

Efficacy & safety of potential biological control agent of the New Zealand Mud Snail

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Classical Biocontrol of NZMS?

- Using exotic, natural enemy to regulate exotic pest
 - National Management Plan describes possible use
 - trematode parasite, *Microphallus "livelyi"* ("mili")
 - well-known from NZ
- (classic host-site evolution—Lively, Dybdahl, Jokela, etc.)

•1st step: Assess Efficacy & Safety (what we're doing)

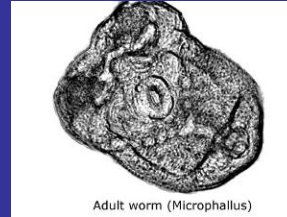
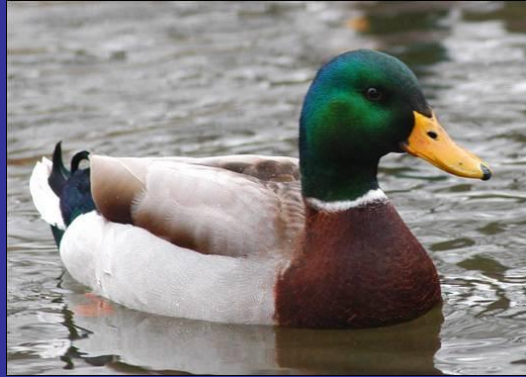
Likely to work?

- Regulate host in NZ?
- Project for North America?
- Infective to North American NZMS?

Non-target effects?

- Infect non-target snails?
 - host specificity in NZ?
 - in Australia?
 - North American snails? (lab)
- Pathogenic to birds?

The trematode, *Microphallus*



eggs



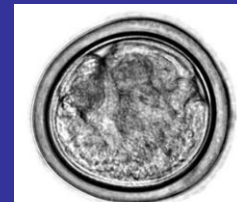
trophic transmission

clonal growth, castration



extreme
specialists

>100 cysts



Efficacy & Safety

Likely to work (efficacy)?

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Non-target effects (safety)?

- Infect non-target snails?
 - in NZ?
 - in Australia?
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Efficacy-New Zealand

- One month
- 71 sites (64 with NZMS)
 - 56 NIWA stream sites (long-term data)
- campervan (bed room, kitchen, lab), >6,000 km
- dissected ~100 snails/site
→ 7,165 snails dissected



wide environmental range



Efficacy-New Zealand

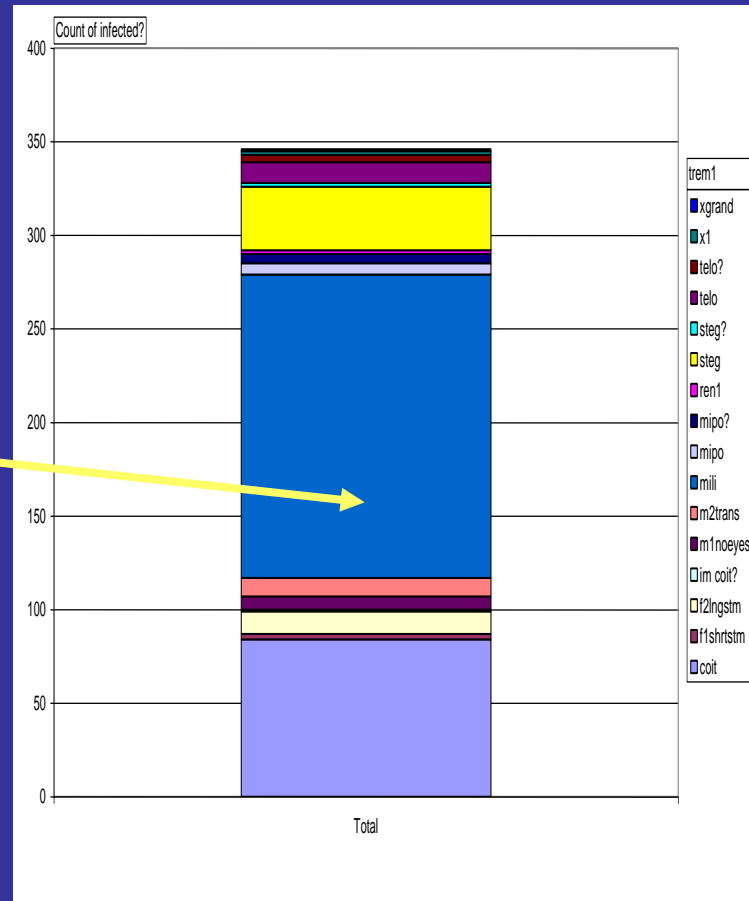
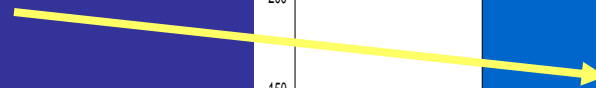
- Trematode parasites

- 383/7183 (5.3%) infected, >12 species

0 in NA NZMS

- low compared to lakes

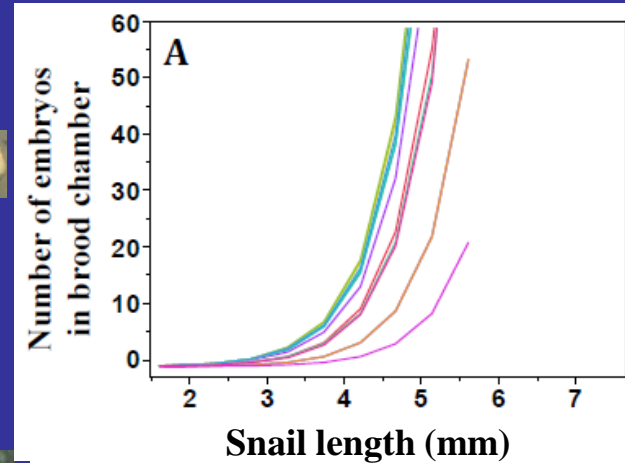
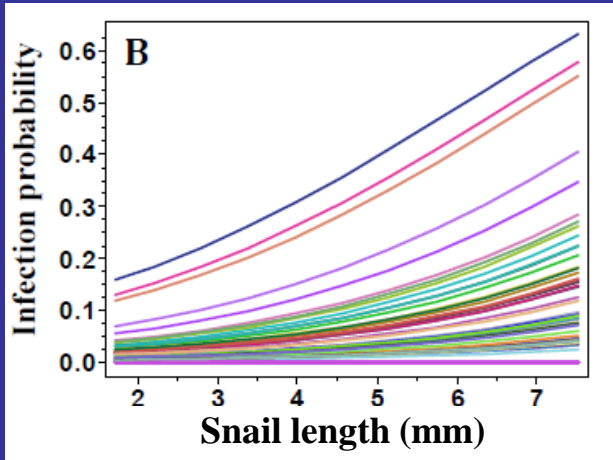
Microphallus most common



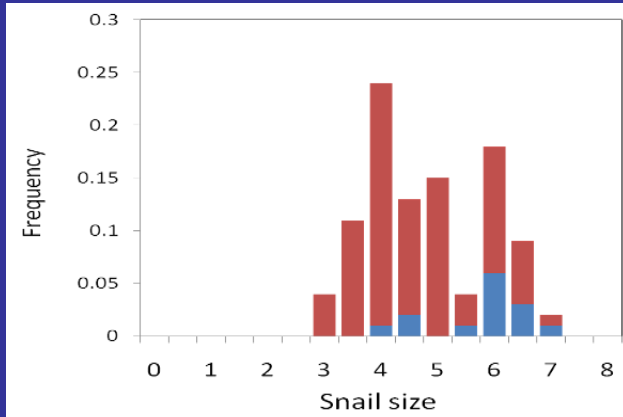
Impacts on NZMS?

↑ probability castrated w/ ↑ snail size

↑ fecundity w/ ↑ snail size

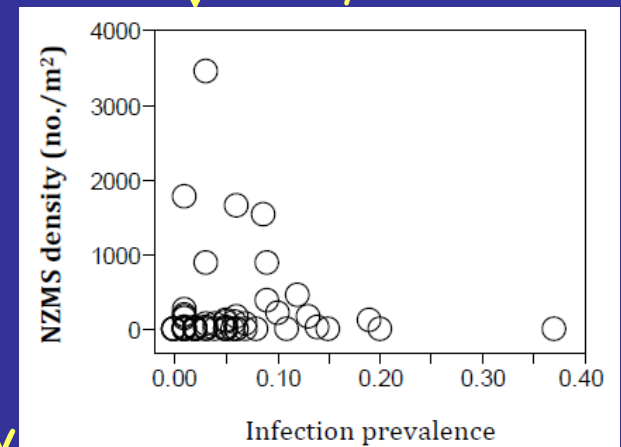


lines:
diff sites



- estimate reduction of pop repro output
- up to >70%
- aver ~6%

Will this ↓ steady state abund?



→ generate mechanistic models for snail density

→ determine what conditions conducive to high infection probabilities

Efficacy & Safety

Likely to work (efficacy)?

- Regulate host in NZ?
- Project for North America?
- Infective to North American NZMS?

Successfully been cycling through NA NZMS. Just now doing a 3rd & 2nd generation.

Non-target effects (safety)?

- Infect non-target snails?
 - in NZ?
 - in Australia?
 - North American snails? (lab)
- Pathogenic to birds?

Efficacy & Safety

Likely to work (efficacy)?

- Regulate host in NZ?
- Predict for North America
- Infective to North American NZMS?

Non-target effects (safety)?

• Infect non-target snails?

• in NZ?



• How specific is the parasite in native range?

• in Australia?

Completely, but no syntopic hydrobiids

• North American snails? (lab)

Not observed in non-target exotics

• Pathogenic to birds?

• *Physa*, *Lymnaea* (Kopp & Jokela 07)

Efficacy & Safety

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- Predict for North America
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Non-target effects (safety)?

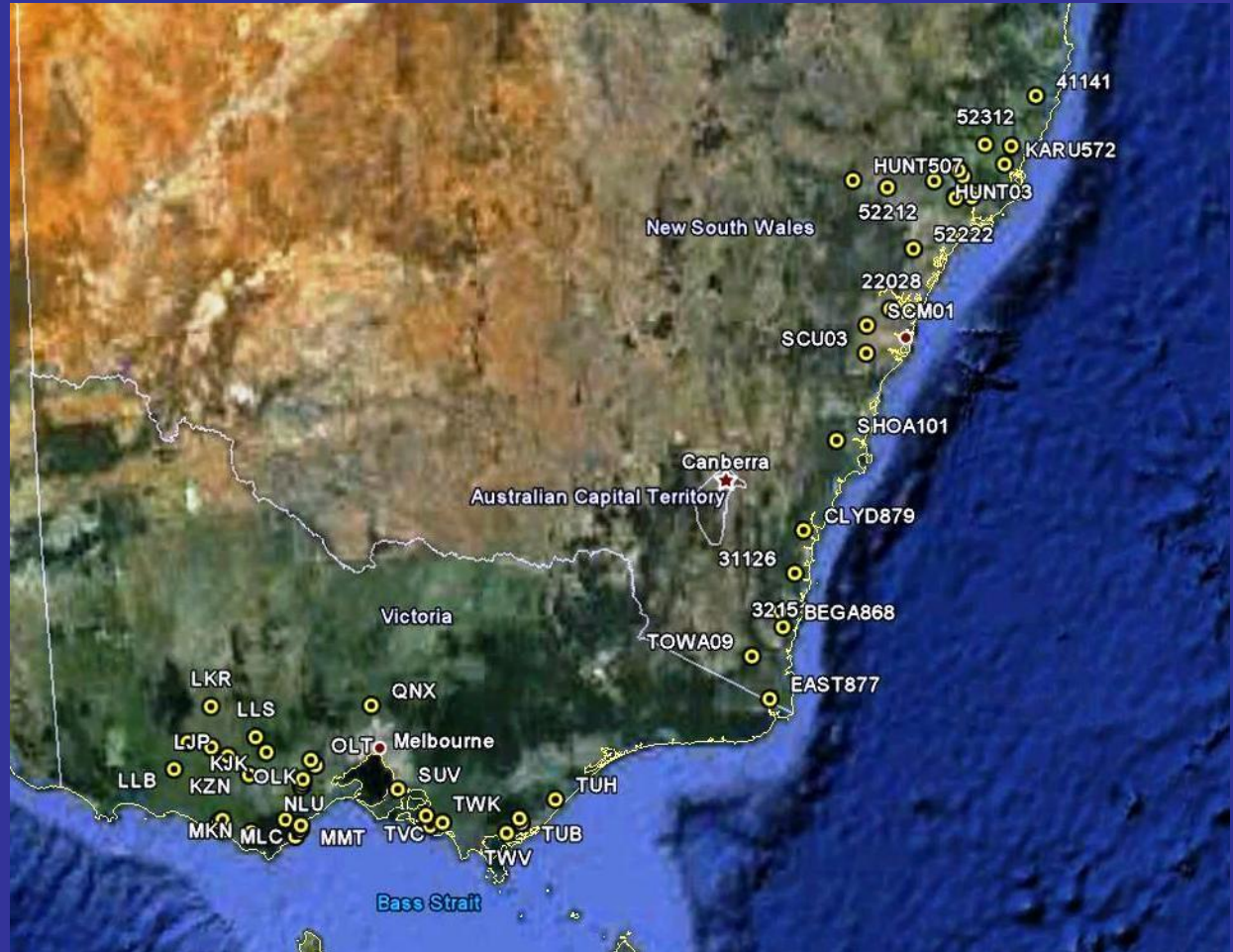
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SE Australia

- NZMS invasive since 1800s
- *Microphallus* reported (Schreiber '98 Fromme & Dybdahl'06)
- Native hydrobiids (related to NZMS)

Is *Microphallus* in the Australian natives?

Is it wiping them out?

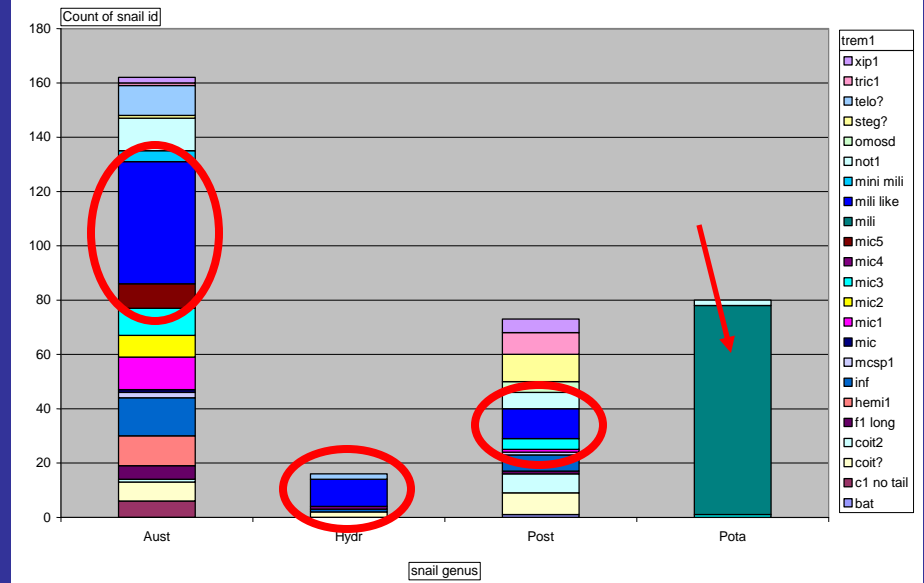
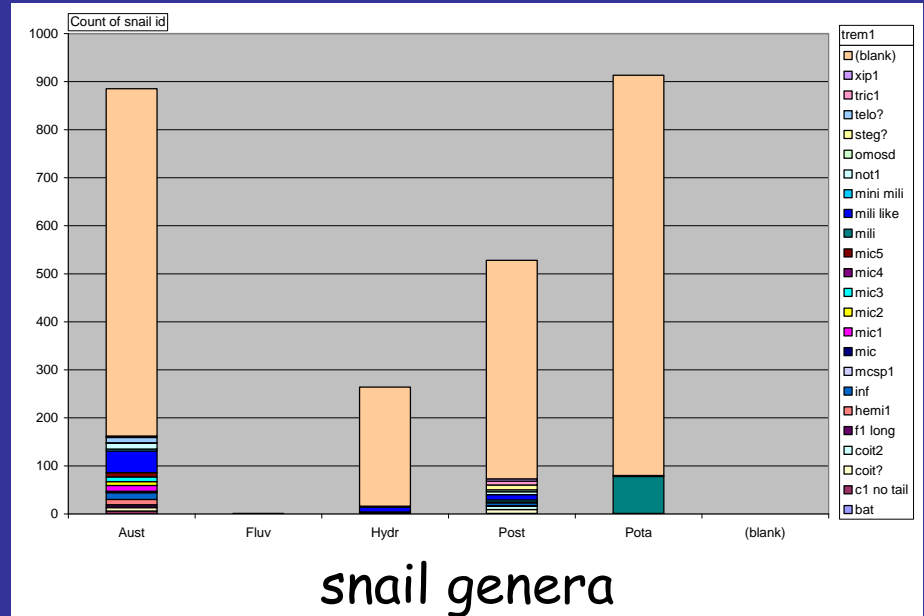


- ~1 month:
- 56 sites
 - 37 sites snails dissected
 - 14 with NZMS



Efficacy-Australia

- 2,590 snails dissected
- NZMS
 - 77 / 913 (8%) infected
 - 3 trem spp, mostly "mili"
- Australian natives (~7 spp)
 - 20 trem spp, inc "mili-like"
 - molecular work



- Is NZ mili in Aust snails?
- Or, Aust mili in NZ snails? Or both?
- But, natives are widespread

Efficacy & Safety

Likely to work (efficacy)?

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- Infective to North American NZMS?

Non-target effects (safety)?

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Host range testing:

(force them into natives)

• Problem getting natives

Six species so far

- *Pyrgolopsis stearnsiana*
- *Pyrgolopsis clathrata*
- *Pyrgolopsis micrococcus*
- *Tryonia imitator*
- *Physa acuta*
- *Helisoma "ammon" or occidentale*

Efficacy & Safety

Likely to work (efficacy)?

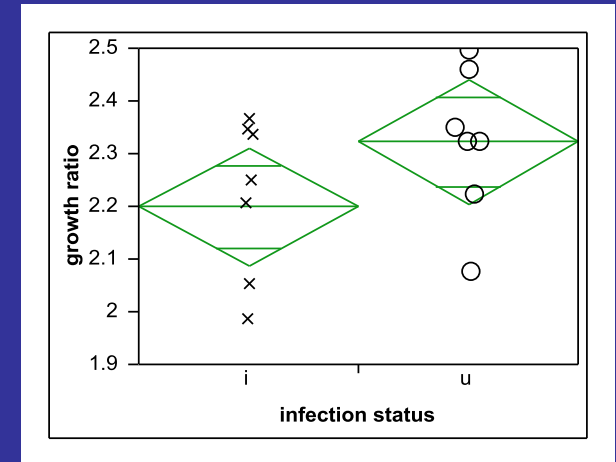
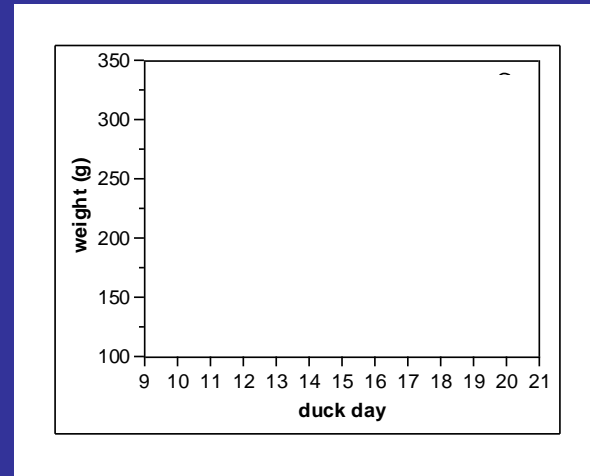
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Safety-ducklings

- what birds?
- use most sensitive individuals:
 - young, rapidly growing, calorie-restricted
- infect with 1000s worms



$p = 0.13$

5% less growth

Doing more ducks

if no effects → more testing

if effects, more realistic experiments

Work in progress

- Soon:

- Analysis of parasite impact on NZMS in native range
- Sharing of trematodes with Australian relatives
- Host-range testing (NEED NA SNAILS PLEASE!)
- Impacts on ducks?

Work in progress

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NEED NON-TARGET SNAILS, PLEASE!

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