

The impact of whitebark pine (*Pinus albicaulis*) mortality on Clark's Nutcracker (*Nucifraga columbiana*) demography and habitat selection
2014-2024 Field Research: Multiscale landscape patterns of habitat selection and resource tracking by the Clark's nutcracker, an avian seed disperser

Project Report/Executive summary

Whitebark pine (WBP; *Pinus albicaulis*) is a keystone species in the western U.S., and an obligate mutualist of Clark's nutcrackers (*Nucifraga columbiana*) because its seeds sprout almost exclusively from nutcracker seed caches. WBP is declining and has been proposed as a threatened species under the U.S. Endangered Species Act. Evidence suggests this decline is leading to a downward trend in local nutcracker populations, which would in-turn decrease WBP regeneration. Clark's nutcrackers are important for forest regeneration and seed dispersal of at least ten conifer species. They shape the ecosystem by annually storing up to 98,000 seeds in thousands of separate locations; seeds not retrieved for food are able to germinate. Nutcrackers are highly mobile, facultative migrants, and information on landscape scale space use is essential for more accurate predictions of nutcracker metapopulation stability, and local and range-wide resilience of the Clark's nutcracker-WBP mutualism. To address this information gap, as part of my larger study of Clark's nutcracker behavior, I began the first study to attempt satellite-tagging Clark's nutcrackers, for the first time studying Clark's nutcracker space use behavior at an ecologically relevant geographic spatial scale. We successfully satellite-tagged seven nutcrackers in Bridger-Teton National Forest in 2014, and seven in the North Cascades, Washington in 2018.

Our primary objectives are to examine variability in seasonal home ranges and core use areas, habitat selection, long-distance movements, and connectivity between distant habitats. Additionally, we are currently developing resource selection (RSF) function maps derived from movements of satellite-tagged Clark's nutcrackers. Results will aid local managers develop strategies for local and range-wide restoration and conservation actions, through improving managers' ability to identify and manage Clark's nutcracker habitats and connectivity between distant habitats, as well as providing definitive information on Clark's nutcracker habitat selection and use, which is critical for designing effective management strategies. Seasonal predictive nutcracker occurrence maps will inform WBP restoration efforts: locations with higher probability of nutcrackers would be ideal for planting blister-rust resistant seedlings, and locations with low probability would require planting. Satellite-tracking Clark's nutcrackers in two geographically distinct regions, northwest Wyoming and Washington's Cascades, enables comparisons, for the first time, of Clark's nutcracker resource tracking, landscape scale long distance movements, and habitat selection in regions with different habitat types and health. These analyses will allow for better predictions of population stability and resilience locally and throughout their range.

2020 Publications

- Ray, C, RM Rochefort, JI Ransom, JCB Nesmith, SA Haultain, **TD Schaming**, JR Boetsch, ML Holmgren, RL Wilkerson, and RB Siegel. 2020. Assessing trends and vulnerabilities in the mutualism between whitebark pine (*Pinus albicaulis*) and Clark's nutcracker (*Nucifraga columbiana*) in national parks of the Sierra-Cascade region. PLoS ONE 15(10): e0227161.
- **Schaming, TD**, and C Sutherland. 2020. Landscape- and local-scale habitat influences on occurrence and detection probability of Clark's nutcrackers: Implications for conservation. PLoS ONE. 15(5): e0233726.

Publications Currently in Preparation

- **Schaming, TD**, TL Lorenz, PH Singleton, and JI Ransom. (*In preparation.*) Clark's nutcracker space use, home range and habitat selection, comparing two regions, the Northern Cascades, Washington and the Greater Yellowstone Ecosystem; implications for conservation.

Outreach (since 2020 status report)

- Since 2018, I have regularly updated a website for this project, www.thenutcrackerecosystemproject.com.
- Clark's Nutcrackers and Whitebark Pine: Pivotal Players in our western mountains. *Invited talk at Williams College.*
- Presentation on my research to International Baccalaureate School, Saudi Arabia, 4th grade class.
- Radio interviewee, "A talk on the wild side", www.kaxe.org.
- I will include my research results in a future presentation to the Jackson Hole Bird Club, sponsored by the Jackson Hole Wildlife Foundation and the Northern Rockies Conservation Cooperative.

Associated research

Since October 2019, I have been collaborating with Dr. Alison Scoville, Central Washington University, and Dr. Teresa Lorenz, U.S. Forest Service, on a Clark's nutcracker acoustic monitoring project in Washington's Cascades. Because nutcracker detection rates have been reported as low and variable during standard point counts, including when radio-tagged birds are known to be present, in 2020 we initiated this study, for the first time quantifying nutcracker occupancy and habitat use with acoustic recorders. Our overall goal is to understand environmental drivers of Clark's nutcracker occurrence relative to WBP stand characteristics and cone production. Our primary project objectives are to: (1) evaluate nutcracker occupancy as a function of WBP stand density, basal area, health, habitat mosaic, and cone presence/absence and density, while accounting for imperfect detection, using acoustic monitor data, (2) inventory WBP cone crop levels and WBP health through cone counts and habitat surveys during a predicted mast cone crop year, to use as covariates in nutcracker occupancy analyses, and (3) enable student engagement and provide research experience for undergraduates. This is the second year of a proposed long-term acoustic monitoring project, building on Clark's nutcracker-WBP research begun in 2009. In our 2020 pilot season, we developed, tested and refined field protocols for acoustic monitor deployment, collected 906 days of acoustic data at 12 random points and completed habitat surveys. In 2021, we will conduct surveys at an expanded number of sites. Comparing nutcracker occupancy and habitat use during the 2020 low WBP cone crop and the 2021 predicted mast cone crop will allow for a better understanding of how habitat

impacts nutcracker occurrence under variable conditions. This project will continue as a series of student projects, with the long-term goal to developing, launching and maintaining a citizen science monitoring project.

How grant money was used

Funds from the Meg and Bert Raynes Wildlife Fund award have been depleted, but the project is ongoing. Current funding is from Seattle City Lights (WA: 2020-2021); United States Forest Service (WA: 2020-2021); North Cascades National Park NR Regional Block (WA: 2020-2023); Ricketts Conservation Foundation (Yellowstone: 2020-2021).