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Abstract: We studied the development of vegetation in a small area at the UWM Field Station planted with prairie species in 1986. The species and quantities of seed and seedlings planted in 1986 were recorded. We sampled the vegetation using permanent quadrats in 1988 and 1994. Native prairie species were already well established in the area in 1988. There was, however, a dramatic change in the composition of the vegetation between 1988 and 1994. The number of native prairie species increased slightly and the number of non-prairie species decreased substantially, so that in 1988, 51% of species were native prairie plants and this figure increased to 62% in 1994. The sum of the mean cover of all plant species almost tripled between 1988 and 1994, primarily due to a large increase in cover of grass species. The relative dominance of several species changed markedly over the six years between samples.

Three practical implications of this study, which can probably be generalized to other plantings, are: 1) A very rapid establishment of dominance by native prairie species was almost certainly the result of intensive early management and investment of labor in the process of planting this small area; 2) No species which failed to germinate in the greenhouse has ever been found established in the planted area; 3) An increase in dominance by prairie grasses may be the result of an intensive burning schedule between 1989 and 1994.

Introduction

Planting of prairie species in old agricultural fields began at the Field Station in 1966. Since that time, the Station has had a policy of maintaining some open grassland areas in order to provide habitat diversity for wildlife, and for research and educational programs. None of the Field Station land has

prairie soil, and the nearest presettlement site of native prairie vegetation was probably at least twenty miles distant. Nonetheless, the Station has continued to plant prairie because of the tremendous increase in vegetation and habitat diversity which can be realized over the typical old-field vegetation found on the site.

A large number and acreage of prairies have been planted in southeastern Wisconsin but few studies have documented the development of vegetation after prairie planting (Blewett, 1981). Most planted prairies receive, at most, informal observations on the dynamics of vegetation in the years after planting; very few have any detailed record of methods or quantities of seed planted. Cottam and Wilson (1966) report on a long-term study of the community dynamics of Curtis prairie, a restored prairie at the University of Wisconsin-Madison Arboretum. This large restoration was begun in the 1930's and received many different planting methods between then and the 1950's. Records of most of the methods employed are maintained in the UW Arboretum files. Blewett (1981) analyzed vegetation samples obtained in the Curtis Prairie and in another UW Arboretum restoration, the Greene Prairie, in 1952, 61, 66, 71, and 1976. Planting methods for Greene Prairie were more carefully documented than for Curtis Prairie (Greene, 1955, cited in Blewett, 1981). Blewett (1981) draws from this long record over two planted prairies to make many generalizations about those species groups which are "increasers", "decreasers", "sensitive" (fluctuating), and "no change" in the planted areas.

In 1985 we planted 0.085 ha (0.21 acres) just west of the Field Station Laboratory building with native prairie species. We sampled vegetation in permanent quadrats in this area in 1988 and 1994. This paper reports on the establishment success of the 53 plant species planted in the area, and the dynamics of vegetation on the site over the six year period between sampling dates. Case studies of vegetation development in planted prairies are valuable as models for future prairie planting projects, and to combine with the results of other case studies (eg. Blewett, 1981) to generalize about the course of vegetation development in planted prairies.

Methods

The created prairie is approximately 0.085 ha (0.21 acres) in size and measures approximately 70 m x 12 m. The site is located just west of the Field Station Laboratory building, T11N, R21E, SE¼ Sec. 30, Ozaukee County, Wisconsin. The soil type is an eroded Casco loam (USDA, 1970). The soil is well drained and overlies a sand and gravel subsoil. Presettlement vegetation on the site was a maple-ash-oak-beech-hickory forest, probably very similar to that currently found in the Field Station upland woods. The area had been

farmed for several decades, and experienced considerable erosion of topsoil before it was abandoned from agriculture in 1965. Old field vegetation occupied the site from 1965 to 1985. In 1985 the site was overwhelmingly dominated by brome grass (*Bromus inermis*). Blue grass (*Poa pratensis*), goldenrod (*Solidago canadensis*), whorled milkweed (*Asclepias verticillata*), and St. John's wort (*Hypericum perforatum*) were sub-dominants.

During the 1985 growing season the area was prepared for planting in 1986. The site was mowed in mid-July 1985 and allowed to regrow before it was sprayed with 1.5% concentration Glyphosate herbicide (a non-selective contact herbicide) in early August. At the end of August the soil was mold-board plowed and disced. The soil was disced and dragged again in the Spring of 1986 immediately before planting. Throughout the 1985 growing season we collected seed of 53 native prairie species (Table 1), primarily from three sources: a prairie nursery planted four years earlier at the Field Station; a large prairie created at the Station in 1966 (Whitford, 1973); and Benedict Prairie, a remnant prairie in Kenosha County, Wisconsin owned by the University (Smith and Kuchenreuther, 1993). Seeds of a few species were purchased from a commercial seed producer. Seeds were stored dry, outdoors, in a metal can over the winter of 1985-86.

Between April 7th and 10th, 1986, we sowed seed of all 53 species in flats in a solar-heated greenhouse. Seeds were sown into flats divided into 72 individual cubicles measuring approximately 4 cm x 4 cm x 6 cm deep. These flats allowed transplanting individual plants with little disturbance to the root system. Between 12 and 42 cubicles of each species were sown. By the time the prepared area was seeded, 43 of the 53 species had germinated in the greenhouse although germination and growth ranged from excellent to very poor (Table 1).

On 29 May 1986 we sowed prairie seed and a flax cover crop, and planted all seedling plugs into the prepared soil. After sowing seed and before planting the seedlings, the area was hand raked and rolled with a water-filled roller. We sowed a total of about 940 g (2.1 lb) of grasses and 1,570 g (3.5 lb) of forbs into the 0.085 ha area (a total seeding rate of approximately 26.4 lb/ acre). Legume seeds were inoculated with nitrogen-fixing bacteria (donated by Nitragen, Inc.) before sowing. The planted area was watered two to three times per week during the month of June. After the flax cover crop germinated, it was removed from a circle (about 10cm radius) around the planted seedlings which had been marked with plastic stakes.

Table 1. Species planted in 1986 and weight of seed directly sown on the site. Percent germination was estimated for seed sown in flats in the greenhouse to produce seedlings for outplanting. Species having 0% germination were not planted as seedlings into the prairie creation since no seedlings were available. All other species had at least two seedlings planted into the site. *, species that were not found in the established flora in 1988 or 1994.

		Weight of seed planted (g)	Percent Germination
Forbs			
* *Allium canadense*	Wild garlic	1	0
* *Allium stellatum*	Onion	1	0
Amorpha canescens	Lead plant	40	<5
* *Anemone cylindrica*	Thimbleweed	1	0
Asclepias tuberosa	Butterfly weed	11	<5
Asclepias verticillata	Whorled milkweed	13	5-10
* *Aster ericoides*	Heath aster	16	10
* *Aster laevis*	Smooth aster	7	20
Aster novae-angliae	New England aster	21	<5
Baptisa lactea	False indigo	25	<5
Coreopsis palmata	Coreopsis	57	10
* *Desmodium canadense*	Beggar's tick	31	0
* *Dodecatheon meadia*	Shooting star	1	0
* *Echinacea pallida*	Pale purple coneflower	149	5-10
Echinacea purpurea	Purple coneflower	28	80
Eryngium yuccifolium	Rattlesnake master	172	40
* *Helianthus grosseserratus*	Saw-toothed sunflower	20	40
Helianthus rigidus	Stiff sunflower	117	20
Heliopsis helianthoides	Sunflower-everlasting	45	60
Kuhnia eupatorioides	False boneset	58	30
* *Lespedeza capitata*	Bush clover	6	<5
* *Liatris aspera*	Lacerate blazing star	24	70
Liatris spicata	Dense blazing star	34	60
* *Lithospermum canescens*	Hoary puccoon	28	<5
Monarda fistulosa	Wild bergamot	37	30
* *Parthenium integrifolium*	Eastern parthenium	15	<5
* *Penstemon grandiflorus*	Beard-tongue	55	0
Petalostemum purpurea	Purple prairie clover	20	<5
* *Potentilla arguta*	Tall potentilla	16	5-10
* *Pycnanthemum virginianum*	Virginia mountain mint	24	40
Ratibida pinnata	Grey-headed coneflower	109	20
* *Rosa carolina*	Pasture rose	3	0
Rudbeckia hirta	Black-eyed Susan	13	90

Table 1. (cont.)

		Weight of seed planted (g)	Percent Germination
Forbs (cont.)			
Silphium integrifolium	Rosinweed	43	15
Silphium laciniatum	Compass plant	39	<5
Silphium terebinthinaceum	Prairie dock	70	10
* *Smilacina racemosa*	False Solomon's seal	20	0
* *Smilacina stellata*	Starry false Solomon's seal	4	0
* *Solidago altissima*	Tall goldenrod	43	80
Solidago rigida	Hard-leaved goldenrod	99	90
* *Veronicastrum virginicum*	Culver's root	51	<5
* *Vicia americana*	American vetch	3	0
Total weight of forb seed (g)		1570	
Grasses			
* *Agropyron trachycaulum*	Slender wheatgrass	10	<5
Andropogon gerardii	Big bluestem	191	60
Andropogon scoparius	Little bluestem	60	80
Bouteloua curtipendula	Side oats gramma	29	40
Elymus canadensis	Canada wild rye	112	70
* *Muhlenbergia racemosa*	Muhly	5	80
Panicum virgatum	Switchgrass	160	30
Sorghastrum nutans	Indian grass	294	90
* *Spartina pectinata*	Cordgrass	49	<5
Sporobolus heterolepis	Prairie drop seed	6	60
* *Stipa spartea*	Porcupine-grass	28	30
Total weight of grass seed (g)		944	

The created prairie received a variety of management between 1986 and 1994. Sweet clover (*Melilotus alba* and *M. officinalis*) was removed by hand before it developed seed in 1987, 1990, and again in 1991. The created prairie was burned between 1 April and 1 May, five times since its creation in 1986 (1989, 90, 91, 92, and 1994).

Vegetation was sampled in the created prairie twice, 4 August 1988 and 26 September 1994. A complete list was made of all vascular plant species within the planted area. Cover of each species present was estimated in 10, 0.5 m^2 quadrats. Quadrats were randomly placed and the center of each quadrat was marked with a large spike in 1988 so that it could be relocated with a metal detector. The location of quadrats was also mapped using triangulation from two permanently marked points. Size and location of quadrats was identical in 1988 and 1994, however, 1988 quadrats were circular while in 1994 square quadrats were used. In 1988 aerial cover of each species was estimated to the nearest 5 percent. In 1994 aerial cover of each species was placed into one of six categories: none, present but less than 5% cover, 5-25%, 26-50%, 51-75%, and 75-100% cover.

Before analysis, 1994 data were converted into a value representing the mid-point of each cover category. The mean cover of each species in each sample year was then calculated by averaging the values in the 10 quadrats. Nomenclature follows Gleason and Cronquist (1991). Voucher specimens were deposited in the UW-Milwaukee Field Station herbarium.

Results

Probably as a result of the intensive early management of the created prairie, the planted area developed prairie vegetation very quickly, compared to the prolonged weedy stage through which most created prairies must pass. We planted seedlings in addition to sowing seed, watered the planting during its first month, and did some hand weeding. The result of this intensive management was that the area had already developed a showy display of prairie species by late summer 1987 and appeared to be dominated by native prairie species as opposed to early successional weedy species.

A total of 52 species were found in the created prairie in 1988 and/or 1994 (Table 2). Twenty-three of these species were present in one of the two sample periods but not in the other. Of the 52 species established in the prairie, 27 (52%) were native prairie species planted in 1986. The other 48% of the flora was non-native weeds, or native species which were not planted but that are common components of old-field vegetation in the area. Only about half (27) of the 53 planted species have ever been found established in the prairie (Tables

1 and 2); the other 26 species were apparently unsuccessful at establishing in this creation. None of the 10 species which failed to germinate in the greenhouse established from seed in the created prairie (Table 1). Likewise, 6 of the 12 species that had less than 5% germination in the greenhouse, failed to become established in the prairie. Therefore, of the 26 species which have not been found in the prairie, 16 had either no, or very poor, germination in the greenhouse, and 16 of the 22 species which had poor germination in the greenhouse failed to establish in the prairie.

There were several major changes in the flora of the planted area between 1988 and 1994 (Table 2). Nine of the weedy species present in the prairie in 1988 had disappeared by 1994. In 1994, six native prairie grasses were established in the prairie. Canada wild rye (*Elymus candensis*) was the only planted prairie species which was lost from the flora between 1988 and 1994. In contrast, seven other planted prairie species were found in the 1994, but not the 1988 sample.

Total plant cover and cover of planted prairie species both increased by 170% in sample quadrats between 1988 and 1994 (Table 3, Figure 1). This increase in cover was due to a 108% increase in planted forb cover and a 227% increase in planted grass cover. Cover by planted prairie species was 83% of the total cover in both 1988 and 1994 (Table 3). Perhaps the most dramatic overall change in the structure of the vegetation in the planted area over the six year interval between samples, was an increase in dominance by grasses (Figure 1). Grass cover increased from 48% of total cover in 1988 to 69% of total cover in 1994. There was a similar increase in the percentage of planted species cover attributed to grasses.

In addition to a large overall increase in cover, and a shift toward dominance by grasses, there were large changes in the cover and relative dominance of several individual species (Figure 2). Kentucky bluegrass (*Poa pratensis*) was not found in the area in 1988 but had an average 19% cover in the quadrats in 1994 (Table 3). Canada wild rye (*Elymus canadensis*) was by far the most dominant grass species in the prairie in 1988, with 13% cover, but was not present at all in 1994. Indian grass (*Sorghastrum nutans*) increased from a minor component of the vegetation in 1988 to the most dominant species in the prairie with 45% cover, a 1,720% increase (Table 3). Both big and little bluestem (*Andropogon gerardii* and *A. scoparius*) also increased substantially over the six year period.

There were also two large changes in forb cover in the quadrats. Purple coneflower (*Echinacea purpurea*) went from a minor cover (1.5%) in 1988 to the most dominant forb in the prairie with 21% cover in 1994. Most of these

Table 2. Plant species found in the created prairie in 1988 or 1994.

Scientific Name	Common Name	Family	Nat.	Plntd.	Present 88	Present 94
Forbs						
Ambrosia artemisiifolia	Common ragweed	Asteraceae	X		X	
Amorpha canescens	Lead plant	Fabaceae	X	X		X
Asclepias syriaca	Common milkweed	Asclepiadaceae	X		X	X
Asclepias tuberosa	Butterfly weed	Asclepiadaceae	X	X	X	X
Asclepias verticillata	Wholred milkweed	Asclepiadaceae	X	X	X	X
Aster novae-angliae	New England aster	Asteraceae	X	X		X
Aster pilosus	Frost aster	Asteraceae	X			X
Baptisia lactea	False indigo	Fabaceae	X	X	X	X
Coreopsis palmata	Coreopsis	Asteraceae	X	X	X	X
Daucus carota	Wild carrot	Apiaceae			X	X
Echinacea purpurea	Purple coneflower	Asteraceae	X	X	X	X
Erigeron annuus	Daisy fleabane	Asteraceae	X		X	
Erigeron canadensis	Horseweed	Asteraceae	X		X	X
Erigeron strigosus	Daisy fleabane	Asteraceae	X		X	X
Eryngium yuccifolium	Rattlesnake master	Apiaceae	X	X		X
Geum aleppicum	Avens	Rosaceae	X			X
Helianthus rigidus	Stiff sunflower	Asteraceae	X	X	X	X
Heliopsis helianthoides	Sunflower everlasting	Asteraceae	X	X		X
Hypericum perforatum	Common St. John's wort	Clusiaceae				X
Kuhnia eupatorioides	False bonset	Asteraceae	X	X	X	X
Liatris spicata	Dense blazing star	Asteraceae	X	X		X
Linaria vulgaris	Butter and eggs	Scrophulariaceae			X	X
Medicago lupulina	Black medic	Fabaceae			X	
Melilotus officinalis	Yellow sweet clover	Fabaceae			X	X
Monarda fistulosa	Wild bergamot	Lamiaceae	X	X	X	X
Petalostemum purpurea	Purple prairie clover	Fabaceae	X	X	X	X
Populus deltoides	Cottonwood	Salicaceae	X			X
Potentilla recta	Erect cinquefoil	Rosaceae			X	
Potentilla simplex	Common cinquefoil	Rosaceae	X		X	
Ratibida pinnata	Grey-headed coneflower	Asteraceae	X	X	X	X
Rudbeckia hirta	Black-eyed Susan	Asteraceae	X	X	X	X
Silene pratensis	White campion	Caryophyllaceae			X	
Silphium integrifolium	Rosinweed	Asteraceae	X	X	X	X
Silphium laciniatum	Compass plant	Asteraceae	X	X		X
Silphium terebinthinaceum	Prairie dock	Asteraceae	X	X	X	X
Solidago canadensis	Canada goldenrod	Asteraceae	X		X	
Solidago graminifolia	Grass-leaved goldenrod	Asteraceae	X		X	X
Solidago rigida	Hard-leaved goldenrod	Asteraceae	X	X	X	X
Taraxacum officinale	Dandelion	Asteraceae			X	X
Trifolium pratense	Red clover	Fabaceae			X	X
Unidentified Brassicaceae	Mustard	Brassicaceae			X	
Verbascum densiflorum	Mullein	Scrophulariaceae			X	
Vitis riparia	River grape	Vitaceae	X			X

Table 2. (cont.)

Scientific Name	Common Name	Family	Nat.	Plntd.	Present 88	Present 94
Grasses						
Andropogon gerardii	Big bluestem	Poaceae	X	X	X	X
Andropogon scoparius	Little bluestem	Poaceae	X	X	X	X
Bouteloua curtipendula	Side oats gramma	Poaceae	X	X	X	X
Bromus inermis	Brome grass	Poaceae			X	X
Elymus canadensis	Canada wild rye	Poaceae	X	X	X	
Panicum virgatum	Switch grass	Poaceae	X	X	X	X
Poa pratensis	Kentucky blue grass	Poaceae				X
Sorghastrum nutans	Indian grass	Poaceae	X	X	X	X
Sporobolus heterolepis	Prairie drop seed	Poaceae	X	X		X
		Total species present			39	42
		Total planted species			20	26

Table 3. Average percent aerial cover in ten permanent quadrats sampled in 1988 and 1994. Species are sorted by mean percent cover in 1994. *, planted prairie species. Percent increase in cover is calculated as: (94 cover - 88 cover) *100/88 cover.

		1988 Cover (%)	1994 Cover (%)	Percent Change 1988 to 1994
Forbs				
Echinacea purpurea	*	1.5	21.5	1333
Ratabida pinnata	*	5.8	7.3	26
Solidago rigida	*	2.8	5.3	91
Rudbeckia hirta	*	9.8	3.0	-69
Hypericum perforatum		0	2.5	
Silphium integrifolium	*	0	2.3	
Heliopsis helianthoides	*	0	2.0	
Petalostemum purpurea	*	0	1.5	
Monarda fistulosa	*	1.3	0.8	-40
Asclepias verticillata	*	0.3	0.5	100
Kuhnia eupatorioides	*	0	0.3	
Erigeron strigosus		0.3	0	-100
Solidago canadensis		0.8	0	-100
Aster pilosus		0.5	0	-100
Erigeron annuus		0.5	0	-100
Medicago lupulina		0.3	0	-100
Unidentified Brassicaceae		0.5	0	-100
Silene pratensis		0.5	0	-100
Ambrosia artemesiifolia		0.5	0	-100
Taraxacum officinale		0.5	0	-100
Verbascum densiflorum		3.0	0	-100
Total Forb Cover		28.5	46.8	64
Percent of total cover		52.3	31.4	
Total Planted Forb Cover		21.3	44.3	108
Percent of planted cover		46.7	35.8	

Table 3. (cont.)

		1988 Cover (%)	1994 Cover (%)	Percent Change 1988 to 1994
Grasses				
Sorghastrum nutans	*	2.5	45.5	1720
Andropogon gerardii	*	4.8	19.0	300
Poa pratensis		0	19.0	
Andropogon scoparius	*	1.8	14.5	729
Bromus inermis		1.8	3.8	114
Bouteloua curtipendula	*	1.8	0.3	-86
Elymus canadensis	*	13.3	0	-100
Panicum virgatum	*	0.3	0	-100
Total Grass Cover		26.0	102.0	292
Percent of total cover		47.7	68.6	
Total Planted Grass Cover		24.3	79.3	227
Percent of planted cover		53.3	64.2	
Total Cover All Species		54.5	148.8	173
All Planted Species		45.5	123.5	171

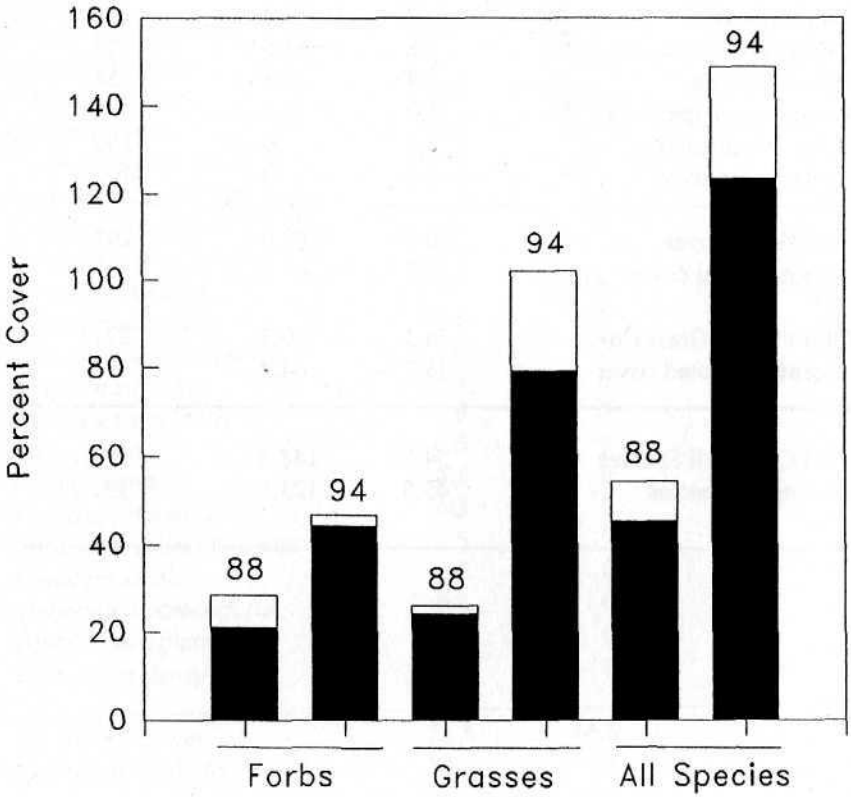

Figure 1. Percent cover of forbs, grasses, and all species in the planted prairie in 1988 and 1994. Solid bars, cover of planted species; open bars, cover of species not included in the planted seed mix.

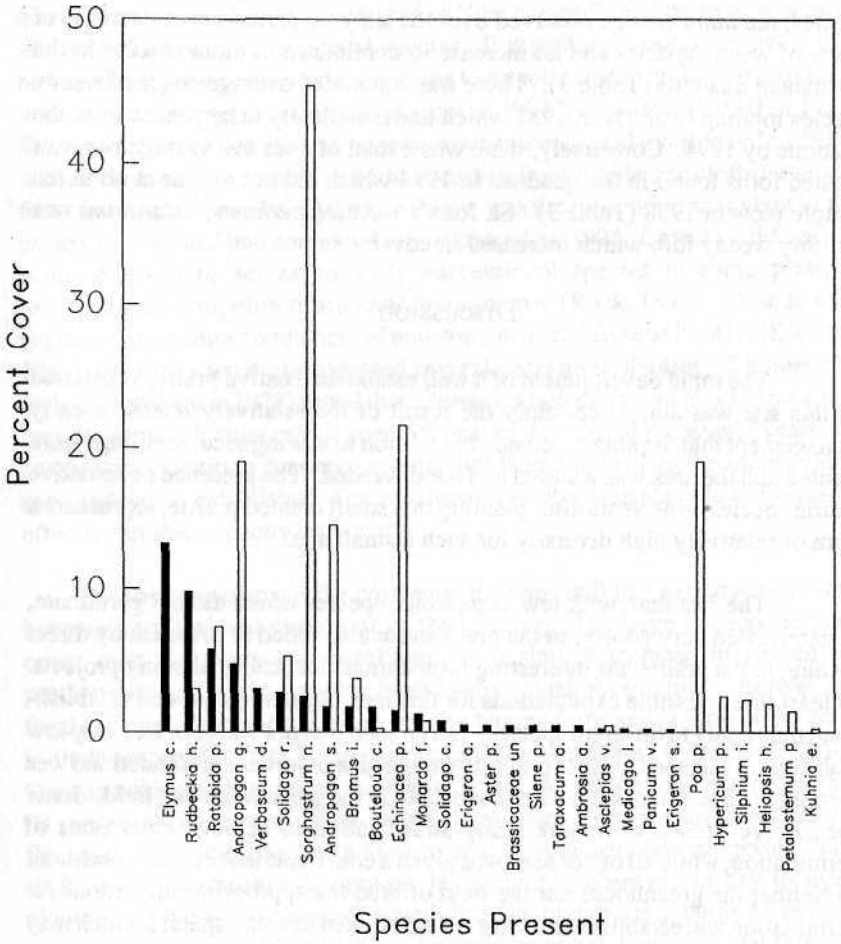

Figure 2. Percent of cover of plant species in ten permanent quadrats arranged in order of decreasing ocer in the 1988 sample. Solid bars, 1988 cover; open bars, 1994 cover. Species are abbreviated as the genus name and the first initial of the species epithet (Table 2).

purple coneflowers appeared to be newly established since they were small individuals not yet flowering in 1994. Black-eyed Susan (*Rudbeckia hirta*) decreased substantially in cover. Other than these large changes for individual species, the main change observed over the six year period was a decrease of cover of weedy species and an increase in dominance of planted forbs in the permanent quadrats (Table 3). There was a summed average cover of weedy species totaling over 7% in 1988 which had completely disappeared from the quadrats by 1994. Conversely, there was a total of over 6% average cover of planted forbs found in the quadrats in 1994 which did not appear at all in the sample plots in 1988 (Table 3). St. John's wort (*Hypericum perforatum*) was the only weedy forb which increased in cover.

Discussion

The rapid development of a well established native prairie vegetation on this site was almost certainly the result of the relatively intensive early management that the area received. In addition to sowing seed, seedlings were planted and the area was watered and hand weeded. The presence of 26 native prairie species, nine years after planting this small created prairie, represents a flora of relatively high diversity for such a small site.

The fact that, with few exceptions, species which did not germinate, or germinated very poorly, in the greenhouse also failed to establish by direct seeding in the prairie has interesting implications for prairie planting projects. At least three possible explanations for this lack of germination and establishment may apply to different species: 1) The seed was not viable or had very low viability. 2) The seed was not properly stratified or otherwise pretreated and was therefore in a dormant state when sown both in the greenhouse and field. Some species are known to require damp stratification to achieve good rates of germination, while all of our seed was given a cold treatment in a dry condition. 3) Neither the greenhouse nor the field offered the appropriate conditions for germination and establishment. We collected seed of some species which may prefer wet to wet-mesic prairies (Curtis, 1959), and planted them in a dry and sandy soil (eg. *Veronicastrum virginicum, Pycnanthemum virginianum, Dodecathean meadia, Spartina pectinata*). Since the open conditions of the field and the moist, well watered condition in the greenhouse represent a broad range of germination conditions, and since few species are known to absolutely require wet stratification for germination, it seems likely that the seed had low viability for at least a substantial portion of those species which failed to establish. The observation that species which could not be germinated in the greenhouse had no ultimate value in the prairie planting has important implications for restoration and creation plantings.

It is not surprising that several weedy species disappeared from the created prairie between its third and ninth year (Blewett, 1981; Rock, 1977). Most of these were early successional species that were eliminated by the increased competition with the prairie species. Blewett (1981) identified a group of species that he characterized as "decreasers", and these were almost all weedy and early successional species. It is perhaps more noteworthy that new planted species appeared to continue to establish in the prairie after its third year. Seven planted species were present in 1994 but not found at all in 1988. Some of these species may have been inconspicuous and overlooked in 1988, while others may have continued to establish from viable seed left in the soil from the original sowing. Canada wild rye was the most dominant plant in the prairie in 1988 and had completely disappeared by 1994. Canada wild rye has been observed to act as an early successional species in some prairies, decreasing as competition becomes more intense (Rock, 1977). Canada wild rye was a very minor component of both the Curtis and Greene Prairies (Blewett, 1981) when they were first sampled several years after planting. Zimmerman and Schwarzmeier (1978) found that *Elymus canadensis* was a good companion crop to plant with other prairie species because it persisted for several years and provided competition for weed species but then declined as the other prairie species became established. Our results suggest that Canada wild rye was also effective in this capacity on our site.

The vegetation in the created prairie was still in a very dynamic state between the third and ninth year of the planting. The large increase in plant cover over six years was paralleled by a similar increase in net annual productivity and hence standing biomass (personal observation). Between its third and ninth year, the prairie went from having forbs and grasses about equal in their percent cover to being an area heavily dominated by grasses. While Canada wild rye disappeared over this period, the vegetation became, both in its measured cover and in its overall appearance, an indian grass prairie. Personal communication with several prairie managers has suggested that a shift toward dominance by grasses is commonly observed in dry to mesic plantings with intensive burning schedules. Our planting was burned five of the six years between 1989 and 1994. It should be noted, however, that this shift of dominance toward the grasses did not mean that the forbs were becoming excluded and decreasing in cover. Cover of planted forbs doubled over the six year period. The large increase in cover of indian grass is similar to the results obtained on both Curtis and Greene Prairies (Blewett, 1981). *Sorghastrum nutans* increased steadily in the Curtis and Greene prairies between 1952 and 1976 until it reached frequencies of 31.0% and 27.6% in 1976. This appears to be an interesting feature of planted prairies since indian grass is not a major component of any of the native prairie types (dry through wet) described by Curtis (1959). *Sorghastrum nutans* reaches its greatest importance in dry-mesic

and mesic prairies. It is found in about 60% of these prairie types, but at frequencies of only 6 to 13% in plots (Curtis, 1959). Perhaps as planted prairies mature, indian grass will eventually be partially replaced by an increasing dominance of *Andropogon gerardii* and *A. scoparius*. In competition experiments lasting five to 15 months Rabinowitz, et al. (1984) found that *Sorghastrum nutans* tended to be out competed by *Andropogon gerardii*, but to out perform *A. scoparius* in de Wit competition experiments.

The increased cover of bluegrass is troubling since it did not even appear in the flora of the area in 1988. While bluegrass may actually have been an inconspicuous and overlooked part of the flora in 1988, there is no doubt that it increased in cover over the period. This is somewhat unexpected since we would have predicted that competition with the larger native grasses and repeated burning would cause a decrease in bluegrass. Only with future sampling of the prairie will we know if the vegetation had reached a more stable state by 1994 or whether large changes will continue to occur. We would expect the rate of change of the vegetation to slow at some point as the plant community matures. Blewett (1981) found that the rate of change of frequency had slowed near the end of the 25 year sampling period on the Arboretum prairies.

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