

The University of Wisconsin Press

# Restoration & Management Notes

Vol. II, No. 1  
Summer 1984



River Restoration

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A five-year-old revegetation plot in the Piceance Basin of northwestern Colorado was used to study how soil factors affect plant species diversity. Soil properties, including coarse fragment content, depth to bedrock, rooting depth, soil volume, soil moisture, fertility, and salt content were quantified for 108 subplots. Using standard simple and multiple regression techniques, plant diversity on the subplots was correlated with the various soil properties.

Although six different seed mixtures had been used on the plot, the greatest variation in soil properties occurred in an area seeded with a mixture of introduced grasses and forbs. Therefore, this mixture was used most extensively to study the diversity-soil property relationships. For this mixture, percent large coarse fragments ( $>4.76$  mm) within the rooting depth had a high positive correlation with the Shannon-Weiner diversity index. Depth to bedrock, rooting depth, total soil volume, soil volume within the rooting depth, and a moisture index all had negative correlations with the Shannon-Weiner index. On a plot seeded with a native grass-forb mixture, where the variation in salt content was the greatest, the sodium adsorption ratio (a measure of sodicity) had a positive correlation with species richness. When all seed mixtures were considered, the rate of fertilizer application had a negative correlation with the Shannon-Weiner index. In every case where a correlation was significant, soil properties normally associated with high production resulted in low diversity. Three mechanisms are proposed to explain the apparent inverse relationship between production and diversity. Management techniques are also suggested which could be incorporated into the reclamation process to increase plant diversity.

**Reference:** Stark, John M. and Edward F. Redente. 1984. Soil-plant diversity relationships on a disturbed site in northwestern Colorado. *Soil Sci. Soc. Amer. J.* (submitted).

**38 Woody Vegetation Clearing on the Platte River Aids Restoration of Sandhill Crane Roosting Habitat (Nebraska)**

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Establishment of cottonwood (*Populus deltoides*), willow (*Salix* spp.), and other shrubs (false-indigo, rough-leaf dogwood) on islands of the Platte has seriously degraded the roosting habitat of the sandhill crane. Flows which once scoured vegetation from the river channel have diminished as a result of increasing water use.

The Whooping Crane Trust has initiated a program to control woody encroachment. Five treat-

ment techniques have been employed: mowing (chopping), mowing followed by disking, mowing followed by spraying resprouts with Roundup (glyphosate), spraying standing shrubs with Roundup, and application of Graslan (tebuthiuron) herbicide on standing shrubs. A 67-hp, 4-wheel-drive tractor with a heavy-duty Bush Hog rotary mower was used for mowing. A D6 Caterpillar tractor and a 30"-blade Miller disk were used in the mowing/disking treatment. The 4-wheel-drive tractor and a 500-gallon sprayer were used for Roundup spraying. Resprouts were boom sprayed, while a hand nozzle was used to spray standing shrubs. Graslan was applied in a pelleted form with hand spreaders.

Vegetation was treated on 210 acres (85 ha) of river islands. The following results concern first-year treatments, and it is clear that subsequent treatments will be necessary to kill shrub regrowth. Mowing followed by disking was the most expensive treatment (\$233/acre), while the cost of mowing alone (\$122/acre), mowing followed by spraying (\$132/acre), and spraying alone (\$130/acre) were comparable and considerably lower. Application of Graslan was the least expensive treatment (\$112/acre). All treatments appear to be economically feasible under appropriate conditions.

Although the effectiveness of these treatments cannot be assessed until regrowth is examined, initial results suggest that mowing followed either by disking or by spraying may be the best methods for woody vegetation control. Mowing followed by spraying is cheaper and appears to be very effective in killing shrubs. Mowing alone would require a continuous annual treatment. Spraying alone has drawbacks because it is hard to maneuver in standing vegetation, and also because spraying has to be followed by burning or mowing to remove dead shrubs.

We feel that mowing is the most cost-effective means for initial treatment of woody vegetation. Because a large amount of time was required to maintain the tractor and Bush Hog, we have purchased a larger piece of equipment (Kershaw Klearway), which is specifically designed for chopping up trees and shrubs. Disking or herbicide applications will most likely be used as follow-up treatments, depending upon which methods are the most cost-effective and environmentally acceptable.

**39 Mast-producing Natives Direct-seeded on Surface-mined Sites (Pennsylvania)**

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Deciduous trees and shrubs can become established on surface mines within ten years, and many of these are beneficial for wildlife. Our work suggests, however, that direct seeding may