Mark and Recapture Analysis of Small Mammals in Pine Barrens Ecosystem

Nathan Mangold, Natural Sciences Department, Paul Smith's College, Paul Smiths, NY, 12970

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

Abstract

The Long Island Solar Farm is located at Brookhaven National Laboratory. It provides power to approximately 4500 homes and sits on approximately 80 hectares. The purpose of this study is to use mark recapture methods to quantify the density of small mammals within the site, and compare it to data collected from previous years, as well managed and unmanaged pine barren forest to determine if the solar farm has an impact on small mammal populations. We also looked at the impact of prescribed fire and mechanical treatment on small mammal populations. The previous data was collected during studies from 2013 – 2015 after the solar farm was built in 2010-2011.. The small mammal population is mostly comprised of white-footed mice (*Peromyscus leucopus*), but also includes shrews, moles, and voles. To conduct the trapping we established three, 50x50m grids in each area, with traps spaced 10m apart for 36 Sherman traps per grid. Each site will be trapped for four nights over the course of the project. When a mammal was first captured, it received a unique ear tag. We recorded species weight, sex, location, and date of capture. For the analysis, I compared captures per trap night between sites. As a result of my work this summer, I have become very familiar with working with Sherman traps, handling small mammals, setting cameras, and working in a professional environment.

Introduction

Small mammals play a crucial role in the food web of the forest, cycling energy up to higher trophic levels (Ostfeld et al, 1996), and are considered a bioindicator for understory health (Carey and Harrington, 2001) (Pearce and Venier, 2005). The population dynamics of small mammals may give insight into the effectiveness of forest management practices and their effect on wildlife populations.

A study looking at disturbances in the New Jersey Pinelands found white footed mice to be the first mammals to colonize after a disturbance, but the mature forests had a much higher diversity. Plots that were one- and six-years post burn had a Simpsons diversity index of 0.0, only capturing white-footed mice (*Peromyscus leucopus*). Pine vole (*Microtus pinetorum*) appeared in a plot 14 years post wildfire, which had a diversity index of .58 (Shenko et al, 2012).

A meta-analysis looking at small mammal responses to disturbances found that deer mice (*Peromyscus maniculatus*) abundance increased in response to all forest disturbances but responded the strongest to wildfire. Red-backed vole (*Myodes gapperi*) abundance decreased significantly in response to disturbances which involved fire (Zwolak 2009).

The goal of this study was to look at the population dynamics of small mammals to understand the impact of the forest management practices being conducted at Brookhaven National Laboratory (BNL). We focused on comparisons of diversity and density between treated and untreated plots. We hypothesized that the treated areas would have a significantly higher abundance of *Peromyscus* but a lower diversity index than the control areas. Also due to past years data we hypothesized hat the solar farm would have significantly less abundance than both the control and treated areas.

Figure 1 . A Sherman trap

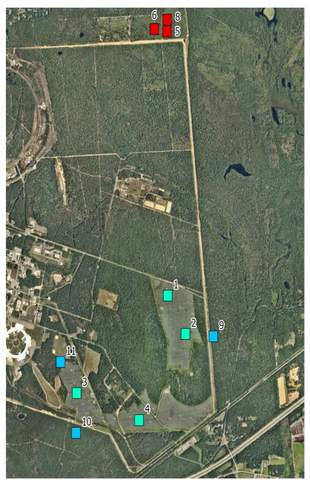

Figure 2. A map of the trapping grids.

A white-footed mouse in trap

Methods

Study Area

The study took place at Brookhaven National Laboratory (BNL) in Upton, New York.

Site Description

The 10 grids were spread over three trapping areas: a solar farm, a burned/mechanically treated area, and control plots. The solar farm covers approximately 80 hectares and was a meadow-like habitat. It was built in 2010-2011. The burned/mechanically treated area was comprised of sparse *Pinus rigida* (Pitch Pine), *Quercus ilicifolia*, (scrub oak), with a thick understory mostly comprised of various *Vaccinium spp.* All grids in the burned area experienced a wildfire in 2012. Grids 5 and 8 were mechanically treated in 2021 and were burned in a prescribed fire in 2023. Grid 6 was mechanically treated in 2023. The control areas are dominated by *Quercus* as well as *Pinus Rigida.* They have a thick canopy and an understory of mostly *Vaccinium spp.*

Trapping Methods

We trapped for a total of four weeks. A week of trapping consisted of 4 consecutive nights, with traps being closed in the morning and reopened in the evening. Our grids were 50x50M with 36 Sherman traps (Figure 1) spaced 10m apart. The solar farm had four grids, while the burn site and control area had three grids (Figure 2). The traps were baited with a mixture of peanut butter and oats. When a small mammal was captured, it was transferred from the trap to a plastic bag for easier handling. We then recorded trap number, species, weight, sex, tag number, and whether the individual had been captured before. If unmarked, the animal received a unique ear tag before being released. Trapping was conducted under IACUC protocol BNL 371.

For analysis we normalized the data for captures/trap night to compare to previous years. A trap night consists of one night where a trap is left open. Our solar grids had 1,152 trap nights each, Controls had 324, and burned areas had 432. We had a total of 1908 trap nights.

Results

Area	Shannon Diversity Index
Solar (2024)	0.176
Control (2024)	0.15
Burn (2024)	0.312

Table comparing Shannon Diversity Index

Site	Captures/Trap Nights
1	0.045
2	0.080
3	0.052
4	0.021
5	0.430
6	0.375
8	0.465
9	0.333
10	0.185
11	0.138

The capture rate by individual site (2024)

Control

Species	Number of Captures
Peromyscus leucopus (White-Footed Mouse)	68
Sorex Cinerus (Masked Shrew)	1
Mus musculus (House mouse)	1

Burn

Species	Number of Captures
Peromyscus leucopus (White-Footed Mouse)	164
Mus musculus (House mouse)	17

Solar

Species	Number of Captures
Peromyscus leucopus (White-Footed Mouse)	55
Blarina brevicauda (Short Tailed Shrew)	1
Mus musculus (House mouse)	1

Table comparing total captures between sites by species

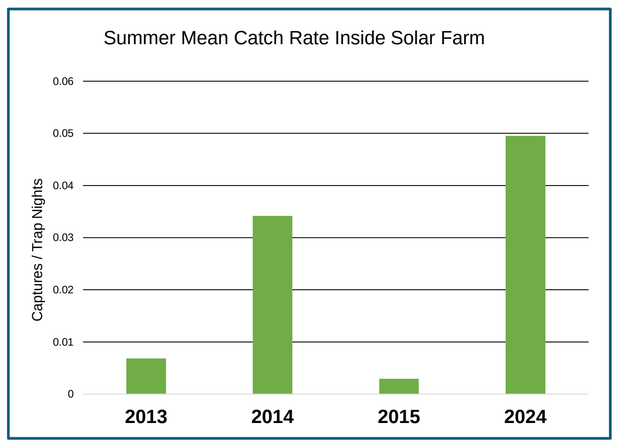

Figure 3. Graph comparing mean catch rate inside Solar Farm

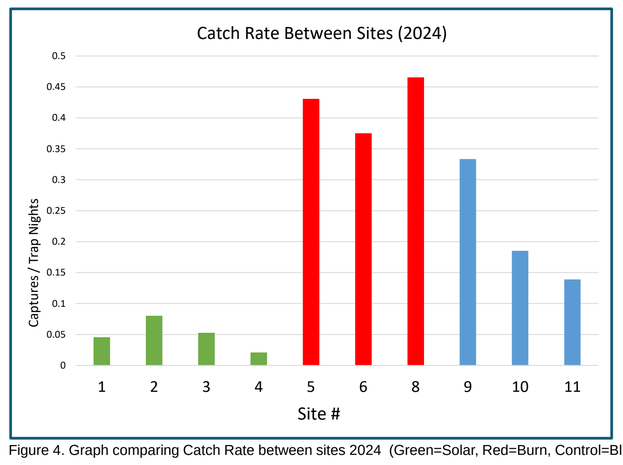

Figure 4. Graph comparing Catch Rate between sites 2024 (Green=Solar, Red=Burn, Control=Blue)

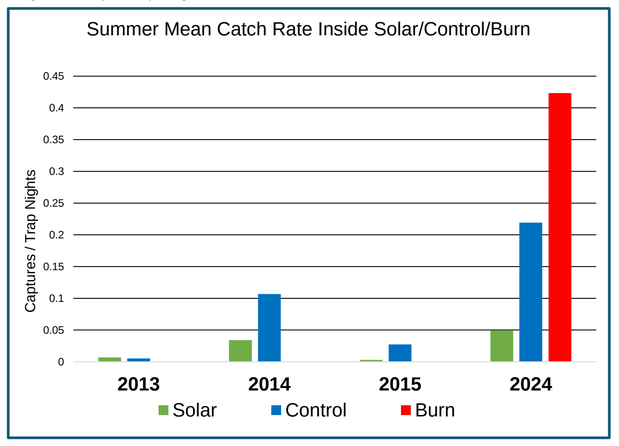

Figure 5. Graph comparing mean summer catch rate between solar, control burn areas

Weighing a white-footed mouse

A docile white-footed mouse

Scruffing a white-footed mouse

Short-tailed shrew

Discussion

The solar farm catch rate was slightly higher in 2024 compared to 2013-2015 (Figure 3). The capture rate in the solar farm was found to be much lower than the control and the burned area (Figure 4). Racoon disturbance to the traps was prevalent in this area which may have negatively affected the catch rate. Racoons were determined to be the cause based on presence of tracks, scat, and the dexterity required to dismantle traps. Disturbance was highest in site four, reaching as high as 83%. This could be attributed to the low amount of vegetation provides little cover for the traps, and they are easily visible to predators. Aerial predators like *Buteo Jamaicensis* (Red-tailed hawk) were frequently sighted while maintaining our trapping grid. The solar farm has a high amount of invasive vegetation as well, most notably *Artemisia vulgaris*, which could limit forage for small mammals.

The burn area had much higher catch rates than the control which supported our hypothesis. The positive response of white footed mice to prescribed fire and mechanical treatment has been seen similar studies (Zwolak 2009). In the burn area there was a dense cover of blueberries, huckleberries and scrub oak as well as high amounts woody debris.

Small mammal capture rate over all areas was higher in 2024 than all previous years (Figure 5). A possible explanation could be the management of white-tailed deer populations (*Odocoileus virginianus*). It has been shown that *Peromyscus leucopus* have a higher abundance in areas that exclude white-tailed deer (Byman, 2013). It also could be attributed to a high acorn mast in the fall of 2023, but reliable data could not be sourced for this area. Future studies are needed to see if these catch rates are reproduceable.

Small mammal diversity was very low for all three sites. We were hoping to encounter either *Microtus pinetorum* (Pine vole) or *Microtus pennsylvanicus* (Meadow vole). Ideally, we would have had one more week of trapping data for both the solar and control areas but due to time constraints it could not be included in these results. For future studies we may focus more on the prescribed burn areas to investigate a possible correlation between stand maturity and *Peromyscus leucopus* abundance.

References

Byman, D., Harding, S. D., & Spear, F. W. (2013). Demographic effects of white-tailed deer (Odocoileus virginianus) exclosures on white-footed mice (Peromyscus leucopus). *The American Midland Naturalist*, *170*(1), 171–183. https://doi.org/10.1674/0003-0031-170.1.171

Carey, A. B., & Harrington, C. A. (2001). Small mammals in young forests: implications for management for sustainability. *Forest Ecology and Management*, *154*(1–2), 289–309. https://doi.org/10.1016/s0378-1127(00)00638-1

Cooch, E., & White, G. (2006). Program MARK: a gentle introduction. *Available in. pdf format for free download at http://www. phidot. org/software/mark/docs/book*.

Ostfeld, R. S., Jones, C. G., & Wolff, J. O. (1996). Of mice and mast. *BioScience/Bioscience*, *46*(5), 323–330. https://doi.org/10.2307/1312946

Pearce, J., & Venier, L. (2005). Small mammals as bioindicators of sustainable boreal forest management. *Forest Ecology and Management*, *208*(1–3), 153–175. https://doi.org/10.1016/j.foreco.2004.11.024

Shenko, A. N., Bien, W. F., Spotila, J. R., & Avery, H. W. (2012). Effects of disturbance on small mammal community structure in the New Jersey Pinelands, USA. *Integrative Zoology*, *7*(1), 16–29. https://doi.org/10.1111/j.1749-4877.2011.00274.x

Zwolak, R. (2009). A meta-analysis of the effects of wildfire, clearcutting, and partial harvest on the abundance of North American small mammals. *Forest Ecology and Management*, *258*(5), 539–545. https://doi.org/10.1016/j.foreco.2009.05.033

Acknowledgments

I would like to thank Jennifer Higbie for her help and guidance throughout this process. I would also like to thank my fellow interns Kay Williams, Rachel Williams and Tara Mansfield who made this possible through their hard work.

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).