Effects of Salvage Logging on Elk Habitat During the First 3-years

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foothills MODEL FOREST
research growing into practice

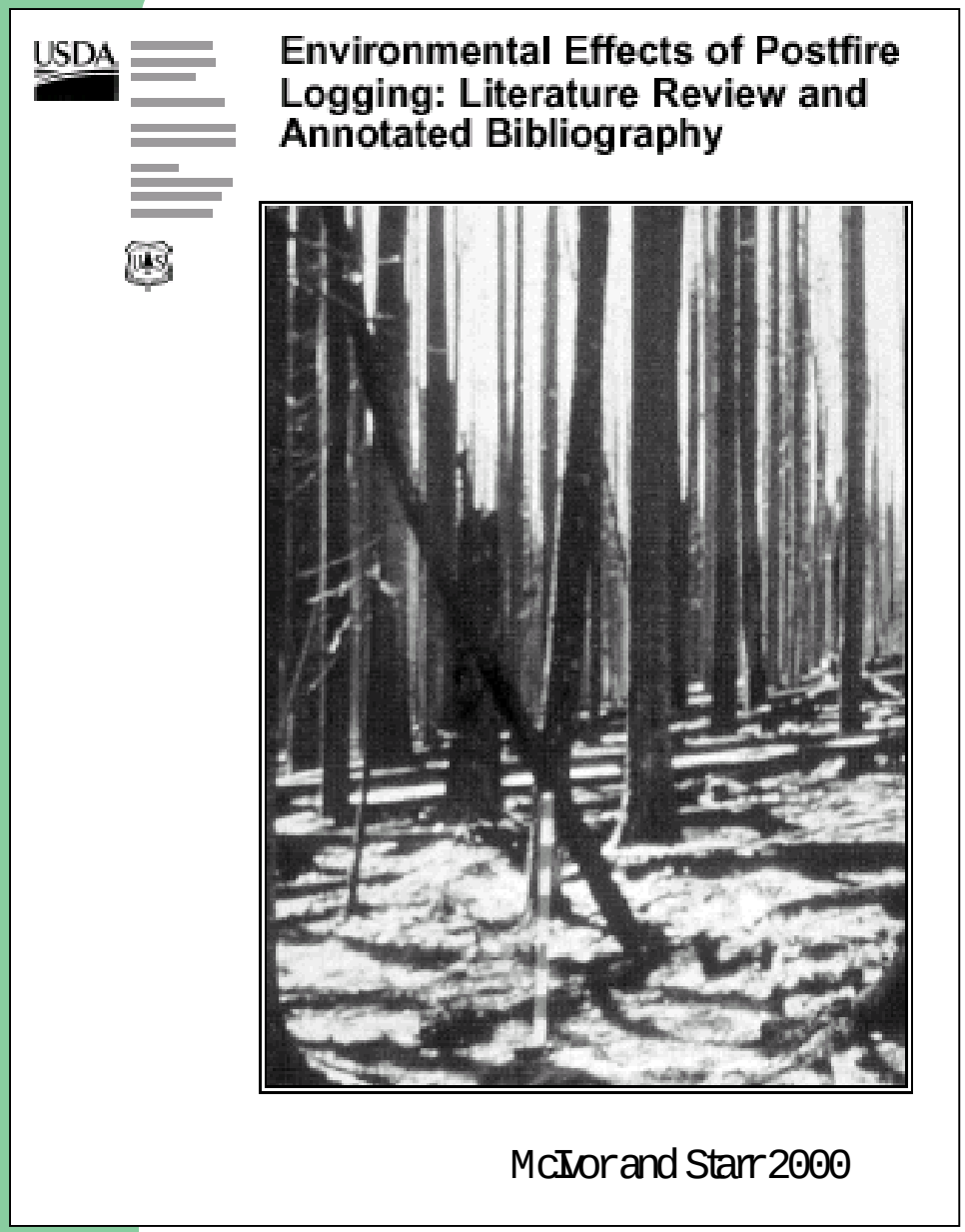
Introduction

- Fire a dominant disturbance for terrestrial wildlife
- Effects of fire vary with species life-history (Smith 2000)
- Climate change will likely increase fire frequency and fire season in Canada (Gillet 2004, Brown 2004)
- Demands for Post-Fire Harvest will be increasingly common (Beschta et al. 2004)

Salvage Logging

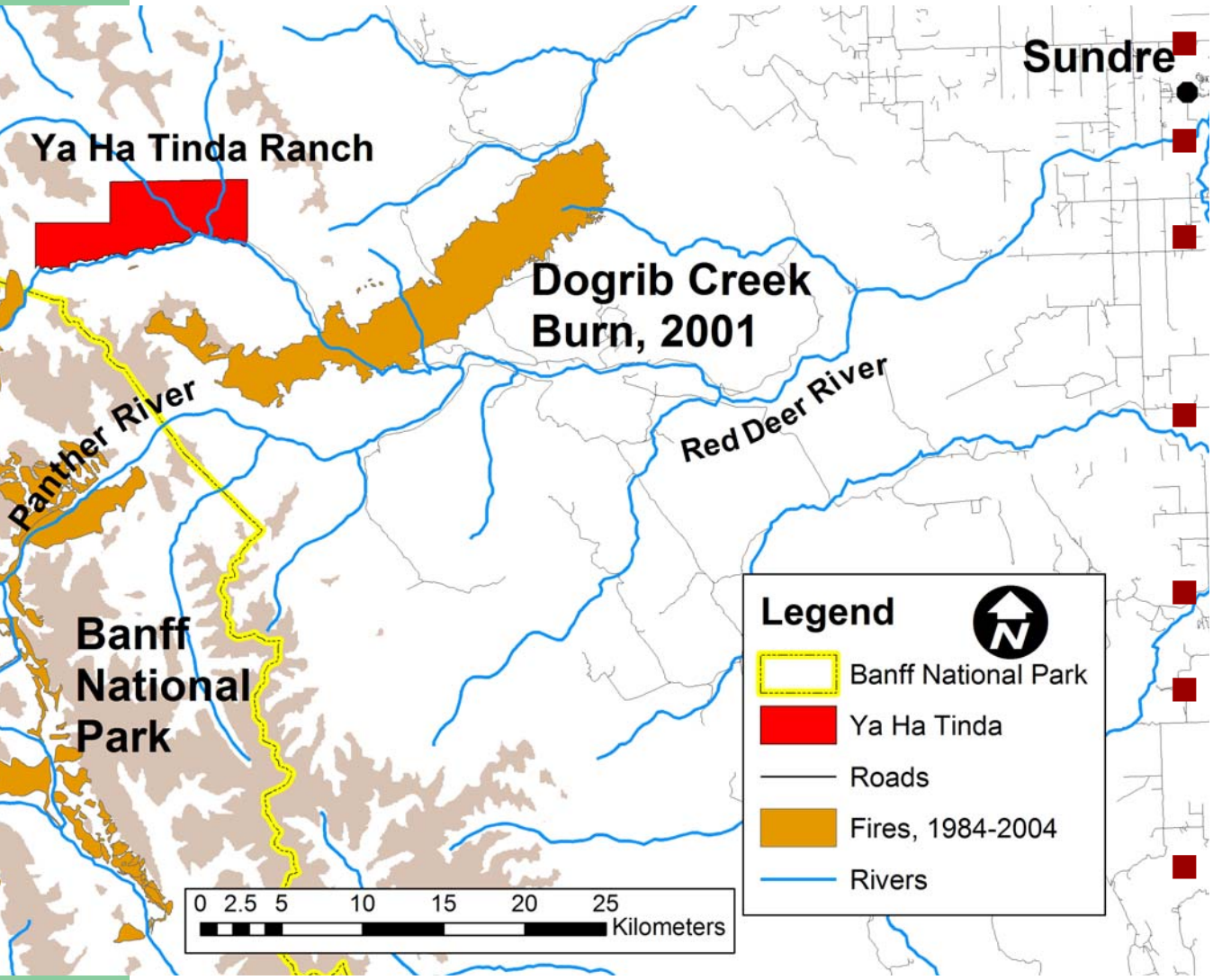
- Few studies of effects of salvage logging on wildlife
- Obligate snag-dependent species negatively affected by salvage (e.g. woodpeckers)
- Little known about effects of salvage logging on other wildlife species
- Ungulates important wildlife species, influenced by salvage logging?

Salvage Logging and Ungulates



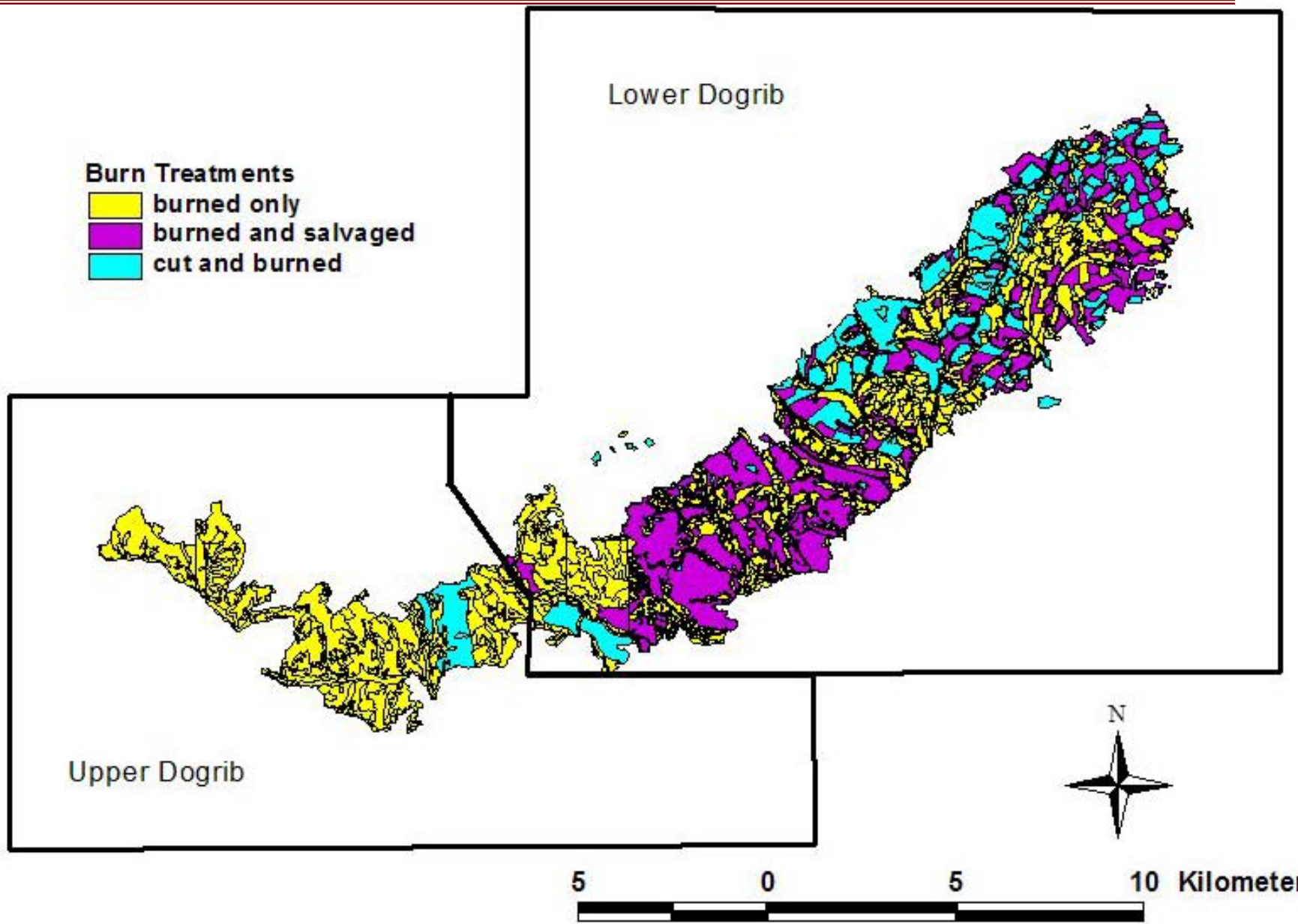
- Post-Fire Logging
- Few studies on ungulates, 0 in Alberta
- Post-fire logging can affect Biomass, species, quality, etc..
- Little research
- 2001 Dogrib Fire
- Burned, Salvaged, and Cut and Burned

Dogrib Fire and Elk



- Dogrib Fire
- Ya Ha Tinda
- Provinces largest elk herd
- Recreation area
- Transboundary
- Regional role of Fire
- Dogrib Salvage Logging

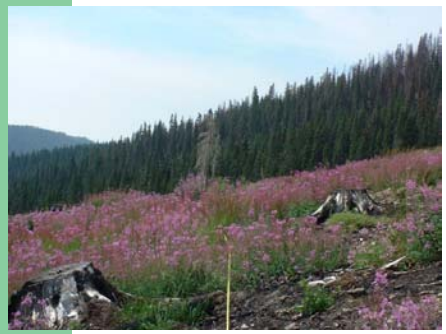
Dogrib Fire


Lower Dogrib
Burn Treatments
burned only
burned and salvaged
cut and burned
Upper Dogrib
N
5
0
5
10 Kilometers

Dogrib Fire Research Objectives

Salvaged

Burned



Cut then Burned

Compare salvaged, burned, and cut and burned treatments for:

1. Forage dynamics (biomass, species, diversity)
2. Ground cover, growing temperature
3. Conifer Regeneration
4. Elk diet and resource selection

Forage Dynamics

During first 3-years post burn, we compared

a) Cut and Burned (salvaged)

b) Burned forest

During just 2003, we compared

a) Cut and Burned (Salvaged)

b) Burned

c) Burned and Cut

Dependent Variables

1) Elk Forage Biomass

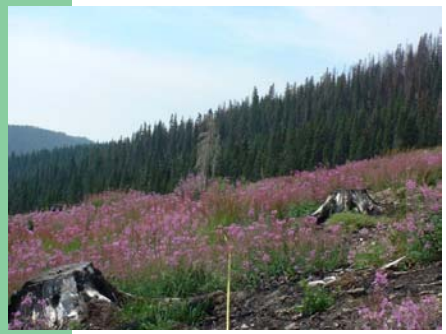
2) Plant species diversity, richness, evenness

3) Ground cover

Forage Sampling Design

Salvaged

Burned



Cut then Burned

Stratified Random Design for

a) *Treatment type (C&B –2003)*

b) *Fire severity (high, low)*

c) *Slope (flat, steep)*

d) *Aspect (north, south)*

- *~ Repeat Sampling*
- *Annual variance reallocation*
- *Coverage Problems*

Methods: Forage

Collected Forage data on

- Total herbaceous biomass (g/m^2) – graminoid, forb.

  - Measured directly

2. Shrub biomass (g/m^2) –

   - Measured indirectly

3. Species composition

   - Diversity, Evenness, # of species

4. Ungulate Pellets

Methods: Temperatures

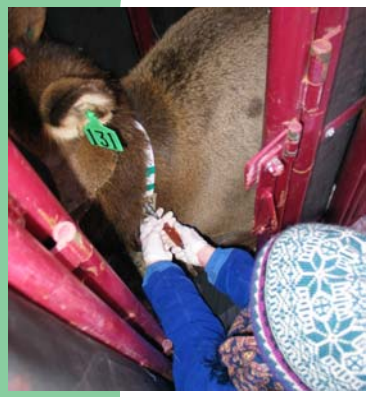
- iBUTTON passive thermisters
- 25 salvage, 25 burned
- July 1 to Oct 1, 2003
- Soil surface temperature
- Summer, Fall Seasons
- Growing Degree Days (GDD), Min, Max, Range
- Blue Hill Tower Station

Methods: Conifer Regeneration

- Sundre Forest Products Regeneration Surveys
- Fall/Spring 2003/04
- Stratified by stand, treatment
- n>3,000 plots
- # conifers/10m^2

Sundre Forest Products
A division of West Fraser Mills Ltd.

Methods: Elk Resource Selection

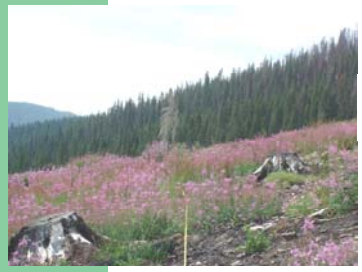


- Radiocollar 110 elk - VHF, 30 - GPS
- Adult female elk *from Ya Ha Tinda*
- Elk Diet – fecal fragment analysis
- VHF and GPS telemetry for resource selection, timing, trends
- Elk Pellet counts – elk, moose, deer across entire burn.

Statistical Analyses: Forage

Salvaged

Burned



Cut then Burned

1) Year*Treatment ANCOVA (Salvage, Burned)
2) 2003-Treatment ANCOVA (S, B, Cut & Burned)

Dependent variables

Total, Forb, Graminoid, Shrub - *ln(g/m^2)*

Diversity, Evenness, Total # of Species

Temperature Variables, Ground cover

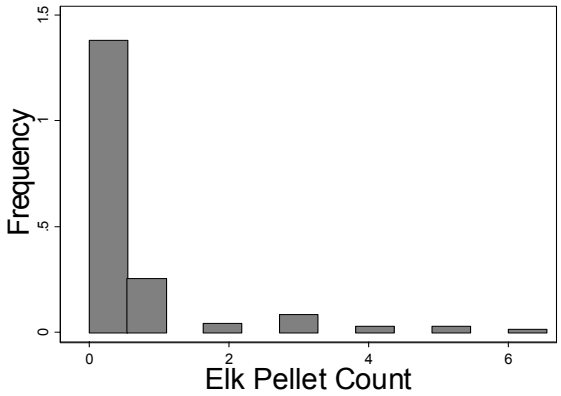
Independent Covariates (GIS)

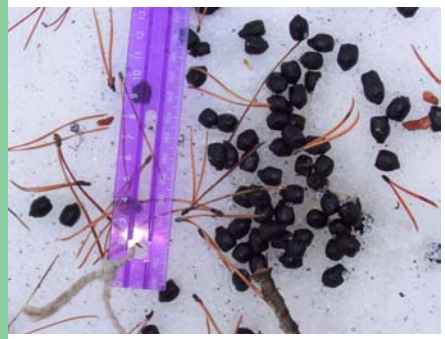
Aspect Class, Elevation, Slope Class, **Hillshade** (DEM),

Fire Severity, Distance to Low Severity Burn, Soil

Moisture Index

Statistical Analyses: II





Conifer and Pellet Counts

- Negative-binomial regression (NBREG) Statacorp (2004)

Conifer Analysis

- Treatment * Stand type
- Stand type (including Cut and Burned)

Pellet Analyses

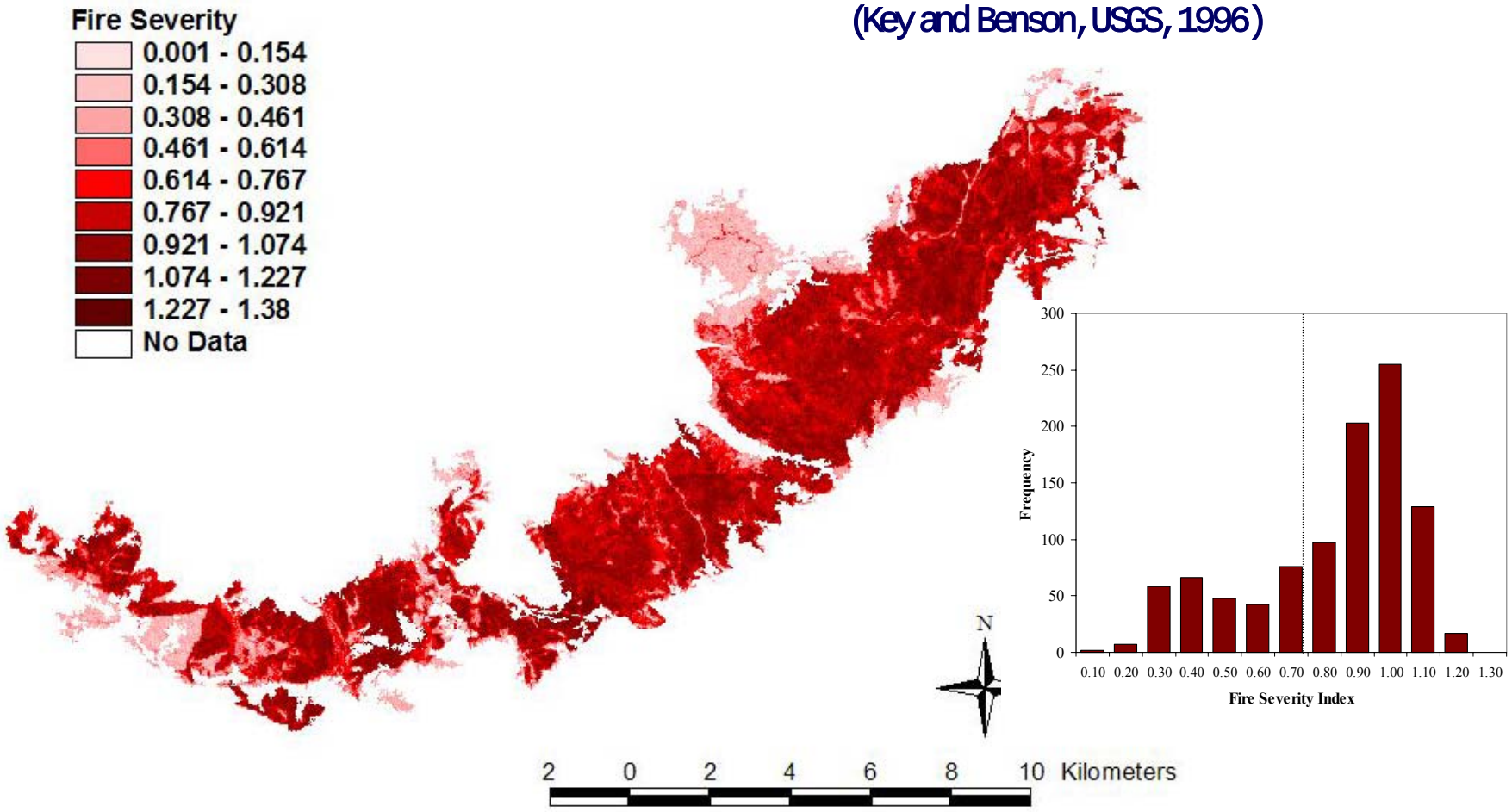
- Treatment

Same independent covariates

GIS Covariates: Fire Severity

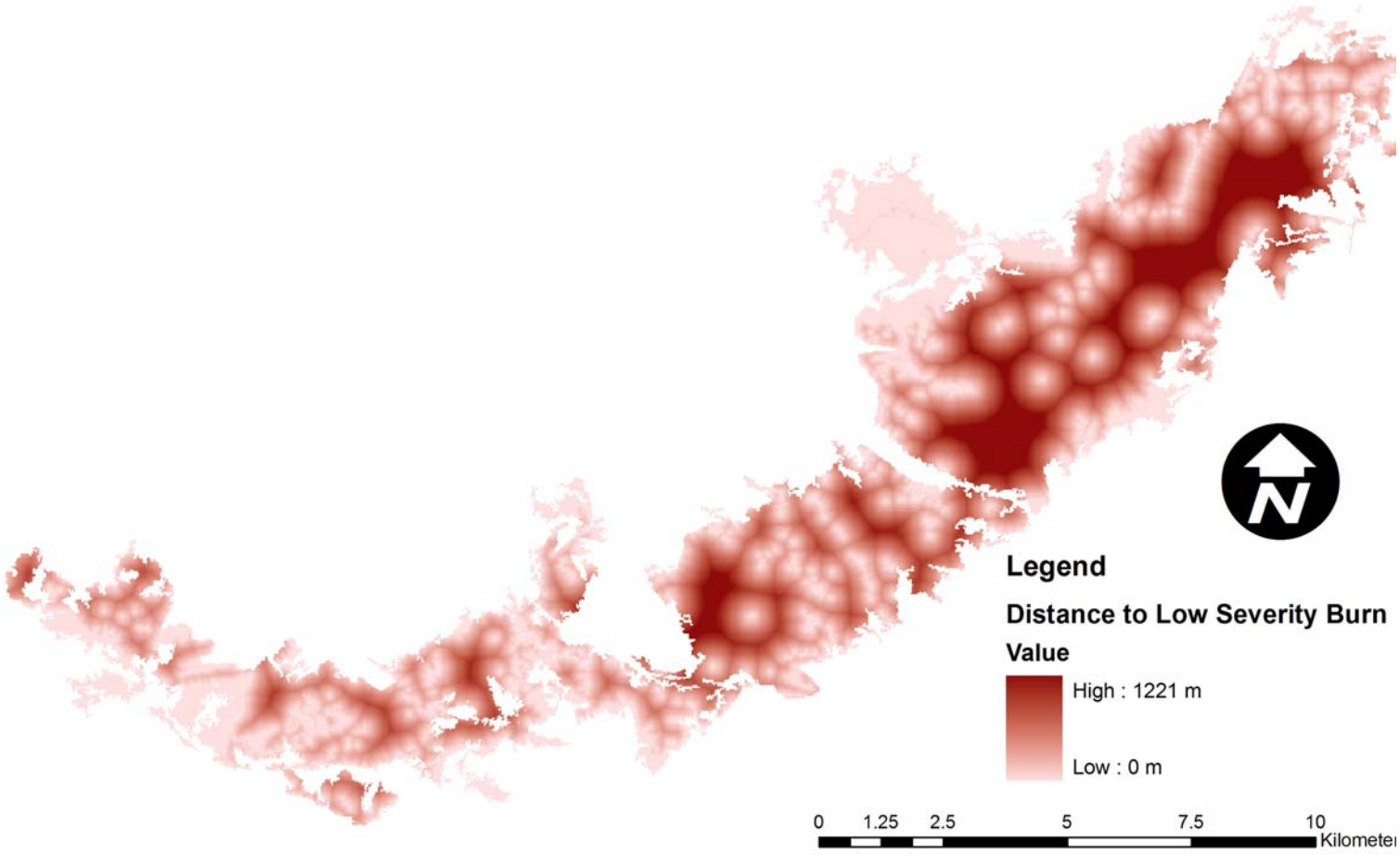
Normalized Burn Ratio calculated from pre- and post- burn LANDSAT TM Imagery

(Key and Benson, USGS, 1996)



Distance to Low Severity Burn

Low severity and unburned sites important seed sources for re-vegetation (Turner et al 1999, Turner et al 2004)



Elk Resource Selection

Animal = sample unit

VHF & GPS locations within Dogrib Burn

1. Seasonal use patterns
2. Yearly % of collared elk using Dogrib
3. Elk Resource Selection for 3 treatments

$$\beta_j = \ln\left(\frac{(u_{ij}/m_i)}{\sum_{i=1}^{n}(u_j/m_i)}\right)$$

where

b_j = the selectivity coefficient for treatment type j (burned, burned and cut, cut and burned),

u_{ii} = the # of locations for animal i=1 in treatment type j,

m_i = the # of radio telemetry locations for individual i, and

n = the # of radiocollared animals used in the sample

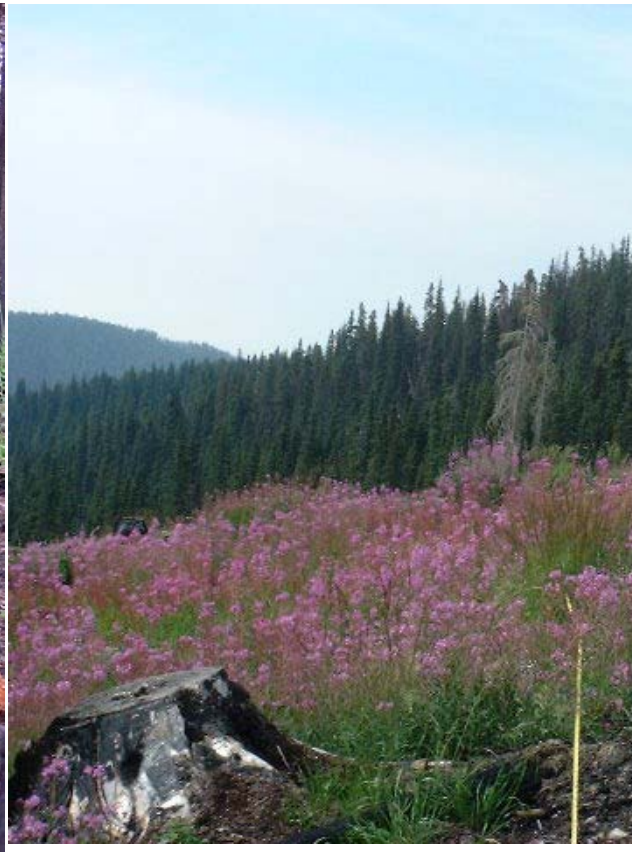
Results: Forage

	2002	2003	2004	Total
Salvaged	6	27	19	52
Burned	7	28	22	57
Cut and Burned		22		22
	13	77	41	132

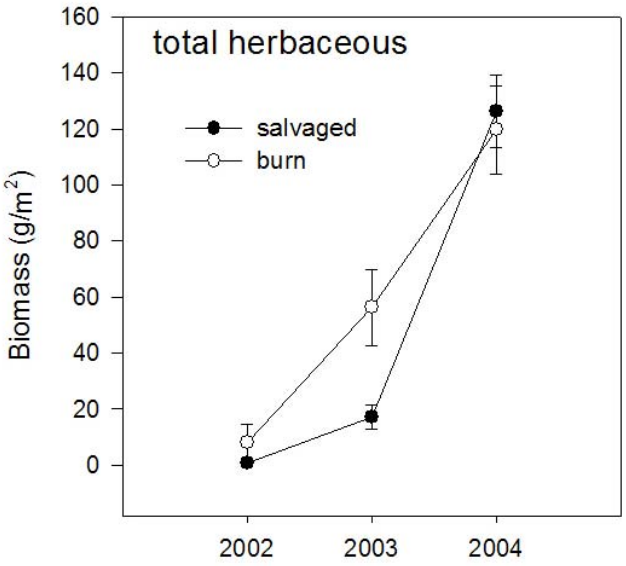
Salvaged

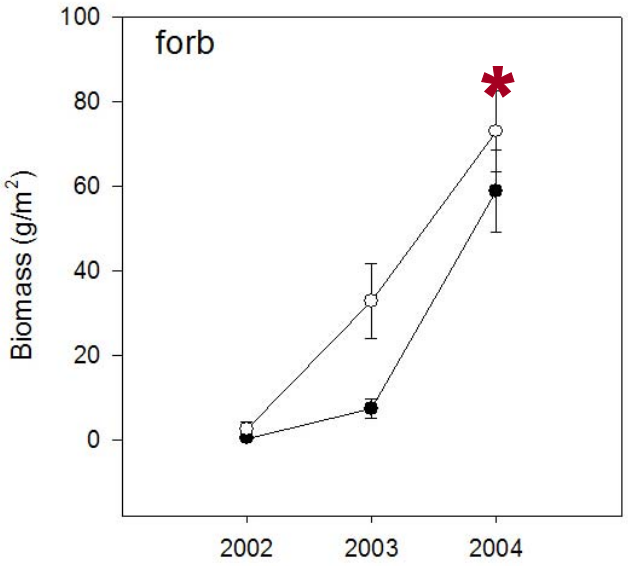
Burned

Cut then Burned



Results: Forage





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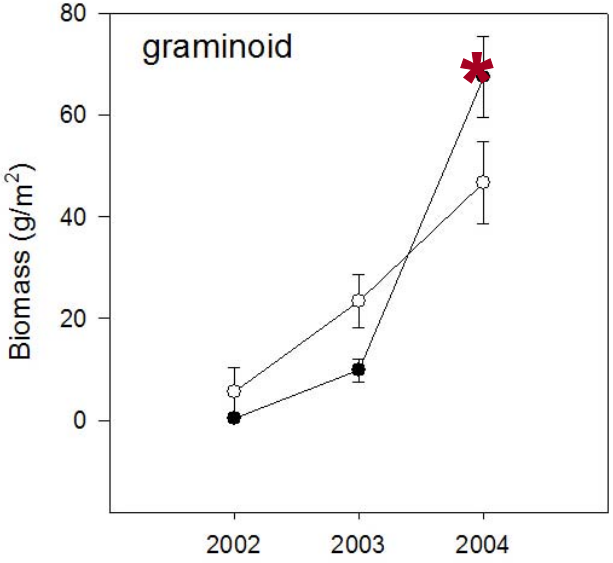
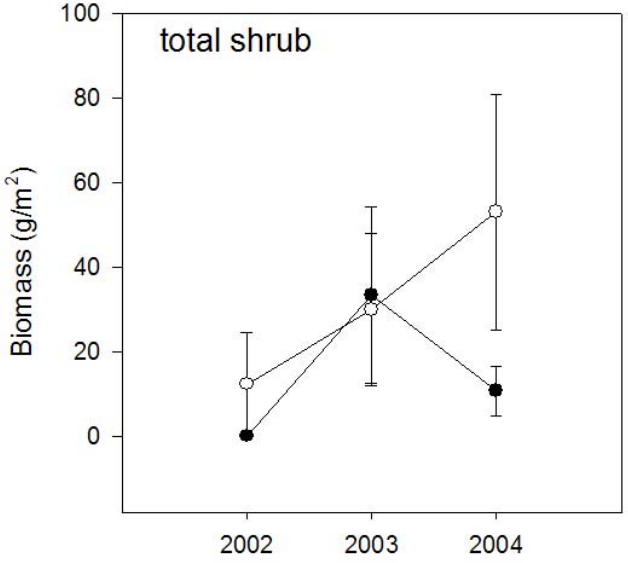
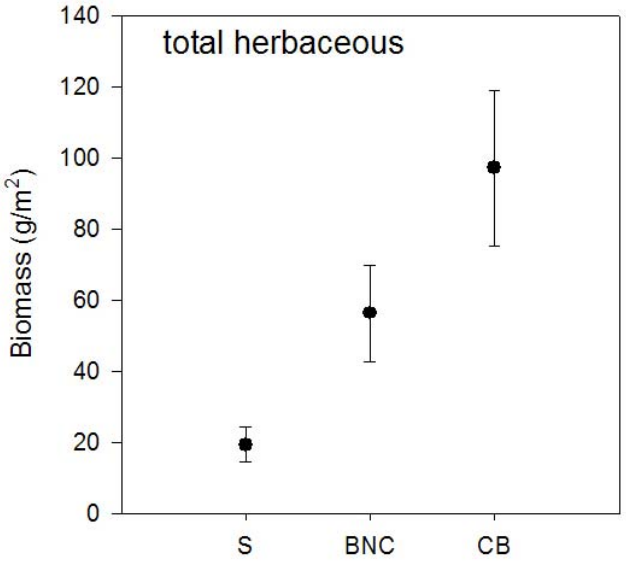
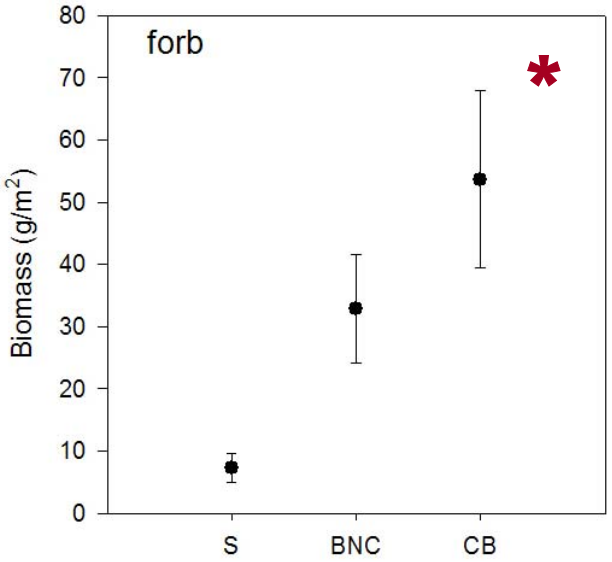
Salvage reduced biomass

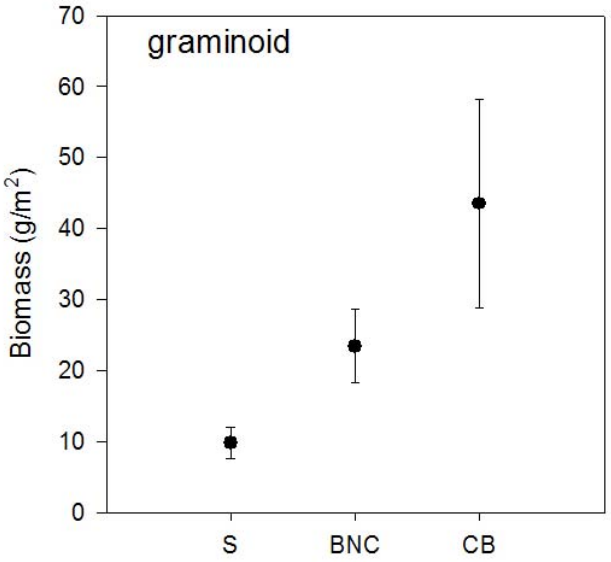


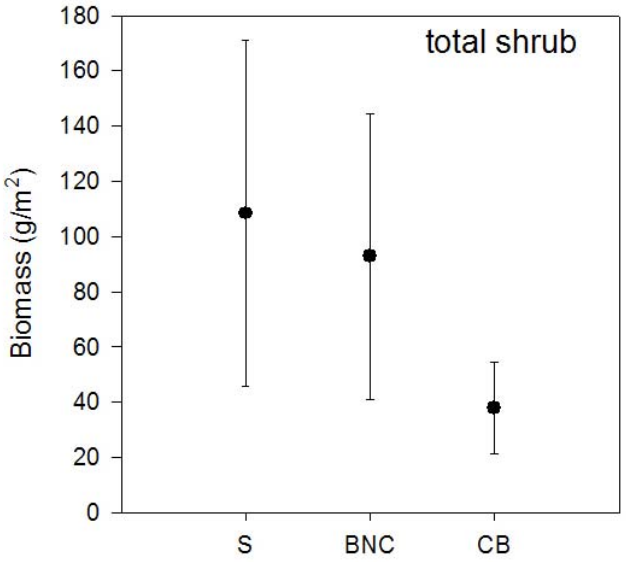


Results: Forage









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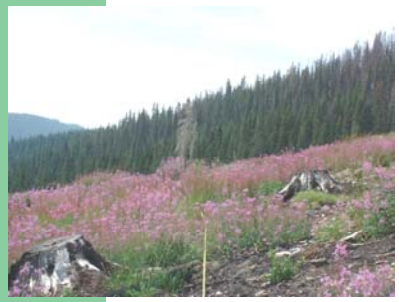
Salvage reduced biomass

Forage Biomass

Salvaged

Burned



Cut then Burned

TREATMENT*YEAR

- Forb biomass reduced in Salvage

- Grass biomass reduced in Salvage during first 2 years, not by 3-year

- Shrub biomass variable

2003-YEAR

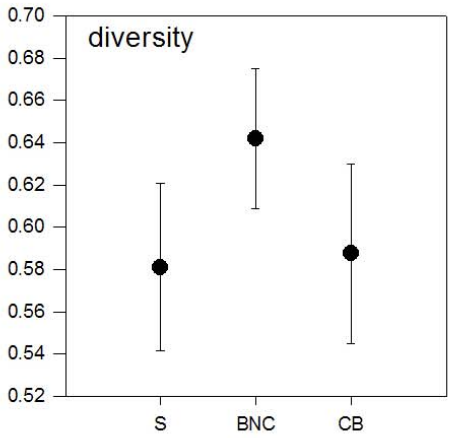
- Forb biomass reduced in Salvage

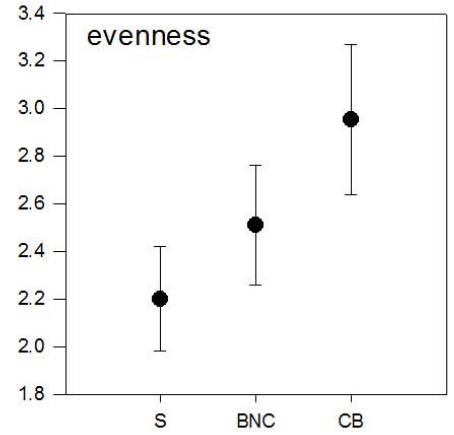
- Fire severity reduced total & grass g/m^2

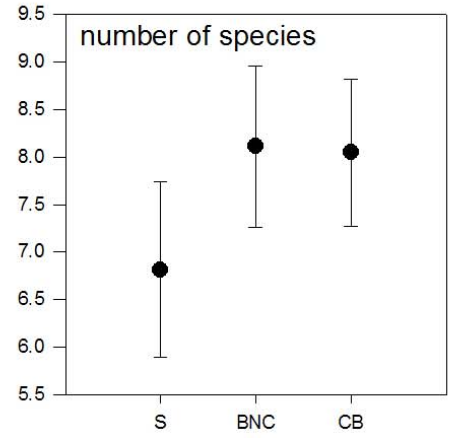
Results: Forage

Salvage had weak effects on

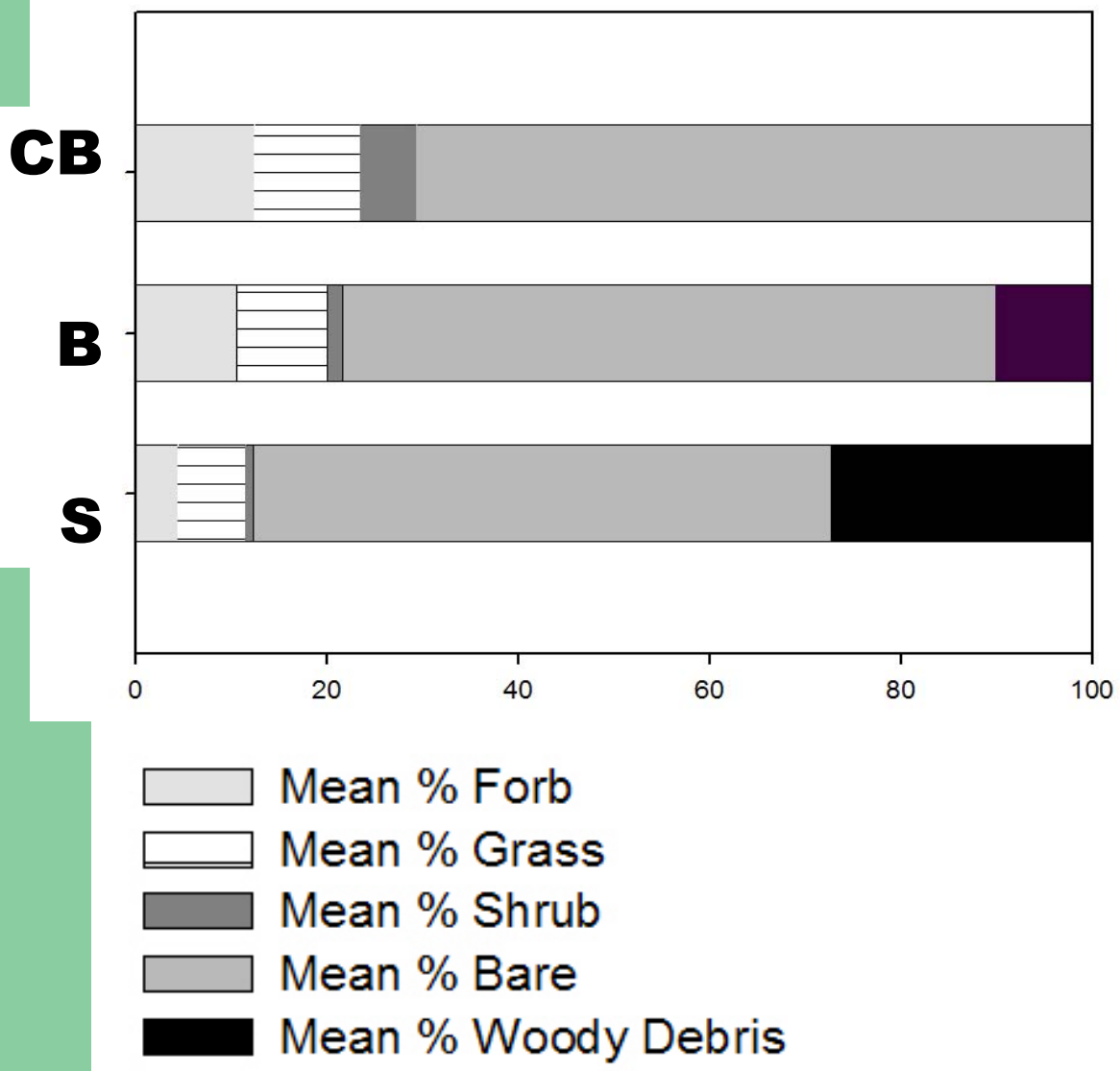
- Diversity (reduced)
- Evenness (reduced)
- # of Species (reduced)
- Fire severity reduced diversity, and # of species







Results: Ground Cover



- Woody Debris reduced herbaceous biomass
- Woody debris was higher in Salvaged (S) than Burned (B) and Cut and Burned (CB)

Results: Temperatures

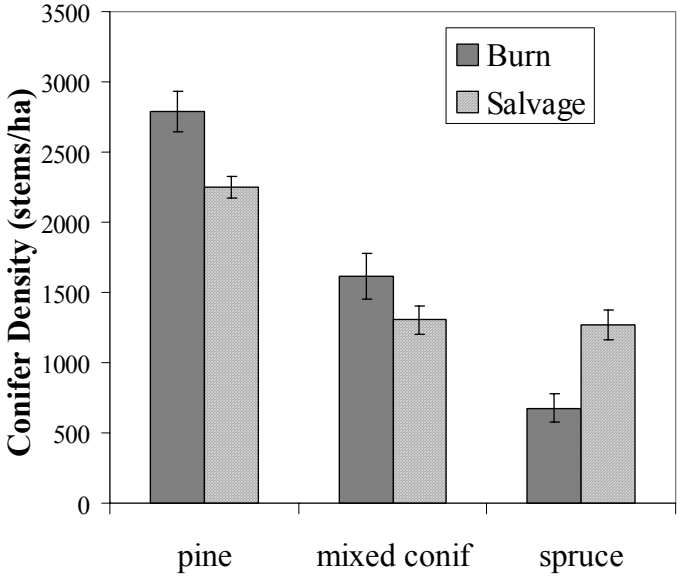
- GDD Salvage –0.29ºC = Burned
- SGDD salvage < SGDD Burned
- Salvage +1.1ºC > Burned
- Salvage –1.1ºC < Burned

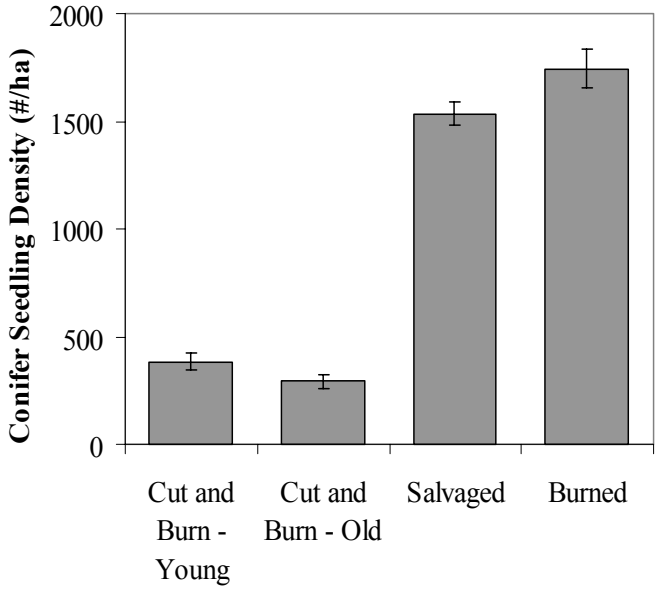
- 3.3ºC cooler than Burned in Fall

- Salvage Range 1.9ºC >> Burned

~ 2002 & 2003 2nd & 6th driest in 34 years, average temperature

Results: Conifer

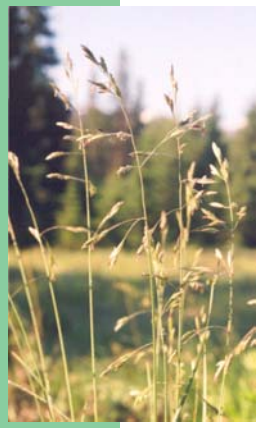




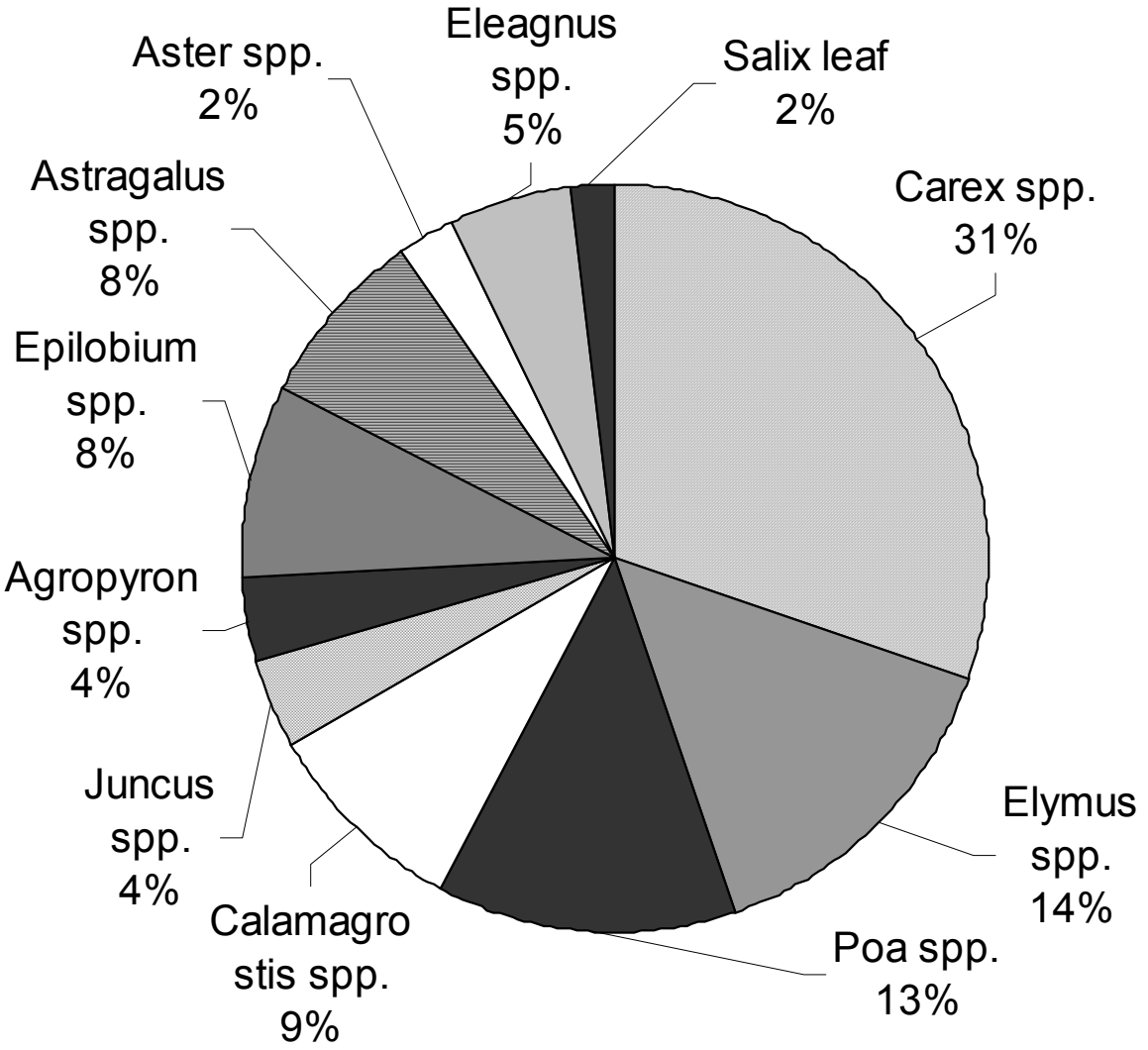
- Overall stems/ha low
- Salvage reduced conifer regeneration
- Cut and burned reduced conifer regen. the most

Parameter	b	SE	
% Grass Cover	-0.012	0.002	←
% Mineral Soil	0.004	0.001	
Hillshade	-0.007	0.002	
Fire Severity	0.8	0.265	←
North Slopes	-0.38	0.093	
Km to Low Severity / Unburned	-0.58	0.101	←

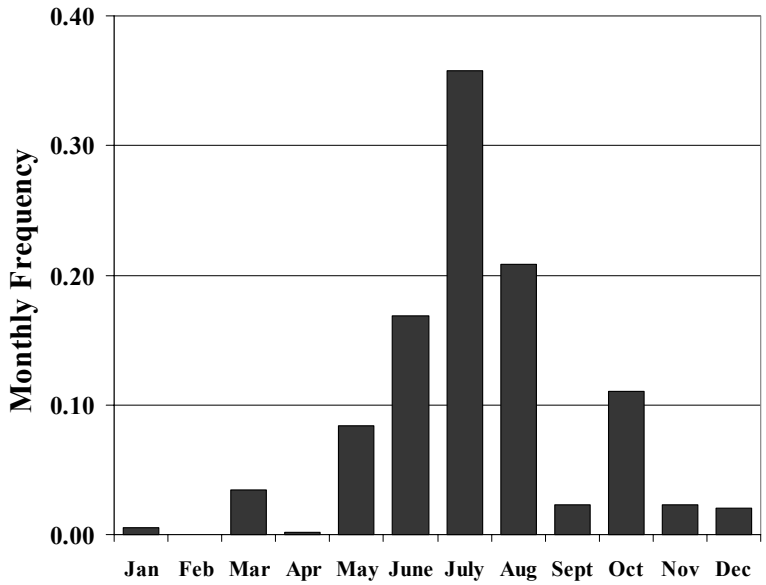
Results: Elk Diet Composition

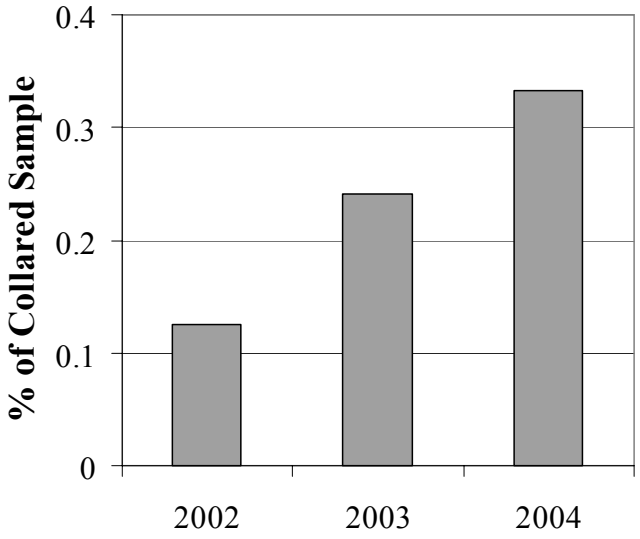


July Elk Diet in the Dogrib Burn



Results: Elk Resource Selection

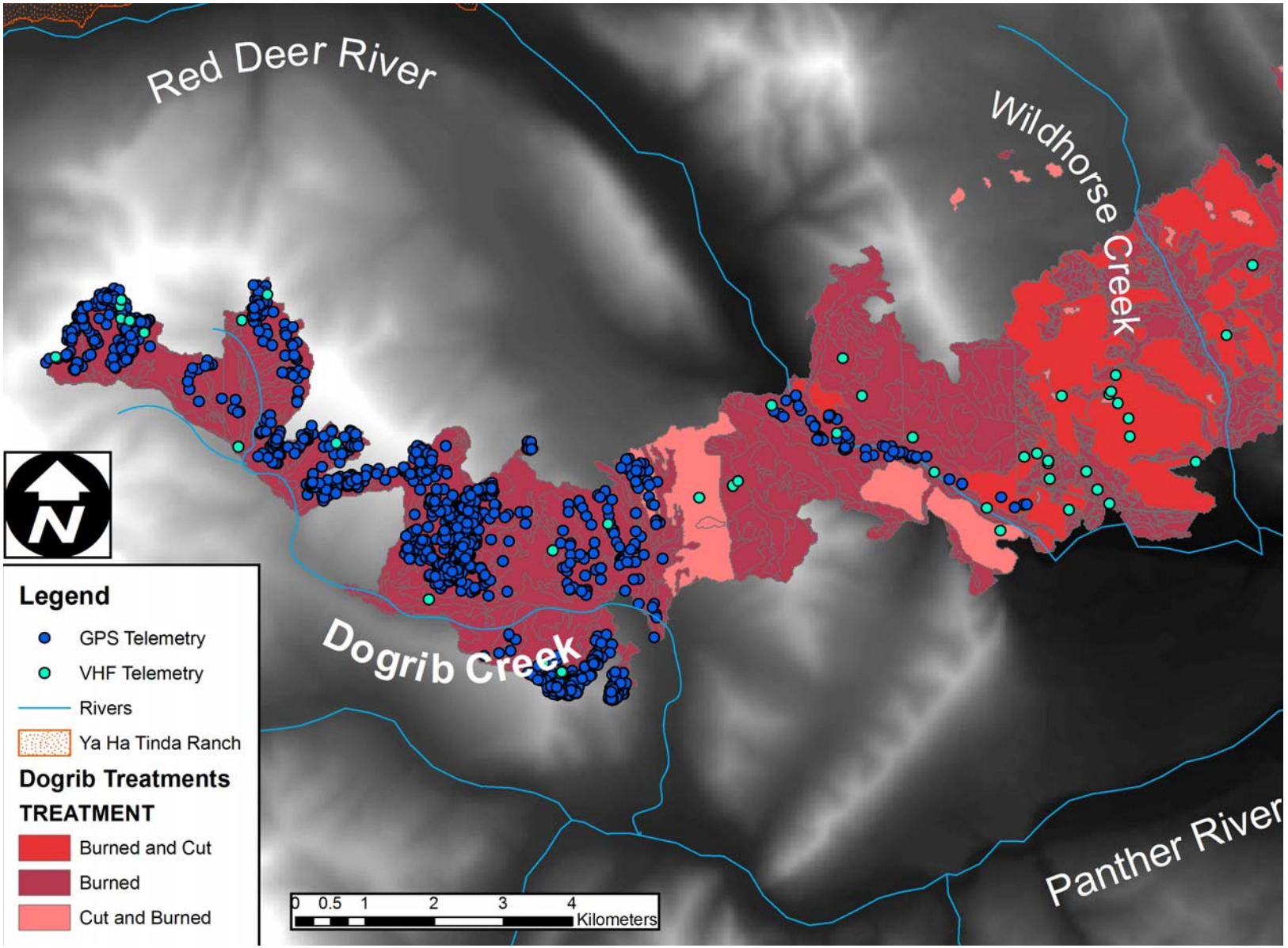




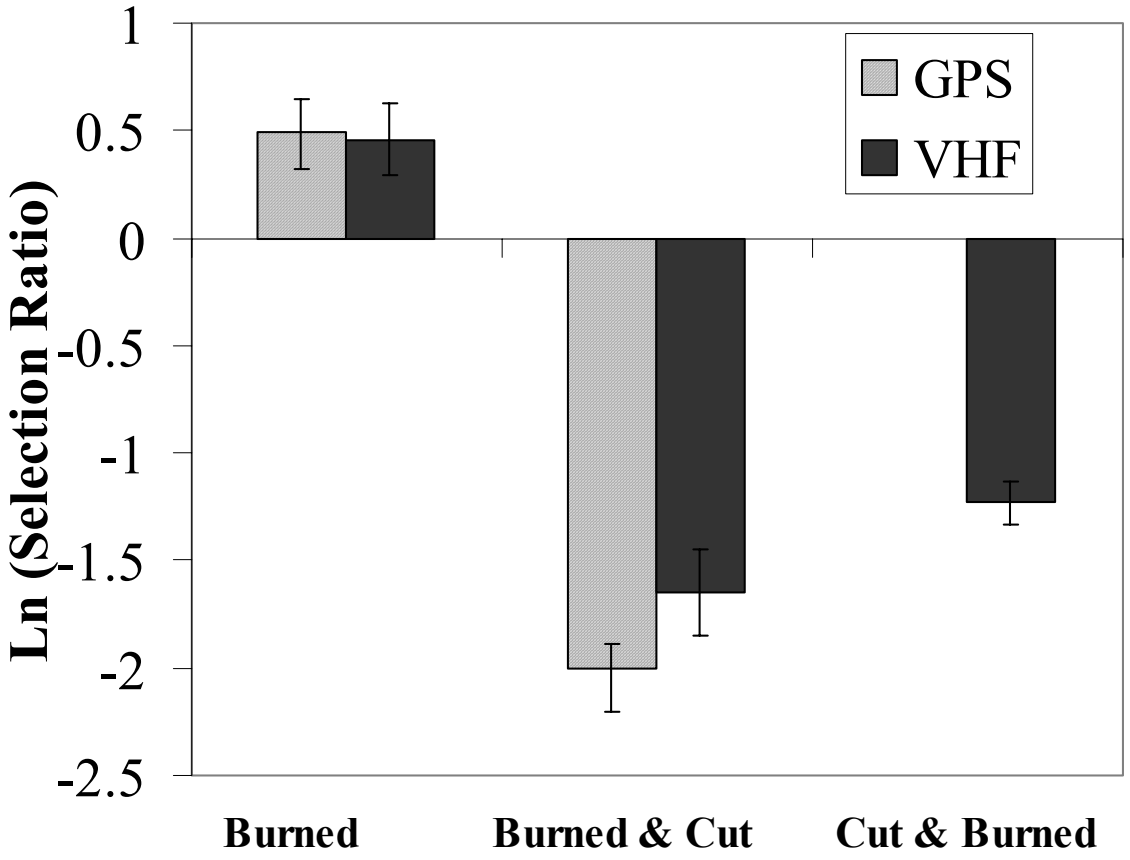
Telemetry: 2002-2004

- 86 VHF locations from 21 different elk
- 2068 GPS locations from 10 GPS collared elk
- Use of Dogrib burn peaked in July, increased over time
- Used ‘Upper’ Dogrib Burn
- Used by Migrants and Resident

Results: Elk Resource Selection



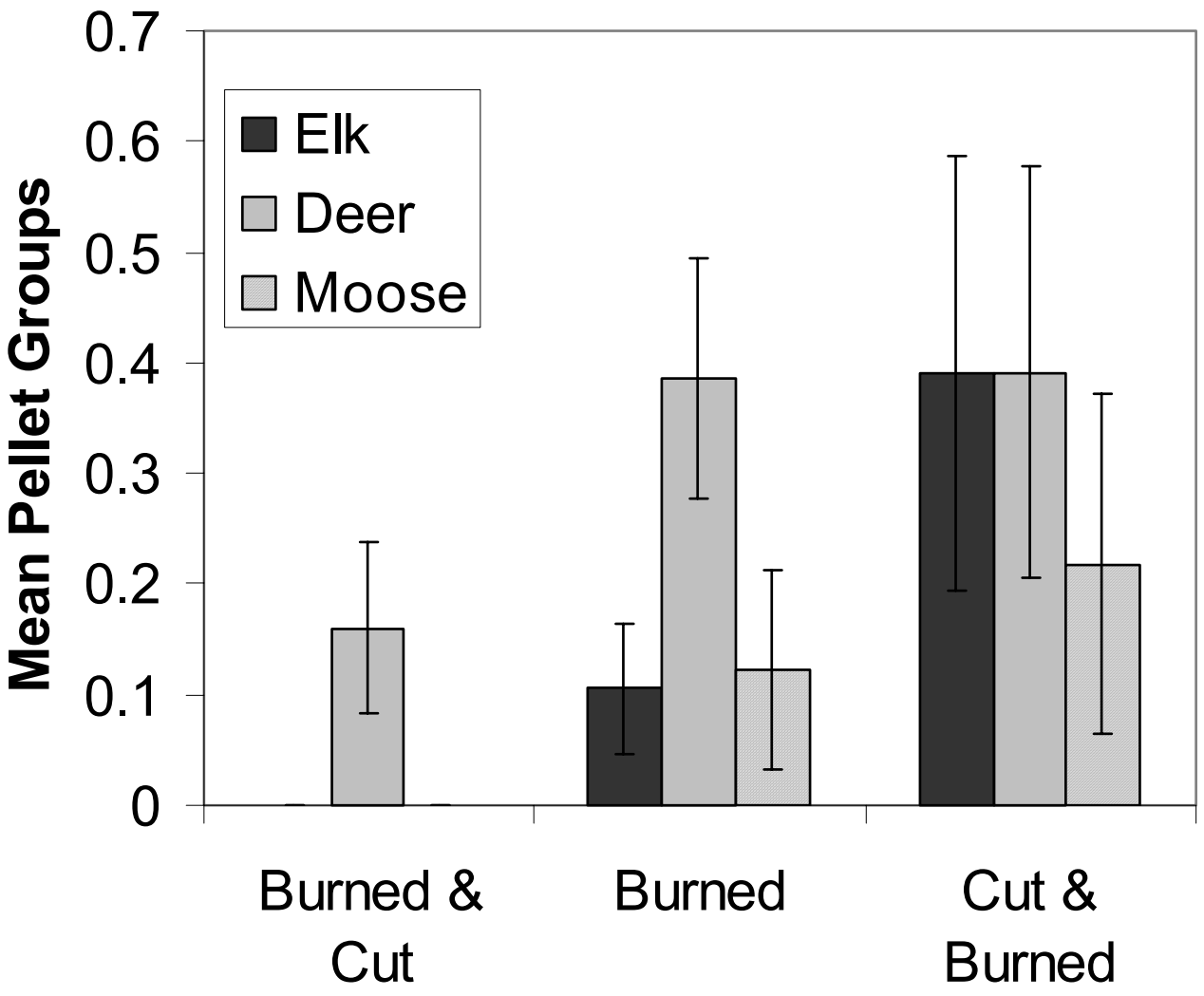
Results: Elk Resource Selection



b_j Selection Ratio

- *Elk Selected for Burned*
- *Avoided Salvaged*
- *Avoided Cut and Burned* **

Results: Elk Pellet Counts



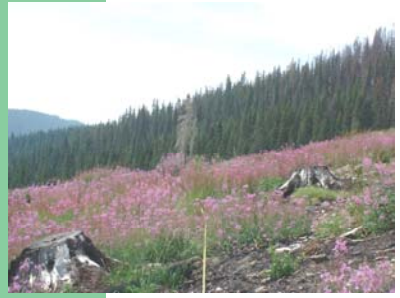
Mean Pellet Groups

- Lowest in Salvaged
- Moderate in Burned
- Highest in Cut and Burned

Summary of Results

Salvaged

Burned



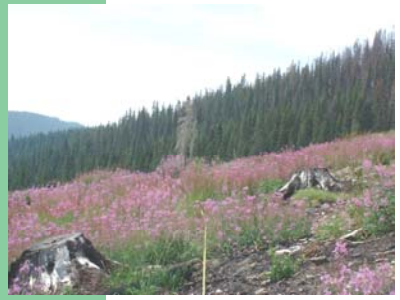
Cut then Burned

- Salvage reduced Forb biomass in all 3-years, grass in 2-years
- Salvage reduced diversity, evenness
- Effects on forage transient
- Salvage had higher woody debris, competed with forage
- Salvage hotter & more variable
- Salvage reduced conifer regeneration
- Cut and Burned highest forage biomass, lowest conifer regen

Discussion: Forage

Salvaged

Burned



Cut then Burned

Results consistent with salvage literature

- Arizona Ponderosa Pine salvage logging had reduced herbaceous ground cover (Blake 1982)
- Idaho Ponderosa Pine salvage logging had reduced forage biomass during first 2-years, slightly reduced diversity (Sexton 1994)
- California Doug-Fir salvage logging reduced shrub, forb 1 and 11 years later (Stuart et al. 1993)
- Shading effects of standing dead (McIvor and Starr 2000)

Discussion: Conifer

- Dogrib conifer regeneration low
- Graminoid biomass and conifer regeneration compete
- Salvage logging reduced conifer regeneration
- Management trade-offs in areas where wildfire is used for wildlife objectives

  - Rationale for not salvaging?

Discussion: Elk

- Effects of salvage logging on Forage resources will be similar as for Fire for species like elk

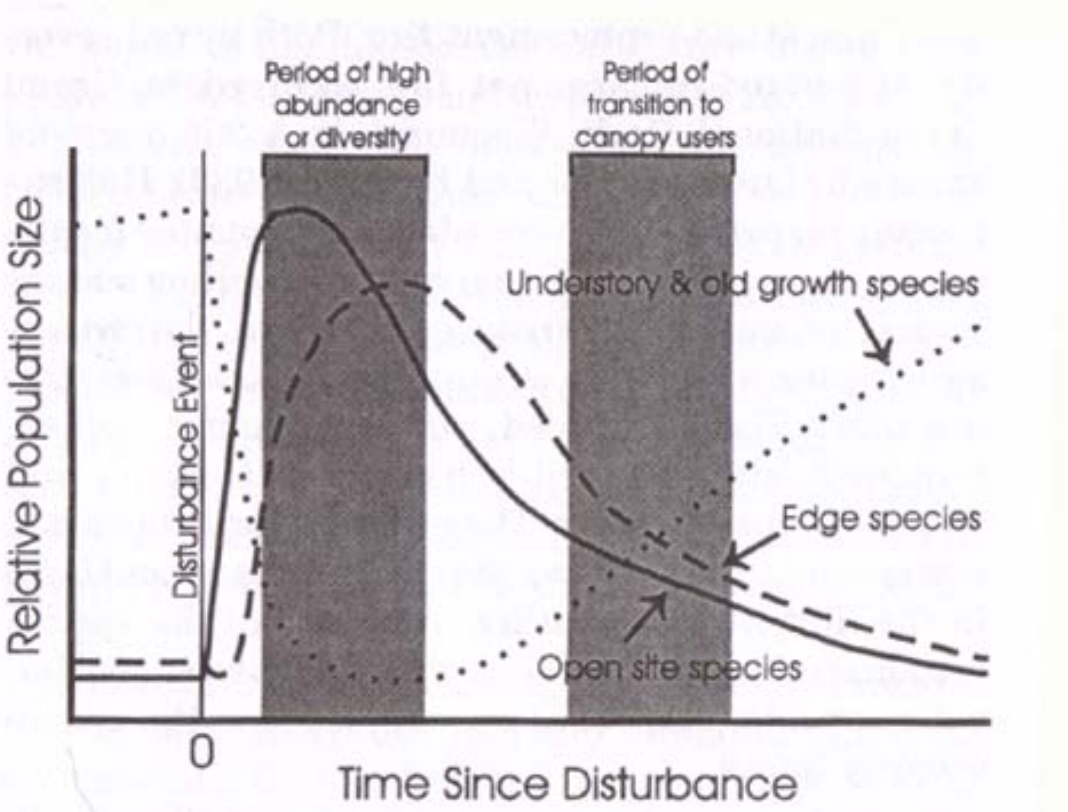
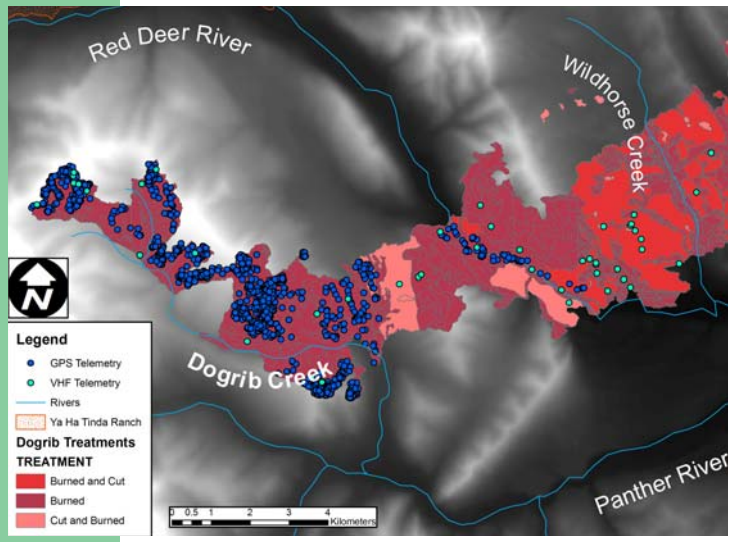


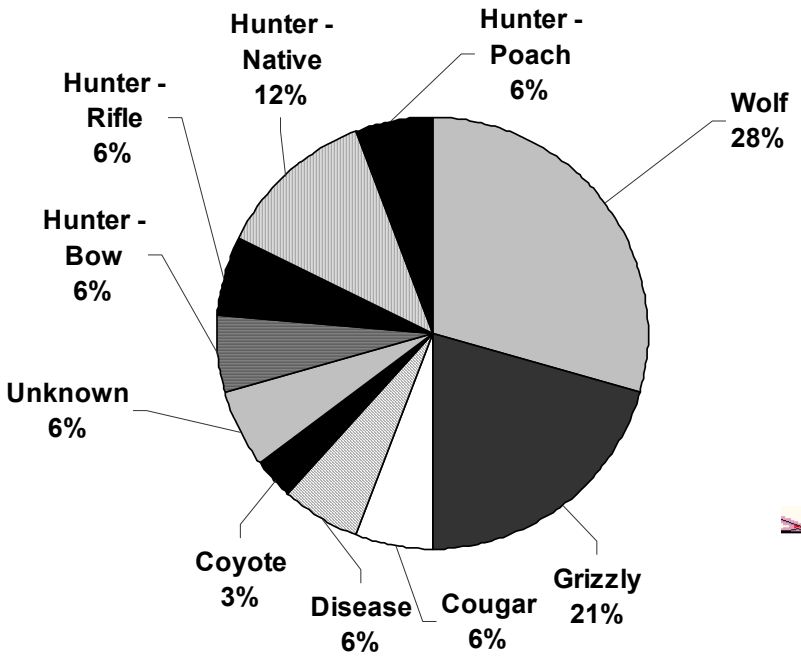
Figure 14—Hypothetical patterns of change in populations of species dependent on three features of forest structure: dense understory/old growth, edge, and open sites. Shaded areas are discussed in the text. Adapted from Oliver and others (1998).

Discussion: Elk



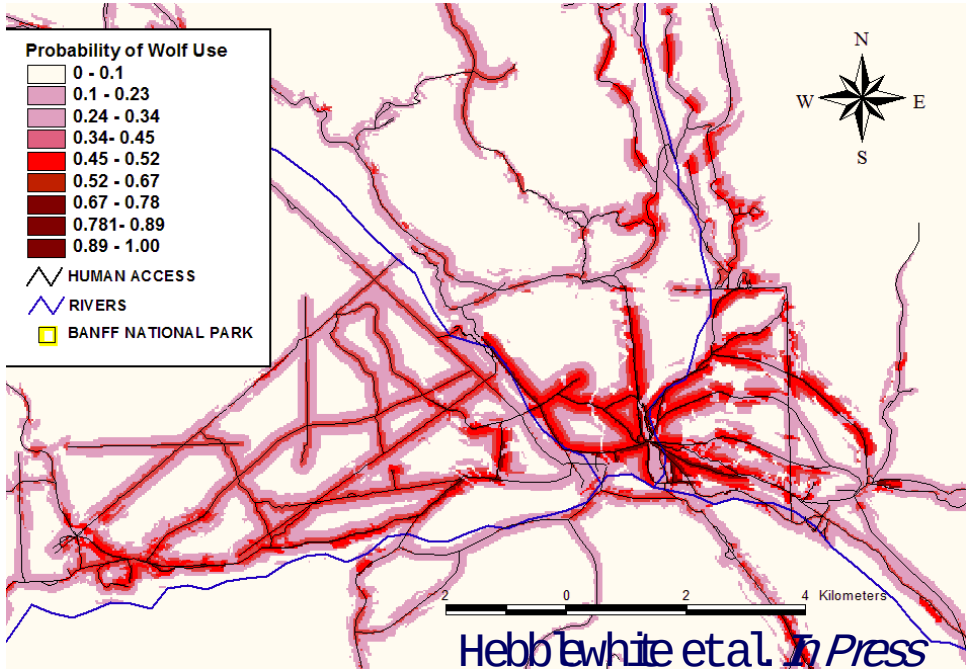
- Ya Ha Tinda elk avoided Cut and Burned
- Elk Pellets higher in Cut and Burned – why?
- Ya Ha Tinda Elk only used ‘Upper’ burn, no Cut and Burned available
- Lower Dogrib burn non-Ya Ha Tinda elk, bull elk.
- But elk consistently used salvaged less than expected and other habitats – **why**?

Why Did Elk Avoid Salvaged?

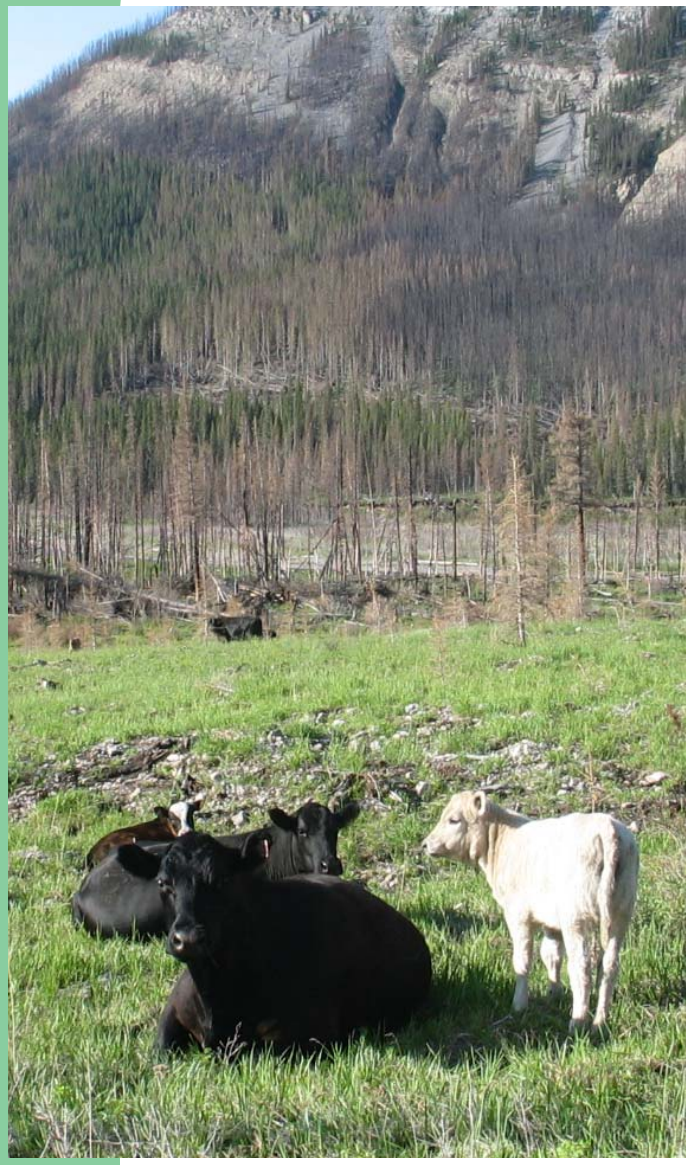


Avoiding Mortality

- Humans & Roads,#101
- Wolves – risk of being encountered for elk by wolves is higher on roads



Discussion: Range Management



Year 3 Biomass Estimates

- Salvaged =1200 KG/ ha

Summer 2003 160 cow:calf pairs pastured in Dogrib burn

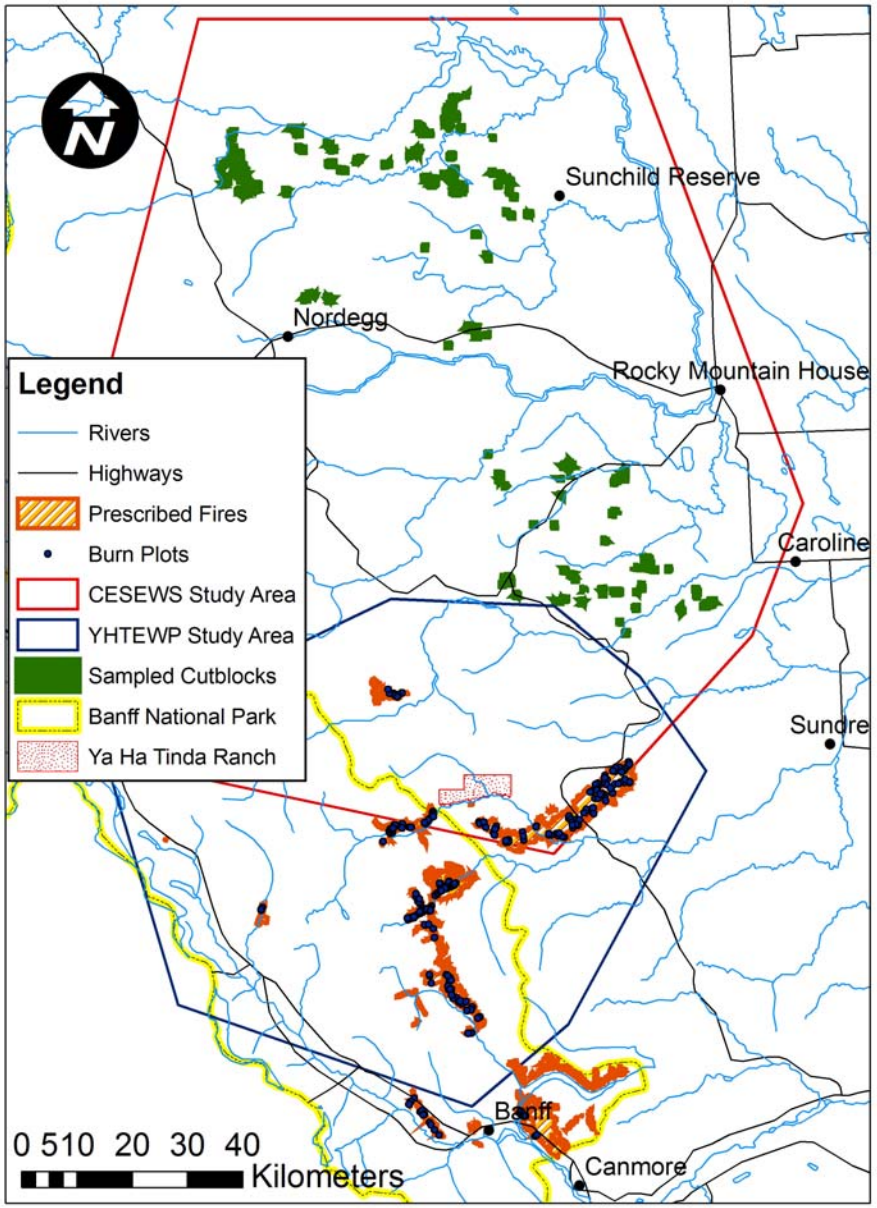
- *Observed conifer seedling damage, plant damage by consumption of roots and shoots in loose soils*

Need to understand trade-offs between land-use

Conclusions

1) Salvage reduced forage biomass for first 2-years, especially forbs
2) Impact minimal by year 3
3) Conifer density highest in burn> salvage >> cut and burned
4) Temperature and woody debris may be mechanism
5) Elk avoided salvaged areas
6) Landscape context of salvaged areas critical – must reduce risk of mortality

Future: Comparing Fires and Cutblocks



Evie Merrill, Robin Munro

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- S.Clare, J. Litke, Fiera Biological Consulting.
- Veg crews; R. Whittington, J. Wheeler, H. Spaedtke, A. Buckingham, G. Williams, M. Lindberg.

Funding & Research Partners

Alberta Conservation Association

the bio-diversity grants program

University of Alberta

Sundre Forest Products
A division of West Fraser Mills Ltd.

Rocky Mountain Elk Foundation
Working for Wildlife

foothills MODEL FOREST
research growing into practice.

Canon
National Parks Service
Science Scholars Program

Alberta Enhanced Career Development – Training on the Job Program

Weyerhaeuser

Centre for Mathematical Biology
University of Alberta

Alberta
SUSTAINABLE RESOURCE DEVELOPMENT

Marmot

Foundation for North American Wild Sheep
F.N.A.W.S.

ACCRU

MOUNTAIN EQUIPMENT CO-OP

Parks Canada

Parcs Canada

patagonia

http://ursus.biology.ualberta.ca/yhtelkwolfproject

Ya Ha Tinda Elk and Wolf Project

University of Alberta


Ya Ha Tinda Ranch


Research Overview


Elk Population Studies

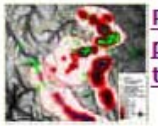

Wolves and Predation

Introduction

The Ya Ha Tinda Elk and Wolf Project is a University-led, cooperative interagency research project on the Ya Ha Tinda Elk population. ***The overall objectives of the study are to understand how predation, humans, and habitat-related factors affect the ecology and migration of the Ya Ha Tinda elk population.*** Furthermore, these research objectives are housed within the overall management objective of providing guidance for federal and provincial governments to improve the interagency management of wildlife populations in the Eastern slopes ecosystem.

Funding Partners


Vegetation research


Putting the pieces together


Personnel and contact info


Reports and Publications

Alberta Conservation Association

ACCRU

Alberta Sustainable Resource Development

Alberta Enhanced Career Development

Parks Canada / Parcs Canada

foothills model forest

Rocky Mountain Elk Foundation

Canon

Mountain Equipment Co-op