

Mapping current conditions and
modeling the dynamic responses of
riparian vegetation and salmon habitat in Oregon

2010 Annual Project Report

Mapping Component: OWEB # 208-8007-5781

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Comparison of actual accomplishments to the tasks and timeline established in the Statement of Work:

The start of the project was delayed to early 2008 because of time required to get funding in place. Following is a status report for budgeted tasks between October 2009 and October 2010.

Develop DEM, stream, and vegetation layers from lidar data (3rd Quarter 2008) – Completed 4th Quarter 2010

- DEMs for the Wilson and MFJD were received from the lidar vendor. We performed additional corrections (bridge removal) and resampling necessary for further stream network analysis.
- Using field data collected in summer 2009, we finalized stream layers and the geomorphic classification for the Wilson and MFJDR area (see Modeling report).
- Development of vegetation layers for the Wilson and MFJD was finished (see next section).

Integrate spatial and plot data to generate rasters of vegetation attributes and classified riparian network (4th Quarter 2008) – Completed 4th Quarter 2010

We integrated spatial data with field plot data collected during summer 2009 to develop maps of vegetation attributes (Fig. 1, 3); and then aggregated these raster layers to classify stream reach polygons associated with the geomorphic network (Fig. 2, 4). To derive statistical models for classifying vegetation type and structure we tested an extensive set of lidar and Landsat-based descriptor variables. Final vegetation raster layers were developed using random forest and regression models. To obtain a more balanced reference sample for characterizing broadleaf and needleleaf forest classes we collected 150 photo-interpretation plots using color-NIR NAIP imagery from 2009. NAIP imagery was further used as reference for first-order evaluations of the output raster layers. Raster layers were generated with a cell size of 5-m and included vegetation attributes showing leaf type, tree size, understory vegetation and tree, shrub and herbaceous vegetation cover.

Examine history of disturbance and succession (Landsat) (1st Quarter 2009) – Completed 3rd Quarter 2010

To describe the history of disturbance and succession during the last two decades we use annual Landsat data and a curve-fitting algorithm (LandTrendr) developed in our lab (Kennedy et al. 2010). The advantage of LandTrendr over traditional change detection methods is that it takes advantage of the full temporal trajectory to capture both the time of an event and its magnitude (Fig 5,6). In addition, by increasing the (temporal) sampling density, this approach is more robust for separating change from no-change.

The application of the LandTrendR algorithm requires the following pre-processing and analysis steps:

- Identify and acquire stack of Landsat imagery (3rd Quarter, 2008)
- Atmospheric correction of a reference Landsat Scene (1st Quarter, 2009)
- Radiometric normalization across the time-series to the atmospherically corrected image (1st Quarter, 2009)
- Mask clouds and cloud shadows (2nd Quarter, 2009)
- Extract spectral trajectories and fit segments (3rd Quarter, 2010)
- Extract summary information from segments (start and end year, duration and magnitude of disturbance (3rd Quarter, 2010)

We finalized maps of disturbance and recovery trends in the 3rd Quarter of 2010 for the Wilson and MFJDR study area (Figure 5-8).

Integrate riparian and upland maps (GNN and ReGAP) planned for 1st Quarter 2011

We have acquired upland vegetation maps and are in the process of integrating them with our riparian maps. This part will be finished in the 1st Quarter of 2011.

Assess accuracy and error structures of map products (3rd Quarter 2010) 4th Quarter 2010

We have assessed the accuracy and error structures of individual vegetation raster layers using cross-validation. Cross-validation can provide reliable estimates of model uncertainty when field plot numbers are limited. When constructing classification trees with RandomForest, each tree is based on a bootstrap sample of the data, and in addition only a subsample of the variables is used to construct each classification node. As a result, RandomForest has the added benefit of providing cross-validation error statistics or out-of-bag errors by default (Breiman, 2001). The accuracy assessment revealed several source of map errors such as tree form and lean angle, terrain complexity, ground cover that is not vegetation (rocks and logs), and errors associated with field observations.

In addition to an accuracy assessment of the individual vegetation raster layers, we performed an evaluation of the vegetation classification at the reach- and/or polygon-level. In this step we compared field-based observations and field-delineated maps of vegetation zones with the vegetation polygons (Fig. 2 and 4) derived from summarizing the vegetation raster data.

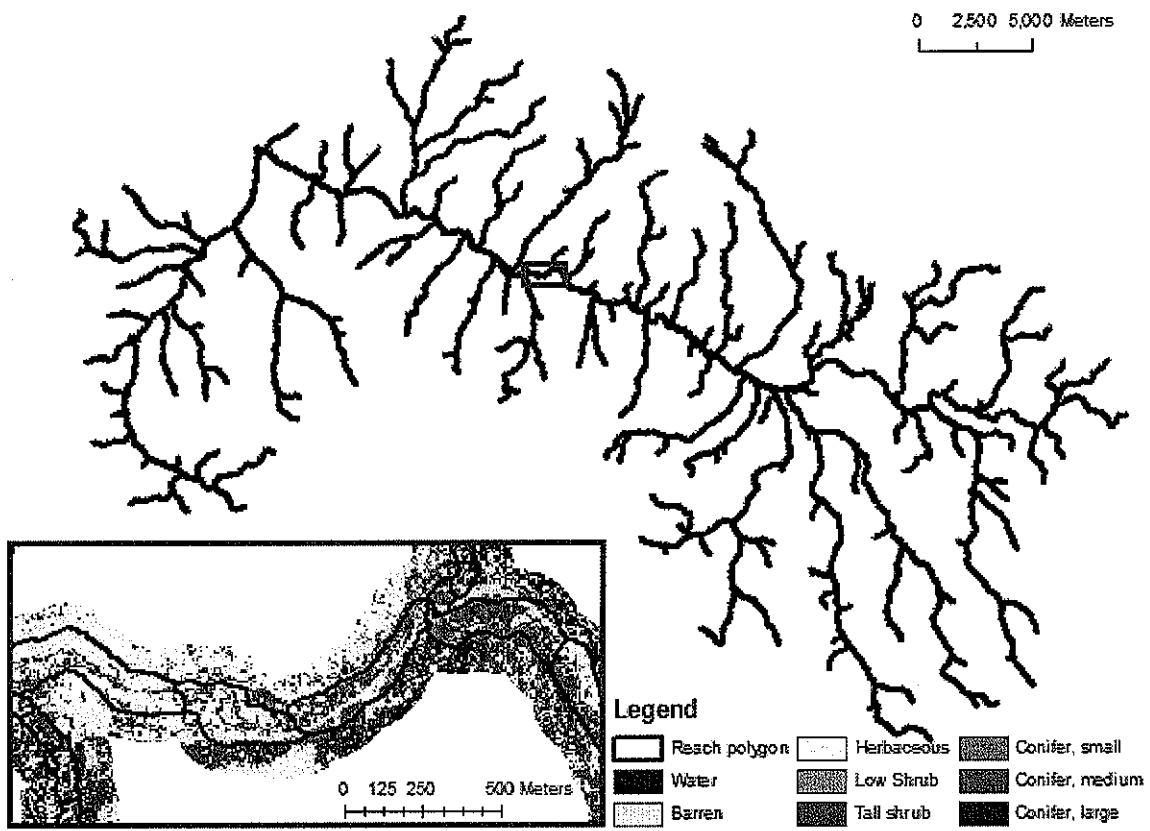
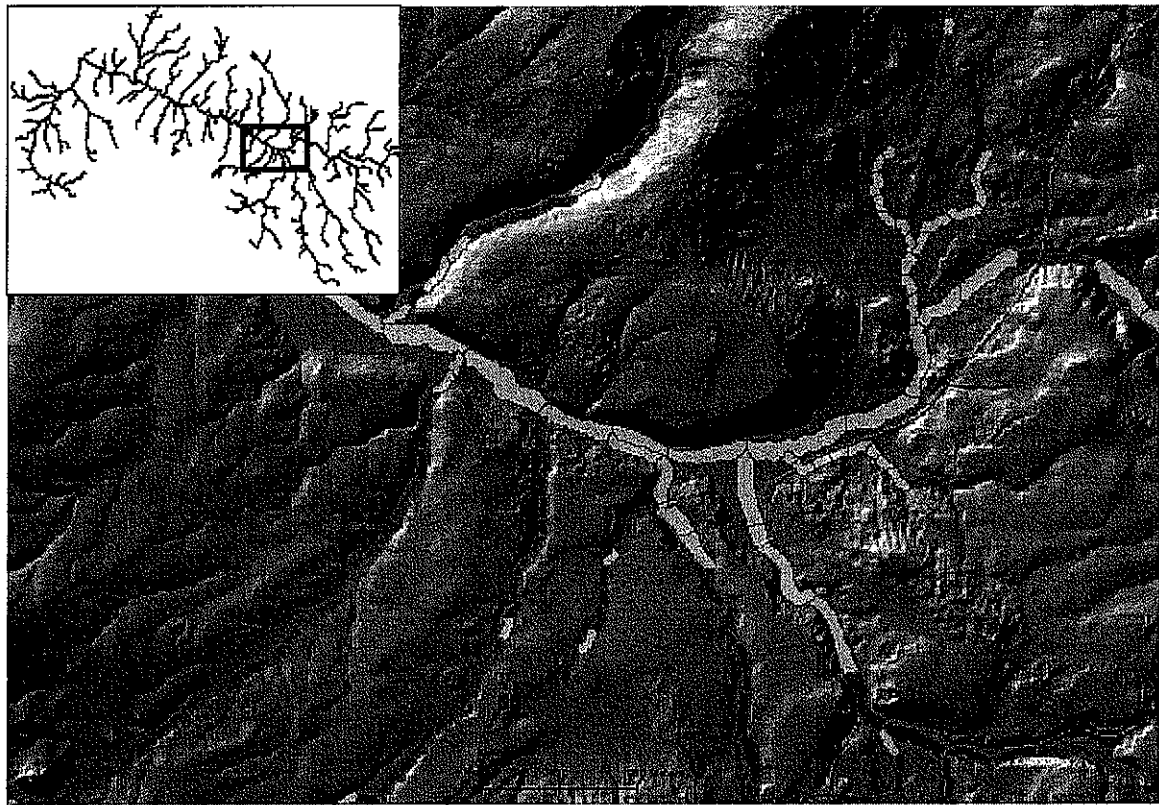


Figure 1: Riparian vegetation type and size classification for the MFJD



Legend


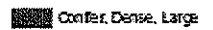
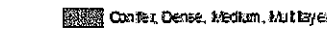
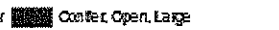
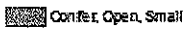


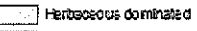
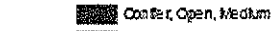

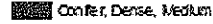
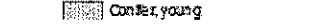
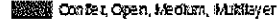
 Shrub, dense	 Conifer, Dense, Large	 Conifer, Dense, Medium, Multilayer	 Conifer, Open, Large	 Conifer, Open, Small
 Shrub, medium	 Conifer, Dense, Large, Multilayer	 Herbaceous dominated	 Conifer, Open, Medium	
 Shrub, open	 Conifer, Dense, Medium	 Conifer, young	 Conifer, Open, Medium, Multilayer	

Figure 2: Vegetation type and structure attributes for the MFJD stream reaches

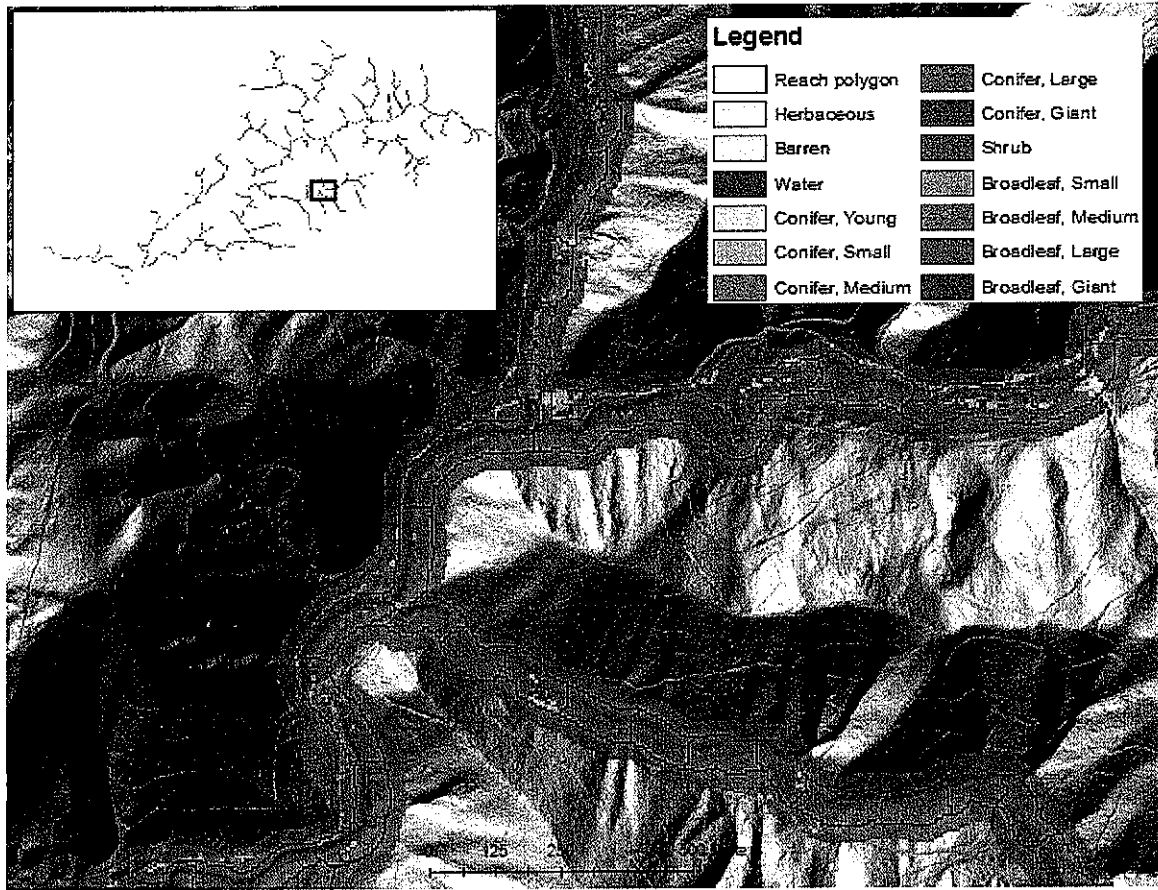


Figure 3: Riparian vegetation type and size classification for the Wilson study area

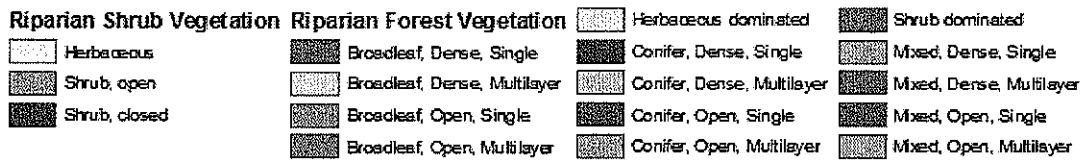
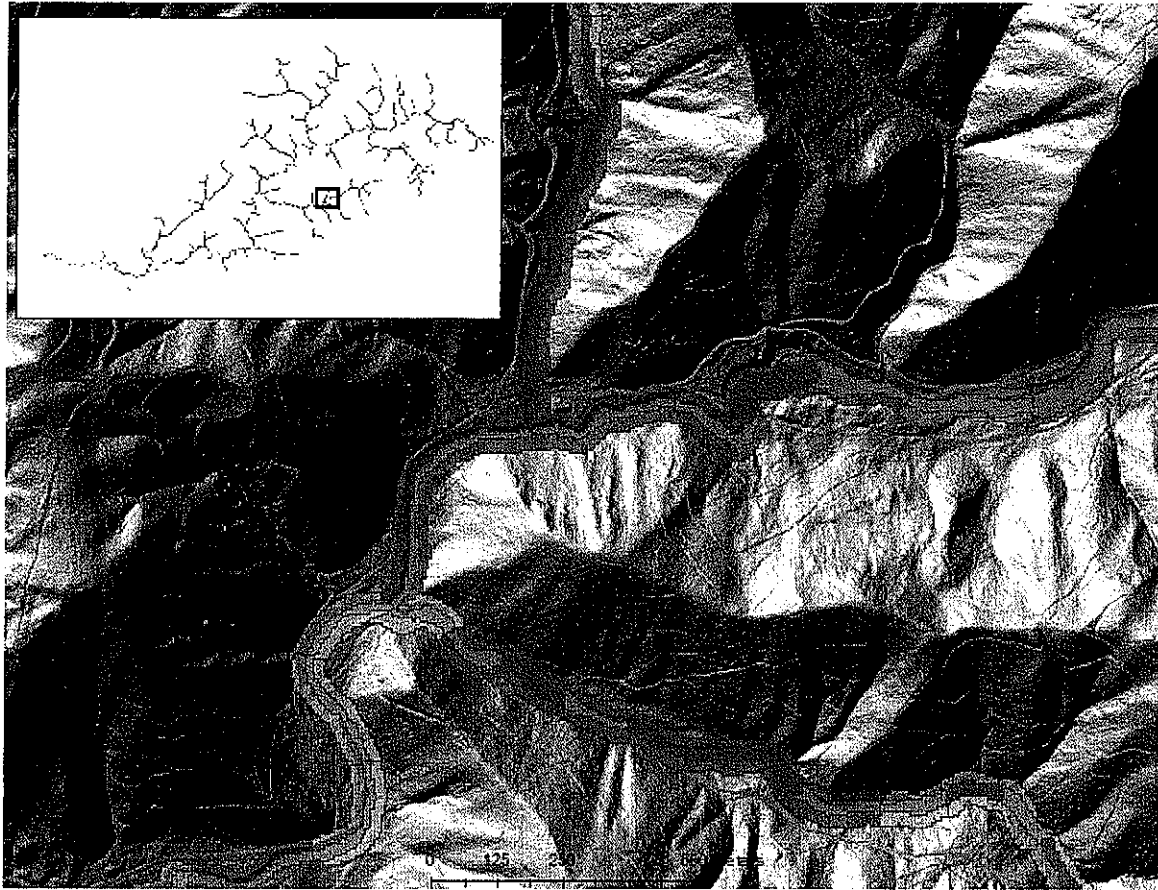


Figure 4: Vegetation type and structure attributes for stream reaches of the Wilson drainage

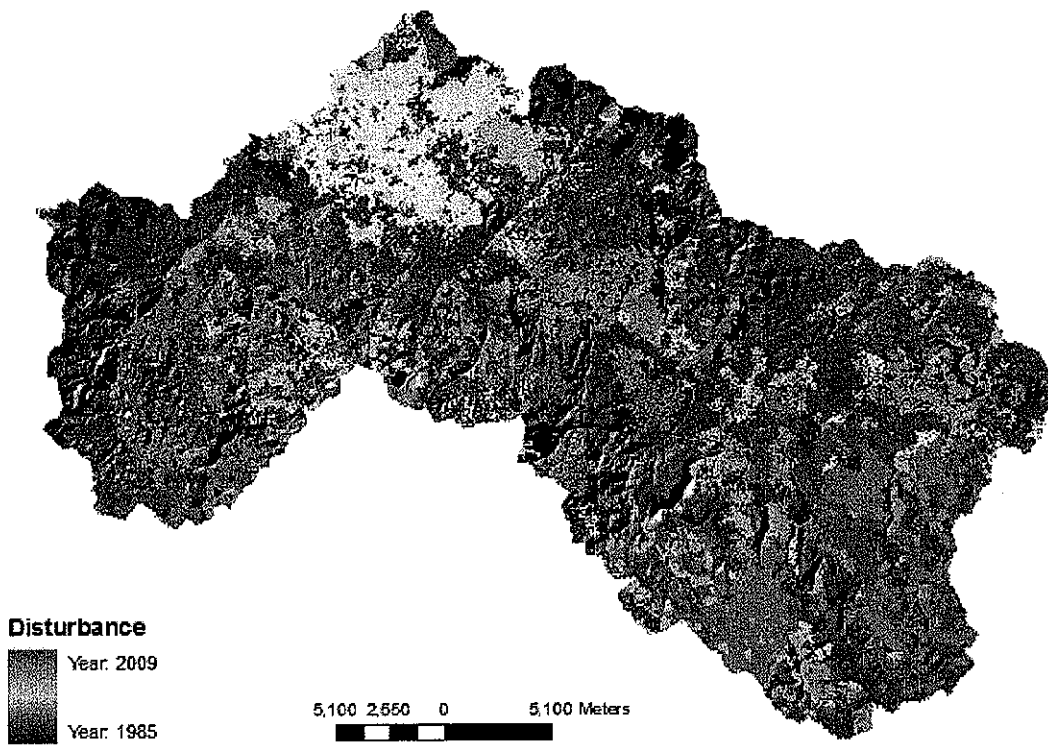


Figure 5. Year of forest disturbance derived from Landsat time-series for the MFJD

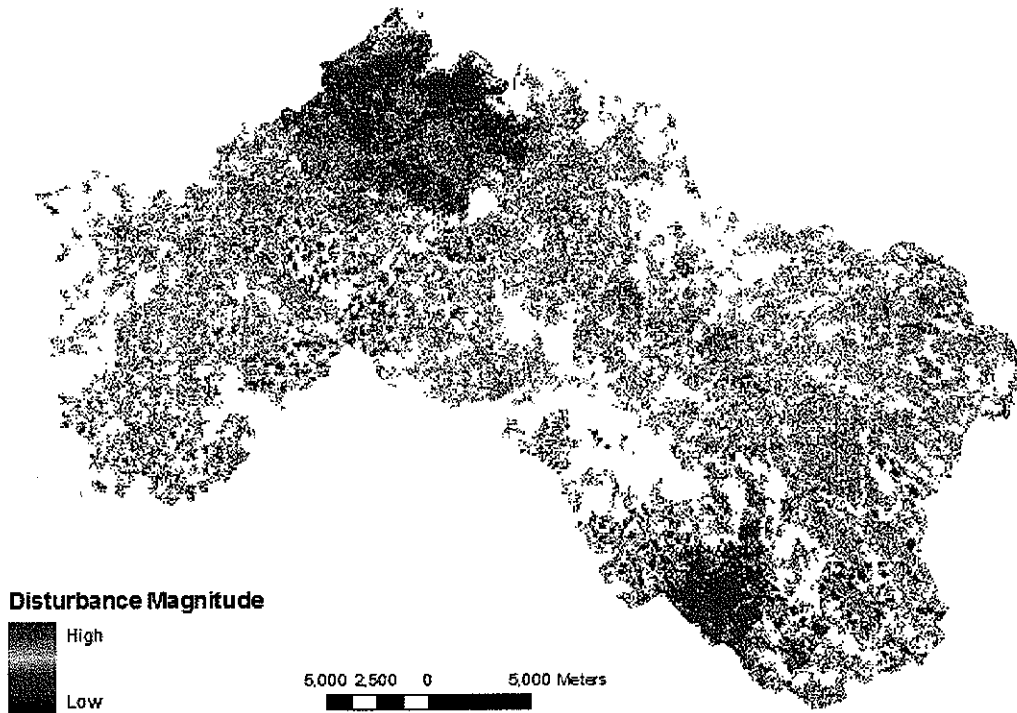


Figure 6. Intensity of forest disturbances between 1985 and 2009 for the MFJD derived from Landsat time-series

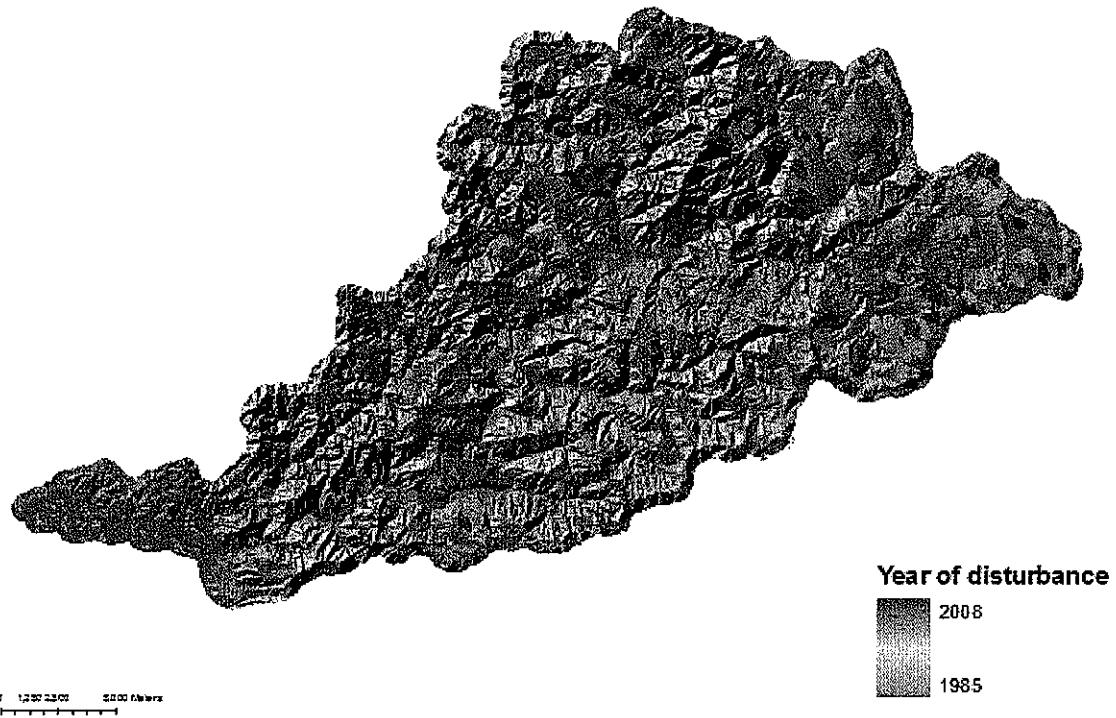


Figure 7. Year of disturbance derived from Landsat time-series for the Wilson drainage

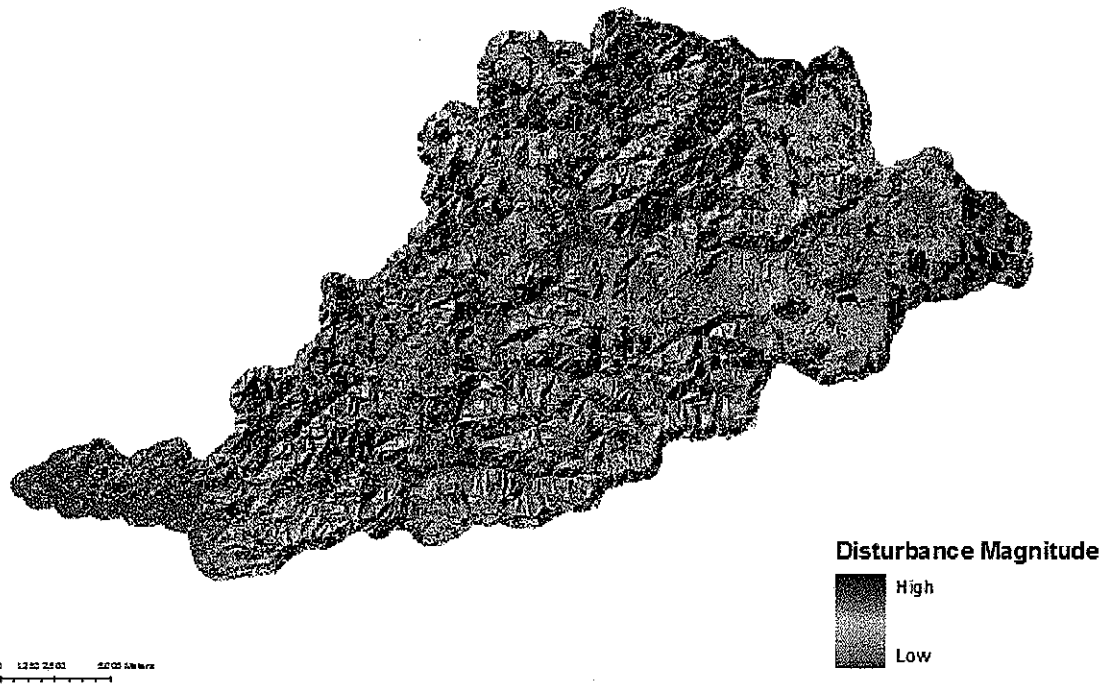


Figure 8. Intensity of forest disturbances between 1985 and 2009 in the Wilson drainage derived from Landsat time-series

Progress toward meeting matching funds requirements:

Matching funds are in kind support for Cohen's salary. This has been met for the FY10 contribution.

Expenditure reports documenting use of project funds:

No project funds were spent in the FY 2010.

References:

Breiman, L. (2001). Random Forests. *Machine Learning*, 45, 5–32

Kennedy, R.E., Yang, Z., & Cohen, W.B. (2010). Detecting trends in forest disturbance and recovery using yearly Landsat time series: 1. LandTrendr - Temporal segmentation algorithms. *Remote Sensing of Environment*, 114, 2897–2910