MAF Fisheries Research

Fish and benthic invertebrate populations of the Rangitata River

Fisheries Environmental Report No. 62

Fisheries Research Division
N.Z. Ministry of Agriculture and Fisheries
ISSN 0111-4794

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by

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N.Z. Ministry of Agriculture and Fisheries

Christchurch

January

1986

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BONNETT, M.L. (Martin Lee)
Fish and benthic invertebrate populations of the Rangitata River. - Christchurch : Fisheries Research Division, Ministry of Agriculture and Fisheries, 1986.

72 p. - (Fisheries environmental report, ISSN 0111-4794; no. 62).

1. Fish populations - New Zealand - Rangitata River. 2. Freshwater invertebrates - New Zealand - Rangitata River I. Title II. Series

ISBN 0-477-03083-1 639.210993155

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1. SUMMARY

This study was initiated in response to the proposed review of the South Canterbury Catchment and Regional Water Board's Rangitata River water allocation plan. Little was known of the river's fish and invertebrate faunas, but it was hypothesised that they were very similar to those of the Rakaia and other east coast braided shingle rivers.

Samples of fish and benthic invertebrates were collected every second month from June 1983 to June 1984 in four areas of the river, including one site above the Rangitata Gorge. Sixteen native and four introduced species of freshwater fish were recorded in the system, and two marine species are also known to occur in the estuary. Blue-gilled bullies, torrentfish, and common bullies were fairly abundant below the gorge, and upland bullies were very common above. Thirty invertebrate taxa were identified from the samples, and greatest diversity occurred above the gorge.

The Rangitata River is typical of east coast braided shingle rivers in terms of the number and composition of fish species and invertebrate taxa. The density of fish and invertebrates also appears to be typical, though they vary considerably with the time and place sampled. The density of fish was generally highest in small side channels and in riffles.

The Rangitata River appears to be atypical in only one respect - the distribution of fish species above and below the gorge. Migratory species rarely penetrate above the gorge, while non-migratory species are rarely encountered below it.

2. INTRODUCTION

This study was part of the Fisheries Research Division's (FRD) programme to investigate the fisheries resources of the Rangitata River, and the value of these resources in relation to flow regime. In 1977 the South Canterbury Catchment and Regional Water Board (SCCRWB) formulated a water allocation plan for the Rangitata, which was published in 1979 (SCCRWB 1979). The plan provides for the sharing of water between abstraction, and fisheries, recreational, and environmental interests in times of low flow, and was due for review in late 1984. FRD's research objectives were aligned with the SCCRWB's recommendation that data relevant to fisheries, environmental, and recreational interests be obtained before the review.

Apart from McMillan (1961) and Docherty (1977), there is very little historical information on the native fish and benthic invertebrates of the Rangitata River, because most fisheries investigations have concentrated on the salmon and trout sports fishery and recreational usage of the river (Boud and Cunningham (n.d.), Hardy 1975, and Davis 1984). FRD had assumed that the native fish and benthic invertebrate populations of the Rangitata were similar to those of other east coast South Island rivers (Hardy 1975), particularly those of the Rakaia River, which have been well described by Davis, Eldon, Glova, and Sagar (1983), Eldon and Greager (1983), Sagar (1983), and Sagar and Eldon (1983).

The objectives of this study were to:

1. Determine the species composition and distribution of native fish in the Rangitata catchment and note any seasonal changes.

2. Identify the benthic invertebrate species present in the Rangitata.

3. Make a comparison between the native fish and benthic invertebrate populations of the Rangitata and Rakaia Rivers.

Although primarily an "inventory" study of one river system, it was intended that information from this study also would enhance our general knowledge of the distribution and ecology of some of the native fish species.

Several other reports pertain to the Rangitata River and its fisheries. Davis (1984) described recreational use of the river in 1980/81, and compared recreational activity with that observed during 1973/74 by Hardy (1975). Davis, Zeldis, and Unwin (in prep.) describe the Rangitata salmon and trout fisheries and Davis, Unwin, Zeldis, and Hayes (in prep.) discuss angling on the river. Teirney, Unwin, Rowe, McDowall, and Graynoth (1982) discussed the national importance of the river in a submission on the draft inventory of wild and scenic rivers, and Teirney, Richardson, and Unwin (1982) described the value of the Rangitata River to South Canterbury anglers.

3. THE RANGITATA RIVER AND CATCHMENT

The Rangitata River is one of several large, braided, shingle rivers located on the east coast of the South Island. The river originates in the Southern Alps and flows for about 120 km to the Pacific Ocean. Much of its 1735 km^2 catchment is steeply mountainous, with the highest points being Mt D'Archiac (2865 m) and Mt Arrowsmith (2796 m). The upper river has several tributaries (Fig.1), notably the Havelock, Clyde, and Lawrence Rivers, which originate in glacial regions

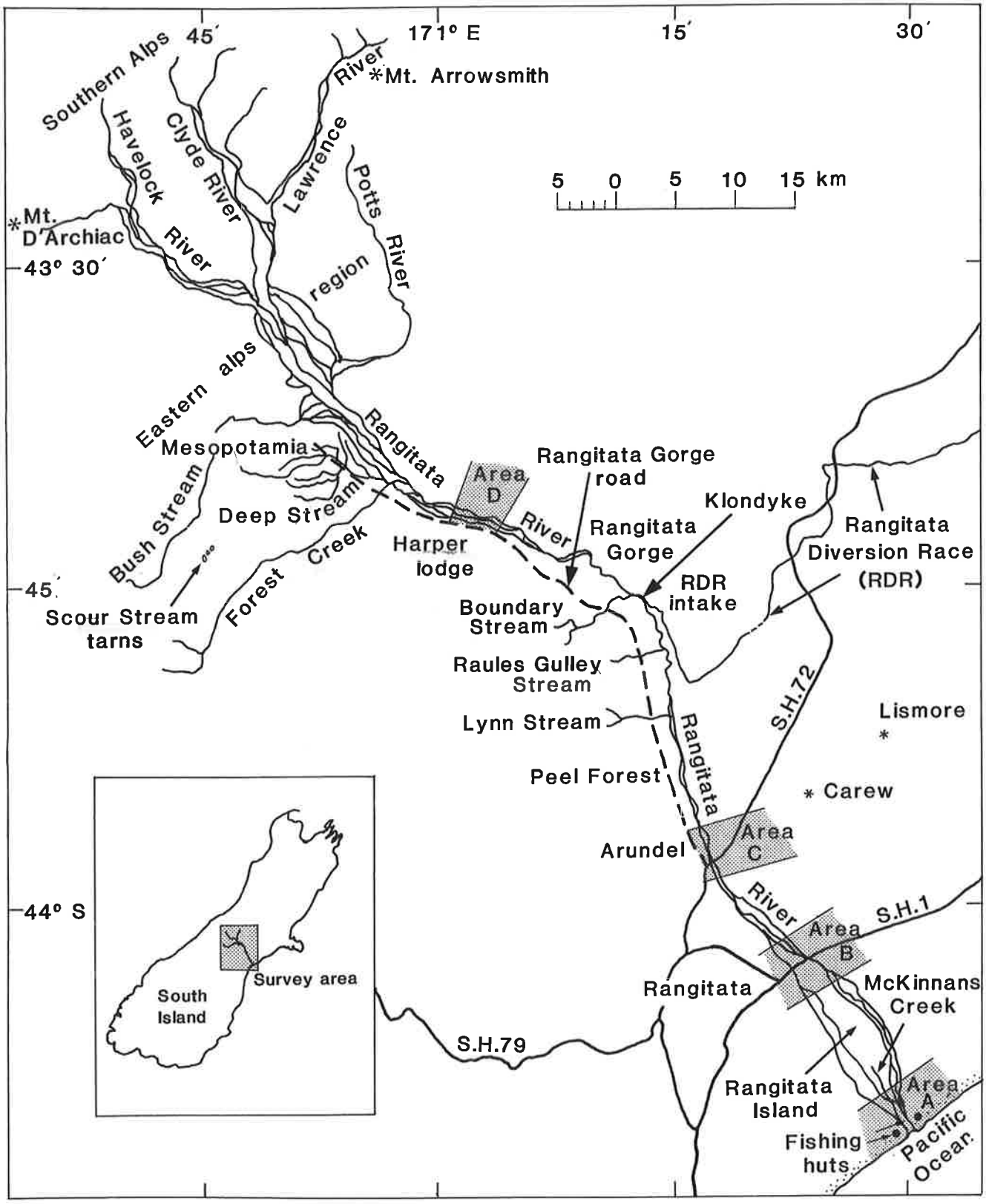

FIGURE 1. Rangitata catchment, showing sampling areas and localities mentioned in the text.

of the Southern Alps, and the Potts River and Forest Creek, which rise in the eastern alps region (Walsh 1975). The upper river is characterised by steep mountain slopes and braided river channels intertwined across shingle "flats" up to 5 km wide.

Downstream the river passes through the Rangitata Gorge, where for about 10 km the river bed is constricted between low mountain ranges. The gorge is narrow and the river flow is confined, turbulent, and swift. At one location the river forms a major cataract and there have been several attempts to modify this area with explosives because it appeared to inhibit the upstream migration of adult salmon (Hardy 1975). Several minor tributaries, for example, Boundary Stream and Lynn Stream, join the Rangitata near the gorge (Fig.1), but these have no significant effect on the river's flow.

The river below the gorge, referred to in this report as the lower river, is entrenched between high terraces of glacial outwash material and river-borne alluvium, and for 15-20 km generally consists of only one or two steep, swiftly flowing channels. Below the Peel Forest-Arundel area (Fig.1) the river begins to fan out into a typical Canterbury braided river, with many channels in a wide, unstable, shingle flood plain. Nearer the river mouth the height of the river terraces gradually decreases and the width of the river bed increases; the Rangitata reaches the sea on a 1.5 km wide front. It is separated from the ocean by a loose, shifting, gravel bank (or bar). The size and location of the river mouth (or mouths) which penetrates this bar alters according to river flow and the wind-driven action of the sea. During this study the mouth was mostly near its southern limit, and the associated estuarine area was fairly small.

The Rangitata River is noted as a steep, swift river containing large substrates (Walsh 1975), and below the gorge the gradient of the river is much steeper than that of equivalent sections of other east coast shingle rivers (Table 1). The tremendous power of the river in flood was recognised as long ago as 1878, and substantial protection works were subsequently constructed at various locations in the lower river (Furkert, Hunter, and Hay 1920).

The Rangitata, as with other similar South Island rivers, is often described as being "snow-fed", but its discharge is really the result of a combination of snowmelt and rainfall from the west and north-west (Hardy 1975). The mean annual flow of the river from 1967 to 1984 was 92 m^3/s, and the range 70-124 m^3/s (SCCRWB 1985). Flood events, sometimes in excess of 3000 m^3/s, are most common from October to May and are usually associated with heavy northwesterly rain. Natural low flows almost always occur from June to August, when precipitation accumulates as seasonal "snowpack" in the headwaters of the catchment (Waugh 1983).

The mean monthly flows presented in Figure 2 have been calculated for the period 1967-84 using flow records supplied by the SCCRWB. (Note that all flows were measured at Klondyke (Fig. 1), upstream of the Rangitata Diversion Race (RDR) intake and therefore do not allow for about 30 m^3/s of water abstracted for irrigation and hydro-electric power generation.) Residual river flows below the RDR intake are known to drop to 10 m^3/s (Waugh 1983), particularly during winter.

The RDR began operation in 1945, and during the irrigation season (generally 1 September to 30 April) it supplies water for three major farm irrigation schemes. During the remainder of the year, or when

TABLE 1. Lower river gradients of large, braided, South Island east coast shingle rivers (Calculated from NZMS1 topographical map series.)

River	Reach	Elevation (m)	Distance to sea (km)	Gradient (m/km)
Waimakariri	S.H.72 bridge to sea	245	58	4.2
Rakaia	S.H.72 bridge to sea	280	62	4.5
Rangitata	RDR intake to sea	350	55	6.4
Waitaki	Kurow bridge to sea	210	58	3.6

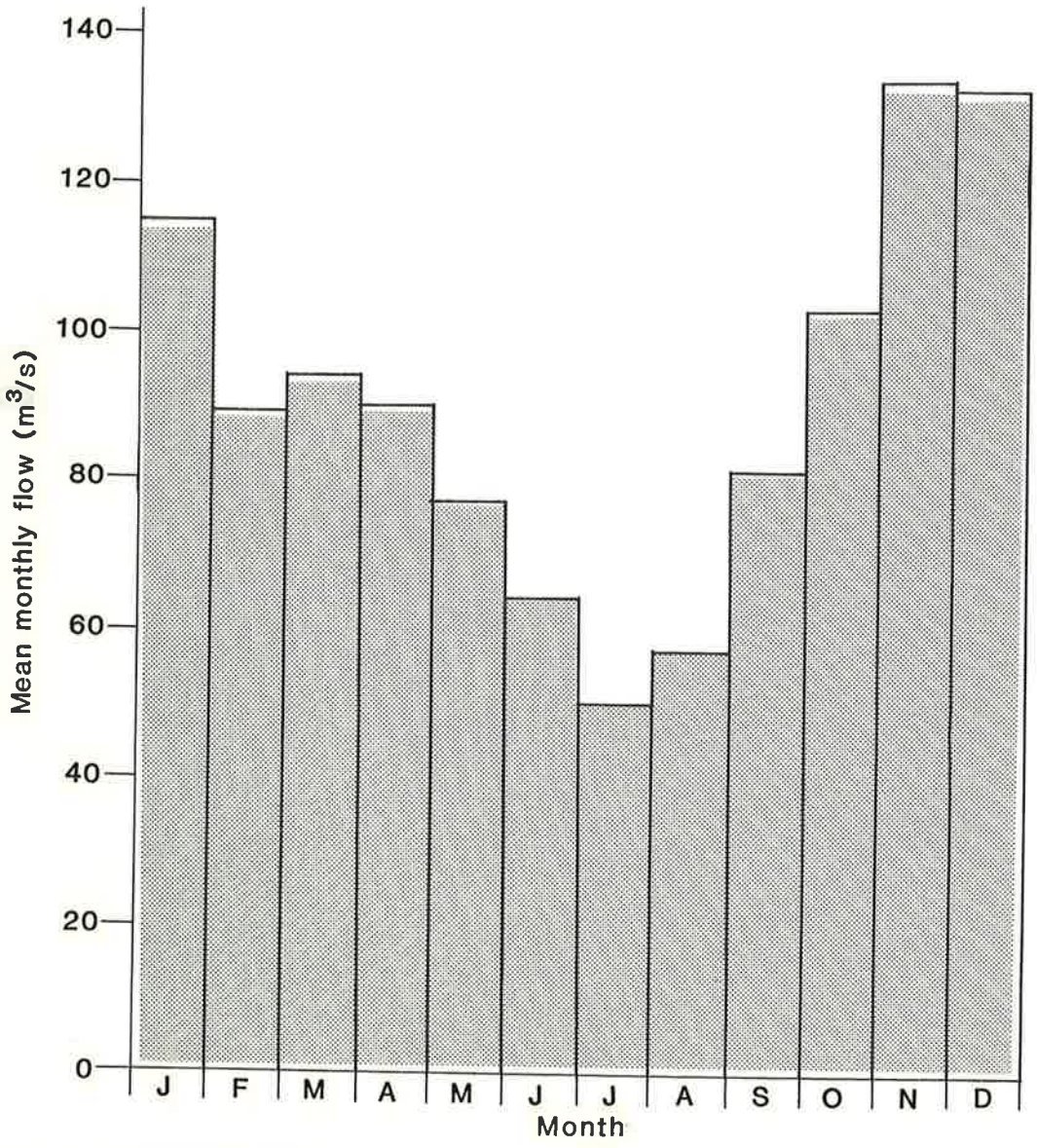

FIGURE 2. Mean monthly flows for the Rangitata River at Klondyke, 1967-84.

there is a surplus to irrigation needs, water is used for hydro-electric power generation (Hardy 1975).

4. SAMPLING SITES AND METHODS

4.1 Sites

Sampling of freshwater fish and benthic invertebrates was carried out in four selected areas of the Rangitata River (Areas A-D, Fig.1). These areas provided a representative range of available fish habitats and were comparable with electric fishing sites sampled in the Rakaia River, in terms of distance upstream and elevation above sea level (Davis *et al.* 1983). Table 2 gives a brief description of each study area, and includes the approximate location, elevation, distance from the sea, and width of flood plain for each site.

The four sampling sites were:

Area A, broadly defined as close to the mouth. It contained many braided channels of various sizes across a broad flood plain. Access was available from either the north or south bank by numerous tracks used by anglers and whitebaiters. River bed substrates in this area consisted of gravels and silts.

Area B, 18 km upstream, in the vicinity of State Highway 1 (S.H.1) bridge. This area contained numerous braided channels in a broad flood plain. Access was available from both banks close to and downstream of the bridge. Substrates in this area consisted mainly of silts and gravels, with some cobbles and boulders.

Area C, 30 km upstream, close to Arundel and S.H.72 bridge. This area usually contained only one or two large swift channels in a

narrower flood plain. Access, from both banks, was mostly close to the bridge. A notable feature of this area was the high proportion of large cobbles and boulders present in the river bed.

Area D, 80 km upstream, above the gorge. This area contained numerous braided channels in a very broad flood plain. Many of the channels in the area were wide, shallow, and slow moving. Access was gained from the south bank where the river passed close to Rangitata Gorge road (Fig.1). Substrates in this area consisted mainly of gravels and silts.

Several tributaries of the Rangitata River also were sampled occasionally, including Deep Stream, Boundary Stream, Raules Gully Stream, Lynn Stream, and McKinnans Creek (see Section 5.3).

On each sampling trip, specific sampling sites within each area were selected for electric fishing and benthic invertebrate collection. Usually a reach containing a good variety of habitats (riffles, runs, pools, side-channels, backwaters, etc) was chosen.

4.2 Methods

Sampling of freshwater fish and benthic invertebrates in the Rangitata River was carried out every second month from June 1983 to June 1984 (Table 3). Mean river flows for each sampling period (measured at Klondyke) are also given in Table 3. Flows were generally in the range expected from the observed annual flow regime of the river (Fig. 2). No sampling coincided with low summer flows, because from early September to mid April daily mean flows did not drop below 50 m^3/s.

TABLE 2. Description of study areas

Area	General location	Approximate altitude above sea level (m)	Approximate distance from the sea (km)	Approximate width of flood plain (km)
A	Near the river mouth	0 - 30	0 - 5	1.5
B	Near S.H.1. bridge	100	18	1.0
C	Near S.H.72 (Arundel) bridge	180	30	0.5
D	Above gorge near Harper Lodge	430	80	2.0

TABLE 3. Sampling dates and river flows

Sampling period	Dates sampled	Mean flow during sampling period* (m^3/s)
Jun 1983	14.6.83 - 16.6.83	63
Aug 1983	10.8.83 - 12.8.83	93
Oct 1983	17.10.83 - 20.10.83	100
Dec 1983	30.11.83 - 2.12.83	106
Feb 1984	7.2.84 - 9.2.84 and 28.2.84	101
Apr 1984	4.4.84 - 7.4.84	68
Jun 1984	7.6.84 - 9.6.84	41

* All flows were measured at Klondyke and do not allow for flow diverted into the RDR.

River conditions and weather were suitable for sampling to be conducted during the scheduled months, though a small flood on 10 February 1984 delayed the February sampling of Area A until 28 February (Table 3).

4.2.1 Electric Fishing

Electric fishing was the only method used to sample fish in the Rangitata River. A pulsed electric current was passed through the water to stun fish and facilitate their capture in a stop net or hand-held dip net.

Two types of electric fishing system were used during the surveys:

1. "Generator" system (Fig. 3a).
   A petrol-driven 230-volt a.c. generator on the river bank supplied power to an electric fishing machine (EFM), which in turn supplied a pulsed d.c. current to the operator's electrode via a 200-m-long cable.

2. "Pack set" system (Fig. 3b).
   Both the power supply (a small lead/acid battery) and the EFM were attached to a pack frame carried on the operator's back. This system was used most of the time because it allowed the operator greater freedom of movement and range.

The electric current used in both systems was potentially hazardous to humans; therefore the operators and assistants had to wear rubber gloves and waders for protection, and had to confine electric fishing to areas where they could wade safely - that is, NOT in areas of deep and/or swift water.

FIGURE 3a. Generator powered electric fishing system: power is provided by a 230-volt a.c. generator (G). The electric fishing machine (M) converts the electricity to pulsed d.c., which is supplied to the operator's electrodes (E) through the cable (C). Note the use of rubber gloves and waders by the operator and assistants, and the bucket for holding the catch.

FIGURE 3b. Pack-set electric fishing system: essentially the same as generator powered fishing, except the power source, a lead-acid battery (B), and the electric fishing machine (M) are carried on the operator's back - thus no cable reel is necessary. In both systems, fish stunned by the electrode (E) either drift downstream into the stop-net (S) or are collected in the operator's dip net (D).

Three or four days of sampling were carried out on each field trip, which allowed at least half of one day for electric fishing as wide a range of habitats in each area as possible. A "downstream" electric fishing action was utilised in most situations, that is, the electrode operator walked and fished downstream towards a stop net held at right angles to the flow. Stunned fish were carried by the water flow into the net, or, in areas of little or no flow, were collected by the operator using a dip net (Fig.3b).

Live fish were retained in a bucket of water harnessed to the person holding the stop net. Later, fish were anaesthetised with a mild solution of benzocaine or 2-phenoxyethanol, then identified and measured before being released back into the river at a location where they could recover without being recaptured.

Although electric fishing is a convenient and quick method of collecting samples of freshwater fish, the method does have some limitations:

1. it can not be used safely in deep or fast water,
2. it does not work effectively in salt water,
3. it has little effect on small fish (less than 25 mm),
4. it is not a good means of capturing large salmon and trout, which are strong swimmers and often can avoid the EFM operators.

Most of the records of fish captured by electric fishing were not used to obtain quantitative information on the Rangitata native fish resource, but rather to provide information on:

1. which fish species were present,
2. distribution of fish species in the river,

3. relative abundance of each fish species,
4. size structure of fish populations,
5. habitats used by fish,
6. seasonal changes in 1-5.

However, some estimates of fish density in various habitats were made during this study. If reasonable numbers of fish were caught by electric fishing in any particular reach, that reach was measured and fished at least once again; the total catch divided by the area fished provided an estimate of density. (Reaches were electric fished more than once because in many cases almost as many fish were caught on the second and third "passes" as on the first). No attempt was made to randomly select habitats for density estimates, and estimates were not made in areas which yielded few fish on the first electric fishing pass - therefore, the estimates presented in section 5.2 are biased towards areas of higher density and do not represent average or minimum densities.

4.2.2 Benthic Invertebrate Sampling

Samples of benthic invertebrates were taken from each of the study areas during each field trip, by use of a modified "Hess" sampler (Waters and Knapp 1961) fitted with a 0.54-mm-mesh net. Three 0.1 m^2 samples were collected from a medium to large sized riffle in each area before electric fishing commenced. All samples were preserved in the field with 10% formalin and later sorted, identified, and counted in the laboratory.

4.3 Other Sources of Information

At about fortnightly intervals from August 1983 until April 1984, FRD undertook sampling of juvenile salmon and trout in the mainstem of the Rangitata River using a pack set electric fishing machine. Information gathered was used for a report on the Rangitata salmon and trout fisheries (Davis, Zeldis, and Unwin, in prep.). Some data relevant to native fish populations were recorded during this study, but because of the limited time available records usually were confined to notes on the occurrence of uncommon species (for example, lamprey or giant bully) and the general distribution of native species in the river.

Further information was obtained from FRD's fish distribution data base (McDowall and Richardson 1983) as well as McMillan (1961), Docherty (1977), and Hardy (1975).

5. RESULTS

5.1 Fish of the Rangitata River

The scientific and common names of 22 species of fish recorded from the Rangitata system are given in Table 4. Four species were not recorded during this study (kahawai, yellow-eyed mullet, koaro, and brook char), but are known to occur in the catchment. It is possible that other species also may occur in the Rangitata, for example, perch (*Perca fluviatilis*) and red-finned bully (*Gobiomorphus huttoni*).

More than 4000 fish were recorded in the seven sampling periods, though lamprey, giant bully, Stokell's smelt, and short-finned eel were each represented by less than five individuals. Table 5 shows the total

TABLE 4. Fish of the Rangitata River system (I = introduced species; M = migratory species.)

	Scientific name	Common name
	*Aldrichetta forsteri**†	yellow-eyed mullet
M	*Anguilla australis*	short-finned eel
M	*Anguilla dieffenbachii*	long-finned eel
	*Arripis trutta**†	kahawai
M	*Cheimarrichthys fosteri*	torrentfish
M	*Galaxias brevipinnis**	koaro
M	*Galaxias maculatus*	inanga
	Galaxias paucispondylus	alpine galaxias
	Galaxias prognathus	long-jawed galaxias
	Galaxias vulgaris	common river galaxias
M	*Geotria australis*	lamprey
	Gobiomorphus breviceps	upland bully
M	*Gobiomorphus cotidianus*	common bully
M	*Gobiomorphus gobioides*	giant bully
M	*Gobiomorphus hubbsi*	blue-gilled bully
IM	*Oncorhynchus tshawytscha*	quinnat salmon
M	*Retropinna retropinna*	common smelt
M	*Rhombosolea retiaria*	black flounder
I	*Salmo gairdnerii*	rainbow trout
IM	*Salmo trutta*	brown trout
I	*Salvelinus fontinalis**	brook char
M	*Stokellia anisodon*	Stokell's smelt

* Not recorded in this study, but known to occur in catchment.
† Marine species.

TABLE 5. Numbers of fish sampled by electric fishing in the Rangitata River, June 1983 - June 1984

Species	Numbers caught				
	Area A	Area B	Area C	Area D	Total
"Estuarine" fish					
Inanga (as whitebait)	139				139
Black flounder	47				47
Common smelt	46				46
Stokell's smelt	4				4
Giant bully	4				4
Short-finned eel	1				1
Lower river fish					
Blue-gilled bully	555	355	138		1 048
Torrentfish	308	307	206		821
Common bully	569	62			631
Lamprey		2			2
Upper river fish					
Upland bully		18		434	452
Alpine galaxias				101	101
Long-jawed galaxias				81	81
Common river galaxias				44	44
Rainbow trout	1			42	43
"All areas" fish					
Quinnat salmon	4	88	53	181	326
Long-finned eel	102	40	57	1	200
Brown trout	27	55	45	59	186
Totals	1 807	927	499	943	4 176

numbers of each species caught in each area over the seven sampling periods. Species have been placed in four categories according to the areas in which they were generally found.

5.1.1 Estuarine Fish

These species were found only in Area A, usually less than 1 km upstream of the river mouth.

The Rangitata River estuary did not seem to support the abundance and variety of wildlife usually associated with estuarine habitats. The estuary was quite small, and, though the level of the lower river was influenced considerably by the tide, there appeared to be little or no influx of salt water upstream of the mouth. The river channels flowing into the estuary and the river mouth are known to be quite unstable, and their size and position seemed to alter according to river flows and the action of the sea.

This part of the river is important to the fish fauna because at least 15 of the 22 species recorded from the Rangitata River either reside in, or pass through, the mouth and estuary at some stage of their life cycle.

5.1.1.1 Inanga (*Galaxias maculatus*)

Many New Zealanders are familiar with the juveniles of this species, because they are by far the most important species in the whitebait catch. No adult inanga were caught in the Rangitata River, but in the October and December sampling periods 139 whitebait were caught near the mouth. These were preserved in formalin for identification and measurement in the laboratory; all were *G. maculatus* of between 40 and 55 mm in length.

Adult inanga, which may exceed 100 mm in length, are known to spawn in river estuaries, mostly in autumn. Eggs are deposited and fertilised amongst marginal vegetation during high spring tides, and the eggs, though they are left stranded by the falling tide, are kept moist by the surrounding vegetation. Hatching occurs when the vegetation is again immersed by a cycle of spring tides. The tiny larvae (about 7-8 mm long) are washed out to sea, but return (not necessarily to the same river) about 6 months later, when they are 40-60 mm long, and migrate upstream in the spring whitebait run (McDowall 1978).

When they first enter fresh water, individual inanga whitebait are quite transparent, though when a large number are seen together they take on a distinctive blue-green colour. As they migrate upstream, the whitebait begin to feed and become pigmented, eventually to attain the adult colouration of a silvery belly and greenish-olive back and sides.

Whitebaiting is a popular recreational activity in the Rangitata during the legal season of 1 September to 30 November (Davis 1984). In the Rangitata it is by far the most popular fishery based on a native fish species, though the river appears to provide very little suitable habitat for adult inanga or for spawning.

It is likely that species other than inanga make a small contribution to the whitebait run. For instance, koaro (*G. brevipinnis*), are known to comprise a small percentage of the whitebait run in the Rakaia and other South Island east coast rivers (McDowall 1965), and giant kokopu (*G. argenteus*) make a small contribution to West Coast whitebait runs (McDowall and Eldon 1980).

5.1.1.2 Black Flounder (*Rhombosolea retiaria*)

This species of flatfish is sometimes known as the river flounder or freshwater flounder and is regarded as a truly freshwater species (McDowall 1978). In the Rangitata, black flounders usually were found close to the mouth, though they have been recorded 20 km upstream, near S.H.1 bridge (FRD unpublished data). Davis *et al.* (1983) suggested that upstream penetration by black flounders in the Rakaia varied from year to year, and the same situation may occur in the Rangitata.

Black flounders were present in Area A on six of the seven sampling periods, and usually were found within 500 m of the mouth in quiet, silty pools and backwaters. The numbers and mean lengths of black flounders sampled are given in Table 6.

TABLE 6. Numbers and sizes of black flounder (*Rhombosolea retiaria*) sampled in Area A

Sampling period	Number sampled	Mean length (mm)	Standard deviation (mm)
Jun 1983	4	236.3	46.6
Aug 1983	1	241.0	-
Oct 1983	1	256.0	-
Feb 1984	2	approx. 250.0	-
Apr 1984	8	87.6	12.6
Jun 1984	31	102.6	18.6

Little is known of the biology of this species, but it is likely that adults migrate to sea to spawn (McDowall 1978). Eldon and Greager (1983) reported that numbers of black flounders decreased in the Rakaia Lagoon during winter, and that an influx of post-larval flounders from September onwards suggested that spawning took place at sea during winter. Juvenile flounders 60-120 mm in length occur in both the Rangitata and Rakaia Rivers during April and June, and though there is

only a limited amount of information on flounders in the Rangitata, it is probable that the ecology of this species in the Rangitata is very similar to that in the Rakaia.

Black flounder, which may reach 450 mm in length, are known as a fine food fish and are taken commercially (McDowall 1981). The species supports a small recreational fishery in the Rangitata estuary and is usually caught in gill nets.

5.1.1.3 Smelts (*Retropinna retropinna* and *Stokellia anisodon*)

Although smelt spend much of their life at sea, adults of both species move into estuarine and lower river areas to spawn. During spring and summer large shoals of smelt often are observed moving into the Rangitata and other South Island rivers. Anglers and whitebaiters sometimes call smelt "silveries" (because of their bright, silvery colouration) or "cucumber fish" (because of their peculiar cucumber-like odour). During this study, a total of 46 specimens of common smelt and 4 specimens of Stokell's smelt were collected in Area A. Sampling was not undertaken in the lagoon area, where much greater numbers would be expected.

Common smelt, which may exceed 140 mm in length, occur in coastal rivers throughout New Zealand. There are also landlocked populations in many inland and sub-alpine lakes (McDowall 1980). Stokell's smelt, which grow to about 100 mm in length (Eldon and Greager 1983), have only been found close to the sea on the eastern and southern coasts of the South Island. What is known of their biology is mostly due to the work of McMillan (1961) who described the migration and spawning of this species in the Rangitata River.

The influx of large shoals of smelt probably has a great impact on the ecology of the Rangitata River estuary, because smelt provide a good source of food for larger fish and some bird species that inhabit the lower river (McDowall 1978). In the last few years, smelt from Canterbury rivers have been harvested commercially and dried for sale in New Zealand and overseas (McDowall 1983).

5.1.1.4 Giant Bully (*Gobiomorphus gobioides*)

Four giant bullies were recorded during this study, and several more were observed during summer and autumn electric fishing surveys for juvenile quinnat salmon. The giant bully, as its common name implies, is much bigger than other New Zealand bullies and may exceed 200 mm in length.

This species is regarded as an estuarine fish, and it is not usually found more than 1-2 km from the sea. In the Rangitata River, giant bullies were caught only within 500 m of the mouth, and seemed to prefer pools and backwaters with an abundance of marginal vegetation and accumulated debris. It appears that the Rangitata River, like other east coast South Island rivers, provides relatively poor habitat for this species.

Giant bullies are widespread, but have been studied little. Virtually nothing is known of their biology, though they probably have a marine larval stage.

5.1.1.5 Short-finned Eel (*Anguilla australis*)

Only one small short-finned eel (132 mm long) was recorded in the mainstem of the river during this study, and was captured near the

Rangitata mouth in April 1984. This species is also known to occur in McKinnans Creek (see section 5.3.5).

Short-finned eels are a characteristic species of lowland swamps and lagoons, whereas the other species of New Zealand freshwater eel, the longfin, is found most often in streams and rivers.

The general life history of these two species is similar, and is discussed in section 5.1.4.2.

5.1.1.6 Marine Fish

Kahawai and yellow-eyed mullet are known to enter the estuarine area of the Rangitata, but neither was recorded during this study. It is unlikely that either species would penetrate more than a few hundred metres upstream. Occasionally these species support recreational fisheries at or near the river mouth.

5.1.2 Lower River Fish

This category refers to fish which were found mainly in the Rangitata River below the gorge, in Areas A, B, and C.

Two lower river species, blue-gilled bully and torrentfish, are considered in some detail in this section, because:

1. They appear to be the most common species of native fish in the Rangitata, comprising about 45% of the total sample and 51% of the native fish sample caught during this study.

2. They utilise areas of the river most likely to be affected by water abstraction or river development.

3. Samples were large enough to illustrate differences in size-frequency distribution between sites, thus giving some insight into migratory behaviour.

5.1.2.1 Blue-gilled Bully (*Gobiomorphus hubbsi*)

Blue-gilled bullies were present at all three lower river areas during each sampling period, and 1048 individuals were sampled during this study (Table 7).

This species is known to occur in many coastal areas in New Zealand, mostly penetrating less than 10-15 km upstream (McDowall 1978). In the Rangitata River blue-gilled bullies were found 180 m above sea level in Area C, but were not recorded further upstream at the Peel Forest or Lynn Creek sites (see Fig. 1), which were regularly electric fished for quinnat salmon between August 1983 and April 1984. Davis *et al.* (1983) found that populations of blue-gilled bullies in the Rakaia did not appear to extend much above 250 m above sea level, and Stokell (1955) noted an upstream limit of about 600 ft (183 m) in the Ashley River.

Blue-gilled bullies are migratory fish, with a marine larval stage which is believed to be of short duration (Davis *et al.* 1983). Juveniles, about 15-20 mm long, are known to migrate from the sea into rivers during spring (McDowall 1978), though Eldon and Greager (1983) suggested there was also an autumn run in the Rakaia River. Juveniles (about 25-35 mm fork length) occurred in the Rangitata during June and August, but the number and timing of their migrations was not determined. Two distinct size classes of blue-gilled bully were present in the river during June 1983 (Fig.4). Juvenile fish, (probably less than 1 year old) were found near the river mouth in Area A, whereas adult fish (probably more than 1 year old) were found mainly further upstream in Areas B and C.

TABLE 7. Numbers and sizes of blue-gilled bullies (*Gobiomorphus hubbsi*) sampled in the lower Rangitata River

Sampling period	Area A	Area B	Area C	Total	Mean length (mm)	Standard deviation (mm)
Jun 1983	70	53	43	166	49.5	16.9
Aug 1983	27	98	29	154	55.3	15.3
Oct 1983	125	43	25	193	58.0	7.9
Dec 1983	157	52	4	213	55.4	9.0
Feb 1984	21	75	22	118	60.3	8.5
Apr 1984	103	29	14	146	54.7	11.2
Jun 1984	52	5	1	58	51.8	7.4
Total	555	355	138	1 048		

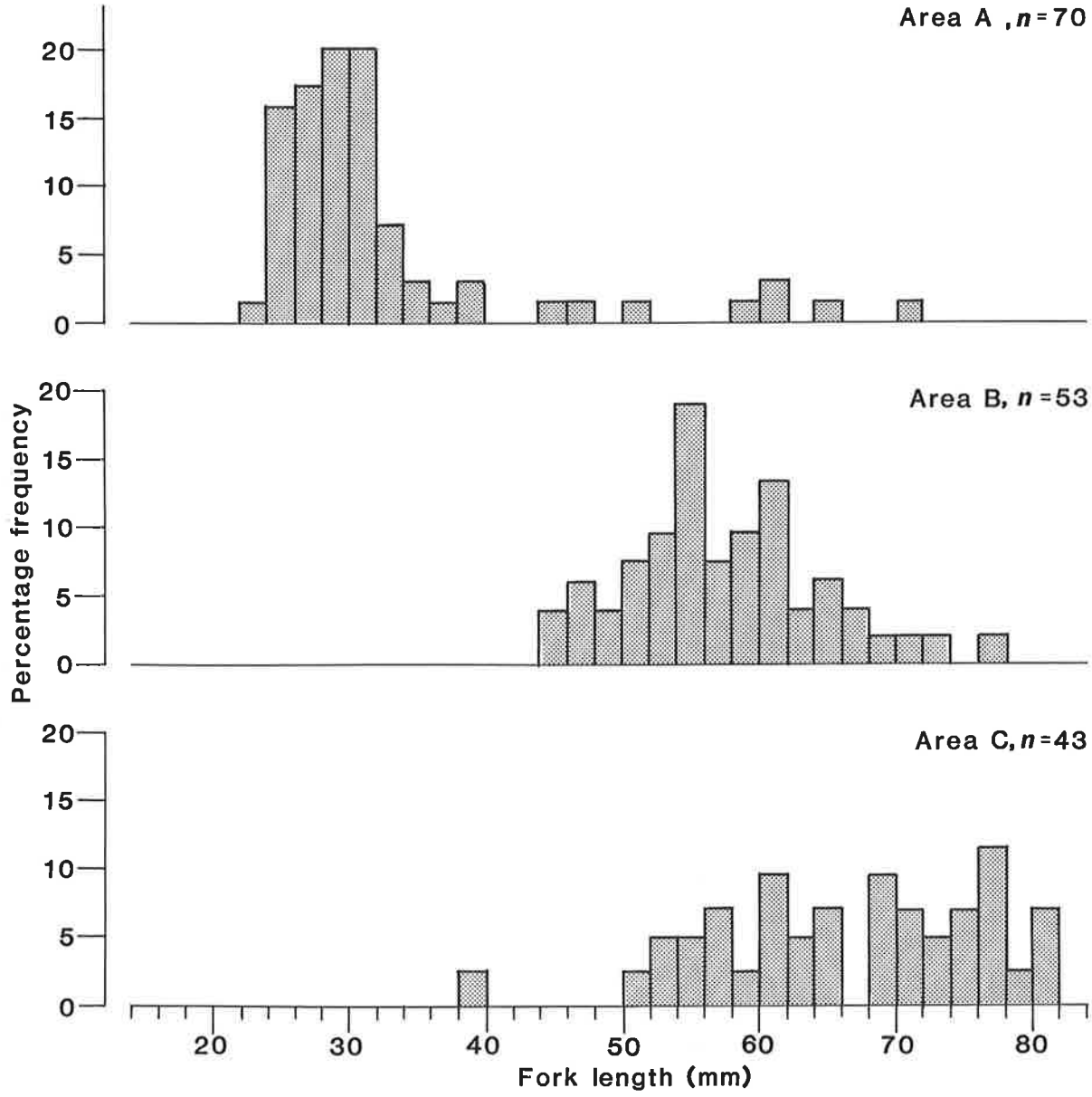

FIGURE 4. Length-frequency distributions of blue-gilled bullies from Areas A, B, and C of the Rangitata River, June 1983.

This size distribution indicates that blue-gilled bullies migrate upstream as they grow, and perhaps the upstream migration continues throughout their lives. This is suggested because total numbers of blue-gilled bullies caught decreased (Table 7), whereas the proportion of large fish (greater than 70 mm fork length) increased (Table 8), with increased distance from the sea, despite equal sampling effort. Adult blue-gilled bullies are usually only 50-60 mm in length (McDowall 1978), but in the Rangitata they often exceeded 80 mm, the largest being 88 mm long.

Little is known of the breeding biology of this species, but it is likely that eggs are laid in fresh water in the adult habitat and the larvae are carried downstream into the sea (Davis *et al.* 1983). Some ripe fish were observed in Areas B and C over summer, particularly during the February sampling period.

The habitats utilised by blue-gilled bullies of all sizes were quite similar; most were either amongst the cobbles and small boulders along the margins and in less turbulent parts of riffles, or amongst the boulders making up steep banks in deep, fast flowing runs, particularly where the boulders seemed to form a stable interlocking "wall" (Fig. 5).

No attempt was made to analyse the food or feeding of blue-gilled bullies in the Rangitata River, but in the Rakaia River their major prey items were the larvae of *Deleatidium* spp., Chironomidae, and caseless caddisflies, and no seasonal differences in diet were apparent (Davis *et al.* 1983).

The frequent occurrence of blue-gilled bullies in the lower Rangitata River samples, and the high proportion of large fish in the catch, indicate that the Rangitata River provides good habitat for this species.

TABLE 8. Distribution of large blue-gilled bullies (less than 70 mm fork length) and their percentage of the total catch of blue-gilled bullies in three areas of the Rangitata River, June 1983-June 1984

Sampling period	Numbers and percentage in sample							
	Area A		Area B		Area C		Total	
	No.	% catch	No.	% catch	No.	% catch	No.	% catch
Jun 1983	1	1.4	3	5.7	19	44.2	23	11.4
Aug 1983	0	0	10	10.2	15	57.7	25	16.2
Oct 1983	1	0.8	5	11.6	9	36.0	15	7.8
Dec 1983	1	0.6	2	3.8	1	25.0	4	1.9
Feb 1984	0	0	5	6.7	11	50.0	16	13.6
Apr 1984	1	1.0	5	17.2	7	50.0	13	8.9
Jun 1984	0	0	1	2.0	1	100.0	2	3.4
Total	4	0.7	31	8.7	63	45.7	98	9.4

FIGURE 5. An example of habitat in which blue-gilled bullies were often found - the boulders making up steep banks in deep, fast flowing runs.

5.1.2.2 Torrentfish (*Cheimarrichthys fosteri*)

This species was recorded from all three lower river sites during each sampling period (Table 9). Torrentfish also have been recorded as far upstream as the RDR intake (see Fig.1), about 350 m above sea level (FRD unpublished data), but have never been recorded above Rangitata Gorge. The species is widely distributed throughout New Zealand rivers, and often is associated with broad, unstable, shingle rivers (McDowall 1973).

Torrentfish are migratory, though their migrations are not yet fully understood. Like many of New Zealand's native freshwater fishes, the larval stage is marine, and juveniles enter fresh water during spring and autumn when they are 23-30 mm in length (Eldon and Greager 1983).

Figure 6 illustrates the length-frequency distribution of juvenile and adult torrentfish collected in the Rangitata River during August 1983. Juveniles (probably less than 1 year old) were found near the mouth in Area A, whereas older fish were found mainly further upstream in Areas B and C. It seems likely that torrentfish in the Rangitata move upstream as they feed and grow.

Investigations of torrentfish populations in the Rakaia River showed that the proportion of females in the population increased with distance from the sea. It was suggested that, during summer, adult females made a downstream migration, spawned in the lower reaches, and then returned upstream (Davis *et al.* 1983). Analysis of samples taken from Areas A, B, and C of the Rangitata River during May 1984 indicated that male and female torrentfish were distributed in a pattern similar to that observed in the Rakaia River (Table 10).

TABLE 9. Numbers and sizes of torrentfish (*Cheimarrichthys fosteri*) sampled in the lower Rangitata River

Sample period	Numbers sampled				Mean length (mm)	Standard deviation (mm)
	Area A	Area B	Area C	Total		
Jun 1983	58	9	5	72	50.1	26.2
Aug 1983	40	75	57	172	69.1	21.2
Oct 1983	35	17	52	104	81.2	20.2
Dec 1983	47	38	40	125	76.6	19.2
Feb 1984	67	68	17	152	84.0	17.0
Apr 1984	40	58	17	115	86.3	16.0
Jun 1984	21	42	18	81	76.4	21.0
Totals	308	307	206	821		

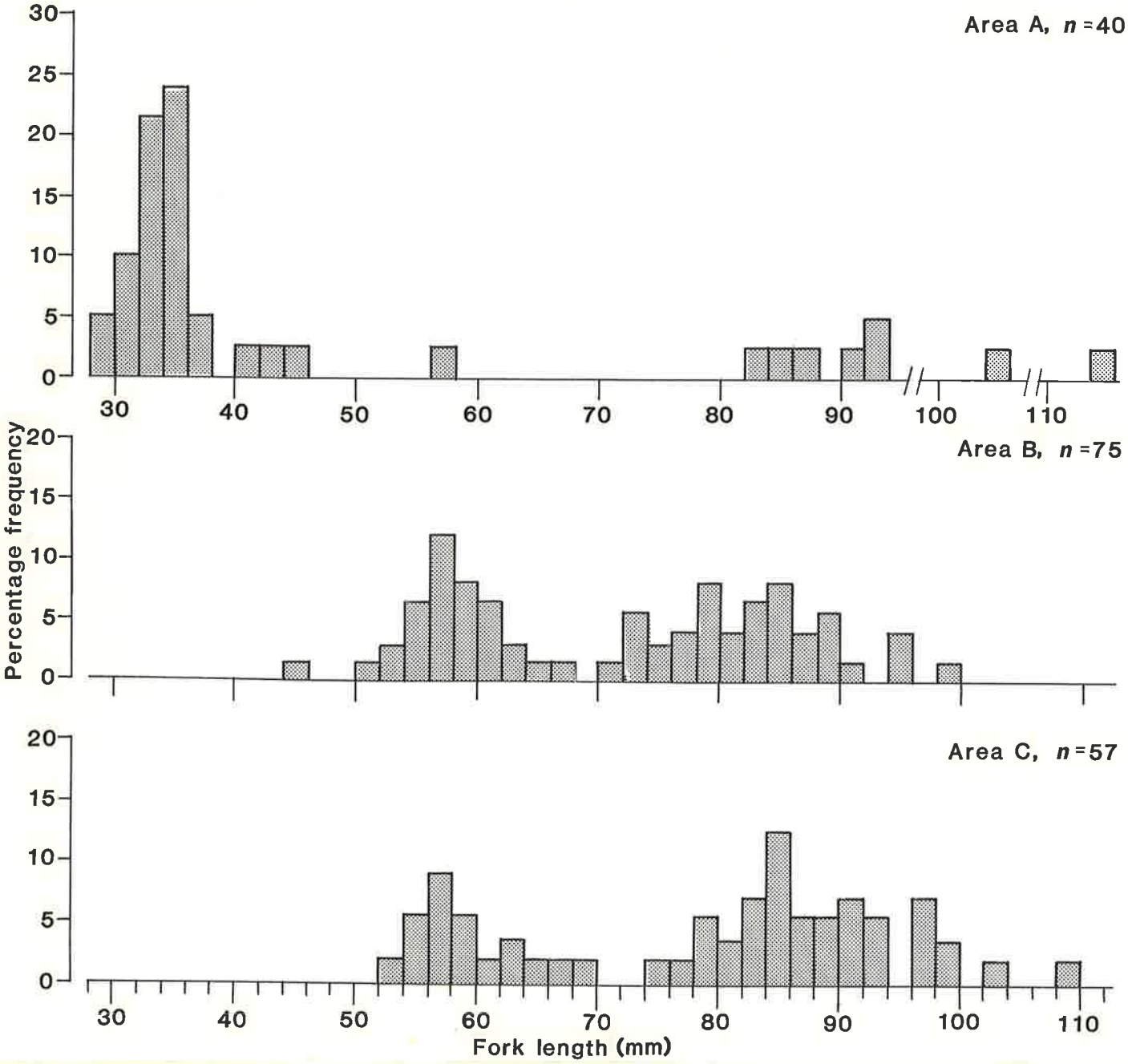

FIGURE 6. Length-frequency distributions of torrentfish from Areas A, B, and C of the Rangitata River, August 1983.

TABLE 10. Sex ratio of torrentfish from three areas of the Rangitata River, May 1984, and, in brackets, comparative data for the Rakaia River, May 1980 (from Davis *et al.* 1983)

Area	Approximate distance from sea (km)	% males in sample	% females in sample	Sample size
A	0-5 (2)	83 (87)	17 (13)	60 (15)
B	18 (24)	30 (29)	70 (71)	53 (21)
C	30 (50)	15 (0)	85 (100)	48 (8)
Total		45 (39)	55 (61)	161 (44)

As the name torrentfish implies, this species is commonly found amongst rapid, tumbling white water, and in the Rangitata River they often were collected in or near the broken water of steep riffles and chutes. Often, blue-gilled bullies and torrentfish were found close together in riffle areas, though it seemed that torrentfish preferred the faster, more turbulent water near the middle of riffles, and blue-gilled bullies the quieter areas along the edges (Fig.7). Many large riffles could be electric fished safely only along the margins, and consequently a significant proportion of the torrentfish population may not have been sampled.

5.1.2.3 Common Bully (*Gobiomorphus cotidianus*)

This species was fairly common in some parts of the Rangitata River and 631 specimens were obtained during the study. However, common bullies did not appear to penetrate very far upstream in the Rangitata system; 90% of the sample was caught in Area A and 10% in Area B (Table 11). None was caught in Areas C or D, though the species is present in various irrigation and stockwater races in the vicinity of Carew and Lismore (see Fig. 1) (FRD unpublished data).

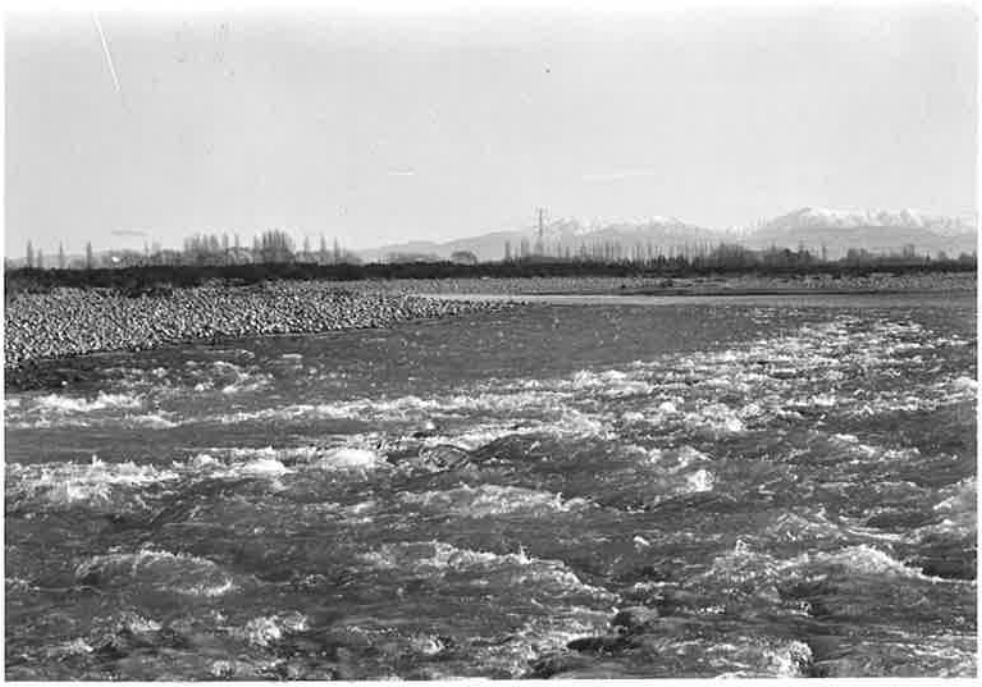

FIGURE 7. Typical torrentfish and blue-gilled bully habitat - a large riffle in Area B. Torrentfish were found mostly amongst the turbulent water in the centre of the channel, and blue-gilled bullies in the calmer areas along the edges of the riffle.

TABLE 11. Numbers and sizes of common bully (*Gobiomorphus cotidianus*) sampled in the lower Rangitata River.

Sample period	Numbers sampled			Mean length (mm)	Standard deviation (mm)
	Area A	Area B	Total		
Jun 1983	53	-	53	69.4	13.4
Aug 1983	109	27	136	61.3	13.8
Oct 1983	111	7	118	60.5	16.5
Dec 1983	94	2	96	67.8	14.9
Feb 1984	75	12	87	56.5	14.9
Apr 1984	81	14	95	68.0	15.6
Jun 1984	46	-	46	62.9	10.7
Totals	569	62	631		

Little is known of the life history of migrating populations of common bullies, except that the larvae are marine and the juveniles return to fresh water during late spring and summer when they are 15-20 mm long (McDowall 1978). Although a few juvenile common bullies (less than 30 mm long) were recorded near the Rangitata mouth during August, October, and February, numbers were not sufficient to show any seasonal migratory patterns.

The common bully is one of the larger bully species, often reaching 110 mm in length, with a recorded maximum of about 150 mm (McDowall 1978). The largest specimen recorded from the Rangitata measured 120 mm, but only 2% of the total sample exceeded 100 mm in length.

This species was nearly always found amongst marginal cover in still, or very slowly flowing, water - typically near an accumulation of gorse, broom, or lupin debris near the edge of a pool or backwater.

Davis *et al.* (1983) suggested that the Rakaia River was poor habitat for common bullies, and Eldon and Greager (1983) noted that numbers in the Rakaia Lagoon were lower than expected. It appears that the Rangitata River provides little better habitat, because common bullies were usually restricted to a small part of the river and individuals did not grow to any great size.

5.1.2.4 Lamprey (*Geotria australis*)

Two specimens of this species were recorded in Area B of the Rangitata River; a 510 mm adult in August and a 106 mm juvenile in June. Lampreys have been observed at various localities in the lower river and are present during several stages of their life cycle. They start life in fresh water as larvae (ammocoetes) and, after several

years living buried in muddy backwaters, ammocoetes of about 80-100 mm in length transform into migratory juveniles (macropthalmia) which migrate downstream into the sea. Lampreys probably spend several years in the sea (McDowall 1978), and mature adults (about 400-600 mm long) re-enter fresh water during winter and spring to breed. Although the breeding habits of this species have not been described, spawning probably occurs in small, rocky, bush streams and creeks. It seems that the Rangitata River does not support a large lamprey population.

5.1.3 Upper River Fish

This category refers to fish species which were caught mostly above the Rangitata Gorge in Area D. Although a small proportion of the total upland bully catch (4%) was recorded in Area B, and one rainbow trout was caught near the Rangitata mouth, these two species have been included in the upper river category.

One notable feature of the five species of fish recorded above the gorge is that they are all regarded as non-migratory, and their entire life cycle takes place in fresh water. The three galaxiid species found in the upper river often shared the same shallow riffles and runs, whereas juvenile salmonids (quinnat salmon, brown trout, and rainbow trout) usually were found together in small swift side channels (Fig.8).

5.1.3.1 Upland Bully (*Gobiomorphus breviceps*)

Upland bullies are very common and widespread in the South Island (McDowall 1978), and though the name "upland" implies a restriction to high country habitats, this species is also found in a wide range of habitats at low altitudes.

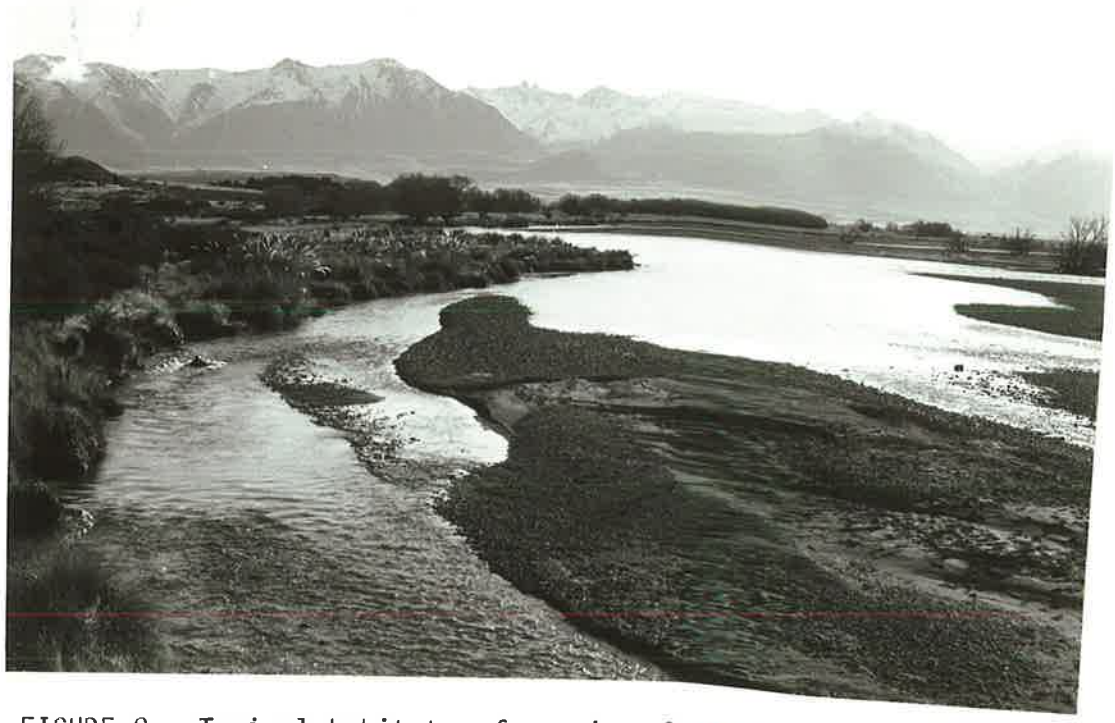

FIGURE 8. Typical habitats of species found in the upper river - Area D. Juvenile trout and salmon were regularly found near the faster flowing water of the small side channel (left), and upland bullies in the quieter pools of the same channel. (Note the abundant bankside cover along this channel.) Common river galaxias, alpine galaxias, and long-jawed galaxias were usually found on or near shallow riffles and runs (right).

TABLE 12. Numbers and sizes of upland bully (*Gobiomorphus breviceps*) sampled in Areas B and D of the Rangitata River

Sampling period	Numbers sampled			Mean length (mm)	Standard deviation (mm)
	Area B	Area D	Total		
Jun 1983	-	144	144	43.3	17.1
Aug 1983	-	42	42	43.4	16.6
Oct 1983	-	42	42	48.2	17.0
Dec 1983	3	41	44	56.1	16.7
Feb 1984	1	22	23	57.0	15.5
Apr 1984	10	92	102	58.2	12.3
Jun 1984	4	51	55	60.4	13.9
Totals	18	434	452		

However, in the Rangitata River upland bullies were found mainly above the gorge, and in several tributaries in the upper catchment (see section 5.3). They were present in Area D during all sampling periods (Table 12), and were the most common species caught there (Table 5). Upland bullies were occasionally caught in Area B and they have also been recorded in various stockwater and irrigation races connected to the lower Rangitata River (FRD unpublished data).

Upland bullies were found in a variety of slack water habitats, but mostly in pools and backwaters that had an abundance of marginal vegetation and/or debris cover. Although this species may exceed 100 mm in length, Rangitata upland bullies rarely reached 80 mm.

The breeding season for this species is from October to December (Hopkins 1970, Staples 1975), though data collected by Davis *et al.* (1983) indicated that breeding in the Rakaia may have occurred at various times between August and May. Small (15-25 mm long) upland bullies were common in the upper Rangitata only during June 1983 and June 1984, and were probably fish which had hatched after the previous spring-summer breeding season, that is, they were roughly 6 months old.

5.1.3.2 Alpine Galaxias (*Galaxias paucispondylus*)

This species was recorded during six of the seven sampling periods and appeared to be fairly common in the upper Rangitata River (Table 13). They were also found in Deep Stream, a high country tributary of the Rangitata (see Fig. 1).

The alpine galaxias is known from a few South Island rivers, mainly those of moderate to high altitude on the eastern side of the Southern Alps. They have been recorded up to 112 mm long, but commonly seem to

grow to only about 80-85 mm (McDowall 1978). Very little is known of their biology or ecology, except that they spend their entire life cycle in fresh water. Spawning probably occurs during spring (McDowall 1978).

In the upper Rangitata this species was usually caught amongst the shallow (10-20 cm deep) broken water of small and medium sized riffles, though a few also were found close to the edge of small swift runs.

5.1.3.3 Long-jawed Galaxias (*Galaxias prognathus*)

Very little is known of this species and it has been found only in a few rivers of the South Island. It was recorded in Area D of the Rangitata River during six of the seven sampling periods (Table 14) and also in Deep Stream (see Fig. 1).

This species, which commonly attains a length of 60-70 mm, was caught mostly in shallow riffles, frequently in the very shallow (less than 10-cm deep) margins where there was little flow. During late summer and autumn long-jawed galaxiids were sometimes collected from areas where small channels had shrunk to trickles less than 0.5 m wide and 5 cm deep.

Nothing is known of the breeding of this species, but McDowall (1978) suggested that spawning takes place during spring.

5.1.3.4 Common River Galaxias (*Galaxias vulgaris*)

The common river galaxias was regularly encountered in the upper river and in several tributaries of the Rangitata (see section 5.3). In Area D this species did not appear to be as common as either of the two alpine galaxiid species, *G. paucispondylus* and *G. prognathus*, and only 44 were recorded (Table 15).

TABLE 13. Numbers and sizes of alpine galaxias (*Galaxias paucispondylus*) sampled in Area D of the Rangitata River

Sampling period	Number sampled	Mean length (mm)	Standard deviation (mm)
Aug 1983	2	53.0	7.1
Oct 1983	3	63.0	4.0
Dec 1983	11	64.0	3.6
Feb 1984	6	49.0	11.6
Apr 1984	45	56.3	7.0
Jun 1984	34	53.6	6.3
Total	101		

TABLE 14. Numbers and sizes of long-jawed galaxias (*Galaxias prognathus*) sampled in Area D of the Rangitata River

Sampling period	Number sampled	Mean length (mm)	Standard deviation (mm)
Aug 1983	1	58.0	-
Oct 1983	6	56.5	10.3
Dec 1983	21	52.0	9.9
Feb 1984	25	48.5	5.0
Apr 1984	26	64.3	3.1
Jun 1984	2	64.5	0.7
Total	81		

TABLE 15. Numbers and sizes of common river galaxias (*Galaxias vulgaris*) sampled in Area D of the Rangitata River

Sampling period	Number sampled	Mean length (mm)	Standard deviation (mm)
Jun 1983	11	60.0	4.0
Aug 1983	9	58.3	8.0
Oct 1983	7	80.1	21.5
Dec 1983	13	79.3	13.9
Feb 1984	1	102	-
Apr 1984	3	94.0	6.9
Total	44		

The biology of this species is reasonably well known from the studies of Benzie (1968) and Cadwallader (1973, 1975, 1976a, 1976b, 1978). Spawning takes place during late winter and spring, and newly hatched young shoal in quietly flowing marginal shallows and pools until they are about 30 mm long. They then move into the adult habitat, typically amongst the gravels and boulders of swiftly flowing streams. Although they may attain a length of 150 mm (McDowall 1978), very few of those caught in the Rangitata exceeded 100 mm.

5.1.3.5 Rainbow Trout (*Salmo gairdnerii*)

Rainbow trout are not native to New Zealand, but since their introduction in 1883 (Scott, Hewitson, and Fraser 1978) they have become a very important sports fish. Liberations into South Island rivers have generally not been very successful, and here the rainbow is better known as a lake fish.

Rainbow trout are occasionally caught by anglers in the upper river and gorge, but this species is believed to comprise only a small proportion of the Rangitata sports fishery (Davis, Unwin, Zeldis, and Hayes in prep.). Mature rainbows enter Deep Stream (see Fig. 1) during autumn to spawn (Davis, Zeldis, and Unwin in prep.).

Juveniles up to 120 mm in length were regularly recorded in Area D, and on one occasion in Area A (Table 16). They were usually found amongst marginal vegetation and debris cover in moderately swift areas of small side channels. Only one rainbow trout greater than 250 mm was encountered, but recent surveys of anglers' catches in the Rangitata (Davis, Unwin, Zeldis, and Hayes in prep.) indicate that more adult rainbow trout were present in the river than our sampling indicated.

TABLE 16. Numbers and sizes of rainbow trout (*Salmo gairdnerii*) sampled in the Rangitata River

Sampling period	Number sampled			Mean length (mm)	Standard deviation (mm)
	Area A	Area D	Total		
Jun 1983	-	3	3	104.3	16.5
Aug 1983	-	4	4	87.8	12.7
Oct 1983	-	6	6	102.7	17.1
Dec 1983	-	3	3	115.3	15.3
Feb 1984	-	9	9	65.3	11.6
Apr 1984	1	10	11	94.2	22.2
Jun 1984	-	7	7	136.7	65.2
Totals	1	42	43		

New Zealand does not appear to have any stocks of "sea-run" rainbow trout, though this species is known to make spawning migrations from lakes and rivers into tributary streams.

5.1.3.6 Koaro (*Galaxias brevipinnis*)

Landlocked populations of koaro are known from two high country tarns known as the Scour Stream tarns (see Fig. 1) in the Rangitata catchment (Docherty 1977).

Although koaro are commonly found in mountain streams (McDowall 1978), they were not found in any of the Rangitata tributaries or in the mainstem of the river during this study. Adults of this species grow quite large; they reach a known maximum of 270 mm in length and are commonly found up to 180 mm (McDowall 1978).

Whitebait of the koaro are thought to comprise a small proportion (probably much less than 10%) of the whitebait run in the Rangitata and other east coast rivers of the South Island (McDowall 1965).

5.1.3.7 Brook Char (*Salvelinis fontinalis*)

This species was introduced into New Zealand last century, and, though widespread, they are not very common. In this country brook char rarely exceed 200 mm in length, and "sea-run" populations have not established.

Populations of brook char exist in the Rangitata catchment (McDowall 1984), but were not recorded during this study.

5.1.4 "All Areas" Fish

The three species in this category were found in all four sampling areas of the Rangitata. All three are migratory fish and two (quinnat salmon and brown trout) have been introduced to this country.

5.1.4.1 Quinnat Salmon (*Oncorhynchus tshawytscha*)

The Rangitata River is well known as a salmon river and various aspects of the river's quinnat salmon recreational fishery have been discussed in Boud and Cunningham (n.d), Davis (1984), and Hardy (1975). The Rangitata River quinnat salmon fishery is also described by Davis, Zeldis, and Unwin (in prep.) and Davis *et al.* (in prep).

Quinnat salmon are migratory fish. Within a year of hatching in stable high country streams, the young move downstream to the sea. Mature fish, 2-5 years old, migrate out of the sea and return upstream to the same spawning grounds. Returning adult salmon often exceed 10 kg in weight and are very popular with anglers.

During this study, 326 juvenile quinnat salmon (30-150 mm long) were recorded (Table 17). Most were caught in Area D, though the high catch

TABLE 17. Numbers and sizes of quinnat salmon (*Oncorhynchus tshawytscha*) sampled in the Rangitata River

Sampling period	Number sampled					Mean length (mm)	Standard deviation (mm)
	Area A	Area B	Area C	Area D	Total		
Jun 1983	-	1	1	4	6	99.0	8.3
Oct 1983	3	79	38	65	185	40.6	6.4
Dec 1983	-	6	3	81	90	53.5	9.1
Feb 1984	-	-	2	14	16	68.7	10.5
Apr 1984	-	-	-	4	4	95.0	1.4
Jun 1984	1	2	8	12	23	103.9	13.5
Totals	4	88	53	181	326		

may reflect their small size as well as their abundance in this area. Juveniles grow as they move downstream and become harder to catch with an electric fishing machine, probably because as they grow they become stronger swimmers and start to utilise deep water habitats which cannot be electric fished.

Most juvenile quinnat salmon caught during this study were found in small side channels with abundant cover (see Fig.8), or along the edges of runs where cover was provided by large substrates. Often they were found with juvenile brown and rainbow trout.

5.1.4.2 Long-finned Eel (*Anguilla dieffenbachii*)

Eels are among the commonest and best known fishes in New Zealand fresh waters, and are found in a variety of habitats throughout the country. There are two species of eel - the longfin is usually associated with streams and rivers, whereas shortfins (see section 5.1.1.5) are more often found in swamps and lagoons.

Although long-finned eels were recorded in all four areas of the Rangitata, nearly all of the sample was caught below the gorge (Table

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i he R ng t ta R ve

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c 1 8	7	4	6		47
e 1 8	18	1	6		25
el 1 8	50	5	3		58
p 1 8	8	7	3		19
u 1 8	4	2	3		14
o al	02	0	7		0

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Adult migrant eels are usually distinguishable because they undergo some changes in colour, eye size, and body shape.

The length of adult eels caught by electric fishing in the Rangitata was estimated rather than measured because of the difficulty of handling and anaesthetising these large, active, and slippery fish.

Long-finned eels greater than 300 mm in length were caught mainly close to the Rangitata mouth, especially during autumn when adult migrants were observed in the samples. Adult eels were caught only amongst dense cover, normally submerged vegetation in deep pools or runs. Eels less than 300 mm long, were found throughout the lower river (Areas A, B, and C) and were caught amongst cobbles and boulders in riffles or along the edges of runs.

It appears that the eel population of the Rangitata is not great and may be limited by a lack of suitable adult habitat in the lower river. Eels do not support a significant commercial or recreational fishery in the Rangitata, and one commercial eel fisherman who occasionally places fyke nets in the river commented that the river is generally too swift to fish, and that, though the eels caught are of good quality, he does not catch many.

5.1.4.3 Brown Trout (*Salmo trutta*)

This acclimatised species is fairly common throughout the Rangitata River and supports a significant recreational sports fishery (Davis *et al.* in prep.). Brown trout were found in all four sampling areas during all but one of the sampling periods (Table 19). Most brown trout sampled were juveniles (up to about 200 mm), but occasionally fish over 250 mm were caught.

TABLE 19. Numbers and sizes of brown trout (*Salmo trutta*) sampled in the Rangitata River

Sampling period	Number sampled					Mean length (mm)	Standard deviation (mm)
	Area A	Area B	Area C	Area D	Total		
Jun 1983	10	2	3	7	22	158.2	108.7
Aug 1983	-	2	9	5	16	114.6	20.7
Oct 1983	2	6	5	8	21	62.5	46.9
Dec 1983	2	19	3	10	34	61.3	45.9
Feb 1984	2	7	2	9	20	119.8	52.7
Apr 1984	4	7	4	10	25	131.0	53.6
Jun 1984	7	12	19	10	48	167.0	55.0
Totals	27	55	45	59	186		

Some information on juvenile brown trout in the Rangitata River also was obtained during fortnightly electric fishing surveys for quinnat salmon in the period August 1983 - April 1984 (see Davis, Zeldis, and Unwin in prep.). Length-frequency data from both stocks were combined to show brown trout fry emergence and growth in the Rangitata River from June 1983 to June 1984 (Fig.9). Fry emerged in October, and during that month 2 year classes (0+ and 1+) were clearly identifiable. Even though the sample sizes each month were small, growth of the fish between sampling periods can be seen. The wide range in length of juvenile brown trout probably reflects different hatching times and rates of growth.

Although they were found in a wide variety of habitats throughout the river, juvenile brown trout were caught most often in small, swift side channels which they often shared with juvenile quinnat salmon and/or rainbow trout (see Fig. 8).

Brown trout are migratory and may spend part of their life at sea. Mature fish are known to spawn in Deep Stream (see Fig. 1) during autumn and winter (Hardy 1975).

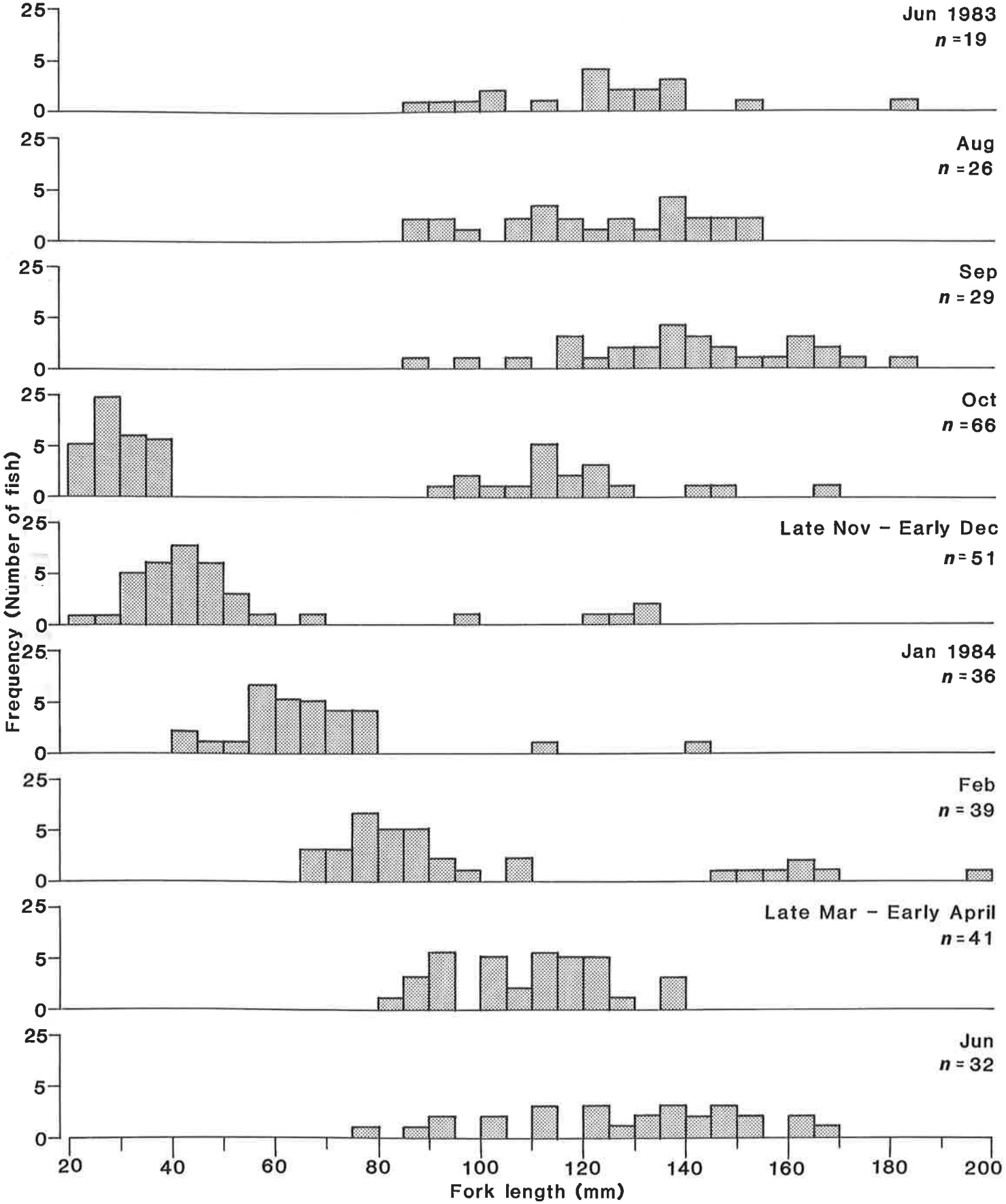

FIGURE 9. Length-frequency distributions of juvenile brown trout sampled from the mainstem of the Rangitata River during 1983-84.

5.2 Fish Abundance and Density

Estimates of fish density calculated from electric fishing in various parts of the Rangitata ranged from less than 0.1 fish per square metre to 1.5 fish per square metre. Small side channels with bank and vegetation cover seemed to support the highest density of fish and variety of species; however, these habitats were rare, especially in Areas B and C. Riffles and the edges of fast runs generally contained many more fish than did pools and sluggish runs. Some pools, notably those which contained accumulations of broom and gorse debris, supported small and locally abundant populations of fish. Throughout the river, fish usually were found near cover of some sort - in riffles and fast runs they occurred in the spaces between gravel and boulders, and in slower water they were associated with marginal vegetation and clusters of gorse or broom debris.

5.3 Tributary Streams

During this study several tributary streams of the Rangitata were sampled by use of an electric fishing machine. Sampling was not done on a regular basis and usually only a short reach of each stream was fished. The following summaries are based on the results of electric fishing surveys and records from FRD's fish distribution data base.

5.3.1 Deep Stream

This tributary enters the upper Rangitata River near Mesopotamia Station (see Fig. 1). It is a stable, spring-fed stream with an annual mean flow of about 6 m^3/s, and it contains abundant bankside and instream cover.

This stream is recognised as being an important salmon and trout spawning area (Hardy 1975), and quinnat salmon, brown trout, and rainbow trout commonly occur in it. Four species of native fish also are known to occur in the stream; upland bullies, long-jawed galaxias, alpine galaxias, and common river galaxias.

5.3.2 Boundary Stream

The reach surveyed was close to Rangitata Gorge road, about 2 km from its outlet near the lower end of the gorge (see Fig. 1). The channel sampled was only one of several branches of Boundary Stream and was quite small (1-2 metres wide with a flow of about 0.2 m^3/s). There was very little bankside vegetation in this area, but abundant instream cover was provided by boulders and cobbles. Although sampled at three different seasons, only upland bullies and common river galaxias were found in the stream. However, local anglers have observed trout in the Boundary Stream system.

5.3.3 Raules Gully Stream

This tributary enters the Rangitata about 5 km downstream of the gorge (see Fig. 1). The reach sampled was near Rangitata Gorge road where the stream flowed through a steep, bush-lined gully. Generally the stream was 1-2 m wide with a flow of about 0.1 m^3/s. This stream was sampled once during summer. Common river galaxias were numerous amongst boulders and cobbles of the streambed, but no other species were found.

5.3.4 Lynn Stream

This tributary enters the Rangitata midway between the gorge and Peel Forest (see Fig. 1). It is a steep, shingle stream and for much of the year the lower sections may be dry. The mouth of Lynn Stream was electric fished regularly, and occasionally juvenile brown trout and quinnat salmon were caught in this area. Quinnat salmon are known to have spawned in this area (Hardy 1975). No native species were recorded here.

Near Lynn Stream, drainage ditches, which flowed directly into the Rangitata, contained numerous long-finned eels from 200 to 600 mm in length.

5.3.5 McKinnans Creek

This creek joins the Rangitata about 2 km from the mouth (see Fig. 1). There is some confusion concerning its name; it is also known locally as Middle Stream, Middle Channel, or Middle Creek.

When sampled during spring the creek appeared to be stable (probably spring-fed) and had an abundance of riparian growth. Although small (about 1-2 m wide and 0.5 m deep), it contained numerous juvenile brown trout and common bullies, as well as both short-finned and long-finned eels. A local farmer reported that adult quinnat salmon sometimes entered the stream.

5.4 Benthic Invertebrates

The abundance of benthic invertebrates at each of the four sampling areas of the Rangitata River is shown in Tables 20-23.

TABLE 20. Abundance of benthic invertebrates collected in Area A of the Rangitata River, June 1983–April 1984. (N.B. No June 1984 sample.) Data are percentage values of three replicate samples

Taxa	Sampling date 15/6/83	12/8/83	19/10/83	30/11/83	28/2/84	6/4/84
Oligochaeta						
Oligochaetae spp.	-*	-	-	-	3.3	-
Mollusca						
Potamopyrgus antipodarum	-	-	-	-	0.7	-
Plecoptera						
Zelandobius furcillatus	30.9	10.3	5.6	1.8	-	0.7
Ephemeropotera						
Deleatidium spp.	60.0	81.9	61.1	83.6	84.8	62.1
Neozephlebia scita	-	0.6	-	-	-	-
Trichoptera						
Oxyethira albiceps	-	-	-	-	1.3	12.1
Aoteapsyche tepoka	-	0.6	-	-	0.7	-
Hydrobiosis frater	1.8	-	-	1.8	-	-
H. umbripennis	-	-	-	-	-	0.5
Hydrobiosis spp.	-	-	-	-	-	0.5
Psilochorema bidens	-	0.6	-	-	-	-
Costachorema callista	-	-	-	-	-	0.7
Coleoptera						
Hydora sp.	-	-	-	-	0.7	1.2
Diptera						
Chironomidae spp.	1.8	0.6	11.1	10.9	5.3	19.9
Austrosimulium spp.	1.8	0.6	22.2	-	3.3	0.3
Eriopterini sp.	3.6	1.3	-	1.8	-	1.8
Molophilus sp.	-	3.2	-	-	-	0.2
Mean number per $0.1m^2$	18.3	51.7	6.0	18.3	50.3	199.0
Number taxa	6	9	4	5	8	11

* Not present.

TABLE 21. Abundance of benthic invertebrates collected in Area B of the Rangitata River, June 1983-June 1984. Data are percentage values of three replicate samples

Taxa	Sampling date 15/6/83	12/8/83	18/10/83	1/12/83	8/2/84	5/4/84	8/6/84
Oligochaeta							
Oligochaetae spp.	-*	2.0	-	-	1.3	-	-
Plecoptera							
Zelandobius furcillatus	15.6	8.0	-	-	-	2.6	1.6
Ephemeropotera							
Deleatidium spp.	62.5	66.0	50.0	44.4	69.0	61.6	66.0
Trichoptera							
Pycnocentrodes spp.	-	-	-	-	-	0.1	0.1
Oxyethira albiceps	-	2.0	-	-	-	-	-
Aoteapsyche colonica	-	-	-	-	-	0.4	0.3
A. tepoka	-	-	-	-	-	0.4	0.3
Hydrobiosis frater	-	-	-	-	-	0.3	0.9
H. umbripennis	-	-	-	-	-	0.9	0.4
H. parumbripennis	-	-	-	-	-	-	0.1
Hydrobiosis spp.	-	-	-	-	0.6	1.6	0.3
Costachorema callista	-	-	-	-	-	1.2	0.3
Costachorema spp.	-	-	7.1	-	-	-	-
Coleoptera							
Hydora sp.	6.3	1.0	7.1	-	1.9	0.4	-
Diptera							
Chironomidae spp.	12.5	11.0	35.7	33.3	24.1	16.7	10.0
Austrosimulium spp.	-	6.0	-	-	2.5	12.8	18.5
Eriopterini sp.	3.1	2.0	-	22.2	0.6	0.7	0.7
Molophilus sp.	-	2.0	-	-	-	0.1	0.5
Mean number per $0.1m^2$	10.7	33.3	4.7	3.0	52.7	227.3	332.0
Number taxa	5	9	4	3	7	14	14

* Not present.

TABLE 22. Abundance of benthic invertebrates collected in Area C of the Rangitata River, June 1983-June 1984. Data are percentage values of three replicate samples

Taxa	Sampling date 14/6/83	11/8/83	17/10/83	1/12/83	8/2/84	7/4/84	8/6/84
Mollusca							
Potamopyrgus antipodarum	-*	-	-	-	-	-	0.1
Plecoptera							
Zelandobius furcillatus	12.5	9.1	-	5.5	-	6.6	2.7
Ephemeropotera							
Deleatidium spp.	72.9	81.8	41.1	89.1	68.2	58.4	60.5
TRICHOPTERA							
Pycnocentrodes spp.	-	-	-	-	-	-	0.6
Oxyethira albiceps	-	-	1.4	-	1.8	1.5	-
Aoteapsyche colonica	-	-	1.4	-	-	-	0.5
A. tepoka	-	-	-	-	11.8	-	0.7
Hydrobiosis frater	-	-	-	-	0.9	0.7	1.0
H. umbripennis	-	-	-	-	0.9	0.7	2.2
H. parumbripennis	-	-	1.4	-	0.9	-	-
Hydrobiosis spp.	-	-	1.4	-	1.8	0.7	2.1
Psilochorema nemorale	-	-	-	-	-	-	0.1
Costachorema callista	-	-	-	-	-	2.9	0.2
Costachorema spp.	2.1	-	-	-	-	-	-
Coleoptera							
Hydora sp.	-	-	2.7	-	-	-	-
Diptera							
Chironomidae spp.	4.2	-	42.5	3.6	10.0	16.1	15.2
Austrosimulium spp.	4.2	6.8	4.1	1.8	1.8	10.9	13.3
Eriopterini sp.	4.2	2.3	2.7	-	-	1.5	0.6
Molophilus sp.	-	-	1.4	-	1.8	-	0.3
Mean number per $0.1m^2$	16.0	14.7	24.3	55.0	36.7	45.7	291.7
Number taxa	6	4	10	4	10	10	15

* Not present.

TABLE 23. Abundance of benthic invertebrates collected in Area D of the Rangitata River, June 1983–June 1984. Data are percentage values of three replicate samples

Taxa	Sampling date 16/6/83	10/8/83	20/10/83	2/12/83	27/2/84	4/4/84	9/6/84
Oligochaeta							
Oligochaetae spp.	0.4	-*	1.3	-	2.3	-	-
Plecoptera							
Zelandobius furcillatus	1.6	1.1	0.6	-	0.3	0.4	0.3
Ephemeropotera							
Deleatidium spp.	67.6	63.4	68.7	91.4	67.4	72.6	64.8
Coloburiscus humeralis	-	-	-	-	-	-	0.1
Trichoptera							
Pycnocentria evecta	-	-	-	-	0.3	0.1	-
Pycnocentrodes spp.	-	-	-	0.5	0.3	-	0.2
Oxyethira albiceps	-	0.4	-	-	0.6	0.6	0.9
Aoteapsyche colonica	-	-	-	0.5	-	1.1	2.3
A. raruraru	-	-	-	-	-	-	0.2
A. tepoka	-	0.4	0.3	-	3.4	0.1	1.0
Hydrobiosis frater	-	1.5	1.0	-	1.1	1.2	1.7
H. umbripennis	0.4	-	-	-	0.6	1.1	2.8
H. parumbripennis	-	-	-	-	-	0.1	-
Hydrobiosis spp.	-	-	-	-	-	0.6	0.8
Psilochorema bidens	-	-	-	0.9	-	-	-
P. nemorale	-	-	0.3	-	-	-	-
Costachorema callista	0.4	-	-	-	1.4	0.6	0.4
C. psaroptera	-	0.4	-	-	-	-	-
C. xanthoptera	-	-	-	-	-	0.4	0.7
Coleoptera							
Hydora sp.	-	-	-	-	1.4	0.2	0.1
Diptera							
Chironomidae spp.	17.0	1.9	2.6	1.4	16.6	13.6	18.7
Austrosimulium sp.	9.9	24.9	24.9	2.7	2.6	6.5	3.7
Eriopterini sp.	2.8	5.3	0.3	2.3	-	0.5	0.3
Paralimnophila skusei	-	0.4	-	-	1.1	0.1	1.0
Aphrophila neozelandica	-	-	-	-	-	-	0.1
Molophilus sp.	-	0.4	-	-	0.6	-	-
Amphipoda							
Paracalliope fluviatilis	-	-	-	0.5	-	-	-
Mean number per $0.1m^2$	84.3	88.3	104.3	73.3	116.7	270.3	604.7
Number taxa	8	11	9	8	15	17	19

* Not present.

(One set of samples, taken from Area A during June 1984, was not properly preserved and consequently could not be sorted, identified, and counted.)

A total of 30 taxa was identified from the mainstem of the Rangitata during the study; 17 taxa in Area A, 18 in Area B, 19 in Area C, and 27 in Area D.

The benthic fauna of all four sampling areas was dominated by larvae of the mayfly *Deleatidium* spp., which was present in all areas throughout the sampling period and accounted for 44.4-91.4% of the animals sampled. The larvae and pupae of two other taxa were commonly found throughout the river; Chironomidae spp. (midges) and *Austrosimulium* spp. ("sandflies"). Above the gorge, Chironomidae and *Austrosimulium* spp. were of roughly equivalent abundance and over the sampling period they made up 1.4-18.7% and 2.6-24.9% respectively of all the samples in this area. Below the gorge, Chironomidae spp. were generally more abundant (0-42.5% of the samples) than *Austrosimulum* spp. (0-22.2% of the samples).

Another 10 taxa were recorded in all four sampling areas at various times: the plectopteran (stonefly) species *Zelandobius furcillatus*; the trichopterans (caddisflies) *Oxyethira albiceps*, *Costachorema callista*, *Aoteapysche tepoka*, *Hydrobiosis frater*, *H. umbripennis*, and *Hydrobiosis* spp; the coleopteran (riffle beetle) *Hydora* sp; and two cranefly (Diptera) taxa *Eriopterini* sp. and *Molophilus* sp.

The remaining 17 taxa (mostly trichopteran larvae) were not collected at all four sites and usually each only accounted for less than 3% of any sample.

The benthic faunas of the three lower river areas (A, B, and C) were similar in terms of species abundance and composition (Tables 20-22). However, samples collected in Area D above the gorge usually had a greater number of taxa and consistently contained a greater abundance of benthic invertebrates - often two or three times the number occurring in any of the lower river areas during the same sampling period (Table 23).

The greatest abundance and number of taxa in all areas occurred during the April and June 1984 sampling periods, probably as a consequence of a long period of stable river flow during autumn and early winter. The highest mean density of invertebrates occurred in Area D (604 per 0.1 m^2 on 9 June 1984), the lowest in Area A (3 per 0.1 m^2 on 1 December 1983).

Species diversity varied considerably both between areas and between sampling periods (Table 24), but no trends were apparent.

TABLE 24. Species diversity index of benthic invertebrates collected from four areas of the Rangitata River, June 1983-June 1984

Formula used:

$$\text{Species diversity index} = \frac{(\text{number of taxa in sample}) - 1}{\text{Log}_e\ (\text{number individuals in sample})}$$

Sampling period	Area A	Area B	Area C	Area D
Jun 1983	1.72	1.69	1.80	1.58
Aug 1983	2.03	2.28	1.12	2.23
Oct 1983	1.67	1.94	2.82	1.72
Dec 1983	1.38	1.82	1.03	1.63
Feb 1984	1.79	1.51	2.50	2.94
Apr 1984	1.89	2.40	2.35	2.86
Jun 1984	*	2.24	2.47	2.81

* No sample.

6. DISCUSSION

From June 1983 to June 1984, 15 native and 3 introduced species of freshwater fish were caught by electric fishing in the Rangitata River. A further two freshwater species (one native and one introduced) are known to occur in the river system, but were not recorded during this study. Two species of marine fish also enter the estuarine area of the river at times. Table 25 lists fish species of the Rangitata River and also summarises the numbers of each species recorded during this study and areas and habitats in which they were usually found.

The number and composition of freshwater species in the fish fauna of the Rangitata River are typical of braided shingle rivers along the east coast of the South Island. Docherty (1979) recorded 20 species from the Hurunui River; Bonnett, Davis, and Unwin (1982) recorded 18 species from the Ashley River; Eldon, Davis, and Unwin (1982) recorded 20 species from the Ashburton River; and Wing (1978) recorded 18 species from the mainstem of the Waitaki River. The reports of Davis (1979), Davis *et al.* (1983), and Eldon and Greager (1983) recorded a total of 21 species from the Rakaia River. Species not recorded in the Rangitata River, but known to occur in other east coast rivers include: red-finned bully (*Gobiomorphus huttoni*) (known from the Hurunui, Ashley, and Waitaki Rivers), and giant kokopu (*Galaxias argenteus*), known from the Waitaki River, though both are rare.

The 20 freshwater and 2 marine species of fish known to occur in the Rangitata catchment can be placed in broad groups based on their distribution in the river (see Table 5). Kahawai and yellow-eyed mullet are marine fish and probably do not penetrate upstream of the estuary. Giant bullies, short-finned eels, inanga whitebait, and the two species

TABLE 25. Summary of fish species known to occur in the Rangitata River catchment

Species (common name)	Total number caught	Areas where found	Habitat where usually found	Comments
Blue-gilled bully	1 048	Most of river below gorge.	Amongst boulders on edges of riffles and fast runs.	Migratory, move as they grow?
Torrentfish	821	Most of river below gorge.	In turbulent white-water areas of riffles.	Migratory, juveniles caught near mouth.
Common bully	631	Most of river below gorge.	Debris and vegetation cover, slack water.	Migratory, high densities in some places.
Upland bully	452	Mainly above gorge.	Slow flowing water, vegetation cover.	Non migratory, common in some tributaries.
Quinnat salmon	362	Throughout river.	Varies with size of fish, juveniles usually dependent on cover.	Introduced, migratory, juveniles only sampled.
Long-finned eel	200	Throughout river, but rare above gorge.	Small (<300 mm) in riffles and runs, larger eels in pools and amongst debris cover.	Migratory, spawn at sea.
Brown trout	183	Throughout river.	Varies with size of fish, often near fast flowing water.	Introduced, migratory, sample was mostly juveniles.
Inanga	139	Near mouth.	Edges of channels.	Only migratory whitebait recorded.
Alpine galaxias	101	Above gorge only.	Shallow riffles.	Non migratory, densities high variable.
Long-jawed galaxias	81	Above gorge only.	Very shallow riffle edges and runs.	Non-migratory, often found associated with alpine galaxias and common river galaxias.
Black flounder	47	Lower river, usually quite close to mouth.	Silty backwaters and pools.	Migratory, occurrence variable.
Common smelt	46	Lower river, below S.H.1.	Silty backwaters and pools.	Migratory, occurrence variable.
Common river galaxias	44	Above gorge only.	Edge of riffles and runs.	Non migratory, common in some tributaries.
Rainbow trout	43	Nearly all above gorge.	Varies with size, usually close to fast flowing water.	Introduced, non-migratory.
Stokell's smelt	4	Lower river below S.H.1.	Spawns near estuary.	Migratory, large shoals enter river to breed.
Giant bully	4	Near mouth only.	Debris and vegetation cover in pools.	Probably migratory, little known.
Lamprey	2	Lower river.	Probably spawns in minor tributaries.	Migrates into river to breed.
Short-finned eel	1	Lower river? some tributaries	Swampy streams?	Migratory, rare in Rangitata system?
Koaro	not recorded this study	High country tarns, tributary streams?	Bouldery forest streams?	Essentially migratory, probably contributes a small proportion of "whitebait" run in Rangitata.
Brook char	not recorded this study	Above gorge, in small tributaries?	Small streams.	Introduced.
Kahawai	not recorded this study	Estuarine areas.	Marine.	Known to fishermen, often present in large shoals near mouth.
Yellow-eyed mullet	not recorded this study	Estuarine areas.	Marine.	Sometimes caught near mouth

of smelt were found only within a few kilometres upstream of the mouth. Black flounders and common bullies also were caught mainly near the mouth, but have been reported 20 km upstream near S.H.1 bridge. Lampreys were rare and only ever found in the lower river near S.H.1 bridge. The fish fauna of the river is dominated by blue-gilled bullies and torrentfish, which were very common at all three sampling areas below the gorge.

During this study, five species of fish were found predominantly above the gorge: upland bullies, alpine galaxias, long-jawed galaxias, common river galaxias, and rainbow trout. Two further species, koaro and brook char are also known to occur in the catchment above the gorge.

The remaining three species (quinnat salmon, brown trout, and long-finned eels) were recorded at all four sampling areas of the river, though long-finned eels appear to be very rare above the gorge.

A notable feature of the Rangitata River native fish fauna was the distribution of species above and below the gorge. Species found above the gorge were predominantly non-migratory and not found below the gorge, whereas species below the gorge were predominantly migratory and did not occur above the gorge. This differs from those other east coast rivers which have very similar faunas (for example, the Rakaia and Ashley Rivers), and where there appears to be considerable "overlap" - migratory species can be found in the upper river, and non-migratory species near the mouth. The separation of species into "above gorge" and "below gorge" groups in the Rangitata may be influenced by:

1. The rugged nature of the gorge, which may prevent the upstream passage of many migratory species.

2. Marked differences in the types of habitats available to fish above and below the gorge. Above the gorge the river is very braided, and broad shallow channels flow gently over fairly small substrates, whereas below the gorge the river is often confined to a few swift, turbulent channels containing large substrates.

Area A, the section of river close to and including the mouth, appears to be the most productive part of the river. Thirteen of the 18 freshwater species caught during this study were recorded in Area A and, in terms of fish abundance, 43% of the total number caught in all four areas was recorded in this area.

Areas B and C of the lower river appear to provide little suitable habitat for all but the two dominant species of fish, blue-gilled bully and torrentfish.

Above the gorge eight species of fish were caught, and though Area D does not appear to be as productive as Area A it is, nevertheless, notable for containing good populations of two uncommon species - alpine galaxias and long-jawed galaxias. The mainstem and tributaries of the upper river also provide most of the suitable spawning and rearing habitats for salmon and trout in the river.

In all four areas sampled the density of fish was generally low - usually less than 1 fish per square metre. Overall, the estimates of fish density in the Rangitata appear to be very similar to those of the Rakaia (Davis *et al.* 1983), and are probably typical of large east coast shingle rivers. In the Rangitata most fish were found either in riffles or small side channels or along the margins of fast runs.

Different species of fish sometimes shared the same habitats. Juvenile salmonids (quinnat salmon, brown trout, and rainbow trout) were

often found together in small, swift side channels. Above the gorge riffles sometimes contained common river galaxias, long-jawed galaxias and alpine galaxias, whereas below the gorge riffles regularly contained blue-gilled bullies and torrentfish.

Throughout the river instream cover appeared to be sparse, consisting mostly of spaces between gravel and boulder substrates. Dense, but very localised, fish populations often were found amongst marginal vegetation and debris clusters (usually composed of broom and gorse). However, such areas are usually transient, and may be washed away or stranded by floods and changes in river bed morphology.

A wide variety of activities is undertaken by the fish species in the Rangitata River; these include spawning, incubation, hatching, resting, and feeding. Many of the species in the Rangitata River are migratory, especially those that are commonly found in the lower river. Migration usually involves movement of adults to spawning areas, followed by a subsequent reverse migration of young fish. The timing and extent of fish migrations in the Rangitata River are probably similar to those of the Rakaia River, where it has been shown that fish migration is occurring throughout the year (Davis *et al.* 1983).

The benthic fauna of the lower Rangitata River appears similar to that of the lower Rakaia River in both species composition and abundance. Sagar (1983) studied three sites on the lower Rakaia mainstem that were comparable to Areas A, B, and C of the Rangitata. He identified a total of 17 taxa during a 12-month sampling period, and 14 of these taxa also occurred in the Rangitata. The lower Rakaia and lower Rangitata appear to differ only in the occurrence of taxa which rarely exceeded 2% of the abundance in the samples. Lower Rakaia taxa

not found in the lower Rangitata included *Berosus* spp, (Coleoptera), Ceratopogonidae sp. (Diptera), and *Pycnocentrodes* spp. (Trichoptera). Taxa identified from the lower Rangitata, but not the lower Rakaia included *Neozephlebia scita* (Ephemeroptera), and three trichopteran taxa *P. nemorale*, *Costachorema callista*, and *Costachorema* spp.

A notable feature of Area D was its greater invertebrate abundance. During most sampling periods both the number of invertebrates per 0.1 square metre, and the number of taxa present, were often two or three times that in any of the other three sampling areas.

In conclusion, the Rangitata River appears to be a typical east coast South Island braided shingle river, and the fish and invertebrate fauna of the system are very similar to those of the Rakaia River in almost every respect.

6. ACKNOWLEDGMENTS

I sincerely thank Colin Docherty, Chris Kime, Andy Greager, John Zeldis, Sally Davis, and Laurel Teirney for assisting with field work, and Paul Sagar and Marlene Skellerup for systematically sorting and identifying the invertebrate samples. I would also like to acknowledge the assistance and constructive comments of Eric Graynoth, Paul Sagar, Sally Davis, and Tony Eldon in preparing this report. Thanks also to Carol Whaitiri for typing the manuscript and Gerald Smith for assisting with the photographs and electric fishing equipment.

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