Predicting Density and Occurrence of Keystone and Umbrella Species Using Drone-based LiDAR

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Project Abstract

NSRC researchers will use drone-based LiDAR to identify and predict forest structural conditions critical for snowshoe hare and American marten in the Northern Forest. Identifying the habitat overlap between an early- and a late-successional species should indicate high biodiversity and inform forest management and conservation in the region. Researchers will work with existing data on hare abundance, marten occurrence, and vegetative structure. They will compare LiDAR with Structure from Motion (SfM) technology and sample a range of forest sites. They will then identify stand attributes and landscape conditions that maximize hare abundance yet provide habitat for martens. To determine if co-occurrence of these species results in higher biodiversity, researchers will collect data on songbird and mammal species richness. Researchers expect findings to reveal how microhabitat influences biodiversity at varying scales and inform forest management to balance wildlife and economic needs. This research will provide tools and guidance for large landowners to map and manage forests and economic opportunities for small businesses and hobby drone users to map smaller parcels. This work will increase forest survey efficiency and broaden public participation in natural resource management and biodiversity conservation.

Progress in 2022

During 2021, we re-established snowshoe hare monitoring plots (n = 695) and set remote cameras (n = 42) in 14 existing sites (20 ha stands) to estimate hare density and mammal biodiversity. We also conducted pilot flights using unpiloted aerial systems (hereafter drones) fitted with Light Detection and Ranging (LiDAR) sensors to map vegetative structure at the sites. In 2022, we conducted snowshoe hare population surveys in the spring and fall to estimate winter and summer density, respectively. We checked cameras each season to download data and entered it into our project database. We also collocated 42 automated acoustic recorders (ARUs) at the camera sites and collected songbird detection data from the breeding season through fall migration. Preliminary results from our hare surveys indicate that snowshoe hare abundance varies in relation to stem density and that habitat use shifts from winter to summer. During the spring of 2022, we mapped all 14 sites using drone-based LiDAR. The processing and analysis of LiDAR data began in the fall of 2022 to produce high resolution forest inventory maps of metrics

Katelyn Courtot setting audio recorders at a project stand in the White Mountain National Forest.

such as stem density and shrub cover. To coordinate field efforts and data analyses, we met once per season, communicating more often during spring and fall fieldwork. In winter 2022, we held an afternoon collaborator meeting to share results and progress in 2021. We also met with project cooperators to discuss low-cost options for mapping forests for wildlife that could be used by small landowners.

Drone, equipped with LiDAR sensor, ready for takeoff at one of our low elevation sites in the White Mountain National Forest.

Plans for 2023

Our focus for 2023 is to continue with analyses and write papers that we plan to submit to peer-reviewed journals that focus on biodiversity conservation and forest management. Briefly, we will compare LiDAR metrics to our plot-based estimates of forest structure collected in 2020. This approach will be useful for determining if LiDAR metrics correlate with traditional forest inventory methods. We will also use the LiDAR metrics as predictors to evaluate forest conditions that lead to 1) higher snowshoe hare abundance, and 2) co-occurrence patterns between hares and American martens. Next, we will use data from remote cameras and ARUs to evaluate if areas used by hares and martens contain higher species richness of mammals and songbirds. Ultimately, the results from these analyses will be used to guide forest management practices that encourage higher biodiversity. To ensure our approach is useful to people and communities of the Northern Forest, we will also explore low-cost methods for mapping forests and wildlife habitat (e.g., Structure from Motion; SfM). The consensus from our meeting in 2022 was that we could map a subset of our sites using less expensive drones outfitted with SfM cameras to see how these compared with higher resolution, more expensive LiDAR maps.

Collaboration

Our team includes co-PI Dr. Tony D'Amato from the University of Vermont, co-PIs Dr. Michael Palace and Franklin Sullivan from the University of New Hampshire, and Dr. David Lutz from Dartmouth College. Our research collaborators, which date back to 2014, include Leighlan Prout from USFS, specifically with the White Mountain National Forest (WMNF), Rachel Cliché from the United States Fish and Wildlife Service, and Jillian Kilborn from the New Hampshire Fish and Game Department. Other project collaborators include Chris Bernier and Dr. Katy Gieder from the Vermont Fish and Wildlife Department and Henning Stabins from Weyerhaeuser. Our research includes a diversity of sites with different management practices and regimes. As such, we expect that results from this study will be useful for guiding forest management for wildlife at the WMNF and other National Forests (e.g., Green Mountain National Forest) as well those that are representative of the landscapes in the Northern Forest.