

Florida's Natural Wonders

SPRINGS

IN WEST-CENTRAL FLORIDA

Southwest Florida Water Management District





Cooter Turtle



Great Egret



Weeki Wachee River

Southwest Florida Water Management District

The Southwest Florida Water Management District (District) manages the water resources for west-central Florida as directed by state law. The District encompasses roughly 10,000 square miles in all or part of 16 counties and serves a population of 4.7 million people. The goal of the District is to meet the water needs of current and future water users while protecting and preserving the water resources within its boundaries. The District's four areas of responsibility are as follows: water supply, flood protection, water quality and natural systems.

The wonders of springs

A spring is a natural opening in the ground where water flows directly from the aquifer to the earth's surface. The source of this freshwater is from seasonal rainfall that soaks into the ground, which is referred to as groundwater. Springs form when groundwater is under pressure and flows up through an opening called a spring vent, supplying water flow to a river or other water body. Springs are vital headwaters, the upper tributaries, of many local rivers.

Springs are unique water resources that provide natural, recreational and economic benefits. For thousands of years people have been attracted to the natural beauty and habitat of these ecosystems.

Springs in west-central Florida are supplied from groundwater in the Upper Floridan aquifer — the same aquifer that provides the majority of the region's drinking water. However, these spring systems have been changing for nearly a century due to increases in nutrients, loss of habitat, increases in salinity and

a decline in rainfall since the 1960s. Therefore, it is important to learn what we can do to help protect and restore these natural treasures.

Source: Southwest Florida Water Management District

Leading scientific agency

The Southwest Florida Water Management District is the leading scientific agency on springs in the region. The District's Springs Team is a diverse group of scientists and engineers committed to restoring our springs. The team's goal is to improve habitat and water clarity in first-magnitude springs and rivers. Since each spring system is different, the team uses a variety of techniques to address each system's individual challenges such as monitoring, research and development, regulation, conservation, restoration, land acquisition and management, and education.

IN THE KNOW. IN THE TIMES.

The Tampa Bay Times Newspaper in Education (NIE) program is a cooperative effort between schools and the *Times* to promote the use of newspapers in print and electronic form as educational resources. Our educational resources fall into the category of informational text.

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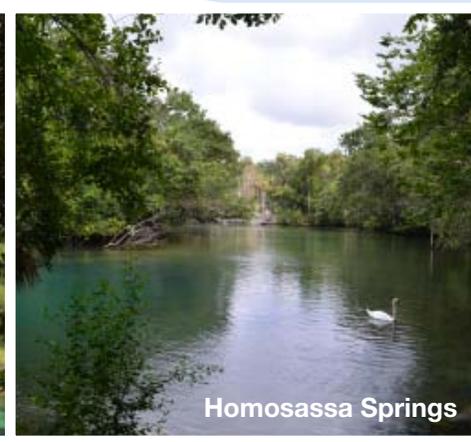
Tampa Bay
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Weeki Wachee Springs



Rainbow Springs



Homosassa Springs

The importance of springs

Spring vents are windows into the aquifer, which is the major source of our drinking water. The springs and their associated rivers and bays have tremendous ecological value, and are home to countless plants and animals.

Additionally, the springs' crystal, calm flows and constant temperatures make them an ideal spot for a variety of recreational opportunities. Some ways people enjoy their beauty are by snorkeling, scuba diving and kayaking. Many come seeking a glance of the springs' most famous seasonal residents — the manatee.

That interest translates to a large economic impact for the small communities that surround these systems. Springs generate about 900

jobs. And the state parks associated with some of these springs bring in about 1 million out-of-state tourists a year, which translates into a \$46 million economic impact.

The District's team of springs experts is working to improve the recreational, economic and ecological value of major springs in the region.

Source: Southwest Florida Water Management District

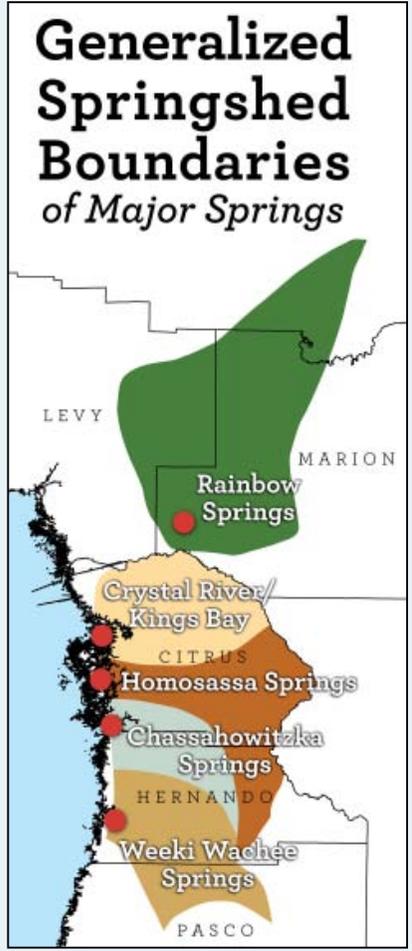
First-Magnitude Springs

Florida has the largest concentration of springs in the world. There are more than 150 springs within the District. Many of these springs are part of the five first-magnitude spring groups — Rainbow River, Crystal River/Kings Bay, Homosassa River, Chassahowitzka River and Weeki Wachee River. The size of a spring is classified by its "magnitude." First-magnitude springs discharge 64.6 million gallons of water or more per day. Together, these five spring groups discharge more than 1 billion gallons of water per day.

Springs and springsheds

A springshed is the area of land that contributes water to a spring. This area includes much more than just the land surrounding a spring. In fact, you can live miles away from a spring and still be located within its springshed. This means that your actions at home, which may be many miles from the spring, can affect the health of the spring and the water flowing from it. For example, the Rainbow Springs Group has a springshed that covers several hundred square miles and extends into three counties. Find out if you live in a springshed — view the map of generalized springshed boundaries for the major springs in this region.

Source: Southwest Florida Water Management District



Learning with the Times



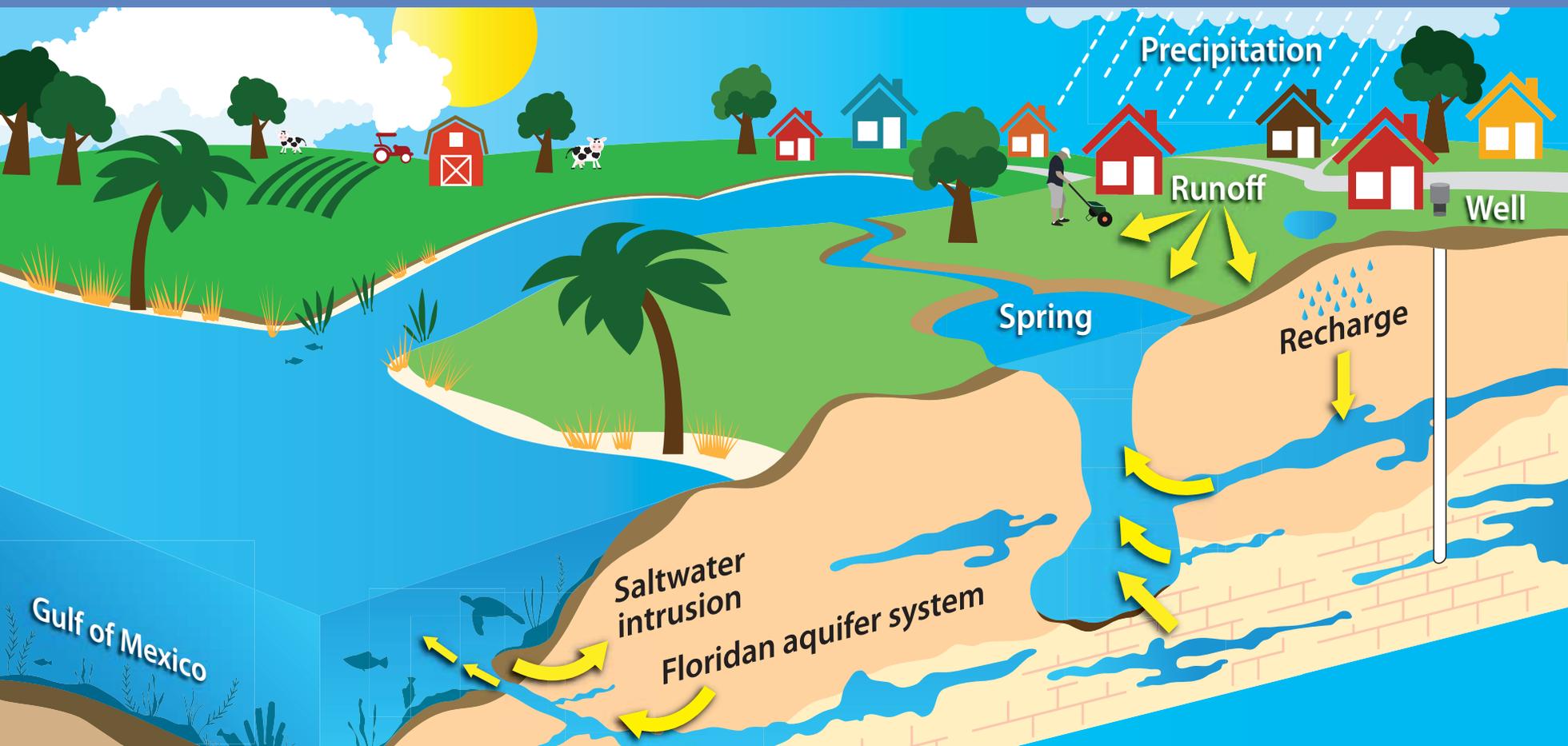
Learning new words

When you study new things, you often come up against some tough vocabulary words! Most vocabulary words are learned from context clues or good old-fashioned dictionary work. While you read this publication, be sure to highlight or circle words you don't know. Try to figure out the words' meanings by looking for clues in the sentences around them. Write down your best guess, and then look up the words in a dictionary. As a group activity, make a list of the words your classmates identified and see which ones stumped the class. Next, use these words for a news scavenger hunt. See if you can find these words in the newspaper. The group that finds the most words wins the game.



Rainbow Springs

The journey of water



The water cycle

To understand Florida's springs and their importance as natural resources, we must first understand the water cycle and aquifer that sustain them. Florida's springs are part of the water cycle as water exits the Floridan aquifer, our local groundwater source.

Rainfall – The journey of water begins in the sky. Rainfall is a function of various atmospheric and physical conditions. The most important of these are gravity and humidity. Every day, more than 150 billion gallons of rain falls in Florida, that is more than any other state in the nation except Louisiana.

Evaporation and condensation – Water's journey through the water cycle begins with a process called evaporation, whereby water stored in surface bodies of water, such as lakes, rivers and the ocean, is converted into water vapor by the heat of the sun. Convection then draws this warmer, wetter air upward, where it comes into contact with cooler, high atmospheric air and eventually condenses back into tiny water droplets.

Transpiration – In addition to evaporation, a significant percentage of the water is released into the atmosphere by trees and plants in a process called transpiration. In order to facilitate photosynthesis, plants absorb water from the soil through their roots, a process that also can clean water by filtering out nutrients and pollution. They then transpire this water back into the atmosphere through their leaves and stems. About 70 percent of all rainfall returns to the atmosphere in the form of evaporation and transpiration.

Runoff – Rainfall that is not absorbed directly into the soil or through the roots and leaves of plants, or accumulated into existing bodies of water such as lakes or rivers, is called surface, or stormwater, runoff.

Percolation – Rainfall seeps underground through a process called percolation, whereby water travels downward through the tiny spaces between rocks and soil particles, and within the structure of the limestone. The water eventually saturates the underlying limestone in much the same way water fills the tiny holes of a sponge. It is this process of percolation that allows Florida's abundant rainfall to replenish the immense volumes of water flowing from the springs.

The connection between rainfall and flow

Rainfall patterns strongly influence the amount of groundwater that discharges from a spring. Beginning in the 1960s, there has been a trend of declining rainfall in west-central Florida. A decrease in spring discharge has corresponded. Discharge has the largest effect on flow in a spring system, and flow plays a significant role in maintaining the ecological health of many springs. Other factors that influence the flow of a spring include the river's width, depth and bottom type as well as aquatic vegetation. Increased sedimentation in a river can also negatively affect flow.



Three Sisters Springs

to and from springs

Karst terrain

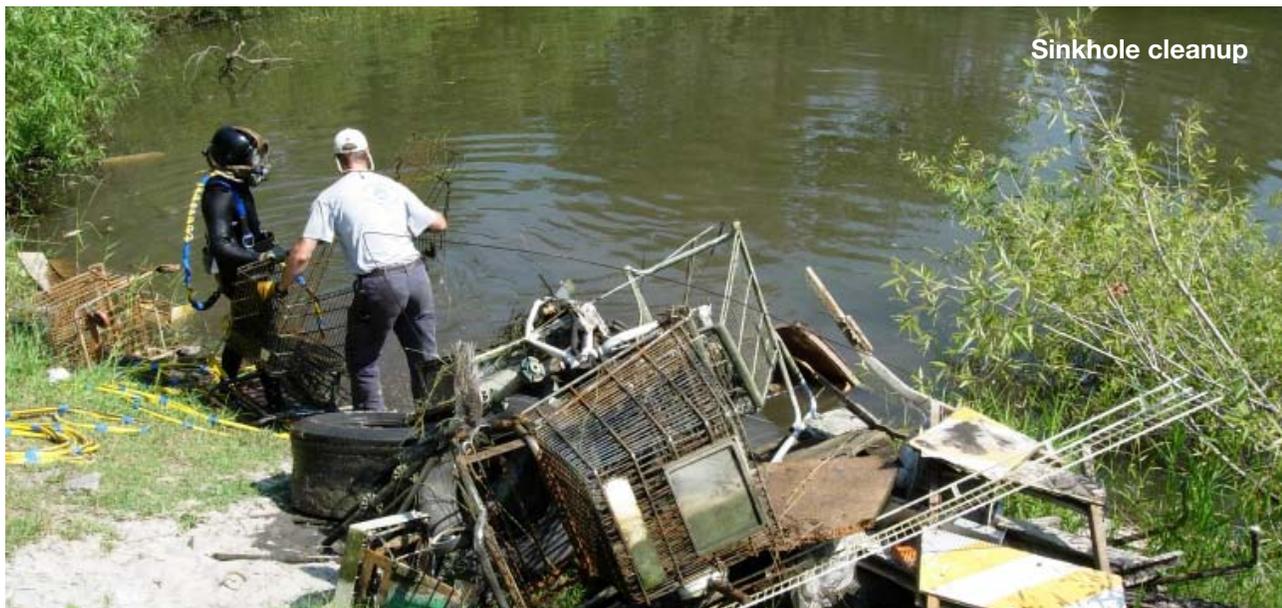
To better understand how the water cycle replenishes Florida's aquifers and springs, let's learn more about the landform that makes it possible. Much of Florida is composed of "karst" landforms. Karst terrain is a land surface produced when bedrock — mostly limestone in Florida — dissolves slowly over time as acidic rainwater passes through it. Karst terrain is characterized by springs, sinkholes, caverns and disappearing streams.

Florida's limestone bedrock is honeycombed with underground fractures, cavities and tunnels that allow water to move easily through them and into the aquifer. Water stored in the Floridan aquifer system provides 80 percent of the water supply in west-central Florida.

Florida residents depend on groundwater and the environment does, too. Weather conditions, such as a drought or a steady decline in rainfall, can reduce the amount of groundwater exiting the spring and supplying water to an associated river. Without adequate flow, the ecology and recreational potential of a spring diminishes.

Sinkholes

Sinkholes are a naturally occurring geologic phenomenon and, like springs, are common features of Florida's karst terrain. Since the land beneath karst topography is very unstable, it



Sinkhole cleanup

may become too fragile to support the surface and may collapse, creating a sinkhole. Sinkholes are depressions or holes in the land surface that can be shallow or deep, small or large. In fact, many of the lakes in Florida are remnant sinkholes. Hydrologic conditions, including a lack of rainfall, excessive rainfall in a short period of time or lowered water levels can all contribute to sinkhole development.

Source: Southwest Florida Water Management District

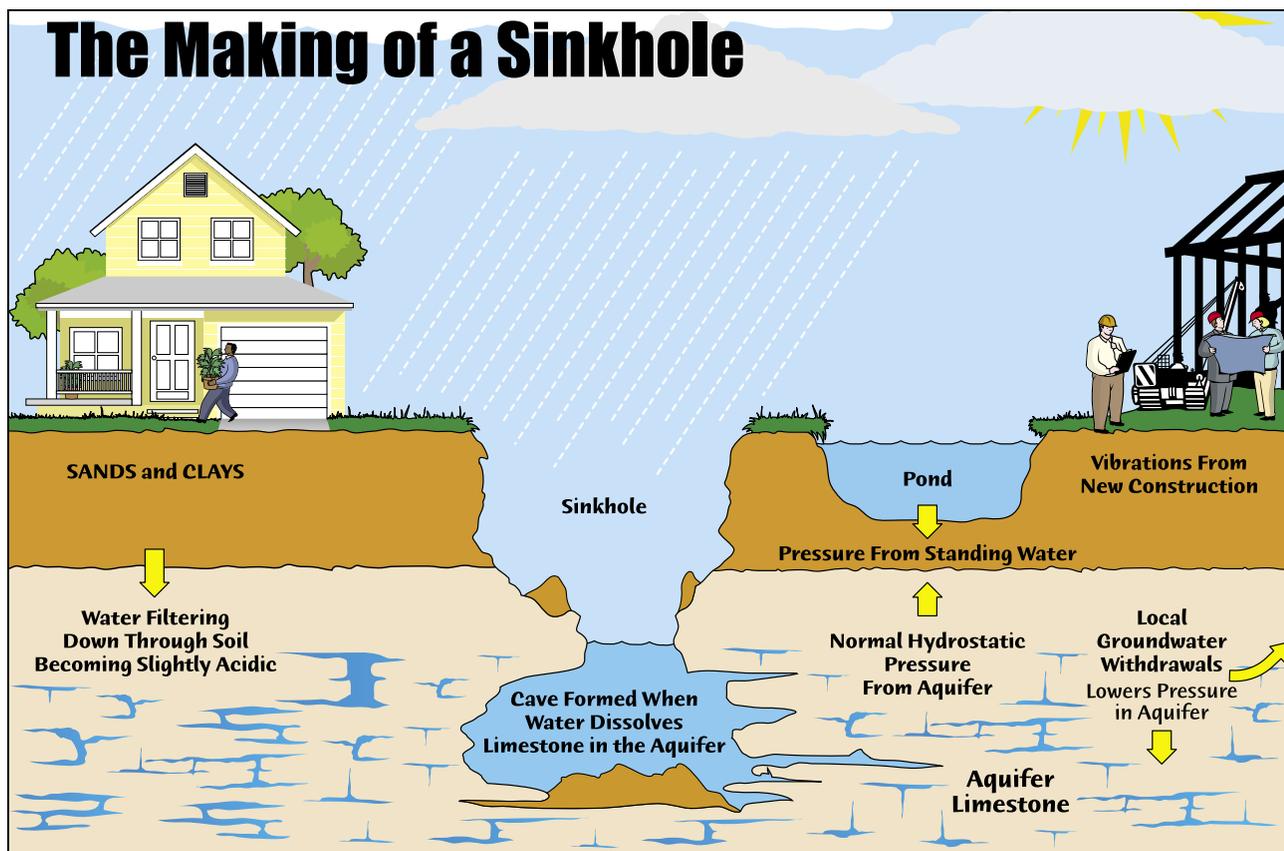
Think about it

Many times sinkholes are directly connected to the aquifer. As a result, debris found in them can have a significant impact on the quality of the water leaving a spring. Therefore, you should always dispose of hazardous household chemicals such as industrial cleaners, solvents, automotive fluids and paints at an approved landfill. In addition, you should never discard trash or debris into a sinkhole because hazardous contaminants can seep into the underground aquifer, our drinking water and springs.

Learning with the Times

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We all need to work together to protect our environment. Conserving water, recycling and protecting our wildlife are important for the future of Earth. Look for articles in the newspaper that show examples of people, groups or organizations that are working to protect the environment. Make a list of those involved and the actions they are taking. Select one of the environmental groups or issues you have read about and do some research about it. Then think about what actions you can take to protect the environment. Share your ideas with others by writing a blog post or short essay that incorporates the information you have learned.



Chassahowitzka Springs



Chassahowitzka Springs, a first-magnitude spring, is made up of a dozen springs that form the headwaters for the Chassahowitzka River. It is a short river that flows 5.6 miles from the headsprings to where it meets the Gulf of Mexico at Chassahowitzka Bay in Citrus County. The Chassahowitzka River is designated an Outstanding Florida Water by the State of Florida.

The Chassahowitzka springshed, which contributes groundwater to Chassahowitzka Springs, is approximately 190 square miles of upland forests, urbanization, agricultural activities and wetland

DID YOU KNOW?

Did you know that Chassahowitzka means pumpkin hanging place? The Chassahowitzka River is unique in that it is one of the healthiest rivers in west-central Florida. The majority of the river is dominated by submerged aquatic vegetation and is surrounded by undeveloped land.

Source: Florida Fish and Wildlife Conservation Commission

forests. This springshed covers portions of Citrus and Hernando counties.

Source: Southwest Florida Water Management District

Ecological shifts

The Chassahowitzka River is unique in that it is one of the most ecologically healthy rivers in west-central Florida. The majority of the river is dominated by submerged aquatic vegetation and is surrounded by undeveloped land. However, there have been ecological shifts in the river caused by sea-level rise and the decline of water discharging from the spring system — primarily due to a long-term decrease in rainfall.

While the river is relatively healthy, the springs that make up the headwaters and the upstream canal system are in poor condition, with significant sediment accumulation and unhealthy Lyngbya algae.

Source: Southwest Florida Water Management District

Chassahowitzka River and coastal swamps

The lower half of the river is part of the more than 31,000-acre Chassahowitzka National Wildlife Refuge. Purchased in the early 1990s, this property is part of a large greenway of public lands that protects the

Chassahowitzka Swamp ecosystem and wildlife resources. The Chassahowitzka River's headwaters and several tributaries and springs are within this tract and are known locally for their great sportfishing and crabbing.



The vast expanse of salt marsh, hardwood swamps, crystal-clear springs and river are a canoeist's paradise. Camping, a boat launch, a boat rental and a camp store are available at the Chassahowitzka River Campground and Recreation Area, which is operated by the Citrus County Parks and Recreation Department.

Source: Southwest Florida Water Management District

Chassahowitzka Springs artifacts

During the District's Chassahowitzka Springs Restoration Project, underwater archaeologists discovered thousands of artifacts that span 10,000 years of Florida's history. From the Paleoindians to the Seminoles, and from the Spanish to Floridians today, the springs served as a vital natural resource.

Primitive arrowheads, a prehistoric stone bowl, dozens of old bottles, a corroded cap pistol from the 1940s, discarded car tires and a shard from a 15th century Spanish ceramic plate were unearthed, among other items.

According to a *Tampa Bay Times* article, the restoration project along the coastal boarder between Citrus and Hernando counties sought to undo decades of accumulated pollution caused by street runoff and leaking septic systems. Over time, the accumulation of sediment had a negative effect on water clarity and quality; and therefore, recreation and public use of the spring.

Using a low-suction vacuum dredge, work crews removed filamentous algae, sand and muck containing approximately 7,600 pounds of nitrogen and 500 pounds of phosphorus.

According to the District's executive director, Robert Beltran, the recovered artifacts are proof that the area has been a lure to visitors long before civilization came along. "This spring and others like it around Florida are rare environmental gems," Beltran said. "It is so important that we do all we can now to preserve them for future generations."

For more information about the Chassahowitzka Headspring Restoration Project, go to WaterMatters.org/Springs/Chassahowitzka/Restoration-project.

Source: Southwest Florida Water Management District



Artifacts pictured from left to right: ceramic water crock, Pasco Plain bowl AD 100 - 1500, late archaic period canoe paddle (BC 750 - 680)



RECOVERED ARTIFACTS TIMELINE

8000 BC: The Suwannee projectile point dates to the Paleoindian period and is the oldest artifact found at the springs thus far.

8000-500 BC: Deer antler was likely a billet used to manufacture stone tools.

8000-500 BC: Bone fishhooks were used from the Archaic period until European contact.

8000-500 BC: Bone pins were used for clothing, hair and body jewelry, and, as may be the case at the Springs, gigging fish.

6000-3000 BC: Kirk-like projectile point with serrated edges, from the Early to Middle Archaic periods.

5000-1200 BC: Newnan-type projectile point, from the Middle to Late Archaic periods.

1200-300 BC: Broward-type projectile point, from the Weeden Island period.

AD 100: Pasco Plain ceramic bowl was made in the Middle Woodland period and, 1900 years later, was recovered intact.

AD 200-700: St. Andrews complicated stamped pottery. These designs were made by carving the pattern into a paddle and then pressing it into the clay before firing.

1600s: Spanish majolica plate, a ceramic type that first arrived in Florida with Juan Ponce de Leon.

1700s: Chattahoochee brushed pottery, a ceramic type used by the Seminoles.



1821-1870: Ricketts-type molded bottle was found with its cork still in place.

1830-1835: Embossed edgeware ceramics were common in the early 19th century.

1850-1930: Bristol slip stoneware jug.

1860: A kerosene lamp was found with kerosene inside; possibly used for night fishing.

1877: Painted enamel sheet metal kettle.

1885-1966: A sample of the recovered soft drink bottles.

1900-1920s: Admiralty anchor was common in the early 20th century.

1940s-1950s: Hubley long barrel Texan Jr. toy cap gun.

1941: Several old boat licenses were found in the springs.

20th century: Butter knife and spoon.

For more artifact photos, visit WaterMatters.org/Artifacts.



Crystal River/Kings Bay



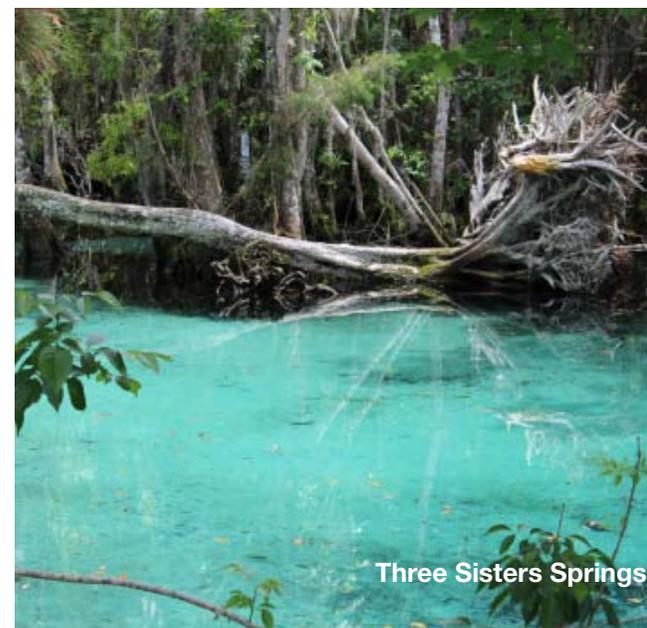
Cystal River/Kings Bay is the second-largest springs group in Florida, with more than 70 springs within the 600-acre bay. The springs are the headwaters of Crystal River, which is a short, tidal river that flows 7 miles from the headsprings to where it meets the Gulf of Mexico at Crystal Bay in Citrus County. Not surprisingly, Crystal River/Kings Bay is a popular tourist destination, where manatee viewing, diving, snorkeling, fishing and recreational boating are extremely important to the area economy.

The Crystal River/Kings Bay springshed, which contributes groundwater to Crystal River/Kings Bay, is approximately 250 square miles of urbanized and agricultural lands, forested uplands and wetlands. This springshed covers much of Citrus County.

Source: Southwest Florida Water Management District

walls and dead-end canals were created to provide waterfront residential and commercial real estate. These activities changed water circulation and reduced the amount of natural wetlands. Although nitrate levels are relatively low, portions of Kings Bay are dominated by unhealthy Lyngbya algae.

Source: Southwest Florida Water Management District



Three Sisters Springs

Crystal River National Wildlife Refuge

This last unspoiled and undeveloped habitat in Kings Bay, the headwaters of the Crystal River, is critical for protection of the West Indian manatee. The primary springs within the wildlife refuge are Idiots Delight, Three Sisters and the King Springs group, which includes Tarpon Hole, Mullet's Gullet and Little Hidden springs.

Source: Florida Department of Environmental Protection

Learning with the Times



How to help

According to the Florida Fish and Wildlife Conservation Commission, the best way to help manatees and other imperiled species survive is to participate with beach and park or roadside cleanups in your area, volunteer your time to educate others and contribute to organizations who administer management, educational and research programs. Check out the FWC website for more information: myfwc.com/wildlifehabitats/managed/manatee/how-to-help/. Look in the newspaper for articles about conservation and how you can help make your community environmentally sound. Using ads in the newspaper as models, create an ad to promote a conservation initiative. Look at the ads in the newspaper. Think about the dynamics of the ads (images, words, placement of items, colors). Think about ways to draw people's attention to your ad and message. Next, design an ad for the print edition of the newspaper and for the website. How is the ad on the print edition going to be different than the Web version of the ad? Write a fully developed paragraph showing the differences in the ads and what your main point of the ads is. Share your ad and the information in your paragraph with your class.

A unique spring system

Crystal River/Kings Bay is unique because it flows into a large, open bay, which is the largest natural winter refuge in the world for the West Indian manatee. While the system is best known for manatee, it is also home to a rich diversity of other species. The Florida Fish and Wildlife Conservation Commission (FWC) has observed 21 species of amphibians, 47 species of reptiles, 191 species of birds and 22 species of mammals, including 26 state or federally listed species. It is a National Wildlife Refuge and was designated an Outstanding Florida Water by the State of Florida and a Surface Water Improvement and Management priority water body by the District.

Source: Southwest Florida Water Management District

Altering shorelines

Extensive dredge-and-fill activities beginning in the 1960s altered much of Kings Bay and portions of the Crystal River shorelines. Numerous sea



Homosassa Springs

Ellie Schiller Homosassa Springs Wildlife State Park

The headspring is located in the area now known as the Ellie Schiller Homosassa Springs State Wildlife Park. The springs have been a tourist attraction since the early 1900s. During that time, trains would stop to let rail passengers rest at the springs while it was loaded with fish, crabs, cedar wood and spring water.

The park serves as a rehabilitation center and refuge for orphaned or injured manatees. These marine mammals, along with many freshwater and saltwater fish, can be seen year round at the park's fishbowl observatory.

Visitors can see West Indian manatees every day of the year from the park's underwater observatory in the main spring. The park showcases native Florida wildlife, including black bears, bobcats, white-tailed deer, American alligators, American crocodiles and river otters.

Manatee programs are offered three times daily. At the Wildlife Encounter programs, snakes and other native animals are featured. Recreational opportunities include picnicking, nature study and bird watching. The park features a children's education center, providing hands-on experiences about Florida's environment. Transportation from the visitor center on U.S. 19 to the west entrance is available by tram or boat.

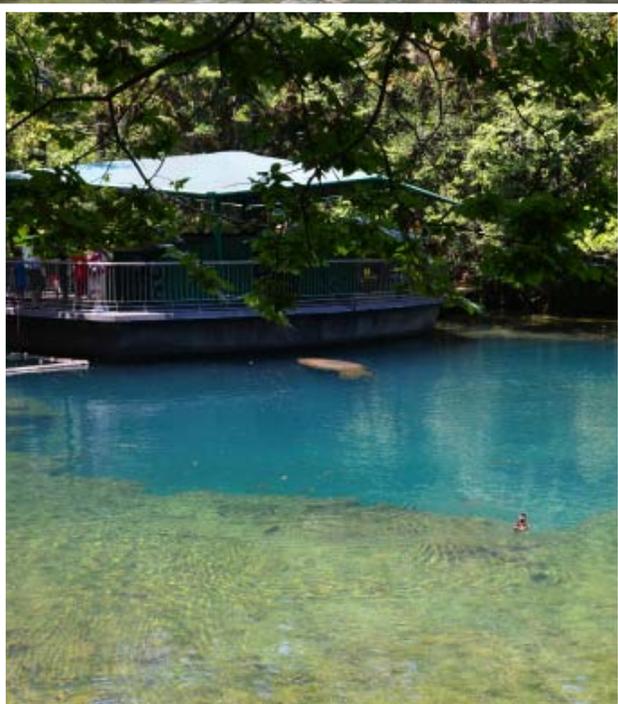
The park has two concessionaire-operated gift shops and a concessionaire-operated café with a selection of beverages and snacks. Plan 3½ to 4 hours to tour the park. Check the ranger programs for a list of interactive events throughout the park each day.

Source: Florida State Parks

Learning with the *Times*

Ecosystems

Everything in the natural world is connected. An ecosystem is a biological community of interacting organisms and their physical environment. In other words, an ecosystem is a community of living and nonliving things that work together. Think about all of the different parts of the spring ecosystems. Research one of the springs from this publication and make a list of all of the interacting organisms in that spring. Next, look for articles, photos and advertisements in the newspaper about your community. Make a list of all of the parts of your ecosystem. Choose some of the most important parts and create a cartoon depicting your personal ecosystem.



Homosassa Springs is the headwaters of the Homosassa River. This short, slow-moving tidal river flows 8 miles from the headsprings to where it meets the Gulf of Mexico at Homosassa Bay in Citrus County.

The Homosassa springshed, which contributes groundwater to the brackish Homosassa Springs, is approximately 270 square miles of urbanized and agricultural lands, forested uplands and wetland. This springshed covers portions of Citrus and Hernando counties.

Homosassa Springs is unique in that the headspring vent flows from three points underground with varying water quality and different salinities that blend together before exiting into the pool. In addition, there are two smaller spring-fed tributaries that flow into the Homosassa River: the southeast fork and the Halls River.

Source: Southwest Florida Water Management District



Rainbow Springs

The Rainbow Springs group is Florida's fourth-largest spring in terms of discharge. It is a first-magnitude spring and the headwaters of the Rainbow River, which is a short, freshwater river that flows 5.7 miles from the headspring south to the Withlacoochee River.

The upper river has an abundance of plant communities providing excellent habitat for many different types of fish and wildlife. It is this natural beauty that also makes the river an important recreational resource. About 220,000 people visit the river annually to dive, swim, boat and fish.

The Rainbow Springs springshed, which contributes groundwater to Rainbow Springs, is approximately 735 square miles of mostly agricultural lands, forested uplands and growing urban areas. This springshed covers portions of Alachua, Levy and Marion counties.



Ecological attributes

The unique ecological characteristics of Rainbow Springs and the Rainbow River were recognized by the State of Florida when the system was designated an aquatic preserve and an Outstanding Florida Water. In 1989, the District

adopted the Rainbow River as a Surface Water Improvement and Management priority water body.

Challenges

Although Rainbow Springs has some of the healthiest submerged aquatic vegetation, it has one of the highest nutrient (nitrate) levels among the west-central Florida spring systems. Nitrates come from numerous sources, including human and animal waste, automobile exhaust and fertilizer. Nutrients also occur naturally in water and support natural processes that are necessary for healthy ecosystems. However, laboratory experiments have shown that excess nutrients can stimulate the growth of phytoplankton and algae. Increases in phytoplankton and algae can decrease water clarity and the diversity of plant and animal communities.

Brief history

Archaeological evidence indicates that people have been using this spring for nearly 10,000 years. The Rainbow River and its immediate surroundings were mined for phosphate in the early part of the 20th century. From 1934 to 1973, the headsprings property was used as a privately owned tourist attraction that included glass-bottom boats and mermaid shows. Today, it is known as Rainbow Springs State Park.

Rainbow Springs State Park

The Rainbow River is popular for swimming, snorkeling, canoeing and kayaking. The headsprings entrance is located 3 miles north of Dunnellon on the east side of U.S. 41. Canoes and kayaks can be rented at the headsprings. A picnic



area includes tables, grills and pavilions, which can be reserved for large gatherings.

A full-facility campground is also available and is located on SW 180th Avenue Road about 2 miles north of County Road 484 and 2 miles south of State Road 40. There is also a tube entrance for tubers to launch; however, tubing is not allowed in the headsprings area. This entrance is located south of the campground on SW 180th Avenue Road.

Source: Southwest Florida Water Management District

Research activity

Florida springs are a vital part of our world. There are many concepts that you can explore in relationship to this topic. When you think about decision making, you need to look at the topic from the following perspectives: social/cultural, economic, ethical/moral, recreational, health and environmental.

- Choose one of the concepts discussed in this publication.
- Create an argument based on that concept.
- With a partner or in a small group, read about the topic and record relevant evidence. Conduct additional research using reliable sources, such as the *Tampa Bay Times*; the *Citrus County Chronicle*; the Southwest Florida Water Management District website, WaterMatters.org; the Florida Department of Environmental Protection website, dep.state.fl.us; the U.S. Geologic Survey website, usgs.gov; and the USF Patel College of Global Sustainability website, psgs.usf.edu/office-of-sustainability.
- Create an Environmental Decision-Making graphic chart using examples from the texts.
- Write a report focused on this topic and your argument.
- Create a visual graphic to summarize your points.
- Share your report and graphic representation with your class.



Weeki Wachee Springs

Weeki Wachee Springs is a first-magnitude spring, which means it discharges 64.6 million gallons or more per day. Weeki Wachee Springs is the headwaters of the Weeki Wachee River. This short, fast-moving river flows 7.4 miles from the headspring to where it meets the Gulf of Mexico at Bayport in Hernando County.

The Weeki Wachee springshed, which contributes groundwater to Weeki Wachee Springs, is approximately 260 square miles of urban or residential areas, rural or agricultural lands and forested uplands. This springshed covers portions of Hernando and Pasco counties.

Source: Southwest Florida Water Management District

Unique features

Weeki Wachee Springs is unique in that its largest spring vent has an extensive underwater cave system that has been explored to a depth of more than 400 feet. In addition, there is a long historical record of water quality and discharge data dating back to the 1930s. The Southwest Florida Water Management District restored portions of Weeki Wachee Springs in 2009 to improve water quality in the headspring and the upper river, as well as enhance the overall natural system.

Source: Southwest Florida Water Management District

Weeki Wachee Springs State Park

The headspring is home to Weeki Wachee Springs State Park, which features a water park and the famous underwater mermaid show. The mermaids at Weeki Wachee Springs have delighted visitors since 1947. Today, visitors can still witness the magic of the mermaids from a 400-seat submerged theater.

Guests also may take a river boat cruise and canoe or kayak on the Weeki Wachee River. Additionally, animal shows provide audiences with an entertaining and educational look at domesticated birds and reptiles.

The water park, Buccaneer Bay, offers a fun-filled flume ride for thrill seekers of all ages. A white sandy beach area and covered picnic pavilions provide a relaxing day for the entire family. The park is located on U.S. 19 at the intersection of State Road 50, just north of Spring Hill and south of Homosassa Springs.

Source: Florida State Parks

Challenges

Nearly all of the natural land around the Weeki Wachee spring and the upper river has been extensively altered. Some of these activities resulted in sediment erosion and accumulation in the spring and upper river. The lower section of the river has been dredged and channelized with canals for riverfront homes and businesses. The canals and lower portion of the river are impacted by the tides in the Gulf of Mexico.

Like many springs in the state, Weeki Wachee Springs and its river have elevated nitrate levels and excess filamentous algae growth. This can be harmful to aquatic insects, amphibians and fish. Large amounts of algae growth can cause reduced water clarity and extreme fluctuations in dissolved oxygen, which is stressful to aquatic life.

Source: Southwest Florida Water Management District

Learning with the *Times*

Environment editorial

Think about how the importance of a springs water environment relates to the future of mankind and the quality of life. With your class, make a list of ways these concepts are interconnected. Next, in a small group, look for articles in the newspaper about springs, water conservation, the environment, pollution or any other topics you discussed with your class. Based on the information you read in these articles, write an editorial on the importance of the springs in your community and to the future of mankind.





Cooter Turtle



Mangrove Snapper



Great Blue Heron

Florida's gentle giants

Did you know that Florida manatees inhabit coastal waters and rivers throughout Florida? They can easily move between fresh, brackish and marine habitats. While the West Indian manatee's range is from the southern United States throughout the Caribbean Islands, Central America and to northern South America, a sub-species — the Florida manatee — lives in many Florida waterways or travels up the eastern coastline into Georgia and the Carolinas, and as far north as Massachusetts during warm months. In the gulf, Florida manatees are occasionally sighted as far west as Texas. During cold months these manatees migrate to the warm waters of south Florida, or find a source of warm water such as artesian springs or industrial discharges.

Source: Florida Fish and Wildlife Conservation Commission

Manatee facts

- A manatee can move each side of its lip pads independently.
- Manatees do not have eyelashes.
- Manatees do not have external ear lobes, but they can hear very well despite the absence of external ear lobes.
- A manatee's heart beats at a rate of 50 to 60 beats a minute.
- Manatees have no "biting" teeth, only "grinding" teeth.
- Manatees have only six cervical or neck, vertebrae. Most other mammals, including giraffes, have seven.
- The manatee's lungs lie along its backbone instead of along its rib cage, as is found in most mammals.

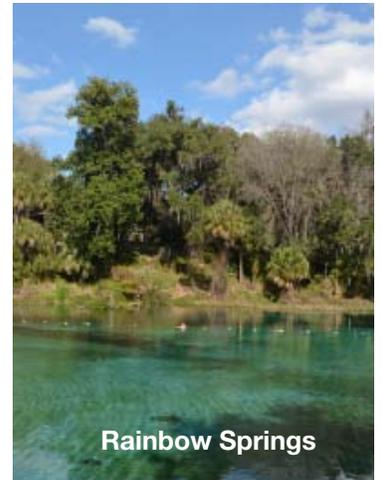
Source: Florida Fish and Wildlife Conservation Commission

Hotspots of biological diversity

For tens of thousands of years, Florida's springs have been hotspots of biological diversity. The ecosystem of springs once provided water, food and habitat for many of North America's most spectacular animals, including the mastodon, the saber-toothed tiger and the giant sloth.

Today, springs are one of the only natural areas in the state that you can encounter many of Florida's resident plants and animals in one geographic area. With a single visit to a spring, you can see species such as the manatee, American alligator, river otter and limpkin. Beneath the surface of the springs, underwater natives such as the greater siren, the loggerhead musk turtle and the Florida gar thrive. At certain springs, many of these species can be seen right from the nature trail along the spring run.

Source: Florida Department of Environmental Protection



Rainbow Springs

Life in a spring

Fish: Florida's clear spring waters provide a natural aquarium for many of Florida's most common, as well as most unique, fish species. For example, the white catfish live in the dark recesses of the springs' underwater caves, only emerging at night to feed. Due to close proximity to the Gulf of Mexico, many springs in west-central Florida have especially high fish diversity since they are home to both saltwater and freshwater species. The American shad is an example of a fish that migrates to the springs from the ocean.

Reptiles and amphibians: A variety of reptiles and amphibians can be found in and around springs, including the American alligator, the largest reptile in North America, and the loggerhead musk turtle, which attains a maximum size of only five inches long.

Birds and mammals: Above the surface of the water, springs are home to many of the most recognizable mammals and birds found in Florida. Some, like the great blue heron, deer and otters, can be found at the springs year round. In the winter, the springs, which maintain a constant water temperature of about 70 degrees, provide a warm-water refuge for species such as the manatee.

Insects and invertebrates: It requires a trained eye to spot some residents of springs. By far the most secretive of them are invertebrates, like the freshwater shrimp and the albino cave crayfish. Often no more than a couple inches in size, these tiny animals comprise some of the rarest species in Florida.

Plants: Due to their constant year round temperatures and stable discharges, Florida's springs support a variety of plant life, including ancient cypress trees, rare orchids and lilies, and lush underwater carpets of eel grass. Collectively, these plant communities nourish a freshwater food web that is among the most unique in all of North America.

Source: Florida Department of Environmental Protection

THINK ABOUT IT

There are four attributes that make up a healthy spring. Fish and wildlife is one of the those attributes. The other three attributes are flow, water clarity and aquatic vegetation.



Filamentous algae often float to the surface and form large mats.

Coontail (common name for *Ceratophyllum demersum*)
Sagittaria (the grass)

A spring vent at Rainbow Springs.

The flora of springs

A characteristic of healthy Florida springs is dense submerged aquatic vegetation. This vegetation provides food and shelter for fish and wildlife, and helps improve water quality by filtering particles. It also removes nutrients from the water and stabilizes sediments.

However, if native aquatic plant communities are replaced by invasive aquatic plants, the environment can be harmed, as can our enjoyment of these areas. Invasive aquatic plants are non-native plant species that live in or around water and spread on their own. Some troublesome aquatic invasive species in west-central Florida are the water hyacinth, hydrilla, water lettuce and Lyngbya. You can learn more about Lyngbya on Page 14.

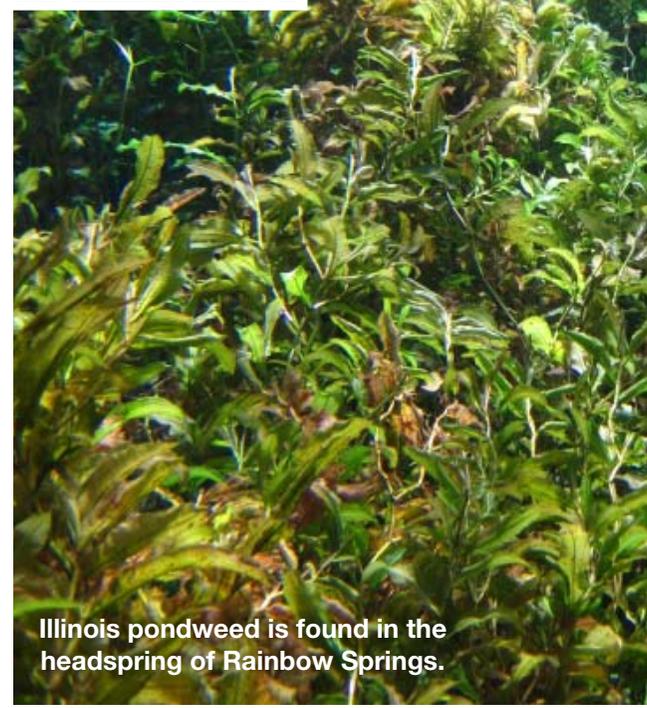
Pests, diseases and other environmental conditions that naturally limit the growth of invasive plants in their native lands are not present in Florida. Therefore, invasive aquatic plants spread rapidly and can become an environmental problem. When large numbers of invasive aquatic plants accumulate, they can interfere with boat navigation, recreation and flood control, and may also decrease property values. Additionally, infestations of invasive aquatic plants can damage fish and wildlife habitat, significantly hinder fish management and habitat restoration efforts, and reduce oxygen levels in the water — increasing the potential for fish kills.

Source: Southwest Florida Water Management District

Managing invasive aquatic plants

Many invasive species are well established and are extremely difficult and expensive to eliminate. Therefore, prevention is the best way to keep new invasive plants out of Florida's natural areas. The methods used depend on the plant species being targeted, the level of infestation, and the size of the water body and its primary use, among other factors. No single method is effective for all situations.

Source: Southwest Florida Water Management District



Illinois pondweed is found in the headspring of Rainbow Springs.

A challenging job

Keeping invasive plants under control is a challenging job. Aside from the District's efforts in managing thousands of acres of public waters, you can do your part in helping to stop the spread of invasive aquatic plants by:

- Learning what plants you should and should not plant in aquatic areas.
- Ensuring that all aquatic plant material is removed from your boat and trailer before and after launching your boat.
- Contacting the Invasive Plant Management Section of the Florida Fish and Wildlife Conservation Commission at 850-245-2809 if you observe invasive plants on your private water body.

Prevention is the best way to fight invasive aquatic plants, so it's important that you get involved. For more information about the District's aquatic plant management program, treatment schedules and applicable water-use restrictions, please visit WaterMatters.org/AquaticPlants.

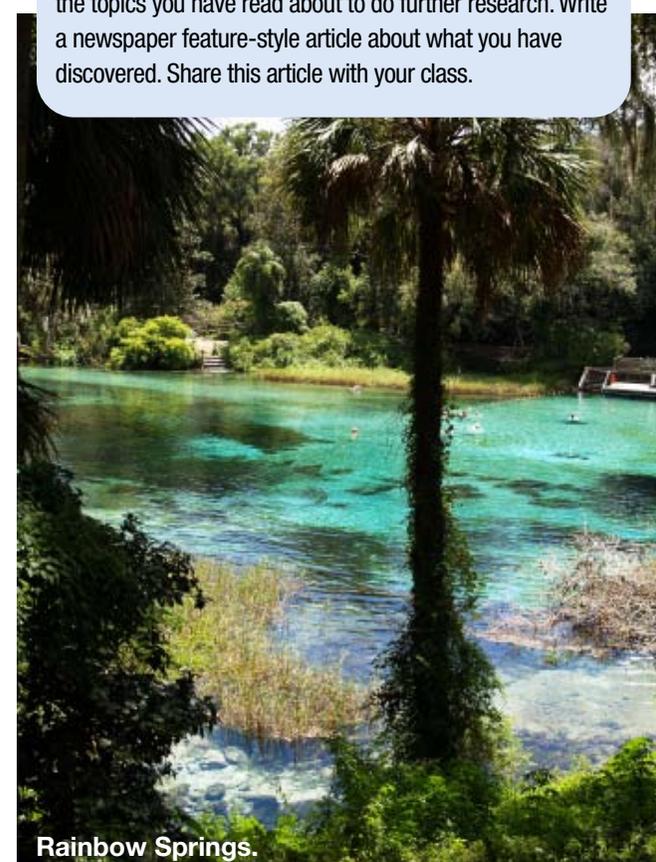
Source: Southwest Florida Water Management District

Learning with the Times



Invasive species

The National Ocean Service defines an invasive species, also known as an exotic or nuisance species, as “an organism or plant that is introduced into a new environment, where it is not native.” Invasive species can be in the form of plants or animals. The non-native dwellers can be hazardous to an ecosystem, especially in a spring. Look for articles in the newspaper that focus on local ecosystems, and invasive and threatened species. Pay special attention to the information about the effects of human activities and invasive species on ecosystems. Keep track in your journal of the articles you find. Choose one of the topics you have read about to do further research. Write a newspaper feature-style article about what you have discovered. Share this article with your class.



Rainbow Springs.

Threats to Springs

The springs in our region are unique, complex systems that have been changing for nearly a century, and it will take time to restore them.



Challenges facing springs

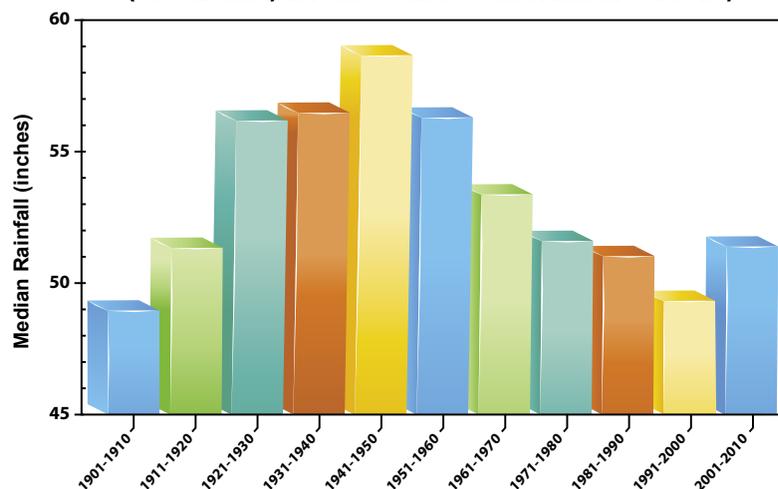
The challenges facing these springs include the following:

- Increases in nutrients such as nitrogen and phosphorus due to development, excessive fertilizer use, wastewater treatment plant discharges and failing septic tanks
- Habitat loss from invasive aquatic plant and algae species as well as from development, sea walls and canals
- Reductions in discharge due to a steady decline in rainfall since the 1960s
- Increases in salinity due to spring flow declines and sea-level rise

Did You Know?

Many springs across Florida are getting saltier, and sea-level rise is a major cause. Monitoring has shown a local rise of 7 inches in 100 years. It may not seem like a lot, but coupled with a steady decline in rainfall and spring discharge, four coastal spring-fed rivers have already been affected. Chassahowitzka, Crystal River/Kings Bay, Homosassa and Weeki Wachee have all seen a shift to more brackish ecosystems. As a result, freshwater vegetation has a hard time surviving in this saltier environment and unwanted vegetation moves in. In the future, sea-level rise may also affect low-lying communities.

Median Rainfall by Decade
(Brooksville, Inverness and Ocala Rainfall Stations)



More on Lyngbya

Lyngbya is a long, hair-like organism that can form large mats on the bottom or surface of the water. These mats grow and then break off and float to new areas. While not all algae are bad, this invasive algae grows and spreads rapidly. It can crowd out or smother native vegetation, reducing the overall stability of the ecosystem. Lyngbya is now a common feature of many lakes and rivers throughout Florida. It produces toxins that may affect animals in springs and can cause skin irritations to humans.

How to help springs

A springshed is the area of land that contributes water to a spring. This area includes much more than just land surrounding a spring. In fact, you can live miles away from a spring and still be located within its springshed. Your actions at home can affect a spring miles from your home. Many of the problems affecting the springs occur many miles upstream in the spring recharge area.

The water quality of springs can be harmed by a variety of actions, including incorrect fertilizing techniques, infrequent septic tank maintenance, improper disposal of garbage and untreated stormwater runoff.

Activities within springsheds can, and do, have impacts on groundwater. Therefore, these activities affect the ecosystem of the spring and spring-fed river.

A spring is only as healthy as its springshed, and protection of springs must occur before the water reaches the spring.

Here are a few ways you can help at home:

- Always dispose of grass clippings, litter and pet waste properly
- Never dump anything down a storm drain
- Use fertilizer sparingly
- Have septic tanks inspected every two to three years
- Plant a buffer zone between the lawn and shoreline

Here are a few ways you can help while visiting a spring:

- Tubers, swimmers, snorkelers and divers should avoid standing in vegetation or kicking up silt, barefoot or with fins. Doing so may destroy native vegetation, which can encourage the growth of invasive plants and algae and reduce habitat for fish and wildlife.
- Boaters should raise the motor in shallow water to avoid destroying native vegetation and wildlife. Row or paddle until reaching deeper water.
- Boaters should turn off the propeller while waiting for swimmers and tubers to pass safely instead of moving to the side in shallow water where vegetation may be scarred by the propeller.
- Boaters are asked to consider a “mushroom” anchor that grasps and releases the bottom, if an anchor must be used, instead of “hooks” that destroy native vegetation.

Find out more about what you can do to help and join us in the community effort to restore our springs by visiting WaterMatters.org/Springs.

Vocabulary

Add the following words to your vocabulary list. Look up the definitions for these words and then see if you can find them in the word search puzzle. [Hint: All of these terms are related to springs.] Try to find these words in the daily newspaper.

- Aquifer _____
- Artesian _____
- Basin _____
- Cave _____
- Algae _____
- Invasive _____
- Springshed _____
- Evaporate _____
- Fissure _____
- Hydrogeology _____
- Karst _____
- Magnitude _____
- Photolineament _____
- Ponor _____
- Porosity _____
- Sediment _____
- Seep _____
- Sinkhole _____
- Swallet _____
- Vent _____

M M H S H O V I V X H A S K D P Z H A C R Q V J K
 H T Y E S E N W N I H E S X O O X B O A P X J Q A
 Z M Q Z L T F G X V D X L Y D R U L E Y X R F B R
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 Q X N J G B N F H D Z H H V B T C P B O W I Z X R
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 D P B N I H I U E I Z O S P H N R M D S U F A U P
 J G E A L J G D M S M I H R T G I V H X S W Y A M
 Z A Y S L L E V A C K O T E G M R R B O S B S P F
 R L H U Y S H R C D T O N T H C V R P P I K L L T
 A L G A E W O X C O T U E A G T H K W S F P X N F
 Z X H S F W L G L E U Z V R T Q U O N B R U O D H
 Q G Q E A C G I L C J F S O Q F G B E B N G P G O
 J Q B K H Q N L A E G G W P O U D D B X A D X O C
 O A D W D E A R I R F Q U A I K U U O R O S R Z L
 N M V I A W S L S O E M A V P T L Q J G P E I B H
 E J A M S I P V T F F F H E I Q W M F Y Z G U N N
 H K E J C Y O T S D H C I N L X I Y H M G J O M H
 O N B O I T B M H W Y C G U R E U T O M M Z I E P
 T I J A I O L N R B P A M X Q J D S D F B Y P M P
 J M V B W O B X X A M H A P B A V J X N U T B Z O
 A P S W F C E L O H K N I S J S G N O X U X X R D



Learning with the Times

Saving our planet
 You do not have to work at the Southwest Florida Water Management District or one of the spring locations to be part of helping keep springs healthy. There are ongoing conflicts between human usage of Earth's resources and what plants and animals need to survive. Things human beings do on land affect the entire planet. Look through the newspaper for articles or pictures that indicate conflict between how humans use the environment and the needs of plants or animals. Read the articles, and think about the main ideas and conflicts presented. Explain in a fully developed paragraph the information presented. Is there a solution to this conflict? What issues are presented? Create a visual display that represents either or both sides of the conflict. Share your display and article with your class.

Meet the Springs Experts

The Southwest Florida Water Management District's Springs Team is leading the effort to improve water clarity and habitat in west-central Florida's springs. These are just a few of the scientists and engineers working to improve springs at the District. The team's knowledge is based on decades of research and development, pilot projects and complex groundwater models.



Chris J. Anastasiou, Ph.D.

Chris Anastasiou is a Chief scientist and the leader of the Springs Team. Anastasiou has nearly 20 year's experience in water resource management of

coastal ecosystems and springs.

In 1994, Anastasiou received his bachelor's degree in geography with a minor in geology from the University of South Florida (USF). In 2001, while working as a staff scientist for the District's SWIM program, he received his master of science degree in ecology and identified ways to improve saltmarsh restoration. In 2009, Anastasiou graduated with his doctorate from USF's College of Marine Science in St. Petersburg, where he worked on NASA- and NOAA-funded projects, applying remote sensing and optical modeling to seagrass management.

Anastasiou also is a lieutenant commander in the U.S. Navy Reserves. He received his commission in 2004 and is a naval meteorology and oceanography officer at Naval Station Mayport near Jacksonville.



Ron Basso, P.G.

Ron Basso is a Chief professional geologist. He has 28 year's experience in groundwater modeling, resource regulation and resource management activities. Basso's role on the Springs Team is to

evaluate how groundwater withdrawal impacts spring flow and to serve as the district's expert regarding the geology of the region.

Basso received a bachelor of science degree in geology from the University of South Florida (USF) in 1985. He also received a master's degree in hydrogeology from USF in 2000.



David J. DeWitt, P.G.

David J. DeWitt is a Chief professional geologist. DeWitt's role on the Springs Team is to assess the geology and hydrology of a springshed. In addition, he collects and analyzes water

chemistry in springs.

For more than 25 years, DeWitt has been working on groundwater resources in Florida, including springs monitoring, aquifer delineation and characterization, test drilling and monitor-well design and construction. DeWitt was the District's representative on the Florida Springs Task Force for the Florida Department of Environmental Protection Florida Springs Initiative.

DeWitt is a 1986 graduate of the University of South Florida, with a bachelor's degree in geology, and has been a licensed professional geologist in Florida since 1994.



Sean King, Ph.D.

Sean King is an expert in the ecology of Florida springs. He specializes in aquatic and wetland ecology, hydrology, GIS, environmental chemistry and ecosystem restoration.

King's role on the Springs Team is to apply his knowledge of springs ecology to management and restoration of District springs. King is a staff engineer and manages several springs restoration projects.

King has a bachelor's degree and a master's degree in environmental engineering from the University of Florida (UF). In 2012, he completed his doctorate at UF.



Philip Rhinesmith

Philip Rhinesmith is a senior environmental scientist. His role on the Springs Team is to oversee permitting and construction for springs restoration projects.

Rhinesmith is a Florida native and has worked for the District for 26 years. He began his career at the District as a water quality chemist. In addition to a Springs Team member, Rhinesmith is the lead scientist for wetland restoration projects on District lands. In 2010, Rhinesmith was awarded the North American Lake Management Society Technical Merit Award for his work on restoring a large freshwater marsh system that is part of the Lake Tsala Apopka Chain-of-Lakes in Citrus County. He earned his Bachelor of Science degree from Saint Leo University in 1987.



Mary L. Szafranec, P.W.S., Ph.D.

Mary Szafranec is an expert in applied springs research, with an emphasis on floral and faunal assessments, water quality and biogeochemical

processes and interactions in spring ecosystems.

Szafranec's role on the Springs Team is to investigate water quality issues and ecological interactions in springs and spring runs. She also serves as a technical expert for constructed treatment wetland design and nutrient source-tracking and removal for springshed restoration projects.

Szafranec has a professional wetland scientist certification from the Society of Wetland Scientists Certification Program; a bachelor of science degree in biology from the University of South Florida; and a master of science degree in environmental engineering sciences with a focus in ecological engineering and systems ecology from the University of Florida (UF). In addition, Szafranec has completed her doctor of philosophy in environmental engineering sciences with a wetland certificate at UF.

Learning with the Times

Making a difference

The Springs Team members are making a difference in their community. What other types of jobs do you think there are at the Southwest Florida Water Management District? Go to the District website, WaterMatters.org, and write down all of the different types of jobs you can find. Choose five of these jobs and write a few sentences about how you feel these people make a difference in their community. Next, find an article in the newspaper that depicts someone making a difference in the community. Write down the main points of the article. Share what you have learned with your class.