
White-headed woodpecker space use in central Washington

2012 annual report

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Introduction

The white-headed woodpecker (*Picoides albolarvatus*) is a species of concern in Washington and Oregon where it occurs in lowland forests dominated by ponderosa pine (*Pinus ponderosa*). White-headed woodpeckers are primary cavity excavators and therefore members of a keystone guild that excavate cavities for many secondary cavity users. Early telemetry studies concluded that they prefer, and may even require, old-growth ponderosa pine stands for population persistence (Dixon 1995a, 1995b). Consequently, the harvest of old-growth pine by early settlers is thought to have caused widespread declines in this species (Dixon 1995a). However, more recent studies of white-headed woodpecker nesting ecology have found them nesting in other forest types, including young and recently thinned and burned stands (Kozma 2009, 2011; Wightman et al. 2010). This suggests that they are more plastic in their habitat requirements than originally thought. Yet information is still lacking on their ecology in managed stands during the non-breeding season, and on their use of space during the breeding season when away from the nest site. To address some of these information gaps we undertook a study in 2011 to examine space use by white-headed woodpeckers in stands representing a range of management histories. This report summarizes preliminary analyses of data collected in 2012, the second year of the study.

Study Objectives

Within our broad study objective, our study questions included:

1. What features within the landscape affect spacing and home range size, and thus density of white-headed woodpeckers?
2. What substrates are used by white-headed woodpeckers for foraging and nesting in stands dominated by young trees versus stands dominated by older trees?

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3. To what extent are current models of nest-site selection (Wightman et al. 2010) and nest success (Hollenbeck et al. 2011) from central Oregon accurate in other regions? Do they accurately predict occupancy and reproductive success in our study population?
4. How are populations structured genetically? Are pairs monogamous within and among breeding seasons, and to what extent does juvenile dispersal affect gene flow within populations?

Methods

We conducted this study in 2012 at four study sites in central Washington: Mission Creek in Chelan County, and Wenas Creek, Nile Creek, and Rimrock Lake in Yakima County (Figure 1). These were the same sites used in our telemetry study in 2011 (Lorenz et al. 2011). Although each study area contained stands of different management history, in general, stands in the Wenas Study Area were dominated by ponderosa pine and composed of younger trees with smaller diameters (Kozma 2011). Stands in the Mission and Rimrock Study Areas were dominated by ponderosa pine but had a greater component of Douglas-fir (*Pseudotsuga menziesii*) and grand fir (*Abies grandis*), and contained older trees with larger diameters. Stands in the Nile Study Area varied from open, heavily thinned patches to areas of small diameter trees and high canopy cover. Portions of the Nile Study Area are within the proposed Nelli Timber Sale. These areas will be thinned and burned beginning in 2013, in part to improve habitat for white-headed woodpeckers.

We used three primary methods to address our study objectives: (1) nest searching/monitoring, (2) color-banding/genetic sampling, and (3) radio telemetry. Nest searching and monitoring during the breeding season (April–July) provided the starting point for all our study objectives. We revisited the locations of historic territories and searched new locations for breeding pairs and their nest cavities. For this report, we

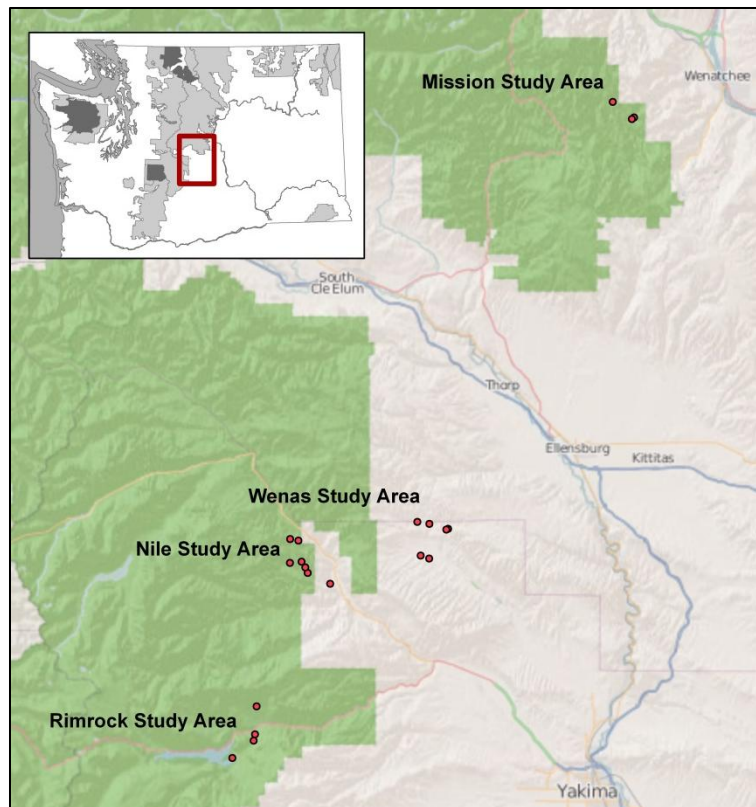


Figure 1. Locations of study areas for this project in central Washington and 2012 nest sites (red circles). Green shading indicates U.S. Forest Service lands.

simply summarized rates of nest success from 2012. Eventually, we will use this information to model nest-site selection and reproductive success across a range of forest types. We also plan to validate models of nest-site selection published in other regions, and determine the extent to which populations differ in regard to habitat features used during nesting.

Color-banding occurred primarily during the breeding season, since birds are most easily captured at their nest sites. Our goal was to color-band all adults and nestlings nesting in the Rimrock, Nile, and Wenas Study Areas. Resightings of color-banded woodpeckers in future years will provide insights into survivorship, site fidelity, mate fidelity, and juvenile dispersal. Genetic samples from all captured woodpeckers will enable us to examine the population genetic structure, as well as provide much-needed information on dispersal and mating systems. Color-banding of nestlings (Figure 2) and intensive genetic sampling within a single population has not occurred for white-headed woodpeckers anywhere in their range.



Figure 2. We banded nestling white-headed woodpeckers 14-21 days after hatching (inset photo) and used the hole-saw method to access nestlings (Ibarzabal and Tremblay 2006). We replaced the sawed hole with a wooden plug and secured it with duct tape and screws. This enabled the adults and their young to resume normal activities as soon as we left the site (main photo). Among 21 nests accessed using this method, all successfully fledged young and all but one had evidence of being used by secondary cavity users after the nesting season.

We used radio telemetry to study white-headed woodpecker space use. Woodpeckers were captured for telemetry at nest sites and water stations using mist-nets, hoop-nets, and noose carpet traps. The transmitters we used have batteries that last 200 days. We fitted transmitters to the back of woodpeckers with an elastic leg-harness (Rappole and Tipton 1991), and visited each individual at least once weekly from May through October. In this report we present summary statistics on home range size and foraging behavior. We plan to further use these data to model space use as a function of habitat attributes, and to examine the extent to which stand age and management history affect spacing and foraging. This will be the first study to examine space use by white-headed woodpeckers in managed and recently thinned and burned stands, and the first to track space use during the entire breeding period.

Results and Discussion

Nest searching

We located 23 nests on 36 white-headed woodpecker territories in 2012. Of the 19 nests we monitored, 15 (79%) were successful (fledged at least one young), three (16%) were unsuccessful and one nest had an unknown outcome. One pair whose nest was predated by common ravens (*Corvus corax*) re-nested by excavating a new cavity and fledged one young. Contrary to published literature (Garrett et al. 1996), this is further evidence that white-headed woodpeckers will attempt to re-nest if their first nest fails early enough in the breeding season to allow time to excavate a new cavity (also see Kozma 2012). Nearest neighbor distances between nests of adjacent pairs ranged from 113–1115 m ($n = 7$ nest pairs), which is comparable to what we observed in 2011 (range 198–1492 m) and what Frenzel (2004) observed in Oregon (335–1383 m). Mean distance between nests from consecutive years (2011–2012) was 225 m (range 27–691 m, $n = 11$), which is similar to the mean of 208 m between nests in 2010 and 2011, and slightly greater than the mean of 179 m reported by Frenzel (2004).

White-headed woodpeckers excavated cavities in snags with the greatest decay (e.g., broken tops) most frequently (69%, $n = 13$), a common trend in this study area (Kozma 2012). Not surprisingly, ponderosa pine snags were used most often. Snags had a mean diameter at breast height (dbh) of 43.6 cm (range 16.0–97.2 cm) which is greater than the eight-year average of 38.1 cm for these same study areas (17.8–69.9 cm, $n = 62$; Kozma unpubl. data). Cavity height averaged 3.9 m (1.0–13.22 m) which is nearly identical to the eight-year average of 3.7 m (0.86–13.1 m, $n = 61$; Kozma unpubl. data), supporting the findings of other research indicating the propensity for this species to nest close to the ground (Raphael and White 1984, Milne and Hejl 1989, Dixon 1995a). Although we began sampling vegetation characteristics at non-used nest sites to model nest-site selection, sample sizes were too small to conduct a preliminary analysis for this report.

Color-banding and radio telemetry

In 2012 we captured and color-banded 16 adults from 11 territories and 35 nestlings/fledglings from 14 territories. Six of these birds were fitted with radio transmitters and an additional nine adults that had been color-banded in 2011 were also radio-tagged.

Survivorship

We estimated annual adult survivorship of white-headed woodpeckers using two methods: color-band returns and telemetry. To estimate survivorship from color-band returns, we used a protocol established by Frenzel (1999) in which adults are banded on territories in one breeding season, and attempts are made to resight them in subsequent breeding seasons. In 2011 we color-banded 29 adults. During the 2012 breeding season we revisited 16 territories to search for 27 of these birds and resighted 21. Following Frenzel (1999), we assumed that turnovers were mortalities and survivorship was 0.77.

This is slightly higher than the range of survivorships of 0.50–0.74 reported by Frenzel (2004) from seven years of color-banding in central Oregon.

We separately estimated survivorship from telemetry, in which we counted the number of mortalities that occurred over the entire period of radio tracking (May through January; Mayfield 1961, Millspaugh and Marzluff 2001). This method is advantageous because mortalities are known, but can underestimate survivorship if radio transmitters themselves affect survival. Based on tracking of 17 birds in 2011 and 18 birds in 2012, survivorship from both years was identical at 0.83. It is noteworthy that this estimate is nearly equal to the estimated survivorship of 0.81 and 0.80 calculated from telemetry data from central Oregon (Dixon 1995a, 1995b; $n = 31$). It is also higher than the estimate of survivorship obtained from color-banding for both this and Frenzel's (2004) study. There are a couple scenarios that may explain why survivorship is higher for telemetry in both study areas. Mortality may be high from January through April, when there have been no telemetry studies that have monitored survivorship. Alternatively, white-headed woodpeckers may not have perfect fidelity to nesting sites between years, and thus turnovers of color-banded birds on breeding territories might not always reflect mortalities.

Home range size

We estimated home range size for two separate time periods. We estimated home ranges for the period July through October in order to compare our study results with Dixon (1995a, 1995b), and separately calculated home ranges for the breeding season (May through August). We used several methods to estimate home range size: 100% minimum convex polygons (MCPs), 85% adaptive kernels, and 95% fixed kernels. MCPs are generally seen as a measure of the entire range of an animal's movements, whereas kernel estimators can be used to describe areas of most frequent use, or core areas (Millspaugh and Marzluff 2001). We used the first two methods in order to directly compare our results with Dixon (1995a, 1995b) but considered the third method, 95% fixed kernels, as the most accurate depiction of home ranges (Millspaugh and Marzluff 2001).

The mean July-October MCP for white-headed woodpeckers in this study was 56 ha (138 acres) (Table 1), which is smaller than the overall mean home range size of 225 ha (556 acres) for woodpeckers inhabiting old-growth ponderosa pine stands in Oregon (Dixon 1995a, 1995b) ($t = 2.29$, $df = 38$, $P = 0.0276$). Many factors can affect home range size, although smaller home ranges are generally associated with higher quality habitat in woodpeckers and other birds (Cody 1985, Convery 2002; but see Van Horne 1983). There was no significant difference in home range size for 85% adaptive kernel estimates between our study (99 ha [245 acres]) and Dixon (76 ha [188 acres]; 1995a, 1995b) ($t = 0.686$, $df = 26$, $P = 0.499$). Thus, it appears that woodpeckers in this study used a similar sized core area to woodpeckers in old-growth stands in Oregon, but ranged less widely than birds in Oregon. From 95% fixed kernel estimates, the mean home range size was 81 ha (200 acres) which is comparable to the estimate of home range size for 85% adaptive kernels (Table 1).

Table 1. Minimum convex polygon (MCP) and kernel estimates of home range size for nine radio-tagged white-headed woodpeckers from July through October 2012 in central Washington.

Territory name	Study area	Sex	n^1	Min. tracked	100% MCP (ha)	85% adaptive kernel (ha)	95% fixed kernel (ha)
New Nile 1	Nile	f	47	290	88	333	170
E-pass Road	Wenas	f	70	290	100	101	115
Boise 2	Wenas	m	88	296	78	91	107
Mud Flat Park	Wenas	m	81	396	65	82	92
Coffin	Wenas	f	126	362	66	94	92
Meadow	Rimrock	f	62	245	48	119	68
Crow	Mission	m	111	327	37	51	58
Peavine	Mission	f	203	629	40	49	42
Lower Nile 4	Nile	m	34	251	17	38	29

¹ n is the sample size of temporally independent telemetry points used in home range analysis

A lightning storm in early September provided an opportunity to assess the immediate response of white-headed woodpeckers to wildfire. A lightning strike within a radio-marked female's home range in Peavine Canyon (Figure 3) on the Wenatchee River District was one of nine fire starts that led to the 19,300 acre Peavine Fire (part of the 57,000 acre Wenatchee Complex Fire), and which later merged with the 42,300 acre Table Mountain Fire. Whenever possible, tracking was continued throughout the 5-week period of fire activity. Aside from taking temporary refuge in a patch of aspen (*Populus tremuloides*) within the Peavine drainage, the wildfire had no visible effect on the movements or foraging of the female who occupied this territory; in fact, rather than range widely or emigrate, she had one of the smallest home ranges of any tracked bird (Table 1). Her response was similar to the behavior of a female tracked in 2011 in our Nile Study Area. Controlled pile-burning was conducted in September and October in her Nile territory but had no visible effect on her movements or foraging behavior. This suggests that disturbance caused by low-intensity fire may have no immediate effect on white-headed woodpecker behavior.



Figure 3. Photos of the Peavine territory before (left) and after (right) the September Peavine fire. The female who occupied this territory showed no visible reaction to the wildfire, except to seek temporary shelter in a low-lying drainage. The snag on the left in the left photo was her 2012 nest site.

Table 2. Minimum convex polygon (MCP) and 95% kernel estimates of home range size for 13 radio-tagged white-headed woodpeckers during the breeding season (May through August) in 2012 in central Washington.

Territory	Study area	Sex	n^1	Min. tracked	Fledgling independence ²	100% MCP (ha)	95% fixed kernel (ha)
Boise 2	Wenas	m	117	392	July 28	134	170
New Nile 1	Nile	f	152	650	August 1	150	153
Peninsula	Rimrock	m	92	364	July 27	107	139
E-pass Road	Wenas	f	57	240	August 19	97	128
Coffin	Wenas	f	116	350	July 20	100	118
Mud Flat Park	Wenas	m	79	251	August 7	83	116
Lower Nile Burn	Nile	m	89	344	-	101	106
Meadow	Rimrock	f	60	266	-	92	101
Nile 3	Nile	m	163	463	July 26	79	83
Nile 3.5	Nile	f	74	417	August 1	62	74
Goose Egg Lower	Rimrock	m	74	229	July 28	63	62
New Nile 2	Nile	f	81	216	-	41	61
Lower Nile 4	Nile	m	145	536	August 20	51	57

¹ n is the sample size of temporally independent telemetry points used in home range analysis

² Fledgling independence was considered to be the end of the breeding season and was not calculated for the following territories: Lower Nile Burn (adult depredated around July 7), Goose Egg Meadow (nest failed around June 14), and New Nile 2 (shed transmitter around July 5).

For the breeding season, the mean 95% kernel home range estimate was 104 ha (257 acres) (Table 2). No studies have measured home range size for the breeding season so we were unable to compare our results to past research. The smallest home range was occupied by a male who resided and nested in an area of high canopy cover within the proposed Nelli Timber Sale in our Nile Study Area. The area within this woodpecker's



Figure 4. Areas of high canopy cover may provide important foraging habitat for breeding white-headed woodpeckers, even though they may be targeted for thinning. Here a radio tagged male in the Nile Study Area forages on a tree marked for sale in an area with high canopy cover.

home range is proposed for thinning in part because it has high canopy cover, which is considered poor quality habitat. Yet as mentioned above, small home ranges are generally associated with high quality habitat. Since this male had the smallest home range, our results suggest that this high-cover patch may provide some important resources. It is possible that areas of high canopy cover provide good foraging habitat for white-headed woodpeckers, whereas many past studies and management recommendations have emphasized nesting habitat requirements (Figure 4). This is supported by research by

Hollenbeck et al. (2011), who reported that a mosaic of both open and closed-canopy forest was selected by nesting white-headed woodpeckers in central Oregon. Collectively, these findings suggest that white-headed woodpecker habitat associations are complex and driven by multiple factors.

Foraging behavior

The three most commonly used substrates for foraging by radio-tagged woodpeckers were dead wood, conifer foliage, and ponderosa pine trunks (Figure 5). Woodpeckers did not use these three substrates equally throughout the study period, but rather focused on one substrate almost exclusively for a period of time before switching to focus on another substrate. Dead wood was used almost exclusively in May and June. Beginning in July they switched to forage nearly entirely on tree foliage, and then for September and October they foraged almost exclusively on ponderosa pine trunks.

Although we did not record the types of food gathered from each substrate, the only food items that we saw woodpeckers extract from dead wood were wood-boring beetle larvae (Buprestidae and Cerambycidae) (Figure 6). While foraging in tree foliage, we observed them collecting caterpillars, likely either of spruce budworm (*Choristoneura occidentalis*) or white pine butterfly (*Neophasia menapia*). Caterpillars generally become more abundant as ambient temperatures increase (Markin 1982) and white-headed woodpeckers may switch to this locally abundant food source in summer to maximize foraging efficiency. We have no information on the types of food gathered from trunks, but presumably woodpeckers were foraging on a variety of insects (e.g. ants [Hymenoptera]; beetles [Coleoptera]), as has been reported in other studies (Garrett et al. 1996).

Figure 5. Proportion of time ($n = 5116$ minutes) spent foraging on different substrates by 14 radio-tagged white-headed woodpeckers in central Washington from May through October, 2012.

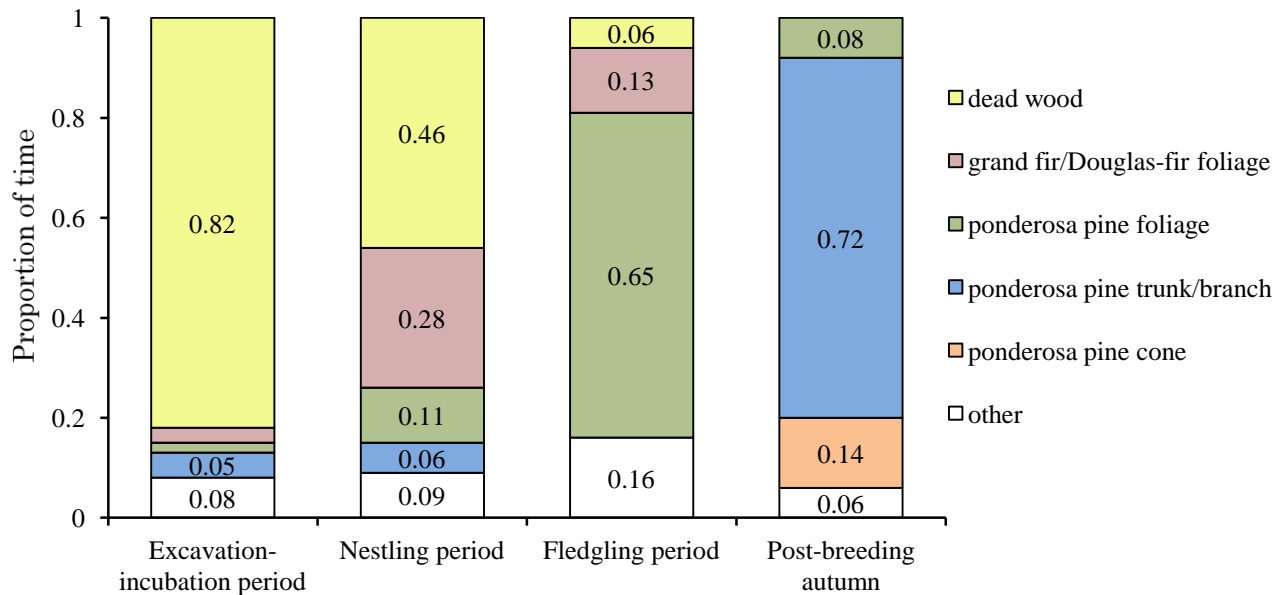




Figure 6. Stumps left from past timber harvest provided one of the most important foraging substrates for nesting white-headed woodpeckers in this study. Here an adult male from the Rimrock Study Area extracts wood-boring beetle larvae from a cut stump (left) for feeding his three growing nestlings (right).

The use of dead wood by woodpeckers in this study is noteworthy since past research suggests that dead wood is rarely used for foraging by white-headed woodpeckers. In fact, their avoidance of dead wood for foraging is considered a defining characteristic of the species (Garrett et al. 1996). In this study, white-headed woodpeckers foraged almost exclusively by drilling into dead wood during critical periods in their reproductive cycle, beginning at nest excavation and continuing through the egg laying, incubation, and early nestling periods.

Differences between this and past studies may be due to differences in foraging among populations, or differences in study methodology and timing. Past studies employing radio telemetry were conducted in old-growth stands. In our study, 96% of their dead-wood foraging was on stumps left from past timber harvest, and such substrates may not have been available for woodpeckers in old-growth stands. Additionally, past telemetry studies observed foraging behavior beginning in July (Dixon 1995a, 1995b), at which time woodpeckers in our study had already switched to foraging on caterpillars. Foraging on dead wood may have been missed in past studies that did not track birds earlier in the breeding season. Overall, results from our study suggest that dead wood can serve as an important foraging substrate for white-headed woodpeckers, at least in some populations.

Our study also differs from much past research because many previous studies have stressed the importance of pine seed as a food source (Garrett et al. 1996). In 2012, we found that ponderosa pine cones were used only in autumn after the breeding season, and they were never a dominant food source (Figure 5). Foraging on pine cones accounted for 15% of all foraging time in autumn, and less than 4% for the entire tracking period. Moreover, not all birds were observed foraging on cones; among 17 birds tracked only 8 were ever observed foraging on cones.



Figure 7. Although pine seed is considered an important food for white-headed woodpeckers, cone foraging accounted for less than 4% of their foraging in our study. Even in autumn when cones should be most abundant, radio-tagged woodpeckers foraged predominately on tree trunks.

It is possible that pine seed was not a dominant food for birds in this study because 2012 was a year of low cone production in central Washington. We did not measure cone production in this study, but cones were not visibly abundant on any home range in autumn 2012. In the absence of cones, woodpeckers in our study most commonly foraged on ponderosa pine trunks (Figure 7). This suggests that while white-headed woodpeckers readily use pine seed when available, they can subsist by foraging on other substrates throughout autumn if necessary.

Future studies should

determine whether survivorship or productivity is higher following years of high cone production, compared to years of low or no seed production

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