United States
Department of
Agriculture

Forest Service

**Intermountain
Research Station**

Research Paper
INT-431

October 1990

Assessment of Nongame Bird Habitat Using Forest Survey Data

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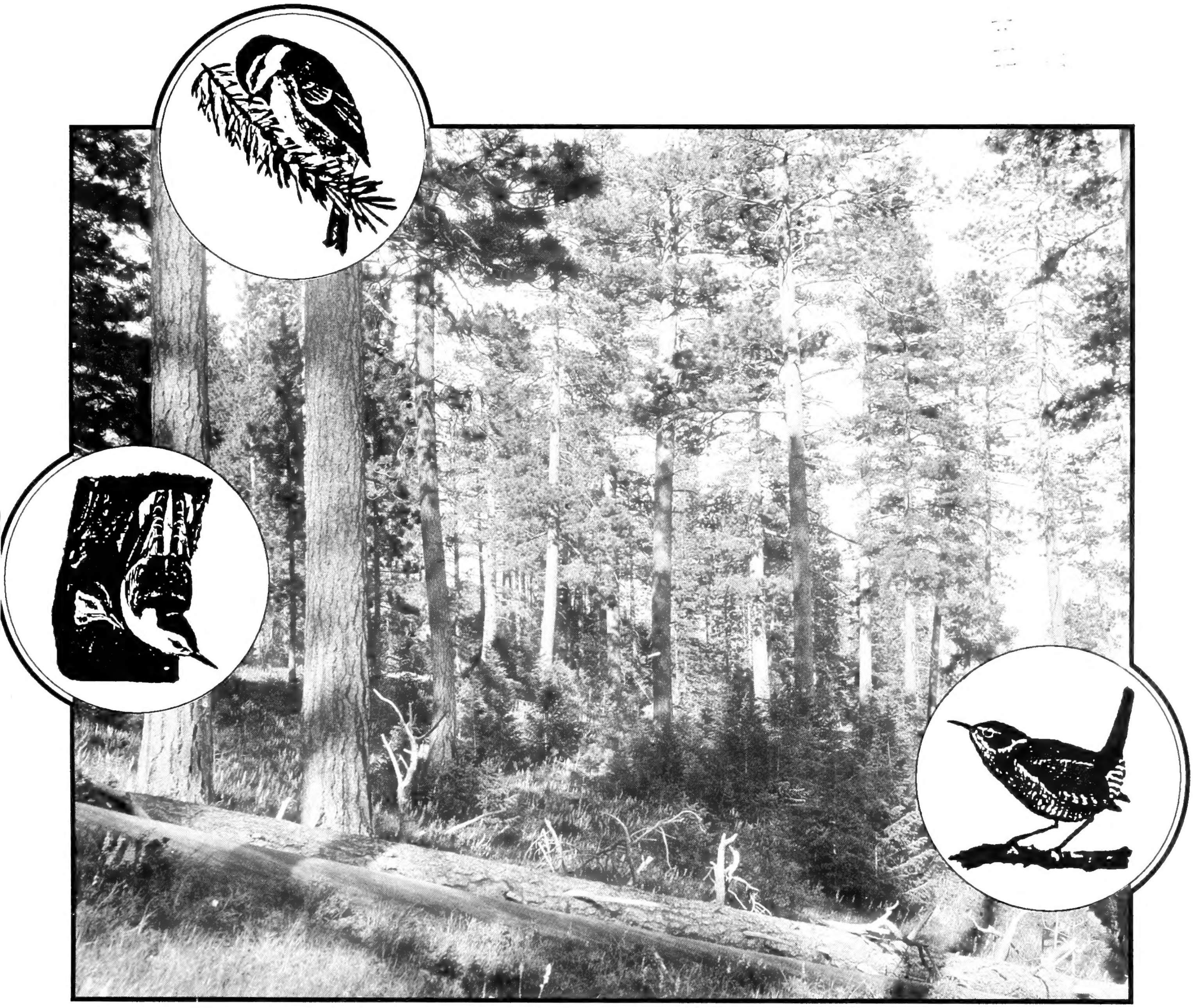

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RESEARCH SUMMARY

Forest Survey data have potential for use in obtaining information on the condition and diversity of the Nation's forest resources relevant to wildlife habitat that is needed for planning and monitoring at State and regional levels. In this study, Forest Survey data were used to assess nongame bird habitat potential based on food and shelter requirements on 24 plots. These assessments were then evaluated using bird numbers. Results of the analyses showed some correlation of bird numbers with tree canopy variables, and illustrate the potential for using Forest Survey data for wildlife habitat assessment, for identifying opportunities to improve habitat through management, and for predicting change in conditions over time.

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INTRODUCTION

Recent environmental concern has generated much public pressure to protect and conserve the Nation's renewable natural resources. Necessary for regionwide decisions is information on current resource conditions. Wildlife habitat is one resource of current interest that is an important element in forest planning and management decisions. Information on existing habitat conditions and predictive capabilities about future conditions on a regionwide scale is needed to allow evaluation of resource tradeoffs involved in management decisions. Forest inventory data may offer opportunity as an efficient way to streamline the task of wildlife resource monitoring.

To meet the requirements for National assessments mandated by the Forest and Rangeland Renewable Resources Planning Act of 1974 and other legislation, forest resource inventories are conducted on public and private lands by Forest Survey, Forest Service, U.S. Department of Agriculture. Forest Survey projects are located throughout the continental United States and Alaska and are some of the most comprehensive, permanent plot inventories in the country. They provide permanent baseline data for most forested land, including most private, State, Bureau of Land Management of the U.S. Department of the Interior, and Indian lands; and excluding some National Forest lands in the West. The inventory procedures for the various Survey projects produce standardized timber statistics, with some regional differences in the scope and details of the inventories.

The Forest Survey data base has the potential to provide information on forest conditions relevant to wildlife populations and on change in these conditions over time (O'Brien and Van Hooser 1983). At the regional level at which Forest Survey operates, some efforts have been made in the area of wildlife habitat assessment by Brooks (1986) in the Northeast, Flather and others (1989) in the South, Ohmann (1983) in the Pacific Northwest, Rudis (1988) in the South, and Sheffield (1981) in the Southeast. This paper focuses on the ponderosa pine forests of Arizona.

Forest Survey variables that could be useful for assessment of potential wildlife habitat are:

Forest type	Aspect	Evidence of use
Basal area	Slope	Distance to roads
No. trees per acre	Habitat type	Fire history
Site index	Percent crown cover	Logging history
Quadratic mean diameter	Species composition	Understory cover and height
Stand-size class	Size of condition	Insect and disease evidence
Tree height	Vegetation concealment	
Elevation		

THE PROBLEM

Evaluating wildlife habitat is complex. Wildlife managers have made use of general timber stand variables such as forest type, stand-size class, age, canopy cover, and other stand features to predict potential wildlife use of a site for feeding, breeding, or resting. Specific habitat suitability models are being developed for predicting occurrence and quantifying value of potential habitat for some wildlife species. Most models are designed to provide site-specific comparisons and are not applicable to extensive forest inventory data. Forest Surveys operate at a much broader level than most research modeling being done for wildlife habitat evaluation. This paper evaluates Forest Survey plot data for potential nongame bird habitat. General habitat criteria on food and shelter from the literature were used for habitat assessment. These habitat assessments were then evaluated using bird numbers collected on the same plots.

The birds chosen for this study were secondary cavity-nesting foliage-gleaners and bark-gleaners (subsequently referred to as cavity-nesting gleaners). These birds are important for several reasons. They are sensitive to timber management practices because they use old and dying trees for nesting (Balda 1969, 1975; Cunningham and others 1980; Diem and Zeveloff 1980; Medin 1985; Owens 1983; Sturman 1968; Szaro and Balda 1979) and because they forage in tree canopies. They are conspicuous, in many places common, and their diets consist of 75 to 90 percent insects (Bent 1946, 1948; Scott and Patton 1975), making them important for insect population control (Thomas and others 1979). Five species of cavity-nesting gleaners found in the study area are the pygmy nuthatch (*Sitta pygmaea*), white-breasted nuthatch (*Sitta carolinensis*), mountain chickadee (*Parus gambeli*), house wren (*Troglodytes aedon*), and brown creeper (*Certhia americana*).

The main food and shelter variables chosen for evaluating cavity-nesting gleaner habitat are foliage volume and snag density. Foliage volume is important due to its relationship to the food supply. The relationship between gleaners and foliage volume is well documented by studies done in the coniferous forests of Arizona by Balda (1969) and Szaro and Balda (1979). Szaro and Balda (1979) reported that gleaners exhibited a positive correlation with increasing foliage volume across five study sites. Medin (1985) reported that among five recognized foraging guilds, gleaners were less numerous on logged plots where foliage volume had been reduced. Foliage volume also represents a number of important niche dimensions other than food quantity, including quality and quantity of perches, and shelter from weather and predators—all important characteristics for survival.

For this study, snags were defined as standing dead trees greater than 1.2 m tall. Snag abundance is assumed to be related to the reproduction of cavity-nesters because they prefer these types of trees in which to excavate holes for nesting. Recommendations for snag size and densities in ponderosa pine forests are documented by Cunningham and others (1980). Snags are also preferred foraging strata for insectivorous birds (Szaro and Balda 1979). Balda (1975) found that snags were used intensively throughout the season relative to their availability. Kendeigh (1944) and Moore (1945) also provide evidence that snag use is not limited to the breeding season. For these reasons snags were included, even though this was not a breeding season study.

Other habitat variables included in the study were woody understory cover and time since logging.

STUDY AREAS

This study was conducted at two locations in the ponderosa pine zone of the northwestern corner of Arizona, which is separated from the rest of the State by the Colorado River. The area is commonly referred to as the Arizona strip. Study area 1 was on the Kaibab Plateau and will subsequently be referred to as Kaibab. Study area 2, just south of Mount Trumbull, will be referred to as Trumbull. It is approximately 80 km southwest of Kaibab. The ponderosa pine zone occurs from 2,074 to 2,501 m elevation.

Kaibab includes the *Pinus ponderosa / Poa longiligula* community type and the *Pinus ponderosa / Bouteloua gracilis* habitat type (Hanks and others 1983). Kaibab is intensively managed for timber. All stands have been thinned to some extent, and the whole area is heavily used by hunters and tourists. Trumbull includes only the *Pinus ponderosa / Bouteloua gracilis* habitat type. Plants common to both areas are Gambel oak (*Quercus gambelii*), New Mexican locust (*Robinia neomexicana*), cliffrose (*Cowania stansburiana*), mountain muhley (*Muhlenbergia montana*), blue grama (*Bouteloua gracilis*), and Indian ricegrass (*Oryzopsis hymenoides*). Trumbull is a more remote and less intensively managed area. There were greater contrasts of forest conditions at Trumbull, including more thickets and more overstocked stands. There was a larger component of oak understory at Trumbull than at Kaibab.

METHODS

The study was conducted in conjunction with the Forest Survey field inventory of Arizona. Twelve plots were sampled for bird numbers at each study area during July and August 1985. Included were actual Forest Survey plots and some supplemental plots added to provide a variety of tree height and canopy cover conditions in order to encompass a wide range of food availability. Five bird counting points approximately 120 m apart were established around each Forest Survey plot (fig. 1), in similar forest conditions. The area sampled for birds at each plot was roughly 6 ha. Birds were counted using the point sampling procedure recommended by Verner and Ritter (1985). Counts were made at each point on two separate days, within 1 hour of sunrise, based on the findings of Robbins (1981). Ten minutes were spent at each of the five points where the number and species of birds were detected and recorded. Detection and identification were based on sightings and calls. Two counts per point, five points per plot, and 12 plots per study area totaled 120 counts at each study area, for a total of 240 counts between Kaibab and Trumbull.

Timber inventory variables were collected according to standard Intermountain Forest Survey inventory procedures (USDA FS 1985) by Forest Survey field crews. The Intermountain Forest Survey uses five variable-radius point samples to sample a 0.4-ha plot (fig. 1). Because points are sampled proportional to basal area, exact snag counts for a fixed area are unavailable. In addition to Forest Survey snag counts, every snag 10.2 cm diameter at breast height (d.b.h.) or larger within 60 m of each bird sampling point was recorded. The relationship between snag densities obtained with a

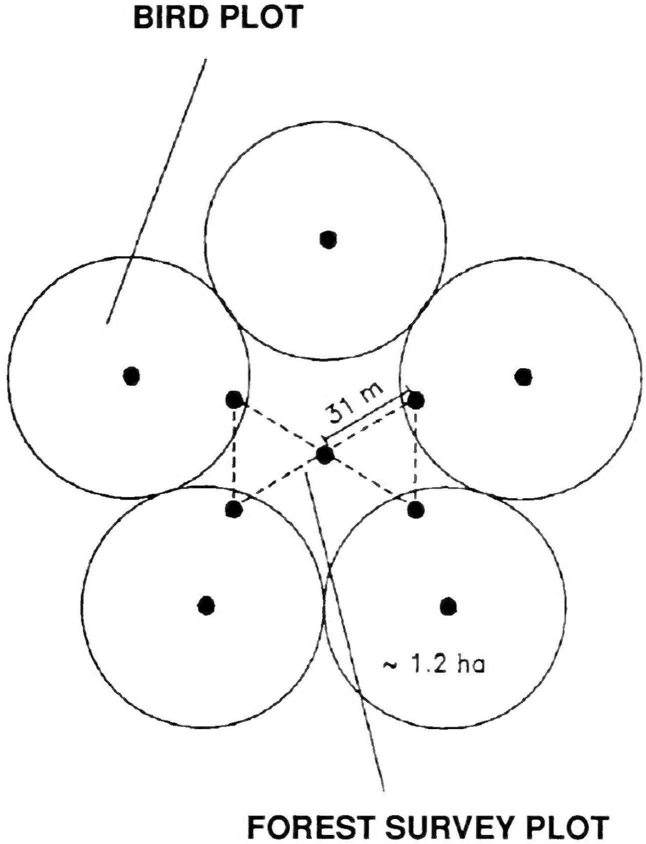

Figure 1—A representation of one study plot including Forest Survey plot and bird point configuration.

variable-radius point sample compared to total fixed-area snag counts is the subject of a separate study and will not be addressed here.

Forest Survey does not measure foliage volume directly. Crown volume was estimated from the Forest Survey data base using measurements of tree height, crown ratio, minimum and maximum crown widths, and crown shape. Foliage volume was then estimated by discounting the crown volume estimates to bring them in line with other estimates reported in the literature for ponderosa pine forests (Cunningham and others 1980). These foliage volume estimates represented the relative foliage volume differences between the plots and made it possible to separate other tree foliage volume from ponderosa pine foliage volume. Cunningham and others (1980) found that bird use of foliage may be better explained if foliage volume is partitioned into ponderosa pine and other tree volume.

Foliage volume was also estimated using an index of food availability developed by Schroeder (1983) as part of a Habitat Suitability Index (HSI) model for assessing potential habitat of the black-capped chickadee (*Parus atricapillus*)—another cavity-nesting gleaner species. This index is an assessment of food availability (the term "availability" was substituted for "suitability" in this paper) computed from a measure of average height of overstory trees and tree canopy closure. These variables are each assigned a rating, then combined in an equation (fig. 2) to arrive at an overall food availability ranking between 0 and 1.0.

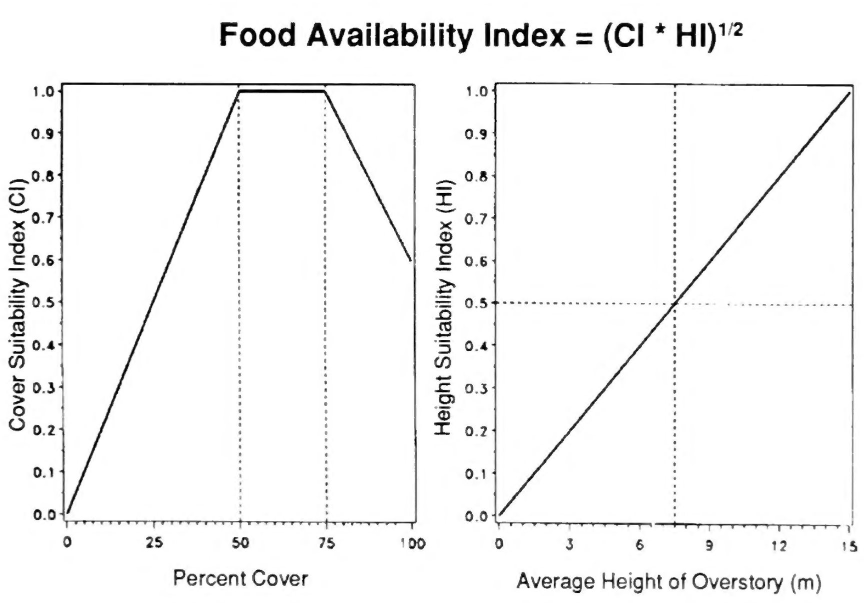

Figure 2—Overall food availability index equation with individual cover and height indices (Schroeder 1983).

Simple correlation and simple and multiple regression were used to analyze the relationships between bird species numbers and the independent habitat variables: average height of tallest trees, crown canopy cover, snag density, foliage volume (ponderosa pine and other), the index of food availability, woody understory vegetation cover, and time since logging. The Spearman test for correlation (SAS 1982) was used because it was assumed that the precision of bird counts was low and because the relationship between variables might not be linear.

RESULTS

The relationship between bird numbers and habitat variables varied depending on study area. Total numbers of the five species of cavity-nesting gleaners were three times more abundant at Trumbull (199) as at Kaibab (65) for sites with similar foliage volume and snag density. There were more than six times the number of white-breasted nuthatches at Trumbull than at Kaibab. This supports one observation made by Cunningham and others (1980) of a positive correlation between white-breasted nuthatches and Gambel oak. No brown creepers were observed on any of the locations.

Table 1 presents a summary of bird numbers and canopy-related habitat variables. Trumbull plots had slightly higher mean canopy cover and food availability, similar mean height and foliage volume, and fewer snags than Kaibab plots.

Spearman correlation coefficients (*r*) were computed between bird numbers and all habitat variables for the two study areas separately and combined and are presented in table 2. Correlation coefficients between bird numbers and habitat

Table 1—Summary of average number of birds and habitat variables per plot

Location number	White breasted nuthatch	Mountain chickadee	House wren	Pygmy nuthatch	Total guild	Crown canopy cover	Average height tallest trees	Ponderosa pine foliage volume	Other tree foliage volume	Woody understory cover	Number snags >10.2 cm/ha	Food availability index
	Number					*Percent*	*m*	*m³/ha*		*Percent*		
					Study area 1 (Kaibab)							
01	1.0	0.5	0.5	0	2.0	51	28	60,864	0	9	1.3	1.00
02	1.0	.5	0	0	1.5	57	26	16,661	4,318	12	1.3	1.00
03	0	0	0	3.5	3.5	37	27	59,519	0	0	.3	.84
04	.5	2.5	0	0	3.0	21	29	36,641	0	0	.7	.63
05	.5	2.0	0	0	2.5	46	10	25,964	0	1	.3	.79
06	.5	6.0	0	0	6.5	42	16	15,055	4,586	29	.2	.89
07	0	0	0	0	0	35	22	35,289	1,229	24	.5	.84
08	1.5	5.5	0	0	7.0	16	13	11,495	5,796	29	.3	.52
09	.5	2.0	2.0	6.5	11.0	49	28	35,226	0	9	2.3	1.00
10	1.5	3.0	1.5	8.0	14.0	81	30	89,253	0	6	3.2	.95
11	0	0	0	0	0	65	16	59,004	0	0	.8	1.00
12	1.0	13.0	0	0	14.0	20	15	8,582	6,578	50	.3	.63
Mean	.7	2.9	.3	1.5	5.4	43	22	37,796	1,876	14	1.0	.84
					Study area 2 (Trumbull)							
13	0	6.5	0	6.5	13.0	23	21	34,425	0	11	0	.71
14	6.5	10.0	0	3.5	20.0	54	21	34,650	7,272	35	.3	1.00
15	4.5	10.5	0	9.5	24.5	54	21	63,079	1,445	1	.2	1.00
16	.5	3.0	0	1.0	4.5	75	18	15,998	9,689	0	.2	1.00
17	4.0	7.0	0	7.5	18.5	58	14	60,232	4,529	6	0	.95
18	5.0	4.5	1.0	5.5	16.0	80	27	53,987	1,222	0	.3	.95
19	7.0	6.5	0	14.5	28.0	48	26	64,622	9,137	11	1.5	1.00
20	4.5	7.5	0	10.5	22.5	50	23	37,752	4,358	17	1.2	1.00
21	0	0	0	0	0	5	13	8,408	0	14	.3	.30
22	.5	2.0	0	3.0	5.5	38	23	12,894	0	16	.2	.89
23	8.0	3.5	0	9.0	20.5	59	27	63,423	1,697	2	.5	1.00
24	6.0	12.5	0	7.5	26.0	58	16	20,308	382	4	0	1.00
Mean	3.9	6.1	.1	6.5	16.6	50	21	39,148	3,311	10	.4	.90

Table 2—Spearman correlation coefficients (*r*) for bird numbers compared with habitat variables; study areas separate and combined

	Crown canopy cover	Average height tallest trees	Ponderosa pine foliage volume	Other tree foliage volume	Woody understory cover	Number snags >10.2 cm/ha	Food availability index
	Percent	*m*	- - - - - - - - *m³/ha* - - - - - - -		*Percent*		
Study area 1 (Kaibab)							
White–breasted nuthatch	0.03	0.07	–0.21	0.35	0.46	0.24	–0.13
Mountain chickadee	–.37	–.18	–.56	.53	.56	–.29	–.48
House wren	.51	.64	.48	–.46	–.08	[1].74	.53
Pygmy nuthatch	.37	.59	.49	–.46	–.31	.47	.28
Total birds	–.23	.11	–.23	.23	.32	–.06	–.32
Study area 2 (Trumbull)							
White–breasted nuthatch	.46	.56	[1].70	.46	–.10	.51	[1].73
Mountain chickadee	.17	–.11	.38	.22	.05	–.21	.56
House wren	.48	.44	.13	–.13	–.44	.13	–.20
Pygmy nuthatch	.06	.42	[1].82	.30	–.04	.32	.55
Total birds	.15	.31	[1].71	.32	–.01	.26	[1].72
All locations							
White–breasted nuthatch	.47	.15	.37	[1].53	.07	.08	[1].51
Mountain chickadee	.11	–.23	.00	[1].58	.27	–.40	.16
House wren	.37	[1].58	.34	–.36	–.18	.48	.20
Pygmy nuthatch	.44	.32	[1].60	.16	–.18	–.01	[1].50
Total birds	.31	.08	.34	.45	.07	–.18	.38

[1] $P \leq 0.01$.

variables produced some significant positive relationships. Pygmy nuthatch exhibited significant positive correlations ($r = 0.82$ and 0.60) ($P \leq 0.01$) with ponderosa pine foliage volume at Trumbull and both study areas combined. House wren exhibited significant positive correlation with the average height of the tallest trees on both study areas combined ($r = 0.58$). White-breasted nuthatch exhibited a significant positive correlation with ponderosa pine volume at Trumbull ($r = 0.70$), as did the four species combined ($r = 0.71$). At all locations combined, white-breasted nuthatch and mountain chickadee had significant positive correlations ($r = 0.53$ and $r = 0.58$) with other tree volume, which included pinyon, juniper, and tree-form Gambel oak. Significant positive correlations were exhibited with the index of food availability by white-breasted nuthatch at Trumbull and the combined study areas ($r = 0.73$ and $r = 0.51$), by pygmy nuthatch on the combined study areas ($r = 0.50$), and by the four species total at Trumbull ($r = 0.72$). These patterns, similar to what Diem and Zeveloff (1980) and Cunningham and others (1980) reported, were more evident at Trumbull or at all locations combined than at Kaibab.

There was little correlation between bird numbers and snag densities, woody understory vegetation cover, or time since logging on either study area, except at Kaibab, where house wren had a significant positive correlation with snag density. Regression analyses performed combining the habitat variables yielded little improvement.

DISCUSSION

Results of this study illustrate the potential associated with using Forest Survey data for the assessment of wildlife habitat. Results of the analyses showed some correlation of bird numbers with the interrelated tree canopy variables: total foliage volume, ponderosa pine volume, other tree volume, and the index of food availability. These findings indicate that general foliage volume estimates or indices can be used to indicate relative habitat suitability.

The food availability index is a good ordered variable (Spearman correlation test) and is sensitive to food availability reduction at high-canopy closure levels (fig. 2). This index of food availability is more easily obtained than foliage volume and appears to be as useful an indicator of food availability for gleaners.

This study also illustrates the problems associated with using Forest Survey data for potential wildlife habitat assessment. One problem is in using variable-radius plots that sample trees proportional to basal area to get information on snags for wildlife. A study is under way to compare snag information obtained with variable-radius plots to actual snag counts.

Habitat variables were tested by comparing differences in bird use of different foliage volume and snag density conditions. However, differences due to study area overshadowed any differences within study area. The threefold increase in bird numbers from Kaibab to Trumbull can possibly be explained by the greater diversity, patchiness, and layering of the vegetation, the importance of which was reported by Langelier and Garton (1986). Reduced numbers of gleaners at Kaibab support the findings of Medin (1985) that gleaners are less numerous on logged plots where foliage volume has been reduced.

The difference due to study area was observable but was difficult to detect using Forest Survey methodology, except that Trumbull plots had slightly higher mean canopy cover and food availability than Kaibab plots. There are two possible reasons. First, a subset of Forest Survey plots were selected and supplemental plots were located to provide a wide range of foliage and snag conditions for this study, thus overriding the inherent differences in the study areas. Second, analysis of additional Forest Survey plot data indicated that both sites have similar percentages of plots on which evidence of logging, occurrence of thickets, and multiple vegetation layers were reported. Forest Survey data are somewhat insensitive to subtle differences in vegetation structure and distribution, due to the general nature of the variables measured. The difference between areas was related to details of horizontal and vertical distribution of the vegetation to which the birds were apparently more attuned but which would require much more detailed, time-consuming methodology to identify.

There are problems with using animal numbers to assess habitat suitability. Van Horne (1983) reported that density may sometimes be a misleading indicator of habitat quality. Density may reflect temporary or recent conditions rather than long-term conditions, social dominance may induce high densities in poor habitats, and censuses may be obtained in noncritical seasons. Diem and Zeveloff (1980) found that the movements of birds can reflect local perturbations that may be temporary responses to short-term environmental factors and that are impossible to monitor. Therefore, high correlation should not be expected when comparing habitat suitability to bird numbers.

Lack of a high degree of correlation between bird numbers and habitat variables does not mean that the other variables included in the study would not be useful indicators of wildlife habitat potential. Even though the value of snags was not demonstrated in this nonbreeding season study, the importance of snags for cavity-nesting birds and other animals in general is well known (Thomas and others 1979). Recent publications emphasize snag management and Forest Service guidelines for retention of snags (Langelier and Garton 1986; Morrison and others 1986). A survey of snag densities on other northern Arizona Forest Survey plots indicates that snag densities are rarely at recommended levels. None of the sites in this study contained recommended (Cunningham and others 1980) snag densities. Morrison and others (1986) concluded that current guidelines for large snag retention are appropriate, but even under snag management strategies, recommended densities are not being met. Although snag densities alone will probably not be a useful indicator of abundance of many bird species, general information on snags from statewide inventories would be useful for monitoring snag densities and, consequently, habitat potential, on all forest lands.

SUMMARY

Forest Survey projects throughout the country collect and maintain statewide multiresource data bases that may be useful for assessing and monitoring elements of wildlife habitat or trends over time in general forest conditions that have relevance for wildlife populations. One problem is that Forest Survey data are primarily collected to generate regional timber resource statistics, whereas most wildlife habitat research is done on a site-specific level. However, the State and regional level at which Forest Survey operates is also the level at which important information on the condition and diversity of the Nation's resources must be monitored and at which program funding takes place.

This study involving bird numbers illuminated some of the problems involved in habitat assessment. It also provided some evidence that Forest Survey data could be used as a starting point in identifying key issues or problem areas that need more site-specific studies. There is potential to use Forest Survey data to assess the capacity of the forests of an area to support insectivores or cavity-

nesters and to identify opportunities to improve wildlife habitat through timber management. Intermountain Forest Survey is investigating other ways of monitoring change in forest conditions on a statewide basis that could have relevance for wildlife and other forest resources.

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Forest Survey data were used to assess nongame bird habitat potential based on food and shelter requirements on 24 plots. These assessments were then evaluated using bird numbers. Results of the analyses showed some correlation of bird numbers with tree canopy variables, and illustrate the potential for using Forest Survey data for wildlife habitat assessment.

KEYWORDS: foliage volume, forest inventory, wildlife habitat assessment

INTERMOUNTAIN RESEARCH STATION

The Intermountain Research Station provides scientific knowledge and technology to improve management, protection, and use of the forests and rangelands of the Intermountain West. Research is designed to meet the needs of National Forest managers, Federal and State agencies, industry, academic institutions, public and private organizations, and individuals. Results of research are made available through publications, symposia, workshops, training sessions, and personal contacts.

The Intermountain Research Station territory includes Montana, Idaho, Utah, Nevada, and western Wyoming. Eighty-five percent of the lands in the Station area, about 231 million acres, are classified as forest or rangeland. They include grasslands, deserts, shrublands, alpine areas, and forests. They provide fiber for forest industries, minerals and fossil fuels for energy and industrial development, water for domestic and industrial consumption, forage for livestock and wildlife, and recreation opportunities for millions of visitors.

Several Station units conduct research in additional western States, or have missions that are national or international in scope.

Station laboratories are located in:

Boise, Idaho

Bozeman, Montana (in cooperation with Montana State University)

Logan, Utah (in cooperation with Utah State University)

Missoula, Montana (in cooperation with the University of Montana)

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