DOWNLOAD PDF ZEBRA MUSSEL (HEALTHY FOR LIFE)

Chapter 1 : Zebra mussel - Wikipedia

Zebra Mussel Fact Sheet. The zebra mussel (Dreissena polymorpha) is a small bivalve originally native to the Caspian Sea region. Zebra mussels reached North America in the.

Within one year, they colonized nearly every firm object in Lake Erie. Zebra mussels quickly spread to parts of all the Great Lakes. Expansion to inland waters continues at an alarming rate. For example, in zebra mussels made their way out of Lake Michigan into the Mississippi River basin via the Chicago Sanitary Shipping Canal â€" an artificial channel that connects the Great Lakes drainage basin with the watershed drained by the Mississippi River. At the end of the season, zebra mussels were found in isolated pockets from Minneapolis to St. They spread up the tributaries of the Mississippi River, often hundreds of miles, by way of recreational watercraft and barges. Today, they have spread overland to hundreds of inland lakes in 28 states. Zebra mussels cost the U. They clog water intakes for municipalities and industries, foul boat hulls, motors, water-related equipment and shipwrecks. They can decrease property values. Sharp shells can litter beaches, cut feet and affect recreation and tourism. Overall, zebra mussels harm our environment, recreation and the economy of communities that depend upon healthy lakes and rivers. Zebra Mussel History Zebra mussels have been spreading to western and central European waterways for nearly years. While we can learn a lot from looking at how zebra mussels behave in Europe, zebra mussels face different ecosystems in North America often making comparisons and predictions complicated. Zebra mussels are native to freshwater lakes and rivers of western Russia including the northern part of the Caspian Sea, which is a freshwater waterbody. Canals built during the late s allowed them to spread throughout Eastern Europe and during the s, canals were built across the rest of Europe. By the s, these mussels covered much of Europe and Britain. Successful introduction of zebra mussels into the Great Lakes probably occurred in or , after transoceanic ships discharged contaminated ballast water from foreign ports into lakes St. Freshwater ballast, picked up in European ports, contained zebra mussel larvae and possibly juveniles, along with several other harmful aquatic invasive species AIS. Being a temperate, freshwater species, they found the plankton-rich lakes St. Clair and Erie to their liking. Zebra mussels extensively colonized all of the Great Lakes, except Lake Superior. Lake Superior is not ideal zebra mussel habitat. While they have been found at nine locations around Lake Superior, only two locations are known to be reproducing: All other locations are open to the influence of this big lake with its colder, less productive and low dissolved calcium level water that zebra mussels need for creating their shells. Zebra Mussel Biology They are small freshwater mussels. Young settled juveniles feel like sandpaper on smooth surfaces. Other than their "cousin" the quagga mussel, they are the only freshwater mussel that firmly attach to hard surfaces. Egg production starts when water temperature warms to about 54 degrees F. A fully mature female mussel may produce several hundred thousand eggs per season. Nearly invisible to unaided eye, veligers remain suspended in the water for three to four weeks, drifting with the currents. Those that find a hard surface quickly attach themselves and transform into the typical, D-shape, double-shelled mussel. Within a year, a zebra mussel can grow up to an inch and become sexually mature. Some can grow as large as 1. European studies report mussels may live four to six years, but in Lake Erie three years seems to be the maximum, and the average is much less. Zebra mussels produce a tuft of fibers known as a byssus, or byssal threads, from a gland in their foot. The byssus protrudes between the two halves of the shell. These threads attach to hard surfaces with a powerful glue that anchors the mussels in place. Small juveniles, referred to as translocators, can actually break away from their attachments and generate new, buoyant threads that allow them to drift short distances with currents. Any hard surfaces can be colonized by zebra mussels â€" rock, metal, wood, vinyl, glass, rubber, fiberglass, paper, plants, and other mussels. Beds of zebra mussels in some areas of Lake Erie contain between 30, and 70, mussels per square meter. Near water intakes, densities can be as high as , mussels per square meter. Zebra mussels can establish regardless of depth or winter temperatures. Colonies grow rapidly wherever oxygen and particulate food is available and water currents are not too swift â€" generally less than six feet per second. Colonies are rare in wave-washed and ice-scoured zones, except for the sheltered undersides of rocks, nooks and crevices. Zebra mussels avoid

bright light so it rare to find them in well sunlit waters. Greatest densities are found at depths ranging from 6 to 45 feet, but can even be found at feet. Zebra mussels also colonize soft bottoms. Hard objects, such as pieces of native mussel shells and even dead zebra mussel shells, act as a base for settling veligers allowing them to gain footholds even on sandy or muddy bottoms. As a few mussels begin to grow, they form barnacle-like colonies and in this way can form extensive mats of zebra mussel carpets on lake and river bottoms. Zebra Mussels Harm the Environment Zebra mussels are filter feeders. They strain water for the food they need. Unwanted food is rejected and bound into mucous pellets called pseudofeces. Vast amounts of pseudofeces in heavily colonized areas provide food for native as well as other aquatic invasive species. Each adult zebra mussel can filter more than one liter of water per day. Most types of phytoplankton, bacteria and some small zooplankton are consumed. Small fish, such as young sportfish or forage fish like minnows, depend on this food for survival and growth. Feeding by zebra mussels can remove so much microscopic plants and animals from the base of the food web that they can starve native fish and wildlife in lakes and rivers. Scientists and boaters now often see great increases in water clarity in inland lakes and rivers like what was seen in Lake Erie between and Since sunlight now penetrates deeper and with more intensity, shallow bays are being recolonized by rooted native and sometimes invasive aquatic plants. Often, these aquatic plants are growing more densely and at great depths completely changing the habitat. In the fall, aquatic plants laden with zebra mussels can wash on shore creating disposal issues. Impacts due to greatly increased water clarity has been observed due to zebra mussels in rivers and lakes across the country. Native North American mussels and clams have suffered greatly when they are encrusted with zebra mussels. Sometimes several thousand zebra mussels can be found on a single native mussel. Clair and Erie and in many rivers, zebra mussels have severely reduced populations of native mussels and clams. Some mussel species in the St. Croix River and elsewhere are very rare and are officially listed as endangered. As they spread, zebra mussels threaten the extinction of at least 30 freshwater mussels. Losses of crayfish and snails have been implicated by zebra mussel colonization. Thirty years ago, the extent of profound impacts due to zebra mussels could not have been predicted. Today, scientists know that zebra mussels can cause increases in toxic blue-green algae, including Microcystis, which produces a poison that causes liver damage when ingested by humans and wildlife. Decaying algae can make waters uninhabitable by causing low levels of dissolved oxygen that result in fish kills. Since , induced algae blooms can trigger botulism type E outbreaks that have killed tens of thousands of loons and other waterfowl. Zebra Mussels Affect Industry and Recreation Costs to manage, control and monitor for zebra mussel, and its cousin the quagga mussel, in the U. Because zebra mussels prefer hard surfaces at moderate water depth, water intake structures, such as those used by power plants and city treatment plants, are susceptible to clogging by zebra mussels. In the late s and early s, some municipal drinking water facilities located on Lake Erie reported major reductions in pumping capacity and occasional shutdowns caused by encrusted zebra mussels. Control costs are operation specific. Today, zebra mussels can usually be controlled at power, municipal drinking and manufacturing plants and irrigation facilities using a variety of strategies, technologies and chemicals. However, those costs are typically passed along to consumers each time electricity and water are used. Recreational users of waters infested with zebra mussels can be harmed. Unprotected docks, breakwalls, boat bottoms, and engine outdrives can provide hard surfaces zebra mussels need to colonize and grow. Across the country, there have been many reports of boat engines overheating because cooling water inlets are clogged by zebra mussels. Boaters need to frequently inspection these areas. Zebra mussels can bioaccumulate polychlorinated biphenyls PCBs , polycyclic aromatic hydrocarbons PAHs and heavy metals due to their filtering capacity. As a result, this has implications for human health. PAH concentrations in some recreational fish have increased 11 to 18 fold in Lake Erie, which approach limits for fish consumption advisories. Research also shows that concentrations in waterfowl increased. In summary, zebra mussels are harmful bioengineers. They form mats of shells physically changing the structure of lakes and rivers they infest. They re-route nutrients, which alters capacity of habitats to sustain native species. They reduce food for fish, kill native mussels, crayfish and snails, foul plants, beaches, boats, lifts, docks and swim platforms, and clog water intakes. Prevention and Containment While there may be a perception that zebra mussels are everywhere and nothing can be done, nothing could be further from the

truth. Zebra mussels can be prevented from spreading to new waters and contained where they currently exist. Key ways they spread by watercraft are: By following the guidelines below, you can prevent the spread of zebra mussels and other aquatic invasive species by helping to Stop Aquatic Hitchhikers! More boaters are doing it. Just Clean, Drain, Dispose, Dry everywhere, every time. What You Can Do Learn to recognize zebra and quagga mussels.

Chapter 2 : Prevent the Spread of Zebra Mussels | Invasive Species in Lake George

Identification: The zebra mussel is a small shellfish named for the striped pattern of its shell. Color patterns can vary to the point of having only dark or light colored shells and no stripes.

They hamper boating, swimming, fishing, hunting, hiking, and other recreation, and take an economic toll on commercial, agricultural, forestry, and aquacultural resources. Zebra mussels were introduced into the Great Lakes in or , and have been spreading throughout them since that time. They were most likely brought to North America as larvae in ballast water of ships that traveled from fresh-water Eurasian ports to the Great Lakes. Zebra mussels look like small clams with a yellowish or brownish D-shaped shell, usually with alternating dark- and light-colored stripes. They can be up to two inches long, but most are under an inch. Zebra mussels usually grow in clusters containing numerous individuals. Zebra Mussel Scientific names: Dreissena polymorpha Ecological threat: Zebra Mussels feed by drawing water into their bodies and filtering out most of the suspended microscopic plants, animals and debris for food. This process can lead to increased water clarity and a depleted food supply for other aquatic organisms, including fish. The higher light penetration fosters growth of rooted aquatic plants which, although creating more habitat for small fish, may inhibit the larger, predatory fish from finding their food. This thicker plant growth can also interfere with boaters, anglers and swimmers. Zebra mussel infestations may also promote the growth of blue-green algae, since they avoid consuming this type of algae but not others. Zebra mussels attach to the shells of native mussels in great masses, effectively smothering them. A survey by the Corps in the East Channel of the Mississippi River at Prairie du Chien revealed a substantial reduction in the diversity and density of native mussels due to Zebra Mussel infestations. Future efforts are being considered to relocate such native mussel beds to waters that are less likely to be impacted by zebra mussels. The recommendation for Zebra Mussels was based upon this literature review developed by the department. If you know of a location that is not listed, send us a report. Once zebra mussels are established in a water body, very little can be done to control them. It is therefore crucial to take all possible measures to prevent their introduction in the first place. Some of the preventative and physical control measures include physical removal, industrial vacuums, backflushing. Chemical applications include solutions of chlorine, bromine, potassium permanganate and even oxygen deprivation. An ozonation process is under investigation patented by Bollyky Associates Inc. This method only works in controlling veligers, and supposedly has little negative impacts on the ecosystem. Further research on effective industrial control measures that minimize negative impacts on ecosystem health is needed.

Chapter 3 : The Invasion of the Zebra Mussel

Zebra mussels are so small and do not have much in the way of "meat" inside them, you would have to be pretty hungry to want to eat them. However, because they are filter feeders, they can accumulate pollutants in their tissues that may not be healthy for people to consume.

Bamboo is used for mussel breeding and propagation Abucay, Bataan , Philippines. Aquaculture of mussels in North America began in the s. Freshwater mussels are used as host animals for the cultivation of freshwater pearls. Some species of marine mussel, including the Blue mussel Mytilus edulis and the New Zealand green-lipped mussel Perna canaliculus , are also cultivated as a source of food. In some areas of the world, mussel farmers collect naturally occurring marine mussel seed for transfer to more appropriate growing areas, however, most North American mussel farmers rely on hatchery-produced seed. After about three months in the nursery, mussel seed is "socked" placed in a tube-like mesh material and hung on longlines or rafts for grow-out. Within a few days, the mussels migrate to the outside of the sock for better access food sources in the water column. Mussels grow quickly and are usually ready for harvest in less than two years. Unlike other cultured bivalves, mussels use byssus threads beard to attach themselves to any firm substrate, which makes them suitable for a number of culture methods. There are a variety of techniques for growing mussels. Intertidal growth technique, or bouchot technique: This method needs an extended tidal zone. On-bottom culture is based on the principle of transferring mussel seed spat from areas where they have settled naturally to areas where they can be placed in lower densities to increase growth rates, facilitate harvest, and control predation Mussel farmers must remove predators and macroalgae during the growth cycle. Raft culture is a commonly used method throughout the world. Lines of rope mesh socks are seeded with young mussels and suspended vertically from a raft. The specific length of the socks depends on depth and food availability. Longline culture rope culture: Mussels are cultivated extensively in New Zealand, where the most common method is to attach mussels to ropes which are hung from a rope back-bone supported by large plastic floats. The most common species cultivated in New Zealand is the New Zealand green-lipped mussel. Longline culture is the most recent development for mussel culture [7] and are often used as an alternative to raft culture in areas that are more exposed to high wave energy. A long-line is suspended by a series of small anchored floats and ropes or socks of mussels are then suspended vertically from the line. Harvest[edit] In roughly 12â€”15 months, mussels reach marketable size 40mm and are ready for harvest. Harvesting methods depend on the grow-out area and the rearing method being used. Dredges are currently used for on-bottom culture. Mussels grown on wooden poles can be harvested by hand or with a hydraulic powered system. For raft and longline culture, a platform is typically lowered under the mussel lines, which are then cut from the system and brought to the surface and dumped into containers on a nearby vessel. After harvest, mussels are typically placed in seawater tanks to rid them of impurities before marketing. Medical[edit] Byssal threads, used to anchor mussels to substrates, are now recognized as superior bonding agents. A number of studies have investigated mussel "glues" for industrial and surgical applications. They are particularly useful since they are distributed worldwide and they are sessile. These characteristics ensure that they are representative of the environment where they are sampled or placed. Their population status or structure, physiology, behaviour or the level of contamination with elements or compounds can indicate the status of the ecosystem. Mussels and other bivalve shellfish consume phytoplankton containing nutrients such as nitrogen N and phosphorus P. On average, one live mussel is 1. These ecosystem services provided by mussels are of particular interest to those hoping to mitigate excess anthropogenic marine nutrients, particularly in eutrophic marine systems. While mussel aquaculture is actually promoted in some countries such as Sweden as a water management strategy to address coastal eutrophication, [11] mussel farming as a nutrient mitigation tool is still in its infancy in most parts of the world. Freshwater Mussels[edit] In the United States and Canada, areas home to the most diverse freshwater mussel fauna in the world, there are known freshwater mussel taxa.

Chapter 4 : NPR Choice page

Zebra mussels are filter feeders and can filter one liter of water per day. Almost all matter in the water is filtered. Zebra mussels feed on phytoplankton and some small zooplankton. Other matter filtered is expelled as pseudofeces. The zebra mussel has some limiting factors such as water temperature, calcium, pH, substrate, salinity and nutrients.

Zebra mussels Dreissena Polymorpha are small, freshwater bi-valve mollusks relatives to clams and oysters that are triangular in shape with an obvious ridge between the side and bottom. The zebra mussel gets its name from the black or dark brown and white striped markings that appear on its shell. How To Identify the Zebra Mussel Zebra mussels look like small clams with a yellowish or brownish Dâ€”shaped shell, usually with both dark and light-colored stripes, which can vary in intensity. Zebra mussels can be up to two inches long, but most are under one inch in length. Zebra mussels grow in clusters containing numerous individuals and are generally found in algae-rich, shallow water 6 â€” 30 feet. Zebra mussels are the ONLY freshwater mollusk that can firmly attach itself to solid objects, including submerged rocks, dock pilings, boat hulls, water intake pipes, etc. They attach using byssal cords, seen in the photo here. Archeologists discovered a colony of adult Zebra Mussels near the village walkway along the southern shore. This was the first confirmed incidence of adult zebra mussels in the Lake. Zebra mussels in the microscopic larvae stage veligers had previously been found. A Zebra mussel task force was formed in to address the problem. Click here or on the photo at right to see a map of all known locations of zebra mussels. The zebra mussel poses a multi-billion dollar threat to the Lake George region. Outdoor recreation, tourism, property values and the municipal water supply are threatened. Zebra mussels can foul boats and boat engines, foul beaches with washed-up remains, clog water intake pipes, alter water quality and affect the overall lake ecosystem. Adult zebra mussels can be transported by attaching to boat hulls, engines and anchors. Zebra Mussel larvae can be carried in the water of engine cooling systems, bilges, live wells and bait buckets. Note the date and precise location where the zebra mussel was found. Take the zebra mussel if possible with you and store it in rubbing alcohol. What you can do to help Learn all you can about the Zebra Mussel. How it spreads, how to identify it, and the threat it poses. Share this information with others. When enjoying the Lake, look on rocks, dock frames, your boat hull, anchors, buoys, chains, etc. Zebra Mussels like to attach to hard surfaces. Where are Zebra Mussels From? Click on the interactive map above to see a progression of zebra mussel infestations in the US over the years. Clair in June of It is believed that Zebra Mussels were introduced into North America through the emptying of ballast water from commercial transatlantic ships into the Great Lakes. Cargo ships carry significant amounts of ballast water to stabilize the vessels during transoceanic crossings. When ballast tanks are filled, many forms of aquatic life in the source water are drawn into the tanks. Once in ballast tanks, organisms can be transported to other areas and subsequently discharged into waters at foreign ports. How Do Zebra Mussels Spread? The veligers float in the water; If they are unable to find a hard surface, the veligers will soon die. Veligers can be spread through a variety of methods including: Zebra mussels are filter feeders that consume large portions of the microscopic plants and animals that form the base of the food web. The removal of significant amounts of phytoplankton from the water can cause a shift in native species and a disruption of the ecological balance of a lake. Increased water transparency may result in an increase in rooted aquatic vegetation, including nuisance species such as Eurasian watermilfoil. Zebra mussels also may contain high concentrations of toxic materials that will harm or kill the fish and wildlife that consume them. Decaying mussels wash ashore littering beaches and creating a noxious odor. Residential, Industrial and Recreational Impacts Zebra mussels can clog the large-scale raw water intake pipes of municipal drinking water plants, and the small-scale water intake pipes of private homes and cottages, causing lost pumping ability, obstructed valves, obnoxious smells from decaying mussel flesh, increased corrosion of cast iron pipes, and safety hazards if sprinkler or hydrant systems are clogged and fail to deliver fire-fighting water. Swimming areas become abandoned due to sharp-edged shells washing up on shore from storms, colonization on rocks near the shoreline, and noxious odors from decomposition of mussels. Boats may overheat due to zebra mussels blocking engine cooling water intakes. Mussels attached to hulls can increase drag, therefore increasing fuel consumption. Historic,

sunken ships and artifacts may become completely obscured by zebra mussel colonies growing on them. Discover the wonders of Lake George and the challenges to keeping it clean and protected. Join us on our Floating Classroom with programs for adults and students.

Chapter 5 : Can you eat zebra mussels? - Non-Ski Gabber - calendrierdelascience.com

The zebra mussel (Dreissena polymorpha) is a small freshwater calendrierdelascience.com species was originally native to the lakes of southern Russia and Ukraine. However, the zebra mussel has been accidentally introduced to numerous other areas, and has become an invasive species in many countries worldwide.

Pocket The first day of June was sunny, hot, and mostly calmâ€”perfect weather for the three young researchers from the University ofâ€¦By Dan Egan The first day of June was sunny, hot, and mostly calmâ€”perfect weather for the three young researchers from the University of Windsor who were hunting for critters crawling across the bottom of Lake St. Sonya Santavy was a freshly graduated biologist aboard a foot-long runabout as the whining outboard pushed the boat toward the middle of the lake that straddles the United States and Canadian border. On a map, Lake St. Clair looks like a mile-wide aneurysm in the river system east of Detroit that connects Lake Huron to Lake Erie, and that is essentially what it is. Water pools in it and then churns through as the outflows from Lakes Superior, Michigan, and Huron tumble down into Erie, then continue flowing east over Niagara Falls into Lake Ontario, and finally down the St. Lawrence Seaway and out to the Atlantic Ocean. The current pulsing through Lake St. Clair because it is as shallow as a swimming pool in most places, except for an approximately foot-deep navigation channel down its middle. Army Corps of Engineers carved that pathway in the late s as part of the Seaway project to allow oceangoing freighters to sail between Lake Erie and the lakes upstream from it. This often meant dumping water from the ship-steadying ballast tanksâ€”water taken onboard outside the Great Lakes. Water that could be swarming with exotic life picked up at ports across the planet. As Santavy and her University of Windsor colleagues puttered over a rocky-bottomed portion of Lake St. Clair in the early summer of , she whimsically dropped her sampling scoop into the cobble below. But there was something odd about two of those tinier pebbles. They were stuck together. In came Thalassiosira weissflogii, a single-celled alga capable of both sexual and asexual reproduction and, unlike sea lampreys, incapable of being controlled ecosystem-wide by any human measures. Five more exotic species of algae showed up during the next two years and a tubificid lake bottomâ€”burrowing worm native to the Black and Caspian Sea basins arrived in A water flea from Europe turned up the year after and a European flatworm two years after that. A crustacean native to the Black and Caspian Seas arrived in Three more exotic species of algae turned up the following year. And the alien organisms continued to arrive, year after year, with an almost metronomic predictabilityâ€”all the way up to that steamy Wednesday morning on Lake St. The important thing about the zebra mussel is to not consider each one as an individual organism but instead, like a cancer cell, part of a greater scourge. He was a graduate student whose job was to study freshwater clams of North America. This made them suspicious enough to bring her specimen back to campus. When Santavy returned to campus she showed her specimen to the professors in the lab. They were also flummoxed. They sent it to the University of Guelph outside Toronto, where an international mussel expert identified it as Dreissena polymorpha, the zebra mussel. This was not good news. Hungary succumbed to an infestation in , London in Rotterdam fell in , followed by Hamburg in and Copenhagen in The mussels had spread to Switzerland and Italy by the s. Clair, some 3, miles from the closest known colony. The sky was the last part of nature to be classified: Very few in scientific circles would Ship-steadying ballast used to be solid materials. In the s bars of iron were used to balance schooners in the slave trade and Europe-bound ships laden with tobacco returned to the New World with bricks for ballast. But as freighters shed their sails and wooden hulls, acquired steam engines and grew to titanic proportions, the ships demanded ever-more stabilizing weight, particularly when a vessel was sailing with less-than-full cargo holds, unevenly loaded freight or through violent seas. Naval architects soon realized water, at just over 8 pounds per gallon, is plenty heavy to function as ballast. More importantly, it does not have to be manually loaded. It can be pumped in or out of the network of tanks tucked under the steel skin of a modern freighter. But liquid ballast does have one huge drawbackâ€”it is anything but dead weight. But seasoned ecologists knew the doom it foretold, like radiologists spotting a telltale speck on an X-ray; the important thing about the zebra mussel is to not consider each one as an individual organism but instead, like a cancer cell, part of a

greater scourge that metastasizes as fast as currents flow. Biologically contaminated ballast water is the worst kind of pollution because it does not decay and it does not disperse. Each female can produce 1 million eggs per year. The hairs also allow a baby mussel to snag food and begin to grow a shell, which eventually weighs it down and forces the mussel to settle on a lake or river bottom. There, it begins its blind hunt for a hard surfaceâ€"rocks, glass, pilings, even other musselsâ€"to attach to. Within a year those babies are sending out puffs of their own veligers to establish new colonies. Distressing as the news was that the zebra mussel had made the jump across the Atlantic, nobody should have been surprised. As early as the late s, naturalists had recognized the zebra mussel as an invasive species juggernaut. Every year, an untold number of foreign organisms find their way into the Great Lakes in shipping ballast water. They found the tanks were basically floating ecosystems, swarming with life sucked up from ports across the globe. The researchers specifically mentioned zebra mussels among the primary threats to make their way into the lakes by hitching a ride in ballast water, which is often discharged when an overseas ship arrives in the lakes in exchange for cargo. In , Congress overrode a President Nixon veto and approved a sweeping package of amendments to the existing federal water pollution regulations that are known today as the Clean Water Act. To get a permit, a company had to agree to install the best available waste treatment systems for the pollution it discharged. These permits had to be renewed every five years, the idea being that the volume of pollution a business could discharge would be continually ratcheted down as better treatment technologies inevitably evolved over the years and decades. Permit violations carried fines that could total tens of thousands of dollars per day, and major offenders could be sentenced to jail. The goals of the Clean Water Act were impossibly highâ€"zero pollution discharges by , with an interim target to make all the waters of the United States swimmable and fishable by The Clean Water Act missed those marks, but the improvements it brought have been immense. By that number had been slashed in half. But the Environmental Protection Agency left one huge loophole in the law the year after it was passed when it expanded an exemption for water discharges from military vessels to all ships sailing in U. The agency was likely motivated by the notion that without a ship discharge exemption, its regulators could be on the hook to somehow police millions of recreational boats. Whatever the reason, the agency clearly did not see freighter discharges as a threat. As the zebra mussel infestation of the Great Lakes would make it abundantly clear, biologically contaminated ballast water is the worst kind of pollution because it cannot be fixed by plugging a pipe or capping a smokestack. It does not decay and it does not disperse. Santavy had found only one mussel that summer day in Everybody knew there had to be more. Tom Nalepa, then an ecologist with the National Oceanic and Atmospheric Administration, remembers making the three-hour drive from his office in Ann Arbor, Michigan, to London, Ontario, in March to meet with 11 other scientists about this latest Great Lakes invader. It turned out to be what is today known as the first International Conference on Aquatic Invasive Species, which has become an almost annual event that draws hundreds of researchers from across the globe. It was just a dozen smart but mystified U. The scientists had been gleaning what they could from research papers written in Russian, Polish, and Danish just to figure out things like its preferred habitat, its temperature tolerance, and its reproduction rate. The researchers turned on a carousel slide projector to look at how far the zebra mussels had spread since Santavy dropped her scoop to the bottom of Lake St. Clair just 10 months earlier. The room got quiet as the wheel stopped on each new image. Clair so encrusted with zebra mussels its piston holes were plugged. Then Griffiths turned on a videotape of a mussel-smothered ferry wharf on the Canadian side of Lake Erie. It would have been like counting stars from the deck of an ocean freighter on a moonless night. Researchers quickly realized that water intake pipes used by cities and industries would likely be prime zebra mussel habitat; the hard surface inside a pipe provides an ideal place to attach and the constant flow of waterâ€"and the plankton floating in itâ€"make for an easy meal, like a floating buffet. It was already starting to happen. The chaos this has brought is like nothing the lakes have suffered in their 10,year history. The North American zebra mussel problem was made worse by the fact that they have no worthy predators in the Great Lakes, and in the most heavily infested areas, they soon began to cluster atop each other like gnarled coral at densities exceeding , per square meter. Each adult mussel, which typically grows no bigger than a nickel, can filter up to a liter of water per day, sequestering inside its hard little shell all the nutrients contained within that water. By the end of , zebra

mussels had turned up all across the Great Lakes, west to Duluth, south to Chicago, and east to the St. Lawrence River below Lake Ontario. A colony was also found near the head of the Chicago Sanitary and Ship Canal that provides a manmade connection between the Great Lakes and the Mississippi River basin. That meant the mussels now had access to a watershed that spans almost half of the continental United States. But the most ominous mussel development of made no headlines. Researchers on Lake Erie found what appeared at first to be a slightly different version of the zebra mussel. It was, they would learn two years later, the quagga mussel, named after a subspecies of actual zebras that went extinct in the s. All that remains of the African savanna grazers are seven skeletons, including one on display at University College London. But their molluscan namesake today, in the Great Lakes alone, numbers in the quadrillions. Zebra mussels proved to be an expensive nuisance indeed for industries and cities that depend on water, costing billions of dollars over the past quarter century to invent, build, and maintain treatment systems that use things like chemicals, heat, and UV light to keep pipes open and water flowing through everything from nuclear power plants to kitchen faucets. Yet the ecological damage wrought by zebra mussels is minor in comparison to their cousin, the quagga mussel. Zebras also only feed during the warmer months. Quaggas filter nutrients out of the water year-round. By that relationship had completely flipped, with the quaggas making up Although the waters of Lake Superior lack levels of the shell-building calcium that zebra and quagga mussels require to thrive, the mussel impacts on Lake Michigan have been similarly repeated on the other lakes, particularly Huron and Ontario. The chaos this has brought is like nothingâ€”not even the sea lampreyâ€”the lakes have suffered in their 10,year history. Together, the zebra right and quagga mussels have nearly stripped the Great Lakes of their rich marine life. Dave Brenner, Michigan Sea Grant The public can comprehend the devastation of a catastrophic wildfire that torches vast stands of trees, leaves a scorched forest floor littered with wildlife carcasses and turns dancing streams into oozes of mud and ash.

Chapter 6 : How the zebra mussels scourge spread across Minnesota - calendrierdelascience.com

The zebra mussel gets its name from the black (or dark brown) and white striped markings that appear on its shell. How To Identify the Zebra Mussel Zebra mussels look like small clams with a yellowish or brownish D-shaped shell, usually with both dark and light-colored stripes, which can vary in intensity.

Zebra mussel larvae have no special defense against predators, but they are so small that only small predators and filter-feeders eat them. The larvae are part of the zooplankton in the water, and pretty much any predator that eats zooplankton eats them. This includes many small fish including the young of large fish , other zooplankton such as copepods, freshwater Cnidaria like hydras , even freshwater sponges. A few fish species have specialized teeth and jaws that are strong enough to break the shells of mollusks, and some of them do eat zebra mussels. In Europe the roach , is a major predator of zebra mussels, along with bream , and silver bream. Round gobies and common carp , native to Eurasia, have been introduced to North America, and eat zebra mussels where they occur. The black carp is an east Asian species that has been introduced to Europe, and eats zebra mussels there. The pumpkinseed sunfish has been introduced to Europe from North America, and eats zebra mussels on both continents. Besides pumpkinseeds, the several other North American fish eat zebra mussels, including freshwater drums , redhorse suckers , river carpsuckers and smallmouth buffalos. Blue crabs Callinectes sapidus consumed many zebra mussels during a study in the Hudson River. Crayfish, including the northern clearwater crayfish, Orconectes propinquus , may prey on small zebra mussels. Geological Survey, What roles do they have in the ecosystem? Zebra mussels can be very important in freshwater ecosystems. If they are enough of them, they can filter an enormous amount of plankton out of the water. This changes the flow of energy in the foodweb -- the energy in the phytoplankton goes to the bottom, to the mussels and the animals that eat them, instead of swimming plankton predators like zooplankton and fish. Also, if zebra mussels clear the water, sunlight can penetrate deeper into the water, allowing more aquatic plants to grow. These plants provide food and hiding places for fish and invertebrates. Zebra mussels attach to the outside of North American freshwater mussels. They slow the larger mussel down, interfere with its growth, sometime jam the shell open, and prevent the large mussel from feeding and pumping water in and out of its shell. Where zebra mussels have moved into the Great Lakes basin, native mussels have been wiped out. Great Lakes Information Network, ; U. Geological Survey, Do they cause problems? The introduction of zebra mussels into many areas of the world has created major economic problems. The mussels grow on all kinds of man-made structures in the water, include water intake pipes for drinking water plants and power plants. So many grow there that they clog the pipes. Businesses and governments spend hundreds of millions of dollars every year to clear out the mussels and keep the pipes open. Mussels also grow on navigational buoys, sometimes sinking them, and on locks and dams, interfering with their operation. They grow on hulls of boats and ships, slowing them down and clogging engine intakes. The ecological impacts of zebra mussels are still happening, and not all the effects are known. They eat phytoplankton faster than zooplankton in the water does. This means zooplankton and the fish that live in the open water like walleye, salmon, and lake trout have less to eat. When zebra mussels have spread to inland lakes in North America, the amount of this toxic type of algae increases. See the references for more information on the many ecological effects of zebra mussels, especially in North America. How do they interact with us? Zebra Mussels were added to freshwater lakes in the Netherlands to help make the water more transparent they eat the phytoplankton that makes the waters cloudy. Other cities in other countries have done the same. Nalepa and Schloesser, ; Neumann and Jenner, Are they endangered? Zebra mussels are still common and abundant in their original range, and have spread far beyond it. They are not considered to be in any need of special conservation efforts.

Chapter 7 : BioKIDS - Kids' Inquiry of Diverse Species, Dreissena polymorpha: INFORMATION

The dreaded zebra mussel â€" an invasive species â€" is killing off native species in lakes and rivers all over the country. But in Lake Ontario, it turns out the zebra mussel has had a positive.

Three color varieties of the shell of the zebra mussel Close-up of a typical shell of a zebra mussel Zebra mussel and the closely related and ecologically similar quagga mussels are filter-feeding organisms. They remove particles from the water column. The zebra mussels process up to one liter of water per day, per mussel. Nonfood particles are combined with mucus and other matter and deposited on lake floors as pseudofeces. Since the zebra mussel has become established in Lake Erie, water clarity has increased from 6 inches to up to three feet in some areas. These plants, when decaying, wash up on shorelines, fouling beaches and cause water quality problems. This biomass becomes available to bottom-feeding species and to the fish that feed on them. Other mussel species frequently represent the most stable objects in silty substrates, and zebra mussels attach to, and often kill these mussels. They build colonies on native unionid clams, reducing their ability to move, feed, and breed, eventually leading to their deaths. This has led to the near extinction of the unionid clams in Lake St. Clair and the western basin of Lake Erie. Zebra mussels also can tolerate a wide range of environmental conditions and adults can even survive out of water for about 7 days. Drawing of zebra mussel, showing the byssus Predators[edit] Research on natural enemies, both in Europe and North America, has focused on predators, particularly birds 36 species and fish 15 and 38 species eating veligers and attached mussels. The vast majority of the organisms that are natural enemies in Europe are not present in North America. Ecologically similar species do exist, but these species are unlikely to be able to eliminate those mussels already established and will have a limited role in their control. An adult crayfish consumes around zebra mussels every day, or about mussels in a season. Predation rates are significantly reduced at lower water temperatures. Fish do not seem to limit the densities of zebra mussels in European lakes. This test was conducted in a lakefront harbor in the western province of Manitoba. They disrupt the ecosystems by monotypic colonization , and damage harbors and waterways, ships and boats, and water treatment and power plants. Water treatment plants are most affected because the water intakes bring the microscopic free-swimming larvae directly into the facilities. Zebra mussels also cling to pipes under the water and clog them. Grossinger reported it in Hungary in Kerney and Morton described the rapid colonization of Britain by the zebra mussel, first in Cambridgeshire in the s, London in , and in the Union Canal near Edinburgh in Canals that artificially link many European waterways facilitated their early dispersal. It is nonindigenous in the Czech Republic in the Elbe River in Bohemia since ; [20] in southern Moravia, it is probably native. The first appearance of the organism in northern Italy was in Lake Garda in ; [22] in central Italy, they appeared in Tuscany in Many water companies are reporting having problems with their water treatment plants with the mussels attaching themselves to pipeworks. Another possible, often neglected, mode of introduction is on anchors and chains, although this has not been proven. Since adult zebra mussels can survive out of water for several days or weeks if the temperature is low and humidity is high, chain lockers provide temporary refuge for clusters of adult mussels that could easily be released when transoceanic ships drop anchor in freshwater ports. They have become an invasive species in North America, and as such they are the target of federal policy to control them, for instance in the National Invasive Species Act Using models based on the genetic algorithm for rule-set production GARP , a group of researchers predicted that the southeastern United States is moderately to highly likely to be inhabited by zebra mussels and the Midwest unlikely to experience a zebra mussel invasion of water bodies. Today, the invasion continues. For instance, in , the Massachusetts Department of Conservation and Recreation confirmed that zebra mussels had been found in Laurel Lake in the Berkshires. This was the first confirmed sighting in the Red River Basin , which extends across the international border into the province of Manitoba. New contamination was found outside treated areas of Lake Winnipeg in and they have also been found in the Red River near the lake in Selkirk Park in This resulted in reduced water supplies during a drought year , worsening water restrictions across the Dallas area. Trailered boat traffic is the most likely vector for invasion into Western North America. This spread is

preventable if boaters thoroughly clean and dry their boats and associated equipment before transporting them to new bodies of water. Since no North American predator or combination of predators has been shown to significantly reduce zebra mussel numbers, such spread would most likely result in permanent establishment of zebra mussels in many North American waterways. A major decrease in the concentration of dissolved oxygen was observed in the Seneca River in central New York in the summer of This decrease was due to extremely high concentrations of zebra mussels in the watershed. Additionally, the Seneca River had significantly less chlorophyll in the water, which is used as a measure of phytoplankton biomass, due to the presence of zebra mussels. When in the water, they open their shells to admit detritus. Since their colonization of the Great Lakes, they have covered the undersides of docks, boats, and anchors. They have also spread into streams and rivers throughout the US. In some areas they completely cover the substrate , sometimes covering other freshwater mussels. They can grow so densely that they block pipelines, clogging water intakes of municipal water supplies and hydroelectric companies. Zebra mussels do not attach to cupronickel alloys, which can be used to coat intake and discharge grates, navigational buoys, boats, and motors where the species tends to congregate. However, because they are so efficient at filtering water, they tend to accumulate pollutants and toxins. For this reason, most experts recommend against consuming zebra mussels. Ormond Lock on the Arkansas River However, zebra mussels and other non-native species are credited with the increased population and size of smallmouth bass in Lake Erie [43] and yellow perch in Lake St. This cleansing also increases water visibility and filters out pollutants. Each quagga and zebra mussel filters about 1 US quart 0. Because zebra mussels damage water intakes and other infrastructure, methods such as adding oxidants, flocculants, heat, dewatering, mechanical removal, and pipe coatings are becoming increasingly common.

Chapter 8 : Zebra Mussels Threaten Inland Waters | Minnesota Sea Grant

Zebra mussels attach to hard surfaces underwater. Biology. A single zebra mussel can filter one quart of water per day while feeding primarily on algae. They live underwater, attached to natural and manmade substrates such as rocks, wood, plants, native mussels, pipes, docks, boat lifts, swim rafts, moored watercraft, and other debris.

FAQs How do you know when a wild plant is safe to eat? Can you eat pythons? What about zebra mussels? How can you get involved in the fight against invasive species? Read the FAQ and send us your questions! Can you eat city pigeons? Pigeons have been hunted and enjoyed by people around Europe and the Old World for centuries. The French brought them to America because they were valued as food. But is pigeon meat healthy in urban areas? There is no evidence that they carry more diseases than other city birds. So can we eat them? A prudent approach would suggest avoiding wild birds and mammals in areas where toxins such as rat poison are set out. How do I know a wild plant is safe to eat? Should I worry about accidentally picking and eating a poisonous plant? Where am I most likely to find invaders? Burned-over and cut-over areas are excellent. Many edible plants are pantropic weeds. What are the risks in the promotion of eating invasives? Critics claim that creating a market demand for a sustainable fishery for species such as Asian carp or green crabs could promote sustainable use of these products and encourage their spread. Clearly, the most effective treatment is prevention and a quick response to new invasions. They, too, worry that if a target species become an economic resource people may try to re-create that market in previously uninvited regions. One should never move living invaders or attempt to expand their range. At best, humans may be just another form of biological controlâ€”capable of reducing the ecological impact of an invader, if not completely extirpating it. Just look at our track record: Atlantic cod, bison, and Pismo clams have all but disappeared under the weight of human demand. We managed to dispatch all 5 billion passenger pigeonsâ€”many of them smoked, roasted, stewed, fried, or baked in pot piesâ€”in fewer than years. After the birds were gone, market hunters missed the pieâ€”half a dozen pigeons with three crimson legs stuck in the crustâ€”as much as they did the birds themselves. Why not put our destructive streak to good use for a change? Are zebra mussels edible? The USGS says, in short: Many species and fish and ducks eat zebra mussels, so they are not harmful in that sense. However, because they are filter feeders, they can accumulate pollutants in their tissues that may not be healthy for people to consume. You should contact local public health officials to learn whether it is safe to eat mussels or fish from a specific waterbody. The culinary world is still reeling, from someone posting the following message on Chowhound in Very hard to find on the internet or in cookbooks. Any help would be appreciated. The meat comes in a 1lb. Keep in mind that as the new apex predator in the Everglades, the Burmese python may have high levels of mercury. One of the earliest laws to address invasive species was the Lacey Act, first passed in Focused on trade, the law prohibited the intentional introduction of fruit bats, mongoose, meerkats, starlings, and English sparrows. Last amended in , the law is the main legal defense against invasive animal species, but the list remains dauntingly small only about two dozen species. A study out of Notre Dame questioned the efficacy of the law, noting the size of the list; the delay in protecting against threats, which could take up to seven years; and the lack of an emergency provision to prohibit imports. Asian carp were added to the list in This law focused on unintentional, but preventable, introductions. It was largely a response to the invasion of zebra mussels in the Great Lakes and focused on controlling species spread through ballast water. In , the law was expanded and renamed the National Invasive Species Act. The law has been valuable, but had several shortcomings, especially in its failure to regulate other vectors such as aquaculture and the pet trade. NISA expired in , but aquatic nuisance species continue to be regulated by the law. Clean your muddy boots, shoes, and clothes before you travel. Remove invasive species from your yard. Carefully bag them for disposal. Do not dump them in the wild. Use only noninvasive species cuttings for mulch and compost. Garden with plants native to your area. If you want to plant wildflower seeds, make sure the seeds in the packet are for wildflowers native to your region, not invaders from elsewhere. The best way to insure this is not to buy a packet of wildflower seed from a national chain store or from a seed catalogue with an address outside of your state unless you have read the fine print regarding the source of the seeds carefully.

Some wildflower seeds in such packets even come from abroad. Many states have websites describing the wildflowers that are native to each area and when and where they should be planted. Buy imported garden plants only from registered nurseries and only if the plants are certified. Half of all invasive plants started as imported ornamentals; then they hopped the fence and went wild. Do not dump it in the wild or flush it down the drain. The Nature Conservancy recommends: Ask if the store where you purchased the pet will take it back. Look for a certified adopter. Ask your vet about humane euthanasia. Check about the availability of a pet amnesty day. If you hunt, hunt wild boar.

Chapter 9 : Zebra Mussels - Wisconsin DNR

Zebra Mussel. Scientific name: Dreissena polymorpha (Pallas,) (ITIS). Common name: Zebra mussel. Spotlight: Bureau of Reclamation Launches Prize Competition Looking to Eradicate Invasive Quagga and Zebra Mussels (Dec 14,).