State Trust Lands Implementation Monitoring Report:
Implementation of Northern Spotted Owl Habitat Maintenance Treatments

Executive Summary

In 2014, the Implementation Monitoring Program continued field-based reviews of the implementation of habitat conservation plan (HCP) conservation strategies, focusing this year on topics selected by DNR region and division staff. This report presents the results of one of these projects that looked at northern spotted owl (NSO) habitat maintenance treatments. For this project, monitoring staff visited 11 forest management units from 6 timber sales. At each, a post-harvest stand level Curtis relative density (RD) greater than or equal to 48 was used to assess HCP compliance (RD is used as a surrogate for 70 percent canopy closure, a component of the NSO habitat definitions). In total, 361 acres of designated northern spotted owl habitat in below-threshold management units received RD maintenance treatments during fiscal years 2012-2014; unit level analysis found all of these acres compliant with the HCP.

Objective

The objective of this review was to determine if DNR timber sales that closed in fiscal years 2012 – 2014 and which were within designated northern spotted owl (NSO) habitat in westside HCP planning units including the Olympic Experimental State Forest, which closed in fiscal years 2012 – 2014, were compliant with the State Lands Habitat Conservation Plan (HCP). Compliance was defined as having a stand level Curtis Relative Density value greater than or equal to 48. The intended audience includes the Services, the public, and DNR staff.

Introduction

The State Trust Lands Habitat Conservation Plan (HCP, Washington State Department of Natural Resources 1997) commits DNR to providing habitat to help maintain nesting areas for the northern spotted owl and to facilitate

their movement through the landscape. When the HCP was developed, DNR-managed lands were assessed for their potential role in northern spotted owl (NSO) conservation. Those lands identified as likely to provide demographic support and contribute to maintaining species distribution were designated as nesting, roosting, and foraging (NRF) management areas. In NRF management areas, habitat is managed to provide roosting and foraging habitat with interspersed nesting structure capable of supporting reproducing owls. Lands identified as important for facilitating owl dispersal (movement by young owls from nest sites to new breeding sites) were designated as dispersal management areas.

Within NRF and dispersal management areas, lands are designated as habitat, next-best stands, or non-habitat. In designated habitat, harvest activities must not remove the stand from habitat status; habitat is defined by the HCP in the context of stand-level structural metrics including but not limited to a certain range of trees per acre (TPA), basal area (BA), canopy closure and cover, top height and canopy complexity, down woody debris, and snag abundance (See the HCP, associated amendments, and HCP annual reports for more information regarding NSO habitat definitions). In next-best stands, harvest activities must not increase the amount of time required to achieve habitat goals beyond what would be expected in an unmanaged stand. Non-habitat has no silvicultural limitations stemming from the NSO conservation strategy.

The HCP identifies a landscape objective that involves maintaining thresholds of habitat in each northern spotted owl management unit (SOMU) or Olympic Experimental State Forest (OESF) landscape unit. In most westside HCP planning units, DNR must maintain at least 50 percent of DNR-managed lands within designated NRF and dispersal SOMUs as habitat or manage stands to achieve the 50 percent target in SOMUs below threshold. In the OESF HCP planning unit, DNR manages to achieve the target threshold of at least 40 percent of each landscape planning unit as habitat, half of which is managed to be old forest habitat (OESF landscape planning units are administrative areas designated primarily along watershed boundaries).

In order to track implementation of the NSO conservation strategy, the department developed a set of spatial and tabular datasets. These data leverage existing DNR systems including Planning and Tracking (P&T), the Forest Resource Inventory System (FRIS), and GIS. When planning timber sales on state lands DNR foresters are instructed to, among other things, consult the DNR NSO habitat layer database when determining potential management options. One inherent challenge associated with this process is the spatial accuracy of the NSO database layers, particularly for stand-level metrics that have the potential to be highly variable within a single stand. Snags and

downed wood are two examples of data in the current inventory system that defines NSO habitat that may be accurate at the resource inventory unit (RIU, an RIU is the stand-level spatial scale in which FRIS data is represented) scale but may not necessarily be accurate at the timber sale harvest unit scale (which may take place in portions of multiple RIUs). Regardless, DNR foresters are instructed to plan management activities in accordance with the NSO habitat layers.

Given these known database limitations, it was determined that snags and downed wood would not be used to assess compliance (snags and downed wood are protected, when operationally feasible, through standard contract language and compliance). Forest cover, commonly expressed in terms of canopy closure (the proportion of the sky hemisphere obscured by vegetation when viewed from a single point), is an integral part of NSO habitat as it provides the above-ground structure that allows for nesting, roosting, and foraging. Canopy closure, however, is notoriously difficult to measure consistently and accurately, and therefore is not conducive to objective implementation monitoring. In order to objectively assess post-harvest overstory structure while also minimizing potential uncertainties in our results, it was determined that the primary assessment measure for determining compliance with the HCP for this review was Curtis' relative density (RD, specifically RD 48, Hicks and Stablins 1995), which the HCP defines as an acceptable surrogate for canopy closure and serves as a basis for contract compliance (HCP IV.11).Curtis' RD is a measure of relative density originally developed for even-aged Douglas-fir stands west of the Cascade crest (Curtis 1982). RD equals stand basal area divided by the square root of quadratic mean diameter.

Methods

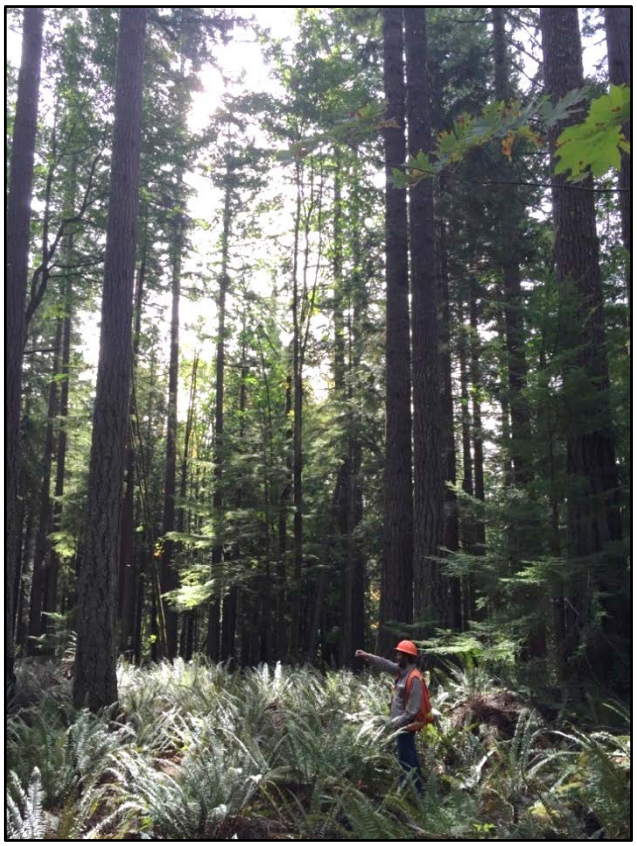
Identifying units for monitoring - Selected Forest Management Units (FMUs) were associated with DNR timber sales located in westside HCP planning units that closed in NaturE (the DNR revenue tracking system) during fiscal years 2012, 2013, and 2014. All selected FMUs were determined to contain designated NSO habitat and were located in below threshold SOMUs/landscapes (the HCP only requires treatments to maintain habitat status in SOMUs that are below threshold). We used archived NSO habitat layers from the time of sale to identify units for monitoring. This was accomplished by reviewing available databases and timber sale documentation.

Defining the sampling area – FMUs selected for monitoring typically contained a combination of habitat and non-habitat (non-habitat includes next-best stands). For the purposes of this project, we were only interested in sampling areas within harvest units that overlaid designated habitat in the NSO database layers. To accomplish this, we used GIS to clip the NSO habitat layers from the time of sale from the FMU layer.

The resulting data layer represented our sampling units. All areas of designated habitat within a common FMU were considered part of the same sampling unit.

Plot locations – Plots were generated on a systematic randomized grid using the Cruiser Sample Plots tool in ArcMap 10. Plots were generated at a density of one plot per four acres of sampling unit, with a minimum of five plots per unit. Plots were located in the field using a Garmin 62s GPS receiver.

Field data collection – Field data collection protocols were adapted from the Field Protocol for Remote-Sensing Inventory Plots (Gould and Strunk 2014). On each plot, we sampled trees all trees and regeneration that were greater than 1-foot tall. Large trees (live and dead trees ≥ 5.5" DBH) were selected using a basal area prism (we used a BAF that resulted in 4 to 7 trees per plot, on average, being selected for measurement. All plots within a common sampling unit used the same BAF for selecting trees). We measured small trees (live and dead trees < 5.5" DBH) on nested 1/100th acre fixed-area plots (11.8 ft radius). Diameter and tree status (live or dead) were measured for all sampled trees in order to calculate RD of live trees. Species, quadratic mean diameter (QMD), top height (top height is defined as the average height of the 40 largest diameter trees per acre), and snag abundance and size were measured/calculated for informational purposes. Other aspects of the habitat definitions, such as shrub cover and downed woody debris, were not measured.



Monitoring staff identifying trees for sampling using a basal area prism. The foreground shows an area that was harvested while the denser forest area in the background is a skip (an untreated portion of the stand).

Data analysis and determining compliance – We used the Forest Vegetation Simulator (FVS) to calculate stand tables. We calculated 95% confidence intervals (CI) for the mean RD of live trees greater than or equal to 3.5" DBH for each sampling unit. A 95% CI that either contains or is higher than the RD 48 (or other stated target RD) was considered compliant; a 95% CI that is

lower and does not contain the prescribed RD was considered non-compliant.

Results

Frequency of NSO habitat maintenance treatments – NSO habitat maintenance treatments in designated NSO habitat are rare. There was a total of 361 acres of designated NSO habitat that received a habitat maintenance treatment in fiscal years 2012 - 2014; this number of acres represents less than 1% of the total harvested acres on DNR-managed lands in westside HCP planning units during this time frame (Table 1). The proportion of NSO habitat maintenance treatments to the total number of harvested acres on DNR-managed lands increased between 2012 and 2014 (from 0.5% to 1.7% of total harvested acres).

HCP compliance - The 95% CI for mean stand-level RD for all sampled units either contained or was higher than the target RD 48, meaning all units were compliant with the HCP (Figure 1). All average stand-level RD values were greater than RD 48 except one; in this unit, the stand-level average RD was 47.2, but this result was not significantly less than RD 48.

Table 1 – Fiscal year breakdown of the total number of acres harvested on DNR timber sales that closed in westside HCP planning units, the number of total acres that were thinned (according to P&T), and the number of thinned acres that were treated with an objective to maintain RD 48 in designated NSO habitat. Some units included in this review implemented gap creation and/or ecological enhancement (snag and down wood creation) within an unthinned forest matrix (See Table 2).

Fiscal Year	Total acres harvested on DNR timber sales that closed in westwide HCP planning units	Timber sale acres that were thinned	Thinned acres that were treated with an NSO habitat maintenance objective	NSO habitat maintenance treatment acres as a percentage of total acres/thinning acres
2012	18,974	2,608	89	0.5% / 3.4%
2013	9,559	1,113	87	0.9% / 7.8%
2014	10,771	2,060	186	1.7% / 6.2%
2012 through 2014	**39,304**	**5,781**	**361**	0.9% / 6.2%

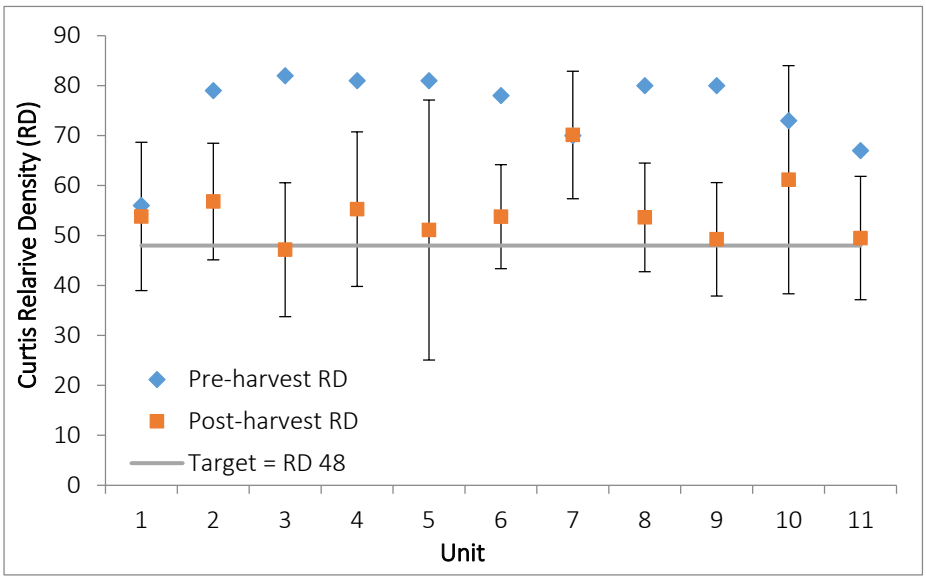


Figure 1. Pre-harvest RD (blue dots; values obtained from P&T), post-harvest RD (orange dots; measured in field), and target RD 48 (gray line; targets stated in timber sale contracts) for each unit monitored. The 11 timber sale units were associated with 6 timber sales. Error bars represent 95% confidence intervals for the mean stand-level RD. Note: Treatment of Unit 1 consisted of the harvest of multiple 1/10th acre gaps with designated skid trails between them. Only half of Unit 7 was thinned with the rest of the unit treated with ecological enhancement activities consisting of snag and down wood creation. Monitoring installed plots throughout the sampling unit, independent of treatment method.

A thinned harvest unit within designated NSO habitat in a dispersal management area. The HCP permits DNR to implement harvest entries in NSO habitat as long as the stand retains habitat status after harvest. The pictured unit was successfully treated with an objective to maintain a Curtis relative density greater than or equal to 48.

Prescriptions and silvicultural techniques used when implementing NSO habitat maintenance treatments – While all monitored units had a common stand-level stocking target and ecological management objectives, there were different silvicultural techniques used when implementing these treatments on the ground. The primary method was thinning from below (removing trees from smaller diameter classes while retaining larger trees) using a combination of TPA, BA, and spacing targets. Two other silvicultural treatment methods utilized in monitored stands include canopy gap creation within an unthinned forest matrix with designated skid trails and ecological attribute enhancement. Gap creation was implemented by marking trees throughout a stand, then instructing the operator (through contract language and compliance) to harvest all trees within 60 feet of the marked tree, creating a gap approximately ¼-acre in size. Ecological attribute enhancement was accomplished by manually girdling trees to create snags, or felling trees and leaving them in place as downed wood.

Ecological attribute enhancement was implemented on many units. At these locations, trees from the largest diameter class were either girdled for snag creation (left two pictures) or felled and left in the forest as downed wood (right picture).

Table 2. This table shows the habitat classification, silvicultural techniques utilized, sampling unit information, current measured BA and TPA (at the time of monitoring), respective stocking targets as stated in the contract for each unit, and data on additional metrics for each unit. Quadratic mean diameter (QMD), snag abundance, and top height are all components of NSO habitat definitions. The information in this table was not used for determining compliance with the HCP but is for informational purposes. Dispersal (all HCP planning units except the OESF) and young forest marginal (only applies to the OESF) habitat types are defined in the HCP, movement habitat is similar to dispersal habitat as re-defined in the South Puget Sound Forest Land Plan in 2010 (Washington State Department of Natural Resources 2010).

Unit Information				*Stand metrics and targets from contracts*				*Additional Information*		
Unit #	**Habitat classification at time of sale**	**Silvicultural techniques used[a]**	**Sampling unit acres (plots sampled)**	**Current BA per acre of trees > 3.5" DBH[b]**	**Target BA**	**Current TPA > 3.5" DBH[b]**	**Target TPA**	**Quadratic mean diameter (in.)**	**Snags/ acre > 20" DBH and > 16' tall**	**Top height (ft)**
1	Dispersal	gaps[1]	15.3 (5)	232 (52)	No BA target[1]	128 (42)	No TPA target[1]	19.0	0.0	134
2	Movement	thin	5.5 (5)	240 (28)	180 - 220[2]	144 (63)	125[2]	18.3	2.9	132
3	Movement	thin	45.1 (10)	204 (76)	180 - 220[2]	110 (54)	125[2]	19.5	0.0	140
4	Movement	thin	14.5 (5)	229 (55)	180 - 220[2]	169 (119)	125[2]	18.1	0.0	136
5	Movement	thin	12.6 (5)	191 (68)	180 - 220[2]	200 (148)	125[2]	14.9	0.0	127
6	Dispersal	thin + eco	49.5 (13)	239 (64)	No BA target	119 (69)	126[3]	20.9	2.4	139
7	Dispersal	thin + eco	37.1 (10)	328 (82)	No BA target	136 (69)	109[3]	22.7	0.0	147
8	Dispersal	thin + gaps	57.5 (15)	240 (74)	200[2]	120 (90)	100[2]	21.0	2.2	126
9	Dispersal	thin + gaps	80 (20)	215 (89)	200[2]	115 (95)	100[2]	20.8	1.6	137
10	Dispersal	thin + eco	10.8 (5)	248 (77)	233[4]	190 (104)	108[4]	16.6	2.3	130
11	Young Forest Marginal	thin	32.7 (8)	210 (56)	211	120 (53)	No TPA target	18.5	0.0	115

[a] thin = thin from below to RD 48; gaps = creation of quarter-acre gaps throughout all or part of the unit; eco = ecological attribute enhancement (snag and downed wood creation)

[b] standard deviations in parentheses

[1] the prescription for this unit consisted of gap creation only with an unthinned forest matrix, so there was no BA or TPA target

[2] stocking targets are for trees ≥ 8" DBH

[3] stocking targets are for trees ≥ 5" DBH

[4] stocking targets are from P&T. The contract describes a spacing goal and species/size preference.

Discussion

DNR successfully implemented harvest operations within designated NSO habitat without removing said stands from habitat status; all monitored units had a sampling unit-level RD greater than or equal to 48. DNR used thinning, ecological attribute enhancement, and gap creation when conducting RD maintenance treatments in NSO habitat.

Assuring operational compliance of a specific RD across a stand can be difficult, but DNR staff proved effective at maintaining a desired minimum average RD through on-the-ground contract compliance. Average stand-level RD of many of our sampled units were within the prescribed target RD range described in the contract (typically 48 RD +- 5 RD or a given BA/TPA range; it is important to note our sampling protocol varied from the methods used for contract compliance, which generally used a

combination of fixed and variable radius plots for calculating RD for overstory trees). When monitoring staff found an RD value not in line with the contract prescription, it is important to note that RD measures were consistently higher than the prescription, indicating a conservative approach to implementing harvest activities in designated owl habitat. While a conservative approach may help achieve treatment success in the context of compliance with the HCP, it may not be the most effective method for achieving ecological management objectives.

Since a single RD can be represented by a number of stand conditions, difficulties assuring operational compliance in the field have the potential to arise. For example, since RD is highly sensitive to the inclusion or omission of single trees on compliance plots, particularly smaller diameter trees, the plot size and/or basal area factor used can result in large differences in calculated RD value. While all of the timber sale contracts reviewed for this project, except one, had a target of RD 48 (the exception had the cutting prescription in the contract and identified RD 50 as the post-harvest objective in P&T), this target was typically associated with additional guidance to the contractor that provided BA, TPA, and/or tree spacing targets. It is clear, through discussions with region staff, that contractors implementing DNR timber sale contracts prefer BA, TPA, and spacing targets to RD targets because they are easier to measure and comprehend in the field. Stand metrics that are easier to understand in an operational context, such as BA and TPA, may also be better predictors of canopy cover and closure and may allow DNR to more effectively and efficiently implement the northern spotted owl conservation strategy (Gould and Donato 2013, Gould et al. 2014).

The plot density utilized in our sampling was greater than or equal to the plot density used by DNR field staff when conducting contract compliance during harvest operations. Even given this density, the 95% confidence intervals for RD in monitored units were typically as wide, if not wider, than the range of plot-level RD values measured in a given sampling unit (our results found that it takes approximately 10 RD plots within a single sampling unit to achieve a confidence interval range that is less than the range of measured RD values). This means that objectively determining compliance using a plot-based stand-level analysis of RD may require a substantially higher plot density that 1 plot per 4 acres, particularly in stands with a relatively high amount of structural diversity. This difficulty highlights a potential disassociation between our ability to objectively determine compliance for these treatments using current methods and our commitment to stated ecological management objectives (guided by the HCP) of increasing stand-level variability for the benefit of owls and other species. Future monitoring efforts should consider these limitations and adjust accordingly (e.g., higher sample plot density, leverage remote-sensing technology where applicable).

Citations

Curtis, R.O. 1982. A Simple Index of Stand Density for Douglas-fir. Forest Sci., Vol. 28, No. 1, 1982, pp. 92-94.

Hicks, L.L. and H. Stabins. 1995. Spotted Owl Habitat Descriptions for Plum Creek's Cascades Habitat Conservation Plan. Technical Report No. 4. Published by Plum Creek Timber Company, L.P. Seattle, WA.

Gould, P. and D. Donato. 2013. Estimation of Canopy Cover and Closure from Stand Density Metrics or LiDAR in Eastside Forests. Washington State Department of Natural Resources. Olympia, WA.

Gould, P. and J. Strunk. 2014. Field Protocol for Remote-Sensing Inventory Plots v1.1. Washington State Department of Natural Resources. Olympia, WA. Published February 2, 2014.

Gould, P., J. Strunk, and K. Tenneson. 2014. Introducing the Remote Sensing Forest Analysis System (RS-FRIS). Washington State Department of Natural Resources. Olympia, WA. Published December 5, 2014.

Washington State Department of Natural Resources. 1997. Final habitat conservation plan. Olympia, WA: Author.

Washington State Department of Natural Resources. 2010. South Puget HCP Planning Unit Forest Land Plan Final EIS. Olympia, WA: Author.

Acknowledgements

Primary author and photo credit
Zak Thomas, Forest Resources Division

Contributing author
Mike Buffo, Forest Resources Division

Field work assistance
Nathan McReynolds, South Puget Sound Region

Reviewers
Dan Donato, Forest Resources Division
Scott McLeod, Forest Resources Division
Heather McPherson, Forest Resources Division
Justin Schmal, Forest Resources Division

Please direct any comments or questions to implementation.monitoring@dnr.wa.gov