High salinity exposure does not preclude germination of invasive *Iris pseudacorus* from populations along a Delta – San Francisco Estuary salinity gradient

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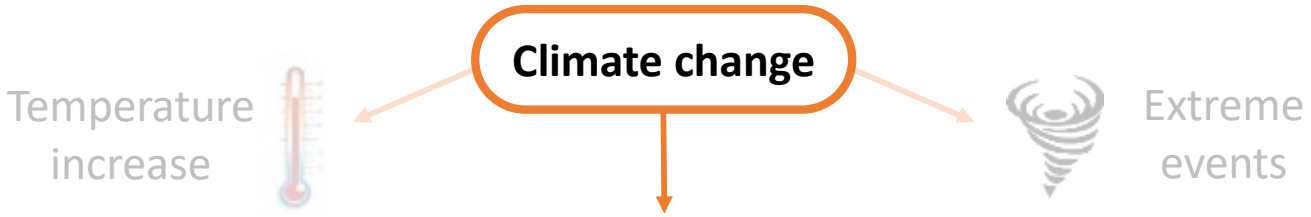
Sea level rise leads to salinity increase in estuaries



Sea level rise

+ 0.3 to +1.1 m by 2100 (IPCC, 2019)

- Saltwater intrusion in aquifers
- Increasing soil salinity
- Changing salinity gradients in estuaries:
  - Expansion of marine communities
  - Reduction of suitable habitats for estuarine communities

Impact of salinity on freshwater aquatic plants

Salt stress can induce lower

growth biomass survivorship

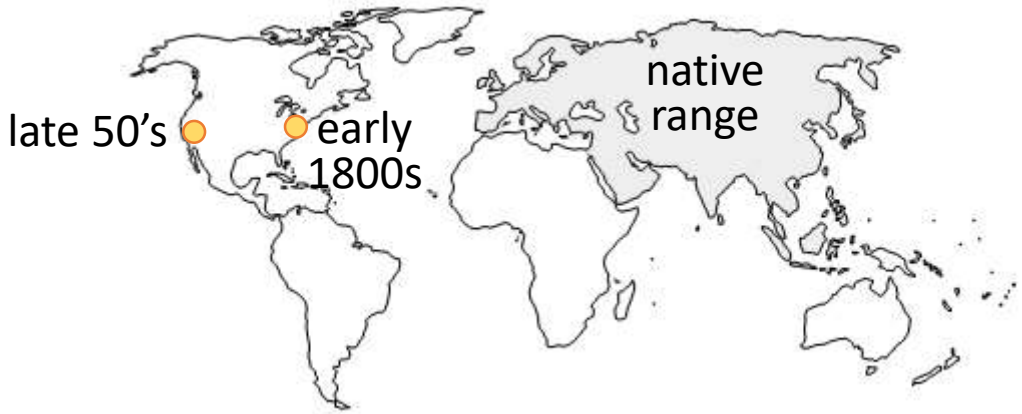
fruit production germination

- Seed exposure to salinity often leads to:
  - Lower germination fraction
  - Total, partial or no recovery

- Tolerance to salinity depends on species and on the degree of local adaptation by populations

→ Salinity increase due to sea level rise: a way to manage invasive macrophytes?

Iris pseudacorus is spreading in California tidal wetlands



Present in:
- Freshwater water bodies
- Tidal wetlands

→ Tolerates some range of salinity levels

- Recently spread into brackish tidal wetlands of the Suisan March, San Francisco Estuary

⚠ Sensitive ecosystem, presence of threatened and endangered species

Knowledge about the ecology of the species needed to establish management plans

- *I. pseudacorus* reproduces almost exclusively through sexual reproduction (Lamote *et al.* 2002, Gaskin *et al.* 2016)
- Seeds are buoyant for months → Hydrochory (Coops et al 1995, van der Broek et al. 2005)
- Few existing information about its germination

Could sea-level rise help to cope with *I. pseudacorus* invasion in estuaries?

Objective

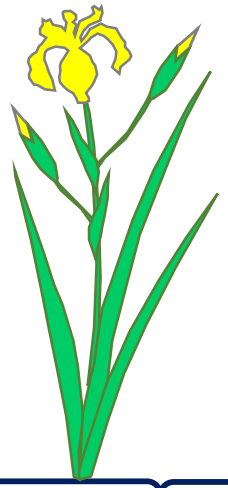
Determine at which extent the germination of *Iris pseudacorus* is impacted by different salinity and water levels

Hypothesis:

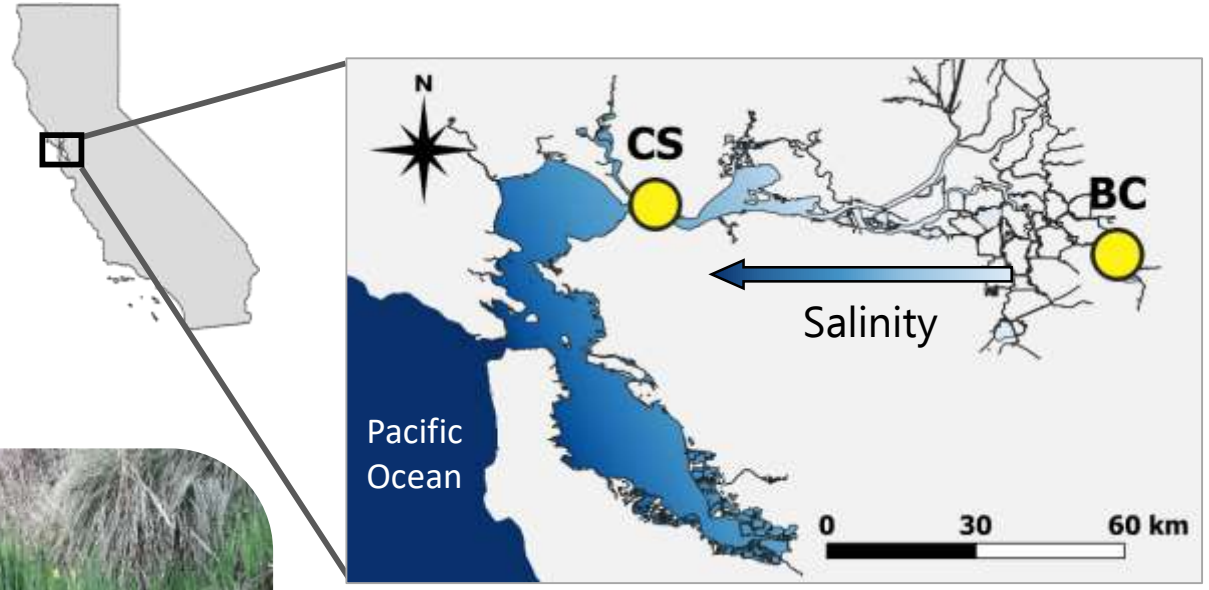
1) Seed germination fraction will decrease as salinity level increases

2) The seeds from a parental population that experienced some salinity level will be more tolerant to salinity than that from a parental population only exposed to freshwater

3) Seeds will germinate better in moist conditions than in flooded conditions

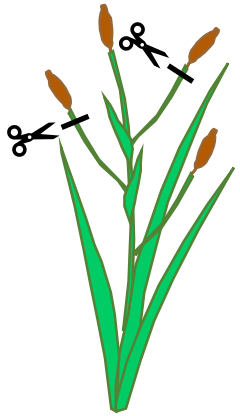


Collection sites



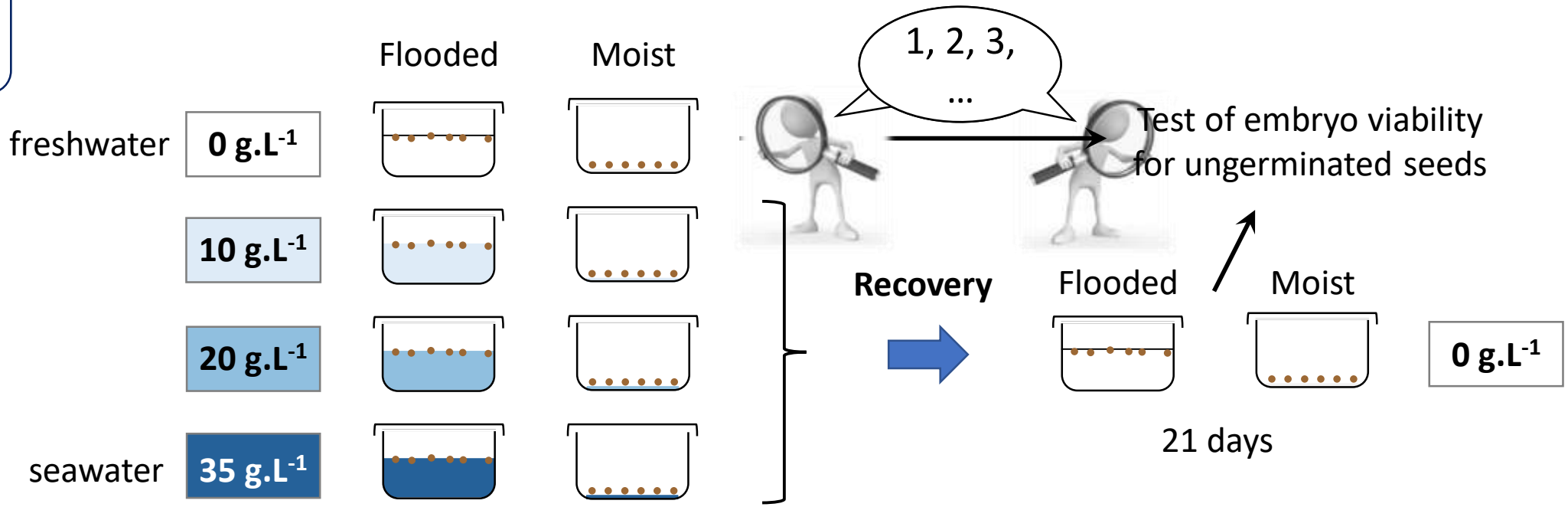
Two invaded sites in the Delta-San Francisco estuary

Glen Cove at Carquinez Strait



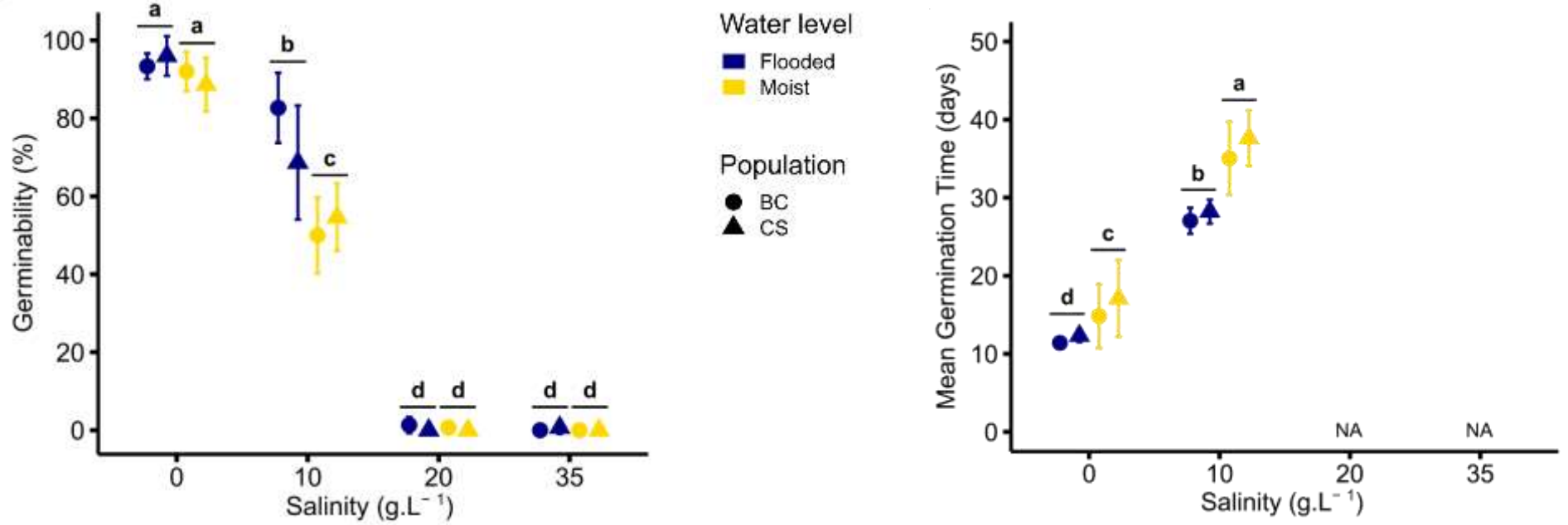
San Joaquin River at Buckley Cove

Experimental design



- 2 populations
- 6 replicates per treatment (lots of 25 seeds)
- 55 days in greenhouse conditions

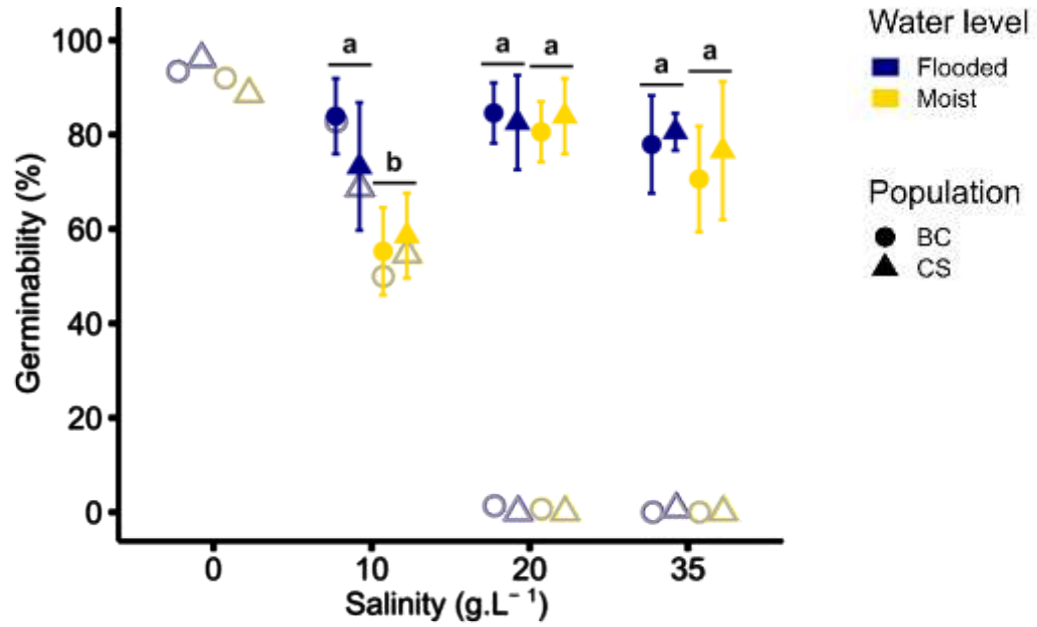
Seed germinability and germination velocity

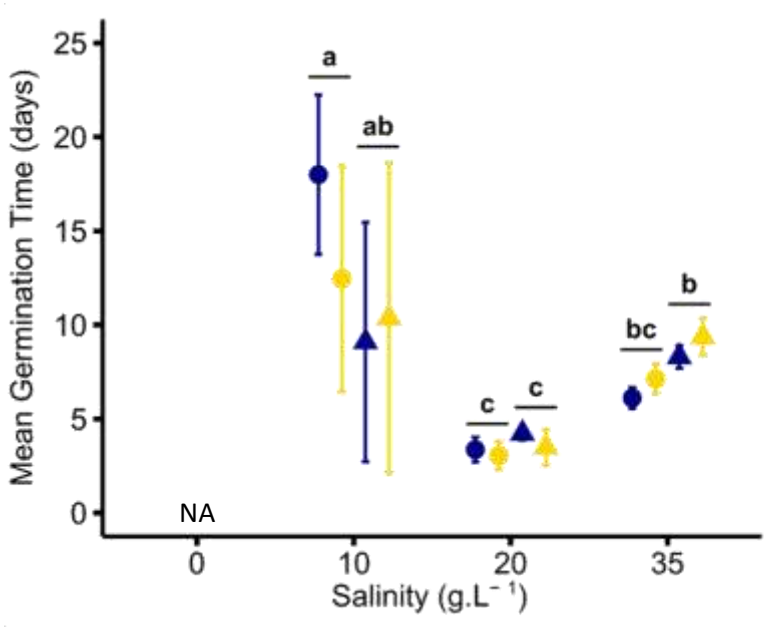


- No population effect
- Greater germination in freshwater
- At 10 $g.L^{-1}$, greater germination in flooded conditions
- No germination at 20 and 35 $g.L^{-1}$

- No population effect
- Slower germination at 10 g.L-1
- Faster germination in flooded conditions

Recovery to salinity exposure

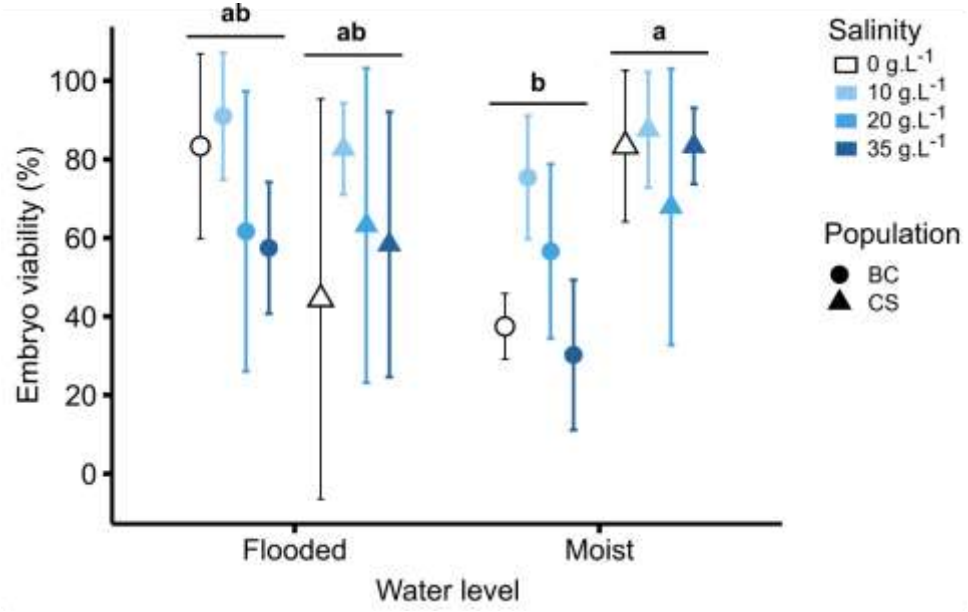




- No population effect
- Few more germination after exposure to 10 $g.L^{-1}$
- Difference between moist and flooded conditions at 10 $g.L^{-1}$ is maintained
- Good recovery of seeds exposed to 20 and 35 $g.L^{-1}$

- Slower germination of seeds that had been exposed to 10 $g.L^{-1}$
- Faster recovery after exposure to 20 $g.L^{-1}$

Embryo viability after exposure to salinity



- Interaction Water level x Population:
Lower embryo viability of BC population when seeds exposed to moist conditions

- No effect of salinity on embryo viability

Summary of the results

Hypothesis:

1) Seed germination fraction will decrease as salinity level increase ✓
   → 90% germination at 0 $g.L^{-1}$
   → 70% germination at 10 $g.L^{-1}$
   → No germination at 20 and 35 $g.L^{-1}$

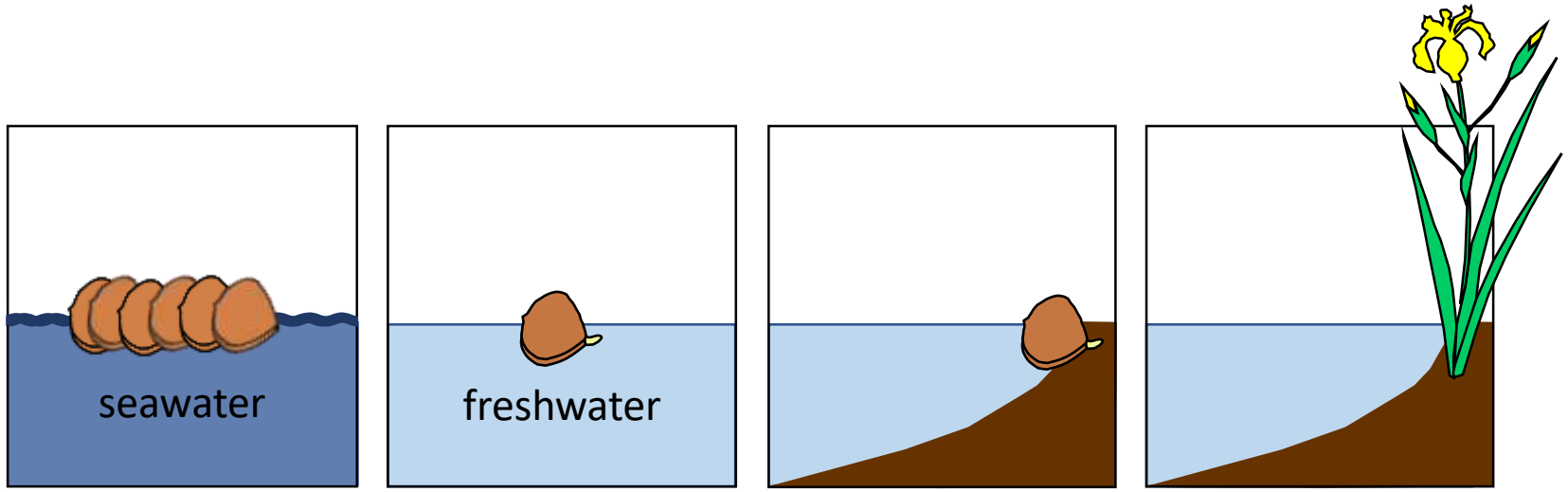
2) The seeds from a parental population that experienced some salinity level will be more tolerant to salinity than that from a parental population only exposed to freshwater ✗
   → No population effect on germination, no local adaptation

3) Seeds will germinate better in moist conditions than in flooded conditions ✗
   → Seeds in flooded conditions showed better performances:
      - Faster germination
      - Greater germination at 10 $g.L^{-1}$
   → No difference during recovery after exposure to 20 and 35 $g.L^{-1}$

Implications for management

- High salinity does prevent seed germination, if they stay exposed to high salinity levels
- High recovery capacities once exposed to freshwater

→ Prolongated period of exposure to seawater does not impede germination capacities of invasive *I. pseudacorus*



Increasing salinity is unlikely to prevent the spread of *I. pseudacorus*

Acknowledgements

Brenda J. Grewell
Joy Futrell
Mohsen Mesgaran
Jesús M. Castillo

Jessica Drost
Reina L. Nielsen
Rebecca A. Reicholf

Christy M. Morgan

Thank you for your attention