SILVER SPRINGS MONITORING SUMMARY

January – March, August 2020

PREPARED FOR
FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION,
DIVISION OF PARKS AND RECREATION

Photo By Zoey Hendrickson
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Our Silver Springs SPRINGSWATCH program would not be possible without the hard work of our volunteer team leader, Ed Camilleri. We would also like to acknowledge the contributions and dedication of our other volunteers: Carol Leslie, Kathy Bailey, Alice Clardy, Flo Rexin, Mo Driggers, Dawn Randall, Elaine O’Farrell, and Worthy Farr.
Section 1.0 Introduction

The Silver River is located in central Marion County, Florida. The river begins at Silver Springs, a group of artesian springs that comprise a first magnitude spring group. The river flows for approximately 4.5 miles to its confluence with the Ocklawaha River. Mammoth Spring is the largest of the Silver Springs group, located at latitude 29°12'58.2" N, longitude 82°03'10.0" W and is surrounded by the Silver River State Park. In 2013, the former Silver Springs attraction property was combined with the 4,418-acre Silver River State Park to become the 4,660-acre Silver Springs State Park. Silver Springs is approximately 6 miles east of Ocala, Florida and is located along the south side of State Road 40 (Figure 1). FSI’s SPRINGSWATCH volunteer citizen-science program has provided enhanced monitoring of the Silver River and Springs system’s ecological health. The resulting data are provided in annual reports and via FSI’s SPRINGSWATCH website (https://floridaspringsinstitute.org/springswatch/) to inform the state’s environmental agencies and educate the public of the springs and river health.

This report was prepared by the Howard T. Odum Florida Springs Institute (FSI) and is focused on ecological monitoring currently being conducted by SPRINGSWATCH volunteers along the Wekiva River and springs.

Figure 1. Silver Springs and River Location
1.1 Monitoring Stations

Figure 2 identifies the sixteen stations monitored from January through March 2020 by Florida SPRINGWATCH volunteers and once in August 2020 by FSI staff for the following ecological metrics:

- Water quality field parameters (temperature, dissolved oxygen, and conductivity)
- Vertical light attenuation
- Vegetation cover estimates
- Visual Bird counts

Figure 2. Florida SPRINGWATCH Silver Springs and Silver River Run - Monitoring Stations
Section 2.0 Methods

Ecological monitoring was conducted on the Silver River from January through March 2020 and once in August 2020. Data collection included water quality field parameters, light measurements, aquatic vegetation estimates, and visual bird surveys.

2.1 Sampling Events

Field measurements were collected from the upper 2,200 meters of the Silver River including the Boat Basin, the Main Boil (Mammoth Spring), and numerous other springs during 2020. Sampling was conducted by the Marion County Silver River Museum (SRM) staff and by volunteers through the Florida SPRINGWATCH Program. Due to circumstances surrounding the COVID-19 global pandemic, state park and museum resources became limited and volunteer sampling was suspended following the March 10th trip. In August FSI staff sampled the sixteen stations while volunteer sampling remained on hold. The monitoring events are summarized below (Table 1) and included the following:

- Water quality field parameters (temperature and dissolved oxygen)
- Vertical light attenuation
- Aquatic vegetation survey
- Visual Bird survey

Table 1. Silver River sampling events (January - March, August 2020)

<table>
<thead>
<tr>
<th>Sample Date</th>
<th>Water Quality</th>
<th>Light Attenuation</th>
<th>Vegetation</th>
<th>Birds</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/14/2020</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>1/28/2020</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>2/11/2020</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>3/10/2020</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>8/26/2020</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

2.2 Water Quality

A YSI ProODO handheld meter was used at each of the sixteen monitoring stations in the Silver Springs System to collect temperature and dissolved oxygen and measurements. These data were collected at each station. Calibration and maintenance of the meter was conducted according to factory instructions and calibrated prior to and after each sampling event.
2.3 Light Measurements

Photosynthetically Active Radiation (PAR) underwater light transmission and attenuation coefficients were measured monthly at the ten monitoring sites during comprehensive ecological assessments. Data were collected using an Apogee MQ-200 quantum meter with an underwater photosynthetically active radiation (PAR) sensor to measure vertical light attenuation in the water column and PAR energy transmittance at one foot intervals from the surface to a depth of two feet. This sensor measures light in the 400-700 nm wavelength range which is the visible portion of the spectrum that supports plant photosynthesis. Figure 3 provides an image of the Apogee MQ-200 light sensor. Light extinction (attenuation) coefficients were calculated from these data using the Lambert-Beer equation (Wetzel, 2001):

\[ I_z = I_o (e^{-k_z}) \]

Where:

- \( I_z \): PAR at depth \( z \)
- \( I_o \): PAR at the water surface
- \( k \): diffuse attenuation coefficient, m\(^{-1}\)
- \( z \): water depth, m

2.4 Vegetation

Submerged Aquatic Vegetation (SAV) and algae percent cover was monitored at all sixteen stations (Figure 2) during each sampling event. Two photographs were taken at each station in two different locations which were sent to FSI for vegetation identification and percent coverage estimations. The two plant cover estimates were averaged to provide the overall estimated percent plant cover at each station.
Section 3.0 Results

This section summarizes field data collected as part of the ecosystem monitoring conducted on the Silver River and Silver Springs from January through March 2020 and once in August 2020. Data collected by FSI and the Florida SPRINGSWATCH volunteers included water quality field parameters, light measurements, aquatic vegetation surveys, and visual bird surveys. These data are valuable to provide a quantitative indication of current conditions in the river and will be useful for future evaluations of the ecological health of the Silver River.

3.1 Water Quality

3.1.1 Florida SPRINGSWATCH Silver River Water Quality

Figure 4 through Figure 7 present field parameter results collected from the sixteen stations along the Silver River as part of the Florida SPRINGSWATCH program. Figure 4 presents dissolved oxygen (DO) results measured in milligrams per liter (mg/L), or parts per million (ppm), and Figure 5 presents DO results measured in percent saturation (%). Groundwater typically exhibits a lower DO concentration and saturation and differs depending on the duration of time the water has spent underground before emerging from a spring vent. At the MB and XMAS stations, the DO saturation is lower (Figure 4, Figure 5) as these stations are spring vent stations where there is water emerging from the ground that could be older than that of the other surrounding springs. As surface water interacts with photosynthesizing SAV and the atmosphere, more free oxygen is absorbed into the water. Higher DO levels exhibited at the downstream stations reflect atmospheric diffusion of oxygen into the low-oxygen water as well as the release of oxygen by the photosynthetic submerged aquatic plant community.

Figure 6 presents data for temperature (°C) field measurements. Temperature in the Silver River remains constant year-round since it is primarily fed by spring water (typically 22°C).

Figure 7 demonstrates the results for specific conductance (uS/cm) field measurements. Specific Conductance levels can be influenced by naturally occurring ions present in spring water but also from ions present due higher levels of nitrate/nitrite, phosphorous, saltwater, and other compounds. Higher specific conductance values suggest a higher concentration of these ions in the water. The results presented in Figure 7 show varying levels of specific conductance, differing most among the spring stations. This could suggest variable levels of nitrate/nitrite influence on the groundwater coming out of the spring stations, mixing with water down-river where specific conductance levels are relatively stable (1200M-2200M) (Figure 7).
Figure 4. Florida SPRINGSWATCH Program Silver River Dissolved Oxygen Measurements (mg/L) (January -March, August 2020)

Figure 5. Florida SPRINGSWATCH Program Silver River Dissolved Oxygen Percent Saturation (DO%) Measurements (January -March, August 2020)
Figure 6. Florida SPRINGSWATCH Program Silver River Temperature (°C) Measurements (January-March, August 2020)

Figure 7. Florida SPRINGSWATCH Program Silver River Specific Conductance (uS/cm) Measurements (August 2020)
3.2 Light Measurements

Figure 8 displays the diffuse attenuation coefficient (k) and percent transmittance estimates collected by the Florida SPRINGSWATCH program along the Silver River from January – March, and August of 2020. Percent transmittance refers to the amount of light that is able to pass through the water column. 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 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 an increase in suspended solids (turbidity) in the water. The results in Figure 8 suggest that water clarity is very good from the Main Boil downstream to Second Fisherman’s Paradise (FP2) but declines significantly below that point. Previous observations indicate the periodic presence of very high levels of turbidity and tannins discharging into the silver River at Half-Mile Creek located just downstream of the 1,200 m station (Figure 8).

Figure 8. Silver River Diffuse Attenuation Coefficient and Percent Transmittance Estimates (January -March, August 2020)
3.3 Aquatic Vegetation Survey

Vegetation cover was estimated at the Florida SPRINGSWATCH Silver River stations using underwater photographs taken at each station (Figure 9). Figure 9 presents the average percent cover of vegetation (by species), bare ground, and algae at each station over the period of study. While filamentous algae appear to dominate the upstream portion of the sampled river segment, dominance shifts to eelgrass and strap-leaf sagittaria with distance downstream.

![Figure 9. Florida SPRINGSWATCH Silver River 2020 Average Percent Cover of Vegetation by Station](image)

3.3.1 Aquatic Vegetation Survey Period of Record

Vegetation cover was estimated at the Florida SPRINGSWATCH Silver River stations from May 2011 to August 2020 and then compiled to show overall trends (Figure 10). Figure 10 represents the overall vegetation cover estimate throughout all sixteen stations. Figure 11 demonstrates changes in coverage at each station. Estimates over 100% reflect vegetation cover overlapping with algae cover. Long-term vegetation trends appear to indicate increasing dominance by strap-leaf sagittaria and decline in the cover of filamentous algae and unvegetated bare bottom.
Figure 10. Florida SPRINGSWATCH Silver River Vegetation Percent Cover Period of Record (2011-2020)

Figure 11. Florida SPRINGSWATCH Silver River Vegetation Percent Cover Period of Record by Station (2011-2020)
3.4 Bird and Wildlife Survey

3.4.1 Bird Survey

General bird surveys were conducted by SPRINGSWATCH volunteer during three sampling trips. Species were identified to the lowest taxonomic group possible and quantities were recorded. Table 2 details the species and quantities observed during each sampling trip.

Table 2. Florida SPRINGSWATCH Silver River Bird Survey Results by date of sampling

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>1/14/2020</th>
<th>1/28/2020</th>
<th>3/10/2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anhinga</td>
<td>Anhinga anhinga</td>
<td>36</td>
<td>29</td>
<td>48</td>
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<tr>
<td>Belted Kingfisher</td>
<td>Megaceryle alcyon</td>
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<td>1</td>
<td>0</td>
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<tr>
<td>Blue winged teal</td>
<td>Anas discors</td>
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<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Cormorant</td>
<td>Phalacrocorax auritus</td>
<td>16</td>
<td>20</td>
<td>10</td>
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<tr>
<td>Eagle</td>
<td>Haliaeetus leucocephalus</td>
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<td>0</td>
</tr>
<tr>
<td>Gallinule/Moorhen</td>
<td>Gallinula galeata</td>
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<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Great blue heron</td>
<td>Ardea herodias</td>
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<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Great Egret</td>
<td>Ardea alba</td>
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<td>5</td>
<td>5</td>
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<td>Green heron</td>
<td>Butorides virescens</td>
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<td>1</td>
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<tr>
<td>Limpkin</td>
<td>Aramus guarauna</td>
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<td>2</td>
<td>4</td>
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<tr>
<td>Little Blue Heron</td>
<td>Egretta caerulea</td>
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<td>9</td>
<td>5</td>
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<tr>
<td>Night heron</td>
<td>Nycticorax nycticorax</td>
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<tr>
<td>Osprey</td>
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<td>Pied Billed Grebe</td>
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<td>Red Shouldered Hawk</td>
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<td>Snowy egret</td>
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<td>Tricolored heron</td>
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<tr>
<td>Turkey vulture</td>
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<td>White ibis</td>
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<tr>
<td>Wood Duck</td>
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<td>Wood Stork</td>
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<td>4</td>
<td>0</td>
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<tr>
<td>Pileated woodpecker</td>
<td>Dryocopus pileatus</td>
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</table>
Section 4.0 References

