HOLOCARPHA MACRADENIA RESPONSE TO EXPERIMENTAL DISTURBANCE REGIMES

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Challenges to Introducing and Managing Disturbance Regimes for *Holocarpha macradenia*, an Endangered Annual Grassland Forb

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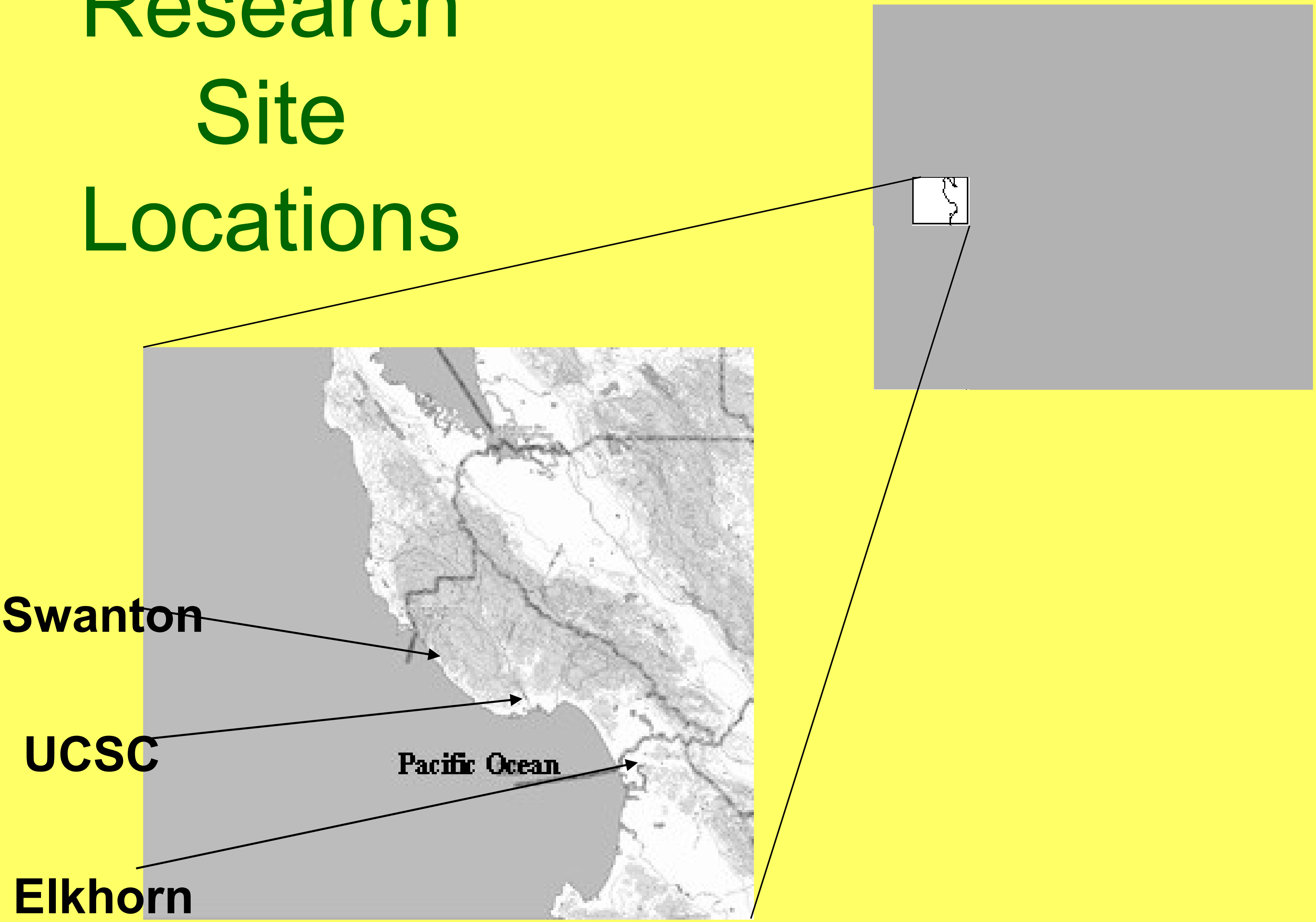
Conservation Biology 2006

Research Site Locations



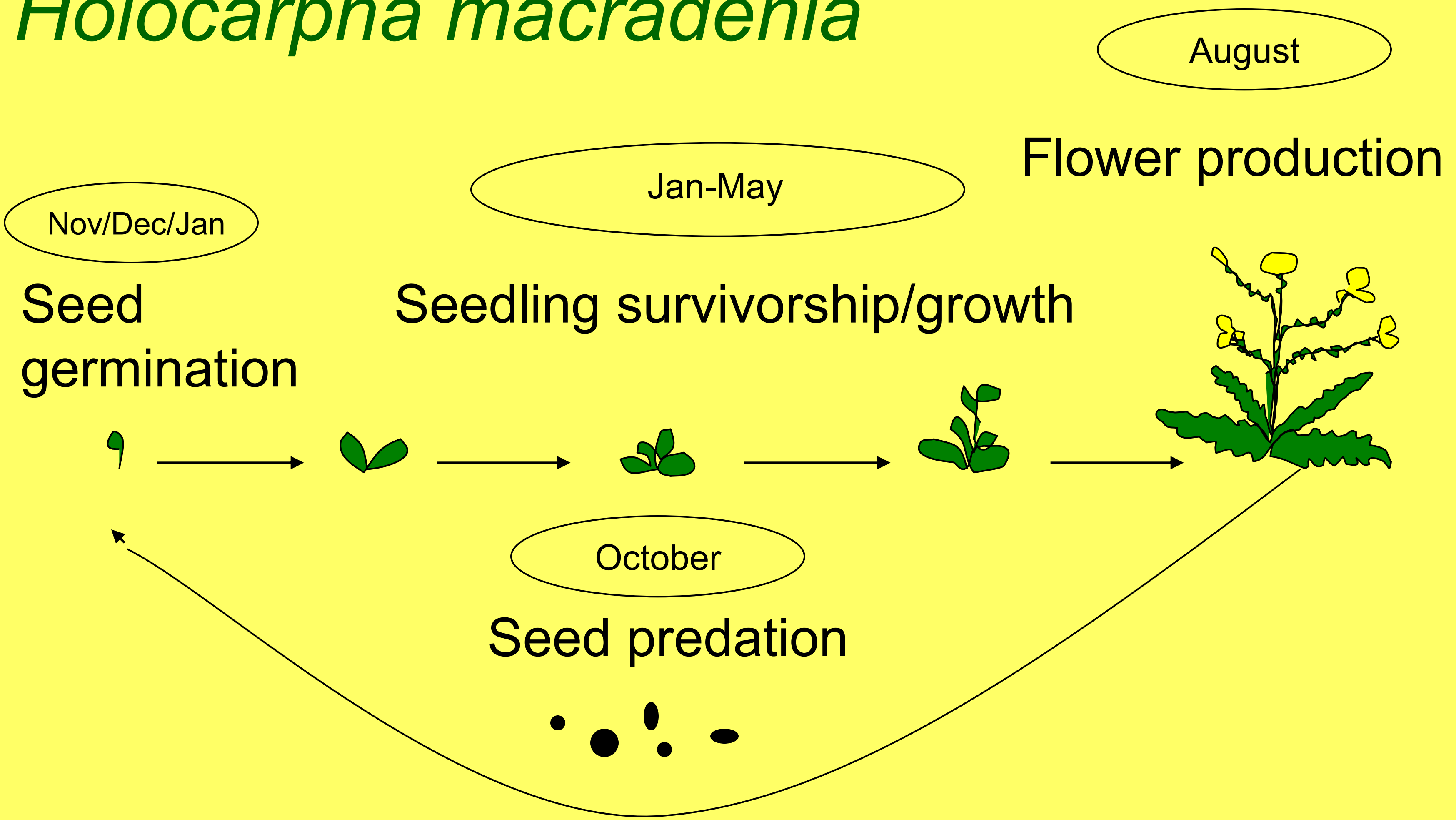
Experimental Design

	Secondary disturbance		
Clipping frequency	Litter accumulation	Litter removal	Soil disturbance
Clipped 2/year	+	+	+
Clipped 3/year	+	+	+
Clipped 6/year	+	+	+
Cattle grazing	na	na	na
No disturbance	na	na	na

- 3 replicates of each treatment at three sites
- Started in 1999 and monitored all plots through 2009
- Seeded and planted in three years

Experimental Plot Layout

Life History Stages of *Holocarpha macradenia*



- Clipping at any frequency and grazing increased germination
- Secondary treatments had minimal effect

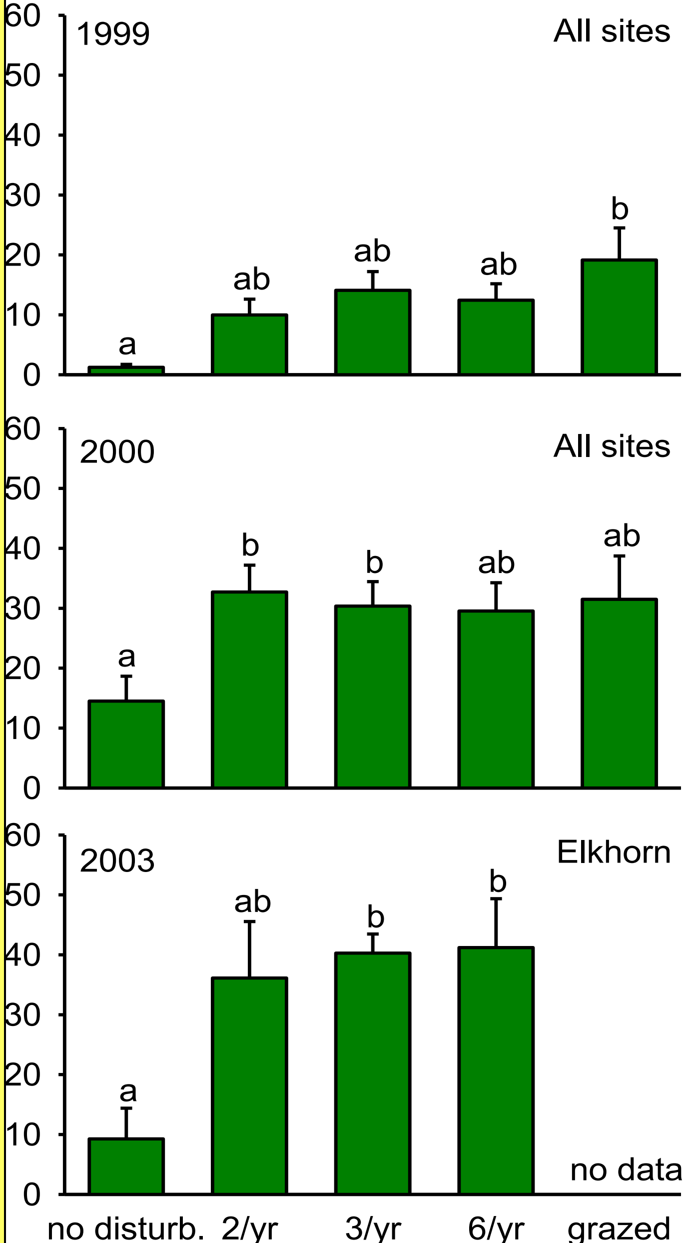


Figure 1 - Percent Germination

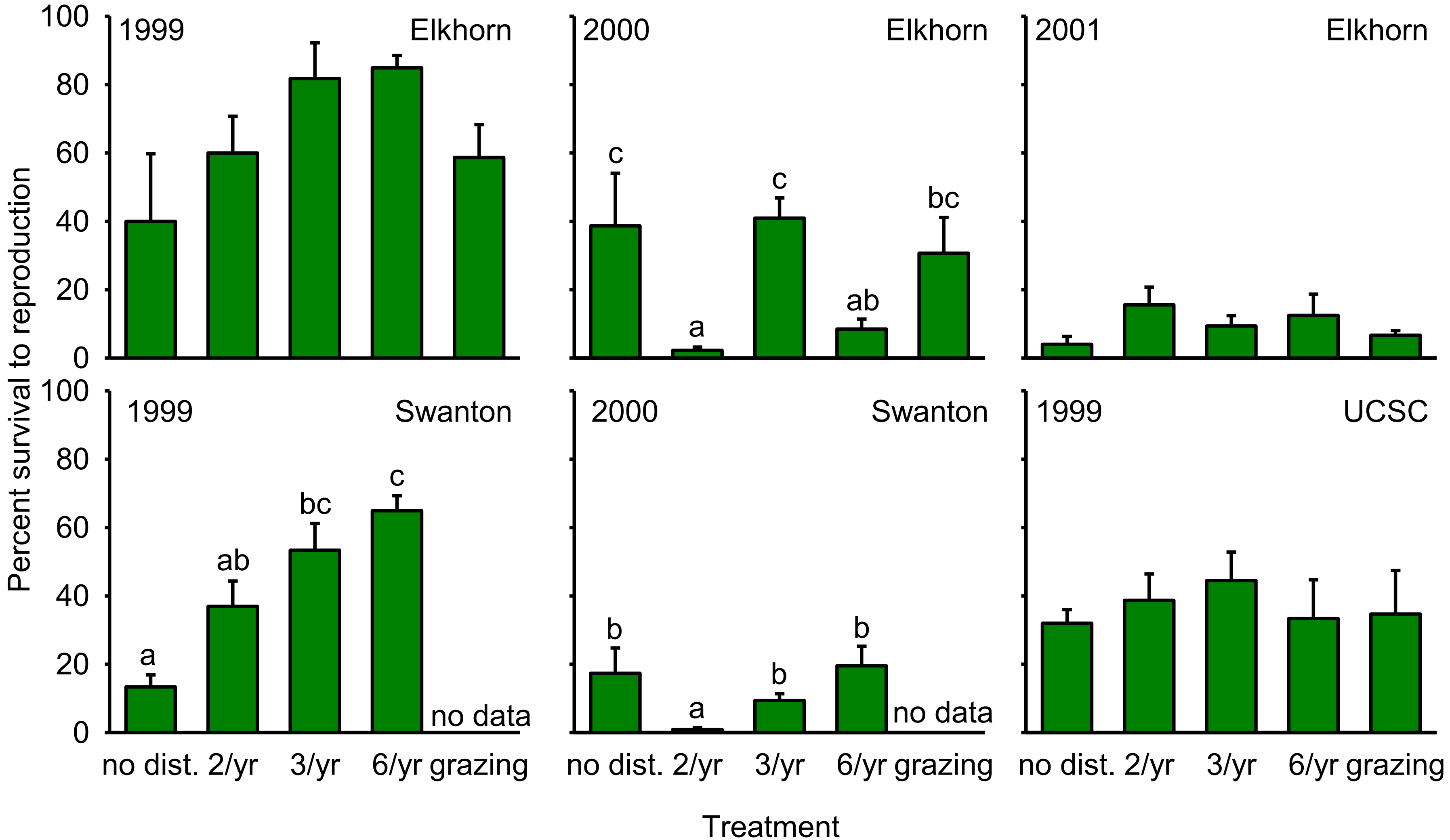
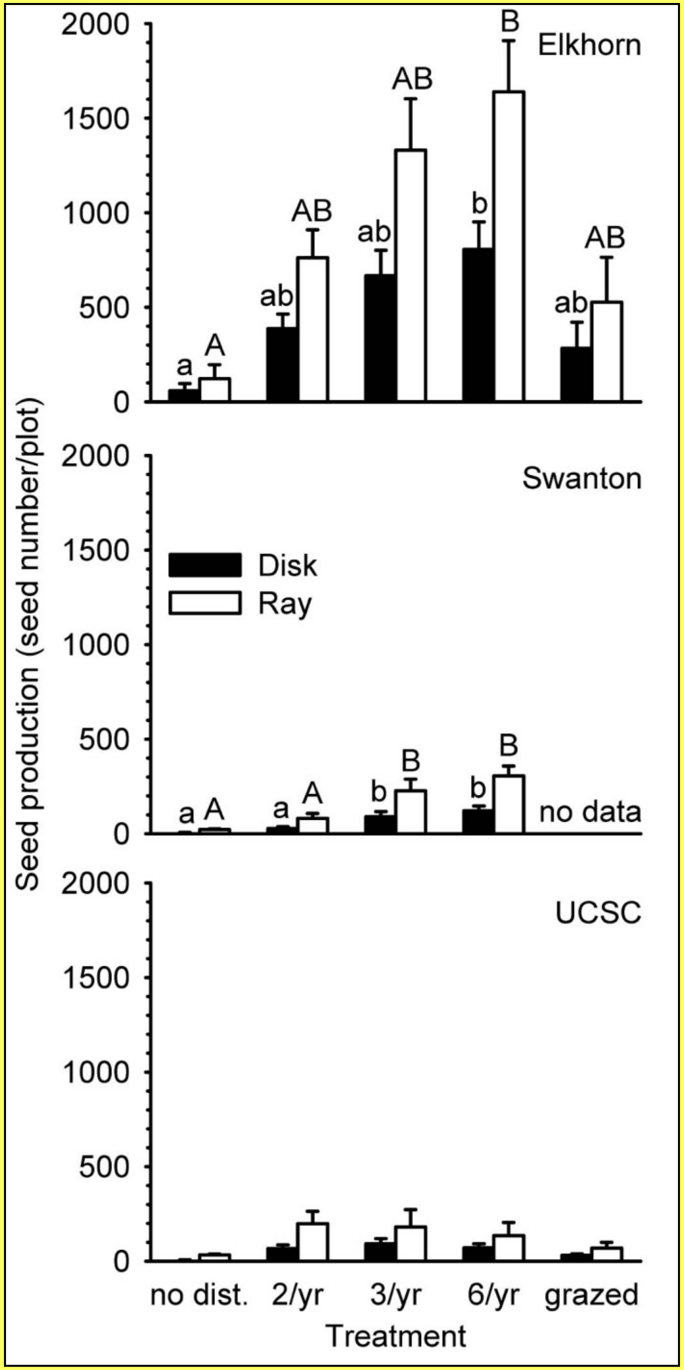


Figure 2 - Percent Survival to Reproduction. Only 1 seedling survived at UCSC in 2000 and seedlings were only planted at Elkhorn in 2001.

Seedling survival was year and site specific. In 1999 more frequently clipped plots generally had higher survival.

- In 1999 more frequently clipped plots generally had higher seed set.
- Much higher seed set at Elkhorn



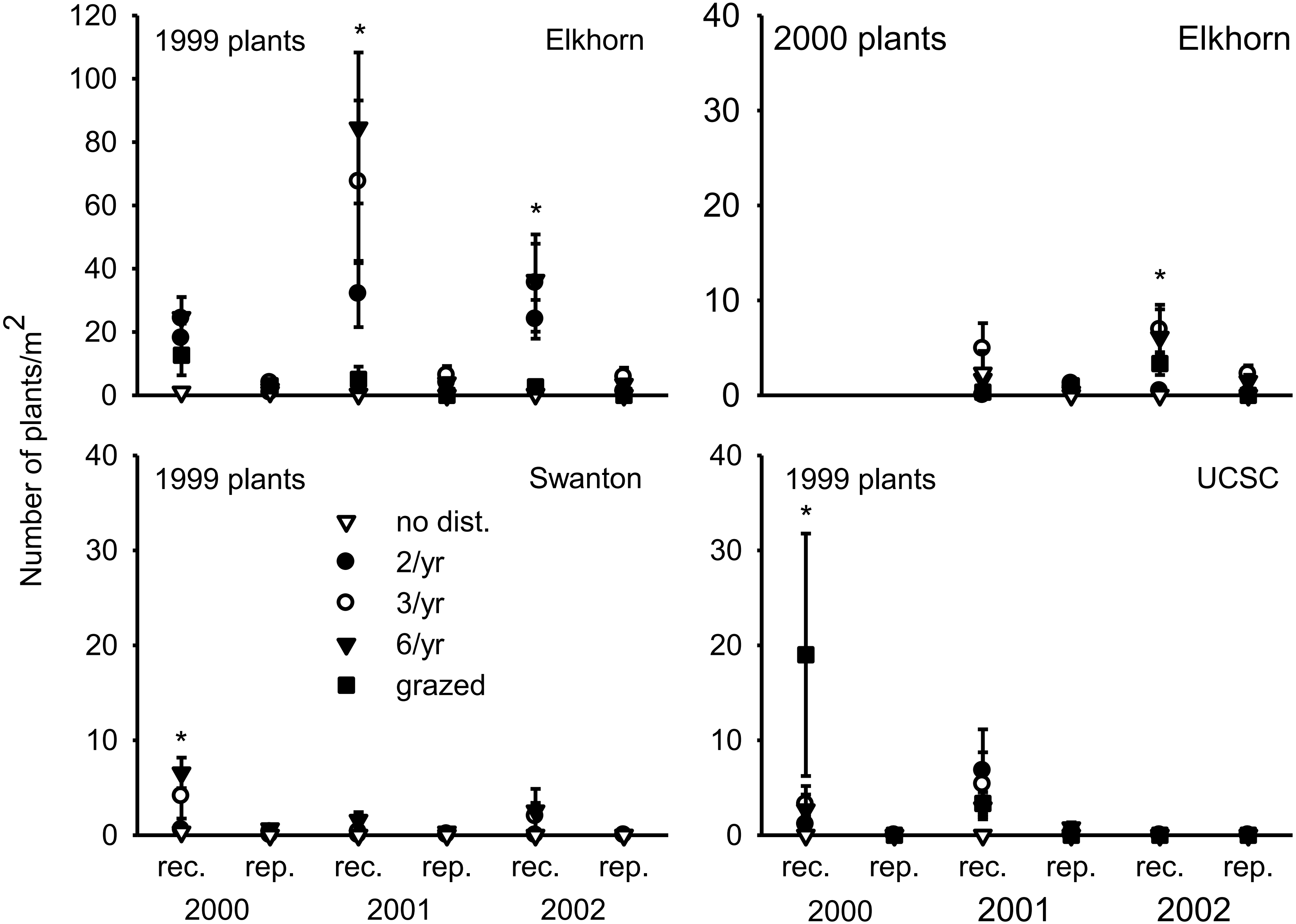


Figure 3 - Number of seedlings recruiting (rec.) and surviving to reproduce (rep.) from plants outplanted in 1999 and 2000. Note different y-axis scales. No seedlings recruited from 2000 plants at Swanton or UCSC.

Possible explanations for abrupt declines in introduced populations

•The coastal prairie sites we selected were not high quality habitat. – *likely, based on demographic comparisons between introduced and natural populations*

•Introduction was poorly timed relative to rainfall conditions. – *unlikely, as we introduced plants in three years.*

•The number of plants we introduced was too small to so plants suffered from allee effects. - *possibly, experiments conducted by Adelia Barber showed effects of population size on seed set in the field, but not in greenhouse conditions.*

•The sites lacked a large, established seed bank, to buffer against environmental stochasticity. – *likely, based on demographic modeling of Will Satterthwaite.*

Conclusions

•Maintaining populations of rare grassland annuals, such as *Holocarpha macradenia*, requires properly timed disturbances.

•Introduction of rare plants requires detailed knowledge of habitat requirements, which is rarely available even for the best studied species.

•Introduction efforts will only be successful if plants are introduced at multiple sites in multiple years, making such efforts quite costly.

•Long-term monitoring of translocation efforts is necessary to evaluate the success of introduction efforts.

•Need to consider seed banks in analyzing population viability.

Seed banks in plant conservation: Case study of Santa Cruz tarplant restoration

Biological Conservation 2007

William H. Satterthwaite[a,*], *Karen D. Holl*[b], *Grey F. Hayes*[b,1], *Adelia L. Barber*[a]

J. E.(Jed) and Bonnie McClellan © California Academy of Sciences

F_d - number of disk seeds per flower

(disk seeds always germinate)

E_s - establishment of seedlings

(prob. success germinate > seedling)

S_j - survival of juveniles

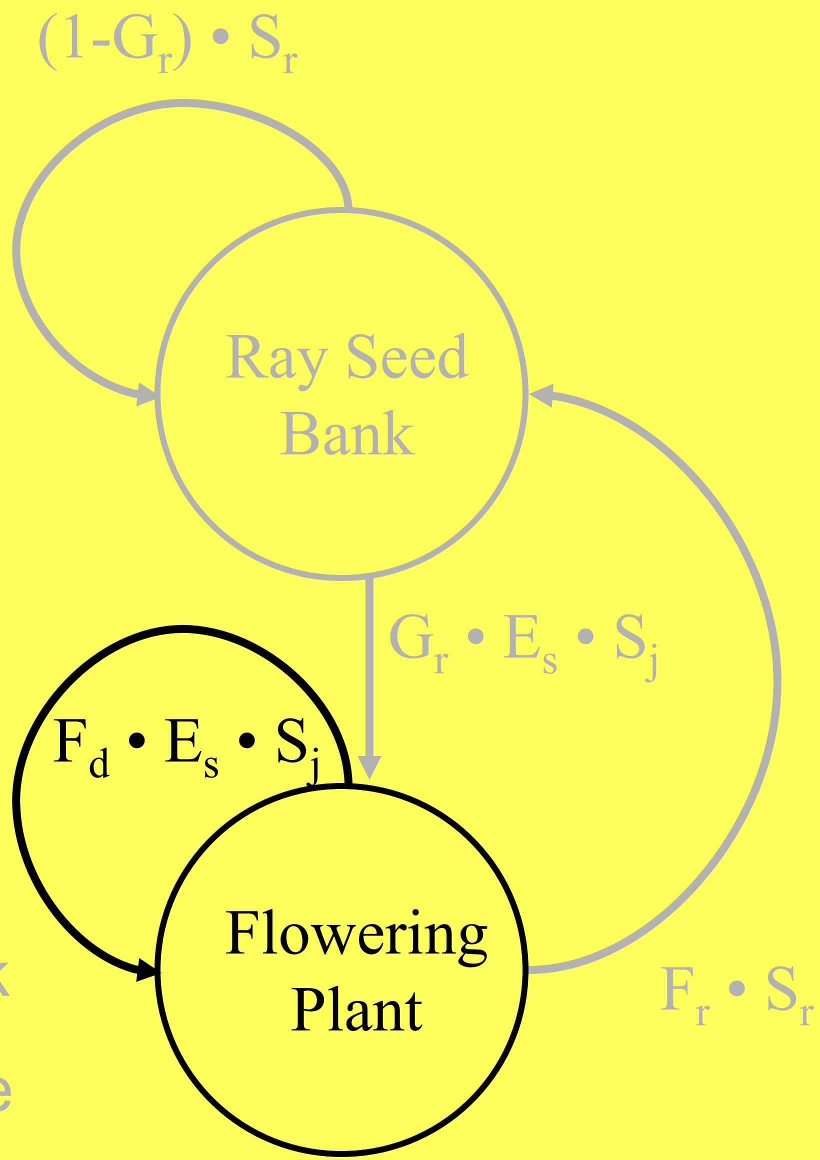
(survival from seedling > flowering)

F_r - number of ray seeds per flower

(ray seeds always start out dormant)

S_r - survival of ray seeds in seed bank

G_r - rate at which ray seeds germinate out of the seed bank



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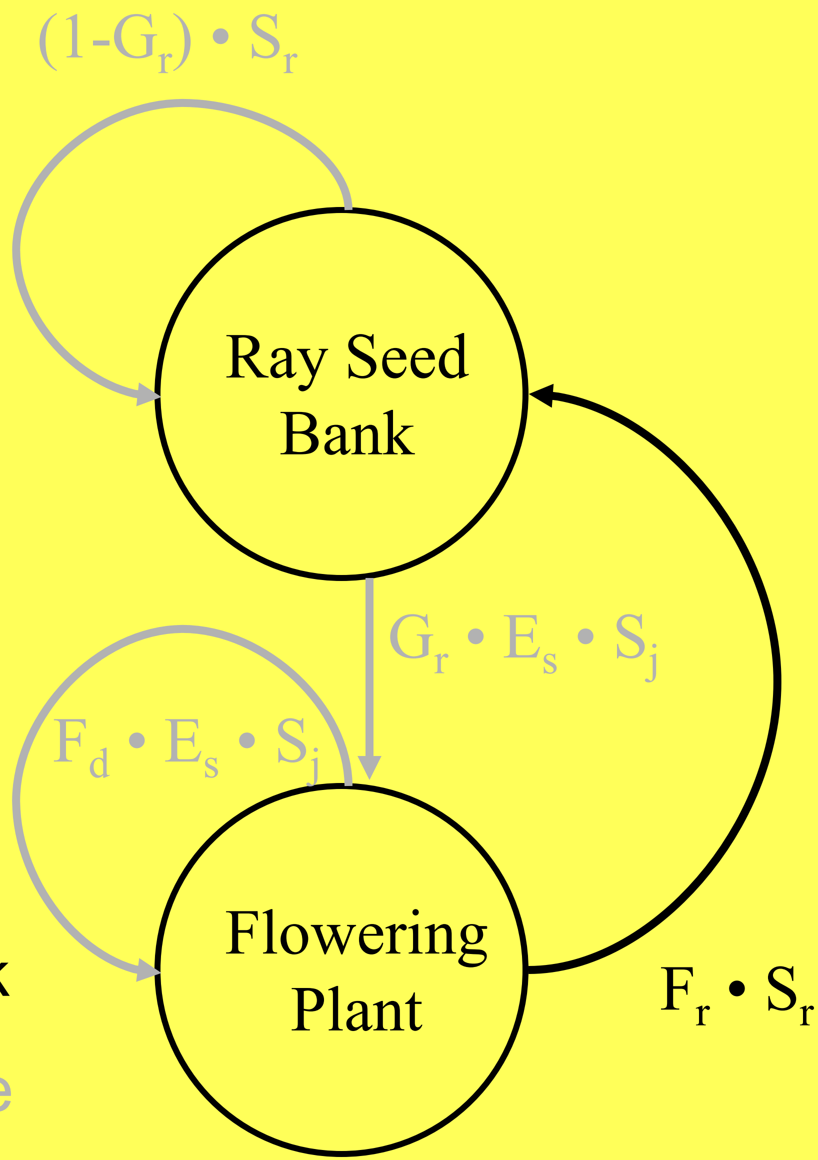

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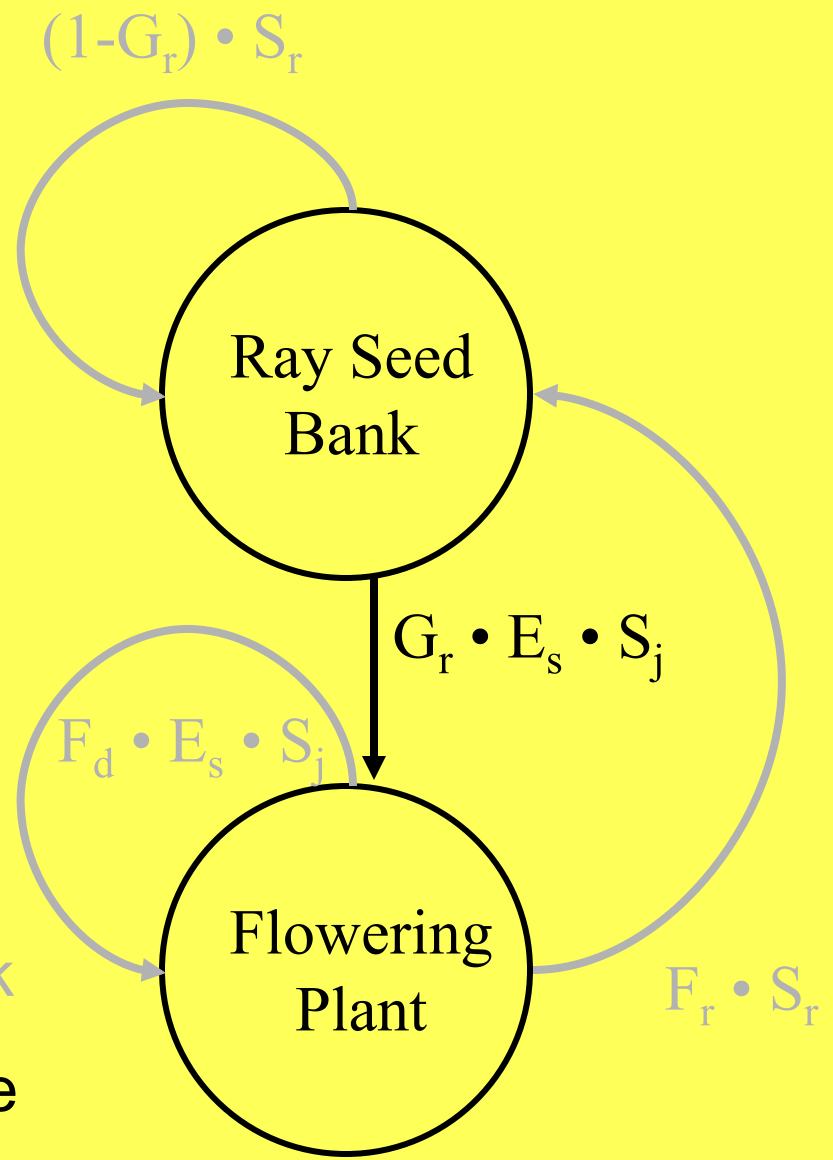

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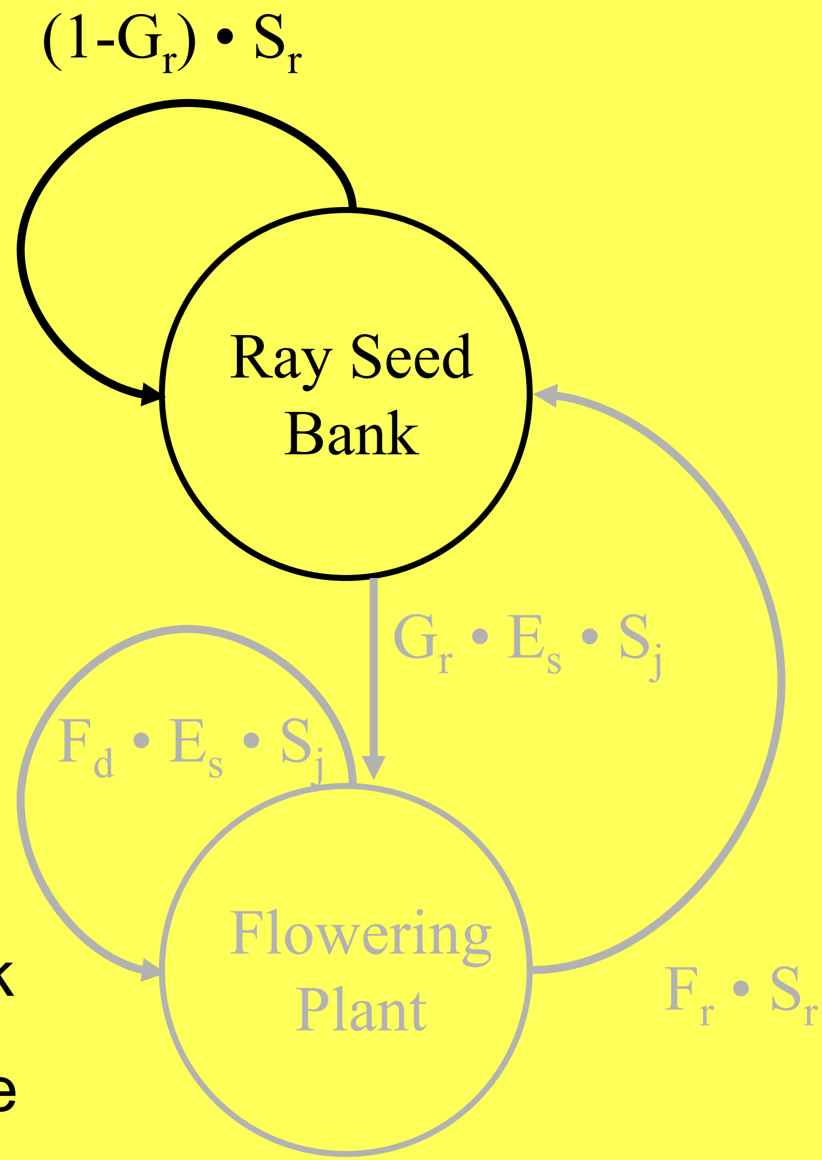

Why use a model?

- Can’t do endless manipulations on an endangered species
- Can use a range of values for numbers we don’t have data for – e.g. ray seed bank of longevity and germination – and test sensitivity
- Can run model simulating environmental stochasticity

Take home points from study

- Clipping or grazing enhanced population viability.
- Enhancing ray seed germination increased population growth in a constant environment
- In a varying environment an intermediate level of germination of the ray seed bank results in the lowest risk of extinction. Remaining seeds buffer against years with poor conditions for reproduction.
- So use scraping cautiously and focus on increasing survival and seed set of plants.