St. Johns River Water Management District

VIDEO LESSON PLAN

www.sjrwmd.com/education/teacher/#lesson-plans

Gizzard shad harvest at Lake George, Florida: Removing excess nutrients to improve water quality

Background:

Water quality is affected by the amount of nutrients (nitrogen and phosphorus) entering the water body from surrounding lands. Human activities can increase these nutrients entering the water from fertilizers, sediments and waste products, such as septic systems and wastewater effluent. Excess nutrients feed harmful blue-green algae and can turn a water body from clear or tannic (tea color in our lakes and rivers caused by tannic acid from decaying leaves) to a sickly green color. Removing gizzard shad, a native fish found in most Florida waters, has been shown to be an effective tool for reducing nutrients in some of the large lakes in the St. Johns River Water Management District. Harvesting gizzard shad, which may be overabundant in waterways with high nutrient levels, can decrease total nutrients within a lake by removing the nutrients that are contained in the fish bodies. Reducing the gizzard shad population also decreases resuspension of nutrients that are disturbed by shad feeding on organic material found in lake sediments. Gizzard shad also eat microscopic zooplankton that are an important component of the food chain. Removing gizzard shad will increase the populations of zooplankton that are a critical food resource for newly hatched game fish species.

Find out more about the St. Johns River Water Management District and water quality improvement projects in large lakes at www.sjrwmd.com/education/shad-harvesting.

VIDEO LESSON PLAN • Gizzard shad harvest at Lake George, Florida

Vocabulary words:

algae
blue-green algae
eutrophic
game fish
microscopic
nitrogen
non-game fish
nutrients
phosphorus
photosynthesis
phytoplankton
proliferate
restoration
sediment
turbidity
zooplankton

Pre-assessment: (5 minutes)

Have students fill in the boxes on the student page for "what you already know about this word" for each vocabulary word.

Engage: (3–5 minutes)

Tell the students they are going to learn more about alternative ways to improve water quality. Have them answer the following questions:

- Describe what comes to mind when you hear the words "water quality" (what colors, what objects, what motions?)
- Is water quality something you can always smell, touch or see?
- What are nutrients?
- How do nutrients affect our ecosystem?

Explore/Explain: (20 minutes)

Review the list of vocabulary words in this teacher packet and watch the video. Instruct students to write down what they hear in the video and learn about the vocabulary words.

Next Generation Sunshine State Standards

SC.3.L.17.1: Describe how animals and plants respond to changing seasons.

SC.3.L.17.2: Recognize that plants use energy from the sun, air and water to make their own food.

SC.4.L.17.3: Trace the flow of energy from the sun as it is transferred along the food chain through the producers to the consumers.

SC.4.L.17.4: Recognize ways plants and animals, including humans, can impact the environment.

SC.7.E.6.6: Identify the impact that humans have had on Earth, such as deforestation, urbanization, desertification, erosion, air and water quality, changing the flow of water.

SS.8.G.5.2: Describe the impact of human modification on the physical environment and ecosystems of the United States throughout history.

SC.912.L17.10: Diagram and explain the biogeochemical cycles of an ecosystem, including water, carbon and nitrogen cycle.

SC.912.L17.13: Discuss the need for adequate monitoring of environmental parameters when making policy decisions.

SC912.L.17.16: Discuss the large-scale environmental impacts resulting from human activity, including waste spills, oil spills, runoff, greenhouse gases, ozone depletion, and surface and groundwater pollution.

SC.912.L17.17: Assess the effectiveness of innovative methods of protecting the environment.

SC912.L.17.18: Describe how human population size and resource use relate to environmental quality.

SC912.E.7.1: Analyze the movement of matter and energy through the different biogeochemical cycles, including water and carbon.

Extend:

Do a project on how we can protect our waterways. Get students to make a video, informational flyer, poster or play to describe what people can do to protect our waterways.

Watch gizzard shad harvesting video https://youtu.be/mGJjpb698zc

Extensions:

- Have students draw the phosphorus cycle with its sources and sinks.
- Have students describe their local water quality status and trends from www.sjrwmd.com/data/water-quality/#status-trends. Students can locate 2–3 of the sampling stations closest to their home and then write a paragraph on Total Nitrogen and Total Phosphorus levels at that station for the past 10 years (status) and how they have changed over the last 15 years (trend).

Evaluate: (5–10 minutes)

After viewing the video, discuss with the students what they have learned about the vocabulary words. On the student page have them choose 3–5 words to fill in the box on "what new things/ ideas you found out about this word."

A fisherman offloads gizzard shad caught during a harvest.

Gizzard shad are cleaned and prepped for use as bait.

Vocabulary words with definitions:

algae	A very broad description of photosynthetic (produce their own energy), aquatic (live in water) organisms ranging from microscopic, single celled organisms, including bacteria to complex gigantic seaweeds like kelp, and nuisance algae in stormwater ponds.
blue-green algae	Aquatic (live in water) and photosynthetic (make their own food) bacteria are also called cyanobacteria. Some of these organisms produce toxins when their populations experience increased nutrients and can grow uncontrollably or "bloom." These organisms can be responsible for harmful algal blooms (HABs).
eutrophic	A body of water rich in nutrients.
game fish	Fish that are intentionally caught by fishermen and frequently are eaten or targeted for commercial fishing.
microscopic	Description of something that is too small to be seen by the naked eye or without the use of a microscope.
nitrogen	One of the necessary elements needed for life and contained in all living organisms. Although it makes up most of the gas in the atmosphere it often limits plant growth in soil. This limitation makes it necessary for it to be a common component in fertilizer along with phosphorus and potassium. Typically, low concentrations of this element occur in water. When there is influx of nitrogen from runoff or other sources, it can cause algae to increase rapidly in numbers.
non-game fish	Fish that are undesirable for harvesting because they are not edible.
nutrients	Substances needed for growth, development and functioning, in other words they are essential for life. Nitrogen and phosphorus are frequently the most limiting nutrients for plant growth.
phosphorus	One of the necessary elements needed for life and contained in all living organisms. Often limited in soil except for in many Florida soils. This nutrient cannot be created artificially although it is an important component in fertilizer. Abundance of this element can cause algal blooms.
photosynthesis	This is the process of cells converting the sun's energy into chemical energy.
phytoplankton	Microscopic photosynthetic (producers) aquatic organisms that act as the bottom of the food chain in aquatic systems.
proliferate	Increase in abundance.
restoration	To return a system back to a prior condition.
sediment	Any particulate matter than can be transported by liquid's movement and eventually deposited as a layer of particles on the bottom of a water body.
turbidity	The measure of relative clarity of a liquid.
zooplankton	Microscopic aquatic organisms that are consumers rather than producers.

Answers to questions:

Directions: Answer the following questions using information you learned watching the video.

1. What is the innovative way that the St. Johns River Water Management District is working to restore the health of Lake Apopka and Lake George explained in this video?

   Removal of nutrients with gizzard shad harvesting.

2. How would you describe the relationship between nutrient level, water quality and water clarity?

   Water quality decreases when nutrient concentrations increase and microscopic blue-green algae in the water column excessively reproduce. Abundant blue-green algae in the water column causes decreased water clarity meaning less light makes it to the bottom which in turn decreases abundance of underwater plants that need light to grow. The underwater plants take up nutrients as they grow, and their decline will cause further declines in water quality. The opposite is true when water becomes clearer. There is a positive feedback loop with underwater plants growing, taking up nutrients and holding the lake sediments in place which further improve water clarity.

3. How do the populations of gizzard shad change in water bodies that have excessive levels of nutrients in comparison to healthy Florida lakes?

   Gizzard shad are found in most lakes across Florida. In healthy lakes they compose 5-20% of fish populations. Gizzard shad populations are not negatively affected by changes in water quality resulting from increased nutrients and blue-green algal abundance so their populations will increase and can account for more than 90% of fish populations in nutrient rich lakes.

4. How do the feeding habits of gizzard shad change from young stages to older? What influence does it have on the food webs within the lake?

   Gizzard shad are filter feeders and consume both zooplankton and phytoplankton. Reducing the number of gizzard shad in a lake can increase the number of zooplankton, which are an important food source for very young game fish (newly hatched). Zooplankton are an important component of the food web. They eat all types of small phytoplankton as well as other zooplankton. However, zooplankton do not consume blue-green algae that cause harmful algal blooms.

   Older gizzard shad are also filter feeders but also begin feeding on the organic material found on the bottom of lakes. Their bottom feeding habits not only stir up sediments, which can decrease water clarity, it also resuspends nutrients that can fuel harmful algal blooms.

5. What happens to nutrient levels and visibility within the lake as the gizzard shad stir up sediments feeding as the adults? What would influence would removing those adults have on nutrient cycling within the lake?

   Bottom feeding by adult gizzard shad physically stirs up the sediments. Sediments contain phosphorus and when sediments are re-suspended in the water column more nutrients become available to feed blue-green algae. Increased sediments in the water and blue-green algal blooms can greatly reduce the amount of light that makes it to bottom of lakes, which in turn will decrease the abundance of aquatic plants. When water is clearer aquatic plants can grow, taking up nutrients and holding lake bottom sediment in place, further improving water quality.

6. The elemental concentrations of freshwater fish have been studied and research has shown that the bodies of the gizzard shad contain 0.8% total phosphorus. In the video, we saw that 0.8% x 1,000,000 pounds (lbs) of gizzard shad harvested= 8,000 lbs of total phosphorus.

   a.) How much total phosphorus has been removed during harvesting from 2013 to 2018 from Lake George with 5,000,000 lbs of gizzard shad removed? (remember to convert your percentage to a decimal)

   *0.008*5,000,000= 40,000 lbs of TP*

   b.) How many pounds of gizzard shad were removed from Lake George in 2019 with the removal of 4,940 lbs of total phosphorus?

   4,940 lbs/0.008= 617,500 lbs of fish

7. What type of data is collected to monitor the activities of the fishermen that are harvesting gizzard shad?

   The number of boats fishing, the total weight of gizzard shad harvested by each boat, and the fishing effort for each boat (number of nets, length of nets, and hours each net was fished). The District also monitors the amount of by-catch (fish that are not wanted to be caught).

8. Because gizzard shad are a non-game fish what is done with them after harvest?

   They are sold as bait for crab to fishermen throughout Florida and the Southeast. Additionally, they are sold to crayfish farms in Mississippi and Louisiana.

9. The use of entangling nets is banned with exception to qualified fishers for scientific research or government purpose like that of the St. Johns River Water Management District. What are two of the ways that the gizzard shad harvesting is conducted that minimizes the impact to desired fish populations?

   Nets are only allowed to be fished for two hours to minimize the mortality of the by-catch. All by-catch must be returned to the water immediately, and the District monitors the by-catch closely to ensure the program is not harming non-target species. For Lake George only, the commercial harvest is conducted only in the summer months to avoid interfering with spawning runs of American Shad, Hickory Shad, and Blueback Herring that occur in the spring.

10. How could individuals reduce nutrients from making their way into our water bodies in the first place?

    Ensuring that fertilizer is applied appropriately, not putting grass clippings down a storm drain, picking up after your dog's waste, maintaining septic tanks properly.

Gizzard shad harvest at Lake George, Florida

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4. How do the feeding habits of gizzard shad change from young stages to older? What influence does it have on the food webs within the lake?

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