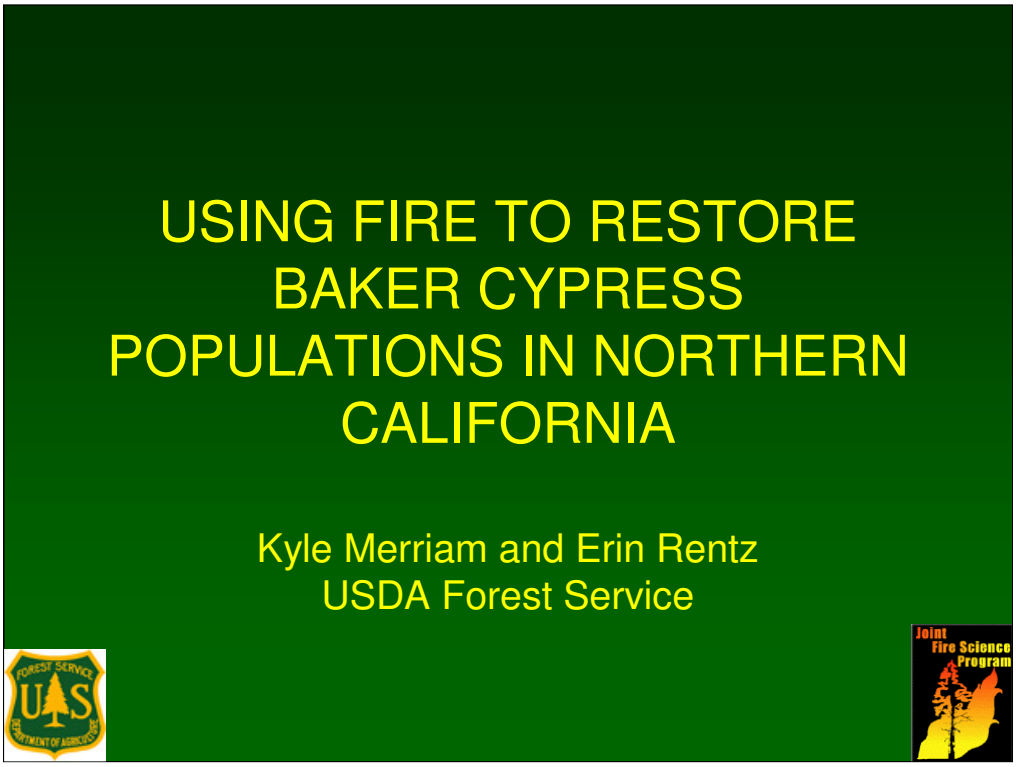


Today I would like to share some preliminary findings from a study examining the potential to use fire to restore populations of Baker cypress. This project is funded by the Joint Fire Science Program with cooperation from the USDA Forest Service.

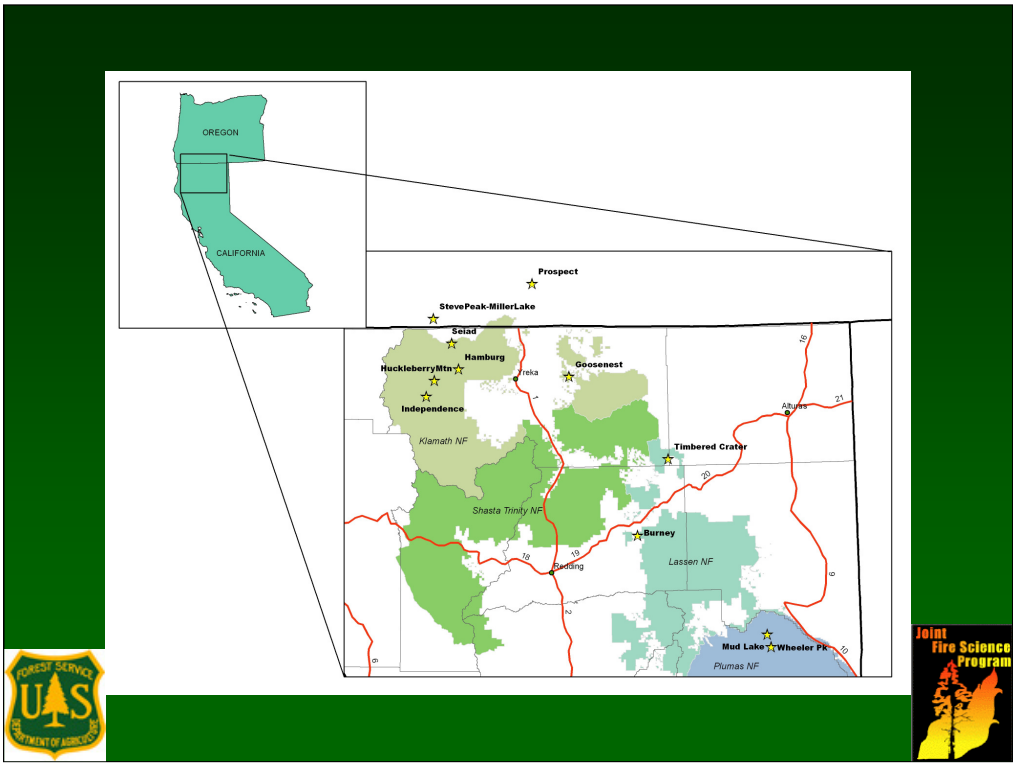
Prescribed fire is an important tool for reducing fuel loads and restoring forest ecosystems. Prescribed burning is most often used in forest types adapted to frequent, low severity fires, such as this ponderosa pine forest. Prescribed fires in these forest types can generally be burned with low flame lengths and slow rates of spread, making them relatively easy to control.

But how do we manage forest types adapted to high severity crown fires? This is a picture of the 1988 Yellowstone fire, a managed fire that escaped and eventually burned 1.2 million acres. Although this was seen as a failure for the park's fire management program, high severity, stand replacing fire is normal for this crown-fire adapted lodge-pole pine forest.

Many species are adapted to high severity fire. For example, Baker cypress (Cupressus bakeri) has closed, or serotinous cones, that require fire to open. Seedlings require high light and bare mineral soil in order to germinate. Most populations of Baker cypress occur in even aged stands established after fire.

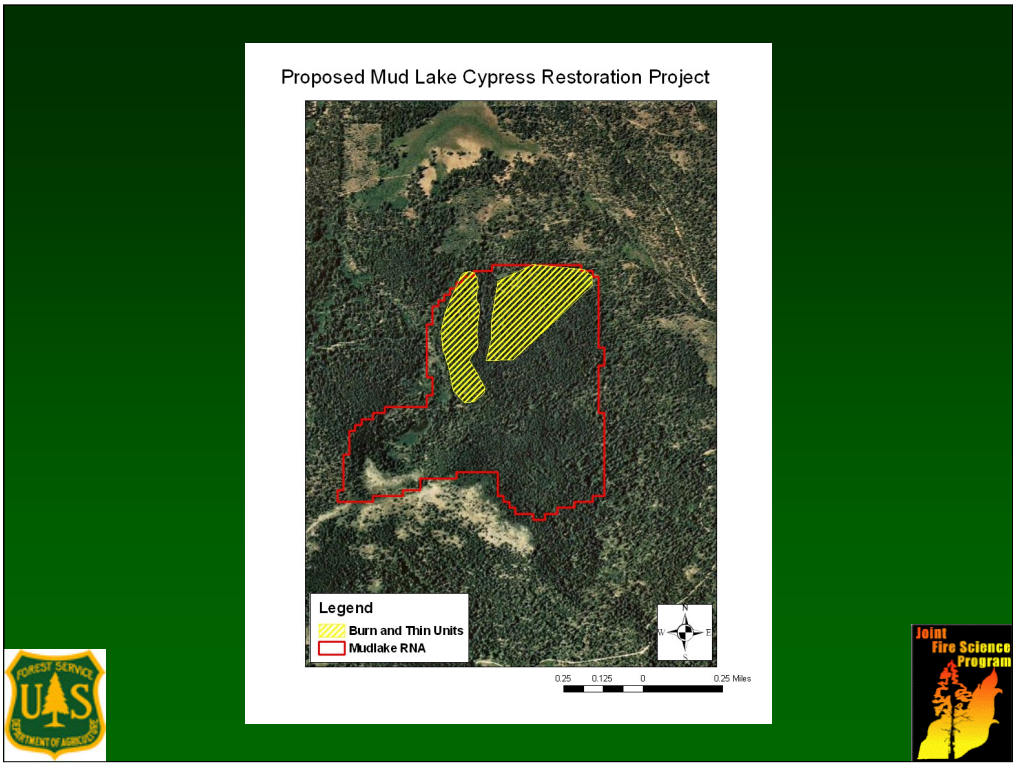
Canopy Seed Storage

Cypress store all of their seeds in cones that stay on the tree for its entire life. This canopy seed bank represents the lifetime accumulation of seeds produced by the tree. If a tree dies before these cones can be opened by fire, the entire seedbank is lost.

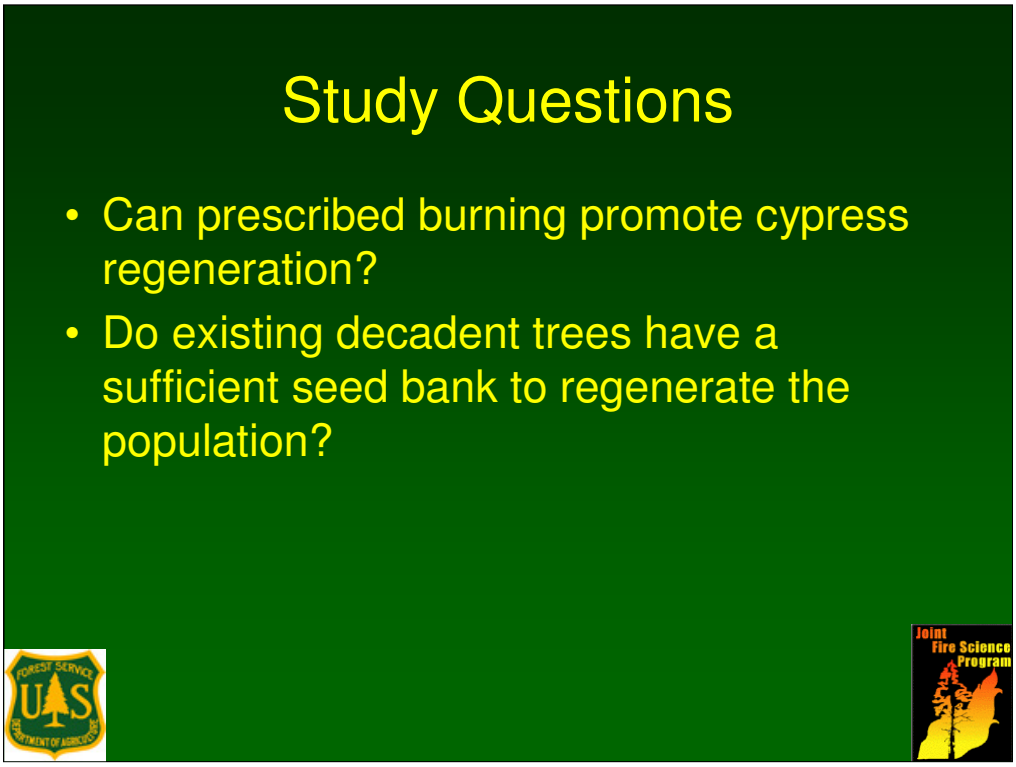


Baker cypress is a rare species limited to about eleven stands in northern California and southern Oregon. It occurs in widely disjunct locations, with over half the populations occupying less than 50 acres.

After a century of fire suppression, many Baker cypress stands are dying with no evidence of regeneration. Without reintroduction of fire, there is concern that these populations may be extirpated. For example, this population of Baker cypress at the Mud Lake Research Natural Area on the Plumas National Forest has gone almost a century without fire, and is heavily suppressed by competition with white fir. A large number of the adult cypress trees are dead or dying (point out yellow arrow). When the Mud Lake RNA was established in 1985, Todd Keeler Wolf wrote, “there is little doubt that the Mud Lake population of Baker cypress will lose out almost completely to white fir within the next several decades unless another fire occurs.”



In recognition of this, the Mt. Hough Ranger District of the Plumas National Forest developed a plan in 2005 to use prescribed burning and thinning to try and restore Baker cypress at this site.



We worked with the district to set up monitoring plots to address two primary questions: Can prescribed burning promote cypress regeneration? And: Do existing decadent trees have a sufficient canopy seed bank to regenerate the population?

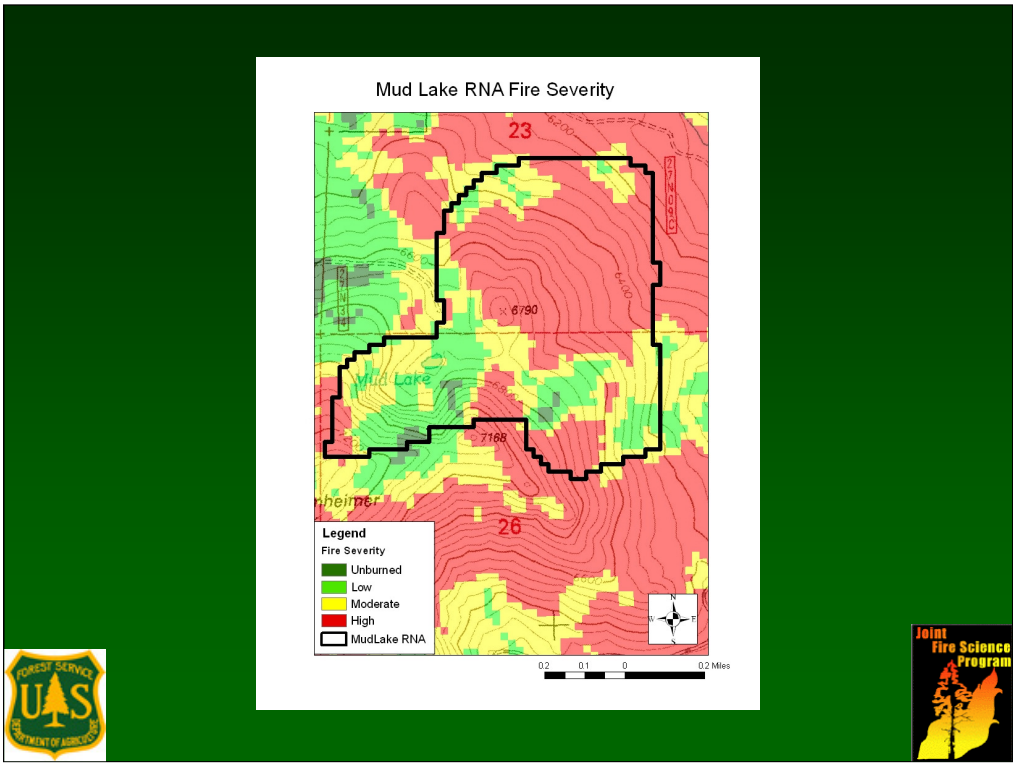
In 2007, before the project could be implemented, the Moonlight fire burned 60,000 acres across the Plumas National Forest, including the Mud Lake RNA.

These are pre- and post- fire photos from one of our plots at the Mud Lake RNA. They show a significant reduction in fuel loads and high tree mortality, which was typical across much of the Mud Lake RNA as a result of the Moonlight fire.

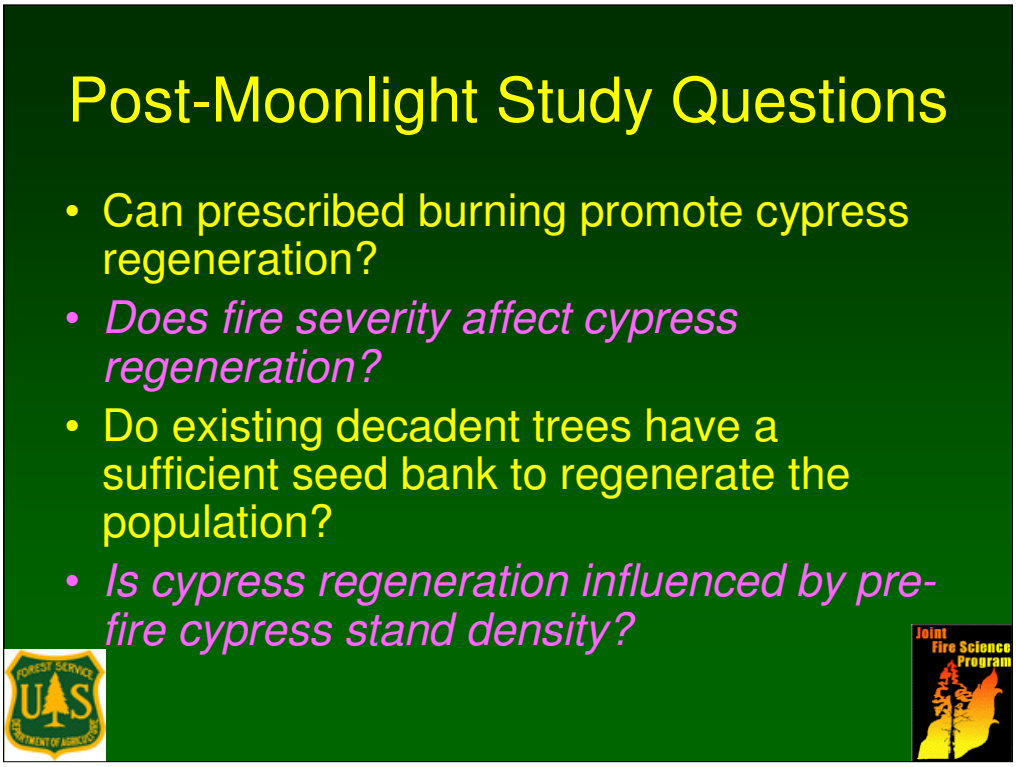
Much of the Mud Lake RNA looked like this after the Moonlight fire. What would be the response of the Baker cypress?

In the spring of 2008 we had our answer!

The forest floor was a literally a carpet of Baker cypress seedlings in some areas of the Mud Lake RNA.



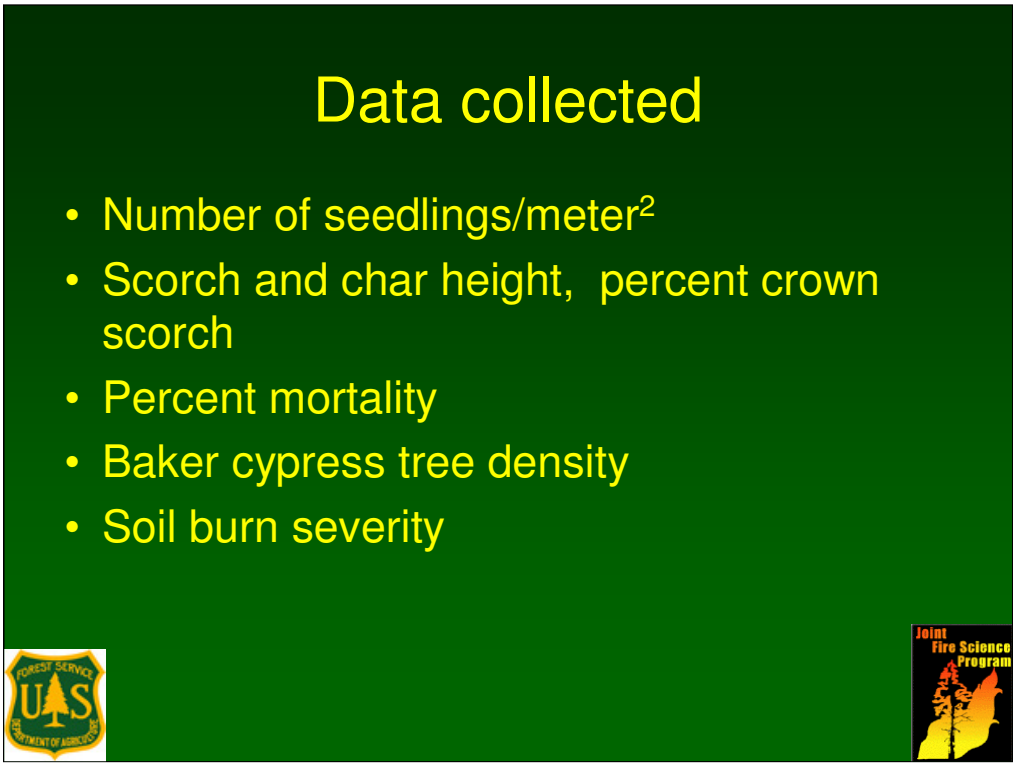
However, patterns of vegetation fire severity mapped with remote sensing showed that 20% of the Mud Lake RNA had burned at low severity, shown on this map in green. Perhaps these areas could shed light on the types of effects a typical prescribed burn might have had?



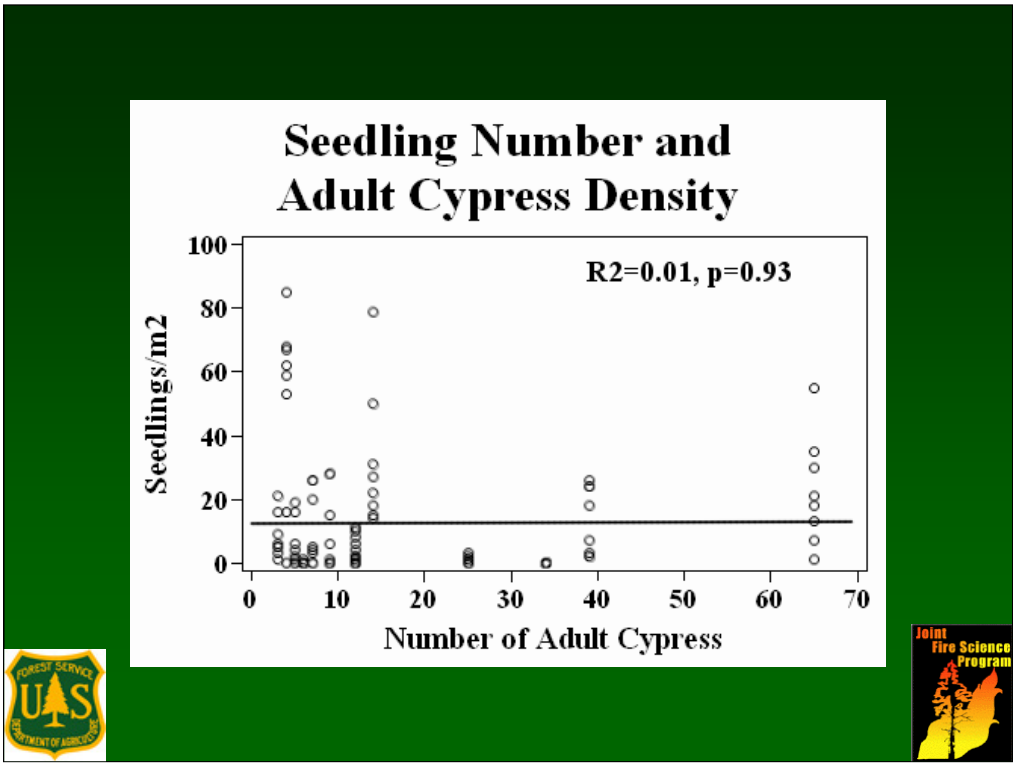
So, we decided to revise our original study questions to take advantage of this opportunity provided by the Moonlight fire as follows:

Instead of asking if prescribed burning could promote cypress regeneration, we could now look at the effect of fire severity over a range of values, including those that might be typical of a low-severity prescribed burn. We revised this question to ask: Does fire severity affect cypress regeneration?

Because the cypress population at Mud Lake varied greatly in density, we could also revise our question about how decadent trees might contribute to regeneration by looking at a range of pre-fire stand densities to ask the question: Is cypress regeneration influenced by pre-fire cypress stand density?

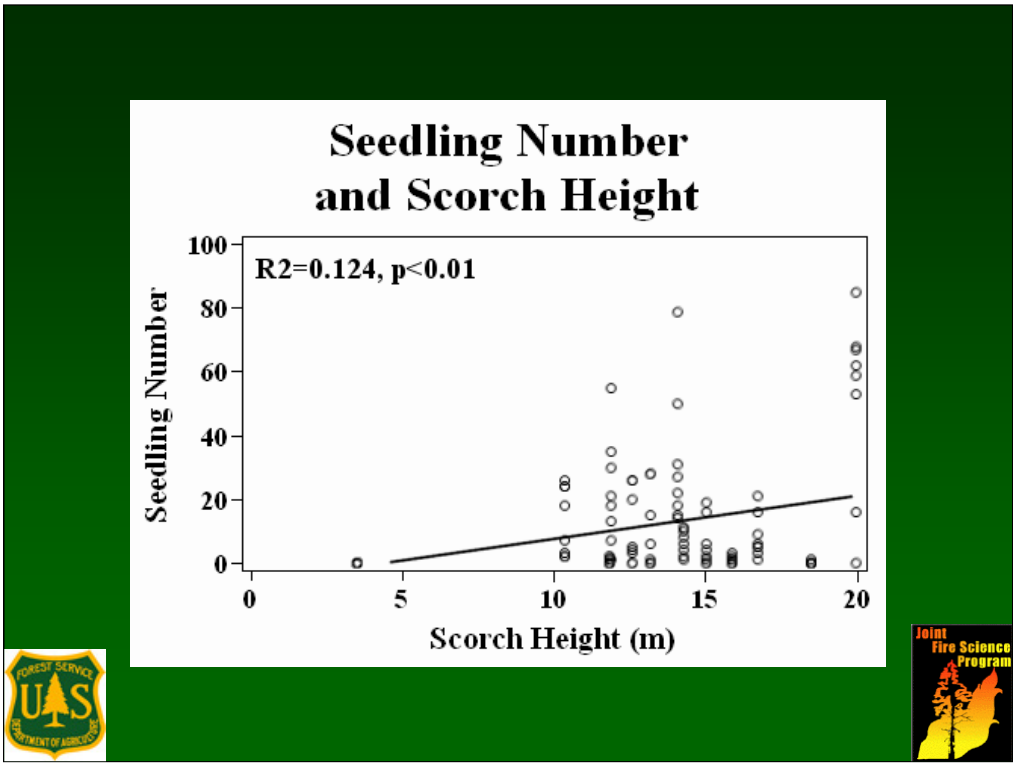


To answer these questions we established a total of 14 plots across the Mud Lake RNA. At each plot we collected the following data. Soil burn severity was based on a categorical rating system developed by the National Park Service.



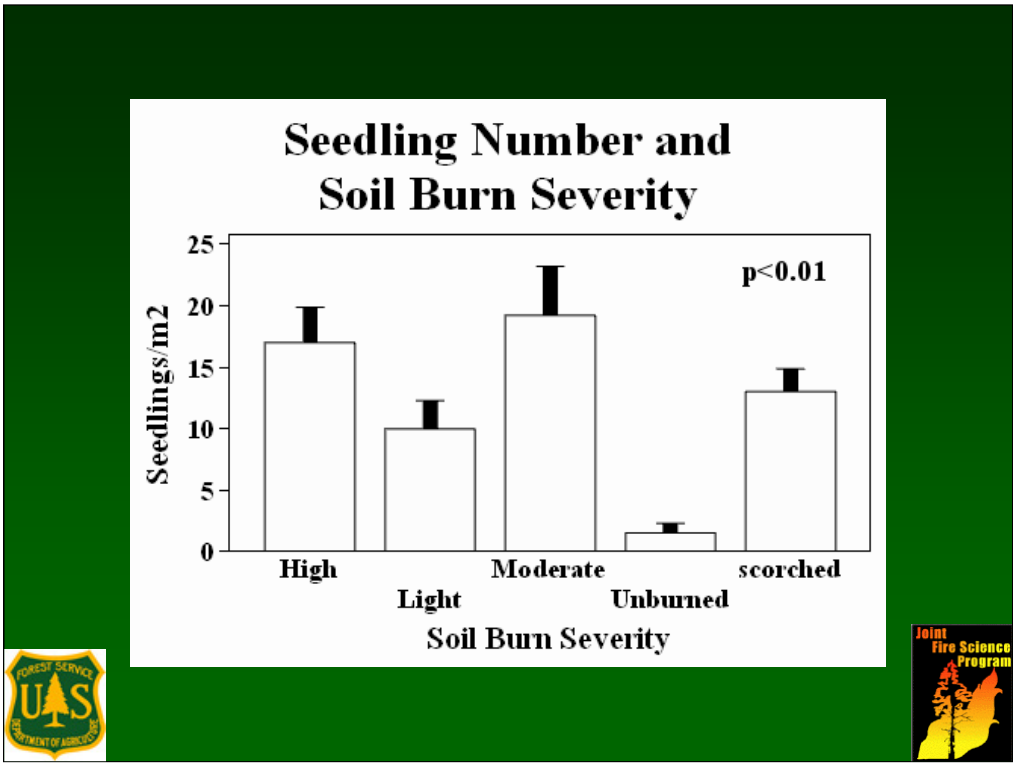
We were very surprised to find that adult baker cypress density had no effect on cypress regeneration. There had been concern that portions of the RNA with very sparse living cypress would not be able to successfully regenerate. However, we found that even in plots with only 3 living cypress there were seedling densities of up to 90 seedlings per square meter.

Perhaps the reason for this is that even older, dying cypress trees can still have impressive canopy seed storage. In our pre-fire plots we estimated that adult cypress had between 100-250 cones per tree. Collected cones had an average of 40 seeds each. This means that even a plot with only three living adult cypress would have had a potential canopy seed bank of between 12,000 and 30,000 seeds.



We found a significant relationship between seedling number and vegetation burn severity, such as scorch height, shown here. As fire severity increased, so did cypress regeneration. In fact, we found the greatest density of cypress seedlings in plots with scorch heights of 20 m or almost 66 feet.

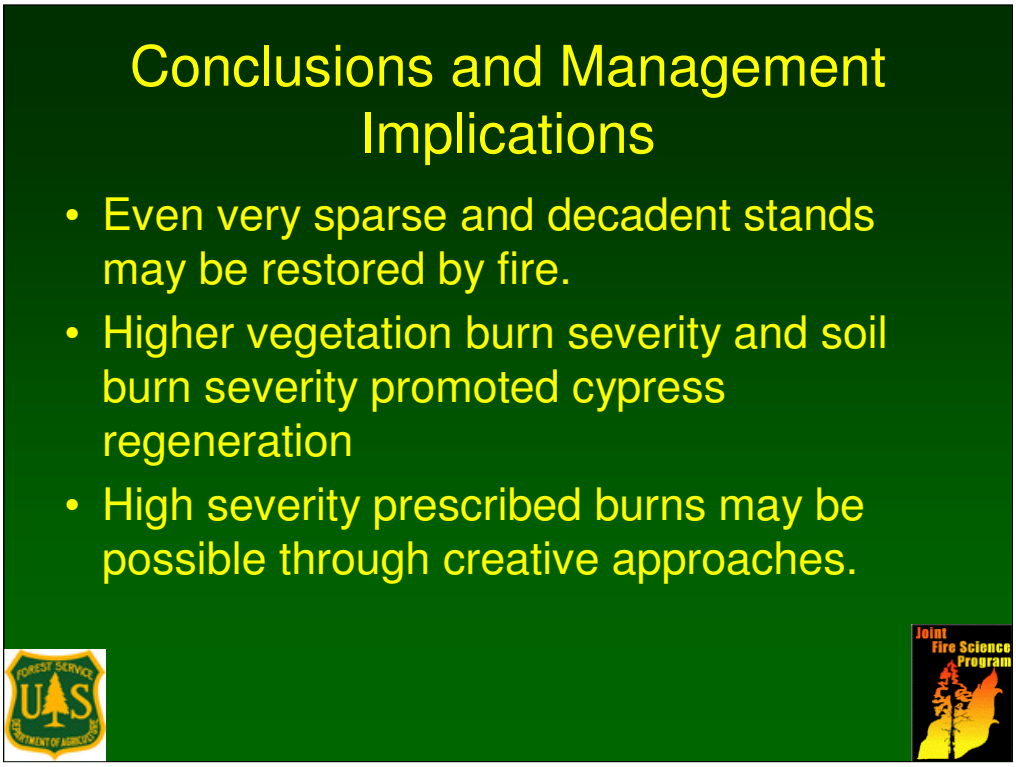
Perhaps this is not surprising because we know that cypress cones require heat to open. However, temperatures as low as 115 degrees have successfully opened cones of other cypress species in the laboratory. A graduate student at Humboldt State University is currently trying to determine the temperature required to open Baker cypress cones. But perhaps high severity fire promoted cypress regeneration in other ways?



For example, we observed significantly higher seedling number in areas that had high and moderate soil burn severity, compared with sites that were only lightly burned, scorched or unburned.

High Soil Burn Severity

This is an example of a site with high soil burn severity. The litter and duff have been completely consumed and there is a layer of fine white ash. These were the sites where we found high cypress seedling densities.



So, in conclusion we found that cypress stand density did not influence regeneration. On the other hand higher vegetation burn severity, such as scorch height, and soil burn severity promoted cypress regeneration. These findings suggest that high severity fires may be required to restore Baker cypress stands. Although prescribed burning at high severity may be challenging, these kinds of burns are currently being conducted routinely for other species, such as aspen. Because Baker cypress occurs in small, disjunct populations, it may be more feasible to use high severity fire to restore populations of this species. Creative approaches such as pile burning under cypress trees, creating larger burn-out perimeters around the stand before burning, or creating special management areas where wildfires are allowed to burn, may allow us to successfully restore fire to other Baker cypress stands across northern California.

Acknowledgements

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