

Endangered Aquatic Species

Virginia's unique natural heritage includes aquatic communities and ecosystems such as in tidal and nontidal wetlands, the Chesapeake Bay estuary, the Atlantic Ocean coast and 49,000 miles of rivers. These marvelous natural environments are home to more than 10,000 animal species and thousands of plant species – some of which are endangered or threatened.

WHAT ARE ENDANGERED AQUATIC SPECIES?

Aquatic species are those organisms that live wholly or mostly in or on the water (fresh, brackish, or salt). These birds, mammals, fish, reptiles, amphibians, invertebrates and plants depend on aquatic environments for food, shelter, protection from predators, and other requirements of life. A list of aquatic species in Virginia that are endangered or threatened appears at the end of this chapter.

EVERY SPECIES' UNIQUE ROLE

Why should we be concerned about endangered species at all? Should we care if a few more species of freshwater mussels in Virginia become extinct? Who would miss the Shiny Pigtoe (one of Virginia's endangered clams) if it were to disappear? In other words, what is the importance of wildlife?

Endangered species: Organisms (animals or plants) that are at risk of becoming extinct.

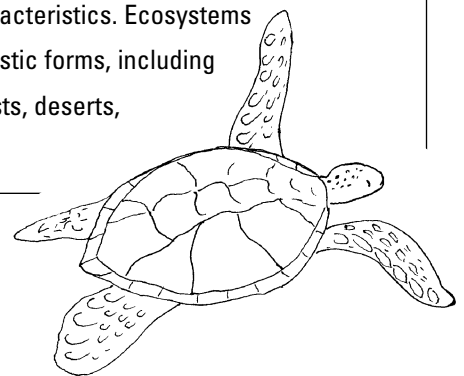
Threatened species: Organisms that are at risk of becoming endangered.

Species of special concern: Organisms that are at risk of becoming threatened or endangered.

Niche: Total role or way of life of a species in an ecosystem; its physical location and function within an ecosystem. Includes all physical, chemical and biological conditions a species needs to live and reproduce. Also called ecological niche.

Habitat: The specific environment (swamp, stream, woods) where an organism or a population of organisms lives or grows, characterized by physical features or by dominant plants.

Ecosystem: A functioning unit of nature that combines biotic communities (plants, animals and other organisms) interacting with each other and with the abiotic environment. Ecosystems vary in size and characteristics. Ecosystems have characteristic forms, including deciduous forests, deserts, grasslands, etc.



HOW CAN WE HELP PROTECT OUR WATER RESOURCES?

In order to understand the value of wildlife, it is important to first understand that all living things are interrelated and dependent in some way on other living things and their environment. An ecosystem, then, consists of all the interacting, interdependent species and the abiotic (nonliving) environment in a given geographic area. As investigated in the Living Systems strand of Virginia's SOLs, plants and animals each contribute to the functioning of the ecological system in this web of interdependence. Every plant and animal has a physical location and function within their ecosystem. The important role they fill is called their niche.

In water-related environments (as in dry-land environments), there are producers, consumers and decomposers. Some aquatic animals are herbivores, while others are carnivores or omnivores. And aquatic food chains have predator-prey relationships just as terrestrial food chains. When the population of one species is eliminated from a biological community, the relationship among producers, consumers and decomposers will undergo a shift.

U.S. Fish and Wildlife Service defines biodiversity as, "The variety of life and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur." More simply stated, biodiversity is all life on Earth including all of its many forms and processes. So, when species go extinct, biodiversity is decreased. Today, scientists around the world believe that protection of biodiversity should be a main priority for world leaders.

REASONS TO PROTECT WILDLIFE

There are additional reasons why we should care about the protection of wildlife. First, species have intrinsic value or value just for being unique and irreplaceable. Species are also ecologically valuable in terms of their relationship and usefulness to other species (including us). When one species becomes endangered or extinct, it can affect all other species that interact with it.

Many aquatic species also have "instrumental" value to humans. This means the species have economic value because they provide us with food, recreation, materials or important services. For example, fish are an important part of our diet. Many species of mollusks, such as mussels, are useful to us as indicators of water quality. They can alert us to water that is not safe. Species can also provide medicines. Many of our medicines today such as aspirin and penicillin originally were obtained from organisms. Beyond their economic value, species are also important to humans for their scientific, spiritual, aesthetic and educational values. Many people greatly enjoy recreational activities such as whale watching. For all of these reasons, protection of wildlife and endangered species is extremely important.

What human activities endanger wildlife?

Species extinction today is occurring at a rate that is alarming many scientists. Biologist E.O. Wilson estimates that 27,000 species go extinct every year (an average of 73 – 74 species per day). He also estimated that only 10 species would become extinct in one year under "normal" circumstances. Human activity

HOW CAN WE HELP PROTECT OUR WATER RESOURCES?

has accelerated the rate. Many species become extinct as a result of many stresses, not just one.

There are five main classes or groups of human activities that cause wildlife and plants to become endangered and eventually extinct. The acronym HIPPO provides an easy way to remember the five categories.

H = habitat destruction and fragmentation

I = introduction of invasive species

P = pollution

P = population growth (human)

O = over harvesting

HABITAT DESTRUCTION AND FRAGMENTATION

With the exception of the whales in our coastal waters, all the endangered and threatened species in Virginia have been listed in part or in whole due to habitat loss. Altering or destroying an ecosystem (or an animal's habitat) can profoundly impact the plant and animal species living there.

Human activities, such as draining and developing wetlands, destruction of aquatic reefs and sea grass beds, expansion of urban areas, logging, mining, farming, construction of roads and dams, and recreation, lead to the loss of important habitat for wildlife.

When a species' habitat is altered such that it is unable to meet its daily needs for survival then it will become endangered and if enough critical habitat is lost, it will become extinct. The following examples illustrate the effects

of human-caused habitat loss on Virginia's aquatic wildlife.

Example 1: Riparian Forest Habitat

Riparian means "...of, on, or relating to the bank of a natural course of water." So, riparian forests are forests along streams, rivers, and bays. They are extremely important as aquatic habitats for several reasons. They help to maintain stream and riverbanks and prevent erosion. Forest trees and shrubs remove nutrients from stormwater runoff and provide food to aquatic organisms from leaf debris. Riparian forest canopies shade and cool the water, improving habitat conditions for the fish, insects, salamanders, frogs and other in-stream organisms. They also provide critical food, shelter and nesting sites for many birds, small mammals and other wildlife. Wildlife such as ducks, herons, salamanders, turtles, and fish are all affected by loss of habitat, and many of these aquatic species are endangered in Virginia partly or wholly due to loss of this critical habitat. Today, hundreds of miles of riparian habitats are being replanted to restore these unique functions and benefits. The Virginia Department of Forestry has more information about riparian buffers in Virginia: <http://state.vipnet.org/dof/rfb/rfb-intro.htm>

Example 2: Wetland Habitat

Wetlands, such as bogs and marshes, have standing water for most of the year and have aquatic vegetation. They provide many direct and indirect benefits to human society, plus are critically important habitats for much of Virginia's aquatic wildlife. Many species of

HOW CAN WE HELP PROTECT OUR WATER RESOURCES?

fish, shellfish, aquatic birds, and mammals depend on wetlands for survival, yet much of the wetland habitat in Virginia has been lost due to human activity. Wetlands and seasonal ponds have been drained or filled by humans for agriculture, road construction, or urban development, contributing to the endangerment of many of Virginia's aquatic species. Underwater habitats in Virginia's streams, rivers and bays have also been altered through increased sedimentation, reduced submerged vegetation beds, dredging, and other activities.

Example 3: Habitat Fragmentation

Development also leads to habitat **fragmentation**, where small, isolated fragments of natural habitat - referred to as ecological islands - are created from what was once continuous natural habitat. These fragmented bits and pieces are like islands surrounded by a sea of towns, roads, fences, power lines, farms and developed land. Fragmentation can lead to:

- local extinctions,
- changes in species abundance, distribution and diversity,
- changes in gene frequencies within a population,
- inbreeding in small, isolated populations,
- barriers (i.e., roads) that prevent movements and dispersal between smaller demographic units of animals,
- increases in the rate of exotic species invasion and
- other disruptions in the ecosystem.

Isolating a local population increases the probability of extinction. Fragmented areas can be too small to provide adequate room and food and so they support fewer species than a larger natural area. Many animal species require several different plant communities during their lifetimes, and may not find all the required elements in one fragmented area. For example, breeding sites requirements may be different than feeding sites. If these critical areas are separated by a road or other barrier, populations will decline.

Can Streams be Fragmented?

Habitat fragmentation can occur in aquatic systems too. Dams separate one part of a stream from another, creating a barrier that migrating fish cannot cross. The reservoir created behind the dam will also have very different characteristics than the natural stream habitat on the other side of the dam, rendering it unsuitable for many aquatic species. Streams that are encased, channelized or otherwise modified are often severed from their adjacent riparian zone, flood plain and wetlands.

To maintain biodiversity, and minimize fragmentation, ecologists recommend that we plan and manage our private and public lands in ways that minimize the isolation of our remaining natural habitats. In addition to minimizing vegetation clearing and road construction, we should restore habitat corridors to connect natural areas. For greatest success, conservation efforts need to be on the comprehensive landscape and watershed scales.

HOW CAN WE HELP PROTECT OUR WATER RESOURCES?

INVASIVE, NON-NATIVE SPECIES

Virginia's native plant and animal communities can be altered, and populations can be decimated, when non-native (non-indigenous) species invade and occupy areas outside of their natural geographic ranges. Invasive or exotic species are non-native plants or animals that lack natural predators and diseases that would control their population. Exotic parasites and pathogens also can inflict great damage to native biota. While not all exotic species cause serious damage, those that are successful in invading an ecosystem typically reproduce quickly and compete with native species for food and other resources such as space. Some native species, not able to compete effectively with the invasive species, quickly decline. Many scientists believe that invasive species are the second greatest threat to threatened and endangered species, behind habitat loss. It is estimated that about 42 percent of endangered and threatened species in the United States are in danger because of the effects of invasive species.

Human actions, both intentional and accidental, are the primary means of invasive species introductions. European colonists who wanted to make the New World more like home originally introduced many species not native to North America. Some intentional introductions of invasive species were intended to help with problems such as erosion and pest control. An example of a plant introduced to control erosion is kudzu, a climbing, perennial vine in the pea family. **Kudzu** was introduced into the U.S. from Japan in 1876 at the Philadelphia

Centennial Exposition, where it was promoted as an ornamental plant, forage crop and soil stabilizer. Farmers were encouraged to plant it to reduce soil erosion, until the mid-1950s when it was recognized as a pest. Kudzu plants grow about one foot per day, and smother other plants under a solid blanket of leaves. Its vines can girdle trees, killing them.

Accidental introductions of non-native organisms can occur when people dump aquariums with exotic plant species or dump ballast water from ships. Organisms can also "hitchhike" on recreational boats, and be introduced to a different body of water. Scientists believe that the disease **MSX**, a leading cause of native oyster mortality in the Chesapeake Bay, was introduced when a foreign oyster was imported to bay waters in the 1930s. To learn more, see The Chesapeake Bay Program's website: <http://www.chesapeakebay.net/baybio.htm>

Invasive Aquatic Plant Species in Virginia

Hydrilla, an invasive submersed freshwater plant, forms dense mats in the Potomac River and Lake Gaston in Mecklenburg and Brunswick counties. It was introduced into Florida in the 1950s and spread to Virginia probably through recreational boating. Hydrilla mats obstruct water traffic and prevent light penetration necessary for the growth of native aquatic plants. **Purple loosestrife** is another invasive plant that grows particularly well in wetlands and marshes in Virginia and is sometimes called the "Purple Plague." Although its purple flowers are beautiful, purple loosestrife

HOW CAN WE HELP PROTECT OUR WATER RESOURCES?

out-competes native plants, and causes loss of habitat for many endangered animals.

Eurasian water-milfoil, indigenous to Europe, Asia and North Africa, is a submersed aquatic perennial that is found throughout the eastern United States. It reduces natural aquatic plant diversity much the way hydrilla does.

Invasive Aquatic Animal Species in Virginia

Rapa whelks, snails that are native to the Sea of Japan, are found in portions of the Chesapeake Bay where they prey on oysters, clams, and mussels. The **mute swan**, a native of Europe and Asia, is a beautiful bird, but is invasive and sometimes kills native waterfowl. It also destroys submerged aquatic vegetation that provides crucial habitat to many native species of fish and invertebrates. The **nutria** is an invasive rodent that lives and breeds in Virginia's fresh and saltwater ponds and swamps. Initially introduced into North America to be raised for fur, nutria destroy native aquatic vegetation.

More information on Aquatic Invasive Plants and Animals in Virginia and the Chesapeake Bay:

The Alliance for the Chesapeake Bay:
http://www.acb-online.org/pubs/invasives_fact_sheet.pdf

The Virginia Natural Heritage Program (in the Department of Conservation and Recreation):
<http://www.dcr.state.va.us/dnh/invinfo.htm>
http://www.dcr.state.va.us/dnh/booke_duc.htm

Invasivespecies.gov: <http://www.invasivespecies.gov>

The Chesapeake Bay Program: <http://www.chesapeakebay.net/baybio.htm>

POLLUTION

Water pollution can have devastating effects on aquatic species. One of the most visible forms of water pollution is the tons of litter and debris that reach our waterways each year from intentional or accidental mishandling of trash. Litter such as cigarette butts, plastic bags, fast food containers, and fishing nets are deposited in streams, rivers and coastal waters. Aquatic species (particularly sea turtles, mammals, and birds) are often killed when they become entangled in or ingest these items. Virginia's sea turtles are endangered and two of the biggest threats to their survival are entanglement in discarded fishing nets and ingestion of marine debris. (See box.)

Toxic pollutants such as chemicals from factories and pesticides are not as visible as solid waste, but are just as harmful to aquatic wildlife. U.S. Fish and Wildlife Service estimates that 136 million pounds of toxic chemicals are discharged directly into streams, rivers, and lakes in the United States each year. Other chemical pollutants enter our waterways by way of polluted runoff from lawns, fields, streets and parking lots. Virginia issues fish consumption advisories every year because many of the fish in our waters have absorbed so many toxins that they are not safe for human consumption. In 2002, poly-

HOW CAN WE HELP PROTECT OUR WATER RESOURCES?

chlorinated biphenyls (PCBs), mercury and a pesticide called Kepone resulted in fish consumption advisories for portions of the following rivers:

North Fork Holston River

South River

South Fork Shenandoah River

North Fork Shenandoah River

Shenandoah River

Roanoke River (Staunton River)

Potomac River and tributaries near Quantico

James River and its tributaries

Levisa Fork River

Dan River

New River

Bluestone River

For current fishing advisories, see the Virginia Department of Health's website: http://www.vdh.state.va.us/HHControl/fishing_advisories.htm

Nutrients

Excessive nutrients are a major source of pollution to Virginia's waterways and the Chesapeake Bay. Human activities that greatly accelerate the input of nutrients into a waterbody include runoff from home fertilizer use, agricultural fields, and confined animal feedlot operations (called CAFOs). Nitrate and phosphate-containing effluents from wastewater treatment plants, and some septic systems also lead to an increase of nutrients

USED MOTOR OIL

It takes very little oil – just one quart – to contaminate 2 million gallons of water, yet each year millions of gallons of oil are dumped, spilled or leaked onto the land and into our waterways. Experts estimate that 50 to 90 percent of the oil polluting estuaries and oceans comes from land sources. Oil that is carelessly poured into roadside ditches or on the ground can enter groundwater and streams. Some people who change the oil in their cars deliberately dump used motor oil down stormdrains, not understanding that stormdrains usually discharge directly to waterways, and the oil will kill the animals that live there. Leaking underground tanks can also contaminate surface and groundwater with home heating oil and gasoline. In addition to the harm oil has on aquatic life, removing oil pollution from water is costly. All motorists, homeowners and commercial garages need to recycle used motor oil and have underground tanks inspected. In addition, oil and other toxic liquids should never be poured down a stormdrain or down any drain at all.

in streams, rivers, lakes, and coastal waters. Another major source of nitrogen entering the Chesapeake Bay and Virginia's waterways is from fossil fuel combustion, about a third of which come from vehicles. (See the box "Atmospheric Deposition of Nitrogen" for more information.) According to the Virginia Institute of Marine Science, excess inputs of

HOW CAN WE HELP PROTECT OUR WATER RESOURCES?

nitrogen into the Chesapeake Bay from fertilizers and automobile exhaust can nurture harmful or toxic algal blooms so dense that they reduce water clarity and shade ecologically important Bay grasses. Also, when the algae die, its decomposition by bacteria depletes the dissolved oxygen in the water. Sometimes the dissolved oxygen level becomes too low to support any life, which can be detrimental to organisms such as mussels and clams that cannot move to new locations. Depleting the dissolved oxygen in an estuary like the Chesapeake Bay results in significant impacts on the people who depend economically on the Bay's living resources. More about the sources and impacts of excess nutrients can be found on the Alliance for the Chesapeake Bay's website: www.bayjournal.com/02-10/qa.htm

Sediment

Sediment, another important water pollutant, is caused by unchecked erosion from construction, logging, or agricultural activities. Riparian forest buffers and erosion-control measures can decrease erosion, and prevent the majority of sediment from entering waterways. Excess sediments can carry toxins to the water, narrow water channels for wildlife, clog fish gills, and cloud the water leading to decreased sunlight for aquatic vegetation. Sediment can also smother underwater habitats, effecting the populations of dragonflies, damselflies, mayflies, and other invertebrate species that have aquatic larva. Recreational boating and personal watercraft also stir up sediment leading to similar problems.

ATMOSPHERIC DEPOSITION OF NITROGEN

Pollution in the air from factories and vehicles becomes water pollution when it is deposited directly onto the surface of the water, or deposited onto land where it can run off into streams. Airborne pollution can fall to the ground in raindrops, snow, dust or simply due to gravity. According to the U.S. Environmental Protection Agency in their 2000 report "Deposition of Air Pollutants to the Great Waters," 21% of the nitrogen pollution entering Chesapeake Bay comes from the air. (See <http://www.epa.gov/oar/oaqps/gr8water/3rdrpt/index.html> for this report.) Nitrogen from atmospheric deposition is added to the nitrogen from other land-based sources, and can threaten the water quality and aquatic living resources. The U.S. Environmental Protection Agency's Office of Wetlands, Oceans and Watersheds has more information on atmospheric deposition: <http://www.epa.gov/owow/oceans/airdep/>

POPULATION

The human populations of the United States and Virginia are increasing. According to the U.S. Census Bureau, the population in Virginia reached over 7 million (approximately 178 people per square mile) in 2000 and continues to increase. Wildlife has to compete with people for suitable habitat, and more people often mean less habitat for wildlife. As demand for housing increases, land is converted from wildlife habitat to residential areas including

HOW CAN WE HELP PROTECT OUR WATER RESOURCES?

homes, roads, and shopping areas. Sprawled, low-density development causes the amount of land used per person to increase, thus decreasing forests, wetlands, and stream habitat for wildlife. Sprawl also increases the amount of air pollution as people drive more. Pavements, rooftops, and other impervious surfaces increase runoff, degrade water quality, and prevent rainwater from percolating into the soil.

Compounding this problem is the fact that 53 percent of the nation's population lives in coastal areas, making these areas the most developed in the nation. According to the Alliance for the Chesapeake Bay, about 14 acres of rural land were developed each hour in the Bay watershed during the mid-1990s, more than double the rate of the 1980s.

The Chesapeake 2000 Agreement (www.chesapeakebay.net/agreement.htm) has set a goal to reduce the rate of "harmful sprawl" 30 percent by 2012. This can be done by encouraging local governments to plan for smarter and more compact development and by increasing the initiatives for landowners to permanently conserve a portion of the landscape. The Alliance for the Chesapeake Bay has more information about urban sprawl: www.bayjournal.com/01-03/develop.htm

OVER HARVESTING

Many species are valuable to humans because they provide food or other goods. When done appropriately on a sustainable basis, harvesting of organisms like oysters, fish, and crabs for food is not detrimental to the species over-

all. However, some species have been over harvested by humans and are now threatened or endangered because of this detrimental human activity.

Whales provide an example of the effects of over harvesting by humans on species populations. Whale oil (oil made from whale fat) provided a major source of light for Americans in the 1800s. This oil was extremely valuable to humans, so whales were hunted to the point that their numbers were drastically depleted. Most whale species are endangered today because of this over harvesting. In Virginia's coastal waters, six whale species are in danger of becoming extinct. One of these species, the right whale, has an estimated total (worldwide) population of less than 400 according to the National Oceanic and Atmospheric Administration.

SOME SPECIES ARE MORE LIKELY TO BECOME EXTINCT THAN OTHERS

Some species have traits that make them more vulnerable to extinction than others. Some species are specialists (as opposed to generalists) because they can only live in a very specialized type of habitat. For example, the piping plover, which is threatened with extinction, is a coastal bird in Virginia that only builds its nests on ocean beaches above the tide line. This specialized habitat requirement has led to the decline of the population of these birds as human development of the beaches and increased human activity on the beaches has greatly decreased the amount and quality of this critical habitat.

HOW CAN WE HELP PROTECT OUR WATER RESOURCES?

Species may also be rare and vulnerable to extinction if they are limited to a small area by barriers that prohibit their movement to other locations. Some species are rare because they naturally have low populations. Typically, very large organisms, organisms with long life spans and low reproductive rates, and top predators do not naturally have large populations. Other species are “nonadaptive,” or cannot adapt quickly to changes in their habitat. If they do not have enough time to

adapt, or move to new areas, their populations will be reduced. Some species will occur only in unfragmented, large patches of their preferred habitat, and cannot live in small patches.

CONSERVING AND RESTORING POPULATIONS OF RARE ANIMALS AND PLANTS

Because extinction is forever, and because public policy decisions can have major impacts

SEA TURTLES-PROTECTED BY THE ENDANGERED SPECIES ACT

Many sea turtle species can be found in Virginia’s waters between May and November. According to Virginia’s Department of Game and Inland Fisheries (one of the agencies and organizations that shares responsibility for protecting and conserving sea turtles in Virginia), between 5,000 and 10,000 sea turtles, mostly juvenile loggerheads and juvenile Kemp’s ridleys, enter the Chesapeake Bay each spring/summer to feed in the warm, shallow waters. Green and leatherback sea turtles are also found within Virginia waters. Occasionally, female sea turtles will crawl out of the ocean to nest on Virginia’s ocean-facing beaches.

All sea turtle species are listed as threatened or endangered and are protected under the Endangered Species Act. In fact, one of the most endangered animals in the world is the Kemp’s ridleys sea turtle. Sea turtles produce many offspring but only about one in 5,000 baby turtles ever reach maturity. They grow slowly and do not reproduce until they are 20–30 years old. Most

sea turtles are predators and depend on large invertebrate populations (such as crabs) for survival. Sea turtles’ already low populations are threatened with extinction by human activities such as littering, development of their critical breeding habitat (beaches), and incidental catch by shrimp and fish trawlers.

Monitoring the distribution and abundance of sea turtles in state waters, examining turtle feeding ecology, and tracking movement patterns of adults and juveniles is coordinated by the Virginia Institute of Marine Science (VIMS). VIMS’ Sea Turtle Program collects data on sea turtle migration, age and growth, physiology and habitat utilization. They work with fishermen and governments to develop fishing gear that can help save turtles’ lives. VIMS’ Sea Turtle Stranding Program treats and rehabilitates injured and ill sea turtles, and determines the cause of death when dead turtles are found. Although the cause of death cannot always be determined, some causes include: drowning due to entanglement, boat strike injuries, illness, and ingestion of fishing hooks, fishing gear or marine debris including plastic bags. In the water, plastic bags resemble

HOW CAN WE HELP PROTECT OUR WATER RESOURCES?

on the geological, physical and biological characteristics of our aquatic ecosystems, governments pass laws to protect existing populations of rare species. In 1973, Congress passed the Endangered Species Act (ESA). The purpose of the act is to provide protection for and to conserve endangered and threatened species and the ecosystems that the species depend on for survival. Federal, state, and local agencies all work together and with

private landowners to provide protection for threatened and endangered species.

The goal of the ESA is “recovery” of endangered and threatened species. Recovery means that the species will no longer be in danger of extinction and will no longer need protection. A species is first listed as threatened or endangered after enough scientific evidence is collected to determine that its existence is threatened. Once a species is listed it is

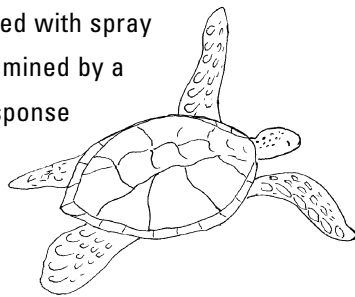
Sea Turtles Continued...

jellyfish, a favorite food of some sea turtle species. When water temperatures drop (usually below 50 degrees Fahrenheit), some sea turtles suffer from cold stunning, where they become disoriented and lethargic and may appear to be dead. Without proper intervention a cold stunned sea turtle will likely die of exposure and hypothermia.

If You Find a Stranded Sea Turtle

If you find a stranded sea turtle (dead or alive) on the western shore of the Chesapeake Bay north of the James River, call the Virginia Institute of Marine Science Sea Turtle Program at 804-684-7313 or toll free at 866-493-1085. For all other strandings, call the Virginia Marine Science Museum Stranding Program at 757-437-6159.

Note: Dead sea turtles marked with spray paint have already been examined by a member of the stranding response team and do not need to be reported again. Do not return live animals to the



water and do not handle any animal without first contacting stranding response personnel for guidance.

More information and resources for teachers:

Virginia Institute of Marine Science Sea Turtle Stranding Program: <http://www.fisheries.vims.edu/turtletracking/stsp.html>

Virginia Marine Science Museum Stranding Team: <http://www.vmsm.com/rescue.html>

Virginia Department of Game and Inland Fisheries: http://www.dgif.state.va.us/wildlife/sea_turtle_strandings.html <http://vafwis.org/bova/lists/CAT03.htm> (species information)

Back Bay National Wildlife Refuge, Virginia Beach: <http://backbay.fws.gov/seaturtles.htm>

National Marine Fisheries Services, Sea Turtle information: http://www.nmfs.noaa.gov/prot_res/PR3/Turtles/turtles.html

Where Sea Turtles Roam by Virginia Department of Game and Inland Fisheries: <http://www.dgif.state.va.us/education/wildwoods/index.html>

HOW CAN WE HELP PROTECT OUR WATER RESOURCES?

protected by the Endangered Species Act from harassment or harm from people. Recovery plans, developed for each listed animal or plant, identify threats and outline strategies for reducing these threats and increasing the populations of the species. Recovery plans can require that critical habitat be set aside and not be developed.

The U.S. Fish and Wildlife Service and the National Marine Fisheries Service (part of the National Oceanic and Atmospheric Administration) are the main federal agencies responsible for the implementation of the ESA. State agencies, such as Virginia's Department of Game and Inland Fisheries, Department of Conservation and Recreation's

Division of Natural Heritage and Office of Plant Protection within the Department of Agriculture and Consumer Services also work toward the recovery of endangered and threatened species, as do local agencies, governments, and private landowners.

Private organizations involved in species protection and recovery efforts include The Ocean Conservancy and the World Wildlife Fund. Organizations in Virginia, such as the Chesapeake Bay Foundation, the Alliance for the Chesapeake Bay, and The Nature Conservancy, also work toward protection of endangered species through protection of habitat necessary for the survival of the species.

Virginia's Mussel Treasures

Virginia's rivers and streams are home to an amazing number of freshwater mussel species. The abundance and variety of Virginia's mussels (also called clams, shellfish, bivalves and unionids) have declined sharply in the last 100 years due to water pollution, sedimentation, dredging, and impoundment of rivers that have destroyed their habitat. Also, during the larval stage of the mussels' complex life cycle, they depend on certain species of fish. Many mussel species will not reproduce in the absence of host fish. Thus, reductions in fish populations due to pollution, dams or other human activities can also have negative impacts on mussel populations. An additional threat to our native freshwater mussels comes from the introduction of non-native species, especially the Asia clam (*Corbicula fluminea*).

Sixty-three counties in Virginia have endangered or threatened mussels in their streams. The majority of these counties have five or fewer, while seven counties in Virginia's southwest corner are home to more than a dozen each. Scott County has the largest number of protected mussel species – 35 in total. The other top counties are Lee (28 species), Russell (26), Tazewell (16), Wise (14), Washington (12) and Smyth (12). These counties are in the watersheds of the Clinch, Powell and Holston Rivers, ancient rivers in which mussels have had an extraordinarily long time to evolve into the diversity we see today. These rivers are unique because they escaped the glaciers of the Ice Age as well as periodic flooding with saltwater.

With colorful names such as snuffbox, monkey face, and heelsplitter, freshwater mussels

HOW CAN WE HELP PROTECT OUR WATER RESOURCES?

Whether employed by a business, private organization, government or school, biologists and specialists devote their careers to studying the habitat and behavior of animals and plants that are rare, threatened, or endangered. Their research and educational efforts help citizens and governments understand that our actions on land can have large impacts on freshwater and marine ecosystems.

Landowners can manage their land to protect natural communities of native plants and animals and improve water quality. Several land trusts operate in Virginia to assist conservation-minded landowners protect the health of our environment by putting conservation easements on their property. These conserva-

tion easements restrict the amount of development that can occur on the land in the future. Conservation, along with active restoration, will ensure that future generations can enjoy the spectacular natural gifts of our state.

Steps to Restore Populations of Rare Species

Communities, schools, and individuals can also help to restore populations of rare animals and plants. Schools and communities can:

- Research the benefits of native plants and locate a waterbody near your school that could benefit from riparian plantings. Plant native vegetation along the shoreline to provide food and shelter for migratory birds

Virginia's Mussels Treasures Continued...

burrow in the bottoms of clear, clean streams and rivers. Some species live in ponds and lakes. They look similar to the saltwater oysters and clams from which they have evolved.

Mussels are of unique ecological importance. As filter feeders, they consume algae, bacteria and organic particles that are suspended in the water column. They serve as natural water filters improving the water quality. They are also an important source of food for fish and wildlife, including muskrats, otters, raccoons and herons. Since the presence of mussels indicates that a waterbody is environmentally healthy, biologists study mussel abundance as an indication of past and present water quality. For example, if all the mussels in a stream die in a short period of time, this indicates

a toxic contaminate has entered the water. Chronic water pollution leads to a gradual disappearance of freshwater mussels.

This extraordinary natural heritage needs protection. Today, Virginians are implementing conservation and recovery projects to inventory existing mussel populations and to artificially culture, reintroduce, and improve the habitats of mussels.

How many protected mussel species are in your county? Refer to the Virginia Water Resource Issues Chart, or visit the Virginia Game and Inland Fisheries web site: <http://vafwis.org/BOVA/LISTS/VCounty.HTM>

More about freshwater mussels:
<http://www.ext.vt.edu/pubs/fisheries/420-014/420-014.html>

HOW CAN WE HELP PROTECT OUR WATER RESOURCES?

and a filter for water entering your local stream, river, or bay. After the planting, monitor the success of the plantings and the wildlife that are using the area. See the Restoring a Stream lesson in this packet for details.

- Research ways local governments can set aside critical habitat for endangered species. Speak to your local government officials about their plans for “smart growth.” Participate in community planning meetings and attend public hearings about development projects in your community.
 - Research safe alternatives to the toxic products we use in our homes. Provide community education about correct disposal of hazardous household wastes and the safe alternatives.
 - Plan a campaign to increase your community’s recycling of motor oil, fishing line, metal items, plastic bags, bottles, cans and more. Include information about the harm litter causes to wildlife.
 - Learn about the amount and types of pesticides and fertilizers that are used by your school and determine if their use could be decreased.
 - Learn what happens to the leaves and grass clippings on your school grounds or in your community. Are they composted?
- Contact the Virginia Land Trust to learn if any landowners in your area have put conservation easements on their land to protect it from future development. Invite the landowner to speak to your class about their decision.

AQUATIC ENDANGERED OR THREATENED SPECIES IN VIRGINIA

This list includes plants and animals that are listed as Endangered or Threatened on the Federal and/or Virginia lists. Additional species are considered “of special concern” or “candidate for listing.” According to Virginia law, “It shall be unlawful to take, capture, kill, possess, transport, process, sell, or offer for sale within the Commonwealth any threatened or endangered species of fish or wildlife unless otherwise specifically permitted by law or regulation.” Learn more from Virginia’s Department of Game and Inland Fisheries: <http://vafwis.org/bova/lists/FSET.htm>

Marine Mammals:

- Manatee, West Indian
- Whale, blue
- Whale, finback
- Whale, humpback
- Whale, right
- Whale, Sei
- Whale, sperm

Mammals (Riparian and Swamp)

- Shrew, water
- Shrew, Dismal Swamp southeastern

Birds (Aquatic, Riparian and Semi-aquatic)

- Plover, piping
- Plover, Wilson’s
- Falcon, Arctic peregrine
- Sandpiper, upland
- Tern, gull-billed

Fish

- Logperch, Roanoke
- Sturgeon, shortnose
- Chub, slender
- Chub, spotfin (= turquoise shiner)
- Madtom, yellowfin
- Darter, longhead
- Madtom, orangefin
- Paddlefish
- Dace, Tennessee
- Darter, sharphead
- Darter, variegate
- Darter, Carolina
- Darter, greenfin
- Darter, Tippecanoe
- Darter, western sand
- Shiner, emerald
- Shiner, steelcolor
- Shiner, whitemouth
- Sunfish, blackbanded

Frog

- Treefrog, barking

Salamanders

- Salamander, Shenandoah
- Salamander, eastern tiger
- Salamander, Mabee’s

Sea Turtles

- Turtle, hawksbill
- Turtle, Kemp’s (= Atlantic) ridley sea
- Turtle, leatherback sea
- Turtle, green sea
- Turtle, loggerhead sea

Turtles

- Turtle, bog
- Turtle, chicken

Mussels

- Monkeyface (pearlymussel), Appalachian
- Pearlymussel, birdwing

- Pearlymussel, cracking
- Bean (pearlymussel), Cumberland
- Monkeyface (pearlymussel), Cumberland
- Pearlymussel, dromedary
- Wedgemussel, dwarf
- Blossom (pearlymussel), green
- Spinymussel, James (= Virginia)
- Pearlymussel, little-wing
- Mussel, oyster
- Mucket (pearlymussel), pink
- Pearlymussel, slabside
- Floater, brook
- Lilliput, purple
- Snuffbox
- Spectaclecase
- Heelsplitter, Tennessee
- Coil, shaggy
- Mussel, slippershell
- Coil, rubble
- Supercoil, spirit

Clams

- Sandshell, black
- Papershell, fragile
- Pimpleback
- Sheepnose
- Supercoil, brown
- Fanshell
- Pigtoe, fine-rayed
- Bean, purple
- Pigtoe, rough
- Rabbitsfoot, rough
- Pigtoe, shiny
- Riffleshell, tan
- Pigtoe, Atlantic
- Pigtoe, pink (= pyramid)
- Deertoe
- Elephant-ear
- Pigtoe, Ohio

Aquatic Crustaceans

- Isopod, Lee County Cave
- Isopod, Madison Cave
- Amphipod, Madison Cave

Snails

- Snail, Virginia fringed mountain
- Ghostsnailed, thankless
- Riversnailed, spiny

Plants (Aquatic, Wetland, Riparian or Semi-aquatic)

- Northeastern bulrush
- Small-anthered bittercress
- Swamp-pink
- Virginia spiraea
- Mat-forming Water-hyssop
- Piratebush
- Variable sedge
- Virginia sneezeweed
- American ginseng

HOW CAN WE HELP PROTECT OUR WATER RESOURCES?

RESOURCES

For the teacher...

A Guide to Endangered and Threatened Species in Virginia. Terwilliger, K., Editor (1995). McDonald & Woodward Publishing Co.

Alliance For the Chesapeake Bay – Bay Journal <http://www.bayjournal.com/>

Chesapeake Bay Foundation - Environmental Education <http://education.cbf.org/>

Chesapeake Science on the internet for Educators www.vims.edu/chessie

Chesapeake Bay Program
<http://www.chesapeakebay.net>

The Diversity of Life. Wilson, E.O. (1992). W.W. Norton & Company

Endangered Species Act <http://www4.law.cornell.edu/uscode/16/ch35.html>

Endangered Whales by National Oceanic and Atmospheric Association <http://www.yoto98.noaa.gov/books/whales/whale1.htm>

Fundamentals of Conservation Biology by Malcolm L. Hunter, Jr. 2002: Blackwell Science, Inc.

Invasivespecies.gov (fact sheets on invasive species) <http://www.invasivespecies.gov>

Marine Mammal Protection Act <http://www4.law.cornell.edu/uscode/16/ch31/html>

Marine Protection, Research and Sanctuaries Act <http://www4.law.cornell.edu/uscode/16/ch32.html>

National Marine Fisheries Service (part of the National Oceanic and Atmospheric Administration) <http://www.nmfs.noaa.gov/>

National Oceanic and Atmospheric Association – Education Program <http://www.education.noaa.gov/socean.html>

Natural Heritage Program (Virginia Department of Conservation and Recreation) <http://www.dcr.state.va.us/dnh/>

Project Wild sponsored by Virginia Department of Game and Inland Fisheries <http://www.projectwild.org/index.htm>

U.S. Census Bureau - Virginia Quick Facts <http://quickfacts.census.gov/qfd/states/51000.html>

U.S. Fish and Wildlife Service, Environmental Contaminants Program <http://sacramento.fws.gov/ec/default.htm>

U.S. Fish and Wildlife Service, Information on Invasive and Endangered Species: <http://www.fws.gov/>

U.S. Fish and Wildlife Service, Teacher's Packet <http://endangered.fws.gov/kids/heyteach.htm>

Virginia Department of Agriculture and Consumer Services Office of Plant Protection <http://www.vdacs.state.va.us/plant&pest/endangered.html>

Virginia Department of Conservation and Recreation's Division of Natural Heritage (Endangered species listed by county) <http://www.dcr.state.va.us/dnh/nhrinfo.htm>

HOW CAN WE HELP PROTECT OUR WATER RESOURCES?

Virginia Department of Game and Inland Fisheries <http://www.dgjf.state.va.us/>

Virginia Fish and Wildlife Information Service <http://vafwis.org/perl/vafwis.pl/vafwis>

Virginia Institute for Marine Sciences - Ocean Sciences Teacher Resource Center <http://www.vims.edu/bridge/>

Virginia Marine Science Museum – Teacher's Corner <http://www.vmsm.com/teachers.html>

Virginia's Natural Resources Education Guide <http://www.deq.state.va.us/vanaturally/guide.html>

World Wildlife Fund's Endangered Species Program <http://www.worldwildlife.org/species/species.cfm>

For the student...

Kids Corner Endangered Species by U.S. Fish and Wildlife Services <http://endangered.fws.gov/kids/index.html>

Piping Plover Fun Stuff for Kids by U.S. Fish and Wildlife Services <http://pipingplover.fws.gov/fun/index.html>

