E. Olympic Experimental State Forest Planning Unit

Integrated Approach to Production and Conservation

UNZONED FOREST

As discussed in the section in Chapter I titled Why the Olympic Experimental State Forest [the OESF or the Experimental Forest] is Unique, the goal of the OESF is to learn how to integrate production and conservation across the landscape. To achieve this goal, the northern spotted owl conservation strategy in the Experimental Forest is based on an "unzoned forest" concept, i.e., a forest in which no special zones are set aside exclusively for either species conservation or commodity production. The intent is to have a forest that includes a full range of forest conditions in order to ensure that trust revenues are produced, quality timber is available for harvest, and native species have sufficient habitat. In this approach, harvestable timber and habitat for northern spotted owl, marbled murrelet, and salmon become outputs of a well-managed, unzoned forest.

The goal of maintaining an unzoned forest will guide management activities and research. In the context of long-term forest management, the unzoned approach will define desired outcomes of activities conducted on the landscape. One desired outcome, for example, is the eventual development of older stands that are well distributed throughout the OESF as part of the forest mix. The unzoned forest is an experimental approach, which is why research, monitoring, and systematic application of the knowledge gained will be so important.

However, the distinction between zoned and unzoned is not absolute, because there is a physical and biological zonation in forest landscapes that must be respected and that links directly to the processes and functions the OESF seeks to understand. The riparian areas, which provide the foundation for the conservation strategies, will be treated almost like "zones", because they are linked to relatively fixed physical features on the landscape. However, these riparian management areas will be tailored to the unique characteristics of each stream in the landscape, and research and experimentation will help managers determine what type and degree of resource use can be allowed within these areas. Thus over time, the riparian management zones may begin to blend more with adjacent areas, although this will not be expected to occur until well into the future.

Within this general approach, several conservation objectives can be identified for the Experimental Forest conservation strategies:

(1) To protect, maintain, and aid natural restoration of riparian systems on DNR-managed lands in the OESF, while promoting a long-term integration of resource use and conservation.

(2) To rely on the riparian strategy to provide the physical and biological foundation around which management activities and upland conservation strategies are constructed, recognizing the vital role of watersheds in supporting the web of life.

(3) To look to natural disturbance regimes for the keys to understanding how to achieve restoration and maintenance of natural systems.

(4) To learn to integrate older forest ecosystem values and their functions with commercial forest activities assuming, as a working hypothesis, that landscapes managed for a fairly even apportionment of forest cover among stands in all stages of development, from stand initiation to old growth (Oliver and Larson 1990) will support desirable levels of both commodities and ecosystem functions.

(5) To consider the spatial arrangement of habitat and other conservation values being provided on federal lands when developing habitat within the Experimental Forest.

(6) To fill critical information gaps related to aquatic, riparian, and upland ecosystems and the links between these and forest management activities in order to enhance DNR's decisions and check assumptions behind management strategies and techniques.

MANAGEMENT PROCESSES

The unzoned forest approach complements the OESF management objectives, which include integrating production and conservation. For effective implementation of this integration and of the experimental approach to conservation, six processes are recommended as part of the Experimental Forest management approach:

(1) research and monitoring,

(2) planning from a landscape perspective,

(3) silvicultural techniques that integrate production and conservation,

(4) systematic application of knowledge gained,

(5) efficient information management, and

(6) effective communication.

Research and Monitoring

For an experiment on the scale being attempted in the OESF, carefully planned, focused information-gathering activities and information-management infrastructure are essential. A broad range of formal research, case studies, and monitoring of operations and conditions are included under the heading of research and monitoring. Information-gathering activities carried out in the Experimental Forest, including activities traditionally described as "management experiments", "operational trials", "field evaluations", "case studies", and "demonstrations", will be part of the research and monitoring activities. (See the sections titled Monitoring and Research in Chapter V.)

The following five objectives underlie the research and monitoring component of the OESF:

(1) Acquire new information that will allow DNR managers to (a) meet trust obligations through timber production, (b) conserve and protect public resources (e.g., wildlife, fish, water), and (c) ensure the long-term health and productivity of the forest ecosystem.

(2) Monitor implementation of the HCP and evaluate the effectiveness of activities in meeting the Experimental Forest objectives.

(3) Ensure that information-gathering activities are carried out in a scientifically credible manner, allowing confident use of results in management decisions.

(4) Ensure that information-gathering activities are well coordinated and that the results of different investigations are integrated to achieve OESF objectives.

(5) Ensure that new information is rapidly incorporated into management of the Experimental Forest and, as appropriate, other DNR-managed lands.

Two categories of research and monitoring will occur within the OESF:

(1) research and monitoring required for HCP compliance with the Endangered Species Act; and

(2) information gathering and analysis required to investigate hypotheses and acquire new knowledge needed to accomplish the mission of the Experimental Forest. To the greatest extent possible, research and monitoring conducted in the first category will contribute directly to the information needs in the second category. It is the second category that directly supports the needs of the OESF and provides the scientific foundation for systematically applying new knowledge to managing the forest. (See also the sections in Chapter V titled Monitoring and Research.)

Landscape-level Planning

Planning from a landscape perspective will be the initial basis for integrating production and conservation in the Experimental Forest, moving from current landscape-level patterns to different patterns at specific points in the future. This is consistent with the emphasis on cumulative effects that landscape planning allows. Activities and the resulting landscape-level conditions can be projected and evaluated across space and time to ensure the forest condition is moving in the desired direction through a dynamic process.

DNR's Olympic Region has set preliminary boundaries related to watersheds for landscape planning throughout the region. Eleven of these landscapes lie within the OESF. (See Map IV.9.) Most of the landscapes range in size from 10,000 to 30,000 acres; the largest is 56,000 acres (Upper Clearwater). Boundaries may be adjusted over time during implementation of this plan. It will take time and funding to conduct landscape planning in these landscapes.

Silviculture as an Integration Tool

One of the underlying hypotheses of integrating production and conservation in the Experimental Forest is that it is possible to produce quality commercial timber and provide and protect ecological values in a managed forest by maintaining an arrangement of forest structure and stand diversity. Through silviculture, a forester works in harmony with natural forest growth to achieve desired structural outcomes, whether for habitat, production, or some other objective.

Forest stands have an arrangement or structure that is three dimensional. On the horizontal plane, various configurations and sizes of open and closed spaces, trees, and other species are all part of structure. Vertically, the quantity of vegetation layers from ground to the upper forest stand canopy is also a part of the stand structure. Configurations of structure are a result of disturbance, either natural or human-caused action. But forests are also dynamic and changing as individual trees grow, die, and are replaced and are commonly described as having four basic stages or structures:

(1) stand initiation, an open condition with new regeneration (also called "open");

(2) stem-exclusion, with tree competition and mortality (also called "closed");

(3) understory reinitiation, with undergrowth development and some tree regeneration (also called "understory"); and

(4) old growth.

A transitional structure (sometimes called "layered") is also sometimes recognized when second growth is being manipulated to create old-growth features and there is greater structural diversity than understory and somewhat less than classic old growth. Silviculture in the OESF is a means to manipulate and produce a variety of possible stand structures based on specific objectives.

Silvicultural techniques are applied at the stand level. However, the results are expressed at both stand and landscape levels. Because of this, silviculture is linked closely with the landscape planning process and is one of the tools essential for integrating production and conservation. A landscape, in an ecological sense, is a large area that is composed of various interacting patterns of stand structure and function going through alterations over time. Natural events, such as the 1921 windstorm on the Olympic Peninsula, can have tremendous effects through the years, altering large areas. Pattern size, patch isolation or connectivity, and edge contrast have profound effects on wildlife and implications for forest utilization planning (Diaz and Apostol 1992). Within this variability however, influencing patterns across the landscape can be planned. Activities that emphasize both commodity production and ecological function can be designed at the stand level with attention to what is retained as well as what is removed and at the landscape level with attention to the arrangements of structures to be developed in and across multiple stands to meet desired patterns. Simulated outcomes of these silvicultural operations across landscapes based on today's ecological conditions can provide glimpses of the future forest. This will provide direction for stand-level prescriptions to meet the desired long-term landscape condition. (See also Section H of this chapter titled Forest Land Management Activities.)

Systematic Application of Knowledge Gained

Integration of new knowledge is to be a scientific, information-based process in the Experimental Forest. In a generic sense, a prudent manager monitors the results of management activities and then adapts future actions based on what has been learned from those results. However, systematic application of knowledge gained has a more focused approach. The basic task is to define a program of experiments that can, over the course of the planning horizon, identify or verify potential avenues for successfully meeting targets for commodity production and ecosystem conservation within the unzoned forest context. The assumptions and hypotheses will be tested through implementation, intentional testing and learning, and making adjustments as activities are conducted and feedback loops provide new information. Such intentional learning should increase the potential benefits of an experimental approach and allow managers to make decisions with greater confidence. The scientifically credible basis for decisions and actions should reduce the risk to the trusts of taking an experimental approach to managing the forest.

Information Management

Information management is used in its broadest sense to include the full scope of computerized and non-computerized information flow. It is in this realm that the research and monitoring activities link directly with the communication and education activities and with operations and decision-making.

Communication Outreach

While research and monitoring focus on acquiring and applying new information, communication and education focus on sharing this new information with trust-land managers and others in a variety of ways, with an emphasis on two-way discussion and learning. Communication can be grouped into five categories: (1) public information, (2) research communications support, (3) technical information exchange, (4) public involvement, and (5) education. A basic premise of the OESF is that by sharing, brainstorming, and working creatively with emerging information, new possibilities and techniques can be discovered for achieving production and conservation goals and can contribute to resolving forest management issues for the trusts and the state.

Experimental Forest communication should be more than a casual sharing of information. The expectations are to identify needs or common goals and work toward them. The communication and education effort envisioned for the OESF will be put into place over time as funding allows. The vision for these efforts can be described as follows:

> Dynamic exchange of ideas internal and external to DNR will contribute to effective problem solving and creative management of the OESF, helping achieve the purpose behind creating the Experimental Forest: to benefit the trusts by integrating production and conservation across the landscape.
>
> Internal mechanisms for effective management response and adaptation to new knowledge will be highly visible and functional, serving the interests of the trusts and providing a well-respected and internationally recognized model for businesses and other government agencies for applying new learning to management.
>
> The Experimental Forest will become a world-renowned site for ecological, forest management, and harvest technology research in a commercially viable forest and for adult and youth education programs built around this emerging knowledge.
>
> Researchers, tourists, recreating visitors, and college and K-12 students will come from throughout the country and around the world to participate in these programs. Laboratories, convention and classroom facilities, trail systems, and field sites will support a broad range of study and research activities. Recreational and tourist activities will link closely with the research and education programs through a joint partnership with peninsula communities and travel organizations.
>
> Modern communication technology will link the activity centers with computer databases and satellite telecommunication networks and provide interactive education experiences.

Partnerships with research and educational organizations throughout the state, nation, and world will help support these programs. Partnerships, participant fees, and external grants will strengthen the core financial base provided by DNR's management account and the state general fund.

SUMMARY

The Experimental Forest conservation strategies are based on current knowledge and are expressed as hypotheses to be tested experimentally. However, DNR recognizes that current knowledge can not answer all the questions about how to achieve integration of conservation and production effectively and economically. Research and monitoring will focus on answering these questions in the OESF. As new information and understanding emerge, feedback loops will allow DNR to apply this knowledge, adjusting management activities and techniques and revising assumptions and hypotheses. This process of intentional learning and systematic application to management should be supported through focused communications and education activities, which can help facilitate discussion, evaluation, problem solving, and decision making that are important parts of the internal and external feedback loops.

Because the Experimental Forest has a special mission of learning how to integrate timber production and habitat conservation across the landscape, the spotted owl, riparian, and multispecies conservation strategies for the OESF Planning Unit are unique, with more emphasis than in the other planning units on experimentation, research, monitoring, and systematic application of new knowledge. The interim conservation strategy for the marbled murrelet is the same as for the five west-side planning units. (See Section B of this chapter.) The conservation strategy for other listed species is the same as for all planning units. (See Section C of this chapter.)

Conservation Strategy for the Northern Spotted Owl in the Olympic Experimental State Forest

INTRODUCTION

The strategy proposed for conservation of the northern spotted owl on DNR-managed lands in the Olympic Experimental State Forest is unique because of the physical and biological conditions and land ownership of the area and because of the experimental approach to integrated management for forest commodity and ecosystem values that is the mission of the OESF. This strategy proposes objectives for restoring a level of habitat capable of supporting spotted owls on DNR-managed lands in the Experimental Forest rather than prescribing forest management activities for those lands. Management to achieve these objectives will be adaptive — that is, it will develop and test a variety of methods to integrate spotted owl habitat and commercial forest management and will apply those methods that are most effective and efficient.

CONSERVATION OBJECTIVES

The objectives for spotted owl conservation on DNR-managed lands in the OESF reflect both the requirements of the Endangered Species Act for approvable habitat conservation plans and the mission of the Experimental Forest. Those conservation objectives are to:

(1) Develop and implement land-management plans that do not appreciably reduce the chances for the survival and recovery of the northern spotted owl sub-population on the Olympic Peninsula.

(2) Develop, implement, test, and refine management techniques for forest stands that integrate older forest ecosystem values — including the stands' functioning as dispersal, foraging, roosting, and nesting habitat for spotted owls — with commercial objectives for those stands.

(3) Develop, implement, test, and refine landscape-level forest management techniques that support a wide range of forest ecosystem values in commercial forests, including their occupancy by successfully reproducing spotted owls that are a functional segment of the Olympic Peninsula sub-population.

The latter two of these conservation objectives may also be thought of as expressions of the primary working hypothesis of the OESF: that DNR can discover and implement forest management practices at the stand and landscape levels that allow for greater integration of natural resource commodity production and ecosystem support than is provided by current practices.

CONSERVATION STRATEGY

The conservation strategy proposes to achieve the objectives listed above, proposes to learn how to achieve these objectives in the most effective and efficient manner, and seeks to avoid explicit, long-term prescriptions for forest management. This is consistent with the OESF management process of systematically applying knowledge gained from research. However, it is necessary, both for evaluation of the strategy and application of new knowledge, to propose managing toward some explicitly stated conditions. These should be considered expressions of hypotheses based on current knowledge and conditions relevant to spotted owl conservation in the Experimental Forest, and they should be expected to change with further knowledge or changing conditions.

The strategy of conserving spotted owls by restoring habitat capability is proposed as a working hypothesis regarding the necessary quality, quantity, and distribution of potential habitat, accompanied by an approach for managing toward those conditions. The strategy is to be implemented in two phases, one of habitat restoration followed by one of maintaining and enhancing a mosaic of habitat that shifts over time as guided by analyses and plans for individual landscape planning units.

Integrating Forest Management and Spotted Owl Conservation: A Working Hypothesis

Management for desired owl habitat conditions will be planned and implemented at the scale of landscape planning units. As discussed earlier in the subsection titled Integrated Approach to Production and Conservation, landscape planning units are watershed-based and contain between 10,000 and 56,000 acres of DNR-managed lands. The objectives of landscape-level management are directed at developing landscapes that produce a mix of commercial products and ecosystem outputs across the entire OESF. Spotted owl conservation will primarily be derived from the integrated, ecosystem-oriented management, rather than direct the management.

A principal working hypothesis of the OESF is that landscapes managed for a fairly even apportionment of forest cover among stands in all stages of development, from stand initiation to old growth (Oliver and Larson 1990), will support desirable outputs of both commodities and ecosystem functions. Mid-aged and older forest stands in the stem-exclusion to old-growth stages support a broad range of commodity and ecosystem functions, including that of spotted owl habitat.

On the basis of current understanding of the responses of spotted owls to forest stands and landscapes (Horton in press), an approach to the integrated management of the Experimental Forest for timber production and spotted owl habitat is proposed. This approach can be stated and implemented as a working hypothesis for evaluation and systematic application and refinement: DNR can meet its objectives for commodity production and spotted owl conservation in the OESF by managing each landscape planning unit to maintain or restore threshold proportions of potential habitat. Those proportions are:

(1) at least 20 percent of DNR-managed lands in the landscape planning unit in the understory-reinitiation to old-growth stages that are potential old-forest habitat (after Hanson et al. 1993); and

(2) at least 40 percent of DNR-managed lands in the landscape planning unit in the stem-exclusion to old-growth stages that are potential old-forest, sub-mature, or young- forest marginal spotted owl habitat types (Hanson et al. 1993), including any old-forest habitat described in (1) above.

The threshold levels for habitat quality and proportion were selected because:

(1) There is substantial concurrence that 30-50 percent habitat at spatial scales from spotted owl ranges to landscapes can support reproductive owl pairs (e.g., Forsman and Meslow 1985; Bart and Forsman 1992; Carey et al. 1992; Lehmkuhl and Raphael 1993; Holthausen et al. 1994; Bart 1995).

(2) A conservation objective of the OESF is to support old-forest ecosystem functions, including that of spotted owl habitat, partly through providing a shifting mosaic of stands that are managed to retain or develop structural complexity. Some of the spotted owl habitat in the Experimental Forest is expected to be provided by these managed stands. There is considerable support among ecologists and silviculturalists that such techniques can be effective (e.g., USDI 1992, Appendix F; Franklin 1992).

(3) There is some uncertainty as to the ability of landscapes devoid of older forests to support successfully reproducing spotted owls. The hypothesized threshold amount of old-forest habitat is based on observations of significantly greater occupancy and productivity by owls in areas with greater than 20 percent cover of older forest than in those with less (Bart and Forsman 1992).

(4) A primary, overall goal of the OESF is integrated management for forest commodities and ecosystem functions. The proposed threshold proportions of spotted owl habitat are at the low end of the range of observed values in order to allow managers and researchers the greatest flexibility in arriving at effective and efficient solutions, but they are consistent with the recommendations of the U.S. Fish and Wildlife Service and Bart's (1995) conclusions as to the proportion of suitable habitat necessary to maintain site or population stability.

The currently proposed threshold proportions of potential spotted owl habitat are not intended to be targets for management; rather, they are minimum standards that reflect the current understanding of forest-ecosystem processes. The quantity and quality of potential spotted owl habitat will ultimately vary among landscape planning units with their physical and biological conditions and other management objectives for commodities and experimentation.

Current Conditions in the OESF

Forest cover on 58 percent of DNR-managed lands in the Experimental Forest is dominated by young stands that have regenerated following timber harvesting during the past 30 years. Structure and composition, not age, best predict the capability of forest stands as spotted owl habitat. However, stand age is correlated with structure and composition and provides a simple estimate of the area of the OESF currently in stands that are potential owl habitat. DNR's inventory (DNR GIS April 1995) shows that 19 percent of the Experimental Forest is in stands over 100 years old; most of these fit the Hanson et al. (1993) description of old-forest habitat. An additional 11 percent of the OESF is covered by stands 51-100 years old (including stands originating from a major 1921 windstorm); many of these stands fit the Hanson et al. (1993) description of young-forest marginal or sub-mature habitat.

An estimate of forest structure and composition (WDFW 1994) using satellite imagery obtained in 1991 generally concurs with the DNR inventory-based estimates for old-forest habitat (18 percent cover of old-growth and large sawtimber) and for sub-mature and young-forest marginal habitat (14 percent cover of small sawtimber). The Washington Department of Fish and Wildlife (1994) estimate of 32 percent total potential spotted owl habitat exceeds the DNR GIS (April 1995) estimate of 30 percent probably for two reasons: some harvesting of potential habitat has occurred in the four years since the satellite images were acquired; and the Washington Department of Fish and Wildlife (1994) estimates based on structure and composition appear to assign some stands to more highly structured categories at ages younger than those used to subdivide the DNR inventory, e.g., some 60-year-old stands were classified as large sawtimber, some 35-year-old stands as small sawtimber.

Both the age-based (DNR GIS April 1995) and structure-based (WDFW 1994) estimates of habitat probably overestimate the amount of younger forest habitat types. Field assessments by Washington Department of Fish and Wildlife and DNR biologists frequently categorize younger, simply structured stands of small sawtimber as not potential spotted owl habitat. By any measure, current amounts and distribution of potential spotted owl habitat across the OESF are decidedly sub-threshold.

Amounts of potential owl habitat vary widely among the 11 landscape planning units (Map IV.9). DNR's inventory estimates from 3 to 30 percent cover of stands more than 100 years old (potential old-forest habitat), 7 to 35 percent cover of stands more than 70 years old (potential old-forest and sub-mature habitat), and 12 to 57 percent cover of stands more than 50 years old (potential old-forest, sub-mature, and young-forest marginal habitat). See Table IV.6. These estimates of the abundance of potential habitat based on stand age are not perfect. For example, some stands not much older than 100 years would be classified as sub-mature habitat based on their structure and composition, just as some 75-year-old stands with a substantial component of older trees would be classified as old-forest habitat. But it is likely that estimates of the abundance of old-forest habitat are relatively unbiased, that is, some stands estimated to be old-forest habitat are really sub-mature and some stands estimated to be sub-mature are really old-forest. Similarly, estimates of the abundance of sub-mature habitat are likely to be relatively unbiased. However, the abundance of young-forest marginal habitat is likely overestimated based on the abundance of stands currently over 50 years old. The structure and composition of some of these

Table IV.6: Two estimates of the current abundance of potential spotted owl habitat in proposed landscape planning units of the Olympic Experimental State Forest

Landscape planning unit[1]	Acres		Estimated stand condition on DNR-managed land[2] (percent)			
	All ownerships	DNR-managed	Old forest[3] Inv./TM	Sub-mature[4,6] Inv./TM	Y-f marg[5,6] Inv./TM	Non-hab[7] Inv./TM
Sekiu	109,260	10,620	3/9	4/15	5/15	88/76
Clallam	79,470	18,374	3/14	32/21	16/21	51/65
Dickodochtedor	111,442	27,842	14/14	16/12	1/12	69/72
Sol Duc	84,035	18,465	5/23	18/22	33/22	45/45
Reade Hill	15,809	8,898	27/27	11/19	0/19	64/54
Goodman	66,251	24,639	21/18	6/11	0/11	75/71
Willy/Huel	51,965	38,963	22/23	3/14	2/14	73/63
Kalaloch	54,420	18,492	18/13	3/12	1/12	81/75
Clearwater	58,329	57,073	30/25	0/11	0/11	73/64
Coppermine	44,244	19,904	16/16	3/13	0/13	83/71
Queets	34,329	22,295	23/16	5/12	2/12	72/72

[1]See Map IV. 9 for location of landscape planning units.

[2]The percentage of DNR-managed land estimated to meet definitions of spotted owl habitat (Hanson et al. 1993) in each landscape planning unit. Two methods of estimation were used: DNR's stand inventory (DNR GIS 1995), column sub-heading "Inv."; and supervised classification of Landsat Thematic Mapper scenes taken July 1991 (WDFW 1994), column sub-heading "TM".

[3]Old forest = stands with origin dates estimated or measured as 1894 or older (Inv.), or old-growth and large-saw cover as estimated by supervised classification of Landsat Thematic Mapper (TM).

[4]Sub-mature= stands with origin dates estimated or measured as 1895-1924 (Inv.), or small-saw cover as estimated by supervised classification of Landsat Thematic Mapper scenes (TM).

[5]Y-f. marg = young-forest marginal habitat. Stands with origin dates estimated or measured as 1925-1945 (Inv.), or small-saw cover as estimated by supervised classification of Landsat Thematic Mapper scenes (TM).

[6]The same TM estimate of small saw is shown in both sub-mature and young-forest marginal columns because TM estimates of small sawtimber probably encompass both sub-mature and young-forest marginal habitat types. This estimate should be counted only once when totaling amounts of habitat by landscape planning unit.

[7]Non-hab = not suitable for habitat. Stands with origin dates estimated or measured as 1946-1995 (Inv.), or pole, sapling, and open-cover classes as estimated by supervised classification of Landsat Thematic Mapper scenes (TM).

stands are such that they would offer too few opportunities for foraging and roosting to be classified as young-forest marginal habitat. It is likely that the current abundance of young-forest marginal habitat is some proportion of the abundance of forest stands between 51 and 70 years of age and that proportion varies among landscape planning units with stand-level and landscape-level features that are unique within landscapes. Currently, potential spotted owl habitat[1] probably does not constitute much more than 40 percent of any landscape planning unit, although old-forest habitat appears to be at or above the 20 percent threshold in several landscape planning units (Table IV.6).

Management During the Restoration Phase

Spatially explicit forest growth models predict that all landscape planning units within the Experimental Forest will meet or exceed the 40 percent threshold for total old- and young-forest spotted owl habitat types in 40 to 60 years. These models demonstrate that time until restoration depends on natural and silviculturally aided successional processes in the abundant young stands and is independent of the level of retention of existing habitat (Table IV.7). This 40- to 60-year period during which existing young stands are developing the characteristics of young-forest marginal and sub-mature habitat is defined as the restoration phase of the proposed conservation strategy for the OESF. The longer period following the restoration phase that is required for threshold amounts of old-forest habitat to develop in all landscape planning units is defined as part of the maintenance and enhancement phase. Management during this phase will be discussed in the next subsection.

Management of the Experimental Forest will be planned and implemented at the level of individual activities within the framework of specific plans for each landscape planning unit. These landscape plans will focus and direct the integration of ecosystem, commodity, and information goals. Several elements of landscape plans will indirectly support the maintenance or restoration of spotted owl habitat. A primary objective for the conservation strategies of the OESF is to maintain and aid the natural restoration of the composition, structure, and function of aquatic and riparian ecosystems. This will likely result in the maintenance or restoration of older forests in streamside areas and on unstable hillslopes. (See the subsection titled the Riparian Conservation Strategy for the Olympic Experimental State Forest.) These streamside forests are of great value to spotted owls and many of their potential prey (Carey et al. 1992; Carey and Johnson 1995), as well as to the function of the aquatic and riparian ecosystems.

Commitments to the conservation of marbled murrelets will be also incorporated into landscape plans. The long-term conservation strategy for murrelets has not yet been developed, but the interim strategy is to defer the harvest of most potential murrelet habitat until after the development of the long-term strategy. (See Minimization and Mitigation for the Marbled Murrelet, in Section B of this chapter.) There is likely to be a high degree of overlap among potential murrelet and spotted owl habitats, thus the probable result of the interim murrelet strategy will be to defer harvest of much potential spotted owl habitat.

Landscape plans will help integrate diverse goals, in part by mapping and scheduling timber harvests and other silvicultural activities so that their influence on ecosystem processes can be assessed in advance. Harvests of currently suitable, potential spotted owl habitat will be planned, scheduled,

[1]In discussions regarding northern spotted owls and the OESF, the term "potential spotted owl habitat is used to generally characterize forest stands that, because of their structure and composition, are similar to those described as young- or old-growth forest spotted owl habitat by Hanson et al. (1993). The adjective "potential" is used to acknowledge that not all such stands will actually be used (become habitat) by owls, for a variety of reasons including that they occur in landscapes dominated by clearcuts and young plantations and are thus incapable of supporting owls.

Table IV.7: An estimate of the future abundance of potential spotted owl habitat in proposed landscape planning units of the Olympic Experimental State Forest and the forest at large based on one set of harvest regimes[1]

Decade	Percent of landscape in cover type: Non-habitat[2]	Young-forest marginal[3]	Sub-mature[4]	Old forest[5]	Total habitat[6]
Sekiu Landscape Planning Unit					
0	88	5	4	3	12
1	75	18	4	3	25
2	69	21	6	4	31
3	54	34	7	5	46
4	33	51	11	5	67
5	23	42	29	6	77
6	33	18	36	12	67
7	37	10	39	15	63
8	34	16	27	22	66
9	31	17	19	33	69
10	28	20	15	37	72
Clallam Landscape Planning Unit					
0	49	16	32	3	51
1	46	9	42	3	54
2	55	14	28	3	45
3	50	32	6	12	50
4	50	28	6	15	50
5	48	18	18	17	52
6	45	20	18	17	55
7	30	24	25	21	70
8	17	31	21	31	83

Table IV.7: An estimate of the future abundance of potential spotted owl habitat in proposed landscape planning units of the Olympic Experimental State Forest and the forest at large based on one set of harvest regimes[1] *(continued)*

Decade	Percent of landscape in cover type: Non-habitat[2]	Young-forest marginal[3]	Sub-mature[4]	Old forest[5]	Total habitat[6]
Clallam Landscape Planning Unit *(continued)*					
9	17	19	28	35	83
10	29	12	21	37	71
Dickodochtedor Landscape Planning Unit					
0	70	1	15	14	30
1	64	6	14	16	36
2	68	13	3	16	32
3	57	23	1	18	43
4	40	40	3	17	60
5	25	40	18	17	75
6	35	19	30	16	65
7	36	13	35	16	64
8	38	17	25	20	62
9	40	15	19	26	60
10	42	11	15	32	58
Sol Duc Landscape Planning Unit					
0	44	34	18	5	56
1	24	42	28	6	76
2	31	26	35	7	69
3	67	9	14	9	33
4	67	9	13	11	33

Table IV.7: An estimate of the future abundance of potential spotted owl habitat in proposed landscape planning units of the Olympic Experimental State Forest and the forest at large based on one set of harvest regimes[1] *(continued)*

Decade	Percent of landscape in cover type: Non-habitat[2]	Young-forest marginal[3]	Sub-mature[4]	Old forest[5]	Total habitat[6]
Sol Duc Landscape Planning Unit *(continued)*					
5	58	18	10	15	42
6	55	16	9	20	45
7	47	16	17	21	53
8	13	48	16	23	87
9	10	39	23	28	90
10	15	8	42	35	85
Reade Hill Landscape Planning Unit					
0	62	0	11	27	38
1	67	2	11	20	33
2	49	29	3	19	51
3	37	40	1	22	63
4	42	26	10	22	58
5	34	24	20	22	66
6	29	19	29	23	71
7	26	16	24	34	74
8	27	10	23	40	73
9	19	17	20	45	81
10	23	19	10	49	77
Goodman Landscape Planning Unit					
0	73	0	6	21	27
1	75	0	6	19	25

Table IV.7: An estimate of the future abundance of potential spotted owl habitat in proposed landscape planning units of the Olympic Experimental State Forest and the forest at large based on one set of harvest regimes[1] *(continued)*

Decade	Percent of landscape in cover type: Non-habitat[2]	Young-forest marginal[3]	Sub-mature[4]	Old forest[5]	Total habitat[6]
Goodman Landscape Planning Unit *(continued)*					
2	73	7	2	19	27
3	53	26	1	20	47
4	29	50	2	19	71
5	17	48	16	19	83
6	25	20	37	19	75
7	30	7	44	19	70
8	41	6	28	24	59
9	44	8	16	32	56
10	42	14	7	37	58
Willy-Huel Landscape Planning Unit					
0	73	2	3	22	27
1	74	3	3	20	26
2	67	10	3	19	33
3	48	31	1	20	52
4	27	48	6	19	73
5	18	41	21	20	82
6	23	18	38	20	77
7	30	6	40	24	70
8	35	5	28	33	65
9	35	9	14	42	65
10	35	12	6	48	65

Table IV.7: An estimate of the future abundance of potential spotted owl habitat in proposed landscape planning units of the Olympic Experimental State Forest and the forest at large based on one set of harvest regimes[1] *(continued)*

Decade	Percent of landscape in cover type				Total habitat[6]
	Non-habitat[2]	Young-forest marginal[3]	Sub-mature[4]	Old forest[5]	
Kalaloch Landscape Planning Unit					
0	78	1	3	18	22
1	77	1	3	19	23
2	72	8	2	19	28
3	50	30	1	19	50
4	25	54	3	18	75
5	24	46	17	13	76
6	31	18	39	13	69
7	40	5	40	15	60
8	44	6	28	22	56
9	47	10	10	32	53
10	35	22	6	37	65
Clearwater Landscape Planning Unit					
0	70	0	0	30	30
1	74	0	0	26	26
2	71	3	0	26	29
3	54	20	0	26	46
4	24	49	1	26	76
5	12	49	13	26	88
6	13	22	38	26	87
7	20	6	47	27	80
8	28	2	36	33	72

Table IV.7: An estimate of the future abundance of potential spotted owl habitat in proposed landscape planning units of the Olympic Experimental State Forest and the forest at large based on one set of harvest regimes[1] *(continued)*

Decade	Percent of landscape in cover type: Non-habitat[2]	Young-forest marginal[3]	Sub-mature[4]	Old forest[5]	Total habitat[6]
Clearwater Landscape Planning Unit *(continued)*					
9	33	4	15	47	67
10	34	9	3	54	66
Coppermine Landscape Planning Unit					
0	81	1	3	16	19
1	81	1	3	16	19
2	77	6	1	16	23
3	52	31	1	17	48
4	28	53	2	17	72
5	16	47	20	17	84
6	22	22	39	17	78
7	25	7	50	19	75
8	35	6	34	25	65
9	40	7	16	37	60
10	34	14	7	45	66
Queets Landscape Planning Unit					
0	71	2	5	23	29
1	74	2	5	19	26
2	67	12	2	19	33
3	53	27	0	20	47
4	39	41	2	19	61
5	22	41	18	19	78

Table IV.7: An estimate of the future abundance of potential spotted owl habitat in proposed landscape planning units of the Olympic Experimental State Forest and the forest at large based on one set of harvest regimes[1] *(continued)*

Decade	Percent of landscape in cover type: Non-habitat[2]	Young-forest marginal[3]	Sub-mature[4]	Old forest[5]	Total habitat[6]
Queets Landscape Planning Unit *(continued)*					
6	29	23	29	19	71
7	40	10	31	20	60
8	47	7	27	20	53
9	42	14	21	23	58
10	47	12	7	34	53

[1]Estimates are based on harvest assessments for the OESF unzoned alternative presented to the Board of Natural Resources on June 6, 1995, and represent one possible set of regimes for illustrative purposes only. Actual harvest levels will be determined through the landscape planning process. Old-forest habitat will not be reduced in amount if it comprises 20 percent or less of a landscape planning unit. See Map IV.9 for location of proposed landscape planning units.

[2]Non-habitat is assumed to be either a) untreated stands 50 years old or younger, or b) stands that were 71 years old or older when they were partially-harvested within the past 10 years.

[3]Young-forest marginal habitat is estimated to be either a) untreated stands 51-70 years old, or b) stands that were 71 years old or older when they were partially-harvested within the past 11-30 years.

[4]Sub-mature habitat is estimated to be either a) untreated stands 71-100 years old, or b) stands that were 71 years old or older when they were partially-harvested within the past 31-50 years.

[5]Old-forest habitat is estimated to be either a) untreated stands 101 years old or older, or b) stands that were 71 years old or older when they were partially-harvested over 51 years ago.

[6]Total habitat is the sum of young-forest marginal, sub-mature, and old-forest habitat.

and implemented using the following guidelines as a filter to determine what is allowable:

(1) Harvests of young- or old-forest habitat will support riparian ecosystem and marbled murrelet conservation as set forth in other sections of this HCP.

(2) Harvest activities will maintain the proportion of old-forest habitat at or above 20 percent of each landscape planning unit and will not further reduce sub-threshold proportions. In this phase, harvest activities in young-forest habitat may occur independent of the 40 percent threshold if consistent with other elements of the HCP.

(3) Plans for harvest of young- or old-forest habitat will recognize the importance of interior old-forest conditions to overall ecosystem function and will maintain or develop these conditions in accordance with landscape plans.

(4) Harvests of available young- and old-forest habitat will be evenly distributed over the duration of the restoration phase. Available habitat will be calculated for each landscape planning unit, and harvests of that habitat will be scheduled and conducted so that they are evenly distributed by decade over the duration of the restoration phase of the HCP.

(5) Harvests of available young- and old-forest habitat will be scheduled in consideration of the value of individual owl sites to conservation, research, and validation monitoring in the Experimental Forest. DNR will consider the recommendations of the U.S. Fish and Wildlife Service when scheduling these harvests during the first decade of the HCP.

(6) Harvests of available young- or old-forest habitat will take advantage of opportunities to learn new silvicultural techniques for retaining old-forest ecosystem functions, including those providing spotted owl habitat. This is an important conservation goal of the Experimental Forest, although not all harvests will necessarily be for research in silvicultural options.

Habitat restoration will also proceed under landscape plans. Harvesting, silvicultural activities, and other activities (e.g., road building, maintenance, etc.) in areas that are not currently suitable habitat will be planned, scheduled, and implemented using the following guidelines as a filter to determine what is allowable:

(1) All activities will support riparian ecosystem and marbled murrelet conservation as set forth in other sections of this HCP.

(2) Activities will restore at least 20 percent cover of old-forest habitat to each landscape planning unit, including the development of some interior old-forest conditions.

(3) Harvests and other silvicultural activities in young (0- to 30-year-old) stands will promote development of young- or old-forest spotted owl habitat so that the restoration phase is expedited.

(4) Harvests and other silvicultural activities in young (0- to 30-year-old) stands will be take advantage of opportunities to learn new silvicultural techniques for accelerating the development of old-

forest ecosystem functions, including those providing spotted owl habitat. This is an important conservation goal of the OESF, although not all such activities will necessarily be for research in silvicultural options.

Activities that precede thorough landscape analyses and plans will be conducted in accord with the above guidance and will proceed cautiously to avoid foreclosing options for commodity production, ecosystem support, and research.

Management During the Maintenance and Enhancement Phase

The maintenance and enhancement phase of the HCP for the Experimental Forest covers the remainder of the permit period and follows the restoration of threshold amounts of total spotted owl habitat in each landscape planning unit. During this phase, some stands will continue developing the characteristics of old-forest habitat to meet conservation needs for riparian ecosystems, as well as possibly for marbled murrelets and spotted owls and for other ecosystem functions. Other stands will receive a variety of silvicultural treatments including clearcut harvests where appropriate, but total spotted owl habitat will make up at least 40 percent of each landscape planning unit. Current estimates are that those landscape planning units that contain less than the threshold amounts of old-forest habitat will attain the threshold level over the next 20 to 80 years. Thus, restoration of the entire OESF to conditions that are currently hypothesized to support desired outputs of commodity and ecosystem products is predicted to take as long as 80 years. This restoration depends on natural and silviculturally aided successional processes, in both young-forest habitat types and the abundant young stands. Conditions and knowledge will likely change substantially over this time, altering strategies and tactics; however, some discussion of the current proposal for management follows.

Activities will likely continue to be planned and implemented at a scale larger than forest stands, but the base units for planning may differ from the current landscape planning units. It is also likely that these plans will continue to integrate diverse goals, in part by mapping and scheduling timber harvests and other silvicultural activities so that their influence on ecosystem processes can be predicted. Activities for this phase should be planned, scheduled, and implemented using the following guidelines as a filter to determine what is allowable:

(1) Activities will support necessary riparian ecosystem or marbled murrelet conservation.

(2) Activities will maintain or enhance at least 20 percent cover of old-forest habitat in each landscape planning unit, including the maintenance or development of interior old-forest conditions in each unit.

(3) Harvest activities will maintain the proportion of young- and old-forest habitat at or above 40 percent of each landscape planning unit.

(4) New research goals will evolve to ensure the success of this phase.

RATIONALE FOR THE SPOTTED OWL CONSERVATION STRATEGY

The non-specific nature of the conservation objectives acknowledges the incomplete understanding of spotted owl population dynamics within the context of the overall mission of the Experimental Forest. Not enough information is available about the numbers, distribution, and demographic performance necessary to maintain the current chances for survival and recovery of the sub-population of spotted owls on DNR-managed lands in the OESF. Nor is it known what management regimes best support that goal. It may be possible to maintain the chances for survival and recovery with very small contributions to spotted owl habitat from the Experimental Forest. However, an important part of the OESF mission is to learn how to manage commercial forests for integrated outputs of commodity and ecosystem products, including those ecosystem products that derive from the workings of older forests. Spotted owls are a visible, measurable output of older forest ecosystems. Management of the Experimental Forest that restores and supports a reproducing segment of the spotted owl population would be an important conservation goal of the OESF whether spotted owls were listed as threatened or not.

The conservation strategy was developed in light of current physical and biological conditions and the land-ownership and land-management context in the northwestern portion of the range of the northern spotted owl. Seven key items were considered:

(1) the physical geography and land-cover patterns of the region;

(2) the size and trends of the spotted owl sub-population on the Olympic Peninsula (see Section A of Chapter III for a discussion of biological data for spotted owls on the Olympic Peninsula);

(3) the current distribution of spotted owls and their habitat on the Olympic Peninsula (see Section A of Chapter III);

(4) patterns of land ownership and current objectives of forest managers (see the section in Chapter I titled Land Covered by the HCP);

(5) recent trends in occupancy by spotted owls on DNR-managed lands in the Experimental Forest and current habitat conditions there;

(6) current knowledge and hypotheses regarding spotted owls and managed forests; and

(7) the mission of the OESF to discover effective approaches for integrated management of commercial forests.

Consideration of these key items led to several conclusions that guided the development of the conservation strategy. Geography and land-use patterns have isolated spotted owls on the Olympic Peninsula from other significant sub-populations in western Washington and Oregon. Recent studies suggest that the sub-population is substantially larger than was formerly believed, is interconnected, and is either stable or declining slowly (Holthausen et al. 1994; Burnham et al. 1994). Currently, the vast majority of spotted owls and potential habitat are found on federal lands in the Olympic National Forest and Olympic National Park. These federal lands border a substantial portion of DNR-managed lands in the Experimental Forest. Management objectives for the federal lands include supporting the recovery of a viable, well-distributed population of spotted owls (USDA and USDI 1994b). Thus, while the conservation of spotted owls on the Olympic Peninsula is of particular concern, the population size, distribution, and status, as well as the substantial commitment to habitat protection and recovery by the Olympic National Forest and Olympic National Park, appear to provide a population and habitat base that allows considerable flexibility in developing a conservation strategy for DNR-managed lands.

The amount and distribution of potential spotted owl habitat on DNR-managed lands in the OESF is currently sufficient to support only a few spotted owl pairs. Recent observations on those lands have found a substantial proportion of sites formerly occupied by spotted owl pairs to be either intermittently occupied by unpaired spotted owls or vacant. Apparently, significant demographic support to the spotted owls on the western Olympic Peninsula from the Experimental Forest must await the development of habitat conditions in the abundant young stands on these lands.

The current understanding is that both the structure and composition of forest stands and the composition and pattern of forested landscapes determine their capability as spotted owl habitat (Horton in press). Some management techniques currently exist to maintain or restore spotted owl habitat capability; many others are hypothesized (e.g., USDI 1992, Appendix F). DNR intends to implement, evaluate, and refine techniques such as these in the OESF. Thus, there is reason to believe that meaningful contributions to spotted owl conservation can result from management of the Experimental Forest.

The conservation strategy is based primarily on the restoration of habitat capability for spotted owls and assumes a level of risk because it allows some reduction in the amount of potential spotted owl habitat in the near term. The level of risk may be acceptable because:

(1) current habitat conditions allow so few spotted owl pairs to occupy these lands successfully that only marginal losses to the Olympic Peninsula sub-population are likely;

(2) the levels of near-term habitat removal are fairly low; and

(3) the overall status of the Olympic Peninsula spotted owl sub-population and habitat appears to be reasonably secure within the context of management plans for federal lands (Holthausen et al. 1994; see the section in Chapter II on the Reanalysis Report for the Spotted Owl on the Olympic Peninsula and Section A of Chapter III on biological data for the spotted owl on the Olympic Peninsula for a brief discussion of Holthausen et al. 1994).

POTENTIAL BENEFITS AND IMPACTS TO SPOTTED OWLS

DNR proposes to manage the OESF as a commercial forest, and simultaneously, to restore a greater level of habitat capability for spotted owls than currently exists there. DNR anticipates that during the life of the HCP, some spotted owls may be displaced and forest management activities may degrade habitat conditions for some individual spotted owls or owl pairs to the point where the habitat is temporarily incapable of supporting them. These activities may constitute incidental take of spotted owls as defined by the Endangered Species Act. The HCP was designed to minimize and to mitigate for this take within the context of its objectives. In fact, it is intended that management of the Experimental Forest will result in spotted owl habitat that is more abundant and widely distributed than it is at present.

Benefits

The HCP for the OESF will potentially benefit spotted owls in several ways:

(1) by deferring older stands (potential old-forest habitat) from harvest to meet (a) riparian or marbled murrelet conservation strategies,

(b) the 20 percent per landscape planning unit threshold for old-forest spotted owl habitat, or (c) harvest scheduling objectives;

(2) by deferring mid-aged forest stands (potential young-forest marginal, sub-mature, or occasionally, old-forest habitat) from harvest to meet (a) conservation strategies for riparian ecosystems or marbled murrelets, (b) harvest scheduling objectives, or (c) the 40 percent per landscape planning unit threshold for young-forest marginal, sub-mature, or old-forest spotted owl habitat; and

(3) by developing spotted owl habitat in young stands. A description of how these three measures will benefit the spotted owl during the restoration phase of the HCP for the Experimental Forest follows.

Preliminary analyses suggest that about 30 percent of the older forests are near stream channels or on unstable hillslopes and an additional 10 percent are in potentially wind-prone areas near streams. Because these older forests will be managed to meet the objectives of the OESF riparian conservation strategy (see the next subsection), DNR expects to maintain the potential of these stands as old-forest habitat for spotted owls. The long-term conservation strategy for murrelets has not yet been developed, but the interim strategy is to defer harvest of most potential murrelet habitat at least until the development of the long-term strategy. (See Section B of this chapter on the marbled murrelet strategy.) Preliminary examination of raw data from a two-year study of upland habitat relationships of murrelets in the OESF suggests that there will be a high degree of overlap among potential murrelet habitat and potential old-forest habitat for spotted owls. Thus, the likely result of the interim murrelet strategy will be to defer harvest of much potential old-forest habitat.

In order to support the 20 percent old-forest habitat threshold for each landscape planning unit, harvest is proposed to be deferred in those forests for 50-80 years in six landscape planning units in which amounts of that cover type are hypothesized to be insufficient. These deferrals will benefit the spotted owl. In the five landscape planning units in which old-forest cover is estimated to be greater than 20 percent, about 8,000 acres are in excess of the threshold amount. The retention of at least 20 percent old-forest cover in these landscapes will benefit the spotted owl. To the extent that harvest of supra-threshold old-forest habitat in these areas does not conflict with conservation strategies for riparian ecosystems or marbled murrelets, DNR proposes harvest be evenly distributed over the duration of the restoration phase of the HCP. Gradual harvest of about 12 percent of the existing old-forest habitat over 40 or more years (while some mid-aged stands are becoming old-forest habitat) will also benefit the spotted owl.

Preliminary analyses suggest that about 20 percent of mid-aged forests are near stream channels or on unstable hillslopes and an additional 10 percent are in potentially wind-prone areas near streams. Because these forests will be managed to meet the objectives of the riparian ecosystem conservation strategy (see the next subsection), DNR expects to maintain or enhance the potential of these stands as habitat for spotted owls. The long-term conservation strategy for murrelets has not yet been developed, but the interim strategy is to defer harvest of most potential murrelet habitat at least until the development of the long-term strategy. (See the earlier section in this chapter on the marbled murrelet strategy.) Preliminary examination of raw data from a two-year study of upland habitat relationships of murrelets in the Experimental Forest suggests that there will be some overlap among potential murrelet habitat and potential sub-mature habitat for spotted owls. Thus, the likely result of the interim murrelet strategy will be to defer harvest of some potential sub-mature habitat. DNR proposes that harvest of other mid-aged forests be evenly distributed over the duration of the restoration phase of the HCP. This gradual harvest of perhaps as much as 20,000 acres of young-forest marginal and sub-mature habitat over 40 or more years while over 100,000 acres of younger forests are becoming young-forest marginal and sub-mature habitat will also benefit the spotted owl.

Preliminary analyses suggest that approximately 130,000 acres of forest stands in the OESF are between 11 and 50 years old (DNR GIS 1995). Currently, these stands provide little if any young-forest marginal habitat for spotted owls. However, during the 40- to 60-year restoration phase of the HCP, most of these stands will, through natural or silviculturally-aided processes, develop into young-forest marginal, sub-mature, and old-forest habitat. (See Table IV.7.) Most of the habitat that will develop during this phase will be of the young-forest marginal and sub-mature types, with more and higher quality habitat developing in the latter half of the restoration phase. The development of young-forest marginal and sub-mature owl habitat while existing, similar habitat is harvested will serve to benefit the spotted owl.

The mission of the Experimental Forest is to learn how to conduct integrated forest management for commodity and ecosystem outputs. One facet of this mission is to learn how to manage commercial forest landscapes such that they support successfully reproducing spotted owls that are a functional segment of the Olympic Peninsula sub-population. DNR expects this to result from several outcomes of proposed management of the OESF:

(1) providing owl habitat during a significant proportion of the management cycle in some forest stands;

(2) providing owl habitat fairly continuously in some forest stands;

(3) supporting older forest ecosystem processes, including spotted owl survival and reproduction, through management of forest landscapes;

(4) learning effective and efficient techniques for supporting spotted owls in commercial forests and conveying this information to forest scientists and managers so that it can potentially be employed elsewhere. A description of how these four measures will benefit the spotted owl during the life of the HCP for the Experimental Forest follows.

Forest stand management in the OESF will increasingly focus on retention of elements of existing stands to promote diversity within each stand and the development of owl habitat at earlier ages than might be achieved without such retention. (See Section H in this chapter titled Forest Land Management Activities.) For example, a regime that harvested 90-year-old stands, retaining one-third of their volume, and conducted intermediate harvests that maintained or enhanced structural diversity may be hypothesized to provide at least young-forest marginal and sub-mature habitat between 50 and 90 years post-harvest (44 percent of the management cycle for the stand). This regime has been used to represent a median silvicultural regime for the Experimental Forest and was the basis for the harvest assessment presented at the Board of Natural Resources Workshop on October 3, 1995. Other silvicultural regimes will develop stands with multiple age classes and large structural elements from previous stands. (See Section H of this chapter titled Forest Land Management

Activities.) Such stands may be hypothesized to provide both younger forest and possibly even old-forest habitat types during portions of the management cycle. An estimate of the rate of development of potential owl habitat in landscape planning units of the OESF is presented in Table IV.7, which shows that substantially more potential habitat that is more widely distributed potential habitat will be developed during the life of the HCP than currently exists. Silvicultural practices that provide owl habitat in commercial forest stands during significant portions of the management cycle and result in substantially more habitat than currently exists result in significant benefits to spotted owls.

Some forest stands will be managed such that they provide owl habitat fairly continuously. Many of these stands will be in or near riparian areas or on unstable areas in the uplands. Silvicultural practices in these areas are currently hypothesized to include: minimal or no harvest; thinnings and light partial harvests designed to enhance structural diversity and thus wind-firmness; and conversion of some streamside areas, which were invaded by deciduous trees or shrubs following timber harvest, to conifer stands in order to better support riparian ecosystem functions. (See the OESF riparian strategy and Section H of this chapter titled Forest Land Management Activities.) It is predicted more than 20 percent of the Experimental Forest will be managed by such methods, and it is predicted that most of these areas will either remain or become potential old-forest habitat for spotted owls. An estimate of the rate of development of potential old-forest habitat in landscape planning units of the OESF is presented in Table IV.7, which shows that substantially more, and more widely distributed, potential old-forest habitat will be developed toward the end of the HCP period than currently exists. Management practices that increase the amount and broaden the distribution of old-forest habitat relative to what currently exists result in significant benefits to spotted owls.

Reproducing spotted owl pairs need substantial areas of potential habitat. The proposed management of forest landscapes to achieve at least threshold qualities and quantities of potential habitat is intended to provide these substantial areas of habitat. An estimate of the rate of development of potential young-forest marginal, sub-mature, and old-forest habitat in landscape planning units of the OESF is presented in Table IV.7. Note that preliminary landscape management regimes used in developing the harvest assessment from which the table was derived result in all landscape planning units surpassing hypothesized threshold qualities and quantities of owl habitat. Management practices that increase the amount and broaden the distribution of young-forest marginal, sub-mature, and old-forest habitat such that the capabilities of forest landscapes to support spotted owls are greater than their current capabilities constitute significant benefits to spotted owls.

Learning how to manage commercial forests effectively and efficiently for ecosystem and commodity values requires a significant commitment to research, monitoring, and information exchange. (See the earlier subsection in this chapter titled Integrated Approach to Conservation and Production as well as the sections in Chapter V titled Monitoring and Research.) It is difficult to predict how much of what is learned in the Experimental Forest will be used to manage other commercial forests so that they provide a greater level of support to the regional population of northern spotted owls. But, given the commitment to such learning, then to the extent that information derived is applied by other forest scientists and managers and produces positive results, those results also constitute benefits to spotted owls.

Impacts

It may be argued that the degradation of spotted owl habitat which occurs during the earlier restoration phase of the HCP is possibly more significant than that which occurs during the later maintenance and enhancement phase because, during that later phase, the harvest and development of potential spotted owl habitat will be more or less at equilibrium and, hypothetically, landscapes will have more or less stable occupancy by owls. This suggests that measures to minimize habitat degradation during the restoration phase are of potentially greater importance than they might be during the maintenance and enhancement phase and that measures to mitigate for take are likely of roughly equal importance during both phases because mitigation during the restoration phase is predicted to enable the equilibrium among harvest and development of habitat that is intended during the maintenance and enhancement phase.

Riparian Conservation Strategy for the Olympic Experimental State Forest

INTRODUCTION

The riparian conservation strategy proposed for the Olympic Experimental State Forest is distinct from that for other HCP planning units because of the unique physical and ecological features of the western Olympic Peninsula. The need for special protective measures stems from a high potential throughout the Experimental Forest for:

(1) mass wasting (i.e., landslides, debris torrents, channel-bank collapse), due to highly erosive, weathered bedrock and overlying glacial deposits, heavy annual precipitation, and steep terrain, and

(2) tree blowdown, due to alignment of major river valleys with the prevailing wind directions, fully saturated soils during the winter months, and edge effects associated with clearcutting adjacent to mature timber stands.

Of the many factors affecting habitat for salmonids and riparian-dependent species, mass wasting and windthrow exert the greatest short- and long-term influences. Hence, this conservation strategy explicitly addresses these two driving factors by creating riparian buffers designed to minimize mass wasting and windthrow. A principal working hypothesis of this approach is that buffers designed to minimize mass wasting and blowdown will be sufficient to protect other key physical and biological functions of riparian systems.

This riparian strategy is unique because it incorporates experimentation as a means of developing and evaluating new methods of integrating forest-commodity production with protection of riparian-ecosystem health. This emphasis reflects the primary mission of the OESF. In addition, the riparian conservation strategy cannot be separated from other conservation and forest management measures for the OESF. All conservation, research, and management strategies were designed in concert to achieve an integrated management approach. Conservation measures for upland species, hence, rely in part on the riparian conservation strategy to meet their short- and long-term objectives. For example, proposed buffers on streams and streamside habitat account for more than 50 percent of habitat projected for the northern spotted owl on DNR-managed lands within the Experimental Forest.

As in the conservation proposal for the northern spotted owl in the OESF, the riparian strategy sets objectives for protecting and restoring functional species habitat, rather than prescriptions for forest practices within proposed riparian-buffer areas. Currently, scientific understanding is incomplete with regard to riparian processes, the complex interactions between physical and biological parameters within riparian ecosystems, and the long-term impacts of forest management activities on these processes. Riparian buffers, therefore, are proposed as the present best means for protecting a number of important habitat features, such as stream bank stability and coarse woody debris inputs, in lieu of a scientifically proven method for protecting all aspects of riparian ecosystems. A central mission of the OESF is to explore these relationships through research and monitoring, in order to acquire a better understanding of riparian ecosystems in managed landscapes. The type and intensity of management activities within proposed riparian buffers will depend on their ability to achieve riparian objectives in the short and long term. Management approaches will be adaptive, to incorporate new insights obtained from experiments and other sources into effective management strategies.

Conservation Objectives

DNR-managed lands within the OESF shall be managed to:

(1) maintain and aid restoration of the composition, structure, and function of aquatic, riparian, and associated wetland systems which support aquatic species, populations, and communities;

(2) maintain and aid restoration of the physical integrity of stream channels and floodplains;

(3) maintain and aid restoration of water to the quantity, quality, and timing with which these stream systems evolved (i.e., the natural disturbance regime of these systems);

(4) maintain and aid restoration of the sediment regime in which these systems evolved, and

(5) develop, use, and distribute information about aquatic, riparian, and associated wetland-ecosystem processes and on their maintenance and restoration in commercial forests.

These objectives reflect the requirements for maintaining habitat that is capable of supporting viable populations of salmonid species, as well as for other non-listed and candidate species dependent on in-stream and riparian environments. The riparian conservation objectives also incorporate the OESF mission. Objective 5, in particular, seeks the implementation of a structured and credible program of research, experimentation, and monitoring to aid forest management and the scientific understanding of riparian systems in managed landscapes.

The principal underlying theme of these objectives is the need to conserve habitat complexity afforded by natural disturbance regimes on the western Olympic Peninsula. Habitat complexity includes (e.g., see Bisson et al. 1992):

(1) variations in stream-flow velocity and stream depth created by structural obstructions to channel flow;

(2) physical and biological interactions between a channel and its floodplain;

(3) aquatic and riparian structures that provide cover from predators;

(4) a variety of stream substrates that includes gravel for fish spawning and macro-invertebrate habitat;

(5) sufficient storage area within channels and floodplains for sediment and organic matter; and

(6) diversity of riparian vegetation that provides adequate sources of woody debris and nutrients to channels and that moderates water and air temperatures within the riparian corridor.

Habitat complexity is maintained by natural events such as landslides, debris flows, peak stream-flows (floods), fires, forest-disease outbreaks, and vegetation changes associated with forest competition, all of which periodically deliver sediment, wood, nutrients, and water to riparian areas from upslope and floodplain sources (Pringle et al. 1988; Benda et al. 1992; Naiman et al. 1992).

Riparian Ecosystem Defined

For the purposes of this riparian conservation strategy, riparian areas are defined as three-dimensional zones of direct interaction between terrestrial and aquatic environments. They encompass the forest canopies, floodplains, wetlands, open bodies of water (e.g., ponds, lakes, estuaries, and nearshore marine environments), channel banks and beds, surface waters, and ground water zones that connect channels with adjacent hillslopes and floodplains (Swanson et al. 1982; FEMAT 1993).

Aquatic systems are considered part of the riparian ecosystem for the purposes of the OESF. Aquatic systems directly influence, and are influenced by, riparian zones and upland areas that contribute water, organic matter, sediment, detrital nutrients, prey (e.g., macro-invertebrates), heat, and energy to a stream channel (Figure IV.8).

The aquatic system of the northwestern Olympic Penisula encompasses estuarine and near-shore marine environments that are occupied during a life stage of anadromous organisms and that influence the nutrient and mineral exchange, water quality, and morphology and dynamics of Olympic coastal channels. DNR recognizes the importance of minimizing impacts to estuarine and near-shore environments associated with forest practices on DNR-managed lands, although the cumulative effects of such impacts are derived as well from management activities on lands not managed by DNR. The OESF riparian conservation strategy, therefore, contains no explicit measures for protecting estuarine and near-shore environments, other than to minimize sedimentation and declines in water quality related to forest practices on DNR-managed lands.

CONSERVATION STRATEGY

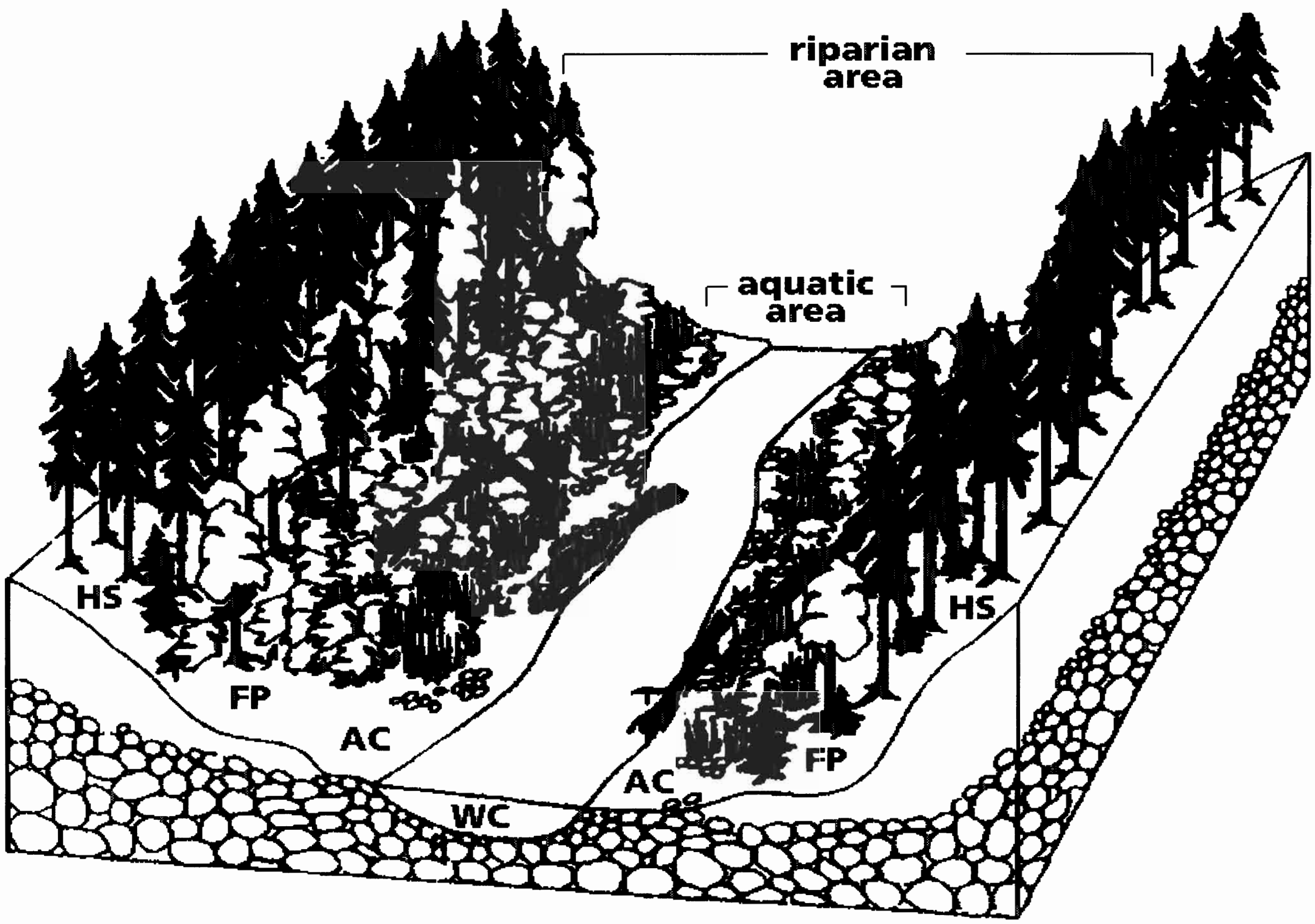
The riparian conservation strategy for the OESF seeks to meet the stated objectives by establishing:

(1) interior-core buffers on all stream types (although not on all streams — see discussion titled Interior-core Buffers regarding buffers for Type 5 streams),

(2) exterior wind buffers on all stream types (although not on all streams — see discussion titled Exterior Buffers regarding use of wind buffers),

Figure IV.8: Geomorphic features associated with riparian areas

The active channel (AC) includes the wetted channel (WC) and active channel surface exposed during low flow. Floodplains (FP) are located between the active channel and hillslope (HS); they support mosaics of herbs, shrubs, and deciduous trees. Conifers dominate riparian forests on lower hillslopes. (Modified from Gregory et al. 1991)



(3) comprehensive road-maintenance plans,

(4) protection of forested wetlands, and

(5) a research and monitoring program integrated with on-the-ground riparian protection.

These five components are described below.

Interior-core Buffers

Interior-core riparian buffers are intended to minimize disturbance of unstable channel banks and adjacent hillslopes (i.e., potential areas of mass wasting) in order to protect and aid natural restoration of riparian processes and functions. Harvesting in interior-core buffers can occur, provided that management activities are consistent with the conservation objectives. The ability of management, conservation, and restoration activities to meet the conservation objectives will be evaluated through landscape-level assessments of the physical and biological conditions of riparian forests (discussed later in the subsection titled Implementing the Riparian Conservation Strategy).

DNR's working hypothesis, based on current knowledge, is that riparian conservation objectives are best met by establishing buffers on streams and riparian forests in order to effectively maintain key physical and biological functions until streams recover sufficiently from past disturbances to allow greater integration of commodity production and conservation. The width of riparian buffers will be determined on a site-specific basis, according to the assessment procedure described later in this section. Although buffers will be established based on landscape-level field evaluations, DNR expects that buffer widths will be, on average, comparable to those in Table IV.5. (See Chapter IV, Section D, pg. IV.58.) The buffer widths for each stream type, as shown in Table IV.5, have been calculated based on average buffer dimensions that were used by DNR's Olympic Region from 1990 through 1994 to protect unstable ground in the Experimental Forest. Buffer widths established once the Experimental Forest is under way, therefore, are not expected to vary substantially from those in Table IV.5 because they reflect current practices for protecting unstable ground.

Average buffer widths are given in Table IV.5 as average horizontal distances measured outward from the outer margin of the 100-year floodplain on either side of the stream. The 100-year floodplain is the valley-bottom area adjoining the stream channel that is constructed by the stream under the present climatic regime and overflowed at times of very high discharge (i.e., flooding associated with storms of a 100-year recurrence interval (Dunne and Leopold 1987)). One-hundred-year floodplains commonly are delineated by the Federal Emergency Management Agency (FEMA) on Flood Insurance Rate Maps (FIRM) for each county of a state. The 100-year floodplain includes meandering, braided (i.e., multiple channel braids), and avulsion channels, as well as side channels that transport water from one part of a mainstream channel to another. Avulsion channels are portions of mainstream and side channels that have been abandoned temporarily by lateral displacement of the channel network elsewhere on the floodplain but are expected to be reoccupied when the network migrates back across the valley bottom.

The 100-year floodplain, which often encompasses the channel-migration zone, frequently occupies a several-hundred-foot wide section of the valley bottom on low-gradient, alluvial river systems. On higher-gradient streams in moderate to steep terrain, the 100-year floodplain typically coincides with the active channel margin or extends only a few feet beyond the active (e.g., the high-water mark). The active channel consists of the wetted area and bed or bank surfaces exposed during low flows, as well as portions of the valley bottom nearest the channel that are inundated during typical flood events (i.e. comparable to the two-year recurring flood). Active channel margins commonly are identified in the field by piles of accumulated flood debris, overbank sediment deposits, streamside vegetation altered or damaged by channel flows, bank scour, and the absence of aquatic biota (e.g., algae) normally found in slack-water channels. In the five west-side planning units and the OESF, DNR manages only a few hundred acres on 100-year floodplains of the major river systems. Most floodplain acreage is privately owned or federally managed. FEMA maps indicate that most 100-year floodplains are associated with Type 1 and 2 waters. Collectively, Type 1 and 2 waters represent less than 5 percent of stream miles on DNR-managed lands. Hence, the impact to DNR management associated with using the 100-year floodplain as the inner margin of riparian management zones is relatively negligible.

Analysis of channel-floodplain geography in the Experimental Forest suggests that the combined interior-core and exterior buffers (to be described in the next subsection) are sufficient to protect the key physical and ecological functions of floodplains. (See Rationale for the Riparian Conservation Strategy later in this section). DNR manages only a few acres on the 50- to 100-year floodplains of the major river systems on the western Olympic Peninsula; most of this floodplain acreage is privately owned. Only 3 percent of the stream network on DNR-managed lands in the OESF is classified as Type 1 streams, and only 2 percent is Type 2 streams. (Stream types are defined in WAC 222-16-030.) On these streams, the 100-year floodplains typically are narrower than the proposed OESF riparian buffers, or the channels are incised deeply through glacial terraces, thereby limiting the stream's ability to migrate laterally or form extensive floodplains.

Widths of the interior-core buffer (Table IV.5) are given as average values because the lateral extent of riparian corridors varies locally with channel size, valley confinement, and landform characteristics. Furthermore, these widths should not be interpreted as maximum or minimum target values because site conditions might call for enlarging or reducing the buffer locally based on the extent of unstable ground. Each interior-core buffer will be designed to accommodate all channel, floodplain, and hillslope areas susceptible to mass wasting. Such protection would include channel-bed and floodplain surfaces that have the potential for trapping sediment and other materials carried downstream by debris flows and associated dam-burst floods. Riparian buffers that have been adjusted on the ground to accommodate site-specific physical conditions and conservation objectives, however, should be comparable in width to the recommended average buffers presented in this strategy. This follows from the fact that the recommended widths were derived statistically from actual riparian buffers that have been implemented to protect unstable ground in the OESF.

All Types 1 through 4 streams will be protected with interior-core buffers (Table IV.5). A separate protocol is warranted for Type 5 channels because of the abundance and variety of intermittent streams found on the western Olympic Peninsula. Management objectives in the Experimental Forest are to protect all Type 5 streams that cross unstable ground and occupy stable ground but have identifiable channels with evidence of water discharge or material transport. An identifiable channel is one in which the channel banks are well defined and measurable (Chorley et al. 1984). In the OESF, approximately 90 percent of Type 5 streams occupy unstable ground and directly contribute materials to the channel network. About 5 percent have identifiable channels on stable ground. The remaining 5 percent exert a negligible influence on aquatic or riparian habitat and, thus, require no special protection. Channels in this last group include those not connected to the watershed stream-network (e.g., sinks, seasonal wet areas excluding forested wetlands), slope depressions with no identifiable banks (e.g., swales with a continuous groundcover), and artificial channels that do not support aquatic habitat (e.g., ditches, yarding trails).

There are no available quantitative models or databases that specify which Type channels require buffer protection. Hence, determinations of location and size of riparian buffers on Type 5 streams will be made on a case-by-case basis in the field, using a 12-step watershed-assessment procedure described later in this chapter. The objectives-based nature of this riparian conservation strategy requires that assessments and proposals for manipulative research or management be reviewed by a qualified physical scientist. In addition, streams listed as Type 9 (unclassified) or streams not in DNR's hydrology databases will be treated similarly. Type 4 or 5 streams documented to contain fish that are proposed or candidates for federal listing will be treated as Type 3 waters. Type 5 channels with a potential for delivering water, wood, sediment, nutrients, and energy to the channel network will be protected from the active channel margin outward tot he topographic break in slop on either side of the channel, as well as upstream to the channel initiation point and downstream to the channel confluence. (See Figure IV.9).

Figures IV.10, IV.11, and IV.12 demonstrate one of several potential scenarios for the adjustment of riparian-buffer widths to meet site conditions. These buffer configurations are based on mass-wasting inventories and field assessments of physical and ecological riparian conditions. Figure IV.10 shows the application of the expected average interior-core and exterior buffer widths to a segment of the Clallam River and its tributaries. Figure IV.11 compares the expected average riparian buffer widths for the same area and buffers designed solely on the basis of mass-wasting inventories. Figure IV.12 shows one potential example of a buffer configuration that would include mass-wasting sites and meet riparian conservation objectives for maintaining physical and ecological functions of the riparian system.

Exterior Buffers

Exterior riparian buffers are intended to protect the integrity of interior-core buffers from damaging winds. Exterior buffers will also help maintain channel-floodplain interactions, moderate riparian microclimate, shield the inner core from the physical and ecological disturbances of intensive management on upslope sites, and maintain diverse habitat for riparian-dependent and upland biota.

This riparian strategy treats the design and the layout of the exterior buffer in two ways:

(1) it intends light partial harvests, tailored to local landform and meteorological conditions, as an initial management approach (see discussion below);

(2) it relies on experiments, from which DNR can gain new knowledge to improve management techniques in riparian forests.

Although tree blowdown is recognized as a significant problem for timber management on the western Olympic Peninsula, the exact relation between timber harvest and tree blowdown is not well understood or documented. Hence, the purpose of the experiments in the exterior buffer will be to determine, for representative site conditions, the optimum buffer width and long-term management strategies for maintaining wind-firm streamside forests. Harvest and other management activities in the experimental exterior buffers, therefore, could follow any one of a series of experimental designs that will be replicated across the landscape to ensure statistical significance of experiment results.

Widths for the exterior buffers were estimated by qualitatively evaluating historical patterns of windthrow resulting from average winter storms in the OESF and by reviewing the limited information available from local wind-buffer trials. As a starting hypothesis, the average width of exterior buffers will be 150 feet for Type 1 through 3 streams and 50 feet for Type 4 and 5 streams (Table IV.8), measured in horizontal distances laterally from the outer edge of the interior-core buffer on either side of the stream. These

Figure IV.9: Example of management protection (riparian buffer) placed on Type 5 channel system

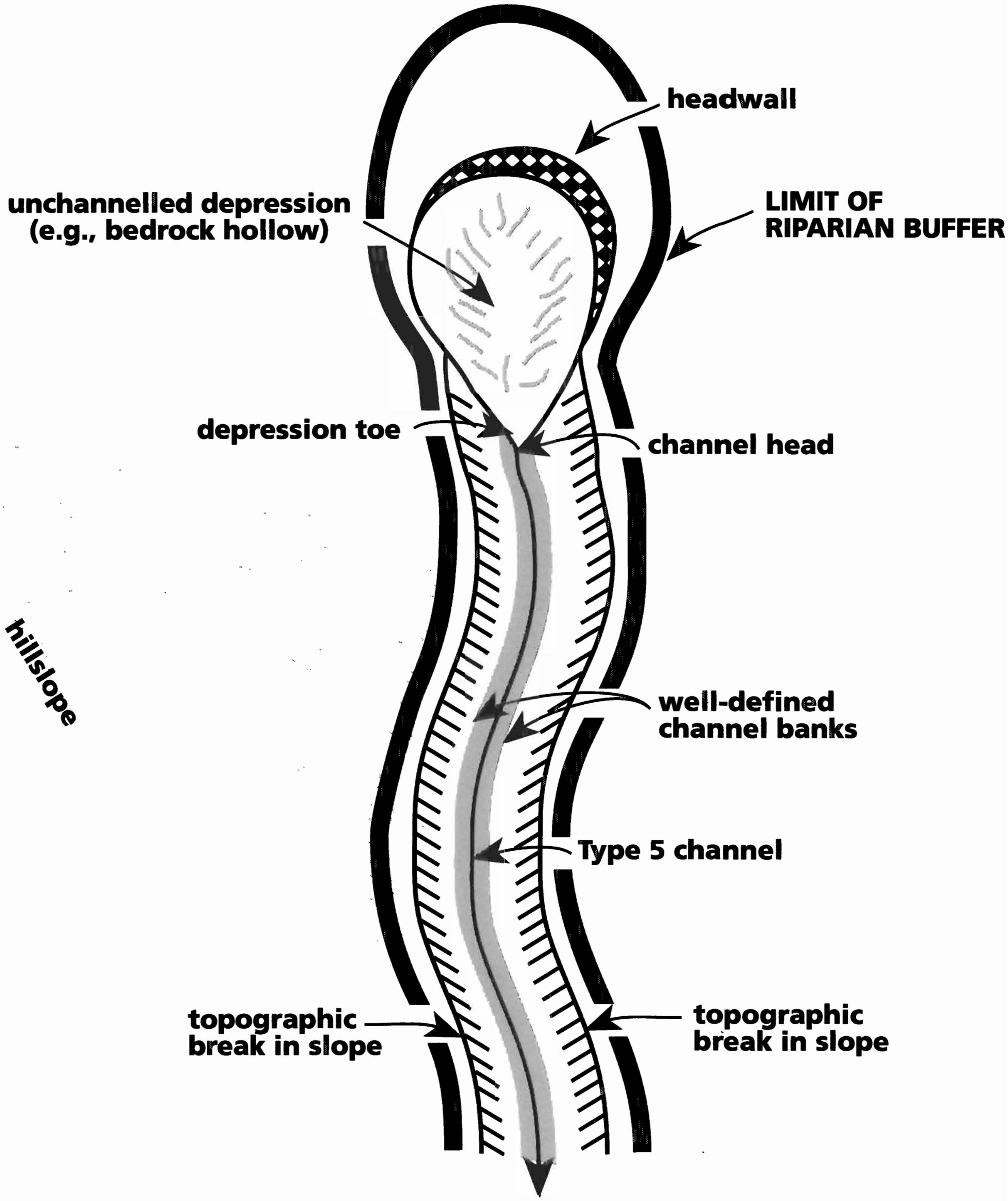
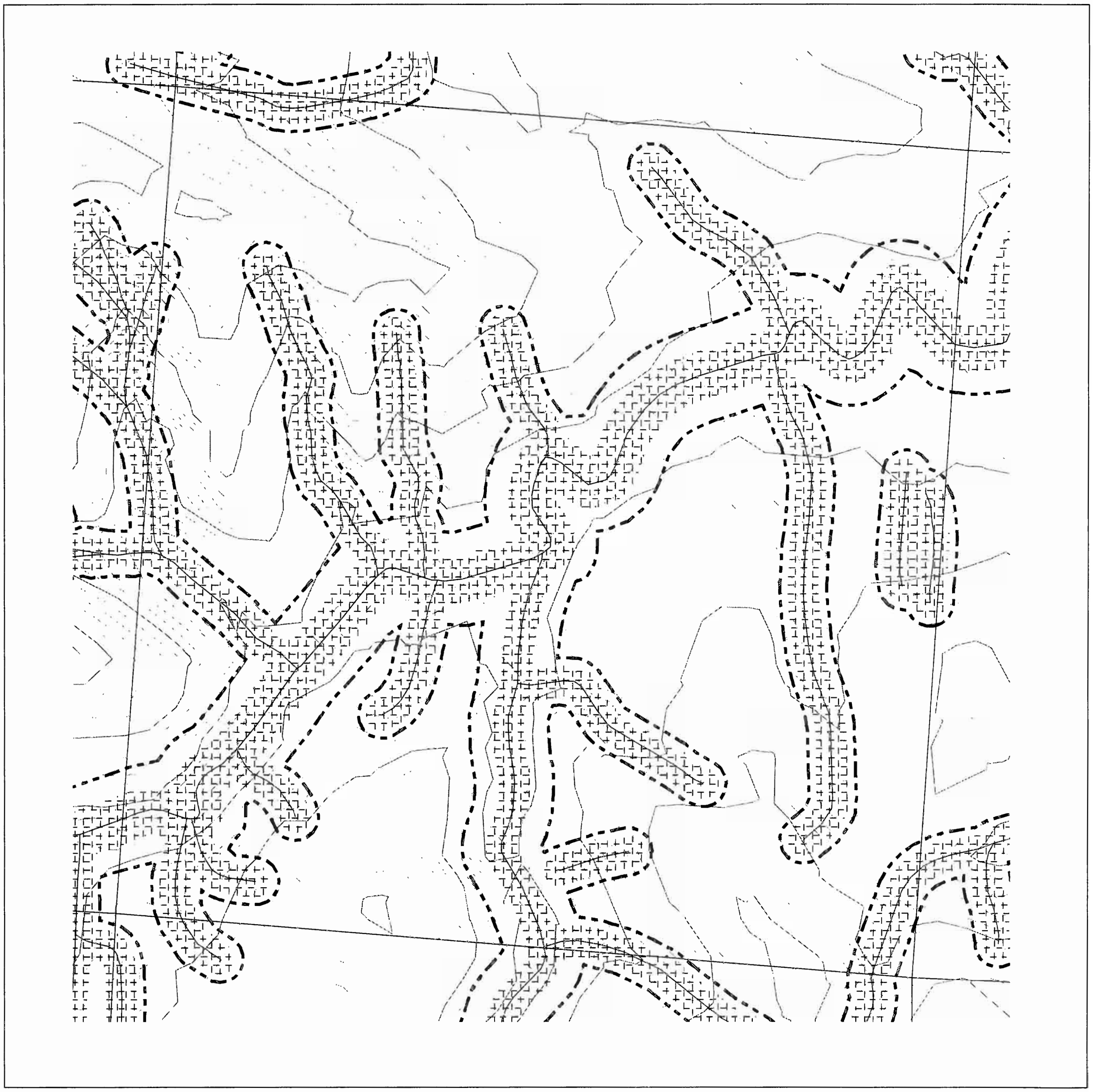


Figure IV.10: Application of expected average interior-core and exterior buffer widths to a segment of the Clallam River and its tributaries

These buffers have not been adjusted to meet site-specific requirements for unstable slopes. For purposes of simplicity, this figure assumes all Type 5 streams are buffered. However, that is not how the strategy will be implemented. See text.

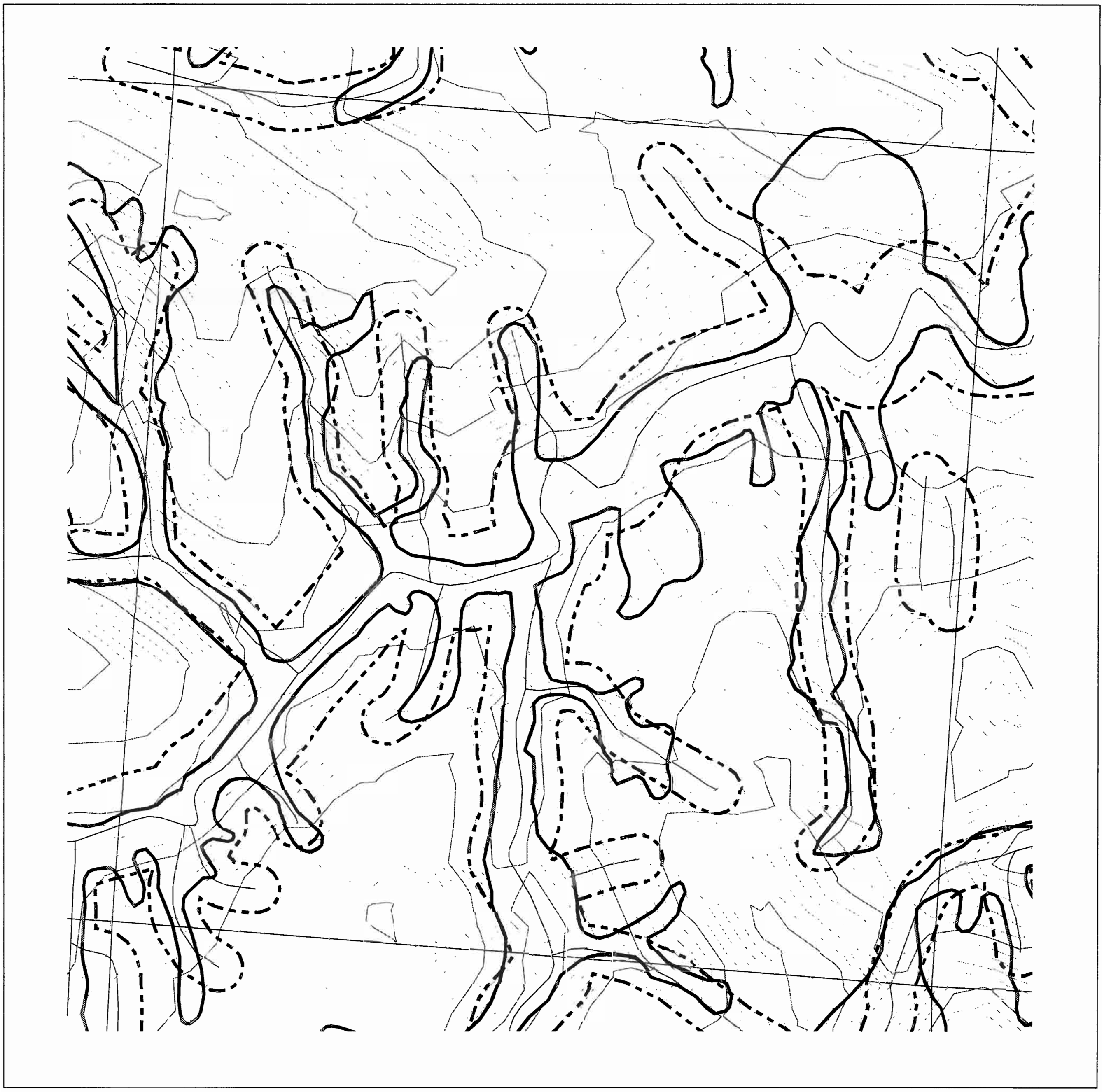


External riparian buffer

Interior-core riparian buffer

T31N R12W - Sec. 8
Scale 1:12,000
Contour Interval = 40 feet
September 18, 1995

Figure IV.11: Comparison of expected average riparian buffer widths and buffers applied to protect only mass-wasting sites for a segment of the Clallam River and its tributaries



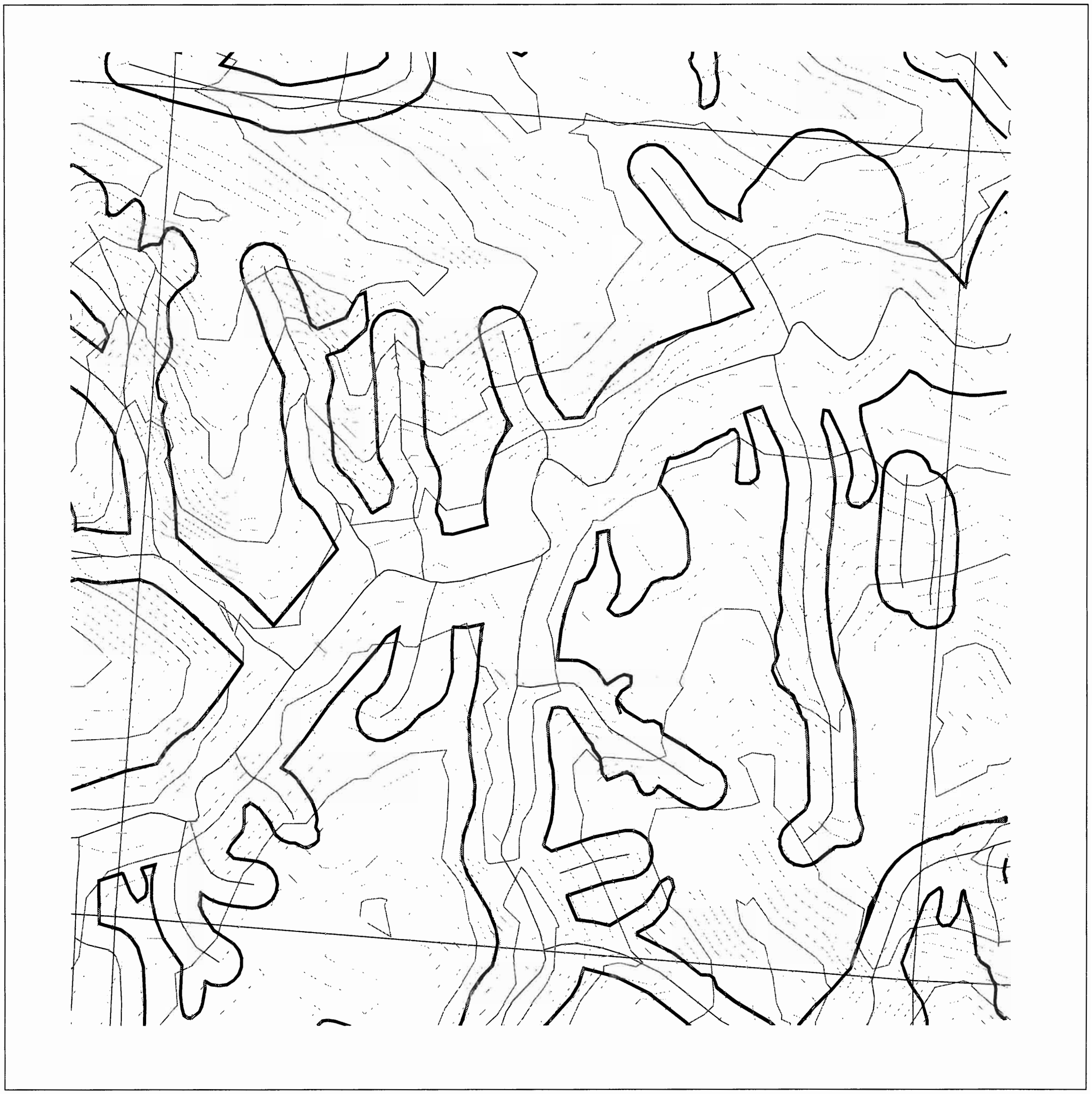
External riparian buffer

Mass-wasting buffer

T31N R12W - Sec. 8
Scale 1:12,000
Contour Interval = 40 feet
September 18, 1995

Figure IV.12: Application of expected average riparian buffer widths adjusted for mass-wasting sites for a segment of the Clallam River and its tributaries: one potential scenario

This buffer configuration meets riparian conservation objectives for maintaining physical and ecological functions of the riparian systems.



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Scale 1:12,000
Contour Interval = 40 feet
September 18, 1995

are average, rather than absolute, values because the size and configuration of wind buffers must vary locally to accommodate terrain and stand characteristics. Management to achieve wind-firm riparian stands will be adaptive, in order to test a variety of strategies and apply those strategies that are most effective in the long term.

Table IV.8: Proposed average widths of exterior riparian buffers in the Olympic Experimental State Forest

Widths are expressed as average horizontal distances measured outward from the interior-core buffer on either side of the stream. Widths are proposed as a working hypothesis and are based on local knowledge of windthrow behavior. Buffer widths and design will be evaluated through experiments in buffer design in the OESF. Buffers will be applied where necessary (see text).

Stream type	Width of riparian exterior buffer (horizontal distance, rounded to the nearest 10 feet)
1	150
2	150
3	150
4	50
5	50

Exterior buffer widths (Table IV.8) will be applied to interior-core buffers through a standard procedure or an experimental approach as follows:

(1) Standard procedure: To achieve the objective of wind-firm riparian forest, wind buffers will be placed on all riparian segments for which stand wind-firmness cannot be documented by historical information, windthrow modeling (e.g., Tang 1995), or other scientific means. Thirty-three percent or less, by volume, of the riparian trees in the designated exterior buffer may be removed for commercial purposes (i.e., excluding pre-commercial thinning and restoration activities) per rotation, until research is available supporting more frequent entry. This percentage corresponds to the lightest intensity partial harvest currently used in the Experimental Forest to produce forest stands that are robust and diverse, both structurally and compositionally. The spacing of tree removal will be determined in the field from an assessment of physical and biological conditions of each site (see Implementing the Riparian Conservation Strategy later in this section), windthrow potential, and the stated objectives of the riparian conservation strategy for the OESF. Exterior buffers within a landscape planning unit will not be harvested a second time until the conservation objectives of the riparian strategy are met in that landscape planning unit.

(2) Experimental approach: Foresters and managers will select from a number of experimental designs for the exterior buffer and apply the chosen design to the management area of interest. The designs for the outer buffer will be developed by DNR with input from others such as the Olympic Natural Resources Center and Timber-Fish-Wildlife Agreement cooperators and approved by DNR. The intent is to create a number of viable experimental designs for each of

several distinct riparian configurations in the Experimental Forest, identified on the basis of their landform, orographic, vegetational, and meteorological characteristics. The process will be documented and monitored closely to ensure that unsuccessful experimental designs are discarded, riparian disturbances are minimized, and adequate numbers of replicated experiments are performed to yield statistically meaningful results.

Not all riparian areas lend themselves to experiments because many forest stands have been fragmented by previous harvest activities. Fragmented forests in the OESF principally contain late successional stands, old-growth remnants, or trees that regenerated after the widespread windstorm in 1921 (referred to as "1921-blow" stands). Management activities in these forests should be consistent with the stated objectives of the riparian conservation strategy and with other conservation efforts that require stands in older age classes to achieve forest-wide biodiversity and suitable habitat (e.g., for species like the northern spotted owl).

DNR anticipates that the standard practice for implementing exterior buffers, as described above, will be applied on approximately 75 to 85 percent of the riparian areas in the OESF. In the remaining acreage, exterior buffers will be established via the experimental procedure. Experimental designs may range from no exterior buffer in wind-firm stands meeting the stated objectives of the riparian conservation strategy to buffers several hundred feet wider than those recommended (Table IV.8) in sites highly susceptible to windthrow. Experiments will be tracked through the OESF research and monitoring program. (See the sections titled Monitoring and Research in Chapter V.) Experiments will be conducted such that the protection and restoration objectives of this riparian strategy will not be knowingly compromised, recognizing that there is some risk of habitat alteration and incidental take associated with conducting experiments in riparian buffers.

Comprehensive Road-Maintenance Plans

The objectives of a comprehensive road-maintenance plan are to:

(1) ensure annual inventories of road conditions;

(2) maintain existing roads to minimize drainage problems and stream sedimentation;

(3) stabilize and close access to roads that no longer serve a management function or that cause intractable management or environmental problems;

(4) assure sound construction of any new roads;

(5) guarantee that additional new roads are built only where no other operationally or economically viable option exists for accessing management areas by existing roads or alternative harvest methods (e.g., full-suspension yarding);

(6) minimize active road density;

(7) prioritize roads for decommissioning, upgrading, and maintaining; and

(8) identify fish blockages caused by stream crossings and prioritize their retrofitting or removal.

No absolute threshold exists for acceptable road densities within drainage basins because the maximum carrying capacity for roads in a watershed depends on the topography, geology, climate, and competing ecological and land-use objectives, as well as road use, type, location, and construction method. Cederholm and Reid (1987) reported that 2.5 miles per square mile or less constitutes the optimum number of road miles for the Clearwater River basin. Roads on flatter ground than the Hoh-Clearwater terrain, however, are less likely to deliver sediment to streams; therefore, comparatively more roads might be possible without degrading water quality. Hence, optimum road densities must be determined on a watershed basis.

The riparian conservation strategy seeks to use landscape-planning tools to analyze the projected needs for roads over the long term (i.e., greater than 100 years) and use this information to minimize the total road density within each watershed. The Clallam River Landscape Plan (DNR Olympic Region 1995) represents one of several prototypes for how DNR envisions carrying out this objective in the 11 landscape planning units in the Experimental Forest. This method or other similar ones would be used to address road densities elsewhere in the Experimental Forest. The specific methods or models used, however, will vary as new technologies become available.

As an example, the Clallam River Landscape Plan covers approximately 16,000 acres in the northern portion of the Experimental Forest. The plan features conservation strategies similar to those proposed for the entire Experimental Forest and seeks to schedule management activities over multiple decades consistent with the dual objectives of sustaining long-term commodity production and ecological values. The present and future transportation network was evaluated through the use of a computer model (i.e., Scheduling and Network Analysis Program, Sessions and Sessions 1994) that analyzes proposed harvest units and road networks for a given landscape unit on the basis of constraints imposed by the conservation objectives and inventoried watershed conditions. The analysis was projected 100 years into the future so that the model would create all possible management units and road networks within the planning area. The resulting road network represented the maximum road density that hypothetically would be necessary at any time in the future. The analysts then systematically evaluated each road in the transportation layer to identify roads that could be eliminated because they duplicated access by other means or, in the case of existing roads, would not be used in the future. This analysis resulted in a comprehensive, long-term (i.e., 100-year) road plan for all essential new construction, abandonment, and relocation.

Protection of Forested Wetlands

The objective of forested-wetlands protection in the Experimental Forest is to maintain and aid natural restoration of wetland hydrologic processes and functions. The wetland strategy for the OESF seeks to achieve this objective by:

(1) retaining plant canopies and root systems that maintain adequate water transpiration and uptake processes;

(2) minimizing disturbance to natural surface and subsurface flow regimes;

(3) ensuring stand regeneration.

In addition, wetlands in areas susceptible to blowdown would be treated comparably to stream buffers, with maintenance of wind-firm stands as a primary conservation objective. Harvest-design experiments to achieve sturdy buffers should be considered in these instances.

Wetlands, as defined by the state Forest Practices Board Manual (WFPB 1993a), will be protected in the OESF. Forested wetlands larger than 0.25 acre and bogs larger than 0.1 acre will be protected with buffers and special management considerations. This is consistent with Policy No. 21 of DNR's Forest Resource Plan, which calls for "no net loss of naturally occurring wetland acreage and function" (DNR 1992 p. 36). Series of smaller wetlands will be protected if they function collectively as a larger wetland. In addition to meeting the requirements stated in WAC 222-30-020(7) (WFPB Manual 1993a), nonforested wetlands will receive buffer protection consistent with DNR's wetlands policy quoted above.

Table IV.9 describes the level of buffer protection proposed for forested and nonforested wetlands in the Experimental Forest. Average buffer widths are measured from the outer edge of the forested wetland, as defined by the U.S. Fish and Wildlife Service. (See Bigley and Hull 1993.) The recommended buffer width for wetlands greater than 5 acres is equal to the average site potential tree height for riparian forests in the OESF. For wetlands between 0.25 and 5 acres, the recommended buffer width averages two-thirds of the site potential tree height. Site-potential tree heights are determined from Wiley (1978) for dominant conifer species; see discussion related to coarse woody debris in Summary: Benefits of the Riparian Conservation Strategy later in this section.

Table IV.9: Proposed protection of forested and nonforested wetlands in the Olympic Experimental State Forest

Average buffer widths are measured from the outer edge of the forested wetland. Average buffer widths for forested wetlands: 150 feet for wetlands greater than 5 acres;100 feet for wetlands 0.25 to 5 acres.

Harvest within forested wetlands and their buffers	▮ Retain at least 120 square feet basal area ▮ Take appropriate steps to maintain wind-firm buffers, as per recommendations for exterior riparian buffers
Harvest within forested buffers of nonforested wetlands	▮ No harvest within 50 feet of wetland edge ▮ Harvest within buffers beyond 50 feet designed to maintain stand wind-firmness, as per recommendations for exterior riparian buffers ▮ Leave trees should be representative of the dominant and co-dominant species in the intact forest edge of the wetland

DNR estimated that retaining 120 square feet basal area in forested wetlands would maintain a minimum level of hydrologic function in wetland trees. This estimate is derived from models of leaf area recovery following harvest. Basal area is assumed to be an adequate surrogate for leaf area index in predicting the impacts of partial harvest on tree evapotranspiration and canopy interception. Predictions of leaf area index response (Kimmins 1993; McCarthy and Skaggs 1992) indicate that improvements in leaf area index with time should compensate for some modifications of wetland hydrology associated with tree removal. (See Section D of this chapter titled Riparian Strategy for the Five West-side Planning Units for additional discussion of the leaf area.)

Integration of Research and Monitoring

The riparian conservation strategy is integrated with the research and monitoring strategy for the OESF described in Chapter V. All experiments performed in riparian areas, particularly those to evaluate windthrow behavior in riparian forests, will be carried out according to research protocols established for the Experimental Forest. Watershed conditions will be monitored over time through:

(1) the monitoring method described in Standard Methodology for Conducting Watershed Analysis (WFPB 1995);

(2) the monitoring program established for the Hoh River, Kalaloch Creek, and Nolan Creek drainages (Hoh Tribe and DNR, Memorandum of Understanding, 1993); and

(3) the monitoring strategy for the Experimental Forest, implemented through the landscape planning program or the proposed 12-step watershed-assessment procedure. (See Implementing the Riparian Conservation Strategy later in this section.)

RATIONALE FOR THE RIPARIAN CONSERVATION STRATEGY

The effects of forest management activities on the physical and biological condition of riparian ecosystems, particularly with regard to the loss of habitat complexity, have been documented locally on the Olympic Peninsula (e.g., Cederholm and Lestelle 1974; Cederholm and Salo 1979; Schlichte et al. 1991; Benda 1993; Shaw 1993; Quinn and Peterson 1994; DNR and U.S. Forest Service 1994; DNR, Olympic Region 1995; McHenry et al. 1995; DNR and U.S. Forest Service, Sol Duc Watershed Analysis, in progress), as well as throughout the Pacific Northwest (e.g., Harr et al. 1975; Bisson and Sedell 1984; Grant 1986; Swanson et al. 1987; Bisson et al. 1992). Management-related modifications of riparian habitat occur, regardless of who owns or manages the land, as a consequence of the terrain characteristics, soil properties, rainfall regimes, and other natural phenomena that increase susceptibility to mass wasting and changes in channel morphology. The principal causes for loss of habitat complexity in the OESF are:

(1) channel erosion and sedimentation associated with landslides and related channel disturbances (e.g., debris flows and dam-burst floods);

(2) reduction in stream shade and delivery of organic debris to the channels due to alteration of the structure and composition of streamside forests; and

(3) channel-bank erosion and loss of long-term sources of coarse woody debris due to past management practices and extensive windthrow disturbances.

The dimensions of the interior-core buffers have been set on the basis of locally documented requirements for protecting channel margins and hillslopes susceptible to mass wasting. DNR chose this physical rationale because relatively more quantitative information exists regarding landforms and geomorphic processes than for ecological processes affecting riparian areas within the Experimental Forest. (See supporting evidence and discussion concerning current riparian practices in the Experimental Forest in the Draft EIS that accompanies this HCP.) Buffers wider than currently mandated by state-regulated Riparian Management Zones (WFPB 1993a) are frequently needed to incorporate unstable ground in the OESF. For example, most Types 4 and 5 streams in proposed harvest areas with slopes exceeding approximately 70 percent are protected by no-harvest buffers because of the recurrence and severity of landslides and debris flows that originate in the headwalls of these drainages (Benda 1993; Hoh Tribe and DNR 1993; O'Connor and Cundy 1993; Shaw 1993; DNR, Olympic Region, 1995; McHenry et al. 1995). Type 5 channels are a special concern in the Experimental Forest because they are the primary conduit for delivering material from upslope areas to fish-bearing stream reaches. Furthermore, current practices in DNR's Olympic Region commonly provide greater protection than state-regulated Riparian Management Zones in low-gradient alluvial stream systems (i.e., Types 1-3) because state-regulated Riparian Management Zones frequently do not adequately protect incised channel margins, unstable terrace and hillslope margins, and floodplain wetlands.

The dimensions of the exterior buffer represent DNR's best understanding of what might be required to protect the integrity of the interior-core buffers. A number of site factors promote susceptibility to windthrow on the western Olympic Peninsula, but there are no proven management techniques for successfully minimizing potential windthrow. The conservation strategy, which really is a working hypothesis, will lead toward better understanding of windthrow in managed forests through experimentation and systematic application and refinement of knowledge gained.

Although the riparian conservation buffers have been established on the basis of physical arguments, DNR expects that these buffers will contribute to the maintenance and recovery of ecological habitat complexity in aquatic and riparian systems. This hypothesis derives from the current understanding of the dynamics and processes of these systems. For that reason, research and monitoring can improve scientific knowledge and management practices in the Experimental Forest.

Table IV.10 compares the average buffer widths proposed for mass-wasting and windthrow protection in the OESF with those recommended in the literature for key physical and ecological parameters that are essential for creating and maintaining riparian and aquatic habitat in the OESF. This is not an exhaustive list of the ecological variables in riparian areas, but rather those key parameters about which enough is currently known to guide the development of best management practices in riparian areas. The importance of these parameters for salmonids is discussed generally in Section D of Chapter III titled Salmonids and the Riparian Ecosystem. The benefits of the riparian conservation strategy with regard to these parameters are summarized in the next paragraphs.

Table IV.10: Comparison of average riparian buffer widths expected as a result of applying the Olympic Experimental State Forest riparian conservation strategy and buffer widths proposed in the literature for several key watershed parameters

Buffer widths are given as average horizontal distances (or range of averages) outward from the active channel margin.

Key watershed parameter	Buffer width by stream type - proposed for the OESF				
	1	2	3	4	5
Mass wasting	150 ft all Type 1 streams will be protected	150 ft all Type 2 streams will be protected	100 ft all Type 3 streams will be protected	100 ft all Type 4 streams will be protected	0-500+ ft; depends on size of contribution area[1] and amount of unstable ground[2]
Mass wasting and windthrow combined	150 ft inner, 150 ft outer[3]	150 ft inner, 150 ft outer[3]	100 ft inner, 150 ft outer[3]	100 ft inner, 50 ft outer[3]	variable inner, 50 ft outer[3]

Key watershed parameter	Buffer width by stream type - proposed in the literature[4]				
	1	2	3	4	5
Coarse-woody-debris recruitment[5]	108-168 ft	108-168 ft	105-153 ft	105-153 ft	105-153 ft
Stream shade availability[5]	108-168 ft	108-168 ft	105-153 ft	105-153 ft	105-153 ft
Riparian forest microclimate[6]	300 ft	300 ft	250 ft for >5-ft-wide channels	125 ft	
Channel bank stability	Commensurate with mass-wasting buffer protection on stream channels.				
Lateral channel migration	Commensurate with combined mass-wasting and windthrow protection on stream channels.				
Water quality[5]	108-168 ft	108-168 ft	105-153 ft	105-153 ft	105-153 ft
Water quantity	Unknown. Objectives of proposed buffers are to help moderate peak-flow discharges related to removal of vegetation (e.g., harvest) by ensuring hydrologic maturity of forests, as per Washington Forest Practices Board (1994).				
Windthrow	Unknown. Objectives of proposed buffers are to enhance stand wind-firmness by decreasing tree height/diameter ratios, fetch distances in adjacent harvest units, and edge effect.				
Surface and road erosion	Variable, depending on site conditions. Objectives are to minimize erosion through implementation and comprehensive road-maintenance plans for each landscape unit (see text).				

[1] "Contribution area" refers to upslope channel heads, bedrock hollows, unchannelized valleys, and topographic depressions; see discussion of OESF Type 5 drainages in the Draft EIS associated with this HCP.

[2] Refer to discussion of Type 5 drainages in the Draft EIS associated with this HCP.

[3] Exterior (wind) buffer, where harvest and management activities are allowed. On Type 5 streams, exterior buffers will only be applied as necessary where there are interior-core buffers. See text.

[4] See discussion in this section of the text for citations of current literature.

[5] Buffer widths are based on available literature citing one site potential tree height for each stream type as the ecologically appropriate measure; see discussion in text.

[6] Buffers widths are recommended by FEMAT (1993) and Cederholm (1994).

Recruitment of Coarse Woody Debris

The probability that a tree will fall into a stream is greatest where the slope distance from the tree base to the active channel margin is less than one site potential tree height (i.e., as defined in Section D of this chapter titled Riparian Conservation Strategy for the Five West-side Planning Units; FEMAT 1993). The interior-core buffer widths for each stream type on the OESF are greater than or approximately equal to the site potential tree height for a 50-year growing cycle and 70 to 90 percent of the site potential tree height for a 120-year growing cycle. Representative site potential tree heights for each stream type were calculated by identifying streams of known type on soil survey maps registered by orthophotos, determining average site indices for growth potential from survey data for soils commonly found on stream banks and floodplains, and employing tree-height tables published in Wiley (1978). Estimated site potential tree heights for the Experimental Forest are: for Types 1 and 2 streams, 108 feet for a 50-year growing period, 155 feet for a 100-year period, and 168 feet for a 120-year period; and for Types 3 through 5 streams, 105 feet for a 50-year growing period, 153 feet for a 100-year period, and 165 feet for a 120-year period. Field measurements (McDade et al. 1990) indicate that buffer widths equal to approximately 60 percent of the average tree height will provide 90 percent of the natural level of instream large woody debris. Extrapolating from these results, a buffer width equal to approximately the 100-year site potential tree height, which is more than 60 percent of the 200-year site potential tree height (i.e., 60 percent of an old-growth tree height), should provide more than 90 percent of the natural level of instream large woody debris.

Stream Shade Availability

Shade regulates stream water temperatures throughout the year. Shade is supplied primarily by the forest canopy above and adjacent to the channel. Shade, however, varies with the type, height, and density of streamside vegetation, as well as local topography and diurnal changes in position of the sun relative to channel orientation (Naiman et al. 1992). The probability that a tree will provide shade is greatest where the slope distance from the tree base to the active channel margin is equal to or less than one site potential tree height. Limited studies in the western Pacific Northwest suggest that riparian buffers about 100 feet wide supply shade equivalent to undisturbed late successional or old-growth forests (Steinblums 1977; Beschta et al. 1987). Steinblums et al. (1984) reported that buffers between 75 feet and 125 feet wide maintain 60 to 80 percent of the undisturbed canopy density and, hence, the potential for stream shading. These widths are commensurate with, or less than, those recommended for recruitment of coarse woody debris. The proposed interior-core buffers, hence, are expected to be wide enough to provide 80 to 100 percent of stream shade, provided that streamside canopies are dominated by mature conifers. In the OESF, hardwood-dominated riparian forests offer insufficient shade following seasonal loss of foliage to moderate winter water temperatures (e.g., Hatten and Conrad 1995). Goals of the OESF riparian conservation strategy, therefore, are to maintain sufficient buffers in mature stands to moderate water temperatures year round and to manage for conifer succession in hardwood-dominated stands and young plantations. Because 70 percent of the riparian areas on DNR-managed lands in the OESF are hardwood-dominated or young stands, however, recovery of full stream-shade potential will take several decades.

Nutrient Input to Streams

Riparian vegetation regulates the food-energy base of aquatic ecosystems by supplying plant and animal detritus to the stream and forest floor. Dissolved nutrients and litter derived from flowers and fruits, leaves, needles, wood, and insects provide essential food for aquatic invertebrates and fish (Gregory et al. 1991; Bilby and Bisson 1992). The Forest Ecosystem Management Assessment Team (1993) suggests that input of plant litter and other organic particulates from streamside forests decreases beyond a distance of about one-half tree height from the active channel margin. Other information relating probability of nutrient input to slope distance from the channel margin is scarce. Hence, the working hypothesis for the OESF is that sufficient forest-generated nutrients will be supplied from the area of interior-core buffers to maintain nutrient delivery to streams. The Experimental Forest will provide a forum for testing these hypotheses.

Alders, in particular, are important components of the aquatic and riparian ecosystem because they fix nitrogen and are significant sources of nitrogen as a dissolved nutrient. Although a goal of the Experimental Forest is to aid regeneration of conifers in hardwood-dominated stands, it is also the intent to maintain a conifer-hardwood mix characteristic of natural disturbance regimes, including alders as dominant and co-dominant species where ecologically appropriate within the riparian system.

Riparian Microclimate

Riparian forests moderate climatic conditions in the transitional areas between terrestrial and aquatic environments. Riparian ecosystems support more aquatic, terrestrial, and amphibious species than upland habitats, in part because streams and streamside forests create a more humid microclimate, have higher transpiration rates, are cooler in summer and warmer in winter, and maintain moister soils and greater air movement (Brown 1985). The ability of a riparian forest to ameliorate microclimate is diminished significantly where vegetation is removed from both sides of the stream. Few data are available from the western Olympic Peninsula or elsewhere in the Pacific Northwest pertaining to the effects of forest management on riparian microclimates. The primary working hypothesis of the OESF riparian conservation strategy, therefore, is that riparian microclimate will be improved by minimizing edge effects associated with proximity of harvest units to channels and their orientation with respect to prevailing wind directions. The exterior riparian buffer reduces wind disturbances of streamside forests and shields the riparian core from edge effects associated with intensive management on adjacent ground. Part of the experimental approach in establishing exterior buffers will be to situate adjacent harvest units and employ harvest designs (e.g., partial cuts, small clearcut units, uneven-aged stands) that reduce the potential for progressive loss of riparian-buffer function by edge-effect processes (e.g., blowdown).

Characteristic riparian microclimates may also be maintained by placing buffers on both sides of a stream that are sufficiently wide to insulate water and soils from direct radiation, reduce wind velocities in riparian forests and retain soil and air humidities.

Water Quality

The riparian conservation strategy seeks to maintain and aid natural restoration of water quality in order to meet state water-quality standards for all existing characteristic uses (e.g., aquatic habitat and domestic and municipal water supplies). The principal causes of declining water quality in the Experimental Forest are water temperatures that exceed state and federal standards and turbidity associated with stream sedimentation on commercial forest lands. According to current scientific understanding, the best method to deal with temperature and turbidity problems is to place buffers on streams that are wide enough to:

(1) maintain natural background sediment-delivery rates and minimize management-related input of sediments to streams;

(2) provide enough shade to regulate water temperatures; and

(3) assure long-term sources of coarse woody debris that will trap sediment and moderate flow.

The riparian conservation strategy seeks to reduce stream turbidity by:

(1) protecting all mass-wasting and surface-erosion sites that have a potential for delivering sediment to streams;

(2) maintaining roads and limiting road densities (i.e., potential new sources of surface erosion) through comprehensive road-maintenance plans; and

(3) restoring long-term sources of coarse woody debris. This strategy also provides for maintaining and restoring stream shade. (See previous discussion of stream shade availability in this section.)

Water Quantity

Increased surface runoff to streams can result from vegetation removal (Likens et al. 1970; Eschner and Larmoyeux 1963; Blackburn et al. 1982; WFPB 1994) and increased numbers of road drainages delivering water to streams. Precipitation conditions on the western Olympic Peninsula that lead to increases in the frequency and volume of peak flows are rain-on-snow events, rainfall of high intensity and long duration typical of winter months, and heavy rain on frozen ground, which can occur during January and February. The potential for these conditions to affect seasonal and annual water quantity is influenced by the type, age, and density of forest vegetation. Approximately 19 percent of DNR-managed lands in the OESF, mostly in the Hoh and Clearwater drainages, lie in the rain-on-snow zone as defined by state forest practices regulations (WFPB 1994). The state addresses the cumulative effects of rain-on-snow events by regulating the percent area in Type 3 basins with greater than 70 percent forest-crown closure and less than 75 percent hardwood or shrub canopies.

DNR recommends using the methods for analyzing rain-on-snow and peak-flow events given in the Standard Methodology for Conducting Watershed Analysis (WFPB 1994). In addition, DNR expects that limiting the amount of new road construction and improving drainages on existing roads will reduce the potential for augmenting peak flows. Furthermore, the unzoned-forest approach to conserving habitat for listed species likely will lead to forest conditions, within about 35 years, that will assure hydrologic maturity in at least 70 percent of each Type 3 basin. Because current knowledge is incomplete, a priority research direction for the OESF is to investigate the relationships between forest management and hydrology in order to improve scientific understanding leading to effective management of water quantity.

IMPLEMENTING THE RIPARIAN CONSERVATION STRATEGY

The OESF riparian conservation strategy will be in effect throughout the life of this HCP. Landscape plans are the vehicle for implementing commodity production and conservation strategies in the Experimental Forest. Riparian buffers will serve as the foundation for landscape plans, around which forest management, conservation, and research activities will be designed. A primary objective of the Experimental Forest will be to support natural restorative processes of streams and streamside forests by whatever means necessary, so that riparian environments can recover suf-ficiently to sustain both commercial forest enterprises and healthy ecosystems.

Prior to landscape planning in each of the 11 landscape planning units in the Experimental Forest, watershed conditions will be evaluated and monitored through a 12-step watershed assessment procedure (described later). Results from assessments of physical and biological conditions obtained from the regulatory watershed-analysis process (WFPB 1994) will be used where possible, in lieu of those assessments required in the 12-step process. Therefore, following the implementation of the OESF, preliminary assessments and management activities will occur before landscape planning in most landscape planning units.

Landscape Planning

Methods and procedures for landscape planning will likely be similar to those developed for the Clallam River Landscape Plan, which was designed for 16,000 acres of state land in the northern part of the Experimental Forest (DNR Olympic Region 1995). In this prototype landscape plan, management, economic, conservation, and recreation objectives were evaluated simultaneously. Maps of riparian buffers, designed to protect unstable ground and key ecological features, served as the primary planning layer around which other management and conservation strategies evolved. The riparian layer was built into a harvest planning model so that designs for harvest units, logging settings, and roads took into account the conservation objectives for and requirements of riparian protection. In addition, economic analyses and harvest level projections factored in the long-term costs and benefits of protecting riparian areas.

Watershed-assessment techniques used during landscape planning might include those found in the "Forest Agreement Related to the Hoh River, Kalaloch Creek and Nolan Drainages" (Hoh Tribe and DNR, Memorandum of Understanding 1993) and Standard Methodology for Conducting Watershed Analysis (WFPB 1994) and designed for the 12-step watershed assessment (described below). The agency may wish to sponsor a regulatory watershed analysis in lieu of some or all parts of the 12-step process. However, given the watershed concerns in the OESF, DNR likely will go beyond the state Forest Practices Board (WFPB 1994) methods in order to account for issues not addressed in the Forest Practices Board manual. Therefore, additional analyses for any given landscape planning unit might include water quality, wildlife habitat, nontimber commodity production, urban influences, estuarine/near-shore marine conditions, or other relevant issues.

Twelve-step Watershed Assessment Procedure

The objectives of the OESF riparian conservation strategy are to maintain and aid restoration of riparian functions at the watershed scale, rather than at the site-specific level. Implementing these objectives, therefore, requires an evaluation procedure by which the aquatic and streamside conditions at a given site can be assessed in relation to the known influences of physical, biological, and land-use factors throughout the watershed. Effective management and conservation strategies are dictated not only by site conditions but also by cumulative effects of management activities both upstream and downstream of the site. Consequently, the watershed assessment should assure that connectivity between riparian segments is accounted for in the design of long-term management, conservation, and research strategies.

No specific restrictions on management activities are given in the riparian conservation strategy, other than on road-building (described later). Adhering to the objectives of the riparian conservation strategy and implementing the watershed assessment procedure likely will identify specific activities that can be performed with minimum impact to the ecosystem. For example, the number of trees that can be removed from a riparian buffer in a particular watershed will be determined by assessing the potential for that buffer to continue providing coarse woody debris, stream shade, wind-firm stands, nutrients, sediment storage, streamflow moderation, and aquatic and terrestrial habitat for sensitive species.

Figure IV.13 outlines the assessment procedure for meeting riparian management and conservation objectives in the Experimental Forest. The intent is that managers, foresters, and scientists work together through the 12 steps to assure that proposed timber management or research activities do not conflict with the objectives of the riparian conservation strategy. This process will begin with the implementation of the OESF and will occur before landscape planning. The assessment methods may also be used during landscape planning. The steps are:

(1) Initiate the decision making procedure. The need for this procedure is triggered when DNR timber management (i.e., cutting trees, building roads) or manipulative research is proposed within a given Type 3 or larger watershed in the Experimental Forest. Manipulative research includes the removal, alteration, or addition of aquatic or riparian features, including live or dead vegetation, water, aquatic and riparian biota, sediments, bedrock, and artificial structures.

(2) Recognize the conservation objective of managing riparian and aquatic systems in the OESF: to maintain and aid natural restoration of riparian and aquatic functions and processes. Commodity production and riparian research are allowed as long as they are consistent with the conservation objective.

(3) Conduct preliminary assessment of physical and biological watershed conditions using results from the regulatory watershed-analysis process, where available. Table IV.11 lists the components of this assessment, some or all of which might be included in the analysis. Methods and guidelines would be established in agency procedures developed for the OESF. Where advantageous, methods described in the Standard Methods for Conducting Watershed Analysis (WFPB 1994) would be employed. Where possible, methods would yield quantitative data for analysis and future monitoring needs. The assessment would include an evaluation of the probable impact of proposed management or research activities on watershed conditions. This assessment would serve as a baseline for evaluating subsequent activity proposals and cumulative effects in the watershed by providing written record of conditions, decisions, activities, and results of management, research, and conservation efforts; and a scientifically sound rationale for the chosen management, research, and conservation strategies.

(4) Evaluate the degree to which watershed conditions meet the needs for maintaining viable riparian and aquatic processes and functions. Refer to objectives of the riparian conservation strategy, buffer-width recommendations, and Table IV.10.

Figure IV.13: Twelve-step watershed assessment procedure for meeting riparian conservation and management objectives in the Olympic Experimental State Forest

See discussion of each step in the text.

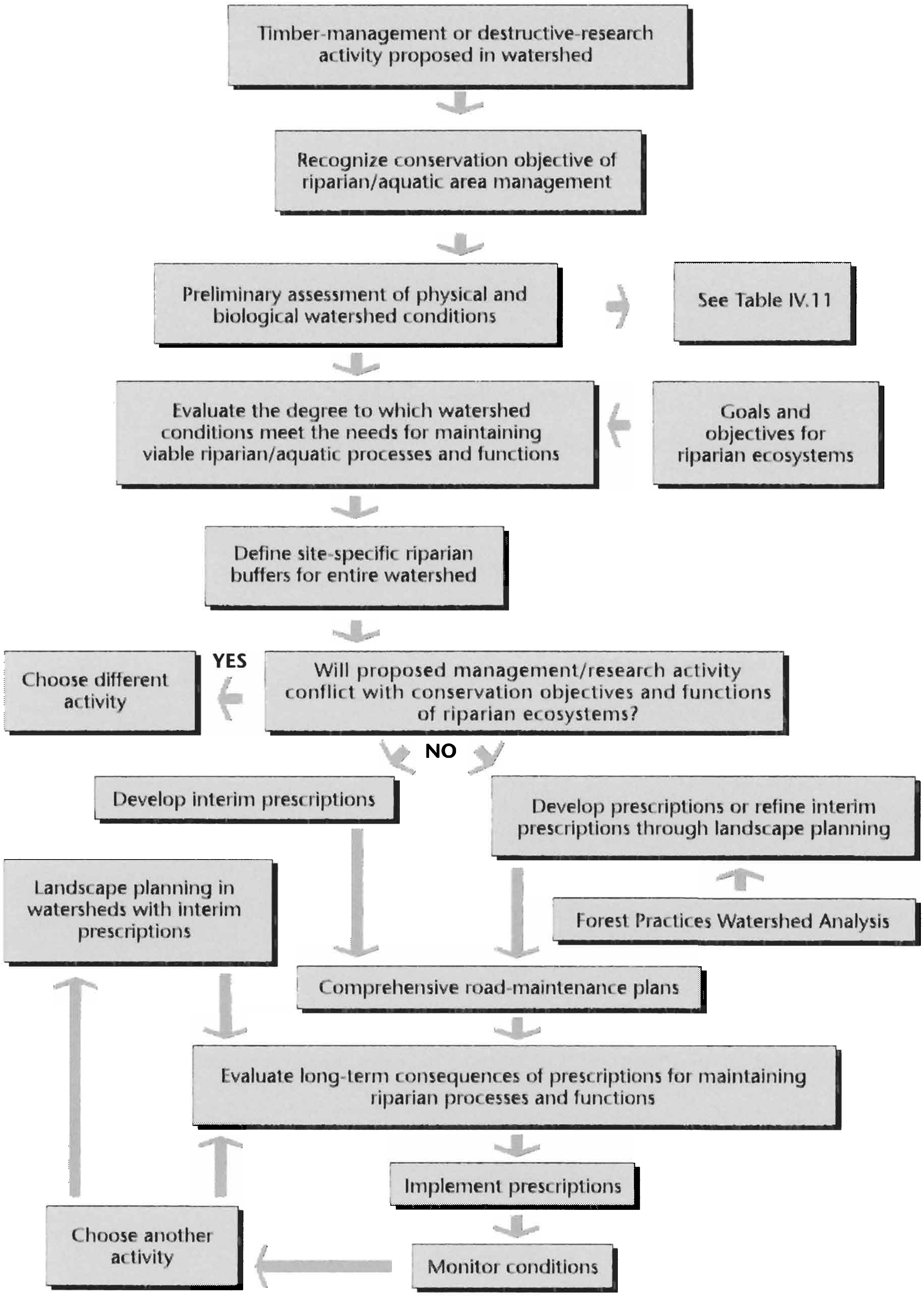

Table IV.11: Components of a preliminary assessment of physical and biological watershed conditions for the 12-step watershed assessment procedure for the Olympic Experimental State Forest

Some or all components might be evaluated, depending on watershed characteristics and the availability of analytical techniques. Methods will be outlined in agency procedures for implementation of the OESF. See step (3) in the text.

Mass wasting — existing and potential sites
Surface erosion — existing and potential sites
Road network densities
Road conditions — use, location, sidecast, and other problems
Road drainage structures — presence and condition
Hillslope hydrology processes (e.g., changes in channel-forming flows, rain-on-snow potential)
Water quality and quantity (e.g., temperatures, turbidity, supply)
Physical stream-channel conditions and processes
Floodplain and channel interactions ▮ physical interactions (e.g., bank erosion, lateral channel migration, hydrology) ▮ biological interactions (e.g., nutrient productivity)
Riparian microclimate (e.g., shade, ambient temperatures)
Coarse-woody-debris recruitment potential
Riparian plant community structure and composition
Riparian forest health
Habitat distribution, quality, and quantity for fish
Habitat distribution, quality, and quantity for fish prey (e.g., macro-invertebrates)
Habitat distribution, quality, and quantity for key riparian-dependent species[1]
Wildlife use of riparian areas (e.g., migration routes, foraging, predation potential)
Wind disturbance patterns (e.g., windthrow potential)
Past and proposed land-use practices (e.g., influence on biological/physical riparian processes)

[1]Key species currently are defined as those that are listed, or are candidates for listing, under the Endangered Species Act or by the Washington Department of Fish and Wildlife, or are listed as threatened, rare, or in need of monitoring by the Department of Natural Resources Natural Heritage Program. Habitat for other unlisted riparian-obligate species will be considered indirectly through consideration of habitat for listed and candidate species.

(5) Using information gathered in the preceding steps, delineate riparian buffers for each stream segment in the watershed so that: (a) conservation objectives for aquatic and riparian protection are met; (b) buffers protect local physical and biological features; and (c) the probable influence of adjacent land-use practices on riparian forests are considered.

(6) Determine whether the proposed management or research activity would conflict with the objectives of the riparian conservation strategy. Choose another management strategy if the proposed activity cannot be accomplished without compromising the long-term sustainability of riparian functions and processes. If no proposed management activity has a high probability of meeting the riparian objectives, then management or manipulative-research activities will be postponed until watershed conditions improve.

(7) Develop interim prescriptions (or long-term prescriptions if this procedure is used as the watershed assessment for landscape planning). Short-term and long-term management and manipulative-research plans would be documented, including proposed schedules for site re-entry and the nature of activities proposed for each entry. Prescriptions might be refined during landscape planning to accommodate new information and technological advances. The riparian conservation strategy will remain in place through the development and implementation of management prescriptions and landscape plans.

(8) Develop a comprehensive road-maintenance plan. In most instances, this plan will be developed for a landscape planning unit prior to landscape planning because the 11 landscape planning units will be evaluated sequentially over the course of several years.

(9) Evaluate the long-term consequences of management prescriptions for each site in maintaining watershed-wide riparian processes and functions, particularly where multiple entries are planned.

(10) Implement interim prescriptions pending landscape plans. On-the-ground implementation will be reviewed by qualified technical experts to assure that conservation objectives are being met.

(11) Monitor riparian conditions on a regular basis (e.g., every two to five years) to evaluate whether conservation objectives continue to be met. Failure to meet these objectives would require restorative or corrective measures and modification of management activities.

(12) Choose another management or research activity in the assessed watershed. Additional proposals will be evaluated using information from the preliminary watershed assessment, landscape planning, monitoring in the watershed, and field investigations of site-specific conditions. Implementing these activities will depend on satisfactory completion of steps (6) and (9) above.

Management activities most likely to occur in the interior-core buffers in the OESF are:

- selective harvest of hardwoods to encourage long-term sources of coniferous woody debris and channel-bank stabilization; harvest would occur on stable ground, where silviculturally feasible and ecologically sound;

- thinning of young stands to promote wind-firm trees;
- restoration efforts, including habitat-enhancement projects;
- research projects, provided that they maintain or improve habitat for aquatic and riparian-dependent species;
- tree pruning to diversify forest structure; and
- single-tree removals, if the number and size of trees removed do not reduce the long-term functions and processes of riparian ecosystems.

Management activities in the interior-core buffers, or forested wetland and their buffers, would exclude herbicide release and new road construction in riparian areas unless, in the case of riparian buffers, stream crossings are essential. Roads in wetlands or their buffers will require on-site and in-kind wetland replacement, in accordance with the Forest Resource Plan (DNR 1992). Crossings will be designed to take the most direct route possible across streams, in order to minimize obstructions to fish passage, peak flows, bank destabilization, and sediment delivery.

Management activities most likely to occur in exterior buffers in the OESF are:

- partial cuts of 33 percent or less by volume, per rotation, aggregated or dispersed, depending on the operational objectives for maintaining wind-firm stands;
- experiments designed to promote wind-firmness of the interior-core buffer; and
- forest-structure modifications, including thinning, pruning, and tree-topping to improve stand wind-firmness.

SUMMARY: BENEFITS OF THE RIPARIAN CONSERVATION STRATEGY

The riparian conservation strategy will benefit the future health of riparian forests in the OESF in several ways:

- Riparian areas will be managed primarily to protect and restore physical and biological processes while allowing some extraction of forest commodities. The conservation's intent is to sustain habitat that is capable of supporting viable populations of salmonids and other aquatic and riparian-dependent species.
- Buffers described in the riparian conservation strategy will be applied to all stream types[2] and on all DNR-managed lands in order to minimize stream sedimentation, stabilize channel banks, reduce windthrow potential, enhance long-term recruitment of coarse woody debris, and protect other key physical and biological functions that maintain habitat complexity for aquatic and riparian-dependent species.
- This strategy ensures that the structural and compositional complexity of riparian habitat will be improved. A goal of this strategy will be to manage hardwood stands such that they regain a conifer-to-hardwood ratio more characteristic of naturally disturbed riparian forests. Approximately 70 percent of riparian areas on

[2]Buffers will be applied to all stream types but not necessarily to all Type 5 streams. See discussions in subsections titled Interior-core Buffers and Exterior Buffers.

DNR-managed lands in the Experimental Forest are dominated by hardwoods or conifer plantations less than 15 years old. The remaining 30 percent are mature second-growth, late successional, or old-growth stands that are highly fragmented; many are susceptible to wind disturbances because they cross exposed hillslopes or valley terraces. Young conifer plantations in riparian areas will be manipulated to promote robust and structurally diverse riparian forests. Management activities will restore long-term sources of coarse woody debris, improve year-round shade potential to streams, diversify riparian habitat, strengthen bank and floodplain stability, and increase wind-firmness of streamside forests.

- This strategy likely will benefit physical and biological conditions of near-shore marine habitat by reducing sediment loads carried from upland sites by river systems and deposited in estuarine and near-shore environments. Estuarine conditions influence salmonid smolting and can govern species survival (e.g., Bisson et al. 1992). Near-shore habitats, including eel-grass and kelp beds, provide shelter and forage for anadromous species and their prey.

- Protecting forested wetlands can improve water quality and aquatic habitat by: (1) minimizing the probability of soil compaction; (2) protecting unstable ground within and adjacent to wetlands; (3) moderating peak and low flows in watersheds; (4) conserving wetland biodiversity; (5) minimizing windthrow; (6) decreasing sediment delivery to wetlands; and (7) providing viable off-channel habitat for salmonids during channel peak-flow events.

Future Riparian Conditions in the OESF

The riparian conservation strategy constitutes a plan for the future in the OESF. Aquatic ecosystems will derive their greatest benefits from restoration of functional forest cover on previously logged, unstable hillslopes and in streamside forests, rather than from concentrating protection measures in existing, mature conifer stands. The intent is to restore riparian areas such that they can be incorporated in the general management strategies for unzoned future forests (see previous discussion in the OESF subsection titled Integrated Approach to Production and Conservation) that will be capable of sustaining both timber production and riparian ecosystem functions. The need for defined buffers will diminish as riparian forests regain the ability to sustain ecological and physical functions without management assistance. Available studies (e.g., Schlichte et al. 1991; Benda 1993; Shaw 1993), however, suggest that this recovery will take several decades to centuries for many river systems in the Experimental Forest.

Statistical analyses of implementing the proposed riparian buffers indicate that approximately 22 percent of the OESF land base will fall inside the interior-core buffer (Table IV.12). DNR currently treats an average of about 18 percent of the land base as no-cut riparian buffers. Therefore, implementing the interior-core buffer strategy on all DNR-managed lands in the OESF will incorporate an additional 4 percent of the land base. For a Type 3 watershed in steep, unstable terrain, this might amount to as much as a 60 percent increase in land placed within the interior-core buffer. However, in contrast with the current no-cut riparian buffers, management activities will be allowed in the OESF riparian buffers as long as these activities are consistent with the conservation objectives. In addition, DNR currently is required to protect all such areas under the Class IV-Special regulations of the state Forest Practices Act (WFPB 1993b). Applying the average recommended exterior riparian buffers increases the acreage in

Table IV.12: Number of acres and percent of land base projected in the Olympic Experimental State Forest riparian interior-core buffer, exterior buffer, and combined (total) buffer, by forest age class

Land base in the OESF totals approximately 264,000 acres. Figures for the total buffer were calculated assuming 33 percent average timber volume removal from the exterior riparian buffer. (See text.)

Forest age class (years)	Interior buffer		Exterior buffer		Total buffer	
	acres	percent	acres	percent	acres	percent
200+	520	0.20	397	0.16	917	0.36
101-199	9,254	3.62	5,164	2.02	14,418	5.64
71-100	3,181	1.24	2,143	0.84	5,324	2.08
51-70	2,369	0.93	1,382	0.54	3,751	1.47
41-50	1,410	0.55	873	0.34	2,283	0.89
31-40	3,265	1.28	1,891	0.74	5,156	2.02
21-30	9,249	3.61	4,985	1.95	14,234	5.56
11-20	16,815	6.57	8,735	3.42	25,550	9.99
0-10	10,653	4.16	5,855	2.29	16,508	6.45
Total	**56,716**	**22.16**	**31,425**	**12.30**	**88,141**	**34.46**

riparian management zones by an estimated 12 percent, although certain harvest activities can occur in these areas (e.g., maximum timber volume removal of 33 percent).

Table IV.12 shows the number of acres and percent of land base in each buffer category, by forest age class, out of 264,000 total acres of DNR-managed land in the OESF. Approximately 35 percent of the total acres, therefore, will contribute to maintaining and restoring riparian functions and processes. These acres also will provide more than 50 percent of the proposed habitat for northern spotted owls and a significant percentage of habitat for marbled murrelets.

Multispecies Conservation Strategy for Unlisted Species in the Olympic Experimental State Forest

INTRODUCTION

It is central to the mission of the Olympic Experimental State Forest to learn how to manage commercial forests that integrate commodity production and species conservation. Management that maintains or restores habitat for populations of native flora and fauna on the Olympic Peninsula is fundamental to the OESF. Plant and animal species for which there is some concern about population viability and features on the landscape that serve important functions as habitat for those species will receive special attention.

The multispecies conservation strategy for DNR-managed lands in the Experimental Forest is different from that for the five west-side planning units because the OESF strategy is based in large part on the unique conservation strategies in the OESF for riparian ecosystems and northern spotted owls and because of the experimental approach to integrated management for forest commodity and ecosystem values that is the mission of the Experimental Forest. (The multispecies conservation strategy for the five west-side planning units is discussed in Section F of this chapter. Neither multispecies strategy will be applied in the east-side planning units under this HCP.)

The strategy proposes conservation objectives for maintaining or restoring a level of habitat capability for unlisted species on DNR-managed lands in the OESF. To achieve these conservation objectives, DNR will develop and test a variety of methods that integrate commercial forest management and maintenance or restoration of habitat for unlisted species and will apply those methods that are most effective and efficient. This habitat management will be planned and implemented at the landscape level. Objectives of this landscape-level management are directed at developing landscapes that produce a mix of robust commercial products and ecosystem outputs across the entire Experimental Forest.

Conservation of habitat for unlisted species will primarily be derived from the integrated, ecosystem-oriented management rather than direct the management. This approach can be stated and implemented as a working hypothesis for evaluation and systematic application and refinement: DNR can meet its objectives for conservation of habitat for unlisted species in the OESF by managing stands and landscapes to meet its conservation objectives for riparian ecosystems, spotted owls, and marbled murrelets and by implementing additional site- or species-specific conservation measures in response to certain circumstances.

The multispecies conservation strategy discusses provision of habitat for animal species of concern and other unlisted species and special landscape features identified as uncommon habitats or habitat elements. For the purposes of the HCP, species of concern are federally listed, state-listed, federal candidate, and state candidate animal species. Federally listed species are addressed in the sections of this chapter on the marbled murrelet (see Section B), other listed species (see Section C), and in the OESF strategy for the northern spotted owl (see earlier in this Section E). The other species of concern are addressed in this subsection, except anadromous salmonids and bull trout, whose habitat is conserved through the OESF riparian conservation strategy (see earlier in this Section E). Other unlisted species include other animal species that may become listed or candidates for listing in the future. Uncommon habitats and habitat elements are talus fields, caves, cliffs, and large, structurally unique trees. (See the subsection titled protection of Uncommon Habitats in Section F of this chapter.)

Within the OESF, 33 animal species are considered species of concern because information indicates they face some risk of at least local extinction: six are federally listed, 10 are federal species of concern, five are state candidates with no federal status, four are sensitive species,and bull trout and seven species of anadromous salmonids have been or are under review for listing by the federal goverment. (The federally listed species are shown in Table III.8,the salmonids in Table III.11, and the other species in Table III.14.) Other species will probably be added to this list in the coming decades, but it is difficult to predict which species are, or will be, at the brink of "at risk."

Federal guidelines (e.g., spotted owl circles) and state rules (WAC 232-12-292, WAC 222-16-080) place species-specific constraints on forest practices for the benefit of federally listed and state-listed species. But, given the large and probably expanding array of listed and candidate species, species-specific forest practices have become an inefficient and impractical means of attaining wildlife conservation objectives and providing income to the trusts. Within the confines of a managed forest, the most effective means for the conservation of wildlife is to provide functional habitat. The Experimental Forest will contribute to the survival of species of concern and other unlisted species through forest management that provides a variety of well-distributed, interconnected habitats.

The multispecies strategy discusses the objectives for conservation of habitat for unlisted species of concern and other unlisted species. Then the benefits to habitat for unlisted species through the other OESF and the marbled murrelet conservation strategies are described. The multispecies strategy closes with a description of conservation of habitat for specific unlisted species of concern and a summary of types of habitat provided on DNR-managed lands in the Experimental Forest.

CONSERVATION OBJECTIVES

The objectives of the strategy for conservation of habitat for unlisted species are:

(1) to develop and implement land-management plans that do not appreciably reduce the likelihood of survival and recovery of unlisted species on the Olympic Peninsula;

(2) to learn to integrate the values of older forest ecosystems and their functions with commercial forest activities; and

(3) to fill critical information gaps related to the composition, structure, and function of aquatic, riparian, and upland ecosystems and the links between these, forest management activities, and conservation of habitat for unlisted species.

DNR anticipates that meeting these objectives will entail a significant effort in forest management, research, and monitoring over an extended period of time. (See the sections titled Monitoring and Research in Chapter V.) Management practices in the near term will be directed by current knowledge and hypotheses, but in time, as knowledge, techniques, and hypotheses change, management practices will adapt to those new circumstances. This is consistent with the mission of the Experimental Forest.

A description of proposed management practices related to conservation of habitat for unlisted species and unique habitat elements follows. Some deviations from these practices will occur in the near term as formal, experimental studies designed to address information needs related to integrating conservation and production. It is also likely that some of the practices may change in the long term as new information, techniques, and other circumstances warrant. Thus, these descriptions are intended to be straightforward ways to characterize a standard level of commitment to conservation while reserving the option to achieve conservation objectives by other means.

For certain species, additional conservation measures are proposed for known nesting, denning, and/or roosting sites. Under this HCP, DNR shall not be required to survey for nests, dens, roosts, or individual occurrences of unlisted species. Currently, baseline data on many of these species are recorded in the Washington Department of Fish and Wildlife Non-game Database.

The habitats most critical for the conservation of unlisted species on DNR-managed lands in the OESF contain elements of late successional coniferous forest, riparian areas and wetlands, or both. The aggregate landscape-level effects of the Experimental Forest riparian and spotted owl conservation strategies and the HCP marbled murrelet conservation strategy, as described below, are expected to provide habitat for most unlisted species. However, some unlisted species require special landscape features or habitat elements that may not be adequately conserved by the species-specific strategies. Thus, special conservation measures for talus fields, caves, cliffs, large snags, and large, structurally unique trees may be important to these species. The protection of uncommon habitats and habitat elements is described in Section F of in this chapter titled Multispecies Conservation Strategy for Unlisted Species in the Five West-side Planning Units. The specific discussion in that section to be applied in the OESF is called Protection of Uncommon Habitats.

CONSERVATION STRATEGY

The Experimental Forest multispecies conservation strategy is proposed as an outcome of landscape-level management in the OESF. Central to the planning and implementation of landscape management are the proposed conservation measures for riparian ecosystems, spotted owls, and marbled murrelets. The aggregate effect of these conservation strategies is the creation of landscapes centered on healthy riparian ecosystems that contain interconnected patches of late successional, mid-aged, and young forests. Late successional forests consist of both mature (80-200 years old) and old-growth (greater than 200 years old) forest age classes (Thomas et al. 1993; FEMAT 1993; Spies and Franklin 1991).

Riparian Conservation Strategy

(See the earlier part of this section on the Experimental Forest titled Riparian Conservation Strategy.)

The principal components of the riparian conservation strategy are forested buffers to protect stream channels and unstable hillslopes. Management activities within these buffers will be governed by the following conservation objectives:

(1) to maintain and aid restoration of the composition, structure, and function of aquatic, riparian, and associated wetland systems;

(2) to maintain and aid restoration of the physical integrity of stream channels and floodplains;

(3) to maintain and aid restoration of water to the quantity, quality, and timing with which these systems evolved;

(4) to maintain and aid restoration of the sediment regime in which these systems evolved; and

(5) to develop, use, and distribute information on aquatic, riparian, and associated wetland ecosystem processes.

The riparian strategy will result in complex, productive aquatic habitats in streams and wetlands and late successional conifer forest as the predominant cover type along streams and on unstable hillslopes. As a result, this strategy will benefit nearly all aquatic, wetland, riparian obligate, and upland species on DNR-managed lands in the OESF.

The riparian strategy will be implemented by establishing interior-core buffers that minimize disturbance of unstable channel banks and adjacent hillslopes and by establishing exterior buffers that protect the interior-core buffers from wind damage. Additionally, DNR will continue its commitment to "no overall net loss of naturally occurring wetland acreage and function" (DNR 1992 p. 36). Interior-core buffers are estimated to cover 56,000 acres (22 percent) of DNR-managed land in the OESF. Exterior buffers may cover up to (31,000 acres) 12 percent of DNR-managed land in the Experimental Forest.

Management within the exterior (wind) buffer will be largely experimental, and the forest conditions allowed to develop within the exterior buffer will be based on their efficacy in minimizing windthrow. DNR currently hypothesizes that structurally diverse, mature conifer forests that sustain varying degrees of harvest will be the long-term outcome of management in many of the exterior buffers.

Suitable habitat for aquatic and riparian obligate species should be provided in the interior-core riparian buffers, especially as their functions are maintained by exterior buffers. Wetland species will be protected because DNR maintains no overall net loss of naturally occurring wetland acreage and function. For upland species, the long-term benefit of riparian ecosystem conservation is a network of late successional forests in streamside areas and on unstable hillslopes that serve as habitat for nesting, foraging, or resting.

Marbled Murrelet Conservation Strategy

(See Section B of this chapter for the marbled murrelet conservation strategy.)

Landscape conditions outside riparian areas and not on unstable hillslopes will be enhanced by management for marbled murrelets. The long-term murrelet conservation strategy is not yet developed, but it will quite likely entail the preservation of some marbled murrelet nesting habitat, and this will increase the amount of late successional forest available to other species.

Spotted Owl Conservation Strategy

(See the earlier part of this section on the OESF titled Conservation Strategy for the Northern Spotted Owl.)

The unzoned spotted owl conservation strategy sets a minimum standard of at least 40 percent of each landscape in young-forest marginal (as defined by Hanson et al. 1993) or better quality habitat and at least half of this, or 20 percent of each landscape planning unit, in old forest (Hanson et al. 1993). Because of the riparian conservation strategy alone, four of the 11 landscape planning units (Reade Hill, Willy-Huel, Upper Clearwater, and Copper Mine — see Map IV.9) are expected to exceed the minimum standard for spotted owl conservation. In the other seven landscape planning units (Kalaloch, Sadie Creek, Clallam, Upper Sol Duc, Goodman Creek, Dickodochtedor, and Queets), the riparian strategy makes a significant contribution toward meeting the spotted owl minimum standard.

DNR-managed lands outside of riparian areas in these landscape planning units will be managed on harvest rotations that provide enough habitat to meet the landscape minimums.

Forest Management in the OESF

The working hypothesis of the OESF is that it is possible to manage forest stands and landscapes for integrated outputs of commodity and ecosystem products. In conjunction with the conservation strategies described for spotted owls, marbled murrelets, riparian ecosystems, and uncommon habitats, a variety of forest stand management prescriptions will be implemented. (See Section H of this chapter titled Forest Land Management Activities.) Some stands may be managed under an even-aged regime of short rotations (50 to 60 years). Other stands may be managed by a series of light, partial cuts that retain the composition, structure, and function of late successional forests throughout all or most of the management cycle. Individual activities will be planned and implemented within the framework of specific landscape-wide plans for each landscape planning unit. These landscape plans will focus and direct the integration of commodity, ecosystem, and information outputs, in part, by mapping and scheduling timber harvests and other silvicultural activities so that their influence on ecosystem processes can be assessed in advance.

After stand-regenerating disturbances such as fire or clearcutting, stand development proceeds through a series of identifiable successional stages. Various systems have been used to describe forest succession. The system of Brown (1985) is based on the structural condition of the stand and identifies six stages: grass/forb, shrub, open sapling/pole, closed sapling/pole/sawtimber, large sawtimber, and old growth. Large sawtimber is approximately equivalent to mature forest. Mature and old-growth forests are considered to be late successional (Thomas et al. 1993). Conifer forest stands are often in the closed sapling/pole/sawtimber stage between about 30 and 80 years of age (Brown 1985), and stands exhibiting such conditions are generally considered to be young forest (Spies and Franklin 1991). Forests subjected to even-aged management and relatively short rotations should provide suitable habitat for species that utilize grass/forb, shrub, open sapling/pole, and closed sapling/pole/sawtimber stages of forest succession. Forests managed under less conventional regimes, e.g., various forms of uneven-aged management, should provide late successional habitat over some portion of the management cycle.

SPECIES BY SPECIES CONSERVATION FOR UNLISTED SPECIES OF CONCERN

Fish

(Habitat for bull trout and anadromous salmonids will be provided through the OESF riparian conservation strategy detailed earlier in this section.)

OLYMPIC MUDMINNOW

The riparian conservation strategy should protect the spawning and rearing habitats of the Olympic mudminnow through:

(1) commiting to "no overall net loss of naturally occurring wetland acreage and function" (DNR 1992 p. 36);

(2) protecting lakes and ponds classified as Types 1, 2, or 3 waters; and

(3) protecting Types 1, 2, 3, and 4 rivers and streams. Additional protection of aquatic habitat will occur through the prohibition of timber harvest on unstable hillslopes and road network management.

Amphibians

VAN DYKE'S SALAMANDER

Van Dyke's salamanders occur primarily in rock rubble near small streams and headwall seepages in the OESF. The interior-core buffers of the riparian conservation strategy are designed to protect these naturally unstable areas. Exterior buffers will protect the functions of interior-core buffers where necessary. Protection of riparian areas and unstable hillslopes as described in the Experimental Forest riparian conservation strategy should provide adequate protection for Van Dyke's salamander habitat within the OESF.

TAILED FROG

Tailed frogs require cool, clean, well-aerated water and a stable microclimate. They primarily inhabitat smaller streams with relatively steep gradients in the OESF. Interior-core buffers of the Experimental Forest riparian conservation strategy were designed to protect these areas from damage to their channel banks or from mass-wasting events at higher elevations in watersheds. Exterior buffers will protect the functions of interior-core buffers where necessary. The OESF riparian conservation strategy should provide adequate protection for tailed frog habitat within the OESF.

CASCADES FROG

Cascades frogs are known both from elevations above DNR-managed lands and from lower elevations in and around the OESF. These frogs occur in and near wetlands and other slow-flowing waters away from the main channels of streams. The OESF riparian conservation strategy is designed to maintain or restore the composition, structure, and function of aquatic, riparian, and associated wetland ecosystems; it incorporates current DNR wetlands policy that states there will be no overall net loss of naturally occurring wetland acreage and function (DNR 1992 p. 36). The OESF riparian conservation strategy and the current DNR policy on wetlands should provide adequate protection for Cascades frog habitat within the OESF.

Birds

HARLEQUIN DUCK

OESF riparian conservation will contribute to the viability of harlequin ducks on the Olympic Peninsula in two ways. First, the maintenance or restoration of mature and old-growth forests within riparian zones, especially along Types 1, 2, and 3 waters, should shelter nest sites from disturbance. Second, the principal foods of the harlequin duck are benthic macro-invertebrates, whose diversity and abundance the riparian conservation strategy is expected to enhance.

NORTHERN GOSHAWK

Under the unzoned spotted owl conservation strategy, at least 40 percent of DNR's forested lands within each landscape planning unit will be young-forest marginal (Hanson et al. 1993) or better quality habitat, and at least 20 percent of DNR's forest lands will be old forest (Hanson et al. 1993) or better. The riparian interior-core and unstable slope protection established under the riparian strategy constitutes, on average, 22 percent of each landscape planning unit, and this will eventually become late successional coniferous forest. These conditions exceed the landscape prescriptions recommended by Reynolds et al. (1992) for northern goshawks. Thus, the combined outcomes of the riparian and spotted owl conservation strategies should provide adequate protection for goshawk habitat within the OESF.

GOLDEN EAGLE

Golden eagles nest in large trees or on cliffs. These uncommon habitats and habitat elements will be protected as described earlier in the discussion on uncommon habitats in the section of this chapter titled Multispecies Conservation in the Five West-side Plannning Units. The combination of the riparian conservation strategy and forest management in the OESF should provide breeding, foraging, and resting habitat for the golden eagle. Many forests on unstable hillslopes will not be harvested and some of these areas will contain large trees. Management within the interior-core riparian buffer is expected to result in the development of late successional forest containing large live trees. Even-aged forest management throughout the OESF will continue to provide openings for foraging habitat.

Golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668, Revised 1978). Under this act, it is unlawful to molest or disturb golden eagles and their nests. RCW 77.16.120 of the Wildlife Code of Washington prohibits destroying the nests of protected wildlife. Consistent with these regulations, trees or snags that contain known active golden eagle nests shall not be harvested. Thus, current laws, regulations, and proposed conservation strategies should provide adequate protection for golden eagles within the OESF.

VAUX'S SWIFT

The combination of the riparian, spotted owl, and marbled murrelet conservation strategies should provide forest conditions suitable for Vaux's swift breeding, foraging, and resting habitat. In concert, these three strategies promote the development of landscapes containing significant amounts of older forests and large trees that will provide nesting, roosting, and foraging habitat. Other foraging habitat will result from general management of upland forests.

Conservation measures for large, structurally unique trees (described in the discussion of uncommon habitats in Section F of this chapter titled Multispecies Conservation Strategy in the Five West-side Planning Units) will retain habitat for nesting and roosting. Consistent with RCW 77.16.120, trees or snags that are known to contain active Vaux's swifts nests shall not be harvested. Green tree and snag retention are subject to the safety standards of the Department of Labor and Industries (WAC 296-54).

Additional Mitigation

Trees or snags known to be used by Vaux's swifts for nesting or roosting shall not be harvested, except as formal, experimental studies designed to address information needs related to integrating conservation and production or as other, exceptional circumstances warrant. Green tree and snag retention are subject to the safety standards of the Department of Labor and Industries (WAC 296-54).

PILEATED WOODPECKER

The combination of the riparian, spotted owl, and marbled murrelet conservation strategies should provide forest conditions suitable for pileated woodpecker breeding, foraging, and resting habitat. In concert, these three strategies promote the development of landscapes containing significant amounts of older forests and large trees that will provide nesting, roosting, and foraging habitat. Other foraging habitat will result from general management of upland forests.

Conservation measures for large snags and large, structurally unique trees (described in the discussion of uncommon habitats in Section F of this chapter titled Multispecies Conservation Strategy in the Five West-side Planning Units) will retain structural elements required by pileated woodpeckers for nesting and roosting. Additional conservation measures for snags (also described in Section F of this chapter) will increase the density of snags, and consequently, opportunities for foraging.

Consistent with RCW 77.16.120, trees or snags that are known to contain active pileated woodpecker nests will not be harvested. In addition, trees or snags that are known to have been used by pileated woodpeckers for nesting will not be harvested. Green tree and snag retention are subject to the safety standards of the Department of Labor and Industries (WAC 296-54).

OLIVE-SIDED FLYCATCHER

There are no established management recommendations for the olive-sided flycatcher. The creation of forest edges through clearcutting probably benefits the species, but extensive clearcutting with short harvest rotations would eliminate the mature forests and tall snags which this species requires. The combination of the riparian, spotted owl, and marbled murrelet conservation strategies should provide forest conditions suitable for olive-sided flycatcher breeding, foraging, and resting habitat. In concert, these three strategies promote the development of landscapes containing significant amounts of older forests and large trees that will provide nesting, roosting, and foraging habitat. Other habitat will result from general management of upland forests. The landscape conditions projected for the OESF are expected to adequately provide for the habitat needs of the olive-sided flycatcher.

LITTLE WILLOW FLYCATCHER

In the OESF, even-aged forest management should provide the type of nesting habitat that the species requires. The landscape conditions projected to occur in the OESF should provide adequately for the nesting, foraging, and other habitat needs of little willow flycatchers.

Mammals

MYOTIS BATS

The combination of the riparian, spotted owl, and marbled murrelet conservation strategies should provide forest conditions suitable for myotis bat breeding, foraging, and resting habitat. In concert, these three strategies promote the development of landscapes containing significant amounts of older forests and large trees for nesting, roosting, and foraging habitat, and productive riparian and wetland ecosystems for foraging habitat. Other habitat will result from general management of upland forests.

Talus fields, cliffs, and caves have been designated priority habitats by the Washington Department of Fish and Wildlife (1995a). Talus fields, cliffs, and caves will be protected (as described in the discussion of uncommon habitats in Section F of this chapter titled Multispecies Conservation Strategy in the Five West-side Planning Units), and DNR will also protect very large old trees as described in that same section.

Additional Mitigation

Live trees or snags that are known to be used by myotis bat species as communal roosts or maternity colonies shall not be harvested, except as formal, experimental studies designed to address information needs related to integrating conservation and production or as other, exceptional circumstances warrant. Green tree and snag retention are subject to the safety standards of the Department of Labor and Industries (WAC 296-54).

TOWNSEND'S BIG-EARED BAT

There are no confirmed breeding sites for this bat on the western Olympic Peninsula. The species requires caves for nursery colonies and hibernacula. No caves are known to exist in the OESF. Therefore, forest management in the OESF is expected to have little or no impact on Townsend's big-eared bats. In the event that a cave is discovered, it will be protected as described in the discussion on uncommon habitats (found in Section F of this chapter titled Multispecies Conservation Strategy in the Five West-side Planning Units).

FISHER

The aggregate landscape level effects of the riparian, spotted owl, and marbled murrelet conservation strategies, will provide more than 68,000 acres of contiguous fisher habitat across the Willy-Huel, Kalaloch, Copper Mine, Upper Clearwater, and Queets landscape planning units. (See Map IV.9.) This habitat area will also provide a connection between the main body of the Olympic National Park and the National Park's coastal strip. The Olympic National Park contains over 284,300 acres of fisher habitat. The Olympic National Forest currently contains 241,100 acres of fisher habitat and under the President's Forest Plan, it should have approximately 334,200 acres by the year 2074 (Holthausen et al. 1994). The contiguous fisher habitat in the OESF is seen as adjunct to this high-quality habitat on federal land.

DNR-managed roads are routinely closed for cost-effective forest management and protection of public resources, including wildlife (DNR 1992 p. 41). Road closures benefit the fisher population by limiting human disturbance and reducing the likelihood of accidental trapping. Road closures will continue on DNR-managed lands and will be consistent with cost-effective forest management and policies set forth by the Board of Natural Resources.

Additional Mitigation

DNR shall place restrictions in its contracts for sales of timber and other valuable materials, as well as in its grants of rights of way and easements, to prohibit activities within 0.5 mile of a known active fisher den site between February 1 and July 31 where such activities would appreciably reduce the likelihood of denning success.

SUMMARY OF HABITAT TYPES PROVIDED ON DNR-MANAGED FOREST LANDS IN THE OLYMPIC EXPERIMENTAL STATE FOREST

See Table IV.7 for an estimate of different habitat types provided in the OESF based on one set of harvest regimes. Refer to footnotes 2-5 of that table for brief explanations of the habitat types.