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Saint-Gaudens National Historic Site Amphibian and Reptile Inventory

March-September 2001

Natural Resource Technical Report NPS/NER/NRTR—2008/120

ON THE COVER
Northern Dusky Salamander (*Desmognathus fuscus*). Photo by Charlie Eichelberger.

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Natural Resource Technical Report NPS/NER/NRTR—2008/120

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Executive Summary

Under a National Park Service/Wildlife Conservation Society Cooperative Agreement, the amphibians and reptiles of Saint-Gaudens National Historic Site (SAGA) in Cornish, Sullivan County, New Hampshire were inventoried from April through September 2001. Six standard methods were employed: anuran calling surveys, egg mass counts, time-constrained search, coverboards, turtle trap surveys, and minnow trap surveys. In addition, animals encountered outside of standardized surveys (temporally or spatially), including observations of rare species by SAGA staff, were recorded as incidental encounters.

In the course of this survey, we recorded 15 species, all previously recorded at SAGA. In addition, park staff observed eastern milk snake, previously recorded at SAGA, and the northern ringneck snake, a species previously undocumented at the park but probably historically present. Thus, 17 of 19 (89%) species known or likely to have historically occurred at SAGA were recently recorded. Of the 17 species documented in this study, there were seven anurans, five salamanders, two turtles, and three snakes. Based on numbers of adults and number of occupied sites recorded, the most "abundant" and "widespread" species in each taxonomic group were northern spring peeper (anuran), red-spotted newt (salamander), painted turtle (turtle), and common garter snake (snake). No "listed" species were found. Because of its northern location, the herpetofauna of SAGA is dominated by amphibians both in terms of species richness (71% of all species) and abundance (99% of all individuals recorded). However, records from the 1930's indicate that reptiles, particularly snakes, were more prevalent in Sullivan County, where SAGA occurs, and suggest that snakes in this region may have since declined. Of the 19 amphibian and reptile species known or likely to have historically occurred at SAGA, 16 appear stable in their population trends. Three other species, the Jefferson salamander complex, wood turtle, and eastern milk snake, are known to be or may be declining in the region, but both historic and current data are too limited to determine trends.

Each survey method was useful for sampling different habitats and species, but may have provided a biased sample. Multiple methods were used to compensate for possible sampling bias, but we could not estimate the bias of any individual method or the extent to which multiple methods balanced the bias. Thus, although total numbers of adults recorded are used as an index of abundance for each species, it is an uncalibrated index and its relationship to actual abundance is unknown. Pond time-constrained search (TCS) recorded the most species (10), whereas eight species were recorded with stream TCS, seven during woodland TCS, six with anuran calling surveys and minnow trap surveys, four as incidental encounters, three with turtle trap surveys, two each with egg-mass counts and field TCS, and one species with coverboards. Twelve species were documented in wetland habitats, 11 in uplands, and eight in streams.

Stressors associated with amphibian and reptile declines are present at SAGA, but they appear to be low intensity and are not known to be causing negative impacts. However, the park should promote protection of the adjoining landscape and watershed. Future monitoring at SAGA should consider anuran calling surveys, stream salamander surveys, egg mass counts, and trapping pond turtles. Further inventory is needed to better determine the presence/absence/status of several other species and the need for or utility of monitoring them.

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Introduction

Saint-Gaudens National Historic Site (SAGA) contains the home, studios, and gardens of Augustus Saint Gaudens (1848-1907), America's foremost sculptor of the Gilded Age. Congress established the park in 1964 to preserve, protect and interpret cultural and natural resources and artwork historically associated with the sculptor. SAGA is located in Cornish, Sullivan County, New Hampshire (43° 30' N, 72° 22' W), and ranges from 91 to 183 m (300' to 600') above sea level. The park is located along the Connecticut River, a federally designated American Heritage River. It occurs within the eastern deciduous forest biome, a region dominated by hemlock and hemlock-beech transition and mesic forest types (Gilman 1997). Well drained sandy, alluvial soils occur primarily in floodplain and wetland areas of the park, whereas shallow stony soils are more common in the forested areas. Geologically, the park is underlain with the Gile Mountain formation; a schistose, calcium rich bedrock that raises the pH of adjacent soils (Gilman 1997). SAGA is predominately forested, but also includes open fields, permanent and temporary ponds, a permanent stream that empties into the Connecticut River, and a narrow, permanent woodland stream.

In 1998, a Cooperative Agreement between the National Park Service and the Wildlife Conservation Society was established to assess amphibian and reptile assemblages within the parks of the "New England Cluster" of the National Park Service. Since information was lacking or inadequate for the amphibians and reptiles of SAGA, a comprehensive, broad-based inventory was conducted in 2001 using a number of survey techniques. As part of this inventory project, SAGA was surveyed monthly from March through September 2001. While the goals of the project varied between parks, they generally were as follows:

- Assist the park service in documenting at least 90% of the species currently estimated to occur in the park.
- Determine the occurrence and status of species of management concern (e.g., state and federal *Threatened*, *Endangered*, and *Special Concern* species, and other declining species).
- Determine abundance categories, distribution, and habitat use of documented species.
- Identify critical habitats of *Threatened*, *Endangered*, and *Special Concern* species.
- Provide a basis for the future development of a long term monitoring program.
- Analyze species occurrence against historical occurrence and evaluate the state of the park's herpetofauna, on a site and regional scale.

Determining the "historic" herpetofauna of SAGA was challenging, due to the incomplete nature of SAGA-specific "historic" data. We used a combination of historic and current records from state-wide surveys (Oliver and Bailey 1939, NH Fish and Game 2006, 2007a) and prior surveys at SAGA (Cronan et al. 1981, Cook 1986) to estimate the likely historic herpetofauna of Sullivan County. In addition to species historically recorded in the county, we assumed that recent detections of native species lacking historic records were the result of inadequate sampling rather than a recent range expansion. Thus, any native species historically or currently present in Sullivan County were considered as historically present in Sullivan County. Furthermore, there are a number of species where records in adjacent counties suggest they are probably present in Sullivan County. Species with the potential to be found in Sullivan County were determined from data available from Vermont (Andrews 2005) and the literature already mentioned.

However, because New Hampshire's herpetofauna includes many species at the limits of their distribution (Oliver and Bailey 1939), we only considered species as probably occurring in Sullivan County when doing so would not extend their range beyond the limit of existing New Hampshire/Vermont records. Based on this approach, we considered the likely historic herpetofauna of Sullivan County to consist of 26 native species known to occur and five native species that probably occur (Appendix A). In addition, there is one introduced species known to presently occur.

Although this provides a reasonable estimate of the likely historic herpetofauna of Sullivan County, it is less useful for SAGA, which is far smaller in acreage. As expected, SAGA-specific inventories conducted in the 1980's (Cronan et al. 1981, Cook 1986) found fewer species than estimated for the entire county, but nonetheless a fairly diverse herpetofauna was present. Most noteworthy of the species recorded in the park were the wood turtle (*Glyptemys insculpta*), a species of *Special Concern* in New Hampshire, and the Jefferson salamander (*Ambystoma jeffersonianum*), an uncommon species found in vernal ponds. Cook (1986) recorded two wood turtles along Upper Blow-Me-Down (BMD) Brook and three Jefferson salamander egg masses in Pond B. Although Cook (1986) documented most of the amphibian species likely to occur at SAGA, documentation of reptiles was not as exhaustive. Efforts to locate snakes were not intensive and a number of species that potentially occurred in the park went undetected. Turtle trapping was only moderately successful. Wood turtles were detected in the course of early spring searches in BMD Brook, but given the general nature of the survey, the number of searches was limited. Northern spring salamanders (*Gyrinophilus p. porphyriticus*) were not detected despite what appeared to be suitable habitat in Blow-Me-Up (BMU) Brook. Although Cronan et al. (1981) listed eastern hog-nosed snake (*Heterodon platirhinos*) as part of the herpetofauna of SAGA, this was a mistake (Cook 1986). In NH, hog-nosed snakes only occur in the southeast, below Concord (Michener and Lazell 1989). Collectively, these sources identify 18 species as previously recorded at SAGA, plus an additional seven species historically recorded in Sullivan County and six species that likely occurred in Sullivan County (Appendix A).

Because the amphibian component of SAGA's herpetofauna was fairly well documented (Cook 1986), the target species of this survey were snakes, aquatic turtles (especially wood turtles), northern spring and Jefferson salamander. Since these target species are broad in terms of taxonomic groups and habitat affinity, the inventory employed a variety of methods in a number of habitats. Choice of sampling sites and amount of sampling effort focused the effort towards target species, but because methods were generalized, data on the more common species were also obtained. Six standardized survey methods were used in the inventory. In addition, incidental encounters both during study implementation (2001) and report writing (2002-2007) were recorded to provide additional information on species presence and distribution. In all cases, sites where amphibians and reptiles were found were described, and the habitat types they occupied were recorded.

Study Area

Saint-Gaudens NHS (SAGA) encompasses 60.7 ha (150 ac) overlooking the Connecticut River, in the town of Cornish, Sullivan County, NH (Figure 1). Approximately 48.6 ha (120 ac) of SAGA are uplands and 12.1 ha (30 ac) are wetlands. Although the historic core of SAGA, covering 12.1 ha (30 ac), is managed as lawns and formal gardens, the remainder of the site is field, woodland, stream, and wetland and provides habitat for a variety of wildlife. The forest communities of SAGA and their dominant tree species include upland hardwood (red maple, *Acer rubrum*; white pine, *Pinus strobus*; red oak, *Quercus rubra*; paper birch, *Betula papyifera*), north-facing hardwood-hemlock (eastern hemlock, *Tsuga canadensis*), south-facing hardwood (eastern hemlock; American beech, *Fagus grandifolia*; red maple), hemlock-hardwood ravine (eastern hemlock), and mixed coniferous forest (white pine). Based on basal area, eastern hemlock is the dominant tree species at SAGA, with the majority occurring in the hemlock-hardwood ravine forest (Cronan et al. 1981). It is also a dominant tree species in the historic core (Walasewicz 1995). The hemlock woolly adelgid (*Adelges tsugae*) is an exotic invasive pest insect that has caused extensive hemlock mortality in the United States. Although it has not been documented at SAGA, it has been found in several New Hampshire towns, particularly along the coast. It is likely that this insect will reach SAGA, where it could cause significant changes to the forest ecosystem. SAGA also has significant and diverse aquatic resources including floodplains, temporary and permanent ponds, a pond formed by damming, a stream flowing from the dam to the Connecticut River, and a high gradient woodland stream (Table 1). Detailed descriptions of SAGA wetlands are provided by Cook (1986).

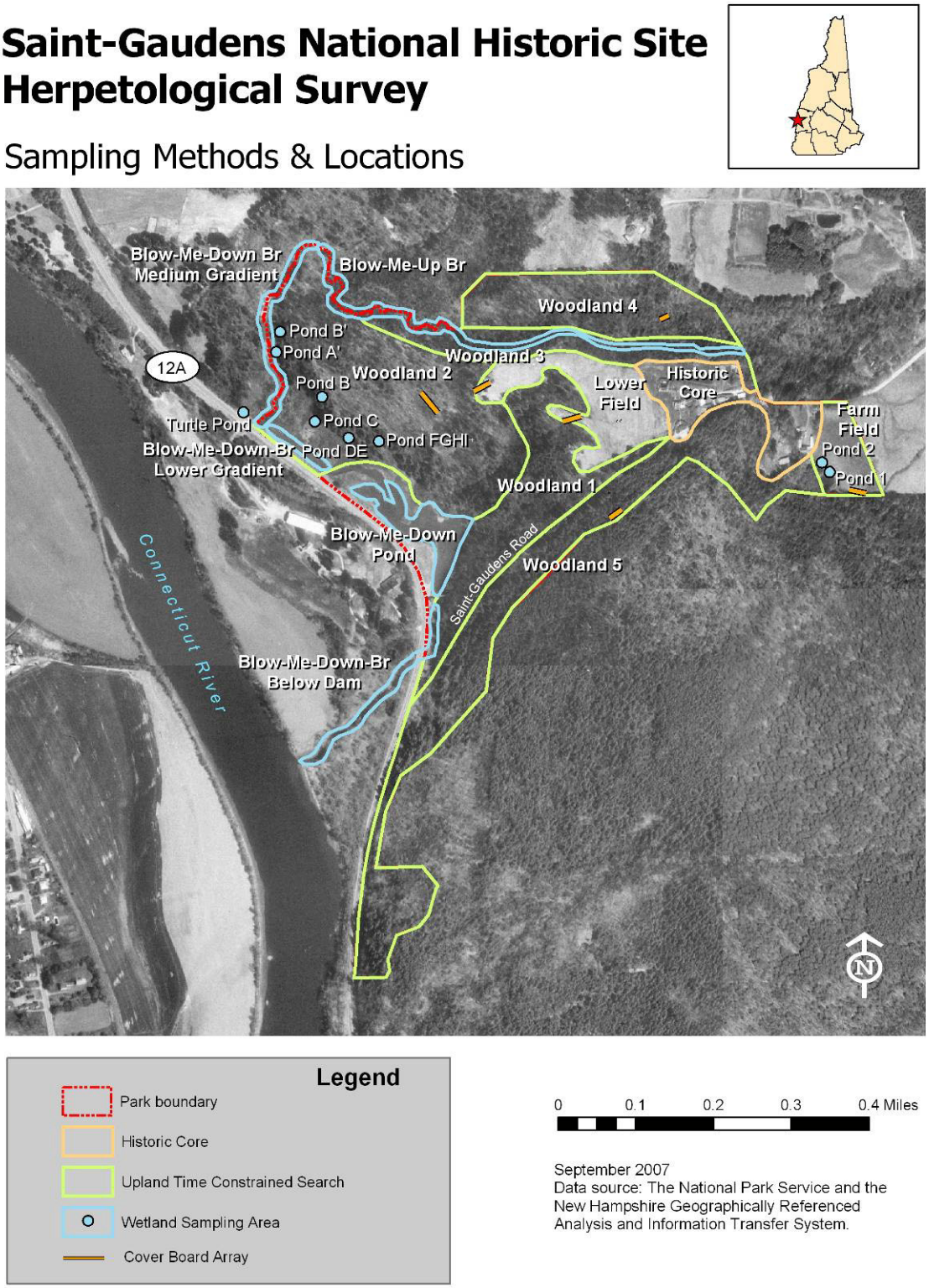

Figure 1. Location of standardized sampling sites and time-constrained search areas used in herpetofaunal inventory at Saint-Gaudens National Historic Site.

Table 1. Overview of standardized survey sites at Saint-Gaudens NHS and sampling methods used at each site.

Site[1]	Habitat Type	Calling Survey	Egg Mass Count	TCS[2] Stream	TCS Woodland	TCS Field	TCS Pond	Cover board	Turtle Trap	Minnow Trap
BMD Brook Below Dam	Permanent Stream			X						
BMD Brook Low Gradient	Permanent Stream			X					X	X
BMD Brook Medium Gradient	Permanent Stream			X						
BMU Brook	Permanent Stream			X						
BMD Pond	Permanent Pond	X					X		X	X
Farm Pond 1	Permanent Pond	X	X				X		X	X
Turtle Pond	Permanent Pond	X					X		X	X
Farm Pond 2	Temporary Pond		X				X			X
Pond A’	Temporary Pond	X	X				X		X	X
Pond B	Temporary Pond	X	X				X		X	X
Pond B’	Temporary Pond		X				X		X	X
Pond C	Temporary Pond	X	X				X		X	X
Pond DE	Temporary Pond	X	X				X		X	X
Pond FGHI	Temporary Pond	X	X				X		X	X
Farm Field	Field					X		X		
Lower Field	Field					X		X		
Woodland 1	Hemlock Forest				X					
Woodland 2	Hardwood Forest				X			X		
Woodland 3	Mixed forest				X					
Woodland 4	Hardwood forest				X			X		
Woodland 5	Mixed forest				X			X		

[1] BMD = Blow-Me-Down, BMU = Blow-Me-Up
[2] TCS = Time constrained search

Methods

Sampling Overview

Sampling at SAGA was conducted by a two person crew as part of an effort to survey the herpetofauna of four NPS sites over the course of the 2001 field season. Because the herpetofauna of most sites in the northeast United States consists of a variety of species, each with differing periods of greatest activity/detectability (which can also vary somewhat annually), the sampling plan called for distributing the sampling effort over the course of the spring and summer activity season. Given this, and the logistics of sampling at four sites (located in Cornish, NH, Saratoga NY, Lexington, MA, and Saugus, MA), we sampled sites in bouts that varied in duration in proportion to a site's size and presumed faunal/zoogeographic complexity.

Over the course of a month the crew sampled a site and moved on to the next, such that a full round of sampling was conducted each month during the months of April, May, June, August, and September. For SAGA, each monthly sampling bout was generally four consecutive days and three nights.

Both general and targeted standard survey methods were used in stream, wetland, and upland habitats. Multiple methods were often used in a given habitat because these habitats might support several amphibian and reptile species and require several methods to sample the entire herpetological community. The habitat of each standardized survey site was classified based on three habitat categories (stream, wetland, and upland) and seven habitat types (Appendix B) to provide a general description of each survey site.

Site selection for standardized surveys was designed to sample across the range of habitat types available as well as be spatially balanced (Table 1, Appendix B, Figure 1). Based on existing maps of wetland (see Cook 1986) and upland habitats, as well as field reconnaissance, all of the ponds/wetlands, streams, major seeps, rivers, field and woodland habitats were identified. Because of the park's small size, the number of streams and wetlands were limited and all were sampled. Similarly, woodland habitat in the park was partitioned into five areas and all were sampled, as were the two field habitats. The region of the park containing historic and administrative structures as well as lawns and gardens was delineated and designated the 'historic core'. Although no standardized surveys were conducted in the historic core habitat, regular use of the area by park staff led to a number of significant incidental encounters.

Anuran Calling Surveys (ACS)

Anuran calling surveys were conducted at eight ponds using the Wisconsin frog and toad survey method (Heyer et al. 1994). Anuran calling surveys record the presence of species at specific sites and provide an index of abundance based on the calling intensity of species heard. Call index values and criteria for assigning them are: 0 = no calls, 1 = individuals can be counted (no overlapping of calls), 2 = overlapping of calls (can still be counted), 3 = full chorus (calls are constant and individually indistinguishable). The surveyors arrived at each sample site at least a half-hour after dusk and listened for anuran calls for 5 minutes, recording an index value for each species heard. For each sampling occasion, the number of individuals of each species calling was also counted or estimated.

Due to variable activity patterns among anuran species, multiple calling surveys conducted throughout spring and early summer months are necessary to thoroughly document species presence at a site (Conant and Collins 1998, Crouch and Paton 2002). Each of the following sites were surveyed once/month, for a total of three times each between 25 April and 26 June 2001.

1. Blow-Me-Down Pond
2. Farm Pond 1
3. Pond A'
4. Pond B
5. Pond C
6. Pond DE
7. Pond FGHI
8. Turtle Pond

Egg Mass Counts (EMC)

Jefferson salamanders, spotted salamanders and wood frogs migrate to ponds in the early spring to breed, depositing gelatinous egg masses attached to branches and vegetation in the water (Petranka 1998). Egg mass counts were conducted to determine presence and document evidence of breeding by these species. When counting egg masses, the observer traversed the entire pond, searching for egg masses, identifying and counting all egg masses observed and recording developmental stage and % mortality (individual egg mortality within each egg mass). While every effort was made to count all masses in a pond, because spawning is only loosely synchronized, counts based on a single survey may underestimate total numbers of egg masses laid. For ponds receiving multiple counts, the highest count (maximum) was used for analyses of abundance (Cook and Boland 2005). Egg mass counts were conducted on 25 and 26 April and 27 and 28 May at eight sites as follows:

1. Farm Pond 1 – 1 count
2. Farm Pond 2 – 2 counts
3. Pond A' – 2 counts
4. Pond B – 2 counts
5. Pond B' – 2 counts
6. Pond C – 2 counts
7. Pond DE – 2 counts
8. Pond FGHI – 2 counts

Time-constrained Search (TCS)

Habitat-specific time-constrained search (TCS) was conducted in all habitats likely to support amphibians and reptiles, i.e., streams, woodlands, fields, and wetlands. Each wetland, stream section, or upland TCS area (woodlands and fields) was searched for a pre-determined period of time, which was commensurate with size. The amount of time allotted to search an area on a given occasion was not enough to search all available cover, and searchers used an approach intended to maximize the numbers and diversity of captures by moving through the area and searching under the best available cover (e.g. logs, rocks, boards, metal debris) favored by amphibians and reptiles (Bury and Raphael 1983), and by dip netting ponds (Heyer et al. 1994). Although the original plans called for sites within each habitat type to be sampled the same

number of times, and sampling sessions at a given site to be the same duration each time, due to the exigencies of field work, this was not always possible. Results of TCS were standardized as a capture rate (CR) for each species, calculated by dividing the total number of individuals recorded by the total search effort (person hours) spent for each search. Person hours are the total amount of time spent searching, multiplied by the number of people participating in the search.

Stream TCS

Stream TCS was employed primarily to survey for stream salamanders in Blow-Me-Up (BMU) Brook and wood turtles in Blow-Me-Down (BMD) Brook. Investigators systematically moved upstream, using a dip net in the stream to capture amphibians as rocks were overturned. Rocks, logs, and debris in the splash zone and on the bank were overturned and searched under. Identification and life stage (adult or larva) were recorded for each animal captured. The adult life stage was defined as any individual not in the larval stage, and the larval stage was defined as an individual with gills, showing pre-metamorphic characteristics. Starting and ending times (Eastern Daylight Time) and the number of people searching were recorded. The following stream sections were searched at least once/month between 24 April and 20 September 2001 as follows:

1. BMD Brook Below Dam – permanent, shallow: 5 surveys, 7.0 search hours
2. BMD Brook Low Gradient – permanent, low gradient: 6 surveys, 6.7 search hours
3. BMD Brook Medium Gradient – permanent, medium gradient: 5 surveys, 7.3 search hours
4. BMU Brook – permanent, shallow: 7 surveys, 13.3 search hours

Woodland TCS

Woodland TCS was employed to survey for the broad range of species likely to occur in SAGA woodlands, especially terrestrial salamanders, several anurans, and snakes. Start and end times, number of searchers, and the identification, number, and sex of individuals found were recorded. The following woodland areas were searched at least once/month between 24 April and 21 September 2001 as follows:

1. Woodland 1 – hemlock forest: 5 surveys, 3.7 search hours
2. Woodland 2 – hardwood forest: 6 surveys, 6.8 search hours
3. Woodland 3 – mixed forest: 7 surveys, 4.2 search hours
4. Woodland 4 – hardwood forest: 7 surveys, 5.5 search hours
5. Woodland 5 – mixed forest: 6 surveys, 4.3 search hours

Field TCS

Field TCS was employed primarily to search for snakes which are often found basking along edges. Start and end times, number of searchers, and the identification, number, and sex of individuals found were recorded. The following sites were surveyed in April, May, June, and August, between 24 April and 18 August 2001 as follows:

1. Farm Field – field by Farm Pond: 4 surveys, 3.3 search hours
2. Lower Field – field below Aspet: 4 surveys, 6.0 search hours

Pond TCS

Pond TCS was conducted at night to survey primarily for amphibians. However, aquatic turtles were also often observed. Searches were conducted by traversing the entire pond, sampling with a dip-net for amphibian larvae and adults, as well as turtles and snakes. Start and end times, number of searchers, and the identification, number and sex of individuals found were recorded. Pond TCS occurred between 24 April and 18 August 2001 and was generally conducted once/month in April, May, June, and August. Specific details of ponds surveyed are:

1. BMD Pond – permanent pond: 4 surveys, 2.2 search hours
2. Farm Pond 1 – permanent pond: 4 surveys, 2.0 search hours
3. Farm Pond 2 – temporary pond: 1 survey, 0.5 search hours
4. Pond A' – temporary pond: 4 surveys, 1.8 search hours
5. Pond B – temporary pond: 3 surveys, 0.8 search hours
6. Pond B' –temporary pond: 3 surveys, 0.7 search hours
7. Pond C – temporary pond: 4 surveys, 1.8 search hours
8. Pond DE – temporary pond: 4 surveys, 1.8 search hours
9. Pond FGHI – temporary pond: 3 surveys, 1.5 search hours
10. Turtle Pond – permanent pond: 5 surveys, 2.5 search hours

Coverboards (CB)

Coverboards (Grant et al. 1992) were used primarily to inventory snakes. Coverboards located near wetlands were also expected to provide cover for terrestrial amphibians. Boards were 0.6m x 1.2m (2ft x 4ft) and made of corrugated sheet metal or plywood. In March 2001, coverboards were deployed on top of vegetation at three woodland and three field sites. Eight boards were placed 5 meters apart in linear "arrays" consisting of alternating wood and metal boards. Coverboards were checked one time each in May and June, twice in August, and once in September as follows:

1. Farm Field – one array: 5 visits, 38 CB checks
2. Lower Field – two arrays: 5 visits, 80 CB checks
3. Woodland 2 – one array: 5 visits, 40 CB checks
4. Woodland 4 – one array: 5 visits, 40 CB checks
5. Woodland 5 – one array: 5 visits, 40 CB checks

Capture rates (CR) were calculated as the number of snake captures divided by the total number of board checks for each site. Each time a board was checked constituted a "board check." Therefore, a site with eight boards visited six times equaled 48 board checks. The number of snakes captured per 100 coverboard checks was calculated as:

$$CR = \frac{(\#\, of\ snake\, captures)}{(total\, \#\, of\ board\ checks)} \times 100$$

Turtle Trap Surveys (TTS)

Welded-wire crab traps measuring 30.5 cm x 30.5 cm x 60.1 cm (12" x 12" x 24"), with a mesh size of 1.3 cm x 2.5 cm (0.5" x 1"), were used to sample shallow areas for small aquatic/semi-aquatic turtles such as spotted turtles (*Clemmys guttata*). Funnel traps made of D-shaped metal

hoops and 2.6 cm (1") nylon mesh were used to sample deeper pond areas for aquatic turtles such as painted (*Chrysemys picta*) and eastern snapping turtles (*Chelydra s. serpentine*) (Harless and Morlock 1989). Number of traps used ranged from one to seven, depending on pond size. Traps were baited with sardines in vegetable oil and checked daily. All but one site was trapped for two sessions, from May 27 to May 30 and June 25 to June 28, as follows:

1. BMD Brook Low Gradient – 3 to 4 traps
2. BMD Pond – 5 to 7 traps
3. Farm Pond 1 – 2 traps
4. Pond A' – 2 traps
5. Pond B – 1 trap
6. Pond B' – 1 trap, 27 May to 30 May only
7. Pond C – 3 traps
8. Pond DE – 2 traps
9. Pond FGHI – 3 traps
10. Turtle Pond – 2 traps

Each turtle captured was assigned a unique identification number and, using a three-sided file, triangular notches were made on marginal scutes to represent that number (Cagle 1939). We determined sex and age of turtles using the approach of Cagle (1942). We classified individuals exhibiting male secondary sex characteristics as adult males. Of the remaining individuals, those exceeding the minimum size at which females mature were considered adult females, and the remainder were classified as immature. Attainment of sexual maturity in turtles is generally a function of size rather than age. Size at sexual maturity varies among individuals within a population and also often varies latitudinally between populations (i.e. size at attainment of sexual maturity increases with latitude) (Tinkle 1961, Iverson 1992). Field determination, based on species-specific criteria, and data on minimum size at sexual maturity from the most geographically appropriate literature available was used to categorize individuals into age classes "juvenile," "adult male," or "adult female." Eastern snapping turtles were sexed on the basis of the relative location of the vent on the tail. In males the vent is posterior to the carapace margin. In addition, the pre-anal tail to posterior plastron length ratio (PAT/PPL ratio) is commonly > 1.2 in males whereas in females it is generally < 1.1 (Ernst et al. 1994). Based on data from Michigan and Quebec (Ernst et al. 1994), males with carapace length (CL) > 210 mm and females with CL > 200 mm were generally considered adult. In painted turtles, we sexed males based on the presence of elongated foreclaws and a long thick tail, with the anal opening posterior to the carapace margin (Ernst et al. 1994). Zweifel (1989) found that elongation of toenails occurred in Long Island, NY, males as small as 76 mm plastron length (PL) and in most, if not all males, by 90 mm PL. Thus, we classified any painted turtle > 90 mm PL and lacking male secondary sexual characteristics as a female (Zweifel 1989). Based on Long Island, NY, data (Zweifel 1989), males with PL > 80mm and females with PL > 110 mm were considered adults.

Turtle abundance was quantified as a capture rate, "captures/100 trap nights." In addition, when possible, the size of turtle populations at specific wetlands was estimated using Chapman's modification of the Lincoln-Petersen method (Thomson et al. 1998) to provide an unbiased estimate of population size. Multiple trapping occasions at a site were consolidated into two

periods of equal sampling effort to provide the two sampling periods required to use the Lincoln-Petersen method (Menkens and Andersen 1988).

Minnow Trap Surveys (MTS)

Standard funnel-shaped wire mesh minnow traps measuring 15.2 cm x 15.2 cm x 30.5 cm (6" x 6" x 12") were used to sample ponds and the low velocity section of Blow-Me-Down Brook for adult and larval *Ambystoma* salamanders, adult and larval anurans, and aquatic snakes (Heyer et al. 1994). Two traps were deployed at each site. Trapping occurred monthly in April, May, June, and August, water permitting. The April trapping period spanned four nights (23 April to 27 April), and the others spanned three nights. Pond C only was sampled a fifth period, for two nights in September. Survey sites were:

1. BMD Brook Low Gradient – 4 trapping periods
2. BMD Pond – 4 trapping periods
3. Farm Pond 1 – 4 trapping periods
4. Farm Pond 2 – 3 trapping periods
5. Pond A' – 4 trapping periods
6. Pond B – 3 trapping periods
7. Pond B' – 2 trapping periods
8. Pond C – 5 trapping periods
9. Pond DE – 4 trapping periods
10. Pond FGHI – 3 trapping periods
11. Turtle Pond – 4 trapping periods

Since this method primarily captures amphibians, which were not marked for individual recognition, abundance was quantified as captures per 100 trap nights.

Incidental Encounters (IE)

Any encounter with an amphibian or reptile not recorded as data in one of the standardized surveys was considered an incidental encounter. These were recorded on observation cards ("Green Cards") to augment data collected during formal surveys, and include credible observations made by park staff and visitors. For each incidental encounter the species, life stage, method of documentation, as well as location, habitat, and UTM coordinates were recorded. Subsequent to the 2001 field season, there were additional significant incidental encounters recorded by SAGA staff (i.e. eastern milk snake in 2007 and northern ringneck snake in 2006 and 2007). These records have been included in this report.

Quantifying Abundance

Quantifying actual abundance of the species encountered was not possible for a number of reasons. The methods used generally did not estimate actual population size, but rather provided a method-specific index of abundance, such as a capture rate (catch per unit effort). In addition, each of the seven methods used provided a sample biased towards a particular species, group of species, or sex. Although sampling effort was divided among the different methods in an attempt to compensate for possible sampling bias, the amount of sampling bias, the extent to which the use of different methods may have balanced this bias, and the influence of other covariates, such as habitat type and breeding habits, were not estimated.

An index of overall abundance for each species was derived by summing the number of adult form individuals (as opposed to eggs or larvae) encountered during each of the seven survey methods. For time-constrained search, coverboard checks, turtle and minnow trap surveys, and incidental encounters, the numbers of adults of a given species encountered during each sampling occasion were summed. For anuran calling surveys we used counts or estimates of numbers of calling males made when the calling index values were recorded. Although not calibrated against known numbers, the relationship between calling index value and numbers of calling males was similar to values obtained by Crouch and Paton (2002) for Rhode Island anurans (except northern spring peeper, *Pseudacris c. crucifer*) and Nelson and Graves (2004) for northern green frog (*Rana clamitans melanota*). When anurans were recorded calling in the course of TCS, the number of males calling was recorded in all instances, except for those involving full choruses of spring peeper. In these instances of full chorus, the mean number of males estimated calling during ACS occasions was used. Because egg mass counts do not directly count adults, the numbers of females represented was estimated as follows. For spotted salamanders (*Ambystoma maculatum*), Cook (1978) determined that, on average, each egg mass represented 0.633 females. Thus, the number of females present at a site was estimated as 0.633 times the number of egg masses. For wood frog egg mass counts, each egg mass represents one adult female (Crouch and Paton 2000). Because amphibians were not marked for individual identification, for the purposes of estimating an overall index of abundance, reptiles were also treated as though they had not been marked.

Although the total numbers recorded for each species provide an index of abundance, it is an uncalibrated index and its relationship to actual abundance is unknown. These numbers, and their derivatives, are best viewed as indicating the order of magnitude of a species' abundance and providing a reasonably accurate representation of relative and ranked abundance within taxonomic orders. Although these numbers are of value for some inter-specific comparisons and community analysis, and are likely accurate in identifying abundant versus rare species, differences between species whose index of abundance are of the same order of magnitude may not reflect true differences in abundance.

Data Management

Common and scientific names and spellings are those of the Integrated Taxonomic Information System (ITIS) at the time data was collected. Data collected during the course of this study were entered into a Microsoft Access database that is associated with this report. The original data sheets are archived with the Northeast Temperate Inventory and Monitoring Network located at Marsh-Billings-Rockefeller National Historic Park in Woodstock, Vermont. Given the low-impact nature of this study, voucher specimens of live animals were not collected. The National Park Service's Northeast Temperate Inventory and Monitoring Network data manager can be contacted to obtain unpublished data files produced by this study.

A Garmin III Plus Global Positioning System (GPS) unit was used to record the coordinates of each survey site (Appendix C). GPS locality data were recorded as Universal Transverse Mercator (UTM) grid coordinates (zone 18 N) with X = x-axis or Easting, and Y = y-axis or Northing, using the NAD1983 datum.

Results

Overview of Park Herpetofauna

A total of 16 species (12 amphibians and four reptiles) were recorded during this survey. This includes a northern ringneck snake observed in the basement of Aspet (historic home of Augustus Saint-Gaudens) in December 2000. One additional species (the eastern milk snake) was recorded afterward, in May 2007 (National Park Service, Steve Walasewicz, Natural Resource Manager, pers. comm., 2007), bringing the total number of recently-recorded species up to 17. Amphibians dominated the herpetofaunal community, accounting for 99.1% of the 5949 individuals recorded. By order, anurans (frogs and toads) comprised 81.6% of all individuals recorded, salamanders 17.4%, turtles 0.8%, and snakes 0.1%. The most frequently recorded species in each order, based on total numbers of adults recorded were northern spring peeper (*Pseudacris c. crucifer*), red-spotted newt (*Notophthalmus v. viridescens*), painted turtle (*Chrysemys picta*), and common garter snake (*Thamnophis sirtalis*) (Table 2).

Species were captured at all 21 standardized survey sites, plus the Historic Core (Figures 2-4). Based on frequency of occurrence, the most widespread species in each taxonomic group were northern spring peeper, northern green frog, and wood frog (all found at 11, or 50% of sites), red-spotted newt (16, or 73% of sites), painted turtle (5, or 23% of sites), and common garter snake (3, or 14% of sites, Table 3). Blow-Me-Down Pond, Pond C, and Pond FGHI were the most species-rich sites with nine species (53% of species) found at each. Blow-Me-Down Pond accounted for the greatest number of individuals recorded (1337 individuals or 22% of total) (Table 4).

By habitat, the numbers of adults recorded was greatest in wetlands (94% of individuals recorded), followed by streams and uplands (each 3% of individuals) (Table 2). Similarly, species richness was greatest in wetlands (12 species), followed by 11 species in uplands, and eight species in streams (Table 2). Within the seven sub-habitat categories, species richness was greatest in temporary ponds (12 species, 71% of recorded species), followed by permanent pond (11 species), permanent stream (eight species), mixed forest (seven species), hardwood forest (six species each), hemlock forest (six species), and in fields (three species) (Table 2, Figure 5).

Table 2. Number of adult amphibians and reptiles encountered during all standardized surveys and incidental encounters listed by habitat category, at Saint-Gaudens NHS. Within-order relative abundance (RA) is the number of individuals of a species divided by total number of adults of species within each taxonomic order, expressed as a percentage.

		Stream	*Wetland*				*Upland*				
Group	**Species Common Name**	**Permanent Stream**	**Temporary pond**	**Permanent pond**	**Field**	**Mixed Forest**	**Hemlock Forest**	**Hardwood Forest**	**Historic Core**	**Total**	**Within-order RA % (Rank)**
FROG	Northern Spring Peeper		2654	1669		1				4324	89.06 (1)
	Northern Green Frog	13	60	213						286	5.89 (2)
	Gray Treefrog		58	79						137	2.82 (3)
	Wood Frog	1	55	2		3		3		64	1.32 (4)
	American Bullfrog		9	10						19	0.39 (5)
	Pickerel Frog	4	1	11						16	0.33 (6)
	Eastern American Toad		1	3		1	1	3		9	0.19 (7)
SALAMANDER	Red-spotted Newt		161	266	1	6	3	24		461	44.41 (1)
	Spotted Salamander	1	238	74	1					314	30.25 (2)
	Northern Two-lined Salamander	103				6	4	2		115	11.08 (3)
	Eastern Red-backed Salamander	10				19	9	41		79	7.61 (4)
	Northern Dusky Salamander	48				10	10	1		69	6.65 (5)
TURTLE	Painted Turtle	1	3	33						37	77.08 (1)
	Eastern Snapping Turtle		1	10						11	22.92 (2)
SNAKE	Common Garter Snake		2		1				1	4	50.00 (1)
	Northern Ringneck Snake[1]								3	3	37.50 (2)
	Eastern Milk Snake[1]						1			1	12.50 (3)
	TOTAL # OF ADULTS	181	3243	2370	3	46	28	74	4	5949	
	TOTAL # OF SPECIES	8	12	11	3	7	6	6	2	17	
		8	12				11				

[1] See *Species Accounts* for more detail on these records.

Table 3. Distribution by habitat category of the 17 species of amphibians and reptiles recorded at Saint-Gaudens NHS based on number of sites at which a species was recorded. Frequency of Occurrence (FO) = the number of sites where a species was detected divided by the total number of sites surveyed (22).

		Stream	*Wetland*				*Upland*				
Group	**Species Common Name**	**Permanent Stream**	**Temporary Pond**	**Permanent Pond**	**Field**	**Mixed Forest**	**Hemlock Forest**	**Hardwood Forest**	**Historic Core**	**Total # Locations**	**FO (%)**
FROG	Northern Spring Peeper		7	3		1				11	50.0
	Northern Green Frog	2	6	3						11	50.0
	Gray Treefrog		3	2						5	22.7
	Wood Frog	1	6	1		2		1		11	50.0
	American Bullfrog		4	3						7	31.8
	Pickerel Frog	1	1	1						3	13.6
	Eastern American Toad		1	2		1	1	2		7	31.8
SALAMANDER	Red-spotted Newt		7	3	1	2	1	2		16	72.7
	Spotted Salamander	1	7	1	1					10	45.5
	Northern Two-lined Salamander	1				2	1	1		5	22.7
	Eastern Red-backed Salamander	1				2	1	2		6	27.3
	Northern Dusky Salamander	1				2	1	1		5	22.7
TURTLE	Painted Turtle	1	2	2						5	22.7
	Eastern Snapping Turtle		1	1						2	9.1
SNAKE	Common Garter Snake		1		1				1	3	13.6
	Northern Ringneck Snake								1	1	4.8
	Eastern Milk Snake						1			1	4.8
	Total # of Locations with detections/Total # of Locations	2/4	7/7	3/3	2/2	2/2	1/1	2/2	1/1	20/22	

Table 4. Number of adults recorded and species richness (S) at each of 21 standardized survey sites and one incidental encounter location (Historic Core) at Saint-Gaudens NHS. Frequency of occurrence (FO) is the number of locations where a species was detected, divided by the total number of locations surveyed (22).

Site[1]	Northern Spring Peeper	Northern Green Frog	Gray Treefrog	Wood Frog	American Bullfrog	Pickerel Frog	Eastern American Toad	Red-spotted Newt	Spotted Salamander	Northern Two-lined Salamander	Eastern Red-backed Salamander	Northern Dusky Salamander	*Ambystoma* spp.	Painted Turtle	Eastern Snapping Turtle	Common Garter Snake	Northern Ringneck Snake	Eastern Milk Snake	Total # of Adults	% of Total	S
Historic Core																1	3		4	0.07	2
BMD Brook Below Dam																			0	0.00	0
BMD Brook Low Gradient		1												1					2	0.03	2
BMD Brook Medium Gradient																			0	0.00	0
BMD Pond	1075	92	28		8		2	33	74					15	10				1337	22.47	9
BMU Brook		12		1		4			1	103	10	48							179	3.01	7
Farm Field								1	1										2	0.03	2
Farm Pond 1	31	25			1	11		228											296	4.97	5
Farm Pond 2	L[2]	1		L		1		45	1				L						48	0.81	6
Lower Field																1			1	0.02	1
Pond A’	146	31	45	1	1		1	14	37				L						276	4.64	8
Pond B	20	2		23				16	7				L						68	1.14	5
Pond B’	212			4				3	16										235	3.95	4
Pond C	874	3	6	16	1			18	95				L	2	1				1016	17.08	9

[1] BMD = Blow-Me-Down, BMU = Blow-Me-Up
[2] Larvae

Table 4. Number of adults recorded and species richness (S) at each of 21 standardized surveys sites and 1 incidental encounter location (Historic Core) at Saint-Gaudens NHS. Frequency of occurrence (FO) is number of locations a species was recorded from, divided by total number of locations (22) (continued).

Site[1]	Northern Spring Peeper	Northern Green Frog	Gray Treefrog	Wood Frog	American Bullfrog	Pickerel Frog	Eastern American Toad	Red-spotted Newt	Spotted Salamander	Northern Two-lined Salamander	Eastern Red-backed Salamander	Northern Dusky Salamander	*Ambystoma* spp.	Painted Turtle	Eastern Snapping Turtle	Common Garter Snake	Northern Ringneck Snake	Eastern Milk Snake	Total # of Adults	% of Total	S
Pond DE	774	10			5			31	28										848	14.25	5
Pond FGHI	628	13	7	11	2			34	54				L[2]	1		2			752	12.64	9
Turtle Pond	563	96	51	2	1		1	5						18					737	12.39	8
Woodland 1							1	3		4	9	10						1	28	0.47	6
Woodland 2				3			2	13			18		1						37	0.62	5
Woodland 3				1				3		5	9	1							19	0.32	5
Woodland 4							1	11		2	23	1							38	0.64	5
Woodland 5	1			2			1	3		1	10	9							27	0.45	7
Total # of Adults	4324	286	137	64	19	16	9	461	314	115	79	69	1	37	11	4	3	1	5950	100.00	16
Total # of Locations	11	11	5	11	7	3	7	16	10	5	6	5	6	5	2	3	1	1			
FO (%)	50.0	50.0	22.7	50.0	31.8	13.6	31.8	72.7	45.5	22.7	27.3	22.7	27.3	22.7	9.1	13.6	4.5	4.5			

[1] BMD = Blow-Me-Down, BMU = Blow-Me-Up
[2] Larvae

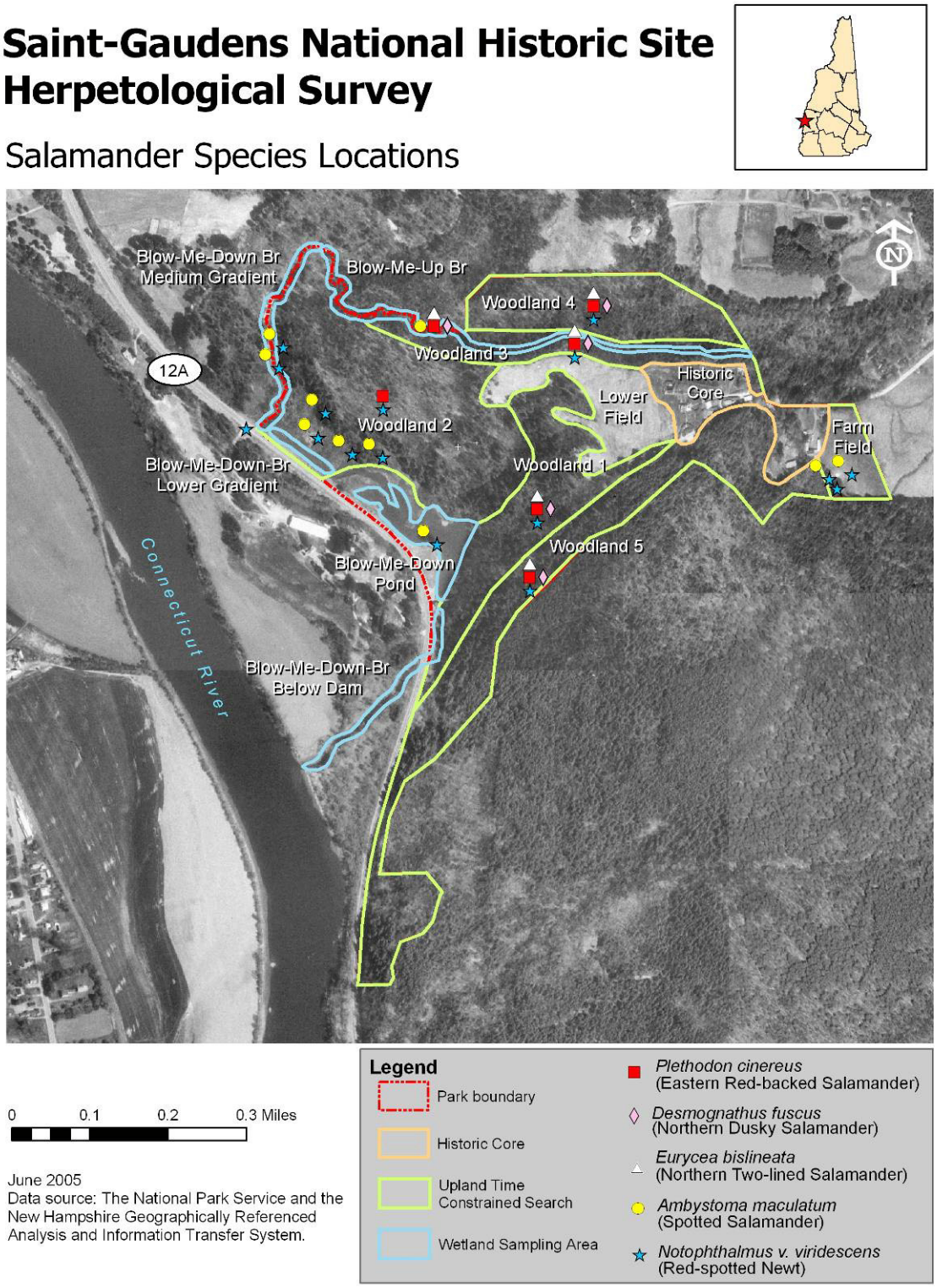

Figure 2. Location of salamander detections at Saint-Gaudens National Historic Site. Points represent central location of survey sites where a given species was recorded, not each individual.

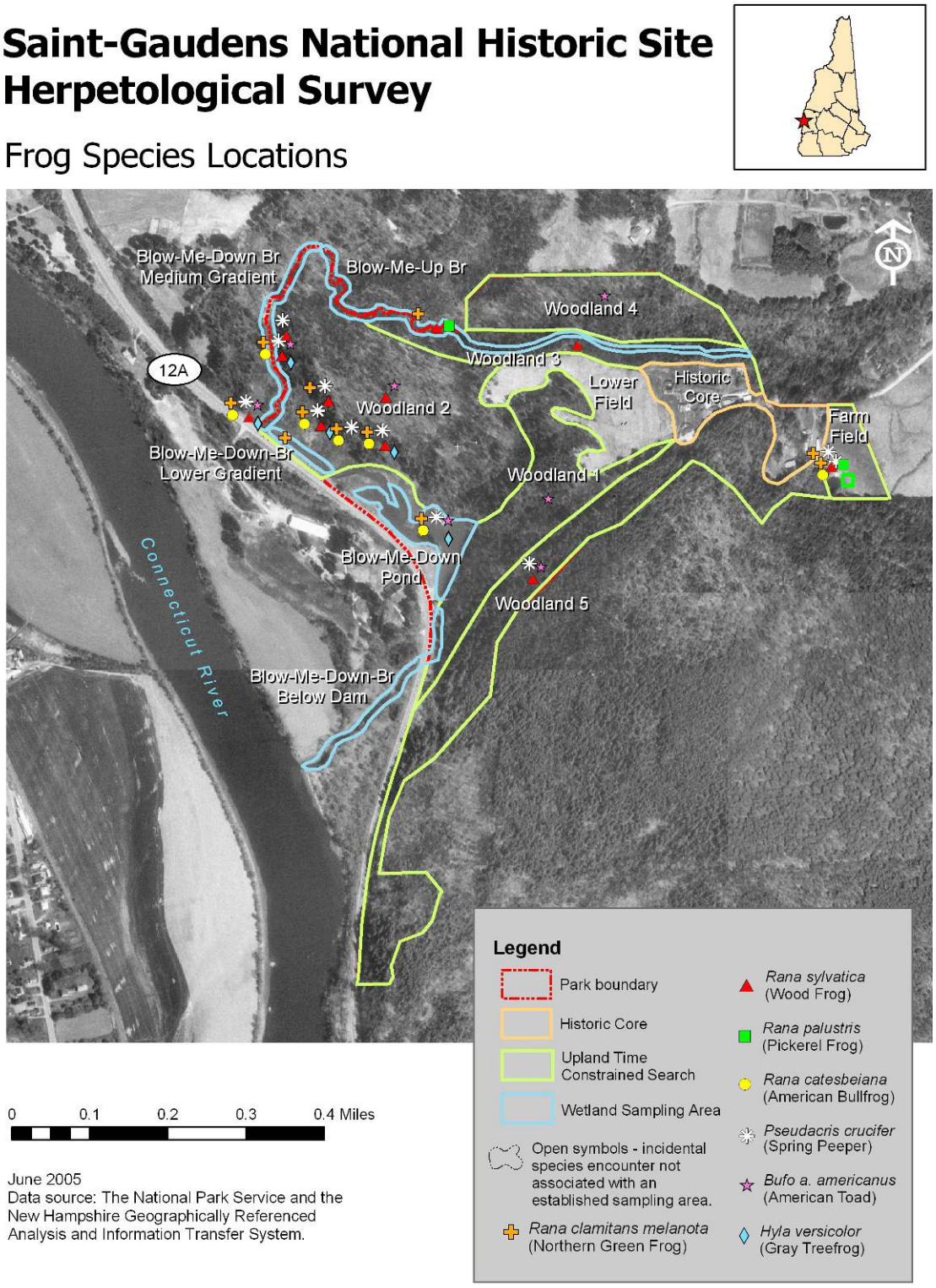

Figure 3. Location of frog and toad detections at Saint-Gaudens National Historic Site. Points represent central location of survey sites where a given species was recorded, not each individual.

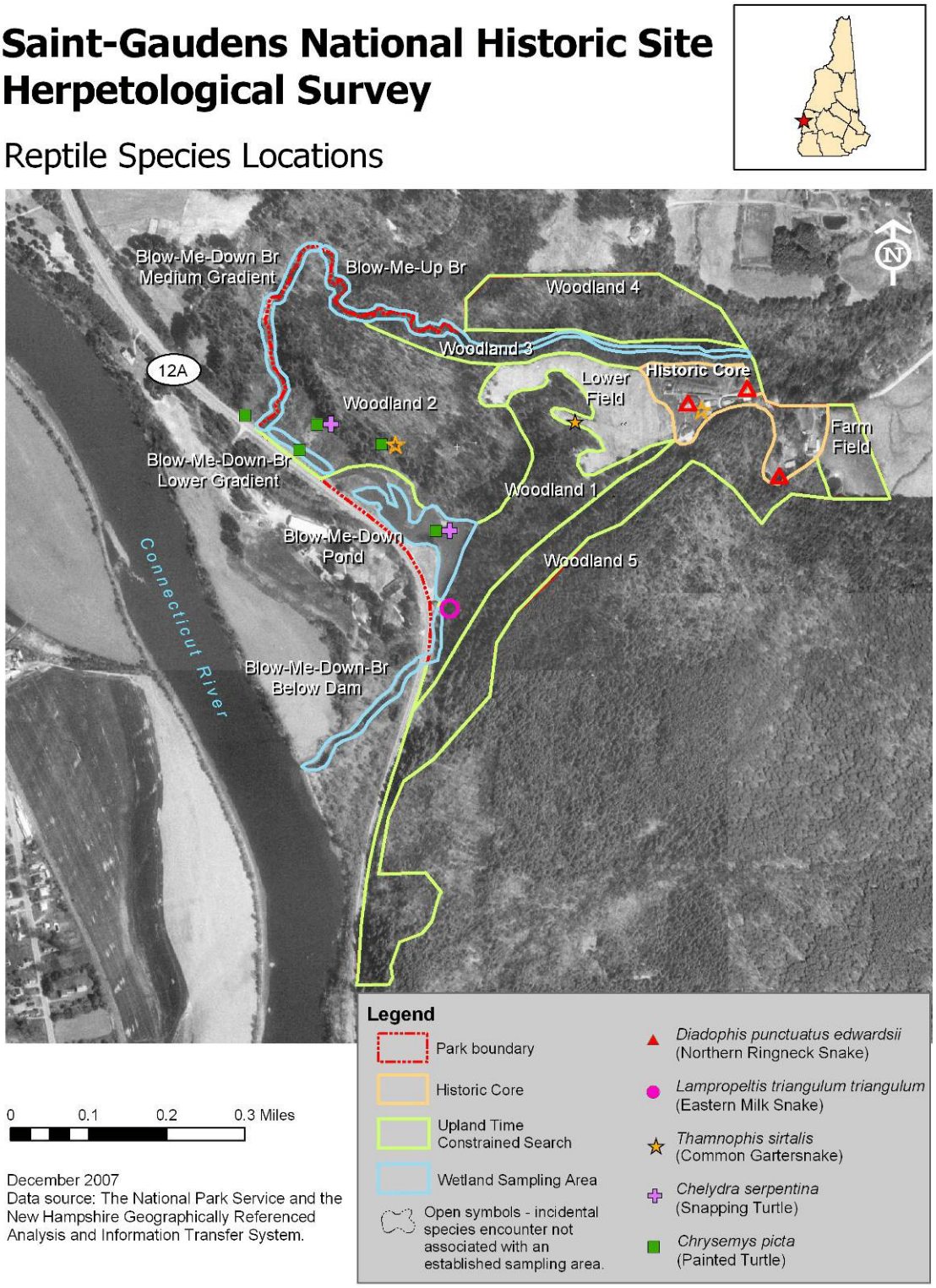

Figure 4. Location of reptile detections at Saint-Gaudens National Historic Site. Points represent central location of survey sites where a given species was recorded, not each individual. Open symbol represents incidental encounter site.

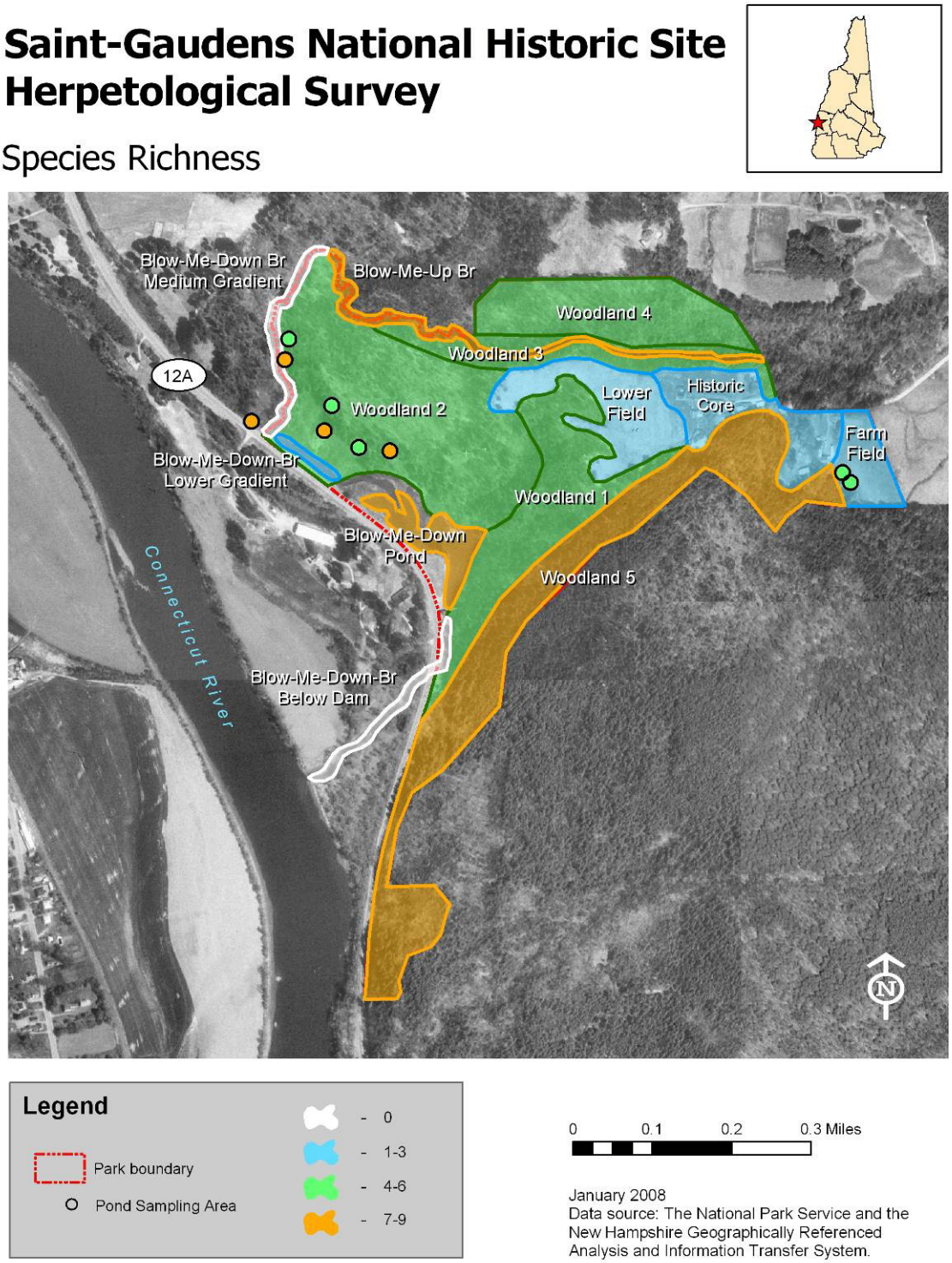

Figure 5. Species richness of areas sampled for amphibians and reptiles at Saint-Gaudens National Historic Site.

Survey Method Summaries

Of the standardized surveys, pond TCS detected the greatest number of species (10) and was the most productive method of capture for northern green frog and American bullfrog (Tables 5 and 6). Anuran calling surveys produced 40% of all individuals recorded and was the most productive method for northern spring peeper, gray treefrog, and wood frog. Stream TCS was the most productive method for northern two-lined salamander and northern dusky salamander, and woodland TCS was the most productive method for eastern American toad and eastern red-backed salamander. Minnow trap surveys recorded six species, and was the most productive method for red-spotted newt and spotted salamander. Turtle trap surveys produced three species (one frog and two turtle species), accounted for 0.7% of all individuals recorded, and were the most productive method for painted and snapping turtles. Field TCS produced two species and coverboards produced the common garter snake. Incidental encounters recorded four species and was the most productive method of capture for pickerel frog, common garter snake, and northern ringneck snake (Table 6).

Anuran Calling Surveys

Six anuran species were heard during calling surveys at eight sites. Northern spring peeper was the most widespread species, heard at all eight sites. Northern green frog was heard from 75% of the sites, followed by gray treefrog (63%), wood frog (38%), and American bullfrog and American toad (25% each) (Table 7). Spring peeper was also the most abundant species (2164 adults) based on counts or estimates of numbers calling, followed by northern green frog (102 adults), gray treefrog (81 adults), wood frog (31 adults), American bullfrog (four adults) and American toad (two adults) (Table 7). Ideally, an equal number of surveys at each site are desired to make equal comparisons between sites. All sites were surveyed three times each from 25 April to 26 June, allowing for equal comparisons between sites. Anuran calling surveys at Pond A' and Turtle Pond produced the most species (five each), and Blow-Me-Down Pond produced the most spring peepers with 650 adults recorded in the course of three surveys.

Egg Mass Counts

Spotted salamander and/or wood frog egg masses were counted from six of eight sites surveyed (Table 8). Spotted salamander spermatophores were counted from five sites, including Pond B' where no egg masses were recorded. Pond B had the greatest number of spotted salamander egg masses (35 egg masses = est. 22 females), and the mean number of egg masses/pond for the six ponds where egg masses were present was 20.00 (SD ± 13.61). Wood frog egg masses were only found in Pond C and Farm Pond 2, and represented two and three females respectively (Table 8).

Table 5. Number and species richness (S) of amphibians and reptiles recorded by survey method at Saint-Gaudens NHS.

Survey Method[1]	Northern Spring Peeper		Northern Green Frog		Gray Treefrog		Wood Frog		American Bullfrog		Pickerel Frog	Eastern American Toad		Red-spotted Newt		Spotted Salamander		Northern Two-lined Salamander		Eastern Red-backed Salamander	Northern Dusky Salamander		*Ambystoma* spp.		Painted Turtle	Eastern Snapping Turtle	Common Garter Snake	Northern Ringneck Snake	Eastern Milk Snake	Total # of Adults	S
	adl[2]	lrv[2]	adl	lrv	adl	lrv	adl	lrv	adl	lrv	adl	adl	adl	eft	lrv	adl	lrv	adl	lrv	adl	adl	lrv	adl	lrv	adl	adl	adl	adl	adl		
ACS	2164		102		81		31		4			2																		2384	6
EMC		1				3		5									120							3						0	4
TCS Stream			12				1				4					1		103	10	10	48	23			1					180	8
TCS Woodland	1						6					5		33				12		69	21	1	1							147	7
TCS Field														1		1														2	2
TCS Pond	2159	25	159	19	56		22	3	9		1	2	67		7	2								116	5					2482	10
CB																												1		1	1
TTS			1																						31	11				43	3
MTS		2	12	68			4	21	6	15			360		1	310								5						692	6
IE											11																3	3	1	18	4
Total	4324	28	286	87	137	3	64	29	19	15	16	9	427	34	8	314	120	115	10	79	69	24	1	124	37	11	4	3	1	5950	17

[1] ACS = Anuran calling survey, EMC = Egg mass count, TCS = Time-constrained search, CB = Coverboard, TTS = Turtle Trap Survey, MTS = Minnow Trap Survey, IE = Incidental Encounter
[2] A = Adult, L = Larvae

Table 6. Percentage of adult-form individuals of each species detected by each survey method at Saint-Gaudens NHS. Derived from Table 5.

Survey Method[1]	Northern Spring Peeper	Northern Green Frog	Gray Treefrog	Wood Frog	American Bullfrog	Pickerel Frog	Eastern American Toad	Red-spotted Newt	Spotted Salamander	Northern Two-lined Salamander	Eastern Red-backed Salamander	Northern Dusky Salamander	Painted Turtle	Eastern Snapping Turtle	Common Garter Snake	Northern Ringneck Snake	Eastern Milk Snake	Total # of Adults	% Total Adults	S[2]
ACS	50.1	35.7	59.1	48.4	21.1	0.0	22.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2384	40.1	6
EMC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	4
TCS Stream	0.0	4.2	0.0	1.6	0.0	25.0	0.0	0.0	0.3	89.6	12.7	69.6	2.7	0.0	0.0	0.0	0.0	180	3.0	8
TCS Woodland	0.02	0.0	0.0	9.4	0.0	0.0	55.6	7.2	0.0	10.4	87.3	30.4	0.0	0.0	0.0	0.0	0.0	147	2.5	7
TCS Field	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2	0.0	2
TCS Pond	49.9	55.6	40.9	34.4	47.4	6.3	22.2	14.53	0.6	0.0	0.0	0.0	13.5	0.0	0.0	0.0	0.0	2482	41.7	10
CB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0	0.0	1	0.0	1
TTS	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83.8	100.0	0.0	0.0	0.0	43	0.7	3
MTS	0.0	4.2	0.0	6.3	31.6	0.0	0.0	78.1	98.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	692	11.6	6
IE	0.0	0.0	0.0	0.0	0.0	68.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	75.0	100.0	100.0	18	0.3	4
Total # Adults	4324	286	137	64	19	16	9	427	314	115	79	69	37	11	4	3	1	5914	100.0	17

[1] ACS = Anuran calling survey, EMC = Egg mass count, TCS = Time-constrained search, CB = Coverboard, TTS = Turtle Trap Survey, MTS = Minnow Trap Survey, IE = Incidental Encounter
[2] S = species richness

Table 7. Results of anuran calling surveys at Saint-Gaudens NHS.

Site	First Date	Last Date	# of Surveys	Northern Spring Peeper		Northern Green Frog		Gray Treefrog		Wood Frog		American Bullfrog		Eastern American Toad		S[3]
				CI[1]	#[2]	CI	#	CI	#	CI	#	CI	#	CI	#	
BMD[4] Pond	25-Apr	26-Jun	3	3	650	3	35	3	22			1	3			4
Farm Pond 1	25-Apr	26-Jun	3	2	20	1	10									2
Pond A'	25-Apr	26-Jun	3	3	120	1	9	3	25	1	1			1	1	5
Pond B	25-Apr	26-Jun	3	2	20					3	20					2
Pond C	25-Apr	26-Jun	3	3	450	1	1	1	1	2	10					4
Pond DE	25-Apr	26-Jun	3	3	350	1	3									2
Pond FGHI	25-Apr	26-Jun	3	3	204			1	2							2
Turtle Pond	25-Apr	26-Jun	3	3	350	3	44	3	31			1	1	1	1	5
		Total # of Sites			8		6		5		3		2		2	
		Total # of Adults			2164		102		81		31		4		2	

[1] Highest call index recorded
[2] Number of adult individuals detected summed across all surveys
[3] S = Species richness
[4] BMD = Blow-Me-Down

Table 8. Maximum number of egg masses and spermatophore groups recorded during egg mass counts at Saint-Gaudens NHS.

			Spotted Salamander			Wood Frog	
Site	**First Date**	**Second Date**	**Spermatophore Groups**	**Max # of Egg Masses**	**Est. # of Females**	**Max # of Eggs**	**Est. # of Females**
Farm Pond 1	26-Apr	--					
Farm Pond 2	25-Apr	28-May	1	19	12	3	3
Pond A’	25-Apr	28-May	1	6	4		
Pond B	25-Apr	28-May	3	35	22		
Pond B’	25-Apr	28-May	3				
Pond C	25-Apr	27-May	2	8	5	2	2
Pond DE	26-Apr	27-May		14	9		
Pond FGHI	26-Apr	28-May		38	24		
		Total	10	119	76	5	5

Time-constrained Search

Stream TCS: Eight species were detected during TCS in four streams/stream sections. Seven of these species and the overwhelming majority of individuals (99%) were recorded in Blow-Me-Up Brook. Only a single painted turtle was observed in Blow-Me-Down Brook Low Gradient, and nothing was recorded in Blow-Me-Down Brook Below Dam and Blow-Me-Down Brook Medium Gradient (Table 9). The northern two-lined salamander was the most abundant salamander (CR = 3.00 individuals/search hour), followed by the northern dusky salamander (CR = 1.40), eastern red-backed salamander (CR = 0.29), and spotted salamander (CR = 0.03). The northern green frog was the most abundant anuran (CR = 0.35), followed by the pickerel frog (CR = 0.12) and wood frog (CR = 0.03, Table 9).

Woodland/Field TCS: Seven species were detected during woodland TCS in five areas. The eastern red-backed salamander and red-spotted newt were the most widespread species, recorded in all five woodland areas surveyed. These were followed by the northern dusky salamander, northern two-lined salamander, and eastern American toad (each in 80% of areas), wood frog (60% of areas), and northern spring peeper (20% of areas, Table 10). The eastern red-backed salamander and red-spotted newt were the most abundant species (CR = 2.91 and CR = 1.39 individuals/person search hour, respectively). The northern spring peeper was the least abundant (CR = 0.04). Woodland 5 had the greatest species richness with seven species recorded, while Woodland 4 had the greatest number of adults recorded (26% of individuals, Table 10).

Only one red-spotted newt and one spotted salamander were recorded during TCS from the Farm Field and no species were recorded in the Lower Field. Whereas seven species were recorded during woodland TCS, only two were recorded during field TCS. Overall abundance was also much greater in woodlands (CR = 6.20) than fields (CR = 0.22, Table 10).

Pond TCS: Ten species were detected during pond TCS at 10 sites. Permanent pond TCS recorded seven species and temporary pond TCS recorded eight species. Painted turtle and American toad were the only species found during permanent pond TCS and not during temporary pond TCS. Pickerel frog and spotted salamander were found during temporary pond TCS but not during permanent pond TCS. Northern spring peeper was the most widespread species, recorded at nine sites, followed by northern green frog and red-spotted newt (each at seven sites), wood frog and gray treefrog (each at five sites), American bullfrog (four sites), eastern American toad (two sites), painted turtle, spotted salamander, and pickerel frog (one site, Table 11). Northern spring peeper was also the most abundant species recorded in both permanent pond TCS (CR = 96.87) and temporary pond TCS (CR = 175.58). Abundance of spring peepers was obtained from adults observed and number adult males heard (Table 11). Estimates of the number of spring peepers present during incidents of full chorus during pond TCS surveys used the average number of adult males heard during full chorus episodes of anuran calling surveys (n = 212). Note that for Tables 9-11 the capture rate (CR) is the number of individuals divided by person hours spent searching detailed in Table 12.

Table 9. Number of amphibians and reptiles recorded during stream time-constrained search at Saint-Gaudens NHS. The capture rate (CR) is number of individuals divided by total search effort (detailed in Table 12).

	# Individuals (CR)											
	Northern Two-lined Salamander		Northern Dusky Salamander		Northern Green Frog	Eastern Red-backed Salamander	Pickerel Frog	Wood Frog	Spotted Salamander	Painted Turtle	Total # of Adults	
Site[1]	**adl[2]**	**lrv[2]**	**adl**	**lrv**	**adl**	**adl**	**adl**	**adl**	**adl**	**adl**		**S[3]**
BMD Brook Below Dam											0 (0.00)	0
BMD Brook Low Gradient										1 (0.15)	1 (0.15)	1
BMD Brook Medium Gradient											0 (0.00)	0
BMU[2] Brook	103 (7.74)	10 (0.75)	48 (3.61)	23 (1.73)	12 (0.90)	10 (0.75)	4 (0.30)	1 (0.08)	1 (0.08)		179 (13.46)	7
Total Individuals	103	10	48	23	12	10	4	1	1	1	180	8
CR (inds/search hour)	3.00	0.29	1.40	0.67	0.35	0.29	0.12	0.03	0.03	0.03	6.21	

[1] BMD = Blow-Me-Down, BMU = Blow-Me-Up
[2] A = Adult, L = Larvae
[3] S = Species richness

Table 10. Number of amphibians and reptiles recorded during woodland and field time-constrained search at Saint-Gaudens NHS. The capture rate (CR) is number of individuals divided by search effort (detailed in Table 12).

		# Individuals (CR)										
		Eastern Red-backed Salamander	Northern Dusky Salamander		Northern Two-lined Salamander	Wood Frog	Eastern American Toad	Northern Spring Peeper	Spotted Salamander	Red-spotted Newt		
	Site	adl[1]	adl	lrv[1]	adl	adl	adl	adl	adl	eft	Total # of adults/efts	S[2]
WOODLAND	Woodland 1	9 (2.43)	10 (2.70)	1 (0.27)	4 (1.08)		1 (0.27)			3 (0.81)	27 (7.30)	5
WOODLAND	Woodland 2	18 (2.65)				3 (0.44)	2 (0.29)			13 (1.91)	36 (5.29)	4
WOODLAND	Woodland 3	9 (2.14)	1 (0.24)		5 (1.19)	1 (0.24)				3 (0.71)	19 (4.52)	5
WOODLAND	Woodland 4	23 (4.89)	1 (0.21)		2 (0.43)		1 (0.21)			11 (2.34)	38 (8.09)	5
WOODLAND	Woodland 5	10 (2.33)	9 (2.09)		1 (0.23)	2 (0.47)	1 (0.23)	1 (0.23)		3 (0.70)	27 (6.28)	7
WOODLAND	Total	69 (2.91)	21 (0.89)	1 (0.04)	12 (0.51)	6 (0.25)	5 (0.21)	1 (0.04)	0 (0.00)	33 (1.39)	147 (6.20)	7
FIELD	Farm Field								1 (0.30)	1 (0.30)	2 (0.61)	2
FIELD	Lower Field										0 (0.00)	0
FIELD	Total	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.11)	1 (0.11)	2 (0.22)	2

[1] A = Adult, L = Larvae
[2] S = Species richness

Table 11. Number of amphibians and reptiles recorded during pond time-constrained search at Saint-Gaudens NHS. The capture rate (CR) is number of individuals divided by search effort (detailed in Table 12).

		# Individuals (CR)																			
		Adults							Vocalization						Larvae						
	Site[1]	Eastern American Toad	Painted Turtle	Northern Green Frog	Pickerel Frog	Red-Spotted Newt	Spotted Salamander	Wood Frog	American Bullfrog	Eastern American Toad	Gray Treefrog	Northern Green Frog	Northern Spring Peeper	Wood Frog	*Ambystoma* spp.	Northern Green Frog	Northern Spring Peeper	Red-spotted Newt	Wood Frog	Total # of Adults	S[2]
PERMANENT	BMD[1] Pond	1 (0.45)		6 (2.73)					5 (2..27)	1 (0.45)	6 (2.73)	51 (23.12)	425 (193.18)							495 (225.00)	5
PERMANENT	Farm Pond 1			9 (4.50)		56 (28.00)			1 (0.50)			6 (3.00)	11 (5.50)			1 (0.50)				83 (41.50)	4
PERMANENT	Turtle Pond	1 (0.40)	5 (02.00)	5 (2.00)		1 (0.40)					20 (8.00)	46 (18.4)	213 (85.2)	2 (0.8)						293 (117.20)	7
PERMANENT	Total	2 (0.30)	5 (0.75)	20 (2.99)	0 (0.00)	57 (8.51)	0 (0.00)	0 (0.00)	6 (0.90)	1 (0.15)	26 (3.88)	97 (14.48)	649 (96.87)	2 (0.30)	0 (0.00)	1 (0.15)	0 (0.00)	0 (0.00)	0 (0.00)	865 (129.10)	8
TEMPORARY	Farm Pond 2				1 (2.00)	5 (10.00)									70 (140.00)		22 (44.00)	3 (6.00)		6 (12.00)	3
TEMPORARY	Pond A'			12 (8.00)		1 (5.33)					20 (13.33)	8 (5.33)	26 (17.33)		25 (16.67)	10 (6.67)				67 (44.67)	5
TEMPORARY	Pond B														1 (1.25)				2 (2.5)	0 (0.00)	1
TEMPORARY	Pond B'					1 (1.43)							212 (302.86)	4 (5.71)						217 (310.00)	3
TEMPORARY	Pond C					1 (0.56)					5 (2.78)	2 (1.11)	424 (235.56)	5 (2.78)		2 (1.11)	3 (1.67)	4 (2.22)		437 (242.78)	5
TEMPORARY	Pond DE			4 (2.22)		1 (0.56)			1 (0.56)			2 (1.11)	424 (235.56)			6 (3.33)				432 (240.00)	4
TEMPORARY	Pond FGHI			3 (2.00)			2 (1.33)	1 (0.67)	2 (1.33)		5 (3.33)	3 (2.00)	424 (282.67)	10 (6.67)	20 (13.33)					450 (300.00)	6
TEMPORARY	Total	0 (0.00)	0 (0.00)	19 (2.21)	1 (0.12)	9 (1.05)	2 (0.23)	1 (0.12)	3 (0.35)	0 (0.00)	30 (3.49)	15 (1.74)	1510 (175.58)	19 (2.21)	116 (13.49)	18 (2.09)	25 (2.91)	7 (0.81)	2 (0.23)	1609 (187.09)	8

[1] BMD = Blow-Me-Down
[2] S = Species richness

Table 12. Time constrained search effort and dates listed by habitat type at Saint-Gaudens NHS.

		Site[1]	First Date	Last Date	# of Surveys	# Observers/ Survey	Effort (search hours)
STREAM		BMD Brook Below Dam	26-Apr	20-Sep	5	2	7.0
		BMD Brook Low Gradient	25-Apr	20-Sep	6	2	6.7
		BMD Brook Medium Gradient	25-Apr	19-Sep	5	2	7.3
		BMU Brook	24-Apr	19-Sep	7	2	13.3
				Total	23		34.3
WOODLAND		Woodland 1	24-Apr	20-Sep	5	2	3.7
		Woodland 2	24-Apr	20-Sep	6	2	6.8
		Woodland 3	24-Apr	21-Sep	7	2	4.2
		Woodland 4	24-Apr	21-Sep	7	2	4.7
		Woodland 5	24-Apr	21-Sep	6	2	4.3
				Total	31		23.7
FIELD		Farm Field	24-Apr	18-Aug	4	2	3.3
		Lower Field	24-Apr	18-Aug	4	2	6.0
				Total	8		9.3
PERMANENT	POND	BMD Pond	24-Apr	18-Aug	4	2	2.2
		Farm Pond 1	24-Apr	18-Aug	4	2	2.0
		Turtle Pond	24-Apr	18-Aug	5	2	2.5
				Total	13		6.7
TEMPORARY POND		Farm Pond 2	18-Aug	18-Aug	1	2	0.5
		Pond A’	24-Apr	18-Aug	4	2	1.5
		Pond B	24-Apr	25-Jun	3	2	0.8
		Pond B’	24-Apr	25-Jun	3	2	0.7
		Pond C	24-Apr	18-Aug	4	2	1.8
		Pond DE	24-Apr	18-Aug	4	2	1.8
		Pond FGHI	24-Apr	25-Jun	3	2	1.5
				Total	22		8.6

[1] BMD = Blow-Me-Down, BMU = Blow-Me-Up

Coverboards
A total of 120 board checks in woodlands and 118 board checks in fields produced only one common garter snake under a metal coverboard in the Lower Field (Table 13).

Turtle Trap Surveys
Most turtle detections at SAGA were through trapping. Thirty-one individual painted turtles, each captured only once, and nine individual eastern snapping turtles (two of which were each recaptured once) were captured (Table 14, Appendix D). Painted turtles were captured at four of 10 sites (40%) and eastern snapping turtles were captured at two of 10 sites (20%). The painted turtle and eastern snapping turtle were most abundant in permanent pond habitat, with 28 and 10 captures and 35.90 and 12.82 captures/100 trap nights, respectively. Eastern snapping turtles were most abundant in BMD Pond, with 10 captures (eight unique individuals) and a capture rate of 22.22 captures/100 trap nights. Painted turtles were most abundant at Turtle Pond (CR = 61.90), but there were slightly more captures at BMD pond than at Turtle Pond (Table 14). The lack of painted turtle recaptures prevents estimation of population size, and for eastern snapping turtles, the estimated population (and 95% confidence interval) of BMD Pond is 10 ± 4. The northern green frog was also captured in traps in Pond DE (CR = 8.33) (Table 14).

Minnow Trap Surveys
Six species were detected using minnow traps. With six species captured, Pond C had the greatest species richness (Table 15). The red-spotted newt was the most abundant adult at permanent ponds (CR = 267.95 captures/100 trap night), and the spotted salamander was the most abundant adult in temporary ponds (CR = 156.29, Table 15). The wood frog and northern spring peeper were the only species recorded in temporary ponds but not in permanent ponds. Minnow trap surveys in BMD Brook Low (the only stream trapped) produced one northern green frog (CR = 3.85). The red-spotted newt and northern green frog were the most widespread species. Both were recorded at 10 minnow trap sites (91% of sites), followed by spotted salamander (73% of sites), American bullfrog (45% of sites), wood frog (36% of sites), and northern spring peeper (9% of sites, Table 15).

Incidental Encounters
Four species were recorded incidentally from four sites. One common garter snake and one northern ringneck snake were recorded from Aspet. The northern ringneck snake, a neonate, was recorded in December 2000 by SAGA staff, and is the first ever documented at SAGA. Since then, two other neonate northern ringneck snakes have been recorded in the historic core: one in the Visitor Center on 25 September 2006 and one in the maintenance building in September 2007 (National Park Service, Steve Walasewicz, Natural Resource Manager, pers. comm., 2007). Two common garter snakes were found near Pond FGHI and 11 pickerel frogs were recorded from Farm Pond 1 (Table 16). The fourth species, eastern milk snake, was observed in May 2007 by S. Walasewicz near Blow-Me-Down Mill.

Table 13. Number of snakes recorded during woodland and field coverboard surveys at Saint-Gaudens NHS, 28 May to 19 September 2001. Capture rate (CR) is the number of captures per 100 board checks. Board checks are number of boards/site, multiplied by number of site visits.

	Site	Common Garter Snake	S[1]	# of Boards/ Site	# of Site Visits	# of Board Checks	# of Boards w/Snakes
WOODLAND	Woodland 2		0	8	5	40	0
	Woodland 4		0	8	5	40	0
	Woodland 5		0	8	5	40	0
	Total (CR)	0 (0.00)	0	24	15	120	0
FIELD	Farm Field		0	8	5	38[2]	0
	Lower Field	1 (1.25)	1	16	5	80	1
	Total (CR)	1 (0.85)	1	24	10	118	1

[1] S = species richness
[2] Two boards were missing in June.

Table 14. Number of turtle captures during trapping at Saint-Gaudens NHS. Capture rate (CR) is the number of captures per 100 trap nights.

	Site	First Date	Last Date	# of Trap Nights	# Captures (CR) Painted Turtle	Eastern Snapping Turtle	Northern Green Frog	S[1]
PERMANENT POND	BMD[3] Pond	27-May	28-Jun		15 (33.33)	10[2] (22.22)		2
	Farm Pond 1	27-May	28-Jun	12				0
	Turtle Pond	27-May	28-Jun	21	13 (61.90)			1
			Total	78	28 (35.90)	10[2] (12.82)	0 (0.00)	2
TEMPORARY POND	Pond A'	27-May	28-Jun	12				0
	Pond B	27-May	28-Jun	7				0
	Pond B'	27-May	30-May	3				0
	Pond C	27-May	28-Jun	19	2 (10.53)	1 (5.26)		2
	Pond DE	27-May	28-Jun	12			1 (8.33)	1
	Pond FGHI	27-May	28-Jun	18	1 (5.56)			1
			Total	71	3 (4.23)	1 (1.45)	1 (1.45)	3
STREAM	BMD Brook Low Gradient	27-May	28-Jun	21				0
			Total	21	0	0	0	0

[1] S = species richness
[2] These snapping turtle captures include eight unique captures and two turtles each recaptured once.
[3] BMD = Blow Me Down

Table 15. Number of amphibians and reptiles captured in minnow traps at Saint-Gaudens NHS. Capture rate (CR) is the number of captures per 100 trap nights.

					# Captures (CR)												
					Adults					Larvae							
	Site	First Date	Last Date	Trap Nights	Red-spotted Newt	Spotted Salamander	Northern Green Frog	American Bullfrog	Wood Frog	Northern Spring Peeper	*Ambystoma* spp.	Red-spotted Newt	Northern Green Frog	American Bullfrog	Wood Frog	Total # of Adults	S[1]
PERMANENT	BMD Pond	23-Apr	20-Aug	26	33 (126.92)	74 (284.62)							9 (34.62)	11 (42.31)		107 (411.54)	4
	Farm Pond 1	23-Apr	20-Aug	26	172 (661.54)								1 (3.85)			172 (661.54)	2
	Turtle Pond	23-Apr	20-Aug	26	4 (15.38)		1 (3.85)						1 (3.85)	2 (7.69)		5 (19.23)	3
			Total	78	209 (267.95)	74 (94.87)	1 (1.28)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	11 (14.10)	13 (16.67)	0 (0.00)	284 (364.10)	4
TEMPORARY	Farm Pond 2	24-Apr	18-Aug	17	40 (235.29)	1 (5.88)	1 (5.88)				3 (17.64)				3 (17.64)	42 (247.06)	4
	Pond A’	23-Apr	20-Aug	24	12 (50.00)	37 (154.17)	2 (8.33)	1 (4.17)							5 (20.83)	52 (216.67)	5
	Pond B	24-Apr	28-Jun	22	16 (72.73)	7 (31.81)	2 (9.09)		3 (13.64)				1 (4.55)		13 (59.09)	18 (81.82)	4
	Pond B’	23-Apr	30-May	12	2 (16.67)	16 (133.33)										18 (150.00)	2
	Pond C	23-Apr	21-Sep	30	17 (56.67)	95 (316.67)		1 (3.33)	1 (3.33)	2 (6.67)	1 (3.33)	1 (3.33)	44 (146.67)			114 (380.00)	6
	Pond DE	23-Apr	20-Aug	26	30 (115.38)	28 (107.69)		4 (15.38)					9 (34.62)	2 (7.69)		62 (238.46)	4
	Pond FGHI	23-Apr	28-Jun	20	34 (170.00)	52 (260.00)	5 (25.00)				1 (5.00)		3 (15.00)			91 (455.00)	3
			Total	151	151 (100.00)	236 (156.29)	10 (6.62)	6 (3.97)	4 (2.65)	2 (1.32)	5 (3.31)	1 (0.66)	57 (37.75)	2 (1.32)	21 (13.91)	407 (269.54)	6

[1] S = species richness

Table 15. Number of amphibians and reptiles captured in minnow traps at Saint-Gaudens NHS. Capture rate (CR) is the number of captures per 100 trap nights (continued).

					# Captures (CR)												
					Adults					Larvae							
	Site	First Date	Last Date	Trap Nights	Red-spotted Newt	Spotted Salamander	Northern Green Frog	American Bullfrog	Wood Frog	Spring Peeper	*Ambystoma* spp.	Red-spotted Newt	Northern Green Frog	American Bullfrog	Wood Frog	Total # of Adults	S[1]
STREAM	BMD Brook Low	23-Apr	20-Aug	26			1 (3.85)									1 (3.85)	1
			Total	26	0 (0.00)	0 (0.00)	1 (3.85)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (3.85)	1

[1] S = species richness

Table 16. Number of amphibians and reptiles recorded as incidental encounters at four localities at Saint-Gaudens NHS.

Location	Common Garter Snake	Pickerel Frog	Northern Ringneck Snake	Eastern Milk Snake	S[1]
Historic Core	1		3		2
Pond FGHI	2				1
Farm Pond 1		11			1
Woodland 1				1	1
Total	3	11	3	1	4

[1] S = species richness

Discussion

Community Composition and Important Habitats

Of the 39 native species of amphibians and reptiles that occur in New Hampshire (NH Fish and Game 2007b), 17 were recently recorded at SAGA. Fifteen of the 18 (83%) species of amphibians and reptiles previously recorded at SAGA were recorded during this inventory (Table 2). The 16th species, the northern ringneck snake, was previously unrecorded at SAGA and in Sullivan County (NH Fish and Game 2007a) but probably was present all along. If so, then 16 of 19 "expected" species were recorded during this survey. Moreover, a recent observation of eastern milk snake on 23 May 2007 (National Park Service, Steve Walasewicz, Natural Resource Manager, pers. comm., 2007) provides a recent record for the 17th of these 19 species.

The herpetofauna of New Hampshire is relatively depauperate (Oliver and Bailey 1939), ranking 44th among the 50 United States (Moriarty 2004). This reflects New Hampshire's northerly latitude and the negative relationship between herpetofaunal species richness and latitude in North America (Porter 1972). In addition to species richness being low in northern locales, northern herpetofaunal communities tend to be dominated by amphibians. In this recent survey, amphibians dominated the herpetofauna of SAGA, both in terms of species richness (71% of species) and in numbers recorded (99% of all individuals recorded). Similar dominance was documented in 1985-86, when amphibians accounted for 76% of species richness and 98% of numbers recorded (Cook 1986). The dominance of northern herpetofaunas such as SAGA's by amphibians is because amphibians generally have lower activity temperature requirements than reptiles (Zug 1993).

SAGA occurs in a state with relatively low species richness (39 native species). Moreover, many of these are species at the limits of their distribution, mostly "southern" species that reach their northern limit in New Hampshire. According to Oliver and Bailey (1939), there are 14 such species. Thus, for New Hampshire's 39 native species, SAGA is at or near the distributional limit of five of 21 amphibians and nine of 18 reptiles, based on current distribution maps (Conant and Collins 1998). Although there were 31 species present or likely present historically in Sullivan County (Appendix A), nearly half of them are near their range limit. Because a species' abundance and frequency of occurrence tends to be low at the limits of its range (Brown 1984), these 14 species are more likely to be localized in distribution and vulnerable to decline. Indeed, nearly all of these 14 species are among New Hampshire's rare and declining species (NH Fish and Game 2006). Considering the relatively small size of SAGA (60.7 ha) and the small number of species that actually may occur in this part of the state, the 17 species recently recorded here (and 19 total) indicates that SAGA supports a fairly diverse herpetofauna.

Among the 12 species that likely occur in Sullivan County but have never been documented at SAGA, seven do not appear to be present here. These are northern spring salamander, Fowler's toad, northern leopard frog, eastern ribbon snake, northern black racer, timber rattlesnake, and spotted turtle. Of these, all but spring salamander and northern leopard frog are at or near their range limit. For the five other species, blue-spotted salamander, four-toed salamander, smooth green snake, northern brown snake, and northern red-bellied snake, further sampling is needed to determine if they are in fact absent. Of these, four-toed salamander and northern brown snake are

also near their range limit. In addition, among these 12 species, six – the northern leopard frog, eastern ribbon snake, northern black racer, timber rattlesnake, spotted turtle, and smooth green snake – have experienced declines in the northeast (Klemens 1993, Kjoss and Litvaitis 2001, NH Fish and Wildlife 2006). Finally, as mentioned above, detectability and adequacy of sampling may be a factor. Snakes can be present but difficult to detect, as in the case of the northern ringneck snake, which was not recorded in Sullivan County by Oliver and Bailey (1939) or the New Hampshire Herp Atlas (NH Fish and Game 2007a), nor in previous SAGA inventories (Cronan et al. 1981, Cook 1986), but has been recorded incidentally by SAGA staff. A record of an eastern milk snake in 2007 (National Park Service, Steve Walasewicz, Natural Resource Manager, pers. comm., 2007) further illustrates this point. Thus, for many of the potentially-occurring species never documented at SAGA, there is no way to know if the lack of records from SAGA is due to historic absence, recent decline, inadequate sampling, or a combination of these factors.

Given that amphibians dominate the herpetofauna of SAGA, the importance of wetland habitats is evident. With the exception of the eastern red-backed salamander, a terrestrial species, all of the amphibians at SAGA depend on some type of wetland or stream habitat for reproduction. In addition, two of the five species of reptiles recorded are aquatic turtles. Wetlands had the greatest species richness with 12 species, followed by uplands with 11, and streams with eight. Similarly, wetlands accounted for 94.4% of all adults recorded (5,613 of 5,949), with uplands accounting for 2.6% (155 of 5,949) and streams 3.0% (181 of 5,949). Some of this disparity is due to sampling bias, because more sampling took place in wetlands, and much of the sampling occurred in spring, when otherwise terrestrial/fossorial amphibians were concentrated in breeding ponds and more readily detected than when in the uplands. However, even Cook (1986), who spent relatively more time in the uplands, recorded 92.4% of all amphibians and reptiles and 13 species in wetlands, 6.0% and 12 species in uplands, and 1.6% and seven species in streams.

Collectively the number and variety of wetlands at SAGA are integral to the abundance and diversity of the site's herpetofauna, particularly amphibians. Semlitsch (2003) describes an ideal landscape for amphibians in which a diversity of ponds within close proximity and varying hydroperiods are available to support all the locally-occurring species. The string of temporary ponds that run parallel to Blow Me Down pond and its marshes, as well as these latter wetlands provide such a landscape, although the extent to which this is an artifact of human activities is uncertain. Had BMD Brook not been dammed in 1890 the extensive marshes of BMD pond may not exist, although beaver in the area would likely have created similar habitat at smaller scales.

Species richness was greatest at BMD Pond, Pond C, and Pond FGHI, with nine species found at each, and the total number of amphibians encountered was greatest at BMD Pond, accounting for 22.5% of all amphibians (Tables 2 and 4). BMD Pond and Turtle Pond were also important to eastern snapping and painted turtles. Ponds A', C, B, DE, and Ponds FGHI and BMD were important breeding sites for wood frogs and spotted salamanders (Table 4). In addition to all the species richness and abundance that BMD Pond directly supports, it is also a critical habitat because of its hydrological connection to the temporary wetlands that occur along the floodplain of BMD Brook, referred to as "overflow" ponds by Cook (1986) because spring high water in BMD Pond backs up into these ponds. Besides this direct flow of water from BMD Pond into the

"overflow" ponds, the creation of BMD Pond presumably has raised the groundwater table along this floodplain, enhancing the hydro-period of these ponds the rest of the year as well.

Permanent and temporary wetlands at SAGA are similar to each other in species richness (S = 11 and 12, respectively), and the species recorded in these two habitat types are essentially the same. This high degree of species overlap is partly because of the close physical proximity and springtime surface connection between BMD Pond and the "overflow" ponds and also because many of the species found at SAGA (e.g. spring peepers, northern green frogs, red-spotted newts, grey treefrogs) typically utilize both habitat types. There are however, some differences between these two wetland types in their relative importance to certain species. For example, 86% of all wood frogs were recorded in temporary ponds, especially ponds B, C, and FGHI, and spotted salamanders occurred primarily in temporary ponds (76% of all recorded), especially ponds C, FGHI, A', DE, and B (Tables 2, 4). Conversely, the preponderance of records in permanent ponds (BMD Pond, Farm Pond 1,and Turtle Pond) for northern green frog (74%), pickerel frog (69%), painted turtle (89%), and eastern snapping turtle (91%) demonstrate the greater importance of this habitat type for those species. Thus while permanent and temporary wetlands overlap in terms of species occurrence, differences in habitat preferences among the various species partition them numerically, such that BMD Pond and the "overflow ponds" complement each other in terms of their relative importance to many of the species present. Similarly, although BMU Brook had only seven species recorded, it is a very important habitat for SAGA's two species of stream salamanders, accounting for 90% of all northern two-lined salamanders and 70% of all northern dusky salamanders. In contrast, there were no species recorded in BMD Brook Medium or BMD Brook Below Dam and only two species recorded in BMD Brook Low (northern green frog and painted turtle are typical of ponds and slow moving streams). The distribution of species among habitats in 1985-86 was similar and Cook (1986) noted that they corresponded to well known patterns of habitat use and preference (Klemens 1993, Ernst et al. 1994, Petranka 1998, Hunter et al. 1999, Ernst and Ernst 2003).

Although freshwater wetlands and streams, especially BMU Brook, are critical to supporting the diversity of amphibian species found at SAGA, the adjacent upland habitats are also important. Many of the amphibians found in pond habitats at SAGA only use them for breeding, and spend the rest of the year in uplands, where they forage and hibernate. Thus, spotted salamander, eastern American toad, northern spring peeper, and grey treefrog are dependent on the woodland habitats of SAGA, as are red-spotted newts, which utilize this habitat for their juvenile stage (red eft), and eastern red-backed salamanders, which are terrestrial and do not breed in wetlands. In addition, the relatively few species of reptiles here depend either almost entirely on uplands for foraging and hibernation (e.g. all SAGA snake species) or, in the case of aquatic turtles, they require open, well drained, uplands for nesting. Thus, although amphibians and reptiles commonly utilize specific habitats for part of the year, their complex life cycles require the use and occupancy of a number of different habitats for breeding, foraging, dispersal, nesting, and hibernation and it is important to ensure the integrity and connectivity of all available habitats at SAGA.

Species at Risk

Most of the 19 species of amphibians and reptiles documented at SAGA are common in the Northeast (Conant and Collins 1998, Klemens 1993) and widespread in North America. From a

preservation of species at risk perspective, SAGA does not support significant populations of any species that are exceptionally rare such that it could be considered a critical site for a rare or declining species. The historic records of wood turtle and Jefferson salamander at SAGA (Cook 1986) are the only records from SAGA of species of conservation concern in New England. The wood turtle is listed as *Special Concern* in New York, Massachusetts, New Hampshire, Vermont, and Connecticut. The wood turtle is a riparian species, found in wetlands and uplands near stream habitats. Inhabiting clean streams, the wood turtle can also be found away from water in the summer months. The Jefferson salamander, listed as a species of *Special Concern* in New York, New Hampshire, Vermont, Massachusetts, and Connecticut, is found in deciduous woodlands for most of the year, and migrates to temporary or semi-permanent ponds in the spring to breed. The decline of these species throughout their range is due to a number of factors, most relating to aspects of development, habitat fragmentation, and road kill. The preservation of stream, wetland, and upland habitats of SAGA, as well as the surrounding communities is important for the preservation of these species.

Population Trends

Determining population trends at SAGA is difficult, given the lack of detailed historic data prior to the 1980's. At best we have old but incomplete and general information from the 1930's (Oliver and Bailey 1939), or more recent and complete SAGA-specific data (Cronan et al. 1981, Cook 1986). Yet, even collectively these works do not provide a definitive list of all the species that once occurred here. Rather than speculate on the decline of species that may or may not have occurred here previously, in the species accounts below, we have attempted to assess the status and population trends of species known to have occurred at SAGA. Based on this approach, 16 of the 19 species previously documented at SAGA appear to be stable in terms of their population trends. Three other species, Jefferson salamander complex, wood turtle, and eastern milk snake, are known to or may be declining in the region, but the data, both "historic" and current, are too limited to determine a trend. These have been listed as "undetermined" (Table 17).

Table 17. “Historic” status and apparent trends in amphibians and reptiles at Saint-Gaudens NHS.

	Stable	**Uncertain**
Abundant	Northern Spring Peeper	
	Northern Green Frog	
	Gray Treefrog	
	Red-spotted Newt	
Common	Wood Frog	
	American Bullfrog	
	Spotted Salamander	
	Northern Two-lined Salamander	
	Eastern Red-backed Salamander	
	Northern Dusky Salamander	
	Painted Turtle	
	Eastern Snapping Turtle	
Uncommon	Pickerel Frog	
	Common Garter Snake	
	American Toad	
Rare	Northern Ringneck Snake	Eastern Milk Snake
		Jefferson Salamander Complex[1]
		Wood Turtle[1]

[1] Not recorded during this study

Stressors

Global stressors tend to affect large geographic areas and are often far removed from their ultimate cause or source. Global stressors include ultraviolet-B radiation and atmospherically transported pollutants such as mercury and acid rain. Stressors such as other heavy metals, chemicals found in fertilizers, herbicides, and pesticides, habitat degradation, disease, road mortality, and introduced species (Dunson et al. 1992, Blaustein 1994, Blaustein et al. 1994, Pechman and Wilbur 1994, Hunter et al. 1999, Daszak et al. 2000, Knapp and Matthews 2000) may also be widespread in their scope, but tend to be more variable across the landscape in their extent. Thus their impacts may be at either a regional or local level.

Few of these stressors are known to be operating at SAGA, although that may be because assessments have not yet been conducted. Mercury is transported atmospherically and deposited, often far from the source, and can be accumulated by aquatic organisms to the point of causing lethal or sub-lethal effects. Mercury deposition is occurring throughout the Northeast, and even aquatic systems of relatively undeveloped areas such as Acadia NP (Bank et al. 2006) and Cape Cod National Seashore contain high levels of mercury. The problem occurs when low pH, in part due to acid rain, leads to elevated concentrations of mercury. This process has been linked to the decline of northern dusky salamanders at Acadia NP (Bank et al. 2006). Given that both acid precipitation and mercury deposition occurs in the vicinity of SAGA (Likens et al. 1996, Chalmers et al. 2005) it is reasonable to conclude that SAGA is subjected to inputs from both of these stressors. In addition to mercury, low pH can increase the solubility of aluminum to levels toxic to amphibians (Clark and Hall 1985). Currently, the pH values of waters associated with SAGA are alkaline, ranging from pH 7.18 to 8.17. This is likely due to the calcium-rich bedrock in the area that buffers the water and soils associated with it (Gilman 1997). Thus, at present, the high buffering capacity of SAGA waters is likely preventing acidification and subsequent elevated levels of mercury and aluminum. This may explain why northern dusky salamanders continue to be abundant here while they have essentially disappeared from Acadia NP. However, long term acidification can reduce buffering capacity (Likens et al. 1996) and while there does not appear to be any immediate problems at SAGA related to acid precipitation or mercury, periodic monitoring is warranted.

High levels of pollutants could negatively impact the amphibians and reptiles in the park. Nutrients such as nitrogen and phosphorous can cause dense masses of algae, which is not conducive to laying eggs. Excess nutrients can also reduce the amount of oxygen available in the water for amphibian larvae and alter the composition and abundance of the invertebrate communities that are food for larvae. SAGA is embedded within a landscape that has been and continues to be a mix of agriculture and forest, and fertilizers and pesticides have undoubtedly been used, but the extent to which these may be a problem is uncertain. A recent study of the overall water quality and biological integrity of representative wetlands within (five sites) and outside (one site) SAGA boundaries described the quality of tributary waters in the park as generally good (NPS 2004). Temperature, dissolved oxygen, conductivity, and stream discharge values varied from month to month and were associated with seasonal changes. The presence of pollution-intolerant macroinvertebrates indicated a lack of pollution in the watershed. Fecal coliform is introduced into watersheds by wildlife, agriculture, and human waste. Although the headwaters of the SAGA streams are located adjacent to areas with residential septic systems, limited agriculture, and development, testing for fecal coliform found limited presence and the

values met New Hampshire Class A standards. Thus, water quality at SAGA appeared to be good at the time of the field work.

Much of SAGA's landscape has been manipulated over the years (Cronan et al 1981), contributing to the invasion of a number of non-native plants. If left unchecked, some non-native species can overwhelm native species and alter the nature of wetland and upland habitats (Malecki et al. 1993, Malecki 1995, Klemens 1993). In recognition of this threat, SAGA implemented a comprehensive exotic plant management program in 2001. Since that time, approximately 27,000 individual invasive plants have been removed throughout the park including 3,200 yellow iris at BMD Pond. In addition, the park implemented a biological control program for purple loosestrife at BMD Pond that has resulted in a decrease in stem density of the species, from just over 10 per square meter in 2003, to under three per square meter in 2007 (National Park Service, Steve Walasewicz, Natural Resource Manager, pers. comm, 2007).

Because amphibians and reptiles utilize both aquatic and terrestrial habitats, they are important indicators of environmental quality. Morphologically the semi-permeable skin of amphibians makes them more susceptible to changes in their environment than other vertebrates, and they are often among the first species to show the effects of changes in environmental conditions (Pough et al. 2004). The loss of keystone species and important habitats can alter the sustainability of herpetofaunal communities and the ecosystem as a whole. Although there is much evidence of amphibian declines in much of the northeast, SAGA currently supports a fairly diverse and robust amphibian community. The reptilian fauna is more depauperate, partly because of geography; the role of anthropogenic factors is unknown. Some road kill occurs on Rt 12A and Saint-Gaudens road, but because most of the amphibian migration from woodlands to breeding ponds does not have to cross these roads, it is probably not a significant problem. Thus, although many of the stressors associated with amphibian and reptile declines are present at SAGA, they occur at what appear to be low levels and are not known to be causing any negative impacts to the herpetofauna.

Recommendations for Management and Future Inventory and Monitoring

Although the stressors impacting upon SAGA do not appear to be severe, there are a couple of management actions recommended. Most importantly, considering the continued development in the region, it will behoove the park to promote protection of the adjoining landscape and watershed, and become involved in ensuring that any future development proposed will not contribute to degradation of the park and vicinity.

Open, early successional habitats such as fields are important habitats for basking snakes and nesting turtles. They will be lost to ecological succession unless maintained. At SAGA this is done by mowing. Because mowers have the potential to kill animals that do not move fast enough to escape them, amphibians and reptiles are at risk. Of these two groups, reptiles are at greatest risk because turtles nest in open habitats and both snakes and turtles utilize open habitats, especially field edges, to bask. This risk can be reduced by timing and choice of mower. When possible, mow during the cold months, when amphibians and reptiles are not active. At SAGA, this is probably limited to late October and November, before snow cover sets in, or early spring, if not too muddy. If warm season mowing is necessary, the hottest, driest part of summer, e.g. August, would be best. Amphibians and reptiles will be less likely to be present in

open habitats then, and most bird nesting is also over. The worst times of year to mow are June-early July, which is generally when turtles nest, and in mid to late spring and late summer-early fall, when snakes are most likely to be basking at field edges. If scheduling all mowing for the cold season is not an option, try to at least mow field edges (ca. 10 m) during the cold season. Mowers with rotary blades or sickle bars are preferable to reel or flail mowers. Blades on these mowers are oriented horizontally and, if set to cut at least 7 inches above ground, they will safely pass over many small animals and wear more slowly (Massachusetts Natural Heritage and Endangered Species Program 2007). Also, since fields do not need to be mowed annually to maintain them, the park should consider only mowing a portion of the field habitats in any given year.

Although much of the herpetofaunal abundance and diversity of SAGA derives from BMD Pond and associated wetlands, these habitats were largely created by damming BMD Brook. The ensuing siltation and succession of aquatic vegetation has slowly turned BMD Pond from an open-water pond to a marsh of emergent and floating leaf vegetation. As a part of SAGA's cultural landscape, the management goal is to maintain BMD Pond as an open-water pond. Thus, some form of dredging will be necessary to reverse succession. Although maintaining BMD Pond as a mix of open water and varied aquatic vegetation is desirable from the perspective of herpetofaunal diversity, depending on the extent and timing, dredging has the potential for negative impacts. In the winter of 1984-85, water levels were lowered to make repairs on BMD Dam, and 9,000 cubic yards of silt were also removed by dredging. In the course of this, an undetermined number of painted turtles were also dredged up, and because it was winter, they died (Cook 1986). Given that planning is underway for future maintenance dredging of BMD Pond (National Park Service, Steve Walasewicz, Natural Resource Manager, pers. comm.), it is important that dredging take place during the warm months, when turtles and other aquatic organisms are not hibernating in the mud. It would also be preferable that some of the aquatic vegetation be retained.

The current survey still leaves uncertainties regarding the presence/absence and status of several species, i.e. Jefferson/blue-spotted salamander complex, four-toed salamander, common mudpuppy, wood turtle, and terrestrial snakes in general. Only three of the nine species of snakes historically or currently present or likely present in Sullivan County have been recorded at SAGA. Six of these nine species are still present in the county and one likely is. Although the preliminary data suggest most of these species are absent or very rare at SAGA, specialized inventories are recommended. For terrestrial snakes, an expanded system of coverboards and coverboard arrays (at least 12 arrays) established along field edges and in open wetland habitat patches, and checked from one to three times/week from April through October would provide a better basis for determining their status here. For the other species, further details are provided in the respective species account below.

Although a detailed monitoring plan is beyond the scope of this inventory, anuran calling surveys, stream salamander surveys, and salamander egg mass surveys would be the most useful methods for monitoring SAGA's amphibians. Long term monitoring of reptiles should include periodic trapping of aquatic turtles to estimate population size and structure. The need for or utility of monitoring snakes and wood turtles can not be addressed at this point. Such long term monitoring is important to better separate natural fluctuations in populations over time from

anthropogenic declines (Pechmann et al. 1991, Pechmann and Wilbur 1994, Stebbins and Cohen 1995). In addition, a more in-depth analysis of changes in stream, wetland and terrestrial habitat quality will help to better identify potential causes of changes in the herpetofauna.

Species Accounts: Species Presently or Historically Recorded at SAGA

Jefferson Salamander (Ambystoma jeffersonianum) and Blue-spotted Salamander (Ambystoma laterale) complex

Jefferson salamanders are among the earliest of spring breeding amphibians and often migrate to ponds when still largely covered in ice (Bishop 1941). Females deposit gelatinous egg masses on twigs and leaves in the pond, then leave the pond and return to adjacent woodlands where they spend most of the year (Petranka 1998, Pfingsten and Downs 1989). Hybrids of *A. jeffersonianum* and blue-spotted (*A. laterale*) are found in New England, although these parental groups utilize different habitats. *A. jeffersonianum* breed in vernal ponds and are found primarily in deciduous forests in steep terrain, whereas *A. laterale* prefer wooded swamps in low elevation woodlands (Klemens 1993). *A. jeffersonianum* are also less tolerant of habitat disturbance than *A. laterale*. The range of the blue-spotted salamander includes areas of southern Canada and northern New England, whereas the range of the Jefferson salamander extends south and southwest from New England. There is an area of hybridization for these two species from approximately northern New England to southern New York, and extending out into the mid-western United States (Klemens 1993). Hybrids within this zone can exhibit a wide array of colors and patterns, making identification difficult.

The basis for inclusion of this "species" at SAGA is the observation on 18 April 1986, of three egg masses attached to twigs in pond B that Cook (1986) identified as Jefferson salamander, based on prior experience with the species in the Connecticut River valley of Massachusetts (Cook 1978). The egg masses contained 30, 41, and 23 eggs, and in shape, clarity, and embryo density looked like *A. jeffersonianum* complex eggs. Because blue-spotted salamanders tend to attach their eggs singly to grass blades (Klemens 1993), it is not likely that these egg masses were deposited by any member of the blue-spotted salamander complex.

Minnow trap surveys and egg mass surveys in late April did not detect the *A. jeffersonianum* or *A. laterale* complex in 2001. Considering that only three egg masses were found in 1986, it appears to have been rare. Because these species tends to breed very early, when ponds are just beginning to open up, the minnow trap surveys in late April 2001, although capturing many male spotted salamanders, may have been too late to capture any Jefferson or blue-spotted salamanders. Egg mass surveys in late April fall within egg mass season for Jefferson salamanders, but would not be able to detect eggs of blue-spotted salamanders. In the absence of additional proof of their occurrence here, or additional surveys aimed specifically at demonstrating absence, it is not possible to say anything definite, other than that if either of these species do occur at SAGA, they are still rare. Additional, intensive surveys, using minnow traps and nighttime Pond TCS at Ponds A', B, B', C, DE, FGHI and other potential breeding sites in March, plus multiple daytime searches for egg masses in late March and early April are recommended to better determine status at SAGA.

Spotted Salamander (Ambystoma maculatum)

The spotted salamander is common and widespread in the Northeast and is essentially a terrestrial species that depends on ponds for embryonic and larval development. Adults are most easily detected in early spring, when they migrate on rainy nights from underground burrows to temporary and semi-permanent breeding ponds. Mating occurs in the ponds and females attach gelatinous egg masses to twigs and vegetation in the pond (Petranka 1998). Spotted salamanders are difficult to find once they leave the breeding ponds and return to their underground retreats.

Oliver and Bailey (1939) considered the spotted salamander to be the most widely distributed of the *Ambystoma* in New Hampshire, but did not record it in Sullivan County. It was however, recorded in Chesire and Grafton counties, to the south and north of Sullivan respectively. It was subsequently observed by Cronan et al. (1981), demonstrating its presence both in Sullivan County and at SAGA, and Cook (1986) considered it relatively common.

In the current survey, the spotted salamander was the second most abundant salamander at SAGA, with a relative abundance of 30.25% and it was widespread, occurring in stream, wetland, and upland habitats (FO = 45.5%, Tables 2 and 3). The majority of individuals (76%) were recorded in temporary ponds adjacent to BMD Pond, and of these, 39.9% were from Pond C (Table 4). Cook (1986) estimated a total of 248 egg masses from the eight "overflow" ponds and captured a total of 42 adults (40 males) in minnow traps. In 2001, a maximum number of 119 egg masses were counted from eight ponds, including the two farm ponds which were not part of SAGA in 1986 (Table 8). In addition, a total of 310 adults (298 males) were captured in minnow traps. Differences in methodology, e.g. Cook (1986) only counted 96 egg masses but used extrapolation to derive his estimate of 248 egg masses, make direct comparison difficult, but the general sense from both egg mass counts and minnow trapping is that the population of spotted salamanders at SAGA remains stable, though not very large.

Cook (1986) noted that some spotted salamander egg masses are laid in the marshes in the main body of BMD Pond and in the current survey, 74 adults were recorded in BMD Pond. Such behavior, while unusual is not unheard of. However, given the presence of many species of fish in BMD pond, and the negative effects they have on reproductive success in spotted salamanders, BMD Pond may be serving as a population sink. Landscape analysis throughout the Northeast U.S. has shown that the ideal landscape for spotted salamanders is a non-urbanized, non-fragmented, roadless, forested landscape with well drained soils and moderately hilly topography, containing long hydroperiod vernal or semi-permanent, fishless, ponds (Cook et al. 2006b). Although the landscape at SAGA has some of these features, much of SAGA is steep, and not well drained. In addition, BMD Pond and the overflow ponds used for breeding by spotted salamanders often contain fish, so that reproductive success may be limited. Compared to many other areas where they occur, the mean numbers of egg masses found in breeding ponds at SAGA are low (see Cook et al. 2006b for review).

Red-spotted Newt (Notophthalmus v. viridescens)

The life history of the red-spotted newt differs from other salamanders, in that it generally metamorphoses twice. Adults primarily occur in still bodies of water such as ponds and lakes and are aquatic, but also occur in and may breed in temporary ponds as well. Following a typical aquatic embryonic and larval stage, juveniles transform into a terrestrial juvenile stage known as red efts. The eft, bright orange with red spots, may be found under logs and brush or seen

moving in woodlands and grassy areas, particularly during rainy conditions (Petranka 1998, Pfingsten and Downs 1989). The efts may spend 2-7 years on land before returning to water and transforming into an aquatic adult, taking on the adult's green coloration and keeled tail (Healy 1974). While red efts may be handled safely by humans, they have toxic skins that deter potential predators (Hurlbert 1970). The newt is considered to be a keystone predator in temporary pond communities where they control insect populations and anuran species composition (Kurzava and Morin 1994). Clear-cut timbering may significantly affect newt populations (Petranka et al. 1993) and repopulation may take 30-60 years (Pough et al. 1987).

Because of its abundance and state-wide distribution, Oliver and Bailey (1939) considered this the best known species of salamander in New Hampshire, recording it from nine towns in Sullivan County. Cronan et al. (1981) recorded its presence at SAGA and Cook (1986) considered it to be abundant, with the terrestrial red-eft among the most frequently observed amphibians at SAGA. In 1985-86, red-spotted newts were the most frequently recorded salamander species, with a relative abundance of 39%, and the most widespread, with a frequency of occurrence of 68% (Cook 1986). In 2001, the red-spotted newt was again the most frequently recorded and widespread salamander species at SAGA with 461 individuals (RA = 44.41%) recorded from 16 sites (FO = 72.7%), primarily in permanent ponds (58% of all individuals, Tables 2 and 3). They were recorded in all habitat types, except for stream (adults in ponds and red-efts in woodlands and field), and the majority (49%) of adults were recorded in the permanent wetland Farm Pond 1 (Table 4). Because the juvenile stage or "red eft" generally lasts for a few years, individuals may disperse long distances from natal wetlands. In addition, because they are toxic and brightly colored, they are both very active diurnally and easily observed. The net effect of these three factors is that many red-spotted newts are observed throughout SAGA. The red-spotted newt is well known for showing tremendous inter-population variability in attributes such as the presence/absence of the red-eft stage, terrestrial habitat use by adults, and neoteny (Petranka 1998). Most of the populations exhibiting these variations from the species' "typical" life history occur along the coast and all indications are that red-spotted newts at SAGA follow the "typical" pattern.

Northern Dusky Salamander (Desmognathus fuscus)

The northern dusky salamander is widespread in eastern North America and is found throughout New England (Degraaf and Rudis 1983, Conant and Collins 1998). This streamside species is frequently found under rocks and logs in the water and along the edge of cool woodland streams, springs, and seeps. Females typically deposit egg clusters in a scooped out depression under rocks or logs along the edge of a stream, and will brood the eggs for a period of time before they hatch (Petranka 1998, Pfingsten and Downs 1989).

Oliver and Bailey (1939) describe the northern dusky as one of the most common salamanders in the eastern United States and recorded it from one town in Sullivan County, as well as all adjoining counties. Cook (1986) documented its presence at SAGA and found it to be common in and along the banks of BMU brook and the other unnamed brooks and seeps in the woods above BMU and BMD brooks. Among salamanders, it had a relative abundance of 7.3%, a ranked abundance of five, and a frequency of occurrence of 21%, which largely reflects its restriction to small brooks, seeps, and adjacent zones at SAGA. In the current survey, the northern dusky salamander was intermediate in abundance, with a relative abundance of 6.65% and a ranked abundance of five. It had a frequency of occurrence of 22.7% and was primarily

found in BMU Brook (70% of individuals), with the remainder recorded from mixed, hemlock, and hardwood forest (30% of individuals)

Although Cook (1986) described the northern dusky salamander as slightly more common than the northern two-lined salamander, he recorded more of the latter. Since that work was not as standardized and systematic as this survey, it is likely that some observations were not recorded. The basis for considering northern dusky salamanders more common than northern two-lined was Cook's observation that he found roughly equal numbers in the stream zone and mostly dusky salamanders under streamside logs and rocks (Cook 1986).

Northern dusky salamanders have declined in many areas of the northeast due to urbanization (Klemens 1993) and they have also declined in non-urban protected areas, such as Acadia National Park, where mercury contamination appears to have driven it to near extirpation (Bank et al. 2006). The current survey shows that northern dusky salamanders remain a common species at SAGA, with a total of 69 adults recorded. During stream TCS in BMU Brook, 48 adults and 23 larvae were recorded in 13.3 search hours (5.34 inds/search hour). In 1985-86, Cook (1986) recorded a total of 24 individuals parkwide and eight individuals in 4 hours of search in BMU Brook (2.0 inds/search hour). Although Cook's records likely under-estimate the relative abundance of northern dusky salamander, the current data suggest that at the very least, northern dusky salamanders remain common at SAGA in BMU Brook and other small brooks and seeps. Considering their apparent sensitivity to mercury pollution, this suggests that impacts from mercury deposition are not currently being manifested at SAGA. Long-term monitoring of northern dusky salamanders is recommended.

Northern Two-lined Salamander (Eurycea bislineata)

The northern two-lined salamander is likely the most widespread and abundant stream salamander in New England, as well as the most urban tolerant (Klemens 1993), even occurring in a small length of remnant stream at the heavily urbanized Saugus Iron Works NHS in Saugus MA (Cook, pers. obs.). This stream salamander is typically more aquatic in nature than the northern dusky salamander, often found in the stream and splash zones of cool, swift moving streams. Females deposit eggs singly on the underside of flat rocks in streams (Petranka 1998, Pfingsten and Downs 1989).

Oliver and Bailey (1939) recorded northern two-lined salamanders from five towns within Sullivan County and Cook (1986) found it to be common in and along BMU Brook and the other smaller, unnamed brooks in the woodlands above that flow into BMD Brook, with a relative abundance among salamanders of 9.4%. In 2001, this species was intermediate in abundance (RA = 11.08%) and was primarily found in BMU Brook (90% of individuals), with the remainder recorded from mixed, hemlock, and hardwood forest (FO = 22.7%, Tables 2, 3, and 4). In 1985-86, 27 individuals were recorded in the course of 4 hours of searching in BMU Brook (6.75 individuals/search hour) (Cook 1986). In 2001, 103 adults and 10 larvae were recorded there in 13.3 hours of TCS (8.50 individuals/search hour). Thus, by all measures northern two-lined salamanders seem to be stable or slightly more abundant in 2001, although methodology in 1985-86 was not as rigorous as in 2001.

As described in Cook (1986), BMU Brook is a high gradient, woodland stream with large rocks, gravel and bedrock, and a series of riffles and pools. It flows through a shaded ravine and is

typically cooler than other bodies of water in the park (NPS 2004). This stream provides the most suitable habitat at SAGA for the northern two-lined salamander. This salamander was, and remains a common stream-dependent species at SAGA, particularly in BMU Brook.

Eastern Red-backed Salamander (Plethodon cinereus)

The eastern red-backed salamander is common in the forests of the northeastern United States and southeastern Canada, with the greatest densities in well-drained, mature forests (Petranka 1998, Pfingsten and Downs, 1989). It is widespread and abundant in the Northeast (DeGraaf and Rudis 1983), and it occurs as a number of different color morphs, with the red striped and gray unstriped the two most common and widespread in New England (Klemens 1993). Oliver and Bailey (1939) considered this species to be widely distributed throughout the wooded areas of New Hampshire. They did not record it in Sullivan County, but did record it in the three adjoining counties (Grafton, Merrimack, and Cheshire). Cook (1986) recorded 34 individuals at SAGA, but because eastern red-backed salamanders tend to be very abundant in such rich forested landscapes, he felt that with a relative abundance among salamanders of 10.3% and a ranked abundance of 3, it was not very abundant.

In the current survey, the eastern red-backed salamander was intermediate in abundance (RA = 7.61%), with a ranked abundance of 4 among salamanders, and was moderately widespread (FO = 27.3%, Tables 2 and 3). This latter point reflects its terrestrial nature, and nearly all individuals were recorded in hardwood forest (52% of individuals), mixed forest (24%), or hemlock forest (11%, Table 2). Cook (1986) also found the eastern red-backed salamander to be most frequently found in hemlock and hardwood habitats, although none were found in mixed conifer forest. Although Cook (1986) considered SAGA to be a place where "one has to work hard" to find eastern red-backed salamanders, our results show it is more widely distributed in the forests and slightly more common at SAGA than previously described by Cook (1986), but by no means abundant.

Eastern American Toad (Bufo americanus) and Fowler's Toad (Bufo fowleri)

The eastern American toad is a terrestrial species found under cover such as flat stones, boards, and logs, and is easily distinguished by its prolonged, high pitched, trilled call heard in spring and summer. These toads breed in a variety of shallow aquatic habitats including temporary ditches, flooded meadows, marshes and ponds (Klemens 1993). The eastern American toad is widespread in the Northeast (DeGraaf and Rudis 1983) and found in moist upland woods. Consequently, it occurs primarily inland, away from the more open and xeric coastal habitats, where the closely related Fowler's toad predominates (Klemens 1993).

Oliver and Bailey (1939) considered the eastern American toad to be the more widespread species of toad in New Hampshire, and recorded it in five Sullivan county towns. Cronan et al. (1981) recorded its presence at SAGA and Cook (1986) described the eastern American toad as a common and widespread species at SAGA, breeding in the overflow ponds and Turtle pond, and dispersing throughout SAGA's uplands, including the historic core. Among anurans it had a relative abundance of 1.0%, a ranked abundance of 5, and a frequency of occurrence of 47%. In the current survey, eastern American toad was the least recorded anuran, with a relative abundance of 0.19% and a ranked abundance of 7 (Table 2). Eastern American toads were recorded from BMD Pond, Pond A', Turtle Pond, and mixed, hemlock, and hardwood forests (Tables 2 and 3). Males were heard during calling surveys at Pond A' on 28 May and at Turtle

Pond on 26 June 2001 (Table 7). We found the eastern American toad in only one overflow pond (Pond A') and did not find them to be very abundant overall, with a total of only nine individuals recorded.

Differences in the numbers of American toads recorded in 2001 compared to 1985-86, nine versus 24, are probably due to differences in the nature and amount of sampling. The American toads recorded in 1985-86 were mostly single individuals encountered incidentally while conducting fish, mammal, and herpetofaunal inventories during 62 days spent in residence at SAGA. In 2001, sampling took place in the course of 19 days of field work directed towards amphibians and reptiles. Given this, and the weather-dependant variability in the activity and detectability of amphibians such as the American toad, which would make them less likely to be recorded incidentally in the course of fewer days of field work, the differences between 1985-86 and 2001 are probably due to sampling. Thus, the population of American toads at SAGA appears to be stable, though not very abundant. It should be monitored to better determine its status.

Although in the Northeast, Fowler's toad typically occurs along the coast and the American toad inland, Fowler's toad extends far inland spreading up the valleys of major rivers, such as the Connecticut, where it has been recorded north of SAGA, in Hanover, NH (Oliver and Bailey 1939) and White River Junction, VT (Barker and Caduto 1984). As noted above, these two toad species tend to occupy different habitat types and where their ranges overlap, these differences tend to separate them locally. However, landscape changes such as colonial-era land clearing helped break down the isolation between these two species and have lead to hybridization (Lazell 1976). Given that the biota of New England moved from south to north as it re-colonized the region after the last glacial period, and that Fowler's toad has been recorded north of SAGA, including a recent record from the town of Orange, Grafton County (NH Fish and Game 2006), it would mean that Fowler's toads and American toads would have come into contact in and around SAGA at some point in time. Although the toads at SAGA are American toads, based on their trilling breeding calls, Cook (1986) noted that some of the individuals he observed showed characteristics of Fowler's toad, such as an unspeckled belly and three or more warts per dark spot (six for one individual). The use of Lazell's "toad score" (Lazell 1976) placed these hybrid individuals towards the American toad side of the gradient. Although the forest-dominated landscape of SAGA is typical of American toad, BMD Pond lies immediately adjacent to the flatter, sandier, more open floodplain habitats of the nearby Connecticut River, which is where nearby populations of Fowler's toad would be most likely to occur, or have occurred. Thus, it is not unexpected that the American toad population at SAGA shows evidence of past hybridization with Fowler's toad. However, to date there are no records of Fowler's toad at SAGA.

Northern Spring Peeper (Pseudacris c. crucifer)

Northern spring peepers are commonly found in permanent and semi-permanent wetlands surrounded by woodlands, and wetlands containing trees and shrubs in and near the water (Conant and Collins 1998). The unique, high-pitched breeding call of the northern spring peeper is often times broadcasted in a deafening chorus of hundreds of individuals. In the Northeast, it is the most ubiquitous and readily detected anuran (Klemens 1993).

The northern spring peeper was the most common anuran at SAGA with 4,324 adults recorded from 11 sites in temporary and permanent ponds and in mixed forest habitat (Tables 2 and 3). The largest percentage (25%) of individuals was recorded from BMD Pond (Table 4). Anuran calling surveys accounted for 50% of individuals recorded (Table 7). Although Oliver and Bailey (1939) did not record northern spring peeper in Sullivan County, Cook (1986) found it to be the most abundant anuran at SAGA, accounting for 88.1% of all recorded, and occurring in 58% of all sampling locations, including many terrestrial habitats as well as BMD and the "overflow" ponds. Our results indicate this is still the case, with a relative abundance (RA) among anurans of 89.06% and a frequency of occurrence (FO) of 50%. .

Gray Treefrog (Hyla versicolor)

The gray treefrog has large toe pads and lives high in trees and shrubs, descending to wetlands to call and breed (Behler and King 1979). It ranges throughout the eastern United States and Canada, south to Florida and west to Texas (Conant and Collins 1998).Their color ranges from gray to brown, green, light gray, to almost white depending on its activity and the environmental conditions (Conant and Collins 1998). This species is also distinguished by the orange/yellow coloration on the underside of the hind limbs and a black-bordered light spot below each eye.

Oliver and Bailey (1939) did not record gray treefrog in Sullivan County, but did record it in the three adjoining counties (Grafton, Merrimack, and Cheshire). However, it was observed by Cronan et al. (1981), demonstrating its presence both in Sullivan County and at SAGA. Cook (1986) found gray treefrogs throughout the wetlands and uplands at SAGA, with a relative abundance among anurans of 2.6% and a ranked abundance of 4. In the current survey, gray treefrog was common, with a relative abundance of 2.82% and a ranked abundance of 3, and moderately widespread (FO = 22.7%, Tables 2 and 3). Cook (1986) identified Pond C and Turtle pond as important breeding sites. In this survey, Turtle Pond was again identified as an important breeding site with 37% of all gray treefrogs recorded there, as was Pond A', with 33%. In contrast to Cook (1986), Pond C only accounted for a small number of the gray treefrogs recorded (4%, Table 4). Whether these apparent shifts in breeding pond use by gray treefrogs reflect long term shifts, annual variation due to differences in water levels, or differences in the timing of observations is uncertain. Regardless, the current survey shows that the gray treefrog continues to be a common and widespread species in the wetlands of SAGA during breeding season. Moreover, although the current survey and most older records are concentrated along BMD Brook and adjacent wetlands, gray treefrogs also occur on the opposite side of SAGA, where Cook (1986) heard males calling from the pond in the Atrium, and occasionally from trees in forested habitats in the summer.

American Bullfrog (Rana catesbeiana)

The American bullfrog is a widespread and common species throughout much of the Northeast, (Behler and King 1979, DeGraaf and Rudis 1983). Bullfrogs require two or more years for their tadpoles to metamorphose hence they breed in open bodies of water such as lakes and permanent ponds (Conant and Collins 1998). Their primary habitat requirement is a permanent water body with abundant emergent and shoreline vegetation (Albright 1999). However, because bullfrogs may require a few years beyond metamorphosis to reach adulthood and, in the case of males, attain a size capable of defending a breeding territory, juveniles will also inhabit temporary ponds and streams. This species is an aggressive predator and includes other frogs, young turtles, small snakes, and many invertebrates in its diet. It is adept at colonizing new habitats, especially

those constructed or modified by humans (Lacki et al.1992) and is relatively urban tolerant (Klemens 1993). While native to SAGA, when introduced to areas where they are not native, bullfrogs can displace native species (Adams 1999, Stumpel 1992) and their tadpoles may dramatically alter aquatic community structure (Kupferberg 1994).

Oliver and Bailey (1939) recorded the bullfrog from nine towns within Sullivan County and Cook (1986) considered it to be common, occurring in the overflow ponds, in BMD Pond and along the banks of BMD Brook where it is a low gradient stream. However, as a higher order predator than the other anurans at SAGA, it was less numerous, with a relative abundance of 0.6% and a ranked abundance of 6. In 2001, 19 American bullfrogs were recorded, providing a relative abundance among anurans of 0.39% and a ranked abundance of 5 (Table 2). Bullfrogs were recorded from seven sites (FO = 31.8%, Table 3), including both temporary and permanent ponds such as BMD Pond (42% of all records) and the overflow ponds (53% of records; Pond A', C, DE, FGHI, and Turtle Pond; Table 4). Data from the recent survey show that little has changed in bullfrog abundance and distribution and it remains a common and widespread species, found primarily in BMD Pond and adjoining wetlands along its floodplain. However, as noted by Oliver and Bailey (1939) and observed by Cook (1986), recently metamorphosed bullfrogs disperse from their natal pond on rainy nights in late summer and many are killed on adjacent roads.

Northern Green Frog (Rana clamitans melanota)

The northern green frog is a common and widespread species in the Northeast (DeGraaf and Rudis 1983). It utilizes a broad range of freshwater habitats, especially permanent bodies of water, which it requires for successful reproduction. Dorsolateral folds extending down the back distinguish the northern green frog from the bullfrog. This species can typically be found in and around ponds, streams, and marshes, and also along roads during rainy nights. Cook (1986) noted their presence on Route 12A and other area roads on rainy nights.

Oliver and Bailey (1939) found northern green frogs to be widespread in New Hampshire and recorded them from 14 towns within Sullivan County, including Cornish. Northern green frogs were common in 1985-86, comprising 3.6% of anurans recorded, having a ranked abundance of 3, and heavily utilizing both temporary and permanent ponds (Cook 1986). In the current survey, the northern green frog was among the most common anurans, with a relative abundance of 5.89% and a ranked abundance of 2. Northern green frogs were also widespread (FO = 50.0%), with 74% of individuals recorded from permanent ponds, 21% from temporary, and 5% from stream habitat (Tables 2 and 3). Similar to Cook (1986), the northern green frog was common in BMD Pond (32% of individuals), and Turtle Pond (34% of individuals) (Table 4). The northern green frog was and continues to be abundant at SAGA with the majority of individuals occurring in permanent pond habitat. However, temporary ponds and streams are also important habitat for dispersal and foraging, especially by non-breeding juveniles that occupy these habitats until they are able to occupy and defend a territory in the breeding ponds.

Wood Frog (Rana sylvatica)

The wood frog is found throughout the Northeast (DeGraaf and Rudis 1983). It is a terrestrial species, occupying moist woodlands except during the breeding season when they breed in fishless vernal pools (Conant and Collins 1998, Klemens 1993). Breeding early in the spring (late-February to March), the wood frog is an explosive breeder. Often a large percentage of a

population migrates to ponds in a short window of time, laying eggs together in large floating masses. The wood frog will often travel away from water in the summer and will hibernate in leaf litter during the winter (Behler and King 1979).

Oliver and Bailey (1939) recorded wood frogs in Sullivan County and their presence at SAGA was noted by Cronan et al. (1981). Wood frogs were common at SAGA in 1985-86, with a relative abundance among anurans of 4.0%, ranked abundance of 2, and they were fairly widespread, with an FO of 47% (Cook 1986). In 2001, the wood frog was intermediate in abundance (RA = 1.32%), was as widespread as spring peeper and northern green frog (FO = 50.0%), and was primarily recorded from temporary ponds (86%), but was also found in permanent ponds, stream, mixed and hardwood forests (Tables 2 and 3). Wood frogs breed in early spring in vernal ponds and on 18 April 1986, Cook (1986) recorded 42 fresh egg masses in Pond C, followed by 14 in Pond G, 10 in Pond H, and six in Pond B, thereby identifying these "overflow" ponds as the prime breeding sites for wood frogs at SAGA. In contrast, few wood frog egg masses were recorded in this survey, only two at Pond C and three at Farm Pond 2 on 25 April 2001 (Table 8). However, many wood frogs were recorded in the course of anuran calling surveys (e.g. an index value of 3 recorded on 25 April 2001 at pond B), TCS, and minnow trap surveys (Tables 7, 11, and 15). This suggests that egg mass searches in 2001 occurred prior to peak egg mass deposition and highlights the need for multiple sampling occasions when using egg mass counts to estimate breeding population size (Crouch and Paton 2000, Cook and Boland 2005). The results of these other methods also provide a total of 64 wood frogs recorded during this inventory (Table 2), which is roughly comparable to the 92 individuals recorded by Cook (1986).

Although not as abundant as spring peeper, or perhaps green frog or grey treefrog, the wood frog (ranked abundance of 4) was, and still remains, a common species at SAGA, with the largest concentration of adults recorded in Ponds B, C, and FGHI during the breeding season. However, animals recorded in late summer in forest habitats during this survey, as well as by Cook (1986), who recorded wood frogs in all of SAGA's terrestrial habitats except lawn, show the extent to which wood frogs range across the uplands of SAGA.

Pickerel Frog (Rana palustris)

The pickerel frog is common and widespread in the Northeast and mid-Atlantic regions (Conant and Collins 1998), and is found in both permanent and ephemeral wetlands (Klemens 1993). This species is distinguished from the northern leopard frog by a dorsal pattern of brown squares arranged symmetrically, and the inner surfaces of the hind legs are orange or yellow (Klemens 1993).

Oliver and Bailey (1939) recorded pickerel frog from 11 towns in Sullivan County and its presence at SAGA was recorded by Cronan et al. (1981). Cook (1986) considered the pickerel frog to be uncommon at SAGA. It was the least common of seven anuran species, only observed three times (relative abundance 0.11%), all out of water on the bank of BMD brook or in hemlock forest. No breeding activity was recorded. Similarly, in 2001, the pickerel frog was among the least common anurans and least widespread species recorded, (RA = 0.33%, FO = 13.6%, Tables 2 and 3). The majority of individuals recorded (69%) were recently transformed metamorphs recorded on 18 August 2001 at Farm Pond 1 (Tables 4 and 16). Four adults were found in BMD Brook and one was found in Farm Pond 2 (Table 4). Pickerel frogs typically

breed in permanent ponds (Cook et al. 2006b) and range along pond shorelines, meadows, and stream corridors outside of the breeding season. Observation of pickerel frogs at SAGA conform to this pattern of habitat use and the current data suggest that the pickerel frog remains an uncommon but stable species at SAGA.

Eastern Snapping Turtle (Chelydra s. serpentina)

The eastern snapping turtle is the largest freshwater turtle in the northeastern United States. It is widespread in North America and is found in all types of fresh water wetlands (DeGraaf and Rudis 1983), as well as in brackish water, but does have a preference for permanent water bodies (Klemens 1993). These highly aquatic turtles are common in the United States, but because they are bottom walkers more than swimmers, and they bask in shallow waters along the shore of a pond or wetland, rather than haul out like a painted turtle does, they are not as readily observable. Rather, when observed by the public, it is most frequently seen crossing roads and traveling over land in late spring-early summer in search of nesting areas, which are typically open, well drained sites such as fields, roadsides and rights-of way. Females dig nests and deposit eggs in loose sand or soil, and the hatchlings emerge in the late summer or early fall (Ernst et al. 1994).

Oliver and Bailey (1939) note that eastern snapping turtles are found in nearly all bodies of water in the southern half of New Hampshire, except coldwater streams, and they recorded it in Sullivan County as well as all adjoining counties. Cook (1986) considered the eastern snapping turtle to be common at SAGA, with a relative abundance among turtles of 22.92% and a ranked abundance of 2, based on a total of 11 records, which included six individuals being captured. Only two of these six were trapped, the other four were hand captured. In 2001, all records of eastern snapping turtles occurred during turtle trapping at BMD Pond (eight new, two recaptures) and Pond C (one new capture) (RA = 22.92%) between 27 May and 28 June (Tables 2, 4, and 14, Appendix D). Based on mark-recapture, the estimated population (and 95% confidence interval) in BMD pond is 10 ± 4 individuals. Although the minimum known population of eastern snapping turtles at BMD Pond is eight individuals (exceeding six, which is the lower limit of the 95% confidence interval) such discrepancies often occur in small populations when sample sizes, especially recaptures, are small (Cook et al. 2007). A comparison of current data with that from 1985-86 suggests that the eastern snapping turtle population at SAGA remains relatively common and stable, with a fairly even sex ratio (four female, four male, one too young to sex), a range of sizes, and evidence of recent successful reproduction (two juvenile, seven adult, Appendix D).

Although nearly all of the eastern snapping turtles captured in 2001 were in BMD Pond, in 1985-86 they were recorded from a broader range of sites here, including BMD Pond (four records), BMD Brook (1), Turtle pond (2), Pond C (2), and Pond I (1). At these latter three sites, animals were captured by hand in April, and were basking in shallow water. Cook (1986) noted that by late May, eastern snapping turtles were not encountered in these shallow ponds and that their use in early spring by eastern snapping turtles was probably because their shallow water is warmer at that time of year than the waters of BMD Pond. Thus, the preponderance of records of eastern snapping turtles from BMD pond in this survey (based on trapping from late May through late June) probably reflects the seasonal shift in habitat use that Cook (1986) observed. From the perspective of snapping turtles, BMD Pond and the shallower “overflow” ponds represent a

single habitat with several micro-habitats that the turtles shift among seasonally in response to temperature.

Wood Turtle (Glyptemys insculpta)

The wood turtle occurs in southeastern Canada, and the northeastern and mid-western regions of the United States (Conant and Collins 1998). It is a stream-dependant species, spending the majority of the fall and winter months hibernating along deep pools, under overhanging root masses or logs. After emerging from hibernation it spends the spring in and along the stream but may move into adjacent terrestrial habitats in the summer months to nest and feed (Ernst et al. 1994). Oliver and Bailey (1939) considered the wood turtle to be second only to the painted turtle in abundance, and they recorded it in two towns in Sullivan County, as well as all adjoining counties. Wood turtles are a "special concern" species in New Hampshire, and they are listed as an "associated species" of critical riparian and riverine habitat. Hunter et al. (1999) noted that because of range-wide population declines, all but one state and one Canadian province have listed the wood turtle as a T&E species. Thus, it is doubtful that wood turtles are as abundant as they were in the 1930's.

Cook (1986) recorded two adult male wood turtles in BMD Brook. One was observed walking along the stream bottom in the medium gradient section (20 April 1986), and the second was basking on the bank in the low gradient section (23 May 1986). No wood turtles were found during surveys in 2001, in spite of 14 search hours of effort in the two sections of BMD Brook where wood turtles were recorded in 1986. Whether this constitutes a "decline" or not is unclear, given the rarity of wood turtles at SAGA in 1985-86. Considering the large home range and complex patterns of movement typical of wood turtles (Gibbs et al. 2007), it is best to view SAGA, particularly the BMD Brook corridor, as part of a larger local landscape that supports what may be a declining population of wood turtles. This landscape includes the Connecticut River and tributaries, and their associated wetland and upland areas, of which SAGA is a part. Additional, more intensive surveys of BMD Brook in April and May are recommended to better understand its status here.

Painted Turtle (Chrysemys picta)

This aquatic species is common in the United States, and is recognized as four subspecies across its range. The two subspecies that occur in the Northeast are the eastern painted turtle (*Chrysemys p. picta*), and the midland painted turtle (*Chrysemys picta marginata*; Klemens 1978, DeGraaf and Rudis 1983). The eastern painted turtle has an unmarked yellow plastron and the seams on the carapace are aligned, whereas the midland painted turtle has a variable dark marking on the plastron and alternating seams on the carapace (Ernst et al. 1994). In much of the northeast and New England, *C. p. picta* and *C. p. marginata* intergrade and form a hybrid swarm (Pough and Pough 1968). Intergrade populations contain individuals that vary in the extent to which their characteristics (e.g. alignment of carapacial scutes, plastral markings) tend towards one or the other subspecies (Klemens 1993, Lazell 1976). Cook (1986) noted that painted turtles at SAGA were variable in exhibiting *picta*-like and *marginata*-like carapacial scute alignment.

The painted turtle is New England's most familiar and conspicuous turtle (Klemens 1993). It is widespread and common at low elevations throughout New England and is found in shallow, permanent, standing bodies of water and slow moving streams (Conant and Collins 1998). Oliver and Bailey (1939) considered it the most common and best known turtle of the southern half of

New Hampshire, recording it in five towns in Sullivan County and all adjacent counties. Cook (1986) considered it the most common turtle (RA = 70.7%) but still not abundant, with a frequency of occurrence of 16%. In 2001, the painted turtle was again the most commonly recorded turtle, with a relative abundance of 77.1%. It was also moderately widespread, with a frequency of occurrence of 22.7%, based on 37 records from five sites in stream, temporary, and permanent pond habitats (Tables 2 and 3, Appendix D). The majority of these were from Turtle Pond (49%) and BMD Pond (41%, Table 4), and reflect this species' aquatic nature. Based on limited trapping effort, abundance was greatest at Turtle Pond (61.90 captures/100 trap nights, Table 14).

The results of this survey correspond fairly closely with those from 1985-86 in that the numbers recorded are similar, 37 in 2001 and 29 in 1985-86. However, one big difference between the two surveys is that Cook (1986) used hand-made traps constructed out of hardware cloth (130 trap nights total) and only caught one painted turtle at Turtle Pond. Most of the records in 1985-86 were of animals observed with binoculars from Rt 12A while basking at Turtle Pond, with a maximum of 19 individuals on one occasion. Only one individual was recorded from BMD Pond, but this site was not as easily observable as Turtle Pond. In contrast, in 2001, commercially made traps were set for 170 trap nights, and 31 unique individuals were captured (84% of all records, Table 5), 13 in Turtle Pond, 15 in BMD Pond, and three in the "overflow" ponds. The more recent data, showing painted turtles well distributed throughout SAGA's permanent wetlands is probably a more accurate representation. In addition, the recent data show a female dominated population (17 female, five male, nine too young to determine) with a wide range of sizes and a high proportion of juveniles (13 juvenile, 18 adults, Appendix D), indicating that successful recruitment is occurring. Thus, painted turtles appear to be a common, though not abundant, species at SAGA with a seemingly stable, viable population.

Common Garter Snake (Thamnophis sirtalis)

The common garter snake is common in the United States and is recognized as many different subspecies ranging across the country. It is found in a variety of habitats including meadows, marshes, woodlands, and cultivated and developed areas (Behler and King 1979), and is the most widespread and ubiquitous snake in New England (DeGraaf and Rudis 1983).

Oliver and Bailey (1939) considered the common garter snake to be the most common and widespread snake in New Hampshire, recording it in five towns in Sullivan County, as well as all the adjoining counties. Cronan et al. (1981) recorded it at SAGA, and Cook (1986) considered it to be uncommon at SAGA. In 1985-86 a total of 12 garter snakes were recorded. In 2001, only four garter snakes were recorded, one each from the historic core and Lower Field and two near Pond FGHI (Table 4). Common garter snake was the most abundant snake at SAGA, but neither very common nor widespread (FO = 13.6%) (Tables 2 and 3), and only one was recorded during coverboard surveys (Table 13).

Eight of the 12 garter snakes recorded by Cook (1986) were in the historic core, of which four were incidental encounters and the other four were under one particular plastic sheet. Moreover, six of the 12 records were incidental encounters and six were found under a board or sheet (2.07 individuals/100 CB checks). Although the numbers of common garter snakes recorded in 2001 were fewer than in 1985-86, and coverboards once again were not very productive (0.85 individuals/100 CB checks), it is difficult to read too much into these meager data. One reason

for the greater number of incidental encounters in 1985-86 is the greater number of days spent in residence, as discussed in the American toad account. Most of the differences in coverboard results are because four individuals were found under the one plastic sheet in the historic core. Taking these factors into account, our results suggest that the common garter snake continues to be a widespread but uncommon species at SAGA and it has probably not declined.

Northern Ringneck Snake (Diadophis punctatus edwardsii)

The northern ringneck snake is common throughout the northeastern United States (Degraaf and Rudis 1983) and is found in a wide diversity of habitats (Klemens 1993). A small, inconspicuous, primarily nocturnal species, the northern ringneck snake is well known for feeding heavily on eastern red-backed salamanders and thus it is typically found in moist woodlands with abundant cover (Hunter et al. 1999, Conant and Collins 1998).

Oliver and Bailey (1939) did not record this species in Sullivan County, but recorded it from the three adjoining ones (Cheshire, Grafton, and Merrimack). This species was previously undocumented in Sullivan County (NH Fish and Game 2007a) and at SAGA until a single individual, a neonate (total length of 12.5 cm), was found by museum technician Martha Knapp in the basement of Aspet during a cold spell on 6 December 2000. None were recorded during this survey, but additional neonates have been recorded since then, one in the Visitor Center on 25 September 2006 and one in the maintenance building in September 2007 (National Park Service, Steve Walasewicz, Natural Resource Manager, pers. comm., 2007). Neonate ringneck snakes are often encountered in buildings this time of year on Cape Cod. Their very small size and diameter (like a piece of spaghetti) leads to their wandering into buildings through small gaps under doors (Cook, pers. obs.).

Although widespread, there is a lot of geographic variation in the abundance of ringneck snakes within their range, and they can be very rare in some areas (Klemens 1993). The observations here suggest that ringneck snakes have been present at SAGA all along, and that they continue to persist as a rare species. Ringneck snakes are frequently found in moist microhabitats such as under loose bark on fallen trees, rocks, logs, and in human debris (Ernst and Ernst 2003). On Cape Cod it was the most frequently captured species during coverboard surveys (Cook, pers. obs.). Although not a species of conservation concern, coverboards set up adjacent to the historic core and further searches in woodlands, near wetlands, and around buildings and rocks are recommended to better understand their status and distribution at SAGA.

Eastern Milk Snake (Lampropeltis t. triangulum)

The eastern milk snake ranges throughout most of the eastern United States and into southern Canada (Degraaf and Rudis 1983). It is a secretive species most active at night and found in habitats ranging from woods, meadows, bogs, streams, and farmland. It is frequently associated with old farm fields, dilapidated structures, and trash piles, and thrives in human-altered habitats (Klemens 1993). Identifying characteristics include a “Y” shaped, cream-colored patch on the nape, and a black and white checkerboard pattern on the belly (Conant and Collins 1998, Hunter et al. 1999). In southern New England, the eastern milk snake is second in abundance to the common garter snake, occuring in most state parks, forests, game management areas, and private sanctuaries (Klemens 1993).

Oliver and Bailey (1939) considered the eastern milk snake to be second in abundance only to the garter snake in southern New Hampshire, and recorded it in two towns in Sullivan County, as well as the counties to the south and east. Cronan et al. (1981) and SAGA employees have previously recorded this species at the park, but none were recorded by Cook (1986) or during this survey in 2001. More recently, an eastern milk snake was observed near the front steps of Blow-Me-Down Mill on 23 May 2007 (National Park Service, Steve Walasewicz, Natural Resource Manager, pers. comm., 2007.)

These results suggest that this specie is rare at best at SAGA, but it is not possible to say if it has always been so. The comment by Oliver and Bailey (1939) regarding their abundance in southern New Hampshire suggests that eastern milk snakes became less common as one moved northward, and recent fieldwork in southeastern NH (Kjoss and Litvaitis 2001) suggests that eastern milk snakes are no longer very abundant there either. Thus, the rarity of eastern milk snakes at SAGA may be a long standing condition (early 20th century), or part of the more recent declines associated with the second half of the 20th century. Experiences on Cape Cod and Long Island, NY, indicate that milk snakes can be readily detected under coverboards (Cook, pers. obs.) and as such a network of coverboards, regularly checked through the warm months is recommended to better understand their status and distribution in the park.

Potentially-occurring Species Never Recorded at SAGA

Common Mudpuppy (Necturus m. maculosus)

The common mudpuppy is a mid-western species of neotenic salamander that is native to Lake Champlain, via an ancient connection to the Saint Lawrence River. Its occurrence in the Connecticut River is best explained as the result of multiple releases of animals used in biology classes in the late 19th and early 20th centuries (Klemens 1993, Richmond 1999). Mudpuppy has been recently recorded in Cornish (NH Fish and Game 2007), presumably in the Connecticut River. If common mudpuppy were present at SAGA, it would most likely occur in BMD Brook below the dam. In the current survey this section of stream was searched on five occasions, for a total of seven search hours (Table 12). In addition, Cook (1986) searched this stream section and conducted minnow trap surveys totaling 40 traps nights. These yielded 283 individuals of 10 fish species, but no common mudpuppy. Given that mudpuppy has been taken in eel pots (Klemens 1993), minnow traps would seem to be capable of detecting their presence. However, since the survey work at SAGA was not conducted with detection of common mudpuppy specifically in mind, further survey work, using either minnow trap surveys or electrofishing (Schmidt et al. 2004) might be needed to more definitively determine its presence/absence.

Northern Spring Salamander (Gyrinophilus p. porphyriticus)

The northern spring salamander is a large, brightly colored salamander typically found in cold, clean high-relief mountain streams (Markowsky 1999). Its range extends throughout Vermont and New Hampshire (Petranka 1998) and includes records across the Connecticut River from Cornish in Windsor VT (Andrews 2005) as well as records elsewhere in Sullivan County NH (NH Fish and Game 2007a). Cook (1986) surveyed BMU Brook with minnow traps (18 trap nights) and searched directly for stream salamanders under rocks and logs on a minimum of four occasions, including one in which its entire length was searched over the course of four hours. Twenty seven northern two-lined salamanders and eight northern dusky were recorded, but no northern spring salamanders. Similarly, in the current survey, BMU Brook was searched on

seven occasions for a total of 13.3 search hours, with 103 northern two-lined and 48 northern dusky salamanders recorded (Table 4). As a higher order predator, northern spring salamanders are uncommon relative to these other two species (Markowsky 1999). However, the lack of any records in spite of all this survey effort suggests they are not present in BMU Brook. Reasons for their apparent absence are uncertain, but since populations of northern spring salamander larvae have lowered growth and survival in the presence of brook trout (Petranka 1998), the presence of a breeding population of brook trout in BMU Brook (Cook 1986) may be a factor.

Four-toed Salamander (Hemidactylium scutatum)

The four-toed salamander is a small terrestrial salamander typically found in woodlands adjacent to sphagnaceous wetlands, to which females migrate in early spring for egg deposition. In New England, four-toed salamanders extend northward into southern Vermont and New Hampshire and coastal Maine (Petranka 1998) and are one of the species considered by Oliver and Bailey (1939) to be at the northern limits of its distribution in New Hampshire. There is a historic record from Grafton County (Oliver and Bailey 1939) and a current record from Orange County VT (Andrews 2005), indicating that Sullivan County falls within the northern limit of this species distribution in the Connecticut River Valley. However, most current records are to the south or east of Sullivan County (NH Fish and Game 2007a). Four-toed salamanders are considered difficult to find (Burgason 1999a). Where they occur, they can be found by nighttime road searches on rainy nights in early spring and they are relatively easy to find by searching through sphagnum hummocks in wetlands for nesting females in mid-spring (Cook et al. 2006a). Conversely they are found infrequently under cover objects, even ones adjacent to wetlands where they nest (Cook, pers. obs.). Thus, the lack of records for Sullivan County may reflect rarity at the edge of their range, or inadequate sampling.

Although Cook (1986) did some road cruising, it was primarily in summer. Since searching under cover objects is not the most effective method for detecting this species and there were no searches for nesting females in either survey, it is possible that four-toed salamanders could have gone undetected. Directed search for nesting females in May in the “overflow” wetlands is needed to resolve this question.

Northern Leopard Frog (Rana pipiens)

The northern leopard frog is found throughout most of the Northeastern and northern Midwestern regions of the United States and into Canada (Conant and Collins 1998). It is widespread across northern New England, extending south into northeastern Massachusetts and into Connecticut via the Connecticut River Valley (Hinshaw 1999). Although historically recorded in nearby Claremont, Oliver and Bailey (1939) found the northern leopard frog to be widespread in northern New Hampshire but restricted in distribution and uncommon in the south. This pattern is also reflected in contemporary records (Andrews 2005, NH Fish and Game 2006), although there is a recent record from the nearby town of Charleston, NH. The northern leopard frog is a Special Concern species in New Hampshire and has apparently declined throughout much of New England due to farm abandonment, forest regeneration, and decreases in grassland (DeGraaf and Rudis 1983, Klemens 1993, NH Fish and Game 2006).

Northern leopard frogs are frequently confused with the pickerel frog (and vice versa). Both species have distinct spots down the back, but the spots of the northern leopard frog are oval and less uniform than the two parallel rows of square spots that appear on the pickerel frog. Also,

northern leopard frogs are typically greener in color and lack the bright yellow-orange coloration present on the undersurface of the hind legs of pickerel frogs. Although both Cook (1986) and this survey documented pickerel frogs at SAGA, there is no evidence of northern leopard frog here. Given their strong association with grassy riparian floodplain (NH Fish and Game 2006), it may be that the forest and shrub dominated riparian wetlands of SAGA do not meet their habitat needs.

Spotted Turtle (Clemmys guttata)

A small aquatic turtle with distinct yellow spots on a black carapace, spotted turtles typically occupy various shallow, muddy bottomed wetlands, including marshes, bogs, red maple swamps, ditches, vernal pools, and small streams (Klemens 1993, Graham 1995). They also may spend a considerable amount of time on land during certain times of the year (Ernst et al. 1994, J. Behler, unpubl. data). The spotted turtle occurs primarily along the Atlantic coastal plain, from Maine to Florida, including lower elevation areas of southern New England (Klemens 1993), and westward into Ohio, Indiana, Illinois, Michigan, and southeastern Canada (Ernst et al. 1994). Spotted turtles are one of the species that Oliver and Bailey (1939) considered as reaching its northern limits in the southern part of New Hampshire, and the vast majority of records for the state are in the southeast. Ernst et al. (1994) show spotted turtles ranging into the lower Connecticut River Valley of Vermont-New Hampshire, and recent records from Windham county, VT (Andrews 2005) and northeast of Cornish, in the Grafton County towns of Enfield, Grafton, and Canaan (NH Fish and Game 2007a) suggest it may also occur in Sullivan County. Cook (1986) spent significant amounts of time, portions of at least 24 days, in SAGA wetlands, primarily in the spring, conducting egg mass surveys, minnow trap surveys, turtle trap surveys, fish surveys, and salamander surveys. In the current survey, these wetland sites were again searched (14.8 search hours) and trapped specifically for turtles, plus additional time was spent conducting egg mass counts and minnow trapping surveys in spring, when spotted turtles are most readily detected (Ernst and Zug 1994). Given the amount of time spent in wetlands in the spring, the absence of any records here suggests that spotted turtles do not occur at SAGA in any meaningful way.

Eastern Ribbon Snake (Thamnophis sauritis)

The eastern ribbon snake ranges from southeastern Maine to South Carolina, southwest to Illinois, Louisiana, and the Florida panhandle and is absent from the Appalachian Plateau west to the Mississippi Valley (Klemens 1993, Conant and Collins 1998). Although the eastern ribbon snake's range in New England is depicted as extending across northern Vermont and New Hampshire into southern Maine (Lortie 1999), Oliver and Bailey (1939) only recorded them in southern New Hampshire, and both historic and current records (Andrews 2005, NH Fish and Game 2006) suggest they do not extend far northward along the Connecticut River. Thus, in spite of a historic record from Sullivan County (Oliver and Bailey 1939), eastern ribbon snakes appear to be rare and marginal there. Eastern ribbon snakes are found in a variety of shallow water habitats including wet meadows, swamps, ponds, bogs, ditches, and grassy areas near streams and woodland swamps (DeGraaf and Rudis 1983, Klemens 1993). On Cape Cod, this species is often encountered in the course of springtime fieldwork in freshwater wetlands (Cook, pers. obs.). Given the amount of time spent in SAGA's wetland habitats by Cook (1986) and in the current survey, the lack of any records of eastern ribbon snake suggests it does not occur at SAGA.

Smooth Green Snake (Opheodrys vernalis)
The smooth green snake ranges across the northern mid-western and eastern states into southern Canada (Ernst and Ernst 2003) and has been recorded throughout most of Vermont and New Hampshire, including Sullivan County (Andrews 2005, NH Fish and Game 2006). Smooth green snakes prefer grassy, open habitats and appear to be declining in southern New Hampshire as farm lands succeed back to woodlands (NH Fish and Game 2006). Smooth green snakes are often found under coverboards (Cook, pers. obs.) and the lack of any records at SAGA, where open grassy habitat is limited suggests that smooth green snakes may not be present. However, our failure to detect another species known to occur here and readily found under coverboards, the ringneck snake, suggests that more intensive sampling is needed to better determine if this species occurs at SAGA.

Northern black racer (Coluber c. constrictor)
The northern black racer is a subspecies of the eastern racer, which is widespread throughout most of the United States, except for the desert southwest (Ernst and Ernst 2003). The northern black racer occurs from the southern Appalachian Mountains northward, extending to the coastal plain in the mid-Atlantic states and into southern New York and southern New England (Conant and Collins, 1998). The northern limits of the northern black racer's range extends into southern New Hampshire (Vickery 1999), and although it has been recorded historically in the Connecticut River valley north of Sullivan County (Oliver and Bailey 1939), contemporary records are limited to southeast New Hampshire (NH Fish and Game 2006) and in extreme southern Vermont (Andrews 2005). Black racers appear to be declining throughout much of the Northeast in response to loss of open, early successional habitat (Kjoss and Litvaitis 2001). On Cape Cod, where this species is still common, it is generally found in open, mixed grass and shrubland habitats (Cook, pers. obs.), a habitat type lacking at SAGA. Because black racers are a large and active species, they are one of the most conspicuous snakes in the region. Given the lack of both habitat for and observations of this species at SAGA, it most likely does not occur in the park.

Brown Snake (Storeria d. dekayi)
The brown snake is a species that ranges throughout most of the eastern half of the United States and into eastern Mexico (Ernst and Ernst 2003). The sub-species found in New Hampshire, the northern brown snake, occurs from South Carolina northward into central New England, southern Canada, and westward to lower Michigan and Ohio (Conant and Collins 1998). It is widespread throughout New York and New England (Klemens 1993, Gibbs et al. 2007). It has been recorded both historically and currently in Sullivan county, but data suggest it may be relatively localized in the Connecticut River valley of Vermont and New Hampshire (Andrews 2005, NH Fish and Game 2007a). Brown snakes occur in a variety of open, disturbed habitats and are readily found under cover objects. The lack of any records at SAGA suggests that brown snakes do not occur here, but as with the smooth green snake, more intensive sampling is needed.

Northern Red-bellied Snake (Storeria o. occipitomaculata)
The northern red-bellied snake is widely distributed over most of the eastern U.S., extending north into southern Canada (Ernst and Ernst 2003). It ranges throughout Vermont and New Hampshire into all but extreme northern Maine, occurring predominantly in moist woodlands (Burgason 1999b). It has been recently recorded in Sullivan County, in the nearby town of

Springfield (NH Fish and Game 2007a). A “secretive” species, it is most commonly found under rocks, logs, and other cover. Given the amount of searching under rocks, logs, and coverboards at SAGA by Cook (1986) and the current survey, the lack of any records at SAGA suggest that the northern red-bellied snake does not occur here, but as with the smooth green snake, more intensive sampling is needed.

Timber Rattlesnake (Crotalus horridus)

The timber rattlesnake was historically widespread through the southern mid-west and east, reaching its northern limits in New York state and southern Vermont and New Hampshire (Ernst and Ernst 2003). Oliver and Bailey (1939) noted that it had declined throughout much of its range in New Hampshire and it is currently listed as endangered in New Hampshire. Although all available locality data (Andrews 2005, NH Fish and Game 2006) suggest it may have once occurred in Sullivan County, there is now only one known extant population in New Hampshire. Given the association of this species in New England with woodlands with rocky ledges and rockslides, there is little reason to expect this species at SAGA.

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Appendix A. Prior and recent (since 2000) records of amphibians and reptiles of Sullivan county and Saint-Gaudens NHS.

		Saint -Gaudens NHS		Sullivan County		Known Occurrence Records in Counties Neighboring Sullivan						
Common Name	**Scientific Name**	**Current**	**Historic[1]**	**Known**	**Likely**	**Chesire, NH**	**Hillsboro, NH**	**Merrimack, NH**	**Grafton, NH**	**Windham, VT**	**Windsor, VT**	**Orange, VT**
Salamander species												
Common Mudpuppy (introduced)	*Necturus m. maculosus*			X_3						X_2	X_2	
Red-spotted Newt	*Notophthalmus v. viridescens*	X_1	$X_{4,5}$	$X_{1,3,4,5,6}$						X_2	X_2	X_2
Jefferson Salamander complex	*Ambystoma jeffersonianum*		X_4	$X_{1,3,4}$			X_6			X_2	X_2	X_2
Blue-spotted Salamander complex	*Ambystoma laterale*			X_3						X_2	X_2	X_2
Marbled Salamander	*Ambystoma opacum*					X_3	X_6					
Spotted Salamander	*Ambystoma maculatum*	X_1	$X_{4,5}$	$X_{1,3,4,5}$		X_3	$X_{3,6}$		X_6	X_2	X_2	X_2
Four-toed Salamander	*Hemidactylium scutatum*				X_7	X_6	X_6		X_6			X_2
Northern Dusky Salamander	*Desmognathus fuscus*	X_1	X_4	$X_{1,4,6}$		X_3	X_3	X_3	X_3	X_2	X_2	X_2
Northern Spring Salamander	*Gyrinophilus p. porphyriticus*			X_3		X_6		X_6	X_6	X_2	X_2	X_2
Northern Two-lined Salamander	*Eurycea bislineata*	X_1	X_4	$X_{1,3,4,6}$						X_2	X_2	X_2
Eastern Red-backed Salamander	*Plethodon cinereus*	X_1	X_4	$X_{1,3,4}$		X_6	X_6	X_6	X_6	X_2	X_2	X_2
Northern Slimy Salamander	*Plethodon glutinosus*					X_6						
	Salamander subtotals:	**5**	**6**	**9**	**1**	**7**	**6**	**3**	**5**	**9**	**9**	**9**
Anuran species												
American Toad	*Bufo americanus*	X_1	$X_{4,5}$	$X_{1,3,4,5,6}$						X_2	X_2	X_2
Fowler's Toad	*Bufo fowleri*				X_7		X_6	$X_{3,6}$	$X_{3,6}$	X_2	X_2	
Northern Spring Peeper	*Pseudacris c. crucifer*	X_1	X_4	$X_{1,3,4}$		X_6		X_6	X_6	X_2	X_2	X_2
Gray Treefrog	*Hyla versicolor*	X_1	$X_{4,5}$	$X_{1,3,4,5}$		X_6		X_6	X_6	X_2	X_2	X_2
American Bullfrog	*Rana catesbeiana*	X_1	X_4	$X_{1,3,4,6}$						X_2	X_2	X_2
Northern Green Frog	*Rana clamitans melanota*	X_1	X_4	$X_{1,3,4,6}$						X_2	X_2	X_2
Mink Frog	*Rana septentrionalis*								$X_{3,6}$		X_2	X_2

Appendix A. Prior and recent (since 2000) records of amphibians and reptiles of Sullivan county and Saint-Gaudens NHS (continued).

		Saint -Gaudens NHS		Sullivan County		Known Occurrence Records in Counties Neighboring Sullivan						
Common Name	**Scientific Name**	**Current**	**Historic** [1]	**Known**	**Likely**	**Chesire, NH**	**Hillsboro, NH**	**Merrimack, NH**	**Grafton, NH**	**Windham, VT**	**Windsor, VT**	**Orange, VT**
Northern Leopard Frog	*Rana pipiens*			$X_{3,6}$							X_2	X_2
Pickerel Frog	*Rana palustris*	X_1	$X_{4,5}$	$X_{1,3,4,5,6}$						X_2	X_2	X_2
Wood Frog	*Rana sylvatica*	X_1	$X_{4,5}$	$X_{1,3,4,5,6}$						X_2	X_2	X_2
	Anuran subtotals:	**7**	**7**	**8**	**1**	**2**	**1**	**3**	**4**	**8**	**10**	**9**
Snake species												
Common Gartersnake	*Thamnophis sirtalis*	X_1	$X_{4,5}$	$X_{1,3,4,5,6}$						X_2	X_2	X_2
Eastern Ribbonsnake	*Thamnophis sauritis*			X_6		X_3	X_3	X_3	X_3	X_2		
Northern Ring-necked Snake	*Diadophis punctatus edwardsii*	X_1	X_1	X_1	X_7	X_6	X_3	$X_{3,6}$	$X_{3,6}$	X_2	X_2	X_2
Smooth Greensnake	*Opheodrys vernalis*			$X_{3,6}$						X_2	X_2	X_2
Northern Black Racer	*Coluber c. constrictor*					X_6	$X_{3,6}$	$X_{3,6}$	X_6	X_2	X_2	
Eastern Milksnake	*Lampropeltis t. triangulum*	X_1	X_5	$X_{1,3,5,6}$	X_7					X_2	X_2	X_2
Northern Brownsnake	*Storeria d. dekayi*			$X_{3,6}$						X_2	X_2	X_2
Northern Red-bellied Snake	*Storereia o. occipitomaculata*			X_3		X_6			X_6	X_2	X_2	X_2
Common Watersnake	*Nerodia s. sipedon*					X_3	X_3	$X_{3,6}$		X_2		
Eastern Hog-nosed Snake	*Heterodon platirhinos*						$X_{3,6}$	X_3				
Timber Rattlesnake	*Crotalus horridus*				X_7	X_6		X_6		X_2	X_2	
	Snake subtotals:	**3**	**3**	**7**	**3**	**6**	**5**	**6**	**4**	**10**	**8**	**6**
Turtle Species												
Stinkpot	*Sternotherus odoratus*					X_3	$X_{3,6}$	$X_{3,6}$				
Eastern Snapping Turtle	*Chelydra s. serpentina*	X_1	X_4	$X_{1,3,4,6}$			X_3	$X_{3,6}$		X_2	X_2	X_2
Blanding's Turtle	*Emydoidea blandingii*											
Wood Turtle	*Glyptemys insculpta*		X_4	$X_{3,4,6}$						X_2	X_2	X_2
Eastern Box Turtle	*Terrapene c. carolina*									X_2		
Spotted Turtle	*Clemmys guttata*					X_3	$X_{3,6}$	X_3	X_3	X_2		

Appendix A. Prior and recent (since 2000) records of amphibians and reptiles of Sullivan county and Saint-Gaudens NHS (continued).

		Saint -Gaudens NHS		Sullivan County		Known Occurrence Records in Counties Neighboring Sullivan						
Common Name	**Scientific Name**	**Current**	**Historic [1]**	**Known**	**Likely**	**Chesire, NH**	**Hillsboro, NH**	**Merrimack, NH**	**Grafton, NH**	**Windham, VT**	**Windsor, VT**	**Orange, VT**
Painted Turtle	*Chrysemys picta*	X_1	X_4	$X_{1,3,4,6}$						X_2	X_2	X_2
	Turtle subtotals:	**2**	**3**	**3**	**0**	**2**	**3**	**3**	**1**	**5**	**3**	**3**
	Total # Species Documented	**17**	**19**	**27**	**5**	**17**	**15**	**15**	**14**	**32**	**30**	**27**

[1] Known or likely to have historically occurred at SAGA

Key to the references

1 - This study
2 - Andrews 2005
3 - NH Herp Atlas, 2007
4 - Cook 1986
5 - Cronan 1981
6 - Oliver and Bailey 1939
7 - Likely to have occurred in Sullivan County based on data from surrounding counties

Appendix B. Habitat categories and types surveyed at Saint-Gaudens NHS.

Habitat Category	Habitat Type	Description
STREAM	Permanent Stream	Narrow (< 3m wide), flowing body of water with water flowing throughout the year.
WETLAND	Temporary Pond	Open or closed canopy body of water that holds water for part of the year, drying during late summer months, and is void of fish. Typically identified by water stained leaves and buttressed tree trunks (i.e., Pin Oak, *Quercus palustris*; Black Gum, *Nyssa sylvatica*). Invertebrates present include fairy shrimp, predacious diving beetles, copepods, cladocerans, and caddisfly larvae.
	Permanent Pond	Open body of water (< 2 ha), holds water the entire year, and fish are usually present. Borders of the pond are well defined.
UPLAND	Mixed Forest	Forest with deciduous (i.e., oak, *Quercus* spp.; maple, *Acer* spp.; birch, *Betula* spp.; and evergreen, *Pinus* spp. trees).
	Hemlock Forest	Forest dominated by hemlock (*Tsuga canadensis*) trees, often found in steep, mesic, montane habitats.
	Hardwood Forest	Forest dominated by deciduous trees (i.e., oak, *Quercus* spp.; maple, *Acer* spp.; birch, *Betula* spp.).
	Field	Open area dominated by grasses and sedges.

Appendix C. Coordinates for 21 standardized amphibian and reptile survey sites and four incidental encounter (IE) localities at Saint-Gaudens NHS.

For streams and coverboards (CB), the pair of coordinates are start and end points of linear features. For fields and ponds, the single point is a central point in what is actually a polygon feature.

Site	Survey Method	UTM X	UTM Y	UTM X	UTM Y
Blow-Me-Down Brook Below Dam	Stream TCS	711904	4819017	712152	4819301
Blow-Me-Down Brook Low Gradient	Stream TCS, TTS, MTS	712087	4819610	711821	4819739
Blow-Me-Down Brook Medium Gradient	Stream TCS	711821	4819739	711958	4820068
Blow-Me-Down Pond	ACS, TCS, TTS, MTS	712027	4819552		
Blow-Me-Up Brook	Stream TCS	711958	4820068	712876	4819830
Farm Field	CB	713039	4819595	713075	4819587
Farm Field	TCS	713030	4819660		
Farm Pond 1	ACS, EMC, TCS, TTS, MTS	712999	4819631		
Farm Pond 2	EMC, TCS, MTS	712976	4819655		
Historic Core – Aspet House	IE	712694	4819766		
Historic Core – Visitor Center	IE	712816	4819796		
Historic Core – Maintenance Building	IE	712882	4819616		
Lower Field	CB (A)	712483	4819747	712445	4819736
Lower Field	CB (B)	712294	4819816	712260	4819799
Lower Field	TCS	712543	4819780		
Pond A’	ACS, EMC, TCS, TTS, MTS	711851	4819880		
Pond B	ACS, EMC, TCS, TTS, MTS	711946	4819787		
Pond B’	EMC, TCS, TTS, MTS	711859	4819922		
Pond C	ACS, EMC, TCS, TTS, MTS	711931	4819736		
Pond DE	ACS, EMC, TCS, TTS, MTS	712001	4819702		
Pond FGHI	ACS, EMC, TCS, TTS, MTS	712064	4819695		
Turtle Pond	ACS, TCS, TTS, MTS	711783	4819755		
Woodland 1	TCS	712382	4819562		
Woodland 1 – Near Blow-Me-Down Mill	IE	712179	4819357		
Woodland 2	CB	712151	4819796	712186	4819754
Woodland 2	TCS	712065	4819795		
Woodland 3	TCS	712460	4819902		
Woodland 4	CB	712665	4819956	712647	4819948
Woodland 4	TCS	712498	4819980		
Woodland 5	CB	712542	4819535	712568	4819553
Woodland 5	TCS	712367	4819421		

Appendix D. Summary of measurements for turtles captured at Saint-Gaudens NHS.

Species	Site	Date	Sex	Age Category	Notch Code	CL[1] (mm)	CW[2] (mm)	PL[3] (mm)	PW[4] (mm)	Wt[5] (g)
Painted Turtle	BMD Pond	28-May	Female	Adult	R3	152	106	138	86	420
		28-May	Female	Adult	R1,3	143	103	136	82	422
		28-May	Female	Juvenile	R2,3	123	95	110	75	231
		28-May	Female	Adult	R2,4	143	109	132	84	355
		28-May	Female	Adult	R2	133	93	120	77	260
		28-May	Female	Juvenile	R1	114	84	107	69	210
		28-May	Male	Adult	R4	133	98	117	80	277
		28-May	Female	Adult	R1,2	143	102	132	84	380
		28-May	Female	Adult	R1,4	163	119	154	97	565
		30-May	Female	Adult	R2,9	148	104	137	85	385
		30-May	Female	Juvenile	R1,2,9	103	84	94	68	158
		26-Jun	Male	Adult	R3,9	145	117	137	88	365
		27-Jun	Female	Adult	R2,3,9	147	105	132	87	380
		27-Jun	Unknown	Juvenile	R4,9	91	76	87	62	120
		27-Jun	Female	Adult	R1,4,9	168	119	156	91	543
	Pond C	26-Jun	Unknown	Juvenile	R1,3,9	71	62	64	51	65
		28-Jun	Unknown	Juvenile	R2,4,9	70	57	61	46	55
	Pond FGHI	28-May	Unknown	Juvenile	R9	67	56	57	43	50
	Turtle Pond	28-May	Male	Adult	R2,3,8	139	103	127	81	320
		28-May	Female	Juvenile	R2,4,8	112	84	101	67	180
		28-May	Female	Adult	R1,8	141	101	131	82	350
		28-May	Male	Adult	R2,8	148	110	136	88	342
		28-May	Unknown	Juvenile	R3,8	93	76	85	60	125
		28-May	Female	Adult	R1,3,8	151	117	141	90	430
		28-May	Unknown	Juvenile	R4,8	91	76	82	60	110
		28-May	Male	Adult	R1,4,8	121	93	105	72	220
		28-May	Female	Adult	R8	157	109	137	84	452
		28-May	Female	Adult	R1,2,8	135	107	129	87	318
		29-May	Unknown	Juvenile	R1,9	74	63	66	49	70
		28-Jun	Unknown	Juvenile	R1,8,9	71	61	62	48	62
		28-Jun	Unknown	Juvenile	R8,9	64	55	53	42	41

Species	Site	Date	Sex	Age Category	Notch Code	CL[1] (mm)	CW[2] (mm)	PL[3] (mm)	PW[4] (mm)	Wt[5] (g)
Eastern Snapping Turtle	BMD Pond	28-May	Female	Adult	R8	268	206	187	191	-
		29-May	Male	Adult	R9	240	185	175	188	-
		29-May	Male	Adult	R10	377	314	261	298	-
		26-Jun	Female	Juvenile	R9,10	187	152	139	136	1671
		26-Jun	Female	Adult	R8,10	261	214	192	196	-
		27-Jun	Female	Adult	R11	241	198	167	179	-
		27-Jun	Male	Adult	R8,11	382	315	235	282	-
		27-Jun	Male	Adult	R9,11	379	312	264	282	-
	Pond C	28-Jun	Unknown	Juvenile	L8	101	86	67	74	228

[1] CL = carapace length
[2] CW = carapace width
[3] PL = plastron length
[4] PW = plastron width
[5] Wt = weight

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