NORTHERN SPOTTED OWL AND MARBLED MURRELET SECTIONS IN CHAPTER 3 OF THE OESF FOREST LAND PLAN

Northern Spotted Owl

1. Description of the species (taxonomy, life history, and ecology)

The northern spotted owl (*Strix occidentalis caurina*) is one of the three recognized subspecies of spotted owls. It is a medium-sized owl with dark brown plumage, a barred tail, white spots on the head and breast, and dark brown eyes surrounded by prominent facial disks.

The geographic range extends from southwest British Columbia through the Cascade Mountains and coastal ranges in Washington, Oregon and northern California. The distribution of the Olympic Peninsula sub-population includes low- and mid-elevation forests up to about 3,000 feet above sea level. The high elevation non-habitat is restricted to Olympic National Park.

Northern spotted owls are non-migratory and highly territorial. Their home range sizes vary regionally, generally increasing from south to north. The median size of the home ranges reported for the Olympic Peninsula is 14,211 acres (USFWS, 1994, recovery plan). Northern spotted owls usually form pairs for life and remain in the same general area throughout the year, expanding their territories in fall and winter when prey becomes more difficult to find. They do not construct their nests and rely on suitable nesting platforms such as tree cavities and mistletoe brooms. Cavity nests predominate on the Olympic Peninsula (Hershey 1998). The species has a long life span, relatively high adult survivorship rate, and low fecundity resulting from delayed onset of breeding, small clutch sizes and variability in nesting success (Guetierrez 1996). Juveniles begin dispersing in September-October with an average effective dispersal distance of about 16 miles for females and 10 miles for males (Forsman et al. 2002). The major predator affecting juvenile and to a lesser extent adult spotted owls is the great horned owl.

Spotted owls' diet varies considerably across their geographic range as well as by forest type. Northern flying squirrels comprise a large percentage of the diet in Douglas-fir and western hemlock forests in the north (Carey et al. 1992, review in Courtney *et al*. 2004, p. 4-7). Flying squirrels are the primary prey for spotted owl on the Olympic Peninsula (Forsman et al. 1991, Carey 1993). The flying squirrel abundances on the Olympic Peninsula are low (Carey et al. 1992) and as a result the spotted owl ranges on the peninsula are some of the largest that have been reported (Holthhausen et al. 1995).

Northern spotted owls generally rely on older, structurally complex forests that provide for their nesting, roosting, and foraging behavior (see review in Courtney *et al*. 2004). Stand features supporting roosting and foraging are closed canopy, canopy layering, large accumulations of snags and down woody debris. Large and deformed trees provide nesting opportunities. Dispersal is facilitated by closed canopy and adequate flying space under the canopy.

Northern spotted owl population performance has been monitored across its geographic range since the late 1980s. The long–term demographic data suggest that populations have been decreasing by about 3.7 percent per year range-wide from 1985 to 2003 (Anthony et al. 2006). Spotted owl populations in Washington are declining at a faster rate than those in Oregon and California. The estimates for the Olympic Peninsula sub-population come from the Olympic Peninsula Demographic study area, which consist of 54 spotted owl territories in the Olympic National Park and 45 territories monitored in the surrounding Olympic National Forest. Basic demographic parameters (age-specific survival and fecundity) are monitored annually in the area since 1992 following the Northwest Forest Plan effectiveness monitoring protocol. The estimate of decline in the Olympic study area is 4.4% a year and 20–30% decline over the last two decades due mainly to the decrease in adult survival **(?**Anthony et al. 2006). The occupancy rates of spotted owl territories in the Olympic National Park in 2008 were about 1/3 of that in the early 1990's with none of the monitored site on the west part of the park being occupied (Gremel 2008).

DNR has formerly monitored occupied sites in the OESF, as well as several sites in the Olympic National Park coastal strip and Queets River corridor. Owl monitoring on state lands covered decreasing number of sites varying from 25 to 5 between 1994 and 2001 following a priority system based on the OESF conservation objectives, level of owl activity, and budget retractions (S. Horton, pers. comm.). The last monitoring report from 2001 field season confirmed absence in the 5 monitored sites in the OESF. No spotted owls have been found in Queets corridor since early 1990' and only one spotted owl was detected in the coastal strip in 2001 when the last monitoring visit was conducted there. All monitoring activity was suspended after 2001.

2. Regulatory Context of Northern Spotted Owl Conservation

a. Federal listing and 5-year status review

The northern spotted owl was listed as threatened under the Endangered Species Act in 1990 because of widespread loss and adverse modification of suitable habitat across its geographic range and the inadequacy of existing regulatory mechanisms to conserve the owl. The 5–year status review completed in 2004 concluded that the northern spotted owl should remain listed as a threatened species under the Endangered Species Act (USFWS 2004).

b. Federal Recovery Plan

The Recovery Plan for the northern spotted owl was finalized and adopted in 2008. The plan identifies criteria and actions needed to stop the owl's population decline, reduce threats and return the species to a stable, well-distributed population throughout its geographic range (USFWS 2008). The Recovery Plan delineates a network of habitat blocks, or managed owl conservation areas (MOCAs), in the westside provinces of the spotted owl geographic range, including the Olympic Peninsula, and recommends management actions within these blocks. MOCAs are identified as the areas that have the highest potential to contribute to the recovery of the species. All MOCAs, including four delineated in the Olympic Peninsula are entirely on federal lands (Figure 1). In areas

where habitat contributions by private, state and some federal lands are expected to increase the likelihood for spotted owl recovery, the Recovery Plan delineates Conservation Support Areas (CSAs). CSAs may provide demographic support to the core populations in the MOCAs and/or facilitate dispersal of juveniles. The two CSAs on the Olympic Peninsula are based on the existing Spotted Owl Special Emphasis Areas (SOSEAs) designated by the Washington Forest Practices Board. (Figure 2) Both CSAs include DNR-managed lands in the OESF (Figure 3). The Recovery Plan also recognizes Habitat Conservation Plans as important tools to assist the recovery of the species (USFWS 2008, p. 27). The spotted owl conservation strategy for the OESF, as described in the 1997 Habitat Conservation Plan (HCP), is compatible with the habitat management actions in the CSAs recommended by the 2008 Recovery Plan.

Recovery plans are not regulatory documents enforceable by law. Rather, they provide guidance to bring about recovery through prescribed management actions and criteria to determine when recovery has been achieved, and are often influential in guiding the land-use decisions of federal and non-federal land managers.

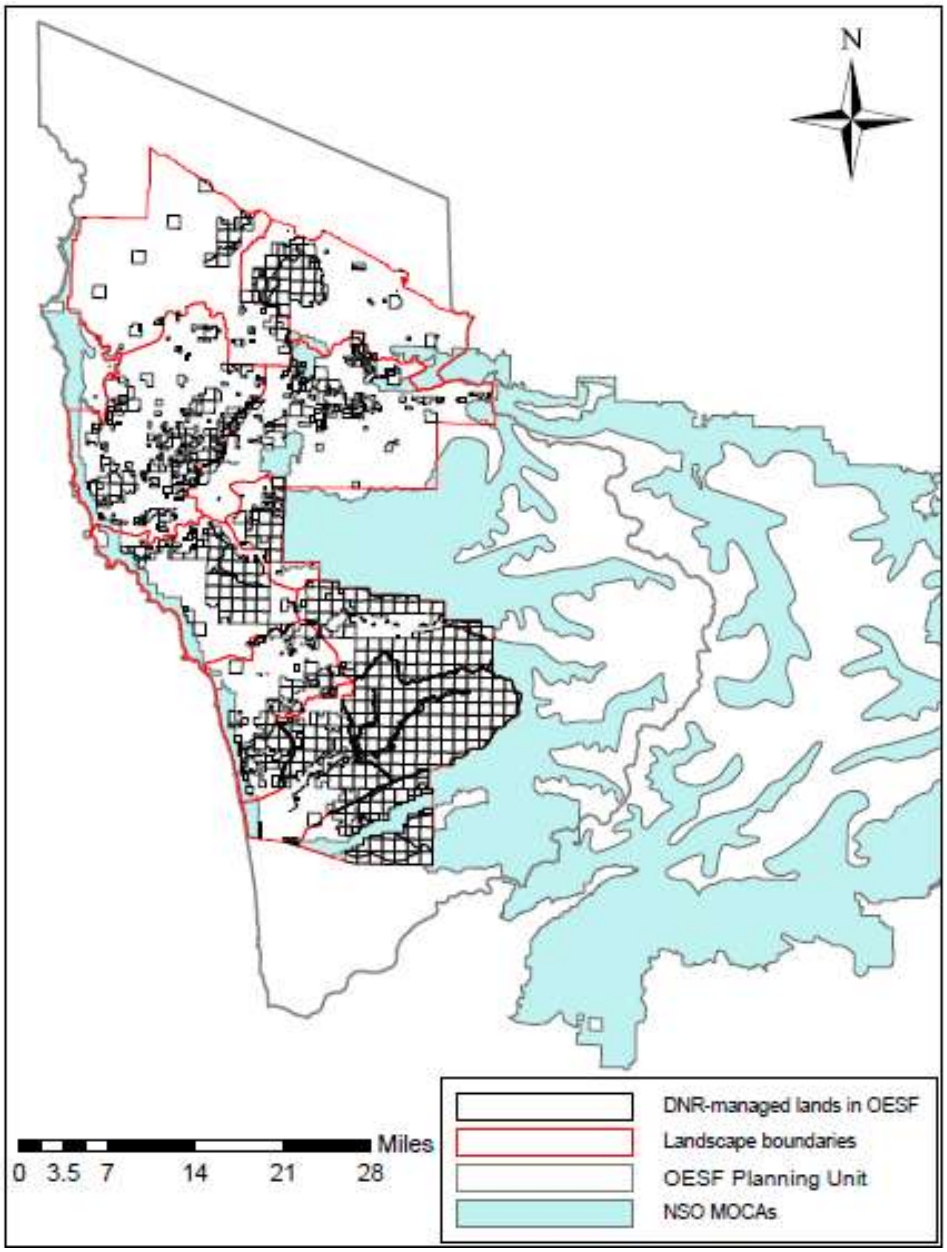


Figure 1. Managed Owl Conservation Areas (MOCAs) in the OESF Planning Unit

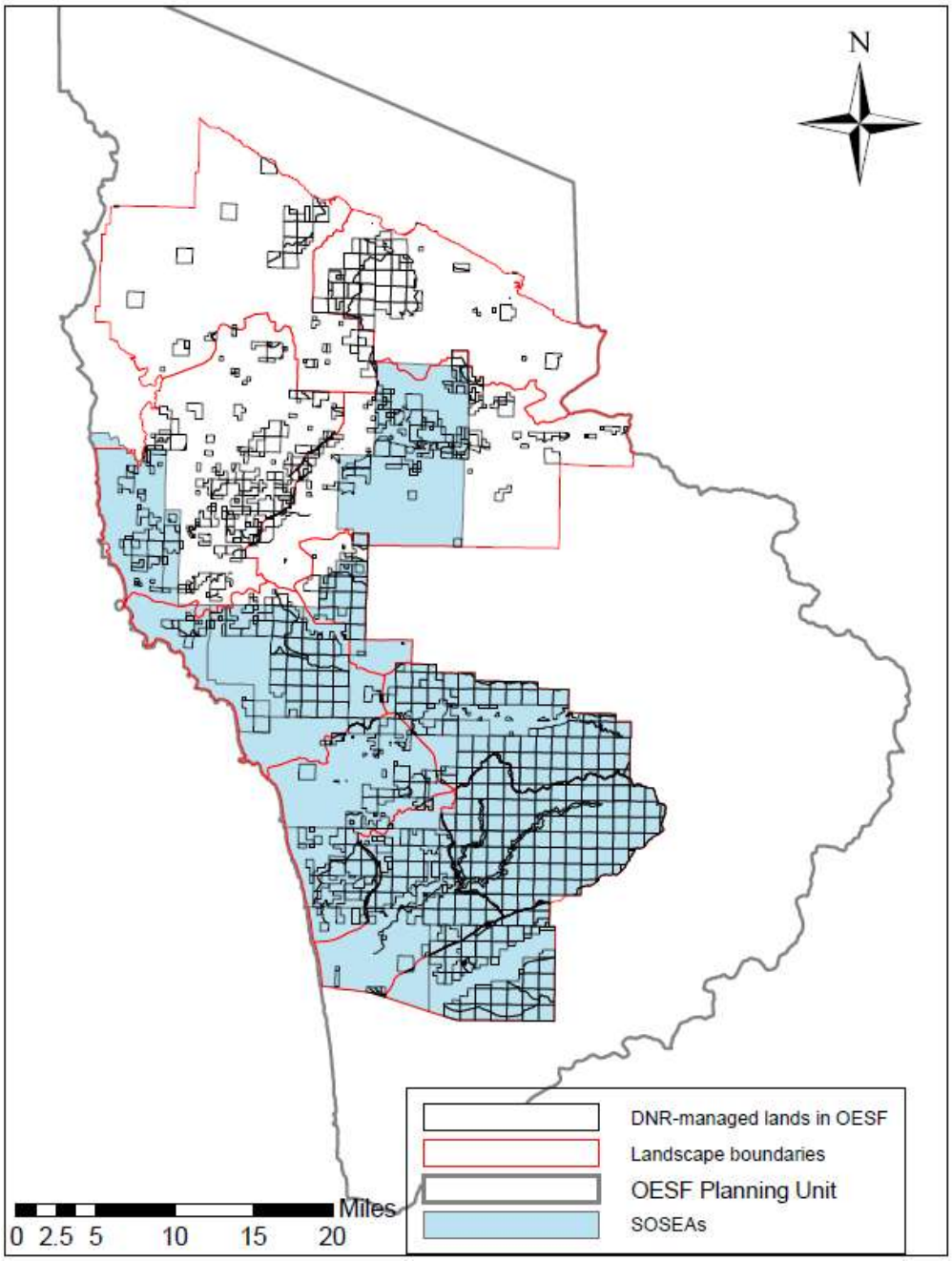


Figure 2. Spotted Owl Special Emphasis Areas (SOSEAs) in the OESF Planning Unit

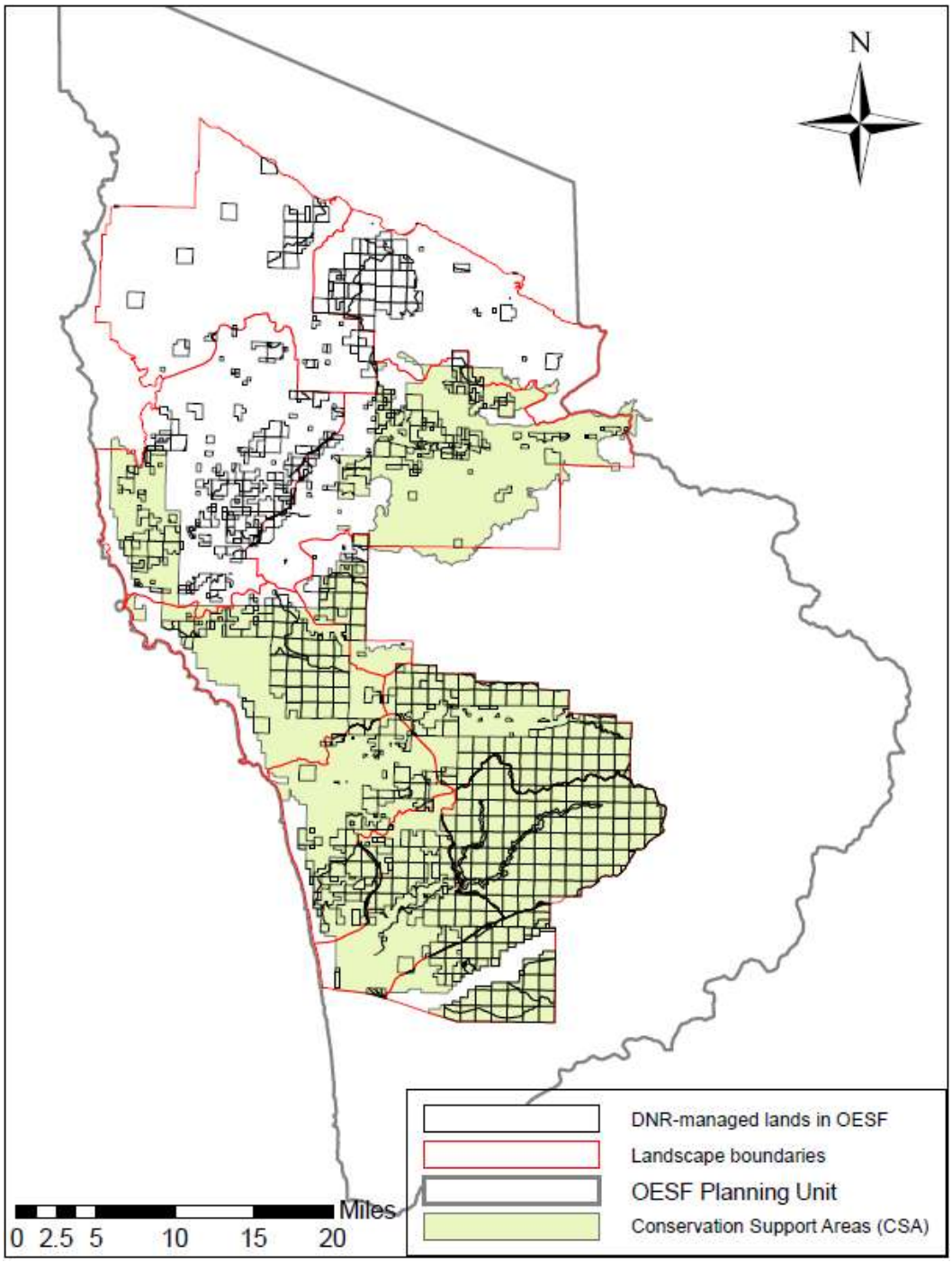


Figure 3. Spotted Owl Conservation Support Areas (CSAs) in the OESF Planning Unit

c. Critical Habitat designation

Critical habitat designates areas that contain habitat essential for the conservation of a threatened or endangered species and that may require special management considerations. Revised critical habitat for the northern spotted owl was designated in 2008, replacing the 1992 critical habitat designation (Federal Register 73, No. 157 FR **47326**). The designation was based on the recovery actions described in the 2008 Recovery Plan and was located entirely on Federal lands. The Olympic Peninsula Habitat Unit of the critical habitat consists of 332,100 ac in Clallam, Jefferson, Mason, and Grays Harbor Counties, and is comprised of lands managed by the Olympic National Forest (Figure 4).

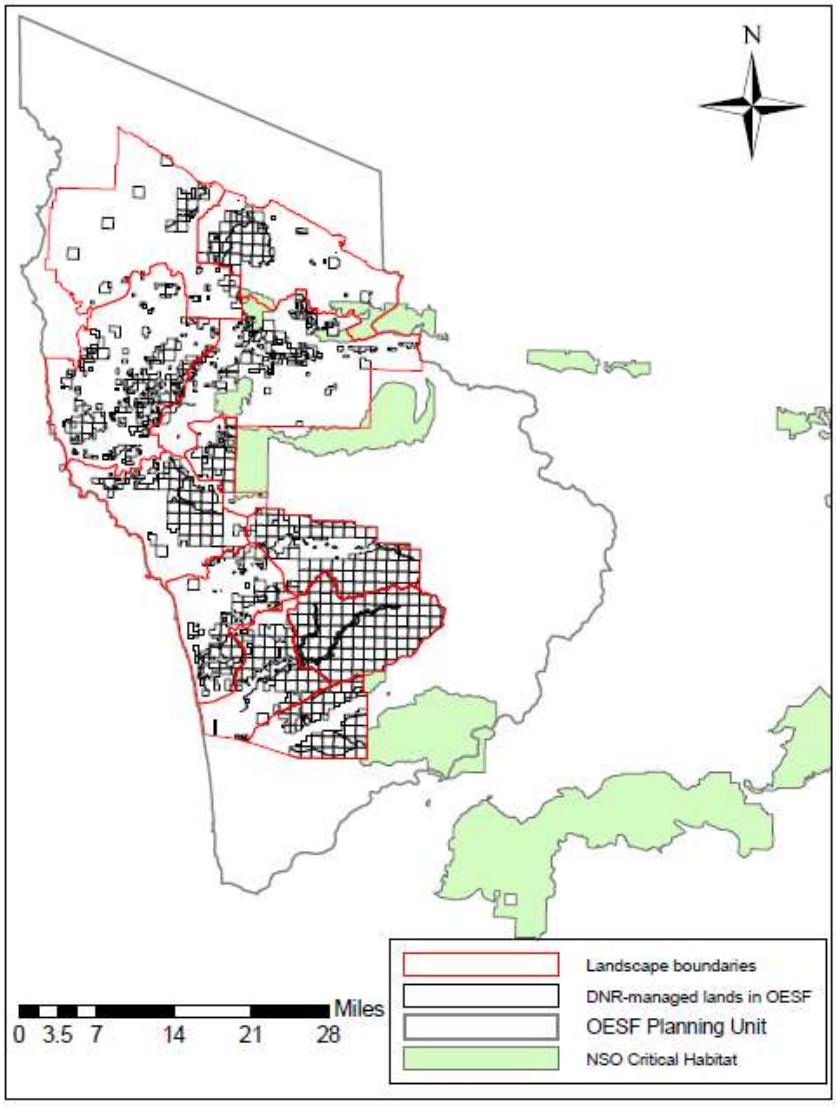


Figure 4. Spotted Owl Critical Habitat in the OESF Planning Unit

d. Northwest Forest Plan

The Northwest Forest Plan, adopted in 1994, established a network of reserved land allocations on Federal lands in Washington, Oregon and California designated to support clusters of reproducing spotted owl pairs as well as other species associated with late-successional forests (USDA and USDI 1994). Management objectives include supporting the recovery of a viable well-distributed population of spotted owls. Federal lands in the Olympic National Forest and Olympic National Park adjacent to DNR-managed lands in the OESF planning unit are covered by the Northwest Forest Plan. The majority of these federal lands on the Olympic Peninsula are deferred from harvest. Silvicultural treatments are allowed in young forests (<80 years old) in Late Successional Reserves with the purpose of accelerating development of late-successional forest habitat.

e. Major threats

The 2008 Recovery Plan cites competition with barred owls, ongoing loss of suitable habitat as a result of timber harvest and catastrophic fire, and loss of amount and distribution of suitable habitat as a result of past activities and disturbances as the most important range-wide threats to the northern spotted owl (USFWS 2008).

Barred Owls, which are dominant in competitive interactions with spotted owls, are recognized in the 2008 Recovery Plan as "extremely pressing and complex" threat, requiring specific and immediate actions. To better understand the impact of barred owls on spotted owls and to start addressing this threat, the Recovery Plan calls for large-scale barred owl control experiments in key spotted owl areas. The plan also recognized that additional spotted owl habitat will alleviate the pressure from barred owl competition. Barred owls were first detected in the Olympic Peninsula in 1985 and the number of sightings has steadily increased. Barred owls (detected incidentally to spotted owl surveys) have been detected in 58% of monitored spotted owl sites (N=52) in the Olympic National Park in 2008. The proportion of spotted owl sites that had barred owl detections for the entire monitoring period 1992-2008 is 87% (Gremel, 2008). The field data suggest that spotted owls are excluded from areas occupied by barred owls rather than remaining undetected. Gremel (2008) also observed that "spotted owl territories which have remained occupied following detections of barred owls have both moved further and had increased in elevation relative to sites where barred owls have been absent".

A considerable amount of spotted owl habitat was lost on the Olympic Peninsula in the 1970s and 1980s as a result of timber harvest. This included private, state, and Forest Service lands. Majority of native forests in the northern part of the OESF were harvested in the 1920s and 1930s and very little old-growth forest remains there. The state lands in the central and southern part of the OESF were harvested from the late 1960s to the late 1980s. Currently the landscapes there are mix of young managed stands (15-40 year old), stands that regenerated from the 1921 windstorm, and old-growth. Since 1990, habitat losses were substantially reduced as a result of spotted owl conservation policies and other state and federal regulations. The adoption of the Northwest Forest Plan in 1994 dramatically decreased timber harvest on the Olympic National Forest. Currently about 80% of the forest is located within reserve allocations: about 66% is in Late Successional

Reserves, which are designed to serve as habitat for late-successional and old-growth related species, and about 14% is within Congressionally Reserved Areas (Wilderness Areas). The management emphasis for these reserved areas is to maintain a functional, interactive, late-successional and old-growth forest ecosystem (USDA and USDI 1994). Analyses of harvested spotted owl habitat on private and state lands in Washington for the period 1996-2004 (i.e., after the adoption of spotted owl Forest Practices rules), estimated that the Olympic zone (state and private lands in the Western Olympic Peninsula) received the lowest harvest levels (3.4%) compared to the rest of the state (Pierce et al. 2005, p.58).

3. Current DNR policies, procedures, and agreements guiding Northern Spotted Owl conservation in the OESF

a. Policy for Sustainable Forests

The main policies in the 2006 Policy for Sustainable Forests that affect northern spotted owl conservation in the OESF are the Policy on Wildlife Habitat and the Policy on Old-Growth Stands in Western Washington. Biodiversity is recognized as "the fundamental guiding principle for sustainable forest management" and implementation of the HCP is expected to "provide habitat conditions that, over time, have the capacity to sustain native wildlife populations and communities" across forested landscapes. DNR defers from harvest old-growth stands (stands larger than 5 acres that originated naturally before the year 1850) and retains "known very large diameter, structurally unique trees". The Silviculture Strategy Policy directs DNR to target 10-15% of each Westside HCP planning unit in older forest conditions over time.

b. HCP Northern Spotted Owl conservation strategy for the OESF

The northern spotted owl strategy for the OESF is unique among other HCP Planning Units in that its' goal is to combine commodity production with spotted owl conservation. This is to be achieved through an un-zoned management approach, experimenting with innovative silviculture, and systematic application of acquired knowledge to adjust management regimes. The conservation objective is to "develop and implement land-management plans that do not appreciably reduce chances of the survival and recovery of the northern spotted owl sub-population on the Olympic Peninsula" (HCP p. IV. 86). The conservation of spotted owls in the OESF will be achieved by restoring the habitat capability of the area. The desired quality, quantity, and distribution of spotted owl habitat is proposed as a working hypothesis, open to change as new knowledge on species' habitat associations is acquired. Management of the desired owl habitat conditions will be planned and implemented at the scale of landscape planning units. Two phases are identified in the strategy implementation – habitat restoration followed by habitat maintenance.

c. 2006 Settlement Agreement *(WEC vs. Sutherland)*

The Settlement Agreement of 2006 (*WEC vs. Sutherland*) on the Sustainable Harvest Calculation of 2004 delineates specific spotted owl habitat types (described in detail in Section 5 below) and identifies management restrictions in addition to the 1997 HCP. For the OESF, the Agreement provisions supplement the HCP spotted owl conservation strategy as follows: 1) DNR will not authorize or conduct any harvests in "old forest" habitat types; 2) "Structural Habitat" is identified as stands that have the structural characteristics of sub-mature or young-forest marginal (detailed definitions are provided in Table 1 below); 3) DNR will not conduct any regeneration harvests in Structural Habitat prior to development of the Forest Land Plan and will impose a planning goal to retain Structural Habitat during the planning process; 4) Any other management activity in Structural Habitat will sustain or improve habitat quality; 4) DNR will perform the same number of acres of enhancement activities in Structural Habitat and non-habitat as regeneration harvests.

A comprehensive spotted owl procedure was developed by DNR in 2007 to integrate the provisions of the Settlement Agreement with the HCP (PR-004-120).

d. DNR procedures on old-growth harvest deferral and protection; management of structurally unique trees; and management of forest stand cohorts (Westside) (PR 14-004-045, PR 14-004-046, and PR 14-006-090)

These procedures provide direction for: the identification of old-growth stands on westside forested state trust lands, including the OESF; harvest deferral and further protection of old-growth stands; specifications for cohort management with ecological objectives for developing structurally diverse stands; and management of structurally complex stands to achieve older forest characteristics with target amounts for each planning unit.

4. Criteria for assessing effects of forest management on spotted owl conservation

Most recent analyses of the spotted owl demography performance and major threats to species recovery throughout its geographic range were presented in the 2004 status review (USFWS 2004) and the 2008 Recovery Plan (USFWS 2008). Both documents acknowledge the more precipitous than earlier anticipated decline in spotted owl population in the northern part of the range as well as the competitive pressure from barred owls emerging as the major factor affecting spotted owl persistence. Nevertheless, both documents conclude that the current recovery strategy of providing habitat in strategic locations continues to be a valid approach. Large blocks of high-quality habitat on Federal lands support clusters of reproducing spotted owl pairs which form the core (source) populations. The private and state lands support the recovery effort on Federal

lands through maintaining and creating various quality habitats in the adjacent areas and this way providing demographic support and facilitating dispersal of the species.

The spotted owl conservation objectives in the OESF described in the 1997 HCP are coherent with the above recovery approach. They call for 1) development and implementation of "land-management plans that do not appreciably reduce the chances for the survival and recovery of the northern spotted owl subpopulation on the Olympic Peninsula" and 2) management practices that develop stands "functioning as dispersal, foraging, roosting, and nesting habitat for spotted owls" as well as landscapes that provide for "occupancy by successfully reproducing spotted owls that are functional segments of the Olympic Peninsula subpopulation". The OESF role in species conservation is viewed in the context of the Olympic Peninsula subpopulation. Providing recovery support to the core spotted owl sub-population on adjacent federal lands is the main criterion for assessing spotted owl conservation in the OESF.

5. Indicators for assessing effects of forest management on spotted owl conservation

The HCP strategy for conserving spotted owls in the OESF is to restore habitat capability in terms of necessary quality, quantity and distribution per landscape unit. The strategy does not target certain number of spotted owls, level of occupancy, reproductive success or any other demography performance indicators. The HCP recognizes this strategy is a working hypothesis (WADNR 1997, p. IV. 87) which assumptions require validation. Meanwhile, the DNR continues to use habitat quality, amount, and spatial configuration as indicators for the success of the spotted owl conservation in the OESF.

a. HCP stand level habitat definitions

The quality of northern spotted owl habitat is determined through stand level definitions described in the 1997 HCP and the NSO procedure*14-004-120*. Recent studies on spotted owl habitat relationships corroborate earlier understanding of species habitat requirements used in the 1997 HCP definitions (see review on habitat associations in Courtney et al. 2004). Description of spotted owl habitat types is presented in Table 1. All parameter thresholds have to be met in order for a stand to be delineated as habitat.

Table 1. Definitions of Northern Spotted Owl Habitat Types

	Old Forest Habitat		Structural Habitat	
Stand parameters\ Habitat type	Type A *(HCP IV.11)*	Type B *(HCP IV.11)*	Sub-mature *(HCP IV.12)*	Young Forest Marginal *(Procedure14-004-120, modified from WAC 222-16-085)*
Species composition	Multispecies canopy	Multispecies canopy	At least 30% conifers	At least 30% conifers
Canopy closure	Greater than 70%	Greater than 70%	At least 70%	At least 70%
Canopy layers	At least 2 of at least 2 species	At least 2 of at least 2 species	-	-
Tree density	Canopy dominated by 15-75 trees ≥30" DBH	Canopy dominated by 75-100 trees ≥20" DBH	115-280 trees per acre	115-280 trees per acre
Tree height	-	-	Dominant and co-dominant ≥ 85 ft	Dominant and co-dominant ≥ 85 ft
Large tree deformities	High incidence of broken tops, large cavities, dwarf mistletoe	Some with various deformities	-	-
Snags	At least 2/ac ≥30" DBH	At least 1/ac ≥20" DBH	At least 3/ac ≥20" DBH	At least 2/ac ≥20" DBH
Large DWD	Large accumulation of fallen trees	Accumulation of fallen trees	5% ground cover	OR 10% ground cover with 20-65% shrub cover
Shrub cover	-	-	-	

b. HCP habitat threshold requirements per landscape

Unlike other HCP planning units, the OESF conservation strategies are based on an experimental concept of an "unzoned" forest. Under this concept, no areas are designated for species' conservation and respectively no areas are available for take. Management of the desired habitat conditions is planned and implemented at the scale of a landscape planning units. A primary working hypothesis of the OESF is that landscapes managed for a fairly even apportionment of forest cover among stands in all stages of development will support desirable outputs for both commodities and ecosystem functions (WADNR 1997, p. IV.87). According to this approach, each landscape planning unit is managed to maintain and restore the following proportions of potential habitat:

1) "at least 20 percent of DNR-managed lands in the LPU in the understory-reinitiation to old-growth stages that are potential old-forest habitat"

and

2) "at least 40 percent of DNR-managed lands in the LPU in the stem-exclusion to old-growth stages that are potential old-forest habitat, sub-mature, or young forest marginal spotted owl habitat types" (WADNR 1997, p. IV.88).

Using the habitat classifications described in Table 1, the above landscape threshold requirements could be summarized as: At least 40 % of each landscape planning unit should be in Structural Habitat conditions with at least 20 % of the landscape planning unit in Old-Forest Habitat conditions. These habitat levels were selected in the 1997 HCP based on studies demonstrating that 30-50 percent habitat at spatial scales from spotted owl ranges to landscapes on the Olympic Peninsula can support reproductive pairs (Forsman and Meslow 1985, Lehmkuhl and Raphael 1993, Carey et al. 1992, Holthausen et al. 1994). The proposed thresholds of spotted owl habitat are at the low end of the range of observed values in order to allow greater flexibility to achieve integration of ecological values and timber production (WADNR 1997, p. IV.88).

6. Current spotted owl habitat conditions in the OESF

Currently there are three DNR datasets representing spotted owl habitat conditions in the OESF:

1. **Settlement Northern Spotted Owl Habitat Classes -** a dataset developed as part of and to implement the 2006 Settlement Agreement (*WEC vs. Sutherland*).
2. **Northern Spotted Owl Habitat Classifications – a** dataset developed to aid in the implementation of the HCP Northern Spotted Owl Conservation Strategy and to report to the Federal Services.
3. **Woodstock Model (Phase 3b) Current Northern Spotted Owl Habitat Conditions** – a dataset developed for the OESF Forest Land Plan estate model.

Detailed description of each dataset is provided in Appendix A.
The amount of spotted owl habitat per landscape planning unit is presented in Tables 2-4 and a graphic representation of habitat proportional distribution per LPU is presented in Figures 5-7.

Table 2. Spotted owl habitat amount per landscape planning unit according to dataset *"Settlement Northern Spotted Owl Habitat Classes "*

LPU	DNR-managed	Old Forest		Structural Habitat (Young Forest)		Disputed Stands		Non-Habitat		Unknown	
	acres	acres	%	acres	%	acres	%	acres	%	acres	%
CLALLAM RIVER	18,305	0	0	1,993	10.9	1,602	8.8	12,325	67.3	2,386	13.0
COPPER MINE	20,454	2,884	14.1	770	3.8	603	2.9	13,510	66.1	2,687	13.1
DICKODOCHTEDAR	29,405	2,432	8.3	3,855	13.1	889	3.0	18,801	63.9	3,428	11.7
GOODMAN CREEK	24,860	4,197	16.9	1,862	7.5	417	1.7	12,493	50.3	5,891	23.7
KALALOCH	19,207	2,351	12.2	565	3	106	0.6	8,568	44.6	7,617	39.7
QUEETS	22,048	4,817	21.9	1,015	4.6	765	3.5	12,367	56.1	3,083	14.0
READE HILL	8,889	1,445	16.3	1,615	18.2	483	5.4	4,451	50.1	895	10.1
SEKIU	10,688	33	0.3	368	3.4	389	3.6	7,712	72.2	2,188	20.5
UPPER CLEARWATER	57,467	14,784	25.7	2,029	3.5	982	1.7	31,121	54.2	8,551	14.9
UPPER SOL DUC	20,047	206	1	2,022	10.1	1,898	9.5	13,510	67.4	2,411	12.0
WILLY HUEL	39,377	7,332	18.6	1	0	0	0.0	274	0.7	31,771	80.7
Total	**270,749**	**40,481**		**16,093**		**8,134**		**135,133**		**70,908**	

Source data: *SHARED_LM.NSO_HAB_SETL*

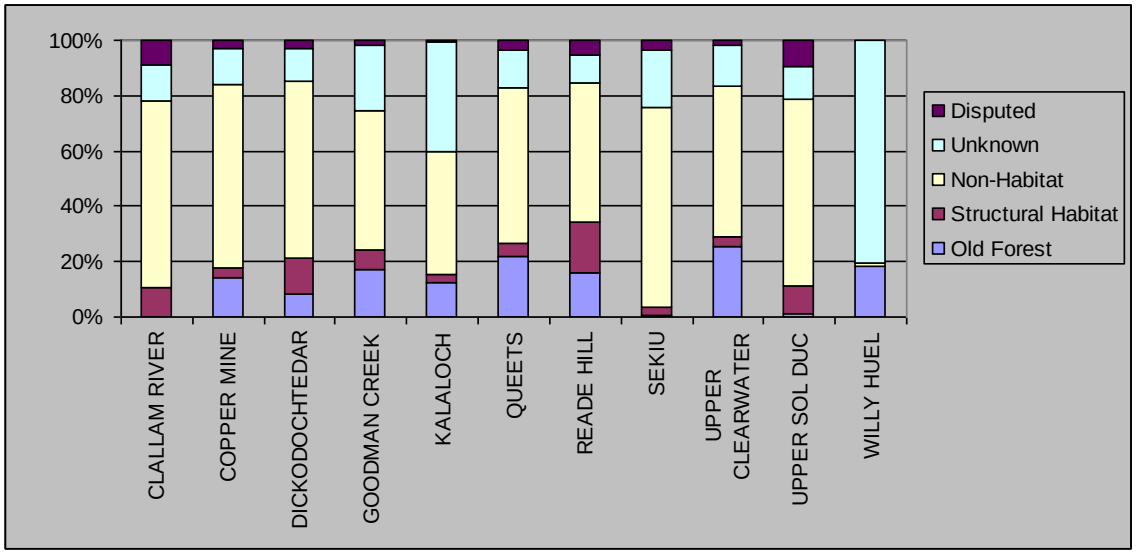


Figure 5. Proportional distribution of spotted owl habitat per landscape according to dataset *"Settlement Northern Spotted Owl Habitat Classes"*

Table 3. Spotted owl habitat amount per landscape planning unit according to dataset *"Northern Spotted Owl Habitat Classifications"*

LPU	DNR-managed	Old Forest		Structural Habitat (Young Forest)		Non-Habitat		Unknown	
	ac	ac	%	ac	%	ac	%	ac	%
CLALLAM RIVER	18,305	0	0	1,931	10.5	14,055	76.8	2,320	12.7
COPPER MINE	20,453	2,879	14.1	744	3.6	14,135	69.1	2,695	13.2
DICKODOCHTEDAR	29,406	2,433	8.3	3,779	12.9	19,809	67.4	3,385	11.5
GOODMAN CREEK	24,862	4,205	16.9	1,800	7.2	13,657	54.9	5,199	20.9
KALALOCH	19,206	2,351	12.2	1,365	7.1	14,319	74.6	1,171	6.1
QUEETS	22,049	4,809	21.8	840	3.8	13,310	60.4	3,084	14.0
READE HILL	8,889	1,443	16.3	1,553	17.5	4,998	56.2	894	10.1
SEKIU	10,689	6	0.1	367	3.4	8,126	76.0	2,190	20.5
UPPER CLEARWATER	57,468	14,768	25.7	1,933	3.4	33,127	57.6	7,640	13.3
UPPER SOL DUC	20,047	207	1	1,961	9.8	15,492	77.3	2,387	11.9
WILLY HUEL	39,451	7,331	18.6	2,379	6	28,536	72.3	1,204	3.1
Total	**270,825**	**40,433**		**18,651**		**179,565**		**32,169**	

Source data: *\\snarf\am\div_lm\ecosystem\ds\layers\nso_habitat\nso_habitat.gdb\nso_habitat_200905_draft*

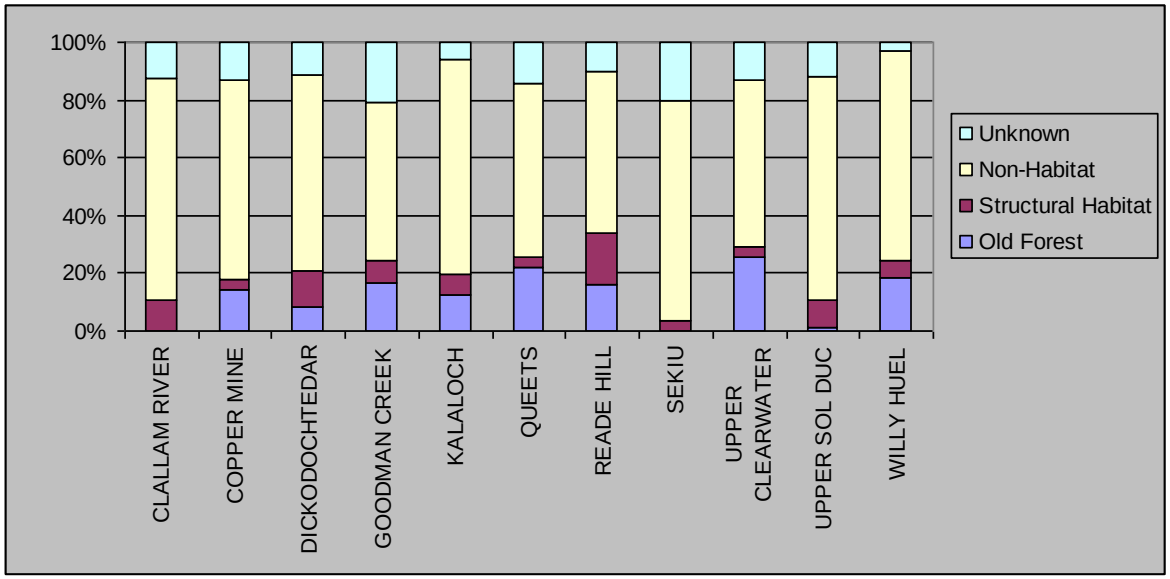


Figure 6. Proportional distribution of spotted owl habitat per landscape according to dataset *"Northern Spotted Owl Habitat Classifications"*

Table 4. NSO habitat amount per LPU according to dataset *"Woodstock Model – Current NSO Habitat Conditions"*

LPU	DNR-managed (LDO)	Old Forest		Structural Habitat (Young Forest)		Non-Habitat	
	acres	acres	%	acres	%	acres	%
CLALLAM RIVER	17910	307	1.7	5109	28.5	12494	69.8
COPPER MINE	19458	2844	14.6	975	5.0	15639	80.4
DICKODOCHTEDAR	28512	2442	8.6	4617	16.2	21453	75.2
GOODMAN CREEK	24638	4182	17.0	2756	11.2	17700	71.8
KALALOCH	18723	2322	12.4	1797	9.6	14604	78.0
QUEETS	21259	4731	22.3	1219	5.7	15309	72.0
READE HILL	8703	1510	17.4	2420	27.8	4773	54.8
SEKIU	10231	44	0.4	906	8.9	9281	90.7
UPPER CLEARWATER	55807	14534	26.0	2436	4.4	38837	69.6
UPPER SOL DUC	19555	358	1.8	4672	23.9	14525	74.3
WILLY HUEL	37154	7322	19.7	1132	3.0	28700	77.2
Total	**261951**	**40596**		**28039**		**193316**	

Source data: *Woodstock Results DEIS 10122009.lyr*

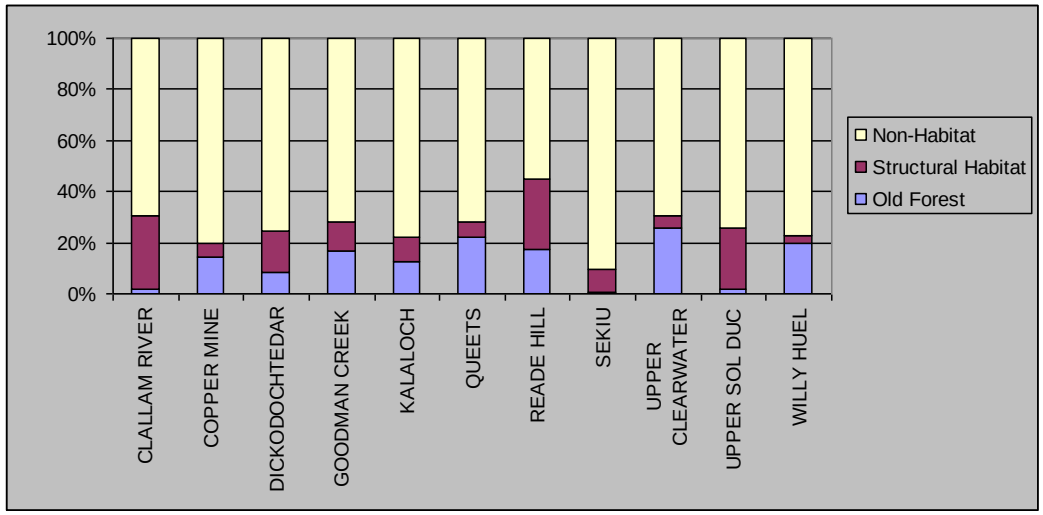


Figure 7. Proportional distribution of spotted owl habitat per landscape according to dataset *"Woodstock Model (Phase 3b)"*

Conservation measures for marbled murrelets and salmonids in the OESF, as described in the HCP, may function as additional protection for spotted owls. The high stream density in the OESF and the width of the required riparian buffers have the potential to contribute considerably towards spotted owl habitat thresholds. This contribution should be assessed with caution. Given that the riparian buffers account for 1/3 of the landscape, and that substantial part of them have higher quality spotted owl habitat than the adjacent uplands, their contribution seems like a logical choice. However, previous modeling has shown that this approach could lead to a high level landscape fragmentation resulting from narrow bands of riparian buffers surrounded by uplands in unsuitable habitat conditions (Clallam Landscape Project 1996). This fragmentation affects spotted owl directly (through exposure to predators and weather elements) and by negatively affecting its major prey – northern flying squirrels.

7. Natural disturbances impacting NSO habitat in the OESF

a. Windthrow

b. Landslides

c. Wildfire

d. Forest health

8. Potential impacts from DNR land management activities

a. Timber harvesting

Depending on the silvicultural technique the result from timber harvesting can be habitat removal, habitat maintenance, or habitat enhancement.

Variable retention harvest is a final harvest system for regenerating stands to accomplish habitat and visual objectives (DNR 2009, Glossary of terms). It replaces most of the forest cover leaving legacy structures such as large trees, snags and coarse woody debris. If conducted in a stand that qualifies as habitat, this technique will remove the stand from the habitat condition until forest cover from the regenerating cohort is reestablished.

In addition to the loss in the amount of suitable habitat, habitat removal increases fragmentation at the landscape level. Increased fragmentation is linked to poor demographic performance of spotted owls in the northern part of the range (review in Courtney et al. 2004). This is likely due to their reliance on one primary prey species (northern flying squirrels) associated with contiguous late-successional forests. Courtney et al. (2004) suggest that fragmentation could impact the rates of re-colonization, reduce dispersal opportunities, and create a lower gene pool flow within and between populations.

Forest stands in earlier stages of development such as Competitive Exclusion and Understory Development provide very few benefits to northern spotted owls because they are deficient of coarse woody debris, large snags, large nesting trees and the high stand densities does not allow owls to fly through. In the absence of disturbance such as

windstorms, fires or harvesting, forest stands may persist in these stages for long periods of time (Carey 2007). Actively managing these closed-canopy stands by removing some competition between trees can accelerate the creation of structurally complex forests needed by owls and their prey (Carey 2003b).

Young stand management activities like tree planting, vegetation control, and pre-commercial thinning affect tree species composition, density, and distribution within a stand. These techniques could be used as part of the biodiversity pathways described by Carey et al. (1996) to develop structurally diverse forests stands that constitute spotted owl habitat.

Traditional commercial thinning could accelerate forest development but it usually does not create structure. This silvicultural technique simplifies forest by reducing both the horizontal and vertical structural diversity.

Variable-density thinning is applied for development of spotted owl habitat by stimulating the development of diverse and patchy understory. The variable-density thinning is one of the elements of biodiversity pathways (Carey et al. 1996). Recent short-term results from a habitat development study utilizing variable-density thinning on the Olympic National Forest demonstrated increased spatial heterogeneity within stands as well as operational feasibility of this silvicultural technique. The five-year postharvest data showed positive tree growth response to thinning, spatially variable tree growth, and increased percent cover of understory (Harrington et al. 2005, Roberts and Harrington 2007).

DNR intends to restore and maintain habitat through active forest management. Although the current assumption is that forest stands managed under the biodiversity pathway approach will develop the habitat elements necessary for northern spotted owls, the management practices employed are relatively new. No long-term habitat monitoring results are available yet. Also, no validation monitoring data are available to compare the extent of spotted owl use of manipulated stands compared to stands having developed naturally over time.

b. Roads

Potential negative effects from roads may result from noise disturbance of spotted owls. Wasser et al. (1997) found elevated levels of fecal corticosterone in male northern spotted owls living within a quarter mile of a logging road. Corticosterone is known as a "stress hormone" and its elevated levels have been linked to suppressed reproductive development and behavior in birds. The 1997 HCP and spotted owl procedure PR-14-004-120 restrict road construction activities in proximity to known spotted owl sites during the breeding season.

Northern spotted owls could be affected by edge effects created by roads, which is likely to happen through negative impact on their prey base (flying squirrels) rather than direct negative effect on the owls.

c. Visual strategies

Visual strategies of leaving additional legacy trees could benefit northern spotted owls because they would eventually develop into a higher number of snags and more large coarse woody debris. This development could support higher densities of prey species such as the northern flying squirrel (Carey 1995). Also, stands with additional legacy trees could develop more vertical diversity and improve canopy closure (Courtney and others 2004).

d. Recreation

Recreation could negatively impact spotted owls by noise disturbance (described in the Roads section above). The preliminary results from a study in the Mendocino and Shasta-Trinity National Forests found that exposure to motorcycle noise significantly increased corticosterone levels in male northern spotted owls relative to controls (Hayward 2004).

e. Land transactions

The entire OESF is managed for spotted conservation (there are no designated conservation management areas and a matrix). As a result, each parcel that is traded out could have a potential negative effect on ability of owls to nest, roost, forage, or move through the area. The magnitude of this effect depends on parcel's size, juxtaposition, and habitat quality. However, if the parcels are transferred with the condition that they continue to be managed under DNR's 1997 *Habitat Conservation Plan*, there would be no additional negative effects on the northern spotted owl.

The policy on old-growth stands in Western Washington (WADNR 2006 p.35) states:

When in the best interest of the trust(s), the department will actively seek to transfer old-growth stands and areas containing very large diameter trees of high social or cultural significance out of trust status, when full market value compensation to the trust(s) is secured. In seeking to transfer such stands out of trust status, the department will immediately prioritize old-growth stands that are not subject to protection under DNR's *Habitat Conservation Plan* or other applicable regulations.

Unless the transfer is done under the condition that the stands are managed under the HCP, the effect of the action will be a decrease in the amount of suitable owl habitat, which will delay meeting the habitat threshold per landscape and thus affect future DNR land management in this landscape.

Marbled Murrelet

1. Description of the species (taxonomy, life history, and ecology)

The marbled murrelet (*Brachyramphus marmoratus*) is a diving marine bird, member of the *Alcidae* family. The species is unique among alcids because it nests on large moss covered limbs and mistletoe brooms of trees in Pacific coastal forests. The species is approximately 9.5 inches long with a heavy compact body and a short tail and neck (Nelson 1997). The body is relatively short compared to wing length. Males and females have identical plumage that varies seasonally (Marshall 1988). In breeding plumage, the bird is dark above with rust coloring at the tips of the back feathers and heavily mottled below. Juvenile (hatch-year) plumage is dusky mottled below, but by the first winter the lower body is mostly white and indistinguishable from adults (Carter and Stein 1995).

The range of the marbled murrelet extends from the Aleutian Islands of Alaska to the central California during the breeding season, and as far south as southern California and occasionally northern Baja Peninsula in Mexico, during the non-breeding season. Within the three-state range (Washington, Oregon, and California), the largest proportion of marbled murrelets is found in Washington, specifically in the Strait of Juan de Fuca and Puget Sound regions. The terrestrial habitat range in Washington includes the entire OESF (Figure 8). In Washington, significant gaps may occur in the distribution of marbled murrelets at sea along the southern Puget Sound (near Seattle to Olympia) and in southern Washington to northern Oregon (Columbia River to Tillamook Head).

The marbled murrelet is a cryptic seabird that nests in old-growth conifer forests and forages in the nearby ocean. It usually feeds within three miles of shore in inland saltwater bays, sounds, inlets and coves throughout the year. The marbled murrelet is a generalist feeder and has a diverse diet, but primary prey include small schooling fish and large pelagic crustaceans (Nelson 1997). Murrelets dive to pursue prey using their wings for propulsion (Burger 2002).

Marbled murrelets do not build nests but use large limbs covered with a thick layer of moss or duff, mistletoe brooms, or other deformities that create a sufficiently wide and flat space (Hamer and Nelson 1995). The primary marbled murrelet nesting range for Washington encompasses suitable habitat within 40 miles of the coast (Madsen et al. 1999). The local distribution of marbled murrelets during the breeding season (April-August), is directly related to the availability of suitable breeding habitat, such as old-growth and mature coniferous forests (Nelson et al. 1992, Ralph et al. 1995b, Meyer et al. 2002, Yen et al. 2004). Actively breeding marbled murrelets are limited to foraging within commuting distance from the nest site (Carter and Sealy 1990). Although breeding adults in Washington, Oregon and California typically forage less than 1.2 miles from shore, they have been documented traveling distances greater than 60 miles between nesting and foraging grounds (Strachan et al. 1995, Whitworth et al. 2000, Hull et al. 2001). Knowledge of inland activities and seasonal movements of marbled murrelets is

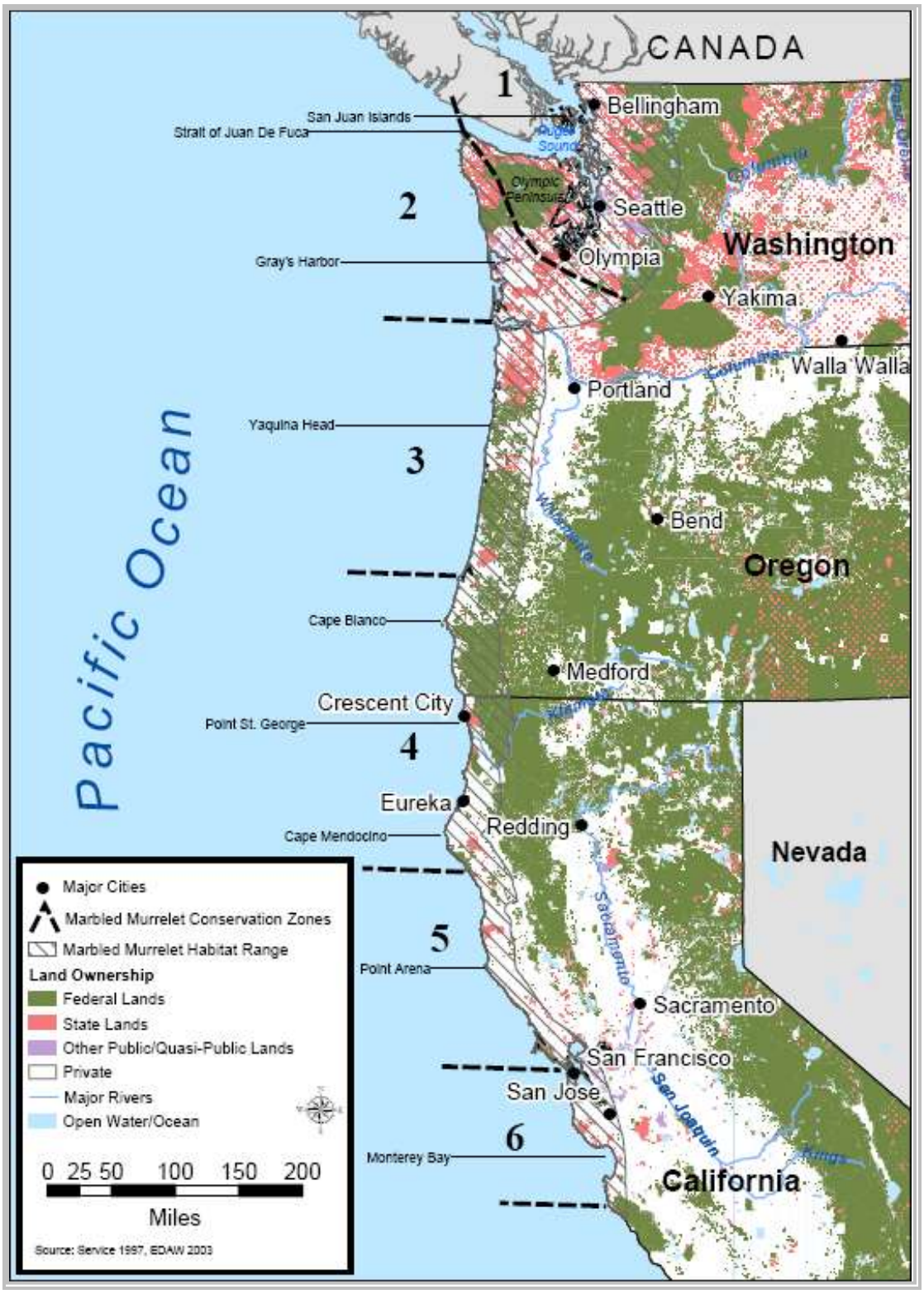


Figure 8. Marbled Murrelet Range in Washington Oregon and California, U.S. Fish and Wildlife Service Conservation Zones Boundaries, and Land Ownership (Figure from McShane et al. 2004).

limited because of difficulties in marking and recapturing marked individuals and because of their solitary nesting habitats (Divoky and Horton 1995).

In the terrestrial environment, predators documented to prey upon marbled murrelet adults at the nest include corvids, falcons, hawks and eagles. In addition, eggs are preyed upon by birds and arboreal mammals. At sea, predation from bald eagles, peregrine falcons, western gulls, and northern fur seals has been documented (Nelson 1997, Hooper 2001, Peery 2004).

Declining murrelet populations have been predicted by demographic models (USFWS 1997, McShane et al. 2004), which estimated losses of about 3-to-7 percent per year for the entire range in the three states. New empirical data from standardized monitoring for 2001-2008 provide estimates of population trends in the listed range. The results from 2001-2008 murrelet density and population monitoring indicate that the marbled murrelet population in Conservation Zones 1-5 (Figure 8) is in decline at an annual rate of about 4.3 percent or an overall decline of 34 percent (USFWS 2009 5-year status review). The statistical power to detect rates of decline at the individual Conservation Zone scale was not sufficient. Therefore, at this time there is not conclusive evidence of population stability or instability for individual Conservation Zones.

In a study on the Olympic Peninsula using radar counts of marbled murrelets flying inland during the breeding seasons from 1996-2004, no significant differences were detected in counts between years (Cooper et al. 2006). However, the authors concluded that their statistical power to detect a two to four percent decline in the population was low and the study would have to be extended 15 and 11 years, respectively, to detect these smaller declines.

Murrelet population modeling showed that population changes would be driven most strongly by variations in adult survivorship (Boulanger et al. 1999). High rates of adult survivorship are necessary to maintain population stability in species with low reproductive output and low recruitment.

2. Regulatory Context of Marbled Murrelet Conservation

a. Federal listing and status reviews

The marbled murrelet was federally listed under the Endangered Species Act as a threatened species in Washington, Oregon and California in 1992 (Federal register 57 FR 45328) and State-listed as threatened in Washington in 1993.

A 5-year status review was completed by the USFWS in 2004 with no change in the species' listing status (USFWS 2004). A second 5-year status review, presented for review in June of 2009 (Federal register 73 FR 57314), determined that the marbled murrelet should remain listed as threatened.

b. Federal Recovery Plan

A recovery plan for Washington, Oregon and California populations was published in 1997 (USFWS 1997). The recovery objectives of the plan are (1) to stabilize and then increase the population size (2) to provide conditions in the future that allow a reasonable likelihood of continued existence of viable populations, and (3) to gather necessary information to develop scientific delisting criteria. The plan identifies stabilization and increase of habitat quality and quantity as the key method to stop population decline and encourage future increase in population growth. The plan identifies 6 Conservation Zones with specific management strategies and monitoring commitments. Most of the OESF falls in Conservation Zone 2, with the easternmost portions in Zone 1 (Figure 8)

c. Critical Habitat Designation

Critical habitat for the marbled murrelet was designated by the USFWS in Washington, Oregon and California in 1996 (Federal register 61 FR 26256) and was comprised of 78 percent Federal land; 21 percent city, county, or state land; and 1 percent private land. In September 2006, the USFWS proposed to revise the designation in the three states. In 2008, after a public review of the proposal, the USFWS determined that it was not appropriate to revise the designation of critical habitat for the marbled murrelet and the 1996 designation remains in effect (Federal register 73 FR 12067).

The critical habitat designation includes only terrestrial habitat, focusing on forested areas with conditions that support nesting. The primary elements of suitable nesting habitat are identified as (1) individual trees with potential nesting platforms and (2) forested areas within 0.5 miles of these trees, with a canopy height of at least one half of the site-potential tree height.

The critical habitat designation in Washington includes federal, state, and private lands. Eight of the eleven landscape planning units in the OESF have DNR-managed lands within the critical habitat designation (Figure 9). Excluded are Sekiu, Clallam River, Upper Sol Duc, and Dickodochtedar.

d. Northwest Forest Plan

The Northwest Forest Plan, adopted in 1994, established a network of reserved land allocations on Federal lands in Washington, Oregon and California designated to maintain and restore habitat conditions for well-distributed and viable populations of late-successional and old-growth related species including the marbled murrelet (USDA and USDI 1994). The plan objective for the marbled murrelet is to ensure persisting populations by providing long-term nesting habitat. Federal lands in the Olympic National Forest and Olympic National Park adjacent to DNR-managed lands in the OESF planning unit are covered by the Northwest Forest Plan.

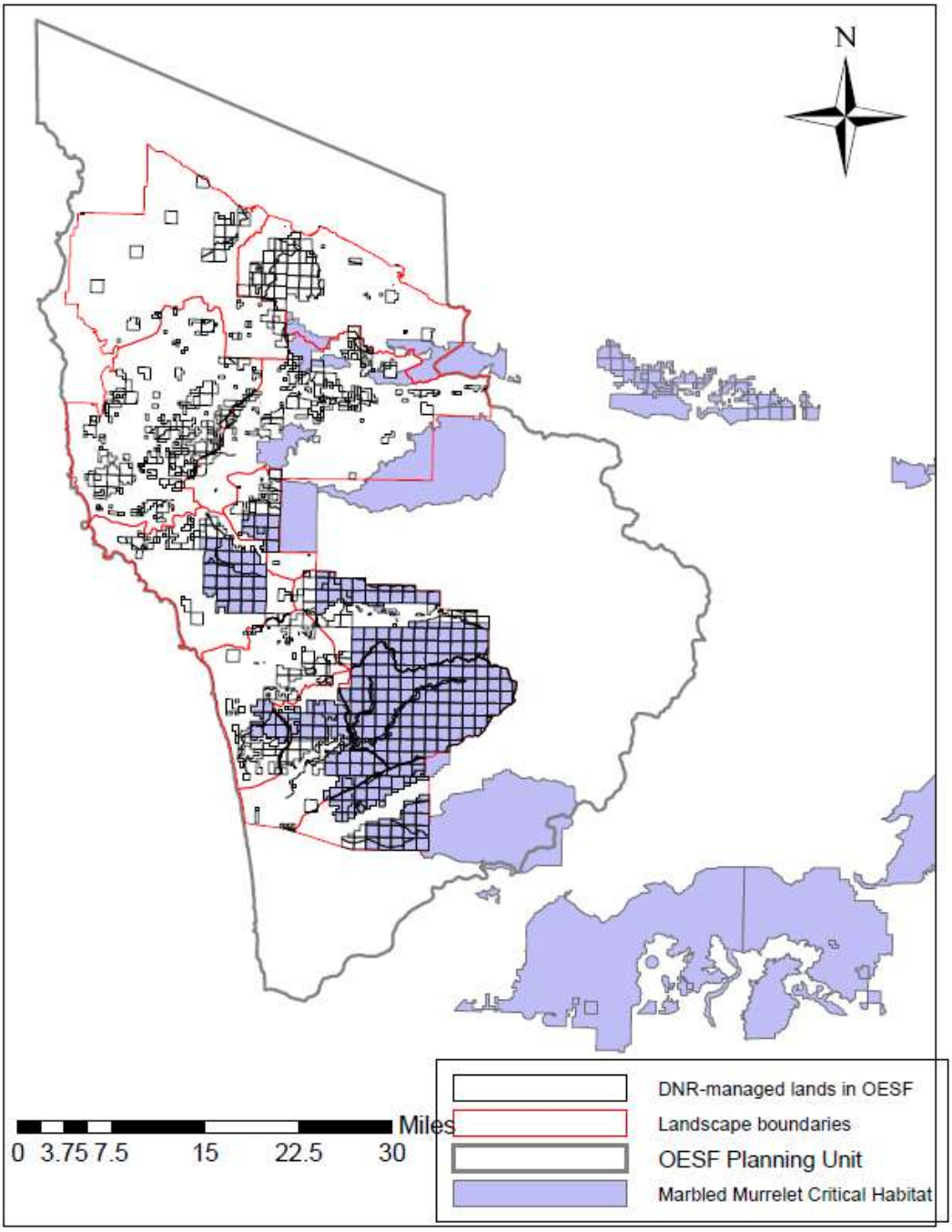


Figure 9. Marbled murrelet critical habitat in the OESF

e. Major Threats

In the listing decision, the USFWS recognized habitat loss as the major factor causing the decline of marbled murrelet populations (Federal Register 57, FR 45328). Threats associated with loss of nesting habitat include the following (Divoky and Horton 1995):

- A decrease in the proportion of the population that is able to reproduce due to reduced nest site availability.
- A decrease in the population's reproductive rate because of the inability of displaced adult breeders to locate new nest sites after their previous sites have been destroyed.
- Fragmentation of existing habitat, which increases nest site predation, deleteriously alters nest site microclimates and isolates portions of the population, leading to increased vulnerability to genetic and environmental changes.

Loss of murrelet nesting habitat as a result of timber harvest on both private and public lands in Western Washington accelerated between 1949 and 1970. Most of this harvest was old-growth forest (USFWS 1997 Recovery Plan). A dramatic decline in logging of older forests occurred at the federal level in the late 1980's and early 1990s since the murrelet and spotted owl listings and adoption of the Northwest Forest Plan. Marbled murrelet habitat losses on Federal lands in Washington, Oregon and California from 1994 to 2003 represented only 1.5% of total nesting habitat on Federal land (Raphael 2006). The majority of that was due to fire and a small percentage was a result from timber harvest. On non-federal lands in the three states, Raphael et al. (2006) estimated about 12%, of higher-suitability nesting habitat has been lost because of timber harvest from 1994 to 2003.

The major at-sea threats to the marbled murrelet include oil spills and commercial fisheries (direct kills and indirect adverse effects through depletion of food resources).

Although still a major concern, threats from oil spills have been reduced in most areas since the 1990s through increased regulation (McShane et al. 2004) and continue to be a small-scale local threat according to the 2009 status review (USFWS 2009).

A detailed assessment of the potential impacts to marbled murrelets in Washington State from gill-net and purse seine fisheries was conducted by McShane et al. (2004). There is sufficient information to indicate that the number of marbled murrelets killed in gill nets for tribal and non-treaty fisheries has declined since the 1980s as a result of increased restrictions and reduced fishing. In general, fishing efforts in northern and western Washington decreased five- to ten-fold between the 1980s and the late 1990s because of lower catches, fewer fishing vessels, and greater restrictions (McShane et al. 2004).

Forage fish abundance has declined indirectly through the effect of climate change on macro-zooplankton abundance and directly through fishing practices (Peery et al. 2004a, Norris et al. 2007). Therefore, it is assumed that marbled murrelets are limited by feeding conditions at sea. This hypothesis was validated by recent trophic level studies (Peery et al. 2004a, Norris et al. 2007). The results indicate a need for more research to further investigate factors influencing the quality of the marine habitat in which marbled murrelets feed.

3. Current DNR policies and procedures guiding Marbled Murrelet Conservation in the OESF

a. Policy for Sustainable Forests

The main policies in the 2006 Policy for Sustainable Forests that affect marbled murrelet conservation in the OESF are the Policy on Wildlife Habitat and the Policy on Old-Growth Stands in Western Washington. Biodiversity is recognized as "the fundamental guiding principle for sustainable forest management" and implementation of the HCP is expected to "provide habitat conditions that, over time, have the capacity to sustain native wildlife populations and communities" across forested landscapes. DNR defers from harvest old-growth stands (stands larger than 5 acres that originated naturally before the year 1850) and retains "known very large diameter, structurally unique trees". The Silviculture Strategy Policy directs DNR to target 10-15% of each Westside HCP planning unit in older forest conditions over time.

b. HCP Marbled Murrelet Interim Conservation Strategy

At the time of the development of the HCP, very limited information on marbled murrelet biology, ecology, and population trends was available to DNR. The department adopted an interim conservation strategy designed to protect the marbled murrelet habitat on DNR-managed lands while participating in collection of the information needed to develop a long-term strategy.

The Marbled Murrelet Interim Conservation Strategy described in the HCP (WADNR 1997, pp. IV.39-45) directed DNR to complete research necessary to the development of the LTCS and involved five main steps. First, DNR identified and deferred harvest of any part of a block of suitable marbled murrelet habitat. Second, within each of the South Coast, Columbia, OESF, and Straits Planning Units, DNR conducted a two-year habitat relationship study to determine the relative occupancy of forest types used by marbled murrelets. Third, after the habitat relationship studies were completed in these planning units, DNR built predictive models to identify the marginal habitat expected to comprise a maximum of 5% of the sites occupied by marbled murrelets on DNR-managed lands within each planning unit (Prenzlow Escene 1999). Marginal habitat types were made available for harvest as described under the incidental take permit. (USFWS authorized harvest of these acres in the incidental take permit.) All acreage constituting the higher quality habitat types, as identified by predictive habitat models (comprising 95% of the occupied sites), was included in a one-time inventory survey using protocols approved by the Pacific Seabird Group to locate occupied sites. All known occupied sites were protected.

Fourth, outside of southwest Washington (SWWA), surveyed, unoccupied habitat was made available for timber harvest if it was not located within 0.5 miles (0.8 kilometers) of an occupied site. After harvest, 50% of the suitable habitat on DNR-managed lands in each Watershed Administrative Unit (WAU) was designated to remain until the

completion of the LTCS. All known occupied sites in each planning unit were protected and any additional occupied sites found during the implementation of the Interim Conservation Strategy were protected.

Additionally, while these steps were being implemented, DNR participated in cooperative regional research efforts to further investigate the biology and ecology of the marbled murrelet. These research projects included:

- Marine surveys to document distribution and population size (Thompson 1999, Lance and Pearson 2005).
- Examination of factors affecting nest success (Marzluff et al. 1999, Marzluff et al. 2000).
- Nest predation studies (Luginbuhl et al. 2001, Bradley and Marzluff 2003).
- Analyses of temporal variability and landscape-level relationships of inland activity by marbled murrelets (Raphael et al. 2002a, 2002b, 2006).
- Development of habitat-based population models as a tool to evaluate conservation planning (Horton 2008).

The information collected during these studies and other research efforts will be used to develop and inform the development of the long-term conservation strategy for the marbled murrelet.

c. 2008 Scientific Report

The first phase of development of the long-term conservation strategy resulted in publishing a scientific report which analyzes habitat conservation and population biology of marbled murrelets and provides a set of recommendations for DNR to consider when developing long-term strategy (WADNR 2008). The report recommends unique conservation plans for each HCP planning unit.

The conservation approach suggested for the OESF takes into account land ownership allocations and existing conservation regulations. The OESF planning unit includes a considerable amount Federal lands and the majority of the suitable murrelet habitat is concentrated on these lands. Most of DNR-managed lands in the planning unit are in the low-elevation Sitka spruce vegetation zone. In addition to protecting existing high-quality murrelet habitat and known occupied sites, DNR could contribute to the federal recovery goals by broadening the ecological distribution of the species (i.e. increasing the number of forest types occupied by murrelets). This contribution will be realized by restoring habitat capability in key areas through active forest management. The report recommended different conservation approaches for the 11 landscape planning units. The approaches differ in their level of reliance on murrelet driven management versus management driven by other HCP conservation strategies (spotted owl and riparian).

The 2008 Scientific Report proposed and demonstrated methods to assess the potential of current and projected murrelet habitat to support populations of marbled murrelets. The goal of the analyses was to present objective, repeatable, quantitative comparisons of current and projected habitat on DNR managed lands and to illustrate potential responses

of marbled murrelets to current and projected habitat using the index of carrying capacity. (WADNR 2008, ES-22)

d. DNR procedures for protecting Marbled Murrelet Habitat

The 1999 Forestry Handbook procedure PR-14-004-320 applies to all west-side forested ecosystems covered by the HCP, including the OESF Planning Unit. It restricts all management activities that will negatively impact suitable marbled murrelet habitat….

e. DNR procedures on old-growth harvest deferral and protection; management of structurally unique trees; and management of forest stand cohorts (Westside) (PR 14-004-045, PR 14-004-046, and PR 14-006-090)

The procedures provide direction for: the identification of old-growth stands on westside forested state trust lands, including the OESF; harvest deferral and further protection of old-growth stands; specifications for cohort management with ecological objectives for developing structurally diverse stands; and management of structurally complex stands to achieve older forest characteristics with target amounts for each planning unit.

4. Criteria for assessing the effects of forest management on marbled murrelet conservation

The U.S. Fish and Wildlife Service's (USFWS) *Recovery Plan for the Threatened Marbled Murrelet* (*Brachyramphus marmoratus*) *in Washington, Oregon, and California* (USFWS 1997) described two principal strategic goals for marbled murrelet recovery:

1. "to stabilize and then increase population size, changing the current downward trend to an upward (improving) trend throughout the listing range" and
2. "to provide conditions in the future that allow for a reasonable likelihood of continued existence of viable populations" (p. 112).

These goals are consistent with widely recognized principles of conservation biology and were intended to provide conditions that enable the species to persist through chronic and catastrophic events. DNR defined its goal in the HCP to contribute to the USFWS recovery objectives and "…*make a significant contribution to maintaining and protecting marbled murrelet populations in western Washington over the life of the HCP"* (DNR 1997a. p. IV.44). In its 2008 report (WADNR 2008), the Science Team used USFWS's (1997) two recovery principles and adopted biological goals that reflect those principles at a scale appropriate to the abundance and distribution of DNR-managed forestlands in Washington. The Science Team recommends that DNR manage forest habitat to contribute to the following three biological goals: a stable or increasing population, an increasing geographic distribution, and thus a population that is resilient to disturbances.

These biological goals could be used as criteria for assessing the impact of proposed DNR land management activities on murrelet conservation in the OESF.

5. Indicators for assessing the effects of forest management on marbled murrelet conservation

Because DNR manages forestland and not wildlife, the agency is able to contribute to the USFWS recovery plan and population goals for the marbled murrelet through the maintenance and creation of nesting habitat. It is recognized that marbled murrelet conservation is largely affected by ocean conditions. However, given the state trust lands allocation, DNR management is restricted to only the terrestrial portion of habitat.

Two sets of indicators can be used for the evaluation of current and future murrelet nesting habitat:

1) Habitat indicators - amount, quality, and distribution of nesting habitat as described in the HCP interim conservation strategy, and;

2) Population based indicators - index of the capability of forest habitat to support nesting marbled murrelets. The index integrates habitat abundance, stand level quality, and negative edge effects. This habitat assessment approach was proposed and demonstrated in the 2008 Science Report (WADNR 2008).

a. Habitat indicators described in the HCP interim strategy

The interim HCP strategy outlined basic steps to identify potential murrelet habitat (DNR 1997, p. IV.39). Those four steps are:

1. Identify and defer from harvest any part of a block of suitable habitat for the marbled murrelet.
2. Complete habitat relationship studies to determine the relative importance, based on occupancy by marbled murrelets, of the various habitats.
3. After the habitat relationship studies are completed, make available for timber harvest the lowest quality habitats, which are expected to contain a maximum of 5% of the occupied sites. All known occupied sites will be protected.
4. Survey for marbled murrelet occupancy by in the higher quality habitat areas identified from the habitat relationships study; certain unoccupied habitats would then become available for timber harvest. Occupied habitat and some unoccupied habitat would be protected.

The habitat relationship study predictive model (Prenzlow-Escene 1999) did not identify all high-quality habitat (termed reclassified habitat) that was to be surveyed in the inventory surveys. This issue was addressed by an inspection of color orthophotos (dated 2005 for OESF), and supplemented by limited field verification. During the orthophoto inspection, the delineation of occupied sites was evaluated, and the condition of marbled

murrelet non-habitat, marginal habitat, and reclassified habitat was evaluated. The "reclassified habitat" category in DNR datasets reflects these adjustments.

The OESF inventory surveys were almost 75% complete in 2002 and were discontinued because USFWS and DNR deemed it reasonable and efficient to enter into the LTCS process with the results available at the time (USFWS/DNR Letter of Concurrence, April 8, 2003). Within the OESF, approximately 39,000 acres (15,800 hectares) of reclassified habitat were surveyed, while approximately 15,000 acres (6,100 hectares) remain unsurveyed. Marbled murrelets were detected at 92% of the survey sites in the OESF, and occupied behaviors were observed at 52% of the sites where they were detected.

After completing the process described above, DNR created a GIS layer named "Marbled Murrelet HCP Policy", which delineates murrelet habitat types and their spatial configuration in the OESF. This dataset could be used to assess current and future amount, quality, and distribution of murrelet habitat. The analyses can be performed at various spatial scales.

b. Population based indicators

The index of the capability of forest habitat to support marbled murrelets incorporates four elements of marbled murrelet relationships with forest habitat (2008 Science Report, p. 4-2):

- Broad-scale correlation of numbers of marbled murrelets to area of habitat
- The gradient in habitat quality caused by variation in stand structure and composition
- The apparent reduction in habitat quality by edge effects
- The influence of distance from their marine habitat

After a critical review of the existing research (see Section 5 of 2008 Science Report), the Science Team used the following assumptions to develop the index:

- The carrying capacity is approximately 170 acres of potential nesting habitat per marbled murrelet.
- Habitat quality of each forested stand was assessed based on two structural characteristics – tree platforms and canopy complexity. DNR FRIS inventory provided the source data, from which these characteristics were derived (neither parameter was directly measured during field inventory). The habitat quality, expressed as probability of occupancy was linked to the description of stand development stages (Carey et al. 1996, Brodie et al. 2004) and each development stage was attributed a predicted probability of occupancy.
- Based on the observed relationship of diminished nest success with stand edges (Manley and Nelson 1999), a discount factor was used to modify the predicted contribution of edge-influenced habitat. Non-forest, non-conifer and early-seral conifer were considered "edge-creating" categories.

- Finally, the influence of the distance between inland habitat and marine foraging areas was reflected by an arbitrary discount factor for stands more then 40 miles from marine waters (not applicable to the OESF).

These assumptions were expressed as mathematical relationships among area, structure, composition, and context of forest stands across the planning area to predict the capability of current and projected habitat to support marbled murrelet populations. However, the index should not be considered an explicit prediction of current or future marbled murrelet numbers; rather, it should be viewed as an objective, repeatable, qualitative index that can be used to judge relative conservation values of DNR-managed lands as well as all other lands across the planning area.

After developing the integrated index following the process described above, DNR created a GIS layer, identifying each forested stand on state lands in the OESF according to its capability to support murrelets. The index (K') is expressed in "marbled murrelet units". The dataset can be used for analyses at various spatial scales.

6. Current marbled murrelet habitat conditions in the OESF

Currently there are three DNR datasets representing murrelet habitat conditions in the OESF:

- **Marbled Murrelet HCP Policy** - a dataset developed as part of and to implement the HCP Interim Conservation Strategy.
- **Marbled Murrelet Planning** – a dataset developed as part of the 2008 Science Report to illustrate the recommended approach for the Long-Term Conservation Strategy.
- **Woodstock Model (Phase 3b) - Marbled Murrelet p(occ) class** – a dataset developed for the OESF Forest Land Plan estate model. Each forest stand is assigned a probability of occupancy index and, according to this value, the stands are grouped in 5 habitat classes.

Detailed description of each dataset is provided in Appendix B.

a. Habitat conditions according to the Marbled Murrelet HCP Policy dataset

Marbled murrelet habitat categories, as defined through the HCP Interim Strategy, are described in Table 5.

Table 5. Marbled murrelet habitat categories in the HCP Policy dataset

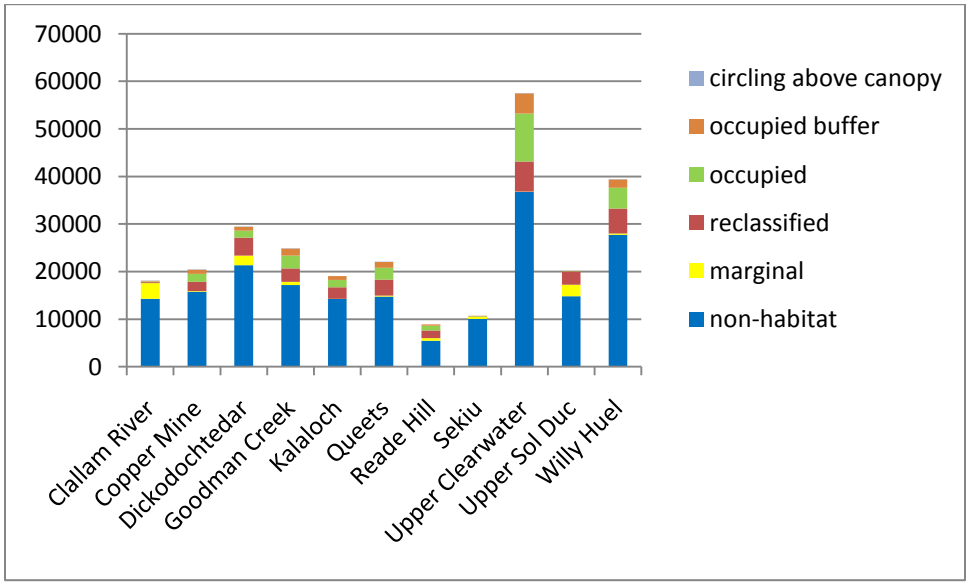
Habitat Term	**Definition**
Marginal habitat	Identified by Step Two of the Marbled Murrelet Interim Conservation Strategy (DNR 1997a) through the use of a habitat relationship study predictive model (Prenzlow Escene 1999). Defined as those lands expected to contain a maximum of five percent of the occupied sites on DNR-managed lands within each planning unit. These areas were made available for harvest. All known occupied sites were deferred from harvest, and were not included in this habitat designation.
Reclassified Habitat	Identified by Step Two of the Marbled Murrelet Interim Conservation Strategy (DNR 1997a) through the use of a habitat relationship study predictive model (Prenzlow Escene 1999). This high-quality habitat **(**in contrast to marginal habitat) is defined as those lands expected to contain at least 95% of the occupied sites on DNR-managed lands within each planning unit.
Occupied Site Occupied buffer Circling above canopy	A "contiguous area of habitat" where at least one of the following marbled murrelet behaviors occur (Evans Mack et al. 2003): 1. A nest is located; 2. Downy chicks or eggs or egg shells are found; 3. Marbled murrelets are detected flying below, through, into or out of the forest canopy; 4. Birds are calling from a stationary location within the area; or 5. Birds are circling above a stand within one tree height of the top of the canopy. A <u>contiguous area of habitat</u> is a minimum 5 acre block of habitat, to a maximum of 1.5 miles from the "point-of-occupancy," but confined to contiguous habitat. Once a 5 acre area whose characteristics meet the criteria of habitat is identified, all adjoining acres that also contain such criteria would be included in the suitable habitat block until there is a 300-foot or wider "break" (an area that does not meet the criteria) that completely encircles the block (DNR 1997a, p. IV.41). A <u>point of occupancy</u> is the point location where behavior or conditions indicating occupancy occurred.

The acreage of habitat categories per LPU are presented on Table 6 and illustrated on the figure beneath the table.

Source data: *SHARED_LM.MM_POLICY*
Located at ROPA.SHARED_LM.MM_POLICY

Table 6. Marbled murrelet habitat categories (acres) per LPU according to dataset *Marbled Murrelet HCP Policy*

LPU	DNR-managed	non-habitat	marginal	reclassified	occupied	occupied buffer	circling above canopy
Clallam River	18043	**14305**	3285	180	121	124	28
Copper Mine	20455	**15771**	102	1949	1716	892	25
Dickodochtedar	29427	**21326**	2021	3747	1519	771	43
Goodman Creek	24861	**17164**	657	2850	2689	1475	25
Kalaloch	19047	**14269**	14	2383	1565	816	0
Queets	22048	**14721**	241	3317	2531	1174	64
Reade Hill	8869	**5458**	524	1622	995	270	0
Sekiu	10700	**10072**	417	121	41	48	0
Upper Clearwater	57467	**36766**	12	6381	10052	4253	3
Upper Sol Duc	20058	**14783**	2463	2724	46	41	0
Willy Huel	39369	**27721**	266	5279	4359	1733	11
Total	**270343**	**192358**	**10003**	**30553**	**25634**	**11598**	**198**



b. Habitat conditions according to the Woodstock model

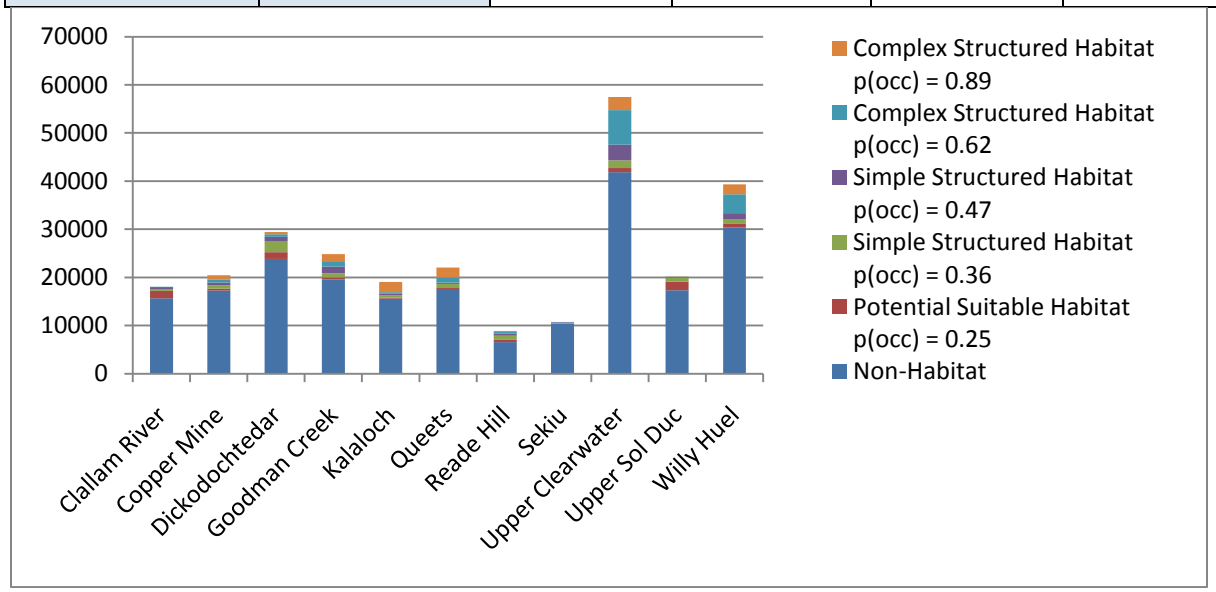
The acreage of habitat categories (defined through the probability of occupancy) per LPU are presented on Table 7 and illustrated on the figure beneath the table.

Source data: *Woodstock Results DEIS 10162009.lyr*

Located at: \\snarf\am\gis_shared\Shared Map Layers\Division - Land Management\OESF\Woodstock Model\Forest Conditions

Table 7. Marbled murrelet habitat (acres) per LPU according to dataset *Woodstock Model (Phase 3b) - Marbled Murrelet p(occ) class*

LPU	DNR managed (LDO)	Non-Habitat	Potential Suitable Habitat p(occ) = 0.25	Simple Structured Habitat p(occ) = 0.36	Simple Structured Habitat p(occ) = 0.47	Complex Structured Habitat p(occ) = 0.62	Complex Structured Habitat p(occ) = 0.89
Clallam River	18043	15691	1498	421	374	59	
Copper Mine	20455	17282	352	731	576	681	833
Dickodochtedar	29427	23875	1391	2286	898	488	489
Goodman Creek	24861	19602	401	819	1456	1117	1467
Kalaloch	19044	15588	209	454	316	372	2105
Queets	22048	17586	177	865	297	1033	2091
Reade Hill	8869	6573	471	850	448	501	26
Sekiu	10700	10442	44	88	84	43	
Upper Clearwater	57467	41847	873	1600	3234	7194	2719
Upper Sol Duc	20058	17314	1786	826	128	2	1
Willy Huel	39330	30324	882	831	1330	3925	2038
Total	**270302**	**216124**	**8084**	**9771**	**9141**	**15415**	**11769**



Other conservation strategies, specifically the northern spotted owl and riparian strategy as well as unstable slopes protection, are expected to provide murrelet nesting habitat and thus support the murrelet conservation goals. In fact, the Science Team recommended that murrelet conservation in two LPUs (Upper Clearwater and Willy Huel) rely entirely on existing policies and procedures and that management in another 6 LPUs is guided by a mix of existing conservation strategies and murrelet conservation measures (WADNR 2008, p. 3-37). As already mentioned in the spotted owl section above, the contribution from riparian buffers should be assessed carefully as it could lead to a high level of landscape fragmentation.

7. Natural disturbances impacting marbled murrelet habitat in the OESF

a. Windthrow

b. Landslides

c. Wildfire

d. Forest health

8. Potential impact from DNR land management activities

a. Timber harvesting

Timber harvest resulting in habitat removal has negative effects on murrelets through direct loss of habitat and through increase in forest fragmentation.

Five independent radar studies from British Columbia and one from the Olympic Peninsula, Washington, reported significant correlations between the numbers of marbled murrelets entering watersheds and existing areas of suitable habitat (Schroeder et al. 1999, Burger 2001, 2002, Raphael et al. 2002a, Raphael et al. 2002b, Steventon and Holmes 2002, Burger et al. 2004). Radar counts from these studies show strong positive correlations with the amount of nesting habitat available at the drainage scale (Raphael 2006). Burger (2001) showed reduced populations in watersheds subjected to intensive logging and concluded that marbled murrelets did not nest in higher densities within remaining old forest stands.

The forest fragmentation impacts on marbled murrelets include alteration of microclimate at nest sites and increases in predation rates. Malt and Lank (2007) found that sites at timber harvest edges (both clear-cuts and regenerating forests) had lower moss abundance than interior sites and natural edge sites (stream corridors and avalanche chutes) due to stronger winds, higher temperature variability and lower moisture retention when compared with interior sites. Burger (2002) found that marbled murrelets are more likely to select suitable nest trees and stands with high rates of lichen and bryophyte growth. Malt and Lank (2007) also found that predation rates were the highest at edge sites adjacent to clear-cuts and low at sites adjacent to regenerating stands and natural edges, suggesting that predation rates may decline at forest edges as adjacent clearcuts regenerate over time. They found no difference in predation rates between natural forest edges, and interior sites.

The current interim HCP strategy requires harvest deferrals of occupied sites and high-quality nesting habitat (termed reclassified habitat) until a long-term conservation strategy is developed.

The 2008 Scientific Report recommends restoring habitat capability in key areas through active management. In the OESF, these areas are mainly in the Sitka spruce vegetation zone and have the biophysical potential to develop murrelet nesting habitat. The enhancement of existing low-quality habitat and development of new habitat is envisioned through a combination of light thinning, heavy thinning and conversion while taking into consideration windthrow risk. When the index of habitat capability (K') was used to compare the effects of habitat development management vs "no management" scenarios, the modeling for the OESF projected slightly greater K' under "no management" scenario (WADNR 2008, p.5-12).

b. Roads and Recreation

McShane et al. (2004) indicated that noise disturbance may affect murrelet fitness and reproductive success, but further research was needed. New information presented in the 2009 status review does not tie observed negative effects of roads and camp sites directly to human disturbance, but further corroborates the tie of human presence to increased predation. Increased human presence is linked to increase in the abundance of corvids. Corvid species are the primary predator of murrelet nests (Raphael et al. 2002). Vehicular traffic noise appears to have little or no effect on murrelet nesting success (Hebert and Golightly 2006, Golightly et al. 2009). All of the new disturbance information is specific to the coastal redwood zone in California.

c. Land transactions

The policy on old-growth stands in Western Washington (WADNR 2006 p.35) states:

When in the best interest of the trust(s), the department will actively seek to transfer old-growth stands and areas containing very large diameter trees of high social or cultural significance out of trust status, when full market value compensation to the trust(s) is secured. In seeking to transfer such stands out of trust status, the department will immediately prioritize old-growth stands that are not subject to protection under DNR's *Habitat Conservation Plan* or other applicable regulations.

Unless the transfer is done under the condition that the stands continue to be managed under the HCP conservation strategies, the effect of the action will be a decrease in the amount of suitable murrelet habitat.

d. Wind energy facilities

In its 5-status review (USFWS 2009, summary), USFWS found that murrelets may be highly vulnerable in localized areas from energy development and production. This includes direct mortality from strikes, as well as loss of habitat and fragmentation, and impacts to reproductive success through changes in prey base, marine habitat and disturbance.
The threat(s) on-shore wind energy projects pose to murrelets may include direct mortality and habitat removal. …

Appendix 1
DNR DATASETS DESCRIBING CURRENT NSO HABITAT CONDITIONS IN THE OESF

4. Settlement Northern Spotted Owl Habitat Classes

The dataset was developed by Angus Brodie and Chris Snyder as part of and to implement the 2006 Settlement Agreement (*WEC vs. Sutherland*).

4.1. File name: NSO_HAB_SETL

4.2. Located at ROPA_SHARED.NSO_HAB_SETL

4.3. Created in March 2006 as part of the Settlement Agreement

4.4. Source data - OCT 2004 Forest Resource Inventory System (FRIS) dataset

4.5. Update status

4.5.1. No correction for harvest activities and inventory data since November 2004

4.5.2. No correction for the change of "disputed" stands to "non-habitat" as agreed by the Settlement Partners in 2007

4.5.3. DWD and snag parameters not projected from the sample year

4.6. Habitat definitions used to assess habitat conditions (see Table 1 for description of the definitions)

4.6.1. "Old Forest" - high quality habitat consisting of old-growth and mature forest types that provides all of the characteristics spotted owls need for nesting, roosting, foraging, and dispersing. It was determined through an aerial photographic interpretation and field reconnaissance procedure by Olympic region wildlife biologist (Scott Horton). While the HCP provided a structure-based definition for old forest owl habitat, it proved to be a poor match for the forests actually inhabited by spotted owls in the OESF. Instead, a subset of potential murrelet habitat (murrelet "category 1") proved to be a very good match with owl habitat. These stands were initially screened using a logistic regression model that predicted the probabilities of murrelet occupancy. Based on the predicted occupancy, coupled with field reconnaissance, these stands were further categorized using aerial photo interpretation. Old forest habitat classification encompasses the following habitat types (as described in the HCP): Old Forest, High Quality Nesting Habitat, Type A habitat, and Type B Habitat.

4.6.2. "Structural habitat" was determined using DNR's Habitat Conservation Plan (HCP) definition for sub-mature habitat (HCP.IV. 12) and DNR Forest Practices definition for young-forest marginal (WAC 222-16-085). Sub-mature habitat provides for all spotted owl requirements for foraging, roosting and dispersal, and young forest marginal type provides for some of these requirements. The

Structural Habitat definitions were screened against the November 2004 FRIS dataset.

4.6.3. "Disputed stands" were screen using DNR's Forest Practices definition for young forest marginal that used a 5 percent cover (equivalent to 2400 cubic feet per acre) for down woody debris instead of a 10 percent cover.

4.6.4. "Non-habitat" label was given to polygons that didn't meet all the criteria for any given habitat type

4.6.5. "Unknown" label was given to FRIS polygons that did not have FRIS sample data and are not classified as old forest using photo interpretation. Sample data was missing for the following reasons: polygon had not been FRIS sampled (only LULC data available); had been regeneration harvested within last 12 years; is a new land acquisition.

As forest stands can meet the threshold for more than one habitat definition, a hierarchy of quality was developed. The habitat quality hierarchy is as follows: 1) Old forest (mapped by Olympic Region biologist); 2) Type A; 3) Type B; 4) sub-mature; 5) young forest marginal; 6) disputed stands; 7) non-habitat; 8) unknown.

4.7. Missing or modified habitat parameters

Detailed table of the included parameters (created by Steve Curry) is located at \\snarf\am\ds\for_inv\curry\Data\1ProjData\2005\SomuHabitatConditDB_20060125\Documentation\

4.7.1. The following parameters have been modified from their original description in the HCP or WAC:

- 5% ground cover of DWD and the requirement of accumulation of fallen trees were substituted with 2400 cubic feet/acre

4.7.2. The following parameters were not included in the screen:

- canopy closure
- tree deformity requirements
- shrub cover

4.8. Landbase used for screening:

All FIU polygons within the OESF are included with total area of 270,749 acres.

5. **Northern Spotted Owl Habitat Classifications**

The dataset was developed by Christina Heimburg to aid in the implementation of the HCP Northern Spotted Owl Conservation Strategy and to comply with terms outlined in a Settlement Agreement that DNR entered in to in March 2006. This dataset is used by Olympic Region for forest management and by Ecosystem Services Section to report to the Federal Services.

5.1. File name: nso_habitat_200905_draft

5.2. Located at \\snarf\am\div_lm\ecosystem\ds\layers\nso_habitat\layer_files\OESF Northern Spotted Owl Habitat_200905.lyr

5.3. Created in May, 2009 for Settlement Partner's meeting

5.4. Source data - Oct. 2004 Forest Resource Inventory System (FRIS) dataset, New Inventory projects (since 2004), P&T, RIU_CURRENT (For age)

5.5. Update status

5.5.1. Updated for harvest activities and inventory data since May, 2009

5.5.2. The latest inventory data for East Hoh & West Hoh block is included

5.5.3. Correction for the change of "disputed" stands to "non-habitat" as agreed by the Settlement Partners in 2007

5.5.4. Slivers< 1 ac are merged with adjacent stands with which they share longest border

5.5.5. DWD and snag parameters not projected from the sample year

5.5.6. This is a work version was presented to the Settlement Partners' meeting in spring of 2009 but rejected as a replacement to the 2006 Settlement layer. It will be posted in ROPA_SHARED replacing the NSO_MGMT layer when underlying Python script is complete and will account for all new inventory, and harvest activities.

5.6. Habitat definitions used to assess habitat conditions

5.6.1. "Old Forest" was determined through an aerial photographic interpretation and field reconnaissance procedure by a Olympic region wildlife biologist (Scott Horton). Old forest habitat classification encompasses the following habitat types (as described in the HCP): Old Forest, High Quality Nesting Habitat, Type A habitat, and Type B Habitat.

5.6.2. "Structural habitat" was determined using DNR's Habitat Conservation Plan (HCP) definition for sub-mature habitat (HCP.IV. 12) and DNR Forest Practices definition for young-forest marginal (WAC 222-16-085). Sub-mature habitat provides for all spotted owl requirements for foraging, roosting and dispersal, and young forest marginal type provides for some of these requirements. The Structural Habitat definitions were screened against the Oct. 2004 Forest Resource Inventory System (FRIS) dataset.

5.6.3. "Non-habitat" label was given to polygons that didn't meet all the criteria for any given habitat type

5.6.4. "Unknown" label was given to FRIS polygons that did not have FRIS sample data and are not classified as old forest using photo interpretation. Sample data was missing for the following reasons: polygon had not been FRIS sampled (only LULC data available); had been regeneration harvested within last 12 years; is a new land acquisition. This also includes stands <25years of age, but is coded differently in the NSO_HAB_CD attribute as "XU"

As forest stands can meet the threshold for more than one habitat definition, a hierarchy of quality was developed. The habitat quality hierarchy is as follows: 1) Old forest (mapped by Olympic Region biologist); 2) Type A; 3) Type B; 4) sub-mature; 5) young forest marginal; 6) non-habitat; 7) unknown.

5.7. Missing or modified habitat parameters

Detailed table of the included parameters is located in Appendix A of the NSO Habitat Layer Core Document Final at http://sharepoint/divisions/lm/Settlement%20Agreement%20Documents/Forms/AllItems.aspx

5.7.1. The following parameters have been modified from their original description in the HCP or WAC:

- 5% ground cover of DWD and the requirement of accumulation of fallen trees were substituted by 2400 cubic feet/acre; 10% substituted with 4800 cubic feet/acre
- Canopy closure of 70% was substituted with RD=48
- The provision for at least 2 canopy layers or 115-280 tpa is replaced with the tpa requirement only

5.7.2. The parameters not included in the screening:

- tree deformity requirements
- shrub cover

5.8. Landbase used for screening:

All FIU polygons within the OESF are included with total area of 270,825 acres.

6. Woodstock Model (phase 3b)– Current Northern Spotted Owl Habitat Conditions

The dataset was created by Weikko Jaross for the OESF Forest Land Plan estate model.

6.1. File name: Woodstock Results DEIS 10122009.lyr

6.2. Located at: \\snarf\am\gis_shared\Shared Map Layers\Division - Land Management\OESF\Woodstock Model\Forest Conditions\Woodstock Results DEIS 10122009.lyr

6.3. Data location, format and content are subject to change! The latest update is from October 12, 2009.

6.4. Source data – FRIS sample data grown through FVS to current date and Large Data Overlay (LDO) from February 2009

6.5. Update status

6.5.1. Harvest activities are updates as of September 2009.

6.5.2. The category “disputed” stands is not considered in this habitat assessment. DWD and snag parameters are projected from the sample to the current year using customized model based on the FVS’ Fire and Fuel Extension

6.6. Habitat definitions used to assess habitat conditions

6.6.1. “Old Forest” was determined through interpreting (querying) the FVS inventory projections for Type A and Type B definitions as provided in PR 14-004-120 (OESF HCP + Settlement Agreement). The Old Forest classification is determined through 1) aerial photographic interpretation and 2) the habitat status of all other forested acres is determined by interpreting (querying) the FVS inventory projections (sample data grown through FVS to current date) for Type A and Type B definitions and, if designated as such, added to the photo delineated stands.

6.6.2. “Structural habitat” was determined by interpreting (querying) the FVS inventory projections for “structural habitat” definitions as provided in PR 14-004-120 (OESF HCP + Settlement Agreement). The Structural Habitat definitions were screened against the current year forest conditions as projected from the sample FRIS inventory.

6.6.3. "Non-habitat" label was given to polygons that didn't meet all the criteria for any given habitat type

6.6.4. There is no “Unknown" category – in the absence of FRIS data, the polygons are assigned to one of the above three categories based on stratified data. The stratification process was developed by Weikko Jaross (stands are assigned to yield table stratum based on site class, primary + secondary species, and relative stocking). NSO habitat indicators such as top height, Curtis relative density, etc. are averaged across each stratum (simple mean). The habitat status of each stratum is determined by interpreting (querying) the simple means of habitat indicators (yields) for Type A and Type B, and structural definitions as provided in PR 14-004-120 OESF HCP + Settlement Agreement.

The habitat types (A, B, and YFM habitat types are not shown in this dataset).

6.7. Missing or modified habitat parameters

6.7.1. The following parameters have been modified from their original description in the HCP or WAC:

- 5% ground cover of DWD and the requirement of accumulation of fallen trees were substituted by 2400 cubic feet/acre
- Canopy closure of 70% was substituted by RD=48
- The provision for at least 2 canopy layers or 115-280 tpa is replaced with the tpa requirement only

6.7.2. The parameters not included in the screen:

- shrub cover
- tree deformity requirements

6.8. Land base used for screening:

Only the forested polygons specified by the LDO field "cover type" as 41 and 42 are included. It excludes roads and small water bodies. As a result, the total area is less than the land base in the previous two layers – 261,950 acres.

Table 1. Definitions of Northern Spotted Owl Habitat Types

	Old Forest Habitat		Structural Habitat	
Stand parameters\ Habitat type	Type A *(HCP IV.11)*	Type B *(HCP IV.11)*	Sub-mature *(HCP IV.12)*	Young Forest Marginal *(Procedure14-004-120, modified from WAC 222-16-085)*
Species composition	Multispecies canopy	Multispecies canopy	At least 30% conifers	At least 30% conifers
Canopy closure	Greater than 70%	Greater than 70%	At least 70%	At least 70%
Canopy layers	At least 2 of at least 2 species	At least 2 of at least 2 species	-	-
Tree density	Canopy dominated by 15-75 trees ≥30" DBH	Canopy dominated by 75-100 trees ≥20" DBH	115-280 tpa	115-280 tpa
Tree height	-	-	Dominant and co-dominant ≥ 85 ft	Dominant and co-dominant ≥ 85 ft
Large tree deformities	High incidence of broken tops, large cavities, dwarf mistletoe*****	Some with various deformities*****	-	-
Snags	At least 2/ac ≥30" DBH	At least 1/ac ≥20" DBH	At least 3/ac ≥20" DBH	At least 2/ac ≥20" DBH
Large DWD	Large accumulation of fallen trees	Accumulation of fallen trees	5% ground cover	10% ground cover with 20-65% shrub cover*****
Shrub cover	-	-	-	

***** Not included in the query

Table 2. NSO habitat amount per LPU according to dataset *"Settlement Northern Spotted Owl Habitat Classes "*

LPU	DNR-managed	Old Forest		Structural Habitat (Young Forest Habitat)		Disputed Stands		Non-Habitat		Unknown	
	acres	acres	%	acres	%	acres	%	acres	%	acres	%
CLALLAM RIVER	18,305	0	0	1,993	10.9	1,602	8.8	12,325	67.3	2,386	13.0
COPPER MINE	20,454	2,884	14.1	770	3.8	603	2.9	13,510	66.1	2,687	13.1
DICKODOCHTEDAR	29,405	2,432	8.3	3,855	13.1	889	3.0	18,801	63.9	3,428	11.7
GOODMAN CREEK	24,860	4,197	16.9	1,862	7.5	417	1.7	12,493	50.3	5,891	23.7
KALALOCH	19,207	2,351	12.2	565	3	106	0.6	8,568	44.6	7,617	39.7
QUEETS	22,048	4,817	21.9	1,015	4.6	765	3.5	12,367	56.1	3,083	14.0
READE HILL	8,889	1,445	16.3	1,615	18.2	483	5.4	4,451	50.1	895	10.1
SEKIU	10,688	33	0.3	368	3.4	389	3.6	7,712	72.2	2,188	20.5
UPPER CLEARWATER	57,467	14,784	25.7	2,029	3.5	982	1.7	31,121	54.2	8,551	14.9
UPPER SOL DUC	20,047	206	1	2,022	10.1	1,898	9.5	13,510	67.4	2,411	12.0
WILLY HUEL	39,377	7,332	18.6	1	0	0	0.0	274	0.7	31,771	80.7
Total	**270,749**	**40,481**		**16,093**		**8,134**		**135,133**		**70,908**	

Source data: *SHARED_LM.NSO_HAB_SETL*

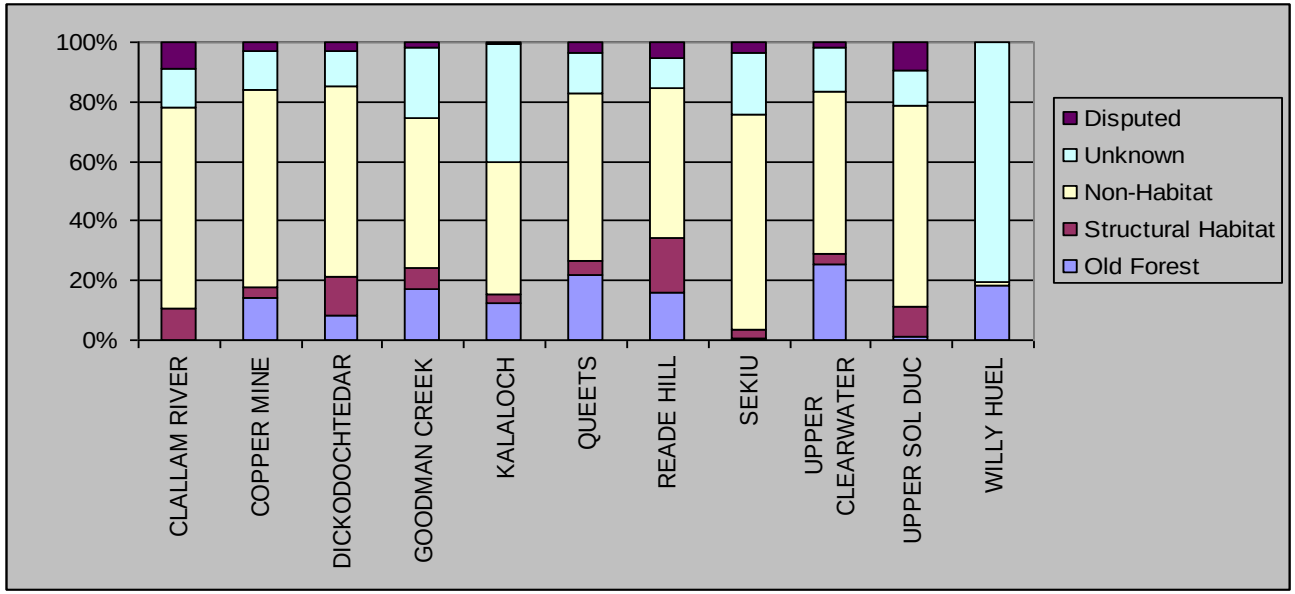


Table 3. NSO habitat amount per LPU according to dataset *"Northern Spotted Owl Habitat Classifications"*

LPU	DNR-managed	Old Forest		Structural Habitat (Young Forest Habitat)		Non-Habitat		Unknown	
	ac	ac	%	ac	%	ac	%	ac	%
CLALLAM RIVER	18,305	0	0	1,931	10.5	14,055	76.8	2,320	12.7
COPPER MINE	20,453	2,879	14.1	744	3.6	14,135	69.1	2,695	13.2
DICKODOCHTEDAR	29,406	2,433	8.3	3,779	12.9	19,809	67.4	3,385	11.5
GOODMAN CREEK	24,862	4,205	16.9	1,800	7.2	13,657	54.9	5,199	20.9
KALALOCH	19,206	2,351	12.2	1,365	7.1	14,319	74.6	1,171	6.1
QUEETS	22,049	4,809	21.8	840	3.8	13,310	60.4	3,084	14.0
READE HILL	8,889	1,443	16.3	1,553	17.5	4,998	56.2	894	10.1
SEKIU	10,689	6	0.1	367	3.4	8,126	76.0	2,190	20.5
UPPER CLEARWATER	57,468	14,768	25.7	1,933	3.4	33,127	57.6	7,640	13.3
UPPER SOL DUC	20,047	207	1	1,961	9.8	15,492	77.3	2,387	11.9
WILLY HUEL	39,451	7,331	18.6	2,379	6	28,536	72.3	1,204	3.1
Total	**270,825**	**40,433**		**18,651**		**179,565**		**32,169**	

Source data: *\\snarf\am\div_lm\ecosystem\ds\layers\nso_habitat\nso_habitat.gdb\nso_habitat_200905_draft*

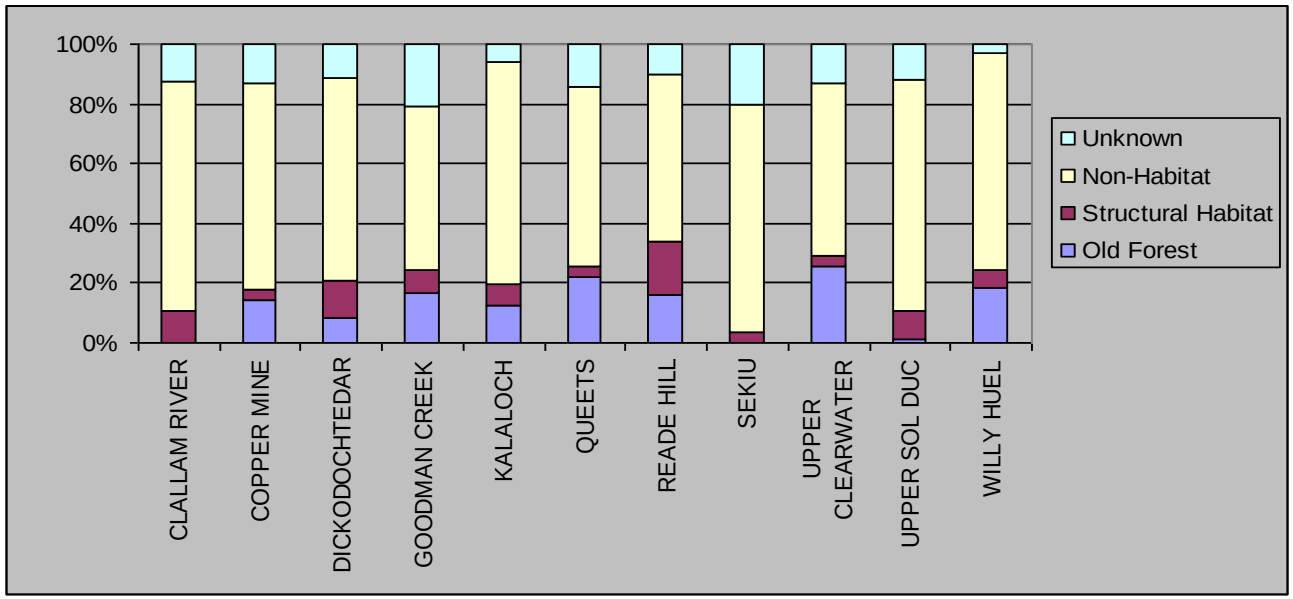
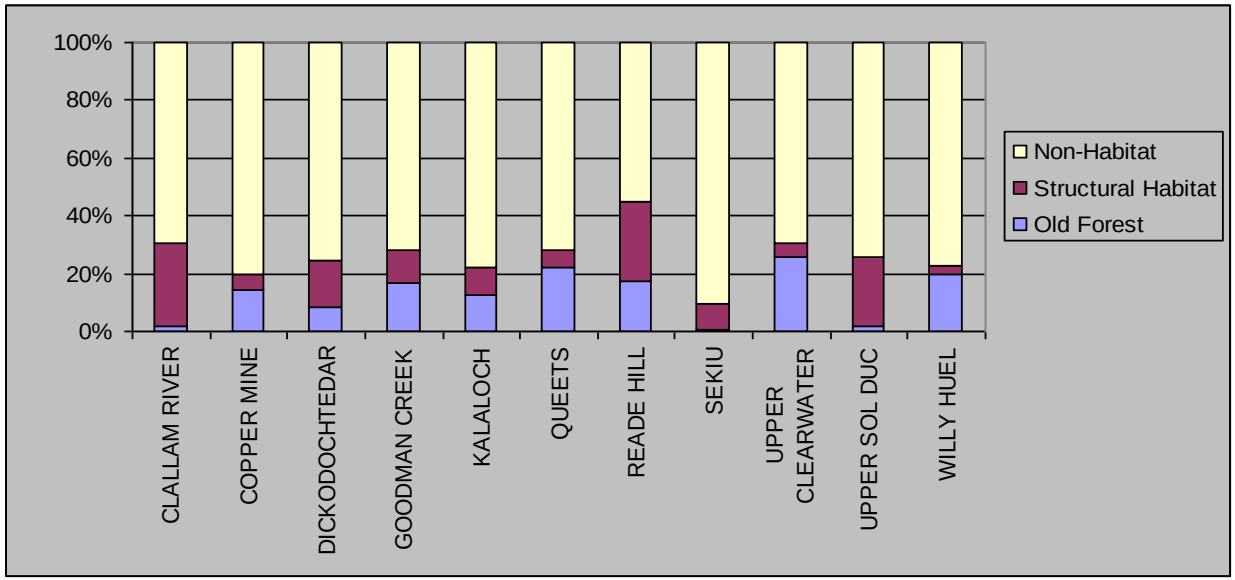


Table 4. NSO habitat amount per LPU according to dataset *"Woodstock Model – Current NSO Habitat Conditions"*

LPU	DNR-managed (LDO)	Old Forest		Structural Habitat (Young Forest Habitat)		Non-Habitat	
	acres	acres	%	acres	%	acres	%
CLALLAM RIVER	17910	307	1.7	5109	28.5	12494	69.8
COPPER MINE	19458	2844	14.6	975	5.0	15639	80.4
DICKODOCHTEDAR	28512	2442	8.6	4617	16.2	21453	75.2
GOODMAN CREEK	24638	4182	17.0	2756	11.2	17700	71.8
KALALOCH	18723	2322	12.4	1797	9.6	14604	78.0
QUEETS	21259	4731	22.3	1219	5.7	15309	72.0
READE HILL	8703	1510	17.4	2420	27.8	4773	54.8
SEKIU	10231	44	0.4	906	8.9	9281	90.7
UPPER CLEARWATER	55807	14534	26.0	2436	4.4	38837	69.6
UPPER SOL DUC	19555	358	1.8	4672	23.9	14525	74.3
WILLY HUEL	37154	7322	19.7	1132	3.0	28700	77.2
Total	**261951**	**40596**		**28039**		**193316**	

Source data: *Woodstock Results DEIS 10122009.lyr*



The “20% threshold” and “40% threshold” that are applied by Weikko in the Woodstok model are lower than the 20% and 40% of the land base. This is because he applies the thresholds to conifer stands only (as defined through LDO). His threshold values in acres are below:

20% old forest threshold per LPU

```
oyfof_CM        >= 7594.6
oyfof_D         >= 10631.2
oyfof_GC        >= 9250.3
oyfof_K         >= 7067.1
oyfof_Q         >= 8027.8
oyfof_RH        >= 3274.7
oyfof_S         >= 3856.8
oyfof_CR        >= 6174.7
oyfof_UC        >= 21828.9
oyfof_UD        >= 6404.6
oyfof_WH        >= 14582.1

40% old+young forest threshold per LPU

oof_CM          >= 3797.3
oof_D           >= 5315.6
oof_GC          >= 4625.2
oof_K           >= 3533.5
oof_Q           >= 4013.9
oof_RH          >= 1637.4
oof_S           >= 1928.4
oof_CR          >= 3087.3
oof_UC          >= 10914.4
oof_UD          >= 3202.3
oof_WH          >= 7291.1
```