

How do characteristics of aspen woodlands and surrounding vegetation affect prevalence of aspen heartrot fungus?

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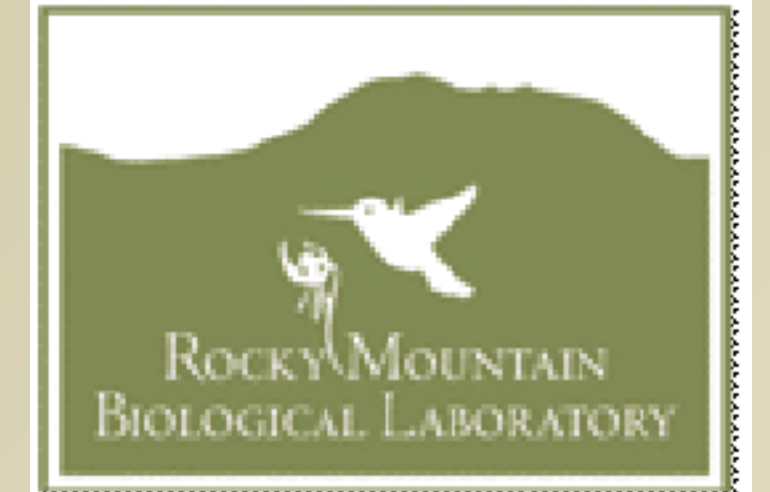


Photo by C. Floyd
Photo by J. Lowney
Fig. 1. Sporocarp (reproductive body) of aspen heartrot fungus (*Phellinus tremulae*) infecting an aspen tree. Arrow indicates nest cavity of red-naped sapsucker.

The red-naped sapsucker, one of the most important keystone species in North America, nests almost exclusively in aspen trees infected with the heartrot fungus, *Phellinus tremulae*. The fungus softens the heartwood, thus facilitating cavity excavation by sapsuckers. Despite the obvious importance of the fungus, little is known about its ecology. Our objective was to determine how the prevalence of the fungus was influenced by characteristics of aspen stands and surrounding vegetation. In June–July 2010, we measured multiple variables within 48 randomly-selected plots (0.25-ha) in the Colorado Rocky Mountains. To account for effects of elevation and riparian zones, we sampled plots within two elevation belts, upper (3000–3050 m) and lower (2850–2900 m); within each belt we selected 12 plots with greater and 12 with lesser amounts of riparian cover within 300 m. Contrary to previous studies we found no effects of stand maturity on fungal prevalence. Fungal prevalence increased with proportion of stand composed of conifers, and it was also higher at sites with greater riparian cover, though only at upper elevations.



Photo by C. Floyd
Fig. 5. Phil Rynish standing in montane meadow, aspen woodlands in background; Elk Mountain Range of Colorado.

Abstract

Background

Sapsuckers and heartrot fungus

Red-naped sapsuckers nest almost exclusively in aspen trees (*Populus tremuloides*) infected with aspen heartrot fungus (*Phellinus tremulae*), which softens the heartwood, facilitating cavity-excavation by sapsuckers (Fig. 1).

Sapsuckers as keystone species

Sapsuckers are considered keystone species because their nest holes ultimately provide nesting habitat for several species of birds, mammals, and invertebrates (Figs. 2 & 3). Additionally, the willow sap wells they create provide food for other animals (Fig. 4).

Conservation implications

Key elements of red-naped sapsucker habitat are riparian zones (where they feed on willow sap; Fig. 4) and aspen woodlands (Fig. 5), both of which have seen extensive degradation in recent decades. E.g., there has recently been extensive dieback of aspen woodlands throughout the Rocky Mountains (Fig. 6). Nesting sapsuckers also depend on the aspen heartrot fungus, the ecology of which is poorly understood.

Methods

Study area

The study area was composed of aspen woodlands in the following valleys of the Elk Range near the Rocky Mountain Biological Laboratory: Carbon Creek, West Brush Creek, Middle Brush Creek, Washington Gulch, and the upper East River Valley (Fig. 7)

Selection of study sites

- Study sites were chosen by overlaying a 22 x 14 grid of squares onto aerial maps (from Google Earth) and randomly selecting squares (each square corresponded to 2 ha on the ground; 308 ha for whole grid)
- The center point of a selected square was deemed a potential study site if it was located within an upper (3000–3050 m) or lower (2850–2900 m) elevation belt, within an aspen woodland, and > 500 m from an already selected site
- From the pool of potential study sites in each grid, we selected two sites—the one with the most and the one with the least riparian cover within 300 m
- We then randomly ordered this reduced list of potential sites and walked to each point. A point was chosen as a study site if it was confirmed to meet the three requirements above
- These methods produced 12 study sites in each of four categories: High elevation/High riparian, High elevation/Low riparian, Low elevation/High riparian, Low elevation/Low riparian



Photo by C. Floyd
Fig. 2. Red-naped sapsucker (*Sphyrapicus nuchalis*) feeding on its nestling in aspen tree



Photo by D. Inouye
Photo by Chris Floyd
Fig. 4. Willow-dominated riparian area with montane meadows, aspen woodlands, and conifer (spruce-fir) forests in background. Inset shows willow branch with wells drilled by sap-feeding red-naped sapsuckers.

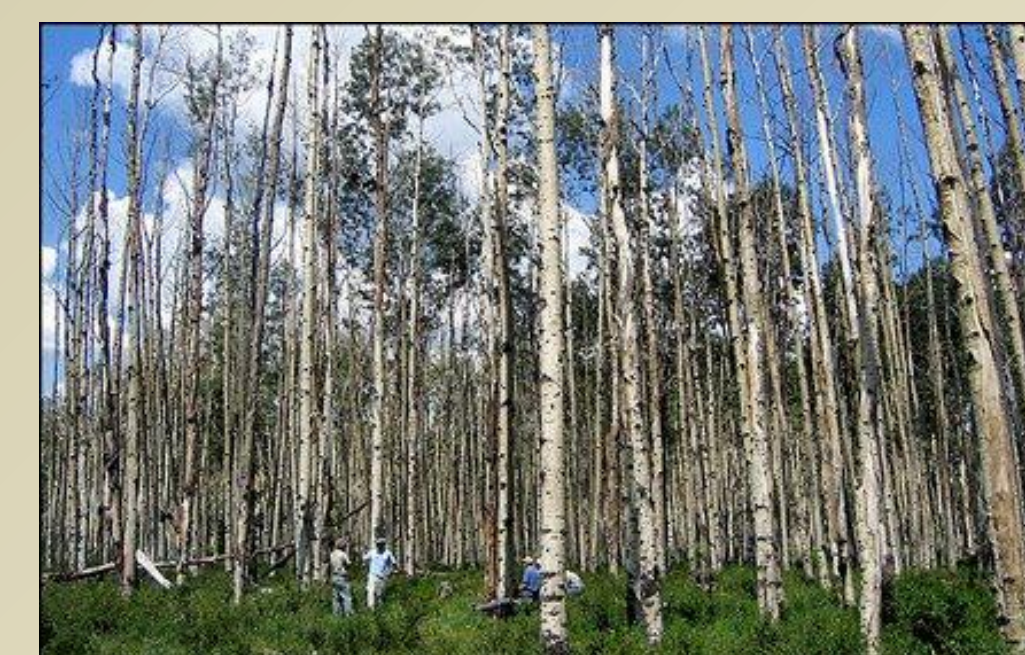


Fig. 6. Example of widespread dieback of aspen woodlands

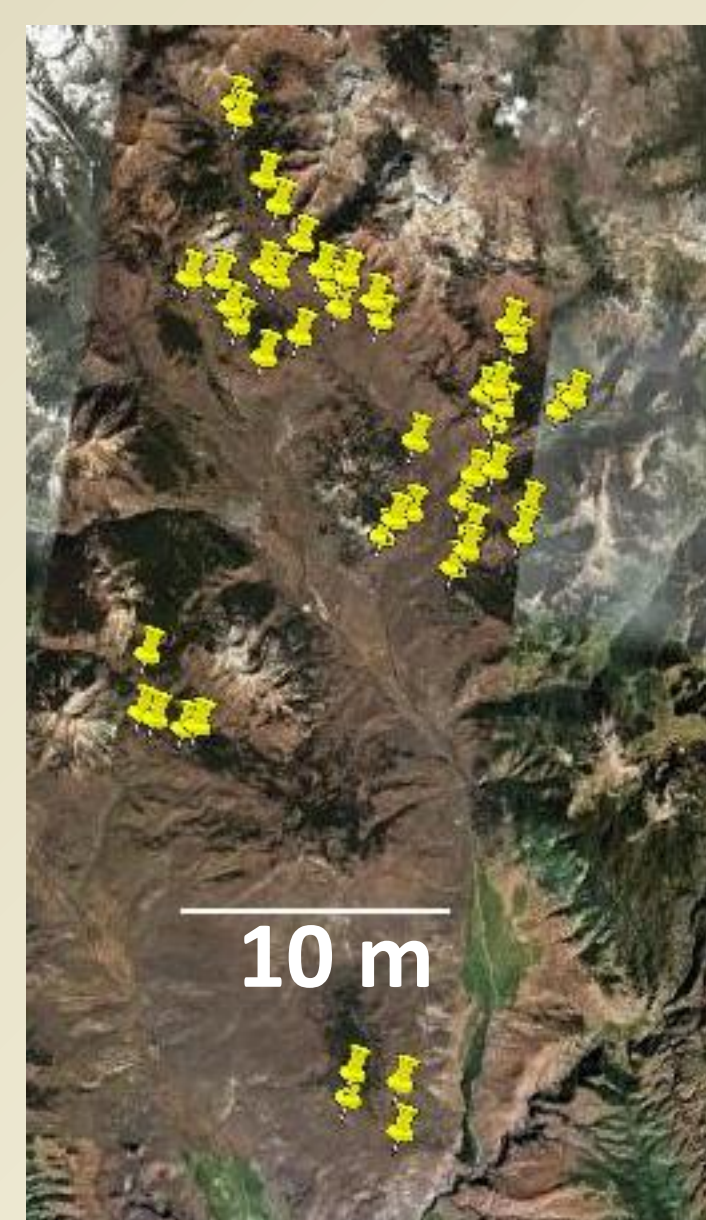


Fig. 7. Study area, located in Elk Mountains near Gothic, Colorado. Yellow markers show study plots.

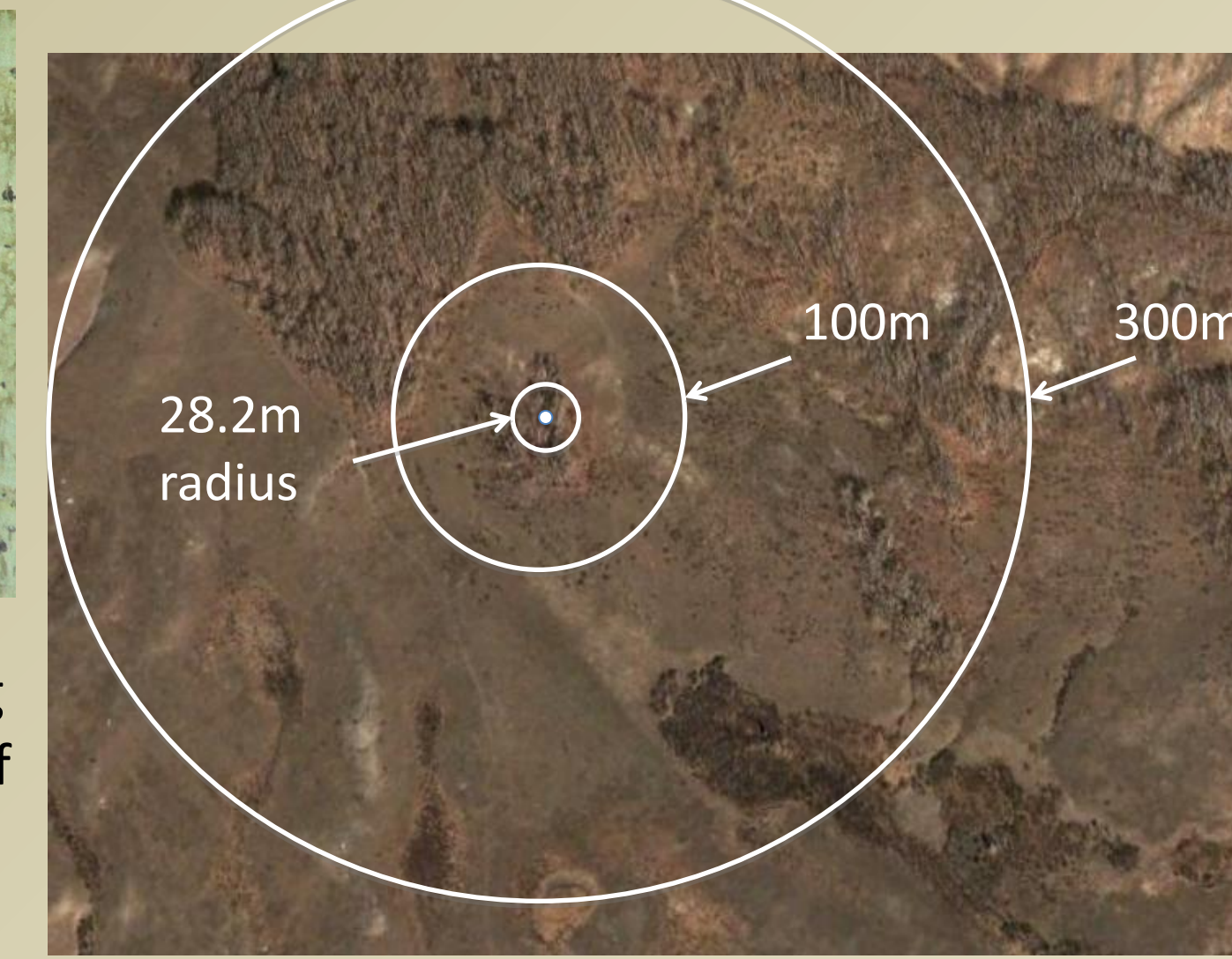


Fig. 8. Scale of measurements: 0.25 ha (28.2 m radius) plots, and area within 100 m and 300 m of center tree. Aspen woodlands are light green; riparian areas darker green (surrounded by meadow).

Variables Measured

Study sites were 0.25 ha circular plots centered on an aspen tree; variables measured within each plot included:

- numbers of large (≥ 17 cm DBH), small (≥ 5 DBH < 17 cm), and sapling (< 5 cm DBH) aspens and conifers; noting whether alive or dead (snags)
- numbers of large and small aspens with sporocarps of heartrot fungus
- numbers of fallen trees > 5 cm DBH

Using Google Earth the following characteristics of surrounding vegetation were measured:

- distance to nearest meadow, nearest willow, and nearest water
- distance upslope from valley bottom
- proportion of cover by aspens, conifer, meadow, and riparian vegetation within 100 m; and cover by riparian vegetation within 300 m

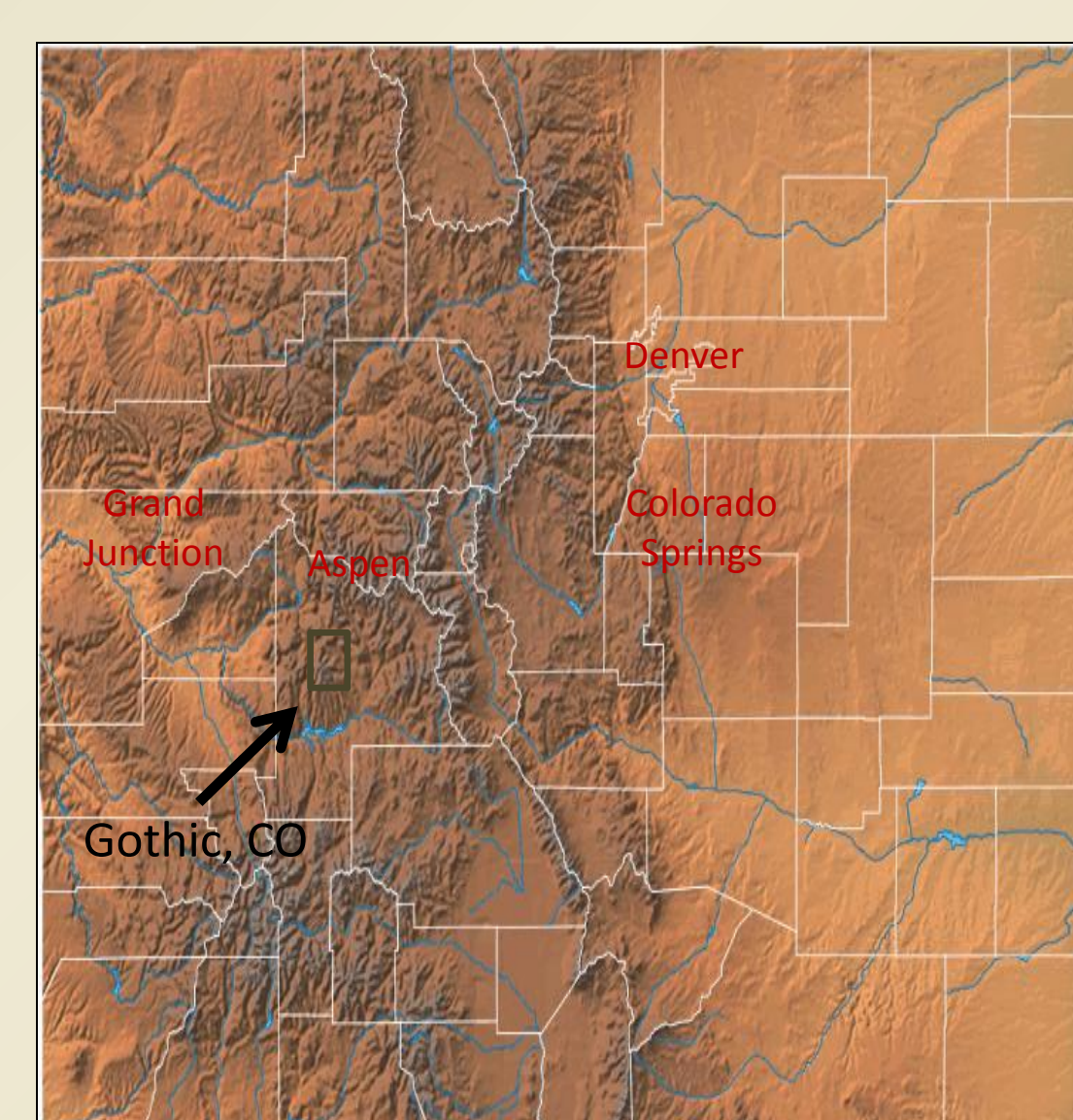


Fig. 7. Study area, located in Elk Mountains near Gothic, Colorado. Yellow markers show study plots.

Results

- No relationship between fungal prevalence (proportion of aspens with heartrot fungus) and forest maturity (measured as proportion of trees that were large and/or dead; and amount of canopy cover)
- Fungal prevalence was significantly higher in sites with greater amount of riparian vegetation, but this relationship was found only at upper elevations (Fig. 9)
- Fungal prevalence increased with proportion of conifers (proportion of trees within plot and within 100 m that were conifers; Fig. 10)

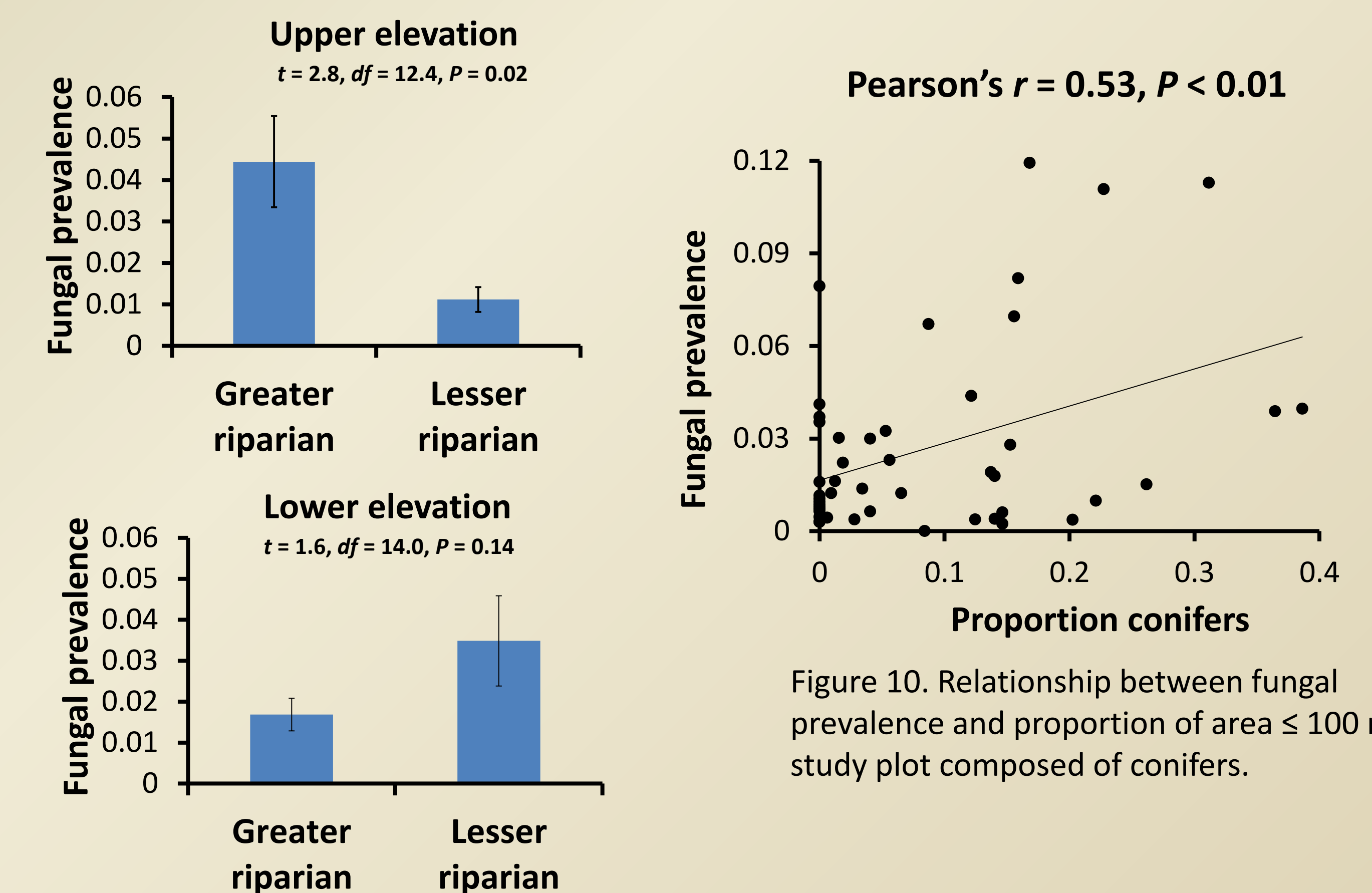


Figure 9. Relationship between fungal prevalence (number of aspens with sporocarps of *P. tremulae*) and amount of riparian vegetation within 300 m of the study plot, at upper (3000–3050 m) and lower (2850–2900 m) elevations. “Greater riparian” was riparian cover > 3%; “Lesser” was < 3%.

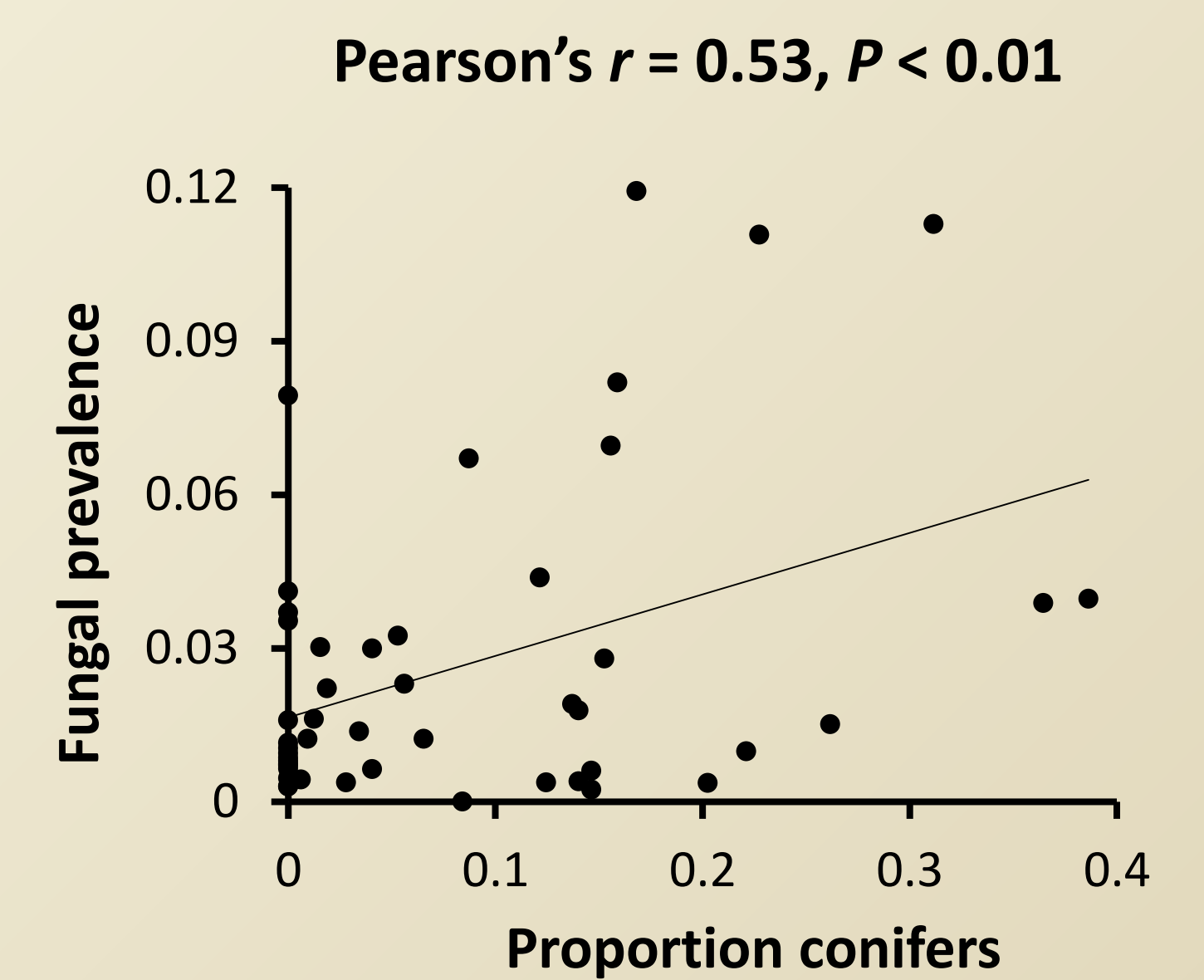


Figure 10. Relationship between fungal prevalence and proportion of area ≤ 100 m of study plot composed of conifers.

Conclusions

- The most important factors determining distribution of aspen heartrot fungus remain elusive
- The correlation between fungal prevalence and conifers suggests that the probability of infection by heartrot fungus increases with stand decadence (as indicated by encroaching conifers)
- The relationship between fungal prevalence and riparian zones varies with elevation
- Effective conservation and management of red-naped sapsuckers and the associated cavity-nesting community may require a more thorough knowledge of the ecology of aspen heartrot fungus

Acknowledgments

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