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EVALUATING HABITAT SUITABILITY USING RELATIVE ABUNDANCE AND FLEDGING SUCCESS OF RED-NAPED SAPSUCKERS¹

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To provide nesting and foraging trees for woodpeckers and other cavity-nesting wildlife, forest management objectives on public lands generally include some level of snag (standing, dead tree) and live-tree retention within cutting units (McClelland 1975, Connor 1978, Thomas et al. 1979). Numerous studies show that some smaller woodpeckers will readily nest and forage in logged stands as long as some trees are left standing (Connor and Crawford 1974, Connor et al. 1975, Franzreb and Ohmart 1978, Dickson et al. 1983, Tobalske et al. 1991).

The drastic alterations of forest composition and structure that occur from logging may alter habitat quality for nesting woodpeckers. Although a species may continue to use logged habitat because proximate cues such as a suitable nest tree are present (Hildén 1965), the ultimate factors to consider are fitness parameters (Van Horne 1983). In this study, I examined the relative abundance of Red-naped Sapsuckers (*Sphyrapicus nuchalis*) in unlogged and recently logged coniferous forest. I augmented this effort with an analysis of fledging success to determine whether such mod-

ified habitats provide suitable nesting opportunities for this species.

STUDY AREA

This study was conducted at Coram Experimental Forest (CEF) and on nearby, similarly managed portions of the Flathead National Forest, northwestern Montana. Regulated by the Intermountain Research Station of the U.S. Forest Service, CEF covers 3,000 ha and ranges from 1,000-2,000 m above sea level. Western larch (*Larix occidentalis*) and Douglas-fir (*Pseudotsuga menziesii*) are the dominant trees; Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) are common. At lower elevations, often in association with riparian areas, paper birch (*Betula papyrifera*) and quaking aspen (*Populus tremuloides*) are present. Unlogged stands are primarily even-aged and standing old-growth larch are over 300 years old. Timber harvesting began in the 1940s and continues today, through clearcutting and various partial-cutting methods. Since the mid-1970s, snags of all tree species as well as living paper birch and quaking aspen have been retained within cutting units in order to conserve cavity-nesting wildlife, based on the guidelines in McClelland and Frissell (1975).

The Terrace Hill Sale Area (THSA) and the Coram Research Natural Area (CRNA) comprise the southern quarter of CEF. Logged stands within the THSA include five clearcuts ranging from 6-14 ha in size (with some snags and live trees reserved) and nine partial cuts ranging from 2-28 ha. Unlogged forest consists of

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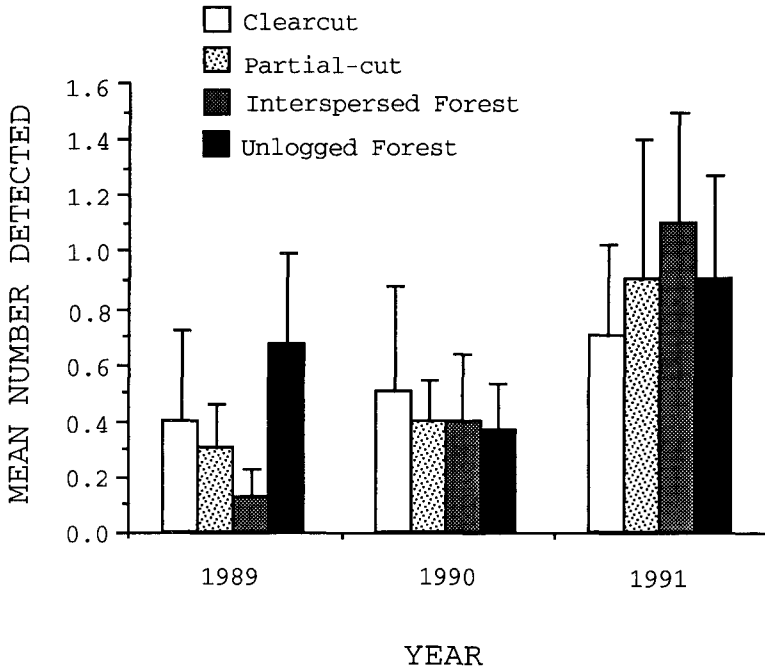


FIGURE 1. Mean number of Red-naped Sapsuckers detected per point count within the four stand conditions at the Terrace Hill study area and adjacent Coram Research Natural Area, Coram Experimental Forest, 1989–1991. Standard error bars represent the upper half of 95% confidence intervals for the means.

134 ha interspersed between cutting units in the THSA and 339 ha of contiguous forest in the CRNA. For further details on harvest methods and site treatments see Tobalske et al. (1991).

METHODS

I estimated the relative abundance of Red-naped Sapsuckers during the 1989–1991 breeding seasons using 100-m radius, fixed-point counts adapted from Hutto (1989). Detections were by sight or sound, including birds in flight over the plot. I visited each point on three days between 1 June and 7 July each year. Counts, 10 min in duration, were conducted between 30 min after sunrise and 10:00 hr MDT.

In the THSA, points were located with a coordinate grid overlay placed upon a U.S. Forest Service map. After scaling distances between lines on the grid to be 200 m apart on the ground and numbering the points of intersection sequentially, I read a random-numbers table to select 10 points within each of the three stand conditions: clearcut, partial-cut, and unlogged forest. Points were selected to be at least 100 m from any other stand condition. These points defined the census plots on the ground; each was marked at the center with a survey flag.

In the CRNA, beginning at the southwest corner, I used a calculator to generate a random number that I then followed as a compass bearing for 250 m. A census point was centered at the destination. Subsequent points were selected in the same manner, with a new bearing for all 10 points. Bearings that would carry a point within 100 m of the boundary of the CRNA were ig-

nored by returning to the origin and taking a new bearing.

Between 20 April – 1 August of each year, I located and monitored Red-naped Sapsucker nests throughout CEF and surrounding portions of the Flathead National Forest. I found nests by following adult birds or the persistent vocalizations of nestlings. I visited each nest, at intervals not exceeding one week, until the young fledged or the nest failed. Measures of fledging success were obtained only during 1990 and 1991, when I climbed the nest trees to count nestlings. Nest contents were viewed using an illuminated dental mirror.

I sampled vegetation within each Red-naped Sapsucker nesting territory. Using survey flagging, I marked a 30-m radius circle around each nest tree (sapsuckers generally defend a circular area of about 30 m around their nest tree; cf. Lawrence 1967) and measured habitat variables within that area: snags and live trees by dbh class, height of overstory (mean of four measurements using a clinometer), and canopy cover (ocular method as in Hahn and Jensen 1987).

Small samples and heterogeneity of variance required non-parametric statistical analysis. To increase the number of non-zero counts in the data, I averaged the three within-year visits to each point giving 10 means per stand condition and year. I compared these values among stand conditions using a Kruskal-Wallis Analysis of Variance (SPSS Inc. 1990). The number of young fledged per nest and the nest-territory vegetation characteristics were compared between logged and unlogged forest using Mann-Whitney *U* tests (SPSS Inc. 1990).

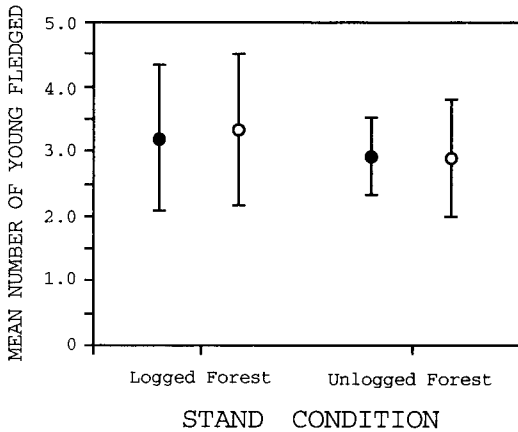


FIGURE 2. The mean number of Red-naped Sapsucker young fledged per nest in logged ($n = 10$) and unlogged ($n = 13$) stands within Coram Experimental Forest and surrounding portions of the Flathead National Forest, 1990–1991. An open circle denotes mean in logged ($n = 9$) and unlogged ($n = 8$) stands after removing nests within 30 m of the edge of a cutting unit from the sample. Standard error bars represent 95% confidence intervals for the means.

RESULTS

The number of Red-naped Sapsuckers detected per point count did not differ among stand conditions ($n = 40$ points, 1989: $\chi^2 = 7.15$, $P = 0.067$; 1990: $\chi^2 = 0.36$, $P = 0.949$; 1991, $\chi^2 = 3.30$, $P = 0.348$) (Fig. 1).

Thirty-one Red-naped Sapsucker nests and territories were examined. Sixteen nests were in paper birch (51.6%), eleven in western larch (35.5%), two in quaking aspen (6.5%), and two in Douglas-fir (6.5%). Twenty-two (71%) of the nest trees used by Red-naped Sapsuckers showed some sign of previous woodpecker nesting or foraging activity. Three of the nest trees used in 1989 were reused in either 1990 or 1991.

The number of young fledged per nest was estimated for 23 nests during 1990 and 1991 (Fig. 2). Adults were most active and the juveniles most vocal two weeks

prior to fledging. Many of the nests (61.3%) were discovered during this period, so samples may have been biased toward successful nests (Mayfield 1961). The nestlings in one nest within unlogged forest were lost to predation, and one nest in logged forest failed because the nest tree fell. All of the other nests from which I estimated fledging success produced one to six young.

The mean number of Red-naped Sapsuckers fledged per nest did not differ between logged forest and unlogged forest (Fig. 2) ($n = 23$, $U = 58.5$, $P = 0.677$). When I removed six nests that were within 30 m of the edge of a cutting unit from the analysis (Fig. 2), the difference was still not significant ($n = 17$, $U = 29.5$, $P = 0.519$).

There were several differences in vegetation characteristics between Red-naped Sapsucker nesting territories in logged and unlogged forest (Table 1). Compared to unlogged forest, there were significantly fewer live trees 10–30 cm dbh, live trees >30 cm dbh, and snags >30 cm dbh surrounding nests in logged forest. Given that there were fewer trees in the logged areas, it is not surprising that overstory canopy cover and height were less there than in unlogged stands. The numbers of birch and aspen in both the 10–30 cm dbh and >30 cm dbh size classes were similar between stand conditions.

DISCUSSION

As the relative abundance of Red-naped Sapsuckers (Fig. 1) and the number of young fledged per nest (Fig. 2) did not differ significantly between logged and unlogged stands, forest management guidelines that require snag and live tree retention within cutting units provided useful nest sites for this species. Moreover, the abundance of Red-naped Sapsuckers within logged stands was not a misleading indicator (Van Horne 1983) of habitat suitability for the nesting phase of their life cycle. This is encouraging, for many studies rely upon census data alone to infer habitat suitability (e.g., Franzreb and Ohmart 1978, Szaro and Balda 1979, Mannan and Meslow 1984, Hutto 1989, Tobalske et al. 1991).

Fledging success is but one indicator of reproductive success for adult birds during the breeding season. Measures of lifetime reproductive success would pro-

TABLE 1. Estimates of vegetation components within Red-naped Sapsucker nest territories in logged ($n = 16$) and unlogged ($n = 15$) stands within Coram Experimental Forest and surrounding portions of the Flathead National Forest, 1989–1991.

Vegetation variable	Logged		Unlogged		<i>P</i> *
	Mean	SE	Mean	SE	
Trees 10–30 cm dbh (no.)	69.2	13.6	116.7	9.7	0.018
Snags 10–30 cm dbh (no.)	6.9	1.9	10.7	2.3	0.081
Trees >30 cm dbh (no.)	10.9	3.3	37.8	4.7	<0.001
Snags >30 cm dbh (no.)	1.6	0.6	5.8	1.3	0.001
Birch, aspen 10–30 cm dbh (no.)	24.4	5.0	20.7	6.5	0.395
Birch, aspen >30 cm dbh (no.)	4.4	1.5	4.3	0.9	0.348
Overstory canopy cover (%)	22.0	4.4	54.9	2.7	<0.001
Overstory canopy height (m)	14.9	1.1	27.7	2.3	<0.001

* Mann-Whitney *U* test.

vide a more complete picture (Newton 1989), but such data are difficult or impossible to obtain. Calculating exposure (Mayfield 1961) takes into account other phases of the nesting cycle, and selective pressure may be shown to vary within a single season. For example, Sullivan (1988) found that the highest rates of mortality among Yellow-eyed Juncos (*Junco phaeonotus*) occurred during the juvenile stage of the life cycle, when young were newly independent of adults.

Juvenile sapsuckers are able to forage on their own soon after they leave the nest (Crockett and Hansley 1977, pers. observ.); moreover, adults and young generally disperse from their home territory soon after the nest is evacuated. Predation pressure may be much greater for juveniles after they leave the comparative safety of the nest, and vegetation characteristics that are related to survival during this time may differ from those related to fledging success.

Although Red-naped Sapsuckers nested successfully in logged areas, unlogged coniferous forest surrounding the cutting units was probably essential to adult survival and productivity. For example, sapsuckers rely almost entirely upon conifer sap as a food source early in the spring when they arrive in northern latitudes following migration (Tate 1973, McClelland 1975, pers. observ.). The sap from birches and aspens is an important food source only after the buds open on the trees (McClelland, pers. comm.). Similarly, insects are not abundant until later in the season.

The spatial scale of my investigation may limit extrapolation from these results to larger cutting units. Most of the cutting units in which I studied Red-naped Sapsucker nests were smaller than 16 ha, and adult sapsuckers foraged much farther from their nests than in the 30-m radius that I selected to define home territories. Examined at a larger scale (Wiens et al. 1987), it may have been the habitat mosaic containing both logged and unlogged areas which provided suitable Red-naped Sapsucker nesting habitat.

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