Reclamation of Disturbed Lands in Glen Canyon National Recreation Area

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This report covers the first half of a project dealing with establishment of field study plots to guide reclamation of disturbed areas in Glen Canyon National Recreation Area and comparable sites. Unpredictable weather in the current drought cycle has required the rescheduling of field work to coincide with favorable soil moisture conditions. In April, 1990, study sites were established in two locations; near Paige, AZ and Hall's Crossing, UT. The site at Paige was ripped prior to planting, and the site at Hall's Crossing was located on fill over a dump area. At each site, 8 replications of 4 planting treatments involving 10 native species of grasses, forbs and shrubs were set out. Treatments were designed to create optimal conditions for establishment; including seeding with a mulch cover, transplanting of container-grown plants, planting into a small water collecting basin, and planting into a basin plus receiving a slow-release fertilizer pellet and a water retaining soil amendment. Tasks remaining are replanting some plants in March, 1991, gathering plant establishment data in March, and completing a literature review on land revegetation under arid conditions.

✦ Objectives

The objectives of the research plan were to,

1. establish two revegetation study plots, one at Paige and one at Hall's Crossing in late 1989 and,
2. review the literature on artificial revegetation in arid regions especially with relation to periods of drought.

During a site visit in September, 1989, tentative sites at Paige and Hall's Crossing were discussed. At that time, the soil in both locations was dry and fall planting operations appeared to be problematical. Also, during the site visit, most of the vegetation appeared to be drought-dormant, and chances for success in plant establishment appeared to be minimal. Additional time was required to provide for a remedial treatment of the soil. Thus, planting was deferred until the Spring of 1990 after consultations with National Park Service personnel.

✦ Selection and Preparation of Plot Areas

Revegetation Plots at Paige

The plot area chosen at Paige was near the service road exit from Highway 89 that services the dam and a view site along the beach front road to Wahweep (Fig. 1). This location was part of an original dam construction site. It had been covered with a layer of gravel over the sandy soil, and sandstone and was very compacted as a result of heavy equipment operations. The vegetative cover was very limited and consisted primarily of small perennial grasses, ephedra *(Ephedra*

nevadensis), blackbrush *(Coleogyne ramosisima)* and a few other shrub species. Because of the compacted nature of the gravelly soil, a ripping operation was recommended to facilitate digging planting holes, increase plant survival, and allow percolation of rain and melting snow into the root zone. On March 26, 1990, the site was visited to determine the effectiveness of the ripping operation, to observe the moisture content of the soil and to schedule a time for planting the plot. The ripping operation had created ridges that were 25 cm high above the furrows, and the spacing between ridges was approximately three feet. The surface few inches of soil were slightly moist from two small rainfall events of .08 cm on March 5th and .15 cm on March 12th. The depth to bedrock was 25-31 cm, as evidenced by the ripper teeth catching some of the sandstone bedrock. On April 7-8, we returned to plant and seed the study area. At this time, Russian thistle *(Salsola kali)* seedlings were growing demsey on the site and fear was expressed that they would withdraw much of the soil moisture needed to sustain the revegetation study. Plot size was two furrows wide 1.7 m long. Plants or seeds were planted in the flat bottom of furrows. The research design consisted of eight replications of four surface management treatments and ten plant species. The treatments were:

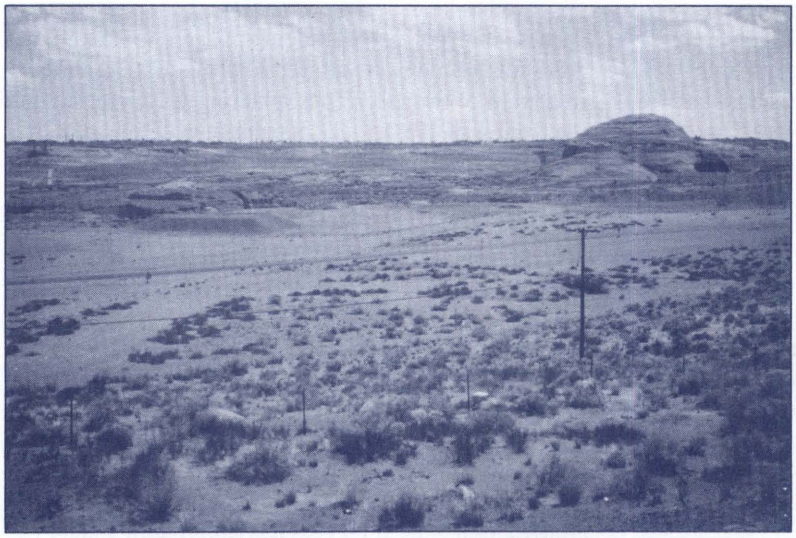

Fig. 1 Disturbed land reclamation study site at Paige, AZ.

Fig. 2 Proposed study site for disturbed land reclamation plots at Hall's Crossing. Actual study site is .8 km north of here on a soil covered dump site.

1. flat seeded and mulched,
2. flat planted,
3. basin planted and,
4. basin planted and mulched. all plants received 1 liter of water and a fertilizer tablet. The species planted were:

Grasses

Indian ricegrass	*Oryzopsis hymenoides*
Sand dropseed	*Sporobolus cryptandrus*
Galletta grass	*Hillaria jamesii*

Forbs

Low desert mallow	*Sphaeralcea ambigua*
Scarlet gillia	*Gillia capitata*

Shrubs

Fourwing saltbush	*Atriplex canescens*
Blackbrush	*Coleogyne ramoisissima*
Silverleaf buffaloberry	*Shepherdia argentea*
Nevada ephedra	*Ephedra nevadensis*
Utah juniper	*Juniperus osteosperma*

Revegetation Plots at Hall's Crossing

The original plot area chosen at Hall's Crossing was on an undulating mesa east of the marina. The area was an abandoned section of road that had been bypassed when a new approach road was constructed (Fig. 2). However, when we inspected the area on April 9, the soil was not only excessively compacted; but there was essentially no moisture in it to support the growth of transplants or seedlings. Based on the essentiality of moist soil as a criteria for success in plant establishment under arid land conditions (Van Epps and McKell 1980) the abandoned road site was not considered suitable without some type of ripping treatment. Instead, a disposal area that had been covered with several feet of sandy topsoil was selected for the revegetation plots. Here, the soil had a slightly moist feel at a depth of 15 cm, but because of its sandy texture the water holding capacity was minimal. Even so, the site represented a typical revegetation problem for the general area. To fit into the space available in the dump area, a total plot area of 27 x 24 m was utilized for 288 plots measuring 1.5 x 1.5 m. The study consisted of 8 replications of 4 treatments of 9 species. The treatments were

1. seeded and mulched,
2. planted flat,
3. planted in basins and,
4. planted in basins with a fertilizer tablet and a soil amendment to retain moisture.

The species planted were the same as at Paige with the exception that Scarlet Gillia was omitted because the remaining plants were too small. All plants received 1 liter of water to settle the roots after planting. After the plots in the two locations were established, plot diagrams were mailed to Mr. Richard Harris, Lake Powell National Recreation Area Headquarters, Paige, AZ.

Plant Propagation Observations

Most of the plants used in establishing the plots were propagated in the Botany greenhouse at Weber State University. The seeds were purchased from Granite Seed Co., Lehi, Utah. Utah Juniper and Silverleaf Buffalo plants were obtained in gallon-can size from the Porter-Walton Nursery in Centerville, Utah. Two species, Nevada (or green) Ephedra and Blackbrush were very difficult to propagate vegetatively. Two different attempts to propagate these two species from cuttings failed for reasons of inadequate greenhouse procedures. In retrospect, the greenhouse flats containing the cuttings should have been given bottom heat and the overhead mist should have been less frequent and of a warmer temperature. However, both species were propagated from seed after stratification in a moist condition in a refrigerator at about 40°C for 15 days. Germinated seeds were transplanted to tubepak containers when the roots were about 1.5 cm long.

✦ Significant Findings

No significant findings have been obtained in the project to this date. One of the most difficult problems to deal with is planning field plantings that depend on a supply of soil moisture during a protracted dry cycle in the region. Because blackbrush and ephedra plants used in the April 8-11, 1990 planting were small, additional plants were grown in the greenhouse during the summer of 1990 and a fall planting was tentatively planned if soil moisture was adequate. However, soil moisture was not adequate until the temperature became too low for a safe planting. Now, an early Spring 1991 date is planned in time for gathering data on establishment success from the original planting and include this information in the final report.

Literature Review on Rehabilitation of Arid Lands

A literature review of the subject is almost complete and will be ready for inclusion in the final report. This review will focus on the specific problems of plant establishment under environmental problems of drought stress and temperature extremes common to areas typical of the Lower Colorado Plateau.

Work to be Done in the Remaining Reporting Period

Three tasks remain to be accomplished in the remaining period of the project. These tasks are planned and resources remain to accomplish them. The first task is to maintain seedings of Ephedra and Blackbrush for a late winter-early spring planting at the Paige and Hall's Crossing study sites when soil moisture is expected to be favorable. Additional plants will be available for planting if conditions and

technical plans warrant. Late March is a proposed time. The second task is to make observations of establishment success of the plantings and seedings made in April, 1990 and summarize this information in the project final report. The third task is to complete the review of literature that is presently in progress. In addition, a visit will be made to 15-year old revegetation plots located on the Henry Mountains to observe the long-term success of plantings made there in 1977. The information obtained there and at the new plots at Paige and Hall's Crossing sites is expected to form the basis for a manuscript on reclamation of disturbed high-risk arid lands.

✦ References

Van Epps, G. A., and C. M. McKell. 1980. Revegetation of disturbed sites in the salt desert range of the Intermountain West. Utah Agric. Exp. Stn. Land Rehabilitation Series No. 5. 22 pp.