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NESTING HABITAT OF LEWIS' WOODPECKERS IN SOUTHEASTERN WYOMING

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Abstract.—We quantified habitat use of nesting Lewis' Woodpeckers (*Melanerpes lewis*) in southeastern Wyoming on an 11,100-ha study area consisting of scattered ponderosa pine (*Pinus ponderosa*) stands. A 1295-ha burn in 1974 and a 1590-ha burn in 1986 occurred prior to the study. Our results showed nest sites occurred in burned areas, which had more ground cover and downed logs. Birds were found in sites where visual obstruction of the sky including vegetation and burned branches was higher than non-use areas. Ninety-eight percent of nests were surrounded by burned ponderosa pine. We found 74% of the nest trees on north- to east-facing slopes. Nests occurred in clumps rather than randomly throughout the habitat. Human disturbance did not appear to be a factor in nest placement and nest trees typically did not differ in height from surrounding trees. Our results also showed that Lewis' Woodpecker nests were more common in the later burn (1986) than in the earlier burn (1974).

HABITAT DE ANIDAMIENTO DE *MELANERPES LEWIS* EN EL SURESTE DE WYOMING

Sinopsis.—Cuantificamos el habitat utilizado para anidar por el carpintero *Melanerpes lewis*, en un rodal de pino ponderosa (*Pinus ponderosa*) que cubría un área de 11,100 ha. en el sureste de Wyoming. Previo al estudio occurrió la quema de un área de 1295 ha en 1974 y otra de 1590 ha en 1986. Nuestros resultados indican que las aves utilizaron para anidar lugares en donde habían occurrido fuegos, que tenían mayor cobertura en los suelos y troncos caidos. Las aves se encontraron en localidades en donde la obstrucción visual del firmamento, incluyendo vegetación y ramas quemadas, fué mayor que en áreas no utilizadas. El 98% de los nidos se encontraron rodeados por pinos quemados. Encontramos que el 74% de los árboles utilizados para anidar estaban orientados al norte o al este de pendientes. Los nidos se encontraron agrupados, no dispersos al azar. El disturbio por parte de humanos no pareció ser un factor asociado al lugar de contrucción del nido y la altura de los árboles utilizados para anidar no resultó ser diferente a la de los árboles que lo rodeaban. Los nidos de este carpintero resultaron más comunes en el lugar que se quemó en el 1986 al comparse con el quemado en el 1974.

Found throughout western North America, the Lewis' Woodpecker (*Melanerpes lewis*) (Bock 1970, Godfrey 1966, Hadow 1973) uses several different types of woodlands for breeding and wintering including evergreen, deciduous, and riparian forests (Bent 1992, Bock 1970, Jackman 1975, Raphael and White 1984, Sousa 1982). Throughout its range, an important habitat for this species is open stands of ponderosa pine (*Pinus ponderosa*) (Bock 1970, Jackman 1975, Raphael and White 1984). In fact, Lewis' Woodpeckers have been termed "burn specialists" because the large majority of nests were found within snags in burned pine forests (Block and Brennan 1987; Bock 1970; Jewett et al. 1953; Raphael and White 1984; Yocom 1945, 1960). This species is believed to be particularly well adapted to burned areas because of the open, sparse canopy that allowed both a dense shrub cover and good visibility.

We examined vegetative characteristics in Lewis' Woodpecker breeding habitat to identify variables associated with habitat selection in the Laramie Range, southeastern Wyoming. The objectives of this study were to provide information on nest-site selection by locating active nests. This was accomplished by determining dispersion of nesting pairs, describing macrohabitat and microhabitat characteristics at their nest sites, and contrasting those with random sites.

STUDY AREA

The study area was located in the Laramie Range of southeastern Wyoming. Two large sites consisting of scattered ponderosa pine stands were selected. The 6216-ha Tunnel Road area (42°0′N, 105°30′W) was the larger of the two sites, and ranged in elevation from 1890–2347 m. Approximately 21% of this area had been burned (1295 ha) in 1974. The 3885-ha Palmer Canyon area (42°07′N, 105°22′W) ranged in elevation from 1615–2412 m. Approximately 41% of this area had been burned (1590 ha) in 1986. The average annual precipitation in the study area was 18.8 cm. The average summer temperature was approximately 20 C.

METHODS

Nest search strategy.—We conducted nest searches and observations during daylight hours from early May to late August in 1993 and 1994. A systematic (transect) search of each area was conducted by vehicle or on foot using 1:24,000 United States Geological Survey topographic maps as a guide. We conducted nest searches in proportion to habitat availability (burned vs. unburned). Once we located an adult woodpecker, we continuously observed it for 40 min or until it entered a cavity. If we were unable to locate a potential nest cavity within 40 min, the area was marked on a topographic map and we returned at a later date to survey again. Nests were assumed to be active if we saw an adult excavating or remaining in the cavity for longer than 2 min or (later in the season) if we heard the sounds of young calling from the nest. Confirmed nests were flagged and plotted on maps. Habitat measurements were made as nests became inactive through fledging or failure.

Habitat sampling methods.—We characterized macrohabitat characteristics of Lewis' Woodpecker nest sites using topographic maps and aerial photographs. Measurements included distance to and type (perennial or ephemeral) of nearest water, burn size, distance to and type of nearest human disturbance (including houses and roads), distance to conspecific nests (nest dispersion), and elevation. If the distances to nearest water, disturbance, or conspecific nests were $\leq$ 100 m from the nest site, they were measured directly in the field. Nest dispersion was determined using the Campbell and Clarke goodness-of-fit test for detecting spatial patterning in populations (Krebs 1989).

We measured microhabitat characteristics at each nest site and random sites in 0.04-ha circular plots using an adaptation of the techniques developed by James and Shugart (1970), with several modifications suggested by Noon (1981). Characteristics of the nest tree included height of tree and nest cavity (determined by clinometer), diameter at breast height

(DBH), orientation of nest cavity (determined by compass bearing), total number of cavities (excluding nest cavity), percent bark cover (visual estimation), and nest tree condition or decay state on a scale of one to nine (as defined by Maser et al. 1979).

For each 0.04-ha circular plot, we measured the condition (dead or alive), DBH, distance, and height of the closest standing tree to the center of the plot per quadrat using the point-quarter distance method (Noon 1981); diameter, distance, and length of the largest downed log using the point-quarter distance method (Noon 1981); and plot aspect and slope determined by using a compass and clinometer. We measured height and DBH, and counted the number of cavities of all live standing trees and standing snags (supplementary to closest standing tree) within each plot. Percent cover was estimated using the ocular tube method (Noon 1981). We counted the number of times there was visual obstruction of the sky (vegetation or burned branches)—sky cover—at five points from the center to the edge of the 0.04-ha circle in each cardinal direction. Percent volume of downed logs in each of three size classes (<30 cm, 30 cm–90 cm, and >90 cm) was estimated visually for each plot. We estimated percent ground cover in four classes: (soil/rock, grass/forb, shrub, and litter) in the 0.04-ha circle. The distance to the nearest rock outcrop also was measured. For nests that were used in two consecutive breeding seasons, microhabitat variables were only entered in analysis once.

Random sampling.—We conducted random samples for habitat characteristics using the same sampling techniques as described for the 0.04-ha circular microhabitat plots. Random sites were located only in areas with potentially suitable habitat and were established at least 12 m from the nest tree in each of the cardinal directions. Sample locations (four for each nest site) were assigned using a random number table. Data were collected at 87 random sites for most variables. Some areas with cliffs or roads or without some variables turned out to be unsuitable to sample at a site.

Analysis.—Comparisons of random sites and nest sites across all microhabitat variables (except aspect) were done using paired *t*-tests. An experimentwise alpha value of 0.10 was chosen making individual *t*-tests significant at a value of $P < 0.003$. A total of 31 microhabitat variables were analyzed by paired *t*-tests using a Bonferonni adjustment. Slope aspect and nest orientation data were circular in nature, and therefore, comparisons of use and random use in these cases were done using chi-squared goodness of fit test (Batschelet 1981).

RESULTS

Nest surveys.—Thirty active Lewis' Woodpecker nests were found during 1993. Of these, 25 were located in the Palmer Canyon area and five were in the Tunnel Road area. During 1994, 30 active nests were found, with 27 in the Palmer Canyon area and three in the Tunnel Road area. Of the 30 nests found in 1994, 11 were previously used in 1993, and 19 were new nests. Three of the five nests found in the Tunnel Road area in 1993 were reused in 1994 and two remained unused, while eight of the 25 nests found in the Palmer Canyon area in 1993 were reused in 1994.

Macrohabitat.—Ninety-eight percent of all active nests located were within or surrounded by burned ponderosa pine habitat. Burns were clearly selected as 41% of the Palmer Canyon area and 21% of the Tunnel Road area were burned ($\chi^2 = 45.18$, $P < 0.001$, df = 1). Confirmed Lewis' Woodpecker nests ranged in elevation from 1761–2042 m in the Palmer Canyon area ($\bar{x}$ = 1889 m) and from 2023–2115 m in the Tunnel Road area ($\bar{x}$ = 2079 m). We found that 74.3% of nest trees were on north-to-east facing slopes ($\chi^2 = 17.46$ $P < 0.001$, k = 4, df = 3), suggesting non-random placement of nests with respect to aspect.

Distance to nearest water ($\bar{x} \pm$ SD, nest site: 215 ± 178 m; random 224 ± 175 m; n = 35) and distance to nearest human disturbance (nest site: = 114 ± 128 m; random = 118 ± 172 m; n = 35) did not differ significantly between random and use sites. Nests were closer together than expected ($\chi^2 = 25.19$; $P < 0.001$, df = 4) for nests distributed at random. Over 91% of the nests were in snags while 9% were in dead portions of live trees.

Microhabitat.—Microhabitat sampling was conducted on 25 nests in 1993 and 10 nests in 1994 field season for a total of 35 nests. Nests ranged in height from 5–20 m ($\bar{x}$ = 11, SD = 3), DBH ranged 33–65 cm ($\bar{x}$ = 48 SD = 8), had an average percent bark cover of 82% (SD = 25, range 20–100), and usually had more than one cavity. The cavities chosen for nesting averaged 7.5 m (SD = 2.5, range 3–13) from the ground and had a wide range of orientations. Twenty-one of the cavities faced in an easterly direction, but the chi-squared goodness-of-fit test ($P > 0.05$) (Batschelet 1981) did not show any significant deviation from random.

The average percent litter in use plots was significantly higher than in random plots (Table 1). Associated with this, there was a slight tendency for there to be less grass/forb ground cover in use plots. The size of the dead and down material in sampling plots was also significantly different, with random plots having a higher percent of the smaller size class (<30 cm), while use plots had higher percentages of larger size classes (31 cm–90 cm; >91 cm). The dispersion of large litter, indicated by the distance to the largest down log, showed a slight tendency to be closer in nest plots ($P = 0.020$). The closest standing tree was significantly closer in use plots than random plots ($P = 0.003$), indicating a greater density of available perches. Utilized areas had a significantly higher average percent sky cover than random sites, indicating a greater availability of foraging and roosting perches in use plots (Table 1).

DISCUSSION

It has been suggested that the main priorities for habitat use by Lewis' Woodpeckers are perch availability, open canopy, and a brushy understory (Bock 1970, Sousa 1982). The microhabitat characteristics associated with nest sites in this study were the amount and size of dead and down material at a site, ground cover, and sky cover which would indirectly indicate

TABLE 1. Habitat variables and *t*-tests for Lewis' Woodpecker use and non-use areas in the Laramie Range, Southeastern Wyoming.

	Random plots			Use plots			*t*-test
	Mean	SD	*n*	Mean	SD	*n*	*P*
Soil/rock height (cm)	29.39	35.58	63	30.24	44.54	28	0.921
Grass/forb height (cm)	39.06	12.89	87	41.19	14.53	35	0.426
Litter height (cm)	60.70	37.85	57	56.53	36.01	34	0.606
Shrub height (cm)	41.35	22.74	80	33.85	13.29	29	0.098
Soil/rock (%)	13.28	15.73	87	16.43	13.96	35	0.304
Grass/forb (%)	57.13	20.07	87	48.71[b]	18.76	35	0.035
Litter (%)	9.02	9.85	87	18.71[a]	11.00	35	<0.001
Shrub (%)	20.35	15.30	87	16.14	13.43	35	0.158
Slope (%)	26.15	16.70	87	29.63	13.54	35	0.274
% vol. down log <30 (cm)	45.99	25.44	87	32.17[b]	17.30	35	0.004
% vol. down log 30–90 (cm)	11.15	5.90	87	15.33[a]	5.61	35	<0.001
% vol. down log >90 (cm)	40.82	25.23	87	51.28[b]	19.83	35	0.030
Distance, rock outcrop (m)	12.96	13.02	87	10.72	10.73	35	0.370
Diameter, largest down log (cm)	10.53	4.18	82	11.69	3.85	35	0.164
Distance, largest down log (m)	6.85	2.09	82	5.82[b]	2.35	35	0.020
Length, largest down log (m)	7.64	3.95	82	8.49	3.70	35	0.278
Condition, closest standing tree[c]	3.71	0.98	64	3.81	0.71	29	0.634
DBH, closest standing tree (cm)	26.22	10.53	64	27.87	10.08	29	0.481
Distance, closest standing tree (m)	7.64	2.32	64	6.07[a]	2.20	29	0.003
Height, closest standing tree (m)	6.24	3.53	64	6.61[a]	3.14	29	0.616
Sky cover (%)	4.00	0.08	87	27.29[a]	0.13	35	<0.001
Number of live tree/plot	0.25	1.27	87	0.49	1.67	35	0.402
DBH of live trees/plot (cm)	19.79	15.31	7	12.32	9.17	4	0.403
Height of live trees/plot (m)	4.48	2.77	7	3.60	1.77	4	0.585
Number cavities/live trees/plot	0.29	0.76	7	0.00	0.00	4	0.479
Number of snags/plot	1.43	3.95	87	2.14	4.35	35	0.361
DBH of snags/plot (cm)	21.65	10.42	30	19.47	13.60	15	0.553
Height of snags/plot (m)	6.31	2.61	30	6.63	2.66	15	0.702
Number cavities/snags/plot	0.20	0.42	30	0.41	1.30	15	0.435
Snag condition[c]	4.08	0.36	30	4.07	0.26	15	0.873
Condition of top, snags[c]	0.47	0.39	30	0.40	0.41	15	0.568

[a] Significantly different from random sites, *t*-test. The experimentwise alpha value (based on a Bonferroni adjustment) is a 0.10, thus, individual tests are significant at *P* values of <0.003.

[b] Values that may indicate significance (discussed in text).

[c] Based on definitions by Maser et al. 1979.

perch sites. The openness of the canopy and the availability and dispersion of dead and down material seemed to be the fundamental habitat characteristics of Lewis' Woodpeckers in the Laramie Range of southeastern Wyoming.

Because the Lewis' Woodpecker is primarily a flycatching woodpecker, perch sites near openings in the forest are probably important. These areas permitted ample visibility for the unique flycatching behavior of this species as well as for scanning surrounding vegetation for insect prey. The majority of nest trees were contained within areas that had been subjected to intense crown-fire burns, and thus the canopy was composed mainly of dead, bare branches. This also allowed for the growth of understory vegetation important for insect production. Sousa (1982) suggested that the optimal canopy closure for Lewis' woodpecker habitat should be less than 30%, which was in agreement with our findings.

Another element that appeared to be important in nesting habitat was the amount and type of ground cover near the nest. Ground cover, including litter and logs would be a result of recent fire and possibly important for the production of insects.

Other authors have suggested that pine habitat may be unacceptable for nesting Lewis' Woodpeckers unless it contained a significant shrubby understory for production of terrestrial insects (Bock 1970, Sousa 1982). Sousa (1982) reported that optimal Lewis' Woodpecker habitat provided a shrub crown cover exceeding 50%. However, our study found a mean shrub density of 16.1% in utilized nest areas. This was more comparable to the findings of Block and Brennan (1987), who found a mean shrub cover of 13.4% in burned habitat on the Modoc Plateau, California.

Lewis' Woodpeckers are known to be primary cavity nesters, often excavating their own nest cavities. However, they have not been known to excavate in live, healthy trees, but rather in dead or dying trees or dead portions of live trees (Bock 1970, Ritter 1988, Sousa 1982). We found that 43 (91%) of the nests were in standing snags and four (9%) were in dead portions of live trees. Live trees, although available, were not often used. Thomas et al. (1979) reported that the minimum height of snags used by Lewis' Woodpeckers was 9.1 m in the Blue Mountains of Oregon and Washington, and Bock (1970) reported a range of nest cavity heights from 1.5–51.8 m. We found a minimum nest tree height of 4.9 m (mean = 10.6 m) with a mean nest cavity height of 7.5 m (range 2.7 to 12.8 m). Also, Thomas et. al. (1979) found a minimum DBH of 30.5 cm for nest trees in the Blue Mountains. Our results for the Laramie Range were similar, with a minimum nest tree DBH of 33.0 cm.

Nests in our study areas were clumped. Jackman (1975) suggested that cavity nesting species may encounter nest site shortages in areas where trees occurred in clumps. In areas such as these, Lewis' Woodpeckers should have been found nesting relatively short distances from one another (Sousa 1982). Clumped distribution may occur because of burn patterns. Wildfires flare up and burn intensely where there are clumps of trees with dry litter. These areas seemed to be the best sites for nesting woodpeckers, thus, the birds clumped together in these areas. Because these birds were in the Wyoming study area only for the nesting period, they may primarily select areas suitable for their nests.

We were also able to see the effect of age of the burn on breeding site selection on Lewis' Woodpeckers. According to Bock (1970), this species is characteristic of old burns. However, Bock (1970) also suggested that "burned areas, in their process of decay and revegetation, were potential breeding habitat for only a part of the cycle" and as the age of the burn increased, the area become progressively more unsuitable as nesting habitat. In the Tunnel Road area where a burn occurred in 1974, use of the area by Lewis' Woodpeckers appeared to be declining. In contrast, the Palmer Canyon area which burned in 1986, had most of the active nests. This site contained the majority of active Lewis' Woodpeckers nests found during this study and appeared to define optimal breeding habitat in the Laramie Range of southeastern Wyoming.

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