Radio-Tagging Clark's Nutcrackers: Preliminary Data from a Study of Habitat Use in Washington State.

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Whitebark pine (*Pinus albicaulis*) has coevolved with Clark's nutcracker (*Nucifraga columbiana*) (Lanner 1982, Tomback 1982) and nutcrackers provide the sole mechanism of primary seed dispersal for whitebark pine (Hutchins and Lanner 1982). Nutcrackers forage on the large seeds produced by whitebark pine in autumn and scatterhoard thousands of seeds in subterranean caches to be retrieved later in the year. Seeds that are not retrieved by nutcrackers are able to germinate (Tomback 1982). In response to a range-wide decline in whitebark pine, there is concern that populations of Clark's nutcracker are declining as well. A downward trend in nutcracker populations would have reciprocal effects for whitebark pine population regeneration, and consequently for the viability of subalpine ecosystems in western North America.

Efforts are underway to restore whitebark pine by sowing seeds and planting seedlings in established plots. Natural regeneration is required, however, because it is not possible for land managers to duplicate the unique population genetic structure, successional advantages, and the growth form characteristics enabled by nutcracker dispersal behaviors. To sustain whitebark pine communities, nutcracker populations must be maintained. This requires information on the habitats that nutcrackers use for critical behaviors. To date, research on Clark's nutcracker has been largely restricted to observational studies of harvesting and caching behavior (e.g. Vander Wall and Balda 1977, Tomback 1978, Hutchins and Lanner 1982, Balda and Kamil 1992). There has been no systematic study of habitat use by nutcrackers anywhere in their range. The current study will specifically investigate the following gaps:

- Nutcrackers are known to forage on and cache the seeds of multiple species of conifer in autumn (Giuntoli and Mewaldt 1978, Tomback 1978); yet the relative importance of habitats containing these conifers is unknown (Tomback 1998).
- Nutcrackers store seeds anywhere between 0.001 and 22 km from harvest trees and in a breadth of landscape features, microhabitats, and microsites (Vander Wall and Balda 1977, Tomback 1978, Hutchins and Lanner 1982, Dimmick 1993); a quantitative assessment of variation in cache site selection has not been possible because of limitations in study methodologies.
- Information is lacking on home range and habitat use by nutcrackers during the spring breeding season; in the literature, only 4 nests have been monitored (Mewaldt 1948,

1956), and there is little information on the habitats used by breeding birds (Tomback 1998).

Overall, the proportional use of different habitats by nutcrackers, particularly for critical behaviors such as foraging, seed caching, and reproduction, is speculative because of a paucity of quantitative data.

The objectives of the current study are to quantitatively measure home range size and habitat use, and to determine habitats that are critical for foraging, caching, and breeding in Clark's nutcracker. These objectives can most effectively be addressed using radio telemetry. Throughout this study, nutcrackers will be trapped in mist-nets and noose-carpet traps. All trapped nutcrackers will be banded, aged, and weighed. Adults will be fitted with a 3.9 g (3% of body weight) transmitter (model #A1080, Advanced Telemetry Systems, Isanti, MN) that is secured to the back with a harness. The transmitter battery is expected to last 415 days. Sites for trapping are located on the Okanogan-Wenatchee National Forest in the central Washington Cascade Range. The boundaries of the study area are not fixed, however, and will be determined by the radio-tagged nutcrackers as they move over the landscape.

Individual home ranges will be delineated using fixed kernels estimates (Worton 1989). A Geographic Information System (GIS) will be used to determine habitat attributes at each point of use. Behavior observations at each point (Marzluff et al. 2001, 2004) will enable a quantitative and probabilistic measure of differential habitat use within home ranges and will provide a quantitative means of correlating habitat use with critical behaviors. Variability in cache site selection will be measured by following radio-tagged nutcrackers between harvest stands and cache sites. The locations of harvest trees and cache sites will be marked on GPS units. Discrete choice models (Cooper and Millspaugh 1999, 2001) will be used to calculate the probability that each cache site was selected as a function of specific habitat attributes: dominant cover type, elevation, aspect, slope, proximity to nurse shrubs, soil type, and linear distance to both the harvest tree and spring nest site.

Preliminary data from five months of data collection indicate that there may be considerable variation within populations in summer and autumn home range size. Average summer home range size for four individuals was estimated to be 20.7 km^2 (range 7.7–38.8 km^2). Home range size may be affected by habitat composition. For two individuals with home ranges containing mature whitebark pine, home ranges averaged approximately 10.3 km^2. Home range size for two individuals without whitebark pine within their home range averaged 31.1 km^2. While three harvested pine seed up to 35 km from their home range, caching was only known to occur within the two individuals respective home ranges. Detailed observations were made on the harvesting and caching behaviors of two radio-tagged nutcrackers. One-way flights of up to 30.6 km were made by one radio-tagged nutcracker while traveling between harvest stands of whitebark and ponderosa (*P. ponderosa*) pine and cache sites. The two radio-tagged nutcrackers were observed caching in three landscape features; within closed canopy forests, on steep, bare slopes (70-90º), and within forest openings (5-10 ha). For both individuals, the majority of caches were placed within closed canopy forests, followed by steep slopes, and lastly in forest openings.

This study is expected to last for three years and final analysis of data will occur in 2009. Fifty nutcrackers will be radio-tagged over the course of this study. Behavior observations on these additional individuals will enable more accurate assessments of home range size and habitat use.

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