Wakulla Springs Alliance
Wakulla Springs Dark Water Causes and Sources Phase I and II
July 14, 2016

This ongoing research project, funded by the Fish and Wildlife Foundation of Florida (Projects PFS #1516-05 and PFS#1617-08), is designed to accomplish the following:

- quantify, characterize, and optically fingerprint the pigments in the waters of Wakulla Spring;
- determine the origins of the dark water at the springhead that are limiting the depth to which photosynthetically active radiation (PAR) is able to penetrate, thereby contributing to the loss of submerged aquatic vegetation in the spring vent and basin; and
- identify the principal water inflows to the aquifer that are contributing the color and turbidity that result in dark water conditions at the spring.

Dark water conditions at Wakulla Spring have two serious consequences: (1) a drastic decline in the number of days when the state park is able to offer glass-bottom boat tours at the springhead and (2) a dramatic loss of the submerged aquatic plant community that once thrived in the spring vent and basin. Data collected by state park staff indicate that the water at Wakulla Spring was clear enough that the glass-bottom boats could run on average 43% of the time between 1987 and 1991. The five-year average dropped to 33-35% in the early 2000s, to less than 20% for 2005-2007, and to less than 10% from 2008-2013. In 2012 and 2013 the park was able to offer glass-bottom boat tours only 4% of the time. In 2010 and the first 11 months of 2014 no tours were offered.

Dark water conditions also reduce the amount of light available to submerged aquatic plants. Intermittent dark water reduces plant growth in the spring basin resulting in less food for manatee and the food web of invertebrates and fish that support the entire spring and upper river ecosystem. Prolonged dark water conditions very likely have contributed to the disappearance of eelgrass and other submerged aquatic plants that once thrived at the mouth of the spring (Howard T. Odum Florida Springs Institute, 2014).

While tea-colored dark water conditions have been observed at the spring since at least the 1930s due to tannins associated with heavy rains, in recent years the spring also has experienced prolonged, continuous "green" dark water conditions due to less concentrated pigments of unknown nature and origin that absorb less light (Howard T. Odum Florida Springs Institute, 2014). Scientists have speculated that the increase may be due in part to changes in hydro-geologic conditions that have increased dark water flows into Wakulla Spring from the Spring Creek springshed. Lost Creek, which lies to the south, appears to be the most important in terms of flow duration and slower travel time (Kincaid, 2011).

McGlynn Laboratories, Inc. (MLI), under contract with the Wakulla Springs Alliance, has nearly completed Phase I of the project conducting the following analyses:

- Daily true color single wavelength scans at the springhead.
- Weekly analyses of chlorophylls, true color, turbidity, and color absorbance from grab samples plus spectralradiometric light absorbance scans at every single wavelength of visible light from the surface to the bottom of the water column at the springhead, obtaining a detailed fingerprint of the optical properties of the water as well as its photosynthetically active radiation (PAR) extinction coefficient.
- Optical fingerprints based on grab sample analyses of chlorophylls, true color, turbidity, and color absorbance at the springhead and from major karst feature sources of inflow for (a) six "dark events" after rainfall events when sinking streams are flowing into the aquifer with tannic water and water at the spring has begun to "run dark" and (b) two "clear events" when water at the spring is running at optimal clarity. Karst feature sources to be sampled include large “sinking lakes” (Bradford Brook Chain of Lakes, Lake Iamonia, Lake Jackson, Lake Lafayette, Lake Miccosukee,

and Lake Munson) and "disappearing streams" that flow into the aquifer through swallets or sinkholes (Black Creek, Cheryl Sink, Fisher Creek, Jump Creek, Lost Creek, and Mill Creek)

Work to date has documented that dark water conditions at the Spring are driven primarily by

a. the flow regime of Spring Creek and its effects on the inflow of tannin-rich waters from Lost Creek
b. an influx of lentic phytoplankton from the cave system that discharges into Wakulla Spring

Historically natural brown dark water conditions at the spring have occurred after periods of extended rainfall during which three sinking streams north of the spring - Black Creek, Fisher Creek, and Jump Creek - have discharged tannin-rich waters into the aquifer via swalletes. Increasingly frequent reductions or complete cessations of flow from Spring Creek have caused flow Lost Creek to flow north into Wakulla Spring further prolonging these natural brown dark water conditions.

Since the late 1990s, the spring has remained "dark" after the dissipation of tannins associated with the sinking streams inflows. The apparent color is green. Phase I has documented that the green pigments are chlorophylls and their degradation products that apparently are flowing into the spring form the aquifer. Phase II will attempt to identify the origin of those green pigments which appear to be associated with lentic phytoplankton associated with lake ecosystems. Suspected possible sources include three lakes that discharge into the aquifer from seepage: Lakes Jackson and Munson and Upper Lake Lafayette. Phase II will include dye tests to conclusively determine long-suspected hydrologic connections to Wakulla Springs from Lake Jackson and Upper Lake Lafayette. Phase II also will include phytoplankton taxonomic identification as a means to trace the origins of chlorophylls being discharged into the spring.

Phase I is scheduled for completion by December 2016. Phase II will continue to December 2017.

For More Information:

Robert Deyle, Vice Chair, Wakulla Springs Alliance; project manager: rdeyle@fsu.edu; 850-443-6657.

Seán McGlynn, Technical Director, McGlynn Laboratories, Inc.: mcglynnlabs@gmail.com; 850-570-1476.

References Cited:

Howard T. Odum Florida Springs Institute. 2014. *Wakulla Spring Restoration Plan*. http://floridaspringsinstitute.org/Resources/Documents/2014.08%20V3%20Wakulla%20Restoration%20Plan.pdf.

Kincaid, Todd. 2011. Where's the Water Come From? Toward A Water Budget for Wakulla Spring. http://wakullasprings.org/wp-content/uploads/2014/09/kincaid-BOCC.pdf.