

The impact of whitebark pine (*Pinus albicaulis*) mortality on Clark's Nutcracker (*Nucifraga columbiana*) demography and habitat selection

2015 Field Research: Multiscale landscape patterns of habitat selection and resource tracking by the Clark's nutcracker, an avian seed disperser

How project objectives were achieved:

Between October 15 and December 11, 2014, I successfully trapped and fit satellite transmitters to eight Clark's nutcrackers. I access location data of the tagged birds from the Argos system via the internet. With the satellite transmitters, I have been documenting nutcracker long distance movements, for the first time studying habitat selection and movement at the ecologically relevant geographic spatial scale over which this conservation-critical mutualism takes place. I will conduct thorough statistical analyses in early 2016 as a portion of my dissertation (expected completion date May 2016). I summarize the highlights here.

I have data from eight Clark's nutcrackers because I removed the transmitter from one bird after 27 days, then reattached it to another bird. Between capture and December 31, 2015, I recorded an average of 688 ± 153 unique points per bird (accuracy of $\pm 250, 500$ or $1,500$ m) on an average of 174 ± 28 unique days per bird (only including data from the seven birds tracked through 2015).

During the 2015 spring breeding season, I discovered that the tagged nutcrackers were regularly moving much further than I had previously documented via tracking with VHF (very high frequency) radio transmitters. As of May 31, 2015, all tagged nutcrackers were primarily located near their trapping sites, as was expected during the winter and spring. However, I documented the birds as far away as 37 km from their trapping site (range = 13 – 37 km), and as far as 35 km between subsequent points (range = 16 – 35 km). These long distance winter and spring movements were previously undocumented. One bird flew ~20 km north into Douglas-Fir/Other conifer (Engelmann spruce, lodgepole pine, and/or subalpine fir) habitat in February, March, April and May, in between returning to its core home range. It also flew west >10 km, across Jackson Hole valley and into the whitebark pine habitat in the Tetons. A second bird flew >10 km west into Douglas Fir/Other conifer, away from its core range, multiple times in October, February, March and April. Not only are Clark's nutcrackers moving long distances in the winter and spring, but they are traveling to distant locations again and again. The birds were also regularly flying at high speeds (average maximum speed = 39 ± 6 km/h, range = 2 – 54 km/h).

The Interagency Grizzly Bear Study Team determined that the 2015 whitebark pine cone crop was average. Clark's nutcrackers are only known to emigrate when there is widespread cone crop failure. Accordingly, because of the average whitebark pine cone crop, I would have assumed that most nutcrackers would remain in the region. However, beginning summer 2015, five of the seven tagged nutcrackers moved out of the Greater Yellowstone Ecosystem. One bird moved ~350 km north, halfway across Montana, then flew back toward the Greater Yellowstone. It was last located in Montana, on the Wyoming border. A second moved to Utah, close to the Wyoming border. Two others moved > 650 km south to the pinyon-juniper woodlands near Escalante National Monument. Another bird stopping transmitting in August, then just began transmitting again in early January from central Utah. In conclusion, five of the seven tagged nutcrackers moved out of Wyoming's Greater Yellowstone Ecosystem, four to Utah, and one to Montana.

State conclusions and effectiveness of project:

These data have important conservation implications. One, Clark's nutcrackers use a much larger area than previously documented for their everyday existence. They use a larger area than expected throughout the year, not only during the fall harvest season, and they use large swaths of space even during a year with an average, healthy whitebark pine cone crop. The birds also use a mosaic of habitat types throughout the year. Based on this data, I expect that the species may require a higher amount of secondary, non-whitebark pine habitat within the Greater Yellowstone than previously assumed. The long distance flights to non-whitebark pine habitat in Utah also suggests that that individuals do not show high fidelity to a region or to specific habitats for fall foraging. This means that if whitebark pine stands decline below a threshold, nutcrackers may largely disappear from the ecosystem, and the Greater Yellowstone may lose the important seed dispersal ecosystem function of this bird. Alternatively, the birds may travel long distances so regularly that even if the majority of individuals move out of the ecosystem due to low whitebark pine cone crops, enough may move through the region that when the cone crop is adequate, they stay and disperse seeds.

No-one has previously satellite tagged Clark's nutcrackers; therefore, as with any new project, there have been surprises. First, all of the birds have stopped transmitting for periods of time, sometimes lasting several months, though most are usually offline for only a few weeks maximum. I also receive many fewer locations for each bird during the winter. This may be because the transmitters only transmit when the batteries are full, and the cloud cover and snow, as well as different behavior in winter, may prevent the panels from receiving adequate sunlight. The transmitters are still functioning, and I continue to receive points. As a result, I anticipate continued transmissions, and an increasing number of transmissions as the year progresses.

How grant money was used:

Funds from the Meg and Bert Raynes Wildlife Fund were used to pay for satellite usage costs for seven satellite-tagged Clark's nutcrackers. See the breakdown of the 2015 costs below:

Amount	Expenses	Date	Source
373.86	satellite usage	Jan 2015	Raynes \$8485 February 2014 Research Award
398.53	satellite usage	Feb 2015	Raynes \$8485 February 2014 Research Award
555.76	satellite usage	June 2015	Raynes \$1500 February 2015 Research Award
527.66	satellite usage	July 2015	Raynes \$1500 February 2015 Research Award
410.95	satellite usage	Aug 2015	Raynes \$1500 February 2015 Research Award
5.63	satellite usage	Sept 2015	Raynes \$1500 February 2015 Research Award
132.23	satellite usage	Sept 2015	Raynes \$3000 July 2015 Research Award
71.54	satellite usage	Oct 2015	Raynes \$3000 July 2015 Research Award
48.95	satellite usage	Nov 2015	Raynes \$3000 July 2015 Research Award

*The dates reflect the month the charges were incurred. Each bill was paid the following month.

*\$2,747.28 is remaining from the Raynes \$3000 July 2015 Research Award. I will continue to use them for satellite usage costs in 2016.

*I currently have additional funds in hand to purchase one new satellite transmitter plus satellite usage, and to fund travel costs for ground truthing satellite location data.

Executive summary

Whitebark pine and Clark's nutcrackers have a fascinating relationship: the trees provide rich, fatty seeds, and the birds "plant" the trees' seeds—a single bird may bury up to 98,000 seeds in a year. The food caches help the birds get through the winter, and the leftovers grow into new trees. Whitebark pine ecosystems are rapidly disappearing in the western United States, and anecdotal evidence suggests this decline is leading to reduced local Clark's nutcracker populations. Since 2009, I have investigated Clark's nutcracker seasonal habitat selection, foraging ecology, movement patterns, and reproductive success in areas with variable whitebark pine mortality, through occupancy abundance surveys, fledgling surveys, radio and satellite tracking, and conducting behavioral observations. In 2014, I fit satellite transmitters to Clark's nutcrackers to document their long distance movements, for the first time studying habitat selection and movement at the ecologically relevant geographic spatial scale over which this conservation-critical Clark's nutcracker-whitebark pine mutualism takes place. My ultimate goal is to determine which management actions will increase the persistence of nutcrackers, and their important seed dispersal function, in the Greater Yellowstone Ecosystem.

In fall 2014, I successfully trapped and fit satellite transmitters to eight Clark's nutcrackers. I continue to access location data of the tagged birds from the Argos system via the internet. I removed the transmitter from one bird after 27 days, then reattached it to another bird. Only including data from the seven birds tracked through 2015, between capture and December 31, 2015, I recorded an average of 688 ± 153 high accuracy, unique points per bird on an average of 174 ± 28 unique days per bird. During the 2015 spring breeding season, I discovered that the tagged nutcrackers were regularly moving as far away as 37 km from their trapping site, much further than I had previously documented via tracking with radio transmitters. Not only are Clark's nutcrackers moving long distances in the winter and spring, but they are traveling to distant locations again and again.

Clark's nutcrackers are only known to emigrate when there is widespread cone crop failure. Accordingly, because of the average size of the 2015 whitebark pine cone crop (per The Interagency Grizzly Bear Study Team data), I assumed that most nutcrackers would remain in the region. However, beginning summer 2015, five of the seven tagged nutcrackers moved out of the Greater Yellowstone Ecosystem. One bird moved ~350 km north into Montana, then flew back toward the Greater Yellowstone. Four nutcrackers moved south to Utah, including two moving > 650 km to the pinyon-juniper woodlands near Escalante National Monument.

These data have important conservation implications. One, Clark's nutcrackers use a much larger area than previously documented for their everyday existence. They use a larger area than expected throughout the year, not only during the fall harvest season, and they use large swaths of space even during a year with an average, healthy whitebark pine cone crop. The birds also use a mosaic of habitat types throughout the year. Based on this data, I expect that the species may require a higher amount of secondary, non-whitebark pine habitat within the Greater Yellowstone than previously assumed. The long distance flights to non-whitebark pine habitat in Utah also suggests that that individuals do not show high fidelity to a region or to specific habitats for fall foraging. This means that if whitebark pine stands decline below a threshold, nutcrackers may largely disappear from the ecosystem, and the Greater Yellowstone may lose the important seed dispersal ecosystem function of this bird. Alternatively, the birds may travel long distances so regularly that even if the majority of individuals move out of the ecosystem due to low whitebark pine cone crops, enough may move through the region that when the cone crop is adequate, they stay and disperse seeds.