# Interloper's legacy: invasive, hybrid-derived California wild radish (*Raphanus sativus*) evolves to outperform its immigrant parents

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# Invasions and evolution

Native Elsewhere

Survival in Transport

Establish in New Areas

Lag Period

Spread

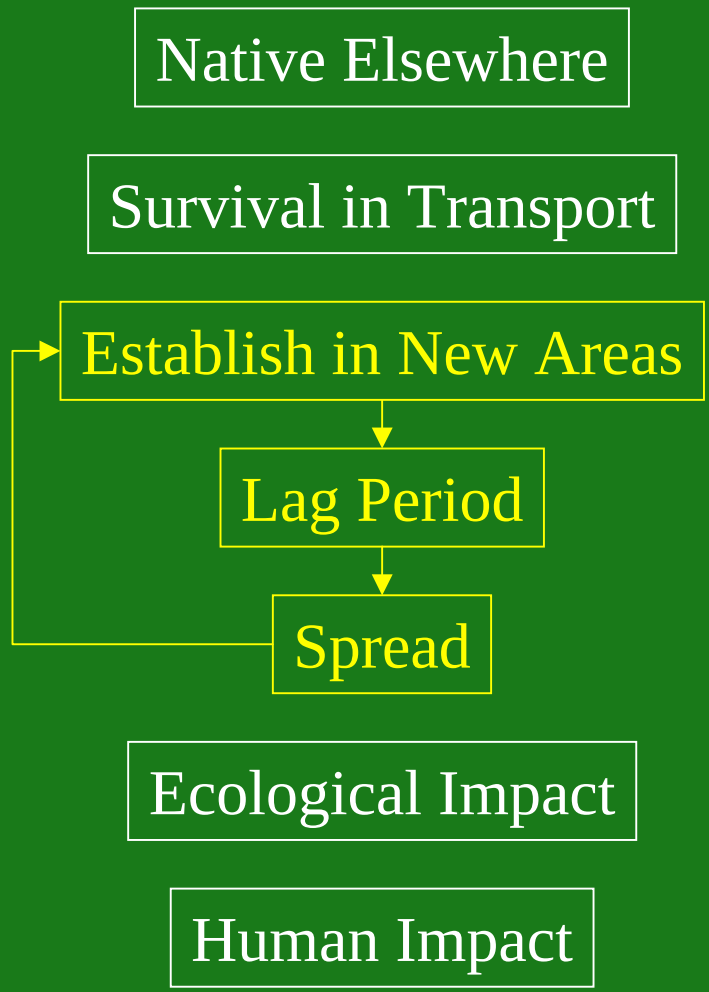
Ecological Impact

Human Impact

Sakai et al. 2001

# Invasions and evolution

- How does a species transition from established to spreading?

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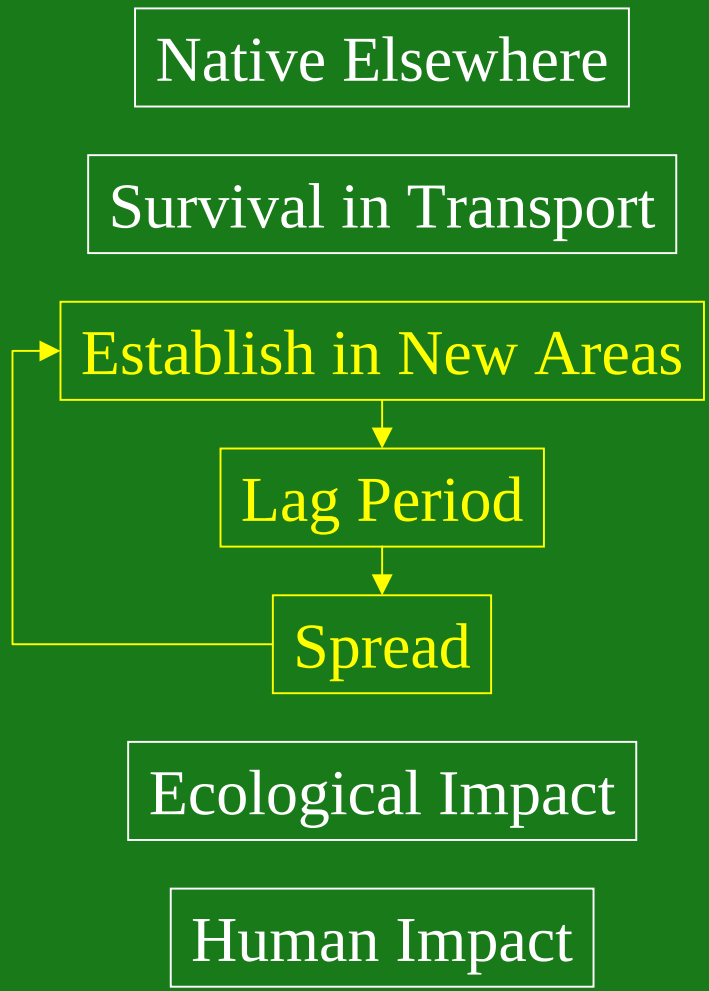


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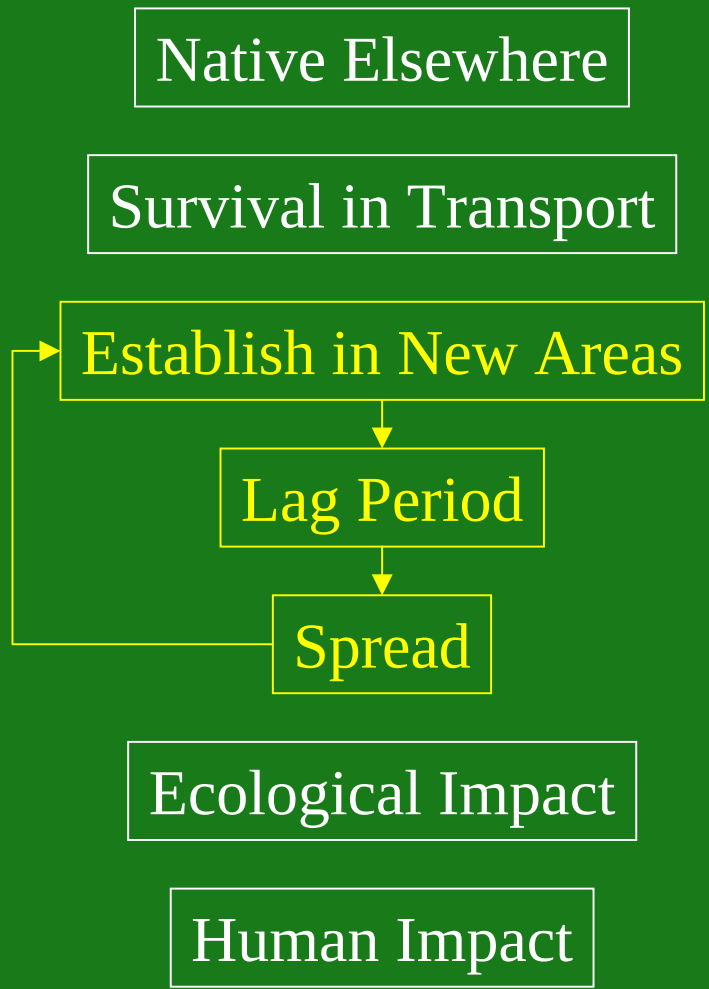


- Evidence in many systems says …

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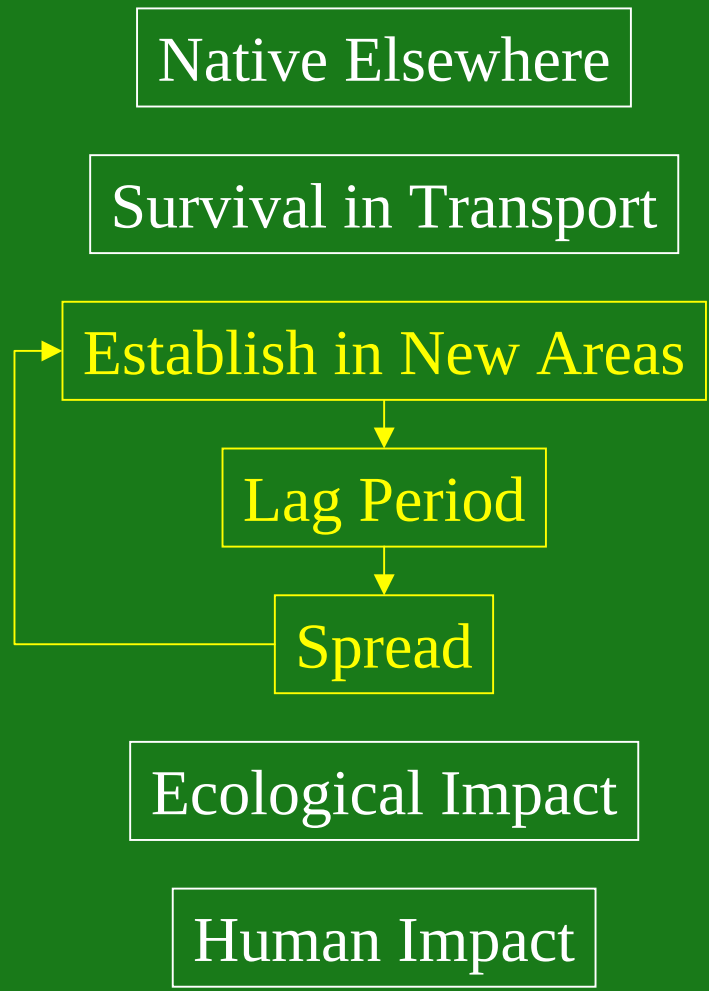


- Evidence in many systems says …


- How? By what mechanisms?

Sakai et al. 2001

# Invasions and hybridization

## Hybridization as a stimulus for the evolution of invasiveness in plants?

Norman C. Ellstrand*† and Kristina A. Schierenbeck‡§

*Department of Botany and Plant Sciences and Center for Conservation Biology, University of California, Riverside, CA 92521-0124; and ‡Department of Biology, California State University, Chico, CA 93740

Invasive species are of great interest to evolutionary biologists and ecologists because they represent historical examples of dramatic evolutionary and ecological change. Likewise, they are increasingly important economically and environmentally as pests. Obtaining generalizations about the tiny fraction of immigrant taxa that become successful invaders has been frustrated by two enigmatic

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Ellstrand and Schierenbeck 2000 PNAS

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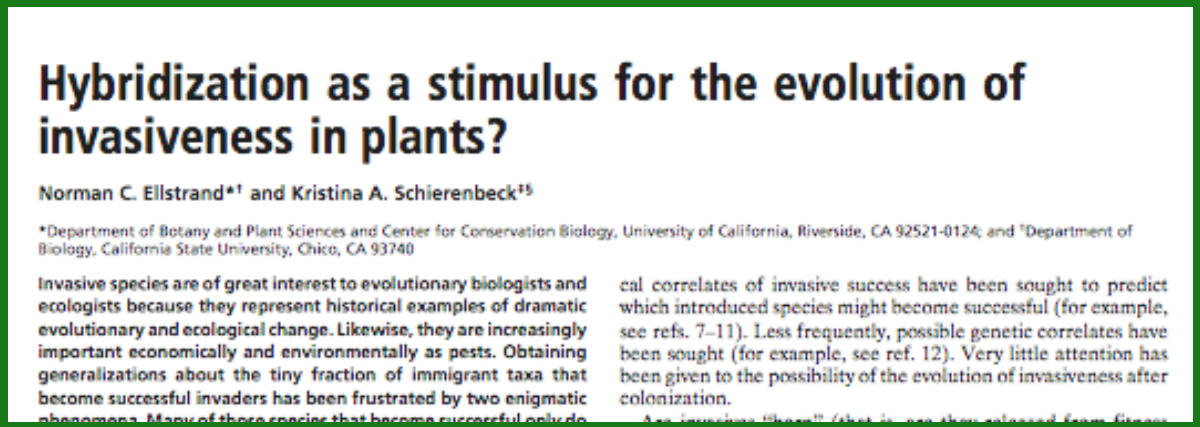

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- Increase reproductive output
  - Purging deleterious alleles
  - Fixed heterosis
  - Transfer of adaptations
- Enhance ability to respond to selection➔increase reproductive output
  - Increasing genetic variation

Ellstrand and Schierenbeck 2000 PNAS

# *Raphanus* in California

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*R. raphanistrum*

Cultivated *R. sativus*

# *Raphanus* in California

California wild *R. sativus*

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- Approach
  - Compare the reproductive output of hybrid-derived California wild radish to that of its progenitor parents.
    - Common garden design
    - Multiple years
    - Multiple, contrasting environments

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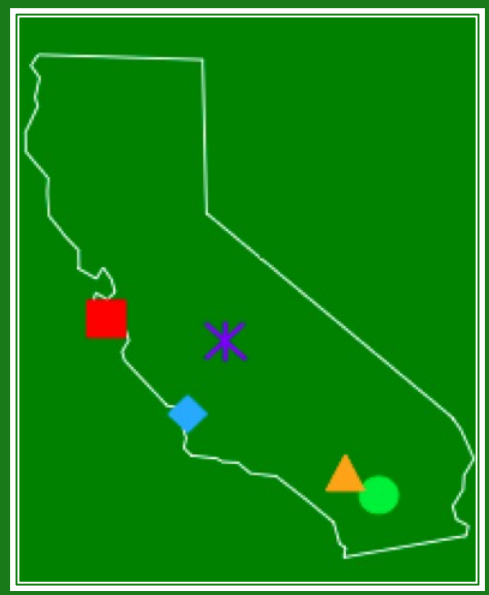
  - 5 populations of California wild radish (x50 indivs each)
    - San Luis Obispo Co., San Mateo Co., Riverside Co. 1, Riverside Co. 2, Tulare Co.



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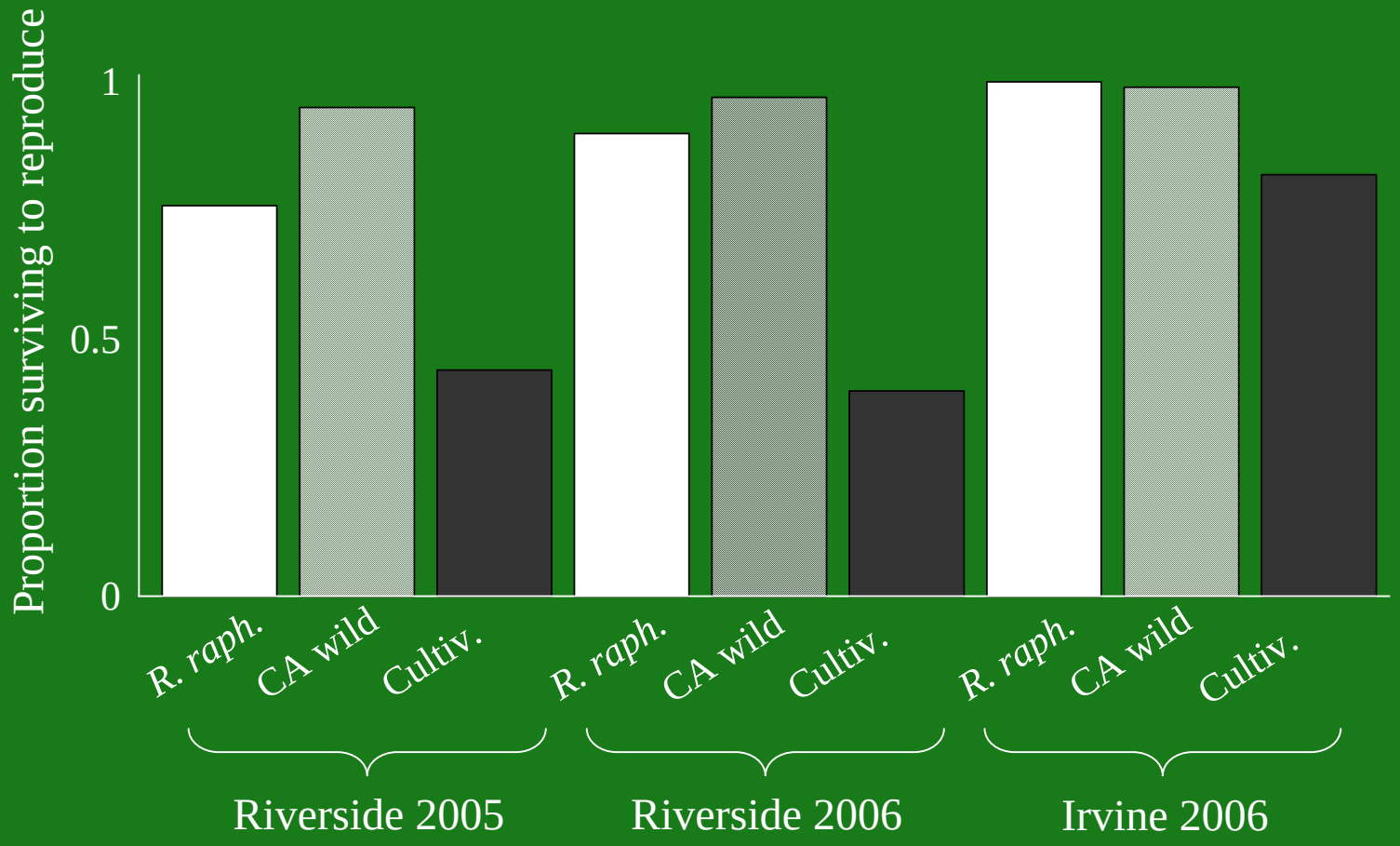
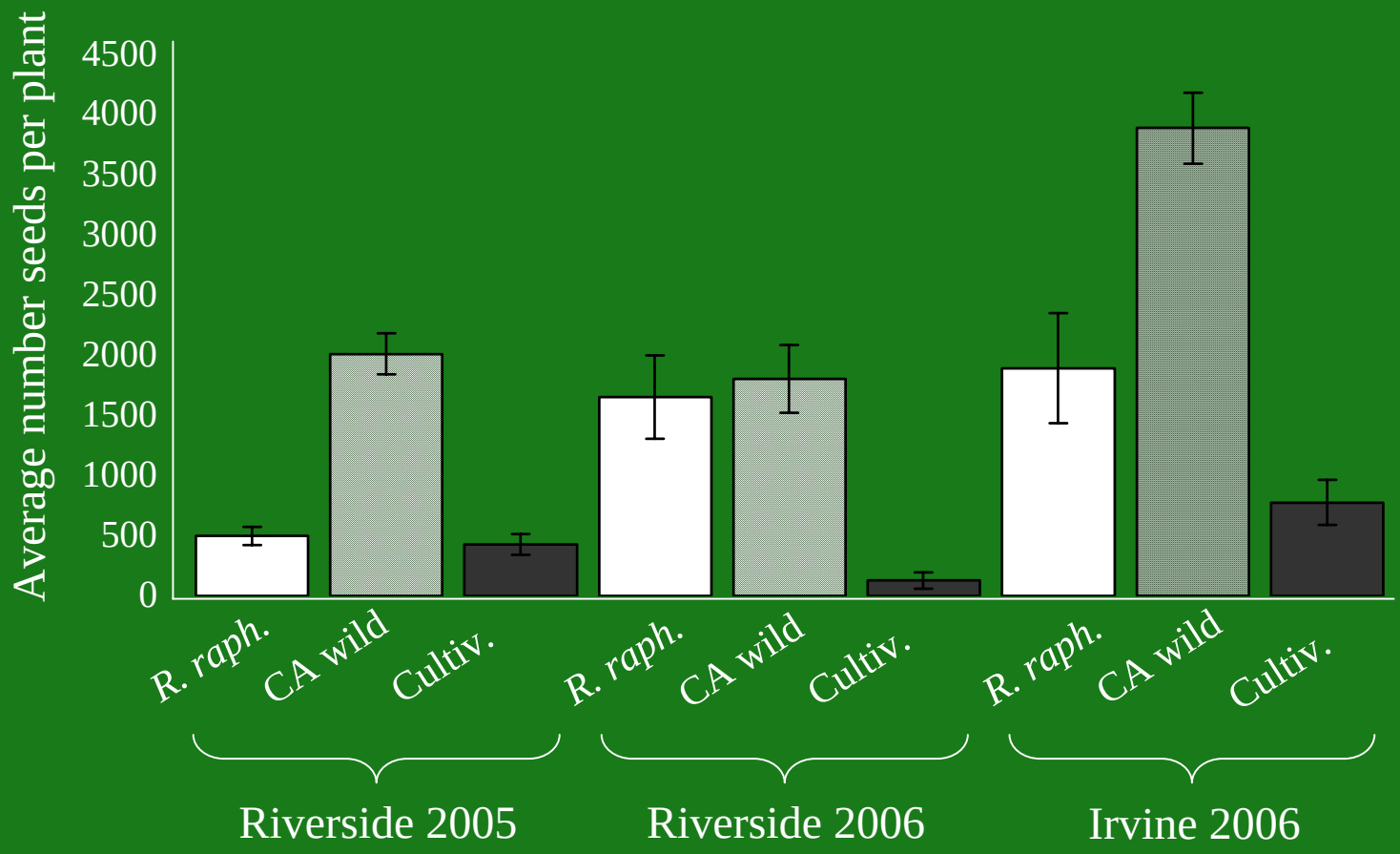
- Traits measured
  - Proportion surviving to reproduce, total number of seeds produced
- Analysis of variance

# Results


Proportion surviving to reproduce
1
0.5
0
R. raph.
CA wild
Cultiv.
R. raph.
CA wild
Cultiv.
R. raph.
CA wild
Cultiv.
Riverside 2005
Riverside 2006
Irvine 2006

# Results


Average number seeds per plant
4500
4000
3500
3000
2500
2000
1500
1000
500
0
R. raph.
CA wild
Cultiv.
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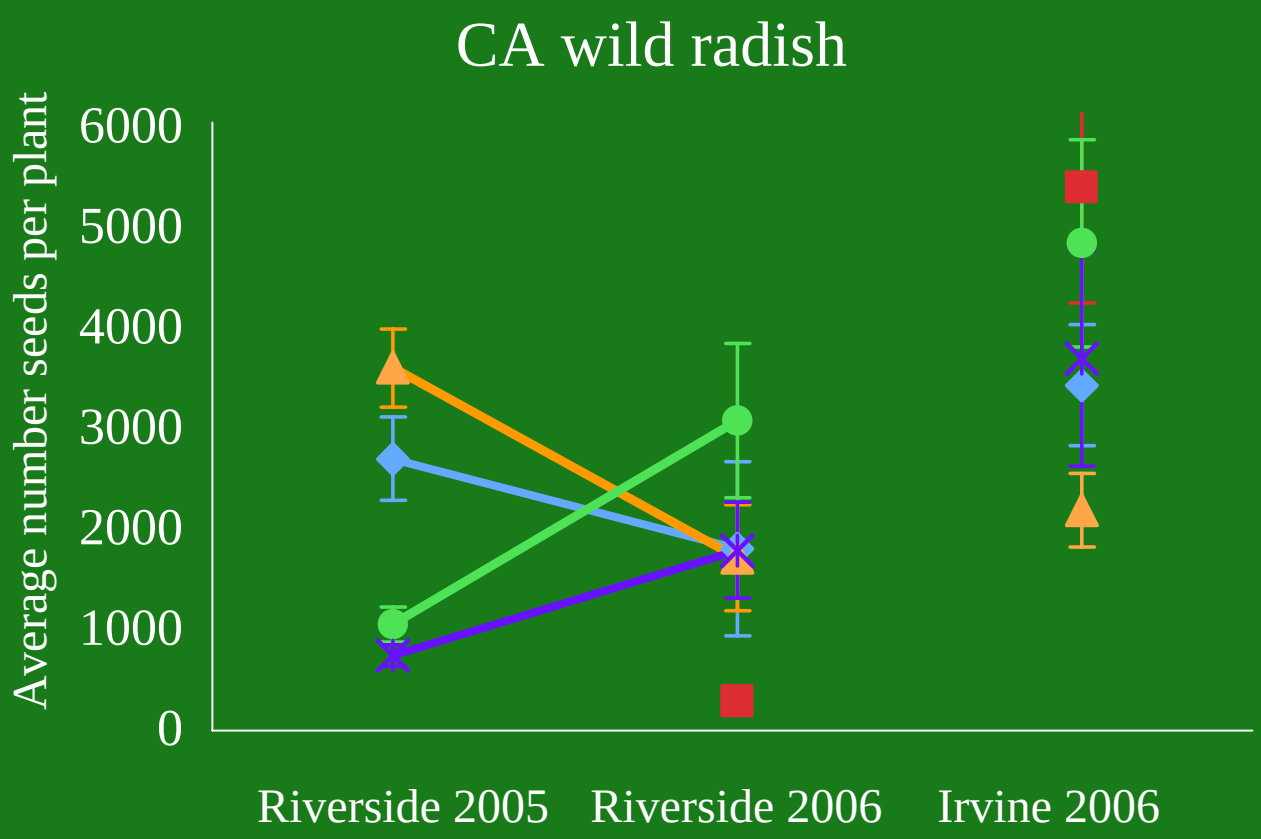
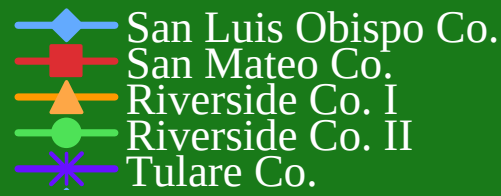
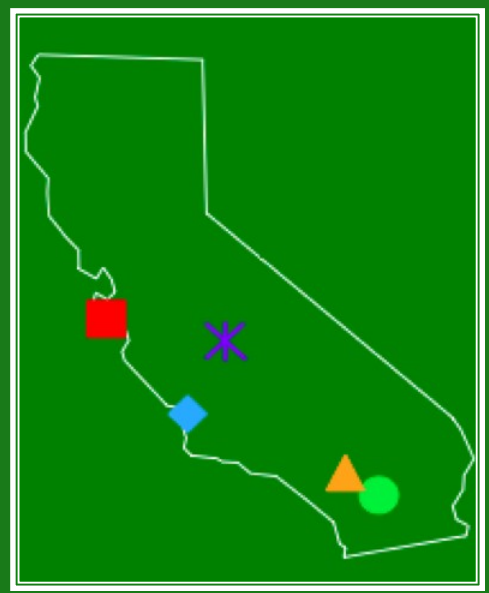

CA wild radish
Average number seeds per plant
6000
5000
4000
3000
2000
1000
0
Riverside 2005
Riverside 2006
Irvine 2006


San Luis Obispo Co.
San Mateo Co.
Riverside Co. I
Riverside Co. II
Tulare Co.



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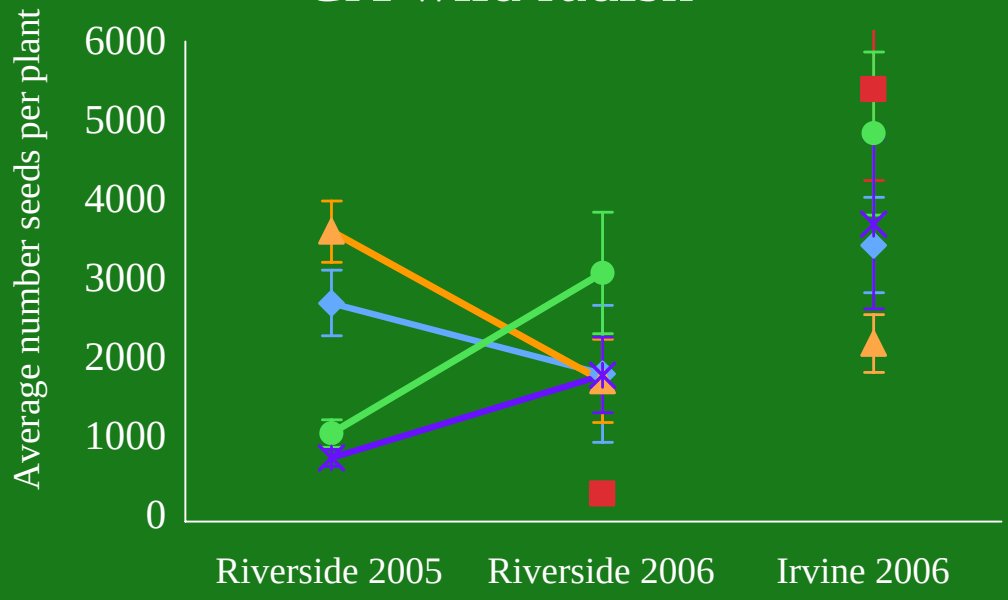
CA wild radish
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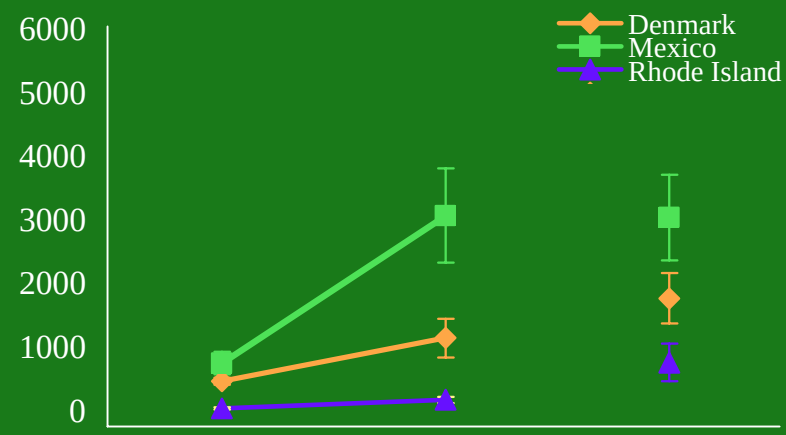
R. raphanistrum
6000
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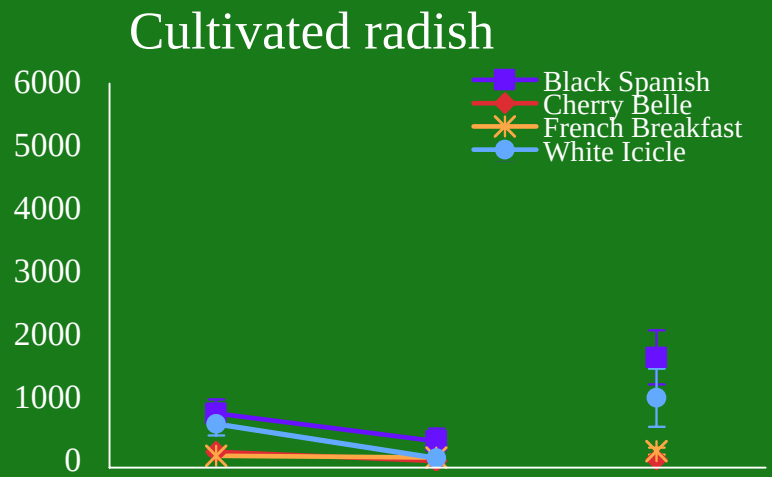
4000
3000
2000
1000
0
Denmark
Mexico
Rhode Island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Cherry Belle
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# Conclusions

- Hybrid-derived California wild radish generally survives and reproduces better than either of its progenitor parents.
  - Implication: Invasiveness can evolve via hybridization.

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  - Implication: Invasiveness can evolve via hybridization.
- The reproductive output of California wild radish populations interacts significantly with the environment.
  - Implication: Hybrid-derived populations are diverse and distinct from one another, which could help explain their invasion into the myriad varied environments in California.

# Thank yous

- Team Ellstrand
- Staff at Agricultural Experiment Station (Riverside, CA) and South Coast Research and Extension Center (Irvine, CA)
- EPA STAR Fellowship, USDA and Department of Botany and Plant Sciences at UC Riverside

Come see more radish research in the poster session!

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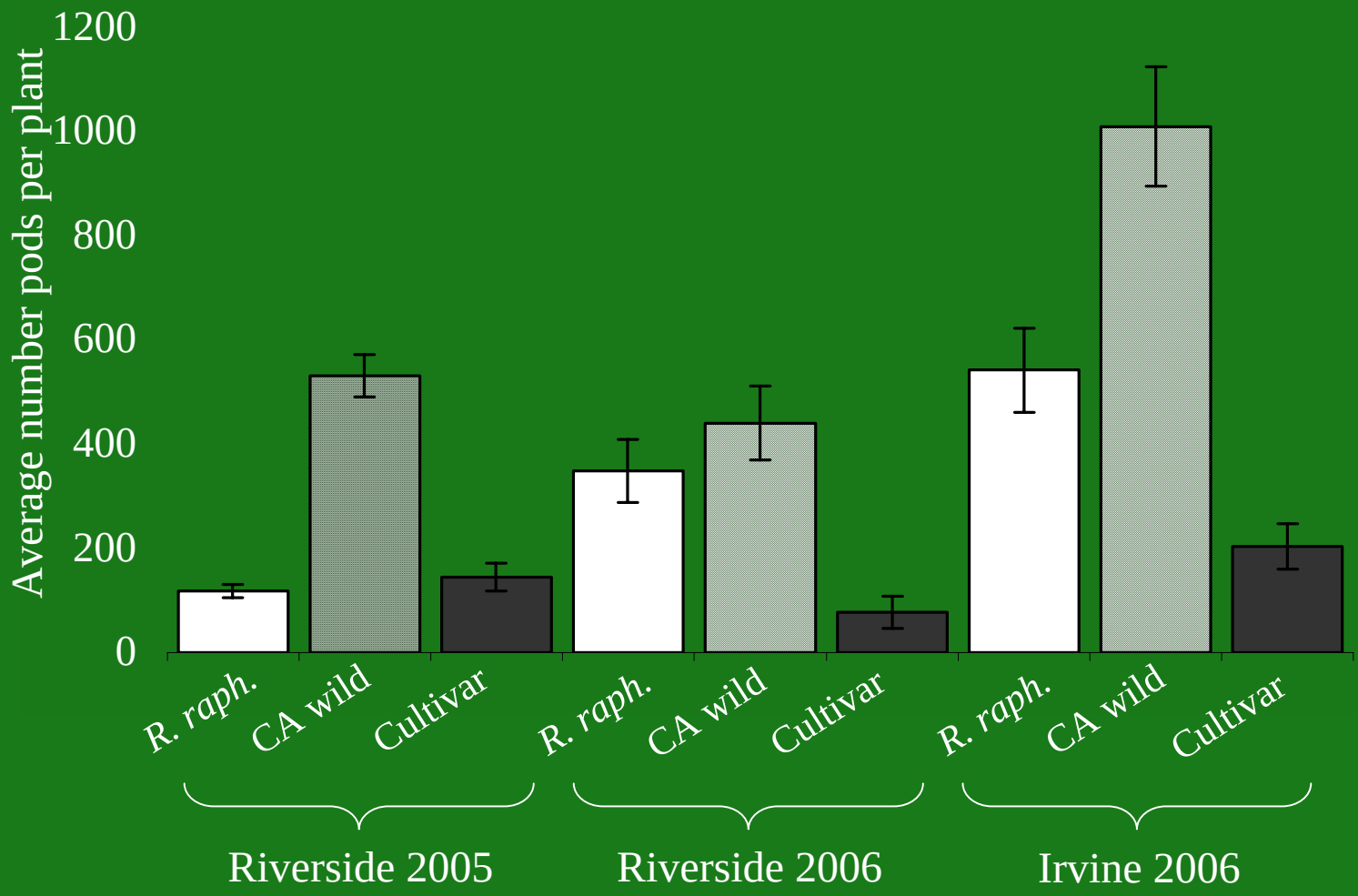
Average number pods per plant
1200
1000
800
600
400
200
0
R. raph.
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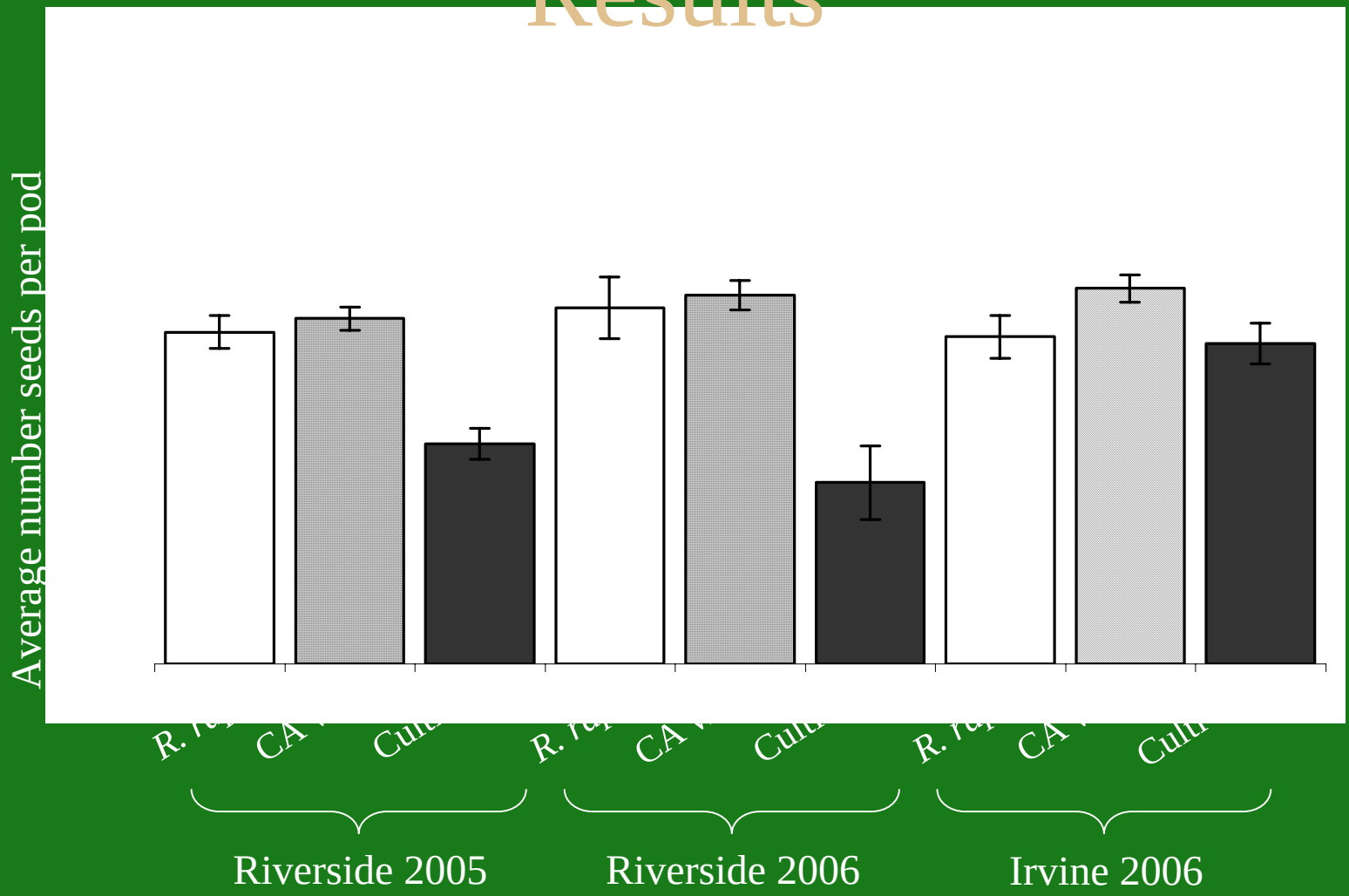
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