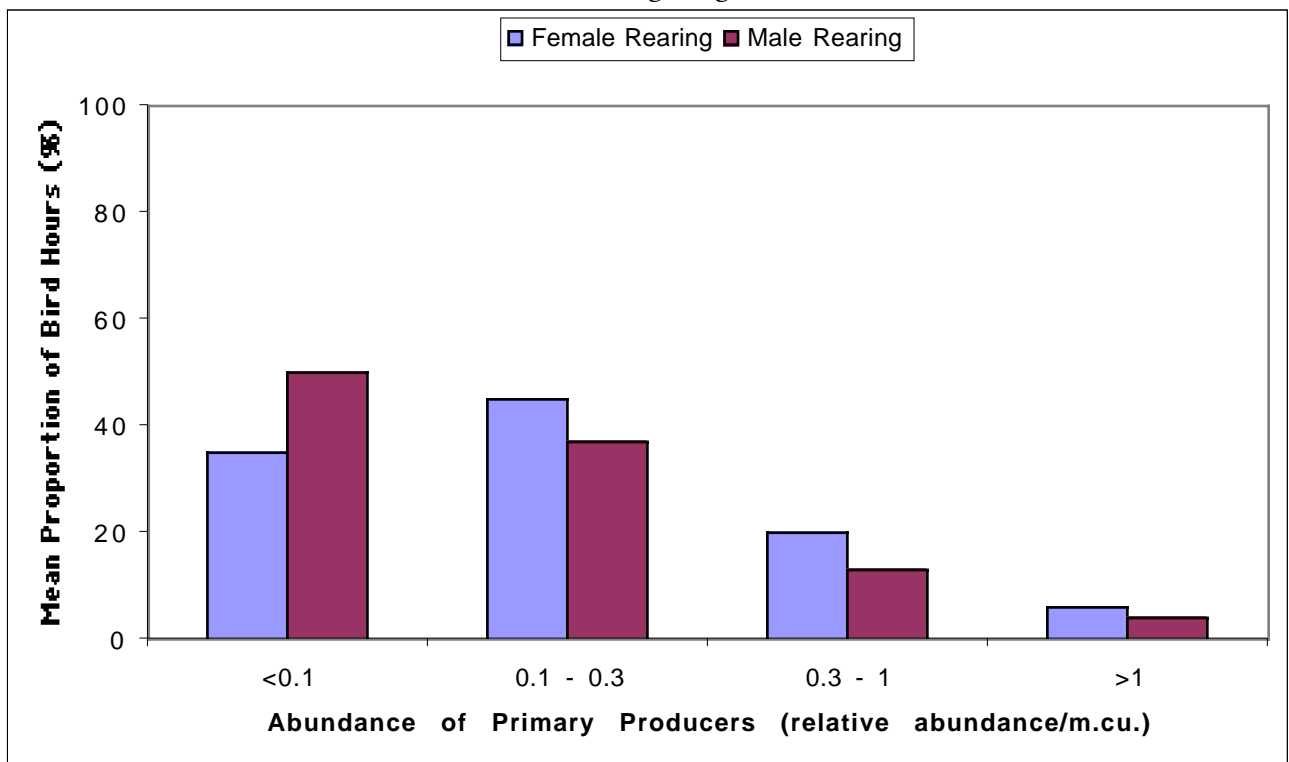


Figure 1

Proportion of time satellite-tracked male and female Black-footed Albatrosses spent in regions with different abundances of primary producers during the brooding and rearing stages. Abundance of primary producers was assessed using monthly averages of chlorophyll concentration from SeaWiFS satellite imagery.

## Teacher Answer Sheet to Albatross Migration Questions

1. Albatrosses spend 95% of their time at sea, coming to land only to nest in the tropical Pacific. Describe 4 hazards an Albatross may encounter either on shore or at sea. After listing your obstacles, classify the hazard as natural or human-influenced.

1. Predators – Sharks (natural)
2. Fishing Lines-getting hooked on a baited longline and then drowning (human influenced)
3. Eating plastic and digesting it (human influenced)
4. Since they fly such long distances, battling weather along the way, finding enough food to sustain them and have enough to regurgitate to chick, keeping wings in good shape to be most efficient (natural)
5. Since Albatross form a life long pair bond, if their mate dies, they may or may not find a new mate (natural)

2. Why do scientists want to know where Albatross go during the nesting season?

Very little is known about pelagic bird species and how they survive. Black-Footed Albatross nest on tiny atolls and islands in the North Pacific, where their preferred prey items are not present. They leave the nest for days and weeks before returning. Finding out where they go can reveal what type of prey items they prefer and need to sustain themselves. If human activities that are detrimental to the species occur where they feed, that piece of information can help decision makers.

3. Looking at the maps, describe the migration route for this bird. Include the beginning and ending locations. How did it vary during the brooding and rearing stages?

Students should describe that during the brooding stage, the bird stayed close to the nesting site, not going too far to forage. During the rearing stage, the bird alternated long trips straight to a productive current, with a few shorter trips.

4. Did the Albatross in this study travel near or through any of the National Marine Sanctuaries?

This female came pretty close to Olympic Coast, Cordell Bank, Gulf of the Farallones, and Monterey Bay National Marine Sanctuaries. Black-footed Albatross are regularly seen all along the west coast. Not enough studies have been done to see how much time they spend in one area or another.

5. What role do National Marine Sanctuaries play in protecting all marine organisms?

The National Marine Sanctuaries protect the biological resources and habitats that have been set aside by Congress. The Sanctuaries serve as a trustee to see that these waters are safeguarded from environmental threats, so that they will be healthy for future generations.

6. Why are international treaties or agreements necessary to protect pelagic (open ocean) species such as the Black-footed Albatross?

Pelagic species see no boundaries of management, whereas state, federal, and international treaties manage the oceans. International treaties involve all nations in determining policies that could affect these species.

7. In a few sentences, summarize what you have learned about satellite tracking programs and their importance to conservation efforts?

Satellite tracking programs show us where species migrate to and what types of habitats they live in or temporarily use for reproduction or foraging. Knowing where they go identifies areas that need to be protected.

8. Refer to Figure 1, find the information about the female and male Black-footed Albatross during brooding and rearing stages. What parameters do the X-axis and Y-axis stand for?

X-axis: abundance of primary producers, Y-axis: mean percentage of bird hours

9. What part of the x-axis has the highest abundance of primary producers?

The right hand side of the x-axis.

10. What does a high abundance of primary producers in the ocean indicate?

Phytoplankton are the basis of marine food webs and its presence indicates that animals higher in the food web may be abundant, such as zooplankton. For the Black-footed Albatross, when there are high amounts of primary producers in the surface waters, it is likely that there is a high abundance of its prey.

11. Based on the graphs and the data points you plotted on your maps, what region of the Pacific do you think provides a large food source for the Black-footed Albatross?

The west coast of the United States (eastern part of the Pacific ocean) has a high abundance of primary producers because of the California current and upwelling.

12. Why do the Black-footed Albatross migrate to the west coast of the United States during rearing stages? To answer, compare the proportion of time spent during brooding and rearing stages in areas with high and low abundances of primary producers.

During brooding both males and females spent all of their time in areas with low abundances of primary producers. During rearing, 5-25% of their time was spent in areas with highest abundances of primary producers. The albatross traveled to the more abundant food sources, which are in the upwelling regions off the west coast.

# Shorebird Seasonal Abundance

## Objective

The Gulf of the Farallones National Marine Sanctuary, with the help of volunteers and students, monitor sandy beaches for birds and sand crabs. Shorebirds and Surf Scoters are major predators of sand crabs (*Emerita analoga*). The seasonal trends in predators may influence the abundance of prey. In this activity, students graph the distribution of shorebirds on the local beaches of the Gulf of the Farallones to analyze seasonal trends.

## Materials and Supplies

Data Table

Graph Paper or Provided Blank Graphs

Colored Pencils

## Background

Over 80 species of shorebirds can be found in the Sanctuary. Shorebirds are known for their extraordinary feats of migration, as some travel over 15,000 miles, fly three to four days nonstop, or fly at speeds exceeding 40 miles per hour. During the spring and fall seasons, millions of migratory birds pass through the San Francisco Bay Area on the “Pacific Flyway.” Each stop along a shorebird’s route is important for feeding before they move on.

Shorebirds have different feeding strategies, which allow a high number of birds to feed in the same area. Using long beaks reaching up to several inches, “probers” unearth small crustaceans hidden within the sand or mud. Each species has a unique beak length, limiting the depth at which food can be obtained. In contrast to the “probers,” the “gleaners” scurry along the beach feeding on invertebrates on the sand surface. The “gleaners” display a horizontal division of foraging, based on their leg length. The longer-legged species are able to travel farther into the surf and are able to feed on items inaccessible to other shorebirds.

Beach Watch is an adult volunteer program where citizen scientists monitor the local sandy beaches for the Gulf of the Farallones National Marine Sanctuary. They collect baseline data and are often the first to detect changes on the beach. Once a month, Beach Watch volunteers walk their beach, recording all the live and dead birds and mammals on and near the beach. They also count humans and dogs on the beach. Many of the beaches are also monitored by students for sand crab abundance.

The data in the table were collected by Beach Watch volunteers identifying and counting birds on their beach. The data are from 31 beaches from Salmon Creek in Sonoma County south to Point Santa Cruz at the San Mateo/Santa Cruz county border. The data are for seven bird species commonly seen along Sanctuary beaches. The data are given as a rate, which is a quantitative measure. In this case the rate is the number of birds counted per kilometer of beach surveyed.

## Activity

1. Describe Beach Watch to students, and how the bird data were collected. Have the students read the shorebird fact sheet, and discuss the different species they will be looking at.
2. Examine Data Table  
The data are the abundance of seven different bird species (rate per km surveyed) averaged from 31 beaches surveyed from September 1993 to May 2002. The shorebird abundance rates are the averages for each month from over 3,000 surveys.

3. Graph the data

Have your students graph the month vs. abundance rate for each bird in a different colored pencil. You can have the students use the provided graphs or make their own graphs on graph paper or on a computer. They should create two separate graphs, due to the difference in abundance levels (the low abundance birds, long-billed curlews, black-bellied plovers, and whimbrels on one graph, and the rest on a second graph.)

4. Analyze the data

Have the students draw conclusions from the data: What was the most abundant bird in the winter? Spring? Fall? What month had the lowest abundance of shorebirds? Where are the birds when they are not here? What bird has the lowest abundance overall in the Sanctuary? What are some human activities that could influence shorebird abundance?

Extension Activity

Have the students analyze the sand crab data from their beach in terms of seasonal trends. Have them hypothesize how they would collect data to be able to compare the seasonal shorebird abundance with sand crab abundance.

Credits

Ehrlich, Paul R. David S. Dobkin, and Darryl Wheye. 1988. *The Birder's Handbook: A Field Guide to the Natural History of North American Birds* Simon and Schuster, Fireside.

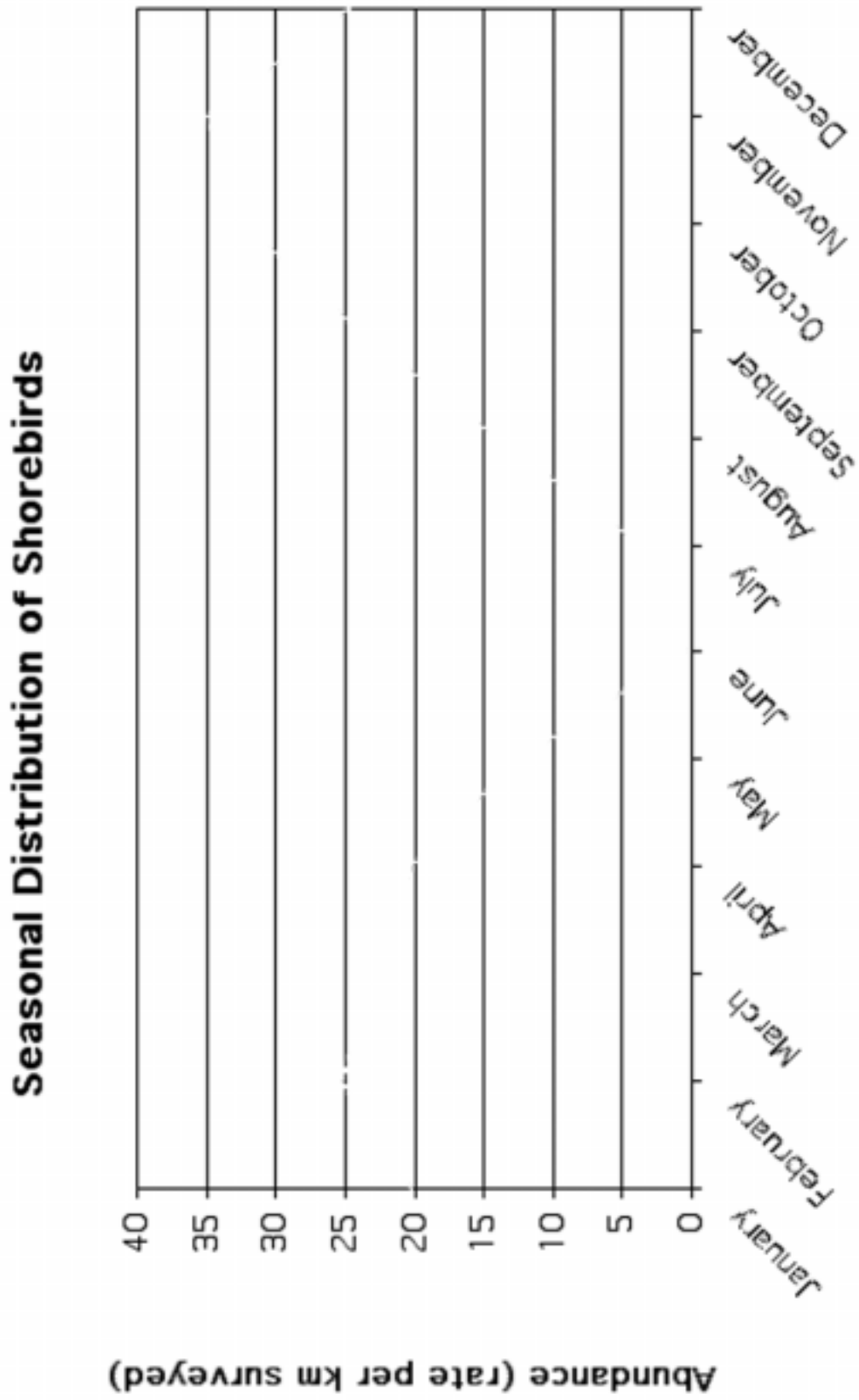
## Descriptions of Birds

<i>Black-bellied Plover</i>	Plovers are tiny birds that dart across the beach, stop, and scurry off again. They are often camouflaged and hard to see among the dunes. They breed in the arctic and are found feeding along the California coast in the winter.
<i>Long-billed Curlew</i>	The Long-billed Curlew is the largest shorebird. It has one of the longest beaks, up to 9 inches long. It uses its forcep-like bill to probe into the dirt. It winters along beaches where it feeds on insects and crustaceans.
<i>Marbled Godwit</i>	The Marbled Godwit has a beak that is bicolored and curved upward. Its plumage is a mottled brown. They spend 60% of their time foraging, 20% sleeping, 17% preening and bathing, and 2% walking or flying. They usually feed in mid-thigh water.
<i>Sanderling</i>	Sanderlings are the tiny birds often seen running in the swash zone. They have short legs and glean food along the surface. They are usually in large flocks. Sanderlings have one of the greatest migration feats, circumnavigating the Americas each year.
<i>Surf Scoter</i>	Surf Scoters are a type of marine duck found in the surf zone of the Sanctuary coast in the winter. They ride the waves and dive down to feed on crustaceans. Acanthocephalan parasites, which are found in sand crabs, reproduce in Surf Scoters.
<i>Whimbrel</i>	The Whimbrel is a “prober”. It’s beak is shorter than the curlew’s beak. Whimbrels migrate to South America in the winter.
<i>Willet</i>	The Willet has a short stocky beak and a plump body. It eats insects, worms, crustaceans, mollusks, and fish.

### Abundance of Birds (rate per km surveyed)

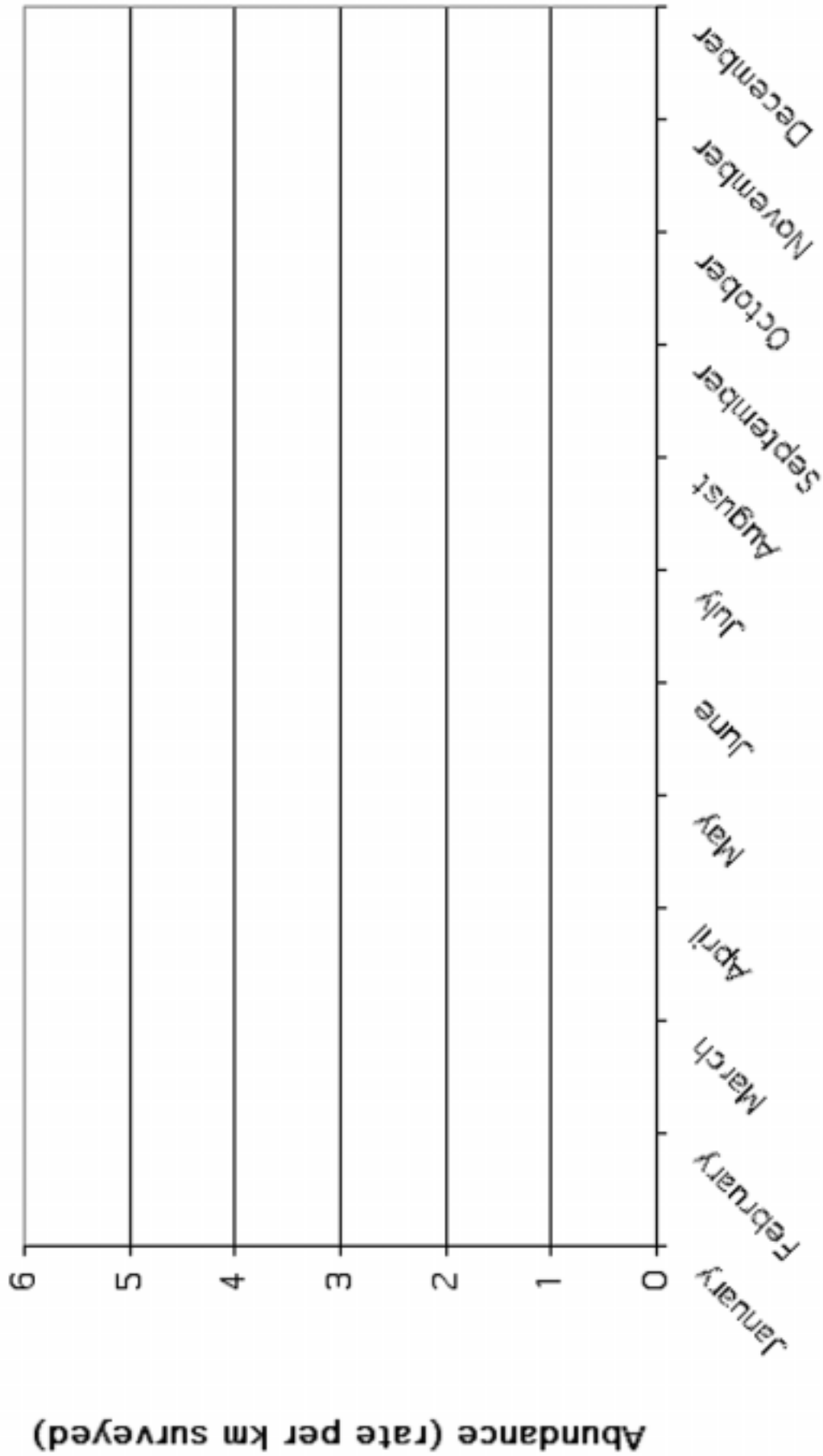
Month	Sanderlings	Surf Scoters	Whimbrels	Marbled Godwits	Willetts	Long-billed Curlews
January	20.2	7.4	0.2	10.1	8.5	0.0
February	25.3	12.4	0.3	6.8	5.9	0.0
March	22.7	8.8	0.7	5.6	11.2	0.0
April	20.2	11.6	5.4	4.5	6.3	0.1
May	12.4	6.2	4.1	1.7	0.5	0.2
June	0.5	3.7	0.4	1.4	0.5	0.0
July	3.5	4.3	2.8	5.4	3.3	0.1
August	13.9	4.4	1.8	6.0	5.0	0.1
September	23.9	4.0	0.6	7.2	6.6	0.1
October	32.3	23.4	0.4	5.2	11.7	0.0
November	34.9	13.1	0.3	5.4	11.6	0.0
December	24.6	12.3	0.3	8.8	9.4	0.0

# High Abundance Graph



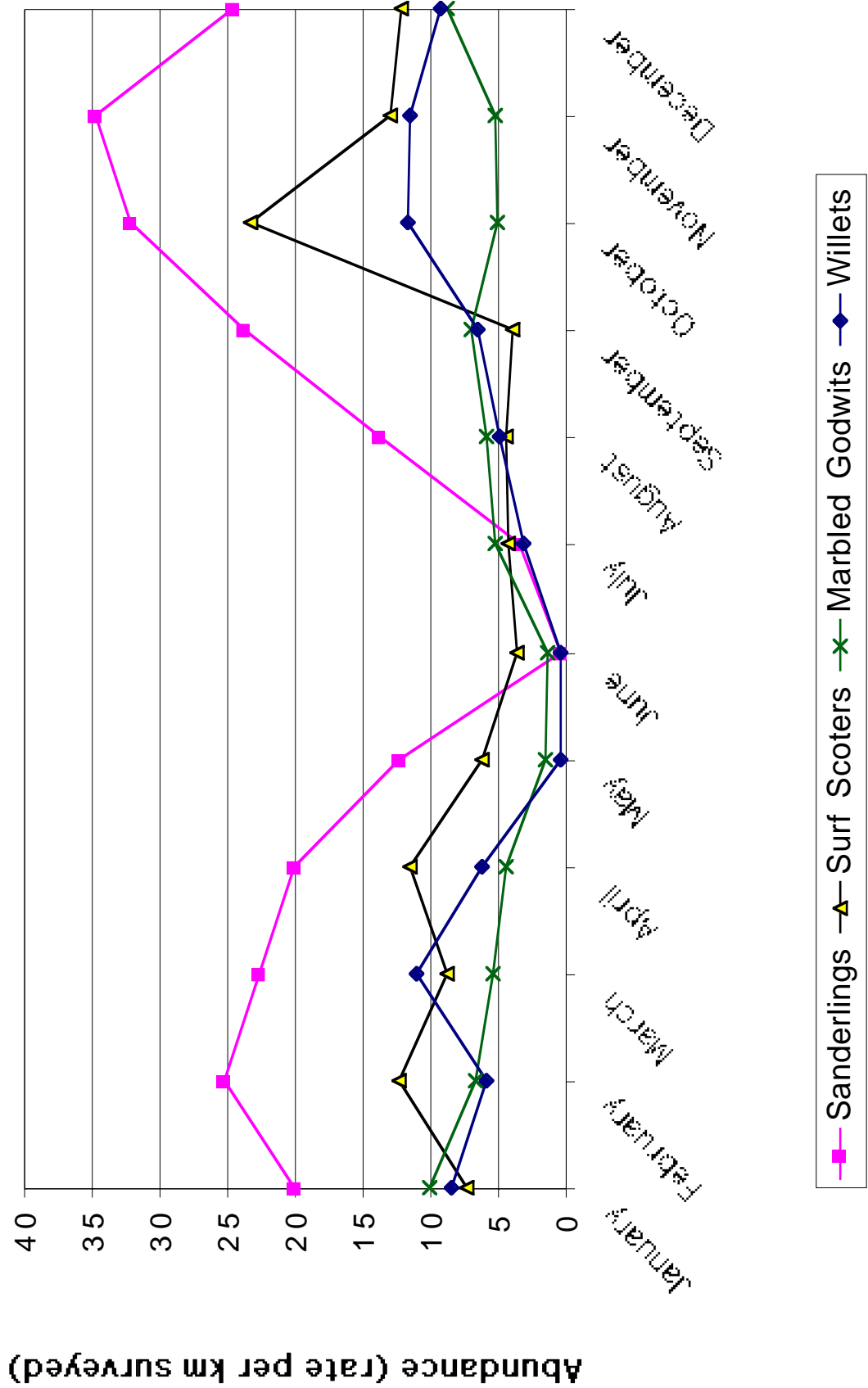
Low Abundance Graph

# Seasonal Distribution of Shorebirds



Teacher Answer Sheet  
High Abundance Graph

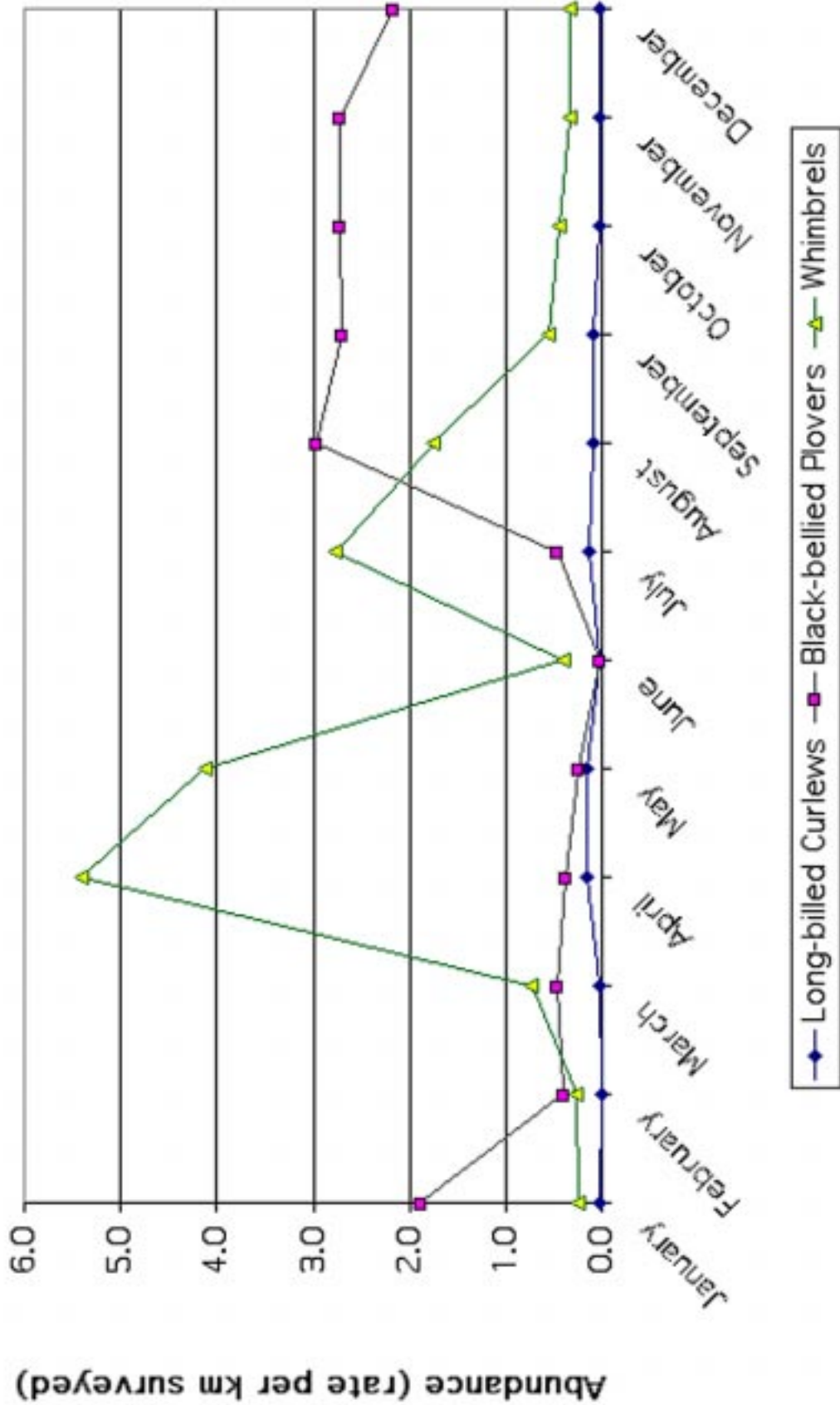
# Seasonal Distribution of Shorebirds



# Teacher Answer Sheet

## Low Abundance Graph

### Seasonal Distribution of Shorebirds



# Seabirds and Shorebirds of the Gulf of the Farallones National Marine Sanctuary

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#	Topic (photographer)	Script ( <i>italicized words in glossary</i> )
1	Title Slide	Welcome to a slideshow sponsored by the Gulf of the Farallones National Marine Sanctuary and the Farallones Marine Sanctuary Association. Today's topic is Seabirds and Shorebirds in the Gulf of the Farallones National Marine Sanctuary.
2	Sanctuary Map	The Gulf of the Farallones National Marine Sanctuary protects over 1,000 square miles of ocean habitat to the west of San Francisco. This productive area is home to thousands of <i>seabirds</i> and <i>shorebirds</i> . The Sanctuary was designated to protect this important habitat for wildlife and birds.
3	Gulls Overhead	As we talk about seabirds and shorebirds today, we will look at the different habitats that they live in. These two groups of birds share the marine resources and avoid competition by having special adaptations they each have their own <i>niche</i> . A niche is the space within a habitat that an organism occupies. First, we will talk about seabirds and then move on to shorebirds.
4	Feeding Flock	Seabirds spend their entire lives on or above the water and only come to land to breed. They rely on the ocean as habitat and as a source of food.
5	Farallon Islands	The Sanctuary surrounds the Farallon Islands, which are protected by the U.S. Fish and Wildlife Service as the Farallon National Wildlife Refuge. The Farallon Islands have the largest colony of breeding seabirds in the contiguous United States, with over 300,000 birds.
6	Tufted Puffin	While the bills, body shapes, and wings vary from species to species, all seabirds, like this Tufted Puffin, have special adaptations that allow them to survive in a saltwater world.
7	Feather	The fine structures of feathers overlap to trap air and keep seabirds warm and dry. Birds have down feathers for insulation and contour feathers for flying. Most seabirds' feathers are waterproof.
8	Tern Preening (J. Hall)	You have probably seen birds <i>preening</i> , which is cleaning and smoothing their feathers. Birds that have waterproof <i>plumage</i> , such as this tern, have a gland near the base of their tail that produces oil. Preening transfers the oil over the feathers, which keeps the feathers dry.

- 9 Laysan Albatross (F.S. Todd) All seabirds have webbed feet at the back of their body for more efficient propelling on or through the water. This is a Laysan Albatross brooding an egg.
- 10 Ashy Storm Petrel Chick (J. Foote) To remove excess salt from their body, seabirds have their own desalination system - a salt gland located near the eye. It removes the salt that they consume from eating food and drinking seawater. Salt is eliminated through the nostrils in liquid form. This Ashy Storm Petrel chick has a “tubenose”, or tubular nostrils for this purpose. Other members of the tubenoses are albatrosses and fulmars.
- 11 Northern Fulmar (F. S. Todd) Seabirds can be grouped by their niche. *Aerialists*, which include albatrosses, frigatebirds, pelicans, and fulmars, such as this Northern Fulmar, have long, slender, and powerful wings to allow these birds long-distance and near-effortless flights.
- 12 Black-footed Albatross (J. Luthur) The Black-footed Albatross can travel more than 4,000 miles by using dynamic soaring, which is using wind energy to ride currents. Although this bird nests in Hawaii, it flies across the ocean to the Gulf of the Farallones to feed during the breeding season.
- 13 Pigeon Guillemot (Point Reyes Bird Observatory) Another seabird group is the open water swimmers, which include guillemots, murrelets, auklets, and puffins. They have wider wings and are better divers than the aerialists. This is picture of a Pigeon Guillemot.
- 14 Common Murres (Point Reyes Bird Observatory) Most of the open water swimmers can be seen sitting on the water’s surface when they are not diving for food. The Common Murre has been known to dive to depths of 192 meters. They are the most abundant seabird on the Farallon Islands, with over 150,000 breeding birds there.
- 15 Cassin’s Auklet (J. Foott) Cassin’s Auklets are nocturnal birds that arrive on the islands shortly after dark and leave again at first light to avoid predators. For these open water swimmers, Bright deck lights on boats can disrupt their reproductive behavior, interfere with chick feeding, and increase predation.
- 16 Gulls on Beach (C. Corben) Although they do not spend their lives at sea, coastal seabirds such as cormorants, gulls, terns, grebes, loons, and marine ducks rely on the ocean for their food.
- 17 Cormorants (J. Hall) Cormorants are a very ancient species, reminiscent of the first aquatic birds. Lacking the waterproofing of other seabirds, cormorants are able to saturate their feathers with water to become less buoyant, which allows them to dive to deeper depths. They can often be seen along the coastline, gathering in large numbers on rocks, holding their wings open to dry.

- 18 Gulls Feeding on Trash Seldom found far from coastal waters, gulls and terns feed on a variety of prey. The most prolific species along the Pacific coast, the Western Gull, has established itself in urban areas as well, feeding from garbage dumps and dumpsters.
- 19 Western Grebe (J.Hall) Grebes are fishing birds usually found on the coastal shores, although they do form large groupings on the open ocean. Grebes are somewhat limited in swimming power by their “lobed” feet (not fully-webbed).
- 20 Surf Scoter Surf Scoters, a type of marine duck, migrate to the Sanctuary in the winter months. They can be seen off the coast, riding the surf, diving down to feed on crustaceans, such as the Pacific mole crab. As you have heard today, there are many different types of seabirds. What makes a seabird cool? These “land animals” have adapted to live and feed on the ocean, only coming to land to breed.
- 21 Shorebirds Now we are going to talk about shorebirds. More than eighty species of shorebirds live in the coastal areas of the Sanctuary. The term shorebird, or “wader” encompasses any bird that relies on beaches or wetlands for habitat to feed and nest. Many can also be found inland.
- 22 Willets & Marbled Godwits Shorebirds generally have long legs, long beaks, and no webbing between the toes. As you can see in these Willets and Marbled Godwits, each species has a different length of beak to probe into the sand for food. The gray Willets have shorter beaks than the brown Godwits.
- 23 Sanderlings Sanderlings are small shorebirds that are constantly scurrying along the beach in search of invertebrates to eat.
- 24 Long-billed Curlew The Long-billed Curlew is the largest shorebird and has the longest beak, reaching up to 9 inches.
- 25 Black Oystercatcher Shorebirds are not only found on the beach but in other habitats as well. The Black Oystercatcher lives in the rocky intertidal and uses its thick triangular beak to pry open mussel and clam shells. You can often hear the distinct, piercing, wheep! or kleep! of the Oystercatcher.
- 26 Estero Americano (Yarish) Shorebirds are also found in the estuaries and mudflats of the Sanctuary, such as in Estero Americano and Tomales Bay.
- 27 Snowy Egret (K. Evans) Seven species of herons, egrets, and bitterns live in the Sanctuary. These long-necked wading birds, such as this Snowy Egret, are found in wetlands and along the shoreline.
- 28 Great Blue Heron (J. Hall) Using dagger-like bills, these predatory birds quickly snatch up frogs, fish, crayfish, and other aquatic life. This ruffled-looking bird is a Great Blue Heron.
- 29 Osprey (F.S. Todd) Coastal waters also provide food for birds of prey, such as Ospreys. They plunge feet first into the water to catch fish with hooked bills.

- 30 Baker Beach  
(J. Saltzman) Humans share the ocean and coastal habitat with birds. As we study seabirds and shorebirds, we need to think about how these interactions can affect animals. We can take steps in our own lives to make a difference.
- 31 Snowy Plover The Snowy Plover is an endangered species due to loss of beach habitat and disturbance. These birds are so camouflaged that you might not even notice them. When you are on the beach, watch out for these small birds, and keep your dogs on leash to avoid disturbing them.
- 32 Historical Hunters Since the first arrival of Europeans, birds and other animals in the Gulf of the Farallones have been harvested. This drawing illustrates a man hunting birds with a net.
- 33 Egg Harvesters The Common Murre population on the Farallon Islands was decimated due to egg collection. This picture from the 1850's shows the hundreds of Murre eggs taken by egg harvesters to feed the growing population of San Francisco.
- 34 Common Murre in Net Today other human activities affect birds. Fishery operations, such as the use of *gill nets*, have added to the mortality of seabirds. Diving birds are caught in the nets and drown. The decline in the Common Murre population led to the banning of gill nets off the coast of California.
- 35 Oiled Gull  
(B. Wilson) This gull has oil on its chest. The Sanctuary does not allow offshore oil drilling, but oil spills are always a concern near San Francisco, one of the busiest ports along the Pacific coast. More than half the oil reaching the ocean is not from big spills, but from waste oil dumped or spilled onto the land from cities, individuals, and industries. Oil is very harmful to birds, especially to open water swimmers that float on the surface. Oil damages the insulative properties of their feathers, so exposed birds often die of hypothermia. Birds preen themselves to clean their feathers, and ingesting oil can be fatal.
- 36 Murre in 6-pack Ring This Common Murre was entangled and killed by plastic debris. Remember to cut 6-pack plastic rings before throwing them away. Marine organisms often mistake plastic debris for food, which can choke and kill them. Always dispose of trash properly and recycle plastic.
- 37 Broken Eggs Pesticides, such as DDT, are used to kill insects, which in turn are eaten by fish, which then are eaten by birds. This process leads to an increase in concentration of the toxin from one food chain level to the next, which is called *biomagnification*. DDT caused birds' eggs to be so thin that when the parent sat on them they would break.
- 38 Brown Pelican with Chicks Brown Pelicans were brought to the edge of extinction from the effects of DDT. Since the banning of the pesticide in 1972, the population has started to rebound. Brown Pelicans come to the Sanctuary after breeding in the south.

- 39 Western Gull Chick  
(C. Schrader) Research is key to understanding bird populations. Banding birds such as this Western Gull chick is a method used to track populations.
- 40 Beach Watch  
(L. Grella) Through the Sanctuary's Beach Watch program, volunteers monitor beaches for marine life and human activity. These citizen scientists are collecting baseline data and are often the first ones to report oil on the beaches surrounding the Sanctuary.
- 41 Dead Cormorant They count live and dead birds and marine mammals on their stretch of beach every month. This dead Cormorant is being recorded and photographed.
- 42 Sunset  
(J. Hall) Seabirds and shorebirds are important members of the Gulf of the Farallones ecosystem. By understanding these amazing animals, we can better live in harmony with the marine environment.

# Books and Resources

## Seabirds and Shorebirds

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Ainley, D. and R.J. Boeklheide. 1990. *Seabirds of the Farallon Islands: Ecology, Dynamics, and Structure of an Upwelling-System Community*. Stanford University Press. ISBN 0804715300.

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Safina, C. 2002. *Eye of the Albatross*. Henry Holt & Company, Inc. ISBN 0805062289.

Salmansohn, P. and S.W. Kress. 1997. *Giving Back to Earth: A Teachers Guide to Project Puffin and Other Seabird Studies Around the World*. Tilbury House Publishers. ISBN 0884481727.

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Stallcup, R. 1990. *Ocean Birds of the Nearshore Pacific: A Guide for the Sea-going Naturalist*. Point Reyes Bird Observatory. ISBN 0962591807.

Stromsem, N.E. 1995. *A Guide to Alaska Seabirds*. Alaska Natural History Association. ISBN 0960287647.

# Selected Websites

## Seabirds and Shorebirds

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U.S. Fish and Wildlife Service ... <http://www.fws.gov>

The Audubon Society ... <http://www.audubon.org>

Oiled Wildlife Care Network ... <http://www.vetmed.ucdavis.edu/owcn/>

Ocean Wanderers ... <http://www.oceanwanderers.com/>

The Bird Source ... <http://www.birdsource.org/>

The Albatross Project - satellite tracking and student activities...<http://www.wfu.edu/albatross/>

US Fish and Wildlife Shorebirds...<http://migratorybirds.fws.gov/shrbird/shrbird.html>

Shorebird Sister Schools Program ... <http://sssp.fws.gov/index.cfm>

The American Ornithologists' Union Bird Checklist ... <http://www.aou.org/aou/birdlist.html>

BirdLife International Seabird Conservation Programme ... <http://www.uct.ac.za/depts/stats/adu/seabirds/index.htm>

Birdnet ... <http://www.nmnh.si.edu/BIRDNET/>

Seabirds in Alaska. . . [http://www.absc.usgs.gov/research/seabird\\_foragefish/index.html](http://www.absc.usgs.gov/research/seabird_foragefish/index.html)

The Puffin Project in the Atlantic ... <http://www.projectpuffin.org/>

### Local Organizations

Point Reyes Bird Observatory ... <http://www.prbo.org>

Don Edwards San Francisco Bay National Wildlife Refuge which includes the Farallon Islands. . . <http://desfbay.fws.gov/>

Golden Gate Raptor Observatory ... <http://ggro.org/>

### Sounds and Images of Seabirds

Seabird Island CD ... <http://www.naturesound.com/nsas/seabird.html>

The Pacific Seabird Group. . . <http://www.pacificseabirdgroup.org/gallery.html>

Seabird Skulls ... [http://www.soldaat.com/edward/seabirds\\_skulls/index.htm](http://www.soldaat.com/edward/seabirds_skulls/index.htm)