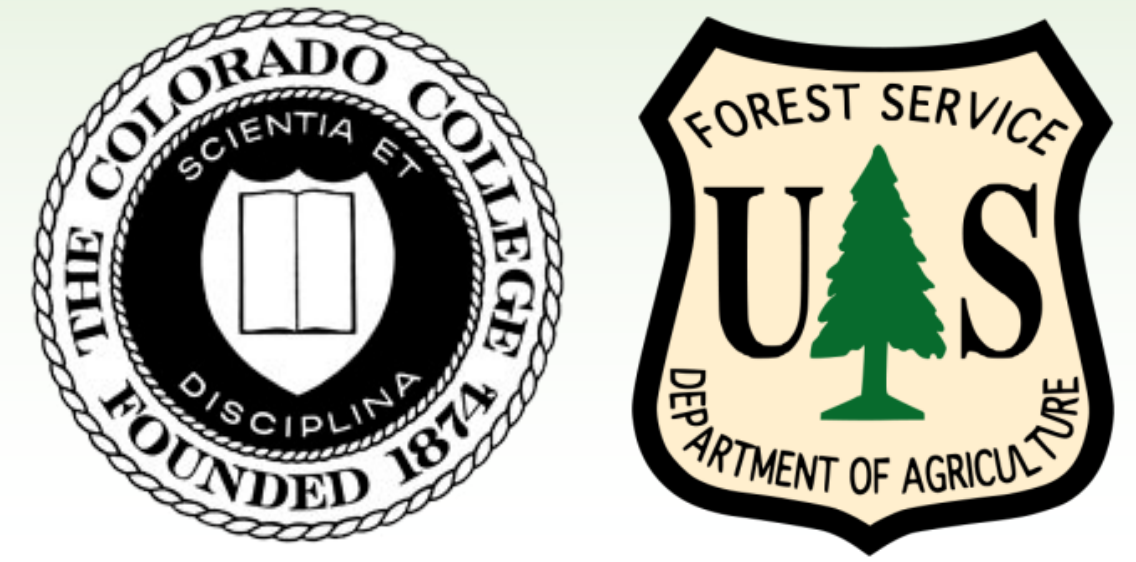




Impacts of Nest Habitat Quality on Flammulated Owl (*Psiloscops flammeolus*) Reproductive Success in the Pikes Peak Region

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INTRODUCTION

The flammulated owl (*Psiloscops flammeolus*) is an insectivorous nocturnal raptor that breeds in the montane ponderosa pine ecosystems of western North America. Male flammulated owls are territorial, and clutch size typically consists of 2-3 eggs (Kaufman 2016). Flammulated owls are obligate cavity nesters that rely on the presence of primary cavity excavators such as woodpeckers (family Picidae) to provide suitable nest habitats that promote the reproductive success of the species. Because flammulated owls are an indicator species, examining characteristics of their nesting habitats can have important conservation implications. Some of these characteristics include the height of the nest cavity as well as the type of excavator cavity.

The American red squirrel (*Tamiasciurus hudsonicus*) is a diurnal mammal that primarily feeds on the seeds of conifer cones and is distributed widely across North America. Although they are primarily granivores, the red squirrel can opportunistically incorporate other food sources into its diet – especially during times of food supply stress. One of these opportunistic food sources for the squirrels is the flammulated owl; the red squirrel will sometimes devour the eggs or even the nestlings of this small raptor. Since 1981, January-June precipitation in the Manitou Experimental Forest has progressively declined significantly over time. This decrease in precipitation has led to reduced conifer cone productivity, so we can infer that there is a correlation between the changes in weather patterns resulting from climate change and the decrease in flammulated owl productivity due to food stress in red squirrels.

Given increases in frequency and severity of drought in the western United States due to climate change (Allen et al. 2010), understanding the nest habitat choices of flammulated owls in their changing environment is crucial. Our study uses nest habitat data collected from 2010-2019 compared to total available suitable cavity habitat data collected from 2014-2016 to focus on specific characteristics of nest habitat selections made by flammulated owls.



Figure 1: A female flammulated owl roosts at the entrance of a large bear-torn nest cavity, keeping watch for predators (and loud humans) with eyes slightly open.

OBJECTIVES & HYPOTHESIS

- Acquire and analyze long-term demographic information on a single population of flammulated owls (*P. flammeolus*) in the Pikes Peak region
- Assess indirect impacts of characteristics of chosen nest habitats compared to the total available suitable nest cavities on a population of flammulated owls
- Because lower cavities are more accessible to opportunistic squirrels, I hypothesize that flammulated owls select higher nest cavities across all tree species than the average height of suitable cavities. Furthermore, I also predict predated nest cavities are lower than successful nests.
- I predict that Northern flicker cavities are more heavily selected for by flammulated owls than sapsucker cavities due to their larger size.



Figure 2: A nestling flammulated owl surveys a new, foreign world after spending its entire life inside the nest cavity. We attempted to band and bleed every nestling in every nest we found.

METHODS

- The four study sites used are located in the Manitou Experimental Forest and were used to examine nest habitat quality of flammulated owls.
- Territory boundaries were determined based on responses of males to territorial calls. These territory boundaries remain similar from year to year.
- Nests were located in each territory, and vegetation sampling was conducted to evaluate nest-selection criteria.
- Members of each breeding pair and owlets were captured, measured, identified (if previously banded), and banded (if previously unbanded).
- Total confirmed nests and captured birds were tracked through Excel spreadsheets on a yearly basis. Statistical analysis was done through use of Excel's statistical analysis package.

FIGURES

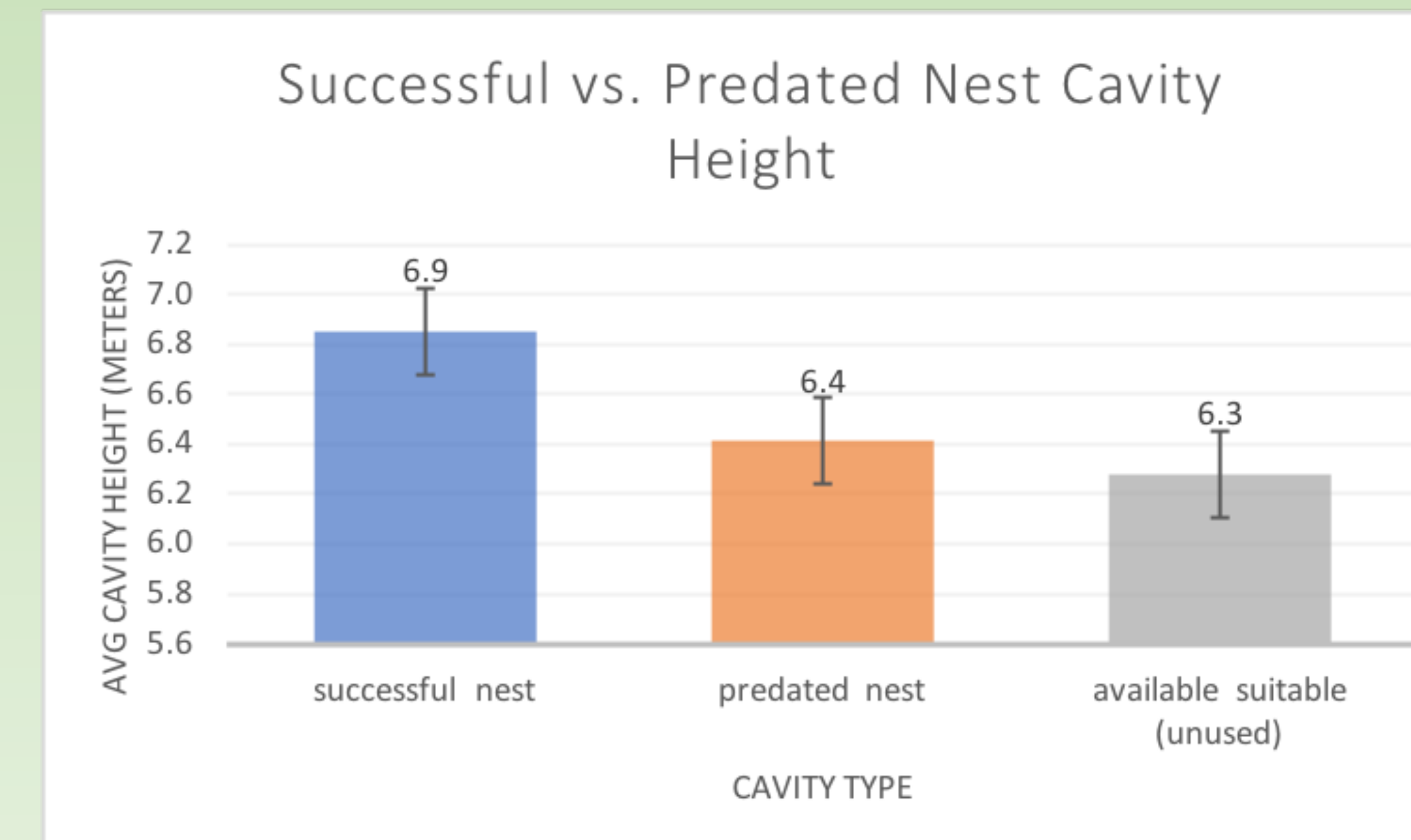


Figure 3: Nests generally have a significantly higher cavity height than available suitable cavities. However, when segregated by nesting success, only successful nests are significantly higher than what is available.

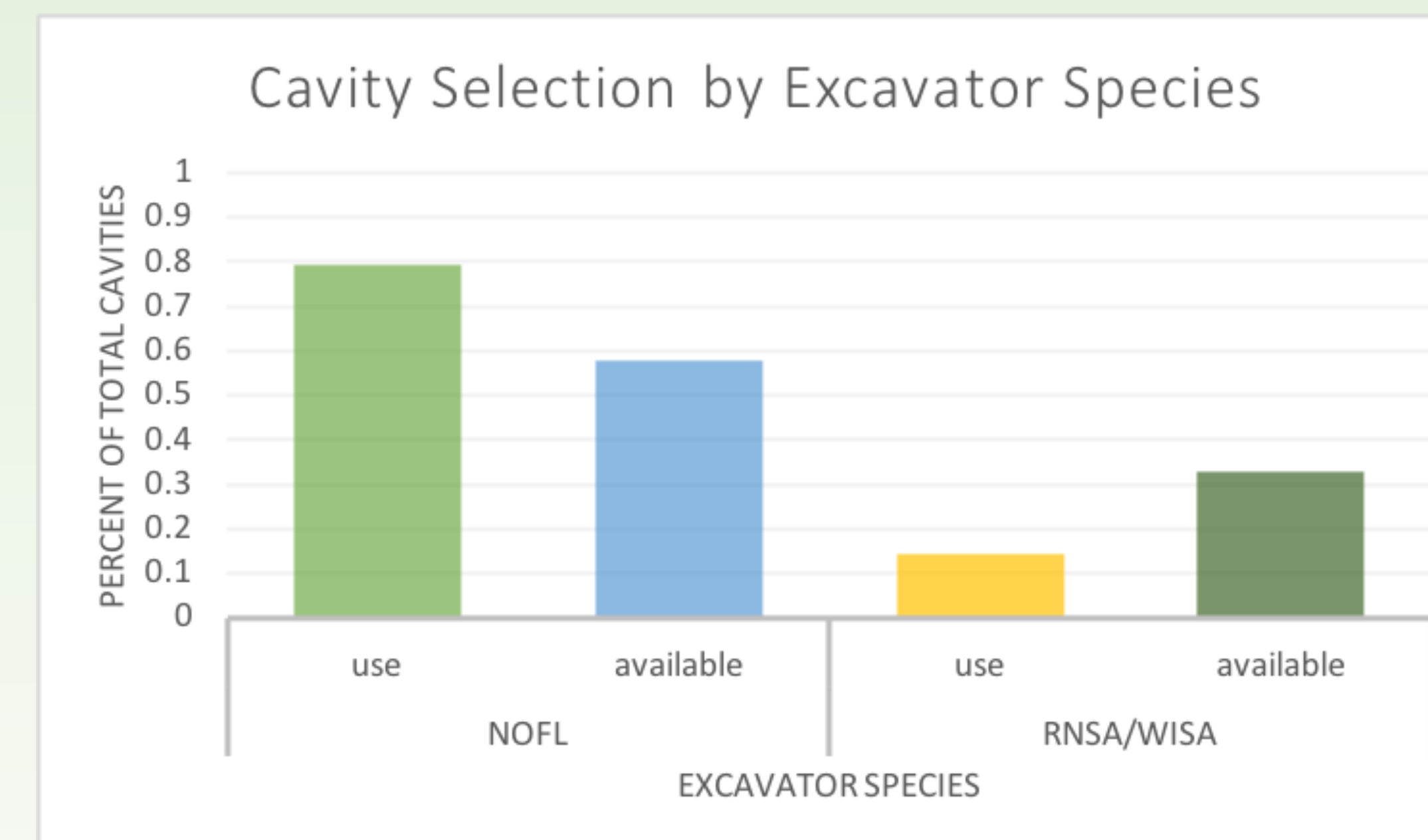


Figure 4: Percentage of cavities available and used by excavator species. Northern flicker cavities are more abundant than red-naped and Williamson's sapsucker cavities, and flammulated owls are more selective for NOFL nests than RNSA/WISA nests.



Figure 5: A mother flammulated owl prepares to take flight from her nest due to human disturbance. After we leave the site, the female will return to the nest generally after several hours.

RESULTS

- Nests have higher cavity heights than available and suitable cavities that go unused.
- Flammulated owls that have successful nests select significantly higher cavities than what is available, but flammulated owls with nests predated by red squirrels do not.
- Flammulated owls select Northern flicker cavities at higher rates than what is available and sapsucker cavities at lower rates than what is available.

DISCUSSION

It was previously thought red squirrels were not a significant selective force on flammulated owl nest habitat selection. However, results of this study provide evidence to suggest that nest predation by red squirrels is driving flammulated owls to select for higher cavities. However, nest predation has become more frequent since 2000 as the impacts of climate change have advanced (Linkhart, unpublished data). As arboreal, opportunistic generalists, red squirrels will incidentally discover and predate nests, but once learned, they may search for nests, especially when traditional food sources are scarce (Pelech et al. 2012). As severity and frequency of droughts in the American West have increased, cone production has decreased in some coniferous species (Roland et al. 2013). Climate predictions for Colorado expect these precipitation trends to only continue (Schwinning et al. 2008). Therefore, one can expect Red Squirrels to continue to heavily shape Flammulated Owl nest habitat selection in the future. It will be important to further understand these predator-prey relationships, especially in managed forests where suitable cavities are more of a limiting resource.

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