

High-Elevation Mammal Communities in a Biodiversity Hotspot in the Southeastern U.S.

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Introduction

The Southern Appalachian Mountains host numerous rare and endemic mammal species, many of which are associated with spruce-fir forests^{1,2}. Spruce-fir forests are restricted to peaks and ridgelines above 1,370 m. This forest type is expected to contract under future climate change and become replaced by lower elevation northern hardwood forests³. The area where spruce-fir forests and northern hardwood forests mix is called the ecotone. **Currently, we have a limited understanding of how mammal communities vary across the spruce-fir—northern hardwood gradient and whether high elevation mammal species can persist in the lower elevation forest types.**

Questions

- How do mammal species richness and species diversity vary between forest types?
- How do mammal communities change across an elevational gradient?

Methods

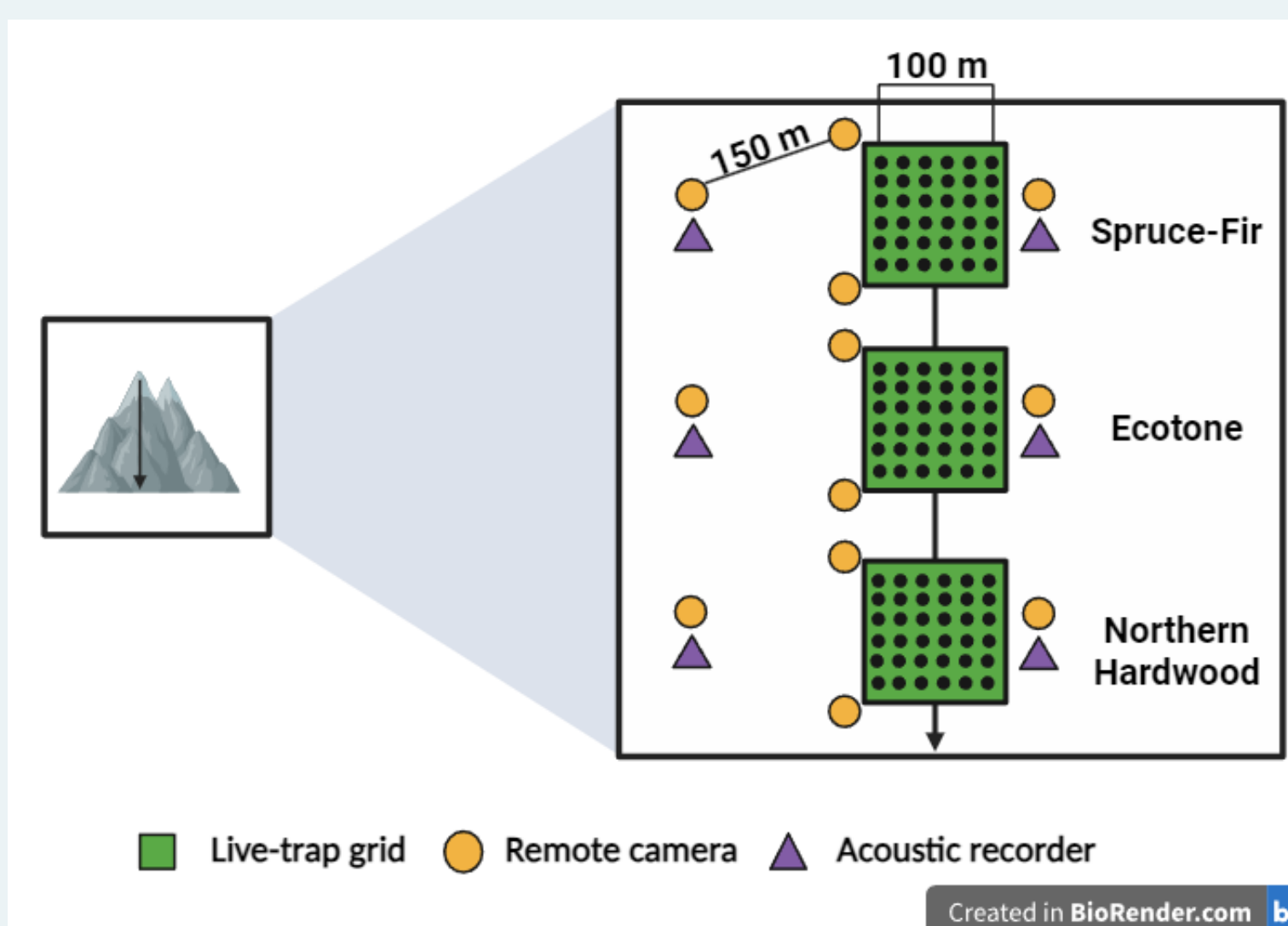


Figure 1. Mammal occurrence data were collected using identical methods at three forest types along an elevational gradient on two mountains during June-July 2023.

Small mammal live-trapping + DNA analysis of *Peromyscus spp.*

Remote camera trapping

Ultrasonic acoustic surveys



Results

- Species richness and diversity were highest in the ecotone on both mountains. Lowest species richness was in the spruce-fir forest on both mountains and lowest diversity was in the spruce-fir forest on Roan Mt. and in the northern hardwood forest on Grandfather Mt.
- On Grandfather Mt., *G. sabrinus coloratus* was the only species found solely in spruce-fir. The remaining nine species, including *P. maniculatus* and *M. gapperi* who are traditionally associated with spruce-fir, were also found in the ecotone and/or northern hardwoods. Four other species were found only in low elevation forest types. On Roan Mt., *Sylvilagus spp.* was the only spruce-fir restricted species; the rest were found across all forest types/in the lower elevation forest types only.

1 How do mammal species richness and diversity vary between forests?

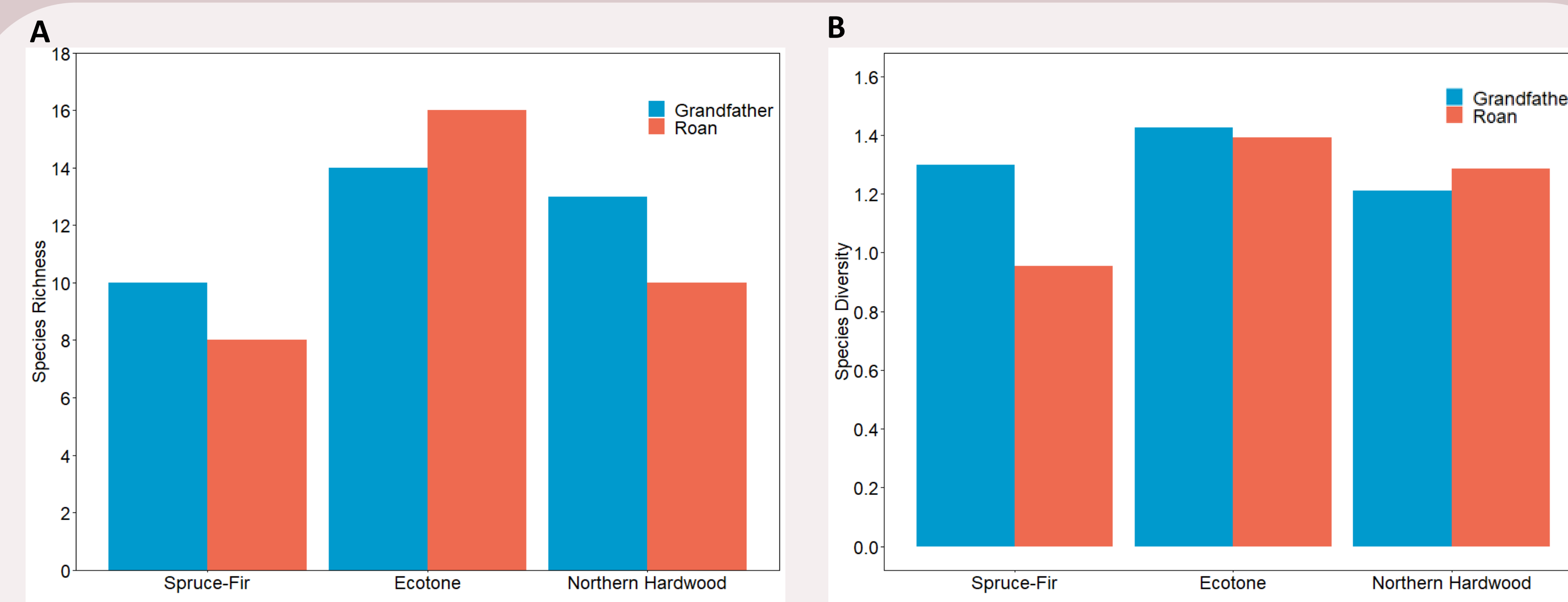


Figure 2. Species richness (A) and diversity (B; Shannon Index) were highest in the ecotone.

2 How do mammal communities change across elevation?

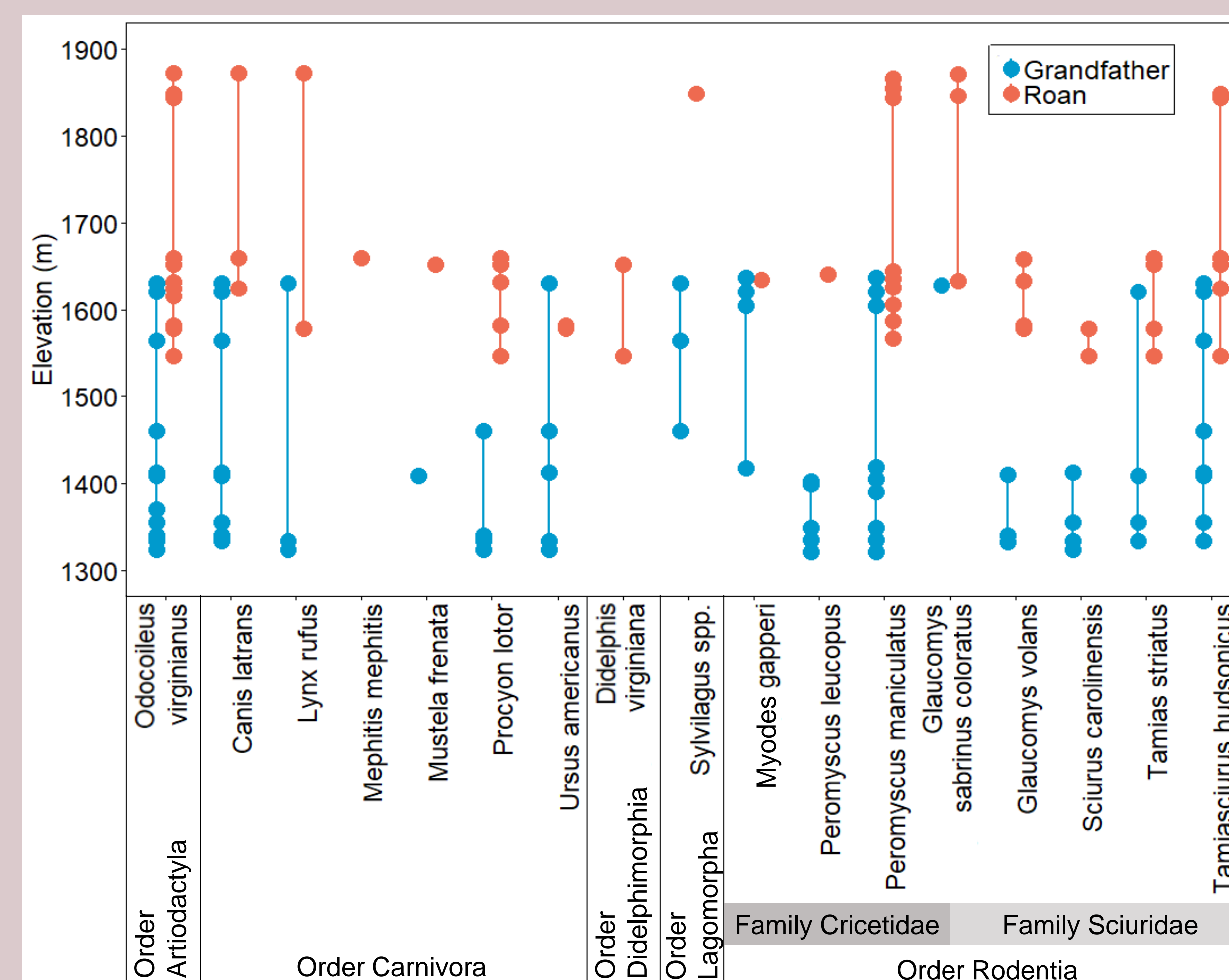


Figure 3. Species detections from all survey types on Grandfather and Roan Mountains. Points show exact elevations where each species was detected. With a few exceptions (*G. sabrinus coloratus*, *Sylvilagus spp.*), spruce-fir-associated species also occurred in the ecotone and in some cases in the northern hardwood forests. Roan Mt. surveys took place between 1,549 m and 1,872 m and Grandfather Mt. surveys took place between 1,324 m and 1,631 m.

Study Sites

Field surveys took place on two mountains in the Southern Appalachian Mountains: Grandfather Mountain and Roan Mountain. The center of each study site is shown below, with Roan Mt. sites pictured on the left and Grandfather Mt. on the right. Topmost photos are of spruce-fir forests, followed by the ecotone, and northern hardwood forests on the bottom.



Future Directions

The ecotone forests may serve as a refugia for spruce-fir adapted mammals under future climate change. Future surveys should replicate this study on additional mountains spanning the spruce-fir—northern hardwood gradient in the Southern and Central Appalachians to better understand the role of the ecotone in facilitating high-elevation species persistence. We also recommend studies to focus on elucidating the abiotic and biotic factors that determine mammalian species distributions and on identifying where species niche overlap occurs within spruce-fir—northern hardwood forests.

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