Clutha River catchment

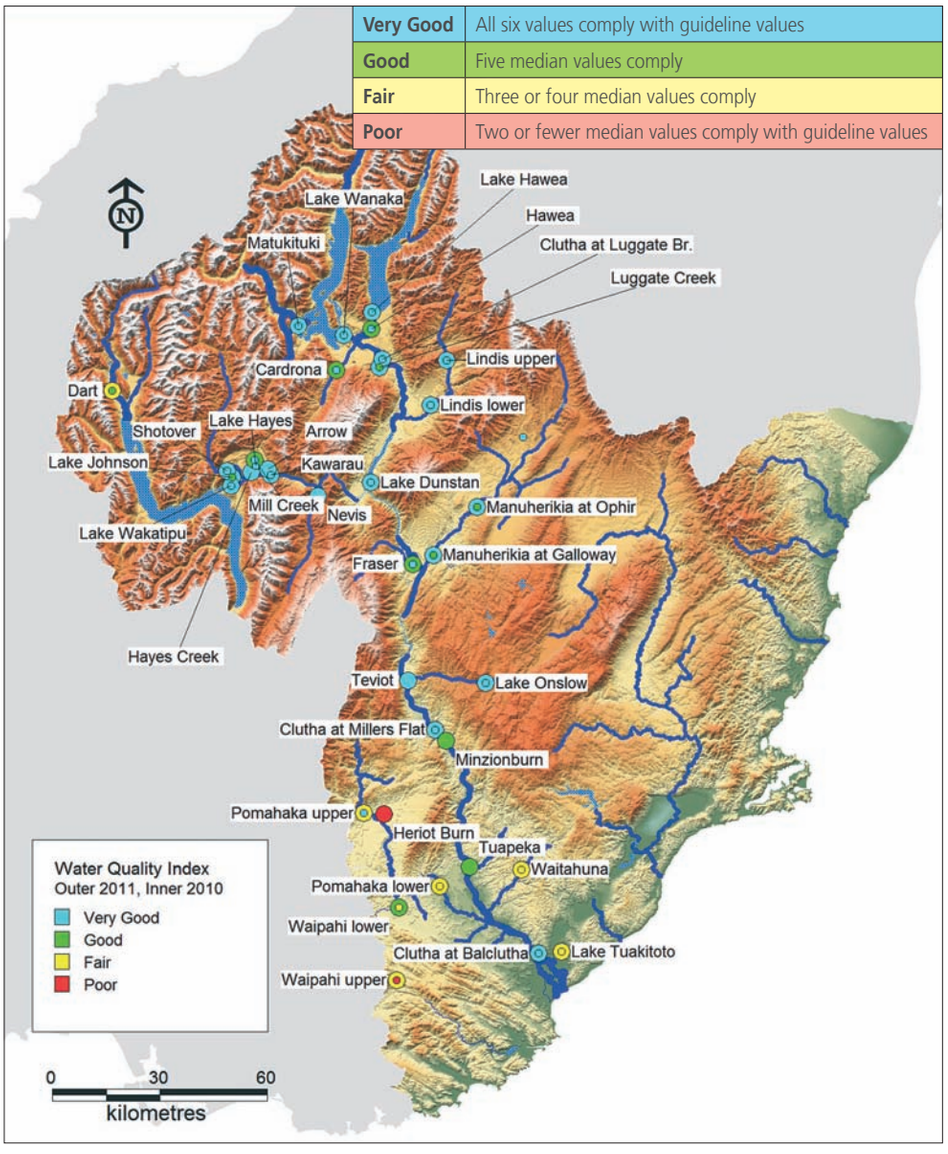
Water quality and ecosystem health
July 2010 to June 2011

Otago Regional Council

Water Quality

Introduction

The Otago Regional Council (ORC) monitored 36 river and stream sites in the Clutha catchment between July 2010 and June 2011 to assess the current state of water quality. Most sites were monitored bi-monthly, but five further sites (Clutha River/Mata-Au at Luggate, Millers Flat, Balclutha, the Kawarau River, and the Shotover River) were monitored monthly by NIWA as part of the National River Water Quality Network (NRWQN). Sites were classified using a water quality index.



Summary

- All but a few sites in the Clutha catchment had good or very good water quality
- The Heriot Burn had the worst quality followed by the upper Waipahi River
- The Dart River had fair water quality in 2011 due to naturally high sediment levels (elevated turbidity) and phosphorus
- Both *Didymosphenia geminata and Phormidium* were present in the Lindis River
- All macroinvertebrate monitoring sites had at least average SQMCI scores
- Generally, most fish monitoring sites had at least two species with trout being found at all but one site.

Water quality index

ORC uses a water quality index (WQI) derived from medians of six indicator variables, turbidity, dissolved oxygen (percent saturation), ammonical nitrogen (NH_4), nitrite-nitrate nitrogen (NNN), dissolved reactive phosphorus (DRP) and Escherichia coli *(E. coli)*.

Median values of the six values are compared with ANZECC (2000) and MfE/MoH (2003) guidelines, enabling classification of water quality into one of the four groups.

Guidelines for nutrients

The ANZECC (2000) guidelines outline trigger values for lowland water courses (less than 150 m above sea level). The trigger values specify a level below which the risks of adverse biological effects are considered low.

The horizontal lines in red (in the graphs) depict the relevant ANZECC guideline value.

The Otago Regional Plan: Water is currently under review with a proposal to introduce a series of effects-based standards for instream values.

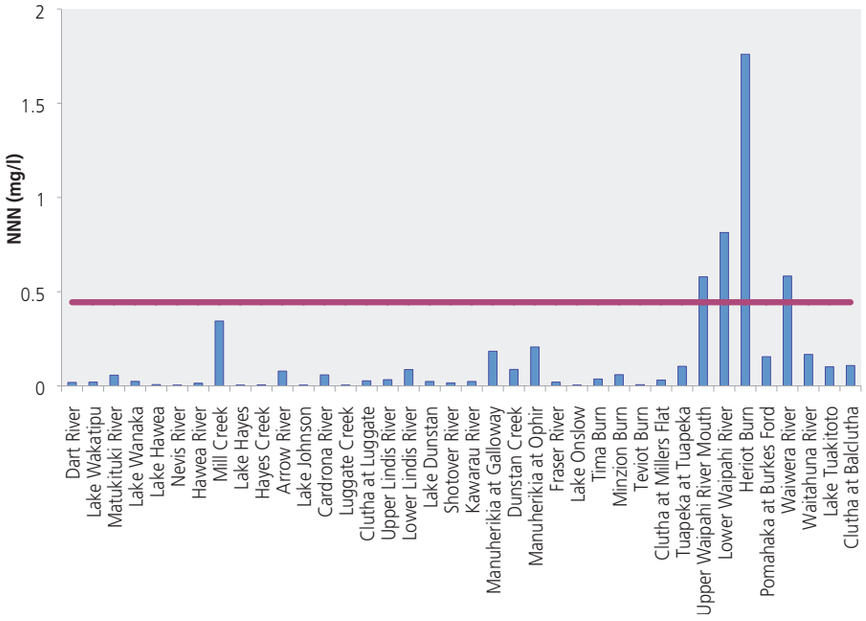
Mill Creek

Waiwera River

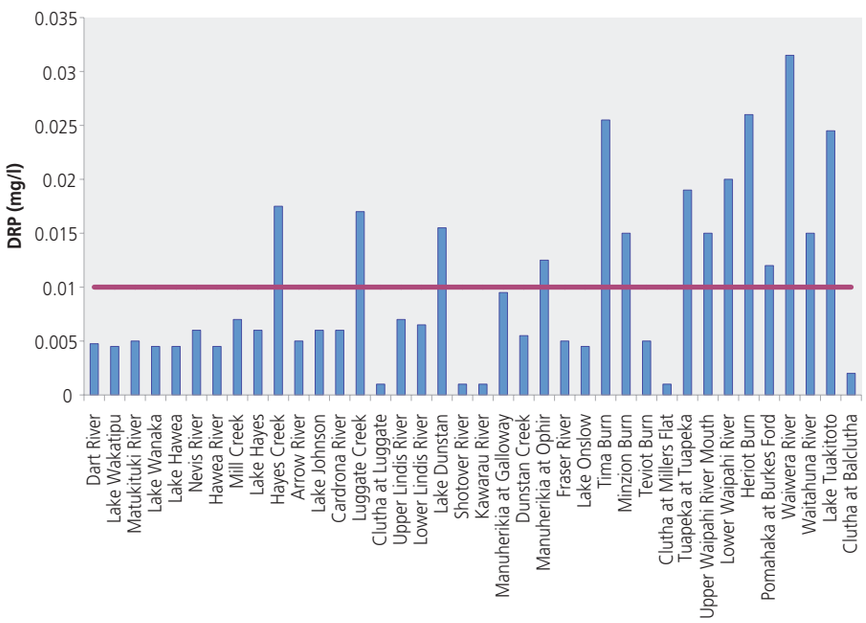
Waipahi River

Nutrients

Nitrite-nitrate nitrogen (NNN) is a form of nitrogen primarily derived from land drainage. It is an important nutrient for algae and plant growth. Most of the sites with low NNN concentrations are in Central Otago and the Clutha Lakes, where land-use is low-intensity sheep farming or dominated by tussock lands. The highest concentrations of NNN in south/south-west Otago are where high intensity sheep farming or dairy farming is common place, as are tile drains. The Heriot Burn had the highest NNN concentration.

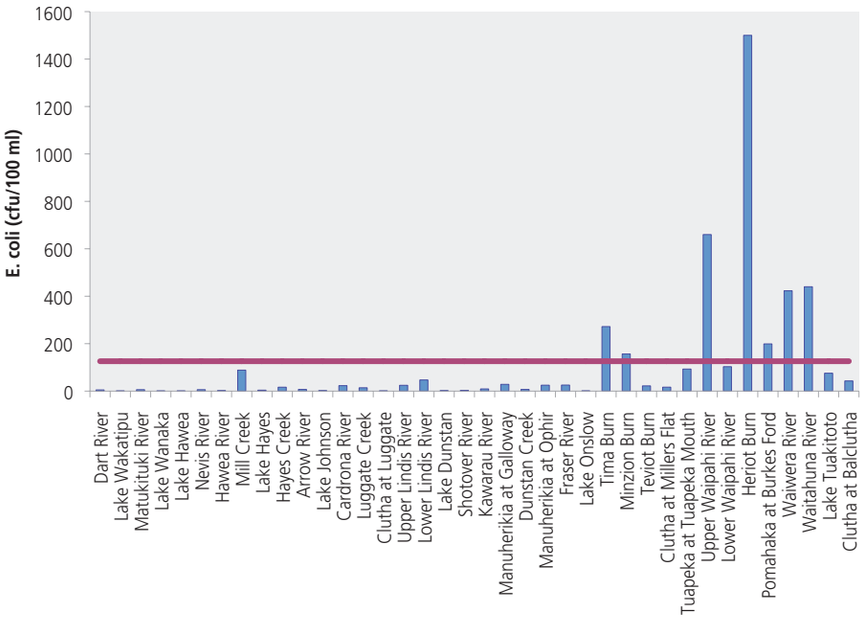


Dissolved reactive phosphorus (DRP) is a growth-limiting nutrient. Sources of DRP can be traced back to point source discharges of wastewater effluent, animal effluent, and fertiliser. The graph below shows that about half of the sites sampled had DRP concentrations exceeding the ANZECC guideline. Several sites were in south/south-west Otago with the Waiwera River recording the highest DRP concentration. Several sites in Central Otago also had high concentrations, such as the Manuherikia at Ophir, Luggate Creek, and Lake Dunstan.



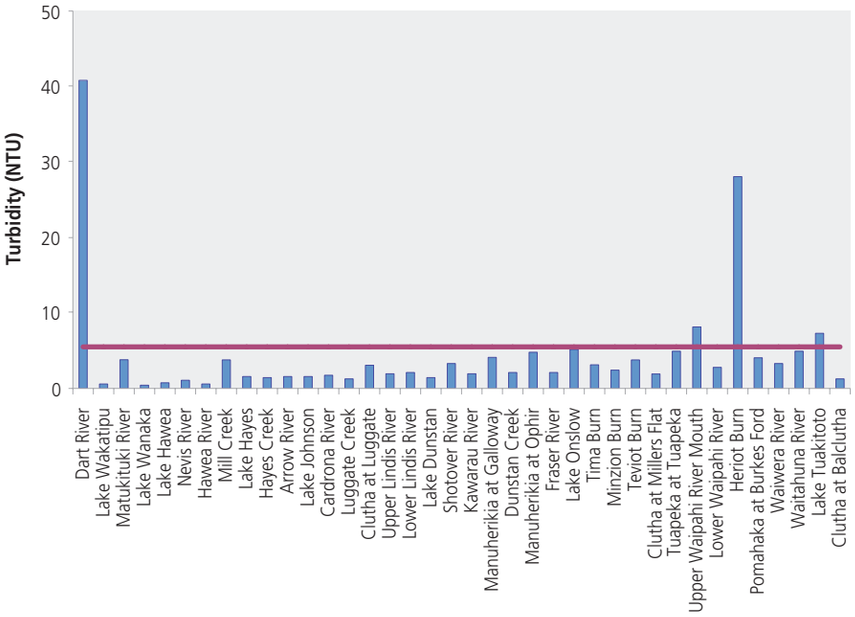
Bacteria

Median concentrations of *E. coli* were above the ANZECC (1992) guideline of 126 cfu/100 ml at seven of the sites. Most of the sites where the guideline was exceeded were in south/south-west Otago where intensive farming is dominant. The Heriot Burn recorded a median concentration of *E. coli* 12 times the national guideline. Some Central Otago sites (Tima Burn and Minzio Burn) also exceeded the guideline. Heriot Burn exceeded the single sampled guideline of 260 cfu/100 ml on all sampling occasions.



Turbidity

Turbidity concentrations were low for the majority of sites except for some sites in South Otago and the Dart River. The Dart River had the highest turbidity concentrations with a median concentration of 40.8 NTU. The Dart River has naturally high turbidity levels as it drains the Dart Glacier. As such it transports high volumes of glacial till.



Guidelines for bacteria

The ANZECC (1992) guidelines recommend a season median of less than 126 cfu (colony forming units)/100 ml.

The Ministry of Health and Ministry for the Environment (2003) guideline recommends that a single sample does not exceed 260 cfu/100 ml.

A sediment plume in the Heriot Burn

Cardrona River

Guidelines for turbidity

Turbidity is a measure of how much light is able to penetrate the water column to the river bed. Streams with high turbidity often have high suspended sediment loads. Having high turbidity can reduce light penetration impacting on macrophyte and algae's ability to photosynthesise, therefore reducing basal food supplies. High sediment loading also tends to smother bed habitat, creating poor fish spawning conditions.

The ANZECC guideline value for turbidity is less than 5.6 NTU (Nephelometric turbidity units).

Ecosystem health

Ecosystem health takes into account a wide range of inter-linked factors such as water quality, habitat and instream biota. It is generally assessed using two communities that are important to the food chain in rivers: streambed macroinvertebrates (e.g. insects, crustaceans, snails and worms) and periphyton (e.g. algae). Biotic indices are used to summarise a large amount of information into a compact and simple form. They are therefore, inherently coarse tools that give a broad view of general patterns. However, they are useful as the presence, abundance, or distribution of species can inform us greatly about the quality and condition of the river in which they live.

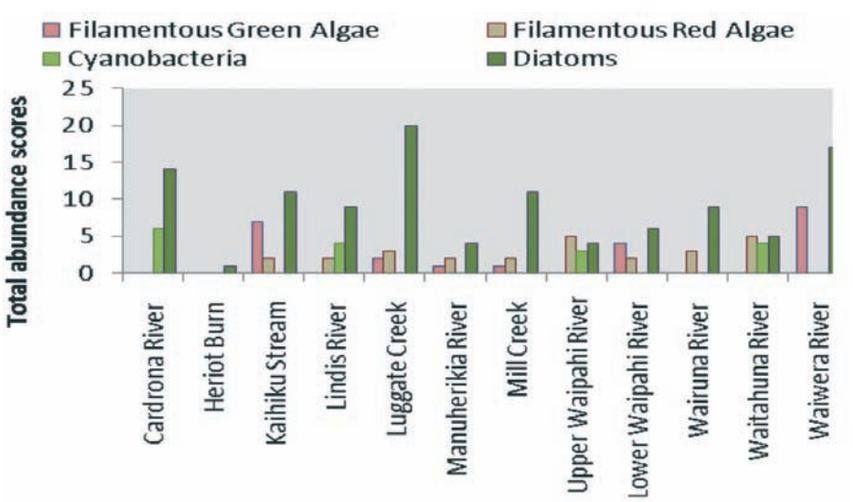
Biggs, B.J.F. & Kilroy, C. (2000) Stream periphyton monitoring manual, Ministry for Environment, Wellington.

Algae (Periphyton)

Excessive amounts of periphyton, in particular, filamentous algae, can reduce the amenity value of waterways by decreasing their aesthetic appearance, reducing visibility, and being a physical nuisance to swimmers. While algae is a useful tool for monitoring the nutrient conditions in rivers and streams, it is just one method used to get a complete overview of the river system. Factors other than nutrient levels also influence the composition of benthic algal communities. These include substrate composition, river flows, the amount of light reaching the river bed, and water temperature.

Algal samples were collected from 12 sites. Algae were given an abundance score ranging from 1 (rare) to 8 (dominant) based on the protocols developed by Biggs and Kilroy (2000). All abundance scores were totalled for each algae type (graph below) to give an appreciation of relative abundance.

All sites were dominated by diatom communities with Luggate Creek having the most dominant diatom community. The Heriot Burn had the least dominance of any algal types while the Waitahuna River was equally dominated by filamentous red algae, cyanobacteria, and diatoms. Didymo was only present in the Lindis River, while *Phormidium* was only present in the Cardrona and Lindis Rivers. The Heriot Burn's low algae scores (despite high nutrients) could reflect the fine sediment on the stream bed providing an unstable surface to adhere to.



Macroinvertebrates (stream bed insects)

Macroinvertebrates are an important component of streams and rivers as they aid ecosystem processes and provide food for fish. Macroinvertebrates are also good for assessing pollution, as different macroinvertebrates have differing pollution tolerances. They also have a relatively long life span, and as such, are good indicators of environmental conditions over a prolonged period. The main measure of macroinvertebrate communities, the MCI index, is designed specifically for stony riffle substrates in flowing water. MCI values can vary due to the availability of suitable habitat, and not necessarily due to water quality. As substrate types can vary greatly between riffles, it is often appropriate to compare changes in MCI values at the same site over a period rather than between sites throughout the catchment. However, the MCI can still be a useful tool for picking up changes in ecosystem health notwithstanding its limitations.

Macroinvertebrate communities were assessed in the summer of 2010/2011 by taking a single kick net from a variety of habitats in each river. The highest macroinvertebrate diversity was found in the Waiwera River with 25 species, 12 of which included the healthy EPT taxa. The site had an MCI score of 97 and an SQMCI score of 4.0 making this an average stream with probable moderate pollution. Conversely, the Waitahuna River had the second-lowest species richness (14 species), but had a high MCI score and high SQMCI score. This site was dominated by caddisflies (*Pycnocentrodes* species and *Helicopsyche* species) and *Deleatidium* mayflies.

Indices to measure macroinvertebrate community health

Macroinvertebrate community index (MCI)

The MCI is calculated by adding the pollution tolerance scores of all species found at a site. Species that are very sensitive to pollution score highly. The invertebrates suited to muddy/weedy-bedded, pool like habitats are generally the more tolerant, low-scoring taxa that tend to reduce MCI values.

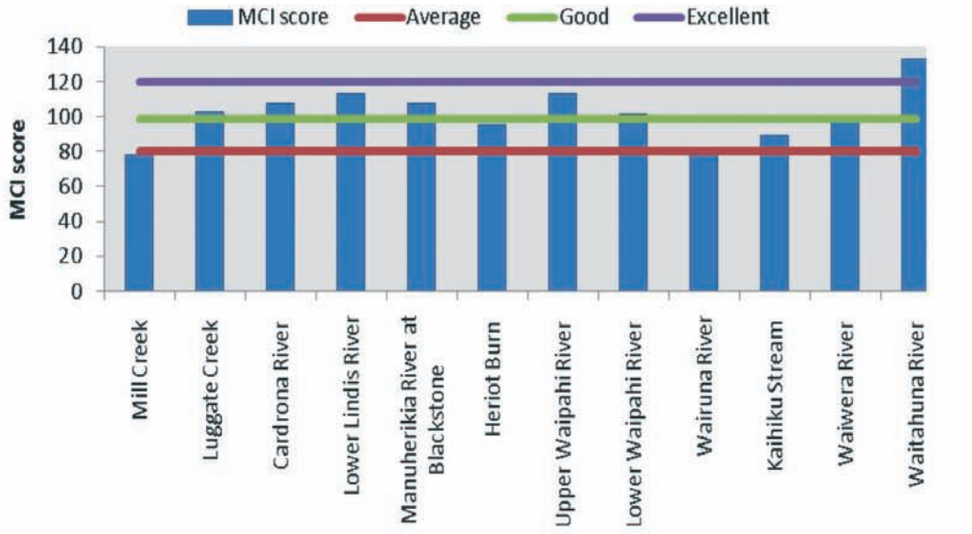
EPT species

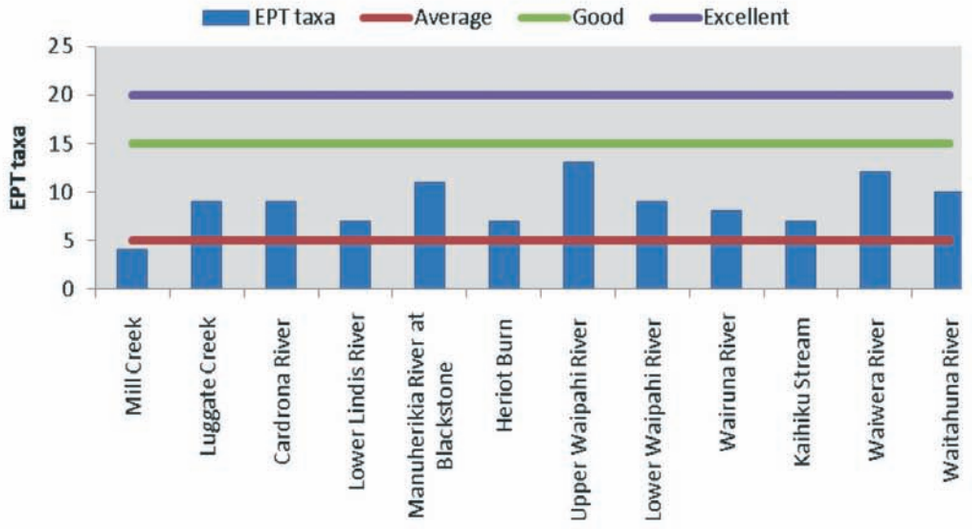
EPT richness is a sum of the total number of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) species collected.

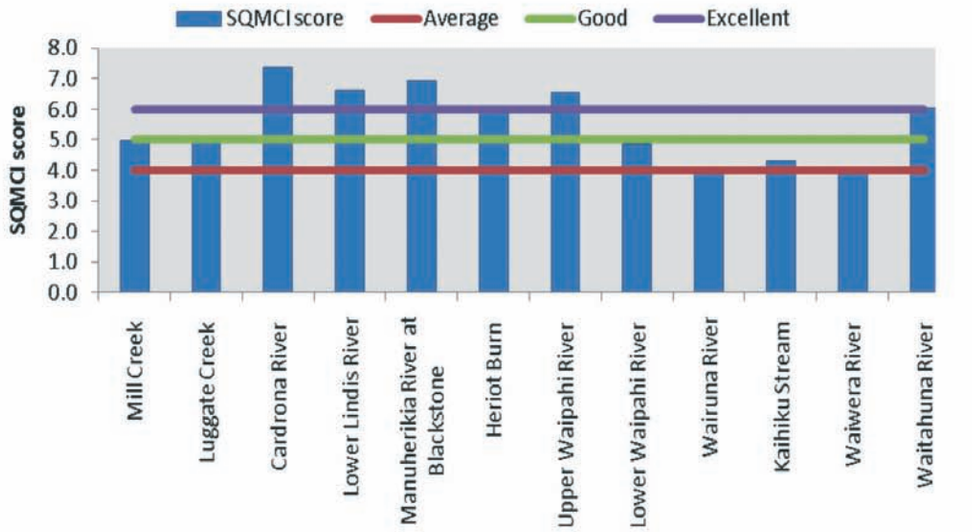
EPT taxa are generally sensitive to a range of pollutants including fine sediment and nutrient enrichment.

Semi-quantitative macroinvertebrate community index (SQMCI)

The SQMCI is also based on the ratios of sensitive to tolerant taxa, but SQMCI results are primarily determined by the most abundant taxa (unlike the MCI where all taxa are given equal weight in the calculation.)





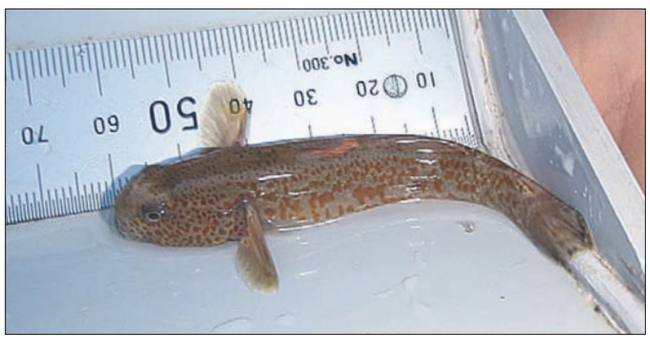


Fish

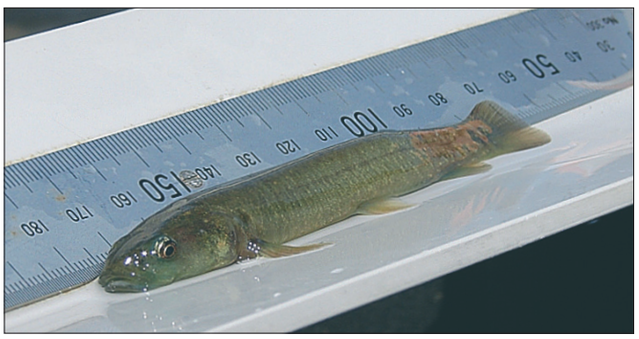
Electric and spotlight fishing methods were employed to survey 11 streams in the Clutha catchment over the 2010/2011 summer. Nine species were recorded, two of which are introduced sports fish (Brown and Rainbow Trout) while the other (Perch) is an introduced pest. The Upper Waipahi river had the highest fish diversity with five fish present, of which four species were native. Most other fish had three or four species with the most common being brown trout or bullies. Luggate Creek only had one fish species present- brown trout.

The table below summarises count data for each species at each site.

Site	Common Bully	Upland Bully	Shortfin eel	Longfin eel	Unidentified eel	Koaro	Clutha Falthead galaxiid	Unidentified galaxiid	Rainbow Trout	Brown Trout	Perch	Number of species	Percent native fish (%)
Cardrona River		48		1		7			15	31		5	80
Upper Lindis River		484								20		2	50
Lower Lindis River	527									7		2	50
Mill Creek	174					6				20	1	4	50
Luggate Creek										225		1	0
Heriot Burn		14		4						218		3	67
Upper Waipahi River		42		8			1			9		4	75
Lower Waipahi River		2		5	5			5		1		5	80
Wairuna River		16	4	17			6		2			5	80
Waiwera River		50		12						206		3	67
Waitahuna River				2						2		2	50



Upland bully



Flathead galaxiid

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