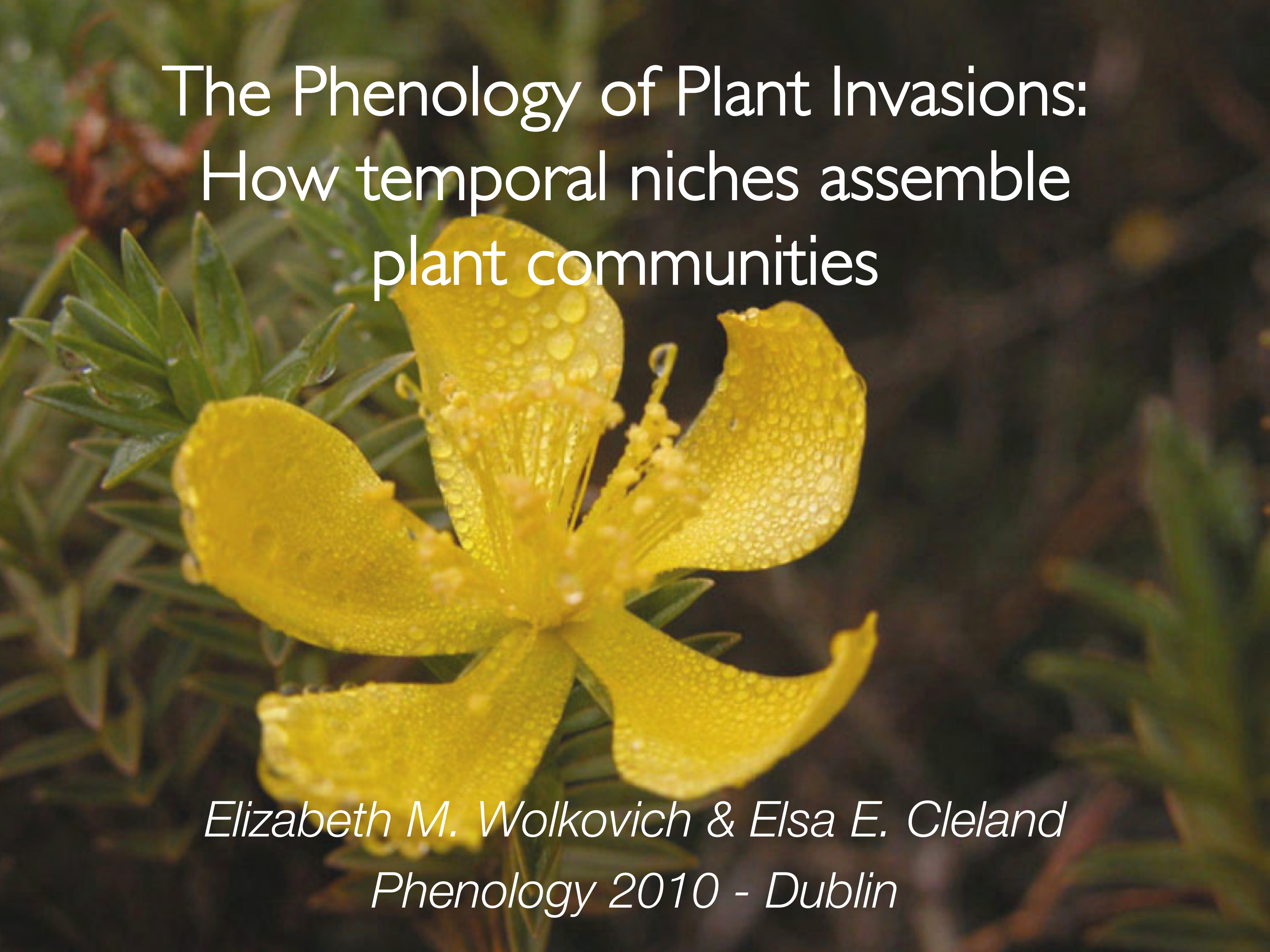


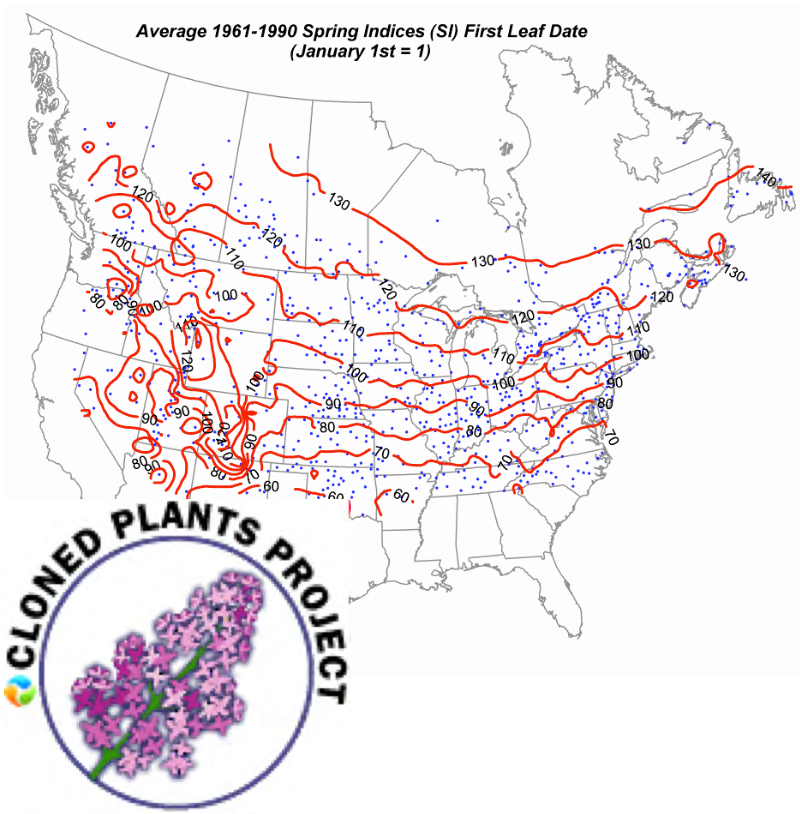
The Phenology of Plant Invasions: How temporal niches assemble plant communities

Elizabeth M. Wolkovich & Elsa E. Cleland

Phenology 2010 - Dublin


Plant invasions

Phenology most commonly used as an indicator of global climate change



US National Phenology Network,
Schwartz et al.

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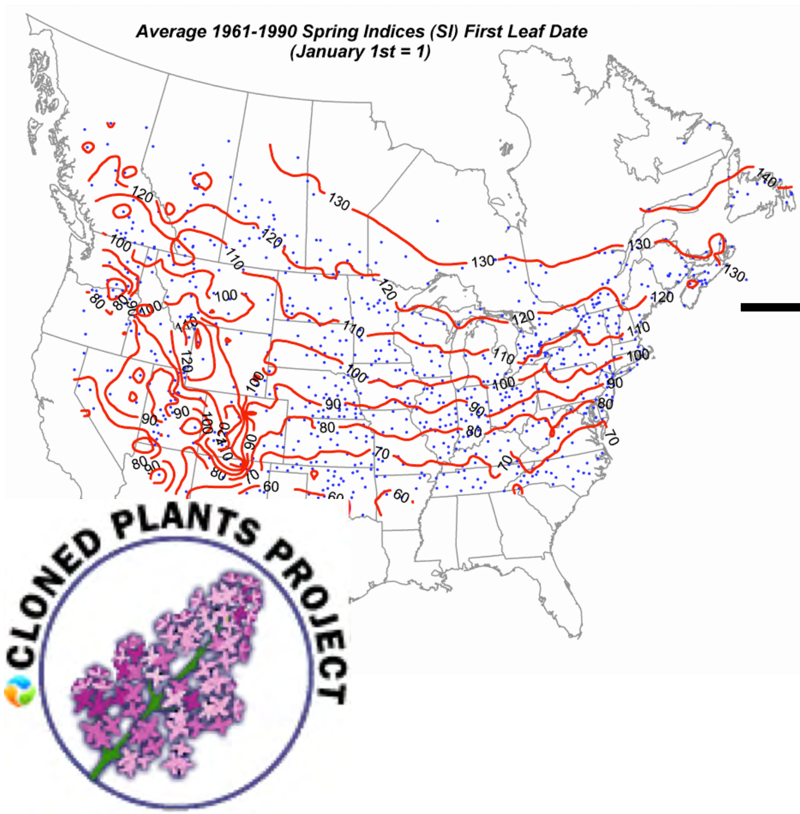


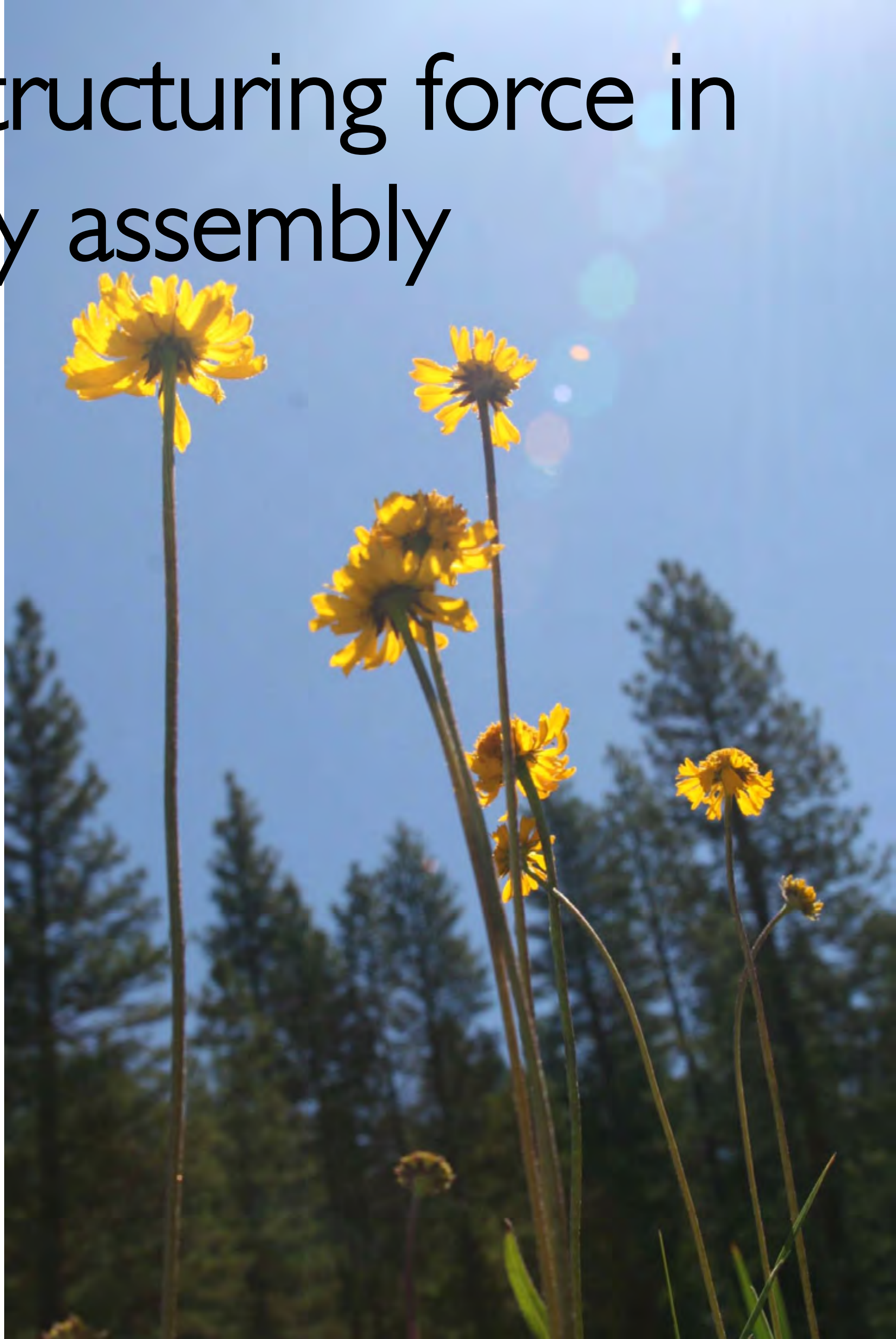
US National Phenology Network,
Schwartz et al.

Extensive plant phenology datasets

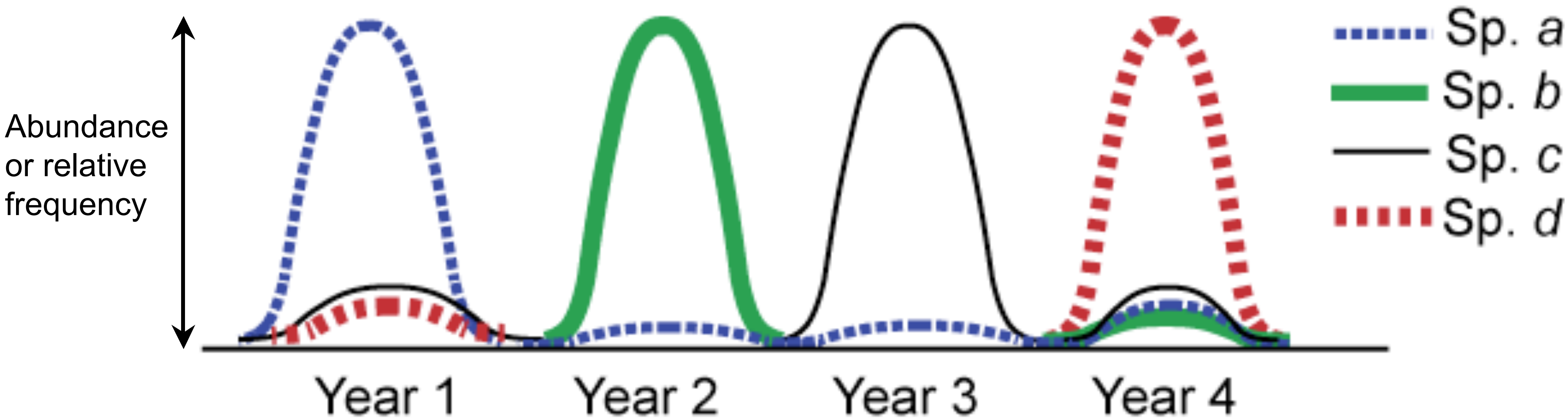
Phenology & community structure

Phenology as a structuring force in community assembly

- Extending theory from space to space-time
  - (A) Vacant niche
  - (B) Priority effects
  - (C) Niche breadth
  - (D) Plasticity
- Phenology data sources and results
- Extensions to management

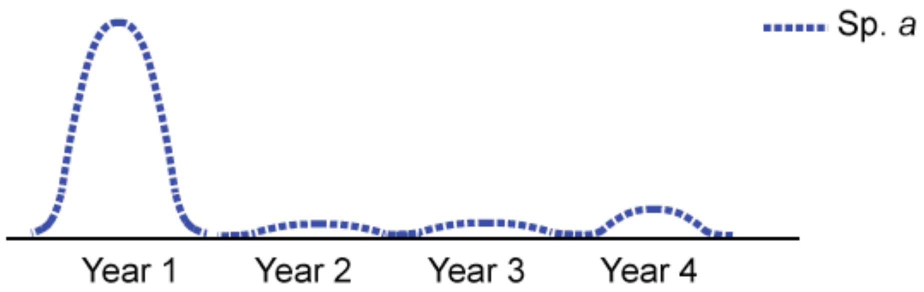


Time in community ecology theory

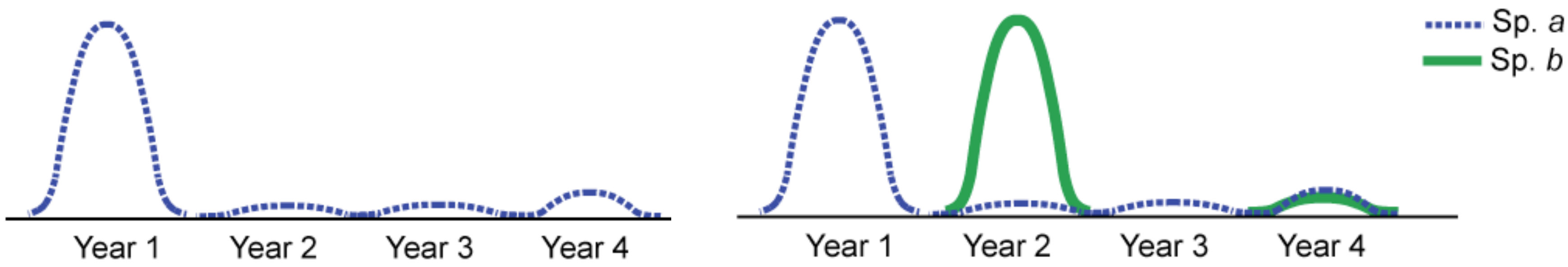


Storage effect model uses interannual variability to promote coexistence

Interannual variability & coexistence



Interannual variability & coexistence



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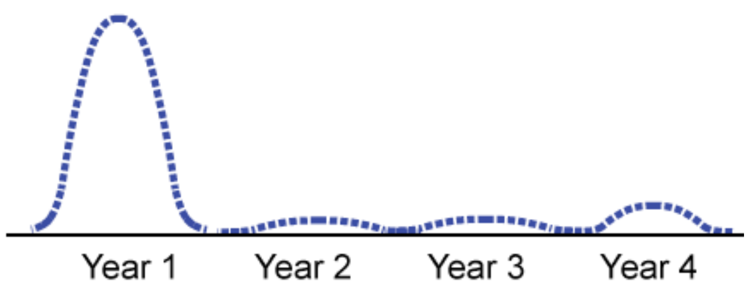
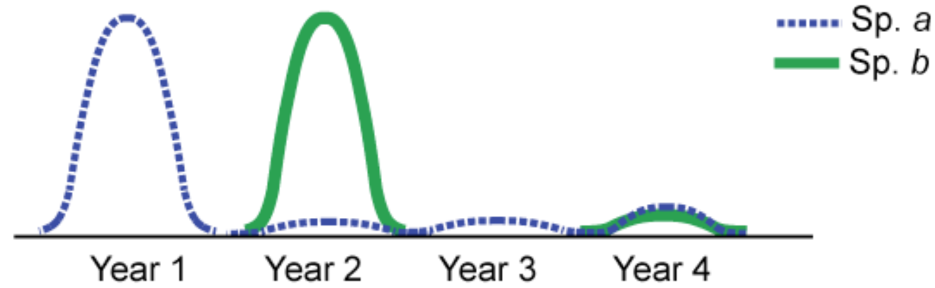
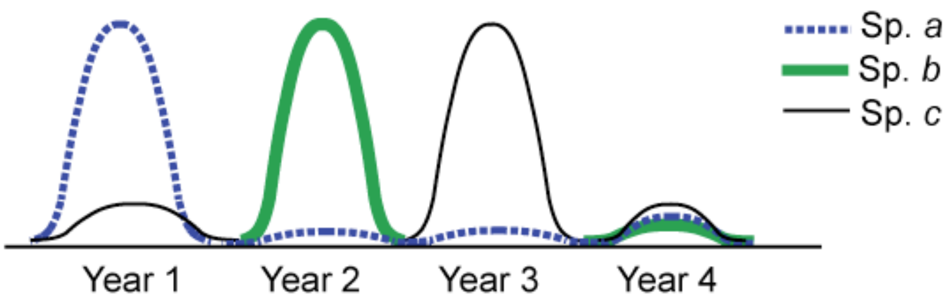
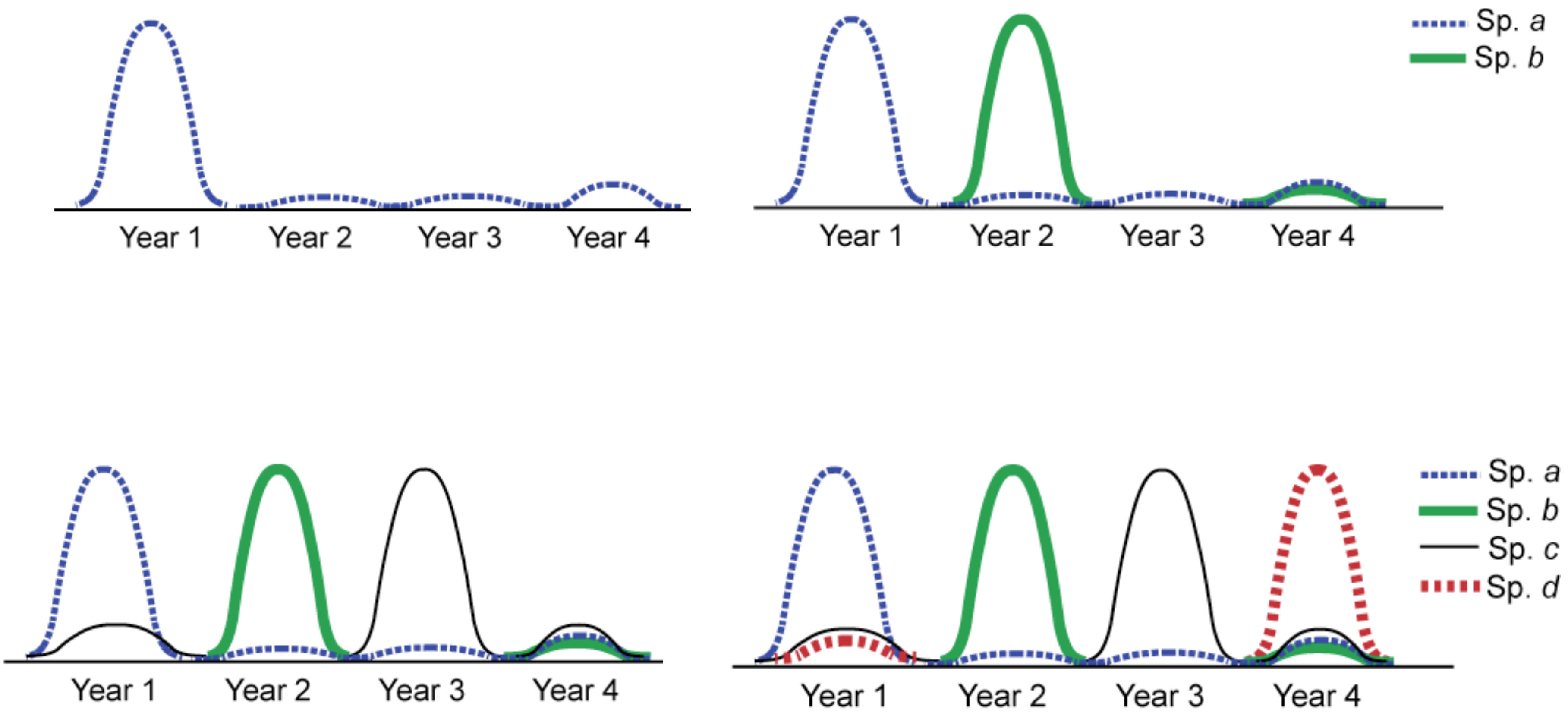


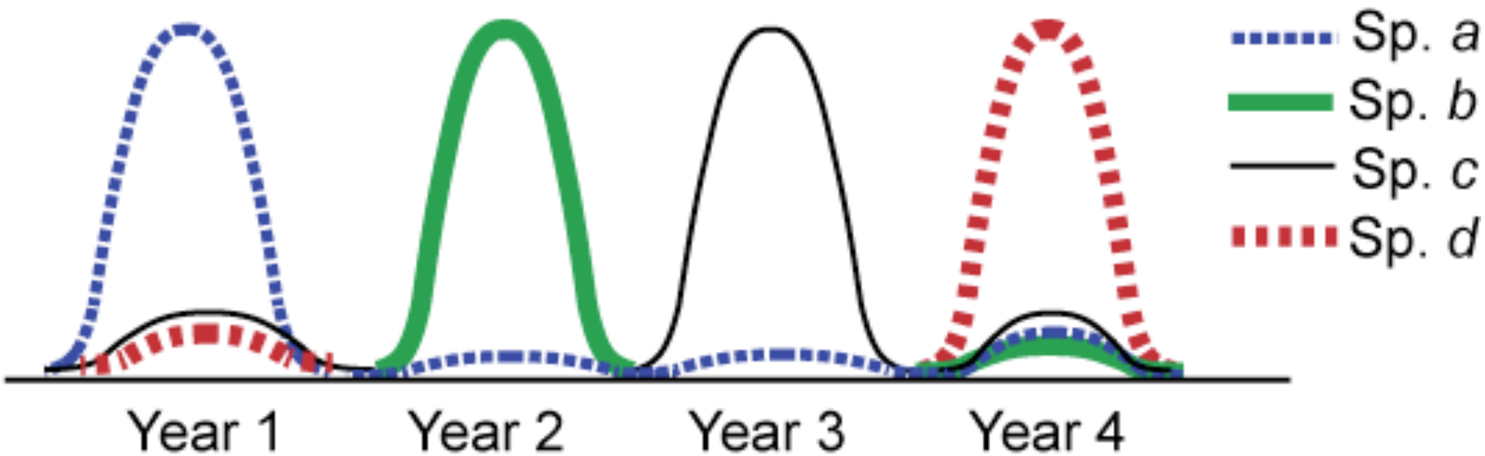




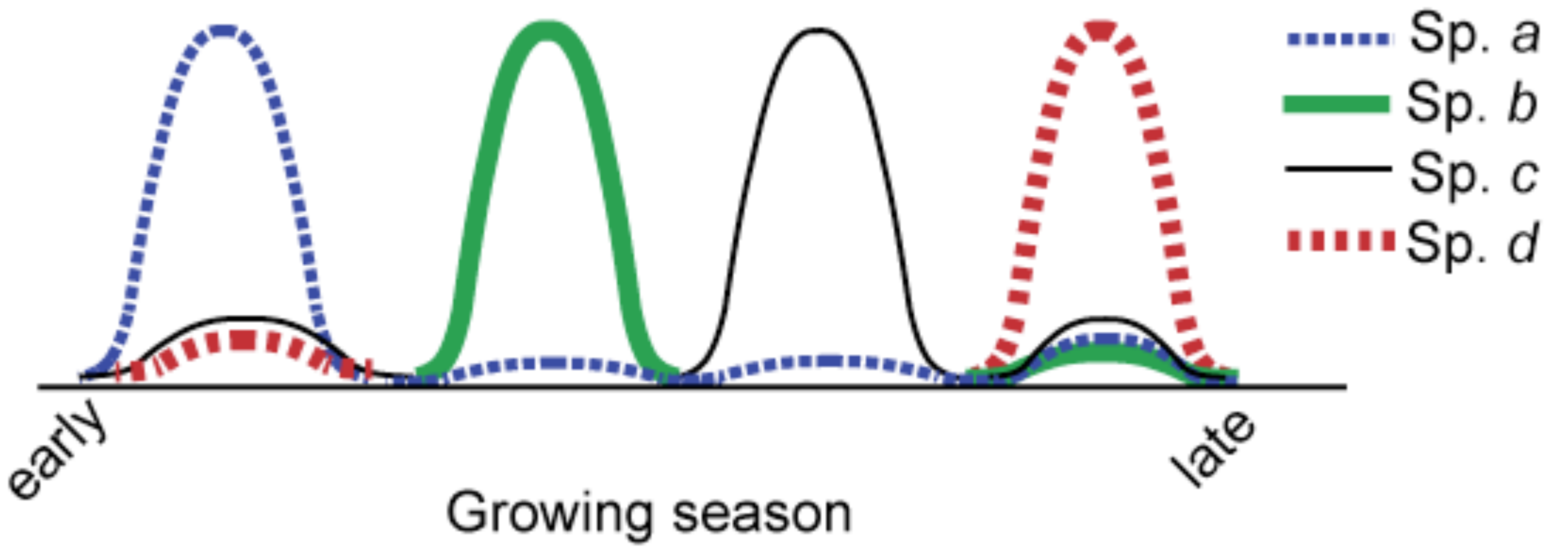
Interannual variability & coexistence



Inter- vs. intra-annual variability



Inter- vs. intra-annual variability

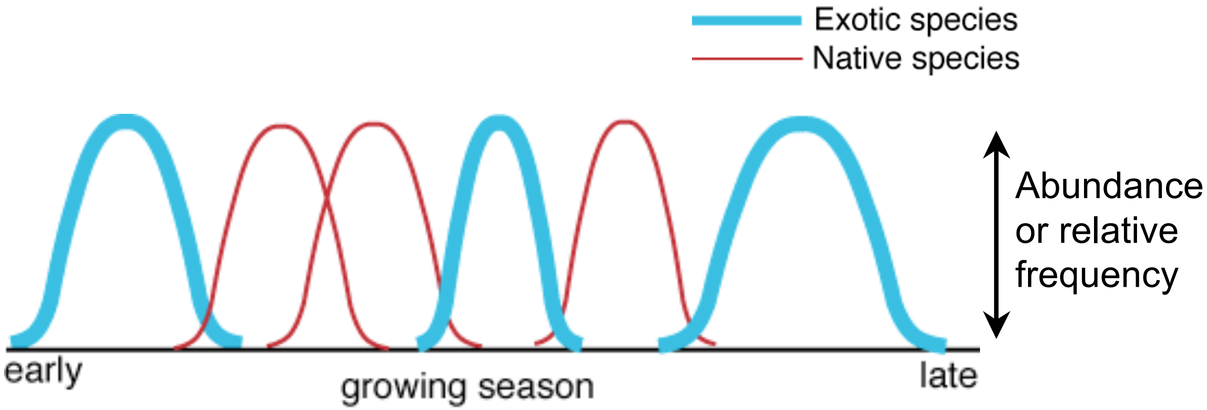


Extending theory from space to space-time

(A) Vacant niche
(B) Priority effects
(C) Niche breadth
(D) Plasticity

A. Vacant niche

- Predicts: Exotic species tend to leaf/bloom when native species not in leaf/bloom



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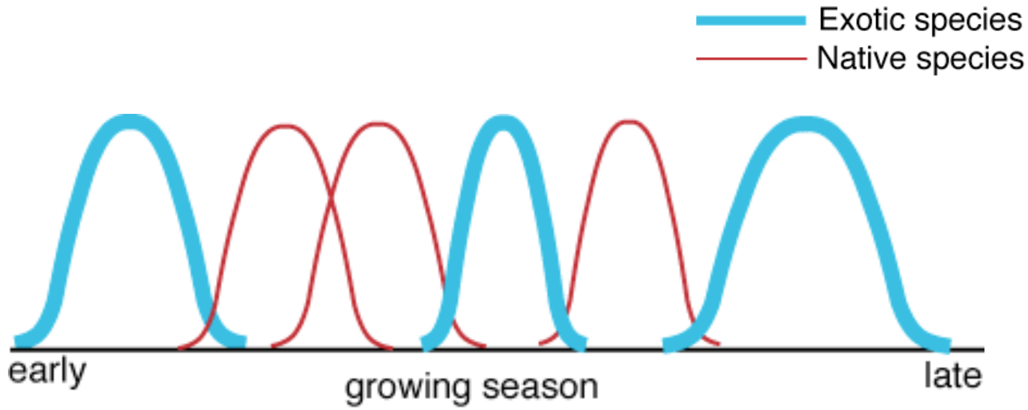
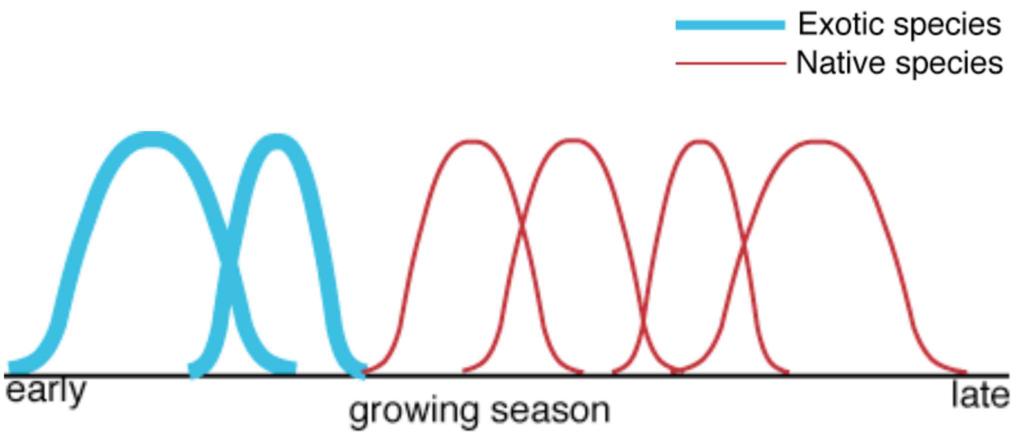


Amur honeysuckle (*Lonicera maacki*) stays green late in season

B. Priority effects

- Predicts: Exotic species leaf/bloom earlier than native species



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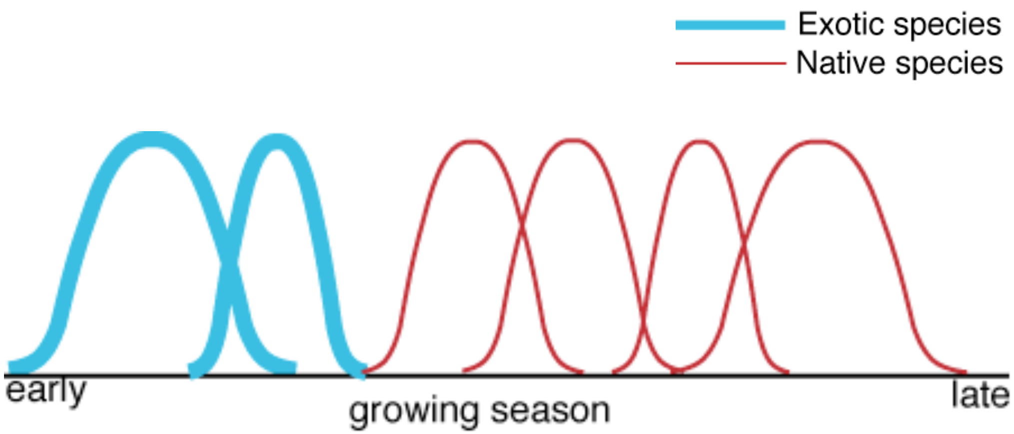
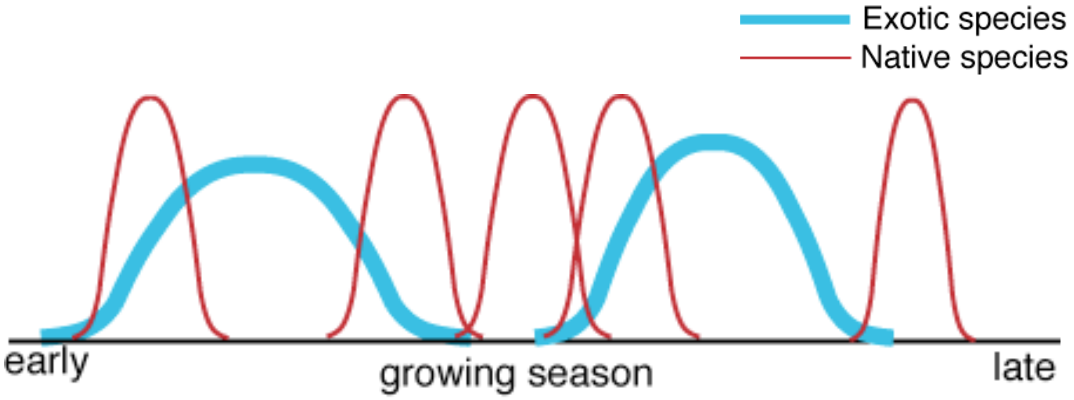


Red brome (*Bromus madritensis ssp. rubens*) greens up earlier

C. Niche breadth

- Predicts: Length of leafing/ blooming period of exotic species is greater than for native species



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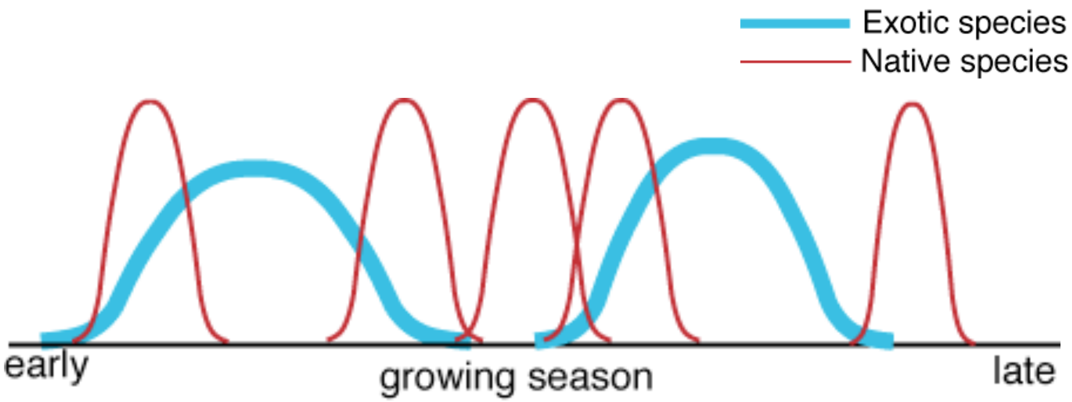
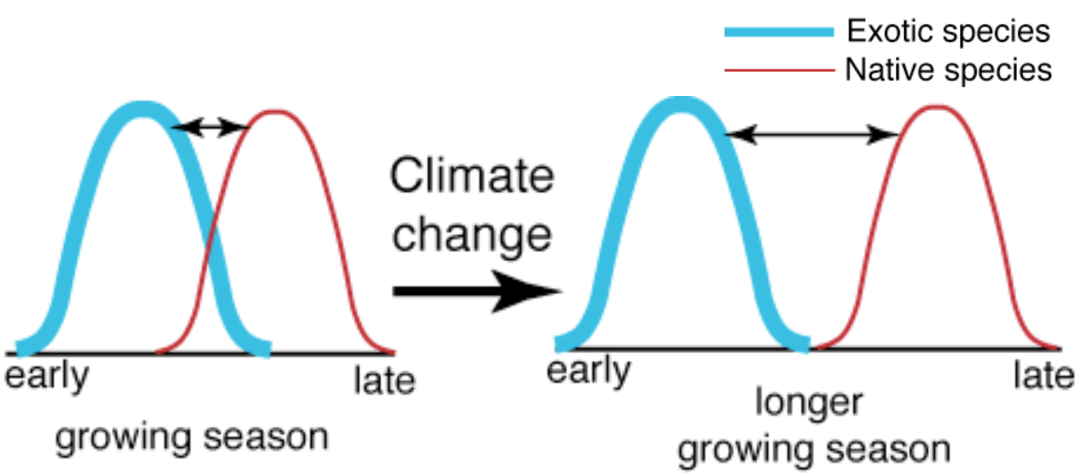


Spotted knapweed (*Centaurea stroebe*) active longer than native species.

D. Plasticity & climate change

- Predicts: Leafing/blooming of exotic species varies across years more than native species, co-varies with climate.



Testing hypotheses

- Spatially-extensive datasets
  - Project BudBurst
  - US-National Phenology Network
- Plant information databases (e.g.USDA Plants)
- Long-term records
  - Concord, Massachusetts
  - Gothic, Colorado
  - Catalina Mountains, Arizona

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Testing hypotheses

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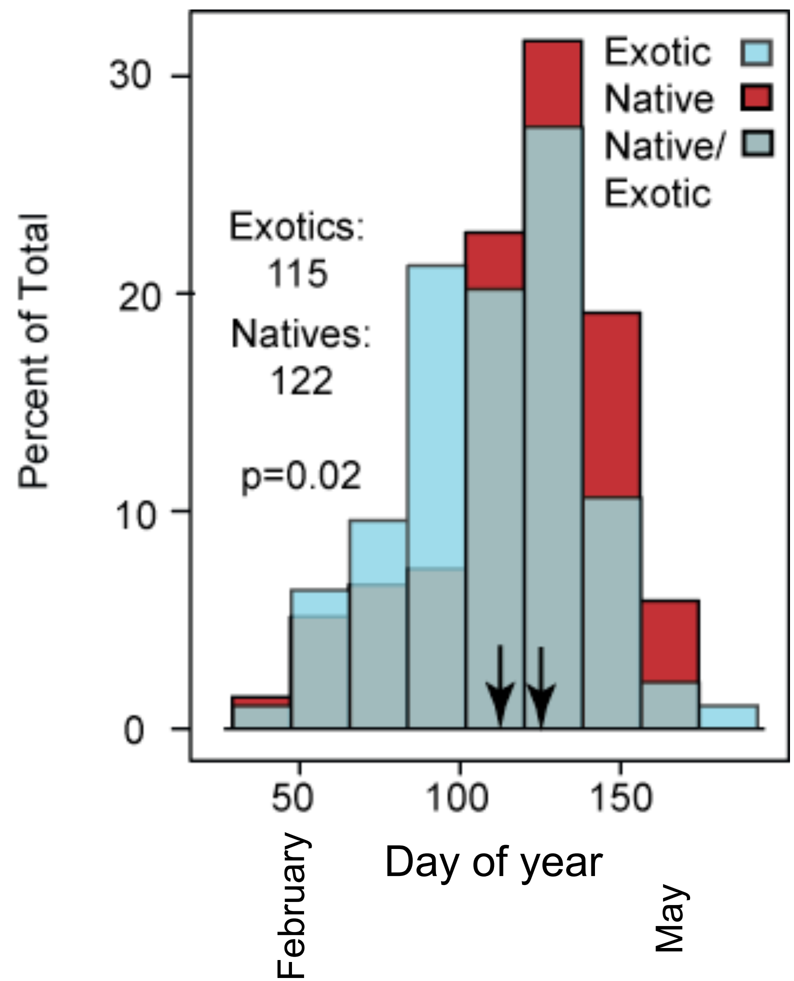
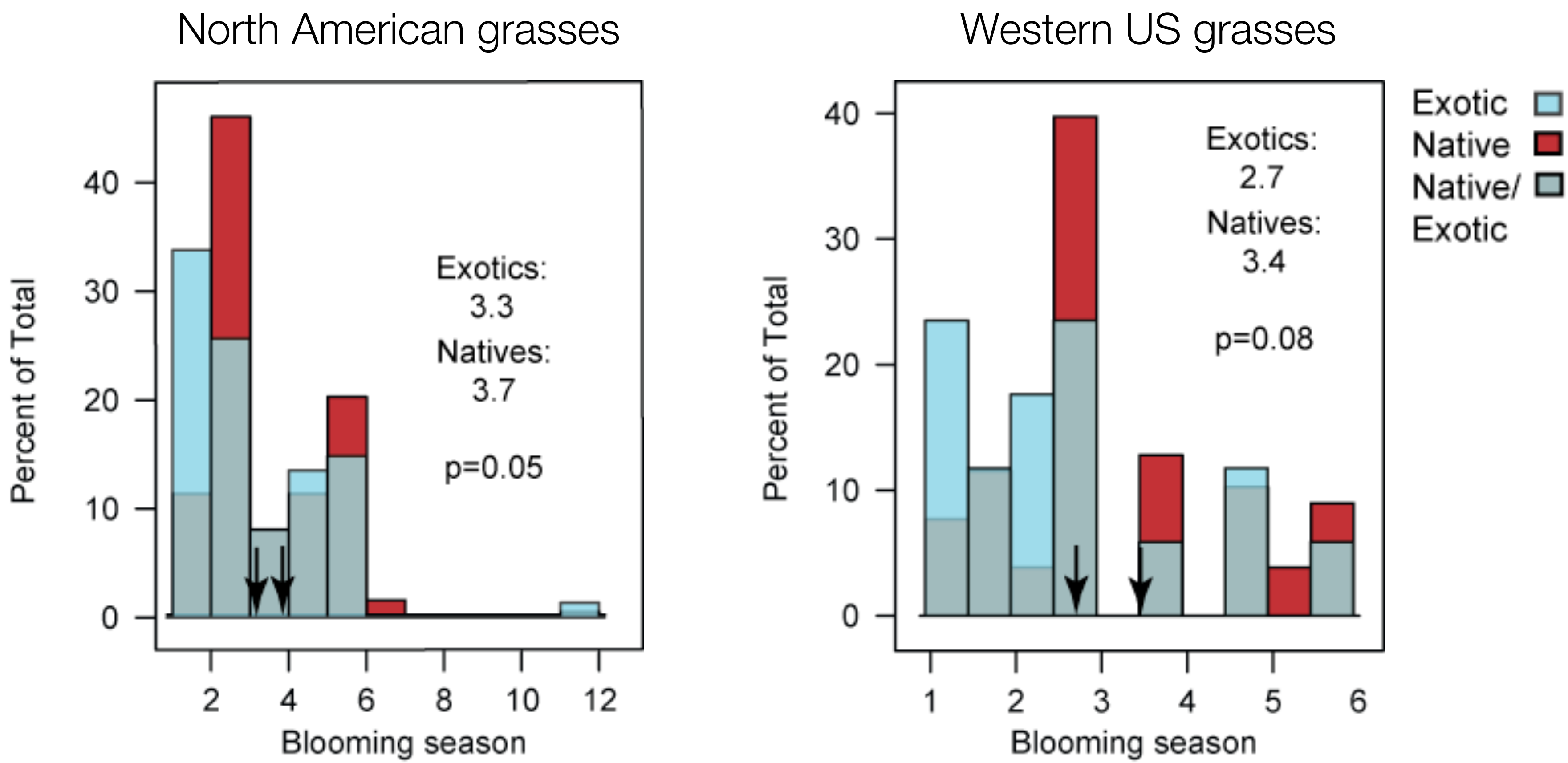
  - Catalina Mountains, Arizona

Exotics show earlier leafburst

- Citizen science
- North Carolina
- Budburst/first leaf for all species
- Supports priority effects



Trend towards earlier flowering increases in the west



Management implications

Management implications

- **Vacant niche & niche breadth:** Herbicide/destructive removal when only exotic is active:
  - Amur honeysuckle (Ohio River Valley)
  - Spotted knapweed (Intermountain grasslands)

Management implications

- Priority effects:
  Targeted management early in the season; Manipulations to trigger growth in unfavorable conditions:
  - Cheatgrass (Great Basin)
  - Red Brome (California grasslands)

Conclusions

- Phenology as important additional axis to community assembly theory
- Exotic and invasive species may succeed via distinct phenologies
- Extensions to management
- Increased importance as climate change continues to adjust seasons.

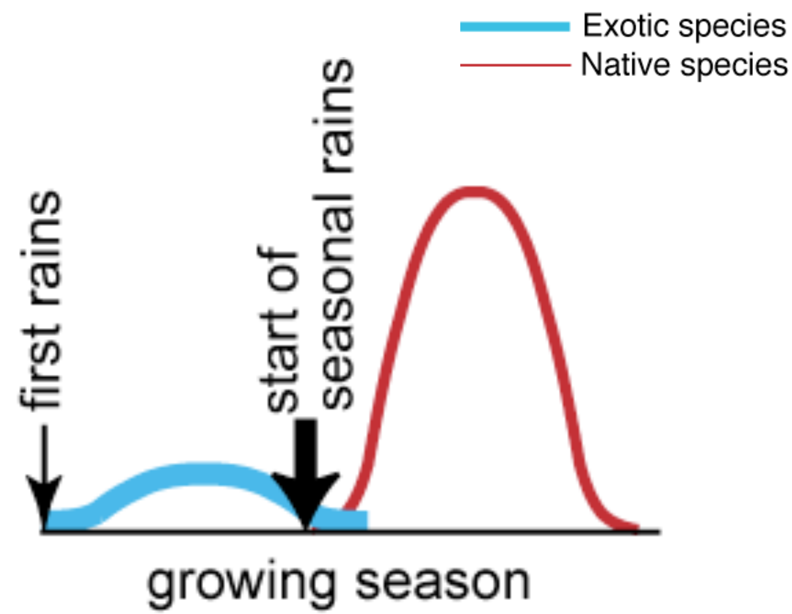
Acknowledgements

- NSF Postdoctoral Fellowship in Biological Informatics
- National Center for Ecological Analysis & Synthesis


Questions?

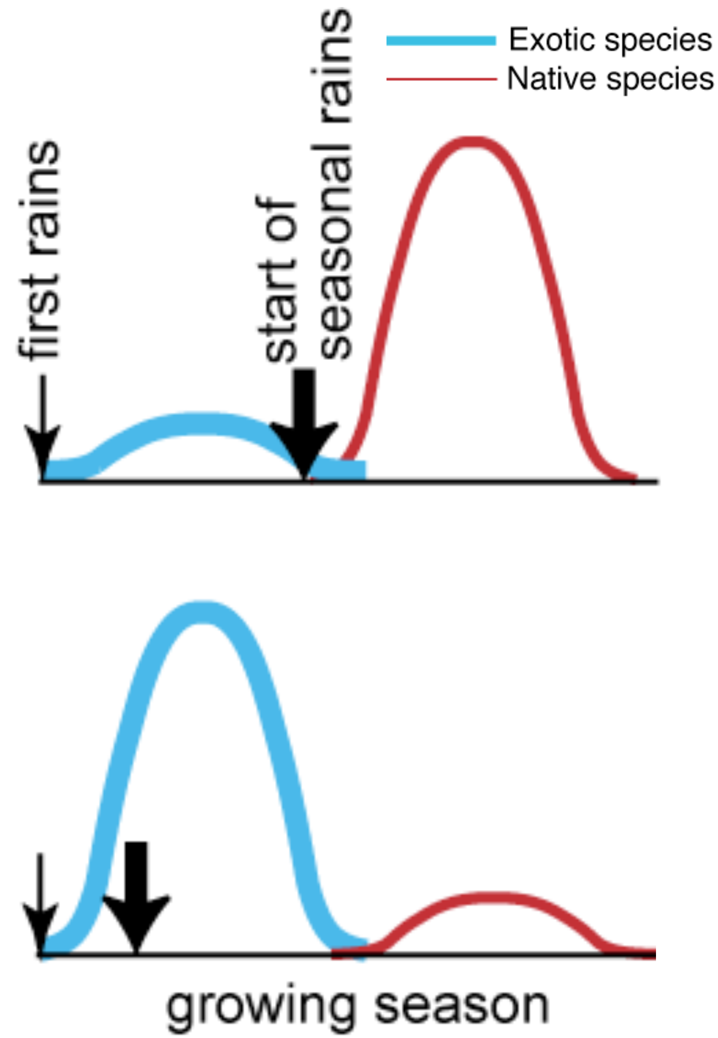
Bet-hedging & priority effects

- Species should be adapted to long-term means



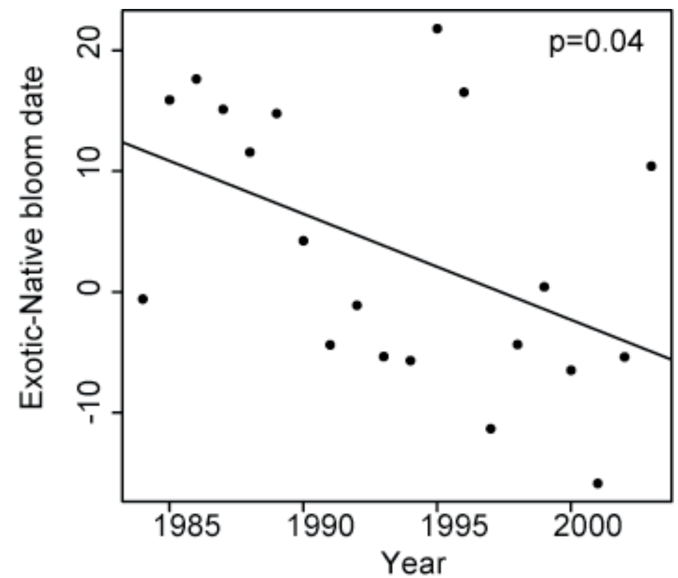
Bet-hedging & priority effects

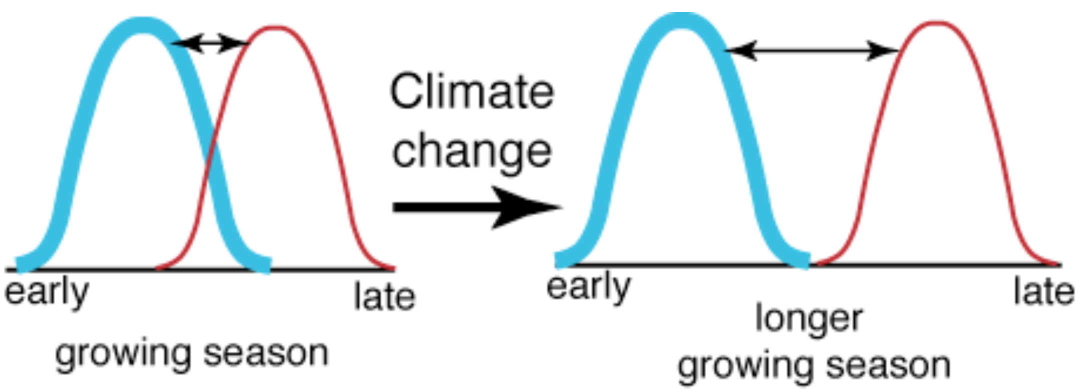
- Species should be adapted to long-term means
- Changing climate may make priority effects a better strategy in some climates



Plasticity & climate change

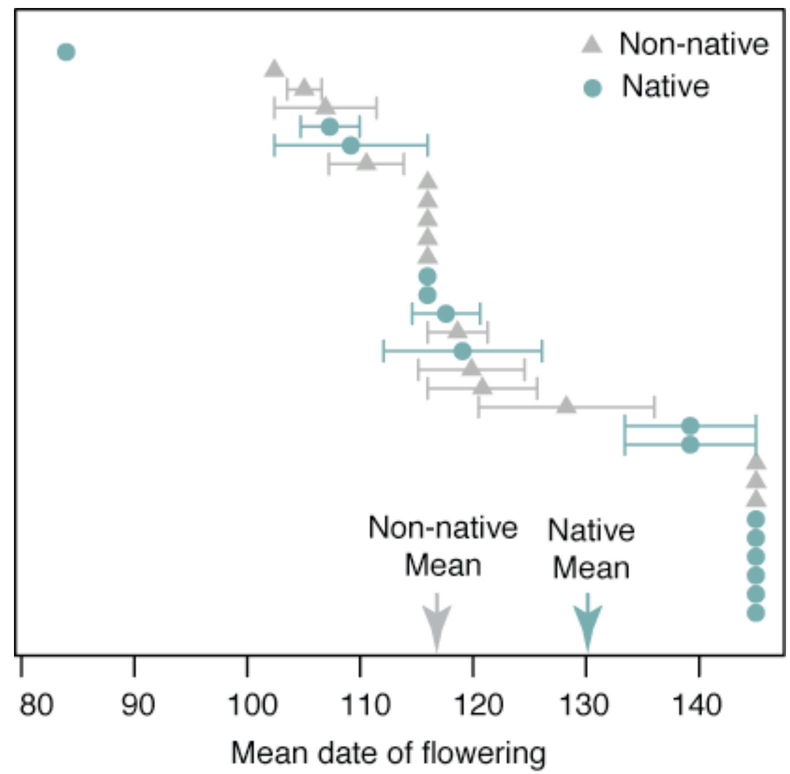
- Leafing/blooming of exotic species varies across seasons, co-varies with climate





Poa spp. in Catalina mountains, Arizona

Exotics show earlier flowering



Cleland & Suding 2007