Investigating Sagebrush Reclamation Success for Bentonite Mined Areas in the Big Horn Basin, WY

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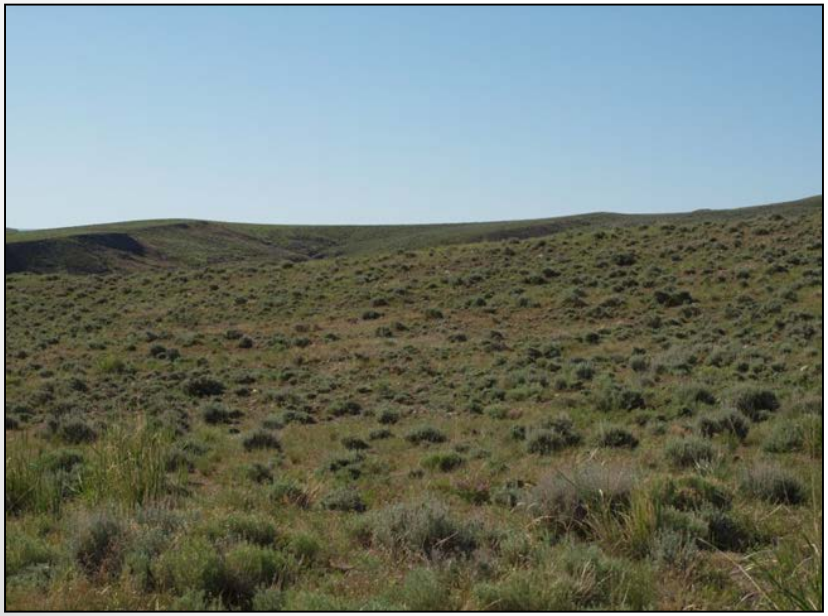
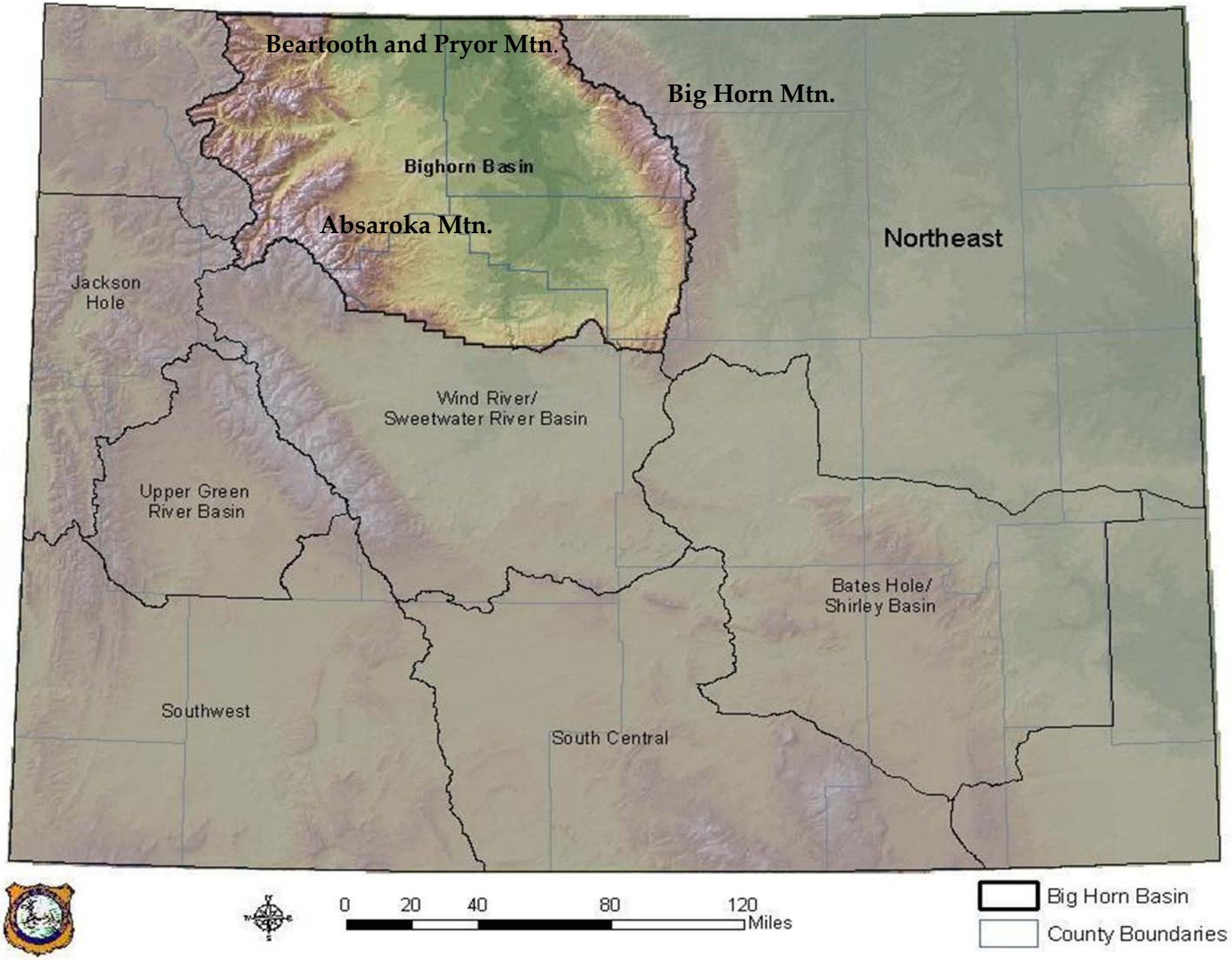
Study Objective

To determine if current and past reclamation techniques are reestablishing sagebrush communities on reclaimed bentonite mined lands in the Big Horn Basin of Wyoming




Beartooth and Pryor Mtn.
Big Horn Mtn.
Bighorn Basin
Absaroka Mtn.
Northeast
Jackson Hole
Wind River/ Sweetwater River Basin
Upper Green River Basin
Bates Hole/ Shirley Basin
Southwest
South Central
0 20 40 80 120 Miles
Big Horn Basin
County Boundaries

Introduction

- Big Horn Basin
  - 12-25cm annual precipitation
  - Mixed desert shrub community
    - Big sagebrush, rabbitbrush, greasewood, perennial and annual grasses
- Land Use
  - Agriculture
    - Native seed production
  - Energy Development
  - Urban Developments and Recreation

Introduction (continued)

- Bentonite mining in the Big Horn Basin since the early 1930's
- Approximately 8498 hectares disturbed
  - 5269 hectares reclaimed (Environmental Assessment 2012)
- Bentonite uses:
  - Drilling fluids
  - Sealant
  - Cat litter

Introduction (continued)

- Historically, reclamation efforts to establish shrub stands similar to pre-disturbed sagebrush (*Artemisia tridentata*) plant communities have been limited
  - Absence of shrub regulatory standards
  - Poor response of sagebrush to reclamation efforts
  - Planting sagebrush in areas that supported a salt-shrub type community prior to mining
  - Limited available water and high clay content in soils

- Resulted in very little sagebrush being reestablished on reclaimed bentonite mined lands

Facts about sagebrush

- Xeric upland species
  - Setting seed only in wet years
- Typical seed size is around 1.0mm X 0.7mm
- 1 meter crown with about 450 flowering branches can produce around 1,000,000 seeds
  - Dispersed primarily by gravity, very limited dispersal
- Seedlings can be susceptible to frost damage, drought and disease
- Sagebrush require a pH range of 6-8.2 and a EC range of 0-8000 µS/cm

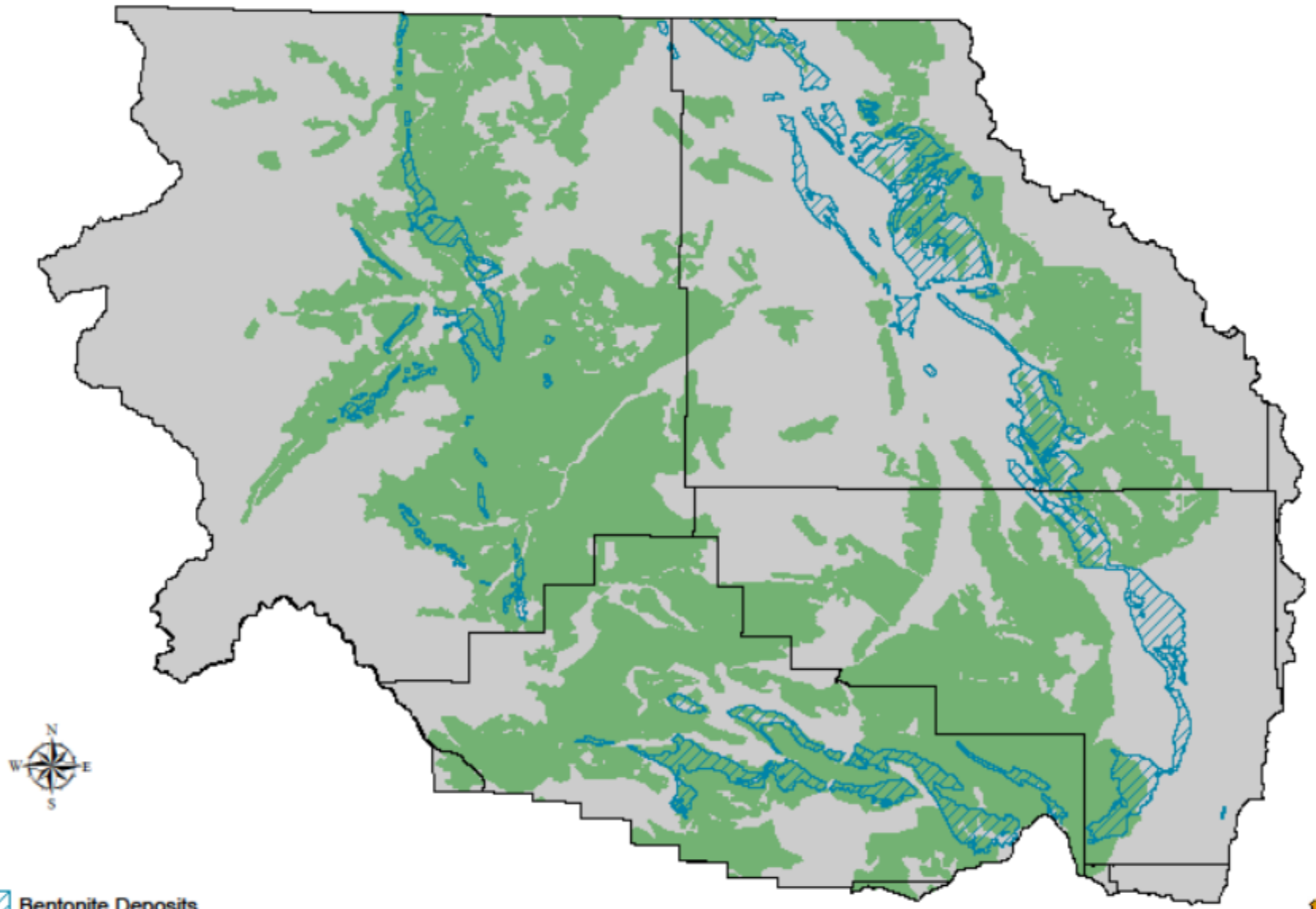
Impacts on Sage Grouse

- The lack of suitable shrub cover is believed to have a negative effect on sagebrush obligate species, such as the greater sage-grouse (*Centrocercus urophasianus*) (Hagen et al. 2007)
  - Reduced habitat. (Breeding, brood-rearing and winter habitat)

- Connelly et al. 2000 lays out heights and canopy cover requirements for sage grouse survival

Arid Sites	**Breeding**		**Brood-rearing**		**Winter**	
	Height(cm)	Canopy Cover(%)	Height(cm)	Canopy Cover(%)	Height(cm)	Canopy Cover(%)
Sagebrush	**30-80**	**15-25**	**40-80**	**10-25**	**25-35**	**10-30**

Bentonite Deposits and Sagebrush Distribution Within the Big Horn Working Group



Nyssa Whitford
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Conventional Reclamation Techniques

- Similar to other surface mining techniques
- Bentonite pits are generally shallow
  - 15m deep and are approximately 1-8 hectares
- Scrappers and bulldozers remove the topsoil and stockpiled
- Overburden is then removed and put in a separate pile
- Desirable material is removed
- Pit is backfilled
- Topsoil replaced
- Graded and the reseeded with desired seed mix

Methods

- Sites located around Thermopolis, Greybull and Lovell, Wyoming
- Site selection
  - Study sites on reclaimed mined lands
  - Based on shrub types communities (> 1% shrub cover)
  - Native undisturbed reference sites located directly adjacent to each reclaimed site
- Originally visited 85 sites
- 35 potential study sites
  - Sites with <1% sagebrush canopy cover were considered failed reclamation sites and therefore excluded from this study
  - 11 sites found to have > 1% sagebrush canopy cover

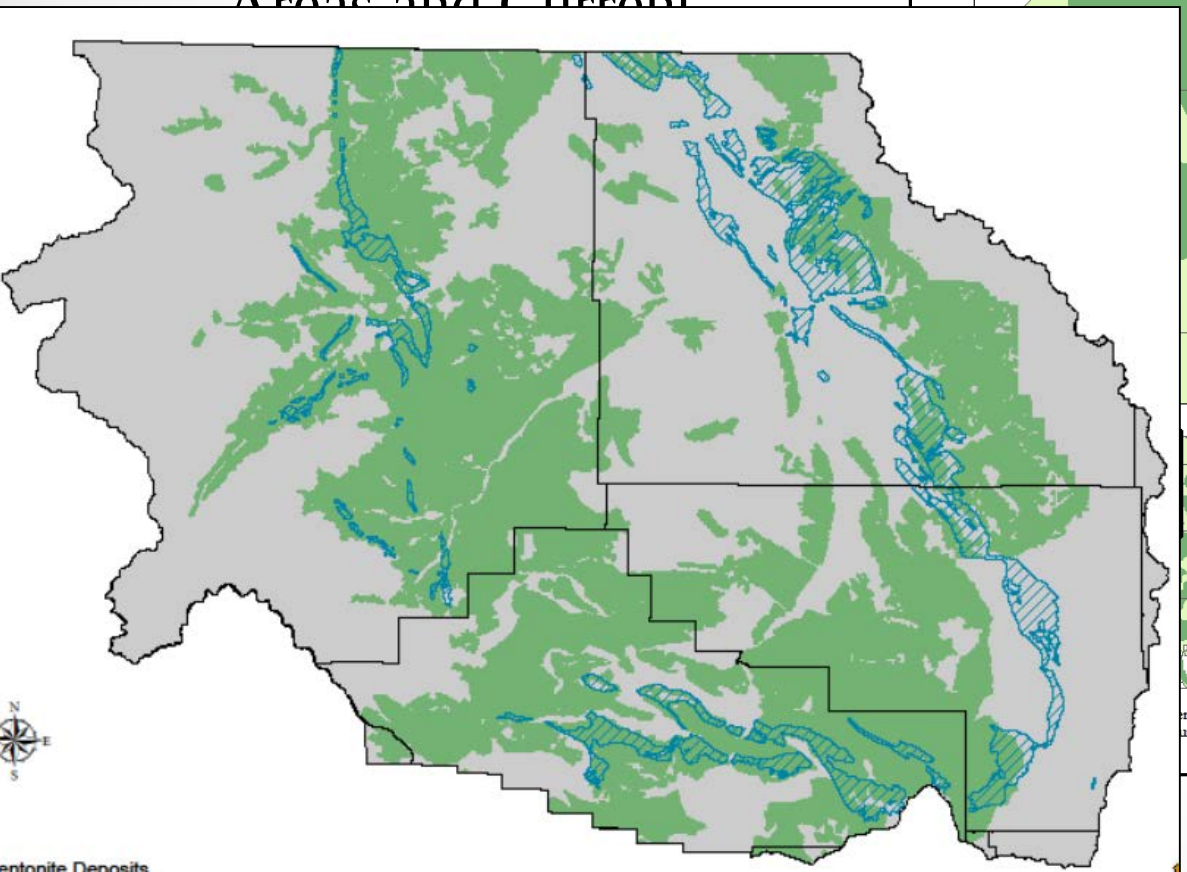
Study Sites Seeded with Sagebrush Seed

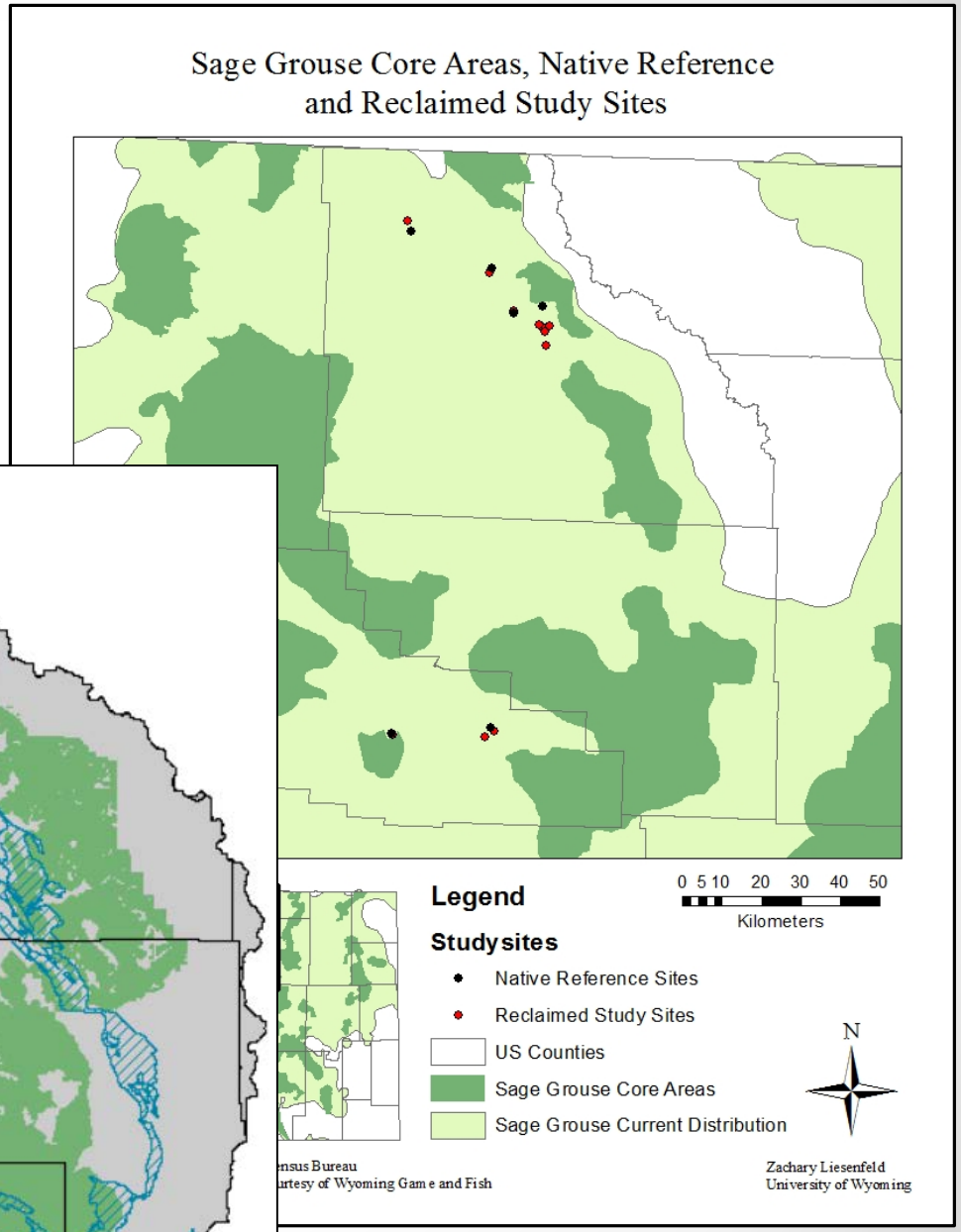
- Five sites without sagebrush seed in the mix
  - Older sites (15-30 years)
- Six sites with sagebrush in the mix
  - Younger sites (2-15 years)

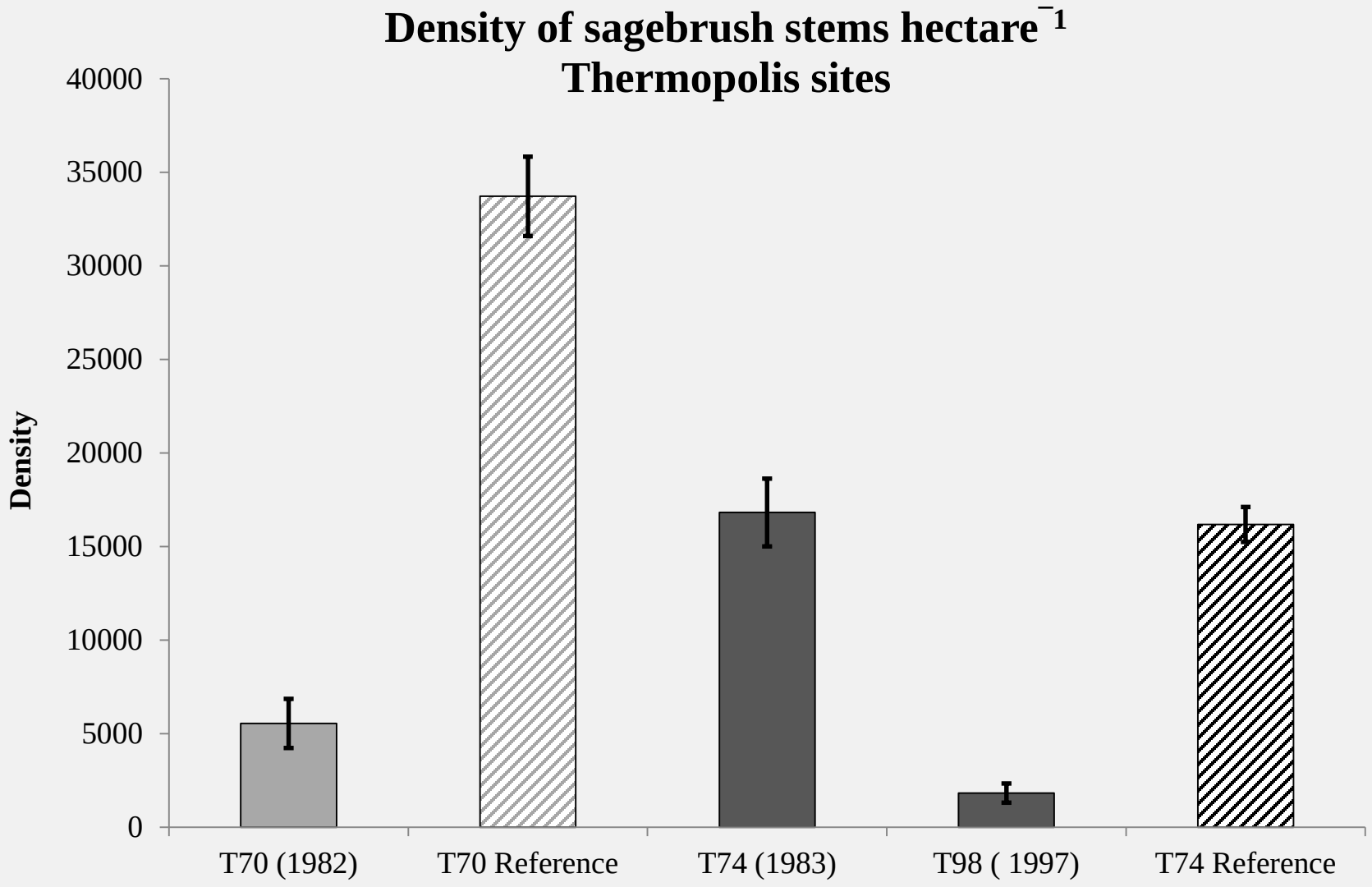
Sagebrush Site Seeding and Dates on Reclaimed Mined Lands			
WY Location	Site Names	Date Reclaimed	Sagebrush seed in mix
Greybull	Flitner	1981	-
Thermopolis	T70	1982	-
Greybull	Dump Area	1983	-
Greybull	Old Dam	1983	-
Thermopolis	T74	1983	-
Greybull	134	1993	+
Thermopolis	98T	1997	+
Lovell	LD29	2004	+
Greybull	Beaver Rim	2005	+
Lovell	Animal-Joy	2008	+
Greybull	Hinkley	2009	+

Study Sites within the Bighorn Basin, WY

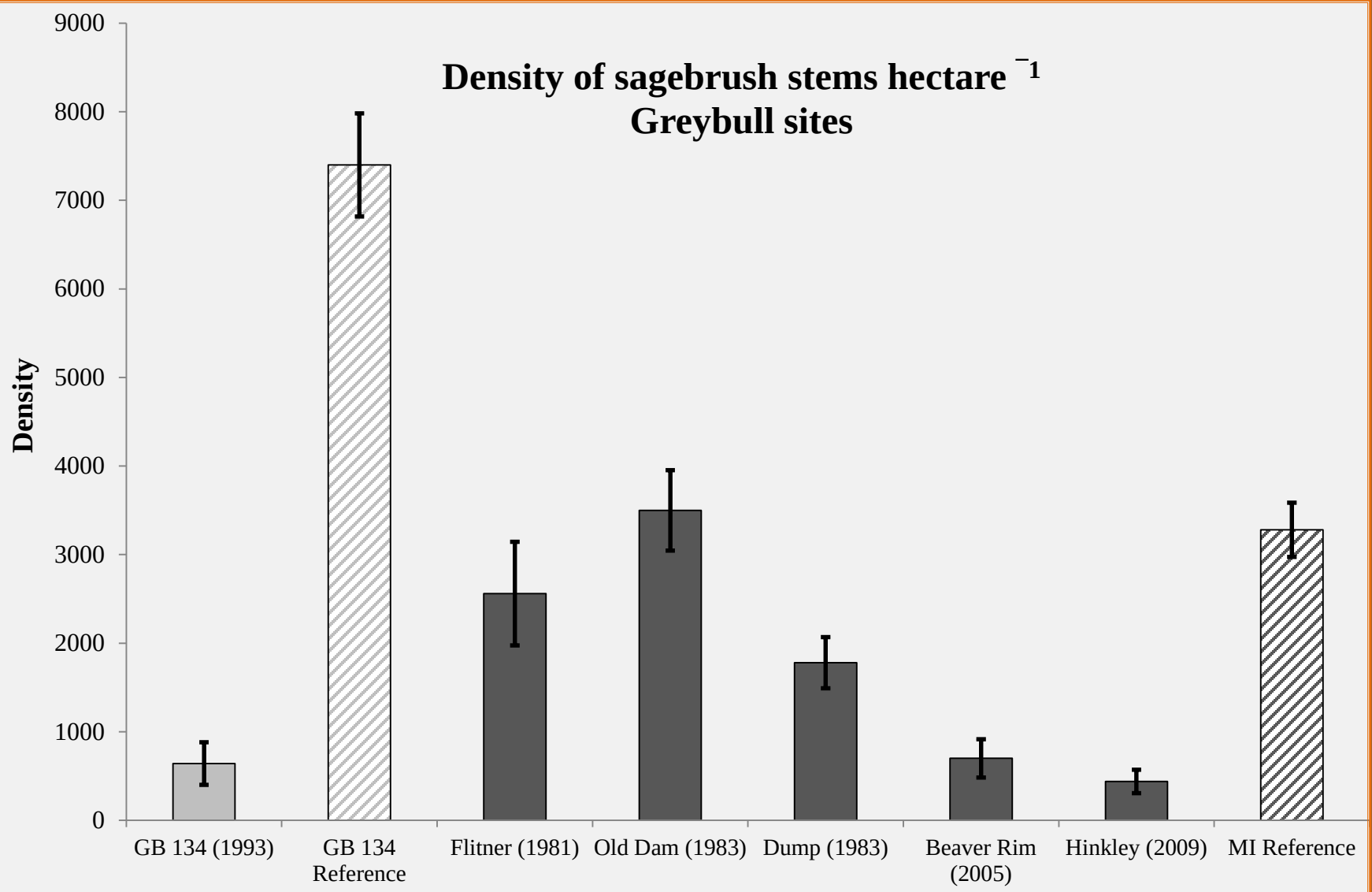
- Sage Grouse Core Areas and Current







Solid Bars-Reclaimed Sites
Slashed Bars-Reference Sites



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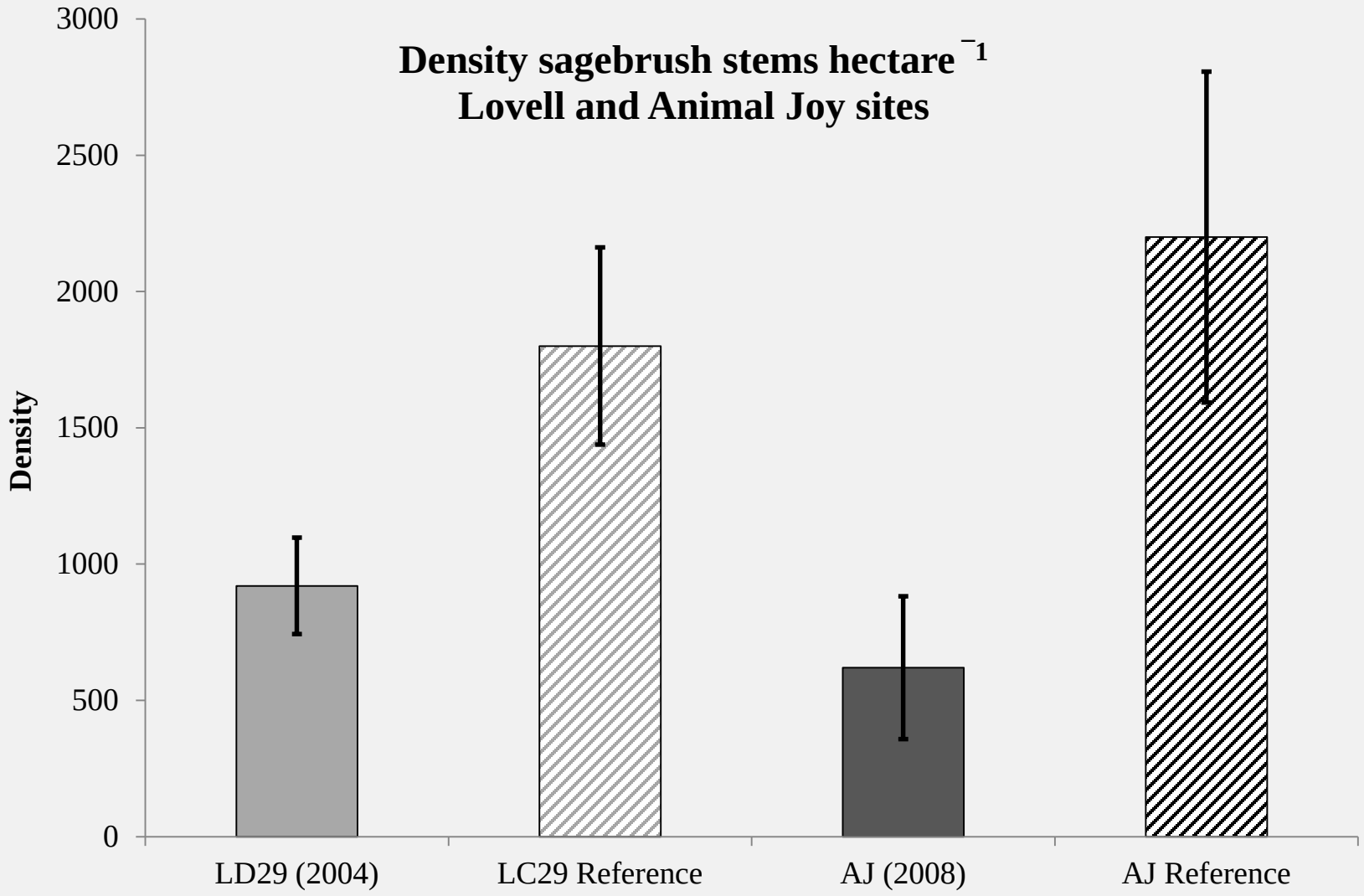


Solid Bars-Reclaimed sites
Slashed Bars-Reference sites

Soil Samples

- Failed to find any relation between soil quality and sagebrush density

- pH and EC within the 6-8.2 pH and 0-8000 µS/cm requirements for sagebrush growth

Greybull, Thermopolis and Lovell Sites

- Findings similar to across the Basin
  - Older sites having greater amounts of sagebrush
  - Younger sites having less amounts of sagebrush
- Older sites were NOT seeded with sagebrush seed
- Younger site WERE seeded with sagebrush seed

Conclusions

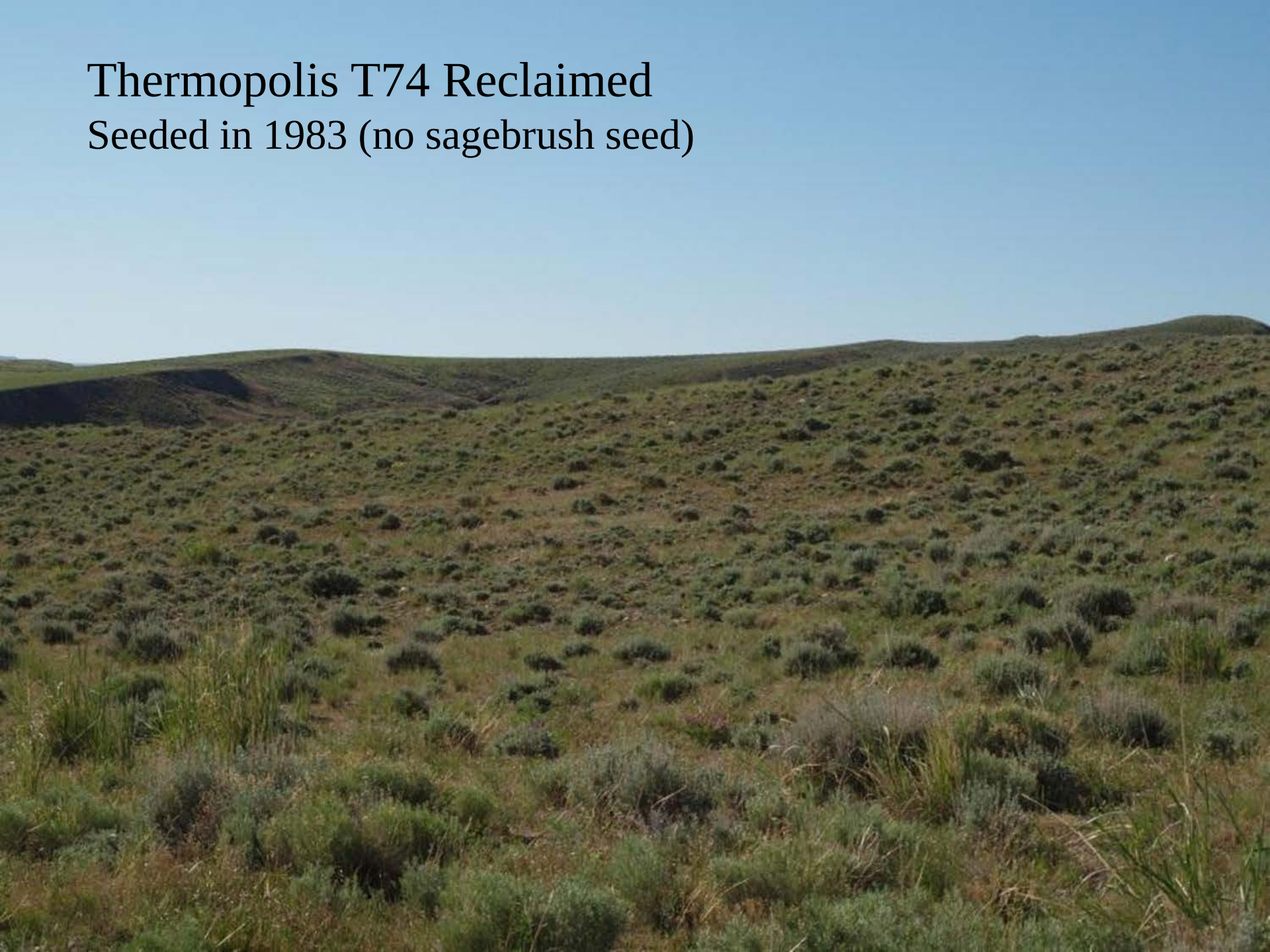
- Current and past reclamation techniques are not reestablishing sagebrush communities on reclaimed bentonite mined lands in the Big Horn Basin
- Historical reclamation practices have in some cases have created conditions that are favorable for reestablishment of sagebrush over time
- Recovering sites are experiencing natural recruitment

Conclusions

- Sagebrush reestablishment and growth are limited on younger reclaimed bentonite pits
  - Competition with exotic invasives, limited resources, poor topsoil
- Rates of sagebrush recovery (stem density and cover) appear to be similar on older sites reclaimed without sagebrush seed to the younger sites reclaimed with sagebrush seed!!!!
- Re-colonization of bentonite mine pits by natural recruitment sagebrush is a slow process (> 20 years) when conditions are favorable

Thermopolis T74 Reclaimed

Seeded in 1983 (no sagebrush seed)



Sage grouse hen and chicks on reclamation

Greybull Old Dam Reclaimed

Seeding date 1983 (no sagebrush seed)


Greybull 134 Reclaimed
Seeded with sagebrush 1993

SamplePoint Analysis

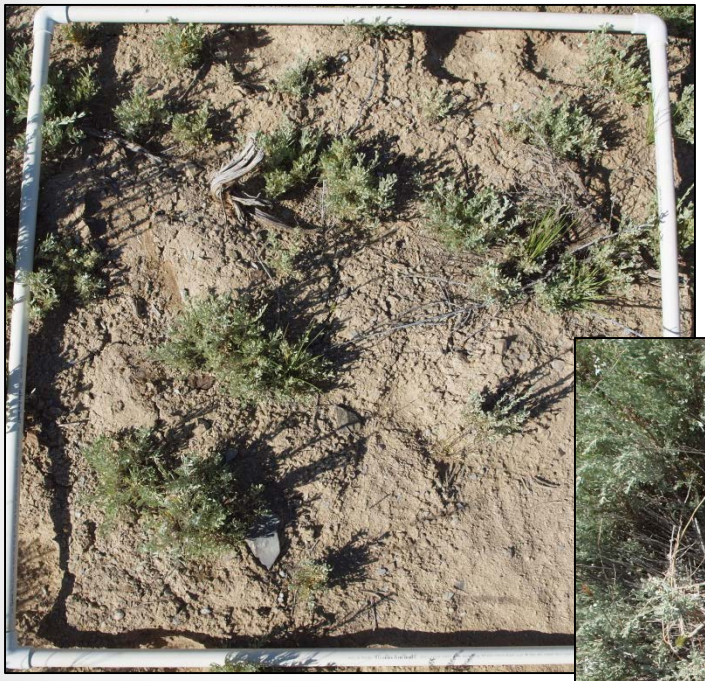
- Looked at sagebrush seeding trials
  - Zeba coated seed
  - Mycorrhizal inoculant
    - Arbuscular Mycorrhizal
  - Supplemental watering
    - Irrigated transplants
  - Gel-packs
  - Mature transplants

Zeba coated seed onto bare soil

Container grow seedling with a gel-pack watering supplement

SamplePoint Analysis

Hand seeded sagebrush seed onto snow banks



Sagebrush seed and jute netting

Mature transplant

Management Implications

- Site specific seed sources
  - Genetically adapted
- Proper seed bed preparation
- Proper seeding times
  - Precipitation events
- Used to develop islands of sagebrush within a disturbed area
  - Facilitating natural re-colonization
- Use multiple seeding methods to customize a reestablishment strategy and maximize survival rates


Questions?