A Case Study in Woodland Restoration

Susan E. Boettcher, W. Carter Johnson, and F. Robert Gartner

A Brief History of the Mortenson Ranch

It was 1942 when Clarence Mortenson first saw the ranch in Stanley County, South Dakota he was one day to operate. He remembers it as a place where "the fences were all down, livestock water development was almost non-existent, and most range sites were in poor condition." Typical of much western rangeland, poor management had taken its toll when settlers occupied tracts of land as small as 160 acres. Those who drafted the Homestead Act were unaware of the fragility of western lands. Even after the original Act was revised to increase the size of a homestead, the number of incoming settlers was greater than the land was capable of supporting. The practice of breaking up the prairie sod in areas of rugged topography, sparse rainfall, and few trees produced severe erosion of soil and depletion of groundwater.

Clarence Mortenson's stepfather, Ben Young, began acquiring property in small parcels in the early 1940's. When Clarence became manager of the land in 1950, he faced the question of how to rejuvenate eroded, impoverished range. Now, with 19,000 acres and over 40 years later, Clarence and sons Todd, Curt, and Jeff can view the outcome of their efforts. The benefits include reduced runoff, a recharged water table, healed-over streambanks, and reestablishment of a diverse woody vegetation. Concurrent with these steps to recovery, the Mortensons have operated a profitable cattle operation.

Steps to Recovery

A great deal of experimentation in restoration methods was required to attain the present range condition; each step taken did not always meet with immediate success. The Mortensons have identified the following key components of their restoration plan.

1) *Recharging groundwater sources before attempting to establish woody vegetation.*

A series of "speed-bump" dams designed and built by Clarence Mortenson slows the flow of intermittent streams after snowmelt and high-intensity rainfall. Water now spreads over the floodplain, percolating into the soil and replenishing the water table. The floodplain accumulates sediment, rebuilds the surface, and renews streamside aquifers. As a result, trees and shrubs have become established and are able to survive in years of relatively sparse rainfall.

2) *Allowing local, native vegetation to be the major seed source.*

A few mature trees were initially responsible for the now rapid spread of younger trees. Because the parent trees survived the drought of the 1930's, their seed produces offspring adapted to severe conditions. By encouraging reproduction of established trees and by scattering seed collected from the ranch, the Mortensons have promoted the growth of woody vegetation adapted to local conditions.

3) *The use of appropriate grazing management.*

The key to any grazing management system is to utilize a management technique that is flexible. One should be suspicious of any grazing plan that is rigid and does not permit the flexibility needed during times of weather extremes. Proper grazing use is a prerequisite for maintaining good conditions for game animals and other kinds of wildlife, for controlling erosion, for maintaining optimal watershed con-

The west-facing site overlooking the Cheyenne River floodplain. Most trees on side slopes are Rocky Mountain juniper.

Susan E. Boettcher and W. Carter Johnson are with the Department of Horticulture, Forestry, Landscape, and Parks, South Dakota State University Brookings, S. Dak. 57007; and F. Robert Gartner is with the West River Agricultural Research and Extension Center, South Dakota State University Rapid City, S. Dak. 57701.

This study was conducted by South Dakota State University with funds from the Renewable Resources Extension Act and cooperative agreement No. 28-C2-639 with the U.S.D.A. Forest Service Rocky Mountain Forest and Range Experiment Station. The Mortenson ranch is part of the larger Foster Creek Riparian Restoration and Demonstration Project which is coordinated by the North Central Resource Conservation and Development Council.

The authors extend their thanks to I. Ahmed for assistance in the field and to the Mortensons for their support of the project.

A. Photo taken in 1983 on the Mortenson ranch. Photo by Clarence Mortenson.

C. An unusual 4-inch rain occurred just after this dam was built in 1986 Photo by Clarence Mortenson.

ditions, and for increasing available forage for all grazing animals.

The restoration of woody vegetation on the Mortenson Ranch resulted from a change in grazing management, and some tender loving care from Clarence and his sons. Grazing management was altered to provide growing season deferment in pastures containing drainages, allowing both woody plants and herbaceous vegetation to increase their vigor. In recent years, fences have been moved and new fences constructed so that riparian areas (or drainages) can be deferred from grazing during most or all of the growing season.

Recently, Todd, Curt, and Jeff Mortenson have accepted the major responsibility for management of the ranch. They contend that all facets of soil, water, vegetation, livestock, and all forms of wildlife must be considered to maintain both healthy, productive cattle and a healthy, productive environment. Their holistic approach to management protects the land, improves the aesthetic value of the property and quality of family life, while operating a successful livestock business. It is a commitment to sound conservation while managing the natural resources of the ranch for a

B. The same view as above in 1992. Compare the size of the trees at photo's center with those in the previous photo. Photo by Clarence Mortenson.

D. The same view as above in 1992. Note establishment of trees. Photo by Clarence Mortenson.

perpetual return, not for immediate financial gain.

Todd Mortenson says: "We merely cooperate with Nature and let the sun do the work." Sunlight, soil nutrients, and water are the basic resources needed to manufacture the crop—native vegetation—that can be harvested by cattle. Todd continues: "It's a simple management philosophy. Let the sun do the work, rather than throwing money into costly inputs like equipment, chemicals, and fossil fuels."

Study Objectives

Because the Mortensons' conservation efforts exemplify successful range restoration and will be continued for many years, a monitoring project was begun to document the changes taking place. The study was initiated in 1992. The data collected will provide a permanent record for comparison to future years.

Methods

Permanent transects and photo points were established in 5 wooded draws. Three of the draws were north-facing, one had a southerly aspect, and one a westerly aspect. These sampling sites were selected to include a wide range of environmental conditions under which woody vegetation had established. At each sampling site, three belt-transects were established perpendicular to the draw. One transect was randomly located in each of the upper, middle, and lower portions of the draw. Transect length was determined by topography, extending only as far as woodland vegetation could be supported. For tree species, diameter at breast height (dbh) of all stems ≥~2.5 inches was recorded, and locations were marked on a map of each transect. Saplings (stems <~2.5 in. dbh and ≥~3 ft. tall) were recorded on the same transects. Seedlings of tree species (<~3 ft. tall) were sampled in contiguous ~10-ft^2 quadrats centered along each transect.

Trees were measured on 15 transects, while saplings and seedlings were sampled on a subset (12) of the transects. Shrub cover was recorded using the line-intercept method along the center of these same 12 transects. Shrub species occurring at the site, but not on the line, were recorded as present.

Tree age was estimated by coring 1 or 2 of the largest trees at each sampling site.

Botanical names follow Great Plains Flora Association (1986).

Table 1. Basal area, density, and age of trees in each sampling location.

Site	Aspect of site	Basal area of stems ≥~2.5 in. at dbh (ft^2/ac)	Density (stems/ac)	Age of oldest tree cored (yrs)
1	North-facing	7.4	66	24
2	North-facing	20.1	153	58
3	North-facing	21.4	182	62
4	South-facing	3.5	26	35
5	West-facing	22.2	143	89
		Ave: 14.9	Ave: 114	

Table 2. Basal area and density of trees by species.

Species	Basal area (ft^2/ac)	Density (stems/ac)
Green ash	9.2	87
Rocky Mountain juniper	1.7	8
Cottonwood	1.3	1
Peachleaf willow	1.3	8
Hackberry	0.9	3
	Total =14.4	Total = 107

Results

Basal Area and Density of Tree Species:

Basal area ranged from 3.5 ft^2/acre on the south-facing site to 22.2 ft^2/acre on the west-facing slope (Table 1). The average basal area of all sites was 14.9 ft^2/acre.

Density was also lowest at the south-facing site (Table 1) where there were 26 stems/acre. The highest density was 182 stems/acre at one of the north-facing sites (Site 3). Mean density of all sites was 114 stems/acre.

Five tree-sized species occurred in the sample (Table 2). Green ash was strongly dominant, accounting for 64% of the basal area and 81% of the density.

Saplings:

The average number of saplings across all sites was 234 stems per acre (Table 3). Green ash saplings were most numerous at every transect sampled, with Rocky Mountain juniper and hackberry occurring in smaller amounts. Densities on the 12 transects ranged from 0 stems/acre at the south-facing site to 765 stems/acre at one of the north-facing sites (Site 3).

Seedlings:

The mean density of seedlings across all 12 transects was 1.1 per ft^2 (Table 3). Again, these were primarily green ash with the lowest and highest densities found on the same sites as for sapling and tree densities. No tree seedlings were recorded on the south-facing slope, while 3.9 seedlings/ft^2 were recorded on a transect at site 3 (north-facing).

Shrub Cover:

Overall, 45.6% of the total line length sampled had shrub cover. The range on the 12 transects was from 12.5% cover at site 3 to 77.2% cover at site 2.

The number of shrub species occurring on or near a transect ranged from 3 to 11; the mean was 7. Across all sites, a total of 17 shrub species was encountered. Wild plum accounted for the greatest amount of relative cover (31.9%), followed by western snowberry, 19.3% choke cherry, 18.2%, and skunkbush sumac, 13.5%. Other species included Saskatoon service-berry, poison ivy, prairie rose, winter grape, and woodbine.

Tree Age:

The oldest tree cored was a Rocky Mountain juniper aged at 89 years (Table 1). The largest green ash trees ranged

Table 3. Average densities of saplings and seedlings.

Species	Sapling density (stems/ac)	Seedling density (no./ft²)
Green ash	197	1.1
Rocky Mountain juniper	23	0.0
Hackberry	14	<.1
	Total = 234	Total = 1.1

in age from 18 to 35 years, with diameters ranging from 5.9 to 8.3 inches.

Discussion

Tree basal area ranging from 3.5 to 22.2 ft²/acre (Table 1) was rather low, although not unusual for sites in a droughty environment where most trees are relatively young. In addition, woody vegetation did not completely cover the area capable of supporting it, but is still filling in and spreading up the side slopes of draws. Along the Snake River in Idaho, Johnson et al. (1992) found a mean basal area of 18.3 ft²/acre when using a sampling protocol similar to that used at the Mortenson ranch. Cottonwood stands sampled near the Grand River in northwestern South Dakota had basal areas ranging from 17.9 to 108.6 ft²/acre (Johnson unpublished data, 1993). Floodplain forests of the Missouri River in North Dakota had an average basal area of 125.6 ft²/acre, comparable to that of eastern U.S. forests (Johnson et al., 1976).

Tree densities on the Mortenson Ranch ranged from 26 to 182 stems per acre. Johnson et al. (1976) found an average density of 232 stems per acre in Missouri River floodplain forests. As for the present study, the species present in the greatest amount was green ash, having an average density of 78 tree-sized stems/acre.

The range of tree sapling density on the Mortenson ranch was from 0 to 765 stems per acre. Butler and Goetz (1984) sampled sapling densities in green ash draws of the North Dakota badlands. The highest density they reported was 555 stems acre, which included *both* shrubs and trees in a lightly grazed area.

Numbers and size distribution of saplings and seedlings on the Mortenson ranch indicate a properly functioning, stable tree population; successful regeneration has been occurring for many years. In addition, the *diversity* of shrub species indicates that pre-settlement composition is perhaps being approached. Variety can also be seen in the herbaceous layer where mesic woodland species including Solomon's seal and false Solomon's seal are present.

To thoroughly document additional progress of the Mortenson ranch restoration, photo points will be revisited, and vegetation transects will be resampled at 5 to 10-yr intervals.

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