2025 WAKULLA RIVER SPRINGSWATCH MONITORING SUMMARY



Prepared for Florida Department of Environmental Protection

Howard T. Odum
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Volunteer and Staff Acknowledgments

This report was prepared by the Howard T. Odum Florida Springs Institute (FSI). Ecological monitoring was conducted by FSI staff and Florida SpringsWatch volunteers under the Florida Department of Environmental Protection (FDEP) Division of Recreation and Parks Research/Collection Permit Number 10102510.

The Wakulla SpringsWatch group would not have been possible without all the hard work from our group lead Sean McGlynn. Sean was assisted by a group of wonderful volunteers including Cal Jamison, Brian Lupiani, Antoine Hahna, David Shepherd, Julia McGlynn, Heather Wharton, Cassie McGlynn, Bill Davis, Laine Howard, Glen Smith, and also Captains Katria Bailis and Scott Roykance.

We would also like to acknowledge FSI's Programs Coordinator Michael Garvey who wrote this report; as well as Senior Environmental Scientist Bill Hawthrone and Environmental Scientist TJ Comer for their continued support, working under the supervision of Executive Director Haley Moody. Special acknowledgement should be given to Outreach Assistant Ada Nesbit and TJ Comer for assistance with data entry and figure development. Finally, we are thankful for the ongoing guidance and vision of FSI founder, Dr. Robert Knight, as well as our board of directors including Tedd Greenwald, Bob Palmer, Steve Walsh, Karen Lenese, Jacqui Sulek, and Melissa Perkins.



Figure 1. Our Amazing Wakulla Volunteers

Executive Summary

In 2025, the Wakulla River SpringsWatch group collected data on eleven separate sampling days throughout the year to analyze the health and productivity of the spring. SpringsWatch volunteers collected data on a number of water quality parameters and ecological indices to examine both abiotic and biotic factors that drive the health of the spring:

- **Water Quality** in the Wakulla River Springs is stable
    - **Temperature** was relatively constant across all stations and fluctuated between 20-22 degrees Celcius
    - **Dissolved Oxygen** increased as stations moved further from the main headspring. This is likely due to primary production and water surface diffusion with the air
    - **Specific Conductivity** was relatively stable but all stations experienced periods of elevation due to saltwater intrusion into the nearby Spring Creek Spring.
    - **Water clarity** was extremely variable ranging from 30-70 meters. This could indicate high variability in the groundwater feeding the spring.
    - **Light** measurements collected were highly variable across all stations.
- **Biology** of the Wakulla River Springs is diverse and healthy
    - **Submerged Aquatic Vegetation** appears to be healthy in this spring shed. High amounts of native eelgrass were seen on surveys but invasive *Hydrilla* was also documented.
    - **Fish** are diverse in the Wakulla River. At least 8 different species of fish were seen during fish surveys, including marine invaders such as Sheepshead.
    - **Birds** are very diverse across the Wakulla River System. In total, 22 different species were seen. The most commonly seen birds were White Ibis, a common wading bird.
    - **Other Large Animals** were also seen in the Wakulla River. Alligators were the most commonly seen large animal and at certain times of year West Indian Manatees were spotted.

Introduction

1.1 Site Overview

Located 16 miles south of Tallahassee, Wakulla Spring is one of the largest first-magnitude artesian springs in Florida and the United States. Wakulla Spring lies within the Edward Ball Wakulla Springs State Park, which is listed on the Natural Register of Historic Places and is designated a National Natural Landmark. Wakulla Spring forms the headwaters of the Wakulla River, which flows for nearly 11 miles before merging with the St. Marks River in the town of St. Marks. Wakulla Springs is renowned for its natural beauty and has been a favorite recreational site, as well as potable water source, for residents of Leon, Wakulla, and surrounding counties. However, the river and springs have not been immune to human impacts, demonstrating reductions/reversals in flow, elevated nitrate nitrogen, increased dark-water days, and increased growth of invasive hydrilla and filamentous algae.

The Wakulla Springs Group was designated as an Outstanding Florida Spring when the Florida Springs and Aquifer Protection Act was passed in 2016. It is currently one of the twenty- six Outstanding Florida Springs or Springs Groups that is considered "impaired".

FSI's SpringsWatch volunteer citizen-science program has provided enhanced monitoring of the Wakulla River and springs ecological health since 2019. The resulting data are provided in annual reports and via the SpringsWatch website (floridaspringsinstitute.org/springswatch) to inform the state's environmental agencies and educate the public about the springs and river's health.

This report was prepared by the Howard T. Odum Florida Springs Institute and is focused on 2025 ecological monitoring along the Wakulla River and springs conducted by SpringsWatch volunteers.

1.2 Monitoring Stations

Figure 1 shows the nine SpringsWatch monitoring stations along the Wakulla River. WAK-HS represents the head spring; WAK-1 through WAK-8 denotes river stations. A summary of all sampling sites, their station names, latitude, and longitude used within the Wakulla SpringsWatch groups can be viewed in Table 1.

Table 1. Coordinates for Wakulla SpringsWatch monitoring stations.

Station Code	Station Name	Latitude	Longitude
WAK-1	WAK-1	30.23587	-84.30107
WAK-2	WAK-2	30.23647	-84.29861
WAK-3	WAK-3	30.23433	-84.29423
WAK-4	WAK-4	30.23285	-84.28791
WAK-5	WAK-5	30.23421	-84.29015
WAK-6	WAK-6	30.2375603	-84.2992201
WAK-7	WAK-7	30.23583	-84.30182
WAK-8	WAK-8	30.23664	-84.30181
WAK-HS	WAK-HS	30.235323	-84.302475



Figure 1. Wakulla SpringsWatch monitoring station map.

1.3 Monitoring Parameters

1.3.1. Temperature

Water Temperature is an extremely important metric in terms of water quality. It is measured in degrees Celsius using a thermometer. Water temperature is relatively constant in Florida springs. However, heavy rain, runoff from land, river flooding, and spring reversals (when surface water flows back into the spring) can disrupt this stability and cause the temperature to fluctuate along the spring run. In Florida, the average temperature from the spring vent is determined by the annual average air temperature and depth of the groundwater source. Temperature directly affects how much dissolved oxygen the water can hold and the metabolism of plants and animals use (Gillooly et al., 2001; Short et al., 2016). The purpose of monitoring water temperature is to indicate any significant changes that may have large effects on other biological and chemical processes in the spring system.

1.3.2. Dissolved Oxygen

Dissolved Oxygen is another very important water quality parameter. Dissolved Oxygen is measured in both percent saturation and milligrams per liter. Healthy aquatic ecosystems typically have higher DO values due to atmospheric diffusion and photosynthesis from aquatic plants and algae. This oxygen in the water can in turn be consumed by fish and other aquatic organisms. Groundwater stored in the aquifer typically has lower DO values which can vary depending on how long it takes for the water to exit out a spring vent. By monitoring DO values, we can get insight into how much oxygen is available for organisms to use inside spring systems.

1.3.2. Specific Conductance

Specific Conductance is a water quality parameter similar to salinity in saltwater. Specific conductance values are influenced by the amount of ions present in the water. These ions can be naturally occurring or may be present from nitrate/nitrite, saltwater, and a number of other compounds. In general, ecoregions dominated by karst limestone typically have higher conductivity values compared to ecoregions

dominated by different geological makeup (Griffith, 2014). Monitoring specific conductivity is important to examine how springs are influenced by the addition or decrease of ions in these aquatic systems.

1.3.3. Nitrate-nitrite Nitrogen

Nitrate and nitrite are forms of nitrogen that move easily through water and are the most common types of nitrogen pollution found in the Floridan Aquifer and many of Florida's springs (Cohen, 2007; Cohen, 2008; Brown et al., 2008). This pollution mainly comes from human activities, with the largest sources being fertilizer used in agriculture and landscaping, wastewater from septic systems and treated sewage released into the ground, and animal waste that has not been properly managed (Eller and Katz, 2014; Mattson et al., 2006). High levels of nitrate can negatively impact spring ecosystems in several ways. It has been shown to affect the reproduction of mosquitofish (Gambusia holbrooki) (Edwards, 2006; Edwards et al., 2007), increase the growth of phytoplankton and algae (Cattaneo and Kalf, 1978), worsen the effects of invasive aquatic plants (Wahl et al., 2021), and may contribute to the decline of amphibian populations (Rouse et al., 1999). Because of these risks, FDEP set a springs impairment level of 0.35mg/L in springs vents; suggesting that concentrations above that level may be harmful to the ecosystem (Brown et al., 2008). It is important to monitor nitrate-nitrite nitrogen because increased concentrations of these pollutants can impact several biotic and abiotic factors vital to springs health.

1.3.4. Photosynthetically Active Radiation

Photosynthetically Active Radiation refers to the specific wavelengths of light that can actually be used by plants to perform photosynthesis. This parameter is extremely important in terms of springs health because aquatic plants create the base of the food webs in these systems and also provide things like oxygen as well as refugia for smaller springs organisms. PAR is measured to estimate how light percolates through the water column depending on depth and water clarity. This parameter is very important to monitor to examine any changes in light availability that could impact submerged aquatic vegetation.

1.3.5. Vertical Secchi Disk Visibility

The Secchi disk is a tool for measuring water clarity in aquatic ecosystems. It is a disk with alternating black and white quadrants that is lowered into the water until it is no longer visible. The depth at which the disk disappears is known as the Secchi depth and is used as an indicator of water quality. The longer the Secchi depth, the clearer the water is. Secchi length can be used to monitor changes in water clarity over time and can be used to identify problems such as algal blooms or pollution.

1.3.6. Submerged Aquatic Vegetation Surveys

As mentioned in the section on Photosynthetically Active Radiation, Submerged Aquatic Vegetation (SAV) is an extremely important indicator of spring health. SAV acts as a food source for many springs animals, provides dissolved oxygen into the water column, and provides housing refugia for a number of small springs organisms. In addition to its benefits, Florida is also home to several species of invasive aquatic vegetation which can be known to outcompete native species (Evans, 2008). It is important to monitor vegetation communities in springs in order to document changes of species composition or density which can have major impacts on other aspects of springs ecology.

1.3.7. Bird Surveys

Birds are a common sight throughout all Florida Springs and use them in a number of different ways including feeding grounds, nesting areas, and critical stopovers during migration. Birds occupy a wide array of biological niches in spring systems and their presence helps to maintain balance in springs food webs. It is important to monitor bird communities to examine potential changes in community density and diversity which could have compounding consequences on the rest of the spring community.

1.3.6. Fish Surveys

Fish are one of the most commonly seen groups of aquatic organisms seen in springs. They play important roles in nearly every trophic level of these systems and their distribution is often dictated by a number of biotic and abiotic factors (Work et al., 2010). Similar to plants, Florida houses a number of invasive fish species that can outcompete native species. It is important to monitor fish communities in springs to document how they change and ensure no further introduction of invasive species.

1.3.7. Large Animal Surveys

Large animals such as reptiles and mammals play critical roles in maintaining healthy ecosystems in springs. Herbivores such as West Indian Manatees graze on aquatic plants and large predators such as American Alligators act as apex predators and keep fish populations in check. It is important to monitor these groups to understand how changes in the spring could be impacting larger species that depend on these critical habitats.

Materials & Methods

SpringsWatch volunteers conducted ecological monitoring at Wakulla Springs from January through December 2025. Data collection included water quality field parameters, vertical light attenuation, water clarity, aquatic vegetation photographs, and wildlife counts.

2.1 Sampling Events

Table 2 summarizes the 11 sampling events that occurred in 2025 along the Wakulla River. Monitoring was conducted by SpringsWatch volunteers with assistance from FSI staff.

Wakulla monitoring events include the following:

- Water quality field parameters (temperature, dissolved oxygen, dissolved nitrate-nitrite, and specific conductivity)
- Vertical light attenuation
- Vertical Secchi disk measurements of water clarity
- Aquatic vegetation survey
- Visual bird counts
- Visual Fish surveys

Table 2: Summary of 2025 Sampling Events

Month	Temp	DO	SpC	PAR	NOx-N	Secchi	SAV	Birds	Fish
Jan.	x	x	x	x		x	x	x	X
Feb.	x	x	x	x		x	x	x	X
Mar.							x		
Apr.	x	x	x	x		x	x		X
May	x	x	x	x		x	x	x	X
Jun.	x	x	x	x		x	x	x	X
Jul.	x	x	x	x		x	x	x	X
Aug.	x	x	x	x		x	x	x	X

Sep.	x	x	x	x	x	x	x	x	X
Oct.	x	x	x	x		x	x	x	X
Nov.	x	x	x	x		x	x	x	X
Dec.	x	x	x	x		x		x	X

2.2 Water Quality

2.2.1 Dissolved Oxygen and Temperature

SpringsWatch volunteers used a handheld YSI ProODO meter at each of the monitoring stations in the Wakulla Springs System to collect monthly measurements of water temperature and dissolved oxygen at each of the 9 monitoring stations. Lead volunteers calibrated and maintained water quality meters according to manufacturer instructions and Florida Department of Environmental Protection Standard Operating Procedures (FDEP, 2017). If either the initial or post-sampling calibration failed, the associated data were excluded from this report and subsequent analyses.

2.2.2 Specific Conductance

SpringsWatch volunteers used a handheld YSI EcoSense EC300A meter at each of the monitoring stations in the Wakulla Springs System to collect monthly specific conductivity readings at each of the 9 stations along the Wakulla River. Team leaders calibrated and maintained water quality meters according to manufacturer instructions and Florida Department of Environmental Protection Standard Operating Procedures (FDEP, 2017). If either the initial or post-sampling calibration failed, the associated data were excluded from this report and subsequent analyses.

2.3.1 Nitrate-Nitrite

Nitrate-nitrite samples were taken in September 2025 by FSI staff at all 9 stations. Water samples were sent to a state-accredited laboratory (McGlynn Laboratories Inc.) for nitrogen as nitrate-nitrite (NOx-N) analysis. Preparation, storage, and analysis all followed FDEP Standard Operating Procedures. Samples were hand collected from approximately 0.1m depth. Sample bottles were re-capped and sealed before being acidified with approximately 0.25mL of 50% sulfuric acid (H2SO4) and then stored on ice prior to transport. Water sampled were held in a refrigerator for <21days before being sent to a state-accredited laboratory (McGlynn Laboratories Inc.) for NOx-N analysis. All analyses were conducted within a standard holding time of 28 days from sample collection.

2.3 Water Clarity

2.3.1 Diffuse Attenuation Coefficient (k) and Percent Transmittance

Photosynthetically Active Radiation (PAR) underwater light transmission and attenuation coefficients were measured monthly at the 9 monitoring sites. Volunteers used a LI-COR brand LI-250A underwater quantum photometer to measure PAR energy reaching the water surface and at depth intervals of one foot and two feet. Figure 2 provides an image of the LI-COR photometer.

2.3.2. Secchi Disk

SpringsWatch volunteers took monthly vertical Secchi disk measurements at Wakulla head spring, station WAK-HS, throughout the sampling period.

2.4 Submerged Aquatic Vegetation Survey

Submerged aquatic vegetation (SAV) was monitored at all 9 stations (Figure 1) during each sampling event. SpringsWatch volunteers took two photographs at each station in two separate locations, which they sent to FSI for vegetation identification. Analysis of vegetative cover was not complete for this report, so photos of typical spring run vegetation are provided instead.

2.5 Bird Surveys

Between January and December 2025, eleven bird counts occurred within Wakulla by SpringsWatch volunteers. Wakulla SpringsWatch volunteers recorded visual observations of birds during the entire sampling session.

2.6 Fish Surveys

Fish were monitored from the surface during monitoring events throughout 2025. SpringsWatch volunteers identified fish seen from the surface down to the lowest taxonomic level.

2.7 Large Animal Surveys

SpringsWatch volunteers recorded visual monthly observations of large animals such as turtles, alligators, and manatees throughout all stations and then identified them to the lowest taxonomic group.

Results & Discussion

This section summarizes field data along the Wakulla River and springs collected from January to December 2025 by SpringsWatch volunteers.

3.1 Water Quality

Figure 4 through 11 present water quality results collected from Wakulla SpringsWatch stations from January to December 2025.

3.1.1 Dissolved Oxygen

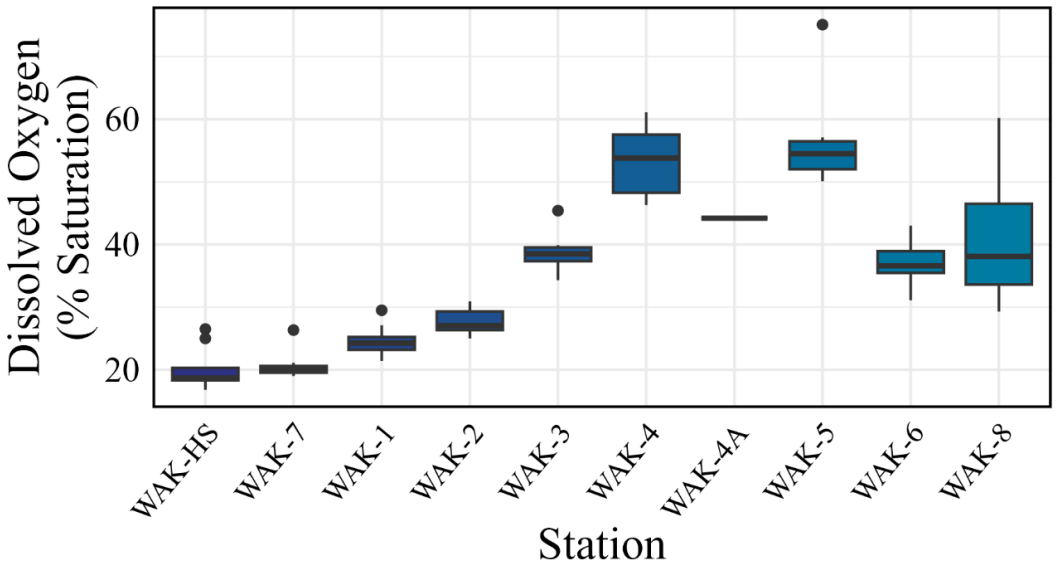


Figure 4: Percent Dissolved Oxygen Measurements across Wakulla SW Stations

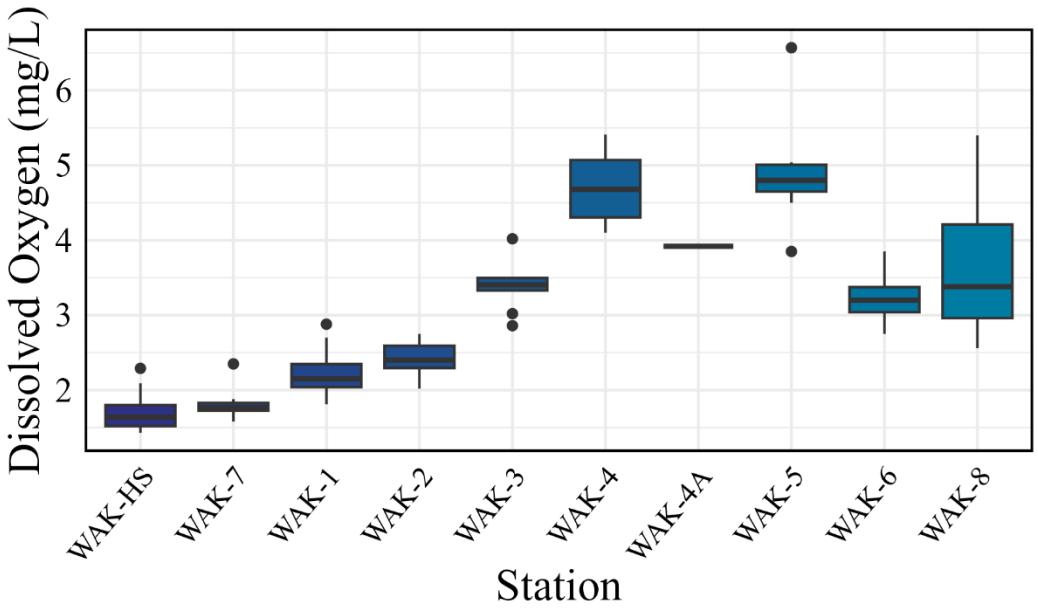


Figure 5: Dissolved Oxygen (mg/L) Measurements across Wakulla SW Stations

Figures 4 and 5 show Dissolved Oxygen measurements across our two sampling stations.

Stations WAK-HS and WAK-7 are closest to the Wakulla Spring vent (Figure 1) and exhibited the lowest DO concentrations. As water moves downstream, its potential to receive oxygen from atmospheric diffusion and from photosynthesizing SAV and algae increases, resulting in higher DO concentrations.

3.1.2 Temperature

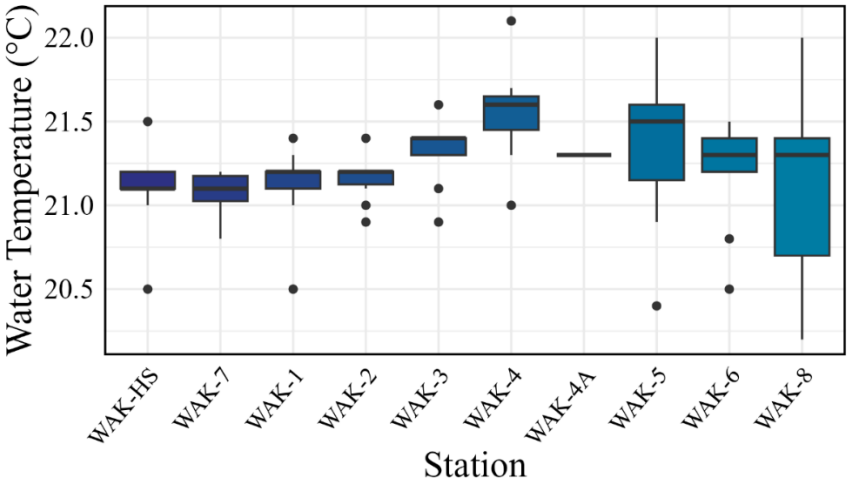


Figure 6: Temperature Measurements across Wakulla SW Stations

Figure 6 shows temperature measurements taken in 2025. Temperature was relatively steady with all values measured between 20-22 degrees Celsius, typical of a freshwater spring.

3.1.3. Specific Conductivity

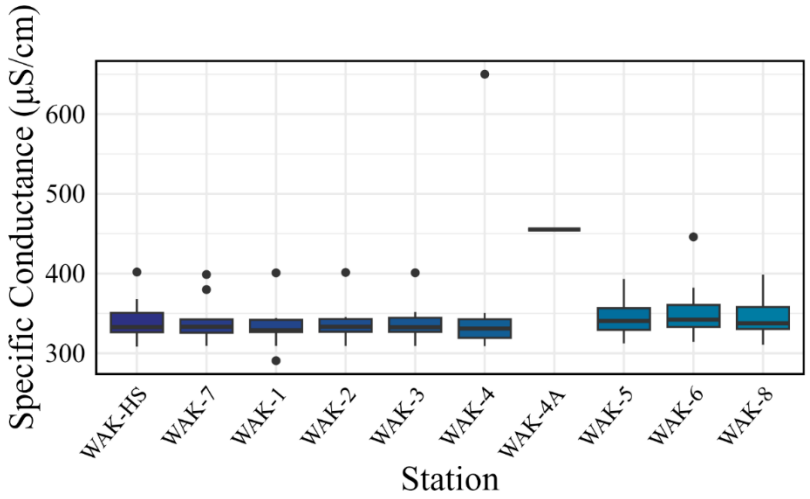


Figure 7: Specific Conductivity Measurements across Wakulla SW Stations

Figure 7 shows Specific Conductivity measurements taken across the nine sampling stations. In general, average measurements were almost constant across all stations and were in the range of 300-400 uS/cm. All stations experienced periods of raised conductivity likely due to backflow of saltwater into the near by submarine spring, Spring Creek Springs (Davis & Verdi, 2013).

3.1.2. Nitrate-Nitrite Nitrogen

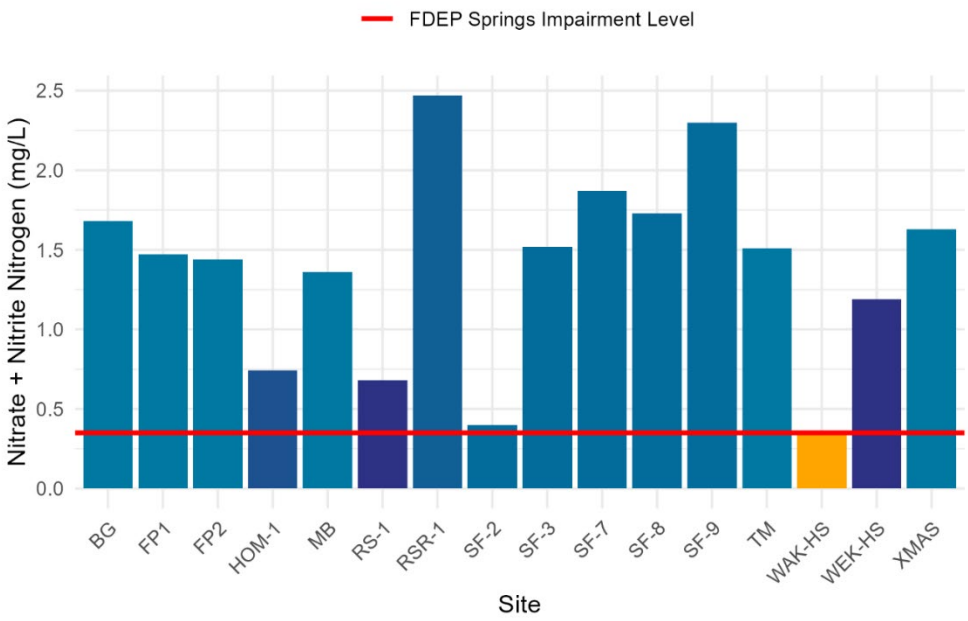


Figure 8: A Comparison of NOx-N Measurements taken across SW Groups

Figure 8 shows a comparison of NOx-N levels collected at several SpringsWatch groups across Florida. All stations are represented by their station codes. BG, FP1, FP2, MB, TM, and XMAS = Silver River; HOM-1 = Homosassa; RSR-1 = Rainbow River; WEK-HS = Wekiva River and RS-1 = Rock Spring Run; SF-2,3,7,8 and 9 = Santa Fe River; and WAK-HS = Wakulla River.

In 2025, the Wakulla headspring had a total nitrogen concentration was at 0.356, right at the FDEP accepted impairment level. Of all nitrogen samples collected, Wakulla headspring had the lowest concentration of any spring system. While this does indicate that this springshed may not be at risk of serious nutrient pollution, it does show that the potential for nitrogen concentrations to rise above the accepted impairment level is likely.

3.2 Clarity and Light Measurements

3.2.1 Secchi Disk Visibility

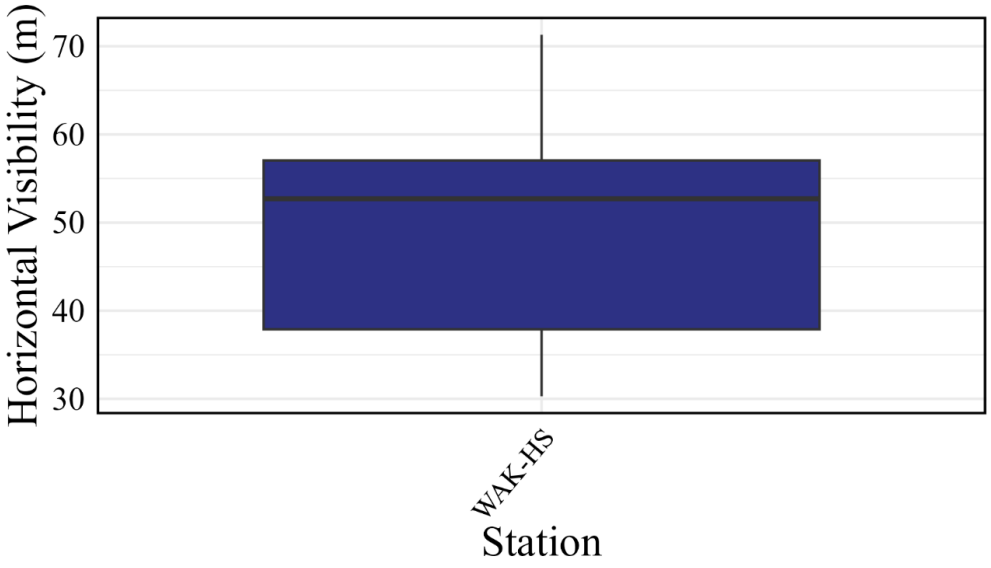


Figure 9: Secchi Disk Horizontal Water Clarity Measurements taken in Wakulla Headspring

Figure 8 shows horizontal water clarity measurements collected with a Secchi disk at the Wakulla headspring. Volunteers recorded a maximum measurement of 71.3 meters (234 ft) and a minimum of 30 meters (98.43 ft). These measures indicate a high variability in water clarity of the groundwater feeding the spring vent.

3.2.2 Light Measurements

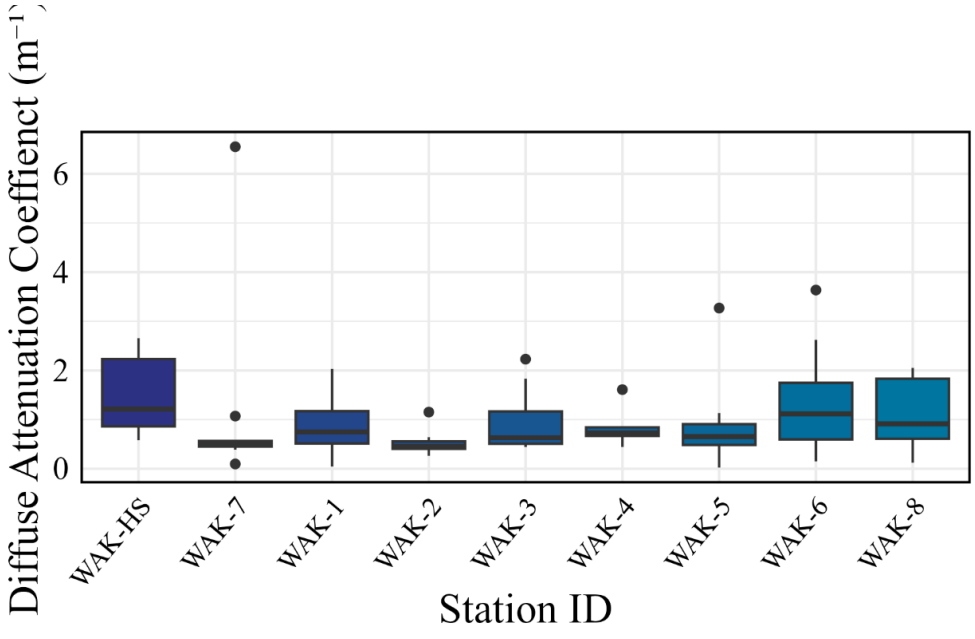


Figure 10: Diffuse Light Attenuation Coefficient Measurements across Wakulla SW Stations

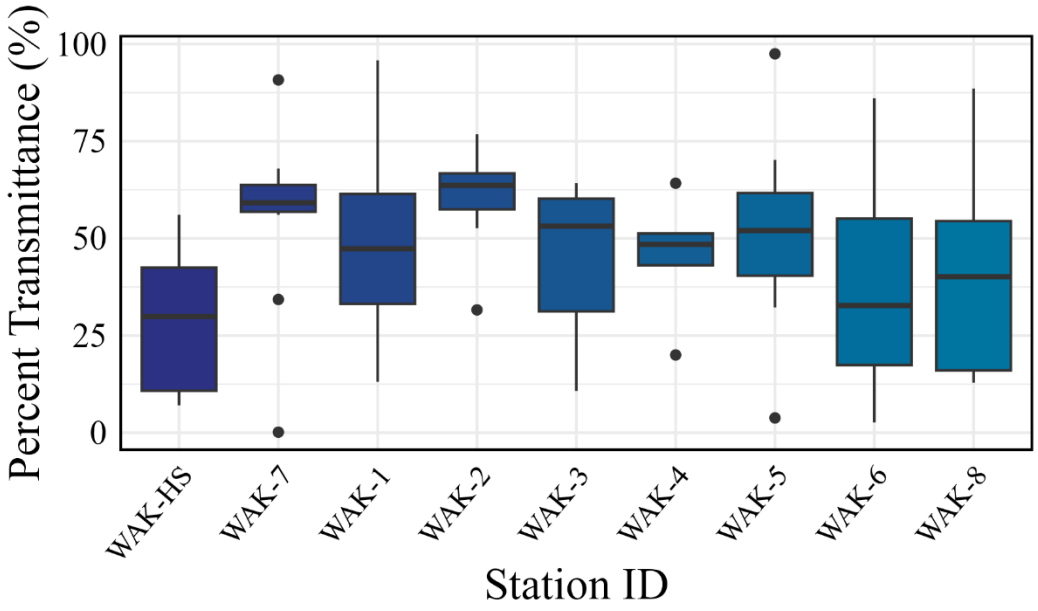


Figure 11: Percent Light Transmittance Measurements across Wakulla SW Stations

Figures 10 and 11 represent the Diffuse Light Attenuation Coefficient (k) and Percent Transmittance measurements collected with PAR meters.

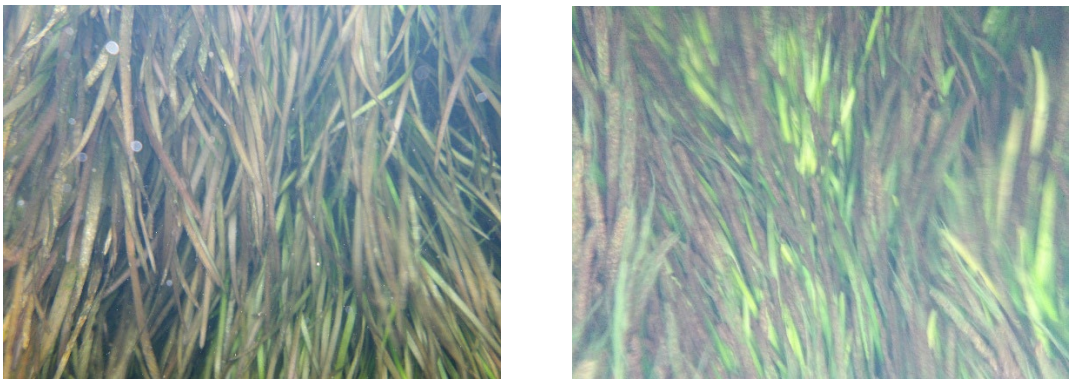
Percent transmittance refers to the amount of light that is able to pass through the water column to a depth of 1 meter below the surface. The diffuse attenuation coefficient (k) is calculated via the Lambert-Beer equation (Wetzel 2001) to measure how readily light dissipates throughout the water column. Higher attenuation values correspond to less water clarity. Higher values of percent transmittance tend to correspond with lower values of coefficient k. Higher k values, or lower percent transmittance values, can indicate poor water clarity since light cannot pass as easily through the water column, often due to increases in dissolved substances such as tannins (color) and suspended solids (turbidity) in the water.

In aquatic ecosystems, the diffusion attenuation coefficient can have a significant impact on the biota that inhabits the water. For example, in shallow, clear water with a low diffusion attenuation coefficient and high percent transmittance, light can easily reach the bottom of the water column, enabling the growth of aquatic plants and phytoplankton. This, in turn, can support the entire food web, from primary producers to top predators. On the other hand, in deep, turbid water with a high diffusion attenuation coefficient and low percent transmittance, light is unable to penetrate as far, limiting the growth of aquatic plants and phytoplankton. This can have cascading effects on the entire ecosystem, potentially reducing the population size and diversity of biota that depend on these primary producers. Thus, the diffusion attenuation coefficient is an important factor to consider when evaluating the health and productivity of aquatic ecosystems.

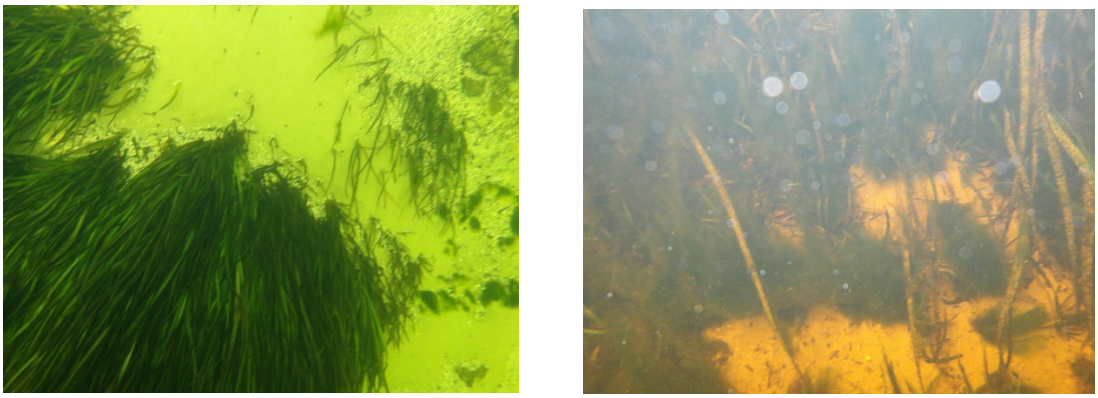
In 2025, light measurements across the Wakulla SpringsWatch stations were highly variable. In general, though, light transmittance in the Wakulla River is lower compared to other springsheds due to the tannic qualities of the water.

3.3 Submerged Aquatic Vegetation Survey

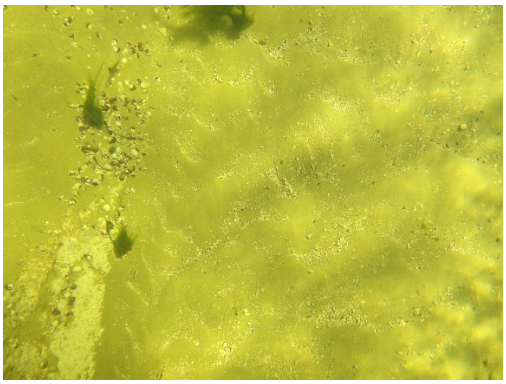
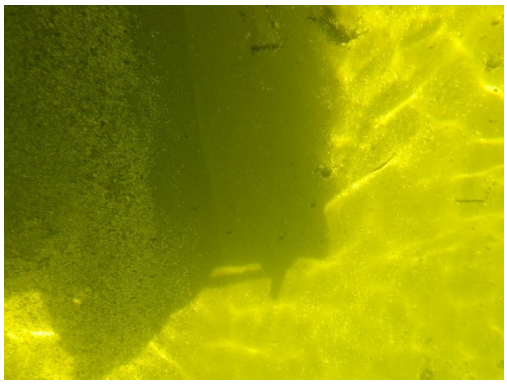
Submerged aquatic vegetation plays an important ecological role within a springs system. It provides habitat and food for fish and other wildlife, increases water clarity, affects nutrient cycles, and stabilizes shorelines and sediments. This data presents an ongoing record of conditions in the spring and will be useful for comparison to future evaluations of the ecological health of the Wakulla River system. Pictured below are river bottom photos taken by SpringsWatch volunteers in 2025 at all 8 sampling stations.



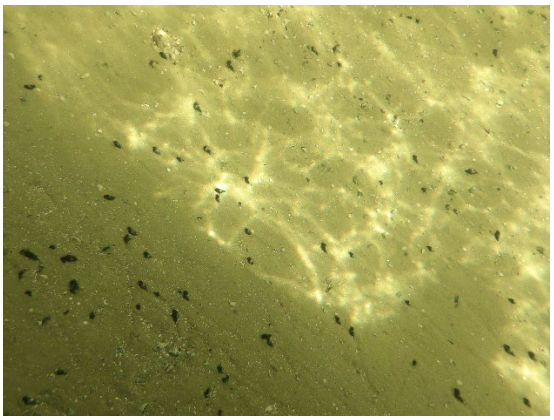
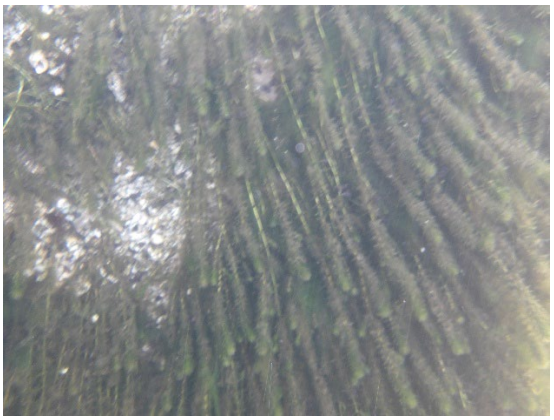
WAK-1 – Large beds of mixed eelgrass and tapegrass (*Vallisneria sp.* and *Sagittaria sp.*)



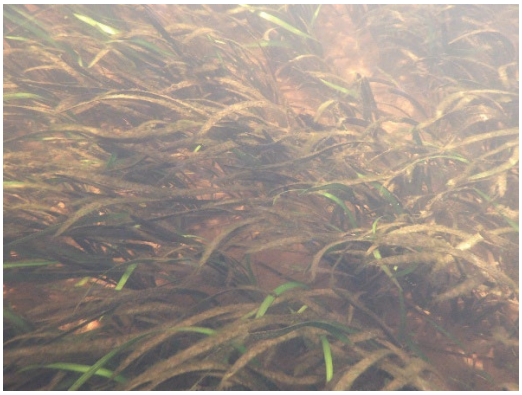
WAK-2 – Beds of *Sagittaria* growing over sand

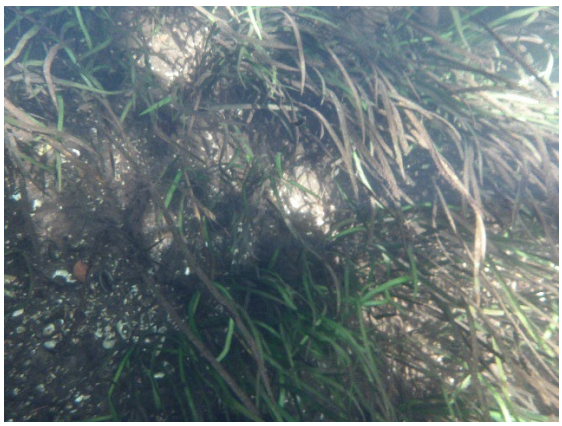
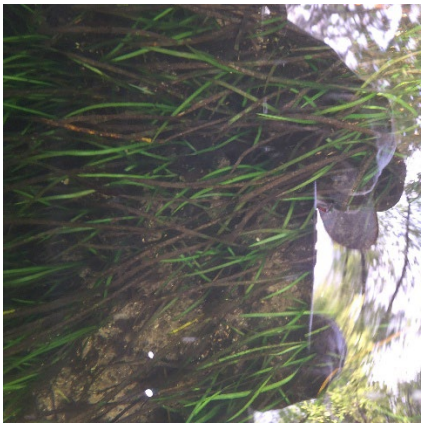
WAK-3 – Bare sand and shells

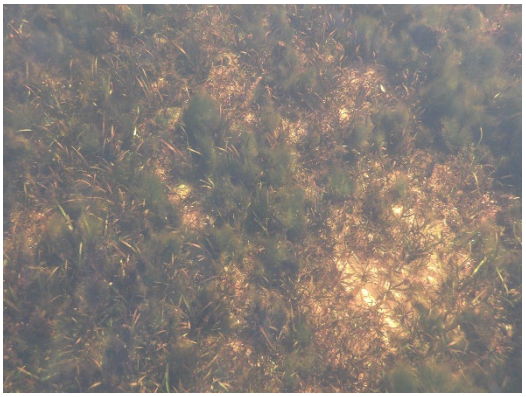
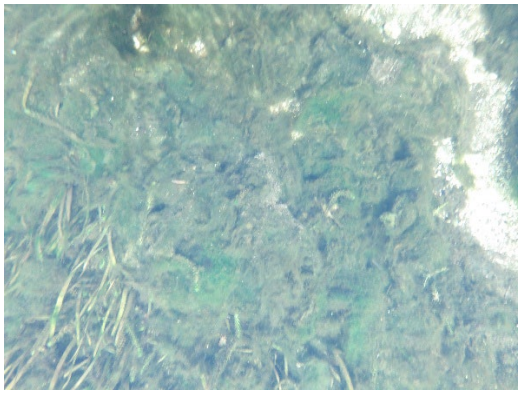
WAK-4 – Bare sand and large *Hydrilla* beds



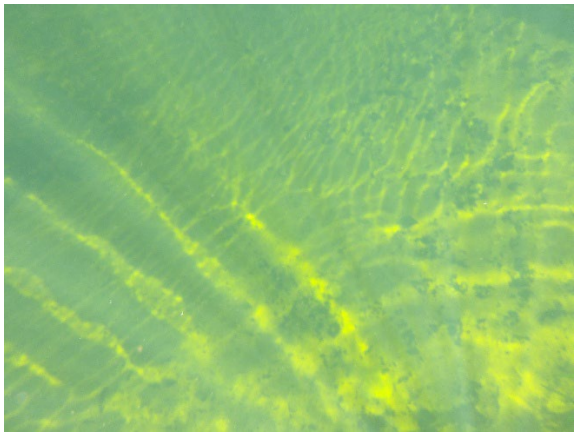

WAK-5 – Large beds of mixed eelgrass covered with periphyton

WAK-6 – Patches of *Sagittaria*

WAK-7- Small patches of eelgrass growing in beds of *Hydrilla*

WAK-HS – Bare sand with a layer of periphyton algae

3.4 Bird Survey

Table 3: Bird Diversity seen during 2025 Wakulla SW Surveys

Common Name	Scientific Name	Average Count
Great Egret	*Ardea alba*	1.67
Green Heron	*Butorides virescens*	0.75
Great Blue Heron	*Ardea herodias*	1.08
Little Blue Heron	*Egretta caerulea*	3.67
Yellow Crowned Night Heron	*Nyctanassa violacea*	3.5
Anhinga	*Anhinga anhinga*	14.6
American Coot	*Fulica americana*	2.91
Double Crested Cormorant	*Nannopterum auritum*	6
Common Gallinule	*Gallinula galeata*	29.95
Pied Billed Grebe	*Podilymbus podiceps*	1.83
Merganser sp.	*Mergus sp.*	17.08
Osprey	*Pandion haliaetus*	0.83
Vulture	*Cathartes sp.*	11.25
White Ibis	*Eudocimus albus*	30.83
Swallowtail Kite	*Elanoides forficatus*	0.25
Least Bittern	*Botaurus exilis*	0.08
Western Cattle Egret	*Ardea ibis*	1.16
Snowy Egret	*Egretta thula*	0.58
Red Shouldered Hawk	*Buteo lineatus*	0.16
Tricolored Heron	*Egretta tricolor*	0.16
Belted Kingfisher	*Megaceryle alcyon*	0.67
Limpkin	*Aramus guarauna*	0.08

Table 3 shows the diversity of birds seen during surveys by our Wakulla volunteers. Throughout 2025, volunteers surveyed birds 10 times and saw a total of at least 22 species. The most commonly seen species was White Ibis, followed by Common Gallinule and Mergansers. Due to difficulty with identification, mergansers could not be identified down to the species level. Pictured below are some of the species seen during 2025 bird surveys.



White Ibis



Limpkin



Anhinga



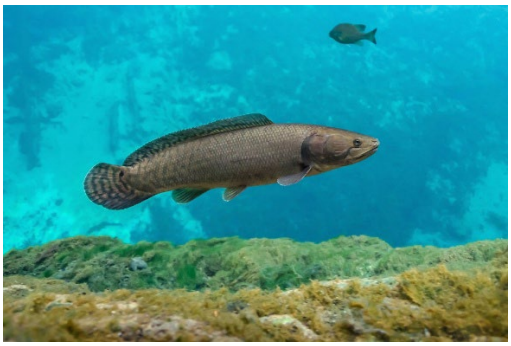
Double-crested Cormorant

3.5 Fish Surveys

Table 4: Fish Diversity seen during 2025 Wakulla SW Surveys

Common Name	Scientific Name	Average Count
Striped Mullet	*Mugil cephalus*	92.33
Sheepshead	*Archosargus probatocephalus*	1.5
Bass sp.	*Salmoides sp.*	17
Sunfish sp.	*Lepomis sp.*	19.03
Gar sp.	*Lepisosteus sp.*	3.58
Minnow sp.	*Notropis sp.*	1.67
Bowfin	*Amia calva*	0.5
Catfish sp.	Family Ictaluridae	0.25

SpringsWatch volunteers conducted fish surveys at ten of the sampling dates across 2025. Table 4 shows that in total they saw at least 8 different species of fish. Unlike other spring systems in Florida, the Wakulla River is under the influence of tidal activity from the Gulf allowing for fish more common to brackish and marine systems to enter the spring run. Species such as Sheepshead are commonly found in marine systems and likely enter the spring system to exploit potential food sources or breed. Pictured Below are some of the common fish and large animals seen by Wakulla volunteers during their surveys.



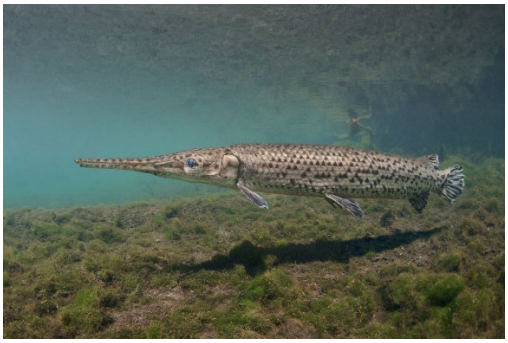
Bowfin



Sheepshead



Striped Mullet



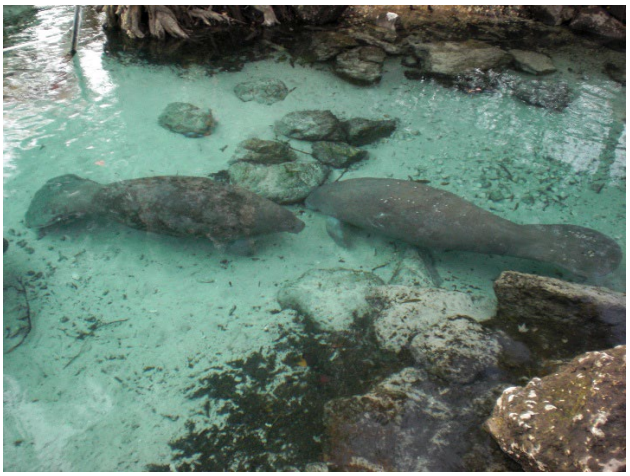
Longnose Gar

3.6 Large Animal Surveys

Table 5: Other Large Animal Diversity seen during 2025 Wakulla SW Surveys

Common Name	Scientific Name	Average Count
American Alligator	*Alligator mississippiensis*	25.67
West Indian Manatee	*Trichechus manatus*	6.33
Turtle sp.	*Pseudemys sp.*	21.08
North American River Otter	*Lontra canadensis*	0.33

Table 5 shows the diversity of large animals other than fish and birds seen during the 2025 sampling season. West Indian Manatees were spotted on several occasions. Their presence in the Wakulla springs system indicates this area could be an important feeding ground and wintering spot for this imperiled species.



West Indian Manatee

Section 4.0 References

Florida Springs Institute (FSI). (2015), *Florida Springs Baseline Ecological Assessment: Standard Operating Procedures.* Howard T. Odum Florida Springs Institute, High Springs, Florida. Unpublished manuscript.

Froese, R., & Pauly, D. (2000). FishBase 2000: concepts, design and data sources. (R. Froese, & D. Pauly, Eds.) Los Baños, Laguna, Philippines. Retrieved from fishbase.org

Wetzel, R. G. (2001). *Limnology: Lake and River Ecosystems. Third Edition.* San Diego, CA, CA: Academic Press.

Brown, M., Reiss, K. C., Cohen, M., Evans, J., Reddy, K., Inglett, P., Sharma-Inglett, K., Frazer, T., Jacoby, C. and Phlips, E. (2008) 'Summary and synthesis of the available literature on the effects of nutrients on spring organisms and systems', Florida Department of Environmental Protection, Tallahassee, Florida, USA.

Cattaneo, A. and Kalff, J. (1978) 'Seasonal changes in the epiphyte community of natural and artificial macrophytes in Lake Memphremagog (Que. & Vt.)', Hydrobiologia, 60(2), pp. 135-144.

Cohen, M. (2008) 'Springshed nutrient loading, transport and transformations', Summary and synthesis of the effects of nutrient loading on spring ecosystems and organisms. Florida Department of Environmental Protection, pp. 53-134.

Cohen, M., Lamsal, S. and Kohrnak, L. (2007) 'Sources, transport and transformations of nitrateN in the Florida environment', St. Johns River Water Management District SJ2007-SP10.

Copeland, R., Doran, N., White, A. and Upchurch, S. (2009) 'Regional and statewide trends in Florida's spring and well groundwater quality (1991–2003)', Bulletin, 69.

Edwards, T. M. and Guillette Jr, L. J. (2007) 'Reproductive characteristics of male mosquitofish (Gambusia holbrooki) from nitrate-contaminated springs in Florida', Aquatic Toxicology, 85(1), pp. 40-47.

Edwards, T. M., Miller, H. D. and Guillette Jr, L. J. (2006) 'Water quality influences reproduction in female mosquitofish (Gambusia holbrooki) from eight Florida springs', Environmental Health Perspectives, 114(Suppl 1), pp. 69-75.

Eller, K. T. and Katz, B. G. (2014) 'Nitrogen source inventory and loading estimates for the Wakulla spring BMAP contributing area', Florida Department of Environmental Protection, Tallahassee, 56

Mattson, R. A., Lehmensiek, M., & Lowe, E. F. (2006). Nitrate toxicity in Florida springs and spring-run streams: A review of the literature and its implications. St. Johns River Water Management District.

Gillooly, Jamie & Brown, James & West, Geoffrey & Savage, V.m & Charnov, Eric. (2001). Effects of Size and Temperature on Metabolic Rate. Science. 293. 2248-2251. 10.1126/science.1061967.

Wahl, C., Diaz, R., & Kaller, M. (2021). Nutrients enhance the negative impact of an invasive floating plant on water quality and a submerged macrophyte. *Journal of Aquatic Plant Management, 59*, 57–65. https://doi.org/10.57257/japm-20215957

Rouse, J., Bishop, C., & Struger, J. (1999). Nitrogen pollution: An assessment of its threat to amphibian survival. *Environmental Health Perspectives, 107*, 799–803. https://doi.org/10.1289/ehp.99107799

Short, F. T., Kosten, S., Morgan, P. A., Malone, S., & Moore, G. E. (2016). Impacts of climate change on submerged and emergent wetland plants. *Aquatic Botany*, *135*, 3–17. https://doi.org/10.1016/j.aquabot.2016.06.006

Evans, J. M. (2008). Ecosystem implications of invasive aquatic plants and aquatic plant control in Florida springs. *Summary and synthesis of the available literature on the effects of nutrients on spring organisms and systems*, 231-270

Work, K., Gibbs, M., Peters, B., & French, L. (2010). Fish assemblage variability in a Florida spring. *Southeastern Naturalist, 9*(4), 649–672. https://doi.org/10.1656/058.009.0402

Griffith, M. B. (2014). Natural variation and current reference for specific conductivity and major ions in wadeable streams of the conterminous USA. *Freshwater Science, 33*(1), 1–17. https://doi.org/10.1086/674704

Davis, J.H. and Verdi, R. (2014), Groundwater Flow Cycling Between a Submarine Spring and an Inland Fresh Water Spring. Groundwater, 52: 705-716. https://doi.org/10.1111/gwat.12125