EROSION CONTROL AND REVEGETATION ON SANTA BARBARA ISLAND IN CHANNEL ISLANDS NATIONAL PARK

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Santa Barbara is the southernmost of the five islands making up Channel Islands National Park, and the smallest, at 260 hectares. The island has a history of ranching and farming that began in the late 1800s, and continued until 1932. Prior to the ranching era, the island vegetation was dominated by native coastal scrub communities. It was home to the Island Night Lizard (*Xantusia riversiana*), endemic to the southern Channel Islands, and listed by the U.S. Fish and Wildlife Service as 'Threatened', as well as to numerous seabird species, many of which formerly nested in burrows constructed in the loose, friable soils of the extensive slopes and plateaus of the island.

Through a combination of burning, tilling, and grazing, the farming and ranching activities converted the native shrublands to grasslands dominated primarily by European annual grasses. Today, these grasslands cover most of the island, forming a dense mat that prevents erosion, but which is still composed mainly of non-native plants. However, native shrubs are beginning to re-invade their original territories, from the canyons and coastal bluffs to which they were restricted during the ranching era. Our restoration goal for the island is to restore the ecosystem processes controlling distribution, numbers, and population dynamics of native biota to an approximation of their 'pre-European-settlement' function. We expect that this approach will eventually result in the development of the island vegetation toward dominance by coastal scrub communities, and toward improvement of habitats for native animals.

On the eastern terrace of the island, there is a 5.5 hectare area that was severely and rapidly eroding (the 'badlands'), which presents bare soils networked with deep, steep-sided gullies and a few small patches of annual grass vegetation, with occasional plants of the native shrub woolly sea blite (*Suaeda taxifolia*). Judging from aerial photographs, this erosion area expanded rapidly between 1943 and 1957, a time when populations of feral rabbits on the island peaked and vegetation was very severely browsed by them. Evidence is strong that the combination of the former farming/ranching uses, rabbit browsing, and cyclic droughts caused this 'badlands' to develop and expand.

Since then, even with agriculture long ceased, and rabbits eradicated from the island, erosion was unchecked, vegetation is largely unable to establish, and the 'badlands' were expanding at the rate of about 1% per year. Studies of the site showed that the former deep topsoil is eroded away, leaving a highly compacted clayey subsoil, with high sodium content and low organic matter and nutrients, that is still eroding at the rate of about 15 cm per year.

To establish the conditions necessary for plants to establish, and thus to move toward our restoration goal, we needed to stabilize these soil surfaces, control and reverse gullying, and facilitate rainfall retention, seed catchment, and successful seed germination and plant establishment. Our immediate objective was to establish adequate vegetation to retain surface soil, and trap sediment, seed, and water, so that the processes of soil formation and nutrient cycling, vegetation recovery, and re-establishment of viable communities can resume, and proceed in the direction of dominance by native species.

Vegetation monitoring data from adjacent areas indicate that native shrubs, including giant coreopsis, sea blite, and others, are invading European foxtail (*Hordeum murinum*) grassland. We want to mimic this natural process of vegetation conversion back to a native shrub cover on the badlands area.

Restoration research conducted in 1987-1990 (D'Antonio et al. 1992) showed that the best method for stabilizing these areas of bare soil is to till shallowly, seed, then cover the area with straw-coconut fiber erosion control matting. This work is best done in early fall to take advantage of the rainy season; research showed that no watering was then necessary to get plants to establish. Four species performed well in both small and large test plots using this site preparation technique; these were the native shrubs giant coreopsis (*Coreopsis gigantea*), sea blite (*Suaeda taxifolia*), the native annual herb pineapple weed (*Ambylopappus pusillus*), and European foxtail (*Hordeum murinum*), a turf-forming annual/biennial grass that has effectively stabilized other areas of highly erosive soils on the island. All of these species are present in the surrounding vegetated areas. These indigenous materials were preferred to agricultural seed sources, or off-site seed collection, either of which would introduce further alien species/genotypes to the island.

In mid-1995, CINP received a grant through the National Parks Foundation, from Target Stores and the

National Fish And Wildlife Foundation, to undertake larger-scale application of these restoration techniques to the 'badlands'. Through the spring and summer of 1995, in hopeful anticipation of the project's implementation, we collected a considerable amount of seed, surveyed the sites to be treated in detail, and developed our materials list. Sources were located and materials purchased in August and September, 1995. Materials were delivered to the island work site by barge and helicopter, since Santa Barbara Island lies 60 miles offshore from Ventura, is accessible only by foot trail from the boat landing, and the work site lies approximately ¾ mile from the landing. Delivery occupied two days. Twenty-five separate loads from barge to island saw 84,000 square yards of erosion blankets, 21,000 staples, several hundred feet of silt fencing, 1000 feet of straw wattles, 800 wooden stakes, a 400-pound rototiller, and assorted tools and fuels neatly stacked near the three separate work sites.

During the late summer of 1995 we contacted a long list of potential volunteers. We also arranged for a Student Conservation Association volunteer to be on site to help implement and direct the anticipated four months of intensive work on the project. Our work trips began on October 6, 1995, and continued through May, 1996. Volunteers and Park staff were on the island nearly every week working on this project. At least 100 person-days were donated by volunteers, and at least 120 person-days worked by Park staff, during the most intensive period.

About 1.2 hectares were 'roto-tilled' to a depth of 10 to 30 cm. Check dams and sinuous water bars, both constructed of polypropylene silt fabric and wooden stakes, were installed in the larger gullies. Small gullies were smoothed and filled with soil during the tilling process. The tilled areas were thoroughly raked and smoothed, to ensure close contact of the matting with the soil surface, and seeded with a mixture of ReGreen®, a commercially-produced sterile hybrid of wheat and wheatgrass, and island-collected seed of available annual grasses such as Mediterranean barley and soft chess (*Bromus hordeaceous*), with a minor component of seed of island-collected native annuals perennials, and shrubs. Though the site is only gently sloping, staples were applied at the spacing recommended for steep slopes, since the island experiences occasional extremely high and turbulent winds.

Through the spring and summer, we were able to do some weeding of the sites, primarily of crystalline iceplant and cheeseweed. We also harvested additional indigenous seed on the island for supplemental broadcast sowing over the restored areas, as might be necessary, in successive winters.

The seeding/matting techniques gave very satisfactory results. Annual plants, primarily grasses, with scattered herbs and perennials, have colonized the site, stabilizing the soil surface against further erosion with a dense cover of live plants and thatch over most of the site, and the process of topsoil formation has begun. Silt-fabric dams are successfully retaining soil in the gullies, so that the gully floors have already risen 10 to 30 cm, leading to eventual complete filling. These retention dams are being installed on an adjoining one hectare of the adjoining untreated area as well, which should help to further slow the flow of water over as-yet-unprotected surfaces, retard further gully development, and prevent excessive siltation of the richly-populated intertidal reefs directly below the site. By the end of the project's second growing season, about 200 seedlings of giant sunflower (*Coreopsis gigantea*) had self-established into the matted areas, compared to no recruitment on the untreated areas.

It is estimated that for at least the next 20 years there will be a shift in the vegetation community in the 'badlands' from bare soil, through annual grassland, to a plant community more similar to the native shrub cover which existed prior to ranching and farming. As vegetation changes, the habitat will become more suitable for the Island Night Lizard, as well as migratory and resident songbirds, and seabirds. Monitoring of the vegetation and wildlife communities will continue, accomplished by Channel Islands National Park (CINP) natural resources management staff, as part of our long-term monitoring programs.

Overall in California, the native perennial bunchgrass purple needlegrass (*Nasella pulchra*) is not a species considered particularly rare; however, the native perennial grassland habitat itself is disappearing under agricultural, residential, and commercial development at an alarming rate. On the Channel Islands, because of intense grazing earlier in the century, stands of this grass are rather rare, and generally small in area. On Santa Barbara Island, USGS-BRD scientists, after thorough surveys in 1994, estimated that fewer than 100 plants of purple needlegrass remained on the island. They collected what seed was available, conducted germination and growth-rate research, and produced more than five hundred healthy seedlings which we planted on the island in early 1996, in two separate test sites in and near the "badlands." These plantings helped us determine the best methods and sites for re-establishing viable, reproducing populations of this on the island, as well as immediately increasing the number of purple needlegrass plants extant on the Island. Our success rate for plant establishment, after three years, was 90+% on a non-eroded site, and about 5% on an eroded site. Soil composition, and the effects of other vegetation on the site, probably account for the great difference in performance, but these factors have not yet been closely investigated. Over the last year, we have produced another 1400 purple needlegrass plants for additional plantings on the island, in areas of favorable habitat, in early 1999.

Numbers and distributions of southern island sagebrush (*Artemesia nesiotica*), a species endemic to the southern Channel Islands, and California boxthorn (*Lycium californicum*), which provides primary habitat for the Island Night Lizard, were also very severely reduced and restricted by agricultural activities and feral rabbits. With the purposes of increasing the populations of these plants, and providing increased habitat for the Island Night Lizard, we have also been propagating and planting these species at

scattered locations throughout the island. Plants are propagated on the mainland in small, readily transportable containers, in sterile media, and are maintained in clean, pest-controlled growing condition, then subjected to rigorous inspection and necessary prophylactic treatments before transport. Plants are transported to the island as soon as possible, to reduce their exposure to biotic contaminants on the mainland. Re-design and rehabilitation of the island's small campground, and completion of new Park facilities on the island, have also afforded opportunities for use of native plants to help screen buildings and structures, assist with waste-water disposal, delineate campsites and provide a sense of privacy, as well as to establish reproductive populations of these plants in areas which have long been depleted of native plants and seedbanks.

LITERATURE CITED

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