Impacts of invasive fish communities on Hawaiian coastal wetlands

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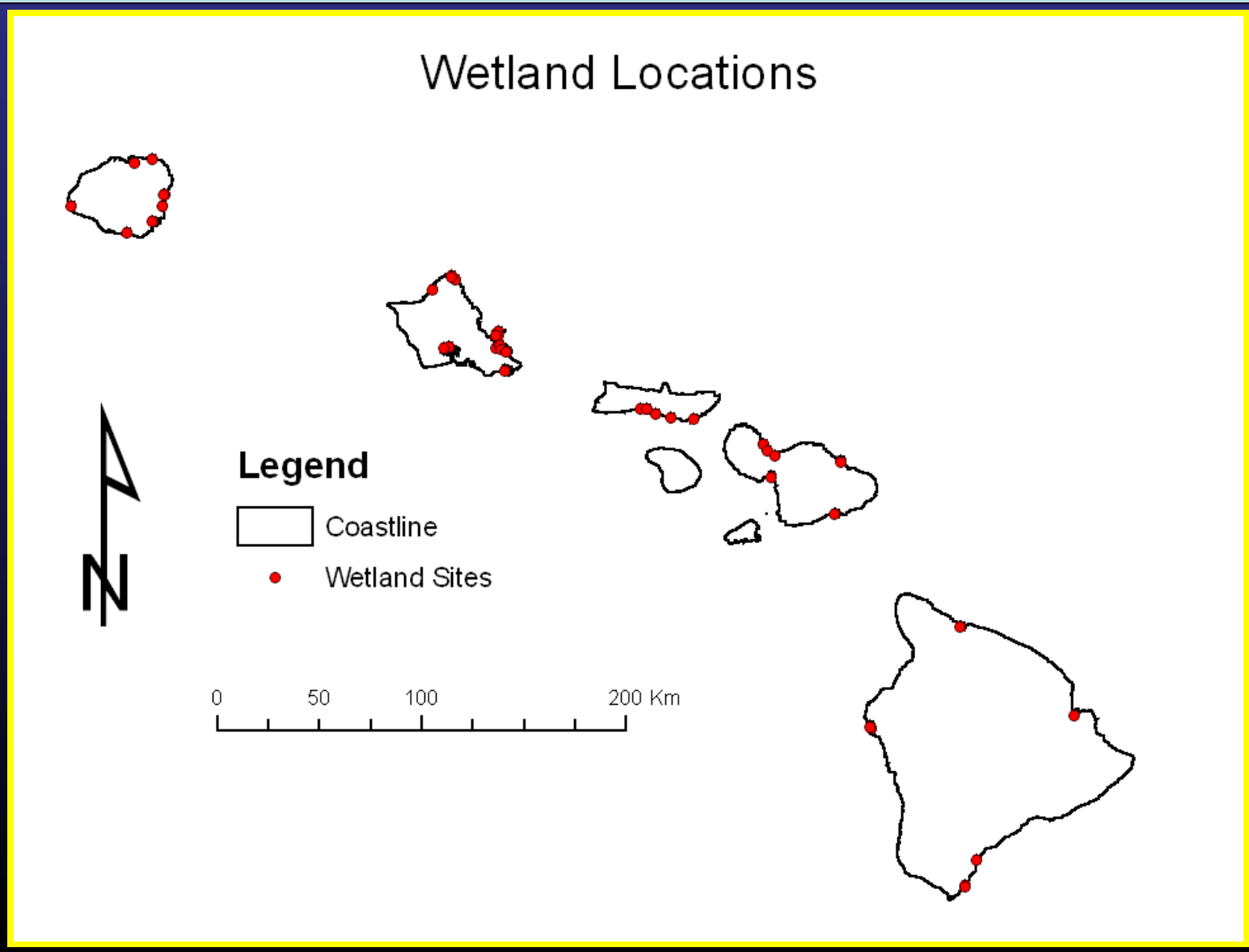
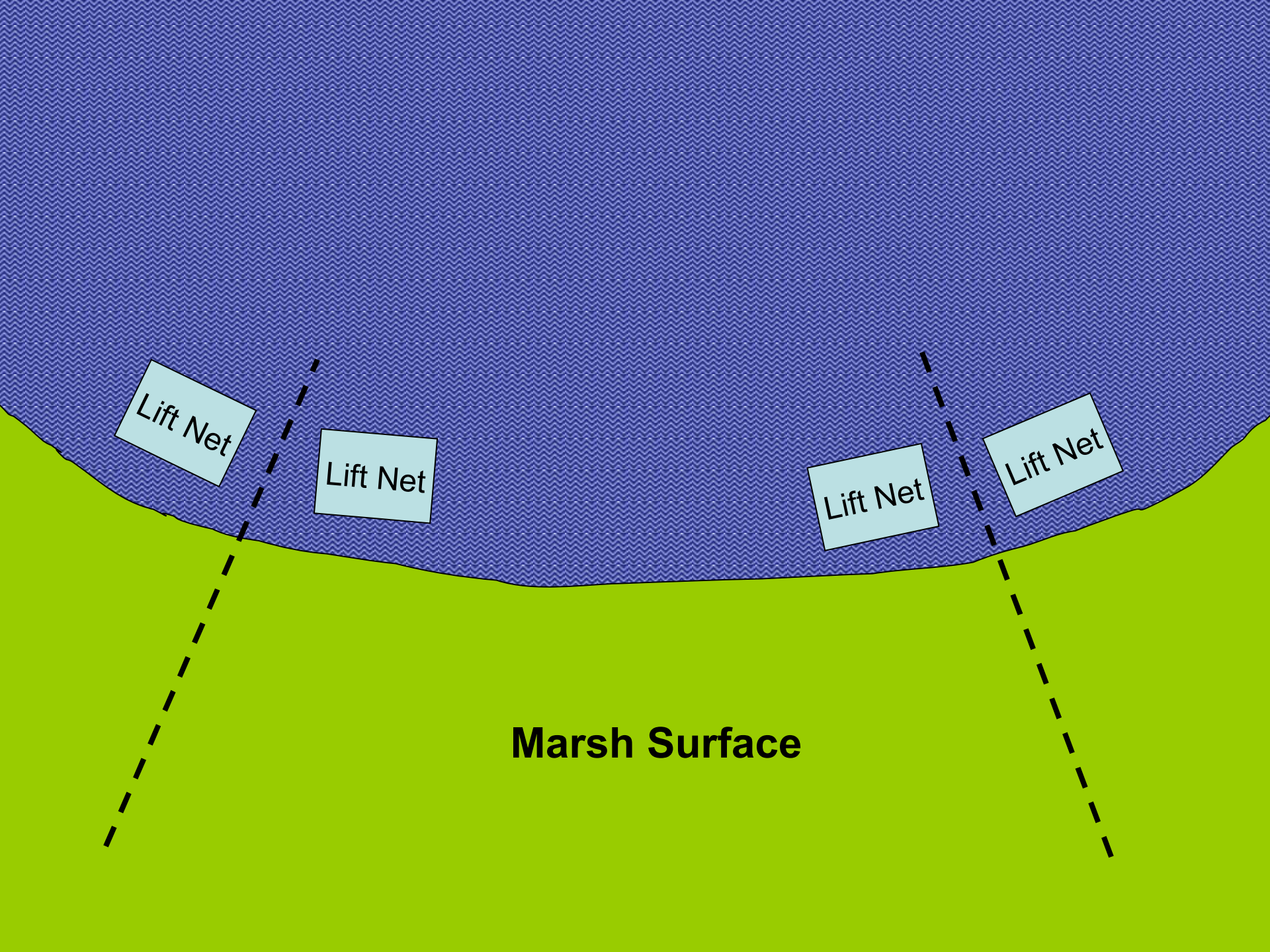
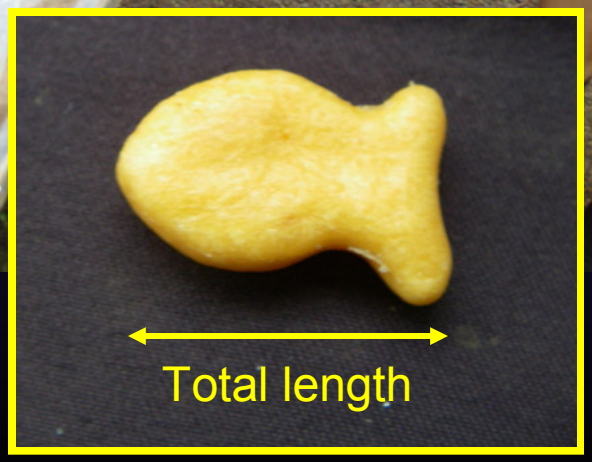
Wetlands Sampling Stations

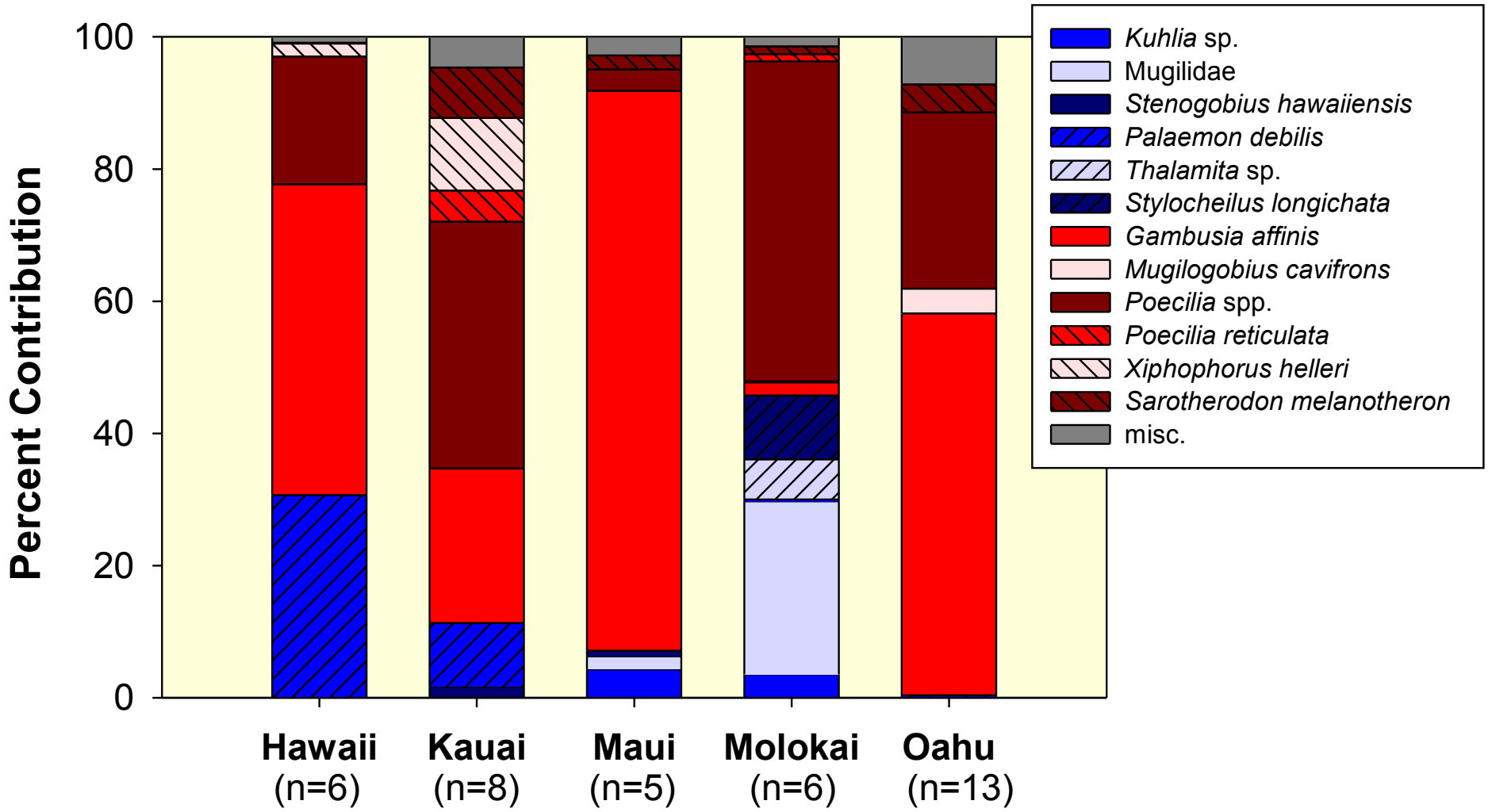



Lift Net
Lift Net
Lift Net
Lift Net
Marsh Surface

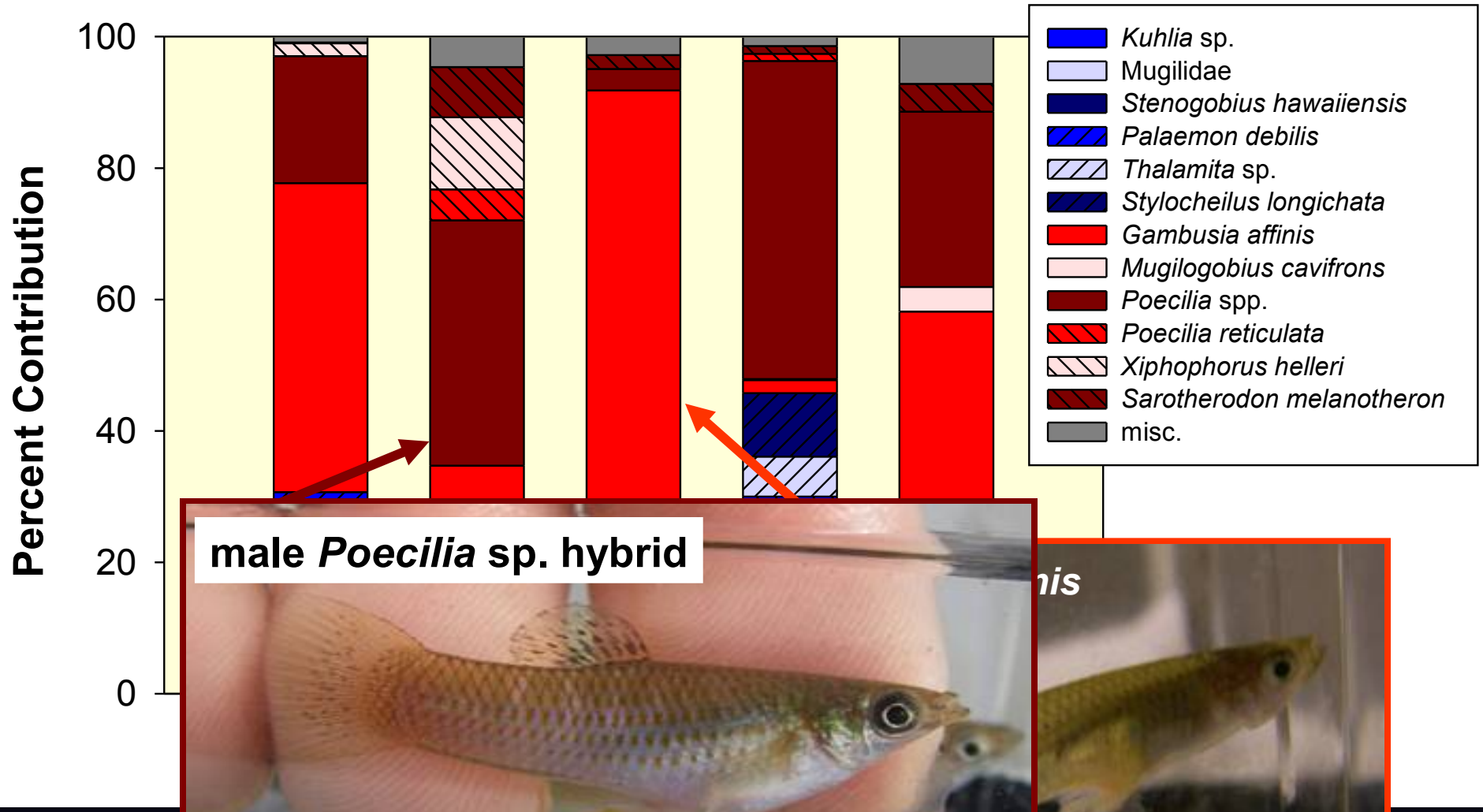

Total length


Cedars
igloo

50 – 90% of nekton community dominated by invasive fish



40 – 90% of invasive fish were poeciliids



Species	Mode of introduction	Year introduced
Gambusia affinus	Intentional biocontrol	1905
Poecilia hybrid sp.	Aquarium release	1950's
Poecilia reticulata	Intentional biocontrol	1920's
Xiphophorus helleri	Intentional biocontrol	1920's

Englund 1999, Van Dine 1907, Yamamoto and Tagawa 2000

- have become quite prolific, reaching densities 10-30 x higher than native spp.
- poeciliids identified as one of the top 100 invasive species in the world
- identified as a species of concern in Hawaii, Oregon, Washington, and New Mexico

Why are poeciliids so prolific?

1. Polyphagous

Why are poeciliids so prolific?

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1. Broad physiological tolerances

Species	**Salinity range (‰)**
Gambusia affinus	0.1 – 64.2
Poecilia hybrid sp.	0.1 – 64.2
Poecilia reticulata	0.1 – 32.0
Xiphophorus helleri	0.1 – 0.2

Why are poeciliids so prolific?

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1. A single pregnant female can colonize an ecosystem

Why are poeciliids so prolific?

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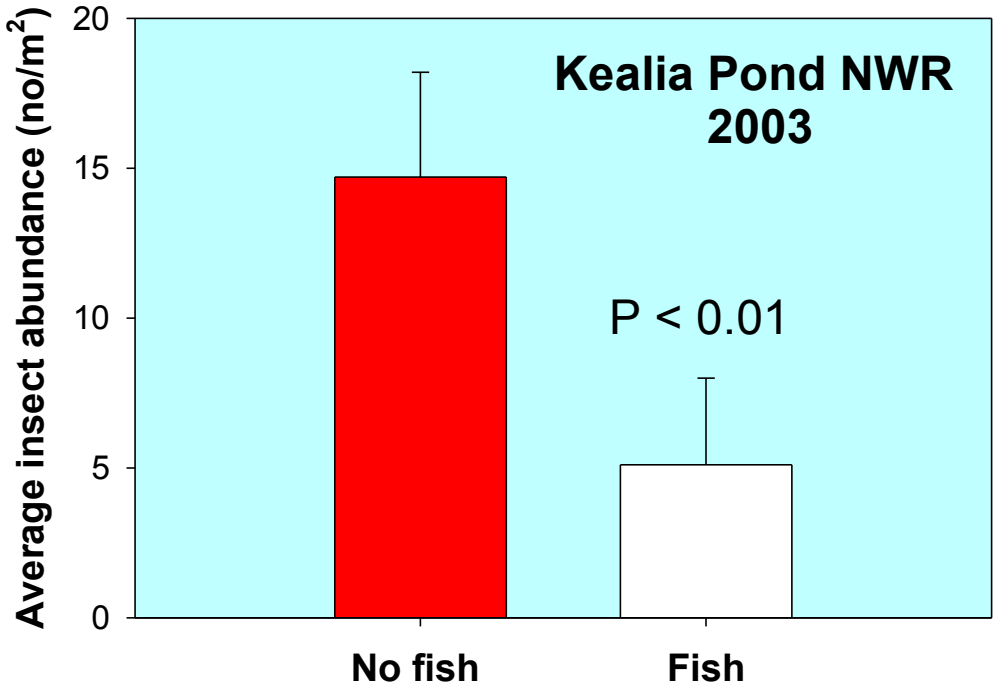
1. Broad physiological tolerances
2. Specialized reproduction
3. Short generation time
4. A single pregnant female can colonize an ecosystem

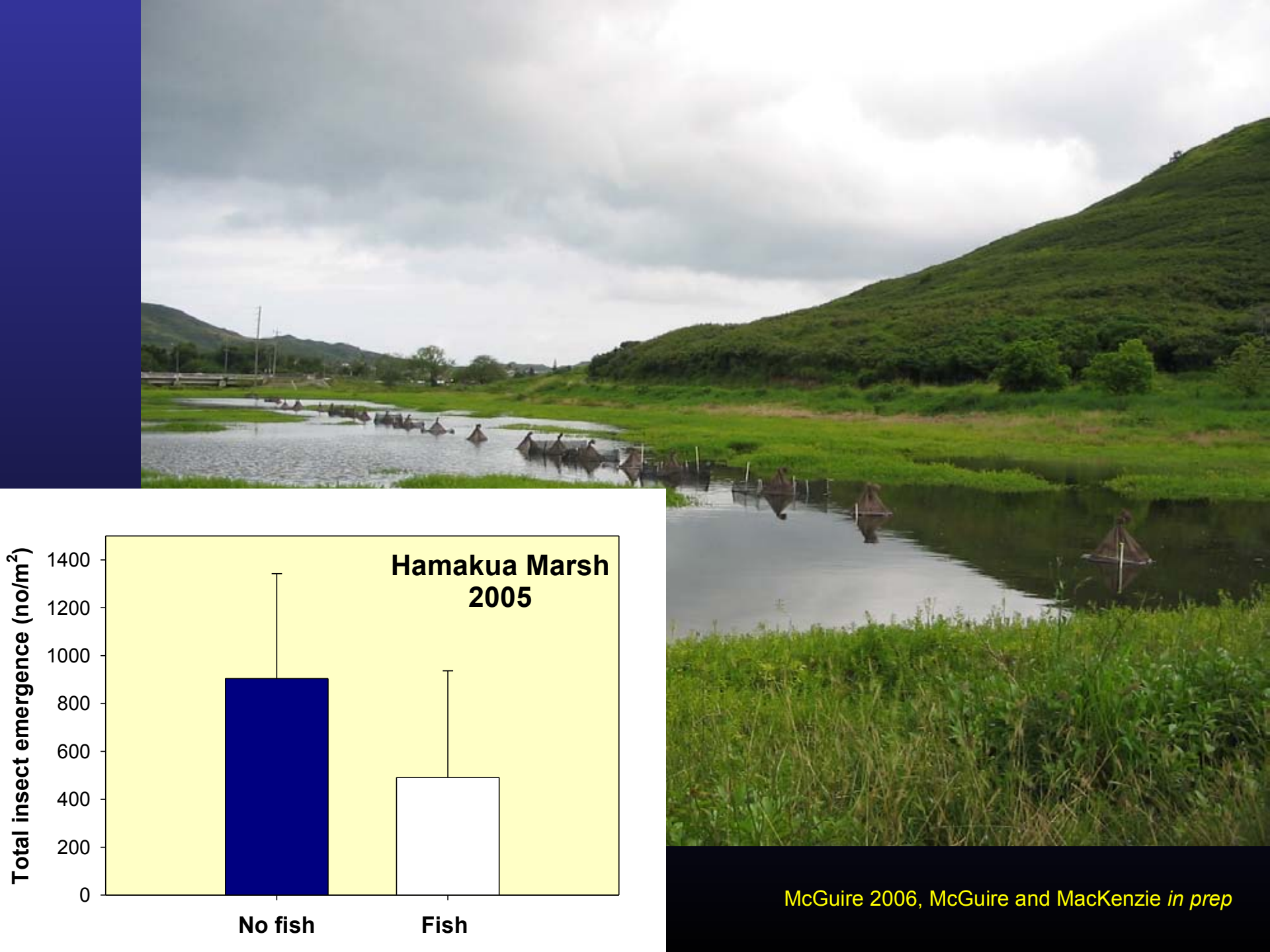
1. High levels of aggression towards other species

How are poeciliids impacting coastal wetlands?

1. Can reduce invertebrate food sources that are also utilized by native fish and birds

Mayer et al., 2008

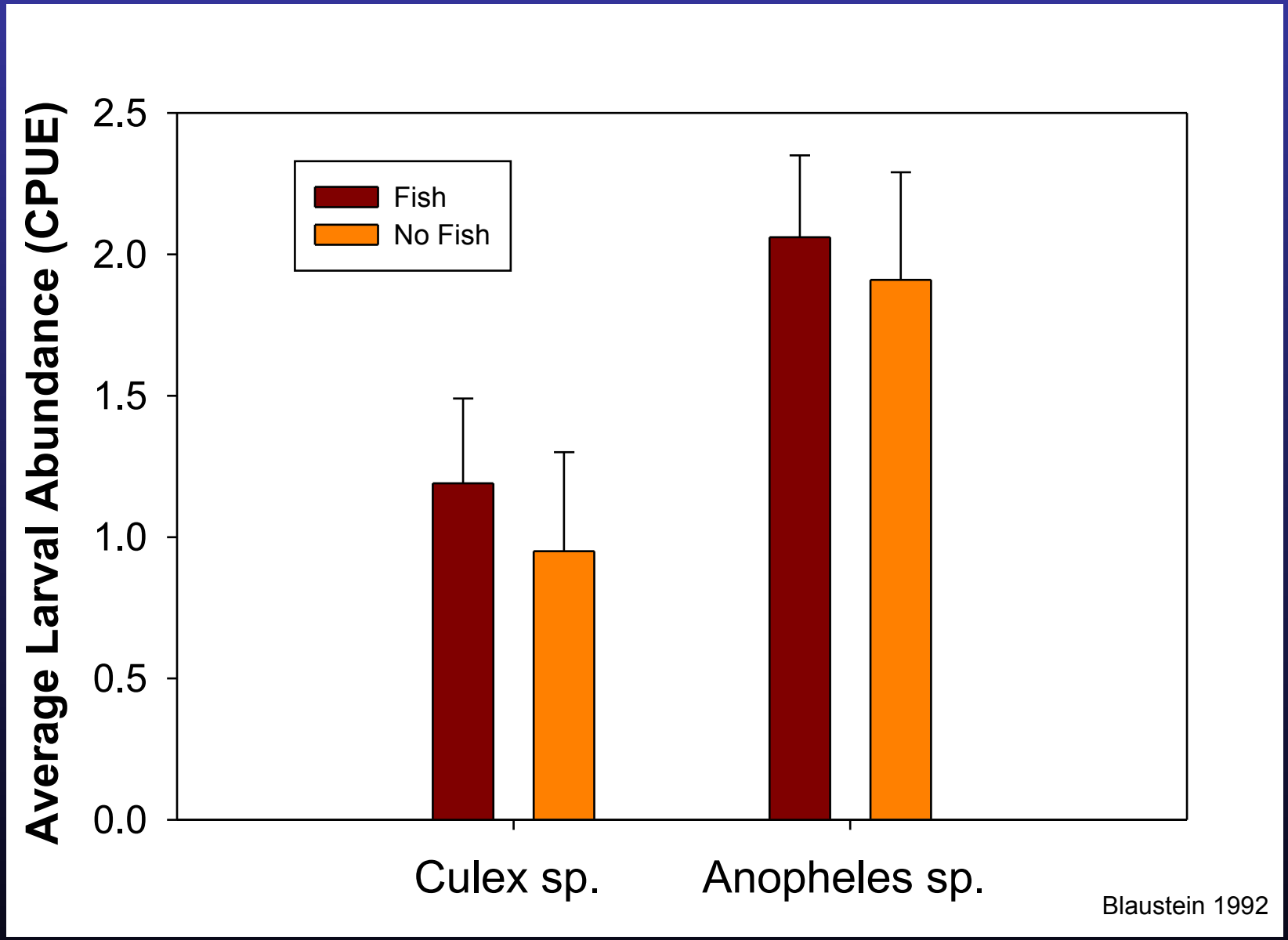




McGuire 2006, McGuire and MacKenzie *in prep*

Relative contribution of food sources to entire gut contents examined using a dissecting scope.

	Insects	Worms	Ostracods	Plant material	Fish parts	Other
Gambusia affinis (n=25)	28%	32%	4%	12%	40%	32%
Poecilia sp. (n=5)	20%	60%	0%	0%	40%	0%



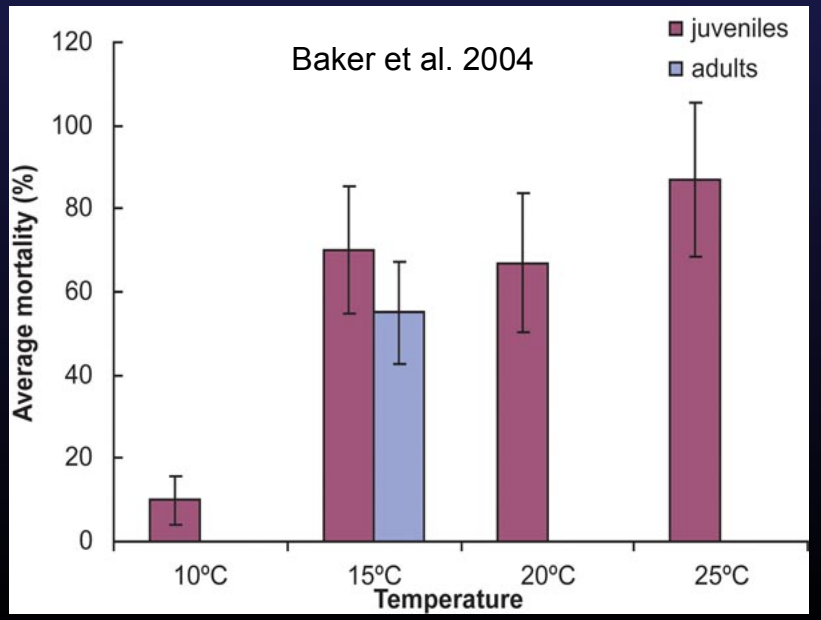
Studies have also shown increases in mosquito larval densities (Hoy et al. 1972, Bence 1988) or increased emergence rates of adult mosquitoes (Blaustein and Karbon 1990) in the presence of poeciliids.

How are poeciliids impacting coastal wetlands?

1. Can reduce invertebrate food sources that are also utilized by native fish and birds

1. Aggressive behavior towards native fish and birds (Baker et al. 2004, Howe et al. 1997, Meffe 1985, Morgan et al. 2004, Rowe et al. 2007, Uyehara et al. 2008)

Photo: C. Baker



How are poeciliids impacting coastal wetlands?

1. Can reduce invertebrate food sources that are also utilized by native fish and birds

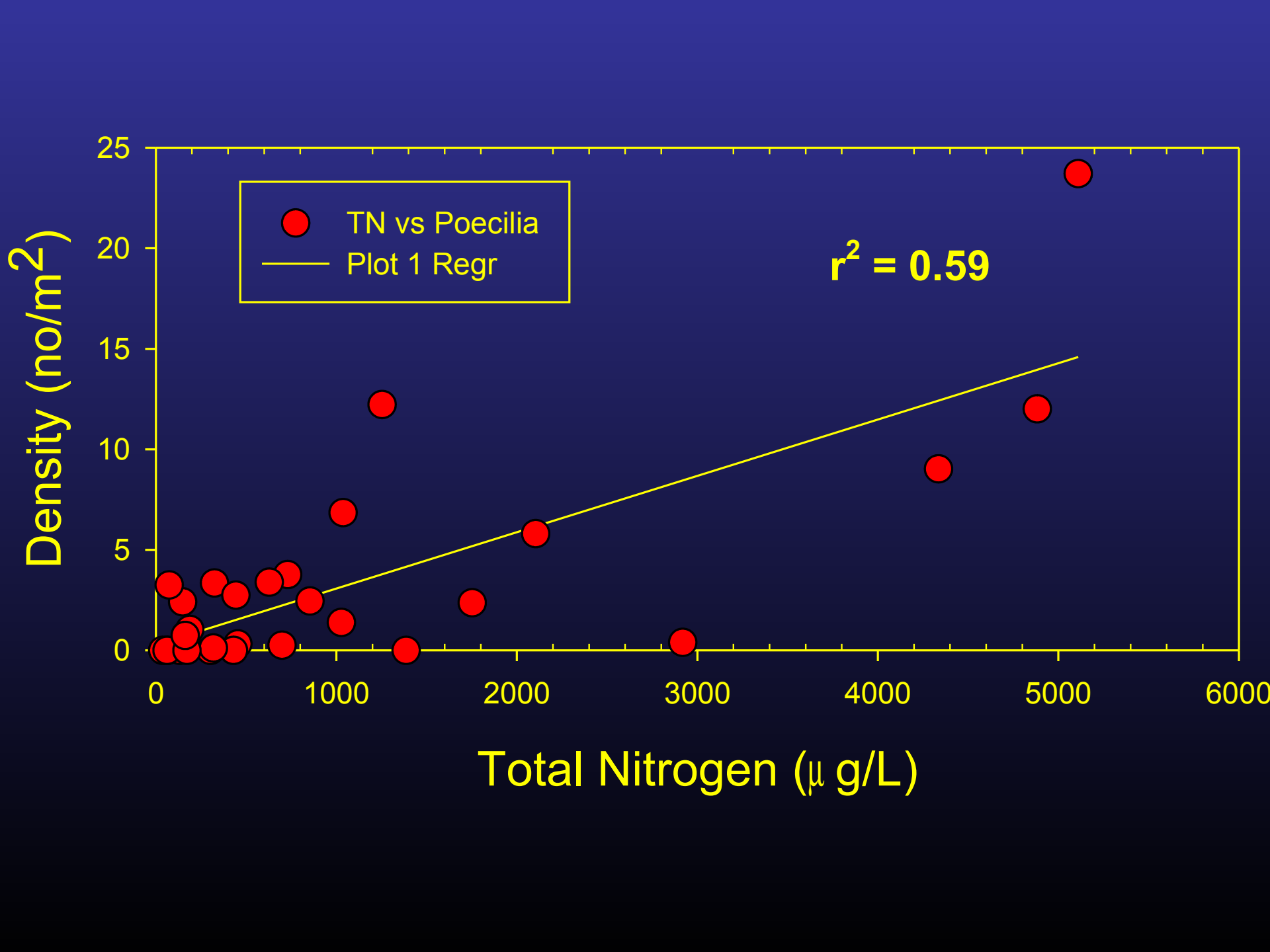
2. Aggressive behavior towards native fish and birds

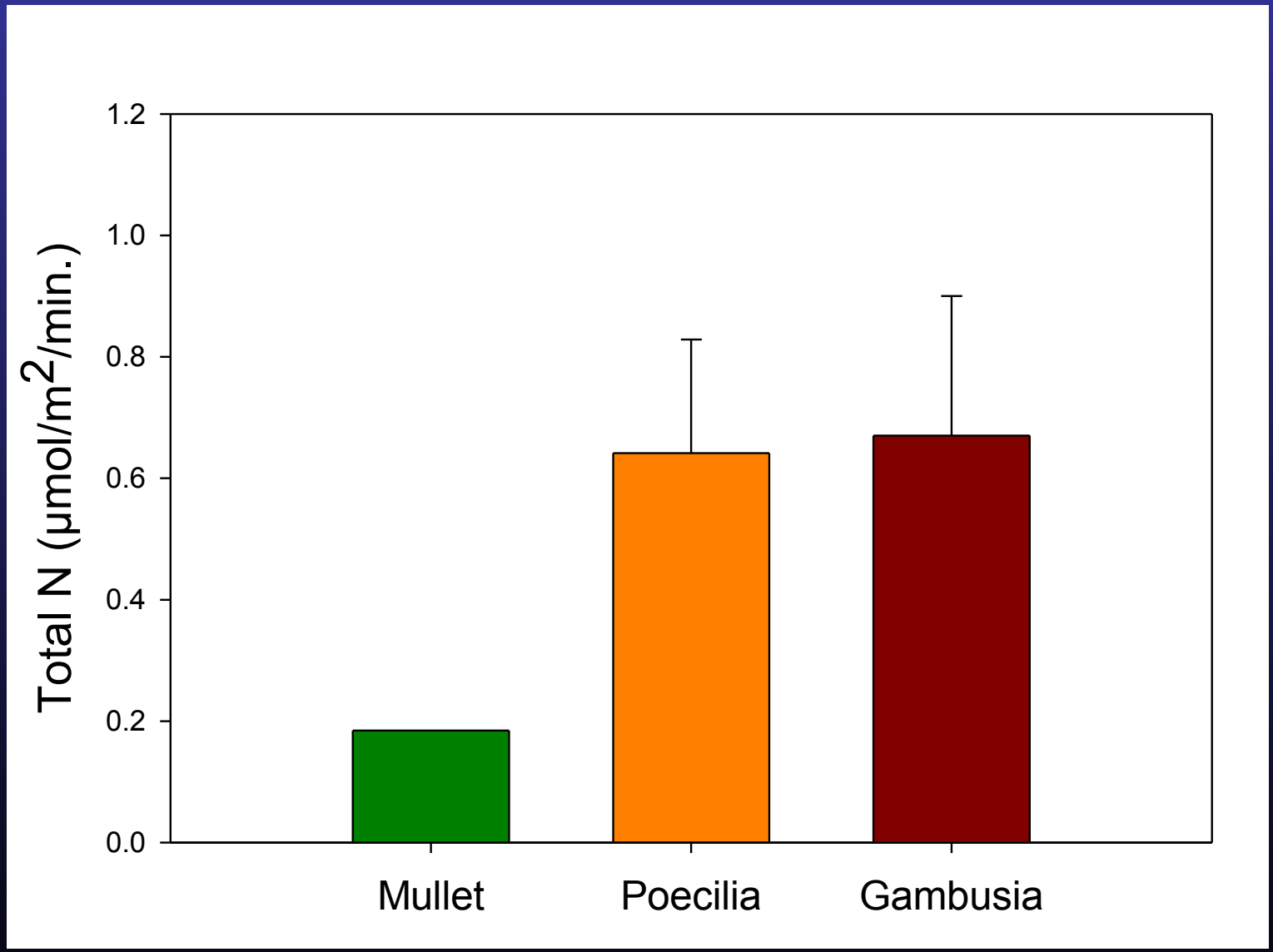
1. **Introduction of parasites and disease (Font and Tate 1994, Font 1997, Font 1998, Font 2003).**

Lawai kai

How are poeciliids impacting coastal wetlands?

1. Can reduce invertebrate food sources that are also utilized by native fish and birds
2. Aggressive behavior towards native fish and birds
3. Introduction of parasites and disease
1. **Increased nutrient loading**


TN vs Poecilia
Plot 1 Regr
$r^2 = 0.59$
Density (no/m^2)
Total Nitrogen (µ g/L)
0
5
10
15
20
25
0
1000
2000
3000
4000
5000
6000


Total N (µmol/m2/min.)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Mullet
Poecilia
Gambusia

- Poeciliids are prevalent throughout the Hawaiian islands and continue to be introduced to bodies of water

- We are only beginning to understand their impacts to native birds, fish, and water quality.

- More research and educational outreach is needed in order to protect and preserve the cultural and ecological values of Hawaii's wetlands from invasive fish

Many mahalos!

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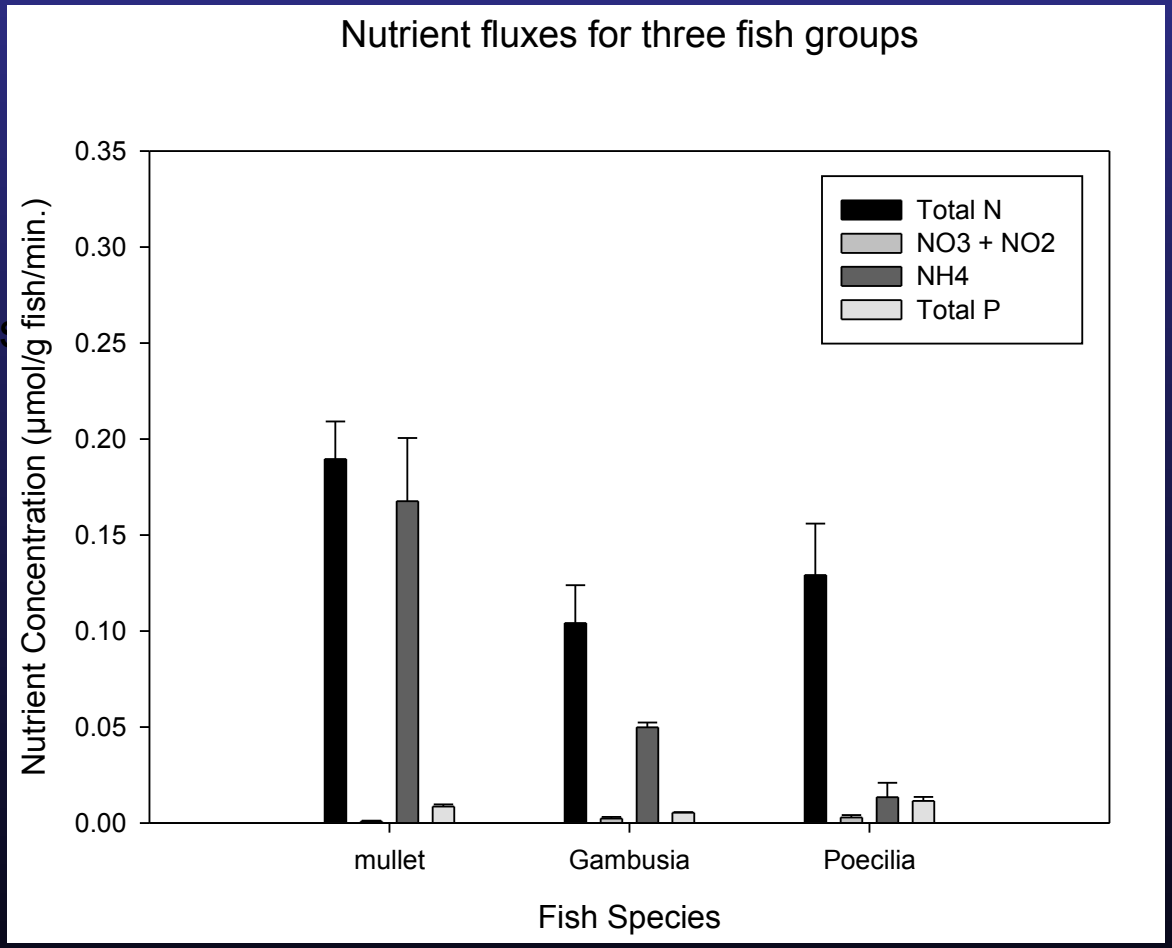
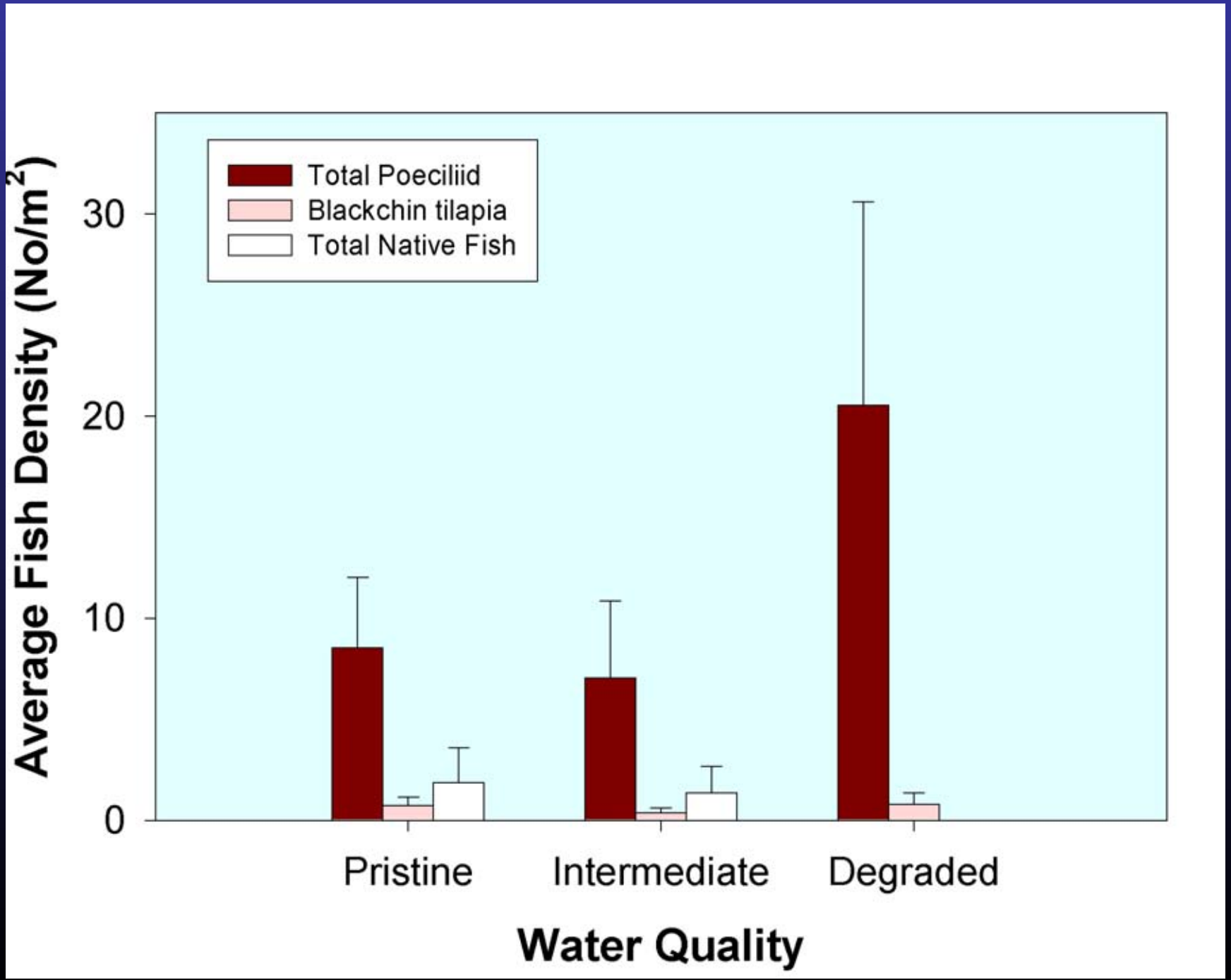
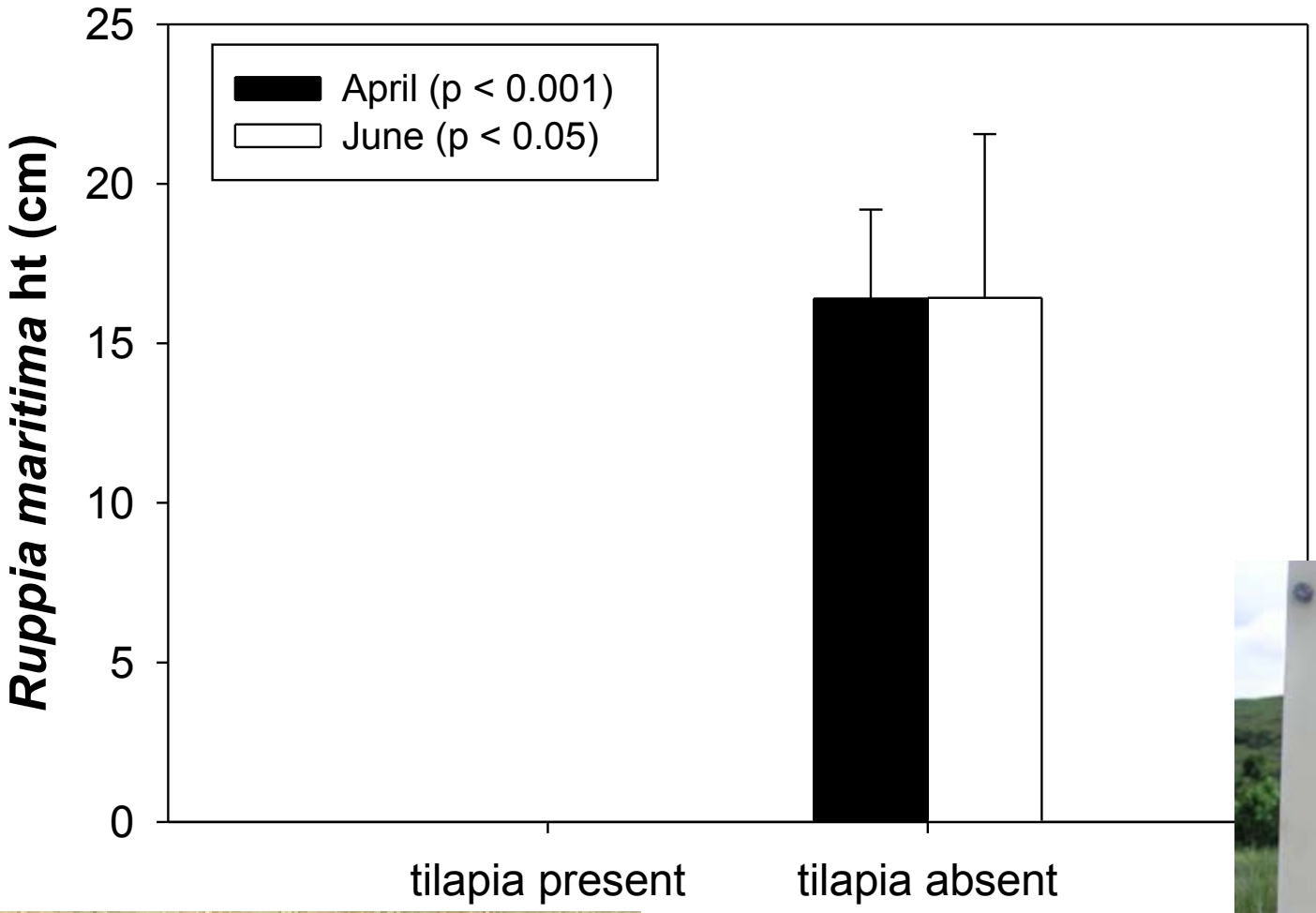
Although the research described in this talk has been funded by the US EPA, it has not been subject to any EPA review and therefore does not necessarily reflect the views of the Agency and no official endorsement should be inferred.

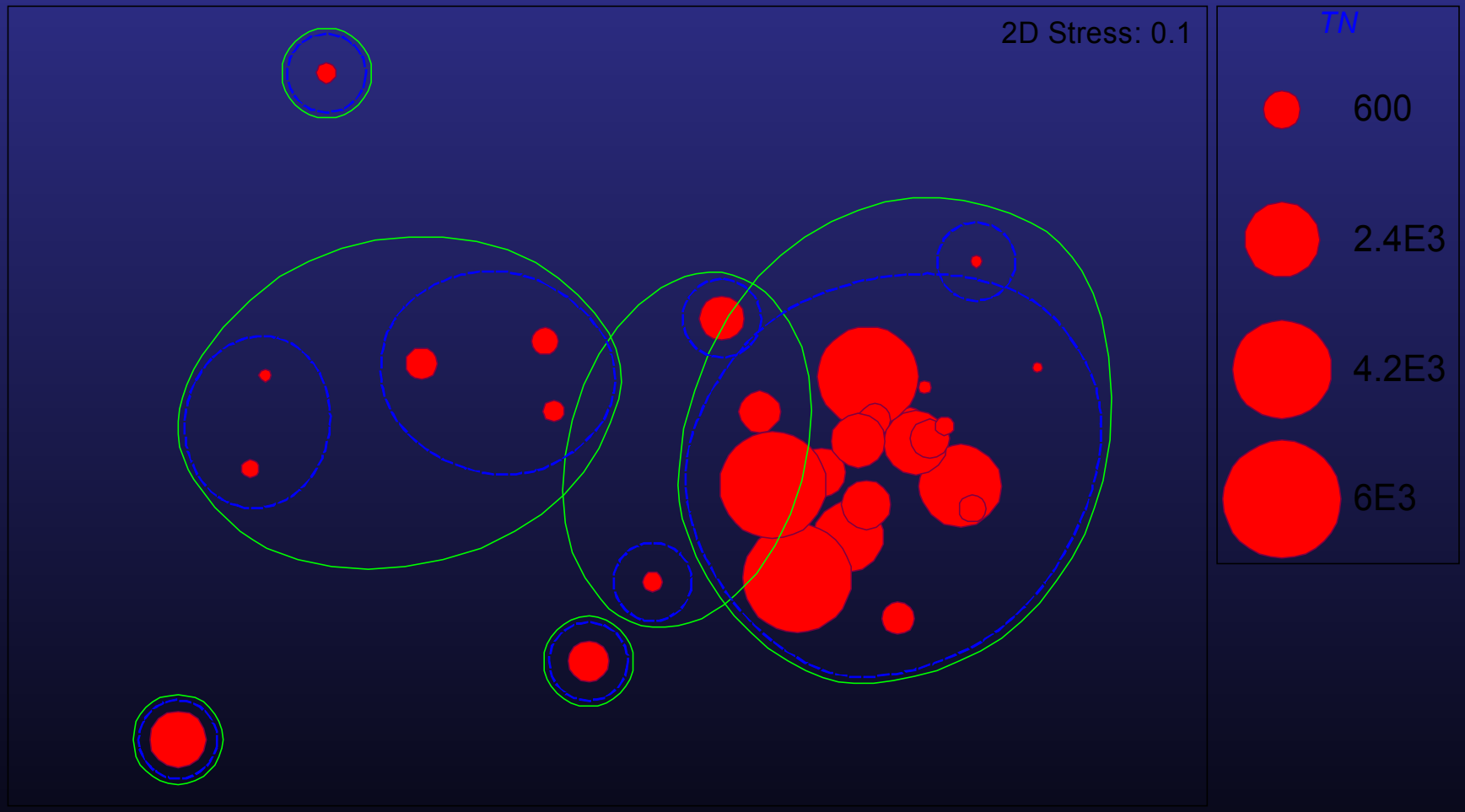
Cailtins


Nutrient fluxes for three fish groups
Nutrient Concentration (µmol/g fish/min.)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Total N
NO3 + NO2
NH4
Total P
mullet
Gambusia
Poecilia
Fish Species

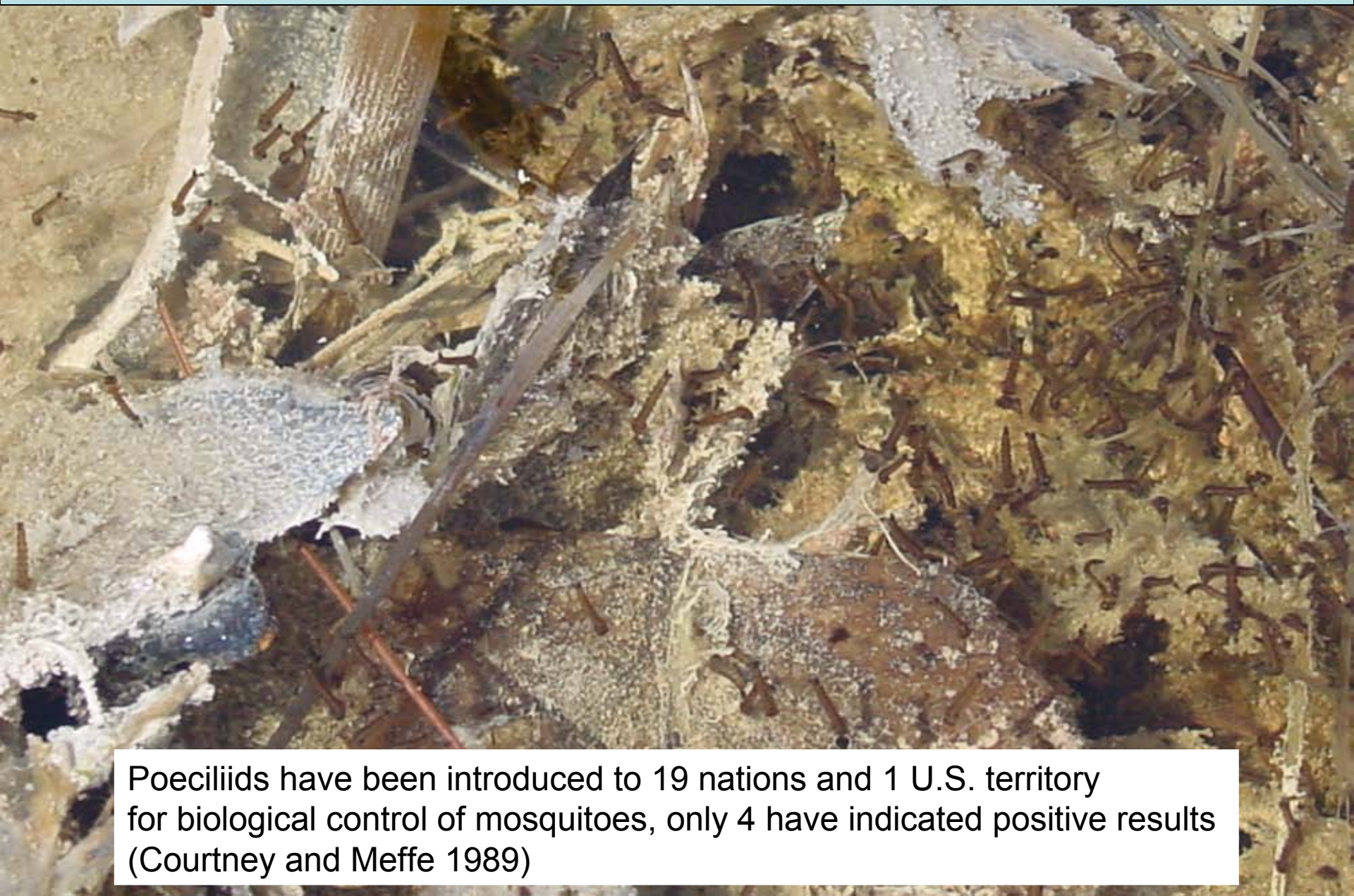

Total Poeciliid
Blackchin tilapia
Total Native Fish
Average Fish Density (No/m2)
30
20
10
0
Pristine
Intermediate
Degraded
Water Quality


25
20
15
10
5
0
Ruppia maritima ht (cm)
April (p < 0.001)
June (p < 0.05)
tilapia present
tilapia absent

Total Nitrogen



Poeciliids as biological control for mosquitoes



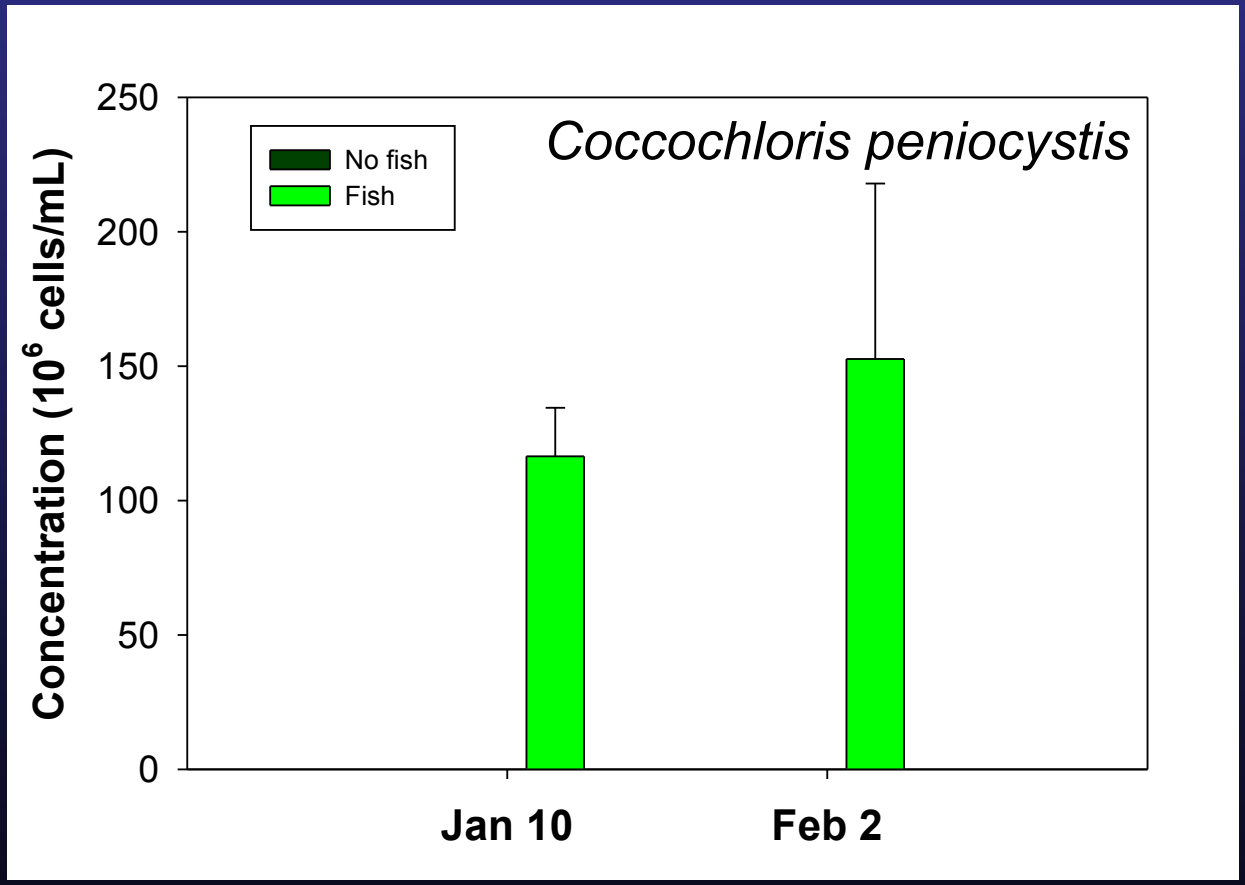
Poeciliids have been introduced to 19 nations and 1 U.S. territory for biological control of mosquitoes, only 4 have indicated positive results (Courtney and Meffe 1989)

“ There is no convincing evidence that mosquitofish have desired effects on mosquito populations and a great deal of information to the contrary….” (Courtney and Meffe 1989).

“…the introduction of *Gambusia* into Michigan waters would have negative impacts on existing aquatic communities and fisheries, with little or no mosquito control.” (Haas et al. 2003)

“Few *Gambusia* are ever likely to find their way to tree holes, old tires, tin cans, and undrained swimming pools where many mosquitoes are.” (Rowes 1987)

Reductions in invertebrates from poeciliids also resulted in a significant increase in algal growth



Hurlbert et al. 1972

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1. Short generation time