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Effects of substrate size and cleaning regime on growth and survival of captive-bred juvenile freshwater pearl mussels, *Margaritifera margaritifera* (Linnaeus, 1758)

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2nd International Seminar on Rearing of Unionoid Mussels 24-27 November 2015, Clervaux, Luxembourg









What we'll cover

- Experiment 1 Effect of substrate size and cleaning regime on survival and size
- Experiment 2 Investigating environmental factors affecting survival and size
 - Flow rate
 - Interstitial space
 - Dissolved oxygen
 - Ammonia concentration





Initial experiment – Exp 1

- In 2012, 3600 juveniles (9 replicates) divided into 4 treatments:
 - 0.25-1 mm cleaned weekly
 - 0.25-1 mm cleaned monthly
 - 1-2 mm cleaned weekly
 - 1-2 mm cleaned monthly









Exp 1 - Method

- Cleaning regime maintained for 25 months
- Substrate emptied into a glass dish, elutriated and poured through a 0.18 mm sieve to catch juveniles
- Sampled every 2 months for growth and survival during first 12 months, then final check at 25 months







Survival







- Survival
 - Significantly (P < 0.001) different on all sampling occasions
 - On day 362 all treatments were significantly different from each other but by day 758 two groupings became obvious, larger and smaller substrate
 - 1-2 mm monthly > 1-2 mm weekly > 0.25-1 mm monthly > 0.25-1 mm weekly
 - Mortality slowed over winter but did not stop completely





Size







- Size
 - Significantly different (P < 0.001) on all sampling occasions
 - Weekly treatments were statistically the same on day 362 (P = 0.058) but all treatments were significantly different by day 758 (P < 0.001) and size ranges increase
 - 1-2 mm weekly > 0.25-1 mm weekly > 1-2 mm monthly > 0.25-1 mm monthly





Exp 1 – Conclusions

- Higher survival in larger substrates
- Higher growth in substrates cleaned weekly
- Near cessation of growth < 10 °C concurring with previous findings e.g. Ziuganov *et al.*, 1994; Buddensiek, 1995; Hruška, 1999
- No size-dependent over-winter survival observed in any treatment
- ...but why these differences???





Additional experiment – Exp 2

- Investigating factors which may affect growth and survival:
 - Flow rate through substrate & interstitial space
 - Dissolved oxygen
 - Ammonia concentration at 4 weeks







Exp 2 - Methods

- Same experimental set up but only 3 replicates
- Took place over 8 weeks starting 21/07/2015
- 1. Flow rate:
 - Measured time to clear 1L of water
 - Repeated after substrate had been cleaned
- 2. Interstitial space:
 - Emptied substrate into measuring cylinder and topped up with water until meniscus touched top of substrate





Exp 2 - Methods

3. DO – logged every 15 minutes over weeks 5-8

- Water column multi-parameter sonde
- Monthly treatments Onset DO loggers
- Weekly treatments PreSens DO dipping probe
- Ammonia concentration of interstitial water taken after 4 weeks by siphoning 2 ml out of sieves using plastic tubing (spectrophotometer)





• Survival (%)

Treatment	2012	2015
0.25-1 mm weekly	40 ±7	72 ±2
0.25-1 mm monthly	75 ±4	68 ±4
1-2 mm weekly	76 ±6	80 ±4
1-2 mm monthly	85 ±4	81 ±8





 Juvenile length (mm) was not significantly different in 2015 (P = 0.53)

Treatment	2012	2015
0.25-1 mm weekly	0.72 ±0.07	0.82 ±0.10
0.25-1 mm monthly	0.70 ±0.07	0.83 ±0.08
1-2 mm weekly	0.65 ±0.08	0.84 ±0.10
1-2 mm monthly	0.63 ±0.07	0.81 ±0.09

More analysis required on size differences & relationship to temperature





1. Flow rate:

- Pre-cleaning, flow through 0.25-1 mm monthly treatment was significantly slower than all other treatments ($F_{(3,8)} = 8.83$, P = 0.006)
- Flow through cleaned substrates was significantly higher ($F_{(3,8)} = 18.80$, P = 0.001) in the 1-2 mm compared to the 0.25-1 mm substrates
- 2. Interstitial space:
 - 0.25-1 mm substrates had significantly less $(t_{(10)} = -4.72, P = 0.001)$ interstitial space (2.6 ±0.61 ml) compared with 1-2 mm substrates (4.3 ±0.25 ml)







3. Dissolved Oxygen





Time





 Ammonia concentrations were the same between the four treatments (F_(4, 14)=1.38; P=0.307)







Conclusions

- Larger substrate provides better survival rates
- Growth patterns were different between exp 1 & 2
- DO and flow are significantly affected by substrate size and cleaning regime
- Further analysis of DO data will help explain this further





References & acknowledgements

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