Dreissenid mussel dispersal through boat hull mediated overland dispersal

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Introduction

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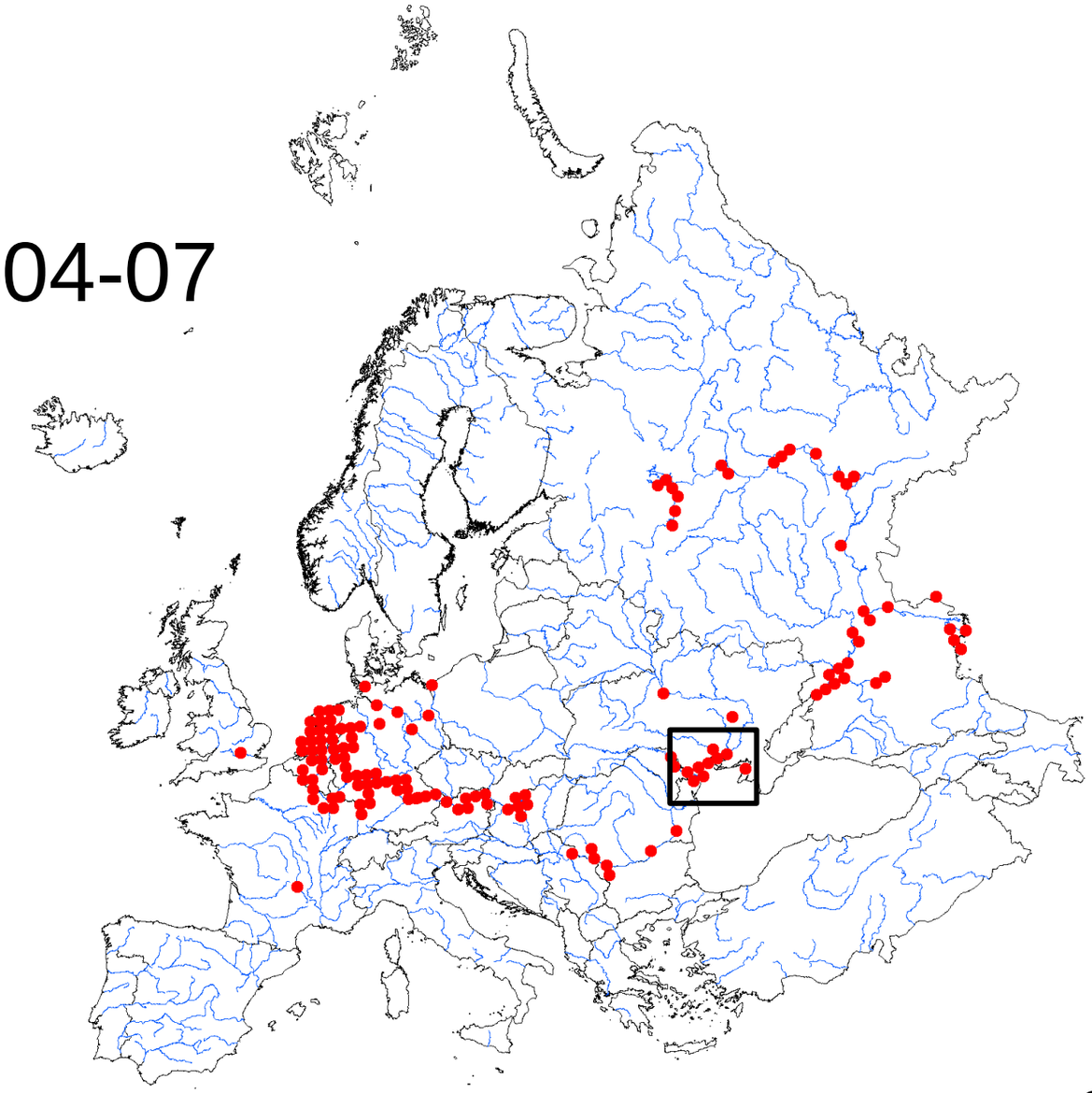


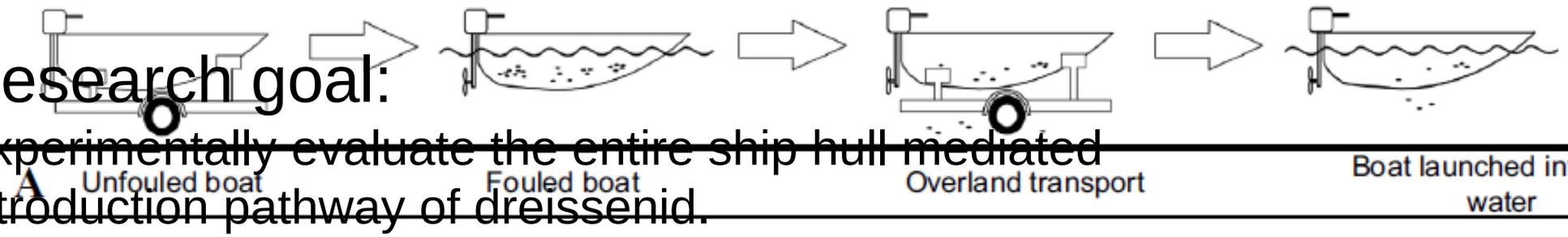
Collas et al. 2017 unpublished

Introduction

- Dreissenid mussel i

Introduction

- Different barriers have to passed before dispersal is successful
  1) Attachment to the ship hull
  2) Survival during overland transportation
  3) Detachment at a new site



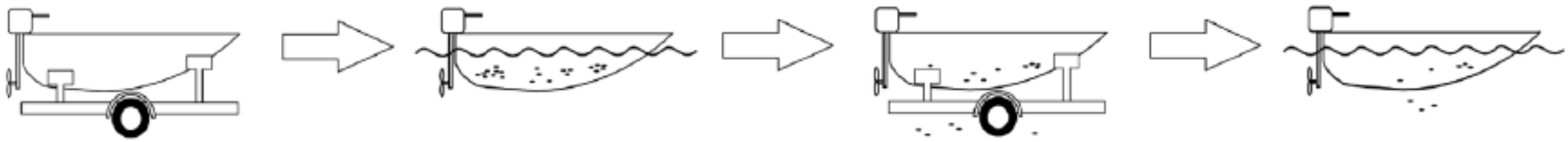
- Research goal:

~~Experimentally evaluate the entire ship hull mediated introduction pathway of dreissenid.~~

  1) Attachment of adult mussels to fibreglass and aluminium
  2) The effect of air exposure duration on alive detachment during rewetting

Materials and methods

- Experiment:
  1) Effect of overland transport duration → 1 and 2 days at 20 ºC



A	Unfouled boat	Fouled boat	Overland transport	Boat launched into new water
B	Clean boat	Boat seven days in water	Overland transport for 24 or 48 hours	Launching in uninfested waters
C		Attachment: fraction	Air exposure: mortality detachment	Rewetting: alive detachment

Materials and methods

- Experimental procedure
  - Individuals ranging in size from 10-20mm (Zebra and Quagga mussels)
  - Aluminium and fibreglass plates
  - Steel cages around each mussel
  - Seven days to attach
  - Not attached individuals removed
  - Start of desiccation treatment
  - After desiccation, attached individuals are immersed again
  - Assessment of survival

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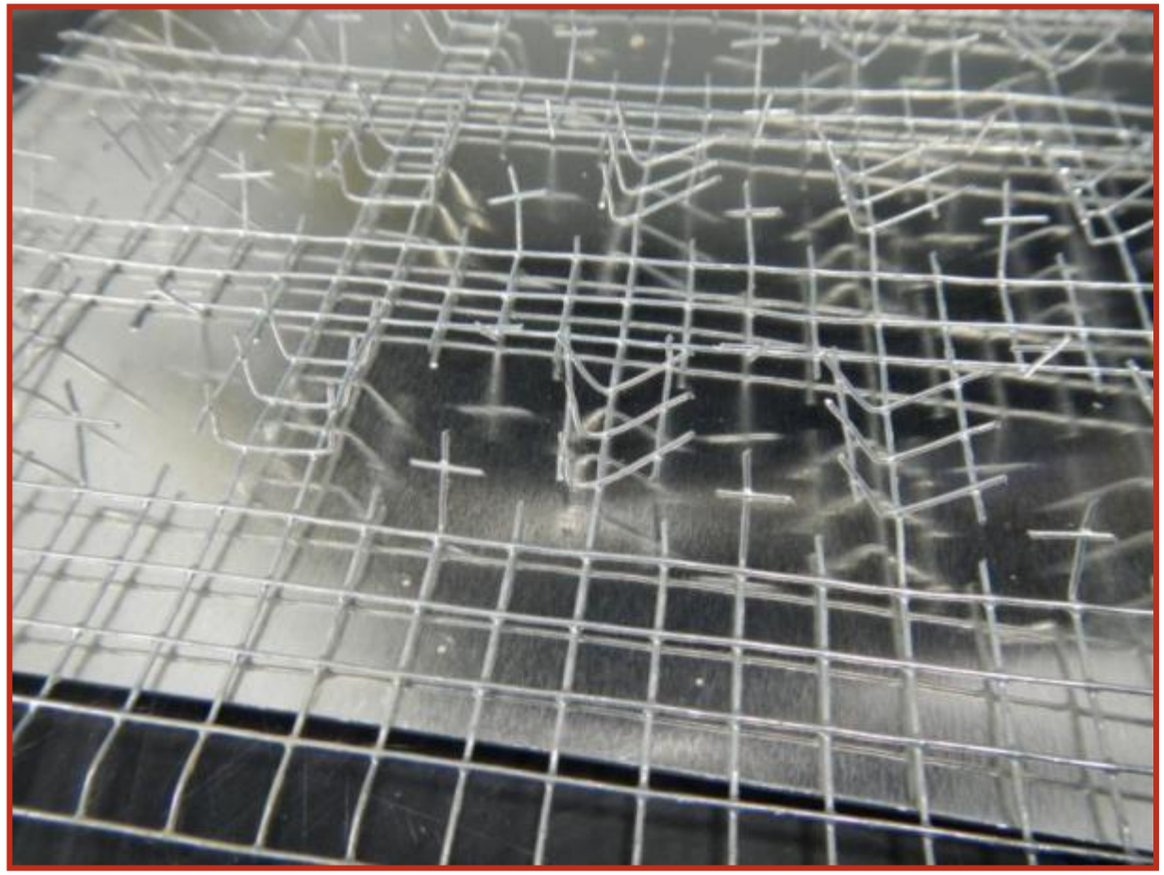

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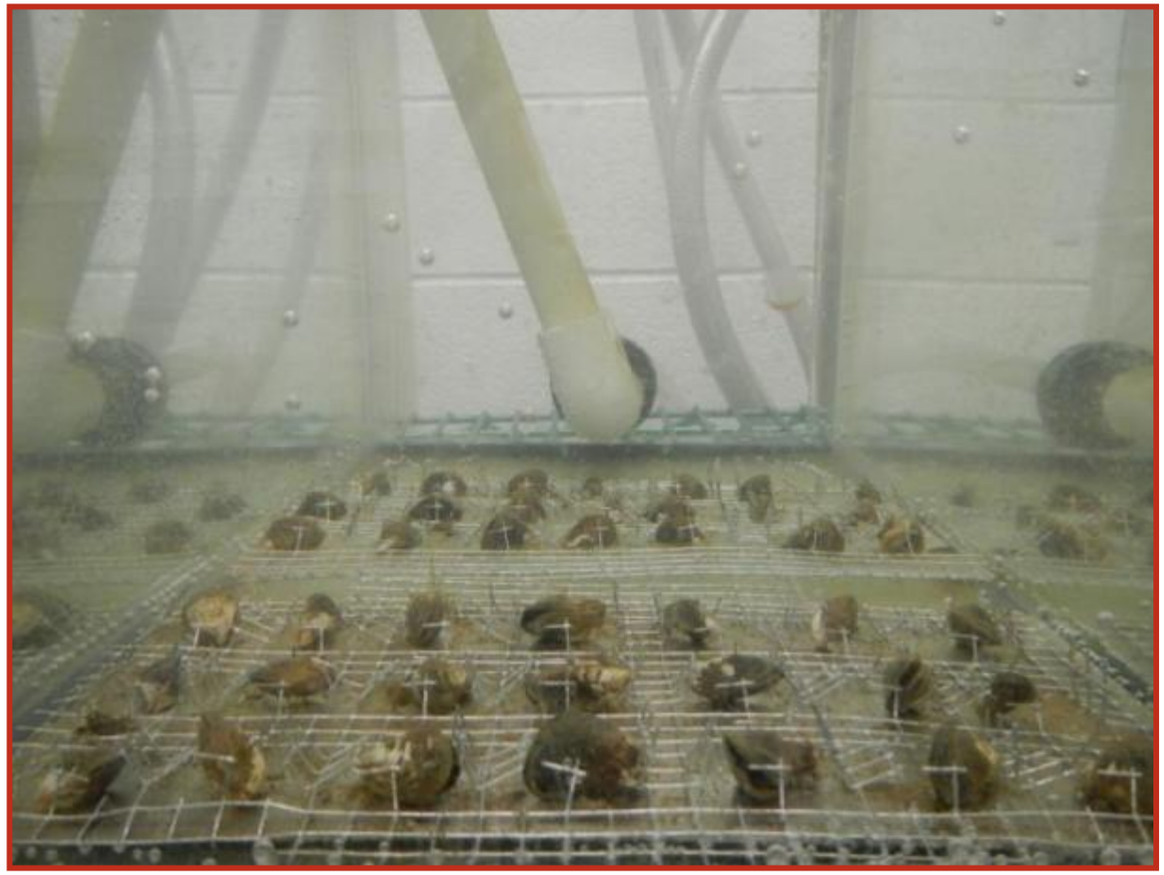

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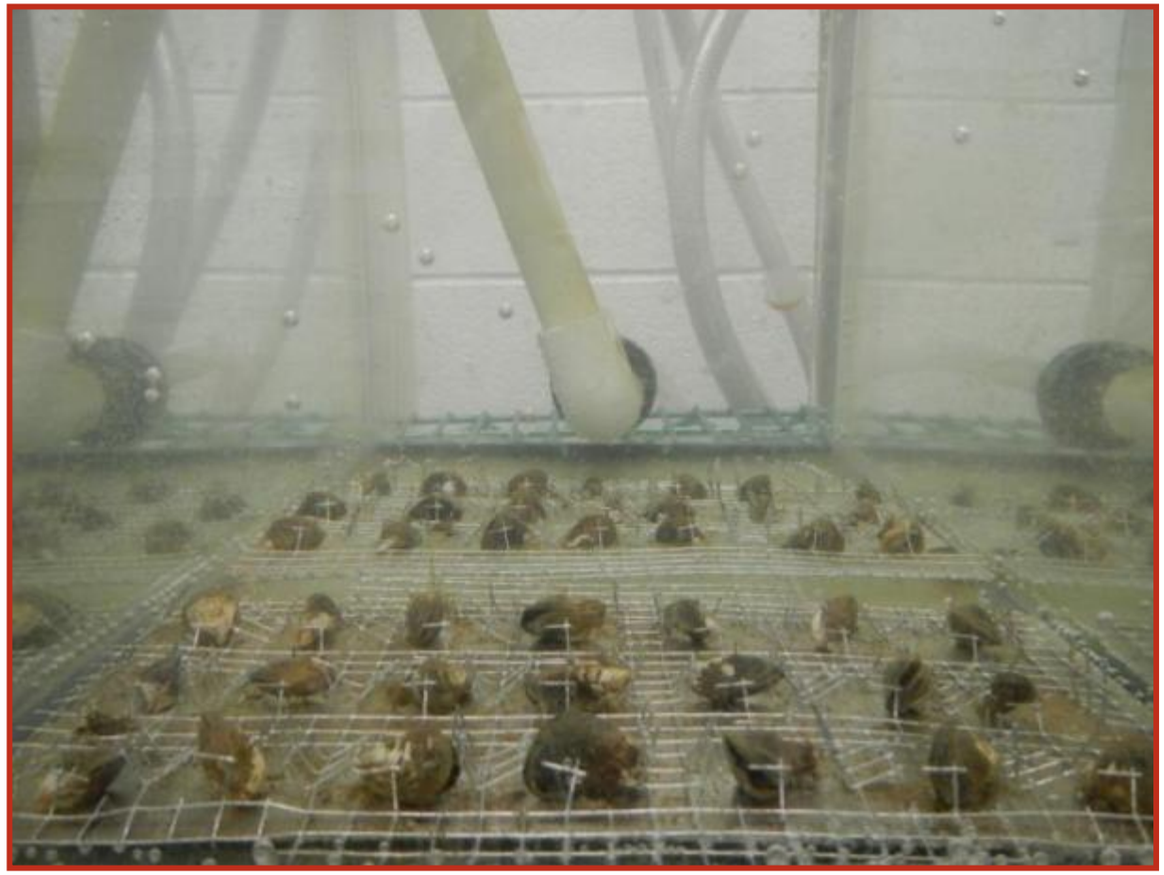

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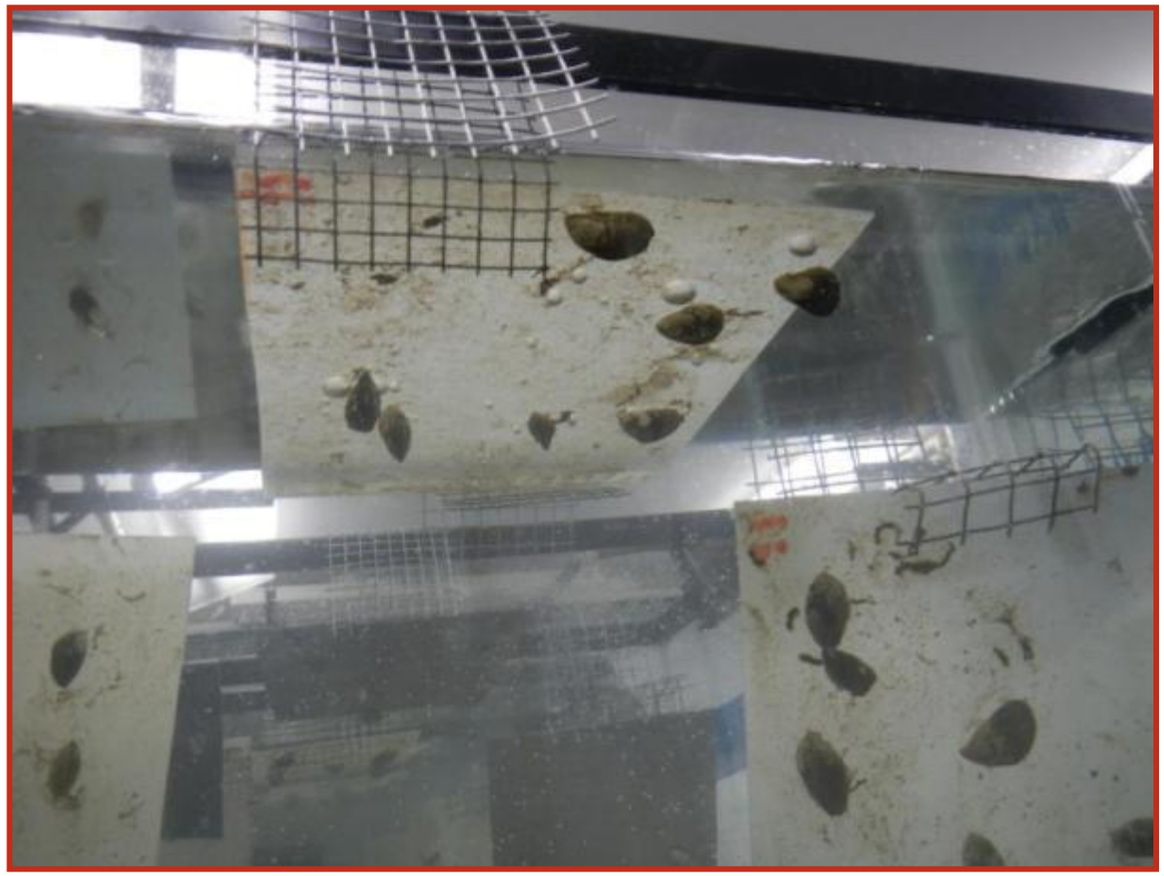

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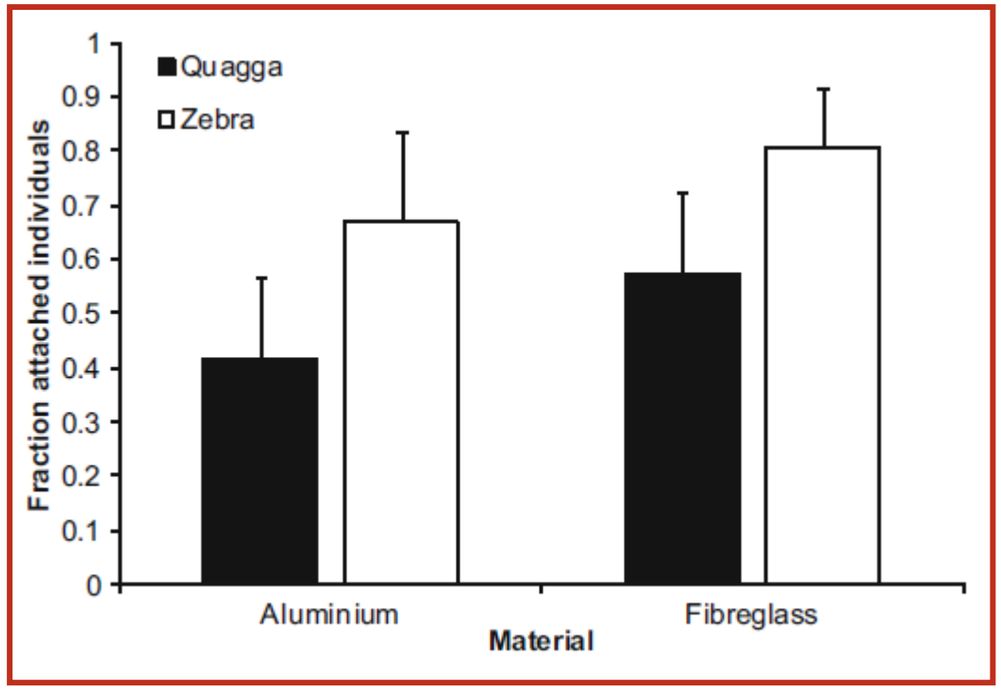
Results & Discussion – Attachment

- Zebra > Quagga
  - → Zebra mussel byssal threads growth ↑
  - → Attachment is stronger
  - → Higher fraction of zebra mussels attached to boat hulls

- Fibreglass > Aluminium
  - →Previous studies showed no difference (larvae)
  - →Fibreglass rougher than aluminium?



Collas et al. 2017 Hydrobiologia

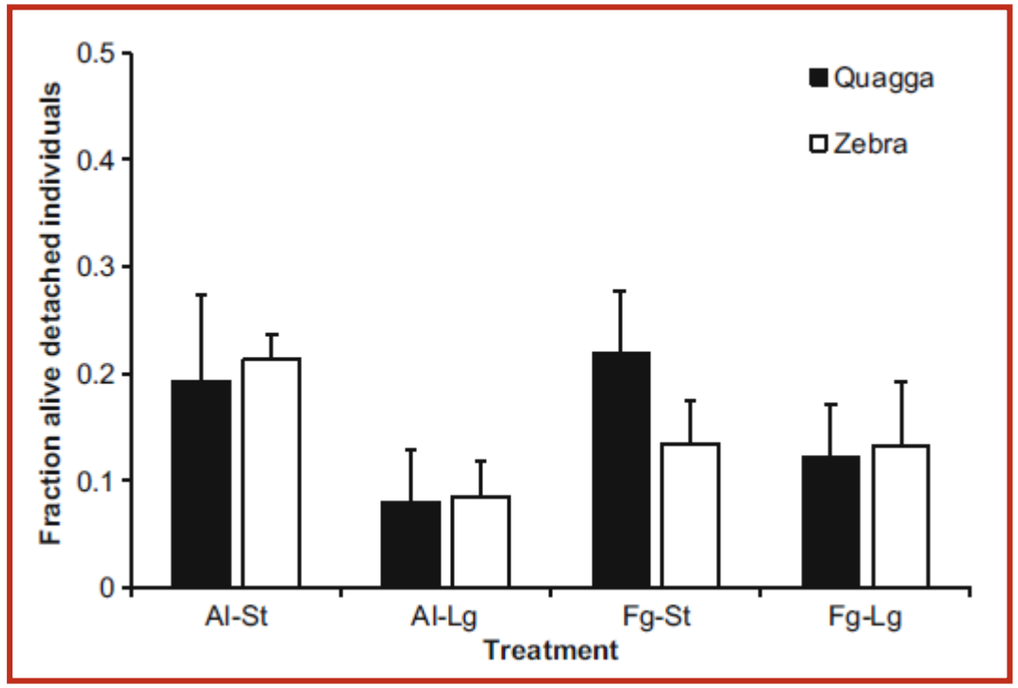
Results & Discussion – Alive detachment

- Average: 14.7%

- Quagga = Zebra
- Aluminium = Fibreglass

- Overland transportation duration
  - 24 hours > 48 hours
    → The longer the overland transport duration the lower the survival

- 80% of the individuals that remained attached was still alive



Collas et al. 2017 Hydrobiologia

Results & Discussion – introduction probability

Propagule Pressure = N_{boats} * $P_{alivedetachment}$ * N_{attach}

- Propagule Pressure: # dreissenids
- N_{boats}: $N_{departing}$ * $P_{attachmenttime}$ * $P_{transportinland}$
- N_{attach}: # of dreissenids attached to boat hulls
- $P_{alivedetachment}$: average fraction that survived and detached during immersion

Results & Discussion – introduction probability

- N_{boats} (Lake St. Clair; Johnson et al. 2001) :
  - $N_{departing}$: 96,800
  - $P_{attachmenttime}$: 8%
  - $P_{transportinland}$: 8.8%
- $P_{alivedetachment}$: 14.7% (this study)
- N_{attach}:4 – 3,940 individuals (Karatayev et al. 2013)

401 – 394,695 dreissenids/ year

- Feasible to calculate the overland dispersal propagule pressure
- Important to teach people to clean hulls

Conclusion

- Zebra mussels have a higher probability of ship hull induced overland dispersal than quagga mussels
  - In accordance with the colonization of N. America by both species:
    - Zebra mussel colonization 17x more than Quagga mussel

- Individuals that remained attached after immersion were often alive → reproduction?

- Fibreglass ships are likely dispersers due to higher attachment fraction

Future research

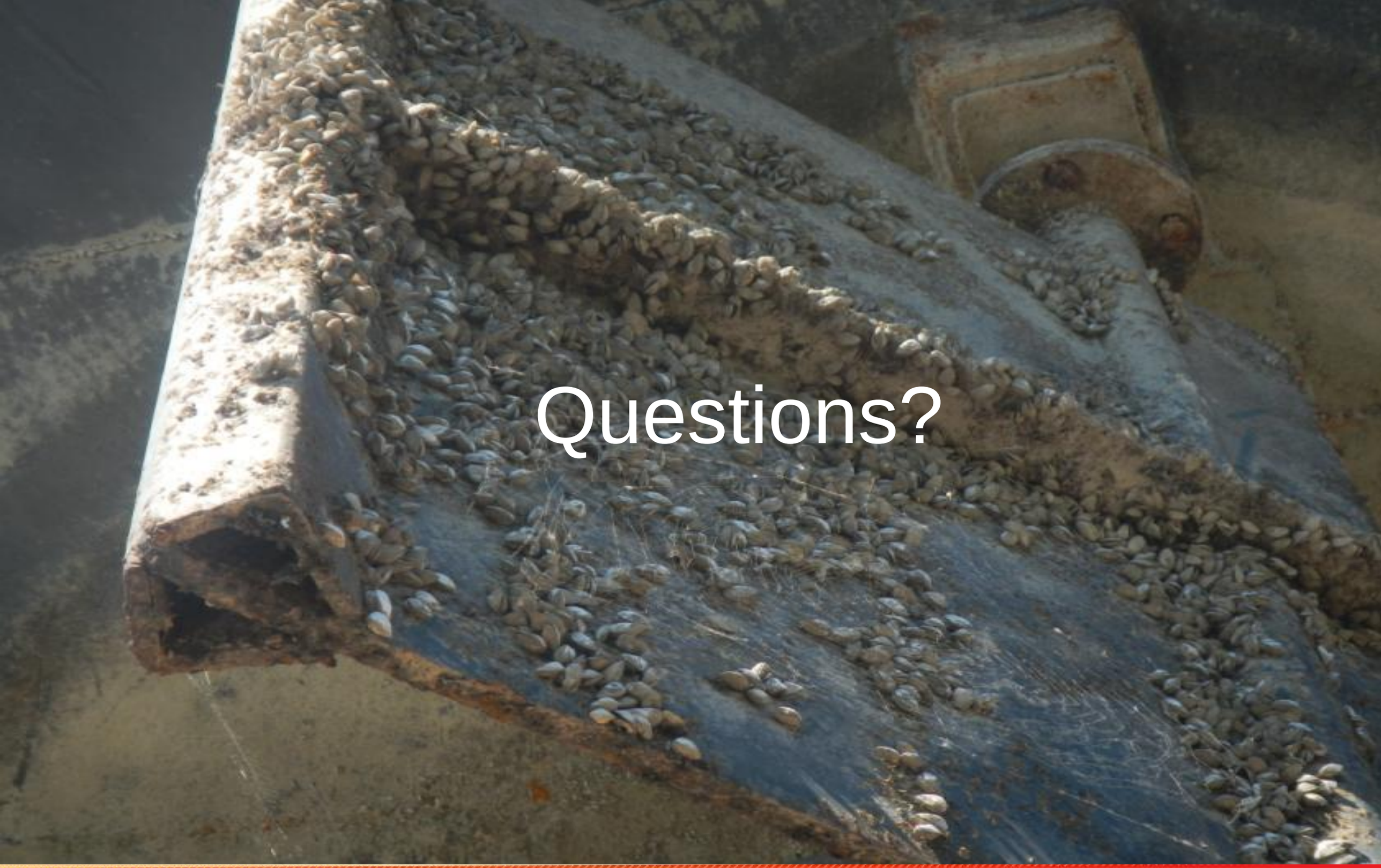
- Include boat movement effects during:
  - Emersion (decreased survival)
  - Immersion (increased detachment)

- Additional data is needed on:
  - Attached mussels under field conditions
  - Boat use and intensity under field conditions

→ More accurate predictions of introduction probability

Acknowledgements

Radboud Honours Academy


Questions?