

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

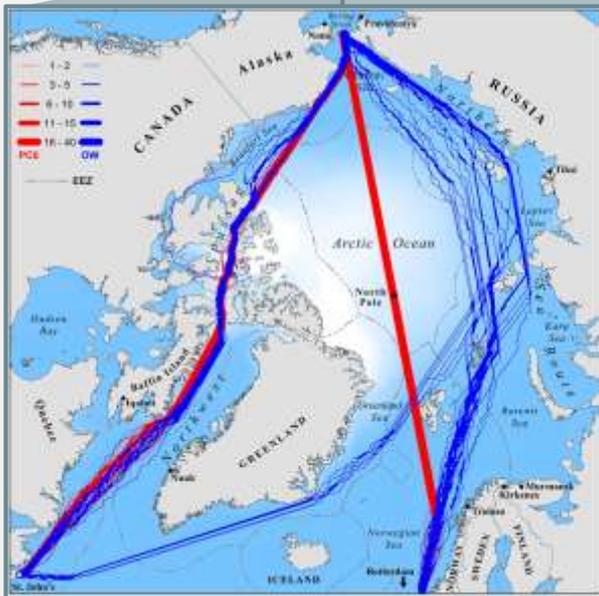
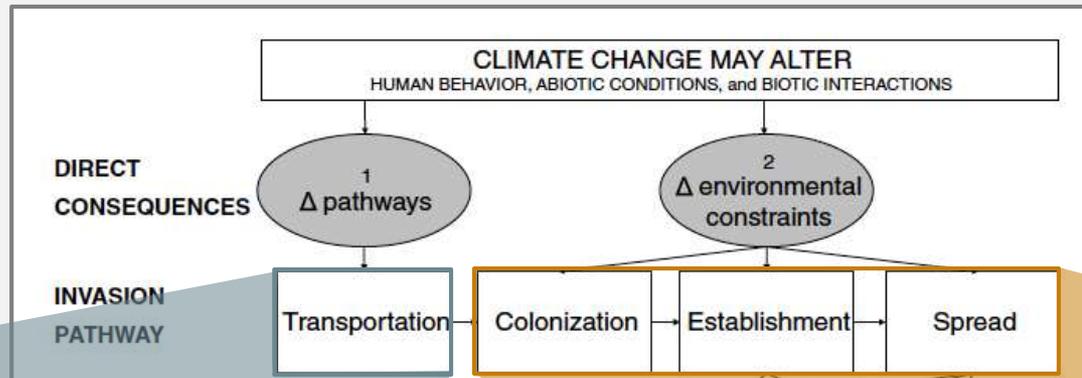


Angela Strecker

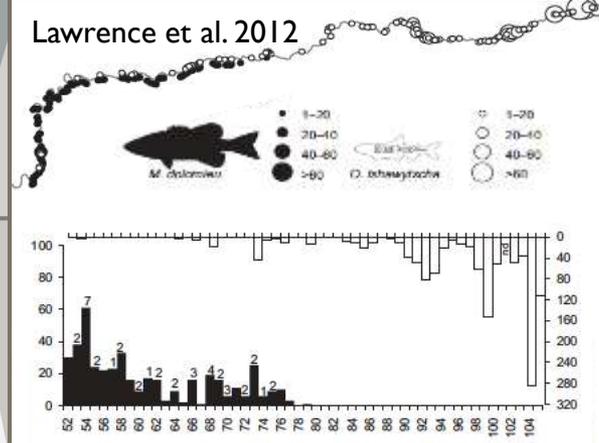
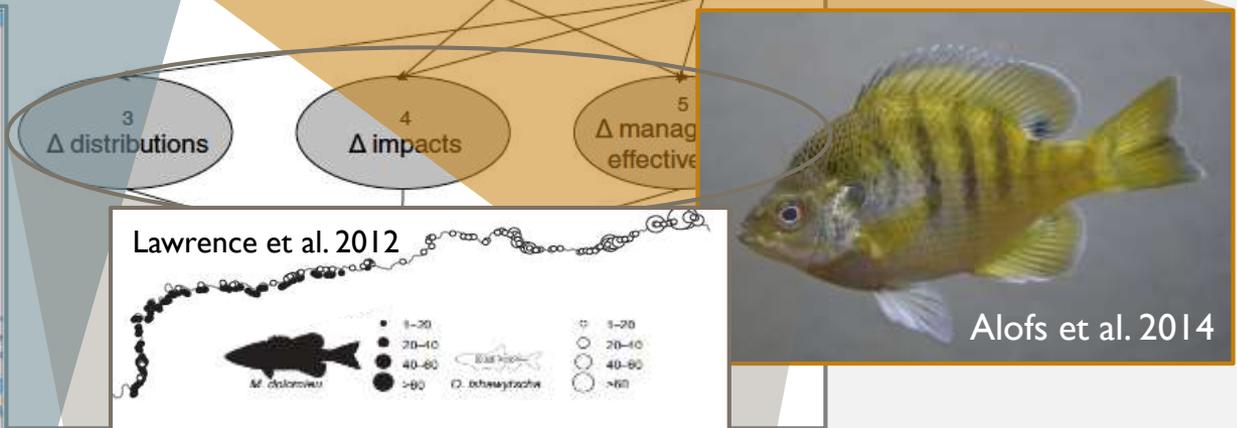
Institute for Watershed Studies

19 August 2020

CLIMATE CHANGE WILL ACT ON ALL ASPECTS OF THE INVASION PATHWAY



Smith & Stephenson 2013 PNAS



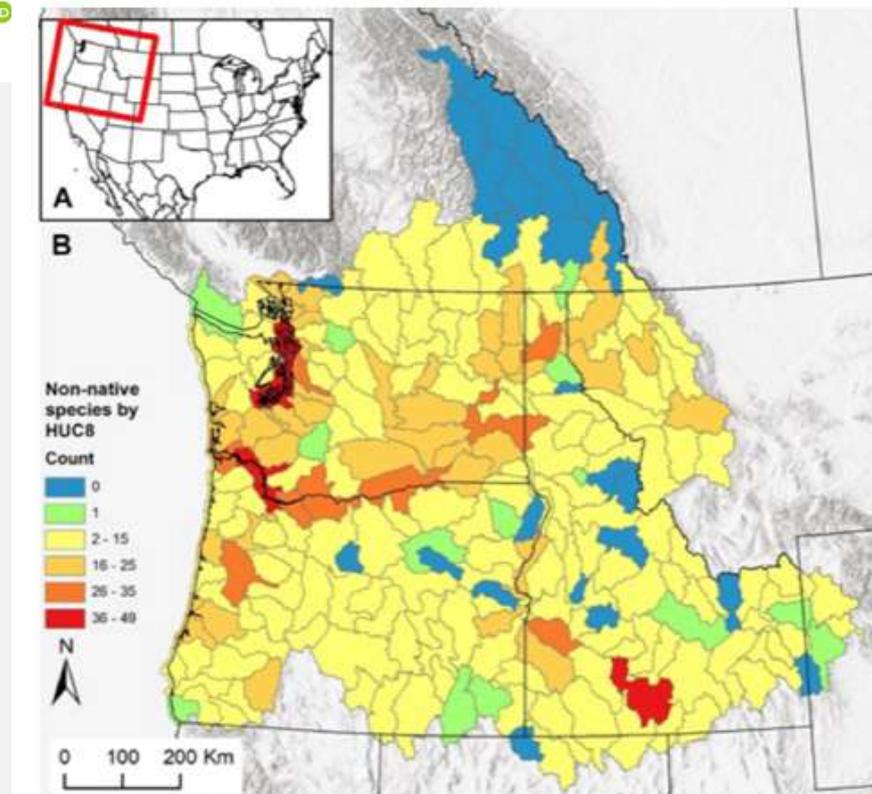
Hellmann et al 2008

SIGNIFICANT KNOWLEDGE GAPS

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

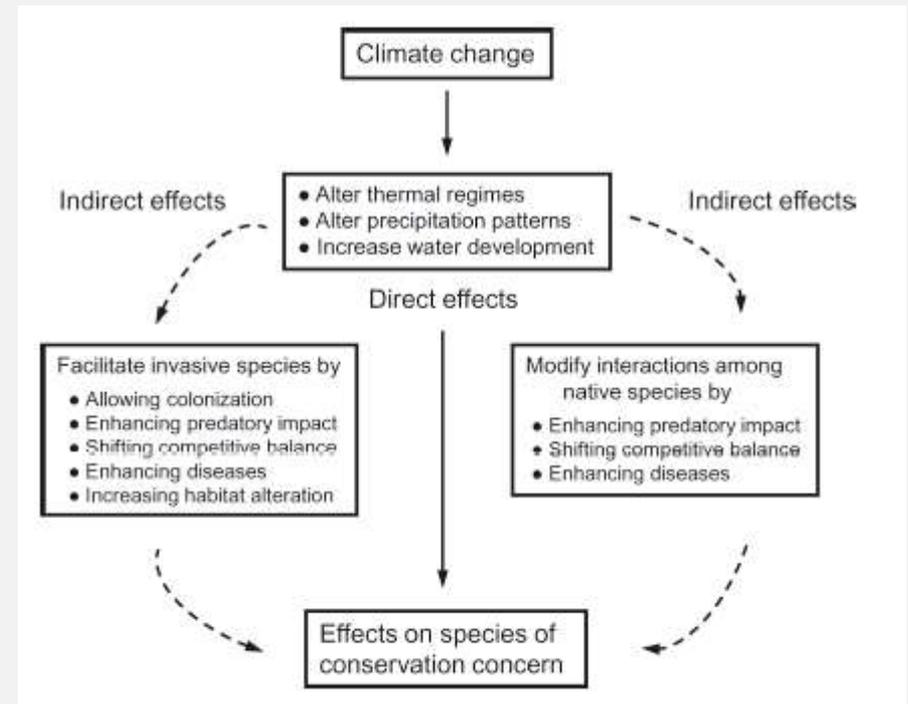
Jennifer A. Gervais  · Ryan Kovach  · Adam Sepulveda  · Robert Al-Chokhachy 
J. Joseph Giersch  · Clint C. Muhlfeld 

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

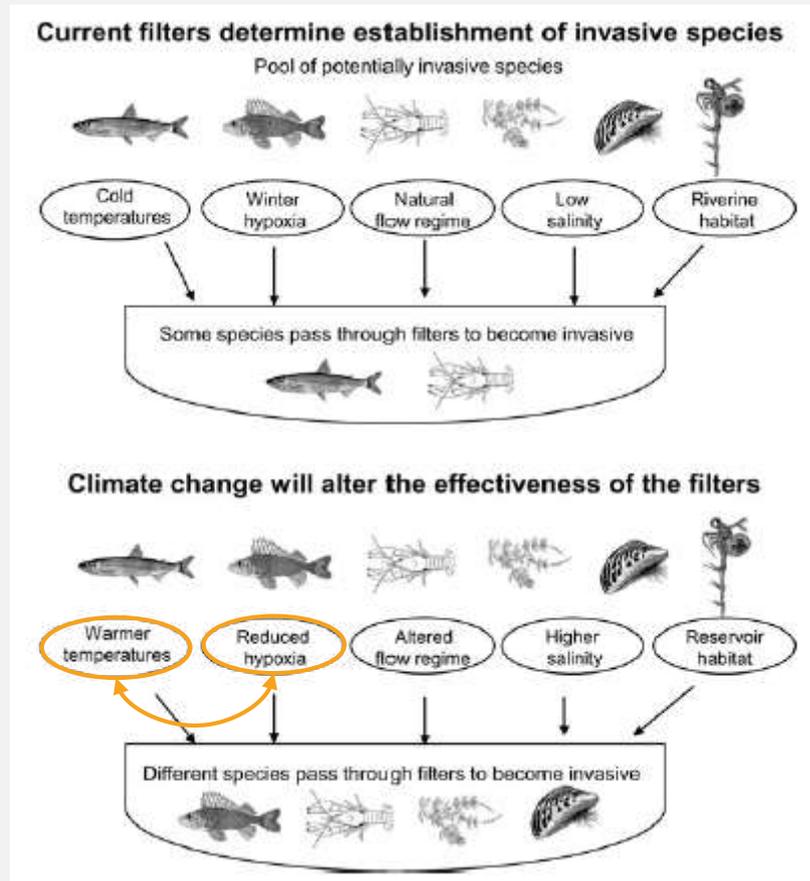


IMPACTS TO NATIVE SPECIES

- 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

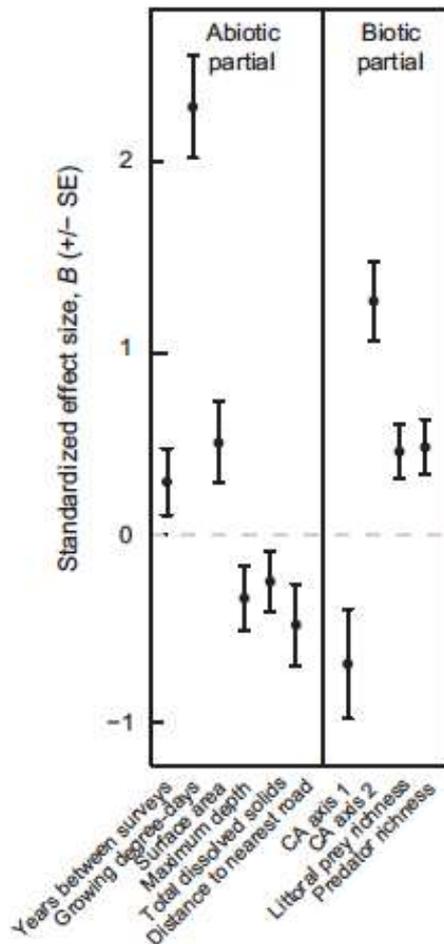


ESTABLISHMENT FILTERS



- 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

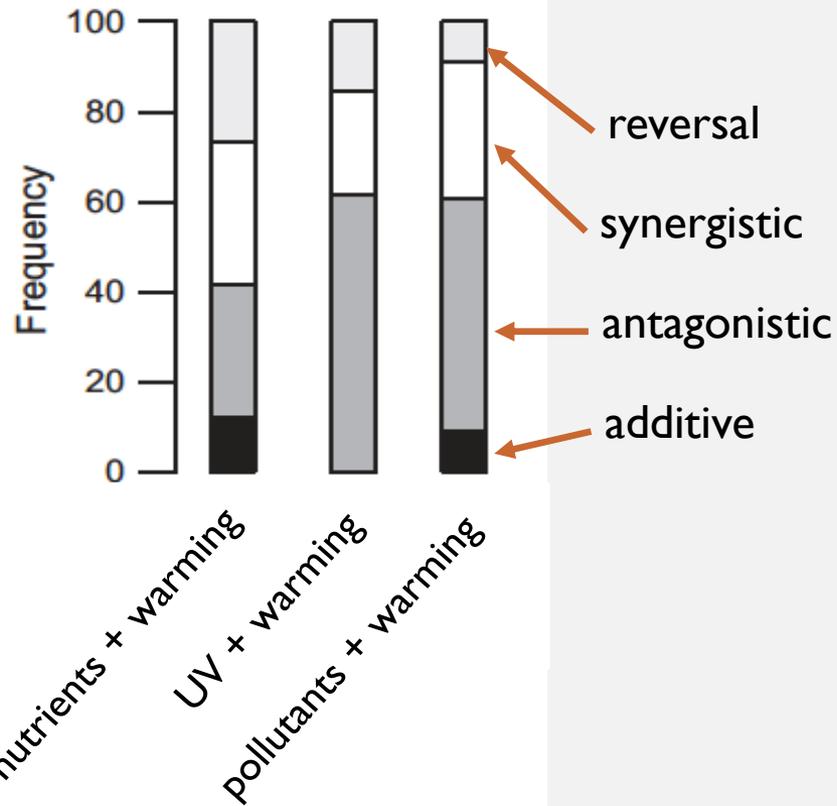
BIOTIC INTERACTIONS INFLUENCE ESTABLISHMENT TOO



- 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



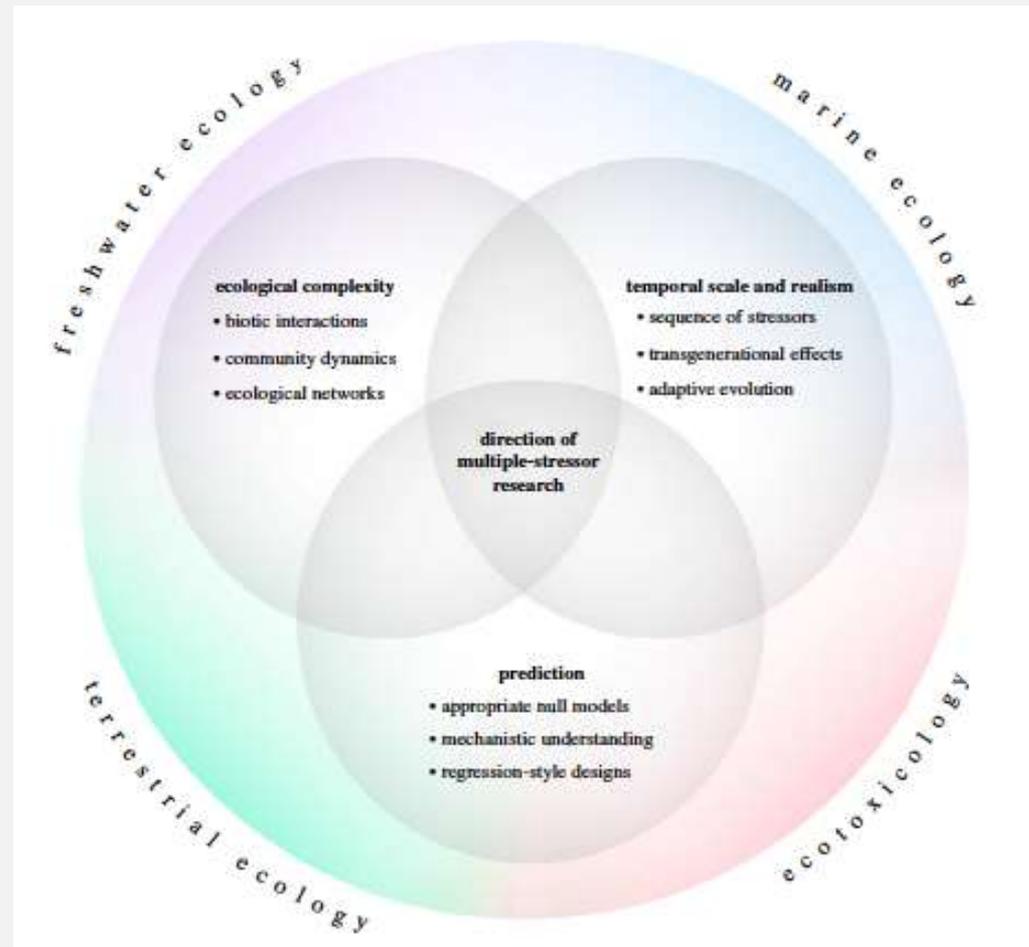
COMPLEX INTERACTIONS



- 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

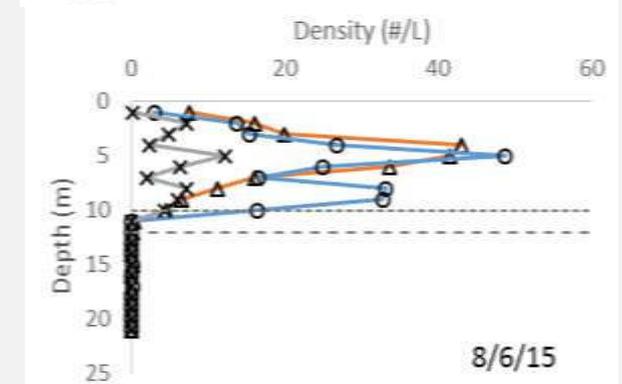
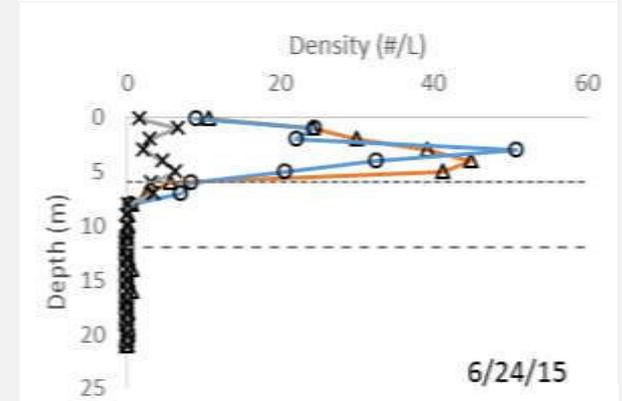
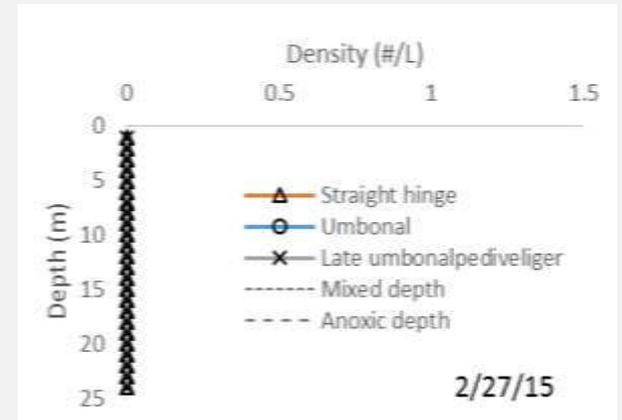
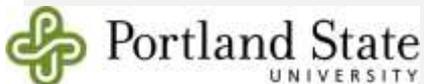
SOME COMMON APPROACHES

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

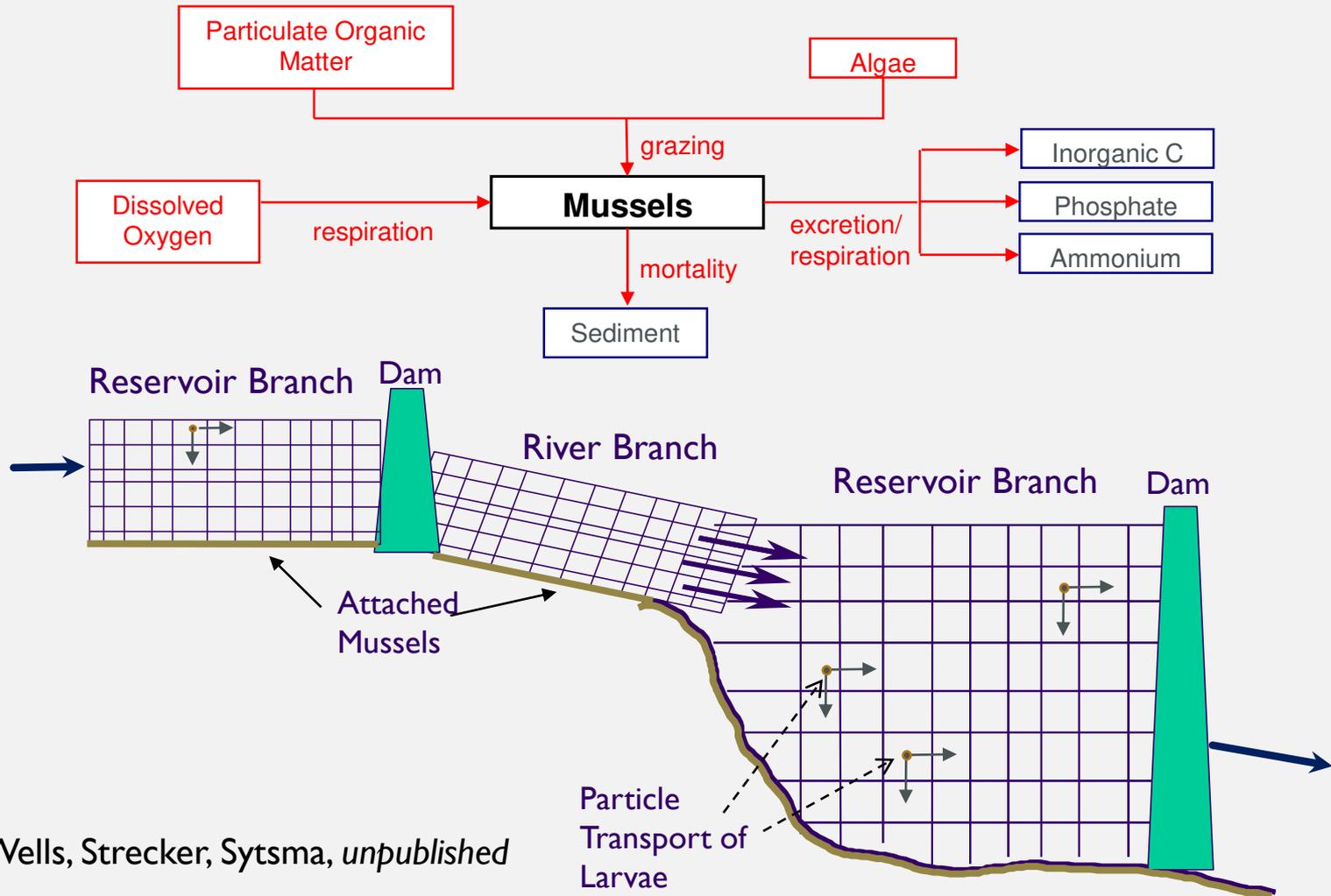


EMPIRICAL STUDIES OF ABIOTIC INTERACTIONS

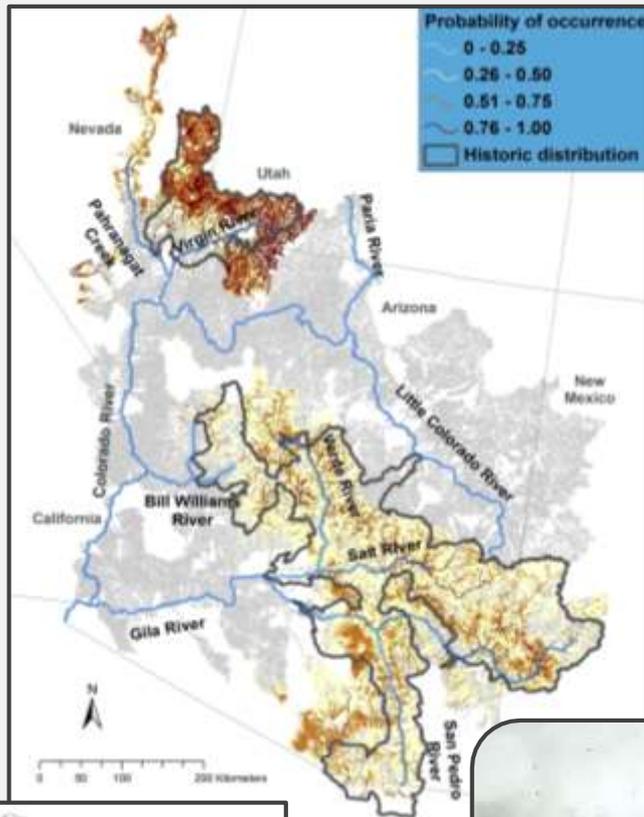
- Zebra mussel veligers appear to be controlled by a combination of temperature and dissolved oxygen



PROCESS MODELS



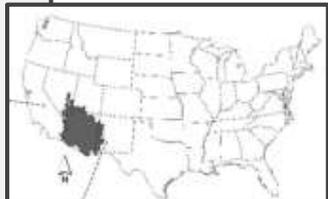
SPECIES DISTRIBUTION MODELS



- 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')

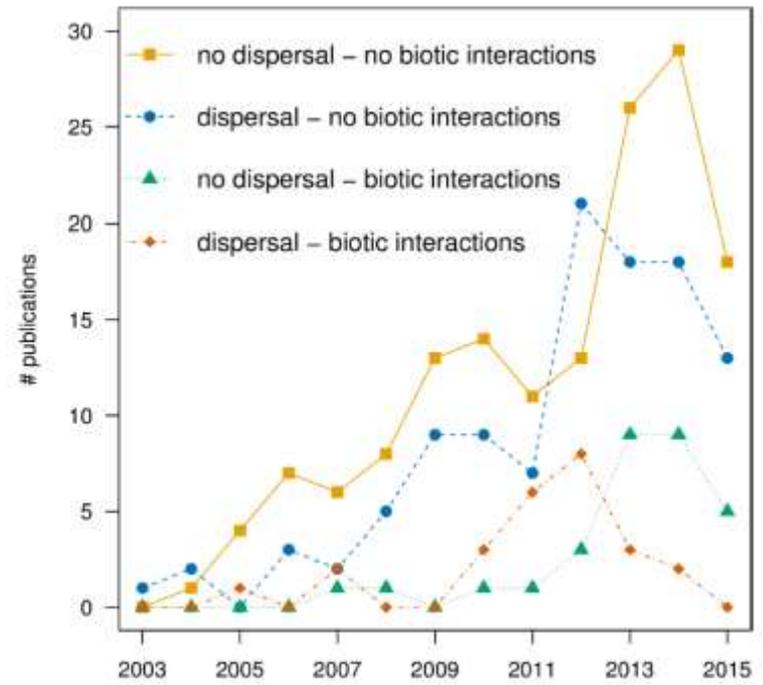
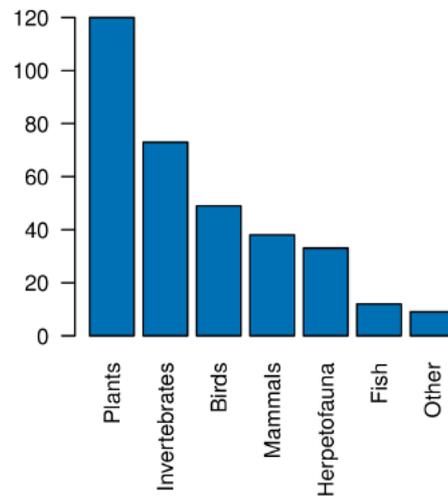
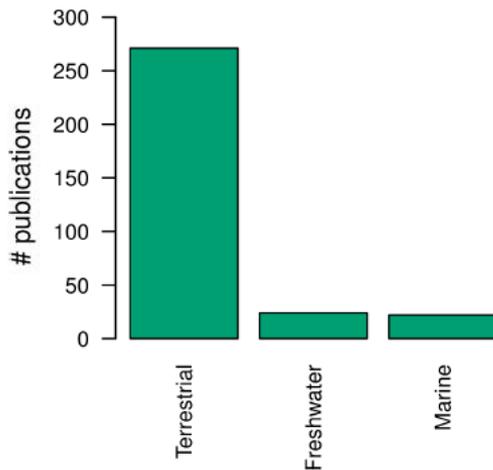
Forecasted range shifts of arid-land fishes in response to climate change

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^{1*}, Angela Strecker^{2*}, Mao-Ning Tuanmu³, Lydia Beaudrot⁴, Phoebe Zametske^{5,6}, Jonathan Belmaker⁷, Beth Gerstner^{8,9}

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?

email: angela.strecker@wwu.edu

Twitter: [@StreckerScience](https://twitter.com/StreckerScience)