Rusty crayfish control on spawning reefs in northern Lake Michigan

Lindsay Chadderton, Matt Herbert, Andrew Tucker, The Nature Conservancy

Jake Kvistad and Tracy Galarowicz, Central Michigan University

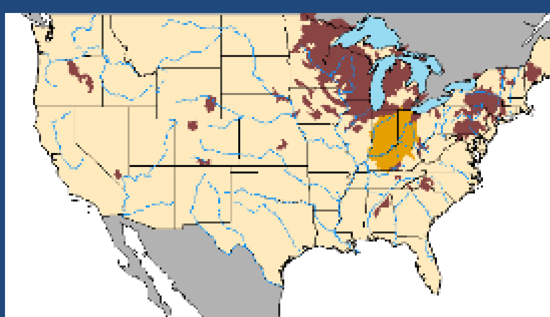
David Clapp, Kris Snyder, Pat O'Neill, John Milan, Dana Castle Jory Jonas, Michigan Department of Natural Resources

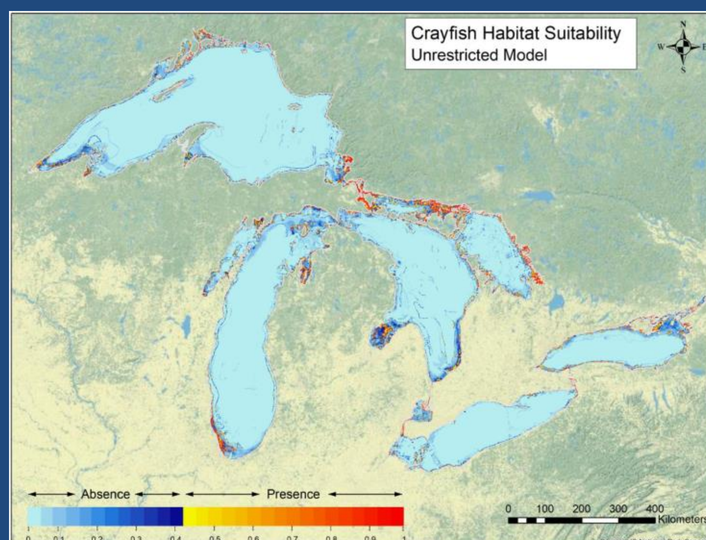
Acknowledgements

- Majority of work will form part of Jake's (Kvistad) PHD Thesis
- Funding from EPA GLRI Project #GL-00E00811-0
- Field support: Ben Turschak, Eric Crissman, Trevor Gronda, Kyle Urban, Erin Prior, Helen Watrous, and Kaitlyn McKnight (MDNR)
- Jason Whalen Photography

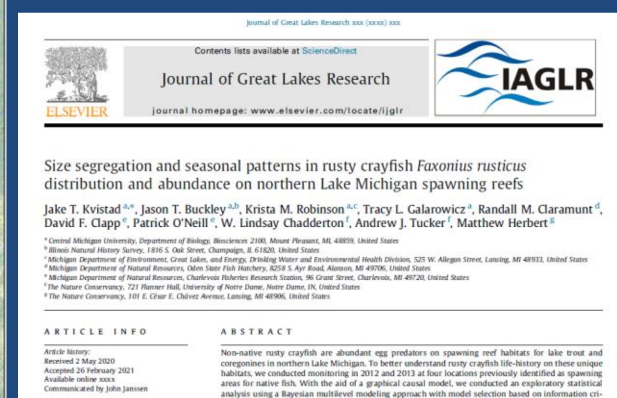
Rusty Crayfish impacts

- replace native congeners,
- destroy aquatic macrophytes,
- prey on or compete with other native fish and invertebrates
- may facilitate regime shifts, alternative stable ecosystem states and diminished ecosystem services
- But majority of studies in inland waters of Great Lakes
- Impacts (and biology) in Great Lakes poorly understood





Egly et al 2018, JGLR



Journal of Great Lakes Research xxx (xxxx) xxx

Contents lists available at ScienceDirect

Journal of Great Lakes Research

journal homepage: www.elsevier.com/locate/ijglr

Size segregation and seasonal patterns in rusty crayfish *Faxonius rusticus* distribution and abundance on northern Lake Michigan spawning reefs

Jake T. Kvistad [a,*], Jason T. Buckley [a,b], Krista M. Robinson [a,c], Tracy L. Galarowicz [a], Randall M. Claramunt [d], David F. Clapp [e], Patrick O'Neill [e], W. Lindsay Chadderton [f], Andrew J. Tucker [f], Matthew Herbert [g]

[a] Central Michigan University, Department of Biology, Biosciences 2100, Mount Pleasant, MI, 48859, United States
[b] Illinois Natural History Survey, 1816 S. Oak Street, Champaign, IL 61820, United States
[c] Michigan Department of Environment, Great Lakes, and Energy, Drinking Water and Environmental Health Division, 525 W. Allegan Street, Lansing, MI 48933, United States
[d] Michigan Department of Natural Resources, Oden State Fish Hatchery, 8258 S. Ayr Road, Alanson, MI 49706, United States
[e] Michigan Department of Natural Resources, Charlevoix Fisheries Research Station, 96 Grant Street, Charlevoix, MI 49720, United States
[f] The Nature Conservancy, 721 Flanner Hall, University of Notre Dame, Notre Dame, IN, United States
[g] The Nature Conservancy, 101 E. César E. Chávez Avenue, Lansing, MI 48906, United States

ARTICLE INFO

Article history:
Received 2 May 2020
Accepted 26 February 2021
Available online xxxx
Communicated by John Janssen

ABSTRACT

Non-native rusty crayfish are abundant egg predators on spawning reef habitats for lake trout and coregonines in northern Lake Michigan. To better understand rusty crayfish life-history on these unique habitats, we conducted monitoring in 2012 and 2013 at four locations previously identified as spawning areas for native fish. With the aid of a graphical causal model, we conducted an exploratory statistical analysis using a Bayesian multilevel modeling approach with model selection based on information cri-

(but see Kvistad et al 2021) JGLR

Non-native egg predators (dominate egg bag samples)

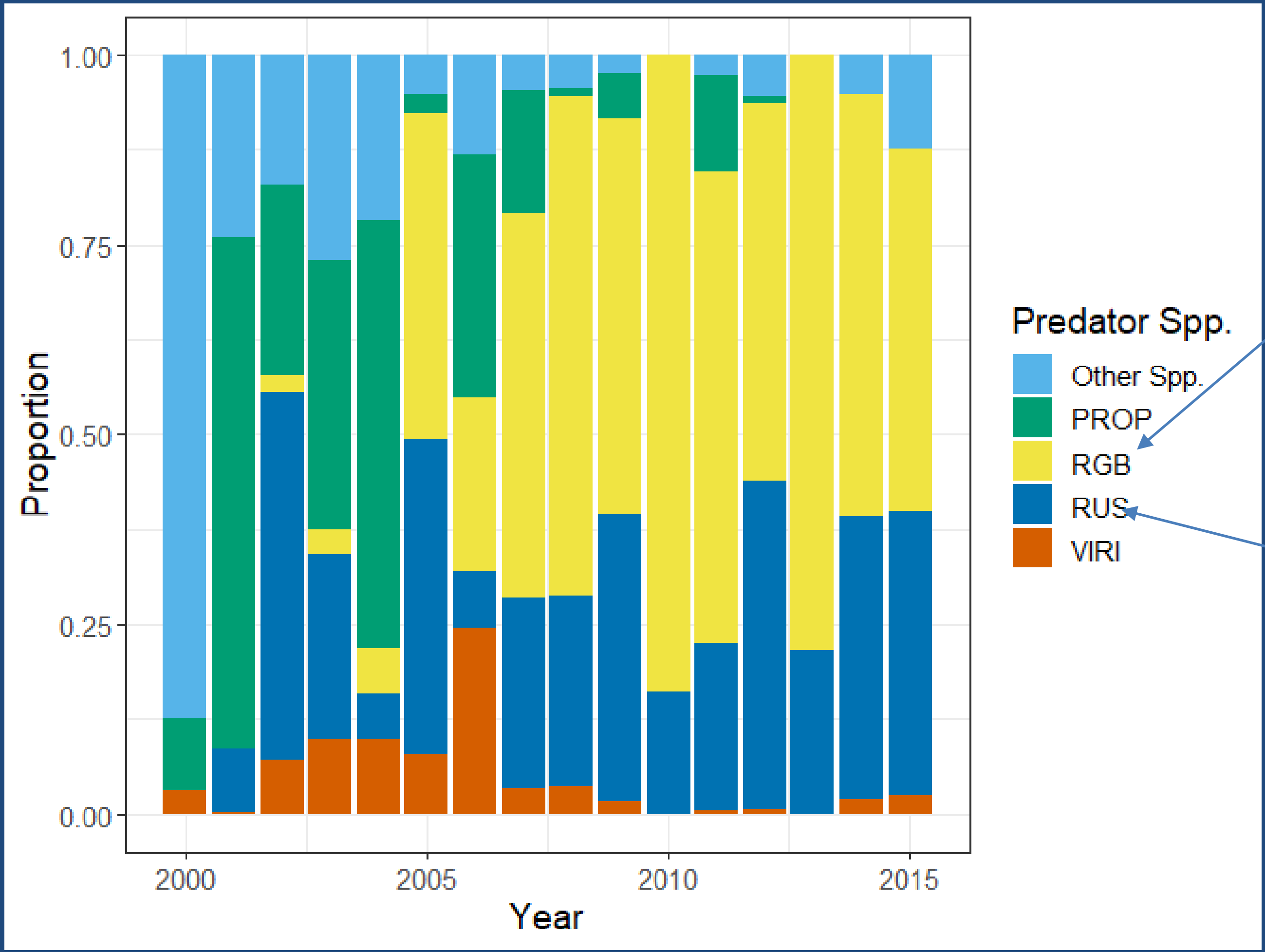


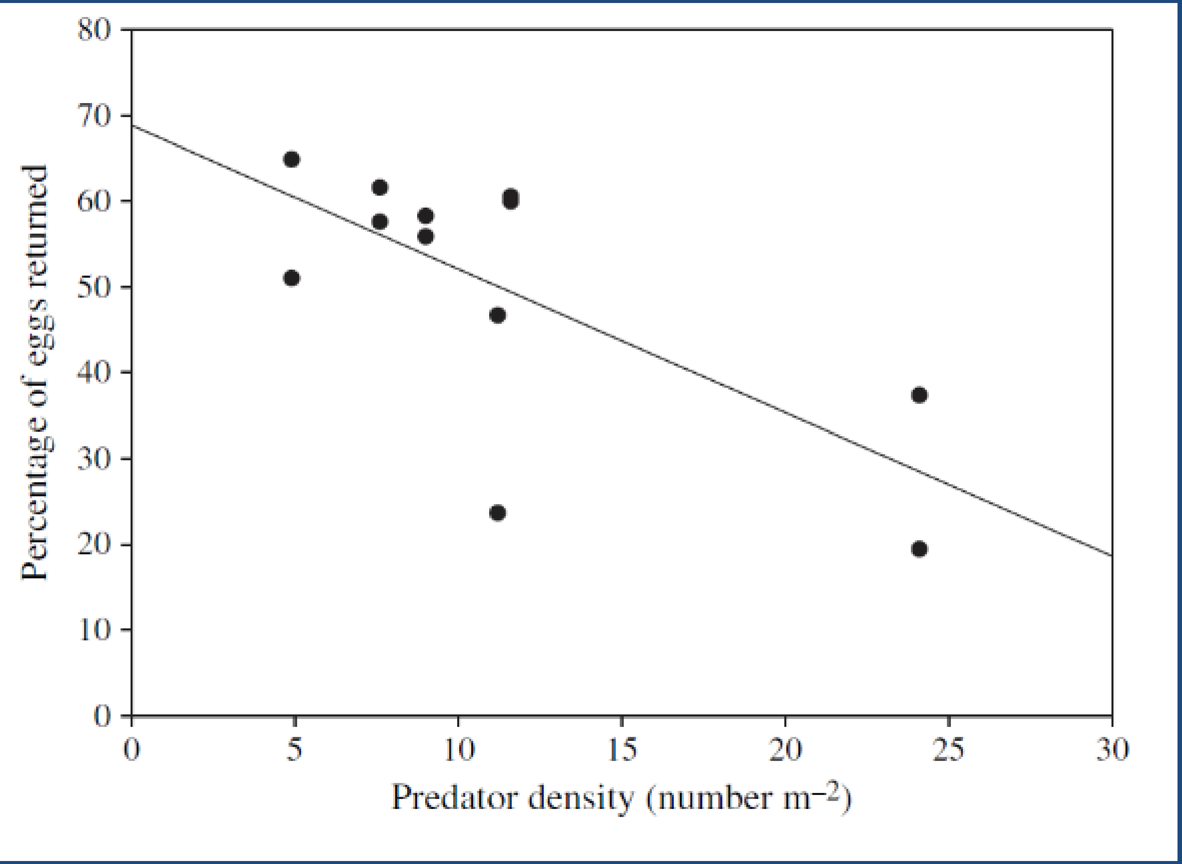
Photo: J. Whalen

Photo: J. Whalen

Northern Lake Michigan
Unpublished MDNR data, courtesy of J. Jonas

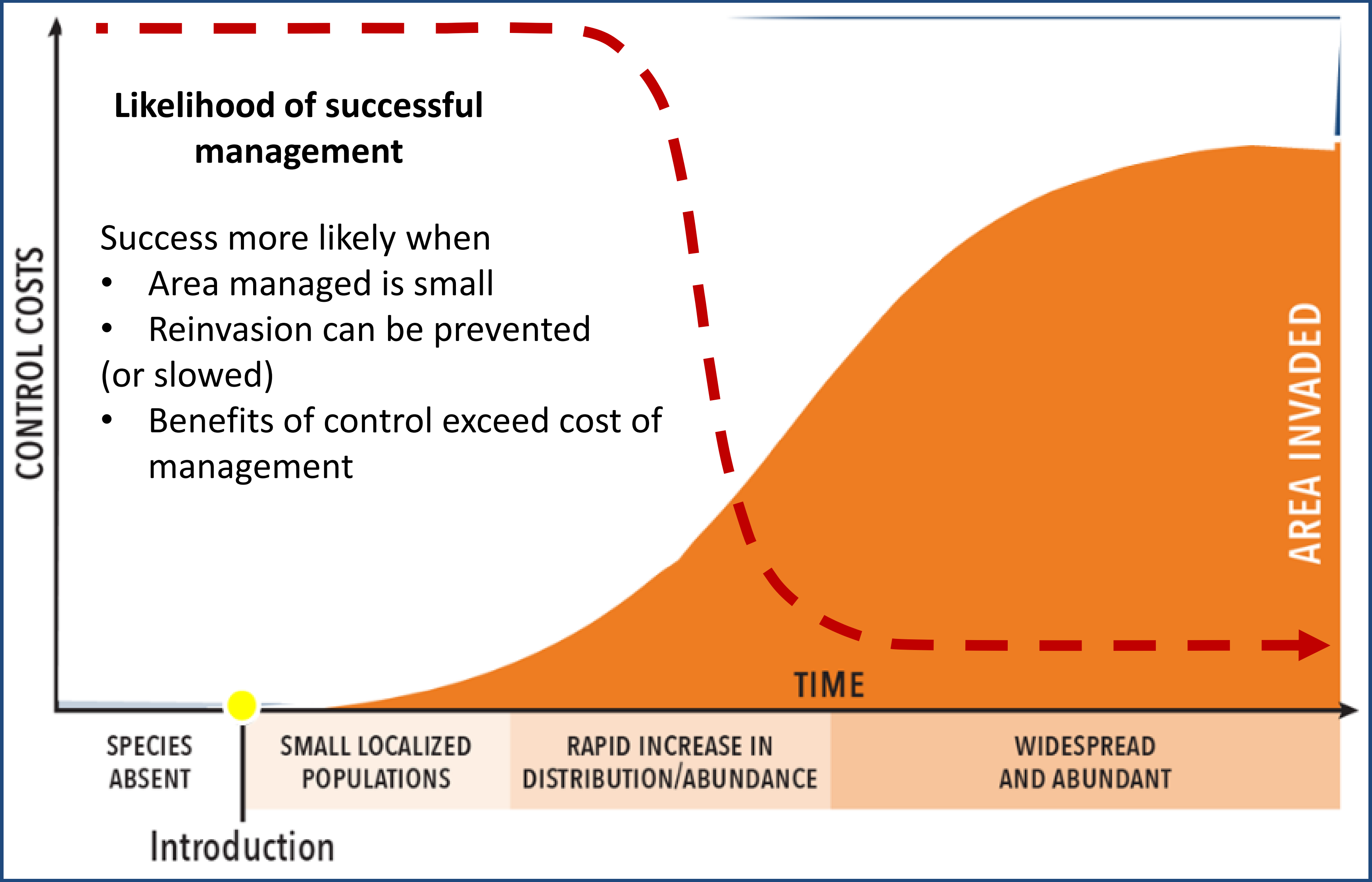
Egg predation by invasive species

(Potential impediment to native fish recruitment on spawning reefs)



Fitzsimons, J. D., et al.." *Journal of Fish Biology* 71.1 (2007): 1-16.

Suppression of established species is difficult



Great Lakes spawning reefs

Engines of fish production in the Great Lakes

- Localized critical habitat
- Scale of benefits to Great Lakes Fisheries likely to be disproportionally greater than area under management
- For fall spawners – fall suppression may protect eggs over winter
- Cooling temperatures may slow recolonization
- Possible shorter suppression window



Challenges

When November gales (*and sailing boats*) come early

These are open coastal sites. Limited days on water in fall due to regular storm events

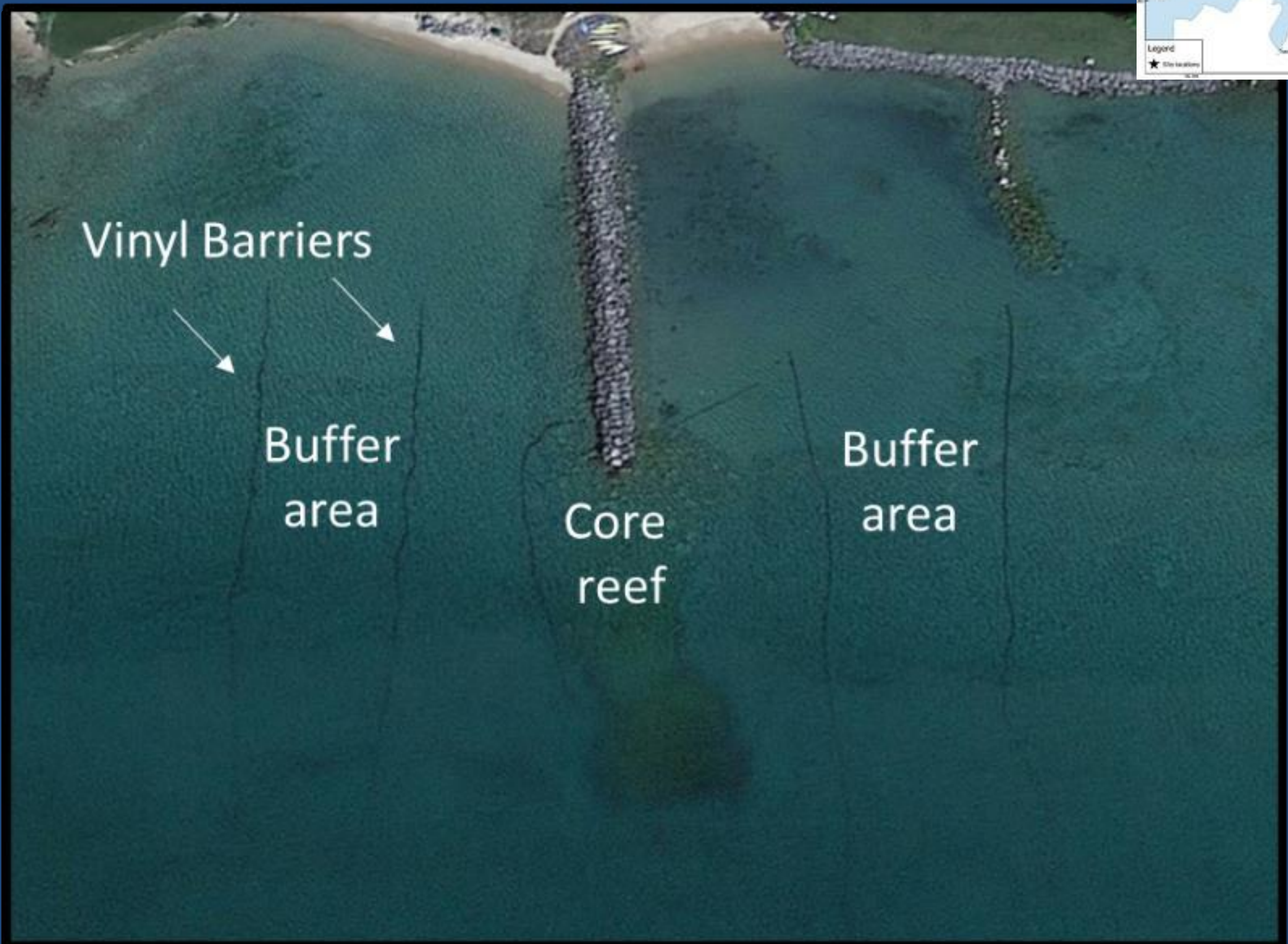
Project goals

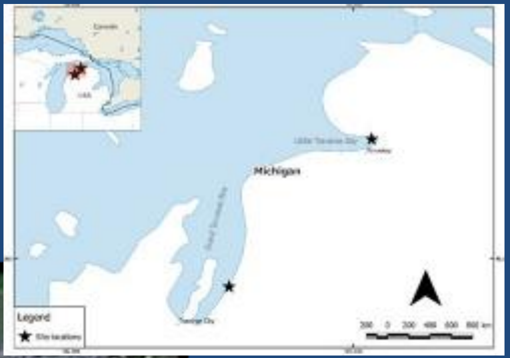
- Cost effectively suppress populations of rusty crayfish on shallow spawning reefs in fall immediately prior to Lake Trout and coregonine spawning
- In order to enhance egg survivorship and hence larval fish production.

By:

- Testing a novel trap designed to reduce escapement and allow longer soak times (fewer fishing days)
- Trap over a large buffer area to slow recolonization of core reef habitats
- Test temporary barriers to further slow recolonization of core spawning reef habitat

Study Area


Vinyl Barriers
Buffer area
Core reef
Buffer area


Michigan
Legend

Crayfish suppression on reefs

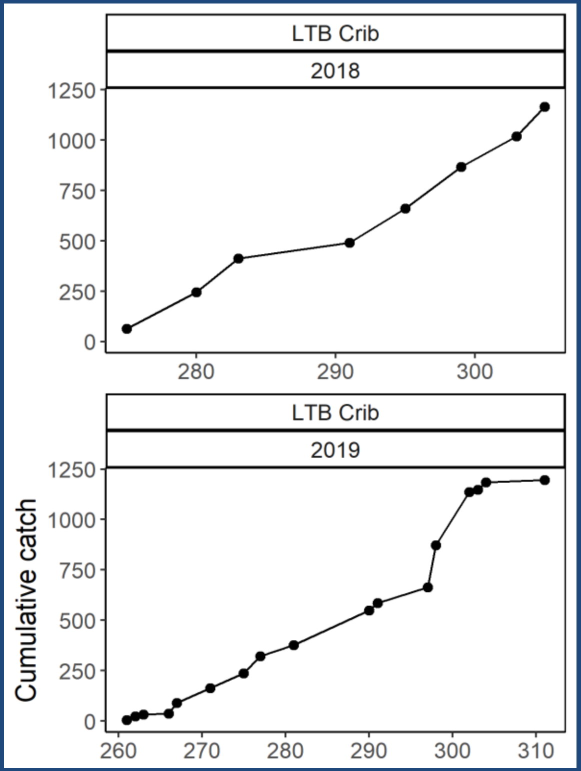
- Intensive trapping (Sept – Nov) - during period of declining water temperatures (Fall 2018 and 2019)

  - 10 – 12 trap main trap lines (buffer area)
  - 11-17 traps per line (5m apart)
  - 3 lines on core reef (3m apart)
  - 165 - 200 traps fished Immediately prior to fall spawning
  - Total trap days (range 4721-8788)

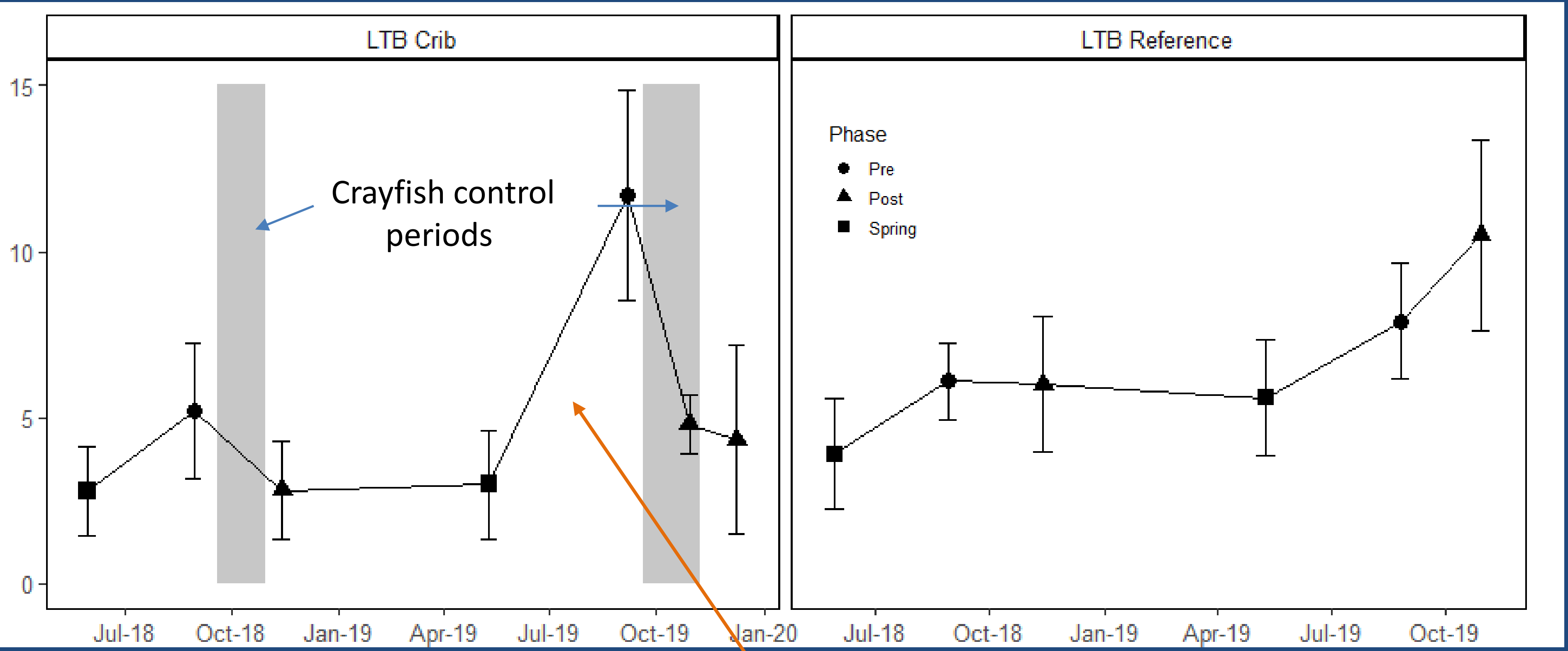



Results

Site	Trapping start date	Trapping end date	Total trap days	Mean soak time (SD)	Mean CPUE (SD)	Total
LTB Crib	09/18/18	11/01/18	4721	4.28 (1.62)	0.29 (0.48)	1165
LTB Crib	09/20/19	11/7/19	8788	4.43 (2.56)	0.17 (0.35)	1197



Rusty Crayfish density
Little Traverse Bay (2018-2019)



Levels of suppression appear to be sustained over winter

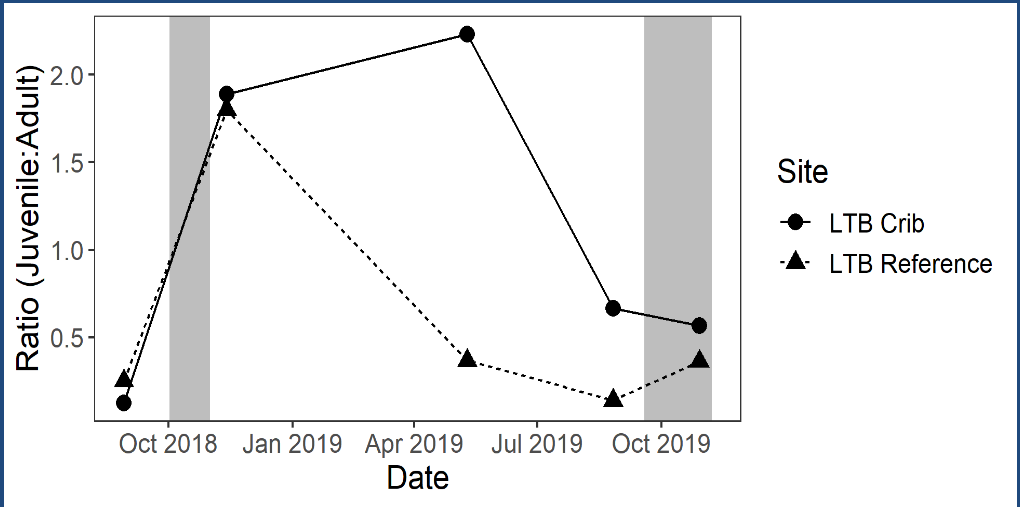
Possible density dependence effects

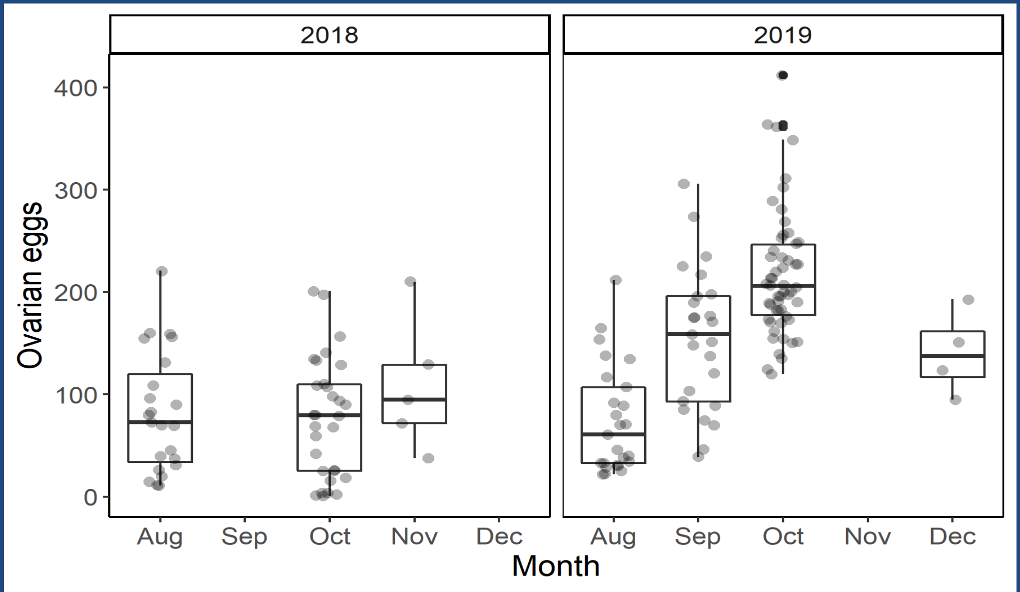
Quadrat densities (n=10)

Potential evidence of density dependence effect

- A cautionary tale
- Threefold increase in density between harvest events
- Driven by increase in abundance of juvenile size classes (spring and summer)
- Coincident increase in ovarian egg counts
- Stock recruitment curve consistent with compensatory response

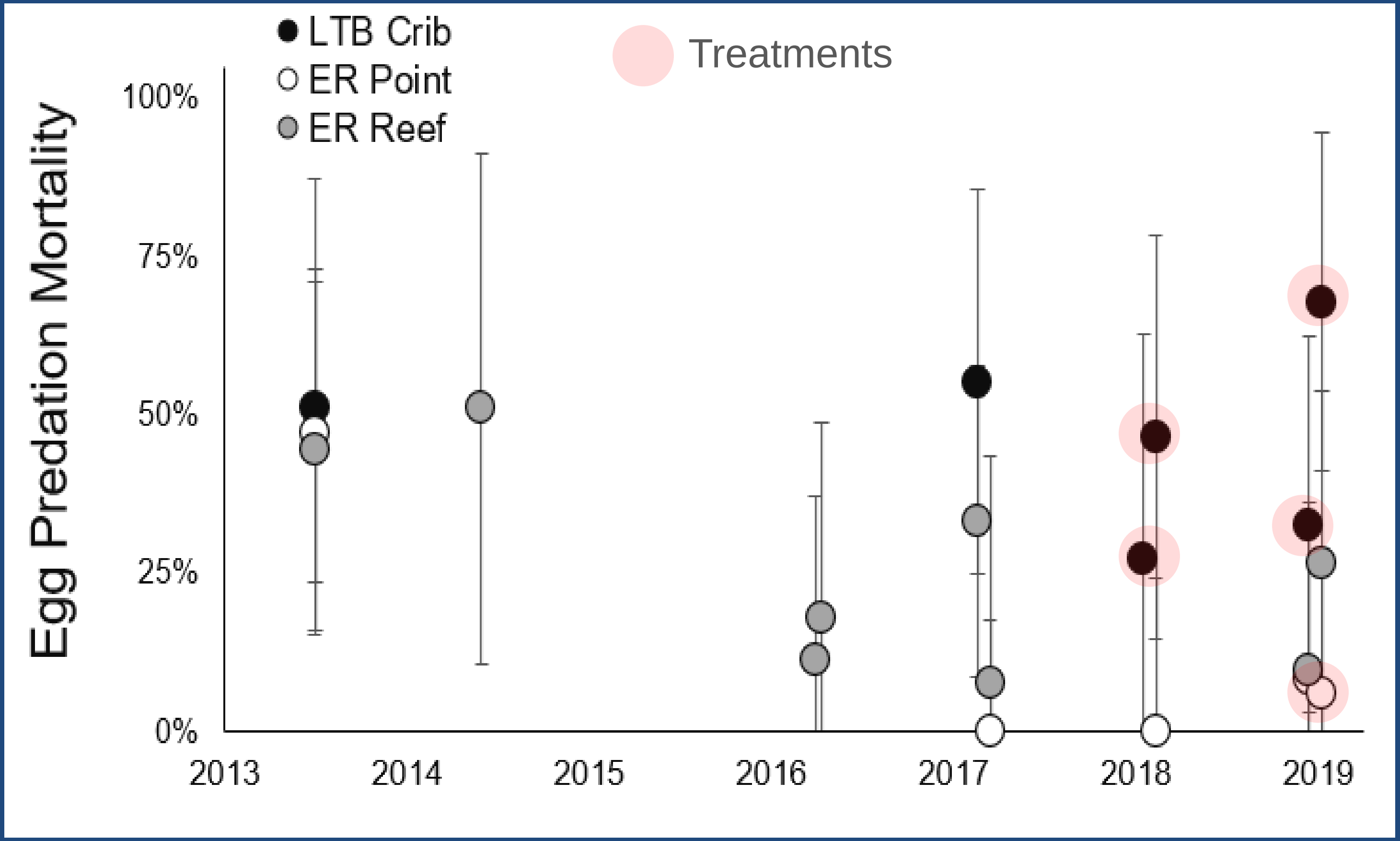
Kvisted et al in prep





Egg retention

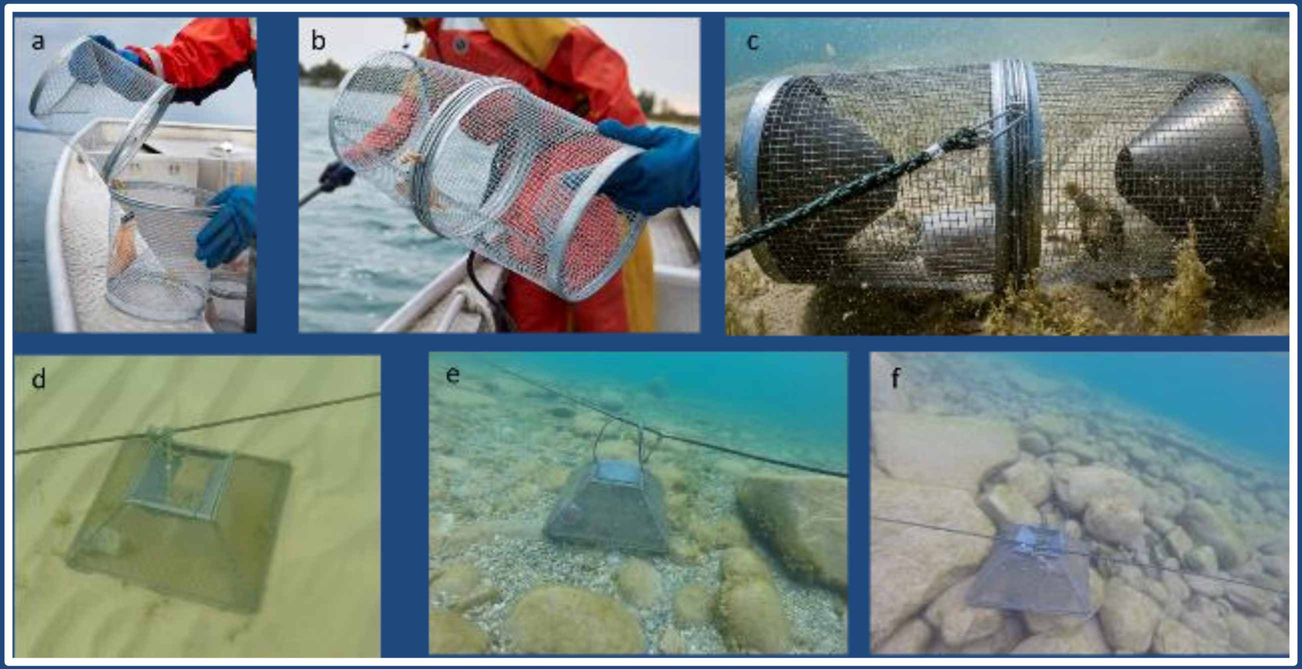
- Egg bags seeded with brown trout eggs and beads (artificial eggs)
- No evidence for decrease in egg predation on treatment reefs



Trap comparison

- CPUE rough equal between Gee minnow and Pyramid trap (Gee minnow cumulative catch slightly higher)
- Gee minnow performed well across all substrates
- Easier to deploy and clear (preferred by trapping team)
- Pyramid best trap on sand
- Escapement slightly higher for Pyramid vs Gee minnow
- Catch peaked around 5- 6 days

(see Kvistad et al 2021: Management of Biological Invasions (2021) Volume 12, Issue 4: 975–996)



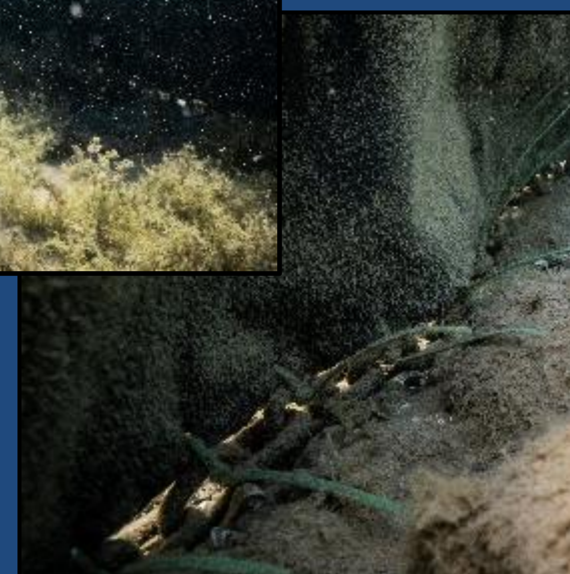
Barriers

- Tested two barrier designs
- Fixed metal mesh with 2 inch flashing lip
- Modified fyke wing (black PVC with heavy bottom chain and large floats)

Performance assessed against,

1. Ease of deployment
2. Bottom seal
3. Storm stability
4. Crayfish escapement behavior
5. Fouling

- Performance varied across depth and substrate.



Barriers

- Modified fyke preferred barrier
- Easy to deploy
- Appears to created an effective barrier in sand and mud
- Durable (sustained on site for 18 months with minimum maintenance)
- Limited efficacy over cobble
- Shallow water remains challenging
- Uncertainty around crayfish Movements (seasonal, storms)

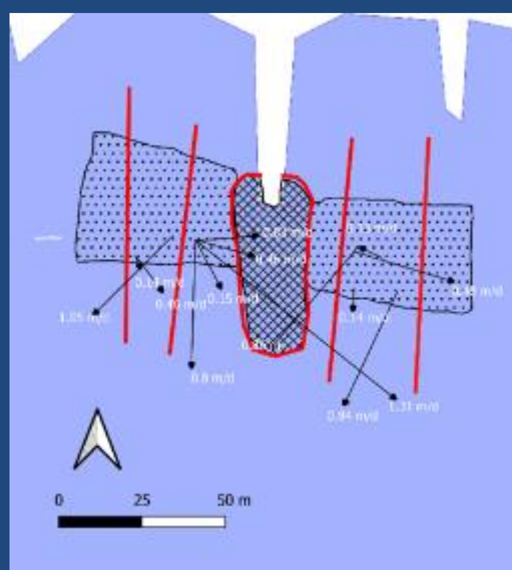


Photo: J. Whalen

Conclusions and next steps

"A work in progress"

- Large effort required to produce moderate reduction in density of larger crayfish
- Effort and barriers difficult to sustain - especially when November gales come early
- Did not observe decrease in egg predation
- Technology transfer to large-scale management operation will be difficult
- DASH – (still need to develop a more efficient harvest method)
- Knowledge gaps: Crayfish movement, density dependent effects
- Need to understand relative importance of Round Goby

Engaging with others

- MSU/MDNR red swamp crayfish group
  (e.g. provide pyramid traps to tests)

- Spawning reef habitat mapping collaboration

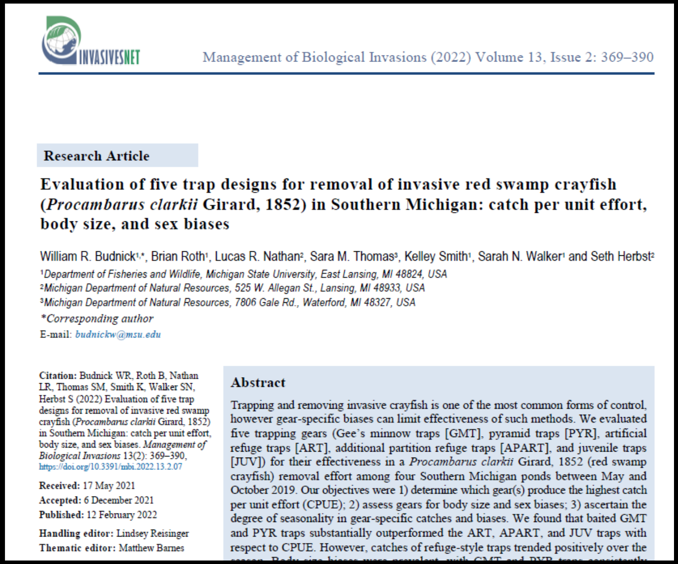
(sharing monitoring methods: Collect consistent density data across GL reefs:

“key questions is whether rusty crayfish predation is a more widespread issue for Great Lakes Spawning reefs

- Absence of successful methods

<u>Potential panel role</u>:

- Information sharing
- Assess regional need for management
- (e.g. Control of established Species project)


INVASIVESNET Management of Biological Invasions (2022) Volume 13, Issue 2: 369–390

Research Article

Evaluation of five trap designs for removal of invasive red swamp crayfish (*Procambarus clarkii* Girard, 1852) in Southern Michigan: catch per unit effort, body size, and sex biases

William R. Budnick[1,*], Brian Roth[1], Lucas R. Nathan[2], Sara M. Thomas[3], Kelley Smith[1], Sarah N. Walker[1] and Seth Herbst[2]
[1]*Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI 48824, USA*
[2]*Michigan Department of Natural Resources, 525 W. Allegan St., Lansing, MI 48933, USA*
[3]*Michigan Department of Natural Resources, 7806 Gale Rd., Waterford, MI 48327, USA*
**Corresponding author*
E-mail: budnickw@msu.edu

Citation: Budnick WR, Roth B, Nathan LR, Thomas SM, Smith K, Walker SN, Herbst S (2022) Evaluation of five trap designs for removal of invasive red swamp crayfish (*Procambarus clarkii* Girard, 1852) in Southern Michigan: catch per unit effort, body size, and sex biases. *Management of Biological Invasions* 13(2): 369–390, https://doi.org/10.3391/mbi.2022.13.2.07

Received: 17 May 2021
Accepted: 6 December 2021
Published: 12 February 2022

Handling editor: Lindsey Reisinger
Thematic editor: Matthew Barnes

Abstract

Trapping and removing invasive crayfish is one of the most common forms of control, however gear-specific biases can limit effectiveness of such methods. We evaluated five trapping gears (Gee’s minnow traps [GMT], pyramid traps [PYR], artificial refuge traps [ART], additional partition refuge traps [APART], and juvenile traps [JUV]) for their effectiveness in a *Procambarus clarkii* Girard, 1852 (red swamp crayfish) removal effort among four Southern Michigan ponds between May and October 2019. Our objectives were 1) determine which gear(s) produce the highest catch per unit effort (CPUE); 2) assess gears for body size and sex biases; 3) ascertain the degree of seasonality in gear-specific catches and biases. We found that baited GMT and PYR traps substantially outperformed the ART, APART, and JUV traps with respect to CPUE. However, catches of refuge-style traps trended positively over the