Forest regeneration experiment of 30 years yields results

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Looking southeast, this photo shows part of regeneration treatment research area in the Bonanza Creek Experimental Forest in 1986, one year after the treatment and three years after the area was burned in the Rosie Creek Fire. Credit: Roseann Densmore

A spruce forest regeneration experiment in Interior Alaska that spanned

nearly 30 years demonstrates which forest management practices produce the best results.

The experiment, launched by three Fairbanks scientists, looked at different combinations of ground treatments to reduce competition from other vegetation and of regeneration methods, such as planting spruce seedlings and broadcast seeding.

The results, published Aug. 19 in the journal *Forest Ecology and Management*, showed that planting white spruce seedlings is the best way to produce a spruce-dominated stand after 28 years. Broadcast seeding was the next most effective method. The two options were the most expensive among those tested.

University of Alaska Fairbanks forest ecologist Glenn Juday, who helped establish the experiment in the mid-1980s and is a co-author on the paper, said the recent research shows the environmental and management situations in which different techniques work best and the situations in which they are unnecessary or even counterproductive.

Juday was a young professor in 1983 when fire swept through the Tanana Valley State Forest southwest of Fairbanks, burning 8,600 acres. The Rosie Creek Fire, whipped by wind, burned into a section of the forest known as the Bonanza Creek Experimental Forest.

Juday and two other scientists, John Zasada and Roseann Densmore, realized that the fire provided a perfect setting for a forest regeneration experiment. They wanted a controlled set of experiments to test which methods worked best to establish white spruce.

White spruce is the Interior's most valuable commercial species but also the most difficult to re-establish, said Juday. Other species, such as birch, establish or resprout readily, grow faster and compete with spruce.

The rectangular plots of dark green vegetation in this 2014 aerial photograph show white spruce thriving in the forest regression test area established almost 30 years earlier. Credit: Ryan Jess

"Regenerating white spruce is our biggest challenge," he said.

The researchers established a 66-acre treatment area in 1985. The plots received four different types of ground treatments to reduce competing vegetation and five different white spruce regeneration treatments, including planting seedlings and broadcast seeding. Some control plots were left to regenerate naturally.

Results from the research were published in a 1999 article that concluded adequate numbers of spruce were established in most treatments. But in 2010, Juday took an aerial photograph that showed much more definitively how the treatments had worked.

"After another decade, it was a lot more obvious who the winners and losers were," he said.

It was time to revisit the experimental area, now known as the Rosie Creek Fire Tree Regeneration Installation. With the help of an assistant, Juday located nearly all of original metal corner posts of 180 plots, which ranged from 40 by 40 meters to 40 by 60 meters.

In 2013 and 2014, while earning a master's degree in natural resources management, Andrew Allaby worked with Juday to design a project that would re-examine the type of trees and the total growth in the plots.

Allaby sampled the trees on 135 of the plots, measuring about 10 percent of the trees in each, and he measured all trees in six plots to check the sampling system. Allaby analyzed the total biomass, stand density and basal area, which is a cross-section of the surface area of a stump if the tree was cut at chest height. Brian Young, who worked for the Division of Forestry and had just completed his doctorate at the University of Alaska Fairbanks, helped with the analysis of the data and on the paper.

Two-year-old spruce seedlings planted in the treatment area in 1985 grow rapidly as shown in this photo, which was taken three years later. The ground vegetation is horsetail and fireweed, a ground cover favorable to white spruce. Credit: Glenn Juday

Their research shows that white spruce basal area in the planted seedling plots was six times greater than in the naturally regenerated plots, and the number of white spruce stems in broadcast-seeded plots was three times greater.

Juday said that when the regeneration experiment began, the production of new stands of large white spruce was the goal almost exclusively. Now some forest landowners want wood of any type for biomass energy and the regeneration installation provided useful information about other trees.

The ground treatments did not have a significant effect on the spruce regeneration but it did encourage an increase in the size and density of birch trees. The researchers also found differences between which regeneration practices worked best on the upland slopes and the ridgeline. The distance from unburned seed sources also made a difference.

Juday is excited about the research, which was supported by a state capital appropriation. Overall, the study is one more important piece of information that shows the state's reforestation practices are working, he said. The Alaska Constitution calls for sustained yield on forestlands. Now this study and a recent long-term study by another graduate student, Miho Morimoto, have directly examined the regeneration of harvested

forestlands.

"We've got much more evidence now that the regeneration practices have worked," Juday said.

As part of timber sales, the Division of Forestry evaluates each site and prescribes different regeneration techniques, based the topography of an area, the distance from seed sources and other considerations. Some of the more successful regeneration treatments examined in the study, including ground treatments, broadcast seeding and planting seedings, are among the treatments required by the state, said Juday.

A science and technical committee established by the Division of Forestry used the new information and research from the Bonanza Creek Long-Term Ecological Research site to revise state reforestation standards.

More information: Andrew C. Allaby et al, Early white spruce regeneration treatments increase birch and reduce aspen after 28 years: Toward an integrated management of boreal post-fire salvaged stands, *Forest Ecology and Management* (2017). DOI: 10.1016/j.foreco.2017.07.047

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