Long-term Ecosystem Productivity: Integrated Research Sites

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Abstract

A set of four installations of a long-term ecosystem productivity experiment is being installed in Oregon and Washington. From this, an integrated 200-year study will be conducted to evaluate a variety of ecological conditions in managed forests, across a range of ecosystems. Each installation or Integrated Research Site has at least three replications of four whole plot treatments to evaluate ecological conditions with differing species composition and abundance. Each whole plot treatment is divided into 6-hectare subplot treatments to examine the effects of different levels of residual organic matter. The design of each subplot allows for both stand-level and substand-level assessments of the different treatments.

Key words: *biomass, Integrated Research Sites, long-term ecosystems productivity, net primary productivity, species composition, organic matter*

An extended debate among scientists, managers and citizens led to the development of two sets of treatments for the Integrated Research Site experiments: studying long-term effects of changes in plant composition (roughly early-, mid- and late-seral groupings); and organic matter removals in a factorial design. Concern was based on the simple truth that rotations of plantations sharply reduce the time that both early- and late-seral species occupy the land relative to historical succession patterns. Hypotheses were that these early- and late-seral species affect the land differently than do conifer plantations (mid-seral). Organic matter treatments were prompted by concern that removal of organic matter may have negative effects on nutrient supply, soil structure and wildlife.

Although many other important questions could have been addressed, the issues regarding species and organic matter were thought to have a continuing, rather than one-time, effect on ecosystem development and productivity and was best addressed in a large, stand-scale experiment extending over many decades. By encompassing a broad range of future possible management strategies, rather than focusing on current management ideas, this experiment differs substantially from many traditional silvicultural trials.

The Integrated Research Site Experiment is regional. Installations are distributed across Oregon and Washington on the Siskiyou, Wenatchee and Willamette National Forests in the Pacific Northwest Region of the United States Department of Agriculture Forest Service and

the Olympic Experimental Forest of the Washington Department of Natural Resources. By testing species composition and organic matter treatments across a variety of ecosystems, we hope to broaden our scope of inference. Land managers are acting in partnership with the Pacific Northwest Research Station, scientists from Oregon State University, University of Oregon, University of Washington, the Olympic Natural Resource Center and interested members of the public.

The Integrated Research Sites are designed to evaluate how to sustain long-term ecosystem function and productivity by examining the inter-relationship among species composition, soil properties and organic matter over several rotations. The treatments will be assessed and compared in many ways by scientists and resource managers representing biological, physical, economic and social sciences. Vegetation, wildlife, soils, special forest products, climate, economics, public perception and social concerns will be examined. This ecosystem study will provide managers, scientists and the public with a better understanding of different strategies to manage forests and trade-offs with ecological, social and economic values. Specifically, it will evaluate the ability to maintain soil productivity, fibre production, and an array of plant and animal species, and determine the level of public acceptance of the treatments.

Each site has at least three replications of four whole plot treatments that evaluate a range of ecological conditions with differing species composition and abundance. Treatments are accomplished through promotion or retention of 1) early-seral species, 2) mid-seral species, and 3) late-seral species and structure, and 4) through no intervention, allowing natural succession to occur. The resultant differing guilds of plant species that dominate these stands will uniquely influence soil and aerial environments, and thus ecosystem function and productivity. The trees on the Integrated Research Sites currently range from 50 to 110 years old.

Each whole plot treatment is divided into subplot treatments (6 hectares each) to examine the effects of organic matter inputs. Treatments are accomplished by leaving a range of organic inputs after harvest–scaled as a percentage of current standing biomass for each site. With the relatively large plot sizes needed to examine stand-level response in this long-term study, a split plot design allows efficient use of the limited land area available. Most of the installations are located in mountainous terrain, where it is difficult to find a sufficiently uniform area to place a block of 10 treatments. Priorities were established so that if space was limited, the middle organic matter treatment for each seral treatment is dropped.

Within each subplot, there is a centrally located mensuration plot to be used for non-destructive sampling to assess stand-level response. Mensuration plots are 1.5 hectares and are either square or rectangular. The boundaries of each mensuration plot are located at least 30 m from a subplot boundary with a different seral treatment to allow for adequate aboveground buffering. Mensuration plot dimensions are 125 m x 125 m, 175 m x 100 m, or 225 m x 75 m. A 25 m measurement grid is established in each mensuration plot. The area outside each mensuration plot is available for small plot studies and destructive sampling. Additional areas for destructive sampling for biomass equation development are also available outside the plot boundaries.

All research on each site is screened by a site manager and science adviser before

implementation. Integration with other research and implementation of a research quality assurance plan are emphasised.

Pretreatment measurements of tree and understorey species composition, biomass, net primary production, soil organic matter, nutrient content and distribution, climate and social perceptions (photo monitoring and evaluation) have been completed on the installations. Additional measures of birds, small mammals, amphibians, mycorrhizae, and fungal sporocarp abundance and diversity are completed on some installations. Treatments will be implemented on some Integrated Research Sites in 1996.