The Effects of Increased Train Activity on Bat Activity at Nahant Marsh

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Summary

Bat research in Nahant Marsh has been ongoing for the past six years. The marsh is located adjacent to an active railyard, and train traffic has increased in recent years due to a train company merger. This research investigated whether the increase in train activity has affected bat activity, and whether proximity to train tracks or train crossings influences bat activity. We found that since the merger, bat activity detected at all monitors has decreased, but the data does not support a correlation between bat activity and proximity to train tracks or train crossings. These findings do not support my original hypothesis and suggest that bats are tolerant to the noise pollution produced by trains. Therefore, the decrease in bat activity throughout the marsh is likely attributed to another cause or a combination of other factors.

Introduction

Nahant Marsh is home to nine native bat species, including two that are federally-endangered. The big brown bat, hoary bat, and eastern-red bat are the most frequently detected species at the marsh, where bat activity research has been ongoing since 2019.

On April 14, 2023, the CPKC rail merger significantly increased train activity near the marsh, which lies adjacent to one of their major railyards. The resulting noise pollution is substantial, with train horns regulated at 100 decibels, and two railroad crossings near the marsh. Although bat echolocation occurs at higher frequencies (20-90kHz) than train horns (typically 300-500 Hz), the elevated ambient noise could still disrupt essential bat behaviors.

Previous studies, such as Finch et al. (2020), have shown that low-frequency noises can decrease bat activity especially in Myotis species. While bats are adapted to detect high-frequency sounds, chronic exposure to low-frequency noise may contribute to habitat avoidance.

Therefore, it is hypothesized that the increased high-decibel noise pollution along with increased rumbling from trains near Nahant Marsh will result in decreased bat activity. Additionally, it is predicted that there will be higher bat activity pre-merger compared to post-merger, especially near the train tracks and crossings.

Objectives

- Determine whether bat activity in the marsh has been affected by increased train activity by analyzing data collected between pre-merger years (2019-2022) and post-merger years (2024-2025).
- Compare the effects of distance from tracks and train crossings on bat activity.

Methodology

This study used acoustic monitors to detect bat activity at Nahant Marsh. Data was collected using Song Meter SM4BAT FS detectors by Wildlife Acoustics. They were programmed to record 30 minutes before sunset and 30 minutes after sunrise. Data was collected every Monday and analyzed using Kaleidoscope Pro's auto-bat ID feature. Only data collected from June 3rd - July 25th was used each year to avoid seasonal discrepancies. Due to variations in past monitor-checking schedules, the data was standardized to calls per night. To ensure a reliable species identification, only detections with a confidence level of $p<.05$ (assigned by the software) was used. Bat monitors ranged from 23 to 653 meters away from the train tracks and 61 to 830 meters away from train crossings.

To assess how the bat activity has changed over time (Figures 1 and 2), we used data from six permanent monitors that have been deployed each year for the last six summers, and categorized them into pre-merger (2019-2022) and post-merger (2024-2025) years. Using Google Earth Pro, I calculated the perpendicular distance from the tracks to the monitors and the distance from the nearest train crossing to each monitor.

This summer we acquired two new monitors. We placed one monitor in a new permanent location and moved one around the marsh weekly to new locations. All of the data collected in 2025 was used in Figures 3 and 4, in order to test new locations at different distances from the train track and train crossings.

Results

Average Bat Calls for Permanent Monitors (2019-2022 vs 2024-2025)

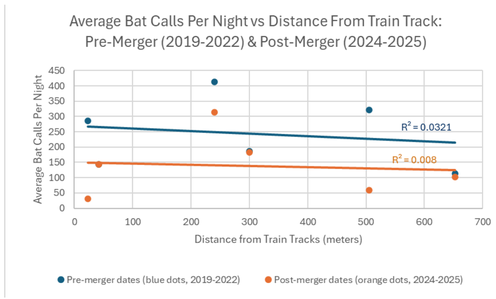

Figure 1. Average number of bat calls per night (pre-merger 2019-2022 and post-merger 2024-2025) as it relates to distance from train tracks. Pre-merger monitors sample sizes range from 14-61 nights, and post-merger monitors sample sizes range from 26-65 nights, with variation due to schedules and monitor errors (e.g., dead batteries, faulty microphone or lack of deployment).

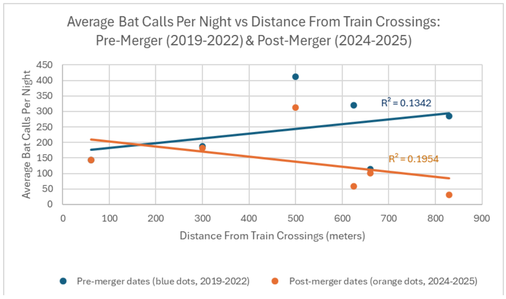

Figure 2. Average number of bat calls per night (pre-merger 2019-2022 and post-merger 2024-2025) as it relates to distance from train crossings. Pre-merger monitors sample sizes range from 14-61 night, and post-merger monitors sample sizes range from 26-65 nights with variation due to schedules and monitor errors (e.g., dead batteries, faulty microphone or lack of deployment).

Data Collected from 2025 Only

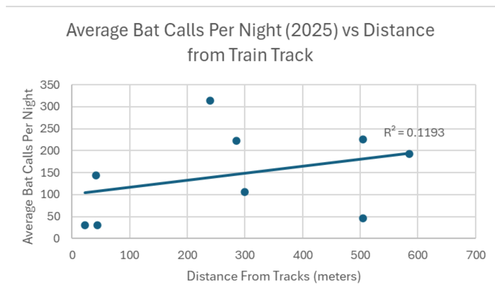

Figure 3. Average number of bat calls per night (2025) as it compares to distance from train tracks. Sample size for permanent monitors (23, 42, 240, 285, 300, 505 meters) range from 26-45 nights and sample size for weekly monitors (44, 505, 585 meters), was seven nights. Data were collected during June 03-July 25, 2025.

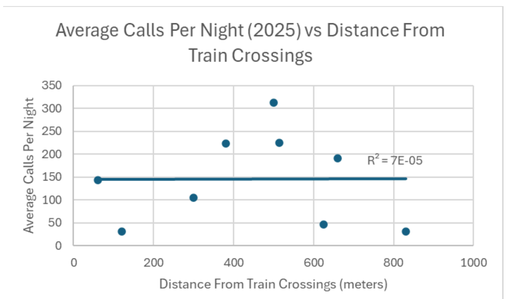

Figure 4. Average number of bat calls per night (2025) as it compares to distance from train crossings. Sample size for permanent monitors (61, 300, 380, 500, 625, 830 meters) range from 26-45 nights and sample size for weekly monitors (120, 515, 660 meters), was seven nights. Data were collected during June 03-July 25, 2025.

Discussion

Across all six permanent monitors in the past three years, bat activity has decreased by 53%, however a t-test comparing pre- and post-merger bat calls across the sites yields a p-value of 0.077, which suggests the decline is only marginally statistically significant. The results in Figures 1-4 yield mixed results. Figure 1 is particularly interesting as the slope of the trendlines are nearly parallel yet the post-merger trendline is numerically lower, suggesting that there is a uniform decrease in bat activity regardless of proximity to train tracks. Figure 2 shows that bat activities pre-merger showed a positive correlation with distance. However, post-merger bat activity has a negative correlation to distance from train crossings. This suggests that bats' activity near train crossings increased even when there was more train activity. Figure 3 and 4 used only 2025 monitor data, which includes one mobile unit moved weekly to investigate bat activity in additional locations. Figure 3 shows a positive relationship between bat calls and distance from the tracks and Figure 4 shows no discernible relationship. Additionally, the R-values of all four graphs are low, which indicates that none of the relationships are strong or well-described by linear trends.

All nine bat species were detected this summer, with the most abundant species being the big brown bat, hoary bat, eastern-red bat, and evening bat. Notably, both federally-endangered bats were detected in the marsh with the northern-long eared bat being detected seven times and the Indiana bat being detected three times.

Conclusion

This study's results do no support my hypothesis that distance from train activity has a positive relationship to bat activity. Instead, the results suggest that there is no relationship between the two. My research however, may indicate that that noise pollution from train rumbling and train horns has a negative effect on bat activity overall since there is a marginal statistical decrease in bat activity since the train merger. There may be a level of tolerance of noise pollution, supported by the findings that close proximity to said noises does not correlate with a decrease in bat activity. Future research should be done to pinpoint the true causes behind the decline in bat activity. Exploring new locations across the marsh, along with assessing the habitat the monitors are placed in is also important given that the proximity to the railyard seems insignificant.

Aknowlegements

I would like to extend my greatest appreciation to the EARTH program for giving me this opportunity. Additionally, I would like to thank James Wiebler and the all the Nahant Marsh Staff for helping with my research this summer.