OWEB Grant #208-8009 "Integrated Dynamic Landscape and Coho Model." Progress Report

Mapping of historical splash damming in the Oregon Coast Range

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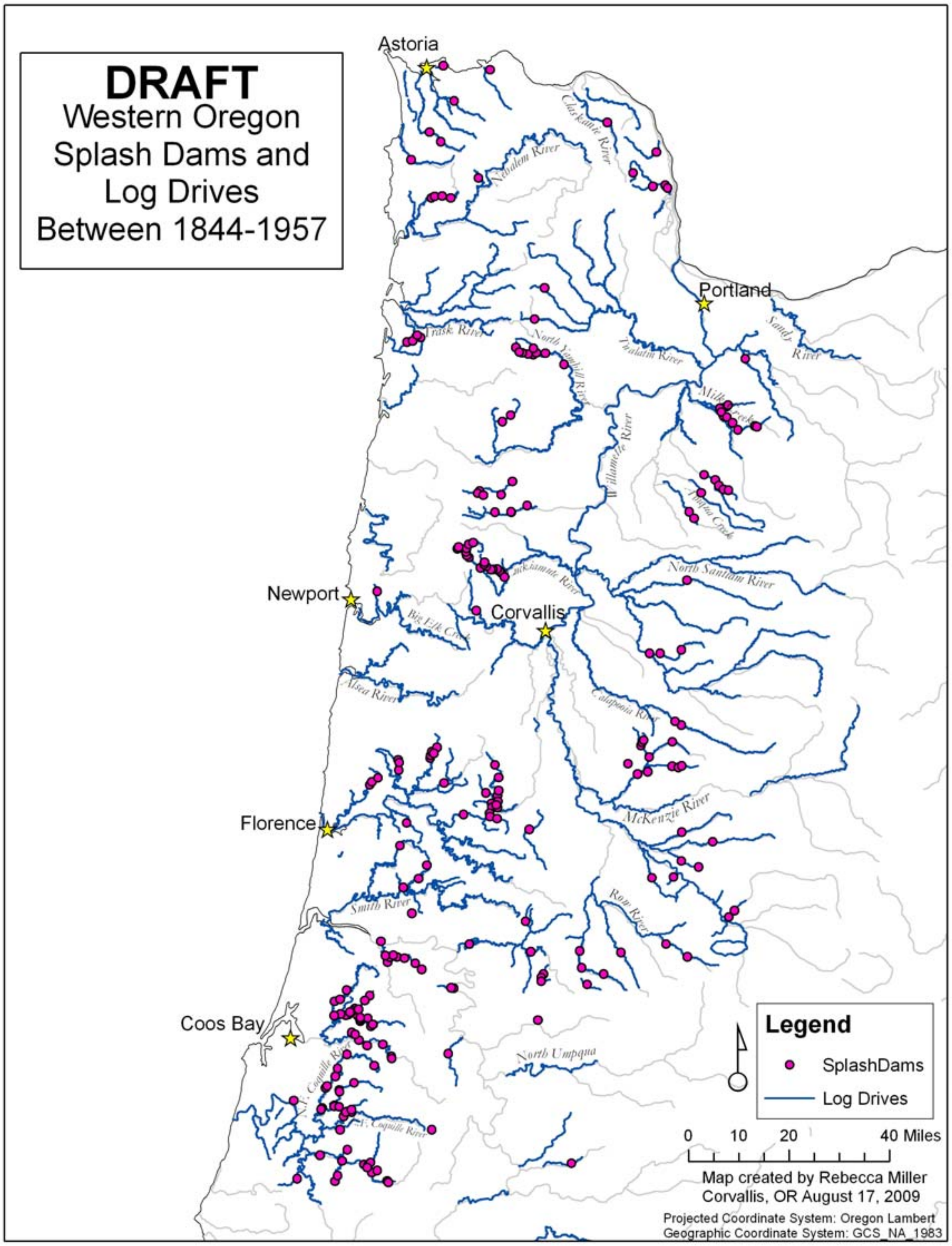
To provide context and help interpret results from the modeling components of project, Rebecca Miller, a MS student in the Department of Fisheries and Wildlife at OSU, is mapping the location of historical splash dams and comparing recent habitat conditions between areas that have and have not been splash dammed. A draft map and geodatabase of 231 splash dams sites from 1879-1957 was completed from historical records and museum accounts (Figure 1). The map also includes known locations of log drives between 1844 and 1957. The geodatabase contains attributes about each splash dam, such as the years of operation and assessment of location accuracy. The accuracy of dam locations was evaluated based on historical aerial photographs and ground searches. Habitat conditions between splashed and unsplashed locations were compared at both the reach and basin scales. Paired t-tests revealed differences in habitat conditions up- and down-stream of splash dams, including more bedrock and less large wood in reaches below than above splash dams. Similarly, paired ANCOVA tests identified differences between splashed and unsplashed basins in several habitat conditions, after accounting for basin area and gradient. A manuscript is being prepared for publication in a refereed journal and Ms. Miller intends to defend her MS thesis in June 2010.

Figure 1. Map of splash dams and log drives in Western Oregon derived from historical records and museum accounts.



Statistical Modeling of Coho Salmon

E. Ashley Steel (NOAA)

We have continued the progress on our first objective, developing statistical models for the entire Oregon Coast Range relating habitat and coho salmon to landscape characteristics.

We finalized the analyses for adult coho salmon at the randomly sampled sites. The analysis of this dataset required significantly more complex statistical analyses than anticipated because of the large number of sites with zero spawners in one or more years. We continued our analyses and developed a new framework for modeling adult spawners in which landscape conditions do not provide information to help us understand whether a fish is present (occupancy) but do provide information to help us understand, if even one fish is present, how many fish might be present (abundance). Presentations on this analysis were given at the Joint Statistical Meetings and many of us met at the Oregon Chapter of the American Fisheries Society Meeting to discuss the final results. The draft manuscript that was prepared last year has been significantly revised and a new draft is attached. It was submitted to Ecological Applications but was not sent out for review there. It will be resubmitted to a different journal by the end of the year.

We conducted analyses to link landscape conditions to the suite of instream habitat conditions known to influence coho salmon growth and survival such as amount of coarse wood, stream power, and percent pools. Despite the high levels of correlation between landscape predictors, we were able to develop a conservative estimate of how layered suites of predictors were correlated with instream condition and, in so doing, to estimate (conservatively) anthropogenic influences at the landscape scale on these instream variables. Kara Anluaf has written a draft manuscript and she is now finalizing and polishing it. Abstract is attached below.

Because of the high level of correlation between landscape-scale anthropogenic factors and natural landscapes, we have initiated some investigations into how landscape-scale correlation structure impacts our ability to detect and understand landscape-coho relationships. These initial analyses, conducted by Yasmin Lucero with Ashley Steel, are demonstrating that (1) there is a significant correlation between non-anthropogenic landscape features and anthropogenic features; and (2) this correlation structure differs by scale of observation, region, and anthropogenic impact. The first set of analyses is complete (see figure 1 as example) and they need to be written up. A simulation exercise will build on these analyses to quantify the effect on coho-landscape models.

(a) (b)

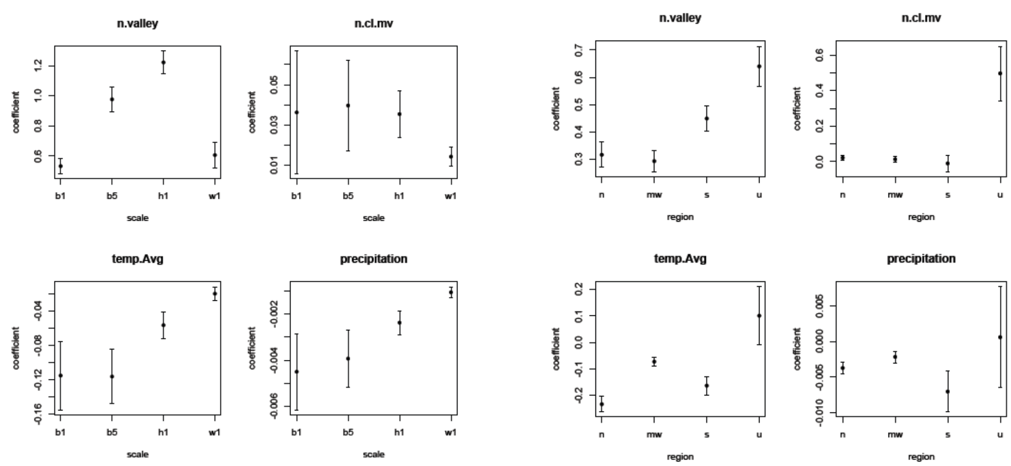


Figure 1: Model coefficients for a model predicting light land-use (rural residential, agriculture, suburban) across the Oregon Coastal Coho monitoring network divided by scale and by region. The four most significant variables are n.valley (proportion of the area or influence designated as valley), c.cl.mv (proportion of area of influence that is of mafic volcanic geology), temp.avg (average temperature), and precipitation (area weighted mean of modeled precipitation from PRISM). The y-axis in all plots is the model coefficient. (A) The x-axes represent the four spatial scales or areas of influence: b1 = 100m buffer; b5 = 500m buffer; h1 = all 6th field HUs touching the survey reach; w1 = watershed draining to the survey reach. (B) The x-axes represent the four regions: north, midwest, south, and Umpqua. From these figures one can see that the relationship between the predictors and light land use varies across scales with valley, for example, having no predictive ability at the smallest and largest scales but having a strong predictive ability at intermediate scales. One can also see that the correlation is quite different in the Umpqua region than in the other regions.

A mechanistic approach to explain the variation in coho salmon (*Oncorhynchus kisutch*) habitat across the landscape

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Abstract

Patterns in local habitats and species assemblages will vary dependent on the landscape features in which they are positioned. In this study, we describe the spatial patterns present in twelve instream habitat features as a function of landscape composition. We focus on the mechanistic relationships that drive the presence and complexity of aquatic habitat. In an attempt to disentangle anthropogenic landscape effects, we separated and summarized landscape factors within each watershed into three groups: 1) stream power indicators, 2) immutable or un-managed factors, and 3) management influenced factors. We used stream reaches across the coast of Oregon, selected from a probabilistic, spatially balanced sample design. We applied three linear regression models in sequence based on the groupings above; final models were composed of the landscape factors from each group that best described the spatial variation seen in instream habitat. Landscape variables representing indicators of stream power best described active channel width the percent of fine sediments in a reach. All habitat models were improved with the addition of immutable landscape factors, with wood volume and unit level complexity most influenced by these factors. Management influenced landscape factors accounted for a portion of the variance in each of the habitat variables, with the largest response seen in wood volume and pool frequency. These results highlight the importance of assessing spatial patterns in stream habitat from a landscape perspective in order to glean more pertinent details about finer scale complexity. Additionally, by segregating management influenced factors from more immutable or natural gradients, we are able to identify those habitat variables more sensitive to land use pressures.

Dynamic Landscape and Coho Salmon Modeling

Peter W. Lawson (NOAA)

A postdoc, Dr. Mark Meleason, was hired in early 2009 with expertise in large wood modeling. He has worked with Dan Miller to develop the dynamic landscape model, incorporating forest growth, forest fires and landslides, parameterized to Oregon Coast Range forests. He is developing the model structure needed to link the landscape model with the coho salmon model.

Major Accomplishments:

a. White Paper: Synchronization of climate variables in the models used in the Coho Landscape Project. This paper outlines a suggested approach for climate synchronization for the models within the Coho Landscape Project and a suggested approach for model "training" and validation.
b. White paper: Coho Landscape Modeling Project: Getting wood into the stream. Figure 1 describes how the models GNN, ZELIG, SUMMARIZ, LAMPS, and the Landscape Model were linked to provide wood recruitment to the stream in the CLAMS project, which is the approach adopted for the Coho Landscape Project.
c. Development and testing of fire prescriptions for the forest model ZELIG (Figure 2). These fire prescriptions can be used in long-term simulations that attempt to reconstruct the past and predict the impacts of global warming.
d. Extend ZELIG runs beyond the 100-yr simulations conducted for the CLAMS project. We now have the capability to include the influence of fire and other large-scale disturbances (e.g., disease, wind throw). A series of 1000-yr simulations (Figure 3) were conducted to test and refine model performance. In addition, a program was written to summarize the results.
e. Assessment of ODFW's stream wood inventory to provide initial wood standing stock to reaches without wood inventories. The method to populate these reaches is almost complete and is based on landownership (Figure 4).

Work in 2010 will include developing linkages between instream habitat from the dynamic landscape simulations and coho salmon life history stages, developing and running the coho model, exploring model behavior, and preparing manuscripts.

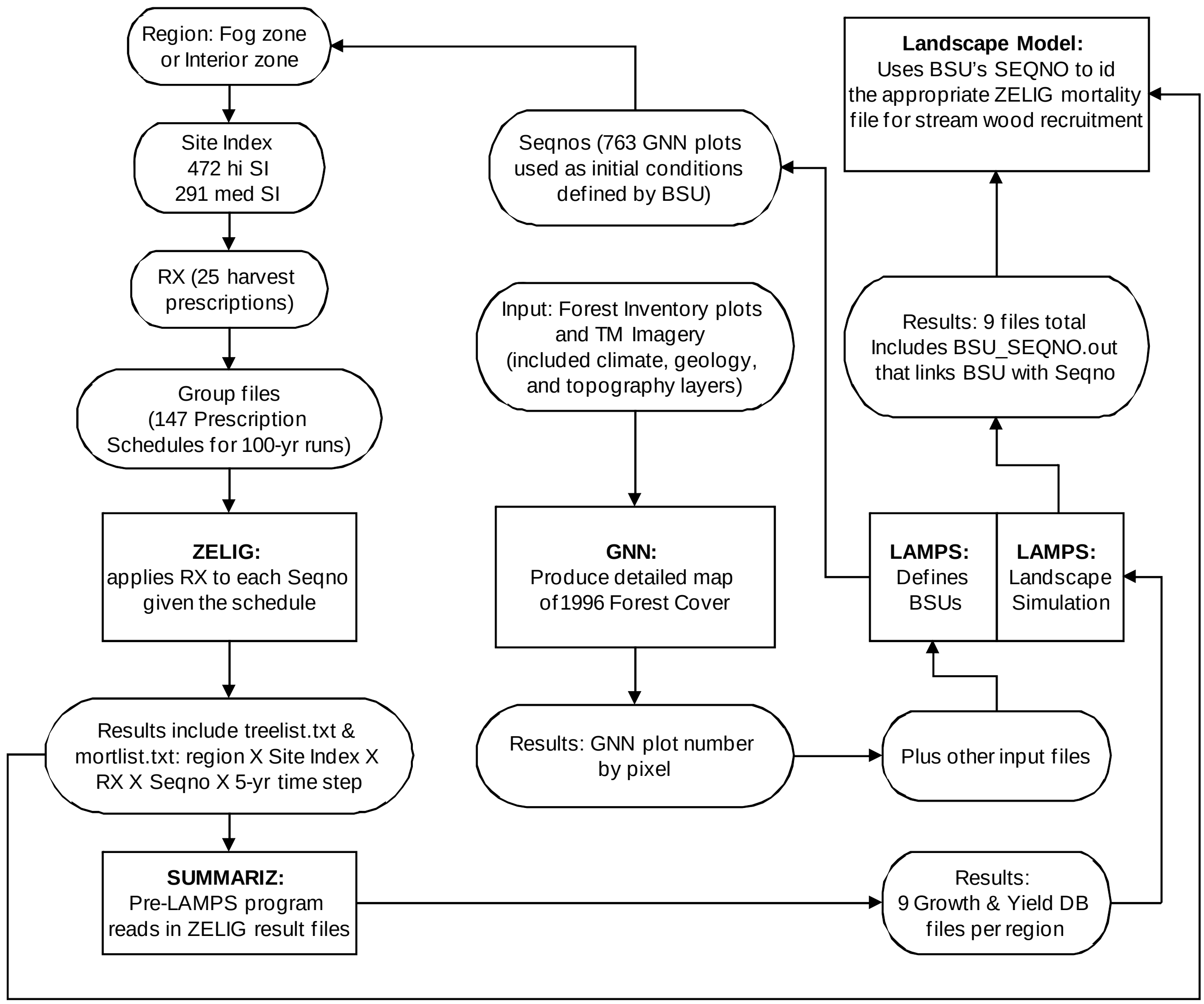

Figure 1. Flow diagram representing the procedure used to deliver wood to the channel. The GNN (gradient nearest-neighbor analysis) model (Ohmann and Gregory 2002) produced a detailed geo-referenced description of forest cover in western Oregon. The LAMPS model uses these data and other input files to define BSUs (basic simulation units – adjacent pixels with the same forest and management prescriptions) within the study area. Each BSU contains a seqnos, which consists of an initial tree list (GNN plot) and a suite of forest management prescriptions for 100-yr simulations. Forest simulations were conducted in ZELIG for each Seqnos by prescription (147 prescriptions possible for each GNN plot), zone (fog and interior), and site class (high and medium). The results of the ZELIG simulations were summarized with the program SUMMARIZ, which were read into the LAMPS model. Landscape-level management scenarios were conducted in LAMPS and the results include a file that links SEQNO to each BSU, which is used to access the appropriate ZELIG tree mortality file that is used for wood recruitment to the stream.

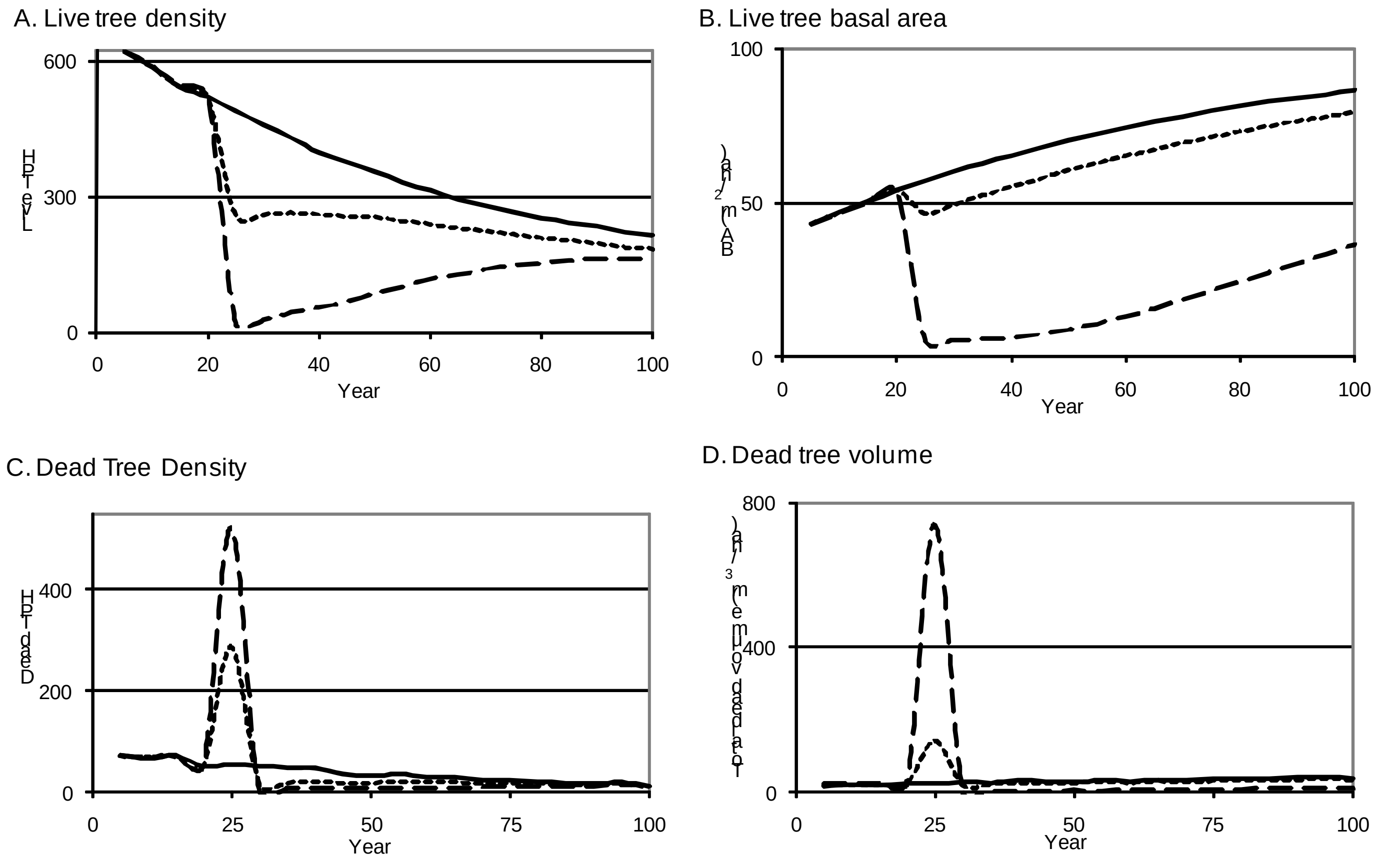

Figure 2. Simulation results illustrating the fire prescriptions added to the CLAMS ZELIG model. These simulation results are the means from 20 plots simulated for 5 iterations of 100 years using a 5-year time step. The fire prescription was applied at year 25. Fire prescriptions were based on the thin-from-below as a proportion of stems on the plot. The three fire prescriptions presented below are as follows: no-thin (solid line), 50% thin (short dash), and 100% thin (long dash). Note that the 50% thin-from-below by live tree density (A) results in a <50% reduction in basal area (B). Also, although the live tree density from the three simulations are similar at year 100 (A), the basal areas are not (B). Note that the dead tree density (C) and dead tree volume (D) are for each 5-year time step.

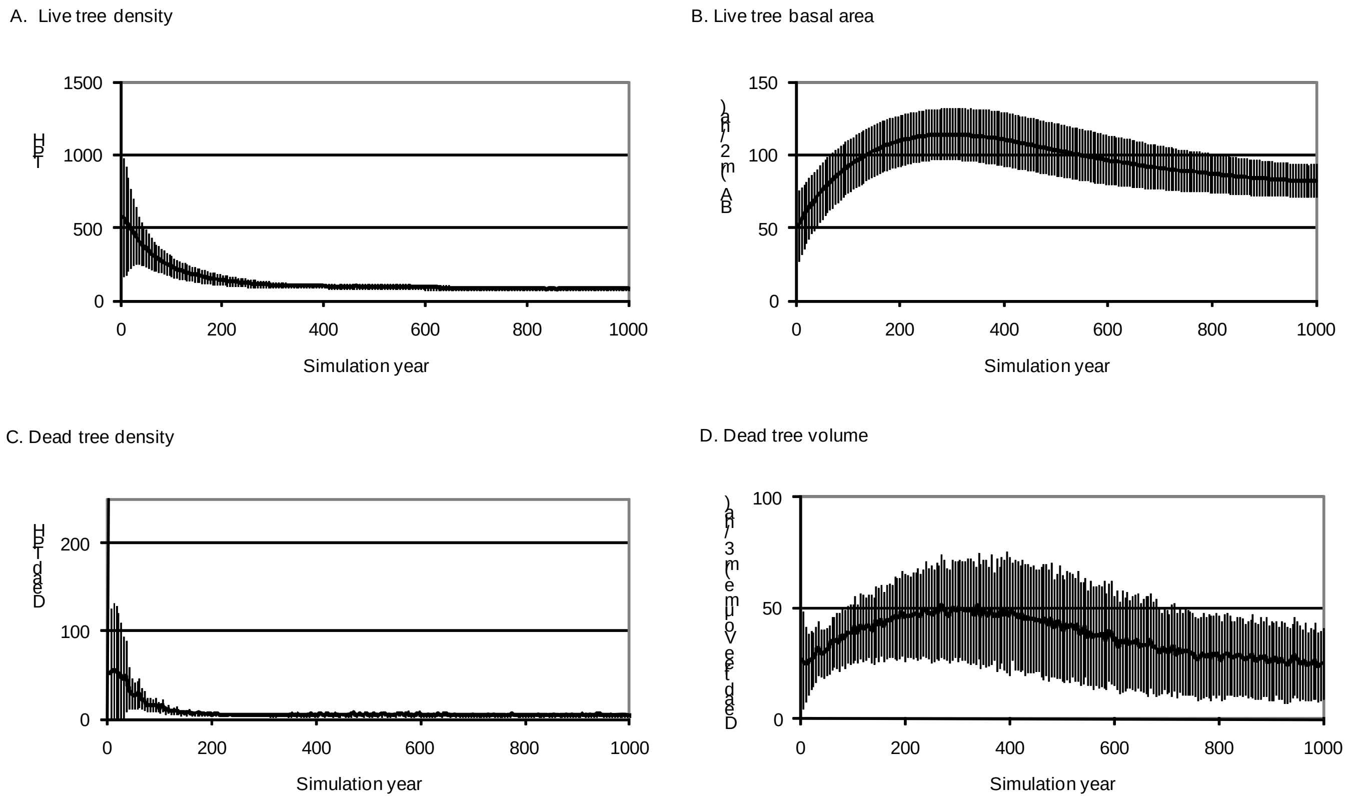

Figure 3. The 1000-yr simulations (5 iterations) for the interior region, high site class (n = 763) using the CLAMS ZELIG forest gap model. Error bars are ± 1 standard deviation. These simulations are a departure from the 100-yr simulations used in the CLAMS project and will serve as the baseline for the inclusion of additional forest disturbance regimes such as fire. A separate model was written to summarize the ZELIG results.

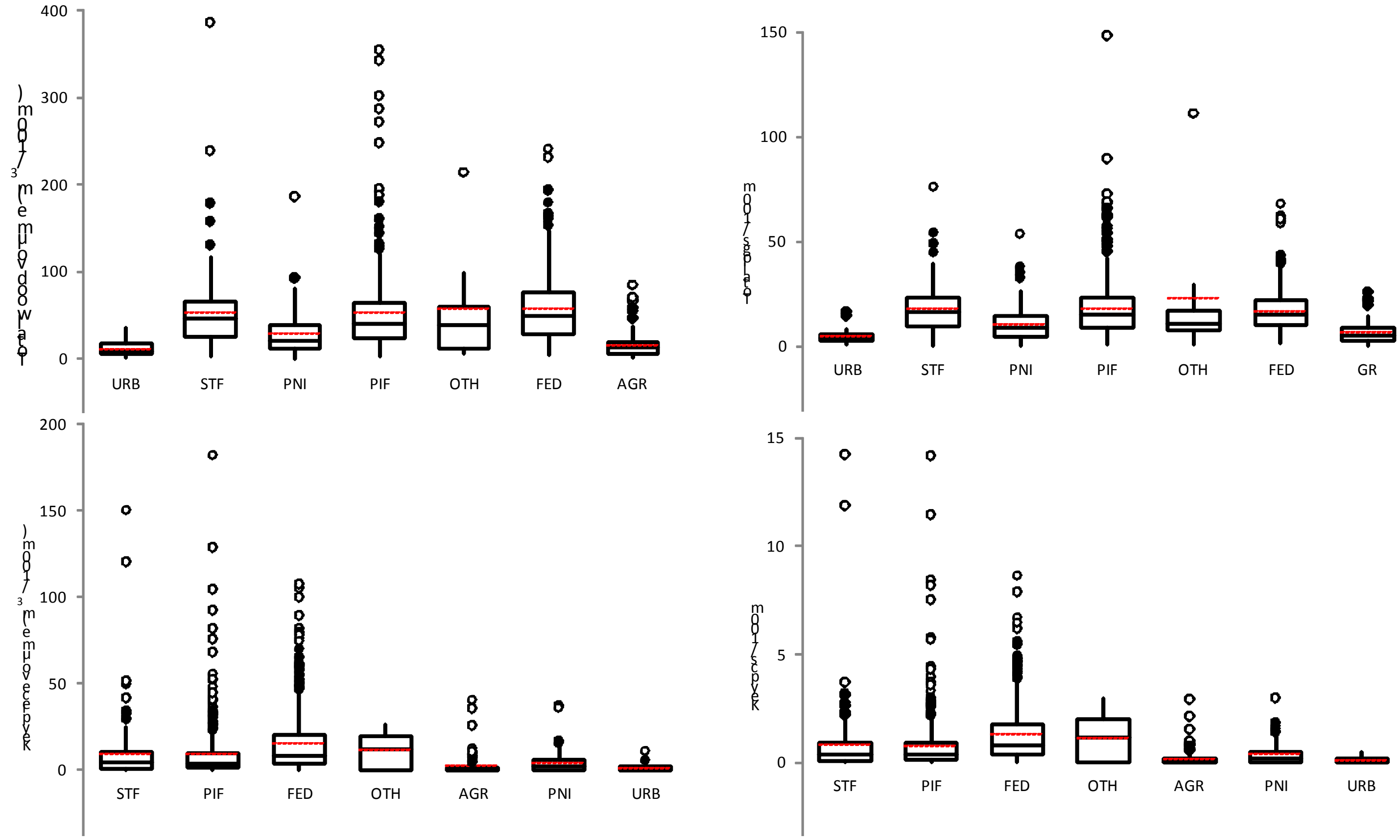

Figure 4. Summary ODFW wood survey data by ownership. These data are the basis for estimating the initial standing stocks of wood in stream reaches without wood inventories. Landownership categories are as follows: URB = urban, STF = state forest, PNI = private, non-industrial, PIF = private industrial forests, OTH = other, AGR = agriculture, FED = federal forest lands and AGR = agricultural lands. Data for this analysis are courtesy of ODFW's Aquatic Inventory Program. Key pieces are logs ≥60 cm diameter and ≥12 m in length. The boxplot presents the inner quartile range (IQR, 1st and 3rd quartiles are the bottom and top of the box respectively), median (bold line within the box), and mean (red dashed line). The "whiskers" extend to 1.5*IQR, filled circles are outliers beyond the whiskers but within 3*IQR, and open circles are outliers > 3*IQR.