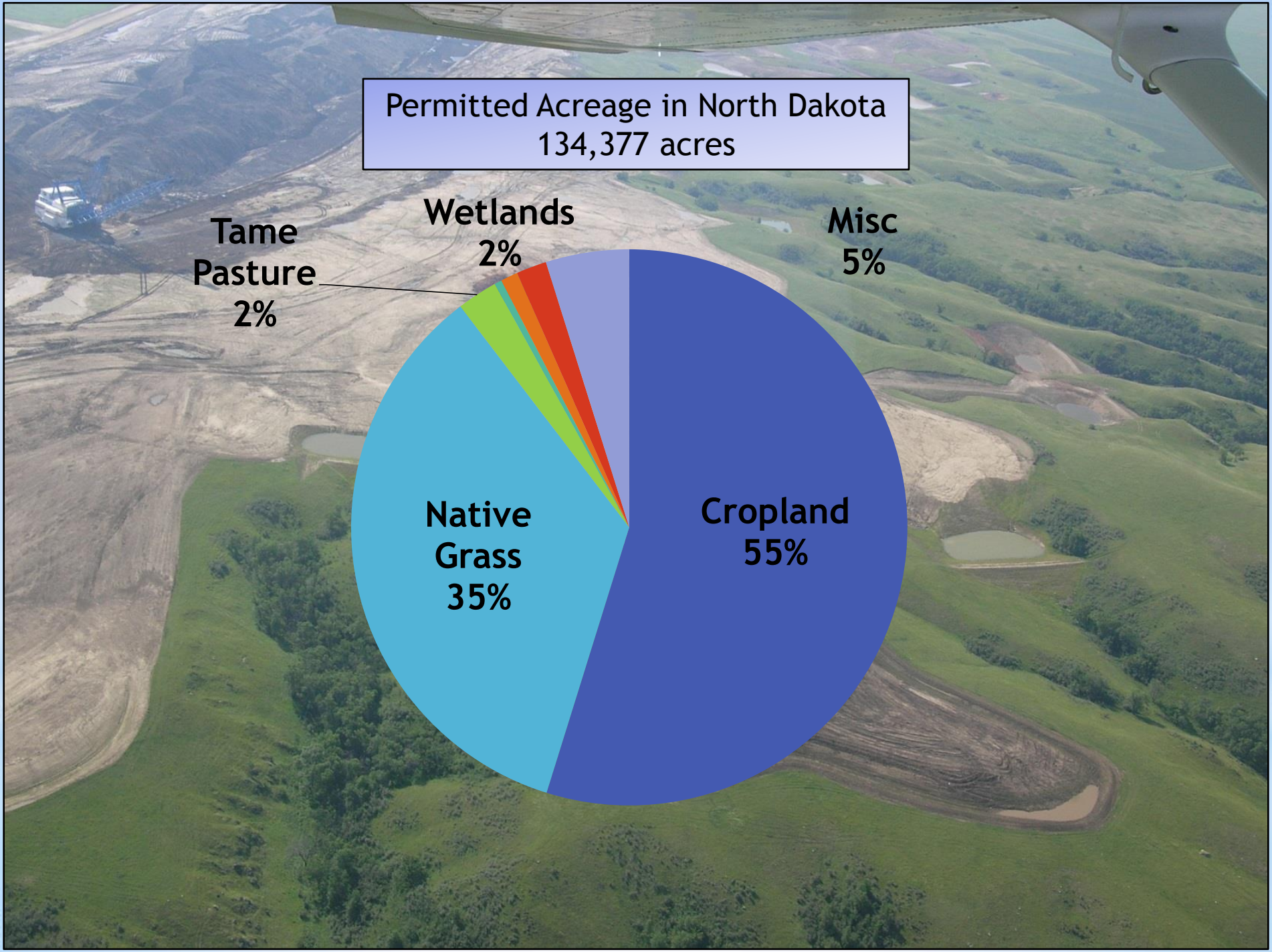
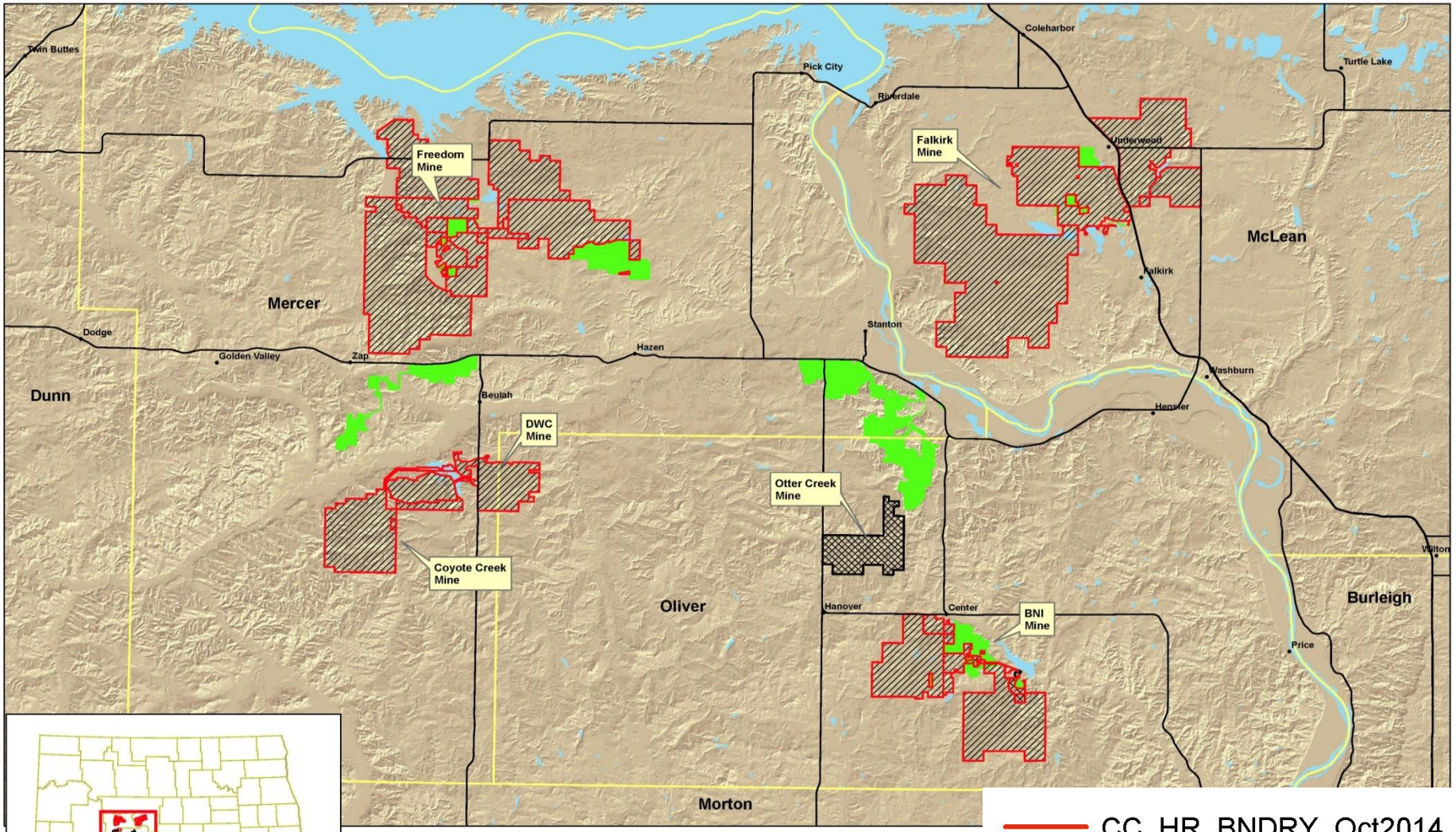
Invasive Species on Reclaimed Native Grassland in North Dakota

Guy Welch
ND Public Service Commission

09/25/2014


Permitted Acreage in North Dakota
134,377 acres
Tame Pasture 2%
Wetlands 2%
Misc 5%
Native Grass 35%
Cropland 55%

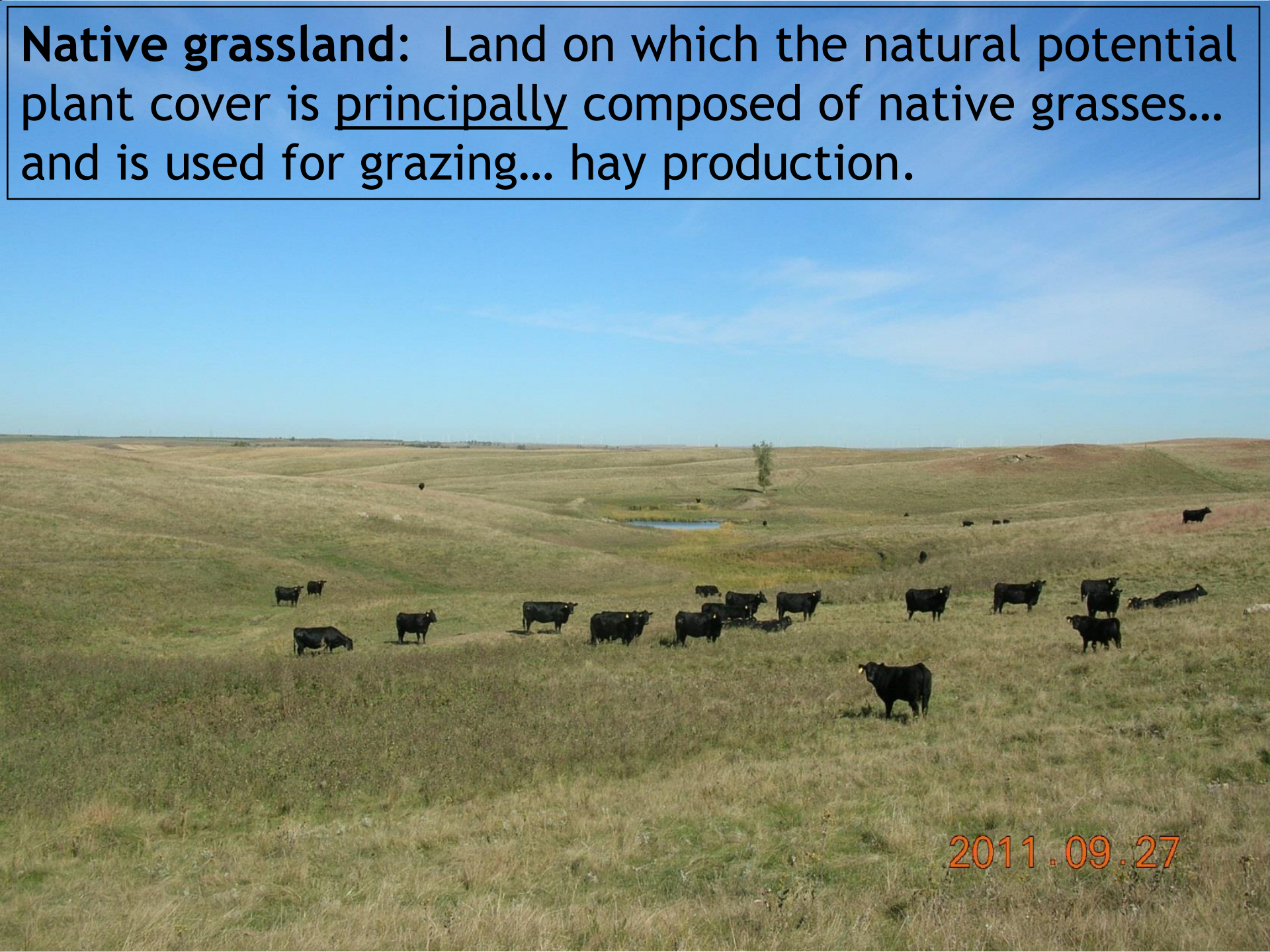
Surface Coal Mining in North Dakota



Central ND Surface Coal Mines

NDPSC April 1, 2015

Native grassland: Land on which the natural potential plant cover is principally composed of native grasses… and is used for grazing… hay production.



Reclaimed Native Grassland

Native Grassland Performance Standards

- Production
- Ground Cover
- Diversity
- Seasonality
- Permanence

Diversity and Seasonality Standard

- 5 native grass species must be present and native plant species must comprise at least 65% of the total species composition by cover or weight.
- Warm season species must comprise at least 15% of the species composition
- 4 native species must each contribute at least 3% of live cover or 5% of the composition by weight, and
- Of these 4, two must be warm season grasses and there must be at least one cool season species

SCS Silty Range Site Description

Relative Percent Composition of the Potential Vegetation

	Mean Productivity lbs/acre	% Composition
Grasses		
Western wheatgrass	486	25
Needleandthread	292	15
Green needlegrass	195	10
Blue grama	272	15
Prairie junegrass	98	5
Porcupinegrass Bearded wheatgrass Red threeawn Sandberg bluegrass	98	5
Kentucky bluegrass Other grasses	98	5
Grass-likes		
Penn sedge Threadleaf sedge Needleleaf sedge	98	5
Forbs		
Heath aster Prairie coneflower Green sagewort Scarlet globemallow Purple prairieclover Hoods phlox Other forbs	195	10
Shrubs and Half-shrubs		
Prairie rose Western snowberry Silver sage Fringed sage Winterfat	98	5
Total	1950	100

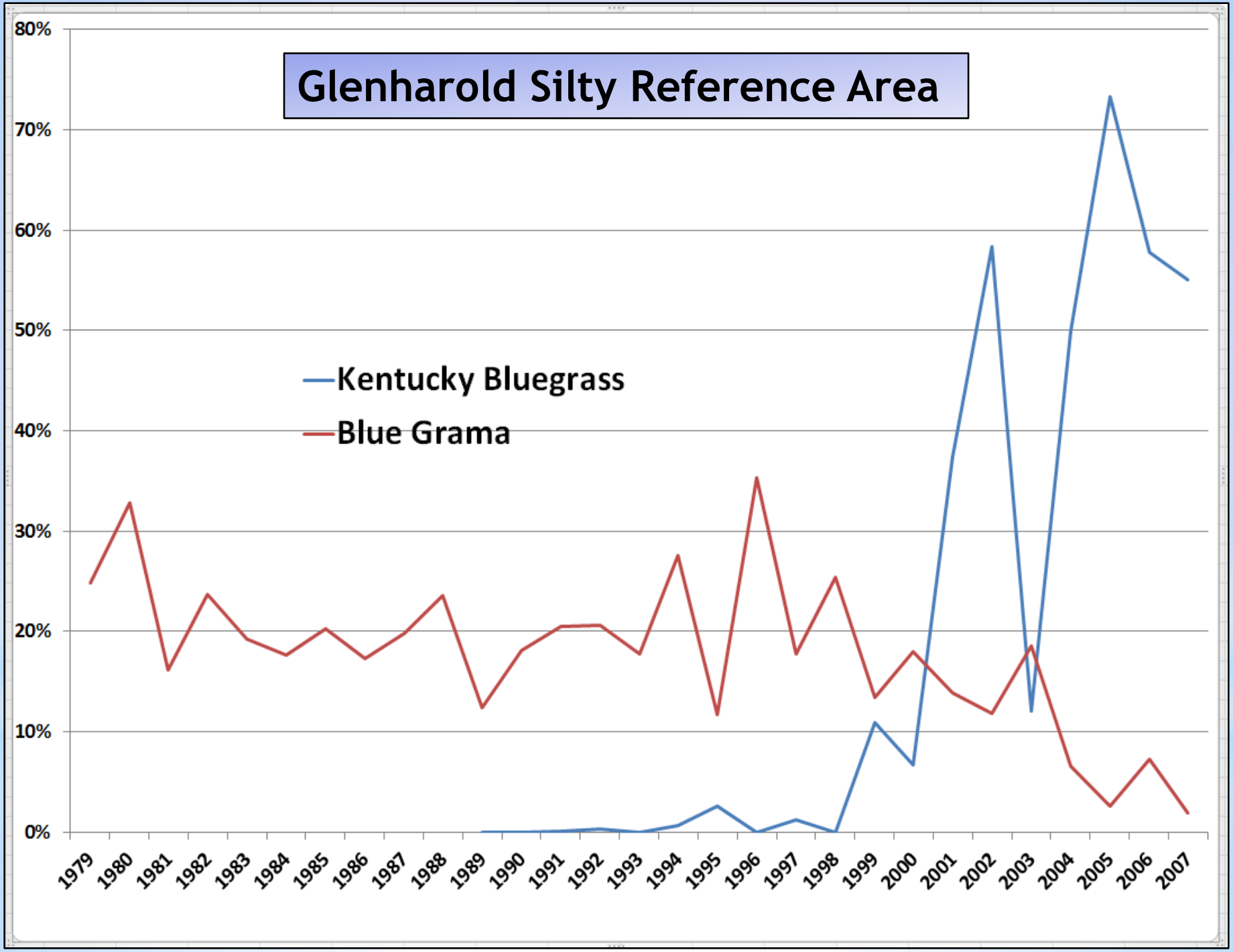
Glenharold Mine Silty Native Grassland Reference Area Data

Table 43: Relative Production of species and groups and Range Condition on the Silty Reference Area from 1979 - 2004.

	25%	5%	15%	10%	15%		5%	10%	5%								RANGE	NO SPECIES	
YEAR	AGSM	KOPY	STCO	STVI	BOGR	POA	SEDGE	FORB	SHRUB	MIN C	OTH W	FORBI	TOT P	TOTGRP	TOTW	TOTC	COND.	0%	5%
1979	10.5%	17.6%		0.0%	24.9%					0.1%	0.0%			78.6%	24.9%	53.6%	61.8%	8	5
1980	6.4%				32.8%						0.8%			79.7%	32.8%	44.1%	59.0%	9	5
1981	6.7%				16.1%						1.3%			75.9%	16.1%	58.4%	61.8%	10	5
1982	5.[illegible]				23.7%						1.2%			77.5%	23.7%	52.5%	61.0%	9	5
1983	[illegible]				9.3%						0.5%			81.8%	19.3%	62.1%	62.8%	8	5
1984					6%						0.7%			82.8%	17.6%	64.0%	62.7%	10	5
1985					2%						0.1%			76.3%	20.2%	53.9%	59.8%	10	5
1986					3%						2.3%			79.5%	17.3%	59.9%	60.6%	10	5
1987					9%						1.3%			84.3%	19.9%	63.1%	59.3%	10	5
1988					6%						0.4%			80.9%	23.6%	56.2%	47.0%	9	3
1989					.4%	0.0%					0.4%			78.3%	12.8%	65.5%	50.4%	9	3
1990	2				8.2%	0.0%	10				0.9%			87.1%	19.0%	68.1%	50.3%	9	3
1991	1.5				20.5%	0.0%	9.6%			.0%	1.4%			94.9%	21.9%	73.1%	44.4%	10	3
1992	1.9%				20.6%	0.3%	18.4%			0.0%	0.0%			96.7%	20.6%	76.1%	44.0%	7	3
1993	2.1%	4.		0.0%	17.8%	0.0%	14.6%	5.7%	0.0%	0.0%	0.0%			94.3%	17.8%	76.5%	47.4%	6	4
1994	2.6%	2.6%	47.8%	0.3%	27.6%	0.7%	8.4%	8.5%	0.0%	0.1%	1.4%			91.5%	28.9%	62.6%	51.2%	10	3
1995	2.0%	6.5%	53.1%	0.2%	11.8%	2.6%	8.9%	14.9%	0.0%	0.0%	0.0%			85.1%	11.8%	73.3%	51.6%	8	4
1996	21.3%	0.7%	27.9%	0.0%	35.4%	0.0%	8.6%	6.2%	0.0%	0.0%	0.0%			93.8%	35.4%	58.5%	63.2%	7	4
1997	0.4%	7.6%	58.0%	0.0%	17.8%	1.2%	9.1%	4.6%	0.0%	0.0%	1.2%			95.4%	19.0%	76.4%	47.5%	8	4
1998	3.3%	8.9%	40.7%	0.0%	25.5%	0.0%	10.2%	10.5%	0.0%	0.9%	0.0%	0.0%		89.5%	25.5%	64.0%	54.2%	7	4
1999	18.0%	5.6%	33.1%	0.0%	13.5%	11.0%	12.4%	5.2%	0.0%	0.0%	0.0%	1.2%		93.5%	13.5%	80.0%	71.6%	9	5
2000	15.3%	8.2%	26.3%	0.2%	18.0%	6.7%	12.5%	12.3%	0.0%	0.0%	0.5%	0.0%		87.7%	18.5%	69.2%	72.7%	10	5
2001	19.5%	1.6%	14.6%	0.4%	13.8%	37.4%	7.4%	4.5%	0.0%	0.0%	0.6%	0.0%		95.5%	14.5%	81.0%	69.5%	6	4
2002	8.7%	0.2%	13.7%	1.0%	11.9%	58.4%	4.3%	0.5%	0.0%	0.0%	1.2%	0.0%		99.5%	13.1%	86.4%	50.4%	6	4
2003	23.1%	6.3%	15.4%	9.9%	18.6%	12.0%	4.6%	9.5%	0.0%	0.0%	0.0%	0.6%		89.9%	18.6%	71.3%	92.1%	6	4
2004	19.6%	0.5%	11.6%	4.7%	6.6%	50.0%	4.5%	0.0%	2.6%	0.0%	0.0%	0.0%		97.4%	6.6%	90.9%	60.0%	6	4
2005-IN	14.9%	0.2%	3.6%	1.5%	2.5%	73.3%	2.6%	1.4%	0.0%	0.0%	0.0%	0.0%		98.6%	2.5%	96.1%	36.7%	6	1
2005-OUT	10.4%	1.5%	2.0%	6.2%	3.0%	**70.2%**	2.2%	3.4%	0.0%	0.0%	0.0%	1.2%		95.4%	3.0%	92.4%	38.6%	6	2
2006-IN	13.4%	1.1%	9.9%	0.1%	7.2%	57.8%	9.0%	1.6%	0.0%	0.0%	0.0%	0.0%		98.4%	7.2%	91.2%	48.2%	6	4
2006-OUT	8.1%	0.3%	2.8%	1.7%	5.7%	**72.6%**	5.4%	3.4%	0.0%	0.0%	0.0%	0.0%		96.6%	5.7%	90.9%	37.1%	6	3
2007-In	**13.5%**	**2.6%**	**8.0%**	0.7%	1.9%	55.1%	**7.9%**	9.3%	0.0%	1.1%	0.0%	0.0%		90.7%	1.9%	88.8%	50.9%	6	3
2007-Out	**14.5%**	0.8%	**5.5%**	0.0%	2.3%	**67.0%**	**4.9%**	5.0%	0.0%	0.0%	0.0%	0.0%		95.0%	2.3%	92.7%	43.0%	5	3
MEAN	8.7%	6.6%	28.6%	1.0%	16.5%	26.2%	8.7%	6.9%	4.1%	0.3%	0.5%	0.2%		88.8%	16.7%	71.7%	55.3%	8.7	4.2
STDEV	6.7%	6.9%	18.4%	2.2%	8.5%	30.0%	3.5%	4.2%	6.3%	0.5%	0.6%	0.5%		7.7%	8.6%	14.2%	11.7%	1.3	0.9
MIN	0.4%	0.1%	2.0%	0.0%	1.9%	0.0%	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%		75.9%	1.9%	44.1%	36.7%	6.0	3.0
MAX	23.1%	24.1%	60.5%	9.9%	35.4%	73.3%	18.4%	17.4%	18.9%	2.1%	2.3%	1.2%		99.5%	35.4%	96.1%	92.1%	10.0	5.0

BOGR = Blue Grama

POA = Kentucky Bluegrass


Glenharold Silty Reference Area
Kentucky Bluegrass
Blue Grama
80%
70%
60%
50%
40%
30%
20%
10%
0%
1979
1980
1981
1982
1983
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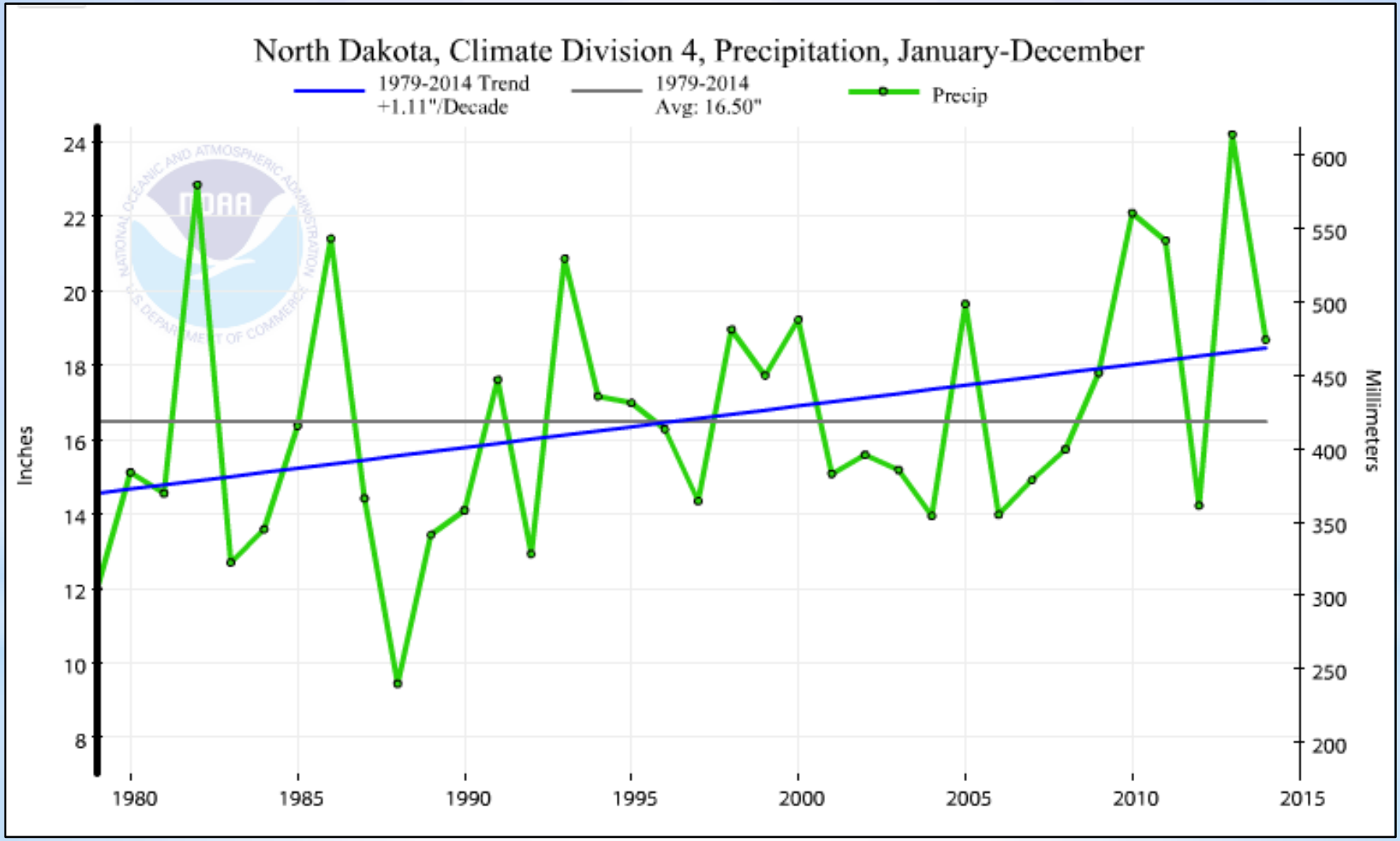
NOAA – Climate at a Glance



Kentucky bluegrass can be counted towards meeting the 65% total native species requirement up to its percent composition on an approved reference area(s).

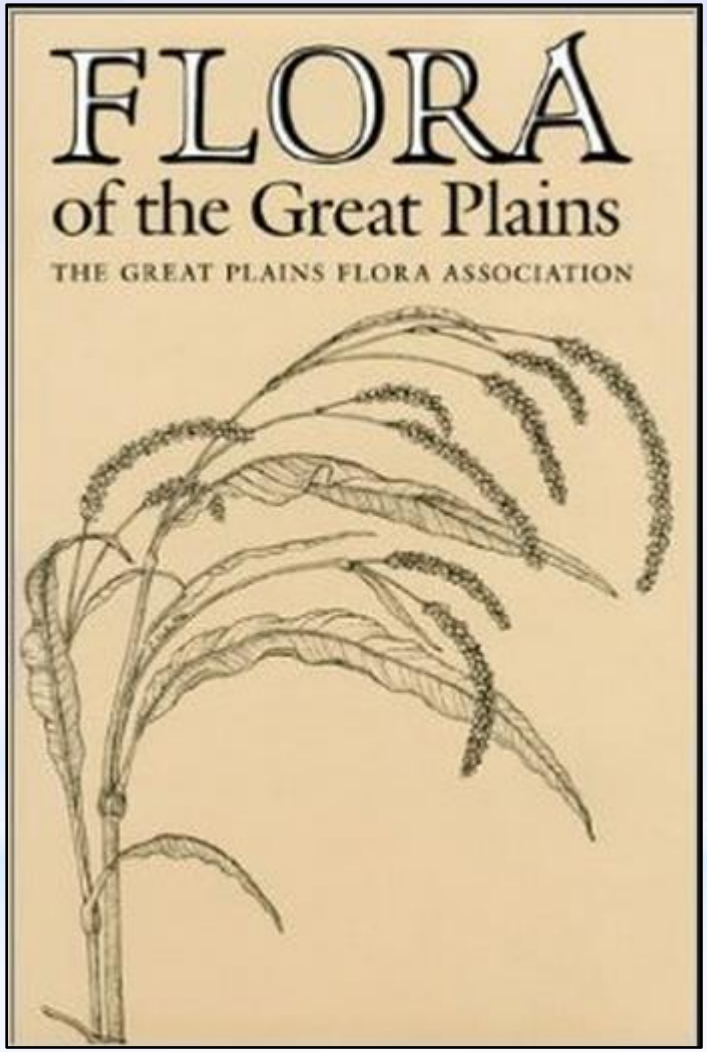
SCS Clayey Range Site Description

Relative Percent Composition of the Potential Vegetation

	Mean Productivity	
	lbs/acre	% composition
Grasses		
Western wheatgrass	720	40
Other wheatgrasses 1/	90	5
Green needlegrass	180	10
Prairie junegrass	90	5
Blue grama	180	10
Sandberg bluegrass Porcupinegrass Needleandthread	90	5
Plains reedgrass Kentucky bluegrass Other grasses	180	10
Grass-likes		
Penn sedge Needleaf sedge Other grass-likes	90	5
Forbs		
Scarlet globemallow Prairie thermopsis Western yarrow Prairie coneflower Prairie onion Large goatsbeard Other forbs	90	5
Shrubs and Half-shrubs		
Western snowberry Prairie rose Fringed sagewort Common winterfat Silver sagebrush Other shrubs	90	5
Total	1800	100

1/ Includes Montana, thickspike, and slender wheatgrasses.

Kentucky Bluegrass – Probably Native & Naturalized




Invasive Species
Kentucky Bluegrass - Naturalized?
Smooth Bromegrass - Introduced species
Crested Wheatgrass - Introduced species
08.08.2012

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

Plant Fact Sheet

KENTUCKY BLUEGRASS

***Poa pratensis* L.**

Plant Symbol = POPR

Contributed by: USDA NRCS Rose Lake Plant Materials Center

Robert H.Mohlenbrock
USDA NRCS 1989
Midwest Wetland Flora
@ USDA NRCS PLANTS

Uses

Beautification: This plant provides a dense green sod especially adapted for parks and home lawns.

Erosion control: Kentucky bluegrass is an excellent erosion control plant because of its dense, vigorous turf forming habit. It can be used as a mix with legumes or other grasses for erosion control in conservation cover, waterways, field borders, heavy use areas and critical areas such as steep banks and pond edges. It is also used alone or in seed mixtures as permanent cover for tree plantings and orchards.

Livestock: The species is highly palatable to horses, cattle, and sheep. It produces relatively low yields compared to other pasture grasses, but can be very productive in the Northeast on closely grazed intensive rotational grazing systems.

Recreation: Kentucky bluegrass turf is excellent for ball fields and other heavy use areas such as camp grounds, golf fairways, and picnic areas.

Wildlife: This plant is highly palatable to elk and is one of the better grasses for deer. The tender plants are grazed immediately after growth begins and the leaves remain succulent and green as long as soil moisture is present. Seeds are eaten by several kinds of songbirds and rodents. Leaves are eaten by rabbits and turkey.

Status

Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Weediness

This plant may become weedy or invasive in some regions or habitats and may displace desirable vegetation if not properly managed. Please consult with your local NRCS Field Office, Cooperative Extension Service office, or state natural resource or agriculture department regarding its status and use. Weed information is also available from the PLANTS Web site at plants.usda.gov.

Description

Poa pratensis L., Kentucky bluegrass, is a perennial, cool-season, sod-forming grass native to Europe. Seedhead stems are 18 to 24 inches tall, but can be 4 to 6 inches in height when used for intensive grazing. The seedhead has an open shape like a pyramid and produces many small seeds. There are approximately 2,177,000 seeds per pound. Leaves are 6 to 12 inches long and boat-shaped (keeled) at the tips. Leaves are smooth, soft, and about 1/8 to 1/4 inch wide. The plant becomes dormant during the heat of summer, but regains or maintains its green color in fall. Growth starts early in the spring. Tiller buds develop into stems or rhizomes. New rhizomes also arise from nodes of older rhizomes. Most rhizomes penetrate 2 to 4 inches into the soil, but some will go down more than 5 inches.

Adaptation and Distribution

Kentucky bluegrass is used throughout the U.S. It is best adapted to well-drained, fertile, medium-textured soils of limestone origin. It performs satisfactorily on

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

Plant Fact Sheet

SMOOTH BROME

***Bromus inermis* Leyss.**

Plant Symbol = BRIN2

Contributed by: USDA NRCS Plant Materials Program

©Larry Allain
@USDA NRCS PLANTS Database

Caution: This plant may become invasive. Please consult a specialist in your area.

Alternate Names
bromegrass, Austrian brome, Hungarian brome, Russian brome

Uses
Livestock: Smooth brome may be used for hay, pasture, or silage. It is compatible with alfalfa or other adapted legumes. The grass is highly palatable and is high in protein content and relatively low in crude-fiber content.

Erosion Control: Since the plant has a massive root system and is a sod former it can be used effectively for critical area planting and grassed waterways if the areas can be irrigated or where annual precipitation exceeds 20 inches.

Wildlife: Smooth brome can be used as a component in various upland wildlife and conservation cover mixes for nesting cover and food. *Note: This species is no longer recommended for wildlife use in some states because of its aggressive nature.*

Status
Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values). This plant has threatened status in Michigan.

Weediness
This plant may become weedy or invasive in some regions or habitats and may displace desirable vegetation if not properly managed. Please consult with your local NRCS Field Office, Cooperative Extension Service office, or state natural resource or agriculture department regarding its status and use. Weed information is also available from the PLANTS Web site at plants.usda.gov.

Description
Bromus inermis, smooth brome, is a leafy, sod-forming, perennial, cool season grass that spreads by rhizomes. This species is both native and introduced. The stems vary in height from 2 to 4 feet. The plant produces numerous basal and stem leaves that vary in length from 4 to 10 inches. Frequently the leaves are marked by a transverse wrinkle resembling a "W" a short distance below the tip. The flower head develops a characteristic rich purplish-brown color when mature. The seed is produced in semi-compact 5 inch long panicles with ascending branches. The flat compressed seed is usually awnless, about 1/3 inch long, and smooth. There are approximately 136,000 seeds per pound. Smooth brome is the most widely used of the cultivated bromegrasses and has been cultivated in the U.S. since the early 1880s.

Adaptation and Distribution
Smooth brome is best adapted to cooler climates and is generally hardier than tall fescue or orchardgrass. It is resistant to drought and extremes in temperature. This plant is very susceptible to disease in areas of high humidity. Smooth brome grows best on slightly

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

Plant Fact Sheet

CRESTED WHEATGRASS

***Agropyron cristatum* (L.) Gaertn.**

Plant Symbol = AGCR

Contributed by: USDA NRCS Idaho State Office

Loren St. John
USDA NRCS Idaho PMC

Uses

Grazing/rangeland/hayland: Crested wheatgrass is commonly recommended for forage production. It is palatable to all classes of livestock and wildlife and is a desirable feed in spring and also in the fall if it re-grows enough. It is commonly utilized for winter forage by cattle and horses, but protein supplements are required to ensure good animal health. It can withstand very heavy grazing pressure (65% use and greater) once stands are established. The best forage types in order are Siberian, desertorum, and Hycrest. The cristatum type is not considered a productive forage type.

Erosion control/reclamation: Crested wheatgrasses are useful for soil stabilization. They compete well with other aggressive introduced grasses, but because of this trait, they are not compatible in mixes with native species. Their drought tolerance, fibrous root systems, and good seedling vigor make these species ideal for reclamation in areas with 8 to 20 inches annual precipitation. In areas above 14 inches of precipitation, the cristatum types may exhibit their rhizomatous traits and make excellent low maintenance lawns. These grasses can be used in urban areas where irrigation water is limited to provide ground cover and to stabilize ditchbanks, dikes, pipelines, powerlines and roadsides.

Wildlife: Birds and small rodents eat crested wheatgrass seeds; deer, antelope and elk graze it, especially in spring and fall. Upland and song birds utilize stands for nesting.

Status

Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Description

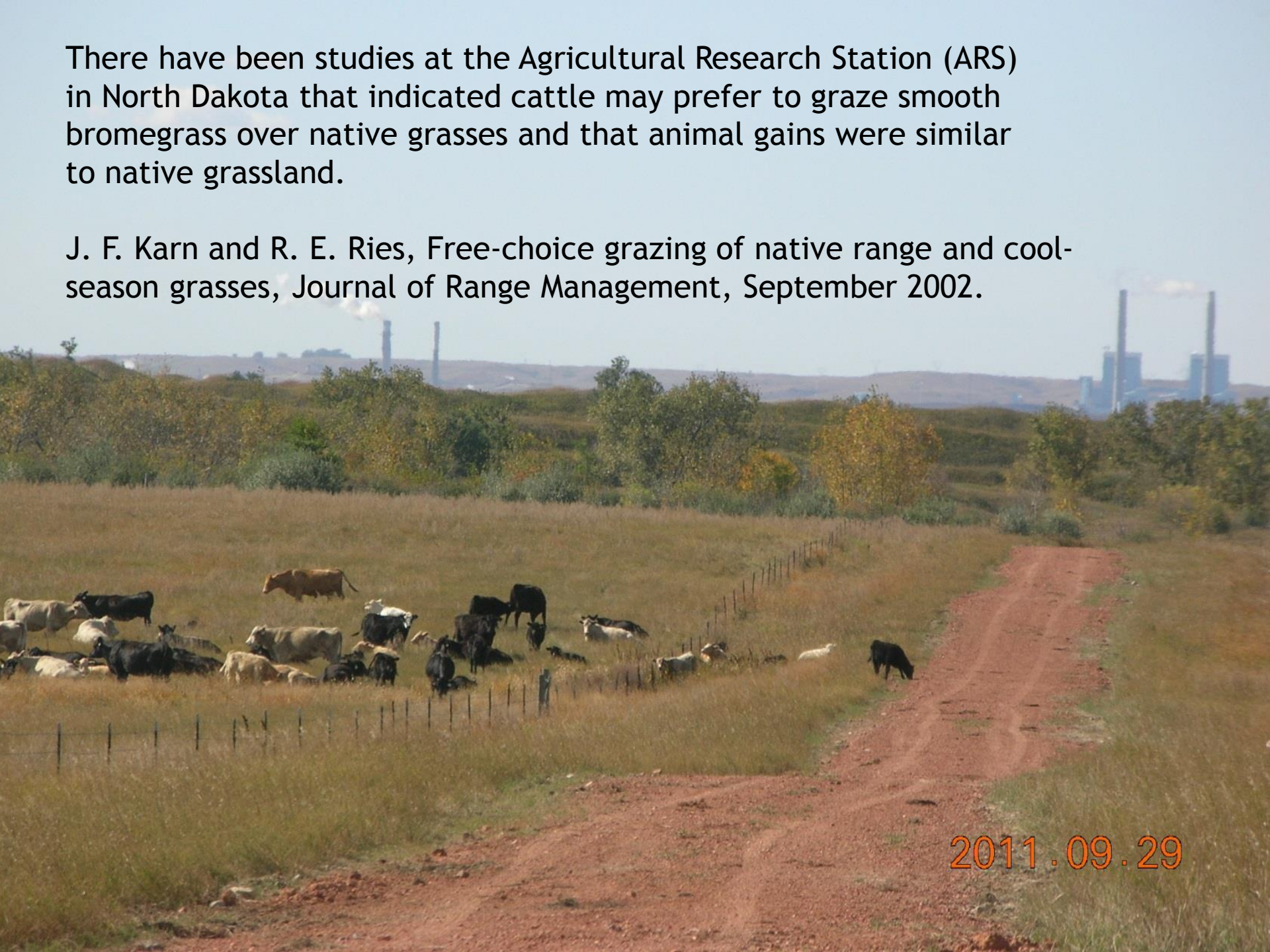
Crested wheatgrasses *Agropyron cristatum*, *Agropyron desertorum*, and Siberian wheatgrass *Agropyron fragile* are perennial grasses commonly seeded in the western United States. They are long-lived, cool season, drought tolerant, introduced grasses with extensive root systems. Cristatum type crested wheatgrass grows from 1 to 3 feet tall and seed spikes may be 1.5 to 3 inches long with a short-broad shape that tapers at the tip. Flower clusters within the spike are flattened and closely overlapping. Each seed has a short awn. Stems are leafy and erect, forming a dense tuft. Leaves are flat, smooth below, slightly coarse above, and vary in width from 1/16 to 1/4 inch.

Adaptation and Distribution

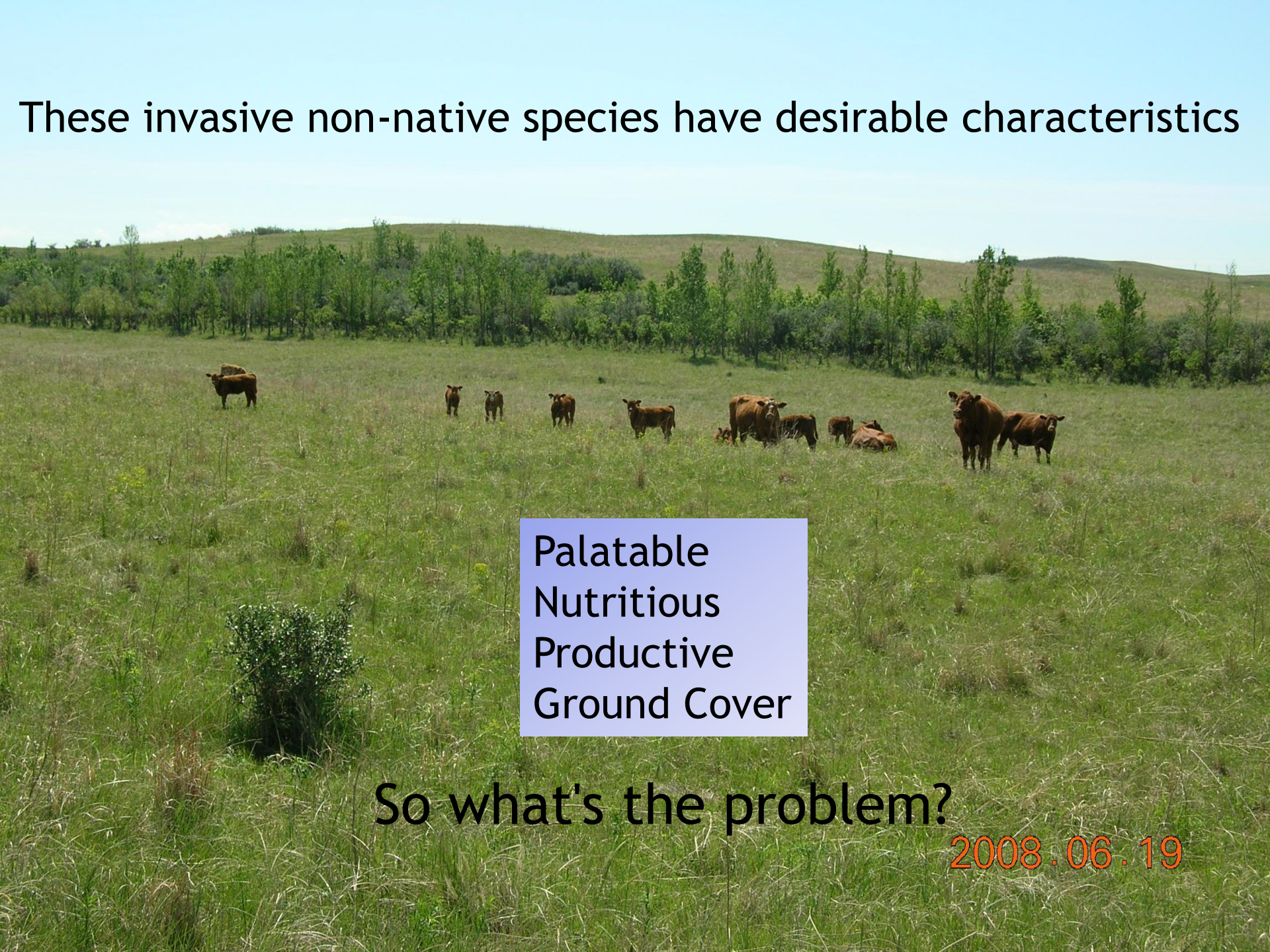
Cristatum type crested wheatgrass is adapted to areas where annual precipitation averages 10 and where the frost free period is generally less than 140 days; it does well up to 9,000 feet elevation. Crested wheatgrass grows on shallow to deep, moderately course to fine textured, moderately well to well drained and weakly acidic to moderately alkaline soils. Under saline conditions, vigor and production are reduced. The cristatum type is not well adapted to silty soils. All crested wheatgrasses are cold tolerant, can withstand moderate periodic flooding in the spring, and are very tolerant of fire. They will not

There have been studies at the Agricultural Research Station (ARS) in North Dakota that indicated cattle may prefer to graze smooth bromegrass over native grasses and that animal gains were similar to native grassland.

J. F. Karn and R. E. Ries, Free-choice grazing of native range and cool-season grasses, Journal of Range Management, September 2002.



These invasive non-native species have desirable characteristics



So what's the problem?

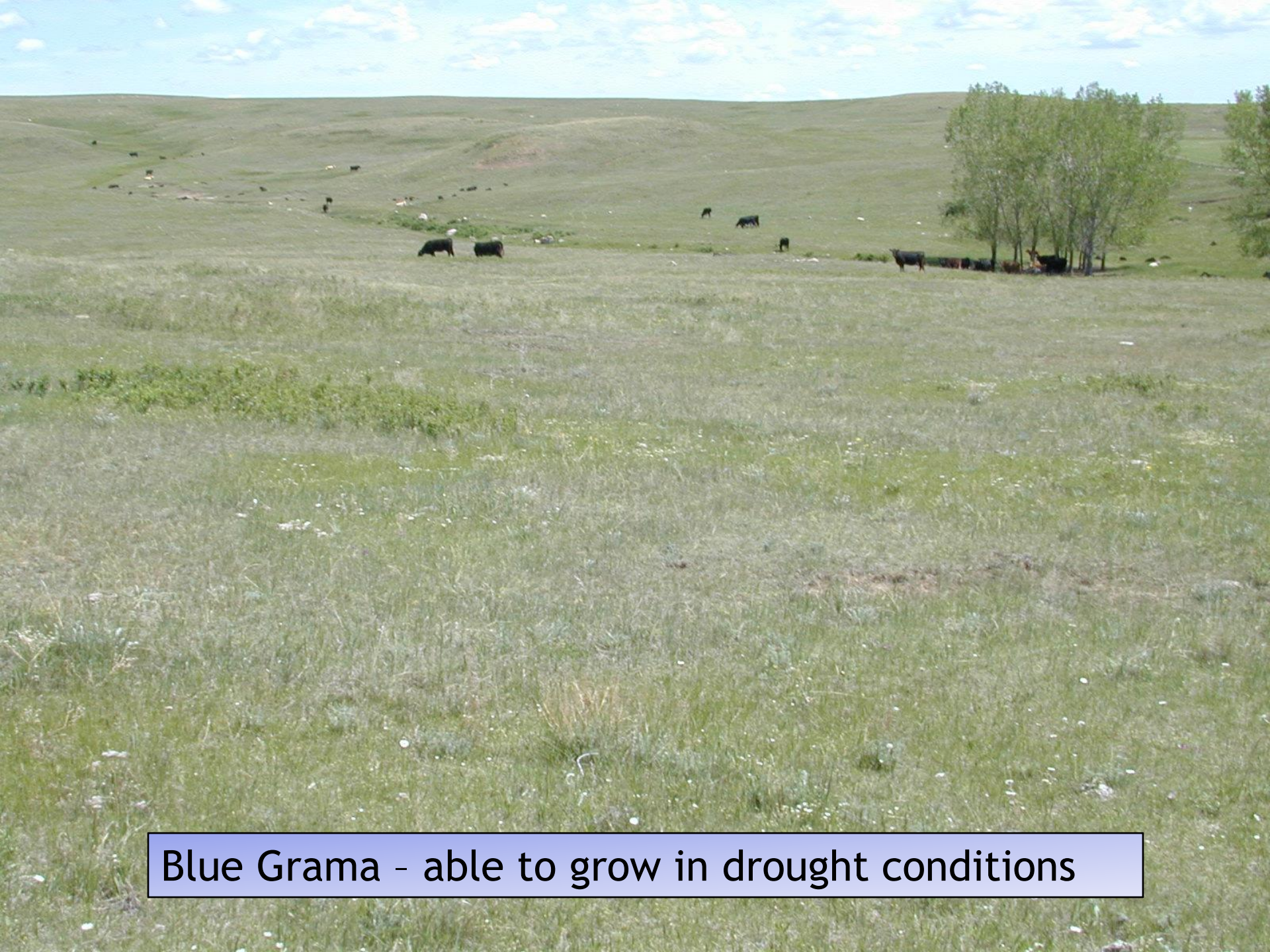
The problem with these species is that they can:

Displace native species

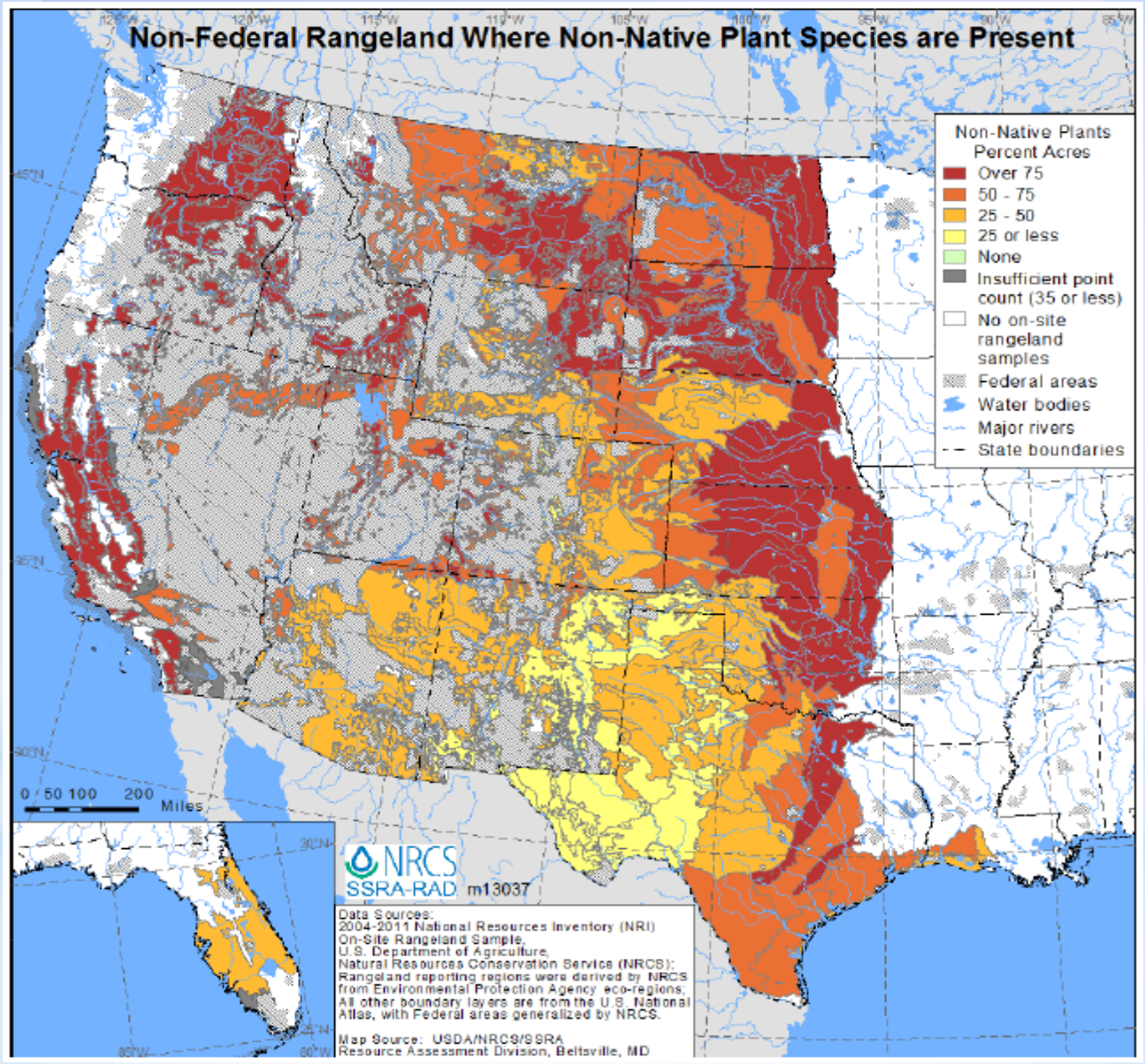
Reduce vegetation diversity & structure

Alters soil surface structure & surface hydrology

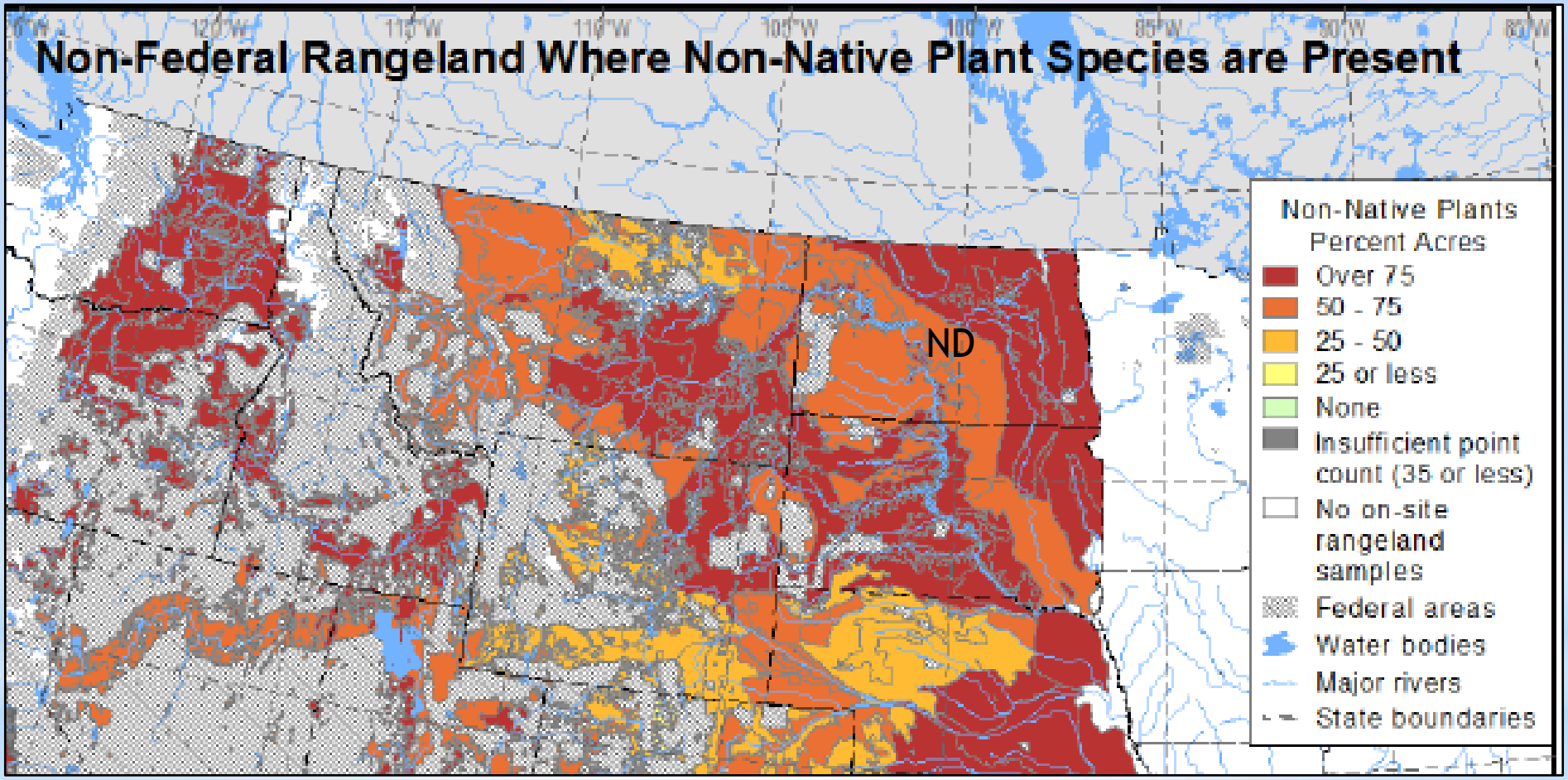
Alter nutrient cycle


Blue Grama – able to grow in drought conditions

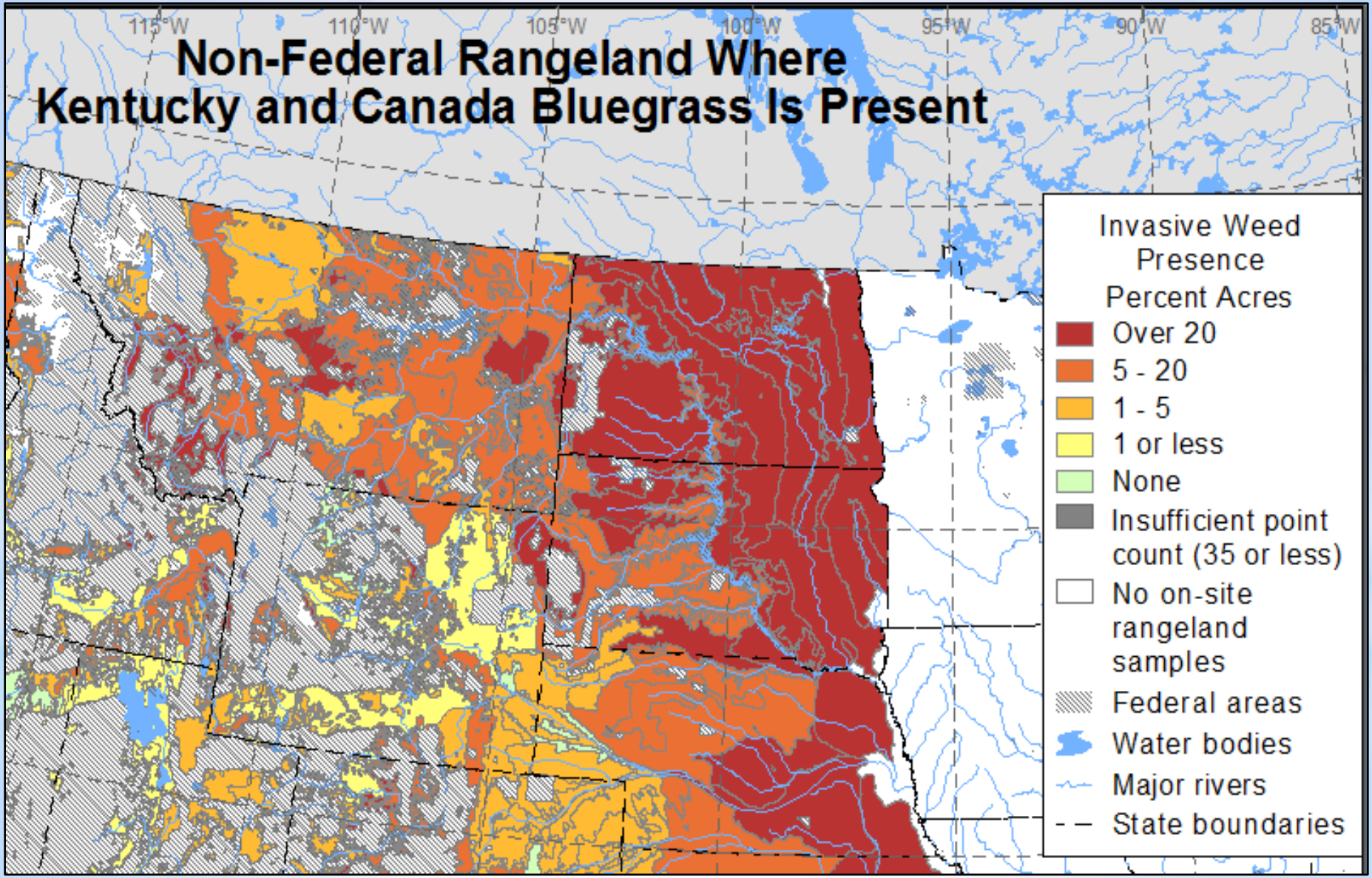
NRCS Natural Resource Inventory (NRI)



NRCS Natural Resource Inventory (NRI)



NRCS Natural Resource Inventory (NRI)



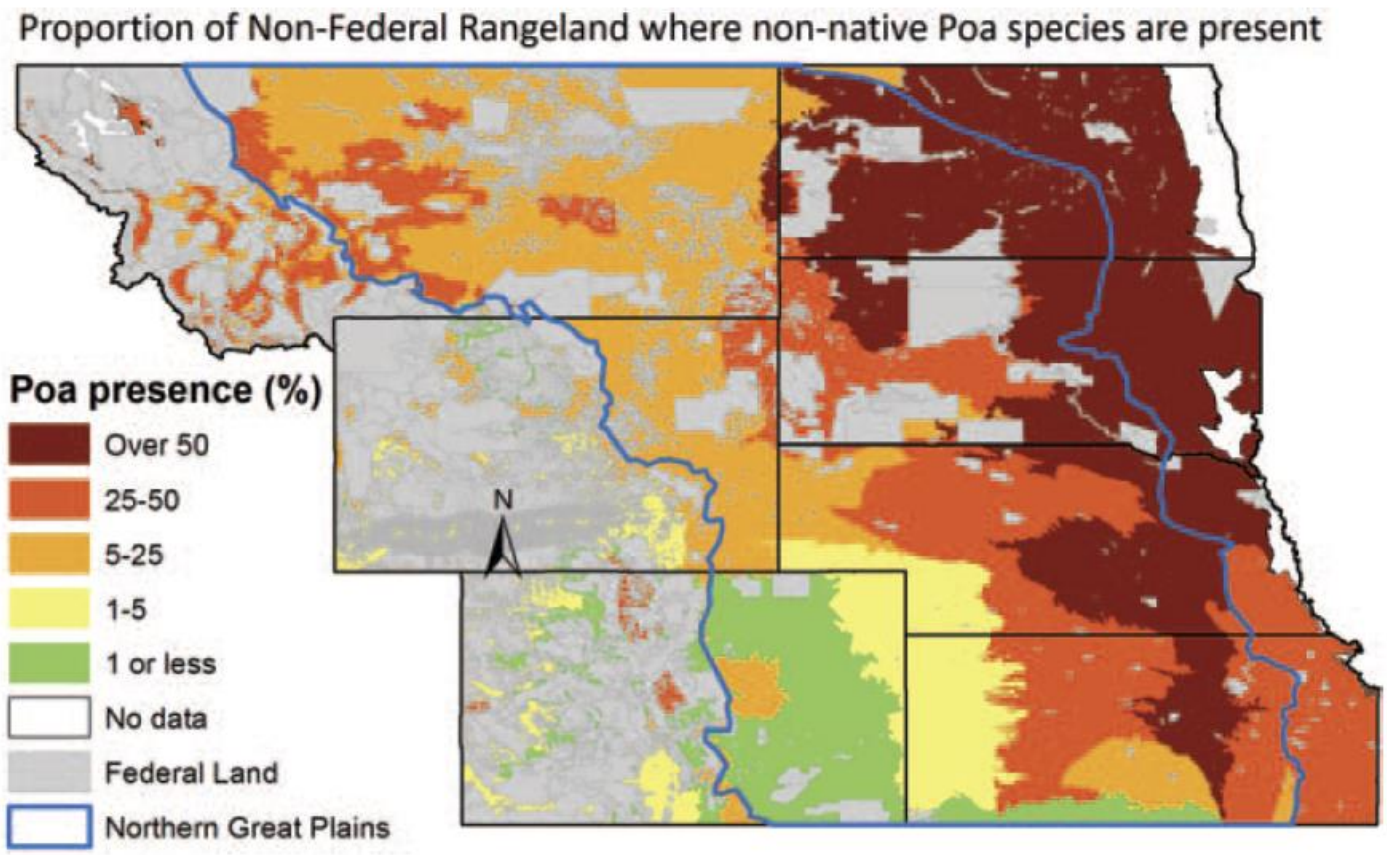
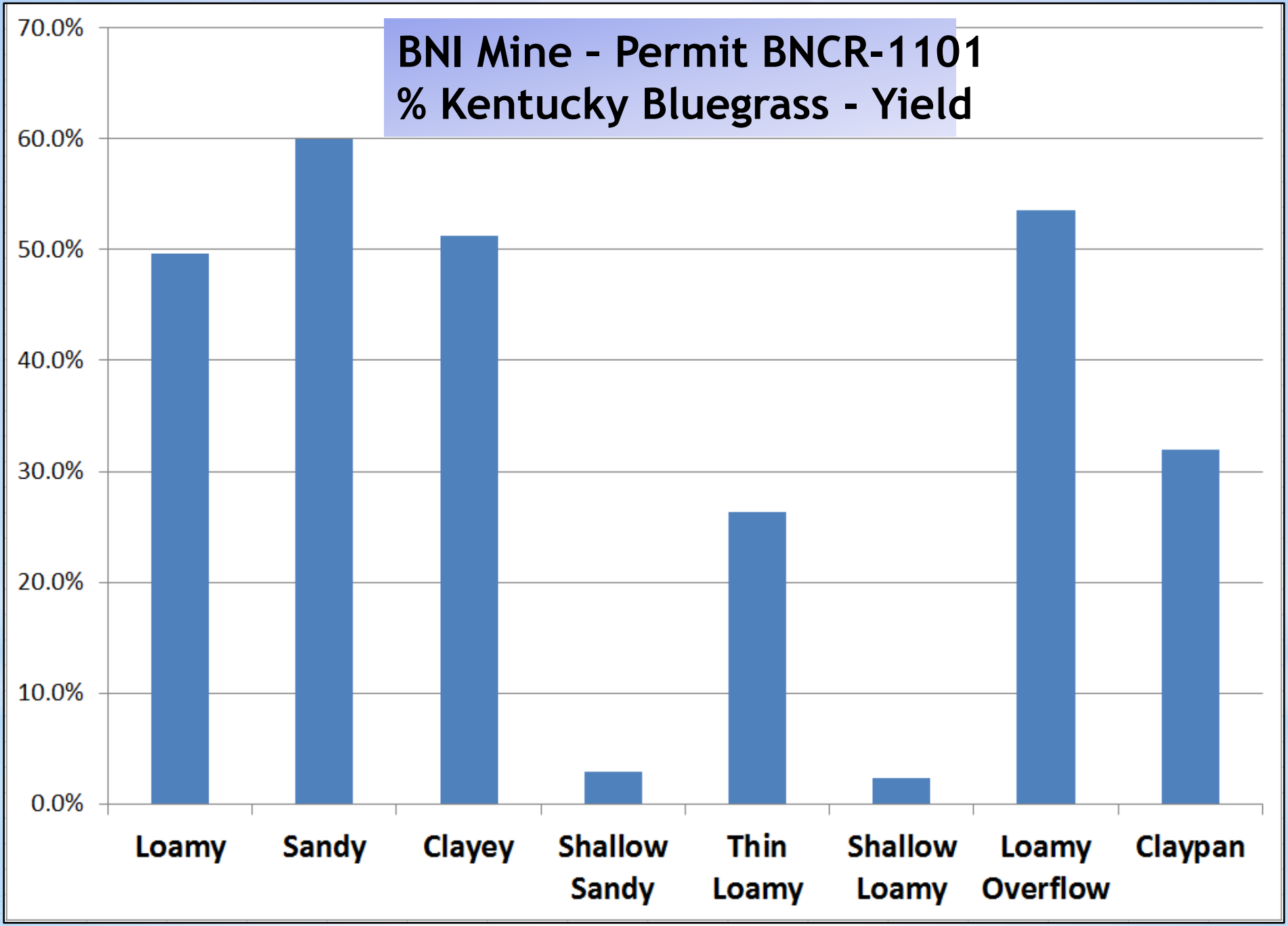


Figure 1. Kentucky bluegrass presence based on 2003 to 2006 National Resources Inventory rangeland canopy foliar cover data (USDA 2014). Percentages refer to the percentage of acres with *Poa* present within Major Land Use Resource Area polygons. For example, in North Dakota, Kentucky bluegrass is present in 82% of the acres of most polygons, and of these areas where it is present, there is at least 50% cover of Kentucky bluegrass in 33% of them (USDA 2014).


BNI Mine - Permit BNCR-1101
% Kentucky Bluegrass - Yield
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
Loamy
Sandy
Clayey
Shallow Sandy
Thin Loamy
Shallow Loamy
Loamy Overflow
Claypan

United States Department of Agriculture
NRCS Natural Resources Conservation Service

.Ecological Site Description

Data Access
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Report Selections
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Complete Report
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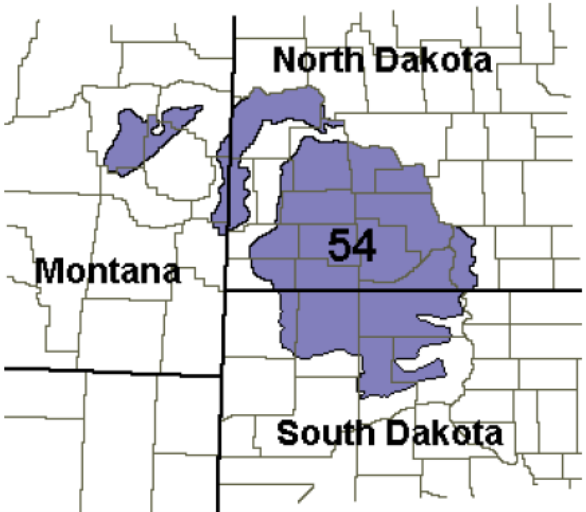
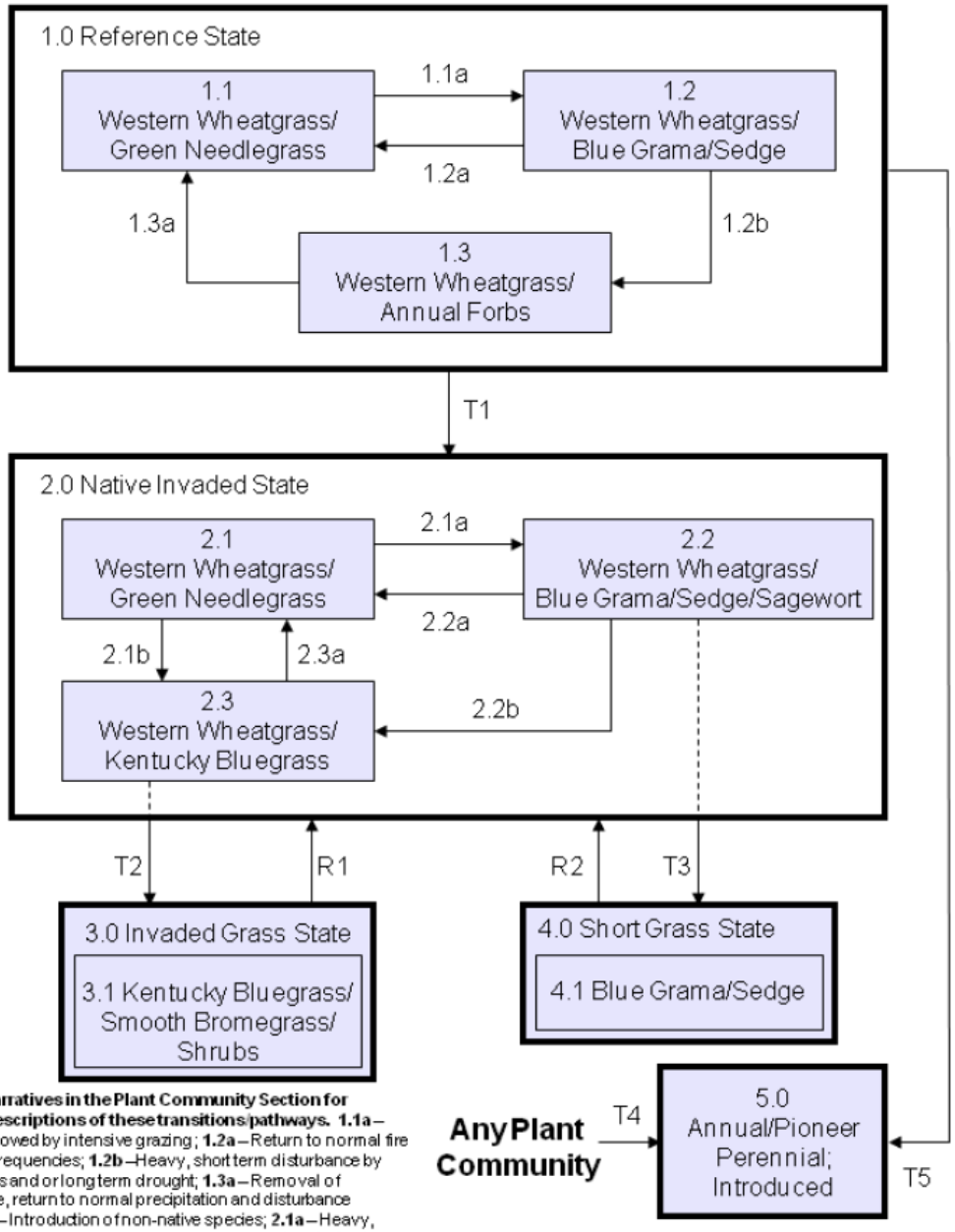
United States Department of Agriculture Natural Resources Conservation Service Ecological Site Description

Section I: Ecological Site Characteristics

Ecological Site Identification and Concept

Site name: **Loamy**
/ *Pascopyrum smithii* - Nassella viridula
(/ WESTERN WHEATGRASS - GREEN NEEDLEGRASS)
Site type: Rangeland
Site ID: R054XY031ND
Major land resource area (MLRA): 054-Rolling Soft Shale Plain





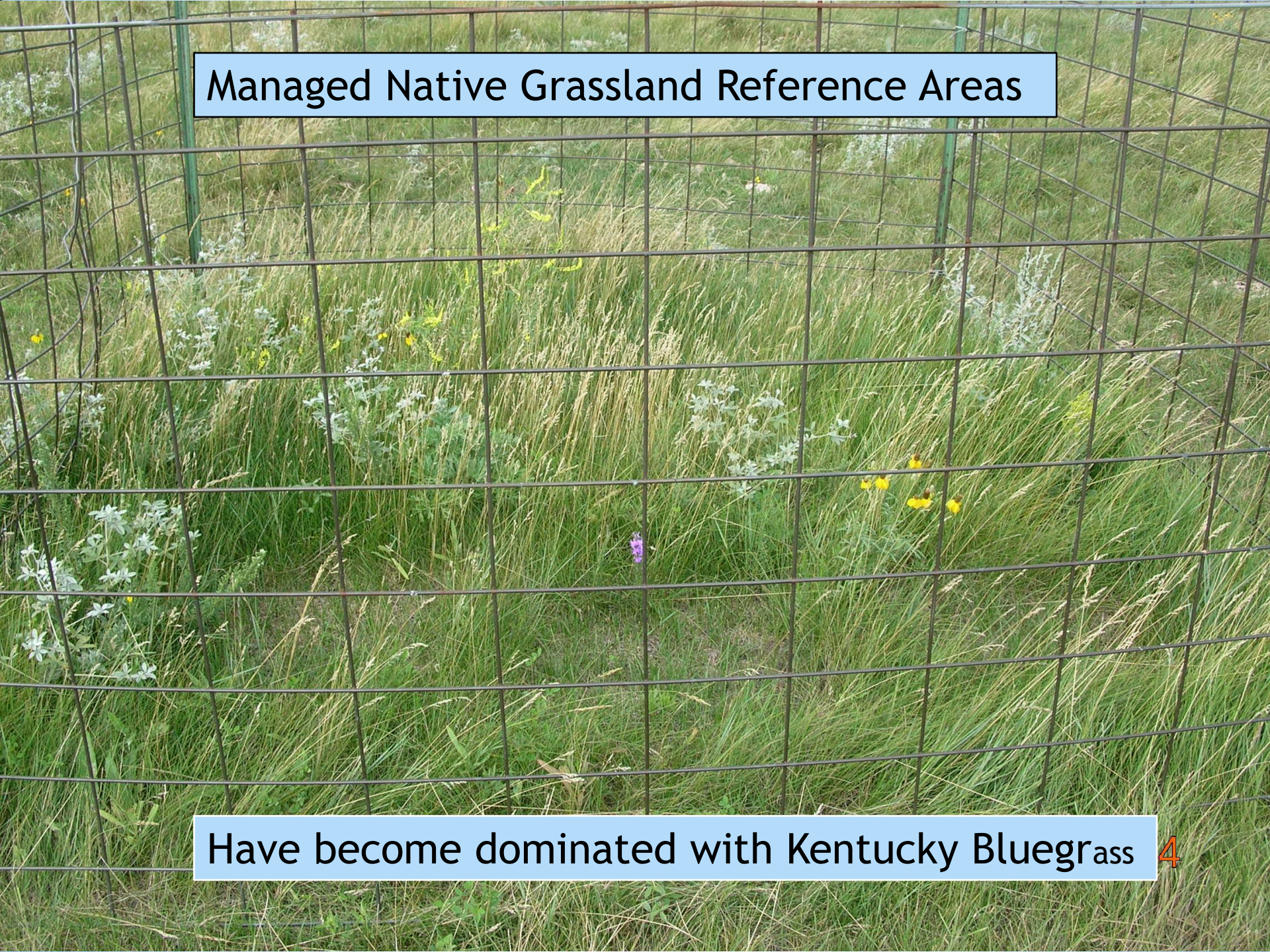
Refer to narratives in the Plant Community Section for detailed descriptions of these transitions/pathways. 1.1a – Fall fire followed by intensive grazing; **1.2a** – Return to normal fire & grazing frequencies; **1.2b** – Heavy, short term disturbance by prairie dogs and or long term drought; **1.3a** – Removal of disturbance, return to normal precipitation and disturbance regime; **T1** – Introduction of non-native species; **2.1a** – Heavy, continuous season-long grazing or seasonal grazing; **2.1b** – Non-use, no fire; **2.2a** – Prescribed grazing; **2.2b** – Non-use, no fire; **2.3a** – Prescribed grazing; **T2** – Non-use, no fire; **T3** – Heavy continuous season-long grazing; **T4** – Cessation of annual cropping; **T5** – Long term occupation by prairie dogs; **R1** – Prescribed grazing, prescribed burning with herbicides or range seeding; **R2** – Herbicides and range seeding

NRCS Ecological Site Description:
Loamy Ecological Site (MLRA 54)

Invaded Grass State:

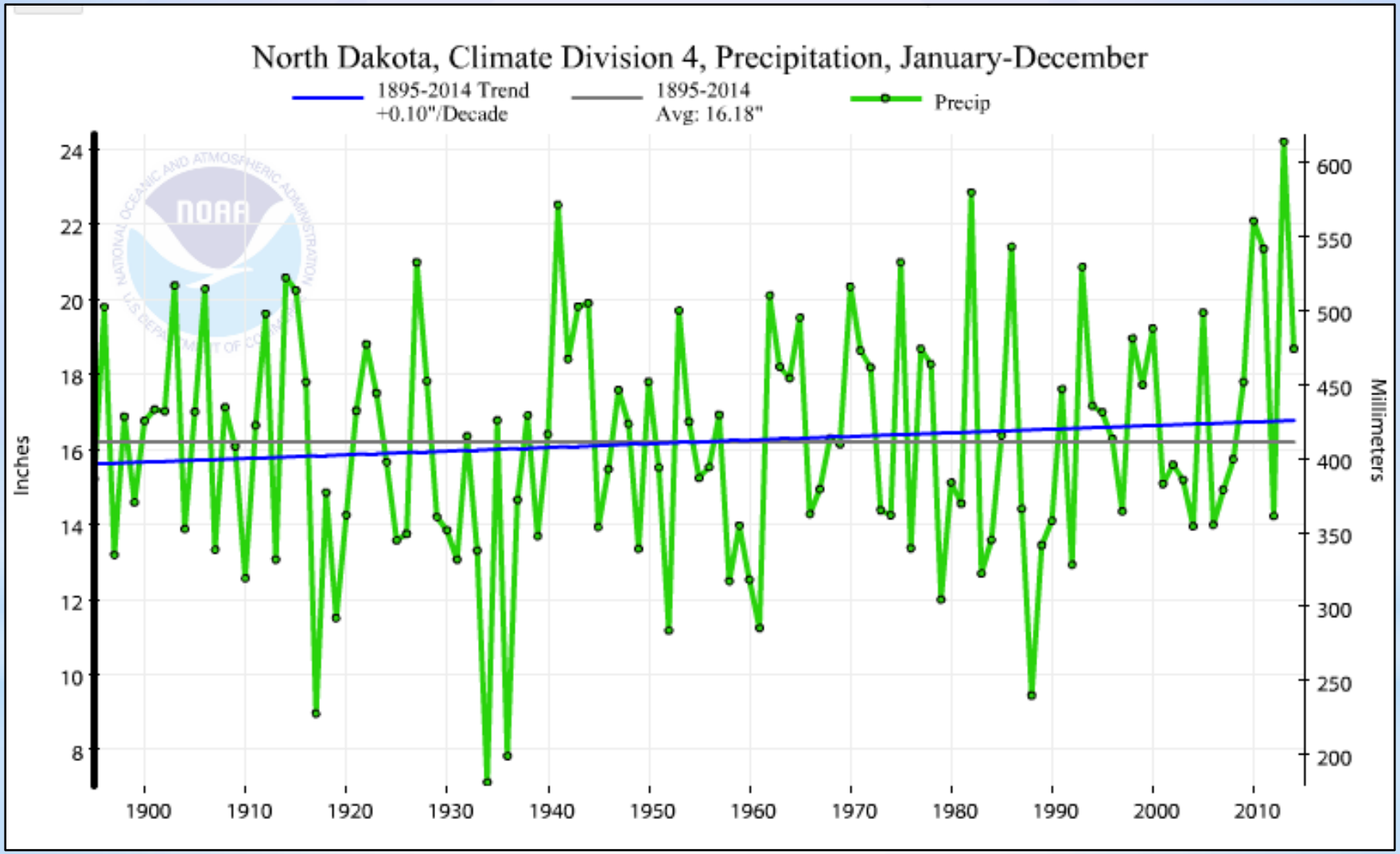
complete rest from grazing and elimination of fire are two major contributors to this transition

A threshold may exist when Kentucky bluegrass exceeds 30% of the plant community and native grasses comprise < 40% of the composition

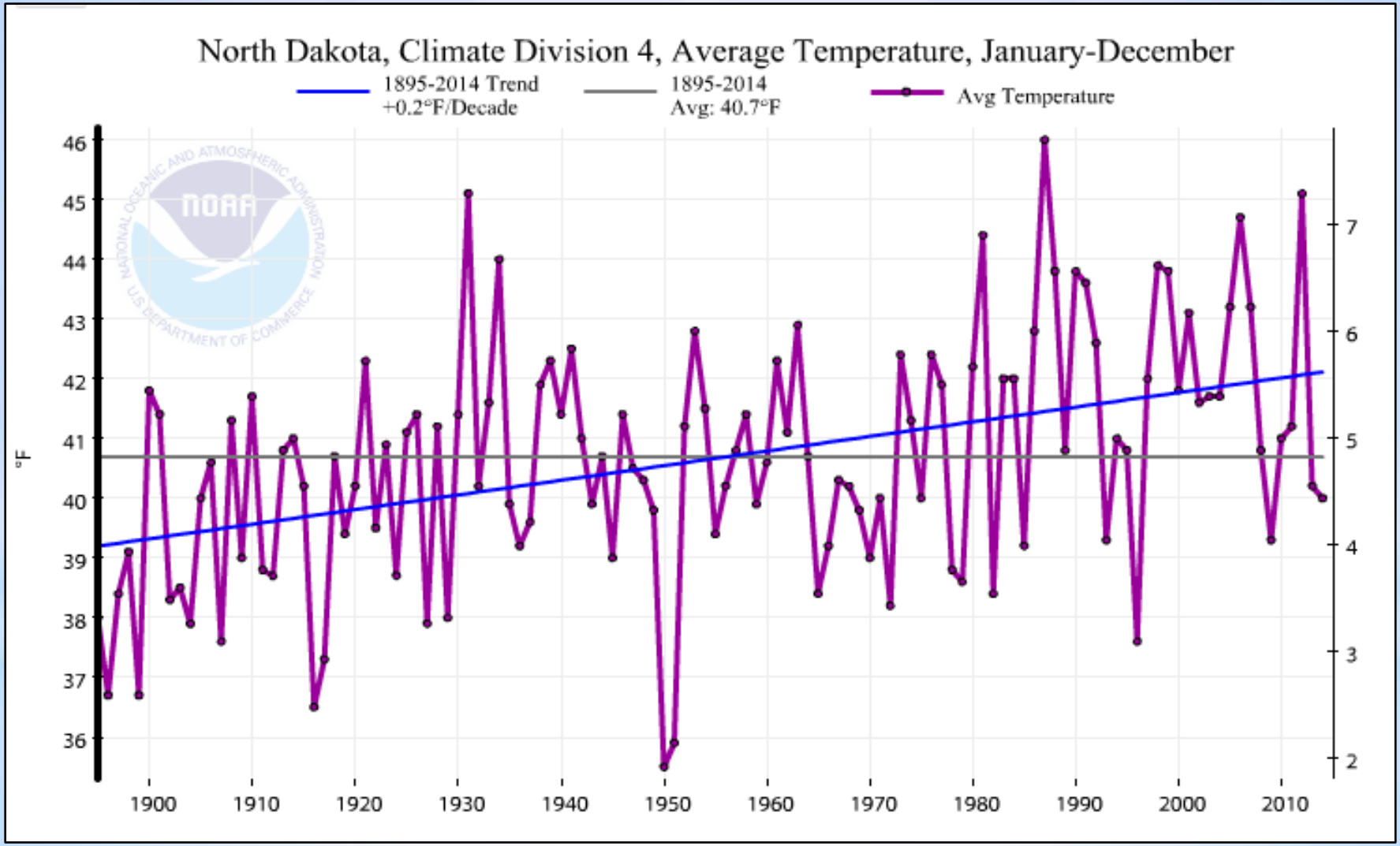

Managed Native Grassland Reference Areas
Have become dominated with Kentucky Bluegrass

Why are invasive species becoming more prevalent?

NOAA Precipitation, 1895 -2014



NOAA Temperature, 1895-2014



Conclusion:

Invasive grass species appear to be more than just a management issue.

How should invasive grass species be dealt with when determining reclamation success?

References:

David Toledo et. al, Extent of Kentucky Bluegrass and Its Effect on Native Plant Species Diversity and Ecosystem Services in the Northern Great Plains of the United States. (Invasive Plant Science and Management, 2014 7:543-552

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NOAA Climate at a Glance: http://www.ncdc.noaa.gov/cag/

Dekeyser: http://www.wssajournals.org/doi/10.1614/IPSM-D-14-00069.1

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