13 Marine Reptiles and Birds

When you have completed this chapter, you should be able to:

LIST the types of reptiles and birds that are found in the marine environment.

DISCUSS the special adaptations reptiles have for living in the sea.

DISCUSS the special adaptations seabirds have for an oceanic life.

The marine environment is home to a variety of birds and reptiles. At first glance, reptiles and birds may appear to be very different from one another. However, on closer examination, you will notice some important similarities.

Reptiles—such as the marine lizard shown above—have a scaly skin, and so do birds; but a bird's scaly skin is limited to its legs and feet. Reptiles and birds also are both vertebrates, animals with backbones. In addition, all birds and many reptiles lay eggs. These similarities are just part of the evidence showing that birds evolved from reptilian ancestors.

Marine reptiles are found mainly in tropical and subtropical habitats. Marine birds have a much wider range; they are found from polar seas to tropical shores. In this chapter, you will learn about some of the similarities and differences between these two classes of vertebrates, and about their adaptations for living in various marine habitats.

13.1 MARINE REPTILES

You have learned that fish are well adapted to life in water. Many millions of years ago, animals evolved from fish that were well adapted to life both on land and in the water—the amphibians. In time, reptiles evolved from the amphibians. Today, there are marine reptiles, but there are no truly marine amphibians. Thin-skinned animals such as frogs, toads, and salamanders cannot survive in salt water.

All reptiles share characteristics that originally evolved to suit life on land, but many have returned to a life in the water. There are four main groups of reptiles alive today. Each group has its marine representatives: sea turtles, sea snakes, marine lizards (iguanas), and saltwater crocodiles. Reptiles, which belong to the class Reptilia, have a dry scaly skin that protects against water loss. All reptiles live in warm or temperate climates because, as ectothermic (cold-blooded) animals, they become sluggish in cold temperatures. Most of a reptile's activities are dictated by the amount of warmth it receives from the sun. For example, if their bodies get too cold, aquatic reptiles such as crocodiles bask in the sun. And if their bodies get too warm from the sun, they cool off in the water (or, as in the case of sea snakes and sea turtles, swim to cooler waters). In some cases, ectotherms attain body temperatures that are actually higher than the temperature of their environment.

Adaptations of Reptiles

Marine reptiles have many characteristics for a terrestrial lifestyle that have been adapted to allow a life in the sea. Rather than gills, however, aquatic reptiles possess lungs for breathing. This means that they have to return to the water's surface periodically to gulp air, since they cannot obtain oxygen directly from the water as fish do. An important terrestrial adaptation first seen in the reptiles is the **amniotic egg**, which contains a large yolk to nourish the developing embryo and is enclosed in a leathery egg case to prevent it from losing water and drying out. Fertilization in reptiles is internal. Most aquatic reptiles, such as turtles and crocodilians, have to return to land to lay their eggs. Some sea snakes live-bear their

young in the ocean. All reptiles have a three-chambered heart—an evolutionary "step up" from the fish's two-chambered heart—except for the **crocodilians** (alligators and crocodiles), which have a four-chambered heart. (A four-chambered heart enables the separation of oxygenated and deoxygenated blood.)

Marine reptiles also have adaptations that are specific to their life in the ocean. Because they live in a saltwater environment, sea turtles and marine lizards need to get rid of excess salt and to conserve freshwater. One of these adaptations is **salt glands**, which are positioned above the animal's eyes. The salt glands secrete great quantities of salty tears; this enables marine reptiles to live without access to freshwater. The salty secretions also wash sand from the turtles' and lizards' eyes when they move about on land. Another adaptation that marine reptiles have for conserving freshwater is the ability to excrete very concentrated urine by reabsorbing most of the water from it.

Saltwater Crocodiles

A large, predatory marine reptile is the crocodile, which belongs to the order Crocodilia. (See Figure 13-1.) Crocodiles often hunt by remaining just below the water's surface, with only their eyes and nostrils above the water, waiting to catch a meal by surprise. Whereas alligators are freshwater species, there are a dozen freshwater and saltwater species of crocodiles, found in Africa, Asia, Australia, and the Americas. (Alligators and crocodiles resemble each other, but crocodiles have a narrower snout.) The American saltwater crocodile (*Crocodylus acutus*) lives only in the Florida Keys. This surprisingly nonaggressive and shy reptile can grow up to 5 meters in length. Like other crocodiles, the American crocodile is endangered, since there are only about 500 to 1200 individuals left. Extensive development along Florida's coast has reduced the num-

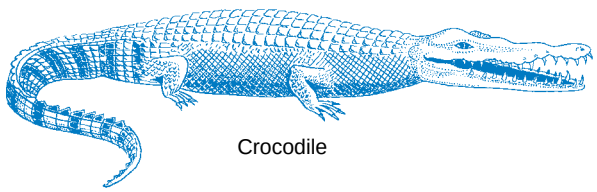


Figure 13-1 The saltwater crocodile, an endangered marine reptile.

ber of crocodiles close to the point of extinction. Now these reptiles are protected by law, so their numbers are slowly increasing.

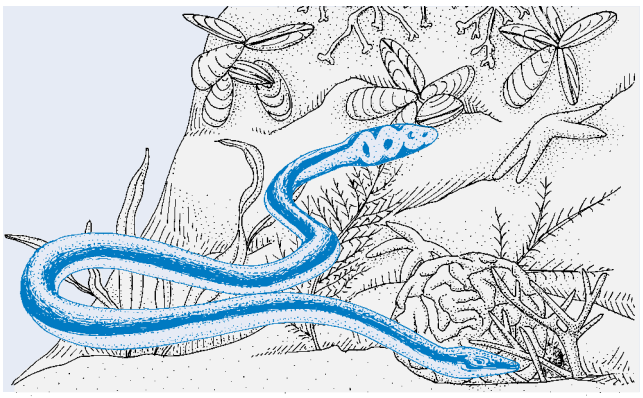
As mentioned above, unlike other reptiles, crocodilians have a four-chambered heart. Also, unlike most reptiles that lay eggs and abandon them, some crocodilians make a nest for their eggs, which they guard until the eggs hatch. The mother provides limited care for the new offspring as well.

Sea Snakes

Another marine reptile that is potentially dangerous to humans is the **sea snake**. There are about 50 species of sea snakes. All of them are venomous, although they are not particularly aggressive. Sea snakes usually range in size from 1 to 2 meters in length, and most species prey on small fish.

Various species of sea snakes inhabit the tropical Atlantic, Pacific, and Indian oceans. The yellow-bellied sea snake (*Pelamis platurus*) is a species found in Pacific waters, from California to Ecuador. (See Figure 13-2.) This sea snake hunts near the ocean surface, where it ambushes small tropical fish. The turtlehead sea snake is a more docile species; it eats fish eggs, which it scrapes off corals.

All snakes (and lizards) belong to the order Squamata. Sea snakes do, in fact, resemble their relatives on land, such as the coral snake. However, their special adaptations enable them to survive in the ocean. The flatter body (side-to-side) and paddlelike tail help the sea snake swim more efficiently. The presence of salt glands in



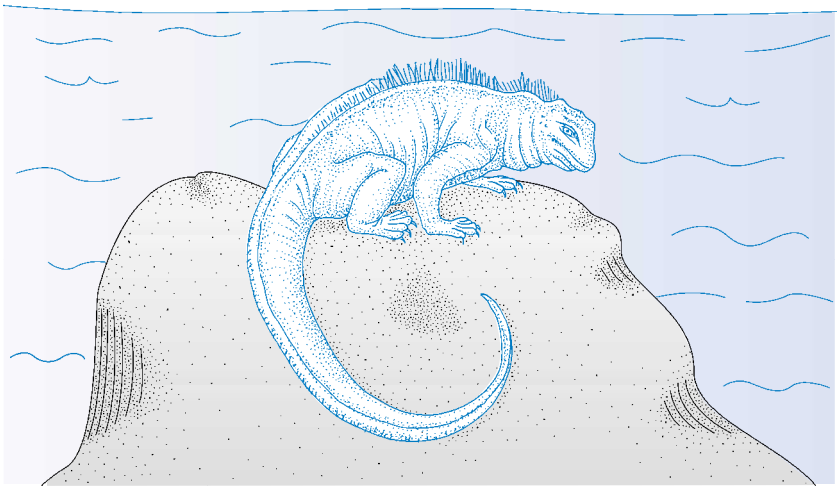
Sea snake

Figure 13-2 The yellow-bellied sea snake, a venomous marine reptile.

the mouth enables the sea snake to get rid of excess salts and thereby maintain a normal water balance in the body. Another adaptation in the sea snake is the special flap of tissue that covers the nostrils. During dives, this flap of tissue prevents water from entering the lungs. The lungs of a sea snake can inflate to three-quarters of its body length. This enhanced lung capacity lets the sea snake stay underwater for as long as two hours on a single breath. As mentioned before, some sea snakes bear their young live in the sea; others come ashore to lay their eggs.

Marine Lizards

Another type of reptile, the lizard, is mostly a land-dwelling animal. However, one species, the **marine iguana** (*Amblyrhynchus subcristatus*), swims and feeds in the ocean. (See Figure 13-3.) Marine iguanas live on the Galápagos Islands, which are located nearly 900 km off the coast of Ecuador in South America. In his book *The Voyage of the Beagle,* Charles Darwin described this marine lizard as a "... hideous looking creature, of a dirty black color, stupid and sluggish of movement...." Although the marine iguana may look menacing, it is harmless; and its movements underwater are graceful. In fact, the marine iguana is vulnerable to harm by humans; in January 2001, thousands of Galápagos iguanas died due to the effects of an oil spill.



Marine iguana

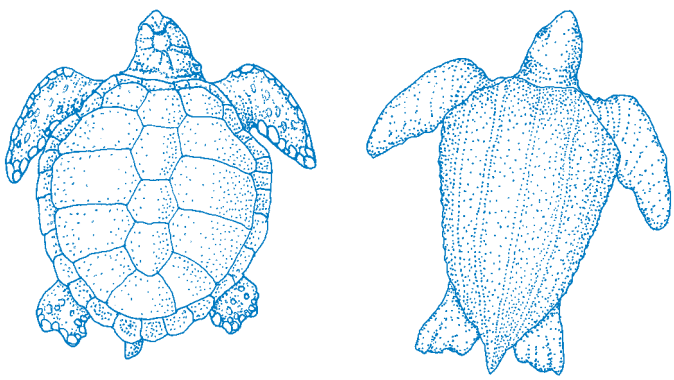
Figure 13-3 The Galápagos marine iguana, the only lizard that swims and feeds underwater.

Like the sea snake, the marine iguana has a flattened tail to aid in swimming. Marine iguanas dive into the ocean to graze on the seaweed and algae that grow on rocks in the subtidal zone. When their bodies get too cold from the water, the iguanas return to the land, where they warm themselves in the sun by lying across the heated lava boulders. Marine iguanas breed (lay their eggs) on land.

Sea Turtles

Of all the marine reptiles, the **sea turtle** is the most widely distributed. Sea turtles inhabit tropical and warm temperate oceans around the world. Along with freshwater turtles and land-dwelling tortoises, sea turtles belong to the order Chelonia. There are six species of marine turtles, and all are endangered: the hawksbill (*Eretmochelys imbricata*), leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempi*), Pacific, or olive, ridley (*Lepidochelys olivacea*), and green sea turtle (*Chelonia mydas*). The different sea turtle species can be distinguished from one another by their size and by the pattern of scales on their top shell, or carapace. All marine turtles have a hard carapace, except for the leatherback, whose top shell, as its name implies, is leathery in texture. In addition, the leatherback is the only sea turtle whose carapace is not fused to its backbone.

The largest marine turtle is the leatherback. An average-sized leatherback measures 2 meters in length and can weigh up to 450 kg. The smallest marine turtle is the Kemp's ridley, which is about 60 cm in length and weighs about 35 kg. (See Figure 13-4.) Some



Kemp's ridley turtle

Leatherback turtle

Figure 13-4 The Kemp's ridley is the smallest sea turtle; the leatherback is the largest. (Not drawn to scale.)

sea turtles can live as long as 200 years—if they can survive their early years when they are most vulnerable to predators.

Sea turtles are well adapted to a marine environment. In fact, a sea turtle's body is smooth and streamlined for ease of movement in the water. The limbs (especially the forelimbs) have evolved into flippers, and their rapid movements enable turtles such as the leatherback to swim at speeds of up to 32 km per hour. These air-breathing animals have fatty deposits and lightweight bones for added buoyancy. However, they can stay underwater for up to 40 minutes on a single breath.

Feeding in Sea Turtles

Most sea turtles prefer coastal waters where food is most plentiful. Although turtles have no teeth, they do have strong jaws (and, in some cases, birdlike beaks) that they use either for breaking open the shells of crabs, clams, and other shelled animals, or for eating underwater vegetation. Mollusks, crustaceans, fish, and jellyfish make up the diet of the loggerhead turtle. The hawksbill turtle eats mollusks and crustaceans in addition to jellyfish and algae. The green sea turtle prefers to graze on the turtle grass and eel grass that grow in shallow waters, whereas the Pacific ridley eats invertebrates that live in eel grass. The leatherback ventures far offshore to feed on jellyfish. Sea turtles that eat jellyfish sometimes die when they accidentally ingest floating garbage such as plastic bags, which resemble their prey.

Reproduction and Development in Sea Turtles

Sea turtles are born on land but spend their lives at sea. The mature sea turtles return every few years to the beaches on which they were born to mate and lay their eggs. Mating occurs in shallow offshore waters. (It is thought that the female stores the sperm from these matings to fertilize the eggs she will lay two or three years later.) After mating, the female turtle swims to the shore and, during the night, emerges onto the beach. The flippers, which are adapted for swimming, cannot support the turtle's weight. So, using her hind limbs and forelimbs, the sea turtle drags herself up the slope of the sandy beach to find a nesting site above the high tide mark.

TECHNOLOGY

Satellite Tracking and Sea Turtles

Sea turtles are long-distance swimmers. For years, the journey of young sea turtles—particularly during their first year of life—has been a mystery to science. Now, through the use of a technology called satellite telemetry, scientists can track the movements of sea turtles across the open ocean. A small radio transmitter with a flexible antenna is glued to a sea turtle's top shell, or carapace. Each time the sea turtle surfaces to breathe, the unit transmits a signal. The signals are sent to four orbiting satellites that are operated by NOAA to monitor global weather patterns and to track radio-tagged animals.

The satellites make a total of six to eight passes each day over the tropical regions where most sea turtles are found. Special instruments in the satellites are designed to listen for transmissions from the turtles. However, to detect a specific turtle, the satellite must be overhead when that turtle surfaces to breathe. After a satellite receives a signal from a turtle, it sends the signal to a location in France, which then relays the data to a facility in the United States. There, a computer accesses the data and converts the information into readings of latitude and longitude. By plotting these continuous readings of latitude and longitude, scientists can track the route of a sea turtle.

Satellite telemetry has uncovered a trans-Pacific migratory route taken by juvenile loggerhead turtles, from their nesting beaches in Japan to their feeding sites in Baja, Mexico. This information is critical for the protection of sea turtles. Now researchers can tell fisheries personnel about previously unknown sea turtle locations, so they can avoid catching these animals in their fishing gear. Satellite telemetry has also identified foraging zones in the open ocean where sea turtles congregate. One particular area, called the Transition Zone Chlorophyll Front (TZCF), is a region in the Pacific Ocean that is rich in sea life.

Scientists have obtained important data about the life cycle and whereabouts of sea turtles from satellite technology. However, coastal development, poaching, pollution, and trawling still take their toll on sea turtle populations. Today, all sea turtle species are considered endangered and are protected by law. Therefore, the valuable information that is gathered in space must be used to protect turtles in the sea.

QUESTIONS

1. How is satellite telemetry used to track sea turtles? What is done with the data?
2. Why is it important to know about the migratory routes of sea turtles?
3. Describe two discoveries made by satellite telemetry about sea turtle locations.

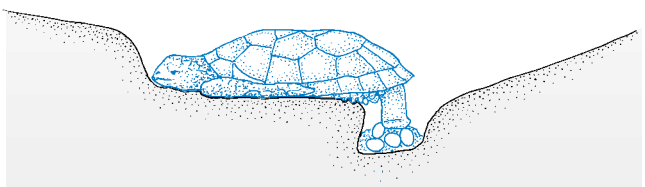
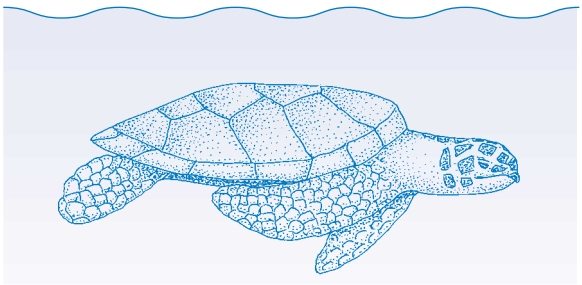


Figure 13-5 Sea turtles come ashore to lay their eggs.

At the nesting site, the turtle first uses all four limbs to dig a depression in the sand; then she uses her hind limbs to scoop out a hole about 30 to 60 cm deep. Into this hole the sea turtle lays about 100 fertilized leathery eggs that look like ping-pong balls. The female fills in the hole with sand and then heads back down the beach to the water, where she mates again. Over the next few weeks, the female will come ashore four or five more times to lay several hundred more eggs. (See Figure 13-5.)

While buried in the sand, the eggs are kept warm and moist and protected from such predators as raccoons, gulls, and rats. The embryos develop inside the leathery eggs for about two months. Interestingly, the sex of a sea turtle is determined by the position, and resulting temperature, of its egg within the nest. Sea turtle eggs that develop at about 28°C and below become males; those that develop at 30°C and above become females. After their development is completed, the baby turtles, called **hatchlings**, break through their shells and dig their way to the surface. Hatchlings usually emerge before dawn and are unprotected; they must quickly wiggle down to the sea. At this stage, they are vulnerable to predation by gulls and large fish.

Where do the hatchlings go after they enter the ocean? Marine biologists have been studying the migrations of sea turtles for a number of years. The green sea turtle, which lives in both the Atlantic and Pacific oceans, breeds every 2 to 3 years. (See Figure 13-6.) One of the breeding grounds is Ascension Island. This tiny island, just 8 km long, is located in the middle of the Atlantic Ocean, midway between South America and Africa. In one turtle study, young hatchlings were tagged on Ascension Island and then recaptured in the coastal waters of Brazil. Apparently, the young turtles were able to make this long journey by hitching a ride on clumps of seaweed that float on the South Equatorial Current, a large ocean current that moves across the Atlantic Ocean from east



Green sea turtle

Figure 13-6 The green sea turtle migrates long distances between its breeding and feeding grounds.

to west. In addition, it is thought that sea turtles may be sensitive to magnetic fields and rely on them during their migrations.

The green sea turtles had migrated to Brazil to feed on the turtle and eel grasses that grow abundantly in the shallow waters. Mature turtles were also tagged in Brazil, and some of these turtles were later recovered on Ascension Island, where they nest. Marine biologists are not sure of the exact route taken by these turtles on their return to Ascension Island. More accurate methods are now being used to track these animals. Radio transmitters, mounted on the backs of some turtles, emit signals that can pinpoint their exact location. (See this chapter's feature on satellite tracking of sea turtles, page 315.)

13.1 Section Review

1. What adaptations do sea snakes have for life in the ocean?
2. How does the marine iguana regulate its body temperature?
3. What kinds of food do the different sea turtle species eat?

13.2 MARINE BIRDS

The sea and the shore provide a haven for many species of birds. Birds that depend on the ocean for their survival are commonly referred to as **seabirds**. There are nearly 9000 species of birds; all are in the class Aves. Not all birds fly, but they all do share several important characteristics.

All birds have feathers, which are attached to the skin. There are

two main types of feathers: down feathers and contour feathers. Down feathers are the small, fluffy feathers closest to the skin. These small feathers trap warm air and hold in body heat. Contour feathers are the larger feathers that cover the wings and the body; some of these are used for flight. Some aquatic birds have **powder feathers**, which repel water to protect the underlying down feathers. Some birds also have a special gland near their tail that produces a waterproof oil. The birds use their beak to spread this oil through their feathers when they groom, or **preen**, themselves.

Most birds have lightweight hollow bones, an adaptation for flight. However, some diving marine birds, such as the penguin, have denser bones. These heavier bones are adaptive for birds that spend time swimming underwater in pursuit of fish. Like most marine reptiles, all marine birds have to return to land (or, in the case of the penguin, to ice) to breed. All birds lay eggs, which are encased in a hard calcium-rich shell. Often both parents tend the eggs, keeping them warm and protecting them from predators. Marine birds nest in a variety of habitats: in tree branches, on cliff ledges along a rocky coast, on patches of vegetation, among pebbles and sand on a beach, or on a few stones out on the ice. Offspring are fed by the parent birds, who sometimes fly out to sea for many days to obtain enough fish or plankton to feed them.

Adaptations of Marine Birds

Seabirds have a variety of feeding methods. Some seabirds forage in the sand and mud along the shoreline. Others make short trips to the sea, diving several times a day for their catch of fish and invertebrates. The more oceanic species spend extended periods out at sea, gliding above the waves and diving into the sea for food.

Marine birds have some physical adaptations that are unique to their lifestyle. Seabird species that spend much of their time in and on the water have webbed feet for paddling and swimming. Like marine reptiles, marine birds have to get rid of excess salt and conserve fresh water. So, like the reptiles, seabirds have salt glands; they are special nasal glands that secrete a salty solution from the nostrils. In addition, seabirds conserve water by excreting a concentrated uric acid.

Common Shorebirds

Various species of marine birds search either in shallow water or in the sand along the water's edge for their food. You can often tell what a bird eats by looking at its beak, or bill. Among the marine birds, beak size and shape show great variation. Look, for example, at the three shorebirds shown in Figure 13-7.

The small **sandpiper** (*Calidris*) has a narrow pointed bill for poking in the sand for small invertebrates, such as worms and insects. Sandpipers are common shorebirds that move in small flocks in the intertidal zone, poking in the wet sand while managing to stay just ahead of the incoming waves. Various species of plovers, which are slightly larger shorebirds, also forage along sandy beaches.

The **oystercatcher** (*Haematopus*) uses its long, red knifelike beak to catch and eat various types of mollusks. The oystercatcher is a large bird, about the size of a hen, that inhabits the marshes and sandy beaches along parts of the Atlantic and Gulf coasts.

The **snowy egret** (*Egretta thula*) inhabits salt marshes along the Atlantic and Pacific coasts. How is the egret adapted for food-getting? Notice the long flexible neck and the pointed bill that it uses to quickly grab small fish that dart about in the shallow water. The long stiltlike legs give egrets the advantage of height in being able to spot fish. In the same family as egrets are various species of herons that hunt for fish and invertebrates in coastal marshes. In tropical areas, flamingos wade in the shallows, using their hooked beaks to capture and strain small invertebrates from the water.

Many aquatic birds obtain their food along the shore where

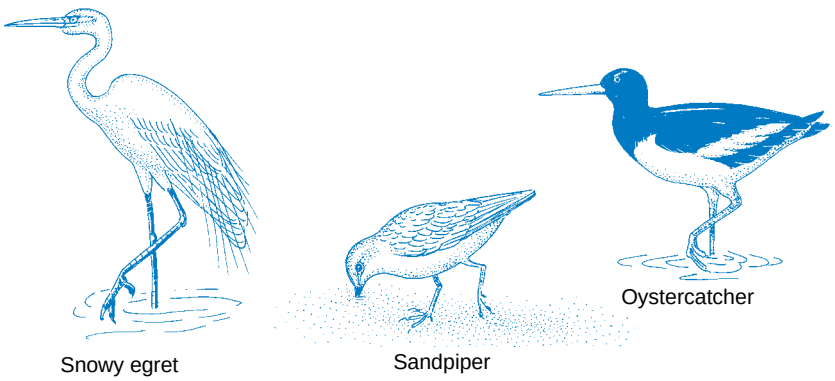
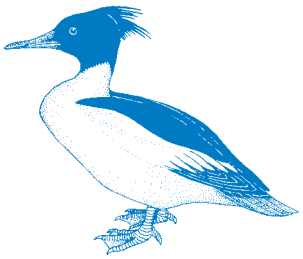
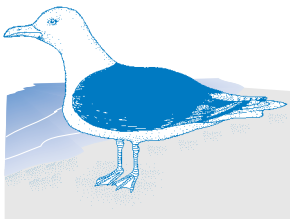


Figure 13-7 Three examples of common shorebirds found along Atlantic, Gulf, and Pacific coasts.



Sea duck
(merganser)

Figure 13-8 Sea ducks, such as this merganser, dive under the ocean surface to feed.



Black-backed gull

Figure 13-9 The sea gull is a common shorebird that scavenges along coasts.

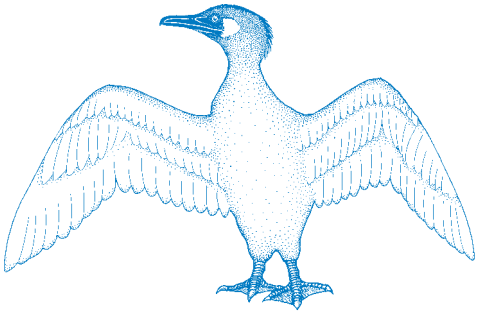
plant communities thrive. Some species of ducks (*Anas*) are well adapted for life in coastal marshes. They use their webbed feet like paddles for moving through the water. Layers of fat, in addition to down and waterproof feathers, keep the birds warm and dry. Marsh ducks feed primarily on tiny aquatic plants, which they strain out of the water with their flat bills. Marshes are also used by ducks for nesting. Various types of hardy **sea ducks**, such as eiders (*Somateria*) and mergansers (*Mergus*), dive into the ocean to feed on mollusks, crustaceans, and fish. (See Figure 13-8.) Other aquatic birds that may feed in coastal areas include grebes and loons.

The **sea gull** is probably the bird most identified with the ocean. There are several different species of gulls. The herring gull (*Larus argentatus*) and the greater black-backed gull (*Larus marinus*) are the most common. (See Figure 13-9.) Gulls are largely scavengers that feed on dead marine animals that are carried ashore by the tides. Sea gulls also eat crabs on the beach and garbage at landfills. (They sometimes drop clams on hard surfaces, such as parking lots, to crack them open. Obviously, humans have had an impact on gulls' feeding choices and methods!) Although they will fly to mainland beaches to scavenge for food, sea gulls prefer to nest in isolated places on offshore islands.

Diving Shorebirds

For seabirds, flight is often necessary for food-getting. The **cormorant** (*Phalacrocorax*) is a common shorebird that dives from the sky for its food. When it spots a fish, the cormorant folds its wings, tucks in its feet, and dives into the water, where it catches the fish with its hooked beak. (See Figure 13-10.) The **common tern** (*Sterna hirundo*), a small shorebird that nests on sandy beaches, makes spectacular aerial maneuvers. The tern can hover over the water before it dives to catch a small fish. Since the tern lays its eggs in sand, the nesting sites are often disturbed by humans. To protect tern colonies, public access has been restricted and the use of recreational vehicles has been banned along many beachfronts.

Another diving bird is the **brown pelican** (*Pelecanus occidentalis*), shown in Figure 13-11. Pelicans are large birds that live along the Florida, Gulf, and California coasts. Pelicans literally "make a splash" when they dive from the sky into the water. This once-



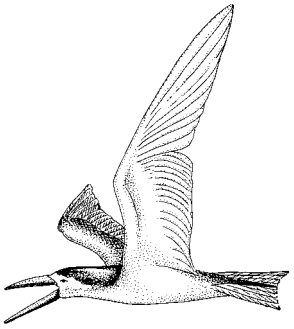
Cormorant

Figure 13-10 The cormorant dives into the water to catch its meal of fish.

Figure 13-11 The brown pelican scoops fish out of the water with its huge pouch.

endangered bird uses its large throat pouch like a net to scoop up fish. Water is squeezed out of the pouch and the fish are then swallowed headfirst to prevent their dorsal spines from getting stuck in the bird's throat.

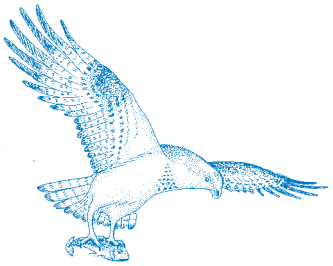
An unusual shorebird that fishes on the wing but does not get its feet wet is the **black skimmer** (*Rynchops nigra*). The skimmer flies low over the water, with the tip of its lower jaw just beneath the surface. By skimming the surface in this way, the black skimmer eventually makes contact with a fish, which it swallows while still in flight. (See Figure 13-12.)



Black skimmer

Figure 13-12 While in flight, the skimmer uses its lower jaw to scoop fish from the water.

Another coastal bird that dives for its meal is the **osprey** (*Pandion haliaetus*), or fish hawk. The osprey swoops down from its nest on top of a tree to grab fish right out of the water. (See Figure 13-13.) Keen vision enables the fish hawk to spot its prey from high up. Like other hawks and eagles, the osprey has strong curved claws, called **talons**, which it uses to grab and hold onto a fish. The long, powerful wings of the hawk provide the lifting power needed to carry the bird and its prey back to the nest. The osprey, which feeds only on fish, lives along the Atlantic, Pacific, and Gulf coasts.



Osprey (fish hawk)

Figure 13-13 The osprey swoops down to grab fish with its sharp talons.

Diving Pelagic Birds

Many seabirds that nest on islands and along coastlines actually spend most of their lives at sea. The pelagic, or open ocean, diving seabirds include a variety of types, from sparrow-sized storm petrels

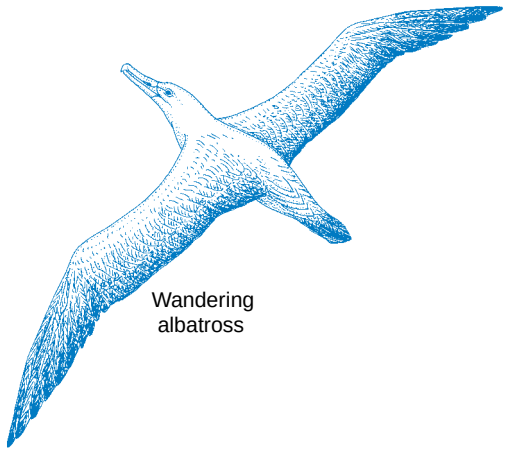


Figure 13-14 One of the largest seabirds, the albatross may spend years at sea before returning to land to breed.

to auks, gannets, puffins, petrels, shearwaters, guillemots, and eagle-sized albatrosses. Some of these birds, such as the shearwaters and storm petrels, migrate thousands of kilometers each year as they follow schools of fish or drifting plankton. Probably the most oceanic of all the seabirds is the **wandering albatross** (*Diomedea exulans*) of the South Pacific. (See Figure 13-14.) The albatross, among the largest of all seabirds with a wingspan of about 3 meters, is adept at gliding effortlessly on air currents over the ocean. The albatross may spend 3 or 4 years at sea before returning to its birth island to breed. During this time, the bird rarely stops flying or gliding and may actually circle the entire globe.

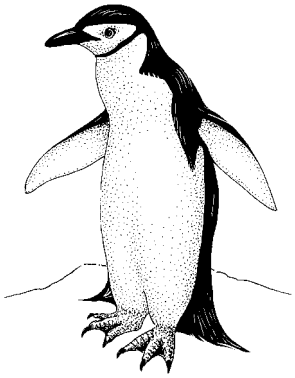
Penguins

Penguins are the most aquatic of all seabirds. There are about 15 species of penguins; all but one species live in the southern hemisphere. They vary in height from about one-third of a meter to more than 1 meter tall. Penguins have no flight feathers and are completely flightless. However, they are excellent swimmers and divers. The smaller wings of a penguin function as flippers that can propel the bird through the water at speeds of up to 24 km per hour. Penguins have dense bones, which help give them the weight necessary for deep dives. (See Figure 13-15.)

On their dives, penguins catch a varied diet of fish, krill, squid, and shellfish. Like other birds that migrate in the open ocean in

search of food, some penguins go to sea for 2 years before returning to land or ice to nest. However, unlike the pelagic birds, which go out to sea and fly over the ocean waves (sometimes diving in or resting on the surface), penguins go out to sea under the waves, swimming in the ocean. When they do return to breed, both males and females share the duties of warming the eggs and feeding the chicks after they hatch.

Penguins can survive the cold air and waters of the Antarctic because they have a thick layer of fat under their skin and densely packed soft down feathers for insulation. These features help to prevent loss of body heat in air temperatures that are often well below zero. Like all other birds, penguins are **endothermic** (warm-blooded). They can generate their own body heat, an ability that enables them to live in regions with cold temperatures.



Chinstrap penguin

Figure 13-15 Penguins are flightless seabirds that are excellent divers and swimmers.

13.2 Section Review

1. Describe three different feeding methods of marine birds.
2. What three features of seabirds are specifically adaptive for life at sea?
3. How is the penguin adapted to live in the cold Antarctic?

Laboratory Investigation 13

Adaptive Features of Marine Reptiles and Birds

PROBLEM: What are some features of birds and reptiles that show adaptations to the marine environment?

SKILLS: Observing and identifying adaptive features.

MATERIALS: Collection of photographs, illustrations, and/or plastic models of various marine birds and reptiles. You may also refer to the figures in this chapter.

PROCEDURE

1. Observe the features of various representative marine reptiles. In your notebook, make a copy of Table 13-1. Then list one or more features for each animal that you think may be specialized for its life in the water. What function does the particular feature serve? That is, how is it adaptive for an animal that spends more time in the water than on land? (You can note the same feature more than once.)

TABLE 13-1 ADAPTIVE FEATURES OF MARINE REPTILES

Reptile	Features/Structures	Purpose/Function
Crocodile		
Sea turtle		
Sea snake		
Marine iguana		

2. Observe the features of various representative marine (or aquatic) birds. In your notebook, make a copy of Table 13-2. Then list the features for each bird that you think enable it to function well in a marine environment (salt marsh or ocean), or list the particular function or purpose that the adaptive feature serves for the bird (depending on which space is left blank). You can add other features or functions that are not listed in the table but that are also important for survival in the bird's particular habitat.

TABLE 13-2 ADAPTIVE FEATURES OF MARINE (AQUATIC) BIRDS

Bird	Features/Structures	Purpose/Function
Skimmer	Longer lower bill	
Osprey		Catching fish (in flight)
Penguin		Swimming underwater
Oystercatcher	Knifelike bill	
Sea duck	Webbed feet	
Sandpiper		Feeding along shore
Heron (egret)	Long legs and bill	
Albatross		Long-distance flight
Pelican	Large pouch	
Cormorant		Fishing underwater

OBSERVATIONS AND ANALYSES

1. Describe three features of marine reptiles that are adaptive for living in an aquatic environment.
2. Describe five features of seabirds that are adaptive for feeding and/or living in a marine environment.
3. What are some adaptive features that are similar in both marine reptiles and marine birds? List the particular birds and reptiles.

Chapter 13 Review

Answer the following questions on a separate sheet of paper.

Vocabulary

The following list contains all the boldface terms in this chapter.

amniotic egg, black skimmer, brown pelican, common tern, cormorant, crocodilians, endothermic, hatchlings, marine iguana, osprey, oystercatcher, powder feathers, preen, salt glands, sandpiper, seabirds, sea ducks, sea gull, sea snake, sea turtle, snowy egret, talons, wandering albatross

Fill In

Use one of the vocabulary terms listed above to complete each sentence.

1. Birds can regulate their body temperature; they are _____.
2. The _____ has venom, a paddlelike tail, and salt glands.
3. A lizard that swims and feeds in the ocean is the _____.
4. Seabirds spread an oil through their feathers when they _____.
5. The most widely distributed marine reptile is the _____.

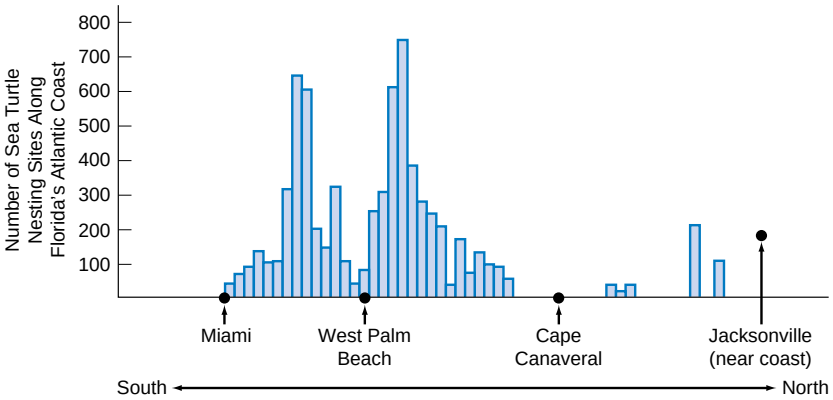
Think and Write

Use the information in this chapter to respond to these items.

6. Marine turtles bury their fertilized eggs in the sand, leaving them to hatch on their own. Discuss the risks and benefits.
7. How do sea snakes resemble their relatives on land? How do they differ, as a result of living in the ocean?
8. Briefly describe the feeding methods of the pelican, osprey, sandpiper, and egret. How is each method suited for getting specific resources in and near the sea?

Inquiry

Base your answers to questions 9 through 11 on the graph below, which shows the approximate number of sea turtle nesting sites on a stretch of monitored beaches along Florida's Atlantic Coast.



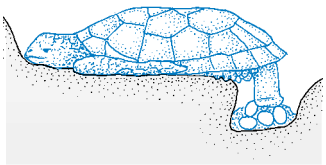
9. The beaches with the highest number of nesting sites are located between *a.* Miami and West Palm Beach *b.* West Palm Beach and Cape Canaveral *c.* Cape Canaveral and Jacksonville *d.* Miami and the Gulf Coast.

10. Which is an accurate statement regarding the data in the graph? *a.* More nesting sites have been found in northern Florida than in southern Florida. *b.* The largest number of nesting sites were found on the beaches around Miami. *c.* The nesting sites increase in number from east to west. *d.* More than 700 nesting sites were found on the coast north of West Palm Beach.

11. A tentative conclusion that can be drawn from the data is that *a.* most suitable nesting sites are found on beaches within the big cities *b.* most suitable nesting sites are found on beaches near, but not in, the big cities *c.* there is an even distribution of nesting sites along Florida's Atlantic Coast *d.* there is an even distribution of nesting sites along Florida's Gulf Coast.

Multiple Choice

Choose the response that best completes the sentence.



12. The pattern of reproduction shown in this reptile is
a. internal fertilization and external development
b. internal fertilization and internal development
c. external fertilization and external development
d. external fertilization and internal development.

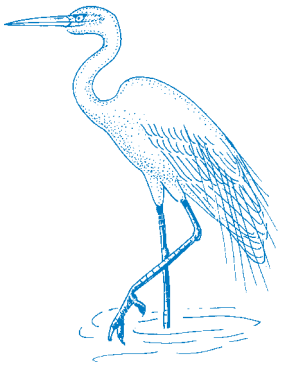
13. The marine reptile that guards its eggs in the nest until they hatch is the *a.* sea snake *b.* green sea turtle *c.* crocodile *d.* iguana.

14. Marine reptiles may have any of the following features *except* *a.* a thick, scaly skin *b.* salt glands *c.* blubber *d.* an amniotic egg.

15. Sea turtles leave the water and come up on land to *a.* find food *b.* lay eggs *c.* find a mate *d.* cool off.

16. Marine turtles have all of the following adaptations *except* *a.* a smooth, streamlined body *b.* flippers for forelimbs *c.* the ability to stay underwater for a long time *d.* gills.

17. The female sea turtle lays eggs that have a *a.* leathery shell *b.* hard calcium shell *c.* jellylike coating *d.* spiny shell.



18. An adaptive feature that this shore bird has for food-getting is *a.* a pointed bill for grabbing small fish *b.* sharp talons for holding onto prey *c.* webbed feet for moving through water *d.* a streamlined body for diving.

19. Penguins have all of the following adaptations *except* *a.* soft down feathers *b.* a thick layer of insulating fat *c.* flipperlike wings *d.* contour feathers for flight.

20. The sandpiper's beak, used to find tiny creatures in the sand, is *a.* long and curved *b.* broad and flat *c.* short and dull *d.* narrow and pointed.

21. The bird that has webbed feet for moving in the water is the *a.* osprey *b.* egret *c.* oystercatcher *d.* sea duck.

22. Marine reptiles are found primarily in *a.* cold regions *b.* tropical habitats *c.* temperate regions *d.* volcanic areas.

23. The osprey uses its sharp talons to *a.* grab and hold onto fish *b.* dig holes to find fiddler crabs *c.* scrape barnacles off wood pilings *d.* crack shells open.

Research/Activity

- Sea turtles travel hundreds of kilometers between their birthplace and feeding grounds. What clues do sea turtles rely on to find their way between their feeding and breeding grounds? Imagine that you had to make such a journey every few years. Write about the clues you would rely on to find your way.
- Collect some feathers near seabird nesting or perching sites. Use your library or the Internet to do research about feather structure; try to identify the species your feathers come from. Prepare a report; illustrate the feather's structure and/or attach the feathers. (Be sure to comply with regulations; do not enter restricted seabird nesting sites.)