ADOPT a STREAM

SOUTH CAROLINA ADOPT-A-STREAM

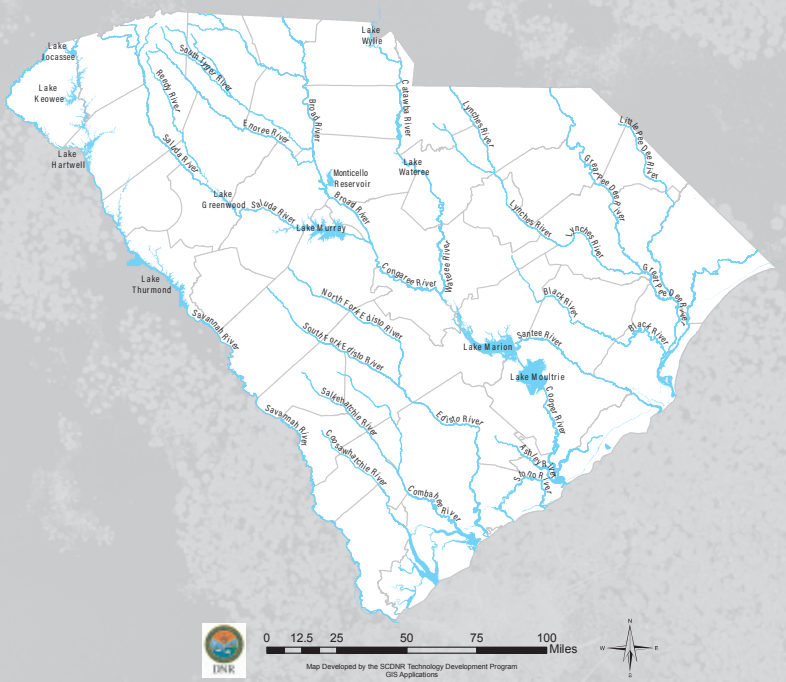
VOLUNTEER *LAKE* MONITORING

CENTER FOR WATERSHED EXCELLENCE
CLEMSON

dhec
Healthy People. Healthy Communities.

Figure 1.

Map of South Carolina Major Rivers and Lakes



HANDBOOK CONTENTS

Need Help?

Most questions can be answered by visiting our website:
www.scadoptastream.org

For questions about adopting a site, where to get monitoring supplies or help getting started, contact staff at:
scaas@dhec.sc.gov

Steps to become a Certified Lake Volunteer monitor with SC Adopt-a-Stream:

Step 1. **Watch** Video
Step 2. **Read** Handbook
Step 3. **Pass** Certification Test
Step 4. **Get** Monitoring Kit
Step 5. **Adopt** a Site
Step 6. **Start** Sampling

LAKE MONITORING SCHEDULE

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

1. Monitor Monthly -- Year Round
2. Date you'll need to renew your annual certification: *(recertify online via email invitation)*

MAR	JUL	NOV

(circle month)

WATER QUALITY EMERGENCY?

For evidence of dangerous pollution discharges, fish kills, or public health hazards, call the 24-hour SC DHEC Hotline:

1-888-481-0125

Overview

SOUTH CAROLINA LAKES

Lakes in South Carolina have many important uses. Lakes are used as drinking water reservoirs, irrigation sources, wildlife habitat, fisheries and areas of recreation. Lakes offer recreation in the form of boating, swimming, relaxing and peaceful scenery. There are over 521,000 acres of lakes in the state of South Carolina. These waters are undergoing constant change on a daily, seasonal and long-term basis. Monitoring changes helps us better understand how to protect and restore our waters.

Most large lakes in South Carolina are man-made and were formed for the generation of power and flood control. Two types of naturally occurring lakes in SC are oxbow lakes and Carolina bays.

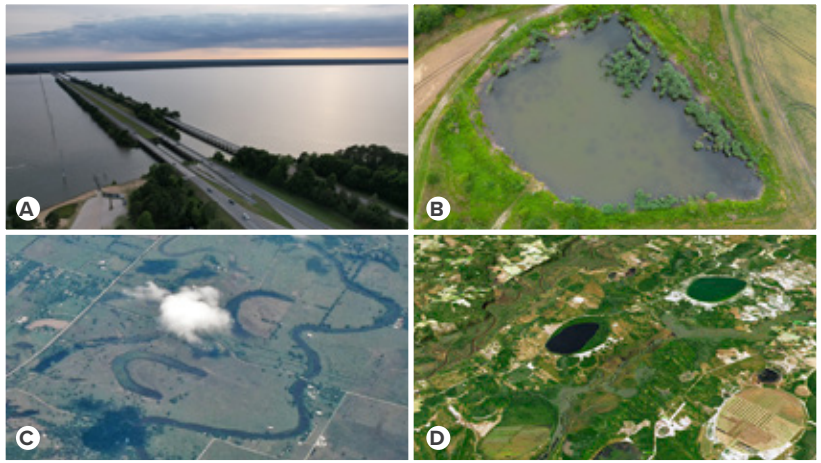


Figure 2. A) Large Reservoir B) Small Lake C) Oxbow Lakes D) Carolina Bays

An oxbow lake starts out as a curve, or meander, in a river. A lake forms as the river finds a different, shorter course. The meander becomes an oxbow lake along the side of the river. Oxbow lakes are stillwater lakes. This means that water does not flow into or out of them. There is no stream or spring feeding the lake, and it doesn't have a natural outlet. Oxbow lakes often become swamps or bogs and can dry up as their water evaporates.

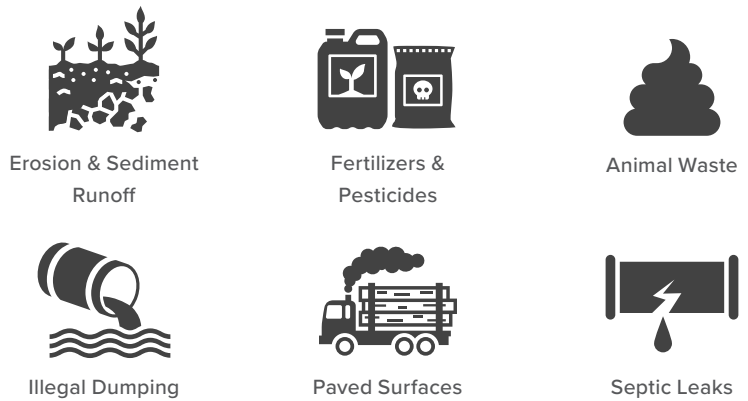
Carolina bays are shallow, elliptical depressions found throughout the Atlantic Coastal Plain from Florida to New Jersey. Many bays have been altered by human activity such as conversion to agricultural uses, commercial or residential development, and ponds. Natural bays collect rainwater and support plant communities associated with wetlands. It is estimated that there are between 4,000 to 200,000 Carolina bays in South Carolina.

WATER QUALITY THREATS

With so many valuable uses both socially and economically, we need to care about the health of our waters. As water travels through the watershed, it picks up various pollutants. There are two main types of water pollution, point source and nonpoint source, that can negatively affect water quality in a watershed.

Point source is where you can see the source of the pollution and/or point to the source. Examples include industrial discharges and municipal sewage treatment plants. This type of pollution is regulated by DHEC. Industries, businesses, cities, and counties go through a lengthy permitting process to discharge into a waterbody. The amount and severity of point source pollution has drastically improved since the Clean Water Act was implemented over 50 years ago.

Figure 3.
What makes Nonpoint Source Pollution?



Nonpoint source pollution is the leading cause of water quality problems in South Carolina. Nonpoint source pollution is where an individual source cannot be identified. Water running into the lake following rain events often carries nonpoint source pollution with it. Runoff is water running over the land surface and into a waterbody following a rain event. Examples of nonpoint source pollution include: runoff from erosion and loose sediment, excess application of fertilizers and pesticides, oil from cars, car washing detergents, and animal wastes. Many impaired waterways have multiple sources of this type of pollution, which makes it hard to track and hard to fix.

In addition to nonpoint source pollution, our lakes are also threatened by litter, invasive species, harmful algal blooms, and human activity. Litter can pose a risk to animals, serve as a breeding ground for bacteria, and negatively impact tourism. Invasive plants and animals can damage the ecosystem balance of a lake and outcompete native species. They can also clog drinking water intakes and other pipes, fill in coves, and render boat ramps inoperable. Humans threaten the health of lakes by littering, contributing to the movement of invasive species, and removing vegetation that grows along the edges of lakes (known as riparian buffers). It is important to leave a vegetated buffer zone between the land and water because this helps stabilize the shore and control erosion.

Figure 4. A) Litter B) Riparian Buffer Example

As lakes get older, they undergo many changes which can include getting shallower and filling in with sediment being brought in by feeder streams and bank erosion. Changes to land use in a lake's watershed, temperature related climate change, rainfall quantities, and nutrient loads can alter the overall water quality for lakes of all sizes and types across our state. Seasonal changes affect the lake's water quality too. Deep lakes can have layers of water that have

different water chemistry or water quality based on temperature changes at different depths. Water quality can change daily due to the movement of water, presence of plants, and weather.

WATERSHEDS

Figure 5. There are eight major watersheds, or river basins, in South Carolina: the Savannah, Saluda, Broad, Catawba, Pee Dee, Edisto, Santee, and Salkehatchie.

To better understand the impacts to lake water quality it is important to understand where the water entering the lake is coming from. A watershed is an area of land and water that drains all the streams and rainfall to a common outlet such as the inflow of a reservoir, mouth of a bay, or any point along a stream channel. The word "watershed" is sometimes used interchangeably with "river basin" or "catchment." Ridges and hills that separate two watersheds are called drainage divides. Rain and runoff from these divides drain to the streams in the watershed, then to outflow points such as lakes, reservoirs, bays, and oceans. Larger watersheds contain many smaller watersheds with different outflow points. It is important to remember that we all live in a watershed. Understanding the boundaries of your chosen lake and how it is affected by the larger watershed provides insights on how land use, permitting, and other occurrences in the watershed may result in changes in your data and observations at your site(s).

WETLANDS

Wetland is a term for the transition between dry land and water, including streams, rivers, lakes, and coastlines. They are natural pollution filters. Wetlands take many forms including marshes, swamps, bogs, and estuaries. Not all wetlands are wet year-round, and these drier types perform significant wetland functions like flood control. Protecting wetlands protects overall water quality.

Wetland Threats

The loss of wetland benefits impacts people, plants, animals, water quality, and water quantity. Filling in one acre of wetland may not seem devastating; however, the cumulative effect threatens the value of remaining wetlands and impacts the entire watershed. More than half the wetlands in the lower 48 states have been destroyed due to the causes listed below:

- Hurricanes, droughts, erosion, and drops in groundwater level.
- Filling wetlands to build housing developments and commercial properties.
- Draining wetlands for agricultural uses.
- Damming and dredging which alters water supply.

Since the 1970's, states with the most original wetland losses are Louisiana, Mississippi, Arkansas, Florida, South Carolina and North Carolina. Wetlands were historically drained for agricultural purposes, but now are mostly drained for development.

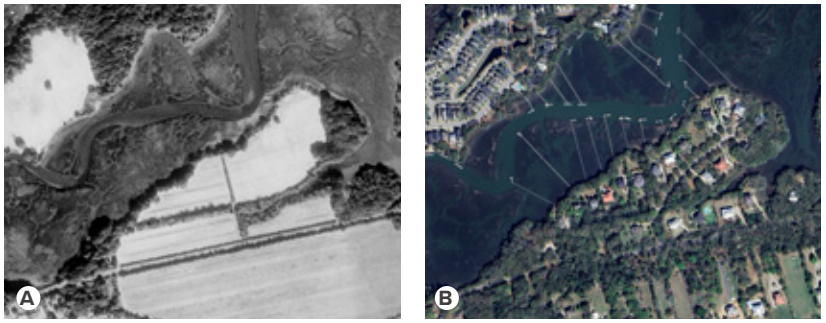
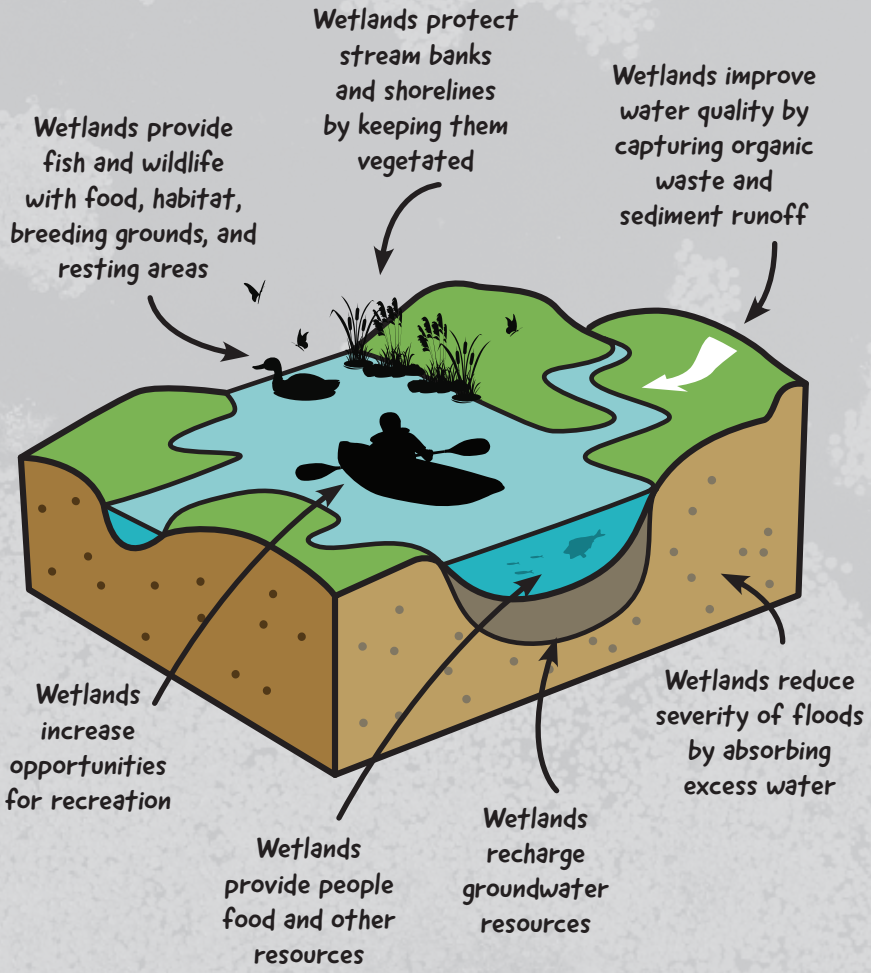


Figure 6. Example of wetland being altered **A)** James Island, Charleston, SC in 1989; **B)** James Island, Charleston SC in 2023 showing filling and development.

How Wetlands Are Beneficial



Site Selection

Volunteers can select a site on a public or private lake for monitoring. If adopting a site on a private lake, make sure you have permission to sample at that location. Many agencies and utilities monitor the water quality of large public lakes. You can choose to adopt more than one site.

Adopted sites must meet the following criteria:

- ☑ Larger than 5 acres in size
- ☑ NOT a stormwater/engineered pond
- ☑ 100 yards away from nearest monitoring site
- ☑ Deep enough to view transparency tool without it hitting bottom
- ☑ Safe access

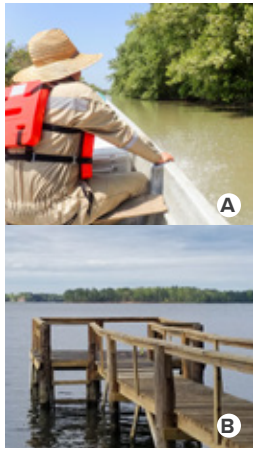


Figure 7. A) Sampling from boat; B) Sampling from a dock

Adopt-a-Stream monitoring volunteers are asked to sample monthly at the same location, at roughly the same time of day during daylight hours. Samples can be taken from a dock or boat from a lake area where you can take a Secchi measurement from above, while looking down at the tool in the water.

SAFETY

It is always best to sample with someone, even if they are not a certified volunteer. However, if you must sample alone, let a friend know where you'll be and what time you plan to leave and return. Never sample if it is unsafe to do so.

- Be aware of hazards like trash or toxic algal blooms
- Wear a life jacket with a whistle – follow the law
- Wear gloves when sampling or identifying plants
- Wash hands after sampling

Lake Monitoring Protocol

With the lake monitoring program, you will record several observations and measurements. Enter this data promptly to the Adopt-a-Stream database located at scadoptastream.org. Only certified volunteers can add new data even though everyone has access to view it.

On your SC AAS Lake Monitoring data form, first list your site ID, monitoring group name, certified volunteers conducting the sampling, date, time, distance traveled to get to your site, and time of travel (one way in a car and/or boat). Also record the amount of time you spent at your site sampling. This information is important because it can help get grants that fund the program and allow us to provide resources to our volunteers.

Figure 8. Find Data Forms for all programs under the "Certified Volunteers "page of SC AAS Website.

OBSERVATIONS

Weather

The first thing to consider when sampling is the weather. Weather strongly influences the physical characteristics of water. Floods, droughts, and other climatic extremes can change the lake dramatically. Heavy rainfall can increase non-point source pollution issues in your lake when the tributaries discharge more stream water into the lake and runoff from rainwater washes various pollutants from the land into the lake.

Record the amount of rainfall in the last 24 hours. Next, document the current weather conditions (sunny, partly cloudy, intermittent rain, heavy rain). Never sample if it is unsafe to do so.

Rainfall Data

cocorahs.org is a great resource for finding local rainfall data. Consider volunteering to collect rain data with this separate citizen science data collection program.

Water Level

The level of water in a lake may depend on many factors including weather patterns, surface soil types, nearby groundwater pumping, and dam operations. With SC AAS, you can use monthly observations and photos to note if the water at your chosen lake site is “normal,” “high,” or “low.” When making your observations and taking photos, make sure that you choose a stable landmark on the shoreline to reference.

Water Surface

Changing conditions at the top of the water can alter the chemical and physical measurements. On the data form note if any of the following are present:

Oily sheens can be caused by petroleum or chemical pollution, or they may be natural by-products of decomposition. To tell the difference between petroleum spills and natural oil sheens, poke the sheen with a stick. If the sheen swirls back together immediately, it may be petroleum. If the sheen breaks apart and does not flow back together, it is likely from bacteria or decomposition of plants and animals.

Figure 9. Example of oil sheen

Surface foam is common and can be naturally occurring. Vegetation can produce surfactants which can cause surface foam. Human-induced surface foam may be an unnatural color (red, pink, blue, yellow, or orange) and have a fragrant smell. This foam is most likely generated by household detergents and may be a sign of a failing septic drain field or an illegal discharge.

Figure 10. Example of surface foam

Algae are important to lake ecosystems, but excessive growth can occur when human activities introduce excess nutrients to the aquatic ecosystem. They can grow on the surface or form thick mats.

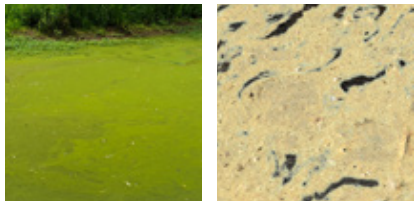


Figure 11. Algae vs Pollen

Algal Bloom

If there is algae present at your monitoring site, note if it is a small patch, cove wide, or lake wide on the SC AAS data form.

Algae is a photosynthesizer that can be found in lakes, but it is not a plant. In a balanced ecosystem, algae provide beneficial food and oxygen for the aquatic ecosystem but can cause issues when overgrowth occurs. Rapid growth of algae is called an algal bloom and can be associated with foam, scum, or thick layers of algae on the surface of water. When algae die and decompose, oxygen is decreased, which affects other aquatic life and the water chemistry. Some algae and cyanobacteria can also produce toxins that are harmful, look or smell bad, and could be deadly to people and pets.

Figure 12. Example of an algal bloom

When a bloom contains toxins that affect the health of people, animals, and the environment, they are known as Harmful Algal Blooms (HABs). For HABs to grow and form they need: sunlight, slow-moving water, nutrients (specifically nitrogen and phosphorus) and warm water temperature. HABs are more likely to occur from late spring to early fall when water temperatures are relatively high and are less likely to occur in winter months.

You can’t tell if a bloom is harmful just by looking at it, and not all blooms are easy to see. **If you suspect a HAB at your monitoring site,** take photos, and call the HABs report line **803-898-8374** or email **WTR_asp_hab@dhec.sc.gov**.

Aquatic Plants

Note if aquatic plants are present or not. Refer to the Plant ID guide found at the back of this handbook to determine if plants at your site are potentially invasive. If invasives are suspected or confirmed, please contact SC DNR in addition to selecting "invasives present" on the observation field of the data form.

Figure 13. Report invasive plants to SC DNR using this QR Code.

Water Conditions

Surface water conditions are important to record at your site because changing conditions can affect physical and chemical measurements. Shallow lakes that experience longer or more frequent periods of rough water tend to better mixed than deep lakes. Some lakes have drastically different physical and chemical measurements between their surface water and water at the bottom of the lake if mixing does not occur. Observe your site water conditions for the following to record on the SC AAS data form:

Figure 14. A) Calm/Smooth; B) Ripples; C) Waves; D) White Caps

Trash Cleanup

It is a good idea to bring heavy duty gloves and a garbage bag when you sample your site. If you find litter present, please clean the site. If there are tires or other large, potentially hazardous material present, you can select "needs organized clean up" and this will generate an alert to Palmetto Pride. It is also recommended to take pictures when selecting this option.

Figure 15. Get litter clean up supplies from palmettopride.org.

Water Color

Pure water is colorless. It is the behavior of light in relation to water depth, refraction, reflection, and suspended particles that causes water to appear different shades. Looking directly down into a lake will not give you an accurate water color because depth, vegetation, and the color of the bottom of the lake can all influence how you see water color. To get a true observation of water color, fill your clear sample cup with water. Collect your sample below the water surface to avoid any algae, pollen or debris that may be present.

Figure 16. Clear water

Water Odor

Water odor can provide immediate clues about the water quality. Make sure that you are smelling the water from sample cup and not the air when you record this observation.

- **Gasoline**—any petroleum or chemical smells may indicate serious pollution problems from a direct source, such as a factory, parking lot, boat, marina or storm sewer runoff.
- **Sewage**—this smell could indicate an ongoing pollution event.
- **Fishy**—this smell may be a sign of dead and decomposing fish in the lake.
- **Chlorine**—this smell may be a sign of pollution and will smell like a swimming pool.

Water Clarity

Clarity is a measure of how far light can penetrate into the water. Suspended sediment or algae in the water column can impact water clarity. Note if the water appears “clear, cloudy, or opaque” when looking through your clear sample cup.

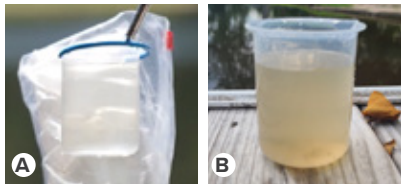


Figure 17. A) Clear B) Opaque

Photos

Take photos of the left shoreline and right shoreline. Be consistent with photos. It helps to have a landmark to see changes over time.

In the additional photo field on the SC AAS Database, please include images of suspected invasive plants, algal blooms, anything of concern (like litter, hazards, or pollution) or fun group pictures. Additional photos can be sent to scaas@dhec.sc.gov.

Figure 18. A) Left Shoreline; B) Right Shoreline

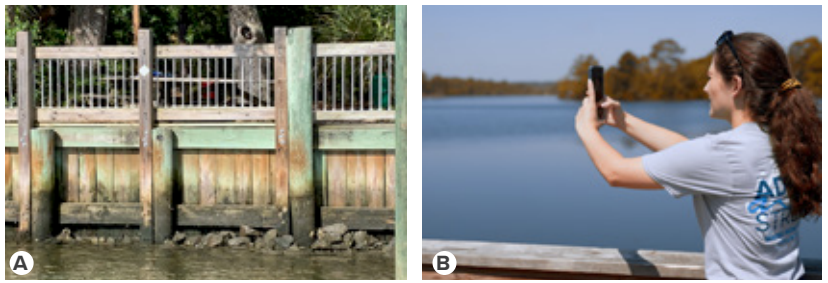


Figure 19. A) Water Height; B) Volunteer Sampling Photo

MEASUREMENTS

Temperature

Water temperature is used to determine which species may or may not be present in an aquatic system. A week or two of high temperatures may make a lake unsuitable for sensitive aquatic organisms, even though temperatures are within tolerable levels throughout the rest of the year. Not only do different species have different requirements, optimum habitat temperatures may change for each stage of life. For example, fish larvae and eggs usually have narrower temperature requirements than adult fish.

Temperature is also very closely linked with how much oxygen water can hold. The higher the water temperature, the less oxygen water can hold. This is why you may see stories about fish kills in the heat of summer. Temperature greatly affects feeding, reproduction, and the metabolism of aquatic animals, making it an important parameter to measure.

Temperature also impacts when plants and algae start growing. In the warmer summer months algae grows faster. When your water temperature starts warming it is important to start looking for algal blooms.

HELPFUL TIPS FOR TAKING TEMPERATURES

- Use your **reacher stick** to suspend and submerge the thermometer
- Do **NOT** wrap your hand around the bottom of the thermometer while reading the result. The heat from your body will warm the thermometer.
- Use a **temperature conversion chart** for easy Celsius and Fahrenheit comparison. (page 54)
- If you have an odd measurement **check to make sure** your thermometer does not have any breaks or air bubbles in the color line.
- If you notice a problem the **data is invalid**, and you will need to replace your thermometer.

To measure temperature **ALWAYS** take air temperature **BEFORE** water temperature:

1. Use an armored case thermometer
2. Suspend thermometer in the air in the shade
3. Let stabilize at least 60 seconds
4. Record air temperature in degrees Celsius
5. Submerge thermometer in the lake
6. Let thermometer stabilize in the water for at least 60 seconds
7. Read while in water or immediately after removing
8. Record water temperature in degrees Celsius

Hue

OPTIONAL MEASUREMENT

Download the "EyeOnWater Colour" app to generate a water "hue" value to enter into the SC AAS database. Once the app is downloaded, take a picture of the water at your site and follow the on-screen instructions. The app will match your surface water color to a color comparator chart to determine the water hue. Water hue can indicate if there is a potential water quality issue like an algal bloom. The units for hue are from the Forel-Ule scale (FU) and should be recorded as a value from 1 to 21 FU.

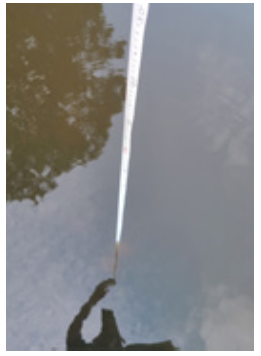
Figure 20. Screenshots from the EyeOnWater Colour app

1-5 FU	**Indigo blue to greenish blue**	Often low nutrient levels because the water is dominated by microscopic algae.
6-9 FU	**Greenish blue to bluish green**	May be dominated by algae, have increased dissolved matter or some sediment load.
10-13 FU	**Greenish**	Possible increased nutrient and phytoplankton levels or may contain minerals and dissolved organic material.
14-17 FU	**Greenish brown to brownish green**	Usually high nutrient and phytoplankton concentrations and may also have increased sediment and dissolved organic matter.
18-21 FU	**Brownish green to cola brown**	Tannic waters in swampy wetland areas may appear this color.

To **learn more** about this tool, visit eyeonwater.org.

Transparency

Transparency is a measure of the clarity of the water. This measurement can help monitor erosion or land use changes in your watershed. Earlier we mentioned that you will take a visual reading of how clear the water is, but now we will use equipment to assign a numeric value. To measure transparency in your lake you will use a Secchi disk. This black and white weighted disk is attached to a measuring tape wheel.



To measure transparency:

1. Remove your hat, sunglasses, and find a shaded area where you can look straight down.
2. Lower the disk into the water until you can no longer see the black and white quadrants.
3. Record the depth from disk to surface of water in meters.

Figure 21. Using the Secchi Disk

4. Raise the Secchi disk until it just reappears. You should be able to barely distinguish the black and white colors.
5. Record the depth from disk to surface of water in meters.
6. The database will average the two readings to find the transparency at your site.
7. Rinse any mud or debris from the Secchi disk and measuring tape and allow the equipment to dry completely. Properly cleaning your equipment can help prevent the spread of aquatic invasives and algae and help maintain the lifespan of your equipment.

When you put the transparency measurement into the database it will automatically convert it to turbidity. Nephelometric Turbidity unit (NTU) is the scale used to measure turbidity. Turbidity is not the same as transparency. Turbidity is a measure of the amount of suspended material in water and is determined by the light transmission of the suspended material. According to state standards, lake turbidity should not exceed 25 NTUs provided existing uses of the lake are maintained (Regulation 31-38 SC Water Classification and Standards).

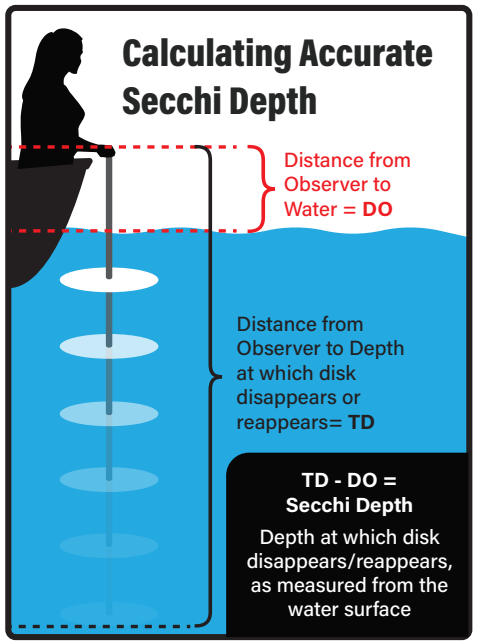


Figure 22. Official depth should be measured from water surface to the disk, NOT from where you are holding the measuring tape.

Lake Level *OPTIONAL MEASUREMENT*

Lake level on large lakes is often monitored by utilities and USGS (https://waterdata.usgs.gov/nwis) for flood control information. To view lake level data for public lakes, go to: hydrology.dnr.sc.gov/streamflow-and-lake-levels.html.

To track changes in water level on private lakes, an elevation gauge can be installed to a fixed point. Official water level elevation marks can be made based on the "Mean Sea Level" measurement on private lakes by contacting SC DHEC's Dams Program to help mark measurements on a fixed object.

Figure 23. Lake level gauge

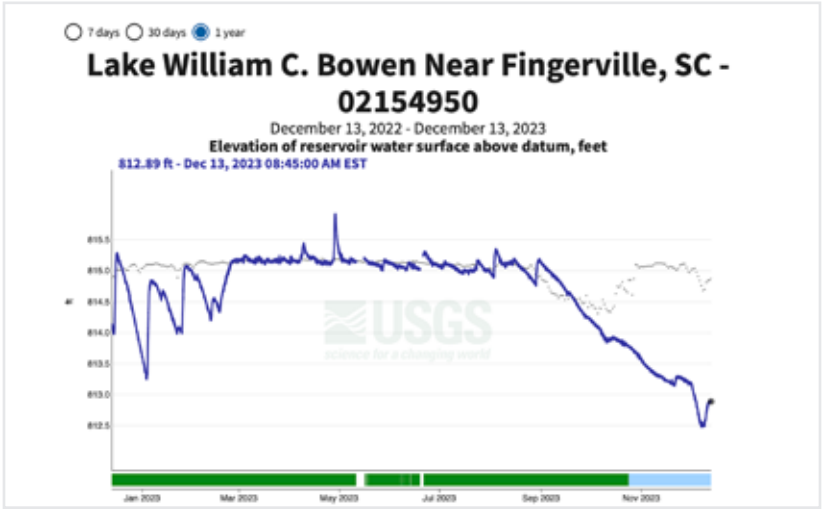


Figure 24. Hydrographs like the one above show lake level over time.

PLANTS

Role of Plants in Lakes

There are many species of native plants that provide important ecosystem services. Plants take up excess nutrients, stabilize soils, add oxygen to the water, provide shade to keep the temperature low, and provide important habitat for fish and other aquatic organisms. Aquatic plants also provide food for many types of animals including fish, amphibians, birds, and mammals.

In general, the presence of plants is a good thing for habitat and water quality when the ecosystem is balanced. However, when excessive growth occurs, or when plants prevent the lake from functioning in its intended use, they can cause problems. Excessive plant growth is usually a symptom of high nutrient levels (often phosphorus or nitrogen). Nutrients often enter the water in rain runoff from a variety of sources including excess fertilizers, soil erosion, sewer overflows, leaky septic systems, and animal waste. Excessive growth of aquatic plants can clog drinking water intake pipes, cover a cove so that people cannot fish or swim, reduce biodiversity, degrade water quality by blocking sunlight, restrict flow causing flooding, and disrupt food chains by displacing native vegetation.

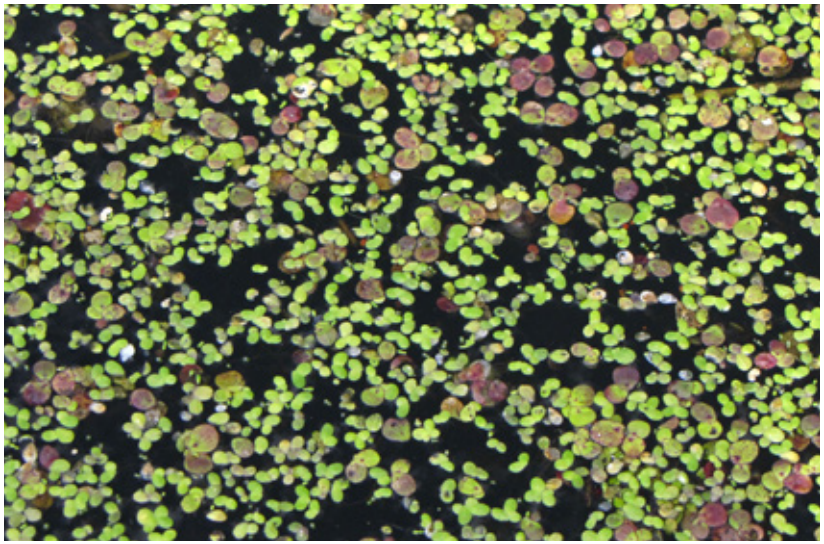


Figure 25. Overgrowth of aquatic plants on a lake

Invasive Plant Monitoring Helps Ecosystems and Economies

Some aquatic plants that can quickly take over and negatively impact aquatic ecosystems are invasive plants. There are many species that are exotic, meaning that they were brought to South Carolina from somewhere else. Once exotic plants are established in a new ecosystem, they can become invasive because they often don't have predators or other means to keep them in check, causing them to spread rapidly or outcompete native plants.

Because of the problems that aquatic invasive plants can cause, it is important to know where they are in the state and how significantly they are impacting our lakes. Millions of federal, state, and private funds are spent attempting to control invasive aquatic plants in public waterways each year. The introduction of new invasive plants or the spread of existing populations can cause extreme ecological and economical harm.

As an example, the aquatic plant *Hydrilla* caused a multiweek shutdown of a hydroelectric facility on Santee Cooper Lake in 1991. This occurred after a large storm dislodged the rapidly growing weeds and flushed them into the debris screens of the water intake canal. While the facility was shut down, this caused water flow to stop moving downstream, causing one of South Carolina's largest fish kills. This series of events caused by a single invasive plant cost South Carolina more than 4.5 million dollars in damages.

Educating homeowners and lake users about preventing the import of additional invasive and non-native species is the best way to keep our lakes healthy. Some of the most costly invasive plants come from people dumping aquariums or unknowingly transporting plants on gear/equipment from other lakes

Figure 26. Underwater view of plants shading the lake bottom.

(called hitchhiking). Some nonnative plants are even intentionally introduced by homeowners as a form of aquascaping. Close to 25% of groups introduced into South Carolina are plants with more than 75% of those being in freshwater environments (as opposed to marine or brackish). Around 88% of these species have only been introduced in South Carolina since the 1950's.

Once invasive plants are introduced to a new aquatic ecosystem, they can spread within the system and to adjoining waters on their own. Monitoring what type of plants are present can help us understand the best treatment and removal options. Some aquatic plants spread by seeds or roots while others can spread by simply breaking the plant apart into smaller pieces. Plant management plans are often species specific and may include physical removal, biological control and/or chemical treatment. Proper disposal of invasive plants after they are removed from the aquatic system is also crucial. Contact a professional for proper plant management.

Your Responsibility

Cleaning and Preventing the Spread of Invasives

Clean

Inspect gear and equipment for hitchhikers.

Drain and Dry

Empty any containers and internal compartments of equipment that may harbor aquatic plants or pests.

Dispose

Do NOT dump unwanted water from aquariums, water gardens, or containers with water from other water sources in to lakes. This includes bait and trash too.

Report

Contact DNR with any invasive species concerns or to verify ID.

Protect

Actions to help water quality:

- use fertilizers wisely
- do not blow grass clippings/ leaves into the lake (mulch or compost)
- landscape with native plants
- keep bare ground covered
- widen or install riparian buffers
- manage waste from humans and animals

Getting Started

READY TO JOIN SC AAS?

To be a certified lake monitoring volunteer through SC AAS you must watch the online training video and pass the open book certification test on www.scadoptastream.org.

Figure 27. Lake monitoring kit

All information needed to pass the test is contained in the online video and in this handbook. Once you are certified, you will need to borrow or purchase a kit to sample with and enter your data into the database. Purchase your own kit from our suppliers Water Rangers here: waterrangers.ca/shop/freshwater-testing-products. The kit will contain an armored thermometer, Secchi disk on a measuring tape wheel, reacher stick, and sampling cup. You will need to provide a string to hang your thermometer on, SC AAS data form, a towel to dry sampling equipment, and a bag to contain your sampling materials.

A printed version of this handbook containing lake ecology information, sampling procedure, and additional resources will be mailed upon request by emailing scaas@dhec.sc.gov.

1. Watch Video
1. Read Handbook
2. Pass Certification Test
3. Get Monitoring Kit
4. Adopt a Site
5. Start Sampling

An important thing to remember is to thoroughly clean and dry your kit after each sampling event. If you are sampling multiple sites this is especially important because aquatic invasives can be transferred to other water bodies, or even from one area of a lake to another from your gear or kit.

DATABASE

The link to the database can be found from our website scadoptastream.org. If you pass the test to become a certified volunteer, you will be added to the database as a certified user. You will receive an email from “SC Adopt-a-Stream” with the subject line “SC AAS Volunteer Sign up” containing a link to create a user profile.

Figure 28. Scan this QR code to view the SC AAS Database.

To enter data:

- Visit scadoptastream.org to view and enter data.
- Log in to the SC AAS database using the instructions sent to you via email after completing the online certification process.
- Complete your profile and add yourself to a group. You can join an existing one or create a new one.
- Add your site. You’ll need to know the lake name, location, watershed HUC 8, and lake size. Use the SC Adopt-a-Stream Watershed Atlas site to find this information: gis.dhec.sc.gov/scaas.
- Enter data under the “sampling events” tab once a month per site.

Data should always be submitted to the database as soon as possible. You can do this from your phone directly or from a computer. Please continue to monitor monthly throughout the year and share this data with your community.

Anyone with internet access can view sampling events, groups or sites. From those pages there are export buttons, or the data can be copied and pasted directly from the screen.

SC AAS ATLAS

The SC Adopt-a-Stream Atlas (gis.dhec.sc.gov/scaas) application is designed to assist certified volunteers in identifying watershed information needed for adopting new sites. The atlas also allows fast look-up of existing monitoring sites. These are displayed as green pins. The map is updated periodically so there will be a lag time in displaying new sites.

Figure 29. Scan this QR code to view the SC AAS Atlas.

To adopt a new a site in the Database you'll need the following information: Waterbody Name, Waterbody Type (Lake, Saltwater or Freshwater), Lake Size (in acres), Watershed Name/Number, Latitude, Longitude, and a Site Description.

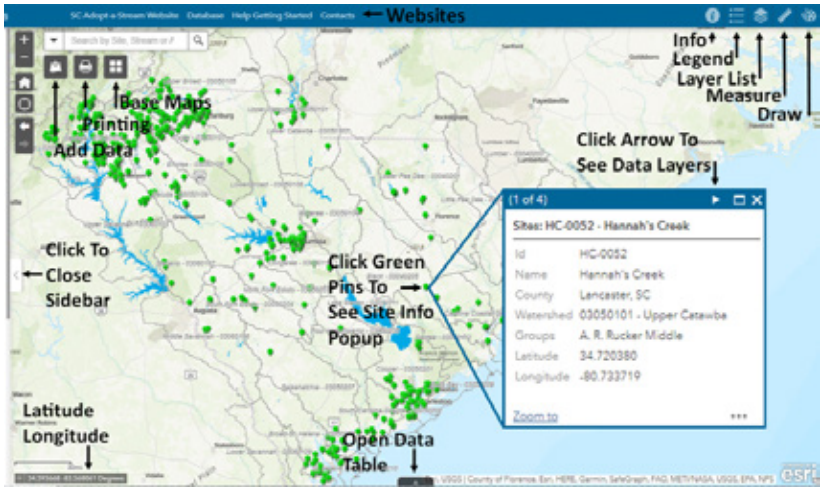


Figure 30. SC Adopt-a-Stream Atlas, available at gis.dhec.sc.gov/scaas

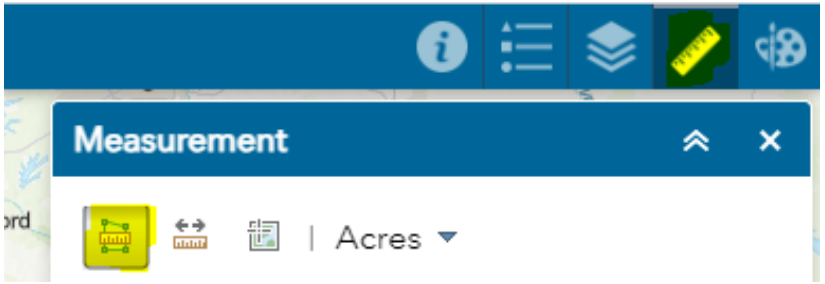


Figure 31. How to determine lake acreage using the SC AAS Atlas.

In the SC Adopt-a-Stream Atlas navigate to and click the location you wish to adopt. A window will pop-up with the watershed name and number. Latitude/longitude coordinates will display in the lower left corner of the map window. The SC AAS Database and Atlas organizes sites by 8-digit HUC watershed numbers. Each watershed is identified by a unique Hydrologic Unit Code, or "HUC." HUCs are useful for identifying which watershed you want to monitor, as watersheds are not always exclusively contained by a single city, county, or state.

Next, open the measure tool and select area (make sure the units are acres). Outline the lake you wish to sample and double click when you have finished the outline. The area in acres will be automatically calculated and show in the right panel. If you are sampling a large public lake, you can also look up the lake acreage in a web browser.

Remember, a lake must be at least 5 acres and not an engineered stormwater pond.

- **Open the 'information' icon in the upper right-hand corner for additional instructions.**
- Hover over icons to identify the tools.
- Popups appear when clicking on existing sites. The popups can have more than one page of information displayed if there is an arrow and page count in the top banner of the window. Use the arrow to toggle through the information.
- If the atlas is missing information, make sure that all layers are turned on (blue check box) in the "Layers List."

AAS PROGRAM OVERVIEW

South Carolina Adopt-a-Stream (SC AAS) is a state-wide volunteer water quality monitoring program that includes monitoring programs for freshwater wadable streams, tidal saltwaters, macroinvertebrates and lakes. Anyone interested in the health, protection, and improved management of South Carolina's waterways can be directly involved by monitoring with SC AAS!

Follow us on **Facebook** (SC Adopt a Stream) and **Instagram** (@scadoptastream). SC Adopt-a-Stream is an ever growing and evolving program, and we hope you join us in monitoring South Carolina's waterways.

Figure 32. SC AAS Volunteers in action.

PROGRAM GOALS AND DATA USE

SC AAS strives to help citizen scientists increase their knowledge, provide more information about the health of waterways statewide, encourage behavioral changes, and provide opportunities for watershed stewardship. SC AAS volunteers ADOPT sites to Actively collect Data Outdoors in order to Protect our streams Together.

Volunteer water quality monitors help our state by collecting data on waterways that may not be regularly monitored otherwise. Our goal is that data generated from the program is used for education, baseline monitoring, and screening for problems. This data gives decision makers and educators the ability to see trends over time and be alerted when pollution events occur. The data collected through South Carolina Adopt-a-Stream is not regulatory in nature and is not to be used for targeting neighbors or businesses. Follow-up from collected data should and does happen at the local level all the way up to SC DHEC and is aided by SC AAS program coordinators. By joining South Carolina Adopt-a-Stream you are agreeing to represent the program with integrity by:

- Following the SC AAS monitoring methods
- Fully and accurately documenting observations
- Reporting data to the database in a timely manner
- Accurately and respectfully discussing the program with others

Sampling according to SC AAS specifications has been approved by an EPA Quality Assurance Program Plan. Volunteers must pass a certification test and be recertified annually (online). Only certified volunteers can upload to the database, though the site is publicly accessible for data viewing and exporting.

Invasive Plant Identification Guide

TYPES OF AQUATIC PLANTS

There are three categories that we use to identify what is growing in the lake based on where it can be found:

A. **Floating Plants**—found on the surface of lakes and are not rooted to the lake bottom. Can vary in size from small flakes to over a foot in diameter. Many have hanging roots from each floating plant.

B. **Submerged Plants**—rooted in the lake bottom, full plant underwater.

C. **Emergent Plants**—rooted in lake bottom but leaves and stems extend out of the water or along the shoreline. Stems are stiff compared to most submerged plants.

Report Issues!

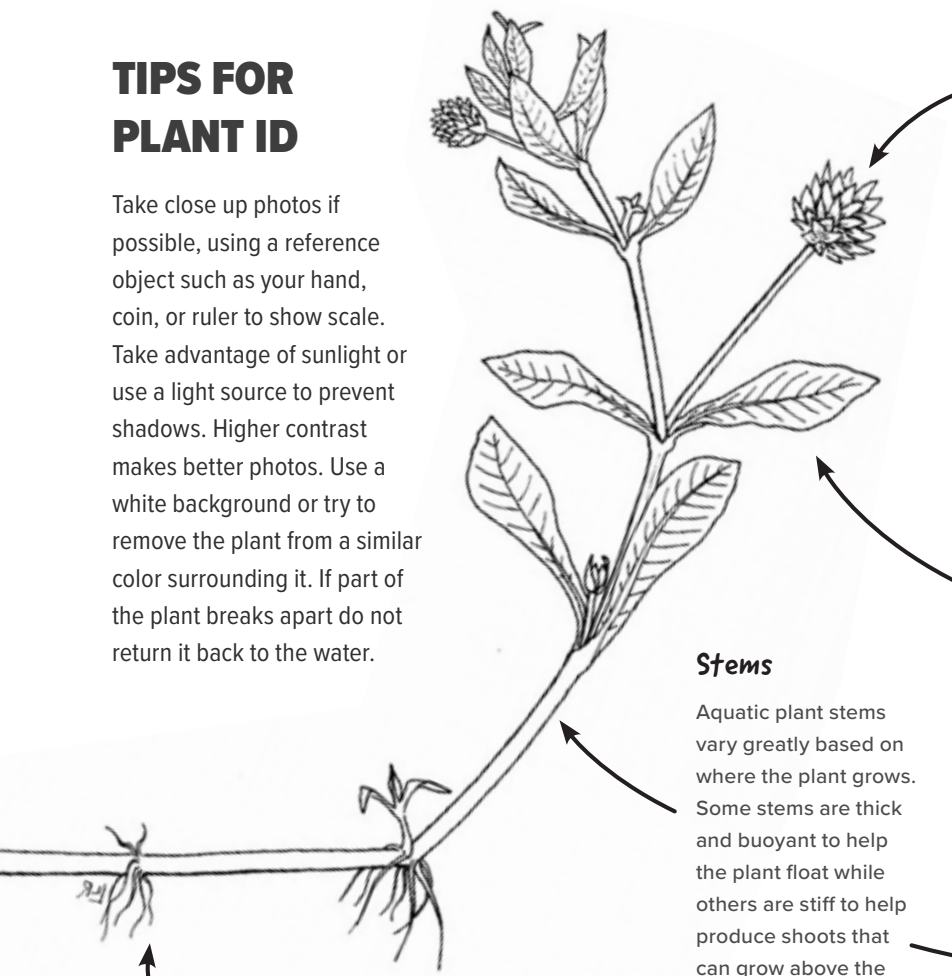
Report aquatic weed problems in public waters to SCDNR by calling 1-803-755-2872 or scanning this QR code. Include the following information:

- Is this a sudden appearance, ongoing or growing problem?
- Where was the specimen found (submerged, floating, shoreline)?

Figure 35. Scan to report issues to SCDNR

TIPS FOR PLANT ID

Take close up photos if possible, using a reference object such as your hand, coin, or ruler to show scale. Take advantage of sunlight or use a light source to prevent shadows. Higher contrast makes better photos. Use a white background or try to remove the plant from a similar color surrounding it. If part of the plant breaks apart do not return it back to the water.



Flowers

Many plants flower above the water's surface, but some do not flower at all. Plants that do not flower reproduce by means other than pollination.

Leaves

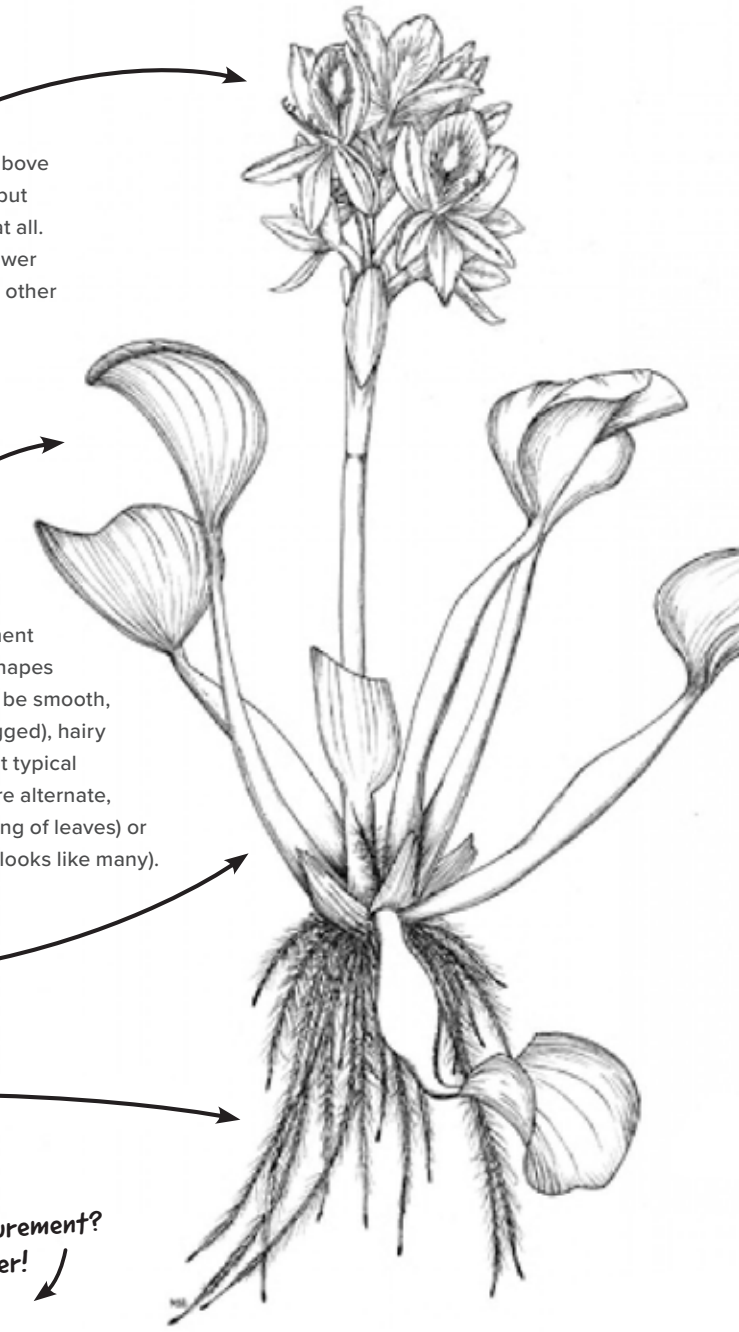
Leaf shape, color, edges and arrangement can be a variety of shapes or colors. Edges can be smooth, lobbed, serrated (jagged), hairy or feathery. The most typical leaf arrangements are alternate, opposite, whorled (ring of leaves) or compound (one leaf looks like many).

Stems

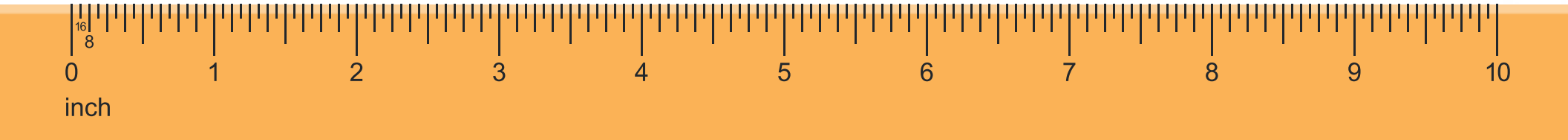
Aquatic plant stems vary greatly based on where the plant grows. Some stems are thick and buoyant to help the plant float while others are stiff to help produce shoots that can grow above the water's surface.

Roots

Roots of aquatic plants are often short and fibrous. Aquatic plants that have rhizomes can grow daughter plants from the roots. Other plants can spread by fragmentation when the roots are disturbed. This is why manual removal of some invasive plants can sometimes increase the growth or spread of the plants. Floating plants may have no roots at all.

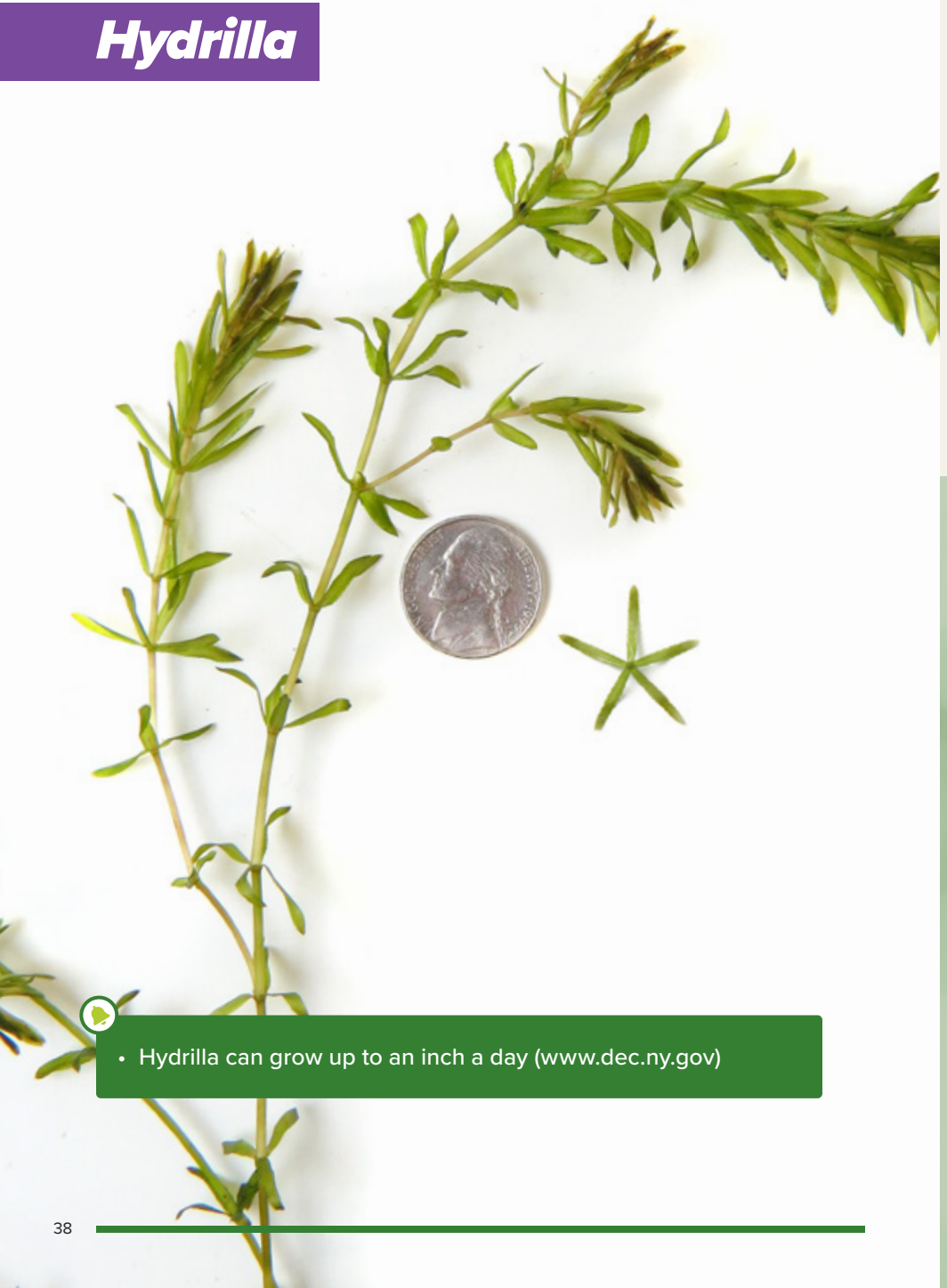


Need a quick measurement? Use this ruler!

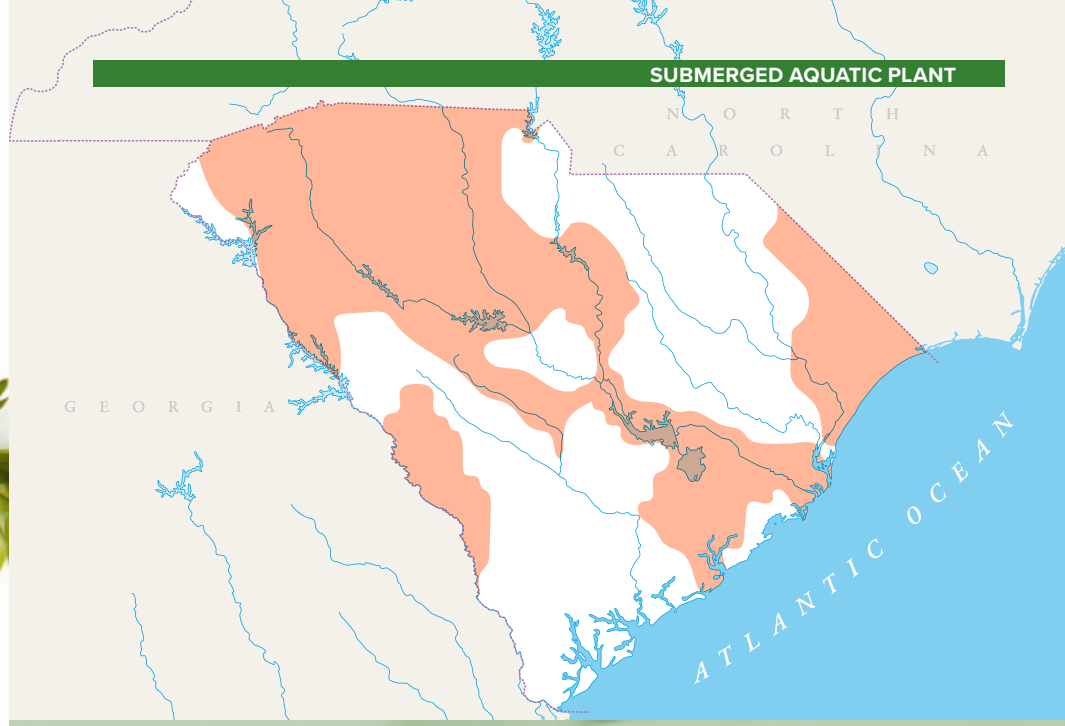


Hydrilla verticillata

Hydrilla



- Hydrilla can grow up to an inch a day (www.dec.ny.gov)



DESCRIPTION

Submersed, branched, usually rooted plant, but can appear as tangled mats on surface or have fragments seen drifting in the water

LEAVES

Submersed leaves have rings of 4-8 leaves, fine teeth on leaf edges and underneath along center vein

FLOWERS

Small, sparse, white, 3 petals on a long stalk

STEM

Slender, soft, branched, up to 25 feet

ROOTS

Lake bottom, potato-like tuber shoots

SIMILAR TO

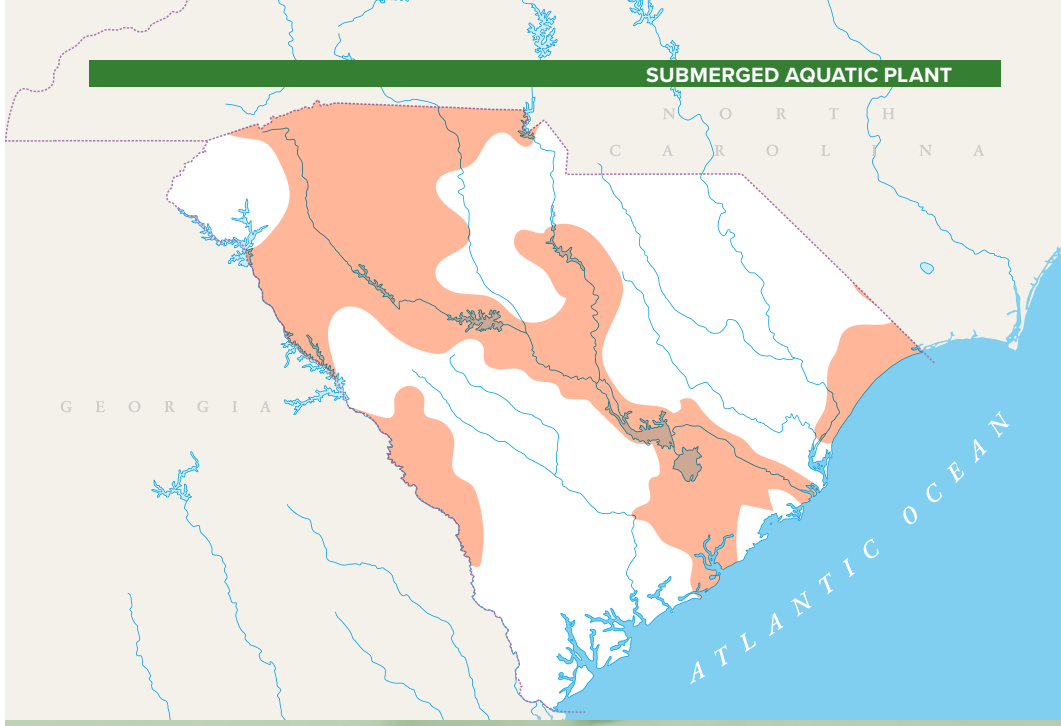
Canadian Waterweed/ American Elodea

- **NATIVE**
- *Elodea canadensis*
- Submersed leaves have rings of ONLY 3 smooth leaves

Egeria densa

Brazilian Elodea / Brazilian Waterweed

- Brazilian Waterweed spreads primarily by vegetative fragmentation and can take root or grow as free-floating mats (dnr.state.mn.us)



DESCRIPTION

Bushy aquatic plant with dense whorls (rings) of bright green leaves

LEAVES

1 inch long, smooth, 1/4 inch wide, rings of 4-6 leaves

FLOWERS

1 inch wide, white, showy, short stalks above water

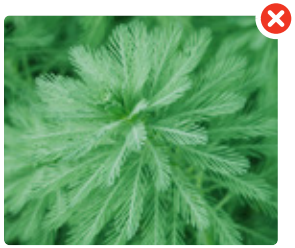
STEM

Slender, soft, branched, up to 15 foot

ROOTS

Can be rooted or free floating, white

SIMILAR TO



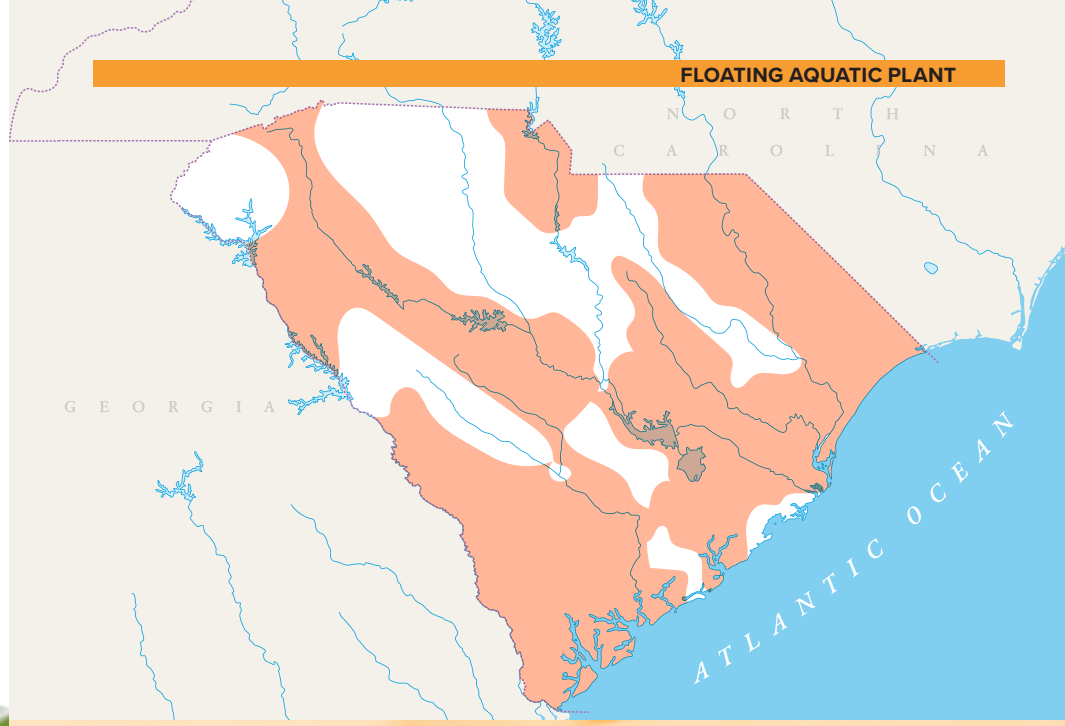
Eurasian Watermilfoil

- **INVASIVE**
- *Myriophyllum spicatum*
- Dark submerged leaves have rings of 4 feathery leaflets up to 1 inch long

Eichhornia crassipes

Water Hyacinth

- A single plant can produce up to an acre of growth in one growing season (SC DNR)



DESCRIPTION

Floating plant with a purple flower that has clusters of leaves around spongy stalks

LEAVES

Glossy, ovate, thick, float above water surface

FLOWERS

Showy lavender flower spikes with yellow spot in center

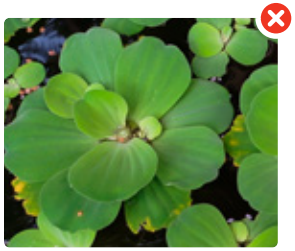
STEM

Short, inflated and unbranched, multiple daughter plants form on horizontal buds, up to 3 feet tall

ROOTS

Short with fibrous rhizomes, typically feathery and black to purple

SIMILAR TO



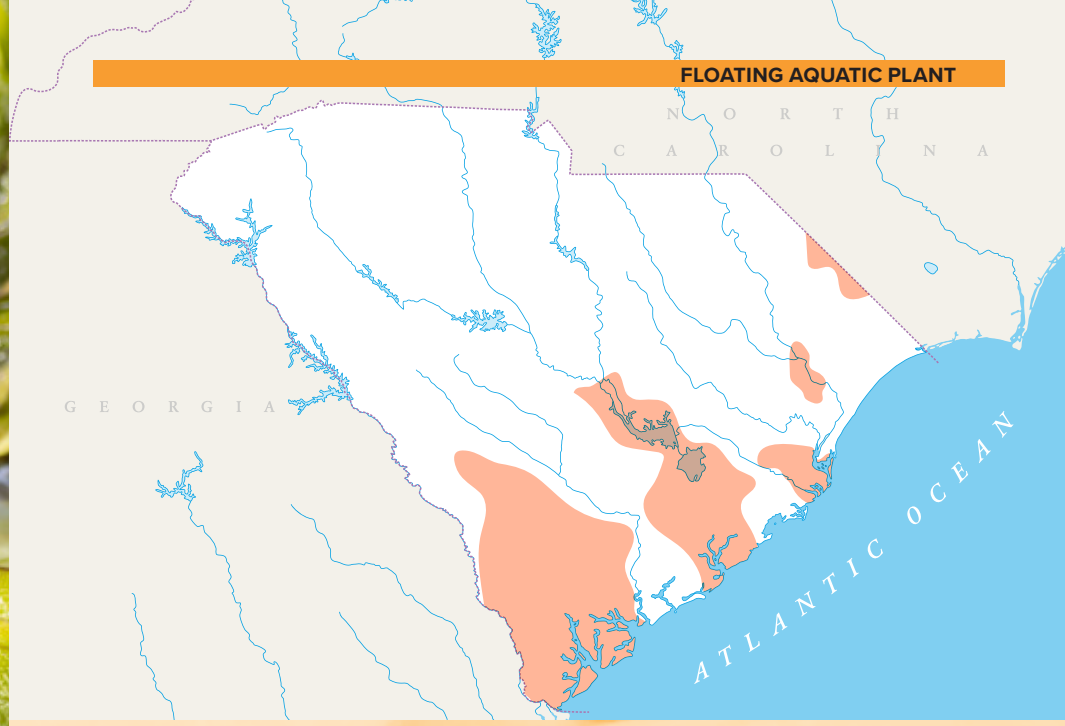
Water Lettuce

- **INVASIVE**
- *Pistia stratiotes*
- Free floating rosettes are grayish to light green around 6 inches across

Salvinia molesta

Giant Salvinia

- The hairs on the leaves are a water repellent, protective covering (USGS)
- Floating mats can be 3 feet thick (USGS)



DESCRIPTION

Free floating aquatic fern with horizontal stems that float below the surface

LEAVES

Paired leaves 1-1.5 inches long and 1-2.5 inches wide. Top leaves are green, oval to oblong, with white bristly hairs. Submerged leaves are brown

FLOWERS

None

STEM

Horizontal

ROOTS

None, submerged leaves help stabilize

SIMILAR TO

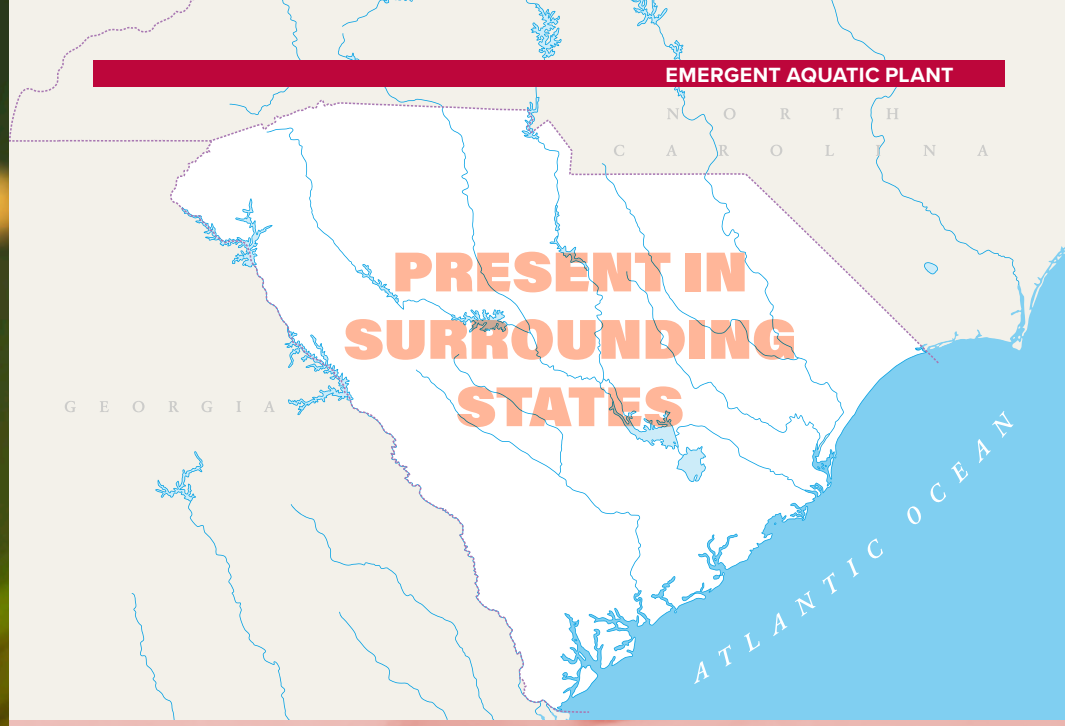
Common Duckweed

- **NATIVE** that can act like an **INVASIVE**
- *Lemna minor*
- Smallest floating plant known. Flat oval leaf <1/4 inch, Duckweed is found statewide but most commonly in the piedmont, midlands and coastal plain

Limnophila sessiliflora

Ambulia

- Ambulia is able to shade out and thus outcompete totally submerged species (European and Mediterranean Plant Protection Organization)



DESCRIPTION

A rooted, submerged and emergent plant with two types of leaves

LEAVES

Submersed leaves are up to 1 inch long, feathery, serrated margins. Emersed leaves are generally lance-shaped, flat with irregular margins and shiny hairs

FLOWERS

Single blue to lavender or pink, 5 fused petals that form a distinct tube, dark purple lines beneath petals

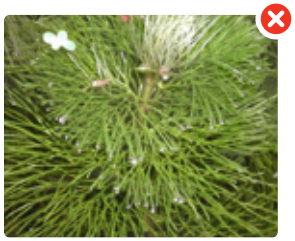
STEM

Up to 12 feet

ROOTS

Rooted in lake bottom, rhizomes look like white strings

SIMILAR TO



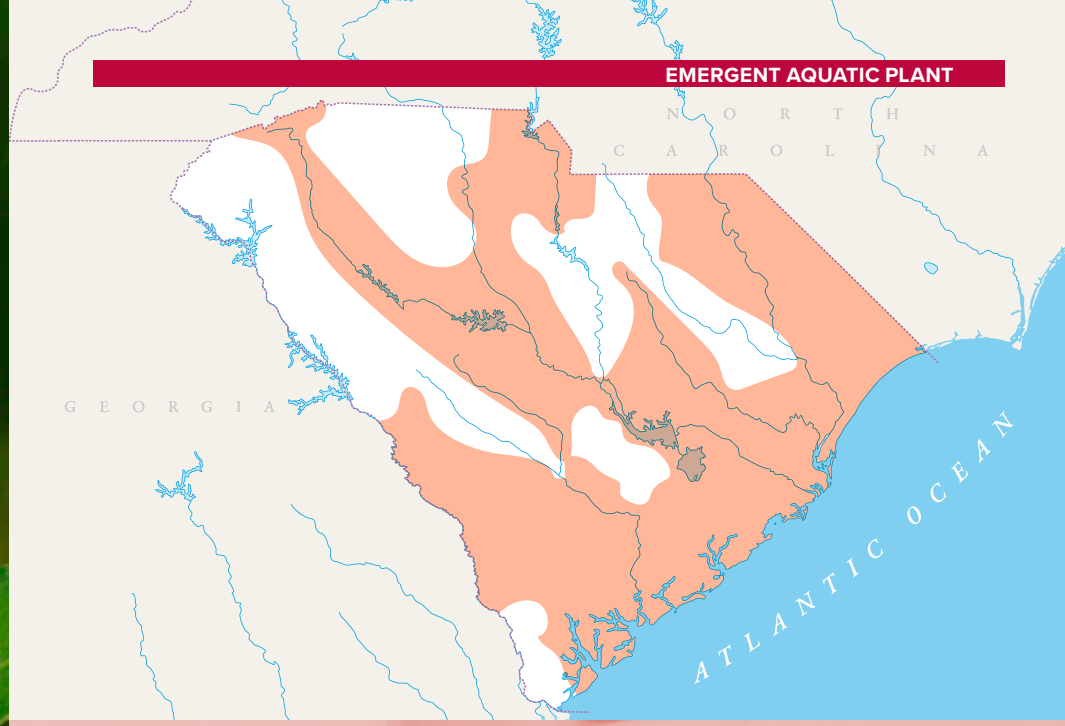
Carolina Fanwort

- **NATIVE**
- *Cabomba caroliniana*
- Mostly submerged except for white to purple flowers with yellow centers, flowers on stalks, and has needle-like leaves that are dark or olive green color

Alternanthera philoxeroides

Alligator Weed

- This plant was likely first introduced into the United States around 1900 in ballast water of ships from South America.



DESCRIPTION

Sprawling plant that is often in a dense tangled mass growing along shorelines or can be free floating

LEAVES

Bright green in opposite pairs, long elliptic-linear in shape, 2-4 inches long and up to one inch wide. Mid-veins prominent on both sides of leaf

FLOWERS

Small and clover-like, 0.3-0.4 inches, white with green shades

STEM

Hollow, buoyant, up to 4 feet long, emergent stalks are about up to 1.5 ft

ROOTS

Thick in good soil

SIMILAR TO

Water Willow

- **NATIVE**
- *Justicia americana*
- While the leaves look similar, alligator weed's can be up to 2 inches shorter than the minimum 3-inch length of water willow leaves

Appendix

HELPFUL RESOURCES AND APPS

Online Resources:

- **SC DNR Aquatic Plant Management Plan:** dnr.sc.gov/water/envaff/aquatic/img/2022PartTwo.pdf
- **USGS Nonindigenous Aquatic Species:** nas.er.usgs.gov/queries/SpeciesList.aspx?Group=Plants
- **Submit an Algae Sample for ID:** hgic.clemson.edu/factsheet/submitting-an-algae-sample-for-identification
- **Rainfall from CoCoRaHS** cocorahs.org
- **SC DNR Major Lakes List** dnr.sc.gov/lakes/search.html
- **SC Adopt-a-Stream Atlas** gis.dhec.sc.gov/scaas
- **DHEC's Watershed Atlas** gis.dhec.sc.gov/watersheds
- **USGS Water Level Data** waterdata.usgs.gov/sc/nwis/current/?type=flow

Phone Apps:

NCSU Aquatic Plants

- https://apps.apple.com/us/app/aquatic-plants/id876023735
- https://play.google.com/store/apps/details?id=edu.ncsu.cropsci.aquaticplants&hl=en_US&gl=US&pli=1

EyeOnWater - Colour

- https://itunes.apple.com/us/app/eyeonwater-colour/id1021542366?mt=8
- https://play.google.com/store/apps/details?id=nl.maris.eyeonwater

ISSUES AND EMERGENCY CONTACTS

SC DNR Aquatic Nuisance Species Program
2730 Fish Hatchery Road
West Columbia, SC 29172
803-755-2836

Clemson Department of Pesticide Regulation
864-646-2150

For evidence of **dangerous pollution discharges, fish kills, or public health hazards**, call the 24-hour SC DHEC Hotline: 888-481-0125

JURISDICTIONS AND RESPONSIBILITIES

SC DNR: Manages statewide invasive aquatic plants in public waters. Education through public outreach and administers the Clean Vessel Program. Manages sterile grass carp population for biological control of plants in public waters.

SC Dept. of Agriculture: Administers the State Noxious Weed Act that includes several aquatic plant species. They can stop movement of aquatic plants through commercial waters, plants sales and distributors.

Santee Cooper: Lakes Marion and Moultrie

Dominion: Lakes Murray and Monticello

Duke Energy: Lakes Cedar Creek (Stumpy Pond), Fishing Creek, Gaston Shoals, Great Falls, Jocassee, Keowee, Ninety-nine Islands, Wateree, and Wylie

SC DHEC Bureau of Water: Protect and preserve State water resources for drinking, swimming, fishing and other uses to benefit present and future South Carolinians through water quality monitoring/assessments/protection, dam safety/stormwater permitting, drinking/recreation water protection, water facility permitting, and water pollution compliance/enforcement.

Clemson Center for Watershed Excellence: Provides hands-on, practical products and services so that communities can enhance watershed management activities for watershed planning, community science, and water protection groups.

South Carolina Law requires individuals to possess a Commercial Pesticide Applicators License in Category 5, Aquatic Pest Control, before they apply aquatic herbicides if the work is done for compensation on the property of another. A license is also required, regardless of ownership, if the application is made to an area where public access to the treated site is expected. Private swimming lakes, where the public would be exposed to the treated waters, are the most obvious example of the latter requirement. On all public facilities, such as golf courses, driving ranges, subdivisions, condominium/apartment complexes and mobile home parks, applicators are required to possess a Category 5 License to apply aquatic pesticides.

NOXIOUS WEED LIST

No person may possess, sell, offer for sale, import, bring or cause to be brought or imported into this state or release into the waters of this state the following plants:

Aquatic and Wetland Plants on the SC Noxious Weed List

COMMON NAME	SCIENTIFIC NAME	CURRENTLY MANAGED	POTENTIAL FUTURE MANAGEMENT
African oxygen weed	*Lagarosiphon major*		
Alligatorweed	*Alternanthera philoxeroides*	X	
Ambulia *	*Limnophila sessiliflora*	X	
Arrowhead *	*Sagittaria sagittifolia*		
Arrow-leaved monochoria *	*Monochoria hastata*		
Brazilian elodea	*Egeria densa*		X
Caulerpa *	*Caulerpa taxifolia*		
Common reed	*Phragmites australis*	X	
Duck-lettuce *	*Ottelia alismoides*		
Eurasian watermilfoil	*Myriophyllum spicatum*		X

COMMON NAME	SCIENTIFIC NAME	CURRENTLY MANAGED	POTENTIAL FUTURE MANAGEMENT
Exotic bur reed *	*Sparganium erectum*		
Giant salvinia *	*Salvinia molesta, S. biloba, S. herzogii, S. auriculata*	X(#)	X
Hydrilla*	*Hydrilla verticallata*	X	
Melaleuca *	*Melaleuca quinquenervia*		
Miramar weed *	*Hygrophila polysperma*		X
Monochoria *	*Monochoria vaginalis*		
Mosquito fern *	*Azolla pinnata*		X
Purple loosestrife	*Lythrum salicaria*		X
Rooted water hyacinth *	*Eichhornia azurea*		
Slender naiad	*Najas minor*	X	
Water chestnut	*Trapa natans*		X
Water hyacinth	*Eichhornia crassipes*	X	
Water lettuce	*Pistia stratiotes*	X	
Water primrose	*Ludwigia uruguayensis*	X	
Water spinach *	*Ipomoea aquatica*		X
Wetland nightshade *	*Solanum tampicense*		

*Also listed on Federal Noxious Weed list
(#) CURRENT STATUS ERADICATED IN SC

Note: Designations are not based on occurrence in the state. Some of the unchecked species exist in the state, but are not currently considered priorities for management.

DATA FORM

Found under "Certified Volunteers" at **www.scadoptastream.org** or by scanning this code with your phone's camera.

TEMPERATURE CONVERSION CHART

CELSIUS	FAHRENHEIT
0 °C	32 °F
1 °C	33.8 °F
2 °C	35.6 °F
3 °C	37.4 °F
4 °C	39.2 °F
5 °C	41.0 °F
6 °C	42.8 °F
7 °C	44.6 °F
8 °C	46.4 °F
9 °C	48.2 °F
10 °C	50.0 °F
11 °C	51.8 °F
12 °C	53.6 °F
13 °C	55.4 °F
14 °C	57.2 °F
15 °C	59.0 °F
16 °C	60.8 °F
17 °C	62.6 °F

CELSIUS	FAHRENHEIT
18 °C	64.4 °F
19 °C	66.2 °F
20 °C	68.0 °F
21 °C	69.8 °F
22 °C	71.6 °F
23 °C	73.4 °F
24 °C	75.2 °F
25 °C	77.0 °F
26 °C	78.8 °F
27 °C	80.6 °F
28 °C	82.4 °F
29 °C	84.2 °F
30 °C	86.0 °F
31	87.8
32	89.6
33	91.4
34	93.2
35	95.0

INTERESTED IN MORE?

If you would like to explore different volunteer monitoring opportunities, check out some of our other South Carolina Adopt-a-Stream programs! The following workshops can be found under the "Become a Volunteer" tab on our website. They are typically six hour, in-person trainings that go into more detailed water quality science and have hands on practice for monitoring parameters.

Freshwater wadable streams: Streams feed our lakes. If you notice a water quality issue in your lake, monitor a stream higher in the watershed to better understand the cause of the problem. This Freshwater Certification will teach volunteers how to measure temperature, transparency, dissolved oxygen, pH, and bacteria in your adopted stream. This program is designed for monthly monitoring.

Macroinvertebrates: With this program you will collect aquatic macroinvertebrates, which are stream creatures that are big enough to see that also lack a backbone. You will identify them while at your site and then release them back into the stream. Monitoring macroinvertebrates gives a good picture of the long-term health of freshwater stream habitat and water quality. Macroinvertebrate monitoring is conducted two times per year, and it is fun to do in groups.

Tidal Saltwaters: If you live near the coast this is a great program to get involved with. This certification workshop covers how to monitor temperature, transparency, dissolved oxygen, pH, and salinity monthly in tidal saltwaters that have a salinity of at least 0.5 ppt. This program is designed for monthly monitoring.

Another way to protect water quality is by getting others in your community involved and educated. Share your data, reach out to local businesses to promote and support SC AAS, and lead community initiatives like litter pick-ups and riparian buffer repairs.

Additional volunteer monitoring programs:

CoCoRaHS: collect local rainfall data

NOAA Phytoplankton Monitoring Network: record the presence of marine phytoplankton and harmful algal blooms (HABs)

FIELD CHECKLIST

☐ Lake Data Form

Found under "Certified Volunteers" at www.scadoptastream.org

☐ Monitoring Kit

- ○ Secchi Disk
- ○ Sample Cup
- ○ EyeOnWater–Colour App
- ○ String
- ○ Thermometer
- ○ Pen
- ○ Life Jacket with Whistle
- ○ Towel
- ○ Reacher Stick
- ○ Camera
- ○ Gloves
- ○ Bag

☐ Optional Items

- ○ Clipboard
- ○ First Aid Kit
- ○ Trash bag for litter
- ○ Sunscreen/Hat/ Sunglasses

PHOTO ATTRIBUTION

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- **Figure 1**
  Map of South Carolina Major Rivers and Lakes
  SCDNR Technology Development Program, GIS
- **Figure 2**
  C. Carolina Bay
  NASA Earth Observatory image by Joshua Stevens, using Landsat data from the U.S. Geological Survey and topographic data from North Carolina State University
- **Figure 6**
  Maps of James Island, Charleston, SC
  Google Earth, earth.google.com/web
- **Figure 7**
  B. Sampling from a Dock
  Sierra Hylton, South Carolina Department of Health and Environmental Control
- **Figure 9**
  Oil sheen on flood waters in Charleston, SC.
  Mic Smith, Associated Press. 2015
- **Figure 12**
  Algal Bloom
  Sierra Hylton, South Carolina Department of Health and Environmental Control
- **Figure 16**
  Clear Water (Colorless)
  Sierra Hylton, South Carolina Department of Health and Environmental Control
- **Figure 17**
  Clear and Opaque Water Samples
  Sierra Hylton, South Carolina Department of Health and Environmental Control
- **Figure 18**
  Left and Right Shoreline
  Volunteer Photo, SC Adopt-a-Stream Database. https://www.scadoptastream.com
- **Figure 19**
  A. Water Height
  Volunteer Photo, SC Adopt-a-Stream Database. https://www.scadoptastream.com
  B. Volunteer Sampling Photo from SC Adopt-a-Stream Lake Monitoring Training Video
  SC Adopt-a-Stream, https://youtu.be/QYx3KZQq9BE?si=SAxSx_5Xb0RwtKIu&t=69
- **Figure 20**
  Screenshots of EyeOnWater
  https://www.eyeonwater.org
- **Figure 21**
  Using the Secchi Disk
  Sierra Hylton, South Carolina Department of Health and Environmental Control
- **Figure 24**
  USGS Hydrograph for Lake William C. Bowen Near Fingerville, SC,
  https://waterdata.usgs.gov/monitoring-location/02154950/#parameterCode=00062&period=P365D&showMedian=true
- **Figure 25**
  Lemna and Spirodella
  Paul Skawinski, Aquatic Plants of the Upper Midwest. Extension Lakes Online Bookstore. cnroutreached.asapconnected.com/#ProductDetail=12743
- **Figure 27**
  Lake Monitoring Kit
  Sierra Hylton, South Carolina Department of Health and Environmental Control
- **Page 36**
  Eichornia crassipes
  IFAS, Center for Aquatic Plants, University of Florida. 1996. https://plants.ifas.ufl.edu/site/assets/files/1085/eichhsm.jpg
- **Page 37**
  Eichornia crassipes
  IFAS, Center for Aquatic Plants, University of Florida. 1996. https://plants.ifas.ufl.edu/site/assets/files/1085/eichhsm.jpg
- **Page 38**
  Hydrilla verticillata
  Paul Skawinski, Aquatic Plants of the Upper Midwest. Extension Lakes Online Bookstore. cnroutreached.asapconnected.com/#ProductDetail=12743
- **Page 39**
  Elodea canadensis
  Christian Fischer, Wikimedia Commons. 2011. https://commons.wikimedia.org/wiki/File:ElodeaCanadensisFlowering.jpg
- **Page 40**
  Egeria densa
  Paul Skawinski, Aquatic Plants of the Upper Midwest. Extension Lakes Online Bookstore. cnroutreached.asapconnected.com/#ProductDetail=12743
- **Page 47**
  Cabomba caroliniana
  Leslie J. Mehrhoff, University of Connecticut, Bugwood.org. 2016, http://www.forestryimages.org/browse/detail.cfm?imgnum=5447120
- **Page 49**
  Justicia americana
  Mason Brock, Wikimedia Commons. 2013. https://commons.wikimedia.org/wiki/File:Justicia_americana_flower.jpg

NOTES

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CR-013410 1/24