Reestablishing the competitive hierarchy in an invaded California grassland

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Contents:

Habitat Implications

- **Development-ranching and agriculture**

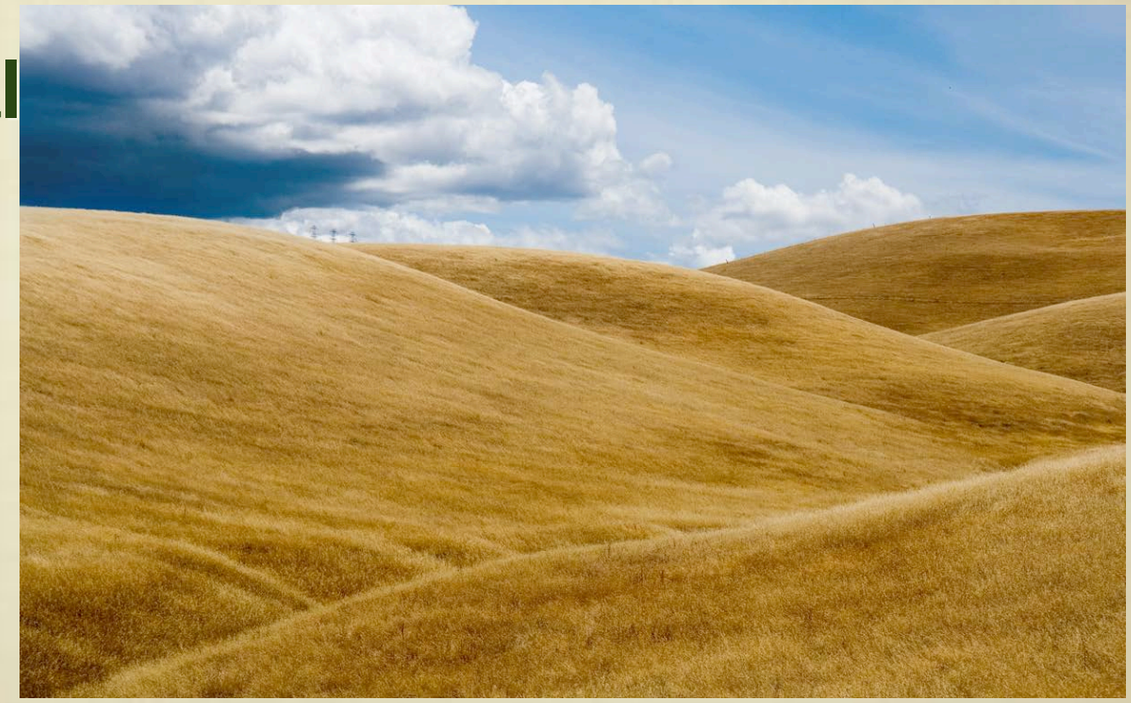
- **Habitat loss and fragmentation**

- **Grasslands have become one of the states most threatened ecosystems** (Noss et al. 1995)

- **Native species account for less that 1% of most grasslands in California today** (Barry et al 2006)

Modern Grasslands

- Dominated with non native annual grasses
- Shallow root systems
- Dense layers of thatch



Invasive Species

- **Deep water resource availability enables further invasion** (Holmes and Rice 1996)

- **Sets the stage for the invasive thistles**

- **Invasion meltdown: The initial invasion of non natives facilitates the introduction of another** (Simberloff and Van Holle 1999)

‘Italian Thistle’ *Carduus pycnocephalus*

‘Star Thistle’ *Centaurea solstitialis*

Yellow Star Thistle

- ***Centaurea solstitialis*** **was introduced to California in the mid 1800's and has spread rapidly** (Maddox and Mayfield 1985)

- **Mature plants have deep tap roots and are capable of producing up to 75,000 seeds**

- ***C. solstitialis*** **is the most widely distributed invasive species in California** (DiTomaso and Healy 2007)

- **Ecological and economic impacts degrading forage**

Competition

- **Invasive plants can compete with native plants for space, light, water, nutrients, and pollinators**

- **Competition has been shown to have strong effects on the distribution and abundance of species in native ecosystems** (Pennings and Callaway 1992)

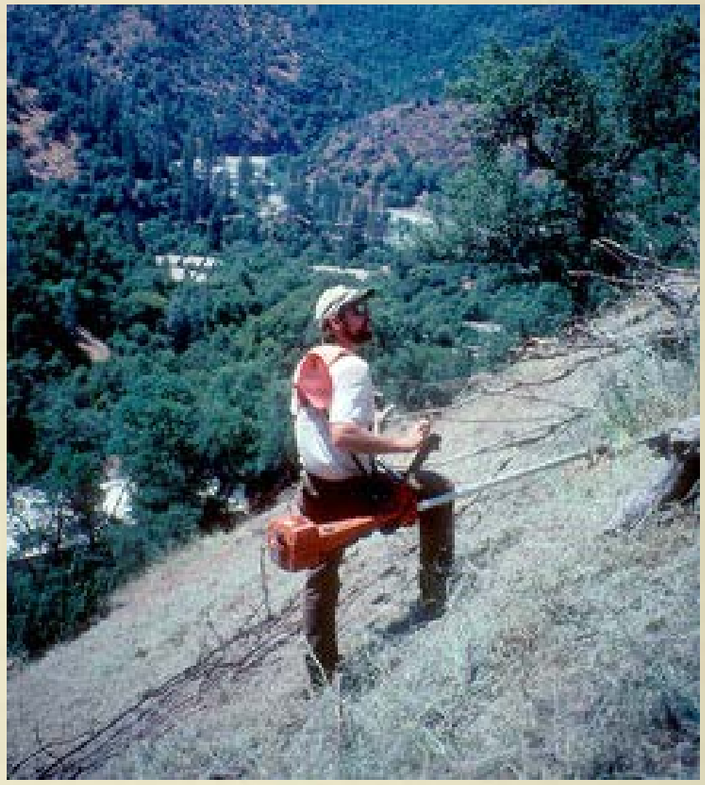
- **Competitive advantages have been found in the context of exotic replacement during disturbance** **(**He et al. 2003, 2009; Skalova and Pysek 2009; Vila and Weiner 2004)

NATIVE FORBES

Close to 90% of the plants listed on California's Inventory of Rare and Endangered Species occur within grasslands (Skinner and Pavlik 1994)

Management

- ***C. solstitialis*** **is currently being managed with herbicides, biocontrols, grazing, burning, mowing, and hand removal.** (DiTomaso and Healy 2007)



Prescribed Burns

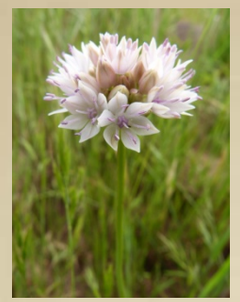
- **Fire is a natural process and a fundamental component of California's ecology** (Hatch et al. 1991)

- **Prescribed burns for *C. solstitialis* were carried out at the Big Chico Creek Ecological Reserve and Upper Bidwell Park in Chico, California in October of 2012**

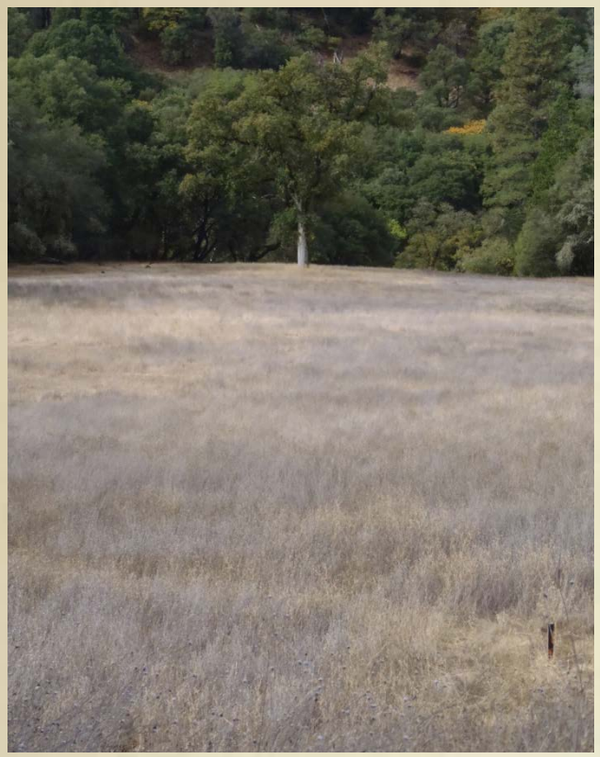
- **Plant communities show increased diversity following fire (Kruger 1983)**

Rx Burn Dynamics

- Duration of suppression- layers of built up thatch
- Weather wind/rain conditions
- Seasons- Spring/Summer/Fall Burn
- Permitting process



The Effect of Fire



- **Research has shown prescribed burns to decrease *C. solstitialis* seed bank and seedling density by 99%** (DiTomaso et al. 1999)

- **Plant communities show increased diversity following fire** (Kruger 1983) **and native forb diversity in grasslands** (DiTomaso et al. 1999)

- **Monitoring 3 years later found they had returned to the preburned state** (Keyser and DiTomaso 2002)

Succession

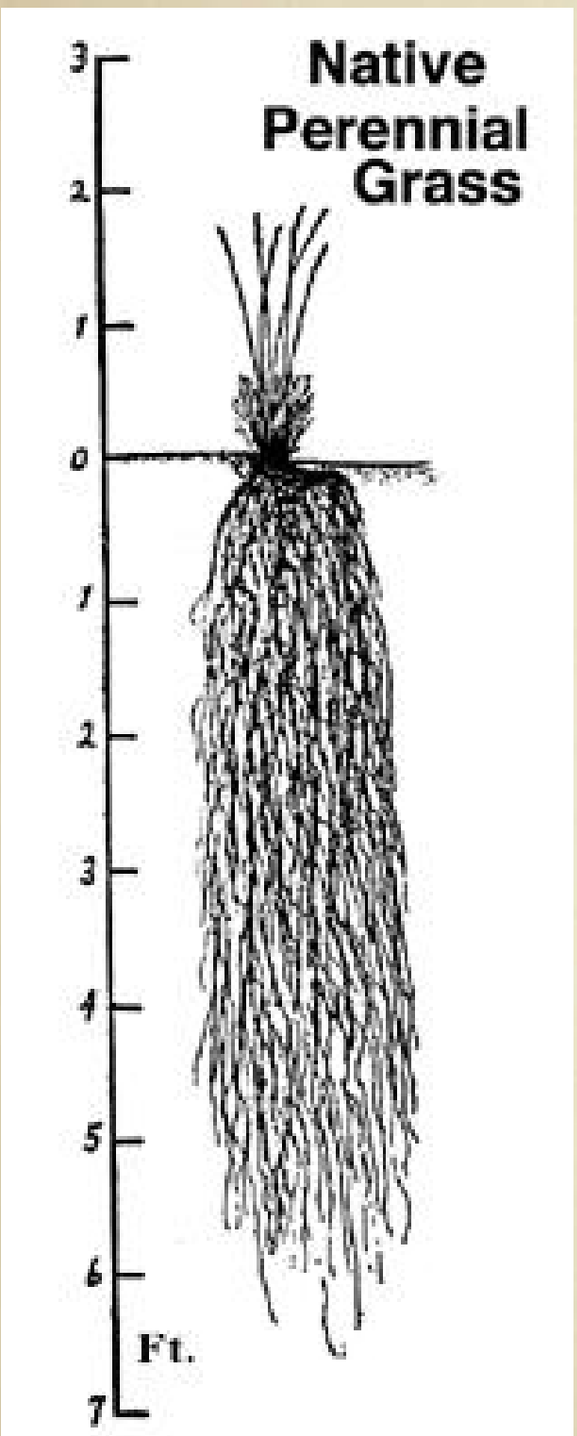
- **Early succession colonizers such as annual grasses quickly become established**
- **Thought to be competitively superior due to having greater seed production** (Heady et al. 1977, Bartolome and Gemmill 1981, Murphy and Ehrlich 1989)
- **Enabling them to overtake ground cover**

Resource distribution

- **Native perennial grasses have been shown to outcompete exotic grasses using seeding treatments in the field** (Seabloom et al. 2012)

- **Once native perennial grasses have established they have been shown to be effective competitors** (White 1967, Jackson and Roy 1986, Dyer and Rice 1997)

Native Grasses



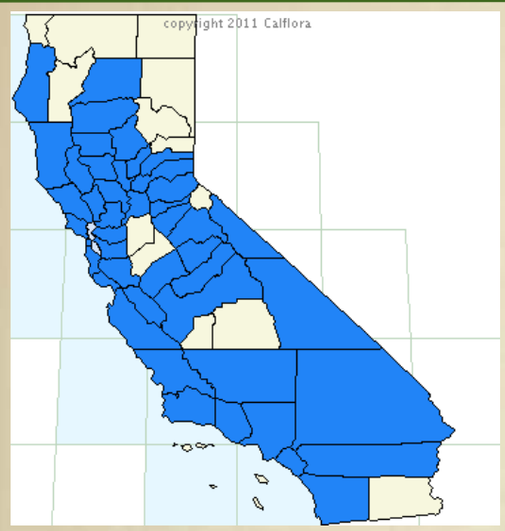
- **Their roots compete for deep water resources**
- **Shown to impede *C. solstitialis* establishment** (Morgan and Rice 2005)
- **They provide open pockets for oak saplings and native forbes**

Role of Restoration

- Native grassland species seeds were collected from with in the watershed of the burn sites in the summer of 2012

- Propagation began at a local native nursery in September 2012

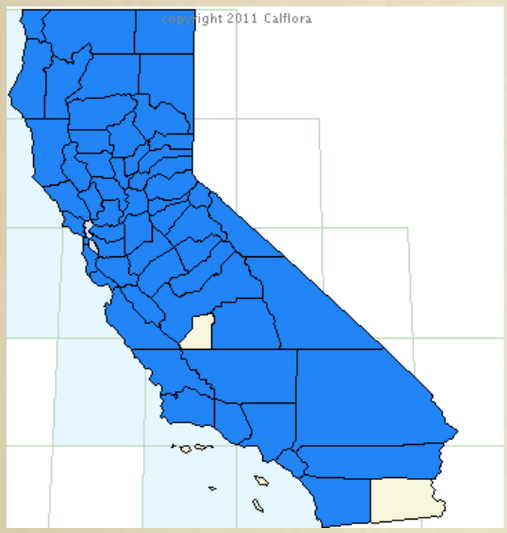
Perennial Grass Species



Purple Needle Grass

Stipa pulchra

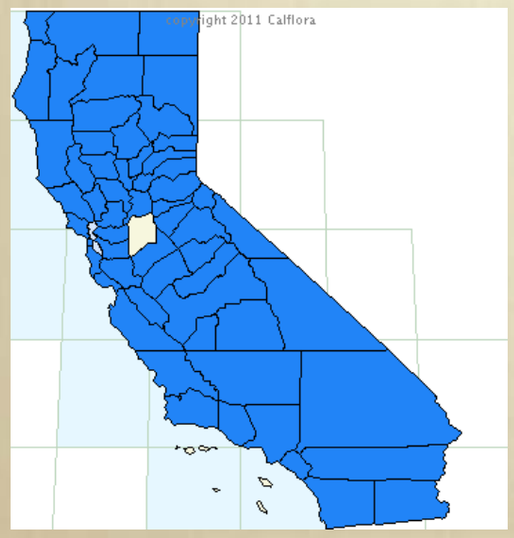
plugs



Blue Wild Rye

Elymus glaucus

plugs

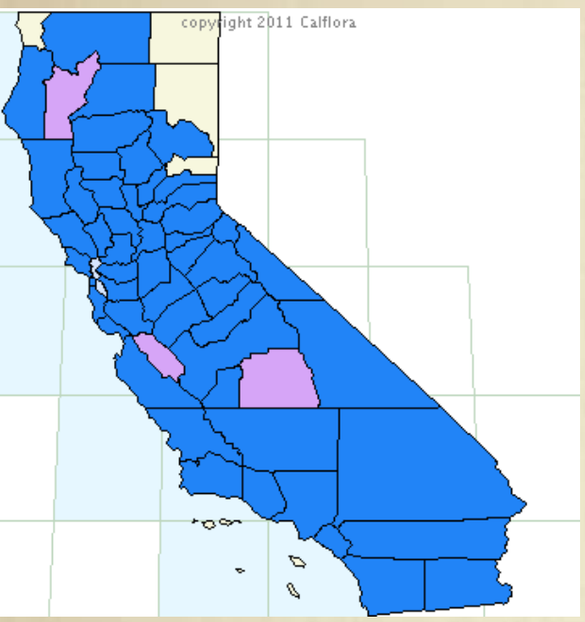


California Brome

Bromus carinatus

plugs

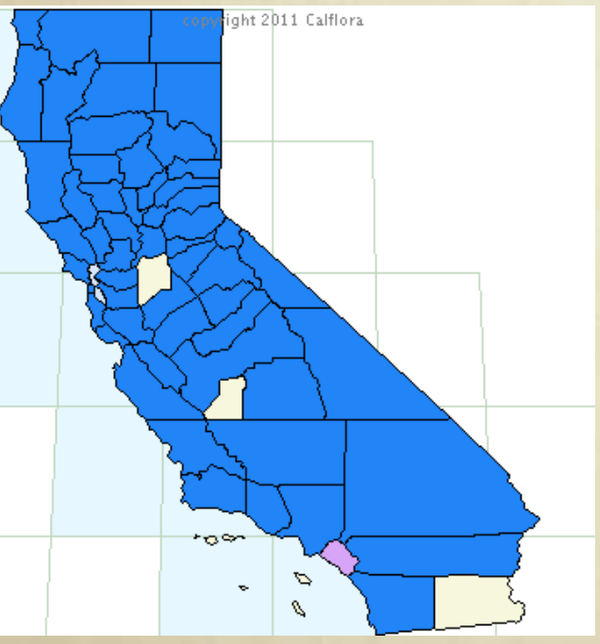
Asteraceae

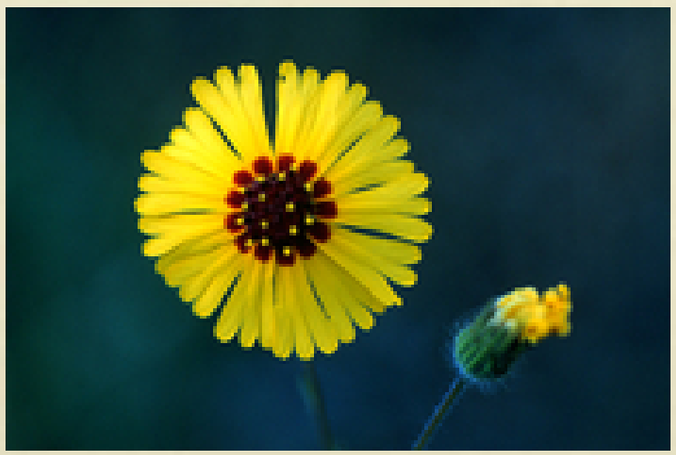


Great Valley Gumplant

Grindelia camporum

plugs





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Tarweed

Madia elegans

Direct seed

Experimental Design

- **Three (4 x 7 m) blocks were established within the two burned fields in each site**
- **Blocks were then divided into 1 m² plots using a systematic randomization**
- **Each 1 m² plot was assigned an individual species treatment (2 direct seeding, 4 plugs, and a Control)**
- **Each treatment was then repeated four times within each of the blocks**

Block Design

7	1	2	3
6	7	1	2
5	6	7	1
4	5	6	7
3	4	5	6
2	3	4	5
1	2	3	4

Treatments

1=*Stipa pulcra*
2=*Bromus carinatus*
3=*Elymus glaucus*
4=*Madia elegans*
5=Control
6= Mixed Grasses
7=*Grindelia camporum*

Direct Seed Treatments

- Seeds were weighed, divided, and evenly distributed to each of the 1 m² treatment plots

  6,000 *Madia elegans* seeds (250 per plot)
  14,400 Mixed Grass seeds (600 per plot)

- Seeds were then spread evenly and raked in during December of 2012

A

B

C

D

A) Stipa pulcra
B)Bromus carninatus
C)Elymus glaucus
D)Madia elegans

Outplanting

- Each 1 m² plot received 16 six inch plugs of each individual native species

- Planting of 1,152 grass plugs along with 216 *G. camporum* was completed in January of 2013

Monitoring

- **Tracked the survival rates of the plugs**

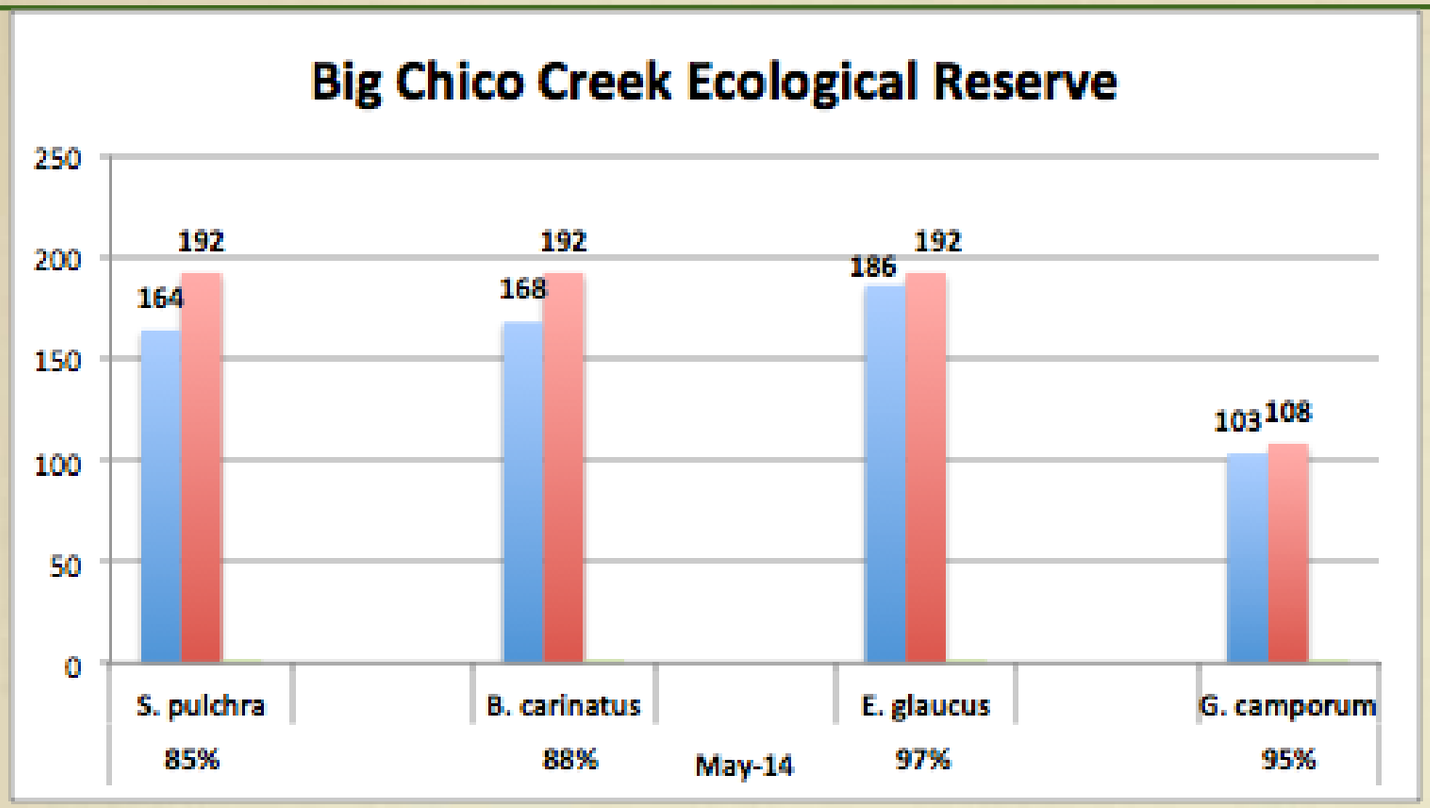
- **Cover values were taken once a month from March 2013-May 2014 using:**
  - **% cover of native species treatment**
  - **% cover of *C. solstitialis***
  - **% cover of non native grass species**
  - **% cover of non native forbes**
  - **% cover of native forbes**

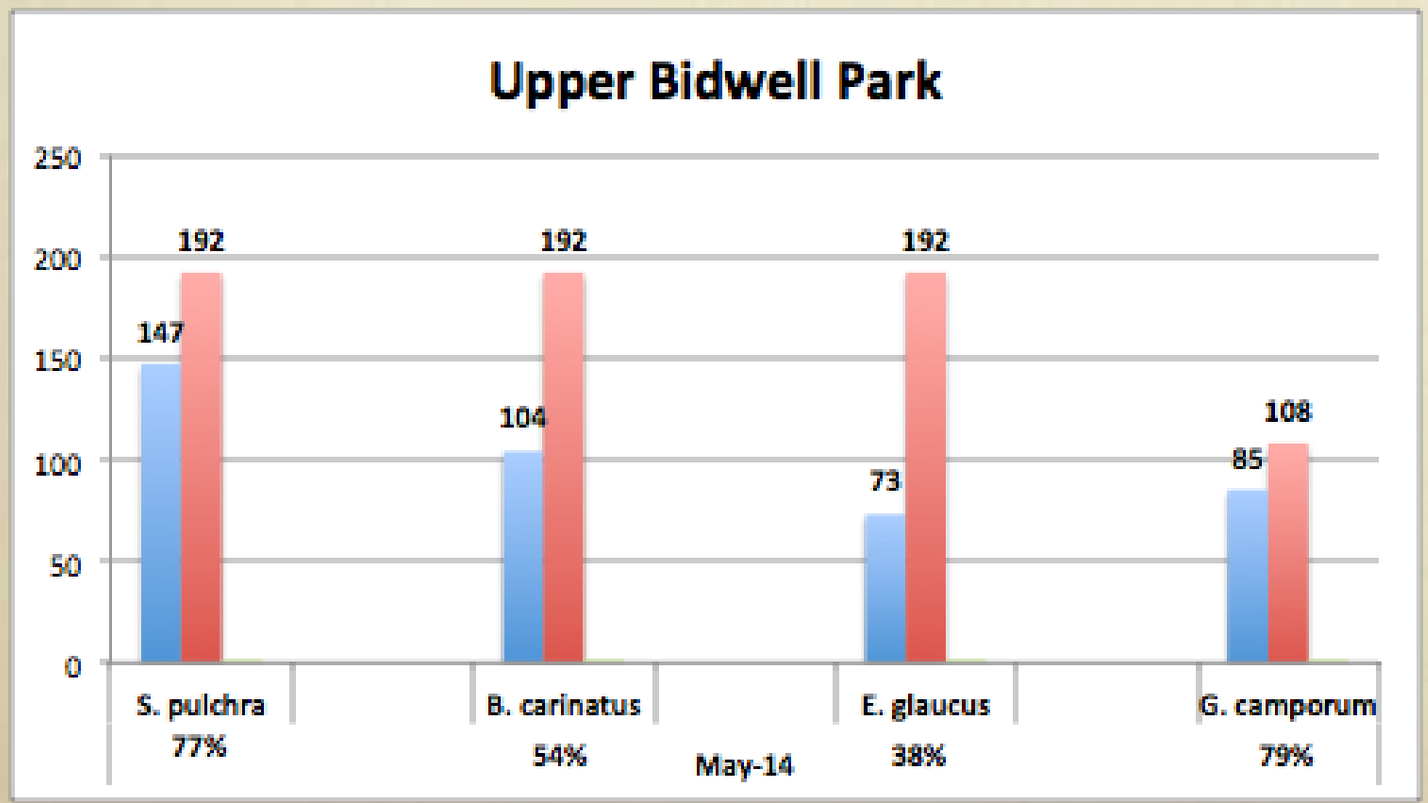
E. glaucus

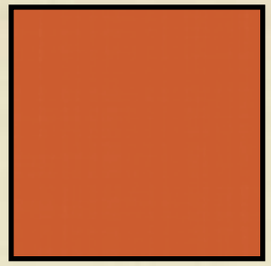
G. camporum

- **No irrigation was used in a record year of drought**
- **We found high success in both sites with variation between the two**

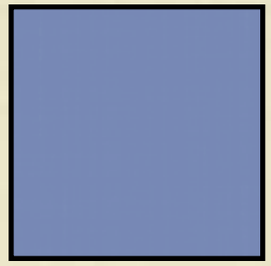
Planting Results (plug survival)







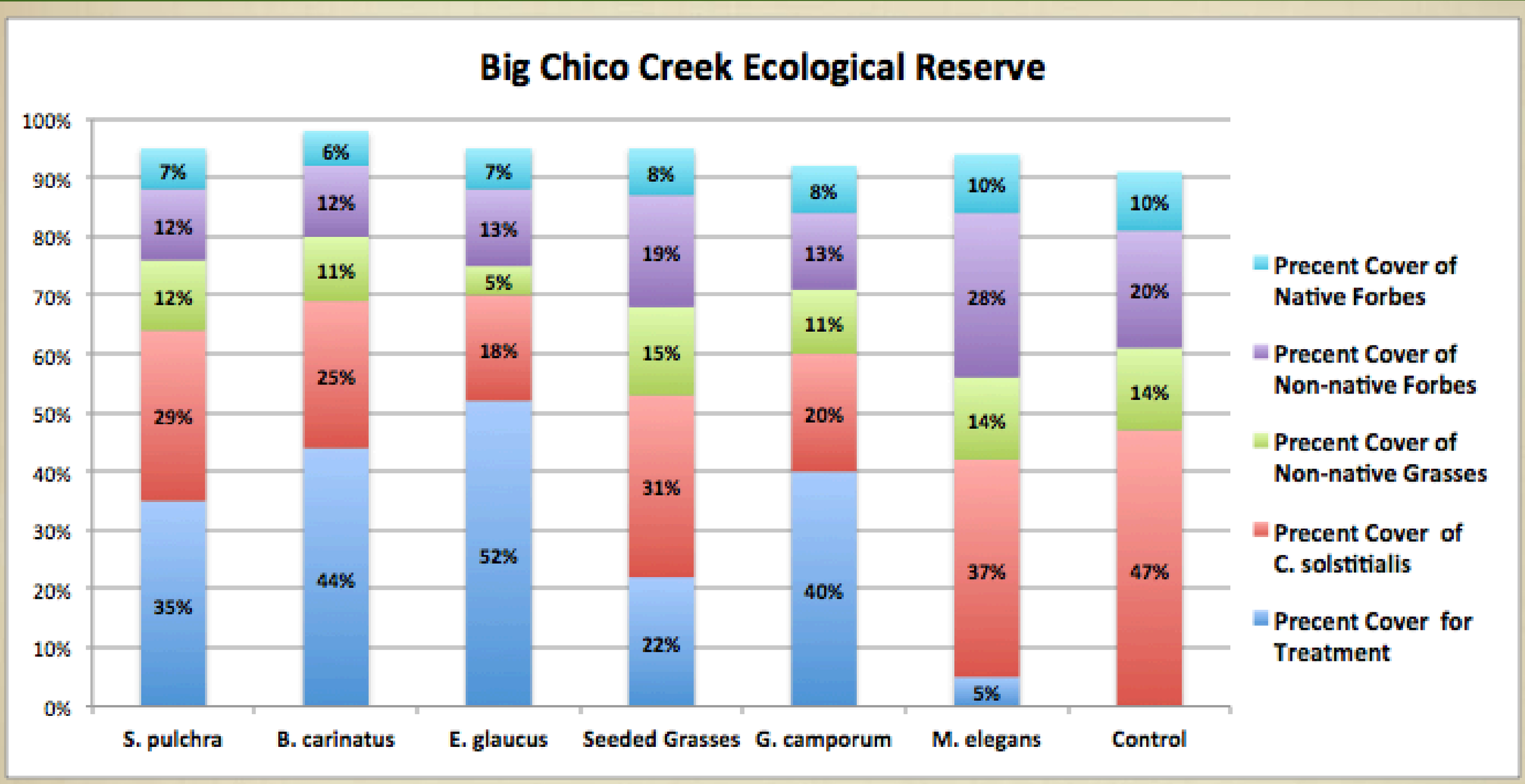
=Total Planted



=Total Survived

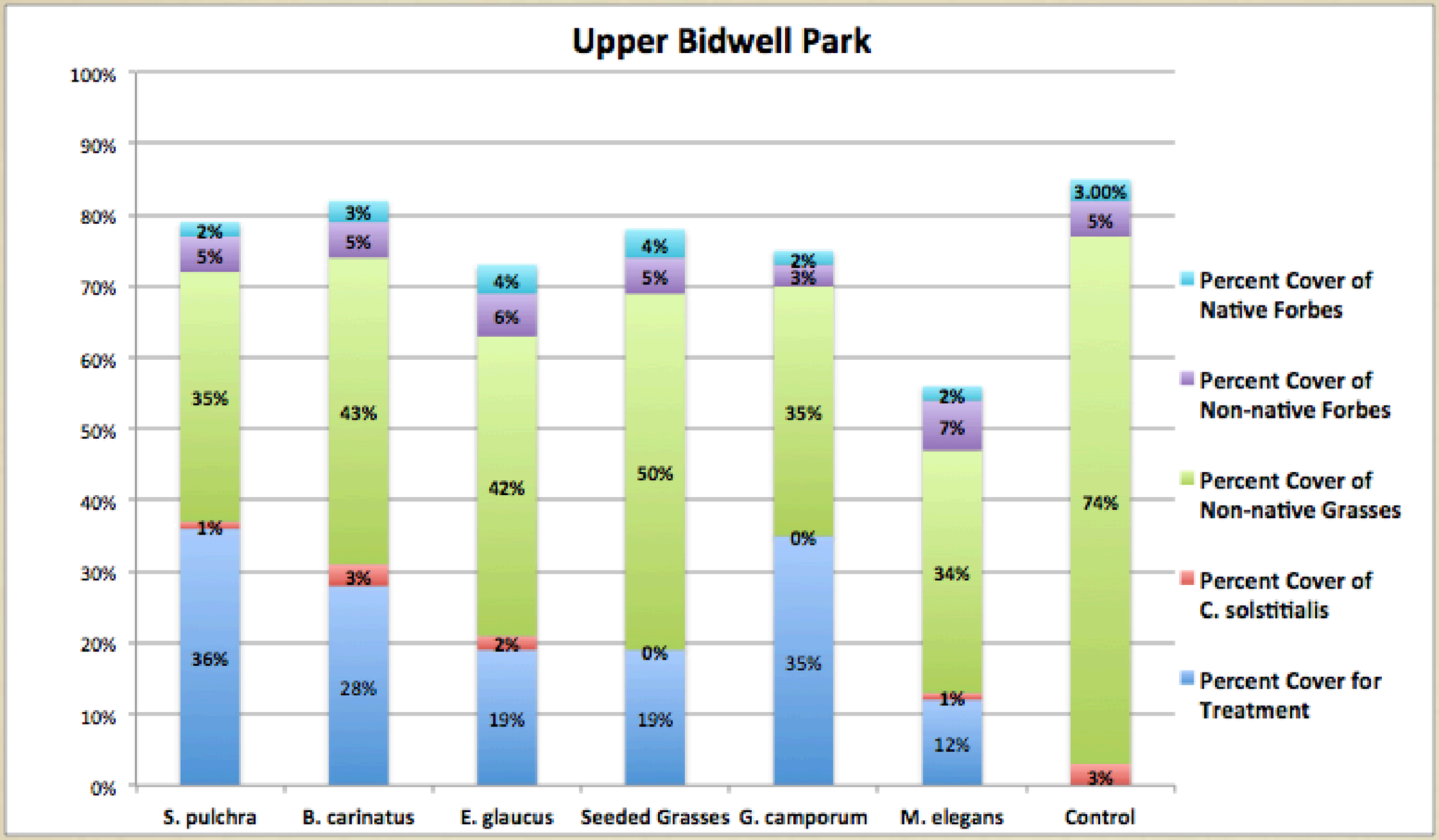
- Accidental herbicide use in Bidwell Park in May and June of 2013

Results-Cover Values



- **The planted treatments show almost 20% lower *C. solstitialis* across the board**

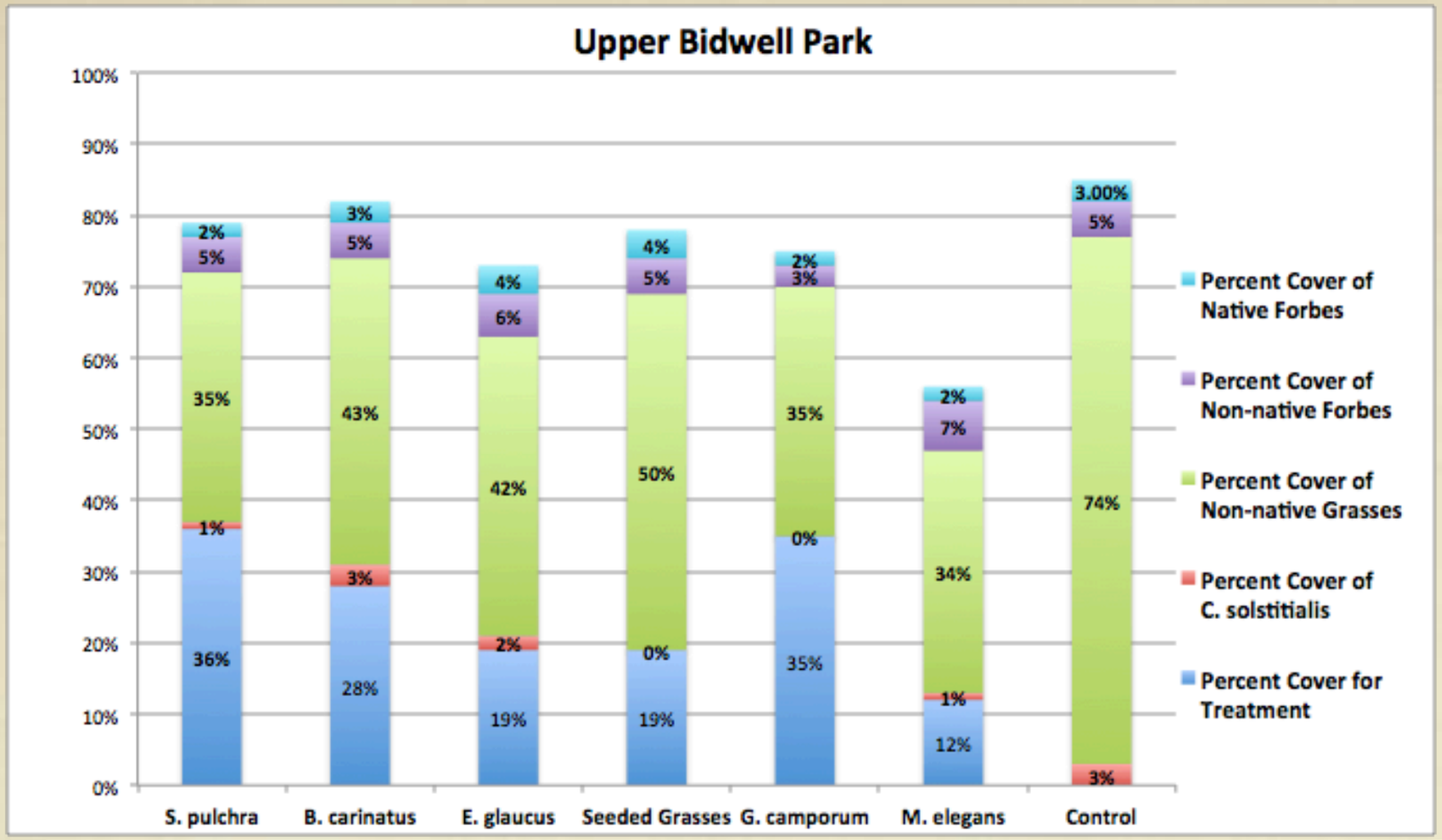
Results-Cover Values

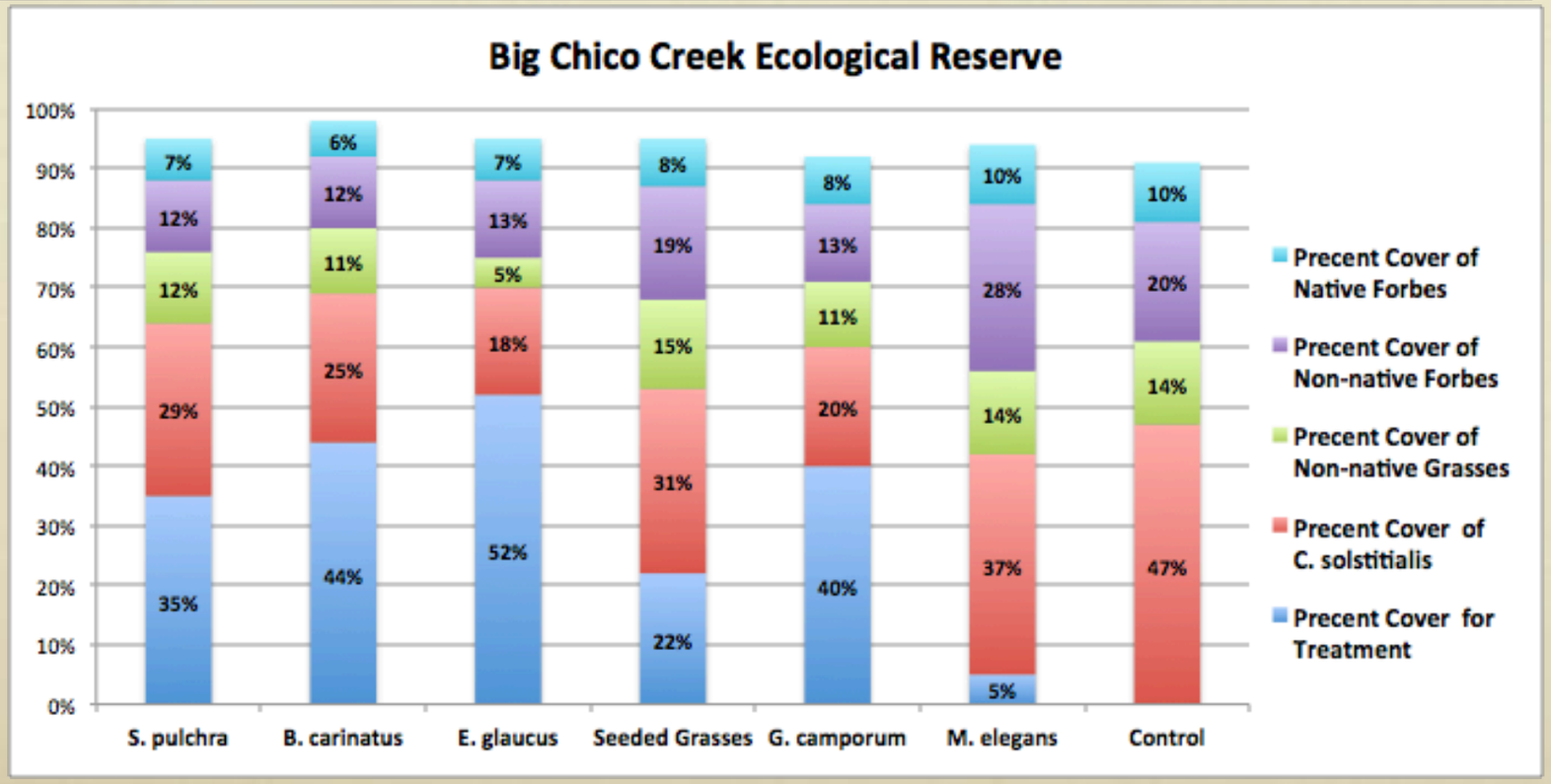


- ***S. pulchra and G. camporum*** **show the highest treatment % cover values**

- **The *C. solstitialis* treated with herbicide was effectively reduced although replaced with a higher level of non native grasses**

Cover Value Comparison





Implications

- **The project enhanced local grassland diversity and contributes to information on the competitive interactions between native and invasive species**

- **The results can aide in future grassland management**

Acknowledgements

- Dr. Maslin for his help on the Big Chico Creek Ecological Reserve
- Floral Native Plant Nursery for the native propagation and plugs
- My wife Ayla for helping with monitoring and species I.D.
- Undergraduate assistants Tony, Alex, Jon, Mitra, Krista, and Kevin