

Reducing Seed Output and Seed Viability of Cultivars: How Much Is Enough to Create a Plant That Will Not Be Invasive?

Tiffany Knight
Washington University

**Jean Burns, Kay Havens, Pati Vitt,
Ed Guerrant**

Ornamental Plants

- **Most are not native**
- **Some become invasive**
- **Traits that we select in our ornamentals**
 - **adaptable to a wide range of conditions**
 - **high flower production**
 - **long flowering period**
 - **able to self seed**

Invasive species

- **Second largest threat to global biodiversity**

Invasive species

- **Second largest threat to global biodiversity**
- **82% of the invasive trees and shrubs in the USA were introduced in horticulture**

Japanese Barberry (*Berberis thunbergii*)

A popular horticultural shrub that has become a natural area invader



“The reasons? Sheer growability... hardy to zone 4, can take sun or shade, wet or dry, and will come back strong after a beating.”

***“one of the most destructive invasive plants in Connecticut”
--Connecticut Botanical Society***

Purple loosestrife (*Lythrum salicaria*)



Lythrum alatum (Winged Loosestrife)



It's back! Yes, you can once again grow loosestrife and not be hounded by the eco-nazis. In fact, *Lythrum alatum* is native to all but 12 US states. Okay, it's not as pretty as purple loosestrife and when grown in a swamp, it's slightly more aggressive, but if you're out to clog up a waterway, it might as well be with a native plant.

Why the resistance?

*Japanese Barberry sales in Connecticut Alone
--\$15-20 million Annually--*



Why the resistance?

35 Cultivars of Japanese Barberry

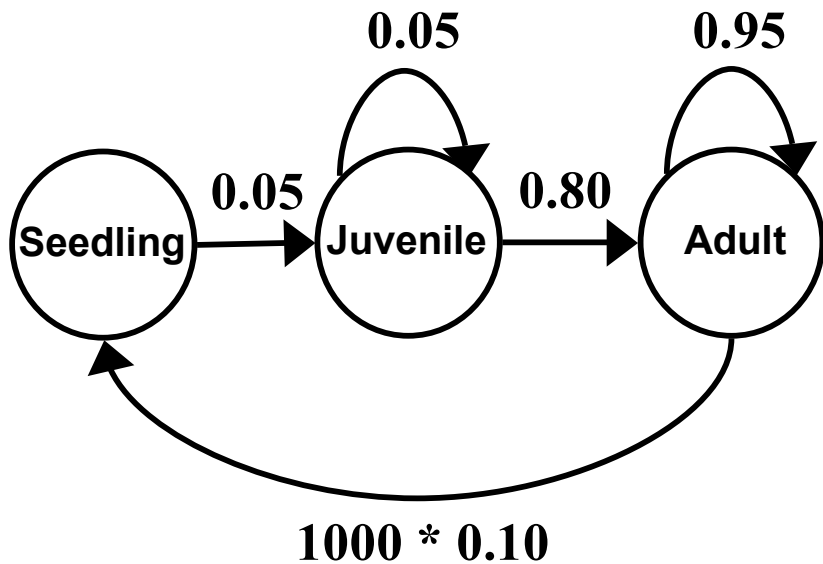
- Aurea
- Bonanza Gold
- Angel Wings
- Crimson Giant
- Rosy Glow

Individuals within these range from producing less than 100 to over 3000 seeds per year

“I know that some Barberries have become invasive but mine doesn't really set any seed and my plants are only 2 feet high after almost 5 years in the ground.”

A demographic approach

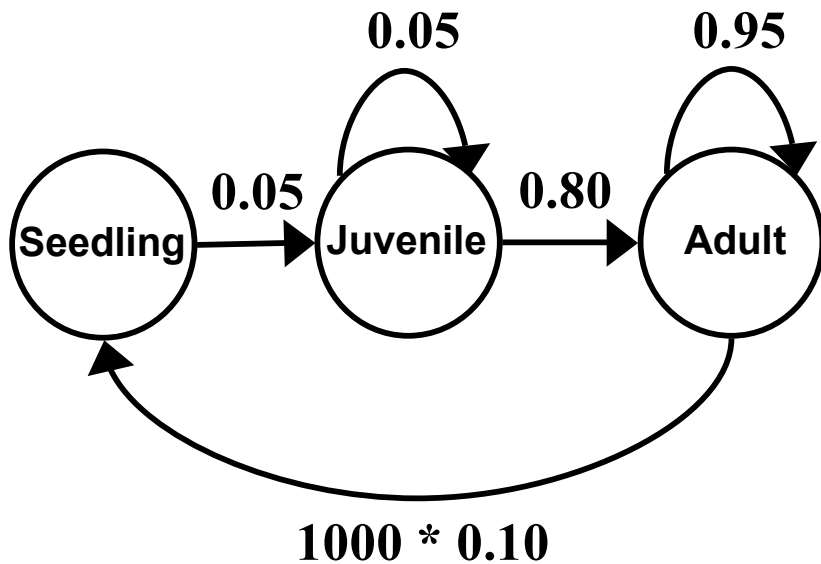
Cultivar #1



$$\lambda = 1.50$$

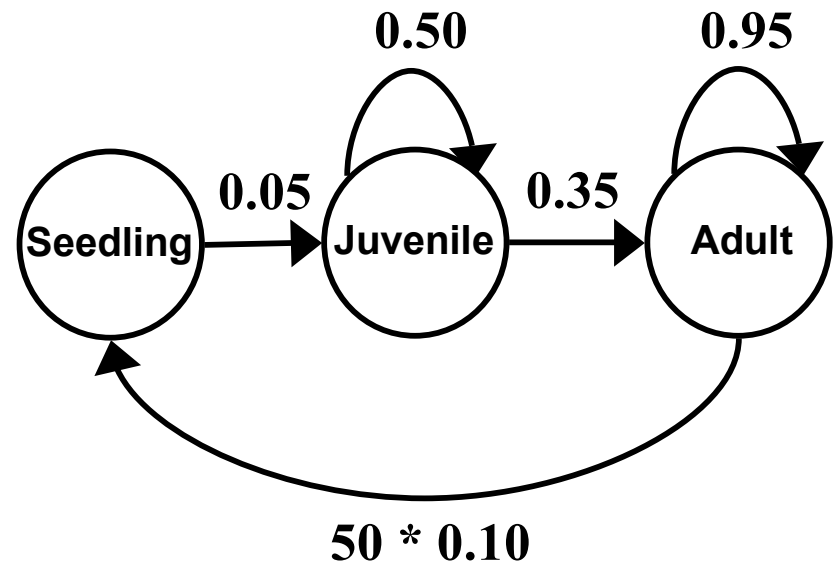
A demographic approach

Cultivar #1



$$\lambda = 1.50$$

Cultivar #2



$$\lambda = 1.00$$

A demographic approach

- **Many horticulturists aim to reduce the seed output or seed viability of invasive ornamentals.**
- **Are cultivars with reduced seed output “safe”?**
- **How much does seed output have to be reduced for a plant to not be invasive (have a population growth rate <1)?**

Plant invasions and matrix models

Plant	Life form	Invasive Range	Selected Reference
<i>Dipsacus sylvestris</i>	Biennial	USA	Werner and Caswell 1978
<i>Alliaria petiolata</i>	Biennial	USA	Davis et al. 2006
<i>Carduus nutans</i>	Monocarpic herb	New Zealand	Shea and Kelly 1998
<i>Heracleum mantegazzianum</i>	Monocarpic herb	Europe	Nehrbass et al. 2006
<i>Cirsium Vulgare</i>	Monocarpic herb	USA	Tenhumberg et al. 2007
<i>Molinia caerulea</i>	Perennial grass	Western Europe	Jacquemyn et al. 2005
<i>Agropyron cristatum</i>	Perennial grass	USA	Hansen and Wilson 2006
<i>Lespedeza cuneata</i>	Perennial herb	USA	Schutzenhofer and Knight 2007
<i>Centaurea maculosa</i>	Perennial herb	USA	Emery and Gross 2005
<i>Clidemia hirta</i>	Shrub	USA	DeWalt 2006
<i>Ardisia elliptica</i>	Shrub	USA	Koop and Horvitz 2005
<i>Cytisus scoparius</i>	Shrub	USA	Parker 2000
<i>Pinus nigra</i>	Tree	New Zealand	Buckley et al. 2005

Alliaria petiolata (Garlic mustard)

A typical short-lived invasive plant



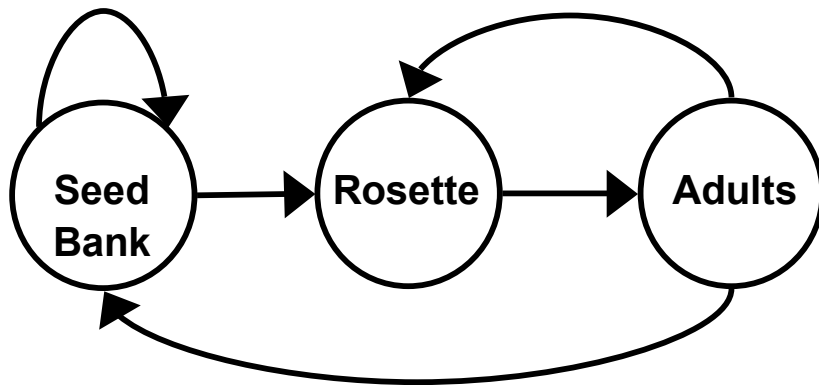
Seed



Rosette



Adult



Alliaria petiolata (Garlic mustard)

A typical short-lived invasive plant



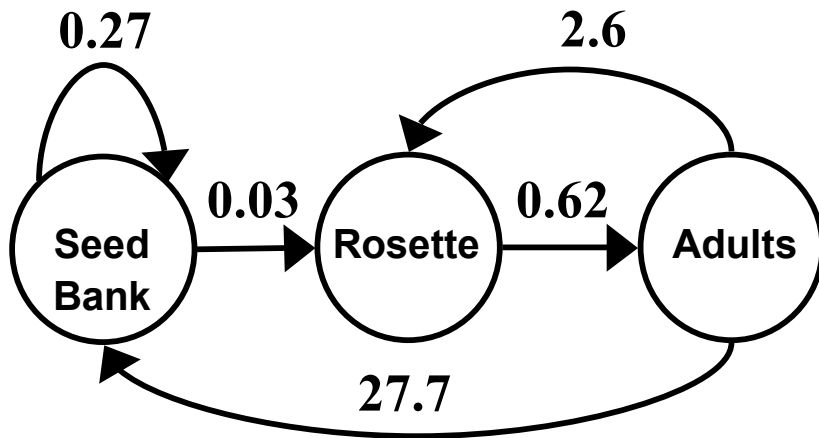
Seed



Rosette



Adult



Alliaria petiolata (Garlic mustard)

A typical short-lived invasive plant



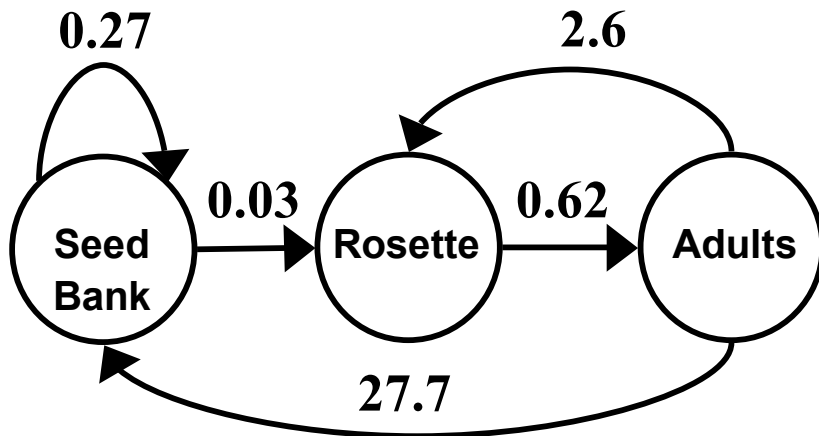
Seed



Rosette



Adult



$$\lambda = 1.42$$

Alliaria petiolata (Garlic mustard)

A typical short-lived invasive plant



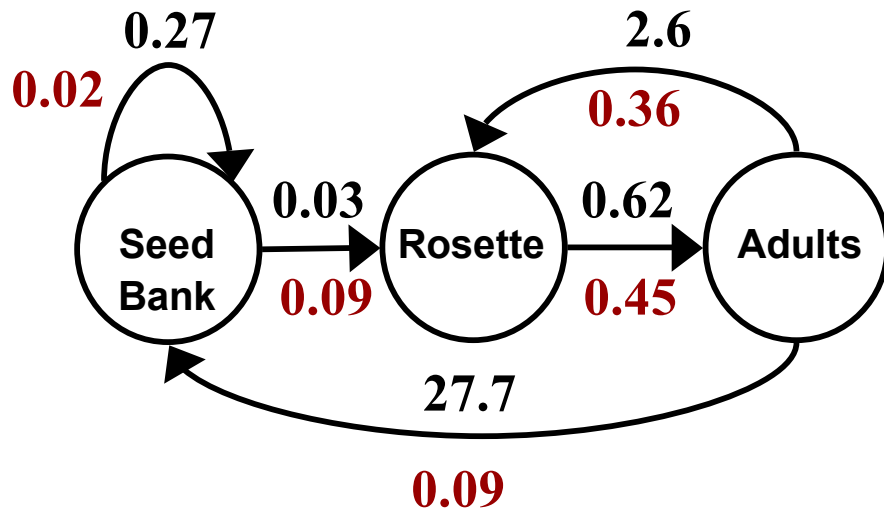
Seed



Rosette

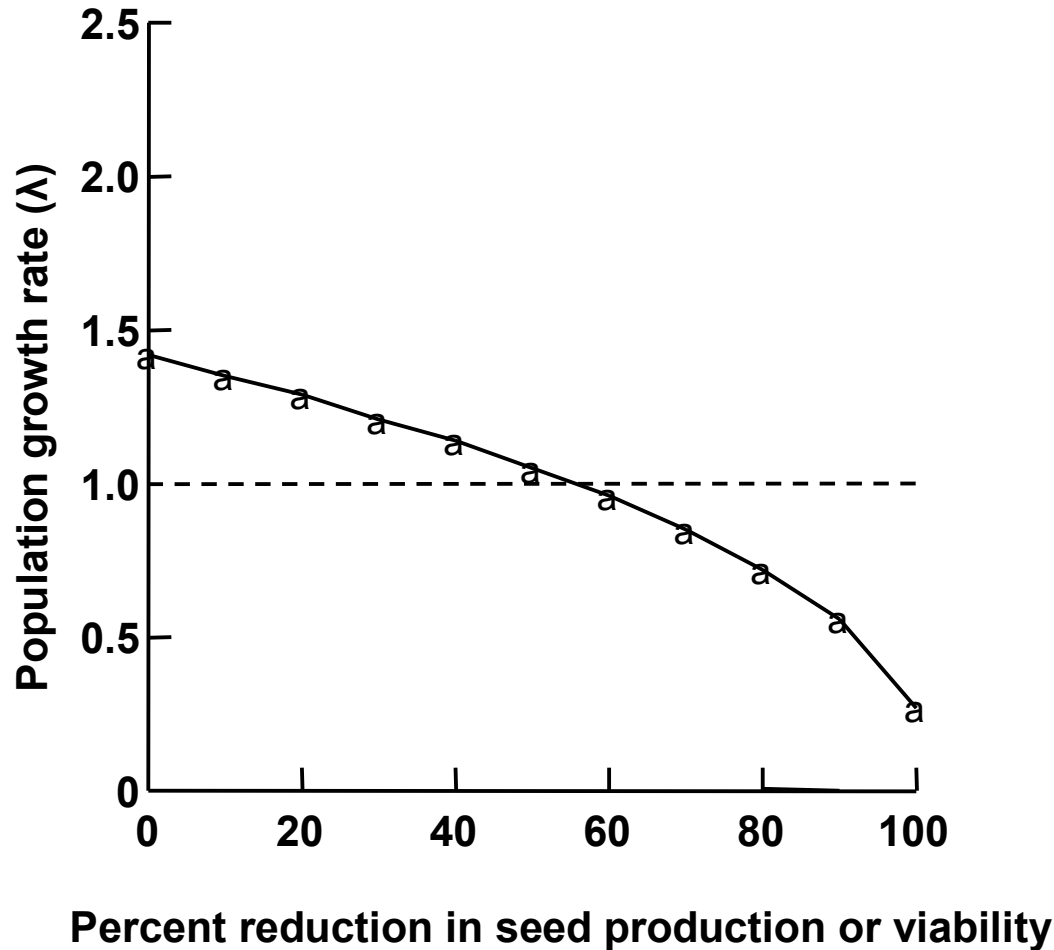


Adult

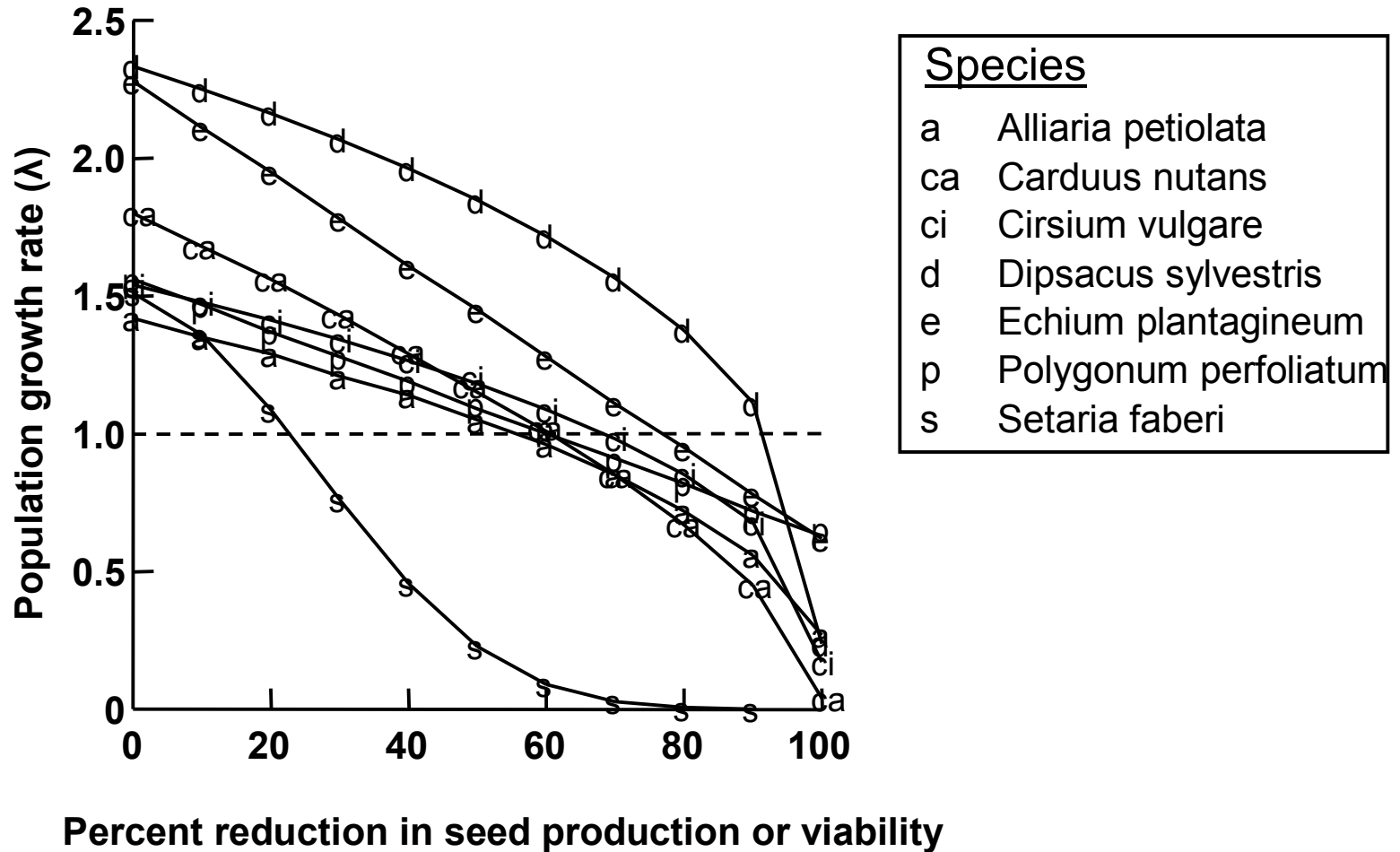


$$\lambda = 1.42$$

Reducing seed output reduces population growth of garlic mustard



Short-lived invasive species



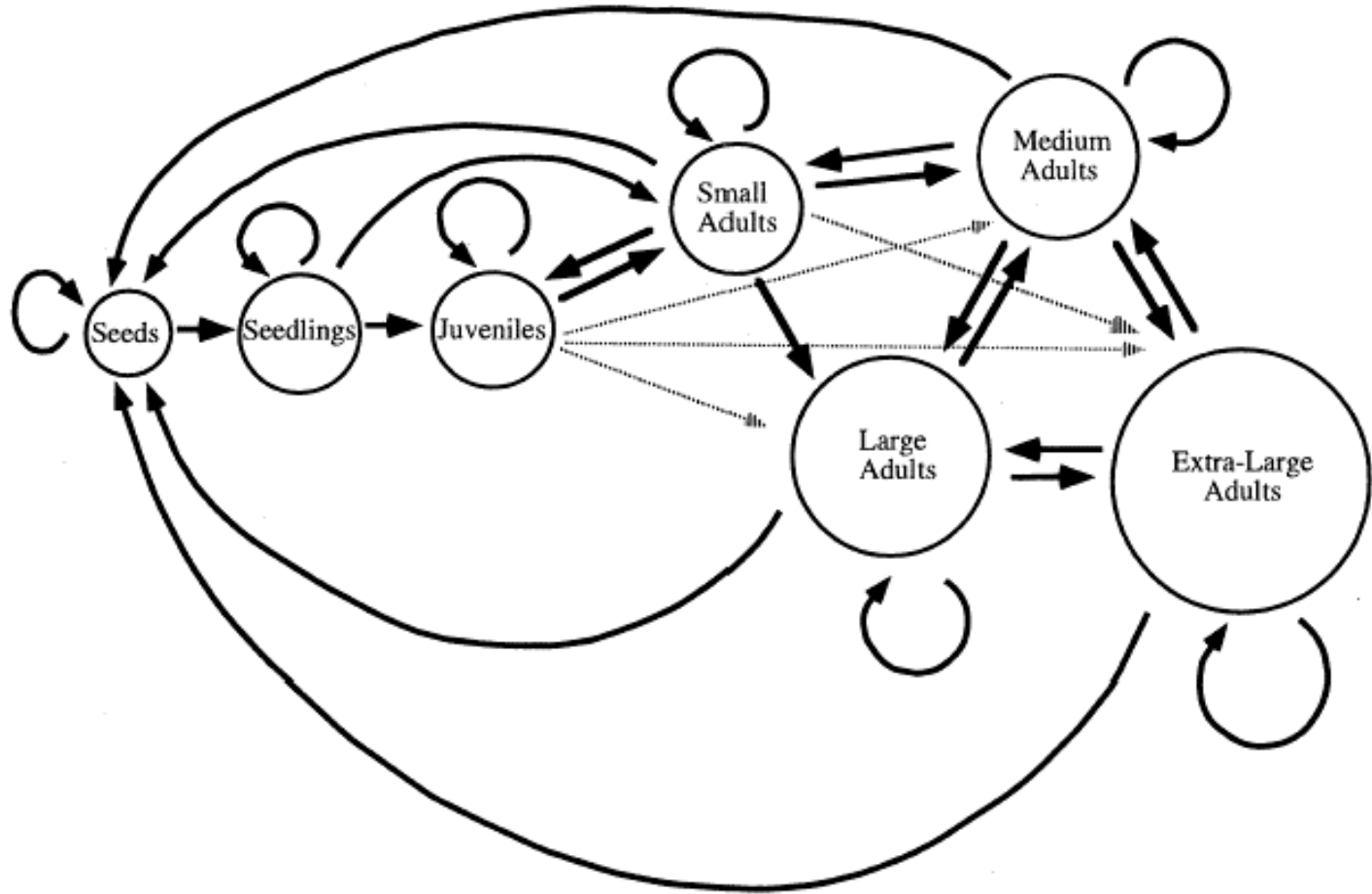
So, reduced seed output is likely to reduce population growth of short-lived species.....

.....But, what about long-lived species such as shrubs and trees?

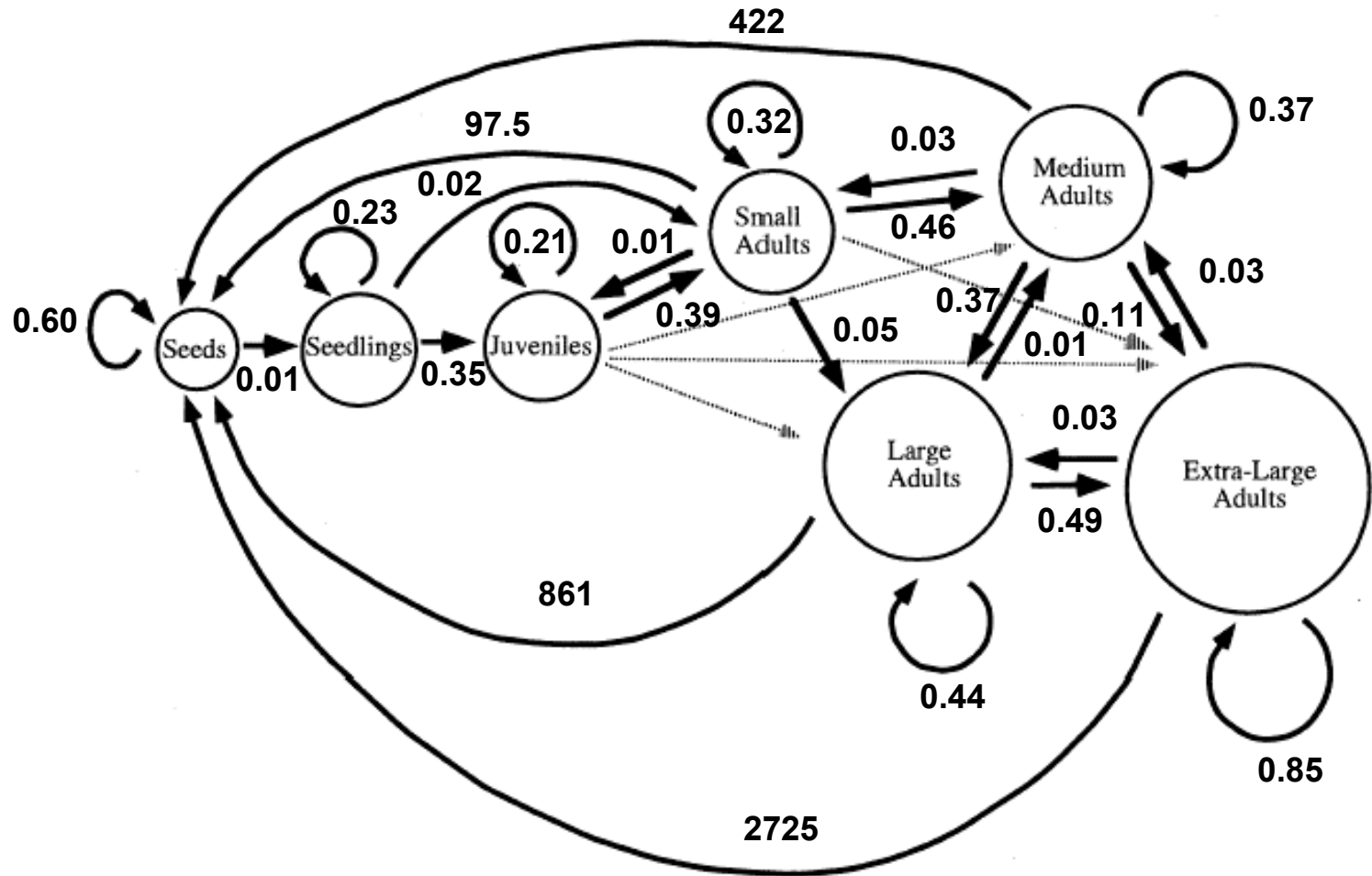
Scotch Broom (*Cytisus scoparius*)



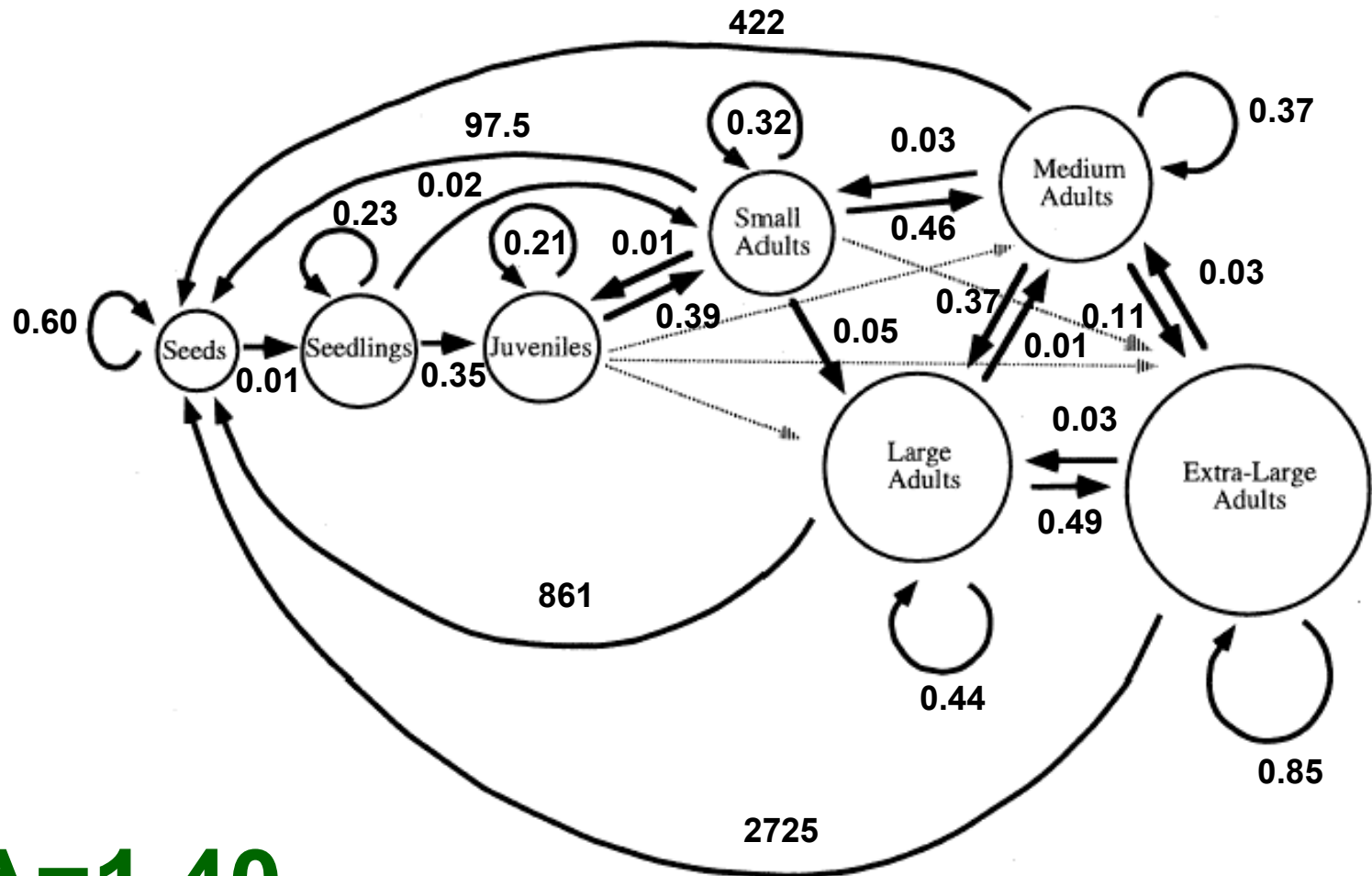
Cytisus scoparius (Scotch Broom)



Cytisus scoparius (Scotch Broom)



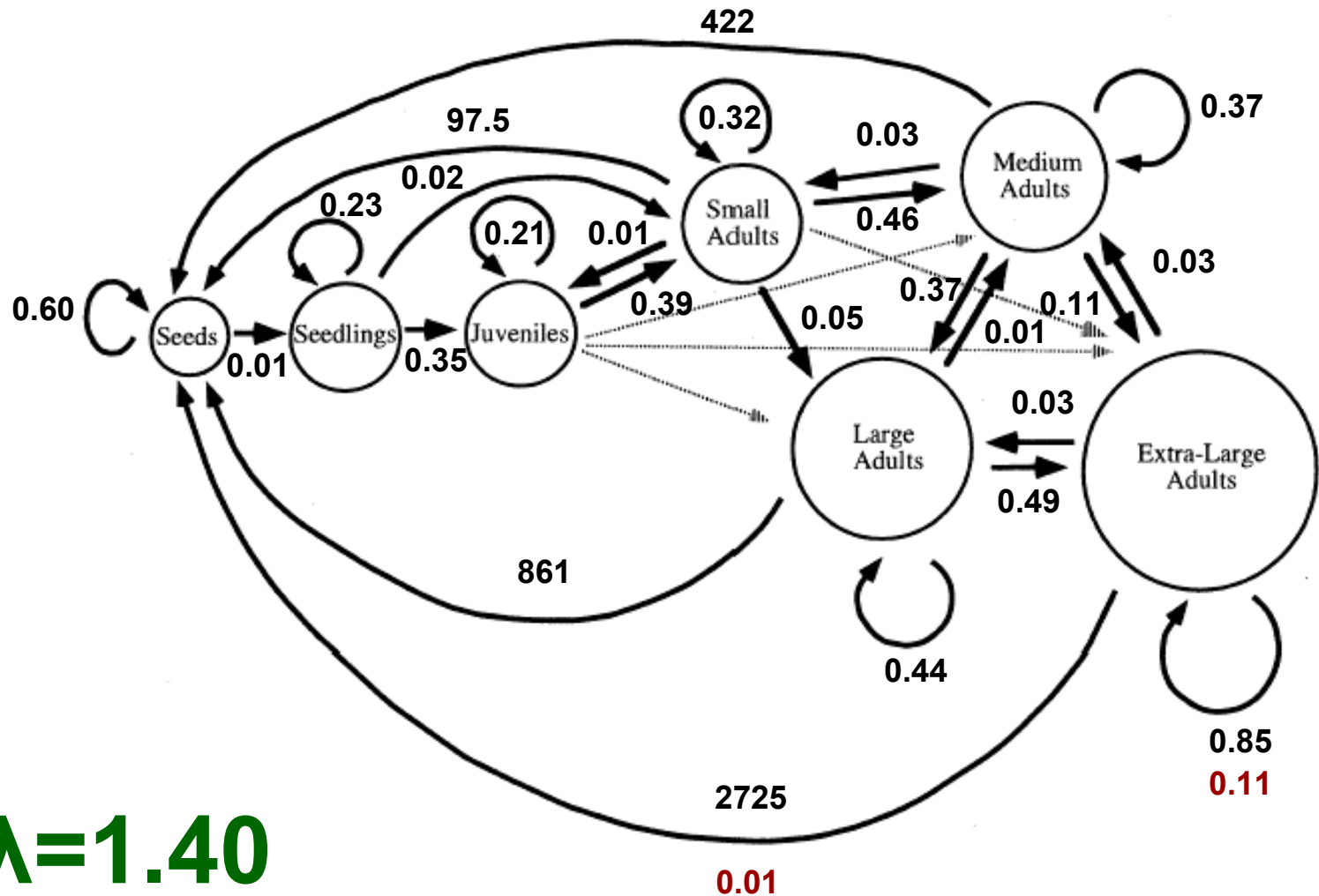
Cytisus scoparius (Scotch Broom)



$\lambda=1.40$

Parker 2000

Cytisus scoparius (Scotch Broom)

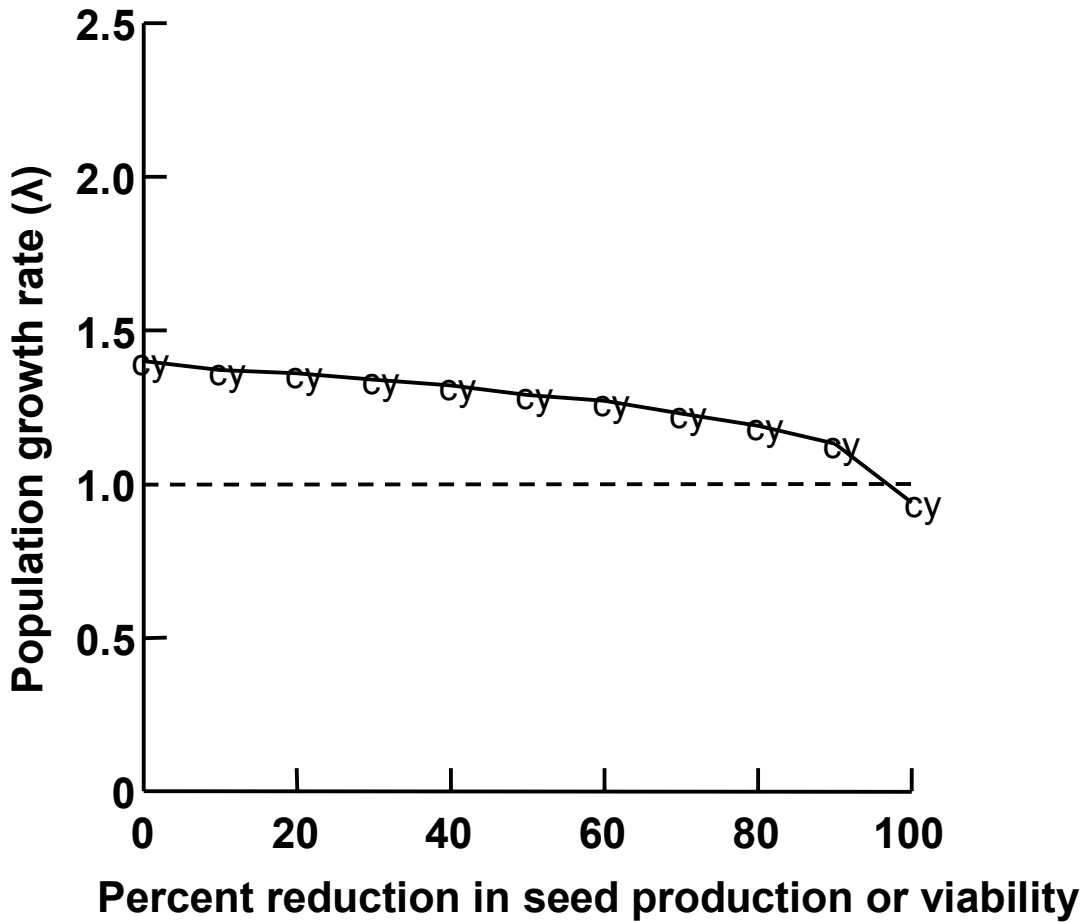


$\lambda=1.40$

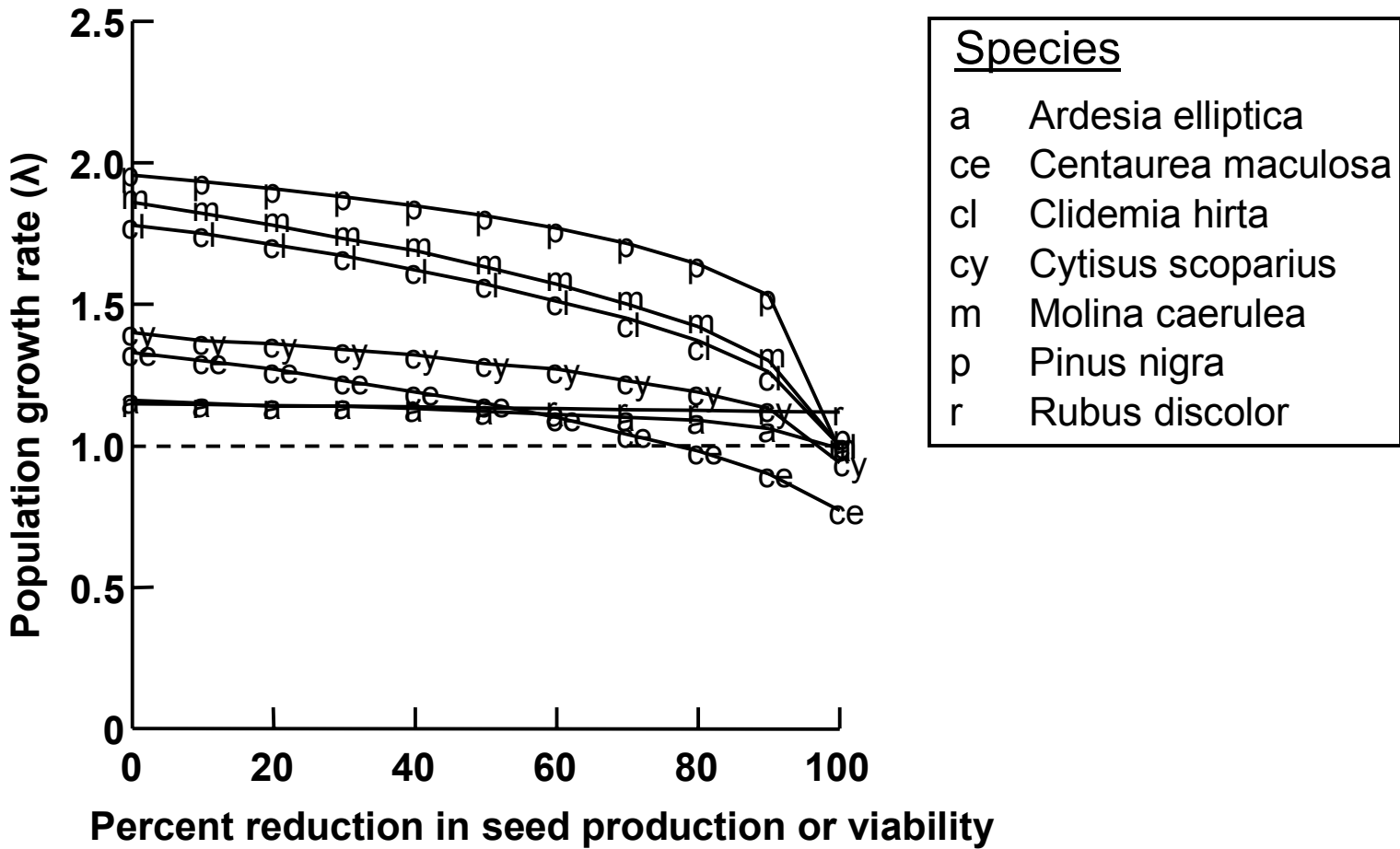
0.01

Parker 2000

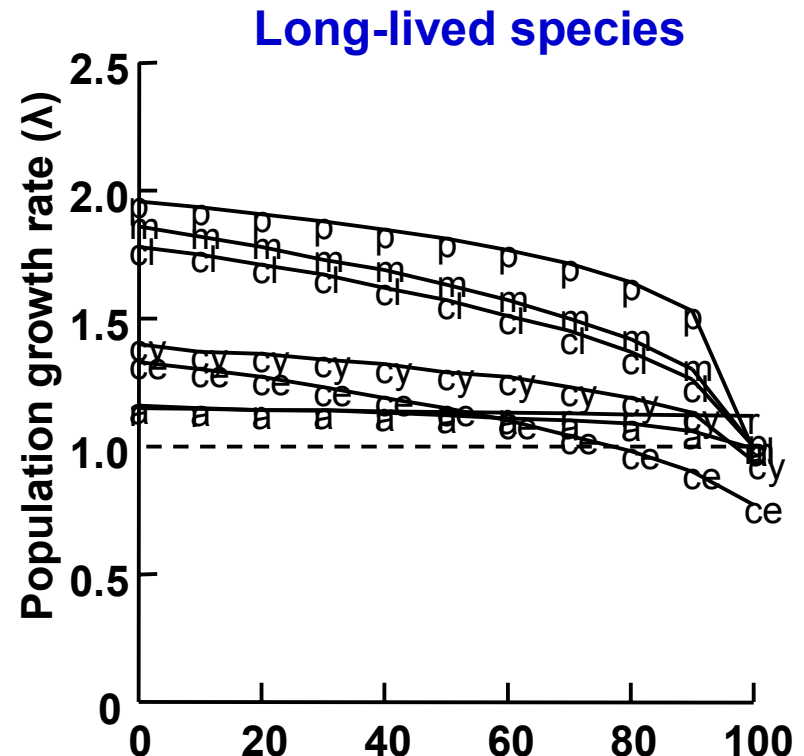
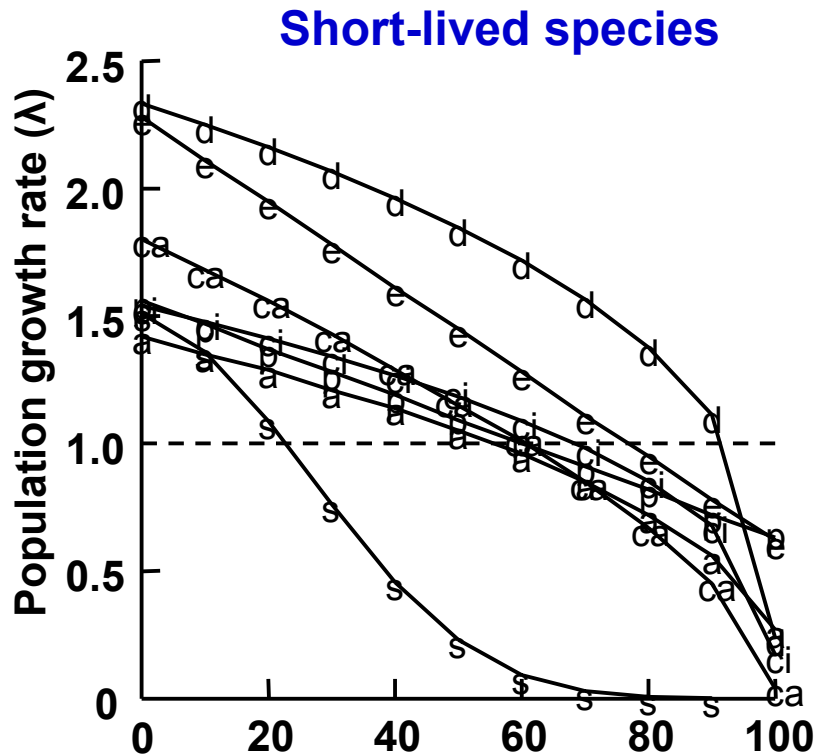
Reducing seed output has minor effects on scotch broom



Long-lived invasive species



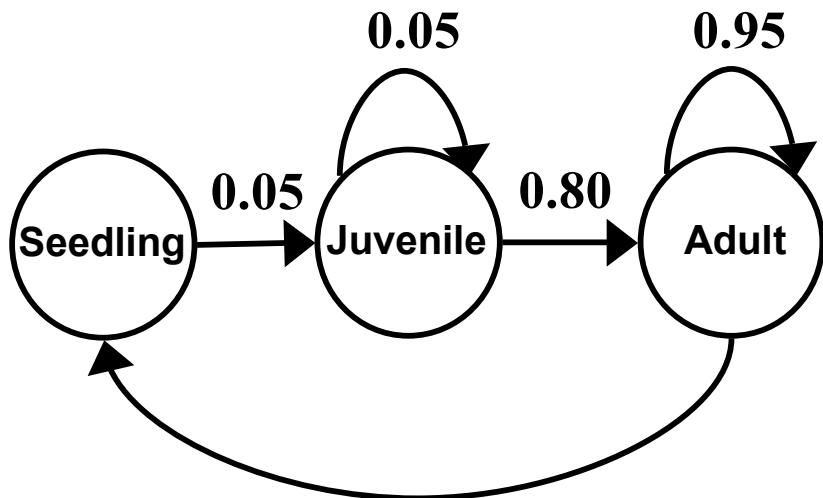
Reducing seed output has larger effects on the growth rate of short-lived species



Percent reduction in seed production or viability

A demographic approach

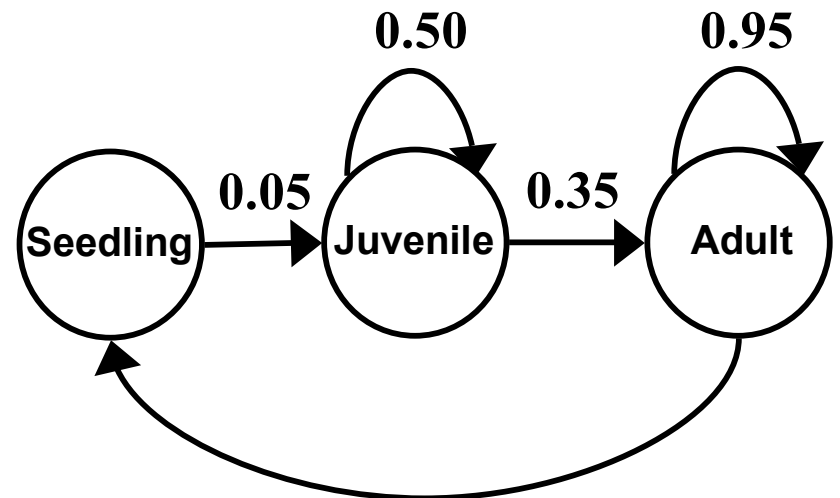
Cultivar #1



$1000 * 0.10$

$\lambda=1.50$

Cultivar #2



$50 * 0.10$

$\lambda=1.00$



Conclusions

Reductions in seed output will not necessarily result in non-invasive cultivars, particular for long-lived species

Demographic modeling can illuminate the invasive potential of different cultivars

- seed output, seed viability**
- life history (time to reproduction)**