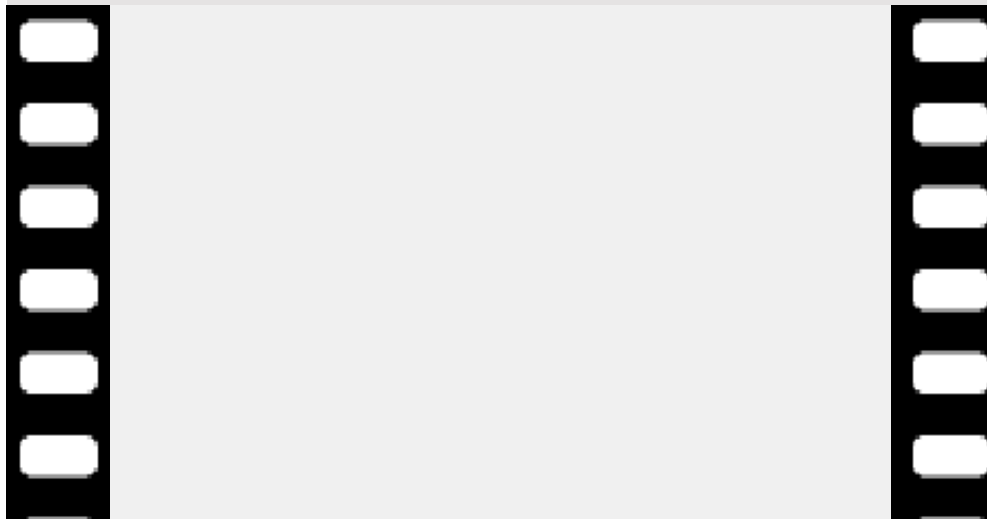


The Lionfish Invasion!

Welcome



**What is as graceful and beautiful as a butterfly,
as ferocious as the most dangerous predator,
and delivers a painful sting with its venomous spines?**



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It is the lionfish, a native to coral reefs in the tropical waters of the South Pacific and Indian Oceans. But you don't have to travel halfway around the world to see a lionfish.

Perhaps you have seen one in a friend's home aquarium?

Lionfish are popular saltwater aquarium fish all over the world, but especially in the United States.

Nowadays, they also live in western Atlantic waters off the East Coast of the United States. These lionfish are what

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scientists call an **invasive species** or an "**alien invader.**"

Discover & Watch: [Run-ins with an Invader!](#) A Chronicle of Lionfish Sightings in U.S. Waters

Invasive species like the lionfish are becoming a major problem in many parts of the world. Scientists are using newly collected data and technology to try to answer the question :

How does an "alien invasion," like that of the lionfish, affect an ecosystem?

Learn about the environmental and economic consequences of invasive species, using the recent invasion of the lionfish as a case study.

Read on to find out more about the lionfish invasion!



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The Lionfish Invasion!

What is an Invasive Species?

An "[invasive species](#)" is a species

- that is non-native (or alien) to the ecosystem it occupies and
- whose introduction causes or is likely to cause economic or environmental harm, or harm to human health.

Some scientists classify an [alien species](#) as an [invasive species](#) if it begins to reproduce and establish a

population in its new ecosystem, which often happens very quickly after introduction. Invasive species can be plants, animals, and other organisms (such as microbes or fungi). Most alien introductions result from human activities. A well-known [terrestrial](#) example of an [alien](#) or [exotic species](#) is the red imported fire ant, a [native](#) of South America first introduced to the United States in 1930s. They entered the U.S. through Mobile, Alabama, probably in soil used for ships' [ballast](#). The fire ant has infested more than 260 million acres of land in nine southeastern states, replacing large parts of the native ant [community](#) as it continues to spread. Another example of an invasive species is the Asian tiger mosquito, introduced to the U.S. from Japan in the mid-1980s and now spreading to many regions. This mosquito attacks more hosts than any mosquito in the world. It can transfer disease organisms from one [species](#) to another, including into humans.



The predaceous Northern snakehead (*Channa argus*), native to China, is a recent alien invader of North America. Reproducing populations of snakeheads have now been discovered in Maryland, California, and Florida. *Click on image* for larger view and further details.



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Invasive species affect all regions of the United States and every nation in the world. People, too, pay a high price, measured in billions of dollars for damaged goods and equipment, a degraded environment, disease, and even death. Alien species invasions can result in the loss of native species and biological diversity at a rate that ranks second only to habitat destruction. Some of the most serious and costly alien invaders include human, animal, and plant diseases (such as West Nile virus), agricultural pests (such as the Africanized honeybee, Russian thistle, and the imported red fire ant), and a host of seemingly harmless species whose sheer numbers overwhelm native ecosystems (such as zebra mussels, purple loosestrife, European green crabs, and hydrilla).



An adult lionfish trolls a wreck about 40 miles off the North Carolina coast. This specimen is about 6 inches long. *Click on [image](#) for larger view and further details.*

In the United States alone, approximately 50,000 alien species are known, and the number continues to grow. By some estimates, the major environmental damages, losses, and control measures for invasive species cost the nation an average of \$138 billion per year. Invasive species also threaten nearly half of the species currently protected under the Endangered Species Act.

The introduction and spread of invasive species are caused by many factors, including, but not limited to:

- expanded global trade,
- the harvesting of exotic marine species to satisfy the popular aquarium trade,
- the use of non-native species in agriculture to control unwanted pests.

Invasive species also are introduced into coastal waters when large ships exchange their ballast water. It is important to study invasive species to learn about the effects they may have on native organisms and the physical environment.

Controlling invasive species is difficult because scientists know little about when new aquatic alien invaders arrive in our

waters. The introduction and [viability](#) of lionfish along the U.S. East Coast are leading to new perspectives on how fish invasions may pose threats to marine ecosystems. Many scientists, like Paula Whitfield and Jonathan Hare (2003), believe that scientists must expand their research on invasive species and develop plans to manage, [mitigate](#) and minimize their effects on [ecosystems](#) that are already stressed due to other human activities (often called [stressors](#)).

Lionfish are highly visible, recognizable, and distinctive. Many other less recognizable invasive [invertebrates](#) and freshwater fish are causing real problems, too. Recent research on lionfish raised potentially troubling questions with no clear answers, such as:

How many other invasive fish species have established themselves along our coasts without being recognized?

What effects are they having on the nation's resources?

Continuing research will provide more answers to these important questions.

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The Lionfish Invasion!

Lionfish Invade U.S. Waters!

Local divers off the coast of North Carolina were not expecting to see what they found one day in August 2002-- the exotic and beautiful lionfish, common to the warm waters of the western Pacific, but unknown at that time as residents of the Carolina coast.

They provided the first solid evidence that lionfish were in the Atlantic--an actual specimen that they collected. A year later, scientists

had documented 19 lionfish sightings at eight locations along the North Carolina continental shelf. By then, lionfish were also being observed off the coasts of Florida, Georgia, and South Carolina. Juvenile lionfish were also showing up off Bermuda and even as far north as Long Island, New York! Since then, many more United States divers have reported sightings of the distinctive fish. Between 2000 and 2003, 49 lionfish sightings were reported at 16 different shipwrecks and natural hard bottom locations. During a summer 2004 research expedition, NOAA scientists collected 155 lionfish at 19 different locations off the North Carolina coast alone. The jump in numbers and distribution over such a short time, plus sightings of juveniles smaller than those sold for aquaria, strongly indicate that the lionfish is reproducing in the Atlantic Ocean. If this is true, it's the first time that a western Pacific fish has populated the waters of the U.S. Atlantic coast.



The red and black dots are locations in the Atlantic Ocean where lionfish have been reported as of May 2003. *Click on image* for larger view and further details.



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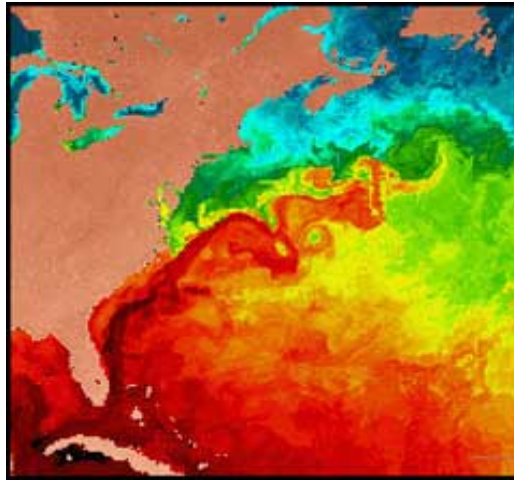
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How did lionfish get into the Atlantic Ocean?

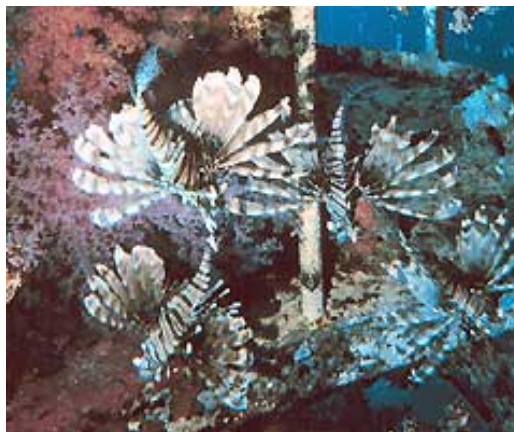
Reportedly, six lionfish were accidentally released in Biscayne Bay, Florida, when a beachside aquarium or nursery broke open during Hurricane Andrew in 1992. It's likely that even more have been released on purpose when people no longer want them as aquarium pets because they grew too large for the aquarium, or they learned the hard way that lionfish will eat their other fish! The swift and warm Gulf Stream, which likely transported buoyant lionfish eggs and larvae from Florida northward, helped the lionfish's Atlantic journey.

It's pretty unusual for non-native, tropical marine fishes, like the lionfish, to establish themselves at this latitude. In Florida waters and along the continental shelf near the Gulf Stream the temperatures are very similar to the lionfish's native waters.

However, from north Florida upward, the waters along the coastline are too cold in the winter for lionfish to survive. Scientists expect them to survive the winter only at water depths greater than 120 ft because this is where the Gulf Stream has influence all year long. Very importantly, the types of predators and competitors present in the



The warm Gulf Stream current (in red) may have dispersed lionfish as far as North Carolina and Bermuda, where water temperature is similar to their native habitat. Lionfish larvae may have been carried in the Gulf Stream to the northeast in a similar way.



marine [community](#) in the Atlantic are very different from the native range of the lionfish. These are a couple of the reasons why

scientists are paying so much attention to the lionfish invasion. Generally, [species](#) like the lionfish have not been perceived to pose a significant threat to marine [ecosystems](#) because they were not likely to survive long. Research on this topic has been minimal, however, so it is hard for scientists to answer questions such as:

Lionfish swimming near the wreck of the *Cedar Pride* , a Lebanese freighter purposely sunk in 1986. This popular dive site is located in the Sea of Aquaba, which is in the northern part of the Red Sea (Jordan). *Click on image* for larger view and further details.



-
- ***Is this new discovery a cause for concern?***
 - ***Should something be done about it?***
-

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The Lionfish Invasion!

Is the Aquarium Trade to Blame?

The [aquarium trade](#) appears the most likely [vector](#) for the introduction of lionfish into U.S. waters, but the lionfish's introduction into the Atlantic remains something of a mystery. Recent research indicates that a number of other tropical aquarium fish are currently surviving off the coast of Florida. Also, the color patterns of lionfish sighted off the Atlantic coast of the U.S. are similar to those from the Philippines, where many lionfish are collected for the aquarium trade.



A lionfish juvenile roams its aquarium after being collected off Long Island, New York. *Click on image* for larger view and further details.

Scientists say it is impossible to determine if the lionfish released in 1992 account for the [species](#) invasion of Atlantic Ocean.

Some scientists have suggested that lionfish entered Atlantic waters when larvae or juvenile fish were trapped in ships moving from the Pacific to the Atlantic and were released when the [ballast water](#) was pumped out.

However, there is no evidence to support ballast water as the source for the lionfish invasion, although it is a common source of aquatic [alien species](#) introductions generally. Further, although lionfish have been introduced into the western Mediterranean, probably through the Suez Canal, there is no evidence that they crossed the Atlantic or that they entered the Atlantic through the Panama Canal. Besides, it is very unlikely

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that the tropical lionfish could survive a journey across the cold water between the two oceans.



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An adult lionfish on display in a home aquarium.
(Photo credit: Hiroshima University, Graduate School of Biosphere Science)



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The Lionfish Invasion!

Some Lionfish Biology

The lionfish (scientific name *Pterois volitans*) is a popular saltwater aquarium fish with distinctive maroon (or brown) and white stripes, fleshy tentacles above the eyes and below the mouth, and an imposing fan of prickly [venomous](#) spines. Although not fatal, the sting of a lionfish is extremely painful. Because these fish are not aggressive toward people, contact and poisoning is usually accidental. The [species](#) of lionfish now found in U.S. waters produce a mild poisoning. Relatives of the lionfish, including the scorpionfish and stonefish, produce a much more severe poisoning; in fact, the sting of the stonefish can be fatal to humans. Today, a person with a home aquarium is more likely to be stung by a lionfish than a diver or fisherman, but they could be placed at risk if lionfish increase in large numbers along the heavily populated East Coast.



Profile of a lionfish showing the distinctive fleshy tentacles above the eyes and below the mouth. *Click on image* for larger view and further details.

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[Lionfish Biology Fact Sheet](#) - Find Out More About the Biology of Lionfish!

The lionfish's sharp, slender spines are located on the [dorsal](#), [anal](#), and [pelvic fins](#). A [venom](#) gland is located at the base of

each spine. The venom is a combination of protein, a [neuromuscular toxin](#), and a [neurotransmitter](#) called [acetylcholine](#). After the fish's spine punctures the victim's skin, the venom travels up a groove in the spine and into the wound. The sting causes intense pain, redness and swelling around the wound site. Although the worst of the pain is over after an hour or two, some people report pain and tingling sensations around the wound for several days or weeks. On rare occasions, when the [venom](#) spreads to other parts of the body, people may experience headaches, chills, cramps, nausea, and even paralysis and seizures.



Look, but don't touch! Although not fatal to humans, the dorsal, anal, and pelvic spines of lionfish can deliver a painful sting, as well as cause headache, vomiting, and respiratory distress. (Photo credit: Stephen Vives)

Lionfish are [native](#) to [coral reefs](#) in the warm, tropical waters of the South Pacific and Indian Oceans. They prey on a wide variety of smaller fishes, shrimps and crabs, and have few [predators](#) in their native range, where they occupy the upper levels of the food chain. At present, little is known about how other coral reef species in the lionfish's "adopted" [environment](#) of the Atlantic Ocean might fare against them.

For now, [reef](#) communities in the western Atlantic Ocean are unlikely to be in much danger, since the number of lionfish is still relatively small. If the population grows large, though, lionfish could damage the [native ecosystems](#). At the same time, other factors are already causing stress to these [ecosystems](#), and these stress factors or "[stressors](#)" tend to favor the lionfish's expansion.

Lionfish also are believed to pose particular risks to the local environment. They are hungry [predators](#) that feed on practically anything that swims. They can easily devour the young of important commercial fish [species](#), such as snapper, grouper and sea bass, many of which use the region's "live bottom" reefs as nursery grounds. Lionfish are ambush predators and may use their outstretched, fan-like [pectoral fins](#) to "corner" their [prey](#). They don't sting their prey, though.

Their [venomous](#) spines are used mostly for defense. Scientists are concerned that lionfish could seriously reduce the numbers of prey species and/or [compete](#) with other reef [predators](#).

When a new species is introduced in an area, it can take over the [niche](#), or role, of a native species in its [ecosystem](#), thus squeezing it out--this process is called competition. Another important factor is that [native](#) prey species lack of experience in confronting the intimidating lionfish might make the lionfish a *more effective* [predator](#).

In their native habitats in the Indian and South Pacific Oceans, lionfish are one of the [top predators](#) in the food chain, but there are often others like sharks. Therefore, lionfish have few, or no, predators in their [native](#) habitat, possibly because of the [venomous](#) spines. Another unknown piece of the lionfish puzzle is:



Sand tiger sharks are possible predators of lionfish in the Atlantic Ocean, but this remains only a hypothesis. *Click on image* for larger view and further details.

what might prey on lionfish in its new Atlantic neighborhood? [NOAA](#) scientist Paula Whitfield has hypothesized that sand tiger sharks (*Carcharias taurus*) may be a possible predator of lionfish in the Atlantic. Still, questions abound on what the top marine predators in the Atlantic Ocean will make of this "new kid on the block."

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The Lionfish Invasion!

Can We Stop the Invasion?

Most scientists agree, it is unlikely that the lionfish's invasion of U.S. waters can be reversed. Any large-scale attempts to remove the existing lionfish from U.S. Atlantic waters appear impractical and would be very costly, because of the large geographic range and depths that the fish now occupies. Lionfish are now found along the entire southeast U.S. coastline at depths between 80 and 260 ft, making their complete removal all but impossible. Scientists point out that the introduction and spread of the lionfish illustrate the difficulty of managing [introduced species](#) in the marine [environment](#). Lionfish now join the ranks of other [aquatic](#) invasive species that have taken up permanent residence in U.S. waters, such as European green crabs, Asian eels and zebra mussels.



NOAA scientists collecting lionfish off the coast of North Carolina to take back to the laboratory for analysis. *Click on image* for larger view and further details.

Scientists are attempting to answer the following questions:

- **How does an "alien invasion," like that of the lionfish, affect an ecosystem?**
- **Are lionfish in the Atlantic a problem?**

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Although scientists don't know much about the [ecological](#) impact of lionfish in the Atlantic at this point, they know very well the impacts of many other [invasive species](#). For example, scientists have studied one of the most infamous stowaways that has entered U.S. waters via [ballast water](#), the zebra mussel. Originally from Europe, it now flourishes in the Great Lakes. Up to 700,000 zebra mussels may occupy only one cubic yard on the surfaces of boats, pilings and pipes. By 2000, these alien invaders had caused \$5 billion damage to the infrastructure of industries, public utilities, ship navigation, boating and sport fishing.



Zebra mussels cover a water current meter in Lake Michigan near Michigan City, IN. ***Click on image*** for larger view and further details.

Another example of a well-studied [aquatic](#) invader is purple loosestrife, a plant now common in wetlands throughout the U.S. and Canada. It was brought to North America from Europe in the 1800s - both accidentally and on purpose. Because it has no natural [predators](#) in North America, purple loosestrife is able to rapidly invade wetlands. Once established, purple loosestrife out [competes](#) and displaces many [native species](#)



Purple loosestrife (*Lythrum salicaria*), an invasive wetland plant native to Europe and Asia, has spread throughout North America. ***Click on image*** for larger view and further details.

such as cattails. Because animals depend on native plants for food, nesting areas, and shelter, purple loosestrife invasions indirectly harm wildlife. Muskrats, bog turtles, and ducks are some of the species that suffer when purple loosestrife takes over.

So, what about the future of lionfish in U.S. waters?

Scientists predict that lionfish will continue to increase in abundance. In 2004, [NOAA](#) scientists collected 155 lionfish at 19 different locations. Some of these were juveniles and females ready to spawn (reproduce). These numbers far surpass their original expectations, and they now believe that lionfish are actually thriving in water depths over 120 ft off North Carolina. Scientists also predict that lionfish presence in United States waters, especially in the southeast, will become more noticeable, and more encounters between people and lionfish will probably lead to more stings. Because most observations of lionfish off the U.S. coast have been at depths of 100 ft or more, scuba divers are most likely to encounter them, but scientists caution that recreational and commercial fishermen will also be catching them in the future.



Lionfish are often seen interacting with native species, like this squirrelfish, in their new Atlantic neighborhood. *Click on image* for larger view and further details.

For now, scientists have five main suggestions:

- ***Track the lionfish population.*** Although more sightings in recent years suggest that more lionfish are present, that may not be the case. It could simply be that more public awareness has led to more reports. A monitoring program is needed to determine if the number of lionfish is actually growing.

- **Conduct more research.**

Scientists' ability to predict the lionfish's future abundance, and its effects on the [ecosystem](#) is greatly hindered by a lack of knowledge. Research is needed to determine the lionfish's ability to survive, reproduce, and grow in the Atlantic Ocean.



- **Educate the Public.**

People need to know that it can be harmful to release aquarium fishes into bodies of water. In the United States and throughout the Caribbean, people should be alerted to the presence of lionfish and encouraged to report sightings. At the same time, people should be cautioned against handling lionfish and made aware of the health risks from their stings.

During an August 2004 research expedition off the coast of North Carolina, NOAA scientists collected 28 lionfish on one shipwreck during a single dive. *Click on image* for larger view and further details.

- **Notify physicians and other health care providers about venomous fish in U.S. waters.** One study of reported lionfish stings, mostly involving [aquarists](#), noted no fatalities. Most stings result in uncomplicated wounds with severe local pain that responds well to soaking treatment. A greater risk appears to be secondary infection resulting from the wound. In addition to medical personnel and health-care providers, boat operators and lifeguards also need to be advised about lionfish stings.

- **Make regulations to control the introduction non-native marine species.** Bermuda's approach, which is to enforce a strict ban on the importation of live fish, is proving an especially effective way to reduce the risk of aquarium releases. But scientists caution that the issue is more complex than simply limiting imports of non-[native](#) species. Some believe that such efforts will fail unless we learn more about how these species [disperse](#) once they are introduced into non-native waters. Although the lionfish invasion is probably here to stay, this dramatic event may prompt the development of effective strategies to reduce the ill effects of other marine invaders.

The Lionfish Invasion!

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A

Acetylcholine—a [neurotransmitter](#) released at [neuromuscular junctions](#) and autonomic synapses.

Alien Species—any species, including its seeds, eggs, spores, or other biological material capable of propagating that species that is not [native](#) to that ecosystem (from Executive Order 13112 on Invasive Species). Also called an [exotic species](#), non-native species, non-indigenous species or [introduced species](#).

Anal fin—the fin on the median (i.e. middle) line behind the vent (i.e. the anus).

Anterior—relating to the front portion of an organism.

Aquarist—a person who keeps or maintains an aquarium.



An adult lionfish in all its glory! Note the fan-like pectoral fins and slender, straight dorsal spines. (Photo credit: John Randall; U.S. Geological Survey)

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Aquarium Trade—the selling of aquatic life for public or private display.

Aquatic—growing or living in, or frequenting water.

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B

Ballast Water—water carried in special tanks (ballast tanks) of ships used to provide stability needed when carrying less than a full load of cargo and to keep the ship at the proper depth in the water. When the ship is loaded with cargo, the ballast water is released to surrounding waters; when the ship is empty, it takes on more water to keep it upright. Some vessels use sand as ballast rather than water.

Benthic—bottom-dwelling, living on the seabed.

Bilge—another term for [ballast water](#).

Biodiversity (or Biological Diversity)—the variety of species, their genetic make-up, and the natural communities which they compose. All the different kinds of organisms living in an area.

Biological Classification—the hierarchical grouping of organisms into categories based on evolutionary relationships. Seven hierarchical levels (or taxa) are commonly used: kingdom, phylum, class, order, family, genus, and species.

Biological Control (or Bio-control)—using one kind of organism to help manage a harmful species. For example, certain beetles feed on purple loosestrife, an [invasive species](#), and help control its spread.

Biome—major regional ecological [community](#) of plants and animals associated with a particular climate. Examples include: tropical rainforest biome, desert biome, lake biome, and estuarine biome.

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C

Community—an association of living organisms that have mutual relationships among themselves and with their environment, and thus function, to some degree, as an ecological unit.

Competition (or Compete)—any interaction that is mutually detrimental or harmful to both participants, occurring between

species that share limited resources such as food or space. The struggle for limited resources.

Competitor—a species that may compete with another species for the same resources, such as food, water or space.

Continental Shelf—the relatively shallow portion of the sea floor that adjoins and surrounds most parts of the continents.

Coral Reef (or Reef)—a massive, wave-resistant structure, built largely by coral, and consisting of skeletal and chemically precipitated materials.

Cycloid Scales—fish scales that are oval or elliptical in shape with a smooth edge. In this type of scale, the [anterior](#) part of each scale is usually overlapped by the [posterior](#) portion of the scale in front of it, giving the fish greater flexibility than fishes with other types of scales. There are four main kinds of scales (placoid, cosmoid, cycloid and ctenoid, and ganoid,) and numerous variations of each kind.

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D

Dispersal (or Disperse)—the spread of a [species](#), population, or individual's offspring over time.

Distribution—where organisms live in an area; the geographical area (i.e., range) within which a species or other group of organisms occurs.

Dorsal—pertaining to the back or upper surface of an organism. In vertebrates, it means nearest to the spinal column. Dorsal is the opposite of [ventral](#).

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E

Ecology—the study of the relationship among organisms and between organisms and their physical environment.

Ecologist—scientist who studies the interactions between species of organisms and their environment (studies the ecosystem).

Ecosystem—all organisms in a community and the associated non-living environmental factors (i.e. the physical and chemical environments) with which they interact.

Ecosystem Services—the fundamental life-support processes necessary for life, including human, to thrive. Ecosystems

provide "services" that:

- moderate weather extremes and their impacts
- disperse seeds
- mitigate drought and floods
- protect people from the sun's harmful ultraviolet rays
- cycle and move nutrients
- protect stream and river channels and coastal shores from erosion
- detoxify and decompose wastes
- control agricultural pests
- maintain biodiversity
- generate and preserve soils and renew their fertility
- contribute to climate stability
- purify the air and water
- regulate disease carrying organisms
- pollinate crops and natural vegetation

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Endangered Species Act—President Richard Nixon signed the Endangered Species Act (ESA) into law in 1973. The ESA provides broad protection for species of fish, wildlife and plants that are listed as threatened or endangered throughout all or a significant portion of their range and the conservation of the ecosystems on which they depend. "Species" is defined by the Act to mean a species, a subspecies, or, for vertebrates only, a distinct population. Provisions are made for listing species, as well as for recovery plans and the designation of critical habitat for listed species.

Endemic—restricted to a given region. A term applied to populations or species that are found in a particular locality, such as an island, and nowhere else.

Envenomation—the process by which [venom](#) is injected from a venom gland into the recipient.

Environment—the physical and biological conditions that surround an organism or a group of organisms.

Exotic Species—a species that has been transported by human activities, either intentionally or accidentally, into a region where it did not occur previously. Also called an [alien species](#), non-indigenous species, or [introduced species](#).

Extinct—the *complete* global disappearance of a species from existence.

Extirpate—the local disappearance of a species, as opposed to extinction, which is global disappearance.

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F

Food chain—the flow of energy and nutrients from sunlight to plants to predators.

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H

Habitat—the surroundings in which individuals of a particular species usually live (i.e. their address).

Hard-bottom Habitat—(or sometimes called “**Live-bottom**” **Habitat**) an area of rocky outcroppings, also referred to as ledges, which are surrounded by a relatively thin veneer of sand, which varies in vertical relief.

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I

Introduced Species—another term for an [alien species](#), [exotic species](#) or non-indigenous species.

Invasive Species—a species that has been transported by natural processes or human activities, either intentionally or accidentally, into a region where it did not occur previously, and reproduces and spreads rapidly into new locations, causing economic or environmental harm or harm to human health (from Executive Order 13112 on Invasive Species).

Invertebrate—an animal that lacks vertebrae (i.e., a spinal column).

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J

Juvenile—a sexually immature organism that resembles an adult.

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M

Mitigate—taking action to avoid or reduce damages or to make less severe or harsh.

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N

Native Species (or **Indigenous Species**)—applied to a species that occurs naturally in an area, and therefore has not been introduced by humans either accidentally or intentionally.

Neuromuscular—relating to nerves and muscles; jointly involving or affecting nervous and muscular components.

Neurotransmitter—a substance that transmits nerve impulses across a synapse (i.e. the gap between two neurons or nerve cells).

Niche—the functional role of a species in an ecosystem. The sum of physical and biological factors necessary for an organism's or species' existence. The environmental factors that influence growth, survival and reproduction of a species.

NOAA—the National Oceanic and Atmospheric Administration (NOAA), a U.S. federal agency that conducts research and gathers data about the global oceans, atmosphere, space, and sun, and applies this knowledge to science and service that touch the lives of all Americans. NOAA provides these services through five major organizations: the National Weather Service, the National Ocean Service, the National Marine Fisheries Service, the National Environmental Satellite, Data and Information Service, and NOAA Research; and numerous special program units. In addition, NOAA research and operational activities are supported by the nation's seventh uniformed service, the NOAA Corps, a commissioned officer corps of men and women who operate NOAA ships and aircraft, and serve in scientific and administrative posts.

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O

Overfishing—harvesting an [aquatic](#) population below its reproductive capacity to replenish itself.

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P

Pectoral Fins—either of the two fins of a fish that correspond to the forelimbs of a quadruped (a four-legged animal). Pectoral fins are those situated on the chest.

Posterior—towards the hind end of the fish.

Predator—an animal that preys on others. [Also see [Top Predator](#)]

Prey—an animal that is preyed upon by a **predator**.

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R

Ray—a jointed rod which supports a fin.

Reef (or Coral Reef) —a massive, wave-resistant structure, built largely by coral, and consisting of skeletal and chemically precipitated materials.

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S

Species—a group of individuals or populations that are similar and are able to mate and have offspring.

Stressor—five stressors are identified as affecting coastal and marine ecosystems: pollution, [invasive species](#), climate change, extreme events, and land or resource use.

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T

Taxonomist—someone who studies the taxonomy, or orderly classification of plants or animals, according to their presumed evolutionary (natural) relationships.

Terrestrial—living on or in or growing from land (rather than in the air or water).

Top Predator—a species eaten by nothing else in the food web.

Toxin—a poisonous substance that is a product of an organisms metabolic activities and is harmful or fatal when introduced into tissues.

Transect—a line across an area to be sampled, marked by a tape measure. Often permanent markers at the ends of line are left so that the line is easily found upon return.

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V

Vector—an organism or force of nature that spreads an organism to a new area; a path, or method, of invasion. For example, a major vector in zebra mussel invasion is ballast water; the zebra mussels travel from their native waters into

new regions when ballast water collected in their [native](#) ranges is discharged into non-native waters.

Venom (or Venomous)—poisonous matter normally secreted by some animals (snakes, scorpions, bees, and some fish) and transmitted to [prey](#) or an enemy chiefly by biting or stinging.

Viability—the capability of surviving outside the mother’s womb. In the case of eggs or seeds, it means the capability to grow and develop.

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