Giant Sequoia Genetic Conservation Plan Progress Report - Sierra Pacific Industries, Updated July, 2015

Introduction

Sierra Pacific Industries (SPI) has developed a Giant Sequoia (GS; Sequoiadendron giganteum) Genetic Conservation Plan (GSGCP) designed to create new GS groves extending its distribution in California. SPI intends to manage these groves in perpetuity. Our effort compliments public sector efforts to maintain this species as an essential component of the Sierra Nevada Mountain Range mixed conifer forest type.

This progress report provides general information on SPI's GSGCP, activities conducted to date and future work plans. Providing the public and interested parties with information about this project is meant to foster increased cooperation with partners and potential partners which will expand and improve these conservation efforts. Note that no commercial use will be made of seeds collected under federal or state permits and all seed will be used for reforestation on SPI lands to expand GS genetic based conservation.

A wide range of public and private organizations, institutions, regulatory agencies, and citizens are concerned about the future of California forests given the risks posed by catastrophic wildfire, insect and disease epidemics, and a changing climate. This concern is partially driven by society's need for reliable sources of drinking and irrigation water, clean air, fish and wildlife habitat, recreation opportunities, forest wood products and the increasing recognition that forests are vulnerable to disturbances. With respect to GS, there is the additional concern about the preservation of a majestic and iconic species that is one of the primary symbols of the Sierra Nevada. SPI's ability to design and implement programs and projects that address these risks and significantly reduce the potential for catastrophic impacts requires public and private sector cooperation and support. These efforts also offer the potential to create new sources of knowledge that can be used to improve the resilience of forests and hopefully improve their adaptation to a changing climate.

Giant Sequoia Geographical Range

The current natural range of GS consists of a narrow band of seventy-five groves distributed within a 260 mile discontinuous corridor from Placer County to Tulare County, all within the Sierra Nevada. The northernmost of these groves is an isolated grove consisting of six trees is located thirteen miles east of Foresthill, California. The reason for the gap in GS distribution between the northern and southern groves is unresolved.

Over hundreds of millions of years the distribution of GS stands has expanded and contracted in response to many environmental factors. The most recently discovered fossil remains with presumed direct lineage to living California GSs are from the Miocene age (10 to 20 million years) Trapper Creek flora located in southern Idaho, approximately 400 miles northeast of the present northern groves found in the Sierra Nevada. Four fossil locations are also known within 100 miles of Reno, Nevada (Axelrod, 1964).

Collaboration

SPI is a member of the Sequoia Working Group. SPI is cooperating with the U.S. Forest Service, Cal Fire, Cal Forest Nursery, Save the Redwoods League, University of California Berkeley, Fresno Pacific University, Humboldt State University, California Polytechnic State University, California State Forests and California State Parks. Two prominent geneticists (Dr. William Libby, University of California Berkeley - retired and Dr. Jay Kitzmiller, US Forest Service California Regional Geneticist - retired) have provided invaluable scientific knowledge and direction to this effort. The potential to broaden our understanding of the genetic variation among GS populations offers useful information for establishing new regeneration from the most appropriate sources (Fin and Libby, 1994).

Planting GS seedlings on SPI lands could help preserve the genetic diversity of GS. The lack of current GS regeneration in native groves threatens the long-term preservation of the gene pool due to the risk of stand replacement wildfires and the eventual senescence of existing groves, especially at low elevation and in the southern part of the range (Tate, 2012). In 2011 SPI formally began assisted dispersal plantings in northern and central California.

SPI is open to other participants who can benefit the GSGCP. Similarly, SPI is cooperating in the Assisted Migration Adaptation Trial (Assisted Migration Bulletin, 2013). This trial is a large long-term climate change provenance tests study in cooperation with the British Columbia Ministry of Forests. The primary objective is to better understand the growth and health of reforestation seed sources from British Columbia and northwestern United States, when planted across a range of climates and latitudes.

Project Design and Description

Historically SPI planted GS tree seedlings in select forest harvest units as a unique part of their reforestation activities. An inventory of 459 existing stands containing GS revealed a broad range of plantation and stand ages (up to fifty-nine years old) distributed across much of SPI's forest land ownership (Figure 1). In 2010 SPI evaluated 131 of these 459 plantations and found that GS was successfully adapted to a broad range of forest sites (Kitzmiller & Lunak, 2012). Earlier research with provenance trials in California and abroad support this finding (Libby, 1981). Based on these observations and data analysis, SPI then developed its GSGCP (SPI, 2011).

This plan proposed that each of the eight SPI forest districts annually choose ten harvest units from two Timber Harvest Plans within which GS tree seedlings would be planted. In the first year (2011/2012), that plan resulted in eighty, 20-acre units, each planted with approximately 1,000 seedlings derived from one to four natural groves. Figure 2 shows the distribution of these outplantings. Approximately 90,000 GS tree seedlings were grown in nurseries and then planted in the first year (2011/2012) of our pilot program. The seed sources for this initial tree planting originated from three groves (Mountain Home, Redwood Mountain and Calaveras Big Trees State Park, South Grove). Cone collections require scientific collection permits from federal and state agencies.

The GSGPC envisions acquiring seed from seventy-three groves over the next two decades. In the first ten years three to four grove replications would be secured per year resulting in an outplanting of thirty to forty grove seed sources. Careful seed collection and record keeping will permit SPI to maintain records of pure grove and mixed grove components in each plantation and will provide the basis for long term genetic conservation provenance evaluations. Eventually SPI lands would contain approximately 1,600 plantations covering approximately 32,000 acres with GS representing twenty to forty percent of the tree species composition. These new groves would be distributed across a wide range of latitudes, elevations, aspects, and site growing conditions of GS mixed conifer forests. These locations are in the Sierra Nevada, Cascade Range and Klamath Mountains. Elevation is the primary variable considered in designing and selecting sites for GS out planting. The outplantings shown in Figure 2 are a typical design for GSGCP plantation locations and elevation range within the SPI California timberlands. Figure 3 shows a typical planted species mix and early growth in a GSGCP plantation.

Figure 1 Sierra Pacific Industries' Plantations with Giant Sequoia Map 10-09 (SPI Black, Natural Groves Green)

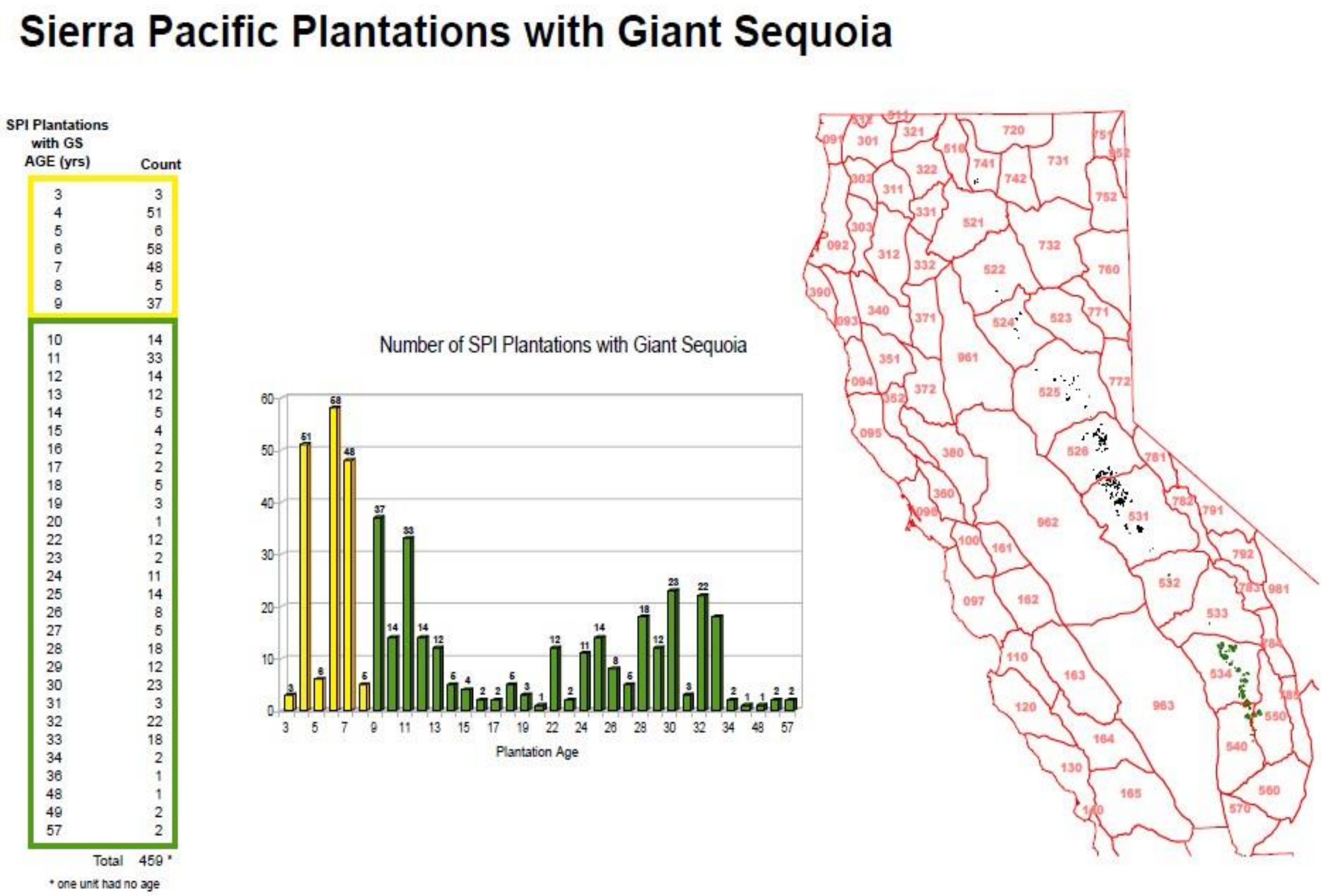


Figure 2. Sierra Pacific Industries GS Genetic Conservation 2011-2012 Out Plantings

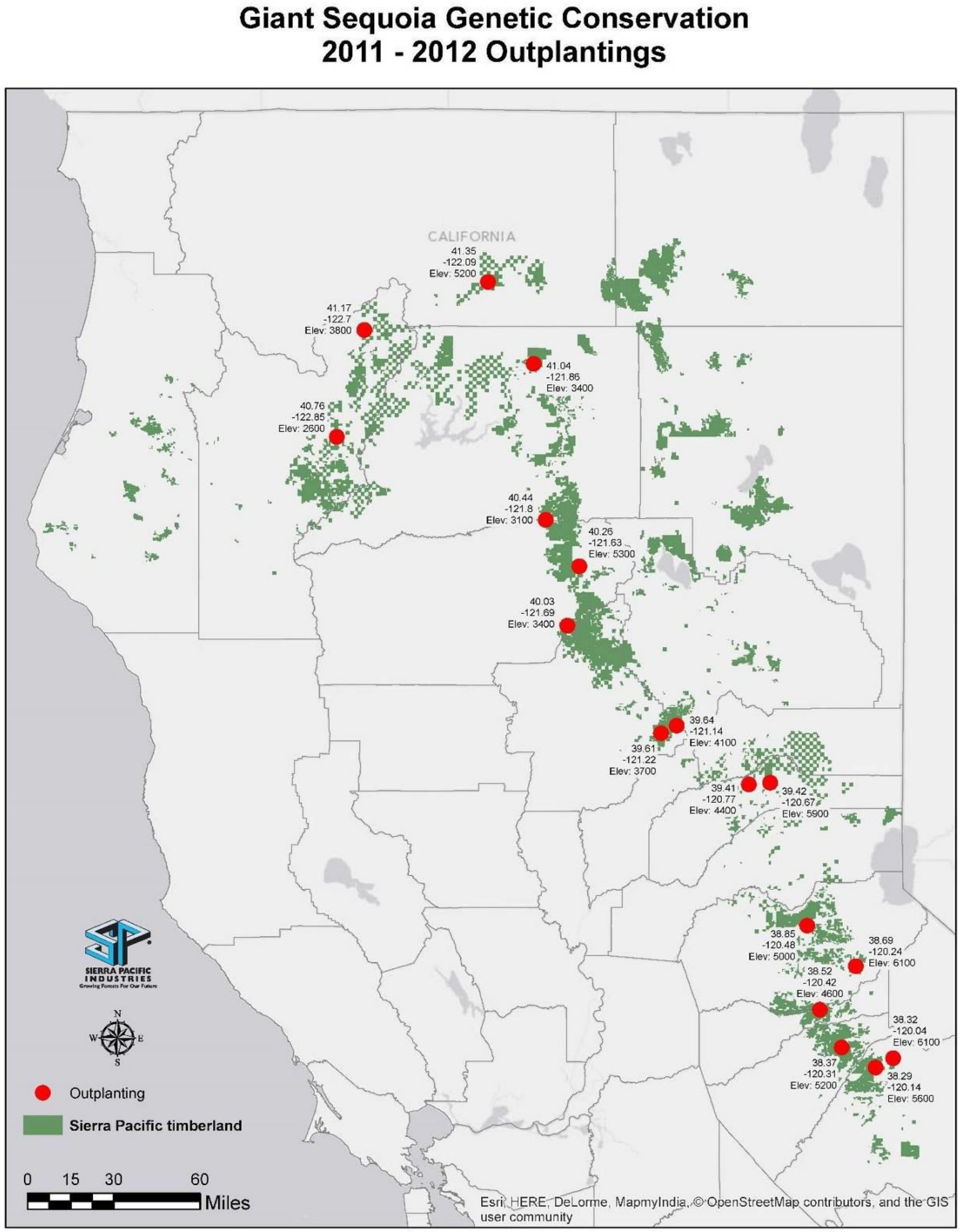


Figure 3. A SPI GSGCP Plantation Planted April 2012 - Stirling District, Feather Falls – August 2014

Over a twenty year period approximately 1.5 million GS tree seedlings will be planted. Those plantations will receive normal plantation management treatments; however GS would be favored for spacing distribution within each genetic conservation plantation. Once early responses at each planted site are evaluated, a designated subset of groves will be selected to manage in perpetuity.

Long term GS management considerations require fire protection and pre-commercial thinning (PCT) from fifty GS trees per acre (TPA) to twenty-five TPA. At a later date thinning will be completed to twenty-six feet spacing or twelve GS TPA and at the end of the first rotation six to twelve GS TPA. At that time SPI would leave those GS as the genetic conservation bank and would continue to manage the forest stand on each site. All thinning would leave the biggest, healthiest and best adapted trees within the forest stand micro-sites. In Watercourse and Lake Protection zones and adjacent zones, SPI would

PCT to thirty-seven TPA and then later thin to eighteen TPA, and at final harvest leave nine TPA in perpetuity. Given GS's wind firm characteristic and resilience to wildfires, these groves should develop over many centuries into genetic conservation banks and hopefully be able to adapt to a changing climate. Second and third rotation GS grove and forest characteristics are discussed below in the section title 'Future Giant Sequoia Groves, Stands and Forests'.

Work Accomplished to Date

SPI and our partners have completed a number of initial tasks to implement this genetic conservation effort. The first set of tasks involved a comprehensive inventory and assessment of SPI plantations and stands containing GS trees. This work was published in the Western Journal of Applied Forestry (Kitzmiller & Lunak, 2012). For additional information see GL-1-10-14 Giant Sequoia Genetic Conservation SPI Annual Activities Report (Lunak, 2014). Information and data have been provided by many partners. Cal Fire at Davis has been extremely cooperative in the cone processing efforts to date, and the private sector Cal Forest Nursery has continued to grow high quality GS seedlings (Figure 4).

Figure 4. SPI GS Genetic Conservation Seedlings. Cal Forestry Nursery, Etna, California

Current Work

In the fall of 2013 and the spring of 2014 SPI planted tree seedlings in two units of each of the eight SPI forest management districts. These seedlings were derived from two groves at Calaveras Big Trees State Park . A grand total of forty-eight units were planted. Fewer units were planted than called for in the draft plan because seed was only available from two groves. Plantation elevations ranged from 3,000 to 5,800 feet. A total of twenty-one plantations were established in the Cascades and twenty-seven plantations were established in the Sierra Nevada.

SPI will continue opportunistic seed collections from groves with federal and state permits and continue to secure advance collection permits. GS seed production varies from year to year. Development of successful cone crops is highly dependent on weather and the population of seed eating insects. SPI is exploring cooperative seed collection with the US Forest Service Giant Sequoia National Monument where seed collection is planned as part of restoration activities approved in its management plan Record of Decision (USFS 2012).

SPI is cooperating with Dr. Deanne Bell from Fresno Pacific University Biology Department to study genetic diversity within and between GS groves. In addition, starting in 2014 and continuing into the future for cones collected from other groves, SPI is funding DNA extraction and storage from GS genetic conservation seedlings at the US Forest Service National Forest Genetics Laboratory in Placerville, California. DNA from thirty-three seedling seed lots, grown from Calaveras Big Trees State Park are stored for future GS genetic analyses.

Future Work

SPI will continue to collect GS seed from specific groves to expand the genetic outplanting program according to the GSGCP. Given the initial twenty year implementation of this cooperative program, SPI will conduct a number of key tasks to ensure that GS seedlings survival, growth and genetic source identity is maintained per the GSGCP. GSGCP plantations will be managed in a manner similar to non-GSGCP plantations, but GS would be favored in thinnings to ensure it is well distributed within each unit, thereby facilitating future grove development. Periodic surveys and inventories will be conducted for GSGCP plantations to assess their survival and condition.

The large number of replicates will allow managers to experiment with differing fuel treatments and other stand management prescriptions to maintain groves. Within the SPI reforestation database, special identification of GSGC plantations is used to track each unit's progress and performance. A relational database is used to track GSGCP seed source, plantation, and plantation management data.

The US Forest Service created a unique plantation located within the Sierra National Forest by harvesting a forest stand while retaining three large GS trees. Approximately twenty-five years after planting tree seedlings, the area now contains an abundant number of young GS trees interspersed among other native conifers. SPI would create plantations containing GS trees dispersed across each unit and manage these stands to eventually create GS groves. We would manage the density and tree species composition of each plantation over multiple rotations (typically eighty years each) favoring GS.

Within 240 years very large GS trees would dominate these plantations and mimic natural GS groves at any earlier stage of their development. Foresters would evaluate each plantation and develop appropriate silvicultural treatments, for example, PCT and commercial thinning, to accelerate the development of GS groves over multiple rotations. Eventually these managed GS groves would contain very large GS trees well dispersed within each plantation and towering over younger forests. Representative graphic simulations of these future stands and groves are described below (please see the section titled - Future Giant Sequoia Stands, Groves and Forests).

Monitoring and Scientific Analysis

Plantation survival and growth surveys will be conducted to determine the results of out-planting and need for plantation management activities. Cooperative studies will continue per current agreements and contracts with academia and federal and state agencies. Scientific papers in peer reviewed journals could provide a wide dissemination of information to interested parties, including agencies that provided access to seed sources from existing GS groves.

Current Issues and Challenges

Wildfires pose a threat to young tree plantations where lower crown height and relatively thinner bark thickness can make them vulnerable. Managing forest fuels and vegetation will require constant attention to ensure these plantations develop into wildfire resilient stands with few ladder fuels.

Our current GS cone collection depends in large part on high winds and other significant weather events that provide cone bearing branches on the ground (Figure 5). Our biggest issue has been mild winters with no significant weather events at the native groves, hence no cones to collect from the ground. Expanding the genetic seed base to all seventy-three existing grove sources will require concerted and committed monitoring and cooperation to take advantage of unplanned opportunities to collect viable seed cones. Obtaining annual tree seed collection permits requires coordination and resources. SPI is currently requesting permission to climb GS's in groves managed by federal and state agencies to expedite cone collections. These requests are based on several factors including the increased vulnerability of some GS groves to catastrophic wildfires.

Figure 5. Ground Cone Collection, Calaveras Big Trees State Park, May 2012

Future Issues and Challenges

Depending on how quickly climate changes in the Sierra Nevada, there may be a need to expedite the development of the GSGC program due to large scale wildfires impacting natural GS groves. These events may alter the SPI initial twenty year implementation strategy and require some advance collection of sufficient seed sources of GS in cooperation with federal and state landowners and managers to expedite reforestation of suitable lands.

Figure 6. Stirling District Carlyle Burn, GS Planted 1960 Evaluated 2010

Resource Limitations and Obstacles –

Money can be a limiting factor especially for public agencies and this constraint requires advance planning to ensure all partners are optimizing their contributions to this genetic conservation project. Where federal and state restoration and fuels management projects include the planting of GS tree seedlings, coordinating cone collection for reforestation projects can provide the means to avoid duplications of effort and benefit all parties.

Future Giant Sequoia Groves, Stands and Forests

What future forests containing significant components of GS might look like requires three dimensional scenario thinking and estimates of forest and stand trajectories. SPI uses a forest structure based management approach to help understand what future forests will look like. Some basic assumptions about future SPI management actions and decisions are useful in charting pathways to future landscapes. Obviously SPI will continue to harvest and reforest their lands with native conifer species. These reforestation efforts will also be augmented by natural regeneration provided by residual trees from adjacent stands.

Approximately 65% of SPI's lands are managed with even aged methods. SPI has inherited stands that historically had a disproportionate harvest of Ponderosa and Sugar Pines, converting these stands to densely stocked, less fire resilient White Fir, Douglas Fir and other shade tolerant species. SPI would restore these lands with the species most ecologically suited to the site. Depending on the assessment of each watershed and its vulnerability to wildfire and other disturbance factors, SPI may vary stand densities to create shaded fuel breaks and other fuel conditions that mitigate disturbance impacts and potentials.

The primary purpose of this project is to conserve, protect and expand the GS's genetic base and expand its current distribution. To accomplish this, SPI will use a wide range of silvicultural treatments to create diverse stands containing GS groves. Since the entire Sierra Nevada has a wide variety of forest conditions – park-like stands, newly planted areas, burned landscapes, and dense second growth-stands – we will attempt to create a similar range of stand biodiversity. This will be represented by groves with variable densities of trees per acre, different species mixes, and different size and age classes of trees. This approach will be guided by studying past and current stand conditions from diverse ownerships in the Sierra, not just on SPI land holdings, and incorporating treatments to create or maintain these conditions.

In creating and maintaining these groves over time, SPI will also allow natural processes, like tree mortality, broken tops, development of a shrub layer, and other tree and stand attributes to occur. Many of these processes create habitat for wildlife species. Areas may occasionally burn (lightning and other ignition sources) and the effects on the groves may benefit different suites of wildlife species. The groves will also function as components of sustainably managed forests, protecting water quality, reducing soil erosion, and sequestering carbon from the atmosphere.

Once the entire program is completed, SPI will manage approximately 1,600 GSGC stands covering approximately 32,000 acres. The current natural range of GS groves is 47,350 acres. By 2092 SPI lands and landscapes would contain a complex mosaic of stands containing significant large diameter and tall GS trees as a stand component. Depending on site conditions SPI's grove network of 1,600 stands could vary in age from 60 to 80 years, not including the 460 plantations that were planted before 2009.

Depending on site productivity, disturbance impacts from wildfire, insects, disease and air pollution, stands would contain species compositions and stand structures representative of even aged forests. Once timber harvesting removed merchantable crops trees, excluding the GS designated for perpetual protection and variable retention groups of residual trees, snags and down woody debris, these stands first rotation stands would transition to multi-storied, multi-age stands with newly planted native trees in the understory. At the end of the first rotation, as described above in the section titled 'Project Design and Description', within each residual stand large diameter GS trees would vary from six to twelve TPA.

Over time many plantations will contain large diameter GS trees and appear similar to some federal GS groves. At the end of the second rotation, 160 years, GS DBH's would range from 96 to 120 inches and tree heights would likely range from a low of 170 feet to a high of 240 feet. GS trees per acre would be 7 or 8 dominant trees. At the end of the third rotation DBH's would range from 120 to 140 inches and tree heights could possibly range from 180 feet to 240 feet depending on climatic conditions and disturbance. GS trees per acre would average approximately six per acre. As the SPI tree plantation photos show GS trees are typically the fastest growing conifers with the widest crown canopies. Figures 7 through 11 show GS trees in stands from existing SPI plantations which are representative of early- to mid-rotation forests.

Figure 7. SPI Plantation (Martell Kuphadt Plantation, 59 Years Old, 2006)

Figure 8. Sonora Mixed Conifer Plantation

Figure 9. SPI Mixed Conifer Thinned Plantation

Figure 10. Cascade Region Mixed Conifer, 34 Year Old Plantation. North of McCloud California.

Figure 11. Cascade Region Mixed Conifer 33 Year Old Plantation. North of McCloud California

Giant Sequoia Grove Simulations

SPI has conducted a series of stand simulations to provide a graphic representation of the evolution of GS stand growth and development over the next 80-160-240 years. These graphic simulations demonstrate the stand structures and heterogeneity for typical SPI sites. GS stand development includes the recruitment of snags and down logs to provide wildlife habitat for species associated with GS mixed conifer forests. Figures 12 through 14 show a stand at the end of the 80 year old first rotation, pre-harvest, during harvest, and post-harvest, respectively. Figures 15 and 16 show the stand at the end of the second (160 years) and third (240 years) rotation, respectively.

GS is a shade intolerant species. Gap size (no trees or vegetative competition) research at the University of California, Berkeley Whitaker's Forest Research Station demonstrates a minimum gap size of ½ acre is required for adequate GS growth (York et al., 2011). As GSGCP stands enter the next stage of development (81 to 240 years old) it's anticipated that there will be GS natural regeneration, but GS growth will be slow compared to the growth of shade tolerant species natural regeneration.

Figure 12. Age 80 End of First Rotation Plantation

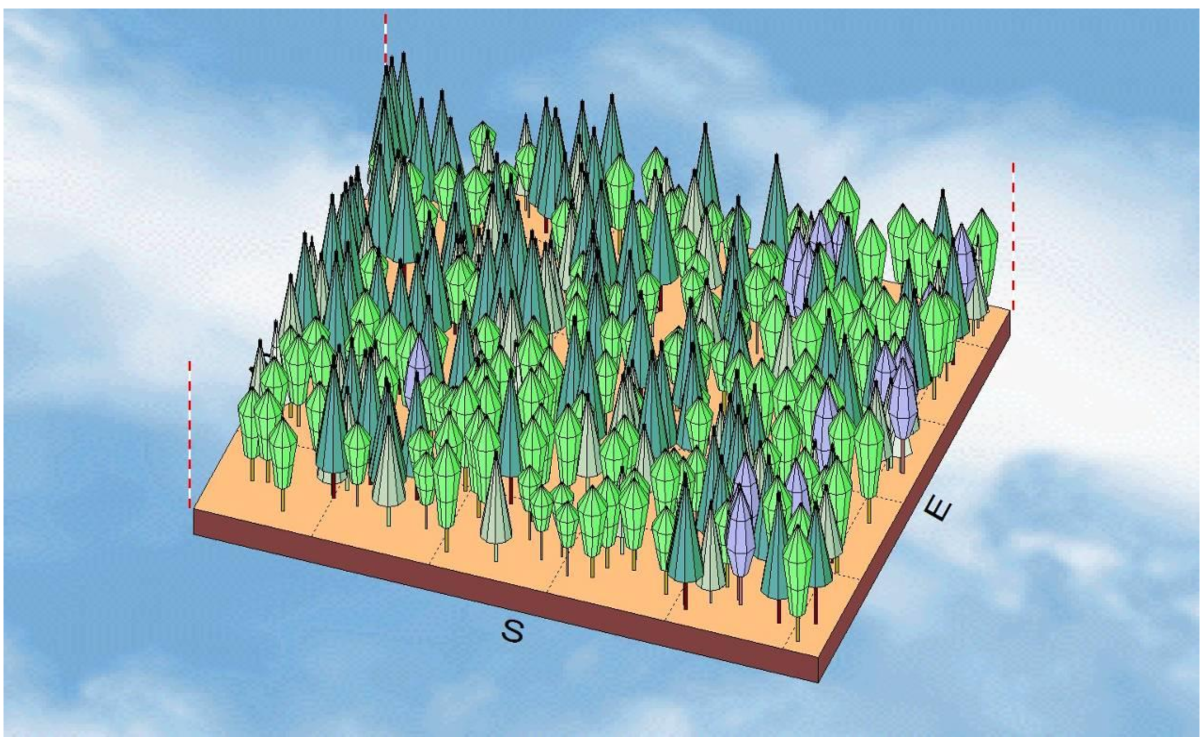


Figure 13. Age 80 First Rotation Post Harvest Residual Giant Sequoia

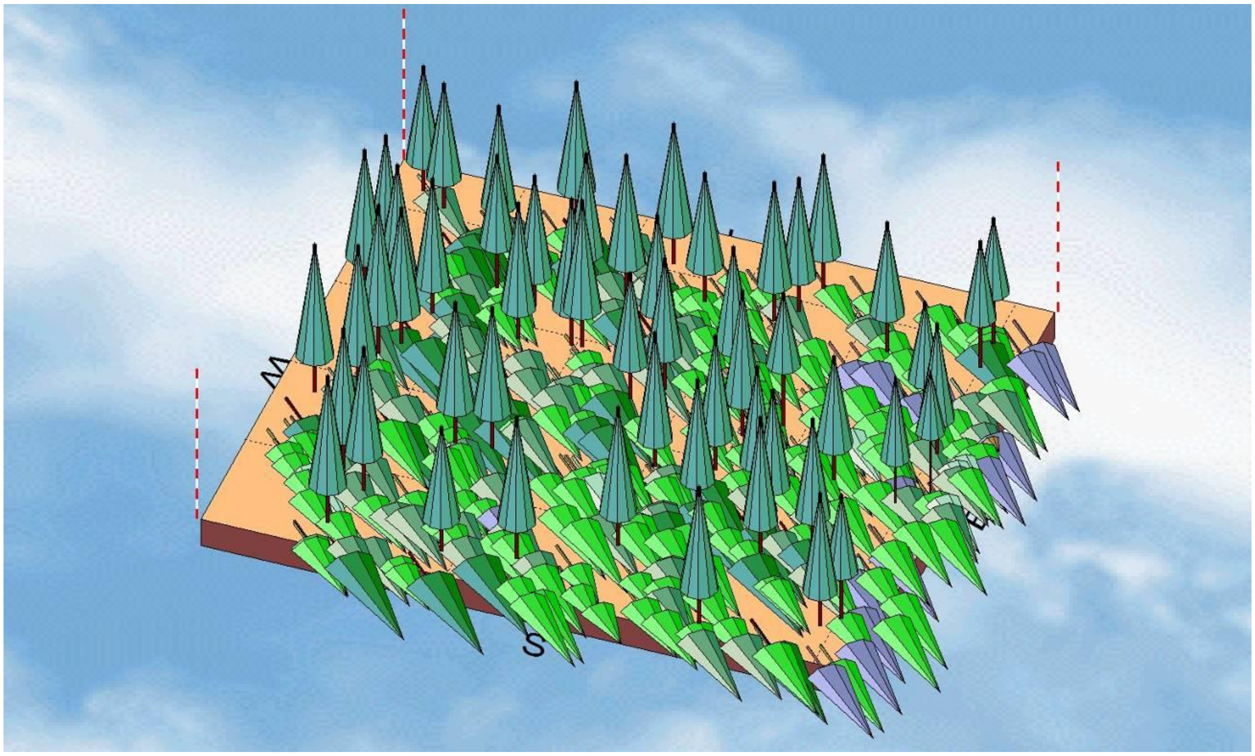


Figure 14. Age 80 First Rotation Harvest with Residual Giant Sequoia

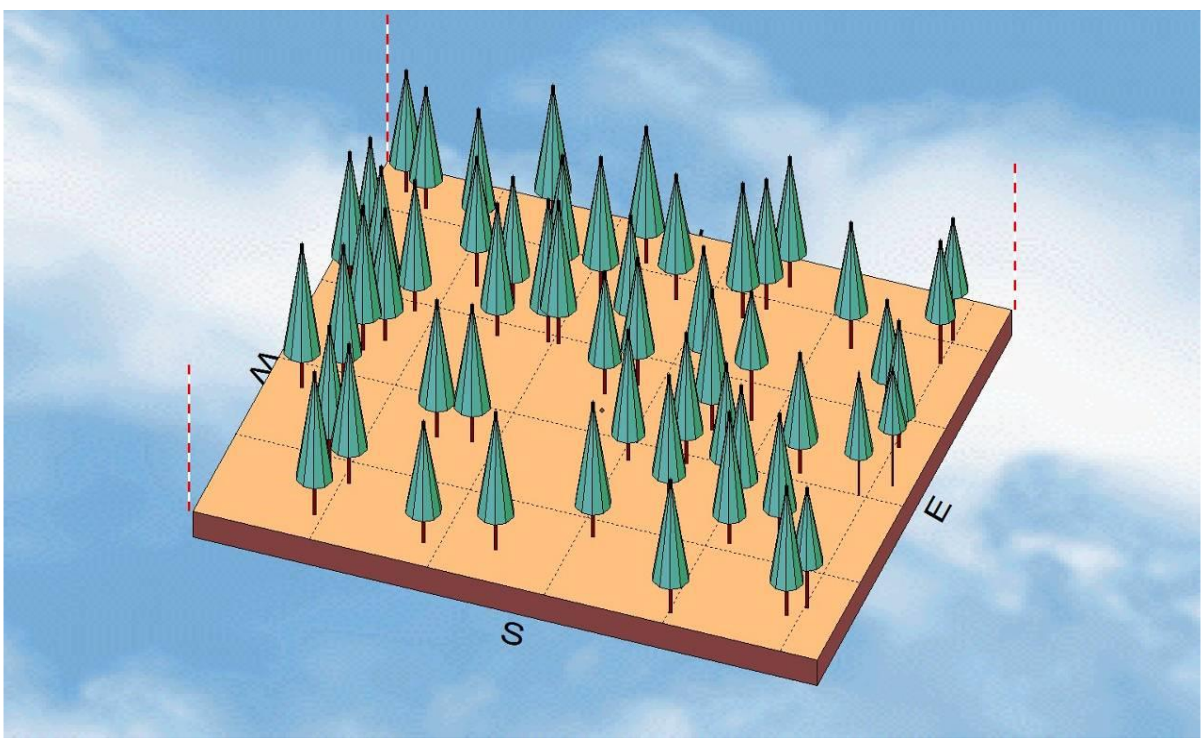


Figure 15. Age 160 End of Second Rotation Giant Sequoia Overstory Canopy

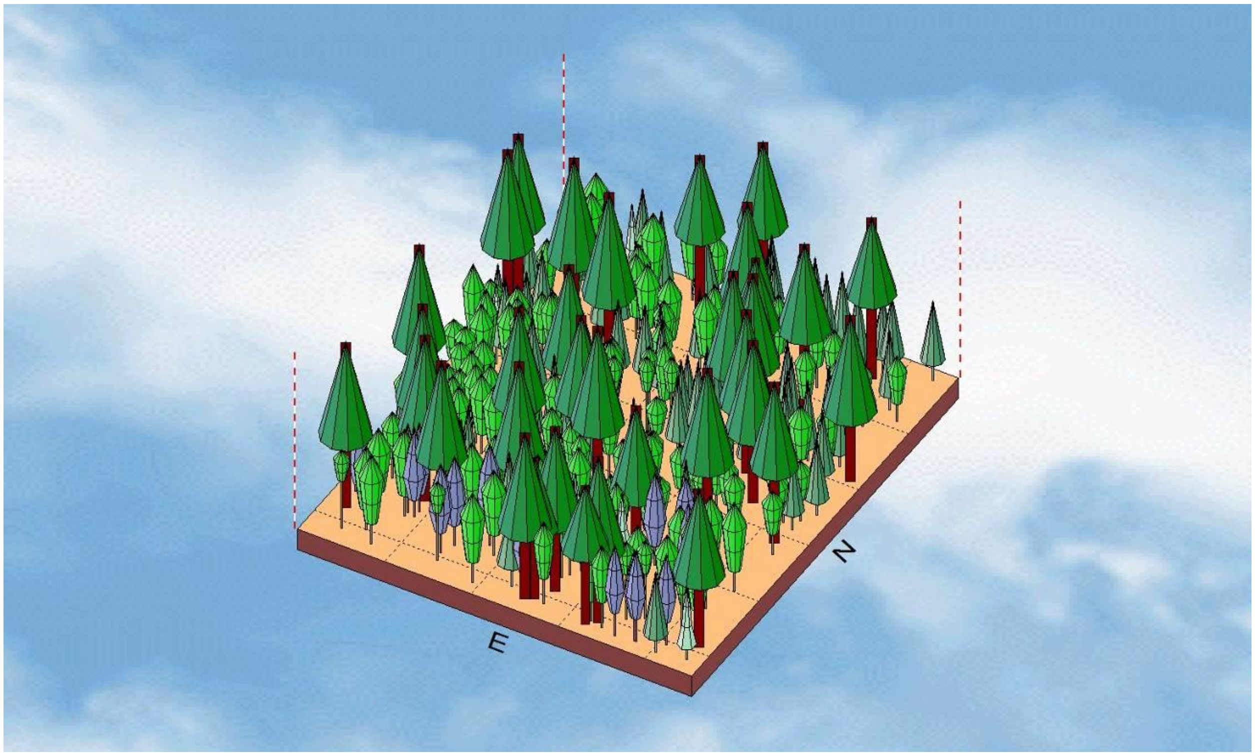
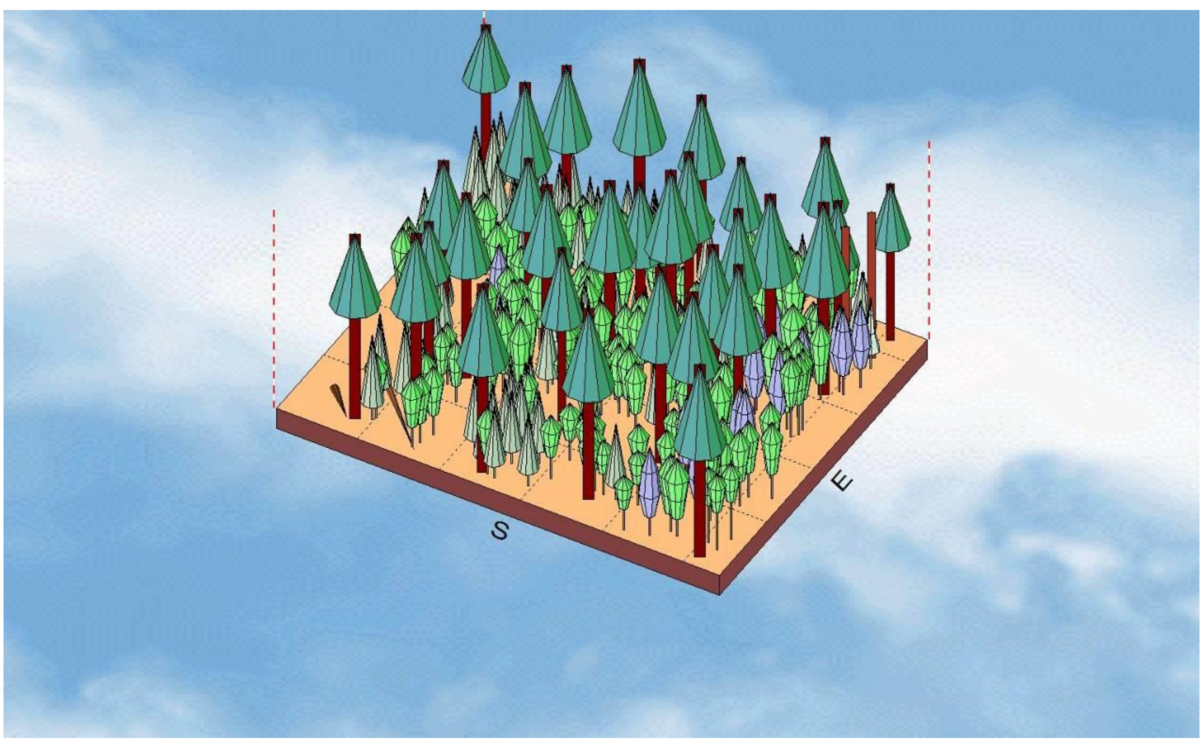


Figure 16. Age 240 End of Third Rotation Giant Sequoia Overstory Canopy



At 80 to 300 years, planted GSGC groves that are adapted to their growing environment can have their cones collected. Seedlings resulting from the cone collections can then be planted in similar growing environments on SPI, government and other timberlands. SPI will maintain a GS native groves cone collection, seed source data base. The GS seed source will be included in GSGC plantation data.

The Sequoia National Forest Giant Sequoia National Monument Plan and FEIS (USFS, 2012) and regeneration analyses by Meyer and Safford (2011) contain representative graphics and pictures that may portray some of the forest stands described above. In addition, several assessments of the potential impacts of climate change in California Sierra Nevada forests have described the likely effects on the distribution and frequency of specific species. Over an 80 to 100 year timeframe it is reasonable to assume that a changing climate, wildfires, insect and disease and perhaps air pollution, will alter some forest species compositions favoring some species at the expense of others. Recent climate change research focusing on soils and the geochemical composition of the underlying bedrock in and adjacent to GS groves adds to our understanding of potential future forest cover due to accelerated mineralization and erosion (Hamn et al., 2014).

Project Benefits Over Time

There are many potential project benefits and opportunities to conserve this long-lived species. One is the preservation of a unique and diverse genetic base. The project demonstrates how adaptive management in a working forest landscape can help create climate change resilient forests in California while aiding in carbon sequestration. Sustainable forest management can offer a predictable future supply of essential goods and services from industrial working forest lands.

Adding a component of GS seedlings to select plantations with suitable microclimates may offer a way to reduce competition or stocking levels (inter-tree and other competing vegetation). This would offer another tool to maintain healthy forests in the face of a changing climate. In general GS has greater resistance to insects and disease problems, which should contribute to the success of establishing and maintaining new groves. After a period of time, the grove seed source provenances planted in various growing environments can be evaluated. Provenance evaluations can provide forest managers with a better understanding of the range of GS adaptive capabilities to varying site conditions.

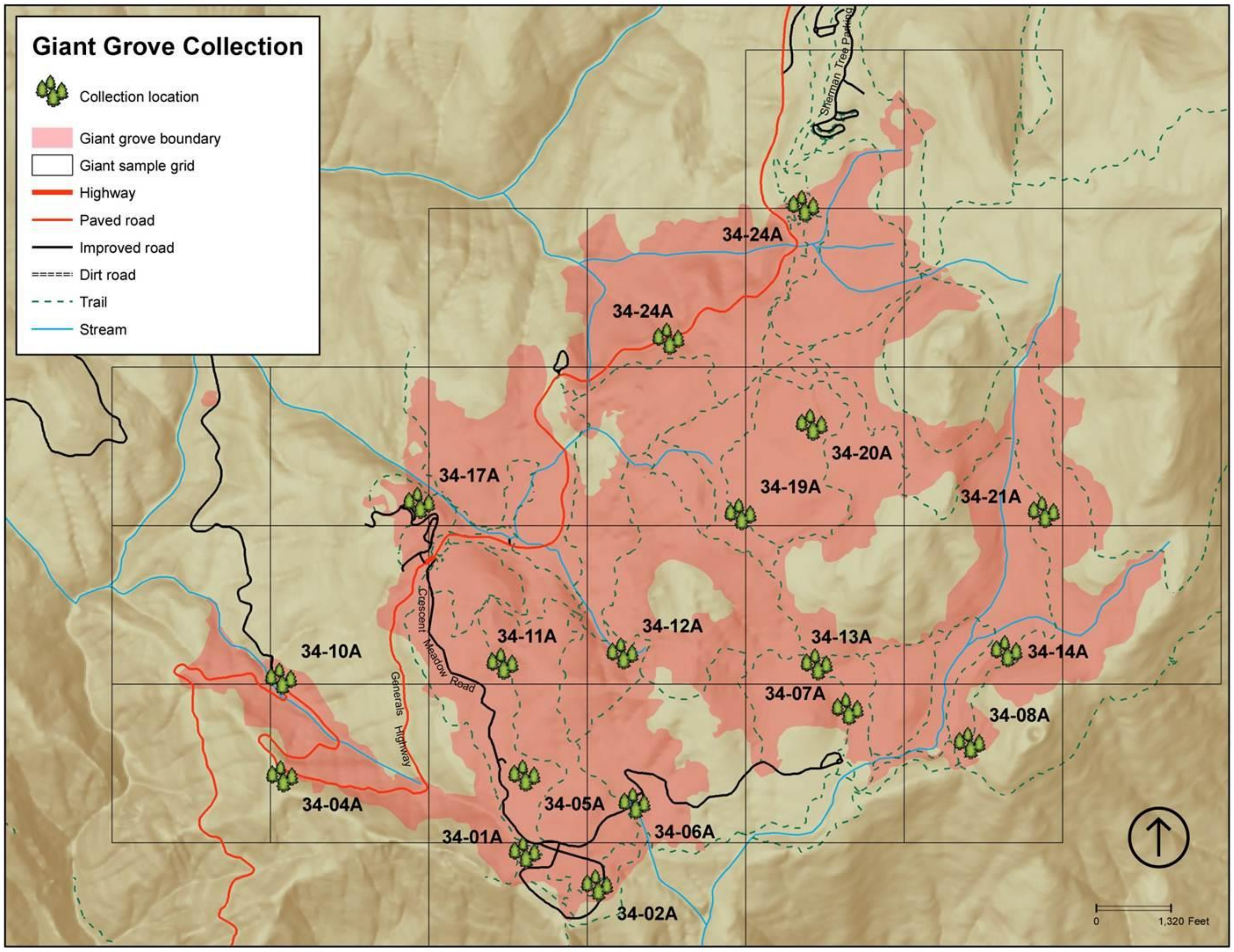
Program Update, November 2014 to July 2015

Due to the lack of recent significant weather events and a desire to move forward with the GSGCP, SPI obtained a permit from the USFS Tahoe NF, American River RD to climb old growth GS in the tiny Placer Grove to collect cones. This was done to determine the feasibility of climbing. Cone and genetic material (scion) collections were made November 2014. Climbing old growth GS is a long & arduous task compared to climbing smaller trees.

December 2014, there was a significant weather event in the Sequoia and Kings Canyon groves region. Some cone bearing limbs were broken out of the old growth GS. Late January 2015, enough snow melted, revealing the limbs. Some of the groves were checked and it was determined that there were enough cones on the ground to complete the grove genetic conservation cone sampling plan. February

2015, the SPI crew made successful genetic conservation sampling, cone collections from the Lost, Grant, and the Giant Forest Groves (Figure 17).

Figure 17. Giant Forest Grove Genetic Conservation Cone Collection Locations, February 2015.



While checking for cones on the ground after the significant weather event, very few cones were found adjacent to the advanced GS 2nd growth (100+ years) or in groves that had been heavily logged from the 1880's to the early 20th century. A significant weather event may never yield enough cones on the ground from the more limber 2nd growth limbs. July 2015, SPI has a permit to climb trees to collect cones from all USFS groves. SPI will apply with the NPS to amend the collection permit to climb. SPI is currently gathering information about 2nd growth GS seed and heavily logged groves.

February to May 2015, the Placer, Lost, Grant, and Giant Forest Groves cones were processed at the Cal Fire seed processing facility at Davis.

2015, seedlings grown at Cal Forest Nursery from the Placer, Lost, and Giant Forest Groves will be planted in GSGC units fall 2015 or spring 2016.

GS Genetics Research

March 2015, seed from 1 GS tree was sent to David Neale (UC, Davis) for GS genetic sequencing. May 2015, seed from Calaveras North and South Groves, Placer, Lost, Giant Forest, and Grant Groves (66 seed lots) was sent to Richard Dodd (UC, Berkeley) for GS genetic diversity research. Starting with the 2014/2015 GSGC cone collections and all future cone collections, a minimum of 3 grams of seed from each seed lot will be held in reserve for genetics research. SPI will continue to provide genetic material to the US Forest Service National Forest Genetics Laboratory in Placerville, California for DNA extraction and storage from the 2015 GS genetic conservation seedlings.

GS Plantations Observations

Rim Fire, August 2013. 30 to 40 year old plantations with GS were burned. Some of the GS survived. There were no stump sprouts or epicormic bole sprouts on the survivors. Some burned limbs have epicormic sprouting. There is some natural GS reproduction.

High elevation fall planted GS, with no winter snow to protect the seedlings, were desiccated and appeared dead in the spring. If some GS seedling foliage was buried in the soil, many of the seedlings re-sprouted in the spring and are growing well.

References

Assisted Migration Bulletin. 2013. Forest Genetics Council of British Columbia and Tree Improvement Branch, British Columbia Ministry of Forests, Lands and Natural Resource Operations, Issue 2, 2pp. www.for.gov.bc.ca/hre/forgen/interior/AMAT_Bulletin_02.pdf

Axelrod, D. I. 1964. The Miocene Trapper Creek Flora of Southern Idaho. University of California Pub. Sci. 50:-1-148.

Fins, L. L. and W. J. Libby. 1994. Genetics of Giant Sequoia. USDA Forest Service Gen. Tech. Rep. PSW-151.

Hamn, W. J., C. S. Riebe, C. E. Lukens, and S. Araki., 2014 Bedrock Composition Regulates Mountain Ecosystems and Landscape Evolution. Proceedings of the National Academy of Sciences USA 111: 3338–3343.

Kitzmiller J. H. and G. Lunak. 2012. Growth of Giant Sequoia Compared to Ponderosa Pine and Other Mixed Conifer in California Plantations. Western Journal Applied Forestry 27: 196-204.

Kitzmiller, J. H. 2005. Provenance Trials of Ponderosa Pine in Northern California. Forest Science 51: 595-607.

Libby, W. J. 1981. Some observations on Sequoiadendron and Calocedrus in Europe. California Forestry and Forest Products 49:1-12.

Libby, W. J. 1986. Genetic Variation and Early Performance of Giant Sequoia in Plantations. USDA Gen. Tech. Rpt. PSW-95.

Meyer, M.D. and Safford, H. D. 2011. Giant Sequoia Regeneration in Groves Exposed to Wildfire and Retention Harvest. Fire Ecology 7: 2-16.

Sierra Pacific Industries. 2011. Giant Sequoia Genetic Conservation Plan.

Lunak, G. 2014. Giant Sequoia Genetic Conservation – Sierra Pacific Industries Annual Activities Report.

Sierra Pacific Industries. 2011 Giant Sequoia Operational/Gene Conservation Practical Planting Design and Draft Long Term Grove Management Strategy.

Sierra Pacific Industries. 2013. Giant Sequoia Genetic Conservation 2011-2012 Out Plantings Map.

Tate, T. 2012. Sierra Pacific Industries Program for Giant Sequoia Management and Fuels Treatment Adjacent to Calaveras Big trees State Park – Notes for the Meeting and Field Trip for the Sequoia Work Group to Calaveras Big Trees State Park, December 4, 2012.

US Forest Service. 2012. Sierra National Forest Giant Sequoia National Monument Management Plan and Final Environmental Impact Statement and Record of Decision.

York, R.A., J.J. Battles, A.E. Eschtruth and F.G. Schurr. 2011 Giant Sequoia (Sequoiadendron giganteum) Regeneration in Experimental Canopy Gaps. Restoration Ecology 19: 14-23.