

# NEW FRONTIERS IN UNDERSTANDING THE RESPONSE OF AQUATIC INVASIVE SPECIES TO CLIMATE CHANGE

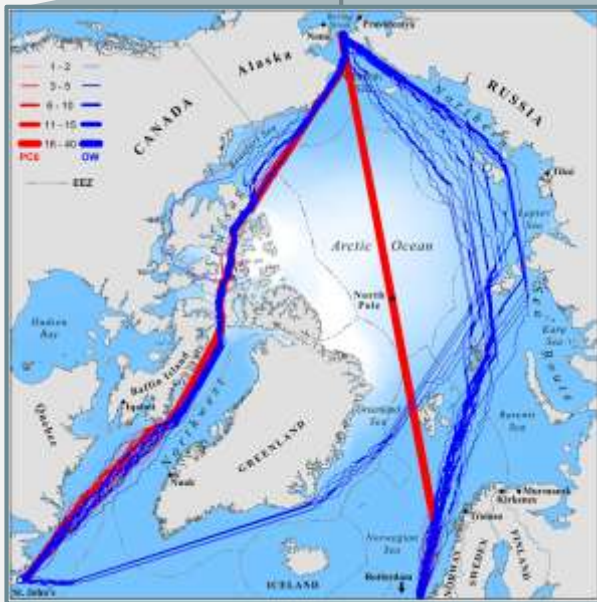
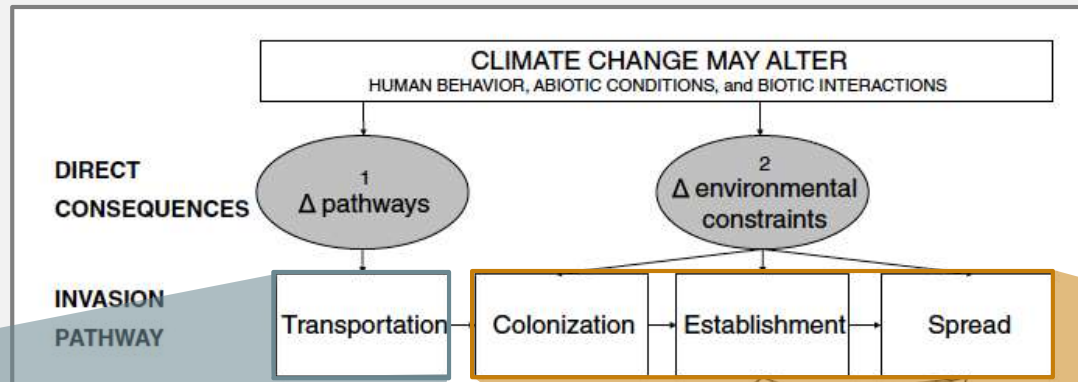


Angela Strecker

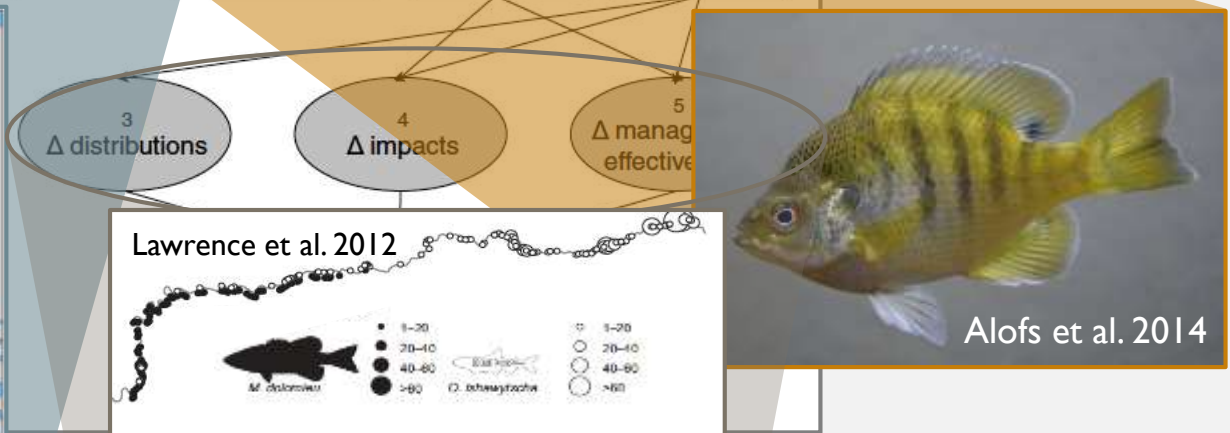
Institute for Watershed Studies

19 August 2020

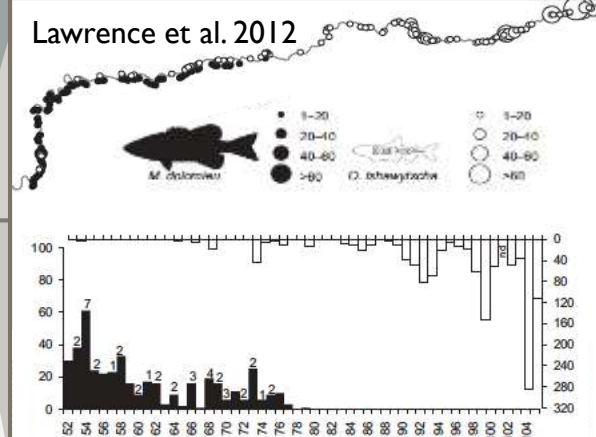
# CLIMATE CHANGE WILL ACT ON ALL ASPECTS OF THE INVASION PATHWAY



Smith & Stephenson 2013 PNAS



Alofs et al. 2014



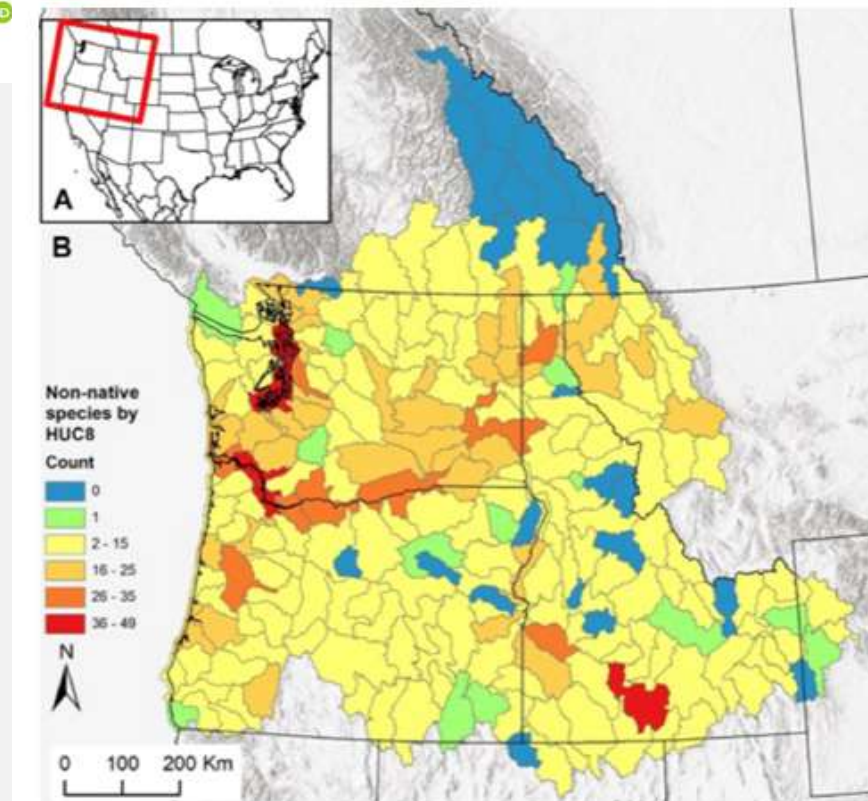
Hellmann et al 2008

# SIGNIFICANT KNOWLEDGE GAPS

## Climate-induced expansions of invasive species in the Pacific Northwest, North America: a synthesis of observations and projections

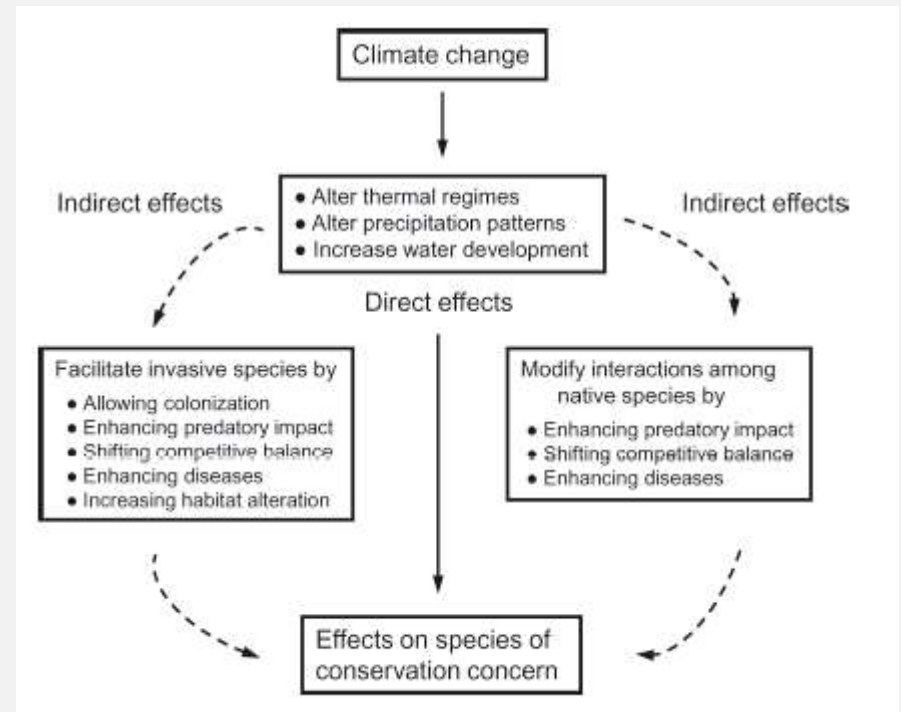
Jennifer A. Gervais  · Ryan Kovach  · Adam Sepulveda  · Robert Al-Chokhachy   
J. Joseph Giersch  · Clint C. Muhlfeld 

- reviewed ~400 studies
- only found 3 that document the observed impacts of climate on AIS in the PNW, all on fish

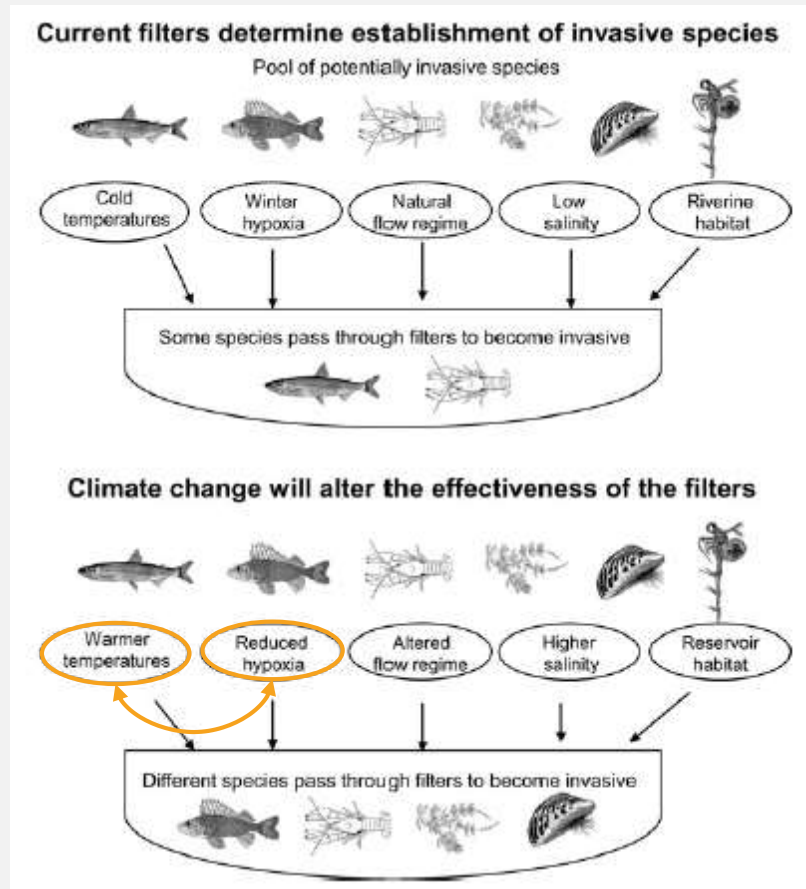


# IMPACTS TO NATIVE SPECIES

- In freshwater habitats, climate change may...
  - increase predation of AIS upon native species
  - shift the balance of competition between natives and invaders
  - increase disease transmission
  - increase habitat alteration

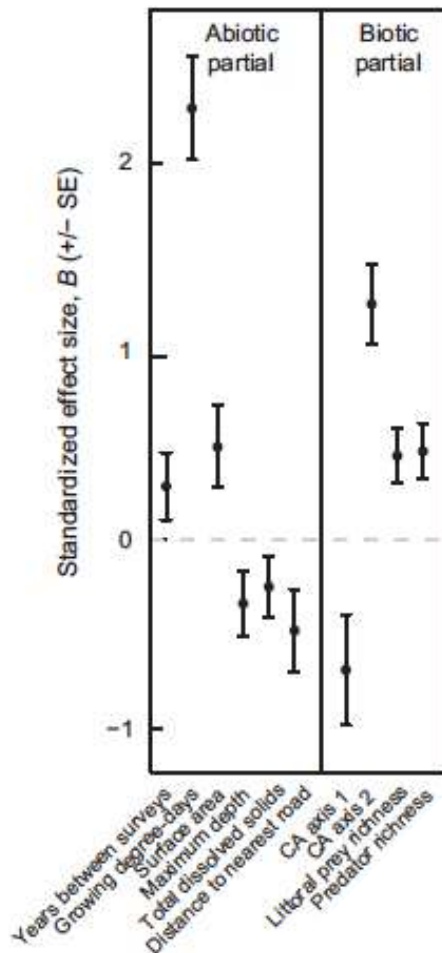


# ESTABLISHMENT FILTERS



- Abiotic filters are a useful framework to understand AIS responses to climate change
- Yet, they fail to capture interactions between variables and the importance of biotic variables

# BIOTIC INTERACTIONS INFLUENCE ESTABLISHMENT TOO

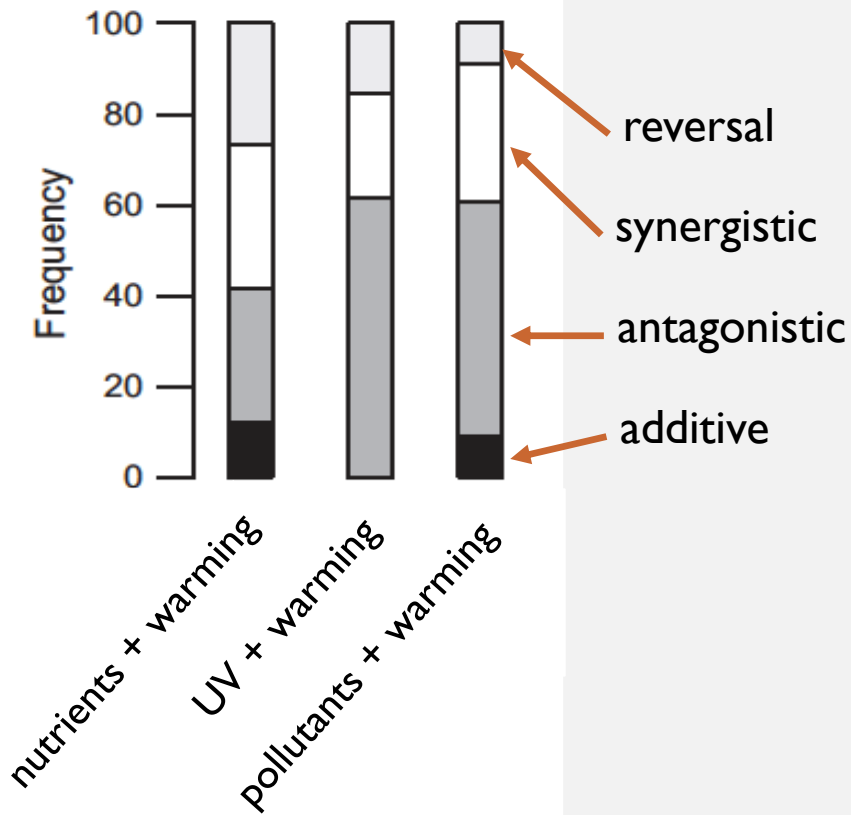


- In addition to abiotic factors, largemouth bass establishment in lakes on their northern range limit was influenced by:
  - presence of other centrarchids
  - predators
  - prey diversity





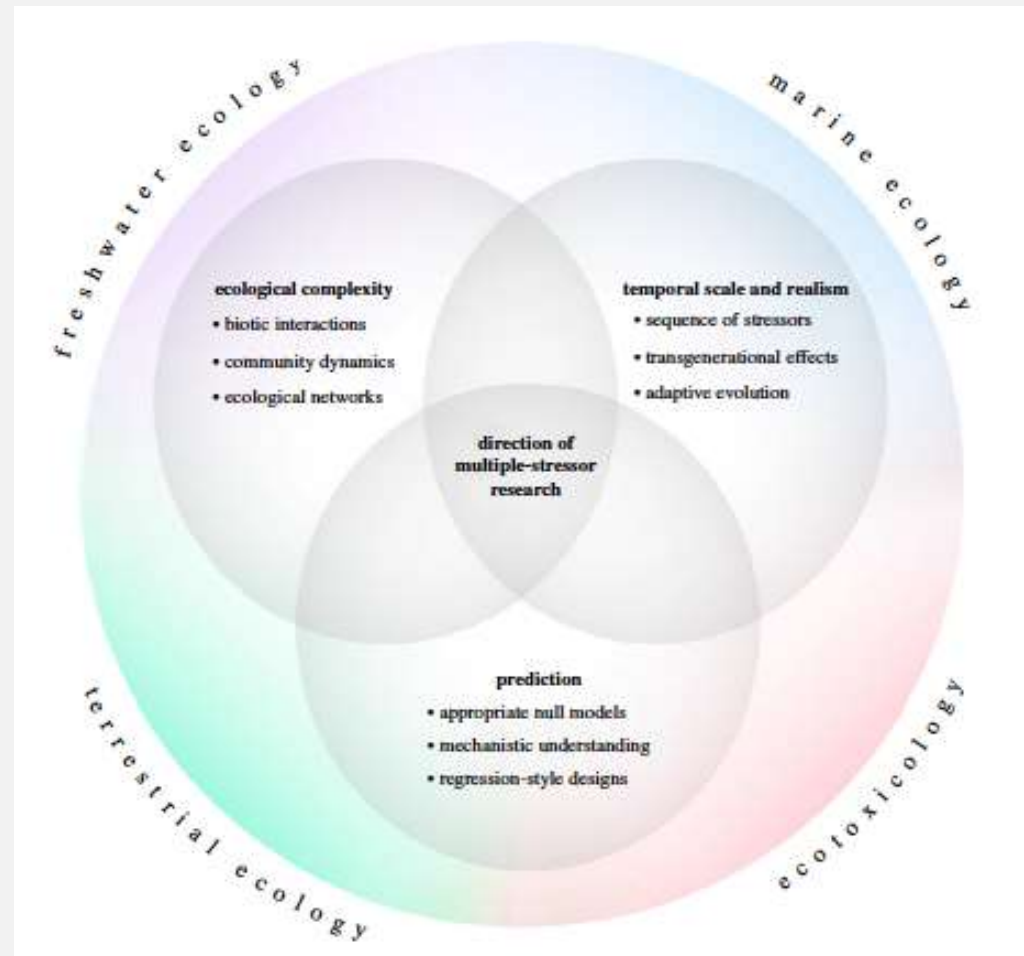
# COMPLEX INTERACTIONS



- Warming interacts with a number of other stressors to affect freshwater species in complex ways
- Therefore, predicting both native and invasive species responses is challenging

# SOME COMMON APPROACHES

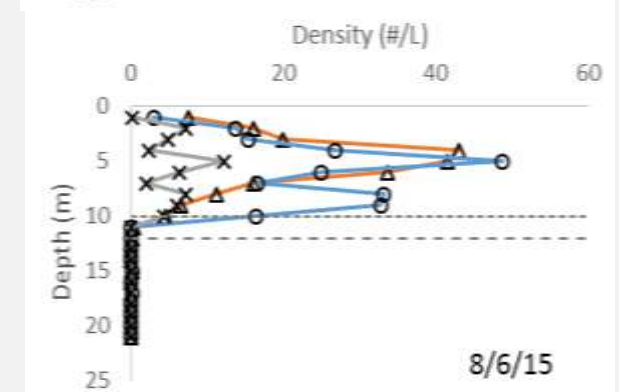
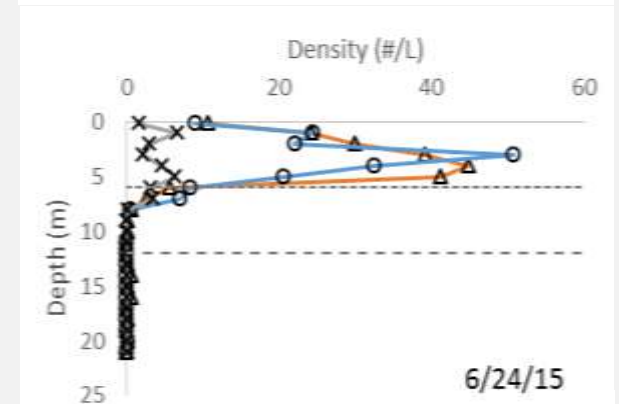
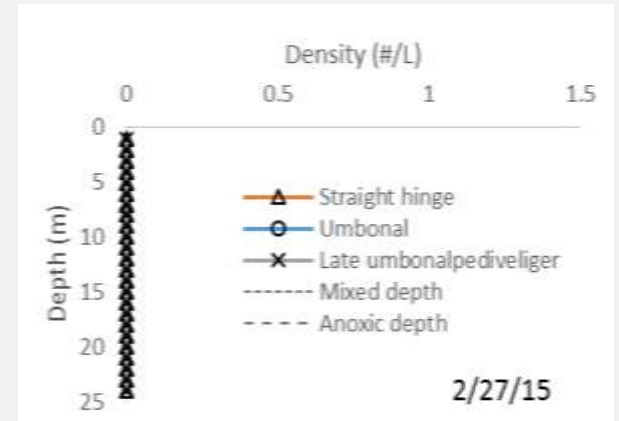
- empirical studies
  - experiments
  - surveys
- models
  - process
  - species distribution



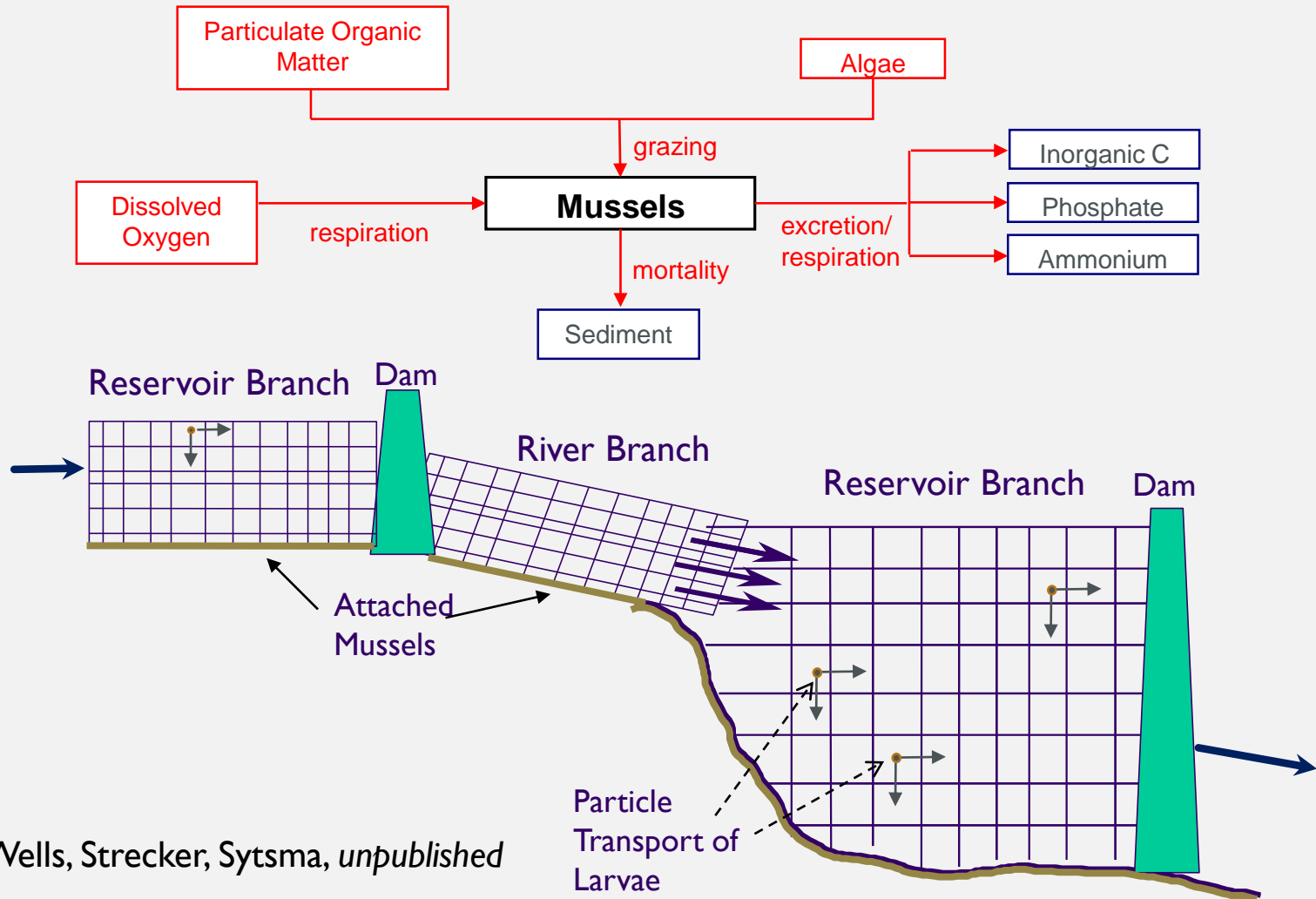


# EMPIRICAL STUDIES OF ABIOTIC INTERACTIONS

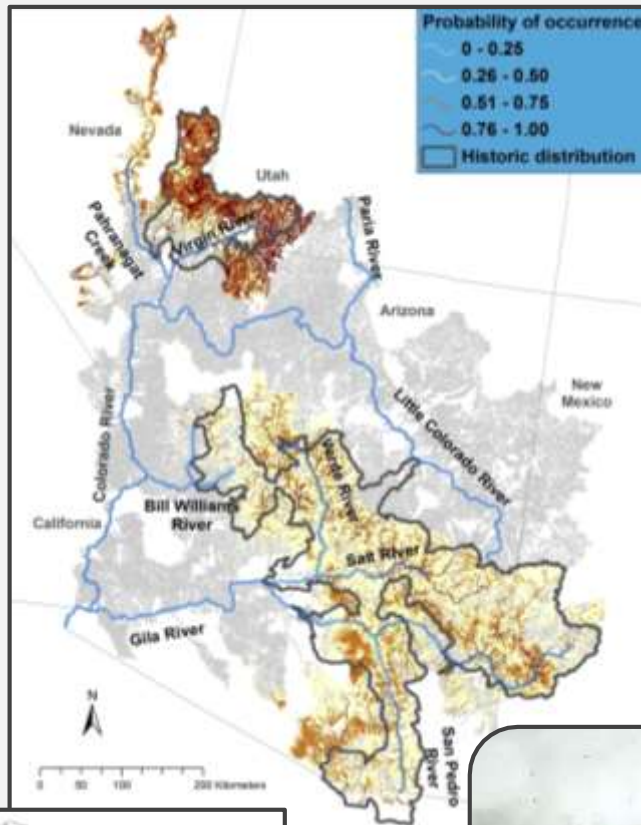
- Zebra mussel veligers appear to be controlled by a combination of temperature and dissolved oxygen



# PROCESS MODELS



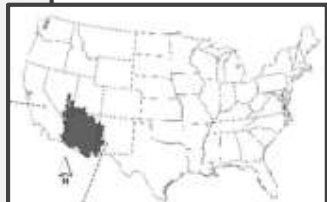
# SPECIES DISTRIBUTION MODELS



- Model contemporary distribution, then use climate predictions to simulate future range shifts
- Non-natives exhibited overall increased range sizes ('winners'), natives decreased range sizes ('losers')

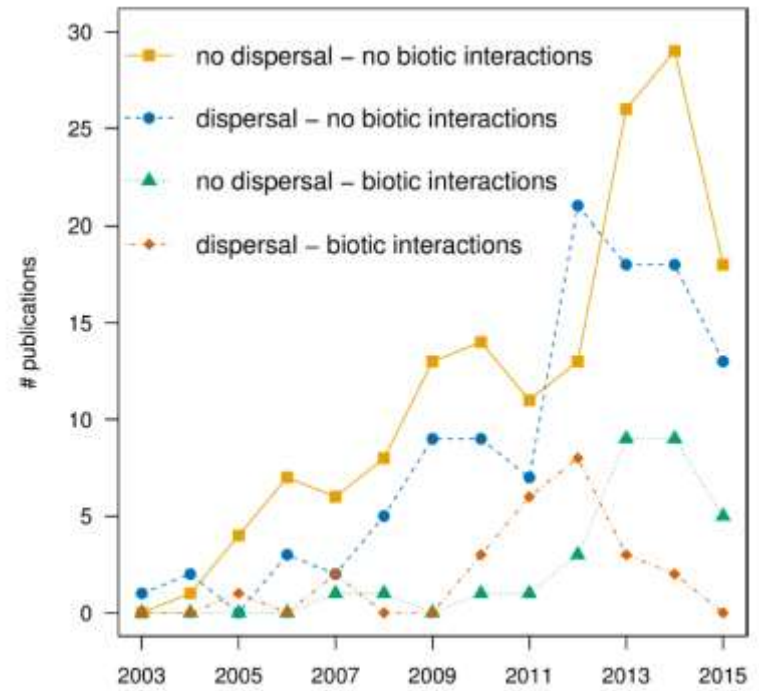
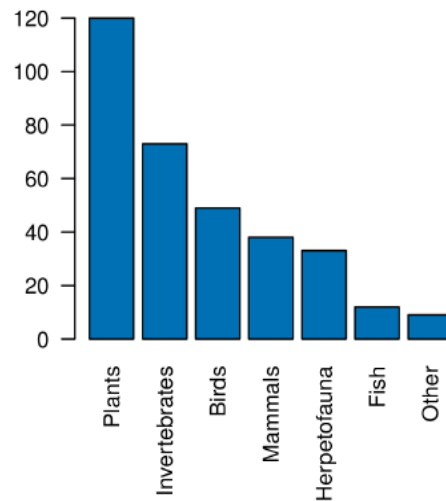
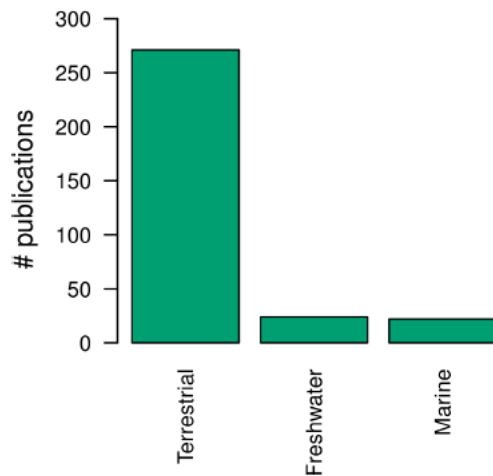
**Forecasted range shifts of arid-land fishes in response to climate change**

James E. Whitney · Joanna B. Whittier · Craig P. Paukert · Julian D. Olden · Angela L. Strecker



# BUT...

- Most species distribution models fail to account for biotic interactions
- Also very few studies in aquatic systems



Does scale matter? A systematic review of incorporating biological realism when predicting changes in species distributions

Sydne Record<sup>1\*</sup>, Angela Strecker<sup>2\*</sup>, Mao-Ning Tuanmu<sup>3</sup>, Lydia Beaudrot<sup>4</sup>, Phoebe Zametske<sup>5,6</sup>, Jonathan Belmaker<sup>7</sup>, Beth Gerstner<sup>8,9</sup>

# CONCLUSIONS

- There are huge knowledge gaps when it comes to how AIS will respond to climate change.
- We lack a mechanistic framework to integrate how the diverse effects of climate change will affect AIS.
- Providing managers and stakeholders with robust predictions about the potential spread and effects of AIS in the future needs to be a research priority.



# QUESTIONS?

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