Novel beach skimming method of gravel extraction offers restoration potential over pit mining in braided rivers.

What we know

- Braided river floodplains in their natural state are composed of a wide range of habitats and landscape elements, representing rare ecosystems that support high levels of biodiversity.
- Braided rivers are in decline and are some of the most threatened ecosystems worldwide.
- Gravel from braided rivers is a valuable resource, providing aggregates for use in construction.
- Gravel extraction can have adverse effects on a river's physical and ecological attributes, although methods of gravel extraction differ.

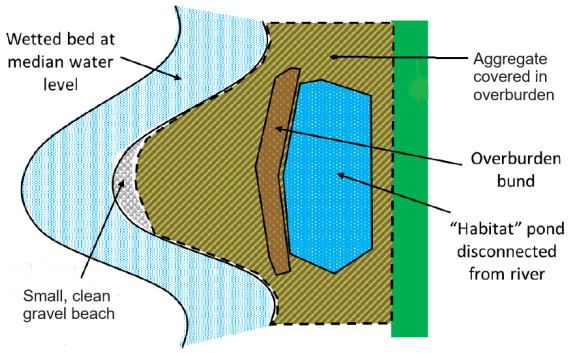
What we don't know

How are fish communities and fish population health in braided rivers impacted by two different gravel extraction techniques: a novel beach skimming method and current pit mining practice.

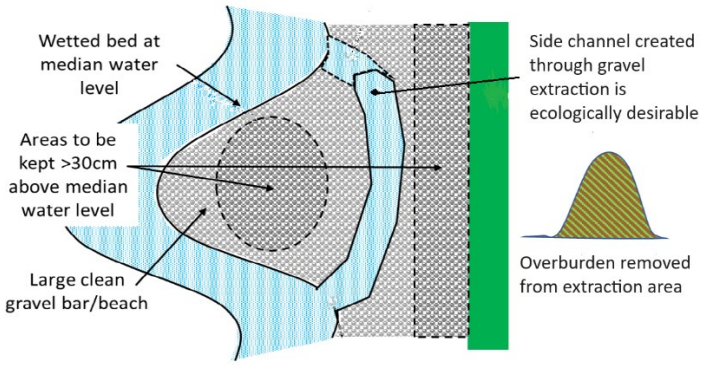
What we did

We compared the freshwater values of ponds, created via pit mining, and of "restoration" sites, where a novel beach skimming technique intended to restore natural braided river features is being trialled. This beach skimming technique has had positive outcomes for nesting braided river birds, but there was a knowledge gap in its freshwater implications. This study took place in Southland, New Zealand.

Pond created via pit mining



Restoration site post-gravel extraction



1. We assessed habitat variables including nutrients, water depth, and wetted width:

2. We used electrofishing (river sites) and trapping surveys (pond sites) to determine fish communities present at each site:

3. We investigated the diets, parasite infection rates, and growth of upland bullies (*Gobiomorphus breviceps*), as measures of population health:

What we found

- Ponds, created via pit mining, had a homogeneous physical structure and stagnant flow. Beach-skimmed restoration sites were heterogeneous, with multiple channels and high flow variation.
- Ponds had high total nitrogen and phosphorus levels which tend to accumulate as ponds age.
- Fish species in ponds were tolerant to elevated nutrient levels and low flow conditions and had introduced perch which made up on average 17% of the fish population. Restoration sites supported fish that prefer rapid flows and had introduced brown trout which made up on average 6% of the fish population.
- Upland bullies in ponds had significantly greater rates of parasite infection than those in restoration sites, potentially caused by low velocity and high nutrient levels in ponds.
- Upland bullies in ponds had significantly faster growth than those in restoration sites, possibly due to greater resource availability from elevated nutrients and potentially higher temperatures in ponds.

Pit-mined ponds 	**Novel beach skimming with restorative intentions** 
Lentic and homogenous	Habitat heterogeneity
Distinct fish communities with largely tolerant species: shortfin eels, Gollum galaxias, upland bullies, longfin eels and introduced perch.	Slightly more diverse fish communities with species that require fast flows: southern flathead galaxias, torrentfish, lamprey, upland bullies, longfin eels and introduced brown trout
More parasites and faster fish growth	Less parasites and slower fish growth

Conclusions and Recommendations

- Pit-mined ponds do not resemble natural braided river habitats and are likely to accumulate nutrients and parasites. Restoration sites are more similar to naturally functioning braided rivers.
- Restoration sites are not currently truly restorative in terms of the freshwater values analysed, but they have good restoration potential.
- The novel beach skimming technique with restorative intentions is an ecologically favourable method of gravel extraction compared to pit mining.
- We recommend further trials of restorative gravel extraction methods, accompanied by long-term freshwater monitoring that assesses the impacts on both species and environmental conditions.
- A holistic, ecosystem-level approach to restoration and river management that encompasses both terrestrial and aquatic species will yield the greatest ecological gains.

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Photos by Eva De Jong and Clement Lagrue.

A scientific paper is being prepared from this research.

Please contact Eva De Jong (evadejong@live.ie) with any questions or for further information.

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