Comparison of marine recreational catch and effort recorded by diarists in 1996 and 1997

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Abstract

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A subsample of the diarists in the 1996 national recreational diary survey agreed to continue keeping a fishing diary during 1997. This enabled an estimate of the variation in recreational harvest from year to year to be made using paired comparisons of catch and effort. Because of the way the subsample was chosen, the actual recreational catch and effort in 1997 cannot be estimated, but the significance of any change can. The proportional changes in catch and effort by the sample can be found and could be used to guestimate changes in the total recreational catch and effort.

The numbers of trips made in all Quota Management Areas (QMAs) were less in 1997 than in 1996, with very significant declines in QMAs 1, 2, 3, 7, and 8. The numbers of trips made in January, February, April, and September were very significantly less in 1997, and very significantly more in July 1997. That is, most of the decline in effort occurred during the first four months of the year, which are generally the months with high recreational fishing effort. The decline in fishing effort in January will have been related to extreme cyclonic weather at the time and weather is probably the major factor causing variation in recreational fishing effort from year to year. The use of lines from private boats, lines from shore, diving from shore, set or gill netting, drag netting, and hand gathering declined very significantly.

The 1997 harvest by the sample was lower than their 1996 harvest throughout New Zealand for nearly all the important recreational species, and no significant increases were detected. Harvests are measured in numbers of fish. A decline in harvest is to be expected when there has been a decline in effort. Very significant decreases (nation-wide) in harvest were noted for kahawai, blue cod, kingfish, yellow-eyed mullet, paua, and cockles. When the harvests from the largest recreational Fishstocks were tested, very significant declines were noted in KAH 3, FLA 2, TRE 1, and PAU 5; significant declines were noted in BCO 5, RCO 2, and CRA 2; and there were marginally significant declines in KAH 2, BCO 8, FLA 1, and PAU 2. To some extent, the large harvest declines in some Fishstocks, which occurred in most parts of the country with the location being species dependent, will be related to area-specific lack of availability of these species to the recreational fishery. Harvest declines will be mostly due to the drop in fishing effort.

A non-significant decline of 7.5% occurred in SNA 1.

Introduction

In 1996, a national diary survey was run by NIWA, under contract to the Ministry of Fisheries, to give quantitative information on marine recreational fishing catch and effort in New Zealand. NIWA subcontracted John Bell & Associates to run the survey and maintain contact with the diarists. The full national diary survey ran from 1 January to 31 December 1996. Several reports on the 1996 survey methods and results have already been published (Bradford 1998a, 1998b, 1998c, Bradford *et al.* 1998a, 1998b) and others are in preparation. These reports should be consulted for further details of the survey method.

The telephone and diary surveys used a preliminary telephone survey to determine the number of households containing marine recreational fishers from a random sample of households with telephones. One randomly selected fisher from each of these households was asked to keep a diary of the recreational fishing trips during a year. The potential diarists were asked further questions about their fishing activity in the previous year. Bell & Associates (1996) summarised the results from the telephone survey run before the 1996 national diary survey.

The results from the telephone survey interviews, together with census data, and information about non-response from the diary survey enabled the catches recorded by the diarists (who can be considered to form a random sample) to be scaled up to give total recreational harvests for all marine recreational fishers in the country. Bradford (1998a) described the method used to estimate the scaling factor. For the national survey, a different sampling fraction was used for South region residents from that for residents in other parts of the country to enable a sufficient sample size to be obtained. Allowance for this has to be made when using the data.

A subsample of the 1996 diarists agreed to continue keeping diaries during 1997 (again from 1 January to 31 December) to provide information on the variations in marine recreational fishing catch and effort from year to year. The continuing diarists were randomly distributed throughout New Zealand and selected from about 1500 of the diarists who were thought to be the most frequent fishers. Of these, 926 agreed to continue keeping a diary in 1997. The diary survey method involves telephoning diarists each 3 months and reminding them to submit their trip records for the past 3 months. This divides each survey into quarters. Diarists who had not fished in the past 3 months may have given a "did not fish" response during the telephone interview. Of the continuing diarists in 1997, 638 responded in all eight quarters and data from these diarists were used in the comparisons. Incentives and newsletters were used to keep up interest in the survey. Despite these efforts, contact was lost with 72 of the continuing diarists by the end of 1997. The other diarists whose records were eliminated from the comparisons were mainly those who had been contacted but had not submitted a return in at least one quarter. Nine were diarists for whom NIWA had no record of their response in a quarter, but who had otherwise responded in the other quarters.

Subsamples of diarists were used in the year following both the 1991–92 South region diary survey (Blackwell 1997a) and the 1992–93 Central region diary survey (Blackwell 1997b). The analysis reported here is similar to that used by Blackwell.

Programme objective

To estimate the recreational harvest by species and Fishstock using telephone/diary surveys

Objectives for 1997–98

1. To complete the survey of about 1000 fishers completing diaries for a second year (ended 31/12/97).

2. To compare catch and effort by diarists in 1996 and 1997.

Comparison methods

As it is desirable to use complete records, the comparisons made below use the data from the 638 diarists who responded in all eight quarters. The results have not been scaled to give a total population estimate, though the catches by South region diarists were adjusted by the ratio of the scaling factors for the South region and the rest of the country (or 80.3/140.0 = 0.534). The diarist catches recorded here could be multiplied by 140 to give a population estimate, but it is unclear who makes up this population as the original sample did not come from all fishers.

Some trip records by diarists are incomplete, missing the date for a trip, the fishing location, or the fishing method. When missing data should contribute to the tabulation being performed, that record was omitted.

Harvest comparisons were made for several species (*see* Table 1) for which the nation-wide recreational harvest is substantial. Fishstock harvest comparisons are made in Fishstocks with a large recreational harvest (*see* Annala *et al.* (1998) for the Fishstock definitions). Effort comparisons are made by Quota Management Area (QMA) and month. As the comparisons by month showed a convenient division into three periods of 4 months each, the effort comparison by period was made overall and for each of the QMAs involved. Figure 1 shows the coastal QMAs with a recreational fishery. No recreational catch is assumed from the offshore QMAs 4, 6, and 10.

The S-PLUS© implementation of the Wilcoxon signed rank test for paired data was used in the main comparisons. In the comparisons of sets of values x and y, the values of x or $y - x$ are assumed to be independent observations from the same symmetric distribution. The null hypothesis is that the median of the distribution of $x - y$ is 0. Normal approximations to the test statistic are used when the number of paired data points is greater than 25, or if ties occur (which covers the cases considered here). For comparing harvests of a species in a Fishstock in 1996 and 1997, the values of x and y are the total catches for individual diarists in 1996 and 1997 and paired for the two years. The diarists used are those who targeted or caught the species in the Fishstock in either year. There is no reason to suppose that the statistical distribution describing the total catches of recreational fishers varies from year to year. The tables give the number of diarists involved (N), the number with increased total catch (or trips) in 1997 (N^+), the number with decreased total catch (or trips) in 1997 (N^-), the value of the Wilcoxon test statistic (W), and the significance level of the test (p). Some diarists had the same catch in both years.

Harvests and trip numbers were not scaled to the total population. Total harvests and trip numbers are adjusted for the different scaling factors (mainly due to the different sampling fractions) used for the South region and the rest of the country. Harvests are expressed in numbers of fish. Where the diarist came from has been ignored in the Wilcoxon test (no suitable way to scale the number of diarists was devised). This means that the test statistics may have a slightly optimistic significance level, but this should be important only in borderline cases.

Results

The first comparison was an estimate of the percentage of the total harvest of several important recreational species (Table 1) taken throughout the country by the sample of diarists during 1996 (Table 2 and Figure 2). The coefficient of variation (*c.v.*) estimated here ignores the *c.v.* on the scaling factors. Importance was determined mainly by the numerical size of the recreational harvest. For most of these species, the sample of diarists caught 35–45% of the total 1996 harvest. The 638 diarists in the comparison sample were less than 20% of all 1996 diarists. The proportional changes calculated for the sample of diarists could be used as a guestimate of the proportional change in the total harvest of these species as could the proportional changes calculated subsequently.

Country-wide harvest comparisons

Changes in species harvests for the whole country were determined first. This gives more diarists in the sample (recreational fishers tend to fish locally) than if Fishstocks were used, and so increases the chance of detecting a significant change in harvest. This will be particularly important for species with a moderate recreational harvest. The species considered in detail are snapper, kahawai, blue cod, tarakihi, red gurnard, red cod, trevally, rock lobster, and paua, and many show significant changes between 1996 and 1997 in at least one Fishstock.

Table 3 and Figure 3 show the percentage change ($\%H = 100 * (H_{97} - H_{96})/H_{96}$) in harvest of the important species by the sample of diarists between 1996 and 1997. The *c.v.* quoted is calculated as $\mathrm{sqrt}(c.v._{96}^2 + c.v._{97}^2)$ and when this is smaller than $\%H$ a significant change in harvest has probably occurred. The only harvest increases in 1997 were for tarakihi, dogfish (spiny dogs and fish recorded as dogfish), school shark, and salmon.

The Wilcoxon signed rank test for changes in the country-wide harvests of the important recreational species showed very significant declines in 1997 for kahawai, blue cod, red gurnard, flatfish, kingfish, trevally, yellow-eyed mullet, paua, and cockles (Table 4).

The harvest of some species has apparently increased, whereas the Wilcoxon statistic is negative. This can arise when a few fishers take most of the harvest, particularly in small samples.

Changes in recreational fishing effort

The trip numbers in an area or time period were compared in a similar way to the harvests. Trip numbers by South region residents were adjusted by the scaling factor. In 1997, 12% of the sample of diarists reported no fishing trips whereas only one diarist from the sample reported no trips in 1996.

Trip numbers were down in 1997 in all parts of the country, very significantly in QMAs 1, 2, 3, 7, and 8 (Table 5). Trip numbers in 1997 were higher in May to August, but lower at other times. The changes in trip numbers in January, February, April, July, and September were very significant, the changes in all other months were non-significant. Dividing the year into three periods – January to April, May to August, and September to December gave very significant declines in the first and last period and a significant increase in the winter period.

Trip numbers were also compared by fishing method and were very significantly down in 1997 for the two most used methods, lines from private boats and lines from shore, and for diving from shore, dredging, set or gill netting, drag netting, and hand gathering (Table 5). Diving from private boats was significantly less and diving from charter boats was marginally down. The use of longlines from private boats and spear fishing had small, non-significant increases.

Table 6 contains similar data to Table 5 tabulated by QMA and season. None of the changes in trip numbers in QMA 9 were significant. The increase in winter trip numbers was non-significant in all QMAs, except QMA 7 where the increase is marginally significant. The decline in trip numbers from January to April was significant in all areas except QMA 9. The decline in trip numbers from September to December was very significant in QMA 8 and significant in QMA 7, but otherwise non-significant. The number of trips in several of the comparisons was small which decreases the likelihood of finding a significant change.

Harvest changes in important Fishstocks

Table 7 shows the numbers of snapper, kahawai, blue cod, tarakihi, red gurnard, flatfish, red cod, trevally, rock lobster, and paua caught in Fishstocks with a large recreational harvest. The percentage changes in harvest are quite variable from Fishstock to Fishstock, and most of the changes show a decline between 1996 and 1997. None of the increases in the Fishstocks considered here were significant. Except for TAR 1, the increases in harvest occurred in Fishstocks where the overall recreational harvest is small and the number of fishers involved in the comparison was small.

The harvest declines between 1996 and 1997 in KAH 3, FLA 2, TRE 1, and PAU 5 were very significant. There were significant declines in harvest in BCO 5 and CRA 2, and marginally significant declines in KAH 2, BCO 8, TAR 8, and PAU 2.

A non-significant decline of 7.5% occurred in SNA 1.

Discussion

The comparison of recreational catch and effort for the same diarists over 2 years allows comparison of paired data and thus more powerful statistical tests. The skill mix in the sample of diarists, which may influence their catch and effort (Cryer & McLean 1991), will have remained roughly the same. Identification problems can arise with some species, but in this study the way species were identified should have remained the same. A major difficulty arises from potential "diarist fatigue" if diarists lose interest in the survey (efforts were made to reduce this effect).

Boxing Day 1996 to mid January 1997 was marked by cyclonic weather that hampered recreational fishing in most parts of the country. This may have caused fishers to take up other activities and not fish for the rest of 1997 (12% of the sample did not fish in 1997). April trip numbers seem to have been strongly influenced by how good the weather was for recreational fishing at Easter and around Anzac Day (25 April). Similarly the fishing weather on other public holiday weekends during the year probably influenced the number of trips made during that weekend. Easter 1996 appeared to have been especially good for fishing (a large fraction of the diarists fished then), and so probably was Labour Day (28 October) 1996 (diarists who had stopped fishing over winter tended to start fishing again then).

***Table 1*: Scientific names of the species used in this report and the groupings of species used where applicable. The species are arranged in three groups – species with the largest recreational harvests (ordered by the number of diarists catching them in this report), other QMS species (in 1996), and other non-QMS species. This arrangement is used in subsequent tables**

Species	Scientific name
Snapper	*Pagrus auratus*
Kahawai	*Arripis trutta*
Blue cod	*Parapercis colias*
Tarakihi	*Nemadactylus macropterus*
Red gurnard	*Chelidonichthys kumu*
Trevally	*Pseudocaranx dentex*
Red cod	*Pseudophycis bachus*
Flatfish	Several species of flounder, sole, and turbot
Rock lobster	Assumed to be *Jasus edwardsii*
Paua	Assumed to be *Haliotis iris*
Barracouta	*Thyrsites atun*
Blue moki	*Latridopsis ciliaris*
Grey mullet	*Mugil cephalus*
Hapuku	*Polyprion oxygeneios* (hapuku), *P. americanus* (bass)
Jack mackerel	*Trachurus declivis, T. novaezelandiae, T. murphyi*
John dory	*Zeus faber*
Rig	*Mustelus lenticulatus*
School shark	*Galeorhinus galeus*
Blue mackerel	*Scomber australasicus*
Blue maomao	*Scorpis violaceus*
Butterfish	*Odax pullus*
Dogfish	*Squalus acanthias* (spiny dogfish) and "dogs"
Kingfish	*Seriola lalandi lalandi*
Koheru	*Decapterus koheru*
Salmon	Probably *Oncorhynchus tshawytscha*
Tuna	*Thunnus albacares, T. alalunga, Katsuwonus pelamis, Allothunnus fallai*
Yellow-eyed mullet	*Aldrichetta dentex*
Cockles	*Austrovenus stutchburgi*
Scallops	*Pecten novaezelandiae*

Table 2: **Numbers of fish caught by diarists throughout New Zealand in 1996. The first set of data is for all diarists, the second is for those diarists continuing into 1997 who are being used in the comparison. N_D is the number of diarists targeting or catching the species; H_D, with its *c.v.*, is the number of fish caught by diarists except that catches by South region residents have been scaled down by the scaling factor ratio; %Harvest is the percentage of the total harvest caught in 1996 by the continuing diarists**

	All diarists in 1996			1997 diarists in 1996			
Species	N_D	H_D	*c.v.*	N_D	H_D	*c.v.*	%Harvest
Snapper	1 303	19 836	2.8	460	7 160	5.0	36.1
Kahawai	1 149	8 829	3.0	433	2 890	5.2	32.7
Blue cod	583	7 732	4.4	248	3 265	7.2	42.2
Tarakihi	452	5 243	4.8	226	2 607	8.2	49.7
Red gurnard	451	2 824	4.8	218	1 042	7.8	36.9
Trevally	462	1 938	4.7	199	737	8.2	38.0
Red cod	349	1 690	5.6	165	770	9.6	45.6
Flatfish	245	3 793	6.5	126	1 634	10.3	43.1
Rock lobster	286	3 818	6.0	118	1 429	10.2	37.4
Paua	180	3 070	7.5	78	1 160	12.6	37.8
Barracouta	241	1 023	6.7	126	279	10.7	27.3
Blue moki	126	638	9.2	68	361	14.8	56.6
Grey mullet	27	798	21.9	14	287	39.6	36.0
Hapuku	170	352	7.9	88	145	14.4	41.2
John dory	184	336	7.5	95	118	16.5	35.1
Jack mackerel	60	717	13.5	38	303	23.0	42.3
Rig	122	507	9.7	57	300	19.1	59.2
School shark	115	369	9.5	59	94	15.3	25.5
Blue mackerel	72	394	12.0	41	113	19.1	28.7
Blue maomao	114	665	9.5	61	292	25.1	43.9
Butterfish	123	712	9.3	56	234	17.7	32.9
Dogfish	155	776	8.5	84	315	14.5	40.6
Kingfish	398	524	5.2	153	192	11.7	36.6
Koheru	69	595	12.3	32	172	21.4	28.9
Salmon	105	144	10.2	56	92	16.2	63.9
Tuna	158	1 090	8.1	69	348	14.7	31.9
Yellow-eyed mullet	208	2 729	7.2	90	931	12.9	34.1
Cockles	87	8 777	11.0	38	3 152	18.8	35.9
Scallops	213	21 079	7.0	109	11 590	11.4	55.0

Table 3: **Harvest in 1996 (H_{96}) and 1997 (H_{97}) by the sample of diarists who responded in all eight quarters together with *c.v.s*. *N* is the number of diarists in the sample who targeted or caught the species in either year; $\%H = 100 * (H_{97} - H_{96})/H_{96}$; $c.v. = \mathrm{sqrt}(c.v._{96}^2 + c.v._{97}^2)$**

Species	N	H_{96}	$c.v._{96}$	H_{97}	$c.v._{97}$	$\%H$	$c.v.$
Snapper	460	7 160	5.0	6 550	5.4	-8.5	7.4
Kahawai	433	2 890	5.2	2 358	5.9	-18.4	7.9
Blue cod	248	3 265	7.2	2 434	8.4	-25.5	11.1
Tarakihi	226	2 607	8.2	2 823	8.1	8.3	11.5
Red gurnard	218	1 042	7.8	933	9.1	-10.5	12.0
Trevally	199	737	8.2	628	9.2	-14.8	12.3
Red cod	165	770	9.6	761	11.1	-1.2	14.7
Flatfish	126	1 634	10.3	1 246	12.4	-23.7	16.1
Rock lobster	118	1 429	10.2	1 296	11.6	-9.3	15.4
Paua	78	1 160	12.6	679	15.9	-41.5	20.3
Barracouta	126	279	10.7	222	14.0	-20.4	17.6
Blue moki	68	361	14.8	218	17.5	-39.6	22.9
Grey mullet	14	287	39.6	243	39.3	-15.3	55.8
Hapuku	88	145	14.4	110	16.8	-24.1	22.1
Jack mackerel	38	303	23.0	147	23.8	-51.5	33.1
John dory	95	118	16.5	117	19.6	-0.8	25.6
Rig	57	300	19.1	184	30.8	-38.7	36.3
School shark	59	94	15.3	159	27.4	69.1	31.3
Blue mackerel	41	113	19.1	74	29.6	-34.5	35.2
Blue maomao	61	292	25.1	258	25.3	-11.6	35.6
Butterfish	56	234	17.7	184	24.0	-21.4	29.8
Dogfish	84	315	14.5	374	18.0	18.7	23.1
Kingfish	153	192	11.7	95	11.2	-50.5	16.2
Koheru	32	172	21.4	123	24.2	-28.5	32.3
Salmon	56	92	16.2	113	16.7	22.8	23.3
Tuna	69	348	14.7	199	15.8	-42.8	21.6
Yellow-eyed mullet	90	931	12.9	411	17.1	-55.9	21.4
Cockles	38	3 152	18.8	537	38.6	-83.0	42.9
Scallops	109	11 590	11.4	9 601	12.2	-17.2	16.7

***Table 4*: Test results on the change in harvest of several species throughout New Zealand by the sample of diarists who responded in all 8 quarters of 1996 and 1997. *N* is the number of diarists in the sample who targeted or caught the species in either year; N^+ *is* the number of diarists whose catch of the species was greater in 1997 than in 1996; N^- is the number of diarists whose catch of the species was less; *W* Wilcoxon test statistic; and *p* its significance level (n.s. > 0.1; * 0.05–0.1; ** 0.01 – 0.1; *** < 0.01)**

Species	N	N^+	N^-	W	p	
Snapper	460	173	195	-1.435	0.151	n.s.
Kahawai	433	152	226	-3.336	0.001	***
Blue cod	248	93	134	-3.007	0.003	***
Tarakihi	226	96	100	0.668	0.504	n.s.
Red gurnard	218	70	110	-2.343	0.019	**
Trevally	199	75	101	-2.481	0.013	**
Red cod	165	61	85	-1.900	0.057	*
Flatfish	126	41	69	-2.444	0.015	**
Rock lobster	118	43	62	-1.936	0.053	*
Paua	78	20	50	-4.122	0.000	***
Barracouta	126	44	72	-2.218	0.027	**
Blue moki	68	20	36	-1.980	0.048	**
Grey mullet	14	8	3	1.612	0.107	n.s.
Hapuku	88	25	29	-0.402	0.688	n.s.
Jack mackerel	38	16	20	-0.668	0.504	n.s.
John dory	95	35	43	-0.403	0.687	n.s.
Rig	57	14	36	-2.581	0.010	**
School shark	59	17	39	-2.147	0.032	**
Blue mackerel	41	11	29	-2.231	0.026	**
Blue maomao	61	29	29	-0.201	0.840	n.s.
Butterfish	56	18	21	-0.316	0.752	n.s.
Dogfish	84	38	44	-0.513	0.608	n.s.
Kingfish	153	33	59	-3.051	0.002	***
Koheru	32	10	21	-1.360	0.174	n.s.
Salmon	56	19	19	0.117	0.907	n.s.
Tuna	69	20	31	-2.139	0.032	**
Yellow-eyed mullet	90	26	58	-3.511	0.000	***
Cockles	38	7	29	-3.620	0.577	n.s.
Scallops	109	47	56	-0.558	0.577	n.s.

Table 5: **The number of trips made in the specified areas or time periods or by fishing method by the sample of diarists who responded in all eight quarters of 1996 and 1997. T_{96} total number of trips in 1996; T_{97} total number of trips in 1997; $\%T = 100 * (T_{97} - T_{96})/T_{96}$; N is the number of diarists in the sample who made trips in either year; N^+ *is* the number of diarists whose number of trips was greater in 1997 than in 1996; N^- is the number of diarists whose number of trips was less; *W* Wilcoxon test statistic; and *p* its significance level (n.s. > 0.1; * 0.05–0.1; ** 0.01 – 0.1; *** < 0.01)**

	T_{96}	T_{97}	$\%T$	N	N^+	N^-	W	p	
QMA									
QMA 1	3 476	3 054	-12.1	341	108	209	-4.806	0.000	***
QMA 2	676	515	-23.8	87	29	53	-3.077	0.002	***
QMA 3	1 208	1 106	-8.4	129	36	81	-3.257	0.001	***
QMA 5	241	179	-25.7	42	11	27	-1.853	0.064	*
QMA 7	1 067	795	-25.5	134	39	86	-3.959	0.000	***
QMA 8	242	164	-32.2	47	11	32	-2.962	0.003	***
QMA 9	455	385	-15.4	86	32	49	-2.023	0.043	**
Month									
January	1 840	1 215	-34.0	553	155	349	-8.277	0.000	***
February	1 124	901	-19.8	451	149	243	-4.468	0.000	***
March	788	802	1.8	436	183	214	-0.442	0.659	n.s.
April	772	512	-33.7	354	102	218	-6.189	0.000	***
May	318	357	12.3	230	107	92	1.206	0.228	n.s.
June	283	291	2.8	203	95	92	0.594	0.552	n.s.
July	188	310	64.9	179	100	61	3.557	0.000	***
August	201	218	8.5	159	72	74	0.186	0.853	n.s.
September	361	230	-36.3	221	70	135	-4.360	0.000	***
October	388	342	-11.9	248	102	128	-1.030	0.303	n.s.
November	335	307	-8.4	227	94	111	-1.179	0.239	n.s.
December	774	718	-7.2	370	150	174	-1.068	0.285	n.s.
Period									
Jan–Apr	4 524	3 430	-24.2	636	171	402	-9.523	0.000	***
May–Aug	990	1 176	18.8	359	172	147	2.183	0.029	**
Sep–Dec	1 858	1 597	-14.0	475	183	262	-2.968	0.003	***
Method									
Lines/priv boat	3 246	2 904	-10.5	488	177	281	-4.345	0.000	***
Lines/charter bt	161	144	-10.6	99	43	49	-0.793	0.427	n.s.
Longlines/p boat	133	152	14.3	62	32	28	0.836	0.403	n.s.
Lines/shore	1 970	1 574	-20.1	321	96	207	-6.543	0.000	***
Longlines/shore	82	76	-7.3	32	13	19	-0.813	0.416	n.s.
Diving/priv boat	327	236	-27.8	87	30	51	-2.329	0.020	**
Diving/charter	52	27	-48.1	19	6	12	-1.875	0.061	*
Diving/shore	215	112	-47.9	60	11	44	-4.451	0.000	***
Dredging	173	191	10.4	65	34	29	0.631	0.528	n.s.
Set/gill netting	412	323	-21.6	104	33	59	-2.594	0.009	***
Drag netting	98	47	-52.0	53	14	37	-3.470	0.001	***
Hand gathering	321	228	-29.0	164	57	94	-3.046	0.002	***
Potting	109	99	-9.2	31	13	15	0.266	0.791	n.s.
Spear fishing	29	39	34.5	20	8	11	0.328	0.743	n.s.
Other	44	51	15.9	13	6	6	0.072	0.943	n.s.

***Table 6*: The number of trips made in each QMA for the time periods by the sample of diarists who responded in all eight quarters of 1996 and 1997. T_{96} total number of trips in 1996; T_{97} total number of trips in 1997; $\%T = 100 * (T_{97} - T_{96})/T_{96}$; N is the number of diarists in the sample who made trips in the area and time period in either year; N^+ *is* the number of diarists whose number of trips was greater in 1997 than in 1996; N^- is the number of diarists whose number of trips was less; *W* Wilcoxon test statistic; and *p* its significance level (n.s. > 0.1; * 0.05–0.1; ** 0.01 – 0.1; *** < 0.01)**

	T_{96}	T_{97}	$\%T$	N	N^+	N^-	W	p	
QMA 1									
Jan–Apr	2 130	1 705	-20.0	328	97	200	-5.608	0.000	***
May–Aug	523	586	12.0	192	93	79	1.355	0.175	n.s.
Sep–Dec	823	763	-7.3	232	94	120	-1.050	0.294	n.s.
QMA 2									
Jan–Apr	390	268	-31.3	73	22	46	-3.140	0.002	***
May–Aug	80	80	0.0	27	15	11	0.394	0.693	n.s.
Sep–Dec	206	167	-18.9	55	21	29	-1.182	0.237	n.s.
QMA 3									
Jan–Apr	755	624	-17.4	124	33	76	-3.532	0.000	***
May–Aug	133	172	29.3	58	21	27	0.000	1.000	n.s.
Sep–Dec	320	310	-3.1	88	36	47	-0.728	0.467	n.s.
QMA 5									
Jan–Apr	140	98	-30.0	34	8	24	-2.048	0.041	**
May–Aug	35	38	8.6	19	10	9	0.446	0.655	n.s.
Sep–Dec	66	43	-34.8	20	7	10	-0.751	0.453	n.s.
QMA 7									
Jan–Apr	669	386	-42.3	122	30	83	-5.228	0.000	***
May–Aug	139	207	48.9	57	30	22	1.726	0.084	*
Sep–Dec	259	202	-22.0	73	25	47	-1.854	0.064	*
QMA 8									
Jan–Apr	153	110	-28.1	44	12	24	-2.005	0.045	**
May–Aug	30	32	6.7	15	6	7	0.029	0.977	n.s.
Sep–Dec	59	22	-62.7	29	6	19	-2.706	0.007	***
QMA 9									
Jan–Apr	284	238	-16.2	79	31	42	-1.468	0.142	n.s.
May–Aug	50	59	18.0	29	13	13	0.209	0.834	n.s.
Sep–Dec	121	88	-27.3	36	13	19	-1.300	0.194	n.s.

Table 7: **Numbers of fish caught in some important recreational Fishstocks by the sample of diarists in 1996 (H_{96}) and 1997 (H_{97}) where the number caught by South region residents has been adjusted by the scaling factor ratio. $\%H = 100 * (H_{97} - H_{96})/H_{96}$; N is the number of diarists who targeted or caught the species in the Fishstock in either year; N^+ is the number of diarists with an increased total catch in 1997; N^- is the number of diarists with a decreased total catch in 1997; W is the value of the Wilcoxon test statistic and p is its significance (n.s. > 0.1; * 0.05–0.1; ** 0.01 – 0.1; *** < 0.01)**

Fishstock	H_{96}	$c.v._{96}$	H_{97}	$c.v._{97}$	$\%H$	N	N^+	N^-	W	p	
SNA 1	6 236	6	5 769	6	-7.5	321	136	153	-1.494	0.135	n.s.
SNA 2	77	21	66	21	-14.3	39	9	7	0.401	0.689	n.s.
SNA 7	326	13	203	16	-37.7	82	17	26	-1.478	0.139	n.s.
SNA 8	514	11	504	13	-1.9	101	30	35	-0.240	0.811	n.s.
KAH 1	1 820	7	1 570	7	-13.7	263	102	127	-1.445	0.148	n.s.
KAH 2	364	16	214	18	-41.2	54	17	26	-1.831	0.067	*
KAH 3	410	10	249	12	-39.3	128	29	70	-4.231	0.000	***
KAH 9	296	15	326	15	10.1	66	30	26	0.532	0.595	n.s.
BCO 1	109	18	89	18	-18.3	53	24	26	-0.291	0.771	n.s.
BCO 2	486	20	230	22	-52.7	33	11	19	-1.897	0.058	*
BCO 3	574	16	487	17	-15.2	57	25	23	0.024	0.981	n.s.
BCO 5	456	19	336	28	-26.3	34	9	21	-2.234	0.025	**
BCO 7	1 175	12	1 025	15	-12.8	82	29	46	-1.430	0.153	n.s.
BCO 8	459	24	267	27	-41.8	23	6	14	-1.951	0.051	*
TAR 1	1 874	11	2 079	10	10.9	137	61	60	0.954	0.340	n.s.
TAR 2	438	22	451	20	3.0	35	17	14	0.493	0.622	n.s.
TAR 7	189	20	255	19	34.9	43	17	19	0.237	0.813	n.s.
TAR 8	92	35	19	34	-79.3	17	5	10	-1.758	0.079	*
GUR 1	809	9	777	11	-4.0	143	48	74	-1.471	0.141	n.s.
GUR 2	73	25	53	30	-27.4	22	5	8	-0.711	0.477	n.s.
GUR 7	83	21	47	25	-43.4	32	10	19	-1.547	0.122	n.s.
GUR 8	77	28	52	31	-32.5	19	6	10	-1.112	0.266	n.s.
TRE 1	601	9	479	11	-20.3	150	54	76	-2.694	0.007	***
TRE 7	113	21	128	23	13.3	42	19	18	0.556	0.578	n.s.
RCO 1	19	37	19	26	0.0	20	12	7	0.584	0.559	n.s.
RCO 2	164	17	139	26	-15.2	39	10	22	-2.030	0.042	**
RCO 3	417	13	408	15	-2.2	74	26	38	-1.247	0.212	n.s.
RCO 7	171	22	195	25	14.0	35	14	19	-0.205	0.837	n.s.
FLA 1	1 008	15	728	18	-27.8	55	19	30	-1.721	0.085	*
FLA 2	149	31	38	49	-74.5	14	2	11	-2.675	0.007	***
FLA 3	308	22	223	24	-27.6	35	14	16	-0.148	0.882	n.s.
FLA 7	169	23	256	32	51.5	26	8	13	-0.881	0.378	n.s.
CRA 1	57	35	36	35	-36.8	18	5	6	-0.496	0.620	n.s.
CRA 2	589	16	474	18	-19.5	52	18	30	-2.228	0.026	**
CRA 4	357	27	463	31	29.7	17	8	9	0.142	0.887	n.s.
CRA 5	108	28	71	37	-34.3	18	6	10	-1.157	0.247	n.s.
PAU 2	438	28	276	34	-37.0	17	5	12	-1.754	0.079	*
PAU 5	313	21	164	25	-47.6	30	9	18	-2.678	0.007	***

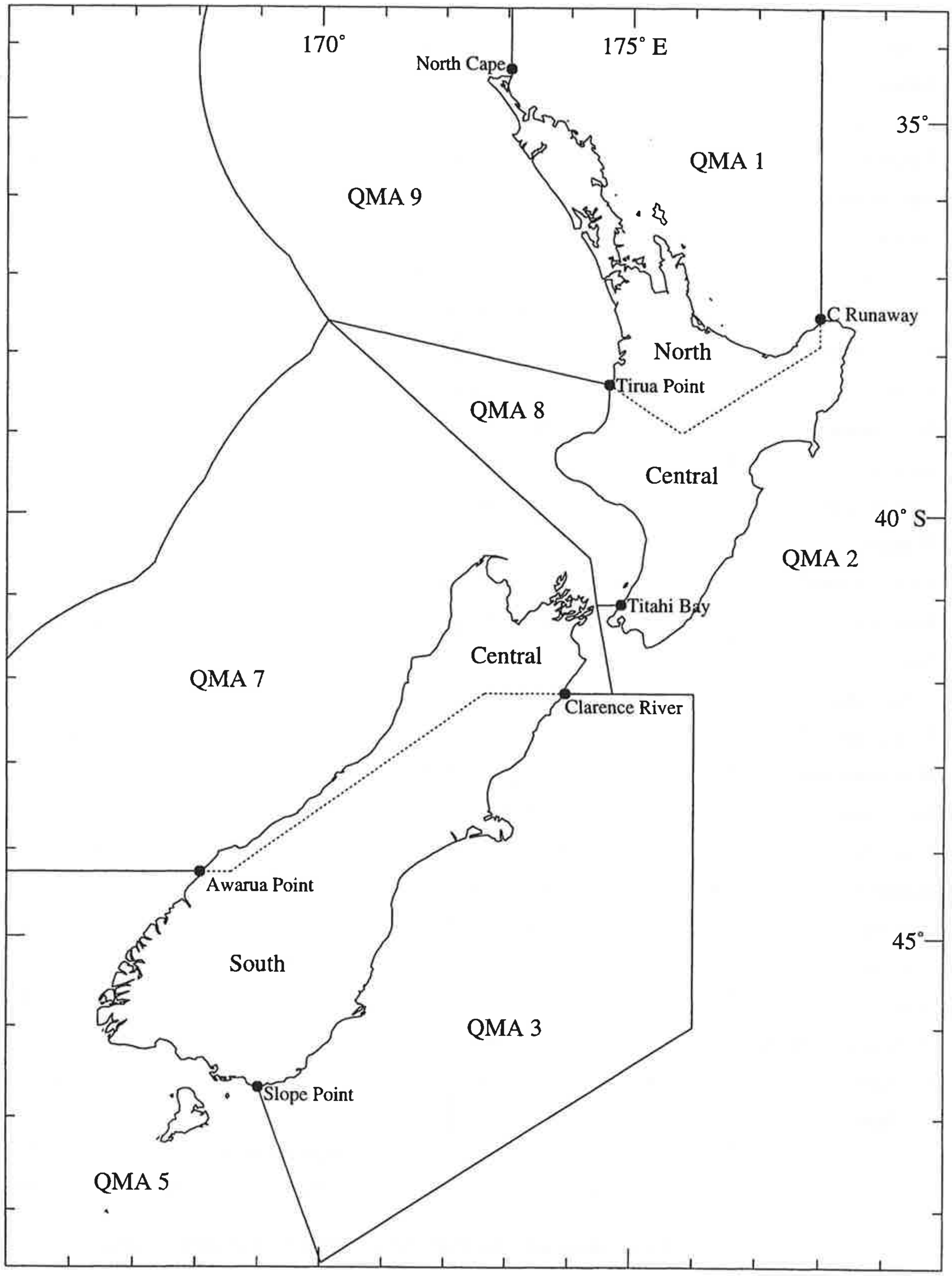

***Figure 1*: Map of New Zealand showing the land areas taken to be associated with the North, Central, and South regions and the QMAs which adjoin the coastline.**

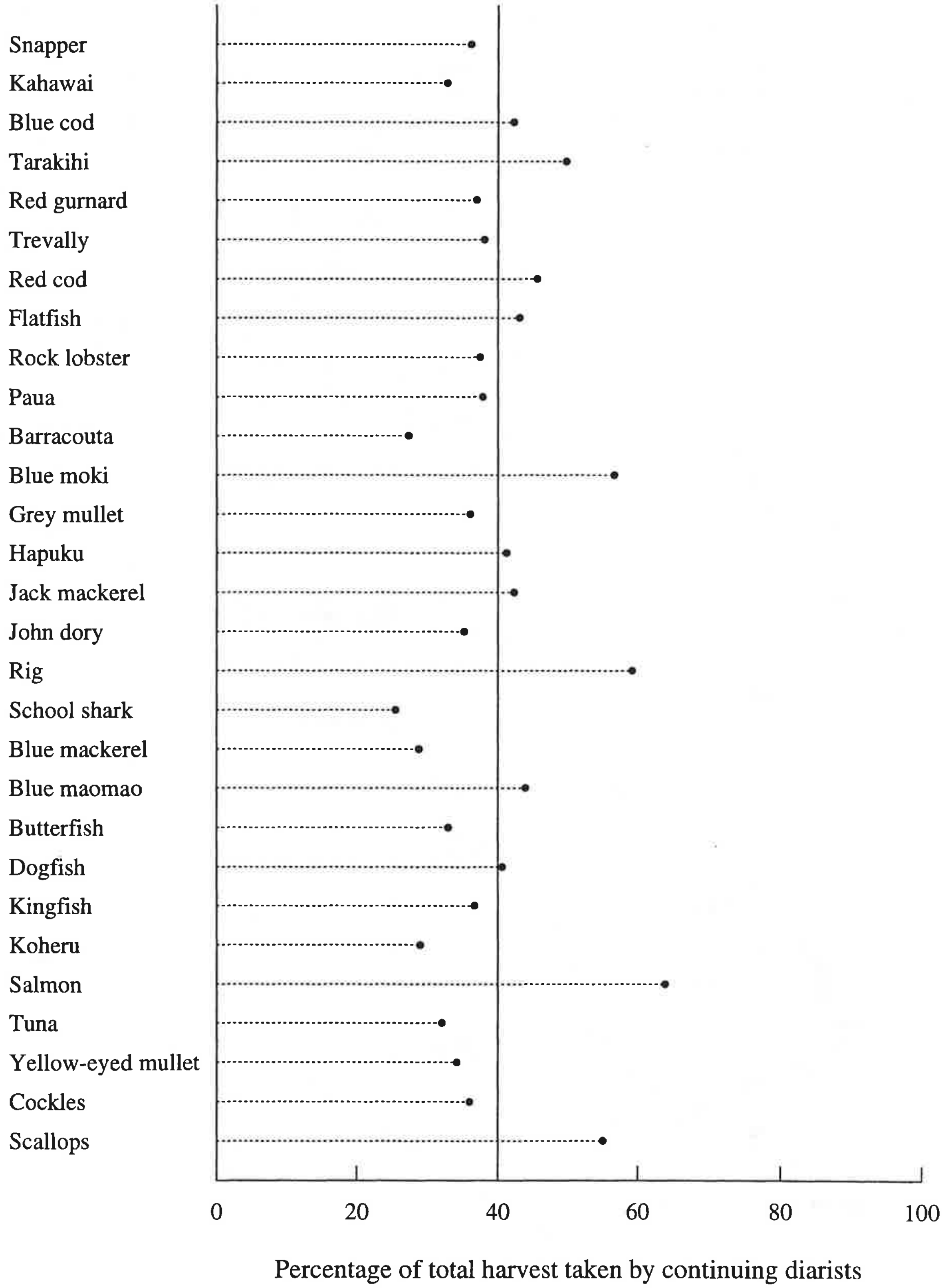

Figure 2: **Percentage of the total 1996 harvest of several species taken by the sample of 1997 continuing diarists during 1996. • percentage of total harvest for the species. The line at 40% is the approximate average harvest by the sample of continuing diarists.**

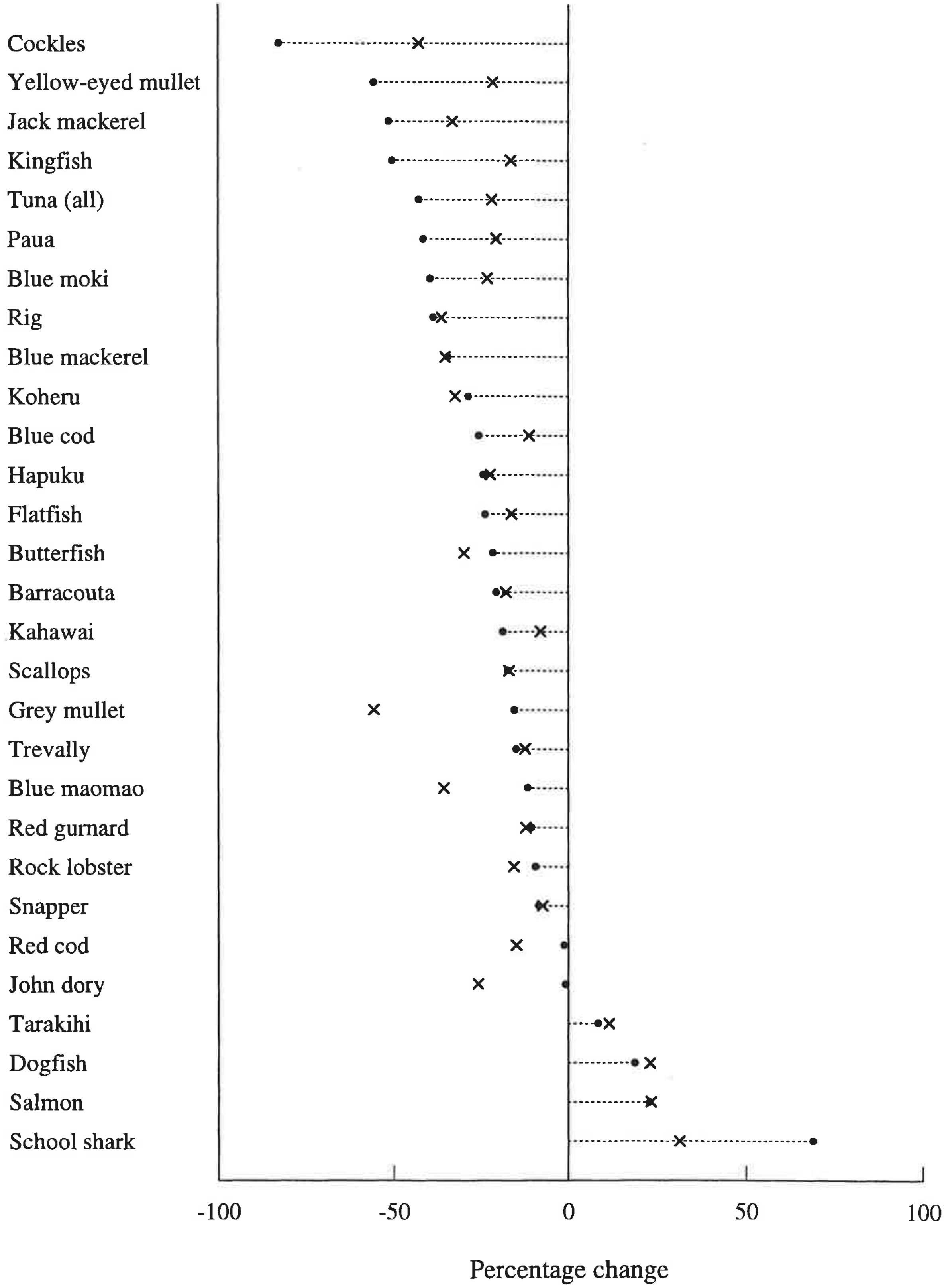

***Figure 3*: Change in recreational harvest ($H_{97} - H_{96}$) as a percentage of, H_{96}, the harvest in 1996 for the sample of continuing diarists (•). Fishstocks are ordered by the size of the change. $\times$ indicates $sqrt(c.v._{96}^2 + c.v._{97}^2)$ where $c.v._{96}$, $c.v._{97}$ are the *c.v.*s on the 1996 and 1997 harvests respectively.**