
The biology of doom:
biotic invasions, extinction, and species responses
to environmental change
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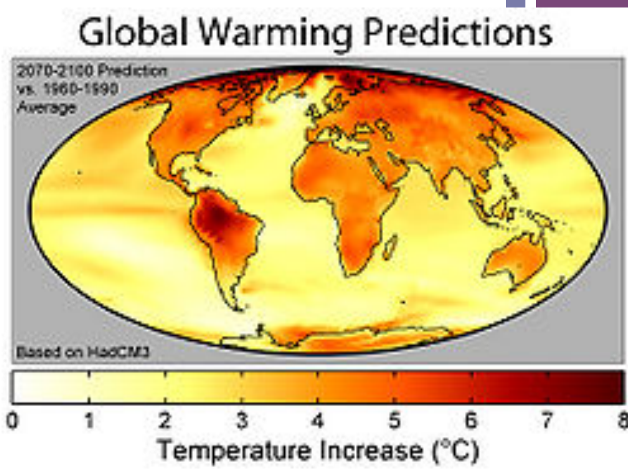
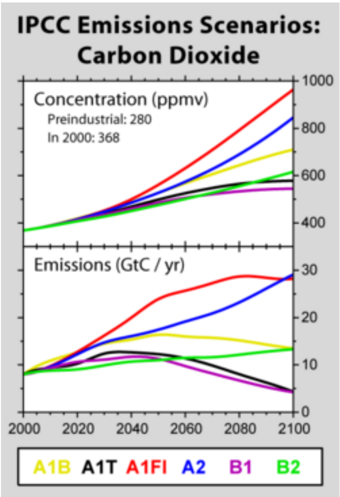
+ A little about me…

- Background
  - Wenatchee High class of '80
  - Math major (WSU, class of '84)
  - PhD in Applied Math (UC Davis, '89)
  - Postdoc in Zoology (U Texas, 1989-91)
  - Professor of Systematics & Ecology (U Kansas 1991-6)
  - Professor of Mathematics and Biological Sciences (WSU 1996-2009)
  - Professor of Biological Sciences (2009-present)
- Research Areas
  - Population biology
  - Population genetics
  - Evolutionary theory
  - "Evo-demo"
- UBM mentored undergrads
  - PhD programs (Cornell, WSU, FHC)
  - NIH internship
  - Co-authored peer-reviewed publications

(Wild) Species encounter changed environments through…

- Habitat destruction
- Climate change
- Colonization
- Biotic invasion
  - Invadee
  - Invader





Species Responses to Altered Environments

- **Adjust**
  - Robustness
  - Plasticity
- **Move**
  - Invade, or be invaded
- **Evolve**
- **Go extinct**

“Evo-Demo”

- = Population dynamics + Evolution
- Needed to predict fate of stressed species
- Primer…
- Basic equations of Evo-Demo:
  - Demography:
  - Evolution:

$$N(t+1) = \overline{R}(t)N(t)$$

$$p_1(t+1) = p_1(t)\frac{R_1}{\overline{R}(t)}$$

Biology of Doom Research Program

- Unpack the canonical evo-demo equations
  - Genetics: beyond clones
  - Nonlinear population dynamics: regulation
  - Phenotypic plasticity: adjustments by individual organisms
  - Incorporate uncertainty
    - Demographic and genetic stochasticity
    - Environmental fluctuations
- Project fate of populations and communities
  - Develop "realistic" models
  - Parameterize models using available data
  - Implement & analyze models

Potential Student Projects

① Phenotypic plasticity and extinction

② Genetics and invasion in harsh environments

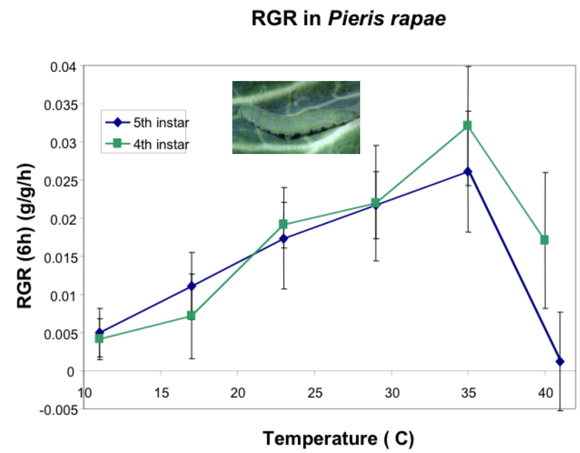
③ Interspecific interactions and invasion

④ Population dynamics, evolution, and extinction in structured populations

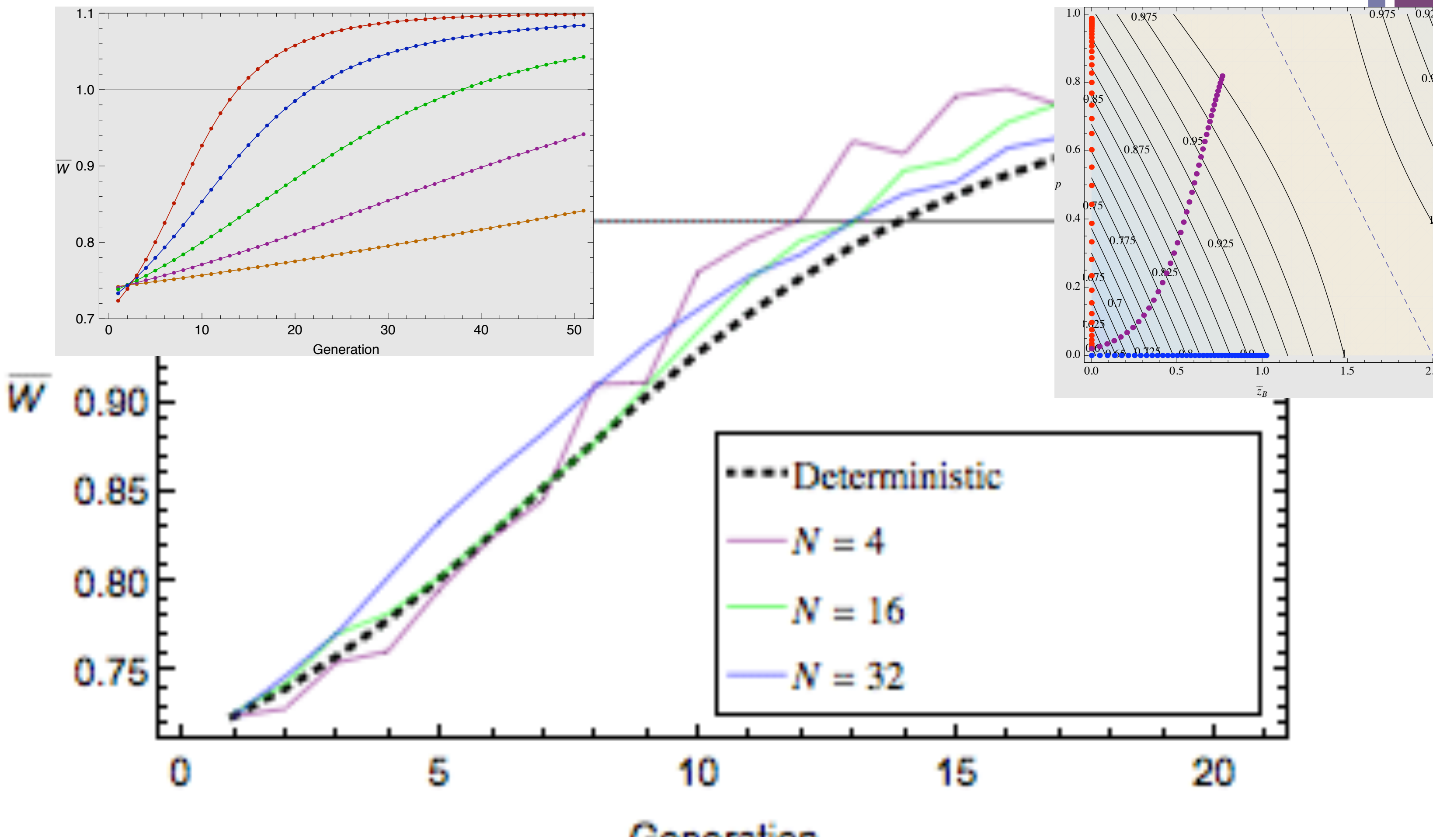
① Phenotypic plasticity and extinction

- "Adaptive phenotypic plasticity": head start of adapation
- What about "maladaptive plasticity"?
  - Predict direct effects of maladaptive plasticity on persistence
  - Develop physiological models of plasticity
  - Model how species encounter variable environments (adaptive and maladaptive plasticity)
  - Evolution of phenotypic plasticity

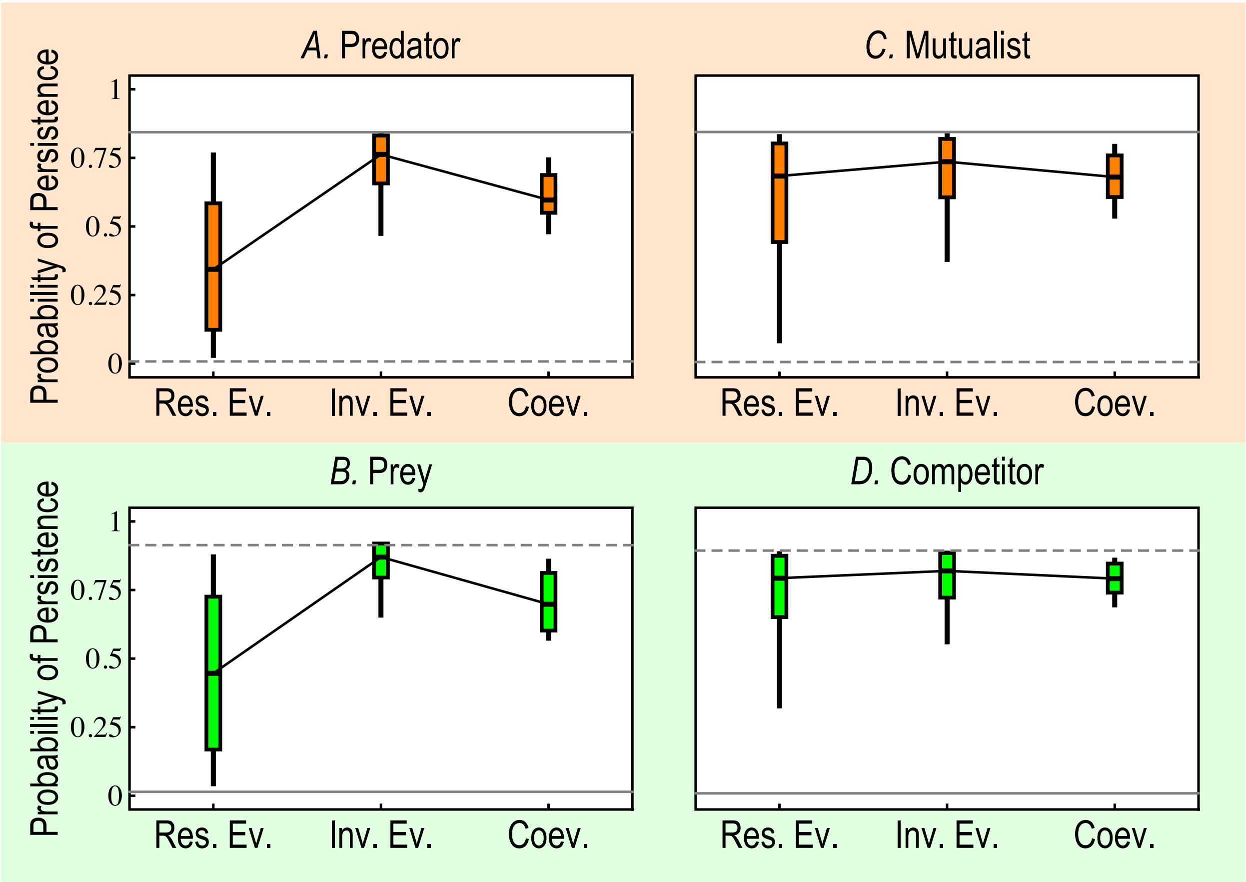
Environmentally-sensitive traits



② Genetics and invasion in harsh environments



③ Interspecific interactions and invasion



④ Population dynamics, evolution, and extinction in structured populations

- Genetically-based demographic heterogeneity & population growth
- Age- vs stage-based population projection
- Seed banks, persistence, and adaptation in novel environments

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