

Draft Recovery Plan for the Northern Spotted Owl (*Strix occidentalis caurina*)



**2007 Draft Recovery Plan
for the
Northern Spotted Owl
(*Strix occidentalis caurina*):
Merged Options 1 and 2**

(April 2007)

Region 1
U.S. Fish and Wildlife Service
Portland, Oregon

Approved: XXXXXXXXXXXXXXXXXXXXXXXXXXXX
Regional Director, U.S. Fish and Wildlife Service

Date: XXXXXXXXXXXXXXXXXXXXXXXXXXXX

Disclaimer

Recovery plans delineate reasonable actions that are believed to be required to recover or protect listed species. Plans are published by the U.S. Fish and Wildlife Service (Service) and are sometimes prepared with the assistance of recovery teams, contractors, State agencies, and others. The objectives in the plan will be attained and funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities.

This draft Northern Spotted Owl Recovery Plan was prepared with the assistance of a Recovery Team representing Federal agencies, State governments, and other affected and interested parties. The Recovery Team members served as independent advisors to the Service. This Plan does not necessarily represent the view or official position of any individual or organization – other than that of the Service – that was involved in the writing of the Plan.

In the final analysis, a recovery plan is a Service document. Although consensus decision-making was a goal for the Recovery Team, it was not achieved on all issues. Participation by any individual Recovery Team member in the development of this Plan is not to be construed as agreement to, or endorsement of, the final provisions of this Plan by that individual or the interested parties he or she represents.

A recovery plan represents the official position of the Service *only* after it has been signed by the Director or Regional Director as *approved*. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery actions.

Notice of copyrighted material

Permission to use copyrighted images in this Recovery Plan has been granted by the copyright holders. These images are not placed in the public domain by their appearance herein. They cannot be copied or otherwise reproduced, except in their printed context within this document, without the written consent of the copyright holder.

Literature citation of this document

U.S. Fish and Wildlife Service. 2007. 2007 Draft Recovery Plan for the Northern Spotted Owl, *Strix occidentalis caurina*: Merged Options 1 and 2. Portland, Oregon. 170 pp.

Availability of electronic version of this document

<http://www.fws.gov/pacific/ecoservices/endangered/recovery/rec_plan.html> and
<<http://www.fws.gov/endangered/recovery/index.html>>

Acknowledgments

The Service gratefully acknowledges the effort and commitment of the many individuals involved in the conservation and recovery of the spotted owl who participated in the preparation of this Plan. Without their individual expertise and support, this Plan would not have been possible. To develop this Plan, the Service appointed a Recovery Team. The Recovery Team was supported by an Interagency Support Team as well as a significant number of contributors who were lead by a Recovery Plan Project Manager. During the development of the Plan, several panels of experts were convened. The Service is indebted to all of these individuals for the guidance they have provided. Their names, affiliations, and roles are listed below.

Recovery Team Leader

David Wesley, U.S. Fish and Wildlife Service

Recovery Team Members

Tim Cullinan, National Audubon Society, Washington State Office

Dominick DellaSala, National Center for Conservation Science and Policy

Lowell Diller, Green Diamond Resource Company

Scott Gremel, National Park Service

Mike Haske, Bureau of Land Management

Cal Joyner, U.S. Forest Service

John Mankowski, Washington Office of the Governor / Lenny Young,

Washington Department of Natural Resources

Ed Murphy, Sierra Pacific Industries

Jim Paul, Oregon Department of Forestry (April 2006 to November 2006)/

Mike Cafferata, Oregon Department of Forestry (November 2006 to Present)

John Siperek, California Department of Fish and Game

David Wooten, Bureau of Indian Affairs

Alternate Recovery Team Members

Sarah Madsen, U.S. Forest Service

Rosemary Mannix, Oregon Department of Forestry

Recovery Plan Project Manager

Paul Phifer, U.S. Fish and Wildlife Service

Interagency Support Team Members

Kath Collier, Bureau of Land Management

Joe Lint, Bureau of Land Management

Kent Livezey, U.S. Fish and Wildlife Service

Elaine Rybak, U.S. Forest Service

Brendan White, U.S. Fish and Wildlife Service

Contributors

Scott Center, U.S. Fish and Wildlife Service

Ray Davis, U.S. Forest Service

Karl Halupka, U.S. Fish and Wildlife Service
Jim Hines, U.S. Geological Survey
Matt How, U.S. Fish and Wildlife Service
Bruce Marcot, U.S. Forest Service
Steve Morey, U.S. Fish and Wildlife Service
Jim Nichols, U.S. Geological Survey
Kristi Young, U.S. Fish and Wildlife Service
Rich Young, U.S. Fish and Wildlife Service
Michele Zwartjes, U.S. Fish and Wildlife Service

Scientist Panelists

Robert Anthony, U.S. Geological Survey
Bill Baker, University of Wyoming
Joe Buchanan, Washington Department of Fish and Wildlife
Louisa Evers, Bureau of Land Management/U.S. Forest Service
Alan Franklin, U.S.D.A. Animal and Plant Health Inspection Service
Eric Forsman, U.S. Forest Service
Rocky Gutiérrez, University of Minnesota
Tom Hamer, Hamer Environmental
Richy Harrod, U.S. Forest Service
Dale Herter, Raedeke Associates
Larry Irwin, National Council for Air and Stream Improvement
Bill Laudenslayer, U.S. Forest Service
John Lehmkuhl, U.S. Forest Service
Trent McDonald, Western Ecosystems Technology
Ron Neilson, US Forest Service
Robert Pearson, Private Consultant
John Pierce, Washington Department of Fish and Wildlife
Marty Raphael, U.S. Forest Service
Peter Singleton, U.S. Forest Service
Carl Skinner, U.S. Forest Service
Jim Thrailkill, U.S. Fish and Wildlife Service
Brian Woodbridge, U.S. Fish and Wildlife Service

Implementer Panelists

Klaus Barber, U.S. Forest Service
Richard Bigley, Washington Department of Natural Resources
William Gaines, U.S. Forest Service
Eric Greenquist, U.S. Bureau of Land Management
Jim Harper, U.S. Bureau of Land Management
Scott Horton, Washington Department of Natural Resources
Margaret Kain, U.S. Forest Service
Patricia Krueger, U.S. Forest Service
Trent McDonald, Western Ecosystems Technology (WEST)
Steve Mealey, U.S. Forest Service, retired; Private Consultant
Tony Melchior, Weyerhaeuser Company
Mark Nuetzmann, Yakama Nation
Bob Pearson, Private Consultant

Ken Risenhoover, Port Blakely Tree Farms
Duane Shintaku, California Department of Forestry and Fire Protection

Peer Reviewers of the Background Section

Robert Anthony, U.S. Geological Survey
Eric Forsman, U.S. Forest Service
Alan Franklin, U.S.D.A. Animal and Plant Health Inspection Service
Larry Irwin, National Council for Air and Stream Improvement

Executive Summary (Options 1 and 2)

Current Status

The northern spotted owl (*Strix occidentalis caurina*) (spotted owl) inhabits structurally complex forests from southwest British Columbia through the Cascade Mountains and coastal ranges in Washington, Oregon, and California, as far south as Marin County (Appendix A). The spotted owl was listed under the Endangered Species Act (ESA) as threatened on June 26, 1990 (USFWS 1990b) because of widespread loss and adverse modification of suitable habitat¹ across the owl's entire range and the inadequacy of existing regulatory mechanisms to conserve the owl. Many of the populations of spotted owls are declining, especially in the northern parts of the species' range. The most important threat currently facing the spotted owl is competition from the barred owl (*S. varia*). Actions associated with addressing the barred owl threat were the only ones given the highest priority in this Plan, meaning the action "must be taken to prevent extinction or prevent the species from declining irreversibly in the foreseeable future" (see Implementation Schedule and Cost Estimates). Other important threats to the spotted owl include loss of habitat quality and quantity as a result of past activities and disturbances, and ongoing and projected loss of habitat as a result of fire, logging and conversion of habitat to other uses.

The most important threat currently facing the spotted owl is competition from the barred owl.

Habitat Requirements

Scientific research and monitoring indicate that spotted owls generally rely on older forested habitats because these habitats contain the structures and characteristics required for nesting, roosting, and foraging. Although it has been found that spotted owls can disperse through highly fragmented forest landscapes, the stand-level and landscape-level attributes of forests needed to facilitate successful dispersal have not been thoroughly evaluated. Furthermore, recent landscape-level analyses in portions of the California Klamath and Oregon Coast Province suggest a mosaic of mid seral and late-successional nesting habitat interspersed with other seral conditions may result in high fitness for spotted owls, though other studies have not found that correlation (e.g., Dugger *et al.* 2005).

¹ "Suitable habitat" is here meant to be an area of forest vegetation with the age-class, species of trees, structure, sufficient area and adequate food source to meet some or all of the life needs of the spotted owl (USFWS 1992b).

Recovery Strategy

The Spotted Owl Recovery Team recognizes the barred owl constitutes a significantly greater threat to spotted owl recovery than was envisioned at the time the spotted owl was listed, or than was discussed in the 2004 5-year review (USFWS 2004b) or the status report (Courtney *et al.* 2004). As a result, the 2007 recovery team recommends that specific actions to address the barred owl threat begin immediately and in a coordinated manner across the range.

In addition to describing specific actions to address the barred owl threat, the Recovery Plan continues to recognize the importance of habitat for the long-term survival of the spotted owl.

In addition to describing specific actions to address the barred owl threat, the Recovery Plan continues to recognize the importance of habitat for the long-term survival of the spotted owl. Designating appropriate habitat for spotted owls can be achieved in different ways and this Recovery Plan presents two options for consideration.

Two Options

The two options contain many similarities. Both options are based on the same underlying science, both use the same information on owl dispersal and habitat needs and population dynamics. The two options contain essentially the same recovery goal, objectives, criteria, and actions. Both address the threat from barred owls in the same way, both address the issues associated with fire and both recognize the continuing importance of maintaining suitable habitat for the spotted owl. Further, both options rely on Federal lands to provide the primary contribution for northern spotted owl recovery.

The options differ in the following ways: Option 1 identifies (i.e., maps) the specific conservation area boundaries where most of the recovery actions and criteria will be targeted. These conservation areas are called Managed Owl Conservation Areas, or MOCAs. The MOCAs are mapped in the Draft Recovery Plan and are intended to be mostly static on the land, though minor adjustments (within established limits) to the boundaries are anticipated and would be consistent with the plan.

Option 2 recognizes the dynamic nature of forest ecosystems and provides flexibility to land managers to ensure sufficient habitat capable of supporting the fundamental needs (e.g., nesting, roosting, foraging and dispersal) of the northern spotted owl is available and distributed to achieve recovery. Option 2 does not designate specific conservation area boundaries, rather it provides a rule set that defines the size and distance of the conservation areas needed for recovery, while recognizing that the habitat demands of the northern spotted owl vary across its range. The rule set is designed to help guide the Federal land management agencies when establishing conservation areas for the northern spotted owl. The flexibility to identify the conservation areas based on

provincial, ecological and management situations, as well as natural disturbances (e.g., catastrophic fire) is intended to ensure the effectiveness and implementability of this recovery plan.

Conservation Support Areas (CSAs) are intended to support the MOCAs or the network of habitat blocks while assisting in achieving the recovery criteria and are found in both options. CSAs are existing land-use allocations that benefit spotted owls and are found on private, State and Federal lands. CSAs may function to provide demographic support to core spotted owl populations in the MOCA or habitat networks, facilitate dispersal of juvenile spotted owls among MOCAs or habitat networks, or serve both of these functions.

This draft Plan should be considered as an options document on which the Service is specifically asking for comment. The draft Plan contains two complete options outlining the above strategies. Several of the chapters are identical, however there are completely separate chapters describing the two options for some sections. Headers on each page will help guide the reader throughout the text.

Recovery Goal

The goal of this Recovery Plan is to recover the spotted owl so that it can be removed from the list of threatened or endangered species.

Recovery Objectives

The objectives of this Recovery Plan are as follows:

- Spotted owl populations are sufficiently large and distributed such that the species no longer requires listing under the ESA.
- Adequate habitat is available for spotted owls and will continue to exist to allow the species to survive without the protection of the ESA.
- Evidence demonstrates that the effects of threats have been reduced or eliminated such that spotted owl populations are stable or increasing and spotted owls are unlikely to become threatened again in the foreseeable future.

Delisting

In order to consider a species recovered, analysis of the five listing factors must be conducted and the threats from those factors reduced or eliminated. The five listing factors are:

- A. The present or threatened destruction, modification, or curtailment of the species' habitat or range
- B. Overutilization for commercial, scientific, or educational purposes

C. Disease or predation

D. Inadequacy of existing regulatory mechanisms

E. Other natural or manmade factors affecting its continued existence

Recovery Criteria

There are five recovery criteria for this Recovery Plan (text in [] represent Option 1 and Option 2, respectively):

- **Recovery Criterion 1 (addresses Listing Factor E):** The percentage of known spotted owl territories that are occupied or influenced by barred owls is sufficiently low (as determined by the research actions outlined in this Plan) to allow the achievement of stable or increasing populations and distribution as noted in Recovery Criteria 2 and 3. This percentage shall have been maintained at or below this threshold averaged over 10 years.
- **Recovery Criterion 2 (addresses Listing Factor E):** The population trend is stable or increasing after 10 years of monitoring, as measured by a statistically reliable method, in each province excluding Western Washington Lowlands, the Willamette Valley, and California Cascades, with a low probability of concluding the population is stable or increasing when it actually is declining.
- **Recovery Criterion 3 (addresses Listing Factor E):** The distribution of spotted owls is sufficient to meet the overall spatial objectives of the spotted owl conservation strategy, i.e., within a period of 5 consecutive years, in each State at least 80 percent of [MOCA 1s][large habitat blocks] contain at least 15 occupied spotted owl sites.
- **Recovery Criterion 4 (addresses Listing Factor A):** In each province, excluding Western Washington Lowlands and the Willamette Valley, at least 80 percent of both types of [MOCAs][habitat blocks] have at least the listed percentage of high-quality habitat². To meet Criterion 4, 80 percent of [MOCA 1s][large habitat blocks] and 80 percent of [MOCA 2s][small habitat blocks] within each listed province need to meet the listed percentage. The percentages for each province are listed in Recovery Criterion 4.
- **Recovery Criterion 5 (addresses Listing Factor C):** In order to monitor the continued stability of the recovered spotted owl, a post-delisting monitoring Plan has been developed and is ready for implementation with the States of Washington, Oregon, and California (Section 4(g)(1) of the ESA).

Recovery Actions

Recovery actions are recommendations to guide the activities needed to accomplish the recovery objectives and criteria. This Recovery Plan presents 37

² "High-quality habitat" is defined here as having the habitat-capable acres in a condition similar to that used by 90 percent of the spotted owl pairs for nesting and roosting in that province.

actions that address overall recovery through maintenance and restoration, monitoring of avian diseases, existing regulatory mechanisms, development and implementation of a delisting monitoring Plan, management of spotted owl populations and distribution, and management of the barred owl. The Recovery Plan calls for the establishment of an inter-organizational Northern Spotted Owl Work Group to coordinate implementation of the Plan.

Estimated Cost to Delist

The estimated cost to delist the spotted owl is approximately \$198 million over 30 years.

Estimated Date to Delist

It is believed recovery of the spotted owl could be accomplished in as little as 30 years (2037) if this Recovery Plan were fully implemented in a timely manner. The uncertainty of this estimate is acknowledged. The timeline is based on the successful management of the barred owl and development and maintenance of sufficient habitat.

Table of Contents

Introduction (Option 1)	14
<i>About Recovery Plans and Delisting</i>	14
<i>Development of This Recovery Plan</i>	15
<i>Biological Constraints and Needs</i>	16
<i>Listing History and Recovery Priority</i>	16
<i>Reasons for Listing and Assessment of Threats</i>	16
<i>Flexibility to Modify MOCAs and CSAs</i>	18
<i>Changes in Management Approaches</i>	19
<i>Need for Cooperative Effort</i>	20
<i>Ongoing Actions</i>	20
Introduction (Option 2)	21
<i>About Recovery Plans and Delisting</i>	21
<i>Development of This Recovery Plan</i>	22
<i>Biological Constraints and Needs</i>	23
<i>Listing History and Recovery Priority</i>	23
<i>Reasons for Listing and Assessment of Threats</i>	23
<i>Need for Cooperative Effort</i>	25
<i>Ongoing Actions</i>	26
II. Recovery Criteria and Recovery Actions (Option 1)	27
<i>Listing Factor E: Other natural or manmade factors affecting its continued existence.</i>	28
<i>Recovery Criterion 1</i>	28
<i>Recovery Criterion 2</i>	31
<i>Recovery Criterion 3</i>	31
<i>Listing Factor A: The present or threatened destruction, modification, or curtailment of the species' habitat or range.</i>	32
<i>Recovery Criterion 4</i>	32
<i>Recovery Criterion 5:</i>	40
<i>Listing Factor B: Overutilization for commercial, scientific, or educational purposes.</i>	41
<i>Listing Factor C: Disease or predation</i>	41
II. Recovery Criteria and Recovery Actions (Option 2)	43
<i>Listing Factor E: Other natural or manmade factors affecting its continued existence.</i>	44
<i>Recovery Criterion 1</i>	44
<i>Recovery Criterion 2</i>	47
<i>Recovery Criterion 3</i>	47
<i>Listing Factor A: The present or threatened destruction, modification, or curtailment of the species' habitat or range.</i>	48
<i>Recovery Criterion 4</i>	48
<i>Listing Factor D: Inadequacy of existing regulatory mechanisms</i>	56
<i>Recovery Criterion 5:</i>	56
<i>Listing Factor B: Overutilization for commercial, scientific, or educational purposes.</i>	56
<i>Listing Factor C: Disease or predation</i>	57

III. Recovery Strategy, Recovery Goal, and Recovery Objectives (Option 1).58
Recovery Strategy.....58
 Barred Owl58
 Habitat.....59
 Monitoring and Research.....60
Recovery Goal.....61
Recovery Objectives.....61

III. Recovery Strategy, Recovery Goal, and Recovery Objectives (Option 2).63
Recovery Strategy.....63
 Barred Owl63
 Habitat.....64
 Monitoring and Research.....67
Recovery Goal.....68
Recovery Objectives.....68

IV. Implementation Schedule and Cost Estimates (Option 1).....70
 Cost Estimate Assumptions.....72

IV. Implementation Schedule and Cost Estimates (Option 2).....82
 Cost Estimate Assumptions.....84

V. Literature Cited and Personal Communications Cited (Options 1 and 2)....94
 Literature Cited94
 Personal Communications Cited104

Appendix A: Background (Options 1 and 2).....105
 Species Description and Taxonomy105
 Population Trends and Distribution106
 Life History and Ecology.....110
 Habitat Characteristics112
 Conservation Efforts and Regulations116
 Federal Lands.....116
 Non-Federal Lands.....117

Appendix B. Maps of MOCAs (Option 1).....119

Appendix B. Example Map of Habitat Blocks (Option 2)122

Appendix C. Threats (Options 1 and 2)125
 Barred Owl.....125
 Loss of Habitat.....126

**Appendix D. Description of Habitat Fitness and Explanation of Goals of
 Habitat-Capable Acres in Recovery Criterion 4. (Options 1 and 2)134**

**Appendix E. Examples of How Recovery Action 22 Might Be Implemented
 (Options 1 and 2)137**

Appendix F: Basis for the Recovery Strategy Concerning Habitat (Option 1) 140

Appendix F: Basis for the Recovery Strategy Concerning Habitat (Option 2) 158

Appendix G: Barred Owl Removal Strategy (Options 1 and 2).....163

Acronyms and Abbreviations

AMA	Adaptive Management Area
BLM	U.S. Bureau of Land Management
CDF	California Department of Forestry and Fire Protection
CDFG	California Department of Fish and Game
CDP&R	California Department of Parks and Recreation
CHU	Critical Habitat Unit
CI	confidence interval
CSA	Conservation Support Area
dbh	diameter at breast height
DCA	Designated Conservation Area
DOD	U.S. Army Corps of Engineers, Department of Defense
ESA	Endangered Species Act
FEMAT	Forest Ecosystem Management Assessment Team
FS	U.S. Forest Service
HCA	Habitat Conservation Area
HCP	Habitat Conservation Plan
ISC	Interagency Scientific Committee
LRMP	Land and resource management plan (used for both BLM and FS)
LSR	Late-Successional Reserves
LSRA	Late-Successional Reserve Assessment
LUA	Land-use Allocation
MOCA	Managed Owl Conservation Area
NPS	National Park Service
NSO WG	Inter-organizational Northern Spotted Owl Working Group
NWFP	Northwest Forest Plan
ODF	Oregon Department of Forestry
SE	standard error
SHA	Safe Harbor Agreement
SOSEA	Spotted Owl Special Emphasis Areas
TBD	to be determined
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WDNR	Washington Department of Natural Resources
WFPB	Washington Forest Practices Board
WNV	West Nile virus

Introduction (*Option 1*)

About Recovery Plans and Delisting

The Endangered Species Act (ESA) of 1973, as amended (16 USC 1531 *et seq.*) establishes policies and procedures for identifying and protecting species of plants and wildlife that are endangered or threatened with extinction. To help identify and guide species recovery efforts, Section 4(f) of the ESA directs the Secretary of the Interior to develop and implement Recovery Plans for listed species. These plans are to include (1) a description of site-specific management actions necessary for conservation and survival of the species, (2) objective, measurable criteria that, when met, will allow the species to be delisted, and (3) estimates of the time and funding required to achieve the plan's goals and intermediate steps.

Recovery plans are not regulatory documents; rather, they provide guidance to bring about recovery and determine when recovery has been achieved. There may be many paths to recover a species. The U.S. Fish and Wildlife Service (Service) developed this Plan in consultation with a recovery team and Federal land management agencies, and it is believed this Plan represents effective guidance for recovering the spotted owl. It is understood that recovering a species takes time and significant effort from multiple parties. Recovering a species is a dynamic process, and judging when a species is recovered requires an adaptive management approach that is sensitive to the best available information and risk tolerances. Given the adaptive nature of this iterative process, recovery may be achieved without fully following the guidance provided in this Recovery Plan. Nevertheless, it is believed this is the best strategy possible based on the current understanding of the spotted owl and its threats.

Recovering a species takes time and significant effort from multiple parties.

When sufficient progress toward recovery has been made, a separate team will assess the spotted owl's status in relation to the five listing factors found in Section (4(a)(1)) of the ESA to determine whether delisting is appropriate (see Executive Summary). This subsequent review may be initiated without all of the recovery criteria in this Plan having been fully met. For example, one or more criteria may have been exceeded, while other criteria may not have been fully accomplished. In this instance, the Service may judge that, over all, the threats have been minimized sufficiently and the species is robust enough to be delisted. If sufficient progress toward recovery has not been made, the spotted owl may retain its current status. If the spotted owl's condition should deteriorate, it may be necessary to change its status to endangered.

New recovery opportunities or scientific information may arise that were unknown at the time a Recovery Plan is finalized. Under an adaptive

management framework, these new opportunities may encompass more effective means of achieving recovery or measuring recovery. In addition, new information may alter the extent to which criteria need to be met for recognizing recovery of the species.

Development of This Recovery Plan

The Plan's foundation was the Northwest Forest Plan (NWFP), which was published in 1994 as the Federal contribution to the recovery of the spotted owl (USDA and USDI 1994a, b). The large reserves of the NWFP also served as a conservation strategy for other rare or little known non-listed species. The NWFP amended the land and resource management plans (LRMPs) that guide the management of each of the 19 National Forests and seven Bureau of Land Management (BLM) Districts across the range of the spotted owl. The LRMPs adopted a set of reserves and standards and guidelines described in the Record of Decision (ROD) for the NWFP. The Plan recognizes the guidance the existing LRMPs provide for the conservation of the spotted owl. Throughout this Plan, use of the term "LRMPs" references all 26 LRMPs that were amended by the NWFP.

Because most readers of this Plan are familiar with the spotted owl and its biology, the recovery criteria and actions are at the front of the Plan for immediate access and use. For readers unfamiliar with the owl's biology, it is recommended that you read Appendix A first to get an understanding of the basic biology and threats associated with this species.

This draft spotted owl Recovery Plan was developed using the best scientific information available and a "step-down" approach of objectives, criteria, and actions. Recovery objectives are broad statements that describe the conditions under which the Service would consider the spotted owl to be recovered. Recovery criteria are objective, measurable metrics that indicate when recovery objectives have been met. Recovery actions are recommendations to guide the activities needed to accomplish the recovery criteria. Recovery actions are recommended throughout the U.S. range of the spotted owl and are designed to address the specific threats identified in this Plan. Implementation of the full suite of recovery actions will involve participation from the States, Federal agencies, non-Federal landowners, and the public.

Implementation of the full suite of recovery actions will involve participation from the States, Federal agencies, non-Federal landowners, and the public.

The foundation of this Recovery Plan is a network of Managed Owl Conservation Areas (MOCAs) located on Federal land in Washington, Oregon, and California (Appendix F). This Recovery Plan recommends specific management actions both inside and outside of the MOCAs that are based on existing Federal land use allocations, regulatory frameworks, and standards and guidelines from the LRMPs. MOCAs represent areas that contain or will develop

habitat considered essential for spotted owl recovery. MOCAs are almost entirely overlaid on LRMP reserves. Management of these key areas to support stable or increasing spotted owl populations is the heart of the recovery strategy. The MOCAs are likely to support stable and well-distributed populations of spotted owls, as long as provisions are in place to ensure that sufficient suitable habitat is maintained, and the threat from barred owls is reduced to an acceptable level. Two types of MOCAs are identified: MOCA 1s are capable of supporting 20 or more pairs of spotted owls, and MOCA 2s are capable of supporting 1–19 pairs of spotted owls.

The Recovery Plan also identifies Conservation Support Areas (CSAs), which are areas between or adjacent to MOCAs where habitat contributions by private, State, and Federal lands are expected to increase the likelihood of spotted owl recovery.

Biological Constraints and Needs

Like any species, the spotted owl has biological requirements that, if not met, will reduce its ability to persist. However, no specific biological attribute of the spotted owl was identified as a factor limiting its ability to recover.

Listing History and Recovery Priority

The spotted owl was listed as threatened on June 26, 1990. The Service recovery priority number for the spotted owl is 6C, on a scale of 1C (highest) to 18 (lowest) (USFWS 1983a, 1983b, 2004b). This number reflects a high degree of threat, a low potential for recovery, and the spotted owl's taxonomic status as a subspecies. The "C" reflects conflict with development, construction, or other economic activity. The spotted owl was originally listed with a recovery priority number of 3C, but that number was changed to 6C in 2004 during the 5-year review of the species.

The spotted owl was listed in 1990 as a result of widespread loss and adverse modification of suitable habitat across the spotted owl's entire range and the inadequacy of existing regulatory mechanisms to conserve the spotted owl.

Reasons for Listing and Assessment of Threats

The spotted owl was listed as threatened throughout its range "due to loss and adverse modification of suitable habitat as a result of timber harvesting and exacerbated by catastrophic events such as fire, volcanic eruption, and wind storms" (USFWS 1990b:26114). More specifically, threats to the spotted owl included low populations, declining populations, limited habitat, declining habitat, inadequate distribution of habitat or populations, isolation of provinces, predation and competition, lack of coordinated conservation measures, and vulnerability to natural disturbance (USFWS 1992b). These threats were characterized for each province as severe, moderate, low or unknown (USFWS 1992b). (The range of the spotted owl is divided into 12 provinces from Canada to northern California and from the Pacific Coast to the eastern Cascades; see

Figure A-1, Appendix A). Declining habitat was recognized as a severe or moderate threat to the spotted owl throughout its range, isolation of populations was identified as a severe or moderate threat in 11 provinces, and a decline in population was a severe or moderate threat in 10 provinces. Together, these three factors represented the greatest concerns about range-wide conservation of the spotted owl. Limited habitat was considered a severe or moderate threat in nine provinces, and low populations were a severe or moderate concern in eight provinces, suggesting that these factors were also a concern throughout the majority of the spotted owl's range. Vulnerability to natural disturbances was rated as low in five provinces.

The Service conducted a 5-year review of the spotted owl in 2004 (USFWS 2004b), for which the Service prepared a scientific evaluation of the status of the spotted owl (Courtney *et al.* 2004). An analysis was conducted assessing how the threats described in 1990 might have changed by 2004. Some of the key threats identified in 2004 were:

- “Although we are certain that current harvest effects are reduced, and that past harvest is also probably having a reduced effect now as compared to 1990, we are still unable to fully evaluate the current levels of threat posed by harvest because of the potential for lag effects...In their questionnaire responses...6 of 8 panel member identified past habitat loss due to timber harvest as a current threat, but only 4 viewed current harvest as a present threat” (Courtney and Gutiérrez 2004:11-7)
- “Currently the primary source of habitat loss is catastrophic wildfire, although the total amount of habitat affected by wildfires has been small (a total of 2.3% of the range-wide habitat base over a 10-year period).” (Courtney and Gutiérrez 2004:11-8)
- “Although the panel had strong differences of opinion on the conclusiveness of some of the evidence suggesting [barred owl] displacement of [spotted owls], and the mechanisms by which this might be occurring, there was no disagreement that [barred owls] represented an operational threat. In the questionnaire, all 8 panel members identified [barred owls] as a current threat, and also expressed concern about future trends in [barred owl] populations.” (Courtney and Gutiérrez 2004:11-8)

On June 1, 2006, a panel of seven experts was assembled to help the spotted owl recovery team identify the most current threats facing the species. Six of the seven panelists were experts on the biology of the spotted owl, and a seventh panelist was an expert on fire ecology. The workshop was conducted as a modified Delphi expert panel, in which the recovery team queried the seven panelists regarding their individual judgments in the context of a structured, open discussion among panelists.

The panel unanimously identified competition from barred owls as a pressing threat across the range of the spotted owl. The other range-wide threats identified were loss

of habitat amount and distribution as a result of past activities and disturbances (including fire), and ongoing habitat loss as a result of timber harvest although timber harvest has been greatly reduced on Federal lands. The panel noted that evidence of these three threat categories is supported by peer-reviewed and published studies. The spread of the threat scores made by the individual panelists was narrowest for barred owl competition and slightly greater for habitat threats. The panel identified disease and the effect of climate change on vegetation as potential and more uncertain future threats.

The panelists ranked the threats by importance in each province. Among the 12 physiographic provinces, the more fire-prone provinces (Eastern Washington Cascades and Eastern Oregon Cascades, California Cascades, Oregon and California Klamath) scored high on threats from ongoing habitat loss as a result of wildfire and the effects of fire exclusion on vegetation change. Westside provinces (Western Washington Cascades and Western Oregon Cascades, Western Washington Lowlands, Olympic Peninsula, and Oregon Coast Range) generally scored high on threats from the adverse effects of habitat fragmentation and ongoing habitat loss as a result of timber harvest. The province with the fewest number of threats was Western Oregon Cascades, and the provinces with the greatest number of threats were the Oregon Klamath and the Willamette Valley.³ For a more complete description of the threats, see Appendix C.

Flexibility to Modify MOCAs and CSAs

This 2007 draft Recovery Plan identifies a network of MOCAs on Federal lands. The MOCA network was based on previous designs of conservation areas for the spotted owl (see Recovery Strategy section), and is intended to support a stable number of breeding pairs of owls over time and allow for movement of spotted owls across the network. CSAs outside of Federal lands were added to support the MOCA network and assist in achieving the recovery criteria.

The greatest current range-wide threats identified by a panel of experts in 2006 were competition from barred owls, loss of habitat amount and distribution as a result of past activities and disturbances, and ongoing habitat loss as a result of timber harvest.

Any recovery plan relying on specific conservation areas for its success must address questions of change. While this Plan has been prepared with clearly delineated MOCAs and CSAs (except for some unmapped CSAs in Oregon), it is recognized that, as new information arises, some changes are inevitable. The need for flexibility has been recognized throughout previous recovery efforts and is well documented. Allowing change to occur while

working within the parameters of the goals, objectives, and criteria established in this Recovery Plan should be viewed as providing flexibility to implementers and regulators and may increase acceptance and adoption of the Recovery Plan. Thus, how change will be accounted for and monitored becomes a critical factor.

³ The Willamette Valley currently has the fewest known pairs of spotted owls of any province (< 5).

Although every effort was made to carefully delineate the boundaries of the MOCAs and CSAs, each MOCA was not intensively analyzed. Therefore, some minor adjustments may be necessary to align the MOCA boundaries to coincide with recognizable physiographic features, e.g., major ridge lines, perennial streams, and permanent roads. All reviewers, especially Federal land managers are asked to recommend any changes during the public comment period.

This Plan recognizes the need for Federal land managers to have the flexibility to make minor adjustments to the MOCA boundaries after the Recovery Plan is finalized. Cumulative boundary adjustments to an individual MOCA should result in no more than a 5 percent loss of habitat-capable acres from the final MOCA delineation as identified in this Plan. In addition, boundary adjustments should be consistent with the objectives of the MOCA network. The efforts should be undertaken with a goal of minimizing the net loss of habitat-capable acres. Minor adjustments, as described above, do not change the recovery criteria for MOCAs as described in this Plan.

All minor changes to MOCA boundaries will be compiled annually by the respective Federal land management agencies and will be forwarded to the Service. The Service will share the information with the Northern Spotted Owl Work Group, whose establishment is proposed as one of the recovery actions in this Plan.

Similarly, CSAs adjustments may be necessary. These adjustments will be governed by applicable regulations and policies for the management of those areas, as informed by the Recovery Plan. Again, boundary adjustments to CSAs should be forwarded to the Service, which will share the information with the Northern Spotted Owl Work Group.

Changes in Management Approaches

On a larger scale, it is recognized that the MOCAs and some CSAs are based on Federal land-use allocations and management approaches that are subject to review and change. Under the principle of adaptive management, approaches other than those described in current Federal land use plans may be shown to be effective in accomplishing recovery goals and objectives. The potential for these changes to affect the recovery of the spotted owl were not considered because the changes have not been fully described and analyzed by the implementing agencies. Substantive changes to existing, underlying Federal land use allocations and management plans that the MOCAs and some CSAs are based upon will follow the process of public involvement required under the National Environmental Policy Act of 1969, as amended (42 USC 4321 *et seq.*) and consultation under Section 7 of the ESA. The determination of the consistency of these approaches to meet the goals and objectives of this Recovery Plan would be done concurrently with National Environmental Policy Act and ESA reviews. The Service, in its review, will consider whether any such proposal would significantly increase the length of time necessary to achieve recovery or render recovery unlikely.

Flexibility to modify the placement or elevation of MOCAs may stem from the following portions of the Recovery Plan:

- The Plan allows that modifications to MOCA boundaries may result in as much as a 5 percent loss of habitat-capable acres in all MOCAs
- Criterion 4 requires only 80 percent of the MOCAs within the province need to be in suitable-habitat condition
- Criterion 4 is based on reaching suitable-habitat targets of 50–70 percent, not 100 percent as in Late-Successional Reserves
- MOCAs were mapped in only 10 of 12 physiographic provinces.

Another element of adaptive management is the recognition that research is ongoing and that new scientific information or management techniques may require a change in recovery actions. As new information becomes available, the Recovery Plan will be revised as appropriate.

Need for Cooperative Effort

Because many jurisdictions and agencies are involved in, or affected by, spotted owls, cooperation is essential for success. The Service encourages all involved to work closely and cooperatively. This cooperation is especially important among the States and regulatory agencies. Coordination and, if possible, combined regulatory reviews will help to ensure that high-priority recovery actions will be implemented in a timely manner.

All involved are challenged to create more effective ways of working together for the benefit of the spotted owl and encourages the immediate implementation of the priority actions presented in this Recovery Plan.

Ongoing Actions

This Plan is intended to complement and provide guidance for ongoing activities to promote the recovery of the spotted owl. Such ongoing activities include prioritizing the research needed to understand and address the threat posed by the barred owl and interagency research and mapping efforts to identify habitat fire risk areas for dry forest provinces.

Introduction (*Option 2*)

About Recovery Plans and Delisting

The Endangered Species Act (ESA) of 1973, as amended (16 USC 1531 *et seq.*) establishes policies and procedures for identifying and protecting species of plants and wildlife that are endangered or threatened with extinction. To help identify and guide species recovery efforts, Section 4(f) of the ESA directs the Secretary of the Interior to develop and implement recovery plans for listed species. Such plans are to include (1) a description of site-specific management actions necessary for conservation and survival of the species, (2) objective, measurable criteria that, when met, will allow the species to be delisted, and (3) estimates of the time and funding required to achieve the plan's goals and intermediate steps.

Recovery plans are not regulatory documents; rather, they provide guidance to bring about recovery and determine when recovery has been achieved. There may be many paths to recover a species. The U.S. Fish and Wildlife Service (Service) developed this Plan in consultation with a recovery team and Federal land management agencies, and it is believed this Plan represents effective guidance for recovering the spotted owl. It is understood that recovering a species takes time and significant effort from multiple parties. Recovering a species is a dynamic process, and judging when a species is recovered requires an adaptive management approach that is sensitive to the best available information and risk tolerances. Given the adaptive nature of this iterative process, recovery may be achieved without fully following the guidance provided in this Recovery Plan. Nevertheless, it is believed this is the best strategy possible based on the current understanding of the spotted owl and its threats.

Recovering a species takes time and significant effort from multiple parties.

When sufficient progress toward recovery has been made, a separate team will assess the spotted owl's status in relation to the five listing factors found in Section (4(a)(1)) of the ESA to determine whether delisting is appropriate (see Executive Summary). This subsequent review may be initiated without all of the recovery criteria in this Plan having been fully met. For example, one or more criteria may have been exceeded, while other criteria may not have been fully accomplished. In this instance, the Service may judge that, over all, the threats have been minimized sufficiently and the species is robust enough to be delisted. If sufficient progress toward recovery has not been made, the spotted owl may retain its current status. If the spotted owl's condition should deteriorate, it may be necessary to change its status to endangered.

New recovery opportunities or scientific information may arise that were unknown at the time a recovery plan is finalized. Under an adaptive

management framework, these new opportunities may encompass more effective means of achieving recovery or measuring recovery. In addition, new information may alter the extent to which criteria need to be met for recognizing recovery of the species.

Development of This Recovery Plan

The Plan's foundation was the Northwest Forest Plan (NWFP), which was published in 1994 as the Federal contribution to the recovery of the spotted owl (USDA and USDI 1994a, b). The large reserves of the NWFP also served as a conservation strategy for other rare or little known non-listed species. The NWFP amended the land and resource management plans (LRMPs) that guide management of each of the 19 National Forest and seven Bureau of Land Management (BLM) Districts across the range of the spotted owl. The LRMPs adopted a set of reserves and standards and guidelines described in the Record of Decision (ROD) for the NWFP. The Plan recognizes the guidance the existing LRMPs provide for the conservation of the spotted owl. Throughout this Plan, use of the term "LRMPs" references all 26 LRMPs that were amended by the NWFP.

Because most readers of this Plan are familiar with the spotted owl and its biology, the recovery criteria and actions are at the front of the Plan for immediate access and use. For readers unfamiliar with the owl's biology, it is recommended you read Appendix A first to get an understanding of the basic biology and threats associated with this species.

This draft spotted owl Recovery Plan was developed using the best scientific information available and a "step-down" approach of objectives, criteria, and actions. Recovery objectives are broad statements that describe the conditions under which the Service would consider the spotted owl to be recovered.

Implementation of the full suite of recovery actions will involve participation from the States, Federal agencies, non-Federal landowners, and the public.

Recovery criteria are objective, measurable metrics that indicate when recovery objectives have been met. Recovery actions are recommendations to guide the activities needed to accomplish the recovery criteria. Recovery actions are recommended throughout the U.S. range of the spotted owl and are designed to address the specific threats identified in this Plan.

Implementation of the full suite of recovery actions will involve participation from the States, Federal agencies, non-Federal landowners, and the public.

The foundation of this Recovery Plan is a network of owl conservation areas (i.e., habitat blocks) located on Federal land in Washington, Oregon, and California. This Recovery Plan recommends specific management actions both inside and outside of these blocks that are based on existing Federal land use allocations, regulatory frameworks, and standards and guidelines from the LRMPs. The habitat blocks represent areas that contain or will develop habitat considered essential for spotted owl recovery. Management of these key areas to support

stable or increasing spotted owl populations is the heart of the recovery strategy. Habitat blocks will be established by Federal land management agencies on Federal land using a rule set described in this Plan. The habitat blocks will be delineated to support stable and well-distributed populations of spotted owls, as long as provisions are in place to ensure that sufficient suitable habitat is maintained, and the threat from barred owls is reduced to an acceptable level. Two types of habitat blocks are identified: large habitat blocks which are capable of supporting 20 or more pairs of spotted owls, and small habitat blocks which are capable of supporting 1–19 pairs of spotted owls.

The Recovery Plan also identifies Conservation Support Areas (CSAs), which are areas between or adjacent to the habitat blocks where habitat contributions by private, State, and Federal lands are expected to increase the likelihood of spotted owl recovery.

CSAs adjustments may be necessary. Such adjustments will be governed by applicable regulations and policies for the management of those areas, as informed by the Recovery Plan. Boundary adjustments to CSAs should be forwarded to the Service, which will share the information with the Northern Spotted Owl Work Group.

Biological Constraints and Needs

Like any species, the spotted owl has biological requirements that, if not met, will reduce its ability to persist. However, no specific biological attribute of the spotted owl was identified as a factor limiting its ability to recover.

Listing History and Recovery Priority

The spotted owl was listed as threatened on June 26, 1990. The Service recovery priority number for the spotted owl is 6C, on a scale of 1C (highest) to 18 (lowest) (USFWS 1983a, 1983b, 2004b). This number reflects a high degree of threat, a low potential for recovery, and the spotted owl's taxonomic status as a subspecies. The "C" reflects conflict with development, construction, or other economic activity. The spotted owl was originally listed with a recovery priority number of 3C, but that number was changed to 6C in 2004 during the 5-year review of the species.

The spotted owl was listed in 1990 as a result of widespread loss and adverse modification of suitable habitat across the spotted owl's entire range and the inadequacy of existing regulatory mechanisms to conserve the spotted owl.

Reasons for Listing and Assessment of Threats

The spotted owl was listed as threatened throughout its range "due to loss and adverse modification of suitable habitat as a result of timber harvesting and exacerbated by catastrophic events such as fire, volcanic eruption, and wind storms" (USFWS 1990b:26114). More specifically, threats to the spotted owl

included low populations, declining populations, limited habitat, declining habitat, inadequate distribution of habitat or populations, isolation of provinces, predation and competition, lack of coordinated conservation measures, and vulnerability to natural disturbance (USFWS 1992b). These threats were characterized for each province as severe, moderate, low or unknown (USFWS 1992b). (The range of the spotted owl is divided into 12 provinces from Canada to northern California and from the Pacific Coast to the eastern Cascades; see Figure A-1, Appendix A). Declining habitat was recognized as a severe or moderate threat to the spotted owl throughout its range, isolation of populations was identified as a severe or moderate threat in 11 provinces, and a decline in population was a severe or moderate threat in 10 provinces. Together, these three factors represented the greatest concerns about range-wide conservation of the spotted owl. Limited habitat was considered a severe or moderate threat in nine provinces, and low populations were a severe or moderate concern in eight provinces, suggesting that these factors were also a concern throughout the majority of the spotted owl's range. Vulnerability to natural disturbances was rated as low in five provinces.

The Service conducted a 5-year review of the spotted owl in 2004 (USFWS 2004b), for which the Service prepared a scientific evaluation of the status of the spotted owl (Courtney *et al.* 2004). An analysis was conducted assessing how the threats described in 1990 might have changed by 2004. Some of the key threats identified in 2004 are:

- “Although we are certain that current harvest effects are reduced, and that past harvest is also probably having a reduced effect now as compared to 1990, we are still unable to fully evaluate the current levels of threat posed by harvest because of the potential for lag effects...In their questionnaire responses...6 of 8 panel member identified past habitat loss due to timber harvest as a current threat, but only 4 viewed current harvest as a present threat” (Courtney and Gutiérrez 2004:11-7)
- “Currently the primary source of habitat loss is catastrophic wildfire, although the total amount of habitat affected by wildfires has been small (a total of 2.3% of the range-wide habitat base over a 10-year period).” (Courtney and Gutiérrez 2004:11-8)
- “Although the panel had strong differences of opinion on the conclusiveness of some of the evidence suggesting [barred owl] displacement of [spotted owls], and the mechanisms by which this might be occurring, there was no disagreement that [barred owls] represented an operational threat. In the questionnaire, all 8 panel members identified [barred owls] as a current threat, and also expressed concern about future trends in [barred owl] populations.” (Courtney and Gutiérrez 2004:11-8)

On June 1, 2006, a panel of seven experts was assembled to help the spotted owl recovery team identify the most current threats facing the species. Six of the seven panelists were experts on the biology of the spotted owl, and a seventh

panelist was an expert on fire ecology. The workshop was conducted as a modified Delphi expert panel, in which the recovery team queried the seven panelists regarding their individual judgments in the context of a structured, open discussion among panelists.

The panel unanimously identified competition from barred owls as a pressing threat across the range of the spotted owl. The other range-wide threats identified were loss

The greatest current range-wide threats identified by a panel of experts in 2006 were competition from barred owls, loss of habitat amount and distribution as a result of past activities and disturbances, and ongoing habitat loss as a result of timber harvest.

of habitat amount and distribution as a result of past activities and disturbances (including fire), and ongoing habitat loss as a result of timber harvest although timber harvest has been greatly reduced on Federal lands. The panel noted that evidence of these three threat categories is supported by peer-reviewed and published studies. The spread of the threat scores made by the individual panelists was narrowest for barred owl competition and slightly greater for habitat threats. The panel identified disease and the effect of climate change on vegetation as potential and

more uncertain future threats.

The panelists ranked the threats by importance in each province. Among the 12 physiographic provinces, the more fire-prone provinces (Eastern Washington Cascades and Eastern Oregon Cascades, California Cascades, Oregon and California Klamath) scored high on threats from ongoing habitat loss as a result of wildfire and the effects of fire exclusion on vegetation change. Westside provinces (Western Washington Cascades and Western Oregon Cascades, Western Washington Lowlands, Olympic Peninsula, and Oregon Coast Range) generally scored high on threats from the adverse effects of habitat fragmentation and ongoing habitat loss as a result of timber harvest. The province with the fewest number of threats was Western Oregon Cascades, and the provinces with the greatest number of threats were the Oregon Klamath and the Willamette Valley.⁴ For a more complete description of the threats, see Appendix C.

Need for Cooperative Effort

Because many jurisdictions and agencies are involved in or affected by spotted owls, cooperation among all is essential for success. The Service encourages all involved to work closely and cooperatively. This cooperation is especially important among the States and regulatory agencies. Coordination and, if possible, combined regulatory reviews will help to ensure that high-priority recovery actions will be implemented in a timely manner.

All involved are encouraged to create more effective ways of working together for the benefit of the spotted owl and encourages the immediate implementation of the priority actions presented in this Recovery Plan.

⁴ The Willamette Valley currently has the fewest known pairs of spotted owls of any province (< 5).

Ongoing Actions

This Plan is intended to complement and provide guidance for ongoing activities to promote the recovery of the spotted owl. Such ongoing activities include prioritizing the research needed to understand and address the threat posed by the barred owl and interagency research and mapping efforts to identify habitat fire risk areas for dry forest provinces.

II. Recovery Criteria and Recovery Actions (*Option 1*)

Recovery criteria serve as objective, measurable guidelines to assist in determining when an endangered species has recovered to the point that it may be downlisted to threatened, or that the protections afforded by the ESA are no longer necessary and the species may be delisted. However, a change in status (downlisting or delisting) requires a separate rule-making process based on an analysis of the same five factors (referred to as the listing factors) considered in the listing of a species, as described in Section 4(a)(1) of the ESA.

The recovery criteria in this Plan represent the best assessment of the conditions that would result in a determination that delisting the spotted owl is warranted, following a formal listing factor analysis in a subsequent regulatory rule-making process. Each recovery criterion includes a parameter to be measured and, when known, a threshold to be reached.

This section is organized by listing factor, with the factors containing the most important threats presented first. The recovery criteria are listed under each listing factor, and the recovery actions are presented under each recovery criterion. In general, the recovery actions are those activities deemed necessary to achieve the recovery criteria or to determine whether the recovery criteria have been met. For a more complete description of the threats, see Appendix C. The criterion and actions associated with the barred owl are listed first to emphasize the significance of this threat.

The first recovery action pertains to all listing factors and recovery criteria and thus is listed separately.

- ***Recovery Action 1. Establish an inter-organizational spotted owl working group (“NSO Work Group”) to coordinate implementation of the Recovery Plan.*** Implementation of a Recovery Plan with the breadth and scope of this Plan would benefit greatly from a working group to facilitate implementation of the numerous recovery actions necessary to carry out the Plan and recover the spotted owl. The NSO Work Group should be responsible for coordinating other necessary work groups, such as one to deal with barred owls. The NSO Work Group is not intended to be a technical or policy “approval” committee.

Listing Factor E: Other natural or manmade factors affecting its continued existence.

Barred Owl

To ensure the long-term recovery of the spotted owl, populations must be free of significantly negative effects from the barred owl. This will be accomplished when the following recovery criteria are met:

Recovery Criterion 1: The percentage of known spotted owl territories that are occupied or influenced by barred owls is sufficiently low (as determined by the research actions outlined below) to allow the achievement of stable or increasing populations and distribution as noted in Recovery Criteria 2 and 3. This percentage shall have been maintained at or below this threshold averaged over 10 years.

Immediate action is needed to address the barred owl threat. As there are still many unknowns associated with the mechanisms of the threat and how it can be managed, these actions need to provide valuable research and management insights.

We anticipate this threshold may vary by province or groups of provinces, so province-specific thresholds probably will be needed. In some areas, especially where the locations of territories of spotted owls are not known, the above percentage may be replaced with a density of barred owl site-centers, or with a frequency of responses by barred owls per survey station after standardizing survey methods. The actions outlined in the Recovery Plan should be done concurrently:

- **Recovery Action 2: Manage to minimize negative effects of barred owls on sympatric spotted owls.** Based on risk assessments conducted both before and after the research listed below is completed, manage the effects of barred owls on spotted owls. This would include production of a barred owl management plan, targeting key areas for removal of barred owls, and assessment of the Federal and State requirements necessary to implement the removal of barred owls. Implementation of any of these activities can occur independently and is not linked to completion of any other activity. This action could apply to areas where barred and spotted owls currently coexist, and to areas where barred owls have completely replaced spotted owls when it is feasible that spotted owls in nearby areas could repopulate the extirpated areas.
- **Recovery Action 3: Establish a working group of entities involved with barred owl research and management (Federal and State agencies, Tribes, timber industry, universities, and non-governmental organizations) that would coordinate actions relative to barred owl research, management, and public outreach.** Coordination within all agencies and non-governmental

organizations that can contribute to the research of barred owls needs to be done to prioritize actions to address the barred owl threat, maximize funding opportunities, minimize redundancies, increase efficiency, analyze risks associated with action or non-actions and discuss with decision makers, and analyze the invasion dynamics of barred owls. This working group could be facilitated by the NSO Work Group.

- **Recovery Action 4: Analyze existing data sets from the demographic study areas relative to effects of barred owls on spotted owl site occupancy, reproduction, and survival.** Decades of incidental data for barred owls from the spotted owl demographic study areas and density study areas should be analyzed with newly defined covariates to determine what further correlations exist relative to the presence of barred owls and negative effects to spotted owls.
- **Recovery Action 5: Analyze habitat use and possible habitat and resource partitioning of sympatric barred owls and spotted owls.** Radio-telemetry studies of sympatric spotted and barred owls need to be conducted throughout the range of the spotted owl to do the following:
 - Determine how the two species use their habitat and resources, including prey, in various areas.
 - Identify habitats, if any, which favor spotted owls over barred owls.
 - Determine how the use of habitats by barred owls changes as their numbers increase.
 - Estimate changes in the detectability of spotted owls as a result of the presence of barred owls.
 - Determine the accuracy of spotted owl survey protocols in detecting barred owls.
 - Determine how best to survey for both species simultaneously in a manner that does not impart additional harm or risk to spotted owls.
- **Recovery Action 6: Estimate the relative densities of barred owls and spotted owls at which negative effects to spotted owls occur to such a degree to prohibit achievement of Recovery Criteria 1 and 2, and experimentally assess the effects of removal of barred owls on spotted owl site occupancy, reproduction, and survival.** Removal experiments have the potential to identify the clearest cause-and-effect relationships between barred owls and the population declines of spotted owls. It is anticipated densities at which negative effects from barred owls occur will vary throughout the spotted owl range. Therefore, removal experiments should be conducted in various parts of the spotted owl range, including a range of barred owl/spotted owl densities as well as managed land (e.g., industrial lands, Tribal lands, Adaptive Management Areas, and matrix lands) and unmanaged lands (e.g., State and Federal park lands). Control experiments should be conducted within spotted owl home

ranges where spotted owl pairs have been detected within the past 5 years. Effectiveness may be increased by implementing control experiments in adjacent spotted owl home ranges or in clumps of spotted owl home ranges currently inhabited by barred owls. See Appendix G for further guidance on implementing removal experiments.

- **Recovery Action 7: Incorporate the presence of barred owls into ongoing spotted owl monitoring.** Once it is determined how well spotted owl survey protocols detect barred owls and how to modify these protocols to detect barred owls, it would be cost-effective to modify ongoing spotted owl monitoring to adequately detect barred owls.
- **Recovery Action 8: Create and implement an outreach strategy to educate the public about the barred owl threat to spotted owl, to support associated research and management.** It is crucial that the public be kept informed concerning this difficult aspect of the recovery of the spotted owl. The public needs to be informed of the potential consequences of not addressing this threat, or if it is not biologically feasible to manage this threat. Public outreach could include production and distribution of brochures, kiosk displays, press releases, and public meetings relative to research and management options.
- **Recovery Action 9: Recommend that permitting of experimental removal of barred owls be given high priority at Federal and State levels.** The concern regarding the current and future negative effects of barred owls on the recovery of spotted owls is considerable, and immediate research is needed. Permitting scientifically sound research on removal experiments will be necessary to answer the question of the impacts of barred owls on spotted owls.
- **Recovery Action 10: Evaluate the effectiveness of existing spotted owl detection survey protocols, and correct any deficiencies.** The presence of barred owls may decrease the effectiveness of current spotted owl detection surveys. If so, these deficiencies need to be identified and corrected, if possible.
- **Recovery Action 11: Evaluate the practice of using spotted owl surveys to declare sites unoccupied.** The presence of barred owls may decrease the effectiveness of current spotted owl detection surveys. If so, it may be inaccurate to use spotted owl surveys to declare a site unoccupied by spotted owls. This action would help determine the likelihood of a site being unoccupied given a spotted owl detection survey approach, and also what detection survey methods would be needed to provide a very high likelihood of concluding that a site is unoccupied by spotted owls.
- **Recovery Action 12: Using a collaborative process including landowners and land managers, create incentives to encourage the development and support of spotted owl habitat, and develop mechanisms so that there is not an incentive for landowners to oppose barred owl management.** Incentives, such as Safe Harbor Agreements, may decrease a private

landowner's concern regarding barred owl management that may increase the presence of spotted owls, a listed species under the ESA.

Population and Distribution

The original listing of spotted owls identified population decline, small population size, and related demographic conditions as threats. In the current assessment, these conditions were viewed as results of other threats and not threats *per se*. However, recovery actions are identified here that are intended to address and ameliorate such demographic conditions.

To ensure the long-term recovery of the spotted owl, populations in the physiographic provinces must be stable or increasing, and the species must be well distributed throughout its range. This will be accomplished when the following recovery criteria are met:

Recovery Criterion 2: The population trend is stable or increasing after 10 years of monitoring, as measured by a statistically reliable method, in each province excluding Western Washington Lowlands, the Willamette Valley, and California Cascades, with a low probability of concluding the population is stable or increasing when it actually is declining.

Recovery Criterion 3: The distribution of spotted owls is sufficient to meet the overall spatial objectives of the spotted owl conservation strategy, i.e., within 5 consecutive years, in each State at least 80 percent of Category 1 MOCAs contain at least 15 occupied spotted owl sites.

- **Recovery Action 13: Continue monitoring the population trend to determine if the population is decreasing, stationary, or increasing.** Monitoring in demographic study areas is currently the primary action to assess the status of populations of spotted owls. Other statistically valid monitoring methods may be possible and should be tested.
- **Recovery Action 14: Conduct occupancy inventory needed to determine if Recovery Criterion 2 has been met.** It is expected this inventory will be initiated at a date when it appears that the spotted owl is close to meeting Recovery Criterion 2. Data for use in determining whether Recovery Criterion 3 is met can be no older than 5 years. Periodic assessment of the distribution of spotted owls in the MOCAs is important because the demographic study areas may not be representative of range wide conditions. As part of this recovery action, a sampling design to estimate occupancy needs to be developed (with for example, frequency of sampling, number of samples, location of samples). Consideration should

be given to using volunteers to conduct surveys, possibly using the Breeding Bird Survey as a general model.

- **Recovery Action 15: Outside MOCA 1s, encourage surveying or monitoring of spotted owls, and the sharing of data gathered to appropriate databases.** Data obtained during surveys of spotted owls outside of MOCA 1s should be shared to produce complementary data and ease of data entry and analysis, and to lessen redundant or competing survey efforts. The NSO Work Group (see Recovery Action 1) should facilitate implementation of this action.

Listing Factor A: The present or threatened destruction, modification, or curtailment of the species' habitat or range.

Recovery Criterion 4: In each province, excluding Western Washington Lowlands and the Willamette Valley, at least 80 percent of both types of MOCAs have at least the listed percentage of high-quality habitat⁵. To meet Criterion 4, 80 percent of MOCA 1s and 80 percent of MOCA 2s within each listed province must meet the listed percentage.

The key threats identified that relate to this listing factor are (1) loss of amount of habitat and changes in distribution of habitat as a result of past activities and disturbances, and (2) ongoing habitat loss from timber harvest and permanent conversion of habitat. The habitat-related threats will be addressed when the following conditions are met:

⁵ "High-quality habitat" is habitat similar to that used by 90 percent of the known spotted owl pairs for nesting and roosting in that province.

Physiographic Province	Percentage of Habitat-Capable Acres in Suitable Habitat ⁶
Olympic Peninsula	70%
Western Washington Cascades	70%
Eastern Washington Cascades	60%
Oregon Coast Range	70%
Western Oregon Cascades	60%
Eastern Oregon Cascades	60%
Oregon Klamath	50%
California Klamath	50%
California Cascades	50%
California Coast	50%

This criterion was developed to allow determination of a stable habitat distribution and to assess when suitable habitat would be at a level to support spotted owl populations and allow delisting to be considered. Cutting suitable habitat in areas that have higher habitat percentages than the listed percentages is not recommended, unless future research indicates otherwise (see recovery actions 32 and 33). See Figure 1 for an illustration of this criterion, and Appendix D for a discussion of how these percentages were developed.

Development of this criterion was aided by the use of a Biomapper-style habitat typing system, which used known spotted owl activity centers to “train” the attribute-recognition software. This criterion allows other typing systems but constrains them to use habitat used by 90 percent of owls around the median value to define spotted owl habitat. The variable percentage targets attempt to adjust for both disturbance-adapted habitats from prey production and fire-adapted perspectives and takes into account the preponderance of flying squirrel prey in the more northern and coastal provinces. The 80 percent threshold of all MOCAs allows for natural fire and other disturbances that might prevent achievement of this habitat standard in all MOCAs at all times. While these habitat percentages are based on the home-range scale analysis from several provinces, Criterion 3 provides appropriate distribution.

⁶ In checkerboard-ownership patterns of Federal and non-Federal land it is assumed all Federal habitat capable acres will contribute high-quality owl habitat within the limits imposed by natural stochastic events, e.g., wildfire. Therefore, in some MOCA 1s the amount of high-quality habitat on Federal lands may not be sufficient to meet the recovery criteria percentage. In those instances, habitat on non-Federal lands that provide at least foraging-quality habitat may be used to meet the recovery criterion percentage. The habitat contribution on the non-Federal lands may be in different locations over time.

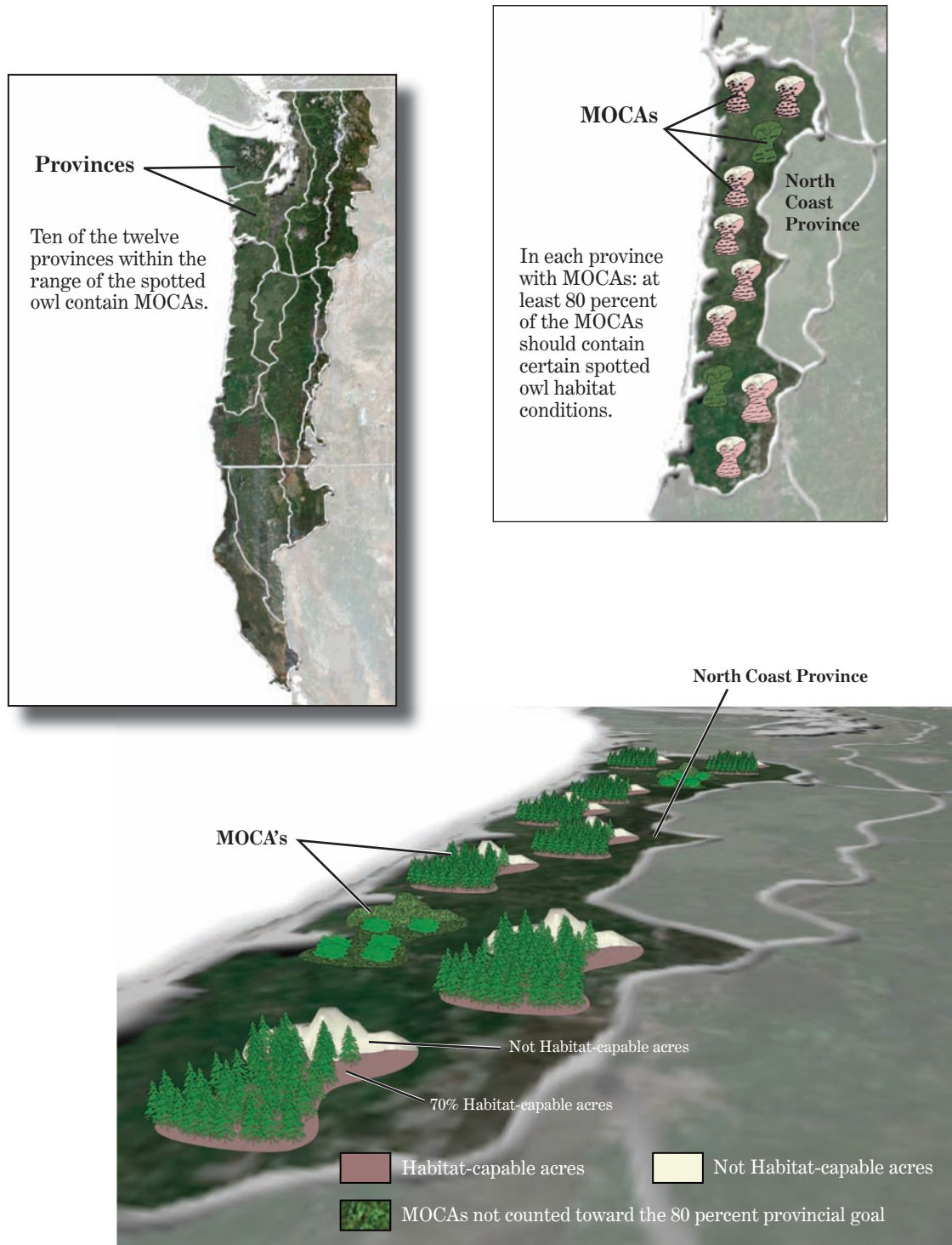
Spotted Owl Habitat

Definitions of spotted owl habitat vary across the species' range, from the drier, more disturbance-adapted southern and eastern portions of the range to the more mesic western and northern portions. To address this variability, a definition based on the spotted owl's use of habitat was chosen – namely, the “habitat quality similar to that used by 90 percent of the known spotted owl pairs nesting or roosting in that province.” “Habitat-capable” is defined per Davis and Lint (2005) as the forest capable land area below the elevation limits of occupancy by territorial owls, excluding serpentine soil areas.

“Habitat-capable” is defined per Davis and Lint (2005) as the forested land area below the elevation limits of occupancy by territorial owls, excluding serpentine soil areas.

“Habitat fitness” is explained in Appendix D.

Figure 1.



In the Oregon North Coast Province, 70 percent of the habitat-capable acres should be in a habitat quality similar to that used by 90 percent of the spotted owl pairs for nesting and roosting in that province.

The spotted owl cannot be considered recovered, and thus delisted, based solely on meeting the habitat criterion; the other population and distribution criteria must also be considered. Recent studies (e.g., Franklin *et al.* 2000, Olson *et al.*

The spotted owl cannot be considered recovered, and thus delisted, based solely on the habitat criteria; the other population and distribution criteria must also be considered.

2004) have shifted the paradigm, from considering spotted owl habitat at the stand level to the landscape level. The studies referred to here are correlational, and the authors caution against basing broad management decisions on their initial results. Given the current state of knowledge, it is not recommended that management occur to reduce the amount or quality of nesting habitat in the MOCAs. The studies were used to guide development of the

delisting criteria for habitat distribution and called for continued research outside the MOCAs to develop experimental habitat distributions and management expertise; such research would aid in understanding the management implications of these important habitat edge relationships. Continued research in this important area is encouraged. Using adaptive management, these percentages may be modified if new information so indicates. A consideration in modifying these percentages is that Franklin *et al.* (2000) and Olson *et al.* (2003), both of which were conducted in the southern half of the spotted owl's range where woodrats are important prey, found that landscape fitness ($\lambda_{(h)}$) fell below 1.0 (a stable population) and adult spotted owl survival rates were decreasing in landscapes with greater than 80 percent nesting habitat. For the present, however, the physiographic, province-specific percentages included in this Recovery Plan should be considered to be the lower end of the target spectrum of the amount of nesting habitat within a spotted owl home range.

The recovery actions necessary for the completion of this recovery criterion follow, as do additional complementary recovery actions.

Overall Habitat Recovery Actions

- **Recovery Action 16: Conduct habitat inventory needed to determine if Recovery Criterion 4 has been met.** Assessment of the quantity and quality of spotted owl habitat within the MOCA will be required to evaluate when proportions of suitable nesting and roosting habitat have met the province-specific levels identified in the habitat criterion.
- **Recovery Action 17: Using a collaborative process, standardize province-specific habitat definitions across the range of the spotted owl.** Identification of existing spotted owl habitat and the management of lands to provide new habitat in the future would benefit greatly from a set of province-specific definitions of spotted owl habitat (nesting, dispersal, foraging, prey-producing habitat, etc.). Variation in habitat structure and use across the spotted owl's range drives the need for province-specific definitions. The definitions should use forest

composition and structure vernacular so that spotted owl habitat can be described in forest management terms.

- **Recovery Action 18: Develop and implement a spotted owl habitat conservation education program to provide understanding of recovery needs.** Providing habitat and offsetting adverse effects from barred owls are essential to recover the spotted owl. Equally important is the understanding of that need by the public, as well as the managers of lands where spotted owls occur now or might occur in the future. A spotted owl recovery education program is a key method of providing this understanding. With understanding, it is hoped that support and participation in the recovery effort will follow.
- **Recovery Action 19: Encourage applicants to develop Habitat Conservation Plans/Safe Harbor Agreements that are consistent with the recovery objectives.** Habitat Conservation Plans (HCPs) and Safe Harbor Agreements (SHAs) are important ways that non-Federal landowners can voluntarily assist in the recovery of the spotted owl. Although HCPs do not require recovery standards, voluntary recovery actions included in an HCP can promote recovery. A concerted effort to inform potential participants of the process and the value associated with HCPs and SHAs may increase participation in this program and provide value-added elements to this Recovery Plan.
- **Recovery Action 20: Evaluate the effect of wildfire and subsequent treatments on spotted owl habitat and their prey.** Assess how wildfire and subsequent treatments, including post-fire salvage, affect the recovery of the spotted owl.

Habitat Maintenance and Habitat Restoration Recovery Actions

In MOCAs in all provinces:

- **Recovery Action 21: Manage the habitat-capable acres in both categories of MOCAs at levels that meet or exceed the Recovery Criterion 4 percentages.** In the portions of the range of the spotted owl where flying squirrels are a primary prey item, habitat blocks should be managed to provide contiguous areas of spotted owl nesting habitat, unless future research indicates otherwise (see recovery actions 32 and 33). Managing all of the habitat-capable acres for nesting-quality habitat will yield the best flying squirrel habitat over time. In the portions of the range of the spotted owl where wood rats are a primary prey item, a combination of habitat blocks interspersed with younger forests may provide conditions for spotted owl nesting as well as prey habitat. Random, naturally occurring disturbance events may influence the achievement of the percentages and should be accounted for in determining the number of habitat-capable acres that are managed for production of spotted owl habitat. The intent of this action is not to remove or modify spotted owl habitat to meet or reach the Recovery Criterion 4 percentages.

- Recovery Action 22:** *Using the best-available scientific information, including LSR Assessments (LSRAs)⁷ as applicable, salvage activities should retain habitat structure (i.e., legacy components) of a quantity and quality so as not to significantly increase the length of time necessary for a spotted owl home-range sized area centered on the salvage area to reach the habitat criterion habitat levels.* To determine whether there is a significant increase in the length of time necessary to reach the needed percentages of habitat-capable acres per province as listed in Recovery Criterion 4, managers will compare the length of time it would take for the habitat-capable acres in a provincial home range-size area around the proposed salvage unit to meet the prescribed levels given the post-disturbance conditions with and without the proposed salvage action (Appendix E). If the time necessary to reach the described levels of the habitat criterion with the salvage action exceeds one additional decade, the salvage action should be modified to reduce the time required to one decade or less. Specific guidance on the analysis process will be developed at a later date. For information on legacy components, see Franklin and Agee (2003) (Appendix E).
- Recovery Action 23:** *Identify and restore (by silviculture and time) the habitat-capable acres in the MOCAs that are not currently in the desired habitat condition to support owl pairs.* As possible, use silvicultural methods in the restoration of habitat to expedite the achievement of Recovery Criterion 4 habitat levels.
- Recovery Action 24:** *In the MOCAs, implement the applicable silviculture principles/ guidelines from applicable LRMPs to accelerate development of spotted owl habitat to achieve Recovery Criterion 1.* Recognize the site-specific information available from LSRAs when applying silvicultural prescriptions.

In MOCAs in fire-prone provinces:

- Recovery Action 25:** *Within MOCAs in the fire-prone portion of the Western Oregon Cascades (i.e., MOCA #22 and #17), Eastern Cascade provinces of Washington and Oregon, and Klamath provinces of Oregon and California, and California Cascades, manage stands in accordance with the appropriate LRMP standards and guidelines to reduce the risk of fire that causes habitat loss within MOCAs.* When implementing actions to reduce fire risk in spotted owl habitat in MOCAs, evaluate fire risk and spotted owl habitat value at the landscape scale. Identify high-value spotted owl habitat that has a high risk of loss due to wildfire. Activities should focus on the reduction of ladder fuels and fuel loading, within targets established by underlying LRMPs or LSRAs, where available and applicable. Limit the use of shaded fuel breaks and canopy reduction to those situations where they are clearly necessary to ensure long-term maintenance of habitat at the MOCA scale and where they will not significantly increase the length of time necessary for the MOCAs to

⁷ A Late-Successional Reserve Assessment is conducted in accordance with the Northwest Forest Plan (USDA 1994a).

reach Recovery Criterion 4 habitat levels. The reduction of fire risk may be an important part of achieving Recovery Criterion 4.

In MOCAs in non-fire-prone provinces:

- ***Recovery Action 26: Maintain all the existing nesting-quality stands within MOCAs in the Westside provinces or in non-fire prone provinces***

Maintenance of existing nesting habitat is important to spotted owl conservation in both the short-term and long-term. In the short-term, these areas are important for maintaining spotted owls in areas until regrowth of nesting habitat allows for nesting reoccupation of the surrounding areas within habitat blocks. In the long-term, these existing stands will form the foundation for building a strong habitat network. Fire management plans for some National Parks and designated wilderness areas permit naturally ignited fires to burn under specific prescriptions and are acknowledged as viable management practices under this action. Fire is an important ecosystem process that plays a key role in creating and maintaining some of the forest structure required by spotted owls and it is not the intent of this action to require that all fires in spotted owl habitat be suppressed.

In CSAs (Table C6, Appendix F):

Mapped or described CSAs are areas between or adjacent to MOCAs where various, voluntary habitat contributions (for dispersal and/or demographic support) by private, State, and some Federal land managers are expected to increase the likelihood that spotted owl recovery is achieved, shorten the time needed to achieve recovery, and/or reduce management risks associated with the recovery strategy and recovery actions. CSAs were delineated and described in areas where private, State, or Federal management regimes – such as Section 10 HCPs, State forest practices rules, and certain Federal Adaptive Management Areas – which can provide important contributions to recovery. CSAs may function to provide demographic support to core owl populations in the MOCA network, facilitate dispersal of juvenile owls among MOCAs, or serve both of these functions.

In Washington. These CSAs are based on existing Spotted Owl Special Emphasis Areas (SOSEAs) designated by the Washington Forest Practices Board. The management provisions for these areas will provide valuable habitat for territorial pairs and connectivity between Federal habitat blocks.

- ***Recovery Action 27: Recognize the designated CSAs in Washington.***
- ***Recovery Action 28: Using a collaborative process, create and adopt measurable habitat objectives for use in landscape planning within the CSAs, using the habitat definitions developed by Recovery Action 17.*** Having measurable objectives will help establish common understanding of goals in these important landscapes, reduce uncertainty, and improve coordinated work to achieve spotted owl recovery.

In Oregon. The five mapped and two unmapped CSAs provide a mix of demographic or dispersal support.

- **Recovery Action 29:** *In all Oregon CSAs, encourage the development of habitat for dispersal of spotted owls between MOCAs and/or provinces. In OCSA 01, 02 and 05 encourage the development of habitat for spotted owl demographic support.*

In California. There are five different types of CSAs in California: State and county parks, private land HCPs, Department of Defense, State demonstration forest, and a potential private land HCP.

- **Recovery Action 30:** *In these CSAs, encourage the continued provision of habitat to support reproducing pairs of spotted owls.*

Outside of MOCAs

- **Recovery Action 31:** *Outside of the MOCAs in the fire-prone provinces (see Recovery Action 25), based on plant association group and fire regime types, strategically (geographically and topographically) modify fuels and stand structure to assist in the suppression of wildfires to decrease the risk of wildfire spread into the MOCAs.* Wildfire does not include wildland fires for resource benefit (WFRB).
- **Recovery Action 32:** *Conduct experiments on forest management outside of MOCAs to better understand the relationship between habitat and spotted owl fitness, including the effects of fire and silviculture on suitable habitat and spatial pattern.* Such forest management experiments should be given high-priority in Federal matrix, adaptive management, and non-Federal lands.
- **Recovery Action 33:** *Research the effects of land management on prey ecology and prey relationships to their environment.* Also research the relationship between prey and spotted owl fitness. Such research should be given high priority in Federal matrix, adaptive management, and non-Federal lands.
- **Recovery Action 34:** *Manage Federal forest-capable landscapes outside of MOCAs to support spotted owl dispersal among MOCAs.* No special management objectives are necessary for providing for dispersal habitat.

Listing Factor D: Inadequacy of existing regulatory mechanisms

Recovery Criterion 5: In order to monitor the continued stability of the recovered spotted owl, a post-delisting monitoring plan has been developed and is ready for implementation with the States of Washington, Oregon, and California (ESA 4(g)(1)).

Regulatory impediments need to be removed to enhance implementing the actions or achieving the criteria identified in this Recovery Plan:

- The Federal Sherman Antitrust Act does not reward landowners for coordinating their forest management activities to achieve landscape-level habitat goals.
- The structure of Federal and State regulations does not reward landowners for developing spotted owl habitat. Forest lands that landowners are free to manage for economic gain because they are not spotted owl habitat become subject to regulatory restrictions if they are managed to create spotted owl habitat.
- There are no meaningful incentives for landowners to develop spotted owl habitat, other than limited relief from the regulatory process and possible public relations benefits. These weak incentives are overshadowed by the economic disadvantages and loss of managerial flexibility that occur if spotted owl habitat is developed where it does not currently exist.
 - **Recovery Action 35: Streamline the process of a landowner gaining approval of an HCP and SHA.** The Service and the National Marine Fisheries Service should implement ways to reduce processing time and make the HCP process more user-friendly.

A monitoring plan should be established prior to delisting, so that regulatory inadequacies are not created after delisting.

- **Recovery Action 36: Determine that a delisting monitoring plan has been developed and is ready for implementation with the States of Washington, Oregon, and California (ESA 4(g)(1)).** Such a plan is necessary to meet the requirements of the ESA.

Listing Factor B: Overutilization for commercial, scientific, or educational purposes

There is no known threat to the spotted owl relative to this listing factor, so no recovery criteria or recovery actions are identified.

Listing Factor C: Disease or predation

There is no recovery criterion specific to this listing factor.

Avian Disease

It is unknown whether avian diseases such as West Nile virus (WNV) or avian flu will significantly affect spotted owls. No diseases are currently implicated.

- **Recovery Action 37: Monitor avian diseases (e.g., WNV, avian flu) and develop a contingency plan.** Monitoring is needed to assess whether any of these diseases becomes a threat.

Predation

Known predators of spotted owls are limited to great horned owls (*Bubo virginianus*) (Forsman *et al.* 1984), and, apparently, barred owls (Leskiw and Gutiérrez 1998). Other suspected predators include northern goshawks (*Accipiter gentiles*), red-tailed hawks (*Buteo jamaicensis*), and other raptors (Courtney *et al.* 2004). Occasional predation of spotted owls by these raptors is not considered to be a threat to spotted owls, so no criteria or actions are identified, including monitoring. Criteria and actions relative to the threat from barred owls are presented in Listing Factor E.

II. Recovery Criteria and Recovery Actions (*Option 2*)

Recovery criteria serve as objective, measurable guidelines to assist in determining when an endangered species has recovered to the point that it may be downlisted to threatened, or that the protections afforded by the ESA are no longer necessary and the species may be delisted. However, a change in status (downlisting or delisting) requires a separate rule-making process based on an analysis of the same five factors (referred to as the listing factors) considered in the listing of a species, as described in Section 4(a)(1) of the ESA.

The recovery criteria in this Plan represent the best assessment of the conditions that would result in a determination that delisting the spotted owl is warranted, following a formal listing factor analysis in a subsequent regulatory rule-making process. Each recovery criterion includes a parameter to be measured and, when known, a threshold to be reached.

This section is organized by listing factor, with the factors containing the most important threats presented first. The recovery criteria are listed under each listing factor, and the recovery actions are presented under each recovery criterion. In general, the recovery actions are those activities deemed necessary to achieve the recovery criteria or to determine whether the recovery criteria have been met. For a more complete description of the threats, see Appendix C. The criterion and actions associated with the barred owl are listed first to emphasize the significance of this threat.

The first recovery action pertains to all listing factors and recovery criteria and thus is listed separately.

- ***Recovery Action 1. Establish an inter-organizational spotted owl working group (“NSO Work Group”) to coordinate implementation of the Recovery Plan.*** Implementation of a Recovery Plan with the breadth and scope of this Plan would benefit greatly from a working group to facilitate implementation of the numerous recovery actions necessary to carry out the Plan and recover the spotted owl. The NSO Work Group should be responsible for coordinating other necessary work groups, such as one to deal with barred owls. The NSO Work Group is not intended to be a technical or policy “approval” committee.

Listing Factor E: Other natural or manmade factors affecting its continued existence.

Barred Owl

To ensure the long-term recovery of the spotted owl, populations must be free of significantly negative effects from the barred owl. This will be accomplished when the following recovery criteria are met:

Recovery Criterion 1: The percentage of known spotted owl territories that are occupied or influenced by barred owls is sufficiently low (as determined by the research actions outlined below) to allow the achievement of stable or increasing populations and distribution as noted in Recovery Criteria 2 and 3. This percentage shall have been maintained at or below this threshold averaged over 10 years.

Immediate action is needed to address the barred owl threat. As there are still many unknowns associated with the mechanisms of the threat and how it can be managed, these actions need to provide valuable research and management insights.

We anticipate this threshold may vary by province or groups of provinces, so province-specific thresholds probably will be needed. In some areas, especially where the locations of territories of spotted owls are not known, the above percentage may be replaced with a density of barred owl site-centers, or with a frequency of responses by barred owls per survey station after standardizing survey methods. The actions outlined in the Recovery Plan should be done concurrently:

- **Recovery Action 2: Manage to minimize negative effects of barred owls on sympatric spotted owls.** Based on risk assessments conducted both before and after the research listed below is completed, manage the effects of barred owls on spotted owls. This would include production of a barred owl management plan, targeting key areas for removal of barred owls, and assessment of the Federal and State requirements necessary to implement the removal of barred owls. Implementation of any of these activities can occur independently and is not linked to completion of any other activity. This action could apply to areas where barred and spotted owls currently coexist, and to areas where barred owls have completely replaced spotted owls when it is feasible that spotted owls in nearby areas could repopulate the extirpated areas.
- **Recovery Action 3: Establish a working group of entities involved with barred owl research and management (Federal and State agencies, Tribes, timber industry, universities, and non-governmental organizations) that would coordinate actions relative to barred owl research, management, and public outreach.** Coordination within all agencies and non-governmental

organizations that can contribute to the research of barred owls needs to be done to prioritize actions to address the barred owl threat, maximize funding opportunities, minimize redundancies, increase efficiency, analyze risks associated with action or non-actions and discuss with decision makers, and analyze the invasion dynamics of barred owls. This working group could be facilitated by the NSO Work Group.

- **Recovery Action 4: Analyze existing data sets from the demographic study areas relative to effects of barred owls on spotted owl site occupancy, reproduction, and survival.** Decades of incidental data for barred owls from the spotted owl demographic study areas and density study areas should be analyzed with newly defined covariates to determine what further correlations exist relative to the presence of barred owls and negative effects to spotted owls.
- **Recovery Action 5: Analyze habitat use and possible habitat and resource partitioning of sympatric barred owls and spotted owls.** Radio-telemetry studies of sympatric spotted and barred owls need to be conducted throughout the range of the spotted owl to do the following:
 - Determine how the two species use their habitat and resources, including prey, in various areas.
 - Identify habitats, if any, which favor spotted owls over barred owls.
 - Determine how the use of habitats by barred owls changes as their numbers increase.
 - Estimate changes in the detectability of spotted owls as a result of the presence of barred owls.
 - Determine how well spotted owl survey protocols detect barred owls.
 - Determine how best to survey for both species simultaneously in a manner that does not impart additional harm or risk to spotted owls.
- **Recovery Action 6: Estimate the relative densities of barred owls and spotted owls at which negative effects to spotted owls occur to such a degree to prohibit achievement of Recovery Criteria 1 and 2, and experimentally assess the effects of removal of barred owls on spotted owl site occupancy, reproduction, and survival.** Removal experiments have the potential to identify the clearest cause-and-effect relationships between barred owls and the population declines of spotted owls. It is anticipated densities at which negative effects from barred owls occur will vary throughout the spotted owl range. Therefore, removal experiments should be conducted in various parts of the spotted owl range, including a range of barred owl/spotted owl densities as well as managed land (e.g., industrial lands, Tribal lands, Adaptive Management Areas, and matrix lands) and unmanaged lands (e.g., State and Federal park lands). Control experiments should be conducted within spotted owl home ranges where spotted owl pairs have been detected within the past 5

years. Effectiveness may be increased by implementing control experiments in adjacent spotted owl home ranges or in clumps of spotted owl home ranges currently inhabited by barred owls. See Appendix G for further guidance on implementing removal experiments.

- **Recovery Action 7: Incorporate the presence of barred owls into ongoing spotted owl monitoring.** Once it is determined how well spotted owl survey protocols detect barred owls and how to modify these protocols to detect barred owls, it would be cost-effective to modify ongoing spotted owl monitoring to adequately detect barred owls.
- **Recovery Action 8: Create and implement an outreach strategy to educate the public about the barred owl threat to spotted owl, to support associated research and management.** It is crucial that the public be kept informed concerning this difficult aspect of the recovery of the spotted owl. The public needs to be informed of the potential consequences of not addressing this threat, or if it is not biologically feasible to manage this threat. Public outreach could include production and distribution of brochures, kiosk displays, press releases, and public meetings relative to research and management options.
- **Recovery Action 9: Recommend that permitting of experimental removal of barred owls be given high priority at Federal and State levels.** The concern regarding the current and future negative effects of barred owls on the recovery of spotted owls is considerable, and immediate research is needed. Permitting scientifically sound research on removal experiments will be necessary to answer the question of the impacts of barred owls on spotted owls.
- **Recovery Action 10: Evaluate the effectiveness of existing spotted owl detection survey protocols, and correct any deficiencies.** The presence of barred owls may decrease the effectiveness of current spotted owl detection surveys. If so, these deficiencies need to be identified and corrected, if possible.
- **Recovery Action 11: Evaluate the practice of using spotted owl surveys to declare sites unoccupied.** The presence of barred owls may decrease the effectiveness of current spotted owl detection surveys. If so, it may be inaccurate to use spotted owl surveys to declare a site unoccupied by spotted owls. This action would help determine the likelihood of a site being unoccupied given a spotted owl detection survey approach, and also what detection survey methods would be needed to provide a very high likelihood of concluding that a site is unoccupied by spotted owls.
- **Recovery Action 12: Using a collaborative process including landowners and land managers, create incentives to encourage the development and support of spotted owl habitat, and develop mechanisms so that there is not an incentive for landowners to oppose barred owl management.** Incentives, such as regulatory assurances, may decrease a private

landowner's concern regarding barred owl management that may increase the presence of spotted owls, a listed species under the ESA.

Population and Distribution

The original listing of spotted owls identified population decline, small population size, and related demographic conditions as threats. In the current assessment, these conditions were viewed as results of other threats and not threats *per se*. However, recovery actions are identified here that are intended to address and ameliorate such demographic conditions.

To ensure the long-term recovery of the spotted owl, populations in the physiographic provinces must be stable or increasing, and the species must be well distributed throughout its range. This will be accomplished when the following recovery criteria are met:

Recovery Criterion 2: The population trend is stable or increasing after 10 years of monitoring, as measured by a statistically reliable method, in each province excluding Western Washington Lowlands, the Willamette Valley, and California Cascades, with a low probability of concluding the population is stable or increasing when it actually is declining.

Recovery Criterion 3: The distribution of spotted owls is sufficient to meet the overall spatial objectives of the spotted owl conservation strategy, i.e., within 5 consecutive years, in each State at least 80 percent of large habitat blocks contain at least 15 occupied spotted owl sites.

- **Recovery Action 13: Continue monitoring the population trend to determine if the population is decreasing, stationary, or increasing.** Monitoring in demographic study areas is currently the primary action to assess the status of populations of spotted owls. Other statistically valid monitoring methods may be possible and should be tested.
- **Recovery Action 14: Conduct occupancy inventory needed to determine if Recovery Criterion 2 has been met.** It is expected this inventory will be initiated at a date when it appears that the spotted owl is close to meeting Recovery Criterion 2. Data for use in determining whether Recovery Criterion 3 is met can be no older than 5 years. Periodic assessment of the distribution of spotted owls in the large habitat blocks is important because the demographic study areas may not be representative of range wide conditions. As part of this recovery action, a sampling design to estimate occupancy needs to be developed (with for example, frequency of sampling, number of samples, location of samples). Consideration

should be given to using volunteers to conduct surveys, possibly using the Breeding Bird Survey as a general model.

- **Recovery Action 15: Outside large habitat blocks, encourage surveying or monitoring of spotted owls, and the sharing of data gathered to appropriate databases.** Data obtained during surveys of spotted owls outside of large habitat blocks should be shared to produce complementary data and ease of data entry and analysis, and to lessen redundant or competing survey efforts. The NSO Work Group (see Recovery Action 1) should facilitate implementation of this action.

Listing Factor A: The present or threatened destruction, modification, or curtailment of the species' habitat or range.

Recovery Criterion 4: In each province, excluding Western Washington Lowlands and the Willamette Valley, at least 80 percent of large and small habitat blocks have at least the listed percentage of high-quality habitat⁸. To meet Criterion 4, 80 percent of large habitat blocks and 80 percent of small habitat blocks within each listed province must meet the listed percentage.

The key threats identified that relate to this listing factor are (1) loss of amount of habitat and changes in distribution of habitat as a result of past activities and disturbances, and (2) ongoing habitat loss from natural disturbances, timber harvest and permanent conversion of habitat. The habitat-related threats will be addressed when the following conditions are met:

⁸ "High-quality habitat" is habitat similar to that used by 90 percent of the known spotted owl pairs for nesting and roosting in that province.

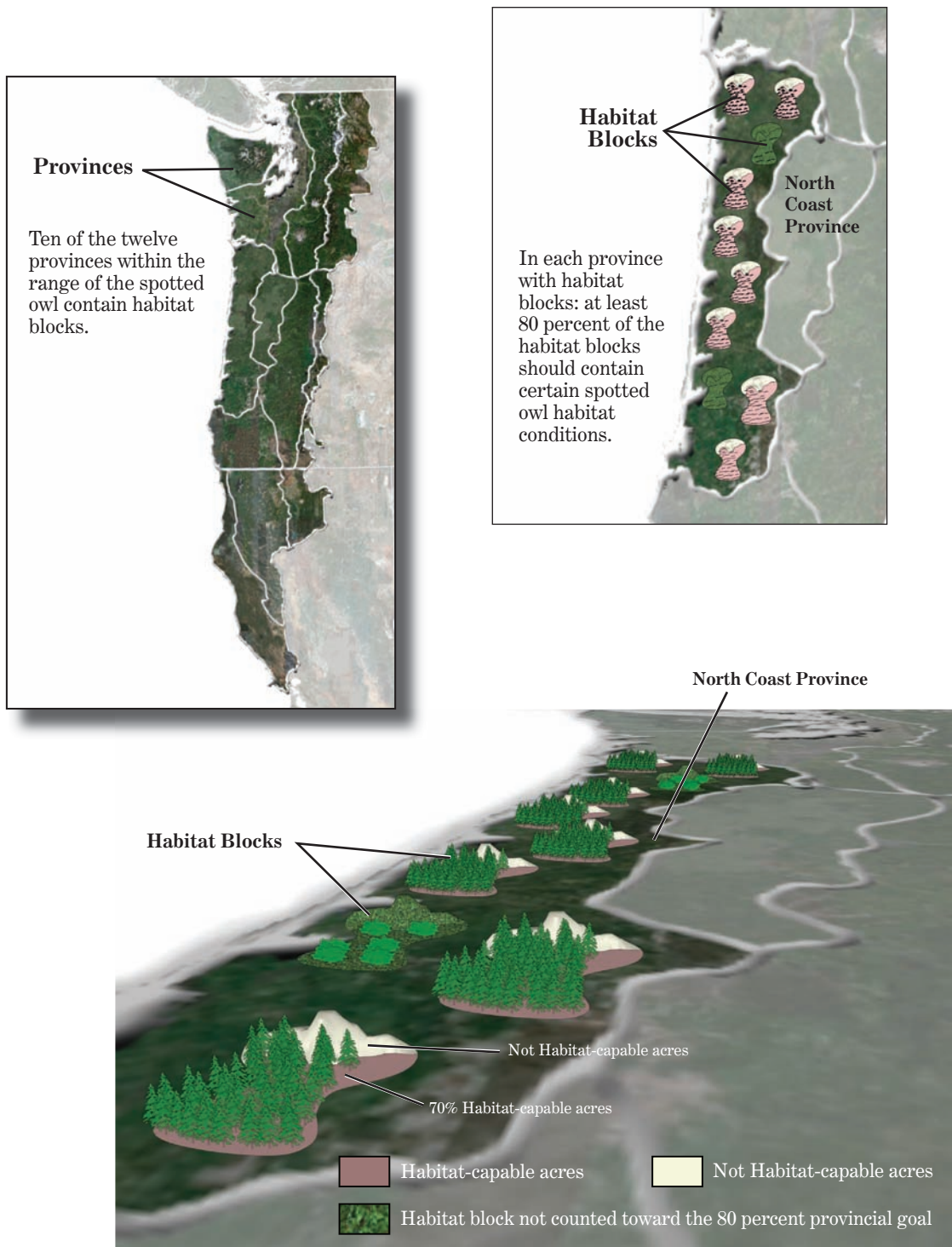
Physiographic Province	Percentage of Habitat-Capable Acres in Suitable Habitat ⁹
Olympic Peninsula	70%
Western Washington Cascades	70%
Eastern Washington Cascades	60%
Oregon Coast Range	70%
Western Oregon Cascades	60%
Eastern Oregon Cascades	60%
Oregon Klamath	50%
California Klamath	50%
California Cascades	50%
California Coast	50%

This criterion was developed to allow determination of a stable habitat distribution and to assess when suitable habitat would be at a level to support spotted owl populations and allow delisting to be considered. Cutting suitable habitat in areas that have higher habitat percentages than the listed percentages is not recommended, unless future research indicates otherwise (see recovery actions 32 and 33). See Figure 1 for an illustration of this criterion and Appendix D for a discussion of how these percentages were developed.

Development of this criterion was aided by the use of a Biomapper-style habitat typing system, which used known spotted owl activity centers to “train” the attribute-recognition software. This criterion allows other typing systems but constrains them to use habitat used by 90 percent of owls around the median value to define spotted owl habitat. The variable percentage targets attempt to adjust for both disturbance-adapted habitats from prey production and fire-adapted perspectives and takes into account the preponderance of flying squirrel prey in the more northern and coastal provinces. The 80 percent threshold of all habitat blocks allows for natural fire and other disturbances that might prevent achievement of this habitat standard in all habitat blocks at all times. While these habitat percentages are based on the home-range scale analysis from several provinces, Criterion 3 provides appropriate distribution.

⁹ In checkerboard ownership patterns of Federal and non-Federal land it is assumed all Federal habitat capable acres will contribute high-quality owl habitat within the limits imposed by natural stochastic events, e.g., wildfire. Therefore, in some habitat blocks the amount of high-quality habitat on Federal lands may not be sufficient to meet the recovery criteria percentage. In those instances, habitat on non-Federal lands that provide at least foraging-quality habitat may be used to meet the recovery criterion percentage. The habitat contribution on the non-Federal lands may be in different locations over time.

Figure 1.



In the Oregon North Coast Province, 70 percent of the habitat-capable acres should be in a habitat quality similar to that used by 90 percent of the spotted owl pairs for nesting and roosting in that province.

Spotted Owl Habitat

Definitions of spotted owl habitat vary across the species' range, from the drier, more disturbance-adapted southern and eastern portions of the range to the more mesic western and northern portions. To address this variability, a

"Habitat-capable" is defined per Davis and Lint (2005) as the forested land area below the elevation limits of occupancy by territorial owls, excluding serpentine soil areas.

definition based on the spotted owl's use of habitat was chosen – namely, the "habitat quality similar to that used by 90 percent of the known spotted owl pairs nesting or roosting in that province".

"Habitat-capable" is defined per Davis and Lint (2005) as the forest capable land area below the elevation limits of occupancy by territorial owls, excluding serpentine soil areas. "Habitat fitness" is explained in Appendix D.

The spotted owl cannot be considered recovered, and thus delisted, based solely on meeting the habitat criterion; the other population and distribution criteria must also be considered. Recent studies (e.g., Franklin *et al.* 2000, Olson *et al.* 2004) have shifted the paradigm, from considering spotted owl habitat at the stand level to the landscape level. The studies referred to here are correlational, and the authors caution against basing broad management decisions on their initial results. The recent studies were used only to guide development of the delisting criteria for habitat distribution and called for continued research outside the habitat blocks to develop experimental habitat distributions and management expertise; such research would aid in understanding the management implications of these important habitat edge relationships.

Continued research in this important area is encouraged. Using adaptive management, these percentages may be modified if new information so indicates. A consideration in modifying these percentages is that Franklin *et al.* (2000) and Olson *et al.* (2003), both of which were conducted

The spotted owl cannot be considered recovered, and thus delisted, based solely on the habitat criteria; the other population and distribution criteria must also be considered.

in the southern half of the spotted owl's range where woodrats are important prey, found that landscape fitness ($\lambda_{(h)}$) fell below 1.0 (a stable population) and adult spotted owl survival rates were decreasing in landscapes with greater than 80 percent nesting habitat. For the present, however, the physiographic province-specific percentages included in this Recovery Plan should be considered to be the lower end of the target spectrum of the amount of nesting habitat within a spotted owl home range.

The recovery actions necessary for the completion of this recovery criterion follow, as do additional complementary recovery actions.

Overall Habitat Recovery Actions

- **Recovery Action 16: Conduct habitat inventory needed to determine if Recovery Criterion 4 has been met.** Assessment of the quantity and quality of spotted owl habitat within the large habitat blocks will be required to evaluate when proportions of suitable nesting and roosting

habitat have met the province-specific levels identified in the habitat criterion.

- **Recovery Action 17: Using a collaborative process, standardize province-specific habitat definitions across the range of the spotted owl.** Identification of existing spotted owl habitat and the management of lands to provide new habitat in the future would benefit greatly from a set of province-specific definitions of spotted owl habitat (nesting, dispersal, foraging, prey-producing habitat, etc.). Variation in habitat structure and use across the spotted owl's range drives the need for province-specific definitions. The definitions should use forest composition and structure vernacular so that spotted owl habitat can be described in forest management terms.
- **Recovery Action 18: Develop and implement a spotted owl habitat conservation education program to provide understanding of recovery needs.** Providing habitat and offsetting adverse effects from barred owls are essential to recover the spotted owl. Equally important is the understanding of that need by the public, as well as the managers of lands where spotted owls occur now or might occur in the future. A spotted owl recovery education program is a key method of providing this understanding. With understanding, it is hoped that support and participation in the recovery effort will follow.
- **Recovery Action 19: Encourage applicants to develop Habitat Conservation Plans/Safe Harbor Agreements that are consistent with the recovery objectives.** Habitat Conservation Plans (HCPs) and Safe Harbor Agreements (SHAs) are important ways that non-Federal landowners can voluntarily assist in the recovery of the spotted owl. Although HCPs do not require recovery standards, voluntary recovery actions included in an HCP can promote recovery. A concerted effort to inform potential participants of the process and the value associated with HCPs and SHAs may increase participation in this program and provide value-added elements to this Recovery Plan.
- **Recovery Action 20: Evaluate the effect of wildfire and subsequent treatments on spotted owl habitat and their prey.** Assess how wildfire and subsequent treatments, including post-fire salvage, affect the recovery of the spotted owl.

Habitat Maintenance and Habitat Restoration Recovery Actions

In habitat blocks in all provinces:

- **Recovery Action 21: Manage the habitat-capable acres in both sizes of habitat blocks at levels that meet or exceed the Recovery Criterion 4 percentages.** In the portions of the range of the spotted owl where flying squirrels are a primary prey item, habitat blocks should be managed to provide contiguous areas of spotted owl nesting habitat, unless future research indicates otherwise (see recovery actions 32 and 33). Managing all of the habitat-capable acres for nesting-quality habitat will yield the

best flying squirrel habitat over time. In the portions of the range of the spotted owl where wood rats are a primary prey item, a combination of habitat blocks interspersed with younger forests may provide conditions for spotted owl nesting as well as prey habitat. Stands that are selected for young forest management should come from existing younger-age class stands that are not targeted to produce older forests. Random, naturally occurring disturbance events may influence the achievement of the percentages and should be accounted for in determining the number of habitat-capable acres that are managed for production of spotted owl habitat. The intent of this action is not to remove or modify spotted owl habitat to meet or reach the Recovery Criterion 4 percentages.

- **Recovery Action 22: Using the best-available scientific information, including LSR Assessments (LSRAs)¹⁰ as applicable, salvage activities should retain habitat structure (i.e., legacy components) of a quantity and quality so as not to significantly increase the length of time necessary for a spotted owl home-range sized area centered on the salvage area to reach the habitat criterion habitat levels.** To determine whether there is a significant increase in the length of time necessary to reach the needed percentages of habitat-capable acres per province within habitat blocks as listed in Recovery Criterion 4, managers will compare the length of time it would take for the habitat-capable acres in a provincial home range-size area around the proposed salvage unit to meet the prescribed levels given the post-disturbance conditions with and without the proposed salvage action (Appendix E). If the time necessary to reach the described levels of the habitat criterion with the salvage action exceeds one additional decade, the salvage action should be modified to reduce the time required to one decade or less. Specific guidance on the analysis process will be developed at a later date. For information on legacy components, see Franklin and Agee (2003) (Appendix E).
- **Recovery Action 23: Identify and restore (by silviculture and time) the habitat-capable acres in the habitat blocks that are not currently in the desired habitat condition to support owl pairs.** As possible, use silvicultural methods in the restoration of habitat to expedite the achievement of Recovery Criterion 4 habitat levels.
- **Recovery Action 24: In the habitat blocks, implement the silviculture practices from applicable LRMPs to accelerate development of spotted owl habitat to achieve Recovery Criterion 1.** Recognize the site-specific conditions, and consider information available from LRMPs when applying silvicultural prescriptions.

In habitat blocks in fire-prone provinces:

- **Recovery Action 25: Within habitat blocks in the fire-prone portion of the Western Oregon Cascades, Eastern Cascade provinces of Washington and Oregon, and Klamath provinces of Oregon and California, and California**

¹⁰ A Late-Successional Reserve Assessment is conducted in accordance with the Northwest Forest Plan (USDA 1994a).

Cascades, manage stands in accordance with the appropriate LRMP standards and guidelines to reduce the risk of fire that causes habitat loss within habitat blocks. When implementing actions to reduce risk in spotted owl habitat in habitat blocks, evaluate fire risk and spotted owl habitat value at the landscape scale. Identify high-value spotted owl habitat that has a high risk of loss due to wildfire. Activities should focus on the reduction of ladder fuels and fuel loading, within targets established by underlying LRMPs or LSRAs, where available and applicable. Limit the use of shaded fuel breaks and canopy reduction to those situations where they are clearly necessary to ensure long-term maintenance of habitat at the habitat block scale and where they will not significantly increase the length of time necessary for the habitat blocks to reach Recovery Criterion 4 habitat levels.

In habitat blocks in non-fire-prone provinces:

- ***Recovery Action 26: Maintain all the existing nesting-quality stands within habitat blocks in the Westside provinces or in non-fire prone provinces consistent with LRMPs.*** Maintenance of existing nesting habitat is important to spotted owl conservation in both the short-term and long-term. In the short-term, these areas are important for maintaining spotted owls in areas until regrowth of nesting habitat allows for nesting reoccupation of the surrounding areas within habitat blocks. In the long-term, these existing stands will form the foundation for building a strong habitat network. Fire management plans for some National Parks and designated wilderness areas permit naturally ignited fires to burn under specific prescriptions and are acknowledged as viable management practices under this action. Fire is an important ecosystem process that plays a key role in creating and maintaining some of the forest structure required by spotted owls and it is not the intent of this action to require that all fires in spotted owl habitat be suppressed.

In CSAs (Table C6, Appendix F):

CSAs are areas where various, voluntary habitat contributions (for dispersal and/or demographic support) by private, State, and some Federal land managers are expected to increase the likelihood that spotted owl recovery is achieved, shorten the time needed to achieve recovery, and/or reduce management risks associated with the recovery strategy and recovery actions. CSAs in areas where private, State, or Federal management regimes – such as Section 10 HCPs, State forest practices rules, and certain Federal Adaptive Management Areas – which can provide important contributions to recovery were delineated and described. CSAs may function to provide demographic support to core owl populations in the habitat blocks, facilitate dispersal of juvenile owls among habitat blocks, or serve both of these functions.

In Washington. These CSAs are based on existing Spotted Owl Special Emphasis Areas (SOSEAs) designated by the Washington Forest Practices

Board. The management provisions for these areas will provide valuable habitat for territorial pairs and connectivity between Federal habitat blocks.

- **Recovery Action 27: Recognize the designated CSAs in Washington.**
- **Recovery Action 28: Using a collaborative process, create and adopt measurable habitat objectives for use in landscape planning within the CSAs, using the habitat definitions developed by Recovery Action 17.** Having measurable objectives will help establish common understanding of goals in these important landscapes, reduce uncertainty, and improve coordinated work to achieve spotted owl recovery.

In Oregon. The five mapped and two unmapped CSAs provide a mix of demographic or dispersal support.

- **Recovery Action 29: In all Oregon CSAs, encourage the development of habitat for dispersal of spotted owls between habitat blocks and/or provinces.**

In California. There are five different types of CSAs in California: State and county parks, private land HCPs, Department of Defense, State demonstration forest, and a potential private land HCP.

- **Recovery Action 30: In these CSAs, encourage the continued provision of habitat to support reproducing pairs of spotted owls.**

Outside of habitat blocks

- **Recovery Action 31: Outside of the habitat blocks in the fire-prone provinces (see Recovery Action 25), based on plant association group and fire regime types, strategically (geographically and topographically) modify fuels and stand structure to assist in the suppression of wildfires to decrease the risk of wildfire spread into the habitat blocks.** Wildfire does not include wildland fires for resource benefit (WFRB).
- **Recovery Action 32: Conduct experiments on forest management outside of habitat blocks to better understand the relationship between habitat and spotted owl fitness, including the effects of fire and silviculture on suitable habitat and spatial pattern.** Such forest management experiments should be given high-priority in Federal matrix, adaptive management, and non-Federal lands.
- **Recovery Action 33: Research the effects of land management on prey ecology and prey relationships to their environment.** Also research the relationship between prey and spotted owl fitness. Such research should be given high priority in Federal matrix, adaptive management, and non-Federal lands.
- **Recovery Action 34: Manage Federal forest-capable landscapes outside of habitat blocks to support spotted owl dispersal among habitat blocks.** No special management objectives are necessary for providing for dispersal habitat.

Listing Factor D: Inadequacy of existing regulatory mechanisms

Recovery Criterion 5: In order to monitor the continued stability of the recovered spotted owl, a post-delisting monitoring plan has been developed and is ready for implementation with the States of Washington, Oregon, and California (ESA 4(g)(1)).

There are several potential regulatory impediments to implementing the actions or achieving the criteria identified in this Recovery Plan:

- The Federal Sherman Antitrust Act does not reward landowners for coordinating their forest management activities to achieve landscape-level habitat goals.
- The structure of Federal and State regulations does not reward landowners from developing spotted owl habitat. Forest lands that landowners are free to manage for other objectives because they are not occupied by spotted owls become subject to regulatory restrictions if they are occupied by spotted owls.
- There are no meaningful incentives for landowners to develop spotted owl habitat, other than limited relief from the regulatory process and possible public relations benefits. These weak incentives are overshadowed by the economic disadvantages and loss of managerial flexibility that occur if spotted owl habitat is developed and occupied where it does not currently exist.
 - **Recovery Action 35: Streamline the process of a landowner gaining approval of an HCP and SHA.** The Service and the National Marine Fisheries Service should implement ways to reduce processing time and make the HCP process more user-friendly.

A monitoring plan should be established prior to delisting, so that regulatory inadequacies are not created after delisting.

- **Recovery Action 36: Determine that a delisting monitoring plan has been developed and is ready for implementation with the States of Washington, Oregon, and California (ESA 4(g)(1)).** Such a plan is necessary to meet the requirements of the ESA.

Listing Factor B: Overutilization for commercial, scientific, or educational purposes

There is no known threat to the spotted owl relative to this listing factor, so no recovery criteria or recovery actions are identified.

Listing Factor C: Disease or predation

There is no recovery criterion specific to this listing factor.

Avian Disease

It is unknown whether avian diseases such as West Nile virus (WNV) or avian flu will significantly affect spotted owls. No diseases are currently implicated.

- **Recovery Action 37: Monitor avian diseases (e.g., WNV, avian flu) and develop a contingency plan.** Monitoring is needed to assess whether any of these diseases becomes a threat.

Predation

Known predators of spotted owls are limited to great horned owls (*Bubo virginianus*) (Forsman *et al.* 1984), and, apparently, barred owls (Leskiw and Gutiérrez 1998). Other suspected predators include northern goshawks (*Accipiter gentiles*), red-tailed hawks (*Buteo jamaicensis*), and other raptors (Courtney *et al.* 2004). Occasional predation of spotted owls by these raptors is not considered to be a threat to spotted owls, so no criteria or actions are identified, including monitoring. Criteria and actions relative to the threat from barred owls are presented in Listing Factor E.

III. Recovery Strategy, Recovery Goal, and Recovery Objectives (*Option 1*)

Recovery Strategy

In 2007, the greatest range-wide threats to the spotted owl were identified as competition from barred owls, loss of habitat amount and distribution as a result of past activities and disturbances, and ongoing habitat loss as a result of timber harvest.

To address these key threats, a recovery strategy was created that has three essential elements:

- Targeted research and management efforts to address the increasing threat from the barred owl
- A network of core habitat areas of sufficient spacing, size, distribution and management to allow spotted owls to move and persist across their range given that, “based on existing knowledge, *large continuous blocks of suitable habitat are still viewed as necessary for the Northern Spotted Owl*” (Franklin and Courtney 2004:15; emphasis in original)
- Multi-faceted monitoring to provide the information needed for adaptive management and to determine when recovery criteria for population trend, distribution, and habitat have been met.

The likelihood of implementing recovery actions will be increased if an inter-organizational NSO Work Group that includes State, Federal, and non-governmental representatives is formed. Such a group would coordinate implementation of all actions necessary to meet the recovery objectives. While this Recovery Plan applies only to the U.S. portion of the spotted owl’s range, communication and coordination with British Columbia, Canada, is encouraged.

Barred Owl

The barred owl constitutes a significantly greater threat to spotted owl recovery than was envisioned at the time of listing (see Recovery Criterion 1). Because the range and number of barred owls are expanding rapidly, the effectiveness in addressing this threat depends on immediate action. If the spotted owl is extirpated from portions of its range, it may take decades for an area to be reoccupied. As a result, it is recommended that specific actions to address the barred owl threat begin immediately.

Because the range and number of barred owls are expanding rapidly, the effectiveness in addressing this threat depends on immediate action.

If a determination is made that a reduction in the effect of barred owls on spotted owls is not feasible, priorities and implementation of other actions will be reevaluated.

Habitat

The following brief description of the basis of the recovery strategy concerning habitat is excerpted from Appendix F.

Previous Recovery Efforts

This recovery strategy builds on concepts and information presented by the Interagency Scientific Committee (ISC) in “A Conservation Strategy for the Northern Spotted Owl” (Thomas *et al.* 1990) and the 1992 Final Draft Recovery Plan for the Northern Spotted Owl (USFWS 1992) which focused on: managing large blocks of habitat in designated conservation areas throughout the range of the spotted owl that could support self-sustaining populations of 15 to 20 pairs of spotted owls; and spacing the blocks and managing the areas between them to permit movement of spotted owls. To this end, the ISC delineated and mapped a network of 193 Habitat Conservation Areas (HCAs). The 192 Designated Conservation Areas (DCAs) in the 1992 Draft Recovery Plan were modifications of the HCAs from the ISC. In 1994, the NWFP amended 26 LRMPs to provide a network of land-use allocations identified as LSRs to provide habitat for late-successional forest species, including the spotted owl (Davis and Lint 2005). The 2004 Scientific Evaluation of the Status of the Northern Spotted Owl (Courtney *et al.* 2004) acknowledged that this conservation strategy of reserves was based on sound scientific principles which have not substantially changed since the species was listed.

Current Recovery Plan (2007)

DCAs. The current, 2007 Recovery Planning effort used the 1992 DCAs as a starting point to identify habitat-capable lands in Oregon, Washington, and northern California that could support clusters of reproducing spotted owls, as

While the basic notion of spotted owl use of mid-seral and late-seral forests is still supported, some new studies have found that a mixture of mid- and late-seral forests with early seral (prey-producing) and non-forest components improved owl productivity and survival.

well as information from the 1992 Draft Recovery Plan to develop a comprehensive plan designed to recover the spotted owl. As a baseline, it assumed that all other existing management plans throughout the range of the spotted owl are being implemented.

Historical work on spotted owl habitat needs were reviewed, finding that, while the basic notion of spotted owl use of mid-seral and late-seral forests is still supported, some new studies have led to a better understanding of the importance of the juxtaposition of spotted owl nesting and roosting

habitats with non-nesting habitats in the southern portion of the species’ range, as noted in the habitat characteristics section (Franklin *et al.* 2000, Olson *et al.* 2004).

MOCAs. The foundation of the 2007 Recovery Plan is a network of identified conservation areas on Federal lands called MOCAs. The MOCA network was designed to support a stable number of breeding pairs of owls over time and allow for movement of owls across the network. CSAs were added to support the MOCA network and assist in achieving the recovery criteria.

MOCAs are areas in which breeding pairs of spotted owls are expected to persist in order to recover the species (Appendix F). The number and spacing of MOCAs are derived from principles of conservation biology (Thomas *et al.* 1990), adjusted in response to current habitat conditions and land management regimes. They are directly tied to recovery criteria. MOCAs are the geographic areas where monitoring will be carried out to determine whether, at some future time, delisting may be warranted.

Province-specific proportions of spotted owl nesting, roosting, and foraging habitat need to be maintained or developed within the MOCAs to support breeding owls. Time and silvicultural techniques and practices are to be used to restore owl habitat and accelerate habitat development. Any salvage activities carried out within MOCAs should retain sufficient habitat structure so as to not significantly delay development of suitable nesting habitat. Many of the recovery actions presented in this Plan recommend specific management actions both inside and outside of MOCAs, based on Federal land use allocations (LUA), regulatory frameworks, and standards and guidelines as described by relevant LRMPs (Table F1, Appendix F).

Any recovery plan relying on specific mapped conservation areas for its success must address questions of change. This Plan has been prepared with clearly delineated MOCAs and CSAs, yet as new information arises, some change is inevitable. The need for flexibility has been recognized throughout previous recovery efforts and is well documented.

Federal lands outside of MOCAs and CSAs may provide habitat for population support and/or owl dispersal. These lands are currently managed under the relevant LRMPs and land use allocations, as well as other laws. Owners and managers of non-Federal lands outside the MOCAs and CSAs are encouraged to voluntarily support owl recovery.

Monitoring and Research

We recommend that a program of research and monitoring be implemented to track progress toward recovery, inform changes in recovery strategy by a process of adaptive management, and ultimately determine when delisting is appropriate. The following four primary elements of this strategy will provide information required to evaluate progress toward the recovery criteria:

Monitoring of spotted owl population trend

Currently, this monitoring is done with a network of demographic study areas, but trends could be monitored by any statistically reliable method. Recognizing that the demographic study areas are costly, it is recommended that, in the absence of another method that would provide trend data at an improved cost-effectiveness, these existing study areas be continued, while other methods are piloted and tested. The studies provide territory-specific demographic data that provide the basis for many of the current and proposed studies of spotted owl ecology. Also, because the demographic study areas have been functioning for approximately two decades, they allow trend estimates in the near term that would not be available for a considerable length of time if new methods were implemented. Given the immediacy of the barred owl threats, the demographic study areas provide a timely opportunity to conduct barred owl control research.

Inventory of spotted owl distribution

When trend data indicate that populations are stable or increasing in the provinces specified in Recovery Criterion 2, sampling would then be required to determine whether 80 percent of the MOCA 1s in each State supported at least 15 occupied spotted owl sites. This sampling is only a means of evaluating whether the spotted owl population is well distributed as required in Recovery Criterion 3 and should not be construed as a means of measuring population abundance. Once a MOCA 1 is determined to contain at least 15 occupied spotted owl sites, no further sampling would be required within the 5-year time frame to meet Criterion 2 (i.e., sampling does not need to provide the total number of occupied spotted owl sites within the MOCA).

Assessment of the quantity and quality of spotted owl habitat within the MOCAs

This will be required to evaluate when proportions of suitable nesting and roosting habitat have met the province-specific levels identified in the habitat criterion.

A comprehensive program of barred owl research and monitoring

This is needed to experimentally determine the effects on spotted owls of competition with barred owls and to incorporate this information into management to reduce negative effects to a level that would promote recovery.

Recovery Goal

The goal of this Recovery Plan is to recover the spotted owl such that it can be removed from the list of threatened or endangered species.

Recovery Objectives

The objectives of this Recovery Plan are as follows:

- Spotted owl populations are sufficiently large and distributed such that the species no longer requires listing under the ESA.

- Adequate habitat is available for spotted owls and will continue to exist to allow the species to survive without the protection of the ESA.
- Evidence demonstrates that the effects of threats have been reduced or eliminated such that spotted owl populations are stable or increasing and spotted owls are unlikely to become threatened again in the foreseeable future.

III. Recovery Strategy, Recovery Goal, and Recovery Objectives (*Option 2*)

Recovery Strategy

In 2007, the greatest range-wide threats to the spotted owl were identified as competition from barred owls, loss of habitat amount and distribution as a result of past activities and disturbances, and ongoing habitat loss as a result of timber harvest.

To address these key threats, a recovery strategy was created that has three essential elements:

- Targeted research and management efforts to address the increasing threat from the barred owl
- A network of core habitat areas of sufficient spacing, size, distribution and management to allow spotted owls to move and persist across their range given that, “based on existing knowledge, *large continuous blocks of suitable habitat are still viewed as necessary for the Northern Spotted Owl*” (Franklin and Courtney 2004:15; emphasis in original)
- Multi-faceted monitoring to provide the information needed for adaptive management and to determine when recovery criteria for population trend, distribution, and habitat have been met

The likelihood of implementing recovery actions will be increased if an inter-organizational NSO Work Group that includes State, Federal, and non-governmental representatives is formed. Such a group would coordinate implementation of all actions necessary to meet the recovery objectives. While this Recovery Plan applies only to the U.S. portion of the spotted owl’s range, communication and coordination with British Columbia, Canada, is encouraged.

Barred Owl

The barred owl constitutes a significantly greater threat to spotted owl recovery than was envisioned at the time of listing (see Recovery Criterion 1). Because the

Because the range and number of barred owls are expanding rapidly, our effectiveness in addressing this threat depends on immediate action.

range and number of barred owls are expanding rapidly, the effectiveness in addressing this threat depends on immediate action. If the spotted owl is extirpated from portions of its range, it may take decades for an area to be reoccupied. As a result, it is recommended that specific actions to address the barred owl threat begin immediately.

If a determination is made that a reduction in the effect of barred owls on spotted owls is not feasible, priorities and implementation of other actions will be reevaluated.

Habitat

The following brief description of the basis of the recovery strategy concerning habitat is excerpted from Appendix F.

Previous Recovery Efforts

This recovery strategy builds on concepts and information presented by the Interagency Scientific Committee (ISC) in “A Conservation Strategy for the Northern Spotted Owl” (Thomas *et al.* 1990) and the 1992 Final Draft Recovery Plan for the Northern Spotted Owl (USFWS 1992) which focused on: managing large blocks of habitat in designated conservation areas throughout the range of the spotted owl that could support self-sustaining populations of 15 to 20 pairs of spotted owls; and spacing the blocks and managing the areas between them to permit movement of spotted owls. To this end, the ISC delineated and mapped a network of 193 Habitat Conservation Areas (HCAs). The 192 Designated Conservation Areas (DCAs) in the 1992 Draft Recovery Plan were modifications of the HCAs from the ISC. In 1994, the NWFP amended 26 LRMPs to provide a network of land-use allocations identified as LSRs to provide habitat for late-successional forest species, including the spotted owl (Davis and Lint 2005). The 2004 Scientific Evaluation of the Status of the Northern Spotted Owl (Courtney *et al.* 2004) acknowledged that this conservation strategy of reserves was based on sound scientific principles which have not substantially changed since the species was listed.

While the basic notion of spotted owl use of mid-seral and late-seral forests is still supported, some new studies have found that a mixture of mid- and late-seral forests with early seral (prey-producing) and non-forest components improved owl productivity and survival.

Current Recovery Plan (2007)

Historical work on spotted owl habitat needs was reviewed, finding that, while the basic notion of spotted owl use of mid-seral and late-seral forests is still supported, some new studies have led to a better understanding of the importance of the juxtaposition of spotted owl nesting and roosting habitats with non-nesting habitats in the southern portion of the species’ range, as noted in the habitat characteristics section (Franklin *et al.* 2000, Olson *et al.* 2004).

The 2007 Recovery Plan proposes a network of habitat blocks of spotted owl pairs on Federal lands. This network will be designed to support a stable number of breeding pairs of owls over time and allow for movement of owls across the network. CSAs will support the network and assist in achieving the recovery criteria.

Rule Set to Guide the Designation of Habitat Blocks

A network of blocks of spotted owl habitat is to be identified that would support clusters of reproducing spotted owls. These blocks are to be spaced so that spotted owls would be capable of moving between them both within provinces and between provinces. The habitat blocks are the areas where breeding pairs of spotted owls are expected to persist in order to recover the species (Appendix F).

The blocks are directly tied to recovery criteria, and they are the areas where monitoring will be implemented to determine whether, at some future time, delisting is warranted. The number, size and spacing of the habitat blocks will be determined by Federal land management agencies following the principles of conservation biology (Thomas *et al.* 1990). The blocks will account for current habitat conditions, and their size and placement will be decided upon using the rule set described in this section.

In designating size and placement of habitat blocks, province-specific proportions of spotted owl nesting, roosting, and foraging habitat should be maintained or developed to support breeding spotted owls. Time and silvicultural techniques and practices are to be used to restore spotted owl habitat and accelerate habitat development. Any salvage activities carried out within the habitat blocks should retain sufficient habitat structure so as to not significantly delay development of suitable nesting habitat (see Recovery Action 22 and Appendix E).

The sizes of large habitat blocks, overall distribution of the large and small habitat blocks, and distances between large and small habitat blocks used in this rule set follow recommendations and results in the available scientific literature, as presented in Appendix F. Acres within blocks are spotted owl habitat-capable acres on Federal lands. When locating blocks, Tribal lands are not considered to be Federal lands.

A. In the

- **East Cascades and West Cascades Provinces of Washington and Oregon**
 - **Klamath Provinces of Oregon and California**
 - **Coast Range Province of Oregon**
 - **Cascades Province of California**
- 1) Designate large habitat blocks, designed to support 20 pairs of spotted owls, to be no farther apart than 12 miles from their nearest large-block neighbor at their nearest points (see Appendix F for specific direction to determine the specific size of the large and small habitat blocks).
 - 2) Designate small habitat blocks, designed to support 1–19 pairs, to be no farther than 7 miles from their nearest neighbor at their nearest points. Smaller habitat blocks should be closer to other habitat blocks to increase the likelihood that dispersing spotted owls find the smaller blocks.

- 3) Establish a large habitat block whenever possible, when the geographic vicinity for adding a habitat block to the network is determined using the spacing criteria above. If adding a large habitat block is not possible, establish a small habitat block with as large a carrying capacity as the available habitat-capable acres and spacing requirements allow.
- 4) Block-spacing as described above is the primary factor in determining the geographic vicinity for location of a given block in the network. Once in the vicinity of where a block will be located, the specific locations of individual habitat blocks should follow these prioritized rules:
 - a. Include habitat-capable acres that occur within Congressionally Reserved Areas or Administratively Withdrawn Areas (e.g., designated Wilderness Areas, National Parks, Natural Areas), if present; and
 - b. Be as compact (i.e., have the smallest perimeter) and contiguous as the pattern of habitat-capable acres in the vicinity allows, given Rule 3(a); and
 - c. Include as many as possible acres of currently suitable habitat in Federal lands and as many known locations of spotted owls as possible, given Rule 3(a).
- 5) In each of the above provinces except the California Cascades and that portion of the Klamath Province in California that is east of the Trinity Alps wilderness, at least 60% of the large and small habitat blocks are to be within the distance limits of at least three other habitat blocks, and at least one of the other three blocks is to be a large habitat block.

This is to assure distribution of the habitat block network across the range of the spotted owl. The ability to create large habitat blocks in these excepted areas is restricted given the limited amount of available Federal lands.

- 6) Designate two habitat blocks, one in each of two adjoining provinces, which meet the prescribed distance limits from each other, ensuring at least one of the two habitat blocks is a large block. Strive for multiple connections between adjacent provinces.

This is to provide for spotted owl movement between provinces, facilitating demographic interaction and genetic interchange among provinces.

B. In the Olympic Peninsula Province of Washington

Due to the unique geographic location and pattern of federal ownership of the Olympic Peninsula:

- 1) Use all habitat-capable acres under the management of the National Park Service, except those in the coastal strip, to provide the large habitat block network on the Olympic Peninsula.
- 2) Establish small habitat blocks on National Forest lands surrounding the Olympic National Park by following these prioritized rules:
 - a. When adding small habitat blocks on national forest lands, use the 7-mile spacing criterion and select blocks that are no farther than 7 miles from
 - (1) The national park boundary; and
 - (2) Another small block that abuts the park boundary; and
 - (3) Other small habitat blocks.
 - b. Select areas for small habitat blocks, given the spacing criteria, that are as compact (have the smallest perimeter) and contiguous as the pattern of habitat-capable acres in the vicinity allows, and include as many of the acres of currently suitable habitat in Federal lands and known owl locations as possible in the vicinity where the block is to be located.
- 3) Do not include considerations for connectivity to other provinces.
- 4) Do not be concerned with any percentage of habitat blocks that need to be within the distance limits of any number of other habitat blocks.

C. In the Coast Province in California

Due to the relatively low amount of Federal ownership and the pattern of land ownership in the Coast province of California:

- 1) Use all the habitat-capable acres under the management of the National Park Service and other Congressionally Reserved Areas and Administratively Withdrawn Areas managed by the BLM to provide the large and small habitat blocks on Federal lands in this province.
- 2) Do not include considerations for intra-province or inter-provincial connectivity on Federal lands beyond those produced by the network of blocks for adjacent provinces.
- 3) Do not be concerned with any percentage of habitat blocks that need to be within the distance limits of any other habitat block.

Monitoring and Research

We recommend that a program of research and monitoring be implemented to track progress toward recovery, inform changes in recovery strategy by a process of adaptive management, and ultimately determine when delisting is appropriate is recommended. The following four primary elements of this strategy will provide information required to evaluate progress toward the recovery criteria:

Monitoring of spotted owl population trend. Currently, this monitoring is done with a network of demographic study areas, but trends could be monitored by any statistically reliable method. Recognizing that the demographic study areas are costly, it is recommended that, in the absence of another method that would provide trend data at an improved cost-effectiveness, these existing study areas be continued, while other methods are piloted and tested. The studies provide territory-specific demographic data that provide the basis for many of the current and proposed studies of spotted owl ecology. Also, because the demographic study areas have been functioning for approximately two decades, they allow trend estimates in the near term that would not be available for a considerable length of time if new methods were implemented. Given the immediacy of the barred owl threats, the demographic study areas provide a timely opportunity to conduct barred owl control research.

Inventory of spotted owl distribution. When trend data indicate that populations are stable or increasing in the provinces specified in Recovery Criterion 2, sampling would then be required to determine whether 80 percent of the large habitat blocks in each State supported at least 15 occupied spotted owl sites. This sampling is only a means of evaluating whether the spotted owl population is well distributed as required in Recovery Criterion 3 and should not be construed as a means of measuring population abundance. Once a large habitat block is determined to contain at least 15 occupied spotted owl sites, no further sampling would be required within the 5-year time frame to meet Criterion 2 (i.e., sampling does not need to provide the total number of occupied spotted owl sites within the large habitat blocks).

Assessment of the quantity and quality of spotted owl habitat within large habitat blocks. This will be required to evaluate when proportions of suitable nesting and roosting habitat have met the province-specific levels identified in the habitat criterion.

A comprehensive program of barred owl research and monitoring. This is needed to experimentally determine the effects on spotted owls of competition with barred owls and to incorporate this information into management to reduce negative effects to a level that would promote recovery.

Recovery Goal

The goal of this Recovery Plan is to recover the spotted owl such that it can be removed from the list of threatened or endangered species.

Recovery Objectives

The objectives of this Recovery Plan are as follows:

- Spotted owl populations are sufficiently large and distributed such that the species no longer requires listing under the ESA.

- Adequate habitat is available for spotted owls and will continue to exist to allow the species to survive without the protection of the ESA.
- Evidence demonstrates that the effects of threats have been reduced or eliminated such that spotted owl populations are stable or increasing and spotted owls are unlikely to become threatened again in the foreseeable future.

IV. Implementation Schedule and Cost Estimates (*Option 1*)

Recovery plans are intended to assist the Service and other stakeholders in planning and implementing actions to recover or protect threatened or endangered species. The following implementation schedule outlines the actions, priority number, duration, potential stakeholders, responsible agencies, and estimated costs for the recovery program for the spotted owl, as set forth in this Recovery Plan. It is a guide for planning and meeting the objectives discussed in this Plan.

It is believed recovery of the spotted owl could be accomplished in as little as 30 years if the Recovery Plan is fully implemented, particularly those high-priority actions to keep the species from becoming endangered (Priority 1). It is acknowledged there is significant uncertainty surrounding this estimate. The timeline is based on the development of sufficient habitat and successful management of the barred owl.

The estimated date of recovery for the spotted owl is 2037, provided that funds are available to accomplish the required recovery actions and that the recovery criteria are met. The implementation schedule outlines recovery actions and their estimated costs for the first 5 years of this recovery program. The costs are broad estimates and identify foreseeable expenditures that could be made to implement the specific recovery actions during a 5-year period. Actual expenditures by identified agencies and other partners will be contingent upon appropriations and other budgetary constraints.

The actions identified in the implementation schedule are those that, in our opinion, should bring about the recovery of this species. However, the actions are subject to modification as dictated by new findings, changes in the species' status, and the completion of other recovery actions. The priority for each action is assigned as follows:

Priority 1: An action that must be taken to prevent extinction or prevent the species from declining irreversibly in the foreseeable future

Priority 2: An action that must be taken to prevent a significant decline in the species' population/habitat quality or some other significant negative impact short of extinction

Priority 3: All other actions deemed necessary to meet the recovery objectives

The column "Action Duration" indicates whether the action is one of five types. (1) Discrete actions are shown by the number of years estimated to complete the action. (2) Continuous actions are to be implemented annually once begun. (3), Ongoing actions are currently being implemented and will continue until the

action is no longer necessary. (4) Intermittent actions are to be implemented as needed. (5) "TBD" (to be determined) actions are those for which the duration was impossible to estimate.

While the ESA assigns a strong leadership role to the Service for the recovery of listed species, it also recognizes the importance of other Federal agencies, States, and other stakeholders in the recovery process. The "responsible parties" identified in the implementation schedule are those partners who can make significant contributions to specific recovery tasks and who may voluntarily participate in any aspect of recovery actions listed. In some cases, the most logical lead agency has been identified with an asterisk. The identification of agencies and other stakeholders in the implementation schedule does not constitute any additional legal responsibilities beyond existing authorities. However, parties willing to participate may benefit by being able to show in their own budgets that their funding request is for a recovery action identified in an approved Recovery Plan and is therefore considered a necessary action for the overall coordinated effort to recover the spotted owl. Also, Section 7(a)(1) of the ESA directs all Federal agencies to use their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of threatened and endangered species.

We have listed the agencies and other parties that we believe are the primary stakeholders in the recovery process, and have the authority, responsibility, or expressed interest to implement a specific recovery action. However, the list of possible stakeholders is not limited to the parties below; other stakeholders are invited to participate.

The following abbreviations are used to indicate the responsible party for each recovery action:

BLM	Bureau of Land Management
CDF	California Department of Forestry and Fire Protection
CDFG	California Department of Fish and Game
CDP&R	California Department of Parks and Recreation
DoD	U.S. Army Corps of Engineers, Department of Defense
FS	U.S. Forest Service
Land managers	Non-Federal land managers
Landowners	Private landowners
NPS	National Park Service
NSO WG	Inter-organizational Northern Spotted Owl Working Group
ODF	Oregon Department of Forestry
States	State governments of Washington, Oregon, and California
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WDNR	Washington Department of Natural Resources
WFPB	Washington Forest Practices Board

Implementation Schedule and Cost Estimates for Draft Recovery Plan for Spotted Owl

Cost Estimate Assumptions

1. Estimates include Federal government reimbursement of travel and per-diem costs of non-governmental employees to participate in recovery actions.
2. Responsible parties include both organizations that carry out the activity and organizations that fund the activity.
3. The cost of each action is estimated independently, unless otherwise noted.
4. The opportunity cost of managing these lands for spotted owls instead of other uses is not included in this analysis.
5. Actions to reduce the risk of high-severity fire or to manage habitat are implemented for multiple reasons, one of which is to support habitat for the spotted owl. So, it is inaccurate to attribute the entire cost of fire risk reduction or habitat management to spotted owl recovery. We estimate only a portion (we use 10 percent) of the costs associated with fire risk reduction and habitat management can be attributed directly to spotted owl recovery.

For most of the actions identified in this Plan, there is no way of deriving a precise estimate of costs. A variety of assumptions were used to produce these estimates. For actions that called for meetings or formation of workgroups, the recovery team assumed the cost of meetings based on the current cost of a single recovery team meeting. For research and monitoring related actions, current similar research or monitoring projects were used as surrogates to estimate these costs. In some cases, researchers were asked to estimate the cost of a particular study or monitoring program.

Several actions call for habitat modification to benefit the spotted owl. These comprise two categories: actions that called for modification of existing practices to benefit the spotted owl, and actions that called for specific types of management. For modifications, the cost of adjusting the action during planning was estimated, rather than the actual cost of implementing the project. In these instances, the cost of conducting the ESA section 7 consultation was used as a surrogate for the cost of modifying an action; this was represented by the estimated cost of a single Level 1 interagency consultation team meeting, under the Streamlined Consultation Procedures. For the actions that call for specific management, actual estimates for conducting a given type of management were used, but the cost attributable to spotted owl recovery was set at 10 percent of this total cost. To complete the estimates for habitat-related actions, base

numbers were obtained using the FS and BLM's 2006 costs and accomplishments within the range of the spotted owl.

The costs are broad estimates and identify foreseeable expenditures that could be made to implement the specific recovery actions. Actual expenditures by identified agencies and other partners will be contingent upon appropriations and other budgetary constraints. There are no Recovery Actions for Listing Factor B: Overutilization for commercial, scientific, or educational purposes.

Priority No.	Action No.	Action Description	Action Duration	Resp. Parties (* = lead)	FY Cost Estimate (in \$1,000s)						
					Total	2007	2008	2009	2010	2011	
3	1	Establish an inter-organizational spotted owl working group ("NSO Work Group") to coordinate implementation of the Recovery Plan.	Continuous	USFWS	180	6	6	6	6	6	6
Listing Factor A: The present or threatened destruction, modification, or curtailment of the species' habitat or range											
3	16	Conduct habitat inventory to determine if Recovery Criterion 4 has been met.	Start at year 10, then intermittent	FWS, FS, BLM, NPS	180	0	0	0	0	0	0
3	17	Using a collaborative process, standardize province-specific habitat definitions across the range of the spotted owl.	2 years	NSO WG	120	60	60	0	0	0	0
3	18	Develop and implement a spotted owl habitat conservation education program to provide understanding of recovery needs.	Continuous	FWS	50	15	5	1	1	1	1
3	19	Encourage applicants to develop HCPs/SHAs that are consistent with the recovery objectives.	Continuous 1 st 10 yrs, intermittent thereafter	FWS	4,000	400	400	400	400	400	400
3	20	Evaluate the effect of wildfire and subsequent treatments on spotted owl habitat and their prey.	5 years	FS, BLM, FWS	141	0	104	74	74	74	30

Priority No.	Action No.	Action Description	Action Duration	Resp. Parties (* = lead)	FY Cost Estimate (in \$1,000s)						
					Total	2007	2008	2009	2010	2011	
2	21	Manage habitat-capable acres in both categories of MOCAs at levels that meet or exceed Recovery Criterion 4 percentages.	Continuous	FS, BLM, NPS	12,000	400	400	400	400	400	400
3	22	Using the best available scientific information, including LSR Assessments (LSRAs) as applicable, salvage activities should retain habitat structure (i.e., legacy components) of a quantity and quality so as not to significantly increase the length of time necessary for a spotted owl home-range sized area centered on the salvage area to reach the habitat criterion habitat levels.	Continuous	FS, BLM	240	8	8	8	8	8	8
2	23	Identify and restore (by silviculture and time) the habitat-capable acres in the MOCAs that are not currently in the desired habitat condition to support owl pairs.	Ongoing	FS, BLM, NPS	12,000	400	400	400	400	400	400

Priority No.	Action No.	Action Description	Action Duration	Resp. Parties (* = lead)	FY Cost Estimate (in \$1,000s)					
					Total	2007	2008	2009	2010	2011
2	24	In the MOCAs, implement the applicable silviculture principles/ guidelines from applicable LRMPs to accelerate development of spotted owl habitat to achieve Recovery Criterion 1.	Continuous	FS, BLM	12,000	400	400	400	400	400
2	25	Within MOCAs in the fire-prone portion of the Western Oregon Cascades (i.e., MOCA #22 and #17), Eastern Cascade provinces of Washington and Oregon, and Klamath provinces of Oregon and California, and California Cascades, manage stands in accordance with the appropriate LRMP standards and guidelines to reduce the risk of fire that causes habitat loss within MOCAs.	Ongoing	FS, BLM, NPS	12,000	400	400	400	400	400
2	26	Maintain all the existing nesting-quality stands within MOCAs in the Westside provinces or non-fire-prone provinces.	Continuous	FS, BLM, NPS	0	0	0	0	0	0
3	27	Recognize designated CSAs in Washington.	1 yr	WFPB*, landowners, land managers	6	6	0	0	0	0

Priority No.	Action No.	Action Description	Action Duration	Resp. Parties (* = lead)	FY Cost Estimate (in \$1,000s)					
					Total	2007	2008	2009	2010	2011
3	28	Using a collaborative process, create and adopt measurable habitat objectives for use in landscape planning within the CSAs, using the habitat definitions developed by Recovery Action 17.	2 years	WFPB, WDNR, land managers, landowners	200	100	100	0	0	0
3	29	In all Oregon CSAs, encourage the development of habitat for dispersal of spotted owls between MOCAs and/or provinces.	Continuous	ODF*, FS, BLM, landowner	2,400	80	80	80	80	80
3	30	In CSAs in CA, encourage the continued provision of habitat to support reproducing pairs of spotted owls.	Continuous	CDF*, CDP&R, DOD, CDFG, Marin Water Dist, landowners	2,400	80	80	80	80	80
2	31	Outside of the MOCAs in the fire-prone provinces (see Recovery Action 25), based on plant association group and fire regime types, strategically (geographically and topographically) modify fuels and stand structure to assist in the suppression of wildfires to decrease the risk of wildfire spread into the MOCAs.	Ongoing	FS, BLM, NPS, WDNR, ODF, CDF, landowners	28,500	950	950	950	950	950

Priority No.	Action No.	Action Description	Action Duration	Resp. Parties (* = lead)	FY Cost Estimate (in \$1,000s)					
					Total	2007	2008	2009	2010	2011
3	32	Conduct experiments on forest management outside of MOCAs to better understand relationship between habitat and spotted owl fitness, including the effects of fire and silviculture on suitable habitat and spatial pattern.	5 years	FS, BLM, FWS, NPS, WDNR, ODF, CDF, CDFG, landowners	5,250	1,750	1,250	1,250	500	500
2	33	Research effects of land management on prey ecology and prey relationships to their environment.	4 years	FS, BLM, FWS, NPS, WDNR, ODF, CDF, CDFG, landowners	3,950	2,000	1,250	1250	1250	0
Listing Factor C: Disease or predation										
3	37	Monitor avian diseases (e.g., WNV, avian flu) and develop a contingency plan.	Continuous	NSO WG	300	10	10	10	10	10
Listing Factor D: Inadequacy of existing regulatory mechanisms										
2	34	Manage Federal forest-capable landscapes outside of MOCAs to support spotted owl dispersal among MOCAs.	Continuous	FS, BLM	1,920	64	64	64	64	64
3	35	Streamline process for a landowner gaining approval of an HCP and SHA.	3 years	FWS	90	30	30	30	0	0
3	36	Determine that a delisting monitoring plan has been developed and is ready for implementation within the States of WA, OR, & CA (ESA 4(g)(1)).	TBD	FWS	10	0	0	0	0	0
Listing Factor E: Other natural or manmade factors affecting its continued existence										

Priority No.	Action No.	Action Description	Action Duration	Resp. Parties (* = lead)	FY Cost Estimate (in \$1,000s)					
					Total	2007	2008	2009	2010	2011
3	13	Continue monitoring population trend to determine if population is decreasing, stationary, or increasing.	Ongoing	FWS, FS, BLM*, NPS, NSO WG	69,000	2,300	2,300	2,300	2,300	2,300
3	14	Conduct occupancy inventory needed to determine if Recovery Criterion 2 has been met.	Start TBD, intermittent thereafter	NSO WG	4,000	0	0	0	0	0
3	15	Outside MOCA 1s, encourage surveying or monitoring of spotted owls, and the sharing of data gathered to appropriate databases.	Intermittent	NSO WG	1,200	40	40	40	40	40
1	3	Establish a working group of entities involved with barred owl research and management (Federal and State agencies, Tribes, timber industry, universities, and non-governmental organizations) that would coordinate actions relative to barred owl research, management, and public outreach.	Continuous for 1 st 10 years, intermittent thereafter	FWS	70	12	6	6	6	6
3	4	Analyze existing data sets from the demographic study areas relative to effects of barred owls on spotted owl site occupancy, reproduction, and survival.	1 year	FWS, FS, BLM, NPS	190	190	0	0	0	0

Priority No.	Action No.	Action Description	Action Duration	Resp. Parties (* = lead)	FY Cost Estimate (in \$1,000s)					
					Total	2007	2008	2009	2010	2011
2	5	Analyze habitat use and possible habitat and resource partitioning of sympatric barred owls and spotted owls.	5 years	USGS, FS, FWS, NPS, BLM	1,820	190	510	440	440	120
1	6	Estimate the relative densities of barred owls and spotted owls at which negative effects to spotted owls occur to such a degree to prohibit achievement of Recovery Criteria 1 and 2, and experimentally assess the effects of removal of barred owls on spotted owl site occupancy, reproduction, and survival.	5 years	TBD	3,000	600	600	600	600	600
2	7	Incorporate presence of barred owl into ongoing spotted owl monitoring.	Continuous	FWS, FS, BLM, NPS	9,600	320	320	320	320	320
1	2	Manage to minimize negative effects of barred owl on sympatric spotted owls.	Start time TBD, continuous once started	FS, BLM, NPS, States, FWS, landowners	11,800	0	0	0	0	0
2	8	Create and implement an outreach strategy to educate the public about the barred owl threat to spotted owl, to support associated research and management.	Continuous	FWS	50	15	5	1	1	1
1	9	Recommend that permitting of experimental removal of barred owls be given high priority at Federal and State levels.	1 year	FWS, States	6	6	0	0	0	0

Priority No.	Action No.	Action Description	Action Duration	Resp. Parties (* = lead)	FY Cost Estimate (in \$1,000s)					
					Total	2007	2008	2009	2010	2011
3	10	Evaluate effectiveness of existing spotted owl detection survey protocols, and correct any deficiencies.	2 years	FWS*, BLM, FS, NPS, States, landowners	200	100	100	0	0	0
3	11	Evaluate practice of using spotted owl surveys to declare sites unoccupied.	2 years	FWS*, States, landowners	9	9	0	0	0	0
2	12	Using a collaborative process including landowners and land managers, create incentives to encourage the development and support of spotted owl habitat, and develop mechanisms so that there is not an incentive for landowners to oppose barred owl management.	2 years to create; implementation continuous once created	FWS*, FS, BLM, NPS, States, landowners	12	6	6	0	0	0
Total for all actions					198,894					

IV. Implementation Schedule and Cost Estimates (*Option 2*)

Recovery plans are intended to assist the Service and other stakeholders in planning and implementing actions to recover or protect threatened or endangered species. The following implementation schedule outlines the actions, priority number, duration, potential stakeholders, responsible agencies, and estimated costs for the recovery program for the spotted owl, as set forth in this Recovery Plan. It is a guide for planning and meeting the objectives discussed in this Plan.

It is believed recovery of the spotted owl could be accomplished in as little as 30 years if the Recovery Plan is fully implemented, particularly those high-priority actions to keep the species from becoming endangered (Priority 1). It is acknowledged there is significant uncertainty surrounding this estimate. The timeline is based on the development of sufficient habitat and successful management of the barred owl.

The estimated date of recovery for the spotted owl is 2037, provided that funds are available to accomplish the required recovery actions and that the recovery criteria are met. The implementation schedule outlines recovery actions and their estimated costs for the first 5 years of this recovery program. The costs are broad estimates and identify foreseeable expenditures that could be made to implement the specific recovery actions during a 5-year period. Actual expenditures by identified agencies and other partners will be contingent upon appropriations and other budgetary constraints.

The actions identified in the implementation schedule are those that, in our opinion, should bring about the recovery of this species. However, the actions are subject to modification as dictated by new findings, changes in the species' status, and the completion of other recovery actions. The priority for each action is assigned as follows:

Priority 1: An action that must be taken to prevent extinction or prevent the species from declining irreversibly in the foreseeable future

Priority 2: An action that must be taken to prevent a significant decline in the species' population/habitat quality or some other significant negative impact short of extinction

Priority 3: All other actions deemed necessary to meet the recovery objectives

The column "Action Duration" indicates whether the action is one of five types. (1) Discrete actions are shown by the number of years estimated to complete the action. (2) Continuous actions are to be implemented annually once begun. (3), Ongoing actions are currently being implemented and will continue until the

action is no longer necessary. (4) Intermittent actions are to be implemented as needed. (5) "TBD" (to be determined) actions are those for which the duration was impossible to estimate.

While the ESA assigns a strong leadership role to the Service for the recovery of listed species, it also recognizes the importance of other Federal agencies, States, and other stakeholders in the recovery process. The "responsible parties" identified in the implementation schedule are those partners who can make significant contributions to specific recovery tasks and who may voluntarily participate in any aspect of recovery actions listed. In some cases, the most logical lead agency has been identified with an asterisk. The identification of agencies and other stakeholders in the implementation schedule does not constitute any additional legal responsibilities beyond existing authorities. However, parties willing to participate may benefit by being able to show in their own budgets that their funding request is for a recovery action identified in an approved Recovery Plan and is therefore considered a necessary action for the overall coordinated effort to recover the spotted owl. Also, Section 7(a)(1) of the ESA directs all Federal agencies to use their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of threatened and endangered species.

We have listed the agencies and other parties that we believe are the primary stakeholders in the recovery process, and have the authority, responsibility, or expressed interest to implement a specific recovery action. However, the list of possible stakeholders is not limited to the parties below; other stakeholders are invited to participate.

The following abbreviations are used to indicate the responsible party for each recovery action:

BLM	Bureau of Land Management
CDF	California Department of Forestry and Fire Protection
CDFG	California Department of Fish and Game
CDP&R	California Department of Parks and Recreation
DoD	U.S. Army Corps of Engineers, Department of Defense
FS	U.S. Forest Service
Land managers	Non-Federal land managers
Landowners	Private landowners
NPS	National Park Service
NSO WG	Inter-organizational Northern Spotted Owl Working Group
ODF	Oregon Department of Forestry
States	State governments of Washington, Oregon, and California
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WDNR	Washington Department of Natural Resources
WFPB	Washington Forest Practices Board

Implementation Schedule and Cost Estimates for Draft Recovery Plan for Spotted Owl

Cost Estimate Assumptions

1. Estimates include Federal government reimbursement of travel and per-diem costs of non-governmental employees to participate in recovery actions.
2. Responsible parties include both organizations that carry out the activity and organizations that fund the activity.
3. The cost of each action is estimated independently, unless otherwise noted.
4. The opportunity cost of managing these lands for spotted owls instead of other uses is not included in this analysis.
5. Actions to reduce the risk of high-severity fire or to manage habitat are implemented for multiple reasons, one of which is to support habitat for the spotted owl. So, it is inaccurate to attribute the entire cost of fire risk reduction or habitat management to spotted owl recovery. We estimate only a portion (we use 5 percent) of the costs associated with fire risk reduction and habitat management can be attributed directly to spotted owl recovery.

For most of the actions identified in this Plan, there is no way of deriving a precise estimate of costs. A variety of assumptions were used to produce these estimates. For actions that called for meetings or formation of workgroups, we assumed the cost of meetings based on the current cost of a single recovery team meeting. For research and monitoring related actions, current similar research or monitoring projects were used as surrogates to estimate these costs. In some cases, researchers were asked to estimate the cost of a particular study or monitoring program.

Several actions call for habitat modification to benefit the spotted owl. These comprise two categories: actions that called for modification of existing practices to benefit the spotted owl, and actions that called for specific types of management. For modifications, the cost of adjusting the action during planning was estimated, rather than the actual cost of implementing the project. In these instances, the cost of conducting the ESA section 7 consultation was used as a surrogate for the cost of modifying an action; this was represented by the estimated cost of a single Level 1 interagency consultation team meeting, under the Streamlined Consultation Procedures. For the actions that call for specific management, actual estimates for conducting a given type of management were used, but the cost attributable to spotted owl recovery was set at 10 percent of this total cost. To complete the estimates for habitat-related actions, base

numbers were obtained using the FS and BLM's 2006 costs and accomplishments within the range of the spotted owl.

The costs are broad estimates and identify foreseeable expenditures that could be made to implement the specific recovery actions. Actual expenditures by identified agencies and other partners will be contingent upon appropriations and other budgetary constraints. There are no Recovery Actions for Listing Factor B: Overutilization for commercial, scientific, or educational purposes.

Priority No.	Action No.	Action Description	Action Duration	Resp. Parties (* = lead)	FY Cost Estimate (in \$1,000s)					
					Total	2007	2008	2009	2010	2011
3	1	Establish an inter-organizational spotted owl working group ("NSO Work Group") to coordinate implementation of the Recovery Plan.	Continuous	USFWS	180	6	6	6	6	6
Listing Factor A: The present or threatened destruction, modification, or curtailment of the species' habitat or range										
3	16	Conduct habitat inventory to determine if Recovery Criterion 4 has been met.	Start at year 10, then intermittent	FWS, FS, BLM, NPS	180	0	0	0	0	0
3	17	Using a collaborative process, standardize province-specific habitat definitions across the range of the spotted owl.	2 years	NSO WG	120	60	60	0	0	0
3	18	Develop and implement a spotted owl habitat conservation education program to provide understanding of recovery needs.	Continuous	FWS	50	15	5	1	1	1
3	19	Encourage applicants to develop HCPs/SHAs that are consistent with the recovery objectives.	Continuous 1 st 10 yrs, intermittent thereafter	FWS	4,000	400	400	400	400	400
3	20	Evaluate the effect of wildfire and subsequent treatments on spotted owl habitat and their prey.	5 years	FS, BLM, FWS	141	0	104	74	74	30
2	21	Manage habitat-capable acres in both categories of habitat blocks at levels that meet or exceed Recovery Criterion 4 percentages.	Continuous	FS, BLM, NPS	12,000	400	400	400	400	400

Priority No.	Action No.	Action Description	Action Duration	Resp. Parties (* = lead)	FY Cost Estimate (in \$1,000s)					
					Total	2007	2008	2009	2010	2011
3	22	Using the best available scientific information, including LSR Assessments (LSRAs) as applicable, salvage activities should retain habitat structure (i.e., legacy components) of a quantity and quality so as not to significantly increase the length of time necessary for a spotted owl home-range sized area centered on the salvage area to reach the habitat criterion habitat levels.	Continuous	FS, BLM	240	8	8	8	8	8
2	23	Identify and restore (by silviculture and time) the habitat-capable acres in the habitat blocks that are not currently in the desired habitat condition to support owl pairs.	Ongoing	FS, BLM, NPS	12,000	400	400	400	400	400

Priority No.	Action No.	Action Description	Action Duration	Resp. Parties (* = lead)	FY Cost Estimate (in \$1,000s)					
					Total	2007	2008	2009	2010	2011
2	24	In the habitat blocks, implement the applicable silviculture principles/ guidelines from applicable LRMPS to accelerate development of spotted owl habitat to achieve Recovery Criterion 1.	Continuous	FS, BLM	12,000	400	400	400	400	400
2	25	Within habitat blocks in the fire-prone portion of the Western Oregon Cascades, Eastern Cascade provinces of Washington and Oregon, and Klamath provinces of Oregon and California, and California Cascades, manage stands in accordance with the appropriate LRMPS standards and guidelines to reduce the risk of fire that causes habitat loss within habitat blocks.	Ongoing	FS, BLM, NPS	12,000	400	400	400	400	400
2	26	Maintain all the existing nesting-quality stands within habitat blocks in the Westside provinces or non-fire-prone provinces.	Continuous	FS, BLM, NPS	0	0	0	0	0	0
3	27	Recognize designated CSAs in Washington.	1 yr	WFPB*, landowners, land managers	6	6	0	0	0	0

Priority No.	Action No.	Action Description	Action Duration	Resp. Parties (* = lead)	FY Cost Estimate (in \$1,000s)					
					Total	2007	2008	2009	2010	2011
3	28	Using a collaborative process, create and adopt measurable habitat objectives for use in landscape planning within the CSAs, using the habitat definitions developed by Recovery Action 17.	2 years	WFPB, WDNR, land managers, landowners	200	100	100	0	0	0
3	29	In all Oregon CSAs, encourage the development of habitat for dispersal of spotted owls between habitat blocks and/or provinces.	Continuous	ODF*, FS, BLM, landowner	2,400	80	80	80	80	80
3	30	In CSAs in CA, encourage the continued provision of habitat to support reproducing pairs of spotted owls.	Continuous	CDF*, CDP&R, DOD, CDFG, Marin Water Dist, landowners	2,400	80	80	80	80	80
2	31	Outside of the habitat blocks in the fire-prone provinces (see Recovery Action 25), based on plant association group and fire regime types, strategically (geographically and topographically) modify fuels and stand structure to assist in the suppression of wildfires to decrease the risk of wildfire spread into the habitat blocks.	Ongoing	FS, BLM, NPS, WDNR, ODF, CDF, landowners	28,500	950	950	950	950	950

Priority No.	Action No.	Action Description	Action Duration	Resp. Parties (* = lead)	FY Cost Estimate (in \$1,000s)					
					Total	2007	2008	2009	2010	2011
3	32	Conduct experiments on forest management outside of habitat blocks to better understand relationship between habitat and spotted owl fitness, including the effects of fire and silviculture on suitable habitat and spatial pattern.	5 years	FS, BLM, FWS, NPS, WDNR, ODF, CDF, CDFG, landowners	5,250	1,750	1,250	1,250	500	500
2	33	Research effects of land management on prey ecology and prey relationships to their environment.	4 years	FS, BLM, FWS, NPS, WDNR, ODF, CDF, CDFG, landowners	3,950	2,000	1,250	1,250	1,250	0
Listing Factor C: Disease or predation										
3	37	Monitor avian diseases (e.g., WNV, avian flu) and develop a contingency plan.	Continuous	NSO WG	300	10	10	10	10	10
Listing Factor D: Inadequacy of existing regulatory mechanisms										
2	34	Manage Federal forest-capable landscapes outside of habitat blocks to support spotted owl dispersal among habitat blocks.	Continuous	FS, BLM	1,920	64	64	64	64	64
3	35	Streamline process for a landowner gaining approval of an HCP and SHA.	3 years	FWS	90	30	30	30	0	0
3	36	Determine that a delisting monitoring plan has been developed and is ready for implementation within the States of WA, OR, & CA (ESA 4(g)(1)).	TBD	FWS	10	0	0	0	0	0
Listing Factor E: Other natural or manmade factors affecting its continued existence										

Priority No.	Action No.	Action Description	Action Duration	Resp. Parties (* = lead)	FY Cost Estimate (in \$1,000s)					
					Total	2007	2008	2009	2010	2011
3	13	Continue monitoring population trend to determine if population is decreasing, stationary, or increasing.	Ongoing	FWS, FS, BLM*, NPS, NSO WG	69,000	2,300	2,300	2,300	2,300	2,300
3	14	Conduct occupancy inventory needed to determine if Recovery Criterion 2 has been met.	Start TBD, intermittent thereafter	NSO WG	4,000	0	0	0	0	0
3	15	Outside large habitat blocks, encourage surveying or monitoring of spotted owls, and the sharing of data gathered to appropriate databases.	Intermittent	NSO WG	1,200	40	40	40	40	40
1	3	Establish a working group of entities involved with barred owl research and management (Federal and State agencies, Tribes, timber industry, universities, and non-governmental organizations) that would coordinate actions relative to barred owl research, management, and public outreach.	Continuous for 1 st 10 years, intermittent thereafter	FWS	70	12	6	6	6	6
3	4	Analyze existing data sets from the demographic study areas relative to effects of barred owls on spotted owl site occupancy, reproduction, and survival.	1 year	FWS, FS, BLM, NPS	190	190	0	0	0	0
2	5	Analyze habitat use and possible habitat and resource partitioning of sympatric barred owls and spotted owls.	5 years	USGS, FS, FWS, NPS, BLM	1,820	190	510	440	440	120

Priority No.	Action No.	Action Description	Action Duration	Resp. Parties (* = lead)	FY Cost Estimate (in \$1,000s)					
					Total	2007	2008	2009	2010	2011
1	6	Estimate the relative densities of barred owls and spotted owls at which negative effects to spotted owls occur to such a degree to prohibit achievement of Recovery Criteria 1 and 2, and experimentally assess the effects of removal of barred owls on spotted owl site occupancy, reproduction, and survival.	5 years	TBD	3,000	600	600	600	600	600
2	7	Incorporate presence of barred owl into ongoing spotted owl monitoring.	Continuous	FWS, FS, BLM, NPS	9,600	320	320	320	320	320
1	2	Manage to minimize negative effects of barred owl on sympatric spotted owls.	Start time TBD, continuous once started	FS, BLM, NPS, States, FWS, landowners	11,800	0	0	0	0	0
2	8	Create and implement an outreach strategy to educate the public about the barred owl threat to spotted owl, to support associated research and management.	Continuous	FWS	50	15	5	1	1	1
1	9	Recommend that permitting of experimental removal of barred owls be given high priority at Federal and State levels.	1 year	FWS, States	6	6	0	0	0	0
3	10	Evaluate effectiveness of existing spotted owl detection survey protocols, and correct any deficiencies.	2 years	FWS* BLM, FS, NPS, States, landowners	200	100	100	0	0	0
3	11	Evaluate practice of using spotted owl surveys to declare sites unoccupied.	2 years	FWS*, States, landowners	9	9	0	0	0	0

Priority No.	Action No.	Action Description	Action Duration	Resp. Parties (* = lead)	FY Cost Estimate (in \$1,000s)					
					Total	2007	2008	2009	2010	2011
2	12	Using a collaborative process including landowners and land managers, create incentives to encourage the development and support of spotted owl habitat, and develop mechanisms so that there is not an incentive for landowners to oppose barred owl management.	2 years to create; implementation continuous once created	FWS*, FS, BLM, NPS, States, landowners	12	6	6	0	0	0
				Total for all actions	198,894					

V. Literature Cited and Personal Communications Cited (*Options 1 and 2*)

Literature Cited

- Anderson, D.R. and K.P. Burnham. 1992. Demographic analysis of northern spotted owl populations. Pages 319–328 *in* Draft final recovery plan for the northern spotted owl. USDI Fish and Wildlife Service, Portland, Oregon.
- Anthony, R.G., E.D. Forsman, A.B. Franklin, D.R. Anderson, K.P. Burnham, G.C. White, C.J. Schwarz, J. Nichols, J.E. Hines, G.S. Olson, S.H. Ackers, S. Andrews, B.L. Biswell, P.C. Carlson, L.V. Diller, K.M. Dugger, K.E. Fehring, T.L. Fleming, R.P. Gerhardt, S.A. Gremel, R.J. Gutiérrez, P.J. Happe, D.R. Herter, J.M. Higley, R.B. Horn, L.L. Irwin, P.J. Loschl, J.A. Reid, and S.G. Sovern. 2004. Status and trends in demography of northern spotted owls, 1985–2003. Final Report to the Interagency Regional Monitoring Program, Portland, Oregon. September 2004. 179 pp.
- Anthony, R.G., E.D. Forsman, A.B. Franklin, D.R. Anderson, K.P. Burnham, G.C. White, C.J. Schwarz, J. Nichols, J.E. Hines, G.S. Olson, S.H. Ackers, S. Andrews, B.L. Biswell, P.C. Carlson, L.V. Diller, K.M. Dugger, K.E. Fehring, T.L. Fleming, R.P. Gerhardt, S.A. Gremel, R.J. Gutiérrez, P.J. Happe, D.R. Herter, J.M. Higley, R.B. Horn, L.L. Irwin, P.J. Loschl, J.A. Reid, and S.G. Sovern. 2006. Status and trends in demography of northern spotted owls, 1985–2003. Wildlife Monograph No. 163.
- Anthony, R.G. and L.S. Andrews. 2004. Summary Report: Winter habitat use by spotted owls on USDI Bureau of Land Management Medford District Lands within the boundaries of the Timbered Rock Fire. Unpublished report, Oregon Cooperative Wildlife Research Unit, Corvallis, Oregon. 29 pp.
- Barrowclough, G.F. and R. J. Gutiérrez. 1990. Genetic variation and differentiation in the spotted owl. *Auk* 107:737–744.
- Barrowclough, G.F., R.J. Gutiérrez, and J.G. Groth. 1999. Phylogeography of spotted owl (*Strix occidentalis*) populations based on mitochondrial DNA sequences; gene flow, genetic structure, and a novel biogeographic pattern. *Evolution* 53:919–931.
- Barrowclough, G.F., J.G. Groth, and R.J. Gutiérrez. 2005. Genetic structure, introgression and a narrow hybrid zone between northern and California spotted owls (*Strix occidentalis*). *Molecular Ecology* 14:1109–1120.
- Bigley, R. and J. Franklin. 2004. Habitat trends. Chapter 6 in S. Courtney (editor), Scientific evaluation of the status of the northern spotted owl. Sustainable Ecosystems Institute, Portland, Oregon.

- Blakesley, J.A., W. LaHaye, J.M.M. Marzluff, B.R. Noon, and S. Courtney. 2004. Demography. Chapter 8 in S. Courtney (editor), *Scientific evaluation of the status of the northern spotted owl*. Sustainable Ecosystems Institute, Portland, Oregon.
- Bond, M.L., R.J. Gutiérrez,, A.B. Franklin, W.S. LaHaye, C.A. May, and M.E. Seamans. 2002. Short-term effects of wildfires on spotted owl survival, site fidelity, mate fidelity, and reproductive success. *Wildlife Society Bulletin* 30:1022-1028.
- Buchanan, J.B. 2004. Managing habitat for dispersing northern spotted owls – are the current management strategies adequate? *Wildlife Society Bulletin* 32:1333-1345.
- Buchanan, J.B. and P. Swedeen. 2005. Final briefing report to the Washington State Forest Practices Board regarding spotted owl status and forest practices rules. Washington Department of Fish and Wildlife, Olympia. 84 pp.
- Buchanan, J., E. Hanson, D. Hays, and L. Young. 1994. An evaluation of the Washington Forest Practices Board Wildlife Committee preferred alternative for a spotted owl protection rule. Washington Forest Practices Board Spotted Owl Scientific Advisory Group. Washington Department of Fish and Wildlife, Olympia, Washington.
- Buchanan, J.B., L.L. Irwin, and E.L. McCutchen. 1995. Within-stand nest site selection by spotted owls in the eastern Washington Cascades. *Journal of Wildlife Management* 59:301-310.
- Burnham, K.P., D.R. Anderson, and G.C. White. 1994. Estimation of vital rates of the northern spotted owl. Colorado Cooperative Fish and Wildlife Research Unit, Colorado State University, Fort Collins, Colorado, USA.
- Caffrey, C. 2003. Determining impacts of West Nile Virus on crows and other birds. *American Birds* 57:12-13.
- CDF (California Department of Forestry and Fire Protection). 2001. California Forest Practices Rules: 2001. Title 14, California Code of Regulations, Chapters 4, 4.5, and 10. CDF, Sacramento, California.
- Carey, A.B., J.A. Reid, and S.P. Horton. 1990. Spotted owl home range and habitat use in southern Oregon coast ranges. *Journal of Wildlife Management* 54:11-17.
- Carey, A.B., S.P. Horton, and B.L. Biswell. 1992. Northern spotted owls: influence of prey base and landscape character. *Ecol. Monographs* 62:223-250.
- Chi, T., A. Henke, J. Smith, and C. Brinegar. 2005. Spotted owl mitochondrial DNA haplotyping. San Jose State University. Unpublished results submitted to U.S. Fish and Wildlife Service.
- Chutter, M.J., I. Blackburn, D. Bonin, J. Buchanan, B. Costanzo, D. Cunningham, A. Harestad, T. Hayes, D. Heppner, L. Kiss, J. Surgenor, W. Wall, L.

- Waterhouse, and L. Williams. 2004. Recovery strategy for the northern spotted owl (*Strix occidentalis caurina*) in British Columbia. British Columbia Ministry of Environment, Victoria. 74 pp.
- Cohen, W.B., T.A. Spies, R.J. Alig, D.R. Oetter, T.K. Maierasperger, and M. Fiorella. 2002. Characterizing 23 years (1972–95) of stand replacement disturbance in western Oregon forests with Landsat Imagery. *Ecosystems* 5:122–137.
- Courtney, S.P., J.A. Blakesley, R.E. Bigley, M.L. Cody, J.P. Dumbacher, R.C. Fleischer, A.B. Franklin, J.F. Franklin, R.J. Gutiérrez, J.M. Marzluff, and L. Sztukowski. 2004. Scientific evaluation of the status of the northern spotted owl. Sustainable Ecosystems Institute, Portland, Oregon.
- Crozier, M.L., M.E. Seamans, R.J. Gutiérrez, P.J. Loschl, R.B. Horn, S.G. Sovern, and E.D. Forsman. 2006. Does the presence of Barred Owls suppress the calling behavior of Spotted Owls? *Condor* 108:760–769.
- Davis, R. and J. Lint. 2005. Habitat status and trends. Pages 21–82 in J. Lint (technical coordinator), Northwest Forest Plan—the first 10 years (1994–2003): status and trends of northern spotted owl populations and habitat. Gen. Tech. Rep. PNW-GTR-648, USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon.
- Deubel, V., L. Fiette, P. Gounon, M.T. Drouet, H. Khun, M. Huerre, C. Banet, M. Malkinson, and P. Despres. 2001. Variations in biological features of West Nile viruses. *Annals of the New York Academy of Sciences* 951:195–206.
- Diller, L.V. and D.M. Thome. 1999. Population density of northern spotted owls in managed young-growth forests in coastal northern California. *Journal of Raptor Research* 33: 275–286.
- Dugger, K.M., F. Wagner, R.G. Anthony, and G.S. Olson. 2005. The relationship between habitat characteristics and demographic performance of northern spotted owls in southern Oregon. *Condor* 107:863–878.
- Dunbar, D.L., B.P. Booth, E.D. Forsman, A.E. Hetherington, and D.J. Wilson. 1991. Status of the spotted owl, *Strix occidentalis*, and barred owl, *Strix varia*, in southwestern British Columbia. *Canadian Field-Naturalist* 105:464–468.
- Fitzgerald, S.D., J.S. Patterson, M. Kiupel, H.A. Simmons, S.D. Grimes, C.F. Sarver, R.M. Fulton, B.A. Fulton, B.A. Steficek, T.M. Cooley, J.P. Massey, and J.G. Sikarskie. 2003. Clinical and pathological features of West Nile Virus infection in native North American owls (family *Strigidae*). *Avian Diseases* 47:602–610.
- Forsman, E.D. 1975. A preliminary investigation of the spotted owl in Oregon. M.S. thesis, Oregon State University, Corvallis. 127 pp.
- Forsman, E.D. 1981. Molt of the spotted owl. *Auk* 98:735–742.

- Forsman, E.D., E.C. Meslow, and H.M. Wight. 1984. Distribution and biology of the spotted owl in Oregon. *Wildlife Monographs* 87:1-64.
- Forsman, E.D., S. DeStefano, M.G. Raphael, and R.J. Gutiérrez (eds.). 1996. Demography of the northern spotted owl. *Studies in Avian Biology* No. 17.
- Forsman, E.D., I.A. Otto, S.G. Sovern, M. Taylor, D.W. Hays, H. Allen, S.L. Roberts, and D.E. Seaman. 2001. Spatial and temporal variation in diets of spotted owls in Washington. *Journal of Raptor Research* 35:141-150.
- Forsman, E.D., R.G. Anthony, J.A. Reid, P.J. Loschl, S.G. Sovern, M. Taylor, B.L. Biswell, A. Ellingson, E.C. Meslow, G.S. Miller, K.A. Swindle, J.A. Thraillkill, F.F. Wagner, and D. E. Seaman. 2002. Natal and breeding dispersal of northern spotted owls. *Wildlife Monographs* 149:1-35.
- Forsman, E.D., R.G. Anthony, E.C. Meslow, and C.J. Zabel. 2004. Diets and foraging behavior of northern spotted owls in Oregon. *Journal of Raptor Research* 38:214-230.
- Franklin, A.B. 1992. Population regulation in northern spotted owls: theoretical implications for management. Pp. 815-827 in D.R. McCullough and R.H. Barrett (editors), *Wildlife 2001: populations*. Elsevier Applied Sciences, London, England.
- Franklin, A.B., D.R. Anderson, R.J. Gutiérrez, and K.P. Burnham. 2000. Climate, habitat quality, and fitness in northern spotted owl populations in northwestern California. *Ecological Monographs* 70:539-590.
- Franklin, J. and J.K. Agee. 2003. Forging a science-based national forest fire policy. *Issues in Science and Technology*.
<http://www.issues.org/20.1/franklin.html>
- Franklin, J. and S. Courtney. 2004. Evolution and effectiveness of strategies for conservation of northern spotted owl. Chapter 9 in S. Courtney (editor), *Scientific evaluation of the status of the northern spotted owl*. Sustainable Ecosystems Institute, Portland, Oregon.
- Gaines, W.L., R.A. Strand, and S.D. Piper. 1997. Effects of the Hatchery Complex Fires on northern spotted owls in the eastern Washington Cascades. Pages 123-129 in J.M. Greenlee (editor), *Proceedings of the First Conference on Fire Effects on Rare and Endangered Species and Habitats*. International Association of Wildland Fire, Coeur d'Alene, Idaho.
- Gancz, A., I.K. Barker, R. Lindsay, A. Dibernardo, K. McKeever, and B. Hunter. 2004. West Nile Virus outbreak in North American owls, Ontario, 2002. *Emerging Infectious Diseases* 10:2135-2142.
- Garmendia, A.E., H.J. Van Kruiningen, R.A. French, J.F. Anderson, T.G. Andreadis, A. Kumar, and A.B. West. 2000. Recovery and identification of West Nile virus from a hawk in winter. *Journal of Clinical Microbiology* 38:3110-3111.

- Glenn, E.M, M.C. Hansen, and R.G. Anthony. 2004. Spotted owl home-range and habitat use in young forests of western Oregon. *Journal of Wildlife Management* 68:33–50.
- Gremel, S. 2005. Factors controlling distribution and demography of northern spotted owls in a reserved landscape. M.S. thesis, University of Washington, Seattle. 49 pp.
- Gutiérrez, R.J. 1989. Hematozoa from the spotted owl. *Journal of Wildlife Diseases* 24:614–618.
- Gutiérrez, R.J. 1994. Changes in the distribution and abundance of spotted owls during the past century. *Studies in Avian Biology* 15:293–300.
- Gutiérrez, R.J. 1996. Biology and distribution of the northern spotted owl. *Studies in Avian Biology* 17:2–5.
- Gutiérrez, R.J., A.B. Franklin, and W.S. LaHaye. 1995. Spotted owl (*Strix occidentalis*) in A. Poole and F. Gill (editors), *The birds of North America*, No. 179. The Academy of Natural Sciences and The American Ornithologists' Union, Washington, D.C. 28 pp.
- Gutiérrez, R. J., M. Cody, S. Courtney, and D. Kennedy. 2004. Assessment of the potential threat of the northern barred owl. Chapter 7 in S. Courtney (editor), *Scientific evaluation of the status of the northern spotted owl*. Sustainable Ecosystems Institute, Portland, Oregon.
- Haig, S.M., R.S. Wagner, E.D. Forsman, E.D., and T.D. Mullins. 2001. Geographic variation and genetic structure in spotted owls. *Conservation Genetics* 2:25–40.
- Haig, S.M., T.D. Mullins, and E.D. Forsman. 2004a. Subspecific relationships and genetic structure in the spotted owl. *Conservation Genetics* 5:683–705.
- Haig, S.M., T.D. Mullins, E.D. Forsman, P. Trail, and L. Wennerberg. 2004b. Genetic identification of spotted owls, barred owls, and their hybrids: legal implications of hybrid identity. *Conservation Biology* 18:1347–1357.
- Hamer, T.E. 1988. Home range size of the northern barred owl and northern spotted owl in western Washington. M.S. Thesis. Western Washington University, Bellingham.
- Hamer, T.E., S.G. Seim, and K.R. Dixon. 1989. Northern spotted owl and northern barred owl habitat use and home range size in Washington: preliminary report. Washington Department of Wildlife, Olympia.
- Hamer, T.E., E.D. Forsman, A.D. Fuchs, and M.L. Walters. 1994. Hybridization between barred and spotted owls. *Auk* 111:487–492.
- Hamer, T.E., D.L. Hays, C.M. Senger, and E.D. Forsman. 2001. Diets of northern barred owls and northern spotted owls in an area of sympatry. *Journal of Raptor Research* 35:221–227.

- Hanson, E., D. Hays, L. Hicks, L. Young, and J. Buchanan. 1993. Spotted owl habitat in Washington: a report to the Washington Forest Practices Board. Washington Forest Practices Board, Spotted Owl Advisory Group. Washington Department of Wildlife, Olympia, Washington. 116 pp.
- Hardy, C.C., K.M. Schmidt, J.P. Menakis, and K.R.N. Sampson. 2001. Spatial data for national fire planning and fuel management. *International Journal of Wildlife Fire* 10:353-372.
- Harestad, A., J. Hobbs, and I. Blackburn. 2004. Précis of the northern spotted owl in British Columbia. Pages. 12-14 in K. Zimmerman, K. Welstead, E. Williams, and J. Turner (editors), Northern Spotted Owl Workshop Proceedings. Forest Research Extension Partnership (Forrex) Series No. 14, Vancouver, British Columbia.
- Henke, A.L., T.Y. Chi, J. Smith, and C. Brinegar. 2005. Spotted owl (*Strix occidentalis*) microsatellite variation in California. Department of Biological Sciences, San Jose State University, San Jose, California. 23 pp.
- Herter, D.R. and L.L. Hicks. 2000. Barred owl and spotted owl populations and habitat in the central Cascade Range of Washington. *Journal of Raptor Research* 34:279-286.
- Herter, D.R., L.L. Hicks, H.C. Stabins, J.J. Millspaugh, A.J. Stabins, and L.D. Melampy. 2002. Roost site characteristics of northern spotted owls in the nonbreeding season in central Washington. *Forest Science* 48:437-446.
- Hoberg, E.P., G.S. Miller, E. Wallner-Pendleton, and O.R. Hedstrom. 1989. Helminth parasites of northern spotted owls (*Strix occidentalis caurina*). *Journal of Wildlife Diseases* 25:246-251.
- Irwin, L.L., D.F. Rock, and G.P. Miller. 2000. Stand structures used by northern spotted owls in managed forests. *Journal of Raptor Research* 34:175-186.
- Iverson, W.F. 1993. Is the barred owl displacing the spotted owl in western Washington? M.S. thesis, Western Washington University, Bellingham.
- Iverson, W.F. 2004. Reproductive success of spotted owls sympatric with barred owls in western Washington. *Journal of Raptor Research* 38:88-91.
- Johnson, K. N., J. F. Franklin, J. W. Thomas, and J. Gordon. 1991. Alternatives for management of late successional forests of the Pacific Northwest. A report to the Agriculture and Merchant and Marine Fisheries Committees of the U.S. House of Representative. Scientific Panel on Late Successional Forest Ecosystems, Washington, D.C.
- Kelly, E.G., and E.D. Forsman. 2004. Recent records of hybridization between barred owls (*Strix varia*) and northern spotted owls (*S. occidentalis caurina*). *Auk* 121:806-810.
- Kelly, E.G., E.D. Forsman, and R.G. Anthony. 2003. Are barred owls replacing spotted owls? *Condor* 105:45-53.

- Kelly, E.G. and E.D. Forsman. 2004. Recent records of hybridization between barred owls (*Strix varia*) and northern spotted owls (*S. occidentalis caurina*). *Auk* 121:806–810.
- King, G.M., K.R. Bevis, M.A. Rowe, and E.E. Hanson. 1997. Spotted owls use of habitat impacted by 1994 fires on the Yakama Indian Reservation: three years post fire. *Journal of Forestry* 95:21–25.
- Komar, N., N.A. Panella, J.E. Burns, S.W. Dusza, T.M. Mascarenhas, and T.O. Talbot. 2001. Serologic evidence for West Nile virus infection in birds in the New York City vicinity during an outbreak in 1999. *Emerging Infectious Diseases* 7:621–625.
- Lamberson, R.H., B.R. Noon, C. Voss, K.S. McKelvy. 1994. Reserve design for terrestrial species: The effects of patch size and spacing on the viability of the northern spotted owl. *Conservation Biology* 8(1):185-195.
- Leskiw, T. and R.J. Gutiérrez. 1998. Possible predation of a spotted owl by a barred owl. *Western Birds* 29:225–226.
- Lint, J. 2005. Population status and trends. Pages 7–19 in J. Lint (technical coordinator), Northwest Forest Plan – the first 10 years (1994–2003): status and trends of northern spotted owl populations and habitat. Gen. Tech. Rep. PNW-GTR-648, USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon.
- Livezey, K.B. 2005. Iverson (2004) on spotted owls and barred owls: comments on methods and conclusion. *Journal of Raptor Research* 39:102–103.
- Livezey, K.B. and T.L. Fleming. In Press. Effects of Barred Owls on Spotted Owls: the need for more than incidental detections and correlational analyses. *Journal of Raptor Research* 41(3).
- Marra, P.P., S. Griffing, C. Caffrey, A.M. Kilpatrick, R. McLean, C. Brand, E. Saito, A.P. Dupuis, L. Kramer, and R. Novak. 2004. West Nile Virus and wildlife. *BioScience* 54:393–402.
- McLean, R.G., S.R. Ubico, S.E. Docherty, W.R. Hansen, L. Sileo, and T.S. McNamara. 2001. West Nile Virus and transmission and ecology in birds. *Annals of the New York Academy of Sciences* 951:54–57.
- Meyer, J.S., L.L. Irwin, and M.S. Boyce. 1998. Influence of habitat abundance and fragmentation on northern spotted owls in western Oregon. *Wildlife Monographs* 139:1–51.
- Miller, G.S. 1989. Dispersal of juvenile spotted owls in western Oregon. M.S. thesis, Oregon State University, Corvallis. 139 pp.
- Miller, G.S., S.K. Nelson, and W.C. Wright. 1985. Two-year-old female spotted owl breeds successfully. *Western Birds* 16:69–73.

- Miller, G.S., R.J. Small, and E.C. Meslow. 1997. Habitat selection by spotted owls during natal dispersal in western Oregon. *Journal of Wildlife Management* 61:140-150.
- Moen, C.A., A.B. Franklin, and R.J. Gutiérrez. 1991. Age determination of subadult northern spotted owls in northwest California. *Wildlife Society Bulletin* 19:489-493.
- Moeur, M., T.A. Spies, M. Hemstrom, J.R. Martin, J. Alegria, J. Browning, J. Cissel, W.B. Cohen, T.E. Demeo, S. Healey, and R. Warbington. 2005. Northwest Forest Plan – the first 10 years (1994-2003): status and trend of late-successional and old-growth forest. Gen. Tech. Rep. PNW-GTR-646. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, Oregon.
- Noon, B.R. and J.A. Blakesley. 2006. Conservation of the northern spotted owl under the Northwest Forest Plan. *Conservation Biology* 20:288-296.
- Olson, G.S., E.M. Glenn, R.G. Anthony, E.D. Forsman, J.A. Reid, P.J. Loschl, and W.J. Ripple. 2004. Modeling demographic performance of northern spotted owls relative to forest habitat in Oregon. *Journal of Wildlife Management* 68:1039-1053.
- Olson, G.S., R.G. Anthony, E.D. Forsman, S.H. Ackers, P.J. Loschl, J.A. Reid, K.M. Dugger, E.M. Glenn, and W.J. Ripple. 2005. Modeling of site occupancy dynamics for northern spotted owls, with emphasis on the effects of barred owls. *Journal of Wildlife Management* 69:918-932.
- ODF (Oregon Department of Forestry). 2006. Forest Practices Administrative Rules and Forest Practices Act. Oregon Department of Forestry, Salem, Oregon.
- Pearson, R.R. and K.B. Livezey. 2003. Distribution, numbers, and site characteristics of spotted owls and barred owls in the Cascade Mountains of Washington. *Journal of Raptor Research* 37:265-276.
- Pearson, R.R. and K.B. Livezey. In Press. Spotted Owls, Barred Owls, and Late-Successional Reserves. *Journal of Raptor Research* 41(2).
- Raphael, M.G. (2006). Conservation of listed species: the northern spotted owl and marbled murrelet. Chapter 7 in R.W. Haynes, B.T. Bormann, D.C. Lee, and J.R. Martin (technical editors), Northwest Forest Plan – the first 10 Years (1994-2003): synthesis of monitoring and research results. Gen. Tech. Rep. PNW-GTR. USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon.
- Schmidt, K. 2006. Northern spotted owl monitoring and inventory, Redwood National and State Parks, 2005 annual report. Redwood National and State Parks, Orick, California.

- Sisco, C.L. 1990. Seasonal home range and habitat ecology of spotted owls in northwestern California. M.S. thesis, Humboldt State University, Arcata, California.
- Solis, D.M., and R.J. Gutiérrez. 1990. Summer habitat ecology of northern spotted owls in northwestern California. *Condor* 92:739-748.
- Sovern, S.G., E.D. Forsman, B.L. Biswell, D.N. Rolph, and M. Taylor. 1994. Diurnal behavior of the spotted owl in Washington. *Condor* 96:200-202.
- Thomas, J.W., E.D. Forsman, J.B. Lint, E.C. Meslow, B.R. Noon, and J. Verner. 1990. A conservation strategy for the northern spotted owl. Interagency Scientific Committee to Address the Conservation of the Northern Spotted Owl. USDA Forest Service, USDI Bureau of Land Management, USDI Fish and Wildlife Service, and USDI National Park Service. Portland, Oregon. 458 pp.
- Thomas, J.W., M.G. Raphael, R.G. Anthony, E.D. Forsman, A.G. Gunderson, R.S. Holthausen, B.G. Marcot, G.H. Reeves, J.R. Sedell, and D.M. Solis. 1993. Viability assessments and management considerations for species associated with late-successional and old-growth forests of the Pacific Northwest. USDA Forest Service, Portland, Oregon.
- Thomas, J.W., J.F. Franklin, J. Gordon, and K.N. Johnson. 2006. The Northwest Forest Plan: origins, components, implementation experience, and suggestions for change. *Conservation Biology* 20:277-287.
- USDA (U.S. Department of Agriculture), U.S. Department of the Interior, U.S. Department of Commerce, and U.S. Environmental Protection Agency. 1993. Forest ecosystem management: an ecological, economic and social assessment. Report of the Forest Ecosystem Management Assessment Team. U.S. Forest Service, Portland, Oregon.
- USDA (U.S. Department of Agriculture), and USDI (U.S. Department of the Interior). 1994a. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl; standards and guidelines for management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl. USDA Forest Service, Portland, Oregon, and USDI Bureau of Land Management, Portland, Oregon.
- USDA (U.S. Department of Agriculture), and USDI (U.S. Department of the Interior). 1994b. Final supplemental environmental impact statement on management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl. USDA Forest Service, Portland, Oregon, and USDI Bureau of Land Management, Portland, Oregon.
- USFWS (U.S. Fish and Wildlife Service). 1983a. Endangered and threatened species listing and recovery priority guidelines. *Federal Register* 48:43098-43105.

- USFWS (U.S. Fish and Wildlife Service). 1983b. Endangered and threatened species listing and recovery priority guidelines: correction. Federal Register 48:51985.
- USFWS (U.S. Fish and Wildlife Service). 1987. The northern spotted owl status review. USDI Fish and Wildlife Service, Portland, Oregon.
- USFWS (U.S. Fish and Wildlife Service). 1989. The northern spotted owl; a status review supplement. USDI Fish and Wildlife Service, Portland, Oregon.
- USFWS (U.S. Fish and Wildlife Service). 1990a. The 1990 status review: northern spotted owl: *Strix occidentalis caurina*. USDI Fish and Wildlife Service, Portland, Oregon. 95 pp.
- USFWS (U.S. Fish and Wildlife Service). 1990b. Endangered and threatened wildlife and plants; determination of threatened status for the northern spotted owl. Federal Register 55:26114–26194.
- USFWS (U.S. Fish and Wildlife Service). 1992a. Endangered and threatened wildlife and plants; determination of critical habitat for the northern spotted owl. Federal Register 57:1796–1838.
- USFWS (U.S. Fish and Wildlife Service). 1992b. Draft final recovery plan for the northern spotted owl. USDI Fish and Wildlife Service, Portland, Oregon.
- USFWS (U.S. Fish and Wildlife Service). 1994a. Letter from D.C. Frederick (USFWS) to J. Belcher (Washington Department of Natural Resources) dated February 1, 1994, regarding correction to spotted owl home-range data for the Olympic Peninsula. USFWS, Olympia, Washington.
- USFWS (U.S. Fish and Wildlife Service). 1994b. Letter from Curt Smitch (USFWS) to U.S. Forest Service and Bureau of Land Management regarding ESA Section 7 consultation guidance for the Northwest Forest Plan. USFWS, Portland, Oregon.
- USFWS (U.S. Fish and Wildlife Service). 1995. Endangered and threatened wildlife and plants; proposed special rule for the conservation of the northern spotted owl on non-federal lands. Federal Register 60:9483–9527.
- USFWS (U.S. Fish and Wildlife Service). 2004a. Trends in suitable habitat for the northern spotted owl (*Strix occidentalis caurina*) on federal lands from 1994 to 2003. For use by: Sustainable Ecosystems Institute for the northern spotted owl 5-year review. USDI Fish and Wildlife Service, Portland, Oregon.
- USFWS (U.S. Fish and Wildlife Service). 2004b. Northern spotted owl: Five Year Review Summary and Evaluation. USDI Fish and Wildlife Service, Portland, Oregon. 73 pp.
- USFWS (U.S. Fish and Wildlife Service). 2006. Data compiled in the northern spotted owl consultation effects tracking system USFWS internal database. July 24, 2006.

- USFWS (U.S. Fish and Wildlife Service). 2007. Analysis of distances dispersed by juvenile spotted owls in Forsman *et al.* (2002) using data supplied by E. Forsman (2007 pers. comm.). USDI Fish and Wildlife Service, Lacey, Washington.
- Ward, J.W. Jr. 1990. Spotted owl reproduction, diet and prey abundance in northwest California. M.S. thesis, Humboldt State University, Arcata, California.
- Ward, J.W. Jr., R.J. Gutiérrez, and B.R. Noon. 1998. Habitat selection by northern spotted owls: the consequences of prey selection and distribution. *Condor* 100:79-92.
- Washington Forest Practices Board. 1996. Permanent rules for the northern spotted owl. Washington Department of Natural Resources, Olympia.
- Weathers, W.W., P.J. Hodum, and J.A. Blakesley. 2001. Thermal ecology and ecological energetics of the California spotted owl. *Condor* 103:678-690.
- Zabel, C. J., K.M. McKelvey, and J.P. Ward, Jr. 1995. Influence of primary prey on home-range size and habitat-use patterns of northern spotted owls (*Strix occidentalis caurina*). *Canadian Journal of Zoology* 73:433-439.
- Zabel, C. J., J.R. Dunk, H.B. Stauffer, L.M. Roberts, B.S. Mulder, and A. Wright. 2003. Northern spotted owl habitat models for research and management application in California (USA). *Ecological Applications* 13:1027-1040.

Personal Communications Cited

- Forsman, Eric. 2006. U.S. Forest Service, Pacific Northwest Research Station, Corvallis, Oregon. Email to Paul Phifer, U.S. Fish and Wildlife Service, Regional Office, Portland, dated August 30, 2006.
- Loschl, Peter, and Eric Forsman. 2006. U.S. Forest Service, Pacific Northwest Research Station, Corvallis, Oregon. Email addressed to Kent Livezey, U.S. Fish and Wildlife Service, Washington Fish and Wildlife Office, dated September 8, 2006.

Appendix A: Background (*Options 1 and 2*)

This section of the Recovery Plan is designed to provide information necessary to understand the Plan's strategy, goals, objectives, and criteria for the spotted owl. While it is not an exhaustive review, information on the spotted owl's status, basic ecology, demography, and past and current threats is included. Detailed accounts of the taxonomy, ecology, and reproductive characteristics of the spotted owl were presented in the 1987 and 1990 Status Reviews (USFWS 1987, 1990a), 1989 Status Review Supplement (USFWS 1989), Interagency Scientific Committee Report (Thomas *et al.* 1990), Forest Ecosystem Management Assessment Team Report (USDA *et al.* 1993), final rule designating the spotted owl as a threatened species (USFWS 1990b), scientific evaluation of the status of the spotted owl (Courtney *et al.* 2004), and several key monographs (e.g., Anthony, R.G. *et al.* 2006 and Forsman, E.D. *et al.* 2004).

Species Description and Taxonomy

The northern spotted owl is a medium-sized owl and is the largest of the three subspecies of spotted owls (Gutiérrez *et al.* 1995). It is approximately 46 to 48 centimeters (18 inches to 19 inches) long and the sexes are dimorphic, with males averaging about 13 percent smaller than females. The mean mass of 971 males taken during 1,108 captures was 580.4 grams (1.28 pounds) (out of a range 430.0 to 690.0 grams) (0.95 pound to 1.52 pounds), and the mean mass of 874 females taken during 1,016 captures was 664.5 grams (1.46 pounds) (out of a range 490.0 to 885.0 grams) (1.1 pounds to 1.95 pounds) (P. Loschl and E. Forsman 2006 pers. comm.). The northern spotted owl is dark brown with a barred tail and white spots on its head and breast, and it has dark brown eyes surrounded by prominent facial disks. Four age classes can be distinguished on the basis of plumage characteristics (Forsman 1981; Moen *et al.* 1991). The northern spotted owl superficially resembles the barred owl, a species with which it occasionally hybridizes (Kelly and Forsman 2004). Hybrids exhibit physical and vocal characteristics of both species (Hamer *et al.* 1994).

The northern spotted owl is one of three subspecies of spotted owls currently recognized by the American Ornithologists' Union. The taxonomic separation of these three subspecies is supported by genetic (Barrowclough and Gutiérrez 1990; Barrowclough *et al.* 1999; Haig *et al.* 2004a), morphological (Gutiérrez *et al.* 1995), and biogeographic information (Barrowclough and Gutiérrez 1990). The distribution of the Mexican subspecies (*S. o. lucida*) is separate from those of the northern and California (*S. o. occidentalis*) subspecies (Gutiérrez *et al.* 1995). Recent studies analyzing mitochondrial DNA sequences (Haig *et al.* 2004a; Chi *et al.* 2005; Barrowclough *et al.* 2005) and microsatellites (Henke *et al.* 2005) confirmed the validity of the current subspecies designations for northern and California spotted owls. The narrow hybrid zone between these two subspecies,

which is located in the southern Cascades and northern Sierra Nevadas, appears to be stable (Barrowclough *et al.* 2005).

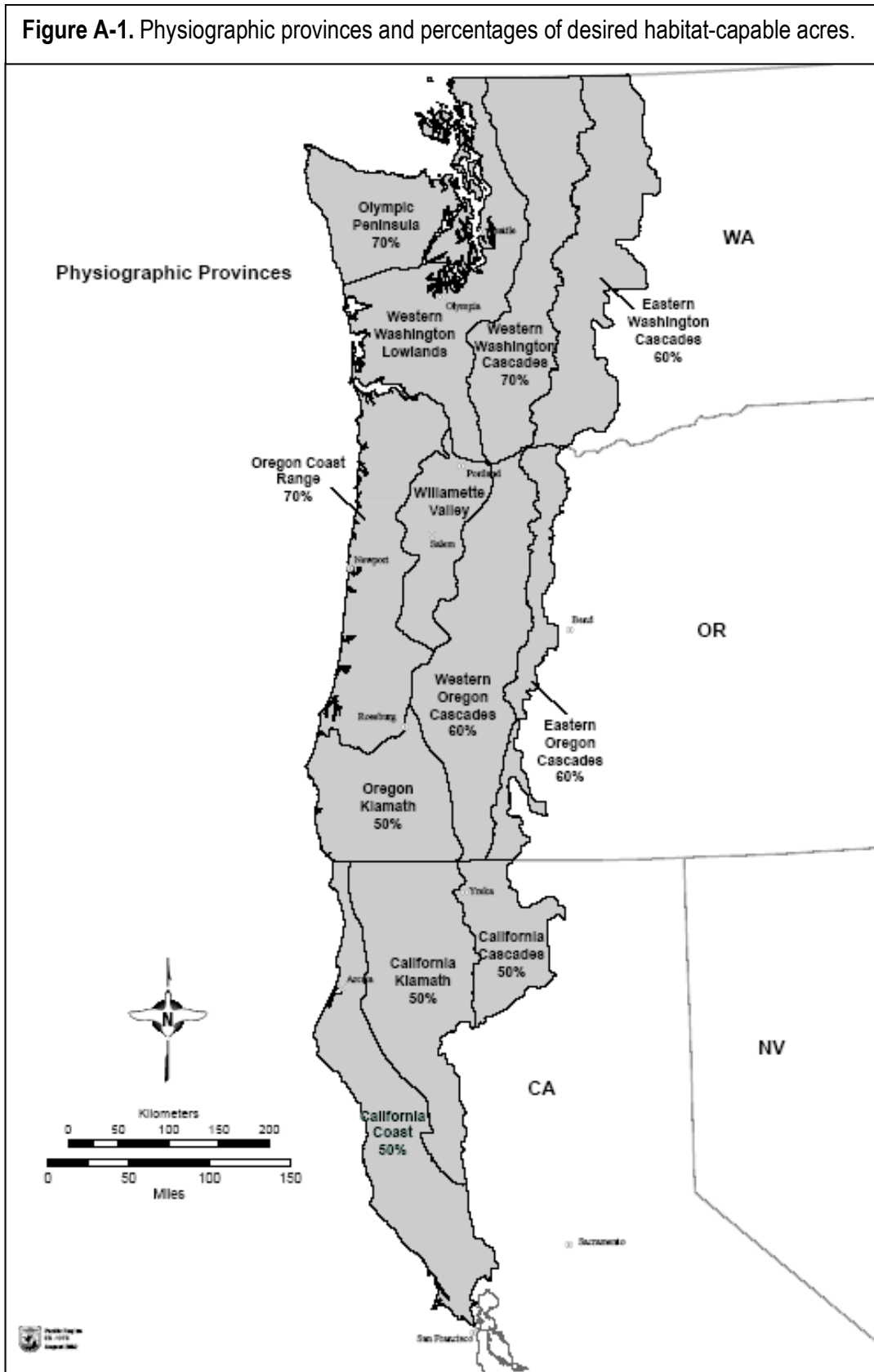
Population Trends and Distribution

There are no estimates of the size of the spotted owl population prior to settlement by Europeans. Spotted owls are believed to have inhabited most old-growth forests or stands throughout the Pacific Northwest, including northwestern California, prior to beginning of modern settlement in the mid-1800s (USFWS 1989).

The current range of the spotted owl extends from southwest British Columbia through the Cascade Mountains, coastal ranges, and intervening forested lands in Washington, Oregon, and California, as far south as Marin County (USFWS 1990b). The range of the spotted owl is partitioned into 12 physiographic provinces (Figure A-1) based on recognized landscape subdivisions exhibiting different physical and environmental features (Thomas *et al.* 1993). These provinces are distributed across the species' range as follows:

- Four provinces in Washington: Eastern Washington Cascades, Olympic Peninsula, Western Washington Cascades, Western Washington Lowlands
- Five provinces in Oregon: Oregon Coast Range, Willamette Valley, Western Oregon Cascades, Eastern Oregon Cascades, Oregon Klamath
- Three provinces in California: California Coast, California Klamath, California Cascades

Figure A-1. Physiographic provinces and percentages of desired habitat-capable acres.



The spotted owl has become rare in certain areas, such as British Columbia, southwestern Washington, and the northern coastal ranges of Oregon.

Many historical spotted owl site-centers are no longer occupied because spotted owls have been displaced by barred owls, timber harvest, or fires.

As of July 1, 1994, there were 5,431 known site-centers of spotted owl pairs or resident singles: 851 sites (16 percent) in Washington, 2,893 sites (53 percent) in Oregon, and 1,687 sites (31 percent) in California (USFWS 1995). The actual number of currently occupied spotted owl locations across the

range is unknown because many areas remain unsurveyed (USFWS 1992a; Thomas *et al.* 1993). In addition, many historical sites are no longer occupied because spotted owls have been displaced by barred owls, timber harvest, or severe fires, and it is possible that some new sites have been established due to reduced timber harvest on Federal lands since 1994. The totals in USFWS (1995) represent the cumulative number of locations recorded in the three States, not population estimates.

Because the existing survey coverage and effort are insufficient to produce reliable range-wide estimates of population size, demographic data are used to evaluate trends in spotted owl populations. Analysis of demographic data can provide an estimate of the finite rate of population change (λ), which provides information on the direction and magnitude of population change. A λ of 1.0 indicates a stationary population, meaning the population is neither increasing nor decreasing. A λ of less than 1.0 indicates a decreasing population, and a λ of greater than 1.0 indicates a growing population. Demographic data, derived from studies initiated as early as 1985, have been analyzed periodically (Anderson and Burnham 1992; Burnham *et al.* 1994; Forsman *et al.* 1996; Anthony *et al.* 2006) to estimate trends in the populations of the spotted owl.

In January 2004, two meta-analyses modeled rates of population change for up to 18 years using the re-parameterized Jolly-Seber method (λ_{RJS}). One meta-analysis modeled all 13 long-term study areas excluding the Marin study area (Table 1), while the other modeled the eight study areas that are part of the effectiveness monitoring program of the NWFP (Anthony *et al.* 2006). Data were analyzed separately for individual study areas, as well as across all study areas in a meta-analysis.

Point estimates of λ_{RJS} ranged from 0.896 to 1.005 for the 13 long-term study areas, and in all study areas but one – the Tyee study area – these estimates were less than 1.0 (Anthony *et al.* 2006). There was strong evidence that populations in the Wenatchee, Cle Elum, Warm Springs, and Simpson study areas decreased during the period of study. There also was evidence that populations in the Rainier, Olympic, Oregon Coast Range, and HJ Andrews study areas were decreasing. The precision of the λ_{RJS} estimates

Demographic data suggest that populations over the 13 long-term demographic study areas decreased by about 3.7 percent from 1985 to 2003.

for Rainier and Olympic study areas was poor and not sufficient to detect a statistically significant difference from 1.00; however, the estimate of λ_{RJS} for the Rainier study area (0.896) was the lowest of all of the areas. Populations in the Tyee, Klamath, South Oregon Cascades, Northwest California, and Hoopa study areas appeared to be stationary during the study, but there was some evidence that the spotted owl population in the Northwest California study area was decreasing ($\lambda_{RJS} = 0.959$ to 1.011).

The weighted mean λ_{RJS} for all of the study areas was 0.963 (standard error [SE] = 0.009, 95 percent confidence interval [CI] = 0.945 to 0.981), suggesting that populations over all of the study areas decreased by about 3.7 percent per year from 1985 to 2003. Anthony *et al.* (2006) explains that the indication populations were declining was based on the fact that the 95% confidence intervals around the estimate of mean lambda did not overlap 1.0 (stable) or barely included 1.0.

Table 1. Spotted owl demographic study areas (adapted from Anthony *et al.* 2004).

Area	Fecundity	Survival	λ_{RJS}	Population change
Wenatchee	Declining	Declining	0.917	Declining
Cle Elum	Declining	Declining?	0.938	Declining
Rainier	Stable	Declining	0.896	Declining
Olympic	Stable	Declining	0.956	Declining
Coast Ranges	Declining?	Stable	0.968	Declining
HJ Andrews	Stable?	Stable	0.978	Declining
Warm Springs	Stable	Stable	0.908	Declining
Tyee	Increasing	Stable	1.005	Stationary
Klamath	Stable	Stable	0.997	Stationary
S. Cascades	Declining	Stable	0.974	Stationary
NW California	Declining	Declining	0.985	Declining?
Hoopa	Increasing	Stable	0.98	Stationary
Simpson	Declining	Stable	0.97	Declining
Marin	Stable	Stable	NA	NA

The mean λ_{RJS} for the eight demographic monitoring areas that are part of the effectiveness monitoring program of the NWFP was 0.976 (SE = 0.007, 95 percent CI = 0.962 to 0.990), and the mean λ_{RJS} for the other five study areas was 0.942 (SE = 0.016, 95 percent CI = 0.910 to 0.974), yielding average declines of 2.4 and 5.8 percent per year, respectively. These data suggest that demographic rates for spotted owl populations on Federal lands were better than elsewhere; however, the interspersed non-Federal land in study areas, and the likelihood that spotted owls use habitat on multiple ownerships in some demography study landscapes, confound this comparison.

The number of populations that declined and the rate at which they have declined are noteworthy, particularly the precipitous declines in the Wenatchee, Cle Elum, and Rainier study areas in Washington and the Warm Springs study area in Oregon.

Decreases in apparent adult survival rates were an important factor contributing to decreasing population trends.

Estimates of population declines in these areas ranged from 40 to 60 percent during the study period of 1990 to 2003 (Anthony *et al.* 2006). Decreases in apparent adult survival rates were an important factor contributing to decreasing population trends. Survival rates decreased over time in five of the 14 study areas: four study areas in Washington, which showed the sharpest declines, and one study area in the California Klamath Province of northwest California (Anthony *et al.* 2006). In Oregon, there were no time trends in apparent survival for four of six study areas, and remaining areas had weak, non-linear trends. In California, three study areas showed no trend and one showed a significant linear decrease (Anthony *et al.* 2006). Like the trends in annual rate of population change, trends in the rate of adult survival showed clear decreases in some areas but not in others.

British Columbia has a small population of spotted owls. This population is relatively isolated from populations in Washington and appears to be declining sharply; spotted owls are absent from large areas of apparently suitable habitat (Chutter *et al.* 2004). Breeding populations have been estimated at fewer than 33 pairs and may be declining by as much as 35 percent per year (Chutter *et al.* 2004)¹¹. The amount of interaction between spotted owls in Canada and the United States is unknown (Chutter *et al.* 2004). The Canadian population has now reached the point at which it is vulnerable to random, naturally occurring demographic events that could cause further declines and perhaps extirpation. Chutter *et al.* (2004) suggest that immediate action is required to improve the likelihood of recovering that population in British Columbia.

Life History and Ecology

Spotted owls are territorial and usually monogamous. Home-range sizes vary geographically, generally increasing from south to north, which is likely a response to differences in habitat quality (USFWS 1990b). Estimates of median size of their annual home range vary from 2,955 acres in the Oregon Cascades (Thomas *et al.* 1990) to 14,211 acres on the Olympic Peninsula (USFWS 1994a). Zabel *et al.* (1995) showed that spotted owl home ranges are larger where flying squirrels are the predominant prey and smaller where wood rats are the predominant prey. Home ranges of adjacent pairs overlap (Forsman *et al.* 1984; Solis and Gutiérrez 1990), suggesting that the defended area is smaller than the area used for foraging. The Service uses a circle of 0.7-mile radius (984 acres) from the activity center to delineate the most heavily used area during the nesting season. Spotted owls use smaller home ranges during the breeding

¹¹ Recent unpublished reports indicate the B.C. spotted owl population continues to decline.

season and often dramatically increase their home range size during fall and winter (Forsman *et al.* 1984; Sisco 1990).

The spotted owl is relatively long-lived, has a long reproductive life span, invests significantly in parental care, and exhibits high adult survivorship relative to other North American owls (Forsman *et al.* 1984; Gutiérrez *et al.* 1995). Spotted owls are sexually mature at 1 year of age, but rarely breed until they are 2 to 5 years of age (Miller *et al.* 1985; Franklin 1992; Forsman *et al.* 2002). Breeding females lay one to four eggs per clutch, with the average clutch size being two eggs; however, most spotted owl pairs do not nest every year, nor are nesting pairs successful every year (USFWS 1990b; Forsman *et al.* 1984; Anthony *et al.* 2006). The small clutch size, temporal variability in nesting success, and delayed onset of breeding all contribute to the relatively low fecundity of this species (Gutiérrez 1996).

The spotted owl is relatively long-lived, has a long reproductive life span, invests significantly in parental care, and exhibits high adult survivorship relative to other north American owls.

Courtship behavior usually begins in February or March, and females typically lay eggs in late March or April. The timing of nesting and fledging varies with latitude and elevation (Forsman *et al.* 1984). After they leave the nest in late May or June, juvenile spotted owls depend on their parents until they are able to fly and hunt on their own. Parental care continues after fledging into September (USFWS 1990b; Forsman *et al.* 1984). During the first few weeks after the young leave the nest, the adults often roost with them during the day. By late summer, the adults are rarely found roosting with their young and usually only visit the juveniles to feed them at night (Forsman *et al.* 1984).

Natal dispersal of spotted owls typically occurs in September and October with a few individuals dispersing in November and December (Miller *et al.* 1997;

Dispersing juvenile spotted owls experience high mortality rates, exceeding 70 percent in some studies. Known or suspected causes of mortality during dispersal include starvation, predation, and accidents.

Forsman *et al.* 2002). Natal dispersal occurs in stages, with juveniles settling in temporary home ranges between bouts of dispersal (Forsman *et al.* 2002; Miller *et al.* 1997). The median natal dispersal distance is about 10 miles for males and 15.5 miles for females (Forsman *et al.* 2002). Dispersing juvenile spotted owls experience high mortality rates, exceeding 70 percent in some studies (USFWS 1990b; Miller 1989). Known or suspected causes of mortality during dispersal include starvation, predation, and accidents (Miller 1989; USFWS 1990b; Forsman *et al.* 2002). Parasitic infection may contribute to these causes of mortality, but the relationship between parasite loads and survival is poorly understood (Hoberg *et al.* 1989; Gutiérrez 1989; Forsman *et al.* 2002).

Analysis of the genetic structure of spotted owl populations suggests that gene flow may have been adequate between the Olympic Mountains and the Washington Cascades, and between the Olympic Mountains and the Oregon Coast Range (Haig *et al.* 2001). Although telemetry and genetic studies indicate

that close inbreeding between siblings or parents and their offspring is rare (Haig *et al.* 2001; Forsman *et al.* 2002), inbreeding between more distant relatives is fairly common (E. Forsman 2006 pers. comm.).

Spotted owls are mostly nocturnal, although they also forage opportunistically during the day (Forsman *et al.* 1984; Sovern *et al.* 1994). The composition of the spotted owl's diet varies geographically and by forest type. Generally, flying squirrels (*Glaucomys sabrinus*) are the most prominent prey for spotted owls in Douglas-fir and western hemlock (*Tsuga heterophylla*) forests (Forsman *et al.* 1984) in Washington and Oregon, while dusky-footed wood rats (*Neotoma fuscipes*) are a major part of the diet in the Oregon Klamath, California Klamath, and California Coastal provinces (Forsman *et al.* 1984, 2001, 2004; Ward *et al.* 1998; Hamer *et al.* 2001). Depending on location, other important prey include deer mice (*Peromyscus maniculatus*), tree voles (*Arborimus longicaudus*, *A. pomo*), red-backed voles (*Clethrionomys* spp.), gophers (*Thomomys* spp.), snowshoe hare (*Lepus americanus*), bushy-tailed wood rats (*Neotoma cinerea*), birds, and insects, although these species comprise a small portion of the spotted owl diet (Forsman *et al.* 1984, 2004; Ward *et al.* 1998; Hamer *et al.* 2001).

Effects to spotted owls from barred owls are described above in Listing Factor E.

Habitat Characteristics

Forsman *et al.* (1984) reported that spotted owls have been observed in the following forest types: Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), grand fir (*Abies grandis*), white fir (*Abies concolor*), ponderosa pine (*Pinus ponderosa*), Shasta red fir (*Abies magnifica shastensis*), mixed evergreen, mixed conifer hardwood (Klamath montane), and redwood (*Sequoia sempervirens*). The upper elevation limit at which spotted owls occur corresponds to the transition to subalpine forest, which is characterized by relatively simple structure and severe winter weather (Forsman 1975; Forsman *et al.* 1984).

Spotted owls generally rely on older forested habitats because such forests contain the structures and characteristics required for nesting, roosting, and foraging. Features that support nesting and roosting typically include a moderate to high canopy closure (60 to 90 percent); a multi-layered, multi-species canopy with large overstory trees (with diameter at breast height [dbh] of greater than 30 inches); a high incidence of large trees with various deformities (large cavities, broken tops, mistletoe infections, and other evidence of decadence); large snags; large accumulations of fallen trees and other woody debris on the ground; and sufficient open space below the canopy for spotted owls to fly (Thomas *et al.* 1990). Forested stands with high canopy closure also provide thermal cover (Weathers *et al.* 2001) and protection from predators.

While spotted owls nest almost exclusively in trees, foraging habitat generally has attributes similar to those of nesting and roosting habitat, but such habitat may not always support successfully nesting pairs (USFWS 1992b). Dispersal habitat, at a minimum, consists of stands with adequate tree size and canopy closure to provide protection from avian predators and at least minimal foraging

opportunities (USFWS 1992b). Forsman *et al.* (2002) found that spotted owls could disperse through highly fragmented forest landscapes, yet the stand-level and landscape-level attributes of forests needed to facilitate successful dispersal have not been thoroughly evaluated (Buchanan 2004). There is little evidence that small openings in forest habitat influence the dispersal of spotted owls, but large, non-forested valleys such as the Willamette Valley apparently are barriers to both natal and breeding dispersal (Forsman *et al.* 2002). The degree to which water bodies, such as the Columbia River and Puget Sound, function as barriers to dispersal is unclear, although radio telemetry data indicate that spotted owls move around large water bodies rather than cross them (Forsman *et al.* 2002). (See Appendix F for a discussion about the role of Federal lands play in providing dispersal habitat for the spotted owl).

Recent landscape-level analyses in portions of Oregon Coast and California Klamath provinces suggest that a mosaic of late-successional habitat interspersed with other seral conditions may benefit spotted owls more than large, homogeneous expanses of older forests (Zabel *et al.* 2003; Franklin *et al.* 2000; Meyer *et al.* 1998). In Oregon Klamath and Western Oregon Cascade provinces, Dugger *et al.* (2005) found that apparent survival and reproduction was positively associated with the proportion of older forest near the territory center (within 730 meters) (2,395 feet). Survival decreased dramatically when the amount of non-habitat (non-forest areas, sapling stands, etc.) exceeded approximately 50 percent of the home range (Dugger *et al.* 2005). The authors concluded that they found no support for either a positive or negative direct effect of intermediate-aged forest—that is, all forest stages between sapling and mature, with total canopy cover greater than 40 percent—on either the survival or reproduction of spotted owls. It is unknown how these results were affected by the low habitat fitness potential in their study area, which Dugger *et al.* (2005) stated was generally much lower than those in Franklin *et al.* (2000) and Olson *et al.* (2004), and the low reproductive rate and survival in their study area, which they reported were generally lower than those studied by Anthony *et al.* (2006). Olson *et al.* (2004) found that reproductive rates fluctuated biennially and were positively related to the amount of edge between late-seral and mid-seral forests and other habitat classes in the central Oregon Coast Range. Olson *et al.* (2004) concluded that their results indicate that while mid-seral and late-seral forests are important to spotted owls, a mixture of these forest types with younger forest and non-forest may be best for spotted owl survival and reproduction in their study area.

One study indicated that while mid-seral and late-seral forests are important to spotted owls, a mixture of these forest types with younger forest and non-forest may be best for spotted owl survival and reproduction in certain parts of the range.

While the effects of wildfire on spotted owls and their habitat vary, in the fire-adapted portions of the spotted owl's range, low- to moderate-severity fires may contribute to this mixture of habitats. Bond *et al.* (2002) examined the demography of the three spotted owl subspecies after wildfires, in which

wildfire burned through spotted owl nest and roost sites in varying degrees of severity.¹² Post-fire demography parameters for the three subspecies were similar or better than long-term demographic parameters for each of the three subspecies in those same areas (Bond *et al.* 2002). In a preliminary study conducted by Anthony and Andrews (2004) in the Oregon Klamath Province, their sample of spotted owls appeared to be using a variety of habitats within area of the Timbered Rock fire, including areas where burning had been moderate. In 1994, the Hatchery Complex fire burned 17,603 hectares in the Wenatchee National Forest in Washington's eastern Cascades, affecting six spotted owl activity centers (Gaines *et al.* 1997). Spotted owl habitat within a 2.9 1.8 mile of the activity centers was reduced by 8 to 45 percent (mean = 31 percent) as a result of the direct effects of the fire and by 10 to 85 percent (mean = 55 percent) as a result of delayed mortality of fire-damaged trees and insects. Direct mortality of spotted owls was assumed to have occurred at one site, and spotted owls were present at only one of the six sites 1 year after the fire. In 1994, two wildfires burned in the Yakama Indian Reservation in Washington's eastern Cascades, affecting the home ranges of two radio-tagged spotted owls (King *et al.* 1997). Although the amount of home ranges burned was not quantified, spotted owls were observed using areas that burned at low and medium intensities. No direct mortality of spotted owls was observed, even though thick smoke covered several spotted owl site-centers for a week. It appears that, at least in the short term, spotted owls may be resilient to the effects of wildfire – a process with which they have evolved. More research is needed to further understand the relationship between fire and spotted owl habitat use.

Spotted owls may be found in younger forest stands that have the structural characteristics of older forests or retained structural elements from the previous forest. In redwood forests and mixed conifer-hardwood forests along the coast of northwestern California, considerable numbers of spotted owls also occur in younger forest stands, particularly in areas where hardwoods provide a multi-layered structure at an early age (Thomas *et al.* 1990; Diller and Thome 1999). In mixed conifer forests in the eastern Cascades in Washington, 27 percent of nest sites were in old-growth forests, 57 percent were in the understory reinitiation phase of stand development, and 17 percent were in the stem exclusion phase (Buchanan *et al.* 1995). In the western Cascades of Oregon, 50 percent of spotted owl nests were in late-seral/old-growth stands (greater than 80 years old), and none were found in stands of less than 40 years old (Irwin *et al.* 2000).

In the Western Washington Cascades, spotted owls roosted in mature forests dominated by trees greater than 50 centimeters (19.7 inches) dbh with greater than 60 percent canopy closure more often than expected for roosting during the non-breeding season. Spotted owls also used young forest (trees of 20 to 50 centimeters (7.9 inches to 19.7 inches) dbh with greater than 60 percent canopy closure) less often than expected based on this habitat's availability (Herter *et al.* 2002). In the Coast Ranges, Western Oregon Cascades and the Olympic

¹² Fire severity is defined in several ways. See the individual studies cited for further information on the definitions of fire severity.

Peninsula, radio-marked spotted owls selected for old-growth and mature forests for foraging and roosting and used young forests less than predicted based on availability (Forsman *et al.* 1984; Carey *et al.* 1990; 1992; Thomas *et al.* 1990). Glenn *et al.* (2004) studied spotted owls in young forests in western Oregon and found little preference among age classes of young forest.

Habitat use also is influenced by prey availability. Ward (1990) found that spotted owls foraged in areas with lower variance in prey densities (that is, where the occurrence of prey was more predictable) within older forests and near ecotones of old forest and brush seral stages. Zabel *et al.* (1995) showed that spotted owl home ranges are larger and smaller where flying squirrels (*Glaucomys sabrinus*) and wood rats (*Neotoma* spp.), respectively, are the predominant prey.

Critical Habitat

On January 15, 1992, the Service designated critical habitat for the spotted owl within 190 Critical Habitat Units (CHUs), which encompass a total of nearly 6.9 million acres. CHUs total 2.2 million acres in Washington, 3.3 million acres in Oregon, and 1.4 million acres in California (USFWS 1992b). Primary constituent elements of CHUs are the physical and biological features of critical habitat essential to a species' conservation. Primary constituent elements identified in the spotted owl critical habitat final rule include those physical and biological features that support nesting, roosting, foraging, and dispersal (USFWS 1992b).

Spotted owl critical habitat was designated based on the identification of large blocks (the mean size was 41,432 acres) of suitable habitat that were well distributed across the range of the spotted owl, although not all critical habitat acres were or are suitable habitat. CHUs were intended to identify a network of habitats that provided the functions considered important to maintaining stable, self-sustaining, and interconnected populations over the range of the spotted owl, with each CHU having a local, provincial, and range-wide role in spotted owl conservation. Most CHUs were expected to provide suitable habitat for population support, some were designated primarily for connectivity, and others were designated to provide for both population support and connectivity.

Since 1994, the Service has conducted Section 7 consultations under the ESA across the range of the spotted owl on the removal or downgrading of 46,945 acres (0.68 percent) of critical habitat as a result of management-related activities, primarily on Federally managed lands. ("Downgraded" habitat is habitat that is changed from suitable nesting, roosting, or foraging habitat to unsuitable habitat.) The majority of the effects in these consultations – 33,008 acres – has been concentrated in the Western Oregon Cascades and Oregon Klamath provinces. In addition, natural events such as fire and insect outbreaks have resulted in the removal or downgrading of approximately 42,679 acres (0.62 percent) of critical habitat that existed in 1994. In general, fires have had more of a temporal impact to spotted owl critical habitat in the interior provinces of Washington and California and the southern and interior provinces of Oregon than in the coastal provinces. More than 50 percent of the spotted owl critical

habitat that was removed or downgraded because of fire can be attributed to the 1999 Megram fire that burned in north-central California and the 2002 Biscuit fire that burned in southwestern Oregon and northern California.

Although some degree of habitat modification has occurred in most provinces within the range of the spotted owl since 1994, total effects have been disproportionately distributed. Approximately 97 percent of the effects to critical habitat have been concentrated in six physiographic provinces (Eastern Washington Cascades, Western Washington Cascades, Oregon Klamath, Eastern Oregon Cascades, Western Oregon Cascades, and California Klamath [USFWS 2006]).

**Range-wide, spotted owl
Critical Habitat Units (CHUs)
overlap approximately 70
percent with NWFP reserved
land use allocations**

The Service is in the process of revising critical habitat for the spotted owl.

Conservation Efforts and Regulations

Federal Lands

Since it was signed on April 13, 1994, the NWFP has guided the management of Federal forest lands within the range of the spotted owl (USDA and USDI 1994a, 1994b). The NWFP was designed to protect large blocks of late-successional forest and provide habitat for species that depend on those forests including the spotted owl, as well as to “produce a predictable and sustainable level of timber sales and non timber resources that will not degrade or destroy the environment” (USDA and USDI 1994a). The NWFP included land-use allocations that would provide for population clusters of spotted owls (*i.e.*, demographic support) and maintain connectivity between population clusters. Certain land use allocations in the plan contribute to supporting population clusters: Late-Successional Reserves (LSRs), Managed Late-successional Areas, and congressionally reserved areas. Riparian Reserves, Adaptive Management Areas and Administratively Withdrawn areas can provide both demographic support and connectivity/dispersal between the larger blocks, but were not necessarily designed for that purpose. Matrix areas were to support timber production while also retaining biological legacy components important to old-growth obligate species that would persist into future managed timber stands.

The NWFP amended the 19 national forest and seven BLM district LRMPs that guide management of individual national forests and BLM districts across the range of the spotted owl. The LRMPs adopted a set of reserves and standards and guidelines described in the Record of Decision (ROD) for the NWFP. Throughout this Plan, use of the term "LRMPs" references the entire 26 LRMPs that were amended by the NWFP.

The NWFP with its rangewide system of LSRs was based on work completed by three previous studies (Thomas et. al. 2006): the 1990 Interagency Scientific Committee (ISC) Report (Thomas et. al. 1990), the 1991 report for the

Conservation of Late-successional Forests and Aquatic Ecosystems (Johnson *et al.* 1991), and the 1993 report of the Scientific Assessment Team (Thomas *et al.* 1993). In addition, the 1992 Draft Recovery Plan for the Northern Spotted Owl (USFWS 1992b) was based on the ISC report.

The Forest Ecosystem Management Assessment Team predicted, based on expert opinion, the spotted owl population would decline in the matrix land use allocation over time, while the population would stabilize and eventually increase within LSRs as habitat conditions improved over the next 50 to 100 years (USDA *et al.* 1993; USDA and USDI 1994a, 1994b). Based on the results of the first decade of monitoring, Lint (2005) could not determine whether implementation of the NWFP would reverse the spotted owl's declining population trend because not enough time had passed to provide the necessary measure of certainty. However, the results from the first decade of monitoring do not provide any reason to depart from the objective of habitat maintenance and restoration as described in the NWFP and incorporated into LRMPs (Lint 2005; Noon and Blakesley 2006). Bigley and Franklin (2004) suggested that more fuels treatments are needed in east-side forests to preclude large-scale losses of habitat to stand-replacing wildfires. Other stressors that occur in suitable habitat, such as the range expansion of the barred owl (already in action) and infection with WNV (which may or may not occur) may complicate the conservation of the spotted owl. Recent reports about the status of the spotted owl offer few management recommendations to deal with these emerging threats.

Non-Federal Lands

In the report from the Interagency Scientific Committee (Thomas *et al.* 1990), the draft Recovery Plan (USFWS 1992b), and the report from the Forest Ecosystem Management Assessment Team (USDA *et al.* 1993), it was noted that limited Federal ownership in some areas constrained the ability to form a network of old-forest reserves to meet the conservation needs of the spotted owl. In these areas in particular, non-Federal lands would be important to the range-wide goal of achieving conservation and recovery of the spotted owl. The Service's primary expectations for private lands are for their contributions to demographic support (pair or cluster protection) to Federal lands, or their connectivity with Federal lands. In addition, timber harvest within each State is governed by rules that provide protection of spotted owls or their habitat to varying degrees.

There are 15 current or completed Habitat Conservation Plans (HCPs) that have incidental take permits issued for spotted owls – eight in Washington, three in Oregon, and four in California. The HCPs range in size from 40 acres to more than 1.6 million acres, although not all acres are included in the mitigation for spotted owls. In total, the HCPs cover approximately 2.9 million acres (9.1 percent) of the 32 million acres of non-Federal forest lands in the range of the spotted owl. The period of time that the HCPs will be in place ranges from 5 to 100 years; however, most of the HCPs are of fairly long duration. While each HCP is unique, there are several general approaches to mitigation of incidental take:

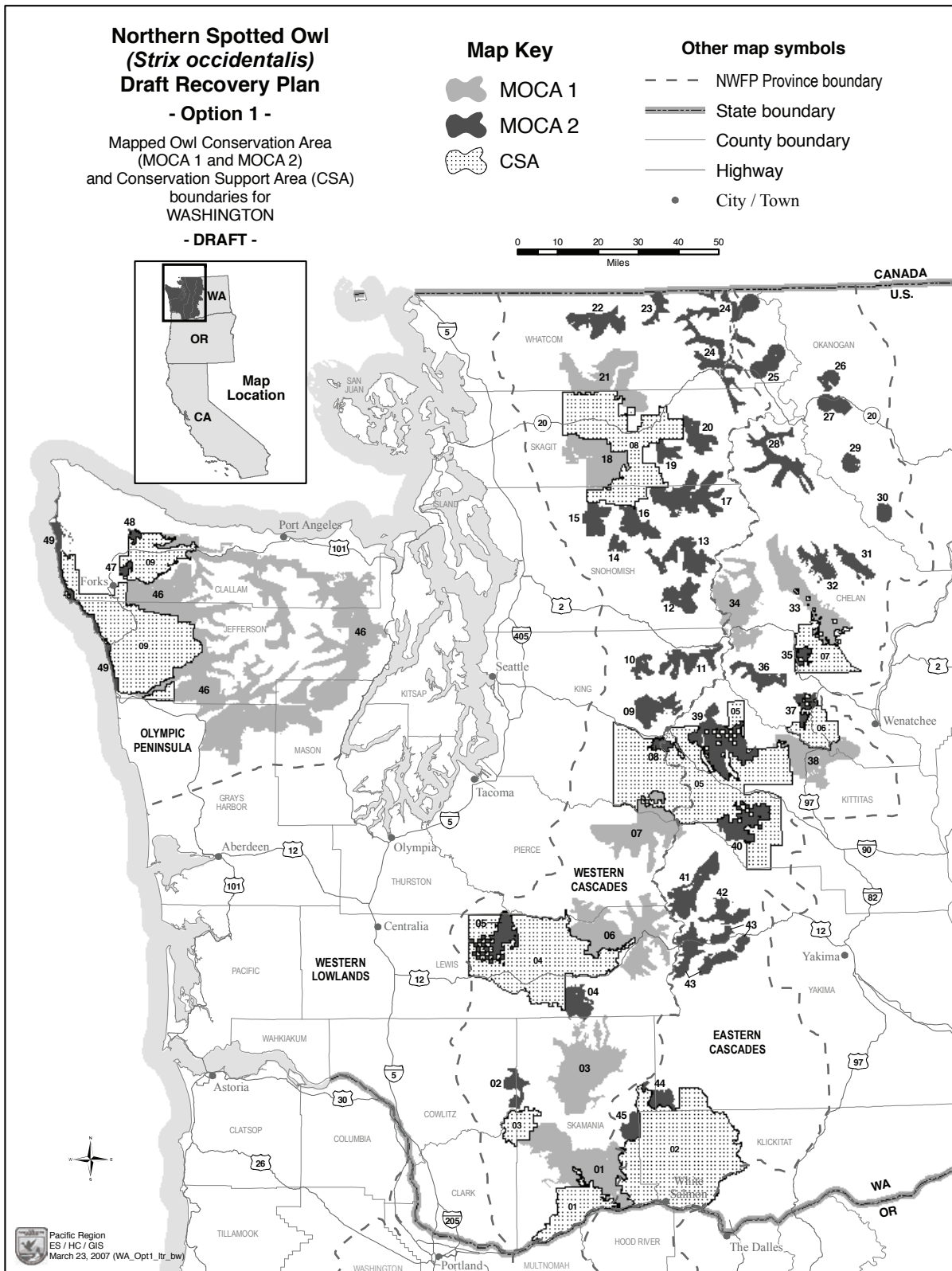
- Reserves of various sizes, some associated with adjacent Federal reserves
- Forest harvest that maintains or develops suitable habitat
- Forest management that maintains or develops dispersal habitat
- Deferral of harvest near specific sites

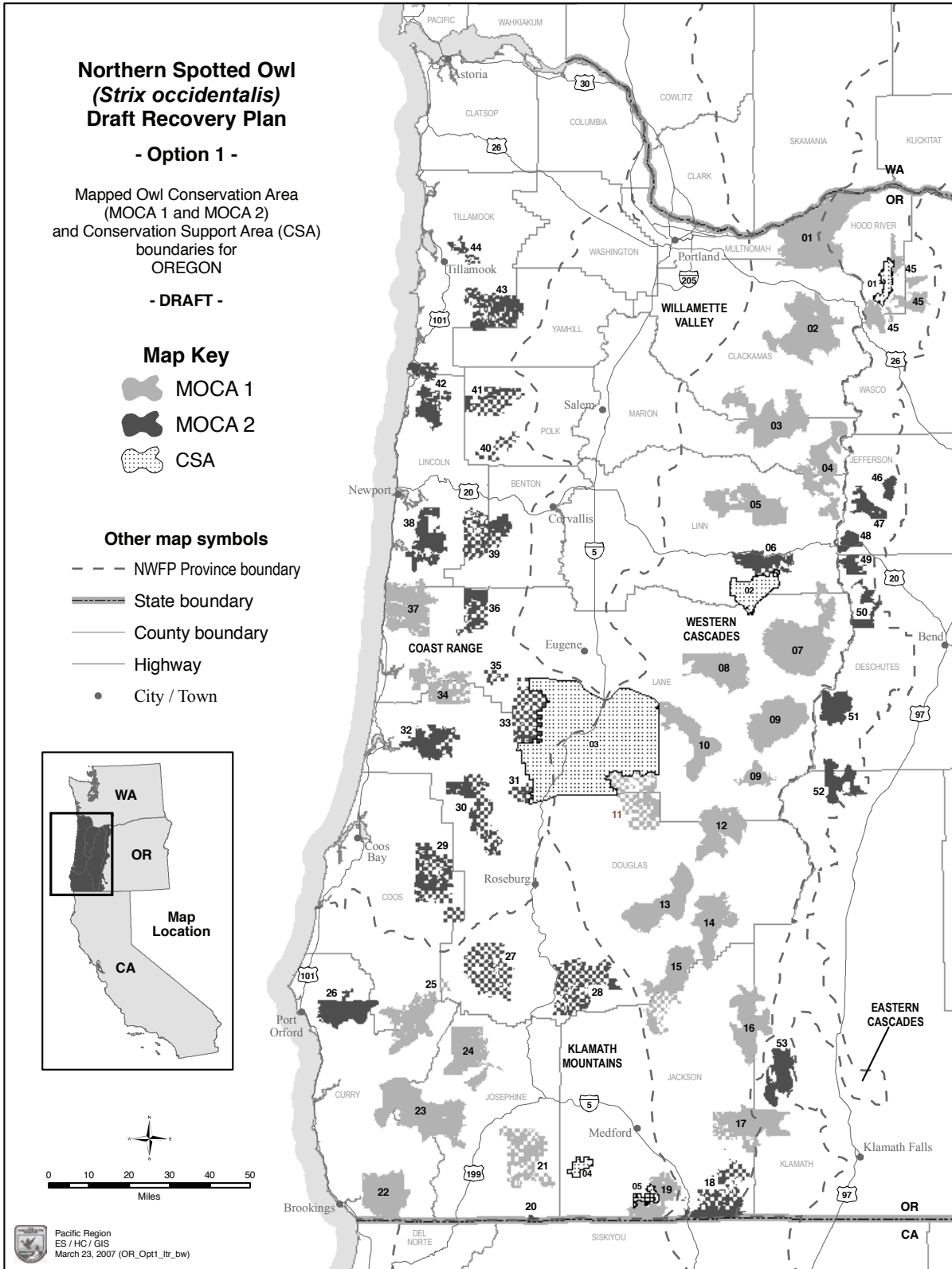
Washington. In 1996, the State Forest Practices Board adopted rules (Washington Forest Practices Board 1996) that would contribute to conserving the spotted owl and its habitat on non-Federal lands. Adoption of the rules was based in part on recommendations from a Science Advisory Group that identified important non-Federal lands and recommended roles for those lands in spotted owl conservation (Hanson *et al.* 1993; Buchanan *et al.* 1994). The 1996 rule package was developed by a stakeholder policy group and then reviewed and approved by the Forest Practices Board (Buchanan and Swedeen 2005). Spotted owl-related HCPs in Washington generally were intended to provide demographic or connectivity support (USFWS 1992b).

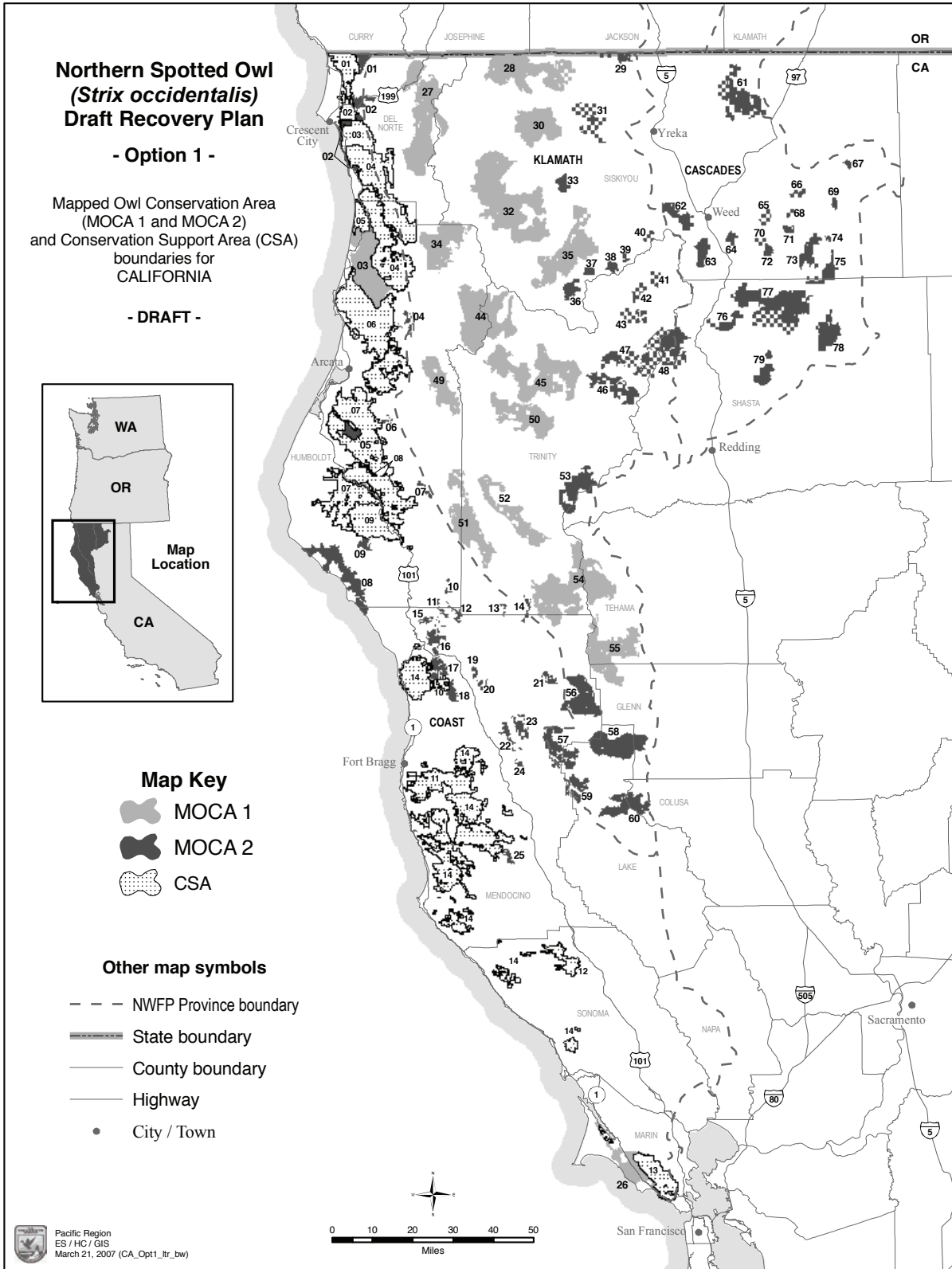
Oregon. The Oregon Forest Practices Act provides for protection of 70-acre core areas around sites occupied by an adult pair of spotted owls capable of breeding (as determined by recent protocol surveys), but it does not provide for protection of spotted owl habitat beyond these areas (ODF 2006). The three spotted owl-related HCPs currently in effect cover more than 300,000 acres of non-Federal lands. These HCPs are intended to provide some nesting habitat and connectivity over the next few decades.

California. In 1990, State Forest Practice Rules, which govern timber harvest on private lands, were amended to require surveys for spotted owls in suitable habitat and to provide protection around activity centers (CDF 2001). Under the Forest Practice Rules, no timber harvest plan can be approved if it is likely to result in incidental take of Federally listed species, unless the take is authorized by a Federal HCP. The California Department of Fish and Game initially reviewed all timber harvest plans to ensure that take was not likely to occur; the Service took over that review function in 2000. Several large industrial owners operate under spotted owl management plans that have been reviewed by the U.S. Fish and Wildlife Service and that specify basic measures for spotted owl protection. Four HCPs authorizing take of spotted owls have been approved; these HCPs cover more than 669,000 acres of non-Federal lands. Implementation of these plans is intended to provide for spotted owl demographic and connectivity support to NWFP lands.

Appendix B. Maps of MOCAs (Option 1)

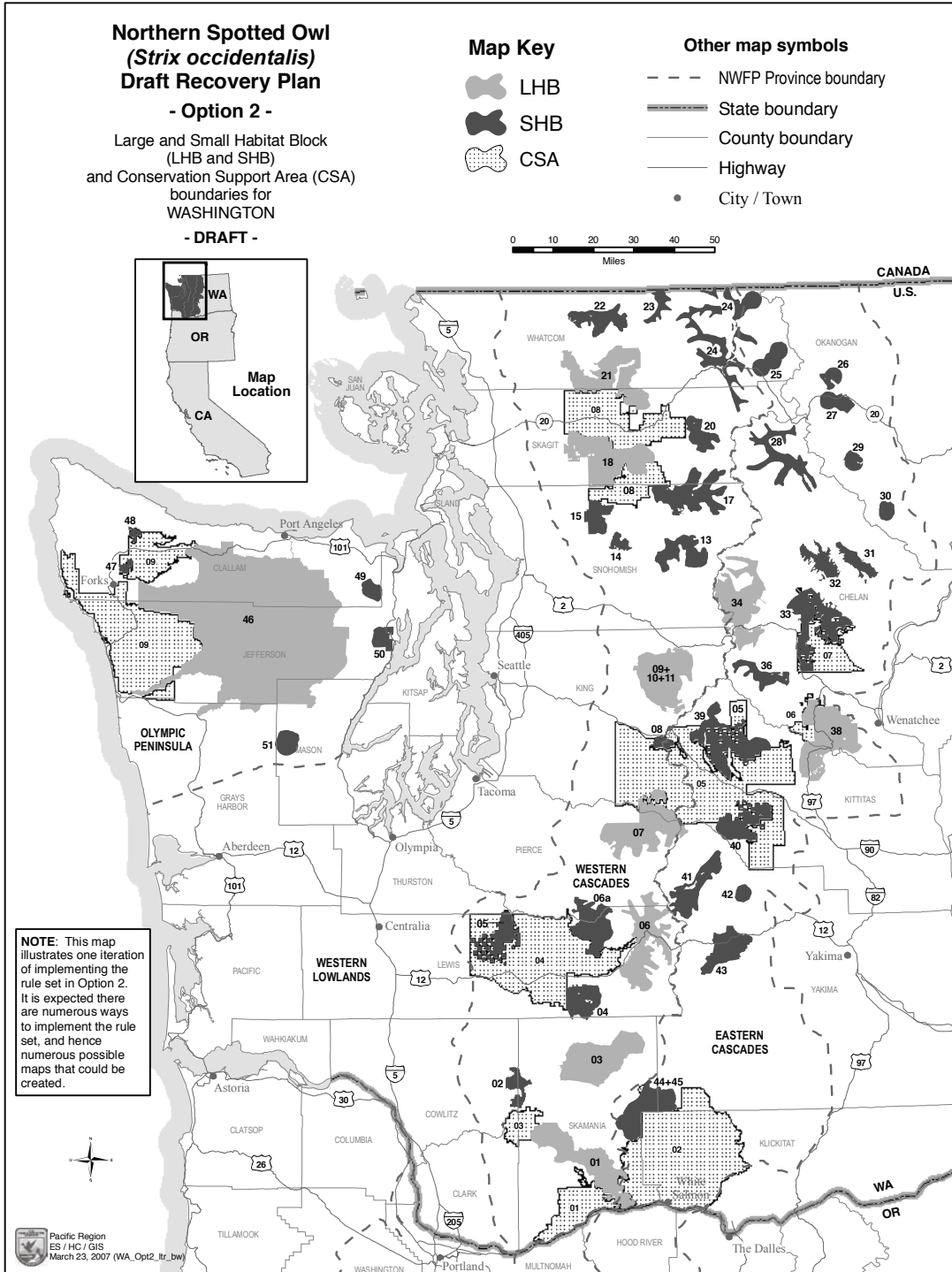


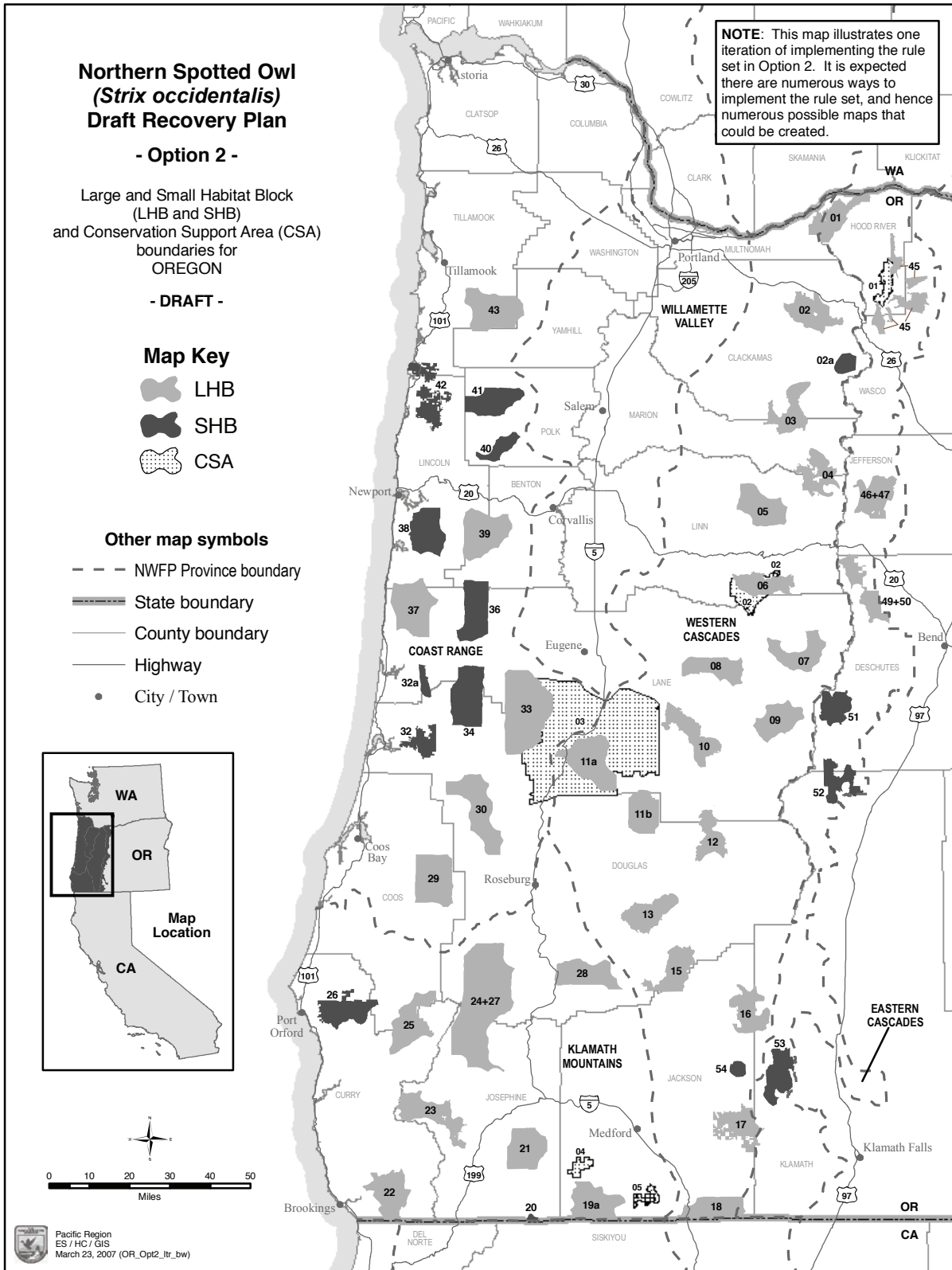


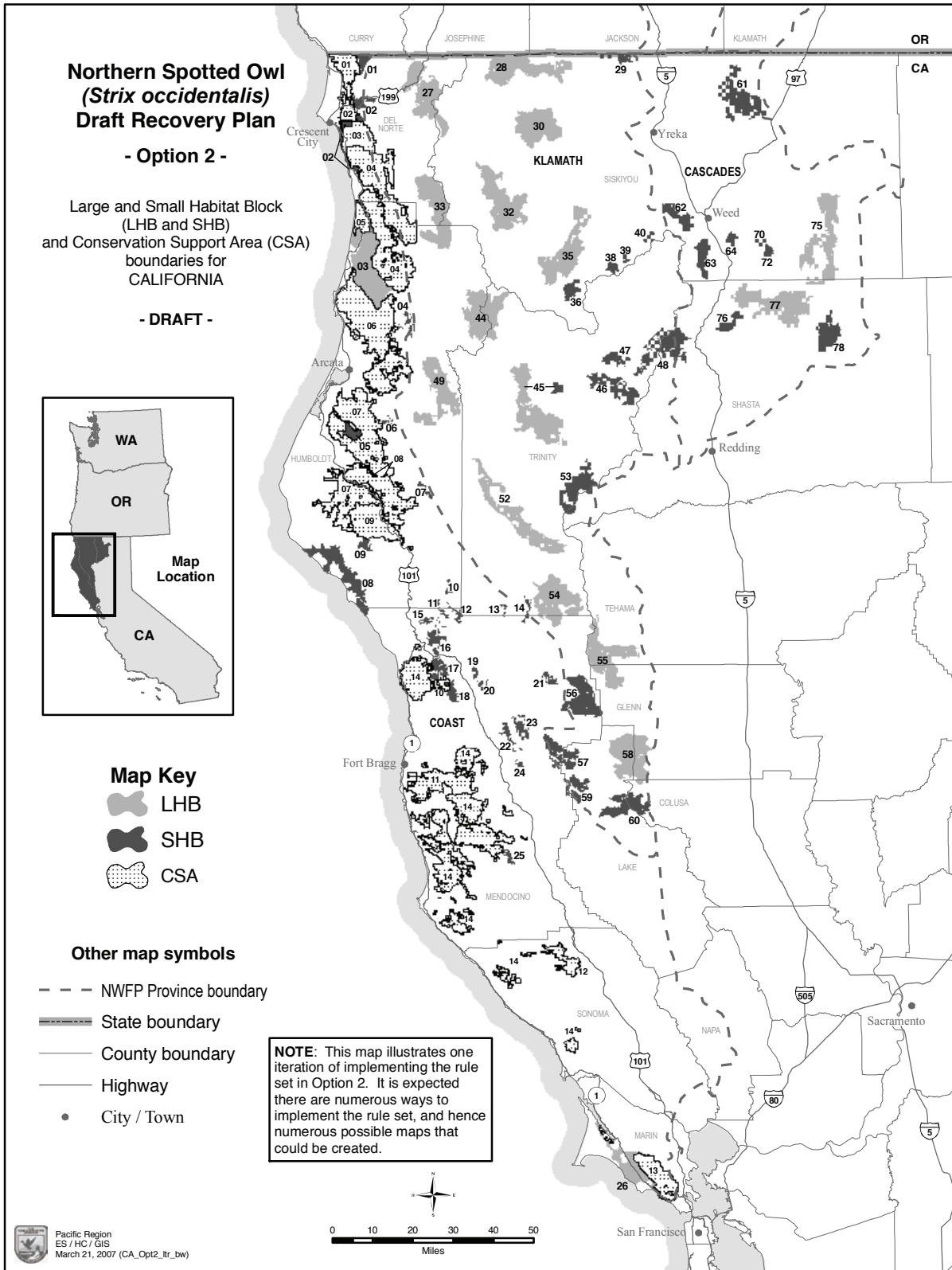


Appendix B. Example Map of Habitat Blocks (Option 2)

The attached maps represent one example of implementing the habitat blocks rule set (see the Recovery Strategy, Recovery Goal, and Recovery Objectives section).







Appendix C. Threats (*Options 1 and 2*)

Barred Owl

With its recent expansion to as far south as Marin County, California (Gutiérrez *et al.* 2004), the barred owl's range now completely overlaps that of the northern spotted owl. Barred owls may be competing with spotted owls for prey (Hamer *et al.* 2001) and habitat (Hamer *et al.* 1989; Dunbar *et al.* 1991; Herter and Hicks 2000; Pearson and Livezey 2003). In addition, barred owls physically attack spotted owls (Pearson and Livezey 2003) and circumstantial evidence indicated that a barred owl killed a spotted owl (Leskiw and Gutiérrez 1998). Data indicating negative effects of barred owls on spotted owls are largely correlational and are almost exclusively gathered incidentally to data collected on spotted owls (Gutiérrez *et al.* 2004, Livezey and Fleming In Press). It is widely believed, but not conclusively confirmed, that the two species of owls are competing for resources. However, given that the presence of barred owls has been identified as a negative effect while using methods designed to detect a different species (spotted owls), it seems safe to presume that the effects are stronger than estimated. Because there has been no research to quantitatively evaluate the strength of different types of competitive interactions, such as resource partitioning and competitive interference, the particular mechanism by which the two owl species may be competing is not known.

Barred owls were initially thought to be more closely associated with early successional forests than spotted owls are, based on studies conducted on the west slope of the Cascades in Washington (Hamer 1988; Iverson 1993). However, recent studies conducted in the Pacific Northwest show that barred owls frequently use mature and old-growth forests (Pearson and Livezey 2003; Gremel 2005; Schmidt 2006). The only study comparing food habits of spotted and barred owls in the Pacific Northwest reported that the diets of barred owls and spotted owls overlapped by 76 percent (Hamer *et al.* 2001). However, barred owl diets are more diverse than spotted owl diets and include species associated with riparian and other moist habitats, along with more terrestrial and diurnal species (Hamer *et al.* 2001).

The presence of barred owls has been reported to reduce spotted owl detectability, site occupancy, reproduction, and survival. Olson *et al.* (2005) and Crozier *et al.* (2006) found that the presence of barred owls significantly reduced the detectability (calling behavior) of spotted owls. Kelly *et al.* (2003:51) reported that the occupancy of historical territories by spotted owls in Washington and Oregon was significantly lower ($p < 0.001$) after barred owls were detected within 0.5 miles of the territory center but was "only marginally lower" ($p = 0.06$) if barred owls were located more than 0.5 miles from the spotted owl territory center. Pearson and Livezey (2003) found that there were significantly more barred owl site-centers in unoccupied spotted owl circles than occupied spotted

owl circles (centered on historical spotted owl site-centers) with radii of 0.5 miles ($p = 0.001$), 1 mile ($p = 0.049$), and 1.8 miles ($p = 0.005$) in Gifford Pinchot National Forest. In Olympic National Park, Gremel (2005) found a significant decline ($p = 0.01$) in spotted owl pair occupancy at sites where barred owls had been detected, while pair occupancy remained stable at spotted owl sites without barred owls. Olson *et al.* (2005) found that the annual probability that a spotted owl territory would be occupied by a pair of spotted owls after barred owls were detected at the site declined by 5 percent in the HJ Andrews study area, 12 percent in the Coast Range study area, and 15 percent in the Tyee study area.

Olson *et al.* (2004) found that the presence of barred owls had a significant negative effect on the reproduction of spotted owls in the Roseburg study area located in the central Coast Range of Oregon. Anthony *et al.* (2006) found significant evidence for negative effects of barred owls on apparent survival of spotted owls in two of 14 study areas (Olympic and Wenatchee). They attributed the equivocal results for most of their study areas to the coarse nature of their barred owl covariate. It is likely that the above analyses underestimated the effects of barred owls on the reproduction of spotted owls because spotted owls often cannot be relocated after they are displaced by barred owls (E. Forsman 2006 pers. comm.). The conclusion that barred owls had no significant effect on the reproduction of spotted owls in one study in the western Washington Cascades (Iverson 2004) was unfounded because of small sample sizes (Livezey 2005).

In a recent analysis of more than 9,000 banded spotted owls throughout their range, only 47 hybrids were detected (Kelly and Forsman 2002). Consequently, hybridization with the barred owl is considered to be “an interesting biological phenomenon that is probably inconsequential, compared with the real threat—direct competition between the two species for food and space” (Kelly and Forsman 2004:808).

The preponderance of evidence suggests that barred owls are exacerbating the spotted owl population decline, particularly in Washington, portions of Oregon, and the northern coast of California (Gutiérrez *et al.* 2004; Olson *et al.* 2005). There is no evidence that the increasing trend in barred owls has stabilized in any portion of the spotted owl’s range in the western United States (e.g., Pearson and Livezey 2003, In Press), and “there are no grounds for optimistic views suggesting that barred owl impacts on northern spotted owls have been already fully realized” (Gutiérrez *et al.* 2004:7-38). The threat from the barred owl was recognized to be significant. Moreover, it was the only threat whose actions received any priority 1s in this Plan.

Loss of Habitat

Historical Levels of Old-Growth/Mature Forest and Rates of Loss. In 1990, the Service estimated that spotted owl habitat had declined 60 to 88 percent since the early 1800s (USFWS 1990b). This loss, which was concentrated mostly at lower elevations and in the Coast Ranges, was attributed primarily to timber harvest

and land-conversion activities, and to a lesser degree to natural perturbations (USFWS 1990a). Davis and Lint (2005) compared the current condition of forests throughout the range of the species to maps from the 1930s and 1940s and found that, in Oregon and Washington, fragmentation of forests had increased substantially; in some physiographic provinces, the increase was more than five-fold. However, fragmentation in California decreased, which the authors speculate may be due to fire suppression in fire-dependent provinces (Davis and Lint 2005).

Current Rates of Loss of Suitable Habitat as a Result of Timber Harvest. Until 1990, the annual rate of removal of spotted owl habitat on national forests as a result of logging was approximately 1 percent per year in California and 1.5 percent per year in Oregon and Washington. Anticipated future rates of habitat removal on BLM lands in Oregon at that time were projected to eliminate all suitable habitat on non-protected BLM lands (except the Medford District) within 26 years (USFWS 1990b).

Since 1990, there have been only a few efforts that have produced indices or more direct estimates of trends or change in the amount of suitable habitat for spotted owls. A recent study (Cohen *et al.* 2002) reported landscape-level changes in forest cover across the Pacific Northwest using remote sensing technology. According to the study, “there was a steep decline in harvest rates between the late 1980s and the early 1990s on State and Federal and private industrial forest lands” (Bigley and Franklin 2004:6-11). Not all forested land is necessarily suitable habitat for spotted owls, so the area of forest that is cut does not necessarily equate to the area of spotted owl habitat removed. However, although these estimates of harvest rates do not translate directly to changes in the amount of spotted owl habitat, they do provide some insight into harvest trends since 1980 (Bigley and Franklin 2004).

The trend analysis for habitat of the spotted owl conducted by the Service (USFWS 2004a) and reported in Bigley and Franklin (2004) indicated an overall decline of approximately 2.11 percent in the amount of suitable habitat on Federal lands as a result of range-wide management activities from 1994 to 2003 (Table C1). This rate of loss is lower than the 2.5 percent-per-decade estimate of habitat loss resulting from management activities that was predicted in the NWFP (USDA and USDI 1994a). The majority of management-related habitat loss was in Oregon, which contributed more than 75 percent of the habitat removed range-wide (121,735 acres). In particular, the amount of habitat in the Oregon Klamath Province has declined by 6.8 percent (53,468 acres) since 1994, which represents an average annual rate of 0.76 percent (Table B1). The California Cascades Province, where the amount of habitat has declined by 5.77 percent (5,091 acres, which represents an average annual decline of 0.64 percent), is the only other area that has shown a relatively high rate of habitat loss during the 9 years of record. Because this province has a smaller habitat baseline, it contributes less to the range-wide rate.

Raphael (2006) estimates that approximately 7.5 million acres of spotted owl habitat existed on non-Federal lands within California, Oregon, and Washington in 1994 (Table C1). Cohen *et al.* (2002) reported that, from the early 1970s through the mid-1990s, the harvest rates on private industrial lands were consistently about twice the average rate of harvest on public land. “In the late 1980s and early 1990s the harvest rate was estimated at 2.4 percent per year for private industrial land. An increase in private landowner harvest rates started in the 1970s when the rate was 0.2 percent per year and continued to increase to the early 1990s when the rate was similar to that of the private industrial lands” (Bigley and Franklin 2004:6-11). Again, these estimates can only be used to infer rates of forest removal on Federal and non-Federal lands and may or may not translate into the same comparisons with respect to habitat loss (i.e. the harvest may not have removed spotted owl habitat). The estimates may also provide some insight into the potential differences in the rates of habitat loss on different land ownerships (Bigley and Franklin 2004). Raphael (2006) estimates that, since 1994, losses of spotted owl habitat from non-Federal timber harvest have far outpaced losses from Federal land, with the range-wide loss at 8.0 percent (12.0 percent in Washington, 10.7 percent in Oregon, and 2.2 percent in California).

Table C1. Summary of lost habitat acres and percent change in northern spotted owl habitat on Federal lands as a result of management activities from 1994 to 2003 (Bigley and Franklin 2004).

Physiographic Province	Forest Plan Baseline (acres)	Management Changes (acres)	Percent Change	Average Annual Rate of Change
Olympic Peninsula	560,217	-87	-0.02	-0.002
Eastern WA Cascades	706,849	-5,024	-0.71	-0.08
Western WA Cascades	1,112,480	-11,139	-1.00	-0.11
Western WA Lowlands	0	0	0	0
OR Coast Range	516,577	-3,278	-0.63	-0.07
OR Klamath	786,298	-53,468	-6.80	-0.76
Eastern OR Cascades	443,659	-13,867	-3.13	-0.35
Western OR Cascades	2,045,763	-51,122	-2.50	-0.28
Willamette Valley	5,658	0	0	0
CA Coast	51,494	-250	-0.49	-0.05
CA Cascades	88,237	-5,091	-5.77	-0.64
CA Klamath	1,079,866	-12,673	-1.17	-0.13
Regional Total	7,397,098	-155,999	-2.11	-0.23

Raphael (2006) conducted a different analysis of habitat loss, this time looking solely at losses due to regeneration harvest. His analysis estimates that nearly 3,000 acres of higher-suitability spotted owl nesting habitat (see Davis and Lint

2005) were harvested on Federal reserved and nearly 26,000 acres of such habitat were harvested on non-reserved lands between 1994 and 2004 (Table C2). This represents less than 1 percent of the over 10 million acres of higher-suitability spotted owl nesting habitat believed to have existed in 1994.

Table C2. Estimated amount of spotted owl habitat at the start of the Northwest Forest Plan (baseline) and losses owing to regeneration harvest from 1994 to 2004, by State and ownership (Adapted from Raphael 2006).

Land Class	Baseline (1994 acres)	Harvest (acres)	Percent Change 1994-2004
	<i>Higher suitability nesting habitat (HS > 40)^a</i>		
Federal reserved	<i>Thousands of acres</i>		
Washington	1964.5	0.4	0.02
Oregon	3002.5	1.6	0.05
California	1754.4	0.9	0.05
<i>Range</i>	6721.4	2.9	0.04
Federal nonreserved			
Washington	531.4	3.2	0.6
Oregon	1944.4	15.7	0.8
California	1104.8	4.1	0.4
<i>Range</i>	3580.6	23	0.6
Non-Federal			
Washington	1748.3	209.6	12.0
Oregon	2906.0	310.6	10.6
California	2910.7	63.3	2.2
<i>Range</i>	7565.0	583.5	7.7
Range Total	17,867	609.4	8.34

^a See Davis and Lint (2005) for methods of defining habitat suitability (HS).

^b Losses represent stand-replacing events, not partial harvest.

Current Rates of Loss of Suitable Habitat as a Result of Natural Events. Habitat loss resulting from natural events in the 10-year period from 1994 to 2003 was 224,041 acres, which equates to a 3.03 percent decline in available habitat range-wide (USFWS 2004a). Most natural loss of habitat resulted from wildfires (75 percent of natural event losses), followed by insects and disease (25 percent). Very little loss from wind throw was reported (Table C3).

The effects of wildfire on spotted owls and their habitat vary by location and by fire intensity. Low-severity fires generally result in habitat mosaics improving

spotted owl habitat, while high-severity fires commonly result in the loss of spotted owl habitat. Mixed-severity fires vary in their impact to spotted owl habitat and may result in delayed mortality of trees, making impacts difficult to determine until well after the fire is over (USFWS 2004a).

Seventy different fires contributed to the loss of habitat as a result of natural disturbances, with the amount of loss from individual fires ranging from 66 to 113,667 acres. Only 14 of 70 fires resulted in losses of suitable nesting and roosting habitat that exceeded 1,000 acres. In general, the Oregon Klamath Province suffered the highest losses of habitat from natural events, all of which were due to wildfire. Ninety-six percent of habitat loss in this province can be attributed to the Biscuit fire that burned approximately 113,667 acres of habitat on three administrative units of the Rogue River basin in 2002 (USFWS 2004a).

Information on the loss of spotted owl habitat as a result of natural disturbances on non-Federal lands was not available.

This approach estimated 600,000 acres of in-growth per decade on Federal lands, representing about an 8 percent decadal increase in forest over 80 years of age on Federal lands relative to the NWFP baseline.

Habitat Recruitment. As with habitat loss, development of suitable habitat contributes to overall trends in habitat availability and distribution. Estimates of late-successional habitat development were calculated at the regional scale using a modeled projection approach (USDA *et al.* 1993; USFWS 2004a). This approach estimated 600,000 acres of in-growth per decade on Federal lands, representing about an 8 percent decadal

increase in forest over 80 years of age on Federal lands relative to the NWFP baseline. In reality, projecting the transition of a forest's age and size classes to different levels of habitat function requires extensive field verification. Estimates of late-successional habitat development are approximations to be used on range-wide scales. Given the uncertainty about the rate of complex forest structure development in the stands older than 80 years, it is likely that habitat development was overestimated, although the extent of overestimation cannot be determined (Bigley and Franklin 2004).

Moeur *et al.* (2005) measured the rate of forest stand change in medium and large older-forest classes (defined as containing trees at least 20 inches dbh) on BLM, USDA Forest Service, and National Park Service lands during the first decade following adoption of the NWFP. They estimated the net change in these types of forests (which includes the loss of these forest classes to regeneration harvest and stand-replacing fires) as a gain of 1.25 to 1.5 million acres.

Table C3. Federal habitat lost resulting from natural disturbances from 1994 to 2002 (acres).

Physiographic Provinces	Fire	Wind	Insects and Disease	Provincial Total	Percent Change	Annual rate of change
Olympic Peninsula	-299			-299	-0.05	-0.01
Eastern WA Cascades	-5,754			-5,754	-0.81	-0.09
Western WA Cascades			-250	-250	-0.02	-0.002
Western WA Lowlands				0	0	0
OR Coast Range	-66			-66	-0.01	0
OR Klamath	-117,622			-117,622	-14.96	-1.66
Eastern OR Cascades	-4,008		-55,000	-59,008	-13.30	-1.48
Western OR Cascades	-24,583			-24,583	-1.20	-0.13
Willamette Valley				0	0	0
CA Coast	-100			-100	-0.19	-0.02
CA Cascades				0	0	0
CA Klamath	-15,869	-100	-390	-16,359	-1.51	-0.17
Regional Total	-168,301	-100	-55,640	-224,041	-3.03	-0.34

Comparison of Current Rates of Habitat Loss Resulting from Management Activities to Rates in 1990.

Average annual rates of the harvest of spotted owl habitat on Federal lands have declined substantially since 1990 (Table C4). Harvest rates on national forests in Oregon and Washington dropped from 1.5 percent (64,000 acres) per year at the time of listing to an average of 0.21 percent (10,341 acres) per year from 1994 to 2003. Harvest rates for spotted owl habitat on national forests in California dropped from 0.6 percent per year (calculated at approximately 4,700 acres) to an average of 0.14 percent (1,653 acres) per year. Harvest rates for spotted owl habitat on BLM lands in Oregon dropped from 3 percent (22,000 acres) per year in 1990 to 0.52 percent (4,911 acres) per year in 2003 (Table C4).

Table C4. Comparison of estimates of the amount of spotted owl habitat annually harvested on lands in the 10-year period prior to the listing of the northern spotted owl with the anticipated and actual rates of harvest of spotted owl habitat after the listing of the spotted owl. Values represent acres, with the average annual percentage in parentheses.

Management Agency and State	Final Listing Document ¹		5-Year Review ²
	Pre-Listing Period (about 1981 to 1990) ³	Anticipated Rates (about 1991 to 2000) ⁴	Calculated Rates ⁵ (1994 to 2003)
Forest Service in WA and OR	64,000 (1.5)	39,400 (1)	10,341 (0.21)
Forest Service in CA	Not reported ⁶	4,700 (0.6)	1,653 (0.14)
Bureau of Land Management in OR	22,000 (3)	23,400 (3)	4,911 (0.52)
Regional Total		67,500 (1)	16,905 (0.24)

¹ Habitat change values were presented in the listing document in units of acres per year, rather than as a percentage of total available habitat per year. We converted these values to annual percentage rates by dividing by the habitat amount in the Northwest Forest Plan's baseline for each management agency and geographic group and multiplying by 100 (annual percentage rates in parentheses, indicating negative changes).

² USFWS (2004b).

³ Reported in USFWS (1990b) as observed trends from 1981 to 1990.

⁴ Estimated in USFWS (1990b) as trends expected in the next decade (1991 to 2001).

⁵ Annual acreage totals calculated as the sum of effects from 1994 to 2003 divided by 9 years of record. Annual percentage rates calculated as described above.

⁶ The listing document references a rate of 12,000 acres of habitat loss per year in California, but it was unclear what time period this rate represented. Consequently, we did not include it here.

Disease. West Nile virus (WNV) has killed millions of wild birds in North America since it arrived in 1999 (McLean *et al.* 2001; Fitzgerald *et al.* 2003; Caffrey 2003; Marra *et al.* 2004). Although birds are the primary hosts of WNV, mosquitoes are the primary carriers of this virus that causes encephalitis in humans, horses, and birds. Mammalian prey may play a role in spreading WNV, if predators like spotted owls contract the disease by eating infected prey (Garmendia *et al.* 2000; Komar *et al.* 2001). One captive spotted owl in Ontario, Canada, is known to have contracted WNV and died (Gancz *et al.* 2004), but there are no documented cases of the virus in wild spotted owls.

Health officials expect that WNV eventually will spread throughout the range of the spotted owl (Blakesley *et al.* 2004), but it is unknown how the virus will ultimately affect spotted owl populations. Susceptibility to infection and the mortality rates of infected individuals vary among bird species (Blakesley *et al.* 2004), but most owls appear to be quite susceptible. For example, eastern screech-owls (*Otus asio*) breeding in Ohio that were exposed to WNV experienced 100 percent mortality (T. Grubb pers. comm. in Blakesley *et al.* 2004). Barred owls, in contrast, showed lower susceptibility (B. Hunter pers. comm. in Blakesley *et al.* 2004). Wild birds may develop resistance to WNV through immune responses (Deubel *et al.* 2001).

Blakesley *et al.* (2004) offer competing scenarios for the likely outcome of spotted owl populations being infected by WNV. One scenario is that spotted owls can tolerate severe, short-term population reductions caused by the virus because spotted owl populations are widely distributed and number in the several thousands. An alternative scenario is that the virus will cause unsustainable mortality because of the frequency and/or magnitude of infection, thereby resulting in long-term population declines and extirpation from parts of the spotted owl's current range.

Inadequacy of Regulatory Mechanisms. The original listing document (USFWS 1990b), Franklin and Courtney (2004), and the 5-year review (USFWS 2004b) noted some inadequacies in existing regulatory mechanisms. The 1990 listing rule concluded that current State regulations and policies did not provide adequate protection for spotted owls; less than 1 percent of the non-Federal lands provided long-term protection for spotted owls (USFWS 1990b). The listing rule stated that the rate of harvest on Federal lands, the limited amount of permanently reserved habitat, and the management of spotted owls based on a network of individually protected spotted owl sites did not provide adequate protection for the spotted owl. If continued, these management practices would result in an estimated 60 percent decline in the remaining spotted owl habitat, and the resulting amount of habitat might not be sufficient to ensure long-term viability of the spotted owl.

When it was adopted in 1994, the NWFP significantly altered management of Federal lands (USDA and USDI 1994a, 1994b; Noon and Blakesley 2006; Thomas *et al.* 2006). The substantial increase in reserved areas and associated reduced harvest (ranging from approximately 1 percent per year to 0.24 percent per year) has substantially lowered the timber-harvest threat to spotted owls. However, the NWFP allows some loss of habitat and assumed some unspecified level of continued decline in spotted owls. Franklin and Courtney (2004) noted that many, but not all, of the scientific building blocks of the NWFP have been confirmed or validated in the decade since the plan was adopted. One major limitation appears to be the inability of the reserve strategy presented in the plan to deal with invasive species; reserves provide no protection against viruses, fungi, or invasive owls. However, this deficiency does not diminish the important contribution of the relevant LRMPs to spotted owl conservation (Franklin and Courtney 2004).

As the Federal agencies develop new LRMPs, they will consider the conservation needs of the northern spotted owl and the goals and objectives of the Recovery Plan. If needed, actions to implement Federal land use plans will be accompanied with either plan or project level consultations to assure management actions align with recovery goals.

Appendix D. Description of Habitat Fitness and Explanation of Goals of Habitat-Capable Acres in Recovery Criterion 4 (*Options 1 and 2*)

Historical research supporting spotted owl use of mid- and late-seral forests and new studies addressing the juxtaposition of spotted owl nesting and roosting habitats to non-nesting habitats was reviewed. These studies in northwestern California (Franklin *et al.* 2000) and southern Oregon (Olson *et al.* 2004) discovered important relationships between spotted owl nesting and roosting habitat and the edge of other habitats that may produce prey. The habitat fitness rates and adult survival rates from the limited dataset provided in these two studies and were plotted against the landscape percentage of nesting habitat (Figures D1 to D3). The landscape percentage at which $\lambda_{(h)}$ (Franklin *et al.* 2000) was maximized was selected as the provincial goals listed in Criterion 4.

Figure D.1. $\lambda_{(h)}$ and adult survival plotted against the percentage of spotted owl nesting habitat within sampled home ranges (adapted from Franklin *et al.* 2000).

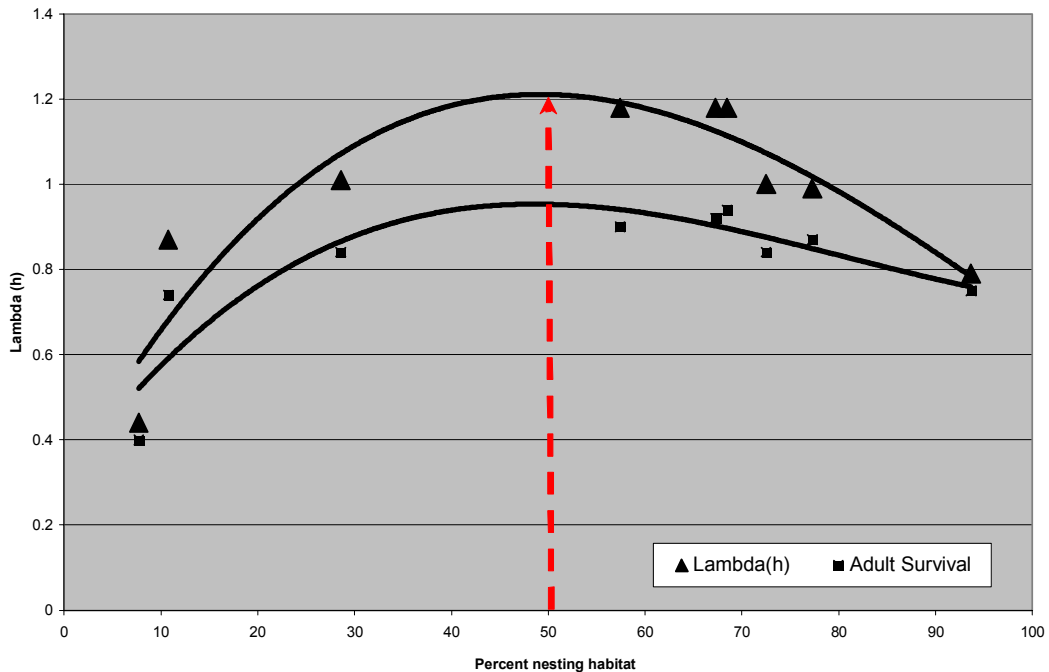


Figure D.2. Lambda (λ) plotted against the percentage of spotted owl nesting habitat within sampled home ranges (adapted from Olson *et al.* 2004).

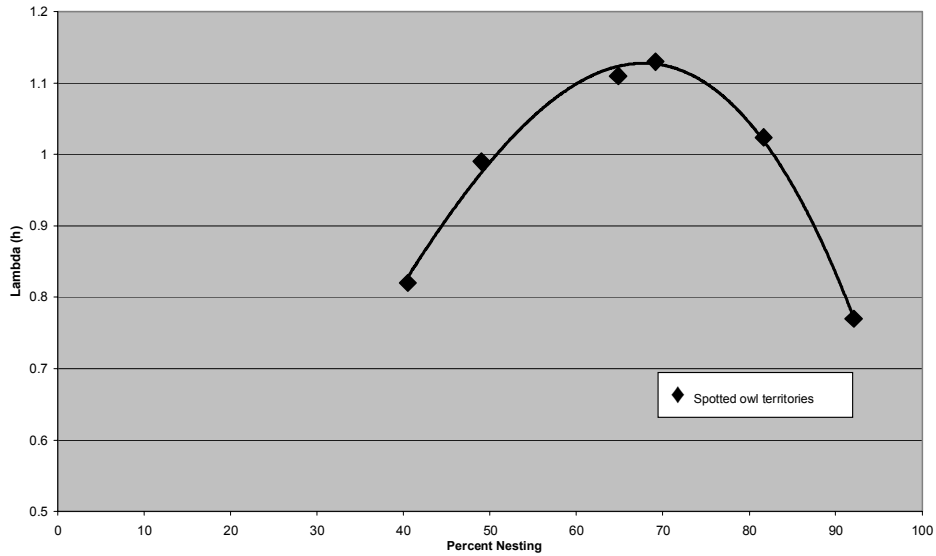
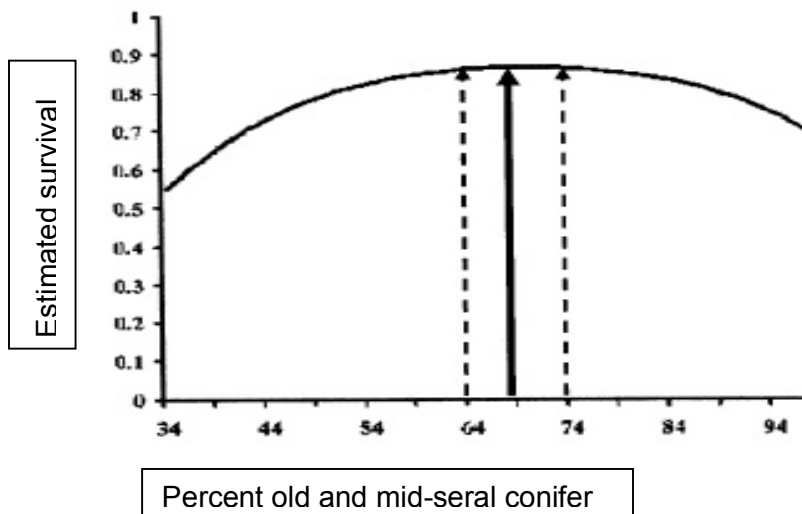


Figure D.3. Estimated spotted owl survival plotted against the percentage of spotted owl nesting habitat within sampled 1,500-meter circles centered on spotted owl activity centers (adapted from Olson *et al.* 2004).



Based on these studies, similarity of vegetation, disturbance regime, and primary prey base, the Criterion 4 landscape percentages were assigned to each

province¹³. Thus, in the California Coast, California Klamath, and California Cascades and the Oregon Klamath Provinces, the habitat threshold was set at 50 percent. Oregon Coast Range was set at 70 percent, while Western Oregon Cascades was set at 60 percent, based on the Olson study (maximum $\lambda_{(h)}$ at 67 percent) being located on the inland edge of the Oregon Coast Range and the western edge of the Western Oregon Cascades Province. Because we did not have studies in Washington or the Eastern Cascades, we used habitat studies, disturbance regimes, prey relationships, and ecological theory to assign these areas. The available prey studies from both Forsman *et al.* (2004) and Hamer *et al.* (2001) showed the expected dominant food source to be northern flying squirrel, but a significant portion of the spotted owl prey base includes species whose preferred habitats include open forests and non-forest conditions (where the available prey include rabbits, hares, gophers, moles, and mice). These two relationships led us to set the habitat criterion threshold for the Olympic Peninsula and Western Washington Cascades at 70 percent. These same factors combined with the disturbance regimes (dominated by fire) led us to set the threshold for the Eastern Cascades in both Washington and Oregon at 60 percent.

On September 20, 2006, Alan Franklin submitted a preliminary analysis that compared the proportions of older forest in sites with λ of less than or equal to 1 vs. proportions of older forest in sites with λ of greater than 1 (Franklin 2006 *in litt.*). Scientific peer review of this preliminary analysis by the recovery team and other biologists and statisticians will be conducted as part of the review process of this draft Recovery Plan.

¹³ The recovery team is especially interested in receiving scientific peer review regarding the expected spotted owl population response to these habitat levels.

Appendix E. Examples of How Recovery Action 22 Might Be Implemented (*Options 1 and 2*)

For each proposed salvage unit, place a circle the size of the provincial home range around the unit using the geometric center of the unit as the center point. Use the following step-wise analysis to estimate the trajectory of the habitat-capable acres in the circle based on the post-disturbance conditions for scenarios with and without salvage.

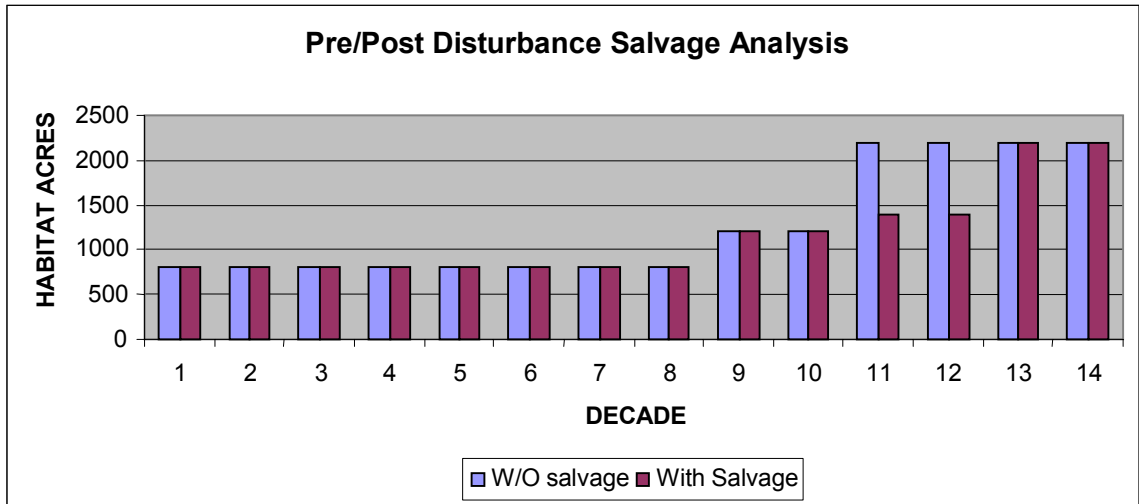
1. Draw the provincial home range circle around the proposed salvage unit.
2. Calculate the number of habitat-capable¹⁴ acres inside the circle. This will be the baseline acreage for the analysis.
3. Classify the habitat-capable acres by the number of years from the date of the last disturbance (*e.g.*, wildfire) that will be required for the acres to meet owl nesting and roosting habitat. For example, areas that met owl habitat conditions prior to the disturbance and were not affected by the event would take 0 years because they remain as habitat. Stands in the 30- to 40-year range, however, may take an additional 50 to 60 years to become spotted owl habitat. For acres of spotted owl habitat that were affected by the disturbance, take into account the legacy that remains when estimating the number of years. A stand that was owl habitat before a stand-replacing wildfire and has large, standing legacy trees may take 80 years to return to owl habitat conditions, but if there are no legacy trees the time may be 100 to 120 years.
4. Once all the habitat-capable acres have been classified, create a graph of all the acres of habitat present at 10-year steps from the disturbance date to the time when all habitat-capable acres in the circle would be owl habitat (Figure A.1). Using the graph, identify the decade when the number of acres of owl habitat would first exceed the level of habitat described in Recovery Criterion 4. This will be the benchmark time for comparison of the effect, if any, of the proposed salvage action on the time when Recovery Criterion 4 levels will be reached within the individual circles in the [MOCA (Option 1)][habitat block (Option 2)].
5. Review the classification for all habitat-capable acres that will be subject to a salvage action within the circle. Adjust the classification of the number of years it will take for them to become owl habitat if the salvage

¹⁴ Habitat-capable acres are those forest-capable lands that fall below the elevation limits where territorial owls occur, not including serpentine soil areas that do not attain the necessary tree size and canopy closure to provide habitat for territorial owls.

prescription is implemented. For example, if there were 200 severely burned acres in the circle but most or all of the trees greater than 20 inches dbh, although dead, still remained standing, you might project on (3) above that owl habitat would be restored in 80 years. If the salvage prescription removed all of these legacy trees, you would likely estimate that it would take longer (perhaps 110 years) for the acres to be restored to owl habitat. It may be possible to salvage some trees > 20" as long as enough legacy trees are left so as to not significantly increase the length of time necessary to reach the required habitat criterion levels. This analysis needs to consider, for example, the total number of trees >20" dbh on the site, adjacent habitat quality and amount, and the size and intensity of the burn or other event.

6. Once the acres proposed for salvage have been reclassified, create another graph of the all habitat-capable acres using the post-salvage estimates of time required to become owl habitat (Figure A.1). Again, identify the decade when the number of acres of owl habitat would first exceed the level of habitat described in Recovery Criterion 4.
7. Compare the decade when Recovery Criterion 4 would be achieved from the post-salvage analysis with the decade when it would occur from the post-disturbance/pre-salvage analysis. If the time to reach the Recovery Criterion 4 level of habitat in the circle is 10 years or more longer than it would take without the proposed salvage, adjust the salvage prescription and/or the number of acres to be salvaged to reduce the percentage of time required to one decade or less.

Figure A.1.



Hypothetical Examples

Figure A.1 shows a 2,200-acre provincial home-range circle where 1,500 acres equals the habitat criterion level under scenarios without salvage and with salvage.

Both scenarios begin with 800 acres of unburned habitat and 400 acres of unburned non-habitat.

Post-Disturbance Habitat Condition Scenario without Salvage

- 800 acres of unburned habitat (0 years to become habitat)
- 400 acres of unburned non-habitat (80 more years to become habitat)
- 1,000 acres of previously high-quality habitat severely burned with legacy of large standing trees (100 years to become habitat)

Post-Disturbance Habitat Condition Scenario with Salvage

- 800 acres of unburned habitat (0 years to become habitat)
- 400 acres of unburned non-habitat (80 more years to become habitat)
- 800 acres of burned salvaged with one large tree per acre retained (120 years to become habitat)
- 200 acres of burned not salvaged

In this case, the number of acres to be salvaged would be adjusted to 700 acres or less so that the 1,500-acre level is met within 1 decade or less of what it would be with no salvage.

Appendix F: Basis for the Recovery Strategy Concerning Habitat (*Option 1*)

This recovery strategy builds on concepts and information presented by the Interagency Scientific Committee in “A Conservation Strategy for the Northern Spotted Owl” (Thomas *et al.* 1990) and the 1992 Final Draft Recovery Plan for the Northern Spotted Owl (USFWS 1992). While the 1992 draft Recovery Plan was never finalized, the plan remains the most-recent spotted owl-specific analysis of habitat needed to provide for a sustainable population of spotted owls across the species’ range. The 2004 Scientific Evaluation of the Status of the Northern Spotted Owl (Courtney *et al.* 2004) also acknowledged this conservation strategy was based on sound scientific principles which have not substantially changed since the species was listed. This recovery strategy also incorporates all relevant recent peer reviewed literature. This strategy focused on the following:

- Managing large blocks of habitat in designated conservation areas throughout the range of the spotted owl that could support self-sustaining populations of 15 to 20 pairs of spotted owls and
- Spacing the blocks and managing the areas between them to permit movement of spotted owls.

Previous Recovery Efforts

1990: Interagency Scientific Committee. The Interagency Scientific Committee (ISC) delineated and mapped a network of 193 Habitat Conservation Areas (HCAs) thought necessary to ensure a viable, well-distributed population of owls. Wherever possible, each HCA was designed with the goal of being able to support a minimum of 20 pairs of owls. The maximum distance between these HCAs was 12 miles. The criterion of 20 pairs was based on models of population persistence and empirical studies of bird populations. Twelve miles was chosen as the maximum distance between HCAs because this value is within the known dispersal distance of about two-thirds of all radio-marked juvenile owls studied. The HCA concept applied primarily to BLM, FS, and NPS lands. The ISC strongly recommended that HCAs be established on State-owned lands in certain key areas to ensure population connectivity. The committee also recommended that resource managers of other State lands, Tribal lands, other Federal lands, and private lands use forestry and silvicultural techniques and practices that maintain or enhance habitat characteristics associated with spotted owls.

Each HCA was designed with the goal of being able to support a minimum of 20 pairs of owls. The maximum distance between these HCAs was 12 miles.

To facilitate the movement of spotted owls, the ISC also recommended that 50 percent of the land base between HCAs be maintained in stands of timber with an average diameter of 11 inches or greater and at least 40 percent canopy closure, even though modeling to estimate the efficacy of the HCAs assumed that the matrix between the HCAs was entirely unsuitable for owl territories (ISC, Appendix M, pg. 253).

1992: Draft Recovery Plan. The 192 Designated Conservation Areas (DCAs) in the 1992 Draft Recovery Plan were modifications of the HCAs from the ISC. The 1992 recovery team's objective in remapping the HCAs was to provide a level of

In 1992, HCAs were modified to create DCAs, to increase the biological and economic efficiency of the network and address deficiencies identified in the HCA network.

habitat protection in the DCAs that was at least equal to that provided by HCAs, while increasing the biological and economic efficiency of the network. The 1992 recovery team also attempted to address deficiencies identified in the HCA network. The fundamental sizing and spacing criteria from Thomas *et al.* (1990) were applied during mapping of the DCAs.

The following additional criteria were used in the 1992 effort to establish DCAs based on HCAs:

- Areas were mapped to include as much high-quality habitat and as many owl locations as possible to achieve an effective and efficient network. Where more effective acres were added to DCAs (meaning acres with more spotted owl locations or better habitat), opportunities were sought to drop less effective areas so that the total area did not increase.
- DCA boundaries were adjusted to accommodate other species' sites where this adjustment could be made without significantly increasing the economic impact of the DCA or significantly decreasing its effectiveness in spotted owl conservation.
- Areas were mapped to include as high a proportion of Federal reserved lands and other lands unsuitable for timber production as possible when consistent with mapping criteria from Thomas *et al.* (1990).
- Where possible, DCA boundaries were modified to place acres capable of full timber yield back into the timber base and replace them in the DCA with acres from which only partial yields were expected because of forest plan allocations.
- In areas where the existing network was identified to be deficient for supporting the desired number of reproducing spotted owls, attempts were made to provide for new spotted owl clusters and populations with the least possible economic impact.
- Where possible, boundaries were refined to avoid conflict with other economic development proposals.

Following the HCA system, DCAs were established that contained approximately 7.6 million acres of Federal forest lands as the primary habitat for the spotted owl. Two categories of DCAs were identified: Category 1 DCAs were established to be large enough to support “20 pairs of owls with contiguous or nearly contiguous home ranges” (USFWS 1992b). Category 1 DCAs were to be spaced no more than 12 miles apart, edge to edge. Category 2 DCAs were established to be large enough to support 2 to 19 pairs of owls. Given their smaller size, category 2 DCAs were to be spaced no more than 7 miles apart, edge to edge.

The process of mapping DCAs was organized by the 1992 recovery team members and involved biologists from the State wildlife management agencies, biologists and timber managers from each of the affected national forests, and biologists and timber managers from each of the affected BLM districts. Maps used in this process included most or all of the following for each national forest and BLM district:

- Spotted owl location maps
- Spotted owl nesting, roosting, and foraging habitat maps
- Maps of lands suitable for timber harvest
- Allocation maps from national forest land management plans
- BLM timber production capability maps
- Sensitive soils maps
- HCA maps
- Maps of other species associated with old forests, and streams with fish species at risk

1994: Northwest Forest Plan. The NWFP was established in 1994, 2 years after the 1992 Final Draft Recovery Plan was prepared. The NWFP amended the 19 national forest and seven BLM district land and resource management plans (LRMPs) that guide management of individual national forests and BLM districts across the range of the spotted owl. The NWFP provides a network of reserve land use allocations identified as late successional reserves to provide habitat for late-successional forest species, including the spotted owl. Davis and Lint (2005) stated:

“The primary contribution of the Northwest Forest Plan (the Plan) to conserving the northern spotted owl (the owl) was the Federal network of reserved land use allocations designed to support clusters of reproducing owl pairs across the species’ range. These ‘reserves’ include late-successional reserves, adaptive management reserves, congressionally reserved lands, managed late-successional areas, and larger blocks of administratively withdrawn lands... Federal lands between these reserves were designed to provide habitat to allow movement, or dispersal, of owls from one reserve to another. The ‘between’ lands are a combination of matrix, riparian reserves, smaller tracts of

administratively withdrawn lands and other smaller reserved areas such as 100-acre owl core areas.”

Current Recovery Plan (2007)

Table F1. Acres of MOCA by Federal ownership and Land Use Allocation in Washington, Oregon and California¹⁵

State	Agency	LUA	Total LUA acres in MOCA	Total LUA acres in State	Percent (MOCA-LUA of Total LUA)
Washington	Forest Service	AMA	65,482	405,326	16
		AW	87,789	429,500	20
		CR	530,650	2,420,462	22
		LSR	1,647,741	2,440,182	68
		MLSA	28,229	92,553	30
		Matrix/RR	0	1,188,259	0
		ND	929	63,253	1
	Fish & Wildlife	CR	185	15,720	1
	National Parks	CR	614,784	1,795,189	34
	Dept. of Defense	CR	0	110,451	0
Total			2,975,788	8,960,896	33

¹⁵ The "LSR" LUA includes the LSR, LSR3, LSR4 and AMR allocations; The "Matrix/RR" LUA includes both Matrix lands and Riparian Reserve allocations; and the "ND" LUA includes Federal lands not designated in 1994.

State	Agency	LUA	Total LUA acres in MOCA	Total LUA acres in State	Percent (MOCA-LUA of Total LUA)
Oregon	Bureau of Land Management	AMA	0	187,388	0
		AW	56,058	84,333	66
		CR	19,072	26,855	71
		LSR	630,747	914,158	69
		Matrix/RR	0	1,169,724	0
		ND ³	0	1,024	0
	Forest Service	AMA	0	355,528	0
		AW	51,244	549,868	9
		CR	593,556	1,279,033	46
		LSR	1,542,327	2,707,997	57
		Matrix/RR	0	2,238,008	0
		ND	163	6,989	2
	Fish & Wildlife	CR	0	19,253	0
National Parks	CR	863	169,277	1	
Dept. of Defense	CR	0	727	0	
Total			2,894,031	9,710,162	30

State	Agency	LUA	Total LUA acres in MOCA	Total LUA acres in State	Percent (MOCA-LUA of Total LUA)
California	Bureau of Land Management	AMA	0	1,807	0
		AW	6,366	23,744	27
		CR	16,532	19,299	86
		LSR	108,359	117,523	92
		Matrix/RR	0	259,493	0
		ND	5,716	6,336	90
	Forest Service	AMA	4,315	541,415	1
		AW	57,894	445,143	13
		CR	427,134	1,185,605	36
		LSR	1,107,093	1,532,152	72
		Matrix/RR	7,187	1,815,072	<1
		MLSA	7,830	7,830	100
		ND	0	10	0
	Fish & Wildlife	CR	0	145	0
	National Parks	CR	104,562	226,980	46
	Dept. of Defense	CR	0	22,260	0
Total			1,852,988	6,204,815	30
Regional Total			7,722,807	24,875,873	

Given the thorough analysis supporting the 1990 HCAs and 1992 DCAs, the 1992 Draft Recovery Plan served as the default habitat network for the 2006 Recovery Plan. The intended role of the DCAs described in Chapter III E of the 1992 Draft Recovery Plan was reviewed by the 2007 recovery team, and a decision was made regarding the configuration of each DCA relative to its role as a MOCA to support the 2007 Recovery Plan.

The 1992 DCAs were used to identify the general amount, size, and distribution of habitat-capable acres needed to meet the 2007 Recovery Plan criteria. Following the 1992 proposed DCA network, two categories of MOCAs were created to match the category 1 and category 2 DCAs (Table F2). Each MOCA 1 has the capacity to support 20 or more reproducing pairs of spotted owl. Each MOCA 2 has the capacity to support 1 to 19 pairs of reproducing spotted owls. This Recovery Plan maps 181 MOCAs, 48 of which are MOCA 1s and 133 of which are MOCA 2s (Table F2).

Two categories of MOCAs were created. Each MOCA 1 has the capacity to support 20 or more reproducing pairs of spotted owl, while each MOCA 2 has the capacity to support 1 to 19 pairs.

In the process of delineating the MOCAs, the 1992 DCAs were either adopted as is, reconfigured into a new MOCA, redesignated as a CSA (Table F3), or dropped altogether. For those DCAs that were retained as MOCAs, the original DCA's overall size, number of habitat-capable acres, and proximity to its closest neighbor were retained to the maximum extent practicable. Where DCAs were modified, the recovery team attempted to keep the new MOCA size as close as possible to the old DCA while also attempting to eliminate conflicts between the new MOCA and the underlying Federal land use allocation¹⁶.

The maximum spacing allowed between MOCAs followed Thomas *et al.* (1990), which was 12 miles (from closest edge to closest edge) between MOCA 1s and 7 miles between MOCA 2s.

Because the LRMPs are designed and implemented, in part, to be the Federal contribution to recovery for the spotted owl (USDA and USDI 1994), the current Spotted Owl recovery team looked first to the DCAs on Federal lands, and specifically lands within the LRMP reserves, for the habitat-capable acres needed to support the recovery objectives under this Recovery Plan.

Only Federal lands were included in the MOCAs.

¹⁶ MOCA size varies based on regional ecological differences; therefore some MOCA 2s may be larger than some MOCA 1s.

Table F2. Summary of total acres, habitat-capable acres, and spotted owl-habitat acres in MOCAs in the range of the northern spotted owl by State and physiographic province.

Washington

Province ¹ / MOCA Number	MOCA Type (1 or 2)	Total Acres in MOCA	Owl Habitat Capable Acres in MOCA	Percent (capable of total)	Suitable Owl Habitat Acres ² in MOCA	Percent (suitable of capable)
Western WA Cascades						
WMOCA-01	1	154,287	153,129	99	78,351	51
WMOCA-02	2	19,955	19,587	98	10,588	54
WMOCA-03	1	143,945	136,070	95	78,278	58
WMOCA-04	2	29,028	28,463	98	14,841	52
WMOCA-05	2	37,811	37,593	99	12,781	34
WMOCA-06	1	158,493	146,453	92	92,903	63
WMOCA-07	1	115,339	84,703	73	46,851	55
WMOCA-08	2	8,078	6,224	77	2,910	47
WMOCA-09	2	35,694	27,956	78	15,191	54
WMOCA-10	2	13,016	11,677	90	6,805	58
WMOCA-11	2	36,915	32,966	89	18,413	56
WMOCA-12	2	29,681	23,830	80	12,650	53
WMOCA-13	2	46,511	30,240	65	16,573	55
WMOCA-14	2	9,285	8,933	96	4,664	52
WMOCA-15	2	26,336	24,592	93	15,203	62
WMOCA-16	2	30,679	24,468	80	12,691	52
WMOCA-17	2	74,722	50,093	67	31,083	62
WMOCA-18	1	83,505	70,885	85	34,244	48
WMOCA-19	2	14,423	9,782	68	6,121	63
WMOCA-20	2	27,051	20,709	77	12,492	60
WMOCA-21	1	101,811	75,379	74	41,029	54
WMOCA-22	2	37,617	25,341	67	14,202	56
WMOCA-23	2	14,405	6,303	44	4,513	72
WMOCA-24	2	93,564	52,515	56	32,014	61
	Total (#1/#2)					
Province Total	6/18	1,342,150	1,107,893	83	615,390	56
						Habitat Threshold ¹⁷ = 70%

¹⁷ Per Recovery Criterion #4.

Eastern WA Cascades						
WMOCA-25	2	26,240	7,181	27	3,697	51
WMOCA-26	2	12,092	4,729	39	1,701	36
WMOCA-27	2	19,360	6,602	34	3,484	53
WMOCA-28	2	52,988	33,439	63	9,748	29
WMOCA-29	2	11,125	6,275	56	3,236	52
WMOCA-30	2	10,126	3,839	38	1,945	51
WMOCA-31	2	20,271	7,331	36	3,363	46
WMOCA-32	2	26,004	9,137	35	6,273	69
WMOCA-33	1	87,991	51,941	59	29,953	58
WMOCA-34	1	99,157	47,604	48	24,796	52
WMOCA-35	2	7,801	7,566	97	3,013	40
WMOCA-36	2	26,029	14,093	54	8,862	63
WMOCA-37	2	12,728	8,921	70	2,985	33
WMOCA-38	1	83,820	54,231	65	29,760	55
WMOCA-39	2	74,860	46,967	63	24,204	52
WMOCA-40	2	43,737	23,423	54	15,293	65
WMOCA-41	2	49,093	31,116	63	23,893	77
WMOCA-42	2	23,675	13,763	58	7,693	56
WMOCA-43	2	67,451	45,234	67	25,825	57
WMOCA-44	2	17,512	16,192	92	10,546	65
WMOCA-45	2	15,568	15,520	100	7,150	46
	Total (#1/#2)					
Province Total	3/18	787,628	455,105	58	247,421	54
						Habitat Threshold = 60%

Olympic Peninsula						
WMOCA-46	1	802,512	689,078	86	405,633	59
WMOCA-47	2	4,650	4,641	100	2,521	54
WMOCA-48	2	4,001	3,989	100	2,034	51
WMOCA-49	2	34,847	33,381	96	7,230	22
	Total (#1/#2)					
Province Total	1/3	846,010	731,090	86	417,419	57
Washington Total	7/42	2,975,788	2,294,087	77	1,280,229	56

¹Physiographic province as identified in Final Draft Recovery Plan

²BioMapper suitable based on SPOW NWFP-10yr report, table 3-4.

Oregon

Province/ MOCA Number	MOCA Type (1 or 2)	Total Acres in MOCA	Owl Habitat Capable Acres in MOCA	Percent (capable of total)	Suitable Owl Habitat Acres ² in MOCA	Percent (suitable of capable)
Western Oregon Cascades						
OMOCA-01	1	152,323	149,987	98	86,388	58
OMOCA-02	1	115,780	111,806	97	73,188	65
OMOCA-03	1	99,904	97,445	98	62,826	64
OMOCA-04	1	76,147	70,650	93	44,246	63
OMOCA-05	1	77,960	77,759	100	42,562	55
OMOCA-06	2	34,411	33,253	97	18,773	56
OMOCA-07	1	133,581	129,678	97	99,843	77
OMOCA-08	1	67,759	67,695	100	32,689	48
OMOCA-09	1	102,415	94,248	92	49,077	52
OMOCA-10	1	65,529	65,271	100	37,517	57
OMOCA-11	1	49,445	48,939	99	22,381	46
OMOCA-12	1	68,907	66,633	97	38,485	58
OMOCA-13	1	77,732	77,637	100	45,231	58
OMOCA-14	1	67,053	62,876	94	38,885	62
OMOCA-15	1	70,788	70,465	100	38,018	54
OMOCA-16	1	70,624	68,839	97	38,804	56
OMOCA-17	1	76,963	69,323	90	31,454	45
OMOCA-18	2	53,859	49,174	91	10,822	22
	Total (#1/#2)					
Province Total	16/2	1,461,180	1,411,680	97	811,190	57

Habitat
Threshold =
60%

Oregon Klamath						
OMOCA-19	1	45,048	20,270	45	12,665	62
OMOCA-20	2	2,008	1,627	81	956	59
OMOCA-21	1	57,995	52,608	91	23,207	44
OMOCA-22	1	71,804	70,886	99	27,972	39
OMOCA-23	1	129,835	111,893	86	48,845	44
OMOCA-24	1	70,650	68,521	97	32,847	48
OMOCA-25	1	69,978	64,914	93	36,661	56
OMOCA-26	2	49,172	48,730	99	21,193	43
OMOCA-27	2	39,319	36,916	94	19,397	53
OMOCA-28	2	51,287	48,666	95	28,523	59
	Total (#1/#2)					
Province Total	6/4	587,096	525,032	89	252,266	48

Habitat
Threshold =
50%

Oregon Coast Range						
OMOCA-29	2	58,722	58,231	99	23,690	41
OMOCA-30	2	48,920	48,610	99	24,011	49
OMOCA-31	2	8,554	8,478	99	5,048	60
OMOCA-32	2	43,375	43,176	100	26,023	60
OMOCA-33	2	34,462	34,136	99	20,757	61
OMOCA-34	1	58,222	58,003	100	28,601	49
OMOCA-35	2	5,388	5,341	99	3,040	57
OMOCA-36	2	30,448	30,294	99	14,750	49
OMOCA-37	1	80,663	80,421	100	40,331	50
OMOCA-38	2	48,238	48,081	100	24,218	50
OMOCA-39	2	42,599	40,780	96	20,780	51
OMOCA-40	2	7,892	7,742	98	3,552	46
OMOCA-41	2	27,252	25,136	92	10,296	41
OMOCA-42	2	45,000	44,685	99	21,031	47
OMOCA-43	2	54,593	54,313	99	21,150	39
OMOCA-44	2	8,397	8,299	99	3,093	37
	Total (#1/#2)					
Province Total	2/14	602,725	595,725	99	290,371	49

Habitat
Threshold =
70%

Eastern Oregon Cascades						
OMOCA-45	1	57,142	53,550	94	32,503	61
OMOCA-46	2	9,693	9,524	98	5,557	58
OMOCA-47	2	20,436	18,893	92	8,963	47
OMOCA-48	2	13,348	12,747	95	5,259	41
OMOCA-49	2	13,450	12,123	90	5,685	47
OMOCA-50	2	18,643	11,258	60	6,301	56
OMOCA-51	2	33,748	29,823	88	17,964	60
OMOCA-52	2	34,233	29,486	86	12,044	41
OMOCA-53	2	42,335	33,432	79	20,149	60
	Total (#1/#2)					
Province Total	1/8	243,030	210,835	87	114,423	54
						Habitat Threshold = 60%
Oregon Total	25/28	2,894,031	2,743,272	95	1,468,250	54

¹Physiographic province as identified in Final Draft Recovery Plan

²BioMapper suitable based on SPOW NWFP-10yr report, table 3-4.

California

Province ¹ / MOCA Number	MOCA Type (1 or 2)	Total Acres in MOCA	Owl Habitat Capable Acres in MOCA	Percent (capable of total)	Suitable Owl Habitat Acres ² in MOCA (b)	Percent (suitable of capable)
California Coast						
CMOCA-01	2	5,787	4,619	80	4,184	91
CMOCA-02	2	14,252	12,918	91	9,456	73
CMOCA-03	1	67,333	64,902	96	51,011	79
CMOCA-04	2	4,126	4,028	98	3,582	89
CMOCA-05	2	7,493	7,432	99	6,436	87
CMOCA-06	2	1,111	1,085	98	937	86
CMOCA-07	2	2,270	2,227	98	1,960	88
CMOCA-08	2	40,308	37,128	92	28,102	76
CMOCA-09	2	4,138	4,066	98	3,765	93
CMOCA-10	2	1,097	1,076	98	634	59
CMOCA-11	2	1,926	1,801	94	1,285	71
CMOCA-12	2	2,982	2,747	92	1,734	63
CMOCA-13	2	930	770	83	364	47
CMOCA-14	2	2,747	2,526	92	1,663	66
CMOCA-15	2	2,639	2,439	92	1,770	73
CMOCA-16	2	8,941	5,546	62	3,232	58
CMOCA-17	2	9,813	9,627	98	7,287	76
CMOCA-18	2	6,843	6,641	97	3,754	57
CMOCA-19	2	2,013	1,566	78	765	49
CMOCA-20	2	1,564	1,246	80	657	53
CMOCA-21	2	3,726	2,224	60	1,592	72
CMOCA-22	2	4,457	3,956	89	2,009	51
CMOCA-23	2	6,858	5,375	78	2,495	46
CMOCA-24	2	1,043	667	64	612	92
CMOCA-25	2	3,260	2,381	73	1,559	65
CMOCA-26	1	30,669	21,551	70	16,700	77
	Total (#1/#2)					
ProvinceTotal	2/24	238,324	210,543	88	157,546	75

Habitat
Threshold =
50%

California Klamath						
CMOCA-27	1	101,680	92,399	91	65,902	71
CMOCA-28	1	79,499	62,945	79	47,770	76
CMOCA-29	2	6,136	4,460	73	4,223	95
CMOCA-30	1	49,230	38,799	79	30,202	78
CMOCA-31	2	14,687	14,113	96	10,473	74
CMOCA-32	1	140,833	118,225	84	87,825	74
CMOCA-33	2	6,294	2,554	41	2,458	96
CMOCA-34	1	52,240	48,787	93	32,614	67
CMOCA-35	1	73,976	47,069	64	38,703	82
CMOCA-36	2	8,788	7,078	81	5,516	78
CMOCA-37	2	3,314	1,711	52	1,594	93
CMOCA-38	2	4,043	1,111	27	995	90
CMOCA-39	2	1,400	286	20	282	98
CMOCA-40	2	2,283	1,585	69	1,084	68
CMOCA-41	2	2,656	2,528	95	2,156	85
CMOCA-42	2	3,881	3,813	98	3,255	85
CMOCA-43	2	7,304	6,970	95	5,743	82
CMOCA-44	1	95,483	90,986	95	68,588	75
CMOCA-45	1	100,914	97,743	97	70,619	72
CMOCA-46	2	23,431	22,422	96	19,406	87
CMOCA-47	2	11,788	10,525	89	9,556	91
CMOCA-48	2	44,026	42,913	97	35,872	84
CMOCA-49	1	38,081	36,296	95	22,701	63
CMOCA-50	1	50,931	50,618	99	39,063	77
CMOCA-51	1	60,162	56,912	95	35,331	62
CMOCA-52	1	42,977	42,498	99	36,258	85
CMOCA-53	2	30,523	28,852	95	23,998	83
CMOCA-54	1	116,254	104,845	90	82,610	79
CMOCA-55	1	65,889	62,169	94	41,158	66
CMOCA-56	2	35,960	32,281	90	20,660	64
CMOCA-57	2	25,739	23,331	91	11,695	50
CMOCA-58	2	43,805	40,618	93	24,660	61
CMOCA-59	2	11,460	10,765	94	7,188	67
CMOCA-60	2	27,813	24,764	89	17,665	71
	Total (#1/#2)					
Province Total	14/20	1,383,479	1,232,969	89	907,826	74

Habitat
Threshold =
50%

California Cascades						
CMOCA-61	2	39,698	29,518	74	20,553	70
CMOCA-62	2	14,511	5,408	37	4,085	76
CMOCA-63	2	10,694	8,819	82	6,725	76
CMOCA-64	2	3,955	3,893	98	2,738	70
CMOCA-65	2	3,034	2,542	84	1,412	56
CMOCA-66	2	2,955	2,690	91	1,918	71
CMOCA-67	2	1,751	1,743	100	1,294	74
CMOCA-68	2	1,453	1,438	99	1,006	70
CMOCA-69	2	2,240	2,239	100	1,145	51
CMOCA-70	2	1,933	1,889	98	1,547	82
CMOCA-71	2	3,058	2,861	94	1,704	60
CMOCA-72	2	3,398	3,364	99	2,941	87
CMOCA-73	2	14,607	14,525	99	10,091	69
CMOCA-74	2	997	997	100	948	95
CMOCA-75	2	12,336	12,254	99	7,642	62
CMOCA-76	2	9,788	8,766	90	5,492	63
CMOCA-77	2	70,643	68,920	98	45,340	66
CMOCA-78	2	21,826	21,012	96	11,415	54
CMOCA-79	2	12,307	11,744	95	4,029	34
	Total (#1/#2)					
Province Total	0/19	231,184	204,623	89	132,024	65
						Habitat Threshold = 50%
California Total	16/63	1,852,988	1,648,135	89	1,197,396	73
Regional Total	51/130	7,722,807	6,685,494	261	3,945,875	183

¹Physiographic province as identified in Final Draft Recovery Plan

²BioMapper suitable based on SPOW NWFP-10yr report, table 3-4.

In some cases, Federal lands outside the large block reserves of the LRMPs (Federal matrix lands, for example) were included in the MOCA system to ensure that the size, spacing, and distribution criteria established by the recovery team were met (see below). Only Federal lands were included in the MOCAs; where necessary to augment or support the recovery strategy, CSAs were designated (see discussion below).

The delineation of the MOCAs followed these rules:

- The original DCA was retained with no boundary change under one of the following conditions:

- The original DCA boundary fell completely within a LRMP reserve and no revision of the DCA adjustment of the boundary was needed.
- The original DCA boundary did not fall completely within a LRMP reserve, but there was no need to change the boundary to move all or a portion of the DCA into the reserve.
- The original DCA was retained with a boundary change under one of the following conditions:
 - The DCA boundary fell completely within a LRMP reserve and a boundary adjustment was made to match all or a portion of the original DCA boundary with the boundary of the reserve.
 - The DCA boundary fell completely within a LRMP reserve and a boundary adjustment was made to include better habitat conditions within the new MOCA boundary.
 - All or a portion of the DCA was outside a LRMP reserve and the DCA was moved to match the reserve as much as possible, resulting in fewer acres of non-reserve land in the DCA.
 - All or a portion of the DCA was outside a LRMP reserve and the DCA was moved to match the reserve as much as possible, resulting in no change to the acres of non-reserve land in the DCA.
 - Non-Federal lands within the DCA boundary were removed or redesignated as a CSA.
- The original DCA was dropped under one of the following conditions:
 - The original DCA was not needed to satisfy the maximum spacing of 12 miles (closest edge to closest edge) between category 1 DCAs and 7 miles between category 2 DCAs (Thomas *et al.* 1990).
 - The original DCA was not needed to provide for a cluster of reproducing owls.
 - The DCA was redesignated as a CSA.

Conservation Support Areas. Mapped or described CSAs (Table C6) are areas between or adjacent to MOCAs where habitat contributions by private, State, and some Federal land managers are expected to increase the likelihood that spotted owl recovery is achieved, shorten the time needed to achieve recovery, and/or reduce management risks associated with the recovery strategy and actions. The recovery team delineated or described CSAs in areas that can provide important contributions to recovery and where private, State, or Federal management regimes support owl habitat (for example, Section 10 Habitat Conservation Plans, State forest practices rules, certain Federal adaptive

CSAs may function to provide demographic support to core owl populations in the MOCA network or facilitate dispersal of juvenile owls among MOCAs.

management areas). CSAs may function to provide demographic support to core owl populations in the MOCA network, facilitate dispersal of juvenile owls among MOCAs, or serve both of these functions.

Table F3. Description of CSAs by State.

State/ CSA Number	Total CSA Acres	Name	Function ¹	Current Management Regime	Notes
Washington					
WCSA-01	85,400	Columbia Gorge	DS	Mixed private and State ownership	Includes "Columbia Gorge" Spotted Owl Special Emphasis Area (SOSEA) ²
WCSA-02	425,112	Klickitat	DS	Mixed private, State and Federal (Matrix) ownership	Includes "White Salmon" SOSEA; E. boundary extends to Klickitat River
WCSA-03	35,146	Siouxon	DS	Mixed private and State ownership	Includes "Siouxon" SOSEA
WCSA-04	316,662	Mineral	DP, DS	Mixed private and State ownership	Includes "Mineral Block/Link" SOSEA
WCSA-05	513,517	I-90	DP, DS	Mixed private and State ownership	Includes "I-90 West", "I-90 East" and "Taneum" SOSEAs
WCSA-06	54,459	Blewett	DP, DS	Mixed private and State ownership	Includes "North Blewett" SOSEA
WCSA-07	72,722	Entiat	DP, DS	Mixed private and State ownership	Includes "Entiat" SOSEA
WCSA-08	259,255	Finney	DP, DS	Mixed private and State ownership	Includes "Finney Block" SOSEA
WCSA-09	397,176	West Olympic	DS	Mixed private, State and Federal (AMA) ownership	Includes "Hoh-Clearwater/Coastal Link" SOSEA
Washington Total	2,159,449				
Oregon					
OCSA-01	16,677	Hood River	DP, DS	Federal Matrix	
OCSA-02	43,586	Central Cascades	DP, DS	Federal AMA	
OCSA-03	495,650	Cottage Grove	DP	Mixed Federal, State and private ownership	Interprovincial connection
OCSA-04	10,501	Lower Applegate	DP	Federal AMA	
OCSA-05	8,971	Upper Applegate	DP, DS	Federal AMA	
OCSA-06	Unmapped	Coquille	DP	Mixed Federal, State and private ownership (not to include Tribal lands)	North from OMOCA-25 and OMOCA-26 to OMOCA-29, East of Myrtle Point and Port Orford, and West of OMOCA-27
OCSA-07	Unmapped	Yaquina	DP	Mixed Federal, State and private ownership (not to include Tribal lands)	North from OMOCA-38 and OMOCA-39 to OMOCA-41 and OMOCA-42
Oregon Mapped Total	575,385				
California					
CCSA-01	26,845	Green Diamond Resource	DS	Private Land HCP	Oregon border to Jedediah Smith SP

State/ CSA Number	Total CSA Acres	Name	Function ¹	Current Management Regime	Notes
		Company			
CCSA-02	10,191	Jedediah Smith Redwoods State Park	DS	State Park	
CCSA-03	32,331	Mill Creek State Park	DS	State Park	
CCSA-04	175,707	Green Diamond Resource Company	DS	Private Land HCP	South of Mill Creek SP to Bald Hills; Straddles Klamath River
CCSA-05	13,186	Prairie Creek State Park	DS	State Park	
CCSA-06	147,861	Green Diamond Resource Company	DS	Private Land HCP	South of Bald Hills to Jacoby Creek/Arcata Bay; Straddles CA-299
CCSA-07	221,088	Pacific Lumber & Green Diamond Resource Cos.	DS	Private Land HCP	South of Eureka, CA to Humboldt Redwoods SP
CCSA-08	405	Grizzly Creek Redwoods State Park	DS	State Park	Two parcels straddling CA-36
CCSA-09	53,528	Humboldt Redwoods State Park	DS	State Park	
CCSA-10	4,126	Angelo Coast Range Preserve	DS	State Park	
CCSA-11	48,443	Jackson State Demonstration Forest	DS	State Land HCP	
CCSA-12	16,420	Dept. of Defense	DS	Federal Non-designated	
CCSA-13	38,592	Tomaes Bay State Park & Marin County	DS	County Park	
CCSA-14	240,000	Mendocino Redwoods	DS	HCP in draft	
California Total	1,028,721				
Regional Total	3,245,755				

¹DP = Dispersal, DS = Demographic Support

²See the Washington State Forest Practices Rules

Appendix F: Basis for the Recovery Strategy Concerning Habitat (*Option 2*)

This recovery strategy builds on concepts and information presented by the Interagency Scientific Committee in “A Conservation Strategy for the Northern Spotted Owl” (Thomas *et al.* 1990) and the 1992 Final Draft Recovery Plan for the Northern Spotted Owl (USFWS 1992). While the 1992 draft Recovery Plan was never finalized, the plan remains the most-recent spotted owl-specific analysis of habitat needed to provide for a sustainable population of spotted owls across the species’ range. The 2004 Scientific Evaluation of the Status of the Northern Spotted Owl (Courtney *et al.* 2004) also acknowledged this conservation strategy was based on sound scientific principles which have not substantially changed since the species was listed. Both of these strategies focused on the following:

- Managing large blocks of habitat in designated conservation areas throughout the range of the spotted owl that could support self-sustaining populations of 15 to 20 pairs of spotted owls and
- Spacing the blocks and managing the areas between them to permit movement of spotted owls.

This plan also recognizes the need to adaptively manage to dynamic ecosystems.

Previous Recovery Efforts

1990: Interagency Scientific Committee. The Interagency Scientific Committee (ISC) delineated and mapped a network of 193 Habitat Conservation Areas (HCAs) thought necessary to ensure a viable, well-distributed population of owls. Wherever possible, each HCA was designed with the goal of being able to support a minimum of 20 pairs of owls. The maximum distance between these HCAs was 12 miles. The criterion of 20 pairs was based on models of population persistence and empirical studies of bird populations. Twelve miles was chosen as the maximum distance between HCAs because this value is within the known dispersal distance of about two-thirds of all radio-marked juvenile owls studied. The HCA concept applied primarily to BLM, FS, and NPS lands. The ISC strongly recommended that HCAs be established on State-owned lands in certain key areas to ensure population connectivity. The committee also recommended that resource managers of other State lands, Tribal lands, other Federal lands, and private lands use forestry and silvicultural techniques and practices that maintain or enhance habitat characteristics associated with spotted owls.

Each HCA was designed with the goal of being able to support a minimum of 20 pairs of owls. The maximum distance between these HCAs was 12 miles.

To facilitate the movement of spotted owls, the ISC also recommended that 50 percent of the land base between HCAs be maintained in stands of timber with an average diameter of 11 inches or greater and at least 40 percent canopy closure, even though modeling to estimate the efficacy of the HCAs assumed that the matrix between the HCAs was entirely unsuitable for owl territories (ISC, Appendix M, pg. 253).

1992: Draft Recovery Plan. The 192 Designated Conservation Areas (DCAs) in the 1992 Draft Recovery Plan were modifications of the HCAs from the ISC. The 1992 recovery team's objective in remapping the HCAs was to provide a level of

In 1992, HCAs were modified to create DCAs, to increase the biological and economic efficiency of the network and address deficiencies identified in the HCA network.

habitat protection in the DCAs that was at least equal to that provided by HCAs, while increasing the biological and economic efficiency of the network. The 1992 recovery team also attempted to address deficiencies identified in the HCA network. The fundamental sizing and spacing criteria from Thomas *et al.* (1990) were applied during mapping of the DCAs.

The following additional criteria were used in the 1992 effort to establish DCAs based on HCAs:

- Areas were mapped to include as much high-quality habitat and as many owl locations as possible to achieve an effective and efficient network. Where more effective acres were added to DCAs (meaning acres with more spotted owl locations or better habitat), opportunities were sought to drop less effective areas so that the total area did not increase.
- DCA boundaries were adjusted to accommodate other species' sites where this adjustment could be made without significantly increasing the economic impact of the DCA or significantly decreasing its effectiveness in spotted owl conservation.
- Areas were mapped to include as high a proportion of Federal reserved lands and other lands unsuitable for timber production as possible when consistent with mapping criteria from Thomas *et al.* (1990).
- Where possible, DCA boundaries were modified to place acres capable of full timber yield back into the timber base and replace them in the DCA with acres from which only partial yields were expected because of forest plan allocations.
- In areas where the existing network was identified to be deficient for supporting the desired number of reproducing spotted owls, attempts were made to provide for new owl clusters and populations with the least possible economic impact.
- Where possible, boundaries were refined to avoid conflict with other economic development proposals.

Following the HCA system, DCAs were established that contained approximately 7.6 million acres of Federal forest lands as the primary habitat for the spotted owl. Two categories of DCAs were identified: Category 1 DCAs were established to be large enough to support “20 pairs of owls with contiguous or nearly contiguous home ranges” (USFWS 1992b). Category 1 DCAs were to be spaced no more than 12 miles apart, edge to edge. Category 2 DCAs were established to be large enough to support 2 to 19 pairs of owls. Given their smaller size, category 2 DCAs were to be spaced no more than 7 miles apart, edge to edge.

The process of mapping DCAs was organized by the 1992 recovery team members and involved biologists from the State wildlife management agencies, biologists and timber managers from each of the affected national forests, and biologists and timber managers from each of the affected BLM districts. Maps used in this process included most or all of the following for each national forest and BLM district:

- Spotted owl location maps
- Spotted owl nesting, roosting, and foraging habitat maps
- Maps of lands suitable for timber harvest
- Allocation maps from national forest land management plans
- BLM timber production capability maps
- Sensitive soils maps
- HCA maps
- Maps of other species associated with old forests, and streams with fish species at risk

1994: Northwest Forest Plan. The NWFP was established in 1994, 2 years after the 1992 Final Draft Recovery Plan was prepared. The NWFP amended the 19 national forest and seven BLM district land and resource management plans (LRMPs) that guide management of individual national forests and BLM districts across the range of the spotted owl. The NWFP provides a network of reserve land use allocations identified as late successional reserves to provide habitat for late-successional forest species, including the spotted owl. Davis and Lint (2005) stated:

“The primary contribution of the Northwest Forest Plan (the Plan) to conserving the northern spotted owl (the owl) was the Federal network of reserved land use allocations designed to support clusters of reproducing owl pairs across the species’ range. These ‘reserves’ include late-successional reserves, adaptive management reserves, congressionally reserved lands, managed late-successional areas, and larger blocks of administratively withdrawn lands... Federal lands between these reserves were designed to provide habitat to allow movement, or dispersal, of owls from one reserve to another. The ‘between’ lands are a combination of matrix, riparian reserves, smaller tracts of

administratively withdrawn lands and other smaller reserved areas such as 100-acre owl core areas.”

Current Recovery Plan (2007)

Blocks of Habitat

Lamberson *et al.* (1994) modeled patch size and patch spacing relative to persistence of spotted owls, and an “earlier version” (Lamberson *et al.* 1990:186) of that work was used as the basis for Thomas *et al.* (1990) for the sizes of HCAs and the spaces between them. Both of these publications used a range of values for five parameters; those in Lamberson *et al.* (1994) included a wider range of values (Table F1).

Table F1. Values of parameters used in simulations in Lamberson *et al.* (1994:Table 2).

Parameter	Range of values
Percentage of total landscape within the clusters	5–40
Cluster size	5–45 pairs
Percentage of sites within clusters that are suitable	20–100
Number of sites searched by dispersing females per cluster	0.2, 0.4, and 0.8 times cluster size
Dispersal coefficient	0.0004–0.30

The major assumptions included in this model were: (1) clusters were circular and every territory within a cluster was of equal size; (2) land between clusters was assumed to be entirely unsuitable for territories; (3) suitability of sites within clusters varied; and (4) all clusters had exactly the same number of neighboring clusters (there were no edges).

Sizes of Blocks of Habitat

Number of pairs of spotted owls the habitat blocks are intended to support.

Following are quotations and results from Thomas *et al.* (1990) and Lamberson *et al.* (1994) used to determine the number of pairs of spotted owls large habitat blocks in this Recovery Plan are intended to support.

“Within the structure of our model, clusters [of] ≥ 15 sites appeared stable; if all sites were initially suitable, at least moderate connectivity existed among clusters, and dispersing owls searched preferentially within their natal cluster. Under more realistic conditions where many spotted owl HCAs would not be continuous habitat, either initially, or ever, stability seemed to require at least 20-pair clusters and low to moderate connectivity” (Thomas *et al.* 1990:265).

“Assuming 60% of the sites in each cluster to be suitable (approximately the current condition), the number of sites sampled [by dispersing females] per cluster to be 40% of cluster size, and a maximum of 22 sites searched, we did not observe a stabilization of mean occupancy within 100 years until each cluster contained at least 15 sites (Fig. 5). Clusters of 20 sites stabilized at approximately 77% occupancy” (Lamberson *et al.* 1994:191).

“Within the structure of our model simulations – 60% of the sites suitable, moderate connectivity among clusters (Table 4), preferential search within the natal cluster before dispersal, equilibrium conditions, and no edge effects – clusters of 20 or more sites appear to support stable populations... Further, our results suggest that a reserve design that provides only for individual pairs or small clusters of pairs has a low likelihood of sustaining the species” (Lamberson *et al.* 1993:193).

“Ours is an all-female model. This simplification eliminated the complication of mate finding... the inclusion of search for mates will further reduce mean occupancies when cluster sizes are small, certainly when they contain less than 20 sites” (Lamberson *et al.* 1994:193).

Following the results of Thomas *et al.* (1990) and Lamberson *et al.* (1994), large habitat blocks in this Recovery Plan are designed to support 20 pairs of spotted owls.

Small habitat blocks are by definition those that can support at least one pair, but less than 20 pairs of spotted owls.

Use of Provincial median home-range sizes to estimate size of large habitat blocks.

“The size of the HCA was established by delineating an area to support the target number of pairs using median annual home-range and density information as a guide” (Thomas *et al.* 1990:318).

The amount of habitat needed per pair of spotted owls is to be determined using median annual home-range size within each province as obtained from the literature and simplified into circles of various radii. Recommended median annual home-range sizes to be used are presented in Table F2, which are the median home-range sizes being used at this writing (2007) in the ESA Section 7 consultations with the Service, FS and BLM (USFWS 1994b). New information may revise these home-range sizes.

Table F2. Estimated home-range sizes of spotted owls by Province.

State/Province	Radius of home-range circle (miles)	Size of home-range circle (acres)
Washington		
East Cascades and West Cascades	1.8	6,514
Olympic Peninsula	2.7	14,657
Oregon		
East Cascades and West Cascades	1.2	2,895
Coast Range	1.5	4,524
Klamath	1.3	3,398
California		
Cascades, Coast, and Klamath	1.3	3,398

To estimate the size of a 20-pair habitat block, we followed the methods used in Thomas *et al.* (1990:320) which used provincial home-range sizes and assumed an average overlap of 25% among territories. Their formula was: (20 pairs) X (acres in home-range circle) X (0.75) = acres in 20-pair habitat block. Following that formula and using the home-range radii (Table F2) resulted in the acreages presented in Table F3.

Lamberson *et al.* (1994) modeled their results using 20,000 ha (49,420 acres) of blocks with 60% suitable habitat and 20 pairs of spotted owls per cluster. The large blocks in this Recovery Plan for Olympic Peninsula, West Cascades, and East Cascades of Washington and Coast Range of Oregon are larger than those in Lamberson *et al.* (1994), and those in the other Provinces are similar in size to those in Lamberson *et al.* (1994).

Table F3. Calculated sizes of 20-pair habitat blocks by Province, assuming 25% overlap of territories.

State/Province	Calculated size of 20-pair habitat blocks (acres)	Rounded size of 20-pair habitat blocks (acres)
Washington		
East Cascades and West Cascades	97,716	98,000
Olympic Peninsula	219,861	220,000
Oregon		
East Cascades and West Cascades	43,429	45,000
Coast Range	67,858	70,000
Klamath	50,969	51,000
California		
Cascades, Coast, and Klamath	50,969	51,000

The size of small habitat blocks are by definition smaller than the large habitat blocks but capable of supporting 1 to 19 pairs of spotted owls.

Overall Distribution of Blocks of Habitat

“Ideally, blocks of habitat should be dispersed in a pattern corresponding to a species’ full geographic distribution. This distribution is the key hedge against major catastrophes that could otherwise extinguish the sole remaining population of a once wide-spread species...” (Thomas *et al.* 1990:285).

Number A5 in the habitat-block rule set was written to implement this recommendation in Thomas *et al.* 1990. This rule set states: “at least 60% of the large and small habitat blocks are to be within the distance limits of at least three other habitat blocks, and at least one of the other three blocks is to be a large habitat block.” This rule distributes habitat blocks throughout the suitable habitat across the range of the spotted owl per the sizes of the blocks in the Provinces.

Distances Between Blocks of Habitat

“...we believe the distances between HCAs should be well within the known dispersal distances of at least 50% of all juveniles. After lengthy discussions of this matter among all members of the Committee and advisors, and consultation with other authorities not closely affiliated with our efforts, we believe the distances between HCAs should be within the known dispersal distances of at least 2/3rds (67%) of all juveniles” (Thomas *et al.* 1990:307).

“Based on available data from 56 juvenile northern spotted owls equipped with radio transmitters, we set the maximum distance between HCAs with at least 20 territory sites (at their nearest point of separation) at 12 miles (appendix P). This distance is within the known dispersal distance of about 66% of the owls studied...” (Thomas *et al.* 1990:26).

“To provide an additional measure of security for small HCAs, we opted to increase the likelihood of successful dispersal from one to another by setting shorter distances between them (see appendix Q for specific guidelines). The distance selected, 7 miles, is less than the median distance estimated from banded birds (table P2) and is within the dispersal range of more than 75% of all radio-marked juveniles (table P1)” (Thomas *et al.* 1990:308).

Forsman *et al.* (2002) reported dispersal distances of 1,475 northern spotted owls in Oregon and Washington for 1985–1996, 324 of which were radio-marked and 1,151 of which were banded. Data from radio-marked spotted owls are more representative than data from banded owls because banding data underestimate maximum dispersal distances (Thomas *et al.* 2000, Forsman *et al.* 2002). Median maximum dispersal distance (the straight-line distance between the natal site and the farthest location) for radio-marked juvenile male spotted owls was 12.7 miles, and that of female spotted owls was 17.2 miles (Forsman *et al.* 2002:Table 2).

Data reported in Forsman *et al.* (2002) did not permit estimating distances dispersed by certain percentages of juvenile owls as was done for the five studies analyzed by Thomas *et al.* (1990). To allow the Service to do this, E. Forsman (2007 *pers. comm.*) provided the data for maximum dispersal distances of juvenile

radio-marked spotted owls used in Forsman *et al.* (2002). Analysis of these data (USFWS 2007) resulted in the information presented in Table F4.

We believe the distances recommended by Thomas *et al.* (1990) and used in this Recovery Plan are sufficiently supported by the data reported in Forsman *et al.* (2002) to allow for the level of dispersal needed to achieve recovery.

Table F4. Maximum distances dispersed by 50%, 66%, and 75% of radio-marked juvenile spotted owls in Forsman *et al.* (2002).

Percent of spotted owls	Distances dispersed (mi)		
	Males (<i>n</i> = 114)	Females (<i>n</i> = 122)	All (<i>n</i> = 236)
50	12.7	17.4	14.5
66	9.6	13.7	11.4
75	7.9	11.1	9.4

Conservation Support Areas

Mapped or described CSAs (Table F4) are areas where habitat contributions by private, State, and some Federal land managers are expected to increase the likelihood that spotted owl recovery is achieved, shorten the time needed to achieve recovery, and/or reduce management risks associated with the recovery strategy and actions.

The recovery team delineated or described CSAs in areas that can provide important contributions to recovery and where private, State, or Federal management regimes support owl habitat (for example, Section 10 Habitat Conservation Plans, State forest practices rules, certain Federal adaptive management areas). CSAs may function to provide demographic support to core owl populations in the habitat blocks, facilitate dispersal of juvenile owls among habitat blocks, or serve both of these functions.

CSAs may function to provide demographic support to core owl populations in the habitat blocks network or facilitate dispersal of juvenile owls among habitat blocks.

Table F4. Description of CSAs by State.

State/ CSA Number	Total CSA Acres	Name	Function ¹	Current Management Regime	Notes
Washington					
WCSA-01	85,400	Columbia Gorge	DS	Mixed private and State ownership	Includes "Columbia Gorge" Spotted Owl Special Emphasis Area (SOSEA) ²
WCSA-02	425,112	Klickitat	DS	Mixed private, State and Federal (Matrix) ownership	Includes "White Salmon" SOSEA; E. boundary extends to Klickitat River
WCSA-03	35,146	Siouxon	DS	Mixed private and State ownership	Includes "Siouxon" SOSEA
WCSA-04	316,662	Mineral	DP, DS	Mixed private and State ownership	Includes "Mineral Block/Link" SOSEA
WCSA-05	513,517	I-90	DP, DS	Mixed private and State ownership	Includes "I-90 West", "I-90 East" and "Taneum" SOSEAs
WCSA-06	54,459	Blewett	DP, DS	Mixed private and State ownership	Includes "North Blewett" SOSEA
WCSA-07	72,722	Entiat	DP, DS	Mixed private and State ownership	Includes "Entiat" SOSEA
WCSA-08	259,255	Finney	DP, DS	Mixed private and State ownership	Includes "Finney Block" SOSEA
WCSA-09	397,176	West Olympic	DS	Mixed private, State and Federal (AMA) ownership	Includes "Hoh-Clearwater/Coastal Link" SOSEA
Washington Total	2,159,449				
Oregon					
OCSA-01	16,677	Hood River	DP, DS	Federal Matrix	
OCSA-02	43,586	Central Cascades	DP, DS	Federal AMA	
OCSA-03	495,650	Cottage Grove	DP	Mixed Federal, State and private ownership	Interprovincial connection
OCSA-04	10,501	Lower Applegate	DP	Federal AMA	
OCSA-05	8,971	Upper Applegate	DP, DS	Federal AMA	
OCSA-06	Unmapped	Coquille	DP	Mixed Federal, State and private ownership (not to include Tribal lands)	East of the line from Myrtle Pt. to Sixes, Oregon, and north of the Siskiyou National Forest (North of Township 32S) to Sitkum, Oregon. West to, and including, R9 West
OCSA-07	Unmapped	Yaquina	DP	Mixed Federal, State and private ownership (not to include Tribal lands)	North of the Siuslaw National Forest south block (starting at T11S), to T8S; and from the coast, east to and including R7W
Oregon Mapped Total	575,385				

State/ CSA Number	Total CSA Acres	Name	Function ¹	Current Management Regime	Notes
California					
CCSA-01	26,845	Green Diamond Resource Company	DS	Private Land HCP	Oregon border to Jedediah Smith SP
CCSA-02	10,191	Jedediah Smith Redwoods State Park	DS	State Park	
CCSA-03	32,331	Mill Creek State Park	DS	State Park	
CCSA-04	175,707	Green Diamond Resource Company	DS	Private Land HCP	South of Mill Creek SP to Bald Hills; Straddles Klamath River
CCSA-05	13,186	Prairie Creek State Park	DS	State Park	
CCSA-06	147,861	Green Diamond Resource Company	DS	Private Land HCP	South of Bald Hills to Jacoby Creek/Arcata Bay; Straddles CA-299
CCSA-07	221,088	Pacific Lumber & Green Diamond Resource Cos.	DS	Private Land HCP	South of Eureka, CA to Humboldt Redwoods SP
CCSA-08	405	Grizzly Creek Redwoods State Park	DS	State Park	Two parcels straddling CA-36
CCSA-09	53,528	Humboldt Redwoods State Park	DS	State Park	
CCSA-10	4,126	Angelo Coast Range Preserve	DS	State Park	
CCSA-11	48,443	Jackson State Demonstration Forest	DS	State Land HCP	
CCSA-12	16,420	Dept. of Defense	DS	Federal Non-designated	
CCSA-13	38,592	Tomaes Bay State Park & Marin County	DS	County Park	
CCSA-14	240,000	Mendocino Redwoods	DS	HCP in draft	
California Total	1,028,721				
Regional Total	3,245,755				
¹ DP = Dispersal, DS = Demographic Support					
² See the Washington State Forest Practices Rules					

Appendix G: Barred Owl Removal Strategy (*Options 1 and 2*)

This recovery plan emphasizes the significance of the threat from barred owls and outlines a recovery criterion (Criterion 1) and actions to guide management of the threat. While specific research and control design is to be determined by the Barred Owl Working Group (Recovery Action 3), the pressing nature of the threat requires appropriate action as soon as possible.

This appendix identifies a more specific strategy to implement Recovery Action 6:

Recovery Action 6: Estimate the relative densities of barred owls and spotted owls at which negative effects to spotted owls occur to such a degree to prohibit achievement of Recovery Criteria 1 and 2, and experimentally assess the effects of removal of barred owls on spotted owl site occupancy, reproduction, and survival. Removal experiments have the potential to identify the clearest cause-and-effect relationships between barred owls and the population declines of spotted owls. It is anticipated densities at which negative effects from barred owls occur will vary throughout the spotted owl range. Therefore, removal experiments should be conducted in various parts of the spotted owl range, including a range of barred owl/spotted owl densities as well as managed land (*e.g.*, industrial lands, Tribal lands, Adaptive Management Areas, and matrix lands) and unmanaged lands (*e.g.*, State and Federal park lands). Control experiments should be conducted within spotted owl home ranges where spotted owl pairs have been detected within the past 5 years. Effectiveness may be increased by implementing control experiments in adjacent spotted owl home ranges or in clumps of spotted owl home ranges currently inhabited by barred owls.

The design of the following control experiments is based on experiments conducted in the Klamath National Forest and Green Diamond Resource Company lands in northern California in 2005 and 2006. In 2005, one pair and three individual barred owls were removed from a single spotted owl territory, and the resident pair of spotted owls, undetected for more than 1 year, returned to the site-center within 2 weeks. In 2006, six pairs and three individual barred owls were removed from eight spotted owl territories. Monitoring the results from the 2006 removals is underway at this writing.

Objective

The primary objective is to conduct barred owl removal experiments in selected areas across the range of the spotted owl to determine the effects these experiments have on spotted owl site occupancy and reproduction. The secondary objective is to determine the feasibility of larger-scale and longer-term removal experiments.

Control Design

Barred owls would be removed from sites apparently unoccupied by spotted owls but known to be occupied by spotted owls during the last 5 years. The sites would be monitored to determine whether spotted owls reoccupy them.

Removal would be accomplished by luring territorial barred owls into close range (<30 m) using recorded calls and an owl decoy. Following visual and auditory confirmation of species identification, barred owls would be collected. A shotgun would be used to prevent wounding and ensure rapid and humane death. Following removal of barred owls sites would be surveyed at least once every 2 weeks to determine reoccupancy by either barred or spotted owls. Spotted owls that reoccupy a site would be "moused" (i.e., captured using a live mouse lure) to determine their pair status and nesting status and to legband them.

Study Areas

Up to 18 study areas are proposed across the range: two study areas in each of the nine physiographic provinces identified as important to supporting spotted owl recovery (see Recovery Criterion 2 which excludes the Western Washington Lowlands, Willamette Valley, and California Cascades).

Study Sites

Each study area would have 6–8 sites. The exact number of sites would be dependent on the number of historical spotted owl sites that have been colonized by barred owls and have had known occupancy by spotted owls within the last 5 years. It is estimated that at least one or two pairs of barred owls would need to be removed per spotted owl site, so 12–32 barred owls would be removed from each study area.

Selection of Areas and Sites for Removal of Barred Owls

Priorities are recommended for selection of sites for removal of barred owls as follows.

1. Removal from sites that have spotted owls still present in the area should benefit spotted owls more than removal from sites without spotted owls nearby, and there would be no discernable benefit from removing barred owls from sites in which spotted owls are reproducing. Therefore:
 - a. Top-priority sites would be those with no known reproduction of spotted owls in recent years (e.g., 5 years) that have either (i)

- known spotted owl occupancy or (ii) possible spotted owl occupancy and are close to sites of known occupancy;
 - b. Sites of either unknown occupancy or probable nonoccupancy would be of lower priority the farther they are from sites of known occupancy; and
 - c. Removal is not recommended in areas where spotted owls are reproducing.
2. We could learn more from sites with marked spotted owls than from those without marked spotted owls. Therefore, sites with radio-tagged or leg-banded spotted owls would be of higher priority than those without marked spotted owls.
 3. Locating sites for control near one another would minimize costs and would lessen the chances that barred owls from adjacent territories would move into controlled sites. Therefore, sites for control should be adjacent to other controlled sites as much as possible.

Timing of Control

The timing of control needs to be conducted to minimize suffering by barred owls. Consequently, to avoid starvation of nestling barred owls, control should be conducted at the beginning of the breeding season before the barred owls have laid their eggs or, if this cannot be done, then after the young have fledged.

Survey Effort

Results of *Strix* surveys may be ambiguous. In such cases, Service personnel and the survey crew leaders would meet and review the survey data to assess the most likely status given survey results. If additional visits are required to address uncertainty, they should be conducted. The most critical factor to evaluate is the current status of spotted owls at the site; observation of a spotted owl response following barred owl removal is probably dependant on whether spotted owls are still present in the area and available to recolonize the site.

State and Federal Permitting

The Service is working to acquire the permits needed to conduct barred owl control efforts.

**Region 1
U.S. Fish & Wildlife Service
Ecological Services
911 NE 11th Ave.
Portland, Oregon 97232-4181**

<http://www.fws.gov>

April 2007

