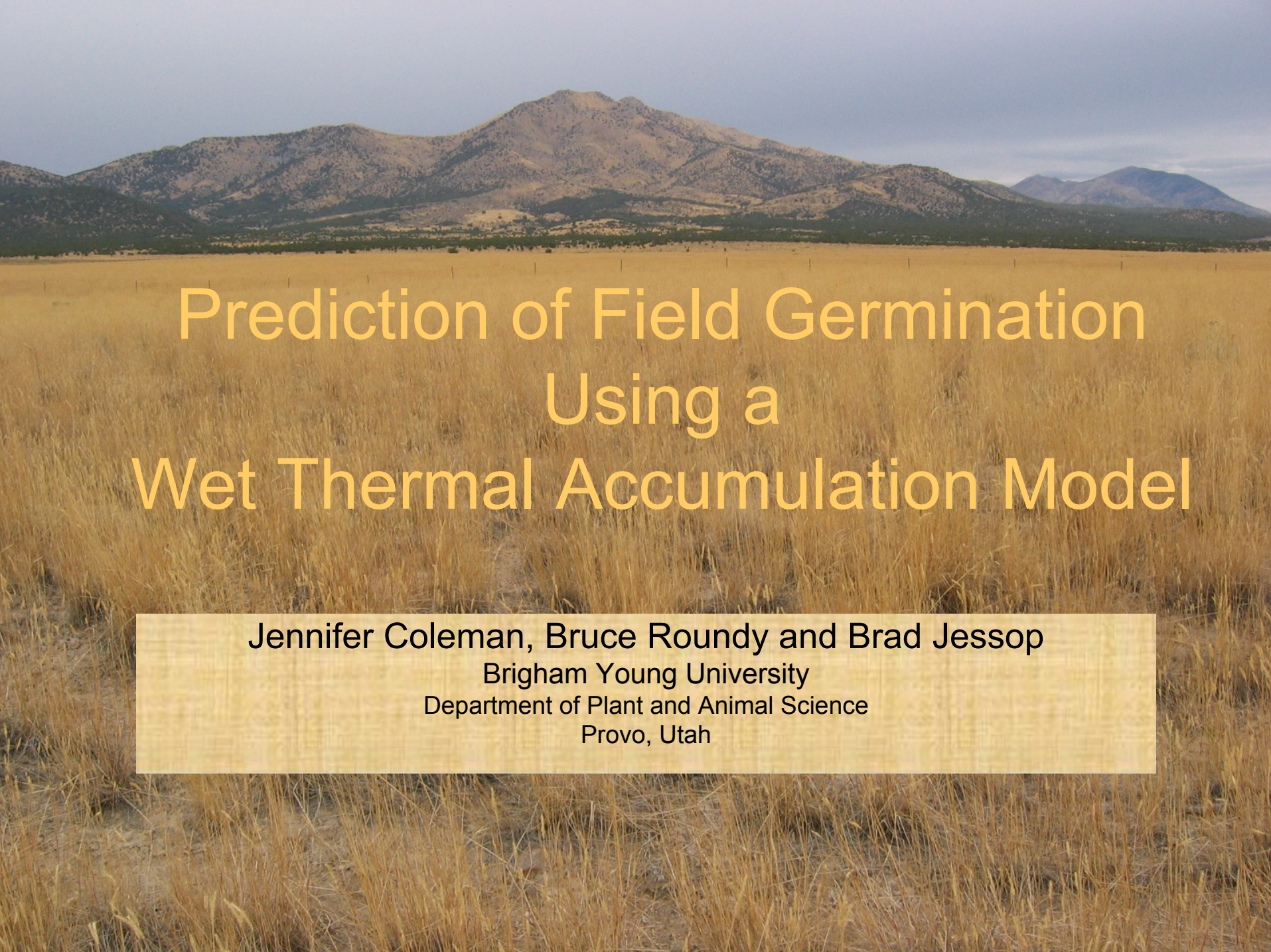

Prediction of Field Germination Using a Wet Thermal Accumulation Model

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Provo, Utah


Disturbance

Germination

Forbs

Appar blue flax

Eagle yarrow

Grasses

Hycrest crested wheatgrass

Anatone Bluebunch wheatgrass

Bottlebrush squirreltail

Cheatgrass

Wet Thermal Accumulation

- Germination requirements

1) Water

- Above base water potential (MPa)

2) Temperature

- Above base temperature for some time (degree days)

Wet Degree Days

- Crested wheatgrass requires 62.9 wet degree days for 50% germination
- Base water potential: -1.5 MPa
- Base temperature: 0° C
- Time to germination:
  - 62.9 days at 1° C
  - 6.3 days at 10 ° C
  - 3.5 days at 20° C
  - 0.0417 degree days/1hour at 1°C
  - 0.417 degree days/1hour at 10°C
  - 0.833 degree days/1hour at 3° C

Methods

1. Constant temperature germination trials

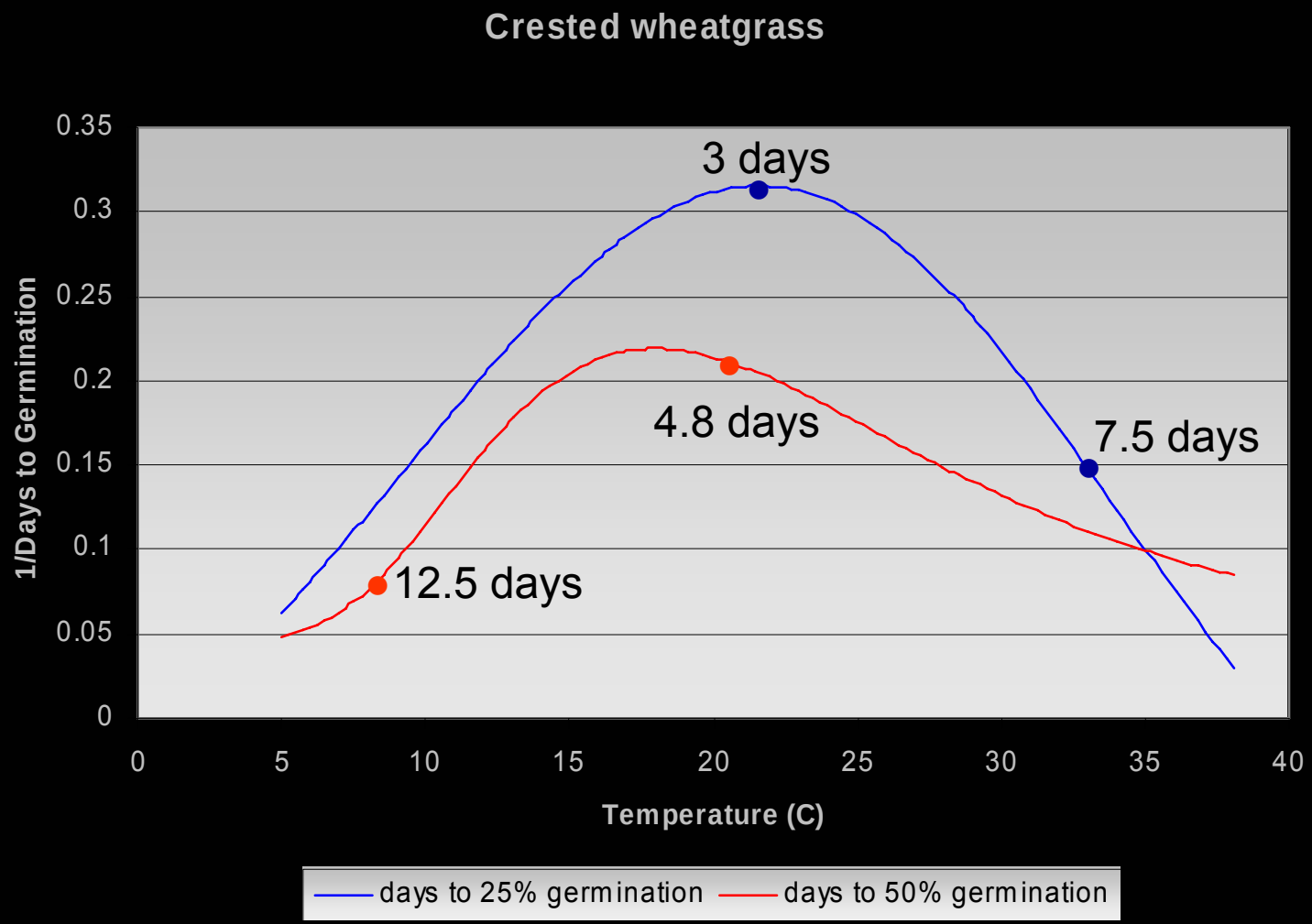
2. Seed bag burial and retrievals

3. Small plot seeding
   - Density
   - Survival

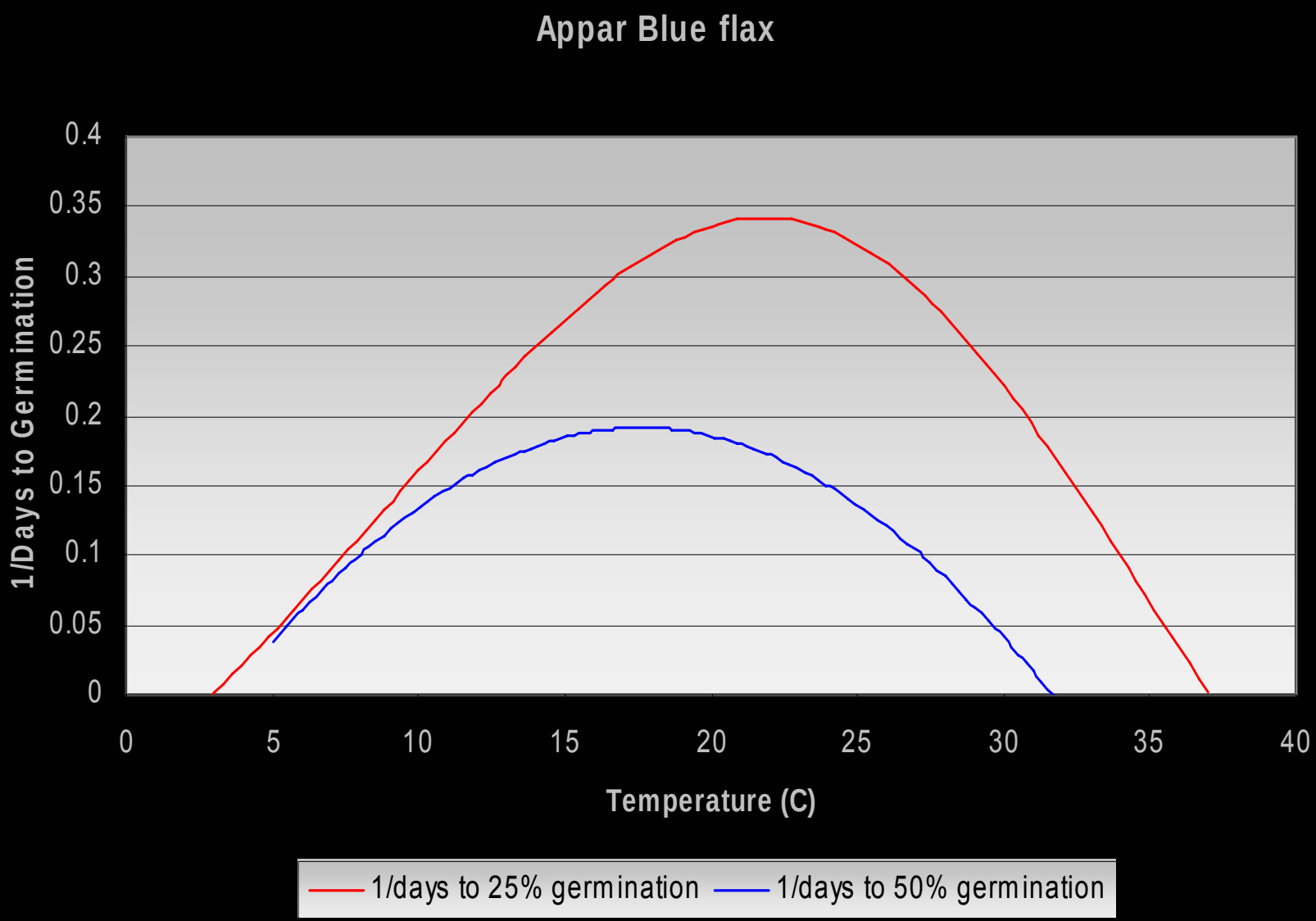
Germination Trials

- Constant Temperatures:
  - 5,10,15,20,25,30,35 °C
- What we measured:
  - Days to 25% germination
  - Days to 50% germination
- What we needed to know:
  - Hourly germination rate

Germination Rate



Germination Rate



Thermal accumulation: 2 methods

Cold

Warm

1) Thermal accumulation stops
2) Thermal accumulation begins again
Germination stops

Ungerminated

Germination

Dry

Wet

Skull Valley

Lookout Pass

Seedbed Monitoring

- Temperature
  - Depths:
    - 2-3 cm
    - 15-16 cm
    - 28-30 cm
- Moisture
  - Depths:
    - 2-3 cm
    - 15-16 cm
    - 28-30 cm

Study Sites

Block	Year	
1	1	Small Plots
		Seedbags
	2	Small Plots
		Seedbags
2	1	Small Plots
		Seedbags
	2	Small Plots
		Seedbags
3	1	Small Plots
		Seedbags
	2	Small Plots
		Seedbags
4	1	Small Plots
		Seedbags
	2	Small Plots
		Seedbags

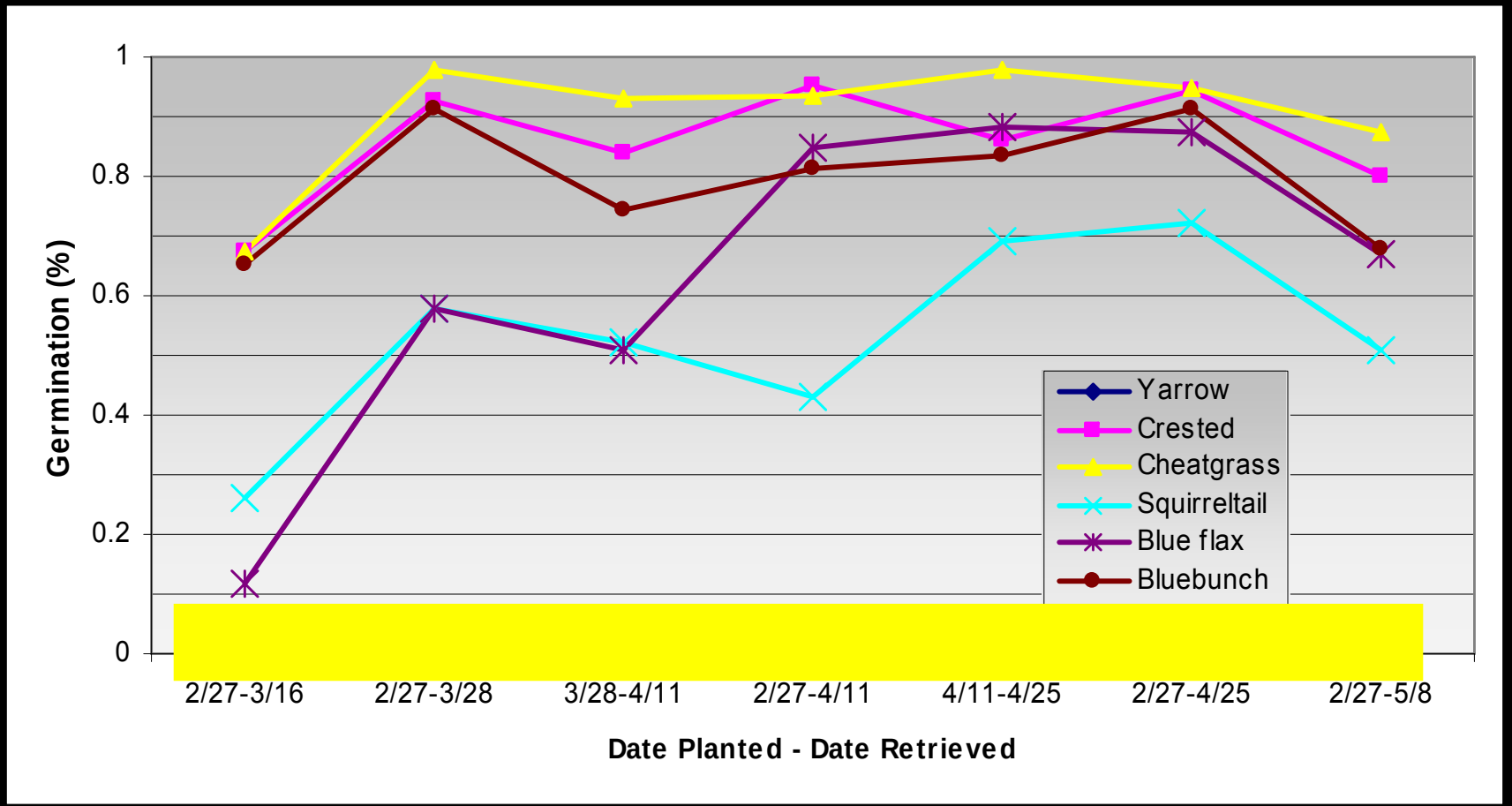
Seedbags

Fall 2005-Spring 2006

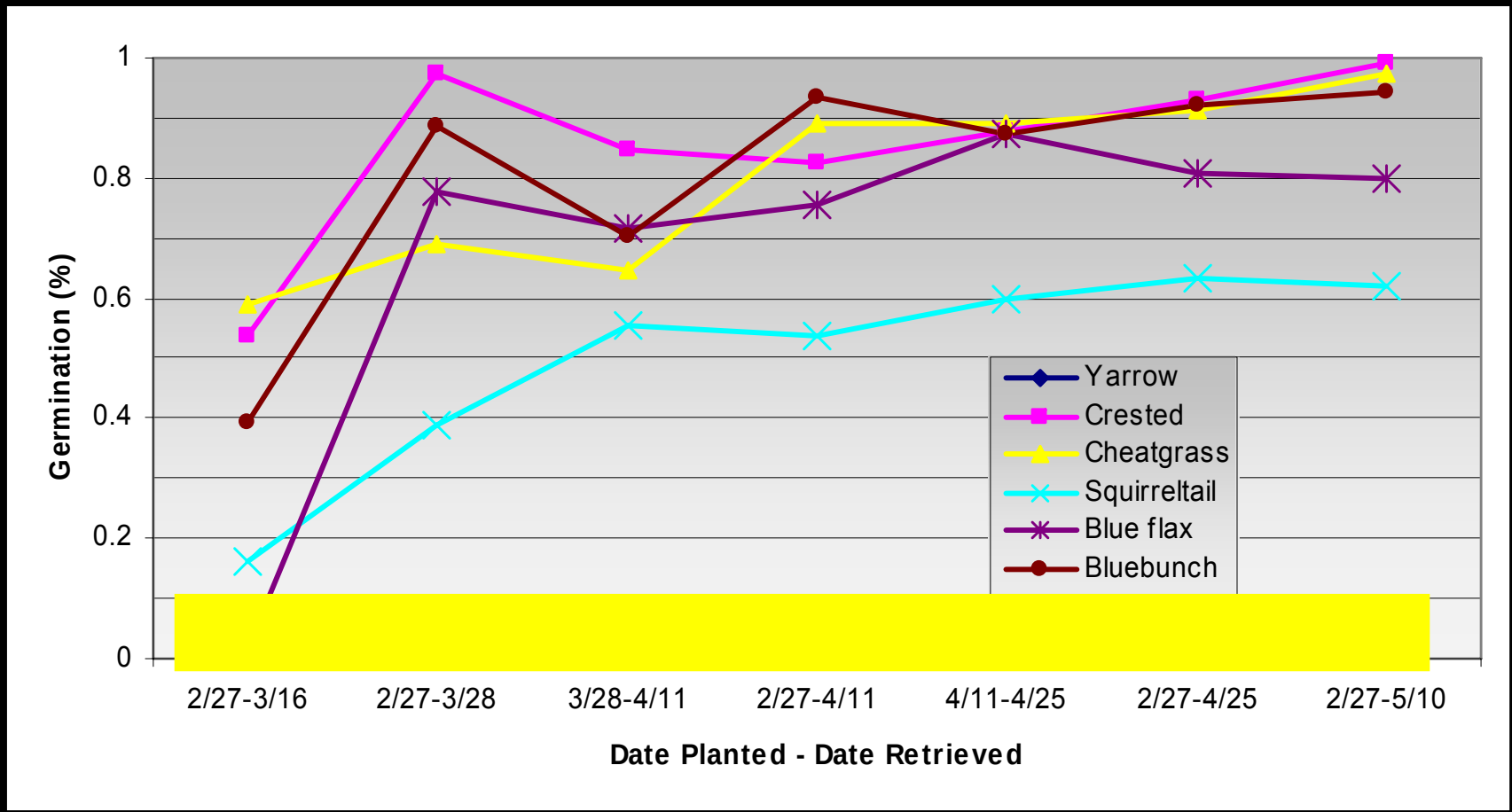
Planted:	Retrieved:
10/15/05	12/04/05
	1/19/06
2/27/06	3/16
	3/28
	4/11
	4/25
	5/10 & 5/11
3/28/06	4/11/06
4/11/06	4/11/06

9 seedbag retrievals

Seedbag germination: Skull Valley



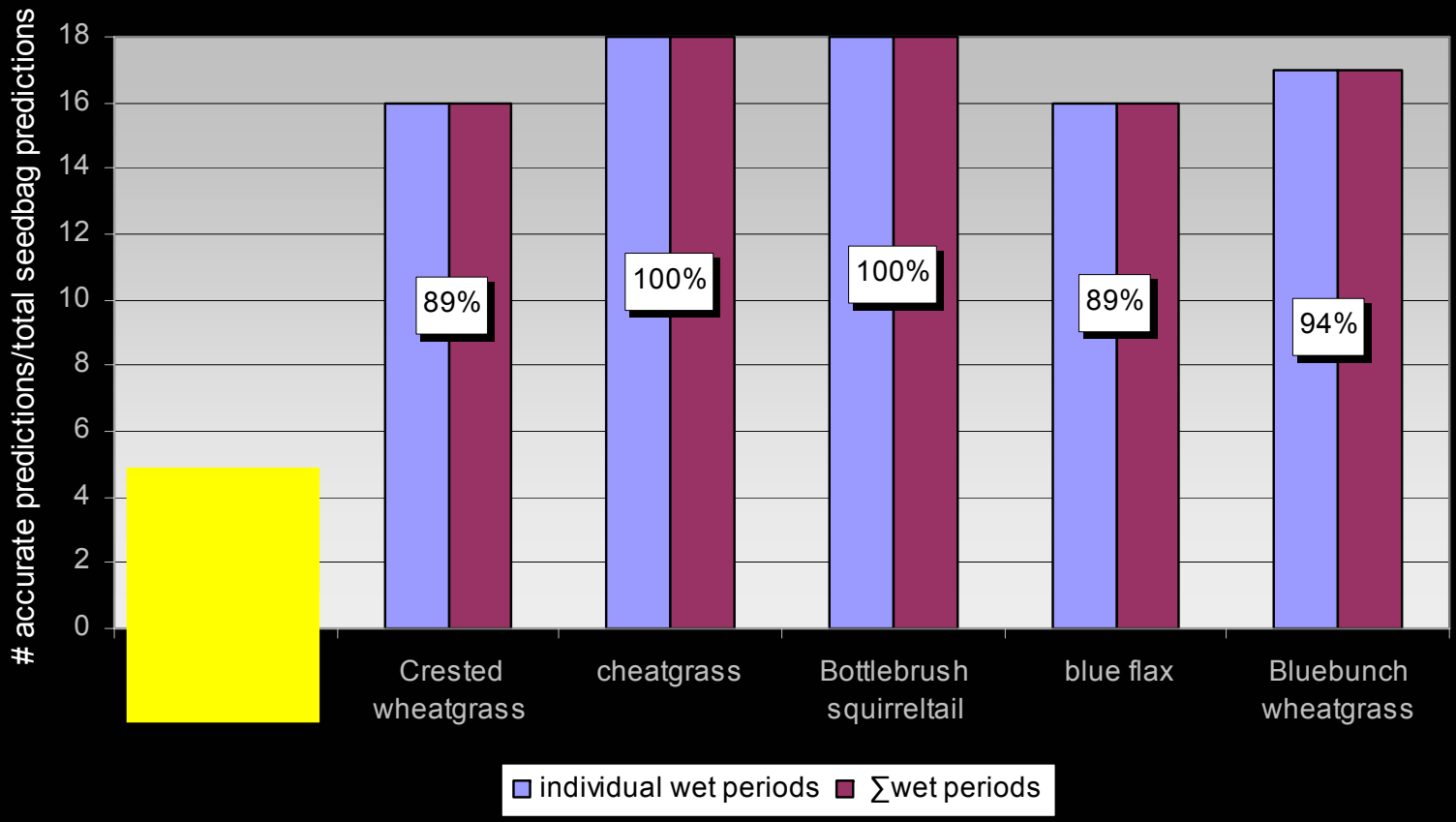
Seedbag germination: Lookout Pass



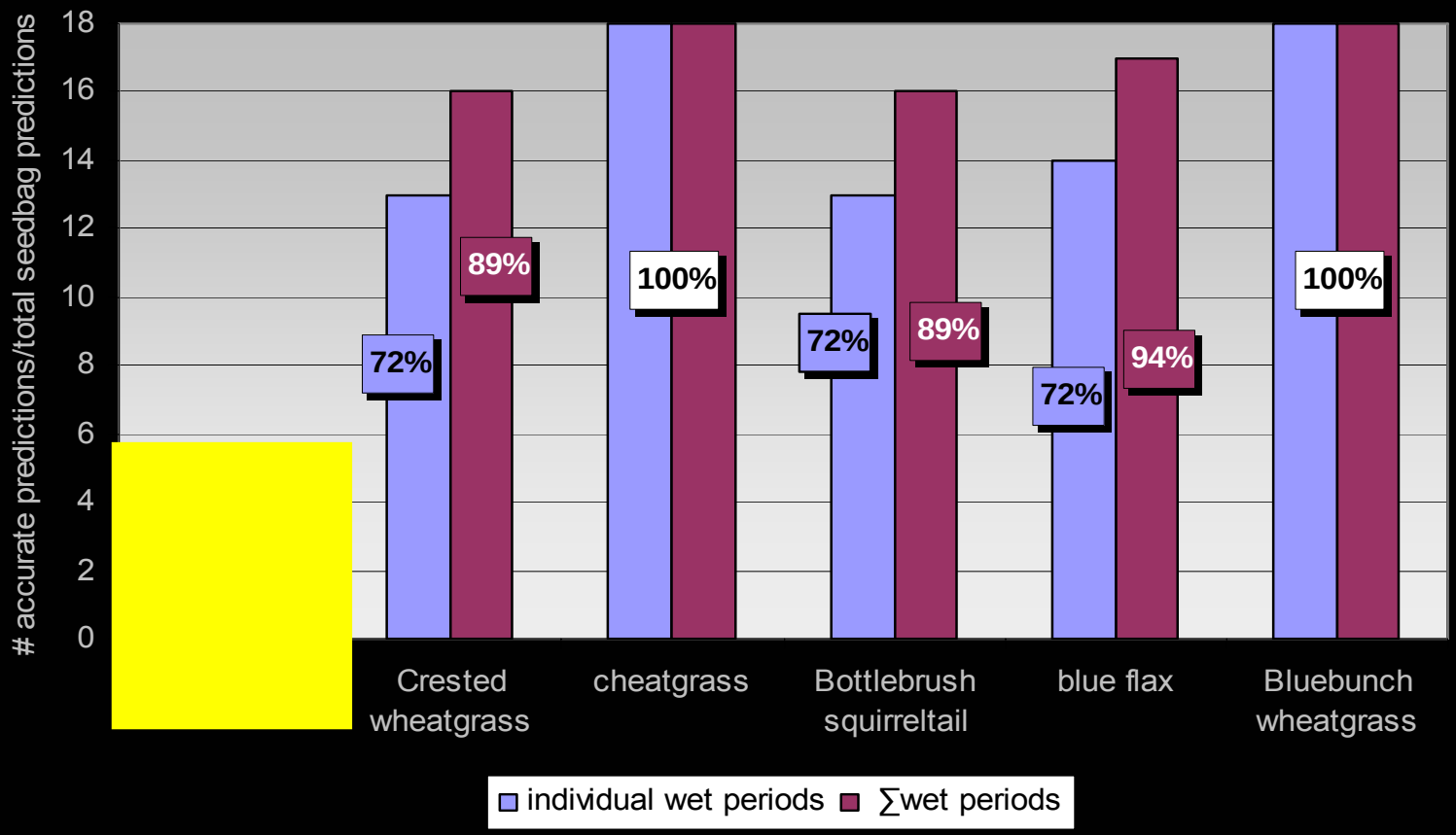
Seedbag Retrievals

1) Thermal accumulation starting over at individual wet periods
   - >25% germination?
   - >50% germination?
2) Continuous thermal accumulation during all wet periods
   - >25% germination?
   - >50% germination?

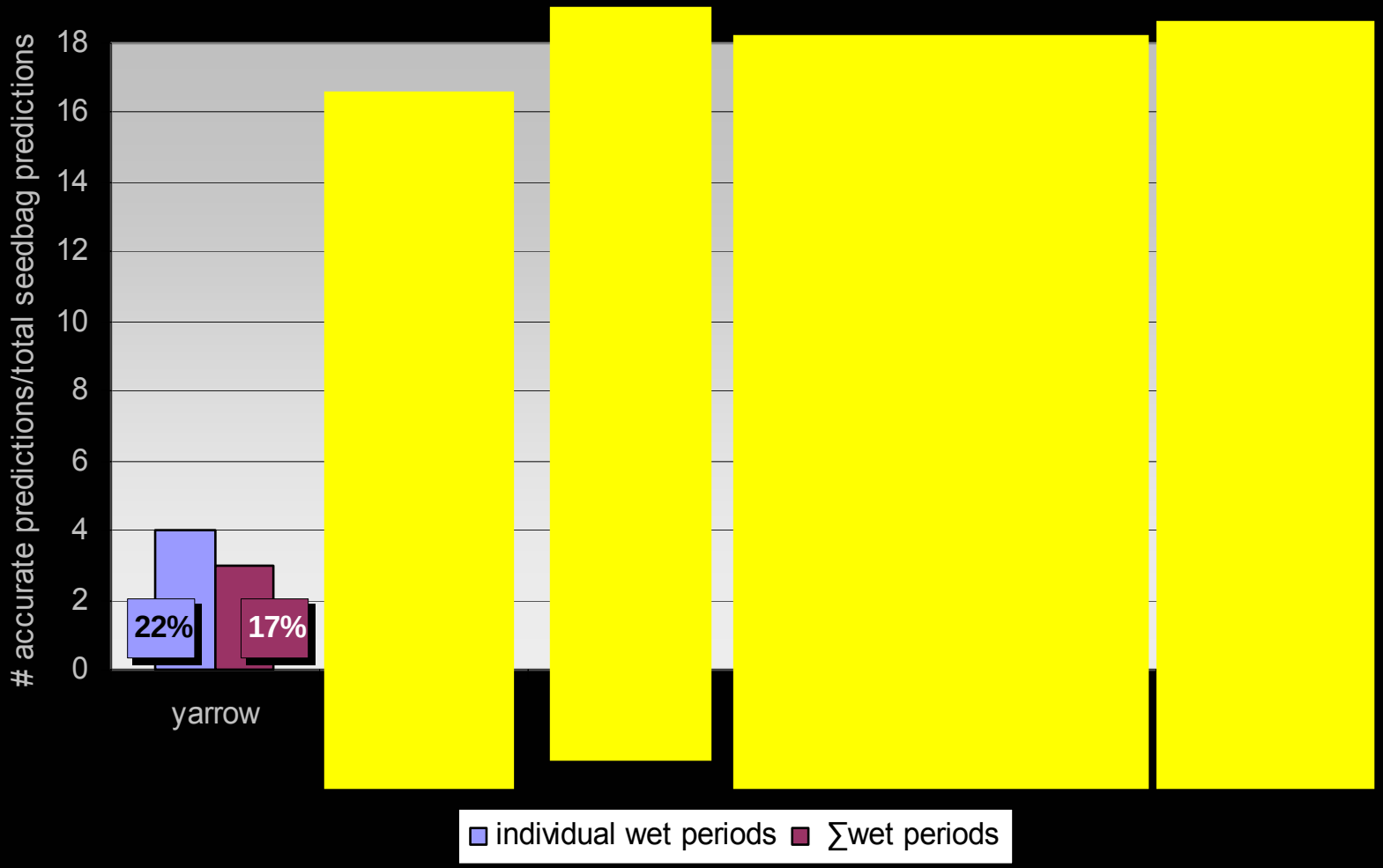
Wet Thermal Accumulation Model Accuracy: Lookout Pass



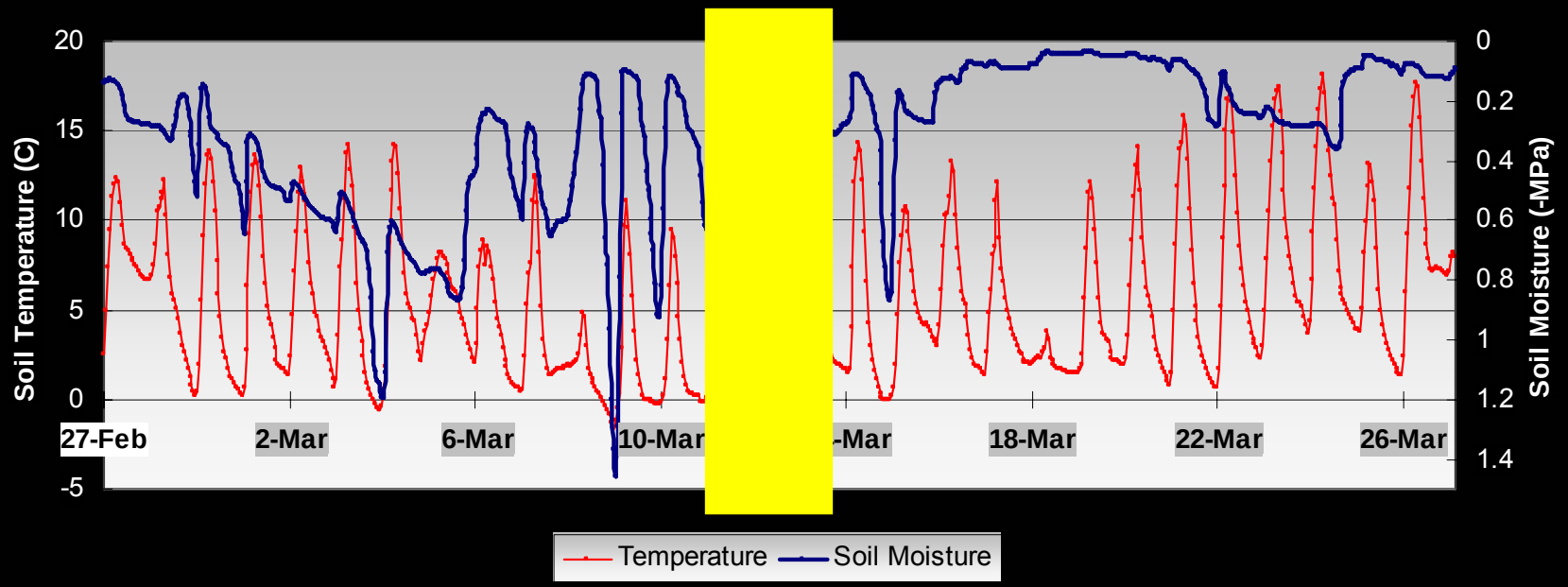
Wet Thermal Accumulation Model Accuracy: Skull Valley



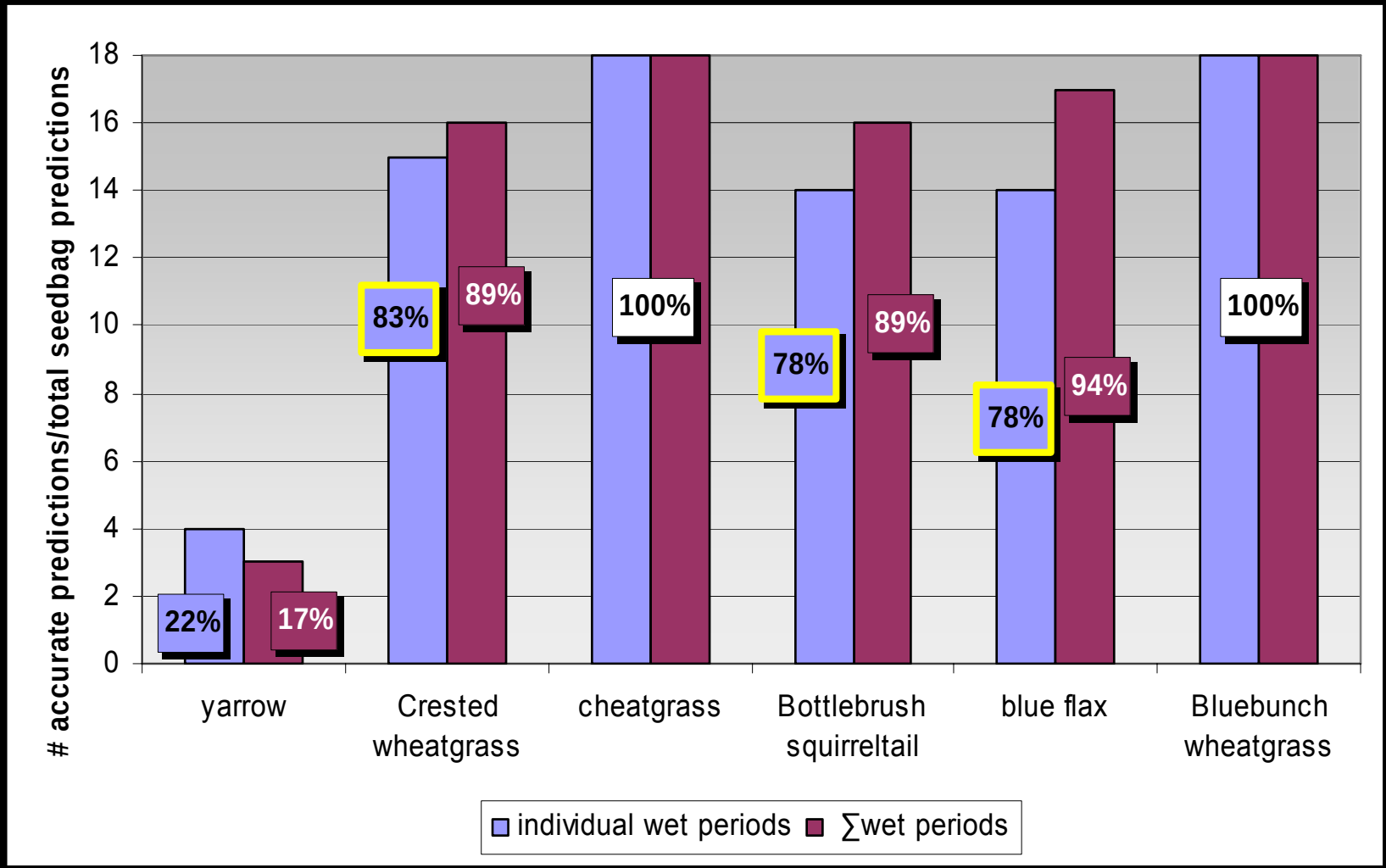
Wet Thermal Accumulation Model
Accuracy: Skull Valley



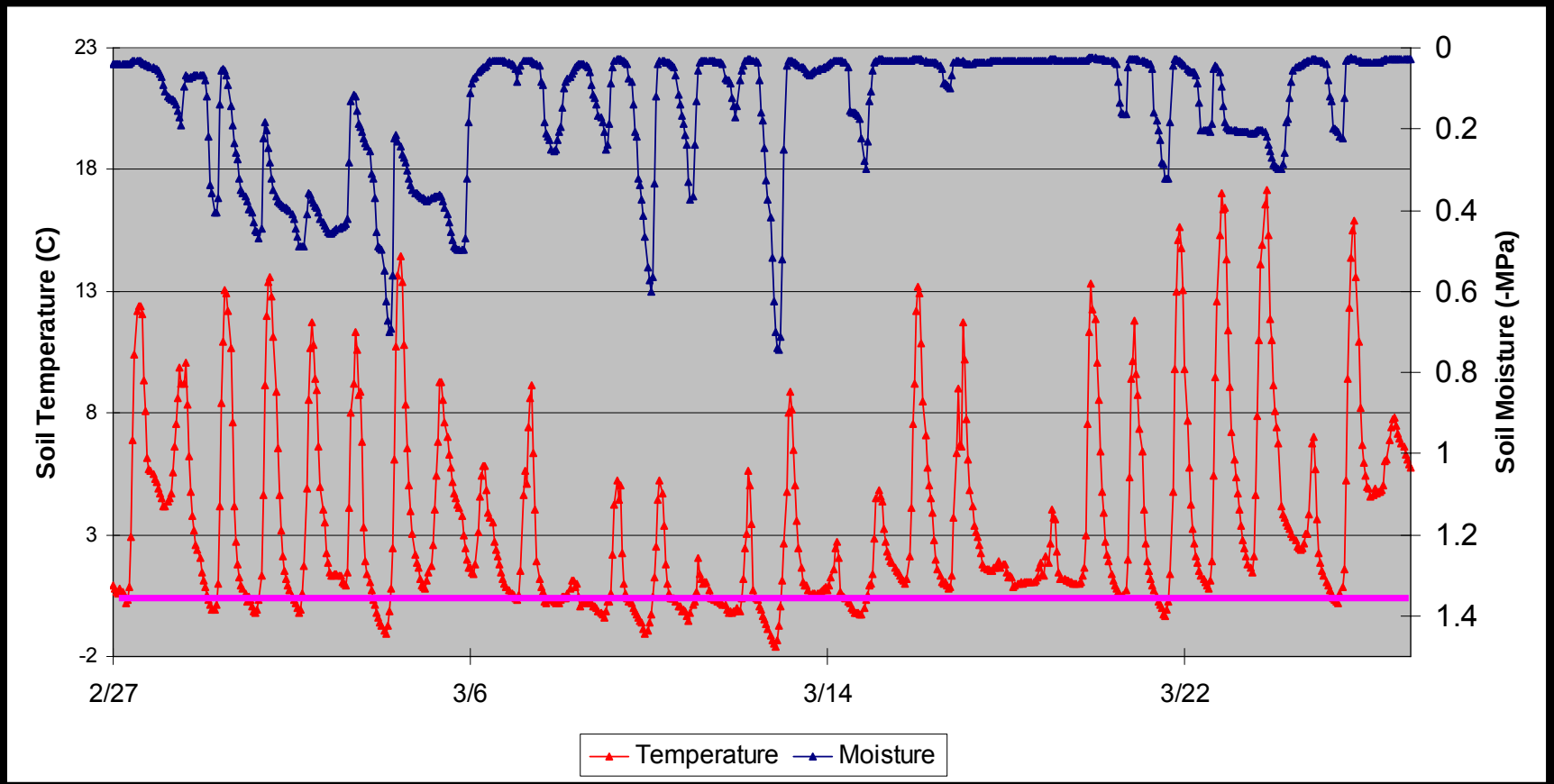
Seedbag Retrieval 4
2/27-3/28/06



Wet Thermal Accumulation Model Accuracy: Skull Valley



Seedbed Conditions:
Lookout Pass

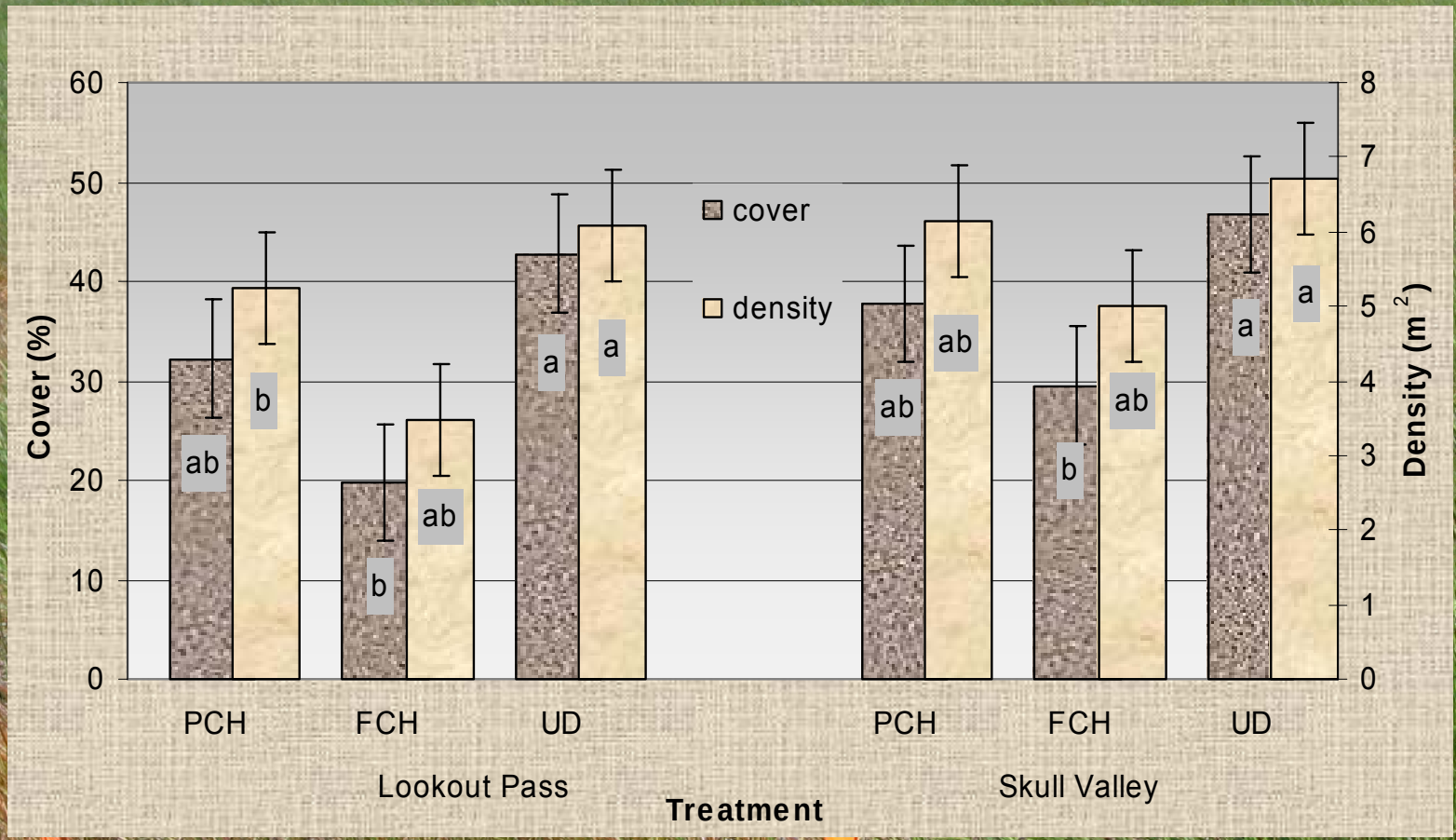


Small Plots

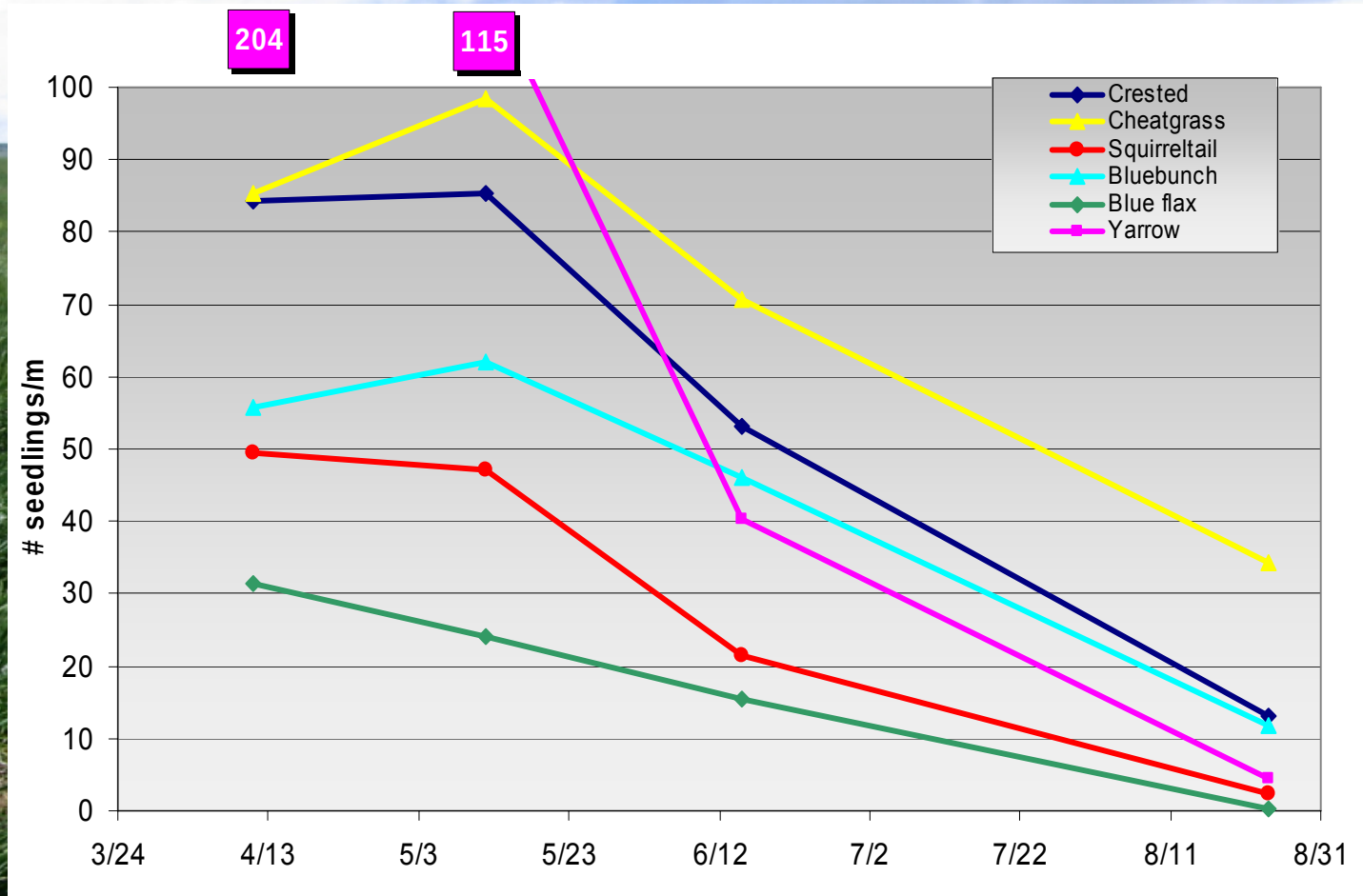
Block	Year	
1	1	Small Plots
		Seedbags
	2	Small Plots
		Seedbags
2	1	Small Plots
		Seedbags
	2	Small Plots
		Seedbags
3	1	Small Plots
		Seedbags
	2	Small Plots
		Seedbags
4	1	Small Plots
		Seedbags
	2	Small Plots
		Seedbags

Treatments

Crested wheatgrass

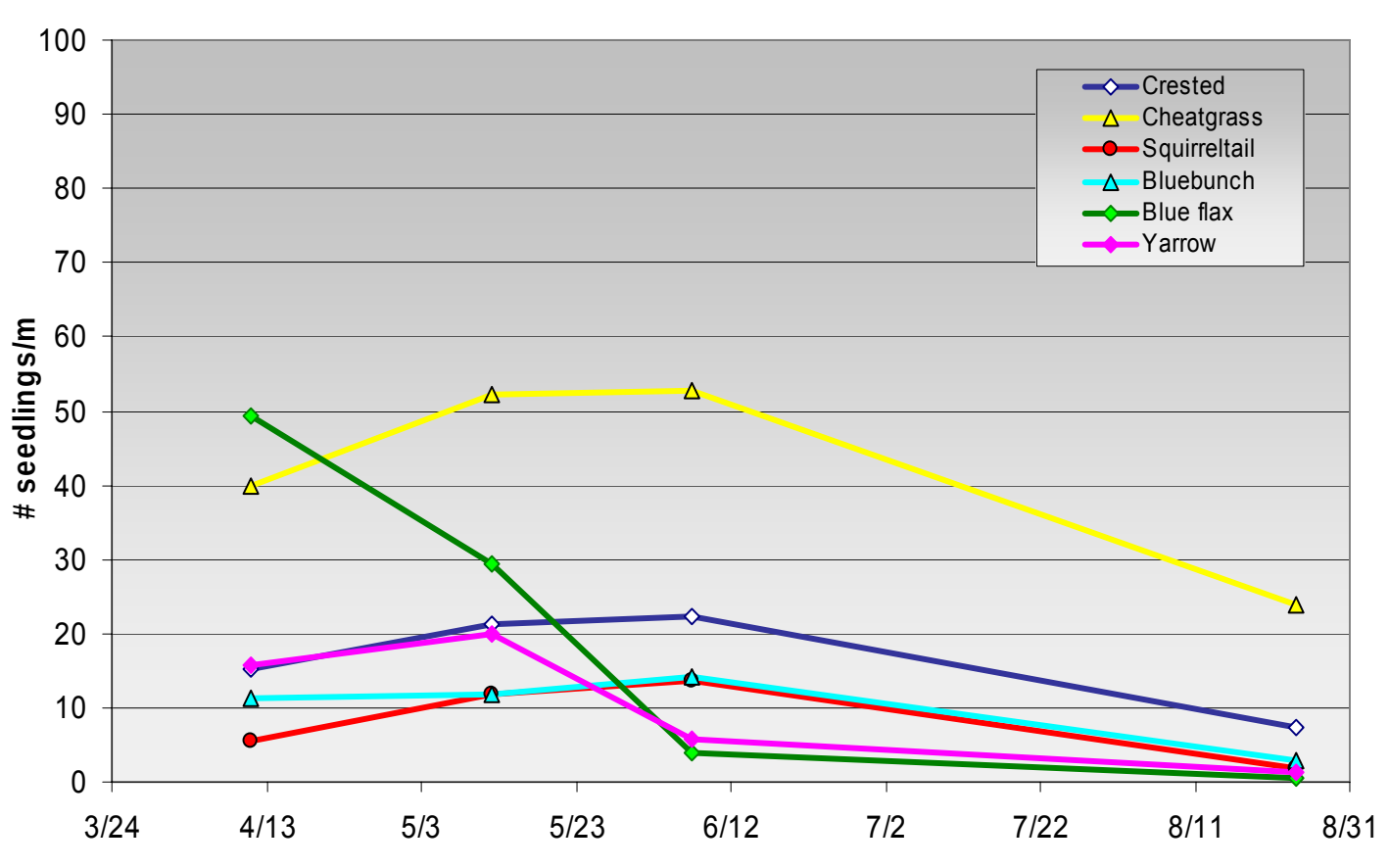


Seedling Density and Survival 2006 Lookout Pass

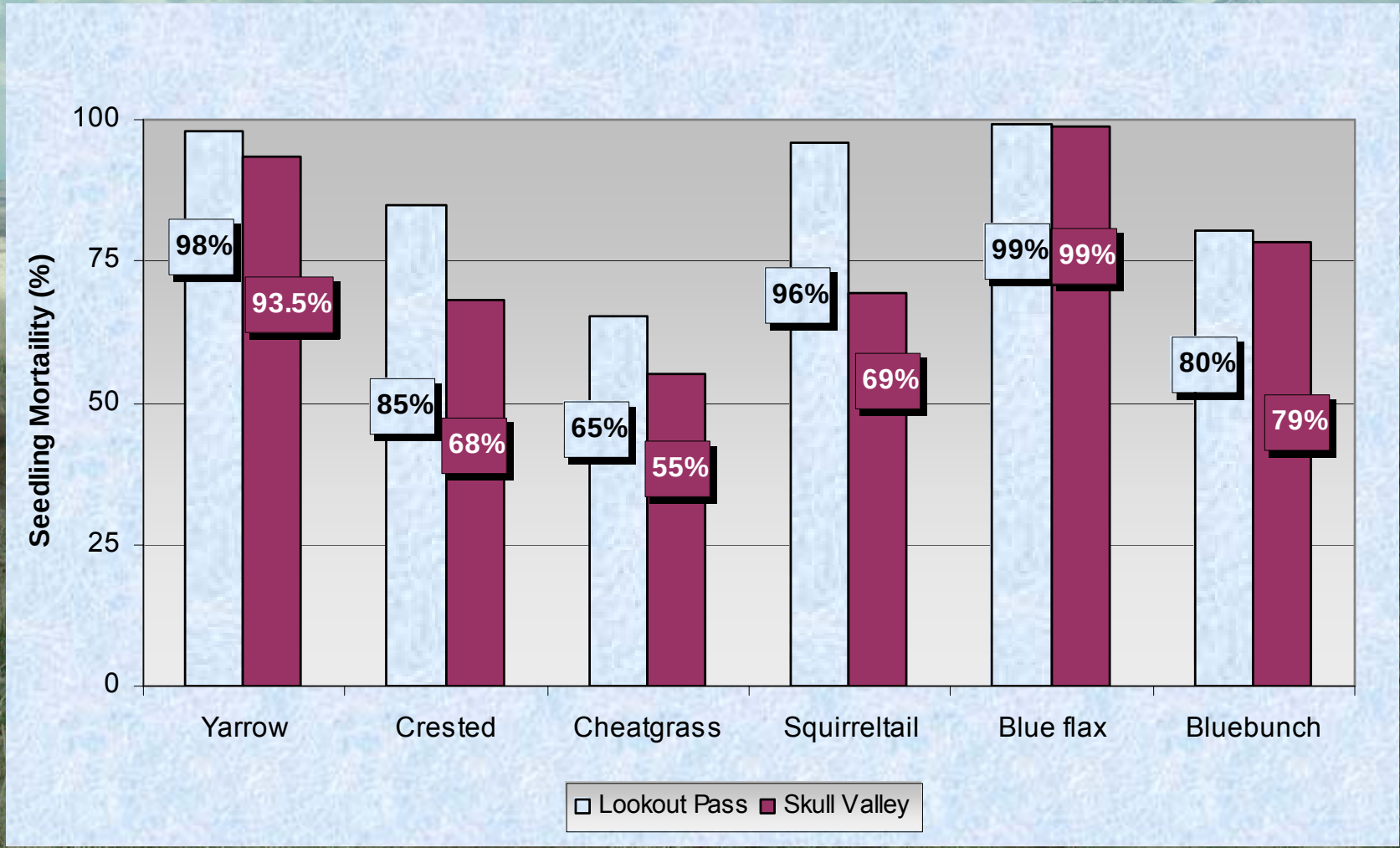


Seedling Density and Survival 2006

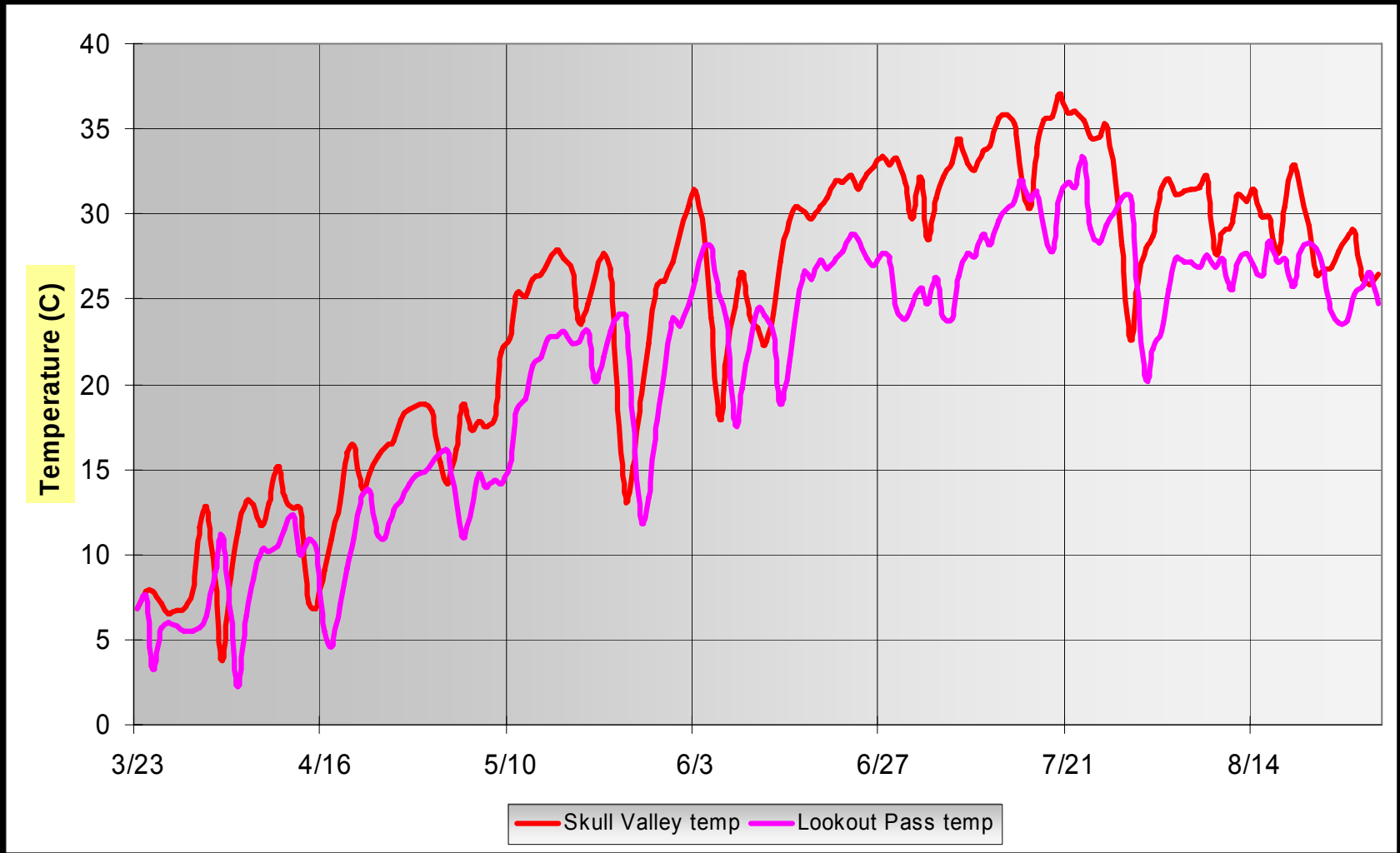
Skull Valley



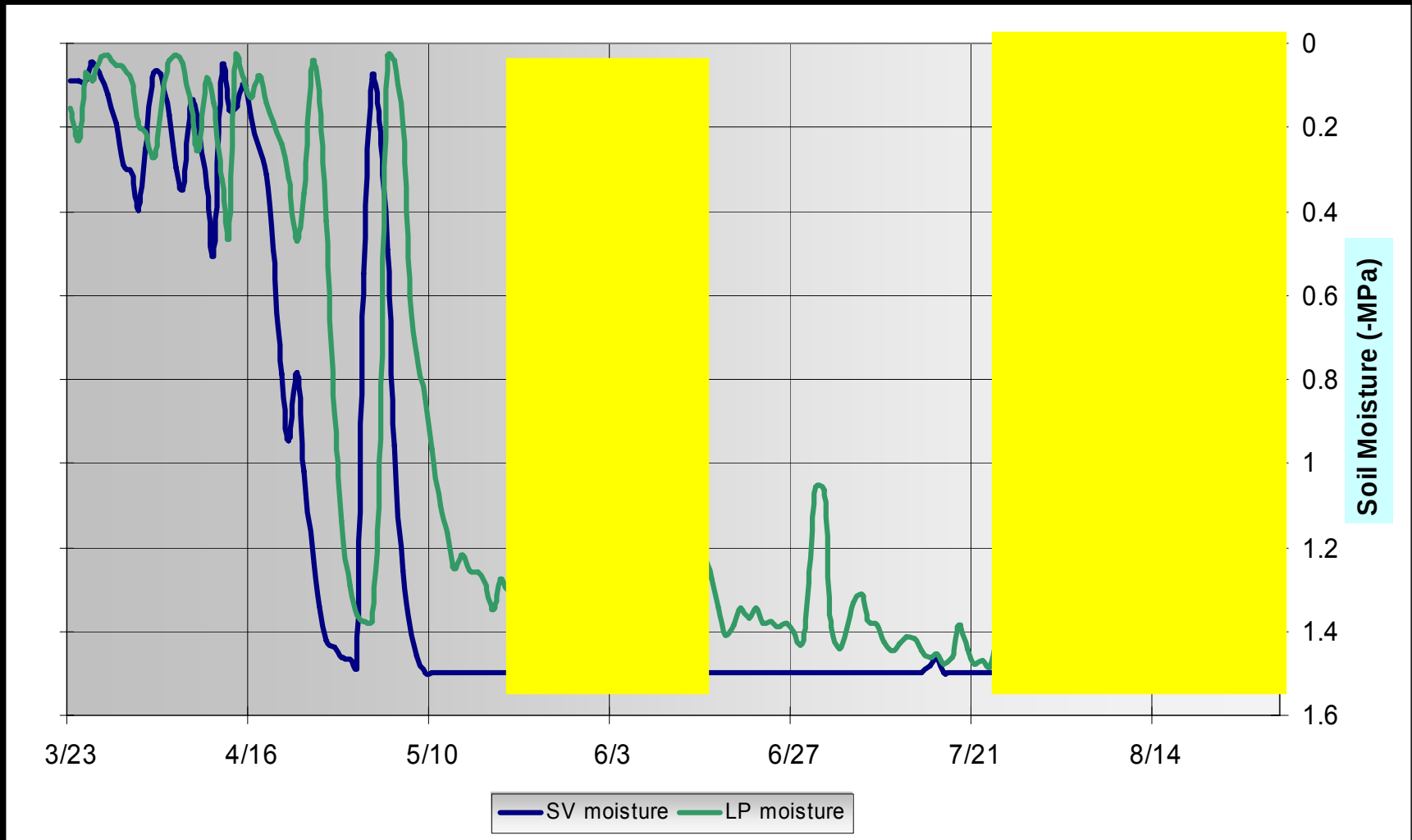
Seedling Mortality



Seedbag Conditions



Seedbag Conditions



Conclusions

- Can a wet thermal accumulation model be used to predict germination?
  - Yes, if no special requirements are needed for germination
    - Ex: light for yarrow
- Precautions:
  - Cold conditions
  - High temperature and moisture fluctuations

Further Research

- Fall 2006 and Spring 2007 seedbag retrievals
- Spring and Summer 2007 small plot readings
- Modelling emergence and survival: Root growth


Questions?