RANGE ECOSYSTEM MANAGEMENT FOR NATURAL AREAS

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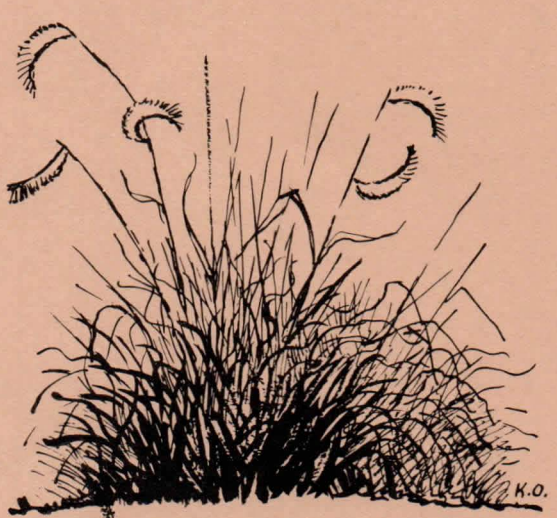

RANGE ECOSYSTEM MANAGEMENT FOR NATURAL AREAS*

Interest in preservation of natural areas has been promoted by several agencies and other groups having conservation interests. The names used for the natural areas have varied by group and by the type of areas to be preserved. This has also resulted in different definitions for natural areas, Anderson (1966), Laycock (1969), Romancier (1974), Laycock (1975), and others. The natural area concept has developed over an undetermined period of time with increasing awareness of the loss of natural ecosystems, geologic formations, etc. "There is high scientific value in preserving samples of typical environments both those relatively little disturbed by man and those which he has materially modified," the Subcommittee on Conservation of Ecosystems (1967). The report further discussed inventorying of major ecosystems and ecosystem reserves and establishment of priorities of action for establishment of additional preserves. Desert biome studies by the International Biological Program are designed to forecast natural sequences such as wet and dry years and such created conditions as air and water pollution, Friedman (1970). "Perhaps of greatest importance, the backup system of natural areas will insure preservation of sufficient gene material so that the small scientific areas do not become mere museums of the past with no ability to respond to change," as stated by the Wisconsin Department of Natural Resources (1973).

Rangeland which contains vegetation in natural condition for the soil and climate (Range Sites) has a history of use as benchmarks in the ecological approach to range condition class determinations and range condition trends, Dyksterhuis (1949) (1951) (1958), Quinnild and Cosby (1958), Passey and Hugie (1963), Heerwagen (1959), Laycock (1969), Ross, Murray, and Haigh (1973), and others. The value of such areas for ecosystems research, range management guidelines, and outdoor classrooms for biological sciences, and for monitoring environmental changes were pointed out by Anderson (1966) and Romancier (1974). Among the values for natural areas, discussed by Dasmann (1973), were a worldwide system of reserves to protect samples of the earth's natural ecosystems for plants and animals in the system, the contribution of animal and plant life in medicine, aesthetic and recreational values and maintenance of natural diversity.

*Adapted from a slide presentation given at the 28th Annual Convention of the Society for Range Management at Mexico City, Mexico, February 13, 1975. The material presented describes methods for managing natural areas but is not necessarily the U.S. Fish and Wildlife Service policy for managing all natural areas.

Many species of plant and animal are becoming rare, others are in danger of becoming extinct, and some have recently become extinct. Maintenance of natural areas can be a source for preserving species of plant and animal life, Schumacher (1972 Technical Note #13), Schumacher (1972 Technical Note #14), Rechenthin (1972), and Cosby and Berlinger (1973). Such plants and animals represent a gene pool whose value cannot be fully assessed nor can their loss to the future of our environment.

Some organizations, which promote natural areas' designations by names which may reflect their primary interest in their preservation, have prerepared publications which list all such designated areas at the time of publication. Recognition of land acquisition, designation, and protection of Research Natural Areas is carried out by the Federal Committee on Research Natural Areas (1968) which listed the areas and included pertinent information. An addendum was added in 1972. The Soil Conservation Society of America recognizes managed natural areas. Listing and other information are published under the title, Managed Natural Areas (1975). The Society for Range Management (SRM) recognizes these and many other natural area programs. Because of the various names used, they adopted the collective term "Reference Areas" and "Rangeland Reference Areas" for those of importance in range plant communities. All such reference areas and the organizations which acquire, promote and/or sponsor them have been given recognition in the SRM publication, Rangeland Reference Areas, Laycock (1975).

The assumption has too often been made that if land is acquired and withdrawn from man's use, the plant communities will improve and maintain themselves. Degeneration of the natural plant resource is the common result. The rate of degeneration is due to several factors which include: (1) condition of the range, (2) soil type, (3) climate, (4) current weather, (5) deposition of silt from wind or water, (6) proximity to other agricultural uses, and (7) excessive mulch accumulations.

A line interception transect was placed in a clone of smooth bromegrass April 22, 1959, in a nonuse area on the Lostwood National Wildlife Refuge located on the Max Moraine in northern North Dakota. Annual precipitation averages about 15.5 inches. This location was characterized by the rough fescue (Festuca scabrella) and (Stipa spartea var. curtiseta) association described by Cosby (1965) and Dodd (1967). The area covered by the smooth bromegrass was also measured from the stakes and plotted. Measurements were made again on July 27, 1962, three years later. The area of coverage by smooth bromegrass was also measured from the stakes and plotted. The area of coverage by smooth bromegrass had increased to 227 percent of the 1959 size. A photograph of the location was made on the same date that the transect was established. The smooth bromegrass spread rapidly but was not photographed again until July 29, 1973, at which time there was severe degeneration of the natural ecosystem, much beyond the limits of the area originally pictured and measured.

Markers were placed in two clones of smooth bromegrass in an area with nonuse since 1947 near Pickstown, South Dakota, on December 22, 1971, to compare the rate of spread in this area of somewhat higher precipitation (21.2" annually). The beginning of transition from Mixed Prairie to True Prairie is evidenced locally by more tall, warm season species. The measurements were made on a coluvial fan on which green needlegrass (Stipa viridula), porcupinegrass (Stipa spartea), and western wheatgrass (Agropyron smithii) should be climax dominants.

The area coverage of the two clones was again measured on September 20, 1972, on October 2, 1973, and on October 19, 1974. The area of one clone had increased to 142, 212, and 109 percent of the previous year, respectively. The other had increased to 192, 219, and 115 percent of the previous year. The large variation between the years 1973 and 1975 is apparently the result of weather. Above-normal fall precipitation in 1973 caused rhizome elongation and, in turn, a large band of new, green growth around the ripened, early growth. There was rank spring growth in 1974 because of carryover moisture, but fall rhizome elongation did not occur because of summer and fall drought.

Kentucky bluegrass (Poa pratensis) has invaded major areas of Mixed Prairie and True Prairie. The dead material of Kentucky bluegrass disintegrates slowly and falls, covering the crowns of the natural vegetation thus creating a "thatched roof" effect resulting in exclusion of light.

Data taken on two soil types in Walsh County, North Dakota, illustrate the degenerating effect of Kentucky bluegrass mulch. The area had received three years of rest when data collection began in 1964. Barnes and Svea loam were among the soil types inventoried for total herbage yield and the percent of the total contributed by species.

Species composition from the zonal soil, Barnes loam, contrasted sharply from the more mesic Svea loam, Table I. Green needlegrass was the key native grass species on Barnes loam at this location. From 1964 to 1969, there was a loss in percentage of green needlegrass in the total yield with a simultaneous increase in Kentucky bluegrass. The phenology of green needlegrass and Kentucky bluegrass is similar enough that the burning in 1968 did not improve the percent of species in the composition, Table I.

Big bluestem (Andropogon gerardi) was the key native grass species on the Svea loam, Table I. As the nonuse period continued, big bluestem declined and Kentucky bluegrass increased. Smooth blueaster (Aster laevis) emerged through the mulch layer sufficiently to increase in percent of the composition and in total yield. In contrast to the green needlegrass-Kentucky bluegrass combination on the Barnes loam, big bluestem and Kentucky bluegrass returned more nearly to their earlier composition. It is not known whether the results obtained on the smooth blueaster are typical.

TABLE I: Trends of two grass species on Barnes loam and two key grass species and one forb on Svea loam as indicated by annual herbage yield and plant composition in Walsh County, North Dakota. Data were taken over a six-year period following approximately three years of rest. The trend is shown for each soil type for the period.

YEAR	TOTAL ANNUAL HERBAGE YIELD LBS/AC. AIR DRY BARNES LOAM	TOTAL ANNUAL HERBAGE YIELD LBS/AC. AIR DRY SVEA LOAM	KEY SPECIES BARNES LOAM	PERCENT OF TOTAL HERBAGE YIELD BARNES LOAM	KEY SPECIES SVEA LOAM	PERCENT OF TOTAL HERBAGE YIELD SVEA LOAM
1964	2750	2870	Green needlegrass	66.00	Big bluestem	71.00
			Kentucky bluegrass	10.00	Kentucky bluegrass	1.00
					Smooth blueaster	2.00
1965	2960	2985	Green needlegrass	68.00	Big bluestem	76.50
			Kentucky bluegrass	3.70	Kentucky bluegrass	5.20
					Smooth blueaster	5.95
1966	3835	3754	Green needlegrass	37.35	Big bluestem	24.15
			Kentucky bluegrass	30.05	Kentucky bluegrass	41.41
					Smooth blueaster	10.06
1967	1958	2113	Green needlegrass	30.04	Big bluestem	52.05
			Kentucky bluegrass	44.31	Kentucky bluegrass	19.53
					Smooth blueaster	6.81
1968	No data were taken, the area had been burned and regrowth was very slight - date of burn was unavailable.					
1969	2071	3456	Green needlegrass	15.83	Big bluestem	78.04
			Kentucky bluegrass	50.92	Kentucky bluegrass	10.67
					Smooth blueaster	00.00

1967 was the lowest year of total herbage yield on all locations during the years these data were collected.

The results of this sampling compare favorably with those reported by Launchbaugh (1964); Dix (1960); Clarke; Tisdale and Skorgland (1943); Launchbaugh (1972); Owensby and Anderson (1967); Anderson, Smith and Owensby (1970); Old (1969); and Wright (1974).

These data indicate that the use of fire to maintain range ecosystems can be expected to have quite different results in the True Prairie from that in the Mixed Prairie. The Brookings Waterfowl Production Area (WPA) near Madison, South Dakota, illustrates the effect of a prescribed maintenance burn on a warm season plant community in the True Prairie. This range was in the excellent condition class with the major dominant grasses being big bluestem and switchgrass (Panicum virgatum) with other warm season species in lesser amounts. The tract was cut for hay in 1968 then rested until June 1, 1972. Enough lodging had occurred to suppress growth and to make the site susceptible to invasion. No treatment was applied on one portion but the rest was burned June 1, 1972. A vigorous growth on the warm season grasses masked the forbs on the burned portion. On the untreated portion, the forbs grew above the less vigorous grasses. Similar results have been obtained by mowing on some locations.

A field trial was made on the Lake Andes National Wildlife Refuge by refuge personnel in 1972 to compare results of removing excessive mulch by fire and by mowing and raking. There had been no herbage removal for four years. One area was mowed and raked along one side of a line and burned on the other. The mowing was done on May 22, but because of rain, burning was not accomplished until June 1. A major portion of the treated area was dominated by cool season grasses. Data were collected on the cool season community by clipping all current plant growth from ten 1.92 square foot plots each on the burned and mowed areas. Each species was clipped and weighed separately, air dried and converted to pounds per acre; the results are shown in Table II. These data show 50 percent less Kentucky bluegrass, by weight, in the burned area and 44 percent less western wheatgrass. There was a large increase of goatsbeard (Tragopogon dubius), annual spurge (Euphorbia spp.), witchgrass (Panicum capillare), and heatheaster on the burned portion. Total herbage produced on the burned was approximately 70 percent of the mowed.

The east end of the treated area had a slight topographical and soil difference. This area contained clones of big bluestem on both the mow and burn treatments. Plots were centrally placed in five separate clones in each of the two treatments; therefore, it was not a random sampling. Separate clones were also selected to minimize bias from genotypic differences. The results are shown in Table III. These data indicate a greater yield of big bluestem on the burned over the mowed but a greater total annual herbage on the mowed.

TABLE II: A comparison of the effects of mowing and burning on rangeland, dominated by cool season species, which had a heavy cover of lodged Kentucky bluegrass. One area was mowed May 22, 1972, and data taken August 9, 1972. Data were taken on the burned area, parallel to the mowed, August 10, 1972.

SPECIES	MOWED		BURNED	
	Lbs/Acre Air Dry Weight	Percent of Total	Lbs/Acre Air Dry Weight	Percent of Total
Agropyron smithii - Western wheatgrass	450	18.40	230	13.43
Amaranthus spp. - Pigweeds			5	.29
Apocynum sp. - Dogbane	5	.20		
Aster ericoides - Heathaster			100	5.83
Astragulus sp. - Milkvetch	5	.20		
Bouteloua gracilis - Blue grama	80	3.27	100	5.83
Bromus spp. - Annual bromegrasses	80	3.27	5	.29
Buchloe dactyloides - Buffalograss	5	.20	45	2.62
Carex spp. - Upland sedges	60	2.45	5	.29
Convolvulus arvensis - Field bindweed	70	2.86	7	.40
Euphorbia spp. - Annual spurges	15	.57	140	8.15
Koleria cristata - Prairie junegrass	5	.20	5	.29
Liatris punctata - Dotted gayfeather	365	14.92		
Lygodesmia juncea - Rush skeletonplant	25	1.02	35	2.04
Melilotus spp. - Sweet clover, yellow and white	15	.57	5	.29
Panicum capillare - Witchgrass	15	.57	170	9.92
Poa pratensis - Kentucky bluegrass	830	33.94	365	21.32
Polygonum convolvulus - Wild buckwheat	5	.20	40	2.32
Setaria spp. - Pigeongrass	5	.20	30	1.75
Sphaeralcea coccinea - Scarlet globemallow	15	.57		
Sporobolus cryptandrus - Sand dropseed	30	1.22		
Stipa comata - Needleandthread	60	2.45	20	1.16
Stipa spartea - Porcupinegrass	115	4.70		
Stipa viridula - Green needlegrass	5	.20		
Tradescantia bracteata - Bracted spiderwort	5	.20		
Tragopogon dubius - Large goatsbeard	160	6.54	365	21.32
Vici americana - American vetch	5	.20	10	.58
Other forbs*	15	.57	30	1.75
TOTAL	2445	99.69	1712	99.88

*Other forbs includes dandelions, annual lettuce, and goldenrod rosette.

TABLE III: A comparison of the effects of mowing and burning on rangeland, Plots were placed within clones of different genotypes of big bluestem in an area mowed May 22, 1972, and one that was burned June 1, 1972. Data were taken from both areas August 11, 1972.

SPECIES	MOWED		BURNED	
	Lbs/Acre Air Dry Weight	Percent of Total	Lbs/Acre Air Dry Weight	Percent of Total
Agropyron smithii - Western wheatgrass	120	2.38	5	.10
Ambrosia psilostachya - Western ragweed			5	.10
Andropogon gerardi - Big bluestem	3600	71.49	4310	90.07
Aster ericoides - Heathaster			140	2.92
Bouteloua curtipendula - Sideoats grama	100	1.99	20	.41
Bromus inermis - Smooth bromegrass	80	1.58	5	.10
Bromus spp. - Annual bromegrasses	5	.09		
Carex spp. - Upland sedges	50	.99	20	.41
Melilotus spp. - Sweet clover	150	2.97	20	.41
Poa pratensis - Kentucky bluegrass	640	12.71	80	1.67
Psoralea argophylla - Silverleaf scurfpea	40	.79	5	.10
Sporobolus asper - Tall dropseed	5	.09	10	.20
Stipa spartea - Porcupinegrass	80	1.58	120	2.50
Tragopogon dubius - Large goatsbeard	100	1.99		
Vici americana - American vetch			5	.10
Other forbs*	60	1.19	40	.83
Other grasses**	5	.09		
TOTAL	5035	99.93	4785	99.92

*Other forbs includes wild buckwheat, heathaster, and common yellow oxalis.
**Other grasses includes threeawn and bluegrama.

Big bluestem is of interest because of the extreme variability between genotypes. Two adjacent clones, both in the mow treatment, were obviously different growth forms. One clone had much heavier basal foliage with heavy leaf growth reaching high upon the stem of the plant. Plot number three was placed in the clone with least foliage and plot number four in the clone with heavy foliage. The yield of big bluestem was at the rate of 5,200 lbs. per acre in plot number four. Plot number three yielded big bluestem at the rate of 3,150 lbs. per acre. The total growth and the growth form of big bluestem varied more between clones within a treatment than it did between treatments.

Both treatments resulted in a release of native grass and forbs from suppression by the dense mulch cover created by Kentucky bluegrass and smooth bromegrass. The benefit to native plants was apparently gone by 1974 at which time it was mowed as a hay crop.

The Althen WPA in the Mixed Prairie in Aurora County, South Dakota, was in a nonuse status from 1967 through 1972. Mulch was collected from a 1.92-square foot plot on April 16, 1973, and segregated into fresh mulch and humic mulch to illustrate the effect, described by Dyksterhuis and Schmutz (1947). The depth of the mat of mulch was 6 inches.

The plot indicated 3,000 lbs. of fresh mulch and 2,750 lbs. of humic mulch totaling 5,750 lbs. per acre before treatment, Table IV. The tract received very close use by cattle in May of 1973. The depth of mulch was reduced to 3/4 of one inch. Fresh mulch was reduced to 1,600 and humic mulch increased to 3,800 lbs. per acre, totaling 5,400 lbs. The indicated net loss was only 350 lbs. per acre, but approximately 1,400 lbs. of fresh mulch was converted to humic mulch. The "thatched roof canopy" of Kentucky bluegrass mulch was broken up and it continued to disintegrate even though there was severe moisture shortage until after August 15, 1973. Switchgrass, big bluestem, little bluestem (Andropogon scoparius), and other native grasses and forbs gave immediate response.

Cattle selectively graze for plants they like best at a given time. In eastern South Dakota, cattle generally select such invader species as Kentucky bluegrass, smooth bromegrass, quackgrass (Agropyron repens), and annual bromegrass species in preference to most native grass plants in May. Western wheatgrass has generally received about the same degree of use as the target species. With a livestock removal date of June 1, heavy use of the target species has frequently occurred with light use on needlegrasses.

TABLE IV: Mulch accumulation following 6 years of total rest and the effect of livestock grazing on the mulch.

Sampling Date	Treatment	Fresh Mulch Lbs/Acre	Humic Mulch Lbs/Acre	Depth of Mulch in Inches	Total Mulch Lbs/Acre
4/16/73	6 yrs. rest	3000	2750	6.00	5750
5/29/73	grazed 5/15 to 6/1/73	1600	3800	0.75	5400

The Hieb WPA in Bon Homme County, South Dakota, rested throughout the years 1972 and 1973. A photo point was established, on a line from which a fence had been removed, separating good and excellent condition class range. Bromegrass invasion occurred in the pictured area as a large circular area overlapping both condition classes. Matting by Kentucky bluegrass was apparent on the good condition portion. Big bluestem matting was most evident on the portion in excellent condition though Kentucky bluegrass was present and favored by the mulch mat. The unit was grazed during May 1974, resulting in heavy use of the target species. Summer moisture in 1974 was much below normal but response was good. The suppression of the bromegrass clone and Kentucky bluegrass is apparent. There was good response of native grass. The excellent condition side was very rich in native forbs including legumes.

Grazing with domestic livestock can be successfully used for managing plants in natural areas. Ecological balances can be induced by planned grazing systems designed for the ecosystems involved. In the Festuca scabrella association in Alberta, Canada, there was richer development of flora under light grazing than in an exclosure over a 12-year period in the same unit (Johnston 1961). Beneficial use of livestock for ecological improvement of the range plant communities has been pointed out by Reardon, Leinweber, and Merrill (1972); Reardon, Leinweber, and Merrill (1974); Lewis (1972); Thomas (1973); Herbel and Anderson (1959); Heady, Box, Butcher, Colbert, Cook, Eckert, Gray, Hedrick, Hodgson, Kearch, Klemendson, Neilson, Sharp, Thomas Workman (1974); and others.

Very light grazing rates for the intent of maintaining natural vegetation and habitat have not generally been successful. This is especially true when the same season of use is continually followed. This is illustrated by units 6 and 7a on the Crescent Lake National Wildlife Refuge in the sandhills of western Nebraska. Prior to 1971, unit 7a was grazed mostly during the season when cattle preferred the warm season species and concentrated on low areas which produced them. Overuse occurred on these areas and on some upland species such as sand bluestem (Andropogon hallii) and sand lovegrass (Eragrostis trichodes). Some upland plants received light use under this type grazing; therefore, an improper plant balance resulted.

Areas remote from the hayed meadows in unit 6 were essentially unused for many years. Degeneration was apparent in local areas and normal plant succession was apparently halted in less than natural condition on the drier sites.

Beginning with 1971, grazing plans were altered to permit changes in use, seasons, and year-long rest periods. The aspect changes were recorded at photo points. Species can be partially determined from the color photographs. Unit 7a was grazed four weeks in June 1971, and deferred the remainder of the year. Needleandthread (Stipa comata) received good utilization which permitted warm season plants to improve vigor during the rest period. This relieved the overuse in previous concentration areas and left unused growth during the rest period. Unit 6 was rested throughout the year.

Grazing began in unit 7a September 21, 1972, using the same AUM rate. Growth was improved and again needleandthread received more use permitting an equalization of pressure on species and rejuvenation of vigor on previously overgrazed species. Rest continued in unit 6 during 1972.

Unit 7a received fall grazing in 1973 and early spring grazing in 1974. The first complete year of rest is scheduled for 1975. Unit 6 received summer grazing in 1973 and was rested the full calendar year of 1974. Increased plant vigor is obvious as is the composition in unit 7a. At the present time, color photographs from the photo point show switchgrass and Indian grass (Sorghastrum nutams) in head, with heavy foliage in the same location that was overgrazed up to 1971. The same amount of AUM's have been used each year since 1967.

SUMMARY

Preserved natural areas on rangeland may, in a short time, be only those which received managed preservation.

Rangeland is a resource base for wildlife, watersheds, livestock grazing, recreation, and other uses. There was, in effect, a symbiotic relationship between rangeland vegetation and natural herbivorous species. The natural, free roaming, grass-consuming herbivores have been removed. If they were put back, in the absence of space to free roam, management problems would be insurmountable. Domesticated livestock can be used to fill this niche, produce livestock products, and to ecologically benefit the range resource. Grazing systems--tailored to the needs of the plant communities for maintenance of natural areas, aesthetics, and for wildlife benefits offer the most adaptable range resource management. Livestock grazing can be used to suppress both alien and increaser plants and to promote succession toward a natural equilibrium.

Management can include one or a combination of the following methods of manipulating the vegetation: grazing by domestic animals, mowing, and burning. Each method requires a knowledge of the plant community, plant phenology, and the results to be expected from such manipulations.

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