

# **Effects of Climate Change on Grasslands in the BC Interior**

**Lauch Fraser  
Natural Resource Sciences  
and  
Biological Sciences**

# **Outline**

- 1. Climate Change**
- 2. Plant Functional Groups**
- 3. Field experiment**
- 4. Stomatal density**
- 5. Plant invasives**

# 1. Climate Change

- ↑ **Frequency of heat waves**
- ↑ **Areas of drought**
- ↑ **Frequency of heavy precipitations events**
- ↑ **Winter temperatures**

**(Intergovernmental Panel on Climate Change 2007)**

## **2. Plant Functional Groups**

**What factors limit  
the amount of living  
and dead plant  
biomass in an area?**

## **2. Plant Functional Groups**

**Two external factors limit the amount of living and dead biomass in any habitat:**

**1.STRESS**

**2.DISTURBANCE**

# **STRESS**

**‘The phenomena which restrict photosynthetic production such as shortages of light, water, mineral nutrients, or sub-optimal temperatures.’**

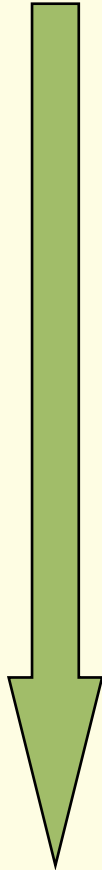
# **DISTURBANCE**

**‘The partial or total destruction of biomass and arises from the herbivores, pathogens, humans (trampling, mowing, and ploughing), and from phenomena such as wind-damage, frosting, droughting, soil erosion, and fire.’**

# Intensity of Disturbance



**Intensity of Stress**



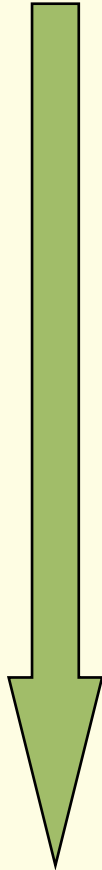
<b>Low D</b> <b>Low S</b>	<b>High D</b> <b>Low S</b>
<b>Low D</b> <b>High S</b>	<b>High D</b> <b>High S</b>



# Intensity of Disturbance



**Intensity of Stress**



<b>Competitors</b>	<b>Ruderals</b>
<b>Stress-tolerators</b>	<b>No viable strategy</b>

## **Competitors**

- **Flood plains**
- **Marsh**
- **Valley bottoms**
- **Old fields**

## **Ruderals**

- **Sea-shore**
- **Tilled land**
- **Heavily grazed land**
- **Desert**

## **Stress-tolerators**

- **Arctic and alpine habitats**
- **Arid habitats**
- **Shaded habitats**
- **Nutrient deficient habitats**

**During evolution of plants, establishment phase of the life-cycle has experienced, in different habitats, three fundamentally different forms of natural selection.**

**C (competitor)**

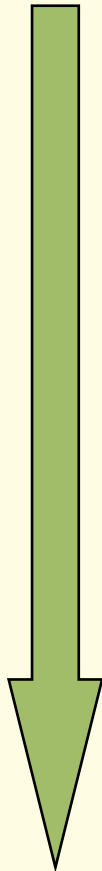
**S (stress-tolerator)**

**R (ruderal)**

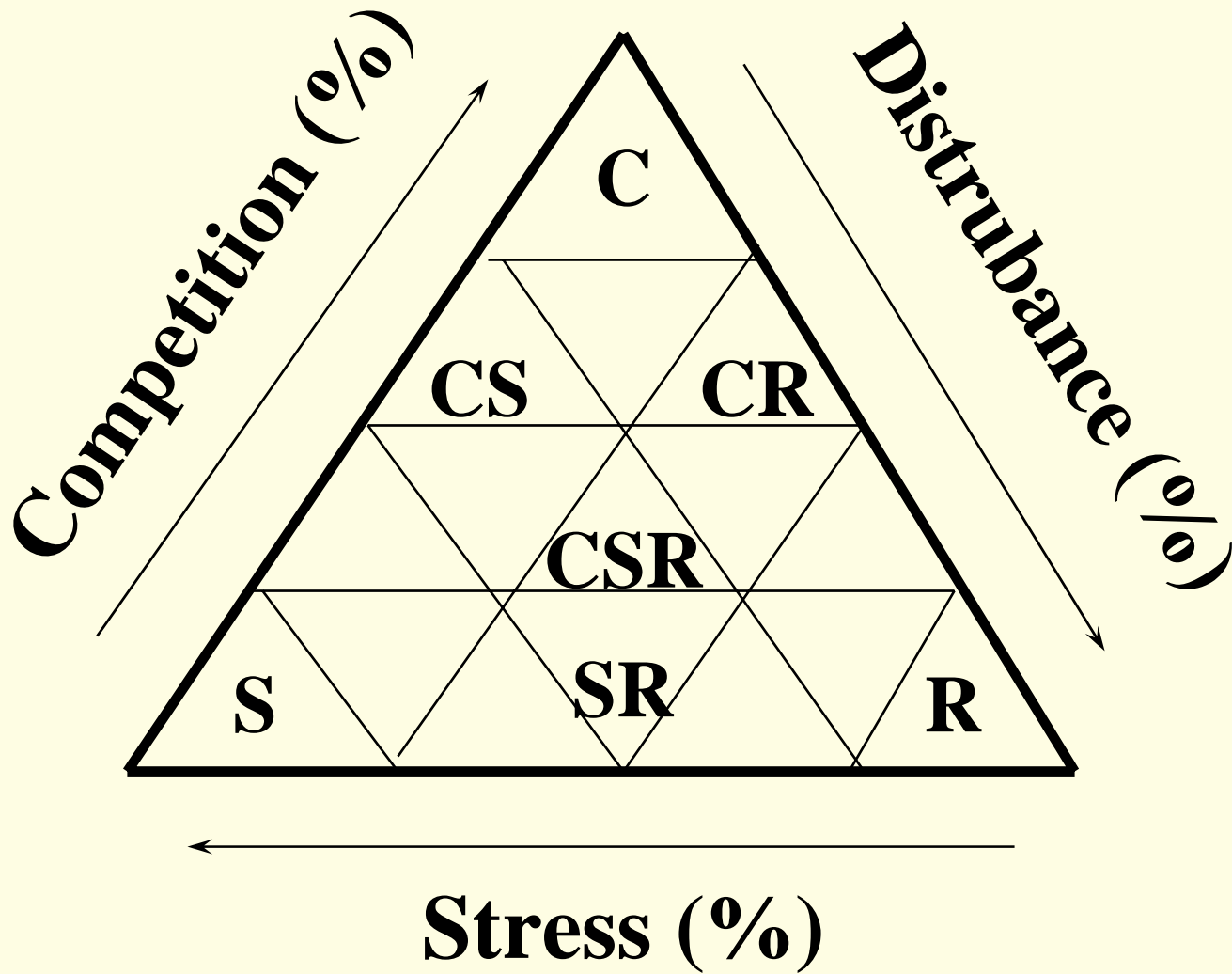
# Intensity of Disturbance



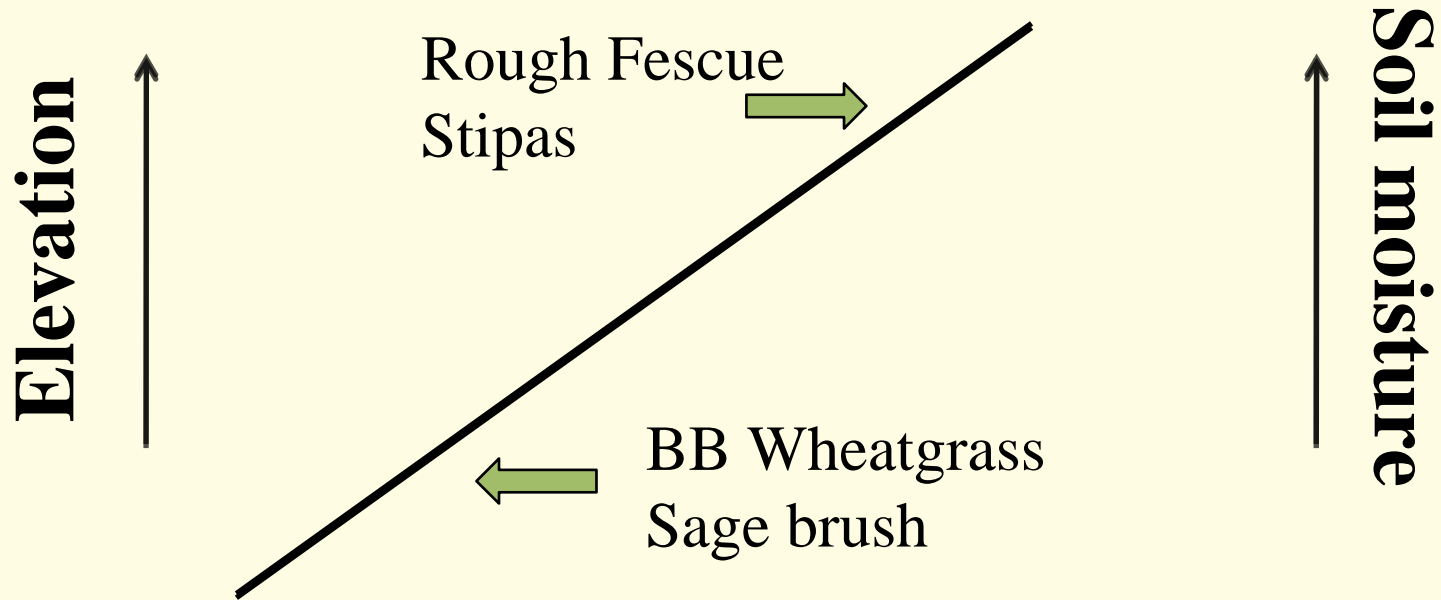
**Intensity of Stress**



<b>Competitors</b>	<b>Ruderals</b>
<b>Stress-tolerators</b>	<b>No viable strategy</b>



# 3. Field Experiment





← **Upper Grassland**

**TREATMENTS**

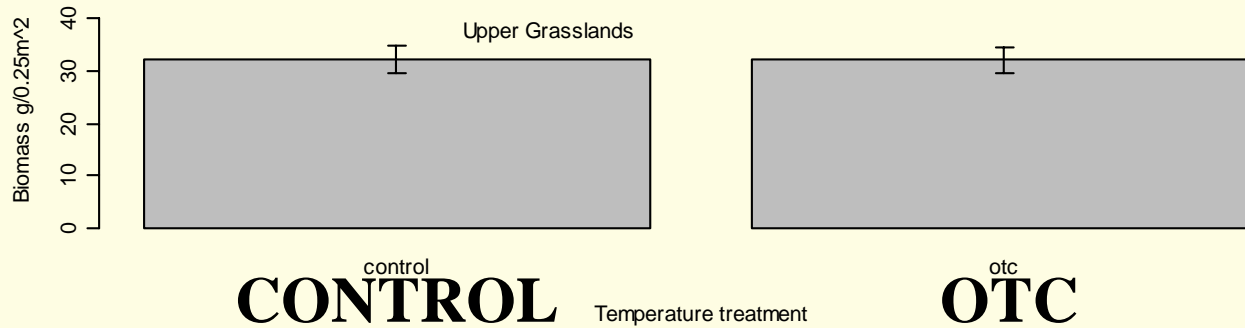
- 2 temperature  
(control and open-top chamber)
- 3 precipitation  
(control, added, removed)



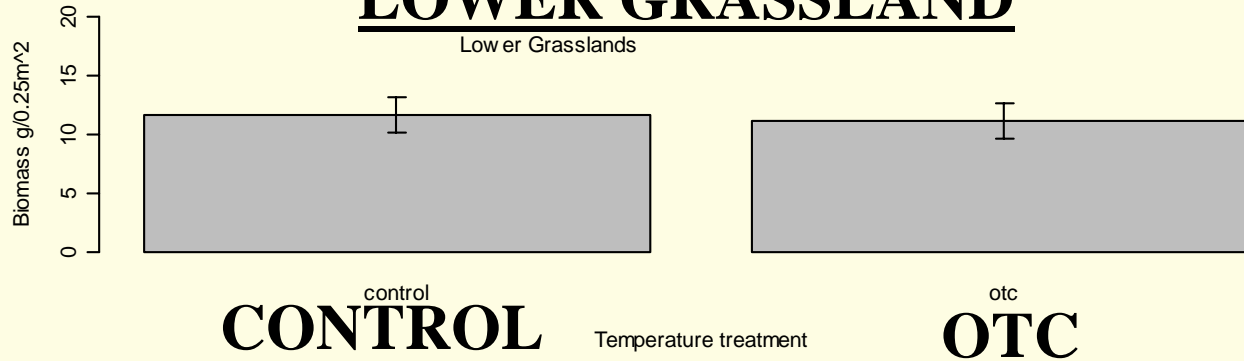
← **Lower Grassland**

# Effect of Temperature on Plant Biomass

## UPPER GRASSLAND



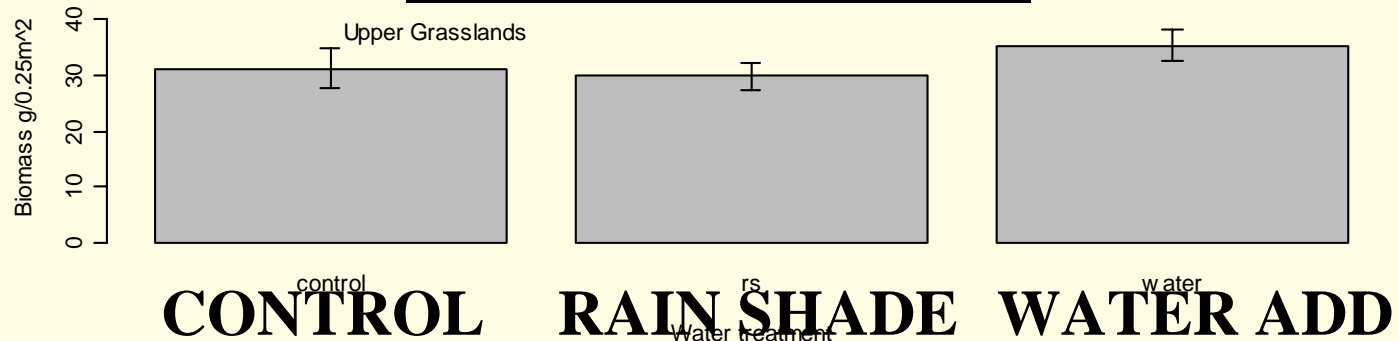
## LOWER GRASSLAND



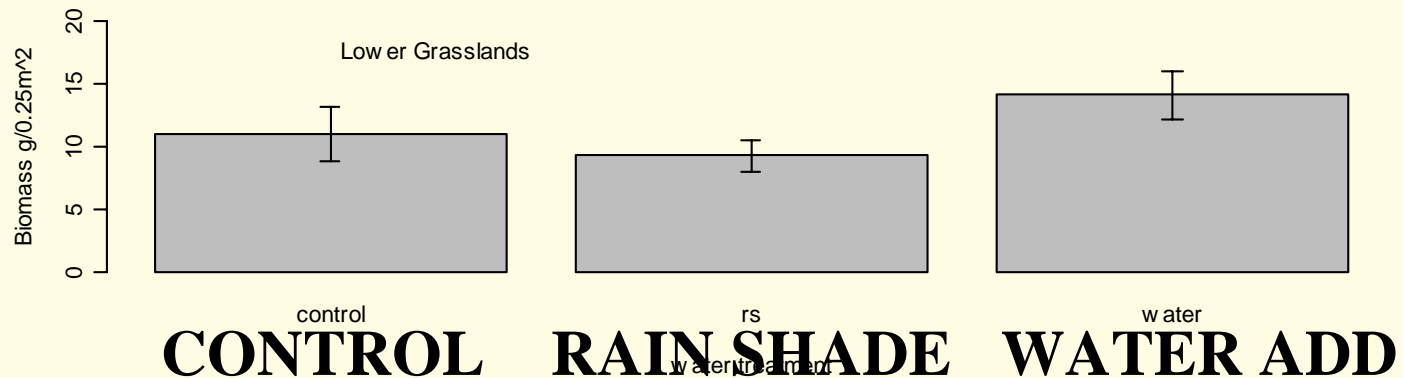


# Effect of Water on Plant Biomass

## UPPER GRASSLAND



## LOWER GRASSLAND



# **Preliminary Conclusions after two growing seasons**

- Temperature does not affect total above-ground plant biomass.**
- Water addition causes an increase in above-ground plant biomass.**

# **MORE QUESTIONS?**

- Does plant composition change?**
- What effect does grazing have?**
- Are there below-ground effects to the climate manipulations?**
- What are the long-term effects of climate manipulation?**

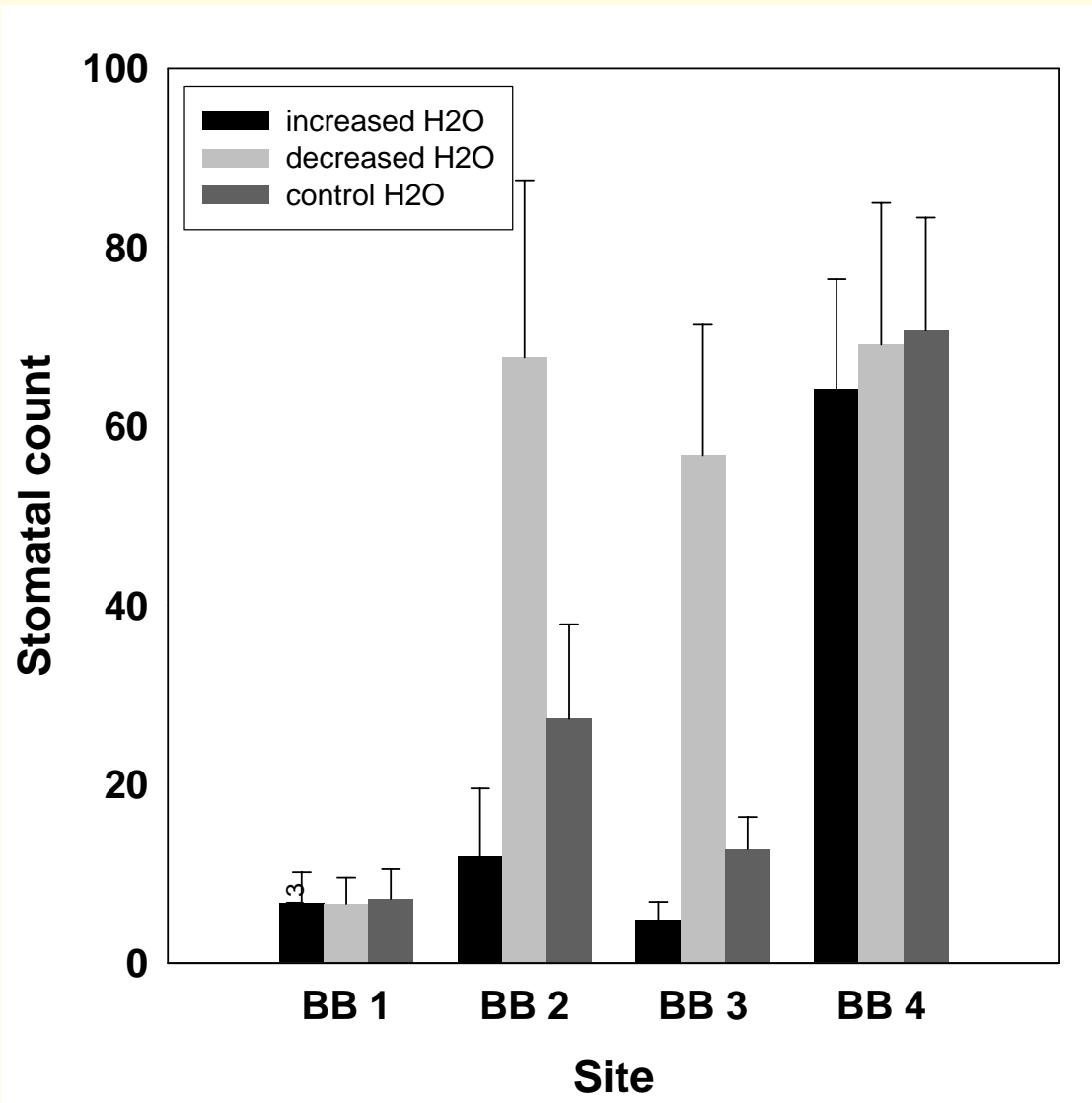
## **4. Stomatal Density**

**Is stomatal density affected by temperature and precipitation?**

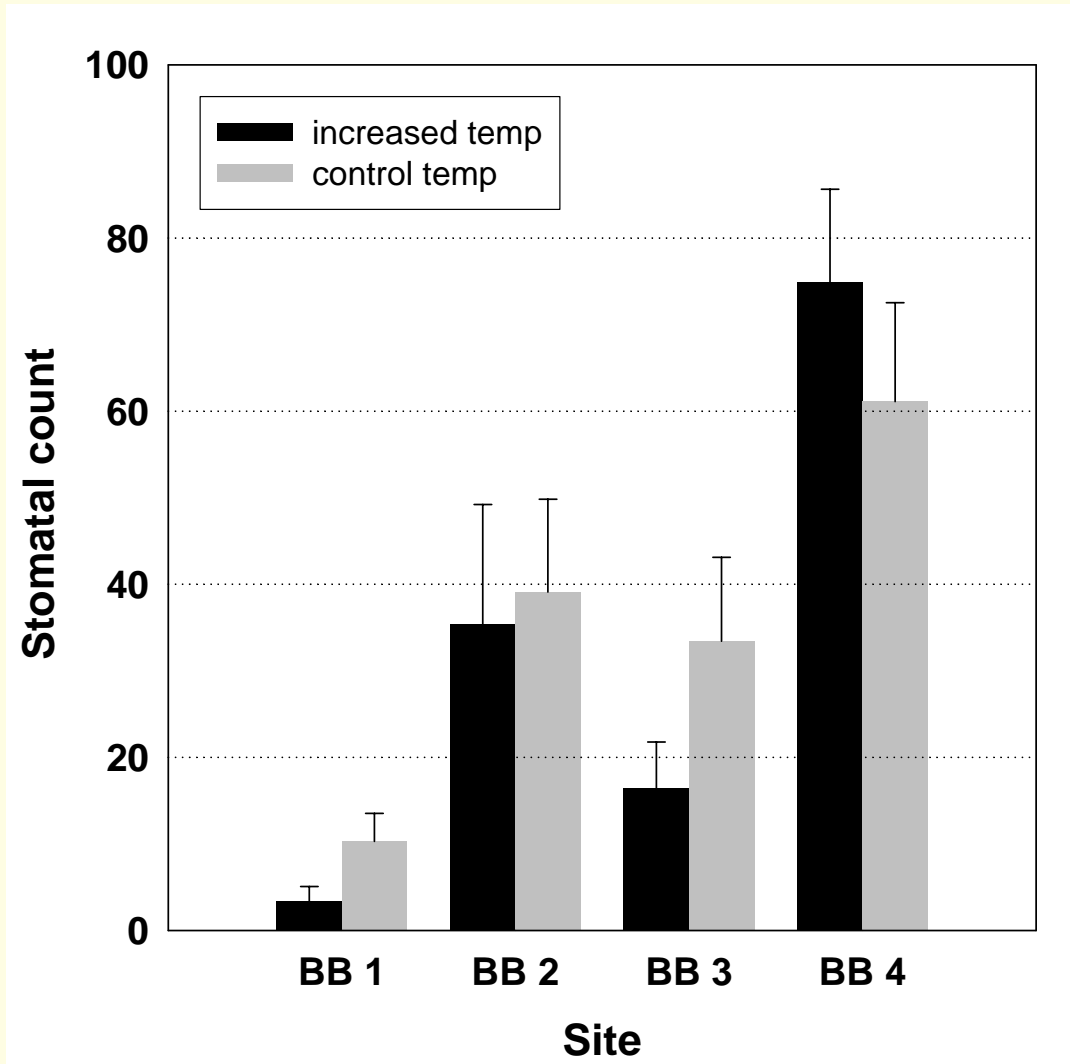


**Three stomata on the abaxial surface  
of the leaf at 400 times magnification**

# Effect of water treatment on stomatal count of Bluebunch Wheatgrass leaves



# Effect of temperature treatment on stomatal count of Bluebunch Wheatgrass leaves



## 5. Plant invasives

How will climate change affect the distribution and competitive performance of *Centaurea maculosa* and *Linaria vulgaris* in south interior grasslands?



Exotic invasives are a serious threat to biodiversity, forage, and livestock health in BC grasslands and rangelands.

Global climate change may further exacerbate the dominance and spread of plant invasives.

Soil Moisture

High

Low

Spotted Knapweed

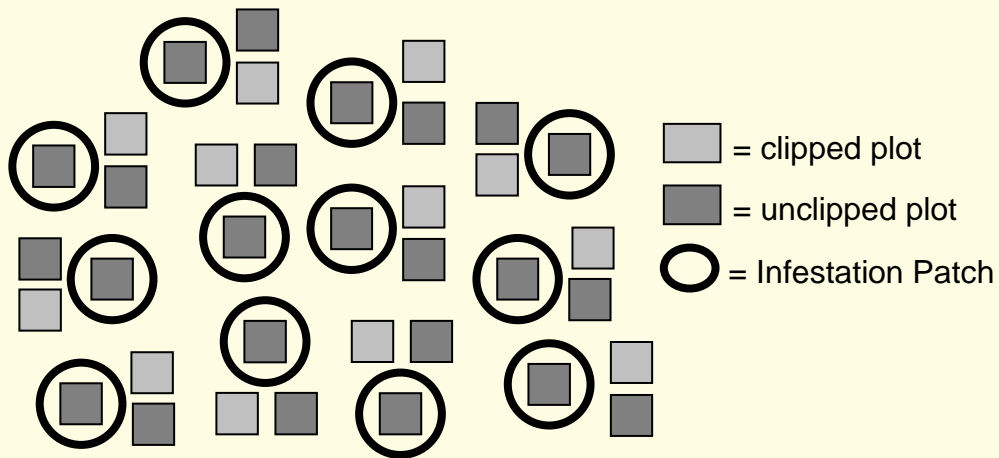
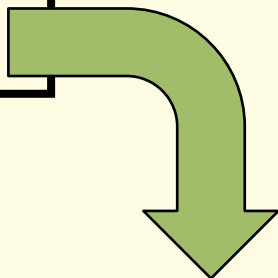
105 Mile

111 Mile

Yellow Toadflax

Tatton

Pete Kitchen



## **Fraser Grad Students**

**Cameron Carlyle – UBC PhD**

**Marc Jones – UBC-O PhD**

**Brian Patrick – Kent State U PhD**

**Amber Greenall – TRU MSc**

**Eleanor Bassett – TRU MSc**

**Lisa DeSandoli – UBC MSc**

**Angi Knopp – UBC MSc**

**Larry Feinstein – U Akron MSc**

# **Research Opportunities for Students**

- **NSERC USRA**
- **FSP grants**

- 1. Climate change experiments**
- 2. Effects of cattle on wetlands**
- 3. Trophic interactions in grasslands**
- 4. Agroforestry**

# Acknowledgements

## Field Experiment:

**Cameron Carlyle (PhD Student)**

**Amber Greenall**

**Montana Burgess**

**Eleanor Bassett**

**NSERC  
FSP**

## Stomatal Density:

**Amber Greenall (MSc Student)**

**Cameron Carlyle**

**Cindy Ross-Friedman**

**NSERC  
FSP**

## Plant Invasives:

**Amber Greenall (MSc Student)**

**NSERC  
FSP**

# Dr. Kathy Lewis, UNBC

- Today at 3:30 – IB1019
- Wood decay and degradation in standing lodgepole pine (*Pinus contorta* var. *latifolia* Engelm.) killed by mountain pine beetle (*Dendroctonus ponderosa* Hopkins: Coleoptera)