RECREATIONAL SUBSTITUTABILITY AND CARRYING CAPACITY

FOR THE RAKAIA AND WAIMAKARIRI RIVERS

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CONTENTS

LIST OF TABLES

PREFACE

This paper represents part of an AERU programme of research in the field of natural resource economics and management.

In an earlier AERU report on "Water and Choice in Canterbury" (Research Report No. 135), it was argued that more information should be sought on potential recreational impacts of water abstraction from the Rakaia.

Little is known about the effect of different levels of water abstraction on the instream recreational resources of Canterbury's rivers. This is particularly so with regard to the fishery resource. Much of the debate over the application for a National Conservation Order on The Rakaia River concerns this issue.

If abstraction of water from the Rakaia will degrade the fishing resource and the fishing experience, it is important to understand the recreation requirements and implications. This paper contributes some information about the recreational uses of the Rakaia and Waimakariri Rivers and the degree to which they might be regarded as substitutes.

Given the assumption that abstraction will degrade the fishing resource, information is reported for various levels of hypothetical impact allowing readers to assess the effects on the spatial distribution of fishermen and the quality of fishing experiences.

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Director

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SUMMARY

The Rakaia and Waimakariri Rivers are located close to each other in Canterbury; they have many of the same physical attributes and appear to offer similar recreational amenities. Both rivers have water right applications pending for large-scale irrigation development, and both are likely to be nominated for preservation under the new 'Wild and Scenic Rivers' amendment to the Soil and Water Conservation Act. These alternative uses are incompatible, and the possibility of a compromise solution depends partly on whether the two rivers are close subsitutes and whether one could accommodate a shift of use from the other. Accordingly, project objectives are to assess substitutability and estimate carrying capacities for salmon fishing on the Rakaia and Waimakariri rivers (page 1).

Previous work suggests that substitutability involves both activity substitutes and resource substitutes. Carrying capacities affect the need for and availability of substitutes. Capacity estimation involves management parameters, impact parameters, and evaluative standards (pages 3 - 7).

Resource substitutes were assessed in terms of existing information on resource characteristics and fishermen's assessments of substitute rivers. Activity substitutes were assessed by asking about fishing and non-fishing activities which might be substitutes for salmon fishing. Carrying capacity information comes from North Canterbury Catchment Board river use surveys, a panel of expert anglers, and questionnaires distributed to fishermen on the Rakaia and Waimakariri (pages 9 - 11).

Respondents in the samples of Rakaia and Waimakariri anglers averaged about the same age and income, and the median number of days free for fishing was comparable. Rakaia fishermen had more years of fishing experience. Rakaia anglers were more likely to have fished the Rakaia, Ashburton and Rangitata, while Waimakariri anglers were more likely to have fished the Waimakariri and Ashley. On average, Rakaia anglers attach a greater importance to salmon fishing; almost half say they would miss it more than anything else they do. Rakaia fishermen take longer trips and are more likely to stay overnight, while Waimakariri fishermen take more trips per year (page 13).

Over 70 per cent of Rakaia fishermen agreed that the Waiau, Hurunui, Opihi, Waitaki, Clutha, Rangitata, Ashley and Ashburton Rivers were not acceptable substitutes for the Rakaia. About half said the Waimakariri was not an acceptable substitute. When asked to specify the best substitute, 46 per cent chose the Waimakariri, and 28 per cent chose the Rangitata, although most felt that these rivers were of less value than the Rakaia. About 18 per cent said there was no substitute for the Rakaia. Most other types of fishing were not considered good substitutes; the exception was trout fishing, which provided similar benefits for 50 per cent of Rakaia anglers. Most anglers felt that non-fishing activities did not provide similar benefits (pages 13 - 20).

Over 75 per cent of Waimakariri fishermen agreed that the Waiau, Hurunui, Opihi, Waitaki, Clutha, Rangitata, Ashley and Ashburton were not acceptable substitutes for the Waimakariri. Only 20 per cent said the Rakaia was not an acceptable substitute. When asked to specify the best substitute, 85 per cent chose the Rakaia.

The Rakaia is more nearly equal in value for Waimakariri fishermen than the Waimakariri is for Rakaia fishermen. Most other fishing activities were not considered good substitutes; the exception was trout fishing, which provided similar benefits for 56% of Waimakariri anglers. Most anglers felt that non-fishing activities did not provide similar benefits (pages 21 - 22).

In terms of resource characteristics, the Rakaia and Waimakariri are different in many ways. Geographically, the Rakaia has a higher catchment, greater flow, wider braided channel, shorter gorge, greater distance from State Highway 1 to the sea and lacks the extensive stop banks found on the lower Waimakariri. The Rakaia is farther from the Christchurch metropolitan area and has less road access in the area below the Gorge Bridge. Salmon fishermen prefer the Rakaia to the Waimakariri, and the salmon run in the Rakaia appears to be at least twice that in the Waimakariri. The Waimakariri has greater facility development in the lower reaches (pages 22 - 29).

Recreation researchers distinguish between ecological, physical, facility and social capacity. Ecological capacity is the province of fisheries and wildlife experts, and social capacity appears to be more limiting than physical or facility capacity (pages 29 - 30).

The management parameter of primary interest is the flow regime in the Rakaia river. Changes in flow will probably affect the number and distribution of fishermen on the Rakaia and other Canterbury rivers. Current use estimates for the Rakaia range from 156 to 571 fishermen per day, and aerial surveys indicate that the Mouth/Lagoon, Mouth to State Highway 1, State Highway 1 to the Gorge, and area above the Gorge each receive about one-quarter of the use. Use estimates for the Waimakariri suggest larger numbers of people and a higher proportion of use at the river mouth (pages 30 - 32).

On the Rakaia, fishermen contacted at the mouth reported an average of 52 other fishermen in sight of their fishing spot; for about half the respondents, the closest anglers were 1 rod length or shoulder to shoulder, and 74% felt crowded. Anglers contacted at upstream locations reported an average of 7 other fishermen in sight; for 90% the closest anglers were 2-4 rod lengths or farther, and 45% felt crowded. Waimakariri anglers reported an average of 79 other fishermen in sight; for 52% the closest anglers were one rod length or shoulder to shoulder, and 75% felt crowded (page 35).

Evaluative standards were developed from angler questionnaires. At the Rakaia Mouth, the average number of anglers in sight is above capacity, the spacing between anglers is about right, and the percent feeling crowded is high compared to other studies. At upstream locations on the Rakaia, the average number of anglers in sight is just below capacity, the spacing between anglers is about right, and the percent feeling crowded is low compared to other studies. For the Waimakariri, the average number of anglers in sight is above capacity, the spacing between anglers is about right, and the percent feeling crowded is high compared to other studies. Expert anglers identified an average of 7 fishing sites in the 4 kilometre study section on the Rakaia, with an average capacity of three fishermen per pool (pages 33 - 44).

Implications for management involve assumptions about current trends and extensions beyond available data. In a "worst case" scenario where fishing on the Rakaia is eliminated, it is possible that on fishable weekend days over 200 salmon anglers would be looking for a place to fish on the Waimakariri, where the environment is more modified, the fishing experience is more developed and congested, there are fewer fishing holes in the accessible areas, there are half as many fish and a third more fishermen, and use is already above capacity. In a "worst case" scenario where fishing on the Waimakariri is eliminated, it is possible that on fishable weekend days over 500 salmon anglers would go to the Rakaia, more than doubling overall use there. At the Rakaia Mouth, which is already over capacity, use would more than triple. Without careful planning, low density and less developed recreation experiences are eventually lost, to be replaced by higher density and more developed experiences (pages 45 - 49).

SECTION 1

INTRODUCTION

There are several proposals for developing irrigation schemes on the Rakaia River. Such schemes would change the flow characteristics of the river, perhaps affecting the salmon fishery. At the present time, recreational salmon fishing is a major use of the Rakaia; results of a survey of recreation organisations by the North Canterbury Catchment Board (Saville-Smith, 1983) suggest that salmon fishing is the primary activity for 77 per cent of the people who use the Rakaia. What alternatives are available to salmon fishermen if the salmon fishing on the Rakaia is altered or eliminated? The present study addresses this question. Accordingly, this project has several specific objectives.

(1) To assess substitutes for recreational salmon fishing in North Canterbury. The most obvious alternative to the Rakaia is the Waimakariri River, so this option is explored in the greatest depth. This involves an assessment of resource characteristics as well as Rakaia fishermen's perceptions of substitutability. The study also explores fishermen's perceptions of the substitutability of other South Island salmon rivers, as well as other activities which are possible substitutes for salmon fishing.

(2) To estimate carrying capacity for recreational salmon fishing on the Rakaia. This will give information about current use levels and indicate the number of fishermen that would require a substitute if salmon fishing is adversely affected by abstraction. The capacity figure also provides an estimate of the potential use if current use is below capacity.

(3) To estimate carrying capacity for recreational salmon fishing on the Waimakariri. This will give information about current use levels on the Waimakariri and its ability to accommodate a shift of users from the Rakaia.

SECTION 2

REVIEW OF PREVIOUS WORK

2.1 Substitutability

Substitutes become an issue when individuals are constrained from participating in a desired activity. Constraints on participation (Baumgartner, 1978) can be externally imposed (e.g. resource areas closed by non-recreational uses) or based on individual limitations (e.g. insufficient time or money to participate). In either case, individuals can compensate by:

(1) selecting a different activity which meets their particular needs;

(2) choosing an alternative resource to continue participation in the original activity; or

(3) deferring participation to a more auspicious time (Vaske and Donnelly, 1982).

The aim of substitutability research is to understand the constraints people face and their subsequent compensatory processes.

The most common approaches to recreation substitutability correspond to the first two compensatory processes. Accordingly, substitutes have been identified between recreation activities and between recreation resources or sites. The former has received the most attention.[1]

2.1.1 Activity Substitutes. The most commonly accepted definition of activity substitutability is "the interchangeability of recreation activities in satisfying people's needs, motives, and preferences" (Hendee and Burdge, 1974). In operational terms this has generally meant using techniques such as factor or cluster analysis to construct activity groupings based on empirical intercorrelations. The measures employed in the analysis include participation rates (e.g. Moss and Lamphear, 1970), reported preferences (e.g. Chase and Cheek, 1979), and perceived similarities between pairs of activities (e.g. Becker, 1976).

Activity groupings have also been based on the kinds of satisfactions sought by participants (Tinsley and Kass, 1978; Hawes, 1978). Measures of "satisfactions" such as getting along with others or utilising abilities are factor or cluster analysed to create groupings that are similar in terms of the satisfactions they provide. The assumption is that activities satisfying similar needs are substitutable. However, satisfaction is a complex concept affected by a number of factors. The focus on phsychological determinants of satisfaction ignores the importance of social and physical contexts (Vaske, 1980).

Activity groupings have also been formed on the basis of the social groups with which an individual participates (e.g. Field and O'Leary, 1973). The assumption here is that the basis for participation may lie

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1. *A complete review of substitutability research can be found in Vaske and Donnelly, 1982.*

in the social group experience rather than the activity itself. Activities within groupings are therefore interchangeable because they provide the same type of group experience. The obvious drawback here is that social group participation is probably only one of the desired outcomes from recreation activities, and is therefore limited as the sole determinant of substitutes.

The assumption in all of these approaches is that because activities are intercorrelated on one of these dimensions they must provide similar satisfactions and are therefore substitutable. Although this makes sense at some levels, some researchers have argued that even similar activities may not provide the same satisfactions, depending on factors such as the activity itself, the "style" in which it is performed, and/or the characteristics of the user. In addition, intercorrelated activities may be complementary rather than substitutable.

For example, Christensen and Yoesting (1977) used four activity types (games and sports, hunting and fishing, nature appreciation, and motorised activities) from an earlier study to see if respondents considered other activities within an activity type to be good substitutes. On the average, only 60% of respondents could substitute within an activity type; activities in the games and sports type were most substitutable (almost 70%), while those in the hunting and fishing type were least so (45%).

In a study of two hunting activities similar in form, Baumgartner and Heberlein (1981) found that deer hunters perceived fewer substitutes than goose hunters, apparently because deer hunters placed more importance on the process of participation, the goal of the activity, and social interaction. It appears that activities will have fewer substitutes if numerous elements of a specific nature are rated important by participants. The results suggest that research on activity substitutes must consider the experiential elements of activities.

Vaske and Donnelly (1981) compare the activity type approach to a "direct question method" where respondents were simply asked to specify substitutes for a particular activity. Maryland turkey hunters who were displaced by season closure were asked to:

(1) specify participation rates in a number of recreation activities (activity type method); and

(2) indicate three substitutes for turkey hunting (direct question method).

The activities predicted as substitutes by the activity type method accounted for only 15% of the activities specified as substitutes by the direct question method.

The lesson to be learned from activity grouping approaches is that substitutions between activities can be complex phenomena. The direct question approach is most easily accomplished and requires the fewest assumptions.

2.1.2 Resource Substitutes. The problem with the activity substitutes approach is that it often overlooks physical and social contexts in which activities take place. The participation group approach looks at a part

of this context, as does Baumgartner and Heberlein's (1981) focus on process and goals. But none of these approaches focus on the resource itself, which is what managers can often manipulate most directly.

Economists have studied substitute and complement relationships for years (Clawson, 1966:90), although there are few empirical studies in the recreation field. Cordell (1976) explored the substitutability of public and private open space in urban areas. Demand for private recreational open space was significantly related to price of private space, quantity of public space, income, and two measures of the quality of private outdoor space (the proportion of land with creeks and golf courses). Income was the variable with the greatest effect, although Cordell argues that willingness to substitute has an effect independent of ability to substitute.

In a study more closely related to rural areas, Kurtz and King (1979) explored substitute and complement relationships for motorboat use of reservoirs in Arizona. Relationships were shown as cross-elasticities of demand, based on equations predicting the number of trips to each area from the costs (on and off site) of participation at each area. Results were explained in terms of characteristics of the individual reservoirs such as proximity to urban centres, access, travel time, travel distance, size of reservoir, facilities available, activities (fishing, water skiing, or cruising) and engine horsepower. Income was not a significant factor in explaining participation rates, presumably because the proportion of income spent on boating at the reservoir was small.

These studies suggest the kinds of factors that might affect the substitutability of resources. The specific variables would change from one area to another, but issues such as access, facilities or developments for recreation, other resource uses besides recreation, perceived site impacts, user density, conflicting recreation uses, and the regimentation of rules or regulations, need to be considered from the resource point of view.

To summarise, the activity-grouping approach to substitutability has received the most attention, but it appears that resource substitutability is the most applicable to the problem of substituting rivers such as the Waimakariri and Rakaia. Research using this approach suggests the kinds of variables which need to be measured. Of the activity grouping approaches, the direct question method should give insights into the views of users regarding the substitutability of resources and activities.

2.2 Carrying Capacity

Carrying capacity is the "level of use beyond which impacts exceed acceptable levels specified by evaluative standards" (Shelby and Heberlein, 1981). Capacity becomes an important issue when the demand for certain types of recreation opportunities increases beyond the resource manager's ability to provide them, a situation which has developed on many rivers in the U.S. Capacities for the New Zealand study rivers are important in two ways.

First, exceeding capacities may create the need for substitutes. Resource developments such as water projects that eliminate fishing may displace all users. But over-use may displace a smaller number of users who have been turned away by crowded conditions and have the same need for a substitute resource or activity. Knowing capacities relative to current demand gives an indication of the need for and availability of substitutes, even if resources are not pre-empted for non-recreational use.

Second, capacity estimates are helpful to determine the recreational value of a resource. Some valuation techniques result in a per person value, and a multiplier is needed to determine total value. Current or past use is often used for this purpose, but this results in under-estimation if use is below capacity or over-estimation if use is above capacity.

Carrying capacity research in the U.S. has a fairly long history, but most work has been prompted by the rapid increases in recreation use that have occurred in the past 20 years.[2] Shelby and Heberlein (1981) identify three major components of capacity decisions. "Management parameters" are those elements that managers can control or manipulate. They include use levels (the number specified by a capacity) as well as other variables such as distribution of use, location of facilities, travel patterns and schedules, and use practices.

"Impact parameters" describe the objective states produced by different management regimes. They include factors such as encounters with other groups on travel routes or at fishing holes (social capacity), time waiting to use developed facilities (facility capacity), and impacts on vegetation or wildlife (ecological capacity). It is necessary to establish the relationship between management parameters and impact parameters in order to specify the consequences of different management alternatives. For example, if 200 people per day enter a recreation area, what are the consequences in terms of the average number of groups seen on tracks, the number of people seen at fishing holes, the time spent waiting to use facilities, or the amount of vegetation in high use areas? Data describing these relationships give information about the effects of different management actions.

"Evaluative standards" are social judgements about which levels of impact are acceptable. For example, suppose a use level of 200 people per day reduces vegetation by 50% as a result of trampling. An evaluative standard is needed to decide whether this change is acceptable; if it is not, what is? Similarly, evaluative standards help define acceptable encounter levels and time waiting to use facilities. Several studies have shown that evaluative standards differ, depending on the type of experience in question (Shelby, 1981).

To summarise, capacities have an important effect on both the need for and availability of substitutes and the criteria for estimating recreation values. In the case of the Rakaia, change in the flow regime is a management parameter with potential for profound impacts. These impacts may include the distribution of fish and fishermen and the quality of the fishing experience on the Rakaia, the Waimakariri, and other South Island rivers. Evaluative

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2. *A complete discussion of carrying capacity concept and methodology can be found in Shelby and Heberlein (1981).*

standards regarding the acceptable proximity of other fishermen at the river mouth and at upstream fishing holes will help evaluate some of these impacts.

SECTION 3

METHODOLOGY

The time and resources available for this project required a carefully limited scope to ensure completion. The available data indicated that salmon fishing is by far the most common recreational activity on the Rakaia, and the North Canterbury Catchment Board was already involved in an on-going study of all recreation activities. For these reasons, it was agreed that this study would focus on substitutability and carrying capacity for salmon fishing on the Rakaia and Waimakariri. Because most of this activity occurs below the Gorge Bridges, the study was aimed at these areas. Although the data are limited in these ways, the methodology developed here can be applied to other activities and settings.

Data for this study came from three major sources. The first is existing resource data describing the Rakaia and Waimakariri, the second is a questionnaire distributed to fishermen on both rivers, and the third is a study of fishing sites on a four kilometre section of the Rakaia. Data collection is described by subject area in the following sub-sections.

3.1 Substitutability

In this study, resource substitutability has been approached from two points of view. First is a review of existing information on resource characteristics describing the Rakaia and Waimakariri. These include river bed and catchment, geology, climate, proximity to population centres, travel times, road accesses, current recreational activities, regulations affecting recreation, river flow, fishery and fish habitat, and developments and facilities. The two rivers are compared in terms of these variables by organising data already available.

The second source of information about resource substitutability is a questionnaire distributed to fishermen on both rivers (see Appendix 1). In order to determine their first hand knowledge about substitutes, fishermen were asked which of the ten South Island salmon rivers they had fished before (questionnaire items are grouped by measurement categories in Appendix 2). Fishermen then indicated which rivers were acceptable substitutes. For those not considered acceptable, they indicated reasons why not. Finally, fishermen were asked to specify the "best" substitute river and evaluate this river in relation to the Rakaia or Waimakariri.

Activity substitutes were determined in two ways. Possible substitute fishing activities were presented in a list; respondents simply circled "yes" or "no" to indicate whether each was a substitute for salmon fishing and then indicated the location where the activity would take place. Fishermen were also asked to list the non-fishing activities that gave them the same type of satisfaction or benefit they obtained from salmon fishing.

Finally, level of commitment to an activity and knowledge of substitutes have been shown to affect substitutability. Commitment to salmon fishing was measured in terms of years spent salmon fishing, length of time spent on an average visit, where the respondent stayed on overnight trips, and a general item indicating the degree of personal involvement with salmon fishing. Knowledge of substitutes was measured by asking about fishing experience on other South Island salmon rivers.

3.2 Carrying Capacity

Information on carrying capacity comes from two sources. The first is a panel of expert anglers. With the help of the New Zealand Salmon Anglers' Association (NZSAA), Leathers and Hughey organised a field study involving fifteen experienced salmon fishermen. At a preliminary meeting the fishermen completed a questionnaire describing personal data, fishing habits, expenditures on angling, and an item on the minimum tolerable distance between themselves and other fishermen. On the day of the field study, experts were transported to a four kilometre section of the Rakaia located near the Gun Club above the State Highway 1 Bridge (the upper four kilometres of the Fisheries Research Division, Ministry of Agriculture and Fisheries (F.R.D.) study area). This section was chosen as typical of the Rakaia. The anglers were then asked to survey and fish the study section, either on foot or using a jet boat that was made available to them. Each angler carried a folder in which he identified potential fishing sites, rated each in terms of "fishability", and indicated how many people could fish the site at one time (see Appendix 3).

Other information on carrying capacity comes from the questionnaires distributed to anglers on the Rakaia and Waimakariri. Reported encounters with and proximity to other anglers were measured by asking fishermen how many others were within sight of the pool they were fishing and how close other fishermen were standing. Anglers were then asked how crowded they felt. Encounter and proximity norms were measured by asking anglers to specify the "right" number of fishermen to have within sight of a pool and the minimum tolerable distance to other fishermen. Fishermen were also asked how many others they preferred to see (as opposed to the number they would tolerate).

3.3 Sampling and Distribution for Fisherman Questionnaire

Questionnaires were distributed on weekend days in February when the river was fishable and fishermen were present. An effort was made to contact all fishermen below the Gorge Bridge on sampling days, using vehicle access points, jet boats, and kayaks. The samples are thus drawn from fishermen present on fishable weekend days in February.

Of the 367 questionnaires distributed on the Rakaia, 146 were completed and returned, a response rate of 40 per cent. Of the 400 questionnaires distributed on the Waimakariri, 121 were completed and returned, a response rate of 30 per cent. The ability to send follow-up reminders would certainly have increased response, but because of limited resources names and addresses of respondents were not obtained. Although disappointing, these response rates are close to what can be expected from a one-shot distribution effort under these kinds of conditions[3].

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[3] *The original study plan called for on-site distribution of questionnaires on both the Rakaia and Waimakariri. The team doing the N.C.C.B. recreation survey (Saville-Smith, 1983) agreed to handle all questionnaire distribution and data collection and deliver approximately 400 completed questionnaires from each river. During their distribution of questionnaires on the Rakaia, however, the river was flooding and unfishable. Very few fishermen were present, and the result was a total of 30 questionnaires completed by fishermen, a number too small to use.*

The possibility of sampling from lists of fishing licence holders from the Ashburton and North Canterbury Acclimatisation Societies was explored, but these lists were unavailable at the time of the study. With time running short, questionnaire distribution and data collection were undertaken by the author. Questionnaires were distributed on the Rakaia with volunteer labour, while N.C.C.B. supplied two student workers to distribute questionnaires on the Waimakariri.

It is difficult to specify the extent to which the samples represent all Rakaia or Waimakariri fishermen because response rates are low and the samples represent only those present on fishable weekend days in February. We have no reason to conclude that these two factors bias the study findings, but that possibility does exist, and results presented later in this report should be viewed as suggestive rather than conclusive. This is a situation where the information available from this study, although somewhat limited in general terms, is better than no information.

SECTION 4

RESULTS

4.1 Fishermen on the Rakaia and Waimakariri

Background characteristics of Rakaia and Waimakariri fishermen are shown in Table 1. On average, respondents in the two samples were about the same age (46–47 years), and earned about the same amount of money ($18,000–$20,000). Rakaia fishermen averaged almost 20 years of fishing experience, while those on the Waimakariri averaged 14. The average number of days free for fishing was greater for Waimakariri fishermen, although the median values were almost identical (50 and 51 days for the Rakaia and Waimakariri, respectively).

Fishermen reported the South Island salmon rivers which they had fished before (see Table 2). The majority had not fished the Waiau, Hurunui, Opihi, Waitaki or Clutha, and for these rivers there were no significant differences between the two samples. Rakaia fishermen were more likely to have fished the Rakaia, the Ashburton and the Rangitata, while Waimakariri fishermen were more likely to have fished the Waimakariri and the Ashley. The average number of salmon rivers fished was about four for both groups. Responses to a more general item suggest that, on average, Rakaia fishermen attached a greater importance to salmon fishing than Waimakariri fishermen did. Almost half (46 per cent) of Rakaia fishermen indicated that "If I couldn't go salmon fishing I would miss it more than anything else I do; for me there is no substitute for salmon fishing", compared with only a quarter (26 per cent) on the Waimakariri (see Table 3).

Average lengths of trips to the two rivers are shown in Table 4. About 29 per cent of trips to the Rakaia are for one day, while about half are for two days or more. Approximately 68 per cent of trips to the Waimakariri are for a half day or less, and another 24 per cent are for a full day. About 24 per cent of Rakaia fishermen reported staying overnight in a bach or hut, and 39 per cent stay in caravans (see Table 5). Most Waimakariri fishermen do not stay overnight. Rakaia fishermen report an average of 30 trips per year to the Rakaia (median = 20), while Waimakariri fishermen report an average of 40 (median = 30).

4.2 Fishermen's Perceptions of Substitutability for the Rakaia

Rakaia fishermen were given a list of South Island salmon rivers and asked to indicate which ones were acceptable substitutes for salmon fishing on the Rakaia (see Table 6). Over 70 per cent agreed that the Waiau, Hurunui, Opihi, Waitaki, Clutha and Rangitata were not acceptable substitutes. For these rivers the most common reason (given by 59–91 per cent of respondents) was that the drive takes too long. Some fishermen (26–40 per cent) also indicated that it is too expensive to fish on these rivers. A substantial number (36–46 per cent) added low salmon numbers as reasons why the Waiau, Hurunui, and Opihi were not acceptable substitutes.

The Ashley and Ashburton Rivers were not acceptable substitutes for 100 per cent and 88 per cent of the fishermen, respectively. However, the length of the drive was less likely to be a problem (26–32 per cent ticked this reason). For these rivers, 45–55 per cent cited fewer salmon and 53–55 per cent cited poor fishing conditions as reasons why they were not acceptable substitutes.

TABLE 1

Background Characteristics

Characteristics	Average Rakaia	(n)	Waimak	(n)	Z—Value
Age (years)	46.6	(140)	45.8	(120)	0.4
Years of fishing experience	19.6	(145)	14.0	(121)	3.7*
Days per year free for fishing	76	(137)	96	(116)	2.1*

* mean values for these characteristics are significantly different, $p < .05$.

TABLE 2

Experience on South Island Salmon Rivers

River	Per cent who have fished before Rakaia fishermen (n = 146)	Waimak fishermen (n = 121)	Z — Value
Waiau	13	17	1.0
Hurunui	40	36	0.7
Ashley	23	44	3.7*
Waimakariri	73	84	6.6*
Rakaia	100	98	4.7*
Ashburton	51	37	2.2*
Rangitata	58	46	2.1*
Opihi	29	19	1.9
Waitaki	29	20	1.7
Clutha	6	3	1.5
Average number of rivers fished	4.2	4.0	0.6

* mean values for these rivers are significantly different, $p < .05$.

TABLE 3

Commitment to Salmon Fishing

If I couldn't go salmon fishing ...	Per Cent Rakaia		Per Cent Waimak	
I wouldn't miss it at all; other activities could easily be substituted	1		3	
I would miss it some, but I could find other things to give me the same type of satisfaction	10	11	24	27
I would miss it a great deal; few other activities give me the same type of satisfaction	44		48	
I would miss it more than anything else I do; for me there is no substitute for salmon fishing	46		26	
TOTAL	100 n=144		100 n=121	

The distributions for Rakaia and Waimakariri anglers are significantly different: Chi-square = 17.06, d.f. = 2, $p < 0.001$

TABLE 4

Average Length of Trip

Trip Length (days)	Per Cent Rakaia Fishermen at Rakaia		Per Cent Waimak Fishermen at Waimak	
Less than one half	2		23	
One half	12		45	
One	29		24	
One and one half	7	29	0	5
Two	22		5	
More than two	28		3	
TOTAL	100 n=137		100 n=112	

The distributions for Rakaia and Waimakariri anglers are significantly different: Chi-square = 91.73, d.f. = 4, $p < 0.001$

TABLE 5

Kind of Overnight Accommodation

Accommodation	Per Cent	
	Rakaia Fishermen at Rakaia	Waimak Fishermen at Waimak
Don't stay overnight	29	80
Bach or hut	24	1
Motel or hotel	2	1
Caravan	39	14
Tent	7	4

TABLE 6

Rakaia Fishermen's Evaluations of Possible Substitutes for the Rakaia

Rivers	Substitute for Rakaia? (Percent "no")	If not, why? (percent ticked)					
		Drive takes too long	Too expensive	Too crowded	Scenery not as good	Fewer salmon	Poor fishing conditions
Waiau	99	79	31	1	3	46	19
Hurunui	86	63	26	0	4	44	17
Opihi	94	61	28	10	7	36	44
Waitaki	95	88	35	2	0	16	11
Clutha	100	91	40	1	0	21	9
Rangitata	73	59	26	12	2	22	16
Ashley	100	32	13	3	9	55	55
Ashburton	88	26	12	16	9	46	53
Waimakariri	50	17	7	40	13	26	19

It is often assumed that fishermen can substitute the Waimakariri for the Rakaia. Of the Rakaia fishermen surveyed, 50 per cent said the Waimakariri is not an acceptable substitute. The most common reason (given by 40 per cent of respondents) was that the river is too crowded, followed by fewer salmon (26 per cent) and poor fishing conditions (19 per cent).

Rakaia fishermen were asked to choose the river which for them was the best substitute for the Rakaia. As the preceding data would suggest, almost half (46 per cent) chose the Waimakariri, while 28 per cent chose the Rangitata. None of the other rivers was chosen by more than three per cent of the respondents, and 18 per cent refused to choose a "next-best substitute", saying there was no substitute for the Rakaia.

In order to assess the trade-offs between the Rakaia and Waimakariri, Rakaia fishermen were asked to indicate how many days of salmon fishing on their substitute river were required to give the same enjoyment as they got from one day on the Rakaia. Responses for those who chose the Waimakariri or Rangitata are shown in Table 7. Only 12 per cent said they were willing to give up one day on the Rakaia in return for one day on the Waimakariri; 43 per cent would need one and one-half to three days on the Waimakariri; 32 per cent would need four to six days, and 14 per cent would need more than six. For those who chose the Rangitata, 15 per cent would need one-half to one day, 60 per cent would need one and one-half to three days, 15 per cent would need four to six days, and nine per cent would need more than six. These results indicate that in general the Waimakariri and the Rangitata are not "equal" in value to the Rakaia for those who consider them the best substitutes.

Fishermen were also asked how many trips they would take to their substitute river if they didn't fish on the Rakaia at all. Responses for those who chose the Waimakariri or Rangitata are shown in Table 8. The average number of intended trips was 16 for the Waimakariri and 11 for the Rangitata. The average length of trips on the Waimakariri was just over one-half day, and on the Rangitata it was one to one and one-half days (see Table 9).

Rakaia fishermen were also asked if any other fishing activities would give them the same satisfaction or benefit they got from salmon fishing (see Table 10). Sea fishing was not a substitute for 84 per cent, and lake salmon fishing was not a substitute for 85 per cent. Flounder and perch fishing were unacceptable for 94 per cent and 99 percent, respectively. Trout fishing did provide the same type of benefit for 50 per cent of Rakaia fishermen, but in a separate item 62 percent indicated that "For me no other fishing is a substitute for salmon fishing". Trout fishing may provide similar benefits for some, but the majority still contend that other types of fishing are not substitutes for salmon fishing.

Rakaia fishermen were asked if any non-fishing activities would give them the same satisfaction or benefit they receive from salmon fishing. Approximately 80 per cent listed no substitute activities and indicated that "For me no non-fishing activity is a substitute for salmon fishing". Fourteen per cent listed one substitute activity, and five per cent listed two.

TABLE 7

Trade-offs between the Rakaia, Waimakariri and Rangitata

	Days on Waimak to equal one day on Rakaia (%)	Days on Rangitata to equal one day on Rakaia (%)	Days on Rakaia to equal one day on Waimak (%)
One half	0	3	15
One	12	12	41
One and one half	5	9	2
Two	26	30	14
Three	12	21	15
Four	7	6	1
Five	9	0	2
Six	16	9	3
More than six	14	9	7
TOTAL	100 (n=58)	100 (n=33)	100 (n=88)
Median	3 days	2 days	1 day

TABLE 8

Trips Intended on Substitute Rivers

Number of Trips	Rakaia anglers on Waimak (%)	Rakaia anglers on Rangitata (%)	Waimak anglers on Rakaia (%)
0 - 4	23	42	17
5 - 9	20	16	24
10-14	13	13	28
15-19	5	8	8
20-24	13	8	11
25-29	4	0	3
30 or more	23	13	10
TOTAL	100	100	100
	n=56	n=38	n=93
Average	16.1 trips	11.4 trips	13.2 trips

TABLE 9

Average Length of Trips on Substitute Rivers

Trip Length (days)	Rakaia anglers on Waimak (%)	Rakaia anglers on Rangitata (%)	Waimak anglers on Rakaia (%)
Less than one-half	28	15	9
One-half	35	19	16
One	26	33	61
One and one-half	2	4	6
Two	5	7	7
More than Two	2	22	2
TOTAL	100	100	100
	n=90	n=27	n=57

TABLE 10

Substitute Fishing Activities for Rakaia and Waimakariri Fishermen

Fishing Activities	Substitute for Salmon Fishing? (percent "no")		Z - Value
	Rakaia Fishermen	Waimak Fishermen	
Sea fishing	84	74	2.0*
Lake salmon fishing	85	78	1.4
Flounder fishing	94	92	0.9
Perch fishing	99	96	1.8
Trout fishing	50	44	1.0

* mean values for this fishing activity are significantly different, $p < 0.05$

TABLE 11

Waimakariri Fishermen's Evaluations of Possible Substitutes for the Waimakariri

Rivers	Substitute for Rakaia? (Percent "no")	If not, why? (percent ticked)					
		Drive takes too long	Too expensive	Too crowded	Scenery not as good	Fewer salmon	Poor fishing conditions
Waiau	94	76	44	0	0	36	18
Hurunui	81	66	38	0	0	39	13
Opihi	96	78	40	5	4	25	21
Waitaki	96	91	46	3	0	3	3
Clutha	100	93	52	0	0	11	8
Rangitata	76	68	38	9	2	4	4
Ashley	88	12	9	3	2	61	56
Ashburton	85	52	31	17	7	30	38
Rakaia	20	28	16	7	1	0	3

4.3 Fishermen's Perceptions of Substitutability for the Waimakariri

Waimakariri fishermen were given the same list of South Island salmon rivers and asked to indicate which ones were acceptable substitutes for salmon fishing on the Waimakariri (see Table 11). Over 75 per cent agreed that the Waiau, Hurunui, Opihi, Waitaki, Clutha and Rangitata were not acceptable substitutes. For these rivers, the most common reason (given by 66 - 91 per cent of respondents) was that the drive takes too long. Some fishermen (38 - 52 per cent) also indicated that it is too expensive to fish on these rivers. A substantial number (25 - 39 per cent) added that there were too few salmon in the Waiau, Hurunui and Opihi.

The Ashley was not an acceptable substitute for 88 per cent of Waimakariri fishermen, primarily due to fewer salmon (61 per cent) and poor fishing conditions (56 per cent). The Ashburton was not a substitute for 85 per cent of Waimakariri fishermen. The most common reason (52 per cent) was the length of the drive, but expense (31 per cent), fewer salmon (30 per cent), and poor fishing conditions (38 per cent) were also cited as problems.

The Rakaia was an acceptable substitute for 80 per cent of Waimakariri fishermen. For those who said it was not, the major reason was the length of the drive.

In order to assess the trade-offs between the Waimakariri and the Rakaia, Waimakariri fishermen were asked to indicate how many days of salmon fishing on their substitute river were required to give the same enjoyment as they got from one day on the Waimakariri. Responses for those who chose the Rakaia are shown in Table 7. The majority (56 percent) said they were willing to give up one day on the Waimakariri in return for one day or less on the Rakaia; 31 per cent would need one and one-half to three days on the Rakaia, six per cent would need four to six days, and seven per cent would need more than six. These results suggest that the Rakaia is more nearly equal in value for Waimakariri fishermen than the Waimakariri is for Rakaia fishermen.

Fishermen were also asked how many trips they would take to their substitute river if they didn't fish on the Waimakariri at all. Responses for those who chose the Rakaia are shown in Table 8. The average number of intended trips on the Rakaia was about 13. The average length of trips on the Waimakariri for this group was just under one day (see Table 9).

Waimakariri fishermen were also asked if any other fishing activity would give them the same satisfaction or benefit they receive from salmon fishing (see Table 10). Sea fishing was not a substitute for 74 per cent, and lake salmon fishing was not a substitute for 78 per cent. Flounder and perch fishing were not substitutes for 92 per cent and 96 per cent, respectively. Trout fishing did provide the same type of benefit for 56 per cent of Waimakariri fishermen. In a separate item, 38 per cent indicated that "For me no other fishing is a substitute for salmon fishing".

Waimakariri fishermen were asked if any non-fishing activities would give them the same satisfaction or benefit they got from salmon fishing. About 65 per cent listed no substitute activities and indicated that "For me no non-fishing activity is a substitute for salmon fishing". Twenty-six per cent listed one substitute activity and five per cent listed two.

In summary, most Rakaia and Waimakariri fishermen agreed that the Waiau, Hurunui, Opihi, Waitaki, Clutha and Rangitata are not substitutes, primarily because the drive is too long. Both groups agree that the Ashley and Ashburton are not acceptable substitutes, primarily due to fewer fish and poor conditions,

although more Waimakariri fishermen (probably those who live north of Christchurch) felt the Ashburton was too far to drive. Most Waimakariri fishermen felt the Rakaia was an acceptable and nearly equal substitute, but only half the Rakaia fishermen felt the Waimakariri was a substitute, and one of lower value at that. Most objections to the Waimakariri centred around crowding and fewer fish. Waimakariri fishermen were a little more likely to view other activities, both fishing and non-fishing, as substitutes for salmon fishing.

The effect of proposed river developments on fishing conditions is not known at this time. As an example, however, let us consider a "worst case" scenario is assumed where fishing on the Rakaia is eliminated. The data suggest that about half (46 per cent) of the Rakaia fishermen might shift to the Waimakariri as a "next best" substitute resource, although most of them would consider it inferior. About a quarter (28 per cent) might shift to the Rangitata, although most would consider this inferior as well. Some of the 50 per cent for whom trout fishing provides similar benefits might shift to that activity, increasing use levels on Canterbury trout streams. These conclusions are based on reports of intentions, and actual behaviour might differ.

4.4 Substitutability Based on Resource Characteristics

Information on resource characteristics is summarised in Table 12; it will be discussed briefly here. The Rakaia and Waimakariri catchments are similar in many ways. They are close to the same length, although the upper catchment of the Rakaia is slightly larger and higher in elevation, with more of the flow from snow and glacial melt. Both rivers have wide braided channels except where they are confined in gorges, although the Waimakariri Gorge is considerably longer than the Rakaia Gorge. The distance from the Gorge Bridges to the sea is nearly the same, although the Rakaia's channel is wider in this area, and the Waimakariri below Halkett is contained by extensive stop banks which reduce channel width. The distance from State Highway 1 to the sea is greater on the Rakaia.

The rivers are in similar geologic areas, with glacial outwash, silt, and loess deposited on the Canterbury plain. Higher alluvial terraces appear nearer the Gorges. The upper catchment of the Rakaia is more glaciated, and there is no large capacity storage reservoir like Lake Coleridge in the Waimakariri catchment. The rainfall for both catchments is highest in the Main Divide area, decreasing rapidly to the southwest. Wind is a dominant climatic factor for both areas.

The major population centres served by the two rivers include Christchurch and vicinity (300,000), Ashburton (15,000), Rangiora (6,400), and Kaiapoi (4,900). The Waimakariri is closest to Christchurch, the largest population centre. Parts of the Waimakariri can be reached in a quarter of an hour from Christchurch, although it may take an hour to reach the Gorge Bridge. The Waimakariri is also close to Rangiora and Kaiapoi. The area serviced by the Rakaia extends from Rangiora to Temuka, while the area serviced by the Waimakariri extends from Culverden to Ashburton (Saville-Smith, 1983).

TABLE 12

Comparison of Resource Characteristics

Resource Characteristics	Rakaia	Waimakariri
River	Total length is 140km, upper catchment = 2640km². Steep slope in upper reaches, flattening as it approaches the sea. Higher elevation than Waimak (28 per cent vs 10 percent of area above gorge bridge is above 1525m). Wide braided channel except where it is confined in the Gorge, which extends only 6km above Gorge Bridge before it begins to widen (in five more km it is again 1 - 2 km wide). Gorge Bridge to sea - 61km, braided channel approx. 1.5 - 2km wide, increasing to 5km below S.H. 1. S.H. 1 to sea is 22km, with low banks, scrub vegetation. S.H. 1 to Gorge has terraces and higher banks with some trees. Steeper topography and more enclosure at Gorge.	Total length is 135km, upper catchment = 2432 km². Steep slope in upper reaches, flattening as it approaches the sea. Wide braided channel except where it is confined in the Gorge, which extends approximately 45km above the Gorge Bridge. Gorge Bridge to sea is approximately 58km. From Gorge Bridge to Halkett, channel is approx. 1km wide contained by higher banks and terraces. Below this point river is contained by extensive stop-banks which gradually reduce channel width below McLeans Island. From Coutt's Island (2km above S.H.1) to sea channel is approx. .5km wide. S.H.1 to sea is 6.5km.
Geology	Glacial outwash gravels, silt, loess. Alluvial terraces nearer Gorge. Upper catchment glaciated (more than Waimak) Lake Coleridge has very large storage capacity	Glacial outwash, gravels, silts, loess. Alluvial terraces nearer Gorge.
Climate	Rainfall up to 7600mm in Main Divide area, decreasing rapidly to southwest. 1000 - 1200mm at Gorge, 750mm west of S.H.1, 600mm at mouth. Sunshine hrs per year - about 2000, slightly more inland. Winter snow line about 2000m. Wind a dominant factor. Big variation in winter and summer temperature.	Rainfall up to 4500mm in Arthurs Pass area, decreasing rapidly to southwest. 1000-1200mm near Gorge, 700-1000mm below Gorge, 600mm at mouth. Other factors similar to Rakaia.

TABLE 12 (contd)

Resource Characteristics	Rakaia	Waimakariri
Population Centres		
Christchurch (300,000)	60 per cent of use (NCCB organisation survey), 60 - 90km, 1 - 1.5 hrs.	5 - 60km, 0.25 - 1hr.
Ashburton (15,000)	24 per cent of use (NCCB organisation survey), 40 - 60km, 0.75 - 1hr.	70 - 100km, 1 - 1.75hrs.
Rangiora (6,400)	80 - 90km, 1.25 - 1.75hrs.	10 - 60km, 0.25 - 1hr.
Kaiapoi	70 - 100km, 1.25 - 1.75hrs.	2 - 60km, 0.1 - 1hr.
Road Access		
Main Routes	S.H. 1 and S.H. 72. Sealed surface roads parallel both sides of river, but well back from river bank. Roads continue above Gorge Bridge but become rougher.	S.H. 1 and S.H. 72 Sealed surface roads parallel both sides of river, but well back from riverbank. Road ends approx. 12km above Gorge Bridge and does not return until Mount White area.
Access Roads (shown in inch to mile maps)	North Bank: Rakaia Huts (at mouth) Dobbins Road Wabys Road Headworks Road Old South Road State Highway 1 Bridge Burns Road Darrochs Road Steeles Road Sleemans Road Gorge Bridge Lake Coleridge and power station Wilberforce River area	North Bank: Kairaki Point (at mouth) Road follows edge of channel from S.H. 1 to just above Normans Road (29 km) Brown's Rock Road Gorge Bridge Woodstock Mt White Bridge S.H. 73 Bridge at Klondike Corner

TABLE 12 (contd)

Resource Characteristics	Rakaia	Waimakariri
	South Bank: Huts (at mouth) Dobsons Ferry Road Wolseley Road McKays Road Somerton Road Methven Road Highbank Power Station Happy Valley Road Gorge Bridge Double Hill Road (near Acheron Flat) Redcliffe Stream Glenrock-Glenariffe Glenfalloch	South Bank: Stewarts Gully Road follows edge of channel most of the way from S.H. 1 to Pitts Road (41 km) Gorge Bridge Mt White Bridge S.H.73 Bridge at Klondike Corner
Recreational Activities	Fishing - salmon 77% - trout 3% Jet boating 10% Canoeing 2% (NCCB organisation survey) Other activities possible (picnics, off-road vehicles, etc). Approx. 20,000 licenses issued annually for fishing in North and Central Canterbury. OCTA Survey: 39% NCAS licensees fish Rakaia at least once per summer. (NCAS Annual Report, 1976)	Fishing - salmon - trout Jet boating (most popular river in Canterbury) (No percentages available) Canoeing (Gorge is popular) Swimming, picnicking 52% NCAS licensees fish Waimak at least once per summer Jet Boat Association survey of members: 67% combine salmon fishing with jet boating.
Regulations Affecting Recreation	NCAS fishing regulations (north side of river) AAS fishing regulations (south side of river) Ministry of Transport rules regarding jet boating.	NCAS fishing regulations Ministry of Transport rules - jet boating prohibited below S.H. 1 Bridge

TABLE 12 (contd)

Resource Characteristics	Rakaia	Waimakariri
Agencies	North Canterbury Catchment Board Canterbury United Council Ellesmere, Malvern and Ashburton Counties Ashburton Acclimatisation Society North Canterbury Acclimatisation Society	North Canterbury Catchment Board Canterbury United Council Eyre, Malvern, Oxford, Paparua and Waimairi Counties North Canterbury Acclimatisation Society
Fishery species	(see Appendix 3 for more detailed information) common bully, long-finned eel, brown trout, guinnat salmon, torrentfish, blue-gilled bully, upland bully, black flounder, common smelt, Stokell's smelt, short-finned eel, lamprey, koaro.	Species composition and numbers probably similar to Rakaia. (Large scale research being done at present by Fisheries Research Division, M.A.F.)
Habitat	The Waimakariri's physical environment is perhaps more stable than Rakaia due to greater riparian cover on islands and river banks. Water velocity and depth, dissolved oxygen levels, water temperature, and sediment loads probably similar to Rakaia. Perhaps better cover for some species due to greater riparian growth on islands and river banks than the Rakaia.	

TABLE 12 (contd)

Resource Characteristics		Rakaia	Waimakariri
Flow (long term monthly means):	Minimum	126 cumecs in July (higher than Waimak due to glaciers)	81 cumecs in June
	Maximum	262 cumecs in November	170 cumecs in October
	Average	196 cumecs (24 cumecs lost before S.H. 1 bridge)	120 cumecs
		(Flows measured at Gorge, 1958-78).	Flows follow rainfall patterns at Arthurs Pass; snow is not a major factor. (Flows measured at highway bridge, 1928-34 and 1967-69.)

Abbreviations:

NCAS - North Canterbury Acclimatisation Society
NCCB - North Canterbury Catchment Board
S.H. - State Highway
AAS - Ashburton Acclimatisation Society

The Rakaia is further from Christchurch, requiring a drive of approximately one to one and one half hours. In spite of this, data from the North Canterbury Catchment Board survey of recreational organisations (Saville-Smith, 1983) indicate that 60 per cent of Rakaia users come from Christchurch and another 25 per cent come from Ashburton. The Rakaia is closer than the Waimakariri to the rural areas southwest of Christchurch (e.g. Leeston, Southbridge, Rakaia). The North Canterbury Catchment Board on-site survey of users shows that 53 per cent come from Christchurch, six per cent from Ashburton, and 25 per cent from the area between the Waimakariri and Ashburton Rivers, excluding Christchurch and Ashburton (Saville-Smith, 1983).

In terms of road access, both rivers can be reached by State Highways 1 and 72. Sealed surface roads also parallel both rivers from mouth to Gorge, although they are well back from the river bank. On the Rakaia, roads continue above the Gorge Bridge, but become rougher. On the Waimakariri, road access above the Gorge Bridge is limited to Woodstock (at the end of the Gorge), Mount White Bridge (above the Gorge), and the State Highway 73 Bridge at Klondike Corner. The long inaccessible Gorge distinguishes the Waimakariri from the Rakaia.

Both rivers have numerous access roads between the river mouth and Gorge Bridge (see Table 12 for a complete listing). In this area, the Rakaia is characterised by roads running perpendicular to the river which offer access to one point only. In contrast, the Waimakariri has roads running right along the river bank for much of this area, particularly in the 30 - 40 kilometres upstream from State Highway 1 Bridge.

In terms of recreational activities, data from the North Canterbury Catchment Board survey of members of recreational organisations suggest that the Rakaia is the "most preferred" river in Canterbury, although the Waimakariri is the "most used" because of its proximity to Christchurch. Overall, 77 per cent of the respondents who use the Rakaia use it primarily for salmon fishing; only four per cent fish for trout, 10 per cent list jet boating as their primary activity, three per cent duck shooting, and two per cent canoeing. No comparable figures are available for the Waimakariri, but Saville-Smith (1983) reports that the Rakaia is the river most preferred by salmon anglers. Trout anglers rate the two rivers about the same, preferring instead the Selwyn River. Information from the Jet Boaters Association and the North Canterbury Catchment Board survey suggests that the Waimakariri is the most preferred jet boating river in Canterbury, although the Rakaia is also popular. Canoeing is more popular on the Waimakariri, particularly in the Gorge. There appears to be more swimming and picnicking activity on the Waimakariri, probably due to the proximity to Christchurch.

In terms of regulations affecting fishing, the North Canterbury Acclimatisation Society fishing regulations apply to the Waimakariri and the north side of the Rakaia. Ashburton Acclimatisation Society regulations apply to the south side of the Rakaia (the two sets of regulations are similar with respect to salmon fishing). Ministry of Transport rules regarding jet boating apply to both rivers. Jet boating is prohibited below the State Highway 1 Bridge on the Waimakariri; there is no such limitation on the Rakaia. Local agencies that have interests in the two rivers include the North Canterbury Catchment Board, Canterbury United Council, county councils, and the Ashburton and North Canterbury Acclimatisation Societies.

Comparisons of the fisheries in the two rivers are difficult because studies on the Waimakariri are being done at the present time. A general summary of available information prepared by the Fisheries Research Division of M.A.F. is presented in Appendix 3, and Cowie (1983) provides a similar analysis. Numerous species reside in the Rakaia, and fisheries experts speculate that the species

composition of the Waimakariri is similar to that of the Rakaia. Fisheries experts consider that the areas downstream of the Gorges are similar in terms of ecosystem characteristics that affect the fishery, including water velocity and depth, dissolved oxygen, water temperature, and sediment loads. The Waimakariri may have slightly greater cover for some species and also greater physical stability because of the greater riparian growth on islands and river banks. Cowie (1983) estimates that the number of salmon in the Rakaia is at least double that in the Waimakariri, probably due to the higher quality spawning area in the headwaters.

In terms of flow, the Rakaia carries more water. Hydrographs for the two rivers follow roughly the same pattern of high and low flow, and North Canterbury Acclimatisation Society data indicate that roughly the same days are fishable. Water quality (in terms of faecal coliforms) is lower on the Waimakariri, particularly in the lower reaches.

Facilities and developments on the Rakaia River are extensively documented in Saville-Smith (1983). No such compilation is available for the Waimakariri, but developments on both rivers are concentrated at the Gorge Bridges, State Highway 1 Bridges, and the river mouths. Because of its channel modification and proximity to Christchurch, Kaiapoi and Belfast, the lower part of the Waimakariri has considerably greater development, particularly in terms of urban or sub-urban facilities such as stores and shops, marinas, and the McLean's Island complex. Saville-Smith argues that the less modified natural environment is part of what attracts visitors to the Rakaia.

4.5 Four Kinds of Carrying Capacity

Recreation researchers have identified four different types of carrying capacities: ecological, physical, facility and social (Shelby and Heberlein, 1981). Each type of capacity will be discussed briefly here, with general examples of how each might apply to the Rakaia. A more detailed discussion of the data will then be presented.

Ecological capacity is concerned with impacts on the ecosystem. On the Rakaia and Waimakariri, several different ecosystem impacts due to fishing can be considered. Impacts on vegetation are probably minimal, at least along the river bed. The shingle appears resistant to damage, and many of the plants are hardy exotic species. Impacts on birds and small mammals are probably minimal as well, although some studies are currently under way. The ecological impacts of changes in flow regimes are discussed at length in Bowden (1983).

The number of fish in the river, particularly salmon, is a more interesting ecological impact parameter. Factors affecting this include the water regime, hatcheries or salmon ranches, fishing pressure, and natural events such as floods. Fisheries experts do not know at this time exactly how all these variables affect salmon numbers. But it may be useful to specify an evaluative standard such as the minimum number of fish needed to sustain a viable run or the number needed to assure anglers a certain catch or catch rate. Management parameters affecting salmon numbers could then be mainipulated accordingly. This area is best left to fishery experts, but the problem fits into the carrying capacity framework developed here.

Physical capacity is concerned with the amount of space in undeveloped natural areas. In terms of the physical capacity for salmon fishing, a large number of fishermen can fit along the edge of the river, especially if they cast over-hand rather than side-arm. They also need space in the water for their lines, which are generally cast slightly upstream and then allowed to

drift down, but if they time their casts carefully snags can be avoided. The point is that physical capacity is probably quite high. Physical capacity at the upstream pools is considerably higher than fishermen would tolerate given the social constraints of a "quality" fishing experience. Physical capacity may be a more relevant consideration at the river mouth, where the fishing experience is defined in terms of higher density levels, but it appears that social capacity is a more limiting factor here also.

Facility capacity involves man-made improvements intended to handle user needs. Salmon fishing requires no facilities right at the river bank. Access facilities include roads, space for parking cars, and launching areas for jet boats, while support facilities include overnight accommodation (camping space, motels, baches), stores, and restaurants. The North Canterbury Catchment Board assessment of recreation facilities (Saville-Smith, 1983) provides further information about the Rakaia. Facility capacity can almost always be increased by spending money on development.

Social capacity is concerned with encounters with other people and the way those encounters affect recreation experiences. How many fishermen can fish a pool before they begin to feel crowded and the experience changes? Social capacity is usually more difficult to determine than other types of capacity, and it is usually more limiting than physical capacity. Social capacity will be the focus of the data reported here.

4.6 Social Capacities for the Rakaia and Waimakariri

4.6.1 Management Parameters The management parameter of primary interest here is the flow regime in the Rakaia River. If irrigation development changes this regime, it may decrease the quality of the fishing environment or the number of fish in the river. If this happens, the number of fishermen on the Rakaia will probably decrease. Assuming those fishermen substitute another fishing activity, the number of fishermen on the Waimakariri and other Canterbury trout fishing rivers will increase.

Other management factors (besides flow) could be used to regulate the number of fishermen on the Rakaia and Waimakariri. These include information programmes, sales of fishing licenses, creation of special fish management districts, changes in access roads or tracks, or changes in launch facilities for jet boats. Because these issues are not currently under consideration, they are not discussed at length in this paper (see Shelby and Heberlein, 1981, Chapters 2 and 7).

4.6.2 Impact Parameters Changes in flow (the management parameter) will probably affect overall use. Impacts of changes in overall use can be seen in terms of the number and distribution of fishermen along the Rakaia and Waimakariri. Data on use levels were collected by the North Canterbury Catchment Board in the course of work done for the Rakaia River Resource Survey (see Saville-Smith, 1983; 50-62). Using on-site and aerial surveys, Saville-Smith estimates an average of 156 persons per day using the Rakaia. However, she points out that this is probably a conservative estimate because weather and water conditions were unusually poor during the study and few fishermen were present. She reports Fisheries Research Division estimates of 30,000 (1981-82), 47,000 (1980-81), and 60,000 (no date specified) angling visits per season. With a 210 day season, this would mean average use levels of 143, 224, and 286 fishermen per day, respectively. If the river is fishable only half the time, as North Canterbury Acclimatisation Society records suggest, use levels would increase to 286, 448, and 571 anglers per fishable day. Given that the highest on-site or

aerial use count by North Canterbury Catchment Board was 353, some of these figures may be high. Accurate use figures will require careful sampling and a large enough number of counts.

Using data from aerial surveys, Saville-Smith estimates the proportion of use that occurs in different sections of the Rakaia. Adjusting these to reflect actual distribution of use on a per flight basis, we find that 24 per cent of the use occurs in the Mouth/Lagoon area, 26 per cent from the Mouth to State Highway 1, 28 per cent from State Highway 1 to the Gorge, and 22 per cent above the Gorge. Although these figures do not reflect fishing use alone and are based on a small number of counts, they provide the best data available to estimate use for different river sections. Table 13 shows section use estimates assuming total use levels of 150, 300, 450, and 600 fishermen per day. Estimates for the Mouth/Lagoon area range from 36 to 144 per day, while estimates for the area from the Mouth to State Highway 1 range from 39 to 156. Estimates for the State Highway 1 to Gorge area range from 42 to 168 persons per day. The author's informal obervations would suggest that on fishable weekend days with fish in the river, total use levels are in the 300-450 range.

There are no on-site use counts for people using the Waimakariri. Fisheries Research Division (Tierney et.al., 1982: 47) estimates a total of 90,000 - 100,000 visits annually to the Waimakariri. With a 210 day season, the lower figure would mean average use levels of 429 anglers per day. If the river is fishable only half the time, use levels would increase to 857 per fishable day.

The North Canterbury Catchment Board gathered aerial survey data on the Waimakariri during their study of the Rakaia. Counts from eight flights are shown in Table 14. Averaging across flights, we find that about half (49 per cent) of the use occurs at the river mouth, 22 per cent from the mouth to State Highway 1, 24 per cent from State Highway 1 to the Gorge Bridge, and five per cent above the Gorge Bridge. Although these figures do not reflect fishing use alone and are based on a small number of counts, they provide the best data available to estimate use for different river sections. Table 15 shows section use estimates assuming total use levels of 150, 300, 450, 600, and 750 fishermen per day. Estimates for the Mouth area range from 74 to 367, while estimates for the area from the Mouth to State Highway 1 range from 33 to 165. Estimates for the State Highway 1 to Gorge area range from 36 to 180. The author's informal observations would suggest that on fishable weekend days with fish in the river, total use levels are in the 450 - 600 range.

TABLE 13

Use Estimates for Sections of the Rakaia River

River Section		Total Use (Anglers per day)			
		150	300	450	600
Mouth/Lagoon	(24%) [a]	36	72	108	144
Mouth to State Highway 1	(26%)	39	78	117	156
State Highway 1 to Gorge	(28%)	42	84	126	168
Above Gorge	(22%)	33	66	99	122

[a] Percentages based on aerial survey figures from Saville-Smith (1983: 59), recalculated to reflect actual distribution of use on a per flight basis.

TABLE 14

Aerial Counts of People Using the Waimakariri River

	Location			
	River Mouth	Mouth to S.H. 1	S.H. 1 to Gorge Bridge	Above Gorge Bridge
Tuesday 7/12/82	8	5	2	0
Saturday 11/12/82	8	5	30	0
Thursday 20/1/83	50	11	27	7
Thursday 27/1/83	-	6	4	0
Tuesday 1/2/83	29	8	4	8
Saturday 5/2/83	66	45	45	10
Thursday 17/2/83	80	33	9	4
Friday 4/3/83	11	15	20	4
Average	36	16	19	4
Per cent	49	22	24	5

TABLE 15

Use Estimates for Sections of the Waimakariri River

River Section		Total Use (Anglers per Day)				
		150	300	450	600	750
Mouth/Lagoon	(49%)	74	147	221	294	367
Mouth to State Highway 1	(22%)	33	66	99	132	165
State Highway 1 to Gorge	(24%)	36	72	108	144	180
Above Gorge	(5%)	8	15	23	30	38

For estimates of use in smaller areas we asked fishermen to report the number of other fishermen within sight of their pool the last time they were fishing. On the Rakaia, questionnaires were coded according to whether they were distributed at the mouth or upstream, giving a rough indicator of the area for which fishermen reported use figures. Those contacted while fishing at the mouth reported seeing an average of 52 other fishermen (median = 30), while users contacted at upstream locations reported seeing an average of seven other fishermen (median = 6). Previous research based on river floaters (Shelby and Colvin, in press) suggests that when contact rates are high user reports tend to under-estimate actual contacts by about half. If this were true for fishermen's reports on the Rakaia, those at the mouth may actually see an average of over 100 other fishermen, while those upstream are in sight of about 14 other fishermen.

Taken together, Rakaia fishermen reported an average of 29 others in sight of their pool (the median number was 12). In contrast, Waimakariri fishermen reported an average of 79 others (median = 50), more than twice as many ($Z = 5.69$, $p < .05$). Again, if user reports under-estimate actual contact rates by half, then average fishermen in the study see about 68 others on the Rakaia and 158 on the Waimakariri.

Fishermen were asked how close other fishermen were on either side of them. Results for Rakaia fishermen are shown in Table 16. Using the same rough division of those contacted while fishing upstream versus those contacted at the mouth, we see that 49 per cent of mouth fishermen report others as close as one rod length (three metres) or shoulder to shoulder. In contrast, 90 per cent of fishermen upstream report the closest others as casting range (12 - 30 metres) or 2 - 4 rod lengths (6 - 12 metres).

For all Rakaia fishermen taken together, the majority (71 per cent) reported that other fishermen were 2 - 4 rod lengths, or casting range (see Table 17). The majority of Waimakariri fishermen (52 per cent) reported that other fishermen were at closer range (one rod length or shoulder to shoulder).

Fishermen were asked how crowded they felt. On the Rakaia, the majority (74 per cent) of those contacted at the mouth felt slightly, moderately, or extremely crowded (see Table 18). Only 27 per cent said they were not at all crowded. In contrast, the majority (55 per cent) of those contacted upstream said they were not at all crowded.

For all Rakaia fishermen taken together, 41 per cent said they were not at all crowded (see Table 19). Waimakariri fishermen were more likely to feel crowded; 75 per cent said they felt slightly, moderately, or extremely crowded.

4.6.3 Evaluative Standards from Fishermen Establishing evaluative standards is often the most difficult part of capacity determination. How many fishermen is too many? How close should they be? How crowded is too crowded? Items in the questionnaire were designed to help answer these questions.

Fishermen were asked, "What is the 'right' number of fishermen to have within sight of the pool where you are fishing? Please indicate the highest number you will tolerate before the fishing experience becomes unpleasant". On the Rakaia, 24 per cent of those contacted at the river mouth said the highest number should be five or fewer, and about half (49 per cent) said the highest number should be 30 or fewer (see Table 20). For those contacted upstream, the majority (63 per cent) said the highest number tolerable was 10 or fewer.

These evaluative standards can be applied to the reported encounter data presented earlier. At the river mouth, the average number of fishermen within sight (52) exceeds the majority tolerance standard of just over 30. Half those

TABLE 16

Proximity of Nearest Fishermen on Rakaia River

Proximity	River Mouth (%)	Upstream (%)
Casting range (12 - 30 metres) or beyond	33	44
2 - 4 rod lengths (6 - 12 metres)	18	46
One rod length (3 metres)	27	7
Shoulder to shoulder	22	3
TOTAL	100 n=67	100 n=68

TABLE 17

Proximity of Nearest Fishermen on Rakaia and Waimakariri Rivers

Proximity	Rakaia (%)	Waimak (%)
Casting range (12 - 30 metres) or beyond	38	33
2 - 4 rod lengths (6 - 12 metres)	33	15
One rod length (3 metres)	17	27
Shoulder to shoulder	12	25
TOTAL	100 n=138	100 n=117

Distributions for Rakaia and Waimakariri fishermen were significantly different: Chi-square = 16.67, d.f. = 3, $p<0.001$.

TABLE 18

Perceived Crowding on the Rakaia River

Perceived Crowding	River Mouth (%)	Upstream (%)
Not at all	27	55
Slightly	31	21
Moderately	28	18
Extremely	15	6
TOTAL	100 n=68	100 n=67

Comparing these two frequency distributions, Chi-square = 12.1, 3 d.f., $p < .05$; Cramer's V = .30.

TABLE 19

Perceived Crowding on the
Rakaia and Waimakariri Rivers

Perceived Crowding	Rakaia (%)	Waimak (%)
Not at all	41	25
Slightly	26	22
Moderately	23	29
Extremely	10	24
TOTAL	100 n=119	100 n=138

Distributions for Rakaia and Waimakariri anglers are significantly different: Chi-square = 13.28, 3 d.f., $p < 0.005$.

TABLE 20

Encounter Norms (Fishermen in Sight)
On Rakaia River

Highest Number Tolerable	Cumulative Percent	
	River Mouth	Upstream
0	1	2
1	3	3
2	6	14
3	13	23
4	19	37
5	24	42
6 - 10	36	63
11 - 15	40	66
16 - 20	45	68
21 - 30	49	69
31 - 50	54	69
Over 50	69	69
Makes no difference	100	100
Average (for those giving a number)	35.0	5.7

sampled at the mouth reported seeing 30 or fewer (the median), which just about matches the evaluative standard. For those contacted at upstream locations, the average and median numbers seen (seven and six respectively) were just below the majority tolerance standard. These data suggest that fishing at upstream locations is just about at capacity and fishing at the river mouth is at or above capacity. If anglers under-report encounters (as Shelby and Colvin, in press, suggest), then both areas are over social capacity.

Encounter norms for fishermen on both rivers are shown in Table 21. On the Rakaia, the tolerable number of other fishermen was five or fewer for 32 per cent of the respondents, and a majority (53 per cent) agreed that the highest number in sight should be 15 or fewer. On the Waimakariri, the tolerable number was slightly higher. The tolerable number was five or fewer for 26 per cent of the respondents, and a majority (51 per cent) agreed that the highest number in sight should be 30 or fewer. Averages for those who gave a number were not significantly different ($Z = 1.07$, N.S.).

These evaluative standards can be applied to the reported encounter data described earlier. For the Rakaia, the average number of fishermen within sight (29) exceeds the majority tolerance standard of 15 or fewer. The median number seen (12), which is the highest number reported by 50 per cent of respondents, is just below the majority standard. For the Waimakariri, the average number of fishermen in sight (79) exceeds the majority standard of 30 or fewer. Here the

median number in sight (50) also exceeds the majority tolerance standard. These data suggest that overall the Rakaia is at or above capacity and the Waimakariri is above capacity. If anglers under-report encounters, then both areas are over social capacity.

Fishermen were also asked how many fishermen they would prefer to see in the area where they fish, and preferred numbers were considerably lower than tolerable numbers. Among those contacted at the Rakaia River mouth, 23 per cent preferred to see no other fishermen, and the majority (51 per cent) preferred to see four or fewer (see Table 22). Among those contacted upstream, 47 per cent preferred to see no other fishermen, and the majority (58 per cent) preferred to see one or fewer.

Preferences for both rivers are shown in Table 23. For all Rakaia fishermen, 37 per cent preferred to see no others, and the majority (57 per cent) preferred to see two or fewer. For the Waimakariri, 22 per cent preferred to see no others, and the majority (52 per cent) preferred to see four or fewer.

These evaluative standards can be applied to the reported encounter data described earlier. Reported encounter measures (both means and medians) exceeded preference standards for Rakaia fishermen contacted at the river mouth and upstream, for all Rakaia fishermen combined, and for Waimakariri fishermen. Preferences represent the "optimal" situation. They establish an ideal to aim for rather than a maximum tolerable capacity.

TABLE 21

Encounter Norms (Fishermen in Sight)
on Rakaia and Waimakariri Rivers

Highest Number Tolerable	Cumulative Percent	
	Rakaia	Waimak
0	1	1
1	3	5
2	10	13
3	18	17
4	28	23
5	32	26
6 - 10	49	39
11 - 15	53	42
16 - 20	57	46
21 - 30	60	51
31 - 50	62	57
Over 50	69	66
Makes no difference	100	100
	n=136	n=110
Average (for those giving a number)	20.2	27.5

TABLE 22

Encounter Preferences (Fishermen in Sight)
for Rakaia River

Preferred Number	Cumulative Percent	
	River Mouth	Upstream
0	23	47
1	33	58
2	44	67
3	44	77
4	51	82
5	58	82
6 - 10	72	96
11 - 15	74	100
16 - 20	79	100
21 - 30	84	100
31 - 50	93	100
Over 50	100	100

TABLE 23

Encounter Preferences (Fishermen in Sight)
for Rakaia and Waimakariri Rivers

Preferred Number	Cumulative Percent	
	Rakaia	Waimak
0	37	22
1	48	28
2	57	41
3	63	47
4	69	52
5	72	55
6 - 10	86	71
11 - 15	89	73
16 - 20	91	79
21 - 30	93	84
31 - 50	97	92
Over 50	100	100
Average (for those giving a number)	8.3	16.1

Fishermen were asked, "under normal salmon fishing conditions, what is the minimum distance you can tolerate between you and another fisherman?" Results for the Rakaia are shown in Table 24. For those contacted at the river mouth, 25 per cent would tolerate others only at casting range, 48 per cent would tolerate others no closer than two to four rod lengths, and 71 per cent no closer than one rod length (average rod length is three metres). Fishermen contacted upstream tended to want other fishermen farther away. Here 37 per cent would tolerate others only at casting range, and 84 per cent would tolerate others no closer than two to four rod lengths.

These evaluative standards can be applied to the reported proximity data presented earlier. Just over half (51 per cent) of the fishermen contacted at the river mouth reported that the nearest other fishermen were two to four rod lengths or beyond, and just under half (48 per cent) specified this distance as their evaluative standard. For those contacted upstream, 84 per cent reported that the nearest others were two to four rod lengths, and 92 per cent specified this as their evaluative standard. Based on these findings, the spacing between fishermen on the Rakaia is about right.

Proximity norms for the two rivers are compared in Table 25. For the Rakaia, 31 per cent would tolerate others only at casting range, and 67 per cent would tolerate others no closer than two to four rod lengths. Waimakariri fishermen were willing to tolerate others at closer range. Twenty-one per cent would tolerate others only at casting range, 47 per cent would tolerate others no closer than two to four rod lengths, and 78 per cent would tolerate others no closer than one rod length.

These evaluative standards can be applied to the proximity data presented earlier. About 71 per cent of all Rakaia fishermen reported that the nearest other fishermen were two to four rod lengths or beyond, and 67 per cent specified this distance as their evaluative standard. Similarly, 47 per cent of Waimakariri fishermen reported the nearest other fishermen were two to four rod lengths or beyond, and 48 per cent specified this distance as their evaluative standard. These findings suggest that the spacing between fishermen on both rivers is about right.

Results from other studies can be used as a rough evaluative standard for perceived crowding (Shelby and Heberlein, 1981: Chapter 4). Table 26 shows the percentage of people reporting some degree of crowding in a variety of settings, including those under investigation here. Based on knowledge of the areas they have studied, Shelby and Heberlein speculate that if more than two-thirds of the people feel crowded, crowding has become a problem and use levels may be above capacity. Perceived crowding levels of Rakaia fishermen taken together and Rakaia fishermen contacted at upstream locations are below this criterion. For Rakaia fishermen contacted at the river mouth and all Waimakariri fishermen, 74 and 75 per cent (respectively) rate the experience as crowded. Both these figures exceed the two-thirds criterion, suggesting that the Rakaia Mouth and the Waimakariri are above capacity.

4.6.4 Evaluative Standards from Expert Anglers Data from the expert angler survey provide additional insights into carrying capacity for salmon fishing on the Rakaia River. The number of sites identified in the four kilometre study section ranged from 4 to 12 (see Table 27). For the 15 anglers, the average number of sites identified was seven; the median was also seven.

TABLE 24

Proximity Norms (Minimum Distance)
for Rakaia River

Minimum Distance Tolerable	Cumulative Percent River Mouth	Upstream
Makes no difference	15	1
Shoulder to shoulder	29	4
One rod length (3 metres)	52	16
2 - 4 rod lengths (6 - 12 metres)	75	63
Casting range or further	100	100
	n=65	n=67

Comparing these two frequency distirbutions, Chi-square = 21.4, 4 d.f., $p < .05$; Cramer's V = .40

TABLE 25

Proximity Norms (Minimum Distance)
for Rakaia and Waimakariri Rivers

Minimum Distance Tolerable	Cumulative Percent Rakaia	Waimak
Makes no difference	7	14
Shoulder to shoulder	16	22
One rod length (3 metres)	33	53
2 - 4 rod lengths (6 - 12 metres)	69	79
Casting range or further	100	100

TABLE 26

Ranking of Perceived Crowding for Different Settings and Activities

Percent Reporting Experience as Crowded

89	Pheasant Hunters-Bong Opening Day
86	Goose Hunters-Firing Line
85	Pheasant Hunters-Control Opening Day
75	Waimakariri salmon fishermen
74	Rakaia salmon fishermen (river mouth)
73	Boundary Waters Canoers and Boaters
70	Mt. McKinley Climbers
68	Rogue River Floaters
61	Wolf River Floaters
59	Rakaia salmon fishermen (all)
53	Brule Fishers, Snake River Floaters, Mt. Jefferson Backpackers
52	Brule River Canoers
50	Sandhill High Density Deer Hunt (1980)
49	Eagle Cap Backpackers
48	Pheasant Hunters-Bong Late Season
46	Wisconsin Deer Hunters
45	Rakaia salmon fishermen (upstream)
44	Maryland Turkey Hunters & Goose Hunters-Horicon
43	Brule River Tubers
41	Stockings Park Drivers
26	Sandhill Doe Deer Hunters (1979), Illinois River Floaters
21	Sandhill Low Density Deer Hunt (1980)
17	Goose Hunters-Managed Hunt

TABLE 27

Total Number of Sites
On a 4 km Representative Stretch of the Rakaia River
(Expert Anglers)

Value	Frequency
4	XXXX
5	X
6	X
7	XXX
8	XX
9	XX
10	
11	X
12	X

Average = 7.00

Standard deviation = 2.56

Anglers also indicated the number of fishermen who could fish each site they identified. Summing these, we get each angler's estimate of the capacity of the four kilometre section. These estimates ranged from 8 to 48; all but two were between 8 and 25 (see Table 28). The average capacity estimate for the study section was 19 fishermen; the median was approximately 17.

Average capacity per fishing site can be calculated by dividing each angler's total capacity by the number of sites he specified. Average site capacities ranged from 1.5 to 12.0, although all but one were between 1.5 and 3.6 (see Table 29). Averaging across all 15 anglers, the capacity for pools in the study section was just over three fishermen per pool; the median was approximately 2.2.

These figures can be used to estimate a capacity for the river, assuming the study section is reasonably representative. The stretch from the Gorge Bridge to the sea is approximately 61 kilometres. Deleting the last kilometre near the mouth and using 19 persons per four kilometres as the evaluative standard, capacity for the 60 kilometre stretch from above the Mouth to the Gorge Bridge is 285 fishermen.

Comparing this figure to the use level figures estimated by Saville-Smith, current use on this section of the river may be a little below capacity. However, data from fishermen indicate that the sites currently used are at or above capacity. This probably means that there are some sites in this section which are under-utilised at this time, perhaps because of difficult access.

Expert anglers also indicated how close they could tolerate other fishermen (see Table 31). About 42 per cent would tolerate others only at casting range, and 79 per cent wanted no one closer than two to four rod lengths. Even with some

difference in question wording and the small sample size, this distribution is similar to the one for Rakaia anglers at upstream locations.

In summary, social carrying capacity appears to be the limiting factor for fishing on the Rakaia and Waimakariri Rivers at this time, although the fishery itself is an important issue which is beyond the scope of this report. Change in the flow regime on the Rakaia is the management parameter of interest here, although the effect of proposed river developments on fishery conditions is not known at this time. If a "worst case" scenario is considered (elimination of fishing on the Rakaia), it is possible that as many as 450 anglers per fishable day could be displaced from the Rakaia. If all of these chose to fish on the Waimakariri, 108 might be expected to go to the Mouth area and the remainder to upstream areas. Questionnaires were distributed to anglers on fishable days in February. Based on angler reports of encounters (which may be under-estimates) fishermen at the Rakaia River Mouth fished within sight of an average of 52 other fishermen, while those at upstream locations saw about seven. Fishermen on the Waimakariri reported seeing an average of 79 other fishermen. For the Rakaia River Mouth, encounter tolerance standards, proximity standards, and perceived crowding standards indicate that fishing use is at or above capacity. For upstream locations these standards indicate that fishing use is just about at capacity. For the Waimakariri, encounter tolerance and perceived crowding standards indicate that use is above capacity, while proximity standards suggest that on average the spacing between fishermen is about right.

TABLE 28

Total Carrying Capacity
for Entire Study Section of the Rakaia River
(Expert Anglers)

Value	Frequency
8	X
9	
10	X
11	XXX
12	X
13	
14	
15	X
16	
17	X
18	X
19	X
20	X
21	
22	
23	X
24	
25	X
37	X
48	X

Average = 19.00

Standard deviation = 2.56

TABLE 29

Average Capacity per Fishing Site
on a Representative Stretch of the Rakaia River
(Expert Anglers)

Value	Frequency
1.5	XX
1.6	
1.7	
1.8	X
1.9	X
2.0	X
2.1	X
2.2	XX
2.3	
2.4	
2.5	X
2.6	X
2.7	
2.8	X
2.9	
3.0	
3.1	X
3.2	
3.3	
3.4	
3.5	
3.6	X
12.0	X

Average = 3.01

Standard deviation = 2.57

TABLE 30

Tolerable Proximity for Other Fishermen
(Expert Anglers)

Minimum Distance Tolerable	Cumulative Per Cent (n = 19)
Shoulder to shoulder	5
1 rod length (3 metres)	21
2 - 4 rod lengths (6 - 12 metres)	58
Casting range (or further)	100

SECTION 5

IMPLICATIONS FOR MANAGEMENT

The effect of proposed river developments on fishery conditions is not known at this time; as Leathers, et al. (1983) point out, some combinations of irrigation, hydroelectric, and salmon ranching projects could conceivably protect or even enhance the salmon fishery. To understand other less favourable futures, however, let us consider what might happen if irrigation development impairs the salmon fishery on the Rakaia or Waimakariri.

Predicting the future is always difficult, and it requires assumptions about current trends and extensions beyond the available data. Realising that such discussions are both speculative and informative, the following is an assessment of some possible consequences of irrigation development for salmon anglers. Several alternative scenarios are discussed.

Although available figures do not specify current use levels, let us assume that on fishable weekend days with fish in the river there are 450 anglers on the Rakaia and 600 on the Waimakariri, distributed as shown in Tables 13 and 15. If the quality of salmon fishing on the Rakaia is impaired by irrigation abstraction and anglers try to substitute a fishing activity, a reasonable estimate is that among those displaced, 46 per cent will substitute the Waimakariri, 28 per cent will substitute the Rangitata, and 26 per cent will turn to trout fishing.

The estimated redistribution of displaced anglers is shown in Table 31. The first column of numbers shows what would happen in a "worst case" scenario, if all 450 Rakaia anglers were displaced. The assumption is that those choosing the Waimakariri would try to relocate in an area comparable to the one where they had been fishing on the Rakaia. Those fishing at the Rakaia Mouth would shift to the Waimakariri Mouth, adding 50 persons per day to the 294 already there. Those fishing on the Rakaia between the Mouth and State Highway 1 would be candidates for the corresponding area on the Waimakariri, but this section is shorter (6.5 km compared to 22 km) and the river is more channelised, so there are fewer fishing holes. Similarly, those fishing on the Rakaia between State Highway 1 and the Gorge Bridge would be candidates for the corresponding area on the Waimakariri, although the lower part of this section is also channelised. Those fishing above the Gorge Bridge on the Rakaia might try to fish in the corresponding area on the Waimakariri, but it is less accessible by road and generally requires a boat. In view of these obstacles, it is conceivable that a larger proportion might try to fish at the Waimakariri Mouth, but those who fish at upstream locations often do so because they dislike the crowded atmosphere at the river mouth. In this "worst case" scenario then, on fishable weekend days over 200 salmon anglers would be looking for a place to fish on the Waimakariri, where the environment is more modified, the fishing experience is more developed and congested, there are fewer fishing holes in the accessible areas, there are half as many fish and a third more fishermen, and use is already above capacity. Assuming the total number of fish caught on the Waimakariri remained the same, the chances of an individual fisherman catching a fish would decrease by about 26 per cent.

The remaining Rakaia fishermen could be expected to shift to salmon fishing on the Rangitata or trout fishing on other Canterbury rivers. Little is known about current use levels on the Rangitata, so it is difficult to assess the effects of adding 126 fishermen on fishable weekend days there. The Selwyn is Canterbury's most popular trout stream (Saville-Smith, 1983), and it is the most easily accessible from the region's population centre. We do not know about current use on the Selwyn, so it is difficult to assess the effects of adding 117 fishermen on weekend days there.

TABLE 31

Estimated Redistribution of Rakaia Fishermen on Fishable Weekend Days

Relocation Area	Fishermen per day Displaced from Rakaia		
	450	300	150
Waimak (46%)			
Mouth	50	33	17
Mouth to State Highway 1	54	36	18
State Highway 1 to Gorge Bridge	58	39	19
Above Gorge	46	30	15
Rangitata (38%)	126	84	42
Trout rivers (26%)	117	78	39

TABLE 32

Estimated Redistribution of Waimakariri Fishermen on Fishable Weekend Days

Relocation Area	Fishermen per day Displaced from Waimakariri		
	600	450	300
Rakaia (85%)			
Mouth	250	188	125
Mouth to State Highway 1	112	84	56
State Highway 1 to Gorge Bridge	122	92	61
Above Gorge	26	20	13
Trout rivers (15%)	90	67	45

An alternative scenario is represented by the last column of numbers in Table 31, where only a third (150) of Rakaia anglers are displaced. Again it is assumed that those choosing the Waimakariri would try to relocate in an area comparable to the one where they had been fishing on the Rakaia. Those fishing at the Rakaia Mouth would shift to the Waimakariri Mouth, adding 17 persons per day to the 294 already there. Those fishing on the Rakaia between the Mouth and State Highway 1, State Highway 1 and the Gorge Bridge, and above the Gorge Bridge would encounter the same obstacles described above when shifting to the corresponding areas on the Waimakariri. In this "one-third displacement" scenario , then, on fishable weekend days just under 70 salmon anglers would be looking for a place to fish on the Waimakariri. Assuming the total number of fish caught on the Waimakariri remained the same, the chances of an individual fisherman catching a fish would decrease by about 10 per cent. The fishermen remaining on the Rakaia would be faced with whatever undesirable circumstances prompted the displaced fishermen to leave.

The other Rakaia fishermen could be expected to shift to salmon fishing on the Rangitata or trout fishing on other Canterbury rivers. As was discussed earlier, lack of information about current use levels makes it difficult to assess the effects of adding 42 fishermen to the Rangitata and 39 to the Selwyn on fishable weekend days.

What about the opposite case, where salmon fishing on the Waimakariri is impaired by irrigation abstraction? Assuming anglers substitute a fishing activity, a reasonable estimate here is that 85 per cent of those displaced will substitute the Rakaia, and the remaining 15 per cent will turn to trout fishing.

The estimated redistribution of displaced anglers is shown in Table 32. The first column of numbers shows what would happen in a "worst case" scenario, if all 600 anglers were displaced. The assumption is that those choosing the Rakaia would try to relocate in an area comparable to the one where they had been fishing on the Waimakariri. Those fishing at the Waimakariri Mouth would shift to the Rakaia Mouth, adding 250 people per day to the 108 already there. Those fishing on the Waimakariri between the Mouth and State Highway 1 would shift to the corresponding area on the Rakaia, adding 112 people per day to the 117 already there. Those fishing on the Waimakariri between State Highway 1 and the Gorge Bridge would shift to the corresponding area on the Rakaia, adding 122 people per day to the 126 already there. Those fishing above the Gorge Bridge on the Waimakariri would shift to the corresponding area on the Rakaia, adding 26 people per day to the 99 already there. This smaller number above the Gorge Bridge would have less impact than the larger number in other areas, but these fishermen might be disappointed by the lack of a remote Gorge area. In this"worst case" scenario, then, on fishable weekend days over 500 salmon anglers would drive the longer distance to the Rakaia, more than doubling overall use there. At the Rakaia Mouth, which is already over capacity, use would more than triple. At upstream locations below the Gorge Bridge, which are just about at capacity, use would nearly double. Assuming the total number of fish caught on the Rakaia remained the same, the chances of an individual fisherman catching a fish would decrease by about 53 per cent overall.

The remaining Waimakariri fishermen could be expected to shift to trout fishing on other Canterbury rivers. Little is known about current use levels on the Selwyn (Canterbury's most popular trout stream), so it is difficult to assess the effects of adding 90 fishermen per weekend day there.

An alternative scenario is represented by the last column of numbers in Table 32, where only half (300) of Waimakariri anglers are displaced. Again it

is assumed that those choosing the Rakaia would try to relocate in an area comparable to the one where they had been fishing on the Waimakariri. Those fishing at the Waimakariri Mouth would shift to the Rakaia Mouth, adding 125 people per day to the 108 already there. Those fishing on the Waimakariri between the Mouth and State Highway 1 would add 56 to the corresponding area on the Rakaia. Those fishing on the Waimakariri between State Highway 1 and the Gorge Bridge would add 61 to the corresponding area on the Rakaia. Those fishing above the Gorge Bridge on the Waimakariri would add 13 to the corresponding area on the Rakaia, although they might be disappointed by the lack of a remote Gorge area. In this "one-half displacement" scenario, then, on fishable weekend days over 250 salmon anglers would drive the longer distance to the Rakaia, increasing overall use there by more than 50 per cent. At the Rakaia Mouth, which is already over capacity, use would more than double. At upstream locations below the Gorge Bridge, which are just about at capacity, use would increase by almost 50 per cent. Assuming the total number of fish caught on the Rakaia remained the same, the chances of an individual fisherman catching a fish would decrease by about 36 per cent.

If these kinds of shifts occur, it might be possible to slightly increase the supply of fishing opportunities without further exceeding capacity. Findings from the expert anglers study suggest that total capacity for the Rakaia from the Gorge Bridge to one kilometre above the sea is about 285 fishermen. Our best estimate of current use in this area is 243 fishermen on fishable weekend days. Reported encounter data indicate that currently used sites are at or above capacity, so it appears that a few sites in this section are under-utilised at this time, perhaps because of difficult access. If these areas were identified, improved access might increase utilisation. This strategy would be less likely to work on the Waimakariri, where use levels are already higher and there is relatively complete road access to areas below the Gorge Bridge.

It might be possible to distribute use more evenly by informing fishermen of less heavily used times or areas. It may be, for example, that fishable week days show lower use than fishable weekend days. If so, information encouraging fishermen to fish on those days might allow a more even distribution of use. Similarly, information might encourage shifts to lower use areas. This type of programme would require better information than is currently available about the distribution of fishermen in time and space. It also assumes that at least some fishermen have the ability to take advantage of lower use times or areas.

Such efforts to increase the supply of fishing opportunities should not be seen as a panacea. Although a definitive conclusion requires more information than is available at this time, it appears that the Rakaia and Waimakariri are now close to full utilisation on fishable days. There is not enough room on either river to absorb a major increase in use.

It is also possible to control use levels through restricting access or limiting license sales. Although such measures might be unpopular with some, evidence from studies overseas suggests that resource users often support restrictions which protect the quality of recreation experiences (see Shelby and Heberlein 1981, Chapters 1 and 7). Such action would require considerable investigation of alternative allocation schemes.

In conclusion, the preceding discussion suggests that the partial or complete loss of fishing on either the Rakaia or Waimakariri would probably lead to increased congestion on the remaining Canterbury rivers. The higher densities of fishermen would mean lower probabilities of catching fish and a change in the nature of fishing experiences. Low density and less developed

recreation experiences could eventually be lost, to be replaced by higher density and more developed experiences.

These are some of the possible costs for salmon anglers if irrigation development impairs fisheries on the Rakaia or Waimakariri. Other studies are intended to show the benefits for the Canterbury region of salmon fishing in particular and irrigation development in general (Maidment et. al (1980), Leathers et. al (1983), Hughey (1982), Tierney (1981)). The AERU are also currently completing a study to assess the total value of the Rakaia River to Canterbury salmon anglers and the value of changes in the size of the annual salmon run.

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APPENDIX 1

Questionnaires Distributed to Fishermen

on Rakaia and Waimakariri Rivers

WAIMAKARIRI RIVER QUESTIONNAIRE

This questionnaire is short and won't take much of your time. Your opinions are important, so please answer each question. The best answer is the one that reflects your opinions or what you actually do. All your answers are strictly confidential. Our results are reported as "60% of salmon fishermen are less than 30 years old", not as individual responses.

Thank you for your help!

How many years have you been salmon fishing? _____ years.

When did you last fish the Waimak? I last fished the Waimak during the 19___ season.

Please tick all the South Island salmon rivers where you have fished before. Circle the river you rish most frequently for salmon.

_____ Waiau	_____ Waimakariri	_____ Opihi
_____ Hurunui	_____ Ashburton	_____ Waitaki
_____ Ashley	_____ Rangitata	_____ Clutha
_____ Rakaia		

Which of the following best represents your feelings about salmon fishing?

If I couldn't go salmon fishing...

_____ I wouldn't miss it at all; other activities could easily be substituted.

_____ I would miss it some, but I could find other things to give me the same type of satisfaction.

_____ I would miss it a great deal; few other activities give me the same type of satisfaction.

_____ I would miss it more than anything else I do; for me there is no substitute for salmon fishing.

If you didn't go salmon fishing on the Waimak, where would you go instead for river (sea run) salmon fishing? South Island salmon rivers are listed below. Next to each one, indicate whether this river is an acceptable substitute for the Waimak for you, given the constraints (time, money, etc) you now have. If the river is not an acceptable substitute, please tick the reason(s) why not.

Rivers	Substitute for Waimak?		If not, why? (tick all that apply)					
			Drive takes too long	Too expensive	Too crowded	Scenery not as good	Fewer salmon	Poor fishing conditions
Waiau	Yes	No	____	____	____	____	____	____
Hurunui	Yes	No	____	____	____	____	____	____
Ashley	Yes	No	____	____	____	____	____	____
Rakaia	Yes	No	____	____	____	____	____	____
Ashburton	Yes	No	____	____	____	____	____	____
Rangitata	Yes	No	____	____	____	____	____	____
Opihi	Yes	No	____	____	____	____	____	____
Waitaki	Yes	No	____	____	____	____	____	____
Clutha	Yes	No	____	____	____	____	____	____

_____ For me there is no substitute for the Waimak.

From the above list, choose the one river that for you is the best substitute for the Waimak.

For me the _____ River is the best substitute for the Waimak.

How does this river compare to the Waimak? We would like to know how many days of salmon fishing on this other river it takes to give you the same enjoyment you get from one day on the Waimak.

To equal the enjoyment of one day on the Waimak, I would need (circle one)
(½ 1 1½ 2 3 4 5 6 more than 6) days on my substitute river.

On average, how many salmon fishing trips per season do you take to the Waimak? _____ trips per season.

For you, how long is an average fishing trip on the Waimak? (circle one)
(less than ½ ½ 1 1½ 2 more than 2) days.

On the average, how many salmon fishing trips per season do you take to your next-best substitute river? _____ trips per season.

For you, how long is an average fishing trip on your next-best substitute river? (circle one) (less than ½ ½ 1 1½ 2 more than 2) days.

If you didn't fish on the Waimak, how many trips would you actually take to your substitute river each season? I would take _____ trips per season.

If you didn't go sea-run salmon fishing at all, would another type of fishing give you the same type of satisfaction or benefit you now get from salmon fishing?

Fishing Activities	Substitute for sea-run salmon fishing?		Location where you would do this
Sea fishing	Yes	No	
Lake salmon fishing	Yes	No	
Trout fishing	Yes	No	
Flounder fishing	Yes	No	
Perch fishing	Yes	No	
Other (specify)	Yes	No	

_____ For me no other fishing is a substitute for salmon fishing

If you didn't go sea-run salmon fishing at all, would any non-fishing activities give you the same type of satisfaction or benefit you now get from salmon fishing?

Substitute non-fishing activities	Location where you would do this

_____ For me no non-fishing activity is a substitute for salmon fishing.

If you usually spend more than one day at the Waimak, where do you stay?

_____ don't usually stay overnight

_____ bach or hut

_____ motel or hotel

_____ caravan

_____ tent

In this section we would like to know how you feel about seeing other fishermen.

About how many salmon fishermen were within sight of the pool where you were fishing the last time you went salmon fishing on the Waimak?

There were about _____ other fishermen in sight of the pool where I was fishing.

About how close were the nearest fishermen on either side of you?

_____ shoulder to shoulder
_____ one rod length (3 metres)
_____ two to four rod lengths (6 to 12 metres)
_____ casting range (12 to 30 metres)

Did you feel the area where you were fishing was crowded?

1	2	3	4	5	6	7	8	9
not at all		slightly crowded			moderately crowded		extremely crowded	

What is the "right" number of fishermen to have within sight of the pool where you are fishing? Please indicate the highest number you will tolerate before the fishing experience becomes unpleasant.

O.K. to see as many as _____ other fishermen in sight of the pool where I am fishing.

_____ makes no difference to me.

Under normal salmon fishing conditions, what is the minimum distance you can tolerate between you and another fisherman.

_____ shoulder to shoulder
_____ one rod length (3 metres)
_____ two to four rod lengths (6 to 12 metres)
_____ casting range (12 to 30 metres)
_____ makes no difference to me.

How many fishermen would you prefer to see in the area where you are fishing?

I prefer to see _____ other fishermen.

In order to compare our results to those of other surveys, we need some background information. Your answers are strictly confidential.

How old are you? _____ years

What is your annual family income before taxes?

_____ less than $5,000	_____ $15,000 to 19,999	_____ $30,000 to 34,999
_____ $5,000 to 9,999	_____ $20,000 to 24,999	_____ $35,000 to 39,999
_____ $10,000 to 14,999	_____ $25,000 to 29,999	_____ over $40,000

About how many days per year do you have free for fishing? I have about _____ days per year available for fishing.

RAKAIA RIVER QUESTIONNAIRE

This questionnaire is short and won't take much of your time. Your opinions are important, so please answer each question. The best answer is the one that reflects your opinions or what you actually do. All your answers are strictly confidential. Our results are reported as "60% of salmon fishermen are less than 30 years old", not as individual responses.

Thank you for your help!

Dr Bo Shelby
Study Director
AERU, Lincoln College

How many years have you been salmon fishing? _____ years.

When did you last fish the Rakaia? I last fished the Rakaia during the 19___ season.

Please tick all the South Island salmon rivers where you have fished before. Circle the river you rish most frequently for salmon.

_____ Waiau	_____ Waimakariri	_____ Opihi
_____ Hurunui	_____ Ashburton	_____ Waitaki
_____ Ashley	_____ Rangitata	_____ Clutha
_____ Rakaia		

Which of the following best represents your feelings about salmon fishing?

If I couldn't go salmon fishing

_____ I wouldn't miss it at all; other activities could easily be substituted.
_____ I would miss it some, but I could find other things to give me the same type of satisfaction.
_____ I would miss it a great deal; few other activities give me the same type of satisfaction.
_____ I would miss it more than anything else I do; for me there is no substitute for salmon fishing.

If you didn't go salmon fishing on the Rakaia, where would you go instead for river (sea run) salmon fishing? South Island salmon rivers are listed below. Next to each one, indicate whether this river is an acceptable substitute for the Rakaia for you, given the constraints (time, money, etc) you now have. If the river is not an acceptable substitute, please tick the reason(s) why not.

Rivers	Substitute for Rakaia?		If not, why? (tick all that apply)					
			Drive takes too long	Too expensive	Too crowded	Scenery not as good	Fewer salmon	Poor fishing conditions
Waiau	Yes	No						
Hurunui	Yes	No						
Ashley	Yes	No						
Waimak	Yes	No						
Ashburton	Yes	No						
Rangitata	Yes	No						
Opihi	Yes	No						
Waitaki	Yes	No						
Clutha	Yes	No						

_____ For me there is no substitute for the Rakaia.

From the above list, choose the one river that for you is the best substitute for the Rakaia.

For me the _____ River is the best substitute for the Rakaia.

How does this river compare to the Rakaia? We would like to know how many days of salmon fishing on this other river it takes to give you the same enjoyment you get from one day on the Rakaia.

To equal the enjoyment of one day on the Rakaia, I would need (circle one)
(½ 1 1½ 2 3 4 5 6 more than 6) days on my substitute river.

On average, how many salmon fishing trips per season do you take to the Rakaia? _____ trips per season.

For you, how long is an average fishing trip on the Rakaia? (circle one)
(less than ½ ½ 1 1½ 2 more than 2) days.

On the average, how many salmon fishing trips per season do you take to your next-best substitute river? _____ trips per season.

For you, how long is an average fishing trip on your next-best substitute river? (circle one) (less than ½ ½ 1 1½ 2 more than 2) days.

If you didn't fish on the Rakaia, how many trips would you actually take to your substitute river each season? I would take _____ trips per season.

If you didn't go sea-run salmon fishing at all, would another type of fishing give you the same type of satisfaction or benefit you now get from salmon fishing?

Fishing Activities	Substitute for sea-run salmon fishing?		Location where you would do this
Sea fishing	Yes	No	
Lake salmon fishing	Yes	No	
Trout fishing	Yes	No	
Flounder fishing	Yes	No	
Perch fishing	Yes	No	
Other (specify	Yes	No	

_____ For me no other fishing is a substitute for salmon fishing

If you didn't go sea-run salmon fishing at all, would any non-fishing activities give you the same type of satisfaction or benefit you now get from salmon fishing?

Substitute non-fishing activities	Location where you would do this

_____ For me no non-fishing activity is a substitute for salmon fishing.

If you usually spend more than one day at the Rakaia, where do you stay?

_____ don't usually stay overnight

_____ bach or hut

_____ motel or hotel

_____ caravan

_____ tent

In this section we would like to know how you feel about seeing other fishermen.

About how many salmon fishermen were within sight of the pool where you were fishing the last time you went salmon fishing on the Rakaia?

There were about _____ other fishermen in sight of the pool where I was fishing.

About how close were the nearest fishermen on either side of you?

_____ shoulder to shoulder
_____ one rod length (3 metres)
_____ two to four rod lengths (6 to 12 metres)
_____ casting range (12 to 30 metres)

Did you feel the area where you were fishing was crowded?

1	2	3	4	5	6	7	8	9
not at all		slightly crowded			moderately crowded		extremely crowded	

What is the "right" number of fishermen to have within sight of the pool where you are fishing? Please indicate the highest number you will tolerate before the fishing experience becomes unpleasant.

O.K. to see as many as _____ other fishermen in sight of the pool where I am fishing.

_____ makes no difference to me.

Under normal salmon fishing conditions, what is the minimum distance you can tolerate between you and another fisherman.

_____ shoulder to shoulder
_____ one rod length (3 metres)
_____ two to four rod lengths (6 to 12 metres)
_____ casting range (12 to 30 metres)
_____ makes no difference to me.

How many fishermen would you prefer to see in the area where you are fishing?

I prefer to see _____ other fishermen.

In order to compare our results to those of other surveys, we need some background information. Your answers are strictly confidential.

How old are you? _____ years

What is your annual family income before taxes?

_____ less than $5,000	_____ $15,000 to 19,999	_____ $30,000 to 34,999
_____ $5,000 to 9,999	_____ $20,000 to 24,999	_____ $35,000 to 39,999
_____ $10,000 to 14,999	_____ $25,000 to 29,999	_____ over $40,000

About how many days per year do you have free for fishing? I have about _____ days per year available for fishing.

APPENDIX 2

Data Sheet Completed by Expert Anglers

FORM B

ANGLER ASSESSMENT SHEET

PLEASE PRINT

Anglers' Name _____

Date of Experiment _____

Angling Site I.D.	Fishability Rating	Comments or Notes	Carrying Capacity

APPENDIX 3

Comparison of Fishery and Fish Habitat

on the Rakaia and Waimakariri Rivers

The following information has kindly been provided by Dr G Glova, Fisheries Research Division, Ministry of Agriculture and Fisheries, Christchurch.

FISHES OF THE RAKAIA RIVER FROM GORGE TO RIVER MOUTH (APPROXIMATELY 60 KM)

			Approximate numbers x 10^6
(i)	Species truly resident for all or most of the year		
	* *Gobiomorphus cotidianus*	Common bully	0.30
	* *Anguilla dieffenbachii*	Longfinned eel	6.78
	+ *Salmo trutta*	Brown trout (juveniles)	4.50
	+ *Oncorhynchus tshawytscha*	Quinnat salmon (juveniles)	1.86
	* *Cheimarrichthys fosteri*	Torrentfish	2.94
	* *Gobiomorphus hubbsi*	Bluegilled bully	2.40
	Gobiomorphus breviceps	Upland bully	4.74
	* *Rhombosolea retiaria*	Black flounder	?
(ii)	Species reliant on the river for spawning only (spring)		
	* *Retropinna retropinna*	Common smelt	very high
	* *Stokellia anisodon*	Stokell's smelt	very high
(iii)	Species reliant on the river for passage only		
	* *Anguilla australis*	Shortfinned eel	low
	* *Geotria australis*	Lamprey	low
	* *Galaxias brevipinnis*	Koaro	moderate
(iv)	Other records (strays from their true habitats)		
	Galaxias vulgaris	Common river galaxias	low
	Galaxias paucispondylus	Alpine galaxias	low
	Galaxias prognathus	Longjawed galaxias	low
	+ *Perca fluviatilis*	Perch	low

* Migratory species

\+ Introduced species

Please note that the approximate numbers are based on estimates of weighted usable area per unit length of river. They represent the optimum number that the river can comfortably support in terms of available physical habitat.

FISHES OF THE WAIMAKARIRI RIVER FROM MAIN GORGE TO RIVER MOUTH (APPROXIMATELY 70 KM)

Species composition would be similar to that of the Rakaia. We are just beginning fisheries/hydrology studies in the Waimakariri and it will be at least a year from now before we fully know what species are present and how they make use of the river. For your purposes it should be safe to assume a similar species complex as in the Rakaia.

As yet, we do not have weighted usable area estimates of the potential physical habitat available for fish in selected reaches from main gorge to river mouth. Hence, I am not able to give you estimates of the numbers of fish present, although I suspect they would be similar to that of the Rakaia.

Diversity/Stability of Ecosystem

Downstream of the gorge, I consider physical and biological diversity of the Rakaia to be similar to that of the Waimakariri. On the other hand, stability in a physical sense may be slightly higher on the Waimakariri than on the Rakaia, because of its greater riparian cover (willows) on the islands and riverbanks.

Although we do not yet have the data for the Waimakariri system, I would summise that the frequency distribution of water velocity and water depth would be similar to the Rakaia. Dissolved oxygen levels, water temperature regimes and sediment loads would also be similar for these two rivers. About food resources and production (I presume you mean that of fish) I am reluctant to say as no data are available for the Waimakariri. The availability of cover for some species of fish appear to be slightly better in the Waimakariri than in the Rakaia because of the greater amounts of riparian growth on the islands and riverbanks.

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