2025 RAINBOW RIVER MONITORING SUMMARY:



Prepared for Florida Department of Environmental Protection

Howard T. Odum
FLORIDA SPRINGS INSTITUTE

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 Rainbow River SpringsWatch group would not have been possible without all the hard work of group leads Mary Timko-Mesmer and Matt Mesmer. These two were assisted by an excellent team of volunteers including Elena Fraser, Tara Barton, Claudia Loftus, Jessica Johnson, Katrina Engelbrecht, and Barry Connor.

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 Rainbow SpringsWatch Volunteers

Executive Summary

In 2025, the Rainbow River SpringsWatch group collected data on nine 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 Rainbow River Springs is relatively constant
    - **Temperature** decreased as stations moved further from the headspring likely due to increased exposure to solar radiation and heat exchange with the air.
    - **Dissolved Oxygen** was relatively similar across all stations. Rainbow River has a high dissolved oxygen content in general but little increase down the spring run could indicate submerged plants are not having as large an impact as in previous years.
    - **Specific Conductivity** was relatively stable across all stations but the headspring had much lower values compared to all other stations.
    - **Nitrate-nitrite Nitrogen** concentrations are high, over 7 times higher than the accepted level of impairment set forth by FDEP
    - **Water clarity** was stable throughout the year indicating low variability in the water feeding the main spring vent
    - **Light** Measurements collected were highly variable but in general, stations further upstream had higher percent transmittance compared to downstream stations
- **Biology** of the Rainbow River Springs is diverse and somewhat healthy
    - **Submerged Aquatic Vegetation** was very healthy but certain stretches of the river were dominated by invasives such as *Hydrilla* and *Hygrophila*
    - **Fish** are somewhat diverse in Rainbow River. At least 6 different species were seen, all of which were historically native to Florida
    - **Birds** are very diverse across the Rainbow River System. In total, 21 different species were seen. The most commonly seen birds were Wood Ducks
    - **Other Large Animals** were also seen the Rainbow River including turtles and North American River Otters

Introduction

1.1 Site Overview

Rainbow Springs consists of twelve named vents that discharge groundwater from the Floridan Aquifer System at a combined historic average rate of more than 485 million gallons per day, making it one of the largest first magnitude spring systems in Florida. Rainbow Springs forms the headwaters of the Rainbow River, which is nearly 6 miles long and merges with the Withlacoochee River at Dunnellon in Marion County.

The Rainbow River was designated a Registered National Landmark in 1972, an Aquatic Preserve listed in 1986, and an Outstanding Florida Waterway in 1987. The state purchased the original area that was the Rainbow Springs Attraction in 1990 and opened Rainbow Springs State Park in 1995, managed by the Florida Department of Environmental Protection's Division of Recreation and Parks.

The Rainbow 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 twenty-six Outstanding Florida Springs or Springs Groups that is considered "impaired".

Since 2017, the Florida SpringsWatch citizen science program has provided enhanced monitoring of the Rainbow River's ecological health through monthly sampling sessions. The resulting data are provided in annual reports and via FSI's SpringsWatch website (floridaspringsinstitute.org/springswatch) to inform the state's environmental agencies and to educate the public about the springs and river health.

This report was prepared by the Howard T. Odum Florida Springs Institute (FSI) and is focused on ecological monitoring along the Rainbow River conducted in 2025 by SpringsWatch volunteers.

1.2 Monitoring Stations

Figure 1 identifies the 10 Rainbow River stations monitored from January to December 2025 by SpringsWatch volunteers.

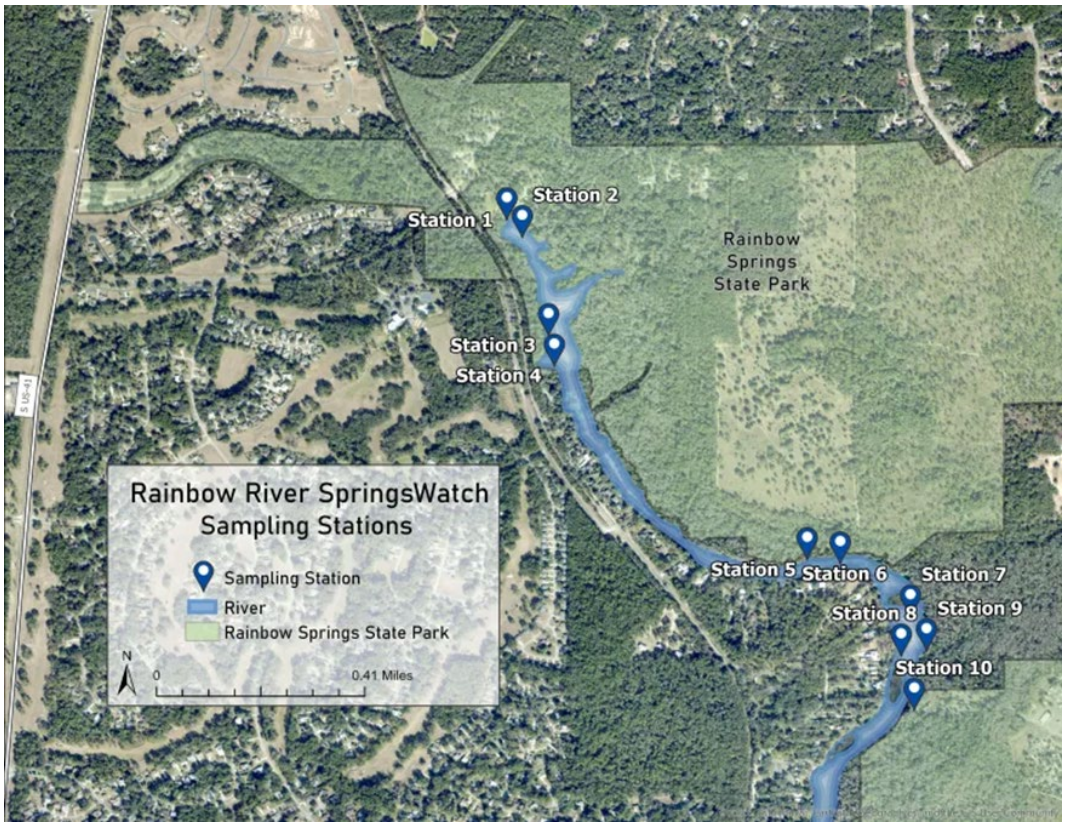


Figure 2. A map of Rainbow River SpringsWatch monitoring stations

Table 1. Coordinates for Rainbow SpringsWatch monitoring stations.

Station Code	Station Name	Latitude	Longitude
RSR-1	RSR-1	29.102677	-82.437694
RSR-2	RSR-2	29.102177	-82.437254
RSR-3	RSR-3	29.099381	-82.436506
RSR-4	RSR-4	29.07329	-82.42640286
RSR-5	RSR-5	29.093011	-82.429145
RSR-6	RSR-6	29.09289	-82.428202
RSR-7	RSR-7	29.091375	-82.4262
RSR-8	RSR-8	29.090264	-82.426466
RSR-9	RSR-9	29.090412	-82.425742
RSR-10	RSR-10	29.088718	-82.426096

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.

1.3.4. Photosynthetically Active Radiation

Photosynthetically Active Radiation refers to the specific wavelengths of light that can actually be used by plants to preform 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.

1.3.3. 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.

1.3.5. Horizontal 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. As Florida springs are often clearer than they are deep, we measure Secchi horizontally. 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.

1.3.6. 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. 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.

1.3.7. 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 monthly ecological monitoring on the Rainbow River from January through December of 2025.

Rainbow River monitoring events included the following:

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

2.1 Sampling Events

Field measurements were collected from a one-mile segment of the Rainbow River from January to December 2025. The monitoring events are summarized below in Table 2.

Table 2: Summary of 2025 Rainbow Springs SpringsWatch Sampling Events

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

2.2 Water Quality

2.2.1 Dissolved Oxygen and Temperature

SpringsWatch volunteers used a handheld YSI ProSOLO meter at each of the monitoring stations in the Rainbow River System to collect monthly measurements of water temperature and dissolved oxygen at each of the 10 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 ProSOLO meter at each of the monitoring stations in the Rainbow River System to collect monthly specific conductivity readings at each of the 10 stations along the Rainbow 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.

2.2.3 Nitrate-Nitrite (NOx-N)

FSI staff collected nitrogen as nitrate + nitrite (NOx-N) grab samples at the stations RS-1 and RS-10 during the August 2025 sampling session. Water samples were sent to a state-accredited laboratory (McGlynn Laboratories Inc.) for NOx-N analysis. Preparation, storage, and analysis all followed FDEP Standard Operating Procedures. Grab 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 (H_2SO_4) and then stored on ice prior to transport. Samples 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. Secchi Disk

SpringsWatch volunteers took monthly horizontal Secchi disk measurements at station RSR-9 throughout the sampling period.

2.3.2 Diffuse Attenuation Coefficient (k) and Percent Transmittance

Photosynthetically Active Radiation (PAR) underwater light transmission and attenuation coefficients were measured monthly with a submersible photometer. Volunteers used an Apogee brand MQ-200 underwater quantum sensor to measure PAR energy reaching the water surface and at intervals of one foot and two feet of depth. The meter provides an image of the Apogee MQ-200 PAR light sensor. Figure 3 provides an image of the Apogee PAR meter. Light extinction (attenuation) coefficients will be calculated from this data using the Lambert-Beer equation (Wetzel 2001):

$$Iz = Io(e\text{-}kz)$$

Where:

Iz = PAR at depth z

Io = PAR at the water surface

k = diffuse attenuation coefficient, m-1

z = water depth, m

2.4 Submerged Aquatic Vegetation Surveys

Submerged aquatic vegetation (SAV) was monitored from January to December 2025 at all 10 stations (Figure 2). SpringsWatch volunteers took two photographs at each station in two different locations, which they sent to FSI for analysis. Analysis of vegetative cover was not complete for this report, so photos of typical spring run vegetation are provided instead.

2.5 Bird Survey

Rainbow SpringsWatch volunteers recorded visual monthly observations of birds between stations RSR-1 and RSR-10 (Figure 1) and then identified them to the lowest taxonomic group.

2.6 Fish Survey

SpringsWatch volunteers donned masks, snorkels, and fins to visually count fish and identify them to the lowest taxonomic group between stations RSR-7 and RSR-9 (Figure 1). Fish surveys were done at four sampling sessions in 2025.

2.7 Large Animal Survey

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

Results & Discussion

This section summarizes the data collected by SpringsWatch volunteers along the Rainbow River from January to December 2025.

3.1 Water Quality

Figures 3 through 10 present water quality field parameter results collected by SpringsWatch volunteers from 10 stations along the Rainbow River from January to December 2025.

3.1.1 Dissolved Oxygen

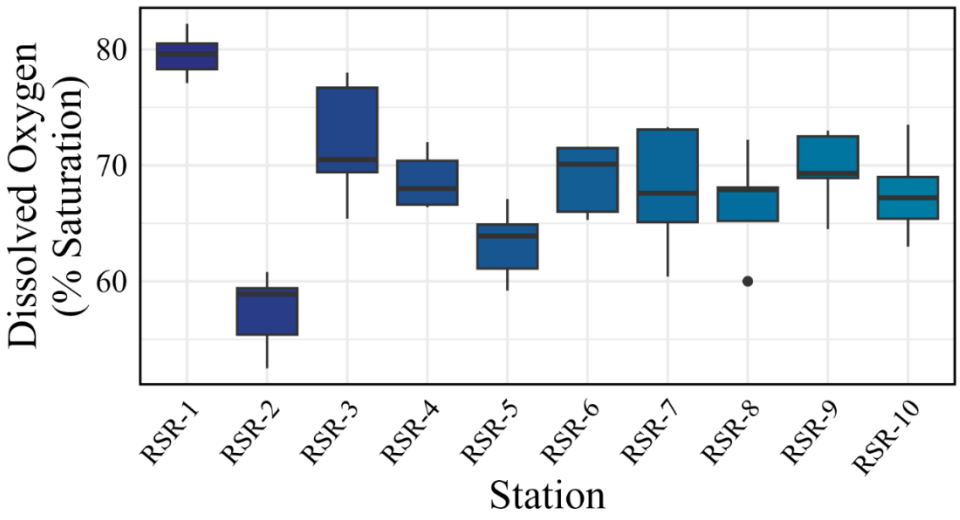


Figure 3: Percent Dissolved Oxygen Measurements across Rainbow Springs SW Stations

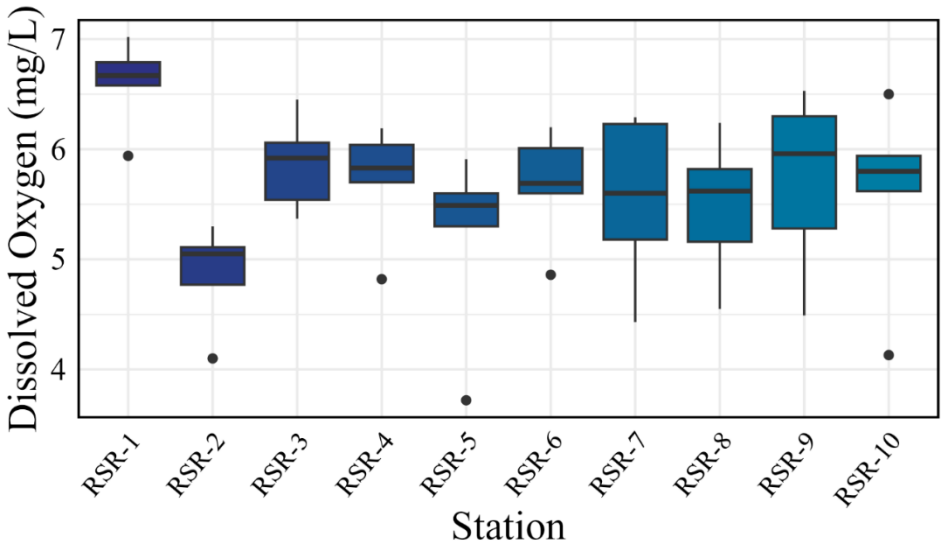


Figure 4: Dissolved Oxygen (mg/L) Measurements across Rainbow Springs SW Stations

Figures 4 and 5 show Dissolved Oxygen measurements across our ten sampling stations. The Rainbow Springs Group is unusual compared to other Florida artesian springs due to its naturally high dissolved oxygen in the emerging groundwater. Historical data indicate that this group of springs has a combined

average DO of about 6.9 mg/L and more than 80% saturation (WSI 2010). Station RSR-1 is about two miles downstream of the headspring.

Normally in a well-vegetated spring run, DO concentration rises with travel downstream due to plant photosynthesis. In 2025 measurements collected showed little increase in DO across all stations which could indicate vegetation is having a decreased impact on this water quality parameter when compared to past years.

3.1.2 Temperature

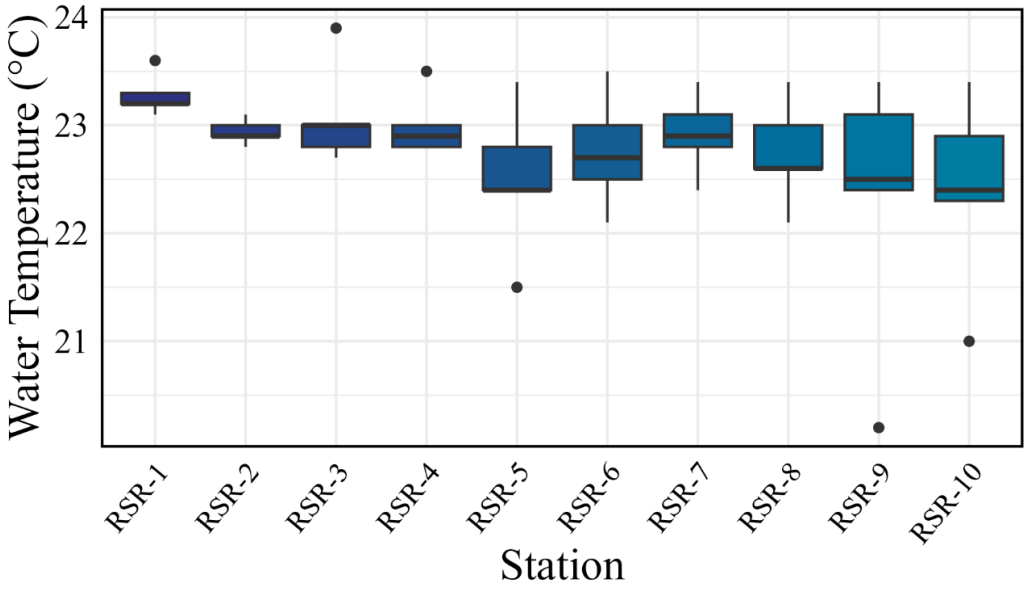


Figure 5: Temperature Measurements across Rainbow Springs SW Stations

Figure 6 shows that in 2025 there was a slight decrease in temperature as stations moved further down the river, but all stations had a similar average value of around 23 degrees Celsius.

3.1.3. Specific Conductivity

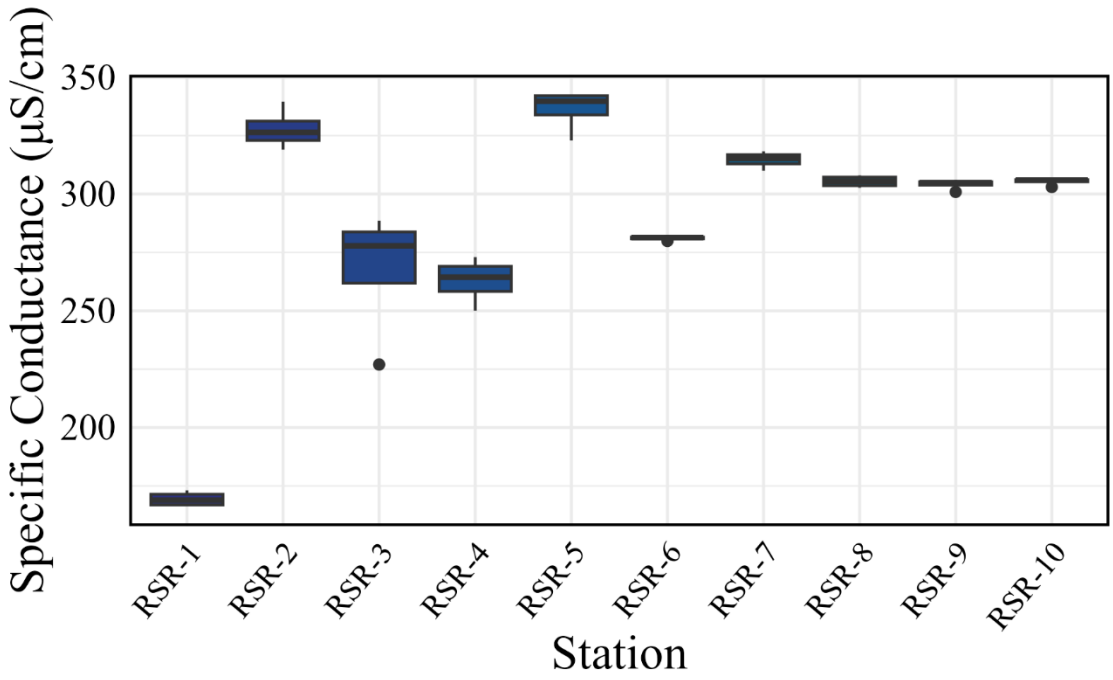


Figure 6: Specific Conductivity Measurements across Rainbow Springs SW Stations

Figure 7 shows Specific Conductivity measurements taken across the ten sampling stations. In 2025 most values measured were between 250 and 350 uS/cm which is typical for freshwater in karst ecoregions. The headspring however had a much lower average measurement below 100 us/cm, this could indicate that stations along the spring run are more impacted by surface run off when compared to the headspring.

3.1.4. Nitrate-Nitrite Nitrogen

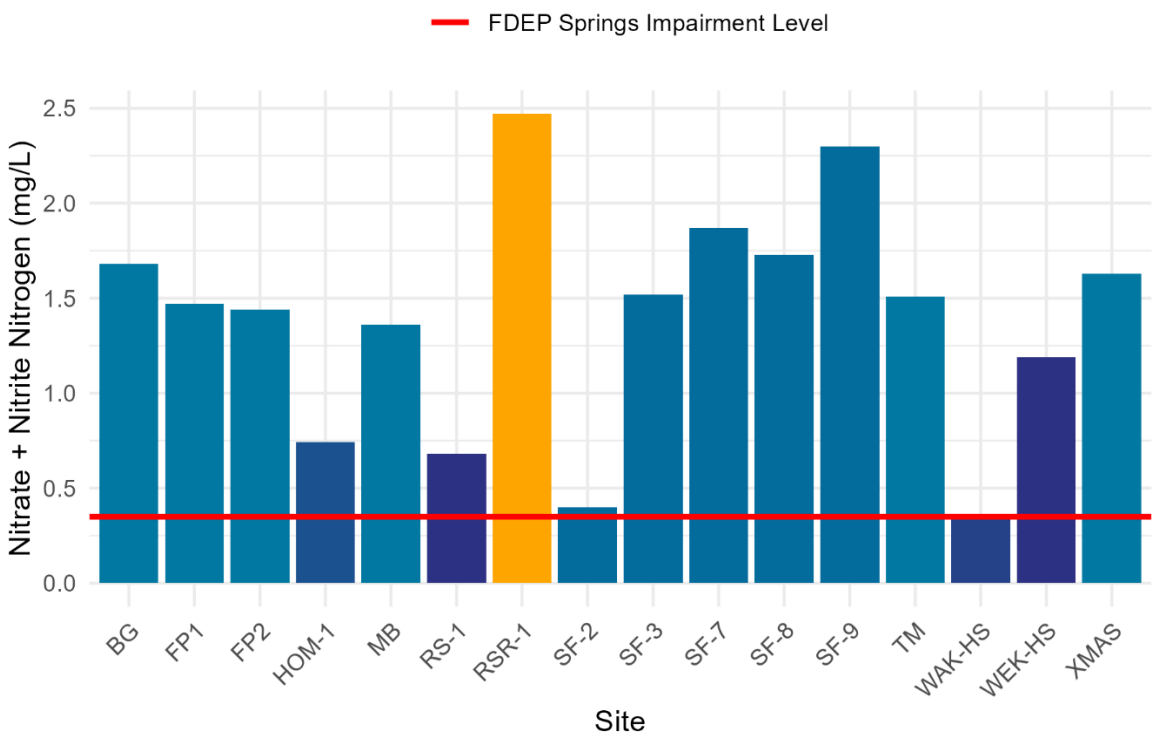


Figure 7: A Comparison of NOx-N Measurements taken across SW Groups

Figure 7 shows a comparison of NOx-N levels collected at several SpringsWatch groups across Florida. All stations are represented by their station code with 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 = the Santa Fe River; and WAK-HS = Wakulla River.

In 2025, the NOx-N level measured in the Rainbow River Headspring was 2.47 mg/L, over 7 times higher than the accepted FDEP impairment level. This measurement was the highest value collected among all springs sampled indicating that the Rainbow river system is at high risk of the potential impacts of increased nutrient loads.

3.2 Clarity and Light Measurements

3.2.1 Secchi Disk Visibility

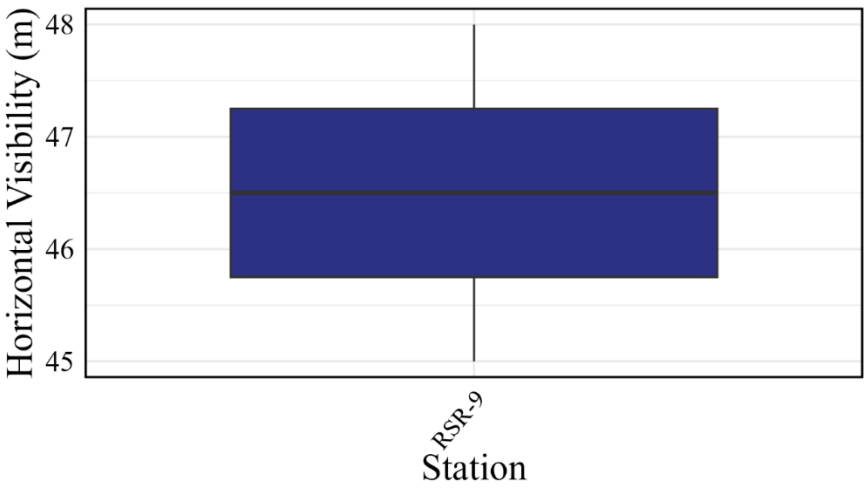


Figure 8: Secchi Disk Horizontal Water Clarity Measurements across Rainbow Springs SW Stations

Figure 8 shows horizontal water clarity measurements collected with a Secchi disk at station RSR-9. Volunteers recorded a maximum measurement of 48 meters (157.48 ft) and a minimum of 45 meters (147.64 ft). These measures indicate a low variability in water clarity of the groundwater feeding the spring vent and relatively constant clarity conditions across the whole year.

3.2.2. Light Measurements

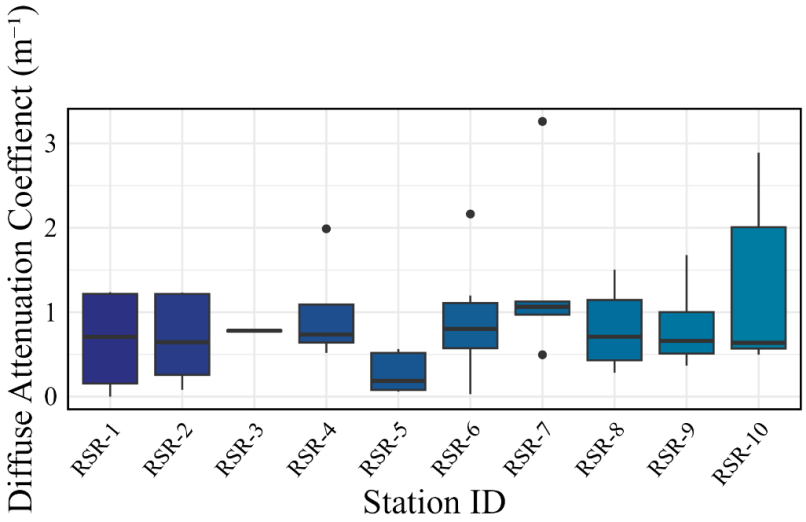


Figure 9: Diffuse Light Attenuation Coefficient Measurements across Rainbow Springs SW Stations

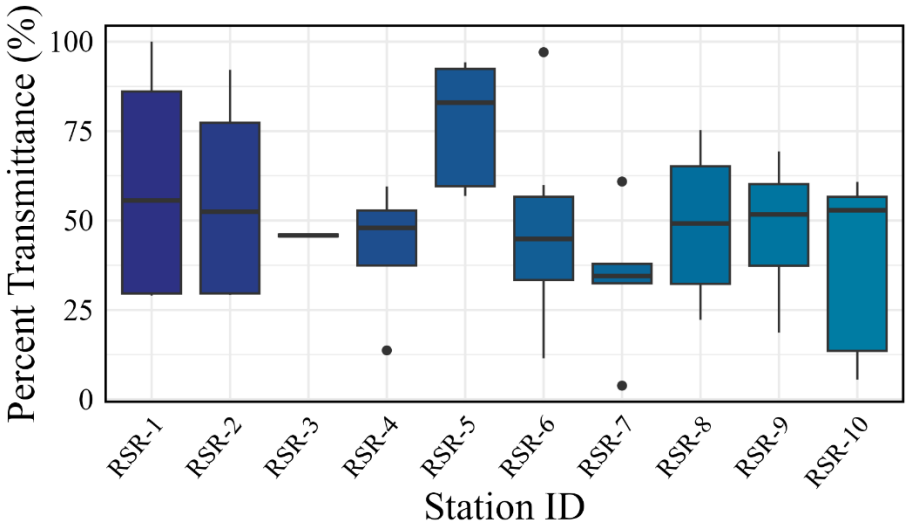


Figure 10: Percent Light Transmittance Measurements across Rainbow Springs SW Stations

Figures 9 and 10 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 inhabit 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 diversity of organisms 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 measurements highly varied across the 10 stations, but in general, lower transmittance was documented at stations further away from the headspring. This could be attributed to stations further downstream being more impacted by surface runoff when compared to the headspring.

3.3 Submerged Aquatic Vegetation Survey

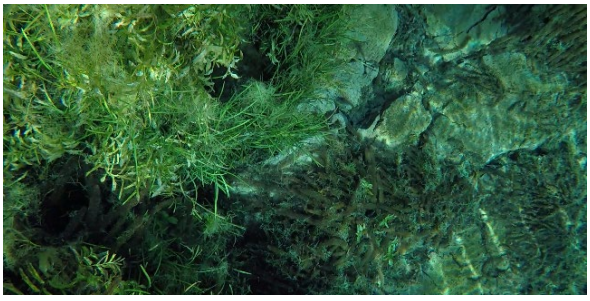
Submerged aquatic vegetation plays an important ecological role within a springs system. It provides habitat and food for fish and other wildlife, increases water clarity, affects nutrient cycles, and stabilizes shorelines

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 Rainbow River system. Pictured below are river bottom photos taken by SpringsWatch volunteers in 2025 at all 10 sampling stations.



RSR-1 - Bare gravel surrounded by beds of *Hygrophila*



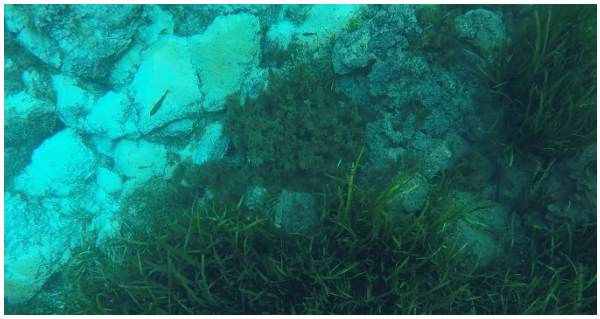


RSR-2 – Beds of eelgrass and *Hygrophila*

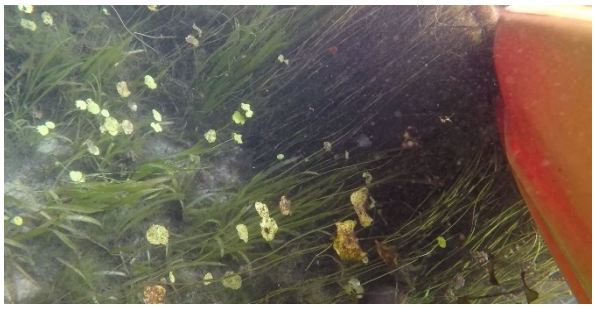




RSR-3 – Bare sand and moss covered with filamentous algae

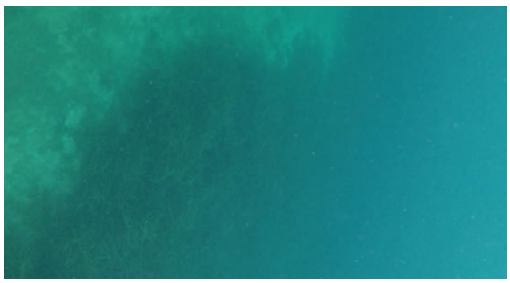
RSR-4 – Large beds of mixed eelgrass

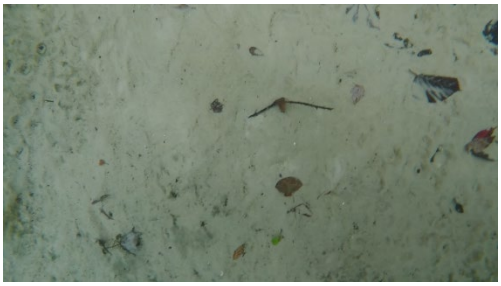
RSR-5 – Beds of mixed eelgrass and *Hydrocotle*




RSR-6 – Large *Sagittaria* beds

RSR-7 – Large beds of *Hydrilla* and mixed Eel Grass




RSR-8 – Bare sand and large *Hydrilla* beds




RSR-9 – Large patches of eel grass and Periphyton Algae




RSR-10 – Large beds of *Vallisneria* and *Hydrilla*

3.4 Bird Survey

Common Name	Scientific Name	Average count
Great Blue Heron	*Ardea herodias*	1
Western Cattle Egret	*Ardea ibis*	0.17
Anhinga	*Anhinga anhinga*	4
Double Crested Cormorant	*Nannopterum auritum*	3.5
Turkey Vulture	*Cathartes aura*	1.33
Common Gallinule	*Gallinula galeata*	4.5
Tufted Titmouse	*Baeolophus bicolor*	0.33
Northern Cardinal	*Cardinalis cardinalis*	0.33
Pied Billed Grebe	*Podilymbus podiceps*	2.5
American Robin	*Turdus migratorius*	1.33
Green Heron	*Butorides virescens*	0.83
Wood Duck	*Aix sponsa*	6.5
Great Egret	*Ardea alba*	0.67
Belted Kingfisher	*Megaceryle alcyon*	1.16
Eastern Bluebird	*Sialia sialis*	0.67
White Ibis	*Eudocimus albus*	2
Black Crowned Night Heron	*Nycticorax nycticorax*	0.17
Osprey	*Pandion haliaetus*	0.5
Red Shouldered Hawk	*Buteo lineatus*	0.5
Mallard	*Anas platyrhynchos*	0.17
Tricolored Heron	*Egretta tricolor*	0.17

Table 3 shows the diversity of birds seen during 2025 SpringsWatch surveys in the Rainbow River. In total, volunteers saw 21 different species of bird. The most commonly seen species were Wood Ducks, followed by Common Gallinules, and Anhingas.



Anhinga



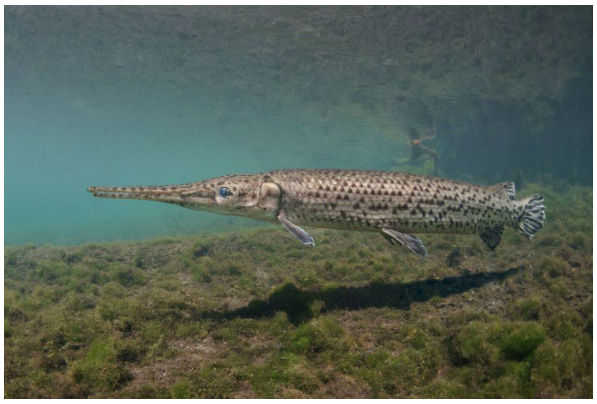
Wood Duck

3.5 Fish Survey

Table 4: Diversity of Fish seen during SW surveys

Common Name	Scientific Name	Average Count
Sunfish sp.	*Lepomis sp.*	177.75
Bass sp.	*Salmoides sp.*	39
Atlantic Needlefish	*Strongylura marina*	3.25
Longnose Gar	*Lepisosteus osseus*	4.5
Minnow sp.	*Notropis sp.*	88.5
Bowfin	*Amia calva*	0.75

Table 4 shows the diversity of fishes seen during in-water fish surveys completed during 2025. In total, at least 6 species of fish were seen across the 4 surveys. It is difficult to estimate an exact number of species due to the use of general categorizations such as Minnow sp and Sunfish sp. Both groups combine several species of fish common to the springs to allow for easier identification by volunteers. Some species, especially those contained in Minnow sp are very difficult to differentiate without professional experience. Fish likely included in this group would be Redeye Chubs, Eastern Mosquitofish, Sailfin Molly, and several representatives of the Shiner genus *Notropis.* Members of the sunfish genus *Lepomis* provide a similar challenge and are often difficult to differentiate under the water. Fish included in this group would be Redbreast, Spotted, Redear, and Bluegill Sunfish.



Longnose Gar



Bowfin



Florida Bass



Bluegill Sunfish

3.6 Other Large Animal Sightings

Table 5: Diversity of Other Animals seen during SW surveys

Common Name	Scientific Name	Average Count
Turtle sp.	*Pseudemys sp.*	37.6
North American River Otter	*Lontra canadensis*	2*

Table 5 shows other animals spotted during fish and bird surveys throughout 2025. Due to lack of pictures of turtles seen, it is difficult to say which species was specifically seen, for this reason turtles have been placed in the group turtle sp. It should also be noted that the two river otters were seen at the same time.

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.

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

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