

**BEFORE THE CANTERBURY REGIONAL COUNCIL**

**UNDER** the Environment Canterbury  
(Temporary Commissioners and  
Improved Water Management)  
Act 2010

**IN THE MATTER** of the proposed Hurunui and  
Waiau River Regional Plan

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**STATEMENT OF EVIDENCE OF MARTIN JOHN UNWIN  
ON BEHALF OF  
THE NORTH CANTERBURY FISH AND GAME COUNCIL  
October 2012**

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## 1. INTRODUCTION

### Qualifications and Experience

- 1.1 My name is Martin John Unwin. I hold the qualification of Master of Science in Physics (with Distinction) from the University of Canterbury. I am a member of the American Fisheries Society and the Gilbert Ichthyological Society, and have recently completed a five year term on the Editorial Advisory Board of the New Zealand Journal of Marine and Freshwater Research, published by the Royal Society of New Zealand.
- 1.2 I have been employed by the National Institute of Water and Atmospheric Research and its predecessor organisations for 34 years, and am currently a Senior Fisheries Scientist. My main research interest has been the biology of Chinook salmon in New Zealand waters, a topic on which I have published over thirty papers in thirteen peer-reviewed international scientific journals.
- 1.3 A strong secondary interest throughout my research career has been collecting and analysing data on usage of New Zealand's fishery resources by recreational anglers. I have helped design and analyse numerous surveys of recreational fisheries in both marine and freshwater environments, and have authored or co-authored over thirty reports on the results.
- 1.4 I have been engaged by North Canterbury Fish and Game Council (F&G) to prepare evidence in relation to the Hurunui and Waiiau River Regional Plan. I previously presented evidence at the Special Tribunal hearing in relation to a Water Conservation Order on the Hurunui River. I am well familiar with the Hurunui and Waiiau catchments through my professional interest in Chinook salmon biology and angling demographics; a lifelong association with the South Island high country; and recreational activities including tramping, white water kayaking, and mountain biking.

- 1.5 I confirm I have read and agree to apply with the Code of Conduct of Expert Witnesses (November 2011). This evidence is within my area of expertise, except where I state where I am relying on what I have been told by another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

### **Scope of Evidence**

- 1.6 The main purpose of my evidence is to characterise the angling values associated with the upper Hurunui and Waiau catchments, based on data from four national surveys conducted between 1980 and 2007. As background, I briefly review sample survey methods as they have been applied to freshwater fishing in New Zealand, describe those surveys with which I have been personally involved, and present the main findings as they relate to both catchments. I then use these results to compare each river with other New Zealand river fisheries of similar type, and hence to place them in a national context.
- 1.7 I conclude my evidence with a review of the Chinook salmon fishery in the lower reaches of the Hurunui River. Maintenance of the salmon fishery is dependent on spawning adults and their progeny having freedom to migrate between the river mouth and the headwater spawning grounds in accordance with the dictates of their life cycle. In this context I offer an opinion on the likely impact of a dam in the upper Hurunui River on the availability of salmon spawning habitat in the upper river, and the viability of the migratory salmon population.

## **2. SUMMARY**

- 2.1 Data collected via nationwide sample surveys of F&G fishing licence holders over a period of thirty years provide a robust and consistent basis for characterising the fishery values of the Hurunui and Waiau Rivers.

- 2.2 The upper Hurunui River sustains a highly valued back country trout fishery, allowing anglers to employ a diverse range of fishing methods in a remote and scenic landscape, frequently in association with other outdoor recreational activities such as camping, picnicking, and tramping.
- 2.3 Four upper Waiau River tributaries – the Hope River, Boyle River, Nina River, and Lewis River – sustain headwater trout fisheries with attributes typical of highly valued wilderness fisheries elsewhere in New Zealand. These fisheries are of regional or local significance.
- 2.4 Annual usage of the upper Hurunui River in 2007/08 was approximately  $5\,500 \pm 1\,000$  angler-days. This figure is high compared to other fisheries of similar type, only three of which - the upper Oreti, Tekapo, and Ahuriri Rivers – sustain equal or greater levels of annual usage.
- 2.5 Most anglers fishing the upper Hurunui River hold licences from the North Canterbury F&G region. Visitors from other regions and from overseas accounting for a relatively low proportion of total usage.
- 2.6 The upper Hurunui receives more visits from New Zealand resident anglers than any other back country fishery. This is in contrast to the upper Oreti, Tekapo, Ahuriri, and upper Buller Rivers, which derive 37% - 58% of their usage from overseas visitors.
- 2.7 More whole-season fishing licences are sold in North Canterbury than in any other New Zealand region, accounting for 16% - 20% of F&G sales. The corresponding figure for the whole of Canterbury, including the Central South Island F&G region, is 25% - 32%.
- 2.8 The Hurunui River sustains a regionally significant salmon fishery, and the Waiau River sustains a locally significant salmon fishery.

Maintenance of both fisheries is dependent on adult and juvenile salmon having unimpeded passage to and from the headwater spawning waters.

- 2.9 A dam on the Hurunui South Branch would result in almost certain loss of salmon spawning habitat in the upper South Branch.

### 3. ANGLING SAMPLE SURVEYS

- 3.1 Any person wishing to fish for salmon and trout in waters managed by F&G must purchase a fishing licence at least annually from one of the twelve F&G regions. Because of this requirement, fishing licence databases are an essential tool for F&G managers seeking to collect information on usage of the angling resource, and are particularly suited to sample surveys. Briefly, sample surveys involve selecting a random sample of licence holders and administering a questionnaire to collect the information of interest. Subject to the assumption that the information so obtained is not significantly influenced either by licence holders who cannot be contacted (non-response bias), or who cannot accurately remember details such as when and where they fished (recall bias), the sample results can be extrapolated to give a result applicable to all licence holders.
- 3.2 For the purposes of this hearing I provide an overview of four national sample surveys, undertaken on behalf of F&G, with which I have been personally involved (via design, analysis, or both) over the last 30 years. These took place in 1979/1981, 1994/95, 2001/02, and 2007/08 (Teirney *et al.* 1987, Teirney *et al.* 1982, Unwin 2009, Unwin & Brown 1998, Unwin & Image 2003). In addition, the Hurunui fishery was the subject of three surveys of North Canterbury anglers conducted annually from 1980 to 1982 (Bonnett *et al.* 1991). Where relevant, my evidence also draws on these surveys.
- 3.3 My evidence focuses on the findings of these surveys and their relevance to the Hurunui and Waiau Rivers, with minimal reference to

the details of the survey methodology. Full descriptions and results for all surveys are publicly available via the reports listed in the bibliography.

#### 4. THE 1979/81 NATIONAL ANGLING SURVEY

4.1 The 1979/81 National Angling Survey was developed in response to the requirements of the 1981 Amendment to the Water and Soil Conservation Act. This Amendment provided a new legislative mechanism (WCOs) for recognising and protecting rivers of national importance, and created a need for consistent and objective data on angler usage of New Zealand river fisheries (National Water and Soil Conservation Organisation 1982, Teirney *et al.* 1982).

4.2 With the benefit of 30 years of hindsight, I see the main legacy of the 1978/79 survey as its role in developing a consistent scheme for characterising individual river fisheries (Teirney *et al.* 1982). Under this scheme, river fisheries fall into one of three broad groupings, defined as recreational (or lowland) fisheries; scenic (or back country) fisheries; and wilderness (or headwater) fisheries (Table 1). These categories encapsulate the transition from highly accessible and heavily used fisheries close to population centres (e.g., Mataura, Rakaia, Motueka), to remote headwater fisheries in pristine wilderness environments (e.g., Caples, Greenstone, Sabine).

4.3 A word on terminology may be helpful to the Commission at this point. Terms such as “lowland river”, “back country fishery”, “wilderness fishery”, “headwater fishery”, and “trophy fishery” have been used freely by a number of authors over many years and have the potential to cause confusion. The important point is that all such terms attempt to characterise individual fisheries along a continuous spectrum, ranging from lowland rivers in highly developed catchments to pristine rivers in remote mountain valleys. It is this spectrum which is important, rather than any arbitrary breakpoints between different river types.

## 5. THE 1994/96, 2001/02, AND 2007/08 NATIONAL ANGLING SURVEYS

### Background

- 5.1 The objective of the 1994/96 - 2007/08 surveys was to obtain consistent estimates of annual usage (during a single October to September angling season) for all waters managed by F&G. The 1994/95 and 2001/02 surveys were limited to New Zealand resident licence holders, who were interviewed by telephone. The 2007/08 survey also included overseas visitors, who were contacted by email drawn from random samples of the ~40% of visitors who provided a usable email address. Total usage estimates for the 1994/95 and 2001/02 surveys are thus slightly conservative relative to those for the 2007/08 survey.
- 5.2 The basic measure of angling effort provided by the surveys is the angler-day, defined as one angler fishing on one day irrespective of the number of hours spent fishing. By summing results across all regions, the survey provides usage estimates for essentially all New Zealand angling waters. Standard errors for most waters are relatively broad (typically  $\pm 20\%$  -  $50\%$ ) but are to be interpreted in the context of usage estimates ranging from well over 10,000 for the most heavily fished waters (e.g., Waimakariri, Maitauro) to single figures for the most remote headwater streams. For example, estimated annual usage of the Rakaia, Ashley, and Halswell Rivers in 2007/08 was  $53,200 \pm 4,400$ ,  $5,400 \pm 2,000$ , and  $460 \pm 180$  angler days, respectively. These standard errors represent relative uncertainties of 8%, 37%, and 39%, respectively, but do not prevent us inferring with confidence that the Rakaia receives about 10 times as much effort as the Ashley, and that the Ashley receives about 10 times as much effort as the Halswell.

- 5.3 For the 2001/02 and 2007/08 surveys, I used National Census data to estimate per capita sales of whole-season fishing licences for each F&G region, on the assumption that 90% of anglers are male (c.f. Teirney et al. 1982). The 2001/02 data include licence sales for the Taupo Conservancy, which is administered by the Department of Conservation (and so lies outside F&G's jurisdiction), and are therefore fully representative of all freshwater angling by New Zealand residents. The 2007/08 data do not include licence sales for the Taupo Conservancy, and are therefore conservative with respect to the number of anglers in the upper North Island.

## 6. SURVEY FINDINGS

### 1979/81 Survey: Hurunui River

- 6.1 The Hurunui River featured prominently in the 1979/81 survey, and was discussed extensively in two reports of which I was a co-author (Teirney *et al.* 1987, Teirney *et al.* 1982). Key findings were:
- a. North Canterbury anglers expended between 15 800 and 23 700 angler-days per year on the Hurunui River;
  - b. The Hurunui River was highly valued for both trout and salmon fishing, with respondents dividing their effort more or less evenly between the two fisheries;
  - c. The trout fishery was primarily confined to the middle and upper reaches of the river, corresponding to the sections from SH 7 to Mandamus, and Mandamus to the headwaters, respectively;
  - d. The upper reaches were highly rated for “scenic beauty” and “feelings of peace and solitude”, both of which were considered exceptional by over 80% of respondents (Table 2).
  - e. Other notable characteristics of the Hurunui trout fishery were the diversity of angling methods it sustained (dry fly, wet fly, spinner, nymph), and the extent to which angling was associated with other recreational activities such as camping, picnicking, swimming, tramping, and shooting (Table 2).

- 6.2 Our 1982 report considered that "... the upper Hurunui has all the attributes of a nationally important river fishery" (Teirney *et al.* 1982). In particular, we noted that its usage (approximately 5000 visits annually from trout anglers) was high given its remote location and limited vehicle access. The salmon fishery in the lower reaches also contributed to the high importance attached to the river as a whole, but was secondary to the headwater trout fishery.
- 6.3 These conclusions were reinforced in our 1987 report (Teirney *et al.* 1987), which focussed specifically on the North Canterbury region and included additional data which were unavailable when the 1982 report was published. These data, based on the 1982 survey referred to in paragraph 3.2 above (Bonnett *et al.* 1991), included a more detailed analysis of the longitudinal distribution of angling effort along the Hurunui River than was possible with the National Angling Survey.
- 6.4 Respondents to the 1982 survey were asked to identify which of seven reaches they fished, including four above the Mandamus confluence. Analysis of these responses showed that:
- a. The reach from Mandamus to the South Branch received relatively little effort (less than ~5% of total effort, including both salmon and trout angling), but accounted for about 10% of the trout caught;
  - b. The South Branch was the least fished of all seven reaches on the river, accounting for less than 5% of total effort;
  - c. The North Branch, (i.e., the Hurunui main stem above the South Branch confluence), including Lake Sumner and the headwaters above the lake, accounted for ~25% of the total effort and about 60% of the trout catch. Effort and catch were evenly divided between the reach below the lake, and the lake and its headwaters.

- 6.5 One of the considerations which led us to rank the Hurunui River as nationally important was the number of anglers it attracted from outside the North Canterbury region. On re-analysing these data for the purposes of this hearing, it appears that 75% (15 out of 20) of these visitors fished only for salmon, or for both salmon and trout. Only 25% of visitors (5 out of 20), all of whom were from the upper South Island (Marlborough and the West Coast), fished solely for trout. I will discuss the significance of this result in relation to my current assessment of the upper Hurunui fishery later in this evidence.

#### **1979/81 Survey: Waiau River**

- 6.6 The Waiau is the northernmost river which sustains an established salmon fishery, and was identified as regionally important in the 1979/81 survey (Teirney *et al.* 1982). The lower and middle reaches of the mainstem support good, but not exceptional, angling for salmon and trout (Table 3), with estimated annual usage (approximately 6 500 angler-days) well below that of the Hurunui. Most (69 out of 73) respondents who fished the Waiau were from the upper South Island, consistent with its regionally important classification.
- 6.7 The most highly valued trout fisheries within the Waiau catchment were associated with the upper mainstem and headwater tributaries, particularly the Hope, Boyle, Nina, and Lewis Rivers. Collectively, these four tributaries support typical wilderness/headwater fisheries, characterised by high ratings for their scenic and wilderness qualities, limited access, and large fish (Table 4). The most popular lures were dry fly, nymph, and wet fly on the Hope and Boyle Rivers, and nymphs and dry flies on the smaller Lewis and Nina Rivers. However, only 2 of the 47 respondents who fished these rivers came from outside the Canterbury region, suggesting that – at least as of c. 1980 – they were of regional or local rather than national value.
- 6.8 Four other Waiau tributaries were fished by at least one respondent, but did not attract enough effort to merit detailed consideration in the

1979/81 survey report. These were the Mason River (4 respondents); the Hanmer River (6 respondents); and the Percival and Doubtful Rivers (1 respondent each).

#### **1994/96 - 2007/08 Surveys: Hurunui River**

- 6.9 The Hurunui catchment has consistently been the third most heavily fished catchment in the North Canterbury region (Table 5), well behind the Waimakariri and Rakaia catchments but well ahead of the next three (Waiau, Ashley, and Selwyn/Ellesmere). Total angling effort in 2001/02 was markedly lower than in either 1994/95 and 2007/08, reflecting the unusually poor salmon fishing season in 2002 (Unwin 2009, Unwin & Brown 1998, Unwin & Image 2003).
- 6.10 Usage of the Hurunui River main stem has varied almost two-fold over the period of record, from 17,100 angler days in 1994/95 to 8,380 angler days in 2001/02. Usage in 2007/08 was intermediate between these two extremes. The main stem accounted for 90% of the effort expended within the Hurunui catchment in 1994/95, 82% in 2001/02, and 66% in 2007/08. The relatively low figure for 2007/08 reflects an increase in the total effort expended elsewhere in the catchment (see paragraph 6.12), but it is unclear whether this reflects an on-going trend or is merely due to annual variability.
- 6.11 The 2001/02 and 2007/08 surveys treated the Hurunui main stem as two sections, corresponding to the reaches above and below the Mandamus confluence (referred to here as the upper and lower reaches, respectively). Based on the 72% of responses for which this information was available, the upper reaches attracted 40% of the effort expended on the Hurunui River in 2001/02, and 44% in 2007/08. Almost all of effort spent on the Hurunui River (100% and 98% in 2001/02 and 2007/08, respectively) was recorded over the eight months from October to May.

- 6.12 The Hurunui catchment sustains eight recognised river and lake fisheries other than the Hurunui mainstem, all but one of which (the Waitohi River) lie upstream of the Mandamus confluence (Table 6). Collectively, these waters accounted for an estimated 1 860, 1 830, and 6 370 angler-days over the three surveys, over 99% of which was associated with Lake Sumner and its immediate neighbours (Lakes Taylor, Sheppard, Mason, and Loch Katrine). Lakes Taylor and Sumner were by far the most popular of these fisheries, jointly attracting over 5 000 angler-days in 2007/08. All five lakes experienced a substantial increase in usage from 2001/02 to 2007/08.
- 6.13 The North Canterbury region accounted for 87% of the effort expended on the Hurunui River in 2007/08, with anglers from other New Zealand regions accounting for 9% of the total and overseas visitors accounting for the remaining 4% (Table 7). The spatial distribution of effort for visiting anglers is partly confounded by effort for which the angling location is undefined, but the available data suggest that most of this effort is expended in the upper reaches. Of the effort which can be assigned to a specific reach, visiting anglers accounted for 21% of the effort on the upper reaches, compared to 2.5% on the lower reaches.

#### **1994/96 - 2007/08 Surveys: Waiau River**

- 6.14 The Waiau catchment currently (2007/08) ranks as the fourth most heavily fished catchment in the North Canterbury region, although given the broad confidence intervals for estimated annual usage it is perhaps more prudently ranked as fourth equal with the Ashley (Table 8). Its popularity appears to have increased since 1994/95, when it was a clear sixth after the Selwyn and Ashley (Table 8).
- 6.15 The Waiau main stem accounted for 49% of effort within the Waiau catchment in 1994/95, and 69% in 2001/02 and 2007/08 (Table 8). Most of the remaining effort was expended on the four headwater trout fisheries identified in the 1979/81 survey, i.e., the Hope, Boyle, Nina,

and Lewis Rivers. Collectively these four rivers accounted for 49% of the catchment total in 1984/85, 22% in 2001/02, and 25% in 2007/08. These figures are subject to considerable uncertainty, but all three surveys suggest that the Hope River and Boyle River attract rather more effort than either the Nina River or the Lewis River, consistent with the findings of the 1979/81 survey.

- 6.16 The North Canterbury region accounted for 81% of the effort expended on these five rivers in 2007/08, with anglers from other New Zealand regions accounting for 10% of the total and overseas visitors for 9% (Table 9). New Zealand resident anglers from other regions tended to fish the Waiau mainstem, which accounted for 77% of visitor effort. Half of this total (220 out of 440 angler-days) was due to anglers from the Nelson/Marlborough region, for whom the Waiau River provides the closest fishery for sea-run salmon. By contrast, overseas visitors were primarily attracted to the headwater tributaries, accounting for 76% of the estimated 2007/08 total for these rivers.

### **Licence Sales and Angling Demographics**

- 6.17 Analysis of licence sales in relation to Census data shows marked variation in the popularity of freshwater angling throughout New Zealand, and highlights four distinct regional trends (Table 10). Specifically:
- a. Angling is significantly more popular in the South Island than in the North Island (participation rate 8.6% - 10.8% vs. 1.9% - 2.5%);
  - b. Participation rates for the most urbanised regions (Auckland 1.0% - 1.4%, Wellington 1.7% - 2.7%) are among the lowest in the country;
  - c. Participation rates tend to increase from north to south, particularly in the South Island;
  - d. More F&G whole-season licences are sold in North Canterbury than in any other region.

- 6.18 The North Canterbury region accounted for 16% of whole season licences sold in 2001/02, and 20% of those sold in 2007/08. Including the Central South Island region, Canterbury accounted for 25.5% of sales in 2001/02, and 32.0% in 2007/08.
- 6.19 Per capita licence sales in North Canterbury (5.8% - 6.6%) are higher than for any North Island F&G region, but low compared to most other South Island regions. This is consistent with the trend towards decreasing per capita sales in the more urban areas, and reflects the relatively low per capita rate for residents of Christchurch city. The corresponding figure for rural North Canterbury residents north of the Waimakariri River (i.e., Waimakariri and Hurunui Districts) was 9.4% (1 797 licences among 19 200 adult males). This is close to one out of every ten adult males, and is more consistent with the exceptionally high per capita rates in the lower South Island.
- 6.20 National variation in per capita sales of fishing licences can be partly attributed to climatic and geographic influences, in that trout (and salmon) are essentially cool temperate species. However, I believe the observed trends also reflects the general tendency for angling to become less viable as a recreational activity as land use patterns change from extensive to intensive, and urbanisation increases. The current level of angling activity in North Canterbury can thus be interpreted as representing an intermediate state between the more highly urbanised areas of the North Island, and the more rural areas of the lower South Island.

## **7. NATIONAL CONTEXT**

### **Hurunui River**

- 7.1 The upper Hurunui River is one of 263 recognised back country fisheries under F&G's jurisdiction. Such fisheries are typically in upland regions characterised by extensive rather than intensive land

use, and are remote from major population centres although still accessible by road (c.f. Table 1). The most highly valued back country fisheries typically attract around 5 000 angler-days per year, in contrast to mainstem and lowland fisheries (some of which attract well over 10 000 angler-days), and headwater fisheries (which rarely attract more than 1 000 angler-days).

- 7.2 A total of six back country river fisheries attracted more than 4 000 angler-days in 2007/08: the upper Oreti, upper Hurunui, upper Taieri, Ahuriri, Tekapo, and Waikaia (Table 11)<sup>1</sup>. Two of these rivers (the Ahuriri and upper Oreti) are subject to WCOs. I have also tabulated usage estimates for the upper Buller River. Estimated usage of the Buller River by New Zealand resident anglers in 2007/08 (2 640 angler-days) was low compared to previous seasons (5 060 and 4 310 angler-days in 1994/95 and 2001/02, respectively), but as a back country fishery covered by a WCO the upper Buller River provides a further basis for comparison.
- 7.3 Adjusted 2007/08 usage estimates for the top six rivers listed in Table 11 range from 6 790 angler-days for the upper Oreti River to 4 460 for the Tekapo River. Given the broad standard errors associated with these estimates, a prudent interpretation is that the upper Oreti is the most heavily fished back country river in New Zealand, followed by the upper Hurunui and then the four remaining rivers (Ahuriri, upper Taieri, Waikaia, and Tekapo). Alternatively, the upper Hurunui could equally well be grouped with these four rivers, with only the upper Oreti likely to be clearly ahead of the field. By comparison, usage of the upper Buller River was well below the top six.
- 7.4 As noted in paragraph 4.3, the definition of a back country fishery is partly subjective. Of the six rivers discussed above, I consider the upper Oreti, upper Hurunui, Ahuriri, and Tekapo to be closest to the notional prototype of a backcountry fishery. All four rivers flow through

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<sup>1</sup> Usage estimates for the upper reaches of some rivers have been adjusted to allow for respondents who did not specify where they had fished (see Appendix 1).

intermontane valleys in the foothills of the Southern Alps, with land use limited to extensive high country grazing. By contrast, the catchments of the upper Taieri and Waikaia are more varied, with some pastoral farming towards the downstream end of each river.

- 7.5 Overseas angler effort in North Canterbury is low relative to other South Island F&G regions (Table 12). Overseas visitors show a strong preference for headwater and back country river fisheries, and appear to follow a well-established circuit which takes in central Nelson and the northern West Coast, Southland, Otago, and the McKenzie Country (Figure 1). In this context, overseas angler usage of the upper Hurunui River (3.6% - 8.3% of total effort) appears to have been well above the North Canterbury average (2.3%). Within the North Canterbury region only the Rakaia River attracted more overseas visitors than the Hurunui River.
- 7.6 In terms of this metric the upper Hurunui River lies well behind the upper Buller, upper Oreti, Ahuriri, and Tekapo Rivers, which derive at least 37% of their usage from overseas visitors. The converse of this is that annual effort on the upper Hurunui River by New Zealand residents ( $5\,200 \pm 1\,080$  angler-days) is at least equal to (and possibly exceeds) that for any other back country fishery (upper Oreti River:  $4\,290 \pm 1\,030$  angler-days; upper Taieri River:  $4\,100 \pm 1\,290$  angler-days).
- 7.7 In a national context the upper Hurunui River fishery thus represents something of a paradox. On one hand, it is one of the most heavily fished back country river fisheries in New Zealand, and may well be the top ranked such river in terms of usage by New Zealand residents. It provides an easy day outing from Christchurch, the dominant population centre in a region which sells more whole-season fishing licences than any other F&G region, and is highly rated for its scenic and wilderness qualities. However, it receives considerably less attention from overseas visitors than other fisheries of similar type, three of which (Buller, upper Oreti, Ahuriri) are currently protected by

WCOs. A possible explanation is that the upper Hurunui is further removed from the main State Highway network, and less well serviced by nearby tourist infrastructure, than is the case for the Buller (St. Arnaud, Murchison), Ahuriri (Omarama, Twizel), and Oreti (Mossburn, Te Anau).

### **Waiau River**

- 7.8 The most striking features of the Waiau catchment are the distinctive character of its headwater trout fisheries (paragraph 6.7), and the relatively high proportion of the effort on these rivers which derives from overseas visitors. The Waiau headwaters above the Hope River confluence are adjacent to the Buller and upper Grey catchments, one of the main centres of angling activity for overseas visitors, and appear to form an outlying part of this cluster. However, overseas visitor usage was relatively low in a national context, consistent with my earlier assessment of these fisheries as of regional or local rather than national value.

## **8. THE HURUNUI AND WAIU SALMON FISHERIES**

### **Biology and Spawning Areas**

- 8.1 Chinook salmon are a migratory species, spending most of their lives at sea before returning to fresh water to spawn. In the Hurunui and Waiau Rivers, as in all New Zealand populations, maturing adults migrate upstream during summer and early autumn, with peak spawning from late April to mid-May. Juveniles hatch during spring and typically spend three months rearing in fresh water before migrating seawards, although in some populations a significant proportion of juveniles remain resident in fresh water for a year before they migrate. The relative proportion of these two life history variants in the Hurunui and Waiau Rivers is unknown.

- 8.2 The distribution of Chinook salmon spawning sites in New Zealand reflects their tendency to be highly selective in their choice of spawning habitat. All sites used by Chinook salmon are also used by brown trout, but – whereas brown trout are ubiquitous – Chinook are restricted to a few well defined and generally localised sites. In 2006 I prepared a report for Environment Canterbury in which I reviewed an earlier inventory of salmonid spawning sites in the Canterbury Region, and re-evaluated all sites with respect to their importance for Chinook salmon (Unwin 2006).
- 8.3 For the Hurunui River my review identified three sites of regional importance: Landslip Stream, a North Branch tributary above Lake Sumner; Homestead Stream, a South Branch tributary; and the South Branch above the North Esk confluence (Figure 2). The main stem of the Hurunui North Branch above Lake Sumner was identified as locally important. The lower rating for the Hurunui North Branch reflected the relative usage of the two main branches by spawning fish, with the South Branch generally accounting for a higher and more consistent proportion of the total than the North Branch.
- 8.4 For the Waiau River my review identified three sites of local importance, all in the upper 30 km of the headwaters above the Henry River confluence (Figure 2). These sites were the middle reaches of the Henry River; the Waiau mainstem above the Ada River confluence; and a small marginal stream opposite the stream draining Lake Guyon, and known locally as Matagouri Point Stream. Their assessment as locally important reflects the relatively low value of the Waiau River for salmon angling.

### **Salmon Angling**

- 8.5 New Zealand's Chinook salmon fishery is essentially contained within the Canterbury province, from the Waiau River in the north to the Waitaki River in the south (Deans *et al.* 2004). Within this region the fishery is dominated by four rivers (Waimakariri, Rakaia, Rangitata,

and Waitaki), which collectively account for 17% - 26% of all river angling in New Zealand. All four rivers sustain annual spawning runs which generally number in the thousands and may exceed ten thousand fish; and attract at least ten thousand angler-days per year, distributed throughout the length of the river. For these reasons, all four are considered nationally significant (Teirney *et al.* 1982, Unwin 2006).

- 8.6 The Hurunui River sustains the most heavily used salmon fishery in Canterbury after the four nationally important rivers (Unwin 2006), and the fishery has been ranked as regionally significant in all surveys which have been conducted over the last thirty years (Bonnett *et al.* 1991, Teirney *et al.* 1987, Teirney *et al.* 1982). Regionally significant salmon fisheries are characterised by annual spawning runs which generally number a few thousands but rarely if ever exceed ten thousand; angling effort is usually between two and ten thousand angler-days per year, with salmon angling predominantly confined to the river mouth and lower reaches; and are mostly fished by anglers travelling within their home F&G region (Unwin 2006). Salmon anglers show a strong preference for the lower and middle reaches of the Hurunui River (Teirney *et al.* 1987), with few salmon caught upstream of Mandamus (Bonnett *et al.* 1991).
- 8.7 The level of effort devoted to the Waiau River salmon fishery is unknown, but – on the assumption that the total effort is evenly divided between salmon and trout angling – is unlikely to exceed 1,000 - 2,000 angler-days per year (c.f. Table 8). This level of usage, together with the local origin (North Canterbury or Nelson/Marlborough) of most New Zealand resident anglers, suggests that the Waiau Salmon fishery is of regional importance.

### **Effects of a Dam on the Upper Hurunui River**

- 8.8 The Hurunui salmon fishery depends on both adult and juvenile salmon having unrestricted passage between the river mouth and the

headwater spawning tributaries, and on retention of adequate spawning and juvenile rearing habitat. Any modification of the upper river involving dams, weirs, impoundments, or diversions, would be disruptive to the salmon fishery, via impacts such as barriers to upstream migration, loss of spawning or rearing habitat, and entrainment of downstream migrating fry.

- 8.9 In the two instances where dams have been constructed on New Zealand rivers sustaining major salmon fisheries, the Waitaki River (in 1935) and the Clutha River (in 1956), the impact on salmon runs has been severe (e.g., McDowall 1994). On the Waitaki River, salmon were subsequently able to find suitable spawning gravels in the mainstem below the dam, but total run strength was greatly reduced. A widely quoted pre-1935 run total of 100,000 fish is almost certainly apocryphal, but there is little doubt that runs fell from several tens of thousands to the current status quo of up to 10 000 fish (Deans *et al.* 2004). Spawning habitat in the lower Clutha River is much more restricted, and present day runs are little more than a relic of pre-1956 levels.
- 8.10 I would expect a dam on the Hurunui South Branch to be equally detrimental to salmon spawning runs. For the purposes of this hearing I assume that such a dam would form an impassable barrier to upstream adult salmon passage. It is possible, albeit at a cost, to construct bypass facilities (such as fish ladders) to facilitate upstream passage. However, New Zealand has little experience with such structures at barriers of a scale commensurate with a dam on the South Branch. In the sole case where a fish ladder of comparable scale was installed, on the Waitaki Dam, it was a complete failure.
- 8.11 The highly localised distribution of spawning areas in the upper Hurunui River suggests that fish encountering a barrier on the South Branch would be unlikely to find other spawning habitats which their species has not already encountered. New Zealand's Chinook salmon stocks have shown considerable local adaptation to New Zealand

habitats in the c. 100 years since their introduction, and appear to have located and populated all suitable habitats within a few decades (e.g., Quinn *et al.* 2001, Unwin *et al.* 2003). Indeed, this is a basic consequence of Darwinian natural selection: the progeny of adults which spawn in the most suitable habitats will survive to perpetuate successive generations, whereas adults which spawn in unsuitable areas will leave few descendants.

8.12 It is possible that the flow regime in the South Branch immediately below a dam may be sufficiently stable as to provide viable spawning gravels in areas that do not currently provide such habitat. However, this remains a matter of conjecture. Past experience – both in New Zealand and overseas – tends to suggest otherwise. For this reason I believe that, with respect to salmon spawning habitat, the most likely consequence of a dam on the Hurunui South Branch would be a reduction in the availability of spawning area in direct proportion to the current ratio of spawning habitat in the South Branch relative to the total upper Hurunui catchment.

8.13 A weir or similar control structure on the outlet of Lake Sumner would have little if any impact on downstream migration, but would potentially represent a significant obstacle to upstream migration depending on its height, and the strength of the resulting velocity barrier. Incorporating a fish pass into such a weir would be more tractable than for a higher structure such as a dam, but – as noted in paragraph 8.10 – New Zealand experience with bypass technology has not been encouraging.

## 9. **CONCLUSION**

9.1 Data collected via nationwide sample surveys of F&G fishing licence holders over a period of thirty years provide a robust and consistent basis for characterising the fishery values of the Hurunui and Waiau Rivers.

- 9.2 The upper Hurunui River sustains a highly valued back country trout fishery, allowing anglers to employ a diverse range of fishing methods in a remote and scenic landscape, frequently in association with other outdoor recreational activities such as camping, picnicking, and tramping.
- 9.3 Four upper Waiau River tributaries – the Hope River, Boyle River, Nina River, and Lewis River – sustain headwater trout fisheries with attributes typical of highly valued wilderness fisheries elsewhere in New Zealand. These fisheries are of regional or local significance.
- 9.4 Annual usage of the upper Hurunui River in 2007/08 was approximately  $5\,500 \pm 1\,000$  angler-days. This figure is high compared to other fisheries of similar type, only three of which - the upper Oreti, Tekapo, and Ahuriri Rivers – sustain equal or greater levels of annual usage.
- 9.5 Most anglers fishing the upper Hurunui River hold licences from the North Canterbury F&G region. Visitors from other regions and from overseas accounting for a relatively low proportion of total usage.
- 9.6 The upper Hurunui receives more visits from New Zealand resident anglers than any other back country fishery. This is in contrast to the upper Oreti, Tekapo, Ahuriri, and upper Buller Rivers, which derive 37% - 58% of their usage from overseas visitors.
- 9.7 More whole-season fishing licences are sold in North Canterbury than in any other New Zealand region, accounting for 16% - 20% of F&G sales. The corresponding figure for the whole of Canterbury, including the Central South Island F&G region, is 25% - 32%.
- 9.8 The Hurunui River sustains a regionally significant salmon fishery, and the Waiau River sustains a locally significant salmon fishery. Maintenance of both fisheries is dependent on adult and juvenile

salmon having unimpeded passage to and from the headwater spawning waters.

- 9.9 A dam on the Hurunui South Branch would result in almost certain loss of salmon spawning habitat in the upper South Branch.

**Martin Unwin**

**12 October 2012**

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**Table 1.** Criteria used to classify river fisheries by fishery type.

<b>Attribute</b>	<b>Type of fishery</b>		
	<b>Recreational / lowland</b>	<b>Scenic / back country</b>	<b>Wilderness / headwater</b>
<b>Location</b>	May be close to population centres	Usually remote from population centres	Remote from population centres
<b>Access</b>	Easily accessible by road	Accessible by road	Not accessible by road
<b>Level of usage</b>	Attract large numbers of anglers	May attract large numbers of anglers	Not fished by large numbers of anglers
<b>Distribution of anglers</b>	Attract visiting anglers from well beyond the local area	May attract visiting anglers from well beyond the local area	May attract visiting anglers from well beyond the local area
<b>Area of fishable water</b>	Extensive	Extensive	Extensive
<b>Scenic beauty and solitude</b>	Not necessarily high	Usually high	Exceptional
<b>Catch rates</b>	High	Intermediate	Relatively high
<b>Size of fish</b>	May be relatively small	Variable	Large
<b>Preferred angling methods</b>	Spinning	Spinning and artificial flies	Artificial flies
<b>Main associated activities</b>	Picnicking	Camping, picnicking	Camping, tramping, shooting
<b>Modifications to catchment</b>	May be relatively major	No major modifications	Minor or absent

**Table 2.** Attributes of the Hurunui River trout fishery as characterised by the 1979/81 National Angling Survey. For the eight fishery attributes, each entry shows the number of respondents who assigned ratings of 1, 2, 3, 4, or 5. For fishing methods and other activities associated with angling, the table shows the number of respondents, out of a maximum of 59, specifying each listed item.

<b>Fishery attribute</b>	<b>Rating (1 = low, 5 = high)</b>					<b>Total replies</b>
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	
Close to home (5 = close)	28	14	7	3	3	55
Ease of access	11	16	11	6	12	56
Area of fishable water	1	6	13	17	21	58
Scenic beauty	1	4	6	14	33	58
Peace and solitude	2	2	3	11	39	57
Catch rate	6	7	20	13	10	56
Size of fish	3	13	15	13	6	50
Overall importance	1	1	13	11	31	57

<b>Fishing method(s) used</b>	<b>Dry fly</b>	<b>Wet fly</b>	<b>Spinner</b>	<b>Nymph</b>	<b>Bait</b>
	31	19	27	23	2

#### **Other activities**

<b>Camping</b>	<b>Picnicing</b>	<b>Shooting</b>	<b>Tramping</b>	<b>Swimming</b>	<b>Canoeing</b>	<b>Rafting</b>
28	17	17	16	13	5	3

**Table 3.** Attributes of the Waiau River trout fishery as characterised by the 1979/81 National Angling Survey. For the eight fishery attributes, each entry shows the number of respondents who assigned ratings of 1, 2, 3, 4, or 5. For fishing methods and other activities associated with angling, the table shows the number of respondents, out of a maximum of 42, specifying each listed item.

<b>Fishery attribute</b>	<b>Rating (1 = low, 5 = high)</b>					<b>Total replies</b>
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	
Close to home (5 = close)	15	9	5	3	5	37
Ease of access	6	9	9	10	6	40
Area of fishable water	1	5	10	12	12	40
Scenic beauty	2	7	14	9	8	40
Peace and solitude	2	4	7	18	9	40
Catch rate	5	14	13	4	3	39
Size of fish	1	7	12	12	2	34
Overall importance	3	3	16	11	9	42

<b>Fishing method(s) used</b>	<b>Dry fly</b>	<b>Wet fly</b>	<b>Spinner</b>	<b>Nymph</b>	<b>Bait</b>
	20	11	24	14	0

#### **Other activities**

<b>Camping</b>	<b>Picnicing</b>	<b>Shooting</b>	<b>Tramping</b>	<b>Swimming</b>	<b>Canoeing</b>	<b>Rafting</b>
12	14	6	7	3		1

**Table 4.** Attributes of the Hope, Boyle, Lewis, and Nina River trout fisheries (summed over all four rivers) as characterised by the 1979/81 National Angling Survey. For the eight fishery attributes, each entry shows the number of respondents who assigned ratings of 1, 2, 3, 4, or 5. For fishing methods and other activities associated with angling, the table shows the number of respondents, out of a maximum of 107, specifying each listed item.

Fishery attribute	Rating (1 = low, 5 = high)					Total replies
	1	2	3	4	5	
Close to home (5 = close)	46	16	11	17	3	93
Ease of access	13	18	42	14	13	100
Area of fishable water	2	19	33	27	20	101
Scenic beauty		6	9	42	47	104
Peace and solitude	1	5	15	22	64	107
Catch rate	25	28	30	12	11	106
Size of fish	8	25	19	31	13	96
Overall importance	7	11	27	34	28	107

Fishing method(s) used	Dry fly	Wet fly	Spinner	Nymph	Bait
	65	34	21	66	6

#### Other activities

Camping	Picnicing	Shooting	Tramping	Swimming	Canoeing	Rafting
28	29	19	20	8	1	3

**Table 5.** Estimated annual usage of North Canterbury lake and river fisheries by catchment (angler-days  $\pm$  1 standard error), 1994/95 to 2007/08. Overseas anglers were not surveyed in 1994/95 and 2001/02, so usage estimates for these two surveys are likely to be slightly conservative.

Catchment	1994/95	% of total	2001/02	% of total	2007/08	% of total
Waimakariri	74 620 $\pm$ 7 600	44.8%	58 570 $\pm$ 4 360	49.7%	86 930 $\pm$ 6 250	43.6%
Rakaia	47 840 $\pm$ 4 200	28.7%	36 920 $\pm$ 2 300	31.3%	76 050 $\pm$ 4 880	38.2%
<b>Hurunui</b>	<b>18 960 <math>\pm</math> 3 360</b>	<b>11.4%</b>	<b>10 210 <math>\pm</math> 1 040</b>	<b>8.7%</b>	<b>18 970 <math>\pm</math> 2 020</b>	<b>9.5%</b>
<b>Waiau</b>	<b>2 920 <math>\pm</math> 730</b>	<b>1.8%</b>	<b>3 080 <math>\pm</math> 450</b>	<b>2.6%</b>	<b>6 300 <math>\pm</math> 1 100</b>	<b>3.2%</b>
Ashley	4 740 $\pm$ 1 060	2.8%	3 850 $\pm$ 720	3.3%	5 650 $\pm$ 2 020	2.8%
Selwyn/ Ellesmere	13 740 $\pm$ 2 110	8.2%	4 160 $\pm$ 680	3.5%	4 230 $\pm$ 930	2.1%
Other	3 860 $\pm$ 1 300	2.3%	1 140 $\pm$ 310	1.0%	1 100 $\pm$ 390	0.6%
<b>Total</b>	<b>166 690 <math>\pm</math> 9 720</b>		<b>117 930 <math>\pm</math> 5 170</b>		<b>199 230 <math>\pm</math> 8 560</b>	

**Table 6.** Estimated annual usage (angler-days  $\pm$  1 standard error), 1994/95 to 2007/08, for all river and lake fisheries within the Hurunui River catchment.

<b>River/Lake</b>	<b>Reach</b>	<b>1994/95</b>	<b>2001/02</b>	<b>2007/08</b>
Hurunui River	Above Mandamus	no data	2 910 $\pm$ 350	4 400 $\pm$ 800
	Below Mandamus	no data	4 370 $\pm$ 850	5 660 $\pm$ 950
	Undefined	17 100 $\pm$ 3 330	1 100 $\pm$ 370	2 530 $\pm$ 730
<i>Hurunui River Total</i>		<i>17 100 <math>\pm</math> 3 330</i>	<i>8 380 <math>\pm</math> 990</i>	<i>12 600 <math>\pm</math> 1 440</i>
Lake Taylor		750 $\pm$ 250	970 $\pm$ 220	3 320 $\pm$ 1 280
Lake Sumner		390 $\pm$ 170	520 $\pm$ 210	1 910 $\pm$ 520
Lake Mason		300 $\pm$ 300	20 $\pm$ 20	380 $\pm$ 150
Loch Katrine		190 $\pm$ 130	200 $\pm$ 70	260 $\pm$ 140
Lake Sheppard		230 $\pm$ 120	120 $\pm$ 50	240 $\pm$ 100
Waitohi River		0	0	220 $\pm$ 190
Mandamus River		0	0	30 $\pm$ 30
Sisters Sream		0	0	30 $\pm$ 30
<b>Total, Hurunui catchment</b>		<b>18 960 <math>\pm</math> 3 360</b>	<b>10 210 <math>\pm</math> 1 040</b>	<b>18 970 <math>\pm</math> 2 020</b>

**Table 7.** Distribution of fishing effort on the Hurunui River (angler-days  $\pm$  1 SE) in 2007/2008 by angler origin.

<b>Angler origin</b>	<b>Above Mandamus</b>	<b>Below Mandamus</b>	<b>Undefined</b>	<b>Total, all reaches</b>
North Canterbury	3 630 $\pm$ 690	5 530 $\pm$ 940	1 800 $\pm$ 690	10 960 $\pm$ 1 360
Central South Island	450 $\pm$ 390	20 $\pm$ 20	130 $\pm$ 90	600 $\pm$ 400
Otago	80 $\pm$ 80	60 $\pm$ 60	150 $\pm$ 150	290 $\pm$ 180
Wellington	60 $\pm$ 40		120 $\pm$ 60	180 $\pm$ 70
West Coast	20 $\pm$ 20	60 $\pm$ 30		70 $\pm$ 40
Nelson/Marlborough			20 $\pm$ 20	20 $\pm$ 20
Northland			10 $\pm$ 10	10 $\pm$ 10
Overseas	160 $\pm$ 100		310 $\pm$ 140	470 $\pm$ 170
<b>Total</b>	<b>4 400 <math>\pm</math> 800</b>	<b>5 660 <math>\pm</math> 950</b>	<b>2 530 <math>\pm</math> 730</b>	<b>12 600 <math>\pm</math> 1 440</b>

**Table 8.** Estimated annual usage (angler-days  $\pm$  1 standard error), 1994/95 to 2007/08, for all river and lake fisheries within the Waiau River catchment.

<b>River/Lake</b>	<b>1994/95</b>	<b>2001/02</b>	<b>2007/08</b>
Waiau River	1 440 $\pm$ 490	2 130 $\pm$ 420	4 340 $\pm$ 1 020
Hope River	510 $\pm$ 300	340 $\pm$ 110	940 $\pm$ 330
Boyle River	390 $\pm$ 270	200 $\pm$ 80	400 $\pm$ 170
Nina River	260 $\pm$ 260	40 $\pm$ 20	200 $\pm$ 120
Doubtful River		50 $\pm$ 40	170 $\pm$ 120
Doubtless River			110 $\pm$ 110
Lewis River	270 $\pm$ 260	110 $\pm$ 50	50 $\pm$ 30
Hanmer River	20 $\pm$ 20	30 $\pm$ 30	30 $\pm$ 30
Ada River	20 $\pm$ 20		30 $\pm$ 30
Henry River			30 $\pm$ 30
Mason River		30 $\pm$ 30	
Lake Guyon		160 $\pm$ 80	
<b>Total</b>	<b>2 920 <math>\pm</math> 730</b>	<b>3 080 <math>\pm</math> 450</b>	<b>6 300 <math>\pm</math> 1 100</b>

**Table 9.** Distribution of fishing effort on the Waiau, Hope, Boyle, Nina, and Lewis Rivers (angler-days  $\pm$  1 SE) in 2007/2008 by angler origin.

<b>Angler origin</b>	<b>Waiau River</b>		<b>Hope River</b>		<b>Boyle River</b>		<b>Nina River</b>		<b>Lewis River</b>		<b>Total</b>	
Hawkes Bay	10 $\pm$	10									10 $\pm$	10
Nelson/ Marlborough	220 $\pm$	110			10 $\pm$	10					230 $\pm$	110
West Coast	60 $\pm$	50	30 $\pm$	30							90 $\pm$	60
North Canterbury	3 760 $\pm$	990	580 $\pm$	300	280 $\pm$	160	180 $\pm$	120	20 $\pm$	20	4 820 $\pm$	1 060
Central South Island	60 $\pm$	50			30 $\pm$	30					90 $\pm$	60
Otago	90 $\pm$	90	60 $\pm$	60							150 $\pm$	110
Overseas	130 $\pm$	140	270 $\pm$	130	80 $\pm$	50	30 $\pm$	30	30 $\pm$	30	540 $\pm$	200
<b>Total</b>	<b>4 340 <math>\pm</math></b>	<b>1 020</b>	<b>940 <math>\pm</math></b>	<b>330</b>	<b>400 <math>\pm</math></b>	<b>170</b>	<b>200 <math>\pm</math></b>	<b>120</b>	<b>50 <math>\pm</math></b>	<b>30</b>	<b>5 940 <math>\pm</math></b>	<b>1 090</b>

**Table 10:** Sales of FGZ whole-season fishing licences for the 2001/02 and 2007/08 angling seasons, in relation to population figures from the 2001 and 2006 Census, by FGZ Region. Successive columns for each region show the adult male population, the number of licences bought by residents of each region, and the percentage of adult males holding a licence. The 2007/08 figures do not include licences sold by the Taupo Conservancy, and therefore underestimate participation rates in the central North Island.

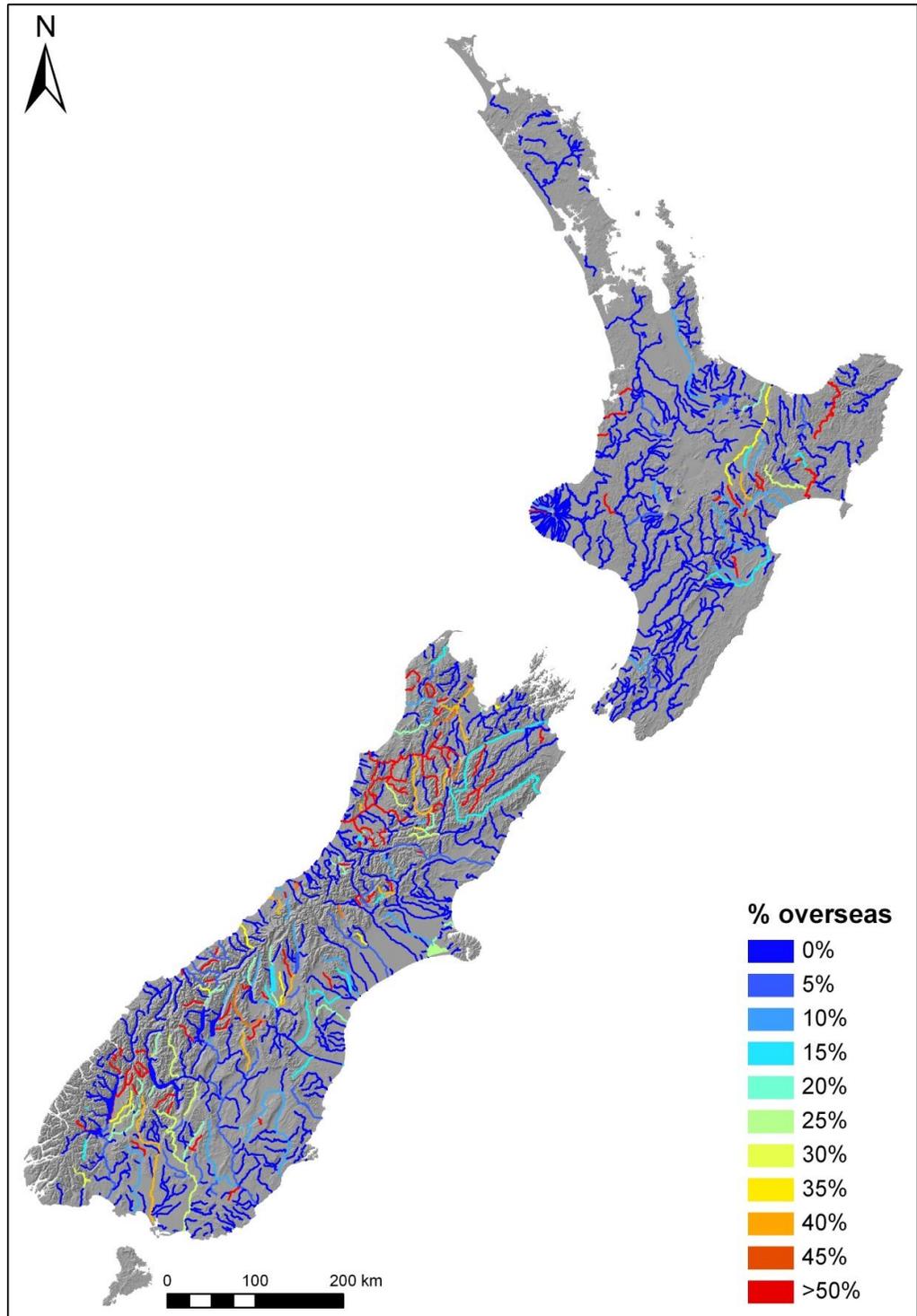
Region	2001/02			2007/08		
	Number of adult males	Number of licences	% of males with licence	Number of adult males	Number of licences	% of males with licence
Northland	46 000	216	0.4%	51 900	269	0.5%
Auckland/Waikato	495 600	7 558	1.4%	583 000	6 327	1.0%
Eastern	95 600	5 808	5.5%	105 300	6 652	5.7%
Taupo Conservancy	10 700	2 711	22.8%	11 700	421	3.2%
Taranaki	48 300	1 406	2.6%	53 200	853	1.4%
Hawkes Bay	43 700	2 440	5.0%	48 100	1 981	3.7%
Wellington	197 600	5 936	2.7%	219 700	4 039	1.7%
<b>Total, North Island</b>	<b>937 500</b>	<b>26 075</b>	<b>2.5%</b>	<b>1 073 100</b>	<b>20 542</b>	<b>1.9%</b>
Nelson/Marlborough	43 900	2 010	4.1%	49 600	2 275	4.1%
West Coast	10 900	921	7.6%	11 900	1 361	10.3%
North Canterbury	138 200	8 868	5.8%	158 700	11 685	6.6%
Central South Island	34 700	5 520	14.3%	37 100	7 159	17.4%
Otago	56 400	7 430	11.9%	66 100	9 982	13.6%
Southland	31 300	5 475	15.8%	33 200	5 961	16.2%
<b>Total, South Island</b>	<b>315 300</b>	<b>30 224</b>	<b>8.6%</b>	<b>356 500</b>	<b>38 423</b>	<b>10.8%</b>
<b>Total, New Zealand</b>	<b>1 252 900</b>	<b>56 299</b>	<b>4.0%</b>	<b>1 429 600</b>	<b>58 965</b>	<b>4.1%</b>

**Table 11.** Estimated annual usage (angler-days  $\pm$  1 standard error) in 2007/08, by angler origin (New Zealand resident vs. overseas visitor) for the six most heavily used back country river fisheries in New Zealand, and the upper Buller River. Estimates for the upper Hurunui, Oreti, Taieri, and Buller Rivers were derived as described in Appendix 1.

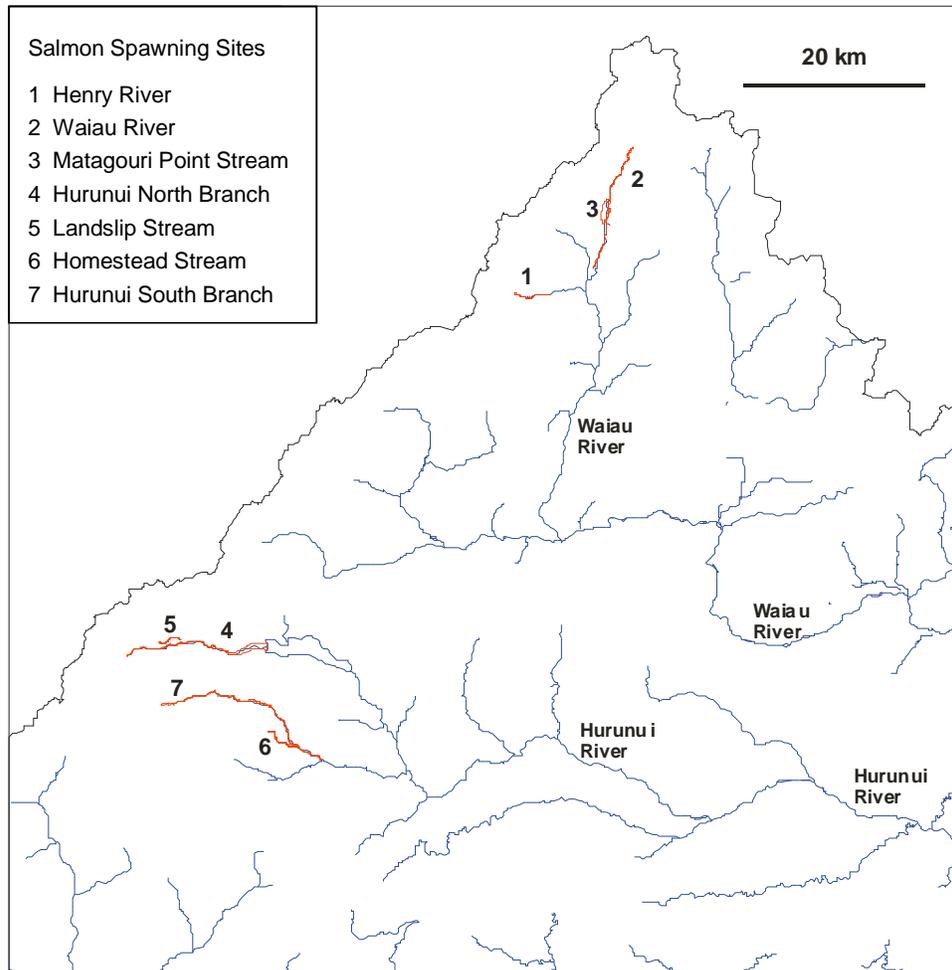
<b>River</b>	<b>All anglers</b>	<b>NZ resident</b>	<b>Overseas</b>	<b>% overseas</b>
Oreti River (upper)	6 790 $\pm$ 1 270	4 290 $\pm$ 1 030	2 500 $\pm$ 740	36.8%
Hurunui River (upper)	5 670 $\pm$ 1 090	5 200 $\pm$ 1 080	470 $\pm$ 170	8.3%
Ahuriri River	4 890 $\pm$ 720	2 730 $\pm$ 600	2 160 $\pm$ 410	44.2%
Taieri River (upper)	4 590 $\pm$ 1 320	4 100 $\pm$ 1 290	490 $\pm$ 310	10.7%
Waikaia River	4 460 $\pm$ 790	3 540 $\pm$ 760	920 $\pm$ 240	20.6%
Tekapo River	4 460 $\pm$ 590	2 800 $\pm$ 430	1 660 $\pm$ 400	37.2%
Buller River (upper)	1 470 $\pm$ 300	608 $\pm$ 130	860 $\pm$ 270	58.6%

**Table 12.** Distribution of estimated angling effort (thousands of angler-days  $\pm$  1 SE) in 2007/2008 by fishing region and angler origin (New Zealand resident vs. overseas visitor). Percentages in the first three columns show the effort expended in each region as a percentage of the national total; thus New Zealand residents expended 11.3% of their effort in the Southland region, whereas overseas visitors expended 25.3% of their effort in this region. The final column shows the effort expended by overseas visitors in each region as a percentage of the total effort in that region; thus overseas visitors accounted for 11.4% of the effort expended within the Southland region.

Region	Total	NZ resident	Overseas visitor	% o'seas
Northland	4.0 $\pm$ 0.6 ( 0.3%)	3.7 $\pm$ 0.5 ( 0.3%)	0.0 $\pm$ 0.0 ( 0.0%)	0.0%
Auckland/Waikato	30.7 $\pm$ 2.4 ( 2.4%)	29.8 $\pm$ 2.4 ( 2.5%)	0.9 $\pm$ 0.2 ( 1.3%)	2.9%
Eastern	215.6 $\pm$ 8.6 (17.0%)	209.5 $\pm$ 8.5 (17.4%)	6.1 $\pm$ 0.9 ( 8.9%)	2.8%
Taranaki	16.9 $\pm$ 1.6 ( 1.3%)	14.9 $\pm$ 1.3 ( 1.4%)	0.5 $\pm$ 0.2 ( 0.8%)	3.2%
Hawkes Bay	36.1 $\pm$ 2.6 ( 2.8%)	32.5 $\pm$ 2.4 ( 2.7%)	3.6 $\pm$ 0.9 ( 5.2%)	10.0%
Wellington	45.1 $\pm$ 2.6 ( 3.5%)	44.4 $\pm$ 2.6 ( 3.7%)	0.7 $\pm$ 0.2 ( 0.9%)	1.4%
Nelson/Marlborough	41.1 $\pm$ 2.1 ( 3.2%)	34.4 $\pm$ 2.0 ( 2.9%)	6.6 $\pm$ 0.7 ( 9.6%)	16.1%
West Coast	51.3 $\pm$ 2.4 ( 4.0%)	44.5 $\pm$ 2.3 ( 3.6%)	8.2 $\pm$ 0.8 (11.9%)	16.0%
North Canterbury	200.1 $\pm$ 8.6 (15.7%)	195.4 $\pm$ 8.6 (16.3%)	4.6 $\pm$ 0.6 ( 6.7%)	2.3%
Central South Island	251.4 $\pm$ 9.0 (19.8%)	240.7 $\pm$ 8.9 (20.1%)	10.8 $\pm$ 0.9 (15.6%)	4.3%
Otago	224.9 $\pm$ 9.4 (17.7%)	215.4 $\pm$ 9.4 (17.9%)	9.5 $\pm$ 0.9 (13.8%)	4.2%
Southland	153.7 $\pm$ 6.2 (12.1%)	136.3 $\pm$ 5.9 (11.3%)	17.4 $\pm$ 1.8 (25.3%)	11.4%
<b>Total</b>	<b>1 271.4 <math>\pm</math> 19.7</b>	<b>1 202.4 <math>\pm</math> 19.5</b>	<b>69.0 <math>\pm</math> 2.8</b>	<b>5.4%</b>



**Figure 1:** Estimated usage of New Zealand lakes and rivers by overseas visitors in 2007/08, with rivers and lake polygons coloured according to the percentage of total usage contributed by overseas licence holders.



**Figure 2:** Significant Chinook salmon spawning sites in the upper Hurunui and Waiau catchments (source: Unwin 2006).