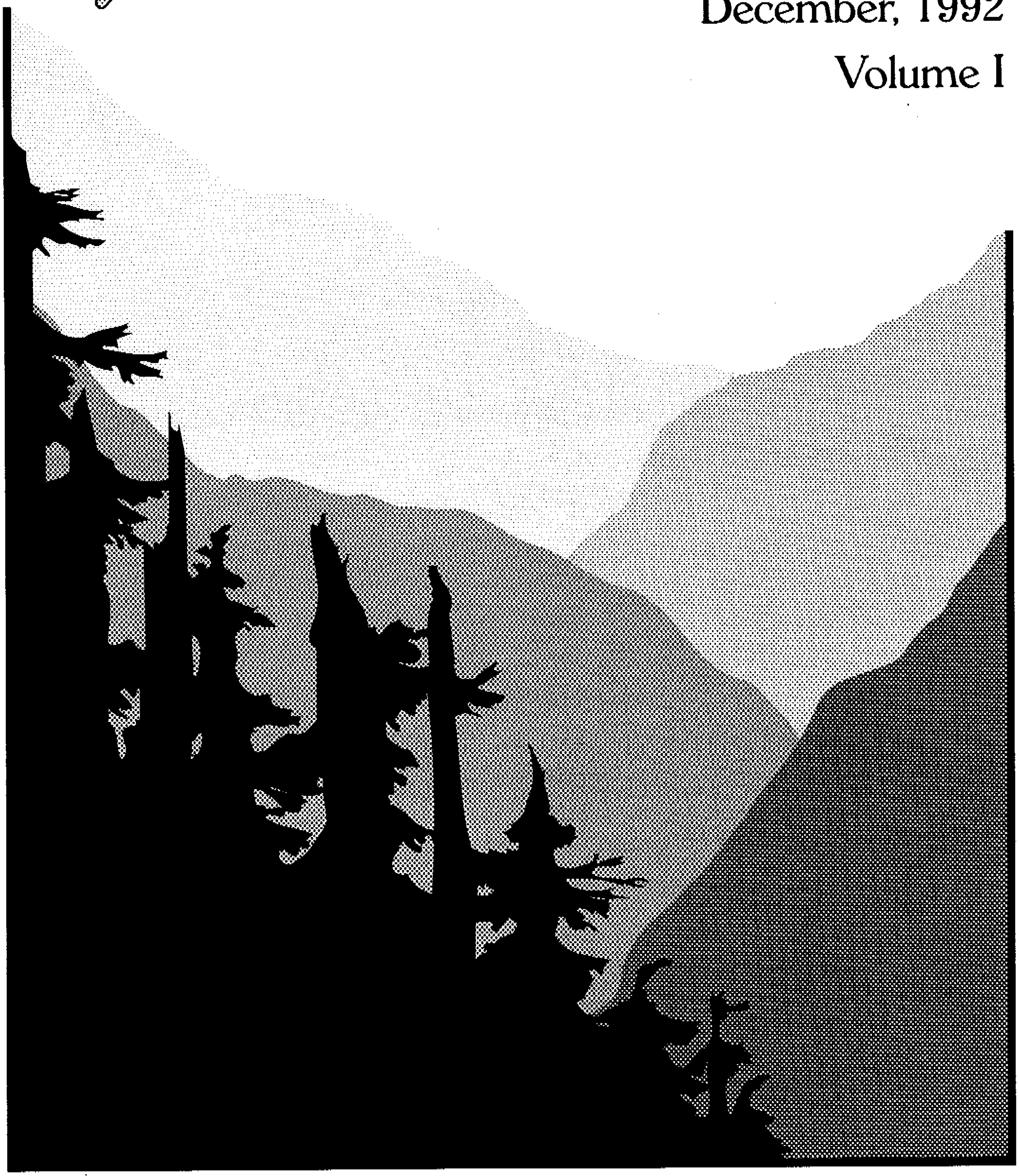
FINAL DRAFT

Recovery Plan for the Northern Spotted Owl

December, 1992

Volume I



Northern Spotted Owl Recovery Team

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8 March 1993

Marvin Plenert
Regional Director, Pacific Region
US Fish and Wildlife Service
Portland, Oregon

Dear Mr. Plenert:

The Recovery Team has completed revisions on the Draft Recovery Plan and is herewith transmitting the Final Recovery Plan for the Northern Spotted Owl.

This Plan is the culmination of a two-year effort involving more than 100 scientists, administrators, and others involved with the spotted owl. All of the agencies that will be affected by the Plan have been involved in its preparation, the Plan has received extensive and favorable review by the scientific community, and the Team has made detailed recommendations designed to reduce social and economic costs. We thus believe that we have fulfilled the letter and intent of our the charge "to develop a plan that will lead to the conservation and survival of the northern spotted owl."

The Final Recovery Plan includes a number of key provisions designed to provide adequate assurance or recovery while minimizing social and economic costs. These include conservation areas similar to those suggested by the Interagency Scientific Committee, guidelines for management activities within conservation areas, identification of activities needed on nonfederal land, proposals for monitoring and research, and recommendations for coordination among the groups that will implement the Recovery Plan.

We have appreciated your support during the past two years, and we hope that the Final Recovery Plan fulfills your expectations.

Sincerely,

Jonathan Bart

Jonathan Bart
Chair

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Introduction

A recovery plan is called for by the Endangered Species Act to set recovery goals and recommend the management actions needed to bring a threatened or endangered species to a condition in which it no longer needs the protection of the act. The northern spotted owl (also referred to in the recovery plan as the spotted owl and the owl) was placed on the list of threatened species in June 1990 (USDI 1990a). Beginning in February 1991, a Recovery Team appointed by Secretary of the Interior Manuel Lujan Jr. has been formulating a recovery plan. This report presents the final recovery plan for the northern spotted owl.

The northern spotted owl recovery plan provides a comprehensive basis for management actions to be undertaken by forest managers and wildlife agencies to alleviate conditions threatening the species. Primary actions will be taken by federal land management agencies in the Pacific Northwest: the U.S. Forest Service, the U.S. Bureau of Land Management, the National Park Service, and the U.S. Fish and Wildlife Service. Further, the U.S. Fish and Wildlife Service will oversee implementation of the recovery plan through its authorities under the Endangered Species Act.

State forest management and wildlife agencies in Oregon, Washington, and California also will take actions that contribute to recovery under the recovery plan. These state agencies have an important role in monitoring wildlif e populations, managing state forests, and regulating forest practices on state and private lands within their jurisdictions. Contributions from habitat on Indian lands also were considered in formulating the recovery plan.

The recovery plan was developed following review of the scientific data from previous plans for the spotted owl, particularly the conservation strategy designed by the Interagency Scientific Committee (ISC) (Thomas et al. 1990), and by analyzing the most recent data available on owl populations and their habitat, including material that has become available since publication of the ISC strategy. This biological information was the basis for designing measures to achieve recovery.

Secretary Lujan also asked that the Recovery Team consider other species and economic effects to the extent allowed by law. The Recovery Team made a substantial effort to determine the status and location of other species that could benefit from actions similar to those needed for owl recovery. Measures that would contribute to recovery of the owl while also helping other species were favored in the recommendations of the recovery plan.

Previous studies show that protection of sufficient habitat for a viable spotted owl population has substantial economic and social costs because it will require a reduction in timber harvest. Under the Endangered Species Act, the recovery plan cannot consider recommending measures that would fall short of achieving recovery of the northern spotted owl, even though such measures might cause significantly less economic and social losses. Instead, the recovery plan seeks ways to achieve recovery that would cause less reduction in timber harvest and fewer job losses in the timber industry.

A draft of the recovery plan was published in May 1992. Public meetings were held in Washington, Oregon, and California to receive input on the draft. Information from those meetings and from more than 1,600 written comments that were received about the draft recovery plan were used to help shape this final recovery plan.

Recovery Goal

The goal of the recovery plan is to remove the northern spotted owl from the list of threatened species throughout its range.

Strategic Principles

The following strategic principles were adopted in formulating the recovery plan:

1. Adequate assurance of recovery must be provided.
2. The recovery plan should minimize social and economic costs.
3. The recovery plan should be comprehensive.
4. All contributions to recovery should be recognized.
5. Needs of other species should be considered.
6. The recovery plan should be responsive to new information.

The Recovery Plan

The recovery plan has eight key elements:

1. A recovery goal and a set of criteria for determining whether conditions exist that would allow the northern spotted owl to be removed from the list of threatened species.
2. A network of designated conservation areas (DCAs) on federal forestlands, with each area designed to sufficiently protect owl habitat in order to support a stable number of breeding pairs of owls over time.
3. A set of guidelines that governs management activities on federal forestlands in designated conservation areas.
4. A set of guidelines that governs management activities on federal forestlands outside of designated conservation areas. These forests outside of DCAs are termed the matrix in the recovery plan.
5. A set of recommendations for contributions from nonfederal forestlands to support spotted owl populations.

6. A monitoring and research program that will provide new information on spotted owls and their habitat, and develop and test management techniques for promoting and maintaining owl habitat while allowing appropriate forest management.

7. An adaptive management program that will provide for changes in recovery plan recommendations over time based on new information and experience with implementation.

8. Implementation mechanisms that provide oversight and coordination, relying primarily on existing authorities and forest management planning procedures.

Each of these elements is described here briefly, followed by a discussion of the scientific basis for the recovery plan and of the economic and social considerations built into the recovery plan.

Delisting Criteria

The primary threat to the northern spotted owl leading to its listing as a threatened species is the reduction and fragmentation of its habitat in forests in Washington, Oregon, and northern California. Northern spotted owls use old-growth forests and other forests with similar characteristics for nesting, breeding, and rearing young. As timber harvesting has proceeded in the Pacific Northwest, the amount of habitat suitable for spotted owls has declined, and remaining habitat areas have become smaller and more isolated from each other, particularly during the last 50 years. While other threats also exist (such as predation) habitat loss is causing the population of spotted owls to decline, in some areas rather sharply.

The goal of the recovery plan is to reduce the threats to the spotted owl so that it can be removed from the list of threatened species throughout its range. The recovery plan recommends that the U.S. Fish and Wildlife Service consider removal of the spotted owl from the list of threatened species on an incremental basis for individual areas, called provinces, or for groups of provinces. For purposes of the recovery plan, the range of the spotted owl has been divided into 11 provinces.

Four criteria must be met before the owl can be delisted: 1) a scientifically credible plan for monitoring owl populations and owl habitat must have been in effect for at least 8 years; 2) the population must have been stable or increasing, as indicated by density and demographic estimates, for at least 8 years; 3) regulatory mechanisms or land management commitments must have been implemented that provide for adequate protection of breeding, foraging, and dispersal habitat, and 4) analyses must indicate that the population is unlikely to need protection under the Endangered Species Act during the foreseeable future. The recovery plan emphasizes that all of these criteria must be satisfied before the owl can be delisted.

Designated Conservation Areas

As the primary means for achieving recovery, the recovery plan recommends establishing 192 designated conservation areas (DCAs) to provide approximately 7.6 million acres of federal forestlands as the primary habitat for the northern spotted owl population. These

DCAs include approximately 46 percent of the total remaining spotted owl nesting, roosting, and foraging habitat on federal lands (Figure ES.1.). The largest DCAs are sized to support a population of 20 or more pairs of owls in habitat conditions that allow successful breeding and rearing of young. They are arranged spatially to allow owls to disperse successfully from one DCA to another. Each DCA contains areas of currently existing owl habitat combined with areas of younger forests. These younger stands will be protected and managed so they can mature into owl habitat. The DCAs contain approximately 1,445 known owl pairs on federal lands. This represents about 51 percent of the total pairs currently known on all federal lands (Figure ES.2.). When the DCAs become fully developed owl habitat, they will contain habitat sufficient to support a population of approximately 2,340 pairs of owls.

DCAs are located to take advantage of other forestlands containing owl habitat that will not be harvested or will be harvested in a manner that does not reduce habitat value to owls. Such areas include parks, wilderness areas, and certain administratively reserved areas. DCAs also are located in a pattern to reduce the risk to the owl population from natural threats to its habitat such as fire, diseases, and insects.

Management of Designated Conservation Areas

The recovery plan recommends that management on federal lands within the DCAs be focused on improving habitat conditions for spotted owls.

The following management guidelines for federal lands in DCAs are recommended:

1. No timber harvest should be allowed in habitat suitable for northern spotted owls. (Limited exceptions are made to this guideline where management is considered essential to reduce risks of natural disturbance.)

2. Silvicultural practices, such as thinning, may be used to promote rapid development of owl habitat in those areas that currently do not provide habitat suitable for owls.

3. Salvage of trees in stands significantly affected by fire, wind, insects, or diseases may occur but will be carefully designed to safeguard owl habitat.

4. Management activities designed to reduce the risk of large-scale fire or insect infestation should be limited to those needed to ensure the continued existence of owl habitat within the DCA.

5. Federal lands inside DCAs, with the exception of wilderness areas and national parks, are recommended to be designated as critical habitat under the Endangered Species Act. (Critical habitat designation is not recommended for nonfederal lands.)

6. A management plan should be prepared for each DCA before management activities are implemented.

Management Guidelines for Federal Forestlands Outside Designated Conservation Areas

The recovery plan recommends guidelines for the maintenance of sufficient habitat conditions on federal lands outside DCAs to provide for successful dispersal of owls among DCAs. Movement among DCAs is necessary to maintain population levels and prevent genetic deterioration of the spotted owl population. These guidelines also contain several recommendations for supplementing the DCA network in specific parts of the owl's range where conditions currently do not allow full implementation of the DCA network guidelines. This will be done by providing habitat for additional owl pairs and territorial single owls outside DCAs. In some areas, the recovery plan recommends management of these areas to reduce the risk of fire and insect damage. In total, these areas in combination with the DCAs will provide for approximately 1,556 currently known pairs of owls on federal lands. This represents about 55 percent of all pairs currently known to occur on federal lands.

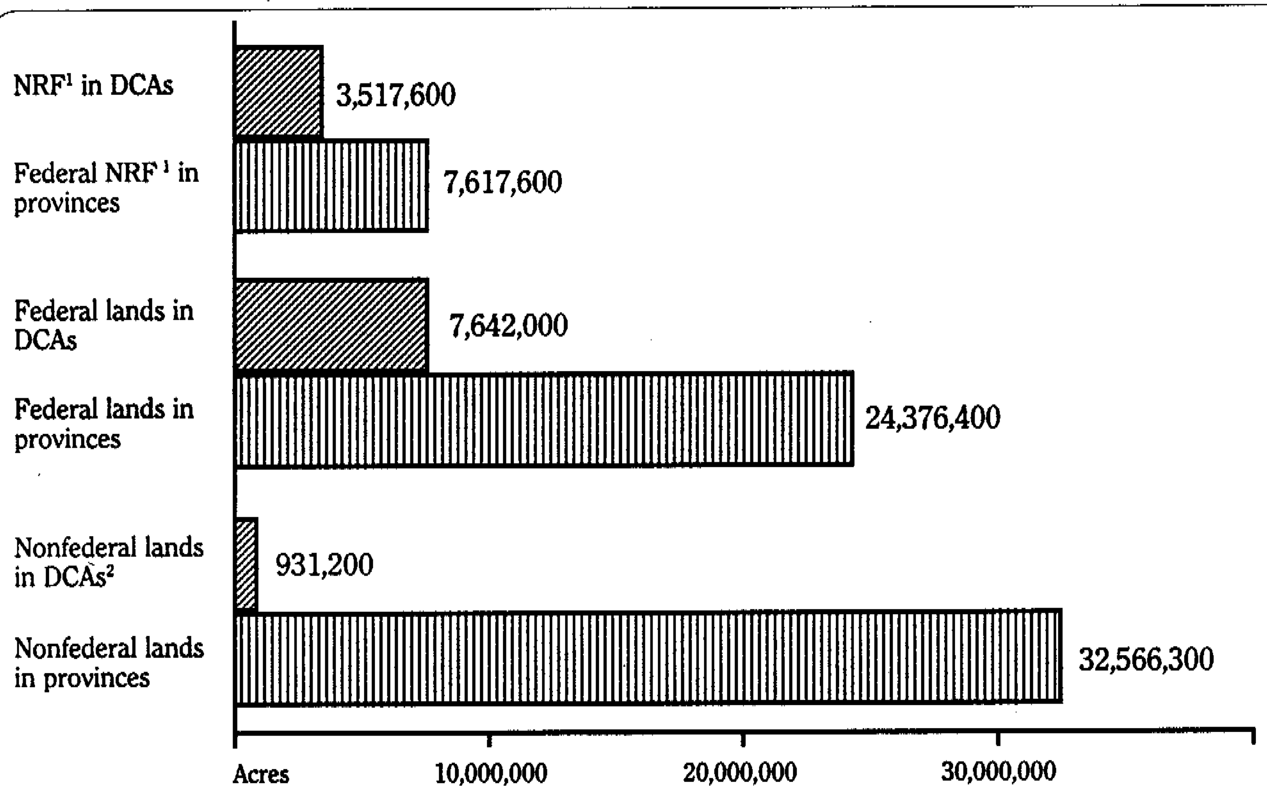


Figure ES.1. *Acres in the range of the northern spotted owl and in the DCAs (designated conservation areas).*

[1]NRF - nesting, roosting, and foraging habitat. This information is available only for federal lands.
[2]Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the province narratives.

Suggestions for Management of Nonfederal Forestlands

The recovery plan relies primarily on federal lands for recovery of northern spotted owls. However, it also recognizes the role of nonfederal lands in recovery, particularly in areas where federal lands are not adequate to fully achieve the recovery goal. Owls are currently protected on nonfederal lands through the Endangered Species Act prohibition of harassing or harming existing owls. However, alternative measures such as habitat conservation plans may provide a more effective contribution to long-term conservation. Adoption of effective nonfederal measures may speed recovery in some areas, and is probably the only means of achieving recovery goals in other areas.

The recovery plan recommends specific contributions from nonfederal lands which will complement federal efforts. These recommendations reflect the varied conditions within individual provinces, the authorities of the three states involved, and the potential for enhanced cooperation with the private sector. They provide a framework for development and implementation of innovative efforts to help achieve recovery. These efforts are termed protective management.

Monitoring and Research Program

The recovery plan used extensive scientific data on northern spotted owls. Based on this information, there is adequate assurance that implementation of the recovery plan will result in recovery of the owl. However, there are significant opportunities to increase knowledge of owls and their habitat. Consequently, the recovery plan recommends a comprehensive monitoring and research program. The program has two objectives:

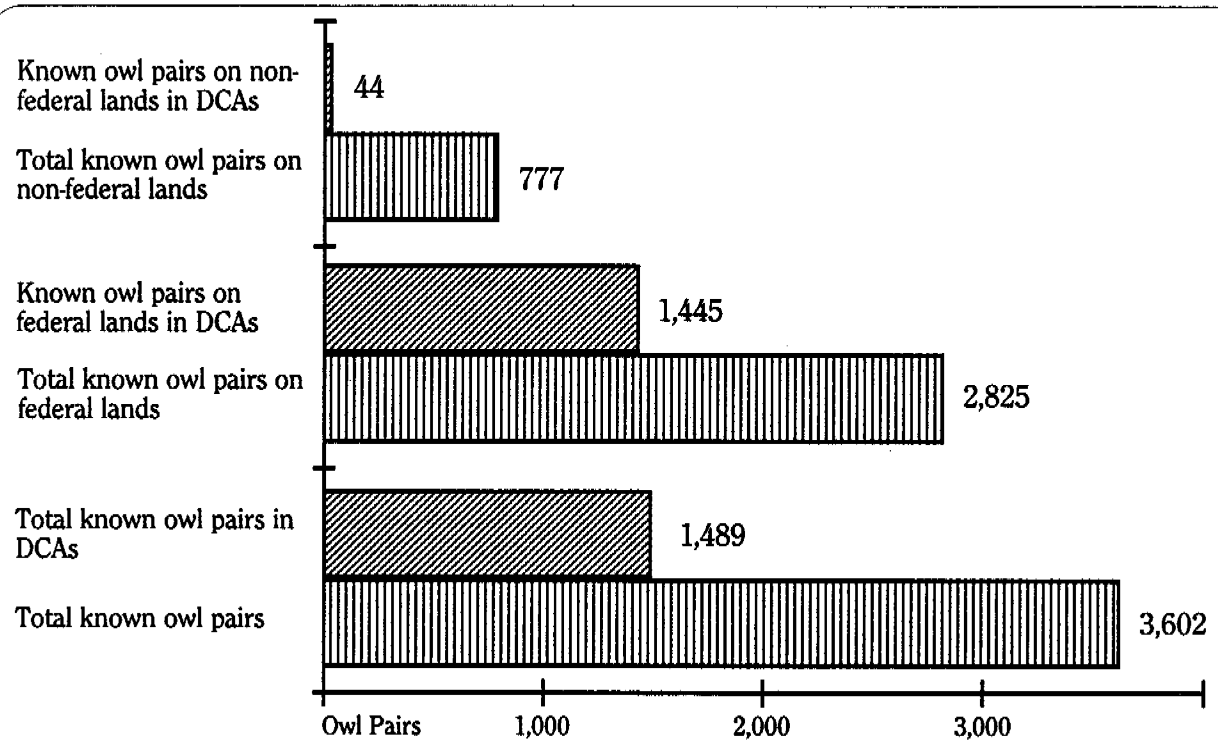


Figure ES.2. *Known owl pairs in the range of the northern spotted owl and in the DCAs (designated conservation areas).*

1. It will help produce information to assist in refining management guidance and practices to promote recovery and, to the extent feasible, achieve greater economic efficiency and effectiveness. Any changes will occur through the process of adaptive management.
2. It will provide documentation necessary to consider delisting the owl in part or all of its range.

Adaptive Management Process

The recommendations in this recovery plan are intended to bring about the conditions under which delisting of the owl could occur. While the goal of delisiting is not expected to change over time, the specific recommendations may change based on new information from monitoring and research. A structured adaptive management process is recommended to provide a way to make those changes in recommendations. This process is crucial to the success and credibility of the recovery plan since the owl occupies a dynamic landscape and knowledge of that landscape will change through time. Static recommendations are not appropriate in dealing with such a system.

The process of adaptive management eventually may result in significant changes in recommended management. The recovery plan adopts a long-term goal to move federal forestlands from a landscape composed of protected areas and matrix toward a landscape where conditions provide a more continuous distribution of owls. Results from monitoring and research may support such a change.

Implementation Mechanisms

Recovery plans are not self-implementing under the Endangered Species Act. Instead, they are used by federal agencies as a guide to refine management plans, procedures, and strategies so that on-the-ground operations help achieve recovery. Nonfederal parties are not required explicitly to follow recovery plans. However, they must comply with other provisions of the Endangered Species Act that protect owls. These provisions are reflected in the recovery plan. The recovery plan suggests an implementation schedule which, if followed, will expedite progress toward recovery and provide increased certainty and stability in owl management. Also, in recognition that recommendations cover an extended time frame and involve federal and nonfederal parties, the recovery plan recommends establishment of a coordinating group to guide implementation over the long term. The group would provide advice and assistance on policies, plans, and other aspects of management including monitoring and research.

The Scientific Basis for the Recovery Plan

The recovery plan is based on field studies of the habitat conditions used by spotted owls for nesting and breeding, on demographic studies, and on studies of owl behavior. It also is based on biological principles that describe the interactions within and among subpopulations that depend on areas of favorable habitat separated by areas of less favorable habitat conditions. The Recovery Team drew substantially on theories and models of population dynamics to determine the desired size of population groups and the overall spotted owl population.

The recovery plan also is based on silvicultural studies of the growth of forests under natural conditions and human management. Silvicultural models were used to study the opportunities for promoting more rapid development of suitable habitat conditions by appropriate management in younger stands.

Consideration of Economic and Social Effects

The recovery plan was designed to reduce economic and social costs without undermining recovery of the spotted owl. For example, the network of DCAs uses much habitat already set aside as not suitable for timber harvest. Management guidelines for the DCAs may allow some commercial wood removal if it is consistent with objectives to promote the development of suitable owl habitat. Guidelines for the matrix forests will allow a broad mix of commercial forest management activities in areas of currently unsuitable and currently suitable owl habitat. The recovery plan also provides programs and procedures to reduce the costs of its implementation. However, the costs of recovering the owl still will be significant, and disruption will be experienced by individuals and communities when restrictions on timber harvest cause unemployment.

Measures recommended in the recovery plan to promote owl conservation would also result in benefits, primarily to recreational values and fisheries, because a reduced level of timber harvest will limit the deleterious environmental consequences of timber harvesting.

When considering the estimates of the economic effects of implementing the recovery plan, it is important to note that they reflect all owl conservation measures on federal lands, not just the protection added to the current management regime by the recovery plan. These estimates were prepared in this way because the recovery plan will provide a comprehensive basis for all owl conservation efforts.

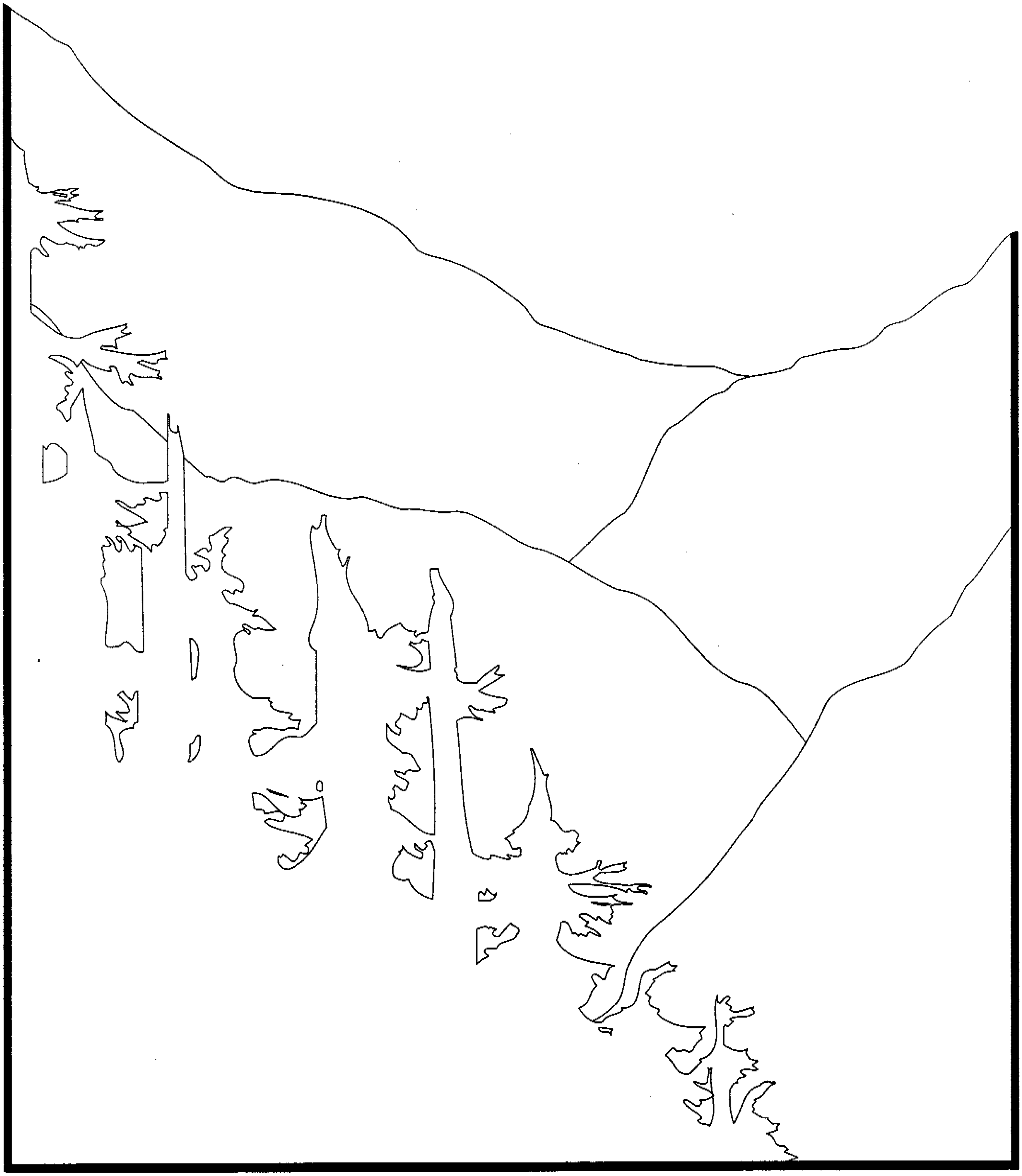
Given these assumptions, owl conservation efforts are estimated to cause lower federal timber harvests by about 2.36 billion board feet per year, and lower employment related to federal timber harvest by about 32,000 jobs (18,800 direct industry jobs and 13,200 related jobs), compared to the levels of employment that would have been expected in 1995 with no protection of the spotted owl. The value of the foregone timber harvest on federal lands is estimated to be $830 million per year. This is about the same as the estimated employment effect of moving forward with current plans and policies. However, putting the recovery plan into effect should help stabilize timber supplies, and it may actually mitigate some of the recent employment losses in the industry.

Conclusion

The conservation of northern spotted owls is a difficult public policy issue. It is important to achieve recovery in a way that is appropriate under the Endangered Species Act, yet also managerially and economically efficient. The recovery plan provides a realistic basis for meeting this objective by allowing for considerable flexibility in its implementation. Consequently, it should meet owl needs and provide greater stability in resource management than now exists. At the same time, however, its success depends on the commitment of and cooperation among federal agencies, the states, and the private sector. If that occurs, it will set a precedent for constructively resolving conflicts between conservation and development of natural resources.

Chapter I

Introduction



I.
Introduction

The northern spotted owl is a medium-sized owl living in older forests of the Pacific Northwest. This forest habitat has been rapidly harvested for timber in recent decades. As a result, the northern spotted owl population is declining and the owl has been federally listed as a threatened species. Without a plan to preserve the owl's remaining habitat and create new habitat, it is likely that the northern spotted owl will be eliminated from large parts of its range and eventually become extinct.

This document is such a plan. It lays out a means to recover the northern spotted owl from this path toward extinction. To succeed, it will require time, money, and the cooperation of private landowners, Indian tribes, and numerous state and federal agencies.

Recovery plans have been developed for a variety of threatened and endangered species of plants and animals. But this recovery plan is different, in its scope and charter. This plan recommends changes affecting millions of acres of productive forests and thousands of people whose jobs are dependent on harvesting timber from those forests. For the first time, in addition to making recommendations to save a species, the economic and social effects of those recommendations were considered in formulating the plan.

The recovery plan for the northern spotted owl is based on the best scientific data available about the owl and its needs, about the conservation of species, and about forest management. The plan contains details about the natural history of the owl; the number of owls known today and their declining populations; natural and human-caused threats to the owl; specific recommendations on federal, state, private, and Indian lands; how those recommendations should be implemented; other species affected by the recommendations; and the costs of implementation.

The Recovery Team that developed this recovery plan believes that its recommendations will allow the northern spotted owl to survive, recover, and eventually thrive in the forests of the Pacific Northwest.

A. The Northern Spotted Owl and the Endangered Species Act

1. How the Owl Came To Be Protected Under the Endangered Species Act

The U.S. Fish and Wildlife Service (FWS) first considered the possibility of listing the northern spotted owl (also referred to in the recovery plan as the spotted owl and the owl) under the Endangered Species Act in the early 1980s, but concluded that it would have been inappropriate. In 1987, a small organization known as GreenWorld, later joined by other environmental groups, petitioned the FWS to list the owl as endangered. On December 17, 1987, the FWS found listing was not warranted.

The legality of the negative finding was challenged in court by several environmental groups, and the federal District Court in Seattle ruled that the finding appeared not to be supported by the status review that the FWS had conducted (see GAO 1989 for a review). When a judge ordered the FWS to produce a record that supported its decision, the FWS requested and was granted time to reconsider its finding in light of the most recent information. In April 1989, the FWS made a finding that listing was warranted. A proposal to list the owl as a threatened species was published in June 1989, and the owl was listed effective July 23, 1990 (USDI 1990a). Critical habitat was designated on January 15, 1992 (USDI 1992b).

2. The Endangered Species Act

The Endangered Species Act of 1973 is an important piece of national environmental law aimed at halting the decline and disappearance of species. The following concepts and terms are components of the Endangered Species Act. They are important for understanding the provisions of the recovery plan.

Listing Process: A process for ascertaining which species need attention is basic to any program of species conservation. The responsibilities and authorities for listing under the Endangered Species Act are framed broadly as the determination "... whether any species is an endangered species or a threatened species ...."

> "Species" means any species or subspecies of plant or animal and, in the case of vertebrate life forms, may include any distinct population segment. (In this recovery plan, the terms "species" and "subspecies" are used in reference to the northern spotted owl.)
>
> "Endangered species" means a species in danger of extinction throughout all or a significant portion of its range.
>
> "Threatened species" means a species likely to become endangered in the foreseeable future throughout all or a significant portion of its range.

Critical Habitat Designation: The Endangered Species Act also directs federal agencies to propose critical habitat "to the maximum extent prudent and determinable." Once again, the act's definitions are important.

> "Critical habitat" means specific areas within the geographical area occupied by a species at the time of listing on which are found those physical or biological features that: 1) are essential to the conservation of the species, 2) may require special management considerations or protection, and 3) include specific areas outside the area occupied by the species determined to be essential to its conservation.
>
> "Conservation" means the use of all methods and procedures necessary to bring a species to the point at which the protective measures of the Endangered Species Act are no longer necessary.

Consultation: Listing of a species triggers the need for federal agencies to comply with section 7 of the Endangered Species Act. The act requires agencies to consult with the FWS concerning programs for the conservation of endangered and threatened species, and to ensure that their actions are not likely to jeopardize the continued existence of a listed species or to destroy or adversely modify its critical habitat.

"Jeopardize the continued existence" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild.

"Destruction" or "adverse modification" means a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species.

Under certain circumstances, federal agencies can be granted an exemption from their obligations under section 7 of the Endangered Species Act by a cabinet-level Endangered Species Committee provided for in the act.

Take Prohibitions : Section 9 of the Endangered Species Act directly prohibits taking of endangered and threatened animal species. Take is defined broadly under the act as "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct." Destruction of the species' habitat that results in harm or harassment to the species may also constitute a taking under the act.

3. Recovery Plans and the Northern Spotted Owl Recovery Team

The Endangered Species Act calls for the preparation of recovery plans for listed species that are likely to benefit from the effort, and authorizes the Secretary of the Interior to appoint recovery teams. A recovery plan must establish recovery goals and objectives that would allow delisting, describe site-specific management actions recommended to achieve those goals, and estimate the time and cost required for recovery. A recovery plan is not self-implementing, but presents a set of recommendations endorsed by an approving official representing the Department of the Interior.

In February 1991, the Secretary appointed an interdisciplinary Northern Spotted Owl Recovery Team with expertise in biology, forestry, silviculture, and economics. The Secretary's directive to the Recovery Team called for a biologically credible plan. The Secretary further directed that the recovery plan should, consistent with its legal mandate, "address concerns such as: potential community and regionwide economic and social impacts; fiscal implications at the local, state and federal levels; compatibility with other legal mandates; effects on other threatened and endangered species and those species which might be listed in the future; and broader, ecosystem-related considerations."

The Northern Spotted Owl Recovery Team includes federal employees, academic scientists, and representatives from the governors' offices in California, Oregon, and Washington. The Recovery Team held meetings each month from March to September 1991 that were open to the public and then met in closed session while it developed final options and recommendations in the form of a draft recovery plan for the Secretary's review.

During preparation of the draft plan, the Recovery Team held numerous meetings as a full team and in smaller committees working on specific matters. Members visited a wide variety of owl habitats and forests in the three states, including lands in the Mt. Hood and Six Rivers National Forests, Olympic National Park, U.S. Bureau of Land Management's (BLM) Eugene District, Yakima Indian Reservation, Oregon's Tillamook State Forest, and several privately owned commercial forests.

The draft recovery plan was released for public comment in May 1992, and public hearings were conducted in the three states during June. Written comments were accepted through August 13, 1992, and all comments were considered in the preparation of this final version of the recovery plan. Appendix K responds to the major comments that were received and describes significant changes made between the draft and final versions of the recovery plan.

The Recovery Team's mandate and its inclusion of some members with backgrounds in areas other than the biological sciences make it unusual among recovery teams. This structure enabled the Recovery Team to consider and, as appropriate, to reduce the costs of recovery.

B. General Background to the Recovery Plan

1. Current Management

Habitat of the northern spotted owl is managed by many individuals, corporations, federal and nonfederal agencies, and Indian tribes. The large number of entities involved and the diversity of statutory and regulatory authorities under which land is managed have posed a challenge for coordinating landscape-level conservation measures for the species. See Appendix J for a complete explanation of federal and state land management authorities and activities. Indian lands management authorities vary by tribe and their voluntary contributions have been developed through joint U.S. Bureau of Indian Affairs and tribal consultations.

The U.S. Forest Service manages the majority of spotted owl habitat within the range of the owl, with more than 6 million acres of suitable owl habitat in 18 national forests.

In 1992 the Forest Service completed an environmental impact statement and developed new regional guidance for owls based on the conservation strategy developed by the Interagency Scientific Committee (ISC). The ISC is discussed later in this chapter. However, timber operations on national forest lands are currently under litigation to respond to new information about owls and to consider the impacts of the proposed regional owl management plan on other old-growth forest species. As a result, the Forest Service is revising its environmental impact statement on the management of the northern spotted owl for all three states, and a final supplemental environmental impact statement is expected in 1993.

The BLM administers 2.4 million acres within the range of the owl, including about 1 million acres of suitable owl habitat, mostly in Oregon. Most BLM lands occur in a checkerboard arrangement intermingled with private and state lands.

Timber operations on BLM lands in Oregon are currently in litigation. The BLM is revising its resource management plans and is formulating alternatives for its western Oregon districts, with final plans and an environmental impact statement scheduled for completion in 1993. Management of BLM lands in Oregon will be based on existing plans until completion of new plans. Current planning efforts for the BLM in northern California are focused on completing a resource management plan.

The National Park Service (NPS) manages lands that provide up to 550,000 acres of suitable habitat. Management is generally compatible with that required for recovery of the northern spotted owl. The goal of the NPS, to "conserve the scenery and the natural and historic objects and the wildlife therein," is consistent with the Endangered Species Act. All management actions for endangered or threatened species are described and assigned priorities in approved resource management plans.

The FWS has responsibility for administering the Endangered Species Act. In January 1992, the FWS designated 6.9 million acres of federal lands as critical habitat for owls (USDI 1992 and 1992b). The FWS has conducted hundreds of consultations under section 7 of the Endangered Species Act on timber sales and other activities of federal agencies. Incidental take of numerous pairs of owls on federal lands has been permitted through these consultations. Although most consultations have resulted in nonjeopardy opinions, a jeopardy opinion was issued in 1991 on 44 timber sales on BLM lands, primarily in the Oregon Coast Range. Exemptions from the prohibition against federal actions likely to cause jeopardy were sought by the BLM from the Endangered Species Committee (also called the "God Squad"), and 13 timber sales were exempted. No timber sales have yet occurred on these tracts.

The FWS has also provided guidance for landowners so that timber may be harvested without violating section 9 of the Endangered Species Act. This guidance has caused considerable concern among state and private landowners and was rescinded in 1991, although possible violations of the Endangered Species Act continue to be investigated. The FWS is working with numerous landowners, primarily in California, to develop habitat conservation plans (HCPs) to permit the incidental take of owls for landowners who have instituted appropriate conservation measures for owl protection.

The three states within the range of the owl have taken different approaches to protection of spotted owls through regulations under their respective forest practices statutes.

In California, the state forestry board has adopted specific rules for the protection and conservation of the owl. A procedure was instituted, with the concurrence of the FWS, whereby timber harvest plans are reviewed to determine whether the plan will result in take. Approval must be withheld for any plan that would cause significant long-term damage to the owl. As an alternative, the forestry board has adopted rules to permit nonindustrial forestland owners holding less than 2,500 acres to submit long-term management and timber harvest plans that prescribe uneven-age management of forestlands. Using this option, spotted owl conservation needs can be integrated with timber harvest and management of nonindustrial forestlands. In addition to the adoption of rules to ensure that timber harvest on nonfederal lands in California would not result in a take of owls, the state initiated a state-wide HCP in 1990 intended to provide the basis for all state and private lands to receive incidental take permits under the Endangered Species Act.

The spotted owl is listed as threatened by the state of Oregon. The state has regulatory and technical assistance programs, land management objectives, and research aimed at conservation efforts for the owl. Owl nesting sites and pair activity centers are protected under state rules. Harvest operations must leave a core area comprising 70 acres of the best available habitat in the vicinity of a nest site or owl pair activity center. Forest practices that would significantly reduce suitable habitat in the core area are prohibited.

The northern spotted owl is listed as endangered under Washington law. Existing programs contributing to or having the potential to contribute to owl conservation include forest practices and land-use regulations, management of state-owned lands, land acquisition, research, and various landowner assistance or incentive programs. State permit decisions currently restrict harvest practices within a 500-acre circle around a known pair of spotted owls. State lands are subject to the same regulatory requirements as those of other landowners. Under a new law the Department of Natural Resources is managing a 260,000-acre experimental forest on the western Olympic Peninsula to test silvicultural prescriptions.

Indian reservation lands have been set aside for the exclusive use and benefit of Indian people pursuant to treaties, statutes, and executive orders. In addition, Indians retain treaty-secured cultural, economic, and hunting and fishing rights within lands ceded to the United States. Indian reservation lands are held in trust by the United States, with the Secretary of the Interior having the principal responsibility for maintaining that trust. Each reservation is governed by a sovereign tribal government. Tribal governments have among their many sovereign powers the right to regulate the uses of land and resources within their reservation boundaries, including the use and management of fisheries and wildlife resources and habitat.

Indian people revere all lands, forests, and wildlife. They have managed their lands prudently for centuries. They recognize the environmental, cultural, and spiritual values of those lands, as well as the economic values and the importance of appropriate forestland management to wildlife. They have taken and will continue to take measures to protect reservation wildlife populations, including the spotted owl. Given this historical perspective, the tribes are voluntarily managing portions of their reservation trust lands in a manner consistent with the northern spotted owl recovery effort. These voluntary contributions are made because the protection of all species–including spotted owls–is ingrained in Indian culture. Within the range of the owl there are six Indian reservations that contain spotted owl activity centers.

The northern spotted owl is listed as endangered in British Columbia, Canada. Take and disturbance are prohibited, but habitat is not protected. Surveys have been conducted, but no special management currently exists. The Ministry of Environment, Lands, and Parks is initiating the preparation of a spotted owl recovery plan.

2. The Interagency Scientific Committee

While the proposal to list the northern spotted owl was pending, the four principal federal agencies involved in its management (Forest Service, BLM, FWS, NPS) commissioned an Interagency Scientific Committee (ISC) to develop a conservation strategy for the owl. The committee delivered its product in May 1990 in the form of a strategy calling for the establishment of habitat conservation areas (HCAs) throughout the range of the owl, and including an adaptive management approach (Thomas et al. 1990). The ISC strategy represented a significant synthesis of information about the biology and conservation of the owl and provided a point of departure for much of what subsequently has occurred regarding owl conservation. The ISC report concluded that management strategies in place at the time were inadequate to ensure the owl's viability. The ISC stated that its strategy, ". . . if faithfully implemented, has a high probability of retaining a viable, well-distributed population of northern spotted owls over the next 100 years" (Thomas et al. 1990:4).

In many respects the task of the Recovery Team was similar to that of the ISC. There are, however, several significant differences. The most fundamental differences concern the frames of reference of the two groups. When the ISC was formed and when it prepared its strategy, the owl had not been listed as threatened and was not subject to protection under the Endangered Species Act. The strategy was commissioned by federal agencies, and members of the core committee of the ISC were federal employees. The ISC had no obligation to and did not attempt to articulate its strategy in terms of the owl's recovery from threatened status. It was commissioned primarily to formulate a strategy for federal lands.

The Recovery Team began its work after the owl had been listed. Protective measures had taken effect and were available as tools for conservation. The Recovery Team, appointed by the Secretary of the Interior, includes in its core membership academic scientists and representatives of the governors of the three affected states in addition to federal employees. Direct participation at this level by the states gave the Recovery Team a greater opportunity to address the entire range of the owl and management of owls on nonfederal lands than was afforded the ISC. Perhaps most important, a recovery plan must, if possible, include goals for the recovery of a species to the point at which it may be removed from the endangered or threatened list and also must describe criteria by which achievement of these goals can be recognized.

Similarities between the ISC strategy and this recovery plan arise from their common foundation in the biology of the owl and reliance on available management tools and principles of conservation biology. Differences between the two reflect the differing charters of the groups that prepared them.

3. The Biological Basis of the Recovery Plan

The conservation measures in the recovery plan reflect general biological principles and specific knowledge concerning the biology of the northern spotted owl. In large part, the recovery plan borrows from and builds upon the concepts and information presented in the ISC strategy. The following principles provide a biological basis for the recovery plan:

- The risk of local or widespread extirpation will be reduced by managing for owls throughout their entire range and in the variety of ecological conditions within that range.
- Emphasis should be placed on management for clusters or local population centers of owls in large habitat blocks, rather than for individual pairs.
- Habitat conditions and spacing among local populations should provide for survival and movement of owls.

For the owl, these principles result in recommendations for 1) a network of designated conservation areas (DCAs) sufficiently large when possible to support 20 pairs of owls each, 2) management within DCAs to maintain or increase suitable habitat for owls, and 3) management to allow owls to move successfully among DCAs. The size and arrangement of DCAs are based on information about the size of home ranges for pairs of owls and the ability of owls to disperse. Knowledge of habitat characteristics needed to support owls provided a basis for recommending management of forestlands to support recovery. Throughout the recovery plan, recommendations are tailored to locally specific information. Design of recovery using multipair habitat areas is particularly appropriate for this species because of knowledge of its behavior, which includes significant inter-pair interaction.

In addition to owl conservation, the recovery plan considers the biology and conservation needs of other species that occur within the range of the owl. The recovery plan incorporates elements to benefit other species and general ecosystem values when doing so adds little or no additional cost while conserving the owl.

4. The Means of Achieving Recovery

The recovery plan recommends an approach to owl recovery that involves federal, state, and private sectors. The underlying strategy is interactive, and accordingly, recommends management objectives and practices consistent with the various implementation mechanisms available among these sectors. This approach is believed to be the most efficient and effective means to achieve recovery. At the same time, however, it is understood that the statutory mandates of the Endangered Species Act impose somewhat different standards on different classes of land managers and owners. In addition, most owls and owl habitat are located on federal lands. Accordingly, the recommendations place strong emphasis on the need for appropriate federal lands management as a basis for recovery. As the recovery plan is implemented, achieving or exceeding recommended state and private commitments in some physiographic provinces may hasten recovery, and perhaps ultimately enable greater flexibility in federal management than the plan now envisions. In other provinces, however, particularly where obstacles to recovery are acute, flexibility is not likely to be possible in the immediate future. In some cases, where recovery actions may not be implemented or successful, uplisting of the owl from threatened to endangered may also occur.

Because of their legal status, recovery plans represent a series of recommendations, not requirements. The language used in the following sections must be interpreted with that understanding. The terms "will" and "must" are used to indicate activities that are judged to be essential to recovery of spotted owls. The same is true for any action described as a "requirement." The terms "should" or "could" indicate actions that would benefit recovery, but exceptions to these actions may be appropriate and acceptable. However, all these terms must be interpreted in light of their legal status as recommendations.

5. Organization of the Recovery Plan

The remainder of this document is separated into 4 chapters and 13 appendices. Chapter II is devoted to a summary of the natural history of the owl and a discussion of the owl's current status and primary threats to its existence.

Chapter III contains the recommendations for coordinated management of the owl and its habitat throughout its range. This begins with a discussion of the criteria that would be used to determine when the owl population would no longer need the protection of the Endangered Species Act. These criteria are followed by a detailed discussion of management recommendations for federal lands, and a general discussion of the types of contributions that would be beneficial from nonfederal lands. Next is a discussion of the owl's status in each of 11 physiographic provinces, and a presentation of both federal and nonfederal management recommendations for each of those provinces. The remainder of this chapter includes tables summarizing recommendations for federal lands; a discussion of how the recovery plan deals with risks to the owl; an analysis of the social and economic effects of the recovery plan; a review of how the recovery plan affects other species associated with old forests; recommendations for monitoring and research needed under the recovery plan; and a discussion of how the recovery plan could be improved over time through adaptive management.

Chapter IV provides information about how the recovery plan should be implemented. It includes schedules and budgets for implementation and a recommendation for coordination of the implementation effort. Chapter V is a list of literature cited in the recovery plan.

The appendices include more detailed technical discussions about many topics including monitoring techniques; habitats used by owls; evidence that owl populations are declining; consideration of other species; risks of natural disturbance to owl habitat; silvicultural practices useful in owl habitat; economic analyses; and detailed information about the conservation areas recommended for owls. The appendices also include a glossary and a review of the activities of the Recovery Team, including its consideration of other possible options for the recovery plan.

6. Sources of Information

Both published and unpublished documents (unpublished documents are commonly referred to as "grey literature") have been used as references in the recovery plan. Grey literature commonly is not subjected to formal, rigorous peer review, and thus its acceptability among scientists is low as a source of information from which inference can be drawn. Likewise, published documents vary in their utility as sources of information. Privately published works and many government documents are also not usually formally reviewed.

In the case of the northern spotted owl, much of the available information is found only in grey literature. Grey literature frequently has been used in this document because it often represents the latest field data. In addition, to categorically reject grey literature would result in a virtual absence of information derived from the timber industry. However, much of this material has received considerably more "peer" review than is customary for such literature because of the extensive litigation that has been carried out regarding the owl. In addition, both the ISC strategy and the draft recovery plan, which are based on this material, have been peer reviewed. Use of such information should result in a stronger recovery plan.

C. Acknowledgments

The Northern Spotted Owl Recovery Team was assisted in its work by a legion of able cooperators. Many of these people volunteered their time and efforts in excess of what anyone could have plausibly expected, and have endured schedules and deadlines that can only be described as unreasonable. The following list is undoubtedly incomplete, and the Recovery Team regrets any omissions. To all named and any unnamed collaborators, we express our gratitude; we could not have completed our work without their contributions. James K. Agee, David Allen, David Anderson, Brad Andres, Keith Aubry, Phil Aust, Robert W. Baker, Allison Banks, Timothy A. Barnes, Joseph Beatty, Gary Benson, Marty Berbach, Bill Beyers, Monte Bickford, Bruce Bingham, Kevin Birch, Helen Birss, Andrew Blaustein, Kathryn Boula, Nancy Brooks, Cupid Brosseau, April Brown, Charlie Brown, Ken Burnham, Bruce Bury, Andrew Carey, Jill Carroll, John Charbonneau, Steve Corn, Eric Cummins, Tom Cyra, Larry Davis, William F. Delaney, Velma Delp, Nicholas Dennis, Randy Dettmers, Lowell Diller, Aimee Dour, Susan Earnst, James Eby, Ed Ehlers, Rich Everett, Robert A. Ewing, Lee Folliard, Eric Forsman, Louise Fortmann, Alan Franklin, Terrence Frest,

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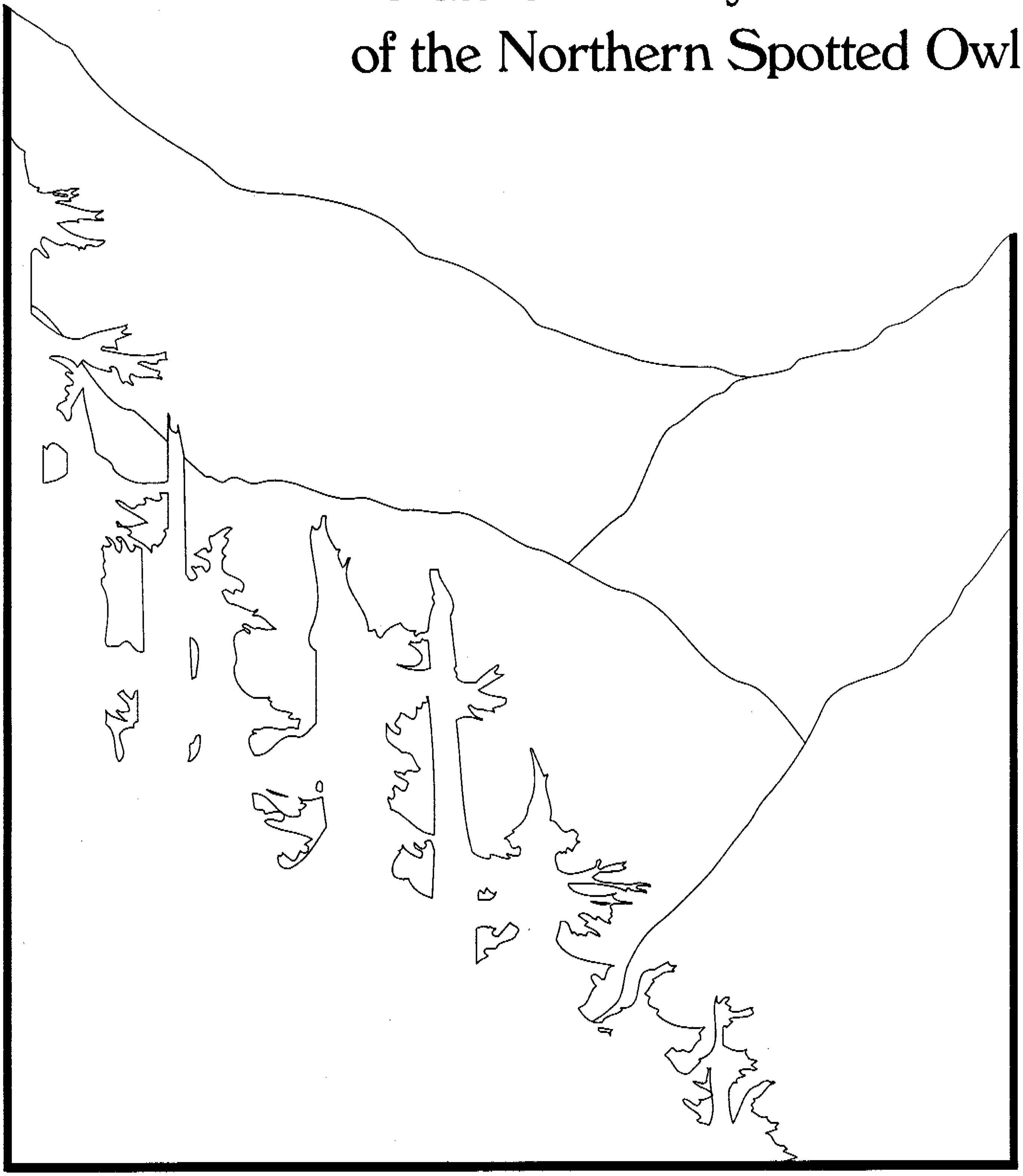
No project like this one comes to fruition without exacting a toll on the participants' personal support groups of family and friends. We appreciate the indulgence of those closest to us, who have put up with our frequent physical and mental absences during the preparation of this recovery plan.

Chapter II

Natural History and Status of the Northern Spotted Owl



II.

A. Natural History of the Northern Spotted Owl*

1. Introduction

The northern spotted owl (*Strix occidentalis caurina*) is one of the most studied and best known owls in the world. The research effort on this subspecies rivals that on some European owls (Southern 1970, Saurola 1989, Nero et al. 1987). This degree of scientific attention is the result of this owl's association with late seral stage conifer forests of high commercial value in the Pacific Northwest (Forsman et al. 1984). The spotted owl is a topic of vigorous debate among foresters, wildlife ecologists, academics, politicians, social scientists, and economists (Heinrichs 1983, Dawson et al. 1987, Dixon and Juelson 1987, Simberloff 1987, USDA 1988, Gup 1990, McKillop 1992, Sample and Le Master 1992).

Because of this widespread interest, three major management plans have been developed to protect the viability of the northern spotted owl (USDA 1988, Thomas et al. 1990, USDA 1991). These documents have been reviewed by scientists (Murphy and Noon 1992) and special interest groups alike (Boyce 1987, Green 1991, Reich 1991, Sheriff 1991). Four reviews of the owl's ecological status have been conducted by the FWS (USDI 1982, USDI 1987, USDI 1989, USDI 1990). These plans have received widespread scrutiny in the scientific literature and the press (Diringer 1992), and by government agencies and the courts (e.g., Simberloff 1987, Gup 1990, GAO 1989, Portland Audubon Society v. Lujan 1991, respectively). In addition, several literature reviews and critiques have been written during the past decade that document the history of knowledge acquisition on this unique nocturnal predator (Solis 1980, Campbell et al. 1984, Gutiérrez 1985, Gutiérrez and Carey 1985, Dawson et al. 1987, USDI 1987, Forsman 1988a, Thomas et al. 1990, USDI 1990). The objective of this section is to summarize the ecology of this important species.

The seminal work on the natural history of the northern spotted owl is Forsman et al. (1984). Thomas et al. (1990) will serve as a reference point for specific data on certain unpublished aspects (home range size, habitat, and food habits) of the natural history of the northern spotted owl in this literature review since that work represents the most complete data yet assembled about the northern spotted owl. However, information published since 1990 as well as information provided to the Recovery Team since Thomas et al. (1990) were reviewed and cited as original contributions in this section.

2. Natural History

Description

The northern spotted owl is a medium-sized owl found in the Pacific Northwest. It is chocolate brown with round to elliptical white spots on the body feathers and white bars on the tail. Other common distinguishing features are its dark eyes surrounded by tawny

*Prepared by R. J. Gutiérrez.

facial disks. Males and females are not easily distinguishable by plumage characters, although Barrows et al. (1982) suggested that the sex of spotted owls can be determined from the number of tail bars. Moen et al. (1991) noted that the tail-bar technique is unreliable for sex determination. Fleming et al. (1991) reported that female owls could be distinguished from male owls by their larger footpad. However, a spotted owl's sex is recognized most readily by voice (Forsman et al. 1984) (see Vocalization in this section) and size (Forsman et al. 1984, Blakesley et al. 1990). Spotted owls, and owls in general, show sexual dimorphism: females are larger than males (Blakesley et al. 1990:323). This sexual dimorphism exists in all commonly measured physical features, but body mass is the single best physical predictor of sex in this owl (Blakesley et al. 1990:323).

Plumage characteristics can be used to distinguish among several age classes of spotted owls. Juvenile spotted owls (ages 1 day to approximately 5 months) are distinguished by visible down feathers (Forsman 1981). The proportion of down feathers decreases with age. Subadult owls are distinguished by the presence of adult plumage and white-tipped, pointed tail feathers (Forsman 1981). In northern spotted owls, two subadult age classes can be recognized. Subadults that are 1 year old have a downy tuft at the tip of the pointed tail feathers, whereas this downy tuft is lost by an owl's second year (Moen et al. 1991). Adult (i.e., more than 27 to 28 months old) owls have rounded tips on the tail feathers, which usually are mottled in color.

Range And Distribution

The range of a species is that general geographic area within which the species may occur. A species' distribution may be synonymous with its range or it may be specific to the habitat types in which it occurs within its range. Northern spotted owls are found from southern British Columbia, Canada, south to Marin County, California. They range eastward through this area to the edge of the Palouse prairie in Washington and the Great Basin shrub steppe in Oregon and California. Although northern spotted owls are sighted in almost all areas of their general range (e.g., urban areas, beach dunes), their breeding distribution is restricted to forest communities (see Habitat in this section). They are found from sea level to as high as approximately 7,500 feet in the southern part of their range and to approximately 4,000 feet in elevation in the northern part of their range. Densities of owls vary throughout this broad range according to habitat type, habitat quality, and habitat quantity (Thomas et al. 1990). The current distribution of known spotted owls within their historic range is in Figure 2.1.

Taxonomy And Genetic Relationships

Spotted owls are members of the largest family, Strigidae, in the order Strigiformes. Some controversy exists regarding the taxonomic and systematic relationships of owls within this order (Sibley et al. 1988, Cracraft 1981), although most of the discussion centers on higher taxonomic levels. The genus *Strix* is a widely distributed group of owls with members occurring in the Nearctic, Palearctic, Neotropical, and Indian fauna regions (Clark et al. 1978). In North America there are three species of *Strix:* the spotted owl, the barred owl (*Strix varia*), and the great gray owl (*Strix nebulosa*; Johnsgard 1988). *Strix* owls may be most closely related genetically to owls in the genus *Athene* (Randi et al. 1991).

Spotted owls were described by early naturalists as three subspecies (the northern spotted owl; the California spotted owl, *Strix occidentalis occidentalis;* and the Mexican spotted owl, *S. occidentalis lucida*). The California spotted owl was first described by Xantus

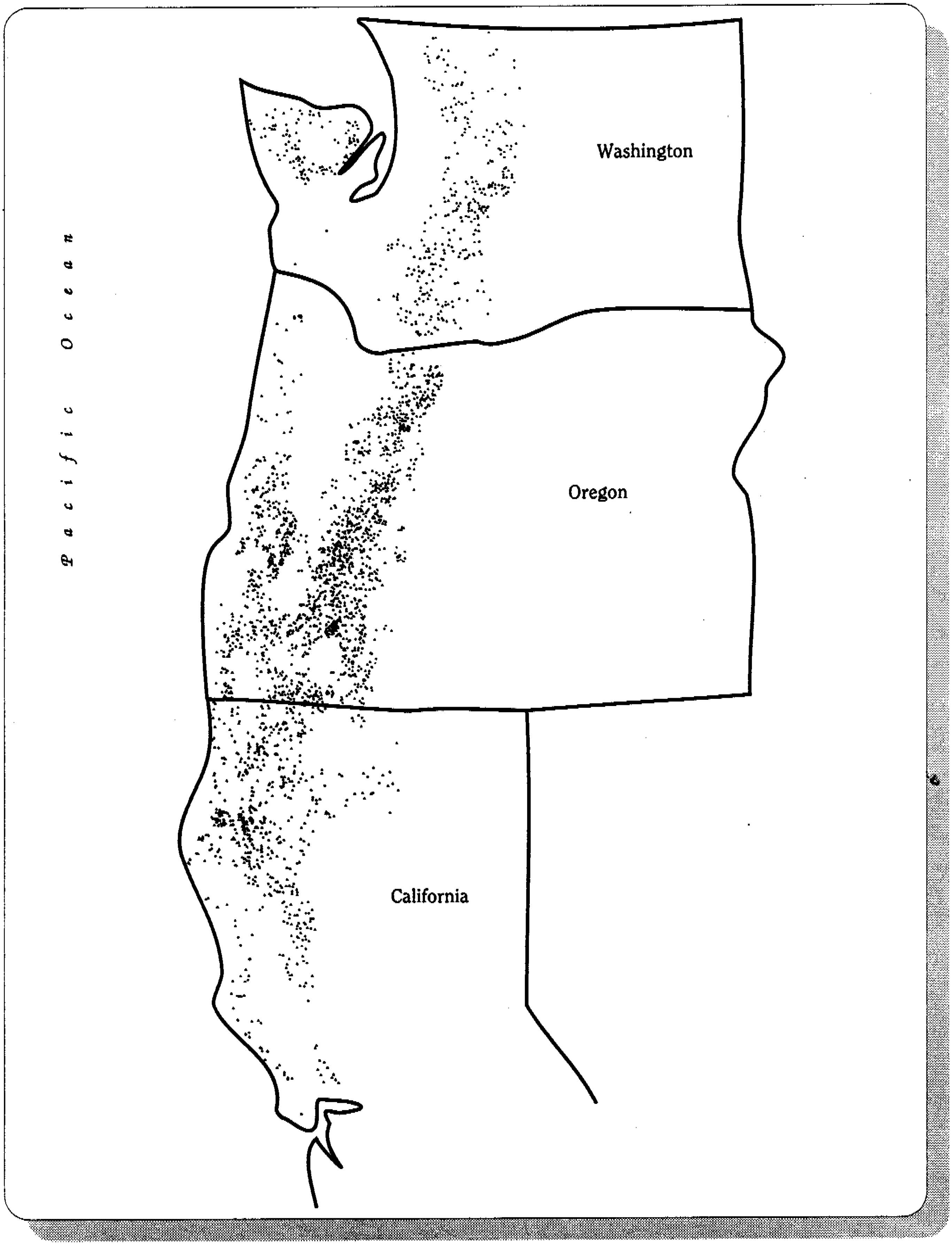


Figure 2.1. *Distribution of known spotted owl pairs located in Washington, Oregon, and California between 1987 and 1991.*

(1859) from a specimen collected in the Tehachapi Mountains of southern California. The northern and Mexican subspecies were named by Merriam (1898) and Nelson (1903), respectively, on the basis of plumage color and other morphological characters. Early naturalists often named subspecies on the basis of slight differences in plumage or size variation. Thus, it was not surprising that Oberholser (1915) recommended that the California spotted owl and the northern spotted owl be merged as one subspecies because of the large variation and overlap in plumage characters between the two subspecies. This recommendation apparently was not accepted by the American Ornithologists' Union (1957) Committee on Nomenclature. More recently the American Ornithologists' Union Committee was requested to reevaluate the subspecific status of the northern and California subspecies. However, it declined to change the current designation because of a lack of adequate study of the subspecies characters (Thomas et al. 1990:59). Nevertheless, the original boundaries delineating the subspecies' ranges were arbitrary (Gould In Prep.).

Barrowclough and Gutiérrez (1990) attempted to elucidate the relationships among the three subspecies using allozyme electrophoresis (a technique employed to assess genetic variation). They compared patterns of protein variation at 19 presumptive loci among eight populations of the three subspecies. Surprisingly, they found no detectable variation among the Pacific Coast populations for any of the loci. One major allelic difference was found between the coastal and Mexican subspecies. Their results did not resolve the subspecific relationships of *caurina* and *occidentalis*. However, *lucida* was clearly a distinguishable taxon, and it probably has been separated from the coastal forms for many hundreds of years (Barrowclough and Gutiérrez 1990:742).

Low levels of genetic variation in wild populations are considered to be a threat to their evolutionary potential (Frankel and Soulé 1981). This is because a population with low genetic variation would not have the variety of genes upon which natural selection could act to promote adaptation to changing environmental conditions over evolutionary time. However, the lack of electrophoretic variation in the coastal forms of spotted owl does not demonstrate unequivocally that these subspecies are genetically depauperate. Barrowclough and Gutiérrez (1990) discussed possible alternative explanations for the lack of electrophoretic variation found in spotted owls.

It is evident from the few studies conducted on the taxonomic and genetic relationships of spotted owls that more needs to be learned to estimate current levels of genetic variation in populations and hybridization with the barred owl. A few northern spotted owl/barred owl hybrids are known from the wild (see Intraspecific and Interspecific Relationships in this section). Hybridization is common among closely related wild birds that are classified as separate species. The key issues to be resolved in evaluating hybridization as a threat to spotted owls are the extent of hybridization (i.e., the levels of gene introgression) and the viability of hybrids. Barrowclough and Gutiérrez (pers. comm.) currently are using advanced molecular genetic techniques to address these issues.

Behavior

Adaptations of a Nocturnal Predator: Spotted owls are primarily nocturnal predators (Bent 1938). Like other nocturnal owls, spotted owls possess three primary adaptations for night life: exceptional eyesight, exceptional hearing, and modified feathers to facilitate silent flight (Payne 1971, Konishi 1973, Clark et al. 1978, Martin 1986). Spotted owls are perch-and-pounce predators (Forsman 1976). That is, owls select a perch and wait, trying to locate potential prey either by sight or sound; once prey is detected, they try to capture it with their talons. If prey is located in an inaccessible location or at some distance, the owls may move closer to the animal. The spotted owls' silent flight allows them to fly close to potential prey without detection by the prey. Spotted owls are agile creatures and can capture arboreal (i.e., living in trees) or terrestrial (i.e., living on the ground) prey. In addition, these owls exhibit "hawking" behavior (i.e., capturing flying prey, primarily birds and insects, Gutiérrez pers. observ.).

Although spotted owls are nocturnal, they can be active during the day. Spotted owls forage opportunistically during the day (Laymon 1991, Sovern et al. In Review). They also move short distances during the day to change roosting position in response to changes either in ambient temperature or exposure to direct sunlight (Barrows 1981, Solis 1983, Forsman et al. 1984).

Several hypotheses have been proposed as possible explanations for this species' affinity for late seral stage and old-growth forests. These hypotheses have been described as the nesting, thermoregulation, predation, prey, or general adaptation hypotheses (Barrows 1981, Forsman et al. 1984, Carey 1985, Gutiérrez 1985). Each hypothesis is discussed in an appropriate section.

Vocalizations: Spotted owls communicate using a variety of hoots, "barks," and whistles (Forsman 1976, Forsman et al. 1984). The precise context of some of these calls is unknown, but researchers generally agree on the function of some of the more common calls. The most common call given by spotted owls is the four-note location call (FLC) (Forsman 1976, Forsman et al. 1984, Fitton 1991). The next most common call is the multiple-note series location call (SLC) (Forsman et al. 1984, Fitton 1991). The FLC can be described phonetically as "hooo hoo hooo." FLCs often are given in replicates of two. SLCs are highly variable renditions of the basic FLC (Forsman et al. 1984, Fitton 1991). The FLC is used by males and females to announce territory occupancy and in territorial disputes. However, this same call, with lower pitch and intensity, also is used by the male to announce prey delivery to the female and in other behavioral interactions. SLCs are used by owls when they are agitated. Whistles usually serve to establish contact between a pair of owls (Forsman et al. 1984). Calls of spotted owls also vary spatially and temporally (Ganey 1990, Fitton 1991).

Spotted owl calls are relatively low-pitched and composed of pure tones (Fitton and Gutiérrez 1991). This is believed to be an adaptation to communicate in dense (forest) vegetation (Morton 1975). One can infer from call structure that spotted owls have evolved in forest environments.

The spotted owl is unusual among the Strigidae because it may have the ability to learn a neighboring spotted owl's call and then make fine adjustments to its own call to imitate the neighbor's call (Fitton and Gutiérrez 1991). Primitive birds such as owls usually do not have the ability to learn calls (Kroodsma 1982). One adaptive advantage of call learning for a species with a large home range may be to prevent aggressive territorial interactions with known neighbors, which probably are energetically costly to this animal. That is, if an owl cannot recognize its neighbor's call, it must expend time and energy defending its territory every time it hears an owl calling near its territory. The call learning hypothesis also suggests that spotted owls have evolved in the presence of neighbors. Thus, management plans that feature isolated habitat patches do not appear consistent with the biology of this owl.

Intersexual Relationships: The central unit of a spotted owl's life cycle is a functional territory. A functional territory is occupied by a pair of reproductively active owls. It is a defended area in which survival and reproduction are sufficient to ensure replacement of the pair in the future. In contrast, a nonfunctional territory would be a defended area in which the habitat conditions did not allow either successful reproduction or reliable survival of offspring. Territories probably are smaller than home ranges, but the exact relationship between the defended area and the used area is unknown. Both members of a pair vigorously defend the territory through vocalizations and visual displays. This propensity to defend a territory also is the key to successful study of the species because one can locate spotted owls by imitating their calls.

Spotted owls often form long-term pair bonds (Forsman et al. 1984). Pair bonds do occasionally dissolve, but the reasons for "divorce" are unknown (Franklin and Gutiérrez unpubl. data). Nevertheless, several behaviors occur commonly among spotted owls which illustrate mechanisms that probably have evolved to reinforce pair bonds. Calling serves to strengthen pair bonds when it is given in the appropriate context (e.g., nest site selection, prey delivery). Courtship feeding by the male is common during the early part of the nesting cycle (Forsman 1976) and may serve as a proximate cue to either food availability or the male's ability to hunt successfully. Finally, physical contact, as exemplified by "allopreening" (i.e., mutual preening of feathers), also serves to strengthen pair bonds (Forsman and Wight 1979). Allopreening is common in other *Strix* owls (Fitzpatrick 1975, Nero 1980), and is ingrained so strongly in spotted owls that captured owls may engage in allopreening with their captors (Nero 1980).

The nesting cycle starts when the pair begins to roost together on a more frequent schedule as day length increases in late winter. The initiation of laying is contingent upon the physical condition of the female, the availability and abundance of prey, and the ability of the male to capture sufficient prey. The condition of the female probably depends on the female's ability to procure food and the prey levels in the territory during the winter and the preceding fall. Once a pair is committed to nesting, the female lays her clutch of eggs and incubates and broods the young. In fact, during incubation and the first half of the brooding period, the female leaves the nest only to defecate, regurgitate pellets, avoid predation, defend against conspecifics (i.e., other spotted owls), or receive prey delivered by the male. The role of the male during the nesting period is to provide sufficient food to the female so that the female need not forage. Once the young have hatched, the juveniles remain 3 to 5 weeks before leaving the nest. Owlets often leave the nest before they can fly, simply jumping from the nest into the surrounding tree branches or onto the ground. These young owls are fed and tended by one or both of the adults until they disperse in early fall (late September or early October) (see Dispersal in this section). Following dispersal of the young owls, adult owls begin to expand their home ranges and to roost together less frequently, signaling an end to the annual reproductive cycle.

Intraspecific and Interspecific Relationships

Competition: Intraspecific competition is the competition for resources among members of the same species. Territoriality is one expression of intraspecific competition. One adaptive advantage of territoriality is that it allows a territory holder to sequester resources for exclusive use. Because spotted owl prey are patchy in distribution and variable in abundance (Ward 1990), it is important, if not necessary, for spotted owls to defend territories and use large areas for foraging.

Preliminary information on habitat selection gathered by Solis and Gutiérrez (1990) and Sisco (1990) suggested that intersexual (competition between males and females of the same species) competition may have led to foraging habitat segregation between males and females. It appears that males and females select forests of different structure, and that the smaller males hunt in denser forests. Alternatively, habitat selection by each sex may be the result of sexual dimorphism, which may have evolved for other reasons besides food competition (Muller 1986).

Competition for resources can occur between different species, this is commonly called interspecific competition. The use of any finite resource in one area by more than one species can result in competition if the depletion of the resource by one species negatively affects another species. Competition is commonly invoked as a selective mechanism for the evolution of niche partitioning (Cody 1974). For example, the relative differences in body size of members of the Pacific Northwest owl community may be an expression of past competition that led to the evolution of differences in body size and foraging strategies that minimize diet or habitat overlap. Alternatively, the owl community structure simply may be an expression of adaptive radiation (adapting to regional environmental conditions) at some time in the past (Wiens 1989). Nevertheless, competition can be a serious problem for a species when an exotic (nonnative) animal of similar body size and ecological requirements invades its habitat. The recent invasion of the barred owl into the range of the spotted owl (Taylor and Forsman 1976) is an example of potential competition between closely related species. Barred owls are larger and more aggressive than spotted owls in interspecific territorial interactions. They also feed on a broader range of prey, occupy a wider range of habitats, and have smaller annual home ranges than do spotted owls (Hamer 1988). Further, they are known to have displaced spotted owls from their territories (Allen pers. comm.). Thus, barred owls are a potential competitive threat to spotted owls.

Hybridization: At least five spotted owl/barred owl hybrids have been observed in the wild (Forsman pers. comm.). It is common in nature for closely related species to hybridize, especially where habitat disruption has occurred (Short 1965, Johnsgard 1970, Mayr and Short 1970, Short 1972). Vincent (1990) expressed concern about the recent invasion of barred owls and the potential effect of hybridization on the integrity of the spotted owl as a species. Several biological outcomes are possible given the rapid expansion of barred owls into the range of the spotted owl. First, the barred owl could, through extensive hybridization, genetically "swamp" the spotted owl. Second, a "hybrid swarm" (i.e., a subpopulation composed primarily of hybrid individuals) could develop in specific areas of contact. Third, selection could act against hybrids, thus favoring development of effective isolating mechanisms. Fourth, low levels of hybridization could occur continuously without loss of the identity of either species. Fifth, hybridization could be a random event. In only the first case is the genetic integrity of the spotted owl seriously challenged. However, in declining populations any loss of spotted owl reproductive capacity to hybridization must be considered a real threat, primarily because of its effect on the short-term demography of the species.

Predation: Another form of interspecific interaction is predation (the killing of one organism by another for food). As a medium-sized owl, the spotted owl kills and eats smaller owls. Therefore, it is not surprising that the larger great horned owl *(Bubo virginianus)* kills and eats spotted owls. This is called a food chain. Predation by great horned owls on spotted owls is a potential hypothesis to explain spotted owl use of old-growth forests, or to explain spotted owl avoidance of open habitats (Forsman et al. 1984). These two species commonly share the same habitats, but great horned owls tend to occupy sites that are more fragmented and open than those used by spotted owls (Johnson 1993), perhaps because their large size makes them less maneuverable in dense forest. There is no current test of this hypothesis (i.e., relative predation rates by great horned owls on spotted owls using habitats with different structure). However, great horned owls probably prey on spotted owls opportunistically rather than seeking spotted owls as prey (Forsman pers. comm.).

Northern goshawks *(Accipiter gentilis)* also prey on adult and juvenile spotted owls (Forsman et al. 1984, Gutiérrez et al. 1985, Miller 1989, Johnson pers. comm.). Nevertheless, spotted owls will nest in a goshawk territory (Forsman et al. 1984) and will defend their young against attacks by goshawks (Gutiérrez unpubl. data). However, because predation is often inconspicuous in the wild, the threat of goshawks and other predators to spotted owl populations cannot be determined with certainty at this time.

Until recently, people have rarely encountered spotted owls and there has been no historic persecution by humans of this docile creature. The recent, conspicuous rise in spotted owl deaths at the hands of humans is a potential threat to local owl populations.

Diseases and Parasites

Disease and parasite infections represent another form of interspecific interaction because they are relationships between organisms in the broad biological sense. However, the topic of pathogens is examined separately here because it is treated separately in status analyses by the FWS when listing a species as threatened or endangered.

Relatively little is known about the diseases and parasites of spotted owls. Gutiérrez (1989) conducted an extensive survey of hematozoan parasites (those that live in the blood) in all three subspecies of the spotted owl. Of the six hematozoan species found, all but one species occurred in the northern spotted owl. The infection rate was 100 percent, which was one of the highest rates of infection by these parasites recorded among birds (Greiner et al. 1975). However, spotted owls must be adapted to carry these high parasite loads because their survival rates are very high where infection rates are high (e.g., northwestern California). Hoberg et al. (1989) examined 20 northern spotted owls for helminth (worm) parasites and found eight species representing nematodes (round worms), cestodes (flat worms), and acanthocephalans (spiny-headed worms). More than 80 percent of the owls were infected with at least one species; and multiple infections were common. Young et al. (In Press) reported two hippoboscid fly (louse fly) species from spotted owls in northwestern California. One species of fly was recorded only once among the 382 owls examined, but approximately 17 percent of those owls were infested with the other species. Fly densities on owls were higher in years of higher summer and fall temperatures and lower winter precipitation. Young et al. (In Press) speculated that low temperatures may have depressed survival of fly pupae. Forsman (pers. comm.) observed two nests where owlets had such high infestations of hippoboscids that the flies caused severe trauma to the young owls. Finally, Clayton and Price (1984) reported the spotted owl as a host for the chewing louse, *Strigiphilus syrnii.*

Habitat

Habitat selection and its context: Perhaps the most controversial aspect of the natural history of the spotted owl concerns its habitat requirements. Thomas et al. (1990:143-144) discussed the complex habitat needs of the northern spotted owl. In addition, Bart and Earnst provide a summary of spotted owl habitat in Appendix B.

Most species exhibit variation in habitat selection (i.e., most species are not strict habitat specialists). Spotted owls are known to use many habitats. Empirical observations of spotted owls in different habitats can provide understanding of the owls' habitat requirements at three different levels (Peek 1986). *Habitat use* is the simple observation of an animal in a habitat without understanding the context of the observation. *Habitat selection* is the choice of a habitat or habitats among those that are directly available to the animal. *Habitat preference* is the selection of habitat that would be made by an animal if all habitats were available to the animal. There have been many observations of spotted owl habitat use, fewer studies of habitat selection, and no studies of habitat preference as defined by Peek (1986). Early studies portray the northern spotted owl as a denizen of primal forests (Grinnell and Miller 1944) based on observations of habitat use. However, Grinnell and Miller (1944) found that geographic variation in habitat use did exist in spotted owls. Subsequent investigations (Forsman 1976, 1980, Solis 1983, Forsman et al. 1984, Gutiérrez et al. 1984, Solis and Gutiérrez 1990, Sisco 1990, Blakesley et al. 1992, Bart and Forsman 1992, Carey et al. 1992) reaffirmed Grinnell and Miller's notions from observations of habitat use, but more importantly, provided analyses of habitat selection. Recent surveys of managed (i.e., previously logged lands) forests, particularly on private lands, have added to knowledge of spotted owl habitat use (Diller 1989, Kerns 1989, Pious 1989, Irwin et al. 1989 and 1991, Irwin 1992a, Irwin et al.1992a). These latter observations are important, but their ecological significance is enigmatic (Irwin 1992b) because, unlike studies conducted on public lands, there is no supporting demographic information. It is essential that more demographic information be gathered to evaluate these populations (see Spotted owl use of young, managed forests in this section).

Variation in habitats used: Spotted owls are known to nest, roost, and feed in a wide variety of habitat types and forest stand conditions throughout their distribution (see Appendix E for discussion of suitable habitat). Spotted owls use western hemlock, mixed-evergreen, mixed-conifer, Douglas-fir, redwood, Douglas-fir/hardwood, evergreen hardwood, ponderosa pine, western red cedar, and other forest types in different parts of their range. Most observations of spotted owl habitat use have been made in areas having a component of old-growth and mature forests (Solis 1983, Forsman et al. 1984, LaHaye 1988, Sisco 1990, Ward 1990, Zabel et al. 1991; see additional summaries in Thomas et al. 1990). However, observations of spotted owls in managed stands (i.e., previously logged redwood stands with residual old-forest characteristics or Douglas-fir forests harvested around the turn of the century) commonly occur (Forsman et al. 1977, Diller 1989, Kerns 1989, Pious 1989, Irwin et al. 1992b, Diller 1992, Miller et al. 1992). Studies evaluating habitat selection showed owl selection for mature and/or old forest stands with concomitant selection against young stands (Forsman 1980, Solis 1980, Carey et al. 1990, Blakesley et al. 1992, Carey et al. 1992). Selection for forest stands of intermediate age and size varied among the owls studied.

Nesting habitat: Most northern spotted owl nest sites observed on public lands have been located in old-growth or mature forests (Forsman et al. 1984, LaHaye 1988). In addition, the proportion of older seral stage forest surrounding nests has been significantly greater than it was in surrounding random sites in the same area (Meyer et al. 1990, Ripple et al. 1991). In areas of privately managed forest, particularly in the California Klamath and California Coast physiographic provinces, where some uneven-aged silviculture has occurred or where fast tree growth facilitates rapid habitat development, spotted owls are known to nest in managed stands, especially if residual old-growth characteristics are present (Forsman et al. 1977, Diller 1989, Pious 1989, Thomas et al. 1990; see Appendix B). The health of these populations is unknown since no critical studies have been completed which estimate the birth and death rates of owls in these habitats. The presence of breeding owls alone is not sufficient evidence to infer that these habitats are occupied by self-sustaining populations.

Spotted owls do not build their own nests; they depend upon suitable naturally occurring nest sites. In older-age forests, owls tend to nest in broken-top trees and cavities; they use platforms (i.e., abandoned raptor nests, squirrel nests, mistletoe brooms, debris accumulations) less frequently (Forsman et al. 1984, LaHaye 1988). In younger forests (i.e., forests less than 150 years old), nests more frequently are found on platforms (LaHaye 1988, Buchanan 1991). In one California study (LaHaye 1988), the proportion of platform nests used by spotted owls increased north to south, but the trend probably is related to the distribution of stand ages in that study rather than latitude.

The presence of suitable nest sites has been hypothesized as one possible basis for the use of old-growth by spotted owls (Forsman et al. 1984). However, owls also use a variety of nest sites in younger-aged stands. But one critical piece of information should be assessed before this hypothesis can be tested. That is, the relative nesting success of spotted owls using cavities and broken-top trees should be compared to that of spotted owls using the presumably structurally less stable debris platforms. Artificial nest sites probably could be considered for these owls in large trees (Woodbridge and Mattison pers. comm.). European owls in the genus *Strix* readily use nest boxes (Southern 1970, Saurola 1989). Barred owls also use nest boxes (Johnson 1987). If spotted owls behave in a similar fashion to other *Strix* owls, providing nest boxes may solve problems with availability of nest sites in some areas. However, a critical study of nest-box acceptance by spotted owls has not been conducted.

Several studies have been conducted on the stand structure of northern spotted owl nesting habitat (LaHaye 1988, Buchanan 1991, Self and Nelson pers. comm.). In two of the studies LaHaye (1988) and Buchanan (1991) compared characteristics of nest sites with characteristics of the general landscape where nest sites were located. In these studies, owls nested in specific stands with characteristics that differed from the average landscape available to them. This suggests selection by the owls for specific characteristics. In general, owls preferentially used forests with greater complexity and structure. Nesting habitat structure in managed forests reported by Self and Nelson (pers. comm.), was strikingly similar to the habitat structure used by foraging spotted owls in unmanaged stands in the same province (Solis 1983; see Appendix B).

Roosting habitat: Northern spotted owl roosting habitat has been described by Forsman (1976), Barrows and Barrows (1978), Forsman (1980), Solis (1983), Forsman et al. (1984), Chávez-León (1989), Sisco (1990), and Blakesley et al. (1992). Roost sites are typically areas of relatively dense vegetation (high canopy closure dominated by large-diameter trees), and, therefore, similar to nesting habitat. During the summer these sites are usually cool, shady spots near streams or are on the lower third of slopes (possibly a simple correlation with stream position; Forsman 1976, Solis 1983, Blakesley et al. 1992). Spotted owls respond to variation in temperature and exposure by moving within the canopy to find favorable microclimate conditions (Forsman 1976, Barrows and Barrows 1978, Forsman 1980, Barrows 1981, Solis 1983, Forsman et al. 1984). The multistoried stand structure of roost sites facilitates this movement. Because of this observed behavioral response to variation in temperature, it has been hypothesized that old-growth forests are necessary to spotted owls for them to avoid heat stress (Barrows and Barrows 1978). However, Gutiérrez (1985) pointed out that there are other plausible hypotheses to explain the association of owls with old-growth.

Foraging habitat: Of the major spotted owl habitat categories, feeding habitat appears to be the most variable (Thomas et al. 1990). This is predictable given the highly variable distribution and abundance patterns of the owl's primary prey (Ward 1990, Carey et al. 1992). Within a given physiographic province, foraging habitat may be more variable than either nesting or roosting habitat. Nevertheless, spotted owl foraging habitat is characterized by high canopy closure and complex structure. Habitats used by foraging owls in unmanaged and managed stands occupied by nesting owls are surprisingly similar in habitat structure in California (see Appendix B).

Solis and Gutiérrez (1990) presented evidence that male and female spotted owls may segregate their foraging habitat. The smaller males appeared to use stands that had higher tree density than did the larger females, which foraged in less dense habitats. Earhart and Johnson (1970) suggested that differential habitat use by male and female owls may occur because the high wing loading of the females would make them less maneuverable than males. However, this probably would be a consequence rather than a cause of reversed sexual dimorphism (Muller 1986, Solis and Gutiérrez 1990).

Carey et al. (1992) analyzed the effect of forest fragmentation on spotted owls. They reported that northern spotted owls responded to increased fragmentation of forests by increased movement in remaining old forest, increased separation of owls in pairs, and increased overlap among pairs. In addition, the social structure of the owls appeared to be affected by increased fragmentation of old forests.

Spotted owl use of young, managed forests: The significance of the owl's relationship to old-growth forests (*sensu* Old-growth Definition Task Group 1986) is obvious: old-growth forests are declining rapidly throughout the owl's range as a result of habitat loss, primarily logging (Thomas et al. 1990, USDI 1990). If northern spotted owls are ecologically dependent (Ruggiero et al. 1988) on old-growth or mature forests, then continued logging of their habitat will lead to the probable extinction of the population (Thomas et al. 1990, USDI 1990). However, Forsman et al. (1977), Forsman (1988b), and Hays et al. (1989) reported spotted owls occupying young, managed stands at lower densities than in old-growth stands. Spotted owls appear to be less abundant in managed forests in the northern part of their range compared to the southern part of their range (e.g., Irwin et al. 1991, Diller 1992, respectively). A managed stand, defined in a broad context, is one in which cutting of trees has occurred. This clarification is necessary because there are no examples of forests in which logging or silviculture has occurred where the response of owls is documented experimentally. Further, Forsman (1980), Solis (1983), Forsman et al. (1984), LaHaye (1988), Chávez-León (1989), Solis and Gutiérrez (1990), and Sisco (1990) described habitat used by northern spotted owls in both old-growth and mature stands. Their descriptions of mature forest structure used by spotted owls are similar to the structure of uneven-aged managed forests in northwestern California where owls have been found (see Appendix B). It is not surprising that spotted owls are being observed in some younger managed forests throughout the distribution of the subspecies (Diller 1989, Irwin et al. 1989 and 1991, Kerns 1989, Pious 1989). A hierarchy of information is needed to assess and understand these observations of owls in managed forests. In order of increasing importance, these classes of information are 1) presence of individuals, 2) presence of pairs, 3) owl density, 4) variation in reproduction, 5) survival schedules, 6) dispersal patterns, 6) ratio of internal to external recruitment, and 7) population stability. Without this information it is impossible to understand the health of a population occupying any forest. The structure and proportions of habitats used by owls relative to available habitats also are necessary to evaluate the observations. Finally, future harvest patterns must be known and must accommodate owl needs in order to predict the effects of logging activities on the owls inhabiting these managed forests.

On one side, this habitat variation argues that spotted owls are not habitat specialists although the similarity in habitat structure does not support this point. On the other side, it suggests that spotted owls show adaptive responses to regional variation in environmental conditions. Regional variation in habitat selection by owls does not indicate that they will respond positively to any human-induced habitat changes in one part of their range that lead to habitat conditions similar to those used by owls in other parts of their range. An additional problem in assessing variation in habitat use is the lack of a consistent definition of vegetation seral stage classification (see Table F1 in Thomas et al. 1990). Terms such as "old-growth, mature, young age, unmanaged, managed, second-growth" are defined in the literature using different parameters and criteria. This impedes rather than facilitates communication among interested persons.

Owls in managed forests in the California Klamath and California Coast physiographic provinces usually occupy stands with high structural diversity, high canopy closure, and either large-diameter trees or residual old trees (see Appendix B). These stands are usually more than 60 years old after partial logging events of the past (Thomas et al. 1990). For example, stands in the redwood region of the California Coast province described by Kerns (1989) have a structure similar to unmanaged (i.e., not previously logged) mature stands occupied by owls in a nearby national forest (Solis and Gutiérrez 1990). Apparently, the fast growth of redwood trees, presence of understory hardwood trees, and the remnant old trees in the stands facilitate rapid structural development of these coastal forests. Critical aspects yet to be estimated in previously harvested forests are the survival, recruitment, dispersal, and reproductive patterns of these owls relative to conspecific populations in unlogged forests.

Home Range Size

Home range is defined generally as the area used by an animal and to which the animal exhibits fidelity. The size of home ranges of spotted owls is a focal point of controversy because of their large size (Table 2.1; Thomas et al. 1990).

Forsman (1980) was the first to estimate spotted owl home range size by using radio-telemetry, although Marshall (1957) guessed at the nightly ranges of Mexican spotted owls in Arizona and Mexico. Radio-telemetry is the only method by which scientists can reasonably estimate the size of spotted owl home ranges (Guetterman et al. 1991). Some concern has been expressed about the effect of radio transmitters on spotted owl survival and reproduction (Paton et al. 1991). Foster et al. (1992) found no significant differences in survival or body mass between radio-marked and unmarked spotted owls, although some owls did die as a result of improper transmitter attachment. But Foster et al. (1992) did record a significant negative effect on reproductive output of radio-marked owls.

Because of Forsman's (1980) initial observations that spotted owl home ranges were very large (averaging more than 2,000 acres) a great deal of scientific effort has been devoted to verifying his original observations and to estimating the geographic and inherent variation in spotted owl home ranges (Forsman 1981, Solis 1983, Forsman et al. 1984, Gutiérrez et al. 1984, Sisco and Gutiérrez 1984, Forsman and Meslow 1985, Allen et al. 1989, Hamer et al. 1989, Hays et al. 1989, Carey et al. 1990, Paton et al. 1990, Sisco 1990, Thrailkill and Meslow 1990, Carey et al. 1992). In addition, Thomas et al. (1990) summarized this information and other unpublished estimates of home range size (Table 2.1).

Interpreting the variation in home range size and habitat use has been a significant challenge to spotted owl ecologists. Variation (i.e., the distribution of observations of a trait) in observed home range size has formed the basis upon which scientific inference and generalization were based about spotted owl home range requirements. From the studies cited earlier, some generalizations can be made about home range characteristics. First, all studies of home range size are consistent with Forsman's (1980) original observations of large spotted owl home ranges (Table 2.1). Second, there is a large degree of overlap in home range areas between members of the same pair (Forsman et al. 1984, Solis and Gutiérrez 1990) and lesser overlap among adjacent pairs (Forsman et al. 1984). But Carey et al. (1992) pointed out that these relationships can be affected by the degree of forest fragmentation in the landscape. Third, there is considerable geographic variation in home range size; owls occupying Washington's Olympic Peninsula have the largest home ranges (Thomas et al. 1990, Carey et al. 1992). Fourth, home range size increases as the amount of old forest in the home range decreases (i.e., loss of habitat from logging; Carey 1985, Forsman et al. 1984, Thrailkill and Meslow 1990). It is unknown if geographic variation is related to latitude, habitat, individual, temporal, or prey-base variation.

The size of an owl's home range probably is dependent on many factors (e.g., food availability, interspecific competition, amount and arrangement of suitable habitat). For example, spotted owl home range size may be a reflection of an adaptive response to low prey abundance and variation in abundance and distribution of prey (Ward 1990, Carey et

Table 2.1 Annual home range areas (in acres) of spotted owl pairs in different states, physiographic provinces, and study areas.[a]

State / Physiographic Province / Study Area	Number Of Pairs	Forest Type[b]	Range: Median	Range: Min	Range: Max	Sources[c]
California						
Klamath Province						
Ukonom	9	MC	3,314	2,056	7,823	1
Mad River	12	MC	2,975	1,803	4,685	1
Willow Creek	2	MC	1,692	1,258	2,126	2
Oregon						
Klamath Province						
South Umpqua	3	MC	1,411	1,035	1,504	3
Cow Creek	6	MC	4,106	2,499	7,494	3
Chetco	4	ME	5,614	5,327	6,197	1
Coast Range Province						
Tyee	5	DF/HEM	3,387	1,880	8,272	3
Peterson	4	DF/HEM	6,318	3,483	10,189	3
Eugene BLM	4	DF/HEM	6,390	3,715	8,180	4
Other[d]	4	DF/HEM	4,183	2,849	9,748	5
Kellogg[a]	5	MC	4,072	1,618	6,281	3
Western Cascades Province	11	DF/HEM	2,955	1,443	9,758	6,7
Washington						
Western Cascades Province	11	DF/HEM	6,657	2,969	17,942	8,9,10
Olympic Peninsula Province	10	HEM/DF	14,271	4,497	27,309	9,11
Eastern Cascades Province	7	MC	7,124	3,694	15,587	11

(Note: table follows Thomas et al. (190) with changes based on Forsman and Hays (pers. comm.).

[a]Pair home ranges were calculated by delineating 100 percent MCP (minimum convex polygons): total - exclusive area of male and exclusive area of female and the area of overlap shared by the two sexes.

[b]MC - mixed-conifer, ME - mixed-conifer/evergreen, DF/HEM - Douglas-fir, western hemlock, HEM/DF - mostly western hemlock with Douglas-fir intermixed.

[c]1 - Paton et al. (1990), 2 - Solis (1983), 3 - Carey (pers. comm.), 4 - Thraikill and Meslow (pers. comm.), 5 - Carey et al. (1990), 6 - Forsman and Meslow (1985), 7 - Miller (pers. comm.), 8 - Allen et al. (1990), 9 - Hays et al. (1989), 10 - Hamer (pers. comm.), 11 - Forsman (pers. comm.).

[d]Includes four sites in the Oregon Coast Range province near Roseburg.

[e]This was a reatively dry area bordering the Umpqua River valley, characterized by mixed-conifer forest more typical of the Oregon Klamath province than the Oregon Coast Range province.

al. 1992). Further, estimates of owl home range size can be influenced by the sampling design of the home range study and the home range estimator used in the analyses (Carey et al. 1989, Call 1989). Although these factors may influence the estimation of owl home range size, predictions of home range sizes of birds of the size and trophic level of spotted owls based on allometric equations are similar to empirical estimates of spotted owl home ranges (Schoener 1969). Predictions of spotted owl home range size (SOW 1991), based on allometric analysis of mammals (Harestad and Bunnell 1979, Lindstedt et al. 1986), underestimate owl home ranges and are not useful because there are many direct measurements of spotted owl home range size.

One important feature of an owl's home range is the amount of suitable habitat within the boundaries of the home range. Thomas et al. (1990) summarized the amounts of old-growth and mature forest in spotted owl pair home ranges (Table 2.2). The median amount of these late seral stage forests for a number of studies in the northern spotted owl's range was 615 to 4,579 acres. In only two studies were median amounts of these forests less than 1,000 acres. In one of these studies (Solis 1983), the sample was small (two pairs) and the pairs were sampled only for a short time. The home ranges and the amount of late seral stage habitat of the study owls were likely to have been underestimated. In any event, the object of Solis' (1983) study was to quantify owl habitat structure, not to provide an accurate estimate of home range size. In the second study (Carey in Thomas et al. 1990:197), the sample of pairs was small and the study was in an area of clumped habitat distribution. Kerns (1989) reported on the habitat use of eight spotted owls occupying "managed" redwood forest with less than 1 percent old-growth,

Table 2.2. Amounts of old-growth and mature forest (in acres) in annual pair home ranges of spotted owls, by state, physiographic province, and study area.

State / Physiographic Province / Study Area	No. of Pairs	Forest Type[a]	Range: Median	Range: Min	Range: Max	Sources[b]
California						
Klamath Province						
Ukonom	9	MC	2,484	1,030	5,654	1,2
Mad River	12	MC	1,365	835	1,953	1,2
Willow Creek	2	MC	800	367	1,233	3
Oregon						
Klamath Province						
South Umpqua	3	MC	615	563	768	4
Cow Creek	6	MC	1,549	1,450	1,983	4
Chetco[c]	4	ME	–	–	–	1
Coast Range Province						
Tyee	5	DF/HEM	2,031	1,645	3,984	4
Peterson	4	DF/HEM	2,609	1,284	3,196	4
Eugene BLM	4	DF/HEM	1,783	799	3,580	5
Other[d]	4	DF/HEM	2,375	1,795	2,625	6
Kellogg[e]	5	MC	1,018	697	1,983	4
Western Cascades Province	9	DF/HEM	1,796	1,050	3,786	7,8
Washington						
Western Cascades Province	11	DF/HEM	3,281	1,715	8,998	9,10,11
Olympic Peninsula	7	HEM/DF	4,579	2,787	8,448	12
Eastern Cascades Province[c]	7	MC	–	–	–	12

(Note: Table follows Thomas et. al. (1990) with changes based on Forsman and Hays (pers. comm.)).

[a]MC = mixed-conifer, ME=mixed-conifer/evergreen, DF/HEM = Douglas-fir, western hemlock, HEM/DF = mostly western hemlock with Douglas-fir intermixed.

[b]1 = Paton et al. (1990), 2 = Paton (pers. comm.), 3 = Solis (1983), 4 = Carey (pers. comm.), 5 = Thraikill and Meslow (pers. comm.), 6 = Carey et al. (1990), 7 = Forsman and Meslow (1985), 8 = Miller (pers. comm.), 9 = Allen et al. (1990), 10 = Hays et al. (1989), 11 = Hamer (pers. comm.), 12 = Forsman (pers. comm.).

[c]Studies provided data for annual home range size; amounts of old-growth and mature forest not yet available.

[d]Includes four sites in the Oregon Coast Range province near Roseburg.

[e]This was a relatively dry area bordering the Umpqua River valley, characterized by mixed-conifer forest more typical of the Oregon Klamath province than the Oregon Coast Range province.

although he did not estimate home range sizes of his marked owls. However, stands used by owls in Kern's (1989) study often contained residual old-growth trees and also had a structure similar to mature forests.

Some animals do not exhibit fidelity to an area, and are considered to be nomadic. Juvenile animals often wander widely in search of a secure home range. Such wandering animals are engaging in dispersal. Some birds may move in or among the territories of other birds, without exhibiting fidelity to any particular area. These birds often are referred to as "floaters." The ecology of floaters is critical to understanding the dynamics of spotted owl populations, but little is known about them (Franklin 1992). Floaters are known to exist in spotted owl populations as well as in other species of birds (Franklin 1992), but they are not commonly detected because they do not vocalize in defense of a territory. Floaters often replace territorial birds that die. Thus, they can maintain the number of territorial birds censused in a population. That is, since only territorial birds are censused during surveys, a population of unbanded owls may appear to be numerically stable from one year to the next, and thus appear to be a healthy population, when the population may be demographically declining (i.e., owl losses exceed gains). While the territorial population is that portion of the population that reproduces and maintains the continuation of the population, the floater "population" may provide an important buffer to the overall owl populations during periods of poor environmental conditions. In fact, the higher the ratio of floaters to territorial owls, the longer the lag period will be before a decline in the territorial population will be detected (Franklin 1992).

Food Habits

Diet: Although spotted owls take prey from a broad array of taxa (e.g., mammals, birds, insects), they primarily eat small mammals (Marshall 1942, Barrows 1980, 1985, 1987, Solis 1983, Forsman et al. 1984, Laymon 1988, Richards 1989, Thrailkill and Bias 1989, Ward 1990, Cutler and Hays 1991). Three mammal species, woodrats (*Neotoma fuscipes and N. cinerea*) and flying squirrels (*Glaucomys sabrinus*), compose the majority of the prey biomass eaten by spotted owls (Solis 1983, Forsman et al. 1984). One of these species usually dominates the owl diet in an area, and this regional variation in diet is related to habitat and the distributional limits of the prey species (Forsman et al. 1984, Thomas et al. 1990).

Barrows (1985, 1987), Laymon (1988), and Thrailkill and Bias (1989) reported that the diet of breeding owls was dominated by larger prey (i.e., woodrats) whereas nonbreeding owl diets were characterized by smaller prey species. This suggested a strong ecological or evolutionary relationship between spotted owls and these larger small mammal species. Unfortunately, the small sample of owls in these studies precludes strong inference about those relationships. Thomas et al. (1990) also pointed out that those relationships may simply mean that large prey may be transported at a higher rate to nest sites than smaller prey. In addition, Ward (1990) and Forsman et al. (pers. comm.) were unable to document that relationship.

Spotted owl prey: Strong functional responses between prey and a variety of owl species have been demonstrated in North America and Europe (Southern 1970, Rusch et al. 1972, Adamcik and Keith 1978, Sonerud et al. 1988, Saurola 1989). It is surprising, therefore, that until recently, little research effort has been devoted to understanding spotted owl prey and ecological responses of spotted owls to their prey. Most prey studies have been concerned with patterns of abundance and distribution of small mammals within the range of the owl (summarized by Thomas et al. 1990). Ward (1990) studied variation in prey abundance and distribution in relation to owl reproductive success and hunting behavior.

In addition, several studies linking prey and spotted owls have been undertaken (Thomas et al. 1990). In Ward's (1990) study, woodrats were the primary prey. Spotted owls foraged in areas where the abundance of woodrats was less variable. This suggests that the owls may have been optimizing their search effort. That is, they were foraging in stands that did not necessarily contain the most abundant woodrats, but they hunted in areas where the occurrence of the animals was more predictable. Ward (1990) also showed that not only was prey abundance low but also that prey populations were variable throughout the landscape. These limited observations help explain the large home range sizes observed among spotted owls.

Carey et al. (1992) conducted the most extensive study of spotted owls and their prey. They showed that spotted owl home range size was inversely related to the amount of available prey biomass in the old forest. That is, the largest home ranges were on the Olympic Peninsula, Washington, where prey biomass was less than one-fifth the prey biomass found in mixed-conifer forests of southwestern Oregon where the home ranges were smallest. Prey biomass was intermediate as was the owl's home range size in Oregon's Douglas-fir forests. The amount of available prey was not only related to the forest type but also to the number of available primary prey species. One, two, and three prey species were found in Carey's et al. (1992) Olympic, Oregon Douglas-fir, and Oregon mixed-conifer habitats, respectively.

Availability of spotted owl prey has been advanced as an explanation for the occurrence of spotted owls in old-growth/mature forests (Forsman 1980, Forsman et al. 1984, Carey 1985, Gutiérrez 1985). On the Olympic Peninsula, northern flying squirrels are the primary prey, and woodrats are absent from Carey's owl areas because those areas did not contain rocky outcrops (Carey et al. 1992). Carey et al. (1992) also reported that flying squirrels were twice as abundant in old forests as in young forests. Thus, flying squirrels clearly depend on forest communities, but woodrats do not. Woodrats are more abundant in early seral stage vegetation (e.g., brushy areas) than they are in old-growth forests (Thomas et al. 1990). Yet spotted owls spend little time hunting in clear-cuts (Forsman et al. 1984, Solis 1983). This unpredicted foraging behavior may be related to the relative susceptibility of woodrats to predation in the two habitats. That is, in the dense vegetation of early shrub-dominated seral stages, spotted owls may not be able to capture woodrats effectively. In the more open, older forests, spotted owls may be more effective predators even though woodrats are less abundant. In addition, the structure of old forests provides more perches and openings in the vertical structure for this perch and pounce predator (Carey et al. 1992). Thus, the hypothesis that prey availability explains spotted owl selection for older age forests cannot be rejected. In addition, if they feed in open areas, spotted owls may be killed by great horned owls (Forsman et al. 1984).

3. Life History

Reproductive Biology

Nesting phenology: Spotted owls begin their annual breeding cycle in late winter (February or March) when the pair begins to roost together. Copulation occurs during this nuptial phase (Forsman et al. 1984). Some owl pairs use the same nest site repeatedly, some use new ones each year, and others alternate nest sites from year to year. Once a clutch of eggs is laid, the female incubates the eggs for approximately 30 days (Forsman et al. 1984). If a nest fails these owls are unlikely to renest. Thus far, only one probable renesting attempt has been reported (Lewis and Wales In Press). After the eggs hatch, the owlets remain in the nest and usually are fed by the pair until they leave the nest. Juvenile owls leave the nest 3 to 5 weeks after hatching. Many abandon the nest site well before they are able to fly. They jump into the branches of surrounding trees or fall to the ground and clamber up a leaning tree to a safe perch. The adaptive significance of this behavior is unknown, but Forsman et al. (1984) suggested that it serves to avoid increasing parasite loads in the nest as the season progresses. Once out of the nest the young owls are fed by the male and the female. They grow rapidly under good food conditions, reaching their parents' body mass prior to dispersal (Gutiérrez et al. pers. observ.). Although juvenile owls are dependent on their parents, they begin to hunt by late summer. Dispersal begins in the early fall, signalling the end of the annual reproductive cycle (Gutiérrez et al. 1985, Miller and Meslow 1985, Miller 1989). Therefore, spotted owls are considered to be "birth pulse" breeders (i.e., they have distinct annual breeding periods)(Caughley 1977). This knowledge is important when choosing an appropriate model to analyze demographic rates (see Demographic Analyses in this section and Appendix C).

Variation in clutch size and nesting success: Spotted owls have one of the smallest clutch sizes among North American owls (Johnsgard 1988). Normally, spotted owls lay one or two eggs (Forsman et al. 1984). A small proportion of the population will lay three-egg clutches. Records of four-egg clutches are rare (Bendire 1892, Dunn 1901). Because clutch size is small, there is relatively little variation in the number of eggs laid by a female. However, there is large variation in nesting success and in the proportion of the population that breeds over time and among regions (Forsman et al. 1984, Gutiérrez et al. 1984, Thomas et al. 1990, Lutz 1992, LaHaye et al. 1992). Nesting success within a population of sampled individuals using the standard techniques (Forsman 1983) can range from 0 to 100 percent (Forsman pers. comm., Gutiérrez et al. 1984, Gutiérrez pers. observ.). Interestingly, Franklin et al. (1990a) reported little variation in nesting success during a 6-year study in northwestern California.

Fecundity: Technically speaking, fecundity is the number of female young produced per female (Caughley 1977). However, the term has been used in a variety of ways in wildlife literature. Fecundity usually is defined relative to females because it is the female segment of the population that is mathematically modeled to project population trends. Fecundity is a measure of the reproductive performance of the female segment of the population. For a population to remain stable, losses (deaths and/or emigration) must be offset by gains (births and/or immigration). The majority of field effort in demography studies is devoted to estimation of birth and death (usually referred to as survival rates). Because reproductive activity varies greatly, fecundity also varies. Since biologists assume there is a 50:50 sex ratio (Noon and Biles 1990, Thomas et al. 1990, USDI 1990) in a spotted owl population, fecundity in an owl population is almost always between 0.1 and 1.5 (Thomas et al. 1990, Forsman 1988a, Franklin et al. 1990a, Lutz 1992, LaHaye et al. 1992).

Age at first reproduction: Spotted owls can breed as early as 1 year old (Barrows 1985, Miller et al. 1985). Yet most owls probably do not breed before they are 3 years old (Franklin et al. 1990a, Thomas et al. 1990). In addition, subadult owls have lower fecundity than do adults (Franklin et al. 1990a). Age-specific fecundity also is an important demographic parameter, but there are no age-specific estimates of fecundity for the adult age classes. Therefore, for purposes of demographic modeling, adult fecundity is assumed to be equal across age classes.

Survivorship

Adult rates: Adult northern spotted owls' annual survival rates are very high: they must be long-lived birds. Based on banding and radio-telemetry, the chance of an adult owl living from one year to the next is 81 to 96 percent (Barrowclough and Coats 1985, Lande 1985, Franklin et al. 1990a, Thomas et al. 1990). Survival rates may vary as a response by owls to varying environmental conditions (Gutiérrez and Pritchard 1990, LaHaye et al. 1992). In long-lived species, studies must be of long duration to achieve reliable estimates of age-specific survival rates. Most wildlife populations fluctuate over time. In a long-lived species, such as the spotted owl, the true trend of a population is most accurately assessed over a long period of study (e.g., a generation length) because researchers observe the response of owls to both good and poor environmental conditions. The key point is that long-term trends are more important to evaluating the dynamics of a long-lived species than are short-term trends which may be simply a reflection of a population's response to short-term poor environmental conditions (e.g., drought). The most recent estimates of northern spotted owl survival rates are in Appendix C.

Subadult survival: Subadult owls have a lower survival rate than adult owls (Franklin et al. 1990a, Thomas et al. 1990; see Appendix C). Since subadults also have lower reproductive rates and fecundity, it may be possible that the same environmental or behavioral factors influence all aspects of the demography of the subadults in the same way. Nevertheless, the subadult segment of the population is relatively small and makes only a modest contribution to the dynamics of the population (Noon and Biles 1990, Thomas et al. 1990).

Juvenile survival: Juvenile owl survival rates have been measured from banded owls and radio-marked owls (Barrowclough and Coats 1985, Gutiérrez et al. In Prep.). Survival rates for this age class are low (the chance of a juvenile living from one year to the next is 7 to 31 percent) relative to adult owl survival rates (see Appendix C). It is well known that first-year owls, in general, have low survival. The rigors of dispersal and the consequences of inexperience (e.g., poor hunting skills, lack of familiarity with a territory) lead to higher mortality rates. Again, juvenile survival rates within a population may vary over time. Thomas et al. (In Prep.) have estimated survival rates for 1991 to 1992 that are slightly higher than those previously observed. Therefore, long duration studies are necessary to accurately assess juvenile survival rates in long-lived species in fluctuating environments.

Mortality: Spotted owls die from a variety of causes. The most frequent cause of mortality recorded among radio-marked birds is predation by other animals (Johnson pers. comm.). They also die from accidents (e.g., flying into objects, automobiles, and drowning) (Gutiérrez et al. 1985; Franklin, LaHaye, Gutiérrez pers. observ.; Johnson pers. comm.). Accidents are considered to be density-independent, whereas predation usually is density-dependent in most prey, although predation may be density-independent in spotted owls. Another source of mortality is starvation. Starvation is common among spotted owls (Gutiérrez et al. 1985, Miller 1989, Johnson pers. comm.), but occurs less frequently among adult spotted owls (Sisco 1990). Starvation could be a consequence of low prey abundance, low prey availability (i.e., poor hunting habitat), or inexperience (inability to hunt successfully).

Density

The number of northern spotted owls is a topic of much debate (Thomas et al. 1990). The number of owls known to exist in the wild is confusing to the public as well as to the press (e.g., Diringer 1992). This confusion centers on two issues: owl population growth and the number of owls necessary to allow delisting the species. The number of owls known to exist in the wild has increased dramatically during the past 20 years. This increase has been misinterpreted by some as evidence that the spotted owl population is growing rapidly. The count of the number of owls has risen during the past two decades because of increasing survey efforts and monitoring of populations. There has been no scientific evidence that spotted owl numbers are increasing because of higher reproduction or survival rates. On the contrary, the evidence indicates that owls are declining gradually over time (Forsman et al. 1984, Thomas et al. 1990, USDI 1990). However, the gradual decline of owls noted in field studies appears contradictory to the accelerating decline in adult female survival rates (see Appendix C). The presence of floaters (nonterritorial owls and owls displaced by logging) could buffer the decline in the territorial population in the short term (Franklin 1992) and, thus, gives the impression of a stable population. The question of "how many owls is enough?" is difficult to answer because it is not a question of the number of owls per se but of the ability of the owls to survive and reproduce at rates that they can replace themselves. Combining information on relative abundance, density of owls, and their demographic performance provides the basis for evaluating the health of a population.

One important step toward estimating the number of owls is to estimate their density. The density of an animal population is the number of individuals per unit area. Once an estimate of density is derived, the estimate can be used to compute an estimate of abundance for all of the area containing similar habitats or environmental conditions. Census and monitoring of northern spotted owls have been a high priority with land management agencies and research scientists (O'Halloran 1989, Simon-Jackson 1989, Azuma et al. 1990, Max et al. 1990, Franklin et al. 1990b, Thomas et al. 1990, Ward et al. 1991). Franklin et al. (1990b) estimated the density of spotted owls in northwestern California to be 0.65 owls per square mile. They also estimated the density of owls in suitable habitat; this value was 1.51 to 1.83 owls per square mile, depending on the method used to estimate the density.

Densities of spotted owls vary throughout their range as a function of habitat quality, physiographic province, and current environmental conditions (Forsman et al. 1977, Franklin et al. 1990b, Gutiérrez and Pritchard 1990, Lutz 1992, Ward et al. 1991, LaHaye et al. 1992). Although much emphasis is placed on density, high densities can be mistaken as evidence of high-quality habitat (Van Horne 1983). For example, the density of owls within an area could be elevated because of immigration of owls displaced by logging, fire, or other habitat losses in adjacent areas. Density estimates are useful for relative comparisons and for evaluating management objectives, but they must be used in conjunction with knowledge of corresponding survival and fecundity values for the populations (see Spotted owl use of young, managed forests in this section).

Dispersal

Dispersal among vertebrates is the process of an animal leaving one area to establish a new home range in another area. Dispersal can be undertaken by juvenile or adult spotted owls. Further, dispersal is often characterized as effective (i.e., successful breeding occurs at the end of the dispersal event) or gross (i.e., breeding may or may not be successful following dispersal) (Greenwood 1980). Scientists know a great deal more about the process and pattern of juvenile spotted owl dispersal than about adult dispersal, despite the difficulty of closely following large numbers of dispersing juvenile owls (Gutiérrez et al. 1985, Miller and Meslow 1985, Miller 1989, Gutiérrez et al. In Prep.).

Gutiérrez et al. (1985), Miller (1989), and Gutiérrez et al. (In Prep.) used radio-telemetry to estimate patterns of gross juvenile spotted owl dispersal. Juvenile spotted owls dispersed from their natal areas in September and October after they had reached adult body mass (Gutiérrez et al. 1985, Miller 1989). They apparently left their natal areas in random directions (Gutiérrez et al. 1985, Gutiérrez et al. In Prep.) and traveled moderate distances (approximately 9 to 30 miles on average) during their first autumn (Gutiérrez et al. 1985, Miller 1989, Gutiérrez et al. In Prep.). The pattern of dispersal varied among cohorts in a variety of ways including differences in direction, distance, and survival (Gutiérrez et al. In Prep.). Effective dispersal distance, estimated from reobserving banded owls, averaged about 4 miles for juvenile male spotted owls and about 12 miles for female juveniles (Gutiérrez et al. In Prep.). Dispersal distances of banded owls were slightly higher for Oregon owls (Johnson pers. comm.). Estimates of dispersal distance based on studies with finite area size have been shown to be underestimates of true dispersal distance (Barrowclough 1980).

Adult spotted owls will leave mates or move from territories, but the causes of these adult dispersal events are unknown. Spotted owls normally form long, stable pair bonds so the number of recorded adult dispersals is low. Also, the conditions surrounding these observations of adult dispersal events have not been summarized.

Demographic Analyses

Because the entire population of owls cannot be censused each year to detect the true population trend, mathematical models are used to analyze population performance using estimates of the vital rates (e.g., fecundity and survival) described earlier. Models can be deterministic (linear projections based on the estimates of the vital rates) or stochastic (projections based on random variation of specific rates or conditions). Stochastic models generally are considered to be more sophisticated because they can be constructed to simulate variation that would be expected in natural environments. Models of both kinds have been used to evaluate spotted owl population dynamics and dispersal (Boyce 1987, Marcot and Holthausen 1987, USDA 1988, Doak 1989, Lande 1988, Noon and Biles 1990, Thomas et al. 1990, USDI 1990, Lutz 1992, Franklin 1992, Lamberson et al. 1992, LaHaye et al. 1992). In addition, Shaffer (1985) suggested that metapopulation models, representing species with populations discontinuous in time and/or space, be used to evaluate spotted owl population dynamics.

An analysis of demographic trends in spotted owl populations is presented in Appendix C. Two parameters are central to understanding the general conclusion of Appendix C: 1) the annual rate of change (λ) in the population size of adult females, and 2) the annual survival probability of adult females (ϕ). Lambda (λ) is an expression of a population's annual demographic performance during the period when data were collected. When $\lambda = 1$, the population was stable during the period of data collection; when $\lambda < 1$, the population was decreasing during the period of data collection; and when $\lambda > 1$, the population was increasing during the period of data collection. Since λ is usually calculated from estimates of survival and fecundity rates, it is also an estimate (denoted as λ in Appendix C). Thus, the value of the estimate of λ is bracketed by a standard error term (see Appendix C) which is an expression of the variation about the statistic λ. In demographic studies of owls, in general, the standard error associated with λ becomes smaller (i.e., becomes more precise) with larger samples and longer duration studies of individually marked owls. Because λ is an estimate and not the true annual rate of change, a statistical test must be used to assess its relationship to a stable population (i.e., $\lambda = 1$). For example, if an estimate of $\lambda = .98$, at face value, one might conclude that the population is declining. However, if the standard error of λ were large, a statistical test would indicate that there is a strong possibility that the true value of λ could be ≥ 1. If $\lambda = .85$ and the standard error were small, a statistical test would indicate that the population was declining. In all of the study areas listed in Appendix C, the calculated decline in the population was statistically significant. The analysis also indicated that the primary reason for the population declines was that the survival rates of females were declining during the study period. Interpretation of these analyses is further discussed in Appendix C.

It is important to remember that λ reflects only that time over which the study occurred (generally 1987-1991). Therefore, it cannot be strictly interpreted as the ultimate fate of the population. The variation in observed fecundity and survival rates can be used to simulate potential populations given a variety of environmental conditions, but λ itself cannot be extrapolated to future conditions. Again, this illustrates the need to continue long-term demographic studies of spotted owl populations.

Population Models

Models can be used to evaluate a population's performance or to project a population's performance under a specific set of assumptions. It is important to distinguish a demographic analysis which is limited to the period of data collection, from a projection which indicates how a population might perform under a given set of vital rates, environmental variability, or other assumptions. Population modeling is an important and useful tool for evaluating hypothetical conditions but should not be interpreted literally.

Almost all modeling projections indicate that spotted owl populations are declining. However, Boyce (1987) criticized the first attempt to use a stochastic model for projecting population trends (USDA 1988) because the model did not incorporate density dependence. Density dependence is the functional response in survival probability and/or fecundity of a population to variation in density. That is, as a population declines the remaining individuals in the population have more resources available to them per capita (i.e., there is less competition) and these resources then can be used by the survivors for reproduction and other life functions. Boyce (1987) argued that if a population declines numerically there should be a density-dependent response in the owl population, which would mitigate the lower density and serve to stabilize the population. In the case of the spotted owl, ecological density (*sensu* Franklin et al. 1990b) has not been declining, only the abundance of owls, because habitat loss is the causative mechanism for the decline. Thus, when Thomas et al. (1990) incorporated density dependence into their metapopulation model, the projected population decline was more rapid. Estimates of changes in northern spotted owl populations, based on demographic analysis, indicate that all populations are declining throughout their range (see Appendix C for additional discussion of changes in northern spotted owl populations).

Models also can be spatially explicit. They can incorporate the influence of landscape character on the underlying population dynamics (Lamberson et al. 1992, Lamberson and Brooks 1991). These models are useful for developing a more complete range of alternative hypotheses to account for observed phenomena. For example, the recent observations of abundant owls in the California Coast province could be a reflection of good habitat for owls, which results in high productivity and high survival among the owls. Or alternatively, the dynamics of these Redwood Zone, coastal owl populations could be the result of immigration of owls from adjacent old-growth/mature forests in national forests in the California Klamath province (Lamberson and Brooks 1991). Lamberson and Brooks' (1991) model illustrates the importance for recovery of the spotted owl throughout all of the physiographic provinces within its range (i.e., recovery of the owl in the California Klamath province probably could not be achieved if there were not a concomitant recovery in the California Coast province).

4. Conclusion

Knowledge of the natural and life history of the northern spotted owl has grown tremendously in the past 10 years. Unlike data available about many threatened and endangered species, preliminary information about the demography of the spotted owl is available so that initial projections of populations can be made. However, estimates of vital rates and, therefore, estimates of lambda (a population's finite rate of growth) in this long-lived species may change as the populations are followed through time. These changes will occur because of normal population responses to good and poor environmental conditions as well as to habitat changes. It is evident that much more needs to be learned about the species (and other late seral stage species) to allow refinement of management plans compatible with the ecology of the species. Nevertheless, more is known about this species than about most endangered or threatened species.

II.

B. Status and Threats

The present range of the northern spotted owl approximates the limits of its historic range. The range extends from southern British Columbia, Canada, south through the coastal mountains and the Cascade Range of Washington and Oregon, and into northwestern California as far south as Marin County. Although the total area of the subspecies' range has not decreased, its distribution has changed greatly. The Puget Trough in Washington and lands adjacent to the Willamette Valley in Oregon no longer support populations of owls because of loss of habitat to urban, rural residential, and agricultural development. In southwestern Washington and northwestern Oregon, timber harvest and wildfires have greatly reduced habitat, and spotted owl populations are very low at present. In British Columbia, only about 20 pairs are known to exist; much of the owl's range in Canada has been logged, and little mature and old-growth forest remains.

Abundance, distribution, and habitat use of the spotted owl vary throughout the forest zones that are in its range. Physiographic provinces, as described by Franklin and Dyrness (1973), incorporate the physical and environmental factors that shape the landscape of the Pacific Northwest. These physiographic provinces were modified by Thomas et al. (1990) and, with slight further modification, were adopted by the Recovery Team to describe the range of the spotted owl (Figure 2.2).

1. Habitat Status

The extent of owl habitat that existed before logging is unknown, but by the early 1980s more than 80 percent of prelogging old-growth had been removed (Booth 1991). Although not all old-growth forests are suitable spotted owl habitat (e.g., high-elevation forests), this great decrease suggests that the 8.3 million acres of habitat that remain today represent only a small portion of the area formerly occupied by spotted owls (USDA 1991).

Remaining suitable owl habitat is not distributed evenly throughout the range of the species. Habitat reduction has been greatest at low elevations and in the Oregon Coast Range and western Washington lowlands provinces, and this reduction is reflected in low populations of spotted owls in those areas. Remaining habitat at higher elevations may be of lower quality than that which historically was present on low-elevation lands (Thomas et al. 1990). Thus, spotted owl habitat that remains in reserved areas or in areas unsuited for timber production (Table 2.3) may not contribute proportionally to productivity, because these lands are commonly at higher elevations.

Most remaining suitable habitat is on federal lands, especially in Oregon and Washington. Rangewide, the Forest Service manages about 79 percent of federal habitat, the BLM about 14 percent, and the National Park Service about 7 percent (Table 2.3). In northern California, as much as 50 percent of spotted owl habitat may be on private lands, especially in the California Coast province (Gould pers. comm.).

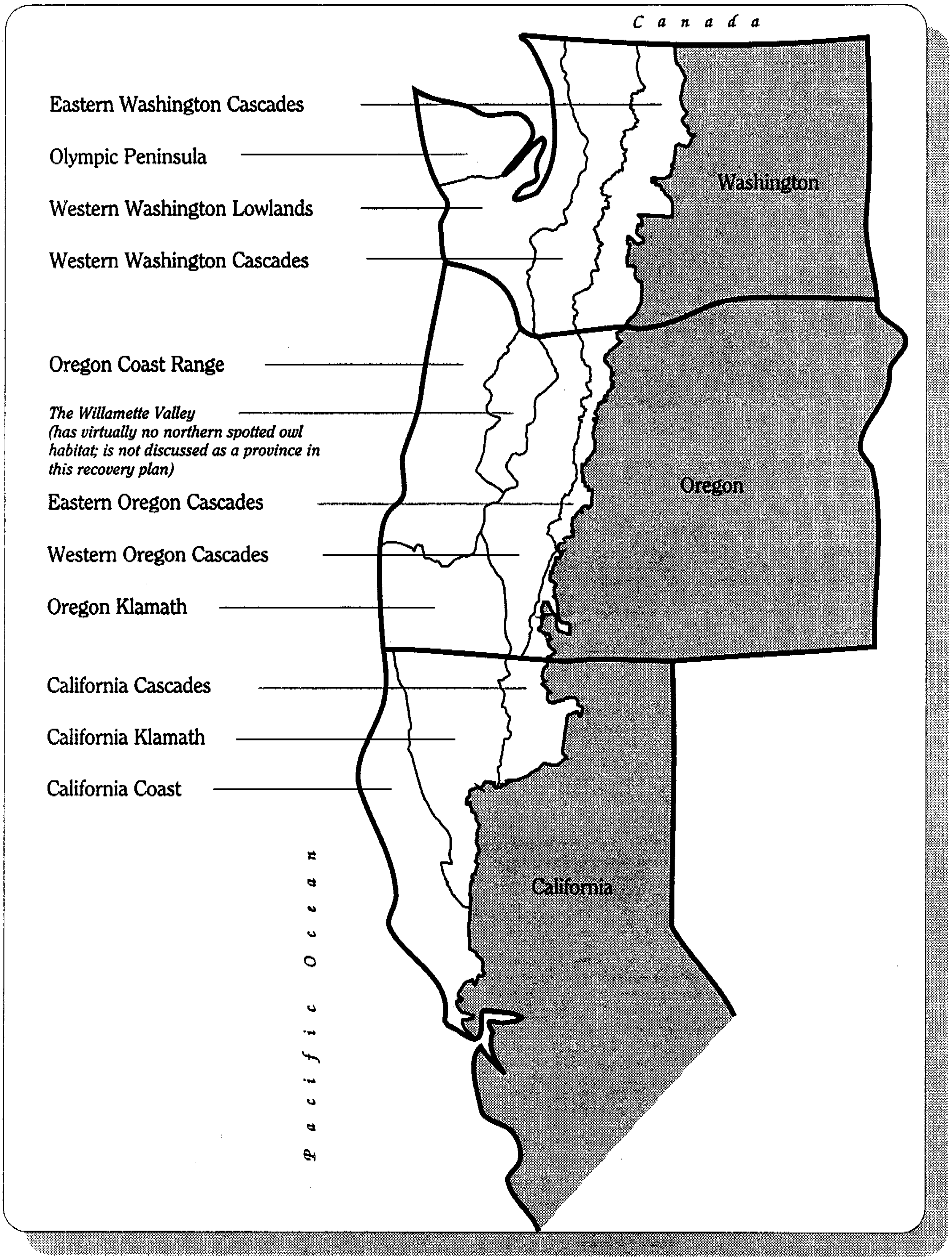


***Figure 2.2.** Provinces within the range of the northern spotted owl in the United States.*

2. Population Status

There are no estimates of the historical population size of the northern spotted owl, but owls are believed to have inhabited most old-growth forests throughout the Pacific Northwest and northwestern California, and they still are found within their historical range in most areas where suitable habitat remains (Thomas et al. 1990).

Northern Washington and southern British Columbia represent the northern extent of the range of the owl. Population densities and numbers are lowest in these areas, with fewer than 20 pairs located in southern British Columbia (Dunbar et al. 1990). A small, potentially isolated population of about 157 known pairs of spotted owls is on the Olympic Peninsula in and around Olympic National Park (Fredrickson et al. 1989, WDW 1991). Fewer than 50 owls have been located in recent extensive surveys in the Coast Ranges of southwestern Washington and northwestern Oregon north of Corvallis (Forsman 1986, Forsman et al. 1987, Irwin et al. 1989b, ODFW 1991). Populations also decrease in size and density from the Mendocino National Forest south to Point Reyes, California, and from the California Klamath province east to the area of contact with the California spotted owl in the Sierra Nevada (Gould pers. comm.).

Most of the present population of owls are in the eastern Oregon Cascades, western Oregon Cascades, Oregon Klamath, California Klamath, and California Coast provinces (Advanced Sciences Inc. 1989, Beak Consultants 1989, Brown 1989, Diller 1989, Irwin et al. 1989, Kerns 1989a and 1989b, Pious 1989, ODFW 1991, WDW 1991). Distribution of remaining habitat is similar to the present distribution of spotted owls.

More than 78 percent of currently known pairs of owls have been observed on federally managed lands. The distribution of these pairs varies widely by land ownership, state, and physiographic province (Table 2.3). Although inventories are least complete in California, about 40 percent of that state's habitat and population of spotted owls may occur in the California Coast province (Gould pers. comm.).

Population data presented here were generally gathered from 1987 through 1991. Data from 1988 through 1992 were used for a few areas where 1992 surveys were substantially more complete than any previous surveys (see Table 2.3). Data gathered during these 5-year periods were analyzed during the development of the recovery plan because they may provide more reliable estimates of actual numbers than longer cumulative periods or single-year counts, given the rapidly changing quantity and quality of habitat. These are also the periods with the most intense inventories, and are within the average life span of the species (about 8 years).

Inventories from 1987 through 1992 indicated a total of about 3,602 known pairs of northern spotted owls in Washington, Oregon, and northern California (Table 2.3). The true population size is unknown. The percentage of federal lands surveyed for owls from 1987 to 1991 is in Appendix K (Table K.2).

3. Significant Threats to the Northern Spotted Owl

Table 2.4 provides a summary of significant threats to northern spotted owl populations by physiographic province. Additional detail about these threats is in the individual province discussions in section III.E. Not all threats are equally important, and no attempt was made

Table 2.3. Estimated spotted owl habitat and number of pairs of spotted owls located during a 5-year period on all lands in Washington, Oregon, and California.

	Estimated Acres of Spotted Owl Nesting, Roosting, and Foraging (NRF) Habitat by Timber Capability				Owl Pairs		
Landowner or Agency[a]	Reserved[b]	Unsuitable for Harvest[c]	Suited for Harvest	Total NRF Acres	Reserved	Non-reserved[d]	Totals
FS, Washington	514,400	804,000	747,000	2,140,200	61	425	486[e]
FS, Oregon	378,100	1,058,000	1,447,000	2,885,900	83	1,081	1,164[e]
FS, California	276,400	519,000	305,000	1,154,400	38	433	471[e]
BLM, Oregon[g]	158,000	–	873,500	1,031,500	1	607	608[e]
BLM, California[g]	5,500	–	–	33,000	0	22	22[e]
NPS, Washington	468,200	NA	NA	468,200	64	0	64[e]
NPS, Oregon	37,000	NA	NA	37,000	8	0	8[f]
NPS, California	40,000	NA	NA	40,000	2	0	2[e]
Indian lands, Washington	–	–	–	257,000	0	32	32[f]
Indian lands, Oregon	–	–	–	54,000	0	36	36[f]
Indian lands, California	–	–	–	32,000	0	37	37[f]
FWS, Washington	1,700	–	5,000	6,700	0	0	0[f]
FWS, Oregon	4,100	NA	NA	4,100	0	0	0[f]
WDNR , Washington	–	–	–	–	0	43	43[f]
WDW, Washington	0	0	5,000	5,000	0	1	1[f]
State parks, Washington	2,000	NA	NA	2,000	0	0	0[f]
Cities of Seattle, and Tacoma, Washington	0	0	1,500	1,500	0	0	0f
ODF, Oregon	0	–	77,200	77,200	0	24	24[f]
State parks, Oregon	8,000	NA	NA	8,000	2	0	2[f]
Counties and cities, Oregon	NA	–	–	–	1	0	1[f]
CDF, California	NA	–	–	–	0	4	4[e]
State parks, California	56,000	NA	NA	56,000	0	10	10[e]
BLM/TNC, California	6,500	NA	NA	6,500	0	0	0[e]
NAS, California	600	NA	NA	600	0	0	0[e]
Private, California	–	–	–	–	0	414	414[e]
Private, Oregon	–	–	–	–	0	128	128[f]
Private, Washington	–	–	–	–	0	45	45[f]
Totals	**1,956,500**	**2,381,000**	**3,461,200**	**8,300,800**	**260**	**3,342**	**3,602**

– = unknown.
NA = not applicable.
[a]Information obtained from landowners, land managers or state wildlife agencies.
[b]Withdrawn from timber harvest (e.g., wilderness, national park, research natural area).
[c]Lands unsuited for timber production because of allocation to other uses by land management plans, or technically unsuited for timber production because of soils problems or difficulty of regeneration.
[d]Owl pairs on lands not withdrawn from timber harvest.
[e]Five-year survey period = 1987-1991.
[f]Five-year survey period = 1988-1992.
[g]Numbers from draft BLM resource management plans.

FS = U.S. Forest Service
NPS = National Park Service
WDNR = Washington Department of Natural Resources
ODF = Oregon Department of Forestry
TNC = The Nature Conservancy
BLM = U.S. Bureau of Land Management
FWS = U.S. Fish and Wildlife Service
WDW = Washington Department of Wildlife
CDF = California Department of Forestry and Fire Protection
NAS = National Audubon Society

Note: Numbers used in this table contain updates that were not availlable for the mapped data used in the geographic information system (GIS).

to assign them weights. Comparisons between provinces cannot be based simply on the number of threats that fall in specific categories, e.g., the number of threats rated severe or moderate. Threats were characterized as follows:

Severe: The threat may cause province-wide population instability and/or decline. Such threats may independently or in combination with other threats result in failure to maintain a population distributed throughout the range of ecological conditions in the province and the significant reduction of linkages and demographic support to adjacent provinces.

Moderate: The threat is not severe at the present time but would be expected to become severe within the next few generations if corrective measures are not taken. Even at current levels, however, moderate threats in combination with other threats could result in province-wide population instability and/or decline, failure to maintain a population distributed throughout the range of ecological conditions in the province, or the significant reduction of linkages and demographic support to adjacent provinces.

Low: The threat currently is not anticipated to cause significant adverse impacts on the province-wide population.

Unknown: Inadequate information currently exists to assess the threat.

List of Threats to Northern Spotted Owls

Declining habitat.

Loss of habitat as a result of clear-cutting or other even-aged harvest methods is the most important threat to northern spotted owls (Thomas et al. 1990). There is widespread agreement among owl biologists that owl populations have declined as a result of habitat loss and that loss of habitat in the future is the most serious threat to the subspecies. Habitat loss has been particularly severe in the northern half of the range (north of the Oregon Klamath and California Klamath provinces and west of the Cascade crest). Little suitable habitat remains on private lands throughout this area, though historically most of them probably did provide suitable habitat. Approximately two-thirds of the suitable habitat present in 1950 has been removed in the past 40 years (USDI 1990). Timber harvest on public lands is projected to continue, and there is no assurance that new suitable habitat will develop on private lands.

In the southern part of the range the situation is more complex. Clear-cutting has been extensive on most federal lands and much of the nonfederal lands, and the regenerating stands in these areas are generally too young to provide suitable habitat. Selective harvest has been practiced on a considerable amount of nonfederal lands, and owls are found in many of these areas. However, few studies of these spotted owl populations have been done, and uncertainty exists about which areas, if any, will continue to provide suitable habitat over the long term.

In the near future, continued rangewide loss of habitat at recent rates (1 to 2 percent per year) will probably accelerate current population declines, ultimately resulting in widespread extirpations. In areas where habitat is already below critically low levels, the continued loss of developing habitat would further reduce management options and lengthen the time required to achieve recovery.

Table 2.4. Significant threats to the owl, by physiographic province (S = Severe, M = Moderate, L = Low, U = Unknown).

	Threats				
Province	**Declining Habitat**	**Limited Habitat**	**Declining Populations**	**Low Populations**	**Distribution**
Eastern Washington Cascades	M	M	U	M	S
Western Washington[a] Cascades (South)	S	M	M	M	M
Western Washington[a] Cascades (North)	S	S	M	S	S
Olympic Peninsula	M	M	M	S	M
Western Washington Lowlands	S	S	S	S	S
Oregon Coast Range	S	S	S	S	S
Western Oregon Cascades	M	L	M	L	L
Eastern Oregon Cascades	M	M	U	M	S
Klamath[b] (Oregon)	M	L	S	L	L
Klamath[b] (California)	M	L	M	L	L
California Cascades	M	S	S	S	S
California Coast	M	M	M	L	M

[a]Western Washington Cascades province divided into north and south portions to reflect differences in severity of threats.
[b]Klamath province includes portions of Oregon and California, thus threats are shown by state.

		Threats			
Province	Isolation	Predation	Natural Disturbances	Conservation[c] Measures	Competition
Eastern Washington Cascades	M	U	S	-	U
Western Washington[a] Cascades (South)	M	U	L	-	U
Western Washington[a] Cascades (North)	S	U	L	-	U
Olympic Peninsula	S	M	S	-	U
Western Washington Lowlands	S	S	M	-	U
Oregon Coast Range	S	S	M	-	L
Western Oregon Cascades	L	M	L	-	L
Eastern Oregon Cascades	M	U	S	-	L
Klamath[b] (Oregon)	M	U	M	-	U
Klamath[b] (California)	M	L	S	-	L
California Cascades	M	L	L	-	L
California Coast	S	L	L	-	L

[c]Because of rapidly changing conservation measures, it is difficult to assess this threat, although it remains significant over much of the range of the northern spotted owl. See text for further discussion.

Limited habitat.

Throughout much of the range of the northern spotted owl, low levels of habitat are resulting in decreased owl productivity and occupancy (Forsman 1986, Hays et al. 1989, Bart and Forsman 1992, Johnson 1993). Bart and Forsman (1992) found that landscapes containing less than 20 percent older forest do not provide suitable habitat for northern spotted owls. They also found that abundance and productivity of owls generally increased with increasing amounts of suitable habitat, with significant differences between areas with less than 20 percent older forest and those with more than 60 percent older forest.

Limited habitat was considered to be a severe threat for those provinces in which the area of suitable habitat had been reduced to levels near or less than 20 percent. Those provinces with a greater proportion of habitat, but generally less than about 60 percent, were considered to be moderately threatened.

Declining populations.

Population trends for northern spotted owls have been difficult to estimate directly by surveys because many adult and subadult owls are probably nonterritorial and difficult to detect on surveys. These "floaters" may wait for several years for a territory to become available before they pair and begin reproducing. If a population is declining, the number of territorial owls is likely to remain nearly constant as long as floaters remain, because territorial owls that die are replaced rapidly from the pool of floaters. Thus, territorial owls are the only segment of the population that can be monitored effectively, but trends in this segment of the population do not necessarily provide an accurate estimate of trends in the overall population.

One way to solve this problem is by analyzing birth and death rates. These rates then can be used to calculate whether the population is declining. The analyses are often complex because they depend on how birth and death rates vary with age. The underlying principle, however, is simply that the birth rate equals the death rate in a stable population. An example may help clarify the method. "Adult" is used in this example to mean owls one or more years old at the start of the breeding season. Suppose that adult females, on average, produce .3 female young that survive until fledgling, and suppose that 40 percent of these fledglings survive until the start of the next breeding season. The average number of female offspring produced per adult female is (.3) X (.4) = .12, so on average, 100 females would produce 12 female offspring alive at the start of the next breeding season. Now suppose the survival rate for adult females is 85 percent. This figure indicates that, on average, 85 of every 100 adult females survive each year and 15 die. The 15 owls that die in this hypothetical example are replaced by 12 surviving young born the previous year. Thus, the population declines at an annual rate of 3 percent per year. This example illustrates how population trends can be estimated from the number of young fledged, their survival rate during the rest of the year, and the survival rate of adults. The methods used in real analyses are somewhat more complex, because birth and survival rates vary annually and with age of the owls. These variations must also sometimes be considered. The principle, however, is the same even when more complex analyses must be used.

The 1990 status review (USDI 1990) provided estimates of the rate of population change for two populations using methods similar to the one previously described. Both populations were shown to be declining. By the fall of 1991, data from 2 more years were available from these study areas, and data were also available from three other study areas. Analysis of this information indicated that all five populations were declining.

Furthermore, the rate of decline may be increasing. Details of the analysis are summarized in Appendix C, along with a discussion of the meaning of these results.

The exact rate of population decline is difficult to estimate from these studies because survival rates were estimated using "capture-recapture" methods. A sample of owls was marked, some were recaptured in subsequent years, and statistical methods were used to estimate the probability that owls survived and remained in the study area. If no owls left the study area, then the results were used as valid estimates of survival rates. However, if some of the marked owls did leave the study area, then the emigration rate had to be estimated, then used to obtain the survival rate. Estimating the emigration rate in these studies was somewhat difficult, and the Recovery Team has not based its management recommendations on the precise estimates of population trends obtained from these studies. The studies, however, reinforce other evidence that populations of spotted owls are declining throughout all or most of their range.

Low populations.

Small populations are vulnerable to extinction from several causes. Random fluctuations in environmental conditions (environmental stochasticity), and age and sex structure of populations (demographic stochasticity), along with potential loss of genetic variability (genetic stochasticity), are most likely to influence small populations.

Distribution of habitat or populations.

Within many provinces, populations and habitat are poorly distributed so that owls are no longer present throughout the full range of ecological conditions (e.g., elevation zones) and local populations are isolated. In these provinces, small clusters of owls are separated widely by habitat unsuitable for dispersal, and populations are vulnerable to extinction from random demographic, genetic, and environmental events (Shaffer 1987).

As distance increases beyond 12 miles, the probability of owls moving between clusters of owls decreases rapidly (Thomas et al. 1990). In provinces where spacing among patches of suitable habitat commonly exceeds this distance, persistence of clusters of owls is severely threatened.

Province isolation.

Small, isolated spotted owl populations are vulnerable to adverse demographic and genetic effects, as well as the effects of large-scale disturbance. Adverse effects of isolation not only threaten subpopulations, but may exclude isolated populations from genetic interchange with a larger, interactive population.

Provinces can be isolated from some or all of the surrounding provinces by physical barriers (e.g., the Columbia River) and/or by distance between areas of suitable habitat. Immigration of only a few individuals per generation may be adequate to prevent deleterious genetic effects from inbreeding. However, immigration of a larger number of individuals may be needed for demographic rescue (USDA 1992).

Predation and competition.

From 1975 to 1991, about 344 adult or subadult, and 85 juvenile spotted owls have been radio-marked within the range of the subspecies (Johnson pers. comm.). Among these owls, 91 adults or subadults and 60 juveniles have died. Forty percent of the adults or subadults, and 25 percent of the juveniles died from predation by other birds.

Key avian predators of spotted owls are the great horned owl, northern goshawk, and red-tailed hawk (*Buteo jamaicensis*). The common raven (*Corvus corax*) also is considered a predator, more likely to prey on juvenile than adult spotted owls.

The great horned owl is the most commonly documented predator of spotted owls (Miller 1989). Great horned owls are abundant throughout much of the range of the northern spotted owl, although severity of this threat is difficult to measure (Table 2.5). Great horned owls are generally more abundant than spotted owls in highly fragmented landscapes (Anthony and Cummins 1989, Hamer et al. 1989, Irwin et al. 1989b, Johnson 1993) and generally less abundant than spotted owls in relatively undisturbed landscapes (Fredrickson et al. 1989, Fredrickson et al. 1990, Johnson 1993). Johnson (1993) reported that while spotted owls were most numerous in landscapes containing 60 percent or more mature/old-growth forest, great horned owls were most numerous in landscapes containing 10 to 20 percent mature/old-growth forest. Further, Johnson found few great horned owls in landscapes containing 70 percent or more mature/old-growth forest. Johnson also found that great horned owls occupied areas that contained significantly less mature/old-growth forest and interior habitat; had greater edge-to-area ratios; had more shrub/forb, sapling, and shelterwood stands; and were more fragmented than areas occupied by northern spotted owls.

Barred owls are expanding into areas occupied by northern spotted owls (Hamer 1988). During 1980 to 1991, barred owls were reported at 17 locations in California, 260 locations in Oregon, and several hundred locations in Washington. Most of these observations occurred since 1985, and were incidental to spotted owl surveys. Relative density of barred owls is high in many areas of the spotted owl's range (Table 2.5). Barred owls are dominant in spotted owl/barred owl interactions, and barred owls have displaced spotted owls in some areas (Taylor and Forsman 1976, USDA 1988, Hamer et al. 1989). Further, barred owls act to reduce the amount of habitat available to spotted owls, show a degree of dietary overlap, and utilize similar nest trees and nest cavities (Hamer et al. 1989). Hybridization between the two species, although rare, has been documented.

Lack of coordinated conservation measures.

At the time the northern spotted owl was federally listed, the lack of effective regulatory provisions and conservation measures was judged to be among the most significant threats to the subspecies. Since that time, various conservation measures have begun to be applied to federal and nonfederal lands. The Endangered Species Act prohibits actions that will result in taking owls, regardless of the land ownership on which the taking occurs. The definition of take is to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect an animal. The Endangered Species Act also prohibits federal agencies from authorizing, funding, or carrying out actions that would jeopardize a listed species, or destroy or adversely modify its critical habitat.

In addition to federal measures specifically protecting owls, the states are pursuing additional measures for owl conservation, and for wildlife habitat conservation in general

Table 2.5. Results of surveys for spotted owls, great horned owls, and barred owls in the range of the northern spotted owl. (Results reported as detections with number of individual owls shown in parentheses where appropriate.)

Location/Province	Dates	Method of Enumeration	Spotted Owls	Great Horned Owls	Barred Owls	Sources
Southwestern British Columbia	1985-1988	Responses to spotted owl calls from different sites	14	-	57	Dunbar et al. 1990
Western Washington	1982, 1983	Responses to spotted owl calls	102	-	11	Hays et al. 1989
Ross Lake Drainage, North Cascades National Park, Washington	1987	Responses to spotted owl calls	0	1	11	Bjorklund and Drummond 1987
Wilderness in Wenatchee and Okanogan National Forests and North Cascades National Park, Washington	1989	Responses to spotted owl calls, some other owl calls, and "volunteer" responses	8	5	12	Irwin et al. 1989a
Washington Cascades	1986-1989	Birds on 122-square-mile study area	(16)	(25)	(31)	Hamer et al. 1989
Hoh-Clearwater, Olympic Peninsula, Washington	1988, 1989	Responses to spotted owl calls and "volunteer" responses	389	274	5	Anthony and Cummins 1989
Western Washington Lowlands	1987, 1988	Responses to spotted owl calls, some other owl calls, and "volunteer" responses	58	279	17	Irwin et al. 1989b
Washington Eastern Cascades (Yakima Reservation)	1991	Responses to spotted owl calls	58 (21)	70	3	Hanson unpubl. data
Oregon Western Cascades	1989, 1990	Responses to spotted owl and great horned owl calls	294 (161)	193 (95)	27 (16)	Johnson 1993
Central Oregon Coast Range	1991	Responses to spotted owl calls; 6 percent of 38,000 acres of state land in trees older than 75 years	0	27 (10)	0	ODFW unpubl. data
Oregon Coast Range	1990, 1991	Responses to spotted owl and great horned owl calls	47 (18)	341 (118)	0 (0)	McGarigal unpubl. data

– = Unknown.
Note: Information is provided for a relative abundance of different species within a study area, not a comparison between study areas.

(see Appendix J). These measures are developing rapidly and further change is expected. Various legal proceedings also have resulted in changes in management practices. In addition, timber harvest on most federal lands has been enjoined because of litigation concerning land management plans. Because of the differences in land ownership patterns, state regulatory mechanisms, and the pace of change, it is difficult to accurately determine the impact of these conservation measures and the implications for the spotted owl.

Despite these developments, the lack of effective, coordinated, rangewide conservation measures is one of the most significant threats to the northern spotted owl. The recovery plan will serve to integrate conservation measures now in place, and will provide biological principles to guide development and implementation of additional measures.

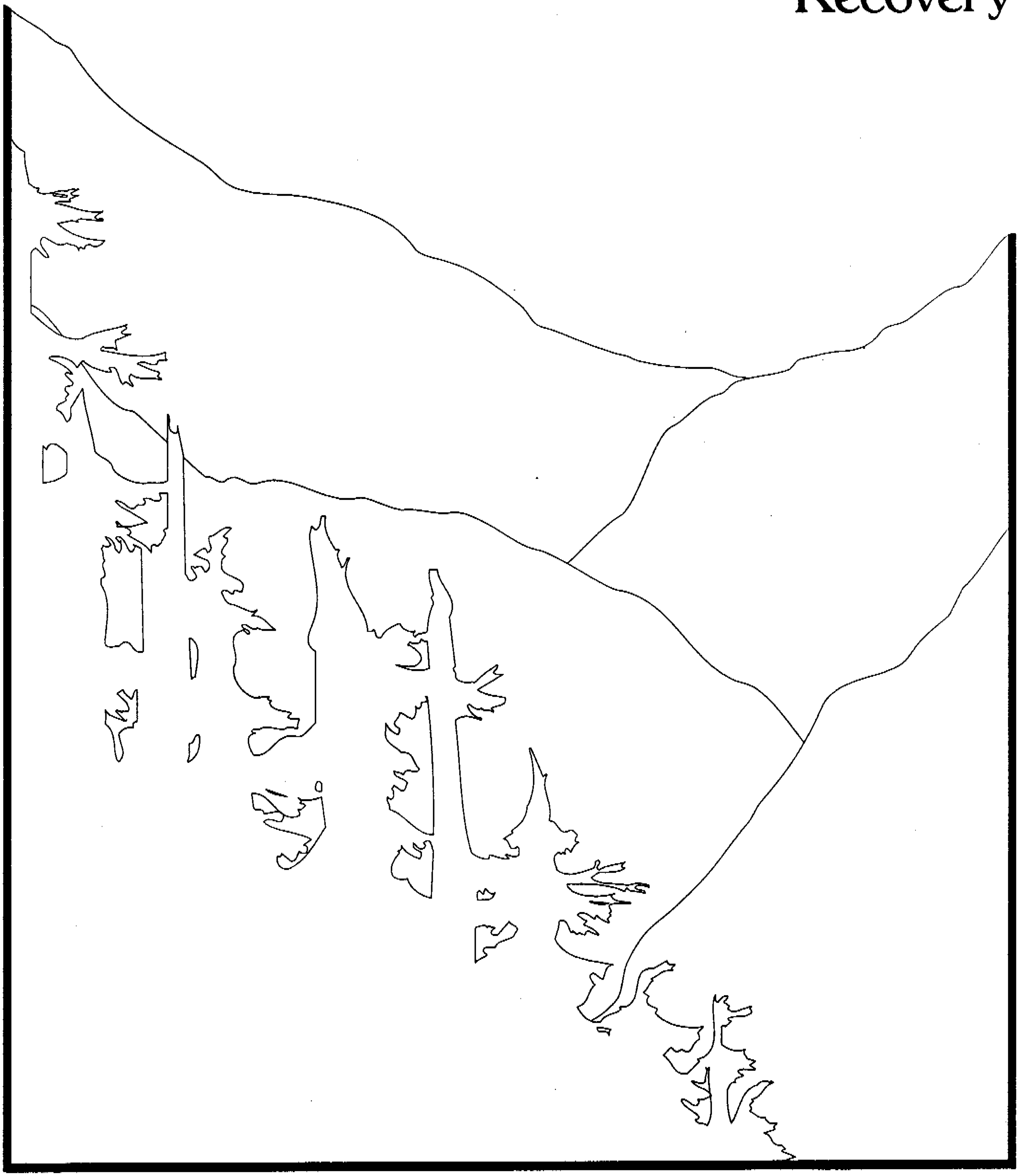
Vulnerability to natural disturbances.

There is significant risk that fire, windthrow, insects, or diseases will reduce habitat, and negatively affect spotted owl populations. Although these disturbances may occur in any of the provinces, the eastern Oregon Cascades, western and eastern Washington Cascades, Olympic Peninsula, California Cascades, Oregon Klamath, and California Klamath provinces are especially vulnerable (see Appendix E).

Although fire currently may represent a threat to spotted owls, the habitat in which the owls evolved owed its structure and species composition to fire (Agee 1991a). Historically, owls occupied a dynamic landscape that often consisted of large areas of burned and unburned forests (Henderson 1990, Teensma et al. 1991). Populations undoubtedly shifted with the changing pattern of this landscape. Today, habitat is greatly reduced and fragmented, and owl populations have become increasingly vulnerable to loss of habitat due to fire.

Chapter III

Recovery



III.

A. Recovery Goal, Delisting Criteria, and Principles Followed in Developing the Recovery Plan

1. Recovery Goal and Delisting Criteria

The goal of the recovery plan is delisting of the northern spotted owl throughout its range. The major threats to the subspecies, identified in the listing decision (USDI 1990a), were that suitable habitat was unprotected and decreasing throughout the owl's range. Evidence was presented that some owl populations already were declining as a result. For delisting to occur, it must be demonstrated that adequate habitat suitable for spotted owls exists and will continue to exist to allow the species to survive without the protection of the Endangered Species Act. In addition, evidence must be available that owl populations are stable or increasing and are unlikely to become threatened again in the foreseeable future.

Four criteria are described here that must be met before the spotted owl is removed from the list of threatened species. The criteria were designed to structure the evidence needed for delisting. The final decision about delisting should be made only after thorough review by the FWS of all relevant information. Delisting would not be considered in any part of the spotted owl's range for a minimum of 8 years. This is the minimum amount of time within which population stability could be demonstrated. In most parts of the range, habitat and populations are still declining. Declines are expected to continue even after recovery recommendations are implemented. Therefore, in most parts of the range delisting probably will not be appropriate for substantially more than 8 years.

Sections III.C., D., and E. contain numerous specific recommendations that the Recovery Team believes must be implemented to achieve the conditions under which delisting would be appropriate. It is recognized that new information may become available permitting the refinement and modification of these recommendations. However, the delisting criteria themselves would generally not be modified (with the possible exception of criterion 2) even if specific management recommendations change.

Delisting may be considered for all or part of the spotted owl's range. The borders of an area to be considered for delisting should follow the borders of the physiographic provinces shown in Figure 2.2. "Area" in the delisting criteria descriptions refers to the area being considered for delisting, and it may include one or more physiographic provinces.

Delisting Criteria

Criterion 1: Owl populations and owl habitat in the area have been monitored with a scientifically credible monitoring plan for the preceding 8 or more consecutive years.

A rangewide sampling plan should be instituted to monitor the progress toward recovery. The plan should be designed using existing information, should provide information to modify the recovery plan when appropriate, and should serve as the basis for delisting once populations have recovered. Section III.J. provides a general description of the components of such a monitoring plan. Appendix A provides additional details about the specific requirements the monitoring plan should meet and contains technical suggestions for efficient sampling methods.

Eight years of survey data are needed before considering delisting because declining wildlife populations often are stable or increase for several years before continuing their long-term decline. Computer simulations and studies of other species indicate that 8 years is the minimum amount of time required to obtain a reliable estimate of the long-term trend.

Criterion 2: The population has been stable or increasing during at least the last 8 years, as indicated by density estimates and demographic analyses, in all parts of the area that would be considered significant under the Endangered Species Act.

Delisting a threatened population while it is declining would be difficult to justify. This is particularly true for northern spotted owls because evidence that populations were declining was a major reason for listing the subspecies. The demonstration of stability must apply to the total population in the area being considered for delisting, or to any subpopulation that would be considered "significant, and thus would qualify for protection under the Endangered Species Act. The term "stable" means that the population trend is approximately zero or positive. The population might decline in some years if it increased in other years. Appendix A discusses this criterion and in more detail. It should be recognized that suitable habitat and owl populations outside of protected areas are likely to decline and several decades may be required before populations stabilize completely, even if recovery is proceeding as anticipated. The Recovery Team believes, however, that delisting eventually might be appropriate if the populations in protected areas were stable or increasing, even if the overall population still was declining slightly. The criteria for delisting under these conditions are difficult to determine precisely at this time, so exact criteria for delisting while the population still is declining at a small rate are not specified. State-of-the-art methods should be used to estimate population trends. Methods that would be appropriate at present are described in Appendices A and C.

Criterion 3: Regulatory mechanisms or land management commitments have been implemented that provide for adequate long-term protection of breeding, foraging, and dispersal habitat, as described in section III.E., Province Narratives.

Delisting would be followed by loss of protection under the Endangered Species Act. Therefore, adequate protection through alternate means is essential before delisting. For example, management plans for federal lands should provide adequate assurances that habitat will be maintained before consideration of delisting. The form of these regulations and commitments will be determined during the coming years and will vary throughout the owl's range. The Recovery Team therefore has not attempted to specify the form of the protection precisely. Reasonable assurance must exist that the conditions which have brought about population stability will be maintained or, if necessary, improved during the foreseeable future.

Criterion 4: The population is unlikely to need protection under the Endangered Species Act during the foreseeable future.

Populations that are temporarily stable but likely to decline again in the foreseeable future cannot be considered recovered and should not be delisted. Detailed analyses of the likelihood that the population will remain stable or increase must be carried out before delisting. The analyses should include observed and anticipated effects of a) fluctuations in spotted owl abundance, fecundity, and survivorship; b) movements by spotted owls within the area and to or from surrounding areas; c) changes in habitat including those due to catastrophic events; d) loss of genetic diversity; and e) any other threats to the population whose effects might be significant. These analyses are particularly important for small populations.

The recommendation that a portion of the overall population could be considered for delisting was based on the following considerations:

- Forest ecology varies from one portion of the range to another, and this variation may allow more rapid progress toward recovery of habitat in some physiographic provinces than in others.

- Loss of owl habitat has proceeded less rapidly in some provinces than others, so the potential for more rapid recovery is higher in these provinces. Also, timber harvest practices have varied across physiographic provinces, and this variation may allow for quicker recovery of habitat in some provinces.

- Land ownership patterns vary from province to province, and the degree and rate of compliance with the recovery plan will likely differ from one landowner to another. Differences will result from state regulations and commitments that vary from state to state and federal regulations that vary from agency to agency.

The possible benefits of delisting by province are 1) to provide incentives for early compliance with the recovery plan and for measures that might exceed the recommendations in the plan and 2) to provide for the efficient use of human, economic, and biological resources. Delisting in some areas could allow the reallocation of time and money that would otherwise be expended on the administration of the Endangered Species Act for the owl.

The recommendation made here does not direct that delisting be done by province. It merely allows the flexibility to consider such a delisting action. Delisting of an individual province, or of a group of provinces less than the whole range, would require that the area being considered fully meet the delisting criteria. This includes criterion 4-that the population in the area being considered would be unlikely to need protection under the Endangered Species Act during the foreseeable future. This criterion requires examination of the interactions between the area to be delisted and surrounding areas. For an area to be delisted, there would have to be convincing evidence that 1) adequate movement of owls was occurring between it and other areas, 2) the condition of surrounding areas would not negatively influence the continued stability of the area being considered for delisting, and 3) delisting would not negatively influence the progress of surrounding areas toward recovery.

2. Principles Followed in Developing the Recovery Plan

Strategic Principles

Adequate assurance of recovery must be provided.

Secretary Lujan's letter directed the Recovery Team to prepare a plan that would "bring the owl to the point at which it will no longer need the protection of the Endangered Species Act." The directive to the Recovery Team recognized the "biological imperative" in the Endangered Species Act. No plan would be acceptable unless it provided adequate assurance that recovery would be achieved. Proposals for recovery were evaluated first to determine whether they provided adequate assurance of recovery. This evaluation was made without regard to economic implications of the proposal, and all proposals were required to meet this biological imperative before being given further consideration.

The recovery plan should minimize social and economic costs.

The Recovery Team attempted to develop a plan which, while meeting the requirement of achieving recovery, would recognize and try to reduce the overall cost and would distribute this cost in an equitable manner throughout the region. For example, the Recovery Team made an intensive effort to place DCAs in locations where suitable habitat existed and timber yield already was reduced (e.g., national parks, wilderness areas); to distribute DCAs in a way that reduced adverse effects on timber-dependent communities; and to identify activities in DCAs that might produce economic returns without reducing the assurance that recovery would occur.

The recovery plan should be comprehensive.

Secretary Lujan directed the Recovery Team to develop a recovery plan that "will serve as a guide to future federal, state, and private activities affecting the owl." These activities will include research, monitoring, habitat protection, development of conservation plans, and numerous other efforts to bring about recovery. The Recovery Team attempted to integrate all of these activities into a single, well-coordinated plan for achieving recovery using all tools available under the Endangered Species Act.

All contributions to recovery should be recognized.

Important contributions to recovery are being made on nonfederal lands and on federal lands outside of DCAs. Some of these contributions are required for recovery, but others may provide higher levels of protection than are needed to assure recovery. Measures beyond those specified in this recovery plan should not be required, and if they are contributed voluntarily, then the possibility of requiring less contribution from other sources should be investigated. This approach is consistent with the goal of minimizing the cost of recovery, and may be particularly important as an incentive for nonfederal landowners to find owls and develop long-term conservation programs for them.

Needs of other species should be considered.

Secretary Lujan directed the Recovery Team to consider "effects on other threatened and endangered species and those species which might be listed in the future." The Recovery Team attempted to identify these species and the habitat requirements of a select group of them that were termed priority species. Efforts then were made to ensure that the recovery plan provided for habitat requirements of these species to the maximum extent practical without increasing the overall cost. The recovery plan also contains additional information on the status of these species. The Recovery Team believes that landowners and managers may want to consider these other species in an effort to reduce the long-term costs of protecting species within the ecosystem inhabited by spotted owls.

The recovery plan should be responsive to new information.

As new information is produced by the monitoring and research program, more efficient ways to bring about recovery may be developed. New data may indicate that DCAs need to be larger or could be smaller; modification of the monitoring program may be required; improved silvicultural methods may be demonstrated to create and maintain owl habitat, or for integrating timber production with owl protection; and new, more effective administrative procedures may be devised. The development and implementation of these improvements is encouraged. Specific recommendations are included for revising the recovery plan periodically and for assuring that proposed modifications to the plan are considered fully and implemented when appropriate.

Biological Principles

This recovery plan is based on biological principles that are widely accepted by conservation biologists. The application of these principles to northern spotted owls first was described in the Conservation Strategy of the Interagency Scientific Committee (Thomas et al. 1990). The most important of these principles are that 1) species are more secure from extinction if habitat and local populations are distributed throughout their entire range, 2) providing for species in large habitat blocks is superior to providing small blocks, and 3) movement of individuals throughout the landscape is vital to the maintenance of all local populations within the range. A summary of the reasons behind each of these principles and their application to northern spotted owls follows.

The risk of local or widespread extirpation of northern spotted owls will be reduced by managing for owls throughout their entire range and the variety of ecological conditions within that range.

Four primary reasons can be cited for the importance of maintaining the full range of the species. First, any significant range reduction most likely would reduce the total number of local populations in the species' metapopulation. A metapopulation is defined as a set of local populations linked by dispersing individuals. The security of the metapopulation is directly related to the number of local populations. A reduction in local populations increases the risk of extinction for the whole metapopulation. Second, a reduction in range also would reduce the overall range of environments occupied by the species, making the species more vulnerable to environmental stochasticity. Habitats at different elevations, in different forest types, in different ownerships, and in different parts of the owl's geographic range may act as refugia for the species in the face of catastrophes, rapid environmental change, chronic degradation of habitat from causes such as forest diseases, or unforseen changes in interactions among species. Populations distributed throughout the geographic and ecological conditions within the spotted owl's range provide a higher likelihood that the subspecies will survive such events. For these two reasons, Thomas et al. (1990) concluded that species well-distributed throughout their range are less prone to extinction than species confined to smaller portions of their range. Third, range reduction around the fringes of a species' geographic or elevational range could have serious consequences because these areas are often the sites of the most rapid adaptations within a species. Eliminating the fringes of the range might reduce the evolutionary capability of the species. Fourth, the elimination of the geographic or elevational fringe portions of a species' range might be considered unwise in the face of possible widespread climatic changes, especially where the direction and magnitude of those changes are uncertain. For example, some scientists believe that global warming could result in some local cooling points in the Pacific Northwest rather than a universal warming effect (Smith 1990). If the climate cooled, it could place increasing importance on the southern parts of the range and on low-elevation habitats. If the climate warmed, it could place increasing importance on the northern extent of the range.

Emphasis should be placed on management for clusters, or local population centers, of owls in large habitat blocks rather than for individual pairs.

Empirical evidence and modeling show that clusters of 15 to 20 breeding pairs have much higher persistence rates than small, isolated clusters. These clusters, or local population centers, can be defined as groups of breeding owls where pairs have overlapping or nearly overlapping territories. The evidence and rationale supporting this principle are described in detail in Thomas et al. (1990).

One of the advantages of local population clusters is that they can provide for a population structure that can sustain itself for many generations. This contrasts with extremely small local populations, composed of one or two pairs, that are highly susceptible to local extinction (Diamond 1984). In order to realize this advantage, the local populations must be large enough to hold multiple breeding pairs, and to support juveniles, subadults, and "floaters." Floaters are nonbreeding individuals without established territories. It is thought that they serve as ready replacements for spotted owls that die or vacate their territories for other reasons (Thomas et al. 1990). This ready replacement of spotted owls in breeding territories should help maintain the populations within the local population centers.

Within each local population center, it is critical to provide for stable or improving habitat conditions. This will reverse the trend of loss and fragmentation of habitat which has been experienced in most areas throughout the range. Fragmentation of habitat is associated with lowered spotted owl densities, decreased productivity of spotted owl populations (Bart and Forsman 1992), increased susceptibility of forest stands to windthrow, decreased success of juvenile dispersal, and possibly increased competition with barred owls and predation by great horned owls (Thomas et al. 1990).

For a strategy based on local populations to be successful, those populations must be capable of acting as sources of surplus owls for the species' metapopulation. A source area is one that has a positive rate of population increase and is capable of contributing individuals to the metapopulation. Local populations might cease to act as sources if they are too small or if they occupy highly fragmented habitat (Thomas et al. 1990). It is important to note that each local population does not have to act as a source each year. It is expected that there will be some variation across populations and across years, and that a portion of the local populations would not act as sources in some years. The strategy of managing for many local populations within the metapopulation should allow maintenance of a nondeclining trend in the metapopulation despite this variation.

The management for local populations within the metapopulation also should be designed to reduce the risk of local or widespread extirpation of owl populations due to catastrophic destruction of habitat. Such destruction could result from natural causes including windthrow, fire, flooding, insects, diseases, volcanic action, or climatic change. The risk to the overall population from large-scale disturbances is reduced by distributing local population centers throughout the species' range, and by providing redundancy of habitats. Additional security from catastrophic loss can be provided by reducing the risk within local population centers. The risk of catastrophic loss within a given population center can be influenced by the size, configuration, and management of that center. Larger areas are less susceptible to complete elimination from fire and windthrow. The likelihood of fire, and the likely impacts of fire, can be reduced through management of fuels within the population center and in the surrounding forest matrix. In some ecological conditions, the risk of serious insect and disease losses may be reduced through appropriate management.

Habitat conditions and spacing between local populations must provide for survival and movement of northern spotted owls.

The northern spotted owl metapopulation is composed of local populations that are linked by dispersing individuals. While each local population might be subject to extirpation over the long term, individuals dispersing among the areas help to reestablish local populations after severe local declines or extirpations. The interbreeding provided by dispersing individuals also provides insurance against deleterious effects of inbreeding. To allow for movement of northern spotted owls among source areas, those areas must be spaced appropriately; there must be redundant linkages among areas; and the intervening habitat must provide the dispersal needs of adults and juveniles.

Studies of dispersing juvenile owls (Miller 1989, Gutiérrez et al. 1985) indicated that the juveniles' initial movements have a strong random component. The probability of a juvenile finding suitable habitat is related to the amount of suitable habitat in the landscape around its natal area and the distance of that habitat from its starting point. Increasing the number of blocks of suitable habitat within the dispersal distance of any given local population center will increase the chance for success of dispersing juveniles. Also, having each block within the dispersal distance of two or more other blocks allows the system of local population centers to retain connectivity even if a given local population is eliminated. In this case, that population center can be reoccupied by owls coming from two or more other centers.

The connecting zones among local population centers must contain habitat that will allow movement of juvenile and adult dispersers and provide for basic life needs during the dispersal period. Key elements for survival include roosting opportunities, protection from predators, and adequate foraging opportunities (Thomas et al. 1990).

Integration of Strategic and Biological Principles

The northern spotted owl has been placed at risk by management actions that have seriously depleted its habitat. The habitat conditions that would best support an owl population would be similar to those that existed before timber harvest began. However, recreating such habitat conditions would not be feasible. Efforts to restore habitat conditions in any part of the owl's range would have large economic effects, and those economic consequences force difficult biological choices in the design of a recovery strategy. The strategy developed here places large blocks of habitat on federal lands off-limits to regular timber harvest and should provide a reasonable assurance of success of recovering the northern spotted owl. However, it required consideration of many compromises in conservation area size and spacing and in the structure of intervening forests. Such compromises are inevitable in a strategy that calls for blocks of superior habitat distributed within a landscape of lower-quality habitat. The situation for owls could be made more secure if favorable habitat conditions could be spread more evenly throughout the landscape. Such a solution would be possible if it can be demonstrated that silvicultural techniques can create and maintain suitable habitat conditions while harvesting timber. The Recovery Team supports the change over time toward such a solution when supported by appropriate data. If such change is appropriate, it would occur through the adaptive management process (section III.K.).

III.

B. Overview

The Endangered Species Act requires that recovery plans recommend recovery goals and objectives, describe actions needed to accomplish those goals, and estimate the time and cost required for recovery. However, recovery plans are not regulations and are not self-implementing. Their implementation occurs through a series of actions taken by all involved entities including federal agencies, the states, and, as appropriate, private landowners.

Because of their legal status, recovery plans represent a series of recommendations, not requirements. The language used in the following sections must be interpreted with that understanding. The terms "will" and "must" are used to indicate activities that are judged to be essential to recovery of spotted owls, the same is true for any action described as a "requirement." The terms "should" or "could" indicate actions that would benefit recovery, but exceptions to these actions may be appropriate and acceptable. However, all these terms must be interpreted in light of their legal status as recommendations.

The recommendations in this recovery plan are based on the principles stated in section III.A. The plan has three main components: establishing designated conservation areas (DCAs) on federal lands; managing the remaining federal lands, referred to as the matrix; and encouraging contributions from nonfederal lands.

1. Federal Lands

The network of DCAs follows guidelines developed by Thomas et al. (1990). The DCAs provide for local spotted owl population centers, or clusters, of reproductive pairs. It is anticipated that birth and survival rates in these clusters normally will equal or exceed death rates, allowing the clusters to serve as source areas for owls. The clusters are arranged throughout the federal landscape to meet, as nearly as possible, the principle that northern spotted owls should be recovered throughout their entire range and the full variety of ecological conditions within that range. Table 3.1 provides a summary of the different management designations recommended for federal lands.

DCAs will be managed to improve owl habitat. Thinning and other silvicultural practices are recommended to accelerate development of suitable habitat in areas that are currently unsuitable. Such management, however, will be used only where existing and new studies and data indicate that the development of suitable conditions could be accelerated. Salvage of dead trees in stands affected by large-scale disturbances also may take place, but only where that salvage will have a positive or neutral effect on owl habitat. Additional management activities are recommended in DCAs where there is significant risk of large-scale habitat destruction by fire, wind, insects, or diseases. Detailed guidelines for management in DCAs are in section III.C.

Outside of the DCAs, it is recommended that federal forestlands be managed to allow dispersal of owls among DCAs. These forests are called the matrix, following the terminology established by Thomas et al. (1990). Dispersal of owls among DCAs is

Table 3.1. Managment designations for northern spotted owl recovery on federal lands.

Designated Conservation Areas (DCAs)	Primary areas where recovery of owls and their habitat is expected to occur. Category 1 DCAs are expected to support 20 or more pairs of owls, while category 2 DCAs are expected to support 1 to 19 pairs. Management of these areas is intended to improve long-term habitat conditions, and will largely focus on areas that are not currently suitable (see Section III.C.1.).
Matrix:	All forestlands outside of DCAs in the range of the owl. The following 3 categories of areas will be provided in the federal matrix (see section III.C.2.):
· **Reserved Pair Areas**	Areas intended to support individual, reproductive pairs of owls. These are interim measures meant to supplement the DCA network in areas where it is currently deficient in either owls or habitat. Management proposed for these areas is similar to that proposed for DCAs.
· **Managed Pair Areas**	Areas intended to support individual, reproductive pairs of owls. These are meant to either 1) supplement the DCA network in areas where it is currently deficient (prescription B) or 2) provide alternative habitat in areas where there is high risk of large scale disturbance in DCAs (prescription C).
· **Residual Habitat Areas**	Small areas intended to retain the core nest sites of known pairs of owls for which incidental take is allowed in the matrix. These will not provide for long-term needs of owl pairs, but will provide future options for managing owls throughout the landscape.

important to replace owls that die and to avoid loss of genetic diversity. This is important under normal circumstances, when individual owls die, and unusual circumstances, when there is large-scale disruption of the population.

Federal matrix lands also will provide habitat to supplement DCAs in areas where existing conditions preclude achievement of the goals for size and spacing of DCAs. These areas of additional habitat are called reserved pair and managed pair areas (see Table 3.1). Specific criteria were used to determine where they should be delineated (see section III.C.2.).

In the eastern Washington Cascades, eastern Oregon Cascades, and California Cascades provinces, large-scale habitat disturbances are likely, due to fire and insect outbreaks. These disturbances are a significant threat to spotted owl populations in those areas. To reduce the risk, the recovery plan recommends providing habitat for additional owl pairs and territorial single owls outside of the DCAs. The plan also recommends managing these areas to reduce risk of fire and insect damage.

Finally, the plan recommends maintaining residual habitat areas around existing owl pairs and territorial singles (see Table 3.1). These small areas will not provide for long-term needs of owls, but will help maintain options to provide for owls throughout the landscape and reduce the dependence on reserves in the future.

A broader array of management practices can be used in the matrix than in the DCAs. The timing and location of management practices will be designed to achieve desired conditions through time. Details of matrix management are in section III.C.2.

2. Nonfederal Lands

In many areas throughout the owl's range, federal lands are not adequate to provide recovery and actions on nonfederal lands are needed if the goal of recovery is to be achieved. Currently, the primary nonfederal action is providing habitat for existing owl activity centers to avoid "take" of those owls, as defined by the Endangered Species Act. A variety of nonfederal contributions is envisioned in this recovery plan (see sections III.D. and III.E.) to achieve recovery. Many of these contributions are also intended to offset the Endangered Species Act prohibition on taking individual owls. These actions are termed protective management (see section III. D.) and may include: 1) helping to meet objectives for DCAs where nonfederal lands are mixed with federal lands, 2) providing for clusters of breeding pairs on nonfederal lands, 3) providing habitat for individual owl activity centers, and 4) providing dispersal habitat.

3. Evolution of the Strategy

The recovery strategy should change as more information is collected on owls and their habitat. The monitoring and research program is designed to provide that information. The plan recommends that an interagency group coordinate this gradual refinement and modification of the recovery strategy. The Recovery Team should be maintained to fulfill this function until a coordinating group is established.

4. Organization of This Chapter

All facets of the recovery plan are discussed in the following sections. Section III.C. reviews management on federal lands. It discusses the delineation of DCAs, criteria used to determine where matrix prescriptions should be applied, and specific management recommendations for the DCAs and the matrix. Section III.D. discusses the types of recommendations made for nonfederal lands. Section III.E. presents a comprehensive discussion of recovery goals and objectives for all lands in each physiographic province and describes how those goals might be implemented on nonfederal lands. Section III.F. presents a summary of recovery plan provisions, and section III.G. describes how recovery plan recommendations are expected to respond to various threats to owls. Section III.H. describes the economic and social effects of the recovery plan, and section III.I. discusses effects on other species. Section III.J. outlines the monitoring and research program that will be needed to improve the recovery plan over time and to provide information for delisting. Section III.K. describes the specific process that will be followed for changing the plan over time through adaptive management.

Implementation of the recovery plan is discussed in Chapter IV. Sections IV.A. and IV.B. discuss implementation strategies and tools for federal and nonfederal lands, and include a proposed implementation schedule. Section IV.C. describes coordination efforts that will be needed to make the recovery plan successful.

III.

C. Management Guidelines for Federal Lands

1. Designated Conservation Areas (DCAs)

Delineation of DCAs

The DCAs recommended on federal lands in the recovery plan were derived from the habitat conservation areas (HCAs) proposed by Thomas et al. (1990). The goal of the original HCA network was to establish habitat areas large enough to support 20 pairs of owls with contiguous or nearly contiguous home ranges. The 20-pair goal was based on empirical evidence from other avian species and on simulation modeling which showed that clusters of 20 interacting pairs were likely to persist for at least 100 years. These areas were to be spaced a maximum of 12 miles apart, edge-to-edge. The spacing guideline was developed to ensure that juvenile owls, dispersing from their birthplace, would have a high likelihood of finding suitable habitat to establish a nesting territory. Two-thirds of the juvenile owls studied at the time of the ISC report had moved at least 12 miles. As an additional provision, HCAs were as circular as possible to minimize the perimeter-to-area ratio.

The 20-pair HCAs were termed category 1 HCAs. Where 20-pair areas could not be established, Thomas et al. (1990) recommended smaller areas capable of supporting 2 to 19 pairs. These smaller areas were termed category 2 HCAs. The recovery plan adopts this convention for category 1 and category 2 DCAs. However, some of the category 2 DCAs have the capability of supporting only a single pair of owls. In the HCA network, many of these same sites were protected with category 3 HCAs.

Thomas et al. (1990) used median annual home range size and population density information to determine the appropriate size for the category 1 HCAs. HCAs were delineated to include the best available habitat and greatest number of known pairs or territorial singles. This process was done iteratively to achieve the best combination of habitat, known owls, and HCA shape. Where category 2 HCAs were delineated because there was no opportunity to create category 1 HCAs, these smaller areas were spaced at a maximum distance of 7 miles to compensate for the smaller size of the reserves. Approximately 80 percent of juveniles that were studied with radio transmitters traveled at least 7 miles (Thomas et al. 1990).

The HCA network was modified slightly in the draft recovery plan using updated inventories of owls and habitat (see Appendix H). Size and spacing criteria were not changed. Boundaries were altered to improve the biological and/or economic efficiency of the system. Additional boundary changes were made for the final recovery plan based on public and agency comments on the draft recovery plan. The resulting DCAs are summarized in tables in Appendix I and illustrated on maps, attached to the recovery plan.

There are 192 DCAs identified for the DCA network, with 53 satisfying the criteria for category 1 status. The remaining 139 areas are category 2 DCAs. To determine which DCAs met the criteria for category 1 status, the future number of owl pairs that could be supported by federal lands in each DCA was calculated. This figure was based on assumptions about the likely future condition of habitat in the DCAs. For lands that had not experienced significant management in the past, such as wilderness, no change in habitat was assumed. For other lands, it was assumed that they would become 80 percent suitable habitat over time.

In the last 5 years 1,445 pairs of owls and 339 territorial singles have been located on federal lands in these DCAs. This represents 51 percent of the 2,825 pairs of owls and 44 percent of the 770 territorial singles located on all federal lands during that period. The percentage of pairs on federal lands included in DCAs by state is 77 percent in Washington, 41 percent in Oregon, and 60 percent in California. Differing percentages among the states result from the differences in current population levels and distribution of owls. The DCAs contain approximately 7.6 million acres of federal lands including approximately 3.5 million acres of nesting, roosting, and foraging (NRF) habitat. This represents about 46 percent of all NRF habitat on federal lands. The percentage of habitat on federal lands included in DCAs by state is 58 percent in Washington, 38 percent in Oregon, and 45 percent in California. A summary of the DCA network is in Figures 3.1 through 3.6 and in section III.F. The DCA network is illustrated on the maps included with the recovery plan, and details of the network for each physiographic province are discussed in section III.E. Additional pairs of owls on federal lands will be protected by matrix management prescriptions which are described in sections III.C.2. and III.E.

Management of DCAs

Effective management of the DCAs is necessary to achieve recovery. The primary objective of all activities in DCAs is to improve the quality of owl habitat. This section describes the management guidelines that will govern activities on federal lands in DCAs. These general guidelines apply throughout the owl's range. However, before they can be applied to projects, they must be refined to be specific to provinces. It is recommended that interagency groups be established to develop this province-specific guidance. Implementation of the guidelines will be guided by management plans prepared for individual DCAs. The recommended components for DCA management plans are described in this section.

The DCA management guidelines have several key objectives. First, they allow natural successional processes to continue operating in areas of currently suitable habitat. Second, they focus silvicultural activities in DCAs on developing suitable habitat conditions for owls where those conditions do not now exist. A third objective is to maintain or reestablish suitable conditions in areas where catastrophic events have occurred and salvage is being considered. Fourth, maintaining suitable habitat conditions over the long term is an important consideration in areas where there is significant threat of large-scale disturbances (i.e., mixed-conifer forests in the eastern Cascades provinces). Some forest management activities which meet these objectives also may yield commercial timber volume, but this volume should not be part of the programmed timber harvest. Finally, DCA management would include other ongoing and proposed activities in DCAs where they are compatible with owl recovery.

A management plan should be prepared and approved for each DCA before design and implementation of habitat manipulation activities. Land management agencies may choose to develop these plans as components of legally mandated plans (e.g., forest or resource management plans), or as stand-alone plans. Agencies are strongly encouraged to work through the coordinating group (see section IV.C.) to develop province-based planning guidelines as a basis for preparing plans. DCA management plans will serve as overview

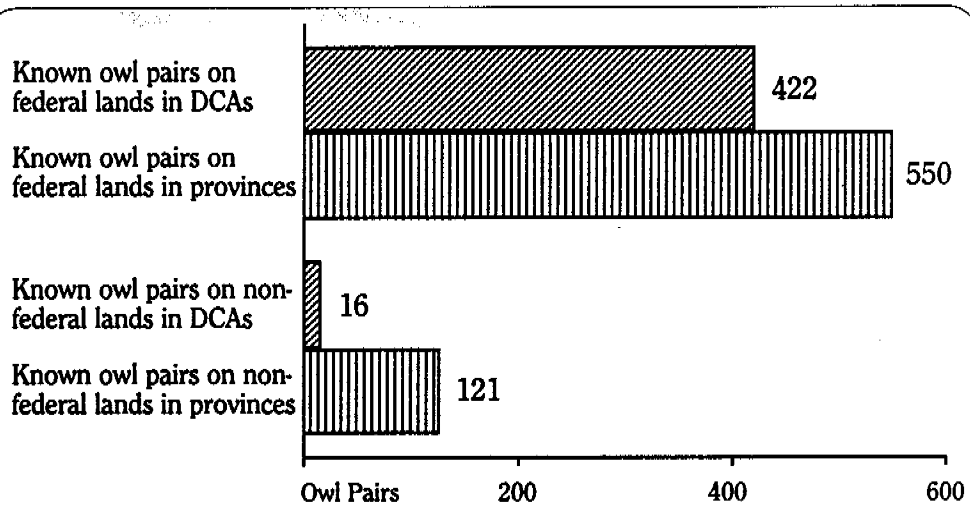


Figure 3.1. *Known owl pairs in the Washington provinces and in the DCAs (designated conservation areas) in Washington.*

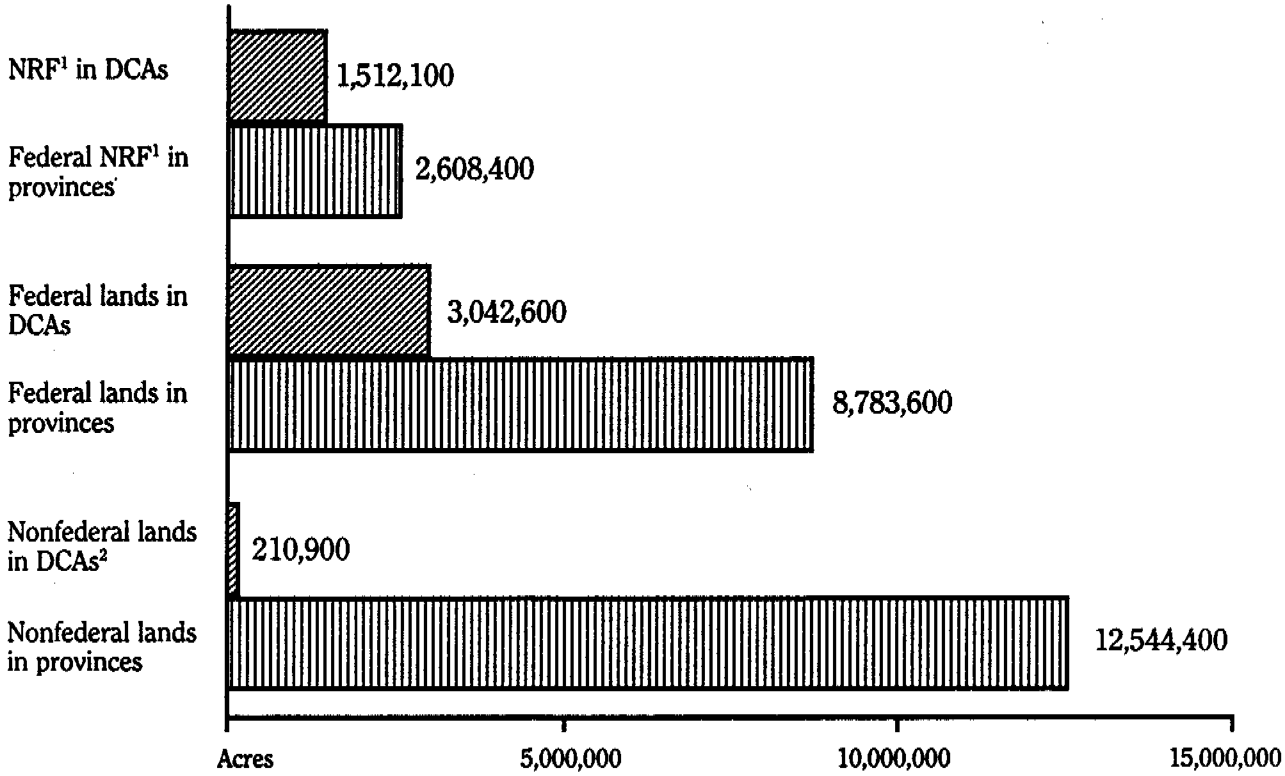


Figure 3.2. *Acres in the Washington provinces and in the DCAs (designated conservation areas) in Washington.*

[1]NRF = nesting, roosting, and foraging habitat. This information is available only for federal lands.
[2]Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the province narratives.

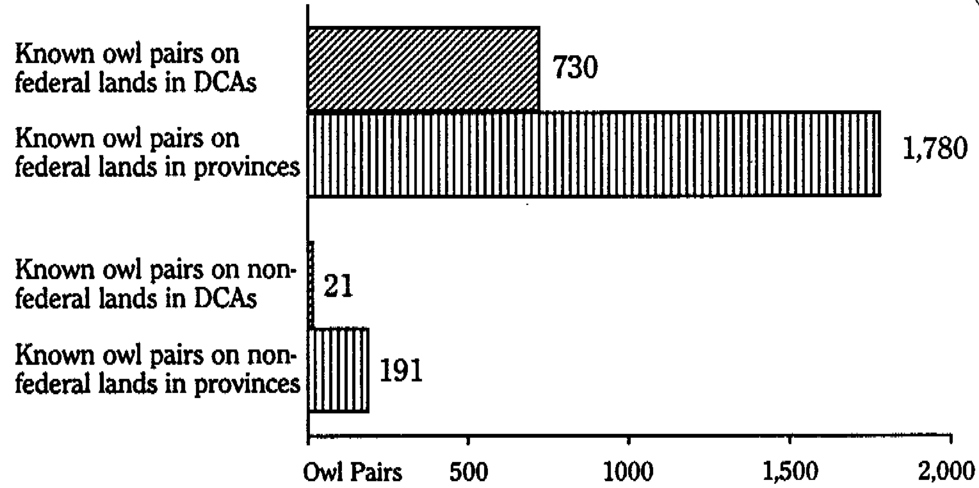


Figure 3.3. *Known owl pairs in the Oregon provinces and in the DCAs (designated conservation areas) in Oregon.*

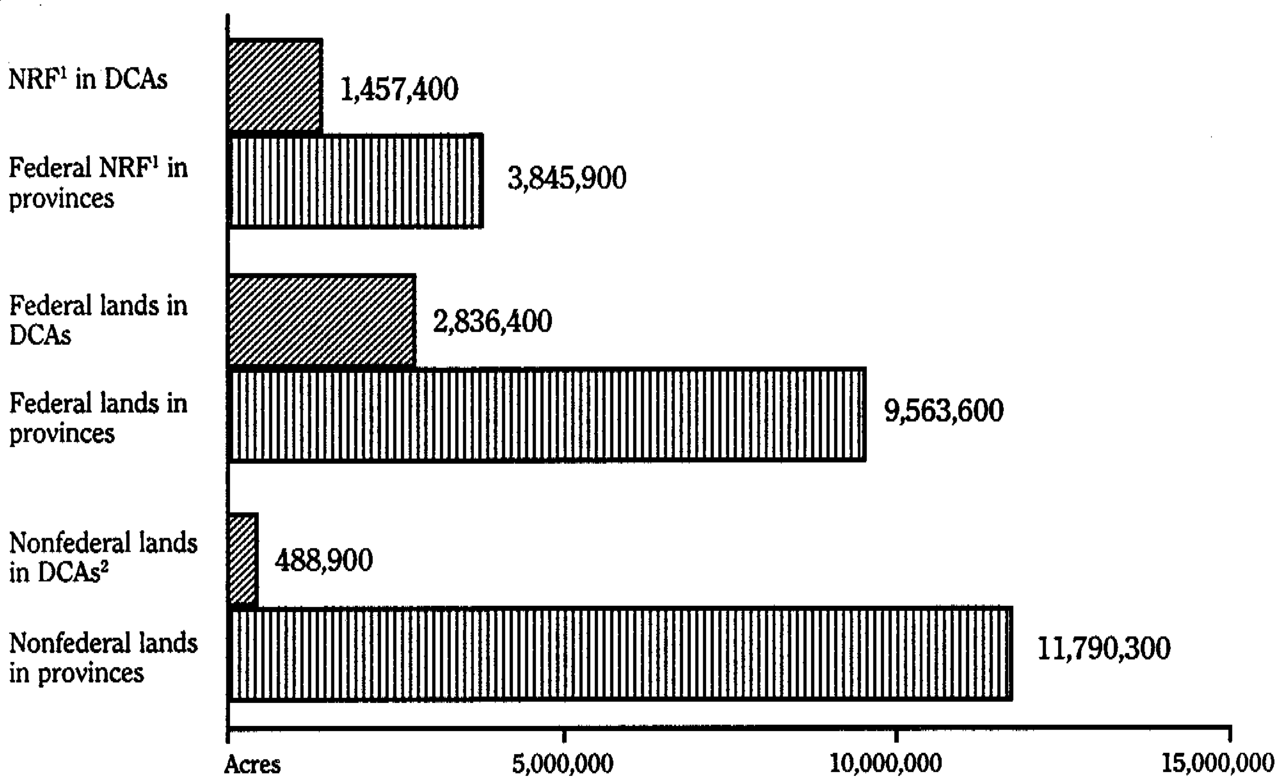


Figure 3.4. *Acres in the Oregon provinces and in the DCAs (designated conservation areas) in Oregon.*

[1]NRF = nesting, roosting, and foraging habitat. This information is available only for federal lands.
[2]Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the province narratives.

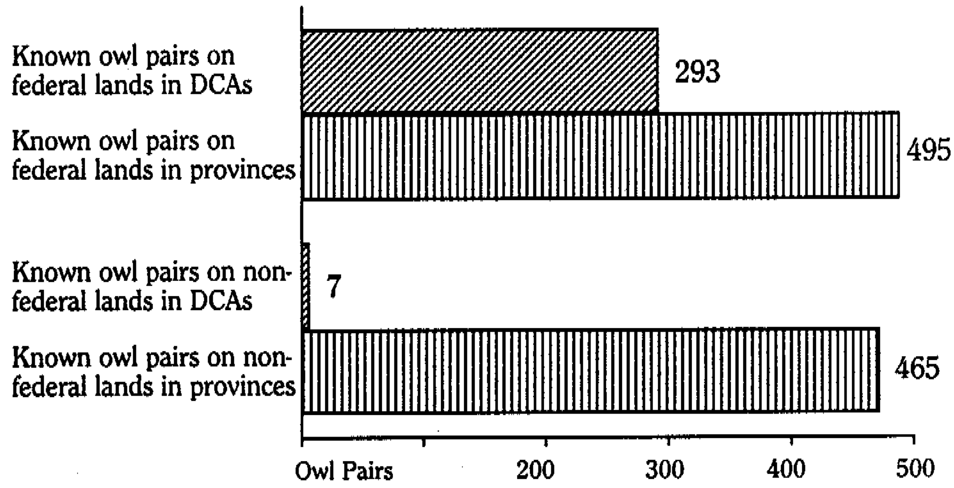


Figure 3.5. *Known owl pairs in the California provinces and in the DCAs (designated conservation areas) in California.*

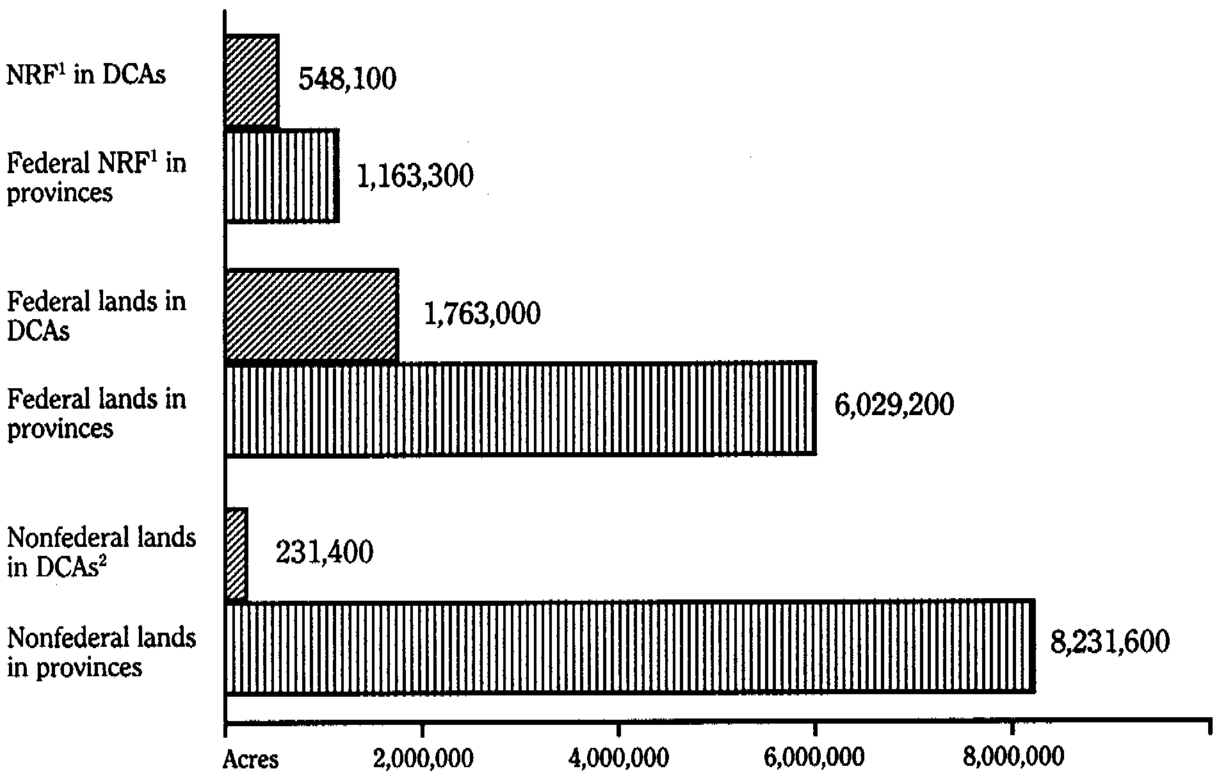


Figure 3.6. *Acres in the California provinces and in the DCAs (designated conservation areas) in California.*

[1]NRF - nesting, roosting, and foraging habitat. This information is available only for federal lands.
[2]Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the province narratives.

documents that provide a framework for carrying out specific activities. Individual plans should include: 1) a history and inventory of overall owl population and habitat conditions, 2) a description of other resources and land uses, 3) a fire management plan, 4) criteria for determining appropriate treatments for specific owl needs, 5) identification of specific areas which could be treated under those criteria, and 6) an implementation schedule tiered to the recovery plan. Individual DCA plans should contain oversight, monitoring, and evaluation components to help assure that activities are carried out as intended and achieve desired results. Interdisciplinary and interagency teams that include wildlife biologists, silviculturists, forest ecologists, fire scientists, forest entomologists, and representatives of other appropriate disciplines should write the DCA plans, and be involved in oversight actions after implementation. More detailed guidance for DCA management plan preparation is presented later in this section.

The recommended DCA management guidelines and planning process are compatible with federal agency mandates and management frameworks. Since the recovery plan recommends that DCAs on certain federal lands be designated as critical habitat (see section IV.A.), the guidelines should be used by the FWS in making determinations of adverse modification as well as jeopardy for those lands under section 7 of the Endangered Species Act. Accordingly, DCA management plans will be submitted to the FWS for formal consultation. After the agency successfully completes section 7 and other regulatory reviews, it is expected that proposed activities could proceed.

Before submission for section 7 review, the DCA management plans should be submitted for technical review to the coordinating group established to help implement the recovery plan (see section IV.C.). This technical review will help the agencies determine if the proposed activities fully comply with the intent of DCA management and the guidelines presented in the recovery plan. Information from this technical review should be helpful for the section 7 consultation process.

Agencies must provide for DCA management plan revisions within reasonable time frames (e.g., the normal agency planning cycle) to incorporate new information. In cases involving major disturbances (e.g., a significant fire), a plan reassessment may be appropriate prior to the normal planning cycle. In the interim period after agency implementation of the recovery plan but before the preparation of individual DCA management plans, any proposed activity would be submitted for consultation on a case-by-case basis. Finally, since the guidelines apply to all federal lands in DCAs, management planning in areas of mixed ownership will necessitate interagency coordination. This will include the use of interagency planning teams to ensure the effectiveness of monitoring and management activities that involve lands of several ownerships. In addition, coordination of planning efforts among federal and nonfederal landowners will help ensure that maximum benefit is derived from all contributions.

Guidelines for silviculture.

The primary objective of silvicultural activities in DCAs is to improve habitat in stands with currently unsuitable conditions. Consequently, activities are encouraged if empirical information and modeling indicate that the development of suitable habitat conditions will be accelerated. Interdisciplinary teams of wildlife biologists, silviculturists, and other specialists are encouraged to develop prescriptions that meet these criteria. General guidelines for silvicultural activities follow.

1. To safeguard the conservation benefits of DCAs, silvicultural activities should be directed at stand types that owls consistently avoid, as documented in habitat selection

studies. Accordingly, activities should generally be directed at young stands where stocking, structure, or composition will prevent or significantly retard development of conditions suitable for spotted owl habitat. This will generally include stands that are composed of trees less than 10 to 12 inches dbh, show no significant development of a multiple-canopy tree structure, and were regenerated following previous harvest activity. There will be exceptions to these guidelines, and judgments on stands to be managed will vary according to forest type and stand history. Activities in other types of stands that do not meet the general guidelines can be considered, particularly where those stands are heavily stocked and not being used by owls. Examples may include stands that were planted following catastrophic fires or stands previously dominated by conifers that converted to hardwoods following harvest. Stands that have the desired structure for spotted owl habitat or that will soon develop it should not be treated unless such treatment is necessary to accomplish risk-reduction objectives (as described later).

2. Prescriptions to be used for each stand should be well thought out and documented. They will be designed to produce stand structure and components associated with stands used by owls. These components include large trees, snags, logs, and dense, multi-storied canopies. Prescriptions should show the treatments to be applied and the anticipated effects on the stand over time. They should also include a discussion of the actions, coordination efforts, and oversight that will be necessary for successful implementation. This discussion should draw on previous efforts made to implement similar prescriptions. Finally, the prescriptions should identify key stand attributes or accomplishments that should be monitored. For example, if snags are to be created, or regeneration established, the accomplishment of these actions and their results should be monitored. Some examples of appropriate prescriptions are described in Appendix F. (Note that the activities shown for older stands in Appendix F are more likely to be appropriate in the matrix than in DCAs).

3. Silvicultural activities must maintain or reduce risk of large-scale natural disturbance. For example, activities should not be implemented if they significantly increase the risk of windthrow in a stand.

4. To promote habitat suitability in stands to be thinned, prescriptions will provide for leaving some trees as snags and others as down wood. Those trees not needed for habitat development may be removed for commercial or fuel hazard reasons.

5. Key attributes of forests inhabited by the northern spotted owl are their diversity and variability on individual sites and from site to site. To promote diversity and variability, a wide range of silvicultural practices should be applied, as opposed to reliance on a limited variety of techniques.

6. Activities that comply with these guidelines should provide positive recovery benefits as discussed in Appendix F. Actual implementation experience, however, is not extensive. A modest rate of implementation is prudent and will provide the opportunity to assess and refine activities. Acreage to be manipulated by silvicultural activities should generally be limited to 5 percent of the total area in any DCA in the initial 5-year period of the recovery plan, unless the need for larger-scale actions explicitly are justified.

7. Some habitat modification activities in DCAs will generate enough revenue to pay for themselves. Others will not and need to be supported by appropriated funds. Since the purpose of silvicultural activities in DCAs is to advance recovery, it is not appropriate to conduct only those activities that generate a commercial return and ignore the needs of stands that cannot be treated commercially.

8. Owl habitat needs are increasingly well defined. However, not all species derive comparable benefits from actions designed to improve owl habitat. To the extent feasible, habitat requirements of other species associated with late-successional forests should also be considered in planning silvicultural activities.

Guidelines for salvage.

Salvage is defined as the removal of trees from an area following a stand-replacing event caused by wind, fires, insect infestations, volcanic eruptions, or diseases. Salvage guidelines are intended to prevent negative effects on owl habitat, while permitting some commercial wood volume removal. In some cases, salvage operations may actually facilitate habitat recovery for owls and their prey. For example, excessive amounts of coarse woody debris (CWD) may interfere with stand regeneration activities following some disturbances. In other cases, salvage may help reduce the risk of future stand-replacing disturbances. Priority should be given to salvage in areas where it will have a positive effect on spotted owl habitat, but salvage operations should not diminish suitability for owls now or in the future.

Tree mortality is a natural process in a forest ecosystem. Diseased and damaged trees are key structural components of suitable owl habitat. Accordingly, DCA management planning must acknowledge the considerable value of retaining dead and dying trees in the forest as well as the benefits from salvage activities.

In all cases, planning for salvage should focus on long-range objectives, which are based on desired future condition of the forest. Since DCAs have been established to provide high-quality owl habitat, management following a stand-replacing event should be designed to accelerate or not impede the development of suitable owl habitat. The rate of development of this habitat will vary among provinces and forest types and will be influenced by a complex interaction of stand-level factors which include site productivity, population dynamics of live trees and snags, and decay rates of coarse woody debris. Because there is much to learn about the development of owl habitat, it seems prudent to only allow removal of conservative quantities of salvage material from suitable owl habitat and retain management options until understanding of the process has improved.

The following guidelines are general. Specific guidelines should be developed for each physiographic province, and possibly for different forest types within provinces. An example of how to apply these guidelines for the western Oregon Cascades and western Washington Cascades provinces is provided in the accompanying box.

1. The potential for benefit to owls from salvage is greatest when stand-replacing events are involved. Salvage in disturbed sites of less than one acre is not appropriate because small forest openings are an important component of old-growth forests. In addition, salvage should occur only in stands where disturbance has reduced canopy closure to less than 40 percent, as stands with more closure are likely to provide some value for owl dispersal and foraging.

2. Surviving trees will provide a significant residual of larger trees in the developing stand. In addition, defects caused by fire in residual trees may accelerate development of structural characteristics suitable for owls and owl prey. Also, those damaged trees which eventually die will provide additional snags. Consequently, all standing live trees should be retained, including those injured (e.g., scorched) but likely to survive. Inspection of the cambium layer can provide an indication of potential tree mortality.

3. Snags provide a variety of habitat benefits for owls, including nest sites for them and their prey species, such as flying squirrels. Accordingly, following stand-replacing disturbance, management should focus on retaining snags that are likely to persist until suitable owl habitat has developed and the new stand is again producing large snags. Although superior owl habitat is not generally found in forest stands less than 150 to 200 years old, 50- to 100-year-old stands in western Oregon and Washington are used in proportion to their availability by some owls for foraging and roosting (Thomas et al. 1990). The BLM projections state that in naturally established and unmanaged stands in western Oregon, suitable habitat with at least foraging value, will develop in 70 years (USDI 1992b-g). In the coastal redwood forests of northwestern California, suitable habitat may develop in stands 40 to 60 years old (Thomas et al. 1990). During this period, the stand does not otherwise contribute significant quantities of large-diameter snags or down logs. Snags from the original stand will be important structural elements of spotted owl habitat as forests develop after the stand-replacing event. Although there is some uncertainty concerning the optimum density of snags to be provided for spotted owls, management to provide maximum likely benefit for owls and their prey is an appropriate strategy for DCAs.

   Snag retention guidelines should be developed for each physiographic province based on the general guidance provided in this section. An example of such guidelines for western Oregon and Washington is presented at the end of this section. This guideline calls for retention of all snags 20 inches dbh or larger. In the development and finalization of guidelines for each province, this basic standard may change. For example, management planning in areas such as northern California may require specific guidance for hardwood snag retention and to provide habitat for woodrats, an important prey species. However, in development of guidelines for all provinces, retention of all 20-inch dbh snags should be a starting point. Although this guideline was developed for the western Oregon Cascades province, snags larger than 20 inches dbh are important to cavity nesters in all provinces, and have relatively slow decay rates. Smaller-diameter snags are generally less important to cavity nesters and are less likely to persist until suitable owl habitat develops. Thus, the salvage of these smaller-diameter snags should not impair the development of suitable habitat throughout the owl's range.

4. CWD biomass (i.e., down logs) provides habitat for organisms that are important food of several owl prey species, as well as having other habitat-enhancing characteristics. During the period of time required for new stands to begin to develop into suitable habitat, the only significant source of CWD is the previous stand. Following a stand-replacing disturbance in Douglas-fir/western hemlock forests in western Oregon and Washington, new stands do not begin to contribute significant amounts of CWD until they reach age 100 years (Spies and Cline 1988). In more productive areas, such as the coastal forests of northwestern California, regenerating stands may contribute significant quantities of CWD at a younger age.

   Following a stand-replacing disturbance, management should retain adequate CWD quantities in the new stand so that in the future it will still contain amounts similar to naturally regenerated stands. The analysis that determines the amount of CWD to leave must account for the full period of time before the new stand begins to contribute CWD. As in the case of snags, province-level specifications must be provided for this guideline. Since CWD decay rates, forest dynamics, and site productivity undoubtedly will vary among provinces and forest types, the specifications also will vary.

5. Some salvage that does not meet the preceding guidelines will be allowed when salvage is essential to reduce the future risk of fire or insect damage to suitable owl habitat. This circumstance is most likely to occur in the eastern Oregon Cascades, eastern

Washington Cascades, and California Cascades provinces, and somewhat less likely to occur in the Oregon Klamath and California Klamath provinces. It is important to understand that some risk associated with fire and insects is acceptable because they are natural forces influencing forest development where owls occur. Consequently, salvage to reduce such risks should focus only on those areas where there is high risk of large-scale disturbance.

6. Removal of snags and logs may be necessary to reduce hazards to humans along roads and trails and in or adjacent to campgrounds. Where materials must be removed from the site, as in a campground, a salvage sale is appropriate. In other areas, such as along roads, leaving material on site should be considered. Also, material will be left where available CWD is inadequate.

7. Where green trees, snags, and logs are present following disturbance, the green tree and snag guidelines (discussed earlier in this section) will be applied first, and completely satisfied where possible. The biomass left in snags can be credited toward the amount of CWD biomass needed to achieve management objectives.

8. These basic guidelines may not be applicable after disturbances in younger stands since remnant CWD may be relatively small. In these cases, diameter and biomass retention guidelines should be developed consistent with the intention of regenerating suitable owl habitat.

9. Logs present on the forest floor before a disturbance event provide habitat benefits that are likely to continue. It seldom will be appropriate to remove them. Where these logs are in an advanced state of decay, they will not be credited toward objectives for CWD retention developed after a disturbance event. Advanced state of decay should be defined as logs not expected to persist to the time when the new stand begins producing CWD.

10. The CWD retained should approximate the species composition of the original stand to help replicate preexisting suitable habitat conditions.

11. Some deviation from these general guidelines may be allowed to provide reasonable access to salvage sites and feasible logging operations. Such deviation should occur on as small a portion of the area as possible, and should not result in violation of the basic intent that owl habitat or the development of future owl habitat should not be impaired throughout the area. While exceptions to the guidelines may be allowed to provide access and operability, some salvage opportunities will undoubtedly be foregone because of access, feasibility, and safety concerns.

12. In addition to these stand-level salvage guidelines, the cumulative effects of any proposed salvage should also be considered at a larger scale. One focus of the analysis should be on spotted owl activity centers known before the disturbance and thought to still be occupied after the disturbance. Where owls are still thought to inhabit the area to be salvaged, the possible effect of salvage around their activity centers should be considered. In particular, special consideration should be given to stands that could again provide foraging opportunities for owls in the near future. For example, small disturbances or the edges of large disturbances may provide habitat for owl prey and access to that prey by owls. Also, denser clumps of residual dead trees may offer foraging opportunities for owls.

    The most current knowledge of prey species should be considered in these cases, and special guidelines developed for these areas. The cumulative effect of any salvage in these areas should be considered.

An example of the application of salvage wuidelines in western Oregon and western Washington.

This section contains an example of the application of salvage guidelines in the Douglas-fir/ Western Hemlock Zone of the western Oregon Cascades and western Washington Cascades provinces. The example shows how specific guidelines would be developed for an area where fire occurred in an old-growth forest stand.

This example is developed for salvage of a hypothetical stand in which a stand-replacing fire occurred. Before the fire, the stand would have been classified as old-growth. Live tree densities for the original stand are in Table 3.2. For this example, the stand is assumed to provide at least some value to owls 70 years after the fire.

Snag Retention

Snag decomposition rates are related inversely to diameter. The Snag Dynamics Projection Model developed by McComb and Ohmann (pers. comm.) predicts that in western Oregon and western Washington the probability of snags smaller than 20 inches dbh persisting for 70 years is less than 15 to 20 percent. Above this diameter, snag survival increases rapidly, reaching probabilities of survival as high as 59 percent and 87 percent for western hemlock and Douglas-fir, respectively, with diameters larger than 40 inches dbh.

Snags larger than 20 inches dbh are especially important for cavity-nesting birds. Nelson (1989) found significant selection by cavity nesters for snags of this size. Smaller snags were not selected. Carey et al. (1991) and Lundquist and Mariani (1991) also found greater use of larger snags. Since flying squirrels are secondary cavity users, management for higher densities of primary cavity nesters (i.e., cavity excavators) will benefit squirrels and, indirectly, owls. Retention of all snags larger than 20 inches dbh will maximize the number of residual snags available to flying squirrels, while providing important habitat for bird species that excavate cavities used by squirrels.

Application of the guidelines for salvage would provide retention of an average of 17 Douglas-fir and 9 hemlock snags per acre based on mean live-tree densities (Table 3.2) for those forests (Spies pers. comm.). Because of the diversity of initial diameters, predicting snag population survivorship is complex. However, projections based on decay rate constants of Harmon et al. (1986) suggested that about four Douglas-fir snags per acre will remain in 70 years. The Snag Dynamics Projection Model of McComb and Ohmann (pers. comm.) predicts that as many as nine Douglas-fir and two

Table 3.2. Live tree densities in example old-growth western Hemlock/Douglas-fir stand prior to stand-replacing fire.

	Stem Density per Acre by Size Class				
	2 to 4 inches	4 to 20 inches	20 to 40 inches	40 to 60 inches	60 inches+
Douglas-fir	10	17	8	7	2
Western Hemlock	23	33	8	1	0

hemlock snags per acre may persist. These estimates are within the range of densities for large snags commonly found in habitats used by northern spotted owls (see Appendix B, Tables B.4, B.5, and B.9). About two Douglas-fir snags per acre would persist until age 100 years when the stand would again start contributing significant quantities of large-diameter snags.

After 70 years, most residual snags will be well decayed but not all snags will have cavities. In mature forests (80 to 195 years old) in western Oregon and western Washington, an average 8 percent of snags larger than 20 inches dbh contained natural cavities and 24 percent had excavated cavities (Spies and Franklin 1991). Even if natural and excavated cavities were in different snags, which is a best-case scenario, only about 30 percent of all snags would have cavities. As a result, post-fire retention of all snags larger than 20 inches dbh may only provide two or three residual snags per acre with cavities. It is prudent to retain maximum numbers of large snags to provide for long-term needs of cavity nesters, including flying squirrels.

In this example, approximately 17 Douglas-fir and 33 hemlock stems per acre between 4 inches and 20 inches dbh would be available for salvage. The volume probably would be similar to that removed during commercial thinning. Application of the snag guideline provides for maximum densities of snags at 70 years, while allowing removal of smaller diameter stems that are unlikely to persist.

Log Retention

In the Douglas-fir/western hemlock forests of the western Oregon Cascades and Oregon Coast Range provinces, new stands do not begin to contribute significant amounts of CWD for 100 years after stand-replacing events. At that age, most naturally regenerated conifer forests contain 9 to 18 tons per acre of down logs (Spies et al. 1988). Assuming a 3 percent annual decay rate (Spies et al. 1988) for 100 years, at least 180 tons per acre of CWD should be retained to provide this quantity, and it may be appropriate to retain twice that amount. Therefore, approximately 50 percent, and possibly up to 100 percent of the original standing biomass of 270 to 360 tons per acre (Spies et al. 1988) must be retained on the site to provide the appropriate amount of CWD at age 100 years. In retaining this material, emphasis should be placed on down logs with diameters larger than 20 inches. These larger logs will decay relatively slowly and provide habitat for forest floor mammals during a longer time period (Carey and Raphael pers. comm.).

If regeneration is delayed, significantly greater amounts of CWD must be retained to compensate for delaying CWD production by the new stand 100 years hence. When areas are salvaged, it is extremely important to regenerate new stands as quickly as possible.

If green trees, snags, and logs are on-site following the disturbance, guidelines to retain all green trees and all snags with diameters larger than 20 inches should be applied first. The determination of CWD that must be retained should reflect the amount of biomass contained in the snags since this standing material eventually will become CWD. For example, if snags were estimated to provide 90 tons per acre, this amount would be deducted from the 180 tons per acre required to be left as logs.

In any case, where the combined biomass of snags and logs larger than 20 inches in diameter does not meet retention objectives (e.g., 180 tons per acre in the western Oregon Cascades and western Washington Cascades provinces), additional logs and/or snags of smaller diameter should be retained.

Guidelines to reduce risks of large-scale disturbance.

Large-scale disturbances are natural events, such as fire, that can eliminate owl habitat on hundreds or thousands of acres. Certain risk management activities, if properly planned and implemented, may reduce the probability of these major stand-replacing events. There is considerable risk of such events in DCAs in the eastern Oregon Cascades, eastern Washington Cascades, and California Cascades provinces and a lesser risk in the Oregon Klamath and California Klamath provinces (as documented in Appendix E). Elevated risk levels are attributed to changes in the characteristics and distribution of the mixed-conifer forests resulting from past fire protection. These forests occur in drier environments, have had repeated insect infestations, and are susceptible to major fires. Risk reduction efforts are encouraged where they are consistent with the overall recommendations in this section.

Silvicultural activities aimed at reducing risk should focus on currently unsuitable habitat in DCAs. The objective will be to accelerate development of suitable conditions for owls while making the future stand less susceptible to natural disturbances. Salvage activities should focus on the reduction of catastrophic insect, disease, and fire threats. Treatments should be designed to provide effective fuel breaks wherever possible. However, the scale of salvage and other treatments should not generally result in degeneration of currently suitable owl habitat.

In some DCAs in these provinces, management that goes beyond these guidelines may be considered. Levels of risk in those DCAs are particularly high and may require additional measures. Consequently, management activities designed to reduce risk levels are encouraged in those DCAs even if a portion of the activities must take place in currently suitable habitat. While risk-reduction efforts should generally be focused on currently unsuitable habitat, activities in suitable habitat may be appropriate if: 1) the proposed management activities will clearly result in greater assurance of long-term maintenance of habitat, 2) the activities are clearly needed to reduce risks, and 3) the activities will not prevent the DCA from playing an effective role in owl population stabilization and recovery. Section III.E. identifies DCAs where high-risk conditions are currently known and special emphasis on risk reduction may be appropriate.

Guidelines for coordination of other multiple-use activities.

A variety of activities currently occurs in DCAs or may be proposed in the future. The highest priority of DCA management is to meet owl needs and promote recovery, and all activities will be evaluated by that standard. The type and extent of multiple-use activities will vary among DCAs, and will be reflected in DCA management plans. It will be necessary to modify or eliminate activities that pose adverse impacts to owls, and impose seasonal or other appropriate restrictions on some other proposed actions. This may require the revision of management guidelines, procedures, or regulations governing these multiple-use activities.

As a general guideline, agencies will analyze all current and proposed multiple-use activities within one-quarter mile of the known owl activity centers in DCAs to assess the likelihood of significant effects on owl reproductive success. This assessment will be included in DCA management plans (a sample outline for a management plan follows this section). Activities that may disrupt owl reproduction will be prohibited under the DCA management plan during a period established by the local FWS field office. In addition, the following guidelines will be followed for specific activities most likely to require attention in DCA management plans.

Road Construction and Maintenance. Transportation needs must be assessed for the DCA and for adjacent areas. The assessment will consider all existing and planned activities in the DCA. Access to nonfederal lands through DCAs will be considered and existing rights-of-way agreements will be recognized as valid. A determination will be made if existing roads are needed or if closure and rehabilitation are appropriate. Future needs of road access for fire protection must be considered when identifying roads for closure and rehabilitation.

Road construction in DCAs for silvicultural, salvage, and other activities generally is not recommended, unless potential owl habitat benefits clearly exceed the costs of habitat impairment. Alternatives such as aerial logging should be considered to provide access for activities in DCAs. If new roads are necessary to implement a practice that is otherwise in accordance with these guidelines and an approved DCA management plan, they will be kept to a minimum, be routed through unsuitable habitat where possible, and be designed to minimize adverse impacts on owl habitat.

New road construction through DCAs may be necessary to access nonfederal lands. In these cases, alternate routes that avoid the DCA should be considered. If roads must be routed through a DCA, they will be designed and located to have the least impact on owls and owl habitat. New roads will not be constructed through suitable owl habitat unless no other feasible alternatives exist.

Road maintenance may include the felling of hazard trees along rights-of-way. Such felling should leave the down trees as CWD unless fuel accumulations are a concern or the down trees pose some other hazard. Topping of trees should be considered as an alternative to felling.

Fuelwood Gathering. If allowed, fuelwood gathering will be restricted to existing cull decks, blowdown blocking roads, or green trees marked by silviculturists to thin overstocked unsuitable habitat. These areas will be mapped as part of DCA management plans or project plans and mitigation recommendations will be included.

Mining. The impacts of ongoing and proposed mining actions will be assessed, and mineral activity permits will include appropriate stipulations (e.g., seasonal or other restrictions) related to all phases of mineral activity.

Developments. In general, construction or development of new facilities that may adversely affect owl habitat or reproductive success should not be permitted in DCAs. Proposals that address public needs or provide significant public benefits, such as power lines, pipelines, reservoirs, or other public works projects, will be reviewed on a case-by-case basis and may be approved when adverse effects can be minimized and mitigated. Maintenance of existing facilities is expected to have less effect on owl recovery than development of new facilities, and such activities may also be approved. Maintenance activities may include the felling of hazard trees along utility rights-of-way. Whenever possible, maintenance, construction, and development of projects should be anticipated and addressed in DCA management plans.

Trail Development. New trail construction will be planned to have the least possible adverse effect on owls. Trails will be located to avoid degradation of suitable owl habitat and adverse effects on owl activity centers.

Land Exchanges. Land exchanges involving DCAs will be considered when they will either promote owl recovery or provide owl benefits equal to current conditions. Acquisition and consolidation of federal lands to improve owl population clusters will benefit recovery likelihood, especially in provinces that have large nonfederal land ownership.

Recreation and Habitat Improvement Projects. Projects designed to improve conditions for fish, wildlife, watershed, or recreation should be considered if they provide owl habitat benefits or their effect on owls or owl habitat is negligible. Small projects required for recovery of other threatened or endangered species should be considered even if they result in some reduction of habitat quality for owls. In all cases, appropriate interdisciplinary coordination will be provided. For example, watershed rehabilitation projects, such as felling trees along streams, will be coordinated with a wildlife biologist and may include seasonal restrictions.

Range Facilities. Range-related facilities that do not affect owls or owl habitat adversely will be developed in coordination with wildlife biologists. Existing grazing activities which have an adverse effect on owl habitat or owl use of the area will be modified.

Fire Suppression and Prevention. Fuels management in the DCA will be in accordance with guidelines for reducing risks of large-scale disturbances where appropriate. Plans for wildfire suppression will emphasize maintaining owl habitat in the DCA. During actual fire suppression activities, a resource specialist familiar with the area and the DCA management plan will be included to assure that habitat damage is minimized.

Christmas Tree Sales. Christmas tree sales may be allowed in areas where trees are removed in accordance with the objective of accelerating the development of suitable habitat conditions in areas that currently are unsuitable. The guidelines for silvicultural activities will be used as appropriate.

Minor Forest Products. Minor commercial uses, such as the collection of ferns, mosses, and mushrooms, generally may be allowed. Where these activities are extensive (e.g., collection of Pacific yew bark), it will be appropriate to evaluate whether they have significant effects on owl habitat. Restrictions may be appropriate in some cases.

Recreational Uses. Dispersed recreational uses, including hunting, generally are consistent with the objectives of DCAs, except as specifically noted elsewhere in the recovery plan.

Research. A variety of wildlife and other research activities (e.g., water quality) may be ongoing and proposed in DCAs. These activities must be assessed to determine if they are consistent with DCA management objectives. Some activities not otherwise consistent with the objectives may be appropriate particularly if the activities will produce results important for owl conservation or the activities represent continuation of long-term research. Such activities should only be considered if there are no equivalent research opportunities outside of the DCAs.

Rights-of-Way, Contracted Rights, Easements. Existing and proposed agreements will be evaluated and revised, where feasible, if they have an adverse effect on owl recovery. In some cases, preexisting agreements may pose legal issues or raise other concerns that require consideration in the DCA management plan.

Other. All other activities should be evaluated by local interdisciplinary teams and appropriate guidelines should be written and documented in the DCA management plan.

A Sample outline for DCA management plans.

This outline provides information for preparing DCA management plans. The DCA description and the multiple-use coordination sections address many management activities that may or may not apply to a particular DCA. Components of these sections not relevant to an individual DCA should be identified as not applicable.

A. Introduction. Provide a clear, written description of the DCA, including an appropriately referenced location map.

B. Status of Spotted Owls. Include data about owl status in the area, but do not include specific nest site locations. Instead, reference files containing additional data and nest site location maps so this information can be accessed easily.

Summarize monitoring data for each known owl activity center to provide the following information: year, presence, occupancy, and reproductive status. Also include documentation of owl surveys that do *not* detect owls, with the year, intensity of effort, and location.

C. DCA Description. Provide a description of the landscape and the factors pertinent to management of the area. Such factors might include, but are not limited to:

1. General vegetation. Provide type, elevation, aspect, drainages (provide maps).
2. Land ownership. Include a breakdown of acreage by ownership and a map.
3. Developments. List and map recreational facilities, roads, and other developments.
4. Fire and fuels. List and map fire history and occurrences and fuel-loading considerations.
5. Forest health. List insect and disease concerns and map areas of concern.
6. Timber management activities. List and map past timber harvest and silvicultural activities.
7. Wildlife and fisheries. Describe wildlife and fisheries communities in the area, their management history, specific concerns, and opportunities.
8. Threatened, endangered, and sensitive species. List threatened, endangered, and sensitive species in the area and proposed management for them.
9. Other uses. List and map any other management considerations not identified earlier, such as:
    - Proposed and expected land exchanges.
    - Minerals extraction.
    - Federal Energy Regulatory Commission (FERC) permits and applications.
    - Research natural areas (RNAs).
    - Wild and scenic rivers.
    - Wilderness.
    - Livestock grazing.
    - Fuelwood gathering areas.
    - Watershed considerations, including existing and proposed impoundments.

D. Spotted Owl Habitat Conditions. Provide a map of spotted owl habitat conditions in the DCA, including locations of nesting, roosting, and foraging habitat and dispersal habitat. Describe the overall habitat conditions including a discussion of habitat fragmentation and areas where good habitat conditions are concentrated. Relate habitat condition to knowledge of owl locations and the history of owl locations in the DCA. Based on this information, describe the most significant habitat-related opportunities and concerns for the DCA.

E. DCA Management Objectives. Based on the recovery plan objectives, owl habitat requirements, and existing habitat conditions in the particular DCA, describe management objectives and desired future conditions for specific areas in the DCA, and provide supporting documentation. The description of desired future condition should be developed first at a landscape scale, and should be related to current owl use and future expected use. The desired future condition should be used to develop objectives that are specific enough to guide silvicultural prescriptions and provide direction for planning other management activities.

The statement of management objectives should: 1) identify areas of unsuitable habitat where silvicultural treatment will be used to facilitate the development of suitable habitat and reduce the fragmentation of habitat in the DCA, 2) identify land exchanges that would provide additional suitable habitat, 3) identify roads no longer needed that could be closed or rehabilitated, and 4) identify areas of fuels management concerns in and adjacent to the DCA. Each management objective will include a map showing areas where the management activity will occur in relation to known owls and habitat.

F. **Silviculture.** Provide a description of the silvicultural prescriptions that are appropriate for the area. Prescriptions should be developed by silviculturists and wildlife biologists. They will contain descriptions of activities necessary to implement each prescription during a 10-year planning period, and will include the following information (easily accessible in permanent files):

1. Descriptions of types and locations of stands where the prescription would be applied.
2. Stand objectives including:
   - a discussion of desired habitat features and how the prescription will provide for them over time.
   - a description of expected stand development over time.
   - an estimate of the time required to achieve objectives in the stand.
3. Silviculture prescriptions and systems.
4. Site preparation treatments.
5. Planting, including information about species that will be planted.
6. Release.
7. Hardwood management.
8. Thinning.
9. Specific actions that will be taken to recruit snags and CWD.
10. A projection of how the stand would develop in the absence of any treatments, and a comparison to the treated stand to demonstrate the benefits of treatment.

In addition, this section should contain, at a minimum, a 5-year projection of the acreage that will be treated under each prescription.

G. **Risk Management.** Identify and define the risks to suitable habitat or potentially suitable habitat through an analysis which includes a discussion of: wildfires, pathogens, wind, insects, and stand density. Based on the analysis, DCA management plan recommendations for risk management will be developed, including prescriptions and implementation plans.

To assure effective fuels management in the DCA, significant fuel accumulations will be identified so they can be managed through prescribed burning or other means, as recommended in the recovery plan.

The DCA management plan will take into account conditions on matrix lands adjacent to DCAs. Silviculturists and fire specialists will evaluate these lands to determine whether such conditions pose a fire or windstorm threat to the DCA, and address them in the DCA management plan. The DCA management planning process also should highlight matrix-related concerns to be addressed through means other than the DCA management plan. For example, it may be necessary to evaluate harvest unit placement and layout to determine the effects of future fuels treatment on owls and owl habitat. Based on that evaluation, unit location may require modification to meet objectives of owl management. In addition, proposed prescribed burns in the matrix will be evaluated. Seasonal restrictions and limitations on locations of burns will be imposed as appropriate.

H. **Salvage.** The recovery plan includes general guidance for salvage of dead trees in the DCAs. Provide specific guidelines for salvage consistent with recovery plan recommendations. These specific guidelines should be based on province-level guidelines prepared by the agencies and reviewed by the coordinating group established to help implement the recovery plan.

I. **Multiple-Use Coordination.** The recovery plan provides recommendations concerning a wide variety of activities that already may occur or may be proposed in DCAs. As applicable, address these in individual DCA management plans. A proposed or existing activity can proceed if, through an evaluation process, a determination is made that the activity complies with the recommendations in a finalized and accepted DCA management plan.

The recovery plan recommends the evaluation of all proposed activities within one-quarter mile of known owl activity centers to determine the effects on owl reproductive success. Activities that would disrupt breeding will be prohibited during a time period specified by the local FWS field office. Aside from this general restriction, the DCA management plan will tailor management practices according to the existing and potential impacts of proposed activities on owl needs and recovery. As noted in the recovery plan, it may be necessary to modify or eliminate current activities that pose adverse impacts, and impose seasonal or other appropriate restrictions. Consequently, the DCA management plan may require the revision of management guidelines, regulations, or procedures governing particular activities.

The following list includes activities most likely to require attention in DCA management plans. Individual plans will address other concerns, as appropriate to the situation in the specific DCA.

1. Road construction and maintenance.
2. Fuelwood gathering.
3. Mining.
4. Development of new facilities.
5. Trail development and maintenance.
6. Land exchanges.
7. Recreation and habitat improvement projects.
8. Range facilities.
9. Fire suppression and prevention.
10. Christmas tree sales.
11. Minor forest products.
12. Recreational uses.
13. Research.
14. Rights-of-way, contracted rights, easements.

J. **Monitoring.** Monitoring should focus on specific activities proposed in the DCA, and should also be tiered to overall monitoring efforts. Efforts should include monitoring of owls and monitoring of habitat.

1. Northern spotted owls. Monitoring tasks and informational needs will be defined, consistent with recovery plan recommendations (see section III.K.). Monitoring of owls will be particularly important in areas where silviculture and salvage activities are implemented.

2. Habitat. Habitat information should be updated periodically in accordance with recovery plan recommendations (see section III.K.). It also should be updated after any significant event (e.g., wildfire, windstorm) that has the potential to alter vegetation. Monitoring of habitat is

especially important in areas where silviculture and salvage activities are practiced. This monitoring would assess 1) whether the activities were implemented properly, and 2) whether they produce the desired effects on habitat. A monitoring plan for these activities is a prerequisite to their implementation. Monitoring should be considered for the following parameters:

- stocking and basal area following thinning
- regeneration establishment and seedling survival
- logging effects
- snag creation
- development of canopy closure and multiple-canopy layers
- shrub development
- stocking and density changes over time.

K. Coordination. All landowners and managers should cooperatively prepare the DCA management plan. Plan development should also include state wildlife agencies and the FWS. Private landowners who choose not to actively participate should be given an opportunity to review the DCA management plan during its development. This cooperation is crucial to the success of inventory and monitoring efforts and to the appropriate implementation of silviculture, salvage, and risk reduction activities. Mechanisms to assure ongoing coordination must be identified in the DCA management plan.

L. List of Preparers. This list should identify everyone who was involved in development of the DCA management plan.

M. References. Include appropriate references as necessary, a list of National Environmental Policy Act (NEPA) documents pertaining to the area, the record of decision, and a brief description of the action for each DCA management plan.

2. Other Federal Lands

For the purposes of the recovery plan, the matrix is defined as lands in the range of the northern spotted owl that are outside of DCAs. This discussion is specific to federal matrix lands. Recovery recommendations for nonfederal lands are in section III.E.

Federal matrix lands will make several essential contributions to recovery. Their most basic function is to maintain adequate habitat conditions to allow movement of owls among DCAs. As described in section III.A., this interchange among DCAs is necessary to allow functioning of the whole spotted owl population. The second function of the matrix is to maintain reproductive owl pairs, where possible, in areas where DCAs cannot fully meet the standards (see section III.C.1.) established for them. These matrix owl pairs will help supplement DCAs where owl populations or habitat are deficient until those deficiencies can be corrected. In some cases, population deficiencies in DCAs may not be corrected for a long period of time and owl pairs in the matrix will remain part of the recovery strategy for the foreseeable future. In other areas, the matrix will be required to support pairs of breeding owls as a safeguard against the possibility of large-scale loss of habitat in DCAs from fire, insects, and diseases. Finally, the matrix will contain additional small areas of nesting habitat that will help preserve options to reestablish owls throughout the landscape.

Since habitat conditions and owl populations vary throughout the spotted owl's range, specific objectives for matrix forests also will vary. Three matrix management prescriptions have been identified. Criteria were developed to determine where these prescriptions will be applied. Those criteria and the implementation guidelines are described in this section. The province narratives (see section III.E.) identify the locations where the prescriptions will be applied.

Recommendations for federal matrix management provide for a broad mix of management activities. It is expected that a wide variety of commercial timber activities will occur in the matrix, with their timing and location designed to meet the conditions specified for the matrix. For some matrix management prescriptions, the acreage on which habitat objectives are met may shift through time. For other prescriptions, such as the reserved pair areas, a more restricted range of activities is described.

Matrix Prescriptions

Prescription A: Maintain dispersal habitat and owl activity centers.

Management objective: Provide habitat to support dispersing owls and maintain residual habitat areas that protect core areas for pairs and territorial singles in the matrix. The other matrix prescriptions are supplemental to this minimum requirement.

Discussion: The minimum role of the matrix is to provide habitat conditions adequate to assure at least short-term survival of a significant proportion of dispersing owls (see sections II.A. and III.A.). To achieve species recovery, the matrix must play this role. The matrix also must protect habitat around a given number of owl activity centers referred to as residual habitat areas. The size requirement for residual habitat areas is based on information about how owls use their home ranges during the breeding season. These areas will not meet long-term needs of owls. However, they will provide areas of high-quality habitat for dispersing owls, prevent the direct elimination of nesting areas, and provide cores of suitable habitat to preserve future options for managing owls in the matrix. Given the long-term goal to reestablish owls throughout the landscape, providing residual habitat areas is essential.

Criterion for applying prescription: Management to achieve these minimum matrix objectives will be practiced on federal lands throughout the range of the owl where forests are sufficiently productive to attain the conditions specified.

Management guidelines for prescription A.

Residual habitat areas:

1. The number of residual habitat areas to be provided is based on densities of owl pairs observed in spotted owl study areas. These target densities vary by province (Table 3.3).

2. Residual habitat areas will be provided for all known and newly discovered owl pairs and territorial singles up to this density.

3. Each residual habitat area will include a minimum of 100 acres of suitable habitat as close to the nest site or owl activity center as possible. This is intended to preserve an intensively used portion of the breeding season home range. Timber management in this area is not appropriate. Management around the area will be designed to reduce the risks of natural disturbance.

Table 3.3 Density of residual habitat areas.

Physiographic Province	Areas Per Township
Olympic Peninsula	4
Western Washington Cascades	6
Eastern Washington Cascades	6
Western Oregon Cascades	8
Eastern Oregon Cascades	6
Oregon Coast Range	8
Klamath (Oregon and California)	10
California Coast Range	10
California Cascades	6

Dispersal habitat:

1. At least 50 percent of the federal forest matrix outside of the DCAs will be managed to provide stands of trees that average at least 11 inches dbh and have at least 40 percent canopy closure. This 50-11-40 rule will be applied in each quarter-township, and will be calculated based on the amount of federal lands in that quarter-township. Calculations should be made separately for lands managed by each of the federal agencies. All forested lands capable of attaining the 11-inch dbh standard and the 40 percent canopy closure standard will be included in the calculation. Hardwoods may be included in meeting the canopy closure standard, but excluded from the diameter calculation where they normally do not attain that size. Canopy contribution of hardwoods will be counted only for evergreen hardwoods. There should be reasonable flying space under the hardwood canopy (i.e., 6 or more feet between the bottom of the hardwood canopy and the top of the shrub layer). The acreage of reserved pair and managed pair areas (see matrix prescriptions B and C) and residual habitat areas may be included in the calculation.

   In general, a stand meets the 50-11-40 rule if the tree of average basal area is at least 11 inches dbh and the total canopy closure is more than 40 percent. However, where there is much variation in dbh, the intent is that 40 percent canopy closure be contributed by trees that meet or exceed the 11-inch dbh standard.

2. In some discrete situations, the 50-11-40 rule may not be fully met on federal lands in individual quarter-townships. This could occur for a variety of reasons, including but not limited to: prior harvest activities, natural disturbances, failure of stands to respond as expected to management, or agency decisions to modify or otherwise not fully adopt the rule. The consequences of not fully meeting the 50-11-40 rule will vary from site to site, perhaps considerably, based on many factors related to land ownership patterns, habitat status, and landscape conditions. In some circumstances,

there may be less risk in deviations from 50-11-40 conditions than in other circumstances. One example might be a small, isolated tract of federal lands remote from any DCAs. Proposals that would result in not meeting the 50-11-40 rule should be assessed through the section 7 consultation process. Through this process, agencies should have the opportunity to justify individual proposals to achieve adequate dispersal conditions through means other than adherence to the 50-11-40 rule. Any proposals for large-scale changes in the rule should occur through the adaptive management process (see section III.K.). The development of such proposals is considered most likely for the eastern Washington Cascades, eastern Oregon Cascades, and California Cascades provinces.

Prescription B: Supplement DCA network.

Management objective. Provide habitat (reserved pair and managed pair areas) for owl pairs and territorial singles in the matrix to supplement the DCA network where the network is deficient because it fails to meet: 1) criteria for existing owl activity centers in DCAs, 2) criteria for existing habitat acreage in DCAs, and/or 3) criteria for overall distribution of the network and owl activity centers throughout the landscape.

Discussion. Existing habitat and landownership conditions make it impossible to implement a fully adequate DCA network throughout the owl's entire range. At numerous locations the existing distribution of habitat and/or owls necessitated deviation from the size, spacing, or owl numbers criteria (see section III.C.1.). Where these deficiencies are significant, it is important to supplement DCAs by maintaining additional suitable habitat and owl activity centers in the matrix. These additional areas may either contain habitat that is simply reserved from harvest (reserved pair areas) or is managed for owl habitat (managed pair areas). These provisions for owls in the matrix are intended to improve interim stability of the owl population and provide additional assurance of dispersal success throughout the matrix.

Criteria for applying prescription. Reserved pair or managed pair areas will be established under prescription B where any of the following conditions occur:

1. Category 1 DCAs contain fewer than 15 currently known owl pairs and territorial singles. The standard here is set at 15 known pairs or territorial singles rather than 20 because it is expected that some pair sites in a DCA might not be occupied at any given time. Even when a DCA has the capability to support 20 pairs, fewer than 20 pairs may actually be present at a particular time. This standard was derived from a table of expected occupancy of areas given different numbers of interacting pair sites and different amounts of suitable habitat in the area (Voss and Noon pers. comm.). These DCAs can be identified in the tables in section III.E.

2. Category 1 DCAs have a current expected capability to support fewer than 20 pairs of owls based on habitat conditions in the DCAs. These areas can be identified in the DCA tables in section III.E. In some situations, DCAs may currently contain more than 20 owl activity centers even though their capability is less. This is thought to result from recent decreases in habitat inside the DCA, or from owls moving into the DCA because of recent harvest activity outside the DCA. Supplementing the DCA will be appropriate in these cases if adequate habitat is not present.

3. In areas composed of category 2 DCAs, the two previous criteria cannot be applied because there is no size standard for category 2 DCAs. Instead, the adequacy of these

portions of the DCA network is judged by the density of protected owl activity centers calculated on a landscape basis. This density calculation is based on acreage in the DCAs and in the matrix. The standard used to determine the need for prescription B areas is an average of two protected owl activity centers per township for the land area being evaluated. This standard was based on the landscape density of a DCA network that fully meets the minimum standards for category 1 areas (20 pair areas spaced 12 miles apart). The need for prescription B areas under this guideline was determined by delineating zones of category 2 DCAs in the network, tallying currently known owl activity centers protected in those zones, and calculating the required number of protected owl activity centers based on the total area of the zones. Maps of these zones are in the recovery plan's administrative record.

Management guidelines for prescription B (assumes implementation of prescription A).

***Designation of areas*:**

1. Where a category 1 DCA does not currently contain sufficient owl activity centers, provide reserved pair or managed pair areas for matrix pairs or territorial singles to increase to 15 the total known owl activity centers associated with the DCA (i.e., the sum of owl activity centers inside the DCA plus those matrix areas designated to supplement it).

2. Where a category 1 DCA does not contain adequate suitable habitat to support at least 20 owl pairs, habitat will be designated in reserved pair or managed pair areas so that the total amount of habitat associated with a given category 1 DCA is adequate to support 20 owl pairs. This will be determined as the sum of the current expected capability for the DCA (see DCA tables in section III.E.) plus the capability of the reserved pair or managed pair areas designated to supplement the area.

3. For areas that do not meet the landscape density criterion, provide enough reserved pair or managed pair areas so that the total protected owl activity center density equals the density where all guidelines for the DCA network are met. This density is an average of two owl activity centers per township.

4. To identify reserved pair and managed pair areas, search for owl activity centers that are as close as possible to the DCAs.

5. The areas designated under prescription B will generally be reserved pair areas. However, managed pair areas may be used in some situations where there is good opportunity to manage habitat or where there is high risk of catastrophic loss of habitat. Management guidelines for reserved pair and managed pair areas are presented next.

6. The reserved pair and managed pair areas that are required by these guidelines were mapped in conjunction with the land management agencies. They are described in section III.E., but are not displayed on the maps included with this document.

7. Reserved pair and managed pair areas will count toward the residual habitat area densities for prescription A.

***Delineation and management of reserved pair areas*:**

1. For each reserved pair area, delineate an area surrounding the owl activity center with an acreage at least equal to the median home range size for pairs in that province. Use data from the spotted owl study area that is most similar to the site being considered (Table 2.1). This area will be delineated to encompass as much suitable habitat as possible, and that habitat will be as close to the owl activity center as possible. Reserve all suitable habitat in that area from timber harvest. If the habitat acreage does not at least equal the median amount found for owl pairs in the province (Table 2.1), additional habitat must be provided from the next best habitat available in the home range area, or by expanding the area to incorporate additional suitable habitat. Use logical physical boundaries to facilitate management of the area. DCA management guidelines for salvage and other multiple-use activities would generally apply in the suitable habitat portion of the reserved pair area.

2. In the reserved pair areas, allow for management of currently unsuitable areas consistent with DCA management guidelines for silviculture and salvage. Management of other multiple-use activities in the unsuitable habitat should follow guidance from agency planning documents, which may allow some activities that would not be consistent with DCA management guidelines.

***Delineation and management of managed pair areas*:**

1. For each managed pair area, delineate an area surrounding the owl activity center with an acreage at least equal to the median home range size for pairs. The size of this area will be determined from median home range data for the province (Table 2.1). Use data from the spotted owl study area that is most similar to the site being considered. The delineated area should be configured so that it contains an amount of suitable habitat that approximates at least the median amount observed in pair home ranges for the province (Table 2.2).

2. Suitable habitat should be maintained through time using various management techniques. The objective will be to always maintain an amount of suitable habitat equal to median amounts observed in pair home ranges in the province. The location of this acreage may change through time as management is rotated through the area. Some uncertainty will be accepted in management to provide habitat in these areas. Refer to Appendix F for examples of management techniques useful in providing for suitable habitat conditions through time.

3. Silviculture, salvage, and other multiple-use activities for these areas always should be guided by the objective of maintaining adequate amounts of suitable habitat.

***Review and oversight for prescription B*:**

1. Management activities proposed in the reserved pair and managed pair areas should be documented and reviewed by the coordinating group established to help implement the recovery plan (see section IV.C.). This review is especially important for activities proposed in the managed pair areas where innovative silvicultural techniques may be applied to manage suitable habitat through time. These techniques may benefit from technical review by the coordinating group.

2. The intent to accommodate some risk in the managed pair areas should be considered in any section 7 consultations in these areas.

Prescription C: Reduce threat from disturbance.

Management objective. In addition to the minimum requirements of prescription A, provide habitat (managed pair areas) for owl pairs and territorial singles in the matrix to supplement DCA populations in areas where there is significant threat of large-scale disturbance in DCAs.

Discussion. The probability of large-scale disturbances in DCAs in different provinces throughout the owl's range was assessed by Agee and Edmonds (Appendix E). In the Oregon Klamath and California Klamath provinces and the eastern Cascades provinces of Oregon and Washington, there is significant probability of large-scale disturbances to the suitable habitat in DCAs due to drought, insects, diseases, and fire.

Several recovery plan factors help to compensate for this potential threat to the DCA network. First, the multiple connections designed into the DCA network helps to buffer owl populations against catastrophic loss in any individual DCA. Second, as noted in section III.C.1. and Appendix E, some forms of active management (e.g., fuels management) may help to reduce the risk of large-scale disturbance in the DCAs. Finally, prescription C calls for innovative management to be used in the matrix to help provide for breeding owls in these managed forests. This will reduce the dependence of owl populations on the DCA habitat.

Criterion for applying prescription C. For application of this prescription, an area must be in high-risk parts of provinces identified by Agee and Edmonds (Appendix E) as having a low probability of long-term maintenance under a strategy where habitat is not managed, but is protected from fire. This prescription will be applied immediately in the California Cascades, eastern Washington Cascades, and eastern Oregon Cascades provinces. Application of this prescription to the Oregon Klamath and California Klamath provinces also should be considered but is not included as an immediate recommendation.

Management guidelines for prescription C (assumes the implementation of prescription A).

Delineation and management of managed pair areas:

1. For all owl activity centers identified under prescription A, delineate an area approximating the size of a pair home range surrounding the activity center. The size of this area will be determined from median home range data for the province (Table 2.1). Use data from the spotted owl study area that is most similar to the site being considered. The delineated area should be configured so that it contains an amount of suitable habitat that approximates the median amount observed in pair home ranges for the province (Table 2.2). If there is inadequate suitable habitat in the home range area, the delineated area should be expanded to include additional habitat if possible.

2. Suitable habitat should be maintained through time using various management techniques. The objective will be to always maintain an amount of suitable habitat at least equal to median amounts observed in pair home ranges in the province. The location of this acreage may change through time. Management will be designed to provide suitable habitat conditions and to alleviate the forest conditions leading to significant threat of large-scale disturbance. Some uncertainty will be accepted in management to provide habitat in these areas. Refer to Appendix F for examples of silvicultural prescriptions useful in providing for suitable habitat conditions through time.

3. Silviculture, salvage, and other multiple-use activities for these areas should be guided by the objective to always maintain the specified amount of suitable habitat. However, in some areas, the amount of currently suitable habitat in managed pair areas may not equal median amounts observed in home ranges. Despite this deficiency, management in suitable habitat should be encouraged if it is necessary to reduce severe risk of catastrophic habitat loss.

Review and oversight for Prescription C:

1. Management activities proposed in the managed pair areas should be documented and reviewed by the coordinating group established to help implement the recovery plan (see section IV.C.). This review is especially important for innovative silvicultural techniques which may be applied to manage suitable habitat through time. These techniques may benefit from technical review by the coordinating group.

2. The intent to allow some risk in the managed pair areas should be considered in any section 7 consultations in these areas. Greater risks may be accepted here than in prescription B areas in order to begin alleviating the threat of large-scale disturbance. This could result in some negative impact on current owl activity centers. The consultation process provides the flexibility to accept this level of risk.

Adaptive Management for Matrix Prescriptions

Several of the matrix management prescriptions are intended to be interim measures. They are meant to supplement the DCA network while appropriate conditions are being developed inside of the DCAs. The purpose of this discussion is to 1) clarify which portions of the matrix management prescriptions are intended to be interim and 2) describe how the direction for matrix management would change over time. Table 3.4 presents a summary of the matrix prescriptions and their expected duration.

As noted in the Table 3.4, prescription B areas are intended to change over time if conditions in DCAs improve. The bases for allowing those changes are discussed in the following section.

Changing management over time for the interim recommendations.

Criteria for changing prescription B areas over time will vary depending on the reasons for their designation. A discussion based on each of these reasons for designation follows. (Documentation of the basis for establishment of each of the prescription B areas is in the recovery plan's administrative record.)

Guideline 1: Supplementing existing pairs of owls in category 1 DCAs.

Either reserved pair areas or managed pair areas may be designated under this criterion. These should be retained until the DCA is verified to contain at least 15 owl activity centers. The standards for verifying 15 owl activity centers are:

1. A single year of six-visit surveys using FWS protocol standards, or
2. Two years of three-visit surveys using FWS protocol standards, not requiring a second year of survey of owl activity centers verified in the first year.

Table 3.4. Summary of the matrix prescriptions and their expected duration.

	Prescription A
Dispersal Habitat	Provided by managing federal forestlands to meet the 50-11-40 rule. This is a long-term recommendation.
Residual Habitat Areas	Core areas of owl activity centers will be maintained in at least 100-acre areas established for owls in the matrix where incidental take is allowed. This is a long-term recommendation.
	Prescription B
Reserved Pair Areas and Managed Pair Areas	These areas will be established to provide for reproductive owl pairs in the matrix where needed to supplement deficiencies in the DCA network. These are interim recommendations that can change when conditions in DCAs improve.
	Prescription C
Managed Pair Areas	These areas will provide for owl activity centers to serve as a back-up in places where DCAs are subject to large, catastrophic loss of habitat. Habitat will be managed to reduce risks of catastrophic events. This a long-term recommendation.

DCA - designated conservation area.

3. In some situations, 2 years of six-visit surveys with the DCA divided in two parts, and each part being surveyed in only one of the years. This would be considered appropriate only for DCAs where topography and access make survey of the entire DCA in a single year very difficult.

Modification of some prescription B areas should be considered as the DCA moves closer to meeting the criterion for 15 owl activity centers. As an example, a DCA might have only six known owl activity centers and have nine designated reserved pair areas. If one of the survey methods noted previously results in verification of 12 owl activity centers inside of the DCA, it would be appropriate to change the direction for 6 of the reserved pair areas to prescription A. If some of these areas had been used to meet the target for residual habitat areas, they would have to retain at least that status.

Guideline 2: Supplementing existing habitat in category 1 DCAs.

Modification of these prescription B areas should be dependent either on 1) the development of additional habitat in the DCA, or 2) a demonstration that the owl population in the DCA meets objectives and is stable. Development of new habitat should be judged based on the most recent definition of suitable habitat for the area. Total capability of the habitat should be evaluated using habitat capability calculations such as those used in this recovery plan.

Demonstration that the owl population is stable under existing habitat conditions could be accomplished by gathering density, reproduction, and survival data. The type of data and years of data needed to establish stability should be based on modeling efforts that explore how long an owl population in a DCA could be sustained at an artificial level by floaters and displacement from other habitat. *Where prescription B areas are needed under both guideline 1 and guideline 2, they should not be modified until both guidelines are met.*

Guideline 3: Supplementing existing pairs in category 2 zones.

Either reserved pair areas or managed pair areas may be designated under this criterion. These should be retained until the DCAs in the zone (see prescription B in this section for discussion of zones) contain enough owl activity centers to meet the target for the zone. The standard of verification for each DCA should be the same as under guideline 1, but the whole group of DCAs can be surveyed for as long as 3 to 5 years. As with guideline 1, there should be an interim step where some of the pair areas can be considered for modification based on discovery of new owl activity centers inside of the DCAs.

Process for modifying the direction for matrix areas.

When the criteria are met, it will be appropriate to consider modification of the management direction for one or more of the reserved pair or managed pair areas. The proposal for modification should be developed by the responsible management agency, and that proposal should be directed through the adaptive management process described in section III.K. During the adaptive management review, it may be appropriate to consider factors such as the status of surrounding DCAs, recent owl population trends in the province, the status of dispersal habitat in the area, new information about the dynamics of local populations in DCAs, and the relationships among actions taken on lands of different ownership or management authority. If a decision is made to modify direction for these areas, at a minimum the areas should still meet the standards for prescription A. Agencies are encouraged to consider measures beyond prescription A that would continue to provide habitat to maintain owls in these areas and speed recovery.

Interactions Between Federal and Nonfederal Matrix Lands

Recommendations for federal and nonfederal lands in the recovery plan are intended to provide an integrated plan that will accomplish recovery goals. Therefore, it is important to note the interactions between federal and nonfederal recommendations (see section IV.A. and section III.E.). In matrix lands, federal and nonfederal recommendations will interact in providing for dispersal habitat and for reserved pair and managed pair areas.

In some areas, recommendations are made for nonfederal lands to contribute to the maintenance of dispersal habitat (see individual province narratives in section III.E.). Generally, these are large areas of nonfederal lands or areas of mixed federal and nonfederal ownership. The contributions are needed because the maintenance of 50-11-40 habitat on federal lands alone in these areas would not adequately provide for dispersal. The second area of federal/nonfederal interaction is the potential to count owl activity centers on nonfederal lands toward the number of required managed pair or reserved pair areas. These owl activity centers may be counted if the protective measures in place result in a level and duration of protection equivalent to that provided under prescription B or C. The protective measures can be demonstrated through recognizable and enforceable instruments, such as state forest practices rules, approved habitat conservation plans, existing easements, title restrictions, or other agreements on the part of the landowner.

The levels of federal and nonfederal contributions should be monitored over time and adjusted if necessary (see section IV.A.).

III.

D. Recommendations for Nonfederal Lands

The recovery plan was prepared with the understanding that the federal government would play the primary role in achieving recovery. However, in many areas throughout the owl's range, federal lands are not adequate to achieve recovery. In these areas, actions on nonfederal lands are needed. Currently, the primary nonfederal action is providing habitat for existing owl activity centers to avoid take of those owls, as defined by the Endangered Species Act. A variety of nonfederal contributions is envisioned in this recovery plan, many of which also offset the Endangered Species Act prohibition on "taking" individual owls. To accomplish these contributions, the recovery plan recommends an approach by which landowners, state agencies, and the FWS would carry out comprehensive planning and implementation to help achieve recovery goals and objectives and provide benefits to landowners. Further details about this approach are presented in section IV.A.

The specific actions that are recommended on nonfederal lands are detailed in section III.E. Those discussions use the following terms:

Areas of special management emphasis: General geographic areas where the recovery plan makes recommendations for nonfederal lands. These areas were identified where federal lands are inadequate for recovery, based on habitat and population considerations and ownership patterns.

Supplemental pair areas: Habitat delineated for spotted owl activity centers on nonfederal lands. These areas are intended to supplement population deficiencies in the federal DCA network. Supplemental pair area habitat may be managed or reserved, depending on agreements made. The areas also may be either short-term or long-term commitments. The size of these areas will vary by province, based on home range information.

Nonfederal clusters: A cluster of three or more spotted owl activity centers supported by habitat on nonfederal lands. These areas will contribute to owl population needs as described in the province narratives.

Protective management: This is a term developed for this recovery plan, intended to cover the range of measures taken by nonfederal entities to conserve spotted owls and/or their habitat; measures may include participation in conservation planning (as defined in section 10 of the Endangered Species Act) or other actions that benefit owls; entities may be states, individual landowners, or groups of private landowners, Indian tribes, or others.

The biological recommendations for nonfederal lands take several forms. The status of local owl populations and habitat conditions determines whether recommendations are made for specific areas, and the form of the recommendations. The biological principles underlying these recommendations are discussed in section III.A. Specific recommendations for each province are discussed in the province narratives (see section III.E.). They generally can be described in one of the following ways:

1. ***Nonfederal lands within DCAs***: Where specified, provide adequate nesting, roosting, and foraging habitat, in conjunction with federal lands, to achieve the DCAs' target for owl numbers and demographic stability. This could apply to checkerboard and

noncheckerboard ownership patterns. It may include the provision of supplemental pair areas. This habitat may be either managed or reserved from timber harvest, depending on the protective management agreements for the area.

2. ***Nonfederal population clusters***: Establishing clusters of owls is recommended in some areas where federal lands cannot meet the province recovery goal without contribution from other ownerships (e.g., southwestern Washington, northwestern Oregon, and coastal California). This would be accomplished by providing habitat for a cluster of breeding owl pairs with contiguous or nearly contiguous home ranges, and for floater owls and dispersing juveniles. Depending on local population needs, clusters may include from 3 to 15 or more owl pairs to provide at least short-term population stability. The size of an area provided for a cluster will depend on the current suitability and natural potential of habitat, the possibility of natural disturbance, and the type and level of forest management proposed within the area. Generally, a large cluster of owl pairs would require 30,000 to 100,000 acres of habitat managed for owls.

   As with supplemental pair areas, habitat for a nonfederal population cluster may be either managed or reserved from timber harvest, depending on the protective management agreements for the area. Clusters provide the opportunity to explore and test hypotheses about owl response to forest management that may not be tested in the federal DCA network.

   In some areas an optional recommendation is made for supplemental pair areas distributed throughout the landscape at a density lower than that described for clusters. This may provide for a self-sustaining local population but with considerably less long-term population stability than clusters.

3. ***Within dispersal distance of deficient DCAs***: Where specified, provide supplemental pair areas to meet the DCAs' target for owl numbers and demographic stability.

4. ***Nonfederal matrix management***: In some areas, a recommendation is made to provide for successful dispersal of owls across a relatively short distance (less than 12 miles) to provide for interaction of owls among managed pair, supplemental pair, and reserved pair areas, DCAs, or nonfederal clusters. This normally would require foraging and roosting habitat distributed throughout the landscape, or possibly arranged in a corridor. However, nesting habitat would enhance dispersal success. Nonfederal dispersal habitat may not necessarily follow the 50-11-40 rule used for federal dispersal habitat. The framework used to accomplish dispersal habitat objectives could be based on local commitments among the FWS, landowners, and the states.

Since the listing of the northern spotted owl as a threatened species, protection measures have been recommended by the FWS to comply with section 9 of the Endangered Species Act requirements for nonfederal lands (prohibition of take), and by various state forest practices acts. These measures are making limited contributions to the accomplishment of biological goals for the provinces. However, accomplishing recovery goals described in each province narrative may require a combination of existing measures and other actions that would be determined through the protective management process.

A result of the protective management process will be further refinement in identifying specific areas where recovery contributions are recommended. The potential for implementation of general recommendations for nonfederal lands in each of the states is discussed in section IV.A. That section also discusses the processes that would be followed to develop more specific management recommendations for owls and owl habitat on nonfederal lands. Generally, protective management would consist of states and private landowners working with the FWS to develop mechanisms within state and federal law that would provide for owl protection while concurrently authorizing take. One method of protective management would be to follow conservation planning under section 10 of the Endangered Species Act.

As individual landowners enter into agreements with the FWS to accomplish recovery goals, incidental take may be authorized for owls on their lands that are not needed to accomplish those goals. After all goals for a province have been established for federal and nonfederal lands and mechanisms are being put in place to accomplish those goals, consideration should be given to authorize take in remaining areas where no long-term nonfederal contribution to recovery of spotted owls is required. If incidental take were authorized, the recommendation would be to protect the nest site during the breeding season. While only areas of special management emphasis are discussed for nonfederal lands, the spotted owls and habitat outside of these areas make contributions to current population maintenance. Until long-term recovery commitments are in place on nonfederal lands, the contribution of these owls and their habitat is important for short-term maintenance of the owl population.

III.

E. Province Narratives

1. Introduction

Discussions in this section are specific to physiographic provinces based on the classification of Franklin and Dyrness (1973) and Bailey (1966)(Figure 2.2). Physiographic provinces are determined by the geophysical landscape characteristics and climate that influence the vegetation. For practical application in the recovery plan, physiographic provinces were modified based on state boundaries, current spotted owl distributions, and land ownership patterns, all of which influence the need for management recommendations.

The status of spotted owls in each province and recommendations for recovery are summarized in this section. Recovery goals and objectives for each province are based on the status of spotted owls, threats to the population (see section II.B.), and the recovery plan goal (see section III.A.). These goals and objectives are intended to alleviate the primary threats in each province. Recommendations for federal and nonfederal lands reflect the obligations of different ownerships under the Endangered Species Act. Voluntary contributions from Indian lands are identified and described.

Recovery strategies and recommendations in this section describe areas and actions by land managers that are necessary for spotted owl recovery. These include the DCAs and matrix management areas on federal lands, and identification of areas of special management emphasis on nonfederal lands with recommendations for those lands.

A primary recovery strategy on federal lands is the establishment and appropriate management of DCAs, as described in section III.C., including designation of DCAs as critical habitat. DCAs are illustrated on maps provided with the recovery plan (Maps 1 through 3).

In the province narratives, category 1 and 2 DCAs are listed, including approximate acreages and owl numbers. Detailed information about individual DCAs is in Appendix I.

Federal matrix lands connecting the DCAs will be managed for dispersal habitat and include areas that require management for reserved pair areas, managed pair areas, and residual habitat areas (see section III.C.2. for a description of matrix prescriptions).

2. Washington Province Narratives

Olympic Peninsula Province

Province description.

The Olympic Peninsula is a relatively isolated province in northern Washington, bordered on three sides by water. The central portion of the peninsula is a mountain range with high-elevation ridges radiating from the central area throughout Olympic National Park and Olympic National Forest. Currently, spotted owl habitat is generally in mid-elevation forests along major river systems draining the mountains. Land ownership and management of the 3-million-acre province are illustrated in the province summary (Figure 3.7).

There are an estimated 200 to 225 owl pairs in the province (157 pairs are known at this time). Owls generally occur on federal lands at mid-elevations, but a smaller number of owls resides on primarily nonfederal lands in lower-elevation habitats in the western part of the peninsula.

The province goal for all lands is to alleviate long-term threats to the population by protecting a large proportion of existing owl pairs and reestablishing connections to other owl populations. The entire Olympic Peninsula province is considered an area of special management emphasis, with recommendations for nonfederal lands.

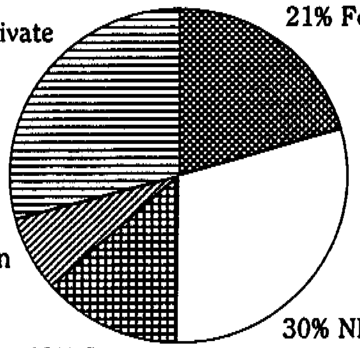
Threats to the Olympic Peninsula province.

Severe threats to the spotted owl population in the province include relatively low numbers of owls, isolation of the province population, and significant risk of large-scale disturbances (wind and fire). An additional threat, which is not discussed for other provinces, is the stochastic patterns of productivity in the Olympic Peninsula population. This topic is included with the 'Declining Populations' discussion.

Declining habitat: Habitat loss has been moderate throughout the province, but more severe at lower elevations, especially on nonfederal lands. This is considered a moderate threat. In the near future, the potential for recovery on nonfederal lands will be significantly hampered because of the expected rate of habitat loss under current management. On national forest lands habitat has been reduced to low levels. Habitat is unchanged and in good condition on portions of national park lands that are capable of supporting suitable owl habitat.

Limited habitat: The current habitat situation in the province leads to a conclusion that limited habitat is a moderate threat. Since World War II, old-growth forests in Olympic National Forest have declined 76 percent (Morrison 1990). Many owl home ranges on national forest lands are highly fragmented, especially along the southern parts of the Quinault and Hood Canal Ranger Districts.

Large areas of habitat loss and fragmentation on the Olympic Peninsula include the Olympic National Forest Shelton Sustained Yield Unit, the Quinault Indian Nation, and the area of state and private ownership west of Forks and north to the Straits of Juan de Fuca.



Acres	Ownership / Management
626,900	U.S. Forest Service
903,400	National Park Service (NPS)
403,700	State of Washington
215,400	Indian Lands
881,100	Private Ownership
3,030,500	**TOTAL**

Federal nesting, roosting, foraging habitat: 507,700 acres

Known owl activity centers:

	Federal		Nonfederal	
	Pairs	Singles	Pairs	Singles
Inside the DCAs	125	18	3	1
Outside the DCAs	9	8	20	13

Federal recommendations:

	Number	Activity Centers	Acres	
			Reserved	Nonreserved
Category 1 DCAs	1	133	475,900	322,500
Category 2 DCAs	5	10	34,700	29,800
Prescription A residual habitat areas (Estimate of current situation)	17	17	–	–

Nonfederal recommendations:
See province narrative.

Figure 3.7. *Olympic Peninsula province summary.*

DCAs = designated conservation areas.
– = unknown.

Northern spotted owls once inhabited these lower-elevation areas, presumably in high densities, but past timber harvest has probably resulted in low numbers of spotted owls on Indian, state, and private lands.

Spotted owl habitat in the main portion of Olympic National Park is in relatively large, intact drainages broken by high, rocky, and snow-covered mountains. In the coastal strip of the park, owl activity centers have become relatively isolated from the remaining spotted owls in the interior peninsula.

Declining populations: Declining populations are considered a moderate threat, based on habitat loss and demographic studies in the province. High rates of habitat loss on nonfederal and national forest lands have presumably resulted in spotted owl population declines.

A compounding threat in this province is stochastic reproduction in the spotted owl population. Reproductive success has been highly variable and continued monitoring will be required for adequate trend assessment. Productivity of the population appeared to be extremely poor in the mid-1980s, good from 1988 through 1990, very poor in 1991, but improved again in 1992 (Forsman pers. comm.). Reasons for these fluctuations and whether there is a pattern to them are unknown. Overriding the uncertainty about the effect of stochastic reproduction, owl populations in the Olympic Peninsula demographic study area are declining (see Appendix C).

Low populations: The current population level is considered a severe threat in the province. There are 157 known pairs and 40 known territorial singles on the peninsula (WDW 1991). The estimated population of 200 to 225 owl pairs on the peninsula is unlikely to persist during the next 100 years unless measures are taken to resolve the existing threats. The threat of low population levels is compounded by the stochastic reproduction. If the population level should drop very low, and then experience a period of low reproduction, the population could die out (see Chapter II).

Distribution of habitat and populations: Distribution of habitat and spotted owls is naturally constrained by the Olympic Mountains in the center of the province. When this constraint is combined with timber harvest effects at lower elevations, the distribution threat is considered moderate for the province. Suitable habitat on the peninsula is shaped largely like a doughnut, with the center or "hole" consisting of high-elevation, nonforested areas of unsuitable habitat. Much of the remaining habitat and owls in the province are distributed around this "doughnut hole" in the mid-elevation areas of Olympic National Park and Olympic National Forest. At low-elevations, large areas of recently logged lands are occupied by scattered, relatively isolated pairs of spotted owls in remaining patches of older forest. This habitat pattern restricts the general distribution of spotted owls to a portion of the province at mid-elevations. The long-term stability is unknown for these populations that once inhabited a wide range of ecological conditions, but are limited now to mid-elevation habitat.

Province isolation: Province isolation is a severe threat to the spotted owl population in this province. The Olympic Peninsula province is bordered on three sides by coastline; the Pacific Ocean to the west, the Strait of Juan de Fuca to the north, and Hood Canal to the east. On the remaining border to the south, timber harvest in the western Washington lowlands province has virtually eliminated spotted owls and their habitat.

Currently, about 60 miles separate owl subpopulations in the Olympic Peninsula province and the western Washington Cascades province. There is little or no documented spotted owl dispersal across this separation, and demographic rescue (see section II.B.) would be unlikely if a severe population decline on the Olympic Peninsula should occur. Following such a decline, inbreeding of the remaining spotted owl population would become more of a concern.

Predation and competition: Levels of predation by great horned owls and northern goshawks on the Olympic Peninsula are considered a moderate threat. The measure of the threat from great horned owls comes from owl surveys which found relatively low densities of great horned owls in Olympic National Park (Fredrickson et al. 1989, Fredrickson et al. 1990), while surveys conducted on adjacent nonfederal lands indicated a large population of great horned owls (Anthony and Cummins 1989).

The threat of competition with barred owls is unknown; while barred owls are present on the peninsula, no evidence of competition has been documented.

Vulnerability to natural disturbances: The loss of habitat to natural disturbances is also considered a severe threat in this province. There is a significant probability of habitat loss due to large-scale windstorms in the western part of the peninsula and wildfires in the eastern portion (see Appendix E). In a worst-case scenario, wind and fire could reduce the capability of the Olympic Peninsula province to support owl pairs by up to 30 percent during the next 100 years (Agee 1991b). These threats to habitat create a risk to owl population stability.

Wind is the dominant disturbance factor along the western coast of the peninsula and as far as 20 to 30 miles inland. Historic stand-replacing wind events occurred in 1921 and 1962 (see Appendix E). Logging in the past 30 years has resulted in increased fragmentation on most landownerships, creating exposed forest edges which are much more susceptible to wind damage than are relatively unfragmented patches.

Fire is also a significant threat on the Olympic Peninsula, particularly in the eastern part. Recent fires, such as the Forks Burn, were stand-replacement events that eliminated large tracts of spotted owl habitat.

Biological goals and implementation on federal lands.

Federal lands are dominant in the interior part of the province, generally surrounded by nonfederal lands. This landownership pattern restricts the ability to design a DCA network using the criteria discussed in section III.C. Therefore, the DCA network in this province reflects an attempt to compensate, as much as possible, for the inadequate distribution of federal lands and elevation constraints.

A large DCA (WD-47) is recommended on federal lands in the interior Olympic Peninsula. This DCA includes all suitable habitat in Olympic National Park and a large proportion of Olympic National Forest adjacent to the park. WD-47 is an unusual configuration and recommended for several reasons specific to the peninsula. Timber harvest in Olympic National Forest has occurred in lower elevations, removing habitat and restricting the remaining owls in the national forest to a relatively narrow band encircling the periphery of Olympic National Park. This national forest habitat, combined with owl habitat in Olympic National Park, result in a ring of habitat surrounding the high-elevation area at the center of the park. The high-elevation area does not contain habitat suitable for owls and probably restricts dispersal.

Because of this unusual configuration of habitat and owl distribution, a single large DCA is intended to ensure connectivity within the province population. A series of smaller DCAs, separated by dispersal habitat, would have provided a lower probability of successful dispersal, given the geography of the peninsula. The large DCA will protect habitat for enough owl pairs to reduce the risk from stochastic environmental or demographic events. This is an extremely important consideration because the spotted owl population on the peninsula is virtually isolated from the remainder of the owl's range (USDA 1988; Thomas et al. 1990).

This large DCA is currently estimated to support 125 pairs of spotted owls (Tables 3.5 and 3.6). The exact number of owl activity centers is difficult to determine because of the roadless nature of Olympic National Park which makes owl surveys extremely difficult to conduct. With only a part of the park surveyed, approximately 50 spotted owl territories have been located. Population estimates for the park were based largely on densities of owls in demographic study areas on adjacent Forest Service lands and Landsat analysis of amounts and distribution of suitable habitat in the park (Thomas et al. 1990). Estimates vary between 80 and 100 owl pairs in Olympic National Park.

A category 2 DCA (WD-51) is recommended on the Olympic National Park coastal strip, encompassing a relatively narrow strip of land from Lake Ozette south to the Queets River. Seven owl activity centers have been located in this coastal portion of the park.

Three category 2 DCAs (WD-48, WD-49, and WD-50) are recommended in the Soleduck Ranger District. These are important to help maintain owl population distribution in the western part of the province and to provide demographic support to WD-47 until that DCA's owl population reaches expected numbers. They would also function with nonfederal lands to support habitat connectivity with Olympic National Park's coastal strip (WD-51).

WD-46 is recommended in the southern part of the Hood Canal Ranger District. This habitat should serve as a focal area for a future small cluster of spotted owls which will be needed to provide interchange of owls between the Olympic Peninsula and the western Washington lowlands provinces.

There are 143 owl activity centers (125 pairs and 18 territorial singles) on federal lands in the recommended DCAs. They represent 93 percent of all owl pairs located on federal lands in the province (Figure 3.8). The DCAs contain 74 percent of the nesting, roosting, and foraging habitat identified on federal lands in the province (Figure 3.9).

The remainder of the federal lands in this province should be managed for dispersal habitat under matrix prescription A (see section III.C.2.). The federal landscape should meet the 50-11-40 rule and residual habitat areas of 100 acres each should be established for all known and future-discovered owl activity centers up to a density of four areas per township.

Biological goals and implementation on nonfederal lands.

Currently, 37 owl activity centers are known on state or private lands on the Olympic Peninsula; additional sites will likely be found. Additional owls with activity centers on federal lands have home ranges which probably utilize state and private lands. Since these owl home ranges overlap several ownerships, protective management on nonfederal lands should be integrated and coordinated with federal lands. Most of the spotted owl activity centers on nonfederal lands are in the western part of the province, north of the Quinault Indian Reservation.

Table 3.5. Summary of acreage and owl numbers for designated conservation areas (DCAs) in the Olympic Peninsula province. (More detailed information, including owl numbers on nonfederal lands, is in Appendix I, Table I.2)

	Acreage			Owl Numbers					
				Known Owls[3]					
				Federal		Nonfederal			
DCA Ident. Number	Total	Percent Federal Lands[1]	NRF Habitat Federal[2]	Pairs	Singles	Pairs	Singles	Current Projected Federal[4]	Future Projected Federal[5]
WD-46	2,900	100	1,600	0	0	0	0	0	1
WD-47	818,200	98	364,000	117	16	2	1	175	215
WD-48	7,800	79	3,200	1	0	0	0	1	1
WD-49	5,900	67	2,800	1	0	0	0	1	1
WD-50	19,900	84	5,600	1	0	1	0	3	4
WD-51	35,100	99	100	5	2	0	0	5	8
Total:	**889,800**	**97**	**377,300**	**125**	**18**	**3**	**1**	**185**	**230**

[1]Management of nonfederal lands within the perimeter of DCAs is discussed in the province narrative.
[2]NRF = nesting, roosting, and foraging habitat for spotted owls. Habitat information was not available for nonfederal lands.
[3]Numbers of spotted owl activity centers verified in a 5-year period; generally 1987 through 1991.
[4]Estimate of the number of pairs of owls that the DCA would be expected to support on federal lands if the population stabilized with current habitat conditions. See Appendix I for further details.
[5]Estimate of the number of pairs of owls that the DCA might support in the future on federal lands if habitat were recovered. See Appendix I for further details.

Table 3.6. Summary comments on the designated conservation area (DCA) network in the Olympic Peninsula province. (Section III.C.1. and Appendix I provide further information about the criteria and process used to delineate these areas.)

Category 1 DCAs	Comments
WD-47	A large DCA is recommended in and around Olympic National Park to provide habitat connectivity among major drainages, to include habitat at a variety of elevations, and to be the primary support of a potentially isolated population
Category 2 DCAs	**Comments**
WD-46, WD-48 through WD-50	Occur as satellites around the major population center to provide habitat and population connectivity to other DCAs and provinces.
WD-51	Coastal strip of Olympic National Park; it is expected to support eight spotted owl pairs.

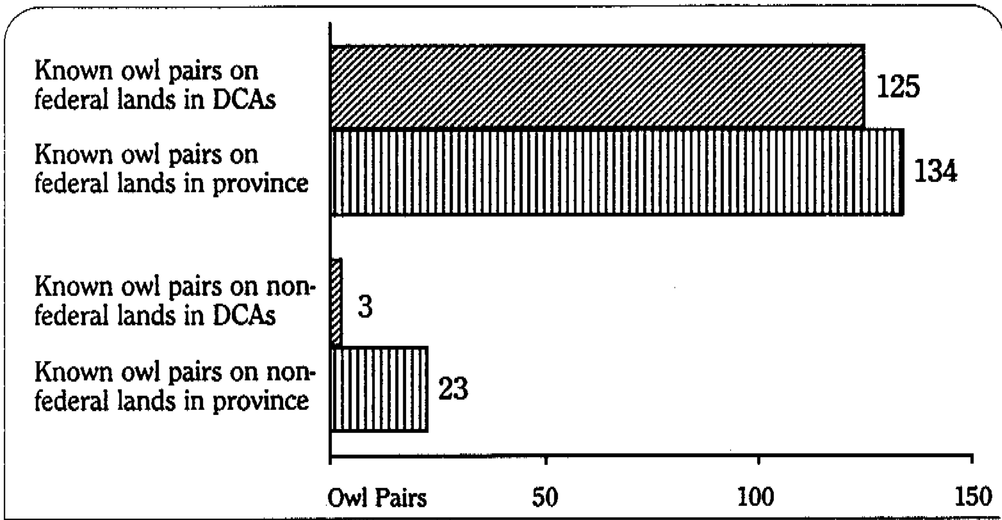


Figure 3.8. *Known owl pairs in the Olympic Peninsula province and in the DCAs (designated conservation areas) in the province.*

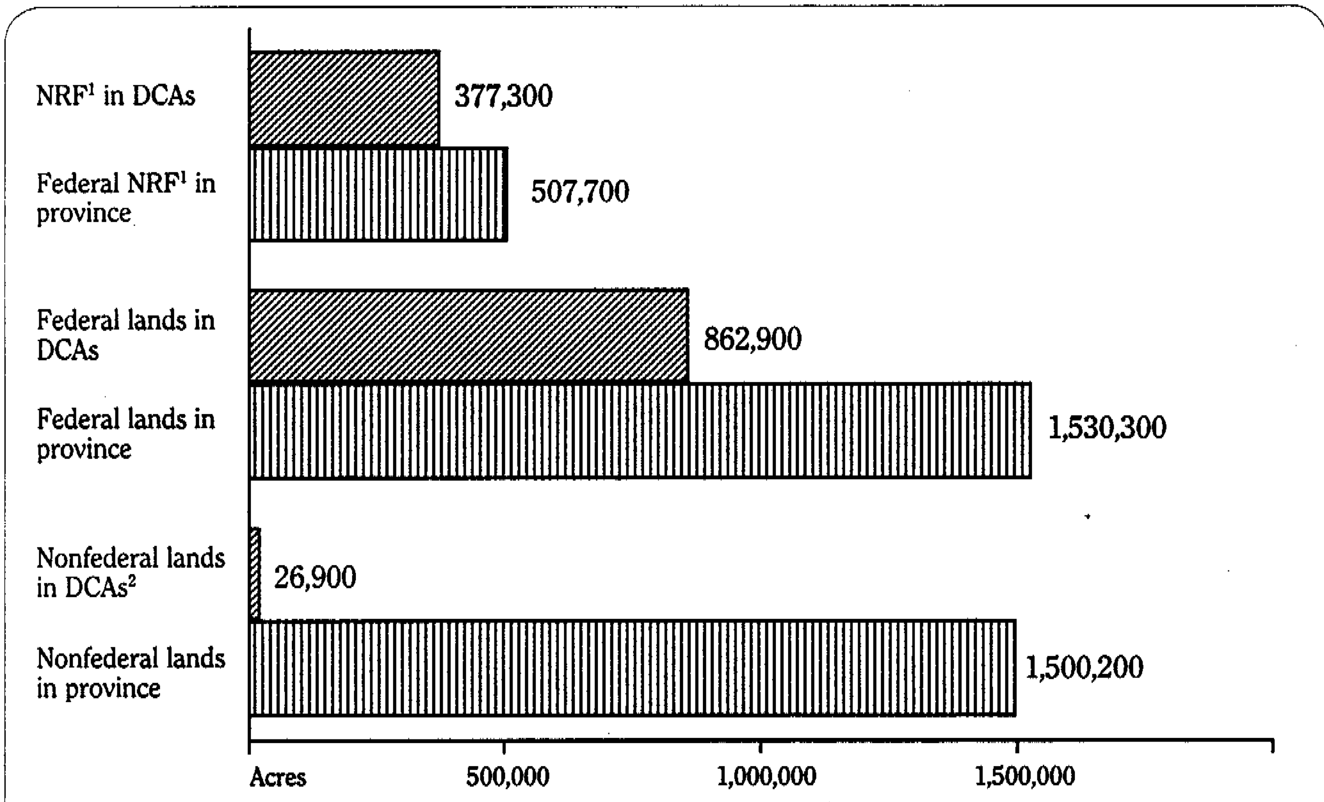


Figure 3.9. *Acres in the Olympic Peninsula province and in the DCAs (designated conservation areas) in the province.*

[1]NRF = nesting, roosting, and foraging habitat. This information is available only for federal lands.
[2]Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the province narrative.

The overall goal for nonfederal lands in the province is to provide demographic support to the Olympic Peninsula owl population. Given the current distribution of remaining owls and habitat, there are at least two possible options to accomplishing the province goal.

The recommended option is to provide demographic support and increased habitat connectivity in the area bounded by Lake Ozette, the Queets River, the coast, and federal ownership to the east. Currently, there are approximately 21 known owl activity centers on nonfederal lands in this area. Long-term provisions for 20 to 30 pairs of spotted owls on all ownerships in this area should meet province objectives for demographic support by a) maintaining owls in the western part of the province in a range of elevational and ecological conditions, and b) increasing the likelihood of successful dispersal between the coastal strip and the interior.

In this recommended option, measures to increase spotted owl population connectivity are recommended in one or two locations between interior federal ownership and Olympic National Park's coastal strip. If this option were implemented, these connectivity areas should consist of contiguous habitat and should be at least 1 mile wide to provide for breeding pairs of spotted owls. Currently, several areas are capable of reestablishing this connectivity in the foreseeable future. The establishment of areas of habitat connectivity, pair protection, and/or small nonfederal clusters would dramatically enhance dispersal capability between the coastal strip and the interior. The need for additional areas of dispersal habitat should be evaluated after the connectivity areas have been designated.

In this option, long-term protective measures to address spotted owl recovery should be planned to provide maximum overlap with needs of other species of concern (e.g., salmon, marbled murrelet, fisher, northern goshawk). Planning should consider the need for contiguous habitat between Olympic National Park's coastal strip and the interior peninsula, as this would provide benefits to spotted owls and may be required for other species associated with late-successional forests.

Another option for providing demographic support is through protection of spotted owls where they currently occur throughout the peninsula. Since remaining spotted owl habitat on nonfederal lands is close to federal lands, such protection would allow owls to disperse to the large DCA (WD-47). In this option, habitat to support small nonfederal clusters of three to four owl pairs near federal lands would be desirable to meet the province objectives.

Regardless of the option selected, individual owl activity centers should be protected with supplemental pair areas. The amount of owl habitat should be equal to the median amount learned from research studies in the province. Owl habitat should be provided to the maximum extent possible in an area equal to the median home range size for the province. Also, nonfederal clusters of owl activity centers are preferred to individual owl activity center protection and, to the extent feasible and practical, should be considered.

Additional information would be beneficial in planning nonfederal contributions on the Olympic Peninsula. The spotted owl life history simulation model developed by Forest Service researchers (see Appendix A) and demographic information from on-going research could be valuable planning tools. Also, several unsurveyed areas of potential habitat remaining on the Olympic Peninsula should be surveyed in preparation of protective management plans.

The State of Washington has proposed several voluntary actions for state trust lands on the west side of the peninsula that can address the objectives of improving spotted owl population connectivity and protecting owl activity centers. These actions include deferring timber harvest on 15,000 acres of spotted owl habitat; transferring 3,000 acres of ecologically sensitive land from 'trust' to 'conservation' status (with compensation to trustors); and creating a 260,000-acre Olympic Experimental State Forest (all state lands in the western half of the province, north of the Queets River). The recovery plan recommends that the experimental forest contribute to province recovery objectives and develop and test silvicultural prescriptions aimed at improving compatibility between protection of owl habitat and commercial forest management. Objectives of the silvicultural prescriptions could include 1) accelerating habitat development of currently unsuitable habitat, 2) creating post-harvest conditions conducive to rapid redevelopment of habitat, and 3) maintaining habitat suitability after timber harvest. Knowledge developed through work in the experimental forest could be useful to owl conservation over time throughout the Olympic Peninsula and in other provinces.

Prohibitions on take are contributing to the province recovery objectives by protecting known owl activity centers. However, protective management, such as conservation planning, as described in section IV.A., could lead to more efficient conservation actions and increase the feasibility of meeting the province recovery objectives. For some private landowners, it also may be possible to negotiate contributions of land in trade for relief from take prohibition (see section IV.A.). State forest practices rules also could be used to ensure protection of known owls, where agreed upon.

Land exchange or purchase could contribute to the province objectives, but the prohibitive expense of purchase makes it appropriate only in special circumstances. Additions of lands to Olympic National Park and/or Olympic National Forest could help achieve province recovery objectives.

Quinault Indian Reservation, background and voluntary contribution.

Under the Indian Allotment Act, the 208,000-acre reservation was allotted to individual Indians in 40- and 80-acre parcels. To obtain quick cash, many of the allottees either obtained fee patents and sold the land to non-Indian timber interests or demanded that their timber be harvested at an accelerated rate. By 1987 the Quinault Indian Nation owned less than 15,000 acres of its 208,000-acre reservation. By 1992 this ownership had increased to nearly 54,000 acres. The Nation's aggressive reacquisition of its reservation was enhanced by the passage of Public Law 100-638. This law returned a portion of the northern boundary of the reservation to the Nation because of a previous survey error (12,000 acres of actual ownership and 5,400 acres along the eastern boundary of the reservation in which 45 percent of the revenues are pledged to the Nation). A prime stipulation in P.L. 100-638 was that revenues generated from the harvest of timber from the north boundary area must be used by the Nation for consolidating land ownership within the Quinault Reservation. This act is proving to be very successful and will enable the Nation, in the long term, to better manage wildlife and fisheries throughout the reservation.

Spotted owl surveys have been completed on 90 percent of the suitable habitat within the reservation. Three owl activity centers have been located. These centers are in the north boundary area. Harvest within this area will be adjusted to protect these activity center cores as long as they remain occupied. These owl activity centers are adjacent to Olympic National Park, which provides the majority of suitable habitat in the area.

It should be noted that the Quinault River valley (approximately 50 square miles on the reservation) and the river's many tributaries form the most important reservation resource to the Quinault people. Preservation and conservation of five species of salmon, two species of trout, and other fishes always will be a main Quinault objective. All other wildlife in this area also is considered in the management scheme. Because the Quinault Reservation originally was allotted to individual Indians in 40- and 80-acre parcels, management of the area as a single unit historically has been difficult. To protect this resource, the Quinault Nation has placed a high priority on consolidation of the river valley into Tribal ownership through land purchase. With consolidated ownership, the Tribe will affect a more consistent and improved riparian zone management. The valley will continue to offer wildlife and fish protection as the primary management objective.

Western Washington Lowlands Province

Province description.

The western Washington lowlands province is in southwestern Washington and consists largely of nonfederal ownership, including major urban, industrial, and agricultural areas. The province occupies a key position in the spotted owl's range; it is the only area where connectivity could be reestablished with the currently isolated population of spotted owls in the Olympic Peninsula province.

Land ownership and management of the 6.5-million-acre province are illustrated in the province summary, which shows the dominance of nonfederal lands (Figure 3.10). Federal lands in the province are managed by the Department of Defense. Most forestlands in this province are owned by the State of Washington and large industrial timber corporations. As a result of timber harvest, spotted owls have been virtually eliminated from the province; only 10 owl activity centers are known.

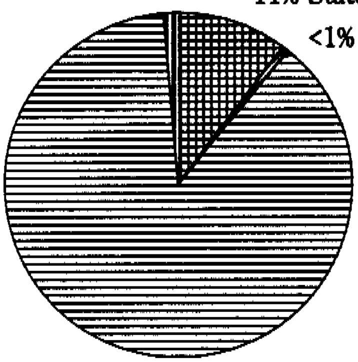
In addition to the threats to the province (discussed next), a contributing concern in this province is the risk to the owl population in the adjacent Olympic Peninsula province. If the Olympic Peninsula owl population should exhibit a further demographic decline, or spotted owls become locally extirpated due to catastrophic events, then demographic and habitat connectivity to other owl populations is essential to restoring this owl population.

Because of the distances involved in the western Washington lowlands province, the presence of breeding population clusters will be necessary to provide a meaningful level of connectivity. Reestablishing population connectivity is the main recovery goal in this province.

Threats to the western Washington lowlands province.

This province exhibits seven severe threats to spotted owls. These include owl population concerns, but focus on habitat related issues.

Declining habitat: The threat of continued loss of habitat in the province is considered severe. Historical observations of spotted owls are documented from the early communities of Seattle and Tacoma (WDW 1991). Permanent habitat loss has been extensive from Tacoma north to the Canadian border, and probably will increase significantly during the next 100 years as human populations and urban areas increase. But extensive forestlands still remain in the southwestern part of the state. Many of these lands already have been logged twice. As a result of timber harvest on nonfederal lands, spotted owl habitat is a very minor acreage in the province. The little suitable habitat remaining probably will be



Acres	Ownership / Management
683,500	State of Washington
29,900	Indian Lands
5,681,500	Private Ownership
86,000	U.S. Department of Defense (DOD)
6,480,900	**TOTAL**

Federal nesting, roosting, foraging habitat: none

Known owl activity centers:

	Federal		Nonfederal	
	Pairs	Singles	Pairs	Singles
Inside the DCAs	0	0	0	0
Outside the DCAs	0	0	6	4

Federal recommendations:

		Activity	Acres	
	Number	Centers	Reserved	Nonreserved
Category 1 DCAs	0	NA	–	–
Category 2 DCAs	1	0	0	65,900

Nonfederal recommendations:

See province narrative.

Figure 3.10. *Western Washington lowlands province summary.*

DCAs = designated conservation areas.
– = unknown.
NA = not applicable.

reduced further unless immediate action is taken. Of equal or greater concern is the rate of harvest of mature forest, which may serve as the potential foundation for restoration of owl habitat in the province.

Limited habitat: The limited amount of spotted owl habitat is also a severe threat. Forestlands in the western Washington lowlands province were logged early in the settlement of the state, and a considerable area was converted to urban, industrial, and agricultural lands.

Because spotted owl habitat has been greatly reduced during the past 60 to 80 years, late-successional forests currently remain in relatively small, scattered parcels, seldom more than a few hundred acres in size. The few existing spotted owls are in these parcels surrounded by young forest or are inhabiting younger forest stands that have retained snags and/or down logs from previous harvest or natural disturbance.

Declining populations: The decline of spotted owl populations in this province is a severe threat. This conclusion is based on the virtual absence of spotted owls from large landscapes that were suitable habitat until timber harvest occurred.

Low populations: There is considerable concern about spotted owls in this geographic region (Thomas et al. 1990, USDI 1990), and low population levels are considered a severe threat. Currently six owl pairs and four territorial singles are known in the province. With spotted owls essentially eliminated, the population stability is seriously hindered.

Distribution of habitat and populations: As reflected in the Limited Habitat discussion, the distribution of owls and habitat is a severe threat in the province. Known owl activity centers are extremely isolated, with little opportunity for interchange among activity centers.

Province isolation: Because of the poor owl distribution in the province, isolation is considered a severe threat for the entire province population. The province currently does not provide for significant demographic interchange with any neighboring province.

Predation and competition: The effects of predation are a severe threat in the province. Predation by great horned owls may threaten the few remaining owls or the development of nonfederal clusters in the future. A reflection of the impact of great horned owl predation is recent surveys which suggest that great horned owls are numerous (Table 2.5).

The threat of competition with barred owls is unknown in the province due to lack of information about the occurrence of barred owls.

Vulnerability to natural disturbances: Wind and fire are moderate threats to the remaining spotted owls in the province. Portions of the province along the coast may be susceptible to wind damage.

Biological goals and implementation on federal lands.

Essentially the only federal lands in the province are on the Fort Lewis Military Reservation, which is recommended as a DCA (WD-45) (Tables 3.7 and 3.8). Habitat is generally young forest. No spotted owls currently are known to occur on these lands. However, Fort Lewis is in an important location to assist in reestablishing demographic interchange between owls in the Cascade Mountains and owls on the Olympic Peninsula. While forestlands should be managed to develop characteristics of spotted owl habitat,

Table 3.7. Summary of acreage and owl numbers for designated conservation areas (DCAs) in the western Washington lowlands province. (More detailed information, including owl numbers on nonfederal lands, is in Appendix I, Table I.2)

	Acreage			Owl Numbers					
				Known Owls[3]					
				Federal		Nonfederal			
DCA Ident. Number	Total	Percent Federal Lands[1]	NRF Habitat Federal[2]	Pairs	Singles	Pairs	Singles	Current Projected Federal[4]	Future Projected Federal[5]
WD-45	65,900	100	0	0	0	0	0	0	8

[1]Management of nonfederal lands within the perimeter of DCAs is discussed in the province narrative.
[2]NRF - nesting, roosting, and foraging habitat for spotted owls. Habitat information was not available for nonfederal lands.
[3]Numbers of spotted owl activity centers verified in a 5-year period; generally 1987 through 1991.
[4]Estimate of the number of pairs of owls that the DCA would be expected to support on federal lands if the population stabilized with current habitat conditions. See Appendix I for further details.
[5]Estimate of the number of pairs of owls that the DCA might support in the future on federal lands if habitat were recovered. See Appendix I for further details.

Table 3.8. Summary comments on the designated conservation area (DCA) network in the western Washington lowlands province. (Section III.C.1. and Appendix I provide further information about the criteria and process used to delineate these areas.)

Category 2 DCA	Comments
WD-45	This DCA is located entirely on the Fort Lewis Military Reservation. Forests are generally less than 70 years old. It will improve connectivity with the Washington Cascade Mountains and the Olympic Peninsula populations. The area has the future habitat capability to support 8 pairs of owls.

native prairies, which occupy approximately 21,000 acres of the 86,000-acre military reservation, should be managed to maintain the biological diversity in the region. To maintain these prairies, some areas in WD-45 may not be developed into spotted owl habitat.

Several thousand acres at Fort Lewis are committed to continued military use and cannot be managed as spotted owl habitat; wherever feasible, these areas were excluded from the DCA. Other types of military training occur in a forest setting and are expected to be compatible with spotted owl habitat management. The importance of the military mission at Fort Lewis is recognized and it is understood that some areas in WD-45 may not be developed into spotted owl habitat or may be reduced in habitat quality due to military training needs.

Because WD-45 is in relatively young forest with unusual ecological conditions and does not currently support spotted owls, it may be appropriate to use management techniques that are more extensive than would be recommended for other DCAs. Experimental approaches to developing spotted owl habitat are being conducted in WD-45 by the Forest Service's Pacific Northwest Laboratory. These studies may provide valuable information and should be continued.

Fort Lewis may provide an important habitat link between the Cascade Mountains and the Olympic Peninsula. However, this can only be accomplished if nonfederal lands ownerships in the region also manage for suitable nesting and dispersal habitat conditions between federal lands in the Cascade Mountains and the Olympic Mountains.

There are no other federal lands in the province, so no federal matrix management is recommended (Figures 3.11 and 3.12).

Biological goals and implementation on nonfederal lands.

The biological goals for the western Washington lowlands province are based on the need to reestablish habitat and population connectivity between the Olympic Peninsula province and other provinces. Providing needed connectivity will require developing subpopulation centers, essentially by growing habitat for a number of nonfederal clusters.

Low habitat quantity and poor habitat distribution require that the entire province be identified as an area of special management emphasis. However, within the province there are areas that should receive focused attention to be most effective in achieving the province goal of reestablishing population connectivity. To achieve this goal, nonfederal clusters and dispersal habitat are recommended. Nonfederal lands should be managed to provide nonfederal clusters of supplemental pair areas. These nonfederal clusters should be designed for a minimum of 15 future spotted owl pairs and spaced a maximum of 12 miles apart. In addition, dispersal habitat should be provided between the clusters with dispersal conditions as continuous as feasible.

The province goal may be difficult to achieve for several reasons. Since there are few existing owl sites in this province, prohibition on take or negotiating conservation in trade for authorization of take may prove to be negligible means of contributing to recovery, if they were restricted to opportunities within this province. In southwestern Washington, there are few relatively small preserved areas, such as the State Natural Heritage Program lands, but they are too small to support clusters of breeding pairs or cannot provide dispersal habitat because of their location. Finally, protection of breeding habitat independent of known owl sites cannot be required under the current Endangered Species Act or state forest practices laws.

To establish nonfederal clusters in this province, land acquisition appears to be the only effective strategy because there are limited opportunities for federal/nonfederal lands exchanges. However, purchase of land and timber sufficient to meet the province objective would be prohibitively expensive (more than $2 billion).

To reduce this cost, purchase of bare land or land with some timber harvest rights reserved to the seller may be feasible (possibly reducing costs to $150 million). This approach would delay achieving the recovery goal for the province by several decades because the forest would have to regrow into owl habitat. However, the severe threat to the owl population on the Olympic Peninsula, which necessitates reestablishment of connectivity, is anticipated to continue for many decades. Even at the lower cost, funding for this approach is unlikely and would have to be considered along with other acquisitions needed to meet recovery goals in other Washington provinces.

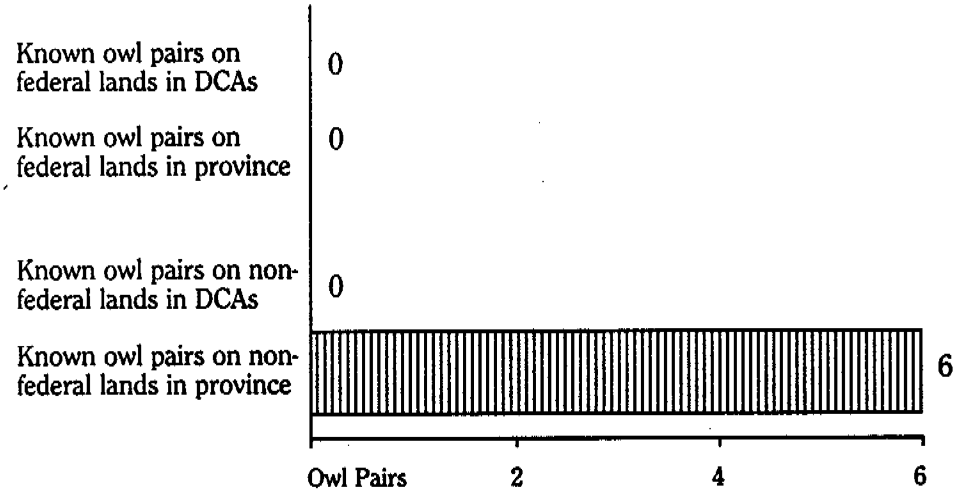


Figure 3.11. *Known owl pairs in the western Washington lowlands province and in the DCAs (designated conservation areas) in the province.*

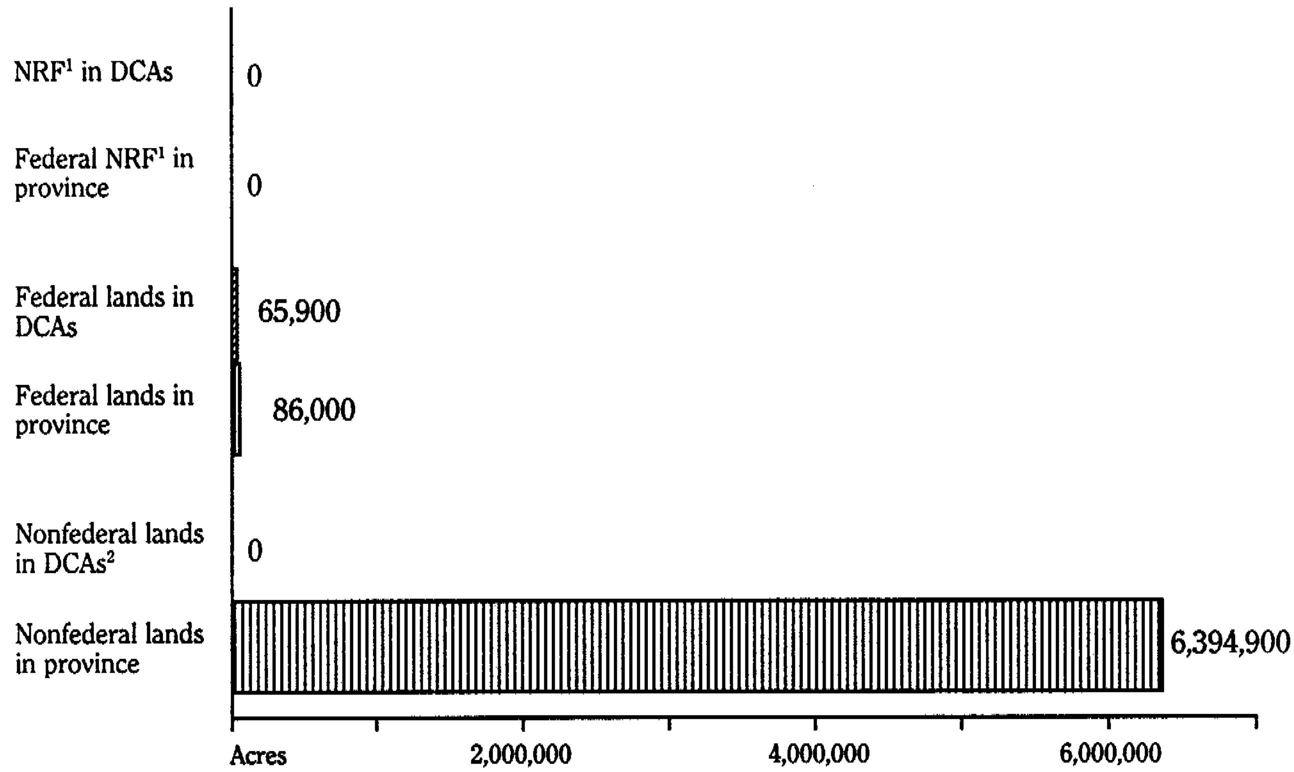


Figure 3.12. *Acres in the western Washington lowlands province and in the DCAs (designated conservation areas) in the province.*

[1]NRF = nesting, roosting, and foraging habitat. This information is available only for federal lands.
[2]Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the province narrative.

To fill the need for dispersal habitat, the only effective mechanism appears to be a combination of incentives for landowners, along with changes in forest practices regulations. New forest practices regulations would have to be developed, and dispersal habitat would have to be well defined. Achieving the dispersal habitat objective is probably feasible, and would best contribute to recovery if applied in combination with successful establishment of nonfederal clusters.

In the interim period, as long-range protective management is being developed, the following specific recommendations are made to facilitate recovery in the western Washington lowlands province:

- Continue surveys of potential owl habitat.
- Continue protection of spotted owl activity centers. These owls should be protected with supplemental pair areas at least as large as the median home range size for pairs in the neighboring Olympic Peninsula province (home range size information from the Olympic Peninsula province is referenced because studies have not been conducted in the western Washington lowlands province). It is recommended that delineation and management of these areas follow guidelines similar to those for reserved pair areas or managed pair areas on federal lands, as described in section III.C.
- Initiate long-range planning efforts to develop conservation measures for the spotted owl.
- Manage nonfederal lands in WD-45 to develop spotted owl habitat over time.

Western Washington Cascades Province

Province description.

The western Washington Cascades province is west of the Cascade crest from the Columbia River north to the Canadian border and east of the western Washington lowlands province. Significant habitat differences occur between the northern and southern portions of the province. The northern area is dominated by high mountains and ridges unsuitable for spotted owls and has lower valleys with suitable spotted owl habitat. The resulting landscape pattern is a mosaic of alternating valleys of suitable habitat and unsuitable ridges, a naturally fragmented environment for spotted owls. The southern portion is more dominated by forested areas, and spotted owl habitat is more continuous, although still highly fragmented by past timber harvest and fires.

Land ownership and management of the 6.2-million-acre province are illustrated in the province summary (Figure 3.13). Federal lands in the province are dominated by the Mt. Baker-Snoqualmie and Gifford Pinchot National Forests and the North Cascades and Mt. Rainier National Parks.

Approximately 335 spotted owl activity centers, including 290 known pairs, occur in the province. Of these, 303 owl activity centers (including 263 pairs) are on federal lands.

Five areas of special management emphasis have been identified and are discussed in the nonfederal province objectives and recommendations. Management concerns in some of these areas also lead to special matrix recommendations on federal lands. These areas are: 1) northern part of the province (north of Interstate 90 (I-90), 2) the I-90 corridor (north of Mt. Rainier to I-90), 3) the Mineral Block (portion of the Gifford-Pinchot National Forest), 4) Siouxon Creek (southwest of Mount St. Helens) and 5) the Columbia River Gorge area.

Threats to the western Washington Cascades province.

Because of the differences in ecological and management situations between the southern and northern parts of this province, many of the threats must be discussed separately for these areas. For the purposes of this discussion, the division of the province is at Mt. Rainier, and is shown in Table 2.4, where the province threats are divided into two areas.

Threats to spotted owls in the province include low rates of reproduction in the northern portion and loss of habitat throughout the province.

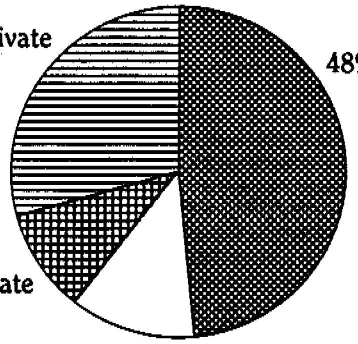
Declining habitat: This threat is considered severe throughout the province. Spotted owl habitat in national forests in the province has declined significantly in the last 30 years, similar to habitat loss in the other provinces. During that time the proportion of old-growth forest that was potential spotted owl habitat decreased from about 60 percent to about 40 percent of the area of the Mt. Baker-Snoqualmie National Forest, with similar decreases from about 40 percent to 30 percent for the Gifford Pinchot National Forest (Henderson 1990). These reductions were primarily due to logging. The relatively low proportions of old-growth in the Gifford Pinchot National Forest resulted from the Yacolt Burn of 1902, the eruption of Mount St. Helens in 1980, as well as logging.

During the past 20 years habitat decline has been most severe in the checkerboard lands of the I-90 corridor and the Mineral Block in the Gifford Pinchot National Forest. (The Mineral Block is a disjunct portion of the national forest north of Highway 12 and west of Highway 17). These lands currently support low levels of suitable habitat. As a measure of the low habitat levels in the province, habitat surrounding 38 randomly selected spotted owl management areas on the Mt. Baker-Snoqualmie and Gifford Pinchot National Forests was analyzed in 1984 (Allen et al. 1989). The average proportion of suitable habitat within 1.5 and 2.1 miles of the center of those areas varied between 49 and 55 percent of the total area. In 1991 a similar assessment was prepared as information presented in the 1991 Forest Service Timber Sale Biological Assessment. This 1991 analysis indicated that the average proportion of suitable habitat within 1.8 miles of spotted owl territories was near 40 percent (Hays pers. comm.). The difference between the 1984 and 1991 habitat estimates, though not using exactly the same techniques, is an indication of habitat decline in a relatively short period of time. In the near future, the expected net rate of habitat loss without protective measures for the spotted owl will continue to decrease the potential for recovery in the province.

Limited habitat: This threat is considered moderate in the southern part of the province and severe in the northern part. Current spotted owl habitat generally is at mid-elevations, and predominantly on national forest lands. Much of the low-elevation habitat has been logged and regenerated to stands which generally are less than 80 years old.

Few blocks of old-growth forest remain on state, private, and municipal lands. Most of the currently known spotted owls on these lands (outside of checkerboard ownership lands) inhabit patchwork mosaics of remnant old-growth stands that survived historic forest fires in larger naturally regenerated second-growth stands.

Declining populations: The impact of this threat is considered moderate in this province, though no demographic studies have been conducted here. However, there have been limited population studies, and based on knowledge of the occupancy rates of known spotted owl home ranges, there is cause for concern.



Acres	Ownership / Management
3,001,800	U.S. Forest Service
760,300	National Park Service (NPS)
630,600	State of Washington
1,815,100	Private Ownership
6,207,800	**TOTAL**

Federal nesting, roosting, foraging habitat: 1,403,400 acres

Known owl activity centers:

	Federal		Nonfederal	
	Pairs	Singles	Pairs	Singles
Inside the DCAs	186	23	3	1
Outside the DCAs	77	17	24	4

Federal recommendations:

		Activity	Acres	
	Number	Centers	Reserved	Nonreserved
Category 1 DCAs	6	122	127,000	601,100
Category 2 DCAs	18	87	272,000	335,800
Prescription B reserved pair areas	10	17	2,600	69,800
Prescription A residual habitat areas (Estimate of current situation)	77	77	–	–

Nonfederal recommendations:
See province narrative.

Figure 3.13. *Western Washington Cascades province summary.*

DCAs = designated conservation areas.
– = unknown.

One measure of the population situation is reproductive success, which has been extremely low in the northern part of the province since structured surveys began in the early 1980s. Reproductive success has been higher in the southern part of the province. However, in a disjunct area of the southern part of the province (the Mineral Block), approximately 25 spotted owl activity centers are known. Many of these sites were checked in 1992; only one reproductive pair was located.

Low populations: The threat of low population levels is severe in the northern part of the province and moderate in the southern part. The currently known spotted owl population includes approximately 335 activity centers. This number will change as historic sites are confirmed and additional areas are surveyed. Spotted owls are found throughout the province, although at lower densities in the northern portion and in the I-90 corridor, where timber harvest has greatly reduced habitat (approximately 20 spotted owl activity centers occur here).

Distribution of habitat and populations: There are several concerns regarding the distribution of habitat and owls in the western Washington Cascades province; the threat is severe in the northern part of the province and moderate in the southern part. In the northern portion, no large clusters of spotted owls currently occur. Much of the habitat in lower-elevation areas has been eliminated, and interchange among remaining individuals or small clusters of spotted owls may be inhibited by nonforested, high-elevation ridges, peaks, and glaciers.

No large clusters of spotted owls currently occur in the I-90 corridor. Distribution concerns are primarily the north-to-south interchange of dispersing young and adults. With greatly reduced levels of suitable spotted owl habitat in this corridor, there is potential for significant isolation of the northern and southern spotted owl populations in both the eastern Washington Cascades and the western Washington Cascades provinces. North-to-south interchange is potentially further restricted by narrowing of federal ownership in the I-90 corridor.

In the southern part of the province, spotted owl populations in Washington are separated naturally from owl populations by the Columbia River. Historically, spotted owls probably were located along the northern and southern banks of the river. Logging and urban development in lowland areas of western Washington and Oregon have resulted in a restricted area of interchange, or "bottleneck," between spotted owls in the two states. Currently, interchange between spotted owl populations in the two states probably occurs only in a 18- to 20-mile zone in the Columbia River Gorge, if at all. It is unknown to what degree spotted owls in the two states interact.

The northwestern portion of the Gifford Pinchot National Forest is the remaining distributional concern. The Mineral Block is critical to potential genetic and demographic interchange between the Olympic Peninsula province and the western Washington Cascades province. Currently, 17 spotted owl activity centers are known in this checkerboard ownership block, and this Forest Service land is surrounded by nonfederal lands.

Province isolation: This threat is moderate in the southern part and severe in the northern part of the province. The two provinces that comprise the Washington Cascades are connected by contiguous habitat and owls in only a few high-elevation areas, such as Steven's, Snoqualmie, and White Passes. The extent of demographic interchange over these mountain passes is unknown. The northern part of the province is virtually at the edge of the species' current range. Spotted owls in southern British Columbia are found in low numbers and densities, and are unlikely to provide demographic support to owls in northern Washington. The degree of province isolation in the Columbia River area is unknown (see discussion of Distribution of Habitat and Populations). Spotted owls in the western Washington Cascades and eastern Washington Cascades provinces probably are isolated demographically from owl populations in the Olympic Peninsula province.

Predation and competition: The impact of these threats is unknown in the province. No formal surveys have been conducted for northern goshawks here. However, one owl survey study (Hamer et al.1989) reported the density of great horned owls to be one and one half times that of spotted owls (Table 2.5). The same study found barred owls at twice the density of spotted owls.

Vulnerability to natural disturbances: Natural disturbances are considered a low threat in the province. One significant loss of habitat occurred when Mount St. Helens erupted and eliminated a large forested region containing a number of spotted owl home ranges. The blast zone is similar in size to an area that might support a category 1 DCA. A volcanic eruption of Mt. Baker, Mt. Rainier, Glacier Peak, or Mt. Adams could result in elimination of one or more DCAs in this province, and isolation of localized owl clusters.

Biological goals and implementation on federal lands.

Based on the DCA network design criteria and the current owl distribution, the recovery plan recommends 24 DCAs for the province (Tables 3.9 and 3.10). Six of these DCAs meet the criteria for category 1 DCAs. One hundred eighty-six pairs of spotted owls have been confirmed on federal lands in these DCAs. This represents about 71 percent of all pairs located on federal lands in the province (Figure 3.14). The DCAs also contain approximately 55 percent of the nesting, roosting, and foraging habitat on federal lands in the province (Figure 3.15).

Four areas have been identified where reserved pair areas are needed to compensate for deficiencies in the DCA network. One reserved pair area, containing five pair home ranges, is needed in the I-90 corridor north of Mt. Rainier (between DCAs WD-7 and WD-8). Four reserved pair areas (with three owl pairs and four territorial singles) are needed between WD-12 and WD-11. Another five reserved pair areas are needed north of Darrington, adjacent to WD-17, WD-19, and WD-21. Each of these five areas contains one owl activity center. The locations and boundaries for reserved pair areas are in the recovery plan's administrative record and will be provided to the national forests involved.

The remaining federal lands in this province should be managed for dispersal habitat under matrix prescription A (see section III.C.2.). The federal landscape should meet the 50-11-40 rule and residual habitat areas of 100 acres each should be established for all known and future-discovered owl activity centers up to a density of six areas per township.

Biological goals and implementation on nonfederal lands.

Specific recommendations for nonfederal contributions are described in the following sections for each of the areas of special management emphasis. These areas are also discussed in the section about threats to this province.

Northern portion of the province (north of I-90): Habitat in this area is naturally fragmented because of the mountainous terrain, and the fragmentation has been worsened by timber harvest. Spotted owls and their habitat are poorly distributed; no large clusters of owls currently occur here.

Table 3.9. Summary of acreage and owl numbers for designated conservation areas (DCAs) in the western Washington Cascades province. (More detailed information, including owl numbers on nonfederal lands, is in Appendix I, Table I.3)

	Acreage			Owl Numbers					
				Known Owls[3]					
				Federal		Nonfederal			
DCA Ident. Number	Total	Percent Federal Lands[1]	NRF Habitat Federal[2]	Pairs	Singles	Pairs	Singles	Current Projected Federal[4]	Future Projected Federal[5]
WD-1	153,700	96	92,100	25	0	0	0	25	35
WD-2	16,800	96	10,300	3	0	0	0	3	3
WD-3	111,800	100	84,300	23	0	0	0	25	32
WD-4	52,200	92	33,900	9	1	0	0	10	13
WD-5	54,700	59	14,900	12	3	1	1	13	9
WD-6	175,500	98	103,600	28	0	0	0	28	39
WD-7	134,700	82	55,000	20	5	1	0	16	25
WD-8	35,400	55	9,900	3	1	1	0	4	4
WD-9	35,600	95	18,200	2	1	0	0	4	6
WD-10	13,600	94	7,100	2	0	0	0	4	4
WD-11	38,400	92	19,300	3	5	0	0	5	7
WD-12	31,300	98	16,800	4	0	0	0	5	8
WD-13	46,600	100	23,800	5	1	0	0	7	9
WD-14	9,700	96	6,300	1	0	0	0	2	2
WD-15	26,400	100	19,100	2	0	0	0	5	7
WD-16	33,300	98	17,200	4	1	0	0	5	8
WD-17	76,900	100	51,300	6	2	0	0	14	18
WD-18	87,900	96	44,200	8	1	0	0	11	24
WD-19	14,400	100	9,600	4	0	0	0	4	4
WD-20	27,300	100	19,100	2	0	0	0	5	6
WD-21	104,100	98	56,800	12	0	0	0	14	28
WD-22	38,000	99	19,000	4	2	0	0	5	9
WD-23	14,400	100	5,400	0	0	0	0	2	2
WD-24	100,900	92	31,800	4	0	0	0	8	10
Total:	**1,433,600**	**93**	**769,000**	**186**	**23**	**3**	**1**	**224**	**312**

1Management of nonfederal lands within the perimeter of DCAs is discussed in the province narrative.
2NRF = nesting, roosting, and foraging habitat for spotted owls. Habitat information was not available for nonfederal lands.
3Numbers of spotted owl activity centers verified in a 5-year period; generally 1987 through 1991.
4Estimate of the number of pairs of owls that the DCA would be expected to support on federal lands if the population stabilized with current habitat conditions. See Appendix I for further details.
5Estimate of the number of pairs of owls that the DCA might support in the future on federal lands if habitat were recovered. See Appendix I for further details.

Table 3.10. Summary comments on the designated conservation area (DCA) network in the western Washington Cascades province. (Section III.C.1. and Appendix I provide further information about the criteria and process used to delineate these areas.)

Category 1 DCAs	Comments
WD-1, WD-3, WD-6	Currently contain sufficient habitat and owl numbers to function as large clusters of interactive owl pairs.
WD-7, WD-18, WD-21	Currently estimated to contain fewer than 20 pairs of owls; each DCA has potential to increase to at least 20 pairs.
Category 2 DCAs	**Comments**
WD-2, WD-4, WD-5, WD-8 through WD-17, WD-19, WD-20, WD-22 through WD-24	These smaller, multipair areas were delineated in this area to address local demographic, distribution, and linkage concerns. Because of natural habitat limitations and low population densities, they can only potentially support 2 to 18 pairs of owls.

The primary recommendation for nonfederal lands in this area is to provide dispersal habitat and supplemental pair areas between WD-18 and DCAs to the north, east, and south. Such habitat should provide dispersal for the maximum number of juvenile owls dispersing from adjacent DCAs. Protective management could contribute to the province objective, as could land exchange. If new state forest practices regulations were developed, and dispersal habitat were well defined, such regulations also could contribute to this objective.

I-90 corridor: Timber harvest in this area of checkerboard ownership has resulted in limited nesting, roosting, and foraging habitat. Low amounts and poor distribution of habitat are serious concerns because they limit opportunities for dispersal between the northern and southern halves of the western Washington Cascades province and between the western Washington Cascades and eastern Washington Cascades provinces through Snoqualmie Pass.

There are three recommendations for nonfederal contributions to recovery in this area. The first is to provide nesting, roosting, and foraging habitat within or directly adjacent to DCAs with checkerboard ownership (WD-7 and WD-8). The second recommendation is to provide nesting, roosting, and foraging habitat to help support the reserved pair area (with five owl activity centers) that will be established on federal lands in the checkerboard ownership between WD-7 and WD-8. Contributions from nonfederal lands are needed to support these owl activity centers because sufficient habitat does not occur on federal lands. These contributions are needed until habitat in the DCAs recovers. The third recommendation is to provide dispersal habitat on nonfederal lands between WD-7 and WD-8.

In the I-90 corridor, prohibition of take on nonfederal lands is contributing to recovery. Nonfederal landowners are affected by prohibitions on take at approximately 20 to 30 owl sites in recommended DCAs in the I-90 corridor, and at a smaller number of sites to the north. Not all of these restrictions are contributing to the recovery objective. Protective management, as described in section IV.A., could lead to more efficient conservation measures and improve achievement of province recovery objectives. State forest practices

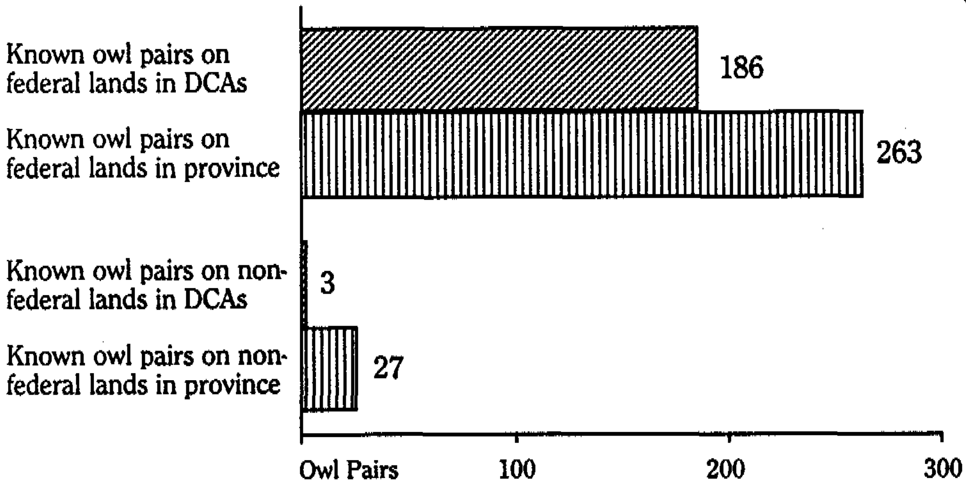


Figure 3.14. *Known owl pairs in the western Washington Cascades province and in the DCAs (designated conservation areas) in the province.*

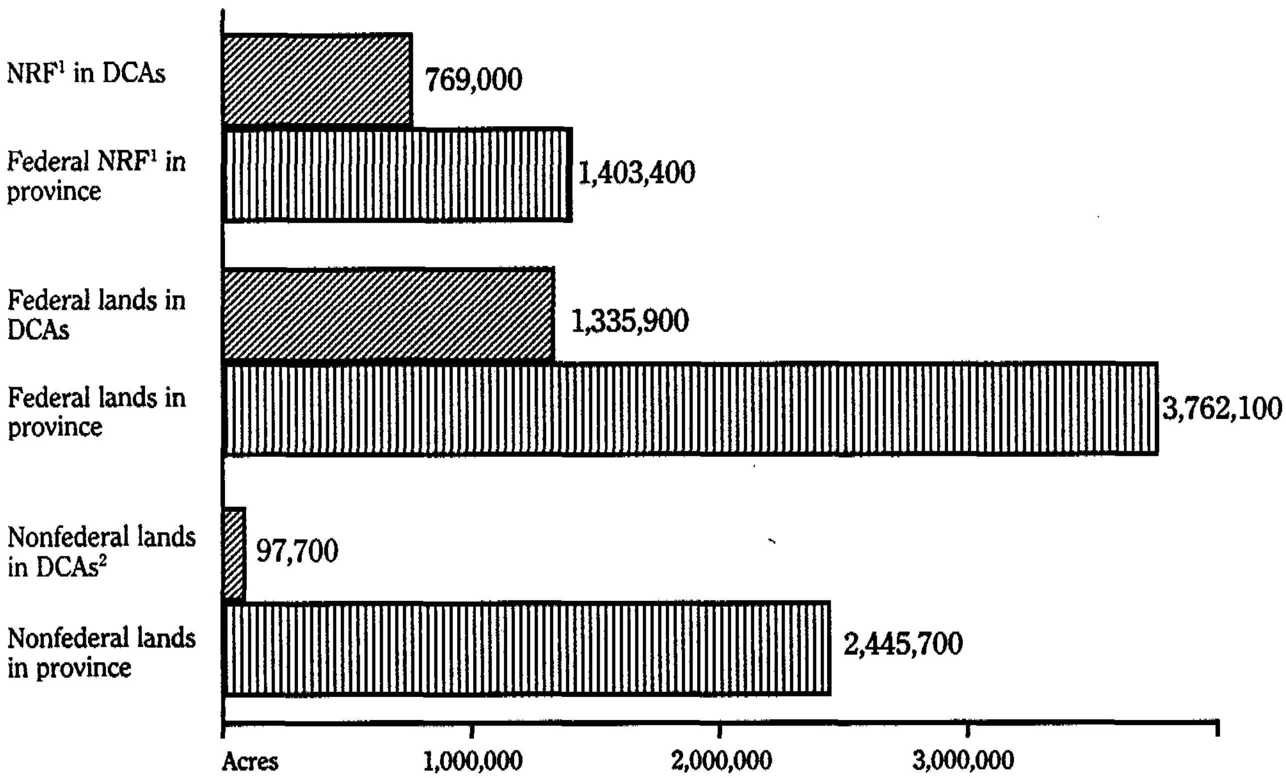


Figure 3.15. *Acres in the western Washington Cascades province and in the DCAs (designated conservation areas) in the province.*

[1]NRF = nesting, roosting, and foraging habitat. This information is available only for federal lands.
[2]Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the province narrative.

rules also could be used to ensure implementation of agreed on protection of known owls. Federal critical habitat designation could provide additional protection. The City of Seattle is protecting suitable habitat in the Cedar River watershed which extends into WD-8. The city's ownership is expected to increase because a land exchange has been approved by Congress. In this watershed the unsuitable habitat is eventually expected to develop into suitable habitat.

In the I-90 corridor, as in all of Washington, known owl activity centers are partially protected through federal prohibition on take. However, protection is limited, and additional habitat is likely to be needed to ensure long-term survival and productivity of each owl activity center. This could be achieved by providing additional protected acreage which would be negotiated in exchange for authorization of take of other owls. Or a larger area could be managed actively to provide long-term protection in exchange for reduced habitat protection in the short term. Opportunities to negotiate protection will be reduced to the extent that the province recovery objective already requires protection of most currently known owl pairs. In that case, little incentive exists for landowners who own land only within this province to make additional contributions. Land exchange or purchase may be necessary in some cases to increase the level of protection.

The Mineral Block: This area is key to the potential for population connectivity between the western Washington Cascades and Olympic Peninsula provinces. Habitat and owls are limited by the pattern of timber harvest in checkerboard ownership. This area is of particular importance for recovery contributions from nonfederal lands. As mapped, WD-5 includes checkerboard nonfederal lands and has a future capability of supporting nine pairs of spotted owls on the federal lands alone (Appendix I, Table I.3). There are presently 17 known owl activity centers on all lands in the recommended DCA. The recommendation is to provide nesting, roosting and foraging habitat on nonfederal lands within, or directly adjacent to, WD-5. This would be best if provided in the form of supplemental pair areas. This is recommended to increase the capability of the DCA so that it will support a minimum of 15 pairs of spotted owls. Nonfederal lands currently support spotted owls, and are important for long-term development of a stable subpopulation in this area.

It is also recommended that nonfederal dispersal habitat (see section III.D.) be provided among WD-4, WD-5, and WD-6. Such habitat should provide for dispersal of the maximum number of juvenile owls produced in the DCAs. If new state forest practices regulations were developed, and dispersal habitat well defined, such regulations could also contribute to this dispersal objective.

Within WD-5, prohibitions on take currently contribute to the province objective of supplementing the owl population in the DCA. Approximately 30 known owl activity centers occur in and near WD-5. Protective management, as described in section IV.A., could improve achievement of province recovery objectives. State forest practices rules also could be used to ensure protection of known owls, where agreed upon. However, if most or all known owl activity centers are needed to meet the province objective for the DCA, and landowners own land only within this province, opportunities will be limited to use protective management to achieve nonfederal contributions. This also will reduce opportunities to gain contributions of dispersal habitat among WD-4, WD-5, and WD-6. Regardless of the difficulties, these contributions are extremely important to developing stable owl subpopulations in the province and building connectivity to other provinces.

Siouxon Creek: This area is southwest of the Mount St. Helens National Volcanic Monument and northwest of WD-1. It provides opportunities to manage for owls in lower-elevation habitat on the west side of the Cascade Mountains, with potential benefits for population connectivity with the Oregon provinces and the Olympic Peninsula province.

This area is important to maintaining population distribution in the province, and it provides a potential link in establishing a second connection between spotted owls in Washington and Oregon across the Columbia River. The recommendation is to provide a nonfederal cluster of three to four owl activity centers in conjunction with federal ownership as either a small nonfederal cluster or as supplemental pair areas.

Prohibition on take will help accomplish this province objective. Opportunities to negotiate more efficient contributions are limited since there are only a few known owl activity centers in this area and all are needed to accomplish the province objective of providing a nonfederal cluster. However, those landowners with land in other provinces may have more flexibility to negotiate contributions. Some voluntary action on state-owned lands is possible but is not likely to achieve the province objective given current management requirements for these lands. Land acquisition through purchase or exchange is possible but would require up to $100 million. Less-than-fee acquisitions may have the potential to contribute to the province objective in this area. Achievement of the province objective in the near term is feasible to a degree.

Columbia River Gorge: Spotted owl populations in Oregon and Washington are separated by the Columbia River. The historic and current levels of interactions between populations in the two states are unknown, but there has been a significant reduction in habitat on both sides of the Columbia River due to timber harvest and urban development. Currently, interchange between spotted owls in Oregon and Washington is limited to the Columbia River Gorge. Ownership on the Washington side of the gorge includes state, private, and federal lands. State and private lands are important in addressing these distributional concerns in the gorge. The portion of the gorge where spotted owls might move between the Washington Cascades and Oregon Cascades is generally located between WD-1 and OD-1. This area includes part of the eastern Washington Cascades province. The recommendation for the area in the western Washington Cascades province is to provide protection for currently known owl activity centers on nonfederal lands using supplemental pair areas. Seven activity centers are known in the Columbia River Gorge.

An additional recommendation in the Columbia River Gorge is to develop strategies for future recruitment of additional habitat (see Appendix F) to provide a density of four owl pairs per township.

For all recommendations for supplemental pair areas, the intention is to provide habitat in an area equal to the median home range size in the province. The acreage of habitat provided should be at least the median amount of habitat used within home ranges, as determined from owl study areas.

Current prohibitions on take are partially contributing to the accomplishment of province recovery objectives in the gorge. However, there is little opportunity to negotiate additional landowner contribution in exchange for relief from take prohibition because of the small number of known owl sites; most owl sites are clustered near the national forest boundary; and most owl sites are needed to meet the province objective for pairs in the area. State forest practices regulations can help ensure protection of known owls and, if new regulations were developed, could provide dispersal habitat among pairs. However, state regulatory protection of breeding habitat independent of known pairs probably would require legislative action to change the statute.

Some state-protected habitat currently exists at Beacon Rock State Park and the adjacent Natural Resource Conservation Area at Table Mountain. Land exchange or land purchase to bring additional lands into public ownership for habitat protection appears necessary to meet the province recovery objective to establish large areas of new breeding habitat. However, this would be very expensive ($10 million to $20 million per owl pair) and would be feasible only with substantial federal funding. (Some land acquisition is occurring in conjunction with establishment of the Columbia Gorge National Scenic Area.)

Eastern Washington Cascades Province

Province description.

This province is east of the Cascade crest in Washington, from the Columbia River to the Canadian border. Land ownership and management of the 5.7-million-acre province are illustrated in the province summary (Figure 3.16).

Approximately 230 spotted owl activity centers have been found in the province; most are on federal lands in the central and southern parts of the province. In the northern part of the province, high mountains create naturally fragmented habitat with low potential for development of large clusters of spotted owls. In the southern part of the province, the highest densities of owls appear to be on the Yakima Indian Reservation.

While state and private lands are lesser ownerships in the province, some of these lands are in important areas for spotted owl management. As a result, three areas of special management emphasis have been identified for recommendations on nonfederal lands; specific recommendations are provided to help alleviate threats to owls in these areas.

Threats to the eastern Washington Cascades province.

General threats to spotted owls in the province include loss of habitat, habitat fragmentation, and lack of stable owl populations. There are severe threats (see section II.B.) from the high risk of large-scale fire and insect damage (see Appendix E), and from owl and habitat distribution issues.

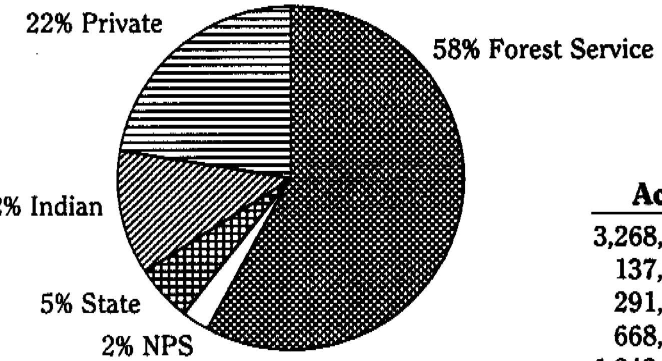
Assessment of the impact of habitat related threats is complicated by the lack of research that would describe suitable nesting, roosting, and foraging habitat in east side forests. Identification of suitable habitat has been difficult because of the varying intensities of timber harvest, and may be further complicated by vegetation conditions that vary significantly with precipitation and natural fire regimes (Irwin 1992a).

Declining habitat: The loss of habitat, in the recent past and from current harvest, is a moderate threat in this province. While it is possible that habitat acreage has increased in the province, due to fire suppression which allowed pine-dominated stands to develop a second canopy layer, timber harvest in these same stands has offset gains in habitat.

Limited habitat: The limited amount of existing habitat is also a moderate threat. In general, habitat in the eastern Washington Cascades province is in somewhat better condition than in the western Washington Cascades province. In the eastern portion of the I-90 corridor, there is approximately 10 to 15 percent more habitat than in the western Washington Cascades province. This difference may have significant effects on occupancy rates of territories and reproductive success of spotted owls (Bart and Forsman 1992). As in other provinces, much of the lower-elevation habitats have been heavily logged, primarily with partial-harvest techniques. Continued silvicultural practices emphasizing partial harvest may contribute to maintaining spotted owls in the province.

Declining populations: Lack of owl population studies in this province means no information is available, and declining populations are an unknown threat.

Low populations: Current low populations are considered a moderate threat in the province. Population estimates for the eastern Washington Cascades province range between 250 and 300 pairs (WDW 1991, Hanson pers. comm.). There are 218 pairs known



Acres	Ownership / Management
3,268,000	U.S. Forest Service
137,200	National Park Service (NPS)
291,300	State of Washington
668,500	Indian Lands
1,243,800	Private Ownership
5,608,800	**TOTAL**

Federal nesting, roosting, foraging habitat: 697,300 acres

Known owl activity centers:

	Federal		Nonfederal	
	Pairs	Singles	Pairs	Singles
Inside the DCAs	111	3	10	0
Outside the DCAs	42	5	55	4

Federal recommendations:

		Activity	Acres	
	Number	Centers	Reserved	Nonreserved
Category 1 DCAs	3	34	60,100	222,700
Category 2 DCAs	17	80	148,900	346,200
Prescription B reserved pair areas	2	4	3,300	7,700
Prescription C managed pair areas	12	23	4,000	97,200
Prescription A residual habitat areas (Estimate of current situation)	23	23	–	–

Nonfederal recommendations:
See province narrative.

Figure 3.16. *Eastern Washington Cascades province summary*

DCAs = designated conservation areas.
– = unknown.

at this time in the province. Owl survey efforts have varied widely among ownerships, with more routine surveys conducted in the national forests. State, private, and Indian lands received varying degrees of survey effort until 1991, when more intensive survey efforts were undertaken.

Currently, owl activity centers for 43 spotted owl territories are on state or private lands in the eastern Washington Cascades province. A larger number of spotted owls with activity centers on federal lands also probably use adjacent state and private lands due to checkerboard ownership patterns. Approximately 20 spotted owl territories occur in the northern part of the province; most are on federal lands. After surveying approximately 45 percent of the suitable habitat, about 34 known owl activity centers were found on the Yakima Indian Reservation. Estimates of owls on the reservation range in excess of 50 pairs (Hanson pers. comm.).

Distribution of habitat and populations: This threat is considered severe in the eastern Washington Cascades province. Most spotted owl habitat in the province is on the Yakima Indian Reservation and in four ranger districts in the Wenatchee National Forest: Naches, Cle Elum, Leavenworth, and Lake Wenatchee (including the checkerboard ownership nonfederal lands). Much of the province is dominated by high-elevation mountains and ridge-tops that are not suitable spotted owl habitat. These topographic restrictions require that recovery recommendations focus on low-elevation, mixed-conifer forests and smaller clusters of spotted owls.

Spotted owls and habitat are poorly distributed in portions of the Okanogan National Forest, the Chelan and Entiat Ranger Districts, on nonfederal lands between the Wenatchee National Forest and the Yakima Indian Reservation, and the mixed-ownership in the southern part of the province, southwest of the reservation.

Province isolation: The threat of isolation of this province is moderate. The Washington Cascades provinces are connected by contiguous habitat and owls in only a few areas. The northern part of the province is virtually at the edge of the species' current range and the few spotted owls in this part of the province are isolated from larger groups of owls south of Lake Chelan. Spotted owls in adjacent southern British Columbia are found in low numbers and densities, and are unlikely to provide demographic support to owls in northern Washington. Finally, the degree of province isolation created by the Columbia River Gorge is unknown.

Predation and competition: The threat of predation on spotted owls is unknown due to lack of documentation of the presence of predators and predation rates.

Information about the occurrence of barred owls indicates that the level of competition is unknown in the province.

Vulnerability to natural disturbances: There is a severe threat to the province owl population due to the probability of large-scale fire. It is unlikely that DCAs in the province will avoid stand-replacing wildfires during the next century (see Appendix E). Historically, ground fuels were removed by frequent, low-intensity ground fires that burned without killing overstory trees. A recent history of fire suppression has resulted in an accumulation of fuels, especially on national forest lands. This fuel accumulation increases the probability of stand-replacement fires that could eliminate spotted owl habitat from large-scale landscapes.

As spotted owls in the province currently are clustered in a few key areas, fire poses a threat to population recovery because it could remove one or more of these key areas. A compounding concern is that spotted owls in areas of the Wenatchee National Forest, where there is a high risk of fire, tend to be more productive than owls in areas of lower fire risk (Irwin 1992a).

A final concern is that volcanic eruptions of Mt. Adams, Mt. Rainier, or Glacier Peak could eliminate one or more DCAs and increase within-province isolation of subpopulations.

Biological goals and implementation on federal lands.

It is recommended that three category 1 DCAs, and 17 category 2 DCAs be established in this province (Tables 3.11 and 3.12). These DCAs include 124 owl activity centers (121 pairs and 3 territorial singles) on federal lands. These represent 72 percent of the total known owl pairs on federal lands (Figure 3.17). The DCAs contain 54 percent of the nesting, roosting, and foraging habitat on federal lands (Figure 3.18).

The DCA recommendations for the area north of Lake Chelan (north of DCAs WD-31 and WD-32) reflect low density of owl populations that result from natural and human-caused habitat fragmentation. In this area, all known owl activity centers have been delineated as small DCAs. When additional owl activity centers are located, they should be added to the DCA network. The long-term recovery objective in this area is to protect all known owl activity centers and to develop small DCAs with owl clusters of two or more pairs, since category 1 DCAs are not possible.

Threats to owls in the province require areas of specific matrix management recommendations. In most cases these federal matrix prescription areas correspond with areas of special management emphasis discussed for nonfederal lands. Areas have been identified as needing matrix prescription B or C (see section III.C.2.).

Northwest of WD-40, one prescription B reserved pair area is required to compensate for deficiencies in the DCA network. This reserved pair area will include three federal pair activity centers; it includes approximately 6,000 acres of federal lands. Habitat provided for this reserved pair area also will contribute to owl dispersal through this checkerboard ownership, and should be coordinated with nonfederal landowners.

Also under prescription B, one reserved pair area is needed between WD-33 and WD-34. This area includes the home range of one known owl activity center and consists of approximately 6,000 acres of federal lands.

Managed pair areas (under matrix prescription C management) are needed on federal lands in areas of high fire-risk mixed-conifer and ponderosa pine forests. At this time, 12 managed pair areas, which include 23 federal owl activity centers, are delineated for all currently known spotted owls on federal lands. Owl activity centers found in these areas in the future should also be delineated as managed pair areas. The areas are:

- Between WD-1 (in the adjacent province) and WD-44: one managed pair area delineated;
- Among WD-40, WD-41, WD-42, and WD-43: five managed pair areas delineated;
- Between WD-39 and WD-38: one managed pair area delineated;
- Among WD-37, WD-38, and the eastern province boundary: two managed pair areas delineated;
- Among WD-33, WD-35, and WD-36: three managed pair areas delineated.

Based on these matrix requirements and known owl activity centers, a total of 27 federal activity centers and 120,000 acres would be included in reserved pair areas and managed pair areas at this time. The locations and boundaries of these areas are in the recovery plan's administrative record and will be provided to the national forests involved.

Table 3.11. **Summary of acreage and owl numbers for designated conservation areas (DCAs) in the eastern Washington Cascades province. (More detailed information, including owl numbers on nonfederal lands, is in Appendix I, Table I.4)**

DCA Ident. Number	Acreage: Total	Acreage: Percent Federal Lands[1]	Acreage: NRF Habitat Federal[2]	Known Owls[3] Federal Pairs	Known Owls[3] Federal Singles	Known Owls[3] Nonfederal Pairs	Known Owls[3] Nonfederal Singles	Current Projected Federal[4]	Future Projected Federal[5]
WD-25	26,200	100	11,500	3	0	0	0	3	5
WD-26	12,800	100	3,300	1	0	0	0	1	2
WD-27	20,100	100	5,100	3	0	0	0	3	3
WD-28	55,300	96	1,700	2	0	0	0	6	10
WD-29	11,500	100	1,800	1	0	0	0	1	2
WD-30	10,300	100	100	1	0	0	0	1	1
WD-31	23,500	100	2,600	1	0	0	0	2	4
WD-32	32,300	100	5,400	3	0	0	0	3	5
WD-33	102,600	92	52,600	10	0	1	0	15	20
WD-34	104,600	98	56,700	5	1	0	0	12	21
WD-35	11,200	68	1,600	2	0	0	0	2	2
WD-36	26,700	93	9,400	4	0	0	0	4	5
WD-37	24,500	71	4,800	7	0	0	0	7	7
WD-38	92,300	93	54,800	17	1	0	0	20	24
WD-39	94,800	61	33,700	12	0	2	0	12	15
WD-40	60,900	74	31,700	11	0	6	0	13	14
WD-41	52,100	97	33,400	7	1	0	0	12	13
WD-42	9,200	100	2,400	3	0	0	0	3	3
WD-43	58,800	99	27,500	10	0	0	0	12	16
WD-44	34,500	99	25,700	8	0	1	0	9	10
Total:	**864,200**	**90**	**365,800**	**111**	**3**	**10**	**0**	**141**	**182**

[1]Management of nonfederal lands within the perimeter of DCAs is discussed in the province narrative.
[2]NRF = nesting, roosting, and foraging habitat for spotted owls. Habitat information was not available for nonfederal lands.
[3]Numbers of spotted owl activity centers verified in a 5-year period; generally 1987 through 1991.
[4]Estimate of the number of pairs of owls that the DCA would be expected to support on federal lands if the population stabilized with current habitat conditions. See Appendix I for further details.
[5]Estimate of the number of pairs of owls that the DCA might support in the future on federal lands if habitat were recovered. See Appendix I for further details.

Table 3.12. Summary comments on the designated conservation area (DCA) network in the eastern Washington Cascade province. (Section III.C.1. and Appendix I provide further information about the criteria and process used to delineate these areas.)

Category 1 DCAs	Comments
WD-33, WD-34	Currently estimated to contain fewer than 20 pairs of owls, but each has the potential to increase to 20 pairs.
WD-38	Currently estimated to support 20 pairs of owls.
Category 2 DCAs	**Comments**
WD-25 through WD-32, WD-35 through WD-37, WD-39 through WD-44	Because of natural habitat limitations and low population densities, these DCAs have potential capabilities to support from 1 to 16 pairs of owls. They were delineated in this area to address local demographic, distribution, and linkage concerns.

Remaining federal lands outside of the high fire-risk forests in this province should be managed for dispersal habitat under matrix prescription A (see section III.C.2.). The federal landscape should meet the 50-11-40 rule and residual habitat areas of 100 acres each should be established for all known and future-discovered owl activity centers up to a density of six areas per township.

Biological goals and implementation on nonfederal lands.

Four areas are identified for special management emphasis on nonfederal lands with recommendations to augment federal management in addressing threats to owl populations. Because the recommendations to alleviate these threats are the same for some of these areas, the discussions are lumped together, though the physical locations of the areas are separated.

The I-90 corridor area of checkerboard ownership, and checkerboard ownership north from WD-38, extending to the area surrounding and adjacent to WD-33, WD-35, and WD-37: In these two areas, habitat loss and connectivity among DCAs are the main concerns. The goal is to contribute to owl population stability in the DCAs. It is recommended that nonfederal lands provide nesting, roosting, and foraging habitat for spotted owls in or directly adjacent to WD-33, WD-35, WD-37, WD-38, WD-39, and WD-40. It is also recommended that dispersal habitat also be provided among these DCAs. Managed habitat is expected to provide characteristics necessary for roosting and foraging, but not necessarily for nesting. Some nesting habitat may be needed in the short term, especially since the DCAs are deficient in owl pairs.

The Endangered Species Act prohibition of take currently is contributing to the province objective of augmenting checkerboard DCAs in the I-90 corridor. Nonfederal landowners are affected by prohibitions on take involving many owl activity centers in the general area identified for special management emphasis. Protective management, as described in section IV.A., could lead to more efficient conservation measures and increase the likelihood of achieving province objectives. New forestry techniques are already practiced

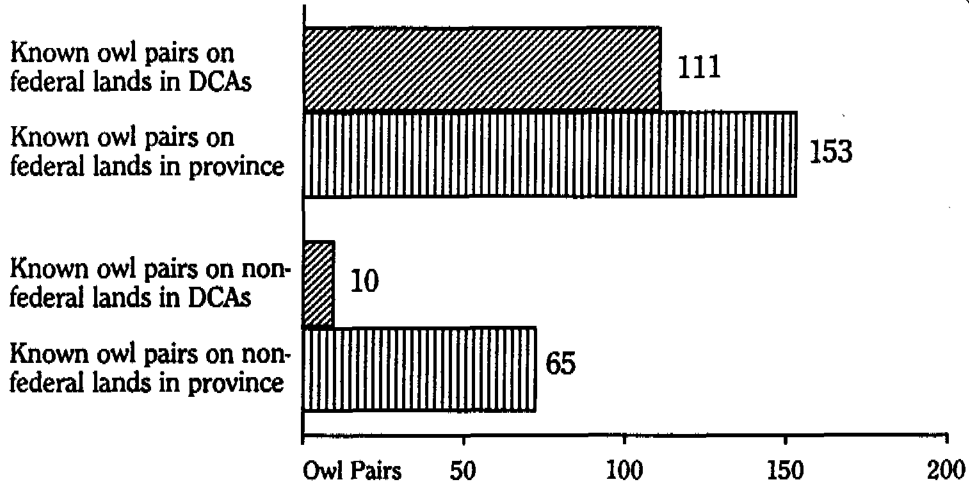


Figure 3.17. *Known owl pairs in the eastern Washington Cascades province and in the DCAs (designated conservation areas) in the province.*

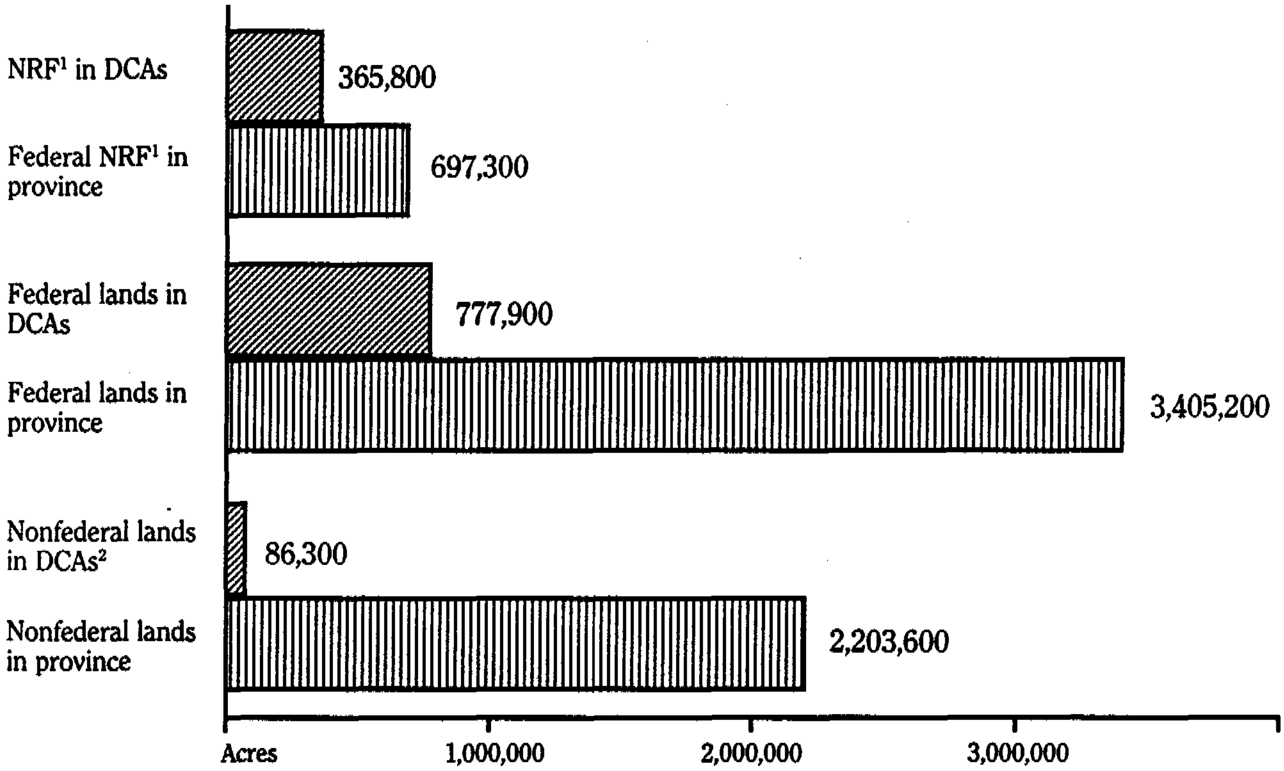


Figure 3.18. *Acres in the eastern Washington Cascades province and in the DCAs (designated conservation areas) in the province.*

[1]NRF = nesting, roosting, and foraging habitat. This information is available only for federal lands.
[2]Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the province narrative.

by some landowners in this area, and should contribute to achieving province objectives in DCAs. State forest practices rules could be used to ensure protection of known owls. Federal critical habitat designation could provide protection beyond that available through other means. Land exchange also may be a useful and acceptable mechanism in these checkerboard ownership areas. Land purchase may be needed for small acreage landowners.

An additional recommendation to alleviate threats in the I-90 corridor is to develop habitat on the L.T. Murray Wildlife Area to support a large cluster of owl pairs (more than 20 pairs) in conjunction with habitat in WD-40. Approximately 20,000 acres are needed to achieve this objective. The L.T. Murray Wildlife Area is owned by the State of Washington and most of the land is dedicated to wildlife habitat uses. Although there is little spotted owl nesting, roosting, or foraging habitat in the area now, development of habitat over time is possible. The recovery plan recommends that mixed-conifer habitat in this area be managed to develop late-successional forest characteristics which would contribute to the province objective of establishing an owl cluster.

Lands between the Yakima Indian Reservation and federal DCAs (between WD-43 and the reservation, and between the reservation and WD-1): The recommendation for these areas is to provide dispersal habitat which should be as continuous as feasible, and broad enough to allow a reasonable likelihood that owls will stay in it as they move between DCAs. In the southern area, this dispersal habitat will improve dispersal opportunities adjacent to the Columbia River Gorge.

Much of this area is in uneven-age management, which in many cases provides dispersal habitat and perhaps foraging habitat. Development of new forestry practices and uneven-aged management may improve the contribution to the province objective. Protective management, as described in section IV.A., and possible new state forest practices regulations could also contribute to this objective.

Yakima Indian Reservation, background and voluntary contribution.

Timber harvests on the Yakima Indian Reservation are done almost exclusively under uneven-age management prescriptions. This reduces impacts to suitable owl habitat while allowing harvesting to proceed. The reservation contains approximately 500,000 acres of forested habitat, of which about 50 percent (250,000 acres) currently is classified as suitable owl habitat. Typically, the northern spotted owl habitat on the Yakima Indian Reservation lies within a band approximately 30 miles (north to south) by 25 miles wide. This band starts near the Cascade crest at elevations below 5,000 feet and extends east until it reaches pure ponderosa pine timber stands. Within that habitat there is an existing block of 60,000 acres of prime suitable habitat that is in Tribally designated reserve status. To date only about 45 percent of the total suitable habitat and less than 5 percent of the reserved area habitat have been surveyed for owls. Forty-one owl activity centers were located during 1989-1992 owl surveys. At a minimum the Tribal biologists estimate a total of at least 50 nesting sites will be found when surveys of all owl habitat have been completed.

The Yakima Indian Nation has a large, effective fisheries and wildlife staff that reviews all on-reservation activities that may have environmental impacts. Currently, the Yakima Indian Nation employs 14 full-time biologists and wildlife technicians on northern spotted owl inventory, monitoring, and habitat utilization studies. Data from these studies will yield valuable insights into the compatibility of uneven-aged forest management techniques in maintaining spotted owl habitat suitability.

3. Oregon Province Narratives

Oregon Coast Range Province

Province description.

The Oregon Coast Range province is west of the Willamette Valley and extends along the coast, from the Columbia River south to about the Coquille River. The province is characterized by generally low-elevation, productive forests in areas of high precipitation.

Land ownership and management of the 5.8-million-acre province are illustrated in the province summary (Figure 3.19). There is a dominance of nonfederal lands, and federal lands include the Siuslaw National Forest and portions of the Salem, Eugene, Coos Bay, and Roseburg BLM Districts. The BLM lands are in a checkerboard ownership pattern in the eastern part of the province. State lands in the northern and southern parts of the province are managed under trust for the counties or for the State Land Board (Common School Trust).

Approximately 380 northern spotted owl activity centers (303 pairs and 77 territorial singles) are known to occur in the province. Despite the minority of federal ownership, 79 percent of the known owl pairs are on federal lands. Most owl activity centers are in the southern part of the province, south of Highway 38. These are primarily on BLM lands.

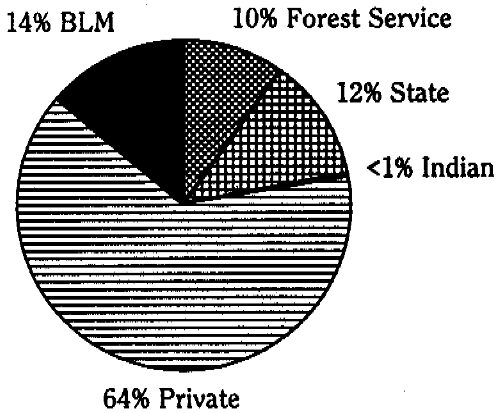
The entire province is an area of special management emphasis with recommendations for nonfederal lands, due to reduced habitat and poor population connectivity in the province and with adjacent provinces.

In the northern and southern parts of the province, where nonfederal lands predominate, and forest stands are primarily young and homogeneous, the recommendation is to provide for nonfederal clusters of owls. In these areas nesting, roosting, and foraging habitat is limited, as is habitat to support dispersal. Federal lands comprise a small proportion of the acreage and are unable to adequately provide for recovery, especially in the northern part of the province.

In portions of the province where federal lands are more prevalent and DCAs have been designated, there are recommendations for nonfederal lands to augment nesting, roosting, and foraging habitat which has been reduced and fragmented in DCAs due to timber harvest. There are recommendations for nonfederal dispersal habitat, as well.

Threats to the Oregon Coast Range province.

Timber harvest and extensive wildfires with subsequent timber salvage have greatly reduced and fragmented spotted owl habitat in this province and led to a severe rating for habitat-related threats. As a result, threats to the owl population in this province are greater than those in any other Oregon province (Table 2.4). These severe threats include: low and declining populations; little nesting, roosting, and foraging habitat; poor distribution of remaining owls and owl habitat; province isolation; and high levels of predators.



Acres	Ownership / Management
588,400	U.S. Forest Service
686,500	State of Oregon
19,100	Indian Lands
3,703,000	Private Ownership
796,600	U.S. Bureau of Land Management (BLM)
5,793,600	**TOTAL**

Federal nesting, roosting, foraging habitat: 478,200 acres

Known owl activity centers:

	Federal		Nonfederal	
	Pairs	Singles	Pairs	Singles
Inside the DCAs	133	33	4	2
Outside the DCAs	105	27	61	15

Federal recommendations:

		Activity	Acres	
	Number	Centers	Reserved	Nonreserved
Category 1 DCAs	3	53	16,700	177,900
Category 2 DCAs	14	113	5,200	397,500
Prescription B reserved pair areas	28	55	0	96,300
Prescription A residual habitat areas (Estimate of current situation)	77	77	–	–

Nonfederal recommendations:
See province narrative.

Figure 3.19. *Oregon Coast Range province summary.*

DCAs = designated conservation areas.
– = unknown.

Declining habitat: Since 1950, suitable owl habitat in the province has declined at an estimated annual rate of 2 percent; as of January 1991, suitable habitat existed only on an estimated 15 percent of the forest landbase in the province (Johnson pers. comm.). Of equal concern is the high rate of harvest of 40- to 60-year-old stands, which could be the foundation for restoring owl habitat in the province.

The decline of habitat has also probably affected the success of owl dispersal in the province. It is likely that successful dispersal is very limited, especially in the northern half, due to the small amount of dispersal habitat on federal and state lands, the general lack of habitat on private lands, and the substantial distances between suitable habitat areas. Assessments of dispersal habitat on federal lands were made in 1991. For BLM lands, 130 of 264 (49 percent) of the quarter-townships containing one section or more of BLM lands did not meet dispersal habitat criteria (i.e., the 50-11-40 rule). For Forest Service lands, nearly all of the quarter-townships containing Siuslaw National Forest lands met the 50-11-40 rule (Frounfelker pers. comm.).

Limited habitat: Most spotted owl activity centers in the province have less than 40 percent suitable habitat in home ranges (USDI 1991a). Fragmentation of habitat in this province is of significant concern, and is compounded by land-ownership patterns. Throughout much of the province, remnant stands of habitat have been reduced to small and often isolated parcels; many of these areas no longer support owls. The remaining suitable habitat in the province typically occurs as scattered pockets in areas of younger Douglas-fir stands (less than 50 years old). This is a result of the nearly simultaneous harvesting of large contiguous blocks of industry-owned lands, primarily by clear-cutting, which has resulted in expanses of relatively young forests that isolate the residual suitable habitat and occupied owl sites.

The scarcity and poor distribution of suitable habitat is particularly acute in the northern part of the province (north of Highway 20) where federal lands are virtually nonexistent. Here, habitat quantity and quality have been reduced severely by: 1) extensive timber harvest, 2) fragmentation and isolation of remaining stands, and 3) catastrophic fires and the resulting salvage of trees.

Declining populations: Section III.B. provides a general description of the primary techniques used to determine the rate of population change, which is the analysis of data about reproduction and survival. This is termed demographic data. Based on demographic data gathered in the Roseburg study area (see Figure C.1 in Appendix C) from 1985 to 1991, an analysis concluded that the annual spotted owl population decline is about 6 percent in the study area. Appendix C provides a further interpretation of this analysis.

Low populations: The owl population in this province is extremely low and considered under a severe threat, particularly in the northern three-fourths of the province. About 303 pairs have been found in the last 5 years and most of these are associated with federal lands. In areas dominated by nonfederal lands, owls are poorly distributed and exist at very low densities, with many pairs isolated by more than 10 miles.

Distribution of habitat and populations: Distribution of habitat and owl activity centers is also considered a severe threat in this province. Approximately 47 percent of the known spotted owl sites are in the southern 25 percent of the province, south of Highway 38. These owl activity centers are generally associated with BLM lands. As a result of timber harvest on interspersed BLM and private lands, this forest landscape is exceedingly fragmented.

Few existing clusters of owl activity centers with more than three pairs of owls occur north of Highway 126. Here, in the northern two-thirds of the province, individual owl sites are generally separated by 3 to more than 15 miles.

Province isolation: The province is adjacent to three other provinces, but has poor habitat connectivity with them, resulting in a severe rating for this threat. The province has a narrow, north-south shape and is isolated from adjacent provinces in the northern two-thirds by the Willamette Valley and large expanses of unsuitable habitat. The province is currently connected to the western Oregon Cascades province through forested lands south of Eugene, and to the Oregon Klamath and western Oregon Cascades provinces south of Roseburg. These remaining key linkage areas contain BLM and private lands in a checkerboard pattern. Due to past and ongoing timber harvest on all lands, habitat is particularly limited here. For example, BLM lands in 50 percent of the quarter-townships containing at least one section in this area do not meet dispersal habitat criteria (i.e., the 50-11-40 rule). There is a great risk that the Oregon Coast Range province will become isolated due to harvest of habitat in these checkerboard areas, which is the only remaining connection with other owl populations.

Habitat connectivity in the northern part of the province is a great concern also. Historically, there was probably a significant connection between the Oregon Coast Range province and the western Washington lowlands province, with owls crossing the Columbia River. Timber harvest since 1920 has probably eliminated this connection. Habitat would have to be developed along both sides of the Columbia River to reestablish the connection between these two provinces and increase the likelihood of population connectivity in them.

Predation and competition: The threat of predation is considered severe in this province. Great horned owls and northern spotted owls were surveyed in the central Coast Range in 1990 and 1991. Great horned owls were nearly seven times more numerous than spotted owls (Table 2.5). As great horned owls are key predators of spotted owls, this great relative abundance is of concern.

Although no formal surveys have been conducted for northern goshawks in this province, the low number of sightings and the dense ground vegetation which would reduce prey availability suggest the goshawk population is quite low.

Regarding competition, barred owls are found throughout the province and have been recorded at 46 sites from 1980 to 1991; they are considered a low threat to spotted owl populations in the province at this time.

Vulnerability to natural disturbances: Loss of habitat to fire and blowdown is considered a moderate threat, based on occurrence rates of these events. Because current suitable habitat areas are limited and disconnected, disturbance events could remove key habitat areas, and significantly contribute to the isolation and poor distribution of owls. Historically, extensive fires have removed large areas of habitat; while fires may be large, their frequency and annual risk is fairly low.

Biological goals and implementation on federal lands.

Seventeen DCAs are recommended for this province, with two DCAs meeting category 1 criteria (Tables 3.13 and 3.14). A total of 166 owl activity centers (133 pairs and 33 singles) has been located on federal lands in these DCAs between 1987 and 1991. This represents approximately 56 percent of the pairs located on all federal lands in the province

Table 3.13. Summary of acreage and owl numbers for designated conservation areas (DCAs) in the Oregon Coast Range province. (More detailed information, including owl numbers on nonfederal lands, is in Appendix I, Table I.5.)

DCA Ident. Number	Acreage			Owl Numbers					
				Known Owls[3]					
				Federal		Nonfederal			
	Total	Percent Federal Lands[1]	NRF Habitat Federal[2]	Pairs	Singles	Pairs	Singles	Current Projected Federal[4]	Future Projected Federal[5]
OD-33	82,300	68	28,200	24	0	0	0	12	17
OD-34	70,700	69	21,600	23	2	2	0	10	15
OD-35	12,500	66	5,700	8	0	0	0	4	4
OD-36	53,100	81	28,900	10	3	0	0	13	15
OD-37	70,400	55	14,600	21	0	0	0	10	16
OD-38	3,400	53	200	1	0	0	0	0	1
OD-39	71,100	84	30,200	9	5	0	1	15	20
OD-40	8,500	58	2,700	3	0	0	0	1	2
OD-41	39,900	75	12,900	10	1	1	0	6	10
OD-42	86,800	91	38,900	8	7	0	0	14	25
OD-43	53,800	87	26,800	2	5	1	0	10	15
OD-44	68,100	61	11,300	5	2	0	1	7	13
OD-45	12,800	56	1,900	2	0	0	0	1	2
OD-46	46,300	58	3,000	2	1	0	0	3	7
OD-47	51,800	85	17,600	2	3	0	0	4	15
OD-48	70,200	76	9,900	1	3	0	0	1	15
OD-49	15,000	50	200	2	1	0	0	0	2
Total:	**816,700**	**73**	**254,600**	**133**	**33**	**4**	**2**	**111**	**194**

[1]Management of nonfederal lands within the perimeter of DCAs is discussed in the province narrative.
[2]NRF - nesting, roosting, and foraging habitat for spotted owls. Habitat information was not available for nonfederal lands.
[3]Numbers of spotted owl activity centers verified in a 5-year period; generally 1987 through 1991.
[4]Estimate of the number of pairs of owls that the DCA would be expected to support on federal lands if the population stabilized with current habitat conditions. See Appendix I for further details. This may be smaller than the current known number where populations are adjusting to rapidly changing habitat conditions.
[5]Estimate of the number of pairs of owls that the DCA might support in the future on federal lands if habitat were recoverěd. See Appendix I for further details.

during that same period (Figure 3.20). The DCAs contain about 53 percent of the nesting, roosting, and foraging habitat identified on federal lands in the province (Figure 3.21).

Federal matrix management in the Oregon Coast Range province will require prescription A and prescription B management (see section III.C.). Because of the low number of owl pairs in DCAs in the northern part of the province, two reserved pair areas (each currently containing one activity center) will be established to supplement owl populations in DCAs OD-47 and OD-48. Future owl activity centers found north of OD-44 on federal lands should also be delineated as reserved pair areas. In the large central area of the province bounded by OD-14, OD-36, OD-43, and OD-44, 20 reserved pair areas will be established to supplement the population in those DCAs. These 20 areas currently contain 40 pairs and 4 single owls, but their capability of supporting owls is probably less than this current number.

Table 3.14. Summary comments on the designated conservation area (DCA) network in the Oregon Coast Range province. (Section III.C.1. and Appendix I provide further information about the criteria and process used to delineate these areas.)

Category 1 DCAs	Comments
OD-39, OD-42	Currently contain fewer than 20 owl pairs, but have a future capability of supporting more than 20 owl pairs, based on federal habitat.
Category 2 DCAs	**Comments**
OD-35, OD-38	Lie in an important area to maintain connectivity between provinces.
OD-40, OD-41, OD-43 through OD-49	Currently support from 1 to 15 pairs of owls.
OD-37	Currently supports more than 20 owl pairs but is expected to stabilize at less than 20 pairs.
OD-33, OD-34, OD-36	These are category 2 DCAs based on federal habitat only. If nonfederal contributions are obtained, the areas are capable of supporting more than 20 owl pairs.

The final general area for reserved pair areas is the southern portion of the province, in the vicinity of OD-33 and OD-34. In this area six reserved pair areas are delineated, and they currently support nine pairs of owls.

The locations and boundaries of reserved pair areas are contained in the recovery plan's administrative record and will be provided to the national forests and BLM districts involved. With the addition of the reserved pair areas to the DCA network, approximately 93 percent of all owl pairs on federal lands in the province will be protected. Nearly all known owl activity centers on federal lands north of Highway 38 will be protected.

The northern part of this province (north of Highway 20) has very little federal land, which precludes delineation of an adequate DCA network. All owls known on federal lands are included in DCAs or reserved pair areas. On the remaining federal lands there is an opportunity for federal agencies to practice silviculture techniques, as described in Appendix F, which could speed the development of suitable owl habitat. By quickening the development of suitable habitat outside of the DCAs, and creating an opportunity for owl populations to increase in this area, the federal agencies would be alleviating some of the severe threats in this province.

The remainder of the federal matrix in this province will be managed for dispersal habitat under matrix prescription A (see section III.C.2). Residual habitat areas of 100 acres each will be established for all known and future-discovered owl activity centers up to a density of eight areas per township.

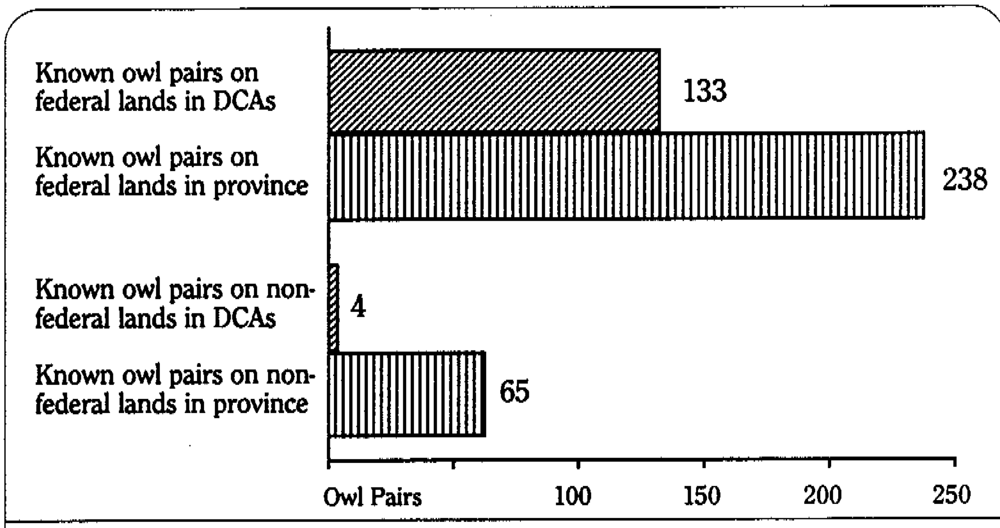


Figure 3.20. *Known owl pairs in the Oregon Coast Range province and in the DCAs (designated conservation areas) in the province.*

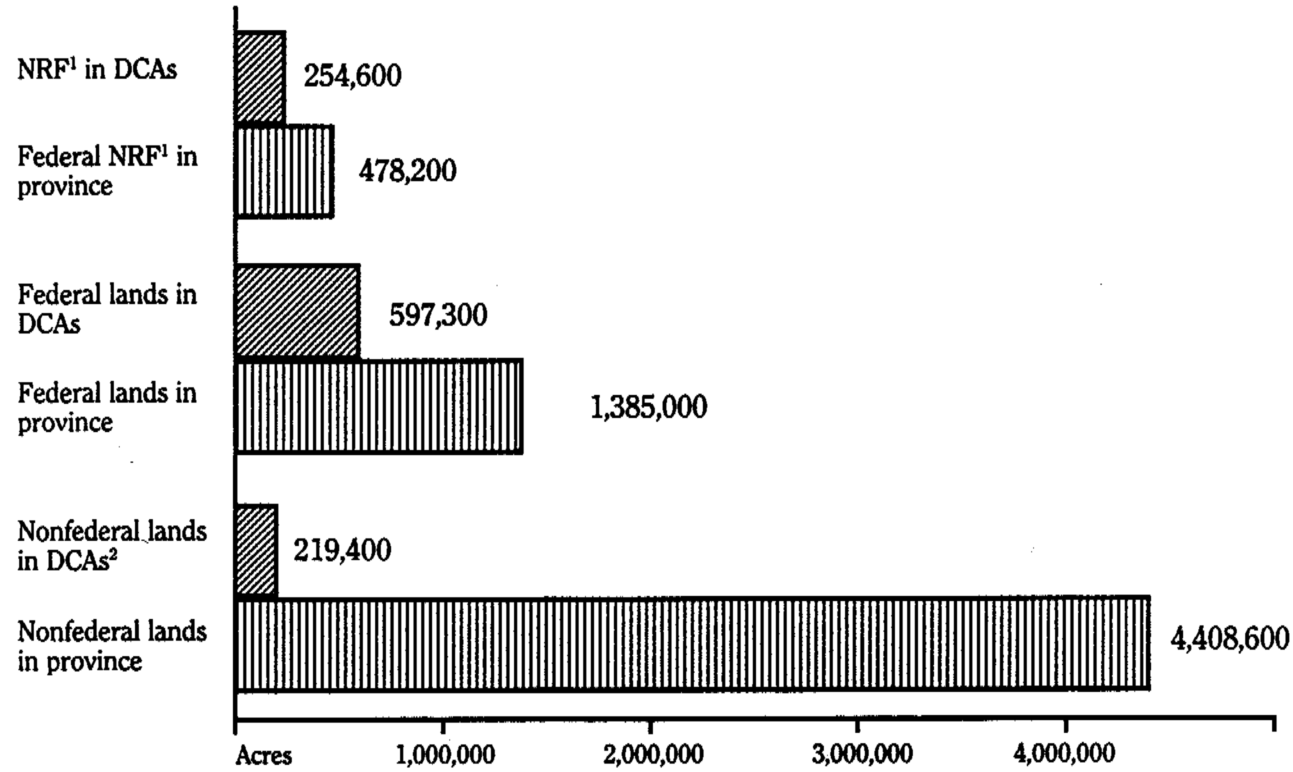


Figure 3.21. *Acres in the Oregon Coast Range province and in the DCAs (designated conservation areas) in the province.*

[1]NRF = nesting, roosting, and foraging habitat. This information is available only for federal lands.
[2]Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the province narrative.

Biological goals and implementation on nonfederal lands.

Achieving the recovery goal in this province will depend heavily on cooperation from nonfederal lands. The entire province has been identified as an area of special management emphasis for nonfederal lands. As described in section III.D., general objectives for nonfederal lands in the area of special management emphasis are to: 1) provide nesting, roosting, and foraging habitat in federal DCAs; 2) provide nesting, roosting, and foraging habitat to support individual supplemental pair areas and nonfederal clusters; 3) provide dispersal habitat; and 4) develop a habitat management plan for the state lands.
For the first general objective, nonfederal lands within DCAs are recommended to provide nesting, roosting, and foraging habitat to augment habitat on federal lands and meet the owl population objective for the DCA. This includes both checkerboard ownerships (DCA OD-33, OD-37, OD-38, OD-40, OD-41, OD-44, OD-45, and OD-46) and other DCAs with less nonfederal land (OD-34, OD-35, OD-36, OD-39, OD-42, and OD-48).

As part of the second objective, in the northern part of the province (north of OD-43 and OD-44), all nonfederal ownerships should provide for a network of nonfederal clusters. To accomplish this, it is recommended that nonfederal lands provide nesting, roosting and foraging habitat in clusters and in supplemental pair areas for all currently known and future-discovered owl activity centers until a functional network of nonfederal clusters exists.

A third objective is to provide dispersal habitat among the supplemented DCAs and nonfederal clusters to assure successful dispersal of owls between the DCAs and to the adjacent provinces.

The fourth objective is the recommendation to develop a cooperative conservation plan for state lands. This conservation plan could be used to comply with the state's Endangered Species Act on state-owned lands. An initial plan has begun for the Elliott State Forest. As of December 1992, management of state lands was affected by 198 owl activity centers (statewide tally; with owls being either on or adjacent to state lands). As a result, state lands are contributing in some measure to recovery due to prohibitions against take. Conservation planning as described in section IV.A. could lead to more efficient conservation measures and improve the likelihood of achieving recovery objectives.

In following with the fourth objective, these specific recommendations are made for state lands in the Oregon Coast Range province:

State lands in Astoria/Tillamook/Forest Grove area: Most state lands in this area are in the Tillamook and Clatsop State Forests and are managed by the Oregon Department of Forestry. Additional state lands providing owl habitat include state parks and Oregon State University's "Blodgett Tract."

The Tillamook State Forest contains 480,000 acres of forestlands, including 14,400 acres supporting stands older than 80 years. Large fires in 1933, 1939, and 1945 burned 345,900 acres. Subsequent timber salvage and reforestation have created a relatively homogeneous forest, with stands 30 to 50 years old. Older forest stands outside of the burned area, now isolated due to timber harvest, contain the remaining owls and habitat.

As of 1992, 14 owl activity centers have been located on state lands in the Tillamook/ Clatsop vicinity. Most of these activity centers are on the western and northern sides of the Clatsop and Tillamook State Forests, where mature stands exist in a landscape shaped by the earlier forest fires and recent logging.

In the Tillamook and Clatsop State Forests, the recommendation is to provide for existing and future clusters of owls by protecting existing and future-discovered owl activity centers (as supplemental pair areas) and dispersal habitat among clusters to create a network of nonfederal clusters.

Also, provision of nesting, roosting, and foraging habitat on state lands in OD-48 and OD-49, and adjacent to OD-49, would serve to bolster federal lands contributions in these areas.

It is anticipated that current management direction for state parks in this area, as well as elsewhere in this and other provinces, will complement other state lands contributions toward owl recovery.

Spotted owls are absent throughout most of the "Tillamook Burn." This large, contiguous block of younger forest could provide the testing grounds for a variety of experimental methods designed to answer many of the questions identified in section III.J.2. of the recovery plan. Similar projects could be conducted in Oregon State University's "Blodgett Tract." At this time, projects involving silvicultural approaches to providing owl habitat should be considered experimental, and as such, should be located outside of occupied owl clusters and supplemental pair areas.

State lands west of Corvallis: State lands west of Corvallis are predominately in the Oregon Department of Forestry's West Oregon District, the McDonald and Dunn Forests (managed by Oregon State University), the VanDuzer Forest Corridor Wayside, and various state parks. Only a few owl activity centers are currently known on these state lands.

Surveys of owls and owl habitat were conducted on 38,000 acres of state lands in the area west of Corvallis during 1990 and 1991. Only 6.1 percent of these state lands (6,257 acres) contained stands averaging 75 years of age or older; mean stand size was 26.2 acres. Only one spotted owl response was found in 1991, and that owl was adjacent to, not on, state lands. Although these state lands probably supported owls in previous years, territorial owls no longer exist here.

It is recommended that state lands in OD-43, OD-44, and OD-45, and adjacent to OD-45, provide nesting, roosting, and foraging habitat to increase the viability of the federal DCA network in these areas.

State lands south of Highway 20 and outside of DCAs are recommended to provide habitat to meet dispersal habitat objectives. As discussed in section III.D., nonfederal matrix management may include the provision of habitat above the minimum dispersal needs.

It is anticipated that current management direction in the VanDuzer Forest Corridor Wayside, along Highway 18 (between OD-46 and OD-48), and state park lands will provide some contribution toward the dispersal habitat objective.

Management planning is currently underway for the 12,000 acres in the McDonald and Dunn Forests. Management for older forest is being considered on a portion of this land base. Such management will contribute to meeting recovery objectives for owls in the area west of Corvallis.

State lands west of Eugene: Most state lands in this area are managed by the Oregon Department of Forestry. These lands are in the checkerboard ownerships of BLM, Forest Service, and private lands. Protection of 44 owl activity centers now affects the management of these state lands.

It is recommended that nesting, roosting, and foraging habitat be provided on state lands in OD-39, OD-41, and OD-42 to increase the viability of these DCAs. Provision of dispersal habitat and supplemental pair areas are recommended for state lands outside of DCAs.

***State Lands Around the Lower Reaches of the Umpqua River*:** Most state lands in this area are south of Highway 38, in the Elliott State Forest. Additional smaller parcels of state lands are intermingled with BLM, Forest Service, and private lands. Most of these state lands are being managed by the Oregon Department of Forestry.

The Elliott State Forest is a 93,000-acre block northeast of Coos Bay. Surveys in 1992 found 19 pairs and 10 single owls here. These owls are of particular interest due to the age structure of trees in the forest. Fifty percent of the forest is composed of trees 90 to more than 140 years old. Trees in 40 percent of the forest are less than 40 years old. Because owl populations elsewhere in the province are in decline, research is needed in the Elliott State Forest to determine if this owl population is self-sustaining.

As of 1992, 30 spotted owl activity centers have been identified in, or immediately adjacent to, the Elliott State Forest. It is recommended that the Elliott State Forest provide for nonfederal clusters and dispersal habitat.

Other state lands along the Umpqua River are impacted by management of owl activity centers. In some of these areas nesting, roosting, and foraging habitat is recommended for state lands in DCAs to augment federal habitat; specifically in OD-33, OD-34, and OD-36.

Regarding the recommendations for nonfederal lands, the implementation opportunities now focus on the prohibition against take. Some opportunity may exist to negotiate for more efficient contributions from nonfederal landowners (see section IV.A.) since they are affected by the prohibition against taking spotted owls, especially in the southern part of the province. However, federal land exchange or purchase may be necessary to meet the objectives. Regardless of the implementation mechanism used, achieving the recovery goal in this province will depend heavily on cooperation from nonfederal lands.

Grand Ronde Indian Reservation, background and voluntary contribution.

The entire reservation has been surveyed and only small amounts of suitable northern spotted owl habitat exist. All of this suitable habitat is in second-growth stands with the majority of the area in the Coast Creek drainage on the eastern part of the reservation. The Coast Creek drainage has been occupied by a successfully breeding owl pair since 1974. An additional resident owl resides on the western part of the reservation. Much of the surrounding Forest Service and BLM timber stands in the Coast Creek area are or are approaching suitable habitat conditions for northern spotted owls.

The enabling legislation establishing the Grand Ronde Indian Reservation has as its principal purpose to provide economic and cultural stability for the restored Grand Ronde Tribe. One of the terms of the Grand Ronde Reservation Act provides that, beginning September 1988 and for the following 20 years, 30 percent of all timber revenue is to be set aside for economic development primarily in Yamhill, Polk, and Tillamook Counties. Given the above situations, the Tribe and the BIA have conducted on-the-ground surveys with the FWS to explore alternatives that will provide protection for northern spotted owls and allow a metered harvest of timber from the Coast Creek area. This agreed upon action began in 1991, and will continue as long as necessary.

Western Oregon Cascades Province

Province description.

The western Oregon Cascades is along the western slope of the Cascade crest, from the Columbia River to the California border. Spotted owl habitat extends from the eastern edge of the Willamette Valley upslope to about 5,000 feet, and from the moist, true-fir forest in the north to the dry, mixed-conifer-pine-oak woodlands in the south.

Land ownership and management of the 6.7-million-acre province are illustrated in the province summary (Figure 3.22). National forests extend almost the length of the province and include portions of the Mt. Hood, Willamette, Umpqua, and Rogue River National Forests. BLM lands, generally occurring in checkerboard ownerships with private lands, are at lower elevations in the western part of the province. These BLM lands include parts of the Salem, Eugene, Roseburg, and Medford Districts. Private lands generally occur in the western portion, at lower elevations. The majority of state lands is in the northern part of the province in the Santiam State Forest.

The province is the largest in Oregon, contains more documented owl pairs than other Oregon provinces, and has the largest acreage of nesting, roosting, and foraging habitat (Figure 3.24). Habitat has been fragmented by timber harvest throughout the province. But fragmentation is less severe at middle elevations than at lower elevations. Higher elevations (generally above 4,500 feet) are naturally unsuitable as spotted owl habitat. These factors have resulted in the current distribution of owls and owl habitat generally in the mid-elevation zone. Owls are commonly distributed in a continuous pattern throughout national forest lands at these middle elevations except for the checkerboard ownership lands in the Santiam drainage. A few owls occur at lower elevations on private lands, where habitat remains, but surveys of these lands are incomplete and the actual number of owls here is unknown.

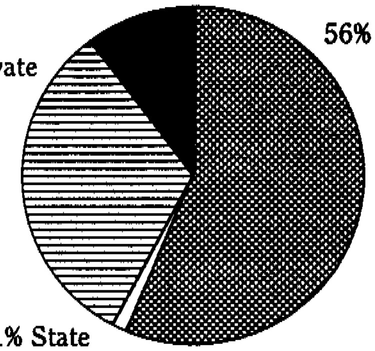
Two areas of special management emphasis have been identified for nonfederal recommendations.

Threats to the western Oregon Cascades province.

Owl management concerns in the province are varied, but none of the threats is considered severe (see section II.B. and the following discussion).

Declining habitat: Declining habitat is considered a moderate threat in the province. Timber harvest from all ownerships for the period 1950 to 1990 indicates an estimated annual rate of habitat loss of 1.4 percent for this province. The rate of habitat loss on federal lands is estimated to be about 1.0 percent annually (Johnson pers. comm.).

Ripple et al. (1991) assessed the changes in forest fragmentation patterns from 1972 to 1987 on approximately 65,000 acres of national forest lands in the central part of the province. They reported a 8.7 percent decrease in the amount of natural forest (as a result of timber harvest) and a concomitant 18 percent decrease in the amount of "interior" habitat. The loss of interior habitat, at nearly double the rate of timber harvest, reflected the harvest of timber in a manner which fragments large blocks of mature and old-growth forest.



Acres	Ownership / Management
3,773,700	U.S. Forest Service
87,700	National Park Service (NPS)
11,300	State of Oregon
2,138,000	Private Ownership
670,800	U.S. Bureau of Land Management (BLM)
6,681,500	**TOTAL**

Federal nesting, roosting, foraging habitat: 2,113,800 acres

Known owl activity centers:

	Federal		Nonfederal	
	Pairs	**Singles**	**Pairs**	**Singles**
Inside the DCAs	411	115	5	1
Outside the DCAs	620	180	45	12

Federal recommendations:

		Activity	Acres	
	Number	**Centers**	**Reserved**	**Nonreserved**
Category 1 DCAs	17	508	292,200	1,078,000
Category 2 DCAs	5	18	0	44,200
Prescription A residual habitat areas (Estimate of current situation)	783	783	–	–

Nonfederal recommendations:
See province narrative.

Figure 3.22. *Western Oregon Cascades province summary.*

DCAs = designated conservation areas.
– = unknown.

Limited habitat: Limited habitat in the province is considered a low threat. Although the western Oregon Cascades province has a higher owl density than any other Oregon province, suitable owl habitat is limited mainly to federal lands. Much of the suitable habitat on federal lands has been fragmented significantly in the past 40 years. For example, in areas approximately equal to the median home ranges of 383 owl-pair sites in the Willamette National Forest, 49 percent of the sites contained less than 40 percent owl habitat, 33 percent contained from 41 to 60 percent habitat, and only 11 percent contained more than 60 percent habitat. No habitat data were available for remaining 7 percent of the owl pairs (Byford pers. comm.).

In 1990, Johnson (1993) assessed the amount of old-growth and mature forest in 70 random plots (totaling 86,695 acres) on Forest Service lands in the central part of the province. The mean amount of old-growth and mature forest in these plots was 53 percent.

Declining populations: Declining populations are considered a moderate threat in this province. Section II.B. provides a general description of the primary techniques used to determine the rate of population change, which is the analysis of data about reproduction and survival. This is termed demographic data. Based on demographic data gathered from the H.J. Andrews study area (see Figure C.1 in Appendix C) from 1987 through 1991, an analysis indicates populations in the central part of the province are declining by about 7 percent annually. The Medford study area also lies partially in the western Oregon Cascades province, and that study area indicated an annual rate of population decline of approximately 16 percent. Appendix C provides a further interpretation of this analysis.

Low populations: This is considered a low threat because owl populations are moderately high on the federal lands, the dominant land status. Areas with low owl numbers occur on 1) private lands, 2) checkerboard BLM lands at lower elevations, 3) checkerboard Forest Service lands in the Santiam Pass area, and 4) higher elevation forests near the Cascade crest. There are approximately 1,081 known spotted owl pair sites in the province.

Distribution of habitat and populations: This threat is also considered low. Given the dominance of owls at mid-elevation, the north-to-south distribution of spotted owls throughout this province is adequate, with the exception of the Santiam Pass area, where owl activity centers are separated by 6 to 10 miles. Owls are scattered on BLM lands along the western part of the province and some activity centers are isolated by intervening private lands with little habitat. The distribution of owls is also affected by the fact that few owls are found above 4,500 feet and little suitable habitat exists above 5,000 feet.

The forested lands on the western edge of the province between the national forest boundaries and the Willamette Valley are predominantly privately owned and contain little suitable habitat. Although owls are present in low numbers on some of these lands, it is unclear whether the owls are self-supporting or are a result of dispersing owls from nearby source populations.

Province isolation: Isolation of the province from other owl populations is considered a low threat. There are some areas along province boundaries which are of concern, but for the most part the province is relatively well connected to others. Before development of the Portland metropolitan area and the Willamette Valley, this province is believed to have been connected to the Oregon Coast Range province along the lower Willamette River. Another possible forested connection may have existed in the Salem area.

There is concern that the Columbia River Gorge, impoundments behind hydroelectric dams, and other recent human activities along the Columbia River impede the movement of spotted owls between the Cascades provinces in Washington and Oregon. Spotted owl habitat in this area mainly occurs in the Mt. Hood National Forest in Oregon and the Gifford Pinchot National Forest in Washington.

On the western edge of the province, there is a weak connection to the Oregon Coast Range province, where there is significant concern for demographic instability and isolation of owls. Habitat that would support east-to-west movements of owls between these two provinces probably can best be achieved on BLM lands south of Eugene.

Linkage to the California Cascades province is hampered by limited forest habitat in the checkerboard areas of BLM and private lands, as a result of past logging and natural ecological conditions.

The western and eastern Oregon Cascades provinces adjoin along the Cascade crest. A natural barrier to dispersal between these provinces exists along much of their common border and consists of high-elevation areas that are 3 miles or more wide, with little or no forest cover.

Predation and competition: Predation on spotted owls by northern goshawks and great horned owls is considered a moderate threat in this province. Owl surveys in the central portion of the province in 1989 and 1990 resulted in great horned owls being 60 percent as numerous as spotted owls (Johnson 1993; Table 2.5).

Northern goshawk densities are considered moderate in this province. Most goshawks have been observed in habitats also used by northern spotted owls and goshawk predation upon adult spotted owls has been observed (Desimone pers. comm.).

Barred owls are distributed throughout the province and were recorded at 156 locations from 1980 through 1991; the threat of their competition with spotted owls is considered low in this province at this time.

Vulnerability to natural disturbances: Fire and wind are the primary causes of natural habitat loss in this province, but their effect is considered a low threat. Key areas of fire concern are along the Columbia River in the Mt. Hood National Forest (see Appendix E), and the area adjacent to the Oregon Klamath province in southern Oregon. Although major wind events have occurred (e.g., in Bull Run watershed in 1973 and 1983, Franklin and Forman 1987) most wind damage occurs on a smaller scale. The effect of most wind events is accelerated windthrow along edges of clear-cuts and roads which border forest stands.

Biological goals and implementation on federal lands.

The dominance of federal lands in the province, and relatively good distribution of spotted owls and habitat, allow the design of a DCA network which is better than in many provinces. Using the design criteria for the DCA network and future habitat capability estimates, 17 category 1 DCAs and 5 category 2 DCAs are recommended for this province (Tables 3.15 and 3.16). These DCAs contain 526 documented owl activity centers (411 pairs and 115 territorial singles) on federal lands. The spotted owl pairs on federal lands in DCAs represent approximately 40 percent of pairs located on federal lands in this province in the last 5 years (Figure 3.23). The DCAs contain about 38 percent of the nesting, roosting, and foraging habitat identified on federal lands in the province (Figure 3.24). Most of these DCAs are in national forests; eight DCAs include BLM lands.

Table 3.15. Summary of acreage and owl numbers for designated conservation areas (DCAs) in the western Oregon Cascades province. (More detailed information, including owl numbers on nonfederal lands, is in Appendix I, Table I.6.)

DCA Ident. Number	Acreage: Total	Acreage: Percent Federal Lands[1]	Acreage: NRF Habitat Federal[2]	Known Owls[3]: Federal Pairs	Known Owls[3]: Federal Singles	Known Owls[3]: Nonfederal Pairs	Known Owls[3]: Nonfederal Singles	Current Projected Federal[4]	Future Projected Federal[5]
OD-1	148,300	100	95,800	11	4	0	0	30	45
OD-2	111,700	100	61,400	23	11	0	0	27	35
OD-3	98,200	91	49,100	11	8	0	0	20	30
OD-4	77,400	95	38,100	23	9	0	0	22	30
OD-5	80,300	93	49,700	20	3	1	0	25	30
OD-6	67,700	94	40,500	20	4	0	0	20	27
OD-7	103,800	100	78,300	20	15	0	0	27	30
OD-8	84,200	100	40,600	28	7	0	0	25	35
OD-9	82,200	100	47,100	19	11	0	0	25	33
OD-10	66,900	93	34,600	24	8	0	0	20	25
OD-11	2,600	55	600	2	0	0	0	0	1
OD-12	3,000	59	400	0	1	0	0	0	1
OD-13	3,200	66	400	0	1	0	0	0	1
OD-14	18,300	43	1,000	2	0	0	0	1	3
OD-15	89,700	57	30,500	33	1	1	1	13	20
OD-16	84,700	97	49,100	26	3	0	0	25	35
OD-17	84,200	96	53,500	34	5	0	0	28	35
OD-18	66,400	99	32,100	15	2	0	0	16	22
OD-19	78,000	82	35,900	38	8	3	0	22	30
OD-20	65,600	98	28,200	26	11	0	0	21	28
OD-21	76,400	92	33,800	24	3	0	0	15	25
OD-22	50,200	62	12,000	12	0	0	0	5	10
Total:	**1,543,000**	**92**	**812,700**	**411**	**115**	**5**	**1**	**387**	**531**

[1]Management of nonfederal lands within the perimeter of DCAs is discussed in the province narrative.
[2]NRF = nesting, roosting, and foraging habitat for spotted owls. Habitat information was not available for nonfederal lands.
[3]Numbers of spotted owl activity centers verified in a 5-year period; generally 1987 through 1991.
[4]Estimate of the number of pairs of owls that the DCA would be expected to support on federal lands if the population stabilized with current habitat conditions. See Appendix I for further details.
[5]Estimate of the number of pairs of owls that the DCA might support in the future on federal lands if habitat were recovered. See Appendix I for further details.

Federal matrix management will follow prescription A, with the federal landscape meeting the 50-11-40 rule and residual habitat areas of 100 acres established around owl activity centers outside of DCAs, up to a density of eight areas per township.

Within and adjacent to the southern part of the province is a large gap in the federal DCA network, centered approximately on the city of Medford. This gap reflects existing conditions that make it impossible to meet recovery plan standards for the DCA network. The Recovery Team suggests that the BLM practice innovative management around owl activity centers in this area to provide adequate habitat to maintain these sites through time. This suggestion is not required to achieve recovery, but is expected to speed the recovery process by building stronger habitat and population linkage.

Table 3.16. Summary comments on the designated conservation area (DCA) network in the western Oregon Cascades province. (Section III.C.1. and Appendix I provide further information about the criteria and process used to delineate these areas.)

Category 1 DCAs	Comments
OD-1, OD-18	Currently estimated to contain fewer than 20 pairs of owls. Both have the potential to increase up to 20 pairs.
OD-2 through OD-10 OD-15 through OD-17 OD-19 through OD-21	Each currently supports 20 or more pairs of owls.
Category 2 DCAs	**Comments**
OD-11 through OD-14	Provide an important link between the western Oregon Cascades province and the Oregon Coast Range province.
OD-22	Recommended to provide population connectivity to the California Cascades province. It is estimated to support 10 pairs of owls in the future.

Biological goals and implementation on nonfederal lands.

As with other provinces, the recommendations for nonfederal lands focus on the areas of special management emphasis. There are two areas of special management emphasis in the western Oregon Cascades province: 1) the area where the Oregon Coast Range, western Oregon Cascades and Oregon Klamath provinces meet; and 2) the area south of OD-21. In each area, there are two main concerns. The first concern is the checkerboard ownership in DCAs where federal lands would be inadequate to fully meet the province objectives for DCAs, especially in the short term. The second main concern is poor population connectivity between key DCAs, which results in weak links between the western Oregon Cascades province and surrounding owl populations. To address the concerns in the two areas of special management emphasis, there are two recommendations which apply to both areas.

The first recommendation is for nonfederal lands in DCAs in checkerboard ownership to provide habitat suitable for nesting, roosting, and foraging. This will include OD-11, OD-12, OD-13, OD-14, OD-15, and OD-22. These DCAs consist of checkerboard ownership where federal lands in the DCAs are not adequate to fully accomplish the DCA objectives.

The second recommendation is for nonfederal lands to provide dispersal habitat in the areas of special management emphasis. Dispersal habitat in these areas has been reduced and fragmented due to timber harvest. In some portions, this is compounded by natural fragmentation. The result is habitat conditions which reduce the likelihood of successful owl dispersal and necessitate this recommendation. Specifically, it is recommended that nonfederal lands provide dispersal habitat in the area southwest from OD-10 which encompasses OD-11, OD-12, OD-13, OD-14, and OD-15. This is the portion of the western Oregon Cascades province that connects to the southern Oregon Coast Range province. Another area needing nonfederal dispersal habitat is the area of special management

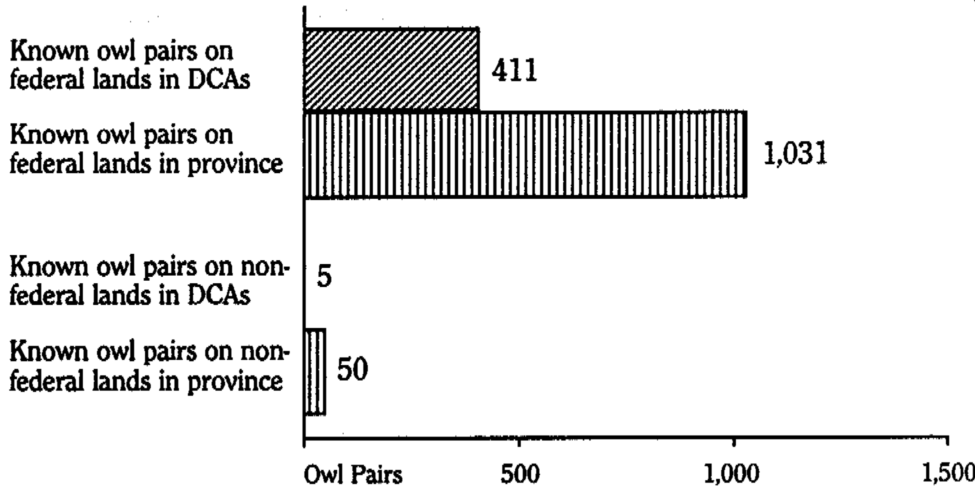


Figure 3.23. *Known owl pairs in the western Oregon Cascades province and in the DCAs (designated conservation areas) in the province.*

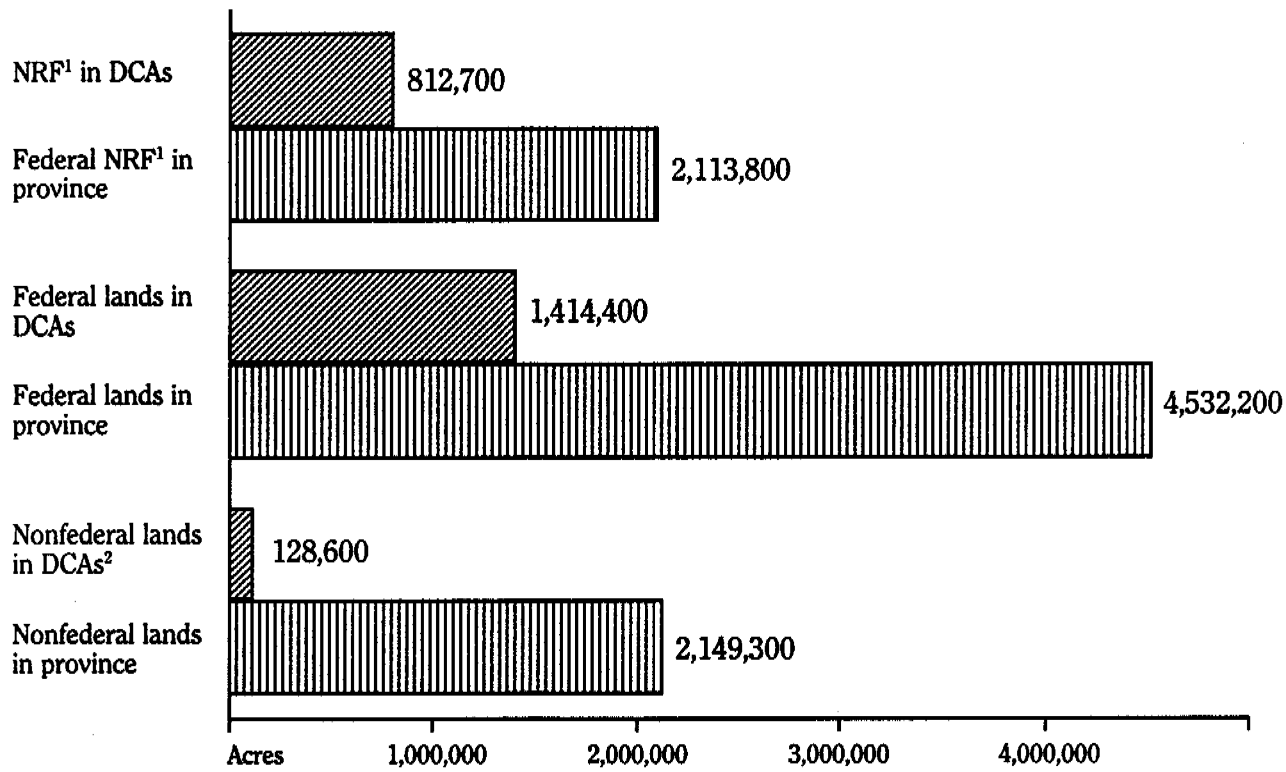


Figure 3.24. *Acres in the western Oregon Cascades province and in the DCAs (designated conservation areas) in the province.*

[1]NRF = nesting, roosting, and foraging habitat. This information is available only for federal lands.
[2]Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the province narrative.

emphasis south of OD-21 and encompassing OD-22 and OD-23. This nonfederal dispersal habitat will assist with habitat connectivity in Oregon, as well as to the California provinces. The area has a compounding risk of habitat loss from fire (see Appendix E), which should be considered during conservation planning to provide dispersal habitat.

Currently, the Endangered Species Act requirements prohibiting take contribute to partial fulfillment of the nonfederal recommendations in the province, but this guidance for protecting spotted owl activity centers does not contribute effectively to the objective of providing dispersal habitat. Protective management, including habitat conservation plans, (see section IV.A.) could lead to more efficient conservation measures.

Federal lands exchange or purchase may be necessary to meet the province objectives for nonfederal lands. Land exchange would be extremely expensive and depend on legal restrictions.

Only a small amount of state land lies in the areas of special management emphasis. State lands can make a larger contribution to recovery elsewhere in the province. In the northern part of the province, a portion of the Santiam State Forest is between OD-3 and OD-5. It is recommended that these state lands be managed to provide owl dispersal habitat between these DCAs. As of 1992, 14 owl activity centers existed on or adjacent to this state forest. The owl sites are currently being managed to avoid take. The Santiam State Forest consists of several large blocks of forested land, and as such, could provide a testing ground for a variety of experimental methods designed to answer adaptive management questions discussed in section III.K. Silver Falls State Park is another parcel of state land in this province which contributes to recovery, by providing nesting, roosting, and foraging habitat for three pairs of owls.

Eastern Oregon Cascades Province

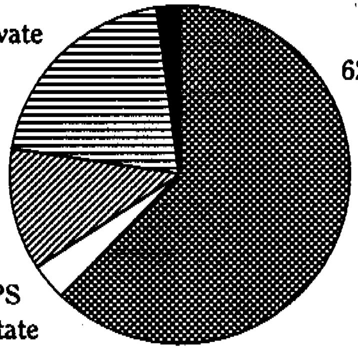
Province description.

The eastern Oregon Cascades province is a narrow band of habitat along the east side of the Cascade crest from the Columbia River to the California border. Habitat suitable for owls is in the Mixed-Conifer Zone which exists between the high-elevation subalpine and mountain hemlock forests and the lower-elevation lodgepole pine and ponderosa pine areas.

Land ownership and management of the 2.2-million-acre province are illustrated in the province summary (Figure 3.25), with federal lands including parts of the Mt. Hood, Deschutes, and Winema National Forests, Crater Lake National Park, and the BLM's Lakeview District. Nonfederal lands include private and state lands which are primarily south of the Winema National Forest.

The nonfederal lands include one area of special management emphasis in the southern part of the province where BLM, private, and state lands are intermingled.

Approximately 220 owl activity centers (181 pairs and 39 territorial singles) were located in the province during a 5-year period (1987 through 1991 for most lands). Of these activity centers, 81 percent were on federal lands.



Acres	Ownership / Management
1,386,600	U.S. Forest Service
77,000	National Park Service (NPS)
5,600	State of Oregon
257,300	Indian Lands
447,600	Private Ownership
48,900	U.S. Bureau of Land Management (BLM)
2,223,000	**TOTAL**

Federal nesting, roosting, foraging habitat: 410,400 acres

Known owl activity centers:

	Federal		Nonfederal	
	Pairs	Singles	Pairs	Singles
Inside the DCAs	61	13	0	0
Outside the DCAs	80	25	40	1

Federal recommendations:

	Number	Activity Centers	Acres Reserved	Acres Nonreserved
Category 1 DCAs	1	24	22,100	46,500
Category 2 DCAs	8	50	47,900	111,600
Prescription C managed pair areas	9	6	6,600	21,400
Prescription A residual habitat areas (Estimate of current situation)	42	42	–	–

Nonfederal recommendations:

See province narrative.

Figure 3.25. *Eastern Oregon Cascades province summary.*

DCAs = designated conservation areas.
– = unknown.

Threats to the eastern Oregon Cascades province.

Severe threats to the owl population include concerns about population distribution and uncertainty about habitat conditions over time due to changes in forest-tree species composition and potential large fires. Assessment of the level of threat from habitat-related concerns is complicated by the limited information about habitat used by owls in this province.

Declining habitat: The decline of habitat throughout the province is considered a moderate threat. Habitat levels probably increased in historic times, as fire suppression allowed pine-dominated stands to develop a second canopy of mixed-conifer. More recently, timber harvest, disease outbreaks, and insect infestations are reducing habitat levels.

Limited Habitat: The limited amount of habitat in this province is considered a moderate threat because of the natural conditions that inhibit forest development into suitable nesting, roosting, and foraging habitat. This assessment of threat is hampered by the fact that very little telemetry research has been conducted in the province to learn which habitat owls are selecting.

Declining populations: There have been no population studies conducted on spotted owls in this province, so there are no data to assess the impact of this threat.

Low populations: Limited owl populations in the province require a moderate rating for this threat. The population of owls is very low, primarily due to the inherently low potential for suitable habitat and to the extent of timber harvest where habitat does exist. Owl pairs occur in moderate numbers and distribution only in the northern portion.

Federal lands in this province have been fairly well surveyed for owls, and the Confederated Tribes of the Warm Springs Indian Reservation have surveyed 80 percent of the suitable habitat on their lands. As a result of these surveys, an estimated 80 to 90 percent of the owl sites are known in the province.

Distribution of habitat and populations: This threat is considered severe in the province and is compounded by the narrow linear shape of the owl's range east of the Cascade crest in Oregon (Figure 2.2). Most spotted owl habitat in the province is in the Mt. Hood and Deschutes National Forests, in the Klamath District of the Winema National Forest, and on the Warm Springs Indian Reservation. Based on surveys from 1986 through 1990, 70 owl pairs are known in the Mt. Hood National Forest, 35 pairs on the Warm Springs Reservation, 30 pairs in the Deschutes National Forest, and 37 pairs in the Winema National Forest. Eleven pairs are found on BLM lands west of Klamath Falls, and three pairs are known in Crater Lake National Park. This information reflects the distribution concerns in the province, where owls and habitat generally decrease in abundance from north to south.

With the exception of the northern part of the province, habitat and owls are poorly distributed. Natural conditions (e.g., soils, moisture conditions), past fire history, and timber harvest have contributed to the isolated nature of habitat and owls in this province. Fairly contiguous habitat potential exists from the Columbia River south to the Metolius River. Habitat south of the Metolius River generally occurs in blocks less than 4,000 acres in size which are isolated from one another by 4 to 25 miles of unsuitable habitat.

Province isolation: The isolation of this province is considered a moderate threat. Due to high-elevation subalpine and nonforested conditions along much of the Cascade crest, the eastern Oregon Cascades province is relatively isolated from the western Oregon Cascades province. These conditions pose a barrier for owls near the Three Sisters Mountains, and from Willamette Pass south to about 25 miles south of Crater Lake National Park. The northern part of the province at the Columbia River Gorge may impede owl movements. The southern end of the province is characterized by decreasing quality of habitat as drier conditions limit forest development here.

Predation and competition: No intensive surveys for great horned owls, northern goshawks, or barred owls have been undertaken in this province. Based on information that is available, the predation threat is considered unknown, while the competition threat is considered low. Incidental observations have suggested that great horned owls are numerous, and that northern goshawks are more common in this province than in the other Oregon provinces. From 1980 through 1991, barred owls were observed at 27 locations, including 17 sites in the Mt. Hood National Forest, one site on the Warm Springs Indian Reservation, and 9 sites in the Winema National Forest.

Vulnerability to natural disturbances: The potential for large-scale loss of owl habitat from fire is higher here than in for any other Oregon province, and is considered a severe threat. There is a low probability that DCAs in the province will avoid a stand-replacing fire over a significant portion of the landscape during the next century (see Appendix E).

Loss of habitat is currently occurring as drought is creating forest health conditions, which are expected to decrease the acreage of suitable habitat in the province.

Biological goals and implementation on federal lands.

Based on the threats to the province, habitat distribution and land ownership patterns, one category 1 DCA and eight category 2 DCAs are recommended (Tables 3.17 and 3.18). Seventy-four owl activity centers (61 pairs and 13 territorial singles) have been located on federal lands in these DCAs. This represents about 43 percent of the pairs located on all federal lands in the province (Figure 3.26). Approximately 27 percent of the nesting, roosting, and foraging habitat identified on federal lands in the province is located in the DCAs (Figure 3.27).

Because of natural limitations of the landscape, it will be difficult to achieve habitat conditions where clusters as large as 20 pairs of owls can be sustained. The alternative is to provide for smaller clusters, relatively near one another, where current or potential habitat exists.

Some DCAs in this province occur in an area where forest health issues result from drought conditions and stand stocking levels. These forest health concerns include the potential for significant loss of habitat (Appendix E) on the Deschutes National Forest. DCAs in this area of catastrophic risk may require forest management activities beyond those recommended for most DCAs (see section III.C.). These activities should focus on unsuitable habitat, but may occur in suitable habitat. At this time, three DCAs (OD-51, OD-52, and OD-53) have been identified as possibly needing higher levels of forest management to reduce the risk of significant habitat loss.

In the part of the province in the Deschutes National Forest, it is recommended that managed pair areas under matrix prescription C (see section III.C.) be established around all currently known and future-discovered owl activity centers in the matrix. At this time nine activity centers have been delineated for this management. The locations and boundaries of the managed pair areas are in the recovery plan's administrative record and will be provided to the Deschutes National Forest.

Table 3.17. Summary of acreage and owl numbers for designated conservation areas (DCAs) in the eastern Oregon Cascade province. (More detailed information, including owl numbers on nonfederal lands, is in Appendix I, Table I.7.)

DCA Ident. Number	Acreage: Total	Acreage: Percent Federal Lands[1]	Acreage: NRF Habitat Federal[2]	Owl Numbers: Known Owls[3] Federal Pairs	Known Owls[3] Federal Singles	Known Owls[3] Nonfederal Pairs	Known Owls[3] Nonfederal Singles	Current Projected Federal[4]	Future Projected Federal[5]
OD-50	69,000	99	47,000	23	1	0	0	21	25
OD-51	9,800	91	4,500	1	0	0	0	1	2
OD-52	20,000	100	8,700	3	1	0	0	4	5
OD-53	12,700	100	3,600	6	0	0	0	2	3
OD-54	13,500	98	4,100	6	0	0	0	2	3
OD-55	18,300	99	4,100	2	2	0	0	1	4
OD-56	16,800	100	8,600	4	0	0	0	4	4
OD-57	28,400	99	9,300	6	1	0	0	6	7
OD-58	42,700	98	22,800	10	8	0	0	13	17
Total:	**231,200**	**99**	**112,700**	**61**	**13**	**0**	**0**	**54**	**70**

[1]Management of nonfederal lands within the perimeter of DCAs is discussed in the province narrative.
[2]NRF - nesting, roosting, and foraging habitat for spotted owls. Habitat information was not available for nonfederal lands.
[3]Numbers of spotted owl activity centers verified in a 5-year period, generally 1987 through 1991.
[4]Estimateof the number of pairs of owls that the DCA would be expected to support on federal lands if the population stabilized with current habitat conditions. See Appendix I for further details.
[5]Estimate of the number of pairs of owls that the DCA might support in the future on federal lands if habitat were recovered. See Appendix I for further details.

Table 3.18. Summary comments on the designated conservation area (DCA) network in the eastern Oregon Cascades province. (Section III.C.1. and Appendix I provide further information about the criteria and process used to delineate these areas.)

Category 1 DCAs	Comments
OD-50	This DCA, entirely on federal lands, is known to have 23 owl pairs. It has a future capability of supporting 25 owl pairs.
Category 2 DCAs	**Comments**
OD-51 through OD-58	The scattered distribution of owls and owl habitat in the province prevented delineating large DCAs capable of supporting 20 owl pairs either now or in the future. These DCAs will support 2 to 17 owl pairs.

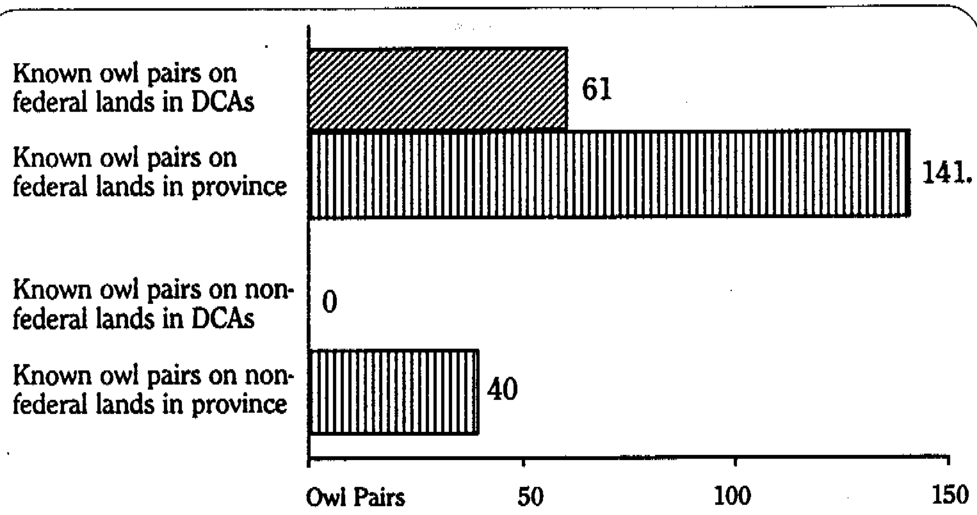


Figure 3.26. *Known owl pairs in the eastern Oregon Cascades province and in the DCAs (designated conservation areas) in the province.*

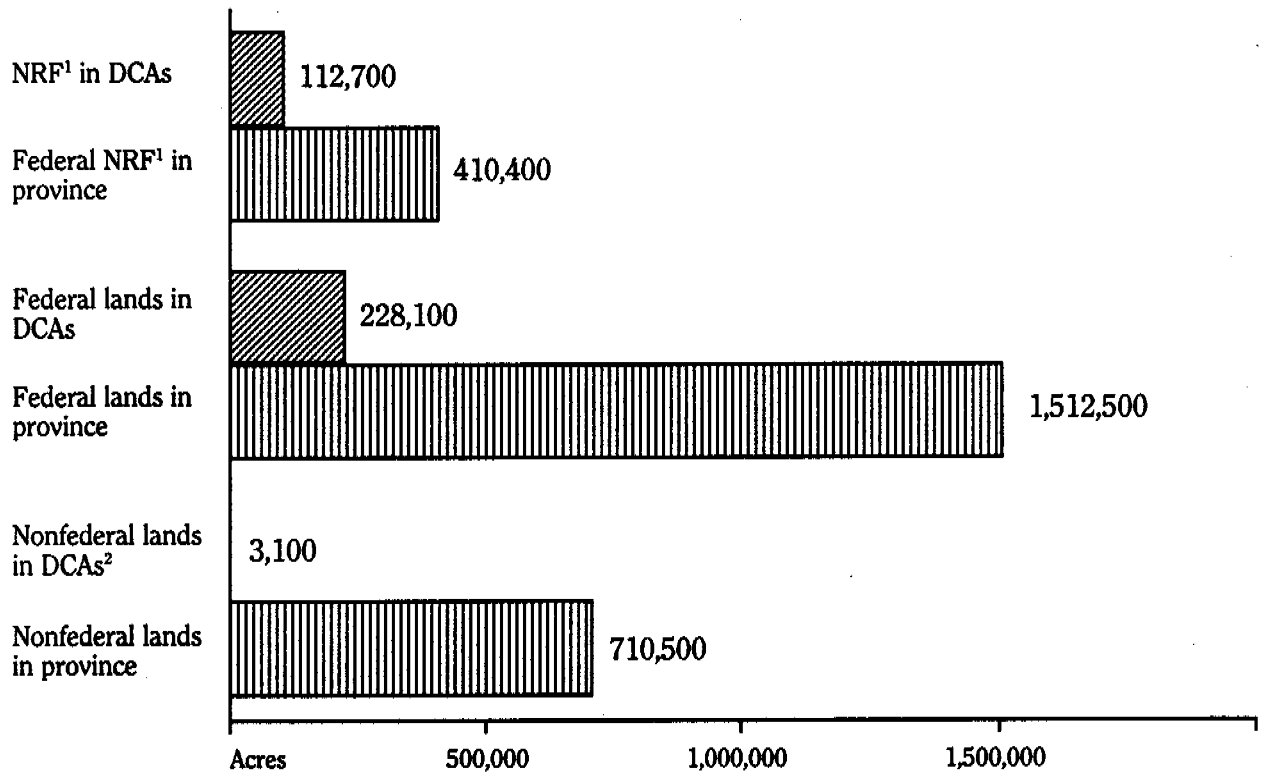


Figure 3.27. *Acres in the eastern Oregon Cascades province and in the DCAs (designated conservation areas) in the province.*

[1]NRF = nesting, roosting, and foraging habitat. This information is available only for federal lands.
[2]Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the province narrative.

The remaining federal forestlands outside the DCAs should be managed under matrix prescription A (see section III.C.). This includes establishing residual habitat areas of 100 acres around owl activity centers in the matrix, up to a maximum density of six areas per township.

Biological goals and implementation on nonfederal lands.

The province recovery objective for nonfederal lands is to provide habitat to improve dispersal conditions in the area of special management emphasis between OD-21 and the California border. Owl habitat has been reduced and fragmented in this area, resulting in poor population connectivity with the California Cascades province. An additional concern is the risk of habitat loss from fire.

This area consists of checkerboard ownership, but is dominated by nonfederal lands. Nonfederal contributions should work in conjunction with federal habitat to provide for dispersal between the eastern Oregon Cascades and the California Cascades provinces. Where ecological potential exists, nesting habitat also could be provided in this area to improve the likelihood of dispersal between provinces. Currently the prohibition on take is unlikely to make substantial contributions toward meeting this objective because few owl sites are known on nonfederal lands in this area.

Warm Springs Indian Reservation, background and voluntary contribution.

Currently, 80 percent of the habitat suitable for northern spotted owls has been surveyed on the reservation. Thirty-six owl activity centers have been located, primarily in the northwestern portion of the reservation.

The Confederated Tribes of the Warm Springs voluntarily have acknowledged the designation of 18,722 acres to be managed for owls as a "Warm Springs Special Habitat Preservation Area" in the southern end of the reservation. This area is a portion of one of several larger Tribal conditional use areas, which are limited-entry set-asides. The primary function of this area is to serve as a connecting corridor and habitat expansion between two DCAs (OD-51 and OD-52) in the Deschutes National Forest.

On a short-term basis, other suitable owl habitat will be managed to maintain some owl activity centers primarily centered on and around the 60,549 acres of Tribal conditional use areas, including the area previously discussed. Additional restricted land use occurs on riparian zone "A" lands, which consist of 21,086 acres where timber harvest is not allowed and two extensive management zones; one zone contains 7,224 acres where timber harvest is not allowed, and a second zone contains 7,418 acres of 200+-year extended age harvest rotation under uneven-aged management prescriptions. All these set-aside or special management areas contain suitable owl habitat. All these special management areas total 96,277 acres of forested land or 25 percent of the Confederated Tribes' total forest resource.

On a long-term basis, the Tribes will mesh owl protection into their overall wildlife management plan in such a manner as to contain all the necessities of owl survival.

Oregon Klamath Province

Province description.

The Klamath province lies west of the Cascade crest, starting in the southern third of Oregon and extending south about 250 miles through most of northern California. The province is characterized by the mountainous terrain of the Klamath and Siskiyou Mountains, a high diversity of forest tree species, often occurring in mixed stands, and large areas of serpentine soils, which generally are incapable of supporting forest conditions. For the purposes of the recovery plan, the Klamath region has been separated into the Oregon Klamath province and the California Klamath province. This discussion focuses on the Oregon Klamath province.

Land ownership and management of the 4-million-acre province are illustrated in the province summary (Figure 3.28). Forest Service management includes the Siskiyou and parts of the Rogue and Klamath National Forests. BLM management includes much of the Medford District, with lesser amounts of the Roseburg and Coos Bay Districts. Unlike the California Klamath province, few spotted owl activity centers are known on private lands, though 47 percent of the province is in private ownership. These private lands are at lower elevations intermixed with BLM lands in a checkerboard ownership pattern. State forestlands are a minor portion of the province and some are in the DCAs. Despite the mixed ownership in the province, most suitable habitat currently exists on federal lands.

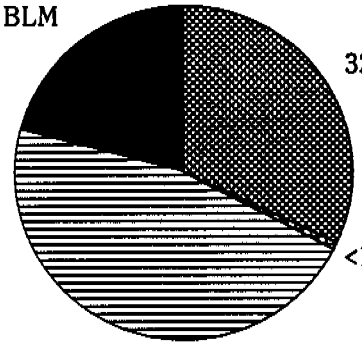
The northern spotted owl population in the province is the major population link between the Oregon Coast Range and western Oregon Cascades provinces. It also provides the primary connection between spotted owl populations in Oregon and California. The province contains approximately 476 owl activity centers (402 pairs and 74 territorial singles); about 92 percent are known on federal lands.

The areas of checkerboard ownership in the northern and eastern portions of this province have been identified as an area of special management emphasis for recommendations on nonfederal lands.

Threats to the Oregon Klamath province.

The most severe threat to the owl population is a declining population (see section II.B. and the following discussion). Lesser threats include loss and fragmentation of habitat due to timber harvest and fires (see Appendix E); and weak population connectivity within the province and with adjacent provinces because of poor habitat conditions in areas of checkerboard ownerships.

Declining habitat: Considered a moderate threat to the province, the estimated rate of habitat decline for all ownerships in the province was 1.3 percent per year for the period of 1950 through 1990 (Johnson pers. comm.), primarily due to timber harvest and fire. The rate of decline has accelerated in the last decade to approximately 3 percent annually, primarily reflecting a continued high harvest level on private lands and an increased harvest level on federal lands.



Acres	Ownership / Management
1,291,100	U.S. Forest Service
30,900	State of Oregon
1,862,700	Private Ownership
828,900	U.S. Bureau of Land Management (BLM)
4,013,600	**TOTAL**

Federal nesting, roosting, foraging habitat: 839,900 acres

Known owl activity centers:

	Federal		Nonfederal	
	Pairs	**Singles**	**Pairs**	**Singles**
Inside the DCAs	125	17	12	0
Outside the DCAs	244	52	21	5

Federal recommendations:

		Activity	Acres	
	Number	**Centers**	**Reserved**	**Nonreserved**
Category 1 DCAs	6	95	106,500	348,400
Category 2 DCAs	4	47	16,400	125,300
Prescription B reserved pair areas	2	2	0	5,500
Prescription B managed pair areas	9	12	0	23,000
Prescription A residual habitat areas (Estimate of current situation)	279	279	–	–

Nonfederal recommendations:
See province narrative.

Figure 3.28. Oregon Klamath province summary.

DCAs = designated conservation areas.
– = unknown.

Limited habitat: The amount of habitat in this province is considered a low threat. Approximately 38 percent of the 3,102,000 acres of forestland in the province now provides habitat suitable for spotted owls (Johnson pers. comm.). This habitat is primarily on federal lands and is extensively fragmented, due to timber harvest patterns on the checkerboard and mixed-land ownerships, as well as natural vegetation patterns.

Declining populations: Section III.B. provides a general description of the primary technique used to determine the rate of population change, which is analysis of data about reproduction and survival. This is termed demographic data. Based on an analysis of demographic data gathered from 1985 through 1991 in the Medford study area (see Figure C.1 in Appendix C), owls in this area are experiencing the highest known annual rate of decline of the five study ares in the range of the owl. Appendix C provides a further interpretation of this analysis.

Another measure of the health of the owl population is nesting success (see section II.A.). The nesting success of owl pairs varies annually in all portions of the owl's range, but has been particularly low in this province and in the Oregon Coast Range province. As a measure of low reproduction, the percentage of pairs producing young was more than 50 percent in only 3 of the last 7 years; the highest was 60 percent in 1986, and the lowest was 14 percent in 1987.

Low populations: Numbers and density of spotted owls are moderate in this province and this threat is currently considered low. Approximately 402 pairs were found in the province from 1987 through 1991. Despite the current good population levels, demographic data indicate that the owl population is in decline and population levels are of concern.

Distribution of habitat and populations: Owls and owl habitat are reasonably well distributed in the province. Low owl numbers and/or poor habitat conditions exist in the Kalmiopsis Wilderness Area, on private lands, and in the areas of checkerboard BLM/ private lands.

Province isolation: Due to the fragmented condition of owl habitat in the checkerboard ownership of the Roseburg and Medford areas, connectivity to the Oregon Coast Range and the western Oregon Cascades provinces is weak. An assessment of dispersal habitat found that on BLM lands, 140 of 284 (49 percent) of quarter-townships containing one section or more of BLM lands did not meet the 50-11-40 rule for dispersal habitat. On Forest Service lands in the Siskiyou National Forest, 8 of 125 quarter-townships did not meet dispersal habitat criteria (Webb pers. comm.). Of particular concern are checkerboard BLM/private lands that are key links between the Oregon Klamath province and adjacent provinces.

Predation and competition: No systematic surveys for great horned owls or northern goshawks have been conducted in this province, which leads to a conclusion that these threats are unknown. Despite this lack of quantified data, great horned owls are routinely encountered during spotted owl surveys, and based on general observation, are considered common throughout the province though more numerous in the eastern part of the province. Northern goshawks, although less common than great horned owls, are considered to have a regular distribution on Forest Service lands in mid to higher elevations where forest habitat is still contiguous, and are less numerous on checkerboard BLM and fragmented landscapes in the province. Relatively low numbers of northern goshawks are believed to occur in the extreme western part of the province.

Competition is also an unknown threat, though 22 barred owl locations were recorded in this province from 1980 through 1991.

Vulnerability to natural disturbances: The potential for large-scale loss of habitat is high because of the regular occurrence of fire (see Appendix E). Due to steep topography and changes in vegetation, fires in this province burn with varying intensities, and create a complex mosaic of burned, partially burned, and unburned areas. As a result, though fires are often large (93,000 acres in the 1987 Silver fire), the total amount of owl habitat actually lost in a fire usually is not great.

Biological goals and implementation on federal lands.

Using the design criteria for the DCA network, 10 DCAs are recommended in the province (Tables 3.19 and 3.20). Six of the DCAs satisfy the criteria for category 1 DCAs. Two of the category 1 DCAs, OD-23 and OD-26, extend into California. Conversely, part of one California Klamath province DCA (CD-30) extends slightly into Oregon. (The data for DCAs that cross state boundaries are in the province that includes the majority of the land.)

Currently there are 142 spotted owl activity centers (125 known pairs and 17 territorial singles) on federal lands in the 10 DCAs. As a result, the DCAs contain about 34 percent of the known pair sites on federal lands (Figure 3.29). This is a relatively low percentage of known protected pairs compared to other provinces. The DCAs contain about 33 percent of the nesting, roosting, and foraging habitat on federal lands in the province (Figure 3.30).

Generally, federal matrix forests should be managed under prescription A, providing dispersal habitat on lands outside of DCAs following the 50-11-40 rule. As part of this prescription, residual habitat areas of 100 acres should be delineated around all known and future-discovered owl activity centers in the matrix up to a maximum density of 10 areas per township.

In addition to prescription A, two areas are identified for matrix prescription B. Reserved pair and managed pair areas will be established in these locations to supplement the DCA network where it is deficient. Two reserved pair areas will be established around owl activity centers south of OD-25. Nine managed pair areas will be established in the province; seven are in the matrix around and between OD-31 and OD-32, and two are northwest of OD-23. The locations and boundaries of these reserved pair and managed pair areas are in the recovery plan's administrative record and will be provided to the federal agencies involved.

Within and adjacent to the southern part of the province is a large gap in the federal DCA network. This gap around the City of Medford reflects existing conditions that make it impossible to meet recovery plan standards for the DCA network. The Recovery Team suggests that the BLM practice innovative management around owl activity centers in this area to provide adequate habitat to maintain these sites through time. This suggestion is not required to achieve recovery, but is expected to speed the recovery process by building stronger habitat and population linkage.

Biological goals, objectives, and implementation on nonfederal lands.

One large area in the province has been identified for special management emphasis. It includes all checkerboard lands in the northern and eastern parts of the province where population connectivity is weak in the province and with adjacent provinces because of poor habitat conditions. This identification is based on the following concerns: 1) nesting,

Table 3.19. Summary of acreage and owl numbers for designated conservation areas (DCAs) in the Oregon Klamath province. (More detailed information, including owl numbers on nonfederal lands, is in Appendix I, Table I.8.)

	Acreage			Owl Numbers					
				Known Owls[3]					
				Federal		Nonfederal			
DCA Ident. Number	Total	Percent Federal Lands[1]	NRF Habitat Federal[2]	Pairs	Singles	Pairs	Singles	Current Projected Federal[4]	Future Projected Federal[5]
OD-23	72,400	85	22,200	24	3	0	0	18	24
OD-24	10,400	99	5,800	4	0	0	0	3	4
OD-25	78,100	73	29,200	16	1	2	0	13	20
OD-26	74,300	97	26,200	16	5	0	0	17	23
OD-27	131,200	99	53,400	4	6	0	0	22	30
OD-28	74,800	93	40,100	9	0	1	0	17	22
OD-29	72,200	90	38,200	10	1	0	0	18	23
OD-30	43,400	94	23,000	2	0	0	0	11	15
OD-31	86,600	52	15,400	19	1	4	0	10	15
OD-32	91,000	50	23,900	21	0	5	0	11	15
CD-30	DCA crosses State boundary; data are displayed in the Calfornia Klamath province table (Table 3.23).								
Totals:	**734,400**	**81**	**277,400**	**125**	**17**	**12**	**0**	**140**	**191**

[1]Management of nonfederal lands within the perimeter of DCAs is discussed in the province narrative.
[2]NRF = nesting, roosting, and foraging habitat for spotted owls. Habitat information was not available for nonfederal lands.
[3]Numbers of spotted owl activity centers verified in a 5-year period; generally 1987 through 1991.
[4]Estimate of the number of pairs of owls that the DCA would be expected to support on federal lands if the population stabilized with current habitat conditions. See Appendix I for further details.
[5]Estimate of the number of pairs of owls that the DCA might support in the future on federal lands if habitat were recovered. See Appendix I for further details.

roosting, and foraging habitat has been fragmented by timber harvest in checkerboard ownership areas; 2) dispersal habitat has been reduced and fragmented by timber harvest; and 3) the risk of habitat loss to fire is high. To alleviate these concerns, two recommendations are made:

1. Within the perimeter of OD-25, OD-31, and OD-32, provide nesting, roosting, and foraging habitat. Providing habitat in these DCAs, in conjunction with habitat on federal lands, would contribute to meeting the province objectives for DCAs. The DCAs currently contain relatively good numbers of owl pairs on federal lands (16 to 21 pairs), but nonfederal habitat is needed to perpetuate these pairs.

2. Provide dispersal habitat on nonfederal lands, especially among OD-28, OD-29, OD-31, and OD-32, and to the adjacent Oregon Coast Range province. This area encompasses a key population connection between the western Oregon Cascades, Oregon Klamath, and Oregon Coast Range provinces.

Although state lands are limited in the area of special management emphasis, they are in locations where they can make an important contribution to strengthening the population connectivity, if they are managed in conjunction with other lands. Although the

Table 3.20. Summary comments on the designated conservation area (DCA) network in the Oregon Klamath province. (Section III.C.1. and Appendix I provide further information about the criteria and process used to delineate these areas.)

Category 1 DCAs	Comments
OD-25 through OD-29	These category 1 DCAs currently contain fewer than 20 known pairs of owls. Each has the potential to increase to at least 20 pairs on federal lands.
OD-23	This DCA currently supports more than 20 known pairs of owls but requires both federal and nonfederal lands to do so. If some nonfederal contributions are maintained, it will continue to support at least 20 pairs.
Category 2 DCAs	**Comments**
OD-24	This DCA is located to alleviate connectivity concerns around the Medford valley. It is expected to support four owl pairs on federal lands.
OD-30	This DCA includes low elevation habitat and provides distribution of the network into the northwest coastal area of the province.
OD-31 and OD-32	These DCAs currently support more than 20 pairs of owls but require both federal and nonfederal lands to do so. In the future they are projected to be able to support about 15 pairs solely on federal lands.

recommendation is to provide dispersal habitat, due to checkerboard ownership patterns and the heavily fragmented nature of the landscape, state and other lands may be recommended to provide habitat conditions that surpass standard dispersal habitat conditions (e.g.. roosting and foraging habitat). As conservation plans for these lands are written and implemented, an evaluation of surrounding land contributions toward dispersal habitat could be conducted. Based on results of this evaluation, provision of habitat conditions of higher quality may be called for. This suggestion is not required to achieve recovery, but is expected to speed the recovery process by building stronger habitat and population linkage.

Currently, Endangered Species Act requirements prohibiting take contribute to partial fulfillment of these nonfederal recommendations in the province. However, the guidelines for protecting owl activity centers do not effectively address the recommendations of providing dispersal habitat. Protective management, including conservation planning (see section IV.A.) could lead to more efficient conservation measures for achieving some of these province recovery objectives.

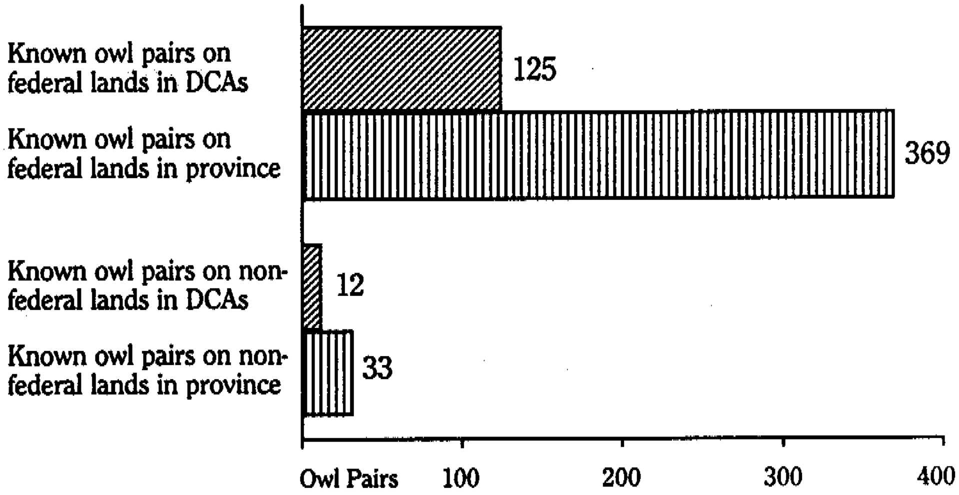


Figure 3.29. *Known owl pairs in the Oregon Klamath province and in the DCAs (designated conservation areas) in the province.*

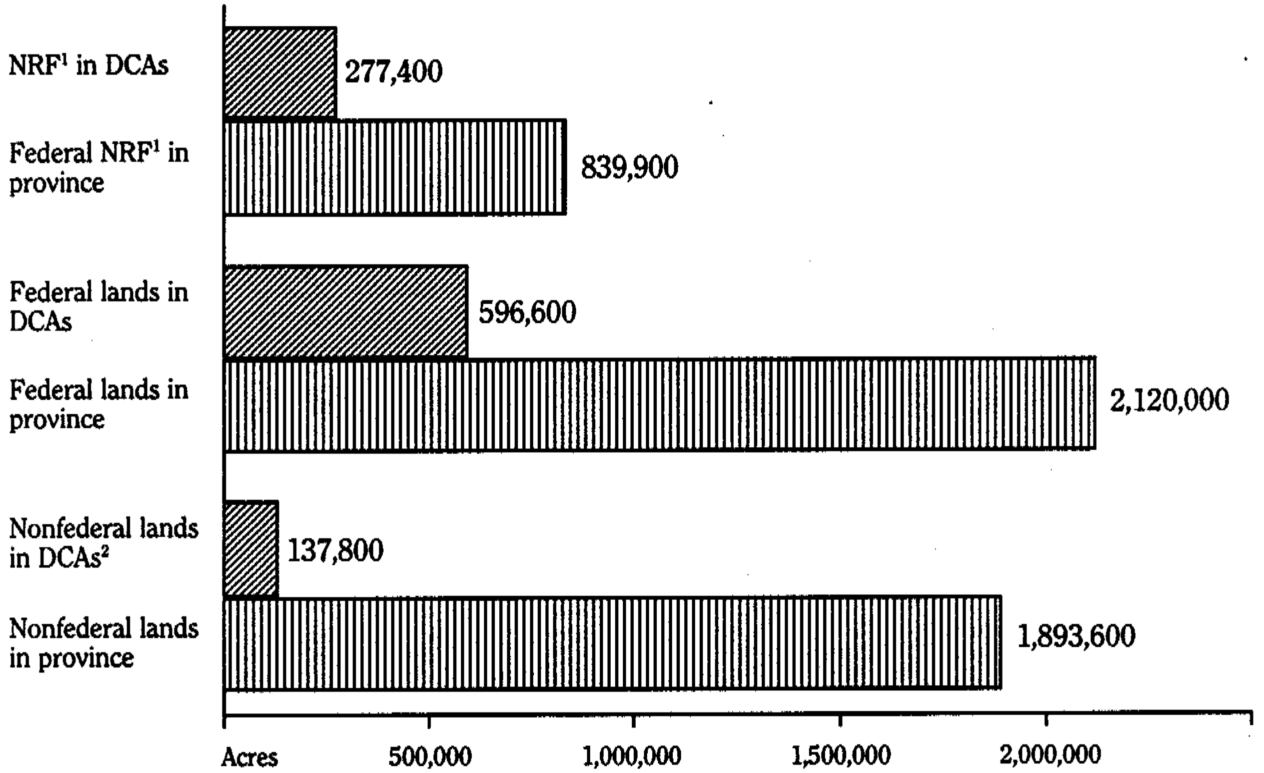


Figure 3.30. *Acres in the Oregon Klamath province and in the DCAs (designated conservation areas) in the province.*

[1]NRF = nesting, roosting, and foraging habitat. This information is available only for federal lands.
[2]Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the province narrative.

4. California Province Narratives

The following province narratives for California are written in detail, to reflect ongoing conservation planning efforts. Since December 1990, California landowners, forestry associations, environmental interests, scientists, and federal and state agencies have been participating in conservation planning under section 10 of the Endangered Species Act (see Appendix J). The following descriptions of biological goals and implementation options are derived from the ongoing conservation planning efforts. The narratives also mention habitat conservation plans (HCPs) that have been or are being prepared by industrial forest owners in California. In the development of the state HCP, the participants have agreed on the term "population centers" for nonfederal owl clusters that are intended to provide for 10 or more pair activity centers. For the California provinces only, the term "population center" is synonymous with "nonfederal cluster."

California Coast Province

Province description.

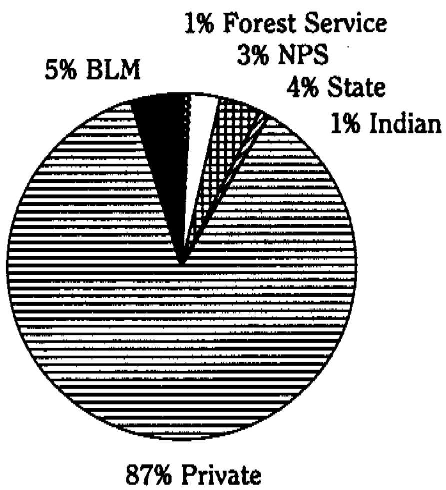
The California Coast province extends from the Oregon border to San Francisco Bay and from the ocean to the western border of national forest lands. The coastal part of the province encompasses the majority of the redwood forest habitat type (described in Appendix B). Inland forests are Douglas-fir and mixed Douglas-fir/hardwood types, the latter often interspersed with chaparral and grasslands.

Land ownership and management of the 5.7-million-acre province are illustrated in the province summary, and is dominated by industrial and nonindustrial private ownership (Figure 3.31). Federal lands are represented by scattered small blocks of BLM lands and four National Park Service areas; Redwood National Park, Point Reyes National Seashore, Muir Woods National Monument, and Golden Gate National Recreation Area. State lands include a state forest, and four large and numerous smaller state parks.

Approximately 40 percent of the northern spotted owl's range and 35 percent of its known population in California are in the California Coast province. Owl populations are relatively high, with 585 historic owl activity centers. Owls have been verified at 456 of these locations during the past 5 years.

Owl habitat in the province is found on a greater variety of ownerships than in any other province of the state. Private industrial land ownerships comprise the largest single group. The multiplicity of ownerships in Marin, Napa, and Sonoma Counties, along with early logging history, agricultural, and residential land developments have resulted in extensive habitat fragmentation. Coordination and cooperation will be necessary in achieving recovery in this province.

Approximately 92 percent of the known spotted owl population in the province is on nonfederal lands. If those owls were extirpated, the remaining populations on federal lands would be too small and scattered to be self-sustaining. The spotted owl populations on federal lands south of northern Humboldt County probably would be extirpated due to lack of demographic support, and that loss would affect populations in the southern part of the adjoining California Klamath province, where owl density and amount of habitat are already low.



Acres	Ownership / Management
57,100	U.S. Forest Service
150,100	National Park Service (NPS)
226,500	State of California
52,900	Indian Lands
4,935,000	Private Ownership
260,500	U.S. Bureau of Land Management (BLM)
5,682,100	**TOTAL**

Federal nesting, roosting, foraging habitat: 14,200 acres

Known owl activity centers:

	Federal		Nonfederal	
	Pairs	Singles	Pairs	Singles
Inside the DCAs	21	14	3	8
Outside the DCAs	2	2	335	71

Federal recommendations:

	Number	Activity Centers	Acres Reserved	Acres Nonreserved
Category 1 DCAs	2	7	99,500	0
Category 2 DCAs	26	28	6,500	112,300
Prescription B reserved pair areas	1	2	0	3,400
Prescription A residual habitat areas (Estimate of current situation)	3	3	–	–

Nonfederal recommendations:
See province narrative.

Figure 3.31. *California Coast province summary.*

DCAs = designated conservation areas.
– = unknown.

Threats to the California Coast province.

The rate of habitat loss (particularly in the Redwood Zone), with the presumed decline in owl population, the low level of suitable habitat composed of Douglas-fir, and the poor distribution of owls and habitat are all moderate threats to the province. The isolation of two populations at the southern end of the range of the subspecies is a severe threat to the province's owl population.

Declining Habitat. The continuing decline of habitat is considered a moderate threat in this province. Redwood trees are limited geographically to the coastal part of the province. The wood from these trees is in relatively high demand, and old-growth redwoods are rare. Harvest on private lands on the north coast accelerated during the 1980s. From 1986 through 1989, the average annual acreage cut in this area was 102,029 acres. Approximately 83,000 of those acres, or about 4 percent of the timber-producing lands, were treated annually with stand-replacement harvests that removed suitable owl habitat.

Limited Habitat. Natural fragmentation and past timber harvest result in limited habitat being a moderate threat in the province. Based on a province-wide analysis, spotted owl habitat is expected to occur in about 79 percent of the townships in the province. There are slightly more than 2 million acres of forestlands in this province where timber production is the main management goal.

There is a long history of habitat alteration in coastal redwood forests. Redwood forestlands cover approximately 1.95 million acres and a large portion (probably more than 75 percent) was historically in old-growth condition. There are approximately 85,000 acres of old-growth redwood forests remaining today; 21,000 acres are in private ownership. In the Redwood Zone most of the known owl activity centers are in well-developed second-growth (older than 50 years). There are approximately 740,000 acres of this type of redwood habitat in the province. Most of these forests are privately owned, commercially available and being harvested by a variety of methods reflecting the management philosophies of landowners. Suitable owl habitat in the redwood timber type appears to be high quality, and supports a good distribution of owl sites with pairs not widely separated.

Inland from the redwood belt, Douglas-fir and Douglas-fir/hardwood forests predominate. This habitat type occurs in roughly one-fourth of the province. There are no commercially available old-growth Douglas-fir or Douglas-fir/hardwood forests, but harvest occurs in the second-growth Douglas-fir forests.

The remaining parts of the province are grasslands, brush, oak/brush and oak woodlands. These lands are generally unsuitable for owls and are interspersed with the suitable habitat in the Douglas-fir forest types, resulting in naturally fragmented habitat.

Declining Populations. Declining populations are considered a moderate threat in the province, based on limited demographic information which indicates that owls in this province are occupying sites and reproducing at rates similar to owls in other areas. Survival information is limited, so estimates of population stability are not possible.

Low Populations. Population levels are relatively high and lead to a conclusion that population levels are a low threat in the province. More than one-third (456) of the known owl activity centers in California are found in this province; about 361 of these sites have had verified pairs between 1987 and 1992. A province-wide average of 2.3 known owl sites per township is expected in those townships containing suitable owl habitat.

Distribution of Habitat and Populations. Spotted owls generally are widespread in the province, but their distribution is uneven, leading to the conclusion that this threat is moderate. As a measure of owl distribution, they have been found in 71 percent of the townships where suitable habitat exists. But the distribution is uneven. Of townships where suitable habitat exists, 50 percent contained one or no known owl sites. In contrast, in three townships more than nine sites each are known, indicating that some habitat conditions can support high densities. One township on heavily harvested, commercial redwood forestlands supports at least 18 sites.

In the northern and western parts of the province where redwood and Douglas-fir habitats predominate, owls and owl habitat generally are abundant and widespread. In these areas owl densities average 3.6 known owl sites per township.

In other areas of the province, owl habitat is distributed naturally in an irregular pattern. A north-to-south band from southeastern Humboldt County to central Mendocino County contains a natural mix of Douglas-fir forests in canyons, hardwood forests on slopes, and grasslands on ridges. This area is relatively unsurveyed, but the distribution of owls and their habitat is not continuous. Similar conditions, without the Douglas-fir forests, continue south through Lake County. One-third of the townships in this area are not expected to contain suitable owl habitat. On average, one known owl site occurs in those townships that are expected to contain suitable habitat.

Owl populations in Marin and Napa, and southeastern Sonoma County (23 and 36 owl sites respectively) are isolated. Naturally occurring grasslands and hardwood/brush areas separate these owl populations from the owl's continuous range that occurs to the north and northwest. The owls in Napa and Sonoma Counties are 16 to 20 miles from the main owl population in western Sonoma County and 32 miles from owls in the southern part of the California Klamath province in Lake County. The Marin County population is at least 17 miles from the contiguous population of owls to the north and 27 to 31 miles from the other isolated population in Napa and Sonoma Counties to the east.

Province Isolation. Concerns about province isolation are focused on the southern portion of the province and lead to the conclusion that the threat is severe. Owl habitat is contiguous along the northern two-thirds of the 220-mile boundary between the California Coast and California Klamath provinces. Along southern one-third of this boundary, suitable habitat in both provinces is naturally fragmented, and owl sites occur at lower densities. The southernmost end of the province is entirely isolated from other provinces and from the California subspecies because the range of the California spotted owl is 110 miles to the south (across San Francisco) and 90 miles to the east (across the Sacramento Valley).

Predation and Competition. Predators such as great horned owls, red-tailed hawks, and ravens occur throughout the province, often in open habitats. The natural grasslands that are interspersed with suitable habitat throughout the province indicate a history of contact between grassland and forest species. However, logging is opening second-growth stands, and when forests are limited, this harvest decreases the dense forest available as refuge for spotted owls from avian predators. The effect is expected to be an increased threat of predation upon spotted owls.

Currently, competition from barred owls appears to be low, but barred owls occupy at least one site previously occupied by northern spotted owls, and a hybrid is known to have paired with a northern spotted owl (Gould pers. comm.). Barred owls were first identified in the province in 1981. Seven of the nine known barred owl sites have been found in the last 3 years.

Vulnerability to Natural Disturbances. The threat of large scale loss of owl habitat due to natural disturbances is low. Fire probably is the major natural threat that would affect forests in the province (see Appendix F). Much of the coastal area supports moist redwood and Douglas-fir forests that do burn, but these fires are generally smaller and less frequent than in other provinces. In the mixed Douglas-fir/hardwood/grassland zone in the eastern part of the province, fires are considerably more frequent and widespread. Wind damage, and insect and drought problems appear to be relatively minor in the province.

Biological goals and implementation on federal lands.

Lack of federal lands in this province limits the recovery potential on federal ownership. As a result, only two category 1 DCAs can be delineated in the province and these require additional habitat and owls from adjacent state parks to support more than 20 pairs of owls. Twenty-six category 2 DCAs are recommended (Table 3.21, Table 3.22). The two largest DCAs are in national parks. The remaining DCAs are in the BLM conservation area, in other BLM lands and in a Forest Service parcel. BLM parcels are included in smaller category 2 DCAs and often could be managed in combination with adjacent state park lands. Fourteen of these parcels might be consolidated into four groups, one of which could be managed as a category 1 DCA.

The DCAs contain approximately 90 percent of the owl activity centers (21 pairs and 14 territorial singles) known on federal lands in the province from 1987 through 1991 (Figure 3.31 and 3.32). The DCAs also contain nearly all of the nesting, roosting, and foraging habitat on federal lands in this province (Figure 3.33).

Consolidation of federal lands, through land exchange or acquisition, to improve owl clusters (i.e., nonfederal population centers) is encouraged in this province. Federal actions to accomplish this may be integrated with nonfederal steps to develop HCPs.

Del Norte and northern Humboldt Counties. Federal lands in this area have too little habitat capability to support 20-pair owl clusters without support from nonfederal lands. DCAs CD-1 and CD-3 are expected to maintain fewer than five owl pairs each, but their owl populations could be strengthened by owl populations on nearby state and private lands.

One reserved pair area, supporting two owl activity centers has been recommended on Forest Service lands to support CD-1. The locations and boundaries of this reserved pair area are in the recovery plan's administrative record and will be provided to the national forest involved.

The boundaries of CD-2 include all of Prairie Creek Redwoods State Park and Redwood National Park south of the state park. This DCA excludes that portion of the national park composed of coastal marshes, dunes, and beaches. The boundaries of the DCA generally include the portion of the national park in the Redwood Creek and Lost Man Creek drainages. Along the eastern boundary of the Redwood Creek drainage (Bald Hills-Coyote Peak area) the national park has planned to manage prairies and oak savannah areas. This management includes conifer removal which may be considered counter to DCA management guidelines. But these prairie and oak savannah management areas are identified and mapped by the national park and should not be considered part of the DCA. There is sufficient forest habitat in the remainder of the mapped DCA to provide habitat for enough pair sites to provide for a category 1 DCA.

Table 3.21. Summary of acreage and owl numbers for designated conservation areas (DCAs) in the California Coast province. (More detailed information, including owl numbers on nonfederal lands, is in Appendix I, Table I.9.).

	Acreage			Owl Numbers					
				Known Owls[3]					
				Federal		Nonfederal			
DCA Ident. Number	Total	Percent Federal Lands[1]	NRF Habitat Federal[2]	Pairs	Singles	Pairs	Singles	Current Projected Federal[4]	Future Projected Federal[5]
CD-1	34,200	40	1,200	1	1	0	0	4	5
CD-2	80,300	83	–	1	0	0	0	18	24
CD-3	8,300	47	900	3	1	0	0	3	3
CD-4	1,600	63	200	1	0	0	0	1	1
CD-5	2,300	100	900	4	0	0	0	3	3
CD-6	40	100	100	0	1	0	0	1	0
CD-7	400	100	100	0	0	0	0	1	1
CD-8	39,800	85	4,900	2	3	0	0	10	12
CD-9	6,500	38	1,000	0	0	0	1	1	3
CD-10	1,200	90	300	0	1	0	0	1	2
CD-11	2,900	58	200	1	0	0	0	1	2
CD-12	4,500	59	1,400	1	0	1	0	1	3
CD-13	1,700	66	–	0	0	0	0	1	2
CD-14	3,400	80	400	0	0	0	0	1	3
CD-15	5,400	52	100	3	0	1	0	3	4
CD-16	12,200	74	100	2	0	0	0	1	3
CD-17	12,900	55	300	1	0	0	0	1	5
CD-18	8,100	83	100	0	0	0	0	0	2
CD-19	3,100	76	100	0	1	0	0	2	3
CD-20	2,800	65	100	0	0	0	0	0	1
CD-21	4,700	79	300	0	0	0	0	1	2
CD-22	7,000	65	100	0	0	0	0	1	2
CD-23	8,300	84	200	0	1	0	0	1	3
CD-24	1,100	97	200	0	0	0	0	1	1
CD-25	1,800	88	300	0	0	0	0	0	0
CD-26	2,600	34	200	0	0	1	0	1	1
CD-27	3,500	92	500	0	0	0	0	1	2
CD-28	74,800	44	–	1	5	0	7	11	11
OD-26	This DCA crosses state boundary; data are displayed in Oregon Klamath province table (Table 3.19).								
Total:	**335,500**	**65**	**14,200**	**21**	**14**	**3**	**8**	**71**	**104**

[1]Management of nonfederal lands within the perimeter of DCAs is discussed in the province narrative.
[2]NRF = nesting, roosting, and foraging habitat for spotted owls. Habitat information was not available for nonfederal lands.
[3]Numbers of spotted owl activity centers verified in a 5-year period; generally 1987 through 1991.
[4]Estimate of the number of pairs of owls that the DCA would be expected to support on federal lands if the population stabilized with current habitat conditions. See Appendix I for further details.
[5]Estimate of the number of pairs of owls that the DCA might support in the future on federal lands if habitat were recovered. See Appendix I for further details.
– = unknown.

Table 3.22. Summary comments on the designated conservation area (DCA) network in the California Coast province. (Section III.C.1. and Appendix I provide further information about the criteria and process used to delineate these areas.)

Category 1 DCAs	Comments
CD-2	This national park land currently is believed to support more than 15 pairs of owls. In combination with adjacent state park land, it is capable of supporting more than 20 owl pairs.
CD-28	This federal land when combined with adjacent state park land, is capable of supporting more than 20 owl pairs.
Category 2 DCAs	**Comments**
CD-1 and CD-8	These areas are important for demographic support of the owl population in the northern California Coast province. These DCAs also assist population connectivity with interior DCAs on national forest lands.
CD-3 through CD-7 CD-9 through CD-27	Many BLM parcels in this province are delineated as DCAs. Size and distribution preclude any parcel from supporting more than five owl pairs and may not be able to support even a single pair without additional suitable habitat on surrounding nonfederal lands. These areas connect suitable habitat throughout the north coast area and provide short-term demographic support and future nesting areas given nonfederal support.

BLM = U.S. Bureau of Land Management.

Southern Humboldt and central Mendocino Counties. As in the rest of the province, federal lands in this area are too small to support 20-pair clusters and should be supplemented by nearby lands with suitable habitat. Also, the category 2 DCAs and the residual habitat areas in this area should be supported by nonfederal lands to make them consistent with size, spacing, and density criteria. Dispersal habitat on federal and nonfederal lands is needed among areas managed for owl population centers.

The remainder of the federal lands in this province should be managed for dispersal habitat under matrix prescription A (see section III.C.2.). The federal landscape should meet the 50-11-40 rule and residual habitat areas of 100 acres each should be established for all known and future-discovered owl activity centers up to a density of 10 areas per township.

Biological goals on nonfederal lands.

The continued presence of owls in the province depends on state and private lands; federal lands alone are insufficient to maintain owls throughout the province. With the lack of federal lands in the province, recovery actions on nonfederal lands are needed to provide demographic stability and maintain northern spotted owl distribution. These goals can be achieved by conservation measures that result in 18 population centers of breeding pairs appropriately spaced throughout the province, with adequate dispersal habitat among them.

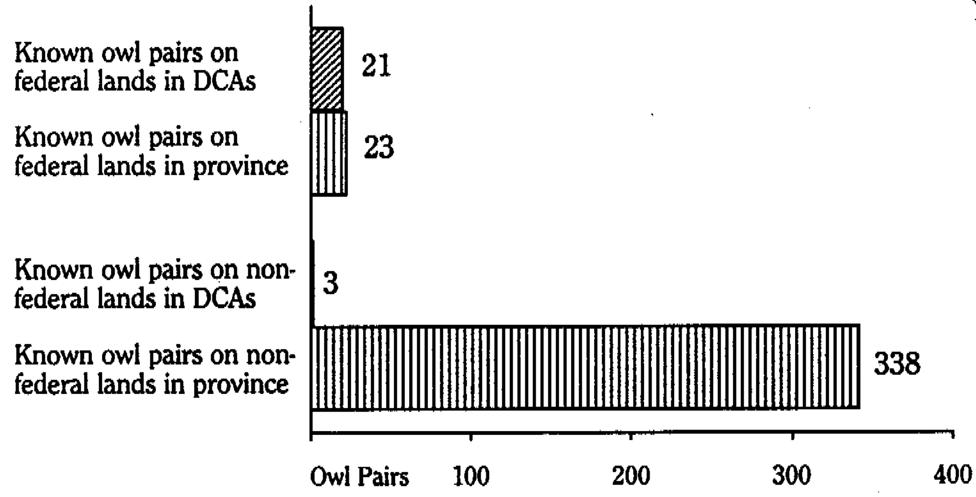


Figure 3.32. *Known owl pairs in the California Coast province and in the DCAs (designated conservation areas) in the province.*

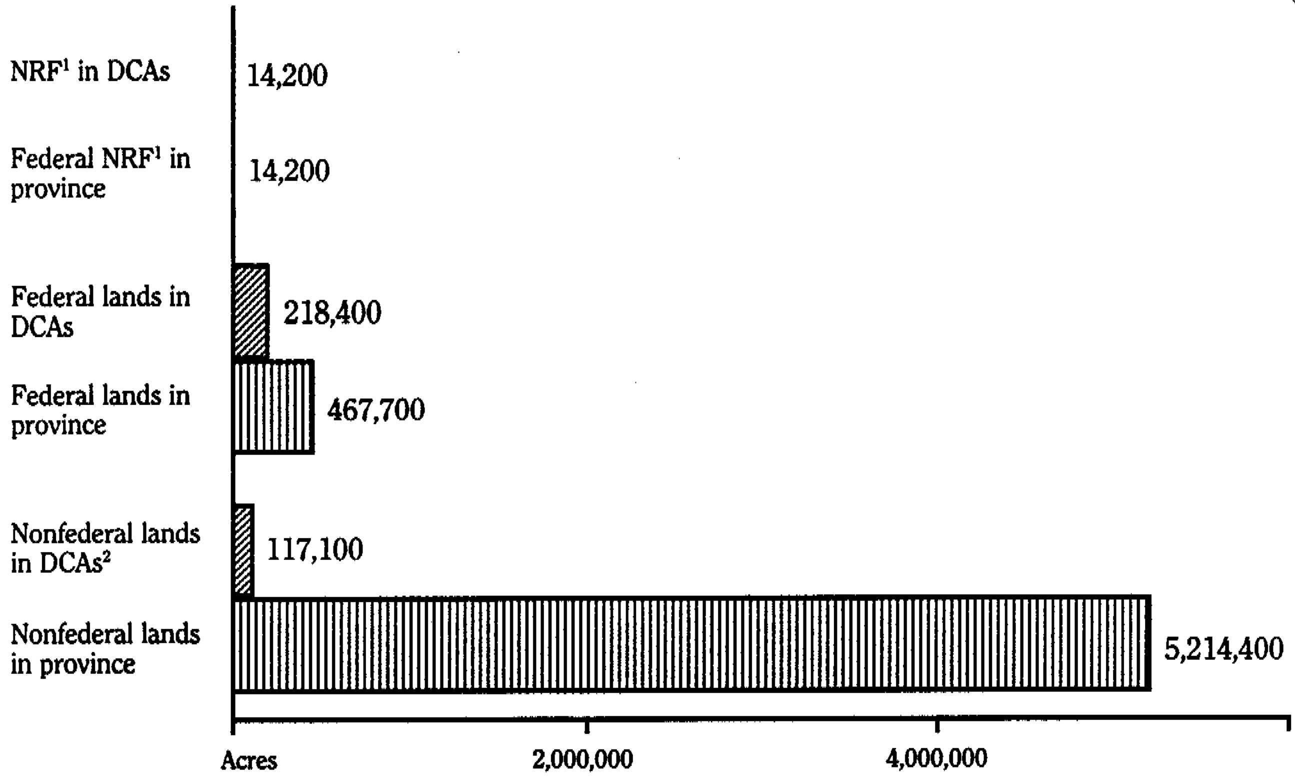


Figure 3.33. *Acres in the California Coast province and in the DCAs (designated conservation areas) in the province.*

[1]NRF = nesting, roosting, and foraging habitat. This information is available only for federal lands.
[2]Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the province narrative.

The owl activity centers on federal lands could contribute to 11 of the 18 population centers needed to maintain the owl population throughout the province. However, only three DCAs in the province can support more than 10 pairs of owls. Also, distances among most of the DCAs on federal lands exceed current spacing standards, creating a critical need for dispersal habitat on the intervening nonfederal lands.

Because there is not enough habitat in the DCAs in this province to support a sustainable owl population, options are presented for nonfederal lands to supplement existing DCAs, and to provide for population centers where spacing between DCAs exceeds the current standards. Supplementing DCAs and providing for population centers does not require reserves of private lands and can be achieved through voluntary actions on private lands and compliance with regulations.

Del Norte and northern Humboldt Counties. Nonfederal lands can be managed for nesting, roosting, and foraging habitat; for supplementing CD-1 and CD-3; and for dispersal habitat among owl population centers and DCAs.

Central Humboldt County. A substantial population of spotted owls occurs east and southeast of Eureka, but no DCAs are possible in this area because there are no federal lands. At least three 20-pair population centers, or equivalent, would be needed on state and private lands in this area to meet recovery goals for demographic stability and distribution throughout the province. Dispersal habitat should be maintained among areas managed for owl population centers.

Southern Humboldt and northern Mendocino Counties. Except for one area where federal lands could be managed as an aggregate to provide for a larger cluster, DCAs and state parks are too small in this area for 20-pair clusters and demographic support must rely on nearby nonfederal lands with suitable habitat. All category 2 DCAs could benefit from support by supplemental pair areas or habitat on state and private lands, as feasible and consistent with current size and spacing criteria. Currently, 17 category 2 DCAs in this area are recommended on federal lands and would benefit from this support. For example, 13 of these category 2 DCAs have the capability to be upgraded to support 20 owl pairs by combining them with other DCAs and instituting favorable management on private and state lands. Additionally, eight owl activity centers on state park lands also would benefit from this type of supporting habitat. In addition to providing nesting, roosting, and foraging habitat, dispersal habitat is needed among areas managed for owl population centers and DCAs.

Southern Mendocino County to northern Sonoma County. Six 20-pair population centers are needed in this area to support local owl populations and those farther south and east in Sonoma, Napa, and Marin Counties. The population centers would be most effective in the generally suitable habitat near the coast; habitat of naturally low suitability occurs west and southwest of Clear Lake. Seven state parks and three small DCAs on BLM lands are available in this area to serve as the basis for larger population centers, supported by management for additional owl pairs on private lands.

Southern part of the province. Owls in the southern part of the California Coast province have the highest risk of extirpation because of their isolation. Habitat in northern Marin County, northeastern Sonoma County, and most of Lake County is either unsuitable, or is of low or questionable suitability. Owls may not disperse readily through these areas. State parks in this part of the province could serve as the basis for population centers, if augmented by private lands. However, except for the Point Reyes area, it may not be possible to aggregate 20-pair clusters in this area. Known owl activity centers on state and private lands in these population centers should be managed conservatively to retain all owl nesting and roosting habitat until monitoring and research indicate that the threat of local extirpation has diminished substantially.

Implementation options on nonfederal lands.

Several options are available for achieving recovery goals on nonfederal lands in the California Coast province. There are several existing reserves, including federal lands and state parks. Most of the state lands in the province are in parks and can be expected to provide owl habitat over the long term. Additional owl support could be provided by a 50,000-acre state park and a 50,000-acre state forest.

Managed forests on private lands also can provide nesting, roosting, foraging, and dispersal habitat. There is great potential for finding additional owls through surveys and this may create an incentive for private landowners to develop landscape management approaches for owl conservation. At least one industrial landowner has an approved HCP providing for one owl population center and two other landowners have approved "no take" plans. Other industrial forest landowners have expressed interest in developing an HCP or other habitat conservation measures.

State forest practices rules and the state-sponsored HCP process provide other avenues for landscape management. Current take prohibitions do not provide directly for adequate clustering of owl pairs or spacing of owl population centers, but do provide for supplemental pair areas where they are found through surveys. State forest practices rules also place constraints on cumulative impacts, activity in riparian zones, and the size and spacing of clear-cuts. Amendments to the forest practices rules would be needed to require specific habitat retention standards, different "zonal" practices, and long-term plans. The forest practices rules currently provide for long-term plans only on nonindustrial ownership. The state-sponsored HCP program is addressing these issues and is expected to be completed in 1993.

Land acquisition opportunities are expected to be limited because of the lack of federal lands available for exchange, lack of funding for purchase, and concerns about removing lands from private ownership.

There are potential implementation difficulties in northern Marin, northeastern Sonoma, and Lake Counties because of habitat and ownership patterns. Owl conservation in this area may have to rely on take prohibitions on a case-by-case basis. The ability to maintain owl populations is limited by poor suitability and distribution of habitat, numerous small ownerships, and the inability to manage landscapes collectively. Existing local land trusts and open-space districts may provide funds for land acquisition but probably will require active participation of county government through local land-use regulations.

Implementation of the province recovery goals would be expedited if landowners were given flexibility in the placement of owl population centers, although this approach may require greater monitoring efforts and conservative targets.

Three options are presented for achieving province recovery goals, however, other options may be appropriate if they achieve equivalent or better protection for the owl. Given the variation in land ownership and specific conservation needs throughout the province, a combination of options is likely to be implemented eventually. Each option must be evaluated by its ability to achieve province recovery goals if fully implemented.

Option 1: Management of individual owl sites

This option would build population centers of owls based on current knowledge of owl sites. These nonfederal population centers would be identified in a specific location with habitat of specified quantity and quality.

This option would provide the opportunity for timber management on private lands to support DCAs and reserved pair areas by meeting standards for suitable habitat quality and quantity around individual owl acitivity centers which are located near the federal lands. Managing to maintain dispersal habitat is recommended for private lands among DCAs and owl population centers on private lands. In northern Marin, northeastern Sonoma, and Lake Counties, concerns about low population and connectivity to the adjacent province would preclude timber harvest of suitable owl habitat.

Habitat requirements for individual sites could be identified by implementing minimum stand structure provisions for each habitat type in this province. On private lands, owners could manage owl habitat if safeguards ensured the maintenance of local owl populations. Safeguards could take the form of performance bonds, mitigation banks, or dedicated areas such as easements.

Implementation and monitoring under this option would require substantial owl surveys. Consequently, this option, compared to other options, may be harder to establish because of management on a site-by-site basis. This option would provide landowners with the least amount of management flexibility at the site level and may raise equity issues among ownerships. Private landowners who have conducted owl surveys on their lands may have a disadvantage over those who have not surveyed for owls when known owl sites are used to establish population centers.

This option, compared to other options, may be easier to monitor for compliance and would allow site-specific management practices tailored to site-specific conditions. The site-by-site application may make it easier to review the impact of management practices. Protecting known nest sites within a larger landscape strategy of population centers and dispersal habitat may present lower risks to owl populations over the short term.

Option 2: Management of population centers with fixed boundaries

This option specifies management for 20-pair population centers, in lieu of the individual site-level management. Population centers would be located with fixed boundaries, and habitat quality and quantity would be managed to support a specified number of owls. Other standards (e.g., minimum habitat block size, spacing of habitat blocks) would be provided. Location of owl sites in the population center may be more variable over time than in option 1. The cumulative impact of timber harvest and other forest management activities on owl habitat within the population centers would be evaluated, and mitigation measures could be proposed to offset the impacts. Owl population centers in the southern extreme of the province would be managed to retain all suitable habitat.

Habitat standards and safeguards would be similar to those in option 1. Since fixed boundaries for supporting DCAs and population centers on private lands would be recommended under this option, implementation could rely on known owl sites or additional owl survey work. Once population centers are established, monitoring habitat conditions over time would be more important than individual owl surveys. This option would provide greater flexibility to landowners than does option 1 and allow for local management options.

This option also would require a higher level of habitat monitoring and perhaps greater amounts of habitat than would option 1, because the status of owl pairs is not stressed. If long-term monitoring determines that forest management does not achieve expected results in owl populations, a longer time or greater conservation action may be required to correct the strategy.

Option 3: Management of population centers with general boundaries

This option would allow greater flexibility to private landowners in meeting province recovery objectives because the boundaries of areas managed for owl population centers are generalized. Each population center would have a designated general size, based on the numbers of owls it should contain and the home range size that would be necessary for owls in the province. Only a general location would be specified to meet spacing guidelines; the location of the perimeter would not be fixed. Guidelines would be based on maintaining owl pairs in clusters rather than maintaining isolated owl pairs or individuals. Landowners would determine where owls would occur in population centers. An owl population center in a single landownership could be managed by the landowner. An owl population center that encompasses land owned by several landowners could be managed through a coordinated resource management plan agreed upon by all landowners. Owls in the extreme southern part of the province would be managed in enlarged clusters with no removal of owl nesting and roosting habitat.

This option would provide the landowner with the greatest number of options in land management and would require minimal owl surveys. Owl surveys could be limited to those required to estimate population trends in the province. The option also could serve as the framework for a more generalized, landscape-based habitat conservation strategy that could consider other species, biological diversity, and ecosystems.

This option would require substantial management planning by landowners to ensure that recovery goals for the province will be achieved and maintained. Habitat monitoring would be the paramount concern and would be the responsibility of landowners and implementing agencies. This strategy also would carry a higher risk of declines in owl populations during the short term or delays in meeting recovery goals, since many of the relationships between owls and forest management over the long term are unclear at this time and have not been tested.

Achieving recovery goals for the province will require effective coordination between private landowners and the state. In many areas, BLM participation will be high because of the numerous small BLM parcels adjacent to state and private lands. In Marin, Sonoma, and Napa Counties, coordination with local and county governments may be critical to maintain owls on private lands and to use zoning to help maintain owl habitat. Coordination in managing owls in this province is underway in the form of a state-sponsored HCP for the northern spotted owl.

Round Valley Indian Reservation (Covelo Indian Community), background and voluntary contribution.

A wildlife management survey has been initiated to survey all wildlife species on the Round Valley Indian Reservation. Spotted owl surveys were conducted in the 1991 and 1992 seasons, resulting in the location of two activity centers. Within the 30,000-acre reservation a survey was conducted on land recently purchased (11,304 acres purchased with a timber-cutting right easement where conifers more than 11 inches in diameter remain the property of the prior landowner). This resource area had one spotted owl activity center. If harvest is not undertaken under the easement and after a complete survey of the reservation has been done, the Tribe will reevaluate its management to provide protection for this activity center.

The Tribe has a new Fish and Wildlife Program that works in conjunction with the Natural Resource Program to manage and protect its wildlife resources within the reservation. For now, the Tribe will manage for the northern spotted owl and continue to inventory this species' habitat and will develop its own management plan.

California Klamath Province

Province description.

The California Klamath province is between the California Coast province and the California Cascades province. It is a continuation of the Oregon Klamath province, south to the Clear Lake Basin in the inner Coast Range. The area is mountainous and covered primarily with Douglas-fir forests. Mixed Douglas-fir/pine forests are common at lower elevations with Douglas-fir/true fir forests at higher elevations.

Land ownership and management of the 6-million-acre province are illustrated in the province summary (Figure 3.34), with federal lands represented by the Six Rivers, Klamath, Shasta-Trinity, and Mendocino National Forests. Four major wilderness areas contain significant suitable owl habitat. There are a few parcels of BLM lands and some private forestlands which occur mostly near the eastern edge of the province.

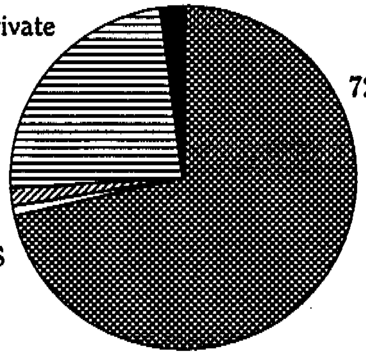
There are 1,077 historic owl activity centers in the California Klamath province, 87 percent of which are on federal lands. During the 1987-91 period, owls were identified at 801 of these sites. Seventy-nine percent of pair activity centers occurred on federal lands.

Spotted owls in this province are important to maintaining genetic contact between the northern spotted owl and California spotted owl subspecies. Genetic contact is considered especially important because of the low numbers and scattered distribution of northern spotted owls in the California Cascades province.

Threats to the California Klamath province.

The province has one severe threat at this time; catastrophic fires have the potential to destroy forested areas large enough to support a 20-pair cluster. Moderate threats (see section II.B.) to the northern spotted owl population in this province arise from reduction of suitable habitat and resulting loss of owls caused by timber harvest in the last 40 years. The final moderate threat is province isolation.

Declining Habitat. Declining habitat is a moderate threat because there has been significant loss of habitat due to clear-cutting on national forest lands, which predominate the province. Most of this harvest has occurred since the mid-1940s. A reduction of 40 percent (212,000 acres to 126,200 acres) of mature and old-growth, closed-canopy forest has occurred in the Six Rivers National Forest. This occurred with an average annual harvest (1960 to 1984) of 158.6 million board feet. Other national forests are also undergoing a decrease in available habitat due to average annual cuts of 80.2 million board feet (before 1984) in the Mendocino National Forest and 248.0 million board feet (1974 to 1984) in the Shasta-Trinity National Forest.



Acres	Ownership / Management
4,356,900	U.S. Forest Service
41,600	National Park Service (NPS)
2,800	State of California
105,200	Indian Lands
1,460,200	Private Ownership
120,100	U.S. Bureau of Land Management (BLM)
6,086,800	**TOTAL**

Federal nesting, roosting, foraging habitat: 1,075,600 acres

Known owl activity centers:

	Federal		Nonfederal	
	Pairs	**Singles**	**Pairs**	**Singles**
Inside the DCAs	244	91	4	3
Outside the DCAs	200	112	111	36

Federal recommendations:

		Activity	Acres	
	Number	**Centers**	**Reserved**	**Nonreserved**
Category 1 DCAs	14	264	361,700	676,900
Category 2 DCAs	19	71	23,700	271,700
Prescription B reserved pair areas	11	9	6,200	20,500
Prescription A residual habitat areas (Estimate of current situation)	303	303	–	–

Nonfederal recommendations:
See province narrative.

Figure 3.34. *California Klamath province summary.*

DCAs = designated conservation areas.
– = unknown.

Much of the lower elevation, mixed-conifer forests on private lands along the northeastern edge of the province was cut heavily earlier in the century. The resultant second-growth is now being cut, primarily using uneven-age management techniques. This management has resulted in loss of fewer acres of suitable habitat than clear-cutting would have, but the quality of the habitat is unknown. From 1986 through 1990, the average area harvested on private lands in Glenn, Shasta, Siskiyou, Tehama, and Trinity Counties (some areas also in the California Cascades province) was 103,000 acres per year. An average of 41,000 acres per year were treated with stand-replacement harvest prescriptions.

Limited Habitat. The threat of limited habitat is low. There are an estimated 1,075,600 acres of nesting, roosting, and foraging habitat on Forest Service lands in the province, which is about one-fourth of the Forest Service lands here. Additional habitat is found on private lands which generally occur along the eastern edge of the province.

Habitat generally is not highly fragmented and individual pairs normally are not isolated or becoming isolated in the western and central parts of the province. However, along the eastern edge of the province, there are areas of poorer soils, intrusions of higher-elevation areas and drier conditions, all of which result in lower amounts of suitable owl habitat. Natural fragmentation and the isolation of individual pairs (such that sites are more than 6 miles apart) occur at the southern end of the species' range in this province. Forests are limited or absent in this area due to lower and drier conditions.

Declining Populations. The threat of declining populations is considered moderate in this province. In the Willow Creek demographic study area, one analysis concluded that populations have been decreasing by nearly 9 percent annually during the last several years (see Appendix C). Another measure of declining populations is the documentation of known owl activity centers which disappeared over time. Studies of densities of territorial owls on Willow Creek suggest that they have been relatively stable since 1985.

Low Populations. Population levels are considered a low threat, as owl populations are substantial in this province, with 1,077 historic sites. About 559 pairs were verified from 1987 through 1991. In the province, suitable habitat contains an average density of 3.7 known owl sites per township.

Distribution of Habitat and Populations. This threat is also considered low in the California Klamath province. As a measure of the distribution of owls and habitat in the province, an assessment was prepared which quantifies the number of known owl activity centers in the townships that contain suitable habitat. In this assessment, owls have been documented in 92 percent of the townships where suitable habitat occurs. While spotted owls are found throughout the full range of ecological conditions that provide suitable owl habitat, their distribution and density varies throughout the province. To illustrate this fact, in 23 percent of the townships where owl habitat occurs, one or no owl sites have been found. In another area more than 9 sites each have been found in 7 townships, and 1 township has 20 known sites.

The eastern part of the province is drier, the forests are more fragmented, and owl densities are lower than in other parts of the province. One-third of the townships in the eastern part have owls at low densities or are not expected to have any owls. However, 94 percent of the townships that contain suitable habitat have one or more owl activity centers.

The southern part of the province is characterized by dry, brush-covered, south-facing slopes and forested, north-facing slopes. Owls occur in 96 percent of the townships here, but only 4 percent of the townships have more than four owl sites per township.

Owls and owl habitat generally are best distributed in the western, northern, and most of the central parts of the province. In the north-central part of the province 42 percent of the townships have more than four known sites per township. The northeastern part contains a large, lower-elevation valley with unsuitable owl habitat, which impairs the owl distribution.

Province Isolation. The California Klamath province is in a key position for connecting with other northern spotted owl populations and with the California spotted owl. Isolation is rated as a moderate threat because of both natural conditions and human-caused habitat loss. This province is between the other two California provinces and is contiguous with the Oregon Klamath province. Owls and habitat occur along the borders with the three other provinces except where areas of natural habitat fragmentation occur along the southwestern and northeastern boundaries. The California Klamath province is contiguous with much of the California Coast province, but in some areas the habitat in the California Coast province supports mostly dispersal habitat and little breeding/roosting habitat.

While the California Klamath province is contiguous with the California Cascades province for about 110 miles, suitable owl habitat only occurs along 55 miles south of Shasta Valley. Even here habitat is not contiguous and is found as pockets of suitable habitat among areas of higher elevations, unsuitable soils, or past timber harvest. South of the city of Redding, the remainder of the eastern border of this province directly abuts California's Central Valley, which is not suitable habitat. The nearest suitable habitat in the range of the California spotted owl is 35 to 80 miles to the east in the Sierra Nevada.

Predation and Competition. Great horned owls occur naturally throughout the province, and their predation on spotted owls has been noted in field studies here. Additional studies will be required to determine whether great horned owl numbers are increasing and whether the effects of predation are higher than would be expected. At this time predation is considered a low threat.

Barred owls have been identified in the California Klamath province during the last 8 years. The number of known barred owl sites has grown dramatically in the last 3 years from 4 to 15 sites. Recently, one-third of these sites were pairs of barred owls. The potential for competition may be increasing rapidly, but the probable effect on spotted owl populations is still a low threat.

Vulnerability to Natural Disturbances. Fire is the major disturbance event likely in the California Klamath province. The history of frequent natural fires makes this threat severe. Especially when combined with fire suppression during the last 70 to 100 years which has resulted in increased accumulation of fuels and has made large and hot fires more likely than was true historically. This has contributed to a recent history of large fires (e.g., Hog fire in the Klamath National Forest; 1987 fires in the Klamath, Shasta-Trinity, and Mendocino National Forests) that disturbed or removed extensive areas of suitable spotted owl habitat.

Wind damage is a relatively small problem here compared to other parts of the owl's range. But drought and drought-caused insect and disease problems are concerns, especially in the drier areas of the province.

Biological goals and implementation on federal lands.

The dominance of federal lands in parts of this province allows for creation of a DCA network that will fairly well provide for owls in those areas. But nonfederal support is still needed in some areas.

Recommended federal lands management in the province includes 14 category 1 and 19 category 2 DCAs (Tables 3.23 and 3.24). All category 1 DCAs occur in the western and northern parts of the province, providing the demographic stability for owl populations in the province. The category 1 DCAs include minimal state or private lands; these nonfederal lands support few owls and are not essential for demographic stability. The large DCAs in the northern and western parts of the province have better natural site conditions and higher known owl populations than do the DCAs in the eastern and southern parts of the province. These large DCAs will reduce the need for contributions from state and private lands in the western part of the province.

Category 2 DCAs are common along the eastern edge and the southern end of the province where lack of habitat in general, and lack of federal lands, preclude larger DCAs.

The DCAs contain about 52 percent of the federal owl activity centers verified from 1987 through 1991, and 45 percent of the nesting, roosting, and foraging habitat on federal lands in the province (Figures 3.35 and 3.36).

Eleven reserved pair areas are delineated under matrix prescription B near DCAs CD-31, CD-46, CD-51, CD-53, and CD-54, where the current number of pair sites and spacing requirements among DCAs cannot be met. The locations and boundaries of these reserved pair areas are in the recovery plan's administrative record and will be provided to the national forests involved.

The remainder of the federal lands in this province should be managed for dispersal habitat under matrix prescription A (see section III.C.2.). The federal landscape should meet the 50-11-40 rule and residual habitat areas of 100 acres each should be established for all known and future-discovered owl activity centers up to a maximum density of 10 areas per township.

Biological goals on nonfederal lands.

Biological goals for nonfederal lands in the province are to provide for local demographic support and maintain owl distribution throughout the province and between this province and the California Cascades province. Given the dominance of federal ownership in the western part of the province, there is no need for local population centers on state and private lands in that part of the province. Recovery will be enhanced by supporting DCAs in the eastern and southern parts of the province with additional pairs from private lands, and by managing for a new population center on state, private, and BLM lands in eastern Trinity County.

Achieving the recovery goals for nonfederal lands in this province would contribute substantial support to the demographic stability of owl populations in the province, and increase the likelihood of more rapid recovery. Increases in dispersal habitat will assist in maintaining the link between the California Klamath and the California Cascades provinces, and support owl populations in the California Cascades province. This linkage could be crucial to maintaining the owl population in the California Cascades province and in maintaining the linkage to the California spotted owl in the northern Sierra Nevada.

Western part of the province: No additional owl population centers or DCA support for owls are needed on state and private lands, other than management for dispersal habitat. Land exchanges or other agreements should be used to consolidate federal lands in the DCAs.

Table 3.23. **Summary of acreage and owl numbers for designated conservation areas (DCAs) in the California Klamath province. (More detailed information, including owl numbers on nonfederal lands is in Appendix I, Table I.10.).**

DCA Ident. Number	Acreage: Total	Acreage: Percent Federal Lands[1]	Acreage: NRF Habitat Federal[2]	Known Owls[3] Federal Pairs	Known Owls[3] Federal Singles	Known Owls[3] Nonfederal Pairs	Known Owls[3] Nonfederal Singles	Current Projected Federal[4]	Future Projected Federal[5]
CD-29	102,200	99	41,500	7	8	0	0	20	25
CD-30	85,500	95	24,900	16	2	0	0	25	29
CD-31	51,100	100	13,500	11	6	0	0	18	20
CD-32	23,100	62	1,600	9	3	1	1	10	8
CD-33	140,700	100	71,600	23	4	0	0	40	42
CD-34	6,300	100	2,300	2	1	0	0	3	3
CD-35	54,600	99	25,300	19	4	0	0	22	24
CD-36	58,000	95	18,300	13	3	0	0	21	23
CD-37	8,900	99	3,600	3	1	0	0	4	4
CD-38	3,400	97	1,400	1	0	0	0	1	1
CD-39	4,200	100	1,400	1	0	0	0	1	1
CD-40	1,700	99	700	1	0	0	0	1	1
CD-41	2,300	96	400	1	0	0	0	1	1
CD-42	3,800	65	200	1	0	0	0	1	2
CD-43	5,500	74	700	1	0	0	0	1	2
CD-44	11,200	66	2,300	3	0	1	1	3	4
CD-45	95,900	99	44,500	11	10	0	0	20	25
CD-46	97,900	98	30,300	8	5	0	0	22	24
CD-47	27,600	86	6,000	2	3	0	0	6	8
CD-48	13,200	85	2,700	2	1	0	0	3	4
CD-49	53,400	72	8,700	4	0	1	1	6	12
CD-50	38,000	95	14,300	27	1	0	0	28	25
CD-51	54,900	95	17,300	11	3	0	0	21	23
CD-52	63,100	95	35,200	15	6	0	0	22	25
CD-53	43,800	91	24,100	9	7	0	0	18	20
CD-54	30,000	91	4,000	5	0	0	0	5	7
CD-55	117,200	95	37,200	9	6	0	0	29	31
CD-56	66,400	98	13,700	12	8	0	0	22	24
CD-57	37,400	96	6,500	5	5	0	0	10	12
CD-58	27,500	88	5,400	5	1	1	0	6	8
CD-59	44,400	98	8,400	2	2	0	0	6	12
CD-60	12,100	93	2,300	3	1	0	0	5	6
CD-61	25,800	98	5,300	2	0	0	0	4	7
OD-23	This DCA crosses state boundary; data are displayed in Oregon Klamath province table (Table 3.19).								
Total:	**1,411,100**	**95**	**481,000**	**244**	**91**	**4**	**3**	**405**	**463**

[1]Management of nonfederal lands within the perimeter of DCAs is discussed in the narrative.
[2]NRF = nesting, roosting, and foraging habitat for spotted owls. Habitat information was not available for nonfederal lands.
[3]Numbers of spotted owl activity centers verified in a 5-year period; generally 1987 through 1991.
[4]Estimate of the number of pairs of owls that the DCA would be expected to support on federal lands if the population stabilized with current habitat conditions. See Appendix I for further details.
[5]Estimate of the number of pairs of owls that the DCA might support in the future on federal lands if habitat were recovered. See Appendix I for further details.

Table 3.24. Summary comments on the designated conservation area (DCA) network in the California Klamath province. (Section III.C.1. and Appendix I provide further information about the criteria and process used to delineate these areas.)

Category 1 DCAs	Comments
CD-33 and CD-50	Currently known to support more than 20 pairs of spotted owls.
CD-29 through CD-31 CD-35, CD-36, CD-45, CD-46, CD-51, CD-52, CD-55, CD-56	Currently support fewer than 20 known pairs of owls. With the exception of CD-31 and CD-53, they all have the current potential so support at least 20 pairs.
CD-31, CD-53	Supports fewer than 20 pairs now, but is expected to support 20 pairs in the future.
Category 2 DCAs	**Comments**
CD-32, CD-34	CD-34 provides connectivity around a high-elevation wilderness area. CD-32 provides connectivity to DCAs farther east.
CD-37 through CD-44, CD-47 through CD-49	Because of the naturally fragmented landscape, larger multipair DCAs are not possible. DCAs are delineated where owls are currently known, future habitat opportunities occur, and where the only demographic support for this local population is possible. Suitable habitat is not uniformly distributed throughout this region because of moisture and soil conditions. These DCAs provide connectivity to DCAs to the east and provide the link between the ranges of the northern spotted owl and the California spotted owl in the Sierra Nevada.
CD-54, and CD-57 through CD-61	The drier and naturally fragmented habitat here will support from 7 to 12 pairs of spotted owls in each DCA in the future.

Eastern and southern parts of the province: These parts of the province are drier and support a smaller known population of owls, reflected by the lack of category 1 DCAs. At least five category 2 DCAs could be augmented with currently known sites on state and private lands. Although this probably would not result in upgrading to category 1 any of these areas, it would increase the stability of the small owl populations in these population centers.

Managing for a new owl population center on state, private, and BLM lands in eastern Trinity County would enhance recovery. This population center would provide stronger demographic support in this part of the province and better connectivity throughout the southern end of the Trinity Alps to the California Cascades province. Managing supplemental pair areas in this area would provide a starting point for creating such a population center.

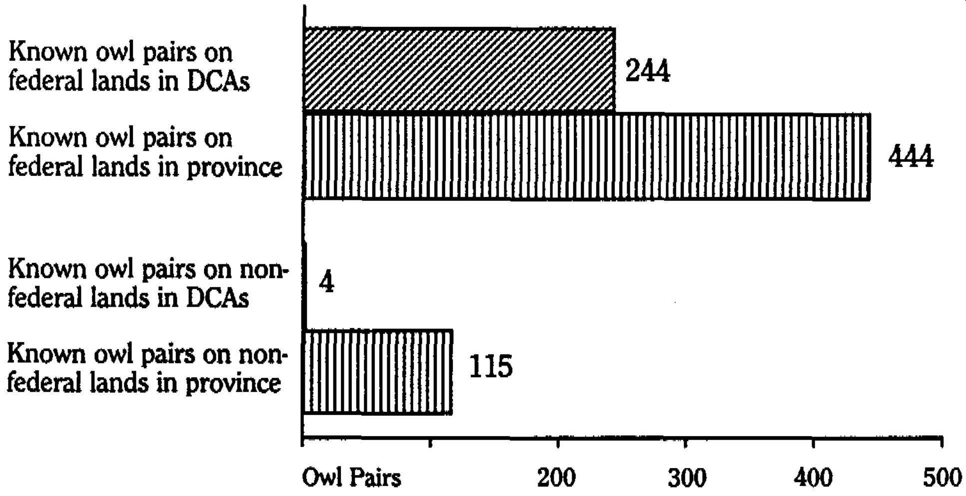


Figure 3.35. *Known owl pairs in the California Klamath province and in the DCAs (designated conservation areas) in the province.*

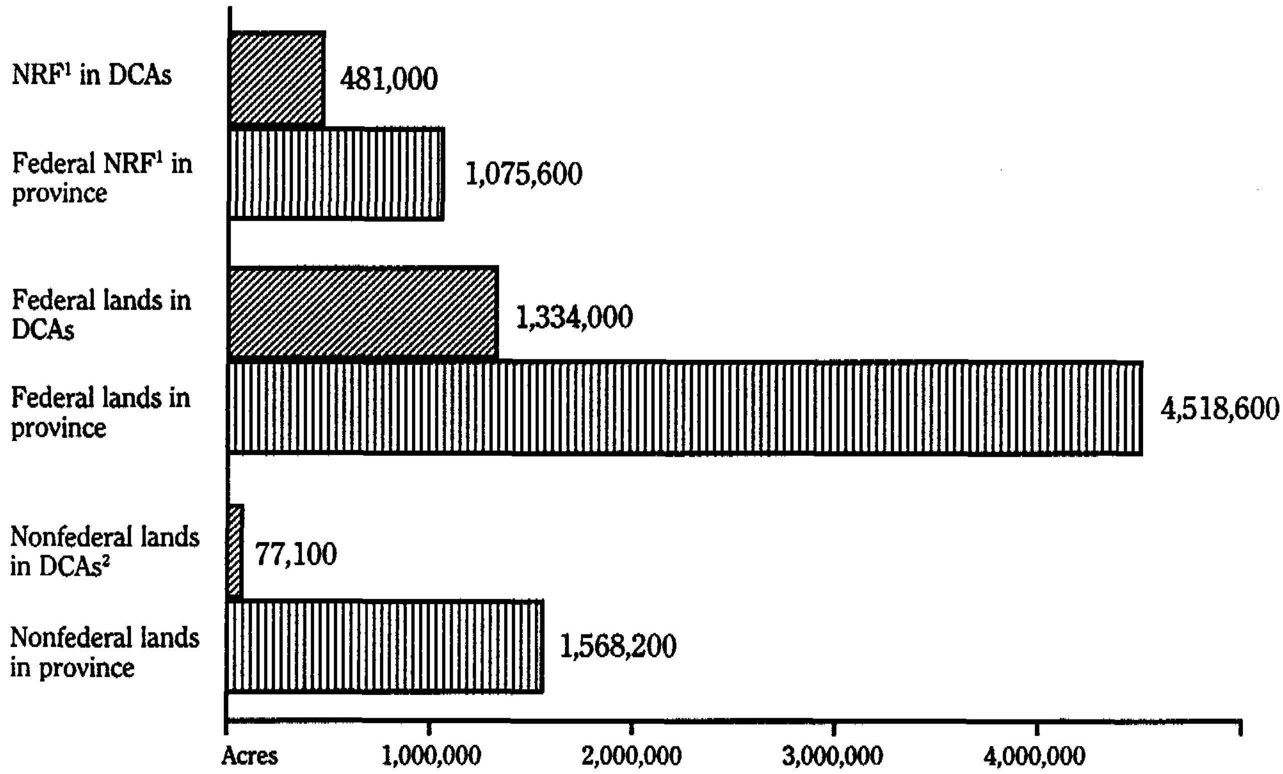


Figure 3.36. *Acres in the California Klamath province and in the DCAs (designated conservation areas) in the province.*

[1]NRF = nesting, roosting, and foraging habitat. This information is available only for federal lands.
[2]Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the province narrative.

Implementation options on nonfederal lands.

Numerous alternatives exist for achieving recovery goals on nonfederal lands in the California Klamath province. There are substantial reserves of public lands, and the recommendations for federal DCAs incorporate most of them. One private timberlands owner with substantial acreage has committed to a management plan incorporating extensive owl surveys to ensure that owls will not be taken as a result of the landowner's timber operations. Several other timberlands owners in the province practice uneven-age management which lessens impact to owl habitat. Other timberlands owners have expressed interest in developing comprehensive owl management plans for their ownerships, in compliance with the current state forest practices rules. The large number of owl activity centers in the area is an incentive for developing these plans, as is the state-sponsored HCP, which could benefit smaller acreage landowners in the province.

Forest practices rules would have to be amended to require specific habitat retention standards, different practices in different parts of the province, and long-term plans. Forest practices rules provide for long-term plans on nonindustrial ownerships only. The state-sponsored HCP is underway and addressing these issues. It is expected to be completed in 1993.

The extensive checkerboard ownership pattern in the province offers greater flexibility to explore land exchanges. Land acquisition is likely to be less attractive, since many of the timberlands owners also own processing facilities that depend on a stable timber base.

The feasibility and likelihood of early implementation of actions to achieve the province recovery goals will increase if landowners are given greater flexibility to designate areas for maintaining nesting, roosting, and foraging habitat for supporting DCAs. However, this flexibility may require greater effort in monitoring and establishment of more stringent initial objectives.

Four options are presented for achieving recovery goals in this province. The options are not exhaustive, and other options may be appropriate if they achieve equivalent or better protection for the owl. Other options might provide for more general landscape-level habitat management, protection for other species, and long-term management. Given the differences in land ownership and specific conservation needs throughout the province, it is possible that some combination of the options eventually will be implemented. All options must be evaluated based on the likelihood that they will achieve province recovery goals when fully implemented.

Option 1: Management of owl sites adjacent to federal DCAs

This option would consolidate DCAs on federal lands through the inclusion of inholdings in the western part of the province. Inholdings would be managed to create and maintain suitable owl habitat. The option would offer nonfederal support to category 2 DCAs and reserved pair areas in the eastern and southern parts of the province, using sites 3 miles or less from the current DCA boundary and all sites within the DCA boundary. Sites used for supporting federal areas would have specified locations (e.g., confine site location to a specific drainage and to within 0.5 miles of the owl activity center) and rules that would ensure that the appropriate quantity and quality of habitat be maintained. Dispersal habitat also would be designated throughout the province. A 20-pair population center in eastern Trinity County would be managed with fixed boundaries and site locations.

Extensive surveying for owls would be necessary to implement this option and monitor it over time. Fixed boundaries and site locations increase the certainty during the short term that owls will be found, but may raise issues of equity between landowners. Unless the area has been extensively surveyed, the use of existing known sites as the basis for restricting management may effectively penalize landowners who have conducted surveys and are engaged in active research. This option limits the flexibility of landowners who have the responsibility of providing for owl sites.

Option 2: Management of owl sites at the watershed level

This option would provide a management strategy to maintain dispersal habitat on private inholdings in federal DCAs in the western part of the province, but would create incentives for consolidating the inholdings with DCA management. It would provide nonfederal support for category 2 DCAs and reserved pair areas in the eastern and southern parts of the province, using lands within the general watershed areas containing the DCA. Sites would be distributed based on known owl occurrence. Owl sites in the major watersheds encompassed by the DCA would be recommended as supplemental pair areas to provide support for the DCA. These sites would be managed to ensure that the appropriate quantity and quality of suitable habitat would be maintained and that the location would be maintained (e.g., similar to current state forest practices rules regarding take, and confine the site activity center to a 3,000-acre area in a specific drainage). Dispersal habitat would be maintained throughout the province. A population center of 10 pairs of owls is an objective for eastern Trinity County.

This option provides somewhat more flexibility to private landowners. It is still based on managing for individual owl activity centers, so extensive owl surveys would be required. The location of sites is more flexible than under option 1, and fewer sites are likely to be required throughout the province. Higher risks may be associated with maintaining only dispersal habitat on inholdings in DCAs in the western part of the province. Implementing this option, which is based on currently known owl activity centers, may effectively penalize landowners who have surveyed extensively for owls, unless the area has been extensively surveyed.

Option 3: Management of all known owl sites

This option would maintain dispersal habitat on private inholdings in DCAs in the western part of the province, but would create incentives for consolidating the inholdings with DCA management. Nonfederal lands would support category 2 DCAs and reserved pair areas in the eastern and southern parts of the province, using all known sites. Habitat requirements for individual supplemental pair areas could be identified and managed by implementing minimum stand structure provisions for each habitat type in the province. Additionally, guidelines would be provided at the population center level to maintain such characteristics as the percentage of suitable habitat in the center, the minimum stand size and distribution of that suitable habitat, and the presence of high-value habitat at the owl activity centers. Dispersal habitat would be designated throughout the province.

This option also would include establishing a new owl population center on state, private, and BLM lands in northeastern Trinity County. This population center has the potential for 20 owl activity centers. Habitat would be provided by prescriptive management rules controlling the quantity and quality of habitat to be maintained. It would confine the population center to a specific drainage and it would be within 0.5 mile of the known owl activity centers.

This option would provide the best demographic support for the owl populations in these areas where habitat conditions preclude maintaining large enough owl clusters to provide a good chance of maintaining a viable population over time. This might result in forming larger clusters than currently possible and in increasing local population stability.

This option would require extensive owl surveys to identify owl sites and to monitor implementation. It creates a disincentive to locate owl sites and an incentive to harvest suitable, but unoccupied, habitat.

Option 4: Landscape-based habitat management

This option would require maintaining dispersal habitat on inholdings within DCA boundaries in the western part of the province, but would provide incentives for maintaining nesting, roosting, and foraging habitat. Category 2 DCAs and reserved pair areas in the eastern and southern parts of the province would be supported by providing suitable habitat in major watersheds included within DCA boundaries. Location of suitable habitat for owl activity centers or supplemental pair areas would not be specified, but quantity and quality would be ensured at the watershed level. Suitable habitat to support 10 pairs of owls would be maintained in eastern Trinity County, using existing federal lands as the basis. Specific owl site locations and population center boundaries would not be designated.

This option provides greater flexibility to the private landowner. It would not require owl surveys to the extent of other options. The option provides incentives for landowners to participate in landscape-level management, and to locate owls or manage habitat in desirable locations.

Coordination. Land ownership is dominated by the national forests. Private lands in the province are primarily large industrial forest holdings. BLM lands constitute a small but relatively important portion of the area where management of a population center is proposed among multiple owners.

This option requires coordination between industrial forest landowners and the state and its forest practices regulation mechanism. A state-sponsored HCP for the northern spotted owl is being drafted that will provide the coordination necessary to accomplish management suggested by this option.

Hoopa (Hupa) Valley Indian Reservation, background and voluntary contribution.

Owl surveys have located 44 activity centers on the reservation. Voluntary consultation (meeting section 7 requirements of the Endangered Species Act) with the FWS has been and will continue to be completed before timber harvests.

Approximately 6,000 acres of the total 88,000 acres of the reservation are inherently unsuitable for northern spotted owls (natural prairies, urban areas, water bodies, etc.). Of the remaining 82,000 acres, approximately 39 percent is designated as reserves, cultural sites, stream zones, or as the Hoopa Valley Wild and Scenic River view shed (Valley View Shed) along the Trinity River, where timber harvest is limited to partial cutting. The Valley View Shed is approximately 2 miles wide (17,000 acres) and serves specifically as a view shed to the Trinity River but also effectively serves to connect DCAs on Forest Service lands north and south of the reservation.

The principal protection provided to wildlife and fish species on the reservation is the maintenance of stream protection zones which are up to 400 feet wide. Stream protection zones include 4,700 acres. The Tribe is concerned with the protection of threatened and endangered species of fish, wildlife, and plants, and also culturally important species such as chinook and coho stocks, lampreys, fishers, pileated woodpeckers, acorn woodpeckers, bald eagles, ospreys, Port Orford cedars, and others.

California Cascades Province

Province description.

The California Cascades province is bordered by the Oregon Cascades provinces, the Oregon and California Klamath provinces, and the north end of the Sierra Nevada. It is the link between the range of the northern spotted owl and the range of the California spotted owl. Suitable owl habitat, which is fragmented on a broad scale by high- and low-elevation areas containing marginal habitat, is predominately in two national forests. However, there are significant blocks and checkerboard ownership areas where industrial private lands can provide suitable habitat.

Land ownership and management of the 2.5-million-acre province and illustrated in the province summary (Figure 3.37), with federal lands represented by the Klamath and Shasta-Trinity National Forests and minor amounts of BLM lands.

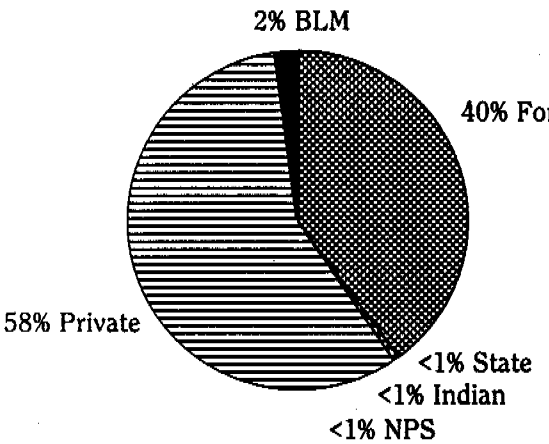
Spotted owls have been found at 90 historic sites in the province; owls have been verified at about 63 of these activity centers in the last 5 years.

The recovery goals and objectives for this province focus on maintaining and improving the link between the two subspecies of the spotted owl in California. Providing local demographic stability to the province, with owls well distributed, is necessary to maintain the link. The value of the contact may be the genetic interchange between the two subspecies. This exchange is not likely to occur if there are no northern spotted owls between the Sacramento River (north of the City of Redding) and the California spotted owls at the northwestern edge of the Lassen National Forest.

Because the province has naturally limited habitat conditions, there is little likelihood of supporting a large population. However, the continued presence of a well-distributed population is vital to maintain a connection between the northern spotted owl and the California spotted owl subspecies.

Threats to the California Cascades province.

The California Cascades province is considered to have four severe and two moderate threats to its spotted owl population. The major threats are low and apparently declining owl populations, and fragmentation of habitat which may prevent the designation of clusters of pairs. Also, habitat conditions tend to isolate the owl populations in the province from one another and from populations in neighboring provinces. These conditions limit the contribution to recovery that naturally can be expected from the California Cascades province. The owl population is at high risk for local and even province-wide extinction.



Acres	Ownership / Management
990,000	U.S. Forest Service
300	National Park Service (NPS)
13,800	State of California
100	Indian Lands
1,435,200	Private Ownership
52,500	U.S. Bureau of Land Management (BLM)
2,491,900	**TOTAL**

Federal nesting, roosting, foraging habitat: 73,500 acres

Known owl activity centers:

	Federal		Nonfederal	
	Pairs	Singles	Pairs	Singles
Inside the DCAs[1]	28	12	0	0
Outside the DCAs	0	3	12	8

Federal recommendations:

	Number	Activity Centers	Acres	
			Reserved	Nonreserved
Category 1 DCAs	0	NA	NA	NA
Category 2 DCAs	22	40	200	210,400
Prescription B managed pair areas	2	0	0	4,900
Prescription A residual habitat areas (Estimate of current situation)	3	3	–	–

Nonfederal recommendations:
See province narrative.

Figure 3.37. *California Cascades province summary.*

DCAs = designated conservation areas.
— = unknown.
NA = not applicable.

Declining Habitat. The rate of habitat loss in this province is difficult to estimate because of the patchy distribution of the habitat used by owls, but it is considered a moderate threat. The patchy distribution of habitat is the result of previous tree cutting and/or thinning, and low historical levels of suitable habitat due to fire history. Timber harvests have covered large areas, but rarely involve clear-cutting.

Limited Habitat. The California Cascades province is small, containing about 110 townships. Twenty-three townships probably do not contain suitable owl habitat and another 43 contain only marginal habitat. Habitat is mainly found in parts of the Klamath and Shasta-Trinity National Forests and interspersed private lands. There are about 73,500 acres of nesting, roosting, and foraging habitat on these Forest Service lands, which is only 7 percent of the Forest Service lands in the province leading to a conclusion that the limited habitat threat is severe. About 220,000 acres have crown diameters larger than 13 feet and canopy closure more than 40 percent, which would meet the 50-11-40 rule. However, much of remaining Forest Service acreage does not meet the 50-11-40 rule for dispersal habitat.

Declining Populations. Because there are no demographic study areas in the province, demographic information about owls is lacking. The only available information is limited to survey and inventory work with anecdotal observations of reproduction, Forest Service monitoring sites, and private lands surveys which have been conducted only in the last 2 years. Preliminary indications are that owl activity centers are occupied less often than elsewhere in the range of northern spotted owls in California, and this threat is considered severe.

Low Populations. Population levels are low in this province, making this a severe threat also. There are only 90 known historic sites, reflecting only 5 percent of the known sites in California. Owls were verified at about 63 sites from 1987 through 1991; 63 percent of these activity centers are on federal lands. The density of sites found since 1970 is only 1.0 per township.

Distribution of Habitat and Populations. Owls and owl habitat are present throughout a range of ecological conditions in the province, but habitat is fragmented and owl population densities are low. This is also a severe threat. Owls are known to occur in only 40 percent of the townships in the province and in 51 percent of the townships where possibly suitable habitat exists. Even though the province is fairly well surveyed, 48 percent of the townships with owls have only one known owl site, and only 5 percent have more than four owl sites each.

Habitat is fragmented throughout the province: known owl distribution consists of six separate clusters in a 1-million-acre area. Suitable habitat is fragmented on a local level and individual owl sites are often widely separated from nearest neighbors. This fragmentation and the isolation of individual sites may be natural, but is compounded by timber harvest. There is only one block of contiguous habitat on federal lands large enough to delineate a conservation area that would support 15 owl activity centers.

The eight owl activity centers north of Goosenest Mountain, in the Klamath National Forest and on private lands, are an isolated population in the province. Natural barriers (Shasta Valley, Klamath River Canyon, and a high-elevation pass) separate this area from the remainder of the province and from other adjacent provinces.

Province Isolation. The California Cascades province is located on the eastern part of the owl's range, as illustrated in Figure 2.2. Although the province is bounded by provinces on three sides, it is somewhat isolated from them and isolation is considered a moderate threat. The Shasta Valley separates the California Klamath province from the Goosenest Mountain section of the California Cascades province by 20 miles. The Sacramento River Canyon now presents a 10- to 13-mile division between known owl sites in the California Klamath and California Cascades provinces.

The province also abuts the range of the California spotted owl to the southeast. A narrow band (about 20 miles wide) of low-density owl habitat provides the only connection for owl movement between the California Cascades province and the northern Sierra Nevada.

While there are forestlands in some of the gaps just described, habitat quality and owl densities in these areas are low. These conditions may be sufficient to ensure genetic connection, but probably limit the amount of demographic support that could be provided by adjacent provinces.

Predation and Competition. Predation on spotted owls is considered a low threat in the province. Great horned owls naturally occur throughout the province because of the open forest condition and the history of large-scale habitat modifications which contribute to open canopies. In some areas fire suppression probably has resulted in the exclusion of great horned owls from habitats where dense tree canopies are less suitable for this species.

Barred owls were first identified at two sites in the province in 1991. Current competition from barred owls is probably a low threat, but is potentially detrimental, especially for this sparse and high-risk spotted owl population.

Vulnerability to Natural Disturbances. Fire is the most likely natural disturbance in the California Cascades province and is considered a low threat. Fire may not be as great a problem as in the California Klamath province, because there are areas of naturally poor soils and sparser vegetation that do not carry a fire as well. However, fire probably affected the composition and structure of the historic forests. Fire suppression during the last 70 to 100 years probably has increased vulnerability of the forests to wildfires. Wind damage is a minor problem, but drought and insect/disease problems are of greater concern.

Biological goals and implementation on federal lands.

Federal lands constitute less than half of the landbase in the province, and 22 DCAs are recommended here (Tables 3.25 and 3.26). Because the owl population in the province is small and dispersed, none of the DCAs will likely contain 20 or more pairs of owls (i.e., none is a category 1 DCA). Only 1 of the DCAs will likely provide for more than 10 pairs. The DCAs contain 40 owl activity centers (28 pairs and 12 territorial singles) and 72 percent of the nesting, roosting, and foraging habitat known on federal lands in the province (Figures 3.38 and 3.39).

The remainder of the federal lands in this province should be managed for dispersal habitat and under matrix prescription B, with the pair areas managed, rather than reserved (see section III.C.2.). The federal landscape should meet the 50-11-40 rule and managed pair areas will be established for all known and future-discovered owl activity centers. At this time two managed pair areas are recommended west of DCA CD-71. The locations and boundaries for these managed pair areas are in the recovery plan's administrative record and will be provided to the national forests involved.

Table 3.25. Summary of acreage and owl numbers for designated conservation areas (DCAs) in the California Cascades province. (More detailed information, including owl numbers on nonfederal lands, is in Appendix I, Table I.11.)

	Acreage			Owl Numbers					
				Known Owls[3]					
				Federal		Nonfederal			
DCA Ident. Number	Total	Percent Federal Lands[1]	NRF Habitat Federal[2]	Pairs	Singles	Pairs	Singles	Current Projected Federal[4]	Future Projected Federal[5]
CD-62	44,100	84	5,300	7	0	0	0	7	9
CD-63	2,500	75	–	1	0	0	0	1	1
CD-64	14,200	95	2,100	0	1	0	0	1	2
CD-65	2,100	98	1,000	0	0	0	0	0	1
CD-66	5,700	99	200	1	0	0	0	1	2
CD-67	1,900	100	700	0	1	0	0	1	1
CD-68	3,700	99	900	0	0	0	0	0	0
CD-69	2,500	94	1,300	0	1	0	0	1	1
CD-70	3,000	97	400	0	1	0	0	1	1
CD-71	2,700	99	100	0	0	0	0	1	1
CD-72	1,300	88	200	0	1	0	0	1	1
CD-73	1,500	100	700	1	0	0	0	1	1
CD-74	2,400	91	700	1	0	0	0	1	1
CD-75	3,600	87	1,200	1	0	0	0	1	1
CD-76	2,700	97	2,400	1	0	0	0	1	1
CD-77	14,500	94	1,100	2	1	0	0	3	4
CD-78	1,100	100	200	1	0	0	0	1	1
CD-79	13,900	85	4,100	2	0	0	0	3	4
CD-80	10,000	96	2,300	1	0	0	0	1	3
CD-81	78,900	86	23,800	8	4	0	0	12	15
CD-82	33,800	63	3,900	1	1	0	0	3	5
CD-83	1,700	97	300	0	1	0	0	1	1
Total:	**247,800**	**85**	**52,900**	**28**	**12**	**0**	**0**	**43**	**57**

[1]Management of nonfederal lands within the perimeter of DCAs is discussed in the province narrative.
[2]NRF = nesting, roosting, and foraging habitat for spotted owls. Habitat information was not available for nonfederal lands.
[3]Numbers of spotted owl activity centers verified in a 5-year period; generally 1987 through 1991.
[4]Estimate of the number of pairs of owls that the DCA would be expected to support on federal lands if the population stabilized with current habitat conditions. See Appendix I for further details.
[5]Estimate of the number of pairs of owls that the DCA might support in the future on federal lands if habitat were recovered. See Appendix I for further details.
– = unknown.

Table 3.26. Summary comments on the designated conservation area (DCA) network in the California Cascades province. (Section III.C.1. and Appendix I provide further information about the criteria and process used to delineate these areas.)

Category 2 DCAs	Comments
CD-62 through CD-83	No opportunities exist to support category 1 DCAs. DCAs are delineated where owls are currently known, where future habitat opportunities occur, and where the only demographic support for this local population is possible. Suitable habitat is not uniformly distributed throughout this region because of moisture and soil conditions. These DCAs provide connectivity to DCAs to the west and provide the link between the ranges of the northern spotted owl and the California spotted owl in the Sierra Nevada.

Biological goals on nonfederal lands.

Goals for nonfederal lands in the province are to provide substantial demographic support to DCAs, maintain owl distribution, maintain the link between northern spotted owls and California spotted owls, and maintain all known and future-discovered owl activity centers on nonfederal lands.

Unless owls on state and private lands are managed to complement the owl population on federal lands, the benefits of conservation efforts on federal lands will be limited and the link between the two spotted owl subspecies will probably be lost over time.

Implementation options on nonfederal lands.

Because of the particular threats to the northern spotted owl in the California Cascades province, relatively few options are available for achieving province recovery goals. Although several tools are available, conservation during the short term must focus on individual owl sites and supplemental pair areas to offset the low population levels and poor distribution of suitable habitat.

Achieving recovery goals in this province will be potentially difficult. Existing reserves and DCAs may not contain sufficient suitable habitat. Current uneven-aged management may be amenable to modification to provide suitable habitat, and there is the possibility of individual HCPs or no-take plans. The scarcity of owls may not make landscape-scale management attractive to landowners, especially if few owl sites are detected through no-take surveys. Forest practices rules do not provide for permanent protection of nest sites if they become unoccupied, and the rules would have to be amended. Habitat on state and private lands could be obtained by purchase or land exchange. There is some potential for land acquisition due to checkerboard ownership, but land acquisition probably would alter timber supply access among different owners. Land purchase is likely to be expensive, and landowners are likely to be concerned about removing land from private ownership, given the need for a timber base to supply existing mills.

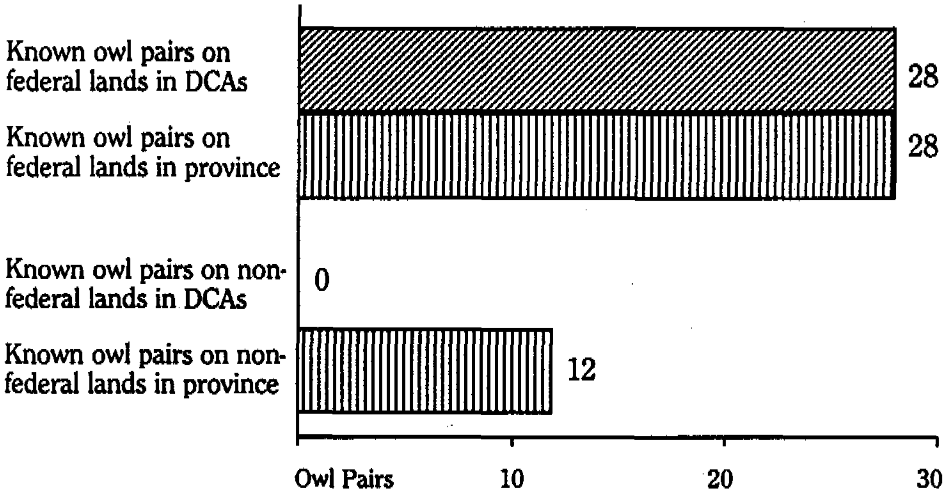


Figure 3.38. *Known owl pairs in the California Cascades province and in the DCAs (designated conservation areas) in the province.*

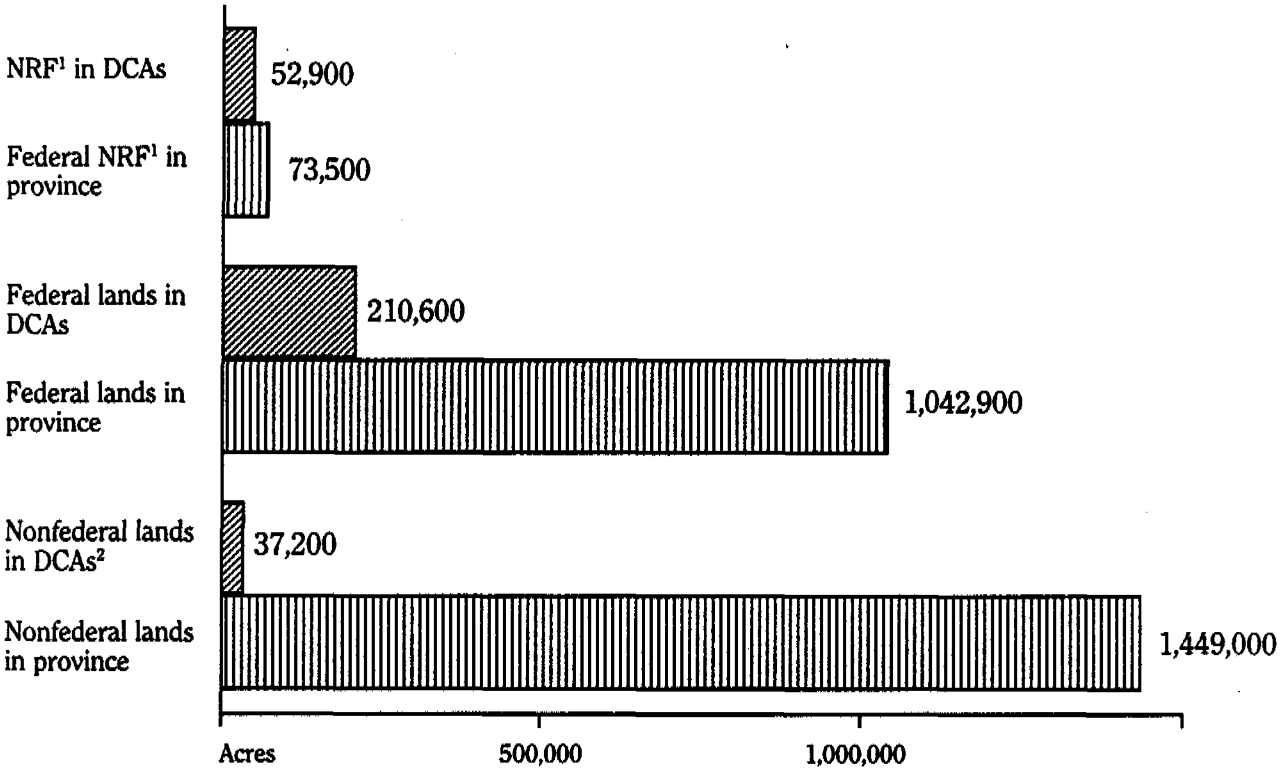


Figure 3.39. *Acres in the California Cascades province and in the DCAs (designated conservation areas) in the province.*

[1]NRF = nesting, roosting, and foraging habitat. This information is available only for federal lands.
[2]Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the province narrative.

Short-term deferral of harvest, until a long-term management strategy with low risk to the population can be drafted, might be accomplished through tax exemptions or habitat conservation easements, but the institutional mechanisms for accomplishing these have not been developed.

One option is presented for achieving province recovery goals. Other options may be appropriate if they achieve equivalent or better protection for the owl. All options must be evaluated based on the likelihood that they will achieve province recovery goals when fully implemented.

Option 1: Manage existing owl sites to establish population centers

This option would include all currently known owl sites on nonfederal lands, and any new sites found in the next few years of intensive surveys, as supplemental pair areas. This would increase the demographic stability of the province during the short term. Existing suitable habitat would be retained in the short term, even if a site became unoccupied. Attempts should be made to combine sites on federal, state, and private lands into clusters of mutually supporting owl pairs. Future evaluation would have to be made to determine if larger population centers could be designated and maintained in a pattern that would provide a lower risk of future local extinction. Combining with other sites may not be feasible for some areas that will remain as reserved pair areas due to their distance from other sites. Areas within population centers that do not have owls should be evaluated for their potential habitat suitability. If these areas can support owl habitat, measures (i.e., prescriptions for certain habitat quality and quantity, time schedule for growth, stand management requirements, and potential management options) should be drafted to guide creation of owl habitat. Dispersal habitat should be maintained throughout the province.

Management of these owl population centers will be a mixture of practices because of the mix of ownerships. All sites on state and private lands need to be managed in a conservative manner to provide support for DCAs and individual owl pairs occurring outside of the DCAs. Tools for implementation include regulations that provide for the quality and quantity of owl habitat to be maintained.

This option provides limited flexibility to private landowners, but it does allow for some conservative management of existing suitable habitat. Extensive owl surveys will be necessary. Attempts to combine individual sites to form mutually supporting population centers will enhance recovery. This option provides little incentive for landowners to participate in landscape management or go beyond conformity with existing rules governing take.

Coordination. Forestlands ownership in this province is dominated by national forests and large industrial landowners. Only small amounts of other ownerships would be involved in maintaining local owl populations.

This option requires strong coordination among federal land management agencies and private landowners, and the state through its forest practices regulation mechanism. This process is ongoing and is being strengthened by the drafting of an HCP by the state. The HCP should assure that both suitable owl habitat and owls occur in the same general area on each side of the boundary between the two spotted owl subspecies.

III.

F. Summary of the Recovery Plan

The northern spotted owl recovery strategy is founded on a network of conservation areas intended to provide habitat for clusters of breeding pairs of spotted owls. Sections III.A. and III.C. provide detailed discussion of the design criteria for the strategy. Category 1 DCAs will provide for large clusters of owls consisting of 20 or more pairs. The ideal network would be composed entirely of category 1 DCAs. However, in many parts of the owl's range a network of category 1 DCAs is not possible due to land ownership patterns and natural conditions. In these cases, smaller areas, termed category 2 DCAs, are recommended.

Table 3.27 displays the number and category of DCAs recommended in each physiographic province. It shows that about one third of the DCAs meet the category 1 criteria, while the rest are category 2 DCAs. In some provinces, including the California Coast, California Cascades, and eastern Oregon Cascades, the network is composed almost entirely of category 2 DCAs. The province narratives in section III.E. provide a further discussion of the situations that lead to these recommendations which deviate from the ideal DCA network.

Table 3.27. Category 1 and category 2 designated conservation areas (DCAs) in each physiographic province.

State and Province	Category 1	Category 2	Total
California			
California Coast	2	26	28
California Klamath	14	19	33
California Cascades	0	22	22
Total	**16**	**67**	**83**
Oregon			
Oregon Klamath	6	4	10
Eastern Oregon Cascades	1	8	9
Western Oregon Cascades	17	5	22
Oregon Coast Range	3	14	17
Total	**27**	**31**	**58**
Washington			
Eastern Washington Cascades	3	17	20
Western Washington Cascades	6	18	24
Western Washington Lowlands	0	1	1
Olympic Peninsula	1	5	6
Total	**10**	**41**	**51**
Three-state Total	**53**	**139**	**192**

The overall effect of the federal DCA network is clarified in Table 3.28 which illustrates acreage of federal lands in different management categories in the DCAs. In these and other tables, "Reserved Acres" are federal lands in Congressionally designated wilderness, national parks, and research natural areas. All of this acreage is reserved from timber harvest regardless of spotted owl recovery recommendations. Wherever possible, these reserved lands were used to provide habitat for the DCA network, so there are more than 2 million acres of reserved lands in the DCAs. However, many reserved lands were not included in the DCA network because they are too high in elevation to provide suitable owl habitat.

In these and other tables "Timber Acres" are lands that the BLM and Forest Service have deemed suitable for timber harvest. More than 3.6 million acres that would be suitable for timber harvest are included in the DCAs. These are the lands that would be removed from the timber base in order to meet recovery recommendations for DCA management. Section III.C.1. describes the appropriate management of all DCA acreage, including the limited forest management on the "Timber Acres."

Another 1.8 million acres in the DCAs are outside of reserved lands, but not suitable for timber harvest due to unstable soils or other multiple-use constraints. In the tables, the acreage of these lands can be calculated by subtracting timber acres and reserved acres from the total acres.

Also presented in Table 3.28 and other tables is nesting, roosting, and foraging (NRF) habitat. This is the acreage of currently suitable spotted owl habitat in the DCA network. Because much of the owl's range has experienced timber harvest or natural loss of owl habitat (e.g., loss due to wildfire), it was not possible to lay out a DCA network made entirely of NRF habitat. Some DCA acreage outside of NRF habitat is naturally unsuitable. Other acres are potentially suitable habitat but have either been harvested or have been modified by events such as fires and windstorms. As the potentially suitable habitat in DCAs regrows, it is expected that a greater percentage of each DCA will become suitable habitat.

At this time, 46 percent of the federal lands in the DCAs is suitable habitat. The management guidelines in section III.C.1. are intended to achieve suitable habitat conditions on the remaining lands in DCAs. At the same time, the existing suitable habitat in the DCAs should be maintained.

The "Pairs" and "Singles" columns in Table 3.28 and other tables reflect owl activity centers located on federal lands in DCAs during a 5-year period, generally 1987 to 1991. In checkerboard DCAs owls may be located on the interspersed nonfederal lands, but these owl activity centers are not presented in this table. The province narratives (section III.E.) discuss the recommended management of owl activity centers on nonfederal lands in DCAs.

Table 3.29 contains the same information as Table 3.28 about total acres, timber acres, NRF acres, and owl locations on federal lands in DCAs. However, this table presents the information by federal agency in each state rather than by physiographic province.

Table 3.30 provides an overview of the known owl pairs and singles on federal lands and all lands, and the number of these owls located in the DCAs. Again, the numbers represent owls located during a 5-year period, generally 1987-1991.

The final three tables show the effects of designating reserved pair areas and managed pair areas. These areas are recommended to supplement weaknesses in the DCA network, and to serve as replacement habitat where the risks of catastrophic loss are high. The federal acreage in these areas, and the number of protected owl locations, are shown in Tables 3.31 and 3.32. Table 3.31 displays this information by federal agency in each state, while Table 3.32 provides the information by physiographic province and summarizes each state. Section III.C.2. describes the delineation and management of these areas, along with the time period they will be needed.

The greatest acreage of reserved pair areas is recommended for the Oregon Coast Range province (Table 3.32) where habitat is highly fragmented and owl populations are relatively low. Significant acreage of reserved pair areas is also recommended in the western Washington Cascades and California Klamath provinces.

The most significant recommendation for managed pair areas is in the eastern Washington Cascades province. This includes acres recommended under both prescription B (supplementing deficiencies in the DCAs) and prescription C (providing replacement habitat) (see section III.C.2.). The large acreage recommended for this province reflects both high risk of habitat loss, and the expectation that the prevalent mixed-conifer forest type can be managed to provide needed habitat conditions.

There are also significant recommendations for managed pair areas in the eastern Oregon Cascades and Oregon Klamath provinces. The recommendation for the eastern Oregon Cascades province reflects the severe risk of catastrophic habitat loss in the province. The recommendation for the Oregon Klamath province is made under prescription B and intended to supplement current deficiencies in the DCA network.

Throughout the range of the spotted owl, the recommendations for reserved pair areas and managed pair areas will protect more than 100 currently known owl pairs and approximately 20 single owls on federal lands.

Finally, summary data for the full initial recovery strategy, including DCAs and the reserved pair and managed pair areas, are shown in Table 3.33. Approximately 8 million federal acres are included in these recommendations, protecting more than 1,550 known pairs and 350 single owls on federal lands. This represents 55 percent of the pairs and 46 percent of the single owls known on federal lands. The 8 million acres includes about 2.1 million acres that are designated as Congressionally reserved from timber harvest. It also includes approximately 3.8million acres that the federal agencies had previously determined were suitable for timber production.

Table 3.28. Estimated federal acres and owl locations for category 1 and category 2 designated conservation areas (DCAs) under the recovery plan strategy, displayed by state and physiographic province.

State and Province	Total Acres	Reserved[1] Acres	Timber[2] Acres	NRF[3] Habitat	Percent[4] Habitat	Pairs[5]	Singles[5]
CALIFORNIA							
California Coast	218,400	106,000	105,500	14,200	6	21	14
California Klamath	1,334,000	385,400	714,600	481,000	36	244	91
California Cascades	210,600	200	163,200	52,900	25	28	12
Total	**1,763,000**	**491,600**	**983,300**	**548,100**	**31**	**293**	**117**
OREGON							
Oregon Klamath	596,600	122,900	367,300	277,400	47	125	17
Eastern Oregon Cascades	228,100	70,000	110,300	112,700	49	61	13
Western Oregon Cascades	1,414,400	292,200	742,100	812,700	57	411	115
Oregon Coast Range	597,300	21,900	505,500	254,600	43	133	33
Total	**2,836,400**	**507,000**	**1,725,200**	**1,457,400**	**51**	**730**	**178**
WASHINGTON							
Eastern Washington Cascades	777,900	209,000	266,200	365,800	47	111	3
Western Washington Cascades	1,335,900	399,000	480,600	769,000	58	186	23
Western Washington Lowlands	65,900	0	*	0	0	0	0
Olympic Peninsula	862,900	510,600	200,400	377,300	44	125	18
Total	**3,042,600**	**1,118,600**	**947,200**	**1,512,100**	**50**	**422**	**44**
Three-state Total	**7,642,000**	**2,117,200**	**3,655,700**	**3,517,500**	**46**	**1,445**	**339**

[1]Federal lands in Congressionally designated wilderness, national parks, and research natural areas.
[2]Lands that the U.S. Bureau of Land Management and U.S. Forest Service have deemed suitable for timber harvest.
[3]Nesting, roosting, foraging.
[4]Percentage of total acres composed of NRF habitat by province.
[5]Number of owls located during a 5-year period, generally 1987-1991. See Table 2.3 for further details.
* = information not determined.

Table 3.29. Estimated federal acres and owl locations for category 1 and category 2 designated conservation areas (DCAs) under the recovery plan strategy, by state and federal agency.

State and Agency	Total Acres	Reserved[1] Acres	Timber[2] Acres	NRF[3] Habitat	Percent[4] Habitat	Pairs[5]	Singles[5]
CALIFORNIA							
U.S. Forest Service	1,534,400	382,000	864,300	528,600	34	272	102
National Park Service	105,600	105,600	0	*	*	2	5
U.S. Bureau of Land Management	123,000	4,000	119,000	19,500	16	19	10
Total	**1,763,000**	**491,600**	**983,300**	**548,100**	**31**	**293**	**117**
OREGON							
U.S. Forest Service	2,113,700	491,300	1,018,500	1,148,600	54	473	162
National Park Service	900	900	0	500	56	1	*
U.S. Bureau of Land Management	721,800	14,800	706,700	308,300	43	256	16
Total	**2,836,400**	**507,000**	**1,725,200**	**1,457,400**	**51**	**730**	**178**
WASHINGTON							
U.S. Forest Service	2,368,500	510,400	947,200	1,287,000	54	370	35
National Park Service	608,200	608,200	0	225,100	37	52	9
Other Federal	65,900	0	*	0	0	0	0
Total	**3,042,600**	**1,118,600**	**947,200**	**1,512,100**	**50**	**422**	**44**
THREE-STATE TOTAL							
U.S. Forest Service	6,016,500	1,383,900	2,830,000	2,964,200	49	1,114	299
National Park Service	714,500	714,500	0	225,600	32	55	14
U.S. Bureau of Land Management	844,000	19,100	825,700	327,800	37	275	26
Other Federal	65,900	0	*	0	0	0	0
Total	**7,642,000**	**2,117,200**	**3,655,700**	**3,517,600**	**46**	**1,445**	**339**

[1]Federal lands in Congressionally designated wilderness, national parks, and research natural areas.
[2]Lands that the U.S. Bureau of Land Management and U.S. Forest Service have deemed suitable for timber harvest.
[3]Nesting, roosting, foraging.
[4]Percentage of total acres composed of NRF habitat by agency.
[5]Number of owls located during a 5-year period, generally 1987-1991. See Table 2.3 for further details.
* = information not determined.

Table 3.30. Numbers of known spotted owl pairs and singles by state and physiographic province[1].

State and Province	Known Owls in the Province/State		Known Owls on Federal Lands		Known Owls in DCAs on all Lands		Owls Protected in DCAs on Federal Lands	
	Pairs	Singles	Pairs	Singles	Pairs	Singles	Pairs	Singles
CALIFORNIA								
California Coast	361	95	23	16	24	22	21	14
California Klamath	559	242	444	203	248	94	244	91
California Cascades	40	23	28	15	28	12	28	12
Total	**960**	**360**	**495**	**234**	**300**	**128**	**293**	**117**
OREGON								
Oregon Klamath	402	74	369	69	137	17	125	17
Eastern Oregon Cascades	181	39	141	38	61	13	61	13
Western Oregon Cascades	1,081	308	1,031	295	416	116	411	115
Oregon Coast Range	303	77	238	60	137	35	133	33
Willamette Valley	4	0	1	0	0	0	0	0
Total	**1,971**	**498**	**1,780**	**462**	**751**	**181**	**730**	**178**
WASHINGTON								
Eastern Washington Cascades	218	12	153	8	121	3	111	3
Western Washington Cascades	290	45	263	40	189	24	186	23
Western Washington Lowlands	6	4	0	0	0	0	0	0
Olympic Peninsula	157	40	134	26	128	19	125	18
Total	**671**	**101**	**550**	**74**	**438**	**46**	**422**	**44**
Three-state Total	**3,602**	**957**	**2,825**	**770**	**1,489**	**355**	**1,445**	**339**

[1] Number of owls located during a 5-year period, generally 1987-1991. See Table 2.3 for further details.
DCAs = Designated conservation areas.

Table 3.31 Estimated federal acres and owl locations for reserved pair areas and managed pair areas under the recovery plan strategy (displayed by state and federal agency).

State and Agency	Reserve Pair Areas Total Acres	Pairs[1]	Singles[1]	Managed Pair Areas Total Acres	Pairs[1]	Singles[1]
CALIFORNIA						
U.S. Forest Service	30,100	7	4	4,900	0	0
OREGON						
U.S. Forest Service	36,500	16	4	28,000	5	1
U.S. Bureau of Land Management	65,300	36	1	23,000	11	1
Total	**101,800**	**52**	**5**	**51,000**	**16**	**2**
WASHINGTON						
U.S. Forest Service	83,400	16	5	101,200	20	1
THREE-STATE TOTAL						
U.S. Forest Service	150,000	39	13	134,100	25	2
U.S. Bureau of Land Management	65,300	36	1	23,000	11	1
Total	**215,300**	**75**	**14**	**157,100**	**36**	**3**

[1]Number of owls located during a 5-year period, generally 1987-1991. See Table 2.3 for further details.

Table 3.32. Estimated federal acres and owl locations for reserved pair areas and managed pair areas under the recovery plan strategy (displayed by state and physiographic province where applicable).

State and Province	Reserve Pair Areas: Total Acres	Reserve Pair Areas: Pairs[1]	Reserve Pair Areas: Singles[1]	Managed Pair Areas: Total Acres	Managed Pair Areas: Pairs[1]	Managed Pair Areas: Singles[1]
CALIFORNIA						
California Coast	3,400	1	1	0	0	0
California Klamath	26,700	6	3	0	0	0
California Cascades	0	0	0	4,900	0	0
Total	**30,100**	**7**	**4**	**4,900**	**0**	**0**
OREGON						
Oregon Klamath	5,500	2	0	23,000	11	1
Eastern Oregon Cascades	0	0	0	28,000	5	1
Oregon Coast Range	96,300	50	5	0	0	0
Total	**101,800**	**52**	**5**	**51,000**	**16**	**2**
WASHINGTON						
Eastern Washington Cascades	11,000	4	0	101,200	20	1
Western Washington Cascades	72,400	12	5	0	0	0
Total	**83,400**	**16**	**5**	**101,200**	**20**	**1**
Three-state Total	**215,300**	**75**	**14**	**157,100**	**36**	**3**

[1]Number of owl located during a 5-year period, generally 1987-1991. See Table 2.3 for further details.

Table 3.33. Estimated federal acres and owl locations for category 1 and category 2 designated conservation areas (DCAs) and reserved pair areas and managed pair areas under the recovery plan strategy (displayed by state and federal agency).

State and Agency	Total Acres	Reserved[1] Acres	Timber[2] Acres	NRF[3] Habitat	Percent[4] Habitat	Pairs[5]	Singles[5]
CALIFORNIA							
U.S. Forest Service	1,569,400	388,200	885,400	534,600	34	279	106
National Park Service	105,600	105,600	0	*	*	2	5
U.S. Bureau of Land Management	123,000	4,000	119,000	19,500	16	19	10
Total	**1,798,000**	**497,800**	**1,004,400**	**554,100**	**31**	**300**	**121**
OREGON							
U.S. Forest Service	2,178,200	497,900	1,062,400	1,191,900	55	494	167
National Park Service	900	900	0	500	56	1	*
U.S. Bureau of Land Management	810,100	14,800	789,600	326,500	40	303	18
Total	**2,989,200**	**513,600**	**1,852,000**	**1,518,900**	**51**	**798**	**185**
WASHINGTON							
U.S. Forest Service	2,553,100	520,300	1,034,300	1,350,700	53	406	41
National Park Service	608,200	608,200	0	225,100	37	52	9
Other Federal	65,900	0	*	*	*	*	*
Total	**3,227,200**	**1,118,500**	**1,034,300**	**1,575,800**	**49**	**458**	**50**
THREE-STATE TOTAL							
U.S. Forest Service	6,302,500	1,406,400	2,982,100	3,077,200	49	1,179	314
National Park Service	714,500	714,700	0	225,600	32	55	14
U.S. Bureau of Land Management	933,100	18,800	908,600	346,000	37	322	28
Other Federal	65,900	0	0	0	0	*	*
Total	**8,014,400**	**2,139,900**	**3,890,700**	**3,648,800**	**46**	**1,556**	**356**

[1]Federal lands in Congressionally designated wilderness, national parks, and research natural areas.
[2]Lands that the U.S. Bureau of Land Management and U.S. Forest Service have deemed suitable for timber harvest.
[3]Nesting, roosting, foraging.
[4]Percentage of total acres composed of NRF habitat by agency.
[5]Number of owls located during a 5-year period, generally 1987-1991. See Table 2.3 for further details.
* =information not determined.

III.

G. Discussion of Risk Associated with the Recovery Plan

1. Qualitative Versus Quantitative Risk Assessment

The purpose of this section is to evaluate the potential effectiveness of the northern spotted owl recovery plan in meeting the goal to delist the owl throughout its geographic range. To meet this goal, spotted owls and their habitat must be well-distributed throughout their range, and their populations must be self-sustaining through time. The recovery plan accepts some risk in trying to meet this goal because it allows substantial loss of habitat with a concomitant loss of owls that depend on that habitat. The primary risk to the northern spotted owl resulting from implementation of the recovery plan depends on the response of owl populations to the loss of habitat and owls during the next 50 years. It is also related to the degree and speed of compliance with the recovery plan by land managers. The potential risks foreseen under this recovery plan are primarily to local owl populations rather than to the rangewide population. This section discusses the potential risks faced by the owl, the uncertainty of scientific knowledge concerning owl responses to changing conditions, and the features of the recovery plan that are designed to lessen each risk factor.

Several risk assessments of proposed management plans have been completed for the spotted owl (USDA 1988, Thomas et al. 1990, USDA 1992, USDI 1992b-g, Johnson et al. 1991). All of these were qualitative assessments with the exception of USDA (1988). The use of qualitative risk assessments is appropriate because there is a lack of empirical knowledge necessary for a quantitative risk assessment, including comprehensive data about owl responses to a variety of environmental conditions. To develop a meaningful quantitative risk assessment the following information is necessary: 1) owl response to variation in habitat (including home range size, movement patterns, and demographic responses); 2) variation, between individuals and through time, in survival and reproductive rates; 3) the interaction between territorial adult owls and nonterritorial owls; 4) dispersal behavior and habitat use/response by juvenile owls; and 5) dispersal behavior of adult owls displaced by logging. Although there is extensive information about habitat-use patterns, movements, home range size, food habits, and demography, much is still unknown. Owl biologists do not thoroughly understand the effects of habitat fragmentation, amount, and quality on the demography of owls. To develop a predictive model of owl response to changing habitat conditions, these kinds of information are necessary.

Although the need for risk assessment in conservation planning is discussed extensively in the literature (e.g., den Boer 1968, Shaffer 1981, Ginzburg et al. 1982, Shaffer 1990), few quantitative risk assessments have been attempted for animals or plants (Shaffer 1981, USDI 1985, Marcot and Holthausen 1987, Ginzburg et al. 1990, Menges 1990, Murphy et al. 1990).

Lacking this information, a qualitative assessment of risks to the owl and the associated features of the recovery plan that address these risks is the only appropriate approach at this time. This qualitative assessment may be aided by a variety of quantitative analyses and modeling efforts which are useful for analyzing hypotheses about owl population dynamics. However, the final recommendations for owl conservation must depend on professional judgments (such as qualitative assessments) because the Recovery Team cannot make definitive, quantitative predictions of owl responses to future conditions for which there are no empirical observations. All of the information needed for a thorough quantitative assessment will become available during the next 5 to 20 years.

In the following sections, specific risks are presented with a discussion of each risk factor; its possible interaction with associated risks; the state of knowledge in the area; and the recovery plan response to the risk.

2. Assessment of Specific Risks

Habitat

Systematic habitat loss.

The single greatest threat to spotted owls is the continuing loss of old forest from logging into the foreseeable future. Logging has been extensive and rapid. A lesser rate of logging will continue on federal lands under the recovery plan, but logging still poses the greatest risk to owls of all the activities foreseen under the recovery plan.

- ***Associated Risk***: In addition to the overall reduction in habitat amount, systematic habitat loss also results in habitat gaps and habitat fragmentation. These risks are discussed later in this section.

- ***State of Knowledge***: It is known from scientific studies that logging, particularly clear-cutting, can displace spotted owls (Forsman et al. 1977, 1984). The threshold of cutting tolerance (i.e., what proportion of habitat can be removed before owls abandon the site) is unknown, but owls are more abundant in areas with more than 60 percent suitable habitat than in areas with less than 20 percent old forest (Bart and Forsman 1992).

- ***Recovery Plan Response***: Suitable habitat will continue to decline in the matrix between DCAs, particularly if clear-cutting is the dominant logging method. Under preferred plans by the Forest Service and the BLM, approximately (assuming a constant harvest rate) 7.5 percent of the unprotected old forest will be logged in the next 10 years. However, loss of suitable habitat in DCAs from logging will be arrested and regrowth of suitable habitat should occur, increasing the habitat quality for spotted owls in DCAs. In total, 7.6 million acres will be protected for spotted owl habitat in DCAs. Management of DCAs will proceed consistent with the recommended DCA management plans and will be subject to review by a coordinating group. While a continued decline in owl numbers is predicted during the next 50 years, the habitat quality in DCAs is expected to continually improve. Silvicultural treatment of currently unsuitable habitat may accelerate that improvement. Dispersal habitat will be maintained in the matrix between the DCAs. Short-term support in the form of take avoidance, managed pair areas, and reserved pair areas will help slow the decline of suitable habitat. Finally, it is expected that some owls displaced by logging in the matrix will become floaters and buffer the territorial owl populations in DCAs from sharp declines for up to 40 years.

Habitat fragmentation.

Habitat fragmentation is the disruption of the contiguous, closed-canopy forest into a patchwork of smaller, disjunct areas of closed-canopy forest mixed with younger-aged vegetation. Habitat fragmentation may have detrimental effects on dispersing juvenile owls.

- ***Associated Risks***: Habitat fragmentation could lead to increased colonization rates by barred owls with potential deleterious effects on owls. Fragmentation also favors great horned owls and increases the potential for predation (Johnson 1993). Increased fragmentation may lead to increased energetic costs for owls because they must move farther between patches of suitable habitat to forage. Finally, increased fragmentation may result in disruption of normal social behavior of owls.

- ***State of Knowledge***: Spotted owls tend to have larger home ranges in highly fragmented areas, which undoubtedly increases their energetic costs and exposes them to predation when moving between patches of suitable habitat. Carey et al. (1992) presented evidence that the social structure of owl populations was abnormal in highly fragmented areas. Spotted owl density was also lower in highly fragmented areas, while great horned owl density was higher.

- ***Recovery Plan Response***: Habitat fragmentation that has resulted from logging will decrease in DCAs as young forests mature. However, habitat fragmentation will generally increase in the matrix. In general, conditions for spotted owls will improve in DCAs and will decline in the matrix. However, because of the relatively slow rate of suitable habitat loss (see previous discussion), there will be opportunities to strengthen habitat protection for owls for the next 10 to 20 years if monitoring and research show that such changes are necessary. The response of dispersing owls to the changing matrix will be ameliorated to some degree by the dispersal habitat prescription (i.e., 50-11-40 rule). Also, establishment of reserved pair and managed pair areas will slow the habitat fragmentation in parts of the owl's range where habitat on federal lands is already highly fragmented and owl numbers are currently low.

Habitat gaps.

Habitat gaps are areas devoid of suitable habitat or areas where suitable habitat is so fragmented that it is generally unsuitable for owls.

- ***Associated Risks***: Large gaps in habitat distribution may act as barriers to dispersal. Owl populations could be isolated and, consequently, incur higher risk of extirpation due to random environmental or demographic events. Gaps can affect local populations as well as provincial populations.

- ***State of Knowledge***: Gaps currently exist in the following provinces: western Washington lowlands, the northwestern part of the Oregon Coast Range, California Cascades, eastern Oregon Cascades, and the northern parts of the eastern Washington Cascades and western Washington Cascades. Owl density and owl numbers are lower in these areas than in areas of more contiguous habitat.

- ***Recovery Plan Response***: In some areas, gaps can be resolved over time by the restoration of suitable habitat conditions on federal lands. In these areas, the recovery plan designates DCAs, and those DCAs will be managed through time to improve habitat conditions. In some of these areas, DCAs will be further supported by establishing reserved pair and managed pair areas. In other areas, gaps can only be resolved through actions on nonfederal lands. The Endangered Species Act provides limited opportunities to restore habitat in the owl's historical range on these lands, so certain provinces may remain at high risk. However, the recovery plan recommends several approaches for nonfederal landowners to manage their lands to alleviate this risk, including development of habitat conservation plans (HCPs). If adequate incentives exist, commitments in HCPs may help reduce large gaps in habitat, through time, in some areas.

Population Dynamics

Population dynamics are the measurements of the vital rates of the population and the changes in a population's characteristics. Population dynamics are influenced by a variety of internal and external events.

Demographic variation.

All wildlife populations fluctuate as a result of changes in birth and death rates of individuals. Birth and death rates vary over time in response to changing environmental conditions (e.g., high and low food years, weather patterns), intrinsic factors (e.g., physiological limitations in egg production), and age structure of the population (i.e., if there are differences in birth and death rates of the different age classes).

- ***Associated Risk***: The way that a species responds to changing environmental conditions influences the risk associated with demographic variation. For example, if a species only responds favorably to a narrow range of environmental conditions, it is at higher risk of extinction than a species that responds favorably to a wider range of environmental conditions. The size of the population also influences the risk associated with demographic variation; small populations are less likely to survive periods of low birth and survival rates than are large populations. Thus, reductions in habitat that lead to reduced population size also increase risks due to demographic variation.

- ***State of Knowledge***: Spotted owl populations exhibit substantial variation in annual reproduction (Forsman et al. 1984, Gutiérrez et al. 1985, see Appendix C). The causal mechanisms for these fluctuations are unknown but may be related to fluctuations in prey populations and/or inclement weather at critical times of the year. It appears that adult annual survival rates are much less variable than reproductive rates, but juvenile survival rates may be more variable than previously thought (Forsman pers. comm.). It is unknown if senescence is a factor in demographic variation in spotted owl populations: only long-term studies will determine the degree that it occurs. There is a declining trend in adult female survival rates in most spotted owl populations studied which indicates that the populations may be declining rapidly (see Appendix C).

Many small populations of other species have been extirpated simply because they were too small to withstand a long period of unfavorable conditions (e.g., Terborgh and Winter 1980). The only known example of an extirpation event in spotted owl populations involved a local population of Mexican spotted owls in the Haulapai Mountains of Arizona (Ganey and Balda 1989). However, even in that case it is not absolutely certain that the local population was extirpated.

·· ***Recovery Plan Response***: The accelerating rate of decline in adult female spotted owl survival rates reported in the draft recovery plan caused serious concern. Therefore, the Recovery Team convened a meeting of the primary biologists working with the northern spotted owl to discuss the estimation of survival rates and the trend in the population (see Appendix K.). It was agreed that the analysis conducted by Anderson and Burnham (see Appendix C) represented "state of the art" methodology. However, empirical (direct observation) information about declining trends in the owl population suggests a lower rate of decline than that indicated by the mathematical analysis of the vital rates. This difference may be due to biases in the estimation of survival rates (see Appendix C). Owl researchers agreed that the true rate of decline probably falls between the rate indicated by demographic analysis and the rate indicated by other empirical observations. The Recovery Team recommends that monitoring procedures be instituted that allow estimation of trends in both the total and territorial owl populations.

Since the factors regulating owl population dynamics are unknown the likely duration of periods of unfavorable demographic conditions cannot be predicted. Thus, there cannot be a precise estimate of the population size needed to withstand a long period of unfavorable conditions. Current knowledge of variations in birth and death rates has been used in modeling which indicates that subpopulations of 20 pairs in DCAs with stable habitat conditions should be adequate to survive periods of low productivity for 50 to 100 years (Thomas et al. 1990). In addition, most provinces dominated by federal lands have at least one DCA in which the number of potential owl pairs is 30 or more, providing greater probability of survival during longer periods of unfavorable demographic rates.

Some subpopulations in DCAs that contain fewer than 20 owl pairs could potentially be extirpated. The extensive DCA network and redundancy in each province will mitigate these chance demographic extinctions. In addition, local populations of an individual species may respond differently to environmental change in different parts of their range. For example, drought is deleterious to California quail populations in southern California, but it is favorable to quail in northern California (Leopold 1977). Thus, it is unlikely that a period of unfavorable conditions will simultaneously affect the entire northern spotted owl population in DCAs throughout its range. In addition, the maintenance of dispersal habitat in the matrix should facilitate the recolonization of any DCAs that have experienced extinction events.

Decline in population size (Allee effect).

A population threshold may exist in populations below which they may not recover regardless of protection. This phenomenon has been detected in mathematical models and is referred to as the "Allee Effect."

• ***Associated Risk***: The risk of the Allee Effect occurring is highest in the matrix where it would operate in conjunction with risk due to continuing habitat loss and in areas where the current owl population is low.

• ***State of Knowledge***: Some populations of wild species have become extinct even though they and their habitat were fully protected (Terborgh and Winter 1980). It is believed that the density of individuals became so low that they had difficulty finding suitable mates.

• ***Recovery Plan Response***: The structure of the DCA network increases the potential for owls finding suitable mates because the network encourages the development and protection of contiguous blocks of habitat. The maintenance of dispersal habitat also is intended to facilitate the movement of owls throughout the landscape. The inclusion of reserved pair areas where the current owl population is low should also lower the risk due to the Allee Effect.

Low success of juvenile dispersal.

Juvenile dispersal is the movement of a first-year owl from its natal area to its settling territory. Juvenile dispersal is critical to population (e.g., recolonization) and evolutionary processes (e.g., exchange of genes).

• ***Associated Risk***: If juveniles are unable to successfully disperse through the matrix, then the entire population is at great risk because recolonization will not occur and inbreeding and/or genetic drift will occur.

• ***State of Knowledge***: Juvenile spotted owls probably initiate their dispersal by leaving their natal areas in a random direction (Gutiérrez et al. 1985, Gutiérrez pers. observ.). Once they leave, they can move rapidly. Some juveniles move long distances, but successful dispersers appear to move shorter distances (Gutiérrez et al. In Prep.). Juveniles incur much higher mortality than do territorial adults. Many juveniles also move through unfavorable habitats (e.g., oak woodlands) in their search for places to live. However, juvenile dispersal ecology is not fully understood, and significant new research is needed in this area.

• ***Recovery Plan Response***: The recovery plan requirement for dispersal habitat is intended to facilitate the movement of juveniles through the matrix as well as to facilitate juvenile survival during dispersal. The requirement for habitat that meets the 50-11-40 rule was developed primarily from studies of habitat use by adult owls. However, juvenile spotted owls have been observed (using radio-telemetry) to move through habitats that would fall in the 50-11-40 rule (Miller 1989). The spacing criteria for DCAs was developed on the basis of known juvenile spotted owl dispersal distances. The presence of reserved pair areas and managed pair areas also should improve the probability of dispersal.

Loss of genetic variation.

When populations become isolated or small, a smaller proportion of the genetic material is maintained in the population (see Frankel and Soulé 1981 for a discussion of the consequences of loss of genetic variation). This results in risks of inbreeding depression and genetic drift. Inbreeding is the mating of closely related individuals and results in increased probability that deleterious recessive genes will be expressed in the population. Inbreeding depression occurs when these recessive genes lead to lower survival or fecundity. Genetic drift occurs when a small subset of genes becomes fixed in a population as a result of a population bottleneck (when a population declines so low that only a few individuals survive) or a founder event (when a few individuals colonize an area). Genetic drift may have the same results as inbreeding or it may simply result in a population with a depauperate gene pool which lowers the ability of the species to adapt to changing environmental conditions.

• ***Associated Risks***: Threats that result from losses in genetic variation are likely to interact with threats resulting from low population size and demographic variation. For example, lowered survival or fecundity resulting from inbreeding depression would probably increase the threat of population crash due to demographic variation.

• ***State of Knowledge***: Inbreeding and genetic drift have been documented in wild and experimental populations. Current research on spotted owls suggests that they have lower genetic variation than other bird species (Barrowclough and Gutiérrez 1990). However, the cause of this lower variation is not believed to be the result of recent events such as loss of habitat.

• ***Recovery Plan Response***: The degree of genetic risk will be influenced by the same features of the recovery plan that affect demographic risk. It is generally agreed that the major problems facing spotted owls are short-term habitat loss and population performance and not loss of genetic variation (e.g., Barrowclough and Coats 1985). It takes many generations of isolation to result in substantial loss of genetic variation in a small population, but it only takes a few immigrants per generation to maintain genetic variation. Owl subpopulations are expected to receive dispersing juveniles on a regular (probably annual) basis because of DCA spacing criteria and the maintenance of dispersal habitat in the matrix.

Environmental Factors

Environmental factors include all the external conditions which can reasonably be expected to occur in the range of the owl over time. Although habitat is part of the owls' environment, it was treated separately earlier in this section because it is the primary factor affecting the distribution and abundance of owls that can be influenced by the recovery plan.

Variation in environmental conditions.

In all natural environments conditions change through time (e.g., drought, inclement weather). For spotted owls, some changes may be favorable and others may be unfavorable. The greater the ability of owls to cope with changing conditions, the greater the chance that the species will persist. For example, wet and dry climatic periods are characteristic of Pacific Northwest forests. If the owls incur lower survival or reproduction under one condition or the other, then the owl population must have the ability to survive the temporary decline in survival or reproduction that occurs under that condition.

• ***Associated Risks***: The risks associated with changing environmental conditions are increased if: a) the distribution of owls is limited such that all segments of the population will simultaneously be negatively affected by unfavorable environmental conditions, b) the number of owls in an area is so low that their decline during unfavorable times does not allow the population to persist through a natural cycle of unfavorable conditions, or c) poor habitat conditions result in a more extreme decline in population during a period of unfavorable environmental conditions.

• ***State of Knowledge***: Spotted owls exhibit variable reproduction (i.e., there are years of high, moderate, and low reproduction) (Forsman et al. 1984, Gutiérrez 1985). Causes of this variable reproduction are unknown but may be related to variation in prey dynamics and/or environmental conditions such as inclement weather during the winter or nesting season. Survival rates of adults do not appear to be as variable as reproductive rates.

• ***Recovery Plan Response***: Delineating DCAs in all of the physiographic provinces and in the full range of environmental conditions decreases the risk that all areas containing owls will simultaneously experience unfavorable environmental conditions (den Boer 1968, Pickett and Thompson 1978, Wilcox 1980). Category 1 DCAs are designed to support at least 20 pairs of owls which should allow a small subpopulation to persist through periods of unfavorable conditions (Thomas et al. 1990). Some larger DCAs, which may support 30 or more pairs, add an increment of stability to the provincial population if unfavorable environmental conditions persist for longer periods. The addition of reserved pair areas in the matrix also supports local populations in DCAs that currently do not maintain the expected number of owl pairs.

Two lines of evidence support delineating DCAs to maintain at least 20 pairs of owls. The first line of evidence is theoretical. Thomas et al. (1990) demonstrated through modeling that demographic stability of subpopulations through time was strongly influenced by the number of pairs in the population when there is variation in birth and death rates. The minimum number of pairs that conferred persistence on a subpopulation over the short term (i.e., 50 to 100 years) was approximately 20. The probability of persistence increased with larger subpopulations. The second line of evidence is empirical. Gutiérrez and Pritchard (1990) studied a small isolated population of California spotted owls in southern California. This population contained approximately 20 pairs of owls and apparently had persisted since the late 1800s when the owls were first reported in the area by ornithologists. Dispersal between this population and neighboring populations is low (LaHaye et al. In Review) suggesting a higher degree of isolation than would be predicted for owls living in Pacific Northwest forests.

Catastrophic events.

Catastrophic events are large-scale changes in owl habitat or population numbers that are unpredictable and deleterious to owl populations. Examples of such events are volcanic eruptions, large-scale forest fires, and large-scale wind storms that destroy forests.

• ***Associated Risks***: Catastrophic events may destroy entire or major portions of DCAs. They also could create barriers to dispersal.

• ***State of Knowledge***: In the past decade volcanic eruptions, fires, and wind storms altered thousands of acres of spotted owl habitat in the Pacific Northwest (Ruediger 1985). While large fires are very disruptive, portions of the burned areas often remain capable of supporting owls (e.g., northern California fires in 1987). Although these events are unpredictable, they are a natural part of the environment and will continue to occur.

• ***Recovery Plan Response***: To deal with uncertainty about the number, location, and magnitude of catastrophic events, safeguards have been built into the DCA network. Each province has a different risk of fire, wind, or volcanic activity. The strategy of maintaining multiple DCAs in each province reduces the risk of losses due to catastrophic events. The DCAs are arranged so that owls from any DCA may disperse to two or more other DCAs. This will keep DCAs from becoming isolated if any DCA is substantially destroyed by a catastrophic event.

Species interactions (competitors, predation, diseases and pathogens).

The barred owl is believed to be a potential competitor with the spotted owl, and it may be better adapted to fragmented landscapes. The barred owl has hybridized with the spotted owl, which may be the result of low populations of one of the species or of the fragmented landscapes dominant in Pacific Northwest forests. Great horned owls are the major predator of spotted owls and are more abundant in fragmented habitat areas than are spotted owls (see section II.A.). Diseases, pathogens, and parasites affect spotted owls in unknown ways.

• ***Associated Risk***: The risks of competition and displacement are part of the overall risks associated with habitat fragmentation. Predation on juvenile owls contributes to the risk associated with low juvenile dispersal success.

• ***State of Knowledge***: Displacement, hybridization, and predation all occur, but the magnitude of their effect on spotted owl populations is unknown. Conditions that influence the relative magnitude of these interactions are not known with any precision.

• ***Recovery Plan Response***: The habitat in most DCAs is currently fragmented, which is believed to facilitate barred owl and great horned owl interactions with spotted owls. Recovery plan recommendations for appropriate protection and management of unsuitable habitat in these areas should result in less fragmented habitat conditions over time. This should reduce the quality of barred owl and great horned owl habitat and there should be fewer negative interactions between these species and spotted owls in DCAs in the future. Requirements for the federal matrix lands also are intended to protect spotted owls from predators.

Lack of Coordinated Conservation Measures

The success of the recovery plan will depend on the ability of the federal land management agencies, the states, and private landowners to effectively implement the recovery plan as well as to coordinate their recovery efforts.

• ***Associated Risks***: The DCA network depends on commitments from several federal agencies. Reducing the number of DCAs would increase risk to the owls by reducing redundancy in the DCA network and by creating gaps in the network. In addition, applying different conservation strategies would result in unknown consequences for the owl.

• ***State of Knowledge***: One of the reasons for federally listing the spotted owl was the lack of adequate regulatory mechanisms. Part of this inadequacy was the lack of consistency and continuity of management strategies between federal land management agencies.

• ***Recovery Plan Response***: The recovery plan is structured to provide consistent guidelines throughout federal lands. The Recovery Team advocates formation of a coordinating group to help interpret the recovery plan guidelines, provide guidance in research and management, and determine when the guidelines should be reevaluated.

The Recovery Team has worked closely with land management agencies and the FWS during the formulation of the recovery plan which should facilitate more effective implementation of the plan.

3. Summary of Risks

It is important to emphasize that there are short-term (5 to 15 years) and long-term (50 to 100 years) risks. Because of the estimates of owl trends generated from analysis of the vital rates, short-term risks to the population have received a lot of attention. The short-term risks are related primarily to continued loss of habitat; the resulting habitat fragmentation and habitat gaps; and the possibility that the demographic response of the species will result in severe population declines. The recovery plan makes three recommendations to lower short-term risks. These are: 1) identify and maintain reserved pair and managed pair areas in the matrix during an interim period; 2) monitor demographic rates and population trends, and adjust the recovery plan as appropriate, and; 3) continually review and revise the recovery plan as needed through adaptive management. Because loss of suitable old-forest habitat will be relatively slow in the next 10 years, the Recovery Team judges that options for increasing owl protection will be available in that period. In the long term (i.e., 50 to 100 years), systematic habitat loss should cease and recovery of habitat in DCAs should continue. Consequently, the long-term risks are related to the adequacy of the overall recovery plan design and will serve as a test of that design. Long-term risks include the possibilities of low success of juvenile dispersal, loss of genetic variation, severe catastrophic events, negative species interactions, and failure to continue the coordination of conservation measures. As discussed earlier in this section, specific design features of the recovery plan are intended to deal with each of these risks. The monitoring and research program will provide continuous information about the effectiveness of each of those measures. Monitoring, research, and adaptive management are critical to the maintenance of acceptable risk levels over time.

4. Recommendations

Several recent efforts to develop management guidelines for northern spotted owls have been criticized because they lacked formal, quantitative risk assessments. These included the report of Thomas et al. (1990); the adoption of that report by the Forest Service (USDA 1992); and the draft of this recovery plan. These criticisms assert that, without a formal risk analysis, there is no demonstration that the management plans will provide for conservation or recovery of the species. Recent critics have focused specifically on the assessment of demographic data presented in the draft recovery plan (see Appendices C and K for a full discussion of this issue). These criticisms deserve attention. A formal, quantitative risk assessment, if possible, would help to determine whether the strategy presented here would ultimately be successful.

Despite the potential value of a risk assessment, it is unlikely that a complete and compelling assessment could be produced any time in the near future, if ever. As noted previously, a valid, quantitative assessment would require complete knowledge of owl responses to a full spectrum of habitat and landscape conditions. Some of these conditions are not currently observable in the owl's range, so their study is not possible. A risk assessment would also require full knowledge of owl population responses to dynamic landscapes. Owl biologists are only beginning to acquire such information, so complete knowledge in this area is probably decades away. Full understanding of habitat trends, including responses to management and projections of catastrophic events, would also be required.

Even with all of this information in hand, there would still be substantial challenges in the development of a reliable risk assessment. All of this information would have to be brought together in a modeling framework. Assumptions in the model, and the overall model structure, would require validation.

These requirements make the development of a robust model, and a comprehensive, quantitative risk analysis, problematic. However, models can still be useful. They can contribute to the understanding of implications of a variety of assumptions, and they can help generate new research hypotheses. They also can help simulate the possible responses of owls to the dynamics of future landscapes. The results of modeling efforts make a substantial contribution to risk assessments, even if the final assessment is qualitative.

For these reasons, it is recommended that a variety of modeling efforts continue, and that the results be considered in ongoing assessments of risk. Modeling and risk assessment are recommended to play a key role in adaptive management under the recovery plan (see section III.K.). Modeling efforts that should continue include:

- Further assessment of demographic data and its analysis, including the possible biases in the data and the sensitivities of models used.

- Further work on models that simulate owl population dynamics in response to landscape dynamics (McKelvey and Noon pers. comm.).

- Further work on models that investigate the relative roles of territorial and nonterritorial owls in the dynamics of the population (e.g., Franklin 1992).

- Efforts to improve the ability to project future habitat conditions in managed and unmanaged situations.

While risk assessments will continue to rely on professional judgments into the foreseeable future, results of these efforts and other efforts outlined in section III.J. will help to improve those professional judgments.

III.

H. Economic and Social Effects of the Northern Spotted Owl Recovery Plan

1. Introduction

The Recovery Team's Assignment

In its charter, the Recovery Team was asked to consider economic and social effects consistent with its legal mandate in formulating a recovery plan for the owl. The decision to consider economic effects in formulating a recovery plan is a departure from past practice. Recovery plans prepared for other species have not formally used economic analysis, although the costs of management actions such as acquisition of habitat have been considered. At the outset, the Recovery Team needed to develop an approach for considering economic effects that was consistent with the Endangered Species Act and would address the controversy that has resulted from concern that the costs of conserving adequate habitat for the spotted owl could be quite high.

Requirements of the Endangered Species Act

The Endangered Species Act establishes a biological imperative that governs the formulation of the recovery plan for the northern spotted owl. The biological imperative requires that the recovery plan include management actions that will achieve recovery. Biological principles and information form the primary basis for designing and evaluating the likely success of management actions for recovery of the spotted owl.

The Problem

When formulating the recovery plan for the northern spotted owl, the Recovery Team encountered many of the fundamental conflicts that generally arise when promoting economic growth and productivity while protecting environmental quality. Protecting habitat for spotted owls will yield a variety of environmental and economic benefits, but it will also cause economic losses in an important regional industry, the timber industry.

Studies done before the Recovery Team began its work suggested that spotted owl conservation could be quite costly. Forest Service and BLM estimates indicated that previously planned timber harvests in federal forests in the 1990s would have yielded about 3 to 4 billion board feet of timber per year, generating more than $1 billion annually in economic benefits and supporting nearly 70,000 jobs in the Pacific Northwest. Projections showed that some owl and old-growth conservation plans would cause a substantial decline in production and employment in the region's timber and wood products industries. Timber harvests from federal lands would be cut nearly in half. Estimates of the costs of such proposals have ranged as high as $25 billion during 50 years (Mead et al. 1990) and 40,000 jobs (Beuter 1990). Appendix G summarizes these and other studies done before the formulation of the draft recovery plan. Although reduced timber harvest may also have substantial benefits, the threat of such high economic costs in an important regional industry has made preservation of the owl controversial.

The Role of Economic Considerations

Several unique challenges confronted the Recovery Team because of the precedent-setting nature of this effort. Advocates of forest preservation and owl conservation expressed concerns that consideration of economic effects would prevent the recovery plan from being based on scientifically credible biological principles and information. Moreover, in comments about other owl conservation proposals, many people emphasized the environmental and economic benefits of owl conservation and forest preservation. These benefits arise from effects of reduced timber harvest such as greater abundance of other species that depend on older forests, improved water quality in streams and rivers, greater abundance of fish, and increased recreation and tourism values. It was recommended that, if an economic analysis were to be used, it should include a full evaluation of the benefits as well as the costs of protecting habitat for the spotted owl population.

In contrast, other people expressed concerns about the substantial economic costs of owl conservation. They recommended that formulation of the recovery plan be based on a systematic analysis of the economic costs and the risks to the owl population under a variety of options. The final recovery plan, they suggested, should be the option having the least costs.

In early discussions of its task, the Recovery Team developed a conceptual approach for considering economic effects. The Recovery Team agreed that such consideration would not diminish the primacy of the biological imperative and that the best available biological information would be used to set recovery objectives and to identify management actions to achieve recovery of the owl. Because recovery of the species is the goal of a recovery plan under the Endangered Species Act, the Recovery Team decided not to consider any options that would not provide reasonable confidence that recovery would be achieved. The Recovery Team recognized, however, that different combinations of management actions could be used to satisfy the biological imperative to provide for the long-term survival and recovery of the owl. Because different management actions have different costs, it should be possible, at least in principle, to design a combination of management actions that would satisfy this biological imperative at least cost. For a similar approach see Judge et al. (1991).

The Recovery Team used an approach that would provide for consideration of economic principles and information as well as use of the best biological information available. Biological principles and information were used to design management actions that would contribute to achieving recovery. Economic principles and information were used to identify ways to achieve recovery at lower costs. This common sense approach is like the efforts of a family to decide what sorts of products meet its needs and then to shop for the lowest prices on those products. It is also consistent with generally accepted principles of public policy for the development of programs in which the result to be achieved has already been specified.

This approach differs in several ways from a comprehensive, systematic cost-benefit study of options for achieving recovery. First, it was designed primarily to facilitate design of a recovery plan rather than to provide information about both costs and benefits that could be used to decide whether to implement the resulting plan. Second, it did not involve the design and evaluation of a wide variety of options.

The Recovery Team decided not to conduct a full evaluation of the benefits of the recovery plan for a number of reasons. It was not appropriate, in light of the requirements of the Endangered Species Act, to consider whether the benefits were sufficient to justify incurring the costs of achieving recovery. Any decision to pursue a goal short of recovery would require an act of Congress and was not within the purview of the Recovery Team.

Furthermore, evaluation of the benefits of particular owl conservation plans is costly and difficult. Whereas the economic benefits of timber harvest are indicated by purchases of timber, most of the beneficial effects of owl habitat protection are not bought and sold in markets. Existing information and analytical methods regarding such nonmarket benefits are generally not sufficient to show how a recovery plan design should be refined in order to enhance these benefits.

In summary, the Recovery Team did not have the charter to determine whether the benefits of recovery outweigh the costs, and it did not have the means to bring information about benefits into the design of owl conservation measures. For these reasons, the Recovery Team chose not to devote its resources to a full assessment of the benefits. The Recovery Team recognizes, however, that such benefits may be substantial. A qualitative summary is included later in this section.

Although the Recovery Team tried to find ways to reduce the costs of achieving recovery, it was not able to design and evaluate a wide variety of options. It found that existing biological models were not adequate to give credible estimates of trends in the owl population for widely different options. In addition, new forest management practices, which could be an important component of less costly options, have not been tested in a manner that supports estimation of their long-term effects on the owl population or timber harvest. Instead of designing and comparing options, the Recovery Team sought ways to reduce the costs of the recovery plan as it produced the detailed design of the plan.

2. The Relationship Between Spotted Owl Habitat and the Timber Resource Base

The high costs of protecting northern spotted owl habitat result from the fact that the owl's range largely coincides with the most valuable timber resources in the Pacific Northwest. Spotted owls appear to concentrate their activities in old-growth stands or in mixed-age stands with both old-growth and mature trees. Recent owl surveys have located owls in a wider variety of habitat conditions. However, until research has shown that owl populations can sustain themselves in areas that do not have classic old-growth characteristics, old-growth stands will be needed as the primary source of the owl habitat needed to ensure the owl's survival and recovery.

Each pair of owls needs a large area (3,000 to 9,000 acres) in which to forage. The need to preserve large areas of old-growth and mature forestlands to support clusters of owl pairs brings owl conservation into direct conflict with timber harvest. Old-growth timber has for decades been the primary source of logs for the timber and wood products industries of the Pacific Northwest. Stands of large trees provide a higher volume of high-quality wood at lower cost than do younger stands.

Unfortunately, traditional forest management practices have been detrimental to owl habitat. Not only does clear-cutting remove old-growth trees from the land, but the regenerated forests grown on cleared land are often even-aged, single-species stands with little habitat value for owls. The patchwork of regenerated clear-cuts distributed throughout the landscape after decades of timber harvest breaks the continuity of the habitat available for owls. Although owls are also found in young or mature stands, their success in mating and raising young appears to be reduced.

There has been considerable debate about other factors affecting timber harvest and employment in the Pacific Northwest. Some people have questioned whether the past level of timber harvest on federal lands is sustainable. This is a complex issue and its resolution is beyond the scope of the recovery plan. However, it is important to recognize that such factors may cause declines in timber harvest and employment even if owl conservation measures are not taken. In addition, investment in technologies that increase labor productivity in the timber and wood products industries will continue to reduce employment, though not at the rate experienced in the 1980s. In general, these effects are separate from the effects of achieving recovery. They will occur even if habitat for the spotted owl is not protected. It is not likely, however, that they will shrink the timber industry to the point at which owl conservation measures would have no further effects.

The economic losses that people are likely to experience because of factors other than owl conservation may be exacerbated by the additional effects of protecting owl habitat. For example, timber-dependent communities may be less able to adapt to the effects of owl conservation because of the effects of other declines in timber harvest and employment. However, to simplify the analysis of the economic effects of the recovery plan, the costs attributable to the need to protect owl habitat were treated as independent from costs associated with other reductions in timber harvest or employment.

3. Summary of Features to Reduce Costs

Part of the process of formulating a cost-effective recovery plan was to consider ways to reduce costs without undercutting the effectiveness of the plan. Some possibilities for reducing costs were rejected for biological reasons, some for lack of demonstrated application, and some for lack of data needed to implement them in designing a recovery plan. Several features, however, were included in the recovery plan as a result of efforts to reduce the costs of achieving recovery. These include the following:

- DCAs were designed to a) make use of areas that have relatively high-quality owl habitat, b) use forestlands that have been reserved for other purposes where possible, and c) reduce the use of forestlands with high potential for timber harvest.

- To promote greater efficiency, the DCA boundaries were refined in formulating the final recovery plan based on the site-specific data available to the federal forest management agencies.

- The DCA management guidelines allow limited salvage as well as silvicultural treatment of areas not suitable for owl habitat to promote more rapid development of suitable conditions and to provide timber.

- The management guidelines for federal lands outside of the DCAs were tailored to local conditions so that the resulting timber harvest restrictions will better assure the habitat conditions in each area that are needed for recovery without incurring unnecessary costs.

- Suggestions were developed for management of nonfederal lands that are intended to increase the efficiency of their contribution to recovery by integrating state authorities and existing programs into a coordinated strategy.

- To provide a basis for improving the cost-effectiveness of the recovery plan, a monitoring and research program and a process for adaptive management are proposed to provide information about habitat conditions that are most productive for owls and forest management practices that are most compatible with production and maintenance of owl habitat.

4. Economic Effects of Implementing the Recovery Plan

Costs

The dedication of substantial areas of federal forestlands to provide owl habitat will remove substantial amounts of land suitable for timber harvest from the federal timber base. What is the economic response and the effect on the various elements of the economy affected by this difference in the future timber supply? In general, the recovery plan would be expected to cause the following differences in future timber markets:

- The rate of federal timber harvest will be substantially lower in future years than it would be without owl habitat protection.

- The price of timber will be somewhat higher.

- The rate of timber production from private lands will be somewhat higher, especially in other regions.

- Federal revenues will be significantly lower because of the timber harvest that is foregone, but revenues will be higher on the remaining harvest because of the price increase.

- Private timber profits will be higher because of higher production and higher timber prices.

- Timber consumers, such as sawmills and plywood mills, will have significantly lower profits because they will have to pay higher timber prices without receiving equal increases from sale of their lumber.

- Some timber industry workers and mill owners will be displaced, foregoing income while unemployed, and to some extent earning less when reemployed.

- Timber exports will be lower and imports will be somewhat greater.

- The use of materials that are substitutes for lumber will be higher.

The primary benefit to the economy from harvesting timber is best measured by the difference between the costs of producing timber and the value of the timber produced. Because federal timber sales are competitive, this benefit is generally reflected in the stumpage prices bid for federal timber. Thus, the primary cost of restricting timber harvests to protect owl habitat is the foregone stumpage value.

The lower supply of timber is expected to cause timber prices to increase. Higher timber prices would induce losses and gains in the economy. Timber consumers, such as sawmills and plywood mills, would lose because they would pay higher prices for timber without being able to pass all of their higher outlays along to their customers. Mills that would have been marginally profitable at the timber prices that were expected without owl conservation will be driven out of business.

However, federal, state, and private forestlands managers and owners would gain from selling timber at higher prices. Private forestlands owners, including those in other regions, would also gain from increasing their rate of timber harvest. In general, the price-induced losses to timber consumers are somewhat greater than the price-induced gains to forestlands owners. Appendix G presents an analytical framework for evaluating these gains and losses.

The timber and wood products industries in the Pacific Northwest will be smaller because of mill closures and other responses to the lower rate of timber harvest on federal forestlands under the recovery plan. At a lower rate of timber harvest, fewer workers will be needed to cut, transport, and process timber. As a result, the employment level will be lower than it would be without owl conservation.

The difference in the employment level in the timber and wood products industries is the economic effect of owl habitat protection that has received the most attention. If owl habitat protection causes a lower rate of timber harvest during several decades, as is expected under the recovery plan, the employment level would be significantly and permanently lower. In the transition from a higher to lower employment level, workers will be displaced. In general, displaced workers will be unemployed for a period of time before finding new employment. Workers will also be displaced from businesses that sell goods and services to the timber and wood products industries as well as from local businesses in communities that are highly dependent on the timber industry. Appendix G provides a more detailed discussion of the relationship between the rate of timber harvest and the employment level.

To assess the economic effects of the recovery plan, it is necessary to specify the baseline to which the conditions resulting from implementation of the recovery plan will be compared. Many people would chose the present or recent past as the baseline. This approach has the advantage of showing the total change people are likely to experience between conditions they have experienced and conditions that will result from implementing the recovery plan. Unfortunately, comparison of current or recent conditions with future conditions under the recovery plan can cause confusion between the effects of the recovery plan and the effects of other economic factors that can affect the timber industry. Such factors include the current recession, other restrictions in the availability of timber from federal forestlands (such as court orders barring timber harvest on federal lands), and changes in labor productivity in the timber industry. To avoid such confusion, the estimates for the recovery plan were developed by comparing expected economic conditions in the mid-1990s with implementation of the recovery plan to conditions in the mid-1990s without the recovery plan.

Of course, one must then specify what policies would be expected to govern timber harvests on federal lands in the absence of the recovery plan. There are a number of possibilities that could be used for purposes of comparison. One is the conditions that would result if federal forestlands were to be managed according to the plans and policies in effect prior to federal listing of the spotted owl. A second basis for comparison would be the current plans and policies governing the federal forests as presented in the most recent plans or draft plans of the Forest Service and the BLM as well as the current policies of the FWS for enforcement of the provisions of the Endangered Species Act regarding the spotted owl. In this report, estimates of economic effects are presented in a manner that allows both comparisons.

Figure 3.40 uses a line drawing to illustrate the basis for such comparisons using employment related to timber harvest on federal lands as the measure of effects. The baseline with "Old Final Plans" represents the employment level expected in light of all factors other than protection of spotted owl habitat that would affect the level of employment related to harvest of federal timber. It shows generally declining employment because of continued technological progress in the timber and wood products industries as well as possible declines in timber harvest due to other constraints on federal timber production. The downward trend in the baseline illustrates the expectation that the number of people employed in the timber industry is expected to decline even without protection of owl habitat.

In Figure 3.40, the lower lines beginning in the early 1990s represent the employment level expected to result with current plans and policies and with implementation of the recovery plan. Estimates of the difference between the baseline and the current regime or the recovery plan were made by estimating how much timber harvest on federal lands would be

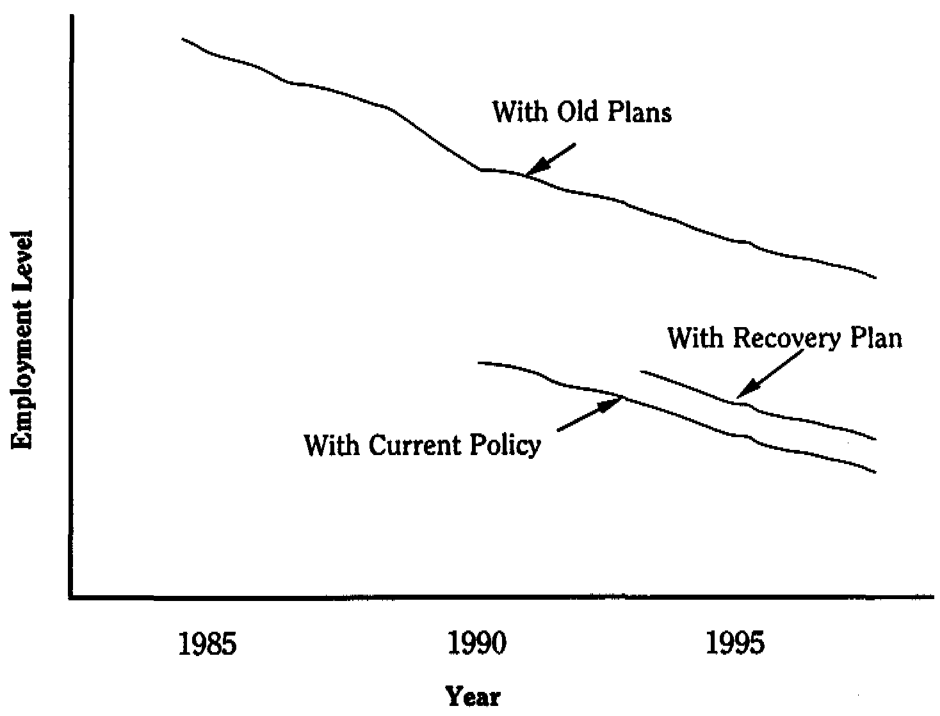


Figure 3.40. Employment related to federal timber harvest.

reduced and by estimating the difference in the employment level that would be caused by the difference in timber harvest. It is important to note that conditions or policies that would result in a lower baseline employment would probably cause the employment level with the recovery plan to be lower by at least the same amount.

Another measure of the economic effect of the recovery plan is the wage losses that would result. The wages that displaced workers are forced to forego while unemployed and when reemployed at lower wages are a personal loss, often with family and social consequences. Such wage losses also represent the value of the foregone contribution their labor could make to the economy.

Benefits

In addition to effects on timber markets, protecting habitat for spotted owls is expected to have beneficial effects on several aspects of environmental quality which may have long term beneficial economic and social effects. Such environmental benefits occur because the environmental damage caused by harvesting timber is lower if the rate of timber harvest is lower. The economic benefits would arise primarily in recreation and fishing. A useful summary of such benefits is provided in *Economic Analysis of Critical Habitat Designation Effects for the Northern Spotted Owl* (USDI 1992a).

In general, implementing the recovery plan would be expected to cause a number of benefits, including:

- Recreational experiences in portions of the federal forestlands that would otherwise be harvested will be higher in value.
- The scenic quality experienced by residents and travelers in the region will be higher in value.
- The biological diversity of the region will be greater. (See section III.I. and Appendix D. for discussions of the benefits to other threatened or endangered species associated with late-successional forests.)
- Conditions in some streams will be more favorable for fishes, other aquatic and riparian organisms, and flora.
- Fishing and other stream-related recreational activities will be higher in value.
- Employment and income in businesses supporting recreation and fishing will be higher.
- Water quality would imrove in many areas.

5. Types of Social Effects of Implementing the Recovery Plan

The social effects of implementing the recovery plan will result from the ways in which individuals, families, and communities respond to the economic effects of the plan. These responses will be affected by the social and political processes that have accompanied the controversy concerning owl conservation and forest management. Social effects may be positive as well as negative.

The economic stress caused by unemployment, the stereotyping and stigmatization caused by the high level of conflict, and the reduction in financial resources available for social services, taken in combination, can cause these responses to be maladaptive rather than positive. Sociologic studies indicate that such conditions are often accompanied by depression, loss of self-esteem, drug and alcohol abuse, and family dysfunction.

The displacement of timber workers, the resulting wage losses, and the losses in the counties' share of federal timber sales receipts create economic stress to which individuals and communities are forced to adapt. Economic evaluation of such adaptation is generally based on the assumption that people affected by economic changes will respond by seeking other opportunities and that they will be reemployed in jobs that allow them to maintain their roles in family and community. Sociologic studies suggest, however, that people placed in such situations often respond with behavior that interferes with this process. Opportunities for nontimber employment are limited in many timber-dependent communities. Some people feel that the reduction in timber harvest on federal lands needed to protect owl habitat represents a failure by the government to meet its commitment to sustain communities that developed in response to federal timber policy. Furthermore, the conflict about preservation of the spotted owl has created a situation in which people in timber-dependent communities feel that their individual worth and the value of their way of life have been attacked. It is difficult for people caught in such situations to take the positive actions needed to move to other areas and occupations.

Communities experiencing stressful economic change usually need increased social services such as counseling, job training and relocation, and health care. If such services are not provided, the social costs resulting from the economic stress are generally higher. Many of the social services in timber-dependent communities are supported by funds that county governments receive from sharing federal timber sales receipts. If these receipts are lower because of reduced timber harvest, reduced social services will contribute to higher social costs.

6. Summary of Estimates of the Economic Costs of Implementing the Recovery Plan

Estimates of the economic effects of the recovery plan are described in Appendix G. They were developed to provide a basis for comparison between the recovery plan and other owl conservation and forest preservation proposals. To provide a consistent basis for such comparisons, the estimates were developed using the same estimation methods applied by the FWS in evaluating the effects of the critical habitat designation for the spotted owl. These estimation methods are summarized in Appendix G and are described in more detail in USDI 1992a which was published by the FWS at the time of the critical habitat designation. The Forest Service and the BLM provided estimates of the timber harvest effects of the draft recovery plan. These estimates and other more recent data were used to update the FWS's methods for estimating the effects of the final recovery plan.

These estimates do not reflect the economic effects of the potential increase in private timber industry harvest or changes in exports and imports in response to the higher timber prices that are likely to result from implementing the recovery plan.

Implementation of the recovery plan would result in lower annual timber harvests in the federal forests of the Pacific Northwest than would occur under the forest plans that were in effect for Forest Service and BLM lands before the owl was listed. Lower timber harvests would also result, however, from the implementation of the ISC strategy under plans recently proposed by the Forest Service and current BLM management plans, as well as from the current designation of critical habitat and compliance with section 7 of the Endangered Species Act. The estimated timber harvests under the recovery plan would be slightly less than would result from continuing these current plans and policies, but the estimated employment effects are about the same.

Table 3.34. Summary of economic effects of the northern spotted owl recovery plan.

Lower Timber Harvest per Year on Federal Lands	2.36 Billion Board Feet
Lower Timber Employment Levels	32,000 Jobs
Wage Losses	$1.6 to $1.8 Billion over 20 Years
Foregone Timber Value	$830 Million per Year
Lower Federal Revenue	$740 Million per Year
Lower County Revenue (share of federal)	$280 Million per Year
Offsetting Gains from Salvage and Silviculture:	
Timber Harvest per Year	120 to 140 Million Board Feet
Employment	915 to 1,230 Jobs

It is estimated that owl conservation would reduce the mid-1990s timber harvests on federal forestlands by 2.36 billion board feet in comparison to the levels that would occur under the federal agencies' earlier plans. Lower timber harvest on federal lands is expected to reduce economic benefits by about $830 million per year. Wage losses of $1.6 to $1.8 billion are estimated over a 20-year period. See table 3.34 for a summary of economic effects (see Appendix G for more details).

In comparison to the mid-1990s employment levels that would result from the federal agencies' earlier plans, the employment level with the recovery plan is estimated to be lower by about 32,000 jobs (18,800 direct industry jobs and 13,200 related jobs).

Several features of the recovery plan will tend to offset the economic effects of restrictions on timber harvest on federal lands. First, the recovery plan would allow silvicultural treatments in DCAs if they are designed to promote the development of habitat conditions suitable for owls in areas that are not currently suitable. Rough estimates of the possible effects of these activities show that treatment of 50,000 acres per year could support about 600 jobs and yield about 100 million board feet of timber per year.

The second feature that will tend to offset the effects of timber restrictions will be allowing limited timber salvage in DCAs. Timber salvage on federal forests averaged more than 650 million board feet per year during the 1980s. DCAs contain a bit less than half of the forestlands available for timber harvest. Salvage of 10 to 20 percent of the salvageable timber in DCAs could yield, on average, 20 to 40 million board feet per year, supporting about 315 to 630 jobs.

Other sources of timber supply, including private forestlands in the Pacific Northwest, may increase production in response to higher timber prices. Although the response in the Northwest is likely to be limited and probably could not be sustained more than a few years, it would slow the rate of job displacement in the early years of recovery plan implementation.

In reviewing these estimates of the economic effects of implementing the recovery plan, it is important to note that they reflect all owl conservation on federal lands. The estimates were prepared in this way because the recovery plan will provide a comprehensive basis for all owl conservation efforts. Thus, these estimates attribute to the recovery plan all of the economic effects of owl conservation on federal lands that would occur after implementation of the plan.

III.

I. Consideration of Other Species

The northern spotted owl is associated with older coniferous forests in the Pacific Northwest (Forsman et al. 1984, Thomas et al. 1990), and optimal habitat for the species can be found in forests older than 200 years. Because of this association and the spotted owls' large home ranges, which vary from 1,000 to more than 10,000 acres, the species often has been used as a symbol of late-successional forests. Late-successional forests are defined here as those that are generally older than 100 years, include mature and old-growth forests as described by Ruggiero et al. (1991), and provide suitable habitat for northern spotted owls. In addressing the conservation of the owl, it became apparent that its range overlaps the ranges of many other species, some of which are federally listed as threatened or endangered, are candidates for listing, or are associated with late-successional forests. Therefore, other species and late-successional forests were considered in developing the recovery plan for the northern spotted owl.

The request to consider other species in the recovery plan came from Secretary of the Interior Lujan, who wrote "There are other forest ecosystem species that may be candidates for listing under the Endangered Species Act which may benefit from any recovery plan for the northern spotted owl. To the extent possible, the team should assess the relative benefits to these species from the implementation of various recovery options." The Recovery Team's working principle was that the recovery plan should take advantage of opportunities to benefit other species where possible and should not negatively impact other species.

This effort was important because conservation efforts for each species will be costly and time-consuming, and a species-by-species approach is not likely to include all the structural parts and functional relationships of late-successional forests. Because the Recovery Team was also directed to minimize the costs of owl recovery, conservation for other species did not include allocations of areas beyond those required for recovery of the owl. Therefore, the recovery plan cannot be characterized as a conservation plan for late-successional forests and all of their associated species. However, the recovery plan will have benefits to numerous species that are federally listed as threatened or endangered, candidates for listing, or associated with late-successional forests.

1. The List of Species Considered

The Recovery Team considered all plants and animals that are associated with coniferous forests in the range of the northern spotted owl. Threatened or endangered species, candidates for federal listing, state sensitive species, and species associated with late-successional forests were emphasized. A list of species was developed by conducting a series of meetings; visiting numerous scientists; acquiring lists of species that are federally listed as threatened and endangered, state sensitive species, and species associated with late-successional forests (Brown 1985, Ruggiero et al. 1991, Thomas et al. In Prep.); and reviewing reports and published literature. In addition, a 2-day workshop was conducted on the ecology and management needs of priority species; a transcript of the workshop is in the recovery plan's administrative record. Appendix D provides a more detailed description of the approach used to select other species considered in the recovery plan, list of species, ecology of riparian ecosystems, and natural history of priority species. During development of the recovery plan, members of the Recovery Team contributed to the Forest Service's Supplemental Environmental Impact Statement (SEIS) for management of the northern spotted owl and species associated with late-successional forests. In particular, the population viability of species that are associated with late-successional forests was assessed by panels of experts. Results of that assessment are in the agency's report, Thomas et al. (In Prep.), see Appendix D.

Brown (1985:37) listed 460 species of birds, mammals, and amphibians that inhabit plant communities west of the Cascade crest in Oregon and Washington. A large number of plant species occurs in this region, including approximately 400 species that are associated with late-successional forests (see Appendix D). The number of invertebrate animals is believed to be large, but cannot be estimated accurately because many of the arthropods (Lattin pers. comm.) and molluscs (Frest and Johannes 1991) have not been surveyed or described adequately. The biota of coniferous forests in the Pacific Northwest is extremely rich in numbers of species and includes numerous species that occur only in the region (endemic species) and are unique among their taxonomic relatives (see Appendix D).

The species considered in the recovery plan include 668 species of plants and animals (Table 3.35). Of those, seven are federally listed as threatened or endangered, 162 are candidates for listing, and about 150 are species of special concern in one or more of the three states. Approximately 110 of the species are narrowly or broadly endemic to the Pacific Northwest, and 482 are species associated with late-successional forests. In addition, the 28 fish species include 779 stocks that are considered at risk (Nehlsen et al. 1991), and many of these may become candidates for federal listing. The large number of candidates for federal listing, species of special concern, endemic species, and older forest associates (Table 3.35) in the Pacific Northwest emphasizes the importance of considering

Table 3.35. Summary of 668 animals and plants considered in the recovery planning process for the northern spotted owl (from Appendix D: Tables D.1–D.9).

Animals and Plants	Federally Listed	Candidate for Listing	State Listed	Species of Special Concern	Endemic[a]	Older Forest Associate	Riparian Associate
Birds (39)	3	3	5	10	5	36	8
Mammals (28)	2	4	3	10	9	22	5
Amphibians[b] (27)	0	9	3	19	23	17	15
Fishes (28)	1	8	3	25	NA	NA	28
Molluscs (58)	0	10	1	29	47	43	45
Arthropods (91)	0	34	0	0	–	55	34
Vascular Plants (207)	1	94	12	49	23	119	6
Nonvacular plants (190)	0	0	0	2	–	190	12
Total (N=668)	**7**	**162**	**27**	**144**	**107**	**482**	**153**

[a]Locally or broadly endemic.
[b]Includes two reptiles, the sharptail snake and western pond turtle.
NA = not applicable.
– = unknown, undetermined.

other species in the recovery plan. In addition, the large number (approximately 150) of species associated with rivers, creeks, ponds, and marshes and their associated vegetation (riparian areas) plus the number of fish stocks at risk are indicative of the importance of riparian ecosystems. Most riparian ecosystems west of the Cascade crest in Oregon, Washington, and northwestern California are associated with coniferous forests, are used by northern spotted owls for nesting or foraging (see Appendix D), and are influenced by land-use practices. The list of species considered in the recovery plan, plus their status and association with riparian areas and late-successional forests, are in Appendix D, Tables D.1 through D.9.

From the large list of species, the Recovery Team identified 18 priority species (marbled murrelet, bald eagle, northern goshawk, marten, fisher, grizzly bear, gray wolf, Oregon slender salamander, Siskiyou Mountain salamander, Larch Mountain salamander, Del Norte salamander, Pacific giant salamander, Cope's giant salamander, Olympic salamander (four species), and tailed frog); a larger list of riparian-associated species including fishes, amphibians, mammals, arthropods, and molluscs; and a list of five primary prey species for the owl (flying squirrel, bushy-tailed woodrat, dusky-footed woodrat, red tree vole, and western red-backed vole). Of these species, the marbled murrelet and many fish stocks were the highest priority because of the recent federal listing of the marbled murrelet as a threatened species and because the fish stocks are considered at risk. The other threatened or endangered species were not assigned as much importance because it was assumed that their management is sufficiently addressed in their recovery plans.

2. Benefits of the Recovery Plan to Other Species

This section describes the benefits that other species will derive from the recovery plan for the northern spotted owl. Many of these benefits cannot be quantified adequately until surveys of the DCAs for other species have been conducted. However, some reasonably accurate statements can be made.

Designated Conservation Areas (DCAs)

The size, spacing, and management of DCAs will provide benefits for other species throughout the owl's range, particularly species associated with late-successional forests. As a result of DCA placement, benefits to other species will be attained with little or no additional cost to owl conservation. For example, two category 2 DCAs were established in the Mt. Baker-Snoqualmie National Forest to include seven pairs of owls and a wild and scenic river corridor along the South Fork of the Stillaguamish River. These DCAs also include locations of marbled murrelet detections and important stream sections for native fishes. The additional DCAs were offset by reductions in the size of the habitat conservation areas (HCAs) recommended in the ISC report (Thomas et al. 1990), which was the basis for the Recovery Team's initial mapping efforts. In Oregon, a DCA was established in the Siuslaw National Forest (south of Waldport, Lincoln County) along the coastal area near Rock, Cummins, and Tenmile Creeks. This DCA includes eight owl pairs and seven single owls as well as 57 locations where marbled murrelets have been detected and three streams with fish stocks at risk. This additional DCA also was offset by reductions in the size of two of the HCAs recommended in the ISC report.

The benefit of DCAs to priority species can be quantified by compiling the number of occurrences (occupied nest sites for birds, trap locations or sightings for mammals) of these species in DCAs for each province (Table 3.36). The DCA network incorporates 934 known sites of priority species throughout the range of the owl which is 32 percent of the known sites for these species. The total includes 622 (48 percent) of the locations where marbled

Table 3.36. Numbers of other species' locations and miles of streams (with fish stocks at risk) in designated conservation areas (DCAs) for the northern spotted owl, summarized by physiographic province.

	Species					
Province	Bald Eagle[a]	Fisher[b]	Northern Goshawk[a]	Marten[b]	Marbled Murrelet[c]	Miles of Stream
California Cascades	3	0	8	4	NA	80
California Coast	0	0	0	0	200	107
Klamath (Oregon and California)	1	18	21	14	17	763
Eastern Oregon Cascades	2	0	7	5	NA	35
Western Oregon Cascades	4	2	11	7	NA	220
Oregon Coast Range	6	1	0	0	204	232
Olympic Peninsula	70	7	12	0	119	236
Eastern Washington Cascades	1	1	14	8	NA	128
Western Washington Cascades	7	8	48	20	81	213
Western Washington Lowlands	1	0	0	0	1	2
Total in DCAs	**96**	**37**	**121**	**58**	**622**	**2,016**
Total in Spotted Owl's Range	**1,032**	**107**	**271**	**213**	**1,270**	**12,414**

[a]Locations are nest sites.
[b]Locations are sightings or trap records.
[c]Locations are sites where murrelets have been detected.
NA - not applicable; marbled murrelets occur less than 50 miles from the Pacific Ocean.

murrelets have been detected, 121 (47 percent) northern goshawk nest sites, 58 (27 percent) marten sightings and trap sites, 37 (35 percent) fisher sightings and trap sites, and 96 (9 percent) bald eagle nest sites. The DCAs also include 2,016 of the 12,414 (16 percent) miles of streams with fish stocks that are considered at risk. The greatest benefits to fishes will be in the Oregon and California Klamath provinces where 763 miles of streams are in DCAs. The greatest benefits to other species will be achieved for marbled murrelets in the California Coast and Oregon Coast Range provinces where 200 and 204 locations of marbled murrelet detections, respectively, are in DCAs. Forty-eight northern goshawk sites in the western Washington Cascades province and 119 locations of marbled murrelet detections in the Olympic Peninsula province are in DCAs. These are known sites and probably do not represent all sites for these species in DCAs. Including these sites in DCAs, along with the conservation of late-successional forests for owl habitat, will provide benefits to these species in the range of the spotted owl.

Management guidelines for DCAs on federal lands are key elements of the recovery plan (see section III.C.1.). These guidelines specify the maintenance of suitable habitat for owls and development of suitable habitat in stands currently unsuitable. The guidelines also specify the kinds of silvicultural activities and salvage that may occur in DCAs, and they suggest ways of managing to limit large-scale disturbance (fire, wind) of habitat in some of the provinces. All of these guidelines are designed to protect and enhance owl habitat. As a result of adhering to these management guidelines, forested areas in the DCAs will provide habitat for a wide array of other species associated with late-successional forests.

Coarse woody debris, as snags and down wood, is important to numerous species of plants and animals. Many cavity dwellers use snags for nesting and foraging, and down wood is important as food sources and refugia for numerous organisms. DCA management guidelines for salvage of down wood which results from catastrophic wind storms and fires, are designed to retain coarse woody debris for long time periods after large-scale disturbances. These guidelines will contribute to the habitat requirements of several cavity dwellers including cavity-nesting birds and flying squirrels. The guidelines also will promote suitable habitat conditions for arthropods, salamanders, nonvascular plants, and small mammals.

Management in the Forest Matrix

Recommendations for management of the forestlands outside of DCAs (forest matrix) on federal lands are designed to provide habitat for dispersing juvenile owls, owl pairs, and territorial singles where the DCA network is deficient or there is a risk of large-scale disturbance (see section III.C.2.). Management of the matrix for dispersing owls alone (i.e. the 50-11-40 rule) is unlikely to provide the necessary habitat for species associated with late-successional forests. However, the forest matrix on federal lands outside of DCAs also will be managed to provide reserved pair areas and managed pair areas, which will provide short-term habitat for these species. Reserved pair areas are to be managed as suitable owl habitat until the DCAs contain the necessary amount of suitable habitat and number of breeding pairs of owls; residual habitat areas will also provide suitable habitat. Habitat around managed pair areas may be maintained through time using various management techniques, and there is some uncertainty about what benefits it will provide to other species. However, if some of these management techniques include longer rotations, selective harvests, and uneven-aged management with a goal of providing large trees, snags, and coarse woody debris, these areas will be used by a number of species. The Yakima Indian Reservation and some private lands in northern California provide examples of some of these management techniques and present opportunities to evaluate them in mixed-conifer forests. Unfortunately, this type of management has been conducted in few areas in the Douglas-fir/hemlock forests in western Oregon and Washington.

3. Further Surveys, Inventory, and Research

There are species in the range of the northern spotted owl about which little is known or further review would be appropriate. The Recovery Team developed four criteria for evaluating each species' current status including:

1. Occupying of an extremely restricted geographic range.
2. A candidate for federal listing.
3. Designation as a species of special concern or sensitive species in one or more states.
4. Lack of information about distribution and or population numbers.

The Recovery Team focused on species that are endemic to the Pacific Northwest and associated with late-successional forests. The species suggested for further review include:

Birds: northern goshawk, Vaux's swift, white-headed woodpecker, black-backed woodpecker, northern pygmy owl, bufflehead, harlequin duck.

Mammals: fisher, marten, lynx, red tree vole (two species), white-footed vole, forest deer mouse, long-legged myotis, fringed myotis.

Amphibians and Reptiles: Larch Mountain salamander, Van Dyke's salamander, Oregon slender salamander, Siskiyou Mountain salamander, Del Norte salamander, clouded salamander, Olympic salamander (four species), Pacific giant salamander, Cope's giant salamander, Shasta salamander, tailed frog, sharptailed snake, western pond turtle.

Fishes: bull trout, coastal sea-run cutthroat, tidewater goby.

The preceding list of birds, mammals, and amphibians includes many species that have medium to low ratings for population viability under the ISC strategy (Thomas et al. 1990) in documents prepared for the Forest Service's SEIS (Thomas et al. In Prep.). Additional surveys, inventory, and research are needed, because little is known about these species' current population status and habitat relationships.

Arthropods and molluscs are two major groups of organisms in the region about which there is little information and a great need for status reviews, surveys, and research. Neither group has been surveyed adequately throughout the range of the northern spotted owl, and many species are not described or named. Any assessment of their status will require considerable effort and should be approached through broad-scale inventories aimed at assessing species composition and distribution. In addition, surveys of amphibians in the Pacific Northwest currently are inadequate to assess the status of many of their populations. This is particularly important, because many amphibians have restricted distributions, limited dispersal capabilities, and high genetic variability, which are characteristics of species that become rare and eventually are federally listed as threatened or endangered. Much of the existing information about the abundance of amphibians in different ages of coniferous forests is presented by Ruggiero et al. (1991), and other limited studies on this subject (see Appendix D).

The amount of research that has been conducted on the major groups of organisms considered by the Recovery Team varies widely. Although there are numerous publications about birds, mammals, and fishes in forested landscapes in the Pacific Northwest (see Appendix D), there is much less information about molluscs and arthropods. Information is lacking about distributions, abundance, and habitat relationships of amphibians, because they cannot be surveyed easily. The information in the Forest Service's "Old-Growth Forest Wildlife Habitat Research Program" (Ruggiero et al. 1991) presented an extensive data base of birds, mammals, amphibians, and plants in unmanaged forests in the Pacific Northwest. These studies provide valuable information about the abundance and habitat relationships of these groups of organisms in unmanaged forests of different ages. However, similar information is needed about intensively managed forests during early- and mid-successional stages. In addition, information is needed about the response of plants and animals to various silvicultural prescriptions including selective harvests, uneven-aged management, long rotations, green tree retention, and snag management in these forests.

There is a lack of information about the taxonomy, distribution, and abundance of arthropods in different forest types throughout the Pacific Northwest. According to scientists at Oregon State University (Lattin and Moldenke pers. comm.), many of these organisms have not been described or named, and little is known about their distribution or abundance throughout the landscape and in different forest conditions. Likewise, definitive information about the distribution and abundance of molluscs in different forest types is lacking, and many of these species are sensitive to land-use practices that alter the microclimates upon which they depend (Frest and Johannes 1991). Similar statements can be made about amphibians (Beatty et al. 1991).

Among the birds and mammals, several species are large and very mobile, and were not sampled adequately by the sampling designs of Ruggiero et al. (1991); therefore they have not been studied intensively. More information is needed about their abundance and habitat relationships in various forest types and their response to different silvicultural treatments. These species include the marbled murrelet, northern goshawk, Vaux's swift, northern pygmy owl, harlequin duck, fisher, marten, and wolverine. Other species, like the red tree voles, white-footed vole, and forest deer mouse are either rare or have behavioral traits that make them particularly difficult to study. These species should be the focus of further study, either individually or in community studies.

Given the lack of information about many species and the restricted geographic ranges of arthropods, molluscs, and amphibians, there are likely to be species whose ranges are not included in or fully protected by management in DCAs. Surveys and research are needed to provide this information, and these groups/species probably will need further conservation efforts. Additional information was compiled concerning the conservation needs of these species for the Forest Service SEIS (Thomas et al. In Prep.). Their report assesses the population viability and risk of extirpation of species that are associated with late-successional forests under the ISC strategy (see Appendix D).

A number of other important research areas probably could be identified. However, the intent here is to highlight some obvious gaps in information about the relationship of plants and animals to different forest conditions throughout the Pacific Northwest. A more complete list of research topics could be developed by a group dedicated to this purpose.

III.

J. Monitoring and Research

1. Functions of the Monitoring and Research Program

The primary objectives of the monitoring and research program are to determine whether implementation of the recovery plan is on schedule, determine if implementation is producing expected effects, improve the plan over time, and, ultimately, determine when it is time to begin delisting procedures. Support for and implementation of a strong monitoring and research program are essential to the success of the recovery effort. Monitoring and research are intended to help achieve stabilization and recovery of the northern spotted owl population with the lowest possible economic and social costs.

The recovery plan incorporates the considerable data available about northern spotted owls, one of the best researched owls in the world (see section II.A.). These data provide reasonable assurance that the recovery plan will succeed in its goal of recovering northern spotted owls. However, there is considerable room for refining and improving the recovery plan and knowledge of owls over time. Ongoing research programs that focus on ecological relationships and population dynamics of owls will provide considerable new information in the next several years. In addition, ongoing management will create a landscape different from the one in which owls have been observed to date, which will expand knowledge of owl ecology in a variety of habitat settings. For these reasons, it is expected that the monitoring and research program will provide information that can be used to improve the recovery plan over time. Improvements may allow increased security of the owl population and reduction of the economic costs of recovery. In addition, the monitoring and research program will provide information needed to determine when delisting of owl populations will be appropriate.

Significant monitoring and research efforts directed at northern spotted owls have been in place for many years and are described in Thomas et al. (1990) and USDA (1988). The ideas and recommendations presented in this section repeat some aspects of those ongoing programs and build on others. Much of what is recommended can be implemented using existing organizational structures. However, some additional structure to provide overall coordination will be necessary for the recovery plan (see section IV.C.).

To be effective, the monitoring and research program must be carefully designed to answer specific questions about owls and their responses to landscapes created by management and natural events. The program can be organized into two basic categories: 1) information needed for adaptive management under the recovery plan, and 2) information needed to consider delisting of the species. While there is some overlap between these categories, they serve as a useful framework for discussing monitoring and research efforts.

2. Information Needed for Adaptive Management

The goal of the recovery plan is delisting of the northern spotted owl throughout its range. However, the decision to delist may be years or decades away in some or all of the owl's range. During that time, the monitoring and research program will have a vital function producing the information needed for changing and improving implementation of the recovery plan. The process of using such information to refine management over time has been formalized as adaptive management (Holling 1978, Walters 1986). In this recovery plan, the objective of adaptive management (section III.K.) is to improve the biological and economic efficiency of the plan while maintaining or increasing the level of protection for owls over time.

Successful use of adaptive management requires a carefully planned structure of monitoring, research, management reviews, and management refinement. The proposed structure of the adaptive management program is described in section III.K. The questions to be answered by monitoring and research must be designed specifically to provide information needed by management, and there should be checkpoints or trigger points that would initiate technical or administrative reviews, possibly resulting in management changes. As part of this structure, it is helpful to divide monitoring and research questions into three categories:

- ***Implementation questions***: Was management direction implemented as specified?
- ***Effectiveness questions***: Did the actions have the effects projected in the recovery plan?
- ***Validation/research questions***: Are critical assumptions used in building the recovery plan correct?

All three categories of information must be collected for adaptive management to be effective. Implementation monitoring assures that implementing mechanisms are operating correctly and provides the basis for oversight. It is necessary to know that the recovery plan was implemented correctly before effectiveness monitoring can be meaningful. Effectiveness monitoring provides the basis for determining if the primary effects predicted by the recovery plan are occurring (e.g., Is habitat becoming less fragmented in DCAs?). These results would be used to determine if some change is needed because the recovery plan's outcomes are different from predictions. Validation monitoring and research provide information needed to determine if the key underlying assumptions of the recovery plan are correct (e.g., that reproductive success of owls is related to the level of fragmentation of habitat). Validation monitoring is extremely important because it tells if a change in the recovery plan is necessary and what type of change might be appropriate. Without validation monitoring, it is possible to know that a change is needed but not know what type of change would be appropriate. Validation monitoring clearly represents a blend of scientific research and monitoring and is successful only when aimed at specific management questions.

The most important implementation, effectiveness, and validation monitoring questions follow.

Monitoring Questions

Implementation monitoring questions.

- Are DCAs being established on the ground following maps and guidelines in the recovery plan?
- Are activities inside of the DCAs being implemented according to guidelines in the recovery plan? Have the land management agencies produced specific plans and guidance for activities in each DCA?
- Are matrix management guidelines being followed?

Effectiveness monitoring questions.

Habitat responses:

- Do DCAs contain the target numbers of total acres and acres of habitat suitable for owls?
- Are activities inside of the DCAs producing the predicted forest structure over time?
- Are activities in stands in the matrix producing the predicted forest structure over time?
- Are desired landscape conditions being maintained over time in the matrix?
- Are habitat trends and causes of those trends as predicted?

Owl population responses:

- Do DCAs provide for predicted numbers of owl activity centers? Does each DCA provide for the predicted number? What proportion of DCAs falls above and below the predicted number?
- Are owls moving successfully among DCAs?
- Is the trend in numbers of owls inside and outside of the DCAs as predicted?
- Are owl reproduction and survival inside and outside of the DCAs as predicted?
- Are owls using created habitats inside and outside of the DCAs? What specific structural conditions are being used by owls and for what functions?

Validation monitoring/research questions.

Dispersal studies:

- How well do various habitat conditions provide for dispersal of owls?
- How well do various spacing distances among DCAs provide for dispersal of owls?
- What is the type of use and relative degree of use of various habitat conditions by dispersing owls?

Spotted owl ecological relationships and population dynamics:

- What is the range of forest structural conditions used by owls? How do owls use those conditions and what is the relative degree of use?
- What are the specific stand features that influence the type and degree of owl use? They may include forest structure, species composition, amount and distribution of coarse woody debris, and number and distribution of snags.
- How are owl reproductive success and survivorship related to habitat conditions, amount, distribution, and rate of change?
- How are owl reproductive success and survivorship related to local population size?
- What are the mechanisms of natural population regulation in owls?

Owl habitat relationships and management:

- What is the influence of various management practices on forest stand composition and structure?
- How do individual owls respond to management practices and resulting stand conditions within home ranges?
- How do owl populations respond to management practices and resulting stand conditions within landscapes composed of multiple home ranges?
- What are efficient and repeatable techniques for assessing habitat conditions at the stand scale and landscape scale?

Economics:

- What are the costs and returns of various silvicultural practices that possibly could be used to develop or sustain suitable habitat conditions?
- How would various types of incentive systems operate to encourage landowner contribution to recovery?

Owl prey, prey relationships, and competitive relationships:

- How do owl diets influence owl survivorship and reproductive success?
- What are the patterns of abundance of principal prey species? How are they related to habitat conditions?
- How do prey species respond to management practices and resulting stand conditions within owl home ranges?
- What are the population dynamics patterns of principal prey species, and how are they influenced by habitat?
- What are movement and dispersal patterns of prey species?
- How do different habitat conditions affect competitive relationships between barred owls and northern spotted owls?
- How do different population levels and habitat conditions affect rates of hybridization between barred owls and northern spotted owls?

3. Primary Information Needed for Delisting Northern Spotted Owl Populations

The criteria for delisting are explained in section III.A. They are: 1) that owl populations and habitat be monitored with a scientifically credible plan, 2) that the owl population be stable or increasing, 3) that commitments be in place to provide long-term maintenance of habitat, and 4) that information from a variety of sources indicates that the spotted owl population will not need renewed protection under the Endangered Species Act. Criterion 1 requires development of an interagency plan that has been approved, accepted, and funded by the involved agencies. Criterion 3 requires that commitments be in place to maintain habitat over time. Criteria 2 and 4 require the collection of specific data. The following section describes the hypotheses that must be tested to satisfy delisting criteria 2 and 4 and the information that must be collected to test those hypotheses.

Information Needed to Test Delisting Criteria

Delisting Criterion 2: *The population has been stable or increasing during at least the last 8 years, as indicated by density estimates and demographic analyses, in all parts of the area that would be considered significant under the Endangered Species Act.*

Hypothesis 1: The change in total number of territorial owls over time is greater than or equal to zero.

Information needed to test hypothesis 1: An estimate or index of the number of territorial owls repeated over time is needed. At a minimum, there must be an adequate estimate made for each physiographic province. Estimates throughout smaller geographic areas should be made if those areas would be considered significant under the Endangered Species Act. Within the provinces, the estimate should be stratified into DCAs and forestlands outside of the DCAs. These separate estimates then must be combined into a single estimate for the entire province. It is important to emphasize that, within the context of metapopulation dynamics, some DCA subpopulations may decline for a variety of reasons (e.g., catastrophic events, random demographic events) even when the metapopulation is stable. Therefore, delisting could occur in the province if the metapopulation as a whole were stable even though some DCAs would not be contributing fully for short periods.

Hypothesis 2: The finite rate of increase of owl populations is greater than or equal to one as determined from estimates over time of demographic parameters.

Information needed to test hypothesis 2: Estimates over time of age-specific or stage-specific survival and reproduction rates, including age at first and last reproduction, are required. Estimates should be made for at least one subpopulation in each physiographic province, with the subpopulation sufficiently large to produce statistically reliable estimates of the demographic parameters. Estimates for additional subpopulations may be necessary to fully represent the range of ecological conditions in each province.

Delisting Criterion 4: *The population is unlikely to need protection under the Endangered Species Act during the foreseeable future.*

Hypothesis 1: There are sufficient immigrants per generation among DCAs to maintain demographic stability and genetic diversity.

Information needed to test hypothesis 1: Data are necessary to determine the number of owls per generation that are immigrating into DCAs. These data can be collected best in conjunction with the studies of demographic rates.

Hypothesis 2: Changes in amount and distribution of northern spotted owl habitat occur at expected rates and result from expected causes.

Information needed to test hypothesis 2: Estimates over time of amounts and distribution of various classes of habitat are needed. These estimates must account for the development of suitable conditions in some areas and the loss of suitable conditions in others.

Hypothesis 3: Long-term demographic projections that include the effects of fluctuations in abundance, fecundity, immigration/emigration, and survivorship indicate that there is a high probability of persistence of the population for 100 years.

Information needed to test hypothesis 3: The data collected to answer questions about population and demographic trends over time can be used in a modeling context to respond to this hypothesis. The models used should, at a minimum, include the effects of: 1) habitat quality on reproduction and survival; 2) habitat quality, sizing, and spacing on dispersal success; 3) environmental variation; 4) fluctuations in vital rates; and 5) expected changes over time in habitat, including the possibility of large-scale disturbances. If only a portion of the owl's range is being delisted, the information presented here should be used to determine that 1) the condition of surrounding areas would not negatively influence the stability of the area being considered for delisting, and 2) delisting would not negatively influence the progress of surrounding areas toward recovery.

4. Monitoring Recommendations

A coordinated monitoring and research program should provide the information needed to respond to the monitoring questions and delisting criteria described earlier in this section. Monitoring and research recommendations are presented separately here. However, the distinction between them is fine, and they should be coordinated to provide the greatest effectiveness and efficiency. The monitoring program should focus on the following areas.

Implementation monitoring.

The first requirement of the monitoring program is to track the implementation of the recovery plan. Responding to the implementation questions should be a high priority. It is particularly important to monitor activities in DCAs. Where silviculture and salvage activities are conducted in DCAs, their proper implementation is essential to the success and credibility of this recovery plan. Consequently, the implementation of all such activities must be carefully monitored. Effectiveness of the activities in producing desired conditions should be monitored at a subset of sites selected to cover a range of activities and a range of ecological conditions.

Effectiveness monitoring.

The second major component of the monitoring and research program is effectiveness monitoring. This component should include both population monitoring and habitat monitoring. Following are specific recommendations for effectiveness monitoring.

Owl population trends. Numerical trends of owls should be monitored in the matrix and DCA network in each province. Several methods have been developed to estimate owl population trends. These can be divided into techniques that estimate trends in total population and techniques that estimate trends in territorial population. Estimation of change in the total population is the more difficult problem because it requires knowledge of the nonterritorial owls or "floaters" that do not normally respond to calls. Consequently, estimating the trend in total population requires careful study of demographic rates. This can be done through studies of owls in large, contiguous areas such as the current demographic studies (see Appendix C). These studies can be supplemented by estimating demographic rates for territorial owls selected at random throughout the landscape.

A broader variety of techniques is available to estimate trends in the territorial population. One technique is simply a total count of territorial owls in fixed areas, such as is done in the core areas of the demographic study areas. This count is repeated over time to provide trend data. Another technique is to randomly sample sites throughout the landscape to see how many of them remain occupied over time. A third possible technique is a system of roadside surveys as described in Appendix A.

As noted in section III.J.3., delisting could only occur if the owl population were stable or increasing over a period of 8 years. To satisfy this criterion, both the total population and the territorial population must be shown to be stable or increasing. The territorial population, by itself, might be a misleading indicator since it might be receiving supplementation from the nonterritorial (i.e., floater) population. Therefore, it is critical that monitoring be in place for the total population. This monitoring must be stratified by province, and at a minimum it must provide an estimate for the DCAs. It would require some combination of demographic study areas and collection of vital information on randomly selected owl activity centers. A recommendation for demographic study areas is presented later in this section.

Information about change in the territorial owl population may help interpret the trends seen for the total population. For example, a declining total population combined with a stable territorial population is a good indicator that the territorial population is being supplemented by floaters. Knowing trends for both segments of the owl population may help develop some early warning signals. Knowing the trend in the territorial population may also be a useful primary technique for those areas where the population is expected to decline, such as in the matrix. Here, it is expected that the trend in the territorial population would match the trend in total owl population if the floaters were not significantly supplementing the territorial population. It is recommended that trends in the matrix be sampled using the techniques for territorial populations. These techniques should be less costly than studies of change in the total population. The technique of roadside surveys may be particularly useful for tracking territorial population trends, but it should be evaluated as a pilot program first to ensure that it provides reliable information about owl population trends.

In addition to monitoring the observed owl population trends, the monitoring and research program should provide the basis for predicting future trends. This could include simple predictions that are entirely habitat-based and predictions based on both habitat and population dynamics. Information needed to provide for such predictions includes:

- Data from demographic studies.
- Habitat association information, including demographic performance related to habitat conditions.
- Habitat trend data and projections.

Owls in DCAs. For the recovery plan to be successful, DCAs must support appropriate numbers of owl activity centers. To ensure that these objectives are being accomplished, surveys within DCAs should continue. Priority should be given to 1) DCAs that have been poorly surveyed and/or contain few known pairs and territorial single owls, 2) DCAs that have been supplemented with one or more matrix prescription areas (see section III.C.2.), and 3) DCAs that are essential to isolated populations or that are in other high-risk areas. Monitoring owls in DCAs is also vital in some subset of areas where habitat manipulations have been conducted in the DCAs.

Owl habitat trends. Trends in habitat must be tracked for both adaptive management and delisting. Monitoring of habitat should be done at several scales, including rangewide tracking of total habitat trends; tracking in specific areas like DCAs; and stand-specific tracking in places where habitat is managed. Habitat monitoring should respond to research efforts to better define the range of habitats used by owls. Habitat monitoring efforts, and the definitions used for owl habitat, must be coordinated among all agencies, researchers, and landowners. The habitat monitoring program should include the collection of basic vegetative information about all stands, and should not simply be a classification of stands into suitable and unsuitable areas. The coordinating group that helps to implement the recovery plan should provide leadership to ensure that all involved entities agree on a basic set of parameters for which information will be collected. All groups doing habitat monitoring should use compatible techniques to measure these parameters. A comprehensive habitat monitoring program should include:

- A rangewide inventory of suitable habitat using definitions and procedures that have been accepted by all involved entities. The inventory should track both nesting, roosting, and foraging habitat and dispersal habitat. It is recommended that interpretation of satellite data be used for this inventory, and that the inventory be repeated at intervals no longer than 10 years. Each inventory of the entire range should be completed in less than 3 years.

- A detailed inventory of selected DCAs using a combination of remote sensing and on-the-ground measurements. Priority for such inventories should go to 1) DCAs where management activities are conducted; 2) DCAs where habitat conditions are complex, such as in the eastern Oregon Cascades and eastern Washington Cascades provinces; and 3) DCAs that have been supplemented with matrix prescriptions based on lack of habitat. Where specific management activities have been conducted in DCAs, a subset of treated stands should be selected for site-specific monitoring to determine the effectiveness of the activities.
- A system that will track events causing change in habitat conditions including timber harvest and catastrophic events.

Overall monitoring system design.

It is important that the overall monitoring program be coordinated among all groups that are monitoring owls and their habitat. This recovery plan does not contain a final design for the program. That design should be one of the first priorities of the coordinating group following the release of the recovery plan.

5. Research Recommendations

Validation monitoring/research questions for the recovery plan are described in section III.J.2. The following research program responds to those questions. The research has been summarized into five major objectives with action items and tasks identified for each of the objectives. This classification of research needs is a revision of the classification first presented in USDA (1988).

Research Objectives

Objective A: Identify and characterize habitats used by spotted owls.

- ***Action Item A.1***: Characterize within and between physiographic provinces variation in habitats used by spotted owls (home range size and boundaries, vegetative composition and structure, habitat configuration within home ranges).

  Task 1 Publish a methods handbook for spotted owl research.

  Task 2 Radio-track spotted owls to determine home range sizes and boundaries and to characterize the vegetative structure and composition of home ranges.

  Task 3 Characterize habitats used by dispersing juvenile owls using radio-telemetry.

  Task 4 Describe amount and pattern of habitat at a landscape scale and relate to distribution, abundance, and vital rates of owls throughout the landscape.

- ***Action Item A.2***: Inventory amount and distribution of suitable habitat inside and outside of the DCAs.

  Task 1 Identify habitat variables and prepare inventory protocols that will be used by managers and researchers.

  Task 2 Conduct habitat inventory according to protocols.

Objective B: Investigate the use of silvicultural activities to create or maintain stand conditions used by owls, and the degree of use by owls of those created conditions.

- ***Action Item B.1***: Investigate the use of silvicultural activities to create and/or maintain forest structure and composition used by spotted owls and their prey species. Consider silvicultural and salvage activities.

  Task 1 Evaluate existing methods and develop new ones to accelerate formation of cavities, snags, down wood, crown structure, and species characteristics of stands suitable for owl habitat.

  Task 2 Evaluate methods for accelerating the development of characteristics associated with owl nesting in managed stands.

  Task 3 Evaluate methods for accelerating the development of characteristics associated with owl foraging and roosting in managed stands.

  Task 4 Evaluate alternative silvicultural prescriptions for their ability to sustain conditions required for owl dispersal.

  Task 5 Evaluate alternative harvest prescriptions for their ability to replace suitable habitat conditions as rapidly as possible following a final harvest prescription.

- ***Action Item B.2***: Determine the use of created stand conditions by owls and prey species.

  Task 1 Determine the response of owls to landscape manipulations designed to accelerate development of nesting habitat.

  Task 2 Evaluate the response of owls to silvicultural activities designed to accelerate development of roosting and foraging habitat.

  Task 3 Evaluate the response of nesting owls to treatments designed to reduce risk of habitat destruction.

  Task 4 Evaluate the effects of disturbance on owl nesting success.

Objective C: Estimate demographic characteristics of owls throughout physiographic provinces and major habitat conditions in provinces.

- ***Action Item C.1***: Estimate age-specific birth and death rates, turnover, pairing, mean age at first reproduction, etc. in large demographic study areas. Determine the influence of senescence on spotted owl populations.

- ***Action Item C.2***: Estimate demographic parameters in studies distributed more broadly throughout the owl's range stratified by state, province, landowner, etc.

- ***Action Item C.3***: Perform independent tests of owl immigration and emigration using radio-telemetry.

Objective D: Characterize relationships among spotted owls and their prey, predators, competitors, and other old-forest associated species.

- ***Action Item D.1***: Characterize spotted owl diets, their relationship to prey abundance, and their influence on survival and reproduction.

- ***Action Item D.2***: Determine the abundance and distribution of key prey species throughout the owl's range.

- ***Action Item D.3***: Determine demographic characteristics of prey species.

- ***Action Item D.4***: Determine factors influencing the abundance of key prey species, especially food habits, foraging behavior, densities, and the relative importance of microhabitat and habitat elements.

- ***Action Item D.5***: Characterize the influence of predation and competition on spotted owls in relation to landscape composition.

- ***Action Item D.6***: Develop silvicultural options for prey habitat and determine the response of prey species to silvicultural manipulations.

Objective E: Develop integrative models of population and habitat dynamics.

- ***Action Item E.1***: Develop ecologically based vegetation dynamics models that are spatially explicit and that incorporate both natural disturbances and succession and human-induced disturbance. Models should operate at a variety of scales (i.e., stand and landscape).

    Task 1 Develop predictive models for aspects of stand development or treatment where information is not currently available.

    Task 2 Develop programs or procedures to link stand- and landscape-scale models from several disciplines.

- ***Action Item E.2***: Develop models that relate vegetation conditions and dynamics to owl population dynamics (and possibly prey species dynamics). These could include models of energy flow in owl-prey systems.

  Task 1 Synthesize current information about existing models.

  Task 2 Develop and adopt protocols for model evaluation.

  Task 3 Refine existing models and develop new models as appropriate.

  Task 4 Incorporate other species in the modeling effort.

Research Priorities

Research work that has been completed to date was reviewed by the Recovery Team according to this classification. A summary of work that has been completed is available in the recovery plan's administrative record. Research priorities for the next 5 years are shown in Tables 3.37 to 3.41. These priorities were based on the summary of existing work and on the current management situation in each province. The tables show the physiographic provinces where research should be conducted, and they separate the research tasks into four broad categories. These are:

1. ***Research that will produce information necessary for immediate recovery actions.*** An example would be research to evaluate the response of owls to silviculture designed to reduce the risk of natural disturbance in habitat. If research in this category were not accomplished, it would impair our ability to accomplish research objectives in one or more areas.

2. ***Research that will produce information necessary to support delisting decisions.*** An example would be research to estimate the demographic characteristics of owls. If research in this category were not accomplished, the data to support delisting decisions would not be available.

3. ***Research that will produce information needed for adaptive management.*** This could include adaptive management actions that accelerate recovery and actions that would improve economic or biological efficiency. An example would be evaluations of alternative silvicultural prescriptions for their ability to sustain conditions required for owl dispersal. If research in this category were not accomplished, it would reduce the ability to make adaptive management changes.

4. ***Research needed to improve understanding of owls and their environment.*** An example would be estimation of demographic characteristics of owl prey species. If research in this category were not accomplished, it would reduce the ability to improve management of the ecosystem on which owls depend.

In many cases, specific research topics fall into more than one of these categories. The categories should not be interpreted as priorities. Rather, when funding and priority decisions are made for research, the implications of accomplishing or not accomplishing specific research items should be understood.

Table 3.37. Need for habitat relationships studies by physiographic province.

Task	Study/Topic	Cat.	Physiographic Province										
			Washington				Oregon				California		
			Olympic Peninsula	Western Lowlands	Western Cascades	Eastern Cascades	Coast Range	Western Cascades	Eastern Cascades	Klamath	Coast	Klamath	Cascades
A1/T1	S1 Methods handbook	3	RW										
A1/T2	S1 Conduct new telemetry study	2,3			X	X			X				X
	S2 Publish symposium	2,3	RW										
	S3 Reanalyze eXisting habitat data	2,3	X				X	X		X	X	X	
	S4 Complete stand-level analysis	2,3	X		X	X		X					
	S5 Develop new techniques to study foraging	3	X		X	X		X		X			
A1/T3	S1 Juvenile dispersal distance	3	X		X	X	X		X	X			X
	S2 Dispersal habitat analysis	3	X		X	X	X	X	X	X		X	X
	S3 Juvenile survivorship related to habitat	3	X		X	X	X	X	X	X		X	X
	S4 Alternative dispersal habitat definitions	3	X		X	X	X	X	X	X		X	X
A1/T4	S1 Landscape habitat amount and pattern	3	X	X	X	X	X	X	X	X	X	X	X
	S2 Post-hoc analysis of monitoring sites	3	X	X	X	X	X	X	X	X	X	X	X
	S3 Evaluate remote sensing techniques	3	X	X	X	X	X	X	X	X	X	X	X
	S4 Habitat change - demographic study areas	2,3	X		X	X	X	X		X		X	
A2/T1	S1 Habitat classification	2,3	X	X	X	X	X	X	X	X	X	X	X
	S2 Stand eXam linkage	2,3	X	X	X	X	X	X	X	X	X	X	X
	S3 Create new habitat maps	2,3	X	X	X	X	X	X	X	X	X	X	X
A2/T2	S1 Conduct periodic habitat inventory	2,3	X	X	X	X	X	X	X	X	X	X	X

Cat. = Categories.
2 = need for delisting.
3 = need for adaptive management.

X = provinces where new or continuing studies are needed.

RW = rangewide - a single effort should be conducted for the entire range of the spotted owl.

Table 3.38. Need for silvicultural studies by physiographic province.

Task		Study/Topic	Cat.	Physiographic Province: Washington – Olympic Peninsula	Washington – Western Lowlands	Washington – Western Cascades	Washington – Eastern Cascades	Oregon – Coast Range	Oregon – Western Cascades	Oregon – Eastern Cascades	Oregon – Klamath	California – Coast	California – Klamath	California – Cascades
B1/T1	S1	Summarize snag and cavity information	1,3	RW										
	S2	Methods to develop snags and cavities	1,3	X	X			X				X		
	S3	Methods to create storied stands	1,3		X			X	X					
B1/T2	S1	Develop prescriptions for nest stands	1,3	X	X	X	X	X	X	X	X	X	X	X
	S2	Test stand level nest treatments	1,3		X			X		X		X	X	
	S3	Test treatments for high-risk stands	1,3				X			X	X		X	
B1/T3	S1	Test stand level roosting-forging treatment	1,3	X	X	X	X	X	X	X	X	X	X	X
	S2	Landscape study roosting-foraging habitat	1,3		X	X	X	X			X		X	
B1/T4	S1	Develop alternative dispersal prescriptions	1,3				X			X	X		X	
	S2	Test alternative prescriptions at stand scale	1,3				X			X	X		X	
	S3	Landscape test of dispersal prescriptions	1,3				X			X	X		X	
B1/T5	S1	Test alternative harvest presecriptions	3		X								X	
	S2	Retrospective tests-habitat recovery	3		X				X				X	
B2/T1	S1	Owl response to nest habitat treatments	3		X			X						
	S2	Retrospective response to nest hab. treatment	3		X			X				X		
B2/T2	S1	Stand test roosting-foraging treatment	3	X	X	X	X	X	X	X	X	X	X	X
	S2	Landscape test roosting-foraging treatments	3		X	X	X	X			X		X	
B2/T3	S1	Owl response to risk reduction	1,3				X			X	X		X	
B2/T4	S1	Retrospective study-nest disturbance	3	RW										

Cat. = Categories
1 = needed to implement recovery recommendation
3 = needed for adaptive management

X = provinces where new or continuing studies are needed

RW = rangewide - a single effort should be conducted for the entire range of the spotted owl.

Table 3.39. Need for demographic studies by physiographic province.

			Physiographic Province										
			Washington				Oregon				California		
Task	Study/Topic	Cat.	Olympic Peninsula	Western Lowlands	Western Cascades	Eastern Cascades	Coast Range	Western Cascades	Eastern Cascades	Klamath	Coast	Klamath	Cascades
C1	S1 Demographic studies	2,3	X		X	X	X	X		X	X	X	
	S2 Analyses of bias	2,3	RW										
	S3 Alternative techniques	2,3	X					X					
C2	S1 Vital rates on random sites	2,3	X	X	X	X	X	X	X	X	X	X	X
C3	S1 Test immigration/emigration	2	X			X		X		X		X	

Cat. = Categories.
2 = needed for delisting.
3 = needed for adaptive management.

X = provinces where new or continuing studies are needed.

RW = rangewide - a single effort should be conducted for the entire range of the spotted owl.

Table 3.40. Need for studies of prey, predator, and competitive relationships by physiographic province.

			Physiographic Province										
			Washington				Oregon				California		
Task	Study/Topic	Cat.	Olympic Peninsula	Western Lowlands	Western Cascades	Eastern Cascades	Coast Range	Western Cascades	Eastern Cascades	Klamath	Coast	Klamath	Cascades
D1	S1 Characterize diets	3	X		X	X	X	X		X	X	X	
	S2 Relate diet to reproduction/survival	3	X			X	X	X		X	X	X	
	S3 Temporal variation in diet	3	X			X	X	X		X		X	
D2	S1 Flying squirrel range and abundance	3	X	X	X	X	X	X	X	X	X	X	X
	S2 Lagomorph range and abundance	3	X		X	X	X	X		X		X	
	S3 Pocket gopher range and abundance	3				X			X				
D3	S1 Demographics and dispersal of red tree voles	3,4						X					
	S2 Demographics and dispersal of woodrats	3,4								X		X	
D4	S1 Review of prey habitat relationships	3,4	RW										
D5	S1 Great horned and barred owl abundance	3	X		X	X	X	X		X	X	X	
	S2 Landscape effects on great horned and barred owl	3	X		X	X	X	X		X	X	X	
D6	S1 Habitat treatments for flying squirrels	1,3		X				X		X		X	
	S2 Habitat treatments for woodrats	1,3		X				X		X		X	

Cat. = Categories.
1 = needed to implement recovery recommendation.
3 = needed for adaptive management.
4 = needed for broader understanding of owls and their ecosystem.

X = provinces where new or continuing studies are needed.

RW = rangewide - a single effort should be conducted for the entire range of the spotted owl.

Table 3.41. Need for modeling efforts.

			Physiographic Province										
			Washington				Oregon				California		
Task	Study/Topic	Cat.	Olympic Peninsula	Western Lowlands	Western Cascades	Eastern Cascades	Coast Range	Western Cascades	Eastern Cascades	Klamath	Coast	Klamath	Cascades
E1/T1	S1 Refine stand models	1,2,3	X	X	X	X	X	X	X	X	X	X	X
E1/T2	S1 Stand models for other disciplines	1,2,3	X	X	X	X	X	X	X	X	X	X	X
E2/T1	S1 Review current owl model information	2,3	RW										
E2/T2	S1 Adopt evaluation protocols	2,3	RW										
E2/T3	S1 Develop and evaluate models	2,3	RW										
E2/T4	S1 Incorporate other species	3	RW										

Cat. = Categories.
1 = needed to implement recovery recommendation.
2 = needed for delisting.
3 = needed for adaptive management.

X = provinces where new or continuing studies are needed.

RW = rangewide - single effort should be conducted for the entire range of the spotted owl.

Recommendations for Specific Research Areas

The Recovery Team makes the following recommendations for study areas and techniques for collecting information.

Demographic studies.

Demographic study areas will provide information about demographic (i.e., vital) rates (e.g., age-specific, stage-specific rates of fecundity and survival, age at first and last reproduction) and the occurrence of immigration. These are large areas, tens to hundreds of square miles, where as many spotted owls as possible are banded. Banding is done on adult, subadult, and juvenile owls. Owls are observed on an annual basis on territorial sites, and young are observed annually on nest sites. These observations are used to estimate age-specific or stage-specific fecundity and mortality rates. Procedures for developing some of these estimates are explained further in Appendices A and C. There are currently more than 12 demographic studies under way in the following physiographic provinces: Olympic Peninsula; eastern Washington Cascades; western Oregon Cascades; Oregon Coast Range; Oregon Klamath; California Klamath; and California Coast. An additional demographic study area should be established in the western Washington Cascades province. Three provinces—western Washington lowlands, eastern Oregon Cascades, and California Cascades—currently cannot support demographic studies equivalent to those found in the other provinces because of low owl numbers. Density and demographic studies could be initiated in these provinces when their owl populations have increased to the point that delisting can be considered.

General recommendations for demographic studies.

1. ***Maintain existing demographic study areas***: Since owls are long-lived animals, long duration population studies will be necessary to estimate population trends. Assessment of annual changes in vital rates is necessary to draw appropriate inferences from each study. The most cost-effective way to evaluate owl populations is to continue the demographic studies. The longer a study has existed the more valuable it is for assessing trends in demography.

   In several physiographic provinces, more than one study is currently taking place. Such redundancy is probably valuable and should provide better estimates of vital rates and the variability in those rates. However, budget limitations may make it impossible for all of these studies to continue. In this case, it is recommended that they be prioritized using the following considerations:

   - Longevity of each study.
   - Representation of all physiographic provinces.
   - Representation of all major ecological conditions.
   - Representation of significantly different management strategies.
   - An analysis of the effect of study area size on the ability to estimate immigration/emigration bias in the data.
   - An analysis of the number of years required for an estimate of immigration/emigration bias.
   - An assessment of the likely contribution of the study to adaptive management and/or delisting decisions.

2. ***Expand selected demographic study areas***: Include larger areas that will encompass owls in several DCAs and the province matrix. This will allow some estimation of immigration into DCAs. While this will not allow an absolute estimate of the number of immigrants, it will provide evidence of immigration and it will provide estimates of the sources of the immigrants and distances traveled. Such large study areas encompassing the demography study areas also would improve the analysis of regional trends in demography.

3. ***Facilitate the validation monitoring/research needed for adaptive management***: The Recovery Team recommends that additional research areas be established near existing demographic study areas in the federal matrix. One research area per province would be desirable, and its area should be equivalent to its companion demographic study area. The Recovery Team recommends that these research areas have as their goal replicated experiments to evaluate a) the response of owls to timber harvest, b) the utility of various silvicultural prescriptions in producing habitat for owls, c) emigration and immigration rates in response to a changing landscape, and d) the demographic response of the owl population in the area. Experiments in these research areas can occur in currently suitable habitat, and will contribute to the recovery plan's goal to delist the owl throughout its range and to achieve forest management that is compatible with owls throughout the landscape. Inferences regarding the compatibility of timber harvest with owls can be achieved only through the execution of controlled, replicated experiments. It is essential that the principal investigators of the companion demography and experimental research areas agree to full cooperation before establishing the research protocol in the experimental research areas.

The Recovery Team also recommends that research continue on Yakima Indian Nation lands and on private lands throughout the owl's range. Ongoing research on Yakima lands is a unique study of owl population responses to a forested landscape that has been managed through an uneven-aged silvicultural regime.

6. Data Base Maintenance

One of the major challenges in developing the recovery plan was assembling data from three states and a variety of ownerships. These data included information about forest vegetation, suitable owl habitat, a spotted owl range map, forest productivity, owl locations, land ownership, land allocations, streams, locations of a variety of other species (see Appendix D), critical habitat designations, physiographic province boundaries, and a variety of possible conservation strategies. These data were installed on a geographic information system (GIS) and used to produce the considerable information contained in this recovery plan.

This is the first multiownership, multistate data base that has been developed for spotted owls and their habitat, and it has proven to be extremely valuable. However, no agency or group has a charge to maintain this data base, so it could rapidly go out of date and fall into disuse. The availability of this data base is important to implementation of the recovery plan, and a cooperative mechanism for maintaining and updating it should be found. This would involve the development of cooperative agreements among all parties that collect and/or use the data. It also would require adequate funding for facilities and personnel needed to maintain the data base.

The data base should be updated on the same cycles as its component data. Spotted owl locations would generally be updated annually when agencies and private landowners complete their surveys. Habitat information would be updated on longer cycles, possibly as long as 5 to 10 years in some locations. Land allocation, ownership, and other data base information would generally be updated less frequently.

One advantage of maintaining this data base is the impetus it provides for standardization of data definitions. The coordinating group established to help implement the recovery plan should lead an effort to standardize basic data definitions and collection techniques.

7. Coordination

To be effective in attaining the goals of this recovery plan, the monitoring and research effort must be coordinated among the responsible federal and state agencies, and private interests, including universities. This coordination should be part of the function of the coordinating group established during the implementation of this recovery plan (see section IV.C.). The coordinating group will help ensure that all required parts of the monitoring program are conducted, monitoring designs are coordinated among agencies and landowners, monitoring proceeds according to design, monitoring reports are prepared and reviewed on an established schedule, periodic reviews are made to see if management adjustments are needed or desirable, and recommended research activities are coordinated among agencies so that research is efficient and representative of the entire range of the subspecies.

III.

K. Adaptive Management

1. The Role of Adaptive Management in the Recovery Plan

The recovery plan proposes a tightly structured strategy which protects owls in DCAs and the matrix. It is designed to deal with the current situation which requires prompt and strict action to prevent the subspecies' further decline. This strategy should be considered a starting point for recovery of northern spotted owls. It is based on currently available information about owls, which is considerable. However, the strategy must be continually reexamined and should be modified over time based on new information and changing circumstances.

In this section, the Recovery Team proposes a process that will use the results of monitoring and research to improve the recovery strategy over time. This process is termed adaptive management (Holling 1978; Walters 1986); it should make the recovery of owls more secure, while also looking for ways to increase compatibility between forestry and spotted owls. One possible outcome of this process could be movement toward the long-term goal of providing spotted owl habitat throughout the forest landscape, with less reliance on a system of reserves.

A variety of factors contributes to the need to make the recovery strategy dynamic. These factors are summarized here.

- While northern spotted owls are extremely well-studied, scientific knowledge about them is far from complete. Significant uncertainty exists in areas such as the use of various forest types and structures for dispersal; use of managed second-growth habitats; cycles in population productivity; and overlap of home ranges among pairs of owls. New information about these areas could suggest significant refinements to the recovery strategy.

- In some instances, recommendations made in the recovery plan are based on average values of information collected throughout the range of the owl rather than on site-specific information. The development of information about how owls use specific forest types may help refine these recommendations.

- The forest landscape occupied by spotted owls is dynamic, and it is likely to undergo significant changes during implementation of the recovery plan. Some of these changes may be unpredictable and dramatic, such as large fires. Other changes may be more predictable and subtle, such as the widespread creation of new stand structures through innovative forest management. These changes, and the owls' response to them, may suggest desirable modifications to the recovery strategy.

- The interaction of owls with their ecosystem is also dynamic and may change through time. For example, the nature of the northern spotted owl's interaction with the barred owl may change and necessitate management actions that are not currently envisioned.

- The legal and regulatory environment for spotted owls may change during implementation of the recovery plan. Changes could occur in state or federal laws and regulations. Changes could also occur in plans that have been put in place to implement these laws and regulations. For example, new recovery plans could be initiated for other species in the same ecosystem. Adjustments to this recovery plan might then be desirable to make the overall effort more efficient.

- The economic situation for forest-based industries might change, and demands for various forest products might shift through time. This could include both consumptive uses such as lumber production, and nonconsumptive uses such as recreation. These changes could make different management practices either more or less economical. They might also cause significant changes in the economic base of communities. All these changes could alter the desirability and feasibility of various forms of forest management.

- Understanding the effects of management on forest stand structure and composition will probably change significantly as new forms of management are tried. This new information will help refine practices intended to produce spotted owl habitat.

For these and other reasons, it is not appropriate to apply static management strategies to a dynamic forest ecosystem. Adaptive management is designed to respond to the changing forest ecosystem and advances in human understanding of the ecosystem.

Two types of adaptive management, passive and active, have been described (Walters 1986, Walters and Hilborn 1978). In passive adaptive management, a plan is implemented as though it were correct, and then it is adjusted through time based on monitoring and the detection of mistakes. In active adaptive management, monitoring and research programs are specifically designed to answer questions about policy decisions. It is recommended that an active adaptive management strategy be pursued for the northern spotted owl recovery plan. The essential requirements for adaptive management include:

- A clear vision of goals.

- A model of how the ecosystem operates, including hypotheses about key processes and elements in the ecosystem.

- A plan that makes future options feasible.

- A clear description of current standards and guidelines, and an understanding of how those standards and guidelines are intended to achieve goals.

- Oversight to ensure that current standards and guidelines are implemented and monitored.

- Clear adaptive management questions and anticipation of how standards and guidelines might be changed over time in response to various outcomes.

- Monitoring and research aimed at key adaptive management questions.

- Established procedures for reviews and making changes. These include:
    - scheduled reviews
    - special reviews
    - clear responsibility and authority, including the presence of a coordinating group chartered to do oversight and review.

- Identification of trigger points based on the model of the ecosystem; knowledge of the standards and guidelines and their basis; and hypotheses about possible outcomes and appropriate responses to those outcomes.

2. Steps in the Adaptive Management Process

The idea of adaptive management seems straightforward and simplistic; when there is better information, provisions of the recovery plan are changed. However, actual application of this deceptively simple process can become complex. Often, there is inherent reluctance to alter decisions and practices that may have taken months or years to develop. There may be significant ownership in those decisions, by those who made them and those who are charged with implementing them. There also may be uncertainty about the development of the original recommendations, which leads to uncertainty about the basis for changing them. The nature of the new decision relative to the prior decision may also be unclear. For example, there may be questions about whether the new decision should entail less risk, equivalent risk, or more risk than the original decision. There may also be significant questions about the proper timing for a new decision.

Having a well-defined adaptive management process in place can help overcome some of these difficulties. The process should provide a structure for dealing with adaptive management questions in an orderly way and producing well-documented recommendations. The following 13 steps represent an initial attempt at such a process.

a. ***Describe the portion of the recovery plan being addressed and the nature of the objective for the original recommendation.*** The key adaptive management questions defined later in this section are a starting point for this step. Each question might be broken into finer parts for analysis through the adaptive management process.

b. ***Describe the current standards and guidelines.***

c. ***Describe the basis for the current standards and guidelines, i.e., the specific information that was used in their development and how that information was synthesized.*** In this step, it would be useful to separate 1) information derived from specific studies, 2) interpretations of that information, and 3) assumptions or professional judgments that were made when information was not available.

d. ***Provide some judgment about the power of the information used in developing the standards and guidelines.*** It is important here to consider both the risk level involved in implementation of the current standards and guidelines and the levels of uncertainty surrounding information that was used to develop them. This will 1) help determine how likely it is that the standards and guidelines will have to be changed and 2) suggest the types of information that should be collected in anticipation of possible changes.

e. ***Describe working hypotheses about how standards and guidelines will function to achieve objectives.*** This may include development of specific models for the parts of the ecosystem being addressed.

f. *Describe as clearly as possible which outcomes will be observed if standards and* ***guidelines are followed and operate as expected.*** These predictions should include ranges of possible outcomes based on empirical observations and the use of simulation models.

g. ***Describe outcomes that might occur if standards and guidelines do not operate as expected.*** These outcomes will help form the basis for trigger points to establish when standards and guidelines would be reviewed.

h. ***Describe the types of changes that might be made to the standards and guidelines if outcomes are not as expected.*** It is important to describe, in advance, what types of possible changes could be envisioned for the standards and guidelines. Research and management experiments could then be directed at these possible new standards to allow an assessment of effectiveness of various options. This step should also include a discussion of how the current standards and guidelines will influence options for the future and an assessment of how likely it is that optional standards and guidelines could be put in place over time. It might also include recommendations for actions that are needed to ensure that options are still feasible over time.

i. ***Describe the monitoring and research information that should be collected to determine: 1)if the standards and guidelines are being properly implemented, 2) if the standards and guidelines are producing expected results, and 3) what changes to the standards and guidelines would be appropriate.*** Establish responsibilities, funding, and specific plans to accomplish the monitoring and research that is outlined. Monitoring and research plans should be integrated. There should also be a description of the role that case studies could play in the development of information needed for adaptive management. A discussion of case studies is presented later in this section.

j. ***Describe trigger points for reviews and changes.*** Trigger points should be of three types. First, there should be triggers for regularly scheduled reviews of all elements of the recovery plan. The longest period between reviews should be 5 years. Second, there should be triggers to review the recovery plan if specific outcomes occur that are outside the predictions made. These are the points normally called trigger points. Finally, in some instances, there may be triggers established based on new research information rather than on the occurrence of specific outcomes from the recovery plan. This is most likely to be the case when the information used to produce a specific standard and guideline was weak, and the outcome of that standard and guideline is difficult to observe.

k. ***If trigger points are reached, review all available monitoring and research data to determine if a new decision is appropriate.*** Societal values, including cost-benefit analyses, may be an appropriate consideration here. Risk analysis, focused on the original decision and the possible change, should be used in developing the recommendation. The risk analysis should also include consideration of the possible timing of changes in standards and guidelines.

l. ***Make decisions and implement new standards and guidelines.***

m. ***Initiate a monitoring program to assess whether the modification is achieving desired results. Subject the new standards and guidelines to steps a. through j.***

It is important to note that these steps should be pursued immediately upon implementation of the recovery plan. Steps a. through j. should be completed as soon as possible for all of the key adaptive management questions. Information from these steps will be used in forming the monitoring and research programs and in developing the operating procedures for the coordinating group that will later consider adaptive management questions.

Differences among physiographic provinces and forest types in those provinces must also be considered throughout these steps. In many cases, province-specific information was available during the formation of standards and guidelines and is reflected in them. In other cases, there was inadequate local information and a single standard and guideline was put in place throughout the owl's entire range. In these cases, standards may change for some portions of the range based primarily on the development of new research information about that part of the range. In all cases, the possible outcomes, trigger points, monitoring and research plans, and assessment of risk may vary from province to province.

3. Key Adaptive Management Questions for the Recovery Plan

The following questions are intended to help focus the monitoring, research, and adaptive management processes. They were used to help formulate the monitoring and research programs discussed in section III.J. They also will provide the primary focus for agency consideration of possible changes to the recovery plan.

Management of federal forestlands in DCAs.

- When and how would DCA boundaries be changed?
- When and how would provisions for silviculture and salvage inside the DCAs be changed?
- When and how would the catastrophic risk management provisions be changed?
- When would it be necessary to add DCAs to the DCA network?
- When would it be appropriate to delete DCAs from the DCA network?
- When and how would the multiple-use coordination recommendations be modified?
- When and how would the distance between DCAs be modified?

Management of federal forestlands outside the DCAs

- When and how would the dispersal habitat guidance (50-11-40 rule) be modified?
- When, where, and how would other provisions of matrix prescription A change?
    - increase density of residual habitat areas?
    - decrease density of residual habitat areas?
    - change size of residual habitat areas?
    - change management of residual habitat areas?
- When, where, and how would matrix prescription B change?
    - increase number of reserved pair and managed pair areas?
    - decrease number of reserved pair and managed pair areas?

- change size of reserved pair and managed pair areas?
- change management of reserved pair and managed pair areas?
- change location and distribution of reserved pair and managed pair areas?

- When, where, and how would matrix prescription C change?
  - increase number of managed pair areas?
  - decrease number of managed pair areas?
  - change size of managed pair areas?
  - change management of managed pair areas?
  - change managed pair area location and distribution?

- When, where, and how would it be appropriate to require additional measures to provide for spotted owls in the matrix?

Interactions between federal matrix forests and DCAs.

- As the recovery effort works toward landscape-scale management, how would DCA management change in response to changes in the matrix conditions? How would changes in the matrix conditions change in response to DCA management?

Nonfederal lands recommendations.

- When, where, and how should take guidance be changed?

- When, where, and how should recovery plan recommendations for specific areas be modified?

- How should recovery plan recommendations be changed?

Interaction between federal and nonfederal lands.

- How would recommendations for federal lands be changed in response to accomplishments on nonfederal lands? How would recommendations for nonfederal lands be changed in response to accomplishments on federal lands?

4. The Nature of Adaptive Management Decisions

Early in the process of implementing the recovery plan, it is important to consider the scope and scale of decisions that may be made through the adaptive management process. These considerations may influence the type of information that will be collected through monitoring and research; the trigger points that are established; and the decision-making process that is pursued. Adaptive management decisions may be made at any of the following scales:

- Rangewide.
- Province-wide.
- For specific forest types in a province.
- For specific locations, such as individual DCAs.

An example of an adaptive management decision that will be made for individual DCAs is the decision to change matrix prescription B or C recommendations through time (see section III.C.). Those decisions will be based on changes that occur in individual DCAs or groups of DCAs, so information must be collected at that level for adaptive management to occur.

Decisions that may be made for forest types in provinces could include salvage and silviculture guidelines for DCAs, guidelines for managing fire-risk levels, and guidelines for managing managed pair areas. Adaptive management decisions at the province level could include modified guidelines for management of dispersal habitat and changes to recommendations for the size of managed pair areas or reserved pair areas. Decisions might also be made at this level to modify the overall recovery plan strategy from management of preserves and matrix to management for owl habitat better distributed throughout the landscape.

Rangewide adaptive management decisions will probably be least common but could be made for standards such as the limitation on silvicultural activities to 5 percent of the land in any DCA.

The consideration of risk levels should be an integral component of the adaptive management decision-making process. It is recommended that an explicit risk assessment be completed that compares the current recommendation with possible future recommendations. This assessment should include an evaluation of 1) the reliability of available data, 2) the current status of owls and their habitat in the area affected by the decision, and 3) the consequences of implementing changes on various time schedules. The decision-making process also should include assessments of economic and social consequences, and effects on other species and other components of the ecosystem. Finally, there must be an evaluation of how decisions would affect future management options.

An Example of the Adaptive Management Process.

This section presents an example of the adaptive management process. The example provides details, for a single case, of steps a. through j. in the suggested adaptive management process. These are the steps that can be completed immediately for all of the primary adaptive management questions. Completion of these steps for other questions should be a high priority for the coordinating group following publication of the recovery plan.

a. *Part of the plan being addressed.* This discussion focuses on the management of federal matrix forests to provide for successful dispersal by juvenile and adult owls among DCAs.

b. *Describe the current standards and guidelines.* Management of federal forestlands for dispersal habitat is in matrix prescription A. This prescription calls for maintenance of specified conditions on at least 50 percent of federal forestlands in each quarter-township. The required conditions are for stands to be dominated by trees at least 11 inches dbh and to have canopy closure of at least 40 percent. This 50-11-40 rule is to be implemented individually for lands managed by each federal agency. Only those lands capable of achieving the 11-40 standard need to be included in the calculation. The 50-11-40 rule may be met by applying a variety of management activities that will allow the specified conditions to be sustained through time. This 50-11-40 rule applies throughout the range of the owl and throughout the entire landscape.

c. *Describe the basis for the current standards and guidelines.* This is divided into 1) the basis for the 11-40 standard, 2) the basis for the 50 percent standard, 3) the basis for using the 50-11-40 rule throughout the range and the landscape, and 4) the basis for using quarter-townships in the 50-11-40 rule.

Basis for 11-40. The 11-inch dbh and 40 percent canopy-closure standard was based on the following:

- Studies that show it is the minimum condition not consistently avoided by owls in radio-telemetry studies of home ranges (Thomas et al. 1990). It should be noted that these studies were drawn from only a few of the physiographic provinces in the owl's range.
- Professional judgment that this condition will provide habitat for key prey species, and that it will discourage high rates of predation on spotted owls.

Basis for 50 percent. The standard that 50 percent of the forest meet the 11-40 standard was based on the following:

- Studies that show spotted owl occupancy decreasing significantly when habitat amount is less than 50 percent (Bart and Forsman 1992) of federal forestlands.
- Professional judgment that this standard will allow for adequate foraging and roosting opportunities for owls.
- An assumption that, under a commercial rotation, 50 percent of the forested landscape could always be maintained in an 11-40 standard.

Basis for managing throughout the landscape. The standard to manage for dispersal habitat throughout the landscape was based on the following:

- The observation that owls may move through any part of the range and do not follow the shortest route between areas.
- The design principle in the recovery plan to provide for redundant dispersal opportunities.
- The interpretation that providing the 11-40 standard would help sustain owls throughout the landscape.

Basis for using quarter-townships. Quarter-townships were selected as the framework for the 50-11-40 rule because they have fixed, easily identifiable boundaries at a scale judged to be appropriate to provide for distribution of dispersal habitat.

d. Provide judgment about the power of this information. This is divided into a discussion of empirical data, ecological theory, and inferences made from both.

Empirical data.

- The habitat data used to develop the 50-11-40 rule were drawn from studies designed for other purposes. Those studies were intended to evaluate owl use of habitats in home ranges.
- The habitat data used were extrapolated throughout physiographic provinces and forest types.
- The information about dispersal patterns came from studies designed for that purpose that were conducted in the western Oregon Cascades and California Klamath provinces. This information was extrapolated to other provinces.

Ecological theory.

- The need for dispersal habitat was based on ecological theories concerning metapopulations and the need for interchange among subpopulations of a metapopulation.
- General guidance was taken from an understanding of how forest raptors use habitats and from the general understanding that survivorship would be directly related to the quality of dispersal habitat.

Inferences.

- Based on ecological theory, it was inferred that the 50-11-40 rule would provide for at least short-term survival of dispersing owls.
- It was inferred from agency management plans that the 50-11-40 rule could be maintained with normal harvest rotation ages.

Summary of the power of information used.

- All of the underlying habitat data apply only indirectly to this problem, and they were extrapolated to forest types and provinces other than those where they were developed.
- Information about pattern of dispersal is sound, but again it was extrapolated broadly from the area where it was collected.
- The underlying ecological theory is sound, but not helpful in quantifying parameters.

e. Describe working hypotheses about how standards and guidelines will function to achieve objectives. Following are six hypotheses concerning how management for 50-11-40 conditions will provide for sufficient levels of movement by juvenile and adult owls among DCAs.

- Stands that meet the 11-40 standard provide higher prey densities than stands that do not, and these densities are adequate to sustain owls during the short term.
- Landscapes that meet the 50-11-40 rule provide higher densities of prey than landscapes that do not.
- Landscapes that meet the 50-11-40 rule provide for lower predation rates on spotted owls than landscapes that do not.
- Landscapes that meet the 50-11-40 rule provide higher levels of juvenile owl survival than landscapes that do not.
- The survivorship of adult and juvenile owls in landscapes that meet the 50-11-40 rule, in conjunction with other demographic parameters, will result in a stable population.
- The survivorship of juvenile and adult owls in landscapes that fail to meet the 50-11-40 rule, in conjunction with other demographic parameters, will result in declining populations.

f. Describe outcomes that will be observed if standards and guidelines are followed and operate as expected. All of the following outcomes would be observed if the 50-11-40 rule were implemented and operating correctly.

- The likelihood of survival would be higher for individual owls that move through landscapes that meet the 50-11-40 rule than for individual owls moving through landscapes that do not.
- Individual owls moving through landscapes that meet the 50-11-40 rule would maintain body mass or lose body mass at a rate that allowed survival during a long enough period to move among DCAs. They would maintain higher body mass than individual owls moving through other landscapes.
- The likelihood of survival of individual owls moving through a landscape that meets the 50-11-40 rule, in conjunction with other demographic rates, would produce a stable population (i.e., lambda greater than or equal to 1).
- 50-11-40 conditions would be maintained through routine forest management with commercial harvest rotations.

g. Describe outcomes that might occur if standards and guidelines do not operate as expected. The standards and guidelines might fail to meet expectations in the following three ways:

- The likelihood of survival of individual owls moving through a landscape that meets the 50-11-40 rule, in conjunction with other demographic rates, would fail to produce a stable population (i.e., lambda less than 1). This would be the case if the guidelines for the 50-11-40 rule were not sufficient.
- The likelihood of survival of individual owls moving through a landscape that fails to meet the 50-11-40 rule, in conjunction with other demographic rates, would produce a stable population (i.e., lambda greater than or equal to 1). This would be the case if the guidelines for the 50-11-40 rule were sufficient but not necessary.
- Normal forest management would not allow the maintenance of the 50-11-40 rule.

h. Describe the types of changes that might be made to the standards and guidelines if outcomes are not as expected. Changes could be made to the guidelines for the 50-11-40 rule in one of five ways, or in some combination of these five ways. First, the standard for individual stand condition, that is, the 11-40 standard, might change. This could include changes to the tree-diameter standard, changes to the canopy-closure standard, or addition of some other standard such as a requirement for more complex canopy structure. Second, the standard for percentage of the landscape to be maintained in 50-11-40 condition, or some other condition, might be changed. Third, the standard that these conditions would be maintained in quarter-townships might be modified so that they would be addressed in larger or smaller areas. Fourth, the requirement that dispersal habitat be provided throughout the landscape could be modified. Finally, the guideline to consider lands under each federal agency's jurisdiction separately might be changed.

In place of these possible changes in the 50-11-40 rule, the strategy for dispersal habitat might be changed in more fundamental ways. For example, a new recommendation could be made for corridors of high-quality habitat either separately or in conjunction with other dispersal habitat.

i. Describe the monitoring and research information that should be collected to determine 1) if standards and guidelines are being properly implemented, 2) if standards and guidelines are producing expected results, and 3) what changes to the standards and guidelines would be appropriate. Implementation monitoring is already well advanced for this guideline. In response to a Recovery Team questionnaire, managers of virtually all Forest Service and BLM management units indicated that they were actively tracking the implementation of the 50-11-40 rule. This is being done through a combination of remote sensing, on-the-ground surveys, and tracking of management activities. Implementation monitoring could be improved through maintenance of the Recovery Team's data base which would allow an assessment of the landscape across ownerships.

There should be three basic aspects of the effectiveness monitoring for dispersal habitat. First, habitat in quarter-townships should continue to be monitored over time to determine if management activities actually do maintain 50-11-40 conditions. This monitoring could also provide information about whether implementation of the 50-11-40 rule caused changes in forest health or forest productivity. In addition, it could allow a determination of the effects of the 50-11-40 rule on entire landscapes as opposed to the effects on individual ownerships.

Second, the effects of the 50-11-40 rule on forest management activities should be tracked. For example, agencies should keep records on the number of management activities that had to be modified to meet the 50-11-40 rule. This could ultimately lead to a tally of the effects of the 50-11-40 rule on harvest levels and associated economic effects.

Third, the effects of the 50-11-40 rule on owl movement must be monitored. This should be done in conjunction with the monitoring for population trends, and would consist of recording the changes in location of banded owls. While this will not provide complete information about rates of movement among DCAs, it should provide an indication of 1) whether movement among DCAs is taking place, and 2) whether there are areas in the owl's range where movement among DCAs is either more successful or less successful than in other parts of the range.

Research on dispersal habitat should have the following objectives (see section III.J.):
- Determine rates of emigration and immigration.
- Determine rates of successful dispersal in landscapes with different habitat conditions.
- Characterize habitats used by dispersing owls.
- Investigate silvicultural prescriptions that can be used to provide required dispersal conditions most efficiently.

j. Describe trigger points for reviews and changes. The trigger points can be divided down into three categories: 1) scheduled reviews, 2) reviews based on the observation of specific outcomes, and 3) reviews based on new research results.

<u>Scheduled reviews.</u> All provisions in the recovery plan should be reviewed on a scheduled basis. The first review should occur no later than 5 years after publication of the recovery plan.

<u>Reviews based on the observation of specific outcomes.</u> Reviews should be scheduled if certain conditions occur. These conditions should be tracked, at a minimum, in each physiographic province. Reviews should take place if one of the conditions is detected in any of the provinces.
- The guideline for dispersal habitat is not being correctly implemented.
- No occurrences of successful dispersal are observed, or the observations of successful dispersal are a low percentage of the total observed number of emigrants.
- It is infeasible to maintain the 50-11-40 rule using commercial forest management practices.
- Forests managed to provide 50-11-40 habitat exhibit forest health problems.
- The rate of population increase is less than one, and poor juvenile survival is judged to be one of the primary causes.

Reviews based on new research results. Reviews based on new research are most likely to be appropriate in cases where the information originally used to produce a standard and guideline was weak. Reviews should occur if any of the following results are observed:

- New habitat use information is developed for at least one province showing that the minimum condition not consistently avoided by owls is significantly different from the 11-40 standard.
- Studies demonstrate that habitats used by owls during dispersal differ significantly from the 11-40 standard.
- Research demonstrates that rates of immigration are lower than expected, or lower than those rates that metapopulation dynamics models would indicate are needed to maintain stable populations.

It is important to note that these conditions would simply trigger a review of the guidelines, and would not necessarily result in a change in a particular guideline.

5. The Role of Case Studies

A basic tenet of adaptive management is that managers should learn from their actions. One way to accomplish that objective is to establish case studies.

Objectives for Case Studies

A case study is a documented example of the response of a system to a treatment or natural event. For example, documentation of the response of vegetation or wildlife to a fire in a particular place would be a case study. Because case studies are not replicated, they lack the power of inference that can be gained from controlled, replicated experiments. In some situations, replication is not possible because the condition being studied resulted from a unique natural event. In other situations, case studies may be useful in assessing the effects of management in local areas. Also, the value of case studies could be increased if they were coordinated to use similar study designs in a variety of locations throughout the range of the northern spotted owl. It is recommended that the coordinating group provide this overview of case studies, and that the possible contribution of those studies be included in assessments of the monitoring and research program.

Information to be pursued through case studies could include the following:

- Better understanding of the range of habitats used by owls for various life functions, and the contribution of various habitat types to owl survival and reproduction;
- Assess the effects of past silvicultural practices and natural disturbances on habitat conditions;
- Develop and test silvicultural prescriptions that can be used in young forest stands to accelerate the development of characteristics associated with owl habitat;
- Determine if and to what degree owls will use stands that have been treated with such prescriptions;
- Develop harvest/silviculture regimes that can be used in currently suitable owl habitat with the least and/or shortest possible decline in the suitability of that habitat;
- Determine if and to what degree owls will use stands that have been treated with these prescriptions;
- Determine the influence of the overall level of management activity in a home range on the survival and reproduction of owls in that area;
- Assess the effects of silvicultural practices on other species.

Retrospective and Opportunistic Studies

Some case studies may be designed in areas where past events produced forest conditions that may be valuable for spotted owls. These may include natural events and unusual forms of management. Studies may be put in place for either past events or recent occurrences.

Natural disturbances.

Natural disturbances that cause considerable change in the environment are common. Wildfires, major wind storms, and volcanic eruptions are examples of natural stochastic events. These events vary in scale from a few acres to thousands of acres. The response of vegetation and wildlife, particularly spotted owls, is of interest because it may provide information about the types of timber harvest regimes, silvicultural practices, and salvage operations that could be tried in experimental management units or in the matrix. These natural catastrophes provide the background information for evaluating the owls' ability to cope with a range of environmental changes from small-scale to large-scale and from low-intensity to high-intensity.

Alternative silviculture.

Relatively little is known about the response of owl populations to different timber harvest and silvicultural practices. In the Pacific Northwest most timber harvest has been clear-cutting. Nevertheless, other timber harvest regimes have been used that vary in degree of disturbance to the existing forest structure. These areas could be studied to evaluate their use by owls. In addition, some alternative silviculture regimes have been instituted specifically for owls but have not been monitored to evaluate their success (Solis pers. comm.). Finally, some areas of private lands have been managed under different regimes in which residual old-forest components have been retained. Owls currently occupy some of these sites, but their population stability is unknown. Case studies could provide insights about types of timber harvest regimes that could be instituted on a larger scale in experimental management units.

Designed Studies

Designed case studies would be conducted in areas where the landscape would be managed in an attempt to provide habitat suitable for stable owl populations while also permitting timber harvest. Such studies could take place at a variety of scales. At the smallest scale, studies could look at owl use of individual stands. At a broader scale, studies could look at the relative use of stands in owl home ranges. Studies at this scale would still be case studies for owls but could allow replication of silvicultural treatments.

At the largest scale, studies could examine effects of timber harvest on owl population stability in areas equivalent in size to DCAs. These could be termed experimental management units (EMUs). They should be large enough to allow inference about the effect of timber harvest on a population of owls. They could be placed in each province where sufficient habitat is present to maintain the integrity of the DCA network and the owl population in general. Preferably, an EMU should be associated with an existing demographic study area to allow comparison with a less impacted population.

EMUs would be coordinated efforts to achieve landscape-scale management by the land management agencies. They would require active coordination and planning from interdisciplinary management teams. Scientists would serve in an advisory role concerning the management prescriptions for the area. However, the land management agencies would be responsible for the overall plan and monitoring through their existing staffing. These EMUs would be examples of the potential to develop compatible timber/wildlife management within the constraints of the existing management system.

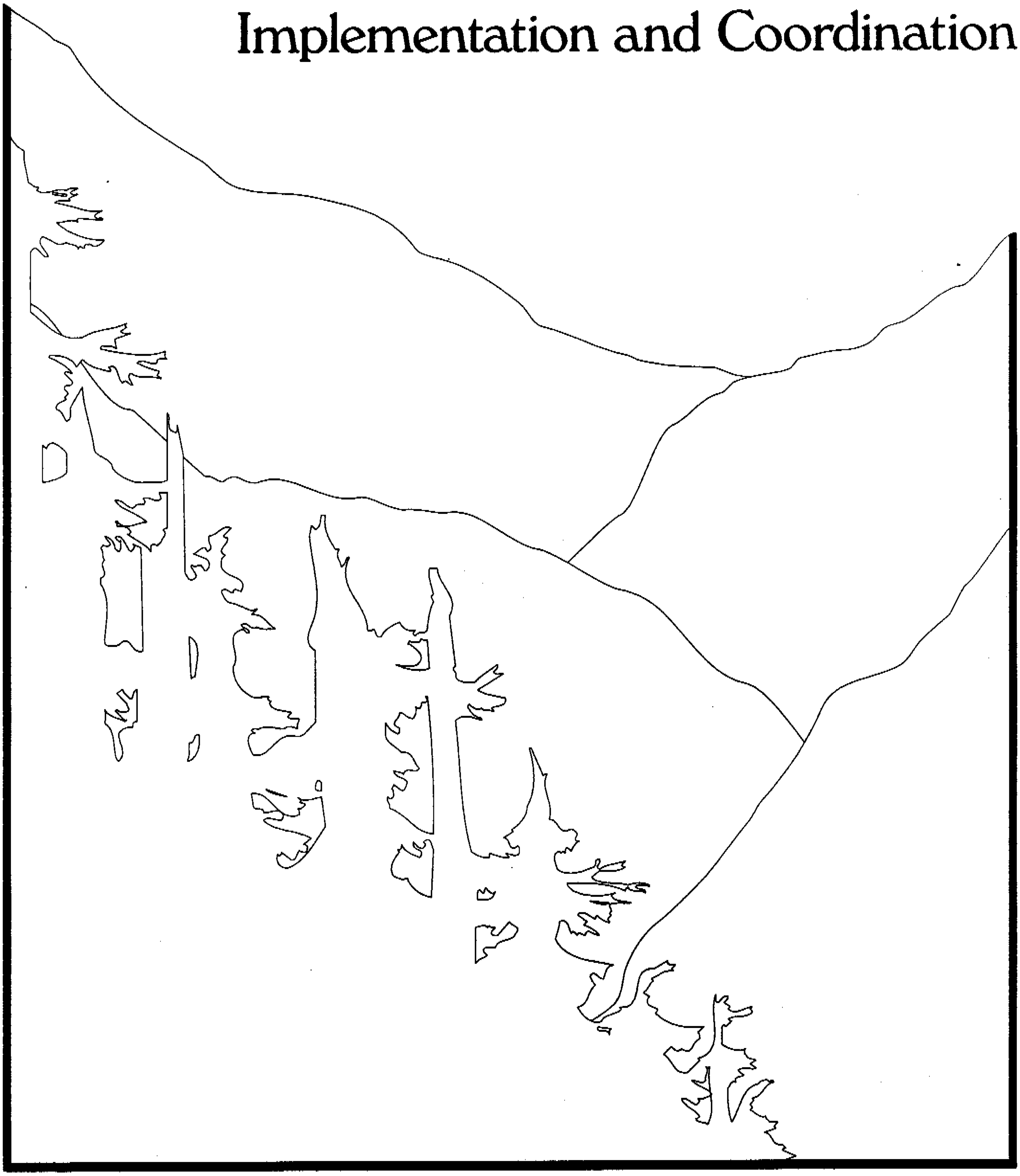
Selection of Case Study Areas

The following criteria should be used in selecting sites for designed case studies:

1. sites that are representative of a significant portion of the owl's range;
2. sites that can be established in conjunction with other ongoing studies;
3. sites where the contribution of subject owl pairs is not considered essential to recovery of the northern spotted owl;
4. sites where adequate control can be established to ensure that a case study is implemented properly;
5. sites where conditions lend themselves to rapid acquisition of new knowledge and insights.

Chapter IV

Implementation and Coordination



IV.

A. Implementation Strategies

1. Federal Lands

Federal Agency Planning

Agency activities submitted for section 7 consultation under the Endangered Species Act should be consistent with the recommendations of this recovery plan. If agencies act inconsistently with the recovery plan for an extended period, reductions in owl populations and degradation of owl habitat could have results that were not anticipated during the plan's development. Such reductions might require a reevaluation of the recovery plan to determine whether it would still provide sufficient assurance of recovery.

Implementation of the recovery plan will require agencies with authority over forestlands to comply with other legal mandates in addition to the Endangered Species Act. The BLM must implement the recovery plan in compliance with the Oregon and California Grant Lands Act (O&C Act), Federal Land Policy and Management Act (FLPMA) and National Environmental Policy Act (NEPA). The Forest Service must implement the recovery plan in a manner consistent with the National Forest Management Act (NFMA) and NEPA. The key initial step is integration of the recovery plan's recommendations into agency land management plans. Although completion of this step is likely to require some time, agencies should exercise interim management to avoid or minimize conflicts with recovery plan recommendations until land management plans are formally revised or amended. Full implementation of the recovery plan should be completed within 5 years.

Federal agencies, the states, and the private sector will need advice and assistance on various aspects of recovery plan implementation. The establishment of a coordinating group is recommended as soon as possible to carry out these functions (see section IV.C.).

Critical Habitat Designation

The recovery plan recommends that federal lands in DCAs, other than national parks and wilderness areas, be designated as critical habitat for the northern spotted owl. The recovery plan does not recommend designation of any other areas as critical habitat at this time. If progress toward reaching recovery goals does not proceed as quickly as anticipated, then designation of additional critical habitat may become appropriate. The FWS should initiate efforts to revise designated critical habitat as soon as the recovery plan is approved so that a final rule is in place soon after agencies formally integrate the recovery plan's recommendations into their land management plans.

DCA Management Plans

The recovery plan recommends that management plans be prepared for each DCA. These plans are an essential component of the effort to implement recommendations, as they will provide a framework and objectives for carrying out specific activities, monitoring their progress, and evaluating contributions toward recovery. The Forest Service, BLM, and National Park Service should initiate efforts to prepare these plans at an early date. Plans for DCAs that cross agency boundaries should be prepared jointly by the affected agencies. Management guidelines for DCAs are in section III.C. 1. An outline for preparing these management plans is included in that section. In addition, it is expected that the proposed coordinating group would provide further guidance upon request from the agencies.

Section 7 Consultation

The following addresses some of the major issues regarding the relationship between recovery plan recommendations and section 7 consultation.

Programmatic consultation.

Federal agencies must consult with the FWS on proposed activities that may affect the owl or its critical habitat. They may consult on site-specific actions, such as proposed timber sales, or on programmatic actions, such as a proposed decadal forest or resource management plan. In a programmatic review, the FWS considers impacts of a series of proposed actions that may be carried out during a period of several years. This approach is more appropriate and efficient than attempting to evaluate separately the effects of individual actions. Programmatic review also is beneficial for the land management agencies since once consultation is complete, activities conducted in accordance with the proposed program and the biological opinion may occur without further FWS review (unless new information is discovered that warrants reinitiation of consultation). Programmatic consultation increases efficiency in agency planning and enables the FWS to increase the technical assistance it provides to agencies. Consequently, consultations related to the northern spotted owl should be carried out on a programmatic, rather than site-specific, basis.

Agency decisions to implement the recovery plan's recommendations would facilitate programmatic review of activities affecting the owl or its critical habitat. "Implement," in this context, means making a formal commitment in a record of decision, or similar document, to establish DCAs in a manner consistent with recovery plan recommendations, and to follow the guidelines for managing the DCAs and the matrix (see section III.C.). Such a document could provide an adequate basis for consultation on activities in the matrix.

However, specifying impacts in DCAs in sufficient detail to complete consultation may be difficult until a DCA management plan is approved. Therefore, consultation on individual projects will be initiated prior to any action in DCAs that might affect northern spotted owls while a DCA management plan is in preparation. As previously noted, activities submitted for consultation should be consistent with recovery plan recommendations as soon as possible, even though efforts to formally integrate those recommendations into agency land management plans will require additional time. The type of management employed during the period until land management plans are formally revised or adjusted will help determine the timetable by which consultation proceeds.

Activities that may result in destruction or adverse modification of critical habitat.

The recovery plan establishes guidelines for the management of DCAs and the preparation of DCA management plans. The FWS should use these management guidelines as a baseline in evaluating the impact of proposed actions in DCAs. The guidelines should serve as a consideration for adverse modification of critical habitat. As previously noted, the critical habitat rule (USDI 1992b) should be revised to conform with DCA boundaries as agencies integrate recovery plan recommendations into their land management plans. The FWS should utilize the matrix management prescriptions (see section III.C.2.) to analyze the impact of actions in critical habitat outside of DCAs until rule revision occurs.

Relationship Between Actions of Federal Agencies.

Achieving recovery depends upon the actions of different agencies. Clearly, recovery will occur more rapidly and effectively if all agencies implement recovery plan recommendations in a timely manner. Past and current actions of individual agencies affect the rangewide potential for recovery of habitat condition and spotted owl populations. Substantial lack of compliance by an individual agency could delay or preclude recovery. The accumulated impacts of actions not consistent with the recovery plan could eventually necessitate redesign of the recovery plan in a particular area. This may result in greater restrictions on timber harvest or other activities, including those of agencies that have complied with the recovery plan. Due to location and ownership patterns, there are few, if any, opportunities to substitute greater contributions from one agency for lesser contributions from another. Nonetheless, it is conceivable that additional contributions by one agency (e.g., increased habitat protection and/or additional reserved pair sites) may partly compensate for insufficient contributions by another agency in some circumstances (e.g., areas with mixed ownership in DCAs or in the matrix).

2. Nonfederal Lands

The recovery plan was prepared with the understanding that the Endangered Species Act's authorities and the preponderance of owl habitat and population concentrations on federal lands give the federal government the primary role in achieving recovery. However, the recovery plan also documents a major role for nonfederal lands in achieving recovery. It recommends a "protective management" approach by which landowners, state agencies, and the FWS would carry out comprehensive planning and implementation activities to help achieve recovery objectives and provide benefits to landowners that are not realized under existing regulatory regimes. The following discussion addresses the habitat conservation plan (HCP) and special rule processes authorized under the Endangered Species Act, and the recovery plan's guidelines for protective management which provide a general basis for preparing these plans and rules (as well as changes in state regulations). It also addresses other mechanisms and approaches for implementing recovery on nonfederal lands.

Habitat Conservation Plans and Special Rules

Nonfederal entities are prohibited from taking listed animal species under section 9 of the Endangered Species Act. However, the Endangered Species Act authorizes them to take listed species in accordance with an approved section 10 HCP or a section 4(d) special rule.

Under section 10, landowners may develop HCPs as a condition for issuance of an incidental take permit. An HCP is a legally binding document requiring NEPA and section 7 compliance. It must describe appropriate conservation measures for habitat maintenance, enhancement, and protection, and include provisions for appropriate mitigation.

HCPs provide an excellent opportunity for nonfederal landowners to participate in protective management because they can be tailored to an individual landowner's situation. In California, several landowners, forestry associations, environmental interests, and scientists currently participate in protective management efforts with the state, FWS, Forest Service, and BLM. In addition, the state is making significant progress in developing a statewide HCP. Some California timber companies are working directly with the FWS to develop HCPs that are expected to be consistent with the statewide HCP. Efforts to develop additional HCPs should be assisted and encouraged by the FWS, other federal agencies, and the states. The coordinating group (see section IV.C.) recommended in the recovery plan should play an important role in this regard.

An HCP should help to bring about recovery in the province in which its activities will occur. Any detrimental impacts of the HCP, such as incidental take, must be balanced by beneficial effects in the province. Consequently, the general standard for determining the acceptability of a proposed HCP should be that its implementation would not distinctly reduce the likelihood or timeline of owl survival and recovery in the province.

Under section 4(d), the FWS may also promulgate special rules for the conservation of species listed as threatened under the Endangered Species Act. The FWS has adopted special rules for more than 30 species. Formulation of a special rule requires NEPA compliance and is subject to public review and other legal and procedural requirements associated with rulemaking.

The special rule mechanism could provide flexibility to design take prohibitions for the spotted owl in ways more likely to promote its conservation. A well-crafted special rule framework would incorporate many of the characteristics of an HCP, but would be more comprehensive and consistent across different ownerships. As previously noted, special rules must promote conservation and are subject to public review and comment. These requirements would tend to ensure that special rules would permit some take only when a more effective program (providing long-term recovery benefits) had been implemented.

One possible role for federal special rules would be to ratify owl protection measures implemented under state authorities. For example, a state could adopt regulations governing the harvest of owl habitat on nonfederal lands, including measures aimed at maintaining unoccupied habitat in some areas to address important connectivity objectives. In areas where nonfederal contributions to recovery do not require absolute prohibition of taking, restrictions on timber harvest might be substantially less than those now applied. The owl population would gain benefits not available under the take prohibition in areas that now have no owls, and landowners could be relieved of some of the current restrictions on take in occupied owl habitat. Another option would be to place more of the substantial restrictions within the federal rules.

Process for Protective Management

Protection afforded spotted owls on nonfederal lands is derived mainly from the Endangered Species Act's prohibition against the taking of listed species (as specified in section 9). This protection is not explicitly designed to promote recovery. Current regulatory activities focus on landowner surveys for spotted owls prior to timber harvest and controlling habitat reductions within circles around owl nests or activity centers. The impacts of this legal protection are significant, but vary in terms of their recovery implications. In some cases, they impose a level of protection under which recovery goals and objectives are unlikely to be met in some provinces; in other cases, protection may exceed these goals and objectives. Nonetheless, they are not explicitly designed to achieve province goals and do not constitute the most desirable means of doing so.

Although nonfederal parties' responsibilities are mainly limited to compliance with the take prohibition, they may choose voluntarily to provide other contributions to owl protection. Conceivably, such contributions might address recovery more directly than avoiding take, yet impose lower costs on landowners than current regulatory compliance. Several measures are available to help achieve recovery through alternatives that would be more effective than the existing regulatory activities previously described. The term "protective management," as used in this recovery plan, refers to planning and implementation activities which encourage creative approaches to recovery to improve species protection and landowners' ability to manage their land. Under protective management, state agencies, landowners, and the FWS would negotiate to formulate HCPs or special rules. Implementation will vary by state due to differences in the degree of federal ownership by province, states' authorities, and availability of information about owls and their habitat.

The following guidelines comprise the general basis for a protective management framework.

Guidelines for protective management.

1. Protective management should identify province goals and objectives for nonfederal lands while placing the minimum burden on landowners necessary to achieve those conservation goals.

2. Protective management should include explicit objectives for nonfederal lands (as derived from the recommendations in section III.E.), describe when recovery would be reached, and how a landowner's efforts would contribute to overall recovery.

   The objectives should identify the amount, spatial and temporal configuration, and function of the necessary habitat; the target number of owls to be supported; and population trends required to achieve delisting. The process should specify the implementation actions needed to achieve the recovery plan's provincial goals.

3. Incentives, rather than disincentives, should be provided for finding owls on nonfederal lands. Possible incentives include: a) landowner flexibility in where they provide habitat; b) reduction of total area required for protection on a landscape scale; c) off-site mitigation for owl protection; d) possibility of managing, rather than reserving habitat; e) relaxation of restrictions on adjacent federal lands. Based on recovery plan recommendations for nonfederal lands, landowners would be authorized some amount of incidental take where conservation measures had been implemented through appropriate mechanisms, such as HCPs.

4. Protective management should explain variations in owl protection requirements based on biological and physiographic distinctions and the degree of federal conservation by province, so the public understands the basis for differences in federal and state owl protection regulations, and the risks and benefits of anticipated public and private actions.

5. Protective management should be based on the recovery plan's general assessment of measures that are necessary to accomplish recovery goals for a province. This should include an assessment of where implementation of provincial recovery objectives can and cannot allow incidental take. Where possible, the allowable amount and rate of take would be identified. The form and pattern of landowner contribution to recovery can be negotiated. If areas are identified where protection of owl activity centers is not essential for conservation, incidental take could be permitted with minimal mitigation. In some cases, greater protection for owls in a particular locale may serve as mitigation for impacts on owls in nearby areas.

6. Protective management should identify and analyze the short- and long-term financial costs of conservation options, and encourage selection of appropriate low-cost options, especially for small-acreage landowners.

   Protective management should minimize the cost of owl protection for small-acreage landowners who are less able than their neighbors with larger acreages to negotiate owl protection. Take prohibitions may encumber a substantial portion of their land, often for owls on adjacent ownerships, and disproportionately restrict access to their small holdings. As appropriate, provisions could be developed to enable these landowners to contribute to conservation in an alternative manner.

   The costs of protective management should be allocated in a manner that does not eliminate the landowner incentives for cost reduction. If landowners are required to bear the full costs of protective management, they may conclude that the planning costs outweigh savings from changes in take prohibitions. State and federal agencies could be funded to help landowners write the plans.

7. In some cases, protective management planning may identify land purchase and exchange for nonfederal areas essential to recovery that do not have take prohibitions.

8. Protective management should recognize the role of state regulators. It should acknowledge the extent to which states have the authority to: a) enforce an agreement between the FWS and landowners, and b) conform state regulatory measures to the requirements of the plan. States also may have requirements independent of take prohibitions that should be assessed in the plan.

9. The feasibility and timing of implementation, such as the development of new state rules, legislative actions, board/commission approval of rules, and availability of funding, should be assessed in formulating approaches to protective management.

Building a climate for negotiating protective management.

This plan indicates that recovery will be enhanced in many instances by replacing the short-term protection of individual owls with long-term conservation efforts consistent with the recovery goal. However, such efforts will not be initiated unless landowners believe they will benefit by participating in protective management. Currently, many landowners are reluctant to participate because they believe such efforts will be too costly, time consuming, and process-bound. Such real or perceived difficulties delay implementation of improved protection for the species. When protective management opportunities are foregone or delayed, habitat may be harvested where allowed by the take prohibition, thus reducing options for recovery. After several years of such management, options for habitat recovery on nonfederal lands may become limited in some areas. Consequently, expeditious development, approval, and implementation of protective management are essential for it to succeed. In this regard, it should be noted that while some HCPs have been completed in 6 to 12 months, others have required substantially more time, and the State of California's effort to develop a statewide HCP has required an extensive level of effort but is not yet complete. Mechanisms to achieve province goals on nonfederal lands should be streamlined to achieve conservation goals in an efficient and cost-effective manner. This will greatly assist creation of a cooperative climate for negotiation among landowners, the states, and federal agencies.

If these concerns are addressed, it will be easier to realize the considerable benefits of protective management, since it is apparent that all key parties–landowners, government agencies, and communities–have much to gain by participating. The following discusses the incentives which already exist and will be enhanced further by constructive negotiation.

Incentives to participate in protective management.

Landowners, communities, and government agencies share several incentives to participate in protective management:

Management flexibility for owl protection and timber harvest planning: Protective management could tailor protection to fit the owl population's long-term habitat requirements, with less emphasis on short-term protection of owl activity centers. Long-term protection could be adjusted throughout the landscape to improve the configuration of owl habitat and to complement actions on federal lands more effectively. If HCPs were prepared, the FWS could authorize take where assurances were provided by landowners that long-term, effective mitigation efforts would be implemented. Other measures, such as designating certain areas to be protected, also might be more attractive to landowners than continuing take prohibitions and annual surveys.

Certainty of owl protection and timber harvest planning: Landowners would manage for long-term owl habitat needs, providing a better guarantee of habitat than is provided by the prohibition on taking. Landowners then could plan timber harvest based on the certainty of knowing which areas would be affected by owl protection.

Reducing costs of owl protection: Perhaps the most compelling incentive for some landowners to participate in an alternative conservation program is the potential for significant reductions in the costs of owl protection they now incur including: a) maintenance of habitat around known pairs of owls, b) conducting annual owl surveys, and c) a portion of administrative costs associated with compliance with state forest practices regulations protecting listed species.

Authorizing incidental take in exchange for implementing conservation measures identified in the recovery plan: Consistent with the Endangered Species Act, landowners could be authorized a level of incidental take through the HCP or special rule processes if they are found to exceed protection recommended in the recovery plan.

Relaxation of owl conservation requirements on federal lands in response to increased efforts on nonfederal lands: Some nonfederal landowners may be more willing to contribute to owl recovery if they conclude their efforts can lead to a reduction of conservation applied on federal lands. Although such cases may be infrequent, they may prove important to conservation efforts.

Mechanisms and approaches for implementing recovery on nonfederal lands.

In developing a comprehensive approach to owl conservation, any combination of mechanisms may be appropriate in a given instance. The following list is not inclusive; other equally valid mechanisms may exist or ultimately emerge through the implementation process. The pace of implementation will vary by province owing to differences in the proportion of federal ownership, state authorities, habitat conditions, and availability of information about northern spotted owls in the area.

Existing reserves: These include state, county, or local parks; known conservation easements; or other areas that have binding, enforceable restrictions on the level of forest management activities that are likely to alter suitable owl habitat. Existing reserves must be evaluated based on the level of existing and future habitat within them, and their size, number, and spacing.

Private voluntary actions: These include actions that are not required by statute or regulation, but that landowners voluntarily undertake. Actions can include, for example, long-term management plans, commitments to long rotations, uneven-aged management, or easements. Such actions must be evaluated on: 1) how binding the commitments are, 2) effectiveness in providing the conservation measures (number of owls, amount and configuration of habitat) stated in the province goal, 3) timing of the contribution of suitable habitat, and 4) the incentives they offer to landowners.

Forest practices statutes and regulations: Statutes and regulations enforced by state or local governments require certain practices be used or certain habitat conditions be maintained. Depending on the definition of different types of owl habitat, these requirements can contribute to certain habitat objectives. Statutes and regulations must be evaluated on: 1) their adequacy in providing conservation benefits toward the recovery goal; 2) whether current state statutes authorize promulgation and enforcement of additional regulations; and 3) the ability, ease, and timing of passing new state legislation.

Prohibition on taking: The Endangered Species Act's prohibition of take, as enforced by the FWS, is not explicitly intended to provide a long-term contribution to recovery. The success of the prohibition in contributing to recovery is variable, and dependent upon the province and existing conditions within owl home ranges. To develop recovery-oriented options, the application of take prohibitions must be evaluated for consistency of results, efficiency, uniformity of enforcement, and adequacy of protection, consistent with the requirements (i.e., HCP or special rule) of the options proposed.

Landscape management as a basis for modifying the take prohibition: This refers to providing suitable habitat adequate to meet a conservation objective, without necessarily focusing on the location of owl activity centers. Landscape management may provide a basis for authorizing take pursuant to either section 10 or section 4(d). The potential role of landscape management must be assessed relative to the current number of known owl sites contributing to province goals objectives and the current burden of surveys. The Endangered Species Act provides mechanisms for landscape-scale management through the HCP or special rule processes.

Critical habitat: The recovery plan does not recommend designation of nonfederal lands as critical habitat unless future monitoring and research efforts indicate insufficient progress toward meeting the recovery goal.

Land exchange.: Exchanging public lands for state and private lands to secure a particular location and/or management may be desirable in some cases. Aside from providing clear benefits to owl conservation, proposals must be evaluated on: 1) the availability of public lands of equal value for exchange, 2) the ownership of the public lands (federal, state, county), 3) the authority of the public body to enter into land exchanges, 4) the change in public timber supply as a result of the exchange, 5) effect on local tax base, 6) the willingness of nonfederal landowners to enter into exchanges, and 7) the timing of the exchange.

Purchase: Purchases of private or state lands may be recommended for reasons similar to land exchange. Aside from providing clear benefits to owl conservation, purchases must be evaluated on: 1) the authority of the public sector to purchase private or state lands, 2) the availability of resources for public purchase, 3) the willingness of the nonfederal parties to sell, 4) the change in public timber supply as a result of the purchase, 5) the effect on local tax base, 6) the timing of the purchase, and 7) whether purchase is of both land and timber or whether some timber harvest rights are retained by seller.

Timber rights trade: Rather than purchasing or exchanging land, federal and nonfederal parties might exchange timber cutting rights without altering land ownership. This should be evaluated in the same way as land exchange or purchase.

Conservation easements, mitigation banks, purchase or transfer of development or harvest rights: Several "market-oriented" tools are available for protective management. These tools are characterized by being voluntary, rather than mandatory, and allow all parties involved to base their decisions on the likely costs and benefits they will incur. The availability of these tools increases the options for efficiently meeting conservation objectives.

A conservation easement is dedicated for conservation purposes, such as open space or wildlife habitat. The landowner is compensated for placing land in an easement, often through preferential property tax treatment. The feasibility of conservation easements must be evaluated in terms of: 1) the availability of suitable areas for easements; 2) the ability to administer the easements, such as the existence of land trusts; and 3) the relative benefits that a landowner could expect from entering into a conservation easement.

Mitigation banking is an off-site mitigation tool intended to compensate for habitat losses associated with future timber harvest or other activities. Credits must be established (e.g., acres of owl habitat) prior to timber harvest. The intent of mitigation banking is to develop a surplus of secured habitat before timber harvest proceeds in existing suitable habitat which will minimize the lag time between losses from timber harvest and replacement from mitigation. Mitigation banking can consolidate mitigation measures from numerous small habitat losses and provide a larger more effective off-site mitigation area. The feasibility of mitigation banks must be evaluated based on: 1) the availability of suitable sites for mitigation banks that would not have been protected otherwise, 2) the ability to establish appropriate measure of credits, 3) the institutional ability to administer the banks and monitor their effectiveness.

Transfer of development or timber harvest rights is another mechanism that may enable higher levels of activity, such as timber harvest, on one location by transferring unused rights from another location (source), thereby reducing the potential level of activities in the source location. Purchase of such rights can be used to lower the overall potential level of timber harvest in an area by not transferring the rights to another location. The feasibility of transfer or purchase of rights must be evaluated against: 1) biological constraints regarding habitat quality, quantity, and location; 2) availability of institutional means to evaluate, monitor, and keep account of the trades; and 3) transaction costs to landowners and administering agencies. Any trades would have to be carefully and conservatively structured because of the uncertainty about their biological, social, and economic effects.

A process for implementing protective management.

The following scenario presumes that the FWS and the states work together to support the recovery plan and that Endangered Species Act compliance on nonfederal lands can be facilitated through appropriate state laws.

1. States and the FWS would develop and initiate a detailed implementation strategy for the use of nonregulatory mechanisms to contribute to the recovery goal.

2. The FWS, states, and landowners agree on a program as follows:

    a. Specific landowner contributions that would allow incidental take to occur would be identified and agreements drafted to implement them.

    b. Arrangements for ensuring and monitoring implementation of the draft agreements would be identified.

    c. Steps a. and b. would be incorporated into HCPs and/or a section 4(d) rule.

    d. The FWS would pursue appropriate actions, including public review, to authorize incidental take and ensure implementation of the protective management agreements.

    e. (optional) States may require additional measures beyond those identified in the recovery plan or under the FWS's take guidelines.

3. Relationship Between Federal and Nonfederal Actions

This recovery plan makes recommendations for contributions to spotted owl recovery from federal and nonfederal lands. The nonfederal recommendations address areas where federal lands are believed inadequate to support recovery. As previously noted, the avoidance of take offers only limited opportunities to contribute to recovery. However, incentives exist for nonfederal landowners to enter into agreements for more efficient conservation measures that would generally implement the recovery plan's recommendations, and additional incentives may be created over time.

Despite these expectations, no assurances exist regarding the nonfederal contribution to recovery. Recovery may not occur if nonfederal contributions (which vary by province) fall below the levels recommended in the recovery plan. Those contributions are judged to be necessary to achieve the conditions under which recovery and delisting may occur, although new information gained through monitoring and research may result in refinements to the recommendations.

To address these concerns, the interactions between federal and nonfederal contributions should be dealt with as part of the adaptive management program (see section III.K.), and additional actions should be considered if recommended contributions are not being achieved. Such actions could include: 1) critical habitat designation on nonfederal lands, or 2) revisions to recommendations for federal lands. As implementation proceeds, both federal and nonfederal contributions should be monitored according to recommendations in this recovery plan. It may become appropriate to designate critical habitat on nonfederal lands or to strengthen federal lands recommendations if: 1) the level of nonfederal contributions fails to meet the recommendations in the recovery plan, and 2) other information suggests that conditions needed to achieve recovery and delisting are not occurring. Any strengthening of recommendations for federal lands should clearly target concerns raised by the lack of nonfederal lands contributions. However, options to strengthen federal lands contributions will decline in time. This further underscores the need for continuous monitoring of federal and nonfederal interactions, and for prompt implementation of changes to recommendations where necessary.

It is important to note that in some areas there is little opportunity for federal lands to compensate for the lack of nonfederal contributions. In these areas, progress toward recovery and delisting is likely to be seriously impeded if nonfederal contributions are not consistent with the recommendations in the recovery plan. Measures on federal lands may be reduced if: 1) nonfederal contributions are being made pursuant to either HCPs or section 4(d) rules, and are exceeding the recommendations in the recovery plan; and 2) other data suggest that conditions required to achieve recovery and delisting are occurring.

4. Implementation Scenario

The recovery plan expects federal agency implementation to occur in phases during the next 5 years. An approach to implementation that is feasible and prompt might occur in three broad phases. The first phase, which should take significantly less than 1 year, involves two actions. The first action is completion of a federal and nonfederal review of recovery plan recommendations to determine organization-specific actions needed to achieve consistency with recovery plan recommendations over the long term (e.g., land management plan revisions or adjustments). The second action is identification and implementation of interim management which serves as an appropriate "bridge" to completion of long-range plans. The second phase, which probably will require up to 2 years, involves completing these efforts to integrate recovery plan recommendations into land management plans, preparing the more specific DCA management plans recommended in the recovery plan, adopting monitoring and research strategies, and initiating related on-the-ground management actions. The third phase includes further refinements of management activities, including monitoring and research, that characterize full-scale implementation, and the development of information for use in reviewing and, as necessary, revising the recovery plan.

The following outline briefly describes this implementation scenario. It should be noted that the scenario should not be used as a substitute for the implementation schedule in the recovery plan, which includes the specific tasks associated with implementation.

The scenario lists anticipated activities in each phase by federal action agencies (Forest Service, BLM, National Park Service), nonfederal entities, and the FWS. Some of the actions specified in each phase are interdependent, and it is assumed they may proceed either concurrently or sequentially, as necessary.

Phase 1

Federal action agencies:

- Review the recovery plan to determine management requirements needed to achieve consistency with recovery plan recommendations (e.g., forest or resource management plan revision or amendment) and the O&C Act, FLPMA, NFMA, NEPA, and any other applicable mandates.
- Impose interim management to assure maximum consistency with those recommendations pending completion of the preced-ing management requirements.
- Support the coordinating group recommended in the recovery plan.

States:

- Review the recovery plan to determine how to implement its recommendations under current authorities and initiate necessary actions (e.g., HCP development and/or modification of regulatory mechanisms) in cooperation with private landowners as appropriate.
- Assess the feasibility of other actions to promote recovery plan implementation.
- Support the coordinating group recommended in the recovery plan.

FWS:

- Establish the coordinating group recommended in the recovery plan to provide implementation advice and assistance.
- Promulgate a draft critical habitat rule to reflect recovery plan recommendations.
- Use DCA management guidelines in making adverse modification and jeopardy determinations.
- Use recovery plan recommendations for the federal matrix lands in section 7 consultation and consider issuing programmatic "no jeopardy" biological opinions (including incidental take statements) for agency plans that are consistent with those recommendations.
- Issue guidance to states and private landowners to help them prepare HCPs.
- Assess the desirability of promulgating a special rule under section 4(d) of the Endangered Species Act.

Phase 2

Federal action agencies:

- Complete actions needed to assure integration of recovery plan recommendations into land management plans, in accordance with legal mandates.

- Adopt monitoring and research strategies.
- Prepare DCA management plans, consult with the FWS, and implement required actions including silvicultural treatments to enhance owl habitat.

States:

- Continue efforts to implement recovery plan recommendations for nonfederal lands, including HCP development.
- Coordinate with federal agencies and the private sector on monitoring and research efforts.

FWS:

- Promulgate a final rule to revise critical habitat when agencies complete integration of recovery plan recommendations into land management plans.
- Consult on DCA management plans submitted by action agencies and consider issuing programmatic "no adverse modification or no jeopardy" biological opinions to cover future actions carried out consistent with those plans.
- Provide advice and assistance about all aspects of recovery plan implementation as required, in conjunction with the coordinating group.
- Assess progress toward recovery plan implementation and provide appropriate recommendations.
- Complete promulgation of special rules, as appropriate.

Phase 3

Federal action agencies:

- Be in "full implementation" regarding program operations, as well as monitoring and research.
- Report on the results of recovery plan implementation during the first 5 years.

States:

- Continue to implement recovery plan recommendations, especially those designed to provide further incentives for owl and habitat conservation.

FWS:

- Devote primary efforts to providing advice and assistance about owl recovery, as opposed to regulatory operations, if federal agencies are in the "full implementation" phase.
- With assistance from the coordinating group, provide guidance to federal action agencies, states, and private landowners about the process and information requirements for recovery plan review after its initial 5-year implementation phase, so this review can begin promptly in January 1998, and revision completed in a time frame that enables the revised recovery plan to serve as a basis for agency decadal planning.

IV.
B. Implementation Schedule

The stepdown outline and implementation schedule in this section outline actions and estimated costs for the recovery program. This chapter is a guide for meeting the recovery goal. The schedule indicates task priorities, task numbers, task descriptions, duration of tasks, the responsible agencies, and lastly, estimated costs. These actions, when accomplished, should bring about the recovery of the species and protect its habitat. Tasks are prioritized within each of five broad categories. A full description of these tasks is included in Chapter III, which explains the recovery program.

The estimated monetary needs for all parties involved in recovery are identified. In most cases these figures reflect the total estimated financial requirements for implementation of the recovery plan. In some cases (e.g., acquisition) it was not possible to determine associated costs; costs are to be determined (tbd). In a number of cases, the costs for some tasks are included under other entries; an entry without identified costs is noted as (-). Although the suggested coordinating group is listed under a number of tasks, direct costs were not identified since the costs are included under tasks for individual agencies. The intent for this entry is to identify interagency responsibilities with this group.

This section summarizes only direct agency costs of achieving recovery. Indirect costs, such as lost employment or benefits resulting from changes in forest management, are discussed in Appendix G.

***Priorities of the implementation schedule are assigned as follows*:**

Priority 1: An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2: An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3: All other actions necessary to meet the recovery goal.

***Key to acronyms and abbreviations used in the implementation schedule*:**

BIA - U.S. Bureau of Indian Affairs
BLM - U.S. Bureau of Land Management
CA - State of California
FS - U.S. Forest Service
FWS - U.S. Fish and Wildlife Service
  ES - Ecological Services Division
  LE - Law Enforcement Division
  RES - Research Division
ICG - Recovery Team, FWS, or interagency coordinating group (as recommended in the recovery plan)
NPS - National Park Service
OR - State of Oregon
PVT - Private entities
WA - State of Washington
cont. - continuing

Stepdown Outline

1. Management Applications

11. Establish and support coordinating group (see section IV.C.).
    111. Establish working structure to oversee and monitor recovery plan implementation.
    112. Identify and prioritize interagency tasks.
    113. Establish adaptive management process.
    114. Conduct activities.

12. Implement recovery plan recommendations regarding DCAs (see section III.C.1.).
    121. Establish (select, map, and secure areas) DCAs.
    122. Prepare guidelines for activities in DCAs.
    123. Prepare DCA management plans.
        1231. Prepare demonstration DCA plans.
        1232. Prepare remaining DCA plans.
        1233. Implement DCA plans.

13. Implement recovery plan recommendations regarding federal matrix lands (see section III.C.2.).
    131. Implement prescription A.
        1311. Establish residual habitat areas.
        1312. Implement residual habitat area management guidelines.
        1313. Implement 50-11-40 rule (manage dispersal habitat).
    132. Implement prescription B.
        1321. Establish reserved pair areas and managed pair areas.
        1322. Implement guidelines for reserved pair areas and managed pair areas.
    133. Implement prescription C.
        1331. Establish managed pair areas.
        1332. Implement guidelines for managed pair areas.

14. Review nonfederal lands for opportunities to implement recovery plan recommendations (see section III.D.).
    141. Review state management opportunities.
    142. Review private management opportunities.
    143. Establish tribal goals and plans.

15. Implement recommendations for nonfederal lands as necessary and appropriate.
    151. Provide recommendations for state management.
    152. Provide recommendations for private management.
    153. Provide recommendations for tribal management.

16. Determine relationships between management of owls and other forest species and processes (see section III.I.).
    161. Establish mechanisms to investigate ecosystem management.
    162. Determine methods to implement strategies.

2. Regulatory Mechanisms

21. Review federal agency plans for consistency with recovery plan.
    211. Evaluate recovery plan recommendations.

212. Revise or amend land management plans.
213. Evaluate and revise plans through adaptive management process.

22. Provide technical assistance to nonfederal landowners.
221. Assist states in developing management plans, planning guidance, etc.
222. Assist private landowners in developing habitat conservation plans.
223. Provide regulatory guidance.
224. Assist and advise on owl surveys and studies.

23. Provide technical assistance to federal land managers.
231. Provide guidance on consultation.
232. Conduct consultations regarding federal actions.

24. Enforce taking prohibition.

25. Evaluate critical habitat for revision consistent with DCA boundaries.
251. Review critical habitat and make recommendations.
252. Implement recommendations.

26. Evaluate potential usefulness of special rules.
261. Provide recommendations on special rules.
262. Use recommendations to develop special rules.

3. Acquisition Mechanisms

31. Evaluate opportunities for exchange, easement, or purchase.
311. Evaluate opportunities in DCAs.
312. Evaluate opportunities in forest matrix.

32. Acquire land or interest in land (includes developing incentives for landowners).

4. Monitoring, Research, and Adaptive Management

41. Establish and maintain compatible data bases.
411. Develop and maintain data bases on habitat and owls.
412. Maintain and refine geographic information system (GIS).

42. Implement population monitoring program (see section III.J.).
421. Agree on objectives and methods for monitoring.
422. Conduct roadside surveys.
4221. Design roadside surveys.
4222. Carry out roadside surveys.
423. Monitor owl activity sites.
4231. Establish owl activity site sampling design.
4232. Carry out owl activity site monitoring.
424. Monitor populations in individual DCAs.
4241. Establish DCA sampling design.
4242. Carry out DCA monitoring.
425. Evaluate demographic information.
426. Evaluate population models.

43. Implement habitat monitoring program.
    431. Monitor habitat rangewide.
        4311. Design habitat monitoring program.
        4312. Implement habitat monitoring.
    432. Monitor habitat in selected DCAs.
        4321. Design DCA habitat monitoring.
        4322. Implement DCA habitat monitoring.
    433. Monitor management activities in DCAs.
        4331. Design DCA management monitoring.
        4332. Implement DCA management monitoring.

44. Implement research program - (references to objectives and action items in the following list refer to the research recommendations in section III.J.5.).
    441. Design and implement research to identify and characterize habitats used by spotted owls (objective A).
        4411. Action item A.1.
        4412. Action item A.2.
    442. Design and implement research on silvicultural activities (objective B).
        4421. Action item B.1.
        4422. Action item B.2.
    443. Design and implement research on demographic characteristics of owls (objective C).
        4431. Action item C.1.
        4432. Action item C.2.
        4433. Action item C.3.
    444. Design and implement research on spotted owl prey, predators, and competitors (objective D).
        4441. Action item D.1.
        4442. Action item D.2.
        4443. Action item D.3.
        4444. Action item D.4.
        4445. Action item D.5.
        4446. Action item D.6.
    445. Develop integrated models of population and habitat dynamics (objective E).
        4451. Action item E.1.
        4452. Action item E.2.

45. Design studies to address adaptive management (see section III.K.).

46. Design programs to study other old-forest species (see section III.I.).
    451. Design survey, inventory, and research programs.
    452. Implement high-priority studies.

5. Review and Evaluation

51. Prepare reports to monitor program implementation.
    511. Prepare annual progress reports.
    512. Prepare 5-year evaluation report.

52. Review and revise recovery plan, as appropriate.

Table 4.1. Estimated costs by broad category from the stepdown outline for the federal and state agencies.

Cost Category	Agency	Estimated Cost (x$1,000) FY94	FY95	FY96
Management Applications	BLM	11,795	12,800	13,200
	BIA	160	160	160
	FWS	675	775	875
	FS	6,000	6,000	6,000
	NPS	255	235	175
	CA	179	165	155
	OR	302	302	317
	WA	238	238	268
Regulatory Mechanisms	BLM	1,000	1,000	750
	BIA	1,315	1,106	1,106
	FWS	2,400	2,200	1,650
	FS	6,000	2,000	2,000
	NPS	25	20	20
	CA	539	433	407
	OR	770	750	460
	WA	660	660	560
Acquisition Mechanisms[1]	BLM	500	1,500	1,500
	FS	1,000	500	500
	CA	40	2,092	5,437
	OR	30	30	30
	WA	20	20	20
Monitoring, Research, and Adaptive Management	BLM	5,589	5,575	5,545
	BIA	170	160	160
	FWS	1,200	1,100	1,100
	FS	6,200	6,700	6,700
	NPS	1,785	1,755	1,655
	CA	380	2,568	3,895
	OR	379	379	379
	WA	470	460	550
Review and Evaluation	BLM	10	10	10
	BIA	55	25	25
	FWS	50	50	50
	FS	200	200	200
	NPS	10	5	5
	CA	27	45	61
	OR	6	6	6
	WA			
Totals	**BLM**	**18,894**	**20,885**	**21,005**
	BIA	**1,700**	**1,451**	**1,451**
	FWS	**4,325**	**4,125**	**3,675**
	FS	**19,400**	**15,400**	**15,000**
	NPS	**2,075**	**2,015**	**1,855**
	CA	**1,165**	**5,303**	**9,955**
	OR	**1,487**	**1,467**	**1,192**
	WA	**1,388**	**1,878**	**1,398**

Acronyms
BLM - U.S. Bureau of Land Management
BIA - U.S. Bureau of Indian Affairs
FWS - U.S. Fish and Wildlife Service
FS - U.S. Forest Service
NPS - National Park Service
CA - State of California
OR - State of Oregon
WA - State of Washington
FY - Fiscal Year

[1]Full costs in this category cannot be estimated pending completion of agency management plans.

Implementation Schedule

Priority of Task	Task	Task No.	Duration (Years)	Responsible Party FWS	Responsible Party Other	Cost Estimates (x$1,000) FY94	FY95	FY96
Management Applications								
1	Establish DCAs.	121	2	ES		-	-	-
					FS	100	-	-
					BLM	300	-	-
					NPS	30	20	-
1	Establish residual habitat areas (prescription A).	1311	1		FS	200	-	-
					BLM	100	-	-
					States	-	-	-
1	Implement 50-11-40 rule (manage dispersal habitat).	1313	cont.		FS	1,500	2,500	2,500
					BLM	600	600	600
1	Establish reserved pair and managed pair areas (prescription B).	1321	1		FS	100	-	-
					BLM	50	-	-
					States	-	-	-
1	Establish managed pair areas (prescription C).	1331	1		FS	100	-	-
					BLM	50	-	-
					States	-	-	-
2	Establish and support coordinating group.	11	cont.	ES		400	400	400
				RES		25	25	25
					FS	100	100	100
					BLM	50	50	50
					NPS	25	25	25
					BIA	10	10	10
					CA[1]	25	20	20
					OR	62	62	57
					WA	93	93	93
2	Review state management opportunities.	141	cont.	ES		75	75	75
					CA	11	20	18
					OR	30	30	30
					WA	15	15	15
					PVT	tbd	tbd	tbd
2	Review private management opportunities.	142	cont.	ES		75	75	75
					CA	11	20	18
					OR	30	30	30
					WA	15	15	15
					PVT	tbd	tbd	tbd
2	Establish tribal goals and plans.	143	3		BIA	150	150	150

Priority of Task	Task	Task No.	Duration (Years)	Responsible Party FWS	Responsible Party Other	Cost Estimates (x$1,000) FY94	FY95	FY96
Management Applications (continued)								
2	Implement recommendations for nonfederal lands.	15	cont.		CA	127	47	42
					OR	100	100	100
					WA	30	30	30
					PVT	tbd	tbd	tbd
3	Prepare guidelines for activities in DCAs.	122	2		ICG	-	-	-
					FS	200	100	-
					BLM	50	50	-
					NPS	10	-	-
					CA	-	-	-
					OR	5	5	-
					WA	-	-	-
3	Prepare demonstration DCA plans.	1231	2		FS	200	100	-
					BLM	50	50	-
					NPS	-	-	-
					CA	-	-	-
					OR	-	-	-
					WA	5	5	5
3	Prepare remaining DCA plans.	1232	2		FS[2]	200	200	-
					BLM	2,000	1,000	-
					NPS	40	40	-
					CA	-	-	-
					OR	-	-	-
					WA	10	10	10
3	Implement DCA plans.	1233	cont.		FS	2,700	2,400	2,400
					BLM[3]	8,325	10,800	12,300
					NPS	150	150	150
3	Implement residual habitat area guidelines (prescription A).	1312	cont.		FS	200	-	-
					BLM	20	-	-
					States	-	-	-
3	Implement guidelines for reserved pair areas and managed pair areas (prescription B).	1322	cont.		FS	200	300	300
					BLM	100	100	100
					States	-	-	-
3	Implement guidelines for managed pair areas (prescription C).	1332	cont.		FS	200	300	300
					BLM	50	100	100
					States	-	-	-

Priority of Task	Task	Task No.	Duration (Years)	Responsible Party FWS	Responsible Party Other	Cost Estimates (x$1,000) FY94	FY95	FY96
Management Applications (continued)								
3	Determine relationships between management of owls and other forest species.	16	cont.	ES		100	200	300
					ICG	-	-	-
					FS	-	-	-
					BLM	50	50	50
					NPS	-	-	-
					BIA	-	-	-
					CA	5	58	55
					OR	75	75	100
					WA	70	70	100
					PVT	tbd	tbd	tbd
Regulatory Mechanisms								
1	Conduct consultations.	232	cont.	ES		400	400	400
					FS	2,000	2,000	2,000
					BLM	500	500	250
					NPS[4]	20	20	20
					BIA	1,315	1,106	1,106
1	Enforce taking prohibition.	24	cont.	LE		300	300	300
					OR	20	20	20
					WA	250	250	150
2	Evaluate recovery plan recommendations.	211	1	ES		200	-	-
					ICG	-	-	-
					FS	-	-	-
					BLM	-	-	-
					NPS	5	-	-
					CA	-	-	-
					OR	10	-	-
					WA	-	-	-
2	Revise or amend land management plans.	212	cont.		FS	4000	-	-
					BLM	500	500	500
					CA	22	110	108
					OR	250	250	100
					WA	125	125	125
2	Assist states in planning.	221	cont.	ES		150	150	150
					ICG	-	-	-
					CA[5]	372	163	157
					OR	80	80	50
					WA	100	100	100

Priority of Task	Task	Task No.	Duration (Years)	Responsible Party FWS	Responsible Party Other	Cost Estimates (x$1,000) FY94	FY95	FY96
Regulatory Mechanisms (continued)								
2	Assist private landowners in planning.	222	cont.	ES		300	300	300
					CA	18	33	30
					OR	10	10	10
					WA	35	35	35
					PVT	tbd	tbd	tbd
3	Assist and advise on owl surveys and studies.	224	cont.	ES		150	150	150
					ICG	-	-	-
					CA	31	56	51
					OR[6]	350	350	250
					WA	150	150	150
					PVT	tbd	tbd	tbd
3	Provide regulatory guidance.	223	cont.	ES		200	200	200
					CA	72	50	41
					OR	30	30	30
					WA	-	-	-
3	Provide guidance on consultation.	231	cont.	ES		150	150	150
					FS	-	-	-
					BLM	-	-	-
					NPS	-	-	-
					BIA	-	-	-
3	Review critical habitat.	251	1	ES		200	-	-
3	Implement recommendations to revise critical habitat.	252	2	ES		300	500	-
3	Evaluate special rules.	26	2	ES		50	50	-
					CA	24	21	20
					OR	20	10	-
					WA	-	-	-
Acquisition Mechanisms								
3	Evaluate opportunities.	31	cont.		FS	1000	500	500
					BLM	500	500	500
					NPS	-	-	-
					CA	13	23	21
					OR	30	30	30
					WA	20	20	20
					PVT	tbd	tbd	tbd

Priority of Task	Task	Task No.	Duration (Years)	Responsible Party FWS	Other	Cost Estimates (x$1,000) FY94	FY95	FY96
Acquisition Mechanisms (continued)								
3	Acquire land or interest in land.	32	cont.		FS	tbd	tbd	tbd
					BLM	-	1,000	1,000
					NPS	tbd	tbd	tbd
					CA[7]	27	2,069	5,416
					OR	tbd	tbd	tbd
					WA	tbd	tbd	tbd
					PVT	tbd	tbd	tbd
Monitoring, Research, and Adaptive Management								
1	Establish owl activity site sampling design.	4231	2		ICG	-	-	-
1	Carry out owl activity site monitoring.	4232	cont.		ICG	-	-	-
					FS	400	300	300
					BLM	275	275	275
					NPS	20	20	20
					BIA	150	150	150
					CA	26	1,070	2,063
					OR	30	30	30
					WA	-	-	-
1	Design DCA habitat monitoring.	4321	1		ICG	-	-	-
					FS	200	-	-
					BLM	5	-	-
					NPS	20	-	-
					CA	-	-	-
					OR	2	2	-
					WA	-	-	-
1	Implement DCA habitat monitoring.	4322	cont.		FS	200	400	400
					BLM	600	600	600
					NPS	100	100	100
1	Action item C.1.	4431	cont.		FS	200	200	200
					BLM	400	400	400
					NPS	-	-	-
					CA	-	150	140
1	Action item C.2.	4432	cont.		FS	200	100	100
					BLM	100	100	100
					NPS	100	100	100
					CA	-	50	55
1	Action item C.3.	4433	cont.		FS	300	300	300
					BLM	200	200	200
					NPS	-	-	-
					CA	-	50	55

Priority of Task	Task	Task No.	Duration (Years)	Responsible Party FWS	Other	Cost Estimates (x$1,000) FY94	FY95	FY96
Monitoring, Research, and Adaptive Management (continued)								
2	Develop and maintain data bases.	411	cont.	ES		100	100	100
					ICG	-	-	-
					FS	100	100	100
					BLM	20	20	20
					NPS	20	20	20
					BIA	-	-	-
					CA	35	35	35
					OR	150	150	100
					WA	250	250	250
					PVT[8]	tbd	tbd	tbd
2	Establish DCA sampling design.	4241	2		ICG	-	-	-
					FS	200	-	-
					BLM	3	-	-
					NPS[9]	100	100	-
					CA	-	-	-
					OR	2	2	2
					WA	-	-	-
2	Carry out DCA monitoring.	4242	cont.		FS	200	300	300
					BLM	900	900	900
					NPS[10]	500	500	500
					CA	4	3	3
2	Design DCA management monitoring.	4331	1		ICG	-	-	-
					FS	200	-	-
					BLM	3	-	-
					NPS	5	-	-
					CA	-	-	-
					OR	3	3	-
					WA	-	-	-
2	Implement DCA management monitoring.	4332	cont.		FS	200	400	400
					BLM	500	500	500
					NPS	25	25	25
					CA	1	2	2
2	Action item B.1.	4421	cont.		FS	200	200	200
					BLM	500	500	500
					NPS	50	50	50
					CA	-	50	40
2	Action item B.2.	4422	cont.	RES		50	50	50
					FS	200	200	200
					BLM	200	250	450
					NPS	50	50	50
					CA	-	-	10

Priority of Task	Task	Task No.	Duration (Years)	Responsible Party FWS	Responsible Party Other	Cost Estimates (x$1,000) FY94	FY95	FY96
Monitoring, Research, and Adaptive Management (continued)								
2	Action item E.1.	4451	cont.	RES		25	25	25
					FS	100	100	100
					BLM	100	100	100
					NPS	50	50	50
2	Action item E.2.	4452	cont.	RES		25	25	25
					FS	100	100	100
					BLM	100	100	100
					NPS	-	-	-
3	Maintain and refine GIS.	412	cont.	ES		200	200	200
					ICG	-	-	-
					FS	200	200	200
					BLM[11]	10	10	10
					NPS	-	-	-
					BIA	-	-	-
					CA	80	160	160
					OR	100	100	75
					WA	70	70	100
					PVT	tbd	tbd	tbd
3	Agree on objectives and methods for monitoring.	421	1	ES		100	-	-
					ICG	-	-	-
					FS	200	-	-
					BLM	3	-	-
					NPS	5	-	-
					BIA	20	10	10
					CA	5	23	20
					OR	10	10	10
					WA	10	10	-
					PVT	tbd	tbd	tbd
3	Design roadside surveys.	4221	2		ICG	-	-	-
3	Carry out roadside surveys.	4222	cont.		FS	1,000	2,000	2,000
					BLM	75	75	75
					NPS	20	20	20
					CA	25	396	742
					OR	-	-	50
					WA	35	35	35

Priority of Task	Task	Task No.	Duration (Years)	Responsible Party FWS	Responsible Party Other	Cost Estimates (x$1,000) FY94	FY95	FY96
Monitoring, Research, and Adaptive Management (continued)								
3	Evaluate demographic information.	425	3	RES		20	20	20
					ICG	-	-	-
					FS	200	100	100
					BLM	10	10	10
					NPS	50	50	50
					CA	23	38	35
					OR	5	5	5
					WA	5	5	5
					PVT	tbd	tbd	tbd
3	Evaluate population models.	426	3	RES		30	30	30
					ICG	-	-	-
					FS	200	100	100
					BLM	5	5	5
					NPS	20	20	20
					CA	-	-	-
					OR	2	2	2
					WA	-	-	-
					PVT	tbd	tbd	tbd
3	Design habitat monitoring program.	4311	1		ICG	-	-	-
3	Implement habitat monitoring.	4312	cont.		FS	-	200	200
					BLM	200	200	200
					NPS	-	-	-
					CA	33	83	80
					OR	75	75	75
					WA	70	70	70
3	Action item A.1.	4411	cont.	RES		300	300	300
					FS	200	200	200
					BLM	150	150	-
					NPS	75	75	75
					CA	-	175	175
3	Action item A.2.	4412	cont.		FS	200	200	200
					BLM	30	30	-
					NPS	75	75	75
					CA	-	25	25
3	Action item D.1.	4441	cont.		FS	100	100	100
					BLM	50	50	-
					NPS	50	50	50
3	Action item D.2.	4442	cont.	RES		50	50	50
					FS	200	200	200
					BLM	400	400	400
					NPS	100	100	100

Priority of Task	Task	Task No.	Duration (Years)	Responsible Party FWS	Other	Cost Estimates (x$1,000) FY94	FY95	FY96
Monitoring, Research, and Adaptive Management (continued)								
3	Action item D.3.	4443	cont.		FS	100	100	100
					BLM	250	250	250
					NPS	50	50	50
3	Action item D.4.	4444	cont.	RES		50	50	50
					FS	100	100	100
					BLM	200	200	200
					NPS	75	75	75
3	Action item D.5.	4445	cont.		FS	100	100	100
					BLM	250	250	250
					NPS	75	75	75
3	Action item D.6.	4446	cont.	RES		50	50	50
					FS	100	100	100
					BLM	75	75	75
					NPS	50	50	50
3	Design studies to address adaptive management.	45	cont.		ICG	–	–	–
3	Design programs to study other old-forest species.	46	cont.	RES		200	200	200
					FS	100	100	100
					BLM	-	-	-
					NPS	100	100	100
					CA	148	258	255
					OR	-	-	-
					WA	30	30	30
					PVT	tbd	tbd	tbd
Review and Evaluation								
3	Prepare annual progress reports.	511	cont.		FS	200	200	200
					BLM	5	5	5
					NPS	5	5	5
					BIA	25	25	25
					CA	22	40	56
					OR	3	3	3
					WA	-	-	-
3	Prepare 5-year evaluation report.	512	1		FS	-	-	-
					BLM	5	5	5
					NPS	5	-	-
					BIA	30	-	-
					CA	5	5	5
					OR	3	3	3
					WA	-	-	-

Priority of Task	Task	Task No.	Duration (Years)	Responsible Party FWS	Other	Cost Estimates (x$1,000) FY94	FY95	FY96
Review and Evaluation (continued)								
3	Review and revise recovery plan.	52	1	ES		50	50	50
					ICG	-	-	-

[1]Figures for CA are mainly derived from estimates included in the state's draft HCP; anticipated costs are included in some categories.
[2]Costs are also included under tasks 1233 and 212.
[3]Includes road maintenance, fire protection, silviculture, ranger staff, etc.
[4]Includes funds for studies, data management, planning, etc.
[5]Include state review of timber harvest plans for "no take" compliance with the Endangered Species Act.
[6]Includes funds for studies.
[7]Includes incentives to create owl clusters, etc., on nonfederal lands.
[8]A number of timber firms and organizations are involved in spotted owl studies. The Recovery Team expects there will be close coordination between agency and nonagency groups on monitoring and research.
[9]NPS costs are expected to be high because of inaccessibility to back country.
[10]Operational funds are included in forest planning (task 1233).
Dash (-) = Unknown.

IV.

C. Coordination

1. Need for Coordination

Implementation of the northern spotted owl recovery plan will require a level of effort that is without precedent in attempts to recover species. The recovery plan will necessitate actions during several decades, including long-term commitments of funding and personnel from a variety of governmental entities and the private sector. Activities will encompass a large and varied geographic area, and involve intensive monitoring, evaluation, research, and management tasks. Although these activities will be integrated with ongoing efforts in wildlife management, forestry, and silviculture to a significant extent, they have distinct objectives that address the recovery plan's goal and delisting criteria. Also, the recovery plan will require periodic updates to promote adaptive management consistent with new scientific knowledge and the results of monitoring and evaluations.

Efficient and effective implementation of the recovery plan will require mechanisms to coordinate the wide variety of activities by the participating entities. Federal agencies (National Park Service, Bureau of Indian Affairs, Fish and Wildlife Service, Bureau of Land Management, Forest Service) and appropriate state government agencies need to be involved in the coordination and implementation of the recovery plan. In particular, the FWS must play a major role in ensuring that the plan is implemented. This will require the FWS's commitment to the consultation process and other areas. In addition, the scope and breadth of coordination needs will clearly require establishing a group to help facilitate recovery efforts during the lengthy time frame contemplated in the recovery plan.

2. Coordinating Group

A coordinating group should be established as soon as possible to guide recovery activities over the long term. The coordinating group should be based regionally and explicitly constituted to facilitate communication among federal action agencies, states, and the private sector in addressing the biological, forestry, and policy issues associated with recovery. This can be accomplished by including people with interdisciplinary and management expertise as members. Each participant should determine an appropriate means of liaison with the group. For example, agencies could establish their own recovery implementation teams or regional advisory bodies.

Scope and Functions

The coordinating group must be structured and its functions defined to avoid potential conflicts with the statutory mandates of the agencies involved. Therefore, there should be no direct regulatory function for the group. This is to avoid creating the potential for confusion and duplication of effort of the FWS's section 7 consultation responsibilities under the Endangered Species Act, as well as the land management planning and operational mandates of action agencies. The group should be chartered to address specific functions outlined in this section. These issues encompass broad policy and programmatic concerns that are critical to progress in the recovery effort and ultimately to achieving delisting. Once the group is chartered, members may determine whether smaller working groups should be formed to address individual areas.

Functions of the group should include the following:

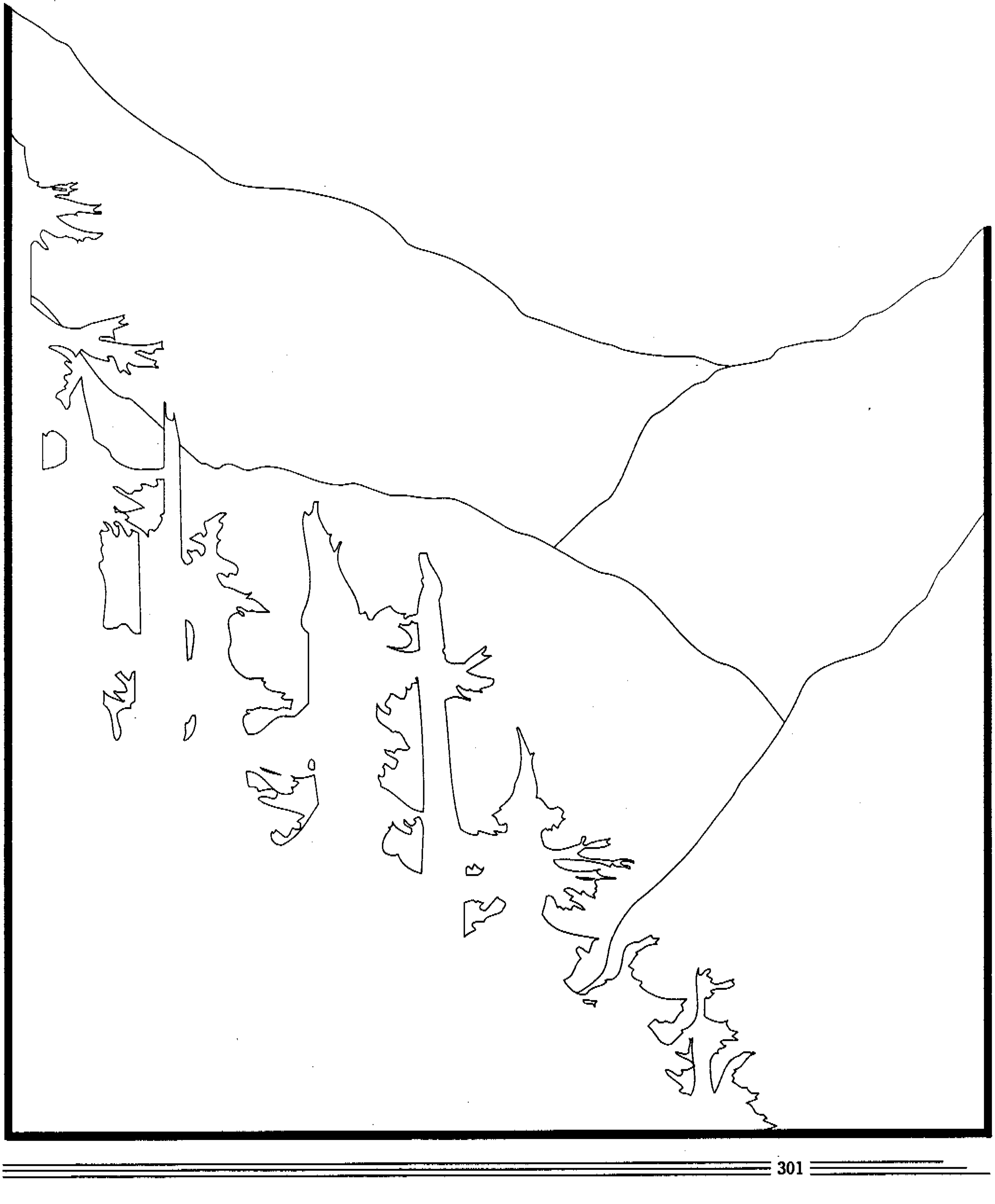
- Recommend population and habitat monitoring standards and guidelines, provide technical advice to agencies about implementing the standards and guidelines, and review results to assess progress.
- Provide a forum to coordinate research agendas of the various entities involved in recovery to ensure that the recovery plan's recommendations are addressed adequately and to maximize the value of the information produced.
- Facilitate consistency of data bases maintained for inventory information (particularly with respect to geographic information systems) and for monitoring and research information.
- At the request of action agencies, review DCA management plans and other proposed actions for technical adequacy and consistency with recovery plan recommendations.
- Review research results and make recommendations concerning management practices in areas such as silviculture to promote the adoption of desired actions in on-the-ground operations.
- Recommend recovery plan revisions through the adaptive management process, based on the results of scientific research, monitoring, and the documented results of program operations.
- Provide technical assistance to federal and state agencies, and to nonfederal parties, as appropriate, concerning issues related to recovery such as DCA management plan development and habitat manipulation. This will include development of province-specific guidelines for application of the general salvage and silviculture guidelines in the recovery plan.
- Upon request from agencies, assess policies, programs, plans, environmental impact statements, and regional guides for consistency with recovery plan objectives and provide recommendations for agency consideration.
- Promote effective communication and coordination among the various federal and nonfederal entities involved in recovery, and with the general public.

3. Organization and Membership

The coordinating group's scope and functions should be determined before organizational issues are addressed. A variety of organizational options is available, including use of the existing Interagency Northern Spotted Owl Conservation Group (INSOCG). Regardless of the arrangement chosen, however, the group's charter should be explicit to clearly establish its role. In addition, membership should comprise the variety of federal and nonfederal entities with responsibilities that affect owl conservation, as well as the private sector. Accordingly, the coordinating group may require chartering under the Federal Advisory Committee Act. Group members will also have to determine the types of subgroup entities and staff assistance that are appropriate.

Chapter V

Literature Cited



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Summary of the Recovery Plan for the Northern Spotted Owl

December, 1992

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Contents

is caused by a number of factors, and is expected to continue at about the same rate whether the owl is protected or not. In addition to that decline, current owl conservation measures, court decisions and administrative appeals have caused a significant drop in the level of employment by restricting timber harvests.

If the recovery plan is not implemented, all these factors will continue to restrict timber harvests. In particular, the Forest Service BLM are likely to continue the policies they have developed. The Endangered Species Act will continue to prohibit federal actions that adversely modify critical habitat or jeopardize the species. The FWS also will continue to enforce the prohibition against taking northern spotted owls, as defined by the Endangered Species Act, on all lands.

Implementation of an approved recovery plan could change some of the factors which currently reduce timber harvest, and provide an opportunity to remove much of the uncertainty that has disrupted the economy in this region, thereby contributing to greater stability in the timber industry.

Even though the recovery plan can help improve the job situation in the future, as compared to a continuation of existing policies, the overall effect of owl conservation will be a smaller work force than would have been expected if nothing were done to protect the owl and its ecosystem. Projecting ahead to 1995, it is estimated that there may be 18,800 fewer timber industry jobs and 13,200 fewer related-sector jobs than there might have been with no owl protection. The value of the timber that will not be harvested because of all owl conservation measures is estimated to be $830 million per year.

Northern goshawk *(Accipiter gentilis)*.

How is this recovery plan supposed to work?

The recovery plan's 7.6 million-acre DCA network is arranged in a way that will support local clusters of breeding northern spotted owls. About 1,450 currently known pairs of owls will be protected in these areas, of the roughly 3,600 pairs known to exist today on all lands. Additional blocks of habitat are recommended to support owls on lands where the DCA network has inadequate suitable habitat or owl populations. This will provide protection for another 111 known owl pairs. The recovery plan also recommends sufficient habitat on lands outside of DCAs for the owls to travel between DCAs. This is called dispersal habitat, and is necessary for the species long term survival.

The unsuitable habitat made up of younger forests inside the DCAs will be allowed, or encouraged through management, to mature into suitable owl habitat. At that time the DCAs are expected to support a total population of about 2,340 breeding pairs of northern spotted owls. In combination with the additional habitat blocks, dispersal habitat, and contributions from nonfederal land, this DCA network will provide an owl population that is sufficient in size and distribution throughout the owl's range to survive and replenish itself despite natural threats such as fires, storms, and diseases.

Will the recovery plan be improved over time?

The recovery plan's intended result is the northern spotted owl being removed from the list of threatened species. While this goal is not expected to change, the specific recommendations to achieve it may change based on new information from monitoring and research. A structured adaptive management process will guide those changes. This process is crucial to the success and credibility of the recovery plan since the owl occupies an ever-changing landscape and our knowledge of that landscape will change through time. Static recommendations are not appropriate in dealing with such a system.

A long-term objective of the recovery plan is to move federal forestlands from a landscape composed of distinct protected areas separated by intensively managed forest, toward a more continuous distribution of managed owl habitat. Results from monitoring and research may support such a change. The process of adaptive management will provide continued improvement of the recovery plan, and eventually may result in incorporation of more of the changes that were encouraged by public comment.

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In a Nutshell...

Why was a recovery plan developed for the northern spotted owl?

The Endangered Species Act, a federal law passed in 1973, and as amended through 1988, says:

> *"The purposes of this Act are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved . . .."*

To achieve this conservation, this law requires that a recovery plan be prepared for any species that becomes federally listed as "endangered" or "threatened." Species are listed when evidence shows that existing conditions and trends are leading them toward extinction. A recovery plan is written to guide actions needed to remove the species from the list, and return it to conditions where it no longer requires the special protections of the law.

A status review by the U.S. Fish and Wildlife Service (FWS) determined that northern spotted owl populations were likely to decline, leading the species toward extinction, if management of their habitat did not change (see Figure 1). The final rule listing the northern spotted owl as a threatened species was published on June 26, 1990, and took effect on July 23, 1990.

The listing focused new attention on efforts to provide protection for northern spotted owls and their remaining habitat. Unfortunately, much of this habitat is the same remnant old-growth forest that was planned for harvest in the near future. The ensuing debate about timber supply versus owl protection has resulted in changing forest management plans, appeals of plans, protests against timber sales, lawsuits, short-term legislation, convening of the cabinet-level Endangered Species Committee, and uncertainty in the timber industry about availability of timber.

At the same time there has been a continuing loss of northern spotted owls and their habitat, and planning for the owl has remained poorly coordinated. The northern spotted owl recovery plan provides a biologically sound strategy to recover the owl, removes some of the uncertainty about timber supply for those people who depend on the timber industry, and provides a starting point for ecosystem conservation.

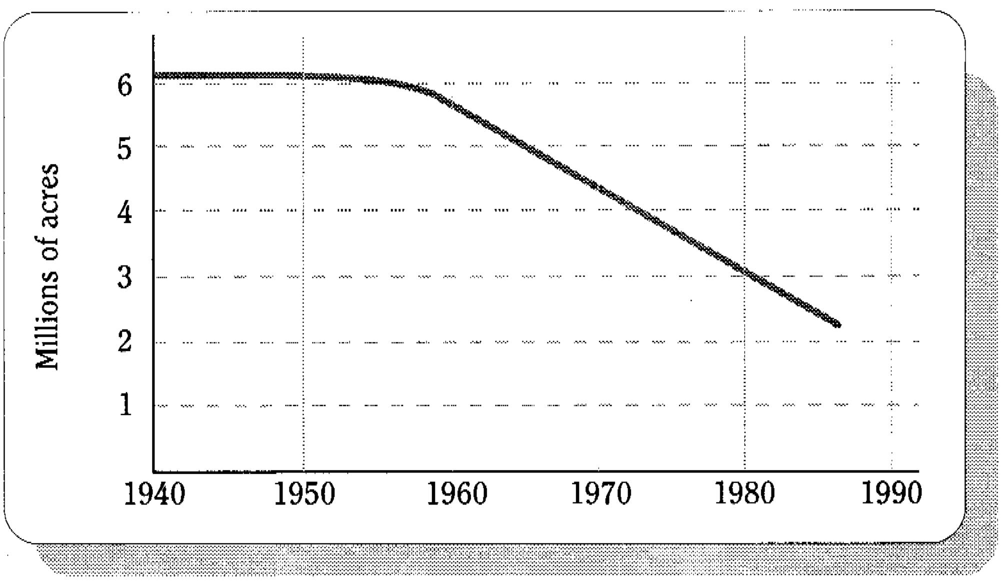

Figure 1. *This graph shows the trend in northern spotted owl habitat on National Forest lands suitable for timber production in Oregon and Washington, illustrating in part why the bird has been listed as a threatened species. Adapted from USDI 1990.*

What is in the recovery plan?

The recovery plan allocates 7.6 million acres of federally managed land (primarily Forest Service, Bureau of Land Management (BLM), and National Park Service (NPS)) for owl conservation. This land is arranged in a way that will support an owl population large enough, and well enough distributed, to survive and replenish itself. Specifically, the recovery plan is built around eight key elements:

1. **A network of 192 designated conservation areas** (DCAs, see Figure 2), each protecting enough habitat on federal forestlands to support a number of breeding pairs of owls. These areas are situated in western Washington and Oregon, and in northwestern California, in a way that meets the owl's biological needs. Of the 7.6 million acres of federal lands in DCAs, about 2.1 million acres are in wilderness areas or national parks.

2. **Guidelines for forest management and other activities on federal lands in the DCAs**, including prohibition of almost all timber harvest in suitable owl habitat.

3. **Guidelines for forest management on federal lands outside the DCAs** to support the DCA network where it is deficient and to provide dispersal habitat among DCAs. These guidelines initially will add about 372,000 acres to the total protected acreage.

4. **A set of standards for judging when the northern spotted owl has reached recovery**, which is defined as a self-sustaining population without need of further help under the Endangered Species Act. The recovery plan allows these standards to be applied to owl populations in each of the 11 physiographic provinces independently or in groups (see Figure 3).

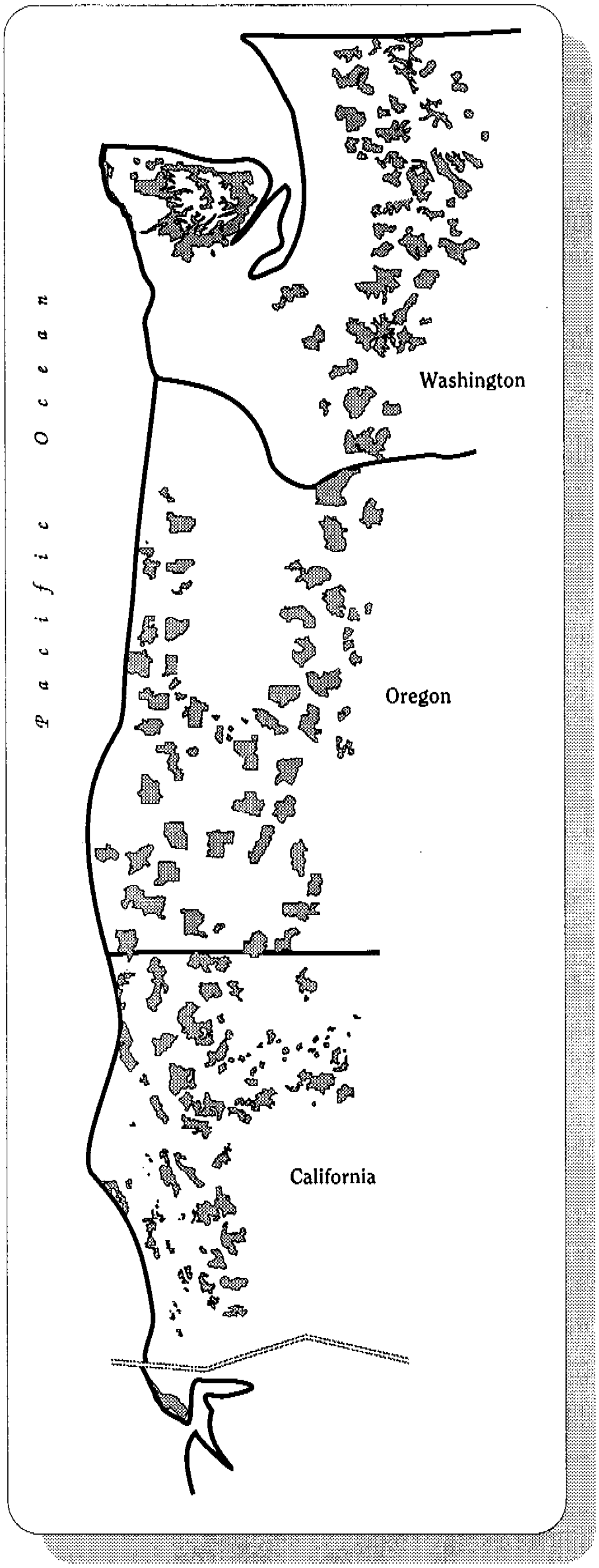

***Figure 2.** The recovery plan's network of 192 designated conservation areas (DCAs).*

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5. **Recommendations for contributions from nonfederal forestlands** to support northern spotted owl populations and to assist landowners in meeting their obligations under the Endangered Species Act.

6. **A monitoring and research program** that will seek new information about northern spotted owls and their habitat, and develop and test techniques for creating and maintaining owl habitat while allowing appropriate forest management.

7. **A plan for changing recovery plan recommendations** as new information is learned about owls, owl habitat, and forest management.

8. **Mechanisms that implement the recovery plan**, provide oversight and coordination, yet rely primarily on existing authorities and planning procedures of state and federal agencies.

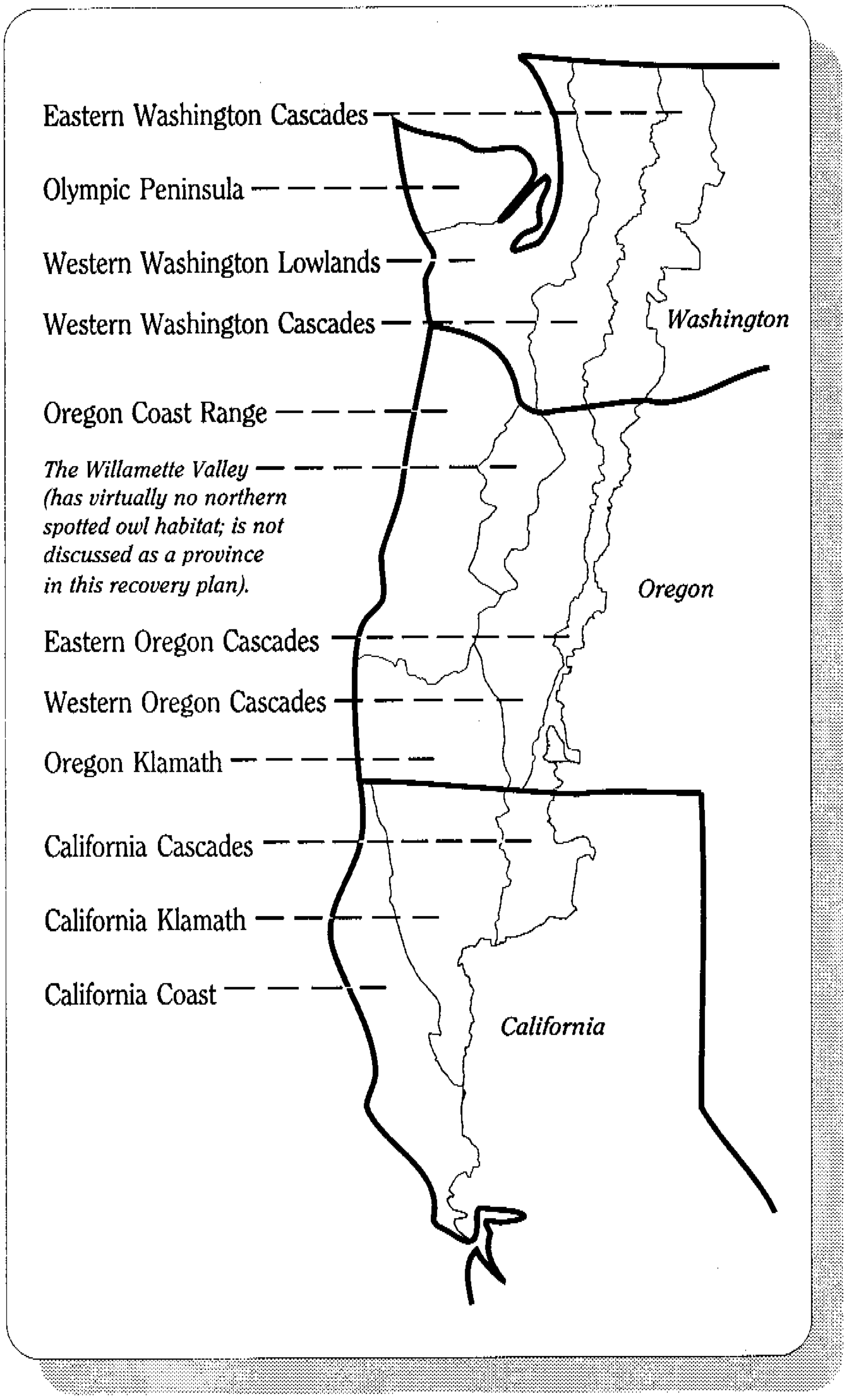


Figure 3. *Provinces within the range of the northern spotted owl in the United States.*

What are the likely effects of this recovery plan?

The initial effect of the recovery plan will be the protection of habitat for about 51 percent of the known northern spotted owl pairs on federal lands. Maintaining the owl's ecosystem will have other positive, but not easily measurable, economic and social effects. The positive effects include the potential continued existence of other species that share the owl's habitat; benefits to fisheries, tourism, recreation, and aesthetics; and the future health and productivity of the entire forest.

The recovery plan also can contribute to higher timber industry employment compared to levels that would be expected if today's forest management and owl conservation policies were to continue. As illustrated in Figure 4, regional employment in the timber industry has been declining at a fairly steady rate for some years. This decline

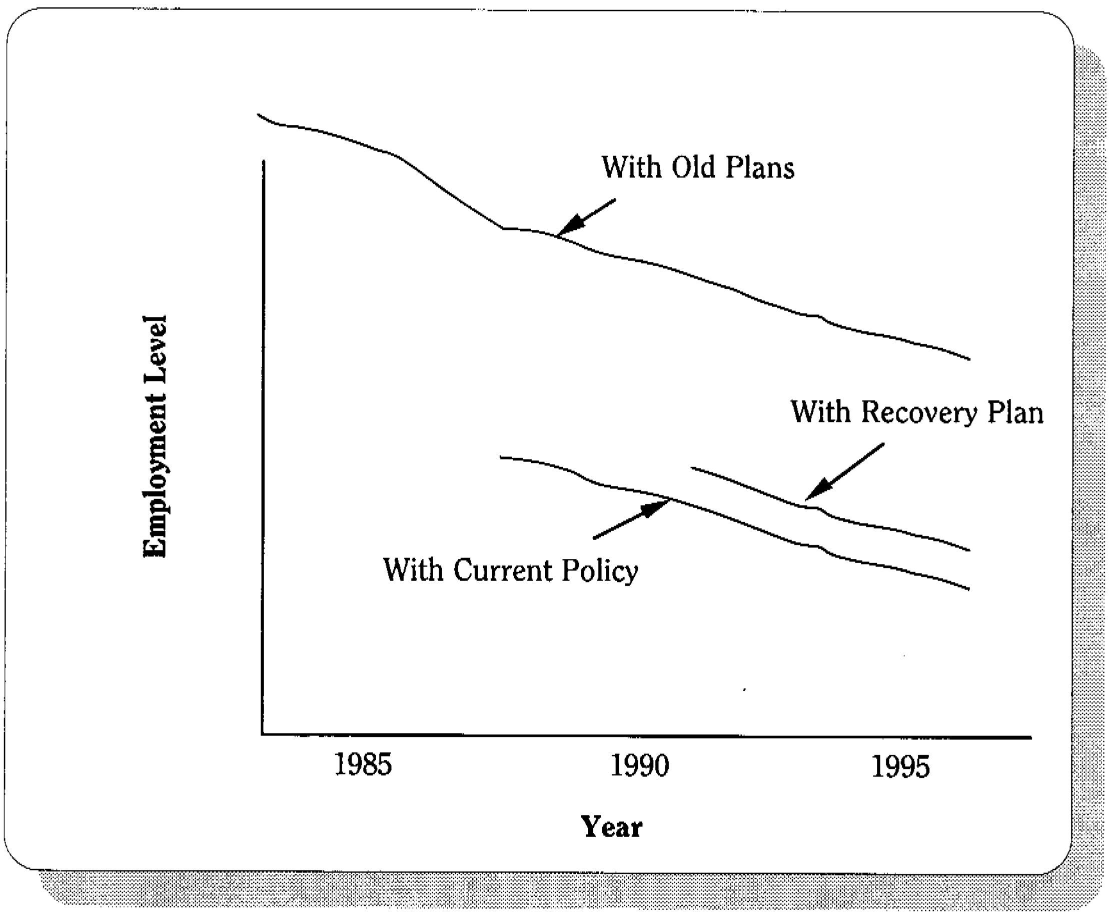


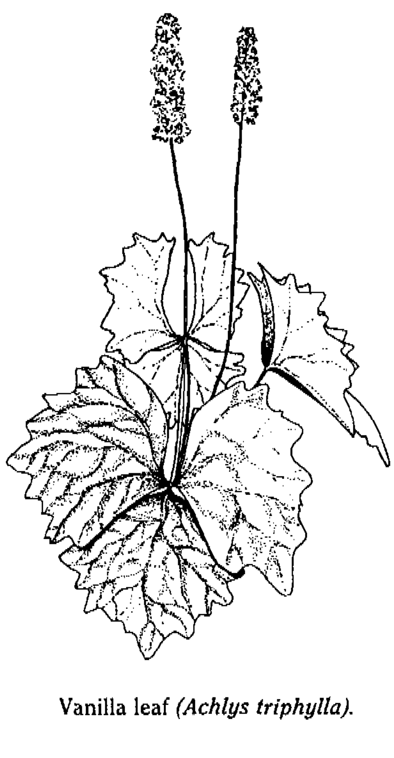
Figure 4. *Comparison of employment levels related to federal timber harvest.*

This Unique Situation

Extensive Habitat

The nature of the northern spotted owl and the decline of its habitat combine to create a situation quite different from that addressed in most recovery plans. Most threatened or endangered species are found in relatively small, localized habitats. Protective measures for those species often involve a small land area, with relatively minor effects on economic activity.

In contrast, the northern spotted owl has existed in huge expanses of natural forest. The owls have lived sparsely distributed throughout the ecosystem, each pair often ranging over thousands of acres to find prey and nest sites.



Vanilla leaf *(Achlys triphylla)*.

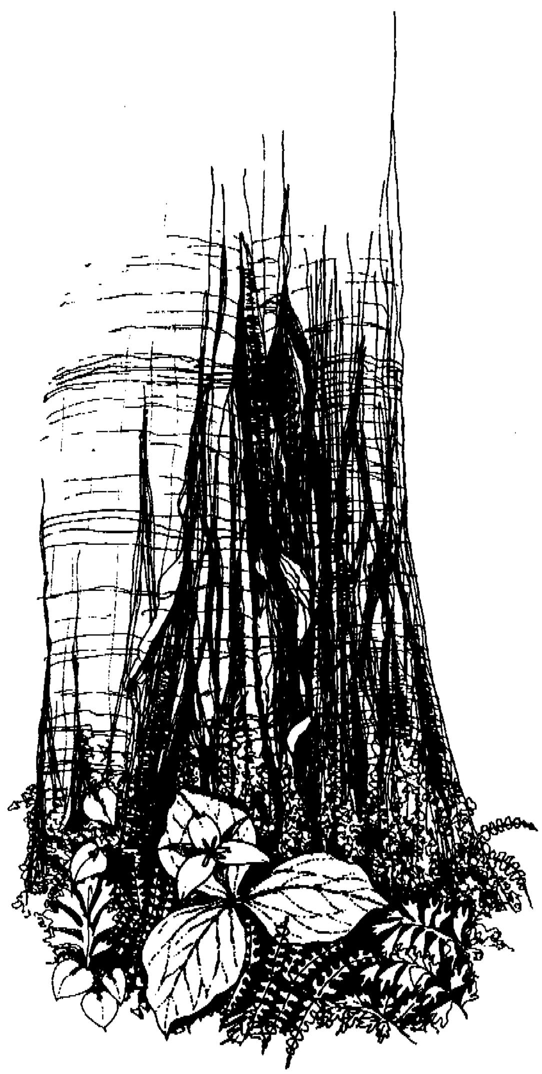
This historic habitat included most of the native forests of the western Pacific Northwest, encompassing large portions of three states (Washington, Oregon, and California) and several different kinds of forests.

Studies show that northern spotted owls select mature or old-growth forests, and generally avoid young forests. But most of the once-extensive tracts of privately owned older forest in the Pacific Northwest were logged early in the region's history. Most timber harvest on public lands also was in old forests, and occurred more recently. Cutting the slow-growing old trees for lumber and replacing them with vigorous new plantations was thought to allow a higher sustainable rate of harvest. Long-term management was aimed at the highest possible sustainable levels of wood fiber production, with some constraints for protection of other values as provided by laws and regulations.

With few exceptions, timber harvest was done by clear-cutting. Clear-cut harvest patterns were driven by economics, ownership, access, and science, leading to checkerboard patterns of clear-cuts and trees in some areas, and very large clear-cuts in others. These harvest patterns have left the remaining older forest highly fragmented, with many of the fragments widely isolated from one another.

This history has left the region with a limited amount of the mature and older forest which was the northern spotted owl's habitat. An article published in the October 1991 *Journal of Forestry* states that as little as 13.1 percent of historical old-growth forests (trees 200 years old or older) may remain in western Oregon and western Washington. Since that publication the remaining acreage of older forest has continued to be harvested, especially on nonfederal lands. Prior to the owls' listing, as much as 70,000 acres of old-growth timber was clear-cut every year from federally managed lands alone.

Those factors (limited existing older forest, rapid harvest of remaining older forest, and uneven distribution of remaining older forest) combine to threaten the existence of the old forest ecosystem and associated species like the northern spotted owl. The recovery plan presents a unique opportunity to achieve recovery of the northern spotted owl, conservation of its ecosystem, benefits for other species, and a return to a more predictable flow of timber from federal forests.



Trillium *(T. ovatum).*

Multiple Ownerships and Regulation

Cooperation will be a vital part of successfully implementing the recovery plan, because of the pattern of land ownership, land management responsibility, and various regulations within the range of the northern spotted owl. Ownership or management of affected forestlands is divided among thousands of large and small corporate and individual owners, several Indian tribes, and a variety of federal, state, and local government agencies.

Furthermore, the three state governments involved, the 50-odd counties, and the five federal land management agencies (BLM, FWS, Forest Service, National Park Service, and U.S. Bureau of Indian Affairs) have substantially different enabling legislation, missions, goals, and regulations.

For example, the BLM oversees more than 2 million acres of forestlands in western Oregon, all within the historic range of the northern spotted owl. The BLM's actions are directed by a number of potentially conflicting federal laws, including the Oregon and California Sustained Yield Act, National Environmental Policy Act, Federal Land Policy and Management Act, Endangered Species Act, and others.

More than 19 million acres of national forests, managed by the Forest Service, also are within the northern spotted owl's range. This adds the National Forest Management Act and other laws to the mix that must be coordinated. Though most of the national forest lands are in larger blocks than the scattered, checkerboard-pattern BLM lands, some are equally fragmented. In addition, broad areas of BLM lands in western Oregon are mingled with the various national forests, and each national forest is managed under its own individual plan.

More than 2 million acres of National Park Service lands also fall within the northern spotted owl's range, but national parks are not managed for timber production, so conflicts with management of owl habitat are minimal. Indian lands are managed under the authority of the Bureau of Indian Affairs, but the tribes are sovereign nations within the boundaries of the United States, and this situation raises other complex questions.

Implementation of the recovery plan must account for an agency's and state's legal abilities and restrictions, as well as the reality of applying a plan over an intermingled ownership. The recovery plan provides a systematic and coordinated approach for dealing with these complexities.

Adult northern spotted owl *(Strix occidentalis caurina).*

Natural History

Introduction

The northern spotted owl (*Strix occidentalis caurina*) is one of the most studied and best known owls in the world. In the past twenty years several major management plans have been developed to protect the owl, and three reviews of its ecological status have been conducted by the FWS.

Northern spotted owls are found from southern British Columbia, Canada, south to Marin County, California. They range eastward to the edge of the Palouse prairie in Washington and the Great Basin shrub steppe in Oregon and California. About 3,600 pairs of northern spotted owls are known to exist today. Although northern spotted owls have been sighted in many habitats within their general range, their breeding distribution is restricted to forests.

Spotted owls are active at night. They are "perch-and-pounce" predators, that is, they select a perch and wait until prey is detected, then pounce to capture it with their talons. Although northern spotted owls capture a broad array of mammals, birds, and insects as prey, they primarily eat small mammals. Woodrats and flying squirrels comprise the majority of their diet. Because spotted owl prey is patchy in distribution and variable in abundance, it is important for spotted owls to defend territories and use large areas for foraging.

Habitat

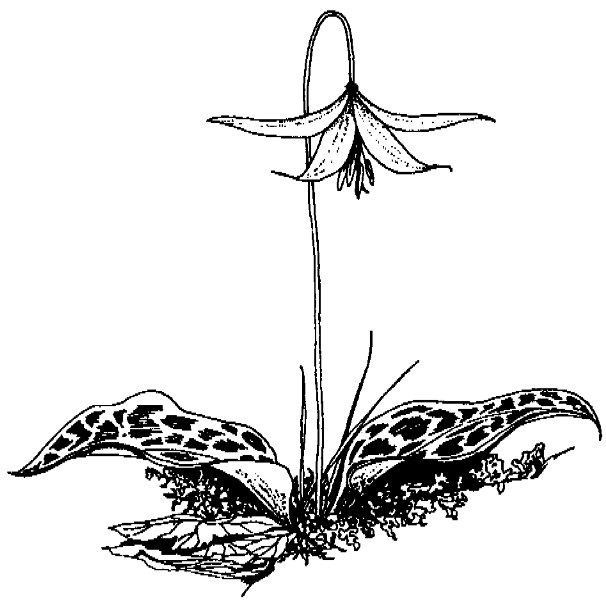
Northern spotted owls are known to nest, roost, and feed in a variety of different kinds of forest. Most observations of spotted owl habitat use have been made in mature and old-growth forests. Although observations of spotted owls in previously logged areas are not uncommon, studies show spotted owls generally prefer areas of mature or older forest and avoid young forests.

Spotted owls do not build their own nests, but depend on naturally occurring nest sites. In older forests, where most spotted owl nest sites are located, the owls tend to nest in broken-top trees and tree cavities. Spotted owls are known to nest in some areas where uneven-aged timber harvest has occurred or where fast tree growth causes rapid habitat development, especially if large trees with old-growth characteristics remain. Studies that compared nest sites with available habitat suggested that the owls, in general, use forests with greater complexity and structure (that is, forests with several tree species, several sizes and ages of trees, containing both snags and down logs, and with open space among the lower branches).

During the summer, roosting (resting) sites are usually cool, shady spots near streams or on the lower third of slopes in relatively dense vegetation. Spotted owls respond to variation in temperature and exposure by moving within the forest foliage to stay in more favorable conditions. Multistoried forests, with trees of various heights supporting foliage at different heights, and having branches more tightly spaced near the treetops and more open underneath (called canopy closure), allow this movement.

Foraging (feeding) habitat generally is similar to other suitable habitats: the upper layer of tree foliage is rather tightly closed, the vegetation is multistoried with large trees, often of several age classes, and there is a mixture of shade-tolerant conifers, hardwood trees, and large numbers of snags or down logs.

Older forests are disappearing rapidly in the northern spotted owl's range as a result of logging. To the extent that northern spotted owls and other species are dependent on these older forests, continued logging of their habitat will threaten them with extinction. Although spotted owls have been reported occupying uneven-aged logged stands (distinct areas of forest) in northwestern California, eastern Oregon, and eastern Washington, forest structure used by spotted owls in these stands is similar to the structure of habitat used by spotted owls in mature and old-growth stands. Owls in managed forests usually occupy areas with high structural diversity, and high canopy closure, with either large diameter or residual old trees. These stands are usually more than 60 years old and remain from partial logging in the past. In some coastal forests the fast growth rate of redwood trees, presence of understory hardwood trees, and the remnant old trees within the stands facilitate more rapid structural development. Important aspects are yet to be estimated for the success of spotted owls in these forests.



Fawn lilly *(Erythronium revolutum)*.

Home Range

Because of the initial observation that northern spotted owl home ranges were very large (averaging more than 2,000 acres), a great deal of scientific effort has been devoted to verifying the original observations and estimating variations in spotted owl home ranges. These studies have resulted in three conclusions. First, all studies of home range size are consistent with the original observations of large northern spotted owl home ranges. Second, there is considerable geographic variation in home range size, with the spotted owls in Washington's Olympic Peninsula having the largest home ranges. Last, home range size appears to increase as habitat becomes more fragmented by logging.

One important feature of spotted owl home ranges is the amount of suitable habitat. From a number of studies, the average amount of suitable habitat in the home range of an owl pair varied from 615 to 4,579 acres. In only two studies were average amounts of suitable habitat found to be less than 1,000 acres per owl pair.

Population Projections

The number of northern spotted owls is a topic of much debate. With increasing survey and monitoring of populations, the count of known owls has increased greatly since the first population estimates were made. These observations of higher owl abundance reflect greater knowledge and effort expended to count owls, not increasing northern spotted owl populations.

Because spotted owls are relatively long-lived, the changing status of their populations is difficult to estimate. Field studies and mathematical models are used to project population trends using estimates of the vital rates, such as birth and death rates. Almost all of these efforts indicate that northern spotted owl populations are declining. Population declines appear to be strongly related to habitat loss.

Summary

Since knowledge of the northern spotted owl has grown so tremendously, there is enough preliminary information about the statistics of northern spotted owl populations to make initial population projections; something that cannot be done for many other species. However, because the owl is long-lived, estimates of the populations' rate of decline may be modified as the populations are studied. Over time, additional information will be gathered about the northern spotted owl and other old-growth dependent species, to help refine management plans.

Northern flying squirrel *(Glaucomys sabrinus).*

Key Considerations in Plan Development

Strategic Principles

In a letter to the Recovery Team, Secretary of the Interior Manuel Lujan Jr. directed the team to prepare a recovery plan for the northern spotted owl with consideration of a number of factors. These factors contributed to the six strategic principles upon which the recovery plan is based.

1. Recognizing the "biological imperative" of the Endangered Species Act, the plan must provide adequate assurance that recovery will be achieved.

2. While meeting the requirement of achieving recovery, the plan should make an effort to minimize social and economic costs, and attempt to distribute such costs equitably throughout the region.

3. The plan must be comprehensive, guiding future federal, state, and private activities affecting the owl, including monitoring, research, habitat protection, development of conservation plans, and other efforts.

4. The plan must recognize all contributions to recovery. If contributions from some areas exceed the plan's recommendations, they may reduce requirements in other areas and help minimize the costs of recovery. Providing incentives for nonfederal landowners to find owls and protect them through management plans may be useful to enhance recovery.

5. The plan must consider its effects on other threatened and endangered species, and those species that might be listed in the future, to reduce the long-term costs of protecting species in these ecosystems.

6. The plan must be responsive to new information and use it to seek more efficient ways to achieve recovery.

Information and opinions received from the general public and the scientific community during the public comment period on the draft recovery plan reinforced these principles.

The Relationship between Biology and Economics

The Recovery Team's directive from the Secretary stated that the recovery plan should address economic and social impacts "to the extent consistent with its legal mandate." This directed the Recovery Team to look for ways to reduce economic and social costs while achieving recovery, and not to determine to what extent recovery should be pursued or compromise the biological adequacy of the plan. In this effort, the Recovery Team recognized the importance of timber harvest as a source of personal and public income. Federal, state, and some local governments derive income from the sale of timber from public lands, and income tax and other tax revenues also are related to timber harvest.

The primary economic costs of owl conservation will be the income lost because timber harvest is restricted to protect owl habitat. Protection of enough habitat to support a self-sustaining owl population will be costly where high-quality habitat contains high-value timber, and in localized areas where timber harvest is the only source of income for communities.

The Recovery Team's efforts to minimize the costs of achieving recovery were based on the knowledge that the quality of northern spotted owl habitat and its ability to produce owls are closely related. The costs of recovery may be reduced by searching for: 1) ways to provide owl habitat with the least possible restriction on timber harvest, or 2) ways to make the protected owl habitat more productive for owls.

The Recovery Team paid particular attention to opportunities to reduce the costs of recovery by:

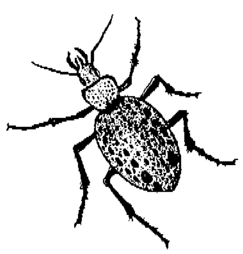
- Recommending measures that directly increase the productivity of DCAs by accelerating the development of younger forests into suitable owl habitat. This also may provide some timber harvest.

- Using forestlands in existing limited-harvest allocations to provide as much as possible of the necessary owl habitat.

- Locating DCAs in existing reserved areas, such as wilderness areas, where possible.
- Preserving or developing owl habitat areas that also contribute to the conservation of other species requiring protection.

The first economic benefit of the recovery plan may be to improve the predictability of the timber supply in the region, once the plan is adopted. Since this and the other positive economic effects of the recovery plan are difficult to measure and express in simple dollar figures, they are not discussed in detail.

There are also long-term benefits from implementation of the recovery plan that may eventually improve the economic and social effects of this plan. Positive effects also may include benefits to fisheries, tourism, recreation, forest health for other forest species, and future productivity of the forests.



Flightless ground beetle
(Cychrus tuberculatus).

Changes made to the Final Recovery Plan

In response to the Secretary's direction, the draft recovery plan was released for a 90-day public review period in May 1992. During the 90 days, three public meetings were held to provide the public and the Recovery Team the opportunity to discuss issues. More than 1,600 written comments were received.

As a result of these, the Recovery Team made refinements to DCA boundaries, DCA management recommendations, and management recommendations for dispersal habitat on federal lands. These changes should improve the ability of federal agencies to implement the recovery plan, and should help ensure that appropriate steps are taken to improve and protect habitat.

Many other comments suggested more fundamental changes to the recovery plan, such as increased reliance on managed forests. The ability of the Recovery Team to respond to these suggestions was limited by the lack of scientific information available about how the changes would affect owl recovery. The adaptive management process will allow ongoing consideration and perhaps incorporation of these suggestions during recovery plan implementation.

A Summary of the Recovery Plan

Introduction

Starting from information and strategies in the Interagency Scientific Committee (ISC) report of 1990, the recovery plan is based on general biological principles and scientific field studies of the habitat conditions northern spotted owls use for nesting, feeding, resting, and traveling through the forest. It also is based on information about birth and survival rates and the movement patterns of owls. This information was analyzed according to the scientific concepts of conservation biology. Theories and mathematical models of population dynamics were used to determine the appropriate size of northern spotted owl population clusters, the habitat that must exist for owls to travel between cluster areas, and the overall owl population necessary to be self-sustaining.

Studies of the growth and development of forests under natural conditions and under human management also were considered. Mathematical models of forest growth were used to study opportunities for promoting more rapid development of suitable owl habitat conditions by managing younger forests. In addition, numerous comments and information from the public and other interested parties were considered and guided the changes made to the recovery plan between the draft and final.

The goal of the recovery plan is to reduce existing threats to the northern spotted owl so it can be removed from the list of threatened species. To measure this, the recovery plan establishes four general criteria that must be met.

1. Northern spotted owl populations and habitat must be monitored with a scientifically credible plan.
2. The population of northern spotted owls must be stable or increasing in the province or provinces being considered for delisting.
3. Commitments from landowners and land managers must be in place to provide long-term protection of owl habitat.
4. Information from a variety of sources must indicate that the population of northern spotted owls will not need renewed protection under the Endangered Species Act.

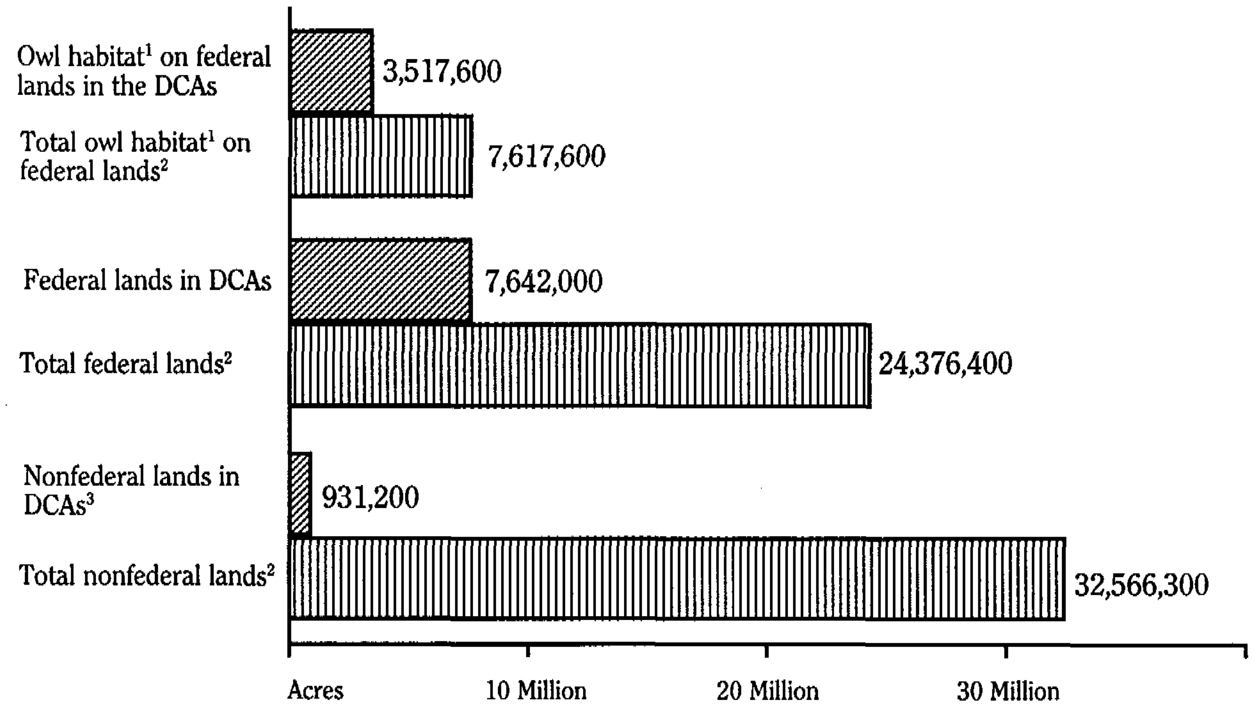
In the recovery plan, comprehensive sets of goals and objectives are established for each of 11 provinces in the owl's range, shown in Figure 3. The physical and biological situations differ among these provinces, so recovery recommendations are specific to each of them.

The broad principles involved include:

- Larger populations are more secure than smaller ones.
- Populations close enough together to allow dispersal among them are more effective than are isolated populations.
- Connected habitat is more valuable than fragmented habitat to a species such as the spotted owl.
- Maintenance of a species throughout its range is more effective and less risky than maintenance of populations in only a part of the range.

These biological principles led to the recommendation for a network of DCAs on federal land. Management recommendations for DCAs are intended to maintain and increase habitat suitability for spotted owls. Recommendations for forests connecting DCAs are intended to allow owls to move from one DCA to another and to support breeding pairs of spotted owls in areas where the DCA network is deficient.

The size and arrangement of DCAs are based on the best information regarding the size of spotted owl home ranges and the ability of juvenile owls to disperse. Organization of the recovery strategy on the concept of multipair habitat areas is necessary for this species because its normal behavior includes significant interaction between owl pairs. Other management recommendations are based on knowledge of habitat characteristics suitable to support the various life functions of owls. A comparison of acreages within and outside DCAs is shown in Figure 5.



[1]Habitat = includes nesting, roosting, and foraging habitat. This information is available only for federal lands.
[2]Includes lands within the range of the northern spotted owl in the United States.
[3]Management of nonfederal lands within the perimeter of designated conservation areas is different from that on federal lands, and is discussed in more detail in the plan.

Figure 5. *Acres in the range of the northern spotted owl and in the DCAs (designated conservation areas).*

Designated Conservation Areas (DCAs)

The DCAs are intended to provide northern spotted owl habitat in relatively large blocks where clusters of breeding pairs of spotted owls will be able to live, reproduce, and interact over time. The 192 DCAs are arranged in a network derived from the ISC strategy. The ISC's network (of habitat conservation areas or HCAs) was based on biological principles, observed evidence, and computer-simulated population modeling. Each HCA was refined in size, shape, and location, seeking the best possible combination of habitat, known owls, and HCA shape. Category 1 HCAs were to be a maximum of 12 miles apart (7 miles apart for the smaller category 2 HCAs) and as nearly circular in shape as possible. The DCA network of the recovery plan is a modified version of the HCA network. Updated inventories of owls, owl habitat, land designation, and other species were considered in an effort to improve the biological and economic efficiency of the DCA network over that of the HCA network. A comparison of owl numbers within and outside DCAs is shown in Figure 6.

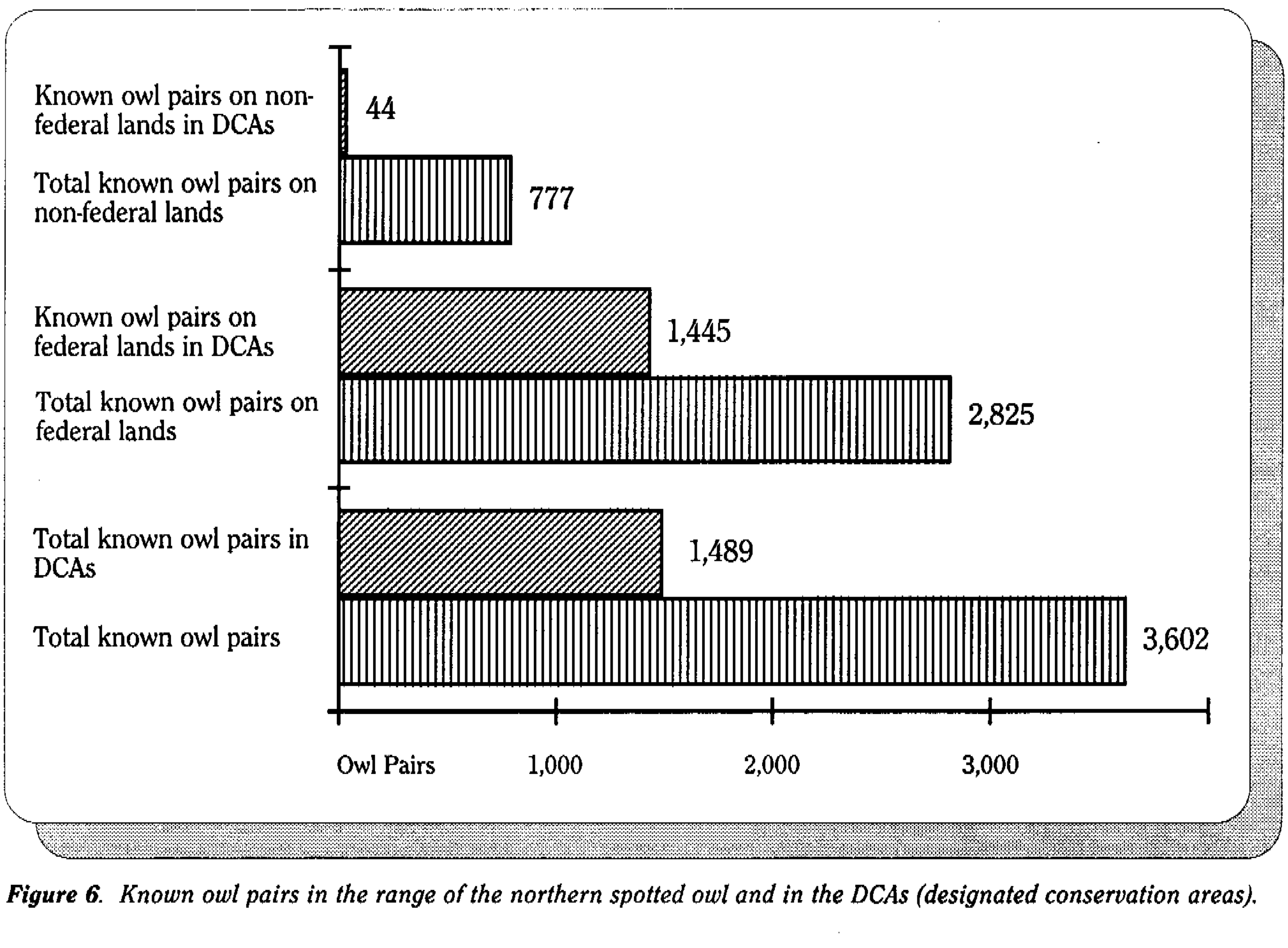


Figure 6. *Known owl pairs in the range of the northern spotted owl and in the DCAs (designated conservation areas).*

Management Within DCAs

The recovery plan contains guidelines for management of federal lands within DCAs. Generally it recommends that there be no timber harvest allowed in suitable habitat inside the DCAs. Silvicultural activities like thinning may be used to promote development of suitable habitat for northern spotted owls, but only where studies indicate that development of owl habitat could be accelerated significantly. The guidelines recommend that silvicultural practices be limited to no more than 5 percent of any DCA within the first 5 years of implementing the recovery plan. These silvicultural practices would generally be used in stands that are even-aged, have an average tree diameter of 11 inches or less, and have not developed a multilayered canopy (as is typical in stands that have been clearcut and replanted). Exceptions may be made in areas where management activities in older stands could reduce the risks of insects, diseases, and fire.

Salvage of dead trees in a DCA following a major fire, wind storm, insect infestation, or disease outbreak may take place under the recovery plan, but only where it would have a neutral or beneficial effect on owl habitat. Salvage would be allowed only in damaged areas larger than 1 acre and where canopy closure is less than 40 percent. Retention of live trees, some snags, and down logs in these areas is required.

The management activities outlined in the recovery plan are intended to be carried out under a comprehensive plan written for each DCA by the appropriate federal land management agency. Plans are to be written by teams including biologists, silviculturists, and others, and should describe management and monitoring that will take place in the DCA.

Management on Federal Lands Outside of DCAs

In the recovery plan, lands within the range of the northern spotted owl but outside the DCAs are referred to as the forest matrix. To support recovery of the owl, federal lands in the forest matrix must:

1. Provide habitat for spotted owls to move between DCAs. This is achieved by a 50-11-40 rule like that described by the ISC: within every quarter-township, at least **50** percent of the forest matrix managed by each federal agency should provide stands of trees that average at least **11** inches in diameter and have at least **40** percent canopy closure.

2. Maintain reproductive owl pairs in areas where DCAs do not yet provide enough owls or habitat to function as intended. These are areas of habitat around owl activity centers outside the DCAs, and include enough nesting, roosting, and foraging habitat to support a pair of owls. They are called either reserved pair areas or managed pair areas, and criteria appropriate for each province were used to determine where, and how large, they should be.

3. Protect against the threat of large-scale natural threats or disturbances. In the eastern Washington Cascades province and other provinces, there is high likelihood of disturbances due to fire and insect infestations. These disturbances pose a significant threat to the sparse spotted owl populations in these areas. To reduce the risk, it is recommended that habitat be provided for additional owl activity centers. These are termed managed pair areas because it is recommended that habitat for these owl pairs be sustained by management that also will reduce the risk of fire and insect infestation.

In addition, it is recommended that small areas, termed residual habitat areas, be maintained around existing owl pairs and territorial single owls. These residual habitat areas are not large enough to support breeding owl pairs, but they will help maintain options to provide for northern spotted owls throughout the landscape in the future. Their number will vary by province.

Nonfederal Lands

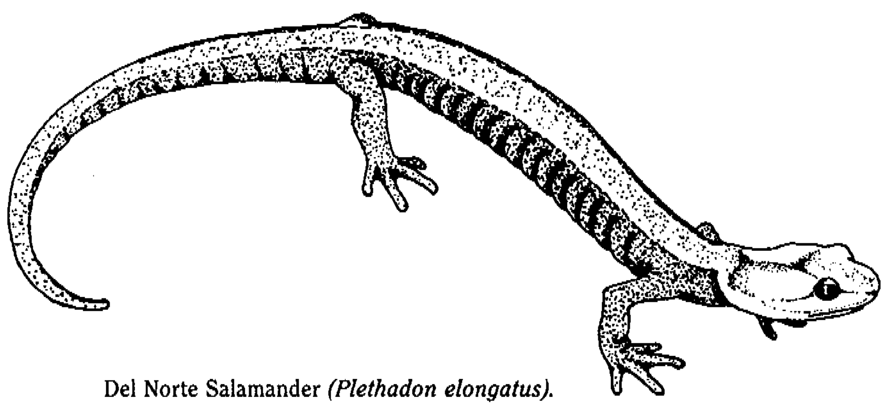
Federal agencies have the major role in recovering the northern spotted owl because the owls are concentrated on federally managed lands. Nonfederal lands, however, are important to recovery of the owl and the recovery plan contains objectives for them. Nonfederal lands are particularly important in parts of the owl's range where federal land is inadequate to provide for recovery.

Some of the tools that may allow nonfederal lands to contribute to recovery include:

- Existing reserves such as parks and conservation easements.
- Voluntary private actions with commitments to long-term maintenance of suitable habitat.
- State forest practices laws and regulations.
- The Endangered Species Act prohibition on "taking" listed species.
- Purchase or land exchange to place selected habitat under federal management.
- Exchange of timber cutting rights, without changing land ownership.
- Conservation easements, mitigation banks, purchase or transfer of harvest or development rights.

Other Species and the Forest Ecosystem

The northern spotted owl is associated with older forests which are also home to numerous other forest and forest-related species. Some of these species are already listed under the Endangered Species Act (e.g., salmon, marbled murrelets), many are candidates for listing, and others are dependent upon these older forests. Provision was made for these species in the recovery plan as long as their consideration did not negatively affect the owl recovery strategy and did not increase the costs of recovery. As a result, the recovery plan will have benefits to many of these other forest species. For example, the recovery plan will protect a large number of the sites known to be used by marbled murrelets. Through consideration of these other species, the recovery plan moves in the direction of management for the ecosystem occupied by the northern spotted owls.



Del Norte Salamander *(Plethadon elongatus).*

Monitoring and Research

The goal of the recovery plan is delisting the northern spotted owl throughout its range. Monitoring and research will provide information needed to support delisting decisions. During the years before delisting, monitoring and research will also be vital to improving the recovery plan. This process is called adaptive management, and its goal is to make improvements in the biological and economic efficiency of the recovery plan while protecting the owl. The intent is the recovery of the owl and an eventual shift toward management does not require reserved areas. But adaptive management and steps to delist the owl cannot be initiated without a strong, coordinated, and long-term commitment to monitoring and research.

Monitoring and research should focus on specific questions, such as the following examples.

- Are DCAs being established as recommended by the recovery plan?
- Are matrix management guidelines being followed?
- Are owl populations inside the DCAs stable or increasing?
- Are activities in DCAs producing the predicted forest structure?
- Are owls moving between DCAs?
- How do individual owls and owl populations respond to forest management practices and resulting stand conditions?
- How well do various habitats provide for dispersal of owls?
- How do economic incentive systems operate to encourage nonfederal landowner contribution to recovery?

Implementing the Recovery Plan

It is recommended that federal agencies adopt the recovery plan as soon as possible after the final recovery plan is approved. It will take about 5 years to fully implement all portions of the recovery plan. During that time, agencies will continue with current policies and plans that are consistent with the recovery plan, and begin the necessary steps to change other plans. If agency actions are not consistent with the recovery plan for an extended period, the recovery plan will have to be reevaluated because unintended reductions in northern spotted owl populations and habitat may occur which could alter the underlying assumptions of the strategy.

It is suggested that the affected states (Washington, Oregon, and California) review the recovery plan, begin to implement its recommendations under current authorities, and initiate other actions (such as habitat conservation plans with private landowners) as appropriate.

The FWS should modify its designation of critical habitat for the northern spotted owl to reflect recovery plan recommendations, use recovery plan recommendations as guidance in section 7 consultations under the Endangered Species Act, and prepare for a continuing review of recovery plan progress.

The recovery plan recommends that a formal federal and state coordinating group provide long-term guidance. This group will assist the FWS in providing advice and assistance to federal agencies, the states, private landowners, and industry. The coordinating group is envisioned to have no regulatory function, but is considered instrumental to the success of the recovery plan. A group, such as the Interagency Northern Spotted Owl Conservation Group, may be the most appropriate forum for this effort.

What was the Recovery Team, and what did it do?

The Recovery Team

The Recovery Team was comprised of 18 members appointed by Secretary of the Interior Manuel Lujan Jr. Members included biologists, ecologists, foresters, economists, federal land managers, and representatives of the governors of California, Oregon, and Washington.

The Recovery Team began its work in March 1991. It held numerous meetings, as a team and in smaller committees working on specific matters such as: owl biology, consideration of other species, economic and social effects, implementation, and silviculture. Members visited a wide variety of northern spotted owl habitats and forests in the three states, including lands in the national forest system, national parks, BLM districts, Indian reservations, and state forests. They also toured commercial forests owned by the Fruit Growers Timber Company, Sierra Pacific, Weyerhaeuser, Willamette Industries, and Port Blakely, and some industry study areas.

Beginning with information compiled by the ISC, the Recovery Team sought new information about northern spotted owls from a variety of sources and commissioned special reviews on topics such as demography; silvicultural practices; and management of forest threats such as fire, insects, and diseases. An automated geographical information system was developed to manage the great array of data about owl sites, habitat areas, and timber resources, and other forest species like the marbled murrelet.

Public Involvement

The public had several opportunities to become involved in the recovery process. Early in this process, most Recovery Team meetings were held in open session, attended by representatives of various interest groups, elected officials, news media representatives, and the general public. During the planning process, the Recovery Team sent agendas and summaries of meetings to a large list of interested parties, including the news media and local, state, and federal elected officials. Also, letters requesting specific new information about northern spotted owls were sent to the same mailing list. A number of people, representing various interests, presented information or points of view to the Recovery Team or its committees. Periodic briefings were held for elected officials and agency staff.

After the draft recovery plan was released in May 1992, there was a 90-day public comment period. During this time there were three public meetings, which were announced in the regional news media and were well attended. More than 1,600 written comments were received and oral comments were delivered at the public meetings. All of this information was considered as the Recovery Team completed the final recovery plan.

The public will have other opportunities to consider and comment on measures in the recovery plan before they are implemented by the individual land management agencies. The National Environmental Policy Act requires federal agencies to follow a process of evaluating alternatives, environmental effects, and public comments before adopting any change in land use practices, such as the requirements of this recovery plan.

Recovery Team Members

Recovery Team members were selected by the Secretary of the Interior because of their affiliation and expertise. Their affiliation at the time of their selection is noted here. However, during the 2-year planning process some members changed positions or were replaced, and the changes are noted here.

Donald R. Knowles - *Secretary's representative and team coordinator* - Associate Deputy Secretary, U.S. Department of the Interior, Washington, D.C.

Marvin Plenert - *Team leader* - Regional Director, U.S. Fish and Wildlife Service Pacific Region (Washington, Oregon, California, Idaho, Nevada, Hawaii, and the Pacific Trust Territories), Portland, Oregon.

Jonathan Bart - *Chairman* - Assistant Leader of the Ohio Cooperative Fish and Wildlife Research Unit; Associate professor, Department of Zoology at Ohio State University, Columbus, Ohio.

Robert G. Anthony - Assistant Unit Leader and Professor of Wildlife Ecology, Oregon Cooperative Wildlife Research Unit, Oregon State University, Corvallis, Oregon.

Melvin Berg - Chief, Division of Forestry, U.S. Bureau of Land Management, Washington, D.C.

John H. Beuter - Deputy Assistant Secretary of Agriculture for Natural Resources and Environment, U.S. Department of Agriculture, Washington, D.C.

Wayne Elmore - State Riparian Specialist for Oregon and Washington, U.S. Bureau of Land Management, Prineville, Oregon.

John Fay - Listing Branch Chief, Division of Endangered Species, U.S. Fish and Wildlife Service, Washington, D.C.

R. J. Gutiérrez - Professor, Department of Wildlife, Humboldt State University, Arcata, California.

H. Theodore Heintz, Jr. - Assistant Director for Economic Analysis, Office of Policy Analysis, U.S. Department of the Interior, Washington, D.C.

Richard S. Holthausen - National Wildlife Ecologist, U.S. Forest Service, Corvallis, Oregon.

Kenneth Lathrop - Supervisory Forester, Forest Products and Sale Administration, U.S. Bureau of Indian Affairs, Portland, Oregon.

Kent Mays - Program Manager for Spotted Owl Research, Development and Application, U.S. Forest Service, Portland, Oregon.

Richard Nafziger - *Representing the Governor of the State of Washington* - Special Assistant to the Governor for Timber Policy and Rural Development and Coordinator of Interagency Task Force on Timber Community Development, Olympia, Washington.

Martha Pagel - *Representing the Governor of the State of Oregon* - Governor's Senior Policy Advisor on Natural Resources, Salem, Oregon. (Transferred and replaced on the Recovery Team by Robert Warren.)

Christine Sproul - *Representing the Governor of the State of California* - Assistant Secretary, Legal Affairs, The Resources Agency of California, Sacramento, California.

Edward E. Starkey - Research Biologist and Terrestrial Ecology Program Leader, National Park Service Cooperative Park Studies Unit, Oregon State University; Professor of Terrestrial Ecology, Departments of Forest Resources and Fisheries and Wildlife, Oregon State University, Corvallis, Oregon.

John C. Tappeiner - Professor of Forestry, Oregon State University, Corvallis, Oregon. (Currently with the BLM Research Laboratory at Oregon State University, Corvallis, Oregon.)

Robert Warren - *Representing the Governor of the State of Oregon* - Special Assistant for Forest Policy and Direction, Governor's Forest Planning Team, Salem, Oregon. (Appointed to replace Martha Pagel on October 22, 1992.)

Team Support

Charles Bruce, Oregon Department of Fish and Wildlife

Philip Carroll, U.S. Fish and Wildlife Service

Catherine Elliott, Washington Governor's Timber Team

Lawrence Finfer, U.S. Department of the Interior

Gordon Gould, California Department of Fish and Game

Ann Hanus, Oregon Department of Forestry

David Hays, Washington Department of Wildlife

David Johnson, Oregon Department of Fish and Wildlife

Linda Kucera, U.S. Fish and Wildlife Service

Barry Mulder, U.S. Fish and Wildlife Service

Cay Ogden, U.S. Fish and Wildlife Service

Craig Partridge, Washington Department of Natural Resources

Fred Seavey, U.S. Fish and Wildlife Service

Raul Tuazon, California Department of Forestry and Fire Protection

Figure of "Saikomal," Cedar Man, from Haida totem.

Glossary

activity center - an area of concentrated activity of either a pair of northern spotted owls or a territorial single owl.

adaptive management - the process of implementing policy decisions as scientifically driven management experiments that test predictions and assumptions in management plans, and using the resulting information to improve the plans.

BLM - Bureau of Land Management, U.S. Department of the Interior.

canopy - a layer of foliage in a forest stand. This most often refers to the uppermost layer of foliage, but it can be used to describe lower layers in a multicanopy stand.

canopy closure - the degree to which the crowns of trees are nearing general contact with one another. Generally measured as the percent of the ground surface that would be covered by a vertical projection of foliage in the crowns of trees.

clear-cut - a common method of timber harvest in western Oregon, western Washington, and northwestern California which results in all the trees in the harvested unit being cut within a few weeks or months.

consultation (as in the Endangered Species Act) - a formal interaction between the U.S. Fish and Wildlife Service and another federal agency when it is determined that the agency's action may affect a species that has been listed as threatened or endangered or its critical habitat.

conservation (as in the Endangered Species Act) - the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided under the Endangered Species Act are no longer necessary.

critical habitat (as in the Endangered Species Act) - specific areas within the geographical area occupied by a species on which are found those physical or biological features essential to conservation of the species.

DCA - (designated conservation area) - a contiguous block of habitat to be managed and conserved primarily for breeding pairs of northern spotted owls, connectivity, and distribution of owls; application may vary throughout the range according to local conditions. These areas were derived from the network of HCAs developed by the ISC. Category 1 DCAs will be adequate to support at least 20 breeding pairs of owls, and category 2 DCAs will support one to 19 pairs.

dispersal - the movement, usually one way and on any time scale, of plants or animals from their point of origin to another location where they subsequently produce offspring.

down tree, or down log - portion of a tree that has fallen or been cut and left in the woods.

ecosystem - an interacting system of organisms considered together with their environment; for example, marsh, watershed, and lake ecosystems.

endangered species - any species of animal or plant that is in danger of extinction throughout all or a significant portion of its range. Plant or animal species identified by the Secretary of the Interior as endangered in accordance with the Endangered Species Act of 1973.

Endangered Species Act - the Endangered Species Act of 1973, as amended through 1988. A federal law with the purpose of conserving the ecosystems upon which endangered and threatened species depend.

forest matrix - forestlands within the range of the northern spotted owl that lie outside of category 1 and 2 DCAs.

FWS - Fish and Wildlife Service, U.S. Department of the Interior

habitat - the place where a plant or animal naturally or normally lives and grows.

HCA (habitat conservation area) - as proposed by the Interagency Scientific Committee, a contiguous block of habitat to be managed and conserved for breeding pairs, connectivity, and distribution of owls; application may vary throughout the owl's range according to local conditions.

ISC (Interagency Scientific Committee) - a committee of scientists established by the four major federal resources management agencies, and mandated by the U.S. Congress in 1989, to develop a conservation strategy for the northern spotted owl.

managed forest - refers to any forestland, including owl habitat, that is treated with silvicultural practices and/or harvested. Generally applied to land that is harvested on a scheduled basis and contributes to an allowable sale quantity.

managed pair areas - a core habitat area, plus additional acreage of suitable habitat around the core, in some portions of the range where it is necessary to provide additional protection for matrix pairs of owls and territorial singles. Appropriate silvicultural treatment is encouraged in suitable and unsuitable habitat in the acreage around the core.

managed stand - see definitions of stand and managed forest.

matrix - see forest matrix.

Oregon and California Sustained Yield Act - (O&C Act) "The Act of August 28, 1937," the law which placed millions of acres of former railroad grant lands in Oregon under the U.S. Department of the Interior (managed today by the Bureau of Land Management) and directed that they be managed "for permanent forest production . . .." The act also requires distribution of funds from sale of timber from these lands, with 50 percent of receipts divided among the 18 O&C counties.

old-growth (as in old-growth forest) - a forest stand with moderate to high canopy closure; a multilayered, multispecies canopy dominated by large overstory trees; a high incidence of large trees with broken tops and other indications of decadence; numerous large snags; and heavy accumulations of logs and other woody debris on the ground.

province - in the recovery plan, 11 provinces are recognized, based on physiographic provinces with acknowledgment of political boundaries and their differing laws. A physiographic province is a geographic region where climate and geology have given rise to a distinct array of landforms. Biology and habitat relationships of northern spotted owls vary by physiographic province due to differences in climate, vegetation, and productivity of habitats.

range (of a species) - the area or region throughout which an organism occurs.

recovery (as in the Endangered Species Act) - a condition at which a species no longer needs the protections of the act.

reserved pair area - area of suitable habitat identified for pairs and territorial single owls. In those portions of the owl's range where habitat and owl populations were inadequate to apply the criteria creating category 1 and category 2 DCAs, individual pair areas also are reserved. The acreage of these areas varies throughout the owl's range, based on data for pairs in each province; all suitable habitat is reserved from timber harvest.

residual habitat area - a 100-acre area of nesting, roosting, and foraging habitat encompassing the activity center for a pair or territorial single owl in the matrix.

roost (as in roost sites or roosting habitat) - an area where a bird finds suitable resting conditions.

salvage - unscheduled harvest of trees killed by storm, insect infestation, or disease.

section 7 - the section of the Endangered Species Act that specifies the roles of interagency coordination in accomplishing the objective of species protection and recovery.

silviculture - the science and practice of controlling the establishment, composition, and growth of forests.

species - 1) a group of individuals that has its major characteristics in common and are potentially interfertile; 2) the Endangered Species Act defines species as including any species or subspecies of plant or animal. Distinct populations of vertebrates also may be treated as species under the act.

stand (as in timber stand) - an aggregation of trees occupying a specific area and sufficiently uniform in composition, age arrangement, and condition as to be distinguishable from the forest in adjoining areas.

take - under section 7 and section 9 of the Endangered Species Act, "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect an animal, or to attempt to engage in any such conduct.

threatened species - a plant or animal species likely to become an endangered species throughout all or a significant portion of its range within the foreseeable future. A plant or animal species identified by the Secretary of the Interior as threatened, in accordance with the Endangered Species Act.

township - a U.S. land survey unit, 6 miles square, containing 36 mile-square sections.