

Species Occupancy and Distribution on Brookhaven National Laboratory



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Abstract

Currently, Long Island is the last area, other than Hawaii, in the United States to be colonized by coyotes (*Canis latrans*). The colonization of coyotes can result in many ecological changes. Long Island has two fox species, the gray fox (*Urocyon cinereoargenteus*) and the red fox (*Vulpes vulpes*). Their populations may be affected by the presence of coyotes due to similar diets, which could result in competition and altered resources for the fox species, which can then result in cascading effects to small mammals. Yet, the colonization can result in some positives as well. One being that currently white-tailed deer (*Odocoileus virginianus*) are overpopulated, which could be reduced by the presence of coyotes. In order to gauge how coyotes will impact the various species of Long Island, we must first look at the current populations of the species. Camera traps were set up throughout Brookhaven National Laboratory, the images were processed into data, and then analyzed to estimate species occupancy, detection, and distribution and maps were created to represent my findings.

Introduction

- Historically coyotes did not exist in New York, but in recent years they have colonized parts of New York and Long Island (Nagy et. al. 2017)
- The colonization will influence both prey and predator species alike
- A study by Duncan et al. 2020 found that white-tailed deer were the most identified prey species in the coyote's diet
- Yet, another study found that coyotes do not impact the overall population growth of white-tailed deer, except in small-scale studies of local deer populations (Bragina et al. 2019)
- Coyotes are opportunistic feeders and tend to eat what they can find, so in order to understand how the colonization will impact Long Island one must first investigate the current species status and distribution
- There are two main predators on Long Island, the red fox and the grey fox, which have very similar diets to the coyote
- Due to this the species will be using similar resources, causing competition and potential cascading effects on prey species
- This can result in both positives and negatives on the environment, such as the grey fox being at risk of being threatened if they have more competition
- One very important positive for Long Island would be the reduction on the spread of ticks on Long Island, which would be caused by the increased number of predators consuming small mammals that are hosts to ticks that spread Lyme disease (Hofmeester et al. 2017)



Figure 5. Image of red fox taken at BNL on a camera trap

Methods

Camera Trap Set-up

- 18 camera traps were randomly placed throughout Brookhaven National Laboratory
- Cameras were left in locations for 2 weeks, then retrieved and put in new locations

Data Collection and Analytical Methods

- Images were loaded onto the image processing program Timelapse2 to extract data such as species and count into a csv file
- Distribution analyses were conducted on ArcGIS Pro for species with sufficient sample sizes such as white-tailed deer
- Occupancy and detection estimates created using the unmarked package in R studio

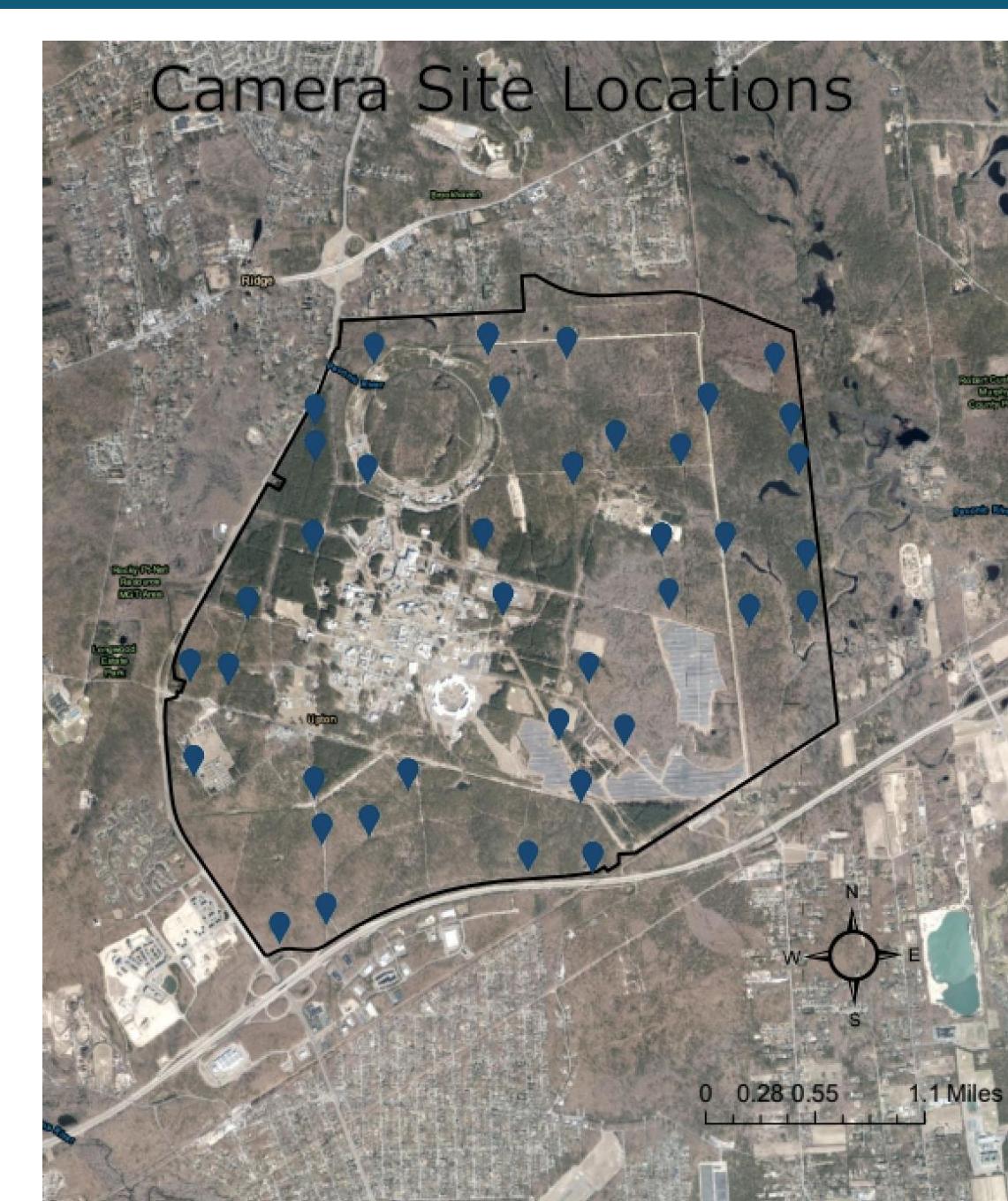


Figure 1. Map of Brookhaven National Laboratory with points indicating the locations of cameras placed

Results

Species	Detection Estimate	Standard Error	P-Value
White-tailed Deer	0.771	0.0368	5.46e-09
Bird Species	0.368	0.0648	0.0522
Wild Turkey	0.417	0.0866	0.349
Raccoon	0.431	0.0916	0.458
Red Fox	0.430	0.124	0.579
Woodchuck	0.316	0.159	0.296
Gray Squirrel	0.281	0.150	0.205
Feral Cat	0.317	0.232	0.474

Table 3. Back-transformed detection estimates per species for summer of 2022. Detection probability of species per week given their presence.

Species	Occupancy Estimate	Standard Error	P-Value
White-tailed Deer	0.934	0.0400	4.28e-05
Bird Species	0.760	0.111	0.0592
Wild Turkey	0.392	0.0924	0.258
Raccoon	0.357	0.0880	0.126
Red Fox	0.194	0.0707	0.00164
Woodchuck	0.161	0.0815	0.00622
Gray Squirrel	0.173	0.0923	0.0153
Feral Cat	0.0646	0.0522	0.00196

Table 4. Back-transformed occupancy estimates per species for summer of 2022. Estimates represent the percentage of sites estimated to have species present.

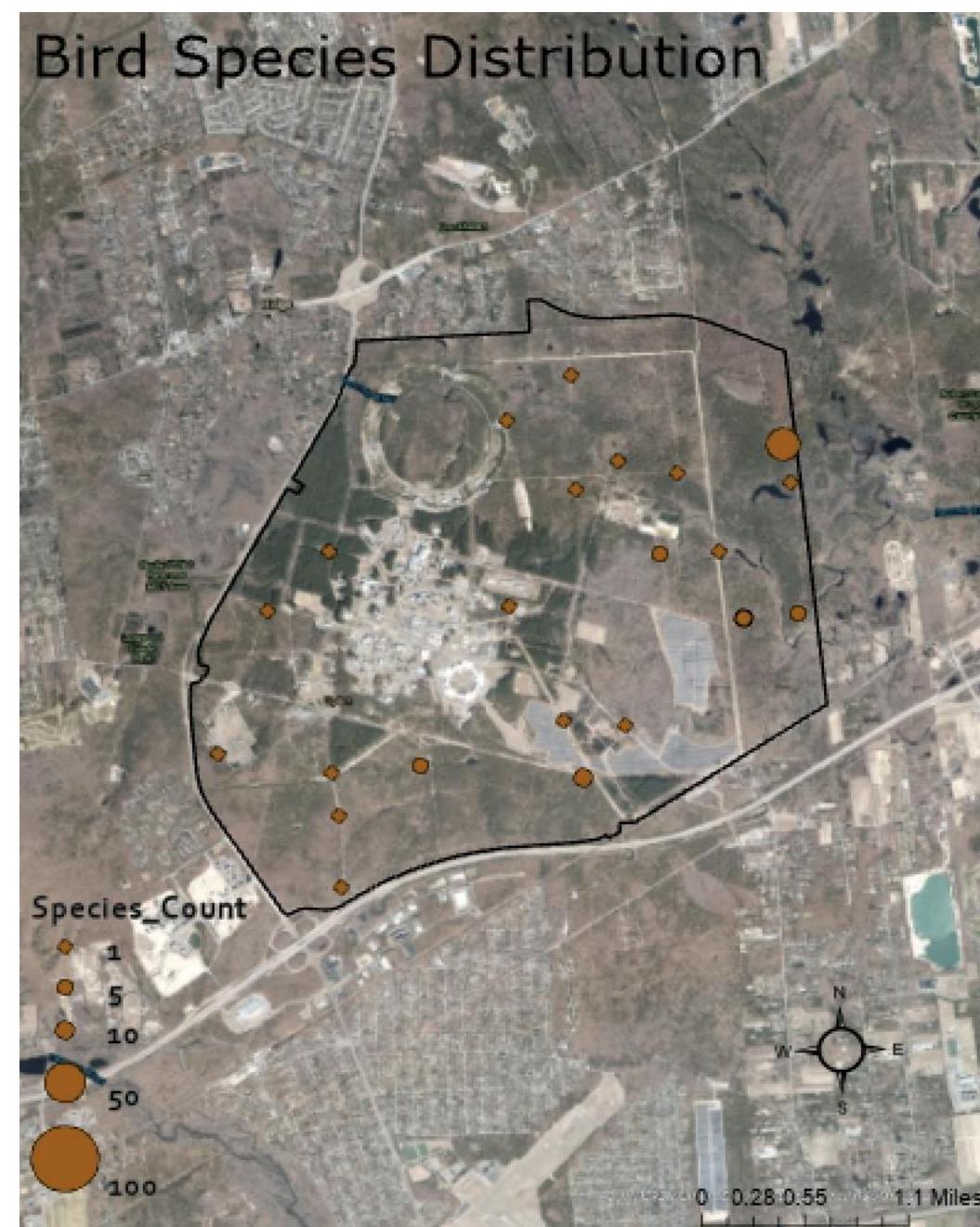


Figure 2. Map indicating Red Fox distribution at each camera site where individuals were detected.

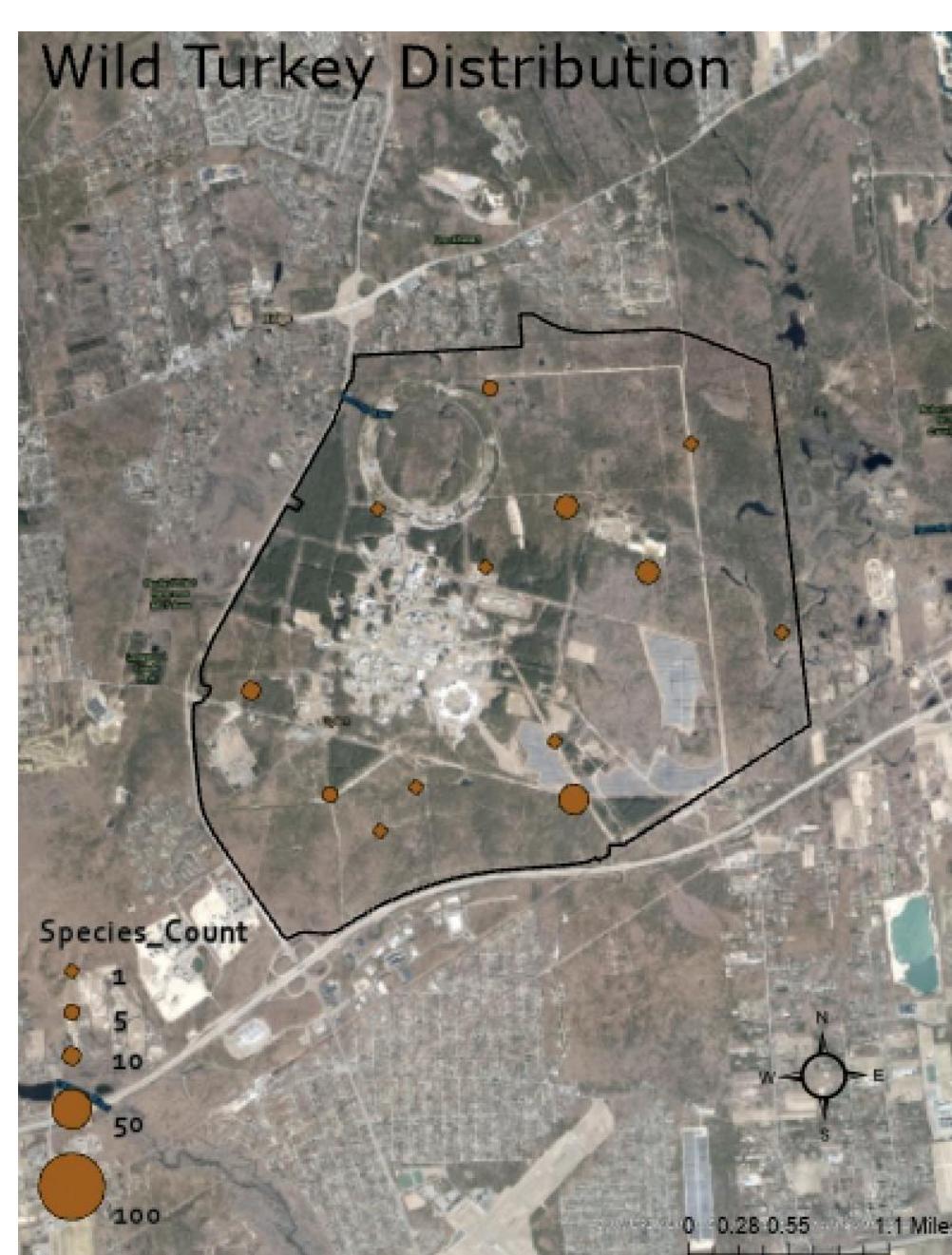


Figure 3. Map indicating wild turkey distribution at each camera site where individuals were detected.

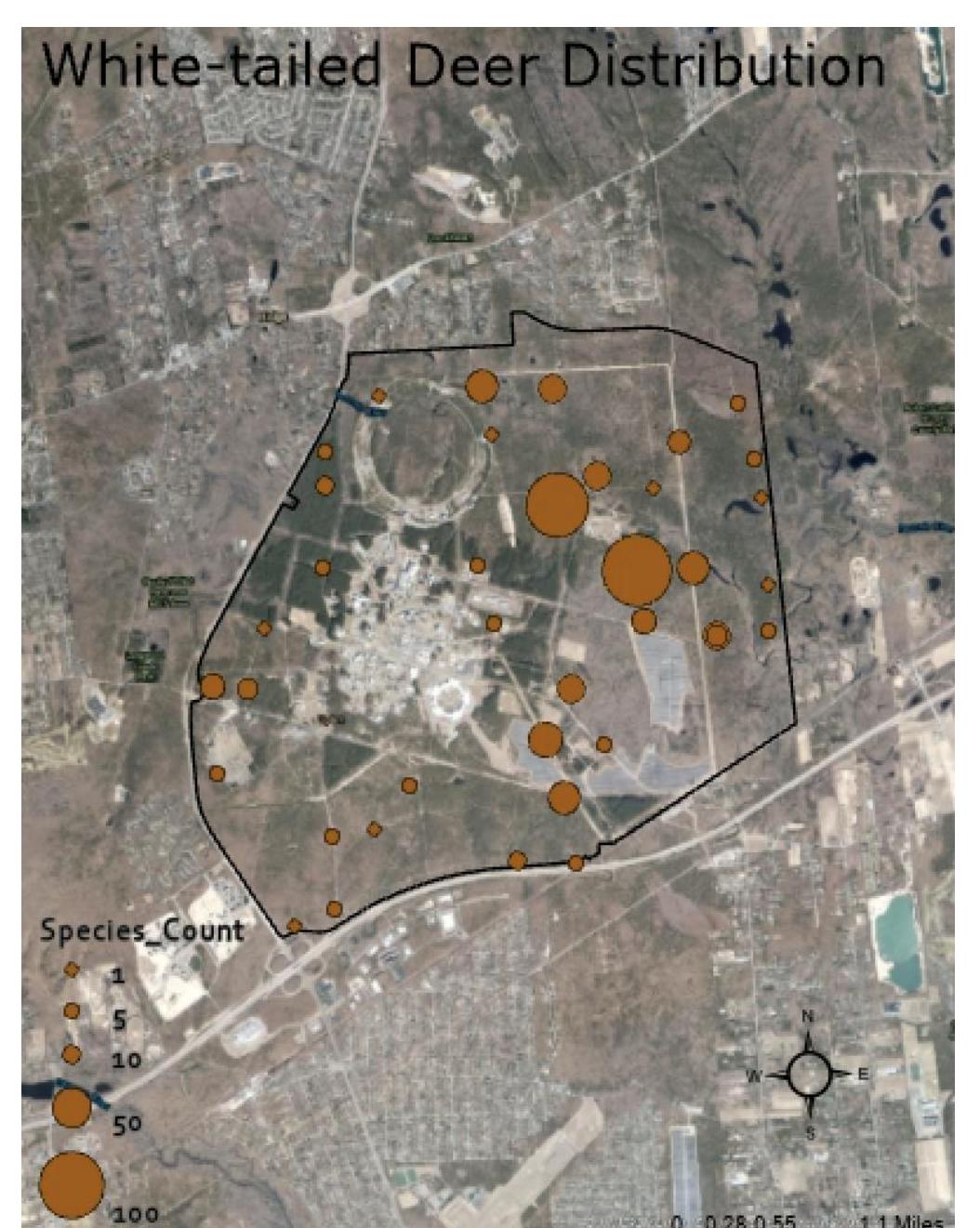


Figure 4. Map indicating white-tailed deer distribution at each camera site where individuals were detected.

Discussion

- Coyotes have recently begun to colonize Long Island, but due to factors such as geography, their ability to adapt and their abundance, they are expected to arrive in the Central Pine Barrens and Brookhaven National Laboratory soon.
- One takeaway from the analyses is that there are a lot of white-tailed deer that are also well distributed at the lab. As discussed earlier this could potentially be affected by the presence of coyotes. A study by Balluffi-Fry et al. 2020, found that in areas with highly dense ungulate populations, coyotes were more likely to prey almost solely on ungulates.
- Another takeaway from the results is the reduction in red fox detections. There are multiple factors that could be causing this decline. The first one being that there may have been a seasonal correlation with red foxes hunting habits. Another potential cause of this could be due to mange. Mange is a skin disease caused by the *Sarcoptes scabiei* mite. A study found that survival could be as low as 41% for adult foxes with mange (Willebrand et al. 2022). Most images of foxes from the summer of 2022 had mange visibly on them.

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