



Aquatic Vegetation Monitoring in Springs at Ozark National Scenic Riverways, 2007-2015

The National Park Service began monitoring aquatic vegetation in large springs at Ozark National Scenic Riverways (OZAR), Missouri in 2007 (Bowles *et al.* 2008). Because many aquatic plants are vulnerable to disturbance, assessing those communities is an important tool for managers to assess potential impacts to springs in the park. This report summarizes aquatic vegetation monitoring data collected annually at OZAR from 2007 through 2015.

Methods:

For details on methods used for vegetation monitoring and analysis see Bowles *et al.* (2008).

- We monitored aquatic vegetation at seven springs: Alley, Big, Blue, Phillips, Pulltite, Round, Welch (Figs. 1 and 2).
- At each spring, the sampling reach was divided into 11 equally spaced transects perpendicular to flow with three sample cells (1 m²) per transect. The one exception was Welch Spring, where only three transects (N=9) were established due to its short spring run (36m).
- Aquatic vegetation was sampled only at odd numbered transects (six transects, N = 18; N = 9 at Welch Spring) using a PVC sampling frame (1 m²) and view bucket to observe vegetation (Fig. 3). The sampling frame was divided into quadrats to facilitate assessing vegetation abundance.
- Foliar cover for each plant species found in each sample cell was recorded using a modified Daubenmire scale: 1 = 0–0.99%, 2 = 1–5%, 3 = 5–25%, 4 = 25–50%, 5 = 50–75%, 6 = 75–95%, 7 = 95–100% (Bowles *et al.* 2008). Data collected from all sample cells were summarized by taxa for the area sampled. Mean values along with a measure of variability (± 1 standard error of the mean) were calculated for the community.
- From these data we calculated Individual Species Frequency (ISF) and Species Importance Values (SIV) for each taxon. The ISF is simply frequency of occurrence, while the SIV takes into account species occurrence as well as areal coverage, thus providing insight into the relative importance of a given taxon to the entire community.
- Summary means were calculated across transects and then across years for each site (n=10).

- Water quality and habitat data were collected in conjunction with vegetation samples (see Bowles *et al.* 2008), but those data are not presented here because they do not allow additional insight into vegetation community structure at this time. Those data will be presented later in a more exhaustive analysis.

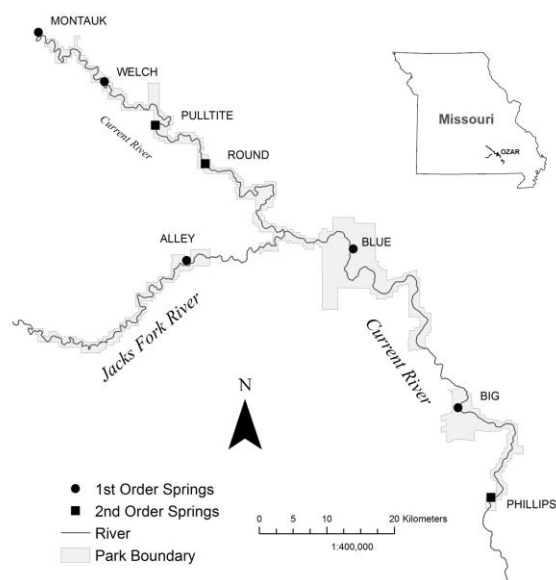


Figure 1. Map showing the locations of large springs at Ozark National Scenic Riverways, Missouri. Montauk Springs is owned by the state of Missouri and was not included in this study.



Figure 2. Blue Spring, Ozark National Scenic Riverways, Missouri.



Figure 3. Staff sampling aquatic vegetation using a view bucket.

Summary of Findings:

The data reported here are similar to those reported by Bowles et al. (2011) and Bowles and Dodd (2015) with the exception of more years being reported (Bowles and Dodd 2016). We found 69 distinct taxa with substantial overlap of species occurrences among springs, including 6 families, 6 genera and 6 species of algae, and 9 families, 12 genera and 19 species of mosses and liverworts (Bowles and Dodd 2015). Among angiosperms, we report 10 families, 13 genera, and 20 species of monocots, and 16 families, 23 genera and 24 species of dicots. A complete list of species can be found in Bowles and Dodd (2015).

Alley Spring had 21 taxa represented among all sampling cells with mosses, *Cardamine bulbosa* and *Nasturtium officinale* having the highest ISF (Fig. 4). Nineteen taxa were represented in cells at Big Spring where *Ranunculus longirostris* had the greatest ISF (Fig. 5). Blue and Pulltite springs had 21 and 16 taxa represented, respectively, but mosses were dominant in both systems (Figs. 6-7). Round Spring had the greatest number of total taxa represented with 22 (Fig. 8). Welch and Phillips springs had the least taxa represented (Figs. 9-10). At Phillips Spring, mosses and *Nostoc* sp. were most frequently encountered while mosses and filamentous green algae were the most frequently encountered taxa at Welch Spring. SIVs generally mirrored ISFs, but in some instances there were taxa with high ISFs that received lower SIVs because they had low areal coverage (Figs. 4-10). Although plant communities were diverse throughout the springs, individual sample cells typically

contained only four to six taxa, and Welch Spring generally had only two to three taxa represented.

Exotic species were not major contributors to the vegetation communities of the respective springs and those that were present occurred infrequently and typically had low foliar coverage of less than 30%, although that value was exceeded in some years. Watercress, *Nasturtium officinale*, was the dominant exotic plant in all springs.

The springs share many taxa in common such as mosses, but the vegetation communities that occur in them and their relative abundances are quite different. We suggest this reflects the broad natural habitat diversity and physical and chemical stability of the springs.

Watershed-level characteristics (recharge zone), local physical habitat factors including substrate size, canopy cover, and other unknown contributing factors may play important yet undetermined roles in structuring these communities. Since many of the taxa are shared in common among the springs, geographic location of taxa does not appear to be a factor. Collecting and analyzing additional monitoring data is required to determine the importance and relative contribution of the environmental factors influencing the springs and their vegetation communities. Additional monitoring also will allow insight into any patterns that may exist in plant community structure among these springs. The data presented in this report provide an important baseline to detect anthropogenic disturbances in these springs, potentially ensuring their protection.

Report Prepared By:

Dr. David E. Bowles and Hope R. Dodd

For More Information Contact:

Dr. David E. Bowles
Aquatic Program Leader
Heartland I&M Network
6424 W. Farm Rd. 182
Republic, MO 65738
David.Bowles@nps.gov

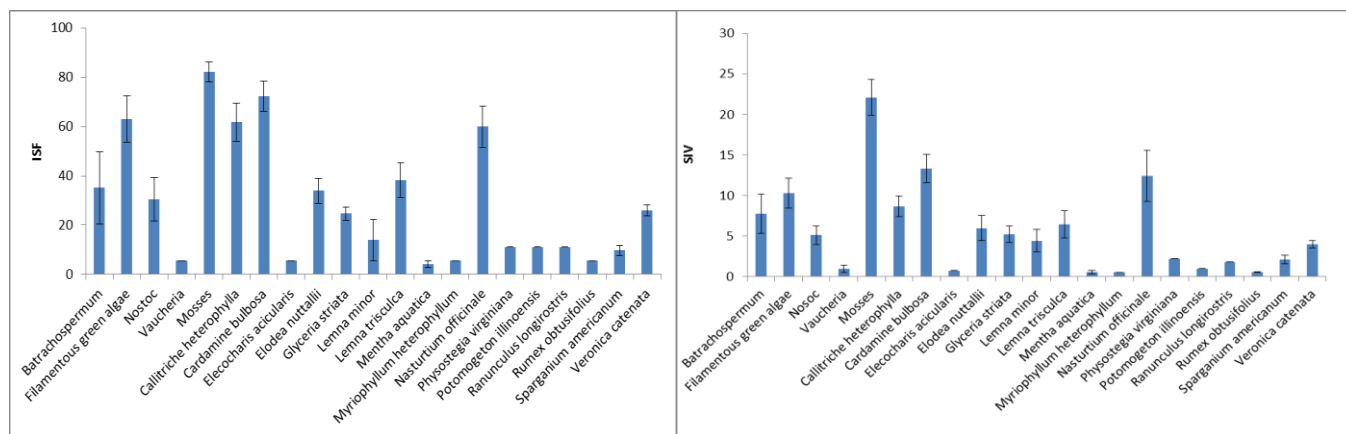


Figure 4. Mean individual species frequency (ISF), mean species importance values (SIV), and standard errors (n=10) for Alley Spring, Ozark National Scenic Riverways, Missouri, 2007-2015. Values are derived from 1 m² replicates.

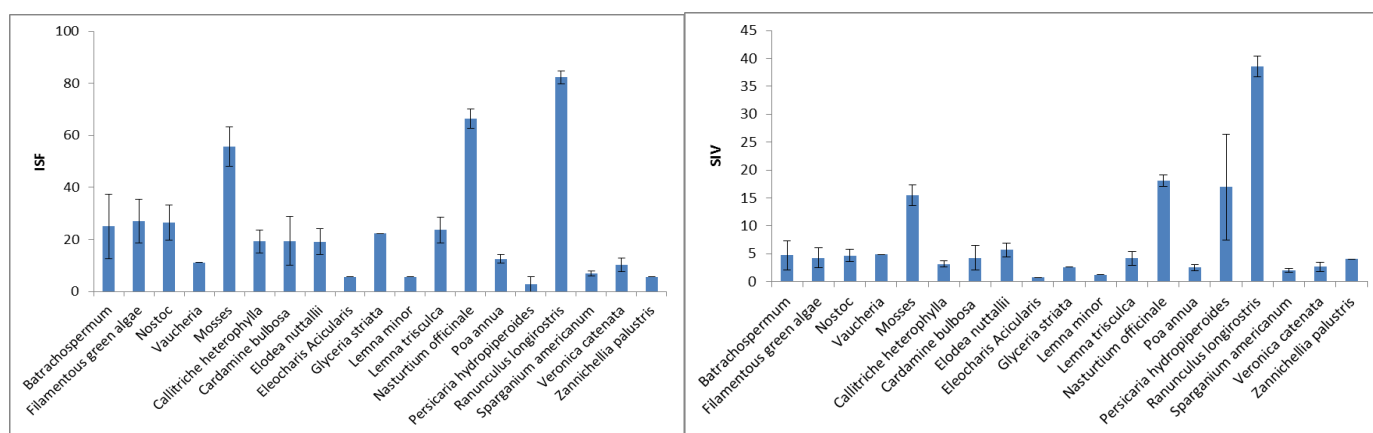


Figure 5. Mean individual species frequency (ISF), mean species importance values (SIV), and standard errors (n=10) for Big Spring, Ozark National Scenic Riverways, Missouri, 2007-2015. Values are derived from 1 m² replicates.

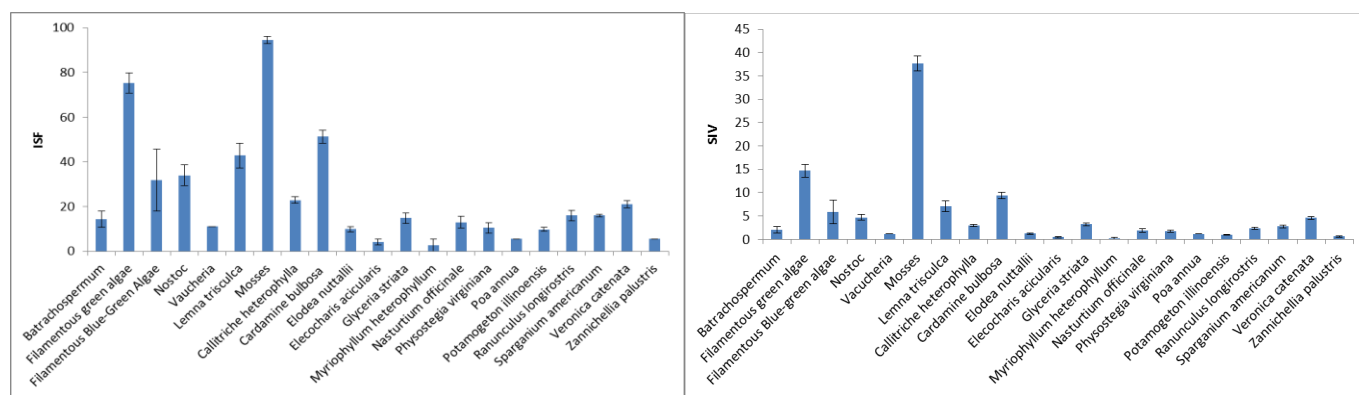


Figure 6. Mean individual species frequency (ISF), mean species importance values (SIV), and standard errors (n=10) for Blue Spring, Ozark National Scenic Riverways, Missouri, 2007-2015. Values are derived from 1 m² replicates.

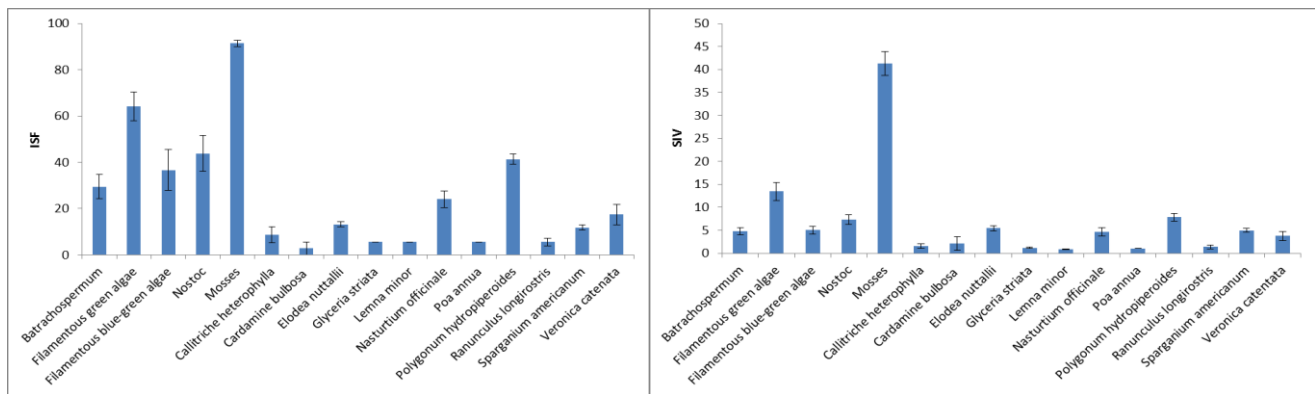


Figure 7. Mean individual species frequency (ISF), mean species importance values (SIV), and standard errors (n=10) for Pullite Spring, Ozark National Scenic Riverways, Missouri, 2007-2015. Values are derived from 1 m² replicates.

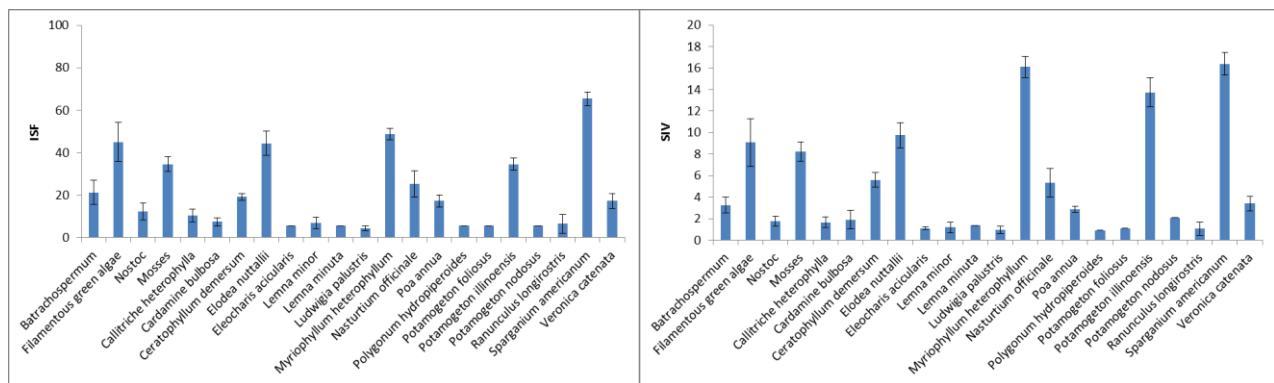


Figure 8. Mean individual species frequency (ISF), mean species importance values (SIV), and standard errors (n=10) for Round Spring, Ozark National Scenic Riverways, Missouri, 2007-2015. Values are derived from 1 m² replicates.

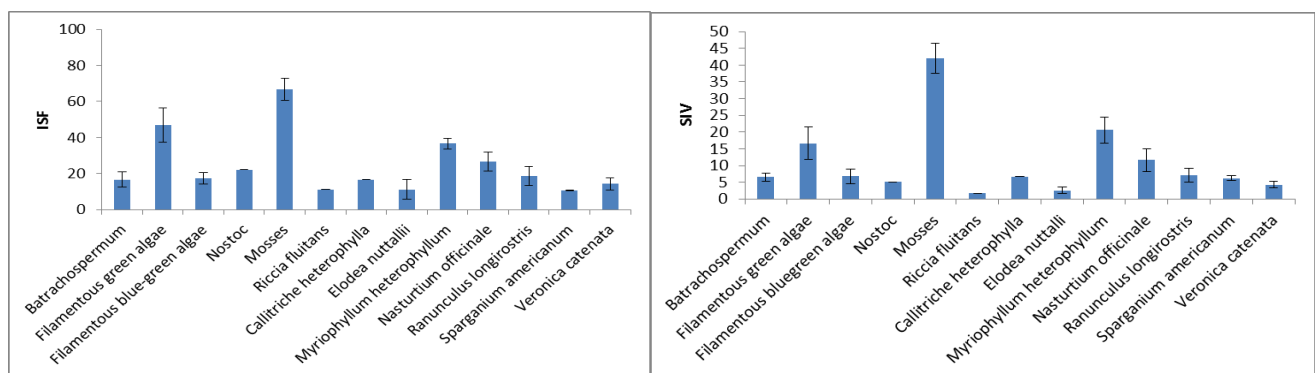


Figure 9. Mean individual species frequency (ISF), mean species importance values (SIV), and standard errors (n=10) for Welch Spring, Ozark National Scenic Riverways, Missouri, 2007-2015. Values are derived from 1 m² replicates.

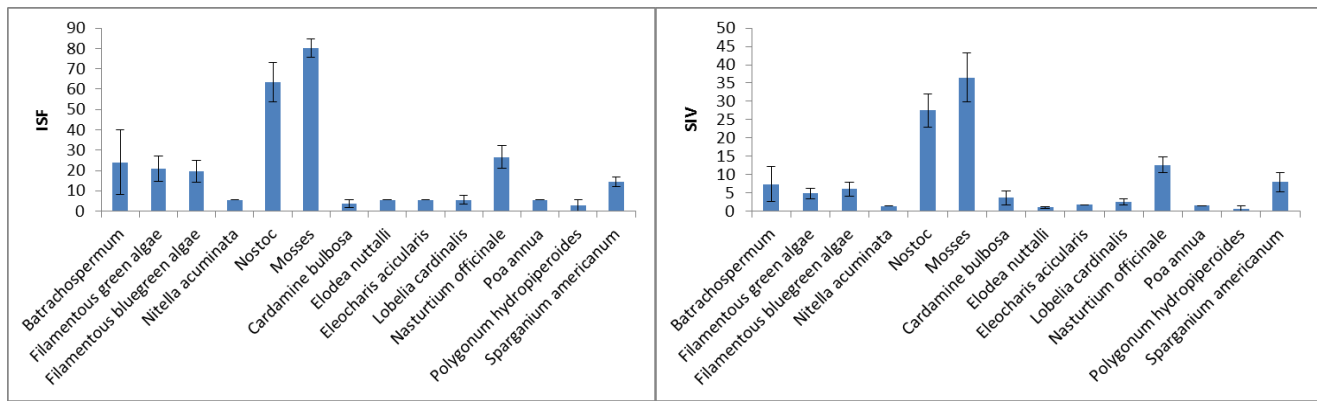


Figure 10. Mean individual species frequency (ISF), mean species importance values (SIV), and standard errors (n=10) for Phillips Spring, Ozark National Scenic Riverways, Missouri, 2007-2015. Values are derived from 1 m² replicates.

Citations:

- Bowles, D. E. and H. R. Dodd. 2015. The floristics and community ecology of aquatic vegetation occurring in seven large springs at Ozark National Scenic Riverways, Missouri. *Journal of the Botanical Research Institute of Texas* 9:235-249.
- Bowles, D. E. and H. R. Dodd. 2016. Aquatic vegetation monitoring in springs at Ozark National Scenic Riverways, 2007-2015. Natural Resource Data Series NPS/OZAR/NRDS—2016/1044. National Park Service, Fort Collins, Colorado.
- Bowles, D. E., H. R. Dodd, J. A. Hinsey, J. T. Cribbs, and J. A. Luraas. 2011. Spring communities monitoring at Ozark National Scenic Riverways, Missouri: 2007-2009 status report. Natural Resource Technical Report NPS/OZAR/NRTR—2011/511. National Park Service, Fort Collins, Colorado. <http://science.nature.nps.gov/im/units/htln/>
- Bowles, D. E., H. R. Dodd, M. H. Williams, L. M. Morrison, K. James, M. D. DeBacker, C. E. Ciak, J. A. Hinsey, G. A. Rowell, and J. L. Haack. 2008. Protocol for Monitoring Spring Communities at Ozark National Scenic Riverways, Missouri. Natural Resource Report NPS/HTLN/NRR—2008/029. National Park Service, Fort Collins, CO. <http://science.nature.nps.gov/im/units/htln/>

Heartland Inventory and Monitoring Network of the National Park Service.
Visit: <http://www.nps.gov/im/units/htln/index.htm>

...protecting the habitat of our heritage

