Attachment 3

United States
Department of
Agriculture

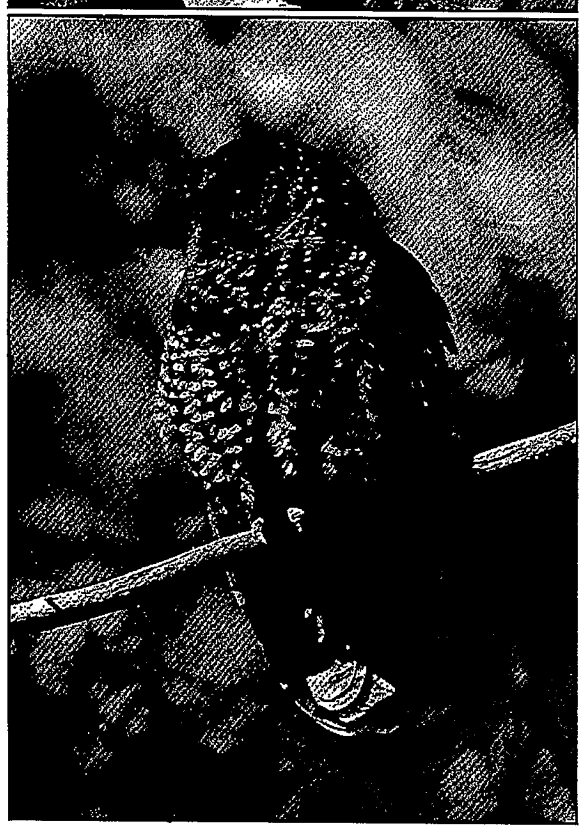
Forest Service

**Pacific Southwest
Research Station**

General Technical
Report PSW-GTR-133

The California Spotted Owl:

A Technical Assessment of Its Current Status



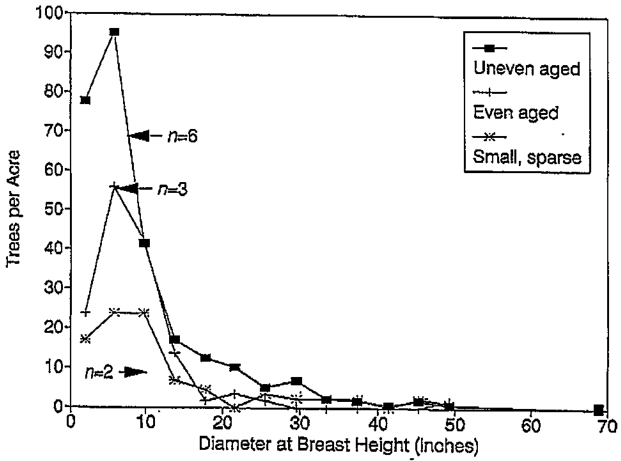


Figure 13M—Nest stand structures in the Sierra National Forest. None of these stands had a large proportion of large-diameter stems, and several were dominated by small-diameter trees.

generally conformed to the uneven-aged structure in the smaller diameter classes, but not in the large diameter classes. Three stands had most of their trees in the larger diameter classes. Nest stands on the Sierra NF also grouped logically into three classes (fig. 13M). Six of them generally fit an uneven-aged distribution form, but the others did not. Stands at two of the sites were made up primarily of stems <12 inches in d.b.h..

Most of these stand structures could be produced through a variety of management methods. Partial removal of the overstory in the past and subsequent ingrowth probably led to the formation of many of these stands. We have no reason to believe that uneven-aged management, if properly applied, could not be used to maintain these structures—but the system should be sensitive to maintaining the large trees, and perhaps modified to generate "reserve form" stands. Reserve form stands are characterized by an inverse "J" distribution in the smaller diameter classes and a normal distribution in the larger diameter classes. In all stands lacking frequent large stems, at least one large tree was present—the nest tree, which was not included in the calculations.

The simple premise that forest structures similar to owl habitat can probably be created and maintained through silviculture does not answer a fundamental question. In the long run, are these the types of stands we wish to maintain? We have many reasons to doubt whether these stand types represent either a necessary or ideal template as an owl nest site. Perhaps the most important reason is that dense stands characterized by single tree-sized openings would have been unusual in mixed-conifer forests before the turn of this century. Dense stands would have existed, particularly in riparian areas and at higher elevations (figs. 13C and 13D), but they would not have been widely distributed across the landscape. A second reason is that these stands are unstable—the stand structure is likely to be altered quickly and unpredictably due to the probability of stand-replacing fires or insect and disease outbreaks. We do not know whether owls inhabited the more open stands that dominated much of the landscape in the past (figs. 13A and 13B). Because such stands are rare today, we are unable to infer anything from current owl locations. We do, however, need to begin to explore potential, alternate stand structures. These structures should be chosen to better mimic natural stands, to maintain tree species diversity, and to be more resilient to wildfires.

Some Potential Management Systems for Mixed-Conifer Ecosystems

General Considerations

A fundamental assumption underlies management of owl habitat, as well as much of forest management in general: Ecosystems are inherently dynamic; they do not stand still. Changes take place both rapidly (through a variety of natural and man-made disturbances) and slowly (through climatic change and natural successional processes), and occur at many spatial and temporal scales. Changes have occurred in the past, and they will occur in the future even if we "do nothing." Given this assumption, management recommendations should consider provision of adequate amounts and distribution of suitable owl habitat both in the short-term and in the long-term. For the short-term, Chapter 1 details management recommendations to be applied during an interim period of at least 5 years. These recommendations are intended to provide some degree of protection to existing owl habitat and to maintain future options for whatever long-term management strategy may be adopted at the end of the interim period. Below, we offer an example of one way in which the short-term (interim period) recommendations in Chapter 1 could be implemented in stand types shown to be selected for nesting by the spotted owl. These short-term practices and resulting stand conditions are not designed to be sustainable over long periods, however. The remainder of this section, therefore, offers potential silvicultural strategies that might be useful for producing and maintaining owl habitat over the long-term.

An Example of a Short-Term Approach

Recommendations in Chapter 1 set limits for cutting large trees and managing other stand components. By definition, management practices cannot exceed these limits—for example, cut more large trees than specified—and still conform to the recommendations. In some situations, however, management objectives may be better achieved by not taking the recommendations to their limits. Following is one example of such an approach to interim management of "*Selected Timber Strata*" (P4G, M4G, M4N, M5G, M5N, M6—codes for timber strata defined in table 1C). (Compare item #1 under "Other Forested Public Lands" in Chapter 1.) Objectives that this example could help to meet include: (1) provide for a shorter recovery period for nesting/

roosting habitat; (2) keep some stocking in middle and lower canopy layers, both to retain existing multiple-canopy character of the stand and to ensure quicker replacement of large trees; (3) provide for some thinning in middle and lower canopy layers to promote growth of trees in these layers into desirable larger size classes; and (4) provide some quantification of fuels management treatments, including reduction of vertical fuel ladders (Chapter 12). Managers should recognize that this example (like any other that places additional constraints) is more restrictive than the basic interim-period recommendations in Chapter 1. Thus, in exchange for the potential benefits indicated above, timber volumes (and associated revenues) will generally be lower, and costs of treating submerchantable stems and other fuels will generally be higher. (Basal area limits and other quantitative data in this example are only approximations. They are not based rigorously on Chapter 5 or any other real data pertaining to owl habitat. If an approach similar to this is to be used, it should be based on the best and most nearly site-specific data available.)

A. Enter a stand for harvesting only once before a long-term strategy for managing the California spotted owl has been implemented on public lands.

B. For stands with a Dunning and Reineke (1933) site index (SI) of ≥60, enter the stand for harvesting only if total basal area of live trees ≥5 inches d.b.h. is greater than 200 square feet per acre. Harvesting will not reduce total basal area to less than 200 square feet per acre or canopy closure to <40 percent. For stands with SI <60, the corresponding basal area limit is 160 square feet per acre. To the extent possible, a mix of tree species should be retained.

C. Remove no live tree ≥30 inches in d.b.h.

D. For stands with SI ≥60, limit cutting in the 21- to 30-inch d.b.h. class so that the combined basal area of live trees in d.b.h classes 21-30 inches and 30+ inches is no less than 120 square feet per acre. A wildlife biologist should be involved in training tree markers to identify potential nest and roost trees in the 21- to 30-inch d.b.h. class so that those trees (including live culls) will be retained as part of the residual basal area. In stands currently having less than 120 square feet per acre basal area in those two size classes, no cutting of trees 21-30 inches d.b.h. will take place. For stands with SI <60, the corresponding basal area limit is 100 square feet per acre.

E. For stands with SI ≥60, limit cutting in the 11- to 20-inch d.b.h. class so as to retain a basal area of at least 60 square feet per acre in that diameter class. In stands currently with basal area <60 square feet per acre in that d.b.h. class, no cutting of trees 11-20 inches d.b.h. will take place. If the stand is entered for harvesting, and if current basal area in the 11- to 20-inch d.b.h. class is >80 square feet per acre, this diameter class will be thinned to a basal area of 60 to 80 square feet per acre. For stands with SI <60, the corresponding range of basal areas would be 40 to 60 square feet per acre.

F. Limit cutting in the 5- to 10-inch d.b.h. class so as to retain a basal area of at least 20 square feet per acre in that diameter class. In stands currently having <20 square feet per acre basal area in that d.b.h. class, no cutting of trees 5-10 inches in d.b.h. will take place. If the stand is entered for harvesting, and if current basal area in the 5- to 10-inch d.b.h. class is >30 square feet per acre, this diameter class will be thinned to a basal area of 20 to 30 square feet per acre. Trees cut in the 5- to 10-inch d.b.h. class will be removed from the stand. Utilization of these trees is encouraged.

G. If the stand is entered for harvesting, and if canopy cover in trees 0-4 inches in d.b.h. is greater than 20 percent, trees will be felled, crushed, masticated, or otherwise rearranged to reduce canopy cover in that size class to no more than 20 percent. The surface fuel bed resulting from these trees, as well as slash from logging of larger trees, should be treated mechanically or with prescribed fire to reduce wildfire hazard to an acceptable level. The emphasis should be on reducing vertical and horizontal continuity of fuels and associated risk of crown fires, especially in the vicinity of large trees. Fuel treatments and logging activities should be designed to minimize disturbance of duff and coarse woody debris. In most cases this will preclude machine piling of slash. Where prescribed burning is used, it should be done when lower duff and large woody debris have high moisture contents to minimize consumption of these materials.

H. Follow guidelines in Chapter 1 for retention of snags and downed wood.

Some Potential Long-Term Strategies

A full discussion of management activities that may be appropriate to manage for owl habitat over the long-term is beyond the scope of this chapter. Instead, our purpose is to provide a sampling of ideas and considerations to stimulate thinking. Innovative managers and resource specialists may be able to use some of these ideas as a starting point in developing suitable management regimes to fit their local conditions and needs. On public lands, initial (interim period) implementation of the long-term strategies described here would be compatible with recommendations (Chapter 1) for "*Other Timber Strata*" used for nesting by owls, but not significantly selected in relation to availability. We encourage managers of private lands to explore these approaches as well. Treatments should be viewed as ongoing management experiments (adaptive management, Chapter 2). Effects of treatments on stand structure and key ecosystem components should be carefully monitored, and owl habitat models should be tested. These experiments would incorporate information from monitoring and research activities into feedback loops that would serve to improve both our management practices and our knowledge of what constitutes suitable owl habitat.

Although the scenarios discussed below describe generalized target stand structures and associated management practices primarily at the stand level, great flexibility exists for distributing variations and combinations of these structures across the landscape and through time. In these scenarios, silviculture would be viewed as the art and science of shaping stands and landscapes to meet management objectives—spotted owl habitat in this case. Timber volume would be an output of, rather than a driving force for, the silviculture undertaken to meet management objectives. Protection of current or future habitat would continue to be a primary concern. Accordingly, appropriate fuels management would be integrated with silvicultural activities.

We focus here on good-quality nesting and roosting habitat for the spotted owl as the "target" conditions for management activities. Foraging habitat appears to be more variable and less restrictive (Chapter 5), and its requirements should be met more easily and with a wider range of management practices. In contrast, successful management to produce, maintain, improve, and protect nesting and roosting habitat may require significant changes from conventional management practices. Some institutional barriers may need to be overcome. It will be more complex and expensive but should provide new and stimulating professional challenges for a variety of specialists to exercise creative thinking and pursue interdisciplinary objectives and activities.

We make several simplifying assumptions about attributes of suitable nesting/roosting habitat (Chapter 5) to help define target stand structures and associated management practices: (1) high canopy closure; (2) stand basal area and canopy closure distributed among two or more size classes of trees; (3) diversity of tree species within the stand; (4) "adequate" numbers of large live trees; (5) "adequate" numbers of large snags; and (6) "adequate" quantities of duff and large woody debris.

Accepting these six assumptions places limits on the range of stand structures that can be targeted by management. Both classical, even-aged silviculture and the classical, single-tree-selection form of uneven-aged silviculture have difficulties in meeting one or more of these assumptions, for reasons discussed below. We believe that two other kinds of stand structures—mosaics of small, even-aged groups or aggregations, and two- or three-storied stands—hold greater promise for producing and maintaining suitable owl habitat over the long-term. We recommend that these two structures, together with their associated silvicultural and fuels management practices, receive emphasis in long-term, adaptive management experiments concerned with owl habitat. Both can be considered intermediate between even- and uneven-aged (single-tree selection) management. But they can be thought of as representing two ends of a continuum, with many intermediate structures differing in density and spatial arrangement of age/size-classes to help meet various specific objectives and to increase diversity across the landscape. Even- and uneven-aged (single-tree selection) methods should be included in these experiments, but at a reduced level.

Even-Aged Silviculture

The requirement for two or more size-classes of trees (assumption #2 above) probably could be met with even-aged silviculture, but it would involve significant modifications from conventional practice. The natural segregation of crown classes could be emphasized by "thinning from the middle"—that is, thinning in codominant and intermediate trees, thereby promoting the separation of dominant from suppressed crown classes and increasing growth in the dominants. Suppressed trees probably would not survive long enough to be of much value for owl habitat unless stand density were reduced below usual target stocking levels, or the lower canopy level consisted largely of shade-tolerant species. The latter scenario probably would be more practical and sustainable in mixed-species stands.

Assuming that such an approach eventually would meet needs for a two- or more-storied stand, the rotation age necessary to meet tree size and decadence requirements (assumptions #4 and #5) probably would be much longer than called for in currently practiced even-aged management. As compared with alternative silvicultural methods, the time from plantation establishment to achievement of conditions suitable for owl nesting and roosting is likely to be much longer. This long time period would necessitate development and/or retention of suitable replacement habitat in the interim.

Whatever may be the disadvantages of even-aged silviculture with respect to owl habitat, even-aged plantations in the Sierra Nevada will continue at some level for the foreseeable future, if for no other reason than because severe wildfires will continue to occur. Even-aged plantations, therefore, should be included in owl-related management experiments.

Uneven-Aged Silviculture Using Single-Tree Selection

To meet the need for tree species diversity (assumption #3 above), stand openings must be large enough to permit regeneration of shade-intolerant species such as ponderosa pine. This requirement generally is not met with the single-tree selection form of uneven-aged silviculture, at least where openings are mostly the size of individual large trees rather than groups of trees. Furthermore, retention of the smallest size-classes of trees well distributed through a stand—a necessity for sustaining this stand structure through time—creates dangerous fuel ladders and makes prescribed burning or other fuels management treatments essentially impracticable. As described earlier, many owl nesting stands had roughly an inverse J-shaped diameter distribution characteristic of uneven-aged stands. Composition of the smaller size classes, however, was strongly weighted toward shade-tolerant species, especially white fir. This resulted from many decades of fire suppression, augmented by partial cutting and preferential harvest of pines. In the absence of stand openings by cutting or by natural agents of disturbance such as fire and insects, these stands will become increasingly dominated by shade-tolerant conifers. Single-tree selection should be included at a reduced level in management experiments to evaluate changes in structural attributes, owl use, managerial difficulty, and costs of implementation. Combining single-tree selection with group selection (discussed below) may work to maintain some vertical structure while permitting regeneration of shade-intolerant species.

Mosaic of Small, Even-Aged Groups

One kind of structure that may have promise for production and long-term maintenance of owl habitat is a multi-aged mosaic of small, even-aged groups or aggregations. Groups would generally range in size from about 2 acres down to a quarter-acre, or possibly less. Probably this type of structure best approximates presettlement stand structures (Chapter 12), thus warranting serious consideration. Openings would be sufficiently large to permit regeneration of shade-intolerant as well as shade-tolerant species. Multiple size classes in general would be separated horizontally rather than vertically, but in sufficient proximity to satisfy this attribute of suitable owl habitat. The horizontal separation of size classes also would confer some degree of resistance to crown fires (Chapter 12).

Group selection cuttings, or modifications thereof, would be used to create and maintain this structure over time. Keeping track of a large number of small openings and groups for management purposes, long considered a major obstacle to the use of group selection, should be significantly easier with the advent of geographic information systems and satellite-based global positioning systems. Treatments certainly would be more complex and more expensive than with even-aged management, however, especially on steeper slopes.

Viewed from the standpoint of area regulation—approximately equal areas maintained in each of several age-classes—a given "stand" of, say, 20-100 acres under steady-state conditions might contain three to six or more different age-classes. Each age-class would comprise many small, variable-sized aggregations and occupy a total area roughly equal to the area of the entire stand divided by the number of age-classes. "Rotation age"—the age at which the oldest aggregations would be regenerated—could be as long as needed to meet and maintain targets for large and/or decadent trees and snags. Periodic entries preceding regeneration cutting for a given age-class could be used to adjust stand structure to meet desired habitat attributes. These intermediate treatments might include thinning to speed development of large trees or to alter species composition, creating snags by girdling or other means, or wounding selected trees to induce decay. In practice, these intermediate treatments would take place within the various age-classes (aggregations) in the stand when the oldest age-class is being regenerated. As an example, if six age-classes and a 240-year "rotation" were selected, entries could be made every 40 years to regenerate one-sixth of the stand and conduct appropriate intermediate cuttings in the remainder of the stand. Or 20-year entries could be made, but regeneration cuttings would be made only every other entry. Successive age-classes would be separated by about 40 years.

In groups to be regenerated, all trees could be removed or, especially in larger groups, scattered live trees and/or snags could be retained. To facilitate fuels treatment and reduce damage to the surrounding stand, cut trees should be felled as much as possible into the newly created opening. Site preparation/fuels treatment methods used on clearcuts should be usable in these small openings, although they are likely to be much more expensive. One promising possibility may be jackpot burning of slash concentrations in the opening at a time of year when fire would not spread into the adjacent stand, thereby minimizing the need for firelines. Shortly thereafter, the rest of the stand could be underburned during somewhat drier conditions. Alternatively, the rest of the stand could be underburned at the same time as the openings. Local trials would help define a workable regime. In any case, we recommend that fuels be treated after each entry into the stand to reduce chances of severe wildfire. Various fuels-treatment methods may be appropriate for a given area. Prescribed underburning, however, has the advantage that it would begin to restore the natural role of fire and associated processes in the ecosystem (Chapter 12). In the scenario described earlier, with successive age-classes separated by 40 years, the youngest (40-year-old) trees probably would be large enough to tolerate an underburn without excessive mortality, assuming early vegetation management to permit relatively rapid early growth.

Openings could be regenerated either naturally or artificially, and with or without vegetation management. Even with planting and vegetation management, growth of tree seedlings would be slower in an opening typical of group selection than in a larger opening because of competition for site resources from large trees surrounding the opening. Without planting and some control of nonconifer vegetation, however, development of conifers could be delayed for several decades. Fuels treatment would be complicated as well.

Development of a mosaic of small groups could be initiated in a wide range of stand conditions—for example, an older plantation, a variable-aged young-mature stand, or an old stand becoming excessively unbalanced in terms of size-class distribution or species composition.

Two- or Three-Storied Stands

Another kind of structure that might be suitable for production and maintenance of owl habitat is a two- or three-storied stand. It differs from the even-aged aggregation structure in that each age/size-class would be more or less uniformly distributed throughout the stand (although many variations in spatial arrangement would be possible). In a two-storied stand, the upper canopy would be sufficiently open to permit regeneration of shade-intolerant species in the understory. If a third canopy layer were to be managed, both of the upper two canopy layers would need to be thinned enough to allow regeneration and growth of multiple species. Typically, this kind of structure would be initiated with a shelterwood cutting. After regeneration is established, the overstory would be retained indefinitely—a practice referred to as irregular shelterwood—instead of being removed as occurs with even-aged management. Understocked stands, traditionally a high priority for clearcutting, could instead be underplanted, leaving most of the overstory in place. An overstory infected with dwarf mistletoe could be underplanted with species other than the one(s) infected.

If desired, this kind of structure could be initiated relatively early in the life of a plantation by having a heavy commercial thinning double as a shelterwood-type regeneration cutting. The cut would be followed by site preparation/fuels treatment and underplanting with the desired mix of species. Throughout the "rotation" of such a stand, thinnings could be applied as needed to maintain desired size classes and species. These should be followed by prescribed burning or other fuels treatments. Snags could be created as needed. Once created, the stand would never be devoid of large trees: each regeneration cutting would be accompanied by retention of some trees in one or two overstory layers. Thus a relatively short period of time would elapse between a regeneration cutting and restoration of a desired stand structure.

Fuels treatments, including use of prescribed burning, should not be particularly difficult for a two-storied stand. Initial site preparation/fuels treatment before establishment of the understory would be the same as for a shelterwood cut. Subsequent treatments would be comparable to those for an even-aged plantation. Separation of canopy layers normally would be sufficient to keep wildfires out of overstory crowns. A three-storied stand could be somewhat more problematical, in terms of maintaining adequate stocking of shade-intolerant species, protecting the small understory during fuels treatments, and keeping wildfires out of the overstory. In all these respects, a three-storied stand would begin to approach conditions in a single-tree selection stand.

Conclusions

We believe that the dynamic trends in forest structure and fuels profiles that are occurring on NFs in the Sierra Nevada are cause for concern. The most troubling aspects are the loss of old, large-diameter trees and associated woody debris, a shift toward more shade-tolerant species, the buildup of fuels associated with mortality in the small diameter classes, and the continued presence of abundant ladder fuels that enable crown fires to occur. We do not believe the management directions elucidated in the current LMPs alleviate these trends; in fact, single-tree selection systems are likely to accelerate them. Even-aged systems can reduce fuel loadings and encourage the growth of shade-intolerant species, but they do so at the expense of the remnant large trees. We believe that other options exist that could deal directly with these concerns. Management plans should focus on addressing undesirable trends, designing potential solutions, and proceeding experimentally to implement those plans on the landscape.

Owl habitat can be described in terms that are compatible with silvicultural methods. In this chapter we have presented preliminary examples of how this process might proceed. The FS can easily gather basic stand-level statistics from known owl nest stands throughout the range of the California spotted owl. To date, most of the data collected are either very coarse (for example, at the timber strata level) or based on ocular estimation and, therefore, are not as reliable as we would like.

Looking to longer-term solutions, we need to begin changing the forest structure back to a form more akin to historical patterns: to generate fire-resistant structures with small-scale horizontal heterogeneity and a significant large-tree component. The silvicultural systems suggested here provide for the maintenance of large trees and complex stand structures, while significantly decreasing the risk of catastrophic wildfire. Through management experiments, we need to ascertain which, if any, of these stand structures may also be suitable for spotted owls.

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