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AMPHIBIANS AND REPTILES OF THE GREAT FALLS BYPASSED REACHES IN SOUTH CAROLINA

MICHAEL E. DORCAS, STEVEN J. PRICE, and GENE E. VAUGHAN[1]

Department of Biology, Davidson College, Davidson, NC 28035

[1]*Duke Power Environmental Services, Huntersville, NC 28078*

Abstract: An inventory was conducted of the amphibians and reptiles inhabiting the Great Falls Bypassed Reaches of the Catawba River in South Carolina. A list of 85 species of amphibians and reptiles potentially occurring in the Great Falls Bypassed Reaches was generated using known distributional ranges and museum records. A variety of survey techniques were used to document the occurrence of 42 species of these amphibians and reptiles, including 12 species of anurans, 6 salamanders, 7 turtles, 6 lizards, and 11 snakes. No species of amphibian or reptile considered rare, threatened or endangered by the state of South Carolina or the federal government was documented. Numerous ephemeral wetlands within the Great Falls Bypassed Reaches provide habitat for several species of amphibians and some reptiles that would likely otherwise not occur there. Adding resource enhancement flows of water, including intentional periodic flooding or spate high water events, to the bypassed reaches will likely eliminate or significantly disturb these wetlands, thus lowering habitat diversity and reducing or eliminating some populations of these species, while potentially creating habitat for riverine species.

Key Words: Amphibians; Reptiles; Catawba River; Great Falls Bypassed Reaches; Herpetological Inventory; Flooding; Diversion Dam; South Carolina.

INTRODUCTION

Approximately half of the more than 450 U.S. amphibian and reptile species occur in the southeastern United States and nearly 100 of these are endemic (Gibbons, 1993; Conant and Collins, 1998; Tuberville et al., 2005). Amphibians and reptiles are ectotherms and characteristically have high energy conversion efficiencies compared to birds and mammals (Pough, 1980). Amphibians and reptiles can often exceed the biomass of all other vertebrates within an ecosystem because they are so energy efficient, although many species are rarely seen (Burton and Likens, 1975; Congdon and Gibbons, 1989; Godley, 1980; Iverson, 1982; Petranka and Murray, 2001). Amphibians and reptiles serve important roles as both predators and prey (Gibbons and Dorcas, 2004; Taylor et al., 1988) and thus represent important trophic links in many ecosystems. Additionally, because many live in both terrestrial and aquatic habitats, they serve as important nutrient vectors between habitats (Gibbons et al., in press). Hence, the diversity and status of amphibian and reptile populations are likely to reflect the ecological integrity of an area, as well as the consequences of anthropogenic habitat modifications (Gibbons, 1988; Gibbons et al., 2000; Knutson et al., 1999; Vitt et al., 1990). The first critical step in assessing an area's ecological integrity is to conduct biotic inventories designed to accurately describe the species present. Documented species lists provide a baseline for and give direction to effective conservation efforts and land management programs.

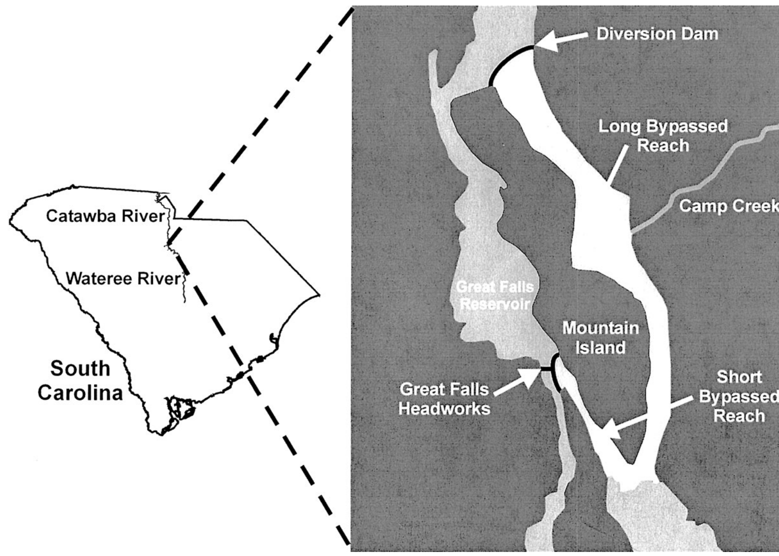

FIG. 1. Location and map of study site near Great Falls, South Carolina.

Unfortunately, knowledge of the herpetofaunal diversity and distribution in many areas of the Southeast is still lacking. One such region is the majority of the state of South Carolina. Except for intensive, long-term surveys of a few areas (e.g., the Savannah River Site), little published documentation of the distribution of herpetofauna in South Carolina exists. Nevertheless, many areas in the state are likely to harbor high herpetofaunal diversities and abundances. One such area includes the Great Falls Bypassed Reaches of the Catawba River situated only slightly north of the juncture of the Piedmont and Upper Coastal Plain. This area is likely to harbor herpetofauna characteristically found in the Piedmont, but may also include some species typically associated with Coastal Plain environments. Additionally, a large number of habitat types within the Bypassed Reaches, including numerous ephemeral wetlands, provide a unique situation particularly favorable for high herpetofaunal diversity.

Our goal was to document the species richness of amphibians and reptiles in the Great Falls Bypassed Reaches of the Catawba River in South Carolina. We also comment on apparent relative abundance of each species and discuss the potential impacts of periodic and permanent flooding on the reptile and amphibian community.

METHODS

Study Site

The Great Falls Bypassed Reaches are situated along the Catawba River near the town of Great Falls, Chester County, SC (Fig. 1). The Great Falls Long Bypassed Reach is immediately downstream of Fishing Creek Dam and was created in 1907 by the building of the Great Falls Diversion Dam (Fig. 1). The purpose of the diversion dam was to divert water through a canal west of Mountain Island for hydroelectric generation at the Great Falls and Dearborn hydroelectric stations. The Long Bypassed Reach consisted of approximately 3.2 km of old riverbed and nearby upland habitats. The Short Bypassed Reach was 1.2 km long.

Numerous habitats exist within the study area. Upland habitats include loblolly pine (*Pinus taeda*), various hardwood and mixed pine-hardwood forests (dominant trees include sweet gum, *Liquidambar styraciflua*; green ash, *Fraxinus pennsyvlanica*; sycamore, *Platanus occidentalis*; winged elm, *Ulmus alata*) on the islands and hillsides on either side of the Bypassed Reaches. Forested habitats on the eastern side tend to be drier than those on the western side of the study area because of greater exposure to the sun. One major stream (Camp Creek) enters the Long Bypassed Reach approximately 1.6 km downstream of the Diversion Dam and provides considerable water flow for approximately 1.8 km along the eastern side of the study area. Rocky hillsides that potentially provide refuge for many species of amphibians and reptiles occur on both sides of the Bypassed Reaches. Within the Bypassed Reaches, the terrain is extremely rocky with substantial soil only occurring in areas not prone to frequent flooding. Numerous seeps provide other aquatic habitats throughout the study area.

Flooding over the Diversion Dam provides water periodically to aquatic habitats during high water events. Partly as a consequence of periodic flooding and the terrain, numerous wetlands and ponds can be found throughout the study area. Some of these are found in upland habitats that apparently were not part of the old riverbed. Most are found throughout the old riverbed with some being ephemeral and others apparently permanent.

Sampling Methods

We generated a list of within-range species for the study area based on geographic distribution maps published by Conant and Collins (1998) prior to initiating field surveys. Unfortunately, there were no publications or documents that provided detailed distribution records for amphibians and reptiles in South Carolina. Consequently, we requested all amphibian and reptile records for Chester, Lancaster, and Fairfield counties in South Carolina from 34 museums, universities, and other appropriate organizations to assist in developing a more accurate potential species list. Based on range maps in Conant and Collins (1998) and other locality records, we categorized species as either potentially occurring in the Bypassed Reaches area or, for species that occur or likely occur in the upper Coastal Plain of South Carolina in close proximity to the study site, peripheral to the Bypassed Reaches area.

Sampling was conducted for 3 to 6 days per month from March through June 2004 and for two days during September 2004. Sampling was not conducted during July and August because many amphibians and reptiles become inactive and thus difficult to find during this time. Sampling was also conducted for two days during spring 2005 to assess the impacts of heavy flooding that occurred following hurricane events (i.e., hurricanes Frances and Ivan) during Fall 2004. Total sampling effort was 23 days (245 total person days). Generally, sampling was conducted during the daytime, but on several occasions when weather conditions were favorable for calling anurans, we sampled at night. Sampling consisted of general herpetological collecting techniques including turning over cover objects, systematic searching in favorable habitats, dipnetting, and anuran calling surveys. For some species a limited number of voucher specimens were collected (anuran tadpoles, salamander larvae). All voucher specimens were deposited in the North Carolina Museum of Natural Sciences.

Intensive sampling was conducted at seven aquatic sites within the study area. These sites were selected because they were representative of the variety of aquatic habitats present in the study area. Combinations of automated recording systems (Peterson and Dorcas, 1994;

Table 1. Peripherally occurring, potentially occurring and documented amphibians of the Great Falls Bypassed Reaches in South Carolina. Documented species are classified as rare (1 observation), somewhat rare (2 observations), common (3–7 observations), or abundant (8 or more observations).

Scientific Name	Common Name	Status
Acris crepitans	Northern cricket frog	Potential*
Acris gryllus	Southern cricket frog	Abundant
Bufo americanus	American toad	Common
Bufo terrestris	Southern toad	Potential
Bufo fowleri	Fowler's toad	Abundant
Gastrophryne carolinensis	Eastern narrowmouth toad	Common
Hyla chrysoscelis	Cope's gray treefrog	Abundant
Hyla cinerea	Green treefrog	Abundant
Hyla femoralis	Pine woods treefrog	Peripheral
Hyla squirella	Squirrel treefrog	Common
Hyla versicolor	Common gray treefrog	Potential
Pseudacris crucifer	Spring peeper	Rare
Pseudacris feriarum	Upland chorus frog	Common
Pseudacris ornata	Ornate chorus frog	Peripheral
Rana catesbeiana	Bullfrog	Somewhat Rare
Rana clamitans	Green frog	Common
Rana palustris	Pickerel frog	Potential*
Rana sphenocephala	Southern leopard frog	Abundant
Scaphiopus holbrookii	Eastern spadefoot toad	Potential
Ambystoma maculatum	Spotted salamander	Rare
Ambystoma opacum	Marbled salamander	Abundant
Ambystoma tigrinum	Eastern tiger salamander	Peripheral*
Amphiuma means	Two-toed amphiuma	Peripheral
Desmognathus auriculatus	Southern dusky salamander	Potential
Desmognathus fuscus	Northern dusky salamander	Somewhat Rare
Eurycea cirrigera	Southern two-lined salamander	Abundant
Eurycea guttolineata	Three-lined salamander	Rare
Eurycea quadridigitata	Dwarf salamander	Potential
Hemidactylium scutatum	Four-toed salamander	Potential
Necturus punctatus	Dwarf mudpuppy	Peripheral
Notophthalmus viridescens	Eastern newt	Potential
Plethodon cylindraceus	White-spotted slimy salamander	Common
Pseudotriton montanus	Mud salamander	Potential
Pseudotriton ruber	Red salamander	Potential
Siren intermedia	Lesser siren	Peripheral
Siren lacertina	Greater siren	Peripheral

* Denotes Species of Special Concern in South Carolina.

Bridges and Dorcas, 2000), systematic dipnetting, minnow traps, and turtle traps baited with sardines (Lindsay and Dorcas, 2001) were used to sample amphibians and reptiles.

RESULTS

Based on published distributions, other documents, and specimen records, we determined that 19 anurans, 17 salamanders, 8 turtles, 9 lizards, and 32 species of snakes potentially occurred within or had geographic ranges peripheral to the study area (Tables 1 and 2). We documented 12 species of anurans, 6 salamanders, 7 turtles, 6 lizards and 11 snake species (Tables 1 and 2; Fig. 2). Species listed by South Carolina or the federal government as endangered, threatened or of special concern in South Carolina were not found.

Table 2. Peripherally occurring, potentially occurring and documented reptiles of the Great Falls Bypassed Reaches in South Carolina. Documented species are classified as rare (1 observation), somewhat rare (2 observations), common (3–7 observations), or abundant (8 or more observations).

Scientific Name	Common Name	Status
Apalone spinifera	Spiny softshell turtle	Somewhat Rare
Chelydra serpentina	Common snapping turtle	Common
Chrysemys picta	Painted turtle	Abundant
Kinosternon subrubrum	Eastern mud turtle	Potential
Pseudemys concinna	Eastern river cooter	Common
Sternotherus odoratus	Common musk turtle	Abundant
Terrapene carolina	Eastern box turtle	Common
Trachemys scripta	Yellow-bellied slider	Abundant
Anolis carolinensis	Green anole	Abundant
Cnemidophorus sexlineatus	Six-lined racerunner	Potential
Eumeces fasciatus	Five-lined skink	Common
Eumeces inexpectatus	Southeastern five-lined skink	Rare
Eumeces laticeps	Broad-headed skink	Somewhat Rare
Ophisaurus attenuatus	Slender glass lizard	Potential
Ophisaurus ventralis	Eastern glass lizard	Peripheral
Sceloporus undulatus	Eastern fence lizard	Abundant
Scincella lateralis	Little brown skink	Abundant
Agkistrodon contortrix	Copperhead	Common
Agkistrodon piscivorus	Cottonmouth	Peripheral
Carphophis amoenus	Wormsnake	Abundant
Cemophora coccinea	Scarletsnake	Potential
Coluber constrictor	Racer	Common
Crotalus horridus	Timber rattlesnake	Potential*
Diadophis punctatus	Ring-necked snake	Common
Elaphe guttata	Cornsnake	Potential
Elaphe alleghaniensis	Eastern ratsnake	Common
Farancia abacura	Red-bellied mudsnake	Peripheral
Farancia erytrogramma	Rainbow snake	Peripheral
Heterodon platirhinos	Eastern hog-nosed snake	Potential
Heterodon simus	Southern hog-nosed snake	Peripheral*
Lampropeltis calligaster	Mole kingsnake	Potential
Lampropeltis getula	Eastern kingsnake	Abundant
Lampropeltis triangulum	Scarlet kingsnake-milksnake	Potential*
Masticophis flagellum	Coachwhip	Potential
Nerodia erythrogaster	Plain-bellied watersnake	Abundant
Nerodia fasciata	Banded watersnake	Potential
Nerodia sipedon	Northern watersnake	Common
Nerodia taxispilota	Brown watersnake	Common
Opheodrys aestivus	Rough greensnake	Potential
Pituophis melanoleucus	Pinesnake	Potential*
Regina septemvittata	Queen snake	Potential
Sistrurus miliarius	Pygmy rattlesnake	Potential
Storeria dekayi	Dekay's brownsnake	Rare
Storeria occipitomaculata	Red-bellied snake	Potential
Tantilla coronata	Southeastern crowned snake	Potential
Thamnophis sauritus	Eastern ribbonsnake	Potential
Thamnophis sirtalis	Common gartersnake	Potential
Virginia striatula	Rough earthsnake	Potential
Virginia valeriae	Smooth earthsnake	Rare

* Denotes Species of Special Concern in South Carolina.

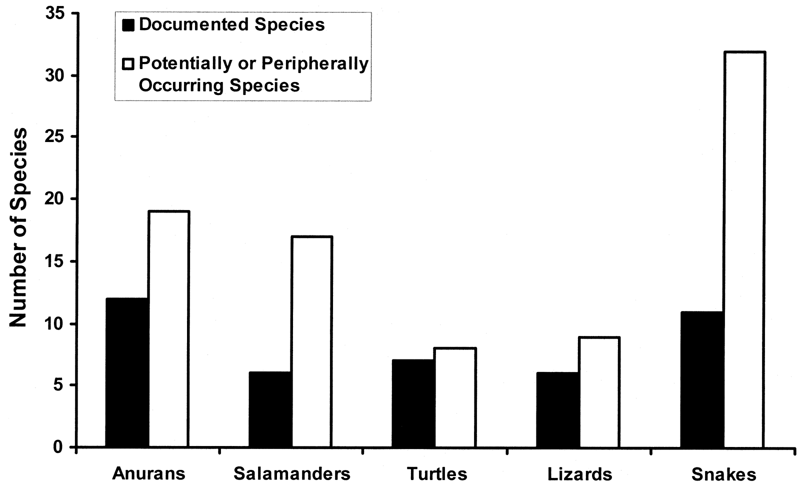

FIG. 2. Number of potential occurring and peripherally occurring (combined) and documented species for herpetofaunal groups in the Great Falls Bypassed Reaches of South Carolina.

Our sampling regime was designed to document as many species of amphibians and reptiles as possible, and thus, not intended to estimate relative or absolute abundances. However, based on our extensive surveys and our knowledge of species' life-histories, we were able to comment somewhat qualitatively on the numbers of individual amphibians and reptiles encountered and make qualified statements regarding the abundances of each within the study area. Species requiring wetlands for breeding or for foraging were relatively abundant within the study area. These species included marbled salamanders (*Ambystoma opacum*), Fowler's toads (*Bufo fowleri*), green treefrogs (*Hyla cinerea*), southern leopard frogs (*Rana sphenocephala*), common musk turtles (*Sternotherus odoratus*) and plain-bellied watersnakes (*Nerodia erythrogaster*). Terrestrial species, such as white-spotted slimy salamanders (*Plethodon cylindraceus*), common kingsnakes (*Lampropeltis getula*), eastern wormsnakes (*Carphophis amoenus*) and little brown skinks (*Scincella lateralis*) were common in upland habitats (Tables 1 and 2).

Flooding from a series of hurricane-related storm events during fall 2004 resulted in prodigious quantities of water flowing through the Long and Short Bypassed Reaches. A limited amount of sampling was conducted during spring 2005 to evaluate the impacts of this severe flooding. Only southern cricket frogs (*Acris gryllus*) and one southern leopard frog (*Rana sphenocephala*) egg mass were found. No marbled salamander (*A. opacum*) larvae were found. During spring 2004, these same wetlands contained large numbers of anuran egg masses and larvae and many marbled salamander larvae. Painted turtles (*Chrysemys picta*), a species typically found in ponds and wetlands (Palmer and Braswell, 1995), were observed in the ponds in 2005 where they were recorded during 2004.

DISCUSSION

A high diversity of amphibian and reptile species was recorded at the Great Falls Bypassed Reaches, generally representative of a typical Piedmont herpetofauna (Conant and Collins, 1998). Although we were unable to detect species that were assigned status by any regulatory agency, several notable species were found that were either locally rare, difficult to find, and/or restricted to specific habitats. Marbled salamanders (*A. opacum*) and spotted salamanders (*A. maculatum*) were both found during our surveys. Both species rely on ephemeral wetlands for reproduction, habitats that are disappearing from much of the southeastern United States (Petranka, 1998). We made several observations of spiny softshell turtles (*Apalone spinifera*), a species of which extreme western populations are considered a Species of Special Concern in North Carolina (North Carolina Wildlife Resources Commission; www.ncwildlife.org; accessed 17 October 2005) but not in South Carolina. Softshells are secretive and notoriously difficult to trap using standard turtle trapping techniques.

We failed to document several potentially occurring species that we expected to find based on geographic range and habitat. For example, we found no eastern mud turtles (*Kinosternon subrubrum*) despite extensive trapping. Mud turtles are easily trapped using standard techniques (Rice et al., 2001) and are often common in ponds and wetlands throughout the Piedmont and Coastal Plain of South Carolina. We found no queen snakes (*Regina septemvittata*), although apparently suitable stream habitat was present south of the junction of Camp Creek and throughout the study area and crayfish, their preferred food, were prevalent throughout all aquatic areas (Gibbons and Dorcas, 2004). Queen snakes were documented along the Catawba River approximately 20 km upstream at Landsford Canal State Park (M. Dorcas and P. Hill, pers. obs.). Surprisingly, we also failed to document any gartersnakes (*Thamnophis sirtalis*) or ribbonsnakes (*T. sauritus*). Many areas of suitable habitat were present, as were many anurans and small fishes, the primary prey of these species (Rossman et al., 1996). Some of the other snake species potentially occurring in the study area such as corn snakes (*Elaphe guttata*), scarlet kingsnakes (*L. triangulum*) and timber/canebrake rattlesnakes (*C. horridus*) likely inhabit the area, but these species may occur in such low numbers and/or are so secretive that detection is difficult. Some species, such as red-bellied snakes (*Storeria occipitomaculata*) may have not been found because the techniques that are often most effective in detecting this species (i.e., drift fences) were not employed. Note that some of the undocumented species potentially occurring in the Great Falls Bypassed Reaches (e.g., southern hog-nosed snakes; *Heterodon simus*) are less likely to actually occur there than other undocumented species (e.g., eastern hog-nosed snakes; *Heterodon platirhinos*) because of a lack of suitable habitat or the fact that their range was peripheral to the Bypassed Reaches.

How various species of amphibians and reptiles are impacted by flooding within the bypassed reaches is difficult to determine. Specific habitat requirements and other ecological requirements for many species are still poorly understood, making their response to environmental change difficult to forecast. However, inventory of herpetofauna within the study area and assessment of qualitative relative abundances does allow us to make educated guesses of how the herpetofauna of the study area has changed since the diversion dams were built and how the herpetofauna might respond to other changes, such as additional flooding.

The change from an apparent high-volume riverine system prior to the installation of the diversion dam to the present system of periodically flooded and isolated aquatic systems has resulted in an apparent increase in species using lentic and ephemeral aquatic habitats and an apparent decrease in species that use lotic systems. For example, the abundances of many amphibians that typically breed in isolated wetlands (e.g., *Ambystoma* sp., *Hyla* sp., *Pseudacris* sp.) have likely increased in the last century whereas populations of species such as brown watersnakes (*Nerodia taxispilota*) and river cooters (*Pseudemys concinna*), which are most abundant along rivers of the southeastern United States, may have decreased in the study area. These riverine species are now likely more abundant in the canal west of the study area through which water is currently diverted. Likewise, many herpetofaunal species that are primarily terrestrial in nature now inhabit the riverbed of the Long Bypassed Reach. These include lizards such as green anoles (*Anolis carolinensis*), four species of skinks (*Scincella lateralis*, and three species of *Eumeces*) and at least eight species of terrestrial snakes.

Intentional, increased frequency of flooding with associated higher flows and velocity would likely alter the habitat within the study area dramatically. The ponds within the Long Bypassed Reach would become more riverine in nature and wetlands that are currently ephemeral would likely become more permanant or disappear altogether. Small rivulets and areas of shallow water currently provide refuge for salamanders (*Desmognathus* sp., *Eurycea* sp.) typically found in small, rocky streams. More frequent flooding would submerge such habitats under larger water flows for greater periods of time. Additionally, many of the terrestrial areas which are currently flooded infrequently would become more regularly flooded, potentially resulting in greater displacement of ground litter. Issues such as introduction of aquatic predators (e.g., fish) and flushing of eggs and larvae represent likely detrimental impacts. Concomitantly, intentional periodic flooding might increase populations of some species. As noted above, species favoring lotic habitats such as brown watersnakes (*N. taxispilota*) and river cooters (*P. concinna*) might increase in number over time if intentional regular flooding occurred. However, it is likely that sustained, continuous flow of water would be necessary for populations of these species to persist in high numbers.

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