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The Bottom Line:
Clark's Nutcracker Seed Cache Recovery

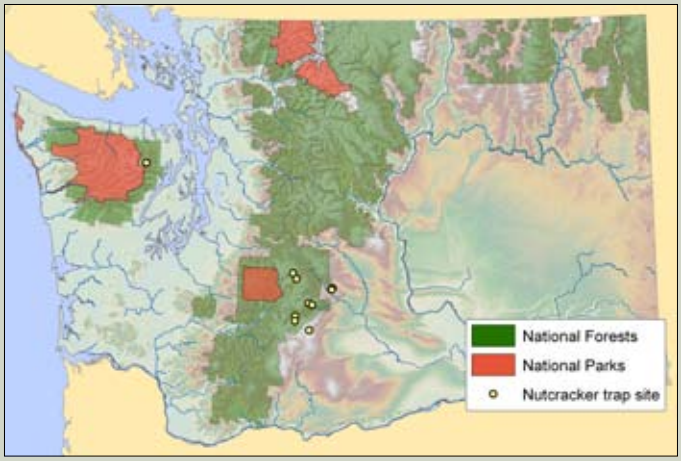
CLARK'S NUTCRACKERS are masters at harvesting and storing tens of thousands of pine seeds every year. But these industrious efforts are but hollow promises for whitebark pine regeneration if all seed stores are consumed. Recovering the cache is the ultimate test of nutcracker dispersal effectiveness. What's a tree (or a manager) to do?

BACKGROUND

We investigated habitat use, caching behavior, and migratory patterns in Clark's nutcrackers in the Pacific Northwest using radio telemetry. Over 4 years (2006–2009), we captured 54 adult nutcrackers at 10 sites in the Cascade and Olympic Mountains in Washington State. We fitted nutcrackers with a back-pack style harness. The battery life on the radio tags was 450 days, and we tracked nutcrackers year-round, on foot (to obtain behavior observations) and via aircraft (to obtain point locations). We obtained more than 6,000 telemetry point locations on radio-tagged nutcrackers, and we observed more than 1,000 seed-harvest events and 655 seed-caching events.

Of nutcrackers captured in this study, we classified 20 nutcrackers as residents and 21 as emigrants wintering on our study area. Among residents, 11 had home ranges in whitebark pine stands and 9 had home ranges in ponderosa pine stands.

The future of whitebark pine is of serious concern because of the species' vulnerability to white pine blister rust, mountain pine beetle infestation, wildfires, and climate change. The Clark's nutcracker is the primary means of whitebark pine seed dispersal.



THE STUDY'S Clark's nutcracker trap sites.

How many seeds do nutcrackers cache each year and how many of these can germinate?

Observations of nutcracker daily time budgets suggest that individual nutcrackers store from 35,000 seeds (California) to 98,000 seeds (Wyoming) in a year of high cone production (reviewed in Tomback 1998). However, not all seeds are placed in locations where seed germination is possible. Using telemetry, we found that 42 percent of whitebark pine seeds were cached in low-elevation habitats, not suitable for germination. Even in appropriate whitebark pine habitat, most caches were placed in trees, such that only 16 percent of all whitebark seed caches ended up in habitats and microsites where germination was possible.

What proportions of whitebark pine seed caches are never recovered?

No studies have measured the number of seeds recovered by nutcrackers in a year. However, using a series of calculations based on nutcracker energetic requirements, Tomback (1982) estimated that 45 percent of seed caches would not be needed by nutcrackers before seeds germinated in June. (Nutcrackers also eat germinating seedlings in spring and summer.)

What's the point of storing all that excess seed?

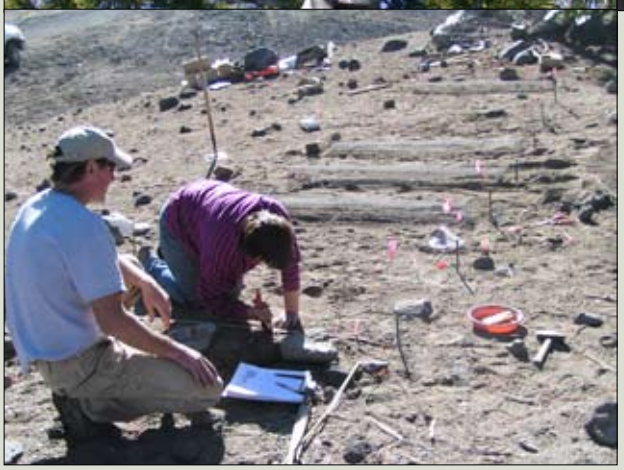
Simple insurance! By storing more seeds than they need to survive and reproduce, nutcrackers protect themselves against loss of cached food due to unpredictable events—such as rodent pilferage, spoilage, heavy snowfall, or erosion. Moreover, nutcrackers might not remember the locations of some seed caches, and these seeds are then effectively lost. Although they do remember the locations of seed caches for long periods of time, nutcrackers appear to begin forgetting the locations of seed caches between 5 and 9 months after cache placement (Balda and Kamil 1992).

When are most seed caches recovered?

Seed caches can be retrieved at any time of the year. However, it appears that most retrieval from memory occurs from mid-winter through early spring (January-March), when energetic requirements are high and when nutcrackers are preparing for their breeding season. In March and April, stored seed becomes less important (Giuntoli and Mewaldt 1978) as insects begin forming a major component of the nutcracker diet, remaining so until early August. Beginning in July, nutcrackers will also start harvesting unripe

Nicholas Ernst

IN THE wild, nutcrackers appear to maintain memory of seed cache locations by revisiting cache sites. They also often move their caches to new locations, sometimes many times over the course of a year.



Clockwise: Kimora Ward, Richard Sniezko, and U.S. Forest Service

ALTHOUGH MORE research is needed, all current studies to date suggest that managers should not rely on Clark's nutcracker seed dispersal for effective restoration—nutcrackers are too efficient as seed predators. The most reliable known method requires the labor-intensive work of collecting seed, growing seedlings in nurseries, and planting seedlings once they are large enough to escape predation.

conifer cones and will forage on conifer seed as long as possible (for ponderosa pine, sometimes until the following spring).

Despite their reliance on stored seed during winter, nutcrackers are opportunistic foragers. We found that nutcrackers in late fall and winter spent most foraging time searching for insects, pecking through old cones, or visiting hunter-killed game. Others have reported nutcrackers predating small birds and mammals or consuming carrion (reviewed in Tomback 1998). By actively searching for food during winter, they reserve their seed stores for situations in which nothing else is available, thereby increasing their chances of survival and reproductive success.

Are seedlings safe or savory?

In past studies, predation of whitebark pine seedlings was typically attributed entirely to rodents. In fact, germinating whitebark pine seedlings can be an important spring and summer food for family groups of nutcrackers, too. From the nutcracker's perspective, one major benefit of foraging on seedlings is that memory of their locations is unnecessary; they can be found and consumed simply by systematically searching along the ground.

From the tree's perspective, there are no benefits to such a behavior—all seedlings are at the mercy of flocks of hundreds or thousands of nutcrackers.

The tree combats this predation by producing crops of seed cones in cycles ("masting"), such that, for most years, relatively few cones are produced and nutcracker populations are culled; in other years, more seeds are produced than can be consumed.

GERMINATING SEEDLINGS, like the one shown above, can suffer high mortality from nutcracker predation in summer.

Douglas Archer

UNRECOVERED NUTCRACKER seed caches are the primary means of regeneration for whitebark pine. Resource managers would like information on the number of unrecovered seeds to assess regeneration potential within stands.

Greg Okimi

TOMBACK (1982) estimated that nutcrackers may store nearly 10,000 extra seed caches—this is seen as a bet-hedging strategy to protect against unpredictable events.

THE BOTTOM LINE: MANAGER'S PERSPECTIVE

Can managers rely on caching alone for restoration?

The relationship between whitebark pine and Clark's nutcracker is one of continual, mutual exploitation. Even though nutcrackers are indispensable for whitebark pine regeneration, the birds are first and foremost seed predators, and the goal of each individual nutcracker is to recover as many seed caches as possible for personal benefit. Trees can increase the likelihood of effective dispersal for their seeds through masting—when occasional bumper seed crops result in more seeds being cached than can possibly be consumed.

Humans have no control over these cycles. Plus, seeds could still be predated by rodents or by other nutcrackers the following summer once they begin germinating. The simple fact is, most seeds will likely be lost to predation or cached in sites where seeds cannot germinate.

How can we maximize regeneration?

Since whitebark pine is already faced with a menacing set of threats from blister rust, fire suppression, and pine beetle, many populations may be poorly equipped to face nutcracker seed predation.

The most reliable way to maximize whitebark pine regeneration is through a pro-active program of collection and plantings. In this way, managers can ensure that trees are placed back on the sites where restoration is needed in a life form that is too old and well-developed to be consumed by seed predators, such as nutcrackers and rodents.

FURTHER READING

Balda, R.P.; Kamil, A.C. 1992. Long-term spatial memory in Clark's nutcracker, *Nucifraga columbiana*. *Animal Behaviour*. 44: 761–769.

Giuntoli, M.; Mewaldt; L.R. 1978. Stomach contents of Clark's nutcrackers collected in western Montana. *Auk*. 95: 595–598.

Tomback, D.F. 1982. Dispersal of whitebark pine seeds by Clark's nutcracker–a mutualism hypothesis. *Journal of Animal Ecology*. 51: 451–467.

Tomback, D.F. 1998. Clark's nutcracker (*Nucifraga columbiana*). In: Poole, A.; Gill, F., eds. The birds of North America. No. 331. Washington, DC: American Ornithologist's Union.

IN FOOD-STORING songbirds, caching behavior is influenced by many factors—for example, black-capped chickadees from northern latitudes cache more food than birds from southern latitudes.

FOR FURTHER INFORMATION

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FACT SHEET 7 of 8 highlighting new details about Clark's nutcracker habitat use in Washington State. Prepared by Teresa Lorenz and Carol Aubry, based on a study conducted by Teresa Lorenz. Research funding provided by Seattle City Light Wildlife Research Program; U.S. Forest Service; Utah State University Biology Department; and Utah State University Ecology Center. Photos by Teresa Lorenz unless otherwise noted. Editorial support provided by Forest Service EMC Publishing Arts. Design and layout by Forest Service PNW Research Station.