JDSF Newsletter

Jackson Demonstration State Forest

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TESTING REDWOOD CLONES ON JDSF

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As of 1989, redwood reforestation on the North Coast is primarily accomplished by planting containerized seedlings grown in nurseries from seeds. While this approach has proven to be generally acceptable, research done over the past 35 years has shown that redwood can be successfully reproduced vegetatively, as clones. Members of a clone are, simply, exact genetic duplicates of each other, all coming from the same original seed, or from a single embryo in a seed. Cloning technology offers the forester the advantage of being able to select, from among a great many trees, an individual tree (genotype) which has the best combination of desired traits, and to then reproduce that genotype in unlimited numbers.

There are several ways to clone redwoods. One option is to find young native redwood seedlings, take cuttings from them, and root them in a greenhouse. Such young seedlings produce cuttings that root easily and grow in a manner very similar to the original seedling. This approach is being used to study the amounts and patterns of genetic variability that occur in the native redwood forests. A large clonal experiment using this approach, including 180 clones from 90 locations throughout the native range of coast redwood, is planned for JDSF in the near future.

A second option is to take cuttings from mature trees that show very desirable qualities. Such cuttings are difficult to

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root, and they often grow for several years in branch form after they are rooted. Tissue from them can be made more juvenile using tissue-culture techniques, and the cuttings taken from tissue-culture plantlets then behave more like cuttings from juvenile donors (Libby 1982a). Mature rooted cuttings can also be kept mature and used in a breeding orchard, where they soon produce abundant male and female strobili (i.e., conifer flowers).

A third option is to use juvenile seedlings produced in a breeding orchard. In 1973, a program selecting mature, apparently superior redwoods was begun on the lands of Simpson Timber Company in Humboldt and Del Norte Counties. Fresh twigs were shot out of their tops, rooted, and planted in large pots. They soon produced male and female strobili. Pollen was carefully collected from some of these, and was then brushed onto the receptive female strobili of others. These female strobili had been protected from unwanted pollens by special bags. This process is called "controlled pollination", and it produced pedigreed families of seedling redwoods. The parents of the seedlings were known as to native location and had outstandingly valuable traits. The first such crosses were made in January, 1977.

These pedigreed families undoubtedly contain some very good seedlings, but they are expensive and limited in number. Before selecting among them, and deploying them as clones, it is important to test them to find which of their parents' outstanding traits appear in which seedlings, and the reliability of such traits in each clone.

As a demonstration of this process, and to provide Mendocino County replications of tests in progress, we have been testing 80 of these clones on JDSF since 1982, and several more since 1984. Four blocks were planted in a clearcut on the 1980 Hare Creek Timber Sale. Each block included a few local redwood seedlings from Georgia-Pacific's Fort Bragg nursery, five of UC Berkeley's "standard" clones used in many such tests in California, and 20 of Simpson's "candidate" clones (Fig. 1).

Figure 1. Member of a "candidate clone" in Hare Cr. seven years after planting.

The most recent measurement and evaluation was in April 1987, after five years on site. The local seedlings had survived the best (96%), followed by the standard clones (90%) and the Simpson candidate clones (81%). But the surviving Simpson candi-

date clones averaged 1.05 meters tall, while the local seedlings averaged 0.91 meters and the UC standard clones averaged only 0.81 meters. Within-block comparisons of the candidate clones to the standard clones had the candidate clones taller in three of the four blocks, and 65% of the time, overall.

Juvenile height is surely an important characteristic, but it was not one of the characteristics selected for by the Simpson foresters. Bole form, crown configuration, volume growth, and overall health and vigor were selected as the primary characteristics. These plots, and another younger set planted in the 1984 Railroad Gulch Timber Sale, will continue as demonstrations and tests. They will be measured and evaluated repeatedly over the next several decades.

By cloning seedlings from selected parents and keeping records on the clones in test plantations such as those at Hare Creek and Railroad Gulch, the below average clones can rapidly be identified and discontinued from production and planting. Eventually, only clones that are performing well above average will be used for redwood reforestation. The cutting donors for such clones will be able to produce cuttings that, when rooted, can supply increasing proportions of the plants used in normal reforestation.

As an example, a single redwood seedling grown in good condition can donate 20 cuttings after about five months, and then an additional 20 cuttings every six to eight weeks thereafter (Libby & McCutchan 1978). Such a seedling and its clonal descendants could produce 10,000 cuttings in two years, and a million in three years! Thus, only a very few high-quality pedigreed and tested clones would be needed to satisfy a region's reforestation needs, and they could do this in a very short time following their selection.

One of the criticisms of cloning in the past has been that genetic diversity in a timber stand will be reduced to the point that insect and disease problems could wipe out an entire stand. Redwood is less vulnerable to these problems than almost all other trees. Furthermore, current theory and research indicate that as few as seven and no more than 30 clones provide adequate diversity even for a stand of a species more susceptible to risk than redwood. This limited number of clones can result in substantial gains in productivity when deployed in a plantation or local region (Libby 1982b). However, many more than 30 will be deployed during the early phases of a clonal program, while the best and healthiest clones are being carefully identified over periods of many years in tests such as those at Hare Creek and Railroad Gulch.

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A HISTORY OF LOGGING IN THE CASPAR CREEK BASIN

Michael Napolitano, Francis Jackson, and Peter Cafferata

(Editor's Note: In the next month, what the JDSF staff has come to know as "The Watershed" will begin to have its young growth timber harvested. While this will actually be the second timber harvest in the North Fork of Caspar Creek, it will be the first in the main watershed study area. With an acceptable set of background (pre-logging) data on streamflow, suspended sediment yield, bedload movement, soil pipe flow, subsurface drainage, fish numbers, and aquatic insect populations, we will now proceed to the harvest phase of the study. Before we do, however, we felt it would be interesting to review how the old growth logging was accomplished here. Mike Napolitano has written a short paper on this subject as part of his Master's degree work in the Geology Department at Humboldt State University. Mike has produced a "sediment budget" for the North Fork, and took past logging history into account in his work. Francis Jackson is a long-time resident of the Mendocino area and an expert on its history and logging operations. He explained to Mike how the old growth was harvested here.)

Caspar, California was named after its first European settler, Siegried Caspar. He was a trapper who lived and worked near the mouth of Caspar Creek prior to 1860, trapping fox, mink, otter, raccoon, and weasel. When civilization arrived, he left Caspar Creek and was not seen again. In 1860, William H. Kelly and Captain William T. Rundle became partners, founding the Caspar Lumber Company. That year they purchased 5,000 acres of forested terrain in the Caspar Creek basin, and built a saw mill at the mouth of Caspar Creek.

Kelly and Rundle's original mill had a capacity of 25,000 board feet per day. After logs were transported to the mill and cut into boards, they were ferried by barge from the mill pond to schooners anchored a short distance from the coast. A few years later, barges were replaced by an incline and chute system, as sedimentation of the mill pond precluded further barge transport. The incline and chute system delivered boards to the top of the bluffs, where they were lowered by cableways to the schooners. In 1861, Jacob Green Jackson was taken on as a third partner in the Caspar Lumber Company. By 1864, Jackson had taken over the company. Kelly and Rundle were forced out by Jackson, when he claimed their interests in the company as payment on debts owed to him. Under Jackson's ownership, the company grew rapidly, and eventually became one of the most successful logging companies on the Mendocino coast.

Crib Dams Built

Soon after obtaining sole ownership in 1864, Jackson hired engineers to build three crib dams on Caspar Creek. They were located on the North and South Forks, and on the main stem a mile up from the ocean. The crib dams supplied additional stream discharge for transporting logs to the mill during log drives. Typically the dams were built in the uppermost reaches of a basin in order to maximize the length of stream below the release point of the water. The dams, like many others in the area, were constructed with a flume and spillway built through the center of the dam and a triggering mechanism that allowed the dam operator to open its gate. The

upstream and downstream face of the dam were constructed with cut logs cribbed together (criss-crossed) log cabin style. The core of the dam between the faces was composed of soil and rock.

The upper crib dams on the North and South Forks allowed logs to float downstream for a considerable distance on the main fork, but eventually the stream gradient becomes very slight. It was here on the alluvial flats that the third dam was constructed. Moving the logs through this last dam was called "sluicing," and was accomplished by opening the gate on the flume, allowing the water to come down to a safe level, and having men walk on "boom sticks" in the pond and guide them through the flume with "pike poles." This last pulse of water allowed the logs to reach the Caspar mill.

Contemporaneous with dam construction, skid roads were excavated in the woods. Skid roads, or corduroy roads as they were often called, were built as straight and level as possible. This was necessary because oxen, and later bulls, were used to transport cut logs along these roads. They were made by placing logs across the road at short intervals, burying them half deep into the soil, and covering them with heavy grease. Tanoak and other trees of low economic value were cut to provide wood for these roads.

Skids were placed into the ground at intervals equal to the step length of the oxen, to prevent the animals from catching their hooves on the logs. Managing a bull team required great skill, and the oxen or bull team driver was the most handsomely paid employee working in the woods. Logs were transported by a team as a train. Log trains were single log sections chained together along a line. They were made easier to transport by applying a ladle-full of water to a skid just before a log passed.

To facilitate the skidding of logs after they were felled and bucked into lengths between 12 and 16 feet, the bark was peeled off. Bark and large amounts of waste from the tops, branches, and breakage presented a problem for transporting the logs downslope to the skid roads. The solution used was to burn the area as soon as it was dry enough to carry fire. Burning was usually done in the late summer or early fall (Sullenberger 1980). This technique was specially suited for the redwoods, since the heartwood is resistant to fire and the continual dampness generally stopped the fire from burning beyond the slash. Usually, one year passed between the time the trees were cut and when they were skidded.

The bull teams delivered the logs to "roll aways" located near stream channels. Like the name suggests, these areas were depots where log trains were unloaded and transferred into the water. Jack screws (mechanically analogous to car jacks) rolled the unloaded logs into the creek. Stacking several logs created tiers which were generally carefully constructed. They were often four to five logs high with logs oriented parallel to the stream channel. Considering the average diameter of the logs (six to eight feet in diameter, Caspar Lumber Company records), it must have been common for the tops of the log tiers to be 30 to 40 feet above the channel bed.

Problems with Log Supply by Water

Log drives were usually games of chance. Too much water, an insufficient boom at the mill (intended to keep logs from going out to sea), or too little water and/or channel obstructions often limited the success of the drives. Articles in the Mendocino Beacon refer to many instances where the Caspar mill was

forced to shutdown after logs had washed out to sea, formed log jams along the Creek, or were not deliverable because of low winter rainfall (which meant insufficient water behind the dams and along the creek to transport the logs). Examples of quotations from these articles include:

10 March 1883
"30 to 32,000 cut logs on Caspar Creek waiting for a freshet."

15 March 1884
"A one and one-half mile log jam (on Caspar Creek) will take an uncommon freshet to move them."

A log drive was considered successful if half or more of the logs stored within the stream reached the mill. From reviewing Union Lumber Company files of the log drives on the Big River system just to the south, Francis Jackson has computed an average of two log drives per winter. Log drives required a "freshet" as well as a full crib dam reservoir. A freshet is loosely defined as a storm capable of raising the water level of the stream by about two feet (i.e., the stage necessary to float a four foot diameter log). During freshets, local stream levels rapidly rise and fall. The crib dam operator had the difficult task of deciding whether or not to open his dam during a freshet.

Railroads Start

Given the inherent uncertainties of transporting logs by water, a more dependable alternative was sought and developed in 1877: railroad transport. Jacob Green Jackson was an excellent businessman who always thought to the future, and early in the 1860's, he began purchasing additional land north of Caspar Creek. When the Jughandle Creek basin was purchased, a standard gauge tramway was constructed from the Caspar Creek mill pond across the flat terrace between Caspar and Jughandle Creeks, and down into the Jughandle Creek gorge. Animal power was used to transport a train of three to four cars of logs, six times per day. This method did not match log drives in volume of timber delivered, but it did generally provide a large enough alternative supply of timber to keep the mill open during dry winters.

In 1877, the tramway to Jughandle Creek became a full fledged railroad. The Mendocino Beacon mentions the first run of a locomotive on the line as December 15, 1877. Also in 1877, Jackson continued expanding northward with the purchase of a sizable portion of the Hare Creek basin. The land at Hare Creek was needed because Jughandle Creek was scheduled to be logged out by 1885, and Caspar Creek by the early 1890's.

The logging at Caspar Creek may have been interrupted, however. The North Fork Caspar Creek crib dam appears to have failed during the winter of 1884-1885. The Mendocino Beacon notes in the March 28, 1885 edition: "Temporary dam (on Caspar Creek) has succeeded in building sufficient head to bring 6000 logs downstream to the mill" (from a log jam just downstream of the dam). The November 11, 1885 edition states "500 logs driven with new dam just built this summer." Neither of the articles mentions the fork the new dam was constructed on, but at that time, the South Fork of Caspar Creek was referred to as Whites Creek. The articles also do not actually describe a dam failure.

In recent years, Francis Jackson has located the crib dams near the headwaters of the South and North Forks of Caspar Creek, as well as the one on the main stem. At the North Fork dam site, there are remnants of the faces of two dams constructed very closely together. A failure can only be considered as well

reasoned speculation, but it offers a satisfying explanation for the construction of an entirely new dam approximately 30 feet downstream of a larger dam on the North Fork of Caspar Creek.

Steam Donkeys and the Final Phase

Early in the 1890's, the Caspar Lumber Company started using steam donkey engines for the first time (Wurm 1986). Bull teams and steam donkeys were used together until 1915, when the bull teams were discontinued. These donkeys were Washington and Willamette yarders fueled by wood, which generated steam to turn drums spooled with manila rope, and later cable. Donkeys were used to drag logs from side hills to the railroad landings. They also replaced jackscrews to load logs on to railcars. In addition, the donkeys allowed inclined railways, or "tramways," to reach previously inaccessible areas on steep slopes. A steam donkey was located in a "winding house" on the top of a ridge and pulled loaded railcars up steep grades. Once on the ridge top, these cars could be lowered down slope to rail lines going up streams in adjacent basins.

Logging had been completed over most of the watershed by the late 1890's. An incline spur, known as Incline No. 1 or Bouton's Tramway, was constructed in 1900 to deliver timber from the last remaining uncut tributary on the North Fork. The incline tramway ran uphill from the Hare Creek railroad line to the ridge dividing Hare and Caspar Creeks, and down into the North Fork Gorge. It was nearly one mile long and required three trestles and excavation on two ridges. Logging was finally completed at Caspar Creek in 1904. Remnants of the tramway still remain well preserved today along a portion of the stream bed of the tributary, and along the slope of the North Fork Gorge toward Hare Creek. The tramway, crib dam, corduroy roads, and other historic artifacts are easily observed in the North Fork basin. They provide the careful observer with a rich source of materials from which to reconstruct the colorful history of logging at Caspar Creek.

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STAFF NOTES

In the last several months, JDSF has filled three vacant forester positions. **Fay Yee** was promoted from Forestry Assistant I to Forester I in November of last year. She is a member of the timber management staff, and is currently preparing a major timber sale. Fay previously worked on our demonstration and experimental staff, and did an excellent job on many different projects. **Brian Barrett** has filled our vacant Forestry Assistant II position. He transferred over to Fort Bragg from Sacramento, where he had been working on the Dutch Elm Disease program. Brian will be primarily involved in timber sales preparation. Finally, **Mike DeLasaux** has been hired to fill the vacant Forestry Assistant I position. He comes to CDF from Cal Poly-San Luis Obispo, where he was a Research Assistant for Dr. Norm Pillsbury. Mike holds a Masters degree in Agricultural Sciences, has taught several college classes, and has been involved in research on hardwoods and biometrics. We are glad to have all three of these foresters aboard!

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