Surveys of Woodpecker Abundance and Reproduction in Response to the Jasper Fire

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Final Report on Woodpecker Breeding in the Jasper Fire
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The Jasper fire burned approximately 83,500 acres in August, 2000, and occurred between Custer, South Dakota and Newcastle, Wyoming. The Black-backed Woodpecker (*Picoides arcticus*) is categorized as a Sensitive Species by the Forest Service, and this species responds positively to large burned areas in dense forest (Dixon and Saab 2000). Recent studies on the role of burned forests suggest that burned forests support a wide variety of woodpecker species (Saab and Dudley 1998), and that burned forests may in fact function as source habitats for some species (Saab and Vierling 2001). Source habitats are habitats in which reproduction exceeds mortality; these sites support population viability and should be preserved (Pulliam 1988). Because Black-backed Woodpeckers require dense forests that are generally unlogged, information pertaining to the occurrence and quality of available breeding habitat will be a valuable tool for resource managers.

Johnson et al. (2000) and Saab et al. (in press) developed a model that suggests that pre-burn forest structure is a good indicator of post-fire use by Black-backed Woodpeckers. This model is based primarily on data gathered by Saab and Dudley (1998) on Black-backed Woodpecker breeding activities in Idaho following stand-replacing burns that occurred in the early 1990's. Saab and Dudley (1998) monitored 35 Black-backed Woodpecker nests between 1994-1998 and quantified a number of different breeding variables (e.g. nest success). Additionally, habitat variables were collected at the nest tree and at random trees in order to develop a model of habitat selection for this species. Based on these habitat data, "suitable" Black-backed Woodpecker breeding sites were in sites with >70% crown closure for trees averaging >23 cm (9") in diameter and "marginal" Black-backed Woodpecker breeding sites occurred in forests with a crown closure between 40-70% for trees averaging >23 cm.

Objective 1: To determine the occurrence of Black-backed Woodpecker nesting activity within predicted "suitable" and "marginal" sites following the Jasper Fire.

Objective 2: To determine the breeding activity of other cavity nesters within the study sites

Objective 3: To determine habitat characteristics associated with cavity nester breeding activity and to compare those habitat characteristics with random sites within the forest.

Where practicable and logical, I have included data from the 2001 field season. While the 2001 field season was not funded by this grant, the inclusion of 2001 data provides additional information relevant to understanding broader woodpecker recolonization into burned forests.

METHODOLOGY

Site selection

Based on Johnson et al. (2000), Saab et al. (in press) and communications with Dr. Saab, Wildlife Biologist Patti Lynch of the Black Hills National Forest Mystic district utilized GIS to generate maps of potential "suitable" and "marginal" sites. The sites were between 300-400ha in size (Dudley and Saab 2001) and a subset of the sites identified through GIS were randomly chosen as study sites. Two suitable sites, two marginal sites, and two random sites were chosen for surveys. The random sites allowed testing of Saab et al. (in press) because these sites did not meet the model criteria necessary to be "suitable" or "marginal" sites; we therefore predicted that Black-backed Woodpeckers would be absent from these areas.

Methodology to meet objectives #1 and #2

Surveys and monitoring

We followed methodology outlined by Dudley and Saab (2001) for surveying and monitoring cavity nesting species. Using belt transects that were between 1-1.6 km long and 200m apart, we surveyed for cavity nesting activity within the 300-400 ha study sites. We surveyed approximately 10 transects/study site. Each transect was traversed slowly and taped calls/drums were broadcast every 200m; if a bird was sighted or drummed in response, we attempted to find the nest cavity associated with that bird. If a bird exhibited breeding behavior (e.g. was carrying food), we followed that bird until we were successful in finding the cavity or until the bird had flown out of sight. During both years, surveys began in early May and were concluded by early July.

Once nest cavities were located, we visited them every 3-4 days and observed the behaviors of adults to determine the approximate stage of the nest cycle. Parents that had a high attendance rate in the nest cavity were likely incubating whereas parents that were feeding hatchlings made frequent trips to the cavities with food visible in their mouths. We determined nest success (the number of nests successful in fledging at least one young) using the Mayfield method (1975) and we quantified productivity (the number of fledglings produced/successful nest) at the time of fledging.

Methodology to meet objective #3

Vegetation sampling

We followed methodology outlined by BBIRD protocol (Martin and Guepel 1993) with some modifications suggested by V. Saab (pers. comm.). The center of the nest vegetation plots were the nest trees themselves. For each nest tree, we recorded variables such as diameter at breast height (DBH), the decay class of the tree, tree species, tree height, cavity height, and tree top condition. The decay classes were based on a scale between 1-5 where a 1 is a slightly decayed tree and a 5 represents a severely decayed tree (after BBIRD protocol; Martin and Guepel 1993). Additionally, we gathered microhabitat characteristics of the area surrounding the nest tree. The percent

ground cover (e.g. herbaceous, bare ground, litter, etc.) was recorded within 5m subplots radiating from the nest tree in cardinal directions. We conducted stem counts of saplings and shrubs within 5m of the nest tree and we gathered overstory estimates using a densiometer facing the 4 cardinal directions.

Within an 11.3m circular plot centered on the nest tree, we also quantified stem counts of snags/trees that were ≥ 8cm DBH, including decay classes and tree top conditions (V. Saab, pers. comm.). After gathering these data at the nest sites (hereafter occupied sites), we used the same methodology at randomly selected sites. We matched occupied sites and random sites within cover types (i.e. if an occupied site was in ponderosa pine, the random site was selected to be in ponderosa pine); our two cover types were ponderosa pine and aspen (*Populus tremuloides*). The same measurements gathered for nest trees were then gathered at these random sites. Sample sizes differ between occupied and random sites due to time constraints during the field season. We gathered vegetation data on 83 nest sites during the two years and on 86 random sites for the same time period.

RESULTS

Objectives 1 and 2: Nesting activity of Black-backed Woodpeckers and other cavity nesters

A total of 83 nests have been monitored in the study sites during the two breeding seasons after the fire. In 2001, we found no Black-backed Woodpecker nest cavities but adults carrying food were sighted only in suitable and marginal sites. In 2002, we found 6 Black-backed nests in the suitable sites, 5 in the marginal sites, and 1 Black-backed Woodpecker nest in the random sites (Table 1).

The relative abundance of woodpecker species nesting in the burn changed between seasons. In 2001, only 8 woodpecker nests were found in the 6 study sites whereas 75 were found in the summer of 2002. The 2001 sample consisted primarily of Red-headed Woodpeckers (*Melanerpes erythrocephalus*), Hairy Woodpeckers (*Picoides villosus*) and Northern Flickers (*Colaptes auratus*). While we found a pair Lewis's Woodpeckers (*Melanerpes lewis*) nesting near the study sites in the summer of 2001, they were eventually displaced from their cavity by Red-headed Woodpeckers. No Three-toed woodpeckers (*Picoides tridactylus*) have been noted in the Jasper Fire study sites during the two years of study.

Table 1. Total number of woodpecker nests in the Jasper Fire during the 2001 and 2002 breeding season. Nest numbers are in parentheses next to species names.

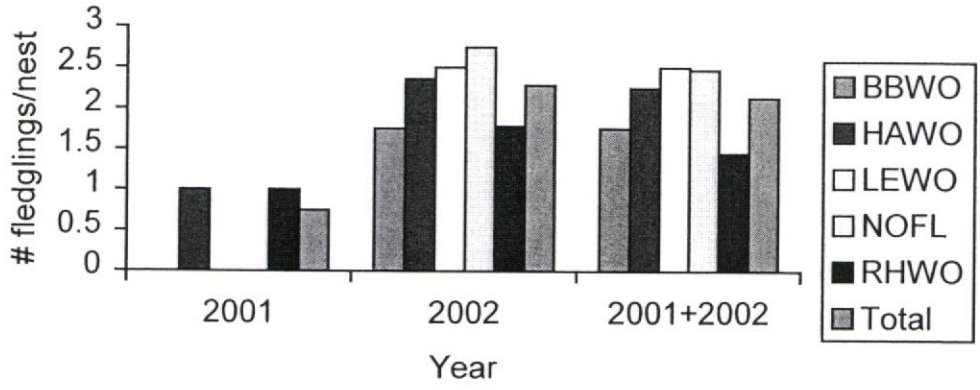
	Suitable sites (n=2)		Marginal sites (n=2)		Random sites (n=2)	
	2001	2002	2001	2002	2001	2002
Black-backed Woodpecker (BBWO)	0	6	0	5	0	1
Hairy Woodpecker (HAWO)	1	22	2	7	0	7
Red-headed Woodpecker (RHWO)	2	4	0	3	0	2
Lewis's Woodpecker (LEWO)	0	0	0	0	0	2
Northern Flickers (NOFL)	1	8	2	3	0	5
TOTAL	4	40	4	18	0	17

Overall nest success varied between years. In 2001, overall nest success was low (37%) as was productivity (0.75 ± 0.13 fledglings/nest) in 2001 (Table 2). The cause of nest failure is unknown due to the lack of cavity viewers, but 25% of the nest failures occurred during the incubation stage and 75% of the failures occurred after parents had initiated feeding activities. In contrast, overall nest success was approximately 80% in 2002, and productivity was higher in 2002 (2.28 ± 0.02) fledglings/nest (Figure 1). We had cavity viewers to assist in our examinations and predation was the major cause of nest failure for nesting woodpeckers in 2002.

Table 2. Nest success (number of nests successful in fledging at least one young) in the 2001 and 2002 field season based on Mayfield analyses. Species names are the four letter AOU acronyms used in Table 1 and nest numbers are in parentheses

	2001	2002	2001+2002
BBWO	0 (n=0)	60.0% (n=12)	60.0% (n=12)
HAWO	67% (n=3)	83.0% (n=36)	84.2% (n=39)
LEWO	0 (n=0)	100% (n=2)	100% (n=2)
NOFL	33% (n=3)	100% (n=16)	80.0% (n=19)
RHWO	0 (n=2)	58.5% (n=9)	45.6% (n=11)
Total	37.5% (n=8)	80.4% (n=75)	74.7% (n=83)

Figure 1. Average productivity (number of fledglings/nest) for 2001, 2002, and 2001+2002 in the Jasper Fire study sites.



Results pertaining to objective #3:
microhabitat characteristics of occupied and random sites

We monitored nesting activity of 8 cavity nesters in 2001 and 75 pairs of cavity nesters in 2002; as trees were shared at times, sample sizes are slightly less than the numbers of cavity nesters observed. Additionally, trends were similar between years so data were pooled and will be presented here. Nest trees were significantly higher than random trees ($F=14.2$, $p<0.001$; Figure 2a) and nest tree DBH (diameter at breast height) was significantly larger than the DBH of random trees ($F = 55.3$, $p<0.0001$; Figure 2b). However, the decay class of nest trees versus random trees did not differ significantly ($F=0.59$, $p = 0.44$); nest trees were categorized with an average of 1.97 ± 0.07 whereas the average decay class for the random trees was 1.87 ± 0.12. Finally, woodpeckers selected trees that had either broken tops or were forked and avoided trees with intact tops ($X^2=10.8$, $p<0.005$)

Figure 2. (a) Tree height (m) and DBH (cm) differences between nest and random trees during the 2001 and 2002 breeding season in the Jasper Fire field sites.

Figure 2a

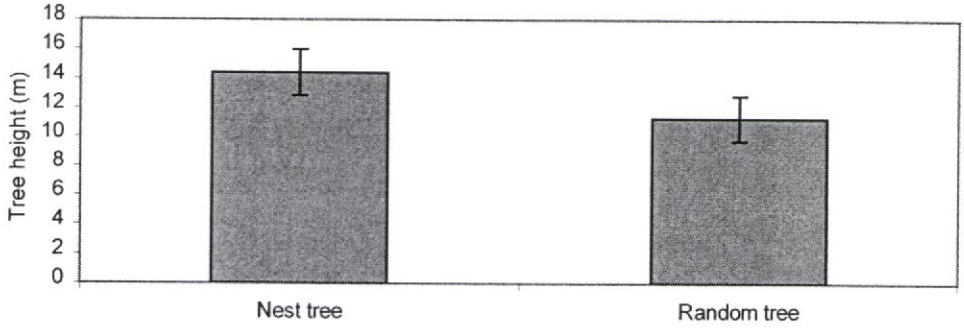
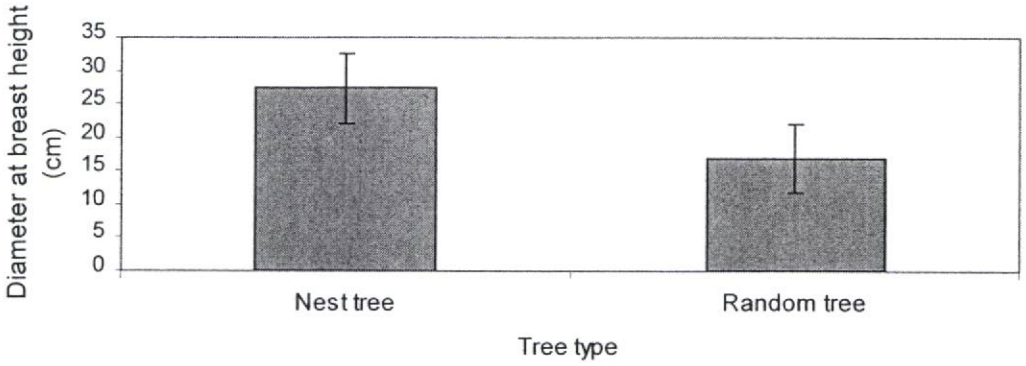


Figure 2b



Microhabitat characteristics were gathered both within 5m of the nest tree/random tree and within 11.3m of the nest tree/random tree. Overstory cover was greater on average in random sites than in occupied sites (Figure 3). In general, overstory cover averaged 26.2% whereas overstory cover surrounding nest trees averaged 19.5%; however, overall overstory cover was not significantly different between nest trees and random trees ($F=2.2$, $p= 0.14$). However, ground cover characteristics were relatively similar (Table 3). Shrub cover was low at both occupied and random sites, presumably because of the intensity of the fire in the study sites, and the only variable that differed significantly between occupied and random sites was in vegetation; vegetation includes both an herbaceous and shrubby component and was significantly higher in occupied than in random sites ($F=7.6$, $p < 0.007$)

Figure 3. % overstory cover of occupied sites compared to random sites in the Jasper Fire during the 2001 and 2002 field season.

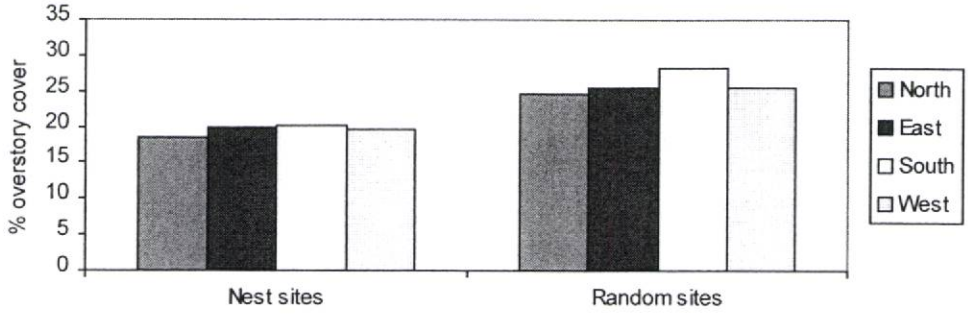


Table 3. Average % ± standard error of microhabitat characteristics surrounding occupied (n=71) and random (n=71) sites in 2002. Vegetation includes the non-overlapping herbaceous + shrub component and was the only variable to differ significantly between occupied and random sites in 2002.

Ground cover	Occupied sites	Random sites
Shrub	10.1 ± 1.8	7.9 ± 1.2
Herbaceous	35.4 ± 3.2	33.2 ± 2.8
Bare ground	37.9 ± 3.2	38.2 ± 2.8
Litter	18.2 ± 1.8	22.4 ± 2.1
Vegetation	45.1 ± 3.7	31.4 ± 3.3

Stem counts for shrubs and saplings were conducted surrounding the nest tree, and virtually no shrubs or saplings with a dbh of greater than 2.5cm occurred in either occupied or random sites. There were significantly more shrubs/saplings with dbh less than 2.5cm within 5 m of the nest tree on occupied sites (60.1 ± 10.7) compared to random sites (27.9 ± 3.9; $F = 7.6$, $p < 0.006$). There were no shrubs or saplings that had a dbh greater than 8 cm within 5m of the nest tree.

Stem counts for trees/snags were conducted within 11.3m of the center of the plot as well, and both occupied and random sites were dominated by ponderosa pine. There were significantly more snags within 11.3m of the nest tree ($X^2 = 48.9$, $p<0.001$) as compared to random sites. While there were more dead trees within 11.3m of the nest tree, the decay class of those trees did not differ much; the decay class of snags within 11.3m averaged 1.7 ± 0.01 in random sites whereas decay class of snags in the occupied sites averaged 1.9 ± 0.01.

Black-backed Woodpeckers nest trees followed trends described above for the woodpecker community, and while few statistical tests could be conducted due to small sample sizes, the trends in breeding site characteristics are described below (Table 4). BBWO nested exclusively in ponderosa pine trees, and the majority of those trees had either intact (n=5) or forked tops (n=5). In general, microsite characteristics differed between BBWO nest sites and sites that were available at random.

Table 4. Nest site characteristics of BBWO nests (n=12) compared to random sites (n=71).

	BBWO nest site (n=12)	Random sites (n=71)
Nest tree height (m)	14.5 ± 0.17	11.3 ± 0.57
Nest tree DBH (cm)	27.1 ± 0.19	17.7 ± 1.0
Decay class of nest tree	2.2 ± 0.06	1.7 ± 0.10
No. of saplings < 2.5cm DBH within 5m	60.1 ± 10.7	27.9 ± 3.9
No. of snags within 11.3m*	25.6 ± 0.48	14.7 ± 0.50

* significantly different at the $p<0.05$ level

Discussion

The data collected in the first two years following this stand-replacing burn suggests that pre-burn canopy coverage can be used to predict post-burn use by Black-backed Woodpeckers, but the relative strength of the model varied between years. The use of burns by Black-backed Woodpeckers and other species varied temporally and this may be related to both the timing of the burn (early fall) and subsequent colonization of the burn by insects. Black-backed Woodpeckers primarily eat wood-boring larvae, and the lateness of the burn likely prohibited establishment of large wood-boring beetle populations in 2001.

Black-backed Woodpeckers appear to select breeding habitats at both the landscape scale (within patches with high canopy coverage) and at the microsite scale (i.e. at the level of the nest tree). While sample sizes are small, the data from this study suggest that Black-backed Woodpeckers in the Black Hills might select nest sites that differ from elsewhere in its range (Table 5).

Table 5. Nest tree characteristics of BBWO across its range; data from other states are taken from Dixon and Saab (2000).

	Black Hills	Wyoming	Montana	Oregon	Idaho
Nest tree height (m)	14.5 ± 0.17	32.7	28	19	21.7
Nest tree DBH (cm)	27.1 ± 0.19	27	40	37	39
Mean nest height (m)	4.1	8.5	11	5	9.5
% nest trees that were ponderosa	100%	0%	0%	67%	54%

Differences in nest tree selection may be due to a variety of causes, including the variability in forest structure across the Black-backed Woodpecker range, different forest management practices, and adaptation to local conditions. Because Black-backed Woodpecker abundance is typically low in the Black Hills, additional study sites in other regions as well as continued examination of this model in the Black Hills will provide important information as to the strength and validity of this model and the habitat requirements of Black-backed Woodpeckers within the Black Hills.

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