PENNSYLVANIA GAME COMMISSION
BUREAU OF WILDLIFE MANAGEMENT
PROJECT ANNUAL JOB REPORT

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TITLE: Pennsylvania Mammal Atlas

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PERIOD COVERED: 1 July 2015 to 30 June 2016

COOPERATING AGENCIES: U.S. Fish and Wildlife Service, Wildlife and Sport Fish Restoration Program; Pennsylvania Department of Conservation and Natural Resources; Pennsylvania Biological Survey, Mammal Technical Committee; Western Pennsylvania Conservancy

WORK LOCATION: Statewide

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ABSTRACT This report outlines progress made on the Pennsylvania Mammal Atlas (Atlas) from 1 July 2015 to 30 June 2016. A total of 55 surveys was completed by Pennsylvania Game Commission staff and 1 contracted vendor and the results entered into databases. Surveys resulted in the collection of 1,479 mammal records and documentation of 30 mammal species. Of all the survey techniques used, camera traps and snap traps resulted in the greatest number of total records, while camera traps and walking surveys resulted in the greatest species diversity. Zero water shrews, northern flying squirrels, or least shrews were captured during these surveys. In addition to efforts completed by professionals, approximately 100 volunteers from the public submitted over 1,000 mammal records to the Atlas website. Four Atlas surveys were not completed during this reporting period due to staff reductions. Five specimens were not prepared, and 2 Pennsylvania Natural Diversity Inventory records and 2 trapping surveys were not entered.

OBJECTIVES

1. Continue mammal surveys within Pennsylvania, focusing on small, non-game, and/or rare species.

2. Continue to collect and display valuable wild mammal data from the public via a citizen scientist website.

3. Continue to collect wild mammal data from outside organizations, and append these records to the Atlas database.

4. Maintain spatial databases that track occurrences of mammal species, from which species detection and occupancy rates can be calculated.

5. Evaluate the effectiveness and efficiency of at least three mammal survey techniques and determine logistics needed to expand survey efforts in following years.

INTRODUCTION

This report outlines progress made on the Pennsylvania Mammal Atlas (Atlas) from 1 July 2015 to 30 June 2016. The Atlas is supported by a collaboration of the Pennsylvania Game Commission and the Mammal Technical Committee of the Pennsylvania Biological Survey, with financial support from a U.S. Fish and Wildlife Service Pittman-Robertson grant. The goal of the Atlas is to document the current spatial distributions of all wild mammal species found within the Commonwealth. As a result, researchers will have a benchmark for conservation planning, environmental review decision making, and future wildlife studies. Furthermore, species distribution data will advance our understanding of topics including, but not limited to, threats faced by mammals, habitat use, biodiversity hotspots, and Important Mammal Areas (IMA).

In order to prepare for the Atlas' statewide effort, the Game Commission began with a pilot in 2014. During the pilot professionals will develop, implement, and evaluate a variety of mammal survey techniques and protocols to determine effectiveness and logistics. A citizen scientist Atlas website was created and will be modified as needed to involve the public in mammal data collection. Analyzing pilot efforts will provide a better understanding of the limitations of surveys, equipment, time, and manpower. Additionally, results will provide insight into species detection rates in Pennsylvania, number of species documented per survey technique, and take (when applicable).

METHODS

Mammal data was collected by professional biologists using a variety of survey techniques described below. In addition to professionals, the general public collected mammal data for the Atlas. Members of the public submitted mammal observations with location data, as described below.

Mammal Observations

Members of the public, as well as professional biologists, submitted wild mammal observations within Pennsylvania via the Atlas website (www.pamammalatlas.com). With a personal account, a volunteer could submit photographs of mammals or mammal sign including caches, latrines, feces, tracks, and hair, as long as the species was distinguishable. Photographs were not required, but suggested, for a record to be submitted. In addition to the photograph, the volunteer provided as much information as possible including mammal age, sex, habitat, location, date, time, and comments. After a volunteer submitted a record, it was verified by professional biologists. If the species was identified incorrectly, a professional corrected the error when possible and

approved the record. Once a record was approved the database and species distribution map on the Atlas website was updated. Anyone visiting the website could view the photograph as well as volunteer name, mammal species, county, date, and time. Specific location was not displayed to protect the resource and the volunteer (e.g., location was the observers' residences).

Mammal Surveys

Professional biologists collected wild mammal data for the Atlas using a variety of survey techniques. Techniques that were selected for a specific survey were not standardized per-say, and rather depended on target species, survey location, habitat type, and season. If the goal of a survey was to document the greatest number of species possible, as was the case for many Atlas surveys, techniques were often used in combination. The standard technique combination for an Atlas survey was referred to as an array and included 4 camera traps, 40 snap traps, 10 Sherman traps, and 10 squirrel-sized cage traps run 3 consecutive nights. Traps were set in 2 parallel lines approximately 100-200 m apart and 100-200 m long, with 10 trap stations per line. Each station received 2 snap traps and either a Sherman or cage trap, alternately. Camera traps were placed at the ends of each line unless visibility was poor and an alternate location was better suited. The layout, type of traps, and number of trap nights for 'non-array' Atlas surveys varied.

Survey site selection also varied depending on target species, available personnel, and survey goal. Locations were selected, not randomly chosen, if the target species was a habitat specialist such as a woodrat or water shrew. Locations were also not random when occurring in conjunction with another research project. For example, a walking survey conducted while hiking to a bat hibernacula or a camera trap set at a bear trapping station. Sites were randomly selected when a survey targeted all mammal species. When location did not matter, sites were selected from random points overlaid on a 20x20 km statewide grid. The goal was to complete at least 2 arrays per grid block in the pilot study area to ensure adequate coverage.

Surveys were conducted throughout the entire year, with an emphasis on spring, summer, or fall trapping. Live traps were not used during winter when temperatures or weather would put an animal at harm.

Snap Traps.--Snap traps used in Atlas surveys were Museum Special snap traps. When targeting small rodents and insectivores, traps were frequently baited with chewed old-fashioned oats and less often with peanut butter. Traps were set on the ground near logs, holes, tunnels, grass clumps, or other natural funnels. Traps were secured to woody or herbaceous vegetation via string and flagging. Traps were checked at least once a day, normally in the morning, and reset if sprung. Animals not killed and not physically harmed (i.e., caught by the tail) were released. Specimens in good condition were dried in corn cob dust and frozen for future use. Specimens in poor condition were discarded. Snap traps were normally run 3 nights, but sometimes trap nights varied from 1 to 4. If a state-listed species was captured (i.e., water shrew), all snap traps were removed from that site.

Sherman Traps.--Live-capture Sherman traps were baited with black oil sunflower seeds and set on the ground, preferably near logs, root balls, woody debris, or grass clumps. The body of the trap was covered with woody or herbaceous vegetation to reduce trap visibility. Traps were checked twice a day, and reset if sprung. Captures were transferred to a plastic bag so researchers

could identify species, age, and sex, and then immediately release the animal. Sherman traps were typically run 3 consecutive nights.

Cage Traps.--Live-capture squirrel-sized cage traps were baited with peanut butter and typically secured to trees approximately 4 ft above the ground. However, at sites such as an herbaceous field, traps were placed on the ground. The body of the trap was covered with woody or herbaceous vegetation to provide shelter from the elements and reduce trap visibility. Traps were checked twice a day, and reset if sprung. Species, age, and sex of the captured animal was identified in the trap and the animal was released immediately. Cage traps were typically run 3 consecutive nights.

Camera Traps.--Trail cameras were secured to trees or other solid structures approximately 2-3 ft above the ground via boxes and cable locks. However, in habitats such as talus, cameras were placed on the ground or among the rocks. Bait applied within the viewing area of cameras included fish oil, anise oil, skunk lure, bacon grease, peanut butter, rolled oats, suet, or apples. Cameras were commonly set to take a 3 photo burst with no time delay between bursts (i.e., photos were taken continuously when motion was detected). One occurrence of a species per day was recorded, and notes were added if there was more than 1 known individual. The length of time a camera was left in place varied. Cameras were removed after 3 nights when used in an array, but often left longer in non-array surveys.

Walking Surveys.--Walking surveys were very informal surveys, with distance covered and time spent non-standardized. Mammals or mammal sign observed or heard while traversing an area (typically while completing an Atlas array) were recorded. One occurrence of a species per day was recorded, and notes were added if there was more than 1 known individual. One Walking Survey was considered equivalent to 1 trap night for reporting purposes.

RESULTS

Mammal Observations

An Atlas website that accepts mammal observations was finalized by a contracted vendor in October of 2015, and a website App was in the development phase. Approximately 500 volunteers from the public signed up using the website. Of those volunteers, about 100 have contributed mammal observations, for a total of greater than 1,000 approved records. Fifty-six (87%) out of 64 mammal species had at least 1 record on the website, and reports came from 61 (91%) out of 67 counties.

Mammal Surveys

A total of 55 mammal surveys were conducted, including 14 arrays. Twelve additional surveys targeted all species, but these surveys included a different number of trap nights or techniques than an array. The remaining 29 surveys targeted a more specific group of mammals and included surveys for carnivores (n = 7), snowshoe hare (n = 1), woodrats (n = 19), spotted skunks (n = 1), and black bears (n = 1). Twenty-one (38%) surveys were completed in the pilot study area, and 34 (62%) were completed opportunistically outside of the pilot area. The latter did not involve any kill traps. At least 1 survey was completed per month, but arrays were only conducted during the months of July to October. Surveys from November to March included

camera traps or walking surveys only. Surveys that were planned, but not completed this reporting period, included 4 arrays to more thoroughly span the pilot area. Omitted surveys were a direct result of staff reductions during this reporting period. An additional 2 trapping surveys were completed, but the results weren't entered into databases and can't be analyzed at this time.

Surveys were conducted on a variety of properties, habitat types, and elevations (Table 1). Landowners of the properties in which these 55 surveys were conducted included the Game Commission (*n* = 33), Pennsylvania Department of Conservation and Natural Resources (*n* = 15), National Park Service (*n* = 1), and private (*n* = 6). Just over 1 third of the surveys were completed in barren habitat (*n* = 20), while deciduous (*n* = 15) and mixed (*n* = 9) forest were also surveyed often (Table 1). The remaining habitat types received 5 or fewer surveys and included urban/suburban, rural, roads/right of ways (ROWs), agriculture, open land, transitional forest, evergreen forest, wetland, and water (Table 1). Twenty-seven (9%) of the 317 grid blocks received at least 1 survey, including 11 (79%) of the 14 blocks comprising the pilot area (Fig. 1). Elevation of the surveys ranged from 500 to 2,300 ft.

Five survey techniques were used this reporting period. A total of 4,494 trap nights were distributed as follows: snap traps (*n* = 1,840), camera traps (*n* = 1,713), Sherman traps (*n* = 420), cage traps (*n* = 420), and walking surveys (*n* = 101). As a result of the 55 surveys, 30 (47%) of 64 mammal species within Pennsylvania were documented (Table 3). The 3 species with the greatest number of total records were southern red-backed vole (*n* = 245), gray squirrel (*n* = 232), and white-footed mouse (*n* = 154; Table 3). The greatest number of records came from camera traps (*n* = 923) and snap traps (*n* = 423). However, the most efficient techniques for getting the greatest number of records per trap night are walking surveys (0.98) and camera traps (0.54; Table 3). Walking surveys and camera traps also documented the greatest diversity. Sherman traps and cage traps were the least efficient techniques, documenting the lowest number of records per trap night, and the least number of species.

Over the course of the year, total take was 9 species and 412 individuals. The 3 most common species included southern red-backed vole (*n* = 168), white-footed mouse (*n* = 125), and northern short-tailed shrew (*n* = 64; Table 2). Average take per trap night was 0.22 individuals.

RECOMMENDATIONS

1. Finalize the Atlas App, and make it available to the public by the end of 2016.

2. Continue using the Atlas website to gather mammal observations from the public, and continue compiling into databases mammal data reported from outside organizations.

3. Target specific groups of species (i.e., threatened, endangered, elusive) or habitats (i.e., rock, water) for future surveys. Focus less on random surveys, as targeted surveys will document generalist species anyhow.

4. For surveys intended to inventory all species presence, continue using a combination of snap traps, camera traps, and walking surveys, while excluding cage traps and Sherman traps. The latter 2 traps have no added value when snaps, cameras, and walking surveys are in place.

5. Continue to work with universities, non-profits, and other groups, making the best use of samples and specimens.

6. Obtain additional and outside funding to continue the Atlas project its full 10 years. Hire full or part-time Game Commission staff, or use contracts with qualified vendors to complete surveys and enter data.

Table 1. Atlas surveys completed per habitat type in Pennsylvania, July 2015 to June 2016.

Habitat Type	**Number of Atlas Surveys**
Urban/Suburban	1
Rural	1
Roads/ROWS	1
Agriculture	1
Open land	1
Forest, Transitional	1
Forest, 90% Evergreen	1
Wetland	1
Water	3
Forest, Mixed	9
Forest, 90% Deciduous	15
Barren	20
TOTAL	55

Table 2. Total take as a result of fifty-five Atlas surveys completed in Pennsylvania, July 2015 to June 2016.

Species	**Take (number of individuals)**
Southern red-backed vole	168
White-footed mouse	125
Northern short-tailed shrew	64
Meadow vole	27
Masked shrew	8
Smoky shrew	7
Deer mouse	4
Meadow jumping mouse	4
Unknown species	4
Eastern chipmunk	1
TOTAL	412

Table 3. Number of records collected per technique as a result of fifty-five Atlas surveys completed in Pennsylvania, July 2015 to June 2016.

Species	Snap Trap	Sherman Trap	Cage Trap	Camera Trap	Walking Survey	Total Records
Deer mouse	4					4
White-footed mouse	130	20		2	2	154
Woodland jumping mouse		2				2
Meadow jumping mouse	4					4
Meadow vole	27					27
Southern red-backed vole	173	9		61	2	245
Northern short-tailed shrew	64	1			1	66
Smoky shrew	7	1				7
Masked shrew	8					8
Eastern chipmunk	1			25	22	48
Red squirrel				1	5	6
Gray squirrel			1	225	6	232
Fox squirrel				1		1
Allegheny woodrat				33	10	43
Muskrat				1		1
Woodchuck				19	2	21
North American beaver					1	1
Eastern cottontail				3	2	5
Snowshoe hare					1	1
Virginia opossum				67	1	68
North American porcupine				5	3	8
Raccoon				59	4	63
Feral cat				5	1	6
Bobcat				3		3
Long-tailed weasel				3		3
Gray fox				4	1	5
Coyote					3	3
White-tailed deer				40	18	58
Elk					2	2
American black bear				21	2	23
Unknown	5			345	10	360
Number of Species	9	5	1	19	20	
Total Records	423	33	1	923	99	
Trap Nights	1,840	420	420	1,713	101	
Records per Trap Night	0.23	0.08	0.00	0.54	0.98	

** Note, number of records does not equal number of individuals. For example, a bobcat that appears 3 consecutive days on a trail camera is recorded 3 times, but is one individual.*

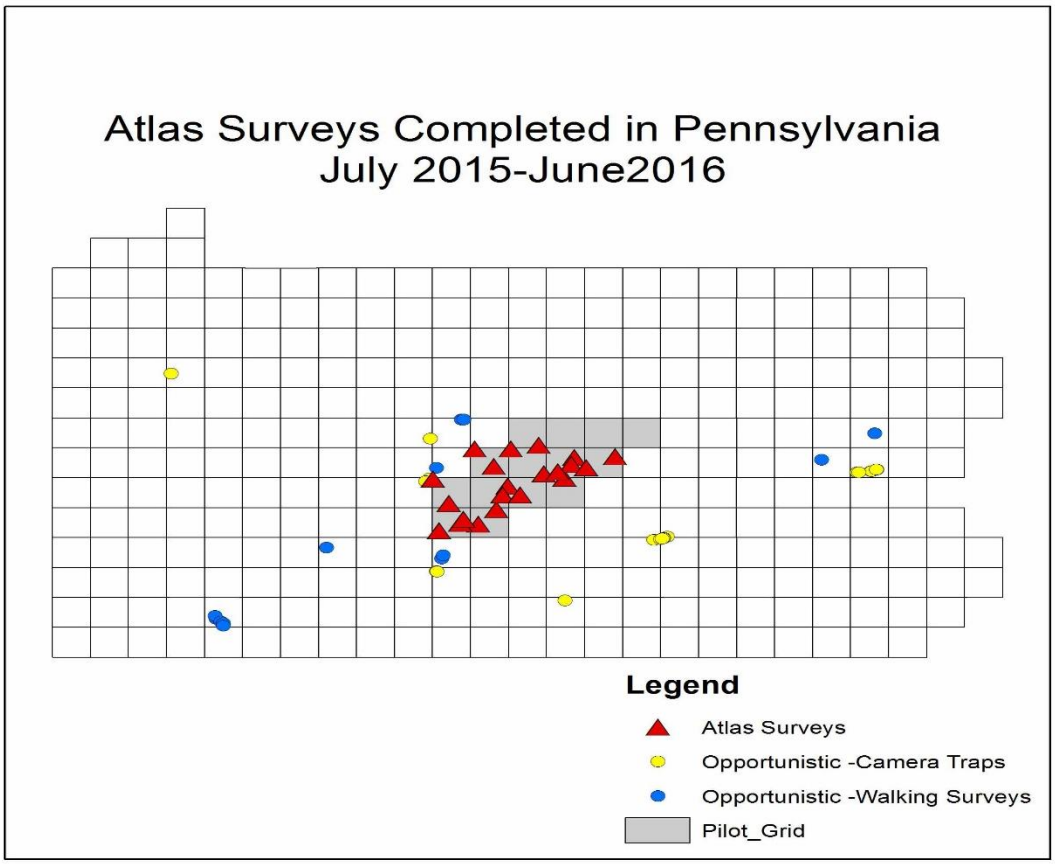

Figure 1. Locations of fifty-five Atlas surveys completed in Pennsylvania, July 2015 to June 2016.