



## Restoring Silver Springs and the “Lost Springs” of the Ocklawaha

Reviewed for accuracy by Robert L. Knight, Ph.D. Springs Ecology and Casey Fitzgerald, SJRWMD Springs Initiative Director (retired)

### Free-Flowing Artesian Springs

Florida is home to more than 1,000 artesian springs, the highest concentration of large springs in the world (Knight 2015). Yet these springs and their associated spring runs are the most endangered ecosystems in Florida, with a total of only 10,000 acres. Springs and spring runs are unique freshwater ecosystems with naturally high productivity of plants and wildlife. Clear water allows sunlight to fuel high primary productivity which translates up the aquatic food web to naturally high and diverse populations of reptiles, fish, mammals, and birds. Constant water temperature, combined with ideal nutrient levels, and flowing water, put healthy springs near the top of ecosystem productivity.

### Silver Springs

The Silver Springs Group includes at least 25 springs that collectively create the 5-mile-long spring run called the Silver River. Mammoth Spring at the river’s source has the highest long-term recorded flow of a single spring outlet in the world. More than 150 years of scientific efforts have focused attention on the Silver Springs and the Silver River. Research conducted in 1979-1980 and in 2004-2005 documented a severe reduction in fish populations in Silver Springs. In addition to observed flow declines and increasing nitrate pollution, the >90% reduction in fish populations was attributed to the exclusion of migratory fish that previously migrated inland from the Atlantic Ocean via the free-flowing Ocklawaha River. This reduced fish abundance has been tied to declining ecosystem productivity and increasing dominance of invasive plant and animal species in the Silver River.

### Lost Springs of the Ocklawaha River

Prior to the initiation of the Cross-Florida Barge Canal project, the Ocklawaha River received clear groundwater from at least 20 freshwater springs; however, these springs are currently submerged beneath artificially high-water levels caused by the dam, rendering them unsuitable habitat for fish and manatees.

Three years after the completion of the dam, Elizabeth Abbott from the University of Florida published a paper about the twenty “lost” springs of the Ocklawaha (Abbott 1971). Her paper provided the name, location, dimensions, run description, additional comments and whether or not they existed in 1971. One of the lost springs and the largest in terms of historic flow and recreational benefits is Marion County Blue Spring, now located under the Rodman Pool. Historically, Blue Spring was described as a “blue crystal pool” where fishermen marveled at the

quality and quantity of the fish including mullet, catfish and bass, but it was replaced with dying vegetation and the murky reservoir waters. Abbott described the Tobacco Patch Landing and Cannon Springs area as having the "most beautiful forest with a mixture of hardwoods and palms". She closes her paper by noting that "Almost all of these springs have been damaged or destroyed by man" and with hopes that the springs that are not completely beyond repair can one day be "restored and preserved to contribute to the natural beauty of the National Forest."

### **The Restoration Solution**

Robert Knight conducted measurements of ecosystem metabolism and fish counts in the Silver River in 1979 and 1980 (Knight 1980). While the spring-fed Silver River retained much of its ecological health 25 years after H.T. Odum's prior study in the 1950s (Odum 1957), there were clear indications of harm to the fish populations documented in Knight's study. Also, managers of the Silver Springs attraction provided qualitative evidence that populations of noxious filamentous algae in the springs and river began to increase with closure of the Rodman Dam in 1967. Based on his data and analysis, Knight concluded his doctoral dissertation by recommending removal of the Rodman Dam.

In 2006 SJRWMD and the FDEP conducted the 50-Year Retrospective Study of Silver Springs and the Silver River (Munch et al. 2006). That study further documented the findings that the Rodman Dam was interrupting the historic movement of migratory fish between the Atlantic Ocean, St. Johns River, and Ocklawaha River that were an important part of the productive and finely-tuned ecosystem documented in the Silver Springs in Odum's 1957 study. One hypothesis for the diminished ecological functioning documented by the Munch study was based on the loss of connectivity:

"Another factor long recognized as having an important impact on the Silver River fish populations and therefore the entire aquatic ecosystem is the Rodman Dam on the Ocklawaha River downstream. Both Knight and Odum implicated the dam in changing populations of seagoing fish species through physical blockage of their migrations and breeding success. Decreased consumer control of the primary producers and lowered gross primary productivity is resulting from lower fish/consumer populations below optimal grazing densities, possibly due to obstruction of fish migration by the Rodman Dam."

In addition to drowning most springs along the Ocklawaha River, aquatic species such as striped bass, catfish, and manatees are barred from moving freely in the connected St. Johns/Ocklawaha/Silver riverway. The dam also alters discharge volumes, movement of sediments and changes nutrient exchanges by turning a free-flowing river into a nearly stagnant reservoir (Borisova et al. 2017, Shuman 1995). This alteration impacts spring biodiversity by changing the physical habitat, life history and recruitment processes of native populations, while increasing the chance of exotic species invasion (Bunn and Arthington 2002). While the desire to fish for trophy species exists, the need for a natural flow regime needs to be recognized as a critical component for the proper function and structure of aquatic ecosystems (Poff et al. 1997).

### **Conclusions**

Silver Springs, perhaps the most visited and important springs group in Florida, has been severely altered over the past 50 years (Knight 1980). The damming of the Ocklawaha River is suspected to be an important contributor to the impaired conditions in Silver Springs and the Silver River.

Angela Bednarek (2001) concluded that dam removal can have long term ecological benefits such as improved water quality, recovery of native and migratory fish and wildlife, and natural sediment transport. When a free-flowing river is turned into a lake, the temperature and dissolved oxygen levels are negatively altered. This increase in water depth and reduced flow may cause temperature stratification which can inhibit gas exchange between highly oxygenated surface and poorly oxygenated bottom layers. Flooding of the 20 Lost Springs with tannic waters greatly diminishes flow and water clarity. These are the two most important physical drivers of springs productivity and habitat.

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