



An Evaluation of Biological Inventory Data Collected at George Washington Carver National Monument *Vertebrate and Vascular Plant Inventories*

Natural Resource Technical Report NPS/HTLN/NRTR—2009/233



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Network

Natural Resource Monitoring

ON THE COVER

Herbert Hoover birthplace cottage at Herbert Hoover NHS, prescribed fire at Tallgrass Prairie NP, aquatic invertebrate monitoring at George Washington Carver NM, the Mississippi River at Effigy Mounds NM.

An Evaluation of Biological Inventory Data Collected at George Washington Carver National Monument

Vertebrate and Vascular Plant Inventories

Natural Resource Technical Report NPS/HTLN/NRTR—2009/233

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Abstract

The Inventory and Monitoring program of the NPS provides twelve basic inventories for park managers, including lists of species that occur in NPS units. Nine hundred fifty seven species are certified on the list of vascular plants and vertebrates for George Washington Carver National Monument (GWCA). Based on a review of the evidence, 909 (95%) species were categorized as Present in Park, and 48 (5%) as Probably Present. One hundred thirty six species were Unconfirmed, Historic, or Encroaching. In addition to documenting the presence of species, reviewers categorized the general abundance of 892 (98%) certified species and determined residency for all documented vertebrates with the exception of two reptiles and one mammal. Species lists for GWCA can be queried from the Natural Resource Information Portal at <http://nrinfo.nps.gov/Home.mvc>.

One hundred twenty (13%) non-native species occur in the monument. Of these, three are birds, two fish, one mammal, and 114 vascular plants. Non-native vascular plant species were assigned a NatureServe Invasive Species Impact Rank (I-Rank) based on impact to native species and natural biodiversity. Ten of the 23 (43%) invasive exotic plants found on GWCA received an overall I-Rank score that included the high category (i.e. most threatening).

A total of 15 species are considered to be of conservation status. These include the state listed endangered bald eagle (*Haliaeetus leucocephalus*) and northern harrier (*Circus cyaneus*). Two federally listed endangered species, the gray bat (*Myotis grisescens*) and Indiana bat (*Myotis sodalis*), and one state endangered species, the spotted skunk (*Spilogale putorius*), are all unconfirmed at the park. Two possibly extirpated species include the federally listed threatened Ozark cavefish (*Amblyopsis rosae*) and state listed imperiled/vulnerable grotto salamander (*Typhlotriton spelaeus*). Both are considered possibly extirpated due to non-conducive habitat at Carver spring. Future inventory efforts are discussed.

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Introduction

As part of the National Park Service's effort to "improve park management through greater reliance on scientific knowledge," a primary role of the Inventory and Monitoring (I&M) Program is to collect, organize, and make available natural resource data. A list of species known to occur in NPS units is considered a basic inventory need (see: <http://science.nature.nps.gov/im/inventory/index.cfm>). The I&M Program's Heartland Network (HTLN) recently completed inventories of vertebrate species and vascular plants at George Washington Carver National Monument (GWCA). In doing so, all existing data were cataloged, targeted field investigations were conducted, and species lists were certified by taxonomic experts. The primary goal of these efforts was to document at least 90% of the vertebrate and vascular plant species believed to occur in the park. This report provides a summary of results.

Methods

The HTLN followed a strategic plan of action set forth in an Inventory Study Plan (Boetsch et al 2000) to complete inventories of vascular plants and vertebrate species. This plan was instigated by the Natural Resource Challenge in response to the National Parks Omnibus Management Act of 1998 and adheres to the requisite approaches delineated in Guidelines for Biological Inventories (NPS 1999) and the recommendations of the Service-wide I&M Program. The Inventory Study Plan identified steps to conduct a natural resource “information assessment” of existing park data. These steps included (1) developing master lists of species known or expected to occur in the battlefield, (2) conducting field inventories, and (3) certifying the resultant species data.

The term species (as opposed to organism) is generically used throughout this report to refer to unique taxa at the species level or below.

Expected Species Lists

In order to determine the completeness of inventory information, the HTLN developed lists of vascular plants and vertebrates expected to occur in the park. The master lists of birds and fish were derived from a statewide species database supplied by Julie Fleming, Natural History Biologist, Missouri Department of Conservation (2000). Amphibian and reptile species lists were developed from county level range maps provided in Johnson’s (1997) *The Amphibians and Reptiles of Missouri*. Mammal lists were developed from Schwartz and Schwartz (1959), *The Wild Mammals of Missouri*. An initial compilation and evaluation of park floras was completed by Dr. Jim Bennett, National Wildlife Health Center, USGS BRD (Bennett 1995). Bennett compiled floras from “numerous sources: park lists, published journal articles and books, vegetation surveys, natural history reports, herbarium lists, park files and memoranda, and other miscellaneous park reports.” Species names were standardized to USDA PLANTS (1999) and inconsistencies in infraspecific designations were resolved on a case-by-case basis.

Compiling Existing Inventory Data

Concurrent with development of expected species lists, HTLN staff worked with technical support from the Natural Resource Program Center (NRPC) to consolidate existing inventories. HTLN staff searched for existing inventory data, extracted species lists from the reports, labeled the lists with appropriate reference information, and forwarded the data to NRPC for processing.

HTLN staff mined inventory data from regional inventory databases, and transferred the network’s Flora database. Staff also assembled bibliographic data concerning the primary park inventories. The Procite bibliographic database, NatureBib (aka NRBIB), was queried to produce an initial list of references. The lists were reviewed to ensure that each inventory: 1) included primary, rather than secondary, inventory data; 2) was based on observed, not expected, occurrences; and 3) was the result of professional surveys or research, rather than amateur observations. Park resource managers then reviewed and added to the lists.

HTLN staff searched for references to botanical collections as sources of species occurrence records. The process of searching regional herbaria for pertinent species records then commenced. The primary objectives were: 1) to find previously unknown collections; and 2) to document the current repository for older, known collections. The HTLN initiated a cooperative agreement with the National Wildlife Health Center (Biological Resources Division) to conduct

computerized searches of regional and national museums and herbaria for park records of vertebrate and vascular plant occurrences. Given the limited timeframe, repositories with searchable collections databases were used. Dr. Jim Bennett, author of a summary of Midwestern NPS floras (Bennett 1995), was the principal investigator and was assisted with results of a search of the GWCA ANCS+ database collection provided by the HTLN.

ANCS+ is a database management system developed by NPS to accession and catalog its museum collections.

The NPSpecies Database

NPSpecies is a master database for documenting the occurrence and status of all organisms in NPS units. The database includes standardized information associated with the occurrence of species, including scientific names and their synonyms (i.e. a local list or a standard list of species names), common names, abundance, residency, nativity, T&E status, and notes of particular management interest to a park. NPSpecies supports NPS staff and collaborators at the park, network, regional, and national levels by managing fundamental park-level species information, and making this information available to other applications and databases for more specialized analyses. A primary purpose for NPSpecies is to provide park managers, planners, and scientists with basic information on species occurrences and status for making decisions and working with other agencies, the scientific community, and the public for the long-term protection of park ecosystems (NPSpecies 2009).

Within NPSpecies, each species record is supported by evidence in the form of voucher specimens, references (scientific reports or datasets), and/or observation records that document the occurrence of the species in the park. Historical and currently-accepted scientific names from multiple taxonomic classification systems are cross-referenced using taxonomic standards (e.g., the Integrated Taxonomic Information System and the USDA PLANTS database) to allow for data integration and sharing across parks and with other agencies and organizations. In addition, parks are able to produce species lists based on the taxonomic authorities that are most accepted in their region and by their partner agencies.

Populating NPSpecies focused on three objectives: 1) transferring existing data; 2) including evidence for each record; and 3) verifying the accuracy of lists. As master species lists were compiled and transferred into NPSpecies a conservative approach was taken while assigning park status (e.g. present, probably present, etc.) to ensure that assessments of completeness were based on verifiable records. Many records imported from previous databases were unsubstantiated (i.e. not linked to a verifiable data source) and were classified as unconfirmed. Verification of vertebrate taxa was conducted by comparing digital records to original sources. The process proved valuable for assuring data quality as transcription errors, spelling mistakes, erroneous names, and synonymy problems were identified and corrected. In the process, park status (e.g. present in park, probable, unconfirmed) were also updated. After verifying and updating, any remaining species without evidence were assigned an 'unconfirmed' status. Reliable status information is necessary to generate verifiable species lists for use in assessing inventory completeness. WASO I&M then completed the processing of these data and returned an NPSpecies database.

Inventories

Targeted field inventories were conducted to augment existing inventory data while addressing information gaps and high priority information needs. Two workshops were held during FY 2000 to assist in determining and prioritizing inventory needs (see appendix F in Boetsch et al 2000). Regional taxa experts participated in these workshops and helped to revise project plans and priorities, and develop a greater awareness of taxa-specific inventory methods.

Subsequent to these initial steps, the HTLN began implementing inventories of amphibians and reptiles, fish, mammals, and vascular plants. When completed, inventory reports were submitted to the HTLN and, once finalized, bibliographic data and the final report were uploaded to NatureBib. Species data (ie. taxonomic name, park status, abundance, etc.) and voucher data were uploaded to NPSpecies. Primary inventory data (ie. locations, events, etc.) and inventory specific data (i.e. bird counts, amphibian observations, etc.) were entered in a Microsoft (MS) Access database standardized to the current natural resource database template (NRDT) and uploaded to the NPS Data Store.

Inventory Certification

To support the objective of documenting 90% of vertebrate and vascular plant species expected to occur, subject matter experts (i.e. those involved with GWCA inventories) participated in the NPSpecies certification of taxonomic and attribute data for each taxa list. The process of certification is a data validation and quality assurance procedure for species checklists performed by subject matter experts most familiar with a particular taxonomic category. Taxon nomenclature are documented as well as park status, abundance, residency, and nativity.

Certification of the bird data relied on a prior breeding bird survey (Jones et al 1995a) and accompanying bird observation summaries (Jones 1992-1996) and personal communications with the author. Amphibian, reptile, fish, and mammal certifications were compiled with current inventory data (Trauth and McCallum 2003, Petersen and Justus 2005, Robbins 2005).

Certification of the vascular plants was completed by Jones (2004) and accompanying reports (Jones et. al. 1995b, 1995c). Generally, species lists were distributed as MS Excel worksheets and returned with revisions. Revised expected species lists containing a species park status (present, probably present, etc), abundance (common, uncommon, rare, etc), residency (breeder, resident, etc), and nativity as well as other attribute details were then updated (where necessary) via the desktop NPSpecies to reflect the current species' park status. These lists were then uploaded to the master online version of NPSpecies.

Results

Thirty references (see Appendix 1) and 137 vouchers led to the certification of 957 species (NPSpecies 2009). In total, 909 species were categorized as Present in Park and 48 as Probably Present (Table 1). Additionally, 136 species were categorized as Unconfirmed, Historic, or Encroaching. Unconfirmed species were ranked as such due to weak evidence supporting their existence on the park.

Currently 83% of the species on the park's species list are documented (i.e., categorized as Present in Park). If species listed as Present in Park and Probably Present are included in the calculation, the percentage of documented species rises to 88%.

Table 1. Count of species by park status categories at GWCA (NPSpecies 2009).

Park Status¹	Bird	Fish	Mammal	Amphibian	Reptile	Vascular Plant	Total
Present in Park	179	27	23	5	13	662	909
Probably Present	13	7	21	3	4		48
Encroaching	3						3
Unconfirmed		1	11			97	109
Historic			1		1	22	24
Total	195	35	56	8	18	781	1,093

¹ Refer to the Appendix for definitions of Park Status categories.

Of the 909 species documented as present, reviewers assigned a general abundance category (e.g., common, rare, etc.) to 892 (98%) (Table 2). Reviewers believed additional information was needed before an abundance category could be assigned to the remaining 17 (2%) species. Results are available to NPS staff through the Natural Resource Information Portal at <http://nrinfo.nps.gov/Home.mvc>. The portal is the product of the Integration of Resource Management Applications (IRMA) project. To learn more see: http://www1.nrintra.nps.gov/im/datamgmt/docs/IRMA_ProjectBrief_v1.0.pdf.

Residency values (e.g., breeder, migrant, resident, etc.) were assigned for all documented vertebrates with the exception of two reptiles and one mammal that were categorized as unknown. Unknown residency values were assigned primarily because it was unclear as to whether or not the species bred on the park. Non-natives documented to occur in the park (i.e., Present in Park) total 120. Of these, three are birds, two fish, one mammal, and the remaining 114 are vascular plants.

NatureServe, in cooperation with The Nature Conservancy and NPS, developed a protocol to rank the impact of non-native invasive vascular plants (Morse et al. 2004). Through a series of standardized questions, non-native species are evaluated and assigned an Invasive Species Impact Rank (I-Rank) based on impact to native species and natural biodiversity. I-Ranks are categorized as high, medium, low, or insignificant. Ten of the 23 (43%) invasive exotic plants found on GWCA (Cribbs et al 2007) received an overall I-Rank score that included the high category (Table 3.). All are known to occur in the park (i.e., Present in Park).

A total of 15 species (Table 4) currently meet at least one of the following criteria, in this order:

- Listed on the Missouri Department of Conservation Heritage Database as a status species for Newton County.
- Listed on the Missouri Fish and Wildlife Information System as a state status species.
- Listed by the U.S. Fish and Wildlife Service under the auspices of the U.S. Endangered Species Act of 1973, as amended.

If a species met the criteria at the local level, the broader level was included. Additional NatureServe global, national, and subnational ranking status is provided when one of the above conditions apply. The 15 listed species included two amphibians, five birds, three fish, four mammals, and one vascular plant. The federally listed threatened Ozark cavefish (*Amblyopsis rosae*) is considered extirpated from GWCA. Two other federally listed endangered species, the Indiana bat (*Myotis sodalis*) and endangered gray bat (*Myotis grisescens*), were unconfirmed at the Monument.

Table 2. Count of species by abundance categories at GWCA (NPSpecies 2009).

Abundance Category¹	Bird	Fish	Mammal	Amphibian	Reptile	Vascular Plant	Total
Abundant	31	3				44	78
Common	40	21	17	1	1	157	237
Uncommon	35	3	5	1	1	238	283
Rare	32			1	2	203	238
Occasional	39					17	56
Unknown	2		1	2	9	3	17
Total	179	27	23	5	13	662	909

¹ Refer to the Appendix for definitions of Park Status categories.

Table 3. Non-native plants, occurring on GWCA, with an Invasive Species Impact Rank (I-Rank) containing high.

Scientific Name	Common Name	Overall I-Rank	Ecological Impact ¹	Management Difficulty ²	I-Rank Reasons Summary ³
Acer platanoides	Norway maple	High / Medium	Medium	Medium / Low	Commonly planted shade and street tree escaping and increasing its presence in natural areas for several years; reproduces vigorously; re-sprouting after cutting makes it difficult to eliminate; widespread.
Bromus inermis	Smooth brome	High / Medium	Medium	Medium	A threat to prairie and grasslands in the Midwest; alters rate of natural succession; changes native species composition; highly persistent.
Bromus tectorum	Cheatgrass	High	High	High / Medium	Found in all fifty states; widespread in abandoned fields, riparian vegetation, riparian meadows, grasslands, abandoned cropland, roadsides, and "waste places".
Carduus nutans	Nodding thistle	High / Low	Medium / Insignificant	High / Medium	Persistent in open areas, including prairies, grasslands, roadsides and areas of disturbance in dense woods; prolific seed production; seeds viable for up to 15 years.
Celastrus orbiculatus	Oriental bittersweet	High / Medium	Medium / Low	Medium	Reduces system-wide light levels and alters community structure and composition; invasive in much of its range; invades a number of habitats; long-lived seed bank.
Datura stramonium	Jimson weed	High / Low	Medium / Low	Unknown	Widespread throughout the US in disturbed habitats and nearby natural areas; poisonous to humans and livestock.
Elymus repens	Creeping wild rye	High / Medium	Medium / Low	High / Medium	Widespread in the US; forms dense, monospecific stands; out competes native grasses suppressing growth and reproductive vigor; difficult, costly, and time consuming to control.
Euonymus fortunei	Winter creeper	High / Medium	Medium	Low / Insignificant	Forms dense mats; climbs and eventually kills trees; prevents regeneration/recruitment of ground flora; competes with native species; found in forests/natural openings; spreads vegetatively.

Table 3 (cont.). Non-native plants, occurring on GWCA, with an Invasive Species Impact Rank (I-Rank) containing high.

Scientific Name	Common Name	Overall I-Rank	Ecological Impact ¹	Management Difficulty ²	I-Rank Reasons Summary ³
Hedera helix	English ivy	High / Medium	Medium	Medium / Low	Negatively effects forest biodiversity; no guaranteed method for either keeping it out of natural areas or removing it once it has established.
Hypericum perforatum	Common St. John's Wort	High / Medium	Medium / Low	Medium	Threatening natural areas in most areas of the US; associated with a loss of biodiversity; forms dense monocultures; treatable if caught early, else, its prolific reproductive ability will prevent easy and inexpensive management.
Ligustrum vulgare	Common privet	High / Medium	High / Low	High / Medium	Extremely aggressive and escapes from cultivation; forms dense and impenetrable thickets that crowd out native species; prolific seed producer; difficult to control.
Lonicera japonica	Japanese honeysuckle	High / Medium	Medium	High / Medium	Can have extremely negative consequences for forest communities/forest structure. Few effective control methods known.
Lonicera maackii	Amur honeysuckle	High	High / Medium	Medium	Exhibits significant canopy disturbance; inhibits native tree seedlings; occurs in most states; capable of invading native wooded areas; control is costly and difficult.
Morus alba	White mulberry	High / Medium	Medium / Low	Medium / Low	Distributed throughout most of the U.S.; spread by birds and mammals; moderate capability of invading undisturbed areas.
Plantago lanceolata	English plantain	High / Low	High / Low	High / Low	Widespread in every US state; common in disturbed areas; invades native grasslands; rapidly colonizes open areas and forms dense swards that crowd out native vegetation; seeds remain viable for 10 years.
Poa compressa	Canada bluegrass	High / Low	Medium / Low	High / Medium	Widespread in the U.S. in disturbed areas, prairies, and ridgetop woodlands; may crowd out native species; forms large colonies; spreads very quickly; control is difficult.

Table 3 (cont.). Non-native plants, occurring on GWCA, with an Invasive Species Impact Rank (I-Rank) containing high.

Scientific Name	Common Name	Overall I-Rank	Ecological Impact ¹	Management Difficulty ²	I-Rank Reasons Summary ³
Potentilla recta	Sulphur cinquefoil	High / Medium	High / Low	Medium / Low	Widespread in the U.S. in open grasslands, shrubby areas, open forest, logged areas, roadsides, waste areas, and abandoned fields; very competitive in native grasslands; can become dominant in forest habitats; colonizes and dominates disturbed sites; capable of invading relatively undisturbed sites; control is moderately difficult.
Securigera varia	Crown vetch	High	High	Low	Alters the fuel loads in fire-adapted ecosystems; creates dense monospecific stands by strongly out competing native plants; impacts high-quality occurrence of common and rare native plant communities; widespread across the U.S.
Sorghum halepense	Johnsongrass	High / Medium	Medium / Low	High / Medium	Severely inhibits pioneer grass species; massive size creates difficulties for the establishment of other plants; competitive edge over other species; one of the most frequently listed noxious weeds in the U.S.; control is difficult and costly.

¹ Subcategory of Overall I-Rank specifically addressing species negative impacts on native plant/animal populations/communities.

² Subcategory of Overall I-Rank specifically addressing difficulty of control.

³ Summary reasons for NatureServe Overall I-Rank. For more information see the NatureServe Species Explorer at <http://www.natureserve.org>. These summaries reflective of NatureServe data last updated 6 February, 2009.

Table 4. Species on the park's local list which possess a state heritage program rank and/or other designated conservation status (State Heritage Conservation Rank/Status, Global, National, Subnational, and/or a Federal Status).

Amphibian	Scientific Name	Park Status¹	State Heritage Program Rank/Status²	Federal Status³	Global / National / Subnational Status⁴	Global Short Term Trend⁴
Eastern tiger salamander	<i>Ambystoma tigrinum tigrinum</i>	Present in Park	Unranked ^a		G5 / N5 / SU	Secure?
Grotto salamander	<i>Typhlotriton spelaeus</i>	Extirpated*	S2S3 ^a		G4 / N4 / S2S3	Declining to stable
Bird						
Bald eagle	<i>Haliaeetus leucocephalus</i>	Present in Park	S3 / Endangered		G5 / N5B,N5N / S3	Stable to increasing
Northern harrier	<i>Circus cyaneus</i>	Present in Park	S2 / Endangered		G5 / N5B,N5N / S2	Stable
Painted bunting	<i>Passerina ciris</i>	Present in Park	S3 ^a		G5 / N5B / S3	Declining
Sharp-shinned hawk	<i>Accipiter striatus</i>	Present in Park	S3 ^a		G5 / N5B,N5N / S3	Declining (10-30%)
Swainson's hawk	<i>Buteo swainsoni</i>	Present in Park	S2 ^a		G5 / N5B / S2	Common/Declining
Fish						
Arkansas darter	<i>Etheostoma cragini</i>	Present in Park	S3S4 ^a		G3 / N3N4 / S3S4	Declining to stable
Ozark cavefish	<i>Amblyopsis rosae</i>	Extirpated*	S2 / Endangered	Threatened	G3 / N3 / S2	Stable
Plains topminnow	<i>Fundulus sciadicus</i>	Unconfirmed	S3 ^a		G4 / N4 / S3	Declining to stable
Mammal						
Black-tailed jackrabbit	<i>Lepus californicus</i>	Historic	S1 / Endangered		G5 / N5 / S1	Declining in Missouri

*The grotto salamander and Ozark cavefish are considered possibly extirpated due to non-conductive habitat.

Table 4 (cont.). Species on the park's local list which possess a state heritage program rank and/or other designated conservation status (State Heritage Conservation Rank/Status, Global, National, Subnational, and/or a Federal Status).

Mammal	Scientific Name	Park Status¹	State Heritage Program Rank/Status²	Federal Status³	Global / National / Subnational Status⁴	Global Short Term Trend⁴
Gray bat	<i>Myotis grisescens</i>	Unconfirmed	S3 / Endangered	Endangered	G3 / N3 / S3	Stable
Indiana bat	<i>Myotis sodalis</i>	Unconfirmed	S1 / Endangered	Endangered	G2 / N2 / S1	Rapidly declining (10-50%)
Spotted skunk	<i>Spilogale putorius</i>	Unconfirmed	S1 / Endangered		G5 / N5 / SNR	Declining in Missouri
Vascular Plant						
Coontail	<i>Ceratophyllum echinatum</i>	Unconfirmed	S1? ^a		G4? / N4? / S1?	Declining (decline of 10-30%)

¹ Refer to the Appendix for definitions of Park Status categories.

² The official endangerment status the Missouri Fish and Wildlife Information System has assigned to this species (species status denoted with ^a were obtained from the Missouri Department of Conservation Heritage Database). Critically Imperiled in the nation or state because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation from the state. Typically 5 or fewer occurrences or very few remaining individuals (<1,000); S2: Imperiled in the nation or state because of rarity or because of some factor(s) making it very vulnerable to extirpation from the nation or state (1,000-3,000); S3: Vulnerable in the nation or state either because rare and uncommon, or found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extirpation. Typically 21-100 occurrences or 3,000-10,000 individuals; S4: Apparently Secure: Uncommon but not rare, and usually widespread in the nation or state. Possible cause of long-term concern. Usually more than 100 occurrences and more than 10,000 individuals.

³ U.S. Endangered Species Act: Current status of the taxon as designated or proposed by the U.S. Fish and Wildlife Service (USFWS), and as reported in the U.S. Federal Register in accordance with the U.S. Endangered Species Act of 1973, as amended.

⁴ The NatureServe conservation status, developed by NatureServe and its network of member (state) programs, of a species from a state/province perspective, characterizing the relative imperilment of the species. G = global (rounded), N = national, and S = subnational; 1 = critically imperiled, 2 = imperiled, 3 = vulnerable, 4 = apparently secure, 5 = secure; B=Breeding population, NR=Not rated. Refer to <http://www.natureserve.org/explorer/ranking.htm#interpret> for additional information on conservation status ranks.

Discussion

The NPS Inventory Strategic Plan states that “the ultimate goal is to establish an accurate inventory of all life forms within a park...” (NPS 2009; see also NPS 1992). The HTLN supports this goal by documenting over 80% of all vertebrates and vascular plants known to occur at GWCA. One result of these efforts is the compilation of reliable species lists. These lists, however sound, should always be considered incomplete. Inventory lists will change as new information about species distributions becomes available. The overall number of species designated as Present in Park or Probably Present is similar to similarly sized parks in the HTLN (Table 5).

Table 5. Number of species designated as present in park or probably present in HTLN parks (NPSpecies 2009).

Park	Bird	Fish	Mammal	Amphibian	Reptile	Vascular Plants	TOTALS	Park Size (ac.)
GWCA	192	34	44	8	17	662	957	210
HOME	81	31	41	6	9	304	472	160
HEHO	120	28	45	1	11	230	435	186
LIBO	224	-	38	13	13	332	620	200
HOCU	274	15	40	21	25	457	832	280
PIPE	252	20	31	6	6	557	872	282
ARPO	111	65	33	17	40	332	598	389
EFMO	220	93	43	9	21	426	812	1,481
WICR	134	53	48	11	31	569	846	1,750
PERI	74	41	44	21	36	665	881	4,300
HOSP	114	52	49	22	45	910	1,192	5,549
TAPR	136	29	42	8	27	456	698	10,894
CUVA	241	65	37	19	21	1,167	1,550	32,859
OZAR	167	122	55	29	45	880	1,298	82,196
BUFF	211	78	58	22	43	1,353	1765	95,730

Future Inventory Efforts

While significant strides have been made in documenting the presence of vertebrate species and vascular plants, it is anticipated that additional survey efforts will be required to increase the number of documented species (i.e. Present in Park). For example, roughly half of the mammals and amphibians and a third of the fish and reptiles are listed as probably present but lack adequate documentation. Additionally, two federally listed species (Indiana bat and gray bat, both endangered) are currently listed as Unconfirmed. If species are thought to be Probably Present or Unconfirmed, follow-up surveys (perhaps targeted inventories?) are warranted or existing monitoring programs broadened to include searches for these species. The grotto salamander and Ozark cavefish are both considered extirpated. Additional follow up inventories coupled with habitat studies may document their presence. Park status for vascular plants may need to be updated with additional inventories. At the onset of the HTLN Inventory Study Plan, local botanists acknowledged that in general, basic inventory needs had been met (Boetsch et al 2000). This was supported by plant collections made by the eminent Missouri botanist, Ernest J.

Palmer, who thoroughly inventoried the park shortly after its inception (1954-1960)(see also Palmer 1983). However, several species are Unconfirmed.

Reviewers assigned a general abundance category for all but 17 of the documented species (9 reptiles, 3 vascular plants, 2 birds, 2 amphibians, 1 mammal). Reviewers also assigned a residency value for all but two reptiles. Continued monitoring of the species may provide for updated abundance and residency.

Based on the results of the data reported herein, future inventory recommendations include:

- additional resources to survey for species listed in Table 4,
- coupled with the above, focus on species listed as Probably Present, Unconfirmed, and Historic,

Key Findings of Management Interest

- Recent mammal inventories suggested that the number of species documented is a good reflection of the methods utilized and that it is likely that many species now designated as probably present will be encountered with additional surveys.
- The recent plant inventory identified three areas of special concern that offered refuge for several species. These are the wet prairie areas located in southwest prairie unit 5, west unit 6, and in the south-central unit 3, Williams Pond, and Harkins woodland. Ongoing plant community monitoring of these and other communities by the HTLN has resulted with “good” baseline data for future analyses.
- The recent invasive exotic plant inventory and current monitoring documented four widespread and abundant species at GWCA. Several species were categorized as a moderate problem but several others may be successfully controlled.
- Four fish species documented by the recent inventory at GWCA were categorized by the USGS as “special interest” to park managers. These include: the cardinal shiner (*Luxilus cardinalis*) and stippled darter (*Etheostoma punctulatum*), endemic to the Ozark Plateaus; the Arkansas darter (*Etheostoma cragini*), restricted to parts of the Ozark Plateaus in the Arkansas River Basin and to other localities in the Arkansas River Basin west of the Ozark Plateaus; and the common carp (*Ctenopharyngodon idella*), present in Williams Pond (and possibly harming native species and habitat).
- The recent herpetofauna inventory discussed the absence of several species and possible causes: absence of several species due to the lack of breeding ponds and lack of sufficient fallen logs within the woodland; absence of the Oklahoma salamander (*Eurycea tynnerensis*) due to fish predation; absence of two spring species, graybelly salamander (*Eurycea multiplicata griseogaster*) and grotto salamander, due to drought conditions and construction of wooden walkways immediately adjacent to the spring. Trauth et al (2003) noted the fact that northern cricket frogs (*Acris crepitans*) were abundant in other aquatic habitats at GWCA but absent from the area around Carver Spring as suspicious. Cricket frogs are

commonly encountered along springs; consequently, because large populations of this species are in the vicinity (e.g., Carver Pond), Trauth et al (2003) expected to find them at this spring as well. No other amphibian species were present in the spring either, although ranid tadpoles were observed in the nearby stream (these ranids are believed to be fairly resistant to pollution).

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Appendix 2. NPSpecies Data Dictionary

Park Status	The current status of each species in each park.	Applicable only to organisms with the <i>Local List</i> checkbox checked. The possible values reflect a combination of confidence, and availability and currency of verifiable evidence in NPSpecies.
Present in Park	Species' occurrence in park is documented and assumed to be extant.	Extremely high confidence that the species is currently in the park. A current, verifiable reference, voucher, or observation is included in NPSpecies.
Probably Present	Park is within species' range and contains appropriate habitat. Documented occurrences of the species in the adjoining region of the park give reason to suspect that it probably occurs within the park. The degree of probability may vary within this category, including species that range from common to rare.	Very high confidence that the organism is currently in the park. Verifiable evidence may exist in NPSpecies, but is not considered current enough to elevate the status to Present in Park. Efforts should be made to obtain current, verifiable evidence in NPSpecies to elevate the Park Status to "Present in Park". If reasonable efforts to obtain current, verifiable evidence are unsuccessful, then the Park Status should be changed to Unconfirmed, Historic, Encroaching, or False Report as applicable.
Unconfirmed	Included for the park based on weak ("unconfirmed record") or no evidence, giving minimal indication of the species' occurrence in the park.	Any confidence from very low to high that the organism is currently in the park. Verifiable evidence may exist in NPSpecies, but it is not considered sufficient enough to elevate the status to Probably Present, nor current enough to elevate the status to Present. Efforts should be made to obtain current, verifiable evidence in NPSpecies to elevate the Park Status to "Present in Park". If reasonable efforts to obtain current, verifiable evidence are unsuccessful, then the Park Status should be changed to Historic, Encroaching, or False Report as applicable.
Encroaching	The species is not documented in the park, but is documented as being adjacent to the park and has potential to occur in the park.	Extremely low confidence that the organism is currently in the park, but extremely high confidence that the organism is currently adjacent to the park. Verifiable evidence may exist in NPSpecies documenting the occurrence in the park, but it is not current. Potential invasive organisms are good candidates for this Park Status designation, either before they enter a park or after they have been eliminated from a park.
Historic	Species' historical occurrence in the park is documented, but recent investigations indicate that the species is now probably absent.	Extremely low confidence that the organism is currently in the park. Verifiable evidence exists in NPSpecies, but is not current. Extinct, extirpated or eliminated species are candidates for a Historic <i>Park Status</i> designation.
False Report	Species previously reported to occur within the park, but current evidence indicates that the report was based on a misidentification, a taxonomic concept no longer accepted, or some other similar problem of interpretation.	Extremely low confidence that the organism is currently in the park. Evidence exists in NPSpecies, but it cannot be sufficiently verified.

Appendix (cont.). NPSpecies Data Dictionary

Abundance	The current abundance of each organism in each park.	Applicable only to organisms with the <i>Local List</i> checkbox checked and a <i>Park Status</i> of "Present". The values attempt to balance abundance with suitable habitat, and temporal/behavioral considerations. In practice, the entered value should apply (although there are numerous exceptions) to the abundance in the most suitable habitat of the organism, and at the time that the organism is engaged in it's principle behavior in (e.g. breeding, migrating, hibernating, etc.), or most important behavior to, the park. A future generation of NPSpecies will address the coding of <i>Abundance</i> (and associated <i>Residency</i>) to separate out the temporal and behavioral aspects. The Data Source field for Abundance is available to provide a citation that specifically addresses abundance in more detail.
Abundant		Animals: May be seen daily, in suitable habitat and season, and counted in relatively large numbers. Plants: Large number of individuals; wide ecological amplitude or occurring in habitats covering a large portion of the park.
Common		Animals: May be seen daily, in suitable habitat and season, but not in large numbers. Plants: Large numbers of individuals predictably occurring in commonly encountered habitats but not those covering a large portion of the
Uncommon		Animals: Likely to be seen monthly in appropriate season/habitat. May be locally common. Plants: Few to moderate numbers of individuals; occurring either sporadically in commonly encountered habitats or in uncommon habitats.
Rare		Animals: Present, but usually seen only a few times each year. Plants: Few individuals usually restricted to small areas of rare habitat.
Occasional		Animals: Occurs in the park at least once every few years, but not necessarily every year. Plants: Not applicable.
Unknown		Abundance unknown.
Residency	Current residency classification for each ANIMAL species in each park.	Applicable only to ANIMALS with the <i>Local List</i> checkbox checked and a <i>Park Status</i> of "Present". The values attempt to balance temporal and behavioral considerations. In practice, the entered value should apply (although there are numerous exceptions) to the residency of the organism at the time that the organism is engaged in its principle behavior (e.g. breeding, migrating, hibernating, etc.) in, or most important behavior to, the park. A future generation of NPSpecies will address the coding of <i>Residency</i> (and associated <i>Abundance</i>) to separate out the temporal and behavior aspects. The Data Source field for Residency is available to provide a citation that specifically addresses Residency in more detail.
Breeder		Population reproduces in the park.
Resident		A significant population is maintained in the park for more than two months each year, but it is not known to breed there.
Migratory		Migratory species that occurs in park approximately two months or less each year and does not breed there.
Vagrant		Park is outside of the species' usual range.
Unknown		Residency status in park is unknown.

Appendix (cont.). NPSpecies Data Dictionary

Nativity	Nativity classification for each organism for each park	Applicable only to organisms with the <i>Local List</i> checkbox checked. If the park-status of an organism is not “Present in Park”, then nativity represents the nativity if the organism were eventually confirmed in the park.
Native	Native	The organism is native, or would be native, to the park (either endemic or indigenous).
Non-native	Non-native	The organism is not native, or would not be native, to the park (neither endemic nor indigenous).
Unknown	Unknown	Nativity status in the park is unknown.

The NPS has organized its parks with significant natural resources into 32 networks linked by geography and shared natural resource characteristics. The Heartland Network is composed of 15 National Park Service (NPS) units in eight Midwestern states. These parks contain a wide variety of natural and cultural resources including sites focused on commemorating civil war battlefields, Native American heritage, westward expansion, and our U.S. Presidents. The Network is charged with creating inventories of its species and natural features as well as monitoring trends and issues in order to make sound management decisions. Critical inventories help park managers understand the natural resources in their care while monitoring programs help them understand meaningful change in natural systems and to respond accordingly. The Heartland Network helps to link natural and cultural resources by protecting the habitat of our history.

The I&M program bridges the gap between science and management with a third of its efforts aimed at making information accessible. Each network of parks, such as Heartland, has its own multi-disciplinary team of scientists, support personnel, and seasonal field technicians whose system of online databases and reports make information and research results available to all. Greater efficiency is achieved through shared staff and funding as these core groups of professionals augment work done by individual park staff. Through this type of integration and partnership, network parks are able to accomplish more than a single park could on its own.

The mission of the Heartland Network is to collaboratively develop and conduct scientifically credible inventories and long-term monitoring of park “vital signs” and to distribute this information for use by park staff, partners, and the public, thus enhancing understanding which leads to sound decision making in the preservation of natural resources and cultural history held in trust by the National Park Service.

www.nature.nps.gov/im/units/htln/



The Department of the Interior protects and manages the nation’s natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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