Anthropogenic influences on the presence and absence of canines at Brookhaven National Laboratory, NY

Jenifer Lemus, Environmental Studies Department, SUNY College of Environmental Science and Forestry, Syracuse, NY 13210

Naomi Boyd, Biological Sciences, Cornell University College of Agriculture and Life Sciences, Ithaca, NY 14850

Jennifer Higbie, Environmental Protection Division, Brookhaven National Laboratory, Upton, NY 11973

Abstract

Human activity can have a significant impact on wildlife. While some species are more tolerant or indifferent to disturbances caused by humans, others can be negatively affected if they are unable to adapt. A generalist species is one that has a broad niche and can thrive in a wide variety of habitats. Some studies suggest that certain mammals are generalist species that have adapted well in urbanized environments, while avoiding contact with humans. Unfortunately, there is still a research gap in understanding the full impacts of human disturbances on wildlife and how these effects differ among species. Our project examines how canines, specifically eastern coyotes and red foxes, react to human activity and how it compares to other mammals. We placed eighteen trail cameras throughout various areas in Brookhaven National Laboratory (BNL) located in New York, for thirteen trap nights at each site. A total of forty-two sites were surveyed from 06/13/23 to 07/27/23. Photos were processed with the help of Timelapse2 and EcoAssist. Based on over 38,000 images captured, we calculated the number of disturbances per deployment period at each site, as well as the average animal encounters and the types of species spotted. Our results included red fox sightings at four sites. Our findings could help us gain a better understanding of the behavioral patterns of certain species in relation to human activity. As a result of this summer internship, I have strengthened my field research skills, including proper trail camera deployment. I've also obtained more analytical skills by using several software for organizing, visualizing and interpreting data. This project aligns with the mission of BNL and the Department of Energy to increase conservation and ecological research.

Introduction

1. Historical Background of Canines on Long Island

Coyotes (*Canis latrans*) are generalist species that can thrive in a wide variety of habitats, including boreal forests, tropical forests, exurbs and even dense urban centers.[1] Having the capability of adapting quickly and efficiently has allowed coyotes to dramatically expand their range over diverse habitats across the United States.[2] Coyotes were first potted in New York City in the 1990's,[3] and since 2004, there have been several independent and confirmed coyote sightings on Long Island.[4] In 2016, a pair of coyotes was photographed for the first time in Suffolk County, which could indicate that a successful breeding population is imminent.[1] In order to better understand how the inevitable growing population of coyotes on Long Island could be affected, as well as the impacts they might have on their surroundings; one should examine other species inhabiting the area and consider human activity and disturbances.

Similar to coyotes, red foxes (*Vulpes vulpes*) are generalist predators that can thrive in contrasting habitats across New York state.[5] Both canines are also opportunistic feeders, meaning that they will eat whatever is available, including small mammals, birds, reptiles, fruit and even anthropogenic waste.[5] Since red foxes are currently the most abundant, widespread and non-domesticated canine on Long Island,[4] many wonder how their behavioral patterns and population dynamics could be affected by the introduction of coyotes. Some studies suggest that coexistence between these two canids might be difficult to achieve due to resource competition or direct killing of red foxes by eastern coyotes.[6] Furthermore, coyotes can negatively affect the space-use of red foxes, forcing them to have smaller home ranges or to be entirely displaced.[5] A study conducted in Maine showed that red fox territories were clustered and never overlapped with coyote core areas,[7] further indicating that red foxes are at a disadvantage when in competition with coyotes.

2. Wildlife-Human Dimensions and Importance of Project

If the introduction of coyotes to Long Island causes the displacement or extirpation of red foxes, the population of other prey animals can be indirectly affected.[8, 9] However, the direct impact of coyotes on the population of other mammals can vary due to the complexity of these interactions and the deficit of associated scientific research. For example, some studies suggests that the presence of coyotes was negatively associated with the relative abundances of cats, opossums, and raccoons; while other studies found no evidence for coyotes influencing the abundance small mammals like raccoons, opossum, and striped skunks.[4] Therefore, further investigating these interactions is extremely necessary in order to predict how coyotes might affect other species and the surrounding environment.

One question that often arises when discussing the presence of wildlife species in urban settings involves the possibility of interactions or conflicts with humans. This concern usually increases when the animal in question is an apex predator like the eastern coyote. The public has mixed opinions on coyotes, some view them as a nuisance or threat, while others have a more positive outlook on their presence.[10] People's contrasting attitudes towards wildlife are typically influenced by individual values and population demographics.[11, 12] However, one study found that taking an educational approach to wildlife safety with communities could have a positive effect on people's views towards coyotes and decrease their sense of fear, which could increase the likelihood of coexistence.[13] As the population of coyotes on Long Island is predicted to increase, it is important to investigate the likelihood of coyote-human interactions and to prepare for any issues that may arise.

The ecological diversity of Brookhaven National Lab makes it a suitable region for conducting observational studies that explore the direct and indirect effects of coyotes on other species, as well as the anthropogenic influences on wildlife. Therefore, this project primarily focuses on using trail cameras to track wildlife activity at BNL and explore any correlations between individual species and human disturbances on site. Collecting data on the presence, absence, and distribution of canines could hopefully help us prepare for the ecological and social changes that are likely to take place.

Methods

1. Study area

Brookhaven National Laboratory located in Upton, New York is a 5,321-acre site with both developed and natural landscapes. The laboratory's campus is located within the Central Pine Barrens of Long Island, which are dominated by a variety of oaks and pitch pine trees. Other undeveloped habitats on site include woodlands, grasslands, and wetlands. As for developed areas, BNL contains several industrialized buildings for research purposes, recreation and housing. The laboratory has over 2,000 employees as well as numerous interns and visitors. BNL is also home to many wildlife species, including meso-predators like the red fox and possible prey animals like groundhogs and squirrels. Overall, the site supports a wide variety of vegetation, birds, reptiles, amphibians, mammals and even endangered or threatened species.[14]

2. Trail Cameras and Deployment

To track wildlife activity and human disturbances, we used Moultrie brand trail cameras. All cameras had the same settings, which included a capture mode of a burst of three photos at high resolution and a detection delay of 30 seconds. Eighteen trail cameras were randomly placed throughout BNL for thirteen days at each site. Trail camera sites were chosen by using a grid of BNL containing 73 locations. This grid acted as a guide for camera placement and helped us accurately sample the property. During the weeks of 06/13/23 to 07/27/23, a total of 42 different sites were surveyed with trail cameras.

When mounting trail cameras to trees, we tried to place them about three feet from the ground. Cameras were also placed facing north in order to avoid overexposure from the sun. Additionally, clippers were used to clear some low-growing plants from the front of the camera to avoid false-movement triggers. Furthermore, we tried to face the cameras looking down trails instead of directly at them in a perpendicular manner. Lastly, scent tabs were used to attract animals to the camera. Scent tabs are small, circular tablets that contain a variety of strong smells which usually pique the interest of wildlife. These scent tabs were placed in holes with the help of a digging tool where an animal is likely to find them. Only scent tab was placed per site, facing the camera. Lastly, an application called Survey123 was used to record the coordinates of each trail camera location. These coordinates were then uploaded to ArcGIS for analysis.

Twenty-seven out of the forty-two locations surveyed had trail cameras facing a path that could have been traveled by foot or vehicle. The number of encounters for leisure activities, like people walking or riding a bicycle, were taken. Additionally, we counted the encounters of motorized vehicles spotted in these sites, including cars, trucks, shuttles and motorcycles. Taking these sightings of human disturbances into account could help us gain a general idea of how likely it would be for wildlife to interact or encounter people.

3. Data analysis

a. ArcGIS

In order to get a better idea of the type of habitat composition at BNL, ArcGIS was used. ArcGIS is a mapping-system software that can help users visualize an area. The coordinates of each trail camera placement were put into ArcGIS and the USA National Land Cover Data (NLCD) layer was added. This allowed us to estimate the habitat near each trail camera. Some of the types of habitats included, deciduous forest, shrub/scrub and different intensities of developed areas. ArcGIS also allowed us to get an idea of how far camera locations are from one another, and ensure that areas in BNL are not being ignored for surveys.

b. EcoAssist

All images captured by the trail cameras were uploaded to a shared drive for easy access by multiple users and safe storage. Over 38,000 photos were then processed through EcoAssist, which is an object detection software with artificial intelligence that facilitated spotting the wildlife captured. EcoAssist has the Microsoft MegaDetector model preloaded, which is trained to spot animals, people and vehicles. If any of these three categories were detected in our images, a colored box would be created around each one.

c. Timelapse2

Once images were processed for object detection, they were more accurately categorized and labeled in Timelapse2. Timelapse2 is useful for getting a rough estimate of the number and the type of entities present in each image. Each image was classified based on the type and count of animal species present and their age, either adult or offspring. As well as the type of human disturbance present, including people on foot or the type of vehicle. Lastly, if images were perceived by the analyst to not contain any entities, the image was labeled as empty. After all images were labeled according to the parameters mentioned, the data was exported as a .csv file and viewed in Microsoft Excel for further analysis and organizational purposes.

Results

1. Wildlife

A wide variety of species were captured by the trail cameras throughout Brookhaven National Laboratory. Some of these species include, white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), wild turkey (*Meleagris gallopavo*), eastern gray squirrel (*Sciurus carolinensis*), groundhog (*Marmota monax*), Virginia opossum (*Didelphis virginiana*) and red fox (*Vulpes vulpes*).

Red foxes were spotted by our trail cameras at four different sites, 25, 33, 70, 71 (Figure 1). There was one encounter at each site and each location had one trail camera collecting data for thirteen trap nights. One of the red fox encounters showed possible signs of Sarcoptic mange because it was rubbing its fur against the grass and had patches of missing hair (Figure 2). Sarcoptic mange in a highly contagious skin infection caused by a parasitic mite (*Sarcoptes scabiei*), which can cause severe itching, inflammation and hair loss.[15] At the sites where the red foxes were spotted, there were several encounters of other species (Figure 3). For example, site 71 had four encounters eastern gray squirrels, one raccoon encounter, seventeen encounters of white-tailed deer and two encounters of small birds.

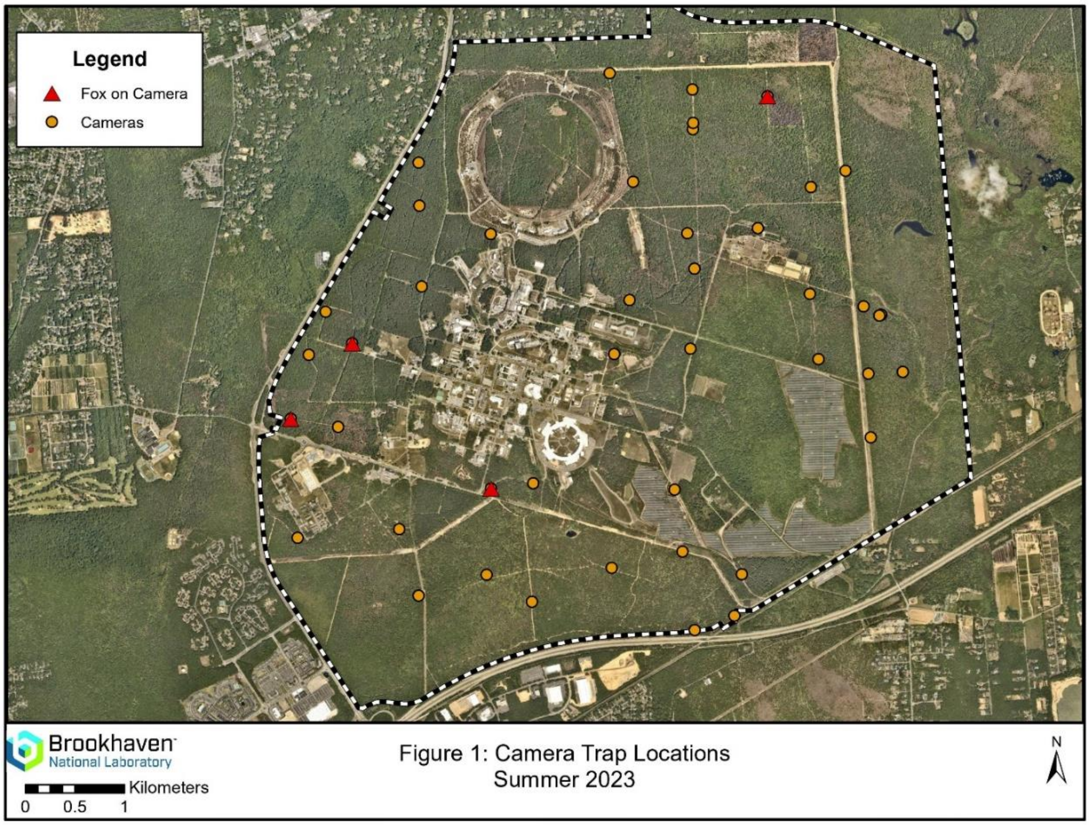

Figure 1: All camera sites that were surveyed during the summer of 2023 on an imagery base-map.

Figure 2: Image of red fox with possible signs of Sarcoptic mange.

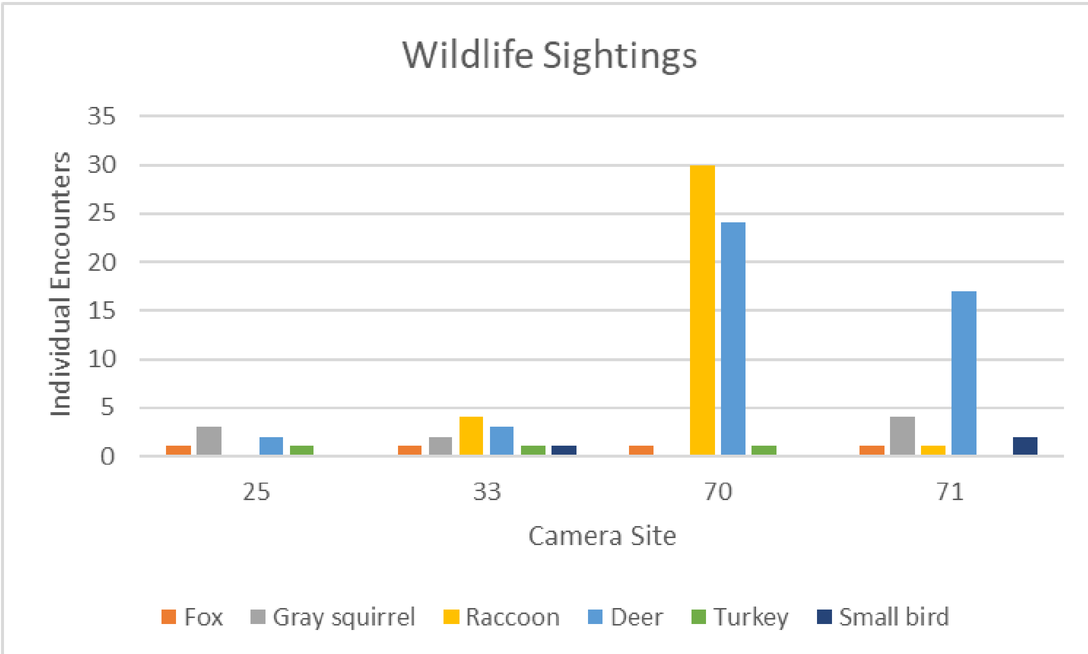

Figure 3: Individual encounters of wildlife species in the sites where red foxes were observed.

2. Human Disturbance

The twenty-seven locations with trail cameras facing a path had varying sightings of human disturbances (Figure 4). For example, site 42 had eighty-nine motorized vehicle sightings and only one leisure activity captured by the trail camera. Site 42 had the largest amount of motorized vehicle encounters captured. The site with the highest leisure sightings was 61, with 25 individual encounters. Sites 33 and 16 had zero human disturbance encounters captured by then trail cameras, even though they were facing a trail.

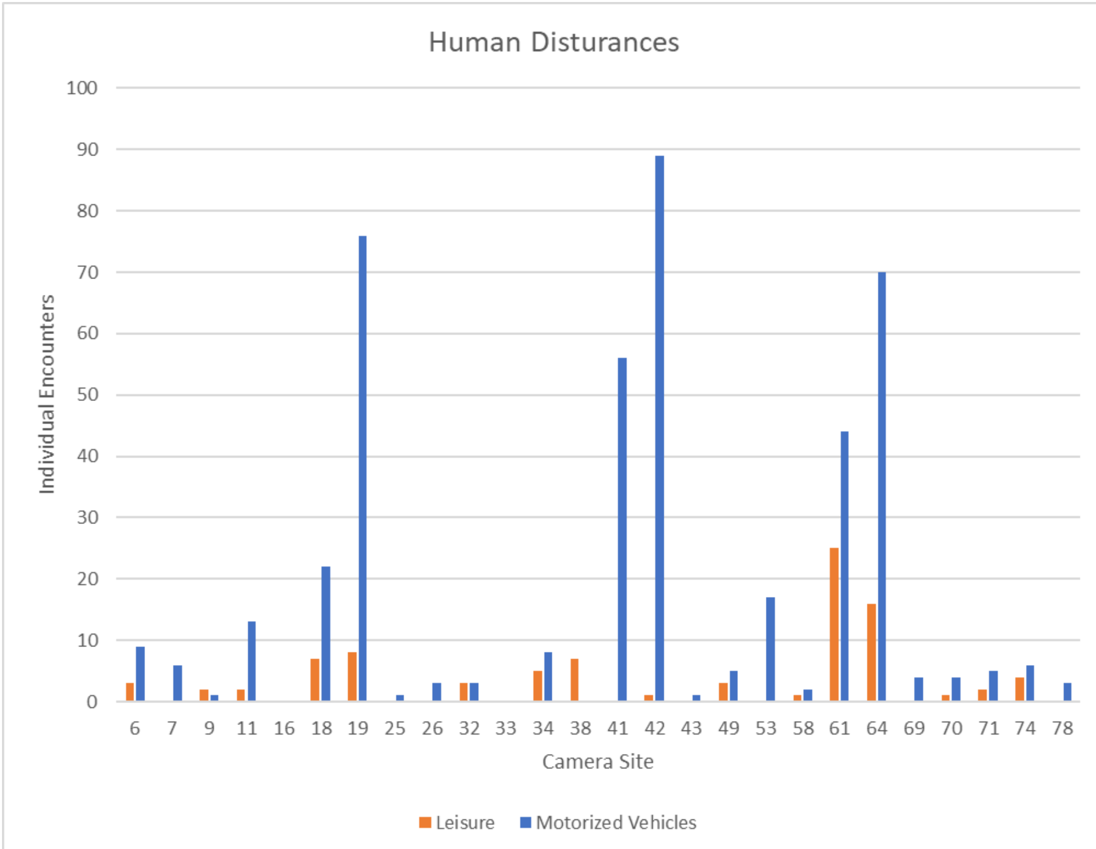

Figure 4: Individual encounters of human disturbances in the sites where red foxes were observed.

3. Habitat Composition

After utilizing the USA NLCD layer, we were able to observe how the trail cameras were placed around various types of habitats throughout BNL (Figure 5). Furthermore, the sites with the red fox encounters seemed to differentiate. For instance, sites 25 and 30 were near developed areas, whereas sites 70 and 71 were near evergreen, deciduous or mixed forests.

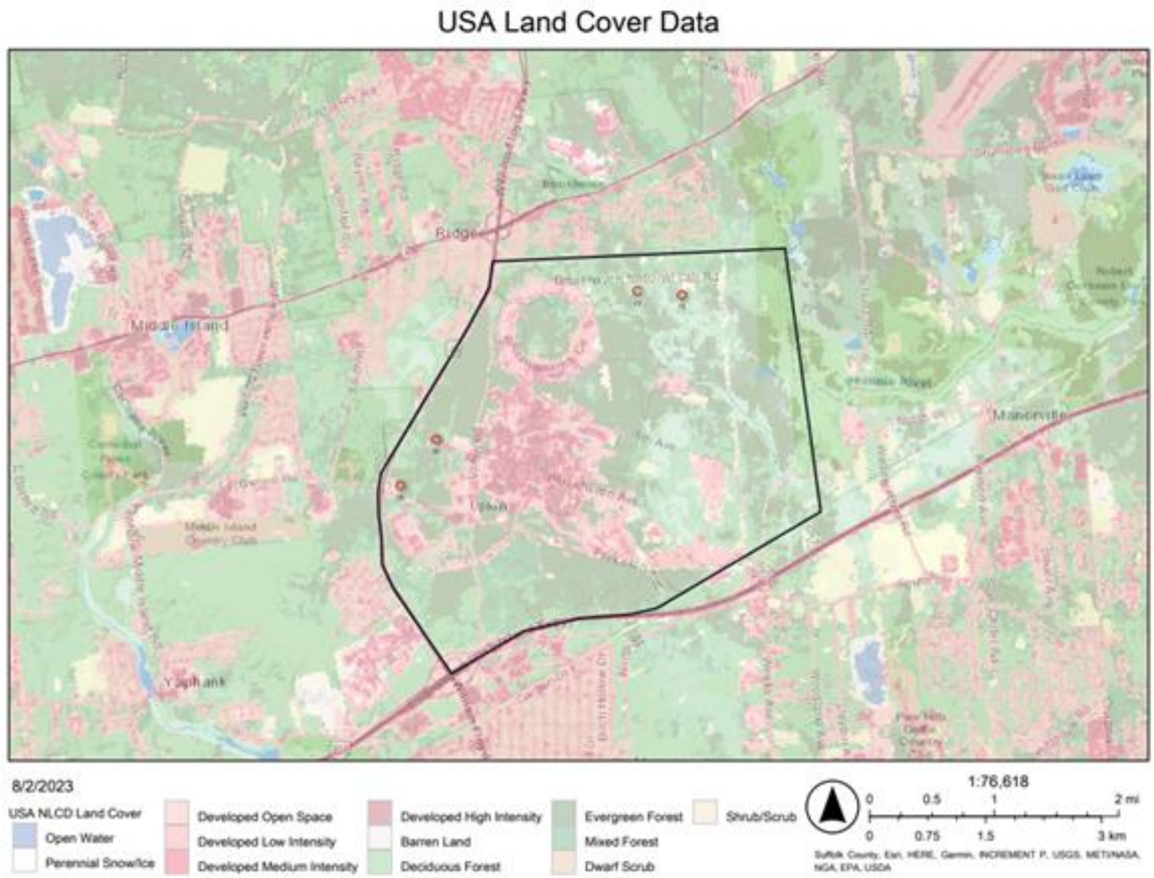

Figure 5: Habitat composition at BNL according to the USA Land Cover Data layer.

Discussion

By using the USA NLCD layer on ArcGIS and examining the different types of land compositions at Brookhaven National Laboratory, one could conclude that the property has a diverse range of habitats. Additionally, all the wildlife that was spotted by our trail cameras could indicate that BNL supports several species and has functioning ecosystems. BNL also has many areas with human activity, which could indicate that wildlife-human interactions could occur. Therefore, the introduction of a new species, specifically an apex predator like the coyote, could affect a wide range of habitats and organisms, including humans. For that reason, it is crucial to collect more data on the current flora and fauna inhabiting BNL and to better prepare for the ecological and social changes that are approaching.

Acknowledgments

I would like to express my sincere gratitude to my mentor, Jennifer Higbie, for all her guidance and support throughout this project. I would also like to thank Dr. Timothy Green for his advice and assistance throughout this internship. Their invaluable wisdom and enthusiasm for science was an inspiration to me. Furthermore, I greatly appreciate my colleague, Naomi Boyd, whose contributions and ongoing dedication made this project possible.

This project was supported in part by the U.S. Department of Energy, Office of Science, Office of Workforce Development for Teachers and Scientists (WDTS) under the Science Undergraduate Laboratory Internships Program (SULI) and by the National Science Foundation, Louis Stokes Alliance(s) for Minority Participation (LSAMP) at the SUNY College of Environmental Science and Forestry, under the LSAMP Internship Program at Brookhaven National Laboratory.

Literature Cited

[1]Nagy, C., Weckel, M., Monzón, J., Duncan, N., & Rosenthal, M. R. (2017). Initial colonization of Long Island, New York by the eastern coyote, Canis latrans (Carnivora, Canidae), including first record of breeding. Check List, 13(6), 901-907.

[2]Gehrt S. D. (2007) 'Ecology of Coyotes in Urban Landscapes', in D. L. Nolte, W. M. Arjo, and D. H. Stalman (eds) Proceedings of the 12th Wildlife Damage Management Conference.

[3]Fener, H.M., J.R. Ginsberg, E.W. Sanderson, and M.E. Gompper. 2005. Chronology of range expansion of the Coyote, Canis latrans, in New York. Canadian Field- Naturalist 119:1-5.

[4]Weckel, Mark; Bogan, Daniel A.; Burke, Russel L.; Nagy, Christopher; Siemer, William F.; Green, Timothy; and Mitchell, Numi (2015) "Coyotes Go "Bridge and Tunnel": A Narrow Opportunity to Study the Socio-ecological Impacts of Coyote Range Expansion on Long Island, NY Pre- and Post-Arrival," Cities and the Environment (CATE): Vol. 8: Iss. 1, Article 5. Available at: http://digitalcommons.lmu.edu/cate/vol8/iss1/5

[5]Peterson, M., Baglieri, M., Mahon, K., Sarno, R. J., Ries, L., Burman, P., & Grigione, M. M. (2021). The diet of coyotes and red foxes in Southern New York. *Urban Ecosystems*, *24*, 1-10.

[6]Gosselink, T. E., Van Deelen, T. R., Warner, R. E., & Joselyn, M. G. (2003). Temporal habitat partitioning and spatial use of coyotes and red foxes in east-central Illinois. *The Journal of Wildlife Management*, 90-103.

[7]Harrison, D. J., J. A. Bissonette, and J. A. Sherburne. 1989. Spatial relationships between coyotes and red foxes in eastern Maine. The Journal of Wildlife Management 53:181–185.

[8]Henke, S. E., & Bryant, F. C. (1999). Effects of Coyote Removal on the Faunal Community in Western Texas. *The Journal of Wildlife Management*, *63*(4), 1066–1081. https://doi.org/10.2307/3802826

[9]Berger, K. M., Gese, E. M., & Berger, J. (2008). Indirect effects and traditional trophic cascades: a test involving wolves, coyotes, and pronghorn. *Ecology*, *89*(3), 818-828.

[10]Lawrence, S. E., & Krausman, P. R. (2011). Reactions of the public to urban coyotes (Canis latrans). *The Southwestern Naturalist*, *56*(3), 404-409.

[11]Fidino, M., Herr, S. W., & Magle, S. B. (2018). Assessing online opinions of wildlife through social media. *Human Dimensions of Wildlife*, *23*(5), 482-490.

[12]Vaske, J. J., & Needham, M. D. (2007). Segmenting Public Beliefs about Conflict with Coyotes in an Urban Recreation Setting. *Journal of Park & Recreation Administration*, *25*(4).

[13]Sponarski, Carly C., et al. "Changing attitudes and emotions toward coyotes with experiential education." *The Journal of Environmental Education* 47.4 (2016): 296-306.

[14]Natural and cultural resources - Brookhaven National Laboratory. (2021, October). https://www.bnl.gov/esh/env/ser/2019ser/ch6_2019_20_final.pdf

[15]Soulsbury, C. D., Iossa, G., Baker, P. J., Cole, N. C., Funk, S. M., & Harris, S. (2007). The impact of sarcoptic mange Sarcoptes scabiei on the British fox Vulpes vulpes population. Mammal Review, 37(4), 278-296.