Results from the Willow Island Study

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Background

Willow Island is a 520-acre island in the Tanana River, just outside the boundary of Bonanza Creek Experimental Forest. In the early 1980s, John Zasada of the PNW Research Station's Institute of Northern Forestry began a large silvicultural experiment there. This document is a brief summary of results from Willow Island, both from the time the study was set up, and from John's and my re-evaluation in 1999 through 2002.

Pre-Harvest Work

The terraces and forest types on Willow Island were mapped before harvest (Juday and Zasada 1984). Before this project began, about 75 percent of Willow Island had white spruce forest characteristic of stage VIII and IX forest types (fig. 1; Viereck et al. 1986). About 10 percent of the island had Stage X vegetation. This mapping proved to be useful in understanding what happened after harvest.

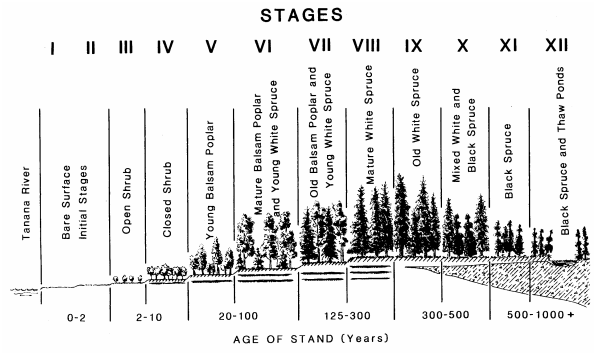

Fig 1. Idealized floodplain successional sequence.

Fig. 2. Willow Island terrace map (from Juday and Zasada 1984)

Fig 3. Height growth histories of mature white spruce trees on each of three Willow Island site types (data from Zasada 1984)

Analysis of individual trees from the stand on each terrace revealed markedly different growth histories (fig. 3). Dominant trees on the stage VIII site had reached 30 m in height in about 140 years, while those from the stage IX site had taken almost 300 years to grow that tall. On the stage X site, dominant 300-year-old white spruce trees were only 20 m tall. We attribute this to declining soil temperature as the sites age.

Treatments

The ice bridge that was built to get to Willow Island is one of the first ice bridges built in interior Alaska. Logging was done from January to March, 1983, and whole trees were skidded to landings. Fire lines were constructed with a bulldozer around units 12 and 16. Three different overstory treatments were used: clearcutting, and two levels of shelterwood cutting.

Fig 4. Willow Island treatment and unit number map.

The two shelterwood treatments were:
(1) closely-spaced, where 100 trees were left per hectare at approximately 9 m (30') spacing, and
(2) widely-spaced, with 60 residual trees per ha at approximately 14 m (45') spacing.

The residual shelterwood trees were never logged off. Portions of all sites were scarified with either a blade or a patch scarifier the following summer, and portions of the stage VIII and stage X sites were broadcast burned in July, 1983 (Fig. 4; Zasada and Norum 1986). Unit 12 was burned severely and uniformly. Unit 16 was burned on two separate days, yielding a lightly burned portion and a severely burned portion. Slash piles were burned in most units. Containerized (Ray Leach) seedlings were planted, and seeds sown, in a variety of different experiments across the island (see below). Thousands of additional seedlings, not part of any particular experiment, were planted in harvested areas. Notably, in 1987, there was an exceptionally large spruce seed crop, which introduced millions of natural seedlings to the island. Youngblood and Max (1992) documented a mean 1987 seedfall of 390 filled seeds per m^2.

Results

Soil Temperature

The Willow Island study first documented the fact that timber harvest and site preparation warms the soil (Dyrness et al. 1988). Dyrness recorded no significant differences in soil T between clearcut and shelterwood units, but both were significantly different than uncut forest (fig. 5).

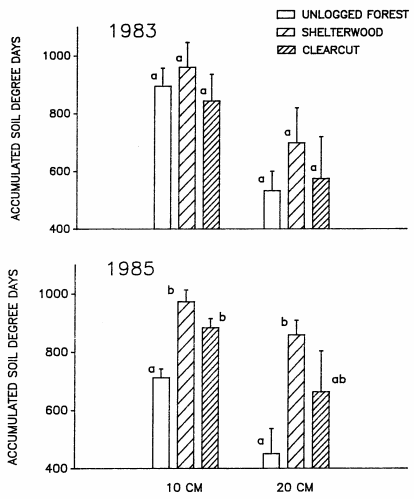

Fig. 5. Soil degree days (0 °C base). Data from all three sites are combined in this figure. There were no differences in 1983, but by 1985 differences had developed between treated units and unlogged controls (Wurtz 1988).

Broadcast burning had the largest effect on soil T (fig. 6). Dyrness did not compare the soil T status of areas subjected to different mechanical site preparation. He collected his last measurements in 1985; we hope to re-measure soil T to see if the differences have persisted.

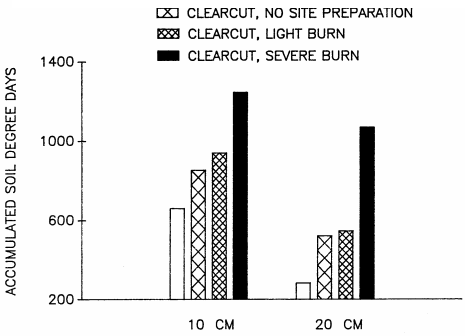

Fig. 6. Soil degree days (0 °C base) for the 1985 growing season on the stage X terrace (Wurtz 1988, using data from Dyrness et al.1988).

Residual stand mortality: In 1999 and 2001, we collected data on the fate of the residual trees in the shelterwood units. About 50 percent of the residual trees were dead, either standing dead, blown over, or broken off. Mortality ranged from a high of 70 percent in unit 4 to a low of 28 percent in unit 14. Twenty-eight percent of the trees in the sample had logging damage, but there seemed to be no relationship between logging damage and mortality. Bob plotted the direction of fall for trees that had either blown down or broken off (fig. 7); there was a strong trend in the direction the trees fell, related to summer prevailing wind direction.

We experienced this first-hand; on one windy day in August 1999, we were working in the shelterwood units and could hear trees falling frequently around us. When we returned to our backpacks, we had to dig them out from beneath a newly-fallen tree.

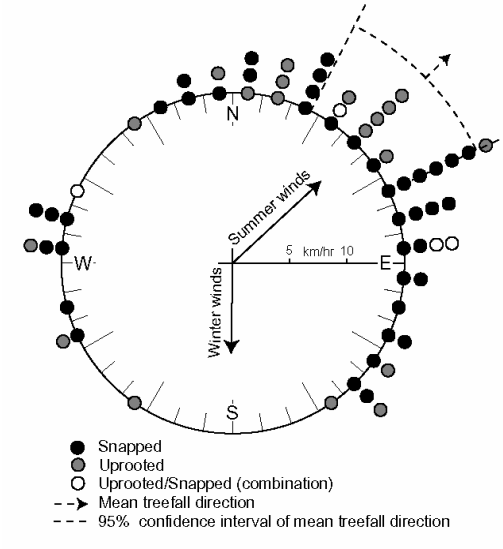

Fig. 7. Direction of fall of Willow Island shelterwood trees. Each dot represents one tree.

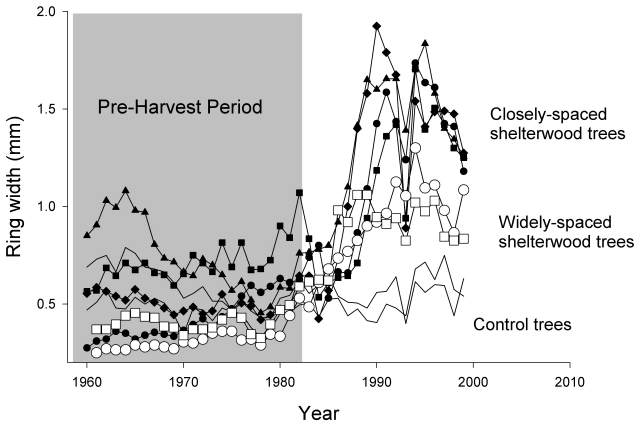

Fig. 8. Diameter growth of shelterwood trees that were still living in 1999.

After logging, shelterwood trees grew more rapidly than trees in nearby unlogged control areas (fig. 8). The larger increase in diameter growth by trees in closely-spaced shelterwoods (as compared to trees in the widely-spaced shelterwoods) may be related to increased solar radiation reaching the forest floor, causing drying and drought.

Other vegetation

From 1982 to 1985, Joan Foote collected extensive vegetation data on Willow Island. In 1999, we revisited some of her plots and collected percent cover estimates, woody stem density data, and tree and shrub growth data for all species. Figure 9 shows trends over time in percent cover of dead wood and two species, prickly rose and horsetail, as examples. I am currently working with these data, looking for trends and comparing them to similar data we have from a study off Zasada Road, in the upland of BCEF.

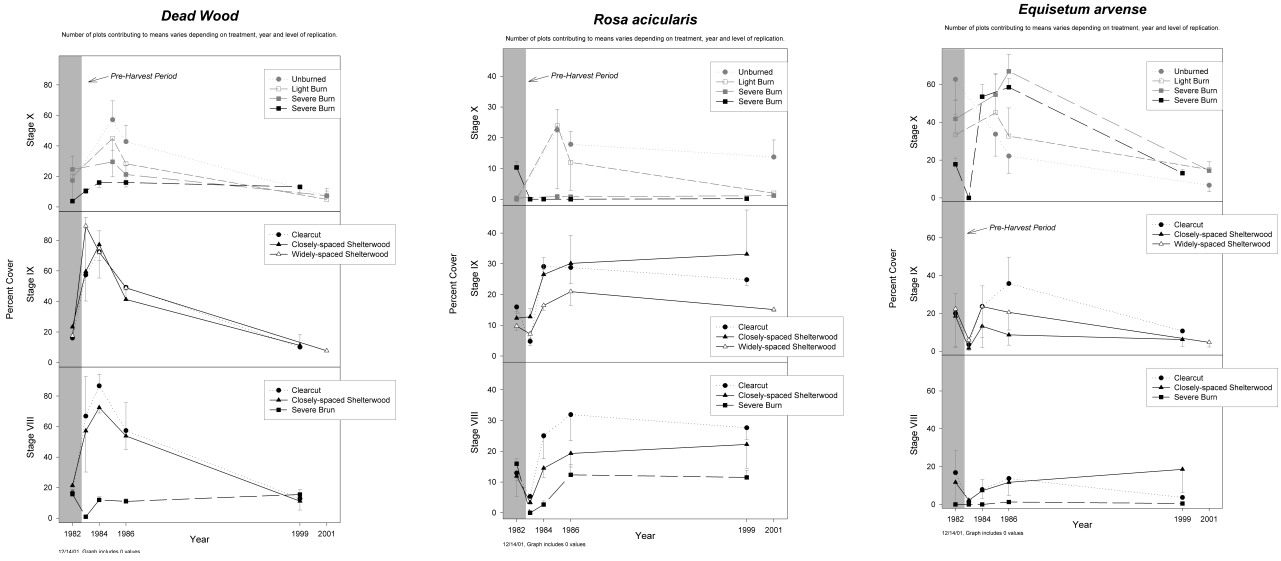

Fig. 9. Percent cover of down and dead wood, prickly rose, and horsetail on Willow Island, 1982 – 1999.