

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of an application pursuant to Section 201 for a
Water Conservation Order on the Hurunui River.

**STATEMENT OF EVIDENCE OF DONALD JOHN JELLYMAN
ON BEHALF OF
THE NORTH CANTERBURY FISH AND GAME COUNCIL
AND THE DIRECTOR GENERAL OF CONSERVATION**

Dated 6 March 2009

1. QUALIFICATIONS AND EXPERIENCE

- 1.1 My full name is Donald John Jellyman. I have the following qualifications: I hold the qualifications of B.Sc (Hons), and Ph. D. (1974) from Victoria University of Wellington.
- 1.2 I am a fisheries biologist with 40 years of experience and I have been employed as a freshwater fisheries scientist with the National Institute of Water and Atmospheric Research Limited (NIWA) from July 1992 to the present. My role is principal scientist, freshwater fish. Prior to that I was employed as a fisheries scientist with the Ministry of Agriculture and Fisheries (1972 – 1992). Since completing my PhD on the ecology of juvenile freshwater eels, my research has principally focused on life history studies of native fish, particularly eels. I have been invited to contribute papers and book chapters on eel biology, and am currently involved with collaborative research with colleagues in Japan and Taiwan. I have presented evidence at several local authority and tribunal hearings, primarily on the effects of river development (hydro, irrigation, flow setting requirements) on the aquatic invertebrate and fish communities. I have published 80 scientific papers in local and international journals, numerous reports and popular articles, and presented papers on fish biology at both local and international conferences. I am a member of the New Zealand Freshwater Sciences society, and the American Fisheries Society.

- 1.3 I have presented evidence at Conservation Order hearings for the Ahuriri, Buller, Grey, Wairau and Oreti Rivers.
- 1.4 I have also researched trout stocks nationally, and have been involved with fisheries impact assessment studies on a number of South Island waterways (eg. Wairau, Waimakariri, Ahuriri, Grey, Buller, Clutha) that have included assessing the impacts of hydro (both large and smaller local-authority schemes where issues involved include fish access, and impacts of fluctuating lake levels and discharges), irrigation, stream channelisation and urbanisation on aquatic resources.
- 1.5 I am the senior author of the National Headwater Trout Survey (Jellyman and Graynoth 1994), and also a report collating anglers perceptions of the status of lowland rivers throughout New Zealand (Jellyman et al. 2003)
- 1.6 I have read the Code of Conduct for Expert Witnesses (Rule 330A, High Court Rules and Environment Court Practice Note) and agree to comply with it. I have complied with the Code in the preparation of this statement of evidence.

2. SCOPE OF EVIDENCE

- 2.1 I have been asked by New Zealand Fish and Game Council and North Canterbury Fish and Game Council to prepare evidence in relation to describing the trout fishery of the upper Hurunui River, and the significance of trout movements throughout the mainstem river. I have also been asked to prepare evidence on behalf of the Director General of Conservation in respect to native fish species, in particular those species that are reliant on unimpeded access to complete their life cycle.

3. THE NATIONAL HEADWATER TROUT STUDY

- 3.1 New Zealand possesses a type of trout fishery that appears to be unique worldwide - the opportunity to catch large wild trout in the clear upper reaches of scenic and often remote, back country rivers. For convenience, such rivers are collectively termed "headwater fisheries". Such rivers are targeted by both New Zealand and overseas anglers, and are gaining increased international recognition.

- 3.2 One of the main challenges facing fishery managers is managing angler pressure (sometimes through restricting angler use) as well as managing fish stocks. These factors, together with increasing concern about possible impacts by hydro power schemes and changed landuse patterns (e.g. forestry), lead to the first nation-wide study to determine the location and characteristics of such rivers (Jellyman and Graynoth, 1993).
- 3.3 This survey used questionnaires of Fish and Game staff to compile a comprehensive list of headwater rivers throughout New Zealand, and classified them as either “all-season” or “early season” fisheries, according to whether they could sustain angling throughout the whole fishing season or not. A separate questionnaire sent to experienced anglers and fishing guides, asked questions about the behaviour of fish, any perceived changes to sizes and catch rates of trout and to the numbers of anglers using nominated rivers. In addition, anglers were requested to record the species and size of fish caught, and also to take scale samples for determination of ages and growth rates.
- 3.4 Although these data were collected from 1989-1991, I would still regard the classifications provided by Fish and Game staff to be valid, unless there has been some obvious and pronounced changes to the catchments, or fishing patterns and practices. I am not aware that either has taken place on the upper Hurunui River, and therefore regard the original classifications as valid.

4. **RESULTS FROM THE NATIONAL HEADWATER TROUT STUDY**

- 4.1 The Hurunui South Branch was listed as an “all-season” trophy and headwater fishery for brown trout throughout all reaches (upper, middle and lower), while the North Branch was listed as an “early season” trophy and headwater fishery for brown trout (with occasional rainbow trout) for its middle reach. Note that as this survey did not attempt to define reaches geographically, the “middle reach” of the North Branch is presumed to be the Mainstem reach below Lake Sumner.

The national totals of headwater rivers were:

- All season: North Island: 20 rivers, South Island 74 rivers (15 in the North Canterbury Fish and Game region)

- Early season: North Island: 3, South Island 40 (4 in the North Canterbury Fish and Game region)
- 4.2 The recreational fishery is based on brown trout, although chinook salmon occur in summer, especially in the river below Lake Sumner, where they congregate prior to moving through the lake to spawn in river above the lake (Bonnett and Docherty 1985).
- 4.3 Some subjective characteristics of the fisheries were provided, with the South Branch listed as having trout of “large size”, that were “challenging” to catch, and the North Branch as having “large size” of fish.
- 4.4 From the database of 2712 scale samples (and fish sizes) received during the National Headwater Trout Survey, a total of 7 samples were received for the Hurunui catchment. While this was a small sample, it did include records of 4 very large brown trout (4.9, 6.4, 4.0, 8.2 kg), although, understandably, the exact location of where these fish were caught was not disclosed.
- 4.5 As an angler myself, if asked where to send a visiting angler interested in fly-fishing high-country water, I would almost invariably direct the angler to the upper Hurunui River because of :
- Ease of access (by road)
 - Extensive water to fish
 - High likelihood of catching a brown trout of above average size
 - Scenic conditions
 - The challenging nature of the angling experience it offers
 - The river below Lake Sumner is fishable after rain when most other North Canterbury rivers would be discoloured

5. **IMPORTANCE OF THE LOWER RIVER**

- 5.1 While the upper Hurunui River is the recognised headwater trout fishery, the lower river has some value as a recreational trout fishery in its own right. Of particular

significance though will be its contribution of adult trout to the headwater fishery of the upper river. Thus, maintaining the quality of habitat in the lower river is of considerable importance to the continued well-being of the headwater fishery.

- 5.2 To assess anglers' perceptions of the status of lowland rivers, a postal questionnaire was carried out of anglers with at least 20 years experience (Jellyman et al. 2003). These anglers were asked to rate any change in angling quality, and the number and size of fish, for rivers that they fished regularly. Scores were ranked from -2 (marked decline) to +2 (marked improvement). While the focus was on lowland rivers, anglers also provided information of the lowland portions of rivers sourced further inland like the Hurunui. With few exceptions, results were negative i.e. anglers perceived that the status of rivers had declined over their fishing experience.
- 5.3 Results (Table 1) indicated that the (lower) Hurunui River was perceived as the least impacted lowland river in the North Canterbury Fish and Game region. While this is commendable, the lower river is subject to water abstraction, river protection works, and much of the catchment is developed for pastoral farming and forestry. Given the presumed important contribution the lower river makes to trout stocks in the upper river, it is of obvious importance to maintain the water quality and quantity of the lower river.

6. **FISH ABUNDANCE**

- 6.1 Fish abundance data were derived from both the National Headwater Trout Survey (Jellyman and Graynoth 1993) and also the national drift diving survey (Teirney and Jowett 1990). Drift diving provides summed counts of trout over measured reaches of river made by experienced divers drifting downstream in a line abreast. This technique is now routinely used by Fish and Game personnel to observe trends in trout abundance in reference rivers nationwide. Again, although the data are 20 years old, in the absence of significant environmental or management changes, I regard them as indicative of the likely numbers of trout in the various rivers (although there will always be some degree of annual variability that is not captured in "one-off" dives like those listed).
- 6.2 Results from the Hurunui drift dive counts and those from a selection of other recognised headwater rivers (Table 2) show that the Lake Sumner outlet has an exceptionally high number of large trout per km; the total number of trout per km is

also the highest of those rivers listed, while the average biomass (i.e. g/m²: total biomass adjusted for the size of the river) is also the highest listed. In fact, of the 158 records (94 individual rivers, and with 64 multiple counts within the same river), the Upper Hurunui was only exceeded in fish/km by the upper Buller (at the outlet of Lake Rotoiti), the Gowan River (at Lake Rotoroa outlet), and the upper Clutha (at Lake Wanaka outlet). All these sites are at lake outlets, where stable flow conditions lead to high invertebrate productivity (especially net-spinning caddis).

6.3 Data from the two Hurunui sites beyond the Lake Sumner influence (near Sisters Stream) have numbers of large trout that are similar to those of other recognised headwater fisheries like the upper Oreti, upper Wairau, a range of upper Buller tributaries, and the upper Maitai.

6.4 In summary, the upper Hurunui River supports very high numbers of brown trout – numbers will vary seasonally as further adult trout join resident trout prior to spawning. Density of trout in the reach below Lake Sumner is typical of that of other lake outlets, fisheries characterised by high densities of fish in turn supported by high benthic production (especially caddisflies). Other reaches of the North Branch have trout densities typical of those of other recognised headwater trout fisheries. I have no knowledge of trout stocks in the South Branch, other than that contained in the National Headwater Trout survey where anglers rated this as an all-season fishery.

7. **NATIVE FISH**

7.1 A total of 12 species of native fish have been recorded in the New Zealand Freshwater Fish Database from the Hurunui catchment (Table 3). In addition, there are 4 species of introduced fish, one of which, brown trout, is the most commonly encountered species within the catchment (Table 4). Amongst native species, the upland bully has been recorded most frequently, followed by koaro and the Canterbury galaxias, the alpine galaxias, and the longfin eel. Usually, longfin eels are the most frequently encountered native species within a catchment, followed by other ubiquitous species like common and upland bullies. The high frequencies of alpine galaxias is probably a reflection of the relatively high intensity of sampling in the upper catchment - ¾ of the 90 records on the Freshwater Fish Database are for sites above Mandamus.

- 7.2 A feature of New Zealand's native freshwater fish fauna is the high proportion of diadromous species i.e. species that carry out part of their life cycle within the sea – for instance, migratory galaxiid species (koaro) and common bully spawn in fresh water but the juveniles are usually swept to sea and recruit back to fresh water several months later; both species of eels migrate to sea as mature adults and juveniles recruit into fresh water in spring. Diadromous species are indicated in Table 3, and for all these, access to the sea is important – for eels it is essential, although koaro and common bully will sometimes form landlocked populations if access to the sea is denied. The two smelt species normally penetrate only a few km inland.
- 7.3 The native species assemblage contains 3 that are listed in the Department of Conservation's threatened species classification. Upland longjaw galaxias and longfin eels are listed as "species in gradual decline", whereas Stokells smelt is a species with a "restricted range". While not listed in the Freshwater Fish Database for the Hurunui catchment, (but known to be present), lampreys are listed as "sparse". Of the 3 recorded "threatened" species, longfin eels have an extensive distribution, and are subject to commercial and some customary exploitation. While no specific surveys of longfin eels have been carried out in the catchment, from a New Zealand wide estimation of longfins eels, it was estimated that the Hurunui catchment contains 218 t of longfin eels of which 22 t are within areas that cannot legally be commercially fished (Lake Sumner). This total biomass (218 t) is approximately 2 % of the national biomass of 12 000 t (Graynoth et al. 2008). Unlike most of the other East Coast South Island lakes, Lake Sumner has no barriers to recruitment of juvenile eels or escapement of adults, and this enhances it's importance as a contributor to the national biomass of spawning eels.
- 7.4 The Upper Hurunui catchment also contains Lake Marion, one of very few lakes below the treeline (680 m elevation) that have a fish fauna completely free of alien fish and a flora free of alien aquatic plants. This lake is connected to Lake Sumner via subsurface flows. Because of these highly-valued ecological attributes, Lake Marion is recognized as a Faunistic Reserve by the Department of Conservation. The lake contains populations of upland bullies, koaro, and longfin eels. The only other lake known to contain a similar assemblage of native fish is Lake Chalice in the Wairau River Catchment (Nelson/Marlborough).
- 7.5 Compared with other South Island East Coast rivers (Table 4), the native fish community in the Hurunui River is diverse but not unusual. The total number of

species recorded (19), is exceeded only by the Waitaki River (21), although records of both banded and giant kokopu are historic as neither species has been recorded from either river for several decades. The most significant species from a conservation viewpoint are longfin eels and upland longjaw galaxias – the former is ubiquitous throughout New Zealand although there are concerns for its long-term well-being as stocks have become reduced through harvest, and habitat loss and lack of access. The upland longjaw galaxias is a species with restricted range, being confined to the upper reaches of large rivers from the Hurunui to the Waitaki.

8. FISH PASSAGE ISSUES

- 8.1 Headwater trout fisheries are maintained by regular recruitment of adult fish from downstream reaches. Usually this recruitment coincides with spawning migrations of fish to the upper reaches. For example, at the Glenariffe salmon station in the upper Rakaia River, 1437 trout were tagged with streamer tags between 1975 and 1984, and 1990 and 1993 (Fox et al. 2003). As shown in Table 3, almost three-quarters of the 376 recaptures were in the Glenariffe stream, but 15 % were from the Rakaia Lagoon, with a further 11 % at locations between State Highway 1 bridge and Lake Heron. Seven female trout were caught out of the Rakaia catchment, but no male trout were recaptured outside the catchment. Overall, of the 106 trout that moved, the largest proportion (56%) had made an extensive migration (approximately 130 km) to the lagoon.
- 8.2 Thus, there is evidence of extensive post-spawning migrations of brown trout, often to the lower reaches of the river that afford enhanced feeding. These data were consistent with observations by Jellyman and Graynoth (1993) that upstream trout populations are dominated by males, with females joining them during the spawning season, after which many females migrate extensively downstream to the lower reaches of rivers to replenish the energy lost during spawning. The lower reaches will contain large quantities of "forage" fish like inanga, smelt and juvenile yelloweye mullet.
- 8.3 The high quality upper river trout fishery in the upper Hurunui River is highly likely to be reliant upon an influx of spawning trout from downstream reaches to maintain stocks; many of these trout are likely to be female (hen) fish from the lower river/estuary where they migrated to after spawning to recover condition.

Maintenance of passage for trout throughout the river is regarded as essential to maintain the high quality upper river fishery.

- 8.4 Any mainstem dam would need to ensure adequate upstream passage facilities for adult trout (as well as migratory native species like eels, lampreys, and koaro). Passage for native fish is relatively straight forward, as individuals will be small and can be attracted to outfall areas; upstream passage for brown trout and Chinook salmon would be more difficult and the type of technology chosen would depend upon the dam height. Options would be either a fish pass that fish would negotiate by themselves (e.g. pool and weir, Denil steep pass), or a fish lift where fish are attracted to a cage which is then lifted up the face of the dam and fish able to exit to upstream reaches. The record of successful upstream passage facilities for salmonids in New Zealand is poor (Jowett 1987), and the design and implementation of an appropriate facility is a technically challenging exercise that still contains elements of uncertainty of success.
- 8.5 **Native species.** As indicated, several migratory native species occur well inland, and would require both up- and downstream access at any mainstem dam or weir in the upper river. Ideally, any fish pass constructed for salmonid passage should also accommodate native species. The most abundant of the native species will be longfin eels, and juveniles (elvers) recruit upstream during summer, mainly mid December – mid March. Several million juvenile eels are transported annually above hydro dams, mostly using a trap-and-transfer technique whereby elvers climb a short ramp and fall into a collection box. From here they are manually transported and released upstream - numbers are estimated and are used as an important means of monitoring annual recruitment throughout New Zealand. Juvenile koaro can negotiate these elver-traps, although migrations will precede those of elvers by several months, necessitating a longer transfer season.
- 8.6 Providing for downstream passage of migrating eels is more difficult. Migrating (silver) eels will tend to migrate downstream in autumn, especially during floods. At dams and weirs, the spillway it is often operating during such periods and eels may be able to negotiate this. In the case of hydro dams, it is very important that eels be prevented from entering turbines as this is almost invariably fatal to large eels like longfin females. Research is underway to find ways of diverting eels from such intakes, and providing a suitable bypass. Depending on the type of dam construction, a small subsurface bypass can be effective, but low voltage electricity and strobe

lights may also prove useful in diverting migrating eels to a bypass or holding facility. Penstock intake needs to be screened (25 mm spacing, and velocities less than 0.5 m/s to prevent eels becoming involuntarily impinged against screens).

- 8.7 The creation of any storage reservoirs in the upper portion of the South Branch could increase the abundance of koaro in this branch of the river by allowing landlocked populations to establish. If so, this could have implications for other native species such as the upland longjaw galaxias, as there is some evidence that koaro tend to outcompete with other non-migratory galaxid species (McDowall and Allibone 1994).

9. SUMMARY

- 9.1 The upper Hurunui River provides a recognised headwater trout fishery, characterised by the opportunity to catch large trout in clear water and scenic conditions. Additional important characteristics of this fishery are its accessibility by road, very high abundance of brown trout in the reach below Lake Sumner, and the opportunity to fish this reach when other rivers are at discoloured by flooding. Maintenance of the high quality fishery of the upper river will be associated with unimpeded access of fish from downstream reaches, as these replenish fish lost from the upper river by natural or angling mortality. Given the high value and use of this recreational fishery I consider that the gazettement of a water Conservation Order would be an appropriate means of ensuring it's continued well-being and conservation.

- 9.2 While the native fish values cannot be claimed to be outstanding, they are nonetheless very significant – the Hurunui River contains a diverse assemblage of native species, typical of that of other East Coast rivers, but it's headwater lakes have unimpeded access for migratory species, something unusual for South Island east coast lakes. Of special significance are the entirely native assemblages of aquatic plants and fish in Lake Marion, something increasingly unusual within New Zealand aquatic ecosystems.

D Jellyman

March 2009

REFERENCES

- Bonnett, M.L.; Docherty, C.R. 1985. An assessment of trout stocks in the Upper Hurunui River. *New Zealand Ministry of Agriculture and Fisheries. Fisheries Environmental Report 57*. 34 p
- Fox, S., Unwin, M., Jellyman, D. 2003. The migration and growth of brown trout in the Rakaia River system. *NIWA Client Report CHC2002-045*. 35 p.
- Graynoth, E., Jellyman, D. & Bonnett, M. 2008: Spawning escapement of female longfin eels. *New Zealand Fisheries Assessment Report 2008/7*. 57 p.
- Hitchmough, R., Bull, L. and Cromarty, P. 2005 (Compilers) (2007). *New Zealand Threat Classification System lists*. New Zealand Department of Conservation.
- Jellyman, D. J.; Graynoth, E. 1994: Headwater trout fisheries in New Zealand. *New Zealand Freshwater Fisheries Report 12*, National Institute of Water and Atmospheric Research, Christchurch, 87 p.
- Jellyman, D.J., Unwin, M.J., James, G.D. 2003. Anglers' perceptions of the status of New Zealand lowland rivers and their trout fisheries. *NIWA Technical Report 122*. 61 p.
- Jowett, I. G. (1987). Fish passage, control devices and spawning channels. In *Aquatic biology and hydroelectric power development in New Zealand*, Aquatic biology and hydroelectric power development in New Zealand edn ed.), pp. 138 - 155. Auckland: Oxford.
- McDowall, R. M. & Allibone, R. M. (1994). Possible competitive exclusion of common river galaxias (*Galaxias vulgaris*) by koaro (*G. brevipinnis*) following impoundment of the Waipori River, Otago, New Zealand. *Journal of the Royal Society of New Zealand* 24, 161 - 168.

Table 1. Anglers perceptions of quality of angling, number of fish, and size of fish for lowland rivers in the North Canterbury Fish and Game region (values are means for rivers where > 5 replies were received).

River (number of replies)	Angling quality	Number of fish	Size of fish
Hurunui (6)	- 0.33	- 0.5	- 0.33
Ashley (9)	- 1.44	- 1.56	- 1.11
Cam (7)	- 1.86	- 1.29	- 1.14
South Branch (7)	- 1.14	- 1.29	- 0.14
Halswell (9)	- 1.89	- 1.89-	- 1.50
Harts Creek (9)	- 1.11	- 1.56	- 0.56
Irwell (9)	- 1.56	- 1.78	- 1.50
L II (14)	- 0.86	- 1.00	- 0.64
Selwyn (21)	- 1.52	- 1.67	- 0.95
Average	-1.30	- 1.39	- 0.87

Table 2. Numbers of trout recorded during drift dives of recognised South island headwater trout fishery rivers. Mean flow from appropriate reach in NIWA Freshwater Fish Database. Data from Teirney and Jowett 1990 (except Oreti River data = NIWA unpublished data). * = existing Water Conservation Order

River	Tributary or Reach		Reach length (km)	Mean flow (m ³ /s)	Trout/km			kg/km	g/m ²
					Large	Medium	Small		
Hurunui	At Lake outlet	Sumner	1.6	26.5	86	243	79	178.5	5.40
	Below Sumner	Lake	4.7	26.5	36	50	52	59.3	1.79
		At Lake Taylor (a)	3.3	29.5	13	9	8	18.6	0.67
		At Lake Taylor (b)	2.8	29.5	10	7	0	13.7	0.49
Oreti *	Upper – catch and release site		3.6	10.2	4	3	1	6.0	0.60
	Upper - Windy Point		4.8	10.2	7	1	1	7.8	0.26
Wairau *	Upper		5.5	28.9	5	3	2	6.8	0.45
Clarence	Upper		1.4	16.2	5	7	3	8.1	0.81
Buller *	Waitahu		1.2	17.1	13	14	0	19.4	0.97
	Waitahu		1.2	17.1	3	6	37	6.8	0.34
	Larrys Creek		2.5	11.3	5	2	2	6.5	0.43
	Stoney		1.0	7.9	4	1	1	5.0	0.50
Karamea	At Crow		2.1	25.2	41	3	18	49.3	1.64
	At Bend		2.0	30.8	44	11	1	54.5	1.21

	Ugly	1.7	13.4	25	4	5	30.4	3.04
	Crow – lower	1.0	6.2	26	1	5	30.7	3.07
	Crow - upper	1.1	4.2	6	2	28	8.7	0.58
Mokihinui	North Branch	2.1	35.5	31	1	1	35.9	1.44
	South Branch	2.0	34.7	55	3	1	64.8	2.16
Tekapo	Lower	1.0	87.2	61	56	336	103.2	2.58
	Upper	1.0	83.8	8	30	40	21.2	0.85
Aparima	Upper	2.4	22.8	29	94	11	63.4	2.12
Mataura*	Waikaia	1.1	25.6	11	19	9	19.5	0.65

Table 3. List of fish species recoded from the Hurunui catchment, and count of the number of records for each species (data from New Zealand Freshwater Fish Database). * indicates a diadromous species.

Scientific name	Common name	Count
Native species		
<i>Galaxias paucispondylus</i>	Alpine galaxias	17
<i>Galaxias vulgaris</i>	Canterbury galaxias	21
<i>Galaxias prognathus</i>	Upland longjaw galaxias	1
<i>Galaxias brevipinnis</i> *	Koaro	24
Galaxias	Galaxiid	3
<i>Gobiomorphus breviceps</i>	Upland bully	30
<i>Gobiomorphus cotidianus</i> *	Common bully	1
<i>Anguilla dieffenbachii</i> *	Longfin eel	12
<i>Anguilla australis</i> *	Shortfin eel	9
Anguilla *	Unidentified eel	3
<i>Retropinna retropinna</i> *	Common smelt	4
<i>Stokellia anisodon</i> *	Stokells smelt	1
<i>Cheimarrichthys fosteri</i> *	Torrentfish	1
-	No species recorded	16
Introduced species		
<i>Salmo trutta</i>	Brown trout	40
<i>Oncorhynchus tshawytscha</i> *	Chinook salmon	4
<i>Perca fluviatilis</i>	Perch	1
Salmo	Trout	5

Table 4: Species of native freshwater fish recorded in the Hurunui River and five other braided rivers on the east coast of the South Island (excludes marine/estuarine species). A= absent; P = present. Data from a range of sources including New Zealand Freshwater Fish Database.

Common Name	Hurunui River	Waitaki River	Ashburton River	Ashley River	Rakaia River	Rangitata River
Diadromous						
Banded kokopu	P	P	A	A	A	A
Black flounder	P	P	P	P	P	P
Bluegill bully	P	P	P	P	P	P
Common bully	P	P	P	P	P	P
Common smelt	P	P	P	P	P	P
Giant bully	P	P	P	P	A	P
Giant kokopu	P	P	A	A	A	A
Inanga	P	P	P	P	P	P
Koaro	P	P	P	P	P	P
Lamprey	P	P	P	P	P	P
Longfin eel	P	P	P	P	P	P
Redfin bully	P	P	A	P	A	A
Shortfin eel	P	P	P	P	P	P
Stokell's smelt	P	P	P	P	P	P
Torrentfish	P	P	P	P	P	P
Non-diadromous						
Total diadromous species	15	15	12	13	11	12
Alpine galaxias	P	P	P	A	P	P
Canterbury galaxias	P	P	P	P	P	P
Canterbury mudfish	A	P	P	P	A	P
Upland longjaw galaxias	P	P	P	A	P	P
Lowland longjaw galaxias	A	P	A	A	A	A
Upland bully	P	P	P	P	P	P
Total non-diadromous species	4	6	5	3	4	5
Total native species	19	21	17	16	15	17

Table 5. Recapture locations of trout tagged at Glenariffe Salmon trap, upper Rakaia River.

Location	Number	%
Glenariffe Stream	270	72.0
Rakaia Lagoon	59	15.7
Glenariffe Stream confluence	17	4.3
Outside Rakaia Catchment (Ashburton and Rangitata River mouths and Lake Ellesmere)	7	1.9
Coleridge Hatchery	4	1.1
Kowhai Flats	4	1.1
State Highway One bridge	4	1.1
Hydro lakes	3	0.8
Lake Heron	2	0.5
Acheron confluence	2	0.5
Rakaia Gorge	2	0.5
Barrhill	1	0.3
Donald's Hill	1	0.3
Total	376	100.0