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FISHERIES ENVIRONMENTAL REPORT NO. 25

SUBMISSION ON

THE VALUE OF THE

ASHLEY FISHERY RESOURCES

FISHERIES RESEARCH DIVISION
MINISTRY OF AGRICULTURE AND FISHERIES
CHRISTCHURCH

Report to: North Canterbury Regional Water Board

SUBMISSION ON
THE VALUE OF THE
ASHLEY FISHERY RESOURCES

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FISHERIES ENVIRONMENTAL REPORTS

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1. INTRODUCTION

The North Canterbury Catchment Board and Regional Water Board (NCCB) recently released a report on the water resources of the Ashley catchment (Bowden 1982). The report precedes compilation and publication by the Board of a draft water allocation and management plan for waters of the Ashley.

Under the Fisheries Act (1908), Fisheries Research Division (FRD) has responsibility for research and advisory functions related to freshwater fish and fishery values. The Ministry of Agriculture and Fisheries as a whole also has responsibility for management of these resources. This submission is made so that the NCCB, who are the water managers, are aware of the fish stocks and fisheries values associated with the Ashley River (Fig. 1). Thus, when the NCCB undertakes the task of setting minimum flows for the Ashley, it is hoped the proposed flow regime will be adequate to protect the fish and fisheries.

FRD conducted some electric fishing surveys in the Ashley River during the late summer and winter of 1981, and summer 1982. The field programme was part of a comparative fisheries/hydrology study carried out jointly with Ministry of Works and Development (MWD) in three Canterbury braided rivers (Rakaia, Hurunui and Ashley). The aims were to identify physical factors that significantly affect the size and biomass of fish populations in braided rivers, and to collect habitat use data on the more common fish species present in these rivers. Surveys were carried out in selected reaches in the vicinity of S.H.1 bridge and near the Bullock Creek confluence (Fig. 1). While the data were not directed at providing information for the NCCB's water allocation plan, they have given an indication of the distribution of some native species in the middle and lower reaches of the Ashley and provided comparative data with the Hurunui and Rakaia Rivers.

In this submission, FRD discusses:

(i) the fish stocks of the Ashley River system

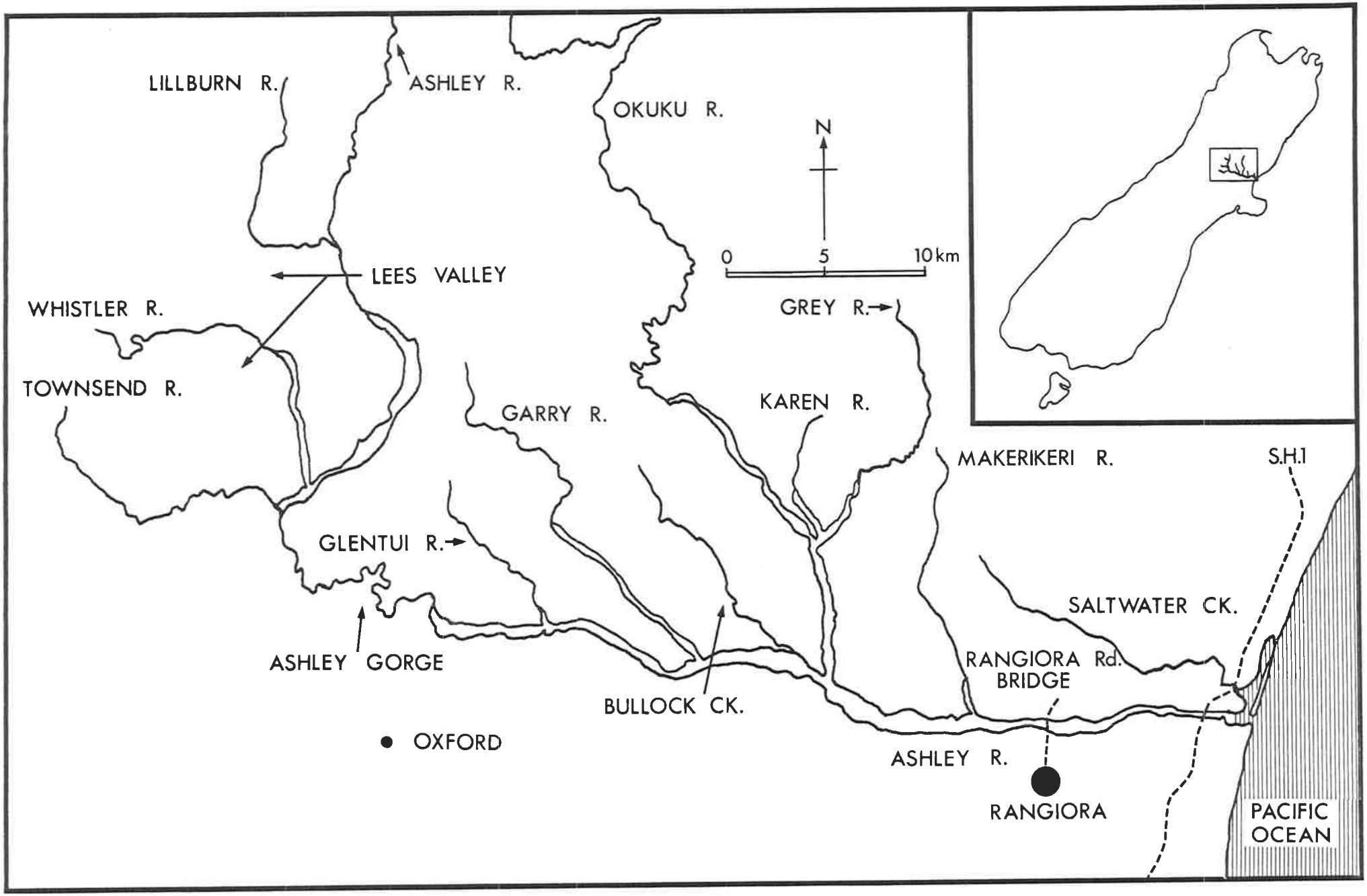

FIGURE 1. The Ashley River system.

(ii) the sports fishery and angler usage

(iii) the effects of low flows on the fishery

(iv) the value of the Ashley wetlands and estuary.

(v) A series of recommendations is made.

2. CATCHMENT DESCRIPTION

The Ashley River enters the sea approximately 30 km north of Christchurch. The river is about 90 km in length, with a catchment area of 1340 km^2 (Bowden 1982). Its headwaters lie in the Puketeraki Range, the highest point being Chest Peak (elevation 1934 m). In the upper reaches, the river flows through Lees Valley, between the Puketeraki Range and the Mt Thomas foothills (Fig. 1). From Lees Valley, the river is entrenched through the area known as Ashley Gorge, until it emerges onto the Canterbury Plains where it flows in a braided, shingle floodplain.

The major tributary entering the river below Ashley Gorge is the Okuku River, but the Glentui, Garry and Makerikeri Rivers also drain the foothills (Fig. 1). A detailed description of the geology, climate and hydrology is given by Bowden (1982).

Flow data are based primarily on flows recorded at Ashley Gorge, as other sites have proved unsuitable for long-term water level monitoring (Bowden 1982).

The Ashley rises in the foothills, and because there is limited storage of snow and ice in the catchment, has a slightly different flow pattern from major South Island east coast rivers. Mean annual discharge is 15.3 m^3/s, with flows peaking in September and uniformly decreasing to a low in February (Fig. 2).

Losses to groundwater and underflow in reaches of the river near the Rangiora Road bridge are significant. In periods of summer low flow the river in this area may become completely dry for a distance of over 3 km, even when there

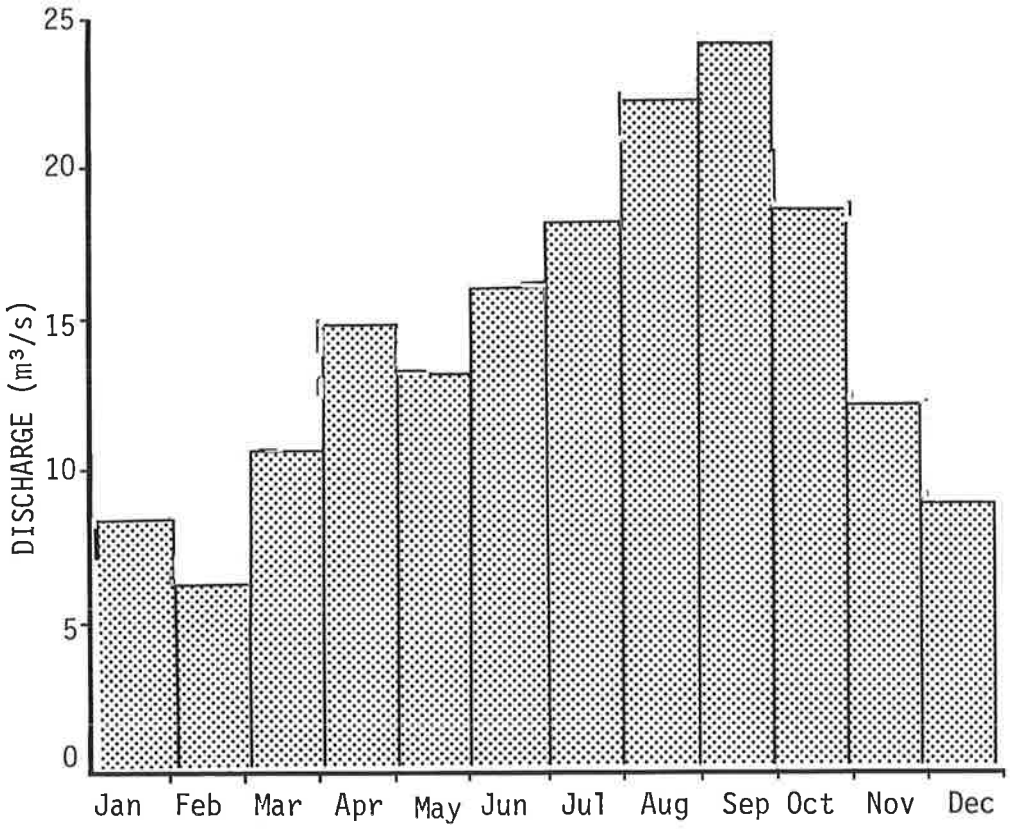

FIGURE 2. Mean monthly discharges for the Ashley River at Ashley Gorge, 1973-1981.

are surface flows in the gorge and between S.H. 1 and the mouth. There appears to be no record of the Ashley River mouth ever closing, probably because of the nature of the estuarine area. Like most other east coast South Island rivers, the Ashley is capable of spectacular floods, with discharges sometimes exceeding 2000 m^3/s.

3. FISH RESOURCES OF THE ASHLEY RIVER

The scientific and common names of twenty-one species of fish known to inhabit the Ashley River system are listed in Table 1.

The Ashley is one of three rivers which FRD and MWD have surveyed as part of a comparative fisheries/hydrology study of braided rivers in Canterbury. During 1981 and 1982, surveys were carried out in selected reaches of the lower river, in the vicinity of S.H.1 and near Bullock Creek. Results from the study should be published in 1983.

The Ashley was generally found to support large numbers and high densities of many fish species, which contrasted markedly with other larger, but similarly braided, shingle rivers of the South Island's east coast.

One species of native fish, the common river galaxias (*Galaxias vulgaris*) has been extensively studied in the Glentui River (Cadwallader 1973, 1975a, 1975b, 1976a, 1976b, 1978) (see Section 3.9).

The following brief notes on the life history and general biology of fish found in the Ashley River are based on the studies noted above, as well as studies in other river systems. More detailed information on the biology and life histories of New Zealand's freshwater fish fauna is contained in McDowall (1978).

3.1 Quinnat Salmon

These popular introduced game fish are migratory, leaving fresh water as juveniles and returning from the sea to their river of origin as adults, two-five years later. The fact that some returning adult fish exceed a metre in length

TABLE 1. Fish of the Ashley River system.

Scientific Name	Common Name
+ * *Oncorhynchus tshawytscha*	Quinnat salmon
+ * *Salmo trutta*	Brown trout
+ *Salmo gairdnerii*	Rainbow trout
* *Geotria australis*	Lamprey
* *Anguilla australis*	Shortfinned eel
* *Anguilla dieffenbachii*	Longfinned eel
* *Stokellia anisodon*	Stokell's smelt
* *Retropinna retropinna*	Common smelt
* *Galaxias maculatus*	Inanga
* *Galaxias brevipinnis*	Koaro
Galaxias vulgaris	Common river galaxias
° *Neochanna burrowsius*	Canterbury mudfish
* *Cheimarrichthys fosteri*	Torrentfish
* *Gobiomorphus cotidianus*	Common bully
* *Gobiomorphus hubbsi*	Bluegilled bully
* *Gobiomorphus huttoni*	Redfinned bully
* *Gobiomorphus gobioides*	Giant bully
Gobiomorphus breviceps	Upland bully
* *Rhombosolea retiaria*	Black flounder
Aldrichetta forsteri	Yellow-eyed mullet
Arripis trutta	Kahawai

* Migratory species

\+ Introduced species

° Not found in the mainstem, but affected by changes to water levels.

and 10 kg in weight may explain why these fish are popular with anglers.

Salmon start life in rivers of the South Island's east coast. After hatching and emerging from the streambed gravels in late winter and early spring, the fry spend a varying length of time in the river before migrating to sea. Some fry enter the sea at an early stage (often because they are swept downstream by spring floods and freshes) but few of these survive the transition to salt water. Those juveniles which reside in the river for some time, gradually moving downstream and finally going to sea up to a year later, make up the bulk of the returning adult salmon run.

Adults returning to spawn may begin moving upstream as early as November, although spawning in the headwaters and stable tributaries does not usually occur until late autumn and winter. Upstream migration in rivers such as the Ashley can be a critical time in the life of salmon, as low flows may not only prevent fish passage, but also subject them to long periods of high water temperatures and intense angling.

Salmon spawning surveys carried out by FRD in 1980 and 1981 indicate that most spawning occurs in Lees Valley, where the Ashley and its tributaries provide areas of suitable gravel and reasonably stable flows. Some spawning may also occur in the mainstem of the lower Ashley and in the Okuku River. After spawning all the adults die.

As is the case in other salmon rivers in New Zealand, the number of adult fish returning to the Ashley varies greatly from season to season. However, low flows in the middle reaches of the river (see Section 5) sometimes prevent access of salmon to the spawning areas for a considerable period over summer. This is probably a major constraint on the size of the Ashley salmon run. Although the Ashley is not regarded as a major salmon river, nevertheless the salmon fishery is well used by anglers (see Section 4).

3.2 Brown Trout

By far the most common introduced fish species in the Ashley is the brown

trout, and it is upon this species that the sports fishery is primarily based.

Brown trout are fish of diverse habits. Some never leave fresh water, and in fact may remain in a relatively small area of river all their lives; others may move extensively throughout one or more river systems or even spend the majority of their lives in the sea.

Brown trout are capable of spawning more than once, and although their breeding habits are otherwise similar to quinnat salmon, a migration of young trout to the sea does not usually occur.

The Ashley trout fishery was investigated in 1961 and 1962 by the Freshwater Fisheries Advisory Service of the Marine Department (Moore and Lane undated). The resident trout population was found to have a high growth rate and was generally in good condition. Observations indicated that trout utilised all the available cover, and lack of cover appeared to limit the number of fish. Data from the national angling diary scheme provided information on the average size of trout (nearly all brown trout) caught by anglers over several seasons in the Ashley River. Fish varied in length from 33.8 cm to 44.7 cm (Graynoth and Skrzynski 1974).

3.3 Rainbow Trout

This species is also an acclimatised fish, but, unlike brown trout, it is uncommon in the Ashley River system. It is more likely to be found in the upper reaches of the river.

New Zealand stocks of rainbow trout are not known to migrate to sea, but in many other respects their life history is similar to that of brown trout.

3.4 Lamprey

This is a migratory species, the adults of which parasitise marine fishes. Although widespread, it is very rare in the Ashley and many other localities. Between May and October adults enter fresh water to spawn, and may spend several months in the river. Juveniles may spend several years in fresh water before going to sea in late autumn and winter.

3.5 Eels

Eels are noted for being very long-lived, and spend nearly all their life in fresh water (Jellyman and Todd 1982). Both species (longfinned and shortfinned) spawn at sea, and then die. Young "glass eels" enter rivers during winter and spring, distributing themselves to their respective habitats. Longfinned eels are commonly found well upstream, while the shortfins usually remain in swamps and estuaries of the lower river. Juvenile longfinned eels were the second most abundant species (in terms of both numbers and biomass) caught during FRD's fisheries/hydrology studies on the Ashley.

Adult migrant eels between nine and fifty years of age, and often over a metre in length, move downstream in late summer and autumn to spawn at sea.

3.6 Stokell's and Common Smelt

Stokell's smelt is a relatively small fish (70-80 mm long), which is confined to the east coast of the South Island. They form an important part of the food chain in estuaries, when large shoals of adults enter rivers to spawn. Eggs are deposited in the reaches immediately above the lagoon, and the larvae are washed to sea as soon as they hatch.

The common smelt has similar habits to Stokell's smelt, although it is longer lived and may spend more time in fresh water.

3.7 Inanga (whitebait)

This species, which is believed to make up most of the Ashley whitebait catch, has a short but complicated life history.

The adults, commonly about 100 mm in length, reside in fresh water. During late summer and autumn they move downstream to estuarine areas during times of high spring tides. Spawning occurs during a full spring tide, and eggs are deposited and fertilised amongst the estuarine grasses and rushes which have been covered by water. Although the eggs are left out of water when the tides recede, they are kept moist by the surrounding vegetation. Hatching occurs about two weeks later, when the vegetation is again immersed by the next cycle

of spring tides. The tiny larvae are washed out to sea, but return about six months later to migrate upstream in the well-known spring whitebait 'run'. In the Ashley, most whitebait are caught in the lower reaches of the river and in the Saltwater Creek area.

Unlike salmon, whitebait do not necessarily return to the river of their origin.

3.8 Koaro (another whitebait species)

Sometimes called 'mountain trout', adults of this species are somewhat larger than inanga (160-180 mm) and usually live in the swift rapids of mountain streams. They do not appear to be common in the Ashley.

Spawning occurs from March to May, and the larvae are apparently washed downstream to develop in the sea over winter. Juveniles migrate upstream in spring and are considered to be the second-most important species in the whitebait catch.

3.9 Common River Galaxias

Although related to whitebait, this species is entirely freshwater dwelling and has a simple life history without migrations. It is relatively common and widespread in the rivers of Canterbury, where it normally inhabits swiftly flowing water. Adults are usually 100-115 mm in length.

This species has been studied intensively in the Glentui River (Cadwallader 1973, 1975a, 1975b, 1976a, 1976b, 1978). Much of our present knowledge of the biology and ecology of this species is derived from Cadwallader's studies, including details of age, growth, condition, feeding habits, home range, movements and breeding biology.

3.10 Canterbury Mudfish

As its name implies, this species is unique to the Canterbury area, and is noted by the International Union for the Conservation of Nature as an "endangered species". This situation has come about purely as a result of the destruction of its habitat.

Although related to whitebait, the mudfish has evolved to an entirely fresh water existence, but it is not a river-dwelling fish. However, its habitat is influenced by river levels, as it occurs in adjacent springs and wetlands. Mudfish fry have been reported from wetlands between the Ashley flood bank and Saltwater Creek, and adult fish from wetlands near the river on the southern side. However, little is known of the size and location of the mudfish population associated with the river system.

A hardy fish with a high reproductive capacity, the Canterbury mudfish is capable of withstanding normal droughts, given a habitat with plenty of cover to provide protection from desiccation.

3.11 Torrentfish

This species was frequently encountered during the Ashley River fisheries/ hydrology studies conducted during 1981 and 1982. It was usually found in the fast and broken water of riffles, where it lived on the river bed amongst sediment-free substrates. Adult fish up to 100-125 mm were commonly seen.

Very little is known about the biology of torrentfish. The larvae are marine and juveniles enter rivers in two waves, in spring and autumn. In the Rakaia River they distribute themselves unevenly throughout the river - females generally upstream, males remaining in the lower reaches (G.A. Eldon pers. comm.).

Females make a return migration downstream to spawn, the timing of which is not fully understood. It seems probable that either the eggs or the larvae are carried to sea on a fresh.

3.12 Common Bully

In the Ashley, this fish is usually found hidden amongst marginal cover - overhanging branches, logs, boulders and piles of debris. Adults of this species may reach 150 mm in length, but are more commonly less than 110 mm.

Spawning occurs during spring and summer, and the larvae which hatch become planktonic and move downstream into the sea. Later in the spring and summer they migrate back into fresh water.

3.13 Bluegilled Bully

The habitat of the bluegilled bully is similar to that of torrentfish, and the two species are often found in close proximity. Adults are usually only 50-60 mm in length.

Little is known of their life history, but spawning is thought to occur in the rivers, with the newly hatched young going to sea and then returning to fresh water to rear.

During FRD's fisheries/hydrology studies in the Ashley, bluegilled bullies were the third most abundant species caught while electricfishing - after torrentfish and longfinned eels.

3.14 Redfinned Bully

These fish are thought to be very rare in the Ashley system. They have a similar life history to other bully species - spawning in fresh water, with the larvae spending some time in the sea before migrating back upstream.

Adult fish of this species are usually less than 100 mm in length, but may reach more than 120 mm. They were not recorded during FRD's recent electric-fishing surveys in the Ashley.

3.15 Giant Bully

As its name suggests, these fish are much bigger than other New Zealand bullies. Most specimens collected are more than 100 mm long and may exceed 200 mm.

Usually giant bullies are found only in estuarine areas, seldom more than 1-2 km upstream. Although they have been recorded in the Ashley system, they are certainly not common.

Virtually nothing is known of their life history, but the larvae are probably marine.

3.16 Upland Bully

A common fish in the Ashley, this bully is usually found amongst rocks at the margins of gently flowing water. It lives entirely in fresh water - the young live and grow near where they hatch. Adults usually reach 85-90 mm in length.

3.17 Black Flounder

This is the only species of flatfish which lives in estuaries and enters fresh water. Little is known of its biology; probably its eggs are free-floating in the surface waters of the sea. It does not enter fresh water until after metamorphosis of the juvenile to the bottom-dwelling form.

Black flounder are reasonably common in the lower Ashley River and estuarine areas, and this species supports a popular recreational fishery.

3.18 Yellow-eyed Mullet

Basically a marine fish, the yellow-eyed mullet may spend much time in fresh water during summer. Its movement in and out of rivers seems to be random, and not associated with any facet of its life cycle. Some netting for mullet takes place in the estuarine areas of the Ashley River.

3.19 Kahawai

This is also primarily a marine fish, but is known to enter river estuaries, often in shoals. These fish provide a popular fishery at the mouth of the Ashley and other New Zealand rivers.

4. RECREATIONAL FISHERIES OF THE ASHLEY RIVER

The Ashley River and its tributaries were among the first Canterbury rivers to be stocked with salmon and trout. Brown trout were introduced into the system between 1868 and 1876, and in 1877 both quinnat salmon and Atlantic salmon were also released (Lamb 1964). There is little information on the release of rainbow trout into the Ashley, but it probably occurred before 1900.

Quinnat salmon, brown trout and rainbow trout are the present basis of the Ashley River sports fishery. The following notes summarise information about the Ashley River trout and salmon fishery collected by FRD's National Angling Survey. (For background information on this survey see Teirney 1980.)

Regional reports for the South Canterbury and Waitaki Valley Acclimatisation Societies have been completed (Teirney, Richardson and Unwin 1982a, 1982b), and should be consulted for more details of the survey methodology. Full results for the North Canterbury Acclimatisation Society will appear in a separate report as part of the Fisheries Environmental Report series. Thus results given here are preliminary, and some figures may change slightly in the final report.

In August 1979, survey booklets were mailed to a random sample of 1557 North Canterbury adult whole season licence holders (representing 13.8% of the 11,325 licences sold). In all, 957 (61%) of these anglers were contacted, of whom 614 returned completed booklets indicating which rivers they fished. Where necessary, the data have been extrapolated to allow for non-respondents.

In terms of its popularity with North Canterbury anglers, the Ashley ranks fourth equal with the Hurunui River, after the Waimakariri, Rakaia and Selwyn (Fig. 3). The Ashley was fished by 158 (26%) of the respondents, with the trout fishery accounting for 108 of these anglers. A further 23 anglers fished for both salmon and trout, while 27 indicated that they fished only for salmon.

Estimates of usage suggest that in an average year, the Ashley is fished by approximately 2300 (± 300) North Canterbury adults, who make 11,000 - 16,000 visits to the river. While these figures are low in comparison with the Rakaia and Waimakariri, both of which attract over 8000 anglers from all over the country, it should be noted that both of these rivers have strong claims to being angling waters of national importance, and are among the most heavily fished rivers in the country. The level of usage on the Ashley is comparable to other well-known angling rivers such as the Motueka in Nelson, the Pomohaka in Otago and the Waiau in Southland, all of which receive about 12 000 visits annually.

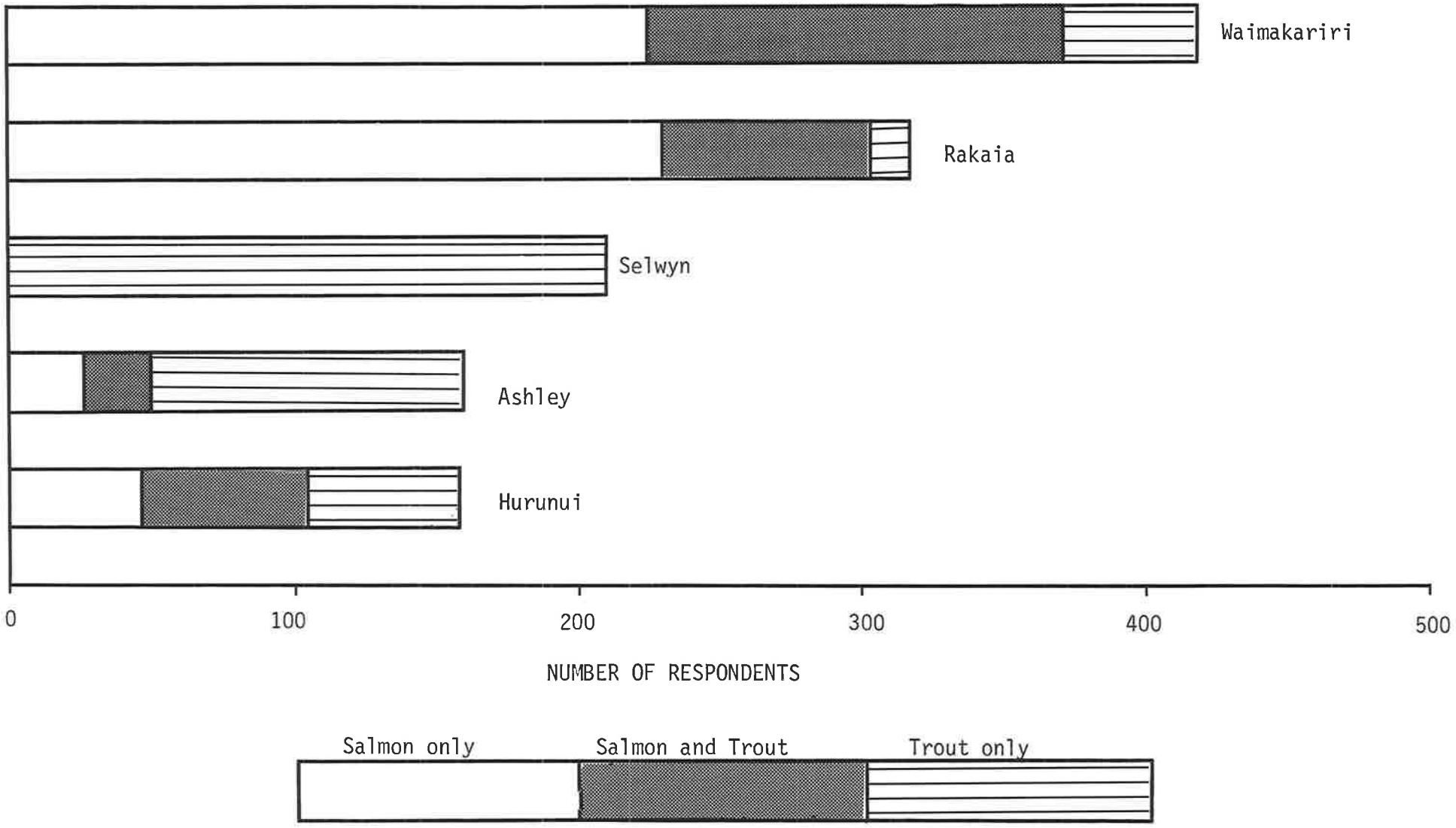

FIGURE 3. Relative popularity of some North Canterbury rivers to North Canterbury adult anglers.

As is clear from Figure 3, the Ashley trout fishery accounts for the bulk of its angling use. However, the fishery is not highly rated in terms of angling quality, receiving a rating of 3 (average) on a 1 to 5 scale. Similar ratings were awarded to the salmon fishery, which was the least highly regarded of all the North Canterbury salmon fisheries (Waiau, Hurunui, Ashley, Waimakariri and Rakaia).

To examine why the Ashley supported a high level of usage despite the relatively low quality of the trout fishery, anglers responses to a series of questions aimed at identifying the important characteristics of each river they fished were examined. These indicated clearly that the Ashley's popularity was related to its geographical characteristics, such as proximity to population centres (e.g. Christchurch, Kaiapoi, Rangiora and Oxford), and ease of access to the river. Those characteristics relating directly to the fishery, such as catch rate and size of fish, were poorly rated.

Anglers also identified which sections of the Ashley they preferred, by indicating whether they had fished the "head", "middle" or "lower" reaches. While these terms were not defined in the survey booklet for individual rivers, the data suggest that the "lower" reaches correspond to the river below Rangiora, the "middle" reaches to the section from Rangiora to below Ashley Gorge, and the "head" to Ashley Gorge and above. In terms of these definitions, the middle and lower reaches were the most heavily fished by trout anglers, being visited by 62% and 46% of the anglers respectively. The headwaters were used by relatively few anglers (20%), but were rather more highly valued as a fishery than the remainder of the river. Problems of access appeared to deter most anglers from fishing in this area. Although a few anglers fished throughout the entire length of the river, approximately 75% of the respondents fished only one of the three reaches listed above.

Anglers reported using a variety of fishing lures. Both wet and dry flies were popular, as were nymphs and artificial spinners. Live bait was less popular, but was used by 14% of the respondents. When asked to nominate other recreational

activities associated with angling, 43% of the anglers mentioned picnicking, with swimming and camping also being moderately popular.

Despite the relatively low ratings for overall importance which were awarded to the salmon fishery (only 11 out of 50 respondents rated it above average), the data suggest that it is a significant recreational resource. The salmon fishery alone attracted 17% of the anglers who fished the Ashley, while a further 15% fished for both salmon and trout. The salmon fishery showed similar attributes to those which characterised the trout fishery (good access etc.), but was centred on the lower reaches and the river mouth. However, some anglers fished for salmon throughout the river, including the headwaters.

Of the Ashley tributaries for which survey data were collected, only the Okuku constituted a significant trout fishery. It was listed by 23 respondents, and accounted for approximately 1500 to 2000 visits per year. As a fishery, it was rated slightly better than the Ashley itself, particularly with respect to attributes such as scenic beauty, peace and solitude, and size of fish.

The popularity of the Ashley River system in relation to the other major rivers in the region indicates that it is of considerable value to North Canterbury anglers. However, unlike the Rakaia, Waimakariri and Hurunui Rivers, all of which can be clearly identified as high quality fisheries, the Ashley River is valued more for its geographical location and suitability for a range of recreational pursuits. For many local anglers, its attraction is simply that it offers an opportunity for a few hours fishing within easy reach of home. The high proportion of anglers who fished only one reach is consistent with this interpretation. Anglers who sought a high quality fishery would be more likely to fish rivers such as the Hurunui or Rakaia, rather than to explore other reaches of the Ashley.

Many anglers sent in written comments with their survey booklets, elaborating further on their feelings about particular rivers. For the Ashley, comments such as "time it was restocked" were typical, and were consistent with the

anglers' assessment of fish size and catch rate. Low flows did not appear to be considered a major problem. Two anglers commented on the ability of the river to dry up at times ("all efforts should be made to have the river flowing all year"), but most anglers were evidently happy with the river in its present condition. However, comments such as the above indicate that if flows were to be reduced much beyond present levels, the river would become progressively less attractive to anglers.

The Ashley is typical of a number of rivers identified by the survey, in that it is characterised by proximity to population centres and average to good (but not exceptional) angling. Other such rivers are the Oreti in Southland and the Ashburton. Much of their value derives simply from their presence as free-flowing rivers in, or close to, a major town. On such rivers, angling has been found to account for a relatively minor proportion of their total usage (passive and active). For example, on the Oreti River (one of the most popular angling rivers in Southland), angling represented only 5% of the total recreational usage (Unwin 1980). For the Maitai River, flowing through Nelson City, the corresponding figure over the 1981 summer period was 1% (Nelson Regional Water Board 1982). How these figures relate to the Ashley is not known, but its total recreational usage is without doubt very much greater than the 11 000 - 16 000 visits made each year by anglers.

The Ashley River also supports a popular recreational whitebait fishery in Saltwater Creek and the estuarine areas. These areas are also often used for flounder and mullet netting, as well as kahawai fishing and occasional commercial eel fishing.

5. EFFECTS OF LOW FLOWS

The fishery and recreational potential of the Ashley River is constrained by low summer flows over much of the river's length. For several weeks or more in summer the middle reaches of the river near Rangiora may in fact be dry.

For many years there has been a need to salvage fish from the Ashley River during summer, when periods of low flow and high water temperatures strand fish in isolated stretches of the river. As well as impeding or preventing the passage of migrating fish (especially salmonids), such conditions may cause high mortality.

One of the first salvage operations occurred in 1904 when a North Canterbury Acclimatisation Society (NCAS) ranger and his son shifted between 7000 and 8000 fish from pools into deep water. The ranger, Mr D. Douglas, was investigating reports of poaching in the river, and saw 70 - 80 fish, believed to have been dynamited, in a hole in the river bed. However, it appeared that the hole had not been disturbed in any way and the fish had been killed by "the hot nor'west weather" (Lamb 1964).

Fish salvage operations have continued to take place in more recent years. NCAS annual reports since 1962 have mentioned salvage work in the Ashley in 1962-63, 1970-71, 1971-72, 1972-73, 1976-77, 1978-79, 1980-81, with as many as 5000 salmon and trout (mostly juveniles) being salvaged in one summer.

The low flows, which occur naturally, are compounded by abstraction (mainly for irrigation) from both the surface and groundwater systems. Since these two systems are likely to be interconnected, FRD considers that further use of either surface water or groundwater resources would be detrimental to the fish and fisheries of the Ashley system.

The major effects of low flow on the fishery are habitat loss, increased water temperatures, increased sedimentation and disruptions to fish passage.

5.1 Habitat Loss

Reductions in water velocity and depth may cause a loss of fish habitat - protective cover decreases as channels recede from their banks and depth over riffle areas also decreases. Where cover is not available fish are often absent, even when velocities and depths are suitable (Baldes and Vincent 1969).

Clothier (1954) observed that after abrupt water reductions in Montana irrigation channels, fish gathered wherever bush and banks gave shelter, while Hardy (1972) noticed a similar phenomenon in the Opihi River (South Canterbury).

FRD's studies indicate that both total fish abundance (number of fish/m^2 of river) and total fish biomass (weight of fish/m^2) in the Ashley exceed values for the Hurunui and Rakaia Rivers by a factor of approximately 10. This suggests that habitat available to fish in the Ashley during summer is probably limiting. It is likely that such high fish densities are a result of "compression" of fish habitat, due to drying up of the middle reaches of the river.

McFadden (1969) and Fraser (1969) found that high population densities and restriction of fish movement can result in intense competition amongst salmonids in streams. This in turn may lead to poor survival and growth rates.

Benthic invertebrates provide the major source of food for fishes and Fowles (1972) in his study of low flow conditions on the invertebrate fauna of the Opihi River, concluded that both the benthic and drift fauna were detrimentally affected by low flows during late summer. Fowles (1972) found that although 'flash flooding' had a deleterious effect on the benthic fauna, recovery following a flood was generally quicker than recovery following a period of desiccation.

Increased sedimentation, associated with reduced flows, may cause an accumulation of silts amongst and over the substrates and lead to a reduction in invertebrate habitat, which in turn may affect food availability for fish.

5.2 Temperature

The limited information on temperatures available for the Ashley River suggests that summer maximums may be lethal to many species of fish. Table 2 lists temperature lethal limits and optimums for brown and rainbow trout from a variety of sources and shows that the optimum temperature for both trout species is generally considered to be less than 20°C, while the lethal limit is probably near 25°C. Table 3 presents temperatures measured in the Ashley River at S.H.1 bridge during routine gauging and water sampling programmes by the

TABLE 2. Optimum and upper lethal temperatures (°C) for brown and rainbow trout (after Richardson and Teirney 1982).

Source	Preferred or growth optimum		Upper lethal	
	B	R	B	R
Alabaster and Downing (1966)			26.4	26.6
Black (1953)				25.7
Craigie (1963)				27
Frost and Brown (1967)	7-19		22.5-25.3	
Gardner (1926)	< 18-20		25	
Garside and Tait (1958)		11.6-15.7		
Hobbs (1948)			> 25	
Hunt and Jones (1972)	10-13			
Jones (1964)			22.5-29.0	
Kwain and McCauley (1978)		11 - 18		
McCauley et al. (1977)		9.8-12.7		
Peterson et al. (1979)		14.7		
Phillips (1929)			> 25.6	
Platts (1981)		18.3		
Spaas (1960)	< 18-20		25.5	

B = Brown trout

R = Rainbow trout

NCCB. (No continuous water temperature data are available.) From Table 3 it can be seen that temperatures during summer can exceed optimum and reach lethal limits for trout. Since the optimum temperature range for migrating quinnat salmon is 11-14°C, and the upper lethal limit 25°C (Bell 1973), salmon in the Ashley are probably under considerable stress during their migration upstream.

TABLE 3. Temperature recordings (°C) at S.H.1 bridge on the Ashley River (from Bowden 1982).

Month	No. of records	Mean	Standard deviation	Range
Jan	4	20.2	3.2	16 - 25
Feb	8	20.2	2.2	17 - 23
Mar	9	19.6	1.9	15.5 - 22.0
Apr	3	13.7	3.2	9.6 - 17.5
May	3	11.7	2.3	8.5 - 14.0
Jun	4	5.8	1.4	4.0 - 8.0
Jul	4	6.8	1.7	4.5 - 9.2
Aug	4	7.5	0.8	6.2 - 8.5
Sep	4	12.5	2.7	8.0 - 15.5
Oct	2	13.5	0.5	13.0 - 14.0
Nov	1	-	-	17
Dec	1	-	-	18

Some information is available on the temperature tolerances of native fish. Woods (1966) showed that juveniles of koaro (*Galaxias brevipinnis*) may die at 17° - 20°C, although if acclimatised to higher temperatures, they may survive in temperatures up to 23°C.

No studies on the temperature tolerances of adult eels in New Zealand are known, although Jellyman (1974) found that glass (juvenile) eels could withstand

changes of ± 8°C from an ambient temperature of 15°C. Shortfinned elvers were better able to withstand higher temperatures than longfinned elvers, the upper lethal limits being 30°C and 25°C respectively.

No studies on the relationship between discharge and water temperature have been done in the Ashley, but Hockey (1981) showed an inverse relationship between discharge and water temperature in the Hurunui River during the summer of 1980/81. Hockey's study was carried out during a summer of relatively high flows and his prediction of a 0.1°C temperature rise with every 1 m^3/s of water abstracted has not been validated at low flows. Nevertheless his data indicate that water temperatures increase with reduced discharge. Since summer water temperatures in the Ashley are already high, further abstraction of water would increase temperature stress in fish and could result in temperatures lethal to some species.

5.3 Fish Passage

Fifteen of the twenty-one species of fish in the Ashley River are migratory (see Table 1) and make at least two migrations during their life. Some (e.g. brown trout), may make an annual upstream and downstream spawning migration.

Not all fish migrations are of the 'positive' type where fish actively move toward a specific location. For instance, the larvae of many native species depend upon high flows to carry them passively to sea.

Table 4 summarises fish migrations which may be subject to disruption by low summer flows in the Ashley River. Note that disruption may occur to more than one life stage of many species, and that access through the river mouth can be an essential part of the life history.

5.4 Water Quality

In terms of chemical and microbiological quality, the waters of the Ashley River are currently adequate for maintenance of fisheries, as well as recreational pursuits, such as swimming and boating. However, there is potential in the future for activities related to forestry practices, shingle and gravel extraction,

TABLE 4. Fish migrations subject to disruption by low summer flows (after Eldon, Davis and Unwin 1982).

Species	Life Stage	Upstream Migration	Positive Downstream Migration	Passive (flood-carried) downstream migration	Affected by closed river mouth	Affected by low flows in mainstem
Quinnat salmon	Adults	+			+	+
	Fingerlings		+		+	+
Brown trout	Adults	+			+[c]	+[c]
	Juveniles		+			+
Shortfinned and	Adults		+		+	+
Longfinned eels	Juveniles	+			+[b]	+[a]
Common smelt	Adults	+			+	+
	Larvae			+	+	+
Stokell's smelt	Adults	+			+	+
	Larvae			+	+	+
Inanga	Adults		+		indirectly	+
	Whitebait	+			+[b]	+
	Larvae			+	+	
Torrentfish	Adults	+	+			+
	Juveniles	+			+	+[a]
	Larvae			+	+	+
Common bully	Juveniles	+			+	+[a]
	Larvae			+	+	+
Bluegilled bully	Juveniles	+			+	+[a]
	Larvae			+	+	+
Redfinned bully	Juveniles	+			+	+[a]
	Larvae			+	+	+
Black flounder	Juveniles	+			+[b]	

a. Only if flows extremely low

b. Only if mouth closes in spring/early summer

c. Only if low flows occur in late summer

agriculture and industry to adversely affect water quality. Such effects, particularly those related to increased sediment loads and discharges, would be aggravated during times of low flow.

The introduction of fine sediments into the river from gravel extraction processes and forestry practices (such as logging, burning and road building) is undesirable. There are many ways in which excessive concentrations of suspended solids may harm a fishery:

(i) By increasing mortality or reducing the growth rates and disease resistance in fish.

(ii) By preventing the successful development of fish eggs and larvae.

(iii) By modifying the natural movements and migrations of fish.

(iv) By reducing the amount of food available to fish.

(v) By reducing cover available to fish.

The European Inland Fisheries Advisory Commission (1965) outlined a relationship between concentrations of suspended solids and fishery conditions (Table 5.)

TABLE 5. Effects of suspended solids on fisheries (after Church, Davis and Taylor 1979).

Sediment Concentration (g/m^3)	Effect on Fishery
0 - 24	None
25 - 80	Good-moderate fishery
81 - 400	Fishery sometimes possible at lower concentrations
401 - 2000	Poor fishery
2001 +	Fish may survive temporary exposure

In the near future, the greatest potential source of sediment to the Ashley River will be from gravel extraction processes. FRD recommends that these activities only be permitted in dry areas of the riverbed. Further, any rights to use water for washing gravel in the riverbed should require a sediment settling pond before discharging back to the river.

In the longer term, forestry activities could have some impact on water quality. Morgan and Graynoth (1978) reviewed the effects of forestry practices on freshwater fish, and the NCCB are referred to their report for further details.

Discharges from milking sheds and runoff from timber processing plants already affect water quality in the lower reaches of the Ashley (Bowden 1982). FRD recommends that the NCCB monitors these discharges and ensures that illegal discharges of organic material are controlled.

6. VALUE OF WETLANDS AND ESTUARINE AREAS

FRD regards the preservation of wetlands and estuarine areas in the Ashley system as an integral part of the management of the resource. Two areas considered to be of prime importance are the wetlands of Lees Valley (unfortunately already partially drained) and the Saltwater Creek - Ashley estuary area.

Many of New Zealand's native species of freshwater fish are habitually found in various types of wetlands, while others are found there occasionally. For example, an FRD electricfishing survey in Saltwater Creek during March 1982 revealed good populations of some native species - especially eels, common bullies and inanga. The area generally had an abundance of cover for fish, but suffered from the effects of livestock, in particular, unstable banks and high nutrient loadings (G.J. Glova pers. comm.).

The following species are associated with wetland and estuarine areas in the Ashley system:

(i) Whitebait

While it is not known how extensively the whitebait species depend on swamps to sustain their populations, there is no doubt that the whitebait fishery depends considerably on the rearing habitat that swamps offer the growing and maturing fish (McDowall 1982).

The estuarine area also forms a very important spawning habitat for inanga, and reduction of suitable spawning areas by protection works and land reclamation could adversely affect the size of the whitebait fishery (especially if the timing of these works interferes with whitebait spawning).

(ii) Eels

New Zealand's commercial fishery is based mainly upon the shortfinned eel, which is the characteristic eel species of swamps and lagoons. (Longfinned eels do use these areas, but are more commonly found in streams and rivers.)

Eels may occupy swamps most of their lives, arriving as juveniles from the sea and remaining until fully grown (20 or more years), before returning to sea to spawn.

There is concern for New Zealand's eel populations, given the current level of exploitation and their loss of habitat as a result of drainage and other development of rivers and lakes.

(iii) Flounder

Adult black flounders typically occupy estuarine or low elevation swamp habitats, usually on sandy or silty substrates.

(iv) Mudfish

The Canterbury mudfish is sometimes associated with springs adjacent to the smaller Canterbury rivers, and these fish have been reported in wetlands near the Ashley.

(v) Common Smelt

These fish will make their way into swamps, and although their spawning

site is not known, McDowall (1978) thought it to be in or near estuaries.

(vi) Other species

Giant bullies are rare in the Ashley but are most likely to be found in the lower river and estuarine areas. Common bullies are a widespread species and seem quite abundant in many parts of the Ashley, including most wetlands.

7. DISCUSSION

FRD is concerned that management of Canterbury rivers should have the least possible adverse impact on fisheries. It is important that any management plan to allocate Ashley River water recognises the importance of non-consumptive users of the river. Continuing river developments have long-term impacts on the ecology of New Zealand's freshwater environment.

The Ashley River system presently contains good populations of native fish species, many of which are endemic - that is, they are found only in New Zealand. These include: torrentfish, bluegilled, common, giant and upland bully; Stokell's smelt; Canterbury mudfish; and common river galaxias. Already, one of New Zealand's endemic freshwater fish species (the grayling) is extinct, and several other species are becoming drastically reduced in numbers - primarily due to loss of habitat.

The Ashley also provides important wildlife habitats - e.g. the estuary is of great value to a diversity of bird species, and is a sanctuary for migratory wading birds. The wetlands in the system are valuable to both fisheries and wildlife, and FRD considers their preservation to be an important part of any management plan for the river.

The Ashley River and its tributaries support highly regarded recreational fisheries - notably those based on trout, salmon and whitebait. The quality of angling is not exceptional, however much of the river is accessible and within easy reach of the population centres of Christchurch, Rangiora and Kaiapoi. It

should be noted that angling is only one recreational activity associated with the river - the area is also popular with sightseers, picnickers, campers and swimmers.

The fisheries of the system appear to be constrained by periods of low flows, which occur in many summers, causing reaches of the river near Rangiora to become completely dry. Low flows appears to occur naturally in the river, but have been compounded by abstraction from the surface and ground water systems, mainly for irrigation.

There seems to be little potential for further abstraction from the surface water resource, and because the ground and surface water systems are likely to be interconnected, greater use of the groundwater resource may further affect surface flows, and hence fisheries, during summer.

FRD recognises that there is already considerable demand on the water resources, but any management plan that ensures a constant flow throughout the river would greatly benefit all users. There may be some potential for storage of water during times of high flow, which could later be used to augment the resource when river flows decrease. However, storage should not be at the expense of salmonid spawning habitat.

As demands on the Ashley system increase, there is a greater need to ensure the efficient use of water. The management plan should ensure that abstractions throughout the system are closely monitored and regulated as well as maintaining the high standards of water quality, which are necessary for both fisheries and recreational use.

8. RECOMMENDATIONS

1. FRD is concerned for the fisheries of the Ashley River and its tributaries, and would oppose any further development of the water resource that may have detrimental impacts on the freshwater environment and recreational

use of the river. More efficient use of existing abstractions and control of illegal abstractions would ease the current demand on the resource over summer. Excessive abstraction from lowland tributaries is potentially of concern. Minimum flows should be set for these streams.

2. The main constraint on the fishery appears to be low flows during summer months. FRD recognises that there are heavy demands on the water resource at this time, but any enhancement of flow, particularly if it prevents the river from drying up in some reaches, would benefit the fishery and the recreational users of the river.

3. There may be potential to store water during peak flows, for use during periods of low flow. FRD recommends that the options be investigated. However, modifications to the river or tributaries to store water would be undesirable if they adversely affected fisheries or recreation.

4. FRD regards preservation of wetlands and estuarine areas in the Ashley River system as an important part of management of the river. The design and timing of such activities as flood protection works near wetlands and estuaries can be critical in minimising any adverse effects on fish and wildlife.

5. Maintenance of high water quality is essential for both fisheries and recreational users of the river. FRD commends the NCCB's efforts in managing water quality.

6. Water temperatures in the Ashley may at times become critical for fish. Monitoring of water temperatures should be commenced in various parts of the river.

7. Minimum flows for the river should be set at Ashley Gorge. The relationship between flow at the Gorge and flow in the lower river appears to be poorly understood. FRD recommends that further investigations of flow patterns and losses to groundwater and underflow be undertaken by the NCCB.

8. Gravel extraction should only be permitted in dry areas of riverbed. Any rights to use water for washing gravel should require a sediment settling pond.

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