Does Loud Peak Noise Impact Insect Populations?

Background

In September of 2019, Vermont became the first state whose national guard air base house a fleet of F-35 fighter jets. This base is situated along the Winooski river near Burlington and Winooski, and the proposal for their placement in this area was met with fierce resistance from the local population. Many concerns were raised about the impact on property values, and damage to hearing over time as a result of the frequent, high-volume fly-overs that these jets would conduct as part of the Vermont National Guard's mission preparedness regimen. Volumes within and near the flight path can reach upwards of 65 decibels, even all the way to 85 decibels at ground level on sites nearest the path. F-35 flight schedules have squadrons departing in the morning and in the afternoon five days a week, plus one weekend of additional training per month and some night flights[6].

The location of the air base and the path of the training routes mean several natural habitats within the Burlington area will be exposed to volume exceeding 65 decibels multiple times a day, on average[6]. While volume levels have been a concern for people who live along the F-35's flight path, there has not been similar studies into the potential impact for the impact to animals and ecosystems as a result of this loud, extraordinary noise. Many of these natural habitats along the F-35 flight path are riparian ecosystems located along the Winooski river[6]. The health of these sites are important for water filtration, floodwater mitigation, and endangered species habitat[4].

Insect populations can be one indicator of the health of an ecosystem[3]. Certain insect population abundances have also been shown to be influenced by background anthropogenic noises[2]. Often, the source of the anthropogenic noise in these studies are roadways, where noise levels are relatively steady throughout the day, and usually sites that experience 75-85 decibels are small and immediately abutting the roadway. With the F-35's and their flight path, large parts of the surrounding ecosystems are exposed to short (1 to 2 minute) bursts of this loud noise[5].

Mayfly: Gallagher, J. (2015). Flat-headed Mayfly (female) [Photograph]. Flickr. https://flic.kr/p/qExzXG

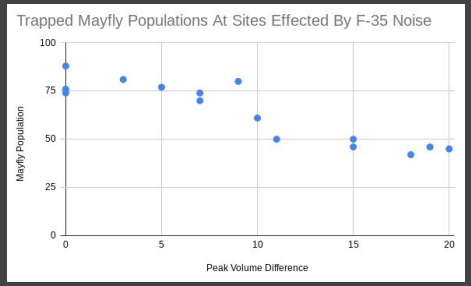
F-35:Allen, D. (2013). F-35A off the coast of Northwest Florida [Photograph]. DVIDS. https://www.dvidshub.net/image/935698/aerial-refueling-f-35-lightning-ii-joint-strike-fighters-eglin-afb-fla#.UZyEMrVU8QY

Hypothesis

We hypothesize that there is a relationship between loud, repeated short bursts of anthropogenic noise, such as the noise produced by F-35s, and mayfly populations.

Predictions

We predict that mayfly populations at sites, as estimated by trap-release counts,will decrease as site volume levels increase, as measured by peak volume recorded by microphone near the trap.



Example of Graph. Self-made.

Citations

1: Ahmed, D., Bearup, D., Blackshaw, R., Petrovskii, S. (2011). *Estimating insect population density from trap counts*. Ecological Complexity, 10, 69-82. https://doi.org/10.1016/j.ecocom.2011.10.002

2: Bunkley, J. P., McClure C. J. W., Kawahara, A. Y., Francis, C. D., Barber, J. R. (2017). *Anthropogenic noise changes arthropod abundances*. Ecology and Evolution, 7(9), 2977-2985. https://doi.org/10.1002/ece3.2698

3: Ramey, T., Richardson, J. (2017). *Terrestrial Invertebrates in the Riparian Zone: Mechanisms Underlying Their Unique Diversity*. BioScience, 67(9), 808-819. https://doi.org/10.1093/biosci/bix078

4: Riparian Areas Environmental Uniqueness, Functions, and Values. (1996). Retrieved November 20, 2020, from https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/?cid=nrcs143_014199

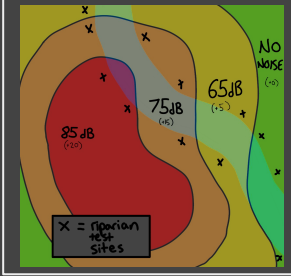
5: Robinette, B., Bruce, H., Hamilton, M., McIntosh, S., Carter, D., & Walter, A. (2019). *Burlington International Airport 14 CFR Part 150 Update 2018 and 2023 Noise Exposure Maps* (Rep. No. 308770.008). Burlington, MA: HMMH.

6: U.S. Air Force. (2013). *Final United States Air Force F-35A Operational Basing Environmental Impact Statement (EIS)*. Langley, VA. https://www.documentcloud.org/documents/799815-f-35-final-eis-volume-1.html

Study Design

Multiple, similar sites will be chosen at riparian sites along the Winooski within the Champlain Valley. These sites will be chosen in such a way that the impact of F-35 noise varies between them (from no impact to 75+ decibel occurrences), but background noise does not significantly vary (such as roadway noise). These sites should be selected based on similarity in environmental factors, including visually estimated species abundance and diversity, size, and fragmentation.

At each of these sites a pheromone insect trap will be set up.These traps are effective for capturing, then estimating populations from[1]. The location of this trap must be similar across sites, especially with regards to proximity to habitat, height, and wind speed (as to ensure the pheromones travel generally the same distance). Multiple microphones will also be arrayed around each site to measure noise in order to categorize the sites. After a period of two weeks, the traps and microphones will be collected and the caught insects counted.



Example Riparian Site Selection. Self-made.

Intended Analysis

First, the sites' volume levels will be analyzed in order to identify abrupt 1 to 2 minute long "peaks" that would correlate to F-35 flights. The average of these peaks will be calculated and the difference between average peak volume and overall peak volume will be used as the independent variable 'peak volume change'. If no peaks are identifiable, the 'peak volume change' will be 0.

Our response variable and our independent variable will be continuous, and so a regression will be calculated. If the regression is indicative of a correlation between peak noise and insect populations, it can be inferred that the presence of F-35s has a negative impact on insect populations at riparian sites.

Because we are choosing sites that are relatively fragmented by human development, and experience similar levels of background roadway noise, our inferences will be limited to a scope of similar sites. However, the results may be strong enough to indicate a significant impact on ecosystem health.