

Winter Movements and Range Use of Radio-marked Mexican Spotted Owls:

An Evaluation of Current Management Recommendations

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**United States Department
of Agriculture**

Forest Service

**Rocky Mountain
Research Station**

**General Technical Report
RMRS-GTR-148-WWW**

January 2005



Ganey, Joseph L.; Block, William M. 2005. **Winter movements and range use of radio-marked Mexican spotted owls: an evaluation of current management recommendations.** Gen. Tech. Rep. RMRS-GTR-148-WWW. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 9 p.

Abstract

We summarized existing knowledge on winter movements and range and habitat use of radio-marked Mexican spotted owls. In light of that information, we evaluated the adequacy of current management guidelines. Seasonal movement or "migration" appears to be a regular feature of the winter ecology of Mexican spotted owls. Most radio-marked owls studied were resident in and around their breeding areas year-round, but some owls migrated in most populations studied. Owls that were year-round residents generally expanded their home range during the non-breeding season, and many exhibited spatial shifts in area used. Despite these shifts, however, overlap between seasonal ranges was relatively great for most individuals. For these owls, current guidelines aimed at conserving nesting habitat also would conserve areas used during the non-breeding season. Additional recovery plan guidelines aimed at protecting habitats with structure similar to nesting areas should be useful in protecting other areas used by resident owls expanding their range during winter. In contrast, migrating owls typically moved to lower elevations and into open habitats not used by breeding owls. Current guidelines do not protect these habitats. However, we currently have (1) no evidence that such habitats are limiting, (2) no evidence that special protection is necessary in these areas and/or habitats, (3) little information on which to base such protective measures if they are necessary, and (4) no objective way to identify important wintering areas used by migrating owls. Until better information is available, we see no compelling reason to develop specific guidelines for protection of wintering areas.

Key words: Mexican spotted owl, *Strix occidentalis lucida*, seasonal movements, migration, conservation planning, range use, winter

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Cover photo: Wintering Mexican spotted owl roosting in a juniper tree. Even in relatively open woodlands, owls managed to find roost sites that provided shade and protection from predators. All photos by J. L. Ganey

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Introduction

The Mexican spotted owl (*Strix occidentalis lucida*) occurs widely throughout the mountains and canyonlands of the American southwest and well into the mountains of Mexico (Gutiérrez and others 1995; Ward and others 1995). This owl typically is associated with either mature forests or rocky canyonlands (Ganey and Dick 1995; Gutiérrez and others 1995; Rinkevich and Gutiérrez 1996; Johnson 1997; Willey 1998). It was listed as threatened in 1993, primarily because of concerns over the effects of timber harvest and wildfire on its forest habitat (USDI 1993).

As with many threatened species, the Mexican spotted owl and its ecology have received considerable research and management attention. Most studies focused on breeding-season ecology, however, so we know relatively little about the ecology of this owl during winter. This knowledge gap is important. Winter is a period of energetic stress for many birds (e.g., Greenwood and others 1992, Newton 1998) and may be a critical period for these owls as well. For example, 9 of 11 mortalities documented in studies of radio-marked spotted owls in Arizona and New Mexico occurred from November through February (J. L. Ganey, unpublished data).

The recovery plan for the Mexican spotted owl (USDI 1995) focused conservation measures on habitats used during the breeding season. It provided no specific recommendations for wintering habitat. This recovery plan is now in revision, and numerous individuals have recommended including protective measures for wintering habitat in this revision (personal observation). Based on these pleas, we re-examined the issue of wintering habitat for Mexican spotted owls. Our objectives were to (1) summarize information in the literature on seasonal movements and wintering habitats of Mexican spotted owls, (2) develop new information where appropriate and feasible, based on existing data, and (3) evaluate the adequacy of recovery plan guidelines in light of that information.

Methods

Data Sources and Analysis

We summarized information from the literature on seasonal home-range size, activity-center size, movements, and habitat use of radio-marked Mexican spotted owls (Ganey and Balda 1989; Ganey and others 1999; Zwank and others 1994; Johnson 1997; Willey 1998). These studies were conducted in seven study areas in four states and represented a variety of landforms and forest and woodland cover types (table 1; additional details on study area characteristics, study duration, and specific field methods are contained in the original reports). Some studies provided data on both seasonal home ranges and movements (Willey 1998, Ganey and others 1999), whereas others provided data only on seasonal movements (Ganey and Balda 1989, Johnson 1997). All studies providing seasonal home-range estimates recognized breeding and non-breeding seasons following Ganey and Balda (1989; breeding season = 1 Mar – 30 Aug).

We supplemented this information with unpublished data on radio-marked owls (Skaggs 1990, J. L. Ganey and W. M. Block, unpublished data), and both published and unpublished accounts of seasonal movements of color-banded owls that were not radio-marked (Gutiérrez and others 1996, Duncan and Speich 2002). We also re-analyzed existing data for radio-marked owls from three study areas in Arizona and New Mexico (described in Ganey and others 1999, 2000) to summarize those aspects of winter range use that were not addressed in the original papers but that were relevant to evaluating adequacy of recovery plan guidelines for habitat protection (see below).

Previous studies documented winter movements or “migration” of some radio-marked owls, whereas other owls remained in or near their breeding areas throughout the winter. Migration typically is defined as a regular seasonal movement from a breeding to a wintering area (e.g., Welty 1975: 463). Movements documented in Mexican spotted owls were highly variable in terms of

Table 1—Characteristics of study areas where movements of radio-marked Mexican spotted owls were monitored.

Study area	State	General landform	Primary cover types ¹	Source ²
San Francisco Peaks	Arizona	Montane slopes	Mixed-conifer, ponderosa pine	1
Walnut Canyon	Arizona	Incised canyon	Mixed-conifer, ponderosa pine, riparian, ponderosa pine / pinyon-juniper / oak	1
Sacramento Mountains ²	New Mexico	Montane slopes and canyons	Mixed-conifer, ponderosa pine, pinyon-juniper	2
Sacramento Mtns – mesic ³	New Mexico	Montane slopes and canyons	Mixed-conifer	3
Sacramento Mtns. – xeric ³	New Mexico	Montane slopes and canyons	Mixed-conifer, ponderosa pine, pinyon-juniper	
Bar-M Canyon	Arizona	Rolling hills, cinder cones	Ponderosa pine-Gambel oak, ponderosa pine	4
Colorado	Colorado	Incised canyons	Mixed-conifer, pinyon-juniper, ponderosa pine	5
Southern Utah	Utah	Incised canyons	Pinyon-juniper, mixed-conifer	6

¹ Dominant species: Mixed-conifer = Douglas-fir (*Pseudotsuga menziesii*) and/or white fir (*Abies concolor*), with ponderosa pine (*Pinus ponderosa*) and southwestern white pine (*P. strobiformis*) common. Ponderosa pine = ponderosa pine. Riparian = box-elder (*Acer negundo*), narrowleaf cottonwood (*Populus angustifolia*), and quaking aspen (*P. tremuloides*). Ponderosa pine / pinyon-juniper / oak = ponderosa pine, pinyon pine (*P. edulis*), various juniper species (*Juniperus* spp.), and Gambel oak (*Quercus gambelii*). Pinyon-juniper = pinyon pine, various species of junipers. Ponderosa pine-Gambel oak = ponderosa pine, Gambel oak.

² Sources: 1 = Ganey and Balda (1989); 2 = Skaggs (1990), Zwank and others (1994); 3 = J. L. Ganey and W. M. Block (unpublished data); 4 = Ganey and others (1999); 5 = Johnson (1997); 6 = Willey (1998).

³ J. L. Ganey and W. M. Block (unpublished data) recognized two distinct study areas in the Sacramento Mountains, whereas Skaggs (1990) and Zwank and others (1994) pooled owls across these areas when estimating size of seasonal home ranges. The mesic area was dominated by mixed-conifer forest, the xeric area by drier forest and woodland types. See Ganey and others (2000) for more details on study areas.

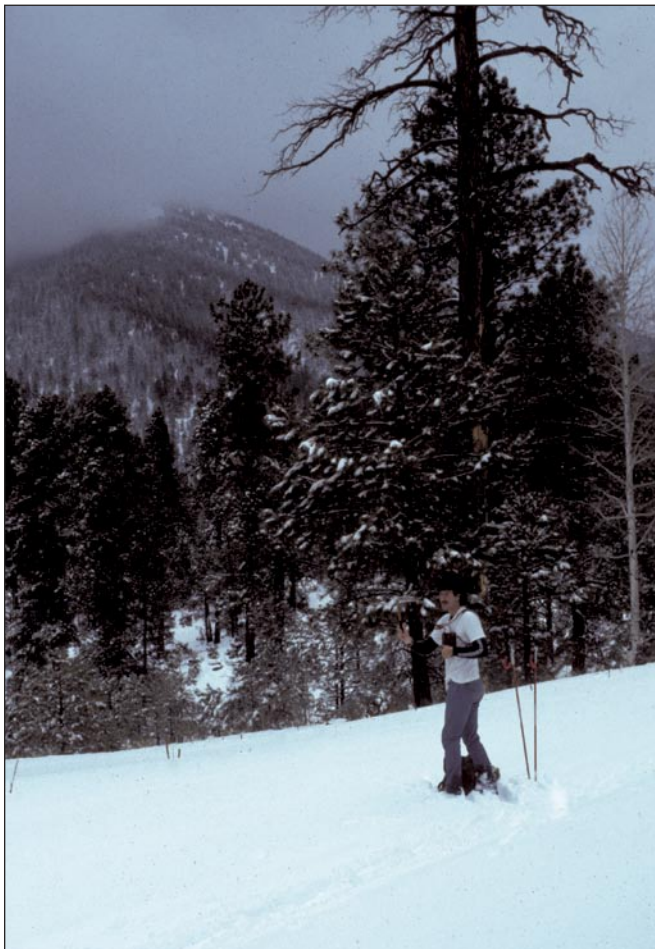


Figure 1—Biologist John Stephenson radio tracking Mexican spotted owls during winter, San Francisco Peaks, Arizona.

both distance moved and duration, however. In some cases, these movements did not appear to fit the classic definition of migration, because they were of relatively short distance or duration. For this discussion, we operationally defined all owls that moved <2 km from their breeding-season home-range center as residents, and all other owls as “migrants.” This distance criterion approximated mean nearest-neighbor distances reported in studies of Mexican spotted owls in Arizona (2.4 km, $n = 42$ pairs; May and Gutiérrez 2002) and New Mexico (2.1 km, $n = 31$ pairs; Peery and others 1999). We recognize that a gradient exists in terms of both distance and duration of winter movements of these owls, however.

For migrating owls, we asked:

1. How common are winter movements outside the home range?
2. What habitats are used by migrating owls?
3. Can important wintering areas and/or habitats be identified objectively?
4. Are specific protective measures needed for such areas and/or habitats?
5. If so, do recovery plan guidelines provide the necessary protection?

For resident owls, we evaluated changes in range use and habitats used between the breeding and non-breeding season, and spatial overlap between seasonal ranges. Because recovery plan guidelines were based on activity-center size, we present estimates for activity-center size (based on the 75% adaptive kernel contour; USDI

1995) where possible. We supplemented that information with estimates of home-range size where estimates were not available for activity-center size. We also summarized shifts in spatial use patterns of resident owls in terms of proportional overlap between seasonal activity centers of individual owls. We used two measures of seasonal overlap. One measured the proportion of the breeding-season activity center contained within the non-breeding-season activity center; the other measured the proportion of the non-breeding-season activity center contained within the breeding-season activity center.

We asked the following questions about resident owls:

1. Do owls use larger ranges during the non-breeding season than during the breeding season?
2. To what extent do seasonal ranges overlap spatially?
3. Do owls use the same types of habitat during the breeding and non-breeding seasons?
4. In light of the above, do recovery plan guidelines offer sufficient protection to wintering areas and habitats?

Recovery Plan Guidelines Evaluated

The recovery plan for the Mexican spotted owl recognized three primary habitat categories: protected habitat, restricted habitat, and other forest and woodland types (USDI 1995:84-96). Protected habitat included Protected Activity Centers (PACs) and mixed-conifer and pine-oak forests on steep slopes with no history of timber harvest within the past 20 yrs. PACs were areas of ≥ 243 ha established around nesting areas of resident owls, to protect those nesting areas (USDI 1995:84-89). PAC size was based on the median size of activity centers (as defined by the 75% adaptive kernel estimate) used throughout the year by 14 pairs of radio-marked owls. Steep-slope mixed-conifer and pine-oak forests without recent timber harvest were included to protect habitats similar in structure to nesting areas (USDI 1995:89-90).

As the name implies, PACs and protected habitat were “protected” from many management treatments.

Restricted habitat included the remainder of the mixed-conifer and pine-oak cover types (i.e., not on steep slopes or included in PACs), as well as riparian habitats. Management was more flexible in restricted habitat than in protected areas. Guidelines called for managing a specified portion of the overall landscape as replacement owl habitat, with the remainder open to most forms of management (USDI 1995:90-95).

Cover types not specifically classified as protected or restricted habitats fell in the “other forest and woodland” category. The recovery plan included no specific recommendations for these cover types (USDI 1995:95-96).

Results and Discussion

Seasonal Migration

Seasonal movements or migration occurred in most areas where movements of radio-marked owls were monitored (table 2). Seasonal migration generally involved a subset of the population, with the size of that subset varying both among study areas and among years within study areas. For example, seasonal migration was observed in the Sacramento Mountains, New Mexico, during the winter of 1989 – 1990, but not in two subsequent studies in the same mountain range (table 2). Similarly, movements of one radio-marked female from the Bar-M Canyon study area were monitored over three winters. This owl was resident during the first winter but migrated in each of the following two winters (table 3).

Migrating owls typically left study areas in November or December and returned from January to April (table 3). Distance moved ranged from 5 km to 50 km for owls whose wintering areas were located. Wintering areas of two owls from the San Francisco Peaks could not be located, despite an aerial search covering thousands of square kilometers. This suggests that some owls may

Table 2—Numbers of radio-marked Mexican spotted owls observed to migrate during the winter in various studies.

Study area	Years	Number of owls radio-marked	Number of owls migrating ¹	Source
San Francisco Peaks	1986-1987	4	2	Ganey and Balda (1989)
Walnut Canyon	1986-1987	2	2	Ganey and Balda (1989)
Sacramento Mountains	1989-1990	8	4	Skaggs (1990)
	1990-1991	9	0	Zwank and others (1994)
	1992-1995	15	0	J. L. Ganey and W. M. Block (unpublished data)
Bar-M Canyon	1990-1993	13	3	Ganey and others (1999)
Southern Utah	1991-1995	15	2	Willey (1998)
Colorado	1992-1996	5	3	Johnson (1997)

¹ Migration was defined as movement >2 km from the center of the breeding-season home range. See table 3 for information on movements of individual owl.

Table 3—Distance moved, movement duration, elevation change, and habitats used by migrating Mexican spotted owls.

Study area	Years	Sex	Distance moved (km)	Duration	Elevation change (m) ¹	Cover type ²	Source ³
San Francisco Peaks	1986-87	F	Unknown ⁴	Nov – Apr	Unknown	Unknown	1
San Francisco Peaks	1986-87	M	Unknown ⁴	Nov – Apr	Unknown	Unknown	1
Walnut Canyon	1986-87	F	10	Dec-Jan	100	MC, PP, P/O/J, R	1
Walnut Canyon	1986-87	M	10	Dec-Jan	100	MC, PP, P/O/J, R	1
Sacramento Mtns.	1989-90	F	10-24	Unknown	Unknown	PJW, SDS	2
Sacramento Mtns.	1989-90	M	10-24	Unknown	Unknown	PJW, SDS	2
Sacramento Mtns.	1989-90	M	~5	Unknown	Unknown	MC	2
Sacramento Mtns.	1989-90	M	~11	Unknown	Unknown	MC	2
Bar-M Canyon	1990-91	M	10	Dec-Jan	0	PO	3
Bar-M Canyon	1990-91	M	50	Dec-Apr	920	PJW	3
Bar-M Canyon ⁵	1991-92	F	50	Dec-Apr	920	PJW	3
Bar-M Canyon ⁵	1992-93	F	50	Dec-Apr	920	PJW	3
Colorado	1992	M	7	Nov-Apr	407	PJW, PP	4
Colorado	1995	F	17	Nov-Feb	335	PJW, PP	4
Colorado	1995	M	7	Dec-Jan	182	PJW, PP	4
Utah	Unknown	F	25	Unknown	+913	SF	5
Utah	Unknown	M	20	Unknown	685	MS	5

¹ Elevation changes are negative unless otherwise indicated.

² Cover types: MC = mixed-conifer forest, MS = mountain shrub, PJW = pinyon-juniper woodland, PO = ponderosa pine-Gambel oak forest, PP = ponderosa pine forest, P/O/J = ponderosa pine/oak/juniper, R = riparian, SDS = semi-desert scrub; SF = spruce-fir forest.

³ Sources: 1 = Ganey and Balda (1989); 2 = Skaggs (1990); 3 = J. L. Ganey and W. M. Block (unpublished data); 4 = Johnson (1997: table 5); 5 = Willey (1998:54-55).

⁴ Wintering areas not located despite an aerial search covering thousands of square kilometers.

⁵ These two records represent one female owl that migrated to the same area in two consecutive winters. This owl did not migrate in the winter of 1990-1991 (but her mate did).



Figure 2—Overview of relatively open pinyon-juniper woodland used during winter by radio-marked Mexican spotted owls from the Bar-M study area, Arizona. This type of habitat was used for nocturnal foraging.



Figure 3—Relatively dense pinyon-juniper woodland used during winter by a radio marked-Mexican spotted owl in Arizona. This area was frequently used for diurnal roosting.

move long distances. Gutiérrez and others (1996) provided another possible example of long-distance winter movement. They banded an adult female owl in 1994 as a member of a territorial pair in the Tularosa Mountains, New Mexico. This owl was found dead in January 1995 in the Chihuahuan desert near Deming, New Mexico, 187 km from the banding location. Gutiérrez and others (1996) described this as an example of adult dispersal, but given movements of radio-marked owls to low-elevation habitats during winter, we cannot rule out seasonal migration as an alternative explanation.

Some non-resident owls moved only short distances and remained in the same forest types represented in their breeding-season home ranges (table 3). In contrast, other owls moved down in elevation, and most of these down-slope migrants wintered in habitats more open in structure than typical breeding habitat, such as semi-desert scrub, pinyon (*Pinus* spp.) – juniper (*Juniperus* spp.) woodland, or mountain shrub (table 3). Duncan and Speich (2002) provided additional evidence for such down-slope migration. They documented a sub-adult owl overwintering in Sonoran riparian deciduous woodland at 838 m in the foothills of the Santa Catalina Mountains, Arizona. They relocated this owl five years later as a member of a territorial pair near the summit of

this range, in mixed-conifer forest at an elevation of 2682 m. We also are aware of numerous anecdotal observations of Mexican spotted owls in woodland, semi-desert, and desert cover types during the winter months. In most cases, it is impossible to tell whether these represent migrating territorial owls or dispersing juveniles, which use similar habitats (Arsenault and others 1997; Ganey and others 1998; Willey and van Riper 2000; Duncan and Speich 2002).

Thus, available information suggests that seasonal migration of some individuals occurs in many or most populations of Mexican spotted owls, and that such migration occurs in both sexes (table 3). Partial migration also occurs in California spotted owls (*S. o. occidentalis*; Laymon 1989; Verner and others 1992). In contrast, migration appears to be rare in Northern spotted owls (*S. o. caurina*; Gutiérrez and others 1995).

Reasons why only some owls migrate are unknown. In addition, some individual Mexican spotted owls migrate in some years but not others (table 3). Migration generally entails a change in elevation for both Mexican (table 3, Duncan and Speich 2002) and California spotted owls (Laymon 1989, Verner and others 1992), with most owls moving down slope (but see Willey 1998). Migration to lower elevations allows owls to winter in

areas that are warmer than their breeding areas during the winter and that lack persistent snow. This may facilitate hunting for small mammals, which comprise the bulk of the diet (Ward and Block 1995). It also may allow the owls to move to areas with more concentrated prey resources, as populations of small mammals reach their nadir in owl breeding areas during the winter months (Ward and Block 1995). From a conservation perspective, some migrating owls occupy cover types that fall in the “other forest and woodland types” category, and thus have no protective measures under the recovery plan (USDI 1995). These cover types also are used by dispersing juvenile owls during the fall and winter (Arsenault and others 1997; Ganey and others 1998; Willey and van Riper 2000; Duncan and Speich 2002).

Also presently unknown is how and why migrating owls select particular wintering areas. For example, the two migrating owls from the Bar-M Canyon study area moved 50 km to winter in pinyon-juniper woodlands. These owls were members of a mated pair but did not migrate together or even in the same year. They occupied adjacent but non-overlapping winter ranges. Much of the area between these wintering areas and their breeding area consisted of pinyon-juniper woodland that was, at least superficially, similar to the wintering areas occupied.

At present, we have little information on specific habitat features that migrating spotted owls use in wintering areas (but see Peterson 2003). Further, owls use these areas at a time of year when they are unlikely to vocalize (Ganey 1990), making it difficult to locate such areas through calling surveys. This leaves us with no objective means to identify and protect such areas. The types of lowland areas in which wintering owls have been observed cover vast areas, and we have no evidence that suitable wintering areas are limiting. Thus, we see little evidence that specific protective measures for wintering areas or habitats used by migrating spotted owls would be useful or appropriate at this time.

Range Use by Resident Owls

Resident owls expanded their home range during the non-breeding season in all areas where seasonal range estimates were available, although the magnitude of this seasonal expansion varied among areas (table 4). Clearly, owl home ranges were larger than the areas protected in PACs. PAC size was based on the size of owl activity centers, however, not home ranges. Size of owl activity centers was more comparable to PAC size in the three study areas where estimates were available (table 4). Further, spatial overlap between seasonal

Table 4—Size (ha) of home ranges or activity centers (where available) of radio-marked Mexican spotted owls during the breeding and non-breeding seasons, as estimated in various studies. Seasons followed Ganey and Balda (1989) in all studies (breeding season = 1 Mar – 30 Aug). *N* = number of owls included in estimates. Home range estimates based on the minimum convex polygon estimator (Zwank and others 1994) or 95% adaptive kernel estimator (Ganey and others 1999; Willey 1998; J. L. Ganey and W. M. Block unpublished data). Activity centers based on the 75% adaptive kernel estimator.

Study area	Breeding season			Non-breeding season			Source
	<i>N</i>	Mean	SE	<i>N</i>	Mean	SE	
Home-range size							
Sacramento Mountains ¹	9	278	75.3 ²	9	365	100.3 ²	Zwank and others (1994)
Sacramento Mtns. – mesic ¹	6	228.1	37.3	6	328.0	59.3	J. L. Ganey and W. M. Block (unpublished data)
Sacramento Mtns. – xeric ¹	6	458.9	83.4	6	895.5	304.8	J. L. Ganey and W. M. Block (unpublished data)
Bar-M Canyon	8	392.5	70.0	14 ³	948.9	146.8	Ganey and others (1999)
Southern Utah	13	506	143.1 ⁴	13	1028	174.7 ⁴	Willey 1998
Activity-center size							
Sacramento Mtns. – mesic ¹	6	69.9	9.5	6	89.3	14.4	J. L. Ganey and W. M. Block (unpublished data)
Sacramento Mtns. – xeric ¹	6	156.2	22.0	6	352.1	131.1	J. L. Ganey and W. M. Block (unpublished data)
Bar-M Canyon	8	121.7	21.8	14 ³	326.5	53.8	Ganey and others (1999)

¹ Zwank and others (1994) pooled owls within the Sacramento Mountains when estimating size of seasonal home ranges, whereas J. L. Ganey and W. M. Block (unpublished data) recognized two distinct study areas in the Sacramento Mountains. The mesic area was dominated by mixed-conifer forest, the xeric area by drier forest and woodland types.

² SE recomputed from data in Zwank and others (1994)

³ Fourteen range estimates computed for 13 individual owls. One radio-marked female dispersed to a new territory during the study, so two separate range estimates were computed for this owl, in different years.

⁴ SE recomputed from data in Willey (1998).

Table 5—Spatial overlap between seasonal activity centers (estimated as the 75% adaptive kernel contour) of radio-marked Mexican spotted owls in three study areas¹. Only owls with valid range estimates during both the breeding and non-breeding seasons were included in estimates.

Study area	% of breeding-season activity center contained in non-breeding-season activity center			% of non-breeding-season activity center contained in breeding-season activity center			
	N	Mean	SE	Observed		Theoretical maximum ²	
				Mean	SE	Mean	SE
Sacramento Mountains –mesic	6	85.7	4.6	66.9	5.6	82.6	8.4
Sacramento Mountains – xeric	6	78.0	7.1	48.8	6.7	65.4	14.0
Bar-M Canyon	8	91.4	3.1	35.5	9.0	42.6	13.0

¹ Based on data from a sample of radio-marked owls included in Ganey and others (1999, 2000, 2003). The parameters estimated here were not included in previous papers.

² Theoretical maximum proportion of the nonbreeding-season activity center that could be contained in a breeding-season activity center given observed size of those breeding-season activity centers, assuming maximum spatial overlap.

activity centers was considerable (table 5). Most of the breeding-season activity center was contained in the non-breeding-season activity center. The mean proportion of the non-breeding-season activity center contained in the breeding-season activity center was lower, but it still indicated considerable spatial overlap. Further, the smaller size of breeding-season activity centers relative to non-breeding-season activity centers effectively limits the possible range for this measure of overlap. Thus, protection of nesting areas provides protection to areas and habitats used throughout the year, not only during the breeding season.

Habitat Use by Resident Owls

Little detailed information is available on habitat use by resident owls during the non-breeding season. Zwank and others (1994) reported that owls in the Sacramento Mountains roosted in “shorter trees with less dense foliage” during the winter. Willey (1998:73) reported that “During winter... spotted owls were observed roosting in more open habitats...”. He also reported that some owls moved out of steep slickrock canyon terrain and into forested uplands during winter. Johnson (1997:49) noted that wintering owls used “... canyons with a north-south orientation dominated by pinyon/juniper woodlands with scattered patches of ponderosa pine.” This latter description included owls classified as both residents and migrants here.

Relative areas of cover types did not differ between seasonal ranges of radio-marked owls in the Bar-M Canyon area, but relative area in canopy-cover classes did (Ganey and others 1999). Relative to non-breeding-season ranges, breeding-season ranges contained more

area with canopy cover $\geq 60\%$ and less area with 20-39% canopy cover. Structural features of forest stands used by foraging owls did not differ between seasons, but structure of stands used by roosting owls did. Stands used for roosting during the breeding season had greater live-tree basal area, oak basal area, and canopy cover than stands used during the non-breeding season (Ganey and others 1999: table 5). In an analysis focused on a finer spatial scale, Ganey and others (2000) concluded that canopy cover surrounding roost “microsites” also was greater during the breeding than the non-breeding season in this area.

Ganey and others (2000, 2003) reported on aspects of habitat use by radio-marked owls in the Sacramento Mountains at these same spatial scales (stand and roost microsite). They found little evidence for differences in seasonal habitat use at either scale within the Sacramento Mountains, for either foraging or roosting use.

Thus, there is some evidence for shifts in habitats and areas used in some areas, but not in others. In general, evidence for seasonal differences in habitat use appears strongest where owls occupy rocky canyons in the northern portion of their range. In mixed-conifer forests farther south, few seasonal differences were observed, and patterns were intermediate in an area where owls occupied pine-oak forest. Where owls do use different habitat during the winter, available evidence suggests that those habitats generally are more open in structure. As most recovery plan guidelines are aimed at retaining structural features typical of closed-canopy forests, special protections may not be as necessary where owls are using more open forest (or other cover) types.

Management Implications

Seasonal migration of some individuals appears to be a regular feature of Mexican spotted owl populations. Although some owls moved short distances and remained within the same general cover type, others moved considerable distances down slope into more open habitats than those used by breeding owls. These habitats are not protected under current recovery plan guidelines, nor do guidelines exist for protecting specific wintering areas. We have no clear understanding of how and why owls select wintering areas, however, and no clear evidence that wintering areas or habitat are limiting. Further, we currently have no objective means to identify appropriate areas or habitats for protection. Given this inability to focus recommendations on the appropriate areas and lacking clear evidence that specific protections are necessary for such areas or habitats, we recommend against including specific guidelines to protect lower-elevation wintering areas or habitats in the recovery plan.

Clearly, PACs would not protect all of the large home ranges used by resident owls during the non-breeding season, but they could potentially protect a good portion of non-breeding-season activity centers (range = 69% - 272%, based on size of non-breeding-season activity center; table 4). Overlap between seasonal ranges was substantial in all study areas (table 5), suggesting that most resident owls used much of the same area throughout the year. Available evidence also suggested that resident owls used similar habitats during the breeding and non-breeding seasons. This appeared to be truer in forested area than where owls occurred in canyon situations (e.g., Johnson 1997, Willey 1998). Thus, forested areas managed to protect nesting habitat should provide habitat useful to these owls throughout the year. In addition, recovery plan guidelines aimed at providing additional habitat similar in structure to nesting areas (see USDI 1995:89 – 92) should aid in protecting additional habitat near PACs, including areas used by owls expanding their home range during the non-breeding season.

Like movements of longer distance, the short-distance movements undertaken by some owls also present a potential problem. Reasons for these movements are unknown, but the areas visited may provide important resources and thus be worthy of special management consideration. Such areas are essentially impossible to locate where owls are not radio-marked, but most owls undertaking these movements used habitats similar to those in their breeding areas. Consequently, we again argue that recovery plan recommendations focused on providing additional habitat similar in structure to

nesting areas (see USDI 1995: 89 – 92) should provide considerable protection to these areas.

We recognize that winter likely is an important period for Mexican spotted owls, and that we still know relatively little about their ecology during this period. Addressing that knowledge gap is an obvious research priority. Until better information is forthcoming, however, we suspect that current recovery plan recommendations are sufficient to protect appropriate wintering habitats near nesting areas. The recovery plan currently contains no guidelines to protect remote wintering areas of migrating owls. Given uncertainty over the location of such areas, as well as the lack of evidence that special protective measures are needed in these areas, we see no compelling reason to change that situation.

Acknowledgments

We thank the many dedicated field-crew members who collected the radio telemetry data summarized here. W. S. LaHaye, T. Theimer, D. Willey, J. C. Bednarz, and two anonymous reviewers commented on earlier drafts of this paper.

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