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REVIEW OF HARVEST ESTIMATES FROM RECENT NEW ZEALAND NATIONAL MARINE RECREATIONAL FISHING SURVEYS

1. INTRODUCTION

Over the last two decades there have been numerous surveys of recreational fishing in New Zealand. The scope and scale of these surveys varied enormously, as has the utility of the results.

In response to growing awareness of the magnitude and importance of recreational fishing and the need to base management decisions on adequate knowledge of all fisheries resource uses, the Ministry of Fisheries commissioned the first large-scale national survey of marine recreational fishing in 1995/96. A second national survey was carried out in 1999/2000. Both of these surveys produced a wealth of extremely valuable information on how many anglers there are in New Zealand, the distribution and associated demographics of marine recreational fishing throughout the country, the amount of fishing done by individuals and the species caught and their size distributions. The aggregate of this information from each survey provided estimates of the total recreational harvest from marine waters. The two estimates of the total harvest varied by approximately 300%.

As differences of this magnitude in estimates of the recreational catch have significant implications for fisheries management and resource use policy, a review of the results of the two surveys, and in particular the reasons for the differences between them, was commissioned in July 2002. This report represents the results of that review.

2. TERMS OF REFERENCE

Three primary questions are to be addressed:

1. Why are the draft harvest estimates from the 2000 survey so much higher than those from the 1996 survey?
2. Are the draft 2000 estimates a reliable indicator of the current magnitude of participation in recreational fishing and of the annual total harvest?
3. What are the major factors that influence the accuracy and reliability of the 1996 and 2000 estimates and what advice can be given to improve the accuracy, precision and value of future surveys?

In addition, comments are to be provided on the relevance of results from the recent Australian recreational fishing survey to the evaluation of New Zealand survey results and to the incorporation of these results into management plans.

Conclusions will then be used to recommend steps that could be taken to obtain the ‘least biased” estimates of recreational harvest from the results of the 1996 and 2000 national surveys.

Finally recommendations will be provided to facilitate the development of the next New Zealand national recreational fishing survey.

3. METHODS AND PROCEDURES

The review was to be carried out in three phases:

The first incorporated preliminary review of the primary documents describing and reporting on the 1996 survey (Bell and Associates 1996, Bradford 1998 a & b) and the 2000 survey (Ransom and Boyd 2002, Boyd

and Gowing 2000 a & b and Reilly 2000 a & b) as well as a search for other relevant documentation. It included one week in Wellington and extensive input into data evaluation and preliminary analysis from Mr David Gilbert of NIWA.

The second was the review of all relevant documentation followed by analysis or re-analysis, where appropriate, of data, and subsequent preparation of this draft report. Unfortunately all of the documentation on the 2000 survey is still in draft. Even the reports from the 1996 survey are only in the grey literature, primarily as NIWA Technical Reports. As such none of the documents have been subjected to thorough independent review.

The third involves presentation of the findings from the review to a workshop including participants from the Ministry of Fisheries, NIWA, Bell & Associates and Kingett Mitchell and contractors. This workshop was held in Wellington on September 6, 2002.

One point of clarification relates to reference to the key 1995/1996 and 1999/2000 surveys. Both these surveys, including pilot work, accumulation of data and analysis of results spanned more than one year. However in the interests of minimising confusion I have throughout this text referred to the surveys as the 1996 survey and the 2000 survey.

4. RESULTS (RESPONSES TO THE THREE PRIMARY TERMS OF REFERENCE)

4.1 Why are the 2000 harvest estimates so much higher than those from 1996?

Neither the Bradford (1998b) report on harvest estimates from the 1996 survey nor the Reilly (2002c) draft report on the 2000 survey provides an estimate of the total combined recreational catch of all species from all areas. Rather, estimates are broken down by species and fishery management areas; generally a far more useful scale of data presentation. Therefore comparison between the two surveys is best done on a species basis. Accordingly, to facilitate comparison of data on a national scale, I have summed the data on harvest estimates for each of ten key species across all of the fisheries management areas for which these species are recorded in Bradford (1998 b) and Reilly (2002c). These data are summarised in Table 1.

Table 1: Comparison of National Harvest Estimates for 1996 and 2000 for Selected Species in Numbers of Individuals Harvested (Data summed from figures given in Bradford 1998b and Reilly 2002c respectively) (in 000s)

	1996	**2000**	**Ratio of increase**
Blue cod	1082	2351	2.18
Flatfish	532	1590	2.99
Red gurnard	395	820	2.08
Kahawai	1233	4419	3.58
Snapper	2773	7885	2.84
Tarakihi	733	1532	2.09
Rock lobster	534	1303	2.44
Paua	430	1864	4.33
Cockles	1225	7101	5.80
Pipi	2746	10788	3.93
Average ratio			3.23

The striking feature of the harvest estimate data in Table 1 is that the 2000 estimates are consistently much higher than comparable data for 1996. This same trend is consistent across almost all of the other species on which the data were gathered during both surveys, such that the increase in the reported 2000 results is, in aggregate, 3.2 times the 1996 figure. A difference of this magnitude clearly has implications for fisheries management and also for the design and implementation of future surveys.

Harvest estimates from both surveys are the product of estimates of, the number of fishers in New Zealand, their average catch per year and the average size of the fish they have taken. In order to investigate possible sources of variation between the 1996 and 2000 results it is necessary to compare data on each of these components.

4.1.1 Estimation of the number of fishers in New Zealand

Each survey estimated the total number of fishers by interviewing a selected sample of the population and raising the results from this sample by the reciprocal of the fraction of the New Zealand population accounted for in the sample. There were minor adjustments in both surveys to a fully randomised

sample, largely to ensure a higher sampling ratio in the South region where fisher prevalence was known to be lower, but these were readily accommodated in the raising factors used.

Both surveys were originally to use telephone interviews to estimate fisher prevalence (those that fish at least once a year) and Bell and Associates did so in 1996 (Bell 1996). However after four, of five, pilot studies had given larger than expected estimates of fisher prevalence, AC Neilson, contracted by Kingett Mitchell, received Ministry approval to use face-to face interviews for their final estimate. An alternate estimate of fisher prevalence in 2000 was obtained by telephone interview as part of the process of selecting diarists for the second component of harvest estimates, discussed below. A summary of the base data from 1996 and 2000 on New Zealand households and the prevalence of fishers within households is given in Table 2.

Table 2: Comparison of numbers underpinning the 1996 and 2000 estimates of fisher household prevalence

	1996 Telephone	2000 Diary recruitment	2000 (b) face-to-face	2000 (c) face-to-face
Total NZ Households	1,283,716	1,300,541	1,300,541	1,300,541
Households targeted	35,038	34,832	55,978	(31,936)
Households contacted	35,038	29,607	47,972	(27,369)
Contact Rate (a)	100%	85.0%	85.7%	(85.7)
Households with interview	35,038	13,116	27,776	15,846 (12,656)
Cooperation Rate (a)	100%	44.3%	57.9%	(57.9%)
Fisher Households	4,860	5,777	-	6,160
Fisher Households as % of interviews	13.9%	51.4%	-	38.9%
Fisher households as % of total households targeted	13.9%	16.6%	-	19.3%

(a) Contact and cooperation rates based on Bell (1996) are assumed to be 100%

(b)&(c) Contact and cooperation rates were determined for a large readership and tracking survey only 57% of which included questions on fishing (Boyd pers. comm., 13/8/02). Estimated figures are in brackets.

From Table 2 it is apparent that both the telephone surveys (1996 and 2000 Diary Recruitment) targeted virtually the same number of households and therefore approximately the same percentage of the New Zealand population. Yet their estimates of the total number of New Zealand households that contain fishers vary by almost 370% (13.9% compared to 51.4%). Kingett Mitchell considers the 2000 readership, face-to face interview technique to be more accurate than the telephone survey. Here the increase over the 1996 figure is 280% (13.9% and 38.9%). Best estimates of fisher prevalence on an individual and not household basis are 9.7% for the 1996 survey and 31.0% for 2000.

Possible implications of the differences in household contact rate and cooperation rate and the similarities between the two surveys in the percentage of the targeted households that contained fishers is discussed in Section 5.1.1.

4.1.2 Estimates of fishing activities by individual fishers (The Diary Surveys)

For both the 1996 and 2000 surveys once fishers were identified by telephone, a selection was asked to keep diaries and record all fishing activities on a quarterly basis for the next year. The subset of the original sample outlined in Table 2 that agreed to, and subsequently kept diaries, together with their trip statistics, is outlined in Table 3. The similarities in the number of individuals asked to keep diaries, the cooperation rate and the ratio of trips to no trips recorded in quarterly logs is remarkable. This demonstrates that once contact is made with individuals who declare that they are fishers, the data generated from these people is consistent. Table 1 confirms this consistency, for even though the harvest estimates of the ten selected species vary by an average of 3.23 between the two surveys, the effect of the difference of 3.20 in fisher prevalence estimates (31.0% and 9.7%) accounts for this difference. The variability between species within the two surveys (Table 1) is no greater than would be expected from surveys of this type. The consistency in diary and demographic data is further endorsed by the high degree of correlation in the comparative demographics of fishers, as discussed in Section 5.1.

Table 3: Comparison of Basic Data from the Recruitment of Diarists and Diary returns on 1996 and 2000. (Data derived from Bradford 1998a and Boyd and Gowing 2000a.)

	1996	2000
Number of households with one or more fishers	4,860	5,777
Fishers per household	1.97	2.07
Individuals asked to keep diary	4,860	4,887
Individuals agreed to keep diary	3,752	3,719
Cooperation rate	77.2%	76.1%
Returns with trips		
1st diary period	1,652	1,711
2nd diary period	988	870
3rd diary period	602	429
4th diary period	877	615

Total	4,119	3,625
Returns with zero trips		
1st diary period	1,473	1,353
2nd diary period	2,196	2,028
3rd diary period	2,186	2,325
4th diary period	1,743	1,901
Total	7,598	7,607
Trips/No trips	0.54	0.48

While the similarity between the two diary surveys is a feature there are, of course, differences. The most striking of these are in Management Area 2. A summary of the differences in Area 2, compared to the similarities discussed above (see Table 1) is given in Table 4. The ratio of change from 1996 to 2000 for area 2 is 7.64 when the total change for all other areas combined for ten key species is 2.88. Note that eight of the changes in Area 2 are increases over the national average while two, blue cod and rock lobster, are decreases. This mix of increases and decreases suggests the peculiarity in data on Area 2 is not due to systemic error in either or both surveys, but is more likely due to an unusual sample in this area in one, or both, surveys.

Table 4: Comparison of National Harvest Estimates for Selected Species in Numbers of Individuals Harvested and for Management Area 2 (in 000's).

	1996	2000	Ratio of increase	Ratio for Area 2 only	Ratio excluding Area 2
Blue Cod	1082	2351	2.18	1.29	2.31
Flatfish	532	1590	2.99	5.67	2.60
Red gurnard	395	820	2.08	5.47	1.71
Kahawai	1233	4419	3.58	12.72	2.39
Snapper	2773	7885	2.84	8.65	2.78
Tarakihi	733	1532	2.09	2.71	1.98
Rock lobster	534	1303	2.44	1.39	3.25

Paua	430	1864	4.33	6.11	2.66
Cockles	1225	7101	5.80	18.30	5.48
Pipi	2746	10788	3.93	14.11	3.70
Average Ratio			3.23	7.64	2.88

There does appear to be some groupings in the species which vary for Area 2 (Table 4). Pipi and cockles are obvious. For both of these species, the number of fishers who made diary entries is small, 19 and 9 respectively, so little weight should be attached to these findings. Snapper and kahawai may also be associated and here the sample sizes are reasonable. Blue cod is one of only two species where the Area 2 increase is less than the national figure and it is noteworthy that data for a species likely to be taken by the same fishers, red cod, actually suggest a decrease in area 2 in 2000 to less than 50% of the 1996 catch figure. While red cod is known to undergo significant variation in year class strength, data for other management areas show increases in red cod catches in 2000, consistent with results for other species.

One result of potentially major management significance which appears at odds with other species is the paua increase in Area 2 of 6.11. The other species which could be expected to reflect a major shift to the type of activity that would harvest paua is rock lobster. Here we have an increase of 1.39, less than the national average. The sample sizes are moderate, 65 for lobster and 63 for paua. Such results could be expected if there was a major shift in effort from the lobster to the paua fishery. However, as pointed out by Rick Boyd (pers.comm.) the estimate of the total paua catch of more than one million animals implies more than 100, 000 trips in a year even if everybody took their bag limit every time, assuming of course, that there is no gross disregard for bag limits. Such a large number of trips appears questionable.

Further analyses of the data from Area 2 using the raw data from both surveys may provide an indication of the cause of this apparent anomaly, but further analyses are not appropriate in this review. It is appropriate, however, to caution against the use of the harvest estimates for Area 2 from either the 1996 or 2000 survey without further scrutiny.

Both diary surveys unearthed a large percentage of people who stated that they would fish in the next year, but who did not (see the large number of diary returns with zero trips in Table 3). These people inflated the estimate of the percentage of the population who are really fishers but had less impact on the comparison of the harvest estimates in 1996 and 2000. There are two primary reasons for this relative lack of impact: firstly the percentage of zero trips reported in the 1996 survey is extremely similar in magnitude and distribution across diary periods to the 2000 figures, and secondly, these zero trips bring down the average catch of the average fisher by an amount which compensates to at least some degree for the over-declaration of fisher prevalence in the sample. This is discussed in detail in Section 5.2 but it should be noted here that adjustment of fisher activities in the diary sample does not alter the fisher prevalence measures derived from either the 1996 or 2000 survey.

4.1.3 Size composition of catches

Even though selected diarists in the 1996 survey were asked to take length measurements of key species (Bell 1996), length measurements used in harvest estimates were from boat-ramp surveys (Bradford 1998b). Similarly size composition data for the 2000 survey were derived form boat-ramp samples (Boyd and Gowing 2000b). Again the outstanding feature of the two data sets is their similarity. While there are, of course, differences they are mostly within the limits expected for normal sample variability, seasonal differences and inter-annual changes. Again the figures for Area 2 may warrant scrutiny, particularly for snapper. What differences exist are not significant contributors to the consistent differences in harvest estimates between the two surveys. In any case the difference in harvest estimates of 3.23 between the 1996 and 2000 surveys (Table 1) is based on numbers of fish caught and is not impacted by size estimates.

4.1.4 Comparison of CV's for harvest estimates

The CVs given for the 2000 estimates (Reilly, 2000c) are, on average, two to three times those given for the 1996 estimates (Bradford 1998b). Reilly (2000c) gives a good explanation for this difference which arises from markedly different estimation techniques. While the CV's for the 2000 estimates may appear high they do not primarily reflect less consistent or reliable data in the later survey. They do reflect the lack of precision in estimates for both surveys which are taken from a relatively small sample of an extremely variable population; there is ample literature on the small percentage of anglers who take the bulk of the total catch and the great range in catches by individual anglers, particularly those who, on average, take greatest catches. The high CV's are a reminder of the imprecision in the best available data. They highlight the need for repeat surveys to test indications, to provide comparative estimates and to develop time series which collectively engender confidence in assessments.

5. ARE THE DRAFT 2000 ESTIMATES A RELIABLE INDICATOR OF THE CURRENT MAGNITUDE OF PARTICIPATION IN RECREATIONAL FISHING AND OF THE ANNUAL TOTAL HARVEST?

The major issue which draws into question the 2000 harvest estimates is their significant variation from the only other truly national survey designed for the same purpose. The strong suggestion, from Section 4 above, that the significant differences in the two national harvest estimates (1996 and 2000) are due to differences in the estimates of fisher prevalence in the two time periods warrants scrutiny.

5.1 Possible causes of the difference between the 1996 and 2000 fisher prevalence estimates

The two estimates of fisher prevalence, 9.7% and 31.0% could differ for a number of reasons, including:

1. What is being measured is, by design, different; that is the definition of prevalence varies between the two.
2. They are both correct and represent real changes in participation in fishing over the four-year period between them.
3. One, or both, of the estimates is in error.

Both surveys use effectively the same definition of fisher participation, or prevalence, which aims to quantify the percentage of the New Zealand population

aged 15 or over, who fish at least once a year in the marine or lower estuarine environment. As both surveys use the resulting number in essentially the same equation to estimate total harvests there seems little doubt the goals of their estimates are similar.

Although no unequivocal statements were available at the time of this review, it seems most unlikely there has been a 300% increase in participation in recreational fishing in New Zealand between 1996 and 2000. Data from eleven years (1991 – 2001 inclusive) of the AC Neilsen 'interests and activities' surveys (see Section 5.1.1) suggest very little change, and no pattern, in recreational fishing over this period. In order to further investigate this issue data on imports of fishing gear and outboard motors were sought from the ministry of Foreign Affairs and Trade. Data on imports of fishing reels, hooks, rods and outboard engines from 1989 to 2002 are summarised in Table 5.

Table 5: Imports into New Zealand, 1989-2002, of Four Items Used in Recreational Fishing (Figures are in NZD and supplied by Foreign Affairs and Trade)

	Reels	Hooks (a)	Rods (b)	Outboard Motors (c)
1989	5,229,060	621,491	1,111,497	20,718,226
1990	4,294,184	704,497	931,024	21,386,614
1991	4,213,822	953,234	961,354	17,440,727
1992	3,683,618	1,214,087	1,139,796	17,059,003
1993	3,563,517	1,380,538	1,346,713	16,749,253
1994	3,800,858	1,341,997	1,591,545	16,043,389
1995	5,052,557	1,405,199	1,826,144	22,095,647
1996	5,979,527	1,622,269	2,053,359	23,249,822
1997	6,112,870	1,380,890	2,904,612	19,660,051
1998	5,151,977	1,682,112	2,303,142	24,579,733
1999	5,606,248	1,693,632	2,338,573	28,463,545
2000	6,933,655	2,375,988	2,317,406	35,200,655
2001	7,338,627	2,025,700	2,376,114	47,982,228
2002	7,099,094	2,104,268	1,843,997	40,704,830
2000/1996	1.16	1.46	1.13	

				1.51

(a) Fish-hooks; unmounted and without attachments, whether or not snelled
(b) Fishing rods; other than of man-made fibres agglomerated with plastic
(c) Engines; for marine propulsion, outboard motors exceeding 5.22kw, spark ignition reciprocating or rotary internal combustion piston engines

There have been relatively consistent increases in all four items since 1989. Increases between 1996 and 2000 varied between 1.13 and 1.51. When adjusted for inflation, and the growing affluence of the average New Zealander, they suggest at most, a marginal increase in participation in fishing. Outboard motor sales are up by about 50% over this period and this could well have been a response by the total boating community to the extremely high profile given to water sports by the spectacular, and popular, defence of the America's Cup around that time. Data from boat-ramp surveys carried out in the 1996 and 2000 survey may be able to be used to provide some corroboration to the above conclusion.

Elimination of the first two options leaves only the possibility that one, or both, of the 1996 and 2000 surveys is in error.

The consistency in the data obtained once people had confirmed that were indeed fishers has been highlighted and discussed in Section 4 above. Further evidence of this consistency is provided by an analysis of the variation in fisher prevalence estimates within the various regions of New Zealand.

The difference in national household fishery prevalence estimates between the 2000 face-to face survey and the 1996 telephone survey is 2.78 (38.7% and 13.9%) and 3.70 (51.4% and 13.9%) for the 2000 and 1996 telephone surveys. All three surveys produced figures on fisher prevalence estimates by region. A little unfortunately the regions used were not exactly the same; Bell 1996 lists the 18 regions he used and these correspond to telephone directory regions, while Reilly (2002b) lists the 14 regions used in the 2000 survey and these are regional council regions. Even accepting these differences a summary of comparisons between regions is illuminating. Both surveys found, as expected, higher fisher prevalence in the north of New Zealand, particularly Northland, and lower in the south. Relatively lower rates were also found consistently for larger metropolitan areas, such as Christchurch, Auckland and Wellington. Comparisons of the fisher household prevalence estimates between six key pairs of regions are given in Table 6. Differences between regions are remarkably consistent within all three surveys with a maximum variation of approximately 30%, and several agreeing almost exactly. This is in spite of the approximately 370% differences in the combined national figures and the different definitions of regions used between 1996 and 2000.

Table 6: Comparison of Household Prevalence Estimates for Different Regions

	1996 Telephone	**2000 Face-to-face**	**2000 Telephone**
Northland/Auckland	2.10	1.85	1.45
Northland/Wellington	2.88	2.20	1.93
Auckland/Wellington	1.32	1.30	1.30
Nelson/Southland	1.71	1.52	1.34
Northland/Southland	2.27	1.81	1.75
Wellington/Canterbury	1.04	0.92	1.03

This, therefore, strongly suggests that the difference in fisher prevalence estimates between the two surveys, and the part that any errors might play in that difference, is systematic and consistent across the whole of the survey(s). The obvious possible causes of the difference (error?) appear to be either how the New Zealand population was sampled, how people who were truly fishers were identified and/or how the number of such people was raised to represent a percentage of the total population.

Information on how the sampling designs and programs were developed suggest fundamental similarity in the two major telephone surveys, even though there are differences in how telephone numbers were selected. Concern over reliability of the telephone method led AC Neilsen to undertake face-to-face interviews for their final assessment. Significantly, this survey gave a lower fisher prevalence figure than the telephone survey carried out by the same company, negating argument that the higher figure in 2000 was due to adoption of face-to-face interviews.

Thus it appears that the most likely cause of the difference in prevalence estimates was the process of the interviews and the ways in which responses were obtained, interpreted, recorded and analysed. Unfortunately the raw data sets from both surveys are not available for comparison: much of the basic data relates to individuals and specific telephone numbers and in the interests of confidentiality is not kept (Bell pers. comm.). Therefore indirect comparison, and consideration of the results of other surveys of recreational fishers, are all that are available to assist in assessing the relative accuracy of the two prevalence estimates.

5.1.1 Consideration of previous surveys

Reilly (2000a, page 2) provides a table of the various sources of estimates of national annual fishing prevalence and figures for these estimates [this table is reproduced below (Table 7)]. Reilly also provides considerable discussion of why the estimates vary, and in particular why he believes the Bell and Associates estimates of 1996 may be in error, which he clearly implies they are. As the variation in the estimates of fisher prevalence is primary to the three-fold difference in harvest estimates between Bradford (1998b) and Reilly (2002c) it is relevant to consider how other surveys support or detract from the conclusions of these two.

Table 7: New Zealand Survey Estimates of Annual Fishing Prevalence (reproduced from Reilly 2002 (a))

	Individual Fishing Prevalence (%)	Household Fishing Prevalence (%)
Tierney et al. 1997		16.4
Bell & Associates (1996(- telephone recruitment for 1996 NMRFS	9.7	13.9
Sylvester et. al. (1994) – reports on 1987 Department of Statistics survey	17.3	-
National Research Bureau (1991)	38	-

AC Nielsen (2000) – telephone recruitment for 1999 NMRFS	39	51.4
AC Nielsen National Readership & Finance Surveys (2000)	31	38.7
AC Nielsen's "interests & activities" 10 year average	19.5	-
Hillary Commission (1991) % fished in week prior to interview, 12 month average	5	-

The Tierney et al. 1997 figure (Table 7) is based on data generated primarily by the same people using essentially the same techniques as those of Bell and Associates (1996). The results from both are lower than those derived from other surveys specifically designed to assess national participation in recreational fishing. The distinguishing feature of the methodology for estimating fishing prevalence in these two reports is the comparatively, extremely high estimates of cooperation amongst those people contacted. Unfortunately no detailed data are provided on the proportion of people contacted who agreed to be interviewed but it is implied that those who refused were so few that their impact could be ignored. In fact they have been ignored in the descriptions of the calculations of fishing prevalence in Bell and Associates (1996), and from Bradford's figures (1998a) it is clear she has assumed 100% contact and cooperation. I discussed the issue of cooperation rate with John Bell (22/07/02) and he suggested that 8-9% of the telephone numbers selected could not be contacted (contact rate 92%) and of those contacted 2-3% hung-up immediately and 1-2% of those who may have been fishers refused to answer questions (cooperation rate 96%). He expressed conviction that this estimate of cooperation rate was real and that the higher than normal rate was due to a large extent to the up-front association of the survey with the Ministry of Fisheries. In his words "this gave the survey credibility" and provoked an extremely high response.

The Sylvester et al (1994) report is a draft commentary on the 1987 survey commissioned by the Ministry of Agriculture and Fisheries and conducted by the Department of Statistics. I have reverted to the original Department of Statistics report. This survey was based on initial face-to-face contact and follow-up telephone interviews of 3078 dwellings. The response rate is given as 97.5% but the definition of response is more akin to cooperation in other reports. The survey estimated the number of fishers 12 years old and older, which would give rise to a slightly different figure than other surveys which had a cut-off of 15-year-olds. Unfortunately the description of methods and results is extremely brief making it difficult to comment on the precision or accuracy of the estimate of participation of 19% (note that the Department of Statistics Report actually gives a figure of 19%, not 17.3% as reported by Sylvester et al). However the very high cooperation rate, approximately 97.5%, again raises some concerns. It adds some weight to the suggestion that the fishing prevalence figure of 19% may be lower than the actual participation (see discussion of cooperation and "soft refusals" in 5.1.2 below).

The National Research Bureau 1991 survey is quoted by Reilly (2002a) as having a fishing prevalence rate of 38%. The 38% participation actually given in the 1991 report includes freshwater fishers so therefore Reilly's use of this figure in this context is in error. From the data available in the National Research Bureau report it is possible to determine the percentage of the total that were marine fishers; this figure is 33% (Kilner pers comm.). Data from this survey suggest a contact rate of 76.2% and 64.5% cooperation rate.

The AC Neilsen (2000) telephone recruitment data on prevalence and the AC Neilsen 2000 National Readership and Finance survey, based on face to face interviews, as reported in detail by Reilly (2002 a, b and c), give prevalence estimates of 39% and 31% respectively. These are the two highest prevalence estimates so far reported for New Zealand. It is significant that before finalising the design of these two surveys AC Neilsen conducted five pilot telephone surveys each using at least some variation in formulation and presentation of questions. Four of these pilots gave very similar results to those of the full telephone recruitment survey (given as household participation of approximately 50%), while one gave a prevalence estimate which was approximately half this level. This is discussed further in 5.1.2 below.

The AC Neilsen "interests and activities" 11-year average figure of 19.5% is based on non-directed questions about participation in various sports. The 11 years of figures are relatively consistent, varying only between 16 and 23%. It is possible they may underestimate total participation in fishing as many people go fishing for reasons other than sport (see for example Kearney 1999). It is also possible they may overestimate participation because they are based on recall and "telescoping" of recall appears significant (as later discussed).

The Hillary Commission figure of 5% participation in fishing is almost certainly an underestimate because of the nature of the survey (for all sports and physical activities, including gardening) and the way in which it was conducted. As mentioned above for the AC Neilsen "interests and activities" survey many people go fishing for reasons other than sport and also when asked general questions about sport and recreation many people concentrate on their dominant activities and so do not accurately present those they do once or twice a year. It is significant that a similar survey on participation in sport in Australia in 1998 by the Australian Bureau of Statistics gives a figure of 4.8% participation in fishing (ABS 1998) when a recently completed national Australian survey specifically designed to estimate angler participation at least once a year, and subsequent harvest, gives a participation figure of 19.5%.

5.1.2 Comparison of fisher prevalence estimates and public cooperation rates.

The possible role that interviewee contact and cooperation rates may have on the subsequent estimate of fisher prevalence has been introduced in Section 4.1.1 above. In order to further the debate on this significant issue response and cooperation rate data from the numerous New Zealand surveys, which might help in the assessment of the differences between the 1996 and 2000 figures, have been summarised and are presented in Table 8. Many of the data sets in Table 8 are not exactly comparable so great care should be taken to not put undue confidence in inferences taken from them. On the other hand the importance of prevalence estimates to harvest estimates, and the lack of other data to assist this investigation, supports the need for analyses of all data that are relevant.

Table 8: Comparison Across Surveys of Fisher Households Prevalence Estimates and Cooperation Rates

	Bell 1996	ACN Pilot 1	ACN Pilot 2	ACN Pilot 3	ACN Pilot 4	ACN Pilot 5	ACN TRS	ACN NRS	1991 Nat Res. Bureau	1987 Dept Stats	Walshe et. al. 1999
Sample size	~35038	1000	1002	1000	349	288	12656	47972	6646	3078	5820
Contact rate	~92	75.8	70.6	74.1	60.7	46.6	85.0	85.7	76.2		67.3
Cooperation	~97	34.1	29.2	26.7	62.9	47.3	44.3	57.9	64.5	97.5	70.0

rate											
Fisher h/h (% of coops)	13.9	49	47	50	22	48	51.4	38.7	~40	~21	~30
Fisher h/h that coop (% of contacts)	~13.5	16.7	13.7	13.4	13.8	22.7	22.8	22.4	~26	~20	21
No. fishers per h/h	1.97	1.74	1.83	1.65		2.1	2.07				

In considering the data in this table several qualifications are required:

1. The contact rate and cooperation rate estimates for Bell 1996 are derived from an interview with John Bell and not from the 1996 report (there were no estimates in the report but 100% contact and cooperation was used in calculating the subsequent harvest estimates by Bradford 1998b).
2. The cooperation rate figures for the ACN pilots 1, 2, 3 and 5 refer to cooperation on telephone interviews started on subjects other than fishing.
3. All figures preceded by ~ are approximations derived by the author from data contained in the respective reports.

The most suggestive figures in this table are the extremely high cooperation rates and lower fisher prevalence estimates for the 1987 and 1996 surveys. Several market researchers, including AC Neilsen and Reilly (2002a), suggest that percentage cooperation rates in the high 90's border on the unbelievable. Reilly suggests it is probable that results derived from such high estimates of cooperation are compromised for a number of reasons, such as inclusion of a significant proportion of interviewees who were interpreted as stating that they did not fish in the last year when their intention was merely to end the interview ("soft refusals" Reilly 2002a page 5). In the absence of detailed comparative data on exactly how people were approached in each survey, how questions were put and the skill of the operators in asking the questions and assessing the answers, it is impossible to provide definitive assessment of the probable magnitude of soft refusals. However an analysis of the percentage of total households with which contact was made (not just those that cooperated) that indicated that at least one resident had fished in the last twelve months (Table 8), reduces the maximum differences in participation estimates between the surveys from 370% to 193% (ie 51.4/13.9 to 26/13.5). While not definite this suggests that the degree of perceived cooperation is influential in the final estimation of participation in fishing.

On the other hand, seven of the eleven surveys summarised in Table 8 were conducted by the one group of researchers, AC Neilsen, over a relatively short time frame. The degree to which each should be regarded as an independent data point is questionable.

It must be noted that AC Neilsen performed a total of five pilot telephone surveys before conducting the final telephone diarist recruitment survey and the face-to-face survey. The sample sizes in these pilots were relatively small, approximately 1000 or less, and the results from four of them suggested household participation rates of approximately 50% while the other gave a household rate of 22%. This one outlier cannot be readily explained although it was different to the other pilots in that it was the first of the pilots to begin the interview with the mention that the survey was about fishing and was for the Ministry of Fisheries. To suggest the mention of the Ministry led to a low result is contrary to the opinion of John Bell, as reported above (Section 5.1.1). AC Neilsen have confirmed to me (01/08/02) that this pilot was, like the others, truly national in scope and contained no geographic or other structural bias of which

they are aware. Reilly (2002a page 4) claims that this figure of 22% was actually too low and call-back of non-fishing households several days later enabled correction to 28%. Such practice seems inappropriate, unless all households, fisher and non-fisher, for all surveys, are systematically reviewed and results adjusted accordingly.

Because of the relatively small sample size of this one pilot, incorporation of the result into a total for all of AC Neilsen's telephone surveys does not significantly move the average from 50% household participation or 39% individual participation.

Combining all the AC Neilsen surveys would give an individual participant rate in the low 30+% estimated from a cooperation rate of little more then 50%.

A major national telephone survey of recreational fishing in Australia, similar in scope to the 1996 and 2000 New Zealand surveys, produced an estimate of response rate of 80%, a cooperation rate of 79% and a combined contact/cooperation rate of 63% (calculated from Henry 2002 pers. com. See Appendix 3). It has been suggested by several market researchers that cooperation rates in New Zealand are lower than in Australia because of the relatively more intense market research industry in New Zealand leading to a high rate of target audience fatigue and associated resistance. If true, this would add weight to the suggestion that the Bell 1996 estimates of fisher participation are lower than actual because of some inaccuracy in accounting for "soft refusals". The possibility that cooperation rates were higher in 1996 than 2000 also warrants consideration, however the 64.5% recorded in the 1991 survey tends to refute the suggestion that they are a solely recent phenomenon and were negligible in 1996. It is, of course, also possible that the high contact and cooperation rates in the 1996 survey accurately reflect Bell's superior technique. There are no data to support or refute this suggestion.

It is also most interesting that the Australian telephone survey across 43,945 telephone numbers produced an estimate of participation in recreational fishing of 19.5% (Appendix 2). This figure includes freshwater and marine activities. The marine component is approximately 15-16% (estimated by the author from data on the number of trips in each sector provided by Henry, pers. comm.). This figure is approximately half the AC Neilsen best estimate for New Zealand but approaching twice that of Bell and Associates. The Australian figures range from 9.90% participation from Melbourne residents and 13.00% for Sydney to highs in the high 40's% and even low 50's% in coastal, less populated areas of Western Australia, South Australia and Northern Territory, thus confirming much higher participation rates where fishing opportunities are greater and most rewarding. Accepting that New Zealand's fisheries resources are considerably richer than Australia's, the cultural similarities between the two peoples and the proportionately greater access to quality fishing environments in New Zealand, at least in summer, it would appear most likely that the participation rate, at least once a year, in New Zealand would be equal to, or higher than, that in Australia.

It is significant that Australia can validate its total estimate of approximately 20% by using figures on the percentage of the population who buy angling licences (now compulsory for marine and freshwater fishing in New South Wales and Victoria; more than half the Australian population) corrected by the fraction of those who fish without a license (from enforcement figures). No similar mechanism for validating New Zealand estimates appears to be available.

5.2 Consideration of those who said they fished in the last year, but who didn't fish in the diary year

As discussed above, harvest estimates from both the 1996 and 2000 surveys are derived from data from three, or four, separate subsets of the New Zealand population. The prevalence estimate is driven by the percentage of the population who responded in the affirmative to questions on whether or not they fished in the last 12 months. This has been discussed in detail above. The information from those who agree to complete diaries, on the supposition that they believe they fished in the last year and anticipate that they will fish in the next year, is then used to derive estimates of where and how often people fished, and subsequently, the number of fish they caught. The similarity in the diary data has been highlighted (Table 3) and discussed in section 4.1.2. What has not been fully discussed are the implications of the surprisingly high percentage of diarists who recorded zero trips.

Bradford (1998a) reported that of the total 3,752 diarists, 1,972 recorded trips, 665 (17.7% of the total, or 25.2% of respondents) made no trips and the rest 1,115 did not respond (see Table 3). Bradford also points out that a disproportionately high percentage of those who did not respond probably made no trips, resulting in a total percentage of no trips greater than 25.2%. There are insufficient data to accurately estimate the correct figure but the great similarity in the patterns of declaration of trips between Bradford's data and that from AC Neilsen (Table 3) suggests that the total percentage in the Bradford study may approach the AC Neilsen figure of 45.6% discussed below.

AC Neilsen provide detailed data on the number of diarists declaring trips or no trips, not responding, or withdrawing for each of the four diary periods (Boyd and Gowing 2002a). A total over the year of 3,626 diaries reported trips and 7,608 reported no trips (calculated from Table 3 of Boyd and Gowing 2002a). As the published data are presented by diary period, it is not possible from these data to estimate the percentage of respondents on an annual basis, however Kingett Mitchell (Boyd pers. comm.) have kindly provided some additional analyses for this review (Appendix 1) which give the annual figure for diarists who made trips at 2,023 and for those who made no trips, 1,695 (45.6%).

Bradford (1998a) draws attention to the need to take account of diarists who made no trips and also those fishers leaving and entering the fishery. The default option of an equal number of fishers entering or leaving the fishery in any one year appears reasonable.

Reilly (2002b) also acknowledges the issue of diarists reporting no trips and combines this, in the form of a "fishing effort ratio" (Reilly 2002b, p. 14) with an evaluation of fishers leaving and entering the fishery, to produce a combined fisher entry adjustment factor:

$$\text{Fisher entry factor} = 1 + \left(\text{Fishing effort ratio} \times \frac{\text{No of new fishers}}{\text{No of continuing fishers}}\right)$$

This procedure appears somewhat questionable, particularly as the estimates of fishers leaving and entering the fishery in one year (136 000 entrants and 256 000 departures) is based on recall at interview. Reilly himself reminds us of the problem of "telescoping" in recall at interview. If correct, Reilly's fishing behaviour data would suggest that either 2000 was a much poorer year for fishing than 1999, or people are systematically leaving the New Zealand recreational fishery. This is not supported by the AC Neilsen "Interests and Activities" survey which suggests little change between years over an 11 year period, 1991 – 2001 inclusive (AC Neilsen 2002). The large number of diarists who said they fished in the last year and thought they would fish in the next, who did not fish (45.6% based on the same data set as used by Reilly, as discussed above) strongly

suggests that “telescoping” is a real problem for interview assessment of recreational fishing and this problem could be worse as the period of recall is extended.

Both Bradford (1998a) and Reilly (2002b) acknowledge the need to accommodate zero trips in the scaling factors for harvest estimates, as discussed above, however fisher prevalence estimates are not adjusted for either survey.

Bell (1996) published his fisher household prevalence figure of 13.9% well before Bradford’s 1998 estimates of harvests, and Reilly (2002) confirms that the household prevalence figure of 38.9% he uses was taken from “the Readership/Finance survey that contained someone who had fished in the 12 months preceding the interview” and well before diary information was available. Therefore even though diary returns which report zero trips are, to at least some degree, accommodated in the raising factors of Bradford and Reilly for diary data, they are not taken fully into account in the estimates of fisher prevalence.

There is also an issue relating to the 2000 harvest estimates being based on a fisher prevalence estimate from one sub-set of the New Zealand population (from face-to-face interviews) multiplied by trip and catch data from a separate sub-set of the population (diarists recruited by telephone). This would not be a problem if the two sub-sets were derived by exactly the same process. The notable difference in cooperation rate (44.3% and 57.9%) confirms, however, that they were not.

The major impacts of changes in the prevalence estimates as outlined above is in the social, economic and political profiles of the recreational fishing sector rather than in altering current assessments of harvest. Of course any future analyses or management actions which use or depend on fishing prevalence as a primary driver will be influenced by any bias, or error, that may be present in the figure used. It would therefore, seem necessary to re-calculate the prevalence estimates for both the 1996 and 2000 surveys using the detailed data on prevalence available from those surveys and the associated diary data on fishing effort. It would also seem appropriate to make provision in future surveys to gather more robust data on participation by both the group who thought they would fish and those who thought they would not. Careful cross-referencing of the interviews and diary data plus some follow up interviewing appears necessary.

6. WHAT ARE THE MAJOR FACTORS THAT INFLUENCE THE ACCURACY AND RELIABILITY OF THE 1996 AND 2000 ESTIMATES AND WHAT ADVICE CAN BE GIVEN TO IMPROVE THE ACCURACY, PRECISION AND VALUE OF FUTURE SURVEYS?

As discussed in Sections 4 and 5 above the major obvious factor influencing the accuracy and reliability of the two national surveys is the 300% variation in the estimates of fisher prevalence. The consistency in data generated from the two diary surveys and from on-going boat-ramp surveys strongly supports acceptance of the reliability of these components. Improvements are possible in the diary and boat-ramp surveys but the need for, and cost-effectiveness of, these improvements will be influenced largely by the specific management objectives being addressed by the survey (further discussed in Section 6.3).

The accuracy of the estimates of fisher prevalence must be addressed if the full value for management of the results, from either and both, of the national surveys is to be realised and future surveys are to be undertaken with confidence. Suggestions on how to optimise the use of the 1996 and 2000 prevalence estimates are given in 6.2 below. For future surveys very explicit directions on

how prevalence estimates are to be derived and how results are to be verified and validated will need to be given to all tenderers. These directions could possibly be best developed by a workshop of people with combined skills in recreational fisheries research, market research and social science. These should include such issues as the design of the whole survey, the preferred medium(s) (eg telephone or face-to face), the format and ordering of the questions to be asked, procedures for accounting for refusals in whatever form and strategies for post-survey re-interviewing of at least a sample of all categories of respondents.

6.1 The relevance of results from the recent Australian national survey on recreational fishing

It is fortuitous that New Zealand and Australia have undertaken national surveys of recreational fishing in approximately the same time frame. The Australian survey has benefited greatly from the two New Zealand surveys which preceded it. There will be mutual benefits from cooperation in assessment of the implications of results and in the design of future surveys. Throughout this review there are references to several of the major relevant findings from the Australian survey. The final report of the Australian survey has not yet been published but summaries of several of the key outputs from Australia, such as estimates of the number of anglers by region, state and country, and a summary of survey response profiles, are given in Appendices 2 and 3 to this report.

When available, much of the Australian report will be relevant to numerous key issues considered in this review. One area of particular interest will be the major design processes and results of the fisher prevalence estimates and in particular factors which influence contact and cooperation rates. Some of the factors relevant to this are discussed in Sections 4 and 5 above, but others, for which results are not yet public, include the suggestion that, when carrying out the initial interviews, female interviewers received a response rate 15-20% higher than male interviewers (Henry pers.comm.), and that all diarists in the Australian survey were telephoned every month and relevant information recorded at the time. The full impact of this extra attention is not known, but it is thought to have helped increase the diary response rates.

6.2 Possible steps to obtain the "least biased" estimates of recreational harvest from the results of the 1996 and 2000 National Surveys

Having now funded two national recreational fishing surveys, and obtained two significantly different estimates of total harvest, the Ministry of Fisheries' need for a "least biased" estimate is obvious.

The very positive outputs from the two surveys are the descriptions of demographics of who fishes in New Zealand and where, what species are taken where and by what method, which species dominate catches and what size fish are taken. The high degree of correlation in these data between the two surveys engenders confidence in the individual, and combined use of the demographic, diary and boat-ramp survey data.

There is also reason to be confident that the numerous correction factors initiated in the analyses of the 1996 survey (Bradford 1998a and b) and developed further after the 2000 survey (Boyd and Gowing 2002 a and b, and Reilly 2002b) adequately interpret the diary and boat-ramp data. The resulting wealth of information can be used as it stands for most purposes, except those that require a measure of total harvest, by species or otherwise. Confidence in estimates of total harvest is currently thwarted by one factor, the variable estimates of fisher prevalence.

The difference of 300% in the base estimates of fishery prevalence remains the primary concern. The data available to assess this difference are not adequate to pinpoint a sole cause in one or other survey. However, they are sufficient to identify the processes of interview and interpretation of responses as the areas where the discrepancies have arisen. Several likely causes of variation have been identified, most notably the markedly different cooperation rates between surveys and problems of interviewee recall for all surveys which report on perceptions of activities a year or more before.

The presumption of 100% cooperation in the 1996 survey results immediately raises doubts about the whole process of this assessment of fisher prevalence. On the other hand, the differences between the numerous A C Neilsen estimates of prevalence (19.5%, 31% and 39%) as shown in Table 7 and discussed in Section 5.1.1, diminishes confidence in accepting any one of these figures as absolute. Derivation of a "least biased" estimate would therefore appear to depend on a subjective assessment based on available data, or the collection of new data.

In view of the complexity of the impacts of recall bias, correction for zero trips and for people leaving and entering the fishery, and cross-referencing from different sub-sets of the New Zealand population, an independent figure on fisher prevalence, even if accurate and precise, would not enable a simple calculation of harvest. More would appear to be gained from recalculation using the available data. One additional data collection exercise may be warranted: Because there is little doubt the 100% cooperation assumed for the 1996 estimate is, to at least some degree, optimistic, it may be worthwhile to repeat enough of the survey to enable revision of this estimate. I would suggest interviewing a sample of the New Zealand population with exactly the same introduction and primary question about participation in fishing as used by Bell and Associates in 1996.

As suggested above, I would also advise some recalculation of the 2000 estimate with particular attention given to how non-contacts are differentiated from non-cooperations, how zero diary returns are assessed and how entry and exit estimates are calculated.

The possibility of using a totally different approach to assessing fisher prevalence could also be considered. In the absence of fishing licenses for marine waters there is no obvious stand-out. Techniques such as serial surveys of the numbers of boats and anglers in combination with creel surveys (boat-ramps and otherwise) have value, but are normally more appropriate for harvest estimates and for local rather than national assessments. They also tend to provide more reliable profiles of catch than of participation. As such, their use for supporting a figure for fisher prevalence would be convoluted. The possibility of using an interview technique with a shorter period of interviewee recall, may also have merit.

A subjective approach would be to form an expert panel to review the available data and provide a 'best guess" solution. Expert panel approaches have their critics but they are gaining acceptance among the scientific community, particularly where it is not feasible to collect data in the time available and yet a management decision is required. They offer a sound alternative to inactivity defended by the argument that the data are not compelling. They also represent a credible option for management as relevant experts are seen to have been part of the process. In this case the panel could comprise preferable at least two of each of the following: market researcher, statistician, fisheries scientist, social scientist and fisheries manager.

In response to the Ministry of Fisheries request that I provide my own "best guess" at the "least biased" estimate from the 1996 and 2000 surveys, suggestions follow:

> Because of the failure to account for non-cooperation (including "soft refusals") as discussed above I think the 1996 figure for fisher prevalence is too low. Subsequently the 1996 harvest estimates are underestimated by approximately the same unknown amount. I therefore caution against their acceptance as an absolute measure of harvest.
>
> The processes underpinning the 2000 estimates are, as expected, an advancement on those used in the 1996 estimates. However, concerns remain. I think the fisher prevalence estimate as defined in this survey, and the 1996 survey, over-estimates the percentage of the New Zealand population who actually fish at least once a year. It is perhaps more closely aligned with the percentage that have fished in the last few years. As such, it could reasonably represent those who consider themselves fishers.
>
> Because at least some of the impact of the inflated fisher prevalence estimate is corrected by the zero trips in diary data, harvest estimates from the 2000 survey are probably more accurate than are the prevalence estimates. However, I recommend they be re-calculated giving increased attention to correction for differences between non-contact and non-cooperation, entry and exit of fishers within the survey period and possible bias which may arise because the prevalence estimate was developed from a different sub-set of the New Zealand population than the one which produced the diary data.
>
> I also stress the need for caution with the use of any of the species or regional harvest estimates where the CVs are particularly high or where there are marked unexplained differences in the diary data between the 1996 and 2000 surveys. For example, estimates for Area 2 warrant careful scrutiny before use for management purposes. The primary value of national surveys is in the provision of a national perspective and in the identification of species and/or areas where more detailed assessments, or longer time-series of data, may be required. As such they are extremely valuable but seldom will they alone provide sufficient precision to support local or even regional resource management. I also caution against the presumption that because some of the harvest estimates from the national surveys appear high they are, by necessity, incorrect. In the absence of quality data perceptions of the magnitude of recreational fish catches have, world-wide, tended to under-estimates.

6.3 The development of the next New Zealand national recreational fishing survey

Many factors will influence the design and implementation of future surveys of recreational fishing in New Zealand. Primary amongst these should be the management objective(s) being served by such surveys. Management could be expected to need data on recreational fisheries for a wide spectrum of reasons including: To increase the understanding of the aspirations and behaviour of New Zealand citizens and visitors; to conserve natural resources, including biodiversity; to wisely allocate resources between indigenous, recreational and commercial users; to equitably distribute access to resources within the recreational sector; to monitor the impact of local, regional and national natural resource use and conservation actions. Variations in the priority given to these and other social, economic and political influences will impact how future recreational fishing surveys should be designed. For example, dominance of priorities related to the conservation of key species could well require greater

precision in the composition of catches in certain regions, while higher priority for allocation of resources within the recreational sector may necessitate more data on the distribution of catches around size and bag limits. Local and regional requirements for data will not always be uniform and national surveys may not always be the most cost-effective means of meeting the country's aggregate requirements.

The wealth of information gathered in the 1996 and 2000 surveys provides an excellent foundation on which to build further understanding of New Zealand's recreational fisheries. Future surveys should greatly increase the utility of the total data set, in particular in the provision of time-series which facilitate monitoring and add precision to assessments. Specific suggestions for improvement of the next survey include:

1. Precise description of the management objectives to be addressed is required before the survey design is finalised. In particular regional areas or individual fish species for which greater precision is required may warrant disproportionate sampling effort.
2. Methods for capturing data on fisher prevalence need to be rigorously assessed and then prescribed. These should include all aspects of selection of people to be contacted, how contact is made and results recorded, and how a follow-up process will address correction for any bias from variation in cooperation rate or from provision of mis-information from interviewees.
3. If possible, the sub-set of the population used to generate prevalence estimates should be the same as the one used in the diary survey.
4. The results from the 1996 and 2000 surveys together with those from the recent Australian survey provide considerable guidance on how to improve the design and implementation of interview and diary surveys for the assessment of recreational fishing. These results should be built on as the foundation for the next survey. To this end, it seems appropriate to have a minimum of one individual who was involved in each of these three surveys involved in the design of the next. A workshop involving all three with other appropriate inputs is suggested.

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Finally, I would like to thank all the participants at the workshop on September 6, 2002 for their comments on a draft of this report.

Appendix 1: Summary of Diarist response and Fishing Categories for All Diarists (From Rick Boyd pers.comm.)

Category	Description	All starting diarists		Diarists completing all 4 diaries	
		No	**%**	**No**	**%**
FFFF	Fished all four diaries	187	5%	187	8%
FFFC	Fished diaries 1, 2 and 3	64	2%	49	2%
FFCF	Fished diaries 1, 2 and 4	144	4%	138	6%
FFCC	Fished diaries 1 & 2 only	309	8%	235	11%
FCFF	Fished diaries 1, 3 and 4	38	1%	29	1
FCFC	Fished diaries 1 and 3 only	66	2%	49	2
FCCF	Fished diaries 1 and 4 only	125	3%	119	5
FCCC	Fished diary 1 only	778	21%	572	26
CFFF	Fished diaries 2, 3 and 4 only	10	0%	8	0
CFFC	Fished diaries 2 and 3 only	13	0%	8	0
CFCF	Fished diaries 2 and 4 only	24	1%	19	1
CFCC	Fished diary 2 only	147	4%	104	5
CCFF	Fished diaries 3 and 4 only	13	0%	8	0
CCFC	Fished diary 3 only	41	1%	28	1
CCCF	Fished diary 4 only	64	2%	49	2
CCCC	Didn't fish all four diaries	1695	46%	619	28
Total by diary					
Diarists fishing at least once		2023	54%	1602	72%
Diarists not fishing		1695	46%	619	28%
Total diarists		3718		2221	

Summary of diarists who started but who did not fish in any period for which they provided a diary

Diary collected, diarist did not fish	Number of diarists
Diary 1	162
Diaries 1, 2 , 3	120
Diaries 1, 2, 3, 4	619
Diaries 1, 3, 4	27
Diaries 1, 2	110
Diaries 1, 3	20
Diaries 1, 4	7
Diaries 2, 3, 4	61
Diaries 2, 3	35
Diaries 2, 4	7
Diaries 2, 4	24
Diaries 3, 4	25
Diary 2	48
Diary 3	26
Diary 4	13
No response for any diary (= starting diaries put in category of did not fish)	391
Total starting diarist who did not fish	**1695**

Appendix 2: Australian Fisher Prevalence Estimates by Region, State and Country Total – March 2002 (from Henry pers.comm)

TABLE 1 NUMBER OF ANGLERS	STATE CODE	ESTIMATED NO. OF ANGLERS	SE	PERCENT (%)	SE (%)
NSW	1	998,501	16,346	17.1	0.3
VIC	2	549,803	11,676	12.7	0.3
QLD	3	785,045	12,076	24.7	0.4
SA	4	328,227	6,255	24.1	0.5
WA	5	479,425	7,909	28.5	0.5
TAS	6	124,590	2,342	29.3	0.6
NT	7	43,932	1,086	31.6	0.8
ACT	8	53,467	2,447	19.2	0.9
TOTAL		3,362,990	25,838	19.5	0.2

TABLE 2 NUMBER OF FISHER HOUSEHOLDS	STATE CODE	ESTIMATED NO. OF HOMES	SE	PERCENT (%)	SE (%)
NSW	1	528,215	11,829	21.9	0.5
VIC	2	313,628	8,678	17.7	0.5
QLD	3	388,515	8,498	28.8	0.6
SA	4	175,581	4,476	28.6	0.7
WA	5	244,254	5,650	34.2	0.8
TAS	6	65,540	1,718	34.7	0.9
NT	7	22,862	811	36.9	1.3
ACT	8	29,951	1,875	24.8	1.6
TOTAL		1,768,547	18,085	24.5	0.3

TABLE 3 NUMBER OF ANGLERS BY SD	SD	ESTIMATED NO. OF ANGLERS	SE	PERCENT (%)	SE (%)
NSW					
Sydney	1	482,739	18,114	13.1	0.5
Hunter	2	131,348	5,683	25.2	1.1

Illawarra	3	73,686	3,841	20.9	1.1
Richmond/ Tweed	4	49,995	2,273	26.0	1.2
Mid North Coast	5	74,441	3,087	29.9	1.2
Northern and Central West	6	62,894	3,374	20.5	1.1
North West and Far West	7	28,404	1,463	22.7	1.2
South Eastern	8	49,264	2,082	30.1	1.3
Murray and Murrumbidgee	9	45,729	2,485	19.9	1.1
TOTAL		**998,501**	**16,346**	**17.1**	**0.3**
VIC					
Melbourne	10	321,051	14,193	10.2	0.5
Barwon	11	33,905	2,008	15.0	0.9
Western District	12	18,858	934	21.4	1.1
Central Highlands	13	18,912	1,136	15.3	0.9
Mallee and Wimmera	14	30,705	1,402	24.5	1.1
Loddon	15	27,173	1,433	18.6	1.0
Goulburn and Ovens-Murray	16	50,678	2,577	20.3	1.0
Gippsland and East Gippsland	17	48,521	2,391	22.9	1.1
TOTAL		**549,803**	**11,676**	**12.7**	**0.3**
QLD					
Brisbane	18	332,340	11,023	22.6	0.8
Moreton	19	142,913	5,945	22.6	0.9
Wide Bay and Burnett	20	59,576	2,923	27.9	1.4
Darling Downs	21	38,729	2,213	21.7	1.2
North West, Central West, South West	22	13,160	747	23.1	1.3
Fitzroy	23	54,535	2,143	34.1	1.3
Mackay	24	37,278	1,529	33.2	1.4
Northern	25	52,471	2,330	30.0	1.3
Far North	26	54,043	2,423	30.1	1.4
TOTAL		**785,045**	**12,076**	**24.7**	**0.4**
SA					
Adelaide	27	202,772	8,075	20.3	0.2
Outer Adelaide	28	30,243	1,353	30.0	1.3
York and Lower North	29	14,758	646	36.5	1.6
Murray Lands	30	23,037	881	37.2	1.4
South East	31	19,201	848	34.0	1.5
Eyre	32	14,433	504	48.1	1.7
Northern	33	23,784	1,014	32.6	1.4
		328,227	**6,255**	**24.1**	**0.5**
WA					
Perth	34	301,949	9,889	24.1	0.8
South West	35	79,502	2,567	46.8	1.5
Upper and Lower Great	36	22,721	1,055	35.7	1.7

Southern Midlands	37	13,760	658	29.5	1.4
South Eastern	38	16,800	794	34.1	1.6
Central	39	19,973	866	39.0	1.7
Pilbara	40	16,205	624	47.5	1.8
Kimberley	41	8,515	297	52.7	1.8
		479,425	**7,909**	**28.5**	**0.5**
TAS					
Hobart	42	50,105	1,603	28.5	0.9
Southern	43	12,125	427	38.4	1.4
Northern	44	35,554	1,428	29.6	1.2
Mersey and Lyell	45	26,807	1,108	27.3	1.1
		124,590	**2,342**	**29.3**	**0.6**
NT					
Darwin	46	31,818	1,066	37.3	1.3
Coast	47	7,249	223	45.2	1.4
Hinterland	48	4,865	447	12.8	1.2
		43,932	**1,086**	**31.6**	**0.8**
ACT	49	53,467	2,447	**19.2**	**0.9**
TOTAL AUSTRALIA		**3,362,990**	**25,838**	**19.5**	**0.2**

Appendix 3: Australian Cooperation and Response Profiles – March 2002 (from Henry pers.comm)

TABLE 1 NATIONAL TELEPHONE RESPONSE PROFILE (Number of Households)	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	TOTAL	Percentag (%)
Fully Responding	6,903	5,870	5,073	3,702	3,394	2,677	1,314	0	28,933	65.8
Full Refusal	264	434	197	123	140	138	55	0	1,351	3.1
Part Refusal	1,178	1,162	1,018	364	539	399	170	0	4,830	11.0
Non-Contact	331	412	338	216	255	157	85	0	1,794	4.1
Part Non-Contact	43	1	15	1	68	6	0	0	134	0.3
Disconnect	1,225	846	1,069	553	848	515	423	0	5,479	12.5
Business Number	159	200	104	48	75	49	48	0	683	1.6
Other Non-Contact	41	77	24	16	11	15	16		200	0.5
Other Sample Loss	156	53	62	67	70	66	67		541	1.2
Gross Sample	10,300	9,055	7,900	5,090	5,400	4,022	2,178	0	43,945	100
Sample Loss	1,540	1,099	1,235	668	993	630	538	0	6,703	
Net Sample	8,760	7,956	6,665	4,422	4,407	3,392	1,640		37,242	
Usables	7,097	6,028	5,183	3,785	3,638	2,755	1,351	0	29,837	
% Responding	81.0	75.8	77.8	85.6	82.6	81.2	82.4	0.0	80.1	
% Non-Contact	3.8	5.2	5.1	4.9	5.8	4.6	5.2	0.0	4.8	
% Refusals/ No Response	15.2	19.1	17.2	9.5	11.7	14.2	12.4	0.0	15.1	

TABLE 2 DIARY ACCEPTANCE AND COMPLETION RATES (Number of Households)	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	TOTAL
Number of Eligible Fishers	4,152	2,895	4,269	2,900	3,710	2,221	1,392		21,539
Number Participating	3,635	2,382	3,459	2,598	3,126	1,765	1,284		18,249
% Fisher Diary Acceptance	87.5	82.3	81.0	89.6	84.3	79.5	92.2		84.7
Number of Eligible Households	2,010	1,515	1,927	1,456	1,824	1,068	619		10,419
Number Participating	1,837	1,345	1,775	1,317	1,484	880	581		9,219
% Household Acceptance	91.4	88.8	92.1	90.5	81.4	82.4	93.9		88.5
Fisher Diarists for 12 mths	3,033	2,232	3,309	2,428	2,982	1,696	1,079	332	17,091
% Complete Participation	83.4	93.7	95.7	93.5	95.4	96.1	84.0		93.7

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