

# Effects of Western Spruce Budworm Defoliation on the Northern Spotted Owl and Its Habitat in Southcentral Washington: Interim Project Report 3 funded by FHM Evaluation Monitoring Program, Project Number WC-EM-06-01

Elizabeth A. Willhite, USDA Forest Service FHP, Jim Ellenwood, USDA Forest Service FHTET, Vernon Thomas, ITX, Inc.

## Abstract

A 19-year period of western spruce budworm (*Choristoneura occidentalis*) defoliation of coniferous forests on the eastern slopes of the Cascade Mountains in southcentral Washington is being analyzed for effects on northern spotted owl (*Strix occidentalis caurina*) populations and their habitat. Analysis includes the use of Region 6 annual insect and disease aerial survey data, owl demographic data, forest inventory plot data (USDA Forest Service R6 Current Vegetation Survey (CVS) and USDA Forest Service Forest Inventory Analysis (FIA)), and satellite image-based change detection analysis. Landsat 5 Thematic Mapper images of pre-defoliation (1985) and ongoing/post-defoliation (2003) vegetation conditions are being characterized and analyzed for similarities and differences. Relationships among vegetation conditions, disturbance history, and owl demography are being examined for trends and associations that characterize the effects and interrelationships of western spruce budworm defoliation, vegetation conditions, spotted owl populations, and other associated disturbances.

## Study Area

The study area covers 2,327,528 acres and represents the southern half of the Washington Eastern Cascades physiographic province. It is bounded on the west by the crest of the Cascades, on the north by Interstate 90, on the south by the Columbia River, and on the east by the habitat boundary of the northern spotted owl as defined in the 1994 Northwest Forest Plan. Ownership patterns are mixed and include public agency - US Forest Service, Bureau of Land Management, State of Washington - tribal, private industrial, and private non-industrial owners. Within the public ownerships are areas having land-use designations that restrict or prohibit forest management activities, e.g., late successional reserves, wilderness, research natural areas, scenic areas, and sensitive habitat designations.

Spotted owl habitat suitability for habitat-capable lands was modeled for federal lands as part of the Northwest Forest Plan 10-year monitoring (Fig. 2). Habitat change was assessed for stand-replacing timber harvest and wildfire, but changes associated with more subtle disturbance, such as partial harvest and insect-caused defoliation, were not addressed.

In our study area, western spruce budworm defoliation has occurred at various locations every year since 1984, and many areas have been repeatedly defoliated for many years. Defoliated areas mapped in the R6 annual insect and disease aerial survey between 1985 and 2003 are shown in Fig. 3.

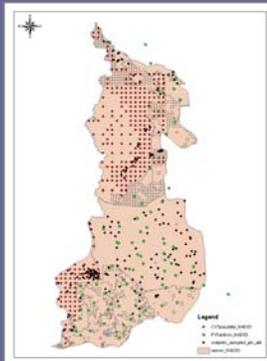


Figure 1. Study area ownership boundaries and ground sample points.



Figure 2. Spotted owl habitat suitability for habitat-capable federal lands (NWFEP Interagency Regional Monitoring Program).

Figure 3. Western spruce budworm defoliation 1985 through 2003.

## Ground Plots

Field collection of calibration data for satellite image classifications was completed in 2006 and preliminary summaries of that data were reported in the 2007 FHM EM poster. During the past year, CVS and FIA inventory data have been summarized for the study area. Table 1 depicts preliminary averages for plot-level means for all study area inventory plots (calibration, CVS, FIA) calculated on a per-acre basis, for plots categorized as western spruce budworm "host" or "non-host." These data indicate host plots have higher levels of percent crown cover, stocking, and larger trees than non-host plots. Also, dead trees on host plots were larger than those on non-host plots. Mortality, while slightly higher on host plots, did not differ much between host and non-host plots. However, causes of mortality, which have not yet been investigated, are likely to be very different. Further analysis will investigate associations among stand attributes, budworm defoliation, and owl habitat.

Plot Type	Percent Crown Cover	Percent Mortality	Live DBH	Dead DBH	Live TPA	Live BA	Curtis Relative Density	Berger-Parker Index
Host	60.98	13.06	11.85	10.72	144.43	137.54	35.59	1.89
Non-host	39.56	11.59	9.65	5.26	96.81	70.76	16.45	1.39

Table 1. Preliminary study area averages of plot-level means for calibration plots (host n=149, non-host n=68), CVS plots (host n=99, non-host n=13) and FIA plots (host n=146, non-host n=168).

North et al. (1988) found tree height class diversity as measured by the Berger-Parker index, a measure of evenness (Magurran 1988), associated with northern spotted owl foraging use intensity. Applied in this manner, the Berger-Parker index is used to provide a rough estimate of canopy layering. Following the methods of North et al. (1988), we applied the Berger-Parker index to seven height classes and five canopy classes assigned to each live tree. Higher Berger-Parker index values indicate a higher degree of canopy layering. Our host plots had higher Berger-Parker indexes than non-host plots, indicating more canopy layering. Multi-layered canopies are also believed to provide favorable habitat for western spruce budworm larvae.

North, M.P., J.F. Franklin, A.B. Carey, E.D. Forsman, and T. Hamer. 1998. Forest stand structure of the northern spotted owl's foraging habitat. *For. Sci.* 45(4):520-527.  
Magurran, A.E. 1988. *Ecological diversity and its measurement*. Princeton University Press, Princeton, NJ. 179 p.

## Preliminary Surfaces

The images used for model development are from 1985 and 2003 Landsat 5 Thematic Mapper data georeferenced to UTM Zone 10, NAD 83. Both image datasets were transformed into Tasseled Cap brightness, greenness, and wetness indexes. A change detection surface was created by taking the difference between each Tasseled Cap dataset and classifying into 100 categories. Using 19 years of aerial survey data (1985 to 2003), a surface was created that represents those areas with western spruce budworm (WSB) damage for at least 5 years. The change detection classified surface was then masked with the WSB surface to identify the change detection classes with the highest frequency of cells that fell in WSB raster cells. Based on these results, the change detection surface was reclassified into three classes of the probability of finding WSB damage: high, medium, and low. Stratified random points were created for each of the three WSB classes: 200 high probability points, 50 medium probability points, and 30 low probability points. Calibration field data were collected in the study area during 2005 and 2006 on 219 sample points (Fig. 1). These data were used to construct and refine models for producing the following preliminary study area surfaces: basal area, stem count, tree mortality, and basal area standard deviation/owl habitat (Figs. 4-7). Forest inventory plot data from study area CVS and FIA plots will be used to further refine and expand the models (Fig. 1).

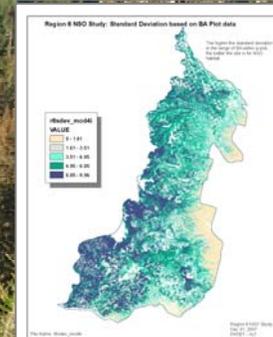


Figure 4. Preliminary surface for basal area standard deviation/owl habitat.

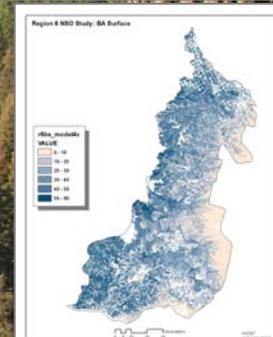


Figure 4. Preliminary surface for basal area.

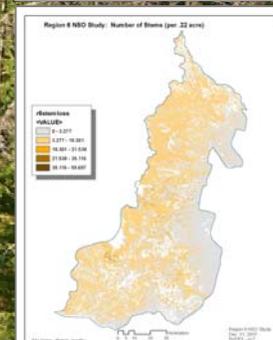


Figure 4. Preliminary surface for number of stems.

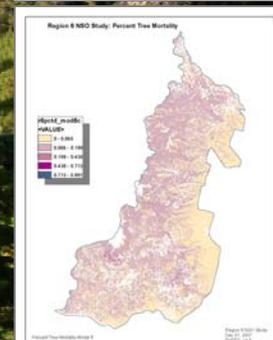


Figure 4. Preliminary surface for percent tree mortality.

## 2008 Objectives

- We anticipate completing this study in 2008. The next phase of analysis will involve:
- Completing data compilation for spray and harvest layers.
  - Creating final study area surfaces.
  - Conducting Time Series analysis with aerial survey data on effects of defoliation.
  - Integrating owl demographic data.
  - Identifying trends and associations among forest structure, owl habitat, owl populations, and budworm defoliation.

## Project Cooperators

Vince Harke<sup>1</sup>, Julie Johnson<sup>2</sup>, Jim Ellenwood<sup>3</sup>, Gina King<sup>3</sup>, Karen Ripley<sup>4</sup>, and Rich Potter<sup>5</sup>

<sup>1</sup>US Fish and Wildlife Service, <sup>2</sup>USDA Forest Service, <sup>3</sup>Yakama Indian Nation, <sup>4</sup>Washington Department of Natural Resources, <sup>5</sup>Hancock Timber Resource Group

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