Glacier Point Restoration Project©

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The Glacier Point Restoration Project involved installation of new facilities, development of a trail system with interpretive signing, and restoration of the landscape at Glacier Point, Yosemite National Park. The landscape restoration work was completed fall of 1997. Landscape restoration presents a challenge at this site due to a variety of factors. Site constraints included limited access, sterile soils, a short growing season, heavy snow load, wildlife use, and heavy foot traffic. The plant palette also presented some challenges and all materials for use in propagation had to be collected within the vicinity of the project. The targeted restoration species included *Arctostaphylos patula*, greenleaf manzanita; *Chrysolepis sempervirens*, chinquapin; and *Quercus vaccinifolia,* huckleberry oak; three species that are particularly difficult to propagate or establish. This project has far-reaching implications regarding our ability to restore native plant communities in disturbed soils throughout the Sierra Nevada.

INTRODUCTION

Yosemite National Park has been a top attraction for many generations since the first tourist parties arrived in 1885. Glacier Point drew many thrill seekers and inspired bizarre theatrics, including driving cars to the edge of the point, performing acrobatics, and pushing burning embers off the edge to the valley below, the famous 'fire fall'. Yosemite was set aside as a National Park in 1890 so future generations could enjoy its beauty. At 7200 feet above sea level, Glacier Point stands 3200 ft above Yosemite Valley. The park's most spectacular vistas can be seen from Glacier Point. One-half million visitors each year are drawn to Glacier Point during its 5-month season.

The areas adjacent to the actual Point include the former site of the Mountain House and the Glacier Point Hotel which burned down in 1968. The site became degraded and barren. Poorly designed and sited restrooms on a septic system and the 26-year-old, temporary-concession facilities contributed to the degraded condition of the area and detracted from the beauty of the site. The objective of the project was to redesign the site and facilities to handle a large number of visitors and to restore native vegetation.

The $2.7 million project was designed by Royston, Hanamoto, Alley of Mill Valley, California. Western Botanical Services designed the plant layout. Cornflower Farms was selected to provide the site-specific native plants.

DESIGN

The design objective of the project was to provide functional facilities in keeping with the spectacular location in a way that would be both harmonious and timeless. The design included a new view terrace and amphitheater constructed of large blocks of Sierra granite, providing informal seating and a place for star gazing and interpretive programs. New restrooms and concession building were set back in the forest

and out of primary view areas. A well-defined asphalt path system was designed with interpretive signing. Design elements incorporated existing contours to minimize site disturbances.

Landscape restoration presents particular challenges at this site. Site constraints included "sterile" soils, a short growing season, heavy snow load, wildlife use, and heavy foot traffic. In addition, the National Park Service requires that all plants be propagated from source material collected close to the site and within the same watershed.

Adjacent, undisturbed montane chaparral was the community targeted for restoration, which is dominated by *Arctostaphylos patula*, greenleaf manzanita; *Chrysolepis sempervirens*, chinquapin; and *Quercus vaccinifolia*, huckleberry oak; three species that are particularly difficult to propagate or establish. Other native shrubs, forbs, and trees were selected for the aesthetic qualities of color and texture. These included *Anaphalis margaritacea*, pearly everlasting; *Keckiella breviflora*, gaping penstemon; *Penstemon newberryi*, mountain pride; *Symphoricarpos mollis*, creeping snowberry; and *Pinus jeffreyi*, Jeffrey pine. Thorny species, *Ribes roezlii*, Sierra gooseberry; *Ceanothus cordulatus*, whitethorn; and *Rubus leucodermis*; blackcap raspberry; were selected to help direct foot traffic and protect the slower-growing plants.

PLANT PROPAGATION

On-site collection and propagation of container-grown plant materials began during the summer of 1995, 2 years prior to out-planting. A total of six trips to the site were completed during this period to collect seeds, cuttings, and native soil (used for inocula for mycorrhizae and laboratory analyses).

A total of 11 species were propagated from both cuttings and seed. The long lead time prior to out-planting combined with multiple collection trips resulted in the highest assurance that the number of plants produced would meet or exceed the number required.

Table 1. Plants and treatment used in the propagation of plants used in the restoration project.

Plant name	Stratification Period at 40°F
Anaphalis margaritacea	No treatment
Ceanothus cordulatus	90 days (after hot water soak)
Chrysolepis sempervirens	90 days
Keckiella breviflora	30 days
Penstemon newberryi	30 days
Pinus jeffreyi	30 days
Quercus vaccinifolia	60-90 days
Ribes roezlii	3.5 to 5.5 months
Rubus leucodermis	3 months warm/3 months cold (7 day bleach soak)

The seeds were collected and logged in. Each seed collection was given a lot number, project ID, and a designated tag color to track them in the field and in the computer. Soft-coated seed like the *Ribes* were slurried; the pulp was floated off and dried. Dry seeds, such as, the *Keckiella,* were crushed and separated from the chaff by screens or air. All of the seeds required some stratification (Table 1). They were mixed with moist, coarse perlite; put in a plastic bag with a venting straw; labeled; and put in the cooler at 40°F. After the stratification period the seeds are either sown in flats to be planted out for the *Ribes* and *Rubus* or direct-sown into the final containers for the *Quercus* and *Chrysolepsis.*

With the exception of *A. patula,* all species were grown in deep pots [2½ inches (diameter) × 10 inches (long), 40 inches^3 volume, with root trainers] because of superior performance achieved in previous projects.

Cuttings were taken from fall through winter. *Arctostaphylos patula* cuttings were taken in the snow in January. Cuttings were trimmed to 4 to 5 inches with the leaves not cut and the bottom inch of stem stripped and wounded, dipped in #8 Hormex, stuck in a flat of perlite and peat (9 : 1, v/v), and set on bottom heat with low mist in the greenhouse. In early spring the rooted flats were hardened off outside then transplanted while the weather was still cool. *Arctostaphylos patula* was grown in a tree pot (4-inches^2 × 14 inches long, 180 inches^3 volume, open bottom, with root trainers).

Native soil, used as inocula for mycorrhizae and other beneficial soil microorganisms, was obtained from healthy appearing plant specimens near the planting site. Laboratory analysis confirmed these soils contained the desired organisms. These soils were either directly incorporated into the container soil or made into a slurry and used as a drench.

Comparative soil analyses from near the site indicated that the site was deficient in nitrogen (and possibly sulfur) by an amount equivalent to 50 lb of total N per acre. Ten gram, tea bag type, slow release fertilizer (18N-6P-6K-5.7S) was placed into every planting hole. It is believed that such a low level of supplemental fertilization would not impair microbial colonization of roots while stimulating plant growth.

INSTALLATION

Landscape installation was completed in the fall of 1997, following completion of all structures and facilities. The work began with the installation of an irrigation system. This automated system insured adequate moisture was provided to the plants during the establishment period. It has operated for 3 years. This buried, permanent system can be reactivated if needed.

All plants were enclosed with hardware cloth and anchored in a 4-inch deep trench. The enclosure protected the plants from browsing and foraging animals and from human foot traffic. These were removed after 3 years. All bare, nonplanted areas were treated with the native seed/mulch mix.

MONITORING

The contractor was responsible for insuring 100% survival 1 year following planting. The contractor was supplied with up to 25% of the original plant numbers for replant. In 1998 after 1 year the overall survival rate for the plants was 92% broken down as such: Jeffrey pine, 100%; Sierra gooseberry, 88%; greenleaf manzanita, 95.5%; huckleberry oak, 95.5%; blackcap raspberry, 99.5%; Mountain pride penstemon, 95%; keckiella, 95.5%; creeping snowberry, 99.5%; and whitethorn, 62%. The

Park Service is responsible for all site improvements and maintenance following Fall 1998.

A visit to the site during the summer of 2000 showed continued good establishment. The protective cages had been removed and some of the species had been heavily browsed. Those that were thorny like the *Ribes* and *Rubus* had not been browsed and were of good size.

CONCLUSION

Short-term project management and propagation objectives were accomplished. Follow-up monitoring over the next several years will assess the long-term success of this approach and project.

Questions/Answers: General Session IV

Martha Booz: Did you water the salt marsh plants with salt water?

Patricia Kreiberg: They were all irrigated with fresh well water. We used 44 parts per thousand in the salt-water soak since in a salt marsh situation the water can get as high as 55 parts per thousand. Sea water is 35 parts per thousand so we chose an intermediate concentration.

Kristin Yanker-Hansen: Do you ever use soil from a restoration site to start the plants before they are permanently planted in the field?

Truman Young: That's an intriguing idea. As soon as you dig field soil up you change its structure. This can affect the success of the restoration project.

Amelia Pohl: What containers were used in your study?

Truman Young: There were several different kinds, rose pots and tree pots.

Truman Young for Ann Chandler: I have a question about Glacier Point. Was soil compaction a problem at that site and, if so, was anything done about it?

Ann Chandler: The soil was very compacted and it was extensively reworked.

Melanie Baer-Keeley: Were the horticultural requirements for the plants primary in the planning and development of the project?

Ann Chandler: This project went like clockwork which isn't always the case. Plant selection was excellent as was the site plan. Plenty of time (2 years) was given for selecting and propagating plants that were used in the project.