Chapter 6

Conservation Status of Flammulated Owls in the United States

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INTRODUCTION

The status of the flammulated owl will be evaluated in this chapter by asking a series of critical questions about the species and its habitat. Answers to these questions will be used to reach one of the following conclusions: (1) populations in the United States are secure and will likely remain so given current land management practices; (2) populations are in peril (declining or experiencing some demographic trauma) or are likely to be in peril in the future given current land management practices; or (3) we currently have insufficient knowledge to determine the conservation status of the species. The conclusions reached here are necessarily tentative, given the incomplete state of present knowledge.

Are the Distribution and Abundance of the Flammulated Owl Declining in All or a Major Part of Its Range?

Distribution

It appears very likely that the flammulated owl's distribution has not contracted in North America. Data are insufficient to extend this conclusion to smaller parts of its North American range or to its Middle American range.

The breeding season distribution of the flammulated owl in the United States is now well understood (Chapter 3 and Map 1). Although details remain to be worked out in local areas, the range of the species is approximately coextensive with that of western yellow pine (i.e., *Pinus ponderosa* and *P. jeffreyi*), with some extension into contiguous pinyon forests of similar stature and occupancy of other vegetation types at similar elevations where these species are absent. The major exception is that pine forests of eastern Wyoming, the Dakotas, and Nebraska are not known to lie within the range of the owl. Available evidence, all of which is circumstantial, suggests that the North American distribution of the species has not changed since the first specimen was obtained in 1860.

The species was collected extensively if not intensively in the nineteenth century before major logging episodes and the subsequent shift in fire history of western yellow pine forests. The locations of these specimen records are throughout the current range of the species (Chapter 3, Map 1). None are outside the currently recognized distribution. On the basis of these data, it appears unlikely that the range of the species has contracted or expanded significantly during the past century.

The winter range of flammulated owls that breed in the United States and Canada is not known, although it is suspected to be in southern Mexico and northern Central America. Too few winter data are available to evaluate changes in winter distribution of the species. Despite the comforting picture presented above for the North American breeding distribution, North American populations cannot be assumed to be in no danger as long as their winter distribution is unknown.

Heretofore, the Middle American distribution of the species has been poorly documented. Specimen and nonspecimen records collated for this study support the idea put forth by early naturalists that the owl is restricted to mid-elevation temperate pine forests throughout Mexico, and perhaps also in El Salvador and Guatemala (perhaps only in winter). New localities are being documented in Mexico owing to work by resident and visiting ornithologists (Adolfo Navarro S., pers. comm.). Changes in distribution will be difficult to document, except by revisiting old collecting sites.

Abundance

There is no reliable evidence that the flammulated owl has increased in numbers anywhere in its North American range. Owing to rapidly increasing knowledge of its range, one might suggest that the species has increased in numbers. Most authorities have concluded that this is not the case, but that improved detection techniques have led to more frequent encounters between researchers or birdwatchers and the owl. Additionally, increases in the number of

birdwatchers in western states, and the desire of many of them to "add this species to their lists," have led to the discovery of many unknown populations. Finally, surveys for spotted owls have incidentally produced new flammulated owl localities.

Although data for testing the hypothesis of change in abundance do not exist, it might be inferred from the increased number of records in recent decades that well-documented changes in pine forest physiognomy have contributed to a population explosion of flammulated owls. McCallum and Gehlbach (1988) examined this inference and rejected it on the basis of their finding that owls nesting in New Mexico evidently preferred an open canopy and low ground cover in front of their nests. The preferred habitat was more similar to presettlement forests than are the heavily stocked stands of the fire-suppression era. Nevertheless, while open forest is apparently preferred for foraging, dense foliage, or at least mistletoe, is apparently used for roosting. It is still possible that the combination of fire-suppression (resulting in dense and often stagnant stands of regeneration) and selective logging (resulting in open stands) may have created a habitat mosaic in some areas that is able to support flammulated owl reproductive activities in the absence of old forest characteristics. This hypothesis would not be tenable if early loggers, like their mid-century counterparts, had removed standing dead trees. In fact, before the advent of chainsaws they often did not, as the test cuts in many hollow, cavity-bearing trees of that era attest.

Evidence for a decrease in abundance is also scanty. Marshall alone (e.g., 1988) has checked old sites, finding the flammulated owl absent in cut-over forests in California and Veracruz. But timber harvest of the kind practiced early in the 20th century must have made some areas unsuitable for decades. The large hot fires that have resulted from fire suppression efforts must similarly have removed suitable habitat. Fire suppression has also allowed yellow pines to be replaced by other, perhaps less desirable, tree species (Chapter 5). As these formerly open forests have become closed, flammulated owls may well have declined or disappeared from some sites. It therefore seems likely that numbers have decreased in the last century owing to loss of habitat resulting from logging, fire, and stand type conversions. This does not mean that persisting populations are inviable, just that total numbers likely have decreased. Losses of this kind do not seem to have reduced the range of the species. The viability of existing populations remains unverified.

Do Habitats Vary in Their Capacity to Support Flammulated Owl Populations or to Support Particular Functional Activities of the Owl? What Are the Important Characteristics of the High Quality Habitats?

Habitats do vary in their capacity to support populations and functional activities such as nesting, foraging, and roosting. The flammulated owl, though widespread and locally abundant, is a habitat specialist. Its range and abundance are functions of the range and abundance of its preferred habitat, not its own ecological amplitude or adaptability. Multiscale analysis of habitat use provides preliminary indications of the habitat characteristics that are essential to the species, although these are hypotheses that remain largely untested. Further exploration of habitat requirements is needed.

At the regional scale, the flammulated owl is restricted year-round to semiarid, cool-temperate climates, which suggests thermoregulatory limits on the habitat it can occupy. Afternoon temperatures may exceed 32° C in occupied areas, but sympatric congeneric species are able to thermoregulate effectively in high ambient temperatures as long as relative humidity is low. Presumably the flammulated owl has similar abilities. Nights are invariably cool to cold in the elevational range it occupies, but apparently the temperature causes little thermodynamic stress as long as food is available. The winter range therefore is probably determined more by thermal constraints on prey activity than by the physiological capabilities of the owl.

At the landscape scale, interior and exterior edge seem to be desirable if not necessary. Grasslands may contain a richer food base than forests during late summer, and interior edge facilitates gleaning of insects from foliage. These factors, plus thermoregulatory constraints, may be responsible for this owl's limitation to pine forests, which happen to occupy the preferred climatic zone and have the preferred physiognomy. Evidence that *Pinus* itself may not be required comes from the occupancy of selectively harvested (and hence open) Douglas-fir stands in the arid interior of British Columbia and certain mountain ranges in Nevada where *Pinus* is absent. However, reproductive success has not been assessed in those habitats.

Occupied home ranges tend to be on ridges and south-facing slopes. These aspects are more likely to support an open stand structure than north-facing slopes and draws, thereby permitting more luxuriant growth of grasses and shrubs that harbor more

phytophagous insects than do conifers. Insects also have longer activity periods and hence higher growth rates in these warmer microclimates. Given these characteristics, it seems more likely that the owls would tolerate the higher temperatures of such sites to obtain home ranges with open stand structure than that they prefer the ambient temperatures and intensity of insolation found there.

At the microhabitat scale, occupied home ranges seem to contain specific characteristics related to nesting, foraging, and roosting. Nesting of course requires a cavity. Nest boxes and natural cavities are used but old woodpecker cavities are used in the vast majority of cases. Most of these are made by sapsuckers, flickers, or pileated woodpeckers, so these species, as well as large trees with dead limbs, may be considered a critical resource for the flammulated owl.

The arthropod prey of this species are captured on the ground, in the air, and on foliage. Open habitat with considerable edge may not only maximize prey density but also facilitate the foraging maneuvers used by this owl.

Recent radio-tracking studies have shown that flammulated owls roost in dense foliage, either in very old trees or in dense stands of subdominant vegetation types (e.g., Douglas-fir). Because the owls also roost in thickets of stunted regeneration where fire is excluded, shade and inaccessibility to predators may be the most significant characteristics of roosting habitat. Detailed information on roost sites in the Colorado study is being prepared for publication (R.T. Reynolds, pers. comm.).

It would appear from this synthesis that the minimal habitat requirements of this species are as follows: (1) cool to moderate air temperatures, with the effects of higher temperatures ameliorable where humidity is low; (2) dense foliage or mistletoe for roosting; (3) open space between trees to promote abundance of phytophagous insects and facilitate aerial maneuvering by the owl while capturing insects; (4) cavities large and deep enough to allow nesting; and (5) perhaps other unspecified characteristics of old mid-elevation forests of yellow pine, Douglas-fir, and aspen, such as specific prey taxa.

Do Habitats Vary in Their Capacity to Support Principal Prey Species?

Habitats vary in their capacity to support prey, but whether this controls distribution is unclear. The diet of the flammulated owl appears to vary with availability of a broad range of arthropods. The only apparently essential prey are noctuids, which are large, cold-hardy nocturnal moths that are abundant in spring and summer when other arthropods are not active or abundant. Whether these are equally abundant in Douglas-fir and yellow pine forests is not known. Otherwise, the relevant source of variation among habitats appears to lie in the abundance and diversity of the arthropods they support, rather than the particular kinds. Because open forests support more shrub and herb growth than closed-canopy forests, the greater foliage volume may support more insects. This is consistent with the low insect abundance in conifer forests when compared to broad-leafed forests and suggests that flammulated owls may nest in broad-leafed forests if other requisites are available. This is apparently the case in aspen forests in Colorado and Nevada.

The presence of grasshoppers in the diets of flammulated owls in numerous localities suggests that proximity to savanna grasslands is a positive habitat attribute. A significant proportion of large patches of grassland will not be accessible to the owls. Consistently high reproductive success in a study site lacking a major grassland component (Reynolds and Linkhart 1987), however, indicates that this is not a requisite. It is not clear, however, that the size of the prey base has an impact on habitat choice in this species, as the preference for open physiognomy may be related to maneuverability and thermoregulation. The relationship between prey availability and reproductive success has not been investigated.

If the Flammulated Owl or Its Prey Rely on Particular Habitats, Are These Habitats Declining or Being Stressed by Current Management?

Because the habitat requirements of the flammulated owl appear to be best met in forests containing (but not limited to) yellow pines, and the vast majority of records of the species are from such forests, this section will assume that such forests are required for the survival of the species.

Global Climate Change

Global changes resulting in hotter and drier conditions in western mountains would presumably cause pine forests to migrate upslope. This would reduce the area of flammulated owl habitat and possibly extirpate the species from lower elevation mountain ranges, but sufficient habitat would likely remain to ensure the survival of the species (metapopulation structure would become more problematical; see below). A shift toward colder,

wetter regional climates would presumably shift the pine forests downslope and increase the area of favored habitat. Under this scenario, the species might pass through a population bottleneck until the new pine forest produced a sufficient inventory of snags and nest cavities. Warmer and wetter, or colder and drier, climates might produce a greater challenge for the owl because these are not equivalent to moving up or down existing montane climate gradients and the resulting plant associations are not predictable. It appears, from present knowledge of flammulated owl habitat, that increases in humidity are more likely to be deleterious than are decreases.

U. S. Forests Under Current Climatic Conditions

Western yellow pine forests are now intensively managed on public and private land and have changed radically in the past century (see Chapter 5). Although it is not known whether flammulated owl populations have increased or declined during this period, it is evident that the species has survived a dynamic interval in the history of its habitat. This fact is reassuring, but the specific components of its biology that enabled that survival remain unknown.

Flammulated owls evidently prefer old forests or at least structural characteristics associated with them. Such forests have declined drastically in extent (Chapter 5). The effect of total fire suppression would appear to have been undesirable for the owl, because it led not only to the proliferation of closed, even-aged stands of stagnant regeneration, but also to an increase in the frequency and intensity of catastrophic fires, which render an area unsuitable for decades to centuries. Data bearing directly on this hypothesis do not exist. Managed attempts to restore the presettlement physiognomy (e.g., thinning of thickets and controlled burning) appear to be beneficial to the owl, but once again data are lacking for testing this hypothesis. Logging, and especially firewood gathering, inevitably lead to a decrease in the inventory of snags, and this is an unqualified disadvantage for the flammulated owl.

Winter Range of Populations Breeding in the United States

No amount of attention to the flammulated owl in the United States will overcome loss of wintering habitat, presumably in southern Mexico. Mexican pine forests have been harvested with much the same abandon in the second half of this century that U.S. loggers employed in the first half. Fortunately for the flammulated owl, the USDA Forest Service bought up pinelands that had been clearcut by private interests and engaged in massive reforestation. Whether similar reforestation occurs in Mexico may be the single most important factor in the long-term survival of the species.

Do the Life History and Ecology of the Flammulated Owl Suggest That Populations Are Vulnerable to Habitat Change?

Details of the life history strategy of the flammulated owl are incompletely documented, but the broad outline of the strategy is clear. This owl is a habitat specialist with low and unvarying fertility. These are adaptations to a stable environment. The only mechanism for dealing with declines in food supply during the breeding season appears to be reduction of the already small broods. Superabundance of food evidently does not lead to increased fertility, unlike some other owls, including the boreal owl. This "conservative" life history strategy, often referred to as K-selected, necessitates long life, i.e., high annual survival rates. K-selected bird species are typically large (which reduces risk of predation) and/or nonmigratory. The tiny, migratory flammulated owl therefore has an incongruous life history strategy, one that is fascinating for the theorist but worrisome for the conservationist. If habitat change causes small changes in survivorship that are not offset by concomitant increases in fecundity (which seems unlikely), the species could even now be on a slow but steady decline toward extinction. Sensitivity analyses of estimated life-history parameters suggest that survival of the species is indeed most sensitive to variation in adult survival. Concomitantly, the species appears to lack the high fecundity necessary to recover quickly from episodic population declines caused by human habitat alteration.

The environment of the flammulated owl has been anything but stable during the past century. Yet, as detailed above, the species seems to be holding its own. If this is not an illusion, it may have declined and rebounded (in which case its low fecundity is adequate to the task of dealing with habitat change), it may have increased in numbers, or it may have been unaffected by the kinds of change that have taken place. Genetic analyses of museum specimens and current populations would shed light on this question.

Metapopulation structure is another aspect of life history that may be influenced negatively by habitat change. A metapopulation is a large regional composite of smaller local populations that are linked

by dispersal. Populations restricted to mountaintops, such as those of the boreal owl in the southern part of its North American range, are classic examples of this type of population structure. Small population size carries with it the twin dangers of extinction owing to chance demographic events (e.g., unusually low overwinter survival), and genetic drift from loss of genetic variability and hence loss of adaptability. Frequent transfers among subpopulations obviate these problems and makes each small population part of a larger, more viable metapopulation.

The general habitat of the flammulated owl is continuous in some regions, e.g., the Mogollon Rim of Arizona, while highly discontinuous in others, e.g., isolated mountain ranges of Nevada, Utah, and southern Arizona. Some populations of this species are therefore probably not as susceptible to problems associated with small population size as others. Nevertheless, because natal dispersal distances are relatively great in most temperate zone bird species, most continuous populations probably have an underlying metapopulation structure, and undetected rescue events may occur frequently. Fragmentation of continuous habitat would then impose a more obvious and challenging metapopulation structure on such a species. When harvests of yellow pines involve selective cuts rather than clearcuts, avenues for dispersal should not be adversely affected by harvest regimes, even if recently harvested areas are unsuitable for nesting. Moreover, the (presumed) migratory nature of the flammulated owl may preadapt it to such situations, in that all members of this species presumably fly across areas of unsuitable habitat en route between their summer and winter quarters. Whether dispersing juveniles (which are the main agents of interpopulation movement in birds) are willing to do this during their late summer dispersal period is unknown.

The flammulated owl has been said by some authors to be semicolonial. Although the cause of the apparent clustering is more likely due to habitat heterogeneity than to social attractions or lack of dispersal ability, this phenomenon does imply a certain amount of population substructuring even in continuous habitat. If this is the case, some effects of small population sizes may already be felt by these clusters of birds. Fragmentation of habitat would exacerbate such a situation.

Is a Conservation Strategy Needed for This Species?

Current knowledge of the habitat requirements and life history strategy of the flammulated owl, which is far from complete, suggests that the species is sensitive to habitat change and therefore likely to be in peril in the future given current land management practices. Because most habitat change in its current range is human-caused, a conservation strategy is needed to minimize or mitigate the effects of this change. The final details of such a strategy, however, cannot be formulated on the basis of current knowledge. Whether populations are secure or declining is not known, but the species currently occupies all of its known historic range in what appear to be good numbers. A crisis is not immediately at hand, and urgent measures are not needed.

It is my judgment that most of the basic information on population trends and habitat requirements necessary to fully determine the conservation status of the species and upon which to build a conservation strategy could be obtained in 5 years of coordinated research. Such information would greatly increase confidence in a long-term conservation strategy. A coordinated research program sufficient to obtain the most critical information is set out in the following section. Piecemeal research would be a terrible mistake.

While urgent measures presumably are not needed, prudence is called for during the proposed 5 years leading toward a conservation strategy. The implications of Chapters 4 and 5, and the direction proposed by the Payette National Forest (Chapter 3), provide a basis for management. In particular, biologists are encouraged: (1) to initiate nocturnal call surveys to detect areas of high owl density; (2) to identify large blocks of suitable habitat (i.e., mature to old ponderosa pine and mixed conifer forest) and initiate systematic nest searches; (3) to ensure retention and recruitment of snags in areas inhabited by flammulated owls for uneven-aged management in blocks of owl habitat; (4) to initiate studies in areas of high owl density to determine viability and habitat preferences; and (5) to support studies of flammulated owl biology as part of a coordinated effort within the Forest Service and with other agencies.

Management during this interim, and in the long run, must be coordinated among landowners across this species' broad distribution. As indicated in Map 1, only a portion of flammulated owl habitat occurs on National Forest lands. Coordination among managers of adjacent lands (e.g., Bureau of Land Management and Forest Service) and among managers across broad regions (e.g., Northern and Southwest regions of the Forest Service) will be a key to both managing and conducting research on this species. The USDI Fish and Wildlife Service's GAP analysis

program could play an important role in providing the information necessary to develop the coordination and cooperation.

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