Can habitat quality influence predation risk? The case of spawning gravels and fish predation.

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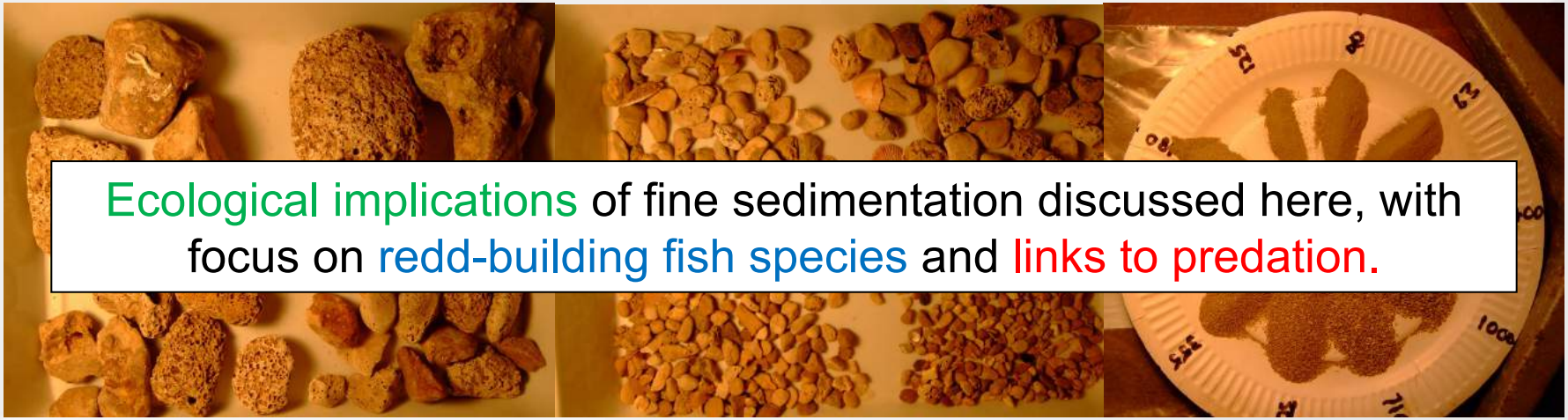
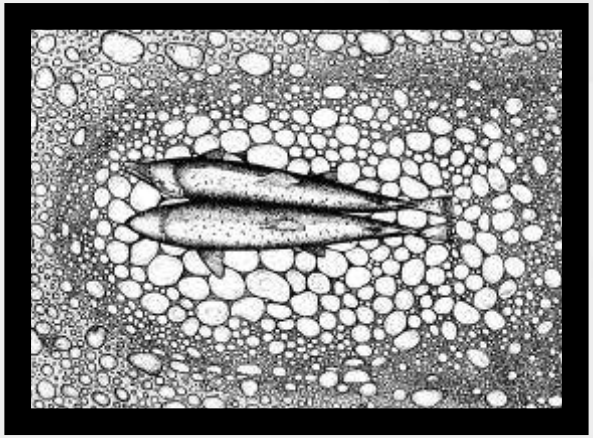
The “boring” stuff… Grain size and spawning substrates

- Substrates include both coarse and fine particles
- Coarse (>2 mm): gravels, cobbles, boulders.
- Fine (<2 mm): sands, silts, clays.
- Human activities increase “fines” in rivers.



Ecological implications of fine sedimentation discussed here, with focus on redd-building fish species and links to predation.

Impacts of fine sedimentation on salmonid fish



Spawning adults

Pink salmon redds

Chinook salmon alevin and eggs in clean gravel

Salmon fry sheltering and feeding in clean gravel

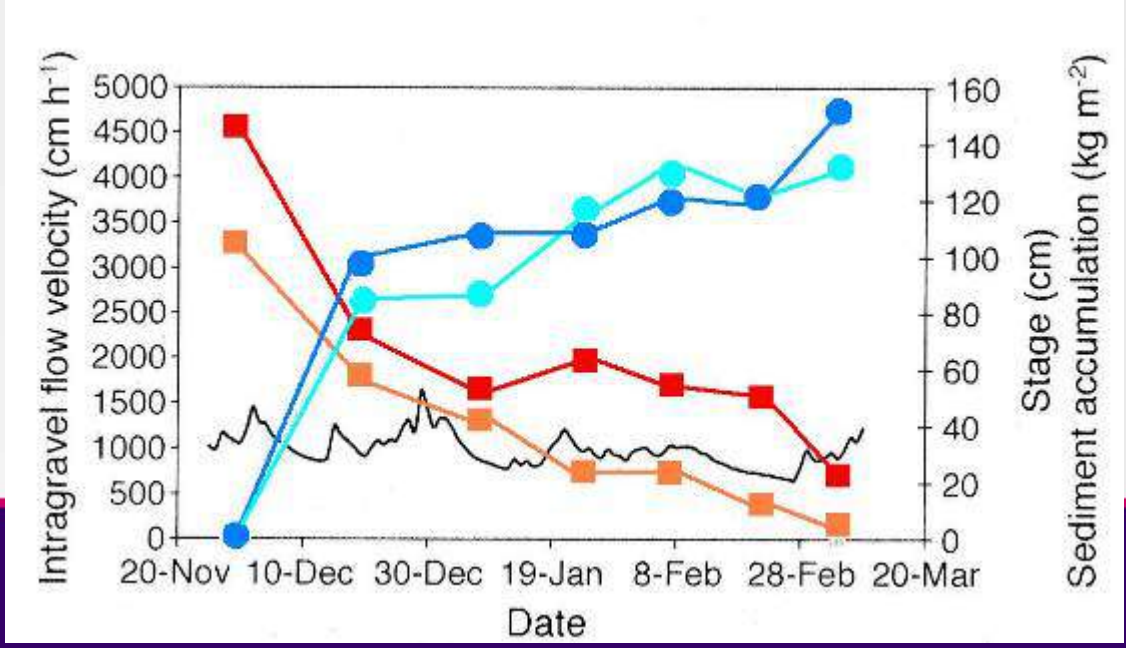
i) Impacts of fines on habitat availability

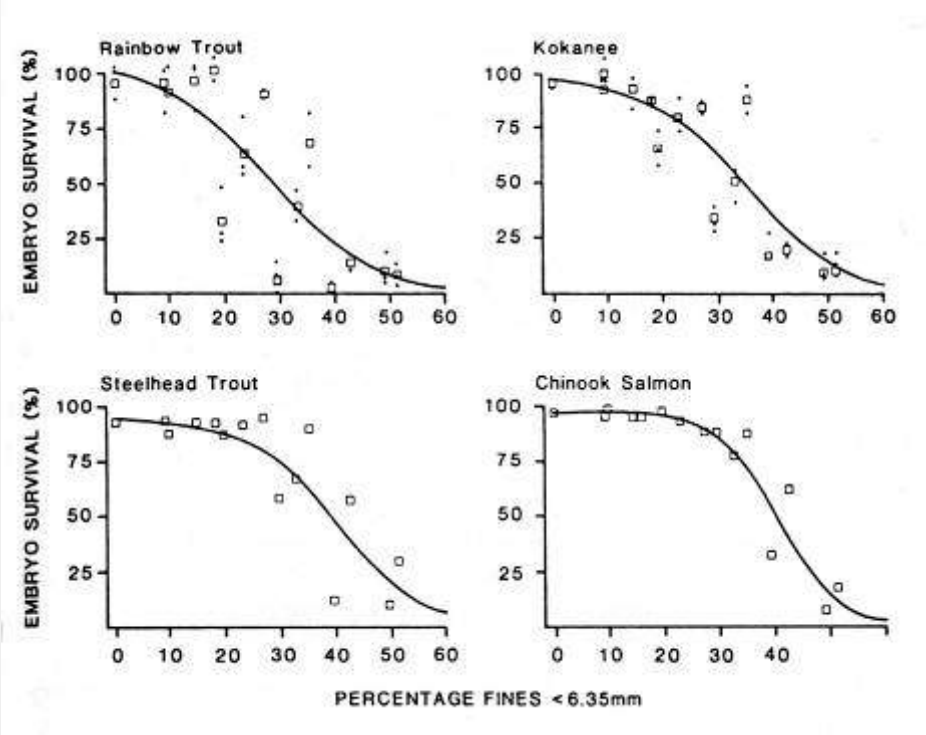
ii) Impacts of fines on spawning success – reduced embryo survival

Caused by:

- Abrasion of eggs and alevins
- Trapping of alevins by surface seals or plugs
- Reduction in permeability and intragravel flow
  - less oxygen
  - more waste products
  - rising temperatures

Grieg, Sear & Carling (2005) sediment accumulation & intragravel flow in two redds

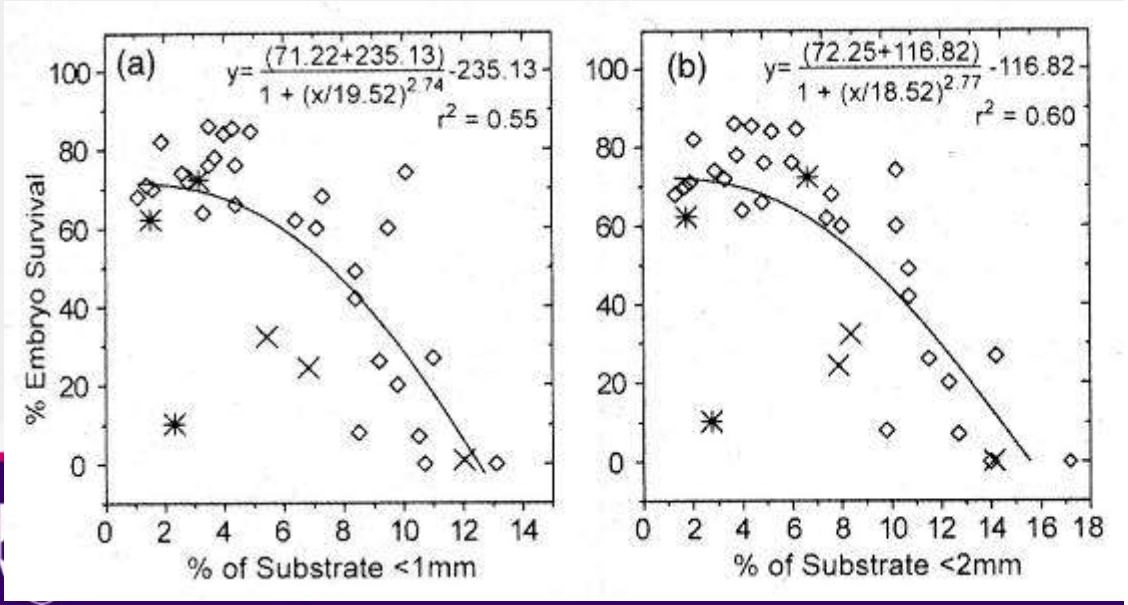




Evidenced by:

Laboratory experiments

e.g. Tappel & Bjornn (1983)



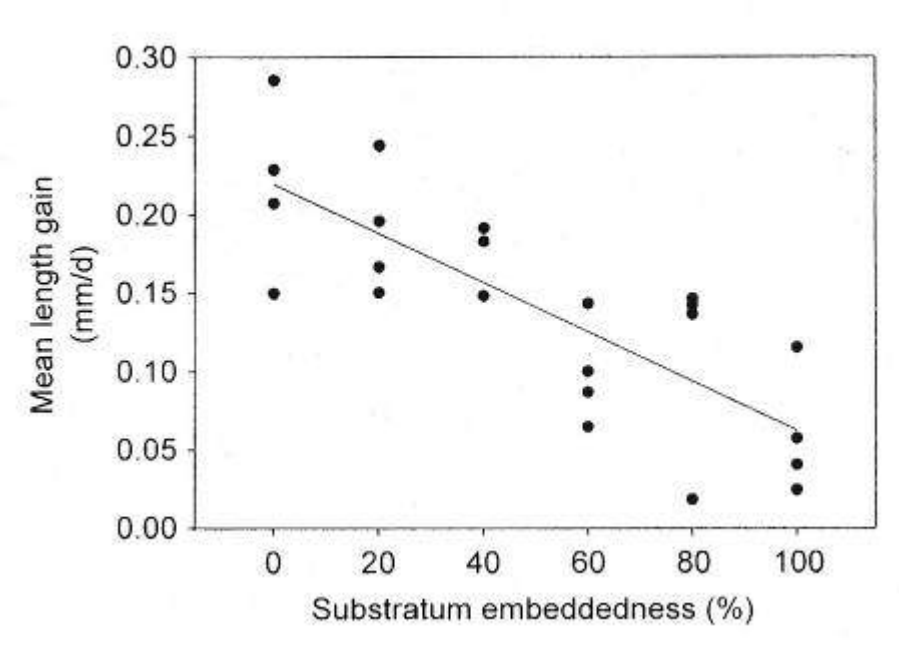
Field experiments

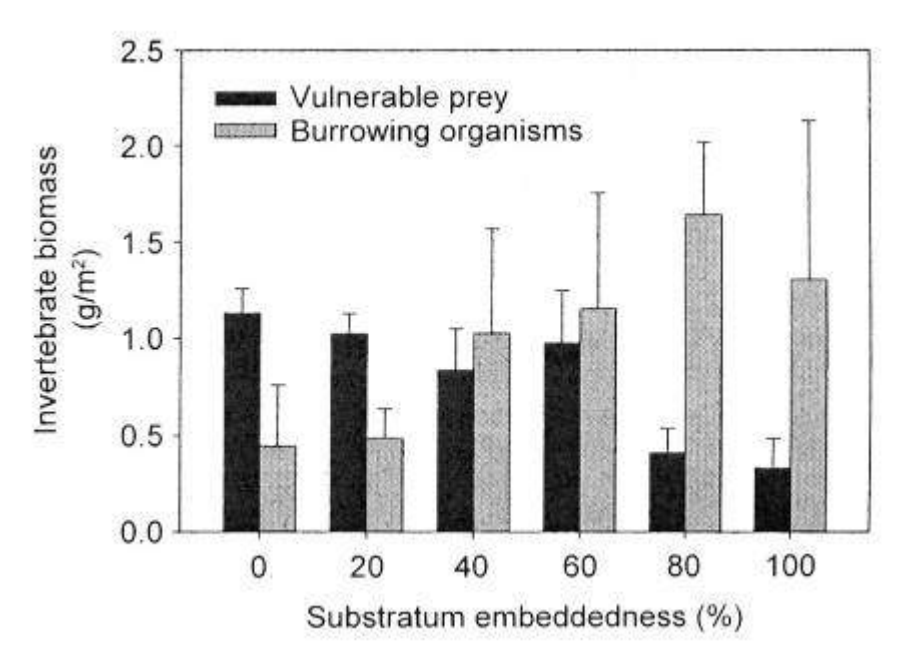
e.g. Heyward and Walling (2007).

Impacts of natural sedimentation on artificial, stocked redds (Atlantic salmon) R. Avon, UK

iii) Impacts of fines on rearing success – reduced growth rates

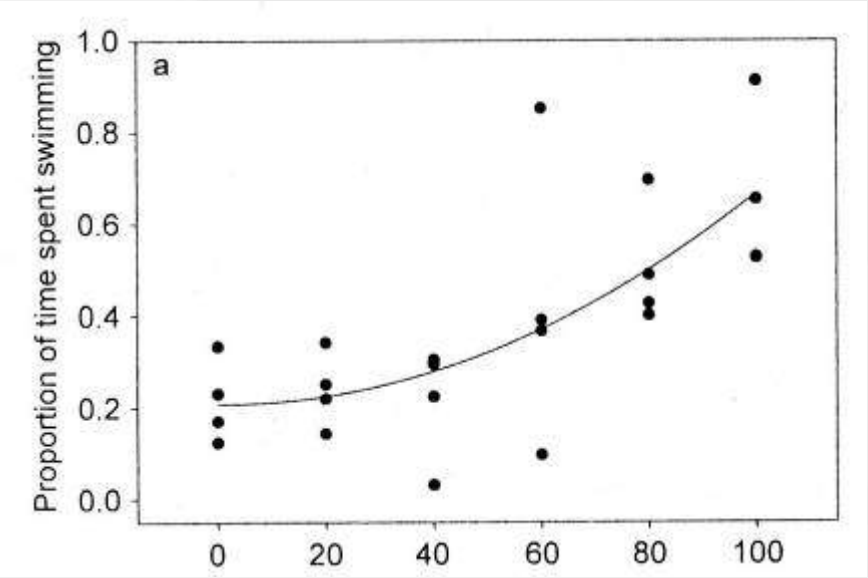
e.g. Suttle et al. (2004) Field experiment, California

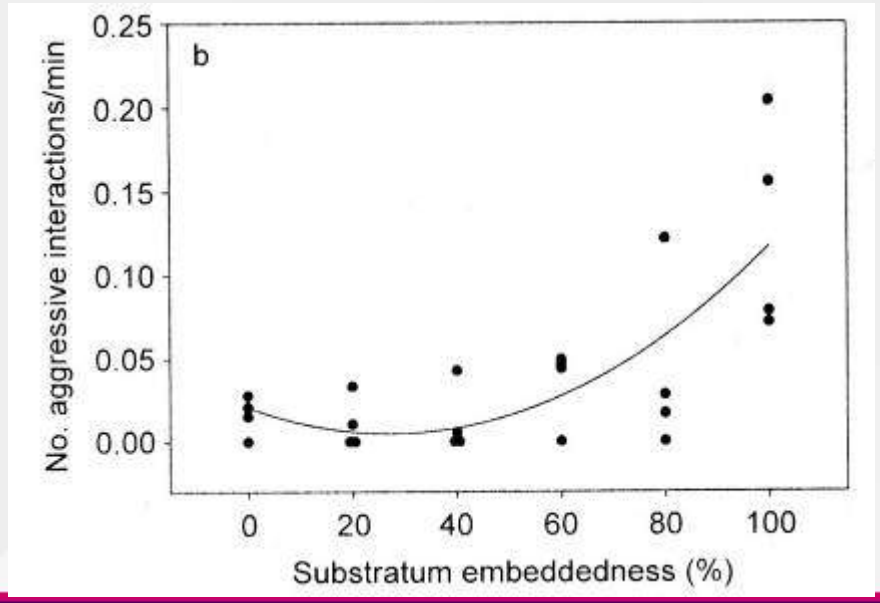




Growth rate declines as fines (embeddedness) increase. Why?

1. Less food - invertebrate communities change from available prey to unavailable burrowing taxa.





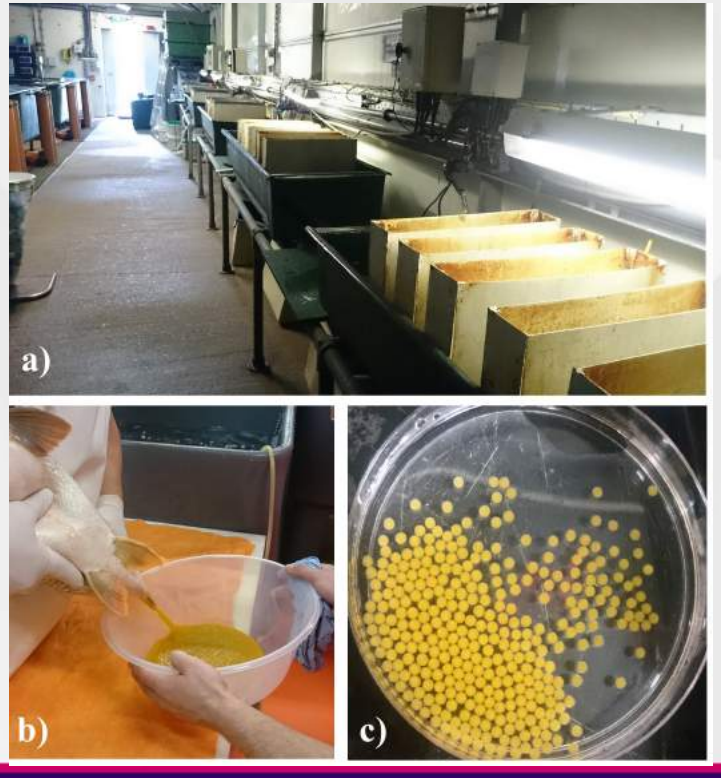
Source: Suttle et al. (2004)

2. Animals spent more time actively swimming and used more energy due to reduced food availability and because fines filled resting spaces amongst the gravel.

3. They also became more aggressive as food and resting sites became scarce.

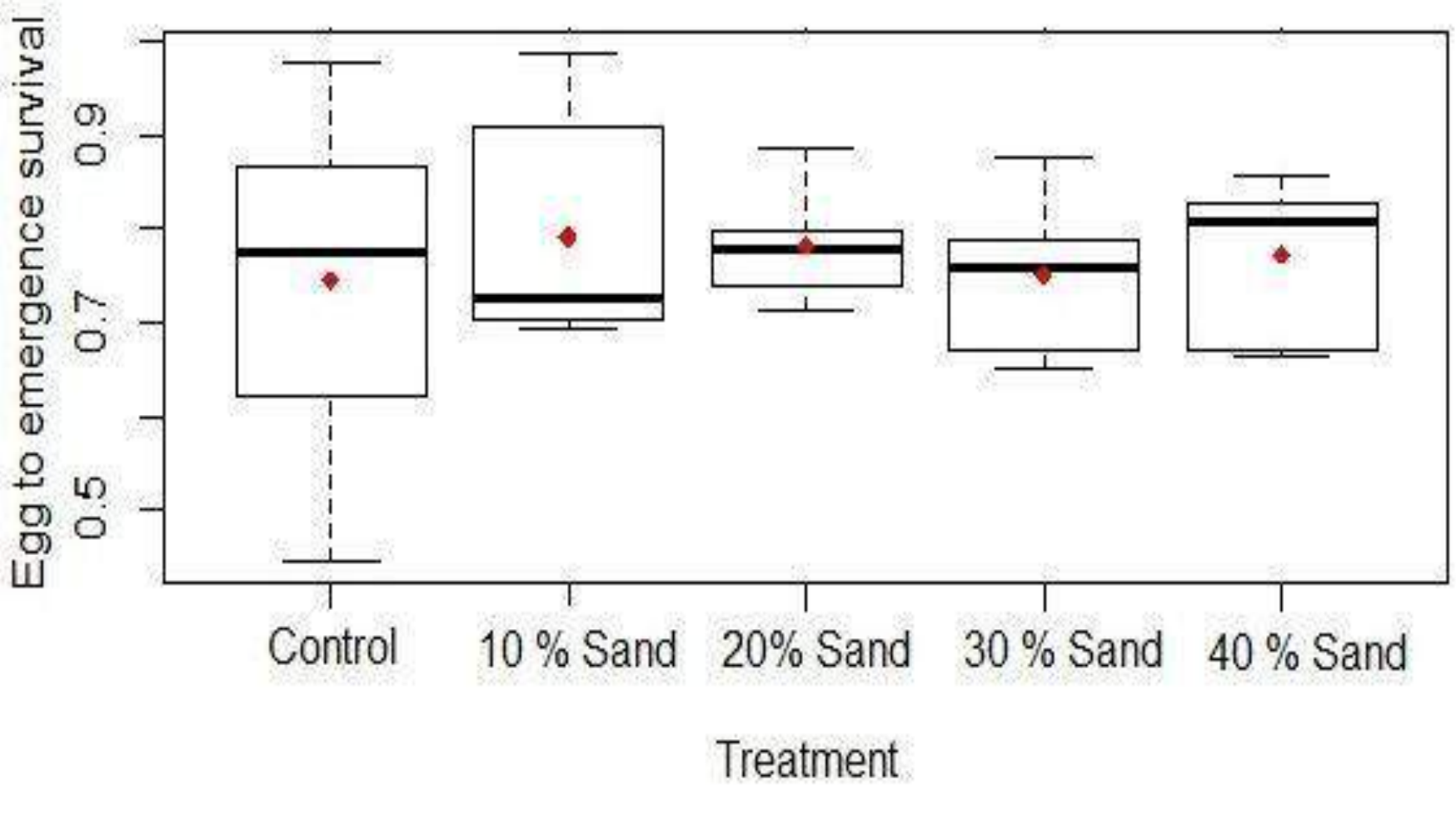
BUT… what about non-salmonid redd builders?

- Little known about non-salmonid species *i.e. we do not know what constitutes "good" spawning habitat, in terms of substrate composition, for a range of UK river fishes.*
- We performed an experiment at Calverton (EA hatchery) to investigate sand impacts on barbel *Barbus barbus egg survival and larval emergence*.



Results:

1. No effect of sand on egg to emergence survival.



Basic, Britton, Rice & Pledger; In review.

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Swim Wild, Swim Free

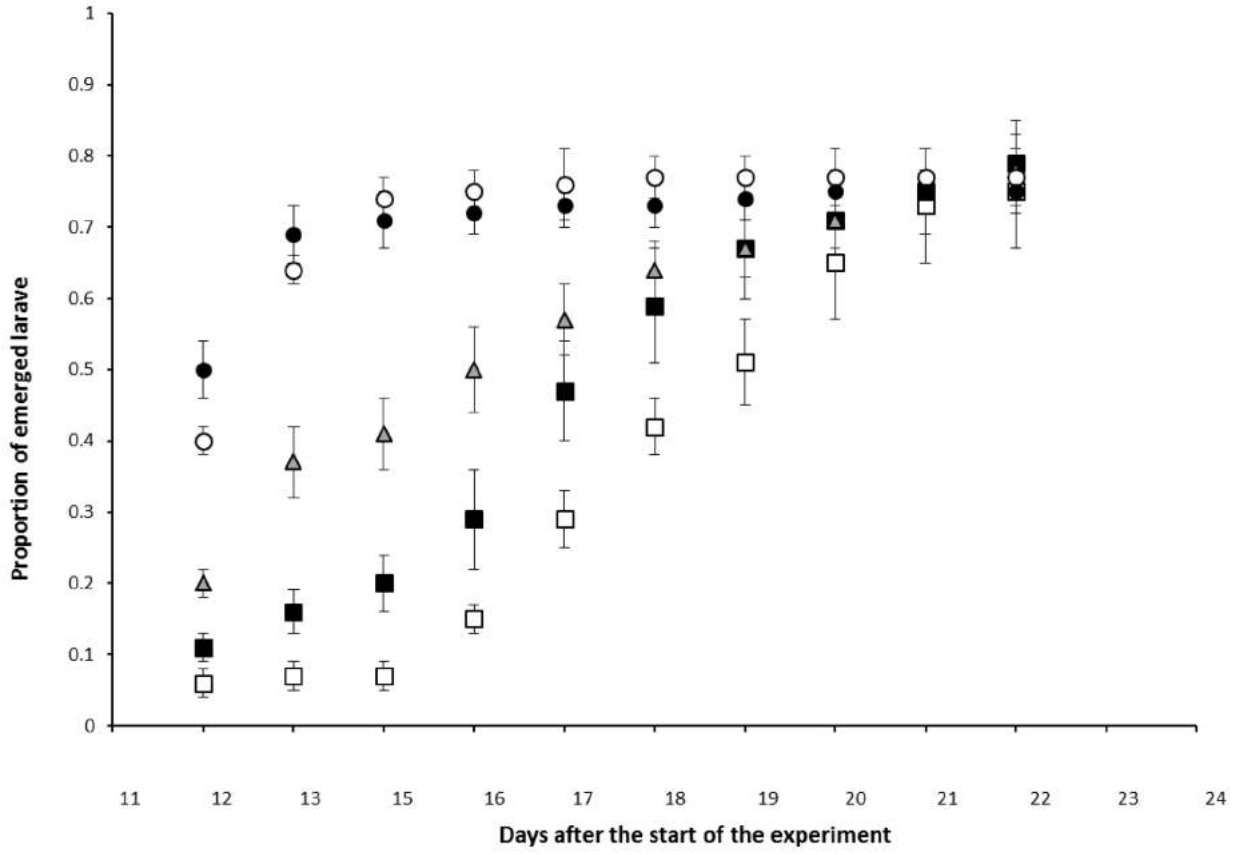
Results:

2. Timing of larval emergence significantly effected.

- Earlier emergence in boxes with 30% and 40% sand
- Larvae blind and unable to swim

Early emergers more susceptible to predation and downstream displacement.

Legend:
White square = control; Black square = 10 % sand; Grey triangle = 20 % sand; White circle = 30 % sand; Black circle = 40 % sand.



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In summary

1. Majority of work done on salmonids and little known about non-salmonid species.

- e.g. for B. barbus, we have some info on sand impacts, but what about silts, clays and combinations of these?

2. More work required to investigate:

- Impacts of fine sediments on egg survival and larval emergence for a range of species.
- Conditions in the wild, to assess suitability for spawning.
- Efficacy of methods for improving sub-optimal conditions.

3. Reasonable to assume premature emergence (blind larvae, unable to swim) and shallower nests (harder to spawn… more energy used also) due to fines-rich/ embedded substrates could increase predation liklihood.

Thanks for listening…

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