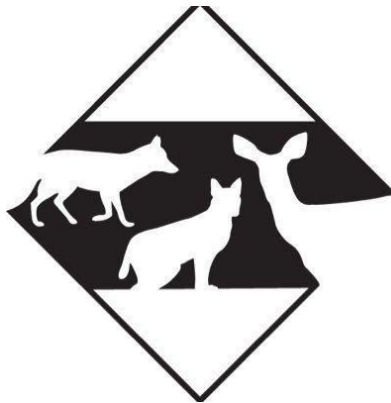




North Carolina's Candid Critters Final Report to the National Park Service



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Executive Summary

From March 2017 through December 2019, North Carolina's Candid Critters worked with citizen scientists to conduct camera trap surveys of mammals in National Park Service lands. Survey locations include the Blue Ridge Parkway, Cradle of Forestry National Historic Site, Fort Raleigh,, Great Smoky Mountains, Price Park, Sheepback Mountain, Wright Brothers Memorial, Guilford Courthouse, Carl Sandburg Home, and Cape Lookout. We stratified camera placement based on habitat type (open, forest, or near trail), surveying a total of 47 locations. The animals in the captured photographs were identified to the species level by the volunteers, reviewed by experts to verify the species identification, and uploaded to the eMammal data repository housed at the Smithsonian Institution. In this report, we present preliminary results of species richness and relative abundance indices for all species observed in National Park Service lands.

This camera trap survey resulted in a total of 4,292 camera nights of survey effort in the National Park Service lands. Of the 13 wildlife species detected by our cameras, white-tailed deer (*Odocoileus virginianus*) were the most common followed by eastern grey squirrels (*Sciurus carolinensis*), wild turkey (*Meleagris gallopavo*), and northern raccoon (*Procyon lotor*). The most rarely detected species were the grey fox (*Urocyon cinereoargenteus*) and woodchuck (*Marmota monax*). Preliminary results comparing animal activity indicates that eastern grey squirrels were the most common wild species seen during the day followed by white-tailed deer and wild turkey. White-tailed deer was the most common species seen at night, followed by northern raccoon and coyote (*Canis latrans*).

Graphical representations of all the results described above as well as more detailed information for each species can be viewed on the following Tableau visualizations:

<https://tabsoft.co/32aP88o>

<https://tabsoft.co/2OlWUqg>

We have published a paper using Candid Critters' data analyzing mammal communities across human development (Parsons et al. 2018), which is attached to this report. Various other papers are also currently in development and will be shared once published.

1.0 Introduction

1.1 General Background

Most mammals occupy large home ranges and are affected by ecological processes that occur on a fairly large scale, however, studies of wildlife on these larger scales are rare. This is because data collection on the larger scales (landscape, regional, national, global) is generally

constrained by budget and manpower. Citizen science represents a new avenue for conducting large-scale biological studies because volunteers provide the manpower and thus larger volumes of data can be collected for less money and effort. While citizen science offers some clear advantages to biological data collection, there are also potential challenges. Variation in volunteer skills can lead to variation in sampling efforts and data quality, which can be a major concern for this type of work. Rigorous training and a simple sampling design are key to getting the most out of citizen science-collected data.

North Carolina's Candid Critters partnered with NC State University, NC Wildlife Resources Commission (NCWRC), NC Museum of Natural Sciences, eMammal, and NC Cardinal Libraries to conduct a statewide citizen science project funded by the North Carolina's Wildlife Resources Commission. The goals of the project were to engage the public while collecting data on white-tailed deer (*Odocoileus virginianus*) fawn-doe ratios, coyote (*Canis latrans*) occupancy, and the distribution and abundance of multiple mammal species across the state. NCCC worked with 580 citizen science volunteers of all ages and backgrounds to set camera traps (motion and heat sensitive trail cameras) around the state.

The Candid Critters citizen scientists collected over 2.1 million photos of wildlife from 4,288 camera traps set from 2016 through 2019. This includes more than 106,000 detections of 39 species, several of which are of concern within the state. We collected 435 new observations of wild pigs (*Sus scrofa*), an invasive species causing significant ecological and fiscal damage across the state (Anderson et al. 2016). Our observations also expanded the known range of the eastern woodrat (*Neotoma floridana*) into eastern North Carolina. In comparison, most published camera trap papers use data from 31 camera trap deployments (Burton et al. 2015). The world's museums contain about 15,000 records of North Carolina mammals and iNaturalist contains about 6,500 mammal records (iNaturalist.org 2019). In three years, we collected roughly five times the number of verified mammal records that were previously available in North Carolina.

1.2 Project Sites

We surveyed a total of 47 camera trap sites in National Park Service lands from March 2017 through December 2019 (Figure 1). Volunteers were required to contact managers before deploying cameras, giving 4,292 camera nights.



Figure 1. Map of camera trap sites across the National Park Service from March 2017 through December 2019.

2.0 Materials and Methods

2.1 Volunteer Recruitment and Training

We recruited college students, naturalists, hikers, hunters, library patrons, and K-12 teachers to participate in the project. We sent out quarterly newsletters, worked with NCWRC on an email campaign promoting the project to hunters, posted on social media outlets, and created 25 videos on YouTube to promote the project, recruit new volunteers, and share our results. We also created lesson plans for bringing NCCC into the classroom and make project involvement more intriguing to teachers (Schuttler et al. 2018). We managed information about volunteers through the NCCC website and a series of linked Google Forms and Sheets, and later with a custom database.

Potential participants signed up on the NCCC website and then were assigned to a training module. We created an online training program that included written instructions, video tutorials, and an online quiz, which took approximately 40 minutes to complete. Once trained, participants were asked to create an account on eMammal, an online data management system for camera trap data and the tool we used to acquire and manage data for this project. For each time a camera was deployed, volunteers filled out a site description form for private property sites or chose one of the thousands of pre-selected public land sites from a custom online map we created. They could then borrow a trail camera from NCCC or use their personal trail camera (if it met technical specifications – i.e., possessed a trigger speed greater than 0.5 seconds and had infrared flash so as to not disturb wildlife) to set their deployment.

2.2 Camera Trap Surveys

Volunteers were able to choose their own camera trapping sites. We used un-baited, infrared flash trail cameras to conduct the wildlife survey continuously over four seasons: winter (December-February), spring (March-May 14), summer (May 15-July), and fall (August-November) from 2016-2019. Citizen scientists set camera traps for two- or three-week deployments, and spaced cameras at least 200 meters apart to maximize spatial coverage and reduce spatial autocorrelation.

We asked volunteers to fill out a site description form that described aspects their camera location that might affect local wildlife (hunting permissions, domestic animals, known animal feeding nearby), record relevant deployment information (dates, location, equipment type) on a datasheet, and use the following field protocol:

1. Attach the camera to a tree at knee height, aimed parallel to the ground, at a relatively open area. Clear vegetation within 2m if necessary.
2. Do not use bait or aim the camera at features such as bird feeders, roads or houses.
3. Camera settings should include multiple pictures for each trigger with no delay between triggers.
4. If on a slope, the camera should face across the slope, not up or downhill.
5. Conduct a “walk test” to record the maximum distance the camera trap will trigger on a human.
6. Obtain GPS coordinates of the camera’s exact location using a volunteer-supplied GPS device (i.e., smart phone).

2.3 Data Collection and Verification

Volunteers deployed their cameras at their chosen location and then uploaded camera trap photos to the eMammal desktop application, identifying animals seen in the pictures (McShea et al. 2016). On average, deployments were identified with a 90.8% accuracy. We then verified species identifications using the eMammal online expert review application, after which the data were archived in the Smithsonian Digital Repository. These data were made public immediately through the eMammal website (eMammal.si.edu).

3.0 Results



Figure 2. Screenshot of our Tableau data visualizations for all camera trap data obtained in public lands across the state, including that obtained within National Park Service lands. This visualization includes a video of favorite animal photos, camera trap timeline, summary statistics, raw animal counts, a map of observations, and detection rates for observed species.

We detected 13 wildlife species in National Park Service lands. Based on number of observations alone, white-tailed deer ($n = 438$ observations) were the most common followed by eastern grey squirrels (229), wild turkey (64), and northern raccoon (57). The most rarely detected species were the grey fox (3) and woodchuck (2). Relative abundance indices take into account the amount of time each camera ran (number of days) and are therefore a more accurate abundance index than raw counts.

Preliminary results comparing animal activity indicates that eastern grey squirrels were the most common wild species seen during the day followed by white-tailed deer and wild turkey. White-tailed deer was the most common species seen at night, followed by northern raccoon and coyote.

Graphical representations of all the results described above as well as more detailed information for each species can be viewed on the following Tableau visualizations:

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Furthermore, we have attached a CSV file with the raw camera trap data from National Park Service lands.

3.1 Property-Specific Results

We conducted a camera trap survey of 47 sites and detected 13 wildlife species within National Park Service lands. We set three camera traps in Cape Lookout and captured four wildlife species: northern raccoons (n = 11 observations), coyotes, (9), eastern grey squirrels (18), and Virginia opossums (1). We did not set any camera traps in the Carl Sandburg Home or Guilford Courthouse. We set 13 camera traps within Blue Ridge Parkway, and obtained 93 observations of five species: 55 observations of white-tailed deer, four observations of northern raccoon, 32 observations of eastern grey squirrels, one observation of grey fox (*Urocyon cinereoargenteus*), and one observation of the American black bear (*Ursus americanus*). Finally, we set nine camera traps within the Great Smoky Mountains National Park and obtained 245 observations of seven species: 28 observations of American black bear, two observations of coyote, 120 observations of eastern grey squirrel, and four observations of elk (*Cervus canadensis*).

4.0 Potential Directions

NCCC data have been used to analyze species activity patterns and compared species distributions to multiple environmental variables (Parsons et al. 2018), and understand how landscape structure, human development, predator occupancy, and forest cover predict deer abundance (Boone 2019). NCCC are data publicly available through eMammal.org and have already been used by a number of groups for local-level projects, regional assessments, and global comparisons.

We have published a paper using Candid Critters' data analyzing mammal communities across human development (Parsons et al. 2018), which is attached to this report. Three other

papers are also currently in development, and will be shared with the National Park Service once published. In the coming years, we will be further analyzing the data collected using more rigorous statistical models. These results will be presented in peer-reviewed publications and copies will be provided to all participants.

We hope managers can use the indices provided in this report as a baseline for regular monitoring of relative abundance indices for each species over time. We can provide support to establish a project within either the eMammal or Wildlife Insights (www.wildlifeinsights.org) data system to manage and review any camera trap data further obtained from the National Park Service. If possible, we recommend that managers continue to monitor wildlife populations at their site using camera traps on a monthly, yearly, or biyearly basis depending on their budget and management goals. This will allow managers to monitor trends in population size and the effects of different management efforts.

5.0 References

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