North and Coastal Otago

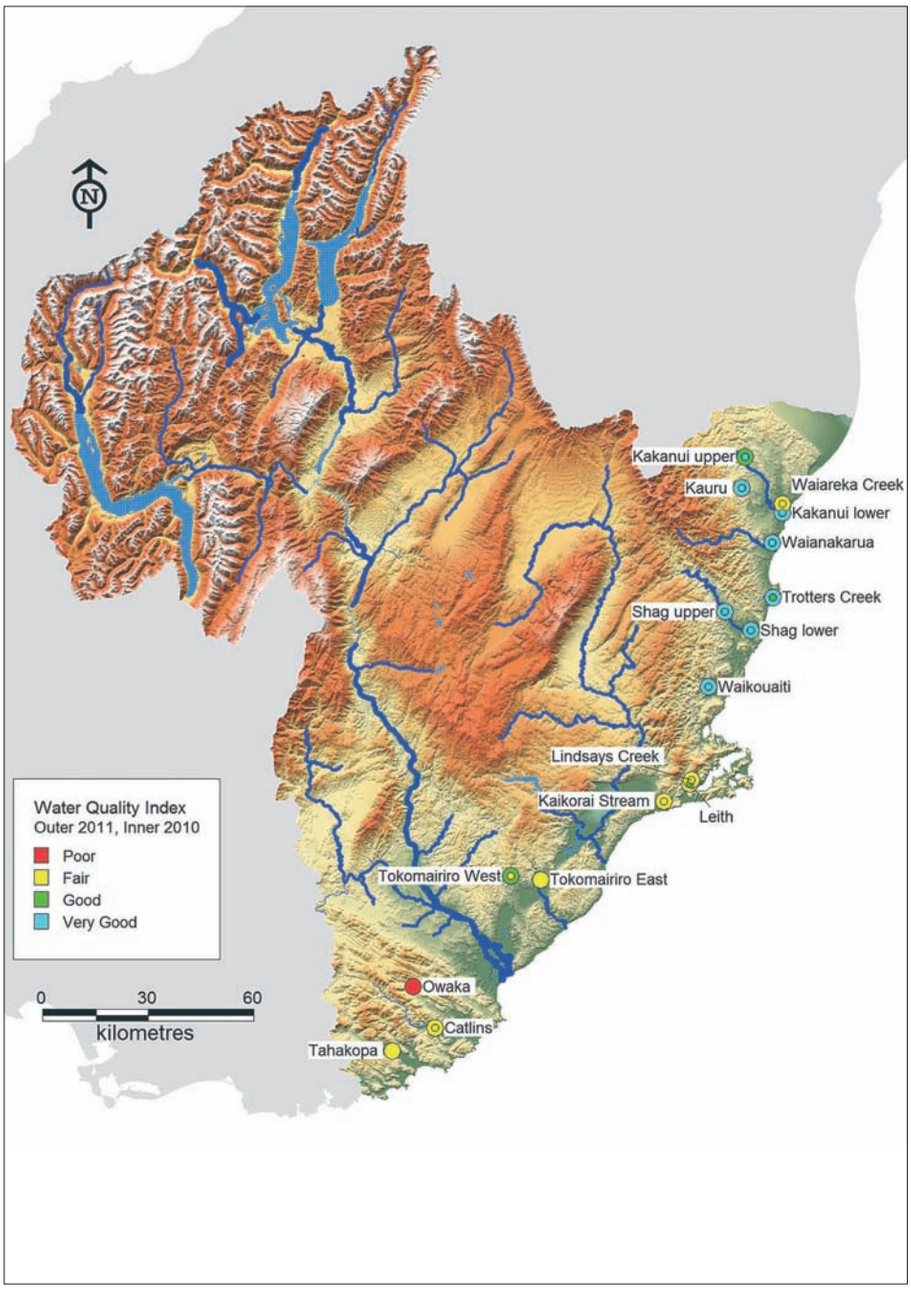
Water quality and ecosystem health
July 2010 to June 2011

Otago Regional Council

Water Quality

Introduction

The Otago Regional Council (ORC) monitored 18 river and stream sites in the northern and coastal areas of Otago between July 2010 and July 2011 to assess the current state of water quality. Sites were classified using a water quality index, and the results are shown in the map below.



Summary

- The majority of sites had good or very good water quality. The Owaka River had the worst water quality in this region
- All water monitoring sites in the Catlins area had either fair or poor water quality with nutrient concentrations either at, or above recommended guideline values
- All urban streams had fair water quality with the highest bacterial reading recorded in Lindsay's Creek
- Didymosphenia geminata (Didymo) was very dominant in the Kakanui and Waikouaiti Rivers
- Six streams had SQMCI scores suggesting long-term and chronic pollution in these rivers
- Fish assemblages were diverse with North Otago rivers tending to have the highest species diversity.

Water quality index

ORC uses a water quality index (WQI) to report water quality. The index is derived from median values 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).

Medians 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.

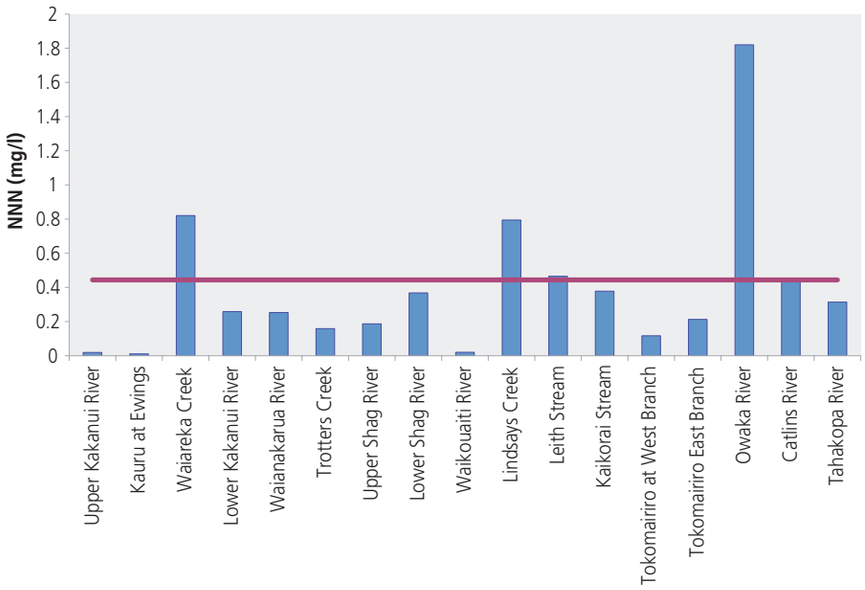
Kaikorai Stream

Kauru River

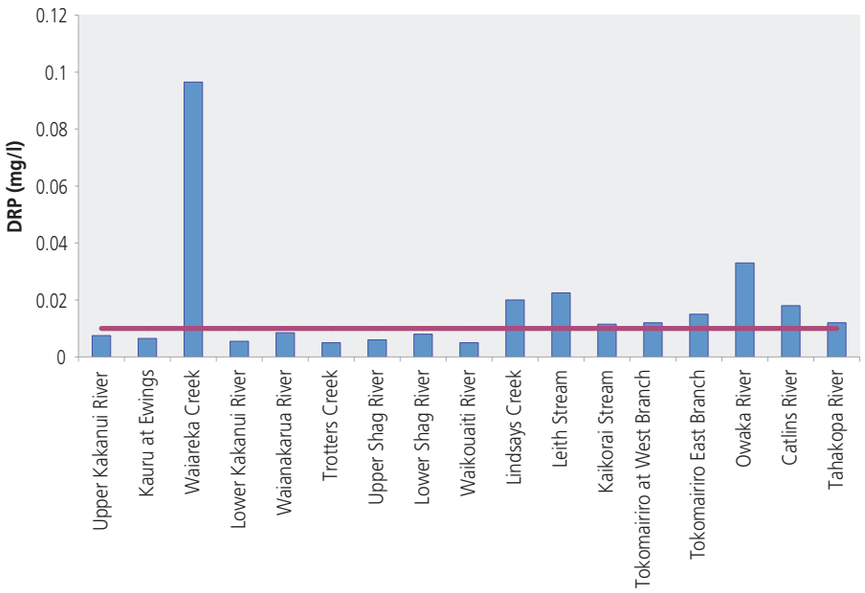
Upper Kakanui River

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. Owaka River had the highest concentration of NNN and was four times higher than the guideline. Lindsay's Creek and Waiareka Creek were also above the guideline, with median concentrations of 0.79 and 0.82 mg/l respectively. The Kauru River had the lowest concentration of NNN. Leith Stream was also just over the guideline.

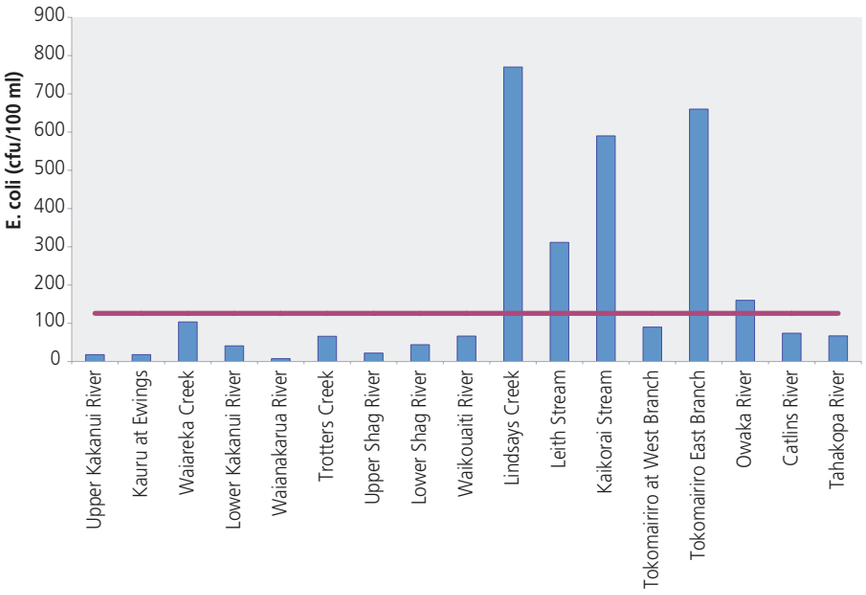


Dissolved reactive phosphorus (DRP) is a growth-limiting nutrient. Sources of DRP can be traced back to point source discharges of wastewater effluent, animal effluent, and fertiliser. The graph below shows that Waiareka Creek had a median DRP concentration almost 10 times higher than the guideline. A further eight sites exceeded the guideline value. The west branch of the Tokomairiro River and the Tahakopa River were marginally over the guideline, while the Owaka River and the Leith were 3 and 2.5 times higher.



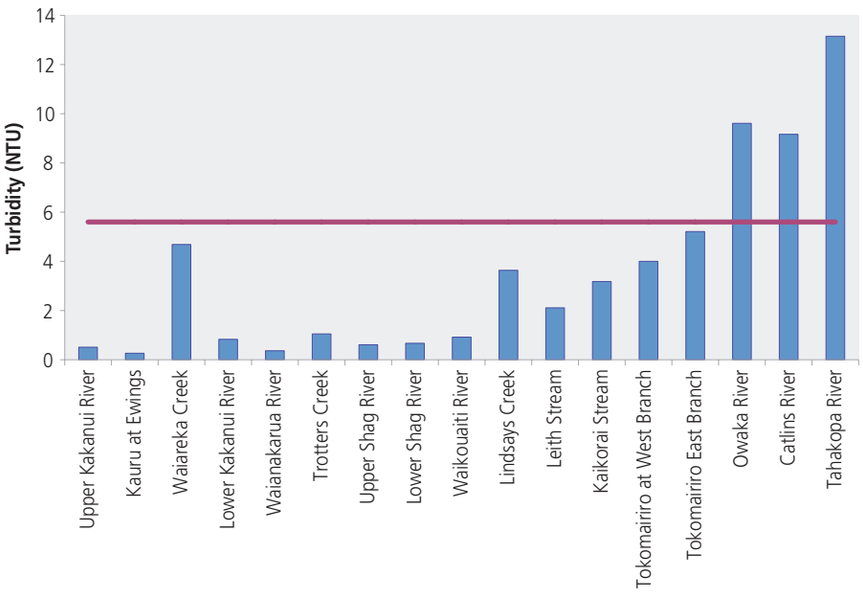
Bacteria

Median concentrations of E. coli were above the ANZECC (1992) guideline of 126 cfu/100 ml at seven of the sites. Of the 18 sites sampled, four sites exceeded the guideline values. Lindsay's Creek had the highest bacterial readings with a median concentration of 770 cfu/100ml followed by the Tokomairiro River. Three of the four streams exceeding the guideline were urban streams.



Turbidity

Turbidity values were elevated in urban streams and streams in coastal south Otago. They were above the guideline in the Catlins region with the Tahakopa River recording the highest turbidity reading of just over 13 NTU. Waiareka Creek in North Otago also had elevated turbidity, but still below the guideline value.



Guidelines for bacteria

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

(A dead lamb in a tributary of the Owaka River. Decomposing stock are a potential cause of bacterial pollution.)

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 reducing basal food supplies in the process. 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 diverse range of inter-linked factors such as water quality, habitat and instream biota. It is generally assessed using two communities which 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 compress 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.

Collecting a macroinvertebrate sample.

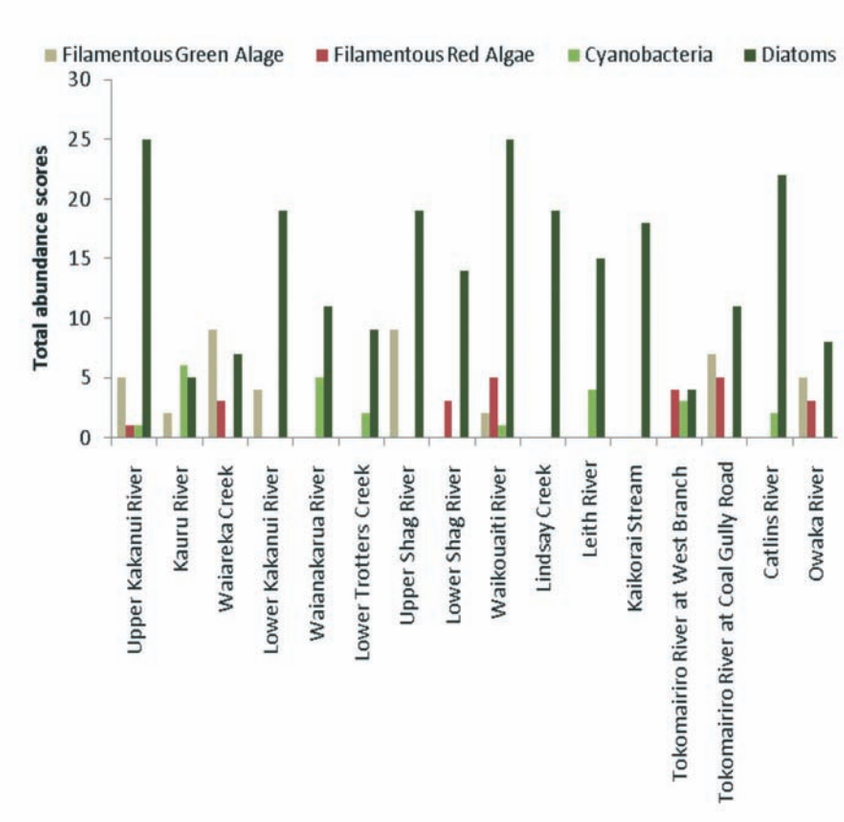
Biggs, B.J.F. & Kilroy, C. (2000) Stream periphyton monitoring manual, Ministry for Environment, Wellington.

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 means of getting an 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 16 sites this season and 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 added up for each algae type (graph below) to give an appreciation of relative abundance.

There was a high abundance of algae in most streams in this region with diatoms being the most dominant community. The exception to this was Kauru River where cyanobacteria (*Phormidium*) was dominant and Waiareka where filamentous green algae were present. All algal groups were of similar dominance in the west branch of the Tokomariro River. *Didymosphenia geminata* was present in the upper Kakanui River (dominance score 6 out of 8) and the Waikouaiti River (dominance score 7 out of 8).



Macroinvertebrates (stream bed insects)

Macroinvertebrates are an important component of streams and rivers. 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 so are good indicators of environmental conditions over a prolonged period. The main measure of macroinvertebrate communities is the MCI, which 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 type can vary greatly between riffles, it is often appropriate to compare changes in MCI values at the same site over time 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 most diverse site in the sub-region (and through those monitored in Otago) this year was the Shag River at Craig Road with 27 species recorded. Despite this high taxonomic richness, the site still had MCI and SQMCI scores suggesting some pollution. The most polluted stream was the urban Kaikorai Stream with MCI and SQMCI scores of 75 and 1.9 respectively. This was followed by Kakanui at McCones with an MCI score of 78. The site with the best SQMCI score (6.6) was Kakanui at Clifton Falls. This site had an abundance of *Deleatidium* mayflies and caddisflies such as *Oecetis* species, *Aoteapsyche* species and *Pycnocentrodes* species.

Indices to measure macroinvertebrate community health

Macroinvertebrate community index (MCI)

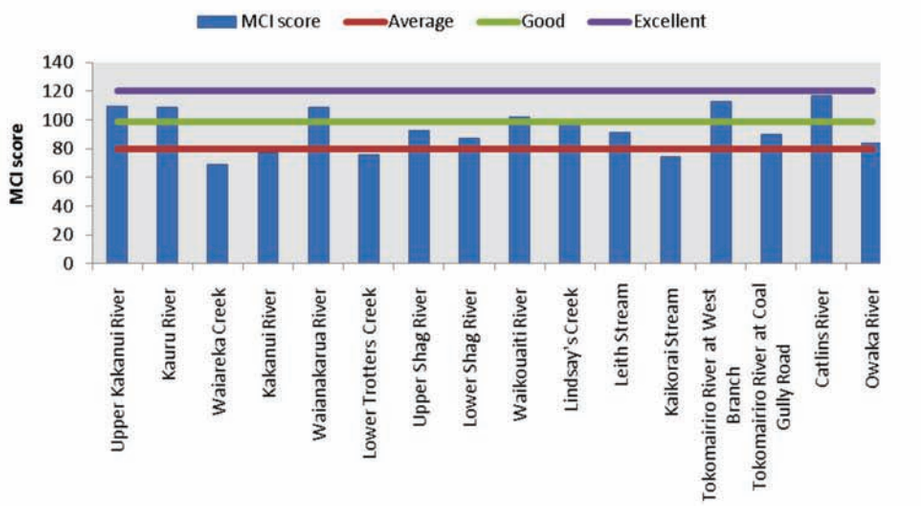
The MCI is calculated by adding the pollution tolerance scores of all species found at a site. Species that are very sensitive to pollution score highly. The macroinvertebrates suited to muddy/weedy-bedded, pool like habitats are generally the more tolerant, low-scoring taxa that tend to reduce MCI values.

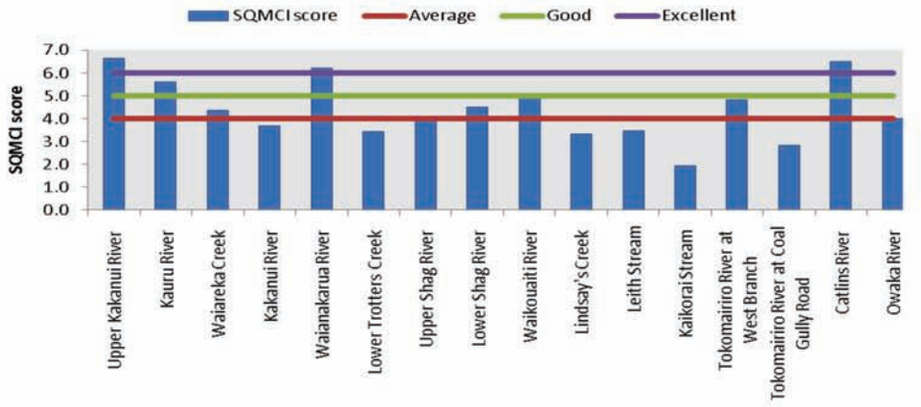
EPT species

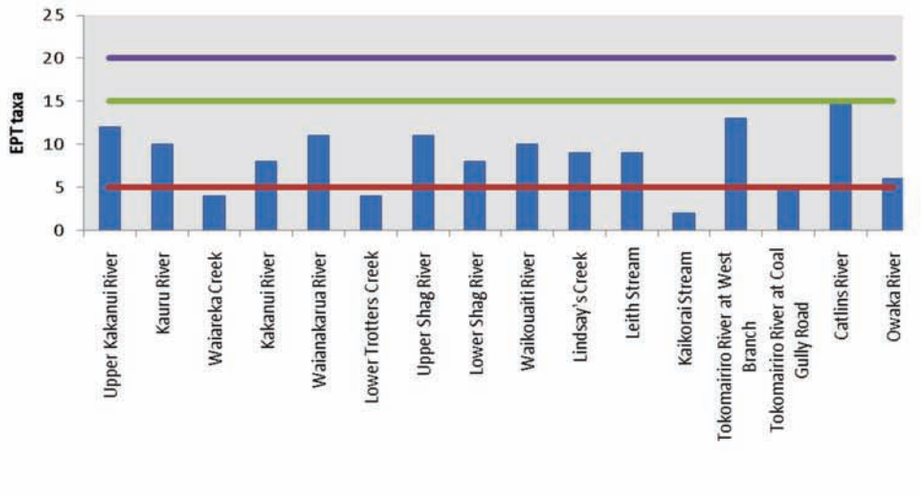
EPT richness is a sum of the total number of Ephemeroptera (mayflies); Plecoptera (stoneflies) and; Trichoptera (caddisflies) species collected.
EPT taxa are generally sensitive to a range of pollutants including fine sediment and nutrient enrichment.

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 fishing and spotlight surveys were conducted in the summer of 2010/2011. This sub-region had the highest species diversity of all the sub-regions. This is because many sites were close to the coast and had a range of native, migratory fish living in them. For many of our native fish (particularly so for the whitebait species such as inanga), they require access to the sea to complete part of their life cycle; hence the higher diversity of fish in coastal streams. The highest number of species caught at any one site was nine species in the Kakanui, Shag, Waianakarua, and Waikouaiti Rivers. The Lower Kakanui River had the highest percentage of native fish with 100%. The lowest diversity of fish was recorded in Lindsay's Creek with three species caught, with brown trout being the most abundant fish present.

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

Site	Shrimp	Inanga	Common Bully	Bluegill Bully	Redfin Bully	Upland Bully	Unidentified Bully	Torrentfish	Black flounder	Short fin eel	Long fin eel	Lamprey (juvenile)	Lamprey (adult)	Koaro	Canterbury galaxiid	Brown trout	Number of species	Percent of native fish (%)
Upper Kakanui River		*P = present*				124				1		4		2	34	8	6	83
Waiareka River		4					1									1	4	75
Lower Kakanui River		10	228	436	1	1		87		10	12	2					9	100
Waianakarua River		1	254	136		113		15		13	3	98			37		9	100
Upper Trotters Creek			2		10		39				1				10	15	6	83
Lower Trotters Creek	P	20	15				10				4						5	10
Upper Shag River		1	136	8		152	57			60	46	5				6	9	89
Waikouaiti River	P	66	521						6	12	19		23	1		13	9	89
Lindsay's Creek												7				288	3	67
Leith Stream					3						2					20	4	75
Kaikorai River	P	2	538		4						33					10	6	83
Tokomairiro West Bridge					7	18				1	1	87		2		210	7	86
Owaka River											2					74	2	50

Blue gill bully

Adult lamprey

Otago Regional Council
Private Bag 1954, 70 Stafford Street
Dunedin 9054

Phone 03 474 0827
fax 03 479 0015

Freephone 0800 474 082
www.orc.govt.nz