Freshwater Ecosystems

'Like a fish out of water': life in a disappearing river

David Kelly, Andrew Davey, *and* ***Gavin James*** *are investigating how fish survive in a river that's not always there.*

The Selwyn River drains the central Canterbury foothills, flowing about 60 km across the Canterbury Plains before entering Lake Ellesmere (Te Waihora). One of the river's main features is that the middle portion has no surface-water flows for much of the year. As soon as the river reaches the plains, water is lost through the porous riverbed to the underlying aquifer. Depending on groundwater levels, the river can disappear entirely within 5 km of leaving the foothills and, apart from a small section below the Hororata River confluence, it can remain dry for the next 35 km. About 15 km upstream from Lake Ellesmere, shallow groundwater re-emerges at the surface, and the Selwyn becomes a permanent river again. This type of intermittent flow is characteristic of many hill-fed rivers of the Canterbury Plains, as well as some of those along the coast in Hawke's Bay. The fronts of the wetting and drying margins move along the river seasonally, determined by surface flows from the foothills upstream and groundwater levels downstream.

Challenging way of life

Disappearing surface flows present significant ecological challenges to plants and animals inhabiting these rivers. In response to loss of surface water, aquatic invertebrates and fish must disperse, seek refuge in remnant pools, or perish. The dry central reaches of the Selwyn River also present a significant barrier for fish migrating between Lake Ellesmere and the headwaters. The environmental effects of flow variability on plant, invertebrate, and fish communities in the Selwyn River are the subject of a six-year FRST-funded research project NIWA is conducting with Lincoln Ventures Ltd. The Selwyn is particularly suited to this research because it is highly responsive to changes in surface-water flows from the foothills, as well as groundwater inputs along the plains, and may serve as a 'sentinel site' for predicting future conditions in catchments where land-use is shifting toward intensive agriculture with high irrigation requirements.

Go with the flow

- The Selwyn River's extremely variable flow provides a challenging habitat for aquatic creatures.
- To understand how the animals cope with the changes, this study began by examining fish abundance and distribution during changing river conditions.
- More detailed fish-tagging studies and experimental work are examining how fish respond to short-term drying events, and what habitats provide refuge during dry periods.

Fishing for answers

So how do fish cope with such extreme environments? The first aims of our study were to identify which species are found in the permanently flowing and the drying sections, and to understand how the degree of flow permanence (the percentage of time wetted) affects the abundance of these species.

We selected six sites along the length of the Selwyn that vary in their degree of permanence, and surveyed their fish populations by electrofishing in spring, summer, and autumn. At each site we sampled three habitat types: riffles, runs, and spring-fed side channels. We predicted that as the river levels drop, some habitats such as shallow riffles can disappear, whereas cool, spring-fed channels could provide a refuge for fish during the dry season.

What lives where, and when?

Overall patterns of fish distributions provided interesting insights into habitat requirements of the species living in the Selwyn. As expected, we observed the greatest abundances and diversity of fishes at our permanently flowing sites; these were located furthest upstream at Coalgate and downstream at Coes Ford. However, the composition of the community was very different at the two sites, with common bullies dominating downstream at Coes Ford, and upland bullies and Canterbury galaxias dominating at Coalgate. Canterbury galaxias appears to be restricted to the upper portion of the river, and is found mainly in swift, boulder-strewn, riffle habitats present only in the upper catchment. In contrast, the two most intermittent sites – Old South Road and Withells Ford (20–30% flow permanence) – had only low numbers of upland bullies when flows were high in November. At sites with an intermediate degree of permanence – the Hororata River confluence and Scotts Road Crossing – the fish community in November was similar to that at Coalgate, but declined

The Selwyn River at Old South Road crossing during October 2003 and then three months later in January 2004. This site is typically wetted for about 30% of the year between August and October.

Photos: Scott Larned

severely as seasonal river flows lowered and then dried.

Perhaps the most interesting findings were for Scotts Road, where our summer and autumn electrofishing surveys followed periods in which the river had been intermittently dry for the previous month. Despite this dry spell, we observed reasonable abundances of Canterbury galaxias in re-wetted riffles; however, other fish species, such as brown trout and upland bullies, had disappeared.

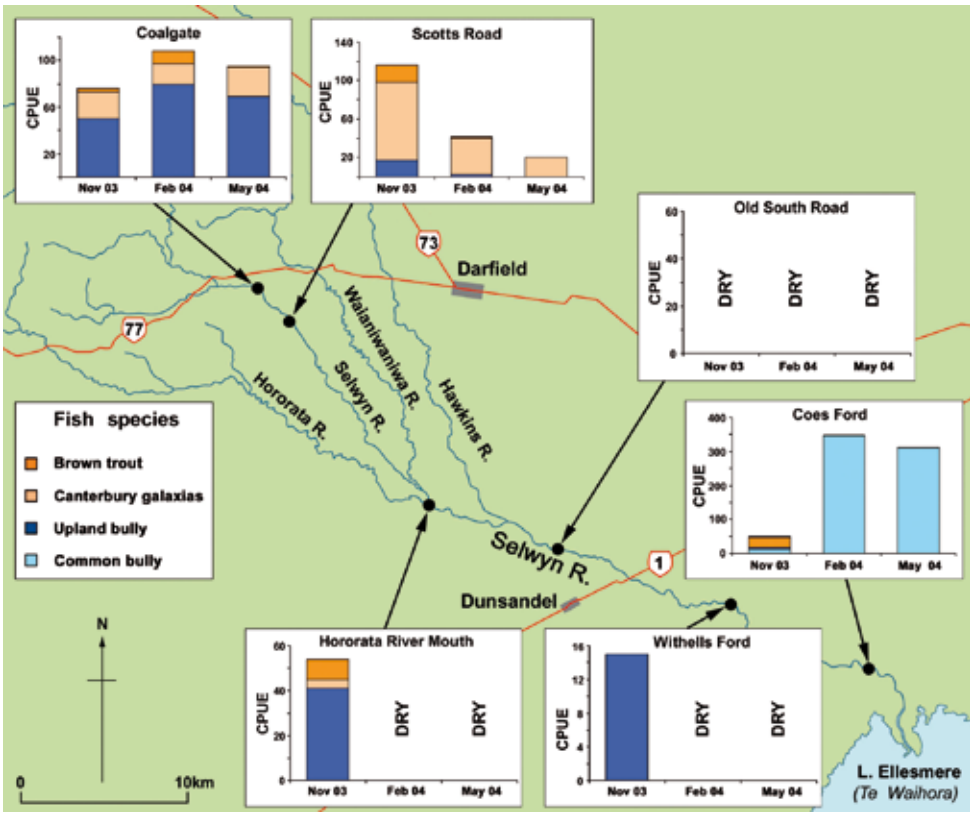
And how do they survive?

So what did the fish do when the river dried? Unfortunately, we didn't survey frequently enough to say with certainty whether the fish remained in remnant pools or spring-fed channels. Alternatively, they may have died, and the fish we found were different individuals that had moved downstream when the river began to flow again. Some other galaxid species, such as longjaw and alpine galaxias, are known to survive temporary drying by burrowing into gravel riverbeds where shallow groundwater is flowing. It is possible that Canterbury galaxias do this in the Selwyn, although this has not been reported for this species.

First findings and future studies

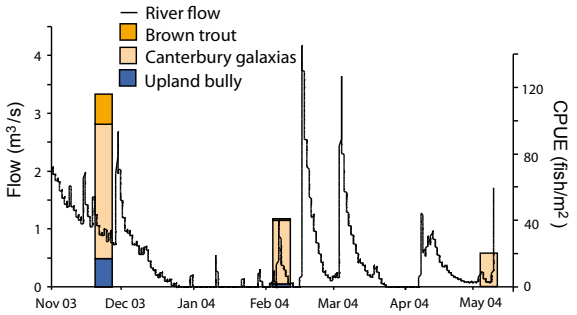
Our initial findings for this long-term research project have let us identify some general patterns of fish communities in the Selwyn, but at the same time have raised more questions than they have answered. Our next steps are to understand how different species cope with intermittent drying, and how long they are capable of surviving such extreme events. Using techniques such as PIT (passive integrated transponder) tags, we plan to follow the movement of fish during periodic drying events. This will give us a better understanding of the proportion of the Selwyn that is potential habitat for these species, and help inform decisions on future irrigation demands on east coast braided rivers.

We also need to further understand the implications of the dried middle reaches of the Selwyn as a barrier for movements up and downstream by species such as brown trout. Currently, North Canterbury Fish and Game operates a fish trap on the lower Selwyn, counting and tagging adult spawning brown trout. Initial observations are that the run is only a tiny fraction of the runs of several decades ago. Recapture information may also provide insights on whether trout populations of the lower and upper Selwyn are geographically isolated, or whether these two populations mix when the river becomes reconnected. W&A



Map: Greg Kelly

Seasonal abundances of fish along the main stem of Selwyn River between Coalgate and Coes Ford.



Fish abundances (measured as catch-per-unit-effort or CPUE) at Scotts Road Crossing between November 2003 and May 2004 at varying river surface flows (fluctuating line). Note that the river dried intermittently between surveys.

Useful link and further reading

Learn more about the fish in this study in the *NIWA Atlas of New Zealand Freshwater Fishes* at www.niwascience.co.nz/rc/freshwater/fishatlas

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