

Small Mammal Survey of National Capital Region Parks - Final Report

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The purpose of the survey is to describe the distribution and relative abundance of small mammals species in eight parks in the National Capital Region. Our survey protocol was not designed to detect every species that might reside or passage through the park, but rather to test the utility of using small mammals as a monitoring tool for park biodiversity. Our results can provide guidance to individual parks and to the region with regards to the relative abundance and distribution of small mammals, as the protocol was maintained across sites and the sites were sampled over what was essentially the same period of time.

Study area

The parks sampled for small mammals included: Antietam National Battlefield (ANTI), Catocin Mountain Park (CATO), Chesapeake and Ohio Canal National Historical Park (CHOH), George Washington Memorial Parkway (GWMP), Harpers Ferry National Historical Park (HAFE), National Capital Parks-East (NACE), and Rock Creek Park (ROCR). Several parks had a particular interest in specific mammals and received additional monitoring for gray foxes and flying squirrels (ANTI, CHOH, GWMP, HAFE, ROCR), or woodrats (CHOH). All the parks were within the drainage of the Potomac River (Figure 1). Three parks (CHOH, HAFE, GWMP) were wholly confined to the Potomac's floodplain and adjoining hills; one park (NACE) was confined to the floodplain of both the Potomac and a major tributary (Anacostia); and one park (ROCR) was confined to the floodplain of a tributary (Rock Creek) (Figure 1).

Methods

Selecting survey points based on landcover classes for each park was dependent on the development of the park's GIS coverage. For CATO, ROCR, and HAFE there were landcover layers within their GIS that were readily usable. We did have to combine habitat classes prior to point selection. For NACE, and GWMP we used a base map the USGS national landcover project (<http://landcover.usgs.gov/natl/landcover.asp>). Their classification system has only 3 forest classes, so no reduction of classes was necessary.

Determining sample locations did vary between the parks. CHOH is linear with few access points and contains many historical sites that would not allow disturbance, so we divided the park into 9 equal sections and located 4 sample areas within each section. Each sample area consisted of 6 survey points that were spaced > 200 apart along the canal road. For sections where the park property expanded beyond the canal zone, we made an effort to select points outside the floodplain. So little forest cover was available for WOTR and ANTI that we were limited in the location of points and relied on field crews to select points. For remainder of the parks with existing habitat coverages, we used a GIS (Arc-View 3.2) to create broad habitat classes for the parks; within each habitat class we used a random number algorithm within ERDAS Imagine to create one survey point for every 37 hectares. The sample points were a minimum of 200 m apart, with additional points (10% of total) were chosen in habitats of special concern to each park. An example of the final survey point distribution is given for ANTI (Figure 2). The geocoordinates of each point were entered into a GIS once the survey points were located by the field team. This selection process resulted in each

park being sampled relative to the size of the park (Table 1), with 2.5-3.0 samples for every 100 hectares within the park. Smaller parks were sampled beyond this level and HAFE received additional sampling after examination of its species accumulation curve.

Each sample point was composed of eight 9" Sherman traps, one 16" Tomahawk trap, and one pitfall array. The traps were live-capture and baited with a mixture of oats and sunflower seeds. The pitfall array consisted of four water-filled containers placed 6" deep and flush with the ground surface and 1-m from each other. The containers were linked to each other by a wire mesh screening, such that there was a central container and three "arms". The Sherman traps were placed in pairs at the most likely capture sites within an 11-m radius of the pitfall array. The Tomahawk trap was attached to a tree using a wooden platform. If the site was not wooded, the Tomahawk trap was placed on the ground. If there was any evidence of subterranean mole activity, we set Victor mole traps within active tunnels. The live-traps were pre-baited for two days, followed by five days of trapping. The traps were checked twice a day and all animals captured were marked and released. The pitfall array was operated for the entire seven-day period and all animals captured were returned to the laboratory for species identification. During the first winter of the study (2000/2001) a Tomahawk trap was placed on a tree platform at each wooded survey point to survey for squirrels. These traps were pre-baited for two days and checked twice daily for five days, as with the summer survey. An abundance estimate was created for each species based on the number of animals captured per trap night.

For those parks surveyed for gray fox, infrared trip cameras were placed at a subset of the sample points. An object within three-m in front of the camera was baited with commercial fox lure, and the camera was operated for one week during the winter. An abundance index for the predators detected was created using the number of pictures per night of camera coverage.

Our criteria for adequate sampling of a park was to construct species accumulation curves for each trapping effort and to detect evidence that the capture of new species using our capture protocol has leveled off. This is not to infer that all species are captured, but can be used to gauge when this combination of live- and pitfall traps has surveyed the mammals "available" to it. We present the species accumulation curves for each park at the end of this report (Appendix 1). At a single park (HAFE) we returned to the park a second time to trap eight additional survey points after examining the species accumulation curves. For the remaining seven parks the graphs did not indicate a need for additional trapping using this protocol.

Results and Discussion

We captured 2,081 small mammals during the survey, with all but 34 of these coming during the summer survey period (Table 2). The most abundant species were *Peromyscus leucopus*, *Sciurus carolinensis*, and *Blarina brevicauda*. Some parks contained individual species that were not detected in other parks, such as *Microsorex hoyi* in CATO and *Neotoma magister* in HAFE. It is difficult to make much of the

comparisons between species because each species differs in their propensity to be captured using our protocol. We are confident that the 3 abundant species are the most common, but the relative ranking of the remaining species is questionable. An example of this is our inability to capture species that we observed at some parks. *Sciurus carolinensis* was observed at CATO, but captured during neither the winter or summer survey. Signs of activity by *Scalopus aquaticus* were observed at NACE and GWMP, but the animal was not captured in either park. We can explain some of the missing species by assuming they are not abundant and the trapping effort was insufficient to sample rare species. Rare species are usually confined to small microhabitats, which may not be sampled using this broad approach. The *Neotoma* at HAFE was not captured during the first survey, but only at a single supplemental point during 2002. We have no explanation for our failure to capture *Sciurus* at CATO.

It is not valid to compare the number of mammals captured at each park because the sampling effort was different at each park. We strived to keep the effort relative to the number of hectares in each park (Table 1). We had 2 exceptions to this: One was the small size of WOTR resulted in our oversampling of that habitat. The second was the size of CATO includes a large area that is inaccessible due to security concerns. The sampling effort at CATO was in line with the amount of forest available to the research team. As to be expected, the number of species captured was positively correlated with the size of the park (Pearson's $R = 0.74$, $P = 0.036$; Figure 3). Of interest for future study, and a focus of our subsequent analysis of these data, were the parks whose species richness was significantly above or below the regression line. HAFE was particularly rich for its size and ROCR and GWMP were noticeably lacking in species richness. Whether these differences can be related to landscape or habitat features is still to be determined.

Our usage of remote-trip cameras to detect mesopredators would follow the same observations (Table 3). Some species, such as *Procyon lotor*, *Vulpes vulpes*, and *Odocoileus virginianus* were commonly photographed and probably occur in each park, even though no photographs of *Vulpes vulpes* was obtained at ANTI (it was observed during subsequent surveys). The less photographed species may be either: 1) truly rare (or absent); 2) less attracted to the lure used, or 3) possess larger homeranges and not encounter the cameras on a weekly basis. We would suggest that future camera surveys extend the period for each camera to >15 days to account for the last possibility. There was a single detection of a gray fox at CHOH and detection of *Canis latrans* at CATO. An additional problem with the camera surveys is that, for most species, individuals cannot be determined. Unlike the live-trapping, where animals are marked before release, we have no way of counting individuals with the camera survey. For example, we do not know how many individuals are represented in the 32 photos of *Vulpes vulpes* at ROCR.

During the first year we conducted both winter and summer squirrel surveys at ANTI, CATO, and HAFE. After comparing the two survey periods (Table 4), we concluded that the summer squirrel survey alone is adequate for the needs of the project. With the exception of a single red squirrel at CATO, we captured the same species during the summer survey period. Several species (*Tamias striatus*, *Sciurus niger*, *Glaucomys*

volans) were more abundant during the summer survey. At the remainder of the parks we surveyed squirrels in the summer only.

There was an effort to identify sites for *Neotoma magister* and *Urocyon cinereoargenteus*. We did detect one location for each species within the park complex, with *Neotoma* captured in HAFE and *Urocyon* photographed in CHOH. Both sites are located in the western half of the survey area and probably represent the persistence of populations in these more rural settings. We examined multiple “suitable” sites for *Neotoma* in CHOH and CATO without success. As *Vulpes vulpes* was one of the most abundant species photographed during the survey, it is not surprising that the shy *Urocyon* was absent from most parks.

There are always concerns about species identification. Soricids are difficult in the field and all specimens collected in the pitfalls were cleaned and examined with reference to collections at the Smithsonian Museum of Natural History and Virginia Commonwealth University. The specimens of *Neotoma magister* were compared to the same reference collections, yet only *Neotoma floridana* resides in the 2 museums. The characteristics and the capture location of our specimens match those of *N. magister*, but it cannot be verified at this time. Field identification of a marsh rat (*Oryzomys palustris*) at NACE proved to be a Norway rat (*Rattus norvegicus*), once the entire morphological range of the species was examined at the museum. A second source of potential error is that initial identifications are given at the field site, but not all specimens were brought into the laboratory. In 2001 there was a field identification of a golden mouse (*Ochrotomys nuttalli*) at ANTI, but no specimen was returned to the lab. We returned to the survey point and surrounding area in 2002 for an additional week of trapping but only *Peromyscus* were captured. We therefore changed the initial identification to a *Peromyscus leucopus*. A single *Peromyscus maniculatus* was identified at CHOH, the specimen was not returned to the laboratory, but morphological measurements taken of this individual at the field site lead us to conclude the identification was accurate. A single individual of *Tamiasciurus hudsonicus* was captured during the winter trapping at CATO. The field measurements and habitat (high elevation pine forest) were concurrent with expectations for this species.

Both *Peromyscus leucopus* and *P. maniculatus* are known from this region, but are difficult to distinguish correctly in the field. Field identifications recorded all captures as *Peromyscus leucopus*, with the exception of one animal. A recent article in the Journal of Mammalogy distinguished the two species on the basis of detailed skull measurements. Fifty-five field-identified *Peromyscus* were prepared as specimens from a wide range of parks and 12 cranial measurements obtained for each animal. At first analysis, the cranial measurements match *Peromyscus leucopus*, but we still need to obtain cranial measurements on known individuals to conduct statistical tests.

Conclusions

There is a suite of species that are common to all parks (Table 5). From small to large body-size these species are *Blarina brevicauda*, *Peromyscus leucopus*, *Sciurus*

carolinensis, *Vulpes vulpes*, *Procyon lotor*, and *Odocoileus virginianus*. The common species showed no obvious patterns with habitat or landuse and should be avoided as candidates for monitoring programs, except possibly as a negative indicator of disturbance. There is some discussion of using body condition for the more common species as a management indicator. It is difficult for us to evaluate this because our sampling was conducted over a broad period and captures in April cannot be compared to those in September. However, there are recent concerns in the literature that weight in small mammals is very sensitive to trapping activities and any use of mass as a management indicator is suspect (Pearson et al. 2003, JWM 67:684-691).

Other species were relatively abundant and constitute a potential suite of species from which park can select monitoring species. Of this second tier of species *Glaucomys volans* and *Sorex* sp. seem sufficiently abundant to monitor and have suitable habitat requirements. *Glaucomys* are associated almost entirely with mature deciduous forest; for *Sorex* species, a diverse and undisturbed ground cover in preferred habitat. Possible inclusion in this group would be *Clethrionomys gapperi*, which should have been more abundant in the study area given the location of the sample points. There are several species that were absent or rare from our sampling and we would not recommend for a monitoring protocol.

Table 1. Sampling effort for each park included in the survey, Winter 2000 – Summer 2003.

Attributes	<u>Parks surveyed</u>							
	WOTR	ROCR	ANTI	HAFE	GWMP	CATO	NACE	CHOH
Number of sample sites	10	30	37	38	43	53	98	204
Size of park (hectares)	52	710	1,318	926	1,706	2,335	3,299	7,785
Sample sites/ 100 hectares	-----	4.2	2.8	4.1	2.5	2.3	3.0	2.6
Total trap-nights	520	1,580	1,924	1,976	2,236	2,226	5,096	10,608
Trap nights/ 100 hectares	-----	222	146	216	131	94	154	136

Table 2. The number of animals for each species captured in pit-fall and live-traps at eight parks in the National Capital Region during the summers of 2001 and 2002. Sample effort in each park was determined by the size of the park.

Scientific name	Common name	Number of animals trapped in each park surveyed							
		WOTR	ROCR	ANTI	HAFE	GWMP	CATO	NACE	CHOH
Blarina brevicauda	Northern short-tailed shrew	1	7	21	3	20	43	48	109
Cryptotis parva	Least shrew	0	0	1	1	0	0	0	0
Sorex cinereus	Masked shrew	0	0	0	0	0	0	2	10
Sorex fumeus	Smoky shrew	0	0	0	2	0	5	0	1
Sorex longirostris	Southeastern shrew	0	0	0	1	1	0	4	1
Microsorex hoyi	Pygmy shrew	0	0	0	0	0	1	0	0
Glaucomys volans	Southern flying squirrel	1	0	2	5	0	1	0	10
Clethrionomys gapperi	Red-backed vole	0	0	0	1	0	3	0	0
Microtus pennsylvanicus	Meadow vole	0	0	9	0	0	0	9	4
Microtus pinetorum	Pine vole	0	0	0	1	1	0	0	6
Mus musculus	House mouse	0	0	2	3	0	0	12	1
Peromyscus leucopus	White-footed mouse	16	33	96	109	64	100	130	604
Peromyscus maniculatus	Deer mouse	0	0	0	0	0	0	0	1
Sciurus carolinensis	Eastern gray squirrel	40	90	9	16	47	0	89	149
Sciurus niger	Eastern fox	0	0	0	0	0	1	0	13

Scientific name	Common name	Number of animals trapped in each park surveyed							
		WOTR	ROCR	ANTI	HAFE	GWMP	CATO	NACE	CHOH
Tamias striatus	squirrel Eastern chipmunk	0	3	7	23	0	7	1	20
Zapus hudsonius	Meadow jumping mouse	0	0	3	0	0	0	1	5
Scalopus aquaticus	Eastern mole	0	0	0	0	0	0	0	3
Rattus norvegicus	Norway rat	0	0	0	0	0	0	3	0
Neotoma magister	Eastern woodrat	0	0	0	5	0	0	0	0

Table 3. Trip camera survey conducted during winter months in 2000 and 2001. Number of photographs does not necessarily represent individuals. NACE was not sampled as part of this study.

Scientific Name	Common name	Number of photos in each park surveyed						
		ANTI	WOTR	ROCR	GWMP	HAFE	CHOH	CATO
<i>Sciurus carolinensis</i>	Eastern gray squirrel	0	0	5	2	2	4	0
<i>Sylvilagus floridanus</i>	Eastern cottontail rabbit	5	0	0	0	0	3	0
<i>Procyon lotor</i>	Raccoon	20	6	15	9	3	14	4
<i>Urocyon cinereoargenteus</i>	Gray fox	0	0	0	0	0	1	0
<i>Vulpes vulpes</i>	Red fox	0	9	32	6	11	13	3
<i>Didelphis virginiana</i>	Virginia opossum	1	0	0	0	0	2	0
<i>Mephitis mephitis</i>	Striped skunk	2	0	0	0	0	0	0
<i>Canis latrans</i>	Coyote	0	0	0	0	0	0	1
<i>Odocoileus virginianus</i>	White-tailed deer	9	3	20	17	1	81	6
Number of sites		6	6	14	16	6	25	9
Number of camera nights		42	42	98	112	55	175	69

Table 4. Winter trapping at select parks during 2001. All trapping was with Tomahawk live-traps placed on tree platforms. In parentheses is the number of animals captured for that species during the summer trapping session (2001 and 2002).

Scientific name	Common name	<u>Park surveyed</u>		
		ANTI	HAFE	CATO
<i>Sciurus carolinensis</i>	Eastern gray squirrel	6 (9)	26 (16)	0 (0)
<i>Sciurus niger</i>	Eastern fox squirrel	0	0	0 (1)
<i>Tamiasciurus hudsonicus</i>	Red squirrel	0	0	1 (0)
<i>Tamias sciurus</i>	Eastern chipmunk	1 (7)	0 (23)	0 (7)
<i>Glaucomys volans</i>	Southern flying squirrel	0 (2)	0 (5)	0 (1)
Trap stations		11	30	60
Trap nights		44	139	240

Table 5. List of potential small mammal species in the region encompassed by the study area. The letter following each species denotes the species abundance relative to our sampling protocol: C- common; LA- locally abundant ; R – rare; A – absent.

<u>Species</u>	<u>Abundance</u>
Sorex cinereus	LA
Sorex fumeus	LA
Sorex longirostris	LA
Microsorex hoyi	R
Blarina brevicauda	C
Cryptotis parva	R
Scalopus aquaticus	LA
Condylura cristata	A
Tamias striatus	LA
Sciurus carolinensis	C
Sciurus niger	LA
Tamiasciurus hudsonicus	R
Glaucomys volans	LA
Oryzomys palustris	A
Reithrodontomys humulis	A
Peromyscus maniculatus	R
Peromyscus leucopus	C
Neotoma magister	R
Clethrionomys gapperi	R
Microtus pennsylvanicus	LA
Microtus pinetorum	LA
Synaptomys cooperi	A
Rattus rattus	A
Rattus norvegicus	R
Mus musculus	LA
<u>Zapus hudsonicus</u>	<u>LA</u> .

Figure 1. Arrangement of National Parks included in this survey. Landcover classification based on USGS Landover Classification Project.

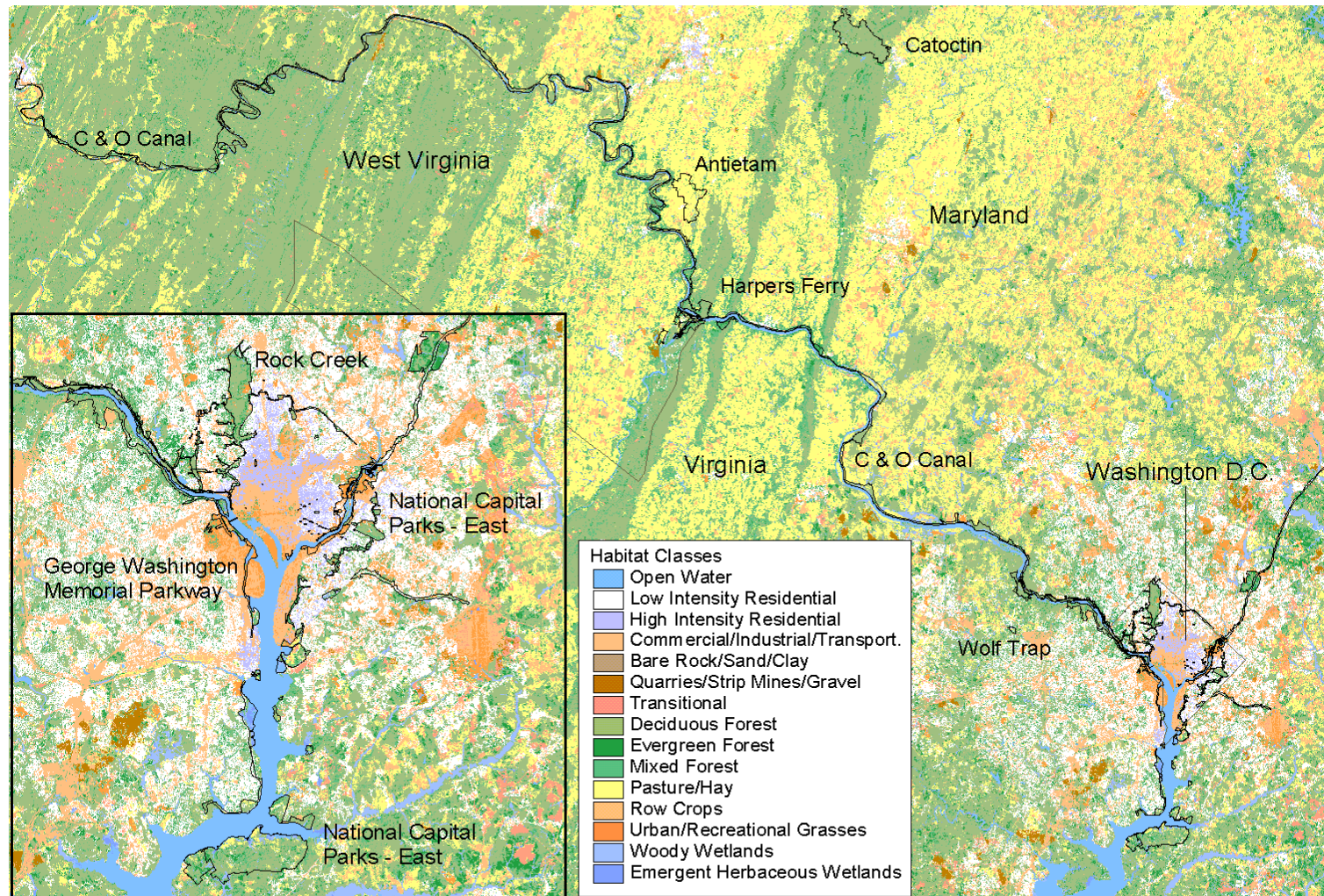


Figure 2. Example of survey site selection at Antietam National Battlefield Park, located outside of Sharpsburg, Maryland. The park is 1,318 hectares of primarily farmland and woodlots. We sampled 37 locations within the park during summer 2001. Sample points are >200 m apart and include all major habitat types found within the park.

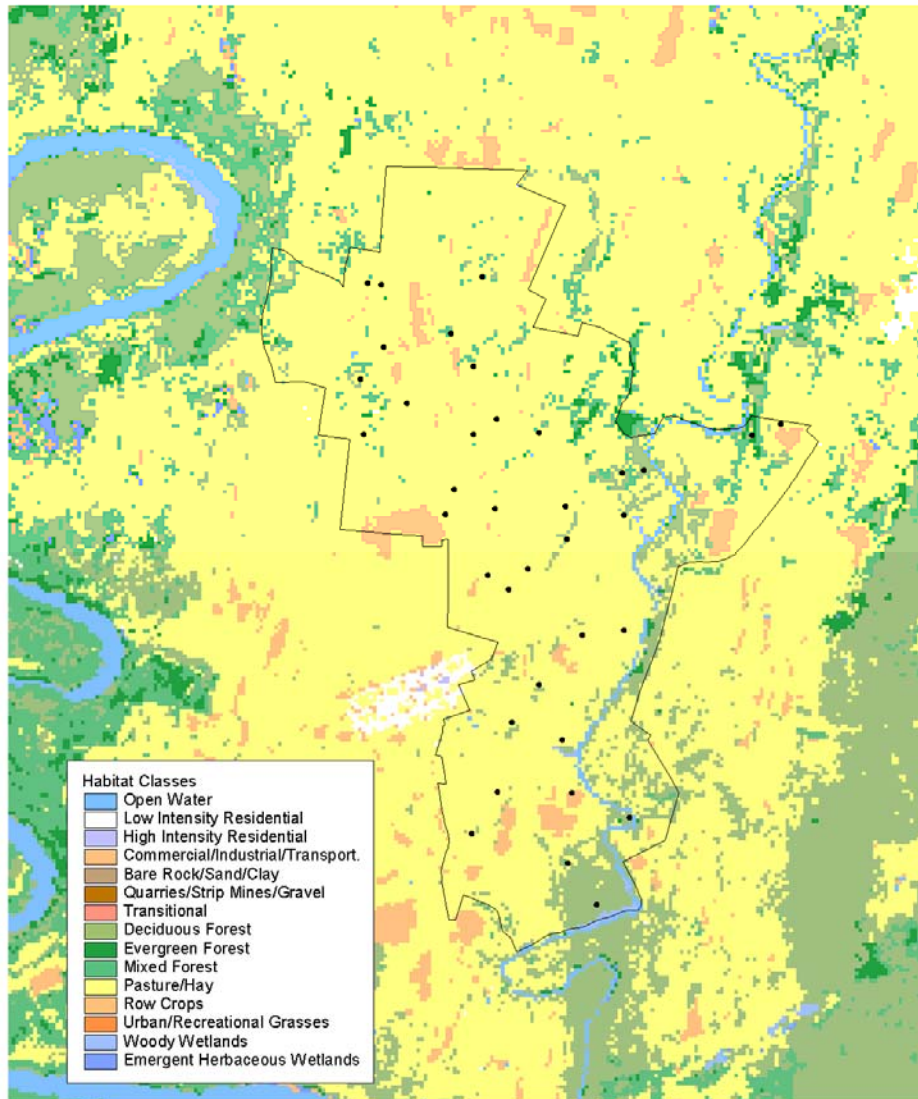
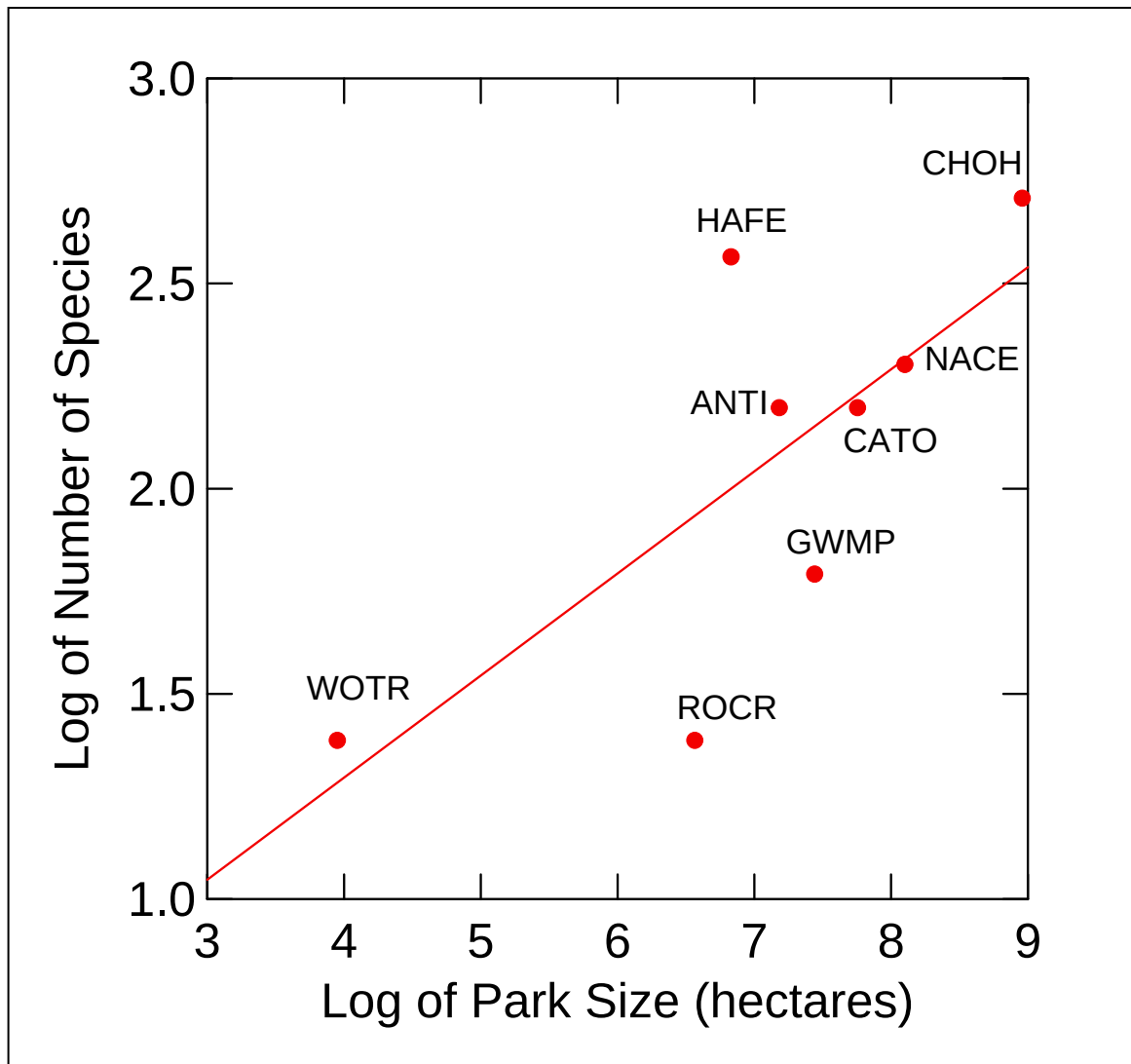
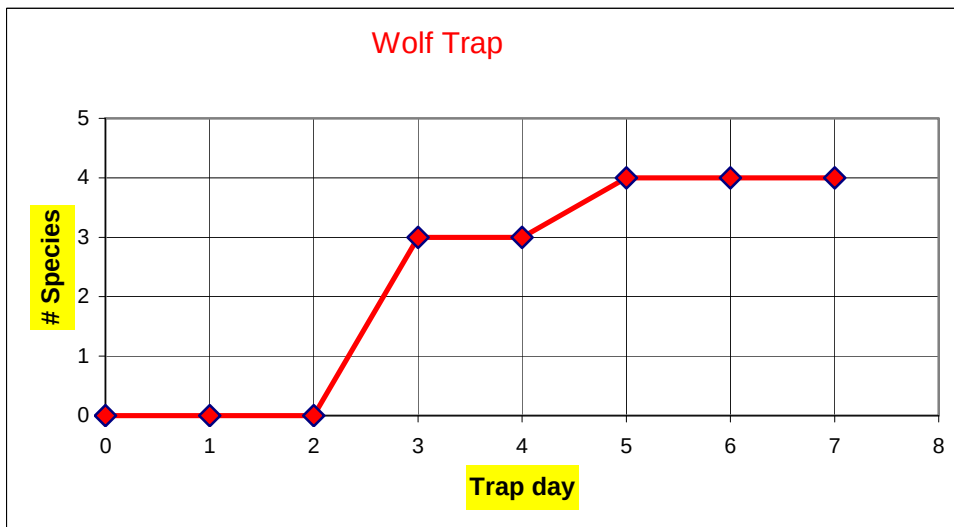
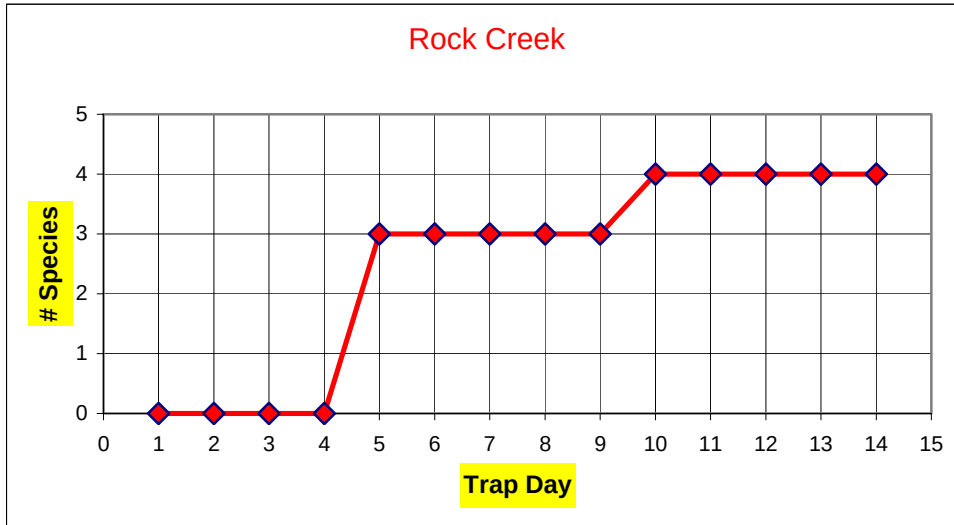
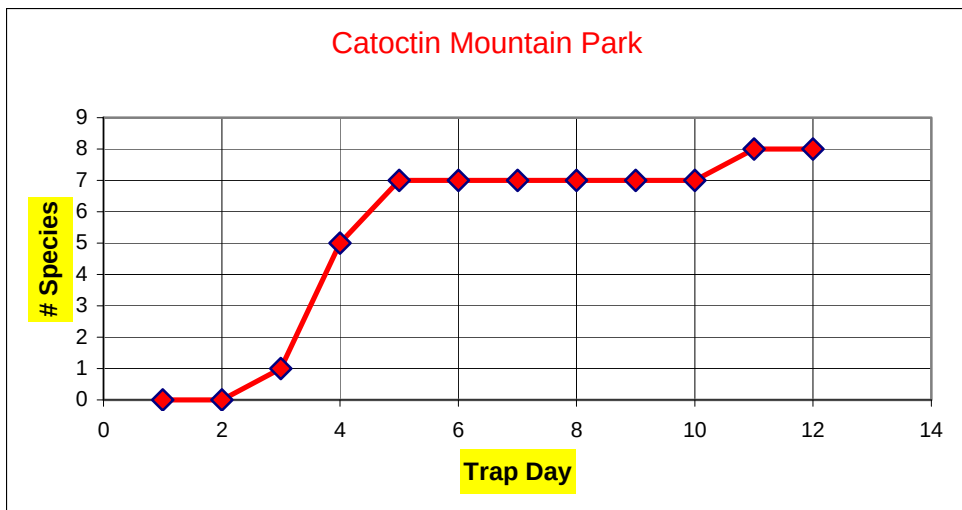
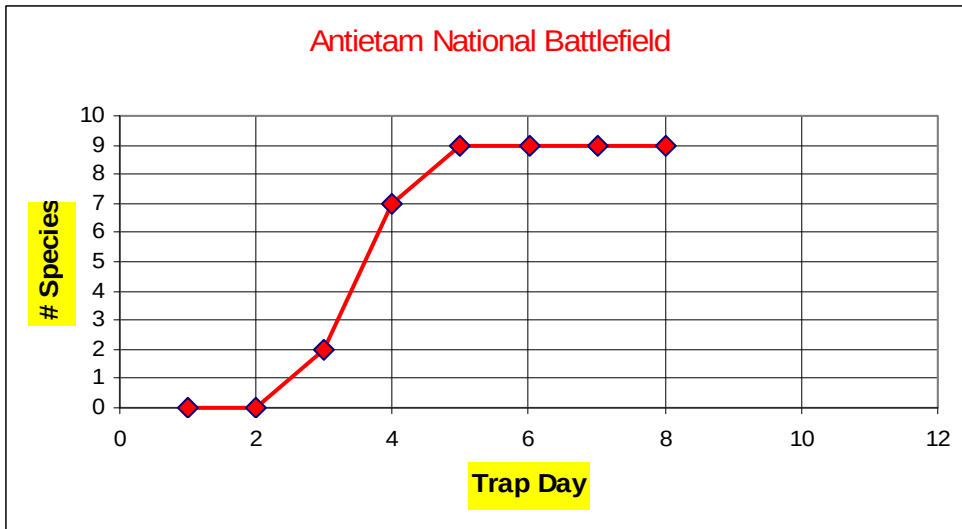


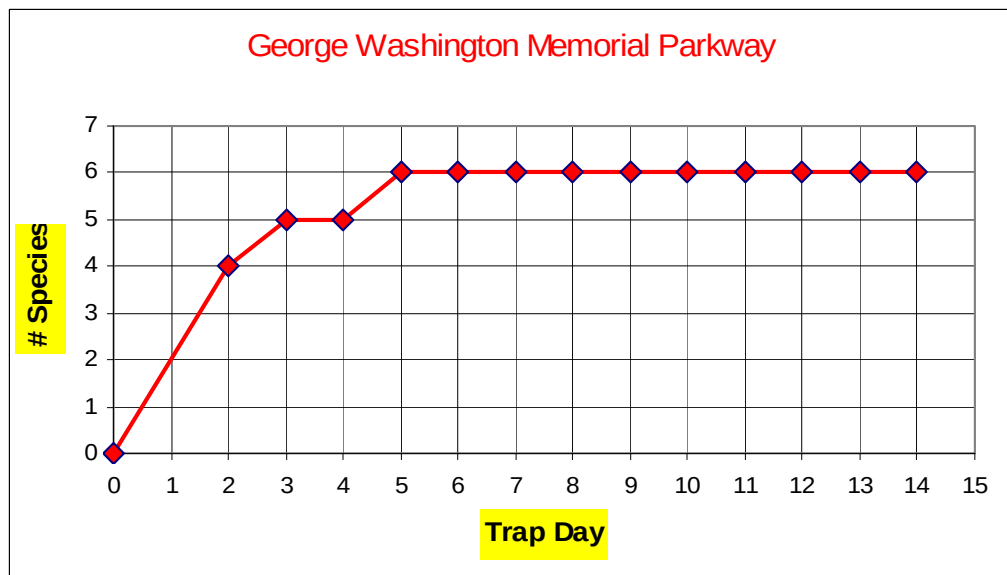
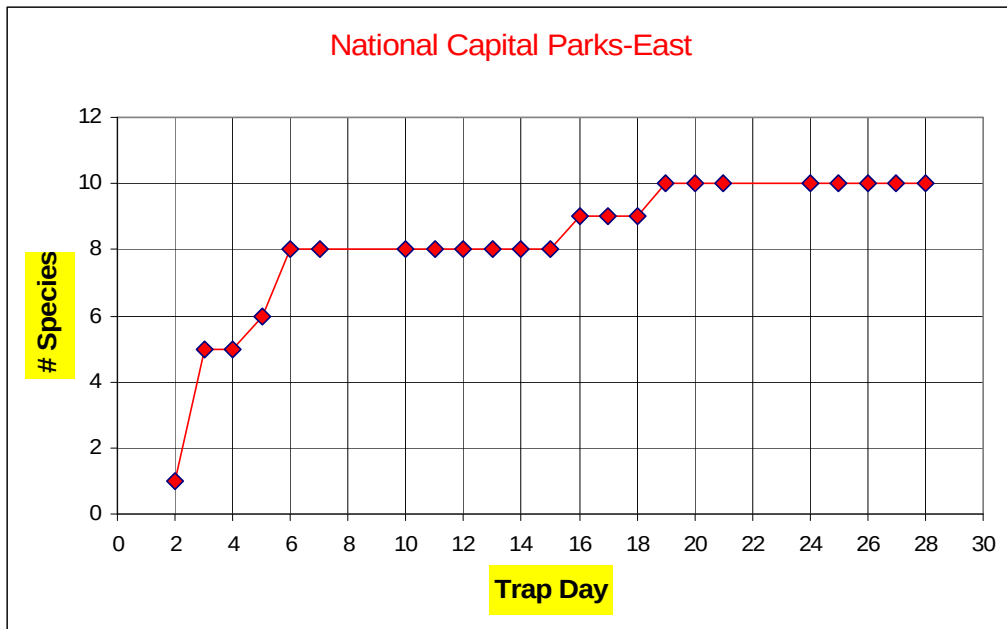
Figure 3. Number of species captured during survey with respect to the size of the park sampled. For park codes see text.

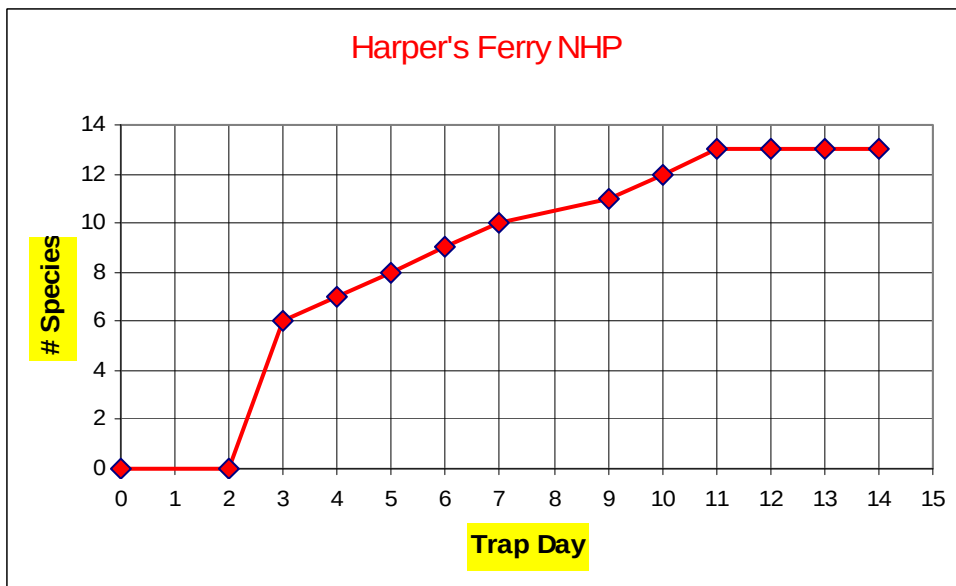
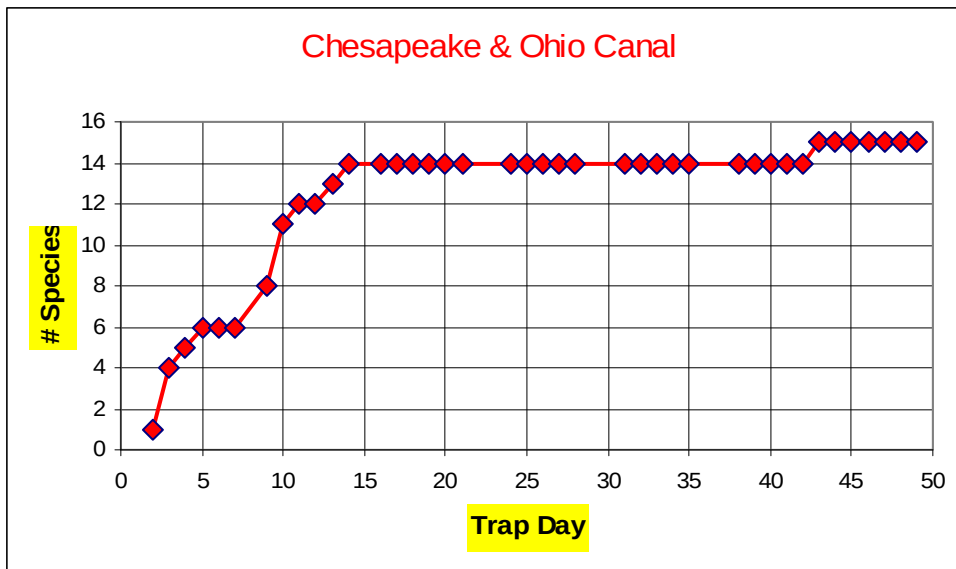


Appendix 1: Species accumulation curves for each park sampled. The number of points sampled daily at each park varied depending on park size. Since the relative effort was constant across parks we can compare the number of species captured / trap day of effort.











As the nation's principal conservation agency, the Department of the Interior has the responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environment and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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