Seed limitation, density-dependence and the persistence of yellow starthistle populations across California

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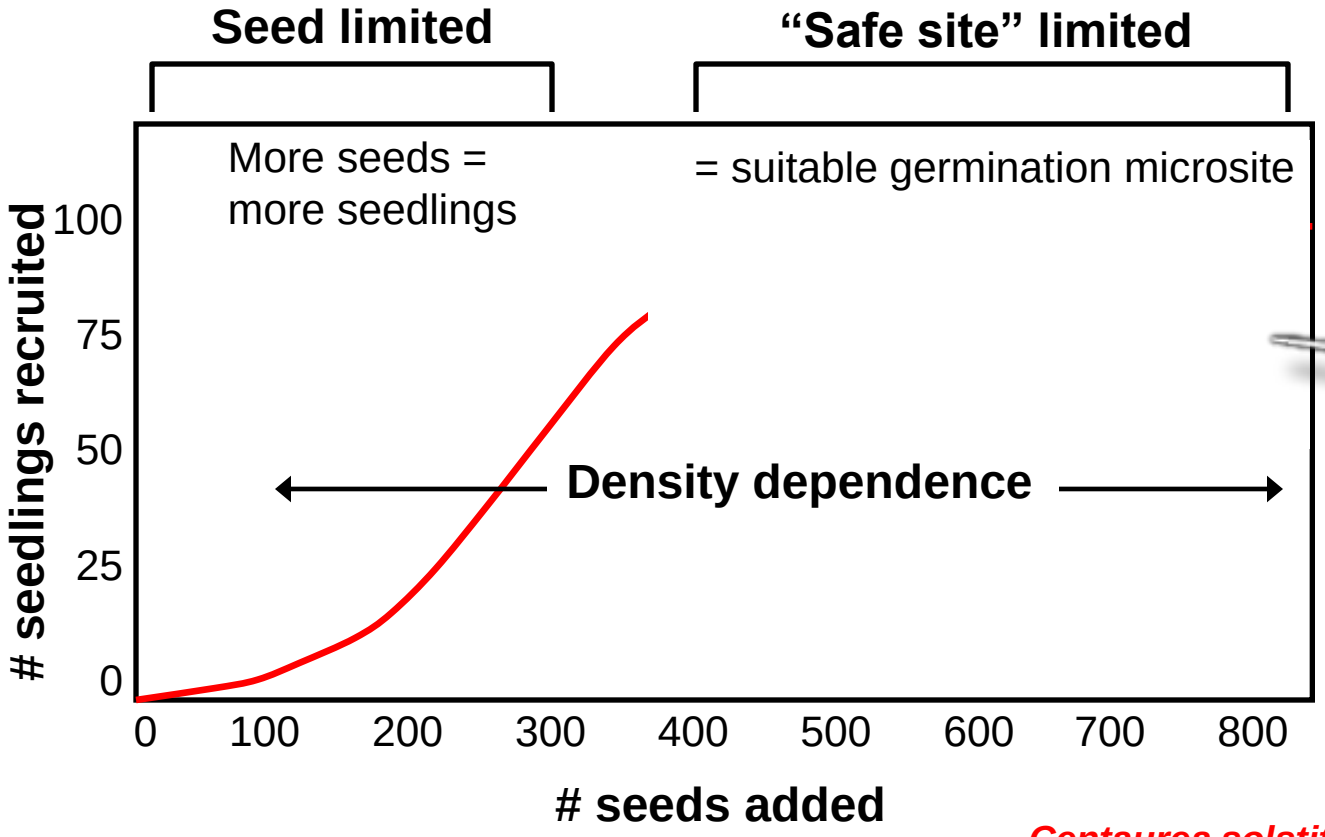
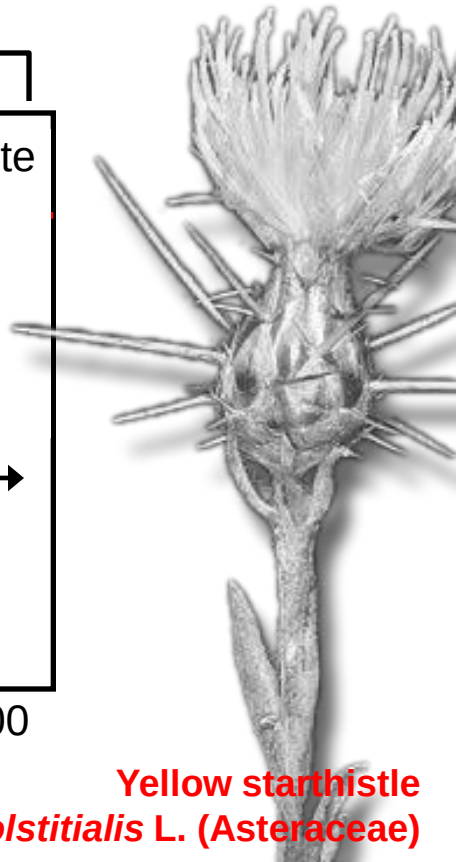
A central goal of weed management

What processes regulate recruitment of new plants and the persistence of populations through time?

Annual lifecycle (yellow starthistle): reinvasion by seed





Yellow starthistle
Centaurea solstitialis L. (Asteraceae)

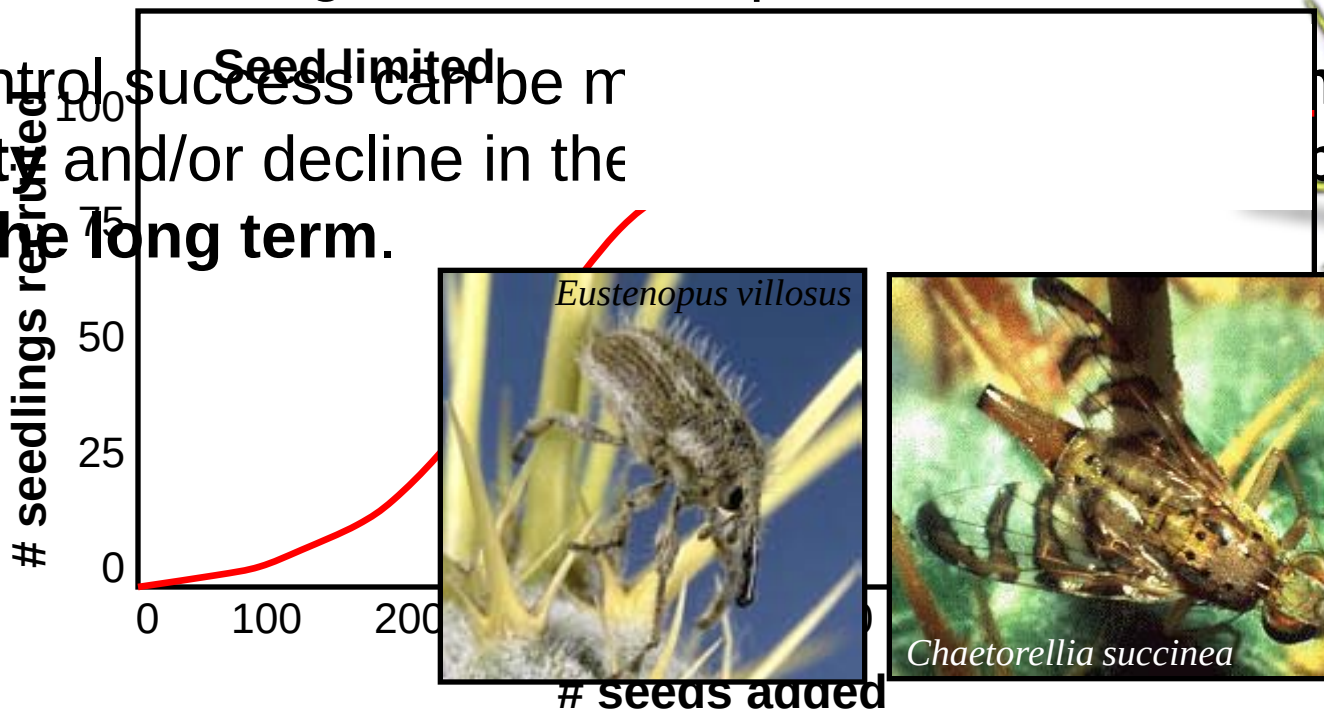
Why is this important to weed management?

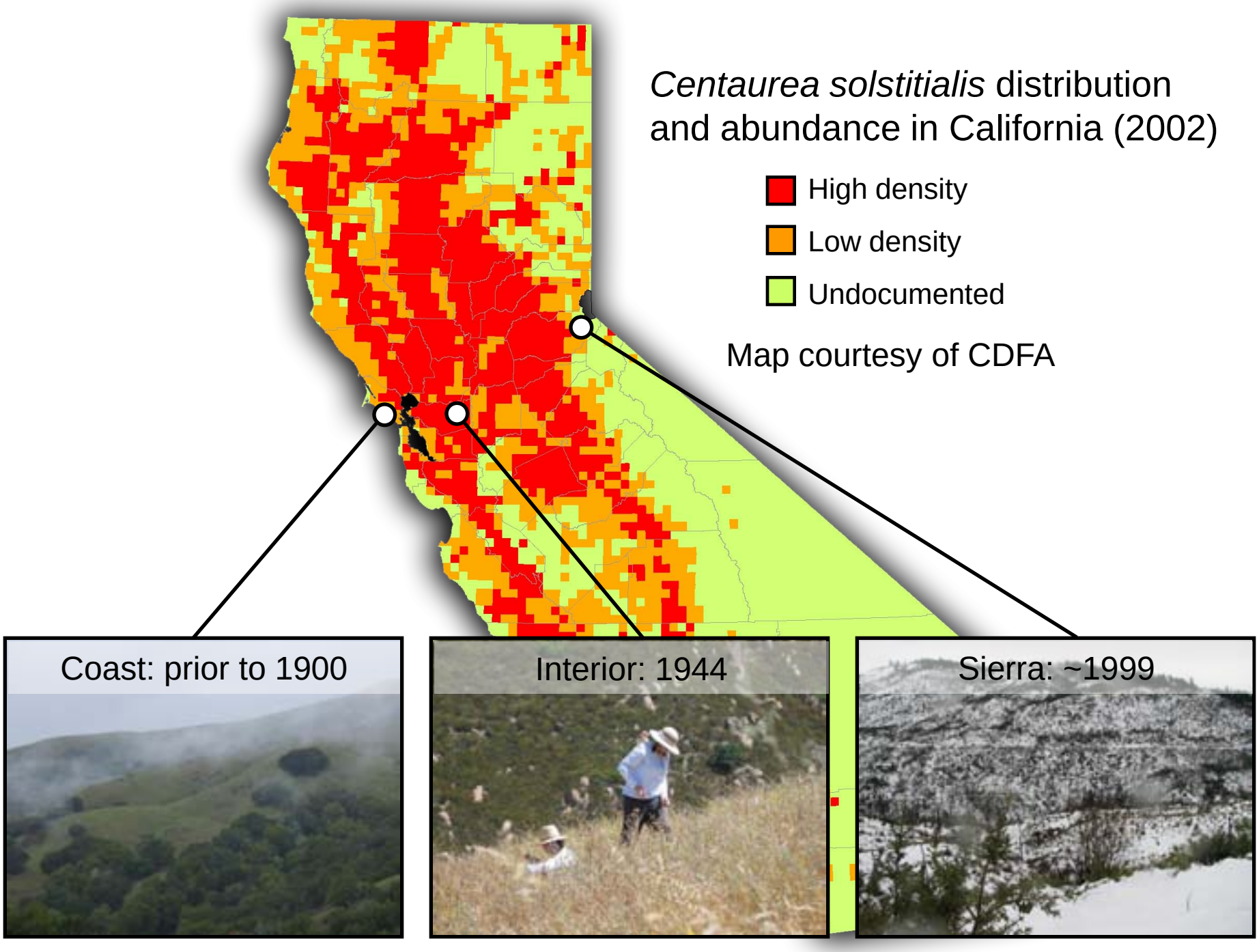
If a population is seed-limited then reducing seed input will reduce seedling establishment …

But if the population is safe-site limited, then reducing seeds will have no effect on establishment (unless the reduction in seeds is very high)

Most biocontrol agents are seed predators

Biocontrol success can be m **n plant density** and/or decline in the **pulation over the long term**.




Centaurea solstitialis distribution and abundance in California (2002)
High density
Low density
Undocumented
Map courtesy of CDFA
Coast: prior to 1900
Interior: 1944
Sierra: ~1999

Seed addition experiment

Uninvaded grasslands (upslope of established invasions)

South-facing slopes at all three sites

0.5m×0.5m plots

4 seed addition levels: 0, 50, 500, 1000 (6 reps of each level)

Censused every 3 wks for 1 yr; followed fate of every seedling

Seed input-seedling recruitment

Established invasions

Long-term demographic study in invaded area downslope

- Same plot size, census methods and schedule
- Careful estimates of seed rain

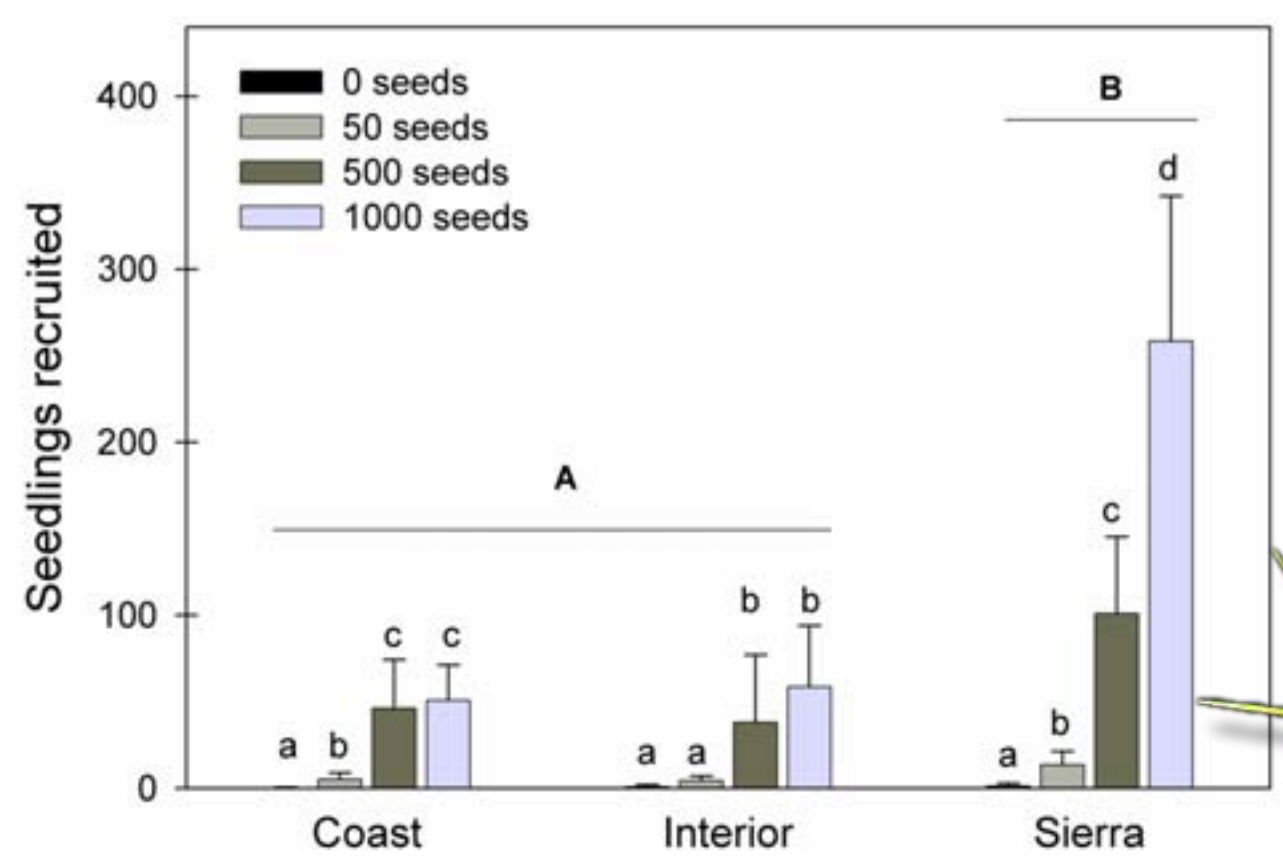
(based on dissecting >10,000 inflorescences in the lab)

n=33

n=35

n=19

Seed input-seedling recruitment



In seed-limited patch: more seeds = more seedlings

In a safe site-limited patch: more seeds ≠ more seedlings

Observational study: established invasions

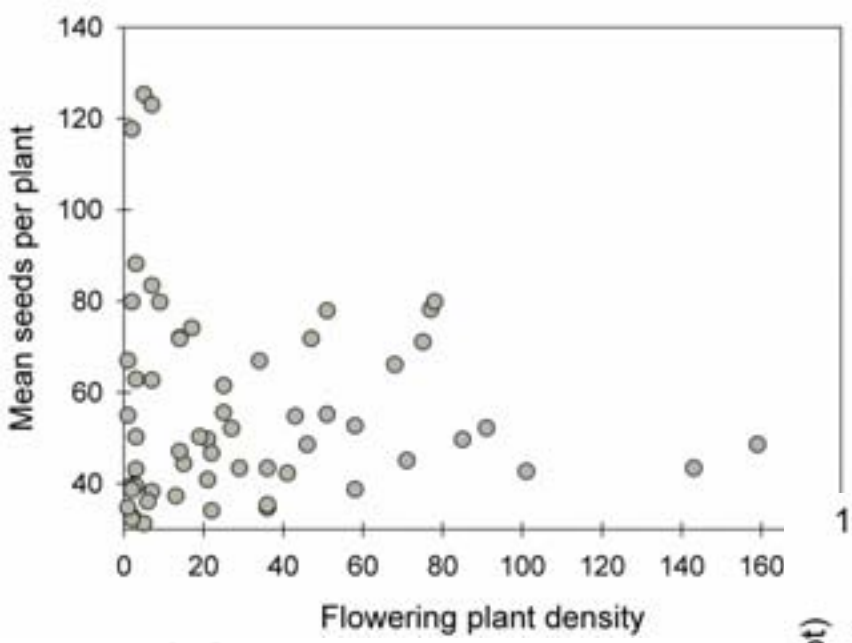
Experimental seed addition plots

Data were ln+1 transformed for analysis with linear regression;
untransformed data with power curves shown for ease of site-site comparisons

Density-mortality

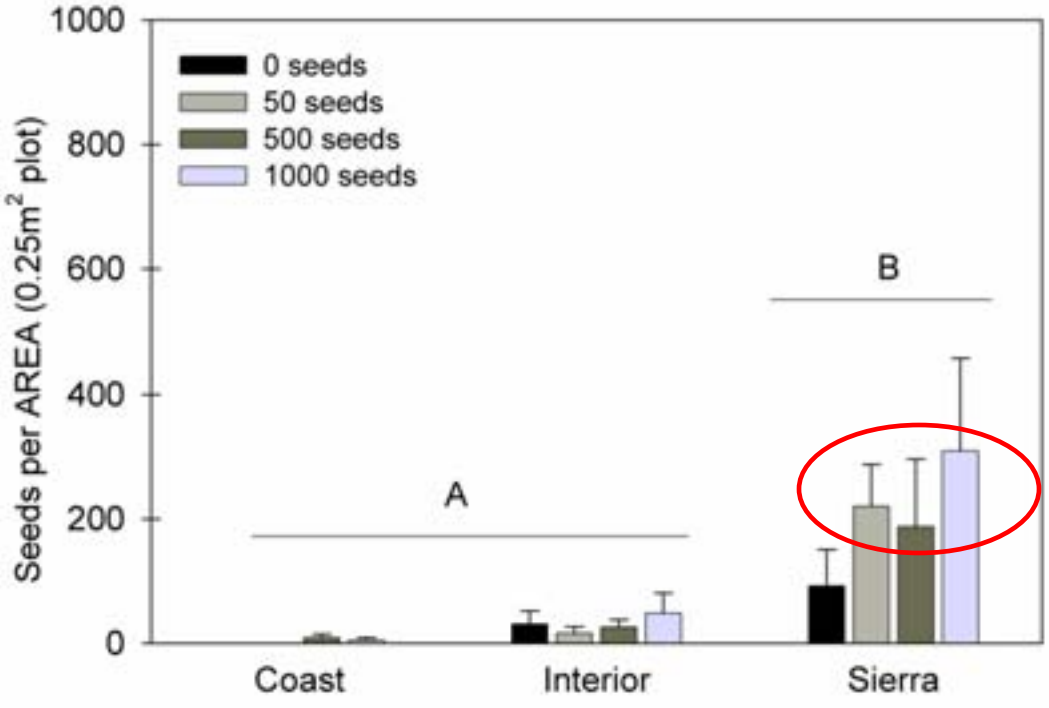
Seed input-flowering plant density

Density-fecundity



A few large plants produce as much seed as a many small plants …

no long-term decline in the persistence of the population.



Reducing seed production will reduce plant density *and* slow the establishment of plants in uninvaded areas

But compensatory response of plants in low density patches will thwart attempts to eradicate populations.