Revegetation of Saline Playa Margins

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Abstract: New shrub recruitment in saline playa margins is limited by extremely high osmotic potentials of the seedbed. In the Eagle Valley playa near Fernley, NV, recruitment is rare and occurs mostly in recently deposited eolian and flood-deposited sediments of low osmotic potential. In most instances, however, sediment is of insufficient thickness to support long-term growth. In 1990, as part of a plant/soil relationship study in the eastern end of Eagle Valley playa, soil pits were excavated by backhoe in an environment consisting of mounds occupied by *Sarcobatus vermiculatus*, *Atriplex lentiformis* ssp. *torreyi*, and *Allenrolfea occidentalis* amid unvegetated interspaces. Soil pits were refilled, but depressions about 2 by 0.5 m in area to a depth of between 20 and 60 cm remained. Within 5 years, a thick veneer of eolian dust had accumulated in all the pits and supported robust recruitment of *S. vermiculatus*, *A. torreyi*, and *A. occidentalis*. By the year 2002, some shrubs were over 0.5 m in stature. Excavating small depressions in saline playa environments appears to be an effective revegetation technology provided the area has a source of low osmotic potential eolian material.

Introduction

Creation of small depressions in the soil surface is a useful seedbed preparation technique to facilitate seedling establishment in dry environments. The technology, alternately named land imprinting, gouging, and pitting, has been shown to enhance water availability to plants in the critical early establishment phase (Munshower 1994; Whisenant 1999). Our purpose here is to report on the recruitment of salt desert shrubs in depressions left from research activities on an extremely saline playa margin environment. We hypothesize that the reason these depressions facilitated shrub recruitment is a combination of enhanced water availability and capture of seeds and eolian dust, which serves as a low osmotic potential media for seed germination and early establishment.

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Methods

The study area is the Eagle Valley playa (39˚44' N, 119˚2' W) just southeast of Fernley, NV. The western boundary was the terminus of the Truckee River during pluvial periods and consists of coarse-textured deltaic and reworked eolian sands. Elevation is 1,234 m. The site is a gradient from barren, flat, fine-textured, salt-encrusted sediments to a higher coarser textured and less saline complex of reworked beach material, eolian sands, and alluvial colluvial material. Based on monitor wells, the water table is less than 3 m in most years. Vegetation occurs on mounds and is dominated by *Allenrolfea occidentalis* ([S. Watson] Kuntze), *Atriplex lentiformis* ssp. *torreyi* ([S. Watson] H.M. Hall & Clements), *Sarcobatus vermiculatus* ([Hook.] Torrey), and by the grass *Distichlis spicata* ([L.] Greene). In the less saline and coarse-textured beach and colluvial deposits, vegetation is dominated by *Atriplex confertifolia* ([Torrey and Frémont] S. Watson) and *Sarcobatus baileyi* ([Cov.] Jepson). In 1990, we described a sequence of seven soils along a transect encompassing the width of the mounded area from the barren playa surface southeast to the less saline upland interface (transect distance about 1.2 km). A backhoe was used to excavate to a depth of approximately 3 m. After description of soils, pits were refilled with stockpiled soil, but settling created depressions averaging over 0.5 m in depth and 2 by 0.5 m in area. The site was ignored for several years, and when we returned in 1995, we were surprised at the robust recruitment of salt desert shrubs from the depressions. Photos presented here were taken in May of 2002.

Results and Discussion

The playa margin community of which this study focuses is an inhospitable environment for plant growth with extreme aridity and high salt content (fig. 1; Blank and others 1998). The surface soil seedbed is far too saline to allow seed germination; total soil water potentials measured monthly throughout a 2-year period average between –35 and –111 MPa for mounds microsite and between –25 and –86 MPa for interspace site (Blank and others 1994). Recruitment does occur along flood washes and impediments where eolian dust accumulates. Our data suggest that these microsites accumulate sediment of low enough osmotic potential to support germination (table 1). However, the low osmotic strength substrate is generally too thin to support plant

Figure 1—General view of Eagle Valley playa looking northeast from the study area. In the middle background is barren, nearly level, lacustrine sediments. Surrounding this central core is a complex mound-intermound community extending outward and merging into alluvial fans. The mounds are occupied by halophytic shrubs. *Distichlis spicata* often occupies intermound areas. Extensive measurements indicate that the total soil water potential (mostly osmotic) is far too negative to allow seed germination. New recruitment requires microsites where low osmotic potential substrates can accumulate.

growth until the roots can reach the water table and sustain growth (Trent and others 1997).

Our soil excavations have allowed eolian dust to accumulate along with seeds and thereby facilitate plant recruitment (figs. 1 through 5). Other factors that may come into play include (1) micro-meteorological benefits from increased shading and (2) a greater chance of roots reaching the water table. We suggest that creating small depressions in similar landscapes may be a cost effective way to recruit new plants into similar saline environments provided there is a source of low osmotic potential wind-driven substrate and a source of seeds.

Table 1—Electrical conductivity and theoretical osmotic potentials for recent eolian sediment and underlying material.

Sample	Electrical conductivity (dS m^{-1})	Theoretical osmotic potential (MPa)[a]
Recent eolian	1.93 sd = 1.10	0.046
Underlying material	29.3 sd = 11.7	.81

[a] Based on 298 °K assuming osmoticum is NaCl.

Figure 2—Partially filled soil description pit in a very saline portion of the study area. There is almost no recruitment of new plants in this community. Most of the established shrubs are nearly dead in this area, which is difficult to judge in this black and white photograph. Even in this inhospitable environment, recruitment of *Sarcobatus vermiculatus* has occurred, fostered by the accumulation of eolian sediments in the soil pit.

Figure 3—Robust plant of *Atriplex lentiformis* ssp. *torreyi* that recruited into one of our soil description pits. This is the largest shrub in any of our soil pits and attests to how conditions in the soil pits facilitate rapid plant growth.

Figure 4—A soil description pit now nearly completely filled in by eolian sediments. Notice the spoil pile in the background. In this soil pit there was recruitment of *Sarcobatus vermiculatus*, *Allenrolfea occidentalis*, *Atriplex lentiformis* ssp. *torreyi*, and *A. confertifolia*.

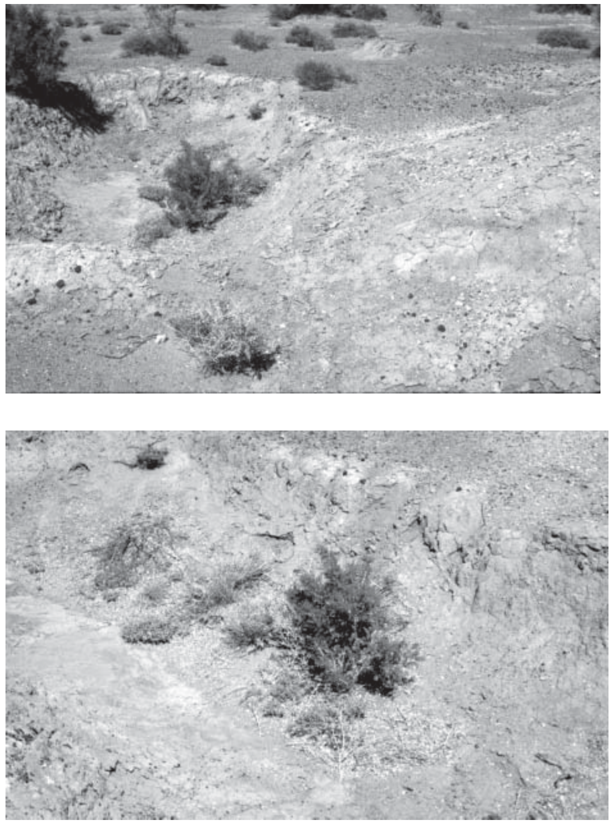

Figure 5—Soil description pit showing recruitment of *Sarcobatus vermiculatus* and *Atriplex confertifolia*. The more general top view shows very minor recruitment in the surrounding area. Photo is taken facing south and shows how eolian sediments accumulate mainly on the west side of pits. Bottom closeup photo shows that the depressions collect seeds.

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