United States Department of Agriculture
Forest Service
Pacific Northwest Region
2011

Caching at the Landscape Scale:
Clark's Nutcracker Cache Site Selection, Part I

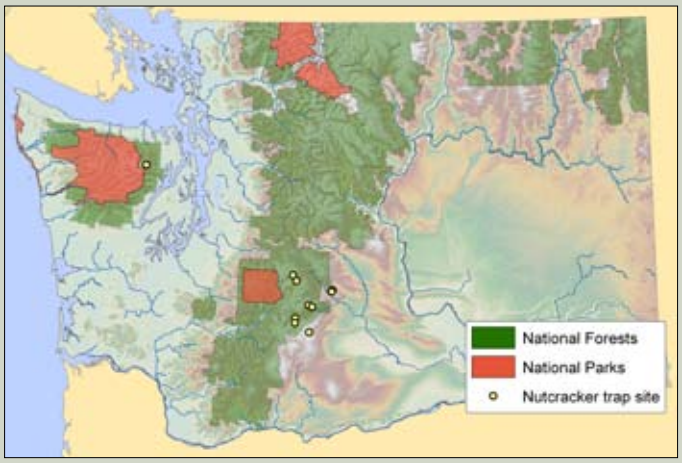
A GOOD home means safety and a reliable winter food supply, but Clark's nutcrackers' home range fidelity and willingness to travel long distances to gather pine seeds could mean bad news for breeding and for the nutcracker's role in whitebark pine restoration.

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.

Where on the landscape do nutcrackers cache seeds?

We found that resident and migratory nutcrackers cached seeds differently. "Caching" describes the food storage behavior of animals that store food in small batches that they later retrieve. A "cache" refers to concealed food items that are typically small in size; most nutcracker caches contain less than 5 seeds. Migratory nutcrackers in this study (2 birds) cached seeds within the seed harvest stands and no more than 2 km from harvest trees; resident nutcrackers (12 birds) cached most seeds within their home ranges. These differences are likely due to differences in overwinter survival strategies—residents overwinter and breed within home ranges, whereas emigrants settle wherever cone production is high.

Why does it matter?

The caching behavior of Clark's 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 must store seeds to have food for winter and spring. The location of seed harvest stands on the landscape relative to nutcracker home ranges appears to be a determining factor in home range quality, and cone production on a landscape scale can limit nutcracker populations by affecting breeding ability.

How far do nutcrackers transport seeds?

Resident nutcrackers in this study transported seeds up to 32 km or more, depending on the location of the seed source relative to the bird's home range; some individuals never transported seeds farther than 2.4 km, whereas others never transported seeds less than 27.9 km (see table, next page).

These transport distances are far greater than seed transport distances reported in past studies. For example, the previously reported maximum seed transport distance for whitebark pine was 12.5 km. Our use of telemetry likely gave us an edge, enabling us to continually track the movements of individuals, even when they transported seeds over canyons, mountain ranges, and up to 33 km.

Our measurements account only for direct, straight-line distances between harvest trees and cache sites, and likely underestimate the energetic cost of long-distance seed transport. For example, nutcracker #312 transported seeds 32.5 km, but travelled over two ridges of 1,850 m elevation between the seed harvest stands at 640 m and its home range at 1,460 m.

TABLE—Seed transport distances for 12 radio-tagged resident Clark's nutcrackers from 13 June 2006 through 20 August 2009

Bird ID (year tracked)	Species of pine harvested	Number of caches	Distance between harvest trees and cache sites[a] (km)	
			Mean	Range
505 (2006)[b]	whitebark	13	29.8	26.5-32.6
	ponderosa	8	20.0	12.9-26.1
746 (2008)	ponderosa	96	17.2	6.1-20.8
091 (2008)	ponderosa	33	0.5	0.0-8.7
043 (2008)	whitebark	64	0.6	0.0-2.4
632 (2008)	ponderosa	84	4.0	3.1-5.6
719 (2006)	whitebark	15	3.6	0.0-7.5
	ponderosa	13	0.5	0.0-3.0
211 (2007)	ponderosa	80	2.9	0.0-8.3
893 (2007)	whitebark	64	2.0	0.0-12.8
	ponderosa	13	8.6	0.0-6.2
893 (2008)	ponderosa	17	11.6	2.8-18.4
312 (2008)	ponderosa	25	18.8	0.0-32.5
312 (2009)[b]	whitebark	20	1.6	0.0-2.0
781 (2008)	ponderosa	39	4.4	3.6-5.2
332 (2008)	ponderosa	7	23.2	20.8-25.6
332 (2009)[b]	whitebark	10	1.5	0.0-2.3
193 (2008)	ponderosa	34	0.9	0.0-4.4
193 (2009)[b]	whitebark	14	5.6	0.0-25.7

[a]Range values rounded one decimal place. [b]Birds 505, 312, 332, and 193 were not tracked for the entire seed harvest season; nutcracker 505 died from a shotgun wound during the ponderosa pine seed harvest season (6 October 2006) and nutcrackers 332, 312, and 193 had radio transmitter batteries fail during the whitebark pine seed harvest season (last dates of tracking prior to transmitter failure were 12 August 2009; 16 August 2009; and 20 August 2009, respectively).

Nicholas Ernst

A SNAPSHOT of whitebark pine regeneration—a Clark's nutcracker caching seeds alongside a whitebark pine seedling cluster and an adult whitebark pine tree.

NUTCRACKER #781 transporting seeds to its home range for caching. Nutcrackers have a unique pouch located beneath their tongues that enables them to transport up to 150 seeds at a time.

NUTCRACKER #893 filling its sublingual pouch with ponderosa pine seeds in September 2008. Based on our observations, all of these seeds were transported 17 km from this harvest tree to cache sites in its home range for storage.

AN ADULT Clark's nutcracker fitted with a radio tag prior to release.

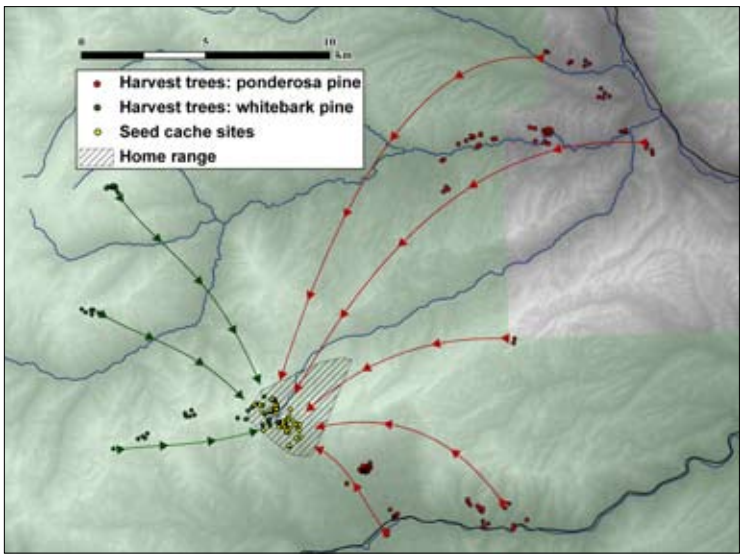
CASE STUDY: Tracking Nutcracker #893 Through Two Autumn Seasons

Clark's nutcracker #893 was captured in 2 consecutive years (2007 and 2008), giving us the unique opportunity to track it during two autumn seasons. It occupied a home range that contained both whitebark pine and ponderosa pine seed sources.

Cone production in whitebark and ponderosa pine varied between years, and nutcracker #893 was forced to harvest seeds from trees in different stands in 2007 compared to 2008. All told, it harvested seeds from more than 20 individual pine stands spread over a 147 km^2 area. Despite ranging far and wide to harvest seeds, nutcracker #893 cached nearly all seeds within its home range. In both years, it cached only about 4 percent of seeds within the distant seed harvest stands, during the early or late parts of the seed harvest season. Based on our calculations, #893 traveled an average of 1,500 km (~1,000 miles) over the course of the autumn seed harvest season (August-November) each year in its efforts to transport seeds home.

The home range represents an area where the nutcracker is less vulnerable to predation and starvation, and a cache of seeds at home means that nutcrackers can forage on nearby food sources during the short, cold days of winter and spring. However, the energy expended by seed-transporting nutcrackers may take its toll. By engaging in energetically costly long-distance seed transport, individuals might not have enough energy reserves for breeding. We found that individuals who transported seeds more than 11 km, on average, did not attempt to breed in the spring following these long distance flights (see table on facing page); in contrast, all nutcrackers that transported seeds an average of 5 km or shorter did attempt to breed.

This seems to be the case for nutcracker #893. In autumn 2007, its average seed transport distance was 3.2 km, and it nested the following spring (March 2008). In autumn 2008, its average seed transport distance was 11.6 km and, to our knowledge, it did not attempt to nest in spring 2009. Overall, the location of cone-producing stands relative to home ranges appears to be a determining factor in the distance that nutcrackers transport seeds, the quantities of seeds stored, and, ultimately, in reproductive fitness.



MAP SUMMARIZING paths of seed transport flights by nutcracker #893 in autumns of 2007 and 2008 (red paths = ponderosa pine seed transport; green paths = whitebark pine seed transport).

Greg Okimi

A PHOTO of the home range of nutcracker #893 above Rimrock Lake, WA. Nutcracker #893 had a prime home range because it contained three major seed sources: whitebark pine occurred at high elevations and above 1,500 m elevation, whereas ponderosa pine and Douglas-fir occurred on south-facing slopes and at elevations below 1,500 m.

THE BOTTOM LINE: MANAGER'S PERSPECTIVE

Can we rely on nutcracker caching to restore whitebark pine stands?

Our results suggest that, at the landscape scale, nutcrackers have the potential to affect genetic diversity in pines more than previously thought and that they are effective long-distance seed dispersers. Could it be possible to increase regeneration in specific diseased whitebark pine stands by simply providing disease-resistant seeds to wild nutcrackers for caching, instead of expensive and intensive planting of disease-resistant seedlings? In short, can we make nutcrackers do the work of restoring whitebark pine on the landscape?

Unfortunately, probably not. For one thing, we cannot easily modify nutcracker caching behavior on a landscape scale. For example, this study showed that nutcrackers show very strong fidelity to home ranges for caching, and until we can alter their selection of home ranges, it is unlikely that we could get them to cache seeds in the stands that are in most need of restoration. Secondly, nutcrackers commonly place seeds in microsites and habitats where seeds are unable to grow and mature. In fact, as whitebark pine declines and low-elevation seed sources become more important food for nutcrackers, a larger proportion of seeds might be transported out of the whitebark pine zone for storage in home ranges located outside whitebark pine zones. Third, and most importantly, nutcrackers are seed predators for whitebark pine, and although many seeds are cached, many seeds are consumed by nutcrackers before they are able to germinate.

FURTHER READING

Lorenz, T.J.; Sullivan, K.A.; Bakian, A.V.; Aubry, C.A. 2011. Cache-site selection in Clark's nutcracker (*Nucifraga columbiana*). *Auk.* 128(2): 237–247.

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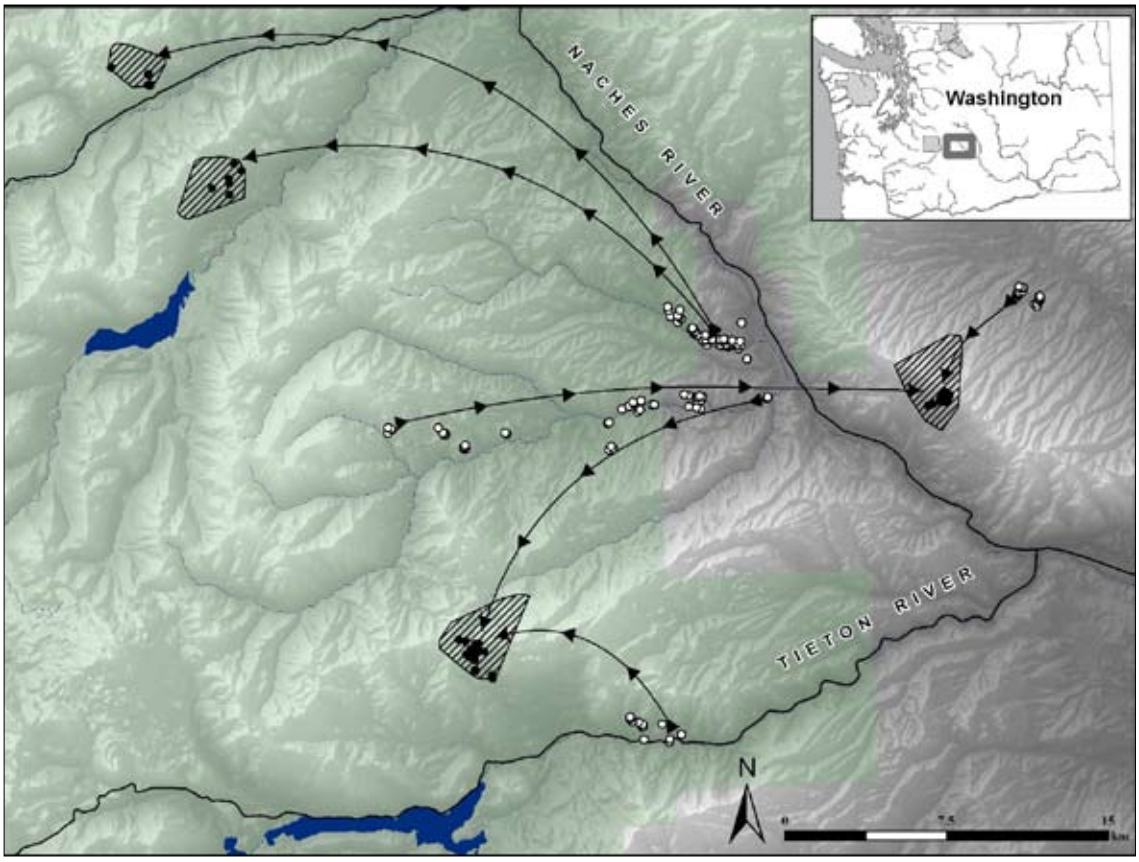

SEED TRANSPORT flights of 4 resident Clark's nutcrackers harvesting and caching ponderosa pine seeds. Polygons represent minimum convex polygons of summer points for the 4 nutcrackers (clockwise and starting at the easternmost home range, nutcrackers #505, #893, #332, and #312). Hollow circles represent seed harvest events, solid circles represent seed caching events, and arrows indicate direction of seed transport from seed harvest stands to home ranges. Seed harvest stands occurred between 649 and 792 m elevation and home ranges between 1,220 and 1,859 m elevation. Nutcrackers #332 and #312 transported seeds over ridges of 1,780 to 2,000 m elevation when traveling between harvest trees and cache sites.

FACT SHEET 1 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.