

Fire effects on bat species diversity present at Brookhaven National Labs

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Abstract

Many bat species are under threat from habitat loss, climate change, and white-nose syndrome (*Pseudogymnoascus destructans*), and it's important to know what species are present in order to manage them properly. This project looked at bat species diversity across sites at Brookhaven National Laboratory, which is located in the heart of the Long Island Central Pine Barrens region. Pine barrens ecosystems are highly fire-adapted and thus prescribed fire is an important tool in managing the forest. Bat calls were obtained through acoustic recorders, and models were run to see if there was a difference in habitat use between the intact and disturbed forest. No significant differences were found, although due to the small study area and timescale more research is suggested.

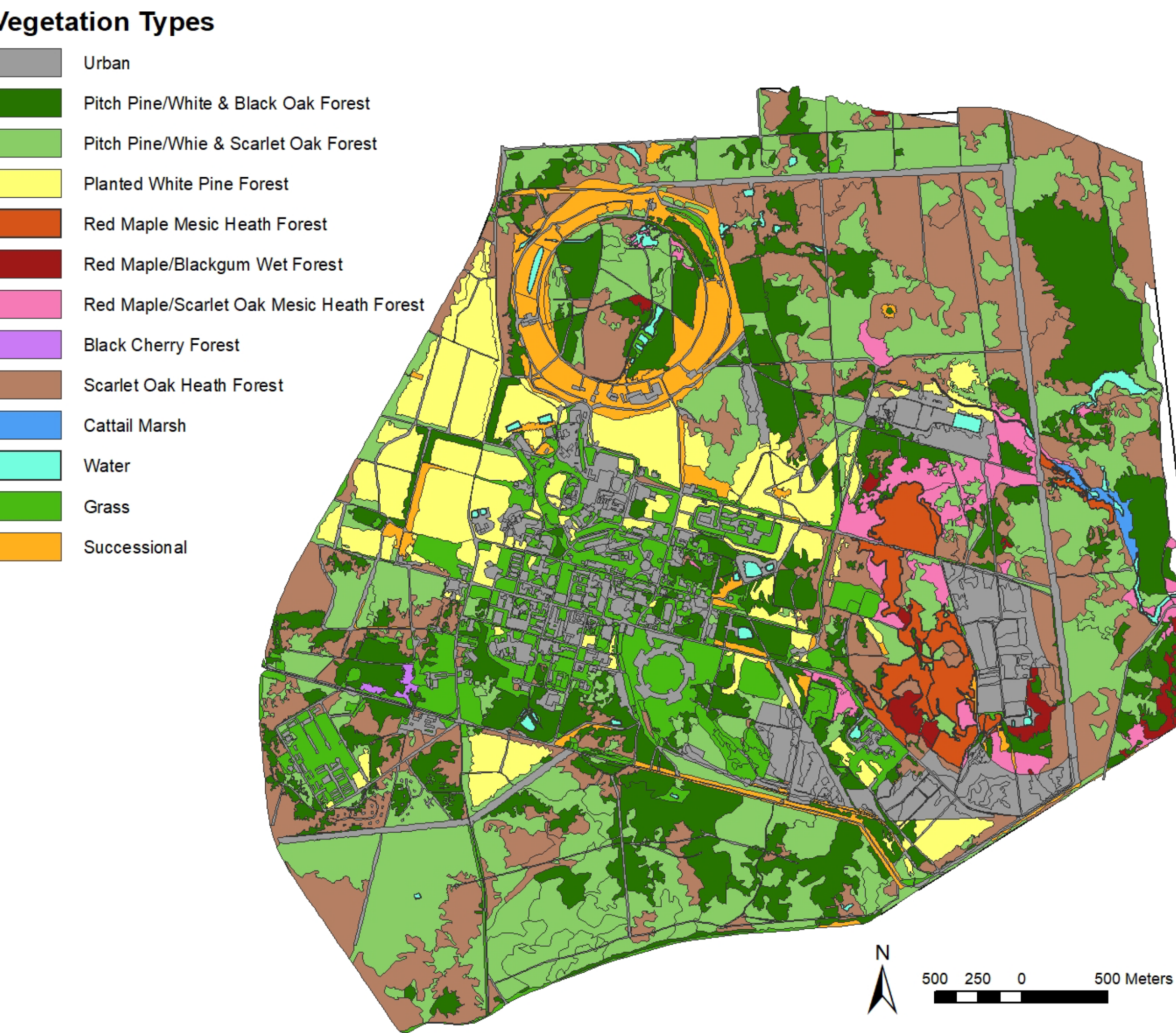
Introduction

Bats play a large role in the environment, and provide many ecosystem services such as arthropod suppression, seed dispersal, and pollination (Kunz et al., 2011). Insectivorous bats in particular have been found to suppress various insect populations, including many species of agricultural and forest pests. Northern long-eared bats (*Myotis septentrionalis*) have been shown to effectively suppress mosquito populations (Reiskind & Wund, 2009). Many bat species are under major threat from habitat loss, climate change, disease so it's important to know what species are present in order to manage them. There are eight species of bats currently found on Long Island, NY, shown below.



The goal of the project is to see what bat species are present at the laboratory, as well as where they occur in relation to different kind of forest disturbances- wildfire, prescribed fire, mechanical thinning, and no disturbance. Brookhaven National Laboratory is located in the Long Island Central Pine Barrens, primarily consisting of communities of pitch pine (*Pinus rigida*) and oak species (*Quercus coccinea*, *Q. rubra*, *Q. alba*, *Q. velutina*) with a varied understory of shrubs and herbaceous plants (BNL, 2021). The pine barrens ecosystems have evolved over thousands of years to be highly fire-adapted, so much of the flora and fauna has ways to withstand and even benefit from fire. Prescribed fires are a critical tool in managing many forests, having been used by Native Americans for hunting and land management prior to European settlers (Ryan, et al., 2013). These fires get rid of the buildup of vegetation and debris that would act as fuel and so reduce the risk of more uncontrollable wildfires, as well as promote a healthier forest by allowing the pines to germinate and put nutrients back into the soil (BNL, 2021). In a review of 52 studies, bats tended to show either positive or neutral responses to prescribed fire, and more negative responses to wildfire, as they're often larger and more severe (Loeb & Blakey, 2021). These responses are complex and rely on several factors such as fire severity, fire frequency, time since last burn, season of burn, and ecological factors of both the forest and the bats themselves. Northern long-eared bats in particular have been observed to shift locations after prescribed burn to follow insect availability and roost microsites and suggests that they are tolerant to prescribed fire (Lacki, et al., 2009).

Figure 1. Map of the vegetation communities at BNL



Methods

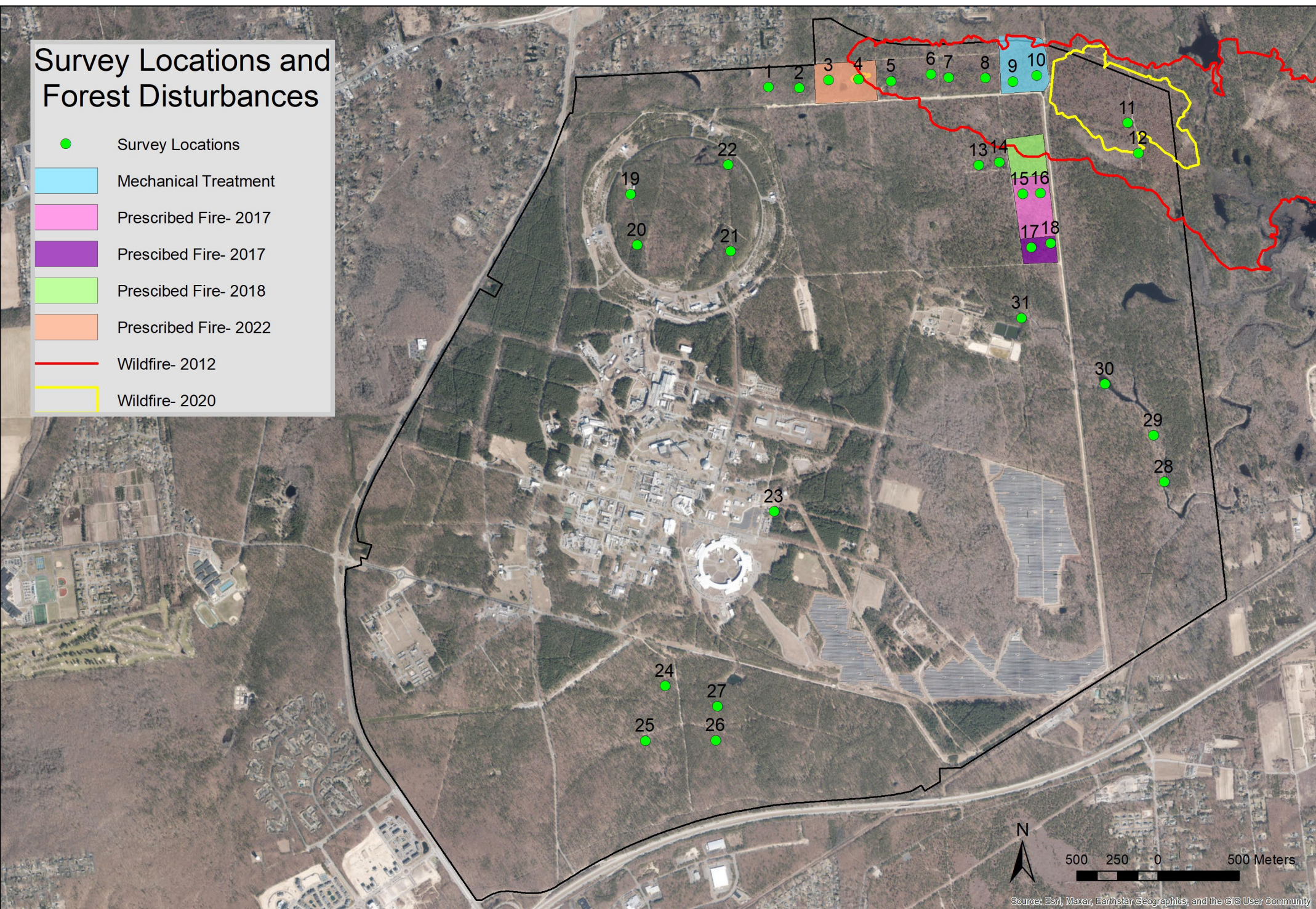
Field Surveys

Ultrasonic recorders (Song meter mini bats) were used to passively detect bat vocalizations, set up over the course of 10 weeks from June through August. There were 12 surveyed plots- one mechanically treated site, three sites that had undergone wildfire, three sites with a prescribed burn, and five sites that had not been burned or cleared. At least two detectors were set up in each plot, a minimum of 50m apart, for a total of 31 survey locations. Detectors were set-up in each plot approximately five ft up the tree, secured with paracord, and left to record for a minimum of three nights, set to start 30 minutes before sunset to 30 minutes after sunrise subject to triggering.

Analysis

Field recordings were analyzed using Kaleidoscope Pro® software to batch process the recordings. Default signal parameters were used, and recordings were filtered to automatically discard noise files. The Auto ID for Bats feature was used to identify the species. If that species had a presence p-value of <0.05, then it was determined that that species was present at that location. If that species had a presence p-value of >0.05, then it was determined that there was insufficient evidence to prove that species was present. Program presence was used to see if any of the disturbance types had affected habitat use by the bats in intact (N=17) and disturbed (N=14) forests. Models were stratified by occupancy probability, detection probability, or both by forest type, and model fit was assessed with a Goodness of Fit test.

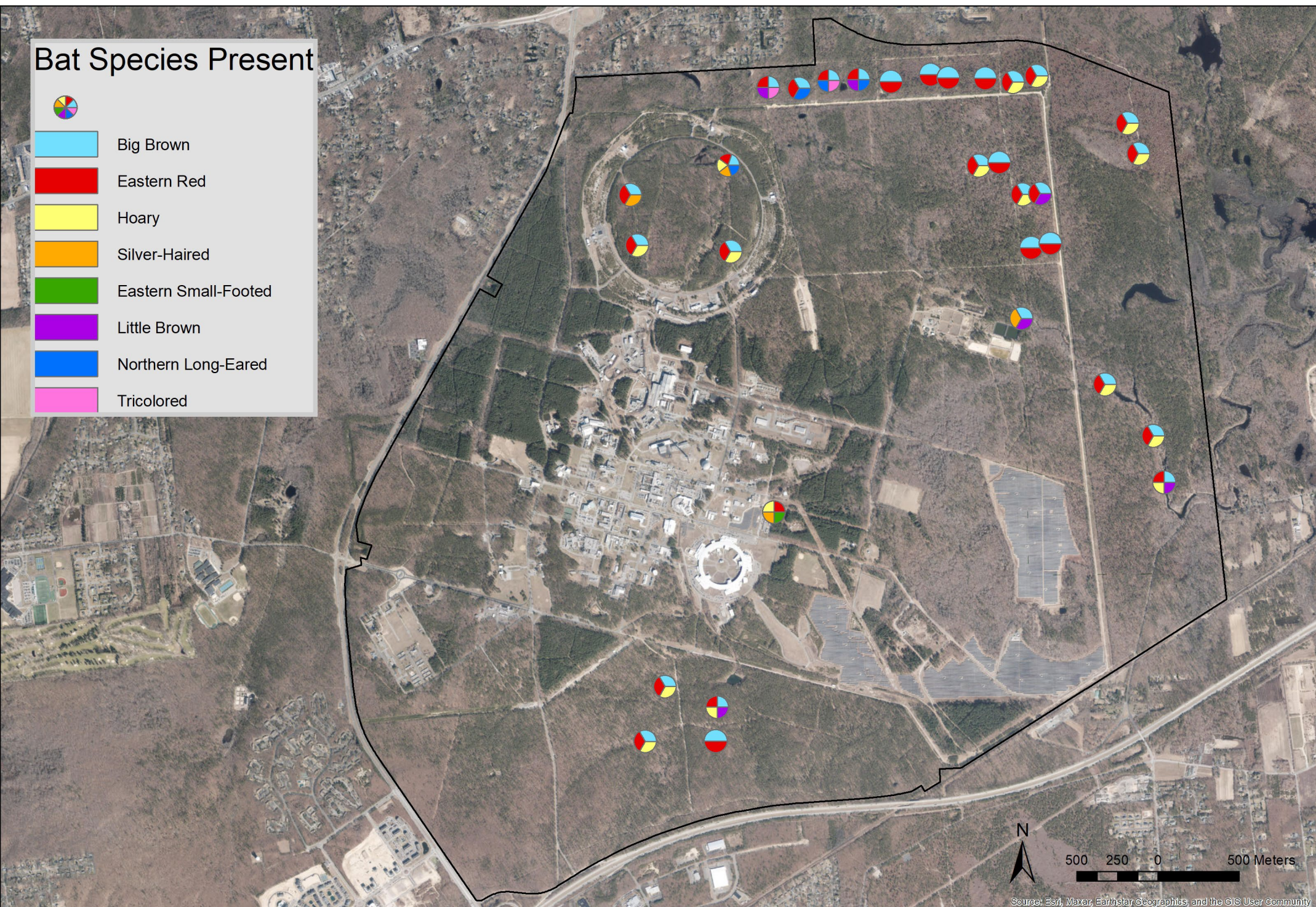
Figure 2. Map showing survey locations and where they occur in relation to the forest disturbances



Results

Over 40,000 audio files were processed, with approximately 16,00 possible bat identifications. For all species tested, the null model, with no effect of forest type on either occupancy or detection, had the highest support.

Figure 3. Map showing where each bat species is present across BNL. All eight species of bats present on Long Island showed up as possible identifications. Important to note that this map does not show abundance of bats, it merely indicates presence or absence at each site.



Discussion

Big brown bats and eastern red bats were the most prevalent across sites, both showing up in 30 out of 31 of the survey locations. While there were no significant differences detected over the different treatment types here, due to the small study area of study and short time frame these may not be indicative of the actual relationship between bats and fire in this habitat and more research is recommended. Although some people have negative preconceived notions about bats, they are an integral part of the ecosystem and provide many benefits. Many species of bats are declining due to various threats against them, and we need to know more about these amazing creatures to be able to help conserve and manage them. It's been proven that fire affects bats in many ways, both positive and negative, and there is still so much to learn.

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