Angler usage of lake and river fisheries managed by Fish & Game New Zealand: results from the 2001/02 National Angling Survey

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Summary

This report summarises the 2001/02 National Angling Survey, conducted jointly by Fish & Game New Zealand (FGNZ) and NIWA from October 2001 to September 2002. The Survey, the second of its type to be commissioned by FGNZ (following the first such Survey in 1994/96), provides estimates of total angling effort for all lake and river fisheries managed by FGNZ, but does not cover fisheries in the Taupo Conservancy (which are administered by the Department of Conservation). We describe the survey design and methodology, present and discuss the main results (via tables and figures in the body of the report, and an Appendix giving more detailed results for all fishing waters identified by the survey), comment on some of the limitations of the Survey, and make brief recommendations for future surveys.

The survey was a telephone sample survey, based on random samples of New Zealand resident anglers drawn from records of fishing licence sales for the 2001/02 angling season. The survey was stratified by time (with the 12 month survey period divided into six two-monthly intervals), and by licence type (Stratum 1: adult whole-season and family licences; Stratum 2: young adult and junior whole season licences; Stratum 3: part-season licences). Sample sizes for each stratum were weighted in favour of whole-season licences, who were expected to contribute most of the total annual effort. In the Eastern Region, child-whole season licence holders were also surveyed. The survey did not include overseas anglers, who made up 5.5% of licence holders in Stratum 1, 2.7% of those in Stratum 2, and 25.2% of those in Stratum 3, nor part-season licence holders from the Otago Region.

Analysis of fishing licence sales showed substantial geographical variation in the popularity of freshwater angling throughout New Zealand. Based on the 2001 Census, participation rates (whole-season licences per adult male) varied from one in sixty-six (in the Auckland/Waikato FGNZ Region) to over one in seven (in the Central South Island and Southland Regions). More whole-season licence holders lived in Invercargill (2724) than in greater Wellington (2531), and almost as many in Oamaru, Timaru, and Ashburton combined (3520) as in greater Auckland (4001). Country of origin data were available for 8 127 overseas anglers from 82 countries, 82% of whom purchased a short-season licence.

Licence holders were contacted by telephone and asked to identify lakes and rivers they had fished over the previous two months, and the number of days spent on each water. Excluding child licencees, 19 098 licence holders were contacted during the survey, of whom 10 847 (56.8%) had fished at least one of 827 recognised lake and river fisheries during the two-month survey period of interest. Responses for each stratum, together with pooled FGNZ and Taupo Conservancy licence records for the 2001/02 season, and a file assigning ID codes to all known New Zealand angling waters, were used to compile a database which allowed related information to be linked via common data fields such as licence number and river code. Standard queries were developed to estimate annual angling effort for each water, and hence cross-tabulate effort by Region, stratum, and other parameters of interest to FGMZ managers.

Total angling effort by New Zealand resident anglers for the 2001/02 season was estimated to be 1 111 000 ± 16 000 angler-days, most of which (86.4%) was contributed by whole-season licence holders. Total effort had changed little, if at all, since the 1994/96 Survey, although there were significant changes at Regional and sub-Regional scales. The most marked changes were in North Canterbury (where total effort fell by 49 000 angler-days), and in Otago (where effort rose by at least 36 000 angler-days). There was some evidence of a shift in favour of lake fishing at the expense of river fishing, part of which appeared to reflect the poor salmon fishing season on the east coast of the South Island.

Most angling (83.2%) was expended by anglers fishing within the Region from which they bought their licence. Cross-boundary fishing was most evident in the South Island, with licence holders from the North Canterbury Region expending 37% of their fishing in other Regions, and visitors to the Central South Island contributing 62 000 angler-days to the total for that Region.

Although overseas anglers were not surveyed, we estimated their contribution (61 300 angler-days) by assuming that total annual effort per licence holder was the same as for New Zealand residents within the same licence stratum. For Otago part-season licence holders, a similar calculation yielded a contribution of 18 500 angler-days, bringing the estimated 2001/02 total for all FGNZ licence holders to 1 190 600 angler-days.

The analyses presented in this report represent only a small proportion of those possible, and leave plenty of scope for Regional FGNZ managers to undertake more specific analyses tailored to their own needs. Some progress has been made towards establishing a GIS-based system for analysing and displaying results from the 1994/96 and 2001/02 Surveys, but further work is required to develop this to its full potential, and thus allow the Survey data to be cross-linked to the River Environment Classification scheme under NIWA's Freshwater Information New Zealand project.

For the third Survey in this series, due to be repeated in 2007 or 2008, the main challenge will be to develop a suitable methodology for sampling overseas anglers. Possibilities for achieving this include recording cell phone numbers for as many licence holders as possible (and using these as the primary means of contact), or developing a simple exit questionnaire to be issued with all licences sold to overseas anglers.

1. Introduction

1.1. Freshwater angling in New Zealand

Freshwater angling, primarily for brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*), and chinook salmon (*O. tshawytscha*), is a popular leisure time activity for many New Zealanders and has a distinctive place in our national culture. Following successful acclimatisation to New Zealand waters over three decades from about 1875 (McDowall 1990, McDowall 1994), all three species rapidly became the basis of lively sports fisheries. Salmon became established on the east coast of the South Island from Otago to north Canterbury, rainbow trout occur throughout the central North Island and South Island high country, and brown trout are widely distributed over the whole of the South Island, and the North Island south of Auckland (McDowall 1990). Smaller and more localised fisheries exist for other introduced salmonids (such as brook trout *Salvelinus fontinalis*), and "coarse fish" such as perch *Perca fluviatilis* and tench *Tinca tinca* (McDowall 1994).

In all fresh waters except Lake Taupo and its inflowing tributaries, angling for acclimatised species is managed by Fish & Game New Zealand (FGNZ). For administrative purposes New Zealand is divided into 12 FGNZ Regions[1], with six in each island (Fig. 1). The Lake Taupo fishery is managed by the Department of Conservation (DOC) (McDowall 1994). All persons wishing to fish for acclimatised species must purchase a freshwater fishing licence at least annually. Licences purchased from FGNZ are freely interchangeable between Regions, and are priced without regard to angler origin: overseas anglers pay the same as New Zealand residents, and residents of each Region pay the same as non-residents. It is possible, therefore, for anglers to live in one Region, purchase a licence from a second Region, and fish in a third. The DOC Taupo Conservancy is the sole exception, in that FGNZ licences are not valid within the Conservancy, and Conservancy licences are not valid elsewhere in New Zealand.

FGNZ management responsibilities create an ongoing need for timely and accurate data on angler use of the freshwater fisheries resource for a number of reasons. Under the 1990 Conservation Law Reform Act FGNZ is tasked with monitoring "… sports fish and game populations…" and the "… success rate and degree of satisfaction of users of the sports fish and game resource…", while also being required to "…maintain and improve the sports fish and game resource". Fulfilling this role effectively demands reliable information on angler usage. Up-to-date usage statistics

[1] Throughout this report words such as "Region" and "Regional", when capitalised, refer specifically to FGNZ Regions.

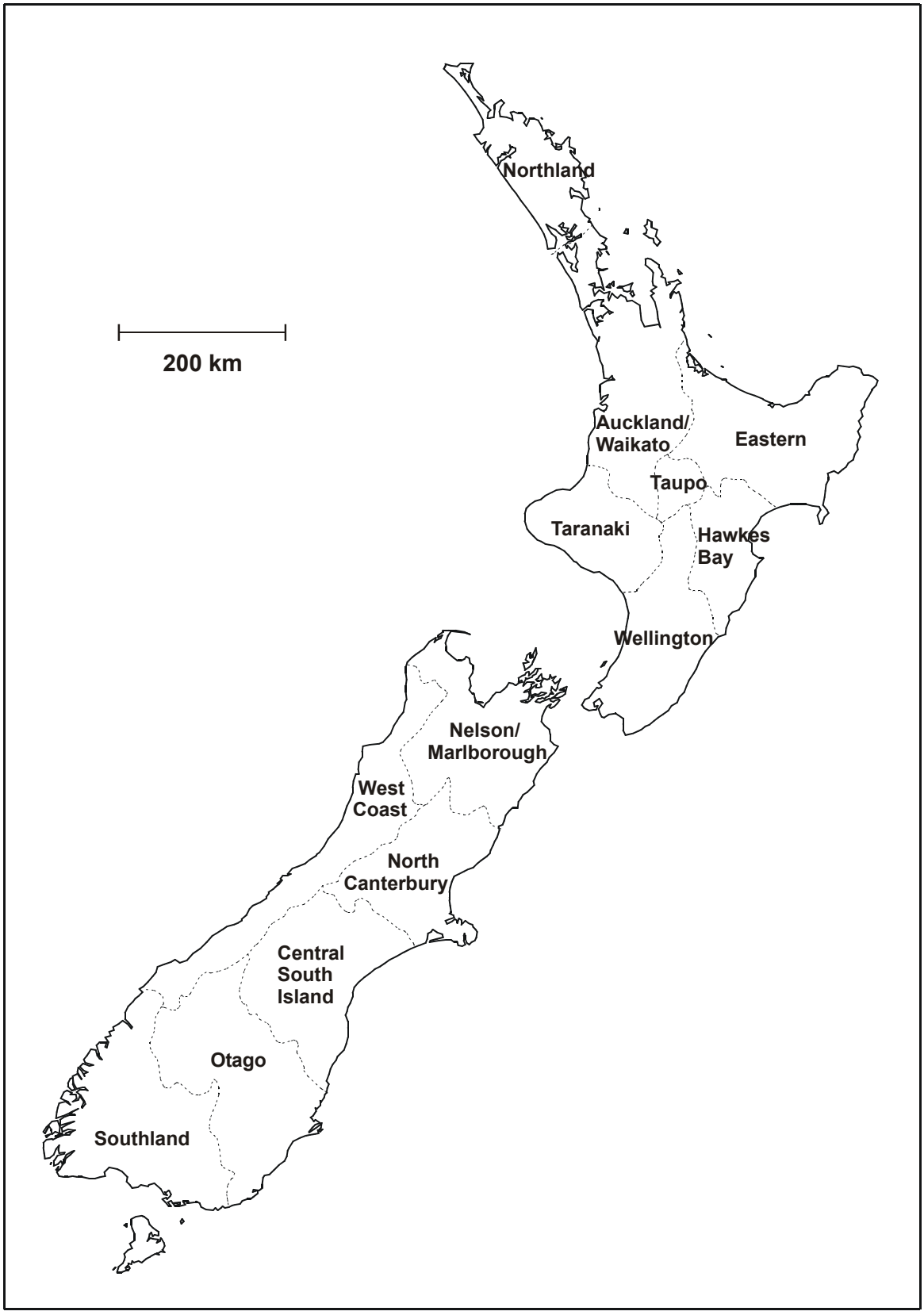

Figure 1. The twelve Fish & Game New Zealand Regions, and the Taupo Conservancy.

are also required by FGNZ when acting as an advocate, on behalf of freshwater anglers, in day to day situations (such as Regional Council or Planning Tribunal hearings) which arise regularly through application of the Resource Management Act.

This report presents results from the 2001/02 National Angling Survey, conducted by the National Institute of Water and Atmospheric Research Ltd. (NIWA) on behalf of FGNZ. This survey provides estimates of angling usage for all significant freshwater sports fisheries within the 12 FGNZ Regions, and is the second of its type since the first such survey was conducted from 1994 to 1996 (Unwin & Brown 1998). By developing and implementing a consistent methodology for these surveys, and repeating them at intervals of 5-7 years, FGNZ aims to compile a long-term angler usage database so that up to date usage estimates are always available, and from which local, regional, and national trends can be readily identified.

2. Survey design and implementation

2.1. Scope, format, and objectives

Like its predecessor, the 2001/02 survey had one primary objective: to obtain consistent estimates of angler usage for all New Zealand lake and river fisheries. The rationale for adopting this narrow focus was articulated in the 1994/96 report (Unwin & Brown 1998) as follows: "…*angler usage is one of the most fundamental parameters needed to characterise a particular fishery, as well as being relatively easy to define and measure. We were also motivated by a desire … to do one job well, rather than attempt to pursue a range of additional objectives which would risk introducing design compromises. … the survey made no attempt to collect any information related to catch rate or size of fish*".

Subsequent events have not altered this viewpoint. The 1994/96 survey is now well-established as a consistent and credible source of usage data for over 700 lakes and rivers throughout New Zealand. In addition, the survey achieved its secondary aim of establishing an angling usage database which would ultimately allow long term trends in the fishery to be identified and documented. Although seven years (rather than five, as originally intended) elapsed between the first and second surveys, further development of this database was an important secondary objective of the present survey.

The 2001/02 survey was a telephone sample survey, based on random samples of anglers drawn from records of fishing licence sales for the 2001/02 angling season (1 October 2001 to 30 September 2002), stratified by Region, date of issue (pooled into six two-monthly intervals), and licence type. Licence records are an ideal basis for surveys of angling within the 12 FGNZ Regions because (at least in principle) they

provide an exhaustive listing of all individuals who are legally entitled to fish, and are readily amenable to selection of random sub-samples of any specified size.

In practice we restricted the survey to anglers who were New Zealand residents. Many overseas visitors purchase short-season (i.e., daily or weekly) licences, and provide contact details which are transient (e.g. C/- a motel or fishing guide) or incomplete (e.g., recorded only as "tourist"). Establishing telephone contact with such individuals is problematical. Even with a relatively short (two month) interval between successive surveys, many overseas visitors are likely to have left New Zealand before the end of the month stratum during which they purchased their licence, and are essentially untraceable. Moreover, licence information becomes available only after the relevant licence records had been gathered from the vendor, and entered into the appropriate Regional database, which often introduces a lag of at least two months.

With this qualification in mind, the primary objective of the 2001/2002 Survey can be stated as follows:

- to obtain consistent estimates of angler usage, for all New Zealand lake and river fisheries, by New Zealand resident anglers;

Because of the exclusion of overseas visitors, these estimates necessarily provide a conservative estimate of the total annual usage for any given fishery. For most Regions, however, the survey data also make it possible to estimate the total contribution from overseas anglers (see Section 3.3.5), and hence to quantify the extent to which our results underestimate total usage. These adjustments apply to each Region as a whole, rather than to individual fisheries, but are in general quite small.

In addition, the 2001/2002 Survey had a number of secondary objectives, some of which evolved (or were developed *post hoc*) as the survey was implemented. These were:

1. to provide the results to FGNZ in spreadsheet format, to facilitate generation and cross-tabulation of usage summary statistics by Region, catchment, period, type of fishery (e.g. lake, river etc.), licence type, and angler origin;

2. to compile a complete database of all FGNZ fishing licence sales for the 2001/2002 angling season, linked (by licence number) to the survey database, to facilitate analysis of fishing patterns by angler origin;

3. to develop a GIS-based interface to facilitate effective graphical displays of the data, including comparisons with results from the 1994/96 survey;

4. to further develop this interface so as to link angler usage data with NIWA's River Environment Classification (REC) (Snelder & Biggs 2002).

We were successful in fulfilling the first two of these sub-objectives, via the present report, and also through a subsidiary report which uses the licence database compiled under sub-objective 2 to estimate the distance anglers travelled from their homes to fish their preferred rivers (Unwin & Deans 2003). However, although we made some progress towards sub-objectives 3 and 4, we encountered significant technical problems which prevented seeing these through to completion. Progress to date, and the key issues which remain to be resolved, are discussed in Section 3.5.

2.2. Sampling design

The 2001/2002 survey benefited considerably from experience gained during the 1994/96 survey, in that several problems which arose during the earlier survey were avoided by making appropriate modifications to the survey methodology. In addition, Regional licence databases were much more consistently structured than in 1994/96, so that sample selection and compiling a single national database were relatively straightforward.

2.2.1. Licence types and strata

The survey was stratified by Region (12 levels), period (6 two monthly intervals), and licence type. Licences are sold (and priced) according to age on the first day of each season (adult 20 and over; young adult, 16 to 20; junior, 12 to 16), and duration (whole season; winter (April to September); week; 48 hour; 24 hour). All combinations of age group and duration are available, making 15 licence categories in all, plus two other special categories: family, and child. Family licences are issued to members of the same family, one of which is designated as the primary licence holder, and cover the whole 12 month angling season. Other family members covered by the same licence can include one spouse or partner of the primary licence holder, and any of their children under 20 years of age[2]. Child licences are issued free to children under 12, and also cover the whole season.

Because angling effort tends to vary widely between licence categories, standard sampling theory (e.g., Kish 1965, Cochran 1977) recommends some level of stratification by category. For example, whole-season licence holders fish an average of about twenty days per season (based on the 1994/96 data), whereas anglers buying a 24 hour licence can fish on at most two days. However, treating all categories as

[2] Family licences are intended to allow families to fish together, and require all family members to fish in the company of the primary licence holder.

separate strata would have resulted in 1224 (12 × 6 × 17) strata, some with single-figure sales, and would not have been practical. We therefore established three strata, representing adult whole season and family licences (stratum 1), young adult and junior whole season licences (stratum 2), and short season licences (24 hour, 48 hour, weekly, and winter) for all age groups (stratum 3). Child licences were not included in the original sampling frame, but were added as a fourth stratum for the Eastern Region because staff there wished to collect data on resource use by children under 12, and were prepared to undertake the additional workload necessary to do so. There were thus 21 strata within Eastern, and 18 in all other Regions, making 222 in total.

To facilitate data analysis, and to provide a more complete record of geographical patterns in angling activity, licence records for the 2001/2002 angling season from all twelve FGNZ Regions were forwarded to NIWA for compilation into a single database. Only data fields relevant to the survey (licence number, licence type, date of purchase, and address) were retained. In addition, records of adult whole-season licence sales for the Taupo Conservancy were supplied by DoC. These records were then screened so as to identify the home address for as many licence holders as possible, based on the gazetteer of New Zealand place names provided by Land Information New Zealand (LINZ) via their web site (www.linz.govt.nz). Addresses corresponding to urban satellites of Auckland, Christchurch, and Dunedin (e.g., Howick, Halswell, Green Island) were inconsistently recorded, and were therefore pooled under the corresponding metropolis. However, licence records for the Wellington Region included postal codes, so we took advantage of these to subdivide greater Wellington into Wellington City (postal codes 6001 – 6005); Porirua (code 6006); upper Hutt (code 6007); and Lower Hutt (codes 6008, 6009). We then used the LINZ database to assign all identifiable locations to the appropriate Region, so as to allow us to differentiate between the Region in which each licence holder lived (home Region), and the Region from which they brought their licence (Region of purchase). Overseas visitors were identified as such, and (where possible) assigned to their country of residence. Addresses which could not be identified were recorded as "unknown New Zealand" if they appeared to be a New Zealand resident, and simply as "unknown" in all other cases. This database offers considerable potential for studies of angler demographics, going well beyond issues of direct relevance to the present survey, and has already been used as the basis for a study relating annual usage to the mean distance travelled by anglers for New Zealand river fisheries (Unwin & Deans 2003).

The ability for anglers holding any FGNZ licence to fish in any of the twelve FGNZ Regions, irrespective of where they live, has the potential to create confusion over what is meant by the word "Region" when presenting and cross-tabulating results. For any fishing event (i.e., any angler fishing any water at any time) up to three FGNZ Regions may be involved: the Region in which the angler lives (Region of residence);

the Region from which they purchased their licence (licence Region), and the Region in which they fished (fishing Region). To avoid any ambiguity, we use the bracketed terms throughout the remainder of this report in any context where the word "Region", on its own, would be unclear.

2.2.2. Survey population

The survey population consisted of all New Zealand resident anglers who purchased a FGNZ fishing licence for the 2001/2002 angling season, based on a combined listing of the relevant fields from all 2001/2002 licence records for all twelve FGNZ Regions. For the purposes of the survey, the relevant fields were licence number, licence type, date of issue, and the holder's address. We used the address to group licence holders into one of three categories: New Zealand residents, overseas visitors, and those of indeterminate origin. If possible, New Zealand residents were assigned to their Region of residence, and overseas visitors were identified by country.

For whole season licences (strata 1, 2), the great majority of holders (94.5% and 97.3%, respectively) were New Zealand residents (Table 1). Overseas visitors accounted for 1.9% - 5.1% of sales, and anglers of unknown origin accounted for less than 1%, numbering single figures in many licence Regions. Overseas visitors made up a much higher proportion (up to 50.2%) of part-season (stratum 3) licence sales within each Region, although totals for all 12 Regions are confounded by the lack of data for Otago, where we could not assume that the 11.5% of part-season records which included a recognisable address represented a random subsample of total sales. Excluding Otago, New Zealand residents accounted for 72.7% of part-season sales, overseas visitors for 25.2%, and anglers of unknown origin for 2.1%.

For practical purposes, the survey population was limited to the subset of licence holders who were contactable by telephone. For each stratum, a random sub-sample of licence holders (in MS-Excel format) was obtained by assigning a random key number to each record, sorting the resulting file on this key, and working through the sorted file from the top down until the required number of interviews had been completed. Up to three attempts were made to contact each person. Response rates (i.e., the number of targeted individuals who were actually contacted) averaged 64%, and was generally very consistent across all strata and survey periods.

2.2.3. Sample sizes

When choosing appropriate sample sizes for each stratum we were helped greatly by data from the 1994/96 survey, which allowed us to estimate the number of licences

Table : **Fishing licence sales for the 2001/2002 angling season by licence Region, licence stratum, and angler origin (n.d. = no data).**

			Angler origin		
	Region	Total licences	New Zealand resident	Overseas visitor	Origin unknown
Stratum 1	Northland	173	128 (74.0%)	35 (20.2%)	10 (5.8%)
	Auckland/Waikato	3 175	3 006 (94.7%)	140 (4.4%)	29 (0.9%)
	Eastern	7 951	7 338 (92.3%)	579 (7.3%)	34 (0.4%)
	Taranaki	628	614 (97.8%)	14 (2.2%)	0 (0.0%)
	Hawkes Bay	1 681	1 543 (91.8%)	127 (7.6%)	11 (0.7%)
	Wellington	2 725	2 674 (98.1%)	46 (1.7%)	5 (0.2%)
	Nelson/Marlborough	2 350	2 108 (89.7%)	242 (10.3%)	0 (0.0%)
	West Coast	1 242	1 161 (93.5%)	78 (6.3%)	3 (0.2%)
	North Canterbury	8 671	8 151 (94.0%)	517 (6.0%)	3 (0.0%)
	Central South Island	6 257	5 967 (95.4%)	191 (3.1%)	99 (1.6%)
	Otago	8 554	8 184 (95.7%)	370 (4.3%)	0 (0.0%)
	Southland	5 516	5 381 (97.6%)	134 (2.4%)	1 (0.0%)
	Total, stratum 1	**48 923**	**46 255 (94.5%)**	**2 473 (5.1%)**	**195 (0.4%)**
Stratum 2	Northland	27	25 (92.6%)	(0.0%)	2 (7.4%)
	Auckland/Waikato	413	409 (99.0%)	3 (0.7%)	1 (0.2%)
	Eastern	858	800 (93.2%)	46 (5.4%)	12 (1.4%)
	Taranaki	131	131 (100.0%)	(0.0%)	0 (0.0%)
	Hawkes Bay	256	236 (92.2%)	15 (5.9%)	5 (2.0%)
	Wellington	389	385 (99.0%)	1 (0.3%)	3 (0.8%)
	Nelson/Marlborough	227	221 (97.4%)	6 (2.6%)	0 (0.0%)
	West Coast	147	146 (99.3%)	1 (0.7%)	0 (0.0%)
	North Canterbury	729	725 (99.5%)	4 (0.5%)	0 (0.0%)
	Central South Island	877	848 (96.7%)	6 (0.7%)	23 (2.6%)
	Otago	975	948 (97.2%)	27 (2.8%)	0 (0.0%)
	Southland	997	990 (99.3%)	5 (0.5%)	2 (0.2%)
	Total, stratum 2	**6 026**	**5 864 (97.3%)**	**114 (1.9%)**	**48 (0.8%)**
Stratum 3	Northland	245	211 (86.1%)	30 (12.2%)	4 (1.6%)
	Auckland/Waikato	2 672	2 464 (92.2%)	141 (5.3%)	67 (2.5%)
	Eastern	16 185	11 831 (73.1%)	4 023 (24.9%)	331 (2.0%)
	Taranaki	345	310 (89.9%)	35 (10.1%)	0 (0.0%)
	Hawkes Bay	1 110	977 (88.0%)	110 (9.9%)	23 (2.1%)
	Wellington	1 338	1 165 (87.1%)	160 (12.0%)	13 (1.0%)
	Nelson/Marlborough	1 893	942 (49.8%)	951 (50.2%)	0 (0.0%)
	West Coast	1 470	754 (51.3%)	595 (40.5%)	121 (8.2%)
	North Canterbury	3 441	2 559 (74.4%)	808 (23.5%)	74 (2.2%)
	Central South Island	3 737	2 636 (70.5%)	1 021 (27.3%)	80 (2.1%)
	Otago	8 842	1 007 (11.4%)	n.d.	7 835 (88.6%)
	Southland	2 406	1 465 (60.9%)	910 (37.8%)	31 (1.3%)
	Total, stratum 3	**43 684**	**26 321 (60.3%)**	**8 784 (20.1%)**	**8 579 (19.6%)**

likely to be sold within each two month period, and the likely distribution of angling effort between each period and licence stratum. Within each licence Region these results allowed us to use Neyman allocation (Cochran 1977) to determine optimal sample sizes for each stratum, in the sense that for a given level of sampling effort (summed across all strata), the survey will minimise the standard deviation (SD) for the total angling effort summed across all strata. In essence, Neyman allocation gives the highest priority to strata which make the largest contribution to total effort and total SD, at the expense of smaller strata. Total sampling effort for each Region could, in principle, have also been based on Neyman allocation, but this would have resulted in Regions such as Northland and Taranaki (which sell relatively few fishing licences) being sampled very lightly, yielding insufficient data to be meaningful to Regional FGNZ managers. We therefore used a degree of judgement, using Neyman allocation to determine minimum sample sizes for all strata, but taking larger samples (particularly for stratum 1) in licence Regions with small angling populations, with a minimum sample size of 20.

The sampling design as actually implemented is summarised in Table 2. Total licences for each survey period are those which are potentially "active". For whole season licences this is simply the cumulative number issued up to and including the last day of each period. Most anglers requiring a whole season licence tend to make their purchase early in the season, so that totals for strata 1 and 2 tend to increase rapidly from October to January (periods 1 and 2), with little or no increase thereafter. For part season licences, only those sold during the relevant two month period are considered to be active, so that population sizes for each stratum tend to be more variable. We assigned weekly and 48 hour licences spanning more than one survey period to the period when they were sold.

To estimate the number of licences sold to New Zealand residents for each period and licence stratum, we assumed that licences sold to anglers of unknown origin were divided between New Zealand residents and overseas visitors in the same proportion as anglers of known origin. Thus, population sizes in Table 2 tend to be slightly higher than total sales for the corresponding licence classes in Table 1. For example, we calculated the total number of stratum 1 licences for the Eastern Region as listed in Table 2 (7370) by adding the number known to be sold to New Zealand residents in Table 1 (7338) to the number sold to anglers of unknown origin estimated to have, in fact, been bought by New Zealand residents (92% of 34, i.e., an additional 32 licences).

In practice 205 of the 222 strata were surveyed as planned (Table 2). The most significant omission was stratum 3 (part-season) licence holders in Otago, where the absence of usable addresses and telephone numbers precluded any attempt to draw and

Table 2: **Population and sample sizes, by licence Region, survey period (Period 1 = Oct-Nov 2001 etc.), and stratum, for the 2001/2002 survey. Three figures are shown for each stratum and period: the estimated number of active licences (i.e., population size; N), the sample size (n), and the sampling fraction (n/N) expressed as a percentage. For data on child licences (Stratum 4, in the Eastern Region only), see Section 3.3.3.**

		Stratum 1			Stratum 2			Stratum 3		
Region	**Period**	**N**	**n**	**n/N**	**N**	**n**	**n/N**	**N**	**n**	**n/N**
Northland	1	90	35	39.1%	18	2	11.1%	17	3	17.6%
	2	127	51	40.3%	27	3	11.1%	59	21	35.6%
	3	134	81	60.5%	27	no survey		34	7	20.4%
	4	135	51	37.8%	27	no survey		44	10	22.7%
	5	136	39	28.7%	27	no survey		60	8	13.3%
	6	136	42	30.9%	27	1	3.7%	71	7	9.9%
Auckland/ Waikato	1	2152	82	3.8%	252	11	4.4%	407	17	4.2%
	2	2778	330	11.9%	363	19	5.2%	427	27	6.3%
	3	3015	357	11.8%	397	15	3.8%	488	9	1.8%
	4	3026	199	6.6%	406	20	4.9%	683	10	1.5%
	5	3027	202	6.7%	409	20	4.9%	647	20	3.1%
	6	3034	200	6.6%	410	20	4.9%	703	18	2.6%
Eastern	1	5376	208	3.9%	544	40	7.4%	1859	72	3.9%
	2	6947	431	6.2%	771	75	9.7%	3013	111	3.7%
	3	7339	452	6.2%	805	85	10.6%	2438	114	4.7%
	4	7368	393	5.3%	811	70	8.6%	2577	170	6.6%
	5	7370	307	4.2%	811	50	6.2%	2174	116	5.3%
	6	7370	180	2.4%	811	35	4.3%	1729	95	5.5%
Taranaki	1	470	142	30.2%	90	20	22.2%	61	13	21.3%
	2	579	149	25.7%	124	20	16.1%	92	20	21.7%
	3	611	151	24.7%	131	20	15.3%	72	20	27.8%
	4	613	150	24.5%	131	20	15.3%	59	20	33.9%
	5	613	100	16.3%	131	20	15.3%	55	no survey	
	6	614	75	12.2%	131	20	15.3%	44	20	45.5%
Hawke's Bay	1	1144	80	7.0%	154	20	13.0%	163	20	12.3%
	2	1459	219	15.0%	209	29	13.9%	221	43	19.5%
	3	1550	220	14.2%	239	30	12.6%	199	31	15.6%
	4	1553	150	9.7%	240	20	8.3%	272	30	11.0%
	5	1553	71	4.6%	241	20	8.3%	256	20	7.8%
	6	1553	70	4.5%	241	20	8.3%	267	20	7.5%
Wellington	1	1951	160	8.2%	245	20	8.2%	183	17	9.3%
	2	2520	302	12.0%	355	32	9.0%	197	10	5.1%
	3	2658	276	10.4%	379	29	7.7%	251	15	6.0%
	4	2673	155	5.8%	386	28	7.3%	376	24	6.4%
	5	2676	161	6.0%	388	23	5.9%	363	25	6.9%
	6	2679	159	5.9%	388	29	7.5%	402	30	7.5%
Nelson	1	1478	163	11.0%	137	20	14.6%	145	30	20.7%
	2	1946	347	17.8%	204	21	10.3%	309	70	22.7%
	3	2107	348	16.5%	220	21	9.5%	236	31	13.1%
	4	2108	160	7.6%	220	21	9.5%	174	30	17.2%
	5	2108	162	7.7%	220	20	9.1%	155	31	20.0%
	6	2108	103	4.9%	221	20	9.0%	158	20	12.7%

		Stratum 1			Stratum 2			Stratum 3		
Region	**Period**	**N**	**n**	**n/N**	**N**	**n**	**n/N**	**N**	**n**	**n/N**
West Coast	1	804	106	13.2%	97	12	12.4%	130	3	2.3%
	2	1054	248	23.5%	137	24	17.5%	212	40	18.8%
	3	1161	249	21.5%	146	26	17.8%	267	26	9.7%
	4	1164	96	8.2%	146	25	17.1%	134	no survey	
	5	1164	152	13.1%	146	25	17.1%	85	17	19.9%
	6	1164	75	6.4%	146	30	20.5%	109	23	21.2%
North Canterbury	1	5717	215	3.8%	410	23	5.6%	515	20	3.9%
	2	7684	505	6.6%	676	45	6.7%	696	45	6.5%
	3	8150	469	5.8%	723	45	6.2%	851	17	2.0%
	4	8154	253	3.1%	725	25	3.4%	438	24	5.5%
	5	8154	129	1.6%	725	16	2.2%	279	15	5.4%
	6	8154	85	1.0%	725	15	2.1%	233	15	6.4%
Central South Island	1	4367	172	3.9%	530	21	4.0%	421	19	4.5%
	2	5827	432	7.4%	841	41	4.9%	1039	40	3.8%
	3	6058	499	8.2%	869	51	5.9%	685	51	7.4%
	4	6063	351	5.8%	871	29	3.3%	311	31	10.0%
	5	6063	139	2.3%	871	24	2.8%	198	18	9.1%
	6	6063	135	2.2%	871	21	2.4%	251	20	8.0%
Otago	1	5988	152	2.5%	615	20	3.3%	§1767	no survey	
	2	7855	337	4.3%	907	30	3.3%	2772	no survey	
	3	8153	349	4.3%	943	30	3.2%	2015	no survey	
	4	8168	249	3.0%	947	20	2.1%	1142	no survey	
	5	8178	250	3.1%	947	20	2.1%	700	no survey	
	6	8184	249	3.0%	948	12	1.3%	1086	no survey	
Southland	1	4298	250	5.8%	779	25	3.2%	370	25	6.8%
	2	5241	400	7.6%	975	30	3.1%	525	30	5.7%
	3	5377	399	7.4%	989	30	3.0%	317	29	9.1%
	4	5382	250	4.6%	991	25	2.5%	167	25	14.9%
	5	5382	197	3.7%	992	20	2.0%	130	20	15.4%
	6	5382	200	3.7%	992	20	2.0%	97	20	20.7%

§ Stratum 3 licence sales listed for Otago are totals for all licence holders, irrespective of origin. Because most of these records did not include a usable address we were unable to estimate the number sold to New Zealand residents, or to complete a sample survey. See Section 2.2.3 for further details.

contact a random sample of anglers. The remaining omissions were small strata in Northland, Taranaki, and West Coast, for which too few successful contacts were made to provide a worthwhile sample. Inclusion of child licences in the Eastern Region contributed a further six strata, bringing the total number of strata actually surveyed to 211. A total of 2342 child licences were issued to New Zealand residents, with sample sizes ranging from 15 (in period 6) to 51 (in period 3).

2.2.4. Interview procedures

Primary responsibility for conducting telephone interviews fell to Regional FGNZ staff, who were tasked with appointing suitable interviewers and ensuring quality control. Interviewers were expected to be familiar with river and lake fisheries in and near their own licence Region, have a pleasant and courteous telephone manner, have

tidy and legible handwriting, and be willing to pay attention to detail. During interviews they were asked to adopt as neutral a tone as possible, so as to minimise any tendency for anglers to shade their responses. In particular, interviewers were asked to use neutral words (such as "manage" or "monitor") when describing how the data would be applied to the fishery, rather than potentially emotive terms (e.g., "protect") which could induce respondents to distort their answers.

Before starting each interview, interviewers were asked to confirm that they were talking to the right licence holder (in case more than one angler lived at the same address), and to specify the two months for which they wished to collect information. For family licences, interviewers were asked to talk only to the principal licence holder, but to emphasise that his or her responses were to cover everyone entitled to fish on that licence. Each interview then began by asking whether or not the respondent had fished during the relevant period. If the answer was "No", the interview ended. If "Yes", interviewers then sought to identify which waters had been fished, and the number of days spent on each water, taking care to seek clarification if they were in doubt as to the identity of any particular water. To facilitate this process, interviewers were provided with a list of names which could apply to more than one river or lake.

When seeking details of fishing effort, interviewers were asked to use the phrasing: "On how many days did you fish the [named] river/lake?". This wording was adopted so as to provide a consistent measure of usage in terms of an "angler day", i.e., one person fishing on one day, irrespective of the duration of fishing. Further refinement of usage data, so as to be expressible in terms of total hours, was beyond the scope of this survey.

For recording purposes, all known angling waters were assigned a unique five digit code using a master list based on the 1994/96 survey. The master list was open-ended, and grew with time as new but seldom visited waters were recorded by interviewers. Updated master lists were circulated to each Region as necessary during the survey. All lakes, and most rivers, were treated as a single unit, so that respondents were not required to specify the particular reach or area they had fished. However, 25 rivers of particular interest to Regional FGNZ managers were divided into up to five reaches, to provide further detail about patterns of usage (Table 3). Interviewers were provided with a list of all subdivided rivers, and encouraged to become familiar with these.

The respondent's licence number and licence type were recorded for all interviews, together with a y/n to indicate whether the respondent had, or had not, fished during the relevant period. If the respondent had fished, then for each lake or river the interviewer recorded the name, and the number of days fished. For family licences, the

Table 3: Mainstem rivers which were subdivided into two or more reaches for the 2001/02 survey.

River	Reach
Waikato	Huka Falls to Lake Ohakuri
	Below Karapiro
Whanganui	Above Ohura confluence
	Below Ohura confluence
Tarawera	Lake outlet to Tarawera Falls
	Below Tarawera Falls
Rangitaiki	Above Rabbit Bridge
	Aniwhenua Dam to Lake Matahina
	Below Matahina Dam
Mohaka	Above Mangatainoka confluence
	Mangatainoka to SH5 bridge
	Below SH5 bridge
Ngaruroro	Above Taruarau confluence
	Below Taruarau confluence
Tukituki	Above Waipawa confluence
	Waipawa confluence to Patangata
	Below Patangata
Manawatu	Above Dannevirke
	Dannevirke to SH2 (Woodville)
	SH2 (Woodville) to Palmerston North
	Palmerston North to Foxton
Rangitikei	Above Mangaohane Bridge
	Mangaohane Bridge to Vinegar Hill
	Vinegar Hill to Tangimoana
Ruamahanga	Above Mount Bruce (SH2)
	Mount Bruce (SH2) to Masterton
	Masterton to Martinborough (SH53)
	Martinborough to Lake Onoke
Buller	Rotoiti to Gowanbridge
	Gowanbridge to Lyell
	Below Lyell (West Coast Region)
Clarence	Above Acheron
	Below Acheron
Motueka	Above Wangapeka confluence
	Below Wangapeka confluence
Pelorus	Above Pelorus Bridge
	Below Pelorus Bridge
Takaka	Above Lindsay's Bridge
	Below Lindsay's Bridge
Wairau	Above Wash Bridge
	Below Wash Bridge
Arnold	Lake Brunner to dam
	Dam to Stillwater
Grey	Above Ikamatua
	Below Ikamatua
Hurunui	Above Mandamus
	Below Mandamus
Waitaki	Waitaki Dam to Kurow Bridge
	Kurow Bridge to Black Point
	Black Point to SH1
	SH1 to tidal limit
	Mouth and tidal zone
Clutha	Wanaka to Lake Dunstan
	Below Roxburgh
Taieri	Above Kokonga
	Kokonga to Outram Bridge
	Below Outram Bridge
Mataura	Above Gore
	Below Gore
Oreti	Above Lumsden
	Below Lumsden
Waiau	Te Anau to Manapouri
	Below Mararoa

principal licence holder replied on their own behalf, and then separately for each secondary holder. Data sheets for each survey were then forwarded to a designated FGNZ survey coordinator within each Region, who added the appropriate numeric codes for each water. Completed data sheets were then forwarded to NIWA for entry into a Microsoft Access database, similar to that used for the 1994/96 survey (Unwin & Brown 1998), allowing related tables to be linked via common data fields such as river codes and licence numbers, or by database-generated primary key fields representing individual FGNZ Regions, survey strata, respondents, and river/lake visits.

2.3. Data analysis

To derive usage estimates for each sample stratum, we assumed that the licence holders contacted by telephone represented a simple random sample of all New Zealand resident licence holders in that stratum. Essentially, this is equivalent to the assumption that those individuals who could not be contacted by telephone (36% of the original sample, on average) had the same fishing characteristics as those who were contacted. Responses for family licence holders were summed across all individuals fishing on that licence, to ensure that the licence (rather than the individual) remained the basic sampling unit across all strata. For all angling waters fished by at least one respondent we then estimated the mean effort per respondent, and hence the estimated total effort for the whole stratum, as

$$E_{ij} = N_j \times \left(\sum_{k=1}^{n_j} D_{ijk} \right) / n_j = N_j \times \bar{D}_{ij} / n_j$$

where

i denotes the i^{th} angling water (i = 1, ~1000);
j denotes the j^{th} stratum (j = 1, 211);
N_j denotes the population size (i.e., number of active licences) in stratum j;
n_j denotes the sample size for stratum j;
k denotes the k^{th} respondent in a given stratum (k = 1, n_j);
D_{ijk} denotes the number of days spent on angling water i by respondent k in stratum j; and
$\bar{D}_{ij}$ denotes the mean number of days spent on angling water i in stratum j,

with variance given by

$$s^2{}_{ij} = N_j \times \left(\sum_{k=1}^{n_j} (D_{ijk} - \bar{D}_{ij})^2 \right) / (n_j - 1)$$

and standard deviation s_{ij}. Estimates of total annual effort E_i for angling water i, taking into account possible contributions from all 211 survey strata, were then obtained by summing E_{ij} over all j, and similarly for the estimated variance s^2_i. In addition, by restricting the sum to selected subsets of the full set of 211 strata, we were able to generate usage estimates for a specified survey period, licence stratum, licence Region, fishing Region, or any combination of these. To maintain consistency between Regions results for child licence holders from the Eastern Region were analysed separately, so that the analyses presented in this report were restricted to the 205 strata listed in Table 2 unless otherwise stated.

For summarising and reporting purposes, we merged these estimates with information on each angling water (such as catchment number and water type) to provide additional opportunities for cross-tabulation. Lake and river fisheries were classified separately, and were also broken down into one of eight generic sub-categories to allow for a finer level of tabulation (c.f. Unwin & Brown 1998). Lake fisheries were classified either as large natural lakes (those exceeding 5 km^2 in surface area, according to Jolly & Brown 1974); small natural lakes (less than 5 km^2); and reservoirs (i.e., artificial impoundments of any type, such as hydro-electric, irrigation, or water supply dams). We classified river fisheries as mainstem fisheries (e.g. Manawatu, Motueka, Mataura); lowland fisheries (e.g. smaller coastal streams or mainstem tributaries wholly or partly flowing through areas of intensive land use, such as the Waihou, Ashley, and Pomahaka); back country fisheries (upland tributaries characterised by extensive rather than intensive land use, e.g. the Maruia, Ahururi, and Manuherikia); headwater fisheries (often remote rivers with limited access, such as the Karamea, Dingle, and Clinton); and artificial waters such as drains and hydro canals. While these distinctions (particularly between lowland, back country, and headwater fisheries) were often partly subjective, and did not allow for the fact that many rivers change in character over their length, they serve a useful purpose by helping to quantify the distribution of angling effort by fishery type and fishing Region.

3. Results

3.1. Licence database

The final 2001/02 licence database compiled during the survey contained 119 343 records, representing all licences issued, including child licences, for eight Regions; all licences except child licences for the remaining four Regions (Taranaki, Wellington, Otago, and Southland); and adult whole-season licences only for the Taupo Conservancy. For adult whole-season licences, and also for family licences (which are not available in the Taupo Conservancy), the database thus provides a complete census of all licences issued for the 2001/02 season, based on the holder's Region of residence rather than their licence Region. The following analysis focuses

on these licence holders, who represent the committed angler, rather than the more casual angler who purchases a part season licence.

When overlaid on a map of New Zealand, these data highlight the extent to which the popularity of angling varies throughout New Zealand (Fig. 2), and suggest several distinct regional trends. To explore these further, we co-located the licence sales data with population figures for the 2001 census, from the Statistics New Zealand web site[3]. On the assumption that 90% of anglers are male (Teirney et al. 1982), we used these figures to estimate, for each licence Region, the number of adult males (20 years and over) who held a whole season licence (Table 4).

The most striking trend was a marked increase in the popularity of angling from North to South, with the average participation rate (i.e., licences per adult male) in the South Island (8.6%) over three times that in the North Island (2.5%). Second, angling tended to be relatively more popular in rural areas than urban areas, with participation rates for the most urbanised Regions (1.4% in Auckland/Waikato, and 2.7% in Wellington) among the lowest in the country. Third, with the exception of the Taupo Conservancy (essentially the combined population of Taupo and Turangi, but possibly inflated by holiday home owners from Auckland and Wellington), participation rates throughout the lower South Island (11.9% - 15.8%) were the highest in the country. In Central South Island and Southland, more than one out of every seven adult males held a whole-season fishing licence. By contrast, the equivalent figures for Wellington and Auckland/Waikato were 1:33, and 1:66, respectively. When broken down in terms of individual towns and population centres (Fig. 2) the discrepancy in participation rates was even more apparent, with more licence holders living in Invercargill (2724) than in all of greater Wellington (2531), and almost as many in Ashburton, Timaru, and Oamaru combined (3520) as in greater Auckland (4001).

The Taupo fishery had a strong influence on angling demographics in the North Island, with up to 40% - 50% of anglers in most areas electing to buy a licence for the Taupo conservancy (and hence valid only for Lake Taupo and its inflowing tributaries) rather than for their Region of residence (Fig. 2). This influence was strongest in the Wellington licence Region, and in metropolitan Auckland, Taranaki, the King Country, and southern Hawkes Bay, and weakest in the Eastern Region, the Waikato, Napier, and the Wairarapa. However, the Taupo influence was barely detectable in the South Island, with only one angler per thousand (43 out of 41 965) opting for a Taupo whole-season licence rather than one from FGNZ.

[3] using the Census Table Finder facility at http://xtabs.stats.govt.nz/eng/TableFinder/index.asp

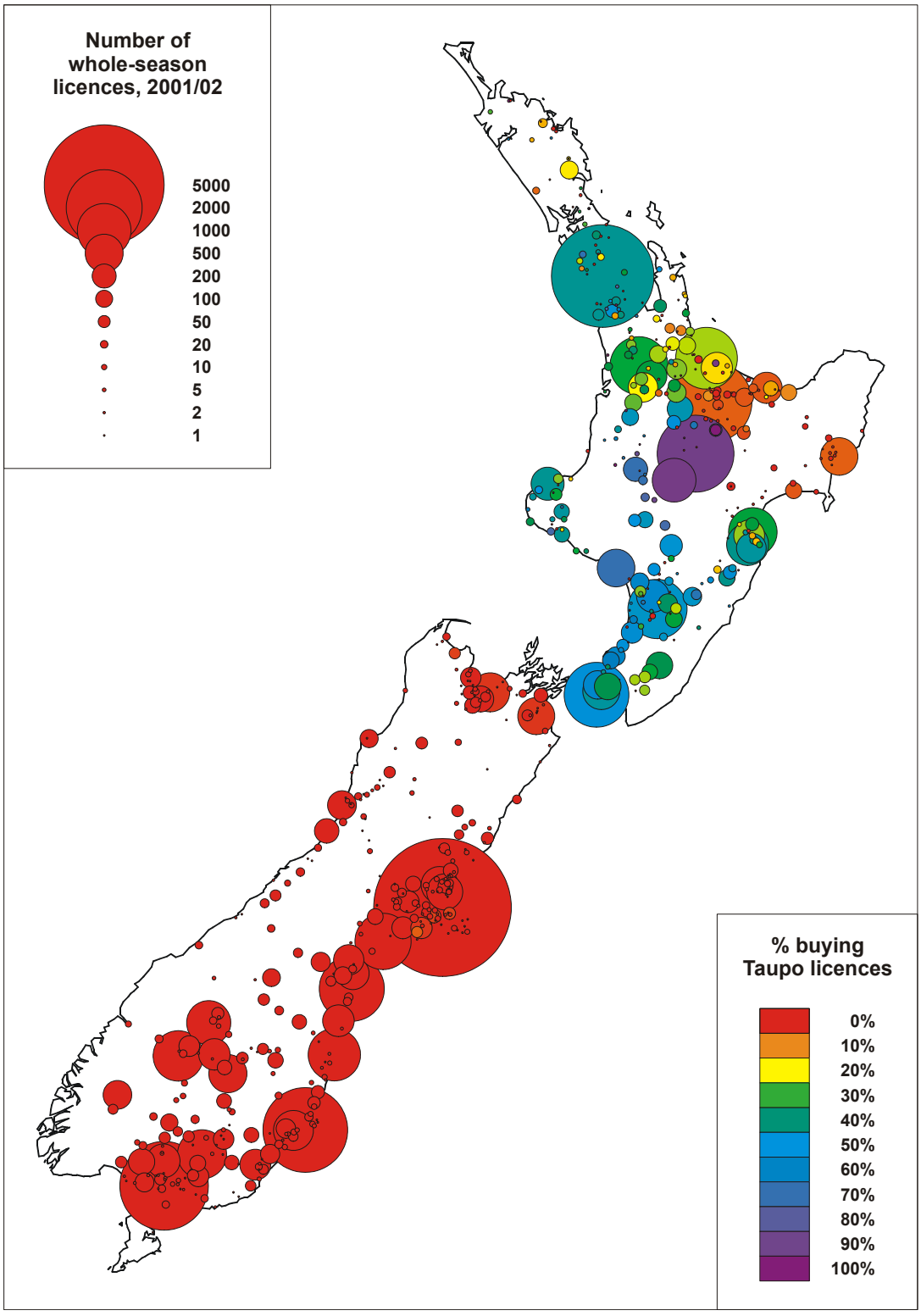

Figure 2: **Geographical distribution of Stratum 1 (adult whole-season and family) fishing licence sales for the 2001/02 angling season, for all of New Zealand (including the Taupo Conservancy). The number of licences sold in each population centre is proportional to the area of each circle, while the colouring shows the proportion of these which were bought solely for the Taupo Conservancy.**

Table 4: **Sales of adult whole-season fishing licences (including family licences) for the 2001/2002 angling season, in relation to population figures from the 2001 Census, by FGNZ Region. The final column shows licence sales per adult male for each licence Region, on the assumption that 90% of holders are male.**

FGNZ Region	Adult male population	Whole-season licences	Licences as % of adult males
Northland	46 000	216	0.4%
Auckland/Waikato	495 600	7 558	1.4%
Eastern	95 600	5 808	5.5%
Taupo Conservancy (DoC)	10 700	2 711	22.8%
Taranaki	48 300	1 406	2.6%
Hawkes Bay	43 700	2 440	5.0%
Wellington	197 600	5 936	2.7%
Total, North Island	**937 500**	**26 075**	**2.5%**
Nelson/Marlborough	43 900	2 010	4.1%
West Coast	10 900	921	7.6%
North Canterbury	138 200	8 868	5.8%
Central South Island	34 700	5 520	14.3%
Otago	56 400	7 430	11.9%
Southland	31 300	5 475	15.8%
Total, South Island	**315 300**	**30 224**	**8.6%**
Total, all New Zealand	**1 252 900**	**56 299**	**4.0%**

A demographic analysis of the percentage of anglers buying a whole-season licence, rather than a part-season licence, is also consistent with the above Regional trends. This analysis, which we restricted to licence holders for whom Region of residence and licence Region were the same so as to avoid bias due the lack of data for Taupo and Otago, shows that the percentage of part-season licence sales generally declined from north to south, and was generally higher in urban areas than in neighbouring rural areas (Table 5). For example, anglers from metropolitan Auckland were more likely to buy a part-season licence than those from Waikato, as were Wellington residents compared to those from Wairarapa, and Christchurch residents compared to those from rural North Canterbury. By far the highest proportion of whole-season licence sales was recorded in the Mataura sub-region in Southland (essentially Gore, Mataura, Wyndham, Edendale, Riversdale, Waikaia, and Balfour), where over 90% of anglers (1462 out of 1624) opted for a whole-season licence. By comparison, the national average was 71% (Table 5).

Table 5: **Fishing licence sales to New Zealand residents for the 2001/02 angling season by licence Region and sub-region (generally based on Territorial Authority boundaries), showing the total number of anglers who purchased a licence from their Region of residence (N_{home}), and the percentage of these anglers who brought a part-season (rather than whole-season) licence. Data on part-season licence holders were unavailable for the Otago Region.**

FGNZ Region	Sub-Region	N_{home}	% part-season
Northland	Bay of Islands	78	40%
	Whangarei	171	48%
Auckland/Waikato	Auckland	2 157	47%
	Coromandel	304	42%
	Waikato	2 225	39%
	South Waikato	749	38%
	King Country	226	29%
Eastern	Bay of Plenty	1 297	43%
	Rotorua	4 583	42%
	Western BOP	2 353	52%
	Taupo	126	34%
	Gisborne	1 845	50%
	Wairoa	214	49%
Taranaki	Taranaki	571	17%
	Wanganui	361	41%
Hawkes Bay	Hawkes Bay	2 287	35%
Hawkes Bay/Wellington	Tararua/Ruahine	423	24%
Wellington	Rangitikei	594	29%
	Manawatu	1 103	26%
	Wairarapa	418	19%
	Horowhenua	223	26%
	Porirua	138	22%
	Upper Hutt	201	24%
	Lower Hutt	327	26%
	Wellington	726	31%
Nelson/Marlborough	Golden Bay	96	20%
	Motueka	322	21%
	Nelson	1 277	26%
	Blenheim	840	22%
Nelson/Marlborough/West Coast	Buller	288	15%
West Coast	Grey	524	21%
	Westland	496	23%
North Canterbury	Hurunui	419	20%
	Waimakariri	1 437	15%
	Christchurch	8 067	23%
	Selwyn	798	16%
Central South Island	Ashburton	1 750	20%
	Timaru	3 145	19%
	McKenzie	541	26%
	Waitaki	568	16%
	Oamaru	1 292	20%
Southland	Mataura	1 624	10%
	Invercargill	3 477	18%
	Oreti	924	19%
	Takitimu	1 057	16%
Total		**52 642**	**29%**

Country of origin data were available for 8 127 overseas licence holders, representing a total of 82 nationalities. Numerically, the most common regions/countries of origin were Oceania (primarily Australia) and North America (primarily the US), followed by the British Isles, Southeast Asia (primarily Japan, Singapore, South Korea, and Hong Kong), and Europe (Table 6). Most overseas visitors (82% of the total) purchased a short-season licence, particularly those from Southeast Asia and Oceania. By contrast, European anglers (over half of whom came from just four of the 23 European countries represented: Germany, Denmark, Switzerland, and the Netherlands) were much more likely to invest in a whole-season licence.

Table 6: FGNZ fishing licence sales to overseas anglers, 2001/02, by origin and licence type.

	Licence type				
Origin	Whole season	Part season	Total	% of total	% whole-season
Oceania	309	2262	2571	31.6%	12%
North America	491	1906	2397	29.5%	21%
British Isles	275	964	1239	15.2%	22%
SE Asia	78	897	975	12.0%	8%
Europe	302	532	834	10.3%	36%
Africa	14	59	73	0.9%	19%
Latin America	0	38	38	0.5%	0%
Total	1469	6658	8127		**18%**

3.2. The replies

Excluding child licencees, a total of 19 098 licence holders were contacted during the survey, of whom 10 847 (56.8%) had fished during the survey period of interest. Taking family licences into account, responses for 24 719 individuals were obtained, representing 15 767 anglers who purchased a single-person licence, and a further 8 952 anglers fishing on 3 236 family licences. Collectively, respondents fished for a total of 72 004 days, on 827 recognised lake and river fisheries, with a further 351 days (0.49% of the total) spent on waters which could not be identified. This proportion was almost three times less than in the 1994/96 survey (1.32%), reflecting the increased effort put in by FGNZ Regional survey coordinators in checking and indexing the raw data sheets.

3.3. Usage estimates

The estimated angling effort by New Zealand resident licence holders during the 2001/02 angling season, totalled over all twelve FGNZ Regions, was 1 111 000 ± 16 000 angler days. Effort varied widely between fishing Regions, ranging from 1 870 ± 520 angler-days in Northland to 229 500 ± 7 600 in Eastern. River fishing (645 000

± 12 000 angler-days) accounted for 58% of the total, with lake fishing (466 000 ± 10 000 angler-days) accounting for 42%. River fishing was the dominant activity in all Regions except Northland, Eastern, and Otago (where lake fishing accounted for 55% - 78% of the total). River fishing was particularly popular in North Canterbury, Central South Island, Otago, and Southland, accounting for a combined total of 418 000 angler-days, or 65% of the national total for rivers. Conversely, three fishing Regions – Eastern, Central South Island, and Otago – accounted for 79% of all lake fishing. A full summary of angling within each fishing Region, giving estimated totals for each water fished by two-monthly survey period, is given in Appendix 1.

Stratum 1 licence holders (adult whole season and family) contributed by far the largest proportion (86.4%) of the total angling effort (959 900 ± 14 900 angler-days; Table 7). Stratum 2 licence holders (junior and young adult whole season) contributed a further 90 300 ± 4 800 angler-days (8.1% of the total), with Stratum 3 (part-season) licence holders accounting for the remaining 5.4% (60 500 ± 2 100 angler-days). However, these figures do not include part-season licence holders from Otago, who contributed an estimated 18 900 days to the national total (see Section 3.3.5). With their contribution included, part-season licence holders fished for 79 400 angler-days, or 7.0% of the national total. Mean effort per licence holder ranged from 20.7 days for Stratum 1 to 1.99 days for Stratum 3 (Table 7).

Table 7: Total angling effort (thousands of angler-days ± 1 standard error) by licence Region and stratum for the 2001/02 angling season. Total licences are for New Zealand residents only.

FGNZ Region	Stratum 1 (adult whole-season & family)	Stratum 2 (junior and young-adult whole-season)	Stratum 3 (part-season)	Total all strata
Northland	0.80 ± 0.10	0.11 ± 0.00	0.29 ± 0.05	1.20 ± 0.11
Auckland/Waikato	43.12 ± 2.00	3.72 ± 0.66	6.93 ± 0.90	53.77 ± 2.29
Eastern	178.34 ± 7.31	15.47 ± 1.53	26.47 ± 1.41	220.27 ± 7.61
Taranaki	7.26 ± 0.50	1.87 ± 0.40	0.59 ± 0.09	9.72 ± 0.64
Hawkes Bay	41.59 ± 2.06	2.81 ± 0.48	4.14 ± 0.50	48.54 ± 2.18
Wellington	41.64 ± 1.98	5.64 ± 0.83	2.23 ± 0.35	49.50 ± 2.18
Nelson/Marlborough	30.59 ± 1.36	2.02 ± 0.39	2.05 ± 0.19	34.66 ± 1.42
West Coast	20.94 ± 1.09	3.10 ± 0.45	1.12 ± 0.14	25.16 ± 1.19
North Canterbury	151.50 ± 6.04	10.86 ± 1.23	8.73 ± 0.79	171.10 ± 6.22
Central South Island	106.46 ± 4.48	6.09 ± 0.91	4.98 ± 0.49	117.52 ± 4.60
Otago	195.06 ± 8.09	17.63 ± 3.04	no data	212.69 ± 8.64
Southland	142.61 ± 5.49	21.01 ± 2.66	2.99 ± 0.36	166.62 ± 6.11
Total effort	**959.92 ± 14.87**	**90.32 ± 4.78**	**60.51 ± 2.06**	**1110.76 ± 15.76**
Total licences	**46 445**	**5 911**	**30 413**	**82 769**
Days per licence	**20.7**	**15.3**	**1.99**	**13.4**

3.3.1. Cross-boundary usage

Most angling (83.2%, i.e., five out of every six angler-days) was expended by anglers fishing within their licence Region, with most of the remainder (13.2%) expended in a geographically adjacent Region (Table 8). North Island licence holders spent an estimated 10 400 angler-days fishing South Island waters, but South Island anglers recorded only 1 300 days fishing North Island waters (excluding the Taupo Conservancy).

For most licence Regions, the total effort recorded by their own licence holders, taking into account those fishing in other licence Regions, was roughly the same as the total effort expended within the Region after taking into account the contribution by visiting anglers from other licence Regions. That is, cross-boundary fishing generally tended to cancel out, so that the total effort expended in each Region was similar to the total effort recorded by licence holders from that Region, irrespective of where they fished. Within the North Island, the main exceptions were Northland, and Auckland/Waikato. Auckland/Waikato licence holders recorded an estimated 17 800 angler-days in other Regions (primarily Eastern, and also Northland), whereas the Auckland/Waikato Region attracted only 7 700 angler-days from other licence Regions. In the Northland Region, by contrast, over half of the estimated total effort (1000 out of 1870 angler-days) was expended by anglers from other licence Regions.

Angler movements within the South Island were generally more pronounced, but – with the exception of North Canterbury and Central South Island – also tended to cancel out. North Canterbury licence holders recorded an estimated 63 500 angler-days (37% of their total effort) in other licence Regions, but 8.8% of the effort recorded in North Canterbury (10 300 out of 117 900 angler-days) was due to visitors from other licence Regions. By contrast, visitors to the Central South Island Region contributed an estimated 62 200 angler-days to the total for that fishing Region, whereas Central South Island licence holders recorded only 11 500 angler-days in other fishing Regions (Table 8). Substantial exchanges of effort (up to 19 200 angler-days) also occurred between other South Island Regions, particularly Southland, Otago, and Central South Island. Fidelity to an angler's licence Region (as measured by the proportion of the total effort expended by licence holders fishing within their Region of purchase) ranged from 62.9% for the North Canterbury Region to 93.4% for the Eastern Region.

Table 8: **Distribution of estimated angling effort (thousands of angler-days), 2001/02, by licence Region (row headings), and fishing Region (column headings). Diagonal entries (bold face) denote effort recorded by anglers fishing within their licence Region; off-diagonal entries represent cross-boundary fishing. Row totals give the total effort (± 1 standard error) recorded by licence holders from each Region; thus, Auckland/Waikato licence holders fished for an estimated 53 770 angler-days. Column totals give the total effort (± 1 standard error) recorded within each Region; thus, an estimated 43 650 angler-days were recorded within the Auckland/Waikato Region. See Section 3.3.1 for further details.**

	Region where angler fished													
Region where fishing licence was issued	**Northland**	**Auckland/Waikato**	**Eastern**	**Taranaki**	**Hawkes Bay**	**Wellington**	**Nelson/Marlborough**	**West Coast**	**North Canterbury**	**Central South Island**	**Otago**	**Southland**		**Total**
Northland	**0.87**	0.04	0.12	0.05	0.03	0.01	0.02	0.01	0.02	0.01	0.01	0.02	1.20 ±	0.11
Auckland/Waikato	0.83	**35.96**	15.03	0.07	0.36	0.14	0.22	0.07	0.18	0.42	0.22	0.29	53.77 ±	2.29
Eastern	0.12	6.04	**205.81**	0.52	2.60	0.89	0.97	0.37	0.20	1.39	1.30	0.06	220.27 ±	7.61
Taranaki	0.02	0.68	1.19	**6.72**	0.09	0.55	0.18	0.03	0.05	0.08	0.07	0.06	9.72 ±	0.64
Hawkes Bay		0.41	5.17	0.01	**41.28**	0.74	0.60	0.15	0.01	0.12	0.01	0.04	48.54 ±	2.18
Wellington		0.27	1.66	0.17	1.67	**42.88**	1.15	0.49	0.11	0.16	0.64	0.29	49.50 ±	2.18
Nelson/Marlborough	0.01	0.01	0.18		0.02	0.04	**28.75**	1.26	1.07	1.84	0.74	0.75	34.66 ±	1.42
West Coast						0.04	0.52	**22.00**	1.37	0.63	0.44	0.15	25.16 ±	1.19
North Canterbury	0.03	0.19	0.24	0.02	0.07		5.28	10.06	**107.59**	36.64	9.76	1.24	171.10 ±	6.22
Central South Island						0.03	0.21	0.40	5.95	**106.06**	4.11	0.77	117.52 ±	4.60
Otago		0.05	0.08		0.23		0.35	1.05	1.21	18.74	**182.19**	8.79	212.69 ±	8.64
Southland			0.02		0.04		0.28	0.13	0.18	2.15	19.22	**144.6**	166.62 ±	6.11
Total	**1.87**	**43.65**	**229.49**	**7.55**	**46.40**	**45.31**	**38.52**	**36.03**	**117.93**	**168.23**	**218.71**	**157.06**	**1110.76 ±**	**15.76**
	± 0.52	**± 2.27**	**± 7.57**	**± 0.59**	**± 2.1**	**± 2.11**	**± 1.75**	**± 1.55**	**± 5.18**	**± 5.87**	**± 8.66**	**± 5.92**		

3.3.2. Multi-reach rivers

Usage estimates for the 25 rivers which were subdivided into two or more reaches provide a more detailed breakdown of their angler usage (Table 9). These estimates were dependent on interviewers prompting the respondent for the necessary additional information, and were partially confounded by missing data, which affected 7% of the total usage. The most consistent results were for the high use rivers (annual effort ≥ 10 000 angler-days), where missing data affected only 3.7% of the estimates. By contrast, missing data affected 12% of the estimates for rivers attracting between 5 000 and 10 000 angler-days per year, and 26% of the estimates for rivers where the annual effort was less than 5 000 angler-days.

3.3.3. Child licence holders (Eastern Region)

Child licence holders from the Eastern Region fished for an estimated 32 000 ± 5 000 angler-days, 93% of which was expended within the Eastern Region (Table 10). The most popular waters were Ngongotaha Stream, the Rangitaiki River, and Lakes Rotorua, Aniwhenua, and Rotoiti. Some effort was recorded as far away as Southland and Otago, although estimates for many of these waters (e.g. the Seaforth River) are based on a single response, and are thus of low precision.

3.3.4. River and lake fishing

Within the Regions administered by FGNZ, river fishing was more popular than lake fishing, accounting for 58% of the total effort (Table 11). However, the popularity of lake fishing varied greatly between fishing Regions, ranging from 5% - 6% of the annual total in Wellington and Hawkes Bay to 78% in the Eastern Region. Most lake fishing (74.4%) occurred on lakes of natural origin, primarily in the Eastern Region and the lower South Island, but artificial reservoirs (particularly large hydroelectric impoundments) were also popular in Auckland/Waikato (e.g., Lake Arapuni); Eastern (e.g., Lake Aniwhenua); Central South Island (e.g., Lakes Aviemore and Benmore); and Otago (Lake Dunstan). In Otago, irrigation dams were also an important angling resource, collectively accounting for 10 800 ± 1400 angler-days in the Taieri catchment, and 9 300 ± 1 000 angler-days in the Clutha catchment (see Appendix 1 for further details).

Table 9: **Estimated angling effort (angler-days ± 1 standard error) for 25 rivers which were subdivided into two or more reaches. Rivers are ordered by catchment number (Anon. 1956), and so appear in clockwise order within each island.**

River	Reach	Effort
Tarawera River	Not specified	1 390 ± 560
	Lake outlet to falls	640 ± 290
	Below falls	2 040 ± 630
	Total, all reaches	4 070 ± 890
Rangitaiki River	Not specified	2 020 ± 630
	Above Lake Aniwhenua/Rabbit Bridge	4 400 ± 1 560
	Aniwhenua Dam to Lake Matahina	2 350 ± 1 570
	Below Matahina Dam	770 ± 250
	Total, all reaches	9 540 ± 2 310
Mohaka River	Not specified	660 ± 170
	Above Mangatainoka confluence	900 ± 230
	Mangatainoka to SH5 bridge	2 350 ± 350
	Below SH5 bridge	3 160 ± 560
	Total, all reaches	7 070 ± 710
Ngaruroro River	Not specified	110 ± 50
	Above Taruarau confluence	980 ± 280
	Below Taruarau confluence	5 150 ± 660
	Total, all reaches	6 240 ± 720
Tukituki River	Not specified	470 ± 180
	Above Waipawa confluence	2 490 ± 480
	Waipawa confluence to Patangata bridge	4 110 ± 650
	Below Patangata bridge	10 140 ± 1 210
	Total, all reaches	17 210 ± 1 470
Ruamahanga River	Not specified	330 ± 160
	Above Mount Bruce (SH2)	150 ± 90
	Mount Bruce (SH2) to Masterton	360 ± 110
	Masterton to Martinborough (SH53)	4 970 ± 720
	Martinborough to Lake Onoke	1 090 ± 300
	Total, all reaches	6 910 ± 810
Manawatu River	Not specified	150 ± 60
	Above Dannevirke	1 170 ± 340
	Dannevirke to SH2 (Woodville)	3 730 ± 710
	SH2 (Woodville) to Palmerston North	6 820 ± 980
	Palmerston North to Foxton	2 000 ± 400
	Total, all reaches	13 860 ± 1 320
Rangitikei River	Not specified	420 ± 150
	Above Mangaohane Bridge	850 ± 170

River	Reach	Effort
	Mangaohane Bridge to Vinegar Hill	2 130 ± 380
	Vinegar Hill to Tangimoana	2 490 ± 490
	Total, all reaches	5 890 ± 660
Whanganui River	Not specified	430 ± 160
	Above Ohura confluence (Auckland Region)	1 260 ± 360
	Below Ohura confluence (Taranaki Region)	190 ± 80
	Total, all reaches	1 880 ± 400
Waikato River	Not specified	470 ± 150
	Huka Falls to L Ohakuri (Eastern Region)	1 930 ± 1 080
	Below Karapiro (Auckland/Waikato Region)	4 360 ± 780
	Total, all reaches	6 750 ± 1 340
Takaka River	Not specified	220 ± 100
	Above Lindsay's Bridge	360 ± 110
	Below Lindsay's Bridge	540 ± 150
	Total, all reaches	1 120 ± 210
Motueka River	Not specified	1 510 ± 470
	Above Wangapeka	1 010 ± 180
	Below Wangapeka	3 870 ± 430
	Total, all reaches	6 390 ± 660
Pelorus River	Not specified	320 ± 140
	Above Pelorus Bridge	180 ± 60
	Below Pelorus Bridge	1 090 ± 200
	Total, all reaches	1 600 ± 250
Wairau River	Not specified	1 230 ± 470
	Above Wash Bridge	1 430 ± 240
	Below Wash Bridge	5 750 ± 680
	Total, all reaches	8 410 ± 860
Clarence River	Not specified	280 ± 130
	Above Acheron	160 ± 80
	Below Acheron	180 ± 80
	Total, all reaches	620 ± 170
Hurunui River	Not specified	1 100 ± 370
	Above Mandamus	2 910 ± 350
	Below Mandamus	4 370 ± 850
	Total, all reaches	8 380 ± 990
Waitaki River	Not specified	1 580 ± 480
	Waitaki Dam to Kurow Bridge	3 600 ± 960
	Kurow Bridge to stone wall/pylons	4 640 ± 760
	Stone wall/pylons to SH1	4 640 ± 900
	SH1 to tidal limit	2 330 ± 390

River	Reach	Effort
	Mouth and tidal zone	10 770 ± 2 070
	Total, all reaches	27 580 ± 2 640
Taieri River	Not specified	1 140 ± 500
	Above Kokonga	3 660 ± 730
	Kokonga to Outram Bridge	1 050 ± 270
	Outram Bridge to Taieri Mouth	13 230 ± 2 470
	Total, all reaches	19 070 ± 2 640
Clutha River	Not specified	2 710 ± 980
	Wanaka to Lake Dunstan	20 160 ± 2 760
	Below Roxburgh	14 450 ± 2 950
	Total, all reaches	37 320 ± 4 160
Mataura River	Not specified	300 ± 90
	Above Gore	15 810 ± 1 800
	Below Gore	36 850 ± 3 510
	Total, all reaches	52 960 ± 3 950
Oreti River	Not specified	340 ± 140
	Above Lumsden	2 700 ± 800
	Below Lumsden	17 590 ± 1 950
	Total, all reaches	20 620 ± 2 110
Waiau River	Not specified	850 ± 320
	Te Anau to Manapouri	5 920 ± 1 120
	Below Mararoa	7 890 ± 940
	Total, all reaches	14 660 ± 1 500
Arnold River	Not specified	510 ± 150
	Lake Brunner to dam	570 ± 130
	Dam to Stillwater	350 ± 80
	Total, all reaches	1 420 ± 210
Grey River	Not specified	730 ± 210
	Above Ikamatua	1 400 ± 350
	Below Ikamatua	4 130 ± 540
	Total, all reaches	6 270 ± 680
Buller River	Not specified	750 ± 360
	Rotoiti to Gowanbridge	1 320 ± 230
	Gowanbridge to Lyell	660 ± 130
	Below Lyell	1 580 ± 280
	Total, all reaches	4 310 ± 520

Table 10: Estimated angling effort (angler-days ± 1 standard error) by child licence holders from the Eastern Region.

FGNZ Region	Lake/river name	Total effort
Auckland/Waikato	Ohinemuri River	30 ± 30
	Waihou River	310 ± 310
	Waikato River	480 ± 360
Eastern	Aniwhenua Lake	2 500 ± 2 500
	Hatchery Kids Pond	50 ± 30
	Kaituna River	30 ± 30
	Matahina Lake	190 ± 140
	McLaren Falls Dam	20 ± 20
	Motu River	100 ± 100
	Ngatamawahine Stream	140 ± 140
	Ngongotaha Stream	6 530 ± 2 140
	Okataina Lake	220 ± 220
	Rangitaiki River	3 770 ± 2 630
	Rerewhakaaitu Lake	300 ± 180
	Rotoiti Lake	2 540 ± 1 310
	Rotoma Lake	930 ± 280
	Rotorua Lake	5 130 ± 1 500
	Ruahihi Canal	140 ± 140
	Ruruanga Stream	1 880 ± 1 070
	Tarawera Lake	1 680 ± 410
	Tarawera River	230 ± 110
	Utuhina Stream	1 270 ± 710
	Waikaremoana Lake	940 ± 450
	Waimana River	20 ± 20
	Waimata River	1 030 ± 1 030
	Waiotahi River	160 ± 160
	Waiteti Stream	30 ± 30
Hawkes Bay	Hautapu River	50 ± 50
Wellington	Manawatu River	30 ± 30
North Canterbury	Coleridge Lake	40 ± 40
Central South Island	Ahuriri River	20 ± 20
	Benmore Lake	160 ± 120
	Pukaki Lake	30 ± 30
Otago	Dunstan Lake	400 ± 400
	Route Burn	330 ± 330
Southland	Seaforth River	330 ± 330
Total		**32 080 ± 5 070**

Table 11: Estimated angling effort (thousands of angler-days ± 1 standard error) devoted to lake and river fishing, by fishing Region, for the 2001/02 survey.

FGNZ Region	Lakes	Rivers	Total	Lake fishing as % of total
Northland	1.34 ± 0.50	0.53 ± 0.12	1.87 ± 0.52	71.7%
Auckland/Waikato	17.08 ± 1.30	26.56 ± 1.86	43.65 ± 2.27	39.1%
Eastern	178.06 ± 6.36	51.44 ± 4.11	229.49 ± 7.57	77.6%
Taranaki	2.46 ± 0.37	5.09 ± 0.46	7.55 ± 0.59	32.6%
Hawkes Bay	2.58 ± 0.40	43.82 ± 2.06	46.40 ± 2.10	5.6%
Wellington	2.26 ± 0.45	43.05 ± 2.06	45.31 ± 2.11	5.0%
Nelson/Marlborough	5.87 ± 0.60	32.65 ± 1.64	38.52 ± 1.75	15.2%
West Coast	11.90 ± 0.95	24.12 ± 1.21	36.03 ± 1.54	33.0%
North Canterbury	21.56 ± 1.25	96.38 ± 5.01	117.93 ± 5.17	18.3%
Central South Island	71.77 ± 3.31	96.46 ± 4.83	168.23 ± 5.86	42.7%
Otago	119.91 ± 5.99	98.81 ± 6.25	218.71 ± 8.66	54.8%
Southland	30.89 ± 2.59	126.17 ± 5.32	157.06 ± 5.92	19.7%
Total	**465.68 ± 9.97**	**645.08 ± 12.21**	**1110.76 ± 15.76**	**41.9%**

3.3.5. Non-sampling errors and adjustments

Because two significant groups of licence holders (overseas anglers, and part-season licence holders from Otago) were not surveyed, the data presented in Appendix 1 and Tables 7-11 underestimate the total angling effort expended on FGNZ-administered waters in 2001/02. To gauge the extent to which this occurred, we adjusted the existing estimates as follows. For overseas licence holders (as identified in Table 1), we assumed that the total effort per licence holder was the same as for New Zealand resident licence holders within the same survey stratum. For example, if a particular stratum represented 5 500 licence holders, of which 5 000 were New Zealand residents, we assumed that results for that stratum were underestimated by a factor of 5500/5000, i.e., 1.10. These adjustments are listed in Table 12.

To estimate the required adjustment for Otago part-season licence holders, we examined the relationship between the total number of licences, and the estimated total effort, for Stratum 3 licence holders in the eleven remaining FGNZ Regions. This analysis (Fig. 3) showed that total effort and total licence sales were highly correlated ($r = 0.979$), with the slope of the regression line (1.930) indicating an average of just under two days per licence holder. We therefore used this regression equation to estimate the total effort contributed by Otago part-season licence holders for the six missing strata.

Table 12: **Adjusted usage estimates (thousands of angler-days, by licence Region) taking into account the contribution from overseas anglers, and Otago part-season licence holders, who were not sampled in the 2001/02 survey. For each Region, successive columns show the unadjusted usage estimates, the estimated contribution from unsampled licence holders, the adjusted usage estimates, and the percentage adjustment. Note that because all figures relate to licence Region rather than fishing Region, they do not necessarily indicate how the adjusted effort should be apportioned between fishing Regions.**

Licence type and FGNZ Region	Estimated usage (unadjusted)	Contribution from un-sampled licences	Estimated usage (adjusted)	% adjustment
Part-season licence holders				
Otago	-	18.51	18.51	-
Overseas licence holders				
Northland	1.20	0.23	1.43	19.3%
Auckland/Waikato	53.77	2.14	55.92	4.0%
Eastern	220.27	21.44	241.71	9.7%
Taranaki	9.72	0.18	9.90	1.9%
Hawkes Bay	48.54	3.60	52.14	7.4%
Wellington	49.50	0.66	50.16	1.3%
Nelson/Marlborough	34.66	4.21	38.87	12.1%
West Coast	25.16	2.00	27.16	7.9%
North Canterbury	171.10	10.57	181.67	6.2%
Central South Island	117.52	4.51	122.03	3.8%
Otago	212.69	7.51	220.19	3.5%
Southland	166.62	4.29	170.91	2.6%
Total, all overseas anglers	**1110.76**	**61.34**	**1172.09**	**5.2%**
Total, all adjustments	**1110.76**	**79.86**	**1190.61**	**7.2%**

These adjustments contributed an additional 79 900 angler-days, made up of 61 300 angler-days from overseas anglers and 18 500 angler-days from Otago part-season licences (including overseas anglers), and bringing the estimated annual total for all twelve FGNZ Regions to 1 191 000 angler-days (Table 12). Subject to the validity of the assumptions detailed in the preceding two paragraphs, therefore, overseas anglers accounted for about 5.1% of the national total.

Although the same procedures could, in principle, be used to adjust usage estimates for the individual waters listed in Appendix 1, we do not believe this is viable. In particular, the assumption that overseas anglers apportion their effort between waters in the same way as New Zealand residents is almost certainly not justified. For

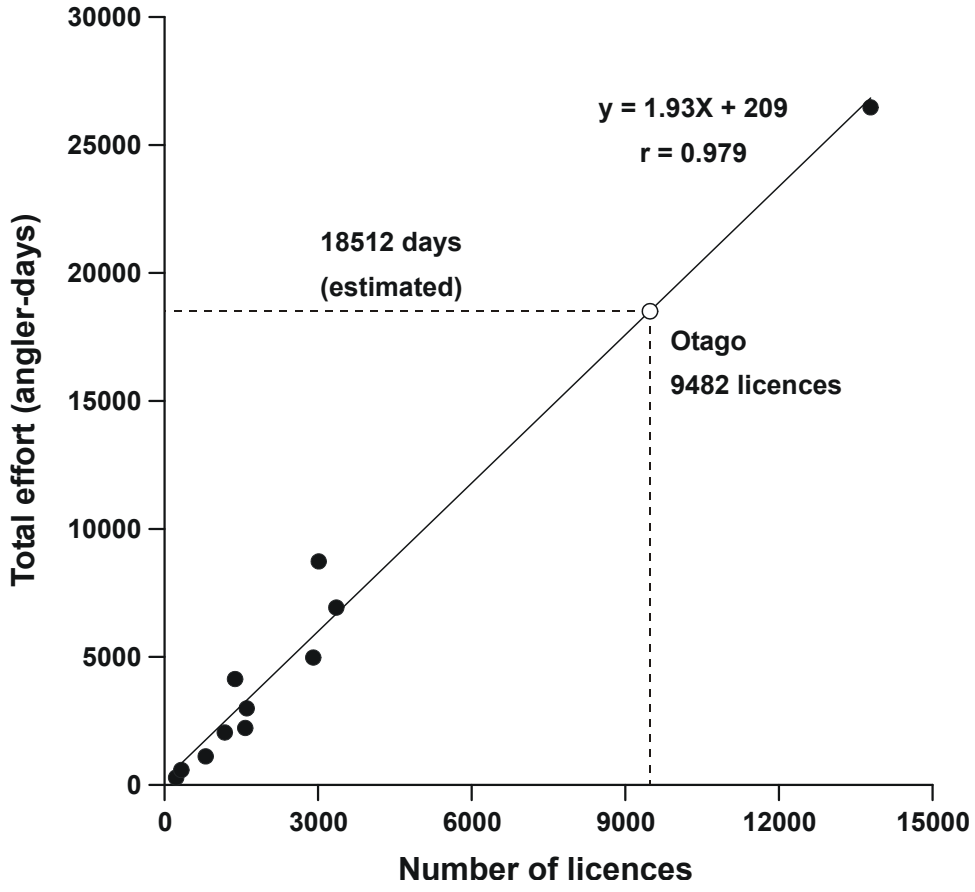

Figure 3: **The relationship between total licence sales and estimated total annual angling effort for Stratum 3 (part-season) licence holders from all FGNZ Regions except Otago (solid symbols), together with the linear regression equation used to estimate total effort for Otago licence holders (open symbol).**

example, creel survey and angler interview data for several FGNZ Regions (e.g., Otago, Nelson/Marlborough) show that overseas visitors make up a much higher proportion of the anglers on some waters than on others, particular high profile fisheries such as the Mataura and Greenstone/Caples. There is also no guarantee that overseas anglers fished exclusively in their licence Region, so that the adjustments listed in Table 12 do not necessarily indicate where the extra effort should be apportioned. Consequently, all subsequent results in this report are based on the unadjusted data.

3.4. Trends in Usage 1994/96 – 2001/02

3.4.1. National trends

To highlight trends in usage between the 1994/96 and 2001/02 surveys, we merged usage estimates for the two surveys into a single dataset, after making a few necessary

updates to the 1994/96 data to allow for changes in the survey methodology (such as multi-use rivers) which were implemented in 2001/02. For tabulation purposes, we ignored the distinction between large and small natural lakes (so that lake fisheries were classified as either natural lakes or artificial reservoirs), and also between headwater and back country fisheries (all of which were grouped as back country fisheries). Usage estimates for 1994/96 are included in Appendix 1.

Comparisons between the two surveys are partially confounded by the different approaches taken to the absence of data for overseas anglers. No allowance was made for these anglers in the 1994/96 survey, in that the number of licences N_i for each stratum (Section 2.2.3) included overseas and New Zealand resident licence holders, rather than just New Zealand residents as in the 2001/02 survey. The 1994/96 usage estimates are thus equivalent to the adjusted estimates for the 2001/02 survey (Table 12), which include an additional 61 300 angler-days contributed by overseas anglers. Inclusion of Otago part-season licence holders represents an additional adjustment of 18 500 angler-days (Section 3.3.5), although most of this is likely to have been confined to the Otago Region. The absence of data for Northland licence holders in 1994/96 introduces a further difference between the two surveys, although the 2001/02 results suggest the resulting discrepancy is less than about 2 000 angler-days.

Taking the above differences into consideration, total angling effort for all twelve FGNZ Regions appears to have changed very little between the two surveys (Table 13). Total estimated usage was 1.156 million angler-days in 1994/96, compared to 1.111 million angler-days in 2001/02. The decrease (45 000 angler-days) is less than the estimated 2001/02 contribution of 61 300 angler-days from overseas anglers, and is further offset by the contribution from Otago part-season licence holders. Including both adjustments, the 2001/02 total exceeds the 1994/96 figure by 35 700 angler-days, with a standard error (based on the unadjusted data) of approximately 24 000 angler-days.

Despite the lack of variation in total effort for the whole country (excluding the Taupo Conservancy), there is some evidence of a move from river fishing to lake fishing in 2001/02 (Table 13). Lake fishing effort increased by 30 100 ± 14 300 angler-days, while river fishing effort decreased by 74 800 ± 18 600 angler-days. The increase in lake fishing effort was most marked in the lower half of the South Island, particularly in the Central South Island and Otago Regions. The main exception to the overall trend was the Eastern Region, where lake fishing effort fell by an estimated 19 300 angler-days. However, overseas anglers fishing on Eastern Region licences contributed an estimated 21 400 angler-days in 2001/02 (Table 12), much of which is likely to have been expended on high profile Eastern lakes such as Tarawera, Rotoiti, and Rotorua, so that the observed decline may be largely an artefact of the differences

Table 13: **Estimated angling effort (thousands of angler-days ± 1 standard error) devoted to lake and river fishing, by fishing Region, for the 1994/96 and 2001/02 surveys. For each type of fishery, and for all waters combined, the table shows total usage for the two surveys and the difference between the two figures. The Northland Region was not surveyed in 1994/96, so the only data available are for anglers from other Regions (predominantly Auckland/Waikato) who fished within the Northland Region.**

	Lake fisheries			River fisheries			All waters		
FGNZ Region	**1994/96**	**2001/02**	**Difference**	**1994/96**	**2001/02**	**Difference**	**1994/96**	**2001/02**	**Difference**
Northland	(0.3 ± 0.1)	1.3 ± 0.5			0.5 ± 0.1		(0.3 ± 0.1)	1.9 ± 0.5	
Auckland/Waikato	18.7 ± 1.4	17.1 ± 1.3	-1.6 ± 1.9	28.1 ± 1.6	26.6 ± 1.9	-1.5 ± 2.5	46.7 ± 2.1	43.6 ± 2.3	-3.1 ± 3.1
Eastern	197.3 ± 8.0	178.1 ± 6.4	-19.3 ± 10.3	53.1 ± 4.6	51.4 ± 4.1	-1.7 ± 6.2	250.4 ± 9.3	229.5 ± 7.6	-20.9 ± 12.0
Taranaki	3.3 ± 0.3	2.5 ± 0.4	-0.9 ± 0.5	8.0 ± 0.6	5.1 ± 0.5	-2.9 ± 0.8	11.4 ± 0.7	7.5 ± 0.6	-3.8 ± 0.9
Hawkes Bay	3.3 ± 0.2	2.6 ± 0.4	-0.8 ± 0.4	34.5 ± 0.6	43.8 ± 2.1	9.3 ± 2.1	37.8 ± 0.6	46.4 ± 2.1	8.6 ± 2.2
Wellington	6.0 ± 1.2	2.3 ± 0.5	-3.7 ± 1.3	62.0 ± 3.0	43.1 ± 2.1	-19.0 ± 3.6	68.0 ± 3.2	45.3 ± 2.1	-22.7 ± 3.9
Nelson/Marlborough	5.5 ± 0.7	5.9 ± 0.6	0.4 ± 1.0	40.8 ± 2.1	32.7 ± 1.6	-8.1 ± 2.6	46.3 ± 2.2	38.5 ± 1.7	-7.7 ± 2.8
West Coast	7.5 ± 0.8	11.9 ± 1.0	4.4 ± 1.2	18.5 ± 1.2	24.1 ± 1.2	5.6 ± 1.7	26.0 ± 1.4	36.0 ± 1.5	10.0 ± 2.1
North Canterbury	19.4 ± 1.9	21.6 ± 1.3	2.2 ± 2.3	147.3 ± 9.5	96.4 ± 5.0	-50.9 ± 10.8	166.7 ± 9.7	117.9 ± 5.2	-48.8 ± 11.0
Central South Island	45.3 ± 2.8	71.8 ± 3.3	26.4 ± 4.4	120.8 ± 4.9	96.5 ± 4.8	-24.3 ± 6.9	166.1 ± 5.6	168.2 ± 5.9	2.1 ± 8.1
Otago	105.2 ± 4.5	119.9 ± 6.0	14.7 ± 7.5	77.7 ± 4.6	98.8 ± 6.2	21.1 ± 7.8	182.9 ± 6.5	218.7 ± 8.7	35.8 ± 10.8
Southland	23.7 ± 1.7	30.9 ± 2.6	7.2 ± 3.1	129.1 ± 4.8	126.2 ± 5.3	-2.9 ± 7.1	152.8 ± 5.1	157.1 ± 5.9	4.2 ± 7.8
Total	**435.6 ± 10.2**	**465.7 ± 10.0**	**30.1 ± 14.3**	**719.9 ± 14.1**	**645.1 ± 12.2**	**-74.8 ± 18.6**	**1155.5 ± 17.4**	**1110.8 ± 15.8**	**-44.7 ± 23.5**

in methodology between the two surveys. By contrast, the decline in river fishing within the North Canterbury and Central South Island Regions appears to have been real, and reflects the poor salmon fishing season in 2001/02. Averaged over the whole country, lake fishing accounted for 38% of the total effort in 1994/96, compared to 42% in 2001/02.

3.4.2. Regional trends

Notwithstanding the uncertainties associated with overseas angler usage, there were some marked changes in usage patterns at Regional level, primarily in the South Island (Table 14). Totalled over the South Island, and based on unadjusted estimates, angler usage increased significantly for lake and reservoir fisheries, for back country fisheries, and for canal-based fisheries, and decreased significantly for mainstem and lowland river fisheries. However, the extent to which these trends were apparent differed markedly between fishing Regions. The largest changes, in the North Canterbury and Central South Island Regions, were associated with the poor salmon season, with mainstem river fishing falling by almost one third (from 204 600 ± 9 800 angler-days in 1994/96 to 140 100 ± 6 200 angler-days in 2001/02). In the North Canterbury Region, where there are no other waters able to sustain fishing on a comparable scale, the poor salmon season was directly reflected in substantially reduced effort for the Region as a whole (Table 13). In the Central South Island Region, by contrast, anglers appear to have switched their attention to the many lake fisheries available, notably Tekapo, Alexandrina, Ohau, Benmore, and Aviemore (Appendix 1). There was also evidence of a marked increase in effort on the various canals of the upper Waitaki hydroelectric schemes, which rose from 1 900 ± 700 angler-days in 1994/96 to 13 500 ± 2 300 angler-days in 2001/02 (Appendix 1).

A decrease in lowland river fishing was recorded in most South Island Regions (Table 14). The most notable decrease was in North Canterbury, where the total effort fell by 60%, from 30 700 angler-days in 1994/96 to 12 300 angler-days in 2001/02. Most of this decrease was associated with lower Waimakariri tributaries such as the Cam and Waimakariri South Branch, and Lake Ellesmere tributaries such as the Selwyn, Halswell, and L II. For the Selwyn/Ellesmere catchment as a whole, annual usage fell by 68%, from 11 700 to 3 700 angler-days (Appendix 1). Other South Island Regions showing a similar decline were Central South Island and Nelson/Marlborough, where a moderate decrease in lowland river fishing effort was paralleled by a comparable decrease on some mainstem rivers (e.g., the Motueka and Opihi), the lower reaches of which share many of the characteristics of lowland rivers.

Table 14 **Estimated angling effort (thousands of angler-days ± 1 standard error), by fishing Region and type of fishery, for the 1994/96 and 2001/02 surveys. Note that the 2001/02 estimates are based on unadjusted data and are therefore conservative, so that values in the difference column will tend to be conservative (i.e., too negative). Tests of significance (based on a t-test, with one, two, and three stars corresponding to p values of 0.95, 0.99, and 0.999, respectively) are therefore conservative for positive differences, and anti-conservative for negative differences. n.d. = no data.**

FGNZ Region	Type of fishery	1994/96	2001/02	Difference	Significance
Northland	Lake	(0.3 ± 0.1)	1.2 ± 0.5	n.d.	
	Reservoir	n.d.	0.1 ± 0.0	n.d.	
	Lowland river	n.d.	0.5 ± 0.1	n.d.	
Auckland/Waikato	Lake	4.9 ± 0.6	2.9 ± 0.5	-2.0 ± 0.8	** (-)
	Reservoir	13.8 ± 1.2	14.2 ± 1.2	0.5 ± 1.7	
	Mainstem river	9.0 ± 0.9	8.6 ± 1.4	-0.4 ± 1.7	
	Lowland river	19.0 ± 1.3	17.9 ± 1.2	-1.1 ± 1.8	
Eastern	Lake	173.4 ± 7.7	160.7 ± 5.6	-12.7 ± 9.5	
	Reservoir	23.9 ± 2.3	17.4 ± 3.0	-6.5 ± 3.8	
	Lowland river	35.3 ± 4.2	33.7 ± 3.5	-1.6 ± 5.5	
	Back country	16.7 ± 1.8	16.7 ± 2.0	-0.1 ± 2.7	
	Canal	1.1 ± 0.4	1.1 ± 0.5	0.0 ± 0.7	
Taranaki	Lake	1.7 ± 0.2	1.1 ± 0.3	-0.6 ± 0.3	
	Reservoir	1.6 ± 0.2	1.3 ± 0.2	-0.3 ± 0.3	
	Lowland river	4.7 ± 0.4	3.6 ± 0.4	-1.1 ± 0.6	
	Back country	3.4 ± 0.4	1.5 ± 0.2	-1.9 ± 0.5	*** (-)
Hawkes Bay	Lake	3.3 ± 0.2	2.4 ± 0.4	-1.0 ± 0.4	** (-)
	Reservoir	< 50	0.2 ± 0.1	0.2 ± 0.1	
	Mainstem river	21.6 ± 0.5	29.5 ± 1.8	8.0 ± 1.8	*** (+)
	Lowland river	11.5 ± 0.3	11.9 ± 1.0	0.5 ± 1.1	
	Back country	1.5 ± 0.1	2.3 ± 0.4	0.9 ± 0.4	* (+)
Wellington	Lake	5.2 ± 1.2	1.7 ± 0.4	-3.5 ± 1.2	** (-)
	Reservoir	0.9 ± 0.2	0.6 ± 0.2	-0.2 ± 0.3	
	Mainstem river	45.0 ± 2.7	32.8 ± 1.9	-12.2 ± 3.3	*** (-)
	Lowland river	13.3 ± 1.2	7.4 ± 0.6	-5.9 ± 1.4	*** (-)
	Back country	3.6 ± 0.6	2.9 ± 0.6	-0.8 ± 0.8	
	Canal	0.1 ± 0.1	< 50	-0.1 ± 0.1	
All North Island	Lake	188.8 ± 7.8	169.9 ± 5.7	-18.9 ± 9.7	
	Reservoir	40.2 ± 2.7	33.9 ± 3.3	-6.3 ± 4.2	
	Back country	25.2 ± 2.0	23.3 ± 2.1	-1.8 ± 2.9	
	Canal	1.2 ± 0.4	1.1 ± 0.5	-0.1 ± 0.7	
	Lowland river	83.8 ± 4.6	75.1 ± 4.0	-8.7 ± 6.1	

FGNZ Region	Type of fishery	1994/96	2001/02	Difference	Significance
	Mainstem river	75.6 ± 2.9	71.0 ± 2.9	-4.6 ± 4.1	
Nelson/Marlborough	Lake	3.8 ± 0.7	4.7 ± 0.6	1.0 ± 0.9	
	Reservoir	1.7 ± 0.3	1.2 ± 0.2	-0.6 ± 0.3	
	Mainstem river	22.0 ± 1.7	17.5 ± 1.2	-4.5 ± 2.1	** (-)
	Lowland river	10.1 ± 0.9	6.6 ± 0.5	-3.6 ± 1.1	*** (-)
	Back country	8.6 ± 0.8	8.4 ± 1.0	-0.2 ± 1.3	
	Canal	< 50	0.2 ± 0.2	0.1 ± 0.2	
West Coast	Lake	7.5 ± 0.8	11.9 ± 1.0	4.4 ± 1.2	*** (+)
	Mainstem river	4.6 ± 0.4	8.0 ± 0.7	3.3 ± 0.8	*** (+)
	Lowland river	0.3 ± 0.1	0.6 ± 0.2	0.3 ± 0.2	
	Back country	13.6 ± 1.1	15.4 ± 0.9	1.9 ± 1.5	
	Canal	< 50	0.1 ± 0.1	0.1 ± 0.1	
North Canterbury	Lake	19.4 ± 1.9	20.6 ± 1.2	1.2 ± 2.3	
	Reservoir	< 50	1.0 ± 0.5	1.0 ± 0.5	
	Mainstem river	111.6 ± 8.7	80.9 ± 4.8	-30.6 ± 10.0	*** (-)
	Lowland river	30.7 ± 3.5	12.3 ± 1.2	-18.5 ± 3.7	*** (-)
	Back country	2.7 ± 0.7	3.2 ± 0.5	0.4 ± 0.8	
	Canal	2.3 ± 1.2	< 50	-2.2 ± 1.2	
Central South Island	Lake	17.4 ± 1.6	30.8 ± 2.2	13.4 ± 2.7	*** (+)
	Reservoir	27.9 ± 2.3	41.0 ± 2.5	13.0 ± 3.4	*** (+)
	Mainstem river	93.1 ± 4.4	59.2 ± 3.8	-33.9 ± 5.9	*** (-)
	Lowland river	16.4 ± 1.5	10.6 ± 1.3	-5.8 ± 2.0	** (-)
	Back country	9.4 ± 1.1	12.2 ± 1.1	2.9 ± 1.5	
	Canal	2.0 ± 0.7	14.5 ± 2.4	12.5 ± 2.5	*** (+)
Otago	Lake	68.9 ± 4.0	77.2 ± 4.9	8.3 ± 6.3	
	Reservoir	36.3 ± 2.1	42.7 ± 3.5	6.5 ± 4.1	
	Mainstem river	41.4 ± 3.6	58.1 ± 5.0	16.7 ± 6.1	** (+)
	Lowland river	17.8 ± 2.2	17.1 ± 2.5	-0.6 ± 3.3	
	Back country	18.5 ± 1.9	23.6 ± 2.8	5.1 ± 3.4	
Southland	Lake	23.7 ± 1.7	30.9 ± 2.6	7.2 ± 3.1	* (+)
	Mainstem river	97.5 ± 4.3	95.0 ± 4.8	-2.5 ± 6.5	
	Lowland river	8.4 ± 1.0	3.7 ± 0.8	-4.7 ± 1.2	*** (-)
	Back country	23.1 ± 1.7	27.5 ± 2.1	4.3 ± 2.7	
All South Island	Lake	140.7 ± 5.1	176.1 ± 6.2	35.4 ± 8.0	*** (+)
	Reservoir	65.9 ± 3.2	85.8 ± 4.3	19.9 ± 5.3	*** (+)
	Back country	76.0 ± 3.2	90.3 ± 3.9	14.3 ± 5.1	** (+)
	Canal	4.3 ± 1.4	14.8 ± 2.4	10.5 ± 2.8	*** (+)
	Lowland river	83.7 ± 4.6	50.9 ± 3.2	-32.8 ± 5.6	*** (-)
	Mainstem river	370.2 ± 11.4	318.7 ± 9.4	-51.5 ± 14.8	*** (-)

The Otago Region was characterised by a moderate increase in all types of fishing except lowland rivers (Table 14), the magnitude of which is likely to have been considerably underestimated because of the lack of water-specific data for the 18 900 angler-days contributed by part-season licence holders. However, the available data suggest that three waters in particular experienced a marked increase in effort between 1994/96 and 2001/02: the Taieri River (from 11 500 to 19 100 angler-days); the upper Clutha River (from 11 400 to 20 200 angler-days; see Table 9); and Lake Hawea (from 18 900 to 28 200 angler-days). The increased popularity of the upper Clutha River and Lake Hawea reflected a general increase over the whole upper Clutha region (above Lake Roxburgh), where total effort rose from 121 800 to 143 100 angler-days.

Elsewhere in the South Island, and in most of the North Island, usage patterns were often remarkably stable, particularly when considered at catchment level (Table 14, Appendix 1). Major catchments showing little if any change in usage between the two surveys included: the Waikato (Auckland\Waikato Region); the Wairoa (Tauranga), Wairoa (Gisborne), Kaituna, and Tarawera (Eastern Region); the Tutaekuri (Hawkes Bay Region); the Ruamahanga, Manawatu, and Rangitikei (Wellington Region); the Wairau and upper Buller (Nelson/Marlborough); the Ashburton (Central South Island Region), and the Mataura (Southland Region). Important exceptions included the Rangitaiki River, Mohaka River, Ngaruroro River, Lake Brunner, Grey River, and the Waiau River in Southland, all of which experienced a significant increase in popularity; and Lake Rotorua, the Taranaki Region as a whole, the Hutt River, Motueka River, Hurunui River, Oreti River, and Aparima River, all of which experienced a decrease.

3.5. GIS Interface: progress and problems

The River Environment Classification (REC) scheme, which is currently being developed as part of NIWA's Freshwater Information New Zealand (FINZ) project[4], is a GIS-based tool intended to provide resource managers with a consistent spatial context for freshwater-related monitoring, impact assessment, and policy development (Snelder & Biggs 2002). For the purposes of the present survey, the key feature of the REC is that it objectively classifies all New Zealand rivers, at a 1:50,000 mapping scale, in terms of physical variables such as flow regime, catchment geology, and land cover, and allows this information to be analysed and mapped at spatial scales ranging from regional ($10^4 – 10^5$ km^2) to local (~ 10 km^2).

Within the REC, the location of river channels is deduced solely from satellite-derived data on land elevation, so as to form a network of linked segments. Each of these is

[4] See http://www.niwa.co.nz/ncwr/finz/, and http://www.niwa.co.nz/ncwr/tools#REC, for further information on FINZ and the REC, respectively.

specified by a unique ID number that is used to allow network tracing, and to associate related information such as segment area, mean altitude, and land cover. However, this information does not include river names, which can be handled only by manually identifying the two segments corresponding to the upstream and downstream ends of each named river or tributary, merging all the intervening segments into a single unit, and assigning the appropriate name to the merged unit. Explicitly carrying out this step is essential, as graphical output from the REC would otherwise be confounded by segments for irrelevant low-order tributaries, particularly in large catchments (such as the Clutha and Waikato) where the REC recognises up to eight levels of stream order.

For the purposes of the present report, we identified all river fisheries recorded in the 2001/02 survey, identified appropriate REC segments to serve as endpoints, and developed a series of programs to extract the relevant intervening segments from the river network. Currently, this dataset allows us to determine local and upstream catchment characteristics for each river segment, including individual reach lengths, but does not allow us to generate information about an entire river. For example, the task of determining the total length of each river, and hence expressing annual usage in terms of angler densities per km, is relatively straightforward, but requires further programming before it can be completed. To achieve maximum benefit from the REC, we would need a further program modification to explicitly associate the uppermost segment for each named river fishery with all contiguous downstream segments. This would allow us to merge all segments making up each individual river, so as to define a geographically meaningful waterway which could be named, and for which relevant physical properties could be calculated.

The current status of this analysis (Fig. 4) gives a good overview of where the main river fisheries lie, but also identifies some of the issues and problems which have yet to be fully resolved. In particular, a key feature of the REC is that lakes are essentially viewed as river segments of zero gradient, and are not well defined. The angler survey river network shown in the figure has been overlaid with a layer showing all New Zealand lakes, giving the impression of having circumventing any such problems, but closer inspection reveals some of the issues which remain unresolved. For example, rivers which flow through a series of lakes, such as the Waikato, Clutha, and Waiau (Southland), are characterised by gaps where the REC has failed to establish a connection between discontinuous reaches, most of which will need to be resolved manually. Given the resources available, and the need to focus on the primary objective of deriving usage estimates for the 2001/02 Survey, we concluded that resolution of these was beyond the scope of the present report.

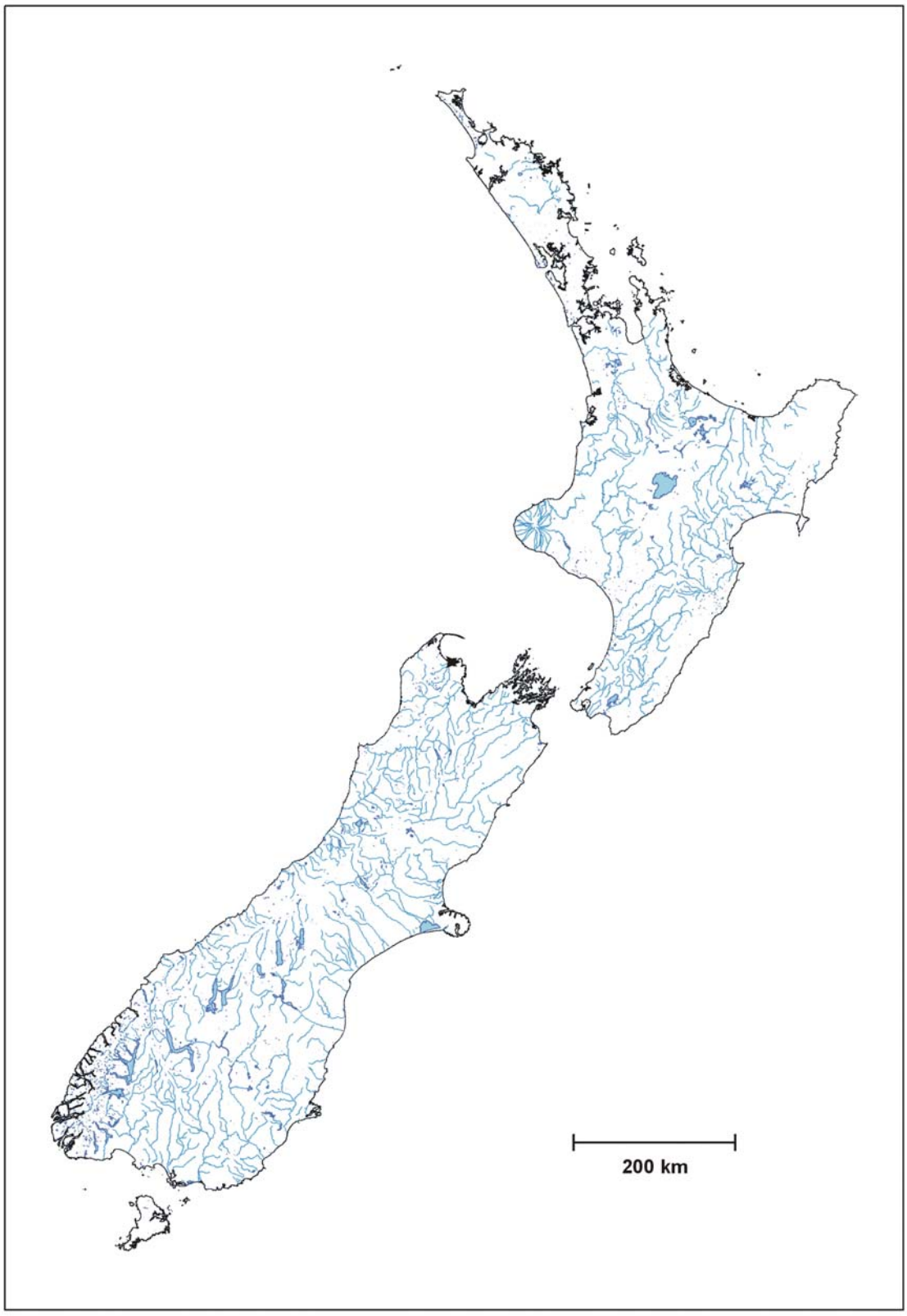

Figure 4: **Current status of the GIS layer under development for New Zealand river fisheries, overlaid with a layer showing all lakes over 1 ha in area.**

4. Discussion

4.1. Limitations of the data

In terms of data quality and consistency, the 2001/02 survey represents a considerable advance from the 1994/96 survey. The 1994/96 survey did not manage to achieve complete coverage of all licence strata in all Regions, with significant gaps in Hawkes Bay and West Coast (Unwin & Brown 1998), and the Northland Region being omitted altogether. By contrast, the only significant strata omitted from the 2001/02 survey were part-season licence holders in the Otago Region. Although their contribution to the total angling effort can be estimated fairly robustly (see Section 3.3.5), it is not possible to allocate this effort to individual angling waters with any confidence, so that our usage estimates for Otago waters popular with part-season licence holders are likely to be conservative. Assigning the task of recording numerical codes for all waters fished by survey respondents to Regional FGNZ staff, rather than to NIWA staff with less detailed local knowledge (as in 1994/96) also resulted in a significant gain in data quality (see Section 3.2).

The major limitation of the present survey (in terms of non-coverage) would appear to be the lack of data for anglers of overseas origin, who we estimate contributed 61 300 angler-days, or 5.2% of the adjusted national total of 1 190 000 angler-days (Table 12). In fact, this limitation also applied to the 1994/96 data, but was not explicitly identified at the time. As with Otago part-season licence holders, we know of no consistent way to apportion this effort to individual waters, so that usage estimates such as those in Appendix 1 will be conservative by an unknown (although usually small) amount. For some waters, however, it may be possible to use on-site data (e.g., from angler interviews or creel surveys) to estimate the proportion of angling undertaken by overseas anglers.

Dividing some larger rivers into reaches generally appears to have been successful in gathering usage information at a finer level of detail, particularly for rivers which were heavily fished by local anglers. In such cases (e.g., the Ngaruroro, Manawatu, Waitaki, Mataura, and Oreti), where local licence holders accounted for at least 90% of the estimated total effort, there were few missing data to confound the overall picture (Table 9). For rivers which were more lightly fished, however, or for which a relatively high proportion of the effort came from anglers interviewed in other Regions (e.g., the Tarawera, Motueka, Buller, and Waiau), reach data were missing for a much larger proportion (up to 46%) of the total usage, so that the resulting data are subject to much greater uncertainty.

The lack of concurrent data for the Taupo Conservancy has no direct effect on usage estimates for the fisheries managed by FGNZ, but precludes giving an estimate of total usage for all acclimatised fish species in New Zealand.

4.2. Accuracy and precision

One of the more pressing issues regarding the present survey (and its predecessor) is the need to validate the basic methodology. Quite apart from the obvious requirement that the results must be able to stand up to scrutiny in arenas such as the Environment Court, it is also essential that FGNZ – if it is to continue with a programme intended to provide baseline monitoring data for the foreseeable future, with a new survey to be conducted at intervals of 5-7 years – has complete confidence in the results. The present methodology makes at least two basic assumptions which should, ideally, be verified. First, we assume that non-response bias can be ignored (Section 2.3). Second, we assume that recall bias can be ignored, or – more pragmatically – that the usage estimates derived using the present methodology are consistent with estimates derived alternative sampling methods (e.g., creel surveys, angler diaries, or aerial counts).

Assessing the effect of non-response bias would require making a concerted effort to contact licence holders who could not be reached by telephone after three attempts, and would be a comparatively straightforward (albeit tedious) task. Initially, it would be sufficient to concentrate on a small number of representative licence strata, representing perhaps 5% of the total survey population. If these data suggested non-response bias were a serious issue, future survey procedures could be amended accordingly. Essentially this would come down to a judgement as to whether the potential error from non-response bias was large enough to justify the additional resources (e.g., more telephone interviewers, more time spent checking and validating telephone numbers) needed to reduce it to a more acceptable level.

Cross-validation of the survey estimates is more problematical, and is likely to be achievable only for a small number of waters where alternative sampling methods can be implemented within the available resources. A useful starting point would be for FGNZ to compile a database of all angling waters which have been targeted using other survey methodologies, so as to identify whether or not a significant problem exists. This may also raise other issues which have yet to be adequately studied, such as the relationship between angler-days (as used in this survey) and alternative measures of effort such as hours fished (from diary surveys or interviews), or head counts (from aerial surveys).

Despite the use of Neyman Allocation to guide our choice of sample sizes (Section 2.2.3), there was essentially no improvement in overall precision from 1994/96 to

2001/02, suggesting that the 1994/96 sample allocation (which was based solely on judgement) was already close to optimum. For both surveys, there was a strongly linear relationship between estimated usage E for each water and its associated variance σ (both log-transformed; Fig. 5), with no significant difference in either the slope or elevation of the fitted regression lines (ANCOVA, $p \geq 0.22$). Pooled across both surveys, σ and E were related via the equation $\sigma = 2.91E^{0.679}$ ($r^2 = 0.882$). Thus, σ increased as approximately the two/thirds power of E, and the coefficient of variation (CV = σ/E) decreased as approximately the cube root of E. In practice, typical CVs were about 75% for $E \sim 50$, 40% for $E \sim 500$, 25% for $E \sim 5\,000$, and $\leq$ 10% for $E \sim 50\,000$.

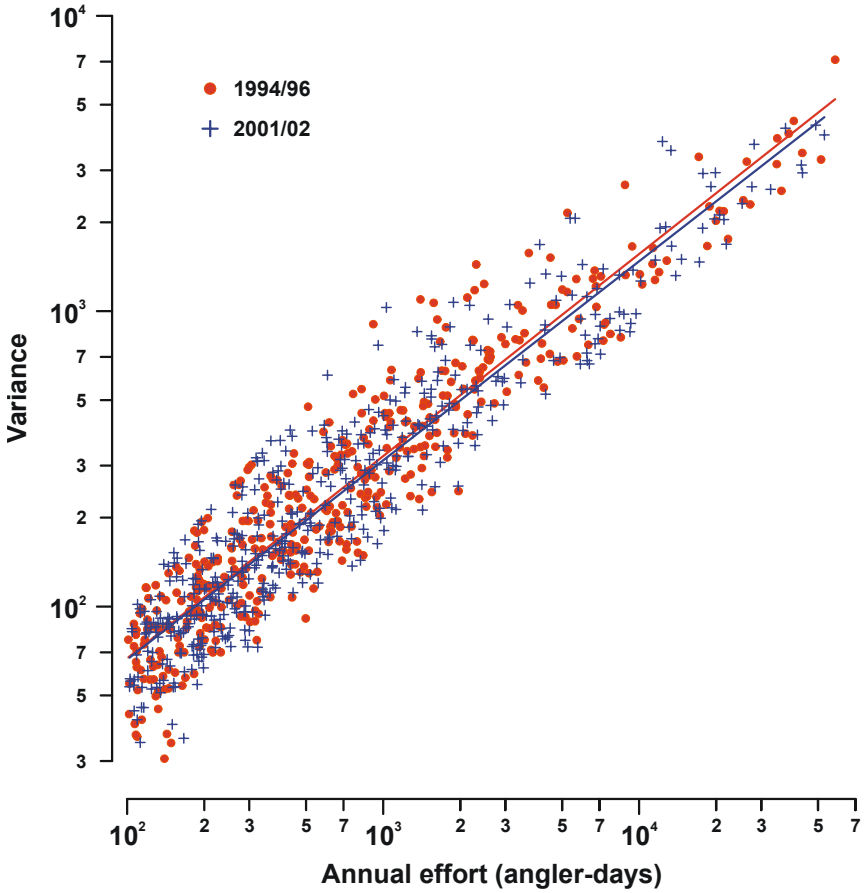

Figure 5: **The relationship between estimated annual effort and the associated variance (both log-transformed) for 911 river fisheries included in the 1994/96 and 2001/02 National Angling Surveys. Minor tick mark labels are to be interpreted as multiples of the power of ten at the preceding major tick mark; thus tick marks between 10^2 and 10^3 (on both axes) represent numeric values of 200, 300, 500, and 700. Linear regressions for 1994/96 (N = 436, red line) and 2001/02 (N = 475, blue line) are also shown.**

A consequence of the very broad CVs for many lightly fished waters is that 95% confidence intervals for *E* may exceed the value of *E* itself. While this is unfortunate, it should be remembered that the survey is rather ambitious in that it attempts to target all angling waters of significance, even though total annual usage differs by over four orders of magnitude between waters, from over 50 000 angler-days for the Mataura and Waimakariri to less than five angler-days for the most lightly fished waters. For example, suppose both the Mataura and a more remote Southland fishery (e.g., the Borland Burn; $E = 60 \pm 30$ angler-days in both 1994/96 and 2001/02) were to be targeted individually, by surveys tailored to their particular characteristics. A random sample survey of Southland licence holders would be a viable approach for the Mataura, which was fished by over 20% of Southland respondents, but would be an extremely inefficient way to collect data for the Borland Burn, which was fished by only three out of 1784 respondents. While obtaining a more precise usage estimate for fisheries as lightly used as the Borland Burn represents a considerable challenge, a diary or interview based methodology drawing on the expertise of fishing guides, local angling groups, and FGNZ local knowledge, would almost certainly capture more complete data than a random telephone survey. The achievement of the present survey (and of its 1994/96 predecessor) in obtaining consistent usage estimates which differ by as much as a factor of 10 000 needs to be recognised in this context.

4.3. Further analyses

One important difference between the current survey and its 1994/96 predecessor is the inclusion, in the current survey database, of an essentially complete record of licence sales for the 2001/02 season, and the ability to link this to usage data for specific waters. This opens up the potential for a number of further analyses, many of which are beyond the scope of the present report. One such analysis has already been completed (Unwin & Deans 2003), but other possibilities include more detailed comparisons between fishing activity patterns for different licence types, particularly for family licence holders vs. adult whole-season licences; analyses of usage patterns pooled at sub-catchment level (e.g. the upper Clutha/Southern Lakes region) or by water type (e.g., Central Otago irrigation reservoirs); or characterising usage patterns in terms of anglers' home addresses (e.g., what differences, if any, are there between the waters targeted by anglers from Wellington city compared to those from the Hutt Valley?). Another possibility, already exploited in the Nelson/Marlborough Region, is to use the survey database to identify anglers who fish particular waters of interest (e.g., the upper Wairau River) and who could thus be targeted in a follow-up survey to collect more specific data on resource usage. Finally, as noted in Section 3.5, there is considerable potential for analysing the survey data in a GIS context once the appropriate layers have been fully developed.

Given the number of potential analyses, and the even greater number of permutations in which two or more analyses are compared and contrasted, the results in this report represent only a small proportion of the information contained in the combined database for the 1994/96 and 2001/02 surveys. It is therefore important that key FGNZ staff within each Region invest the effort required to become familiar with the full database (available on a CD-ROM, together with this report), so that they can further develop analyses and cross-tabulations which are directly relevant to their management needs.

4.4. Recommendations for future surveys

As has been noted earlier in this report (Section 3.2), the experience gained from the 1994/96 Survey helped us implement several changes in methodology for the 2001/02 Survey, with a consequent improvement in data quality. Likewise, the consistency and quality of FGNZ's licence records has improved greatly since 1994/96, with all Regional databases in good shape, and a few which could fairly be described as excellent. Two Regions included postal codes for New Zealand resident licence holders, which proved extremely useful for characterising anglers by home address (Unwin & Deans 2003), and would be worthwhile implementing as a national standard. Identifying overseas anglers from the available licence records was usually straightforward, although there were some Regional inconsistencies. Specifically recording country of residence for all licence holders would help to resolve these differences, and would also provide a more complete database on the origin of overseas visitors. Alternatively, licences could simply include a yes/no check box for anglers to indicate whether they were, or were not, a New Zealand resident. This information is particularly important for licences sold via FGNZ's 0800 phone number, or for those sold via fishing guides or lodges, many of which were ambiguous as to angler origin.

By far the most significant challenge for future surveys is to extend the methodology so as to include overseas anglers, whose estimated 2001/02 contribution of 61 000 angler-days exceeds the annual total for seven of the twelve FGNZ Regions (Table 8). We believe there are two main possibilities for achieving this on a national scale. First, the rapidly increasing usage of cell phones, and the increasing ease with which phone numbers can be accessed from anywhere in the world, suggests that – by the time the next national survey is conducted, in 2007 or 2008 – cell phones will be sufficiently ubiquitous that a viable contact phone number could be recorded for essentially all licence holders, irrespective of where they live. Overseas anglers could thus be included in the sampling frame for each Region, pooled into a single Stratum, and the task of interviewing them assigned to contract workers with the requisite foreign language skills. While it may not be easy to find speakers of (for example) Korean who also have a reasonable knowledge of New Zealand lakes and rivers, the

difficulties associated with non-English speaking licence holders should not be overestimated. Anglers from Oceania, North America, and the UK account for over 75% of overseas licence holders (Table 6) and are therefore likely to speak English as a first language, while many of the remainder (e.g., those from Western European countries such as Germany and the Netherlands, and Southeast Asian countries such as Hong Kong and Singapore) are also likely to be fluent in English.

The second option to be considered by FGNZ, for the angling season to be included in the next survey, would be to design a simple exit questionnaire to be issued to all overseas licence holders by the vending agent, to be completed and returned when their licence has expired, or (at the latest) when they leave New Zealand. While this would require a high degree of cooperation from licence vendors and fishing guides, it would be possible to encourage this via incentives such as including the vendor in a prize draw, based on all completed questionnaires received. A similar scheme, with a first prize such as a return air fare to New Zealand and a week of guided fishing, could be used to encourage anglers to respond to the survey. Even if the response rate were as low as 10%, this would still amount to a database representing over 1000 anglers, and would be a considerable advance on our present state of knowledge. Moreover, if non-response bias were likely to be a significant problem, telephone calls to a random subsample of non-respondents could be used to address any such bias.

5. Acknowledgements

We thank Kathy Walter and Jenny White for data entry, Glenn Maclean for providing licence sales records for the Taupo Conservancy, and Helen Hurren, Michelle Wild, and Mark Weatherhead for GIS help. Particular thanks are extended to the survey coordinators in each FGNZ Region, whose efforts contributed greatly to the smooth running of the survey, and to the 19 000 anglers (some of whom were interviewed as many as six times) whose responses made the whole survey possible.

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Appendix 1: Estimated usage (angler-days ± 1 standard error) for all New Zealand lake and river fisheries recorded in either the 1994/96 or 2001/02 National Angling Surveys, grouped by fishing Region and catchment. Catchments are ordered clockwise around New Zealand (Anon. 1956); catchment sub-totals are given for all catchments containing five or more recognised fisheries.

Northland Region

		2001/02							1994/96
Catchment	**River/Lake**	**Oct-Nov**	**Dec-Jan**	**Feb-Mar**	**Apr-May**	**Jun-Jul**	**Aug-Sep**	**Total**	**Total**
Awanui River	Victoria River	< 10	20 ± 20	< 10				30 ± 20	
Rangitane River	Manuwai Lake	30 ± 10	10 ± 10	< 10	30 ± 10	10 ± 10	80 ± 30	170 ± 40	
Kerikeri River	Kerikeri River	10 ± 10		< 10				20 ± 10	
Waitangi River	Waitangi River		< 10				120 ± 10	120 ± 10	
Kawakawa River	Tirohanga River	< 10						< 10	
Hatea River	Mangakino Stream			< 10				< 10	
	Whau Valley Dam	30 ± 30	20 ± 20		< 10	< 10	40 ± 20	100 ± 40	
Wairua River	Kaiikanui River		< 10					< 10	
	Kaimamaku Stream			< 10				< 10	
	Mangahahuru Stream	10 ± 10						10 ± 10	
	Mangakahia River		100 ± 100					100 ± 100	
	Mangatu Stream		< 10					< 10	
	Waiotu Stream	< 10	10 ± 10					20 ± 10	
	Wairua River	40 ± 30	20 ± 10	40 ± 30	20 ± 10			110 ± 50	
	Whakapara Stream		< 10	30 ± 20	< 10			40 ± 30	
Total, Wairua catchment		**50 ± 30**	**140 ± 100**	**80 ± 40**	**20 ± 10**			**300 ± 110**	
Kaiiwi Lakes	Kaiiwi Lakes	20 ± 10	160 ± 100	640 ± 490	30 ± 20	80 ± 30	130 ± 50	1060 ± 500	340 ± 120
	Taharoa Lake					10 ± 10		10 ± 10	
Waihou River	Waihou River		30 ± 30					30 ± 30	
	Waipapa River	< 10	20 ± 20					30 ± 20	
Total, all waters		**150 ± 40**	**420 ± 150**	**740 ± 490**	**90 ± 20**	**110 ± 40**	**370 ± 60**	**1870 ± 520**	**340 ± 120**

Auckland/Waikato Region

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
Waitemata Harbour	Carter Holt Ponds	30 ± 30						30 ± 30	
	Chelsea Sugar Works Pond	30 ± 30	20 ± 20	20 ± 20			50 ± 50	110 ± 60	600 ± 210
	Henderson Lake			50 ± 50				50 ± 50	
	Pupuke Lake		< 10	150 ± 110	330 ± 310		110 ± 80	610 ± 330	1240 ± 340
Wairoa River	Wairoa River		20 ± 20	20 ± 10		10 ± 10		50 ± 30	
Kape-o-kati Coast	Kaiaua Gravel Pits Pond	50 ± 40		30 ± 30	50 ± 30	10 ± 10	60 ± 40	200 ± 70	450 ± 140
Waihou River	Hikutaia River								20 ± 20
	Kakahu Stream		80 ± 70	50 ± 30	50 ± 40	60 ± 60		250 ± 100	30 ± 20
	Komata River								20 ± 20
	Ohinemuri River	680 ± 320	310 ± 100	670 ± 240	300 ± 100	330 ± 170	350 ± 150	2630 ± 480	1620 ± 390
	Omahine Stream	30 ± 30		< 10		30 ± 30		70 ± 40	< 10
	Oraka Stream			30 ± 30		60 ± 60		100 ± 70	130 ± 50
	Purere Stream	30 ± 30						30 ± 30	
	Rapurapu Stream	30 ± 30		40 ± 30	20 ± 20	60 ± 60		150 ± 80	130 ± 100
	Waihou River	140 ± 80	340 ± 80	480 ± 130	700 ± 180	630 ± 220	660 ± 350	2960 ± 480	1780 ± 320
	Waimakariri Stream	280 ± 130	130 ± 70	110 ± 60	130 ± 70	60 ± 60	50 ± 30	770 ± 190	550 ± 130
	Waitawheta River	210 ± 160	110 ± 40	120 ± 60	60 ± 40	60 ± 50	90 ± 50	650 ± 190	160 ± 50
	Waitekauri River	30 ± 30	80 ± 40	70 ± 60	20 ± 20			190 ± 70	300 ± 190
Total, Waihou catchment		**1410 ± 390**	**1050 ± 170**	**1600 ± 300**	**1270 ± 220**	**1310 ± 310**	**1150 ± 380**	**7780 ± 750**	**4760 ± 570**
Kauaeranga River	Kauaeranga River	110 ± 110	20 ± 20	< 10				130 ± 110	140 ± 50
Waiomou Stream	Waiomou Stream	50 ± 40	260 ± 130	50 ± 30	100 ± 50	30 ± 30		490 ± 150	490 ± 140
Waiwawa River	Waiwawa River		50 ± 40	< 10				60 ± 40	1050 ± 410
Tairua River	Tairua River			60 ± 50				60 ± 50	320 ± 100
Whanganui River	Mangatepopo Stream								20 ± 10
	Ongarue River	80 ± 60	180 ± 70	30 ± 20				290 ± 100	690 ± 370

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
	Piopiotea Stream				< 10			< 10	
	Taringamotu River			50 ± 50				50 ± 50	20 ± 20
	Waimiha Stream	50 ± 50	< 10		30 ± 30			90 ± 60	220 ± 140
	Waione Stream								40 ± 30
	Whakapapa River	130 ± 80	190 ± 120	590 ± 250	100 ± 90	30 ± 20		1030 ± 310	330 ± 90
	Whanganui River	220 ± 110	500 ± 230	900 ± 280	180 ± 100	60 ± 40	20 ± 20	1880 ± 400	1780 ± 520
Total, Whanganui catchment		**480 ± 160**	**880 ± 270**	**1560 ± 390**	**320 ± 140**	**90 ± 50**	**20 ± 20**	**3350 ± 520**	**3090 ± 660**
Tongaporutu River	Ohura River	30 ± 30						30 ± 30	50 ± 50
Awakino River	Awakino River	170 ± 120	50 ± 20	500 ± 330	110 ± 50	10 ± 10		840 ± 360	800 ± 150
	Mangaotaki River		20 ± 10	20 ± 10	30 ± 30			70 ± 30	190 ± 70
	Mangapehi Stream				50 ± 50			50 ± 50	
	Mokau River	100 ± 70	60 ± 40	< 10				170 ± 80	280 ± 170
Tawarau River	Mangaohae Stream	100 ± 60	< 10	< 10	20 ± 20	40 ± 30		180 ± 70	300 ± 90
	Marokopa River		< 10	60 ± 30			30 ± 20	100 ± 40	150 ± 50
	Tawarau River	130 ± 90	40 ± 40	50 ± 50				230 ± 120	30 ± 20
Waikato	Arapuni Lake	930 ± 330	1440 ± 270	2180 ± 400	1700 ± 460	1590 ± 360	1890 ± 540	9730 ± 980	7300 ± 900
	Hakanoa Lake	30 ± 30						30 ± 30	150 ± 60
	Hamilton Lake		40 ± 20	30 ± 30				70 ± 30	440 ± 180
	Kaiwhitiwhiti Stream		80 ± 80					80 ± 80	
	Kaniwhaniwha Stream	30 ± 30	190 ± 110	50 ± 20	70 ± 70	30 ± 30		370 ± 140	860 ± 220
	Karapiro Lake	230 ± 140	520 ± 160	530 ± 230	300 ± 190	200 ± 130	530 ± 230	2320 ± 450	4810 ± 680
	Little Waipa Stream	30 ± 30	130 ± 90			10 ± 10		170 ± 90	730 ± 210
	Mangaokewa Stream			20 ± 20				20 ± 20	40 ± 20
	Mangaorongo Stream								280 ± 270
	Mangatangi Reservoir	80 ± 80	30 ± 30	30 ± 20				140 ± 90	840 ± 150
	Mangatawhiri Reservoir	180 ± 110	20 ± 20	50 ± 30		30 ± 30	20 ± 20	300 ± 120	
	Mangatawhiri River	20 ± 20						20 ± 20	
	Mangatutu Stream	380 ± 190	220 ± 60	250 ± 80	70 ± 50	100 ± 70	50 ± 50	1070 ± 230	1600 ± 350
	Mangauika Stream			< 10	140 ± 140			140 ± 140	
	Mangawara Stream		40 ± 20		30 ± 20		20 ± 20	90 ± 30	10 ± 10

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
	Mangawawa Stream		< 10					< 10	
	Mangawhero Stream	50 ± 50						50 ± 50	90 ± 70
	Mangawhio Stream			40 ± 40		30 ± 30		70 ± 50	
	Matarawa Stream						610 ± 610	610 ± 610	
	Moakurarua Stream	50 ± 40	60 ± 30	30 ± 10			20 ± 20	150 ± 50	320 ± 200
	Moananui Lake	260 ± 260		60 ± 60				330 ± 270	
	Muirs Lake		40 ± 20					40 ± 20	
	Ngakoaohia Stream	160 ± 100	20 ± 20	100 ± 60		40 ± 30	100 ± 80	430 ± 140	270 ± 100
	Ngutunui Stream	30 ± 30		< 10				30 ± 30	80 ± 40
	Parkinsons Lake		20 ± 20	30 ± 30				40 ± 30	20 ± 20
	Pokaiwhenua Stream	50 ± 40	40 ± 30	80 ± 60	20 ± 20	40 ± 40		230 ± 80	360 ± 110
	Puniu River	70 ± 50	170 ± 80	310 ± 120	130 ± 80	60 ± 40	100 ± 60	840 ± 180	1220 ± 270
	Rangiriri Stream		120 ± 50		30 ± 20		110 ± 90	250 ± 110	
	Waikato River	740 ± 350	2200 ± 1040	940 ± 250	970 ± 340	810 ± 500	1580 ± 540	7240 ± 1390	7240 ± 790
	Waipa River	70 ± 40	130 ± 60	510 ± 290	490 ± 220	10 ± 10	340 ± 130	1560 ± 400	2600 ± 680
	Waipapa Lake	290 ± 260	220 ± 180	300 ± 130	210 ± 130	110 ± 90	230 ± 160	1370 ± 410	820 ± 450
	Waipapa River		80 ± 40	100 ± 70	30 ± 20			220 ± 80	440 ± 110
	Waipari River		50 ± 40				20 ± 20	70 ± 40	50 ± 40
	Whangamarino River	60 ± 60	< 10	< 10				70 ± 60	80 ± 30
	Whatihua Lake		80 ± 50	20 ± 20			20 ± 20	110 ± 50	80 ± 40
Total, Waikato catchment		**3740 ± 680**	**5980 ± 1130**	**5680 ± 650**	**4190 ± 680**	**3090 ± 640**	**5590 ± 1030**	**28270 ± 2020**	**30740 ± 1750**
	Bombay Pond		50 ± 40		140 ± 140		30 ± 30	220 ± 150	460 ± 150
	Kereta Lake								130 ± 60
	Ototoa Lake	80 ± 40	120 ± 60	140 ± 70	360 ± 180	250 ± 200	300 ± 150	1250 ± 320	930 ± 270
	Okaihau Lake			110 ± 100				110 ± 100	320 ± 90
Kaipara River	Kumeu/Kaipara River								20 ± 20
	Tomarata Lake		< 10		30 ± 20			40 ± 20	180 ± 160
Total, all waters		**6510 ± 830**	**8650 ± 1190**	**10130 ± 900**	**7000 ± 830**	**4860 ± 750**	**7320 ± 1120**	**44480 ± 2320**	**46720 ± 2100**

Eastern Region

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
Tuapiro Creek	Tuapiro Creek		40 ± 30					40 ± 30	
Wairoa River	Mangatarata Stream					40 ± 40		40 ± 40	
	McLaren Falls Dam	680 ± 400	190 ± 90	210 ± 110	20 ± 20	40 ± 30	80 ± 50	1230 ± 420	1690 ± 630
	Ngamuwahine River	390 ± 320	80 ± 50	110 ± 60	410 ± 300		20 ± 20	1000 ± 440	160 ± 100
	Ohourere Stream		30 ± 30			20 ± 20		50 ± 40	
	Omanawa River			60 ± 60				60 ± 60	
	Opuiaki River		20 ± 20					20 ± 20	
	Ruahihi Canal	30 ± 30	50 ± 50	510 ± 370	20 ± 20			600 ± 370	1070 ± 420
	Wairoa River	30 ± 30	30 ± 20	20 ± 20	20 ± 20	70 ± 70		160 ± 80	140 ± 110
Total, Wairoa catchment		**1120 ± 510**	**390 ± 120**	**910 ± 400**	**460 ± 300**	**170 ± 90**	**100 ± 50**	**3160 ± 730**	**3070 ± 770**
Waimapu Stream	Waimapu Stream		50 ± 50					50 ± 50	
Kaituna River	Awahou Stream		550 ± 390	730 ± 400	130 ± 130			1420 ± 580	190 ± 130
	Hamurana Stream	50 ± 50	210 ± 160	160 ± 90	360 ± 300	760 ± 720		1550 ± 810	1070 ± 580
	Hatchery Kids Pond	50 ± 30						50 ± 30	
	Hauparu River								70 ± 70
	Kaituna River	150 ± 90	240 ± 100	330 ± 180	20 ± 20	800 ± 720	50 ± 50	1590 ± 760	2460 ± 650
	Mangowera River	30 ± 30		20 ± 20				40 ± 30	
	Ngongotaha Stream	2410 ± 1260	3540 ± 1320	4040 ± 1420	2980 ± 1140	2420 ± 870	2370 ± 1070	17770 ± 2930	8800 ± 2670
	Ohau Channel	100 ± 60	330 ± 190	110 ± 70	180 ± 100	1370 ± 1020	80 ± 60	2180 ± 1050	4720 ± 1050
	Rotoiti Lake	6350 ± 1070	11330 ± 1370	10440 ± 1410	5870 ± 1020	6430 ± 1410	2660 ± 1310	43080 ± 3120	43370 ± 3430
	Rotorua Lake	2100 ± 430	9700 ± 1420	5410 ± 940	6750 ± 1330	4750 ± 900	3920 ± 1020	32640 ± 2580	40190 ± 4400
	Utuhina Stream	400 ± 200	1380 ± 760	1450 ± 1010	630 ± 310	460 ± 240		4320 ± 1340	2310 ± 1440
	Waiari Stream			40 ± 20				40 ± 20	260 ± 180
	Waiteti Stream	50 ± 40	810 ± 520	350 ± 140	340 ± 150	1490 ± 890	90 ± 90	3130 ± 1050	1840 ± 580
Total, Kaituna catchment		**11690 ± 1730**	**28090 ± 2590**	**23080 ± 2480**	**17260 ± 2080**	**18490 ± 2550**	**9190 ± 1980**	**107800 ± 5530**	**105280 ± 6530**
Waihi Estuary	Pongakawa Stream								50 ± 40

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
	Rotoehu Lake	860 ± 660	150 ± 80	120 ± 60	250 ± 130	400 ± 180	410 ± 300	2190 ± 770	2290 ± 580
	Rotoma Lake	1320 ± 350	2740 ± 700	990 ± 290	1880 ± 530	1970 ± 490	1240 ± 610	10130 ± 1260	6610 ± 1290
Tarawera River	Okareka Lake	260 ± 130	490 ± 210	340 ± 140	780 ± 260	470 ± 210	1410 ± 1160	3750 ± 1240	3410 ± 800
	Okaro Lake	160 ± 110	30 ± 30	20 ± 20				200 ± 120	100 ± 70
	Okataina Lake	900 ± 260	1280 ± 260	1490 ± 440	1220 ± 280	1990 ± 620	170 ± 70	7050 ± 890	5830 ± 940
	Rerewhakaaitu Lake	660 ± 250	2380 ± 660	2010 ± 700	1810 ± 530	810 ± 300	700 ± 620	8380 ± 1320	9390 ± 1660
	Rotokakahi Lake					20 ± 20		20 ± 20	920 ± 900
	Rotomahana Lake	440 ± 270	360 ± 260	20 ± 20				820 ± 380	1220 ± 420
	Ruruanga Stream	820 ± 780	1060 ± 740					1880 ± 1070	170 ± 100
	Tarawera Lake	6250 ± 920	13440 ± 1580	7870 ± 1330	7240 ± 1030	6230 ± 980	2450 ± 1230	43480 ± 2940	38440 ± 3990
	Tarawera River	970 ± 340	180 ± 120	1140 ± 530	360 ± 190	530 ± 230	1110 ± 550	4290 ± 900	5010 ± 1180
	Tikitapu Lake	30 ± 30	30 ± 30	60 ± 30	20 ± 20	310 ± 180	20 ± 20	470 ± 190	260 ± 160
	Waiwhakapa Stream			40 ± 30				40 ± 30	
Total, Tarawera catchment		**10490 ± 1340**	**19230 ± 1920**	**12990 ± 1660**	**11440 ± 1240**	**10360 ± 1250**	**5870 ± 1890**	**70390 ± 3860**	**64750 ± 4760**
Rangitaiki River	Aniwhenua Lake	2960 ± 1660	1700 ± 990	1650 ± 1000	760 ± 320	1730 ± 1440	3540 ± 2680	12340 ± 3760	11330 ± 1640
	Flaxy Canal	50 ± 50	20 ± 20	390 ± 390	10 ± 10	120 ± 120		590 ± 410	
	Flaxy Lake	260 ± 140	620 ± 340	800 ± 460	310 ± 300	60 ± 50	360 ± 330	2410 ± 740	1520 ± 440
	Horomanga River	30 ± 30	< 10	10 ± 10	20 ± 20	120 ± 90		190 ± 90	1240 ± 420
	Matahina Lake	210 ± 210	150 ± 130	20 ± 20	260 ± 160	150 ± 110		780 ± 310	880 ± 400
	Ngatamawahine Stream			150 ± 140		20 ± 20		170 ± 140	
	Otamatea River		< 10					< 10	
	Otangimoana Stream								20 ± 20
	Rangitaiki River	1940 ± 880	2010 ± 1030	2050 ± 1080	1680 ± 680	2210 ± 1560	3420 ± 2520	13310 ± 3500	5680 ± 1280
	Waihua Stream	80 ± 80	30 ± 30	110 ± 70		50 ± 50		270 ± 120	310 ± 300
	Wheao River	50 ± 50	20 ± 20		310 ± 150	20 ± 20		400 ± 160	550 ± 180
	Whirinaki River	330 ± 140	240 ± 160	50 ± 20	60 ± 30	60 ± 60	20 ± 20	750 ± 230	1710 ± 520
Total, Rangitaiki catchment		**5900 ± 1900**	**4790 ± 1480**	**5220 ± 1590**	**3410 ± 840**	**4550 ± 2140**	**7340 ± 3700**	**31210 ± 5220**	**23240 ± 2290**
Whakatane River	Ruatahuna Stream		30 ± 30					30 ± 30	
	Urewera Stream		< 10					< 10	
	Waikare River		260 ± 260					260 ± 260	

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
	Waimana River	210 ± 140	130 ± 70	60 ± 60	90 ± 60	20 ± 20		510 ± 180	1920 ± 670
	Whakatane River	240 ± 140	110 ± 40	260 ± 150	400 ± 310	30 ± 30	410 ± 370	1450 ± 530	2230 ± 800
Total, Whakatane catchment		**450 ± 200**	**530 ± 270**	**320 ± 160**	**490 ± 320**	**60 ± 40**	**410 ± 370**	**2260 ± 610**	**4150 ± 1040**
Waiotahi River	Waiotahi River	50 ± 50	20 ± 20			20 ± 20	160 ± 160	240 ± 170	110 ± 60
Waioeka River	Kahunui Stream	30 ± 30						30 ± 30	
	Koranga River	30 ± 30						30 ± 30	
	Opato Stream	30 ± 30	30 ± 30		20 ± 20			80 ± 40	
	Waioeka River	30 ± 30	750 ± 430	400 ± 220	170 ± 110	190 ± 110		1540 ± 510	2480 ± 1240
	Wairata Stream	80 ± 80	60 ± 50	240 ± 240		20 ± 20		410 ± 260	110 ± 80
Total, Waioeka catchment		**180 ± 90**	**840 ± 440**	**650 ± 330**	**190 ± 110**	**220 ± 110**		**2080 ± 580**	**2590 ± 1240**
Otara River	Otara River		60 ± 40					60 ± 40	260 ± 160
Motu River	Motu River	100 ± 70	430 ± 160	150 ± 60	60 ± 40	600 ± 360	40 ± 40	1390 ± 410	240 ± 130
	Takaputahi River		20 ± 20		20 ± 20			30 ± 20	40 ± 40
Haparapara River	Haparapara River			40 ± 40				40 ± 40	
Mata River	Mata River								50 ± 50
Waimata River	Waimata River			1030 ± 1030				1030 ± 1030	
Waipaoa River	Wharekopae River				70 ± 70			70 ± 70	
Wairoa River	Aniwaniwa Stream				130 ± 90			130 ± 90	
	Hangaroa River		60 ± 60	190 ± 110	70 ± 50	120 ± 90		450 ± 160	620 ± 420
	Hopuruahine Stream		50 ± 50	< 10	130 ± 90			180 ± 100	
	Kaitawa Lake		50 ± 50					50 ± 50	180 ± 180
	Mangaone Stream		10 ± 10	10 ± 10			40 ± 40	70 ± 40	
	Mangapapa Stream			20 ± 20				20 ± 20	
	Mangapoike River	30 ± 30						30 ± 30	
	Mokau Stream				60 ± 60			60 ± 60	
	Ruakituri River	230 ± 110	300 ± 120	370 ± 100	480 ± 170	50 ± 50		1420 ± 260	2380 ± 620

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
	Tuai Lake	10 ± 10		< 10				20 ± 20	1200 ± 460
	Waiau River	70 ± 70		110 ± 110	20 ± 20			200 ± 130	280 ± 160
	Waikareiti Lake	90 ± 60	20 ± 20	120 ± 60			20 ± 20	250 ± 80	510 ± 270
	Waikaremoana Lake	3290 ± 690	5670 ± 1590	3700 ± 680	3110 ± 550	2070 ± 490	1870 ± 420	19710 ± 2050	20620 ± 2190
	Waikaretaheke River					20 ± 20		20 ± 20	
	Wairoa River		30 ± 30		< 10			40 ± 30	
Total, Wairoa catchment		**3720 ± 710**	**6200 ± 1600**	**4530 ± 710**	**4010 ± 590**	**2260 ± 500**	**1920 ± 430**	**22640 ± 2090**	**25790 ± 2390**
Waikato River	Aratiatia Lake		60 ± 50	20 ± 20				70 ± 50	180 ± 100
	Atiamuri Lake	80 ± 80	240 ± 210	150 ± 130	30 ± 20	70 ± 50		570 ± 260	540 ± 230
	Maraetai Lake	260 ± 260	270 ± 190	60 ± 40	210 ± 140			800 ± 350	650 ± 320
	Ngahewa Lake			30 ± 30				30 ± 30	
	Ngapouri Lake			60 ± 40	50 ± 40	60 ± 60		170 ± 90	80 ± 60
	Ohakuri Lake	10 ± 10	260 ± 100	140 ± 90	110 ± 90	570 ± 490	120 ± 120	1210 ± 530	2560 ± 740
	Poutu Stream	40 ± 40	10 ± 10		< 10			60 ± 40	10 ± 10
	Pueto Stream								80 ± 50
	Rotoaira Lake	20 ± 20				10 ± 10	50 ± 50	90 ± 50	
	Ruatawiri Stream			100 ± 100				100 ± 100	
	Tahunaatara Stream		260 ± 210					260 ± 210	440 ± 300
	Torepatutahi Stream		90 ± 80	90 ± 90				180 ± 120	190 ± 120
	Waikato River								3710 ± 1570
	Whakamaru Lake	30 ± 30	140 ± 90	230 ± 120	50 ± 30	50 ± 30	80 ± 50	570 ± 170	3360 ± 1050
	Whirinaki River	130 ± 90	120 ± 80	20 ± 20	110 ± 100	20 ± 20		410 ± 160	110 ± 80
Total, Waikato catchment		**570 ± 290**	**1440 ± 400**	**900 ± 250**	**570 ± 200**	**800 ± 500**	**250 ± 140**	**4530 ± 780**	**11910 ± 2100**
Total, all waters		**36450 ± 3140**	**65040 ± 4010**	**50940 ± 3670**	**40110 ± 2730**	**39890 ± 3680**	**26910 ± 4690**	**259340 ± 9070**	**250420 ± 9270**

Taranaki Region

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
Turakina	Namunamu Lake	< 10	< 10				20 ± 20	30 ± 20	300 ± 110
	Turakina River								60 ± 60
Whangaehu River	Lahar Lake						< 10	< 10	
	Makotuku Stream	< 10						< 10	
	Mangawhero River	50 ± 20	80 ± 50	210 ± 120	70 ± 40	30 ± 30		430 ± 140	620 ± 180
	Ohakune Lake								110 ± 40
	Omarae Stream								10 ± 10
	Rotokura Lake		< 10		< 10			10 ± 10	110 ± 40
	Taonui Stream	< 10	10 ± 10	50 ± 30	< 10			70 ± 40	400 ± 260
	Tokiahuru Stream			10 ± 10	20 ± 20			30 ± 20	80 ± 40
	Waitaiki Stream		30 ± 20		< 10			40 ± 20	30 ± 20
	Whangaehu River								< 10
Total, Whangaehu catchment		**60 ± 20**	**130 ± 60**	**270 ± 120**	**110 ± 50**	**30 ± 30**	**< 10**	**600 ± 150**	**1370 ± 320**
Kaitoke Stream	Kohata Lake			110 ± 30		< 10		110 ± 30	
	Pauri Lake	< 10						< 10	40 ± 30
	Wiritoa Lake	20 ± 10		30 ± 20		< 10		50 ± 30	10 ± 10
Whanganui River	Makatote River								120 ± 90
	Manganui-o-te-ao River	90 ± 40	140 ± 50	370 ± 110	130 ± 50	20 ± 20		760 ± 140	1970 ± 250
	Orautoha Stream			30 ± 30				30 ± 30	
	Retaruke River		50 ± 40	30 ± 20	< 10			80 ± 50	80 ± 60
	Ruatiti Stream								30 ± 30
	Virginia Lake	50 ± 30	50 ± 50		< 10			100 ± 60	320 ± 80
	Waimarino Stream	< 10		< 10	20 ± 10			40 ± 20	20 ± 10
Total, Whanganui catchment		**140 ± 40**	**240 ± 80**	**440 ± 110**	**170 ± 60**	**20 ± 20**		**1010 ± 160**	**2540 ± 280**
Patea River	Kahouri Stream								40 ± 40
	Konini Stream								20 ± 20

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
	Makuri Stream								110 ± 90
	Patea River	100 ± 40	470 ± 260	270 ± 110	20 ± 20		20 ± 20	880 ± 280	280 ± 120
	Piakau South Stream								40 ± 30
	Rotorangi Lake	20 ± 10	80 ± 50	40 ± 30	< 10			150 ± 60	230 ± 70
Total, Patea catchment		**120 ± 40**	**540 ± 260**	**310 ± 110**	**30 ± 20**		**20 ± 20**	**1030 ± 290**	**720 ± 170**
Tawhiti Stream	Tawhiti Stream								< 10
Waingongoro River	Mangatoki Stream	20 ± 20	< 10		< 10			30 ± 20	200 ± 120
	Waingongoro River	440 ± 130	180 ± 50	210 ± 90	70 ± 30		100 ± 70	1010 ± 180	1550 ± 240
Kapuni Stream	Kapuni Stream	20 ± 10	80 ± 40	10 ± 10				110 ± 40	50 ± 20
Waiokura Stream	Waiokura Stream		20 ± 20					20 ± 20	
Kaupokonui Stream	Dunns Creek				< 10			< 10	
	Kaupokonui Stream	130 ± 80	70 ± 40	< 10	< 10	10 ± 10	< 10	230 ± 90	160 ± 110
	Mangawhero Stream	< 10	20 ± 10	< 10	< 10			30 ± 10	
Otakeho Stream	Otakeho Stream	< 10						< 10	
Taungatara Stream	Taungatara Stream								< 10
Mangahume Stream	Mangahume Stream		< 10					< 10	10 ± 10
Waiaua River	Opunake Lake	< 10						< 10	30 ± 20
	Waiaua River	< 10	< 10					< 10	100 ± 40
Oaonui Stream	Oaonui Stream		50 ± 50					50 ± 50	
Okahu Stream	Okahu Stream	< 10	< 10					< 10	80 ± 50
Waitotoroa Stream	Waitotoroa Stream	10 ± 10						10 ± 10	
Kapoaiaia Stream	Kapoaiaia Stream		< 10					< 10	
Warea River	Warea River		20 ± 10			10 ± 10		30 ± 20	30 ± 10

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
Waiweranui Stream	Waiweranui Stream	< 10	< 10					< 10	
Stony River	Stony River	220 ± 120	120 ± 60	< 10	50 ± 50			410 ± 140	150 ± 30
Timaru Stream	Timaru Stream	< 10						< 10	30 ± 10
Oakura River	Oakura River	< 10	< 10	30 ± 30	< 10			40 ± 30	30 ± 10
Huatoki Stream	Huatoki Stream								60 ± 30
Te Henui Stream	Te Henui Stream	< 10	10 ± 10					20 ± 10	290 ± 140
Waiwhakaiho River	Kaiauai Stream								100 ± 40
	Mangamahoe Lake	240 ± 80	260 ± 160	190 ± 70	70 ± 30	60 ± 40	10 ± 10	830 ± 200	1380 ± 230
	Mangorei Stream								110 ± 70
	Rotomanu Lake	340 ± 230	230 ± 110	30 ± 30	< 10	10 ± 10	10 ± 10	620 ± 260	720 ± 160
	Waiwhakaiho River	180 ± 100	120 ± 40	20 ± 20	10 ± 10	10 ± 10		340 ± 110	530 ± 120
Total, Waiwhakaiho catchment		**750 ± 260**	**610 ± 200**	**230 ± 80**	**90 ± 40**	**90 ± 40**	**30 ± 20**	**1790 ± 350**	**2840 ± 310**
Waiongana Stream	Mangaoraka Stream	40 ± 30	50 ± 50					90 ± 60	190 ± 110
	Waiongana Stream	< 10	20 ± 10					20 ± 10	100 ± 50
Waitara River	Cowley Lake								80 ± 30
	Maketawa Stream	30 ± 20	< 10	< 10				40 ± 20	100 ± 40
	Mangamawhete Stream								< 10
	Manganui River	110 ± 50	20 ± 10	10 ± 10	< 10		< 10	150 ± 60	160 ± 70
	Ngangana Lake		50 ± 30		110 ± 50	30 ± 20	< 10	200 ± 60	
	Ngatoro Stream	< 10						< 10	40 ± 30
	Ratapiko Lake	120 ± 60	50 ± 20	30 ± 20	20 ± 20	20 ± 10	110 ± 100	340 ± 120	
	Te Popo Stream	10 ± 10						10 ± 10	
	Waitara River		< 10	< 10				10 ± 10	20 ± 10
Total, Waitara catchment		**270 ± 80**	**140 ± 40**	**50 ± 20**	**130 ± 50**	**50 ± 30**	**120 ± 100**	**760 ± 150**	**410 ± 90**
Total, all waters		**2300 ± 350**	**2330 ± 370**	**1720 ± 240**	**670 ± 120**	**220 ± 60**	**310 ± 130**	**7550 ± 590**	**11360 ± 680**

Hawkes Bay Region

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
Mohaka River	Hautapu River	80 ± 60		< 10				90 ± 60	50 ± 20
	Inangatahi Stream	< 10	20 ± 20	< 10				30 ± 20	130 ± 20
	Kaipo River	30 ± 30		< 10				30 ± 30	30 ± 10
	Makahu River		< 10					< 10	100 ± 10
	Mangatainoka River			10 ± 10				10 ± 10	200 ± 30
	Mangatutu Stream	30 ± 20	30 ± 10			50 ± 50		110 ± 60	300 ± 40
	Mohaka River	1190 ± 240	2210 ± 390	1560 ± 370	990 ± 260	190 ± 70	930 ± 310	7070 ± 710	3770 ± 220
	Mokomokonui Stream				< 10			< 10	
	Oamaru River	70 ± 60						70 ± 60	
	Ripia River		90 ± 50	110 ± 50				190 ± 70	130 ± 20
	Te Hoe River			< 10				< 10	10 ± 10
	Toropapa Stream			10 ± 10				10 ± 10	
	Waipunga River	80 ± 50	90 ± 60	80 ± 50	50 ± 40	40 ± 40		340 ± 110	50 ± 20
Total, Mohaka catchment		**1490 ± 260**	**2440 ± 390**	**1800 ± 370**	**1040 ± 260**	**280 ± 100**	**930 ± 310**	**7980 ± 730**	**4800 ± 230**
Waikari River	Waikari River			< 10				< 10	120 ± 40
Aropaoanui River	Opouahi Lake	10 ± 10						10 ± 10	
	Tutira Lake	320 ± 130	370 ± 100	340 ± 110	240 ± 80	510 ± 200	570 ± 250	2340 ± 380	3090 ± 150
	Waikoau River	< 10	70 ± 30	290 ± 280				370 ± 280	70 ± 10
Esk River	Esk River	10 ± 10	90 ± 40	50 ± 20	10 ± 10	20 ± 20		190 ± 50	1950 ± 90
Tutaekuri River	Donald River			< 10				< 10	
	Mangaone River	130 ± 50	150 ± 50	110 ± 110				390 ± 130	370 ± 30
	Te Pohue Lake			10 ± 10				10 ± 10	260 ± 40
	Tutaekuri River	1770 ± 400	1420 ± 320	1450 ± 300	840 ± 280	100 ± 60	1150 ± 410	6730 ± 770	7130 ± 240
	Twin Lakes	< 10	70 ± 60	140 ± 90				220 ± 110	
Total, Tutaekuri catchment		**1910 ± 400**	**1640 ± 330**	**1730 ± 330**	**840 ± 280**	**100 ± 60**	**1150 ± 410**	**7360 ± 790**	**7760 ± 240**
Ngaruroro River	Ikawetea Stream	70 ± 70						70 ± 70	

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
	Mangatahi Stream					70 ± 70		70 ± 70	
	Ngarururoro River	1320 ± 410	1660 ± 370	1390 ± 260	1230 ± 330	60 ± 40	580 ± 200	6240 ± 720	3760 ± 170
	Ohara Stream	100 ± 90	40 ± 20	140 ± 100	10 ± 10			290 ± 140	170 ± 20
	Otamauri Stream			10 ± 10				10 ± 10	
	Poporangi Stream								100 ± 20
	Taruarau River	10 ± 10	100 ± 60	250 ± 140				360 ± 150	220 ± 80
Total, Ngarururoro catchment		**1500 ± 420**	**1800 ± 380**	**1800 ± 310**	**1240 ± 330**	**130 ± 80**	**580 ± 200**	**7040 ± 760**	**4250 ± 190**
Tukituki River	Maharakeke Stream		40 ± 30		20 ± 20			60 ± 30	
	Makaretu River		< 10					< 10	
	Makaroro River	30 ± 30	10 ± 10					40 ± 30	40 ± 0
	Mangaonuku Stream	180 ± 110	260 ± 150	120 ± 50	10 ± 10			560 ± 190	200 ± 20
	Mangataura Stream	10 ± 10						10 ± 10	100 ± 10
	Tukipo River	410 ± 170	520 ± 230	50 ± 30	70 ± 50			1050 ± 290	140 ± 80
	Tukituki River	5440 ± 990	3860 ± 590	4570 ± 690	990 ± 200	210 ± 120	2140 ± 550	17210 ± 1470	14020 ± 410
	Waipawa River	620 ± 210	660 ± 250	620 ± 200	< 10		140 ± 90	2050 ± 390	610 ± 40
Total, Tukituki catchment		**6690 ± 1030**	**5360 ± 700**	**5370 ± 720**	**1090 ± 210**	**210 ± 120**	**2280 ± 550**	**21000 ± 1560**	**15100 ± 420**
Maraetotara River	Maraetotara River	10 ± 10	110 ± 90	20 ± 20				140 ± 90	700 ± 190
Total, all waters		**11960 ± 1220**	**11880 ± 950**	**11390 ± 980**	**4460 ± 550**	**1250 ± 270**	**5500 ± 820**	**46440 ± 2100**	**37830 ± 630**

Wellington Region

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
Pahaoa River	Pahaoa River	10 ± 10						10 ± 10	
	Wainuioru Stream		< 10			10 ± 10		20 ± 20	
Ruamahanga River	Atiwhakatu Stream						30 ± 30	30 ± 30	
	Henley Lake		30 ± 20				250 ± 250	280 ± 250	2250 ± 800
	Huangarua River	10 ± 10		30 ± 30	20 ± 20			60 ± 40	
	Kopuaranga River	110 ± 80	150 ± 100	240 ± 140	20 ± 20			520 ± 190	520 ± 240
	Kourarau Dam	150 ± 100	50 ± 40	60 ± 40	140 ± 70	130 ± 80	80 ± 70	610 ± 170	850 ± 230
	Mangatarere Stream			40 ± 40		120 ± 80		160 ± 90	260 ± 130
	Onoke Lake			10 ± 10			10 ± 10	30 ± 20	
	Oporua Spillway								80 ± 80
	Ruamahanga River	940 ± 290	1560 ± 290	1430 ± 300	1630 ± 540	540 ± 160	830 ± 270	6910 ± 810	7390 ± 910
	Tauherenikau River	10 ± 10	170 ± 140		30 ± 30			220 ± 150	360 ± 280
	Tauweru River	10 ± 10	50 ± 40	50 ± 30			30 ± 30	140 ± 60	50 ± 40
	Waingawa River	40 ± 30	30 ± 20			70 ± 50		140 ± 60	430 ± 210
	Waiohine River	70 ± 50	140 ± 80	80 ± 50	420 ± 420	170 ± 140	90 ± 60	960 ± 450	1320 ± 410
	Waipoua River	220 ± 170	40 ± 40					260 ± 180	140 ± 80
	Wairarapa Lake		120 ± 80			30 ± 30		150 ± 80	200 ± 140
Total, Ruamahanga catchment		**1560 ± 370**	**2340 ± 360**	**1930 ± 340**	**2260 ± 690**	**1050 ± 250**	**1320 ± 380**	**10470 ± 1030**	**13860 ± 1390**
Orongorongo River	Orongorongo River	40 ± 40						40 ± 40	
Wainuiomata River	Wainuiomata River	340 ± 130	200 ± 80	200 ± 70			20 ± 20	750 ± 170	2390 ± 590
Hutt River	Akatarawa River	140 ± 90	60 ± 60	80 ± 80	30 ± 30			310 ± 140	70 ± 70
	Hutt River	590 ± 220	2300 ± 620	1440 ± 340	660 ± 220	830 ± 280	330 ± 140	6160 ± 830	19960 ± 2020
	Mangaroa River			< 10				< 10	120 ± 80
	Pakuratahi River	50 ± 50						50 ± 50	50 ± 40
	Whakatikei River		80 ± 70					80 ± 70	70 ± 30
Total, Hutt catchment		**780 ± 240**	**2440 ± 620**	**1530 ± 350**	**700 ± 220**	**830 ± 280**	**330 ± 140**	**6610 ± 850**	**20270 ± 2030**

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
Korokoro Stream	Korokoro Stream								20 ± 20
Kaiwharawhara Stream	Kaiwharawhara Stream								20 ± 20
Karori Stream	Karori Stream								120 ± 80
Makara Stream	Makara Stream		50 ± 50		20 ± 20			70 ± 50	100 ± 60
Pauatahanui Stream	Whitby Lakes	30 ± 20	350 ± 140	30 ± 20				410 ± 150	930 ± 500
Wainui Stream	Wainui Stream	10 ± 10	50 ± 40	< 10				70 ± 50	90 ± 80
Waikanae River	Waikanae River	40 ± 30	100 ± 50	120 ± 90	70 ± 50	80 ± 60		420 ± 130	750 ± 190
Otaki River	Otaki River	60 ± 40	130 ± 60	60 ± 30	30 ± 30	70 ± 50		350 ± 90	690 ± 220
Waitohu Stream	Waitawa Lake	40 ± 40	110 ± 60					140 ± 70	820 ± 540
Waikawa Stream	Kopureherehere Lake	90 ± 90	< 10	50 ± 30	50 ± 50	20 ± 20		210 ± 110	710 ± 350
Ohau River	Ohau River		90 ± 70	40 ± 40			50 ± 40	180 ± 90	230 ± 100
Manawatu River	Hokowhitu Lagoon	280 ± 250	20 ± 20	40 ± 40	70 ± 70	20 ± 20		430 ± 260	220 ± 100
	Kahuterawa Stream								110 ± 50
	Makakahi River	40 ± 40	60 ± 30	60 ± 40				160 ± 70	1170 ± 460
	Makiekie River		< 10					< 10	110 ± 80
	Makuri River	160 ± 60	230 ± 90	100 ± 50	30 ± 30			520 ± 130	820 ± 240
	Manawatu River	2950 ± 510	2730 ± 500	3050 ± 440	2470 ± 710	1640 ± 670	1060 ± 280	13890 ± 1320	11970 ± 1360
	Mangahao River	150 ± 110	70 ± 30	350 ± 130	50 ± 50	90 ± 90	120 ± 90	820 ± 220	210 ± 70
	Mangapuaka Stream		20 ± 20	30 ± 30				50 ± 30	
	Mangatainoka River	440 ± 120	630 ± 210	330 ± 140	70 ± 70	70 ± 70	140 ± 70	1670 ± 310	3040 ± 530
	Mangatoro Stream		30 ± 30					30 ± 30	50 ± 40
	Oroua River	50 ± 30	60 ± 30	270 ± 240	90 ± 90		140 ± 100	610 ± 280	200 ± 80
	Pohangina River	40 ± 30	250 ± 90	340 ± 160	210 ± 130	20 ± 20	70 ± 40	920 ± 230	1400 ± 350
	Tiraumea River			< 10				< 10	50 ± 40
	Tokomaru River	20 ± 20	< 10	20 ± 20				50 ± 30	160 ± 80

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
	Turitea Stream		20 ± 20					20 ± 20	100 ± 50
Total, Manawatu catchment		**4140 ± 600**	**4130 ± 560**	**4590 ± 570**	**2980 ± 730**	**1820 ± 680**	**1530 ± 320**	**19200 ± 1450**	**19610 ± 1600**
Rangitikei River	Hautapu River	40 ± 20		160 ± 120	30 ± 20	30 ± 30		260 ± 130	1060 ± 450
	Kawhatau River	20 ± 20		30 ± 20	30 ± 30			80 ± 50	330 ± 110
	Mangaohane Stream								30 ± 30
	Mangateweka Stream								90 ± 60
	Moawhango River	10 ± 10		50 ± 30				60 ± 30	190 ± 100
	Rangitikei River	910 ± 230	1370 ± 270	1990 ± 450	790 ± 250	320 ± 150	520 ± 160	5890 ± 660	5710 ± 700
	Whakaurekou River			30 ± 30	70 ± 70			100 ± 80	
Total, Rangitikei catchment		**980 ± 230**	**1370 ± 270**	**2260 ± 470**	**910 ± 270**	**360 ± 150**	**520 ± 160**	**6390 ± 680**	**7400 ± 850**
Alice Lake	Alice Lake								10 ± 10
Total, all waters		**8110 ± 790**	**11390 ± 980**	**10800 ± 890**	**7020 ± 1070**	**4250 ± 800**	**3760 ± 540**	**45340 ± 2110**	**68030 ± 3230**

Nelson/Marlborough Region

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
Aorere River	Aorere River		170 ± 60	80 ± 40	30 ± 20		20 ± 20	300 ± 80	650 ± 210
Takaka River	Anatoki River		10 ± 10	10 ± 10	10 ± 10			40 ± 20	350 ± 240
	Cobb Reservoir	20 ± 10	50 ± 30	70 ± 30	40 ± 40		40 ± 40	220 ± 70	440 ± 130
	Cobb River	90 ± 40	50 ± 30	130 ± 100				260 ± 110	290 ± 90
	Takaka River	180 ± 70	530 ± 150	260 ± 90	160 ± 90			1120 ± 210	1160 ± 350
	Waikoropupu River		10 ± 10	50 ± 40	10 ± 10			80 ± 50	40 ± 40
	Waingaro River		40 ± 20		10 ± 10			50 ± 20	50 ± 40
Total, Takaka catchment		**290 ± 90**	**690 ± 160**	**520 ± 150**	**240 ± 100**		**40 ± 40**	**1770 ± 260**	**2330 ± 450**
Riwaka River	Riwaka River	240 ± 130	150 ± 70	170 ± 50				570 ± 150	620 ± 220
	Riwaka North Branch	< 10		< 10				20 ± 10	
	Riwaka South Branch	< 10	10 ± 10	< 10				30 ± 10	
Motueka River	Baton River	30 ± 20	90 ± 30	30 ± 10				150 ± 40	440 ± 140
	Graham River	< 10		40 ± 20				50 ± 20	
	Motueka River	1100 ± 240	2040 ± 310	1360 ± 200	1110 ± 340	80 ± 50	710 ± 360	6390 ± 660	10070 ± 1330
	Motupiko River	100 ± 40	160 ± 60	30 ± 20				290 ± 80	380 ± 150
	Orinoco River	50 ± 50	40 ± 30					90 ± 60	
	Pearse River		20 ± 20	10 ± 10				30 ± 20	270 ± 240
	Rainy River		< 10	< 10				10 ± 10	
	Rolling River	< 10						< 10	< 10
	Wangapeka River	190 ± 70	350 ± 80	170 ± 50	110 ± 80			820 ± 140	970 ± 200
Total, Motueka catchment		**1490 ± 260**	**2700 ± 330**	**1640 ± 210**	**1220 ± 350**	**80 ± 50**	**710 ± 360**	**7830 ± 690**	**12130 ± 1380**
Waimea River	Lee River	< 10	20 ± 10	50 ± 30				80 ± 30	130 ± 120
	Roding River			50 ± 50	20 ± 20			70 ± 60	
	Wai-iti River		30 ± 20	< 10				30 ± 20	100 ± 50
	Waimea River	60 ± 40	30 ± 20	80 ± 40			70 ± 50	240 ± 80	1780 ± 340
	Wairoa River	50 ± 50	230 ± 90	120 ± 50	140 ± 80			550 ± 140	280 ± 90

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
Total, Waimea catchment		**120 ± 70**	**310 ± 100**	**310 ± 90**	**170 ± 80**		**70 ± 50**	**980 ± 180**	**2290 ± 370**
Maitai River	Maitai River	20 ± 10	180 ± 170	20 ± 10	50 ± 40	20 ± 20		280 ± 170	180 ± 60
Wakapuaka River	Wakapuaka River	90 ± 70	20 ± 20	20 ± 10				130 ± 70	280 ± 190
Whangamoa River	Whangamoa River			10 ± 10				10 ± 10	
Pelorus River	Opouri River	30 ± 30	40 ± 20		70 ± 40			130 ± 50	500 ± 250
	Pelorus River	130 ± 50	430 ± 100	680 ± 170	70 ± 40	160 ± 70	140 ± 120	1600 ± 250	2100 ± 380
	Rai River	240 ± 150	130 ± 40	200 ± 80	160 ± 110		10 ± 10	740 ± 200	1440 ± 320
	Ronga River	< 10	10 ± 10					20 ± 10	
	Tinline River								< 10
	Tunakino River		10 ± 10	< 10	10 ± 10			30 ± 20	< 10
	Wakamarina River			20 ± 20	20 ± 20			50 ± 30	
Total, Pelorus catchment		**400 ± 160**	**620 ± 120**	**900 ± 190**	**330 ± 130**	**160 ± 70**	**160 ± 130**	**2560 ± 330**	**4060 ± 560**
Kaituna River	Kaituna River	20 ± 10	20 ± 20					30 ± 20	190 ± 180
Wairau River	Argyle Pond	140 ± 70	210 ± 60	250 ± 120	210 ± 140	70 ± 40	60 ± 40	940 ± 210	1280 ± 240
	Bartletts Creek	< 10	< 10					10 ± 10	20 ± 20
	Branch River		20 ± 10					20 ± 10	230 ± 120
	Goulter River	10 ± 10	60 ± 30	< 10	10 ± 10			90 ± 40	30 ± 20
	Leatham River	< 10	20 ± 20					30 ± 20	100 ± 40
	Opawa River	50 ± 40	220 ± 100	180 ± 160	10 ± 10	50 ± 50		500 ± 200	870 ± 290
	Rainbow River	< 10	30 ± 20					30 ± 20	80 ± 40
	Roses Overflow								50 ± 40
	Spring Creek	80 ± 50	80 ± 60	200 ± 80	< 10			360 ± 110	170 ± 70
	Taylor River	70 ± 60	50 ± 30	60 ± 30				180 ± 70	140 ± 110
	Tuamarina River								20 ± 20
	Waihopai River		70 ± 40					70 ± 40	100 ± 70
	Waikakaho River		160 ± 150					160 ± 150	20 ± 10
	Wairau Diversion		170 ± 170					170 ± 170	
	Wairau River	970 ± 280	3630 ± 670	1680 ± 260	860 ± 220	830 ± 250	430 ± 200	8410 ± 860	8480 ± 820

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
Total, Wairau catchment		**1340 ± 300**	**4720 ± 720**	**2370 ± 330**	**1100 ± 260**	**940 ± 260**	**490 ± 200**	**10970 ± 950**	**11560 ± 920**
Awatere River	Awatere River	20 ± 20	20 ± 10	30 ± 20		100 ± 100		170 ± 110	200 ± 120
Clarence River	Acheron River		< 10	40 ± 30				50 ± 30	80 ± 60
	Alma River								40 ± 40
	Bowscale Tarn	120 ± 120	30 ± 20	< 10				160 ± 130	
	Clarence River	< 10	390 ± 150	160 ± 70	50 ± 50			620 ± 170	840 ± 370
	Severn River			20 ± 20	50 ± 50			70 ± 60	20 ± 20
	Tennyson Lake		80 ± 50					80 ± 50	450 ± 330
Total, Clarence catchment		**130 ± 130**	**510 ± 150**	**230 ± 80**	**110 ± 70**			**970 ± 230**	**1420 ± 500**
Kahutara River	Kahutara River		30 ± 30					30 ± 30	
Conway River	Conway River	20 ± 20	10 ± 10	30 ± 30				60 ± 40	10 ± 10
Buller River	Buller River	320 ± 100	1230 ± 220	550 ± 100	210 ± 90	350 ± 340	70 ± 50	2730 ± 440	3460 ± 640
	D`Urville River	70 ± 50	70 ± 30	20 ± 10	10 ± 10			170 ± 60	90 ± 40
	Daniells Lake	90 ± 80	70 ± 50					160 ± 90	230 ± 150
	Deepdale River			< 10				< 10	
	Fyfe River			10 ± 10				10 ± 10	
	Glenroy River		70 ± 40	< 10	10 ± 10			90 ± 40	70 ± 40
	Gowan River	50 ± 30	60 ± 30	190 ± 90	50 ± 40			350 ± 110	70 ± 40
	Hope River	< 10	130 ± 70	120 ± 70				260 ± 100	40 ± 20
	Howard River		20 ± 20					20 ± 20	
	Lyell Creek						40 ± 40	40 ± 40	
	Mangles River	40 ± 20	90 ± 60	40 ± 20	10 ± 10			180 ± 70	400 ± 140
	Maruia River	220 ± 80	360 ± 100	1160 ± 870	60 ± 30		20 ± 20	1830 ± 880	1190 ± 370
	Matakitaki River	70 ± 40	200 ± 70	190 ± 70	40 ± 30	50 ± 50		560 ± 120	510 ± 150
	Matiri River		30 ± 20	40 ± 40	10 ± 10		10 ± 10	100 ± 40	90 ± 60
	Owen River	60 ± 20	160 ± 60	110 ± 30				320 ± 70	140 ± 70
	Rotoiti Lake	270 ± 80	1010 ± 210	460 ± 100	120 ± 40	80 ± 60	30 ± 20	1970 ± 260	2060 ± 550
	Rotoroa Lake	880 ± 260	580 ± 180	320 ± 100	150 ± 60	390 ± 330	40 ± 30	2350 ± 470	1030 ± 220

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
	Sabine River	50 ± 20	30 ± 20	80 ± 40				150 ± 50	230 ± 90
	Speargrass Creek		10 ± 10					10 ± 10	80 ± 80
	Station Creek		10 ± 10					10 ± 10	
	Travers River	50 ± 20	190 ± 60	< 10	50 ± 50			290 ± 80	450 ± 160
	Tutaki River	20 ± 10	< 10	50 ± 30	10 ± 10			90 ± 40	210 ± 80
	Warwick River		20 ± 20	< 10				20 ± 20	
	Woolley River	20 ± 20	30 ± 30					50 ± 30	
Total, Buller catchment		**2200 ± 320**	**4380 ± 410**	**3350 ± 910**	**750 ± 140**	**870 ± 480**	**210 ± 80**	**11760 ± 1160**	**10330 ± 1010**
Anatori River	Anatori River		20 ± 20		40 ± 40			60 ± 40	
Paturau River	Paturau River								< 10
Total, all waters		**6390 ± 580**	**14560 ± 950**	**9690 ± 1030**	**4020 ± 500**	**2160 ± 560**	**1690 ± 450**	**38520 ± 1750**	**46270 ± 2210**

West Coast Region

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
Hope River	Hope River			10 ± 10				10 ± 10	
Cascade River	Cascade River		20 ± 20	< 10			20 ± 20	50 ± 20	200 ± 80
	Martyr River								30 ± 30
Arawata River	Arawata River		110 ± 90		60 ± 60		160 ± 160	330 ± 190	200 ± 180
	Ellery Lake								70 ± 40
	Jackson River	30 ± 30			< 10			30 ± 30	80 ± 40
Waiatoto River	Waiatoto River		30 ± 30	160 ± 160				190 ± 170	
Hapuka River	Hapuka River								20 ± 20
Turnbull River	Turnbull River	50 ± 50	20 ± 20	170 ± 160	30 ± 30			270 ± 180	70 ± 30
Okuru River	Okuru River		80 ± 50	20 ± 20				100 ± 60	220 ± 120
Haast River	Haast River	130 ± 110	130 ± 100	10 ± 10	120 ± 100	20 ± 20		420 ± 180	370 ± 150
	Landsborough River			< 10				< 10	
	Thomas River	120 ± 120	50 ± 30					160 ± 120	20 ± 20
Waita River	Waita River			< 10				< 10	
Moeraki River	Moeraki Lake		70 ± 40	60 ± 30	10 ± 10			130 ± 50	40 ± 20
	Moeraki River								40 ± 30
Paringa River	Paringa Lake	90 ± 60	20 ± 10	100 ± 60	10 ± 10			220 ± 90	480 ± 130
	Paringa River		< 10	80 ± 70	10 ± 10			100 ± 70	130 ± 80
Mahitahi River	Mahitahi River				10 ± 10			10 ± 10	60 ± 60
Jacobs River	Jacobs (Makawhio) River	80 ± 80	10 ± 10	60 ± 40	10 ± 10		20 ± 20	180 ± 90	140 ± 60
Karangarua River	Copland River		80 ± 80					80 ± 80	< 10
	Karangarua River	30 ± 30		< 10	20 ± 20	80 ± 80		140 ± 90	50 ± 40

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
Okarito River	Mapourika Lake		100 ± 40	780 ± 150	20 ± 20		50 ± 50	950 ± 160	1460 ± 490
	Okarito River		50 ± 30	170 ± 80	50 ± 30	< 10	40 ± 30	310 ± 100	30 ± 20
	Wahapo Lake		< 10	80 ± 70				90 ± 70	< 10
Waitangi-taona River	Waitangi-taona River	50 ± 50	70 ± 30	20 ± 10	110 ± 110			250 ± 120	100 ± 30
Whataroa River	Whataroa River		30 ± 20	30 ± 20				60 ± 30	30 ± 20
Poerua River	Poerua River	< 10	20 ± 20	50 ± 40				70 ± 40	80 ± 40
Wanganui River	Ianthe Lake	70 ± 50	50 ± 20	60 ± 30	30 ± 20	30 ± 30	< 10	250 ± 80	140 ± 40
	La Fontaine Stream		150 ± 80	70 ± 40	20 ± 20			240 ± 90	280 ± 130
	Wanganui River	20 ± 20	30 ± 20	30 ± 20	20 ± 20			110 ± 40	110 ± 100
Waitaha River	Kakapotahi River	100 ± 70		< 10				110 ± 70	60 ± 30
	Waitaha River	< 10		30 ± 20		150 ± 150		190 ± 150	190 ± 80
Mikonui River	Mikonui River	20 ± 10	20 ± 20	< 10		40 ± 40		80 ± 50	
Totara River	Totara River					50 ± 50	80 ± 80	130 ± 100	10 ± 10
Mahinapua Creek	Mahinapua Creek		30 ± 20	20 ± 10	< 10			50 ± 20	80 ± 30
Hokitika River	Harris Creek		80 ± 40	30 ± 20	< 10			120 ± 50	100 ± 20
	Hokitika River	240 ± 110	160 ± 60	240 ± 80	120 ± 70	330 ± 240	30 ± 20	1120 ± 290	940 ± 240
	Kaniere Lake	70 ± 50	< 10	60 ± 40	10 ± 10	80 ± 80	< 10	230 ± 100	500 ± 90
	Kaniere River	< 10		20 ± 20				30 ± 20	30 ± 20
	Kokatahi River		20 ± 20	< 10	20 ± 20			40 ± 30	< 10
	Mahinapua Lake		< 10					< 10	50 ± 40
	Murray Creek		50 ± 20	10 ± 10				60 ± 30	50 ± 20
	Styx River		20 ± 10	< 10				30 ± 20	30 ± 10
	Toaroha River		< 10					< 10	
Total, Hokitika catchment		**320 ± 130**	**330 ± 80**	**370 ± 100**	**160 ± 80**	**410 ± 250**	**30 ± 20**	**1630 ± 310**	**1700 ± 260**
Arahura River	Arahura River	200 ± 130	140 ± 70	100 ± 50	100 ± 80	350 ± 240	60 ± 60	950 ± 300	220 ± 80

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
	Kawhaka Hydro	80 ± 50	10 ± 10		20 ± 20			120 ± 60	< 10
Taramakau River	Big Hohonu River		< 10	10 ± 10				20 ± 10	
	Clear Creek		< 10					< 10	
	Dredge Ponds		10 ± 10					10 ± 10	
	Hohonu River								20 ± 10
	Kapitea Reservoir		10 ± 10					10 ± 10	
	Nicholas Creek		< 10					< 10	
	Orangipuku River	80 ± 40	270 ± 160	30 ± 20	30 ± 20			410 ± 170	110 ± 40
	Taipo River	30 ± 30						30 ± 30	10 ± 10
	Taramakau River	630 ± 210	220 ± 100	560 ± 220	190 ± 120	100 ± 60	20 ± 20	1720 ± 350	1890 ± 390
Total, Taramakau catchment		**730 ± 220**	**530 ± 190**	**600 ± 220**	**220 ± 120**	**100 ± 60**	**20 ± 20**	**2220 ± 390**	**2020 ± 400**
New River	New River	80 ± 60			40 ± 30	50 ± 50		170 ± 80	10 ± 10
Grey River	Ahaura Lake	40 ± 30		< 10				50 ± 30	30 ± 20
	Ahaura River	50 ± 20	380 ± 130	90 ± 40		20 ± 20	60 ± 60	610 ± 150	680 ± 170
	Arnold River	470 ± 140	570 ± 130	300 ± 80	50 ± 30	20 ± 10	20 ± 20	1420 ± 210	1590 ± 430
	Big River	20 ± 20	< 10	40 ± 30				60 ± 40	130 ± 50
	Blackwater River	70 ± 50	30 ± 20					100 ± 60	
	Blue Grey River								50 ± 20
	Brown Grey River	50 ± 40		40 ± 40		10 ± 10		100 ± 50	
	Bruce Creek	30 ± 30	40 ± 20	20 ± 20				80 ± 40	150 ± 90
	Brunner Lake	1640 ± 430	2100 ± 340	2540 ± 420	1030 ± 320	1130 ± 400	840 ± 290	9280 ± 910	4240 ± 550
	Clarke River		10 ± 10		10 ± 10			20 ± 10	20 ± 20
	Crooked River	270 ± 90	490 ± 140	100 ± 50		< 10	< 10	870 ± 170	580 ± 390
	Deep Creek		10 ± 10					10 ± 10	< 10
	Eastern Hohonu River	80 ± 80				20 ± 20		100 ± 80	
	Grey River	1040 ± 230	1750 ± 330	1940 ± 380	850 ± 320	490 ± 210	200 ± 80	6270 ± 680	3390 ± 610
	Haupiri Lake	130 ± 50	90 ± 60	20 ± 20				240 ± 80	50 ± 30
	Haupiri River	80 ± 40	150 ± 100	20 ± 10	20 ± 20			270 ± 110	140 ± 30
	Hochstetter Lake		< 10					< 10	
	Kangaroo Lake		< 10					< 10	

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
	Lady Lake	40 ± 40		< 10				50 ± 40	
	Little Grey River	20 ± 20	30 ± 20	180 ± 130	110 ± 70			340 ± 150	20 ± 20
	Mawheraiti River	120 ± 120	10 ± 10	10 ± 10				150 ± 120	130 ± 50
	Molloy Creek	50 ± 40	20 ± 20					70 ± 40	
	Moonlight Creek	20 ± 20	10 ± 10					30 ± 20	20 ± 10
	Nelson Creek		100 ± 80	< 10		< 10		120 ± 80	120 ± 60
	Poerua Lake	50 ± 20	200 ± 80	110 ± 80	20 ± 20			370 ± 120	440 ± 180
	Poerua River	60 ± 30	80 ± 80					150 ± 90	< 10
	Robinson River	50 ± 40	50 ± 30	60 ± 50				160 ± 70	
	Rough River	20 ± 10	40 ± 30	100 ± 40	20 ± 20			180 ± 60	200 ± 90
Total, Grey catchment		**4400 ± 560**	**6190 ± 560**	**5580 ± 600**	**2130 ± 460**	**1710 ± 450**	**1130 ± 310**	**21120 ± 1220**	**11990 ± 1040**
Punakaiki River	Punakaiki River		20 ± 20		10 ± 10			30 ± 20	70 ± 30
Pororari River	Pororari River								50 ± 30
Fox River	Fox River	50 ± 50		20 ± 20	10 ± 10			80 ± 60	20 ± 10
Waitakere River	Waitakere River								40 ± 30
Okari River	Okari River								< 10
Buller River	Awarau River	40 ± 20	60 ± 30	110 ± 50	40 ± 40			250 ± 70	120 ± 70
	Bradshaws Creek								20 ± 10
	Buller River	350 ± 130	700 ± 210	340 ± 120	140 ± 60	30 ± 20	20 ± 20	1580 ± 280	1600 ± 220
	Inangahua River	150 ± 60	480 ± 140	360 ± 140	80 ± 60	< 10		1080 ± 220	790 ± 170
	Montgomerie River	< 10						< 10	20 ± 10
	New Creek								< 10
	Ohikanui River		20 ± 10	30 ± 20				50 ± 30	320 ± 100
	Stony (Te Wharau) River	< 10	20 ± 20	20 ± 20				40 ± 30	80 ± 40
	Trent River								< 10
	Waitahu River	60 ± 30	120 ± 50	120 ± 50				300 ± 70	110 ± 40
Total, Buller catchment		**610 ± 150**	**1400 ± 260**	**980 ± 200**	**260 ± 100**	**40 ± 20**	**20 ± 20**	**3320 ± 370**	**3070 ± 310**

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
Orowaiti River	Orowaiti River								30 ± 10
Mokihinui River	Johnson River		20 ± 20					20 ± 20	50 ± 40
	Mokihinui River	230 ± 190	100 ± 40	50 ± 40	10 ± 10	< 10		400 ± 190	720 ± 160
Little Wanganui River	Little Wanganui River			50 ± 30	10 ± 10			60 ± 30	20 ± 10
Karamea River	Beautiful River			20 ± 20				20 ± 20	
	Crow River								70 ± 40
	Karamea River	< 10	290 ± 160	70 ± 40	30 ± 20	< 10		400 ± 170	920 ± 430
	Leslie River		10 ± 10	10 ± 10	10 ± 10			40 ± 20	40 ± 20
	Roaring Lion River	40 ± 30	20 ± 20	20 ± 20				90 ± 40	110 ± 60
Heaphy River	Heaphy River				60 ± 40			60 ± 40	20 ± 10
Total, all waters		**7550 ± 710**	**10220 ± 710**	**9930 ± 760**	**3660 ± 530**	**3050 ± 600**	**1620 ± 370**	**36030 ± 1540**	**26000 ± 1420**

North Canterbury Region

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
Waiau River	Ada River								20 ± 20
	Boyle River	30 ± 30	140 ± 70		30 ± 30			200 ± 80	390 ± 270
	Doubtful River		20 ± 20		30 ± 30			50 ± 40	
	Guyon Lake		100 ± 60	60 ± 50				160 ± 80	
	Hanmer River	30 ± 30						30 ± 30	20 ± 20
	Hope River	110 ± 50	180 ± 90	50 ± 40				340 ± 110	510 ± 300
	Lewis River	20 ± 20	70 ± 50	20 ± 20				110 ± 50	270 ± 260
	Mason River		30 ± 30					30 ± 30	
	Nina River		40 ± 20	< 10				40 ± 20	260 ± 260
	Waiau River	420 ± 150	360 ± 160	670 ± 230	100 ± 70		580 ± 270	2130 ± 420	1440 ± 490
Total, Waiau catchment		**590 ± 160**	**940 ± 210**	**810 ± 240**	**170 ± 90**		**580 ± 270**	**3080 ± 450**	**2920 ± 730**
Hurunui River	Hurunui River	880 ± 210	2820 ± 440	3220 ± 800	1170 ± 310	280 ± 130		8380 ± 990	17100 ± 3330
	Katrine Loch	80 ± 50	20 ± 20	70 ± 30	30 ± 30			200 ± 70	190 ± 130
	Mason Lake			20 ± 20				20 ± 20	300 ± 300
	Sheppard Lake	30 ± 30	50 ± 30	50 ± 30				120 ± 50	230 ± 120
	Sumner Lake	30 ± 30	330 ± 170	70 ± 50			100 ± 100	520 ± 210	390 ± 170
	Taylor Lake	200 ± 100	120 ± 60	280 ± 70	130 ± 80		240 ± 140	970 ± 220	750 ± 250
Total, Hurunui catchment		**1210 ± 240**	**3330 ± 470**	**3710 ± 810**	**1330 ± 320**	**280 ± 130**	**340 ± 170**	**10210 ± 1040**	**18960 ± 3360**
Motunau River	Motunau River								20 ± 20
Waipara River	Waipara River		30 ± 30	50 ± 40				80 ± 50	
Ashley River	Ashley River	910 ± 250	880 ± 280	900 ± 260	740 ± 510	90 ± 70		3520 ± 680	4530 ± 1050
	Glentui River								210 ± 120
	Okuku River	30 ± 30						30 ± 30	
	Saltwater Creek	20 ± 20	100 ± 100					110 ± 100	
	Waikuku Stream					190 ± 190		190 ± 190	
Total, Ashley catchment		**950 ± 260**	**980 ± 290**	**900 ± 260**	**740 ± 510**	**270 ± 200**		**3850 ± 720**	**4740 ± 1060**

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
Waimakariri River	Broken River		90 ± 40	100 ± 50	30 ± 30	60 ± 60		290 ± 100	680 ± 330
	Cam River	30 ± 30	90 ± 80	< 10				120 ± 80	1580 ± 1070
	Cass Hill Stream		50 ± 50					50 ± 50	
	Courtenay Stream		< 10					< 10	
	Cust River	30 ± 30	20 ± 20					40 ± 30	360 ± 190
	Esk River		80 ± 40					80 ± 40	
	Eyre River								80 ± 50
	Grasmere Lake	30 ± 30	190 ± 70	150 ± 70	80 ± 50			440 ± 110	820 ± 280
	Hawdon Lake	80 ± 60	100 ± 50	210 ± 90				380 ± 120	180 ± 110
	Kaiapoi Lakes	320 ± 320	80 ± 80	210 ± 150				600 ± 360	
	Kaiapoi River	550 ± 280	870 ± 330	320 ± 160	60 ± 50			1800 ± 460	5250 ± 2150
	Kowai River	50 ± 50	150 ± 150	70 ± 50				270 ± 170	10 ± 10
	Letitia Lake	50 ± 40	20 ± 20					70 ± 40	
	Meremere Lake	50 ± 50	80 ± 30	210 ± 90				340 ± 110	
	Minchin Lake								200 ± 190
	Minchin Stream		30 ± 20					30 ± 20	
	Monopolies Pond			70 ± 70				70 ± 70	
	Ohoka Stream		20 ± 20	100 ± 100				120 ± 110	
	Pearson Lake	480 ± 150	530 ± 150	660 ± 170	300 ± 150	130 ± 90	190 ± 130	2290 ± 350	1750 ± 630
	Porter River	30 ± 30	30 ± 30	50 ± 40	60 ± 60			170 ± 90	370 ± 270
	Poulter River		80 ± 30					80 ± 30	30 ± 30
	Rotakahautu Lake	320 ± 320						320 ± 320	
	Sarah Lake	50 ± 50	100 ± 50	110 ± 60				270 ± 100	560 ± 190
	Silverstream		140 ± 80	180 ± 130				320 ± 150	1400 ± 620
	Styx River	40 ± 40	560 ± 300	110 ± 70				710 ± 310	440 ± 190
	The Groynes	220 ± 130	< 10	210 ± 160				440 ± 210	
	Waimakariri River	5560 ± 1140	10770 ± 1370	15510 ± 1800	10790 ± 3300	2790 ± 510	3540 ± 780	48950 ± 4260	58360 ± 7100
	Waimakariri South Branch	20 ± 20	240 ± 90	30 ± 30				290 ± 100	2560 ± 690
	Winding Creek	30 ± 30						30 ± 30	
Total, Waimakariri catchment		**7920 ± 1280**	**14310 ± 1470**	**18310 ± 1840**	**11340 ± 3300**	**2980 ± 520**	**3730 ± 790**	**58570 ± 4360**	**74620 ± 7600**
Avon River	Avon River	110 ± 110	170 ± 100	30 ± 30	100 ± 100	180 ± 140	150 ± 100	730 ± 250	1020 ± 450

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
	Bryndwyr Lake		40 ± 40					40 ± 40	300 ± 290
	Heathcote River	30 ± 30	230 ± 160					260 ± 160	30 ± 30
	Wairarapa Stream								230 ± 140
Forsyth Lake	Forsyth Lake	30 ± 30	120 ± 80	20 ± 20		60 ± 60	100 ± 100	330 ± 140	310 ± 170
	Little River								510 ± 310
	Okana River		20 ± 20	30 ± 30				60 ± 40	
Ellesmere/Selwyn	Ellesmere Lake		150 ± 150					150 ± 150	420 ± 280
	Halswell River		100 ± 70	120 ± 110				220 ± 130	1760 ± 880
	Harts Creek	270 ± 90	170 ± 70	50 ± 40				480 ± 120	1010 ± 520
	Hawkins River	40 ± 30			30 ± 30			80 ± 50	210 ± 140
	Hororata River								160 ± 130
	Irwell River		30 ± 30					30 ± 30	430 ± 240
	Kaituna River								90 ± 90
	L II River	50 ± 40	420 ± 260	210 ± 110				680 ± 290	2130 ± 1110
	Selwyn River	350 ± 220	690 ± 190	900 ± 440	60 ± 60	130 ± 130		2130 ± 540	6700 ± 1370
Total, Ellesmere/Selwyn catchment		**710 ± 240**	**1560 ± 370**	**1290 ± 460**	**100 ± 70**	**130 ± 130**		**3780 ± 660**	**12920 ± 2080**
	Tentburn Outfall			30 ± 30				30 ± 30	2280 ± 1180
Rakaia River	Acheron River	160 ± 70	60 ± 50	300 ± 280	40 ± 40			560 ± 300	
	Avoca River	160 ± 70	30 ± 20					190 ± 80	
	Catherine Lake	100 ± 60	30 ± 20	20 ± 20			100 ± 100	250 ± 120	620 ± 350
	Coleridge Lake	1290 ± 260	2260 ± 380	1830 ± 370	1590 ± 430	1380 ± 320	870 ± 290	9210 ± 850	7090 ± 1310
	Evelyn Lake		20 ± 20		30 ± 30			50 ± 40	
	Georgina Lake	340 ± 140	180 ± 70	140 ± 80				660 ± 170	890 ± 280
	Glenariffe Stream	110 ± 50	30 ± 20	50 ± 40				190 ± 70	
	Harper River	110 ± 50	80 ± 40					190 ± 70	120 ± 120
	Hydra Waters			< 10				< 10	
	Ida Lake	160 ± 60	180 ± 80	200 ± 110	130 ± 80	60 ± 60		740 ± 190	510 ± 470
	Lake Stream	400 ± 250						400 ± 250	
	Lilian Lake		30 ± 30					30 ± 30	
	Lyndon Lake	470 ± 190	520 ± 130	500 ± 150	420 ± 220	60 ± 60		1970 ± 360	3290 ± 800

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
	Rakaia River	1290 ± 260	7910 ± 1310	7890 ± 1140	1970 ± 800	600 ± 260	1800 ± 630	21460 ± 2040	34650 ± 3850
	Ryton River		30 ± 20	20 ± 20				50 ± 30	70 ± 70
	Selfe Lake	80 ± 80	380 ± 110	180 ± 80	210 ± 90	130 ± 90		980 ± 200	600 ± 220
	Wilberforce River		20 ± 20	40 ± 40				50 ± 40	
Total, Rakaia catchment		**4660 ± 530**	**11760 ± 1380**	**11160 ± 1250**	**4390 ± 940**	**2230 ± 430**	**2770 ± 700**	**36970 ± 2300**	**47840 ± 4200**
Total, all waters		**16210 ± 1460**	**33490 ± 2140**	**36330 ± 2440**	**18160 ± 3490**	**6130 ± 740**	**7650 ± 1110**	**117970 ± 5170**	**166690 ± 9720**

Central South Island Region

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
Rakaia River	Heron Lake	690 ± 280	1230 ± 870	480 ± 130	180 ± 160			2580 ± 940	2620 ± 730
Wakanui Creek	Wakanui Creek		60 ± 60					60 ± 60	
Ashburton River	Ashburton River	1610 ± 630	1360 ± 290	1840 ± 850	450 ± 240	170 ± 120	40 ± 40	5480 ± 1130	4170 ± 780
	Bowyers Stream	280 ± 240						280 ± 240	150 ± 130
	Camp Lake		180 ± 110	110 ± 60	60 ± 60	130 ± 130		470 ± 190	680 ± 190
	Clearwater Lake	440 ± 170	820 ± 260	170 ± 70	50 ± 50			1480 ± 330	2900 ± 820
	Emily Lake	30 ± 30	90 ± 40	20 ± 20				130 ± 50	20 ± 20
	Emma Lake	80 ± 60	150 ± 110	130 ± 50	20 ± 20			370 ± 140	440 ± 150
	Maori Lakes		190 ± 120	20 ± 20				220 ± 120	70 ± 30
	Mystery Lake								60 ± 60
	Roundabout Lake								50 ± 40
	Taylors Stream		10 ± 10					10 ± 10	
Total, Ashburton catchment		**2440 ± 690**	**2800 ± 440**	**2280 ± 860**	**580 ± 250**	**300 ± 180**	**40 ± 40**	**8450 ± 1230**	**8530 ± 1160**
Hinds River	Hinds River		290 ± 170	40 ± 40				320 ± 170	210 ± 100
Rangitata River	Deep Creek	80 ± 80						80 ± 80	20 ± 20
	Deep Stream		10 ± 10					10 ± 10	190 ± 120
	Rangitata River	2750 ± 1330	4160 ± 810	4220 ± 1030	760 ± 290	90 ± 60	730 ± 360	12710 ± 1930	35960 ± 2550
	RDR Canal	940 ± 770			20 ± 20			960 ± 770	20 ± 20
Orari River	Coopers Creek	30 ± 30						30 ± 30	
	Ohapi Creek								120 ± 120
	Orari River	690 ± 310	740 ± 360	880 ± 300				2310 ± 560	6330 ± 770
Opihi River	Hae Hae Te Moana River			10 ± 10				10 ± 10	
	Kakahu River			20 ± 20				20 ± 20	120 ± 110
	Opihi River	3790 ± 1070	4970 ± 950	3790 ± 770	580 ± 280	130 ± 100	130 ± 130	13390 ± 1660	18450 ± 1660
	Opuha Lake	380 ± 120	980 ± 320	1170 ± 240	70 ± 50	70 ± 70		2670 ± 430	
	Opuha River	440 ± 320	440 ± 150	330 ± 130	100 ± 70			1310 ± 390	1500 ± 490
	Te Ngawai River	30 ± 30	320 ± 220	550 ± 320				890 ± 390	90 ± 50

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
	Temuka River	320 ± 260	510 ± 210	140 ± 70				970 ± 340	1280 ± 280
	Waihi River	30 ± 30	460 ± 380	170 ± 90	30 ± 30			690 ± 390	1670 ± 790
Total, Opihi catchment		**4980 ± 1160**	**7680 ± 1130**	**6180 ± 880**	**780 ± 300**	**200 ± 120**	**130 ± 130**	**19960 ± 1870**	**23110 ± 1930**
Pareora River	Pareora River	180 ± 130	550 ± 250	90 ± 50	30 ± 20			850 ± 290	190 ± 110
Waimate Creek	Waimate Creek								20 ± 20
Waihao River	Waihao River	910 ± 580	50 ± 50	70 ± 60	60 ± 50			1100 ± 590	650 ± 290
	Waihao South Branch			10 ± 10				10 ± 10	
Waitaki River	Ahuriri River	590 ± 260	640 ± 200	1310 ± 450	390 ± 150			2930 ± 580	2590 ± 720
	Alexandrina Lake	2170 ± 640	3830 ± 1020	2810 ± 630	530 ± 200	140 ± 70		9470 ± 1380	4480 ± 720
	Aviemore Lake	2440 ± 790	5880 ± 1100	2280 ± 570	340 ± 110	550 ± 210	90 ± 90	11580 ± 1490	8850 ± 1320
	Avon Burn								20 ± 20
	Bell's Pond	160 ± 160			70 ± 70			220 ± 170	
	Benmore Lake	2780 ± 580	8930 ± 1140	5360 ± 790	1640 ± 350	1380 ± 410	1820 ± 530	21900 ± 1680	12830 ± 1480
	Cameron Loch	80 ± 80	40 ± 40					120 ± 90	
	Cass River		30 ± 20					30 ± 20	
	Coal River								20 ± 20
	Dobson River	100 ± 100	50 ± 50	110 ± 70	30 ± 20			280 ± 130	
	Fork Stream								40 ± 30
	Godley River		90 ± 80	10 ± 10	20 ± 20			120 ± 80	100 ± 80
	Grays River		150 ± 80	70 ± 50	30 ± 30			260 ± 100	90 ± 60
	Hakataramea River	960 ± 370	420 ± 150	240 ± 200				1610 ± 440	1920 ± 480
	Hopkins River	130 ± 90						130 ± 90	350 ± 220
	Huxley River								260 ± 140
	Irishman Creek	30 ± 30						30 ± 30	20 ± 20
	Jollie River		90 ± 80	30 ± 30				120 ± 90	
	Kelland Pond	640 ± 410	110 ± 70		30 ± 30			770 ± 420	20 ± 20
	Kurow River		60 ± 40	< 10				60 ± 40	270 ± 130
	Larch Stream								100 ± 70
	Macaulay River		130 ± 90					130 ± 90	
	Maerewhenua River	40 ± 40	120 ± 80	40 ± 40				200 ± 90	470 ± 230

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
	Maitland Stream			90 ± 90				90 ± 90	20 ± 20
	Mary Burn	60 ± 50	110 ± 50	20 ± 20				200 ± 70	30 ± 20
	McGregor Lake	130 ± 130	280 ± 130	180 ± 120				590 ± 220	20 ± 20
	Merino Lake		70 ± 70					70 ± 70	
	Middleton Lake		20 ± 20	30 ± 30				40 ± 30	880 ± 350
	Ohau Canal	400 ± 200	740 ± 200	1090 ± 370	2380 ± 1940	200 ± 110	560 ± 500	5370 ± 2060	1080 ± 630
	Ohau Lake	740 ± 270	1840 ± 430	1020 ± 310	420 ± 150	250 ± 190	360 ± 220	4630 ± 680	1520 ± 380
	Ohau River	150 ± 90	300 ± 120	40 ± 30				480 ± 150	640 ± 190
	Omarama Stream			390 ± 290				390 ± 290	490 ± 170
	Otamatapaio River			50 ± 50				50 ± 50	
	Otematata River	40 ± 40	10 ± 10	130 ± 100				180 ± 110	590 ± 210
	Parsons Rock Creek								50 ± 40
	Poaka Lake		10 ± 10					10 ± 10	
	Pukaki Canal	430 ± 400						430 ± 400	
	Pukaki Lake	180 ± 100	490 ± 260	150 ± 70	180 ± 90		120 ± 120	1130 ± 320	620 ± 190
	Ruataniwha Lake	630 ± 410	550 ± 170	400 ± 160	70 ± 40		40 ± 40	1700 ± 480	1030 ± 340
	Stony River		40 ± 40					40 ± 40	
	Sutherlands Creek			50 ± 50				50 ± 50	
	Tasman River			< 10				< 10	
	Tekapo Canal	810 ± 310	1760 ± 360	1940 ± 390	850 ± 220	180 ± 110	2150 ± 680	7700 ± 940	870 ± 240
	Tekapo Lake	1170 ± 340	2020 ± 390	1700 ± 390	1370 ± 320	1160 ± 430	1310 ± 500	8730 ± 980	3000 ± 770
	Tekapo River	1760 ± 490	1710 ± 340	1000 ± 310	310 ± 130	130 ± 130		4910 ± 700	2420 ± 490
	Twizel River	260 ± 240	510 ± 160	370 ± 130	100 ± 60			1250 ± 320	720 ± 360
	Waitaki Lake	430 ± 280	750 ± 300	1730 ± 780	130 ± 100			3050 ± 880	5230 ± 1160
	Waitaki River	5710 ± 1370	7810 ± 1620	7890 ± 1280	4400 ± 720	1120 ± 370	640 ± 380	27580 ± 2640	34500 ± 3150
	Wardell Lake	30 ± 30						30 ± 30	20 ± 20
Total, Waitaki catchment		**23030 ± 2170**	**39600 ± 2680**	**30560 ± 2150**	**13290 ± 2170**	**5100 ± 780**	**7100 ± 1210**	**118680 ± 4830**	**86130 ± 4310**
Kakanui River	Kakanui River	130 ± 80	90 ± 70					220 ± 100	2040 ± 650
Waianakarua River	Waianakarua River			140 ± 140				140 ± 140	
Total, all waters		**36840 ± 3070**	**57260 ± 3210**	**44950 ± 2710**	**15700 ± 2230**	**5690 ± 810**	**8010 ± 1270**	**168450 ± 5860**	**166140 ± 5640**

Otago Region

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
Shag River	Shag River	430 ± 260	140 ± 100	90 ± 70	130 ± 100		100 ± 70	880 ± 310	1060 ± 290
Waikouaiti River	Waikouaiti River		190 ± 130	20 ± 20	820 ± 820	230 ± 180	100 ± 70	1360 ± 850	2630 ± 700
Waitati River	Waitati River		100 ± 70				30 ± 30	130 ± 80	670 ± 300
Water of Leith	Northern Reservoir								30 ± 30
	Sullivans Dam	620 ± 380	790 ± 320	340 ± 180	280 ± 140			2030 ± 540	420 ± 190
	Water of Leith	40 ± 40		20 ± 20				60 ± 50	
	Tomahawk Lagoon	530 ± 340	140 ± 140					670 ± 370	
Kaikorai Stream	Southern Reservoir	630 ± 320	60 ± 50	140 ± 140	70 ± 70	200 ± 200		1090 ± 410	430 ± 240
Taieri River	Blakeleys Dam	180 ± 130	70 ± 50	30 ± 30				280 ± 140	730 ± 330
	Coal Pit Dam	100 ± 100	330 ± 160	300 ± 180	30 ± 30			760 ± 260	460 ± 240
	Deep Stream	80 ± 80	260 ± 190	< 10				340 ± 200	190 ± 140
	Hamiltons Dam								40 ± 40
	Hoffmans Dam		60 ± 40	190 ± 120	30 ± 30			280 ± 130	30 ± 30
	Hore's Pond	40 ± 40						40 ± 40	
	Knights Dam		70 ± 70					70 ± 70	30 ± 30
	Kye Burn	80 ± 80		20 ± 20				100 ± 80	
	Lee Stream	40 ± 40	20 ± 20					50 ± 40	170 ± 90
	Logan Burn Reservoir	820 ± 320	1260 ± 300	820 ± 300	1340 ± 680	30 ± 30		4280 ± 860	1320 ± 340
	Lone Pine Dam								20 ± 20
	Mahinerangi Lake	720 ± 290	890 ± 410	1820 ± 810	1250 ± 530		70 ± 70	4750 ± 1090	4130 ± 690
	Mathias Dam	80 ± 60	120 ± 80					200 ± 100	340 ± 160
	Meggat Burn		50 ± 50					50 ± 50	
	Rutherfords Dam		70 ± 50	50 ± 40				120 ± 70	190 ± 120
	Silver Stream		20 ± 20					20 ± 20	
	Sutton Creek		60 ± 60	20 ± 20				80 ± 60	150 ± 80
	Taieri River	4350 ± 1750	5540 ± 1200	3040 ± 630	2340 ± 610	2250 ± 1140	1550 ± 630	19070 ± 2640	11530 ± 1270

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
	Three O'Clock Stream		< 10					< 10	
	Waihola Lake	390 ± 250	140 ± 100	880 ± 520	230 ± 200			1640 ± 620	310 ± 210
	Waipori Lake								120 ± 90
	Waipori River	320 ± 210	130 ± 90	70 ± 70	100 ± 70	100 ± 100		720 ± 270	320 ± 160
	West Eweburn Dam								30 ± 30
Total, Taieri catchment		**7200 ± 1840**	**9090 ± 1340**	**7240 ± 1210**	**5330 ± 1080**	**2380 ± 1140**	**1610 ± 630**	**32860 ± 3090**	**20090 ± 1590**
Tokomairiro River	Tokomairiro River		920 ± 580	2040 ± 1430	30 ± 30	130 ± 90	960 ± 670	4090 ± 1680	850 ± 270
Clutha River	Albert Burn								30 ± 20
	Arrow River								210 ± 120
	Bannockburn River								190 ± 120
	Blue River		20 ± 20					20 ± 20	20 ± 20
	Boundary Creek	80 ± 80						80 ± 80	
	Butchers Dam	70 ± 50	120 ± 80		20 ± 20			200 ± 90	170 ± 80
	Camp Creek	80 ± 80						80 ± 80	
	Caples River	200 ± 120	30 ± 30					230 ± 120	190 ± 100
	Cardrona River								30 ± 30
	Cluden Stream								40 ± 40
	Clutha River	7070 ± 1590	11230 ± 2310	9580 ± 1770	3790 ± 1740	760 ± 260	4890 ± 1800	37320 ± 4160	26340 ± 3210
	Conroys Dam		70 ± 50	10 ± 10				80 ± 50	60 ± 40
	Dart River	40 ± 40						40 ± 40	90 ± 50
	Diamond Creek	170 ± 100	140 ± 100		70 ± 70			380 ± 160	30 ± 20
	Diamond Lake	110 ± 80	150 ± 80	160 ± 140	100 ± 100			520 ± 210	330 ± 170
	Dingle Burn	80 ± 80	20 ± 20					100 ± 80	120 ± 60
	Dunstan Creek		40 ± 40					40 ± 40	160 ± 140
	Dunstan Lake	2910 ± 1010	9020 ± 2120	4840 ± 1580	2110 ± 680	690 ± 320	300 ± 200	19870 ± 2940	22250 ± 1750
	Falls Dam		20 ± 20	120 ± 80				130 ± 80	30 ± 30
	Fast Burn		210 ± 210					210 ± 210	
	Fraser Dam		90 ± 70					90 ± 70	60 ± 50
	Fraser River		160 ± 120	370 ± 370				530 ± 390	410 ± 150
	Greenstone River		120 ± 70	150 ± 140	100 ± 70			370 ± 170	460 ± 160
	Hawea Lake	5080 ± 1180	9350 ± 1570	10790 ± 3060	1350 ± 310	590 ± 240	1000 ± 340	28160 ± 3670	18820 ± 2260

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
	Hawea River	1970 ± 1060	2080 ± 580	620 ± 480	260 ± 170	30 ± 30		4970 ± 1310	1920 ± 470
	Hayes Lake	880 ± 790	160 ± 70	350 ± 210	40 ± 30	30 ± 30	70 ± 70	1540 ± 830	1430 ± 480
	Hunter River	180 ± 110	1070 ± 550	160 ± 80	220 ± 160			1630 ± 580	610 ± 170
	Johnson Lake	80 ± 80						80 ± 80	
	Kaihiku Stream								20 ± 20
	Kaitangata Channel								30 ± 30
	Kaiwera Stream	70 ± 70						70 ± 70	100 ± 70
	Kawarau River	750 ± 640	170 ± 110	310 ± 150	390 ± 390	< 10	70 ± 70	1700 ± 770	3500 ± 1000
	Kirkpatrick Lake			70 ± 70				70 ± 70	500 ± 300
	Lindis River	40 ± 40	110 ± 80					150 ± 90	280 ± 100
	Lochy River		110 ± 90	150 ± 140				260 ± 170	130 ± 70
	Luna Lake								40 ± 40
	Makarora River	80 ± 80	720 ± 310	280 ± 190	340 ± 160	< 10	50 ± 50	1480 ± 410	1460 ± 350
	Manor Burn		30 ± 30	350 ± 190	60 ± 60			440 ± 210	220 ± 90
	Manorburn Reservoir	540 ± 300	1220 ± 370	190 ± 110	390 ± 220			2350 ± 540	510 ± 130
	Manuherikia River	1370 ± 720	3380 ± 1900	550 ± 280	320 ± 230			5630 ± 2060	3570 ± 840
	Matukituki River	40 ± 40	50 ± 30	120 ± 80	330 ± 270			530 ± 280	870 ± 240
	Minaret Burn								50 ± 30
	Moke Lake	200 ± 120	860 ± 360	220 ± 120		230 ± 160	20 ± 20	1520 ± 430	370 ± 170
	Mototapu River		20 ± 20					20 ± 20	150 ± 80
	Nevis River	40 ± 40	150 ± 50	60 ± 40				250 ± 80	110 ± 70
	Onslow Lake	1040 ± 350	1250 ± 330	840 ± 250	150 ± 110		160 ± 130	3450 ± 570	2720 ± 490
	Pomahaka River	2860 ± 1280	1290 ± 420	670 ± 250	860 ± 340	330 ± 270		6000 ± 1440	6780 ± 1210
	Pool Burn	140 ± 110	90 ± 40	90 ± 60	20 ± 20		30 ± 30	370 ± 140	
	Poolburn Reservoir	630 ± 300	1160 ± 420	710 ± 280	280 ± 130	< 10	30 ± 30	2810 ± 600	2270 ± 540
	Puerua River		20 ± 20	70 ± 70				90 ± 70	
	Rees River	80 ± 80	< 10	50 ± 30				130 ± 90	290 ± 200
	Rere Lake		< 10					< 10	
	Route Burn	40 ± 40	380 ± 330					420 ± 340	
	Roxburgh Lake	130 ± 80	80 ± 50					210 ± 90	50 ± 40
	Shotover River	100 ± 70	140 ± 140	180 ± 90	700 ± 460			1120 ± 500	130 ± 60
	Staircase Creek								80 ± 80
	Temple Creek	80 ± 50						80 ± 50	40 ± 30

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
	Teviot River	140 ± 140	140 ± 140	20 ± 10	30 ± 30			330 ± 200	160 ± 70
	Timaru Creek	240 ± 90	150 ± 100	100 ± 60				480 ± 150	170 ± 60
	Tuapeka River		110 ± 100					110 ± 100	90 ± 60
	Twelve Mile Creek								20 ± 20
	Von River	260 ± 120	30 ± 20	180 ± 150	50 ± 40			520 ± 190	190 ± 90
	Waikerikeri Creek								30 ± 20
	Waikoikoi Creek	340 ± 310						340 ± 310	
	Waipahi River	940 ± 320	220 ± 110	310 ± 210	90 ± 70	260 ± 260		1810 ± 490	2370 ± 630
	Waitahuna River	40 ± 40	820 ± 460	20 ± 20				880 ± 460	10 ± 10
	Waiwera River	320 ± 250						320 ± 250	110 ± 90
	Wakatipu Lake	2890 ± 760	7630 ± 1400	3560 ± 680	1980 ± 530	460 ± 190	1190 ± 580	17720 ± 1910	21410 ± 2180
	Wanaka Lake	3180 ± 690	12800 ± 1750	6330 ± 1220	1660 ± 410	620 ± 250	680 ± 310	25270 ± 2310	25530 ± 2370
	Wilkin River	40 ± 40		70 ± 70	30 ± 30			140 ± 90	200 ± 120
	Wye Creek								520 ± 210
	Young River		20 ± 20	90 ± 90				120 ± 100	30 ± 20
Total, Clutha catchment		**35610 ± 3330**	**67240 ± 4790**	**42790 ± 4230**	**15750 ± 2200**	**4020 ± 700**	**8480 ± 1970**	**173880 ± 7810**	**149100 ± 5840**
Catlins River	Catlins River	320 ± 190	140 ± 100	90 ± 90	160 ± 120		200 ± 200	910 ± 330	4500 ± 1520
	Owaka River	60 ± 60			130 ± 100			190 ± 110	1400 ± 1100
Tahakopa River	Maclennan River		150 ± 140					150 ± 140	10 ± 10
	Tahakopa River	210 ± 130	510 ± 360					720 ± 380	1630 ± 940
Tautuku River	Fleming River				20 ± 20			20 ± 20	
	Tautuku River	330 ± 220	40 ± 30		20 ± 20			390 ± 230	60 ± 40
Total, all waters		**45970 ± 3880**	**79520 ± 5040**	**52780 ± 4630**	**22730 ± 2590**	**6960 ± 1370**	**11480 ± 2190**	**219440 ± 8670**	**182870 ± 6470**

Southland Region

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
Waikawa River	Waikawa River	520 ± 340	240 ± 160	< 10	110 ± 110	50 ± 50		930 ± 400	1020 ± 440
Mataura River	Argyle Burn								20 ± 20
	Dome Burn	20 ± 20						20 ± 20	< 10
	Eyre Creek	30 ± 30	10 ± 10					50 ± 40	210 ± 200
	Fortune Creek								40 ± 30
	Gow Burn								40 ± 40
	Mataura River	10980 ± 1730	17730 ± 2550	14650 ± 1900	6880 ± 1160	700 ± 300	2020 ± 1020	52960 ± 3950	51360 ± 3260
	Mimihau Stream	280 ± 120	870 ± 500	240 ± 130	150 ± 110			1540 ± 540	900 ± 290
	Mokoreta River	430 ± 210	210 ± 110	390 ± 180	60 ± 50			1090 ± 300	250 ± 110
	Muddy Creek	20 ± 20						20 ± 20	
	Nokomai River	20 ± 20	370 ± 270					380 ± 270	760 ± 520
	Otamita Stream	400 ± 200	260 ± 130	120 ± 80	60 ± 50			840 ± 260	1370 ± 590
	Pukerau Stream								20 ± 20
	Redan Stream								10 ± 10
	Steeple Burn								20 ± 20
	Titiroa Stream		80 ± 80					80 ± 80	
	Tomogalak Stream		10 ± 10					10 ± 10	70 ± 40
	Waikaia River	2800 ± 940	2130 ± 580	950 ± 250	490 ± 200	220 ± 220	260 ± 220	6850 ± 1190	6810 ± 1030
	Waikaka Stream	680 ± 520	530 ± 350	400 ± 250	140 ± 90			1750 ± 680	980 ± 240
	Waimea Stream	70 ± 40	510 ± 300	110 ± 90				680 ± 310	150 ± 60
	Wyndham Stream								2140 ± 450
Total, Mataura catchment		**15710 ± 2060**	**22700 ± 2720**	**16860 ± 1950**	**7790 ± 1190**	**920 ± 370**	**2280 ± 1040**	**66270 ± 4250**	**65150 ± 3570**
Waituna Lagoon	Waituna Lagoon	210 ± 160	210 ± 140	720 ± 510			80 ± 50	1220 ± 550	1120 ± 320
Waihopai River	Waihopai River		200 ± 190					200 ± 190	
Oreti River	Acton Stream	100 ± 100	80 ± 60					180 ± 120	10 ± 10
	Cromel Stream		30 ± 30					30 ± 30	
	Dipton Stream								180 ± 90

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
	Dunsdale Stream	20 ± 20	10 ± 10	130 ± 100	60 ± 50			230 ± 110	360 ± 210
	Hedgehope Stream	90 ± 90	80 ± 70	120 ± 110				290 ± 160	10 ± 10
	Irthing Stream	120 ± 100	30 ± 30	50 ± 40				200 ± 110	90 ± 50
	Lora Stream	20 ± 20	40 ± 30	10 ± 10				80 ± 40	100 ± 60
	Makarewa River	240 ± 120	980 ± 550	410 ± 160	230 ± 140		50 ± 50	1910 ± 610	3610 ± 670
	Murray Creek		30 ± 30					30 ± 30	
	Oreti River	5370 ± 870	6710 ± 1050	4910 ± 1080	1490 ± 370	460 ± 240	1680 ± 1120	20620 ± 2110	27180 ± 2300
	Otapiri Stream	230 ± 150	340 ± 120	150 ± 110	90 ± 60	50 ± 50	130 ± 110	990 ± 260	950 ± 220
	Waikiwi Stream								130 ± 80
	Weydon Burn		70 ± 70					70 ± 70	10 ± 10
	Windley River	20 ± 20	50 ± 50					70 ± 60	
Total, Oreti catchment		**6210 ± 910**	**8430 ± 1200**	**5800 ± 1110**	**1860 ± 400**	**520 ± 250**	**1870 ± 1120**	**24690 ± 2230**	**32650 ± 2420**
Waimatuku Stream	Waimatuku Stream	50 ± 50	350 ± 230			50 ± 50	30 ± 30	490 ± 250	1420 ± 410
Aparima River	Aparima River	860 ± 290	2930 ± 600	1670 ± 450	650 ± 310	160 ± 120	480 ± 430	6750 ± 970	11280 ± 1440
	Etal Stream								30 ± 20
	Hamilton Burn	400 ± 210	420 ± 270	30 ± 30	40 ± 40		150 ± 150	1030 ± 380	190 ± 80
	Otautau Stream		30 ± 30	270 ± 210				300 ± 210	50 ± 50
	Pourakino River		160 ± 160	10 ± 10		50 ± 50		230 ± 170	480 ± 220
Total, Aparima catchment		**1250 ± 360**	**3530 ± 680**	**1980 ± 500**	**690 ± 310**	**220 ± 130**	**630 ± 460**	**8300 ± 1080**	**12030 ± 1460**
Waiau River	Awe Burn			360 ± 360				360 ± 360	
	Borland Burn		30 ± 20				30 ± 30	60 ± 30	60 ± 30
	Clinton River	10 ± 10	40 ± 30					50 ± 30	660 ± 320
	Doon River	< 10		10 ± 10				20 ± 20	60 ± 50
	Eglinton River	150 ± 80	310 ± 110	420 ± 370	140 ± 70			1020 ± 400	660 ± 190
	Electric River		30 ± 30	360 ± 360				400 ± 370	20 ± 10
	Fergus Lake		50 ± 50					50 ± 50	
	Freeman Burn		10 ± 10	310 ± 310				320 ± 310	
	Glaisnock River			20 ± 20				20 ± 20	50 ± 30
	Grebe River		10 ± 10	310 ± 310				320 ± 310	110 ± 60
	Green Lake				< 10			< 10	

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
	Gunn Lake		100 ± 80	20 ± 10				120 ± 80	30 ± 20
	Hankinson Lake								10 ± 10
	Henry Lake		30 ± 30		60 ± 60			90 ± 70	
	Home Creek		< 10	10 ± 10				20 ± 10	
	Iris Burn								60 ± 50
	Island Lake				< 10			< 10	
	Junction Burn	< 10		10 ± 10				20 ± 20	30 ± 20
	Kiwi Burn		10 ± 10					10 ± 10	
	Letham Burn	120 ± 70						120 ± 70	20 ± 10
	Lill Burn		40 ± 20		40 ± 40			80 ± 50	120 ± 70
	Lugar Burn	< 10						< 10	
	Manapouri Lake	630 ± 200	1440 ± 310	1890 ± 660	1340 ± 520	420 ± 180	200 ± 100	5920 ± 940	5490 ± 870
	Mararoa River	850 ± 230	960 ± 260	660 ± 210	470 ± 430	30 ± 30		2970 ± 590	2230 ± 380
	McKenzie Burn			50 ± 50				50 ± 50	
	Monowai Lake	1230 ± 390	1870 ± 590	1670 ± 760	470 ± 200	500 ± 210	520 ± 310	6250 ± 1120	4030 ± 580
	Monowai River	110 ± 90	190 ± 100	380 ± 320		< 10		690 ± 350	440 ± 160
	Morley Stream		50 ± 40					50 ± 40	30 ± 20
	North Mavora Lake	280 ± 120	820 ± 350	930 ± 300	150 ± 80	460 ± 310	110 ± 90	2760 ± 580	1420 ± 290
	Orauea River	140 ± 80	460 ± 280	50 ± 30	40 ± 40			690 ± 290	760 ± 340
	Princhester Creek			40 ± 40				40 ± 40	
	Snag Burn								20 ± 20
	South Mavora Lake	300 ± 200	250 ± 110	420 ± 170	30 ± 20	30 ± 30	110 ± 80	1130 ± 300	690 ± 140
	Spey River			270 ± 270	130 ± 130			400 ± 300	50 ± 40
	Te Anau Lake	1320 ± 310	3170 ± 520	3740 ± 870	1390 ± 330	1960 ± 1540	500 ± 210	12080 ± 1910	10280 ± 1230
	Thomas Lake	100 ± 90	130 ± 90	160 ± 90				390 ± 150	130 ± 50
	Upukerora River	< 10	750 ± 320	180 ± 90	100 ± 60	160 ± 160		1190 ± 370	630 ± 180
	Waiau River	3240 ± 550	4740 ± 650	2620 ± 370	2940 ± 1000	10 ± 10	1100 ± 620	14660 ± 1500	7720 ± 840
	Wairaki River	170 ± 120	200 ± 160	80 ± 70		10 ± 10		460 ± 210	220 ± 70
	Walker River		30 ± 30					30 ± 30	
	Wapiti River		10 ± 10					10 ± 10	340 ± 250
	Whitestone River	90 ± 60	230 ± 90	130 ± 60	20 ± 20			470 ± 130	710 ± 350
	Windon Burn	20 ± 20						20 ± 20	70 ± 70
	Worsley Stream		20 ± 20	80 ± 80				100 ± 80	800 ± 300

Catchment	River/Lake	2001/02 Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Total	1994/96 total
Total, Waiau catchment		**8790 ± 860**	**16000 ± 1260**	**15200 ± 1700**	**7340 ± 1280**	**3590 ± 1600**	**2570 ± 740**	**53490 ± 3160**	**37940 ± 2050**
Wairaurahiri River	Hauroko Lake	30 ± 30	150 ± 110	50 ± 40	60 ± 60	10 ± 10	< 10	320 ± 140	130 ± 60
	Wairaurahiri River	20 ± 20						20 ± 20	
Big River	Monk Lake			50 ± 50				50 ± 50	
Dusky Sound	Seaforth River		330 ± 330	< 10				340 ± 330	
Sutherland Sound	Dark River			70 ± 70				70 ± 70	
	Light River			70 ± 70				70 ± 70	
Arthur River	Arthur River	< 10		10 ± 10				20 ± 10	170 ± 150
Cleddau River	Cleddau River								90 ± 70
Hollyford River	Alabaster Lake	30 ± 30	20 ± 20					40 ± 30	30 ± 20
	Hidden Falls Creek	30 ± 30						30 ± 30	
	Hollyford River	140 ± 120	20 ± 10		20 ± 20			190 ± 120	600 ± 280
	McKerrow Lake	400 ± 370	40 ± 40					440 ± 380	360 ± 220
	Pyke River			80 ± 70	130 ± 130			210 ± 150	100 ± 80
	Wilmot Lake		10 ± 10					10 ± 10	
Total, Hollyford catchment		**600 ± 400**	**90 ± 50**	**80 ± 70**	**150 ± 130**			**920 ± 430**	**1080 ± 370**
Total, all waters		**33400 ± 2500**	**52230 ± 3340**	**40900 ± 2910**	**18010 ± 1830**	**5370 ± 1670**	**7470 ± 1760**	**157390 ± 5930**	**152820 ± 5050**