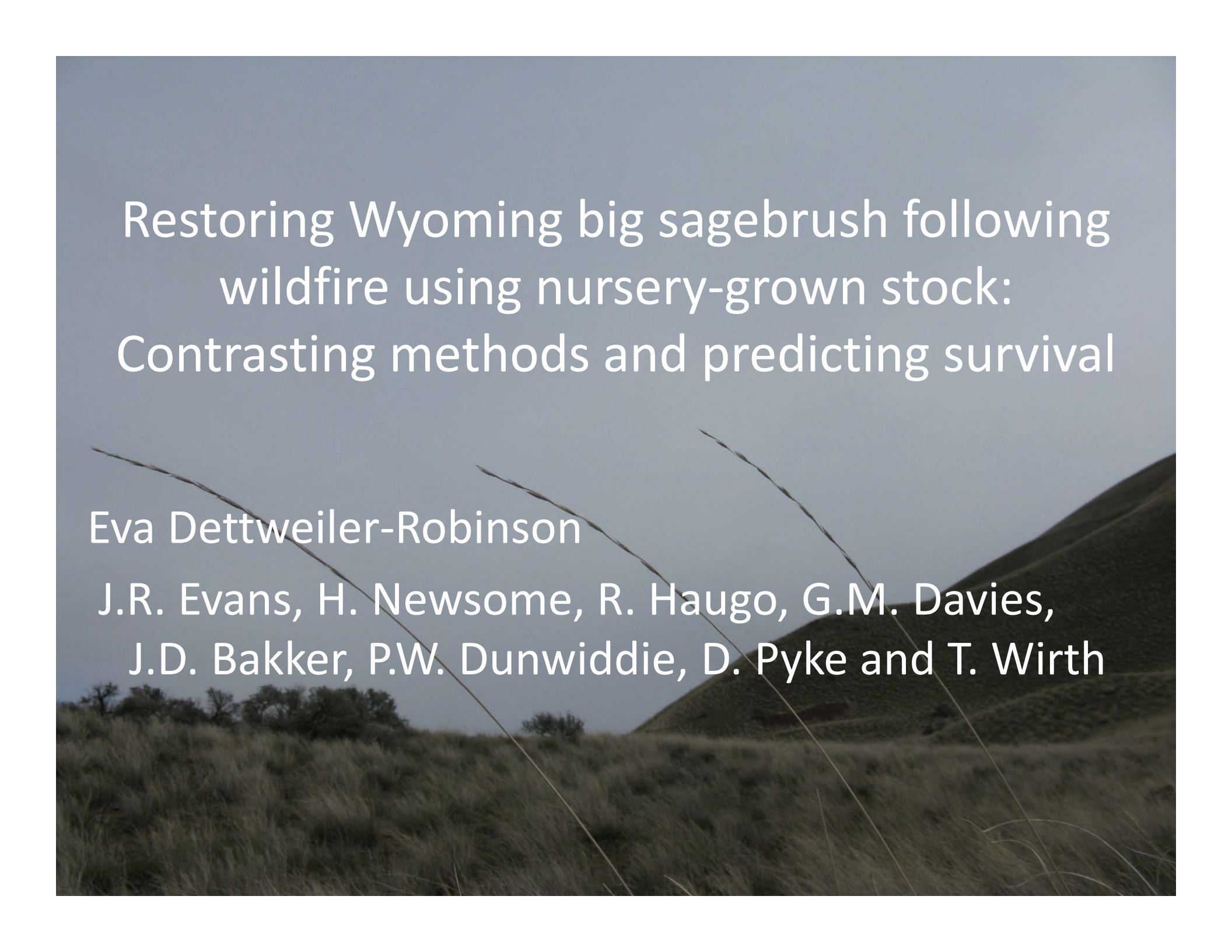


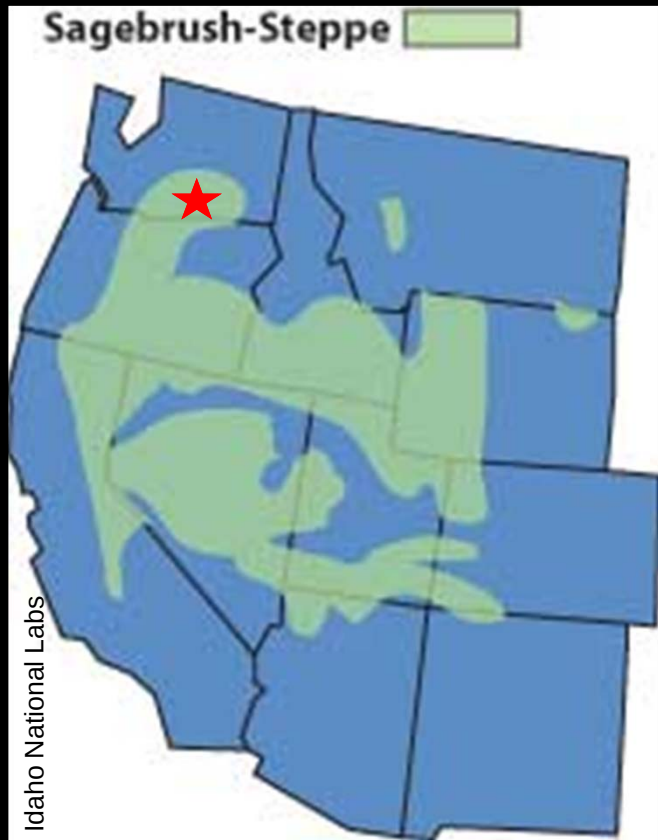


# Restoring Wyoming big sagebrush following wildfire using nursery-grown stock: Contrasting methods and predicting survival

Eva Dettweiler-Robinson

J.R. Evans, H. Newsome, R. Haugo, G.M. Davies,  
J.D. Bakker, P.W. Dunwiddie, D. Pyke and T. Wirth

# Extent and Characteristics



- dominated by perennials
- ~ 100 year fire return interval
- endangered obligate species

# Threats

V

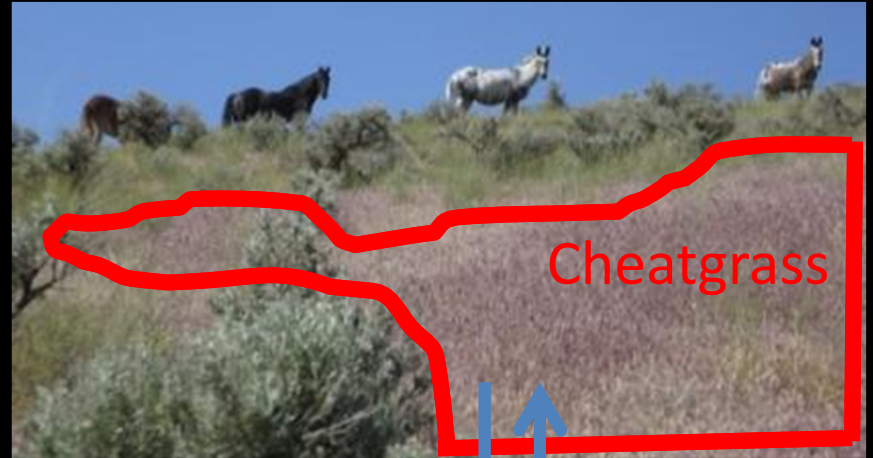
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• short-lived seedbank

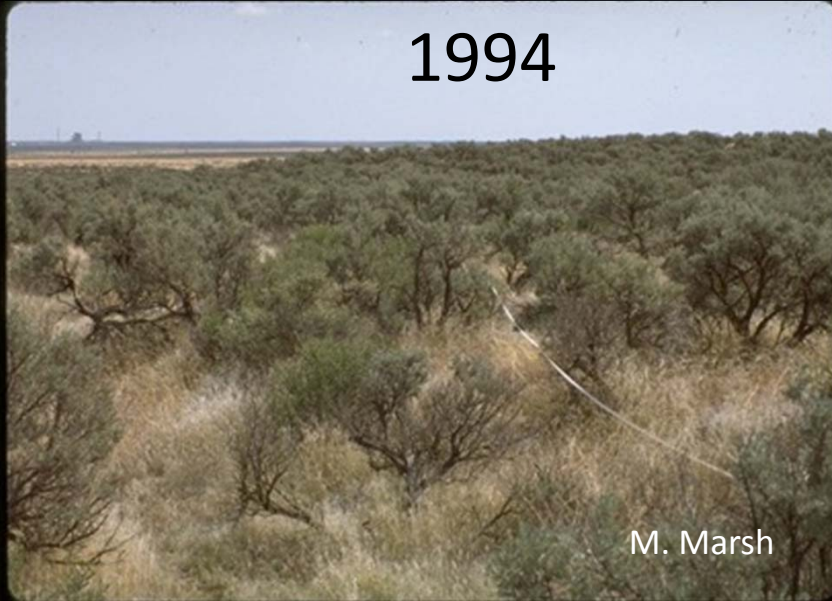
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2000 fire  
30,000 ha burned

# Arid Lands Ecology Reserve

1994



M. Marsh

2001



J. Evans



D. Wilderman



J. Evans

# Questions

- How best to reintroduce sagebrush?
- Does seedling stress predict future survival?



# Methods

- Nursery grown from locally collected seed
- Professional contractors planted over 1,000,000 seedlings
- Site Selection
  - Low cheatgrass density
  - Good bunchgrass cover
  - Connect remnant sagebrush patches
  - Near roads



# Tubelings/ Container stock



USFWS

4 in<sup>3</sup> or 10 in<sup>3</sup>  
(140 cm<sup>3</sup> or 340  
cm<sup>3</sup>)

# Bare root

## Control



## Inoculated



Hydrogel

Mycorrhizae

1

2

# Cohorts

2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010

**FIRE** **FIRE**

Planted 1 2 3

Planted 1 2 3 7 8

Planted 1 2 3



## Monitoring

2001, 2002

- 45 transects total, 100 plants on each
- Monitored each individual
  - Alive
  - Dead
  - Stressed

2007

- 30 transects
- Recorded density

## Analysis

- Generalized Linear Modeling using quasibinomial distribution

# Results

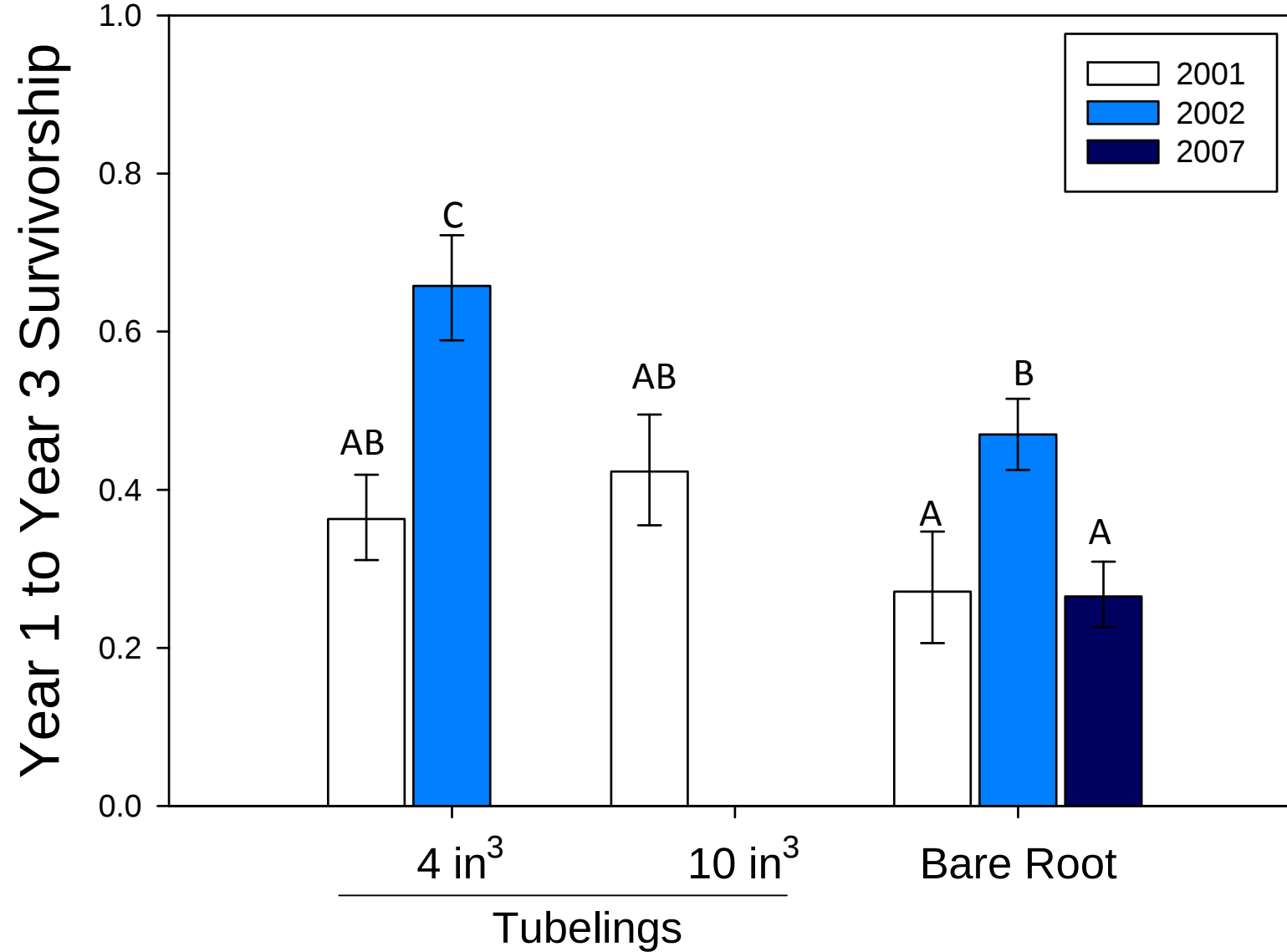
- Planting sites did not differ significantly in abiotic or vegetation characteristics
- Overall 3 year survivorship of 2001 and 2002 cohorts was 28%

## Questions

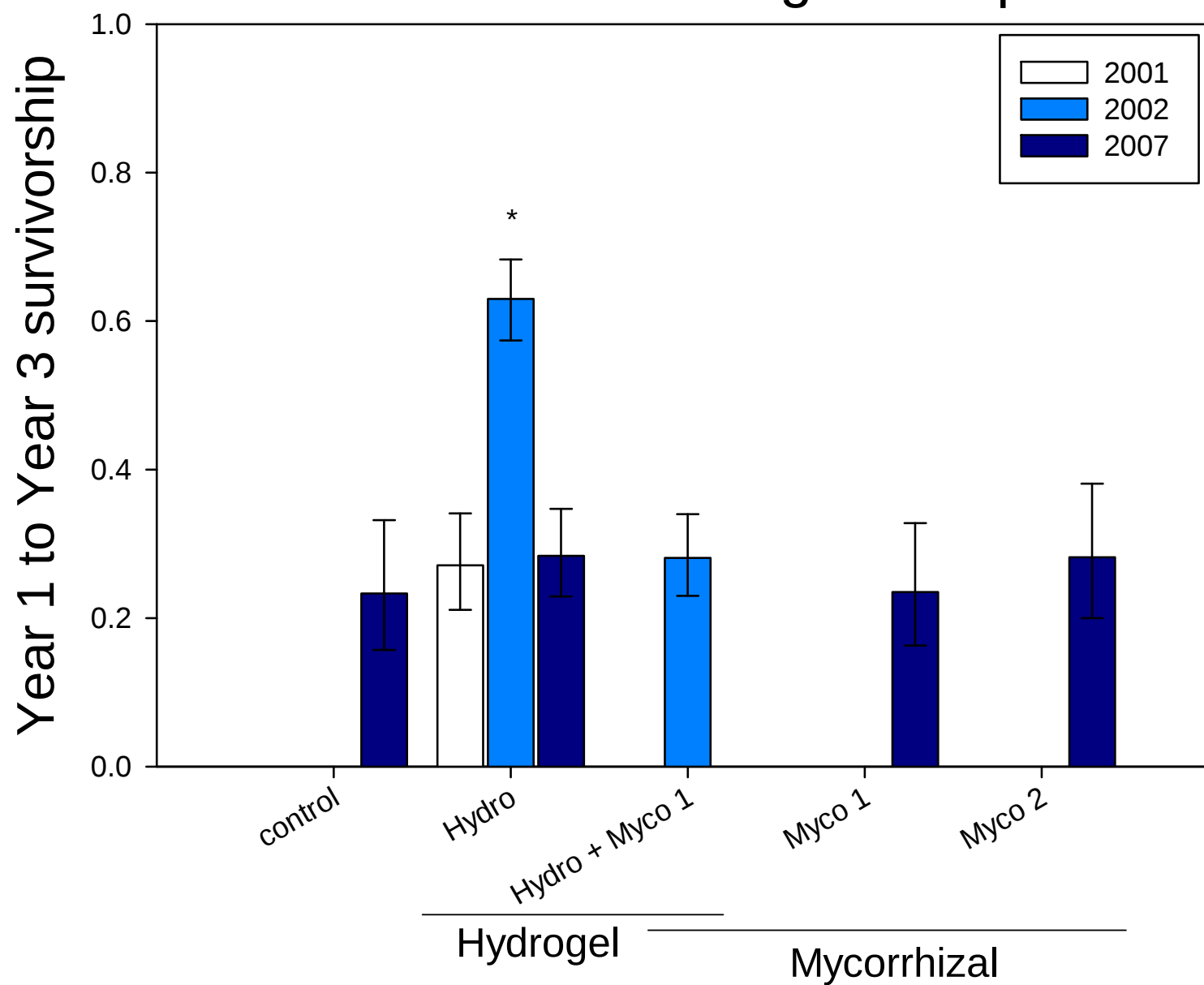
- **How best to reintroduce sagebrush?**
- Does seedling stress predict future survival?



# Planting Stock Type

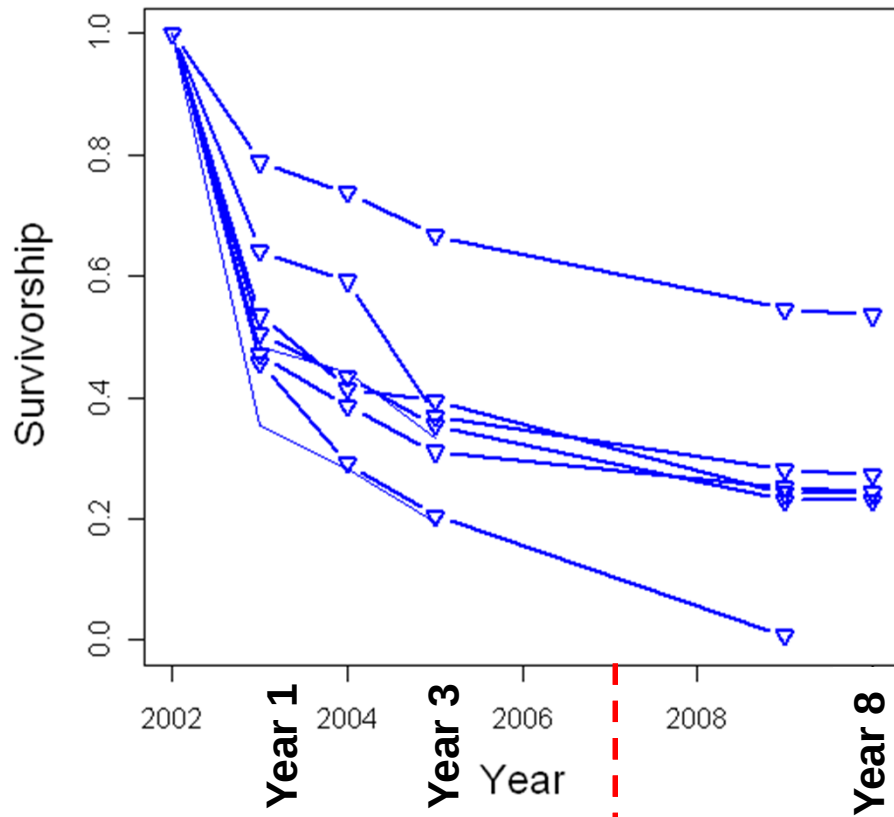


# Bare Root Planting with dips

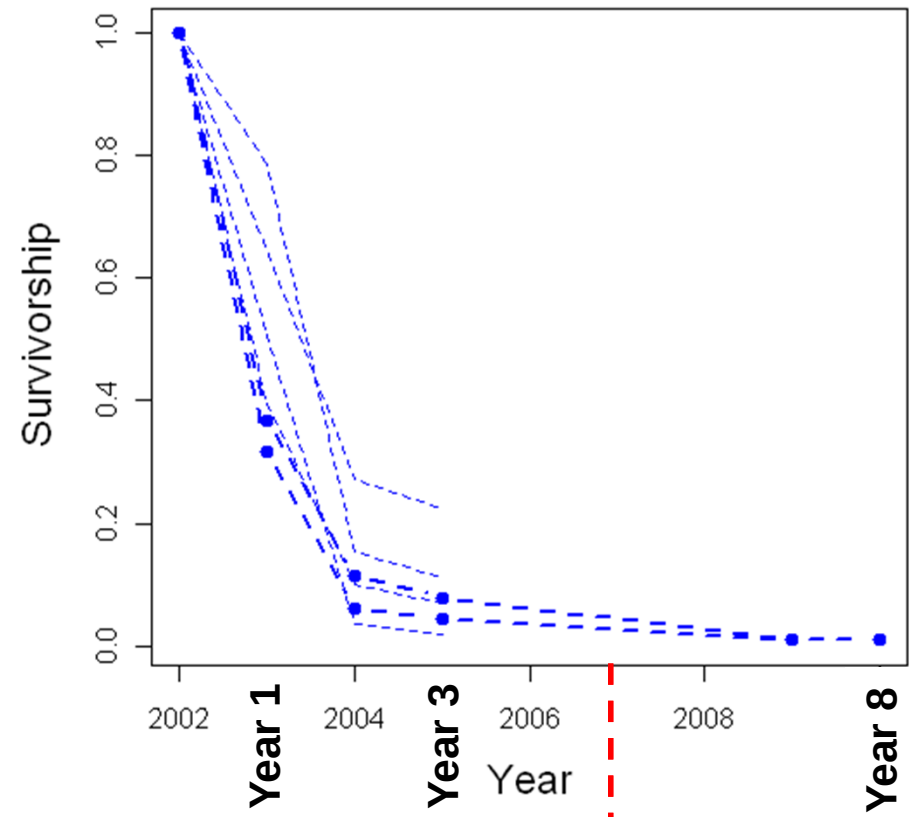


# Survivorship over time

2002 Cohort: 4 in Tubeling



2002 Cohort: Bare root + Hydro + Myco 1



# How best to reintroduce sagebrush?

- Overall, tubelings had better survivorship
- Little difference in survivorship with different inoculant
- Higher year 1 survivorship indicated higher longer term survivorship
- Year 3 survivorship was similar to year 8 survivorship

# Cost Effectiveness

## Bare Root

### Pros:

- Larger size initially
- Begin flowering sooner
- Easier to scale up production

### Cons:

- Variable survival

## Tubelings

### Pros:

- Easier to install
- Consistent survival

### Cons:

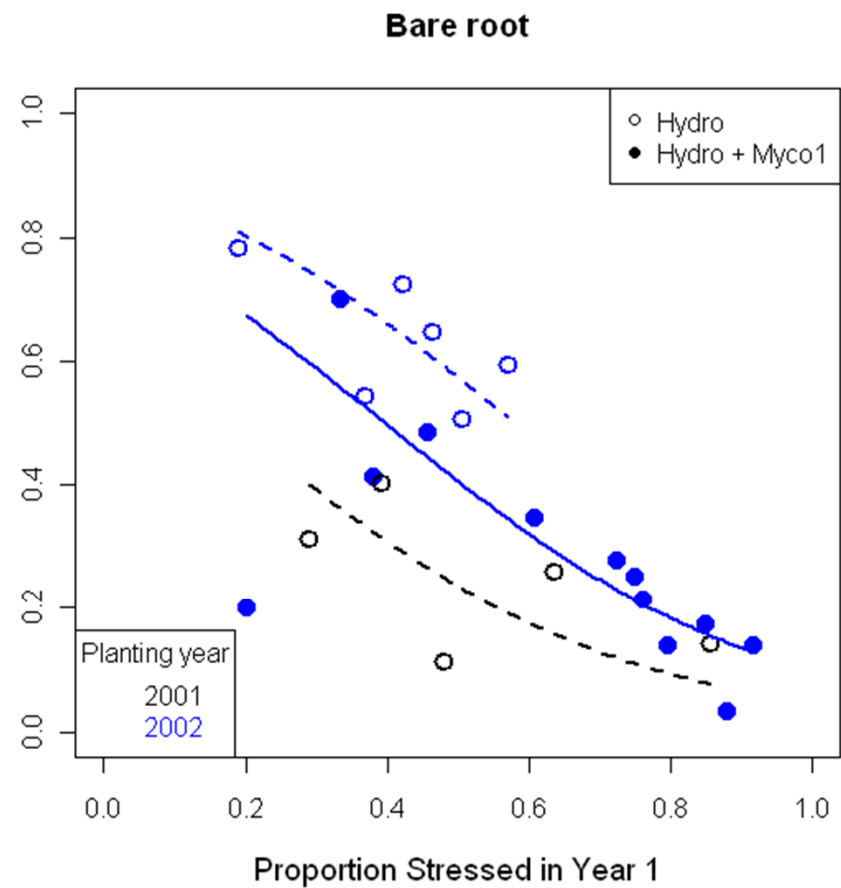
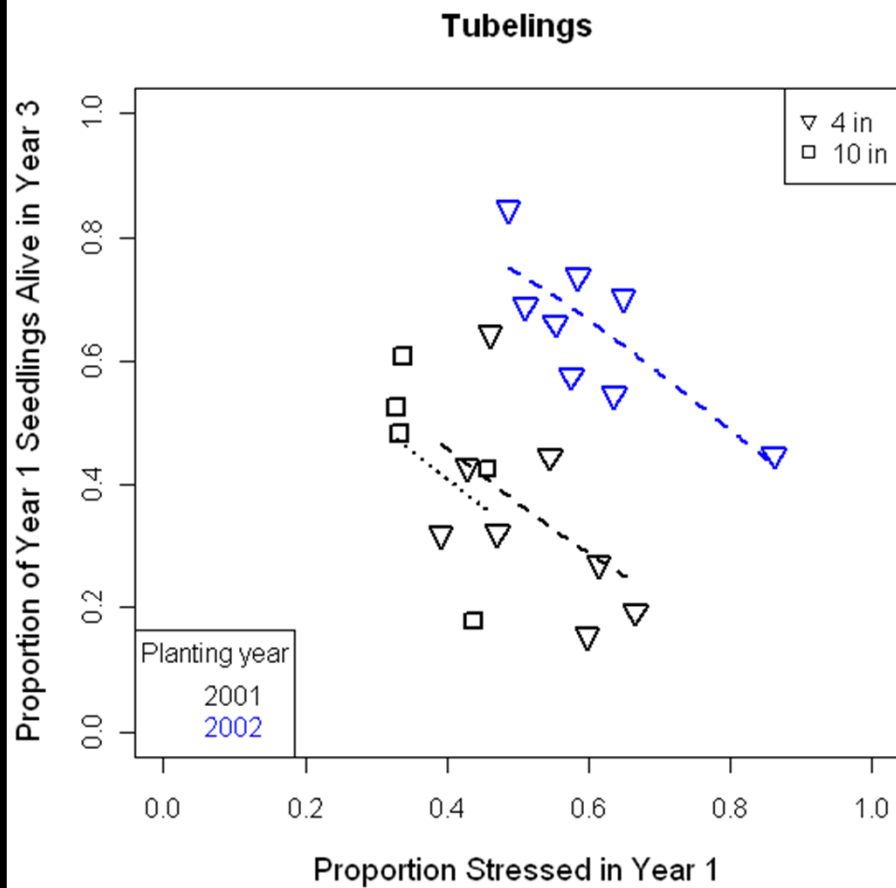
- Longer time to flowering
- Monitoring more intensive due to small size

# Questions

- How best to reintroduce sagebrush?
- **Does seedling stress predict future survival?**



# Stress and survival



# Does seedling stress predict future survival?

- Plantings with lower proportion stressed in the first year had higher survivorship from year 1 to year 3
- More stressed plants survived to year 3 in 2002 cohort



# Consideration for repeated disturbances

## Protect seedlings

- Aerial spraying of herbicide
- Aerial seeding
- Maintain fire breaks
- Prevent human ignitions



# Conclusions

- Planting year had a strong effect on survivorship
- Small tubelings had best survivorship but took longer to become “habitat”
- No difference between inoculation treatments
- First year survival and proportions of stressed plants can help predict longer term survival rates



# Acknowledgements

Michael Gregg

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Greg Hughes

Jeff Howland

Sonia Hall

Many field assistants



# Conclusions

- Planting year had a strong effect on survivorship
- Small tubelings had best survivorship but took longer to become “habitat”
- No difference between inoculation treatments
- First year survival and proportions of stressed plants can help predict longer term survival rates



# Precipitation in first year after planting

|                        | 2001    | 2002    | 2007    |
|------------------------|---------|---------|---------|
| December –<br>November | 3.85 cm | 8.54 cm | 5.07 cm |

# How quickly plantings become habitat

| 2002 Cohort                                                    | Bare Root<br>Hydro +<br>Myco | Bare Root<br>Hydro | 4 in <sup>3</sup><br>Tubelings |
|----------------------------------------------------------------|------------------------------|--------------------|--------------------------------|
| Individuals<br>flowering per<br>total planted<br>after 3 years | 3%                           | 14%                | 5%                             |

# Goals for Management

- Protect and restore the native habitats and biodiversity of the Hanford shrub-steppe ecosystem.
- Monitor, protect, and recover native plants and animals that are federally or state listed and any other species that are in any other way considered sensitive.