Interaction between experimentally-elevated winter pond temperature and biotic resistance; implications for fish invasion and climate change

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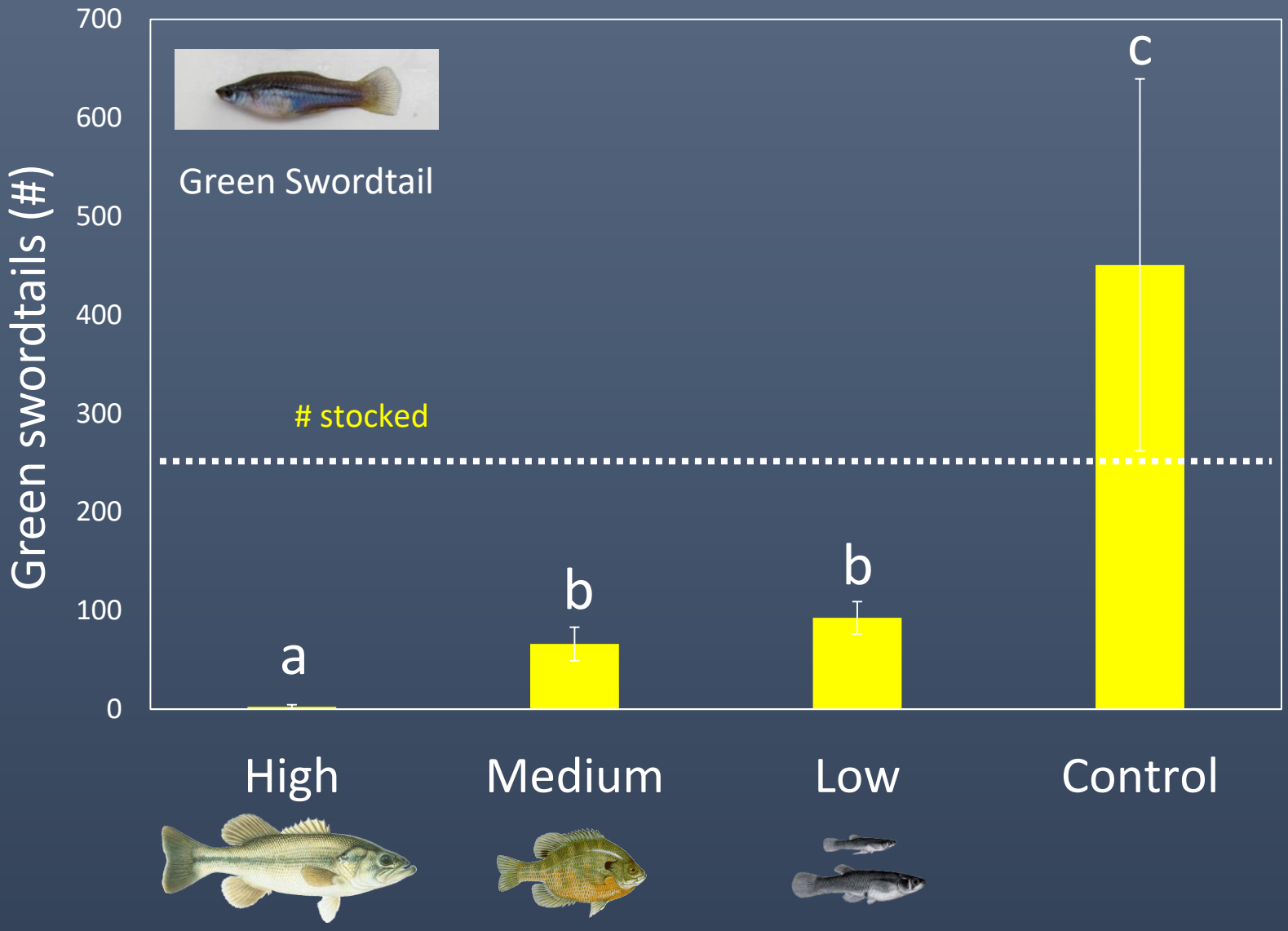
Funding:

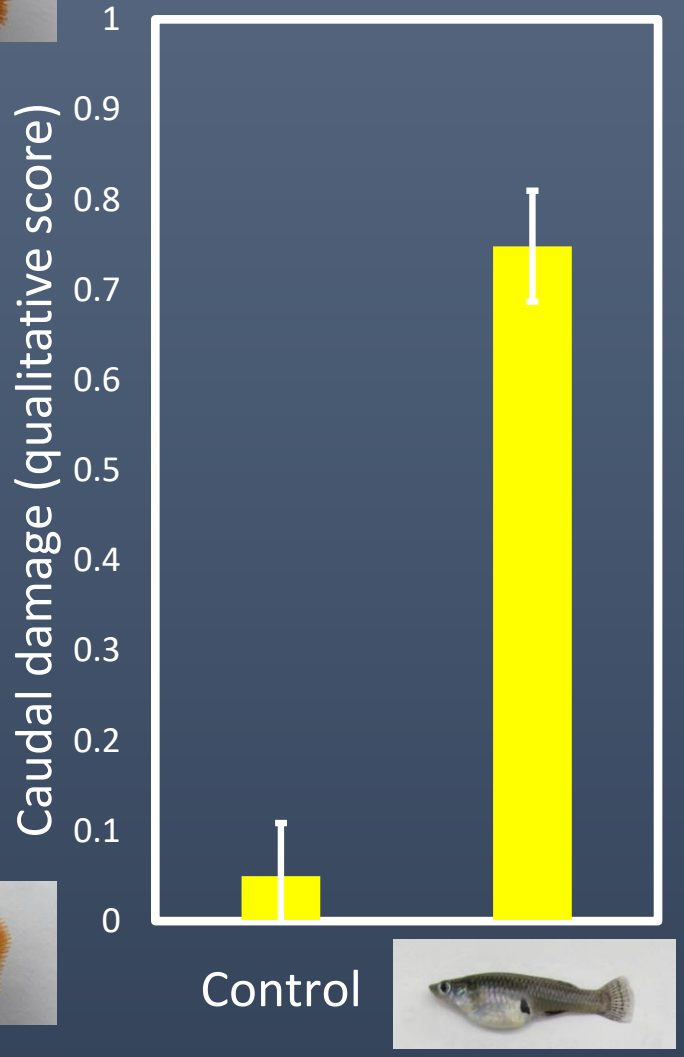
Support:

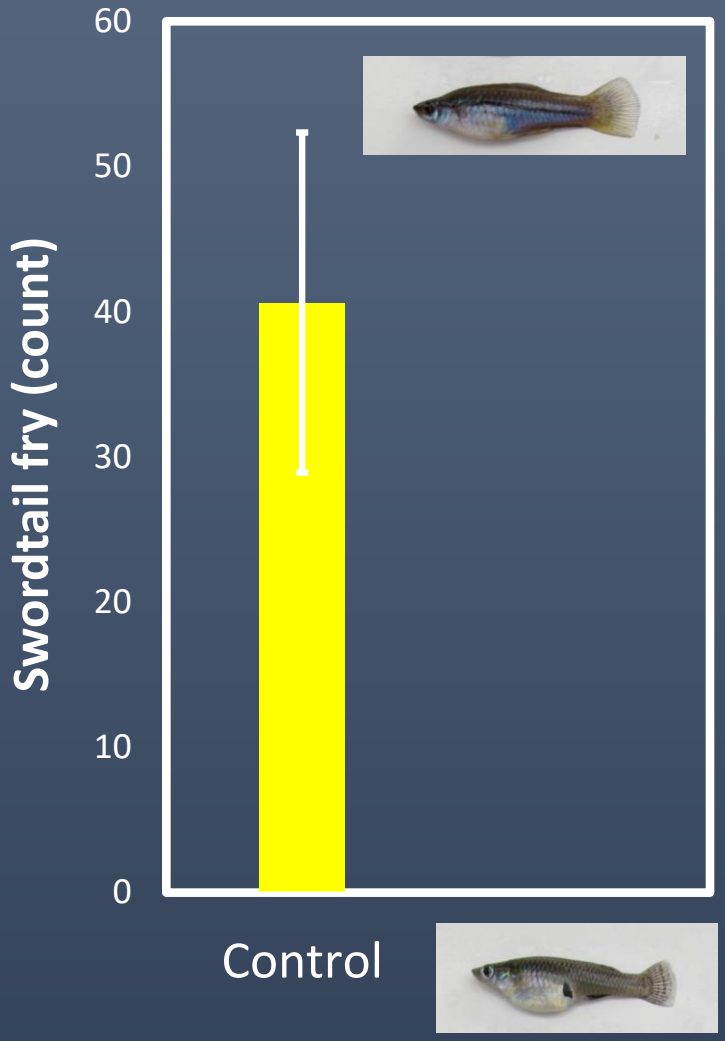
In Florida, temperature is an important habitat filter

Biotic Filter: strongly-interacting native species in Florida

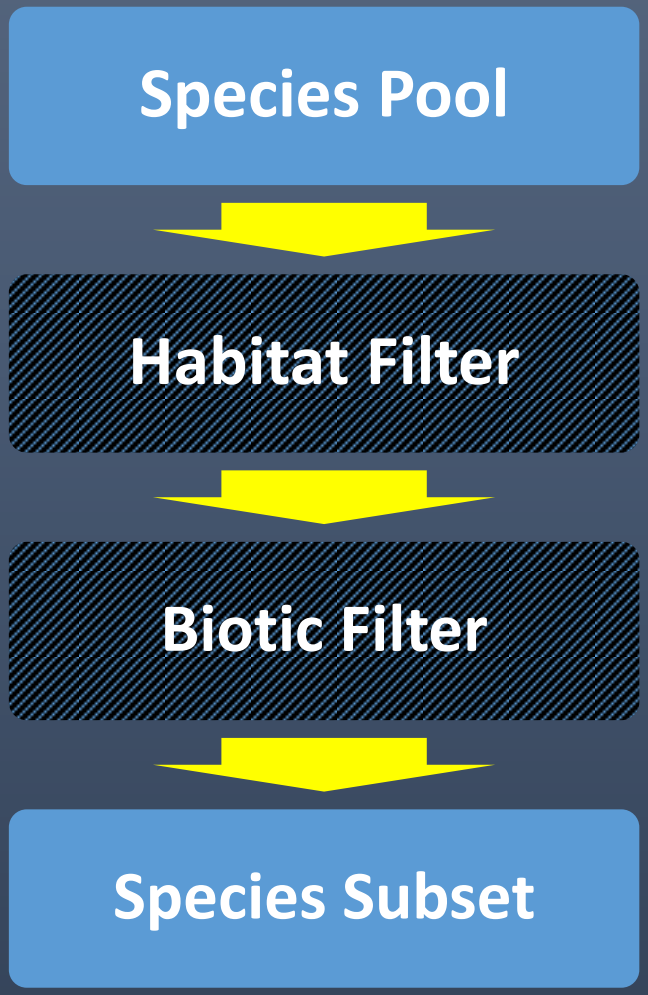


Mesocosm experiment with/without eastern mosquitofish (*Gambusia holbrooki)*



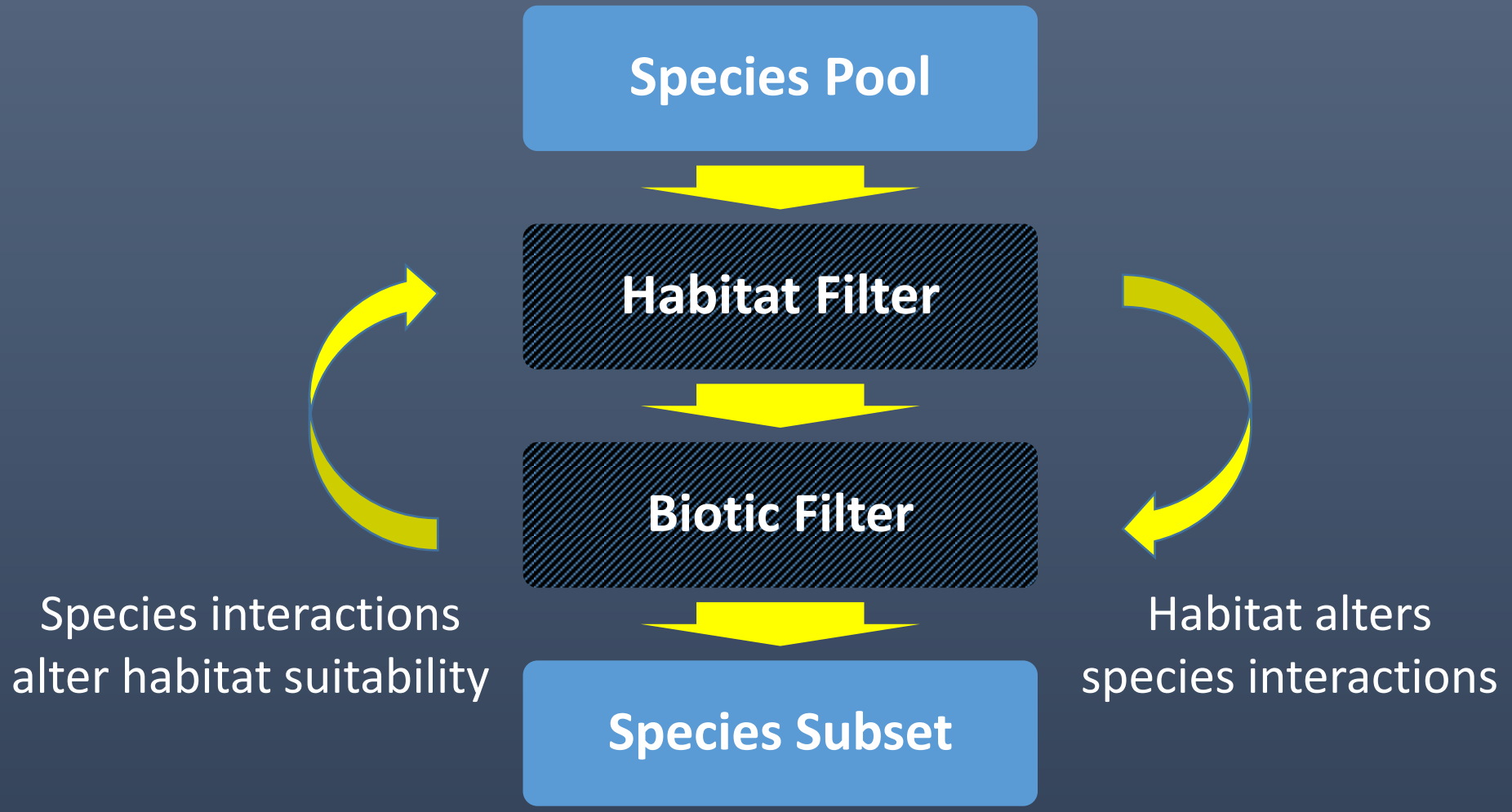


Community assembly theory applied to invasion



- Begin with species pool
- Habitat filter: is habitat suitable?
- Biotic filter: species interactions
- Arrive at species subset
- Neutral processes also important

Need to consider potential for interactions

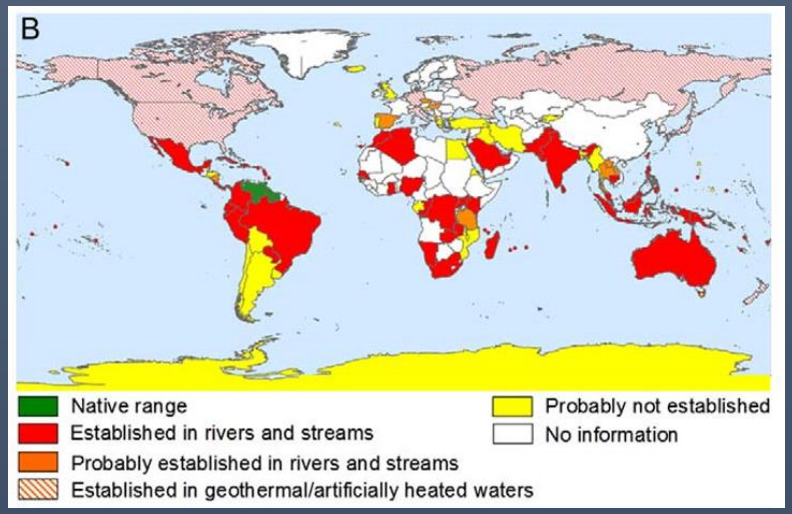


Two widely introduced poeciliids:

Southern Platyfish (*Xiphophorus maculatus*)

Southern Platyfish (GBIF)

Guppy (*Poecilia reticulata*)



Guppy (Deacon et al. 2011)

- Southern Platyfish: Mexico to Belize
- Guppy: Lesser Antilles, northern South America
- May lack necessary cold tolerance to survive Florida “winter”

Overall Goal: reveal how temperature interacts with biotic resistance to affect invasion success

- Objective 1: determine chronic lethal minimum temperature for guppy and platy
- Objective 2: examine response of native poeciliids to warming
- Objective 3: examine interaction between warming and biotic resistance

Chronic lethal minimum (CLmin) temperature trials

Chronic lethal methodology (reduce temperature 1°C/day)

How important is the habitat filter?

Replicated pond study

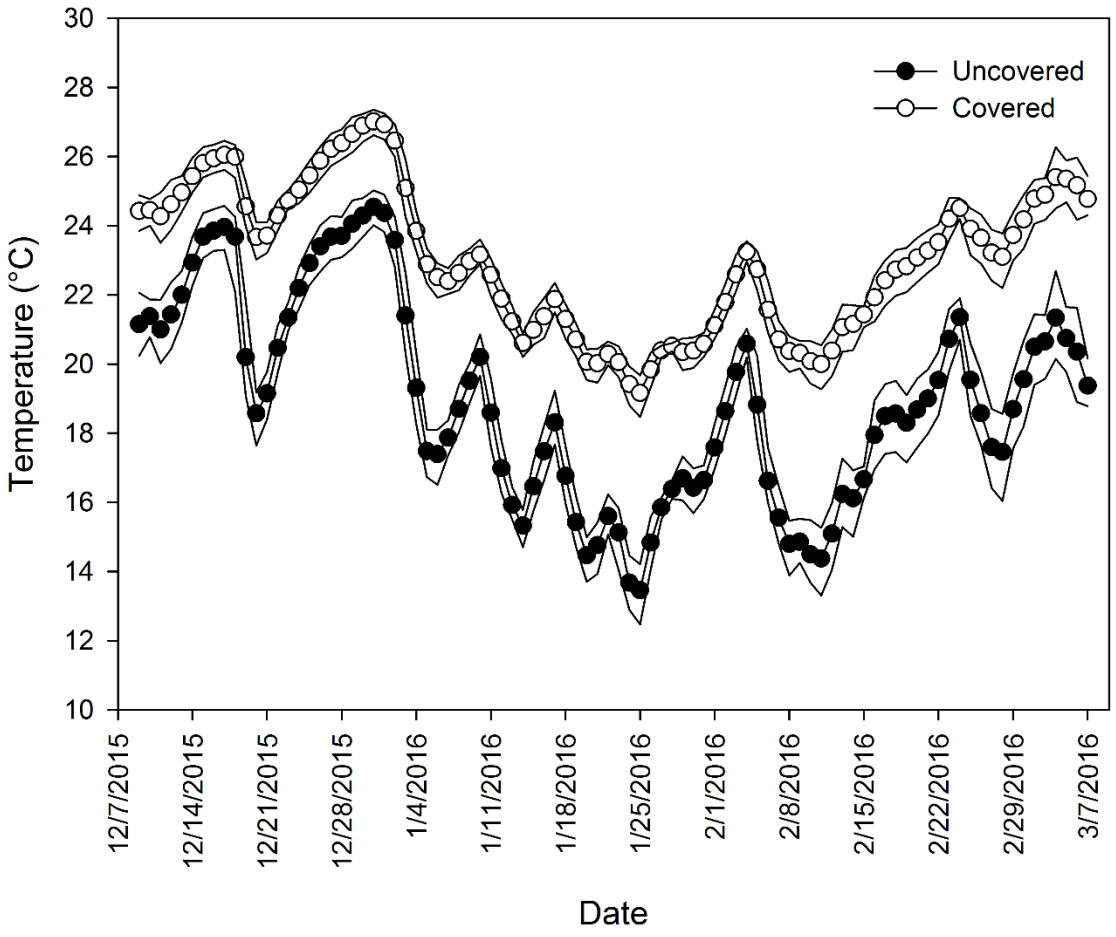
- Ponds with basal native community: eastern mosquitofish, least killifish, sailfin molly
- Factorial design: covered ponds X presence of largemouth bass
- 200 guppy & southern platyfish added
- Eight week trial
- Response: # native and non-native poeciliids

Chronic Lethal Minimum Temperature

Species	CLmin (°C)	Range	TL (mm)	Wt (g)
Guppy	9.2	7.9-10.0	30.8	0.3
Southern Platyfish	7.3	6.0-9.1	34.4	0.6

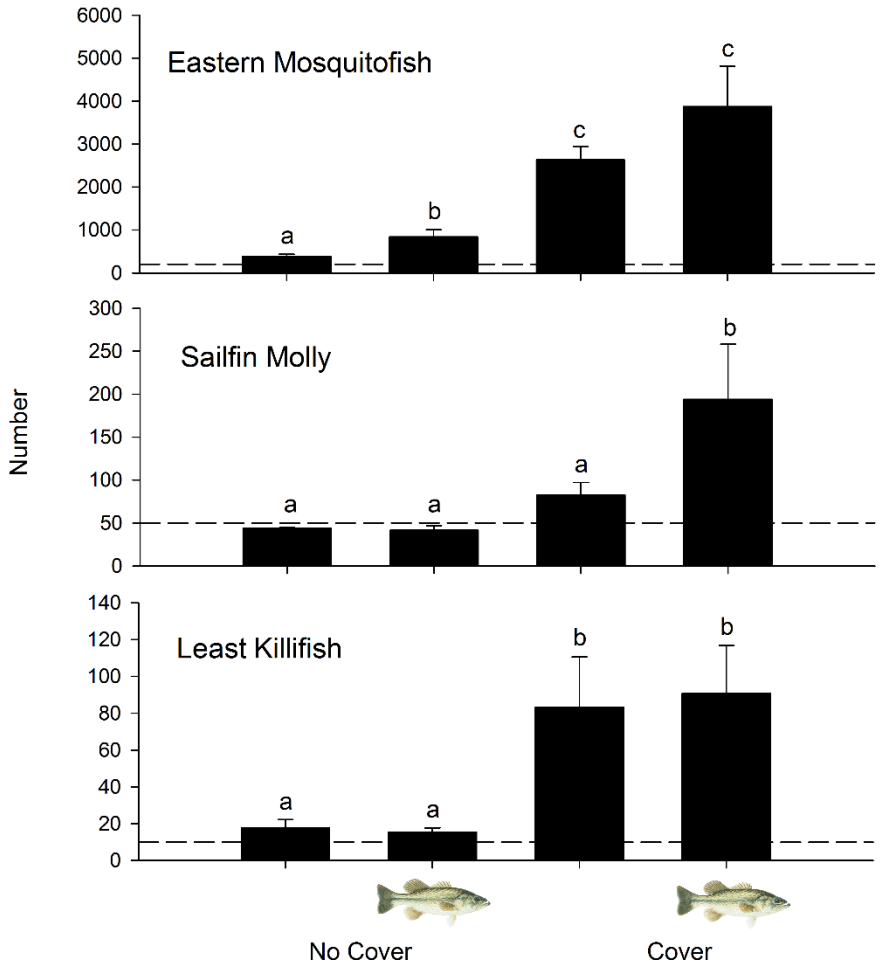
Could be affected during cold periods, especially Guppy

Winter temperature (December to March) in covered and uncovered ponds



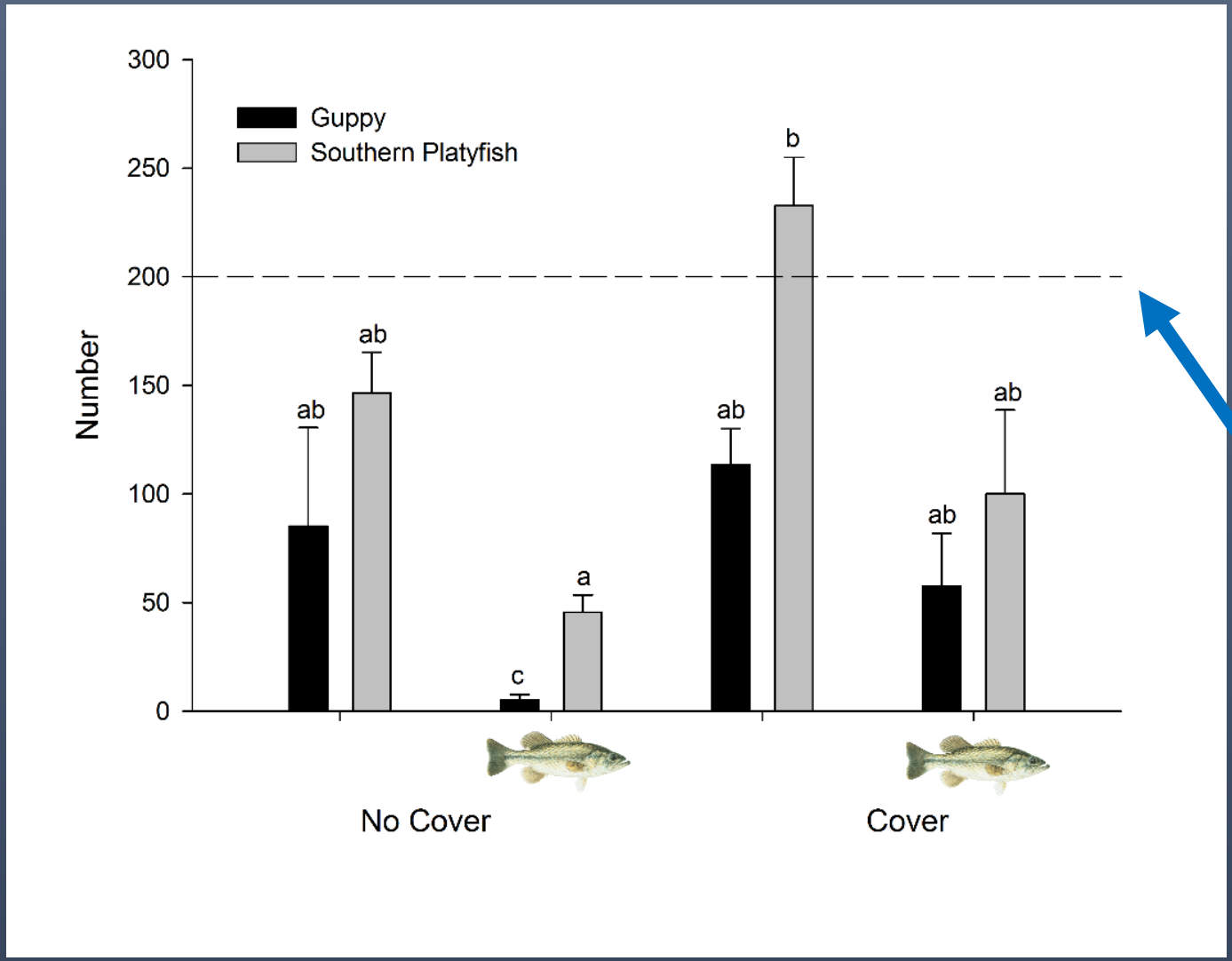
- Covered on December 8th
- Covered ponds on average 4°C warmer
- Temperature was sub-lethal

Native fish response



Note variable scale on vertical axis

Guppy and southern platyfish response

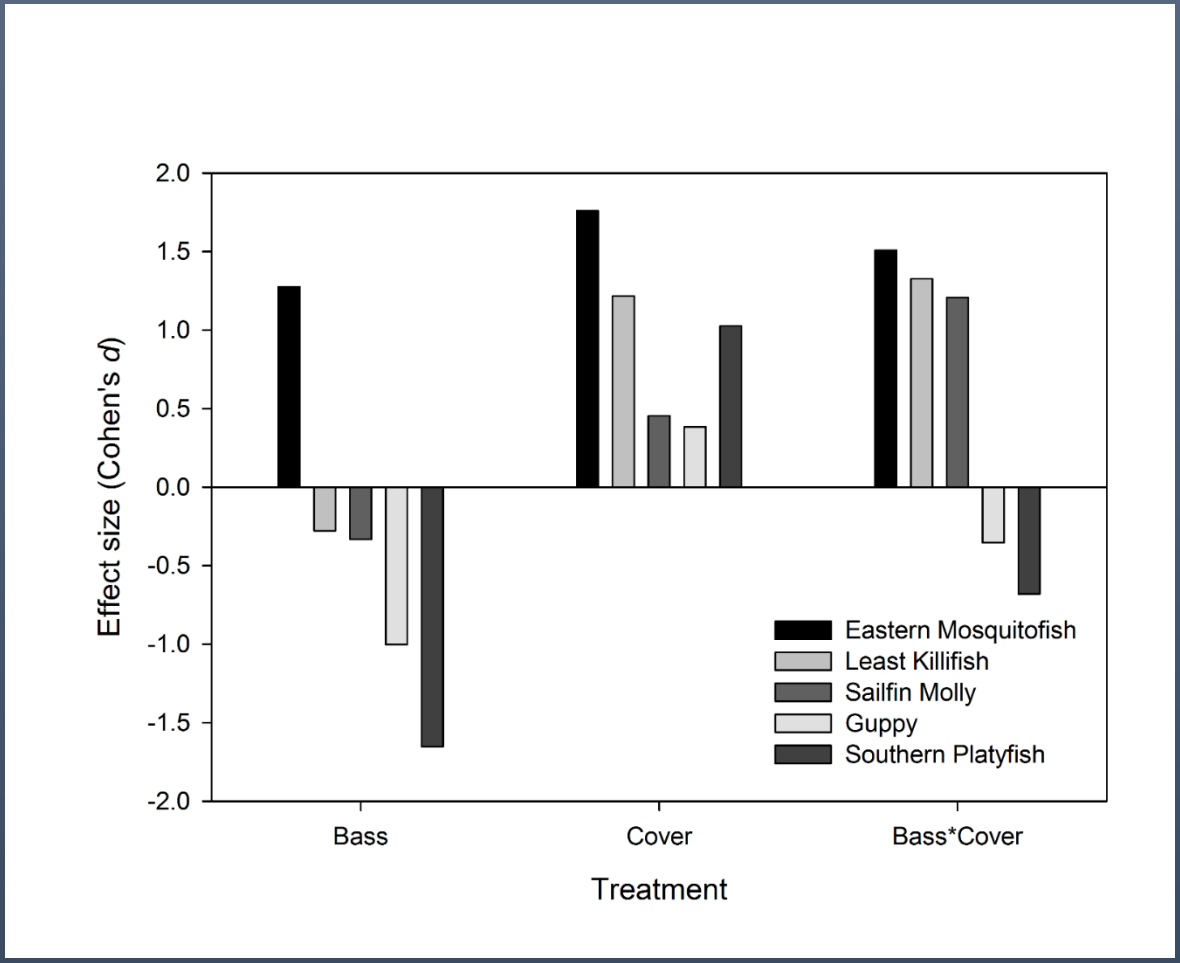


Number stocked in each pond

Some potential for interactions

Term	*p*
Bass	**< 0.001**
Warming	**< 0.001**
Species	**< 0.001**
Bass*Warming	**0.024**
Warming*Species	0.193
Bass*Species	0.184
Bass*Warming*Species	0.083

How large are the effects?



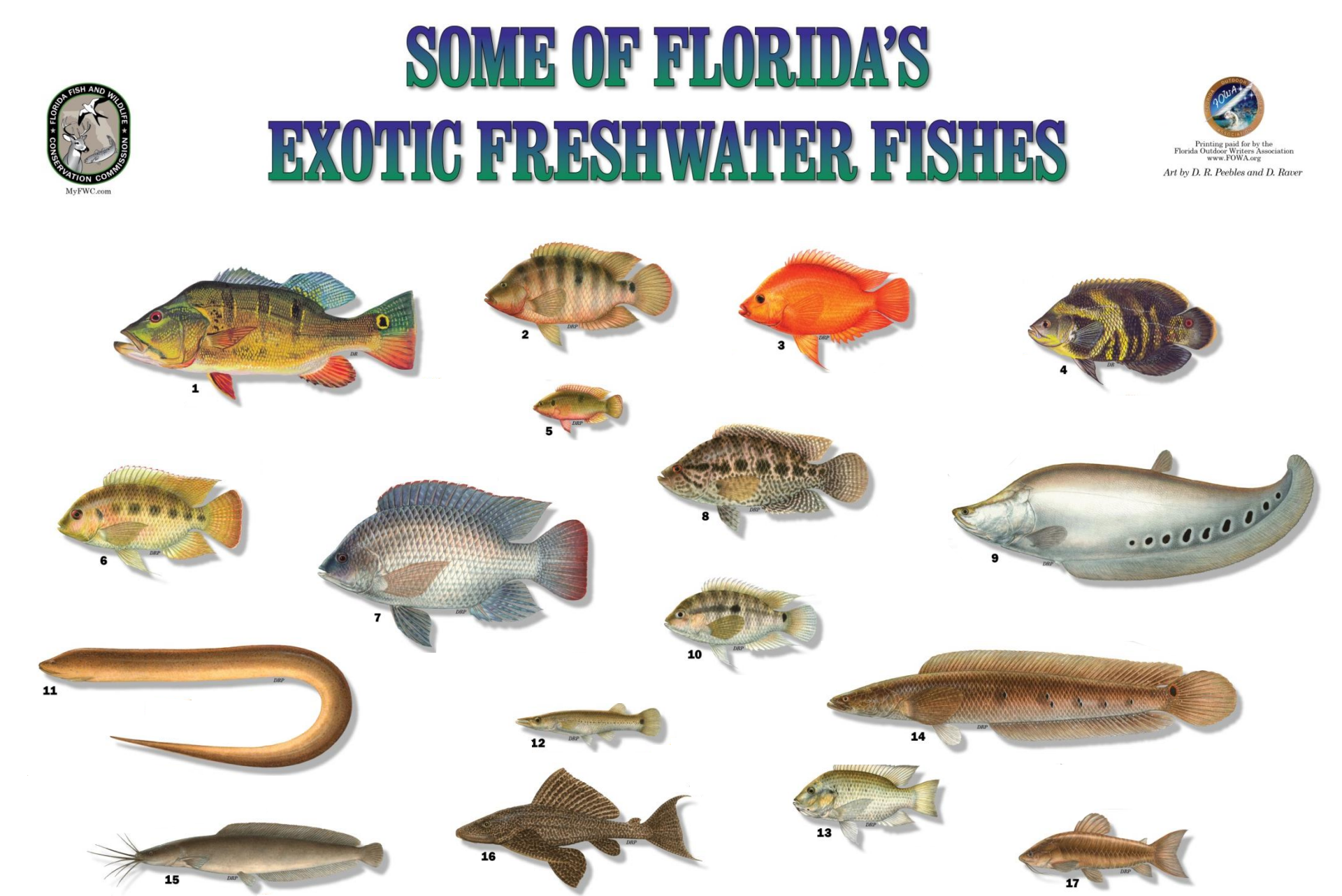
Addition of bass eliminates benefits of cover, increases eastern mosquitofish

Largemouth Bass just one component of the fish community

Multiple predator/competitor effects?

Implications for invasion and climate change in Florida… uncertainty

- Uncertain future climate:
  - Predictions include both warming and cooling
  - Incidence of extreme cold events – sweeping effect on tropical non-natives
- Uncertain response of native fish:
  - Response of natives may be regional and taxon specific – biotic resistance may follow suit
- Ultimately:
  - Freshwater fish fauna of Florida composed of many weedy species which are invasive elsewhere: largemouth bass, eastern mosquitofish, bluegill



Uncertainty: range expansion/decline of established fish

Acknowledgments

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