

AG IN THE CLASSROOM—HELPING THE NEXT GENERATION UNDERSTAND THEIR CONNECTION TO AGRICULTURE

Dad: Do remember this lake?

Chris: Yes. I caught my first fish there. We camped nearby and there were lots of birds. I thought I saw a bat. We fished from the rocks. The next day we went boating.

Dad: Do you want to go back?

Chris: Can we? I love camping. I wish we lived there and could go fishing and boating every day.

Dad: What do you remember about the rocks?

Chris: It was part of the dam. You said the water was deep next to the rocks, and that the water was stored in the reservoir so farmers and people in cities would have water when they needed it.

Dad: Do remember anything else about your time there?

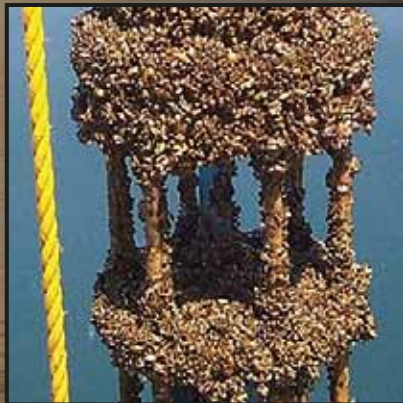
Chris: We went to a wildlife class at the campground. They told us about the different birds and other animals that lived near the lake. We looked at some birds through binoculars and saw tracks in the dirt from deer and raccoons.

Dad: Who takes care of the lake?

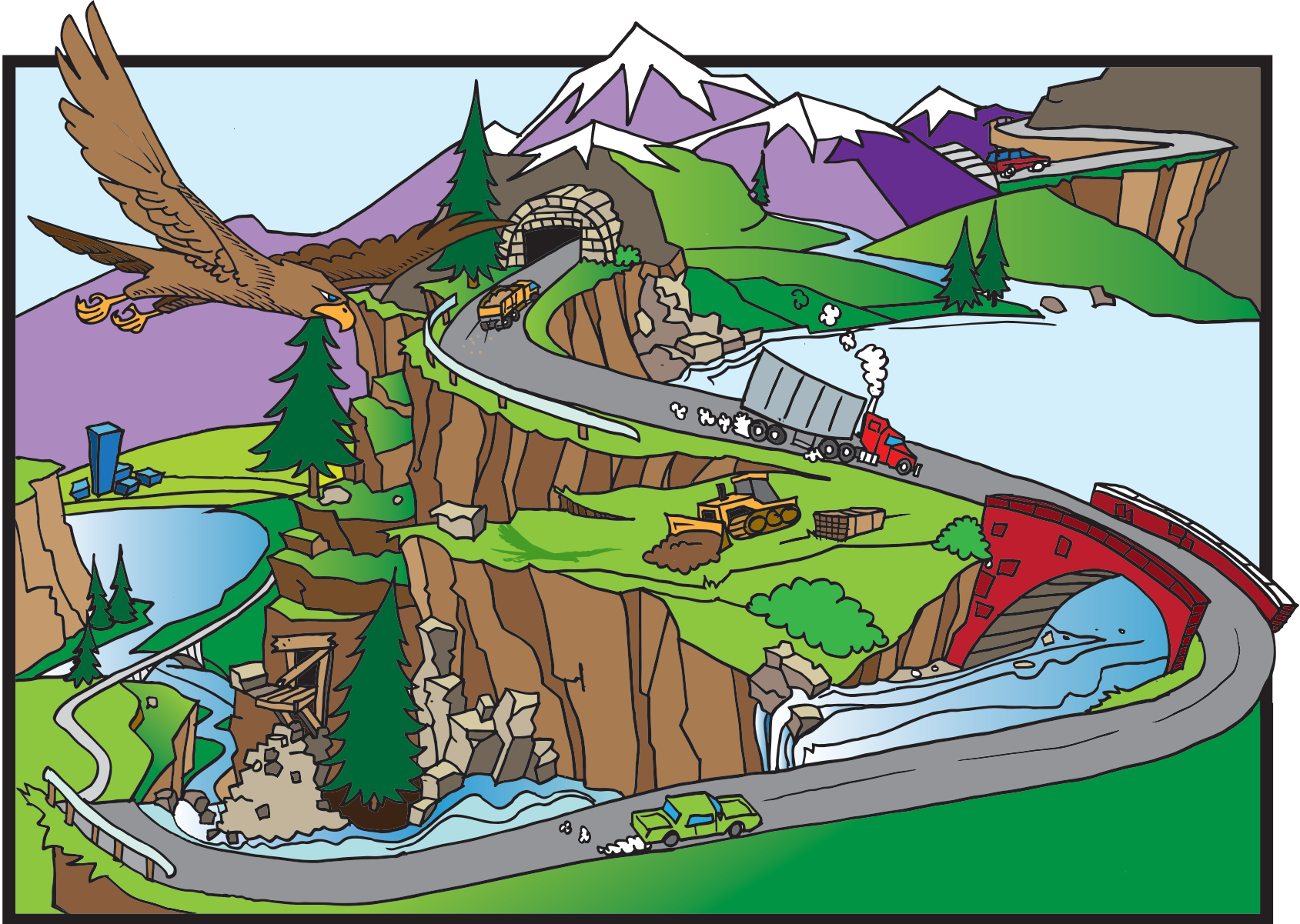
Chris: There were rangers and volunteers to help, but they said all of us needed to help by not littering or polluting.

Dad: What would you think if people didn't take care of this lake?

Chris: I'd be sad. That's the best place to visit...



**Don't Move a Mussel!
See inside!**



The water you drink starts as snow in the mountains. When it melts, it begins its journey toward the ocean, forming creeks, rivers and lakes. Along the way, it may help grow crops, fill your

bathtub or provide a drink for wildlife. The water is pretty clean when it starts, but what are some of the sources of pollution that may impact water that will later supply your home or school?

Study the Picture Above to Find Possible Sources of Water Pollution

Dad! Look at that stuff going into the storm drain! Where does it ALL go?



Write your answer here...

No Swimming, No Fishing, No Boating, No Baths?

What if you arrived at your favorite lake for a vacation and the sign said closed? No camping. No Boating. No fishing. No Swimming. No fun. Or, what if you got a notice that the water in your home wasn't safe to drink or bathe in?

It could happen. Our waterways are delicate ecosystems that are threatened in many ways. Sooner or later, the water

Colorado: Mother of Many Rivers

There's no place like Colorado—spectacular mountains, vast plains and mighty rivers. Each of these areas has its own distinct ecosystem. A fragile balance of climate, geography, soil, plants and animals. If something disrupts this balance, the entire system can suffer.

People are part of this balance. Our food, water and natural resources all share in this interdependent relationship.

In particular, water plays a critical role. The snow that accumulates in the mountains melts in the spring, feeding rivers that supply water to 18 states and Mexico.

According to the U.S. Environmental Protection Agency, the number one threat to our drinking water supply is runoff pollution, sometimes called nonpoint source pollution.

To better understand runoff pollution, consider a parking lot somewhere in your community. You'll see oil spots and skid marks from vehicles, litter, dirt and maybe chemicals or salt on the ground. When it rains or

snow melts, these pollutants are washed away into storm drains which lead to nearby waterways. In a large city, there could be thousands of such parking lots adding their pollutants to a river. Runoff pollution is the impact from all of these different sources.

When pollution from many sources comes together in a waterway it can become concentrated, damaging habitat for fish and plants. When the habitat is damaged, it also impacts birds and other animals that depend on the rivers and lakes for food. The water might also become unsafe to grow food. The rivers, lakes and reservoirs also provide our drinking water. The more polluted it becomes, the more difficult and expensive it becomes to treat and make safe for human consumption.

We may not usually think of aquatic nuisance species (ANS) as a pollutant, but ANS can alter the balance in our ecosystems. They can destroy habitat and infrastructure needed to store, treat and deliver water.

from your favorite lake is going to be somebody's drinking water—maybe yours. If it becomes polluted it usually can be cleaned, but the dirtier it is, the more expensive it is to clean.

While we can usually turn the water faucet on at school, clean water is a limited, precious resource. A resource we can't live without.

What Are Aquatic Nuisance Species (ANS)?



Zebra mussels multiply rapidly and can damage water pipes, boats and other objects in the water.

Plants and animals that live in the water or along the water's edge are called aquatic species. Colorado has aquatic species that are not native to the state and have been brought here from somewhere else. These non-native species can be invasive. In the September 2009 *Colorado Reader*, we learned what an Invasive Species is and how these non-native plants and animals can cause harm to the environment, cause economic loss to humans and affect human health. **Aquatic**

Nuisance Species (ANS) are a type of invasive species that includes aquatic plants and animals.

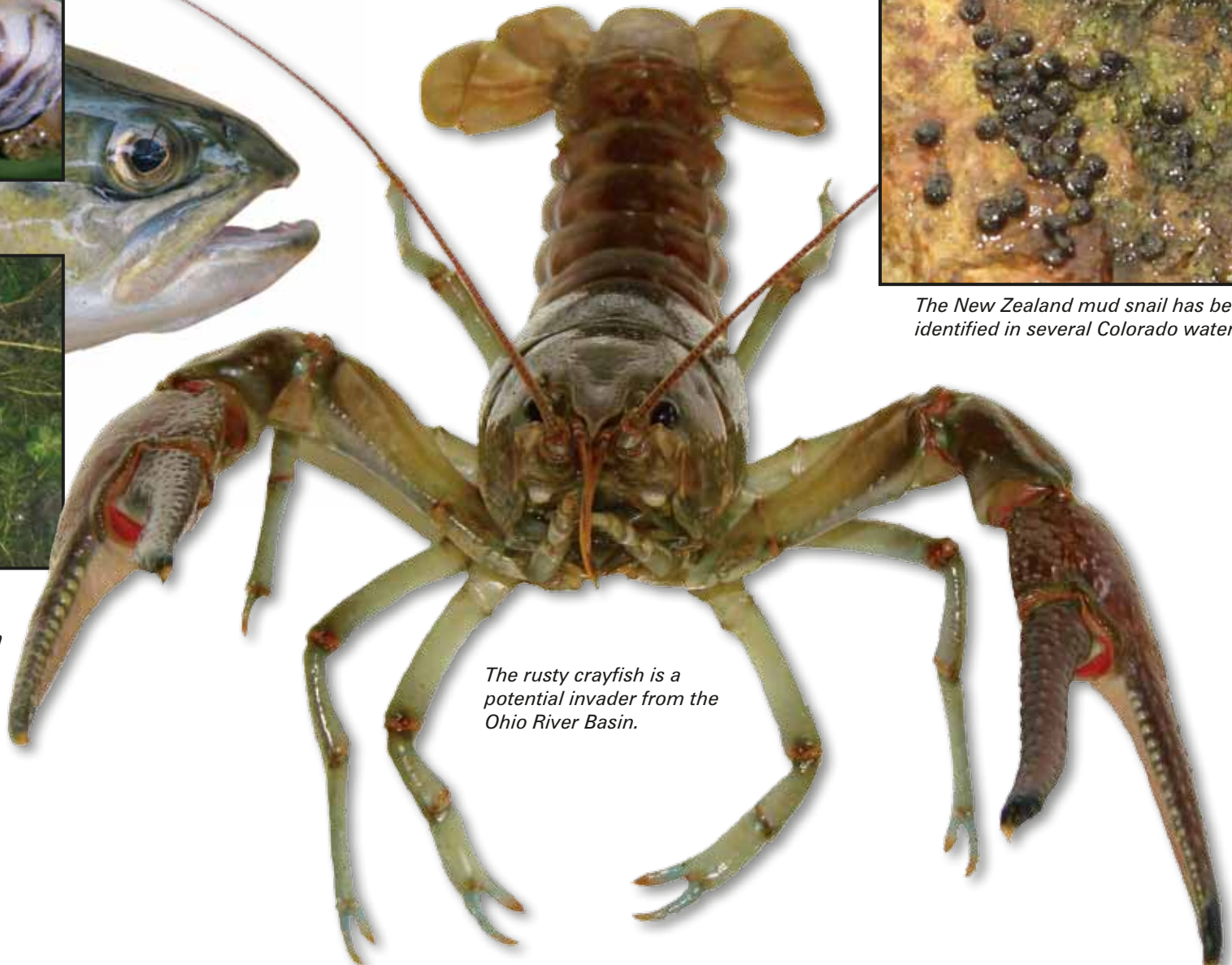
ANS are non-native aquatic plants, animals, viruses and pathogens (microbes) that harm native aquatic plants and animals. They also cause problems for the many ways humans use water (drinking water, water treatment plants, irrigation, power, recreation, etc.).

ANS threaten native species by eating their food and taking over their space. ANS can clog boat motors and intake pipes, making it difficult to go boating, water-skiing or fishing. By attaching to boats, ANS are able to "hitchhike" over land and be transported great distances from one lake to another causing more problems as they spread. ANS interfere with municipal, commercial and agricultural water supplies by clogging pipes, streams and ditches, which make it very expensive to move water from our reservoirs to our farms and cities.

COLORADO'S MOST UN★WANTED



Zebra mussels (top) are an example of a nuisance species. Eurasian watermilfoil (above) is a nuisance plant species.



The rusty crayfish is a potential invader from the Ohio River Basin.



The New Zealand mud snail has been identified in several Colorado waterways.

Aquatic Nuisance Species (ANS) are rapidly growing threats to Colorado's waters. These are non-native animals, plants and pathogens that can destroy our fish habitats and aquatic ecosystems. Some ANS are already present in Colorado.

Recreational boating and fishing is the main way people spread ANS. They can also be introduced from aquariums and fishing bait. Never release aquarium pets or bait into ponds, streams, rivers, lakes or reservoirs.

New Zealand Mudsail

Native to New Zealand, the tiny mudsnail was first detected in the United States in 1987 in Idaho's Snake River and has since spread throughout the West. The mudsnail is currently found in three Colorado locations. It only takes 1 mudsnail to cause a new infestation since they are all clones of each other. They have been known to reach densities as high as 700,000 snails per square meter.

Eurasian Watermilfoil

Native to Europe, Asia, and Northern Africa, Eurasian Watermilfoil (EWM) was first found in the eastern United States in the 1940s. In 1999 it was found in the Rio Grande River in Colorado. EWM is an aquatic, perennial weed that roots on the bottom of water bodies. EWM leaves are finely divided with 12-20 leaflets and occur in whorls of 3 to 4 along the stem, giving milfoil a unique feather-like appearance. EWM stems are pink or olive in color, and they usually grow 3 to 10 feet in length, but can exceed 30 feet. New plants emerge from each stem joint forming thick mats.



EWM is an aggressive aquatic plant that can grow up to 1 foot per week. EWM is like an underwater tumbleweed, in that it will break off pieces of itself, send them downstream, where they will grow

Zebra and Quagga Mussels: The Worst Aquatic Invasive Species!

Zebra and Quagga mussels are freshwater bivalve mollusks—animals with two shells. They are relatives of clams and oysters. Zebra and Quagga mussels look very much alike, and it is difficult to tell the two species apart. They get their name because of the shell color which alternates between light and dark brown, forming stripes like a zebra. The mussels range in size from very, very small up to about two inches long. Adult zebra and quagga mussels do not live in the mud but live on hard surfaces such as rocks, dams, sand, boats, ropes, docks and pipes. They have tiny threads called **byssal threads** that they use to attach themselves to the hard surfaces. Our native mussels don't have the ability to attach to surfaces because they don't have byssal threads. This ability to attach is one reason why zebra and quagga mussels are so invasive!



The zebra and quagga mussels have three phases to their life cycle. Their microscopic babies are called “veligers” and are free-

floating in the water. As they grow, they start to build their shells and use their byssal threads to attach themselves to a solid surface. Once their shells are fully formed, they are considered adult mussels.

Division of Wildlife scientists have been monitoring Colorado waters for ANS since 2005. When sampling for mussels, the scientists perform three different tests—one for each life cycle. The first test is to look at water samples for the veligers. The second test is to check hard surfaces for the juveniles. The third test is to turn

over rocks and other surfaces along the shoreline searching for the adults. When mussels first arrive in a new lake, they live in deep, dark waters where it is difficult to find them.

Zebra mussels are native to the Black and Caspian Seas. They were discovered in the Great Lakes in 1988 and have since spread to 26 states in the United States. Quagga mussels are native to the Dnieper River Drainage in the Ukraine, and were first found in the Great Lakes in 1989.

new roots, settle in the lake or river and grow an entire new population. EWM forms dense weed mats that can clog ditches and canals, making it hard to move water to cities and farms. These dense weed mats also make it tough for people and fish to swim in infested water.

Spiny Water Flea and Fishhook Water Flea



Spiny and fishhook water fleas were introduced to the Great Lakes from Europe. Water fleas are found in all of the Great Lakes and have expanded to many inland lakes and rivers. Spiny and fishhook water fleas are not present in Colorado. Like zebra and

quagga mussels, water fleas can “hitchhike” on boats and recreational equipment, increasing the chance of them coming to Colorado.

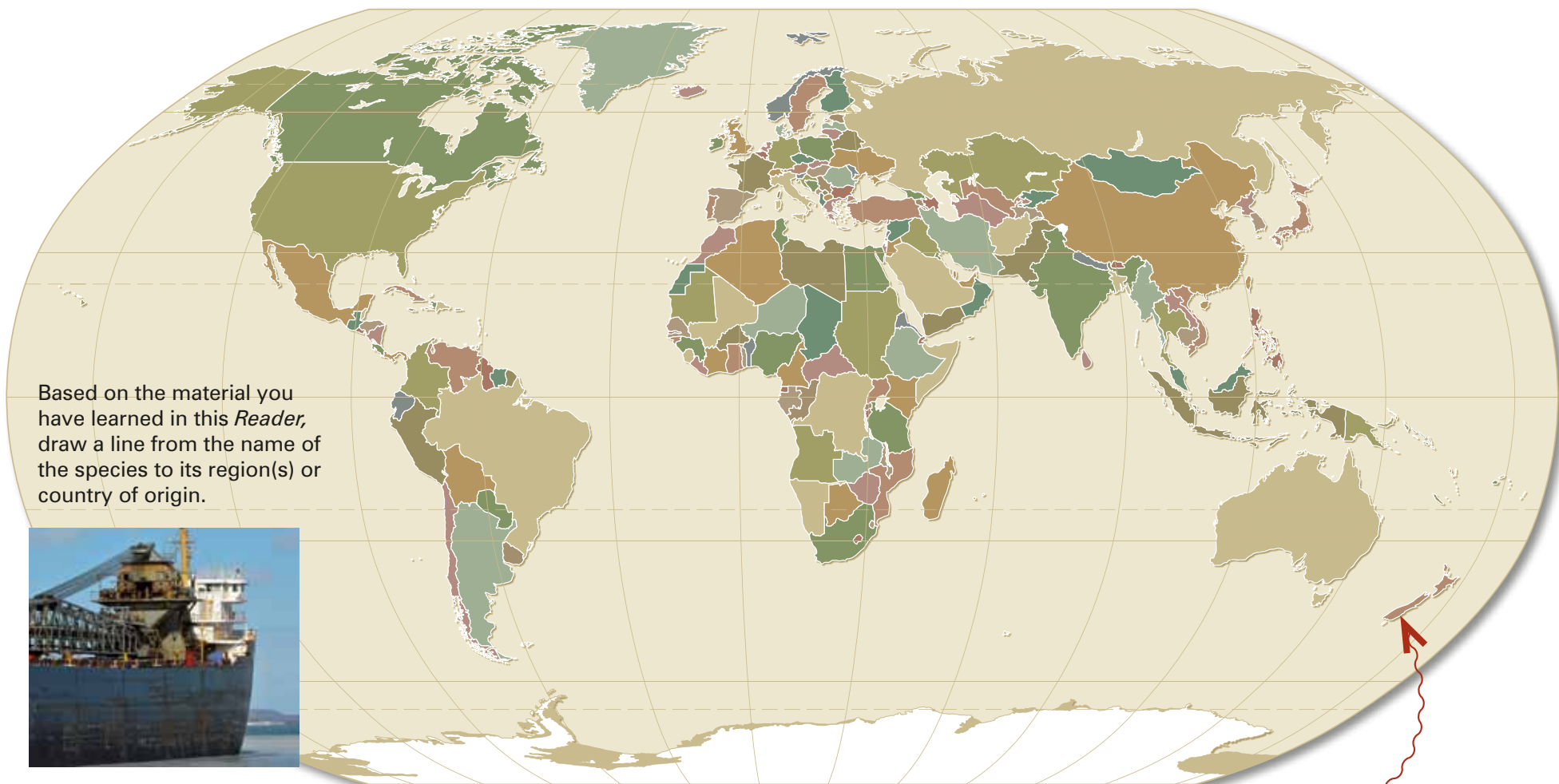
Viral Hemorrhagic Septicemia Virus

Viral hemorrhagic septicemia virus (VHS) is a deadly virus that kills fresh and saltwater fish. VHS originated in Europe and was first detected in the United States in 1988. The virus has spread throughout the Great Lakes Region. VHS has not been detected in Colorado. VHS infected fish experience bleeding of their internal organs, skin and muscle. Some fish show signs of infection that include bulging eyes, bloated abdomens and bruised-looking skin, gills and fins.

Rusty Crayfish

Native to the Ohio River Basin, the rusty crayfish has spread throughout the northeast United States. Rusty crayfish are used as bait to catch other fish. Rusty crayfish inhabit lakes, ponds and both pool and fast-water areas of streams, making many areas in Colorado potentially suitable habitat.

The rusty crayfish is an aggressive and opportunistic feeder with a voracious appetite for aquatic plants, native crayfish, juvenile fish and fish eggs. In heavily infested areas, rusty crayfish also affect recreational swimming. The fear of stepping on and being pinched by the aggressive, large-clawed “rusties” is very real.



Based on the material you have learned in this *Reader*, draw a line from the name of the species to its region(s) or country of origin.



- 1. Quagga Mussel
- 2. Zebra Mussel
- 3. Spiny Water Flea

- 4. Fishhook Water Flea
- 5. Eurasian Watermilfoil
- 6. Viral hemorrhagic septicemia virus

- 7. New Zealand Mudsnail
- 8. Rusty Crayfish

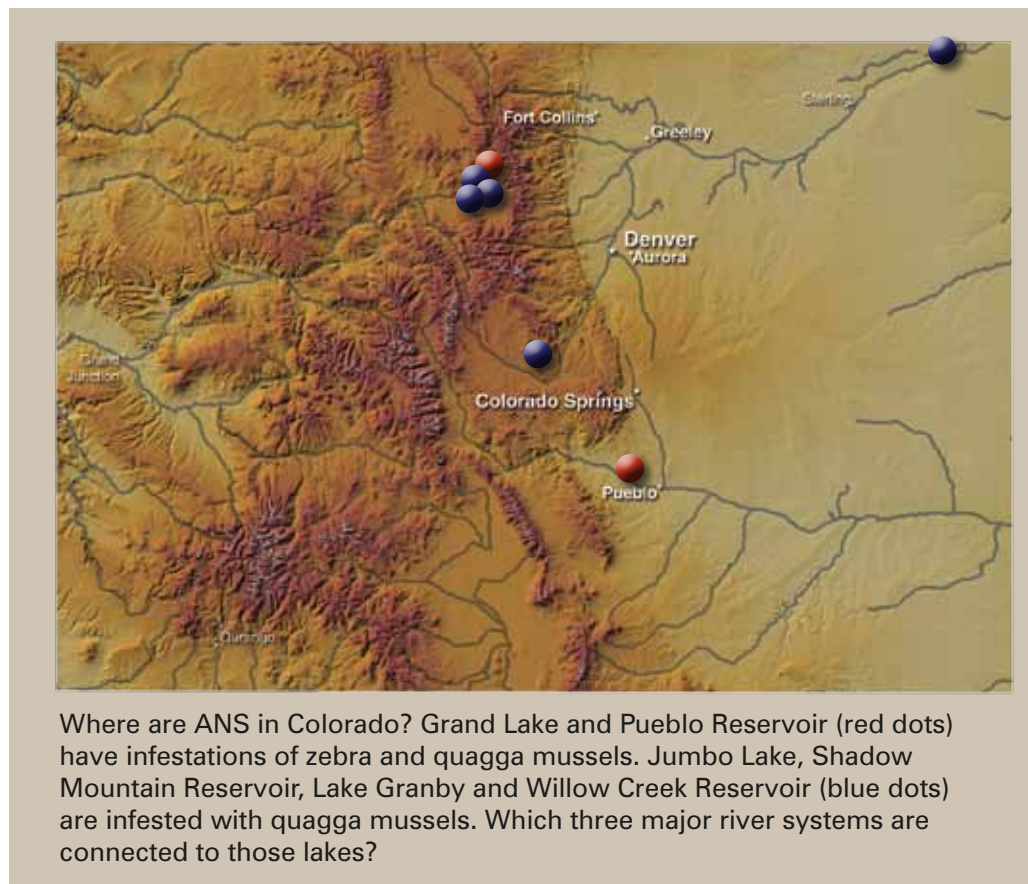
Do the Math...

Let's start with one pair of mussels that lays 1 million eggs each year. Ten percent survive to breed the next year. These mussels also lay 1 million eggs and 10% survive. How many mussels will there be at the end of 5 years? Enter the missing numbers below (the first one is a sample):

- Yr. 1: 100 Thousand
- Yr. 2: _____ Billion
- Yr. 3: _____ Quadrillion
- Yr. 4: _____ Quintrillion
- Yr. 5: _____ Septillion

What does a septillion look like?
 1,000,000,000,000,000,000,000
That's a big bunch of mussels!

Answers: 100 (sample), 10, 1, 100, 10



Where are ANS in Colorado? Grand Lake and Pueblo Reservoir (red dots) have infestations of zebra and quagga mussels. Jumbo Lake, Shadow Mountain Reservoir, Lake Granby and Willow Creek Reservoir (blue dots) are infested with quagga mussels. Which three major river systems are connected to those lakes?

Which Watercraft Are The Greatest Risk For Transporting ANS?

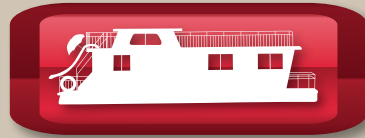
All boats and floating devices must be inspected for ANS prior to and leaving an infested water or entering Colorado from out of state.

Marina boats are the highest risk, especially commercially hauled boats. Hand-launch craft have very low risk.

Help Put a Stop to these Nasty Villains!

Pets and personal equipment such as waders, fishing gear, and decoys can transport mussels too. Although this usually only a very low biological risk for mussels, there is still a high possibility that

Don't Move a Mussel...



House Boats, Cabin Cruisers, Ski Boats with Ballast Tanks—High Biological Risk—Requires thorough inspection.

Zap the Zebra...



Large Open Boats, Sailboats, Wake Board Boats, Personal Watercraft (PWC, Jet Skis)—Medium to High Biological Risk. Verify that no mussels or other ANS can be found on hull, engine, or trailer and that ballast bilge, and live wells are drained. There should be no mud or plants on craft.

pets and equipment will transport other ANS, such as New Zealand mudsnails. All pets and equipment, especially fishing waders and gear, need to be cleaned and dried every time they are used.



Smaller Open Boats with Outboard Motors (No Live Wells, No Bilge Tanks)—Low Biological Risk—Verify that there are no mussels on the hull or trailer and that ballast and engine water is kicked out. If the boats or personal watercraft are very dirty, clean prior to launch.



Hand-launched Craft: Canoes, Kayaks, Belly Boats, Inflatables—clean and dry between launches. If the water craft are very dirty, clean prior to launch.

Bust Rusty Crayfish...

Nail the Snail...

Clean, Drain, and Dry!

What can you do?

Educate yourself, friends and family about Aquatic Nuisance Species.

- ▲ Never release your pet turtles, fish, snails, frogs, rabbits (etc) into the wild, lake or stream.
- ▲ Clean/drain/dry your boat and trailer each time it is used.
- ▲ Clean and dry your pets.
- ▲ Clean and dry any gear that's been in the water, especially fishing gear and waders.
- ▲ If you keep a fish, use a bucket instead of the boat's live well.
- ▲ Don't use live bait from another location. Throw unused live bait in the trash when done. If you purchase bait, be sure to store it in a bucket, not the live well, and keep your receipt to identify its point of origin.
- ▲ If you find a mussel, call or contact the Colorado Division of Wildlife Mussel Hotline at 1-303-293-6581 or the Federal ANS Hotline at 1-877-STOP-ANS (1-877-786-7267).
- ▲ Learn more on the Web site at www.colorado.gov/wildlife
- ▲ Learn more about the Colorado State Parks boat inspection program to protect the state's reservoirs and rivers at www.colorado.gov/parks.

Salty language...

There are a few boating terms in this reader you may find unfamiliar unless you've spent time aboard large boats or ships. Sailors sometimes use the word "salty" to refer to things that are part of sailing or life at sea. Sailors are sometimes called "old salts."

On ships, the lower part of the ship—the part that's partially below the water—is called the hull. The hull commonly has an inner and an outer layer. Water that collects in the area between the two layers is called "bilge." Bilge water is one way ANS can "hitchhike" around the world.

Similarly, ships have tanks onboard that are used to store water to help the ship's stability and how it sits in the water. The water stored in these tanks is known as ballast water. This water is usually pumped into the ship when it is ready to go to sea and is often pumped out after the ship's cargo is unloaded at its destination—another possible free-ride for ANS.

Boats used for fishing—large and small—often have what is known as a "live well." This is a tank where bait or fish can be stored alive. You might think of it as being similar to having an aquarium on board. Unfortunately, live wells can also provide transportation for ANS from one place to another.

You may not be an "old salt" yet, but you now know your bilge from your ballast!

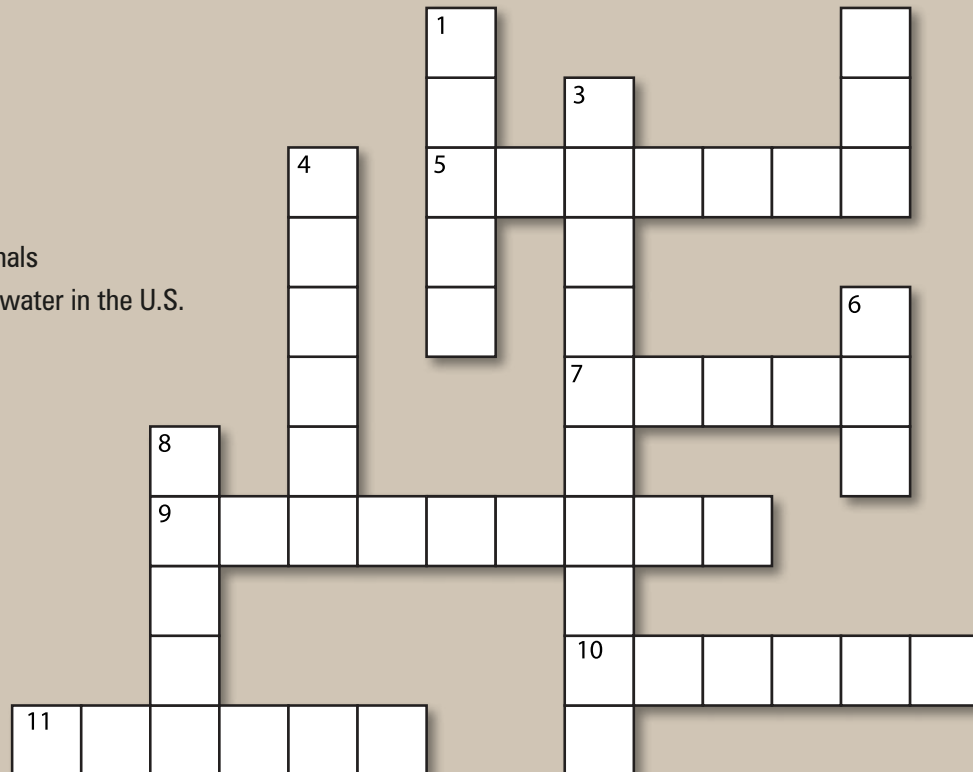
ANS Crossword Puzzle

ACROSS

- 5 Aquatic nuisance _____
 7 Our most precious resource
 9 The balance of climate, geography, soil, plants and animals
 10 The type of pollution that is the largest threat to clean water in the U.S.
 11 Don't move a _____ mussel

DOWN

- 1 _____ Crayfish
 2 Aquatic nuisance species
 3 The start of a river
 4 Foreign country that gets water from Colorado
 6 Clean, Drain and ____
 8 Zap the _____ mussel



Do your part!



I Pledge To Help Protect Colorado's Water By:

Please check at least five actions below that you are ready to try.

- I will clean all my toys and equipment that comes in contact with lakes or streams.
- I will clean my pets after they come in contact with lakes or streams.
- I will tell my parents to clean, drain and dry all water craft and equipment that have been in lakes or streams.

Do not release any pets or plants into the wild!

- I will not release my aquarium fish to any natural waters.
- I will not put my aquarium plants in any natural waters.
- I will not capture any animal or plants and put them in any different natural waters.
- I will keep water clean, because we all live downstream.
- I will not throw trash in any water body.
- I will pickup my pet's poo and put it in the trash.

Make a copy of your pledge and post it on your refrigerator so you can remember your action plan!

To get a Free H2O Jo & Flo magnet, review your pledge with a parent, sign your name, have them sign it and then send to:

Colorado Foundation for Agriculture
 P.O. Box 10
 Livermore, CO 80536

Please be sure to put your return address on your envelope!

 Student signature

 Parent signature



STOP AQUATIC HITCHHIKERS!™

Teacher's Guide

AG IN THE CLASSROOM—HELPING THE NEXT GENERATION UNDERSTAND THEIR CONNECTION TO AGRICULTURE

ANS Web Resources

Colorado Division of Wildlife: <http://wildlife.state.co.us/WildlifeSpecies/Profiles/InvasiveSpecies/ZebraandQuaggaMussels.htm>

National Invasive Species Information Center: www.invasivespeciesinfo.gov/unitedstates/co.shtml

100th Meridian Initiative: <http://www.100thmeridian.org/>

Protect Your Waters: <http://www.protectyourwaters.net/>

Colorado State Parks: <http://parks.state.co.us/NaturalResources/ParksResourceStewardship/AquaticNuisanceSpecies/>

United States Federal Aquatic Nuisance Species Task Force: <http://www.anstaskforce.gov>

NPS Web Resources

Nonpoint Source Colorado <http://www.npscolorado.com/>

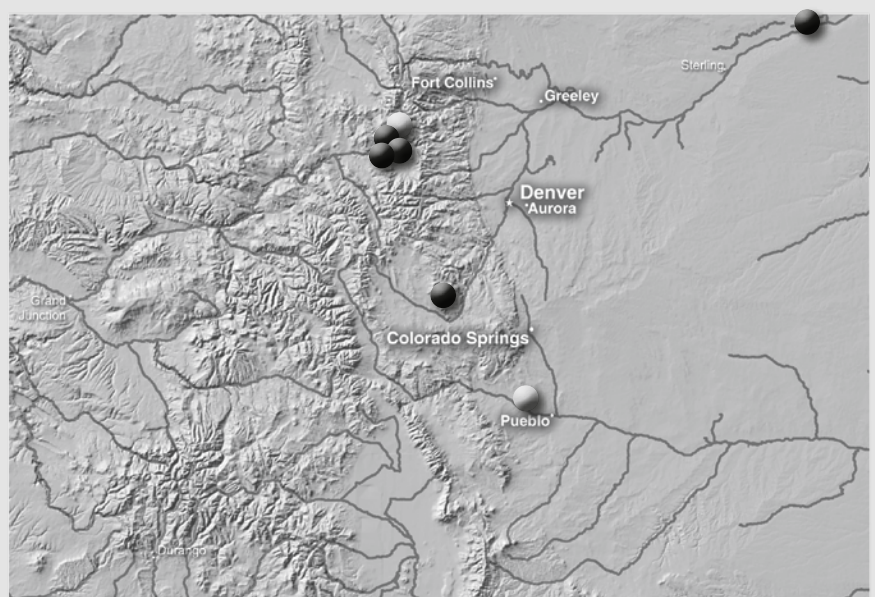
CDPHE Nonpoint Source Program <http://www.cdphe.state.co.us/wq/nps/>

CFA's Water Pollution: Problems & Solutions To Nonpoint Source Pollution http://www.growingyourfuture.com/lessonPlans/hs_nps.html

CFA Comix: Watershed Defenders <http://www.growingyourfuture.com/programs/comix/index.html>

Colorado Water Protection Project <http://www.ourwater.org>

Comments, questions, suggestions and feedback about the Colorado Reader are welcome. Contact: Colorado Reader Publisher: Colorado Foundation for Agriculture Bette Blinde, Director, P.O. Box 10, Livermore, CO 80536, Phone (970) 881-2902, bblinde@growingyourfuture.com



Grand Lake and Pueblo Reservoir (gray dots) have infestations of zebra and quagga mussels. Jumbo Lake, Shadow Mountain Reservoir, Lake Granby and Willow Creek Reservoir (black dots) are infested with quagga mussels. Which three major river systems are connected to those lakes?

How Did The Mussels Get To Colorado?

Many aquatic nuisance species (ANS), including zebra and quagga mussels, were introduced into the Great Lakes in the discharged ballast water of ocean-going ships. Once in North American waters and wetlands, aquatic nuisance species (ANS) can travel downstream in the water currents, or hitched rides to other lakes and reservoirs on the boats, trailers and any equipment that was in the water where the mussels live. Without even knowing it, boaters and fishermen can transport ANS from place to place on their boats, fishing waders and or bait buckets. Some water skiing and wake boarding boats fill with water for ballast. If the ballast water isn't emptied, and the boats and trailers cleaned, drained, and dried, they can transport mussels from place to place just like the ballast water on the Great Lakes. Zebra and quagga mussels were introduced into Colorado by boats hauled on trailers. In January 2008, the first mussels were found in Colorado. There is no way to know where or when mussels first entered the state of Colorado, but it is believed they entered on more than one boat. The U.S. Geological Survey (USGS) updates a sightings map for both species daily at <http://nas.er.usgs.gov/taxgroup/mollusks/zebramussel/>.

Why Should We Be Concerned About Zebra And Quagga Mussels?

Zebra and quagga mussels are a great ecological and financial threat to the state. The invasion of these mussels can affect every Coloradan in some way even if you don't live near a lake or reservoir. The impacts could be harmful because:

They grow and reproduce quickly

Zebra and quagga mussels reproduce exponentially. They can reproduce or spawn year-round if there is enough food and water temperatures are warm enough. A single female mussel can produce up to one million eggs a year! As the mussels population explodes and grows quickly, they cover the bottom and sides of the waterway.

They clog water infrastructure, impacting water supply and quality

As mentioned before, zebra and quagga mussels can attach via byssal threads to underwater structures. They can form dense clusters that impair facilities and impede (obstruct, stop or slow) the flow of water. They clog intake pipes and trash screens, canals, aqueducts, and dams and can disrupt water supply to homes, farms, factories and power plants. Zebra and quagga mussels can hurt or degrade water quality and can alter the taste and smell of drinking water. Zebra and Quagga mussels eat what's good in the water and leave what's bad. They eat the good algae and leave the not so good blue-green algae that can make the water taste and smell bad. Other ANS plants such as Eurasian watermilfoil can grow better when there are Zebra and Quagga mussels in a lake. Eurasian watermilfoil, like many of the other plant ANS, can cause taste and odor problems and lower dissolved oxygen when the plants die and decay.

They have recreational impacts

Zebra and quagga mussels can cover or encrust docks, boats, ropes, buoys and any object. Attached mussels increase drag on boats. Young, small mussels can get into engine cooling systems causing them to overheat. Boats that are in the water for long periods of time can have more damage and cost more money to fix. The weight of attached mussels can sink navigational buoys. Zebra and quagga mussels also impact fish populations and can reduce sport fishing because they can cover the bottoms of the lakes and streams where the fish like to live and spawn. Their sharp shells can cut the feet of unsuspecting swimmers and beach goers.

They have significant economic impact

Zebra and quagga mussels cost everyone money because they increase the maintenance costs for power plants, water treatment facilities, ditches, dams and pumps. They also increase the cost of food production and utilities. In the Great Lakes area, maintenance costs in water treatment plants, power plant intakes and dams have been in the billions of dollars annually. The destruction of native fisheries also has a wider economic impact in terms of tourism and recreation dollars not spent. Tourists and fisherman do not go to areas where the mussels have destroyed the native fisheries. Marinas and watercraft dealers could suffer business declines.

They have significant ecological impact

Invasive species can make it hard for the native plants and animals to live and can change the aquatic ecosystems and native plant and animal communities. Zebra and quagga mussels eat such large amounts of food and produce such large amounts of waste that they can alter or change the ecosystem and can harm fisheries. The mussels are filter feeders, meaning they pull the water through their shells and eat the

Do the Math...

Let's start with one pair of mussels, that lays 1 million eggs each year, of which 10% survive and breed each year. These mussels also lay 1 million eggs and have 10% survive. How many mussel will their be at the end of 5 years? Enter the missing numbers below (the first one is a sample):

Yr. 1: 100 Thousand, Yr. 2: 10 Billion, Yr. 3: 1 Quadrillion,
Yr. 4: 100 Quintrillion, Yr. 5: 10 Septillion

microscopic plants and animals (plankton) that are in the water. The plankton that they filter and eat form the base of the food chain, leaving little or nothing for native aquatic mussels or fish species to eat. Also, Zebra and quagga mussels can attach to and encrust native organisms (crayfish, native mussels), essentially smothering them and removing more animals from the food chain.

What can be done?

Educate yourself, students, friends and family about Aquatic Nuisance Species.

- ▲ Never release pet turtles, fish, frogs, rabbits, snails (etc) into the wild, lake or stream.
- ▲ Clean/drain/dry your boat and trailer each time it is used.
- ▲ Clean and dry your pets.
- ▲ Clean and dry any gear that's been in the water, especially fishing gear and waders.
- ▲ If you keep a fish, use a bucket instead of the boat's live well.
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- ▲ If you find a mussel, call or contact the Colorado Division of Wildlife Mussel Hotline at 1-303-293-6581 or the Federal ANS Hotline at 1-877-STOP-ANS (1-877-786-7267).
- ▲ Learn more at www.colorado.gov/wildlife

Protecting Our Water

The upper illustration on page two of the Reader depicts the idea of a watershed and some of the challenges we face in protecting source water.

Runoff pollution, also called nonpoint source pollution, is one the biggest threats to clean water in the United States. Dirt, oil, chemicals and other substances build up on hard surfaces such as roads and sidewalks. These pollutants are carried into nearby rivers and lakes as rain or snowmelt moves across the surface. Mismanaged construction sites can contribute to excessive sediment in runoff. Mismanaged farms can contribute to chemical and sediment issues. Colorado's mining past can also create pollution issues as water that flows through and near abandoned mines and tailings can become contaminated. Your students may not be able to tackle these issues first hand, but they can help by reducing litter.

Litter is a major threat to clean water. Many people falsely believe that runoff into storm drains is treated before returning to waterways. Storm drains lead directly to nearby rivers, lakes and wetlands. The cumulative effect of improperly used deicers, fertilizers and other household chemicals can have a significant impact on water quality.

The key point about runoff pollution is that it is the cumulative effect from many seemingly small sources that leads to major problems. The good news is we can use the same math to help protect our water. If we all make the small effort required to properly dispose of our trash, properly use household chemicals and pick up after our pets, we can make a major contribution to protecting Colorado's water and environment.

Zebra Mussel Life Cycle — *Southern Illinois University Rivers Project*

In the Great Lakes the zebra mussel has a life span of about three years. They become sexually mature at about one year of age. Spawning is triggered by factors including temperature and phytoplankton abundance.

1. Egg Stage—an average adult female can produce 30,000 to 40,000 eggs per season. Eggs are released into the warm water and the male mussels sense the presence of the eggs around them and release sperm into the water.

2. Veliger Stage—Several hours after fertilization the larvae, known as veligers, emerge. They have a clump of hair-like filaments called cilia that help suspend them in the water. During this time they feed heavily on plankton and grow in size.

3. Post-Veliger Stage—When they attain a size of about 200 micrometers, the veligers are too heavy to remain afloat. They settle on the bottom and try to find a hard surface to which they can attach. Attachment of the post-veligers is made possible by byssal threads which are secreted.

4. Settling Stage—Within the next three weeks, post-veligers transform into juveniles forms. These resemble adult mussels and attain maturity the following year. Juveniles often detach their byssal attachment and move around, trying to locate areas with abundant plankton supplies.

5. Adult Stage—A Zebra Mussel attains about 2.5 cm (1 inch) in the first year and adds another 1.25 to 2.5 cm during the next year.

Vocabulary

Watershed—the area of land where all of the water that is under it or drains off of it goes into the same place. John Wesley Powell, scientist geographer, put it best when he said that a watershed is:

“that area of land, a bounded hydrologic system, within which all living things are inextricably linked by their common water course and where, as humans settled, simple logic demanded that they become part of a community.”

Watersheds come in all shapes and sizes. They cross county, state and national boundaries. In the continental US, there are 2,110 watersheds; including Hawaii Alaska, and Puerto Rico, there are 2,267 watersheds.

Ecosystem—A complex set of relationships among plant and animals, including humans. When a system is healthy, it’s referred to as “sustainable.”

Nonpoint Source Pollution (NPS)—Pollution that occurs when rainfall, snowmelt or irrigation runs over land or through the ground, picks up pollutants, and deposits them into rivers, lakes, and coastal waters or introduces them into ground water. Also commonly called runoff pollution.

Non-native species—a plant or animal species found outside its natural range.

Aquatic nuisance species (ANS)—Non-native aquatic plants, animals, viruses and pathogens (microbes) that harm native aquatic plants and animals.

Pathogen— An agent that causes disease, especially a living microorganism such as a bacterium or fungus.

Infrastructure—The basic facilities, services, and installations needed for the functioning of a community or society, such as transportation and communications systems, water and power lines and public institutions.

Habitat—The natural environment of an organism; place that is natural for the life and growth of an organism.

Waders—The high, waterproof boots used for wading by fishermen, duck hunters or laborers.

Pollution—The introduction of harmful substances or products into the environment.

Marina—an area of a lake or other waterway offering dockage and other services for small craft.

ANS Crossword Puzzle

ACROSS

- 5 Aquatic nuisance _____
- 7 Our most precious resource
- 9 The balance of climate, geography, soil, plants and animals
- 10 The type of pollution that is the largest threat to clean water in the U.S.
- 11 Don't move a _____ mussel

DOWN

- 1 _____ Crayfish
- 2 Aquatic nuisance species
- 3 The start of a river
- 4 Foreign country that gets water from Colorado
- 6 Clean, Drain and _____
- 8 Zap the _____ mussel

The crossword puzzle grid is filled with the following words:

- Across:**
 - 5: Aquatic nuisance species
 - 7: Our most precious resource (water)
 - 9: The balance of climate, geography, soil, plants and animals (ecosystem)
 - 10: The type of pollution that is the largest threat to clean water in the U.S. (runoff)
 - 11: Don't move a quagga mussel
- Down:**
 - 1: Crayfish
 - 2: Aquatic nuisance species (snail)
 - 3: The start of a river (head)
 - 4: Foreign country that gets water from Colorado (Mexico)
 - 6: Clean, Drain and Runoff (S)
 - 8: Zap the quagga mussel (quagga)