A Vascular Plant Inventory of Springs and Seeps of Buffalo National River

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Summary

Plant species composition of the spring and seeps of the Buffalo National River were inventoried via stratified random sampling and inspected 3 times during the field season of 2001-2002. Seventy three species in 31 families were identified-a species richness considered low. Seeps and springs were found to be fairly depauperate and to contain a fairly high number of dry, weedy species as most sites showed evidence of human manipulation. Several structures have been built around the seeps and springs to contain or capture water for human or livestock use. This use, in some cases, probably dates back to presettlement and is the likely reason for the low number of species and for the "weedy" character. Most springs were not flowing during the dry summer and autumn of 2001 and several were not flowing during the moist spring of 2002. Five springs were not flowing during any visit. No distributional affects to plant composition due to the springs perennial/ephemeral natures, substrate types, or district (upper, middle, lower) were detected. It is estimated that more than 90% of the species found in seeps and springs were documented. Park management may want to consider reclassifying all of the seeps and springs of the park as to perennial/ephemeral status. Voucher specimens are stored at the Buffalo National River office in Harrison, AR.

Acknowledgments

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Introduction

In 1998 Congress passed the National Parks Omnibus Management Act in response to concerns about the condition of natural resources within the national parks. The act requires each park to gather baseline inventory data on pertinent natural resources, data that will provide a pivotal step toward establishing an effective monitoring program furthering the ability to effectively manage and protect park resources. The National Park Service (NPS) responded with the Natural Resource Challenge program, including the establishment of biome-based inventory and monitoring networks. The Heartland Network, as part of the NPS Inventory and Monitoring (I&M) program, has undertaken inventories of vascular plants and vertebrates within fifteen parks in eight Midwestern states.

Stemming from this challenge and a widespread concern regarding the status of seeps and springs and their resident vascular plant species at Buffalo National River, an inventory was deemed necessary to determine status and species presence.

External threats from changing land use and development are major concerns for park resource protection. Additional issues include: impounding of river tributaries outside of park; the small portion (11%) of the Buffalo River watershed within National Park Service administrative authority; increasing poultry and livestock operations with minimal state regulation adjacent to the park and throughout the watershed; karst geohydrology of the area expediting rapid transport of pollutants via underground water systems; and finally, little information exists on groundwater recharge to the National River.

A diverse array of wildlife has been documented at Buffalo National River (birds, DeChant and Smith 1996; Kellner 2003; bats, Harvey 1985; herpetofauna, Trauth 1993; plants, Jenkins et al 1997; Logan 1992, 1999) and many rare and unique animal and plant species have been documented (Table 1). Sensitive species include the federally endangered gray bat (*Mysotis grisescens*), Indiana bat (*Myotis sodalis*), and Ozark big-eared bats (Plecotus rafinesqii). Forty-two populations of rare plants are associated with seeps and springs and the park contains the Ozark's only elk herd consisting of approximately 400 animals.

The inventory described in this report describes the status of seeps and springs at Buffalo National River and establishes baseline data for the resident vascular plants.

Study Area

Buffalo National River is located in the rugged Ozark Highlands of northern Arkansas (Figure 1). The region is characterized by narrow valleys separated by steep winding ridges and broad mountaintops. The National River encompasses 149 narrow, linear square miles (95,730 acres) and includes 135 miles of the 150-mile-long Buffalo River from the Boston Mountains to the White River. The headwaters are within the Ozark National Forest and were recently designated as part of the National Wild and Scenic Rivers System.

Overall, 11% of the 1338 square mile watershed lies within National Park Service (NPS) administration and 29% is in other federal or state ownership. The majority of the watershed is in private ownership. One-third of the national river's acreage is a part of the National Wilderness Preservation System.

The river has a variety of vegetation types underlain with a karst geology of sink holes, springs, seeps, and approximately 300 known caves including the longest cave system in the state. The vegetation consists of oak, hickory, and beech forests, cedar and sandstone glades, rare river cane communities, and relic plant communities such as post oak savanna remnants.

Materials and Methods

Spatial data including springs/seeps locations, geology, and elevation were combined with information regarding water discharge to stratify potential sample locations via geographic information system (GIS). Using a combination of geographic distribution, flow, aspect, elevation and substrate a suite of sites was chosen from the Lower, Middle, and Upper Districts of Buffalo National River.

Springs and seeps to be sampled were selected by choosing proportionally from these three districts, the proportion being based on the number of known springs from each district. Five of the 14 springs and seeps were chosen in Lower District; five from the Middle District; and 14 from the Upper District. Sites were further divided by rock strata (i.e. formation) and chosen to reflect the proportions of sites found in the various strata (Table 1). Perennial and ephemeral sites were then selected at random based on the above.

Springs and seeps were each visited 3 times, June and September of 2001 and again in May of 2002. Vascular plants were identified and a voucher specimen of each species encountered was collected. Specimens and labels were prepared according to National Park Service (NPS) standards. No rare species requiring alternative documentation were encountered.

Wetland indicator status for plants, developed by the USDA NRCS (2003), was used as an indicator of wetness at each sample site.

Environmental variables on types of springs and seeps and variables which might effect plant diversity were collected using standard NPS forms. Nomenclature used was based on NPS standard species names.

Springs and seeps were located via combination map and compass and habitat features.

Results

A total of 73 species in 32 families were documented. The Poaceae and Asteraceae were both represented with ten species and the Cyperaceae seven. Four common species (>5 occurrences) include Virginia creeper (*Parthenocissus quinquefolia*), clearweed (*Pilea pumila*), poison ivy (*Toxicodendron radicans*), and wild hydrangea (*Hydrangea arborea*).

Of the 24 springs inventoried, an average of 6 plants per spring was found with a maximum of 16 (Bunk Ridge Spring). No vascular plants were found at Madle Spring and Stovepipe Spring. Twenty five species documented were typical of wetter situations: 6 obligate (occurs almost always in wetlands) and 19 facultative (usually occurs in wetlands) wetland species. Bunk Ridge, Acorn, and Stillhouse Hollow springs had at least 5 wetter species, the latter with all wet species (Table 2).

Discussion

A species-area curve was examined after the first collection to determine if 90% of the possible species had been collected. The resultant curve indicated that greater than 90% of the species at springs and seeps have been identified. However, since the total number of species found at that time was only 68, any new species found would result in a significant increase in the percentage.

The flora of the springs and seeps of the park consists primarily of common species that are hardy, even weedy. No rare species were found although giant cane (*Arundinacea gigantea*) was found (warbler habitat). The total number of species (73) is low. Most of the springs showed evidence of human manipulation. Several of them had structures built around them to contain or capture the water for human or livestock uses. The use by human populations, in some cases probably dating back to presettlement, is the likely reason for the low number of species and for their "weedy" character.

No distributional affects to plant composition due to the springs perennial/ephemeral natures, substrate types, or district (upper, middle, lower) were detected.

Due to the inability to obtain GPS locations in many situations, and because most of the ephemeral or intermittent springs and seeps as well as several of the perennial springs and seeps were not flowing when the first site visits were made, it was sometimes necessary to identify the spring outlets by vegetation patterns. Microhabitats that appeared most moist were chosen. No locations identified in this manner were later determined to be in error. It is estimated that more than 90% of the species found in BNR springs were identified.

Voucher specimens will be stored at the BNR office at Tyler Bend.

Conclusion

Most of the springs, even those identified by park personnel as perennial springs, were not flowing during the dry summer and autumn of 2001. Several of the springs were not flowing during the moist spring of 2002. Pebble Spring, Ice Box Spring, Angle Spring, Un-named Cecil Creek spring, and Un-named spring Hasty Quad were not found to be running during any of the three visits. Park management may want to consider reclassifying all of the spring of the Buffalo River as to whether they are perennial/ephemeral.

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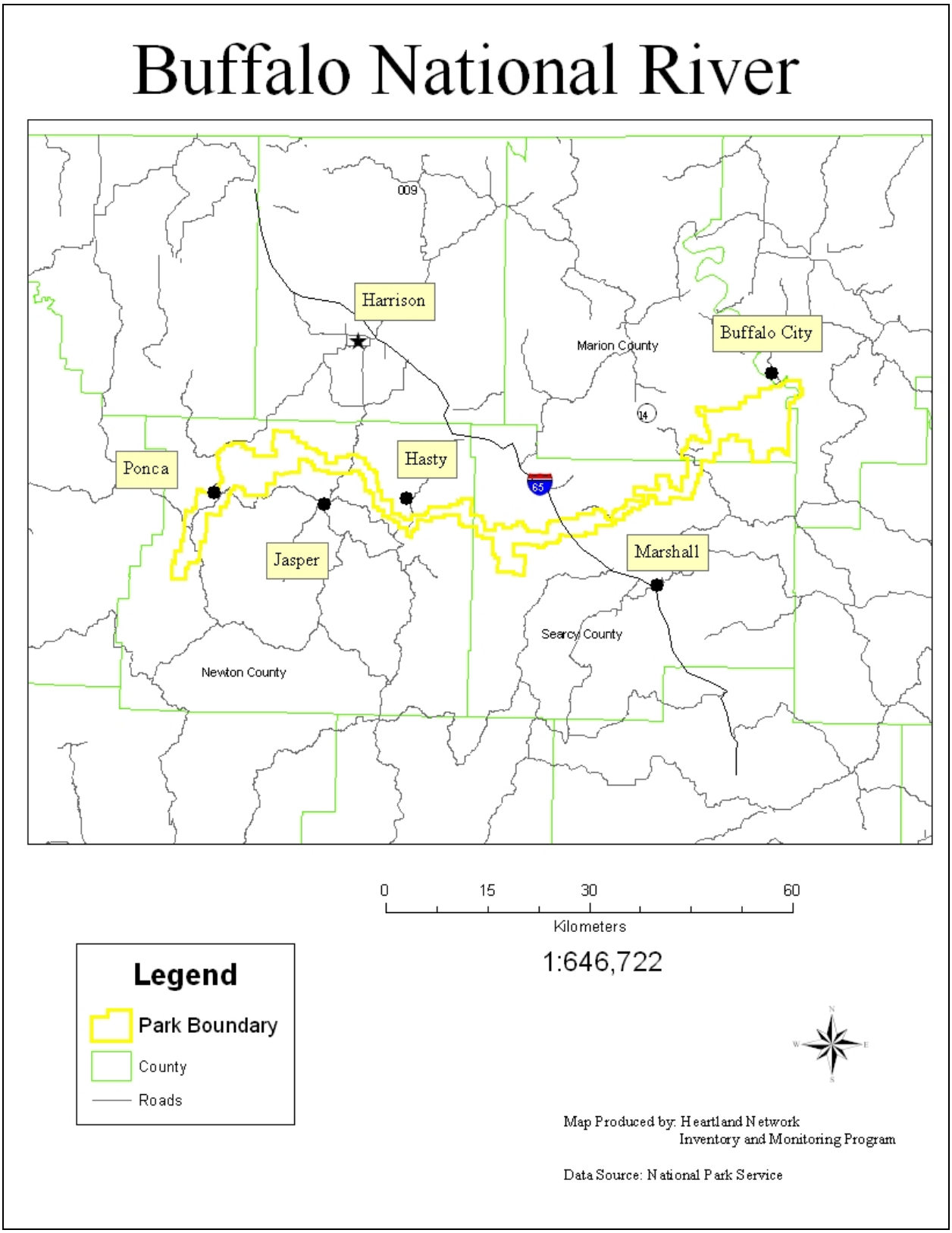

Figure 1. Location of Buffalo National River.

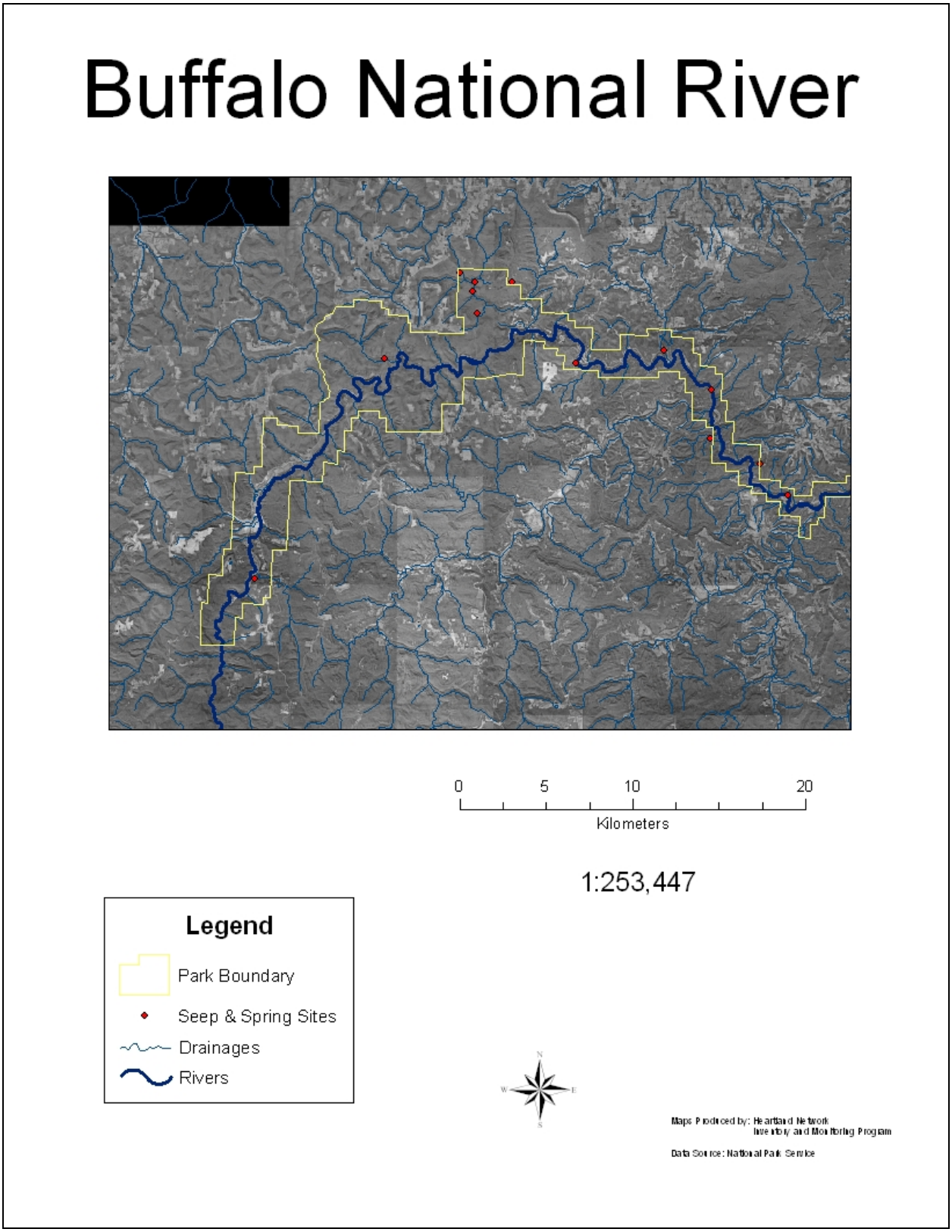

Figure 2. Location of springs and seeps (western sites) at Buffalo National River.

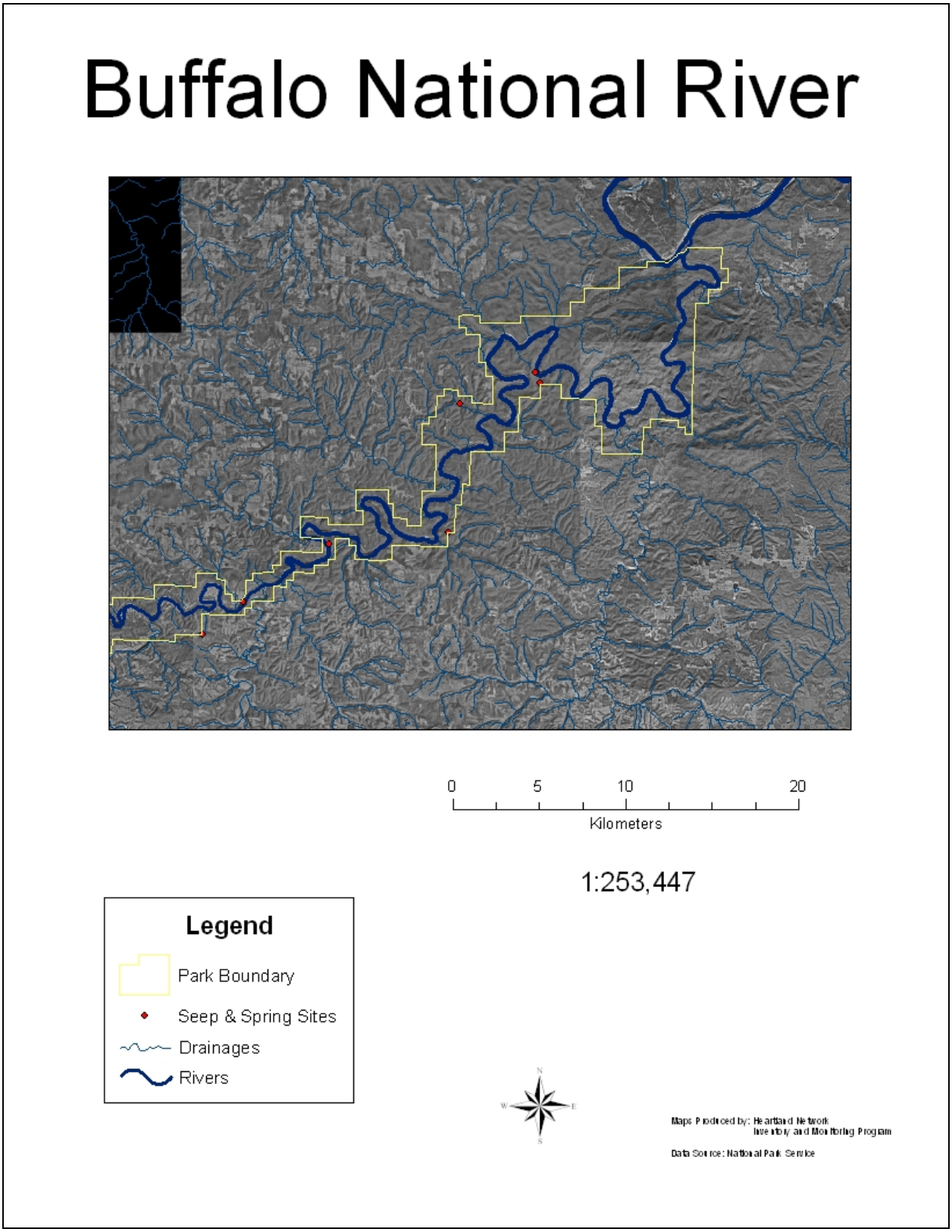

Figure 3. Location of springs and seeps (eastern sites) at Buffalo National River.

Table 1. Springs and seeps selected for plant species analysis

District	Site Name	County	Quad	Discharge	Stratagraphic Horizon
Lower	Acorn Spring	Searcy	Cozahome	Perennial	Limestone
	Duck's Neck Cave	Marion	Cozahome	Perennial	Everton
	Pebble Spring	Marion	Cozahome	Ephemeral	St.Peter sandstone & Everton
	Temple Cave	Marion	Cozahome	Perennial	Everton
	Unknown	Marion	Buffalo City	Perennial	Everton
Middle	Ezell Spring	Searcy		Perennial	Everton
	Gilbert Spring	Searcy	Marshall	Perennial	Ordovician
	Unknown	Searcy	Snowball	Perennial	Boone
	Silver Hill Spring	Searcy		Perennial	Boone
	Stovepipe Cave Spring	Searcy		Perennial	Boone
Upper	Angle Spring	Newton	Jasper	Perennial	Everton
	Bunk Ridge Spring	Newton	Hasty	not sure	Unknown
	Hasty Overhang Spring	Newton	Hasty	Ephemeral	St. Joe Ordovician contact
	Ice Box Spring	Newton	Ponca	Ephemeral	Unknown
	Luallen Spring #1	Newton	Boxley	Perennial	Boone
	Madle Spring	Newton	Ponca	Perennial	Pitkin limestone and Fayetteville shale
	Milk Cow Spring	Newton	Ponca	Perennial	Everton
	Mill Creek Boil	Newton	Hasty	Ephemeral	Everton
	Walled Spring	Newton	Ponca	Perennial	Fayetteville
	William Parker Spring	Newton	Ponca	Perennial	Weddington Sandstone
	Willis spring	Newton	Ponca	Perennial	Boone
	Stillhouse Hollow Spring	Newton	Mt. Judea	Perennial	Unknown
	Unknown	Newton	Ponca	Perennial	Boone
	Unknown	Newton	Hasty	Ephemeral	Everton

Table 2. Species found in each spring surveyed in the Buffalo National River

Spring Name	**ScientificName**	**Wetland Indicator**
Acorn Spring	Apios americana	FACW
	Berchemia scandens	FACW
	Equisetum hyemale affine	NA
	Galium concinnum	UPL
	Impatiens capensis	FACW
	Lobelia siphilitica	OBL
	Parthenocissus quinquefolia	FAC
	Sanicula Canadensis	FACU
	Senecio aureus	FACW
	Urtica dioca	FAC+
Angle Spring	Arundinacea gigantean	FACW
Bunk Ridge Spring	Aster lanceolatus	FACW
	Carex blanda	FAC-
	Carex vulpinoidea	OBL
	Carex vulpinoidea	OBL
	Chasmanthium latifolium	FAC-
	Cryptotaenia canadensis	FAC+
	Elymus villosus	FACU
	Erigeron annuus	FACU
	Panicum clandestinum	FACW
	Pilea pumila	FACW
	Ranunculus sceleratus	OBL
	Rumex crispus	FAC
	Rumex crispus	FAC
	Sanicula Canadensis	FACU
	Solidago caesia	FACU
	Toxicodendron radicans	FAC
Duck Neck Spring	Cystopteris fragilis	FACU
	Galium triflorum	FACU
	Hydrandgea arborea	FACU
	Pilea pumila	FACW
Ezell Spring	Hydrandgea arborea	FACU
	Parthenocissus quinquefolia	FAC
	Pilea pumila	FACW
	Polymnia Canadensis	NA
	Sanicula Canadensis	FACU
	Toxicodendron radicans	FAC

Table 2. Species found in each spring surveyed in the Buffalo National River (cont.)

Spring Name	**ScientificName**	**Wetland Indicator**
Gilbert Spring	Alliaria petiolata	FACW
	Elymus virginicus	FAC
	Glechoma hederacea	FACU
	Impatiens pallida	FACW
	Laportea canadensis	FACW
Hasty Overlook Spring	Adiantum pedatum	FACU
	Galium triflorum	FACU
	Impatiens capensis	FACW
	Lindera benzoin	FACW
	Muhlenbergia sobolifera	NA
	Parthenocissus quinquefolia	FAC
Ice Box Spring	Festuca elatior	FACU
	Hydrandgea arborea	FACU
	Impatiens pallida	FACW
	Parthenocissus quinquefolia	FAC
	Ruellia pedunculata	NA
	Smilax bona-nox	FAC
	Toxicodendron radicans	FAC
	Ulmus rubra	FAC
Luallen Spring	Cystopteris fragilis	FACU
	Desmodium glutinosum	NA
	Galium concinnum	UPL
	Impatiens pallida	FACW
	Parthenocissus quinquefolia	FAC
	Solidago caesia	FACU
Milk Cow Spring	Campsis radicans	FAC
	Erigeron annuus	FACU
	Festuca elatior	FACU
Milk Cow Spring	Heuchera Americana hirsuticaulus	NA
	Hydrandgea arborea	FACU
	Muhlenbergia sobolifera	NA
	Pilea pumila	FACW
	Platanus occidentalis	FACW-
	Satureja arkansana	FACW

Table 2. Species found in each spring surveyed in the Buffalo National River (cont.)

Spring Name	**ScientificName**	**Wetland Indicator**
Mill Creek Boil	Asimina triloba	FAC
	Chasmanthium latifolium	FAC-
	Equisetum arvense	FAC
	Hedyotis purpurea	NA
	Parthenocissus quinquefolia	FAC
	Rudbeckia laciniata	FACW
	Salvia lyrata	FAC-
	Senecio aureus	FACW
	Solidago caesia	FACU
	Toxicodendron radicans	FAC
Pebble Spring	Cystopteris fragilis	FACU
	Pilea pumila	FACW
Silver Hill Spring	Parthenocissus quinquefolia	FAC
	Perilla frutescens	FAC
	Pilea pumila	FACW
	Toxicodendron radicans	FAC
	Urtica dioca	FAC+
Stillhouse Hollow Spring	Bidens frondosa	FACW
	Eleocharis acicularis	OBL
	Impatiens capensis	FACW
	Phyla lanceolata	FACW+
	Pilea pumila	FACW
Temple Cave Spring	Adiantum pedatum	FACU
	Cystopteris fragilis	FACU
	Galium concinnum	UPL
	Galium triflorum	FACU
	Hydrandgea arborea	FACU
	Polymnia Canadensis	NA
Un-named Buffalo City Spring	Berchemia scandens	FACW
	Carex cherokeensis	FACW-
	Carex hystericina	OBL
	Carex lupulina	OBL
	Chasmanthium latifolium	FAC-
	Hydrandgea arborea	FACU
	Panicum boscii	NA
	Parthenocissus quinquefolia	FAC
	Parthenocissus quinquefolia	FAC
	Senecio obovatus	FACU
	Vernonia baldwinii	UPL

Table 2. Species found in each spring surveyed in the Buffalo National River (cont.)

Spring Name	**ScientificName**	**Wetland Indicator**
Un-named Cecil Creek Spring	Asplenium rhizophyllum	NA
	Commelina communis	FAC
	Cystopteris bulbifera	FAC
	Pilea pumila	FACW
	Staphylea trifolia	FAC
	Toxicodendron radicans	FAC
Un-named Hasty Spring	Carex vulpinoidea	OBL
	Chasmanthium latifolium	FAC-
	Lindera benzoin	FACW
	Parthenocissus quinquefolia	FAC
	Polymnia Canadensis	NA
	Smilax bona-nox	FAC
	Staphylea trifolia	FAC
	Toxicodendron radicans	FAC
Un-named Snowball Spring	Agrimonia rostellata	FAC
	Botrychium virginianum	FACU
	Panicum boscii	NA
	Parthenocissus quinquefolia	FAC
	Sanicula Canadensis	FACU
	Scutellaria elliptica	NA
	Solidago caesia	FACU
	Strophostyles helvula	FAC
	Toxicodendron radicans	FAC
Walled Spring	Commelina communis	FAC
	Hydrandgea arborea	FACU
	Parthenocissus quinquefolia	FAC
	Toxicodendron radicans	FAC
William Parker Spring	Hydrandgea arborea	FACU
	Pilea pumila	FACW
	Ulmus rubra	FAC
Willis Spring	Carex caroliniana	FACW
	Elymus hystrix	NA
	Festuca elatior	FACU
	Juncus tenuis	FAC
	Krigia biflora	FACU
	Lobelia siphilitica	OBL
	Pilea pumila	FACW
	Sphenopholis intermedia	NA

Wetland Indicator status follows USDA (2003). OBL = Obligate Wetland; species occurs almost always (estimated probability 99%) under natural conditions in wetlands. FACW = Facultative Wetland; species usually occurs in wetlands (estimated probability 67%-99%), but occasionally found in non-wetlands. FAC = Facultative; species is equally likely to occur in wetlands or non-

wetlands (estimated probability 34%-66%). FACU = Facultative Upland ; species usually occurs in non-wetlands (estimated probability 67%-99%), but occasionally found on wetlands (estimated probability 1%-33%). UPL = Obligate Upland; species occurs in wetlands in another region, but occurs almost always (estimated probability 99%) under natural conditions in non-wetlands in the regions specified. If a species does not occur in wetlands in any region, it is not on the National List. NA = Not applicable. A positive (+) or negative (-) sign "indicates a frequency toward the higher end of the category (more frequently found in wetlands), and a negative sign indicates a frequency toward the lower end of the category (less frequently found in wetlands)".

Appendix 1. List of plant species found in springs and seeps of the Buffalo National River.

Family	**Scientific Name**
Acanthaceae	Ruellia pedunculata
Anacardiacaceae	Toxicodendron radicans
Annonaceae	Asimina triloba
Apiaceae	Cryptotaenia canadensis
	Sanicula canadensis
Asteraceae	Aster lanceolatus
	Bidens frondosa
	Erigeron annuus
	Krigia biflora
	Polymnia canadensis
	Rudbeckia laciniata
	Senecio aureus
	Senecio obovatus
	Solidago caesia
	Vernonia baldwinii
Balsaminaceae	Impatiens capensis
	Impatiens pallida
Bignoniaceae	Campsis radicans
Brassicaceae	Alliaria petiolata
Commelinaceae	Commelina communis
Cyperaceae	Carex blanda
	Carex caroliniana
	Carex cherokeensis
	Carex hystericina
	Carex lupulina
	Carex vulpinoidea
	Eleocharis acicularis
Equisetaceae	Equisetum arvense
	Equisetum hyemale affine
Fabaceae	Apios americana
	Desmodium glutinosum
	Strophostyles helvula
Hydrangeaceae	Hydrandgea arborea
Juncaceae	Juncus tenuis
Lamiaceae	Glechoma hederacea
	Perilla frutescens
	Salvia lyrata
	Satureja arkansana
	Scutellaria elliptica

Appendix 1. List of plant species found in springs and seeps of the Buffalo National River (cont.).

Family	**Scientific Name**
Lauraceae	Lindera benzoin
Lobeliaceae	Lobelia siphilitica
Platanaceae	Platanus occidentalis
Poaceae	Arundinacea gigantea
	Chasmanthium latifolium
	Elymus hystrix
	Elymus villosus
	Elymus virginicus
	Festuca elatior
	Muhlenbergia sobolifera
	Panicum boscii
	Panicum clandestinum
	Sphenopholis intermedia
Polygonaceae	Rumex crispus
Polypodiaceae	Adiantum pedatum
	Asplenium rhizophyllum
	Botrychium virginianum
	Cystopteris bulbifera
	Cystopteris fragilis
Ranunculaceae	Ranunculus sceleratus
Rhamnaceae	Berchemia scandens
Rosaceae	Agrimonia rostellata
Rubiaceae	Galium concinnum
	Galium triflorum
	Hedyotis purpurea
Saxifragaceae	Heuchera americana hirsuticaulus
Smilacaceae	Smilax bona-nox
Staphyleaceae	Staphylea trifolia
Ulmaceae	Ulmus rubra
Urticaceae	Laportea canadensis
	Pilea pumila
	Urtica dioca
Verbenaceae	Phyla lanceolata
Vitaceae	Parthenocissus quinquefolia