

BEFORE THE MINISTER FOR THE ENVIRONMENT SPECIAL TRIBUNAL

IN THE MATTER of an Application by New Zealand and Otago
Fish & Game Council for an Amendment to the
Kawarau Water Conservation Order

**STATEMENT OF EVIDENCE ON BEHALF OF NEW ZEALAND AND OTAGO FISH &
GAME COUNCIL**
Dated this 6th day of March 2008

Introduction

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.
2. I have been employed by the National Institute of Water and Atmospheric Research and its predecessor organisations for 32 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.
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.
4. I have been engaged by Fish & Game New Zealand (FGNZ) to assist with their submission regarding their application for a Water Conservation Order (WCO) on the Hurunui River. I am well familiar with the Hurunui River and its environs 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.

5. I confirm I have read and agree to apply with the Code of Conduct of Expert Witnesses (July 2006). 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

6. I begin my evidence with a brief review of the Chinook salmon fishery in the lower reaches of the river. Although this hearing is primarily concerned with the upper reaches of the river above Mandamus (which I will refer to as the “upper Hurunui River” throughout), 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.
7. The bulk of my evidence focuses on angler usage and evaluation of the upper Hurunui River, as quantified by various sample surveys with which I have been involved over the last thirty years. I will briefly review the methodology underpinning these surveys, and present the findings as they relate to the Hurunui River. I will then use these results to compare the upper Hurunui River with other New Zealand river fisheries of similar type, and hence to place it in a national context.

THE HURUNUI SALMON FISHERY

8. New Zealand's Chinook salmon fishery essentially coincides with 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).
9. 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 FGNZ 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).

10. Chinook salmon are a migratory species, spending most of their lives at sea before returning to fresh water to spawn. In the Hurunui River, 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 emerge from the gravel nest (or *redd*) 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 River is unknown.
11. In 2006 I prepared a report for Environment Canterbury (ECan) 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). My review identified three sites of regional importance (Landslip Stream, Homestead Stream, and the South Branch above the North Esk confluence), and one of local importance (the main stem of the Hurunui North Branch above Lake Sumner; Figure 1). 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.
12. The salmon fishery in the lower reaches of the Hurunui River therefore 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 potentially 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.

ANGLING SAMPLE SURVEYS

13. Fishing licence databases are an important tool for FGZ managers seeking to collect information on usage of the angling resource, and are particularly suited to sample surveys. Any person wishing to fish for salmon and trout in waters managed by FGZ must purchase a fishing licence at least annually from one of the twelve FGZ Regions. Licences are freely interchangeable between Regions, so that an angler may live in one Region, purchase a licence from a second Region, and fish in a third.
14. FGZ manages all freshwater fishing in New Zealand with the sole exception of the Lake Taupo catchment, which is administered by the Department of Conservation (DoC) and requires anglers to purchase a licence specifically for the Taupo region.

FGNZ licence records thus provide a complete census of anglers fishing anywhere in New Zealand except Lake Taupo and its tributaries.

15. A sample survey involves selecting a random sample of licence holders, representing a known percentage (e.g., 5%) of total sales, and administering a questionnaire to collect the information of interest. Questionnaires may be administered by post, telephone, or (most recently) email, depending on the target group and the type of information required. 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), results for the anglers in the sample can then be extrapolated to give a result applicable to the full population of licence holders.
16. This methodology has been used to collect angling usage data, in one form or another, since the late 1940s. For the purposes of this hearing I provide an overview of four national sample surveys, undertaken on behalf of FGNZ, 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. The last of these was completed in October 2008 and is currently being analysed, with a final report due in mid 2009. The 1994/95, 2001/02, and 2007/08 surveys represent the first three of what FGNZ hopes to continue as a series, at intervals of 6-7 years, with essentially the same objectives and format.
17. In addition, the Hurunui fishery was the subject of three surveys of North Canterbury anglers conducted annually from 1980 to 1982. These surveys provide more detailed information than do any of the national surveys, but do not provide (and were not intended to provide) comparative information on the Hurunui relative to other New Zealand river fisheries. Where relevant, my evidence also draws on these surveys.
18. My evidence focuses on the findings of these surveys and their relevance to the Hurunui River, with minimal reference to the details of the survey methodology. The methodology for all surveys is well documented, and is publicly available via the reports listed in the bibliography.

THE 1979/81 NATIONAL ANGLING SURVEY

Background

19. 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 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).

20. The survey was implemented via questionnaires issued to a random sample of fishing licence holders throughout New Zealand. Respondents were asked to identify which rivers they had fished, to rate the importance of each river on a 1-5 scale, and to provide similar 1-5 ratings for qualitative attributes such as ease of access, area of fishable water, and size of fish. A total of 4 692 replies were received, providing 20 800 assessments of 817 river fisheries (Teirney & Richardson 1992, Teirney et al. 1982).
21. River fisheries were assessed as nationally, regionally, or locally important, based on their mean importance rating, the total number of respondents who had fished (as a surrogate for total usage), and the extent to which anglers were attracted from elsewhere in New Zealand. Rivers identified as nationally important fell on a spectrum representing a balance between usage and importance, with less heavily fished rivers being assessed as outstanding only if their importance ratings were exceptionally high.
22. To facilitate characterisation of individual river fisheries, the spectrum described in the preceding paragraph was sub-divided into three categories, defined as recreational fisheries, scenic fisheries, and wilderness fisheries (Table 1). These categories encapsulate the transition from highly accessible and heavily used fisheries close to population centres (e.g., Maitai, Rakaia, Motueka), to remote headwater fisheries in pristine wilderness environments (e.g., Caples, Greenstone, Sabine).
23. With the benefit of nearly thirty years of hindsight, I consider this classification scheme to be the main legacy of the 1978/79 survey. It has provided (and continues to provide) a sound conceptual basis for comparing the relative value of river fisheries with widely differing levels of annual usage, from up to 50 000 angler days on heavily used rivers such as the Maitai to less than 500 angler days on the most remote Headwater fisheries.

The Hurunui River

24. The Hurunui River featured prominently in the 1978/79 survey, and was discussed extensively in two reports of which I was a co-author. These were a 1982 report prepared as a submission on the former National Water and Soil Conservation Authority's draft inventory of wild and scenic rivers of national importance (Teirney et al. 1982), and a 1987 report focussing on the North Canterbury region (Teirney et al. 1987). Key findings were:

- North Canterbury anglers expended between 15 800 and 23 700 angler-days per year on the Hurunui River;
 - 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;
 - 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;
 - 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).
 - 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).
25. On the basis of these characteristics, 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.
26. 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 17 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.
27. Respondents to the 1982 survey were asked to identify which of seven marked reaches they fished, four of which were above the Mandamus confluence. Analysis of these responses showed that:
- The reach from Mandamus to the South Branch received relatively little effort (less than ~5%, including both salmon and trout angling), but accounted for about 10% of the trout caught;
 - The South Branch was the least fished of all seven reaches on the river, accounting for less than 5% of total effort;

- The North Branch, 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.

28. 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) fished solely for trout, all of whom were from the upper South Island (Marlborough and the West Coast). I will discuss the significance of this result in relation to my current assessment of the upper Hurunui fishery later in this evidence.

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

Background

29. 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 FGNZ. This contrasts with the 1979/81 survey, which emphasised qualitative rather than quantitative aspects of each river fishery. Detailed results from the 1994/95 and 2001/02 have been published in two reports for FGNZ (Unwin & Brown 1998, Unwin & Image 2003). At the time of writing (March 2009), the 2007/08 survey is in progress, with the final report likely to be available within the next two months. This section of my evidence draws on results from all three surveys, with the caveat that results from the 2007/08 survey are preliminary.

30. In each survey, the 12 month angling season was divided into six two-monthly segments, with respondents being contacted at the end of each period. This interval was chosen based on previous FGNZ studies, which indicated that recall bias became significant only after a recall period of three months or more. Respondents were asked whether or not they had fished over the previous two months, and – if so – which rivers and lakes they had fished, and the number of days they had spent on each. Surveys were conducted simultaneously in all twelve FGNZ Regions¹, and the data for all Regions pooled into a single national database.

31. Sample sizes for these surveys were extremely large for a random sample survey, reflecting the need to collect information on rivers which may be fished by only a few individuals out of a total survey population of up to 100 000. For example, the 2007/08

¹ With the exception of the Otago Region in the 1994/96 survey, which was surveyed one year after the other eleven regions.

survey recorded the fishing activity of 11 803 out of 65 025 whole-season licence holders, representing 18.2% of the total.

32. 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, over the full 12 month angling season, 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 which vary by a factor of more than ten thousand between the most heavily fished waters (e.g., Mataura, Rakaia) to single figures for the most remote headwater streams.
33. During analysis of the 1994/96 survey we developed an alternative model for classifying river fisheries, based on their physical attributes and catchment land use rather than the angler-oriented attributes associated with the 1979/81 survey (Unwin & Brown 1998). River types included lowland fisheries (e.g. smaller coastal streams or mainstem tributaries such as the Waihou, Ashley, and Pomahaka, wholly or partly flowing through areas of intensive land use); back country fisheries (upland tributaries characterised by extensive rather than intensive land use, e.g. the Maruia, Ahururi, and Manuherikia); and headwater fisheries (remote rivers with limited access in lightly modified or unmodified catchments, such as the Karamea, Dingle, and Clinton). Large mainstem river fisheries (e.g. Manawatu, Motueka, Mataura) were grouped separately.
34. This model parallels the 1979/81 original, with close relationships between the “scenic” (1979/81) and “back country” (1994/96) categories, and the “wilderness” (1979/81) and “headwater” (1994/96) categories, but provides additional guidance when considering individual river fisheries as part of a broader spectrum. The Hurunui River above Mandamus was classified as a back country fishery, although the upper reaches above Lake Sumner (where 4WD access becomes increasingly limited) could equally well be classified as a headwater fishery.
35. The 1994/95 and 2001/02 surveys were limited to licence holders who were New Zealand residents. Overseas visitors account for about 8% of whole-season licence sales and about 25% of part-season licence sales, so usage estimates for these two surveys are conservative. To address this problem, overseas anglers were included in the 2007/08 survey by using email as the method of contact. Overseas visitors who purchased a whole-season licences and provided a valid email address were sampled at six monthly intervals, in April and November 2008, yielding response rates of 68% (172 of 253) and 47% (132 out of 278), respectively. Visitors holding a part-season licence were surveyed at the end of the 2007/08 season, yielding a response rate of 29% (79 of 272). In practice, overseas visitors were most active during the first six

months of the angling season (October 2007 to March 2008), and results for this period appear to be robust.

Licence sales and angling demographics

36. For the 2001/02 and 2007/08 surveys we used Census data from 2001 and 2006, respectively, to estimate fishing licence sales per capita for each FGZ region. To facilitate these calculations we restricted our analysis to whole season licences (which account for over 85% of the total effort), and assumed that 90% of anglers are male (based on data from previous surveys including the 1979/81 National Angling Survey). Our 2001/02 analysis include licence data for the Taupo Conservancy (provided by DoC), thus providing a complete listing of all New Zealand resident anglers who purchased a whole season licence in 2001/02. The 2007/08 data were based on FGZ licences only, and are therefore conservative with respect to the total number of anglers.
37. This analysis highlights the extent to which the popularity of angling varies throughout New Zealand (Table 3), and suggests several distinct regional trends. First, angling is at least three times more popular in the South Island than in the North Island (2001/02 participation rate 8.6% vs. 2.5%). Second, participation rates for the most urbanised Regions (Auckland 1.0% - 1.4%, Wellington 1.7% - 2.7%) are among the lowest in the country. Third, with the exception of the Taupo Conservancy (essentially the combined population of Taupo and Turangi, but probably inflated by holiday home owners from Auckland and Wellington), participation rates tend to increase from north to south. Fourth, more FGZ whole-season licences are sold in North Canterbury than in any other region, which accounts for 19.8% (i.e., one out of every five) of total sales. Including the Central South Island region, Canterbury accounts for just under one third (32%) of total FGZ sales.
38. Per capita licence sales in North Canterbury (5.8% - 6.6%) are higher than for any North Island FGZ region, but are 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 2007.08 figure (11 685 licences per 90% of 158 700 adults; 6.2%) is below that for more southern regions such as Central South Island, Otago and Southland (13.6% - 17.4%), although considerably higher than for Auckland and Wellington combined (10 366 licences; 802 700 adults; 1.4%). By contrast, the corresponding figure for North Canterbury residents living 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 elsewhere in the rural South.

39. Part of the tendency for per capita sales of fishing licences to be highest in the rural South Island can be attributed solely to climatic and geographic influences, in that trout (and salmon) are essentially cool temperate species. However, I believe that this trend 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.

Angling in North Canterbury

40. Total annual angling effort in the North Canterbury region is strongly influenced by the strength of the Chinook salmon fishery, making the region one of the most volatile in the country in terms of annual variability (Table 4). This total (in angler-days per year) was 166 690 in 1994/95, 117 930 in 2001/02, and 200 050 in 2007/08, corresponding to salmon runs generally regarded as good, poor, and very good, respectively. River fisheries account for 82%-88% of the effort, with the remaining 12%-18% expended on lakes.

41. The fishery is dominated by the Waimakariri and Rakaia Rivers, which have collectively accounted for 56% - 64% of the total effort over the three surveys to date. The Hurunui River and Lake Coleridge are the third and fourth most popular, well behind the two main salmon rivers but well ahead of the next two rivers (Ashley and Waiau) in terms of total usage (Table 4).

THE HURUNUI RIVER

Estimated Angler Usage

42. Beginning with the 2001/02 survey, the Hurunui River has been divided into two reaches for the purposes of recording angler activity, corresponding to the reaches above and below the Mandamus confluence (referred to here as the upper and lower reaches, respectively). Telephone interviewers were asked to prompt respondents who fished the Hurunui River to indicate which reaches they had fished, and the name of days spent on each reach (Unwin & Image 2003).

43. In practice, some interviewers – particularly those assigned to regions other than North Canterbury – remembered to do this, resulting in some loss of reach-specific data. Of 166 respondents who fished the Hurunui River, 120 (72%) provided these data, whereas the remaining 46 (28%) did not. For tabulation purposes, the reach preference for these responses is listed as “undefined”. For the sake of simplicity I have ignored this distinction in the next few paragraphs, but will return to it when comparing the upper Hurunui with other New Zealand rivers in paragraph 52.

44. The upper reaches attracted $2\,910 \pm 350$ angler-days in 2001/02, and $4\,400 \pm 800$ angler-days in 2007/08. Making the conservative assumption that all of the undefined effort occurred below Mandamus, these figures can be interpreted as minimum estimates of total annual effort in the upper reaches.
45. Almost all of this effort (100% and 98% in 2001/02 and 2007/08, respectively) was recorded over the eight months from October to May. Averaged over these two seasons, 77% of this effort was recorded between 1 December and 31 March, i.e., during summer and early autumn.
46. 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 5). 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.
47. The absence of any records for the Hurunui South Branch in Table 5 contrasts with results from the 1981/82 survey of North Canterbury anglers, which indicated that 3% of the total annual effort on the Hurunui River (i.e., 3% of 23 700, or ~700 angler-days) was expended on the South Branch (Bonnett et al. 1991). A possible reason for this discrepancy is that upper Hurunui anglers who responded to the 2001/02 and 2007/08 surveys did not differentiate between the two branches of the Hurunui River during their telephone interview. Neither the North Branch nor the South Branch was nominated by any of the 63 respondents who fished above Mandamus, even though much of this activity must have occurred on the North Branch either above or below Lake Sumner. For this reason, the 2001/02 and 2007/08 usage estimates should be construed only as measures for the upper Hurunui River as a whole, rather than indicating the distribution of effort between the North and South Branch.

Origin of Hurunui Anglers

48. A second metric of the significance or value of an individual fishery is its propensity to attract anglers from outside the local area, including overseas visitors. Other things being equal, a fishery which is used by anglers from throughout New Zealand is likely to have a higher intrinsic value than a fishery which sustains similar levels of effort but is used only by local anglers (Teirney et al. 1982).
49. The Hurunui River attracted relatively little effort from New Zealand resident licence holders from outside the North Canterbury region, but visitors who nominated a particular reach showed a strong preference for the upper reaches (Table 6). For the

2007/08 season, 17.5% of the effort recorded on the upper reaches (770 out of 4 400 angler-days) was expended by visitors, compared to 2.3% (130 out of 5 660 angler-days) on the lower reaches. A further 740 angler-days were expended by visitors who did not specify which reach they visited.

50. Overseas visitors expended an estimated 470 ± 170 angler-days on the Hurunui River (Table 6), representing 3.7% of the total for the whole river. In addition, overseas visitors expended a further 160 ± 70 days elsewhere in the upper Hurunui catchment, primarily on Lakes Taylor and Sheppard.

NATIONAL CONTEXT

51. The upper Hurunui River is one of 263 recognised back country fisheries under FGNZ's jurisdiction. Such fisheries, as noted in paragraphs 33 and 34, 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. 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).
52. 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 7). 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 ($2\ 640 \pm 390$ angler-days) was low compared to previous seasons ($5\ 060 \pm 680$ and $4\ 310 \pm 520$ angler-days in 1994/95 and 2001/02, respectively), but as a back country fishery covered by a WCO the upper Buller River provide a further basis for comparison.
53. As with the upper Hurunui, usage estimates for the upper Oreti, upper Taieri, and upper Buller are conservative because they do not allow for respondents who are known to have fished each river, but did not specify which reach. By contrast, figures for the Ahuriri, Tekapo, and Waikaia apply to the entire river, and are thus directly comparable. To place the upper Hurunui in a national context, therefore, it is necessary to adjust the raw usage estimates for the upper reaches of the four subdivided rivers so as to allow for these anglers. Table 7 sets out the relevant data so as to document the procedure used to perform these adjustments.
54. The key step is to apportion the effort for "undefined" reaches in proportion to the known usage for each reach, performing separate calculations for New Zealand residents and overseas visitors. In the case of the Hurunui River, for example, I assumed that the $2\ 230 \pm 720$ angler-days expended by New Zealand residents on an

undefined reach was distributed between the two named reaches in the proportion 4240:5660, corresponding to the known usage of each reach. This yields an adjusted estimate of $5\,670 \pm 1\,090$ angler-days for the upper reaches in 2007/08, of which 470 ± 170 angler-days (8.3%) were contributed by overseas visitors.

55. Final 2007/08 usage estimates for the top six rivers listed in Table 7 range from $6\,790 \pm 1\,270$ angler-days for the upper Oreti River to $4\,460 \pm 590$ for the Tekapo River. All of these estimates have broad standard errors, typically at least $\pm 20\%$, so that differences as large as 1000 angler-days between rivers are unlikely to be significant. A prudent but credible interpretation of Table 7 is that the upper Oreti is the most heavily fished back country river in New Zealand (approximately $6\,800 \pm 1\,300$ angler-days), followed by the upper Hurunui ($5\,700 \pm 1\,100$), followed by the four remaining rivers (Ahuriri, upper Taieri, Waikaia, and Tekapo, all between $4\,500$ and $5\,000$ angler-days). However, 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 ($1\,470 \pm 300$ angler-days) was well below the top six.
56. A caveat to my conclusion in the previous paragraph is that classifying individual rivers as lowland, back country, or headwater, based on the definitions in Table 1, is partly subjective and does not necessarily imply that all such fisheries are equivalent. 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 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. Over its lower 10 km the Waikaia River is readily accessible from SH 94 between Gore and Lumsden, and acquires more of a lowland character as it approaches the Mataura River at Riversdale. The middle and upper reaches (particularly above Piano Flat) clearly have a backcountry or headwater character, but effort on this section is likely to be somewhat less than the estimated $4\,500 - 5\,000$ angler-days spent on the river as a whole. Similarly, the upper Taieri River retains a lowland character for some 10-20 km above Kokonga, with intensifying land use in recent years as irrigation becomes more prevalent.
57. Overseas angler effort in North Canterbury is low relative to other South Island FGZ regions (Table 8). A full analysis of the fishing patterns of overseas anglers is beyond the scope of this evidence, but can be summed up by the observation that they show a strong preference for headwater and back country river fisheries, and appear to follow a well-established circuit which takes in central Nelson, the West Coast, Southland, Otago, and the McKenzie Country. 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 (500 ± 210 angler-days) attracted more overseas visitors than the Hurunui River.

58. 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 equal to (and possibly exceeds) that for any other back country fishery (upper Oreti River: $4\,290 \pm 1\,030$; upper Taieri River: $4\,100 \pm 1\,290$).
59. 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 FGNZ 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. One can only speculate as to why this is the case, although the upper Hurunui is perhaps 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 (Mosburn, Te Anau). Irrespective of the reason, assessing the significance of the upper Hurunui River fishery in the light of this apparent paradox is clearly one of the challenges facing this tribunal.
60. As a final point of guidance to the tribunal, I would offer a comparison between the upper Hurunui River and one of its nearer neighbours, the Waimakariri River. The Waimakariri has consistently been one of the two most heavily fished rivers in New Zealand (along with the Mataura River) in all surveys to date, accounting for between 7.6% and 10.4% of all river fishing effort. For this reason alone it was one of the first rivers to be nominated as of national significance when such matters were first considered in the early 1980s (Teirney et al. 1982), although this assessment has yet to be tested in the context of a WCO application. It is therefore relevant to note that less than 3% of its usage derives from outside Canterbury, and (in 2007/08) only 0.5% (350 out of 75 000 angler-days) from overseas visitors. The Waimakariri is thus an example of a fishery of a specific type (i.e., mainstem east coast salmon fishery) which is highly used by New Zealand anglers but is virtually ignored by overseas visitors. Similar arguments apply to the Rakaia, Rangitata, and Waitaki Rivers, which have consistently ranked in the top twelve New Zealand rivers in terms of usage and include two (Rakaia and Rangitata) with WCOs, but (in 2007/08) derived 0.9%, 0.8%, and 0.4% of their usage from overseas visitors. On this basis I suggest that the tribunal may wish to consider usage by overseas visitors as an attribute which can

enhance the value of a fishery when it is sufficiently high (as is manifestly the case for the Buller, upper Oreti, and Ahuriri), but should not automatically detract from its value when low (as for the upper Hurunui River).

Summary

61. The Hurunui River sustains a regionally important salmon fishery in its lower reaches, maintenance of which is dependent on adult and juvenile salmon having unimpeded passage to and from the headwater spawning waters.
62. Data collected via nationwide sample surveys of FGZ fishing licence holders over a period of nearly thirty years provide a robust and consistent basis for characterising the fishery values of the upper Hurunui River.
63. The upper Hurunui River sustains a highly valued back country 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.
64. The North Canterbury region accounts for 19.8% of the whole-season fishing licences sold by FGZ, more than any other region, although per capita sales are lower than in more rural areas of the South Island. The corresponding figure for the whole of Canterbury, including the Central South Island FGZ region, is 32%.
65. Annual usage of the upper Hurunui River in 2007/08 was approximately 5 500 angler-days, with a standard error of ~1 000 angler-days. This estimate is based on a total of $4\,400 \pm 800$ angler-days for survey respondents who specifically identified the upper Hurunui River, plus an additional ~1 200 angler-days for respondents known to have fished the Hurunui river but who did not specify which reach.
66. Usage is high for a fishery of this type. Detailed analysis of figures for other popular back country fisheries identifies only three (the upper Oreti, Tekapo, and Ahuriri Rivers) with equal or greater annual usage.
67. Most anglers fishing the upper Hurunui River hold licences from the North Canterbury FGZ region, with visitors from other regions and from overseas accounting for a relatively low proportion of total usage. Consequently, 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.

Conclusion

68. The attributes of the upper Hurunui River documented above are consistent with FGZ's application for protection of the fishery via a Water Conservation Order. The river sustains a highly valued back country fishery which attracts more effort from New Zealand resident anglers than any other fishery of similar type, and provides spawning habitat for the sea-run Chinook salmon which sustain a regionally important fishery in the lower reaches of the river. It receives relatively little use from overseas visitors and is fished mostly by Canterbury anglers, suggesting it is primarily of regional rather than national importance. However, as the most popular back country fishery in a region which accounts for one out every five whole-season fishing licences sold by FGZ, any change in the status of the fishery would have national as well as regional implications. These implications should be acknowledged by the tribunal when considering the need for a WCO, and the appropriate level of protection should an Order be granted.

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Table 1. Criteria used to classify nationally important river fisheries into recreational, scenic, and wilderness categories.

Attribute	Type of fishery		
	Recreational	Scenic	Wilderness
Location	May be close to population centres	Usually remote from population centres	Remote from population centres
Access	Easily accessible by road	Accessible by road	Not accessible by road
Level of usage	Attract large numbers of anglers	May attract large numbers of anglers	Not fished by large numbers of anglers
Distribution of anglers	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
Area of fishable water	Extensive	Extensive	Extensive
Scenic beauty and solitude	Not necessarily high	Usually high	Exceptional
Catch rates	High	Intermediate	Relatively high
Size of fish	May be relatively small	Variable	Large
Preferred angling methods	Spinning	Spinning and artificial flies	Artificial flies
Main associated activities	Picnicking	Camping, picnicking	Camping, tramping, shooting
Modifications to catchment	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.

Fishery attribute	Rating (1 = low, 5 = high)					Total replies
	1	2	3	4	5	
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

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

Other activities

Camping	Picnicing	Shooting	Tramping	Swimming	Canoeing	Rafting
28	17	17	16	13	5	3

Table 3: Sales of FGZ whole-season fishing licences for the 2007/2008 angling season in relation to population figures from the 2006 Census, by FGZ Region. The three columns for each region show the adult male population, the number of licences bought by residents of each region, and the percentage of males holding a licence on the assumption that 90% of holders are male. Note that these figures do not include licences sold by the Taupo Conservancy, and therefore underestimate participation rates in the North Island (c.f. Unwin & Image 2003).

Region	2001/2002			2007/2008		
	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%
Total, North Island	937 500	26 075	2.5%	1 073 100	20 542	1.9%
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%
Total, South Island	315 300	30 224	8.6%	356 500	38 423	10.8%
Total, New Zealand	1 252 900	56 299	4.0%	1 429 600	58 965	4.1%

Table 4. Estimated annual usage of North Canterbury lake and river fisheries (angler-days \pm 1 standard error), 1994/95 to 2007/08, showing all fisheries which attracted at least 1 000 angler-days in 2007/08. Note that (a) overseas anglers were not surveyed in 1994/95 and 2001/02, and (b) data for the 2007/08 season are provisional and are likely to be conservative.

River/Lake	1994/95	2001/02	2007/08
Waimakariri River	58 360 \pm 7 100	48 950 \pm 4260	75 430 \pm 6 070
Rakaia River	34 650 \pm 3 850	21 460 \pm 2040	53 200 \pm 4 440
Lake Coleridge	7 090 \pm 1 310	9 170 \pm 850	13 400 \pm 1 580
Hurunui River	17 100 \pm 3 330	8 380 \pm 990	12 600 \pm 1 440
Ashley River	4 530 \pm 1 050	3 520 \pm 680	5 430 \pm 2 020
Waiau River	1 440 \pm 490	2 130 \pm 420	4 340 \pm 1 020
Kaiapoi River	5 250 \pm 2 150	1 800 \pm 460	3 760 \pm 1 190
Lake Taylor	750 \pm 250	970 \pm 220	3 320 \pm 1 280
Lake Pearson	1 750 \pm 630	2 290 \pm 350	2 840 \pm 540
Lake Lyndon	3 290 \pm 800	1 970 \pm 360	2 820 \pm 790
Lake Georgina	890 \pm 280	660 \pm 170	2 020 \pm 510
Lake Selfe	600 \pm 220	980 \pm 200	1 920 \pm 630
Lake Sumner	390 \pm 170	520 \pm 210	1 910 \pm 520
Selwyn River	6 700 \pm 1 370	2 130 \pm 540	1 000 \pm 300
Other rivers	19 260 \pm 2 580	8 010 \pm 810	11 960 \pm 1 560
Other lakes	4 640 \pm 910	5 010 \pm 660	4 100 \pm 540
Total, all waters	166 690 \pm 9 720	117 930 \pm 5170	200 050 \pm 8 600

Table 5. 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.

River/Lake	Reach	1994/95	2001/02	2007/08
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 \pm 3 330</i>	<i>8 380 \pm 990</i>	<i>12 600 \pm 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
Total, Hurunui catchment		18 960 \pm 3 360	10 210 \pm 1 040	18 970 \pm 2 020

Table 6. Distribution of fishing effort on the Hurunui River (angler-days \pm 1 SE) in 2007/2008 by angler origin.

Angler origin	Above Mandamus	Below Mandamus	Undefined	Total, all reaches
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
Total	4 400 \pm 800	5 660 \pm 950	2 530 \pm 730	12 600 \pm 1 440

Table 7. 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. Adjusted estimates for the upper Hurunui, Oreti, Taieri, and Buller Rivers were derived as described in paragraph 54.

River	Reach	All anglers	NZ resident	Overseas	% overseas
Ahuriri River		4 890 \pm 720	2 730 \pm 600	2 160 \pm 410	44.2%
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%
Hurunui River	Upper	4 400 \pm 800	4 240 \pm 800	160 \pm 100	3.6%
	Middle/lower	5 660 \pm 950	5 660 \pm 950		0.0%
	<i>Undefined</i>	2 530 \pm 730	2 230 \pm 720	310 \pm 140	12.3%
	Upper (adjusted)	5 670 \pm 1 090	5 200 \pm 1 080	470 \pm 170	8.3%
Oreti River	Upper	5 230 \pm 1 090	3 800 \pm 850	1 430 \pm 680	27.3%
	Middle/lower	13 330 \pm 1 600	13 280 \pm 1 600	50 \pm 40	0.4%
	<i>Undefined</i>	3 290 \pm 650	2 180 \pm 590	1 110 \pm 280	33.7%
	Upper (adjusted)	6 790 \pm 1 270	4 290 \pm 1 030	2 500 \pm 740	36.8%
Taieri River	Upper	4 050 \pm 1 130	3 600 \pm 1 080	460 \pm 310	11.4%
	Middle/lower	10 340 \pm 2 680	10 340 \pm 2 680		0.0%
	<i>Undefined</i>	1 970 \pm 700	1 940 \pm 700	30 \pm 30	1.5%
	Upper (adjusted)	4 590 \pm 1 320	4 100 \pm 1 290	490 \pm 310	10.7%
Buller River	Upper	910 \pm 210	520 \pm 120	390 \pm 170	42.8%
	Middle/lower	1 750 \pm 360	1 750 \pm 360		0.0%
	<i>Undefined</i>	840 \pm 240	370 \pm 110	470 \pm 210	56.2%
	Upper (adjusted)	1 470 \pm 300	608 \pm 130	860 \pm 270	58.6%

Table 8. 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%
Total	1 271.4 \pm 19.7	1 202.4 \pm 19.5	69.0 \pm 2.8	5.4%

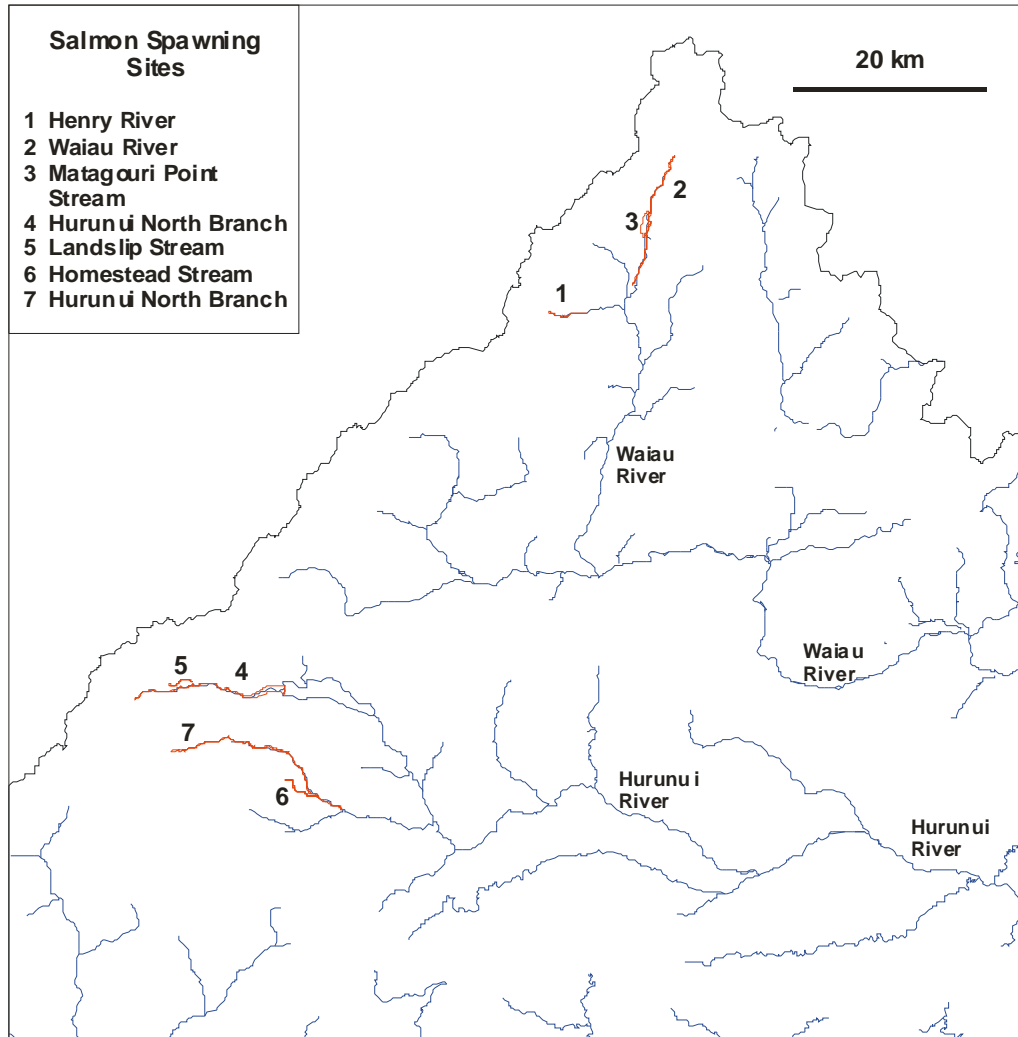


Figure 1: Significant Chinook salmon spawning sites in the upper Hurunui and Waiau catchments (source: Unwin 2006).