The views expressed in this presentation are those of the author and do not necessarily reflect the views or policies of the US EPA

A mesocosm approach to test eDNA monitoring of ballast tanks

Courtney Larson, Donn Branstrator, Megan Corum, Meagan N Aliff, Abigail Latanich, Erik Pilgrim, Chelsea Hatzenbuhler, Matthew Julius, Matthew Etterson, and Euan Reavie

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JASM 2022

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A mesocosm approach to test traditional morphological and eDNA monitoring of Spiny Water Flea in ballast tanks

Courtney Larson, Donn Branstrator, Megan Corum, Meagan N Aliff, Abigail Latanich, Erik Pilgrim, Chelsea Hatzenbuhler, Matthew Julius, Matthew Etterson, and Euan Reavie

The State of Water

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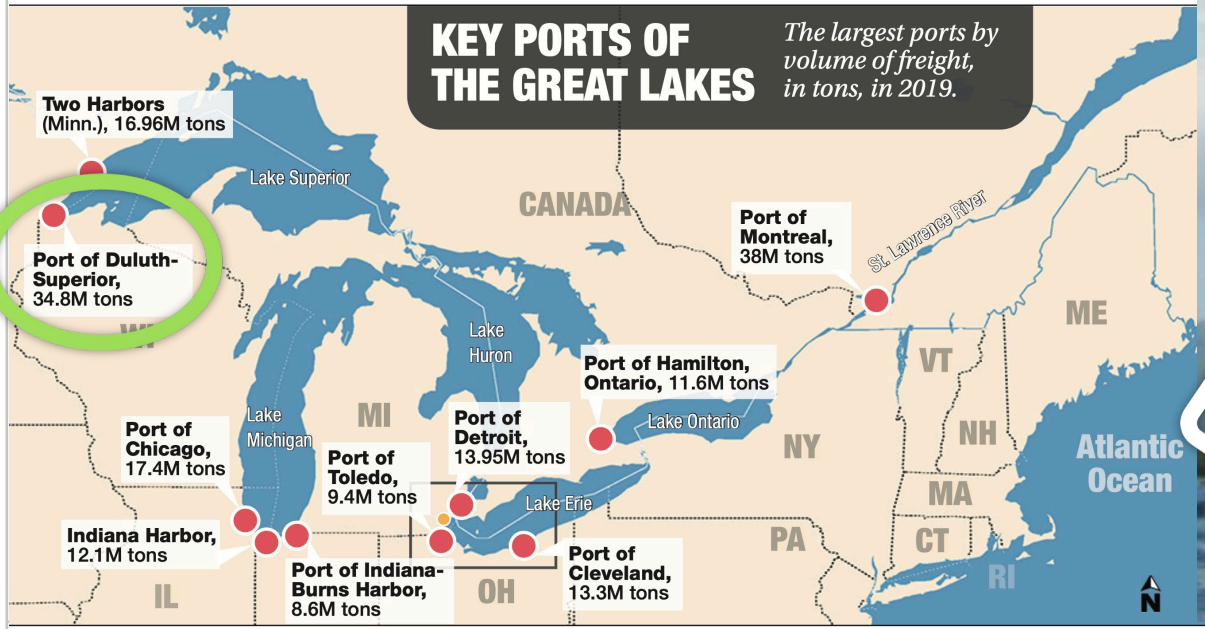
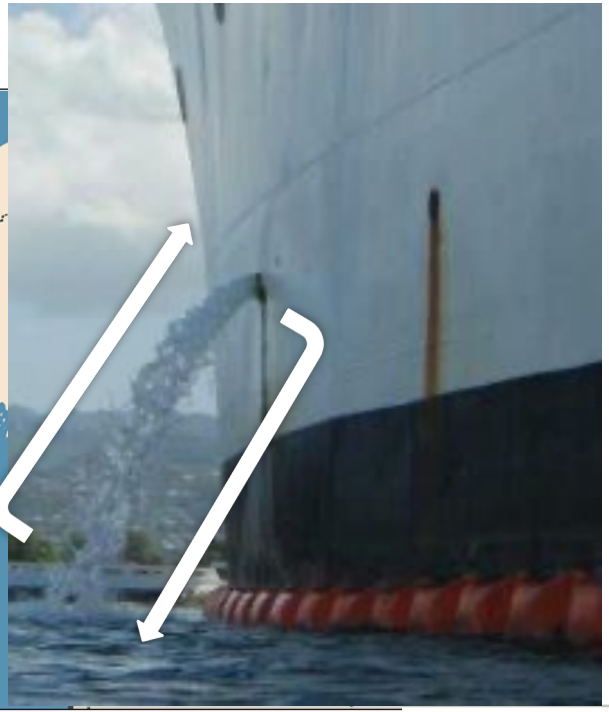
Ballast water

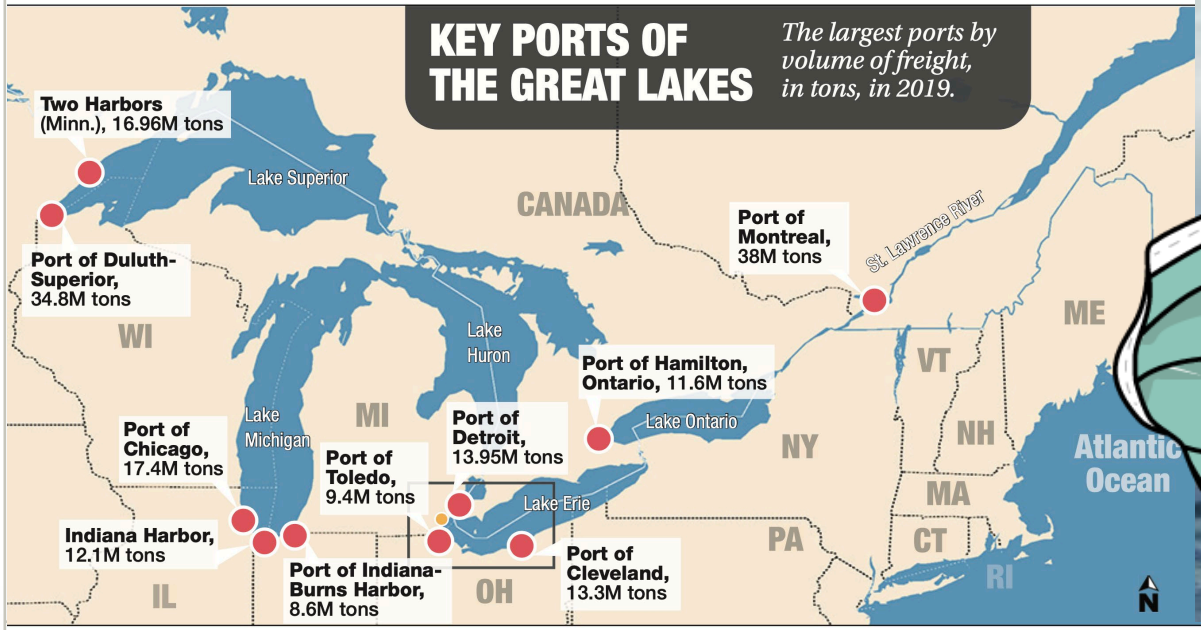




SOURCE: Google, SJ Consulting Group

THE BLADE

Ballast treatment and monitoring



SOURCE: Google, SJ Consulting Group

THE BLADE

Question: How clean is clean?

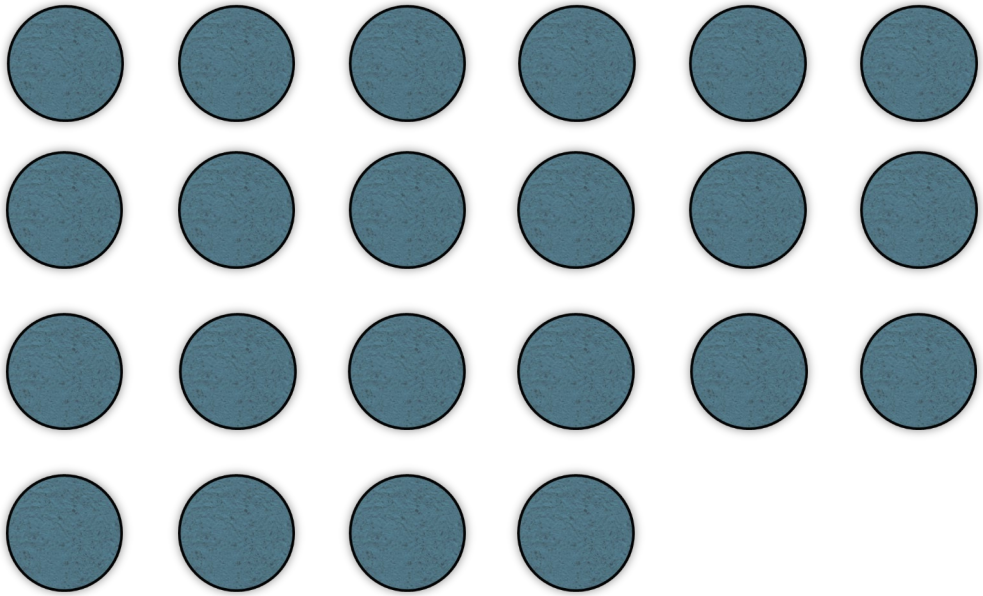
- What is the risk-release relationship for potential aquatic invaders?
- How can potential aquatic invaders be detected in ballast and ballast discharge?
  - Identify individuals morphologically
    - Adults
    - Larvae
    - Eggs
  - Identify populations genetically (eDNA)

Study organism: *Bythotrephes cederströmii / longimanus* Spiny Water Flea

Mesocosm methods

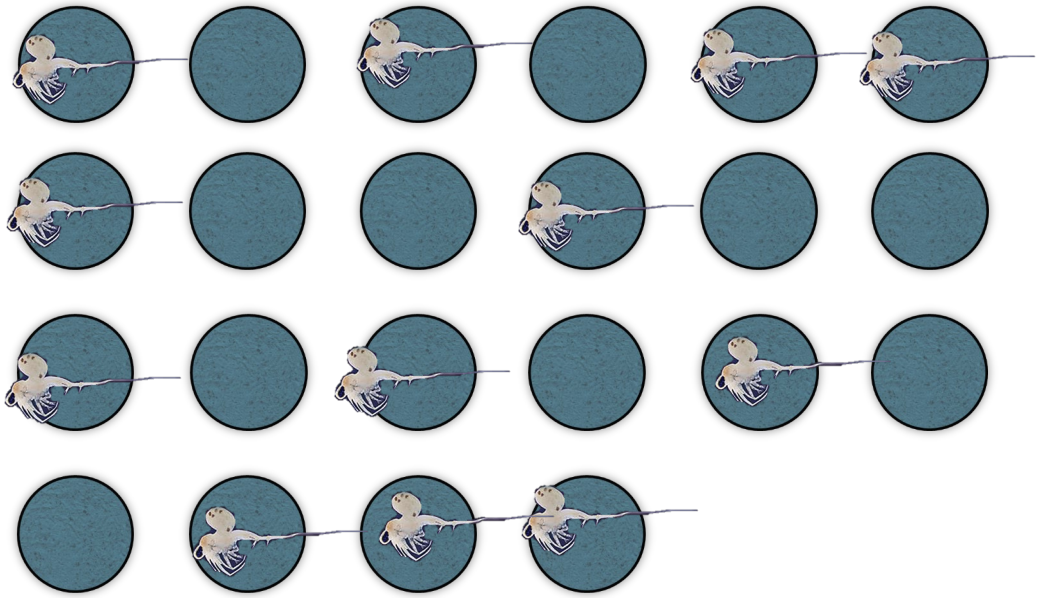
- 22, ~1 m^3 mesocosm filled with harbor water

Mesocosm methods



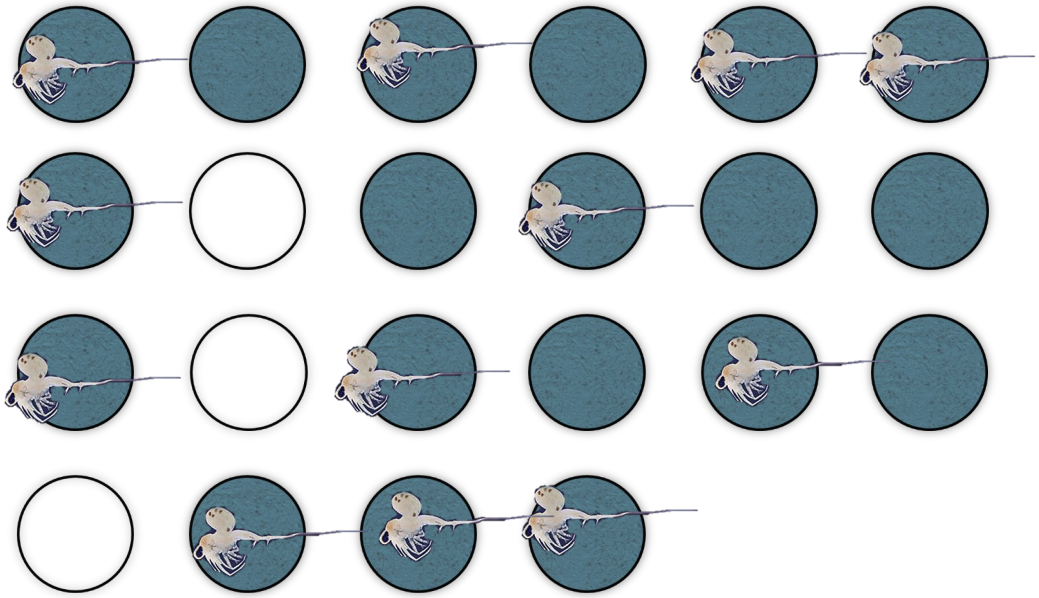
- 22, ~1 m^3 mesocosm filled with harbor water

Mesocosm methods



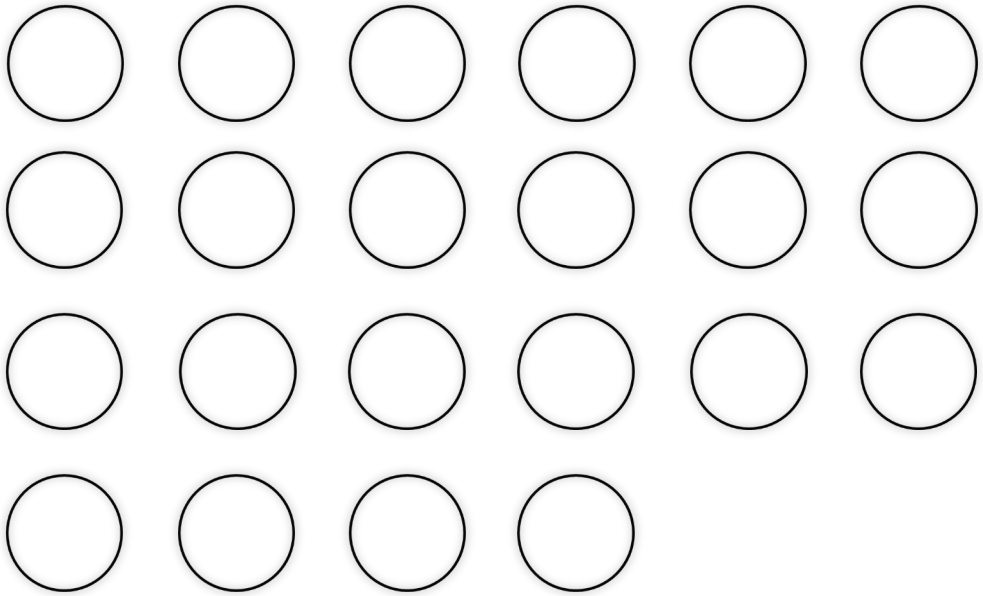
- 22, 1 m^3 mesocosm filled with harbor water
- Introduce spiny water flea (SWF)

Mesocosm methods



- 22, 1 m^3 mesocosm filled with harbor water
- Introduce spiny water flea (SWF)
- Drain subsets over time

Mesocosm methods



- 22, 1 m^3 mesocosm filled with harbor water
- Introduce spiny water flea (SWF)
- Drain subsets over time
- Examine population at draining

Phase 1

If we introduce spiny water flea around the International Maritime Organization standard of 10 organisms per m^3, what happens?

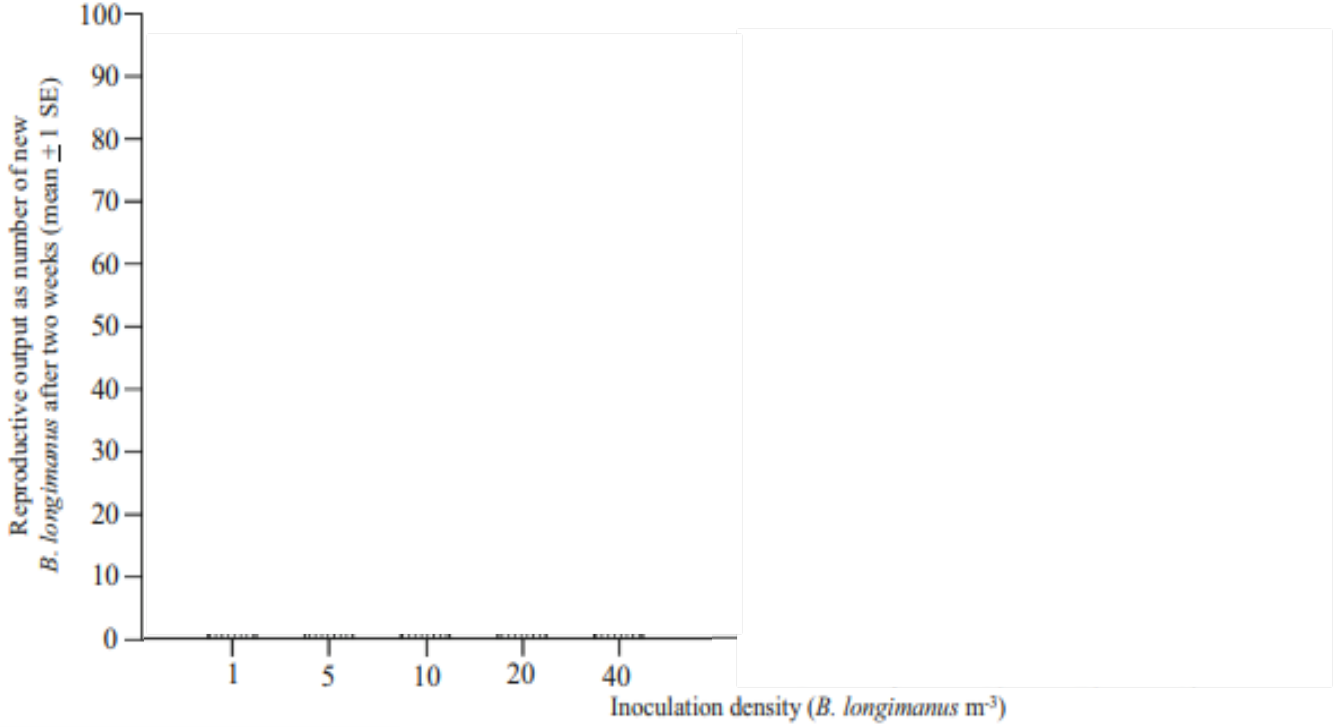
Biol Invasions (2019) 21:3655–3670
https://doi.org/10.1007/s10530-019-02077-8

ORIGINAL PAPER

Evaluation of a method that uses one cubic meter mesocosms to elucidate a relationship between inoculation density and establishment probability for the nonindigenous, invasive zooplankter, *Bythotrephes longimanus*

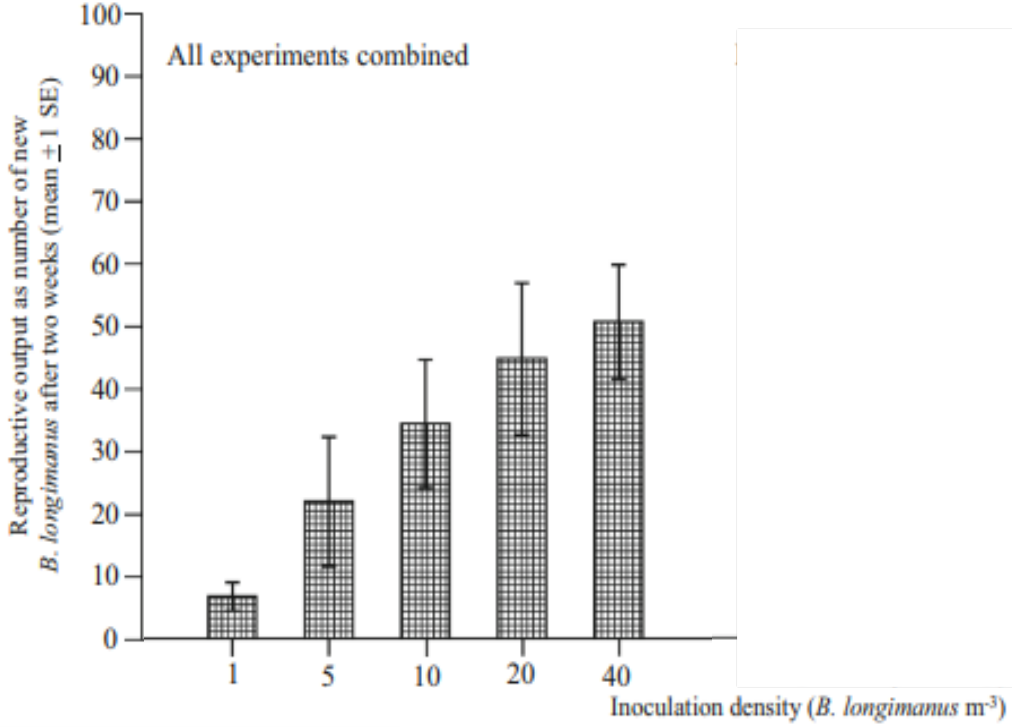
Donn K. Branstrator · Matthew C. TenEyck · Matthew A. Etterson · Euan D. Reavie · Allegra A. Cangelosi

How does inoculation density affect population growth?



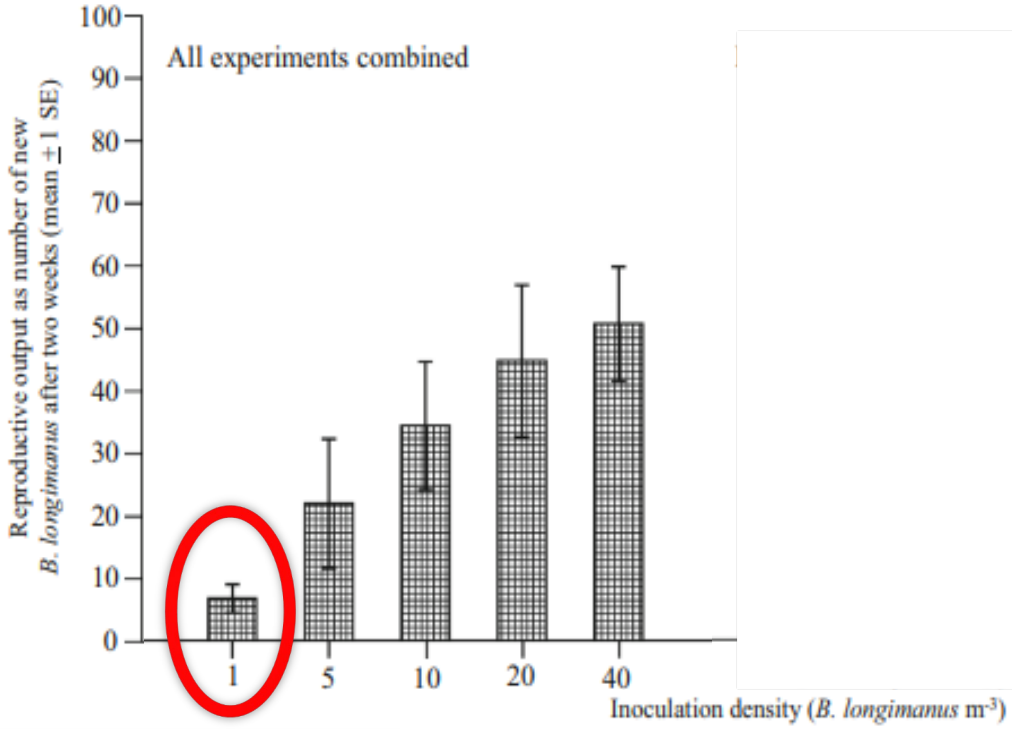
Branstrator et al. 2019

How does inoculation density affect population growth?



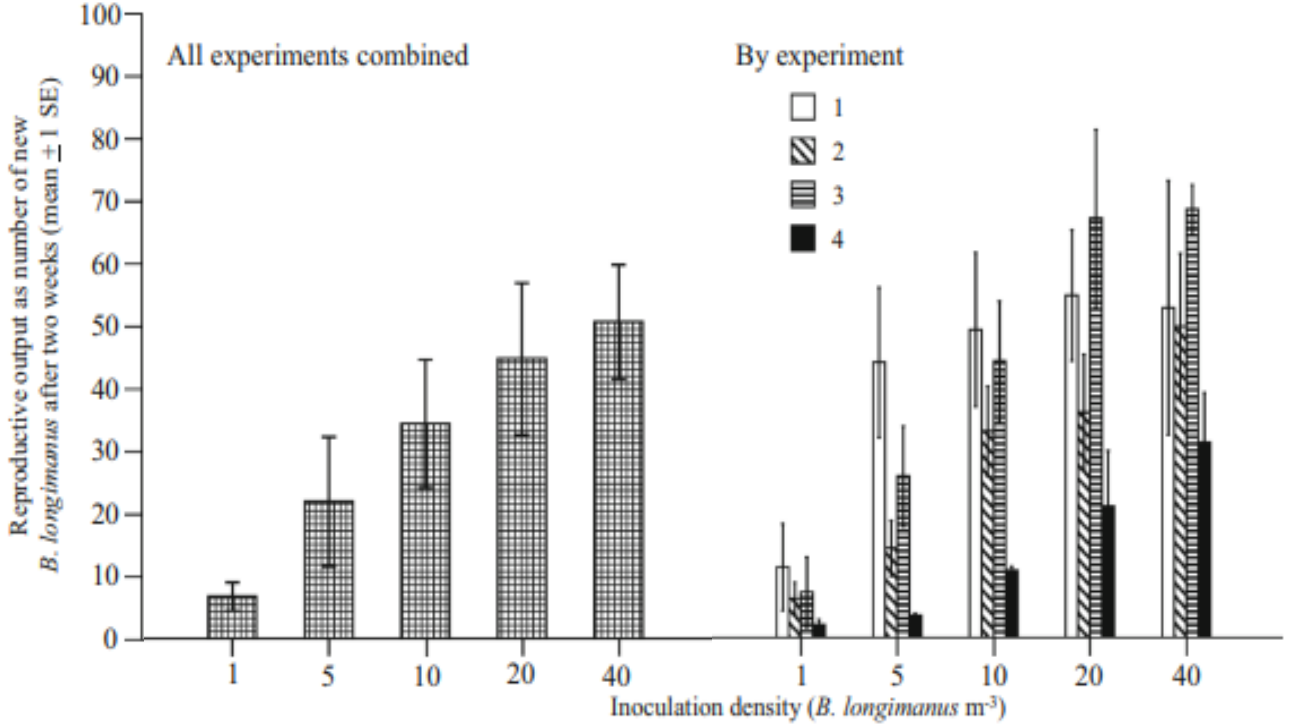
Branstrator et al. 2019

How does inoculation density affect population growth?



Branstrator et al. 2019

How does background conditions affect population growth?



Branstrator et al. 2019

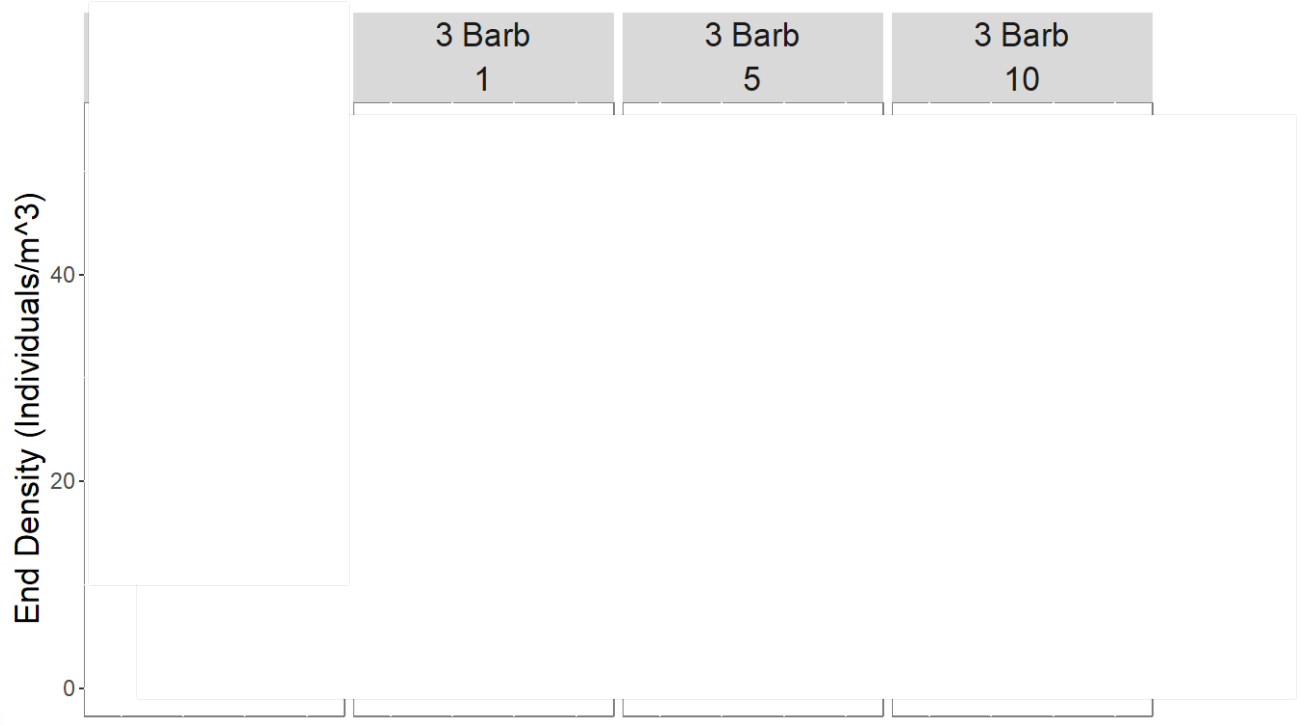
Phase 1 Conclusions

- Population growth occurs with even 1 inoculate SWF at 3-barb life stage
- Background conditions affect overall growth, but same trends for each experiment

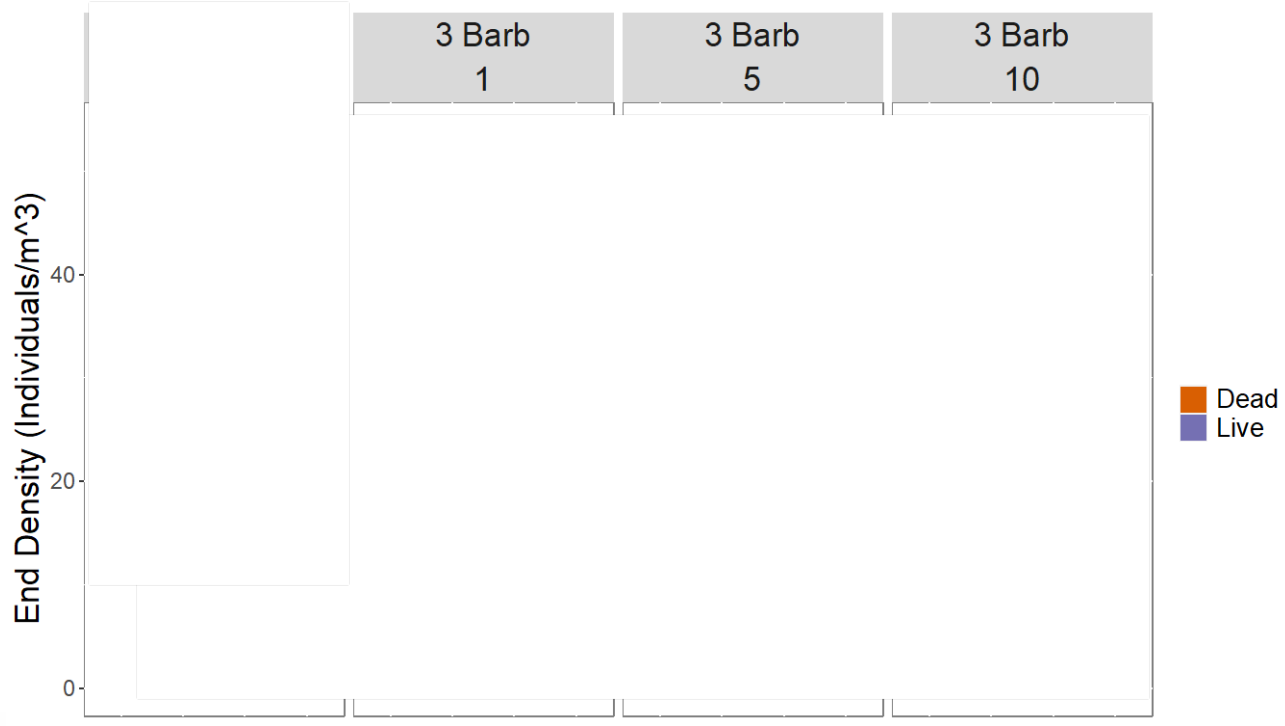
Next questions – Phase 2 Summer 2021

- What about different life stages?
  - Compare 2 and 3 barb
  - Examine live vs. dead

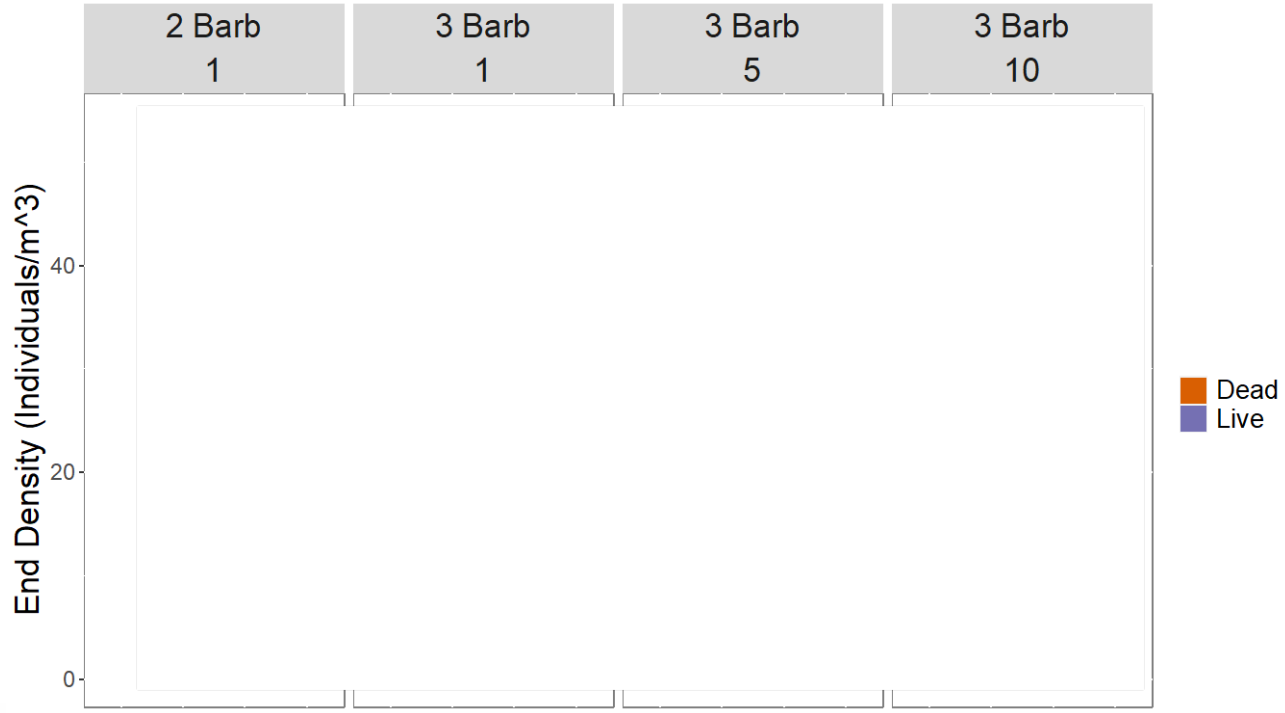
Same treatments as Phase 1



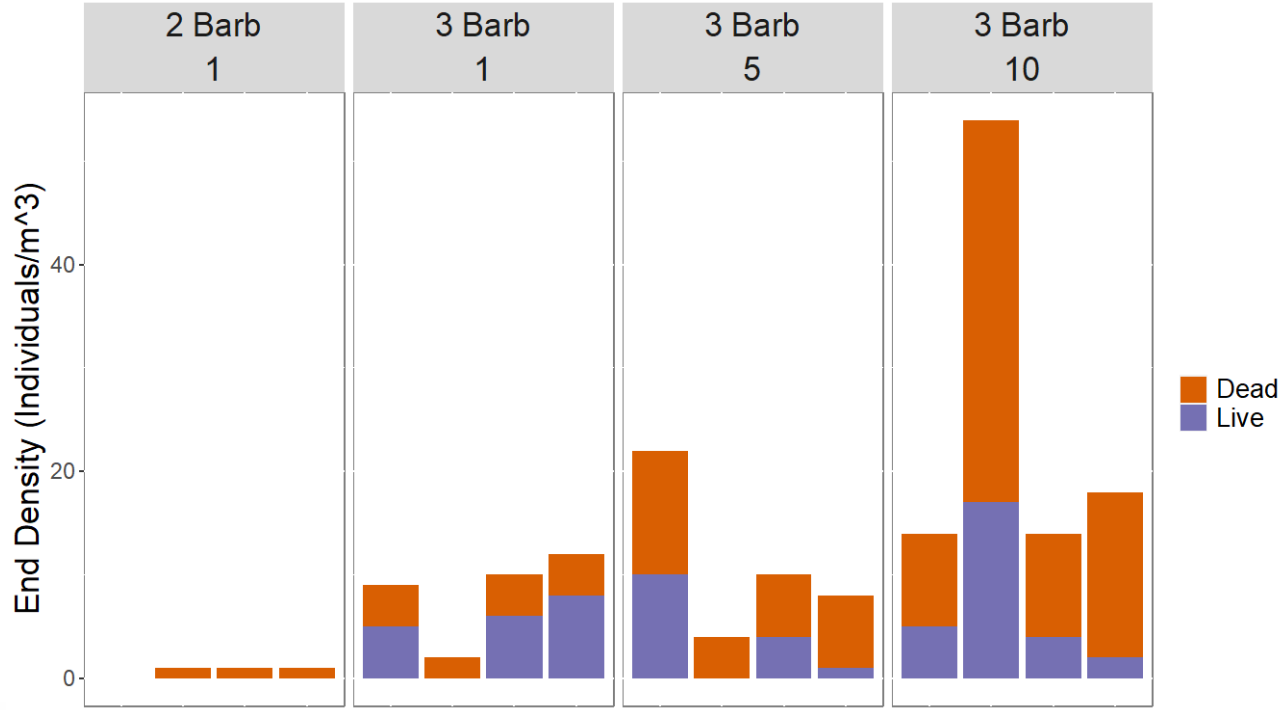
Distinguish live and dead



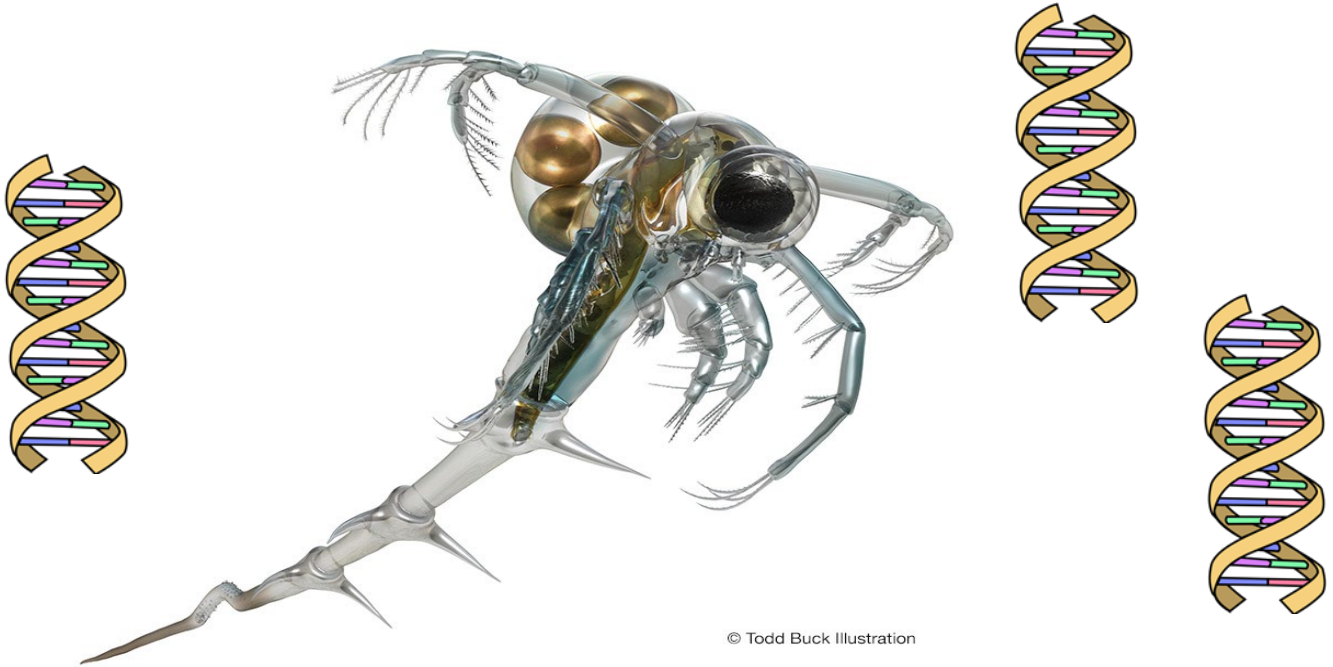
Add 2 barb life stage



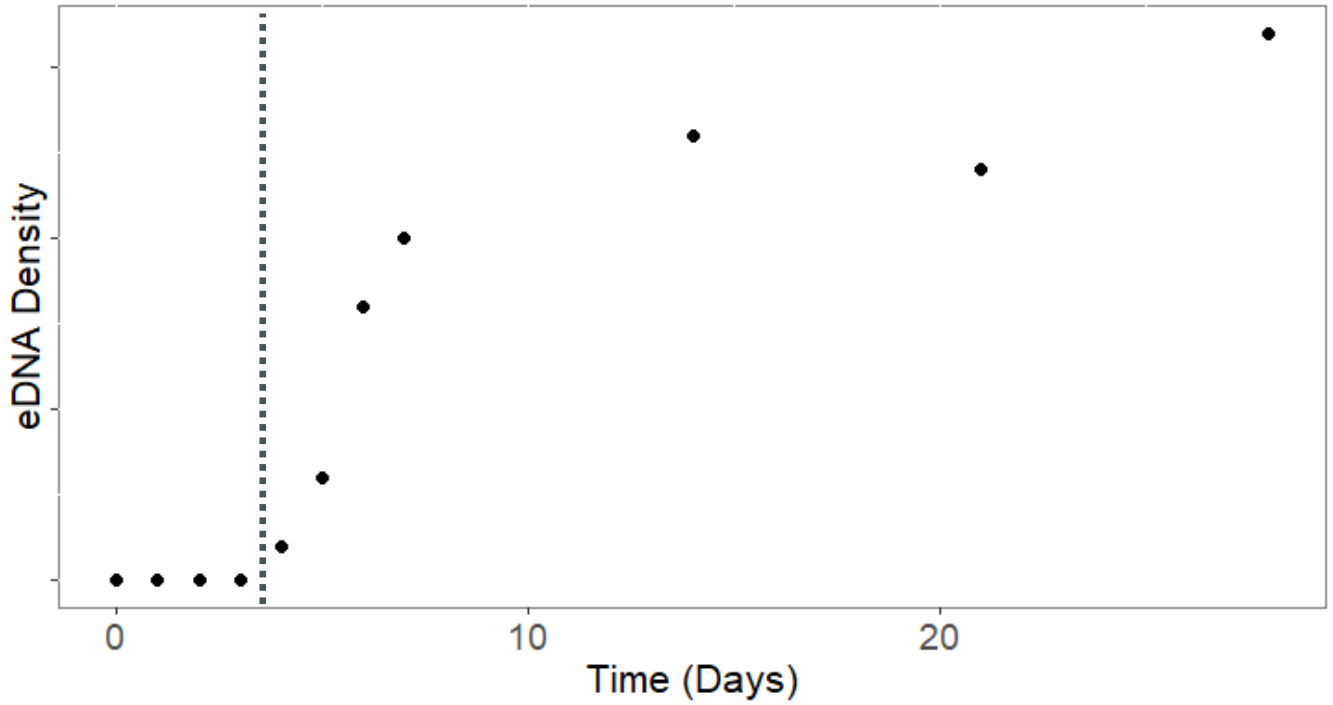
Life stage affects population growth



Future questions: eDNA

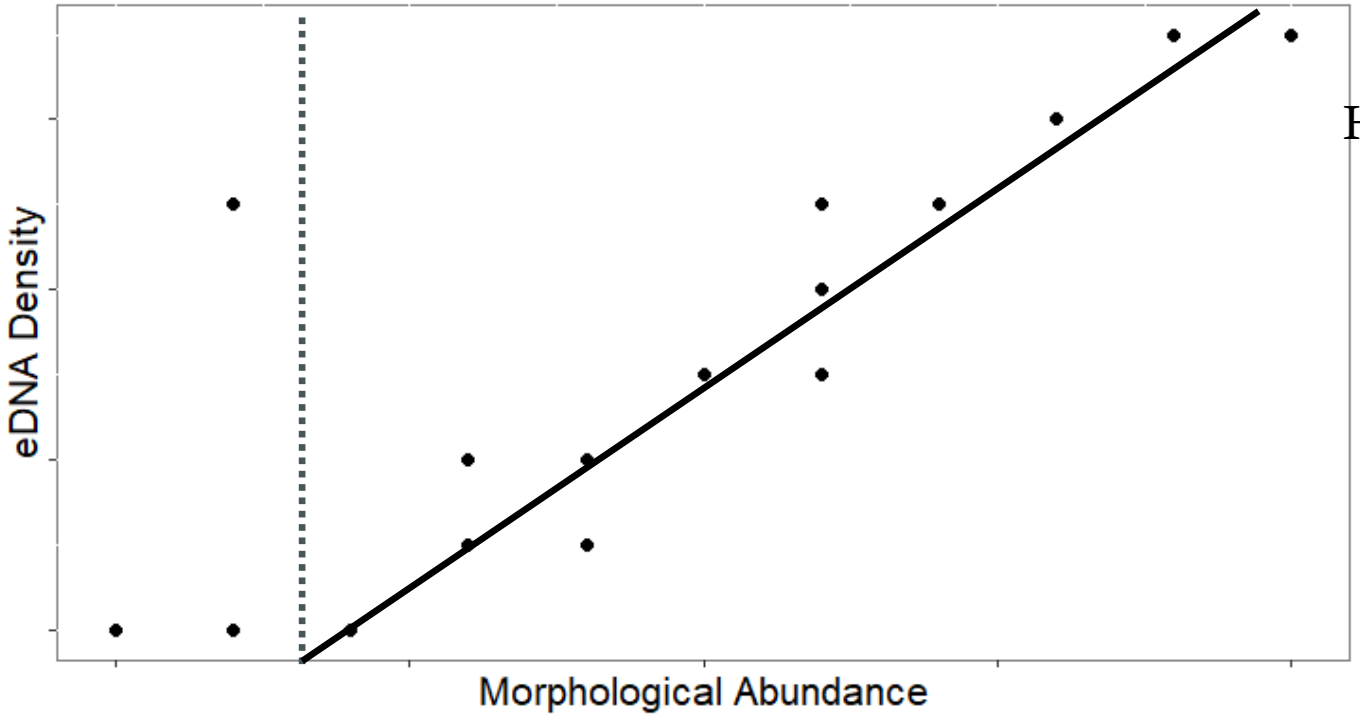


Predictions: eDNA lag time to detection



Hypothetical data

Predictions: eDNA density can be calibrated to number of individuals



Hypothetical data

Phase 3: Summer 2022

- How many individuals at an earlier life stage need to be introduced to get population growth?
- What is the eDNA signature for different spiny water flea life stages?

Life stage	1	5	10
1-barb		X	X
2-barb		X	X
3-barb	X	X	

Average clutch size

IMO Standard

Conclusions

- Mesocosm experiments can be used to determine reasonable thresholds of introduction in evaluating ballast treatment
- Develop eDNA tool for evaluating ballast treatment

Acknowledgements

Khe Mee Yang
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Becky Smith
Holly Wellard Kelly
Katie Bruesewitz
Anett Trebitz
Joel Hoffman
Heidi Rantala

Time