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Caching at the Microsite Scale:
Clark's Nutcracker Cache Site Selection, Part III

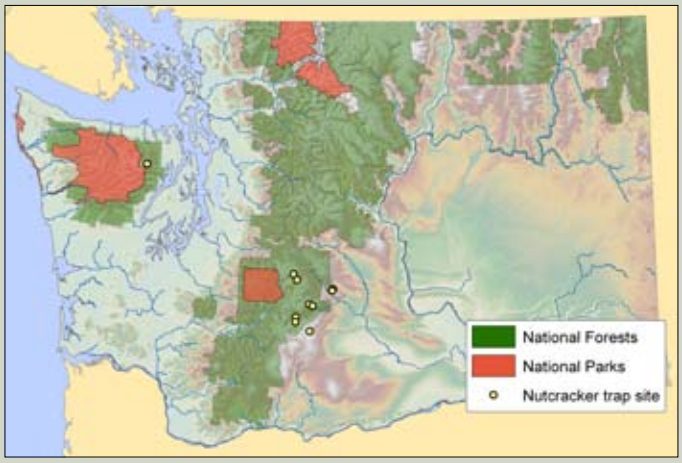
WITH EASE, nutcrackers fly into the canopies of trees, poke at the bark, and tussle bunches of lichen. Why? They're placing more than half the seeds they collect up in the canopies of living trees, a good way to keep seeds out of the deep winter snow, but not good places for young trees to germinate and grow. How important is microsite, anyway?

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.

What microsites did nutcrackers select for seed caches in this study?

We observed 655 caches placed by 12 resident nutcrackers; 450 ponderosa seed caches, 199 whitebark seed caches, and 6 caches of an unknown seed type. Among ponderosa and whitebark pine caches, they cached 59 percent of seeds above ground in the forest canopy (385 caches) and the remaining 41 percent below ground in soil, gravel, or forest litter (264 caches). Most aboveground caches were placed in living trees with foliage (86 percent, or 330 of 385 caches), and caches were placed under slips of bark, in clumps of needles, or in bunches of lichen. Most below ground caches were placed in sites with understory or overstory cover and within 4 m of a tree that could be used for cover from predation (see table, next page). Even when caching seeds in open habitats like talus slopes, nutcrackers selected sites near trees. Overall, 93 percent of below ground caches were placed within 9 m of a tree offering possible cover. There was no significant selection for sites with a particular slope, aspect, or ground cover type.

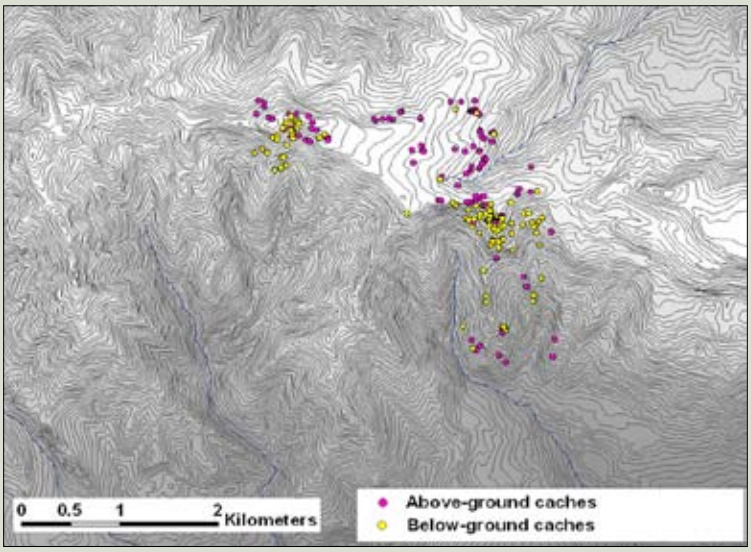
Why does it matter?

The caching behavior of nutcrackers in autumn determines patterns of regeneration in whitebark pine. This is because nutcrackers subsist year-round on pine seeds, which are produced only in autumn, so the birds need to store seeds in order to have food for winter and spring. Nutcrackers place the seeds in small "caches" of one to five seeds and, for various reasons, some caches are never retrieved. Clark's nutcrackers play a critical role in seed dispersal for more than 10 conifer species in western North America. Some species, like the declining whitebark pine, rely on nutcrackers for all seed dispersal.

TO INVESTIGATE microsite scale caching, we compared features at nutcracker cache sites to a random sample of microsites available within home ranges.

TABLE—Number of whitebark and ponderosa pine seeds placed in above- and below-ground cache sites and in different habitats by 12 resident Clark's nutcrackers from 2006 through 2009

		Whitebark pine seed caches		Ponderosa pine seed caches	
Habitat type	*Number placed in habitat type*	*Number of above-ground caches*	*Number of below-ground caches*	*Number of above-ground caches*	*Number of below-ground caches*
Cliff/talus	83	13	23	11	36
Mixed high elevation forest	75	64	5	4	2
Mixed low elevation forest	183	36	32	73	42
Parkland whitebark pine forest	3	2	0	0	1
Parkland ponderosa pine forest	134	5	4	58	67
Whitebark pine forest	57	7	2	47	1
Ponderosa pine forest	108	2	4	62	40
Burns	6	0	0	1	5
Total		129	70	256	194



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THIS MAP shows the placement of aboveground and below ground caches by 4 Clark's nutcrackers in the autumns of 2006–2008. Note that most aboveground caches were placed on north-facing slopes and at high elevations (sites that receive and accumulate high amounts of winter snow) compared to below ground caches, which were placed on south-facing slopes or at lower elevations. The photo shows the terrain depicted in the map, with the steep, south-facing slope used for most below ground caches and the higher elevation, north-facing whitebark pine stand used for aboveground caches.

How specifically did we study 'microsite scale' selection?

We first followed radio-tagged nutcrackers to their cache sites, marking the locations of all observed caches using portable GPS units. Then we noted whether the cache was placed below ground (in the soil, forest litter, or gravel) or above ground (in stumps, logs, or tree branches). For all accessible below ground caches, we revisited the cache sites in summer. We estimated the following parameters within a 1-m-radius circle centered on each cache site:

1. Percentage canopy cover;
2. Percentage understory cover;
3. Percentage ground cover by rock, soil, litter (usually pine needles), and vegetation;
4. Slope;
5. Aspect;
6. Distance to nearest tree that could be used for cover from predation; and
7. Patch type.

We then measured these same features at one random site located within 30 m of the cache site. We used logistic regression to evaluate whether features were selected or avoided relative to their availability (Manly et al. 2002).

How does this compare to past studies?

Previous studies revealed that nutcrackers select a wide variety of microsites for caching. Among 24 observed caches, Tomback (1978) found that most were placed at the bases of logs or trees. Dimmick (1993) observed 911 caches and found that 60 percent of caches were placed near trees that could be used for cover. These results suggest that nutcrackers most commonly cache seeds below ground and near living trees. However, these studies did not measure the availability of microsite features, so there is no information on whether features were selected (used in greater proportion to their availability), avoided (used in lesser proportion to their availability), or simply used in proportion to their availability (Manley et al. 2002).

What does habitat-scale selection have to do with microsite-scale selection?

We found that the selection of a microsite depended highly on the cache habitat type (see table, facing page). In high-elevation whitebark pine and mixed forest types, the nutcrackers we observed placed 90 percent of all seeds in aboveground cache sites. In low-elevation forests (or south-facing slopes), they placed only 56 percent of caches aboveground in trees and favored below ground caches. Why? Nutcrackers typically retrieve their seed stores in winter and spring; therefore, they are likely to select cache sites that will enable easy access during winter months. Although they are capable of digging through snow to retrieve seed stores, it is unlikely that they are capable of digging through the 3-m-deep snowpacks typical of the higher elevation forest types in our study area. By selecting aboveground cache sites in those habitat types, nutcrackers place the seeds well above the level of winter snowpack, where they can retrieve them.

IN OUR study of cache site selection, nutcrackers placed most seed caches in aboveground sites. Nutcracker #312 is shown here, caching ponderosa pine seeds under a slip of bark on a Douglas-fir branch.

WHEN CACHING seeds in below ground locations, nutcrackers selected concealed sites, presumably because this minimized predation risk. This photo shows nutcracker #632 caching ponderosa pine seeds in a site shaded with nearly 100 percent understory cover.

THE BOTTOM LINE: MANAGER'S PERSPECTIVE

Can we count on nutcrackers to restore whitebark pine populations?

We quantified seed dispersal effectiveness of Clark's nutcrackers by determining the numbers of whitebark pine seeds placed in locations that were favorable for the establishment of mature, reproductively active trees. In our study area, habitats favorable for whitebark pine maturation include talus slopes and whitebark pine stands. Favorable microsites are below ground and in soil or gravel, where seed germination is possible.

All told, only 16 percent of whitebark pine seed caches were placed in suitable sites—that is, in whitebark pine stands or on talus slopes (suitable habitats) and below ground (suitable microsites). This number seems very low. Because nutcrackers are co-evolved mutualists of whitebark pine, we expected that most seeds would be placed in suitable microsites. But most seed dispersal effectiveness achieved at the landscape and habitats scales was compromised at the microsite scale. Consequently, nutcracker caching behavior raises important questions regarding the roles of humans compared to birds in restoring whitebark pine.

It has been proposed that nutcracker seed dispersal could be a suitable restoration method for whitebark pine in some locations (i.e., a natural regeneration approach). Our results show that nutcrackers disperse relatively few whitebark pine seeds to suitable sites. Although nutcrackers evolved as seed dispersers for whitebark pine, they are likely most effective only when there are mast crops.

Given that whitebark pine seed production has dropped due to tree mortality caused primarily by white pine blister rust and mountain pine beetle, our results suggest that humans should take an active role in collecting seed, growing seedlings, and planting trees on the landscape for effective regeneration.

FURTHER READING

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NUTCRACKERS RETRIEVE most of their seed caches in winter and early spring. Consequently, they need to select cache sites that will be accessible despite a deep snowpack.

FOR FURTHER INFORMATION

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FACT SHEET 3 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.