In the High Court of New Zealand
Auckland Registry CIV2005-404-4495

Under Part I of the Judicature Amendment Act 1972

In the matter of an application for review

between

The New Zealand Recreational Fishing Council Inc, and New Zealand Big Game Fishing Council Inc

Plaintiffs

and

Minister of Fisheries

First Respondent

and

The Chief Executive of the Ministry of Fisheries

Second Respondent

and

Sanford Limited, Sealord Group Limited, and Pelagic & Tuna New Zealand Limited

Third Respondent

Affidavit In Reply of Jonathan Clive Holdsworth

Sworn 19/10 October 2006

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I, **Jonathan Clive Holdsworth**, of Whangarei, fisheries consultant and scientist, swear:

Purpose

1. I have the qualifications and experience set out in my affidavit of 26 August 2005. I acknowledge that I have read the code of conduct for expert witnesses in the High Court Rules and agree to comply with it.

2. The purpose of this affidavit is to comment on aspects of the evidence of the third respondents particularly in relation to statements as to:

   - decline in abundance of kahawai stocks; and
   - any requirement for constraint on the recreational catch.

3. I also address two matters raised by the Minister in relation to:

   - New information presented to the Minister in 2005; and
   - The Minister's consideration of the Hauraki Gulf in 2005.

The Minister's Affidavit – New Information in 2005

4. At paragraph 54, the Minister refers to the Ministry having provided a briefing outlining new information gathered since decisions in 2004.[1] Some of this "new information" includes data on the length, age and catch rates of kahawai from recreational fishers interviewed at boat ramps in east Northland, the Bay of Plenty, and the Hauraki Gulf. These surveys have been conducted annually since 2000[2]. The basic interview format is the same as used in 1991, 1994 and 1996[3].

5. In relation to the Minister's 2005 decisions the "new" information from the ongoing kahawai boat ramp surveys by NIWA, led by Mr Bruce Hartill, was the 2003–04 results showing fewer kahawai

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[1] Referenced at pages 636-641 of exhibit VW1 to affidavit of Vaughan Wilkinson

[2] Results from this ongoing research has been previously reported as Hartill *et al.* (2003) Length and age compositions of recreational landings of kahawai in KAH 1 in 2000–01 and 2001–02. Hartill *et al.* (2004) Monitoring length and age compositions of recreational landings of kahawai in KAH 1 in 2000–01 and 2001–02 and 2002–03.

[3] The older boat ramp survey information, going back to 1991, 1994 and 1996 data has been available in published form for some time and is reported in publications authored by NIWA scientist Dr Elizabeth Bradford, see for example her 1999 report *Comparison of marine recreational harvest rates and fish size distributions.*

encountered during the survey in the Hauraki Gulf, despite far more intensive sampling that season.[4]

6. There were also preliminary results available from a separate research project using a different method of estimating recreational harvest than was used in the previous telephone and diary surveys. The result of the new harvest survey using the aerial overflight method is of interest, but direct comparisons to telephone diary survey estimates need to be treated with some caution in my view. This is because the two methods are based of different data collection methods and a completely different set of assumptions. However, as I have stated above, since 1991, all boat ramp surveys have adopted the same interview format. In my opinion, the low number of kahawai caught per fishing trip and the changes in this recreational catch per unit effort (CPUE) in the Hauraki Gulf are significant, as the Minister recognises in 2005. The data come from NIWA observers on boat ramps who inspect and measure the catch using the same interview method from year to year. The results from the boat ramp surveys are not dependant upon a large number of assumptions, scaling and associated uncertainties which affect surveys of total recreational harvest. One limitation however in interpreting this CPUE/ catch rate data from the boat ramp surveys is that there is no comparable information that pre-dates the expansion of the purse seine fleet and high annual commercial landings in the 1980s.

7. CPUE is very useful in fisheries management and stock assessment. If collected in a consistent manner trends over time potentially show changes in availability and abundance in a fish stock in an area. Differences in abundance between areas can be compared and in the case of recreational fishers, catch rates can indicate fishing success.

8. Low recreational kahawai catch per boat trip in the Hauraki Gulf was also described as "new information" in the advice to the Minister in Figure 3 of the IPP 2005[5], even though the information

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[4] This information is reported in Hartill *et al.* (2006) Length and age compositions of recreational landings of kahawai in KAH 1 January to April 2004 (presented as a draft to the Pelagic Fishers Assessment Working Group in April 2005)
[5] From Sullivan et al (2005) Report of the Fishery Assessment Plenary, Mary 2005: stock assessments and yield estimates.

on low catch rates, especially in the Hauraki Gulf have been available to the Ministry for many years commencing in 1991.

9. Catch per boat trip, is quite a crude measure of CPUE. This is because the number of people fishing, the target species and the time spent fishing will vary and may be different across areas or time. It is preferable to split the CPUE by target species and report the average number of fish caught per fisher per hour. Data from the earlier 1996 boat ramp surveys has been summarised in this way for northern areas and compared with 1991, 1994 and 1996 survey data by Dr Elizabeth Bradford.[6] This includes information concerning the west coast of the North Island, called KAH 9 in the report and now called KAH 8. Recreational catch rates in this area are reasonable, (as I noted at paragraph 23.52 of my earlier affidavit) and recreational fishers there have not expressed dissatisfaction, something noted by the Minister (his paragraph 86).

10. Poor recreational catch rates are a key issue driving the dissatisfaction with previous and current kahawai management in many areas. Given that good quality survey information on recreational kahawai CPUE exists, particularly in northern New Zealand from the boat ramp surveys commencing in 1991, it is reasonable in my view to expect that the Ministry would describe recreational catch rates by area in some detail and apply this information when advising the Minister to assess the fishery in individual QMA's. The Minister lists (at his para 107.2) the factors that he could take into account when reviewing the TACs. He makes no express mention of the data collected of recreational CPUE by the boat ramp surveys.

11. So that there are available copies of the relevant boat ramp survey reports to which I have referred in this affidavit and my earlier affidavit, I attach as exhibits **A**, **B** and **C** respectively the following reports:

    a. Bradford (1999) Comparison of marine recreational fishing harvest rates and fish size distributions

    b. Hartill *et al.* (2003) Length and age compositions of recreational landings of kahawai in KAH 1 in 2000–01 and 2001–02;

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6 Bradford (1999) Comparison of marine recreational fishing harvest rates and fish size distributions.

c. Hartill *et al.* (2006) Length and age compositions of recreational landings of kahawai in KAH 1 January to April 2004: and

The Minister's Affidavit – Hauraki Gulf

12. In the 2005 FAP the Minister was provided with more detailed information concerning the Hauraki Gulf than the Minister was provided with in 2004. The advice concluded that area constraints within the Hauraki Gulf were unlikely to be effective (see paragraph 59, affidavit of the Minister). At paragraph 243 of the 2005 FAP MFish advised the Minister:

> 243 As mentioned in the IPP at paragraph 104 k, you are required under s 11(2)(c) of the Act to consider how the proposals for KAH 1 meet the requirements of section 7 and 8 of the Hauraki Gulf Marine Park Act 2000. This Act's objectives are to protect and maintain the natural resources of the Hauraki Gulf as a matter of national importance. MFish considers that, under both options, the management measures for KAH 1 will meet the purpose of the Hauraki Gulf Marine Park Act, however, Option 2 will provide a more certain position in this regard.

13. In terms of providing a more certain position, I agree that fish movement of mobile species such as kahawai is likely to mean that biomass levels outside the Marine Park will be a factor relevant to fish abundance within the Marine Park. Whether adopting a uniform national response of a 10% reduction for an area of national significance, which currently has a very poor recreational kahawai fishery is adequate, may be queried.

14. I observe that the information presented to the Minister in relation to the Hauraki Gulf in 2005 related to areas within the inner and outer Hauraki Gulf, which is not synonymous with the geographic boundaries of the Hauraki Gulf Marine Park, which extends into the western Bay of Plenty along the eastern side of the Coromandel Peninsula. This latter area is fished by purse seine vessels, and is in relatively close proximity to their home port of Tauranga.

Decline in Abundance: Starr / Winstanley / Murray / Reid

15. Paul Starr states that available evidence on the status of kahawai stocks is equivocal.[7] He states this is largely because population biomass estimates are hard to obtain and a key component of the total catch is not available. I agree that much of the data for a full stock assessment of kahawai is either lacking or uncertain including a reliable measure of kahawai abundance. Therefore in my opinion it is important to consider other sources of information, such as recreational CPUE from boat ramp surveys and observations from experienced recreational kahawai fishers in assessing the status of kahawai stocks.

16. Paul Starr states a number of times that there is "*no scientific evidence of a decline in kahawai stocks*".[8] While he is correct that there is no consistent and reliable method presently available to determine the abundance of any of the kahawai stocks, there is available information (see the appendix to my affidavit of 26 August 2005) to show low recreational kahawai catch rates and changes in the size of fish caught and the age structure of the population. This information, which was available and known to the Ministry in 2004, is consistent with the stock being fished down. In my opinion kahawai abundance declined significantly in the late 1980s and early 1990s. I base this on own personal observation, the significant number of complaints I received while I working for the Ministry of Agriculture and Fisheries in their Whangarei district office at that time, and from data collected by researchers prior to the decline as described in my affidavit of 26 August 2005.

17. In my opinion the change in population structure is likely to have led to a contraction in the distribution of kahawai, which are now much less available in inshore waters than they used to be. The Hauraki Gulf appears to have undergone a significant change, with NIWA surveys showing almost no adult kahawai occurring in the recreational catch in this area (as described in paragraph 23.22 of my affidavit of 26 August 2005).

18. There is evidence that recreational catch rates have not improved since 1991. The kahawai catch per trip in the Hauraki Gulf has

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7 At para 63.5 of the affidavit of Paul Starr

8 See para xxx and elsewhere affidavit of Paul Starr

been very low and declined further in recent years. This information is described in paragraphs 23.13 to 23.32 of my affidavit dated 26 August 2005. Catch rates at the important traditional fishery at the mouth of the Motu River also appear to have declined significantly between 1982 and 1991.[9]

19. The fishing down of kahawai stock in KAH 1 is noted in other evidence provided by the third respondents. The affidavits from the purse seine skippers Murray and Reid state that stocks were impacted prior to the introduction of purse seine limits, although it is their impression that current stock levels have improved rapidly in recent years.

20. Kevin Lawrence Murray, skipper of the purse seine vessel *San Columbia*, states in his affidavit:

> *"I consider that the abundance of kahawai has changed twice since I have been fishing. Before the commercial limits were introduced in 1990-1991, there was a decrease in the abundance of kahawai as the stock was fished down – kahawai schools became smaller and harder to find."*

21. Peter George Reid, the skipper of the purse seine vessel *Matariki* and *Tawera II* states in his affidavit:

> *"I have noticed changes in abundance of kahawai over the years. In the late 1980, when the catch of kahawai was unrestricted, there was a noticeable decline in the abundance of large kahawai schools over time."*

22. These skippers also state that in their opinion they are encountering more schools now than in the 1990s. In my opinion the information on recreational catch rates and age structure of kahawai in KAH 1 from the boat ramp surveys is consistent with an overall decline in abundance. This is consistent with a change in the distribution of kahawai as the stock has been fished down. A change in the distribution of kahawai at a lower biomass is not inconsistent with observations that kahawai schools still aggregate in areas of prime habitat, such as the western Bay of Plenty where these commercial

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9 This information is reported in the Ministry's 2004 Plenary Report on kahawai (section 1.b.).

fishers usually operate. Other areas in KAH1 are observed to have fewer kahawai.

23. As noted in the affidavits of Jeffery Romeril and Kim Walshe, it was from the 1980's when the kahawai stock was heavily fished by purse-seine vessels that recreational fishers started to express strong concerns that recreational catch rates were declining. Surveys to estimate recreational harvests and catch rates did not start until 1991. A dedicated annual survey of the length and age structure of recreational kahawai catch has only been operating since 2000.

24. It is a general characteristic of all plausible fisheries stock assessment models that the biomass of a fish stock declines from its virgin level when subject to substantial fishing. The combined commercial and non-commercial fisheries in KAH 1 have probably caught at least two thousand tonnes per year for that last 30 years. This means that it can be stated with certainty that the stock in this area has declined, probably significantly, from its virgin biomass. At issue is the effect of this decline in kahawai biomass (or abundance) on amateur fishing interests and whether the stock size is above or below B_{MSY} in each QMA.

25. There are two potential impacts on recreational fishers resulting from the development of a large unconstrained commercial kahawai fishery in the 1970s and1980s. The first potential impact is that recreational catch rates could be expected to decline as a result of the fishing down of kahawai stocks from their (near) virgin biomass to a much lower biomass. The affidavit by Jeffery Romeril details the many submissions by the New Zealand Big Game Fishing Council expressing concern about the large decline in recreational kahawai catch rates and a reduction in the number of schools of kahawai seen by recreational fishers. These observations of recreational fishers are consistent with the fishing down of kahawai stocks.

26. The second potential impact is that as recreational kahawai catch rates and availability declined so did total recreational harvest. The evidence of Ross Winstanley[10] supported by Paul Starr [11] states

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[10] Para 73.6 of affidavit of Ross Winstanley

[11] Para 61.3 of affidavit of Paul Starr

that the failure to manage one sector of the fishery while restricting the second inevitably leads to reallocation of catch from the first to the second sector. There was no constraint on the purse seine catch prior to 1991. Commercial catches increased rapidly after kahawai was left out of the quota management system in 1986. Purse seine catch limits were introduced in response to public concerns about the state of kahawai stocks. As a result, a major reallocation of kahawai in KAH1 away from recreational fishers to the commercial sector took place in the 1980s when commercial harvests were not controlled.

27. The Ministry of Fisheries' policy of adopting a proportional allocation of the resource to different sectors based on recent catch history using the 'claims based' allocation approach has cemented this reallocation away from the recreational sector.

Need for Constraint on Recreational Catch: Starr / Wilkinson

28. Starr and Wilkinson say there is a need to further constrain the non-commercial catch.[12] There is a contradiction in these statements to the effect that it is said that the non-commercial harvest estimates are implausibly high (they say much higher than actual catch) and at the same time, it is said that the Minister should act to ensure that the non-commercial catch is constrained within the non-commercial allowance.

29. Apart from the setting of TAC's neither Starr nor Wilkinson accept the need for sustainability measures for kahawai in any QMA. The concern appears to be the potential for reallocation away from the commercial sector if the recreational catch is unconstrained. Leaving aside the cause of the drop in abundance, the need to constrain a sector to its allowance, (such as through reducing recreational bag limits) will be more compelling where there is a clear sustainability rationale, and the sector is likely to exceed the allowances provided. However, I am not aware of any information that would have suggested to the Minister that the non-commercial catch (customary Maori and recreational) was likely to exceed the reduced allowances made for those sectors in 2004 and 2005. The available information on recreational catch rates does not indicate

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[12] See section F pages 22 and 23 and elsewhere affidavit of Paul Starr, and section F7 pages 50 to 54 and elsewhere affidavit of Vaughan Wilkinson

that there has been an unrestricted or rapid increase in recreational harvests of kahawai in recent years that may threaten the commercial catch.

30. There are also a number of other factors that act as practical constraints on the recreational catch. These constraints include:

a. The fishing gear/technology employed by recreational fishers is limited in scale. Most recreational fishers use a rod and reel (or less frequently hand lines) with one or two hooks. There are exceptions, for example where recreational fishers use set-lines with multiple hooks. Amateur fishing regulations restrict the amount of fishing gear that recreational fishers are allowed to use. Fishing with hand held lines limits the fishing effort that can be expended by individual recreational fishers.

b. In my experience the amount of recreational fishing effort is constrained by the amount of time people have available and favourable weather conditions. Often the two do not coincide.

c. Non-commercial fishers (as a group) do not modify their fishing effort to ensure that the sector's "allowance" is reached.

31. The Minister's decision in respect of bag limits was to await further information. Any bag limit reductions would have no effect unless they are set very low, and even then, they may be ineffectual.[13] In my view, and given these constraints on the recreational catch, the Minister's decision not to introduce any further bag limit or other restraints on recreational fishers was open to the Minister, particularly given that there was no evidence that the recreational sector's allowance was exceeded.

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[13] See my affidavit of 26 August 2005, paras 19.8 to 19.16, and the affidavit of Paul Starr, paragraphs 62.1 to 62.4

SWORN by **JONATHAN CLIVE**	)
HOLDSWORTH at Auckland	)
This 19th day of October 2006	)
before me:	)

JC Holdsworth

A Solicitor of the High Court of New Zealand

MARK ELLSAR

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"A"

NIWA
Taihoro Nukurangi

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Comparison of marine recreational fishing harvest rates and fish size distributions

This is the paperwriting marked "A" mentioned and referred to in the annexed Affidavit of **Jonathan Clive Holdsworth** sworn at Auckland this 19th day of October 2006 before me: [illegible]

A Solicitor of the High Court of New Zealand

E. Bradford

NIWA Technical Report 48
ISSN 1174-2631
1999

Abstract

Bradford, E. 1999: Comparison of marine recreational fishing harvest rates and fish size distributions. ***NIWA Technical Report 48.*** **54 p.**

Boat ramp surveys were carried out in the Ministry of Fisheries North region in 1991, 1994, and 1996. The importance placed on the objectives and the timing of these surveys differed in the three years leading to difficulty in selecting comparable data. A further problem is that the recreational boat fishery in the North region is so dominated by the snapper fishery that the data sets are unbalanced and contain an overabundance of snapper data and very little data for many other species. The objective set by the Ministry of Fisheries required the comparison of harvest rates and size distributions for 20 main species.

The report starts with an overview of the 1996 harvest rate data given to indicate the problems which arise and why subsequent selections of data were made. The 1996 snapper and kahawai harvest rates are given in some detail. Three estimators of harvest rate for individual fishers are used. These estimators measure different quantities and the choice of estimator depends on how it will be used. Where there are sufficient data, comparisons of harvest rate are made using data collected during the day at weekends in March and April to maximise the comparability between surveys.

Snapper harvest rates were generally highest in 1994. Most of the recreational kahawai harvest is taken as a bycatch of the snapper fishery and there are indications that this bycatch harvest rate may have risen. Estimated harvest rates in the target kahawai recreational fishery in KAH 1 may have dropped between 1991 and 1994.

Target fisheries for tarakihi (baited line) red gurnard (longline and set net), flatfish and grey mullet (set net), and tunas, kingfish, and striped marlin (trolling) exist and for some of them, enough data exist to estimate and compare harvest rates (now using all available data).

Target fisheries of measurable size exist for rock lobster, scallops, and green mussels and harvest rates were estimated for 1994 and 1996. No shellfish data were collected in 1991 and other than for rock lobster in 1996, the counting of animals may have been inconsistent. The bag limits applying to most shellfish species appear to be limiting the harvest and perhaps causing high grading.

To reach 20 species, the estimated bycatch harvest rates of the snapper fishery were included for several species.

Size distributions collected from the three years were plotted and mean lengths and weights calculated. Where the data were sufficient, lengths from January to June were used. Some comparisons with the January to December data suggest that using data from part of the year introduces small differences in mean weight but such differences are unlikely to make a significant error when used to obtain a total tonnage estimate (given all the other errors involved in obtaining such estimates). For many of the size distributions shown, the sample size was small and data from different years may need to be amalgamated if estimating a mean weight.

Introduction

Three boat ramp surveys were carried out in the New Zealand fisheries management North region in 1991, 1994, and 1996. For each survey, recreational fishers were interviewed at boat ramps by trained survey interviewers at the end of their fishing trips. The interviewers asked a standard set of questions about number of fish of each species harvested, methods used, target species, location, and hours fished. The lengths of many of the fish that were landed were measured. The objectives of each survey were different and are outlined below. More detailed information is available elsewhere (1991 survey: Sylvester 1993a, 1993b; 1994 survey: Sylvester 1994a, 1995; 1996 survey: Hartill *et al.* 1998). This section draws heavily on an unpublished report by Todd Sylvester, Ministry of Fisheries, Auckland, entitled: "Catch rate comparisons for snapper and kahawai between the 1991, 1994, and 1996 boat ramp surveys".

The main objective of the 1991 survey was to obtain baseline data on recreational fishing harvest rates (HPUE) from boat ramps throughout the North region. Most of the interviews were conducted at weekends. From Boxing Day 1990 to near the end of January 1991, interviewing was done at the main ramps in the Bay of Islands, Tutukaka, Whangarei, the western and inner Hauraki Gulf, Manukau Harbour, eastern Coromandel, and Tauranga. Interviewing was infrequent in February. From March to June, the survey involved 30 ramps throughout the North region. During this second phase, land-based surfcasters were also regularly interviewed at two west Auckland localities (Piha, Whatipu) and at two Bay of Plenty localities (Matata, Opotiki to Te Kaha). Sylvester (1993b) gave details of the survey and the ramps used.

The main objective of the 1994 boat ramp survey was to check on aspects of the North region diary survey of marine recreational fishers being run at that time. It was suspected that the diary survey results might contain some biases introduced by misreporting, wrong species identification, and inaccurate weight measurements. Initially, the 1994 survey concentrated on four main areas: Bay of Islands, Hauraki Gulf, Manukau Harbour, and the eastern Coromandel. The interview survey was expanded in March 1994 to other areas of the North region. Much interviewing (including mid-week) was done in the Hauraki Gulf as part of the aerial-boat ramp survey that was conducted at that time (Sylvester & Cryer, unpubl. results). Sylvester (1994a) described the inter-relationships between the boat ramp, aerial, and diary surveys that were being conducted in 1994 and Sylvester (1994b) gave details of the ramps used.

The main objective of the 1996 interview survey was to obtain a representative sample of fish lengths caught by recreational fishers throughout the North region over a one year period. These fish lengths were converted to fish weights and hence to a mean weight of a species caught by recreational fishers in a Fishstock. These mean weights were used to estimate the tonnage of the recreational harvests in the North region Fishstocks using an estimate of the number of fish caught obtained from the 1996 national diary survey (Bradford 1998a). Most of the interviews began in early January 1996, with heaviest sampling in the months to the end of April, less frequent sampling was conducted throughout the rest of the year. Midweek sampling was conducted in 1996. The 50 ramps used in the North region and the number of interview sessions at each ramp were given by Hartill *et al.* (1998).

The harvest rates for 1996 are discussed in detail. Comparisons are made for snapper and kahawai using restricted data so that all three surveys are comparably represented. All available data from the three surveys were used for other species. For these other species data are few and comparability less certain.

Size frequency data from 1991, 1994, and 1996 are compared and mean lengths and weights (where possible) are calculated. The different priorities for the three surveys mean that the data are not necessarily strictly comparable. In 1991 and 1994, catch rate information was collected in preference to length data and in 1996 collection of length data was usually the first priority. The size data for the less common species are sparse and may not be representative of the fishery. The snapper and kahawai data are again treated in more detail than that for the other species. The 1996 length frequencies for the major species are given by Hartill *et al.* (1998) where further stratifications of the data were shown, particularly for snapper and kahawai. Some other comparisons of the kahawai data were given by Bradford (unpubl. results, Final Research Report to the Ministry of Fisheries, project KAH9701).

Programme objective

This work was carried out under contract to the Ministry of Fisheries within the modelling recreational fisheries project (REC9702) and fulfils the requirements of the third objective of the project for 1997–98:

- To compare fish size and catch rates of the 20 main species in the 1996 boat ramp survey in the North region with results from earlier surveys in 1991 and 1994.

The recreational boat fishery in the North region in 1996

The North region recreational boat fishery is dominated by the snapper fishery. All other target fisheries are small and few have sufficient data to allow good estimation of harvest rates. Thus there are considerable problems involved in selecting 20 species for which there are adequate data for meaningful comparison of harvest rates and size distributions. Rock lobster, for example, were not measured in 1991 and 1994, and flatfish and grey mullet were not included in 1991. I produce several tabulations of the 1996 harvest rate data by region, method, and target species to indicate the problem. Data from the earlier surveys differ in detail, but not in gross structure.

I tabulated the data from the 1996 boat ramp survey in the North region in various ways to investigate which harvest rates could be sensibly calculated. Detailed definitions of fishing methods were used in the surveys and I have grouped these methods into a limited set for convenience (Table 1).

Table 2 contains further definitions used in this report and describes the quantities which are tabulated in the harvest rate tables (*see* Tables 14 onwards). Scientific names for the species are given in the section comparing size distributions (*see* Table 30). The harvest rates given in this section (*see* Tables 8, 10, 11, and 13) are calculated as the total catch divided by the total number of hours fished, that is, are ratio-of-means estimates (H_2 in Table 2).

The intention in the design of the 1996 boat ramp survey was to have the number of fishers interviewed proportional to the expected fishing effort. The actual results may not be proportional to fishing effort due to design modifications for cost reasons and unexpected changes in fishing effort (possibly caused by weather). The results shown are for the measurements made and may not represent the fishery.

A trip is defined as a fishing operation using a given method in a given location. Hence a fisher may have made more than one trip when interviewed. For example, a fisher mainly targeting snapper with a baited line who saw a school of kahawai and changed his fishing method to jigging or trolling (and target species to kahawai) would be recorded as undertaking two trips. Only trips made using a trailer boat were included in this analysis as trips from other boat types and from shore are unlikely to be properly represented in the data.

The harvest has been taken to include all fish "killed" and includes fish thrown back dead and undersized fish (snapper) landed. Todd Sylvester has previously estimated the catch rate of legal sized snapper (Sylvester 1993a, 1993b, 1994b, 1995).

Tables 3 and 4 give the percentages of trips by method and by region and target species. These tables show that over three-quarters of the trips were made by people using a baited line (from a boat) and nearly all of these trips were targeting either snapper or a mixture of species (which would mostly have included snapper). Trolling was the next most frequent method and involved several target fisheries (striped marlin, kahawai, and tunas). Some species were targeted by a limited number of methods; for example, flatfish and grey mullet were targeted only by methods using a net.

Tables 5 and 6 tabulate the mean fishing times of trips by method and by region and target species. The overall mean time is about 3.5 hours. The high mean fishing time using the method called "Hand" in the Bay of Plenty arises from the way methods were grouped as Hand included potting and the mean included a number of trips that were potting for rock lobster where the pots were left in the water for about 12 hours. The methods that make up "Hand" will be treated separately when shellfish are discussed.

Tables 3–6 show the dominance of finfish in the North region recreational fishery and more detailed results for 10 important finfish (flatfish, grey mullet, red gurnard, John dory, jack mackerel, kahawai, kingfish, snapper, tarakihi, and trevally) are shown. Tables 7 and 8 give their catches and harvest rates by method. The data have now been limited and all shore based methods, methods usually used for shellfish, and "Other" methods have been excluded. Tables 9 and 10 show similar data by region. Only a few of the cells in these tables show a large catch or a reasonable harvest rate (most harvest rates given are from bycatch fisheries).

Tables 11 and 12 show the catch and harvest rate for the 10 finfish species by target species. The numbers are shown in bold when the caught species matches the target species. Jack mackerel and John dory were targeted so rarely that these target trips were included in "Other finfish" (the targeted jack mackerel harvest rates for the few trips involved was very high). A large fraction of the snapper, trevally, flatfish, and grey mullet were caught in the target fishery for those species and with comparatively high harvest rates. The target kahawai fishery also had a high harvest rate, but only 11.5% of the kahawai were caught in the target fishery. Table 13 gives the harvest rate for the 10 finfish species individually by target species and fishing method.

Examination of these tables shows that harvest rate can be well estimated for a few target fisheries where the number of trips made is reasonably large, and perhaps for some bycatch fisheries.

Another problem arises when year to year comparisons of data are to be made in that the fishing effort was sampled differently in 1991, 1994, and 1996. The 1994 survey was conducted mainly between February and June and surveying was heavily concentrated in the inner and western Hauraki Gulf. In 1991, there was little sampling in February. May and June are winter months when fishing effort is much lower and harvest rates may differ from those in summer. The sampling at weekends and during the week was not in the same proportion in all surveys and not representative of the fishery in 1991 and 1994. In the 1991 survey, most sampling was carried out between 9 a.m. and 6 p.m. (Todd Sylvester, Ministry of Fisheries, Auckland, pers. comm.) though it is daylight for several more hours in summer.

Estimation of harvest rates

Harvest rates for snapper and kahawai from the 1996 survey (Tables 14 and 15) are tabulated and then compared across years using those parts of the data which are reasonably well represented in all three years. For other species, except kahawai, there are not enough trips surveyed to restrict the data.

The North region has been divided into diary zones (Figure 1). Sylvester (1994b) further subdivided the diary zones into smaller fishing locations named according to a feature within the location. For each species, estimation of harvest rates begins by using the smallest practicable area of fishing activity.

Harvest rates vary throughout the year and may vary depending upon whether the fish were caught during weekends and holidays, or during the week. "Weekends" is taken to mean weekends and holidays. The variations in harvest rate during the year may be largely dominated by differences in availability of species to the recreational fishery, but could depend on the skill mix of fishers with only the more experienced fishers fishing throughout the year. Cryer & McLean (1991) have pointed out the effect of the skill of fishers on harvest rate. Differences in harvest rate between weekends and weekdays could arise from a different skill mix of the fishers at these times (with a greater fraction of more experienced fishers fishing during the week). The tables contain the harvest rates for all the data available, for, summer (November to April inclusive) and winter, and for summer weekends and weekdays.

The harvest rates tabulated are estimates of the true mean harvest rate, defined in Table 2 and, where applicable, given a mathematical definition in Appendix 1. Two methods of estimating the average harvest rate are used: the mean-of-ratios estimator, H_1, and the ratio-of-means estimator, H_2. H_1 and H_2 estimate different quantities and usually have different values. The mean-of-ratios estimator is often recommended in the literature (*see*, for example, Jones *et al.* 1995) when a measure of fisher satisfaction is required. When data are collected with equal probability, that is, at the end of a trip, then the sample estimator of H_1 is an unbiased estimator of H_1 for the population (Jones *et al.* 1995). The estimator of H_1 may be biased by errors in the individual harvest rates particularly when short fishing trips with high catches are involved, and its variance may be poorly defined (Pollock *et al.* 1997). The problems with the variance of H_1 seem to come from the distribution of trip harvest rates which can be a mixture of low (zero) and high harvest rates. The ratio-of-means estimator is recommended when the total harvest is to be calculated by multiplying the harvest rate by an independent measure of effort. The estimator of H_2 using sample data collected using equal probability sampling is a biased estimator of H_2 for the population (Jones *et al.* 1995). The variance formulae for H_2 and its estimator are complicated approximations of the true variance. Appendix 1 gives the formulae for the *c.v.*s used here. A further quantity, p_0, the probability of an unsuccessful trip is included. Equally, 1 - p_0 (the probability of catching the species) could have been used and may be the best measure to use for bycatch fisheries.

Two estimates of mean harvest rate are tabulated for snapper and kahawai and the main target species. Previous published results have used the H_2 estimator (Sylvester 1993a, 1993b, 1994b, 1995). Though the primary use for this report is to calculate a measure of catch rate which can be used as an expression of recreational satisfaction (H_1), both estimates are given for compatibility with Sylvester's results.

A letter code (R) to describe the harvest rate is included for snapper and kahawai to simplify understanding the numbers in the tables. R is based on ranges of the mean-of-ratios estimator chosen for convenience (*see* Table 2).

No results are given when the number of trips involved in the space-time stratum was less than 20. Jones *et al.* (1995) suggested that at least 100 trips could be required to get reliable harvest rate means with actual confidence intervals of the expected size for the stated confidence level. They also showed that the actual confidence intervals were skewed, but become less so as the sample size increased. Results where the number of trips is less than 100, and all *c.v.*s should be viewed with caution.

Estimated snapper harvest rates in 1996

The trips selected in the estimation of harvest rates were those where snapper or "general fish" was the target and the method was either using a baited line or jigging with or without a bait. The estimated harvest rate of snapper is greater when snapper is the target, but I have assumed that most recreational fishers in the North region are hoping to catch snapper, unless they specify otherwise. Fishers specifying a "general fish" target are likely to be less experienced (or perhaps more realistic) than those who specify a particular target species. The estimated harvest rates for the methods above are different for snapper, but the descriptions used for these methods makes them difficult to distinguish.

Table 14 contains the estimated snapper harvest rates by fishing location and time strata. The fishing locations are grouped by diary zone (*see* Figure 1) and represent an area around the named location (Sylvester 1994b). The ratio-of-means estimator, H_2, is usually smaller than the mean-of-ratios estimator, H_1, but differences are generally small for the snapper data. The median value of p_0 (probability of an unsuccessful trip) is 0.45.

The lowest estimated snapper harvest rates tend to occur within harbours, particularly in winter. Sylvester (unpubl. report) has pointed out that snapper become unavailable to the recreational fishery in harbours in winter, possibly because they move out of the harbours. The highest estimated snapper harvest rates occur away from the most populated areas, for example, Bream Bay, Coromandel Islands, and Opotiki.

Many of the space-time strata used in Table 14 are based on trip numbers which are less than or not much more than 100. To have strata based on a larger number of trips, and to reduce the table to a more comprehensible size, the estimations were made by diary zone (Table 15). If the estimated harvest rates are not to be affected by extraneous factors, we have to assume that the sampling effort of trips made in each locality in the zone was roughly the same in each time stratum, or that the harvest rate did not change much throughout the zone. These assumptions are not necessarily true in all areas.

Comparisons of estimated snapper harvest rates between years

Comparisons of estimated snapper harvest rates in 1991, 1994, and 1996 were made using the same method and target selections as above but limiting the data to weekends in March and April and for trips where the fishing ended between 0900 and 1800 hours to maximise the overlap between the surveys. Undersized snapper landed, and snapper thrown back dead, have been included which differs from the way harvest rates were defined by Sylvester (unpubl. data).

Table 16 contains the comparisons of estimated snapper harvest rates by diary zone tabulated in the same manner as the results in Table 15. There may be variations within the diary zones which may need to be investigated. The estimated harvest rates within some important harbours which do not form the whole of a diary zone are given in Table 17. These rates are generally low. The estimated harvest rates for the three years by diary zone are plotted in Figures 2–5. All the estimated harvest rates show the same general trends, being highest (lowest for p_0) in 1994 in most cases. The 1996 values are higher than the 1991 values in east Northland, the western and inner Hauraki Gulf, northern and middle Bay of Plenty and possibly Waikato. The 1996 estimated harvest rates are at their lowest values in Tauranga Harbour, the eastern Bay of Plenty and Manukau Harbour and at their highest in Whangarei Harbour and northern (and possibly middle) Bay of Plenty. The low estimated harvest rates in the eastern Bay of Plenty in 1996 will include the very low estimated harvest rates in Ohiwi Harbour (Table 17).

Kahawai estimated harvest rates

Table 11 shows that kahawai are predominantly a bycatch of the snapper and "general fish" fisheries. Table 18 gives the estimated kahawai bycatch harvest rates by diary zone in KAH 1 and 9 and time stratum in 1996, and Table 19 gives similar results with the data grouped by region (Bay of Plenty, East Northland, Hauraki Gulf, and west coast). These estimated harvest rates are generally low; they are highest in the Bay of Islands, the eastern Bay of Plenty, and the west coast. The estimated harvest rates tend to be higher in winter than summer. The harvest rates are generally low and the differences between H_1 and H_2 are generally small.

Tables 20 and 21 show the comparisons by year of the estimated kahawai bycatch harvest rates in March and April weekends by region and diary zone in KAH 1 and 9 respectively. The harvest rates for the three years by diary zone are plotted in Figures 6–8. These data suggest that the estimated kahawai harvest rate as a bycatch of the recreational snapper fishery increased in most areas between 1991 and 1994.

Table 22 gives the harvest rates in the kahawai target fishery (any method with kahawai as the target species) by region and time stratum in 1996. These harvest rates are generally high (several times higher than the snapper bycatch kahawai harvest rate) and tend to be lower in winter than summer. The kahawai target fishery will include those fishers who set out to catch kahawai (these fishers would include the time taken to locate a kahawai school in their fishing time) and those who changed to targeting kahawai after they had sighted a kahawai school (and could have a high harvest rate and short fishing time).

Table 23 and Figure 9 show the year to year comparisons in the kahawai target fishery. As before, the comparisons are made for March and April weekends. As the number of trips made is small, these comparisons are made by kahawai Fishstock. There are indications that the kahawai target harvest rate dropped in KAH 1 between 1991 and 1994 and may have increased somewhat in 1996. This harvest rate increased in KAH 9 between 1991 and 1994. There were too few kahawai target trips intercepted in KAH 9 at the relevant time for the 1996 data to be included in the comparisons; the kahawai target harvest rates were relatively high over the whole summer (again with a small sample size).

The values of H_1 are generally higher than those of H_2. In the kahawai target fishery the differences can be large, probably because kahawai harvest rates can be high and the fishing time short after a school has been sighted. Short fishing times are hard to estimate accurately and can lead to biases in H_1.

Two further estimates of harvest rate are considered for the kahawai target fishery in Appendix 2. These estimators both give values which are lower than the mean-of-ratios estimator, H_1.

Other recreational target fisheries for finfish

There are recreational target fisheries for tarakihi, red gurnard, flatfish, grey mullet, and tunas where the numbers of trips surveyed are large enough to allow adequate estimation of harvest rates. For these fisheries, all the trips recorded are included and the data stratified by summer and winter and for QMA 1 and 9. Comparisons by year are given. The data from the 1991 and 1994 surveys could be biased as the fishing effort was not sampled proportionately. There are other target fisheries where the numbers of trips recorded or the harvests recorded are too small. These include kingfish and striped marlin where we have the added problem of catch and release making harvest rates much lower than catch rates.

Tarakihi

There is a substantial recreational target fishery for tarakihi using baited lines (including jigging). This fishery is predominantly in the eastern Bay of Plenty and operates throughout the year. The estimated harvest rates are given in Table 24. The apparent increase in 1996 may be an artefact of the sampling regime when proportionately more sampling was done in the eastern Bay of Plenty. The size distributions of tarakihi (*see* Figure 16) suggest that a strong year class entered the fishery in 1996 which also may have affected harvest rates.

Red gurnard

There is a small target fishery for red gurnard but it is a mixed method fishery including longline and set net. Estimated harvest rates in 1996 may be lower than in previous years (*see* Table 25). The diary survey results show the overall red gurnard harvest in 1996 was considerably lower than in 1994 (Bradford, unpubl data, Final Research Report to the Ministry of Fisheries, project REC9701 Objective 4).

Flat fish

There are target set and drag net fisheries for flatfish mainly in QMA 9 (*see* Table 26). Flatfish were not counted in the 1991 survey.

Grey mullet

There is a target set net fishery for grey mullet mainly in QMA 9 (*see* Table 26). Insufficient trips where recorded in 1994 to adequately estimate harvest rate, and grey mullet were not counted in 1991.

Skipjack and albacore tuna

There are several specialised troll target fisheries (with or without bait or lures) which catch a limited number of species. As might be expected from what is known of the seasonal distribution of tunas, these are predominantly summer fisheries, mainly in QMA 1. For skipjack tuna, the troll fisheries where skipjack tuna, albacore and yellowfin tunas, striped marlin, and "general" were the target were included. For albacore the troll target fisheries for albacore, striped marlin, and yellowfin tuna were included. The results are given in Table 27. The estimated harvest rate of skipjack is variable and probably is partly related to the abundance of skipjack in New Zealand waters in any year. The estimated harvest rates of albacore are low and may have declined.

Despite the interest in targeting striped marlin and yellowfin tuna, the success rate and total harvest in these fisheries are too low to allow adequate estimation of a harvest rate.

Target shellfish fisheries

The estimated harvest rates in the target fisheries for rock lobster, scallops, and greenshell mussels are considered. No shellfish were counted in 1991 and shellfish may not have been counted consistently in 1994.

Rock lobster are taken by diving (both scuba and snorkling) and by potting. These methods are considered separately as potting usually involves a long soak time, whereas diving trips are usually short. The estimated harvest rates by rock lobster Fishstock and season are given in Table 28. Diving is more common than potting and potting trips were recorded only from CRA 2. More rock lobster are caught per trip when using cray pots but not per hour (cray pots are generally in the water for 12 to 24 hours, diving trips are generally short). The bag limit of six may be limiting the catch taken from pots in CRA 2.

Scallops are taken by dredging and by diving (both scuba and snorkling). The results are given by areas which correspond to the scallop management areas. The estimated harvest rates (*see* Table 28) are comparable for the two method groups.

Greenshell mussels are taken by hand gathering and by diving. These methods have been treated together (*see* Table 28). It appears that recreational fishers can take their bag limit of 50 in somewhat less than an hour.

Other finfish in the snapper bycatch fishery

The objective requires that the harvest rates of the 20 most important species be estimated. The important target fisheries have already been considered. To get harvest rates as measured at boat ramps of 20 species, we need to include the bycatch of the snapper fishery. The estimated bycatch harvest rates of the snapper fishery are different from those for target fisheries.

The snapper fishery has been expanded to include the following nominated target species: snapper, blue and pink maomao, blue cod, John dory, kingfish, koheru, red gurnard, red snapper, and tarakihi. (Only one target species can be specified in the boat ramp surveys.) The method was baited hooks including jigging. Again, all trips using trailer boats are included and the estimated harvest rates are tabulated for QMAs 1 and 9 and for summer and winter. Strata where less than about 20 fish were caught are not tabulated. Table 29 gives the harvest rates in the snapper bycatch fishery for blue cod, blue maomao, John dory, jack mackerel, kingfish, koheru, pink maomao, red snapper, and trevally. The harvest rates are low to very low. They will be affected by the spatial distribution of the snapper fishery and by sampling effort. Only the results for the ratio-of-means estimator, H_2, and the probability of not catching the species, p_0, are given.

Comparison of size distributions

Hartill *et al.* (1998) plotted the size distributions of the main species measured in the 1996 boat ramp survey by species, area, season, and day type and tabulated mean lengths and weights. Bradford *et al.* (1998) compared the 1996 boat ramp survey size distributions and the size distributions collected by diarists. Bradford (unpubl. Final Research Report to Ministry of Fisheries, project KAH9701) gave further comparisons of the kahawai size distributions from the boat ramp surveys

Table 30 contains the coefficients in the weight length relations used to estimate mean whole weights from lengths (where they are available) and includes the scientific names of the species. Table 31 contains the mean weights and lengths together with their *c.v.*s for the size distributions plotted in Figures 10–24.

Snapper

Again, the snapper size data are available in abundance. These data have already been used in various ways, mainly in association with the snapper stock assessment. Here a limited number of comparisons are given mainly using January to June data from all surveys to maintain compatibility with the 1994 data. Data have not been split by day type.

Figure 10 compares the January to June data from the three boat ramp surveys collected from SNA 1 and the part of SNA 8 in the North region. The minimum legal size for recreationally caught snapper was increased from 25 cm to 27 cm on 1 December 1994 and hence the mean snapper weights in 1996 are expected to be higher than before. Figure 11 shows the snapper size distributions (January to June data) in the two major subregions of SNA 1 used in the snapper stock assessment, that is, East Northland and the combined Hauraki Gulf and Bay of Plenty. Figure 12 is similar to Figure 11 but contains January to December data (for 1991 and 1996). The snapper mean weights tend to be slightly higher when the data from throughout the year are used (Table 31). If mean weights are being used to convert fish number estimates to tonnage estimates, length samples should ideally be taken throughout the time period to which the number estimate applies, though the differences in mean weight when using different time periods are small and any change in tonnage will be small when compared with other possible errors in the tonnage estimates.

Kahawai

The kahawai size distributions differ from the snapper size distributions in that several modal peaks exist and the kahawai size distribution has a wider spread. This is somewhat exaggerated by measurers favouring length intervals of 5 cm, especially in 1991. A reduction in kahawai mean length can mean a strong 3$^+$ year class (fish about 30 cm fork length) present in the fishery in that year, for example.

Figure 13 compares January to June size data from the three surveys from KAH 1 and KAH 9 and Figure 14 compares the size data in East Northland and the Hauraki Gulf. Figure 15 compares both January to June and January to December data from the Bay of Plenty. For kahawai, the mean weights were slightly lower throughout the whole year than in the first six months (Table 31). Kahawai appear to suffer from "deconditioning" (become thinner) at some times of the year, including during the spawning period (Bradford 1998b).

Other QMS and related finfish species

For other species, all the available data are used in the size distributions to be compared. Sample sizes are small.

Figure 16 compares the tarakihi size distributions from TAR 1 and the red gurnard size distributions from GUR 1. A strong year class appears to have entered the tarakihi fishery in 1996; the mean weight dropped between 1991 and 1994 and again between 1994 and 1996. The tarakihi harvest increased between the 1994 North region and the 1996 national diary survey (Bradford, unpubl. Final Research Report to Ministry of Fisheries, project REC9701 Objective 4). The red gurnard mean weight also dropped slightly between 1991 and 1994 and 1996.

Figure 17 compares the trevally size distributions in TRE 1 and the part of TRE 7 in the North region. The trevally are generally smaller in TRE 7 than TRE 1, and the mean weight was highest in TRE 1 in 1994 and in TRE 7 in 1996. The number of fish measured in TRE 7 in each year may be too small to estimate the size distribution well.

For most subsequent plots the number of fish measured may be too small to adequately estimate differences in size distribution from year to year. The species selected are those where the most length measurements are available. Rock lobsters were measured in 1996 only and their size distributions were plotted by Hartill *et al.* (1998) and are not repeated here. Some lengths measured in 1996 are available for other shellfish but may not be representative and are not given.

Figure 18 compares the blue cod size distributions from BCO 1 and the John dory size distributions from JDO 1. There are increases in mean size for these species but sample sizes are small.

Figure 19 compares the size distributions for jack mackerel and blue mackerel in QMA 1. The numbers measured of both these species has dropped from 1991 to 1996.

Figure 20 compares the 1994 and 1996 size distributions of flatfish in FLA 1 and grey mullet in GMU 1. These species are mainly caught by set net and samples collected during boat ramp surveys may not be representative.

Figure 21 compares kingfish and barracouta size distributions. Data from all the North region are used. Both these species grow large and the plots have been constructed to show the middle of the size range with data outside the range lumped at the end points. A minimum legal size of 65 cm is now in place for kingfish. The practice of catch and release is common for kingfish.

Non QMS species

Figure 22 compares the size distributions of albacore tuna and skipjack tuna caught throughout the North region. Observer data from the commercial tuna longliners on green weight and length (extracted from the observer database by Lynda Griggs, NIWA) were used to estimate weight length relations. Observers are used on the larger boats (Lynda Griggs, pers. comm.) which probably fish further away from the coast than most recreational fishers and these boats catch a wider size range of fish than the recreational fishers.

Figures 23 and 24 compare size distributions of koheru (*Decapterus koheru*), parore (*Girella tricuspidata*), red snapper (*Centroberyx affinus*), and pink maomao (*Caprodon longimanus*) which are all caught mainly in association with the snapper fishery. These are important recreational species. No weight-length relations are available for them.

Discussion

This report first describes how, where, and for which target species the fish counted in the 1996 boat ramp survey were caught. This demonstrates the dominance of the snapper boat fishery in the North region and explains why the data to estimate harvest rates and most other species are limited. Thus the report is dominated by estimated snapper harvest rates and size distributions. The estimated bycatch harvest rates of the snapper fishery were included for several species.

Two estimates of mean harvest rate and the probability of not catching the species have been tabulated for snapper, kahawai, and the main target species. Figures 2 to 9 show that all three estimates of mean harvest rate have the same trends over time and space, but the values of H_1 and H_2 may be different. Intuitively, the mean-of-ratios estimator, that takes an average of individual fishers' harvest rates, should be used as an indicator of recreational satisfaction. Previous published harvest rates used the ratio-of-means estimator (Sylvester 1993a, 1993b, 1994b, 1995). The question of which estimator to use is one for fisheries managers. Of importance, is that the same estimator of mean harvest rate is used when making comparisons and that the data are collected in the same manner.

The lowest estimated snapper harvest rates tended to occur within harbours and the highest rates occurred away from the highly populated areas. Estimated kahawai harvest rates when kahawai were a bycatch of the snapper fishery were generally low (most of the kahawai harvest is taken as a bycatch of the snapper fishery). Estimated harvest rates in the kahawai target fishery were much higher; in this fishery the two methods of estimating a mean harvest rate often give different results.

The three boat ramp surveys had different emphases on their objectives and the sampling was stratified differently. To maximise comparability in the data, snapper and kahawai harvest rate comparisons were made using data collected during the day, at weekends, and during March and April. Estimates were obtained for diary zones. Estimated snapper harvest rates were generally highest in 1994. The 1996 values were higher than the 1991 values in East Northland, the western and inner Hauraki Gulf, the northern and middle Bay of Plenty, Waikato, and Kaipara.

The harvest rate of kahawai as a bycatch of the snapper fishery may have increased in some areas. The target kahawai harvest rate may have dropped in KAH 1 between 1991 and 1994 and may have increased somewhat in 1996. The target kahawai harvest rate increased in KAH 9 between 1991 and 1994, and there were insufficient data to make an estimate in 1996.

The target kahawai fishery (targeting surface schools) accounts for a small fraction of the kahawai recreational harvest in the North region (under 10% in the 1996 boat ramp survey). However, it probably dominates people's perceptions of the state of the kahawai fishery. Little is known about the percentage of the kahawai population that is on the surface at any time, but this percentage seems to be generally small (maybe about 10%) and probably variable depending on environmental factors.

The 1990s kahawai harvest rates in the Plenary Report (Annala *et al.* 1998) are for the snapper bycatch fishery. The earlier figures for the kahawai harvest rate (Penlington 1988) best approximate the kahawai target harvest rate.

Target fisheries for tarakihi (baited line), red gurnard (longline and set net), flatfish and grey mullet (set net), and tunas, kingfish, and striped marlin (trolling) exist and for some of them enough data exist to estimate and compare harvest rates (using all available data).

Target fisheries of measurable size exist for rock lobster, scallops, and greenshell mussels and harvest rates were estimated for 1994 and 1996. No shellfish data were collected in 1991 and, other than for rock lobster in 1996, the counting of animals may have been inconsistent. The bag limits applying to most shellfish species appear to be limiting the harvest and perhaps causing high grading.

Size distributions collected from the three years were plotted and mean lengths and weights estimated. Where the data were sufficient, lengths from January to June were used. Some comparisons with the January to December data suggest that just using data from part of the year may be introducing a small bias (in either direction depending upon the species). Thus, stratified estimations of overall tonnage (from a mean weight and a number estimate) could be used where the quantity of data allows, though any difference in tonnage would be small when compared with other errors in the tonnage estimates.

The size distributions of most of the species are inadequately defined in most years. Bradford (1998a) combined lengths measured in different years to estimate mean weights.

Acknowledgments

This work was funded by the Ministry of Fisheries, project REC9702. I thank Todd Sylvester for many useful discussions on the nature of the data and organising the boat ramp surveys; Bruce Hartill (NIWA, Auckland) who took over the running of the 1996 survey during the year, David Fisher (NIWA, Wellington) for supervising the loading of the 1996 data to the recreational fisheries database, Kevin Mackay (NIWA, Wellington) for loading the 1991 and 1994 data to the database, and Dave Gilbert, Mike Beardsell (NIWA, Wellington), and Kevin Sullivan (Ministry of Fisheries, Wellington) for useful comments to improve the clarity of the report.

References

Annala, J. H., Sullivan, K. J., O'Brien, C. J., & Iball, S. D. (Comps) 1998: Report from the Fishery Assessment Plenary, May 1998: stock assessments and yield estimates. 409 p. (Unpublished report held in NIWA library, Wellington.)

Blackwell, R. D. 1997: Abundance, size and age composition and sex ratio of blue cod in the Marlborough Sounds, September 1995. *New Zealand Fisheries Data Report No. 88.* 52 p.

Bradford, E. 1998a: Harvest estimates from the 1996 national marine recreational fishing surveys. New Zealand Fisheries Assessment Research Document. 98/16. 27 p.

Bradford, E. 1998b: Unified kahawai growth parameters. *NIWA Technical Report 9.* 52 p.

Bradford, E., Fisher, D., & Bell, J. 1998: National marine recreational fishing survey 1996: snapper, kahawai, and blue cod length distributions from boat ramp and diary surveys. *NIWA Technical Report 19.* 49 p.

Cryer, M. & McLean, G. D. 1991: Catch for effort in a New Zealand recreational trout fishery – a model and implications for survey design. *in* Cowx, I. G. (Ed.) Catch effort sampling strategies: their application in freshwater fisheries management. pp 61–71. Fishing News Books, Oxford, UK.

Elder, R. D. 1976: Studies on age and growth, reproduction and population dynamics of red gurnard, *Chelionichthys kumu* (Lesson and Garnot), in the Hauraki Gulf, New Zealand. *Fisheries Research Bulletin No. 12.* 62 p.

Hartill, B., Blackwell, R., & Bradford, E. in 1998: Estimation of mean fish weights from the recreational catch landed at boat ramps in 1996. *NIWA Technical Report 31.* 40 p.

Hore, A. J. 1982: The age, growth, and reproduction of John dory, *Zeus faber* (Unpublished MSc thesis, University of Auckland.)

Hurst, R. J. & Bagley, N. W. 1994: Trawl survey of middle depth and inshore bottom species off Southland, February–March 1993 (TAN 9301). *New Zealand Fisheries Data Report No. 52.* 58 p.

James, G. D. 1984: Trevally, *Caranx georgianus*: age determination, population biology and fishery. Ministry of Agriculture and Fisheries. *Fisheries Research Bulletin No. 25.* 51 p.

Jones, C. M., Robson, D. S., Lakkis, H. D., & Kressel, J. 1995: Properties of catch rates used in analysis of angler surveys. *Transactions of the American Fisheries Society. 124*: 911–928.

Paul, L. J. 1976: A study on age, growth, and population structure of the snapper, *Chrysophrys auratus* in the Hauraki Gulf. *Fisheries Research Bulletin No. 13.* 62 p.

Penlington, B. P. 1988: The kahawai fishery at the Motu River mouth. *New Zealand Freshwater Fisheries Report 103.* 27 p.

Pollock, K. H., Hoenig, J. M., Jones, C. M., Robson, D. S., & Greene, C. J. 1997: Catch rate estimation for roving and access point surveys. *North American Journal of Fisheries Management 17*: 11–19.

Sylvester, T. 1993a: Recreational fishing research survey. *N.Z. Professional Fisherman*, February 1993: 32–35.
Sylvester, T. 1993b: Recreational fisheries catch per unit effort trends in the North region (1990/91). Northern Fisheries Region Internal Report No. 14. 23 p. (Unpublished report held in Ministry of Fisheries North, Auckland.)
Sylvester, T. 1994a: Recreational fisheries research in the North region. *Seafood New Zealand*, February 1994: 27–28.
Sylvester, T. 1994b: North region 1994 recreational fishing survey instruction booklet for boat ramp interviewers. (Draft report held by Ministry of Fisheries North region.)
Sylvester, T. 1995: Initial results of the northern boat ramp survey. *Seafood New Zealand*, February 1995: 11–13.
Tong, L. J. & Vooren, C. M. 1972: The biology of the New Zealand tarakihi, *Cheilodactylus macropterus* (Bloch and Schneider). *Fisheries Research Bulletin No. 6*. 60 p.

Table 1: **Definitions of the fishing method combinations used in the tables. Some unrelated methods have been combined for simplicity**

Method	Definition
Bait	Line fishing with a bait and from a boat
Diving (dive)	Scuba diving or snorkel diving
Expert (expt)	Expert methods or a combination of them: balloon fishing, kite fishing, kon tiki, poppers, spinning, fly casting
Jigging (jig)	Jigging with or without a bait
Longline (Lline)	Long-lines (set from a boat)
Netting (nets)	Set netting or drag netting
Trolling (troll)	Trolling with a lure, or bait, or both
Shore (shr)	Surfcasting off rocks, or from a sandy beach, or both; fishing from a wharf
Hand	Shellfish methods: hand gathering, dredging, potting
Other	Includes drop/dahn line, spearing

Table 2: **Explanations of the variables used in the tables with harvest rate estimations. Formal definitions of the estimators are given in Appendix 1**

n	The number of trips involved
Fish	The total number of fish of the species of interest that were caught
Hours	The total number of hours involved
H_1	The mean-of-ratios estimator of harvest rate, that is, the mean of the individual fisher harvest rates
H_2	The ratio-of-means estimator, that is, the ratio of the total number of fish caught to the total number of hours fished
p_0	The probability of not catching the species, that is, the fraction of unsuccessful trips
R	A categorisation of the values given by H_1: A $\geq$ 0.8; 0.6 $\leq$ B < 0.8; 0.4 $\leq$ C < 0.6; 0.2 $\leq$ D < 0.4; E < 0.2

Table 3: **Percentage of trips by method and region in 1996. Within the table, the numbers are the percentage of trips on which the method was used in the region. The numbers in the margins give the percentage of trips made in each region, and the percentage of trips on which the method was used. The methods are defined in Table 1. - means no trips were made**

Region	Bait	Dive	Expt	Jig	Lline	Nets	Troll	Shr	Hand	Other	% by region
Bay of Plenty	31.2	41.0	13.3	16.2	79.1	16.3	35.8	-	28.5	100.0	31.6
East Northland	20.5	48.1	26.7	41.5	4.5	12.2	43.3	31.6	12.4	-	24.7
Hauraki Gulf	29.5	5.6	53.3	34.0	7.5	5.0	3.3	68.4	19.6	-	25.3
West coast	18.7	5.3	6.7	8.4	9.0	66.5	17.5	-	39.5	-	18.4
Total (% by method)	76.9	6.6	0.2	3.5	0.4	1.4	8.8	0.1	2.1	0.0	100.0

Table 4: **Percentage of trips by method and target species in 1996. Within the table, the numbers are the percentage of trips on which the method was used for the target species. The numbers in the margins give the percentage of trips on which the species was targeted, and the percentage of trips on which the method was used. The methods are defined in Table 1. - means no trips were made**

Target	Bait	Dive	Expt	Jig	Lline	Nets	Troll	Shr	Hand	Other	% by species
Flatfish	-	-	-	-	-	57.5	-	-	-	-	0.8
Grey mullet	-	-	-	-	-	17.2	-	-	-	-	0.2
Red gurnard	0.8	-	-	0.9	1.5	0.5	-	-	-	-	0.7
Kahawai	0.8	-	16.7	4.9	-	3.6	25.5	-	-	-	3.1
Kingfish	1.0	1.4	16.7	13.8	1.5	1.4	10.0	-	0.6	-	2.3
Snapper	64.6	2.3	43.3	55.7	50.7	1.8	0.1	10.5	-	20.0	52.1
Tarakihi	2.5	-	-	0.9	-	0.9	-	-	-	-	2.0
Trevally	0.2	-	-	0.3	-	-	-	-	-	-	0.2
Mixed fish	29.0	4.5	23.3	19.7	34.3	11.3	8.4	89.5	1.2	60.0	24.5
Any tuna	0.1	-	-	0.5	1.5	-	20.3	-	-	-	1.9
Other finfish	0.9	1.0	-	3.3	10.4	5.4	2.9	-	4.9	20.0	1.4
Striped marlin	-	-	-	-	-	-	32.8	-	-	-	2.9
Any sharks	0.1	-	-	-	-	0.5	-	-	-	-	0.1
Shellfish	-	90.8	-	-	-	-	-	-	93.4	-	8.0
Any target (% by method)	76.9	6.6	0.2	3.5	0.4	1.4	8.8	0.1	2.1	0.0	100.0

Table 5: **Mean length of trip (hours) by method and region in 1996. The methods are defined in Table 1. - means no trips were made**

Region	Bait	Dive	Expt	Jig	Lline	Nets	Troll	Shr	Hand	Other	% by region
Bay of Plenty	3.28	1.65	0.69	4.09	3.59	4.14	2.98	-	10.77	4.50	3.28
East Northland	3.58	1.40	4.00	3.34	2.67	2.81	4.13	5.00	1.22	-	3.34
Hauraki Gulf	3.83	1.43	3.84	4.20	1.90	7.23	1.22	2.67	0.81	-	3.73
West coast	3.71	1.22	8.50	4.63	4.33	3.94	8.01	-	1.93	-	3.72
Any target (% by method)	3.58	1.50	3.77	3.86	3.49	4.00	3.77	3.40	4.14	4.50	3.49

Table 6: **Mean length of trip (hours) by method and target species in 1996. The methods are defined in Table 1. - means no trips were made**

Target	Bait	Dive	Expt	Jig	Lline	Nets	Troll	Shr	Hand	Other	% by species
Flatfish	-	-	-	-	-	3.57	-	-	-	-	3.57
Grey mullet	-	-	-	-	-	4.86	-	-	-	-	4.86
Red gurnard	3.16	-	-	1.48	4.00	1.50	-	-	-	-	3.08
Kahawai	3.02	-	2.00	2.33	-	3.84	1.08	-	-	-	1.58
Kingfish	4.11	4.62	2.70	3.72	1.75	2.75	1.93	-	2.75	-	3.17
Snapper	3.60	3.89	4.37	4.15	3.52	9.25	0.75	4.83	-	3.00	3.63
Tarakihi	3.43	-	-	2.60	-	7.50	-	-	-	-	3.45
Trevally	2.83	-	-	1.00	-	-	-	-	-	-	2.69
Mixed fish	3.56	1.75	4.71	3.90	3.88	5.30	4.44	3.24	2.48	5.50	3.59
Any tuna	4.70	-	-	2.58	2.50	-	3.92	-	-	-	3.93
Other finfish	3.60	2.41	-	3.11	2.36	1.21	3.87	-	1.06	3.00	3.19
Striped marlin	-	-	-	-	-	-	6.17	-	-	-	6.17
Any sharks	5.20	-	-	-	-	6.00	-	-	-	-	5.25
Shellfish	4.61	1.36	-	-	-	-	-	-	4.33	-	2.11
Any target (% by method)	3.58	1.50	3.77	3.86	3.49	4.00	3.77	3.40	4.14	4.50	3.49

Table 7: **Total harvest of flatfish (FLA), grey mullet (GMU), red gurnard (GUR), John dory (JDO), jack mackerel (JMA), kahawai (KAH), kingfish (KIN), snapper (SNA), tarakihi (TAR), and trevally (TRE) by method counted in the 1996 boat ramp survey**

Method	FLA	GMU	GUR	JDO	JMA	KAH	KIN	SNA	TAR	TRE
Bait	2	6	1 915	260	1 523	6 168	225	21 098	2 351	1 764
Dive	0	0	0	14	0	1	24	37	5	14
Expt	0	0	0	0	2	16	0	22	0	3
Jig	0	0	40	9	96	368	36	740	33	106
Lline	0	0	104	2	0	5	2	116	0	1
Nets	837	318	2	1	0	80	0	6	2	10
Troll	0	0	10	3	1	602	28	17	9	9

Table 8: **Harvest rates (fish per hour estimated by ratio-of-means) of flatfish (FLA), grey mullet (GMU), red gurnard (GUR), John dory (JDO), jack mackerel (JMA), kahawai (KAH), kingfish (KIN), snapper (SNA), tarakihi (TAR), and trevally (TRE) by method from the 1996 boat ramp survey**

Method	FLA	GMU	GUR	JDO	JMA	KAH	KIN	SNA	TAR	TRE
Bait	-	-	0.043	0.006	0.034	0.137	0.005	0.470	0.052	0.039
Dive	-	-	-	0.051	-	0.004	0.087	0.134	0.018	0.051
Expt	-	-	-	-	0.018	0.141	-	0.194	-	0.026
Jig	-	-	0.018	0.004	0.043	0.166	0.016	0.334	0.015	0.048
Lline	-	-	0.445	0.009	-	0.021	0.009	0.496	-	0.004
Nets	0.954	0.362	0.002	0.001	-	0.091	-	0.007	0.002	0.011
Troll		-	0.002	0.001	-	0.111	0.005	0.003	0.002	0.002

Table 9: **Total harvest of flatfish (FLA), grey mullet (GMU), red gurnard (GUR), John dory (JDO), jack mackerel (JMA), kahawai (KAH), kingfish (KIN), snapper (SNA), tarakihi (TAR), and trevally (TRE) by region as counted in the 1996 boat ramp survey**

Region	FLA	GMU	GUR	JDO	JMA	KAH	KIN	SNA	TAR	TRE
Bay of Plenty	83	1	1 123	107	431	2 133	139	6 423	2 188	615
East Northland	31	20	28	132	257	1 558	110	4 948	175	784
Hauraki Gulf	29	0	12	30	859	1 152	38	8 039	23	190
West coast	696	303	908	0	75	2 397	28	2 626	14	318

Table 10: **Harvest rates (fish per hour estimated by ratio-of-means) of flatfish (FLA), grey mullet (GMU), red gurnard (GUR), John dory (JDO), jack mackerel (JMA), kahawai (KAH), kingfish (KIN), snapper (SNA), tarakihi (TAR), and trevally (TRE) by region from the 1996 boat ramp survey**

Region	FLA	GMU	GUR	JDO	JMA	KAH	KIN	SNA	TAR	TRE
Bay of Plenty	0.005	-	0.074	0.007	0.028	0.140	0.009	0.423	0.144	0.040
East Northland	0.002	0.002	0.002	0.010	0.020	0.121	0.009	0.185	0.014	0.061
Hauraki Gulf	0.002	-	0.001	0.003	0.056	0.076	0.002	0.528	0.002	0.012
West coast	0.065	0.028	0.084	-	0.007	0.223	0.008	0.244	0.001	0.030

Table 11: **Total harvest of flatfish (FLA), grey mullet (GMU), red gurnard (GUR), John dory (JDO), jack mackerel (JMA), kahawai (KAH), kingfish (KIN), snapper (SNA), tarakihi (TAR), and trevally (TRE) by target species as counted in the 1996 boat ramp survey. The numbers in bold are when the caught and target species were the same**

Target	FLA	GMU	GUR	JDO	JMA	KAH	KIN	SNA	TAR	TRE
Flatfish	**812**	36	0	0	0	12	0	0	0	3
Grey mullet	1	**219**	0	0	0	39	0	0	0	1
Red gurnard	0	0	**82**	0	1	89	0	138	0	25
Kahawai	0	13	6	0	24	**628**	5	36	2	7
Kingfish	0	0	8	13	62	220	**74**	105	5	84
Snapper	4	0	1 054	175	1 177	3 436	152	**17 476**	527	1 240
Tarakihi	0	0	31	13	4	68	2	250	**1 348**	26
Trevally	0	0	2	0	0	31	0	10	3	15
Mixed fish	22	56	875	64	331	2 613	67	3 914	495	491
Any tuna	0	0	0	3	1	47	6	15	0	1
Other finfish	0	0	5	21	22	40	6	90	20	12
Striped marlin	0	0	8	0	0	17	3	2	0	2

Table 12: **Harvest rates (fish per hour estimated as ratio-of-means) of flatfish (FLA), grey mullet (GMU), red gurnard (GUR), John dory (JDO), jack mackerel (JMA), kahawai (KAH), kingfish (KIN), snapper (SNA), tarakihi (TAR), and trevally (TRE) by target species from the 1996 boat ramp survey. The harvest rates in bold are when the caught and target species were the same**

Target	FLA	GMU	GUR	JDO	JMA	KAH	KIN	SNA	TAR	TRE
Flatfish	**1.792**	0.079	-	-	-	0.026	-	-	-	0.007
Grey mullet	0.005	**1.186**	-	-	-	0.211	-	-	-	0.005
Red gurnard	-	-	**0.238**	-	0.003	0.258	-	0.400	-	0.073
Kahawai	-	0.016	0.008	-	0.030	**0.789**	0.006	0.045	0.003	0.009
Kingfish	-	-	0.007	0.011	0.052	0.186	**0.063**	0.089	0.004	0.071
Snapper	-	-	0.034	0.006	0.038	0.111	0.005	**0.566**	0.017	0.040
Tarakihi	-	-	0.028	0.012	0.004	0.062	0.002	0.227	**1.226**	0.024
Trevally	-	-	0.029	-	-	0.443	-	0.143	0.043	**0.214**
Mixed fish	0.002	0.004	0.061	0.004	0.023	0.183	0.005	0.275	0.035	0.034
Any tuna	-	-	-	0.003	0.001	0.039	0.005	0.013	-	0.001
Other finfish	-	-	0.007	0.030	0.031	0.057	0.009	0.129	0.029	0.017
Striped marlin	-	-	0.003	-	-	0.006	0.001	0.001	-	0.001

Table 13: Harvest rate (fish per hour estimated by ratio-of-means) by target species and fishing method (Table 1) for 10 finfish species. Data are from the 1996 boat ramp survey in the North region. - indicates no harvest. The harvest rate is shown in bold when more than 200 trips were involved, and in italics when the harvest rate is greater than 0.5 fish per hour

Method	FLA	GMU	GUR	KAH	KIN	SNA	TAR	TRE	GEN	Oth
Flatfish										
Bait	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dive	-	-	-	-	0.00	0.00	-	[illegible]	0.00	0.00
Expt	-	-	-	0.00	0.00	0.00	-	[illegible]	0.08	-
Jig	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lline	-	-	0.00	-	0.00	0.00	-	-	0.00	0.00
Nets	*1.79*	0.01	0.00	0.00	0.00	0.08	0.00	-	0.16	0.07
Troll	-	-	-	0.00	0.00	0.00	-	-	0.08	0.00
Grey mullet										
Bait	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dive	-	-	-	-	0.00	0.00	-	-	0.00	0.00
Expt	-	-	-	0.00	0.00	0.00	-	-	0.00	-
Jig	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lline	-	-	0.00	-	0.00	0.00	-	-	0.00	0.00
Nets	0.08	*1.19*	0.00	0.42	0.00	0.00	0.00	-	0.38	0.00
Troll	-	-	-	0.00	0.00	0.00	-	-	0.00	0.00
Red gurnard										
Bait	-	-	0.21	0.01	0.01	0.03	0.03	0.03	0.06	0.01
Dive	-	-	-	-	0.00	0.00	-	-	0.00	0.00
Expt	-	-	-	0.00	0.00	0.00	-	-	0.00	-
Jig	-	-	0.00	0.00	0.00	0.01	0.00	0.00	0.07	0.00
Lline	-	-	2.25	-	0.00	0.24	-	-	0.74	0.00
Nets	0.00	0.00	*1.33*	0.00	0.00	0.00	0.00	-	0.00	0.00
Troll	-	-	-	0.01	0.00	0.00	-	-	0.00	0.00
John dory										
Bait	-	-	0.00	0.00	0.02	0.01	0.01	0.00	0.00	0.04
Dive	-	-	-	-	0.00	0.07	-	-	0.06	0.08
Expt	-	-	-	0.00	0.00	0.00	-	-	0.00	-
Jig	-	-	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.02
Lline	-	-	0.00	-	0.00	0.00	-	-	0.02	0.00
Nets	0.00	0.00	0.00	0.00	0.00	0.03	0.00	-	0.00	0.00
Troll	-	-	-	0.00	0.00	0.00	-	-	0.00	0.00
Jack mackerel										
Bait	-	-	0.00	0.08	0.12	0.04	0.00	0.00	0.02	0.00
Dive	-	-	-	-	0.00	0.00	-	-	0.00	0.00
Expt	-	-	-	0.00	0.00	0.04	-	-	0.00	-
Jig	-	-	0.00	0.00	0.00	0.05	0.00	0.00	0.03	0.34
Lline	-	-	0.00	-	0.00	0.00	-	-	0.00	0.00
Nets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00
Troll	-	-	-	0.00	0.00	0.00	-	-	0.00	0.00

Table 13 — continued.

Method	FLA	GMU	GUR	KAH	KIN	SNA	TAR	TRE	GEN	Oth
Kahawai										
Bait	-	-	0.27	*0.65*	0.21	0.11	0.06	0.46	0.19	0.06
Dive	-	-	-	-	0.00	0.01	-	-	0.00	0.00
Expt	-	-	-	*0.60*	0.00	0.00	-	-	0.30	-
Jig	-	-	0.00	0.49	0.23	0.14	0.08	0.00	0.18	0.00
Lline	-	-	0.00	-	0.00	0.03	-	-	0.02	0.00
Nets	0.03	0.21	0.00	*0.85*	0.00	0.00	0.00	-	0.02	0.00
Troll	-	-	-	*0.94*	0.16	*2.67*	-	-	0.20	0.09
Kingfish										
Bait	-	-	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.01
Dive	-	-	-	-	0.17	0.09	-	-	0.04	0.00
Expt	-	-	-	0.00	0.00	0.00	-	-	0.00	-
Jig	-	-	0.00	0.00	0.08	0.00	0.00	0.00	0.02	0.00
Lline	-	-	0.00	-	0.00	0.00	-	-	0.01	0.06
Nets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00
Troll	-	-	-	0.01	0.04	0.00	-	-	0.01	0.00
Snapper										
Bait	-	-	0.42	0.10	0.14	*0.57*	0.23	0.15	0.29	0.20
Dive	-	-	-	-	0.23	0.20	-	-	0.02	0.00
Expt	-	-	-	0.20	0.00	0.21	-	-	0.24	-
Jig	-	-	0.00	0.03	0.05	0.44	0.54	0.00	0.28	0.05
Lline	-	-	0.00	-	0.00	0.60	-	-	0.49	0.00
Nets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	0.04	0.07
Troll	-	-	-	0.00	0.00	0.00	-	-	0.02	0.00
Tarakihi										
Bait	-	-	0.00	0.00	0.00	0.02	*1.26*	0.04	0.04	0.05
Dive	-	-	-	-	0.00	0.00	-	-	0.06	0.00
Expt	-	-	-	0.00	0.00	0.00	-	-	0.00	-
Jig	-	-	0.00	0.00	0.02	0.01	0.00	0.00	0.05	0.00
Lline	-	-	0.00	-	0.00	0.00	-	-	0.00	0.00
Nets	0.00	0.00	0.00	0.00	0.00	0.00	0.13	-	0.00	0.00
Troll	-	-	-	0.01	0.00	0.00	-	-	0.01	0.00
Trevally										
Bait	-	-	0.07	0.02	0.08	0.04	0.02	0.22	0.04	0.03
Dive	-	-	-	-	0.10	0.04	-	-	0.04	0.00
Expt	-	-	-	0.00	0.00	0.00	-	-	0.09	-
Jig	-	-	0.00	0.00	0.11	0.04	0.08	0.00	0.05	0.00
Lline	-	-	0.00	-	0.00	0.00	-	-	0.01	0.00
Nets	0.01	0.01	*0.67*	0.07	0.00	0.00	0.00	-	0.02	0.00
Troll	-	-	-	0.00	0.02	0.00	-	-	0.00	0.00

Table 14: Snapper harvest rates (fish per hour) by baited line or jigging by fishing location and time stratum in 1996 where snapper or "general fish" was the target. See Table 2 for an explanation of the column headings. The *c.v.*s are expressed as percentages

Locality	Time stratum	n	Fish	Hours	H_1	c.v.	H_2	c.v.	p_0	c.v.	R
North Cape to Cape Brett											
Mangonui	Total	525	911	1 710	0.553	5.9	0.533	6.5	0.42	3.8	C
	Summer	435	725	1 356	0.556	6.7	0.535	7.5	0.44	4.2	C
	Summer, weekend	317	545	1 028	0.539	7.5	0.530	8.5	0.42	4.8	C
	Summer, weekday	118	180	328	0.602	13.9	0.549	15.5	0.47	8.7	B
	Winter	90	186	354	0.535	11.6	0.526	12.8	0.37	8.0	C
Taupo Bay	Total	82	149	349	0.444	16.2	0.427	18.6	0.39	8.8	C
	Summer	66	145	289	0.556	16.0	0.502	18.7	0.30	8.1	C
	Summer, weekend	53	128	287	0.606	17.0	0.617	20.7	0.30	9.0	B
Whangaroa H	Total	114	72	409	0.144	20.1	0.176	21.8	0.74	15.7	E
	Summer	101	60	359	0.137	22.7	0.167	24.4	0.75	17.3	E
	Summer, weekend	64	17	196	0.086	35.8	0.087	37.3	0.86	30.9	E
	Summer, weekday	37	43	162	0.225	28.5	0.265	29.2	0.57	18.8	D
Bay of Islands											
Black rocks	Total	286	573	950	0.689	8.6	0.603	7.8	0.39	4.7	B
	Summer	206	376	644	0.651	10.1	0.584	10.1	0.45	6.3	B
	Summer, weekend	139	226	405	0.585	12.3	0.558	13.1	0.48	8.2	C
	Summer, weekday	67	150	239	0.788	17.4	0.628	15.5	0.39	9.7	B
	Winter	80	197	307	0.789	16.0	0.642	11.7	0.24	6.2	B
Cape Brett	Total	116	234	414	0.565	14.4	0.566	13.4	0.43	8.1	C
	Summer	75	110	225	0.456	17.4	0.489	19.2	0.49	11.4	C
	Summer, weekend	58	61	170	0.320	19.6	0.358	21.2	0.55	14.6	D
	Winter	41	124	189	0.679	17.4	0.656	17.0	0.32	10.6	B
Rawhiti	Total	281	509	906	0.503	7.5	0.562	8.7	0.44	5.3	C
	Summer	204	396	691	0.496	8.9	0.573	10.2	0.43	6.1	C
	Summer, weekend	146	259	500	0.441	10.9	0.518	12.4	0.45	7.4	C
	Summer, weekday	58	137	190	0.636	15.1	0.719	17.6	0.40	10.6	B
	Winter	77	113	215	0.519	14.1	0.525	16.5	0.45	10.4	C
Russell	Total	139	176	377	0.408	15.1	0.467	15.6	0.60	10.3	C
	Summer	103	127	278	0.412	17.6	0.457	17.8	0.58	11.6	C
	Summer, weekend	67	68	181	0.308	21.0	0.376	21.5	0.61	15.3	D
	Summer, weekday	36	59	97	0.606	27.5	0.610	29.8	0.53	17.6	B
	Winter	36	49	100	0.395	29.7	0.492	32.4	0.64	22.2	D
Whangarei Harbour											
Whangarei H.	Total	307	673	1 100	0.672	9.0	0.612	8.3	0.41	4.7	B
	Summer	281	656	1 012	0.718	9.1	0.648	8.4	0.38	4.7	B
	Summer, weekend	192	448	707	0.701	11.0	0.634	9.7	0.41	6.0	B
	Summer, weekday	89	208	306	0.753	16.4	0.680	16.3	0.34	7.6	B
	Winter	26	17	88	0.182	33.0	0.193	39.3	0.65	27.0	E

Table 14 — continued

Locality	Time stratum	n	Fish	Hours	H_1	c.v.	H_2	c.v.	p_0	c.v.	R
Cape Brett to Cape Rodney											
Bream Bay	Total	119	257	419	0.928	16.4	0.614	12.9	0.34	6.6	A
	Summer	113	239	391	0.944	16.9	0.612	13.4	0.35	7.0	A
	Summer, weekend	72	123	280	0.816	28.0	0.440	18.7	0.38	9.1	A
	Summer, weekday	41	116	111	1.170	15.2	1.045	20.5	0.32	10.6	A
Hen&Chickens	Total	97	209	432	0.445	11.7	0.483	13.2	0.42	8.7	C
	Summer	95	198	421	0.433	12.1	0.470	13.7	0.43	8.9	C
	Summer, weekend	54	112	264	0.418	15.6	0.423	18.0	0.44	12.2	C
Poor Knights	Total	135	284	561	0.557	15.5	0.506	11.0	0.36	6.5	C
	Summer	110	213	401	0.579	17.9	0.531	12.9	0.40	7.8	C
	Summer, weekend	75	156	257	0.664	22.0	0.606	15.9	0.39	9.2	B
	Summer, weekday	35	57	144	0.396	21.6	0.396	19.9	0.43	14.6	D
	Winter	25	71	160	0.459	20.1	0.445	19.2	0.20	10.0	C
Taiharuru	Total	103	167	384	0.501	14.1	0.435	14.4	0.46	9.0	C
	Summer	89	140	334	0.484	15.2	0.419	15.8	0.47	10.0	C
	Summer, weekend	65	101	257	0.385	17.0	0.393	18.8	0.49	12.2	D
	Summer, weekday	24	39	78	0.754	26.8	0.503	30.0	0.42	17.3	B
Tutukaka	Total	138	167	472	0.323	12.9	0.354	14.2	0.54	9.2	D
	Summer	127	155	424	0.332	13.3	0.366	14.8	0.52	9.2	D
	Summer, weekend	101	102	334	0.304	15.8	0.305	15.6	0.53	10.7	D
	Summer, weekday	26	53	90	0.441	24.5	0.591	30.9	0.46	18.2	C
Barrier Islands											
Little Barrier	Total	33	94	136	0.780	18.8	0.690	20.3	0.27	10.7	B
Western Gulf											
Kawau	Total	222	386	628	0.674	9.5	0.614	9.4	0.39	5.4	B
	Summer	211	368	597	0.668	9.4	0.616	9.5	0.38	5.4	B
	Summer, weekend	142	260	383	0.749	11.7	0.679	11.8	0.41	7.0	B
	Summer, weekday	69	108	214	0.501	13.1	0.504	15.4	0.32	8.2	C
Mid Hauraki G	Total	25	83	117	0.646	11.5	0.712	20.9	0.04	4.1	B
	Summer	25	83	117	0.646	11.5	0.712	20.9	0.04	4.1	B
	Summer, weekend	20	76	88	0.744	10.5	0.864	22.8	0.05	5.1	B
Omaha Bay	Total	73	69	202	0.306	24.8	0.341	24.1	0.68	17.3	D
	Summer	47	61	155	0.398	28.0	0.395	25.9	0.62	18.5	D
	Summer, weekend	40	35	113	0.302	35.2	0.311	34.0	0.72	25.7	D
	Winter	26	8	48	0.141	43.3	0.168	47.8	0.81	40.2	E
Tiri	Total	95	108	323	0.366	13.9	0.335	12.2	0.42	8.7	D
	Summer	76	87	239	0.396	15.4	0.364	13.5	0.42	9.8	D
	Summer, weekday	59	75	181	0.452	15.8	0.414	13.9	0.37	10.0	C

Table 14 — continued

Locality	Time stratum	n	Fish	Hours	H_1	c.v.	H_2	c.v.	p_0	c.v.	R
Inner Gulf											
Motuihe Ch.	Total	554	944	2 066	0.453	6.8	0.457	6.4	0.44	3.8	C
	Summer	411	857	1 571	0.557	7.1	0.546	6.7	0.36	3.7	C
	Summer, weekend	241	417	933	0.450	9.9	0.447	9.9	0.47	6.1	C
	Summer, weekday	170	440	638	0.710	9.8	0.690	8.9	0.22	4.6	B
	Winter	143	87	495	0.152	13.5	0.176	14.8	0.65	11.8	E
Noisies Group	Total	314	451	1 308	0.347	9.6	0.345	9.7	0.54	6.1	D
	Summer	200	373	889	0.451	10.4	0.420	10.6	0.46	6.5	C
	Summer, weekend	148	238	647	0.411	13.8	0.368	13.6	0.52	8.6	C
	Summer, weekday	52	135	242	0.564	16.5	0.558	16.6	0.27	8.4	C
	Winter	114	78	419	0.165	20.6	0.186	21.2	0.69	14.1	E
Rangitoto Ch.	Total	518	527	1 644	0.334	9.5	0.321	9.5	0.65	6.0	D
	Summer	163	351	492	0.704	11.2	0.714	12.1	0.30	6.2	B
	Summer, weekend	68	159	207	0.674	21.3	0.768	22.2	0.49	11.8	B
	Summer, weekday	95	192	285	0.725	12.3	0.674	12.3	0.32	7.0	B
	Winter	355	176	1 152	0.165	14.5	0.153	13.0	0.78	9.9	E
Tamaki Str.	Total	901	1 974	3 725	0.562	5.2	0.530	3.9	0.37	2.2	C
	Summer	682	1 529	2 840	0.575	5.7	0.538	4.4	0.30	2.5	C
	Summer, weekend	515	1 111	2 122	0.560	7.0	0.524	5.2	0.32	3.0	C
	Summer, weekday	167	418	718	0.622	9.1	0.582	8.4	0.25	4.5	B
	Winter	219	445	886	0.519	12.4	0.502	8.2	0.33	4.7	C
Firth of Thames											
Firth Thames	Total	346	961	1 439	0.723	6.9	0.668	6.0	0.24	3.0	B
	Summer	284	719	1 164	0.665	6.9	0.618	6.6	0.24	3.4	B
	Summer, weekend	204	531	880	0.654	8.1	0.603	7.5	0.23	3.8	B
	Summer, weekday	80	188	284	0.692	13.2	0.662	13.5	0.29	7.1	B
	Winter	62	242	275	0.992	18.5	0.881	12.7	0.21	6.5	A
Eastern Gulf											
Coromandel Is.	Total	728	2 369	3 052	0.850	4.4	0.776	4.1	0.25	2.1	A
	Summer	379	1 267	1 582	0.770	5.3	0.801	5.9	0.26	3.0	B
	Summer, weekend	344	1 206	1 429	0.810	5.4	0.844	6.1	0.24	3.0	A
	Summer, weekday	35	61	153	0.375	18.2	0.400	19.9	0.43	14.6	D
	Winter	349	1 102	1 470	0.937	6.9	0.749	5.5	0.23	2.9	A

Table 14 — continued

Locality	Time stratum	n	Fish	Hours	H_1	c.v.	H_2	c.v.	p_0	c.v.	R
Northern Bay of Plenty											
Mercury Bay	Total	188	240	511	0.543	12.6	0.469	9.8	0.47	6.9	C
	Summer	188	240	511	0.543	12.6	0.469	9.8	0.47	6.9	C
	Summer, weekend	127	149	330	0.545	16.3	0.452	11.1	0.45	8.0	C
	Summer, weekday	61	91	182	0.538	19.4	0.500	18.4	0.52	13.4	C
Shoe & Slipper	Total	454	759	1 662	0.574	10.9	0.457	6.7	0.45	4.2	C
	Summer	333	532	1 173	0.564	12.5	0.454	8.3	0.47	5.1	C
	Summer, weekend	253	397	877	0.609	14.9	0.453	9.5	0.47	6.0	B
	Summer, weekday	80	135	295	0.421	15.4	0.457	17.1	0.45	10.1	C
	Winter	121	227	490	0.601	21.9	0.464	11.1	0.40	7.4	B
Whangamata	Total	153	281	429	0.659	11.2	0.655	11.3	0.44	7.1	B
	Summer	77	189	187	0.903	12.5	1.010	14.1	0.34	8.1	A
	Summer, weekend	52	129	128	0.952	14.6	1.010	16.4	0.29	8.8	A
	Summer, weekday	25	60	60	0.801	24.5	1.008	27.6	0.44	17.7	A
	Winter	76	92	242	0.413	21.1	0.381	17.5	0.54	12.4	C
Middle Bay of Plenty											
Matakana Is.	Total	467	927	1 594	0.614	7.5	0.581	6.6	0.45	4.1	B
	Summer	328	828	1 128	0.796	7.8	0.734	7.1	0.37	4.2	B
	Summer, weekend	186	485	598	0.910	9.9	0.811	8.8	0.32	5.1	A
	Summer, weekday	142	343	530	0.647	12.4	0.647	11.7	0.42	7.2	B
	Winter	139	99	466	0.185	12.6	0.212	13.5	0.63	11.1	E
Mayor Is.	Total	38	79	175	0.555	23.9	0.451	23.7	0.47	15.4	C
	Winter	22	43	86	0.660	32.5	0.503	36.2	0.55	23.4	B
Motiti Is.	Total	115	264	471	0.604	12.8	0.560	13.0	0.40	7.6	B
	Summer	87	158	343	0.517	17.1	0.461	17.2	0.47	10.1	C
	Summer, weekend	48	88	180	0.440	22.0	0.490	21.8	0.58	17.1	C
	Summer, weekday	39	70	164	0.612	25.7	0.428	28.0	0.33	11.3	B
	Winter	28	106	128	0.873	17.5	0.828	17.9	0.18	8.8	A
Papamoa Bch	Total	84	228	315	0.840	15.6	0.723	12.6	0.31	7.3	A
	Summer	40	128	130	1.225	20.2	0.984	17.2	0.25	9.1	A
	Summer, weekend	28	78	89	0.996	18.1	0.878	19.9	0.29	12.0	A
	Winter	44	100	185	0.490	16.5	0.540	18.5	0.36	11.4	C

Table 14 — continued

Locality	Time stratum	n	Fish	Hours	H_1	c.v.	H_2	c.v.	p_0	c.v.	R
Tauranga Harbour											
Katikati	Total	298	189	649	0.260	15.8	0.291	15.8	0.79	11.3	D
	Summer	276	189	603	0.281	15.7	0.313	15.7	0.78	11.2	D
	Summer, weekend	172	137	383	0.329	18.2	0.358	17.7	0.72	12.3	D
	Summer, weekday	104	52	221	0.201	30.8	0.236	32.7	0.87	24.9	D
	Winter	22	0	45	0.000	-	0.000	-	1.00	-	E
Te Puna Inlet	Total	289	240	992	0.221	12.4	0.242	13.5	0.70	9.0	D
	Summer	235	231	810	0.262	12.5	0.285	13.7	0.65	8.9	D
	Summer, weekend	101	88	413	0.209	16.9	0.213	18.0	0.60	12.3	D
	Summer, weekday	134	143	397	0.302	16.8	0.360	19.2	0.69	12.8	D
	Winter	54	9	181	0.042	54.7	0.050	59.0	0.91	42.6	E
Eastern Bay of Plenty											
Matata Beach	Total	128	432	404	1.213	11.9	1.069	9.6	0.33	6.2	A
	Summer	73	234	235	1.195	13.9	0.996	13.1	0.36	8.7	A
	Summer, weekend	42	124	133	0.953	17.9	0.935	16.8	0.33	10.9	A
	Summer, weekday	31	110	102	1.522	25.0	1.075	20.7	0.39	14.3	A
	Winter	55	198	169	1.238	14.8	1.171	14.1	0.29	8.6	A
Ohiwa H.	Total	117	9	258	0.040	40.8	0.035	39.5	0.94	36.6	E
	Summer	92	8	201	0.046	44.1	0.040	42.6	0.93	39.5	E
	Summer, weekend	86	7	195	0.044	48.0	0.036	46.7	0.94	43.4	E
	Winter	25	1	57	0.020	100.0	0.018	100.7	0.96	98.0	E
Opotiki	Total	364	878	1 071	0.897	7.3	0.820	7.0	0.40	4.3	A
	Summer	231	670	669	1.078	7.9	1.001	7.5	0.31	4.4	A
	Summer, weekend	184	485	532	1.034	9.2	0.911	8.7	0.30	4.8	A
	Summer, weekday	47	185	137	1.249	15.4	1.348	15.1	0.36	11.0	A
	Winter	133	208	402	0.582	16.5	0.518	15.5	0.56	9.9	C
Cape Runaway	Total	476	824	1 952	0.414	8.9	0.422	9.2	0.55	5.1	C
	Summer	273	478	1 063	0.418	12.0	0.450	12.7	0.57	7.0	C
	Summer, weekend	162	238	639	0.348	19.7	0.372	20.8	0.62	10.1	D
	Summer, weekday	111	240	423	0.520	13.8	0.567	14.6	0.50	9.4	C
	Winter	203	346	889	0.408	13.3	0.385	13.1	0.53	7.4	C
Whale Island	Total	295	556	899	0.609	9.5	0.619	8.9	0.46	5.4	B
	Summer	206	418	590	0.682	11.0	0.709	10.2	0.41	5.8	B
	Summer, weekend	135	199	379	0.493	14.1	0.526	14.8	0.51	8.8	C
	Summer, weekday	71	219	211	1.041	15.8	1.038	13.0	0.23	6.4	A
	Winter	89	138	309	0.442	18.3	0.447	18.2	0.57	12.3	C

Table 14 — continued

Locality	Time stratum	n	Fish	Hours	H_1	c.v.	H_2	c.v.	p_0	c.v.	R
Waikato											
Albatross Pt.	Total	20	27	76	0.387	47.5	0.356	43.8	0.50	22.4	D
	Summer	20	27	76	0.387	47.5	0.356	43.8	0.50	22.4	D
Crayfish Pt.	Total	65	186	260	0.873	23.3	0.714	22.1	0.55	13.8	A
	Summer	51	171	200	1.052	23.7	0.854	22.8	0.47	13.2	A
	Summer, weekend	35	138	143	1.184	27.9	0.963	26.7	0.43	14.6	A
Kawhai H.	Total	31	10	80	0.129	32.8	0.125	37.9	0.74	30.5	E
	Summer	31	10	80	0.129	32.8	0.125	37.9	0.74	30.5	E
	Summer, weekend	20	6	48	0.146	36.7	0.126	35.9	0.70	34.2	E
Papanui Pt.	Total	80	169	357	0.442	20.1	0.473	21.2	0.64	14.8	C
	Summer	51	96	223	0.413	28.3	0.430	31.4	0.69	20.7	C
	Summer, weekday	40	75	197	0.374	35.5	0.381	37.3	0.70	24.2	D
	Winter	29	73	134	0.493	27.6	0.545	26.7	0.55	20.6	C
Raglan H.	Total	561	149	1 925	0.077	14.1	0.077	14.6	0.86	10.6	E
	Summer	339	140	1 188	0.118	14.6	0.118	15.1	0.80	10.7	E
	Summer, weekend	244	98	851	0.110	18.3	0.115	19.7	0.82	13.5	E
	Summer, weekday	95	42	337	0.139	24.1	0.125	20.7	0.75	17.6	E
	Winter	222	9	737	0.015	38.7	0.012	36.4	0.96	34.7	E
Manukau Harbour											
Manukau Hds	Total	293	261	1 274	0.158	12.5	0.205	13.2	0.73	9.7	E
	Summer	198	259	950	0.231	12.0	0.273	12.8	0.62	9.0	D
	Summer, weekend	155	187	760	0.199	14.3	0.246	15.1	0.65	10.8	E
	Summer, weekday	43	72	190	0.349	21.5	0.379	24.3	0.51	15.6	D
	Winter	95	2	323	0.005	71.4	0.006	70.5	0.98	70.0	E
Papakura Ch.	Total	483	488	1 741	0.295	7.1	0.280	6.7	0.51	4.7	D
	Summer	465	472	1 680	0.295	7.1	0.281	6.7	0.51	4.7	D
	Summer, weekend	316	274	1 153	0.248	10.1	0.238	9.6	0.58	6.6	D
	Summer, weekday	149	198	527	0.395	9.4	0.375	8.7	0.36	6.1	D
Purakina Ch.	Total	171	178	665	0.274	10.9	0.268	11.8	0.53	8.1	D
	Summer	141	175	557	0.329	10.4	0.314	11.7	0.44	7.5	D
	Summer, weekend	86	83	351	0.235	15.3	0.236	16.3	0.53	11.6	D
	Summer, weekday	55	92	206	0.476	13.2	0.447	15.7	0.29	8.6	C
	Winter	30	3	108	0.014	73.5	0.028	73.9	0.93	68.3	E
Waiuku Ch.	Total	98	141	313	0.719	23.7	0.451	14.7	0.44	8.9	B
	Summer	92	139	300	0.757	23.9	0.463	14.7	0.41	8.7	B
	Summer, weekend	61	105	186	0.993	26.8	0.565	18.2	0.38	10.0	A
	Summer, weekday	31	34	114	0.294	22.0	0.298	21.8	0.48	17.4	D
Wairopa Ch.	Total	74	58	283	0.212	35.5	0.205	38.5	0.85	27.8	D
	Summer	20	57	67	0.771	31.1	0.853	35.6	0.50	22.4	B
	Winter	54	1	217	0.005	100.0	0.005	100.1	0.98	99.1	E

Table 14 — continued

Locality	Time stratum	n	Fish	Hours	H_1	c.v.	H_2	c.v.	p_0	c.v.	R
Kaipara Harbour											
Helensville	Total	101	208	417	0.557	10.8	0.499	12.4	0.29	6.3	C
	Summer	101	208	417	0.557	10.8	0.499	12.4	0.29	6.3	C
	Summer, weekend	88	197	388	0.566	11.7	0.508	12.8	0.30	6.9	C
Pouto	Total	54	173	249	0.817	23.7	0.695	21.5	0.46	12.6	A
	Summer	54	173	249	0.817	23.7	0.695	21.5	0.46	12.6	A
	Summer, weekend	41	172	186	1.072	22.6	0.924	20.3	0.32	10.6	A
Dargaville											
Hokianga Entr.	Total	29	147	106	1.442	13.8	1.381	15.5	0.14	7.4	A
	Summer	29	147	106	1.442	13.8	1.381	15.5	0.14	7.4	A
	Summer, weekend	22	110	75	1.422	15.8	1.467	19.2	0.15	10.1	A
Hokianga H.	Total	97	208	284	0.819	16.8	0.731	13.9	0.37	7.8	A
	Summer	97	208	284	0.819	16.8	0.731	13.9	0.37	7.8	A
	Summer, weekend	46	51	126	0.351	18.1	0.406	19.6	0.50	14.7	D
	Summer, weekday	51	157	159	1.241	19.4	0.988	16.6	0.25	8.2	A

***Table 15*: Snapper harvest rates (fish per hour) by baited line or jigging by diary zone and time stratum in 1996 where snapper or "general fish" was the target. See Table 2 for an explanation of the column headings. The *c.v.*s are expressed as percentages**

Time stratum	n	Fish	Hours	H_1	c.v.	H_2	c.v.	p_0	c.v.	R
North Cape to Cape Brett										
Total	744	1 245	2 589	0.500	5.4	0.481	5.7	0.46	3.4	C
Summer	619	1 007	2 086	0.504	6.0	0.483	6.5	0.46	3.7	C
Summer, weekend	437	707	1 444	0.487	6.8	0.490	7.8	0.47	4.5	C
Summer, weekday	182	300	642	0.546	12.0	0.467	11.5	0.45	6.6	C
Winter	125	238	503	0.479	11.2	0.473	11.7	0.42	7.7	C
Bay of Islands										
Total	903	1 617	3 050	0.532	4.9	0.530	4.8	0.44	3.0	C
Summer	636	1 088	2 072	0.514	5.9	0.525	6.0	0.47	3.7	C
Summer, weekend	429	633	1 346	0.440	7.2	0.470	7.6	0.50	4.9	C
Summer, weekday	207	455	727	0.668	9.6	0.626	9.4	0.39	5.5	B
Winter	267	529	977	0.575	8.9	0.541	8.1	0.39	4.9	C
Cape Brett to Cape Rodney										
Total	599	1 085	2 285	0.544	7.5	0.475	5.9	0.43	3.6	C
Summer	541	946	1 989	0.550	8.1	0.476	6.3	0.44	3.8	C
Summer, weekend	367	594	1 393	0.509	11.4	0.426	7.9	0.45	4.7	C
Summer, weekday	174	352	596	0.638	10.0	0.590	10.5	0.42	6.4	B
Winter	58	139	296	0.486	16.2	0.470	15.3	0.33	9.2	C
Whangarei Harbour										
Total	307	673	1 100	0.672	9.0	0.612	8.3	0.41	4.7	B
Summer	281	656	1 012	0.718	9.1	0.648	8.4	0.38	4.7	B
Summer, weekend	192	448	707	0.701	11.0	0.634	9.7	0.41	6.0	B
Summer, weekday	89	208	306	0.753	16.4	0.680	16.3	0.34	7.6	B
Winter	26	17	88	0.182	33.0	0.193	39.3	0.65	27.0	B
Barrier Islands										
Total	69	186	345	0.705	13.8	0.540	14.5	0.20	6.1	B
Summer	54	165	291	0.728	13.9	0.568	15.3	0.13	5.3	B
Summer, weekday	52	164	287	0.746	13.9	0.572	15.2	0.12	5.0	B
Western Gulf										
Total	415	646	1 270	0.537	7.3	0.509	7.2	0.43	4.3	C
Summer	359	599	1 107	0.574	7.4	0.541	7.4	0.40	4.3	C
Summer, weekend	219	385	642	0.625	10.0	0.597	10.1	0.45	6.1	B
Summer, weekday	140	216	466	0.494	9.9	0.464	10.1	0.31	5.7	C
Winter	56	47	162	0.303	32.6	0.290	25.2	0.64	17.9	D

Table 15 — continued

Time stratum	n	Fish	Hours	H_1	c.v.	H_2	c.v.	p_0	c.v.	R
Inner Gulf										
Total	2 346	3 984	9 004	0.452	3.6	0.442	3.1	0.46	1.9	C
Summer	1 504	3 194	6 001	0.563	3.8	0.532	3.4	0.36	1.9	C
Summer, weekend	1 012	2 006	4 089	0.518	5.1	0.491	4.5	0.41	2.6	C
Summer, weekday	492	1 188	1 912	0.687	5.6	0.621	5.3	0.26	2.7	B
Winter	842	790	3 003	0.253	8.3	0.263	6.5	0.63	4.5	D
Firth of Thames										
Total	346	961	1 439	0.723	6.9	0.668	6.0	0.24	3.0	B
Summer	284	719	1 164	0.665	6.9	0.618	6.6	0.24	3.4	B
Summer, weekend	204	531	880	0.654	8.1	0.603	7.5	0.23	3.8	B
Summer, weekday	80	188	284	0.692	13.2	0.662	13.5	0.29	7.1	B
Winter	62	242	275	0.992	18.5	0.881	12.7	0.21	6.5	A
Eastern Gulf										
Total	732	2 382	3 070	0.849	4.4	0.776	4.0	0.24	2.1	A
Summer	379	1 267	1 582	0.770	5.3	0.801	5.9	0.26	3.0	B
Summer, weekend	344	1 206	1 429	0.810	5.4	0.844	6.1	0.24	3.0	A
Summer, weekday	35	61	153	0.375	18.2	0.400	19.9	0.63	14.6	D
Winter	353	1 115	1 488	0.934	6.8	0.749	5.4	0.22	2.9	A
Northern Bay of Plenty										
Total	819	1 330	2 690	0.581	7.0	0.494	5.0	0.45	3.2	C
Summer	619	1 002	1 945	0.597	7.7	0.515	5.9	0.45	3.7	C
Summer, weekend	445	697	1 377	0.624	9.6	0.506	6.9	0.45	4.3	B
Summer, weekday	174	305	569	0.527	10.6	0.536	11.0	0.47	7.1	C
Winter	200	328	745	0.532	16.2	0.440	9.4	0.44	6.3	C
Middle Bay of Plenty										
Total	704	1 498	2 556	0.636	5.9	0.586	5.3	0.42	3.2	B
Summer	471	1 150	1 691	0.768	6.7	0.680	6.0	0.38	3.6	B
Summer, weekend	262	651	867	0.833	8.4	0.751	7.6	0.37	4.7	A
Summer, weekday	209	499	824	0.687	11.1	0.605	9.7	0.39	5.5	B
Winter	233	348	865	0.370	10.1	0.402	10.6	0.52	6.8	D
Tauranga Harbour										
Total	587	429	1 640	0.241	10.3	0.262	10.3	0.75	7.1	D
Summer	511	420	1 414	0.272	10.3	0.297	10.4	0.72	7.1	D
Summer, weekend	273	225	796	0.285	14.1	0.283	13.0	0.68	8.8	D
Summer, weekday	238	195	618	0.258	15.3	0.316	16.7	0.76	11.7	D
Winter	76	9	226	0.030	55.0	0.040	59.3	0.93	43.2	E
Eastern Bay of Plenty										
Total	1 401	2 712	4 626	0.620	4.6	0.586	4.5	0.51	2.7	B
Summer	896	1 821	2 800	0.671	5.6	0.650	5.4	0.49	3.3	B
Summer, weekend	616	1 053	1 892	0.579	7.2	0.557	7.4	0.53	4.3	C
Summer, weekday	280	768	909	0.872	8.8	0.845	7.9	0.40	4.9	A
Winter	505	891	1 825	0.531	8.1	0.488	7.8	0.54	4.8	C

Table 15 — continued

Time stratum	n	Fish	Hours	H_1	c.v.	H_2	c.v.	p_0	c.v.	R
Waikato										
Total	773	554	2 753	0.198	11.9	0.201	11.5	0.79	7.1	E
Summer	505	457	1 814	0.263	13.0	0.252	12.7	0.73	7.3	D
Summer, weekend	329	290	1 146	0.256	17.3	0.253	16.5	0.74	9.3	D
Summer, weekday	176	167	668	0.275	19.3	0.250	19.8	0.71	11.8	D
Winter	268	97	939	0.077	25.8	0.103	26.8	0.91	19.9	E
Manukau Harbour										
Total	1 127	1 127	4 305	0.286	6.9	0.262	5.4	0.59	3.6	D
Summer	918	1 103	3 561	0.343	6.9	0.310	5.3	0.51	3.4	D
Summer, weekend	630	665	2 489	0.309	10.1	0.267	7.0	0.57	4.6	D
Summer, weekday	288	438	1 072	0.418	7.3	0.409	7.8	0.38	4.6	C
Winter	209	24	743	0.035	40.2	0.032	33.9	0.94	28.0	E
Kaipara Harbour										
Total	155	381	665	0.648	12.1	0.573	12.1	0.35	5.9	B
Summer	155	381	665	0.648	12.1	0.573	12.1	0.35	5.9	B
Summer, weekend	129	369	574	0.727	12.5	0.643	12.1	0.30	5.8	B
Summer, weekday	26	12	92	0.255	33.3	0.131	27.9	0.58	22.9	D
Dargaville										
Total	126	355	391	0.962	12.2	0.908	11.0	0.32	6.1	A
Summer	126	355	391	0.962	12.2	0.908	11.0	0.32	6.1	A
Summer, weekend	68	161	201	0.698	14.8	0.802	16.9	0.40	9.8	B
Summer, weekday	58	194	190	1.273	17.2	1.020	14.4	0.22	7.1	A

Table 16: **Comparison by year of snapper harvest rates (fish per hour) by baited line or jigging where snapper or "general fish" was the target by diary zone during March and April weekends. See Table 2 for an explanation of the column headings. The *c.v.s* are given as percentages**

Year	n	Fish	Hours	H_1	*c.v.*	H_2	*c.v.*	p_0	*c.v.*	R
North Cape to Cape Brett										
1991	292	182	1 039	0.188	14.3	0.175	11.3	0.70	9.0	E
1994	34	105	120	0.835	26.8	0.873	29.6	0.24	9.5	A
1996	279	479	850	0.568	8.1	0.564	9.2	0.42	5.1	C
Bay of Islands										
1991	358	395	1 403	0.321	9.9	0.282	9.4	0.63	6.9	D
1994	516	1 061	1 594	0.710	6.1	0.666	6.4	0.40	3.6	B
1996	191	375	660	0.527	9.4	0.568	10.1	0.41	6.0	C
Cape Brett to Cape Rodney										
1991	249	325	898	0.362	9.9	0.362	10.6	0.55	7.1	D
1994	134	265	417	0.545	12.4	0.636	14.1	0.48	8.3	C
1996	225	395	892	0.450	12.1	0.443	9.6	0.44	5.9	C
Whangarei Harbour										
1991	230	314	842	0.389	15.5	0.373	12.8	0.62	8.4	D
1994	192	321	501	0.512	11.0	0.640	14.2	0.58	8.5	C
1996	117	324	423	0.853	12.5	0.767	11.7	0.36	6.9	A
Western Gulf										
1991	606	747	2 144	0.360	7.5	0.348	8.4	0.59	4.8	D
1994	722	1 419	2 456	0.577	5.7	0.578	5.9	0.43	3.3	C
1996	159	247	409	0.642	12.7	0.604	12.9	0.50	8.0	B
Inner Gulf										
1991	3 178	5 062	11 552	0.440	2.9	0.438	3.0	0.51	1.8	C
1994	3 509	10 229	13 585	0.769	2.2	0.753	2.3	0.31	1.1	B
1996	498	1 150	2 054	0.565	5.7	0.560	5.7	0.33	3.1	C
Firth of Thames										
1996	53	161	235	0.716	9.7	0.685	9.7	0.02	1.9	B
Eastern Gulf										
1991	94	308	353	0.921	8.4	0.873	9.4	0.19	5.0	A
1996	155	720	715	1.053	7.0	1.007	7.7	0.11	2.8	A
Northern Bay of Plenty										
1991	733	917	2 152	0.410	6.3	0.426	6.6	0.61	4.6	C
1994	579	790	1 699	0.475	8.1	0.465	7.3	0.53	4.4	C
1996	288	544	998	0.761	11.4	0.545	7.5	0.34	4.2	B
Middle Bay of Plenty										
1991	220	404	776	0.519	11.0	0.521	12.3	0.48	6.4	C
1996	85	309	299	1.197	12.3	1.033	10.6	0.21	5.6	A
Tauranga Harbour										
1991	1 226	2615	4 815	0.540	4.8	0.543	4.9	0.51	2.9	C
1994	417	836	1 462	0.674	10.4	0.572	8.7	0.56	5.5	B
1996	123	71	407	0.179	21.1	0.175	16.4	0.69	13.5	E
Eastern Bay of Plenty										
1991	569	1 416	1 631	0.868	6.7	0.868	6.7	0.44	3.7	A
1994	416	1 408	1 464	1.002	6.6	0.962	6.8	0.36	3.7	A
1996	382	715	1 135	0.658	8.5	0.630	7.9	0.52	5.3	B

Table 16 — **continued**

Year	n	Fish	Hours	H_1	*c.v.*	H_2	*c.v.*	p_0	*c.v.*	R
Waikato										
1991	561	158	2 097	0.078	14.7	0.075	15.6	0.87	10.9	E
1994	151	289	571	0.544	15.5	0.506	14.3	0.57	9.4	C
1996	143	71	507	0.150	23.5	0.140	25.2	0.77	15.3	E
Manukau Harbour										
1991	735	906	2 289	0.436	9.7	0.396	9.2	0.71	5.8	C
1994	586	1 149	2 075	0.635	11.1	0.554	7.1	0.53	4.3	B
1996	381	463	1 610	0.292	8.3	0.288	8.2	0.51	5.2	D
Kaipara Harbour										
1991	320	742	1 358	0.515	8.5	0.546	8.6	0.53	5.9	C
1994	100	327	337	0.922	14.4	0.969	14.0	0.41	8.3	A
1996	62	169	282	0.679	11.2	0.600	11.0	0.24	7.2	B
Dargaville										
1991	40	105	97	1.174	22.1	1.088	25.2	0.42	13.6	A
1994	92	290	265	1.016	13.3	1.095	15.5	0.32	7.1	A
1996	39	118	117	0.915	16.9	1.006	20.4	0.28	10.0	A

Table 17: **Comparison by year of snapper harvest rates (fish per hour) by baited line or jigging where snapper or "general fish" was the target in harbours which are not separate diary zones during March and April weekends. See Table 2 for an explanation of the column headings. The *c.v.s* are given as percentages**

Year	n	Fish	Hours	H_1	*c.v.*	H_2	*c.v.*	p_0	*c.v.*	R
Whangaroa Harbour										
1991	72	22	265	0.055	39.9	0.083	42.3	0.90	35.9	E
1996	22	6	60	0.143	49.0	0.099	55.5	0.82	45.2	E
Ohiwi harbour										
1991	107	62	210	0.285	39.4	0.296	30.5	0.84	22.2	D
1996	75	5	179	0.033	51.6	0.028	52.3	0.95	48.6	E
Kawhia Harbour										
1991	206	34	635	0.064	23.2	0.054	20.8	0.88	18.7	E
Raglan harbour										
1991	126	29	482	0.058	21.9	0.060	21.2	0.82	18.9	E
1994	42	13	123	0.161	44.5	0.146	36.8	0.76	27.6	E
1996	128	44	451	0.107	24.9	0.098	23.4	0.80	17.9	E

Table 18: Kahawai harvest rates (fish per hour) in the snapper bycatch fishery by diary zone in KAH 1 and time stratum in 1996. The snapper target fishery was defined as using baited lines or jigging with snapper or "general fish" as the target. See Table 2 for an explanation of the column headings. The *c.v.*s are expressed as percentages

Time stratum	n	Fish	Hours	H_1	*c.v.*	H_2	*c.v.*	p_0	*c.v.*	R
North Cape to Cape Brett										
Total	744	306	2 589	0.138	9.6	0.118	9.1	0.75	6.3	E
Summer	619	270	2 086	0.152	10.3	0.129	10.0	0.74	6.8	E
Summer, weekend	437	221	1 444	0.174	11.9	0.153	11.5	0.71	7.6	E
Summer, weekday	182	49	642	0.097	18.2	0.076	17.8	0.80	14.9	E
Winter	125	36	503	0.070	19.5	0.072	20.4	0.79	17.5	E
Bay of Islands										
Total	903	650	3 050	0.212	8.3	0.213	8.4	0.70	5.1	D
Summer	636	421	2 072	0.193	10.8	0.203	10.9	0.72	6.4	E
Summer, weekend	429	243	1 346	0.190	19.2	0.181	11.4	0.72	7.8	E
Summer, weekday	207	178	727	0.200	18.7	0.245	20.5	0.72	11.1	D
Winter	267	229	977	0.258	12.7	0.234	13.0	0.66	8.4	D
Cape Brett to Cape Rodney										
Total	599	170	2 285	0.086	15.5	0.074	14.6	0.85	9.8	E
Summer	541	143	1 989	0.080	16.3	0.072	15.7	0.85	10.4	E
Summer, weekend	367	102	1 393	0.070	17.2	0.078	19.3	0.84	12.0	E
Summer, weekday	174	41	596	0.099	31.7	0.069	26.3	0.88	20.5	E
Winter	58	27	296	0.147	44.4	0.091	39.5	0.86	32.8	E
Whangarei Harbour										
Total	307	75	1 100	0.067	18.6	0.068	17.7	0.86	14.3	E
Summer	281	44	1 012	0.041	20.7	0.043	19.4	0.89	16.9	E
Summer, weekend	192	35	707	0.045	23.6	0.050	22.2	0.88	19.1	E
Summer, weekday	89	9	306	0.034	43.3	0.029	39.2	0.92	36.3	E
Winter	26	31	88	0.348	29.3	0.352	29.3	0.58	22.9	D
Barrier Islands										
Total	69	30	345	0.076	37.1	0.087	41.1	0.87	31.1	E
Summer	54	30	291	0.097	36.6	0.103	40.8	0.83	30.4	E
Summer, weekday	52	29	287	0.091	39.5	0.101	42.1	0.85	32.5	E
Western Gulf										
Total	415	38	1 270	0.027	27.2	0.030	28.3	0.95	21.3	E
Summer	359	27	1 107	0.024	26.6	0.024	25.6	0.95	23.0	E
Summer, weekend	219	15	642	0.024	36.1	0.023	35.5	0.95	30.9	E
Summer, weekday	140	12	466	0.023	37.6	0.026	36.8	0.94	34.3	E
Winter	56	11	162	0.049	75.0	0.068	75.4	0.95	56.2	E
Inner Gulf										
Total	2 346	701	9 004	0.074	6.8	0.078	6.2	0.84	4.7	E
Summer	1 504	326	6 001	0.050	8.6	0.054	8.5	0.87	6.8	E
Summer, weekend	1 012	257	4 089	0.056	9.7	0.063	9.9	0.86	7.7	E
Summer, weekday	492	69	1 912	0.036	18.4	0.036	16.3	0.91	14.0	E
Winter	842	375	3 003	0.116	9.9	0.125	8.7	0.78	6.5	E

Table 18 — continued

Time stratum	n	Fish	Hours	H_1	*c.v.*	H_2	*c.v.*	p_0	*c.v.*	R
Firth of Thames										
Total	346	94	1 439	0.070	18.0	0.065	18.2	0.85	12.9	E
Summer	284	67	1 164	0.061	23.3	0.058	23.9	0.88	16.4	E
Summer, weekend	204	32	880	0.039	23.4	0.036	22.1	0.89	19.6	E
Summer, weekday	80	35	284	0.119	37.6	0.123	41.0	0.88	29.6	E
Winter	62	27	275	0.110	23.3	0.098	21.9	0.71	19.9	E
Eastern Gulf										
Total	732	197	3 070	0.068	14.7	0.064	13.7	0.85	8.9	E
Summer	379	59	1 582	0.045	23.0	0.037	18.4	0.89	15.0	E
Summer, weekend	344	54	1 429	0.047	24.1	0.038	19.6	0.90	15.8	E
Summer, weekday	35	5	153	0.025	48.8	0.033	51.3	0.89	47.1	E
Winter	353	138	1 488	0.093	18.8	0.093	17.8	0.81	11.0	E
Northern Bay of Plenty										
Total	819	159	2 690	0.067	13.9	0.059	14.1	0.89	9.8	E
Summer	619	110	1 945	0.072	15.9	0.057	14.8	0.89	11.2	E
Summer, weekend	445	87	1 377	0.080	17.8	0.063	17.2	0.88	12.6	E
Summer, weekday	174	23	569	0.051	35.1	0.040	28.4	0.91	23.8	E
Winter	200	49	745	0.054	28.0	0.066	31.2	0.89	20.1	E
Middle Bay of Plenty										
Total	704	249	2 556	0.096	10.3	0.097	10.4	0.81	7.7	E
Summer	471	188	1 691	0.102	11.6	0.111	12.1	0.79	8.9	E
Summer, weekend	262	103	867	0.108	15.0	0.119	15.2	0.79	12.1	E
Summer, weekday	209	85	824	0.095	18.3	0.103	19.4	0.78	13.2	E
Winter	233	61	865	0.084	21.6	0.071	20.3	0.84	15.1	E
Tauranga Harbour										
Total	587	145	1 640	0.084	18.7	0.088	23.2	0.87	10.8	E
Summer	511	92	1 414	0.065	18.4	0.065	15.1	0.89	12.5	E
Summer, weekend	273	65	796	0.089	22.6	0.082	17.3	0.85	14.6	E
Summer, weekday	238	27	618	0.038	29.8	0.044	29.9	0.93	23.4	E
Winter	76	53	226	0.210	42.7	0.234	57.5	0.76	20.6	D
Eastern Bay of Plenty										
Total	1 401	1 176	4 626	0.286	5.5	0.254	5.2	0.63	3.5	D
Summer	896	790	2 800	0.306	6.6	0.282	6.3	0.62	4.3	D
Summer, weekend	616	514	1 892	0.283	8.1	0.272	7.8	0.63	5.3	D
Summer, weekday	280	276	909	0.354	11.3	0.304	10.9	0.59	7.2	D
Winter	505	386	1 825	0.250	9.7	0.211	9.3	0.65	6.1	D

Table 18 — continued

Time stratum	n	Fish	Hours	H_1	c.v.	H_2	c.v.	p_0	c.v.	R
Waikato										
Total	773	800	2 753	0.307	9.7	0.291	9.1	0.72	5.8	D
Summer	505	461	1 814	0.259	12.2	0.254	12.3	0.76	7.9	D
Summer, weekend	329	224	1 146	0.204	15.4	0.196	16.6	0.79	10.7	D
Summer, weekday	176	237	668	0.363	19.0	0.355	17.9	0.70	11.6	D
Winter	268	339	939	0.396	15.5	0.361	13.2	0.65	8.2	D
Manukau Harbour										
Total	1 127	971	4 305	0.315	21.9	0.226	6.8	0.66	4.2	D
Summer	918	638	3 561	0.287	29.2	0.179	8.2	0.70	5.0	D
Summer, weekend	630	464	2 489	0.333	36.6	0.186	9.6	0.70	6.2	D
Summer, weekday	288	174	1 072	0.188	12.2	0.162	16.5	0.69	8.8	E
Winter	209	333	743	0.435	10.6	0.448	11.5	0.50	6.9	C
Kaipara Harbour										
Total	155	84	665	0.132	18.4	0.126	16.9	0.72	12.8	E
Summer	155	84	665	0.132	18.4	0.126	16.9	0.72	12.8	E
Summer, weekend	129	60	574	0.091	19.2	0.105	21.4	0.77	16.0	B
Summer, weekday	26	24	92	0.336	32.4	0.262	25.2	0.46	18.2	D
Dargaville										
Total	126	62	391	0.151	23.9	0.159	25.4	0.76	15.9	E
Summer	126	62	391	0.151	23.9	0.159	25.4	0.76	15.9	E
Summer, weekend	68	51	201	0.213	29.6	0.254	29.8	0.72	19.5	D
Summer, weekday	58	11	190	0.079	29.7	0.058	28.0	0.81	27.1	B

***Table 19*: Kahawai harvest rates (fish per hour) in the snapper bycatch fishery by region and time stratum in 1996. The snapper target fishery was defined as using baited lines or jigging with snapper or "general fish" as the target. See Table 2 for an explanation of the column headings. The c.v.s are expressed as percentages**

Time stratum	n	Fish	Hours	H_1	c.v.	H_2	c.v.	p_0	c.v.	R
Bay of Plenty										
Total	3 511	1 729	11 512	0.163	4.6	0.150	4.6	0.77	3.1	E
Summer	2 497	1 180	7 851	0.160	5.5	0.150	5.1	0.77	3.7	E
Summer, weekend	1 596	769	4 931	0.165	6.6	0.156	6.2	0.76	4.5	E
Summer, weekday	901	411	2 919	0.152	9.6	0.141	9.1	0.79	6.4	E
Winter	1 014	549	3 662	0.170	8.8	0.150	9.4	0.75	5.4	E
East Northland										
Total	2 622	1 231	9 369	0.142	5.6	0.131	5.6	0.77	3.6	E
Summer	2 131	908	7 451	0.130	6.6	0.122	6.6	0.79	4.1	E
Summer, weekend	1 427	602	4 893	0.135	7.8	0.123	7.2	0.77	4.9	E
Summer, weekday	704	306	2 558	0.119	12.3	0.120	13.5	0.82	7.9	E
Winter	491	323	1 918	0.194	10.7	0.168	10.6	0.72	7.3	E
Hauraki Gulf										
Total	3 839	1 030	14 782	0.067	5.8	0.070	5.3	0.86	3.9	E
Summer	2 526	479	9 854	0.047	7.5	0.049	7.2	0.89	5.6	E
Summer, weekend	1 779	358	7 040	0.048	8.4	0.051	8.1	0.88	6.4	E
Summer, weekday	747	121	2 814	0.042	16.1	0.043	15.7	0.91	11.6	E
Winter	1 313	551	4 928	0.107	8.4	0.112	7.6	0.79	5.4	E
West coast										
Total	2 181	1 917	8 114	0.289	12.9	0.236	5.2	0.69	3.2	D
Summer	1 704	1 245	6 431	0.255	18.2	0.194	6.5	0.72	3.9	D
Summer, weekend	1 156	799	4 409	0.262	25.6	0.181	7.6	0.74	4.9	D
Summer, weekday	548	446	2 022	0.240	10.9	0.221	11.7	0.70	6.5	D
Winter	477	672	1 683	0.413	9.7	0.399	8.8	0.58	5.4	C

Table 20: Comparison by year of kahawai harvest rates (fish per hour) in the snapper bycatch fishery by diary zone in KAH 1 during March and April weekends. The snapper target fishery was defined as using baited lines or jigging with snapper or "general fish" as the target. See Table 2 for an explanation of the column headings. The c.v.s are expressed as percentages

Year	n	Fish	Hours	H_1	c.v.	H_2	c.v.	p_0	c.v.	R
North Cape to Cape Brett										
1991	292	47	1 039	0.056	27.0	0.045	26.4	0.93	21.6	E
1994	34	48	120	0.349	33.6	0.399	33.1	0.62	21.8	D
1996	279	189	850	0.241	12.9	0.222	12.7	0.65	8.1	D
Bay of Islands										
1991	358	66	1 403	0.055	22.0	0.047	21.2	0.91	16.6	E
1994	516	157	1 594	0.105	14.4	0.098	13.1	0.83	9.6	E
1996	191	167	660	0.301	16.5	0.253	13.3	0.61	9.1	D
Cape Brett to Cape Rodney										
1991	249	16	898	0.024	33.2	0.018	32.7	0.96	29.5	E
1994	134	38	417	0.080	26.2	0.091	27.3	0.86	21.3	E
1996	225	82	892	0.095	19.4	0.092	22.7	0.80	13.2	E
Whangarei Harbour										
1991	230	11	842	0.015	41.0	0.013	34.8	0.96	32.2	E
1994	192	43	501	0.052	25.9	0.086	28.2	0.89	20.6	E
1996	117	26	423	0.056	28.2	0.062	27.1	0.86	23.2	E
Western Gulf										
1991	606	22	2 144	0.009	23.4	0.010	22.9	0.97	22.0	E
1994	722	105	2 456	0.038	14.6	0.043	14.1	0.91	11.9	E
1996	159	14	409	0.031	38.0	0.034	37.3	0.94	32.4	E
Inner Gulf										
1991	3 178	350	11 552	0.032	9.5	0.030	9.2	0.94	6.9	E
1994	3 509	501	13 585	0.038	10.1	0.037	9.2	0.93	6.2	E
1996	498	161	2 054	0.069	13.6	0.078	13.6	0.85	10.6	E
Firth of Thames										
1996	53	15	235	0.064	29.3	0.064	31.0	0.79	26.8	E
Eastern Gulf										
1991	94	19	353	0.328	97.3	0.054	79.5	0.95	43.5	D
1996	155	28	715	0.051	40.1	0.039	31.6	0.90	24.5	E
Northern Bay of Plenty										
1991	733	170	2 152	0.076	10.9	0.079	11.8	0.85	8.8	E
1994	579	153	1 699	0.090	13.1	0.090	13.3	0.84	9.5	E
1996	288	78	998	0.105	19.3	0.078	18.6	0.84	13.5	E
Middle Bay of Plenty										
1991	220	69	776	0.085	16.3	0.089	18.2	0.80	13.7	E
1996	85	61	299	0.207	20.1	0.204	21.6	0.72	17.3	D
Tauranga Harbour										
1991	1 226	601	4 815	0.122	7.1	0.125	7.1	0.76	5.1	E
1994	417	134	1 462	0.097	17.5	0.092	17.0	0.84	11.1	E
1996	123	48	407	0.151	27.0	0.118	19.8	0.76	16.2	E
Eastern Bay of Plenty										
1991	569	617	1 631	0.396	8.5	0.378	7.6	0.60	5.2	D
1994	416	323	1 464	0.221	10.4	0.221	10.8	0.66	6.8	D
1996	382	327	1 135	0.301	10.6	0.288	10.3	0.64	6.8	D

Table 20 — continued

Year	n	Fish	Hours	H_1	c.v.	H_2	c.v.	p_0	c.v.	R
Waikato										
1991	561	224	2 097	0.095	15.2	0.107	17.4	0.85	10.2	E
1994	151	160	571	0.268	14.7	0.280	15.3	0.63	10.6	D
1996	143	177	507	0.356	18.4	0.349	19.7	0.71	13.2	D
Manukau Harbour										
1991	735	323	2 289	0.154	15.6	0.141	11.9	0.81	7.6	E
1994	586	252	2 075	0.132	13.9	0.121	12.3	0.80	8.3	E
1996	381	343	1 610	0.192	9.1	0.213	10.2	0.64	6.9	E
Kaipara Harbour										
1991	320	346	1 358	0.253	10.2	0.255	10.5	0.66	7.8	D
1994	100	65	337	0.197	17.9	0.193	17.1	0.63	13.0	E
1996	62	29	282	0.097	28.8	0.103	27.0	0.74	21.5	E
Dargaville										
1991	40	5	97	0.049	53.4	0.052	52.3	0.90	47.4	E
1994	92	47	265	0.187	35.4	0.177	29.8	0.84	23.6	E
1996	39	23	117	0.171	32.5	0.196	33.2	0.69	24.0	E

Table 21: Comparison by year of kahawai harvest rates (fish per hour) in the snapper bycatch fishery by region during March and April weekends. The snapper target fishery was defined as using baited lines or jigging with snapper or "general fish" as the target. See Table 2 for an explanation of the column headings. The c.v.s are expressed as percentages

Year	n	Fish	Hours	H_1	c.v.	H_2	c.v.	p_0	c.v.	R
Bay of Plenty										
1991	2 748	1 457	9 373	0.164	5.3	0.155	4.7	0.76	3.4	E
1994	1 412	610	4 625	0.131	7.5	0.132	7.7	0.79	5.1	E
1996	878	514	2 838	0.206	8.3	0.181	7.9	0.73	5.6	D
East Northland										
1991	1 129	140	4 182	0.040	14.7	0.033	14.2	0.94	11.3	E
1994	876	286	2 633	0.099	11.1	0.109	10.9	0.84	7.7	E
1996	812	464	2 825	0.188	9.1	0.164	8.3	0.71	5.5	E
Hauraki Gulf										
1991	5 878	391	14 049	0.036	22.7	0.028	9.2	0.94	6.5	E
1994	4 231	606	16 041	0.038	8.7	0.038	8.0	0.93	5.5	E
1996	865	218	3 413	0.059	12.0	0.064	11.4	0.87	8.9	E
West coast										
1991	1 660	890	5 867	0.150	8.5	0.153	7.4	0.80	4.9	E
1994	929	574	3 248	0.167	9.2	0.161	8.4	0.76	5.8	E
1996	625	572	2 516	0.219	8.7	0.227	8.9	0.67	5.7	D

Table 22: Kahawai harvest rates (fish per hour) in the target kahawai fishery (any method with kahawai as the target species) by region and time stratum in 1996. See Table 2 for an explanation of the column headings. The *c.v.s* are expressed as percentages

Time stratum	n	Fish	Hours	H_1	c.v.	H_2	c.v.	p_0	c.v.	R
Bay of Plenty										
Total	175	221	284	1.215	17.3	0.779	14.5	0.51	7.8	A
Summer	147	191	239	1.326	18.5	0.799	15.6	0.47	7.8	A
Summer, weekend	94	127	173	1.139	16.0	0.733	18.2	0.46	9.3	A
Summer, weekday	53	64	66	1.658	36.3	0.973	28.8	0.49	13.5	A
Winter	28	30	45	0.633	38.6	0.674	41.3	0.75	37.7	B
East Northland										
Total	189	190	207	1.381	14.0	0.916	11.7	0.52	7.5	A
Summer	178	175	195	1.355	14.8	0.898	12.2	0.52	7.8	A
Summer, weekend	124	129	143	1.476	17.2	0.899	14.2	0.49	8.8	A
Summer, weekday	54	46	51	1.078	28.3	0.895	23.6	0.59	16.4	A
Hauraki Gulf										
Total	50	75	97	0.879	19.8	0.774	28.8	0.52	14.7	A
Summer	34	47	72	0.802	24.6	0.651	36.0	0.53	18.2	A
West coast										
Total	91	142	208	1.556	35.8	0.682	18.9	0.55	11.6	A
Summer	49	82	104	2.382	42.4	0.785	24.5	0.47	13.4	A
Summer, weekend	37	53	93	2.109	61.7	0.570	31.9	0.54	17.8	A'
Winter	42	60	104	0.593	35.0	0.578	30.1	0.64	20.7	C

Table 23: Comparison of kahawai harvest rates (fish per hour) in the kahawai target fishery (any method with kahawai as the target species) by Fishstock during March and April weekends. See Table 2 for an explanation of the column headings. The *c.v.s* are expressed as percentages

Year	n	Fish	Hours	H_1	c.v.	H_2	c.v.	p_0	c.v.	R
KAH 1										
1991	388	738	594	1.834	9.2	1.243	8.4	0.39	4.1	A
1994	206	245	381	1.261	20.2	0.643	14.7	0.55	7.7	A
1996	146	165	197	1.431	15.5	0.839	12.5	0.44	7.3	A
KAH 9										
1991	119	129	338	0.372	19.7	0.381	23.2	0.69	13.6	D
1994	26	48	61	1.180	32.2	0.783	31.6	0.46	18.2	A

Table 24: Comparison by year of harvest rates (fish per hour) for the tarakihi target fishery (baited lines or jigging with tarakihi the target species). See Table 2 for an explanation of the headings. The *c.v.s* are expressed as percentages

Year	Area	Time	n	Fish	Hours	H_1	c.v.	H_2	c.v.	p_0	c.v.
Tarakihi											
1991	QMA 1	Total	156	401	558	0.777	15.5	0.718	15.5	0.59	9.6
		Summer	120	321	414	0.862	17.5	0.774	18.2	0.57	10.6
		Winter	36	80	144	0.490	26.6	0.556	26.2	0.64	22.2
1994	QMA 1	Total	136	196	439	0.425	16.5	0.446	16.8	0.62	11.1
		Summer	112	188	373	0.492	16.7	0.504	17.1	0.58	11.1
		Winter	24	8	67	0.109	65.7	0.120	64.7	0.83	45.6
1996	QMA 1	Total	317	1 346	1 085	1.351	7.8	1.241	9.2	0.32	3.9
		Summer	170	603	544	1.203	9.7	1.108	10.1	0.38	6.0
		Winter	147	743	540	1.521	12.0	1.376	14.4	0.27	5.0

Table 25: Comparison by year of harvest rates (fish per hour) for the red gurnard target fishery (mixed method, mainly longline and set net with red gurnard as the target species). See Table 2 for an explanation of the headings. The *c.v.s* are expressed as percentages

Year	Area	Time	n	Fish	Hours	H_1	c.v.	H_2	c.v.	p_0	c.v.
Red gurnard											
1991	QMA 1	Total	125	302	377	0.788	15.3	0.802	15.8	0.46	8.3
		Summer	58	82	196	0.353	23.3	0.419	27.3	0.48	12.7
		Winter	67	220	181	1.166	17.4	1.215	18.8	0.45	11.0
	QMA 9	Total	69	75	238	0.343	27.9	0.315	23.1	0.67	17.0
		Summer	35	14	102	0.107	37.2	0.137	39.8	0.80	33.8
		Winter	34	61	136	0.587	31.1	0.448	25.1	0.53	18.2
1994	QMA 1	Total	68	111	240	0.528	25.9	0.463	30.5	0.65	16.4
		Summer	51	78	192	0.519	28.6	0.407	32.8	0.61	17.4
		Winter	17	33	48	0.556	58.8	0.691	69.0	0.76	43.7
	QMA 9	Total	85	261	291	0.948	15.3	0.898	14.7	0.31	7.2
		Summer	52	136	169	0.754	22.3	0.804	22.2	0.38	11.0
		Winter	33	125	121	1.253	20.7	1.030	19.2	0.18	8.2
1996	QMA 1	Total	54	37	149	0.239	29.0	0.249	30.1	0.69	20.1
		Summer	39	12	92	0.133	34.7	0.131	34.8	0.79	31.5
		Winter	15	25	57	0.484	41.1	0.437	37.8	0.40	21.1
	QMA 9	Total	57	36	192	0.216	[illegible]	0.187	28.8	0.70	20.3
		Summer	38	19	133	0.192	37.2	0.143	30.4	0.71	25.4
		Winter	19	17	59	0.264	43.8	0.286	51.0	0.68	33.8

Table 26: Comparison by year of harvest rates (fish per hour) for the flatfish (set and drag net) and grey mullet (set net) fisheries. See Table 2 for an explanation of the headings. The *c.v.*s are expressed as percentages

Year	Area	Time	n	Fish	Hours	H_1	c.v.	H_2	c.v.	p_0	c.v.
Flatfish											
1994	QMA 1	Total	22	97	121	0.951	20.3	0.802	25.1	0.41	14.6
	QMA 9	Total	62	510	189	5.123	16.5	2.692	15.2	0.29	8.1
		Summer	44	306	127	2.405	15.3	2.417	17.1	0.32	10.3
1996	QMA 1	Total	35	119	151	1.349	32.6	0.786	30.7	0.43	14.6
		Summer	24	78	118	1.407	43.5	0.658	39.8	0.50	20.4
	QMA 9	Total	92	693	302	2.693	11.3	2.296	11.0	0.16	4.6
		Summer	49	318	170	2.133	17.7	1.868	15.9	0.22	7.7
		Winter	43	375	132	3.331	14.2	2.850	15.7	0.09	4.9
Grey mullet											
1996	QMA 9	Total	36	195	169	1.572	25.0	1.157	18.2	0.14	6.7

Table 27: Comparison by year of harvest rates (fish per hour) for the skipjack tuna and albacore troll fisheries. See Table 2 for an explanation of the headings. The *c.v.*s are expressed as percentages

Year	Area	Time	n	Fish	Hours	H_1	c.v.	H_2	c.v.	p_0	c.v.
Skipjack tuna											
1991	QMA 1	Total	447	198	2 166	0.201	25.3	0.091	18.0	0.83	10.6
		Summer	419	159	2 093	0.155	33.2	0.076	21.5	0.86	12.3
		Winter	28	39	73	0.902	25.9	0.532	24.3	0.39	15.2
1994	QMA 1	Total	303	384	1 262	0.562	12.0	0.304	10.9	0.6	7.0
		Summer	293	366	1 240	0.560	12.5	0.295	11.3	0.6	7.2
1996	QMA 1	Total	634	382	3 259	0.175	11.7	0.117	10.8	0.76	7.2
		Summer	623	378	3 238	0.173	11.8	0.117	10.9	0.76	7.2
Albacore tuna											
1991	QMA 1	Total	618	176	2 679	0.072	17.2	0.066	15.6	0.86	10.1
		Summer	570	176	2 570	0.078	17.1	0.068	15.5	0.85	10.1
1994	QMA 1	Total	470	85	1 645	0.054	19.4	0.052	17.4	0.89	13.1
		Summer	431	85	1 592	0.059	19.4	0.053	17.4	0.88	13.0
1996	QMA 1	Total	522	37	2 981	0.016	25.5	0.012	21.8	0.95	19.1
		Summer	519	37	2 973	0.016	25.5	0.012	21.8	0.95	19.1

Table 28: Comparison by year of harvest rates (fish per hour) for the rock lobster, scallop, and green mussel target fisheries. See Table 2 for an explanation of the headings. The *c.v.*s are expressed as percentages. WC harbours for scallops are the Manukau and Kaipara Harbours

Year	Area	Time	n	Fish	Hours	H_1	c.v.	H_2	c.v.	p_0	c.v.
Rock lobster — diving											
1994	CRA 1	Total	127	211	148	1.496	10.3	1.426	11.1	0.40	7.3
		Summer	79	127	94	1.445	13.5	1.358	15.4	0.44	10.0
		Winter	48	84	54	1.580	16.1	1.545	15.1	0.33	10.2
	CRA 2	Total	232	399	269	2.305	13.0	1.485	8.7	0.44	5.8
		Summer	152	229	175	1.733	13.2	1.307	11.4	0.49	7.9
		Winter	80	170	94	3.391	21.9	1.817	13.8	0.35	8.2
	CRA 9	Total	48	117	47	3.191	12.7	2.468	14.5	0.19	6.9
		Summer	18	59	23	4.026	18.0	2.525	23.1	0.06	5.7
		Winter	30	58	24	2.690	17.3	2.413	15.2	0.27	11.0
1996	CRA 1	Total	286	624	398	2.381	9.4	1.567	10.6	0.34	4.2
		Summer	246	532	353	2.257	10.8	1.508	11.8	0.35	4.6
		Winter	40	92	46	3.142	17.7	2.018	20.8	0.30	10.4
	CRA 2	Total	364	1 020	603	2.576	7.2	1.691	6.4	0.27	3.2
		Summer	283	794	430	2.648	7.2	1.846	7.2	0.28	3.7
		Winter	81	226	173	2.324	21.3	1.306	13.3	0.26	6.6
	CRA 9	Total	28	127	21	7.510	10.6	6.145	15.7	0.11	6.5
		Summer	23	113	15	8.652	8.5	7.533	16.6	0.04	4.4
Rock lobster — potting											
1996	CRA 2	Total	90	460	1 053	0.510	15.7	0.437	15.4	0.23	5.8
		Summer	52	174	634	0.353	17.0	0.274	14.8	0.27	8.4
		Winter	38	286	419	0.724	22.9	0.683	22.2	0.18	7.7
Scallops — dredging											
1994	WC Harbours	Total	120	1 662	123	18.39	9.2	13.47	8.8	0.23	5.0
1996	Coromandel	Total	41	689	32	29.53	9.9	21.70	12.4	0.07	4.4
	WC Harbours	Total	122	1 833	224	13.14	13.0	8.17	10.6	0.19	4.4
Scallops — diving											
1994	Coromandel	Total	40	676	38	24.03	12.6	17.78	11.2	0.10	5.3
	Northland	Total	24	510	18	36.57	14.3	27.95	17.4	0.12	7.7
1996	Coromandel	Total	74	1 363	81	27.56	15.5	16.81	10.6	0.11	4.0
	Northland	Total	109	2 034	118	26.93	8.6	17.21	11.2	0.11	3.4
	WC Harbours	Total	21	326	40	12.25	19.9	8.21	15.1	0.19	10.6
Greenshell mussels											
1994	QMA 1	Total	99	3 679	95	56.9	12.2	38.9	8.7	0.06	2.6
1996	QMA 1	Total	110	4 608	84	65.1	6.0	54.7	7.9	0.09	3.0

Table 29: **Comparison by year of harvest rates (fish per hour) for several finfish species caught essentially as bycatch of the snapper fishery (baited-line and jigging with a range of possible target species). See Table 2 for an explanation of the headings. The c.v.s are expressed as percentages**

Year	Area	Time	n	Fish	Hours	H_2	c.v.	p_0	c.v.
Blue cod									
1991	QMA 1	Total	16 593	253	56 411	0.004	10.1	0.99	7.7
		Summer	13 666	168	46 359	0.004	10.7	0.99	9.2
		Winter	2 927	85	10 052	0.008	21.4	0.98	14.2
	QMA 9	Total	2 749	10	10 003	0.001	67.8	1.00	57.7
1994	QMA 1	Total	18 809	492	66 100	0.007	10.3	0.99	6.2
		Summer	13 770	236	49 144	0.005	16.6	0.99	8.8
		Winter	5 039	256	16 956	0.015	12.6	0.97	8.8
	QMA 9	Total	2 522	23	8 664	0.003	28.5	0.99	25.7
1996	QMA 1	Total	10 552	143	37 701	0.004	12.0	0.99	9.7
		Summer	7 539	102	26 431	0.004	15.0	0.99	11.6
		Winter	3 013	41	11 270	0.004	18.7	0.99	17.3
	QMA 9	Total	2 265	22	8 417	0.003	29.4	0.99	24.9
Blue maomao									
1991	QMA 1	Total	16 593	1 360	56 411	0.024	8.1	0.98	4.9
		Summer	13 666	1 058	46 359	0.023	9.4	0.98	5.6
		Winter	2 927	302	10 052	0.030	15.1	0.96	9.7
	QMA 9	Total	2 749	21	10 003	0.002	49.2	1.00	40.8
1994	QMA 1	Total	18 809	1 395	66 100	0.021	6.7	0.98	4.6
		Summer	13 770	1 242	49 144	0.025	7.2	0.97	4.9
		Winter	5 039	153	16 956	0.009	16.2	0.99	12.6
1996	QMA 1	Total	10 552	665	37 701	0.018	10.7	0.98	6.8
		Summer	7 539	578	26 431	0.022	11.7	0.98	7.5
		Winter	3 013	87	11 270	0.008	23.8	0.99	16.6
John dory									
1991	QMA 1	Total	16 593	179	56 411	0.003	8.3	0.99	7.8
		Summer	13 666	111	46 359	0.002	10.6	0.99	10.0
		Winter	2 927	68	10 052	0.007	13.2	0.98	12.6
1994	QMA 1	Total	18 809	345	66 100	0.005	6.7	0.98	5.8
		Summer	13 770	191	49 144	0.004	8.1	0.99	7.6
		Winter	5 039	154	16 956	0.009	11.3	0.98	9.0
1996	QMA 1	Total	10 552	267	37 701	0.007	7.3	0.98	6.6
		Summer	7 539	174	26 431	0.007	8.9	0.98	8.1
		Winter	3 013	93	11 270	0.008	12.5	0.97	11.3

Table 29 — continued

Year	Area	Time	n	Fish	Hours	H_2	c.v.	p_0	c.v.
Jack mackerel									
1991	QMA 1	Total	16 593	1 442	56 411	0.026	7.9	0.97	4.3
		Summer	13 666	1 246	46 359	0.027	8.5	0.97	4.6
		Winter	2 927	196	10 052	0.019	20.3	0.98	12.0
	QMA 9	Total	2 749	64	10 003	0.006	21.1	0.99	17.0
		Summer	2 422	57	8 642	0.007	22.7	0.99	18.1
1994	QMA 1	Total	18 809	5 230	66 100	0.079	4.0	0.91	2.4
		Summer	13 770	4 604	49 144	0.094	4.3	0.90	2.5
		Winter	5 039	626	16 956	0.037	8.9	0.95	6.4
	QMA 9	Total	2 522	166	8 664	0.019	14.6	0.97	10.5
		Summer	1 998	159	6 851	0.023	15.1	0.96	10.9
1996	QMA 1	Total	10 552	1 500	37 701	0.040	6.7	0.95	4.4
		Summer	7 539	1 284	26 431	0.049	7.4	0.95	4.9
		Winter	3 013	216	11 270	0.019	14.6	0.97	9.8
	QMA 9	Total	2 265	72	8 417	0.009	18.3	0.98	16.1
		Summer	1 758	66	6 634	0.010	19.5	0.98	17.2
Kingfish									
1991	QMA 1	Total	16 593	489	56 411	0.009	6.4	0.98	5.2
		Summer	13 666	423	46 359	0.009	7.1	0.98	5.6
		Winter	2 927	66	10 052	0.007	14.9	0.98	13.5
	QMA 9	Total	2 749	23	10 003	0.002	27.8	0.99	24.9
1994	QMA 1	Total	18 809	287	66 100	0.004	7.3	0.99	6.4
		Summer	13 770	245	49 144	0.005	7.5	0.98	6.8
		Winter	5 039	42	16 956	0.002	23.5	0.99	18.5
	QMA 9	Total	2 522	72	8 664	0.008	25.2	0.99	17.3
1996	QMA 1	Total	10 552	231	37 701	0.006	8.4	0.98	7.1
		Summer	7 539	180	26 431	0.007	8.3	0.98	7.8
		Winter	3 013	51	11 270	0.005	24.4	0.99	16.6
	QMA 9	Total	2 265	23	8 417	0.003	22.5	0.99	21.7
Koheru									
1991	QMA 1	Total	16 593	1 374	56 411	0.024	6.8	0.97	4.4
		Summer	13 666	1 218	46 359	0.026	7.3	0.97	4.7
		Winter	2 927	156	10 052	0.016	17.9	0.98	12.8
	QMA 9	Total	2 749	81	10 003	0.008	15.9	0.98	13.9
1994	QMA 1	Total	18 809	386	66 100	0.006	11.6	0.99	8.6
		Summer	13 770	336	49 144	0.007	12.7	0.99	9.3
		Winter	5 039	50	16 956	0.003	27.8	1.00	22.9
1996	QMA 1	Total	10 552	718	37 701	0.019	10.7	0.98	6.7
		Summer	7 539	580	26 431	0.022	12.4	0.98	7.4
		Winter	3 013	138	11 270	0.012	19.4	0.99	15.5

Table 29 — continued

Year	Area	Time	n	Fish	Hours	H_2	c.v.	Po	c.v.
Pink maomao									
1991	QMA 1	Total	16 593	323	56 411	0.006	16.3	0.99	10.4
		Summer	13 666	169	46 359	0.004	16.2	1.00	12.7
		Winter	2 927	154	10 052	0.015	29.1	0.99	18.2
1994	QMA 1	Total	18 809	272	66 100	0.004	13.1	1.00	10.5
		Summer	13 770	254	49 144	0.005	13.4	0.99	10.9
		Winter	5 039	18	16 956	0.001	38.8	1.00	37.8
1996	QMA 1	Total	10 552	197	37 701	0.005	14.3	0.99	11.7
		Summer	7 539	116	26 431	0.004	18.8	0.99	15.0
		Winter	3 013	81	11 270	0.007	23.2	0.99	18.5
Red snapper									
1991	QMA 1	Total	16 593	251	56 411	0.004	15.0	0.99	10.6
		Summer	13 666	129	46 359	0.003	16.6	1.00	13.3
		Winter	2 927	122	10 052	0.012	25.4	0.99	47.3
1994	QMA 1	Total	18 809	324	66 100	0.006	14.5	0.99	8.7
		Summer	13 770	269	49 144	0.005	16.6	0.99	9.9
		Winter	5 039	55	16 956	0.003	27.2	0.99	18.8
1996	QMA 1	Total	10 552	144	37 701	0.004	15.1	0.99	11.4
		Summer	7 539	97	26 431	0.004	18.3	0.99	13.8
		Winter	3 013	47	11 270	0.004	26.8	0.99	20.3
	QMA 9	Total	2 265	39	8 417	0.005	65.4	1.00	44.7
Trevally									
1991	QMA 1	Total	16 593	1 117	56 411	0.020	4.9	0.96	3.7
		Summer	13 666	783	46 359	0.017	5.4	0.96	4.3
		Winter	2 927	334	10 052	0.033	10.2	0.94	7.1
	QMA 9	Total	2 749	297	10 003	0.030	8.6	0.93	7.0
		Summer	2 422	263	8 642	0.030	9.0	0.93	7.4
		Winter	327	34	1 362	0.025	27.2	0.94	22.3
1994	QMA 1	Total	18 809	1 470	66 100	0.022	4.5	0.95	3.3
		Summer	13 770	916	49 144	0.019	5.0	0.96	4.0
		Winter	5 039	554	16 956	0.033	8.6	0.95	6.1
	QMA 9	Total	2 522	413	8 664	0.048	8.1	0.90	5.9
		Summer	1 998	331	6 851	0.048	9.5	0.90	6.7
		Winter	524	82	1 813	0.045	14.5	0.89	12.3
1996	QMA 1	Total	10 552	1 548	37 701	0.041	4.1	0.91	3.1
		Summer	7 539	1 079	26 431	0.041	4.8	0.91	3.7
		Winter	3 013	469	11 270	0.042	8.1	0.91	5.9
	QMA 9	Total	2 265	291	8 417	0.035	10.3	0.92	7.4
		Summer	1 758	191	6 634	0.029	11.4	0.93	8.8
		Winter	507	100	1 783	0.056	20.7	0.90	13.3

Table 30: Coefficients in the weight-length relation $W = a L^b$ for the finfish species for which a mean weight estimate is made. W is the greenweight and L the length (usually forklength, but total length where appropriate). Common and species names are included. Unpublished sources are given as Annala *et al.* (1998).

Fishstock	Common name	Scientific name	a	b	Source
BAR (all)	Barracouta	*Thyrsites atun*	0.0075	2.900	Hurst & Bagley (1994)
BCO (all)	Blue cod	*Parapercis colias*	0.0102	3.123	Blackwell (1997)
EMA (all)	Blue mackerel	*Scomber australasicus*	0.0088	3.110	Annala *et al.* (1998)
GMU (all)	Grey mullet	*Mugil cephalus*	0.0360	2.754	Annala *et al.* (1998)
FLA (all)	Flatfish[1]		0.0380	2.660	Annala *et al.* (1998)
GUR 1	Red gurnard	*Chelidonichthys kumu*	0.0100	2.990	Elder (1976)
GUR 7			0.0053	3.190	Stevenson (1998)
JDO (all)	John dory	*Zeus faber*	0.0364	2.900	Hore (1982)
KAH 1&9	Kahawai	*Arripis trutta*	0.1024	2.502	Bradford (1998a)
KIN (all)	Kingfish	*Seriola lalandi lalandi*	0.0246	2.845	Annala *et al.* (1998)
SNA (all)	Snapper	*Pagrus auratus*	0.0447	2.793	Paul (1976)
TAR (all)	Tarakihi	*Nemadactylus macropterus*	0.0141	3.087	Tong & Vooren (1972)
TRE (all)	Trevally	*Pseudocaranx dentex*	0.0160	3.064	James (1984)
ALB 1991	Albacore tuna	*Thunnus alalunga*	0.0107	3.136	MFish data[2]
ALB 1994			0.0965	2.627	MFish data[2]
ALB 1996			0.0038	3.346	MFish data[2]
SKJ	Skipjack tuna	*Katsuwonus pelamis*	0.0075	3.230	MFish data[2]

[1] Several species of flounder, sole, and turbot are included in this grouping

[2] Weight-length relations for the tunas were derived from data extracted from the observer database by Lynda Griggs. There are over 15 000 sets of green weight and length for albacore but only 25 for skipjack. Data from the year of the boat ramp survey were used for albacore to determine the weight length relation.

Table 31: **Mean weight (W_M in g), mean length (L_M in cm), their *c.v.s*, and the number of points in the sample (*N*) for data from the boat ramp surveys conducted in the North region in 1991, 1994, and 1996. The *c.v.s* are expressed as percentages**

Fishstock	Survey	*N*	W_M	*c.v.*(W_M)	L_M	*c.v.*(L_M)
Snapper (Jan – Jun)						
SNA 1	North 1991	19 670	775	1	31.5	0.2
SNA 1	North 1994	18 596	719	1	30.9	0.1
SNA 1	National	13 730	886	1	33.3	0.2
SNA 8	North 1991	3 040	649	1	29.8	0.3
SNA 8	North 1994	2 956	658	2	30.0	0.4
SNA 8	National	1 960	877	2	32.9	0.5
East Northland	North 1991	2 255	836	2	31.5	0.6
East Northland	North 1994	2 582	849	2	32.2	0.5
East Northland	National	3 949	1 026	1	34.5	0.4
Gulf & Bay	North 1991	17 912	769	1	31.5	0.2
Gulf & Bay	North 1994	18 502	724	1	31.1	0.1
Gulf & Bay	National	10 697	849	1	33.0	0.2
Snapper (Jan – Dec)						
East Northland	North 1991	2 350	836	2	31.4	0.6
East Northland	North 1994	2 582	849	2	32.2	0.5
East Northland	National	4 204	1 038	1	34.6	0.4
Gulf & Bay	North 1991	18 286	775	1	31.5	0.2
Gulf & Bay	North 1994	18 502	724	1	31.1	0.1
Gulf & Bay	National	11 902	869	1	33.2	0.2
Kahawai (Jan – Jun)						
KAH 1	North 1991	4 708	1 193	1	40.7	0.3
KAH 1	North 1994	1 920	1 321	1	42.4	0.5
KAH 1	National	2 969	1 485	1	44.8	0.4
KAH 9	North 1991	2 213	1 192	1	40.9	0.4
KAH 9	North 1994	1 101	1 168	2	40.3	0.7
KAH 9	National	1 192	1 005	2	37.7	0.7
East Northland	North 1991	475	1 267	2	41.7	1
East Northland	North 1994	458	1 375	2	43.4	0.9
East Northland	National	1 046	1 599	1	46.7	0.5
Hauraki Gulf	North 1991	1 034	841	2	35.4	0.7
Hauraki Gulf	North 1994	896	1 167	2	39.9	0.9
Hauraki Gulf	National	614	1 007	2	38.0	0.9
Bay of Plenty	North 1991	3 434	1 290	1	42.2	0.4
Bay of Plenty	North 1994	950	1 437	2	44.1	0.7
Bay of Plenty	National	1 545	1 556	1	45.6	0.5
Kahawai (Jan – Dec)						
Bay of Plenty	North 1991	3 660	1 278	1	42.0	0.3
Bay of Plenty	North 1994	950	1 437	2	44.1	0.7
Bay of Plenty	National	1 731	1 536	1	45.3	0.5

Table 31 — continued

Fishstock	Survey	*N*	W_M	*c.v.*(W_M)	L_M	*c.v.*(L_M)
Tarakihi						
TAR 1	North 1991	911	698	2	32.6	0.4
TAR 1	North 1994	442	639	3	31.5	0.7
TAR 1	National	1 183	611	1	31.3	0.3
Red gurnard						
GUR 1	North 1991	4 150	432	1	34.8	0.2
GUR 1	North 1994	1 671	437	1	35.1	0.3
GUR 1	National	1 578	411	1	34.3	0.3
Trevally						
TRE 1	North 1991	1 075	1 150	2	36.5	0.7
TRE 1	North 1994	825	1 266	2	38.1	0.7
TRE 1	National	1 129	1 180	2	37.4	0.6
TRE 7	North 1991	375	930	4	33.7	1.3
TRE 7	North 1994	299	970	4	34.9	1.2
TRE 7	National	241	1 061	4	36.1	1.3
Blue cod						
BCO 1	North 1991	210	430	5	29.1	1.3
BCO 1	North 1994	221	457	5	29.7	1.3
BCO 1	National	125	564	4	32.1	1.5
John dory						
JDO 1	North 1991	178	1 779	3	40.5	1.2
JDO 1	North 1994	282	1 831	2	41.2	0.7
JDO 1	National	251	1 997	2	42.3	0.9
Jack mackerel						
JMA 1	North 1991	1 091	324	2	27.2	0.5
JMA 1	North 1994	716	266	1	25.6	0.5
JMA 1	National	175	324	3	27.4	1.1
Blue mackerel						
EMA 1	North 1991	95	453	6	31.6	1.9
EMA 1	North 1994	55	315	7	28.3	2.3
EMA 1	National	2	429	42	31.5	14.3
Flatfish						
FLA 1	North 1994	183	342	2	30.3	0.9
FLA 1	National	459	339	1	30.4	0.4
Grey mullet						
GMU 1	North 1994	54	883	5	38.7	1.8
GMU 1	National	240	979	2	40.3	0.7
Kingfish						
KIN	North 1991	637	3 035	4	56.6	1.2
KIN	North 1994	282	4 398	5	66.5	1.4
KIN	National	266	7 429	5	79.4	1.6

Table 31 — continued

Fishstock	Survey	N	W_M	c.v.(W_M)	L_M	c.v.(L_M)
Barracouta						
BAR	North 1991	31	2 961	7	83.3	2.8
BAR	North 1994	40	2 349	11	73.6	4.4
BAR	National	68	2 879	5	82.4	1.9
Albacore						
ALB	North 1991	194	2 138	2	48.5	0.7
ALB	North 1994	85	3 395	3	52.8	1.6
ALB	National	119	4 212	3	62.2	1.5
Skipjack						
SKJ	North 1991	226	2 874	2	57.0	0.6
SKJ	North 1994	195	2 340	3	49.5	0.8
SKJ	National	202	2 845	4	51.8	1.2
Koheru						
KOH	North 1991	1 135			26.4	0.5
KOH	North 1994	144			27.2	1.5
KOH	National	74			28.1	2.6
Parore						
PAR	North 1991	29			33.2	3.6
PAR	North 1994	34			31.3	2.0
PAR	National	79			35.1	2.2
Red snapper						
RSN	North 1991	179			26.5	0.9
RSN	North 1994	121			27.1	1.3
RSN	National	144			29.2	1.1
Pink maomao						
PMA	North 1991	175			30.1	1.2
PMA	North 1994	176			32.9	1.0
PMA	National	163			31.8	0.9

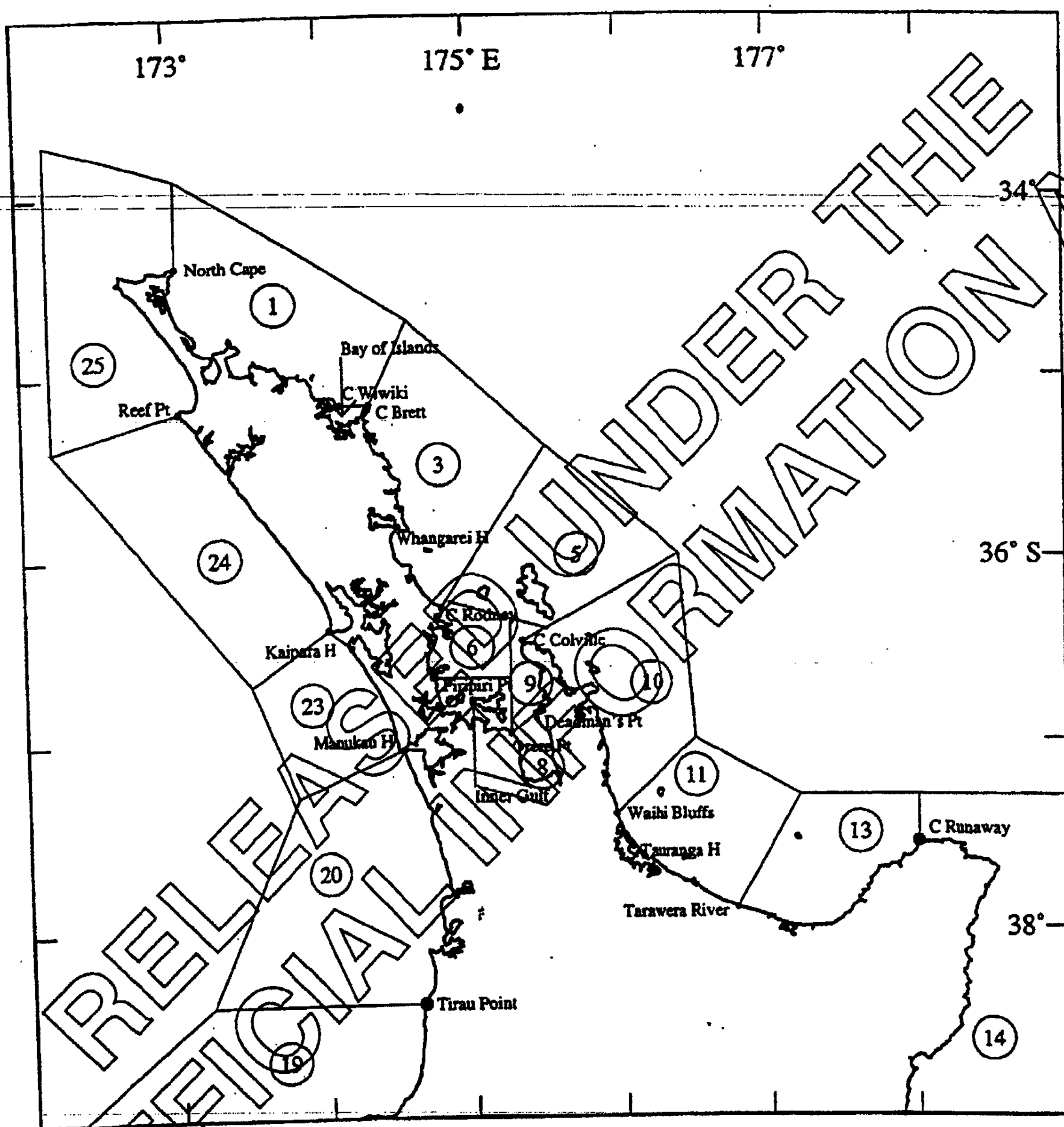

Figure 1: Map of the North region of New Zealand showing the diary zones numbered as in the 1996 national diary survey. The names are used for the diary zones in this report are: 1 – North Cape to Cape Brett; 2 – Bay of Islands; 3 – Cape Brett to Cape Rodney; 4 – Whangarei Harbour; 5 – Barrier Islands; 6 – Western Gulf; 7 – Inner Gulf; 8 – Firth of Thames; 9 – Eastern Gulf; 10 – Northern Bay of Plenty; 11 – Middle Bay of Plenty; 12 – Tauranga Harbour; 13 – Eastern Bay of Plenty; 20 – Waikato; 21 – Manukau Harbour; 22 – Kaipara Harbour; and 24 – Dargaville.

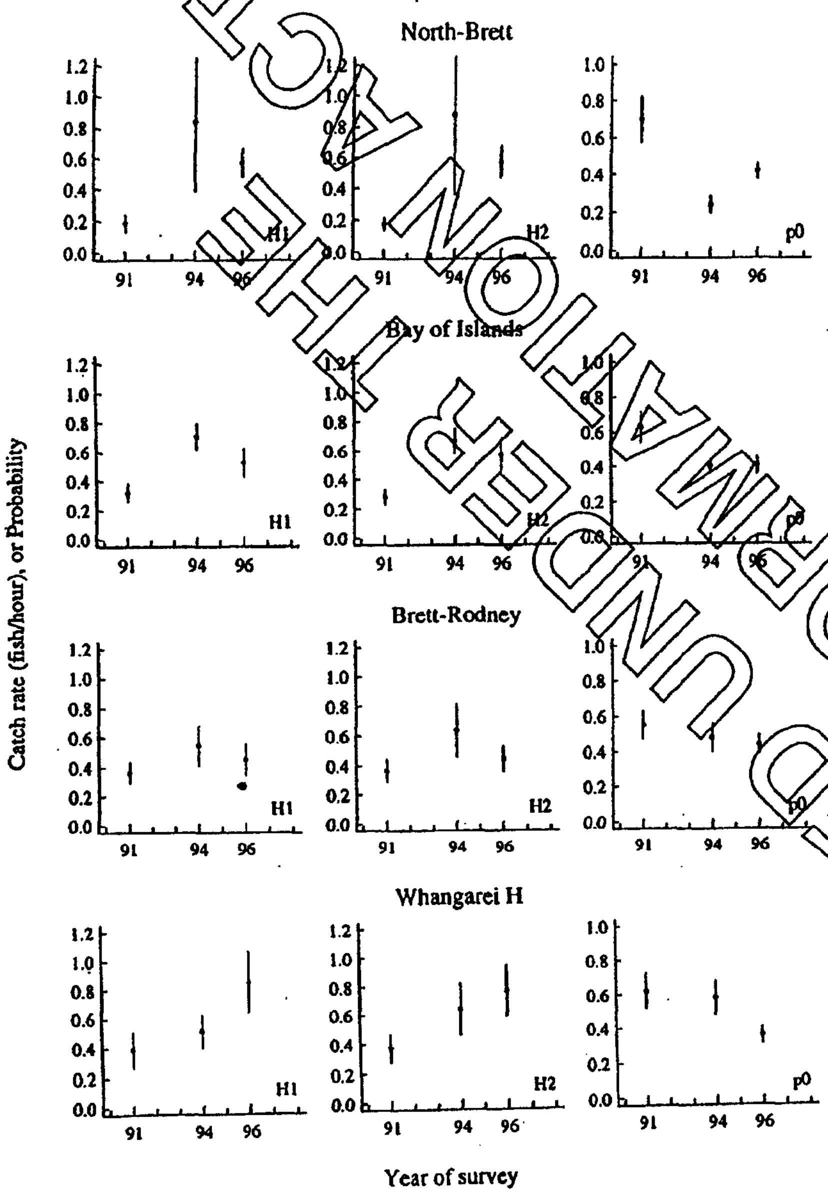

Figure 2: Mean-of-ratios (H_1) and ratio-of-means (H_2) snapper harvest rates and the probability that snapper were not caught (p_0). The data are for trips using a baited line, jigging, or jigging with a bait, and where the target species was snapper or general. The resul[illegible] re plotted by diary zone in east Northland.

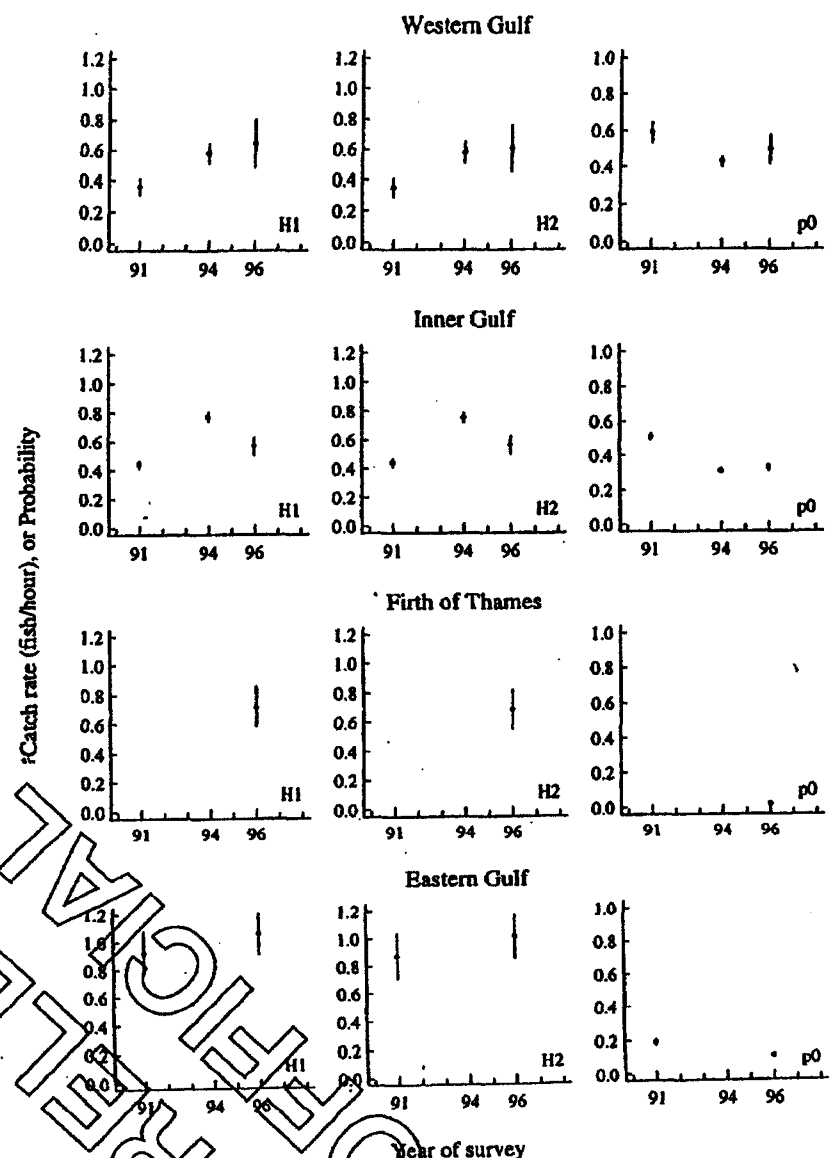

Figure 3: Mean-of-ratios (H_1) and ratio-of-means (H_2) snapper harvest rates and the probability that snapper were not caught (p_0). The data are for trips using a baited line, jigging, or jigging with a bait, and [illegible] re the target species was snapper or general. The results are plotted by diary zone in the Hau[illegible] Gulf.

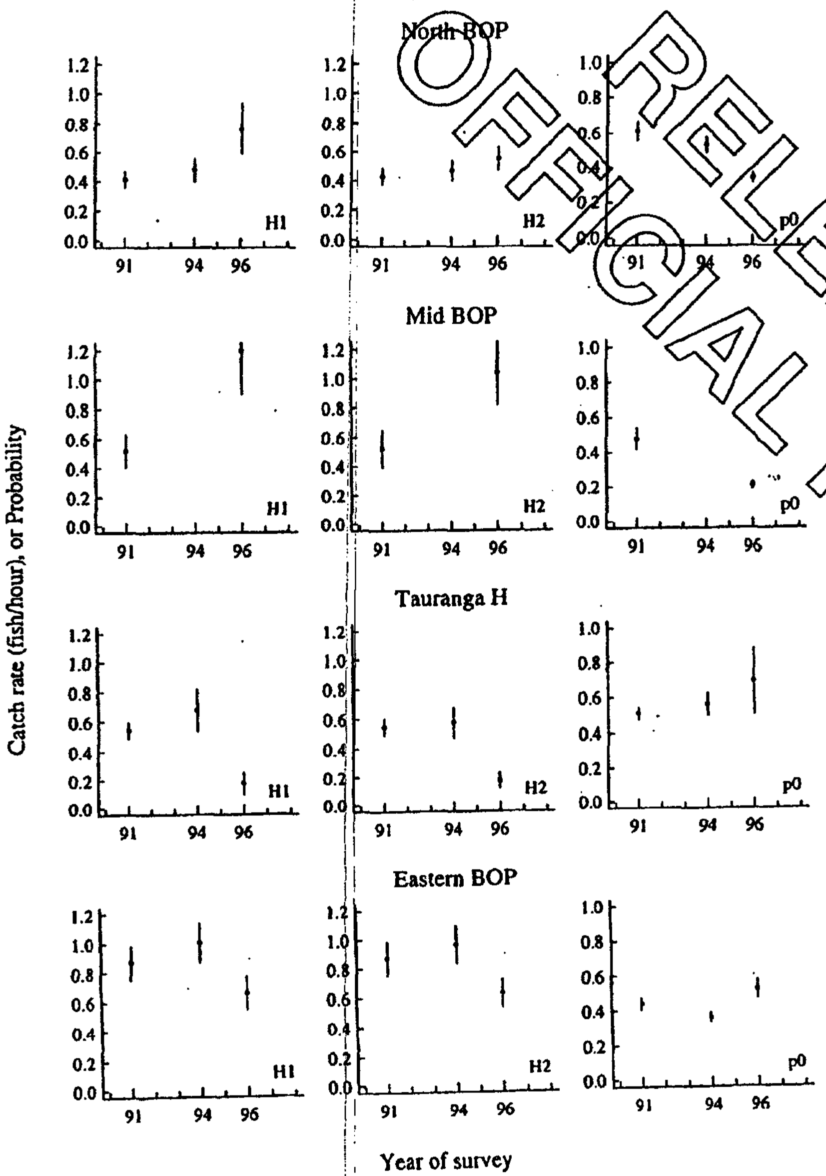

Figure 4: Mean-of-ratios (H_1) and ratio-of-means (H_2) snapper harvest rates and the probability that snapper were not caught (p_0). The data are for trips using a baited line, jigging, or jigging with a bait, and where the target species was snapper or general. The res[illegible] are plotted by diary zone in the Bay of Plenty.

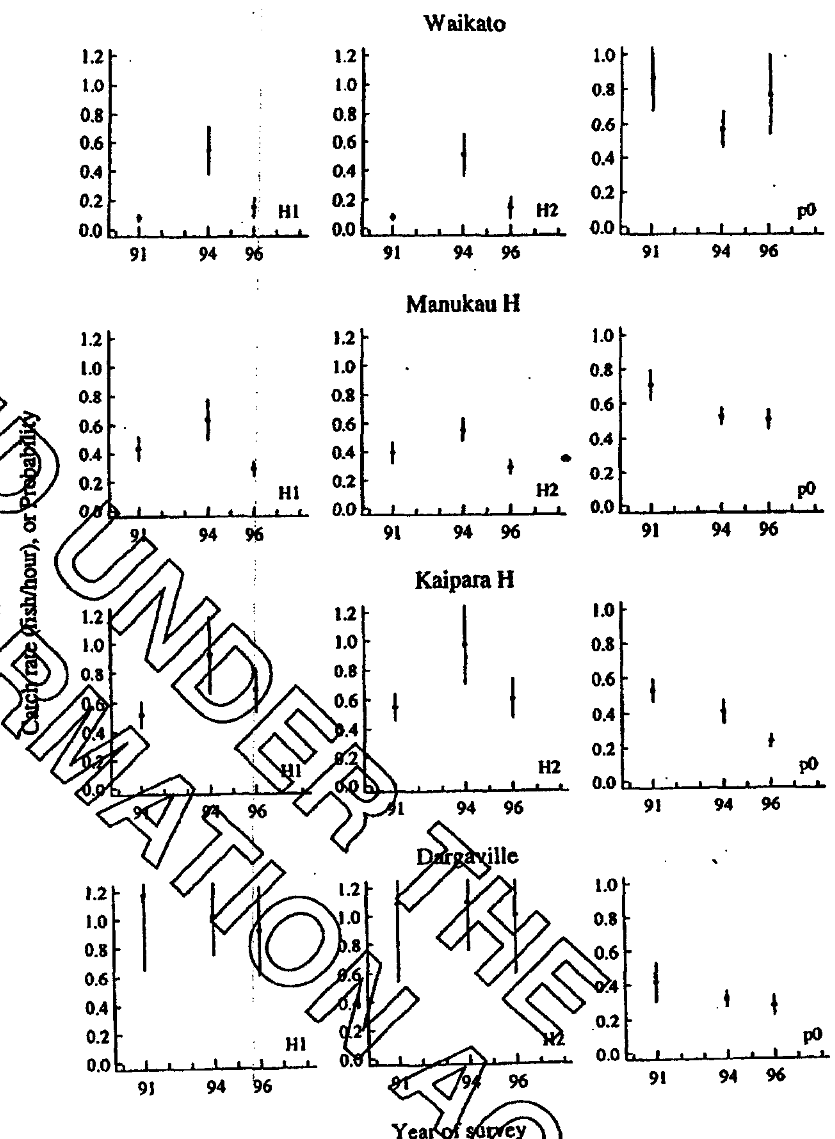

Figure 5: Mean-of-ratios (H_1) and ratio-of-means (H_2) snapper harvest rates and the probability that snapper were not caught (p_0). The data are for trips using a baited line, jigging, or jigging with a bait, and where the target species was snapper or general. The results are plotted by diary zone on the [illegible] coast of the North Island.

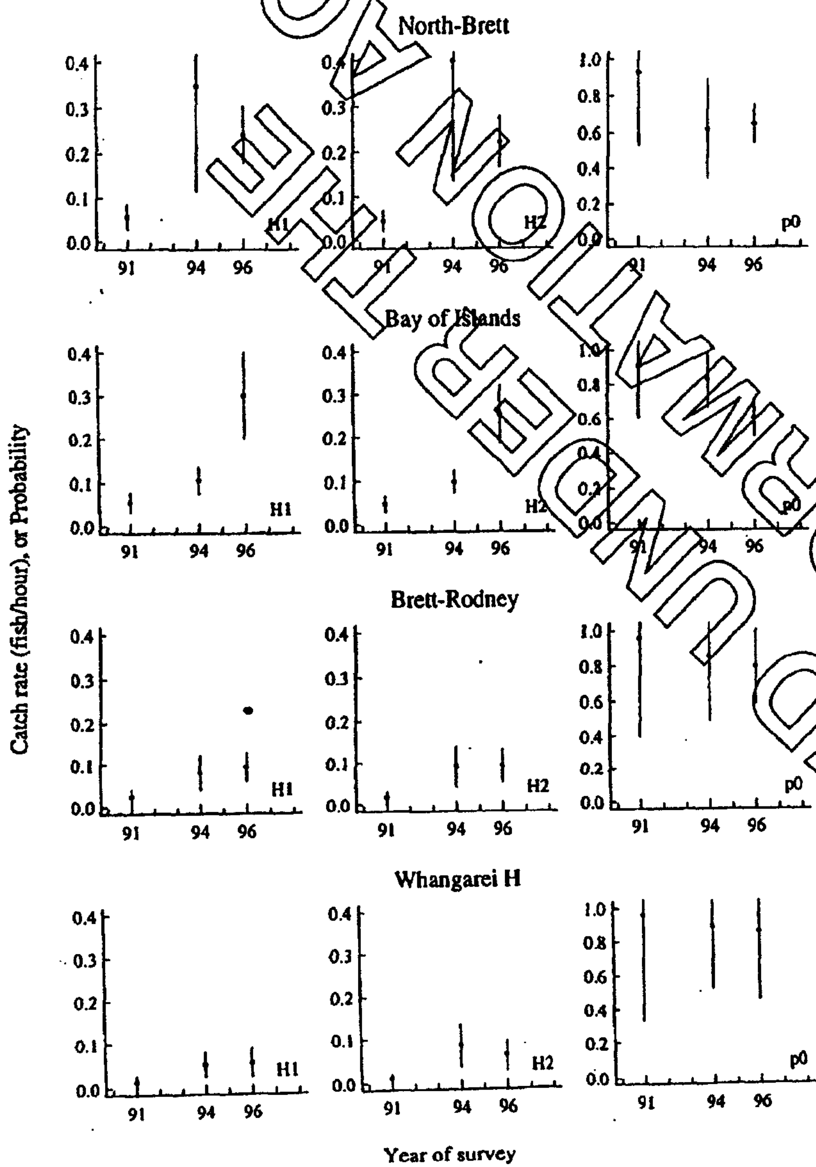

Figure 6: Mean-of-ratios (H_1) and ratio-of-means (H_2) kahawai harvest ra[illegible] d the probability that kahawai were not caught (p_0). The data are for trips using a baited line, jigging, or jigging with a bait, and where the target species was kahawai, snapper, or general. The results are plotted

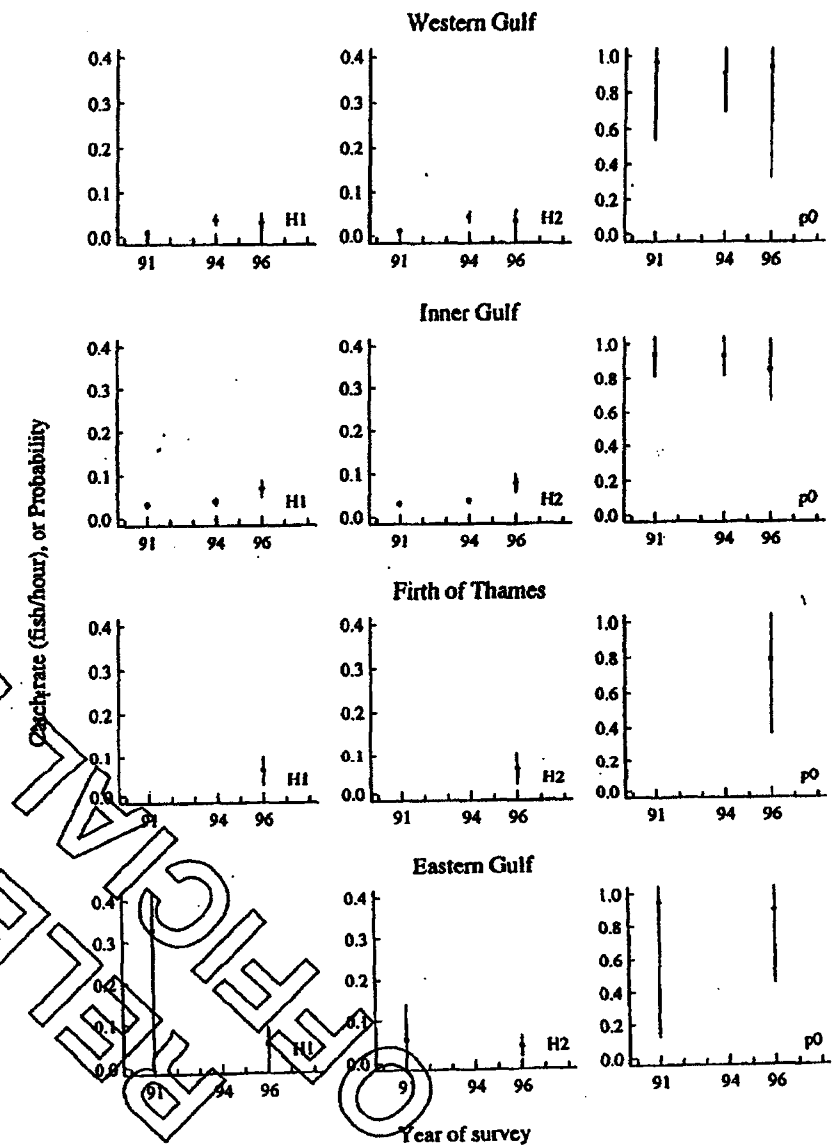

Figure 7: Mean [illegible] atios (H_1) and ratio-of-means (H_2) kahawai harvest rates and the probability that kahawai we[illegible] not caught (p_0). The data are for trips using a baited line, jigging, or jigging with a bait, and where the target species was kahawai, snapper, or general. The results are plotted

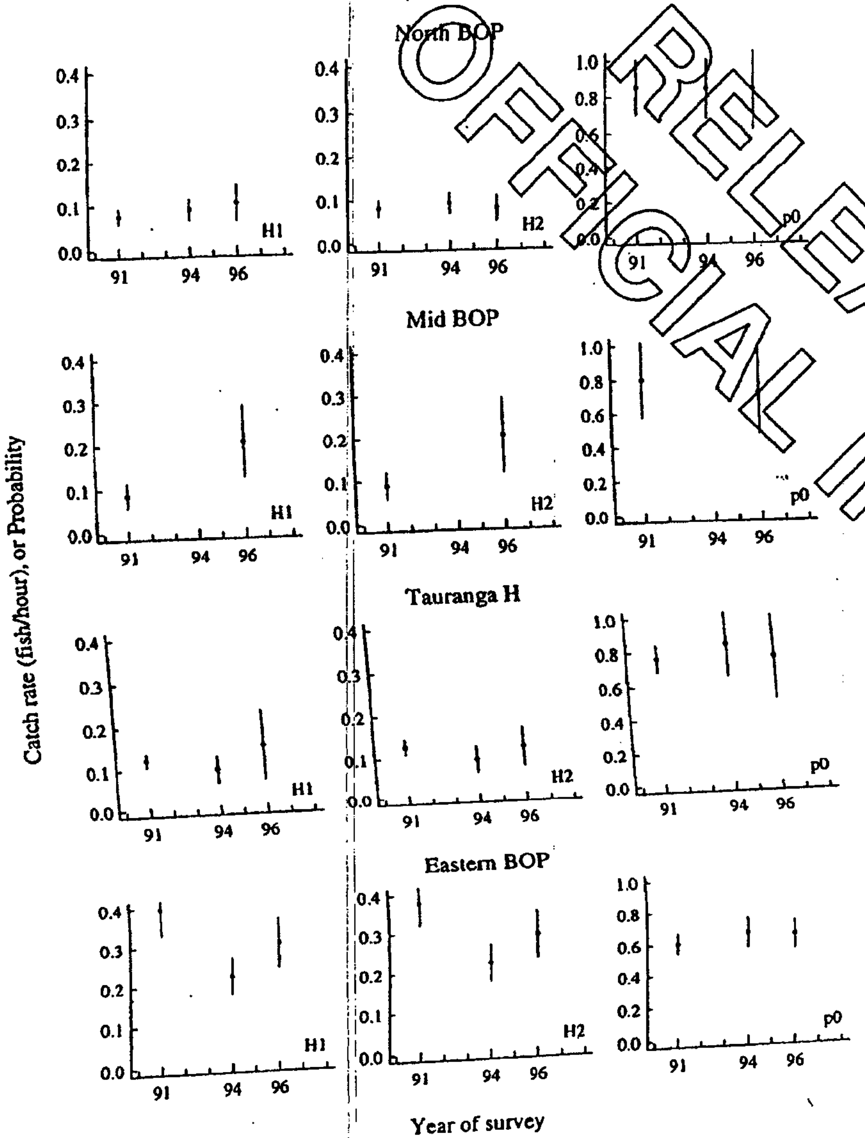

Figure 8: Mean-of-ratios (H_1) and ratio-of-means (H_2) kahawai harvest rates and the probability that kahawai were not caught (p_0). The data are for trips using a baited line, jigging, or jigging with a bait, and where the target species was kahawai, snapper, or general. The results are plotted by diary zone in the Bay of Plenty.

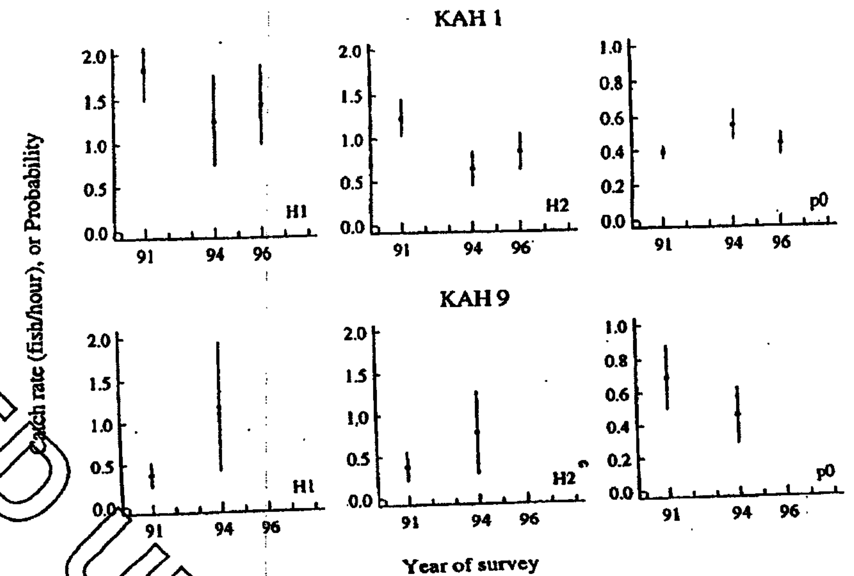

Figure 9: Mean-of-ratios (H_1) and ratio-of-means (H_2) kahawai harvest rates and the probability that kahawai were not caught (p_0). The data are for trips where kahawai was the target species. The data are plotted for the kahawai Fishstocks, KAH 1 and KAH 9.

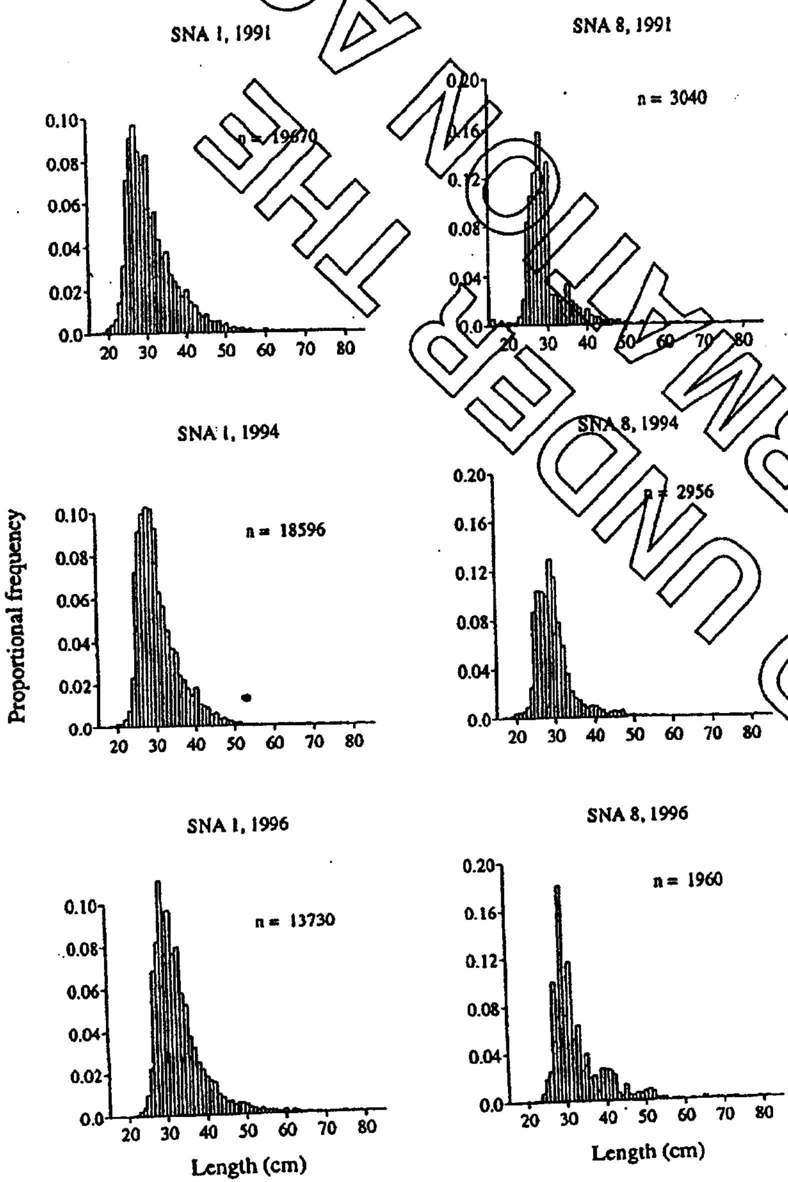

Figure 10: Snapper length frequencies from SNA 1 and SNA 8 measured at boat ramps in the North region in 1991, 1994, and 1996. Data collected between January and June are used. The

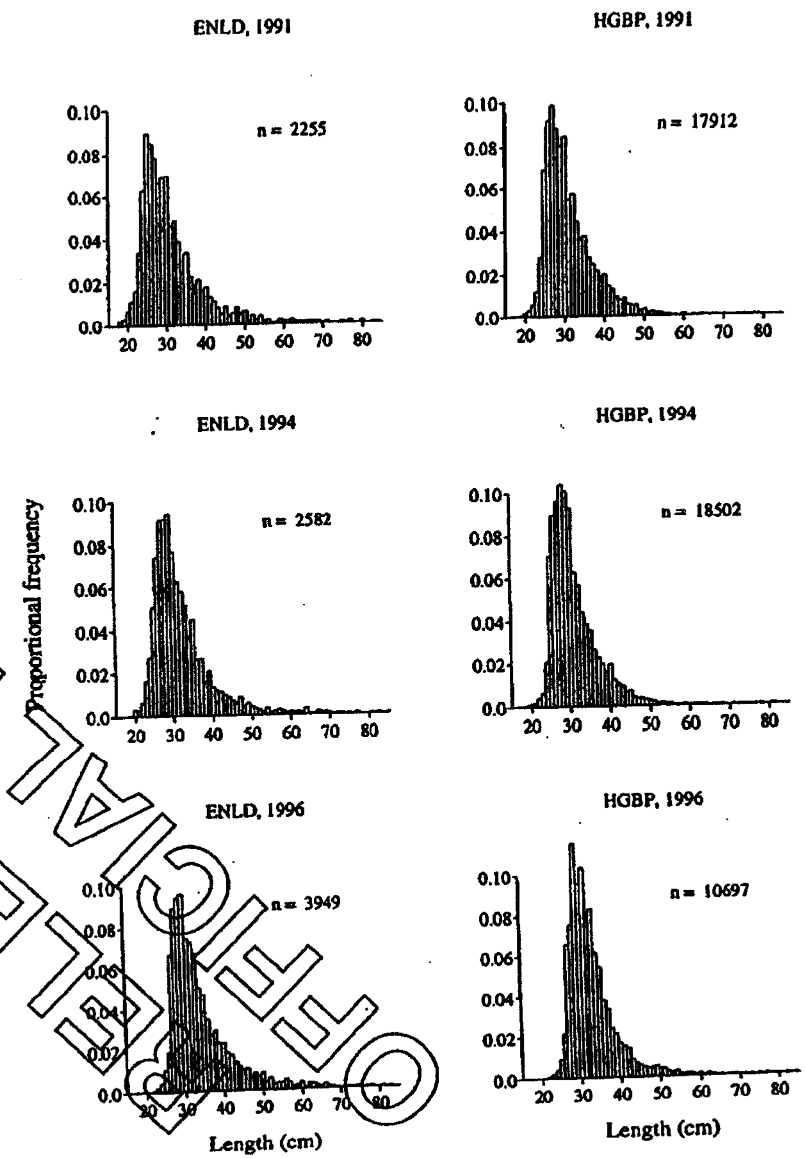

Figure 11: Snapper length frequencies from East Northland (ENLD) and from the Hauraki Gulf and the Bay of Plenty (HGBP) measured at boat ramps in the North region in 1991, 1994, and

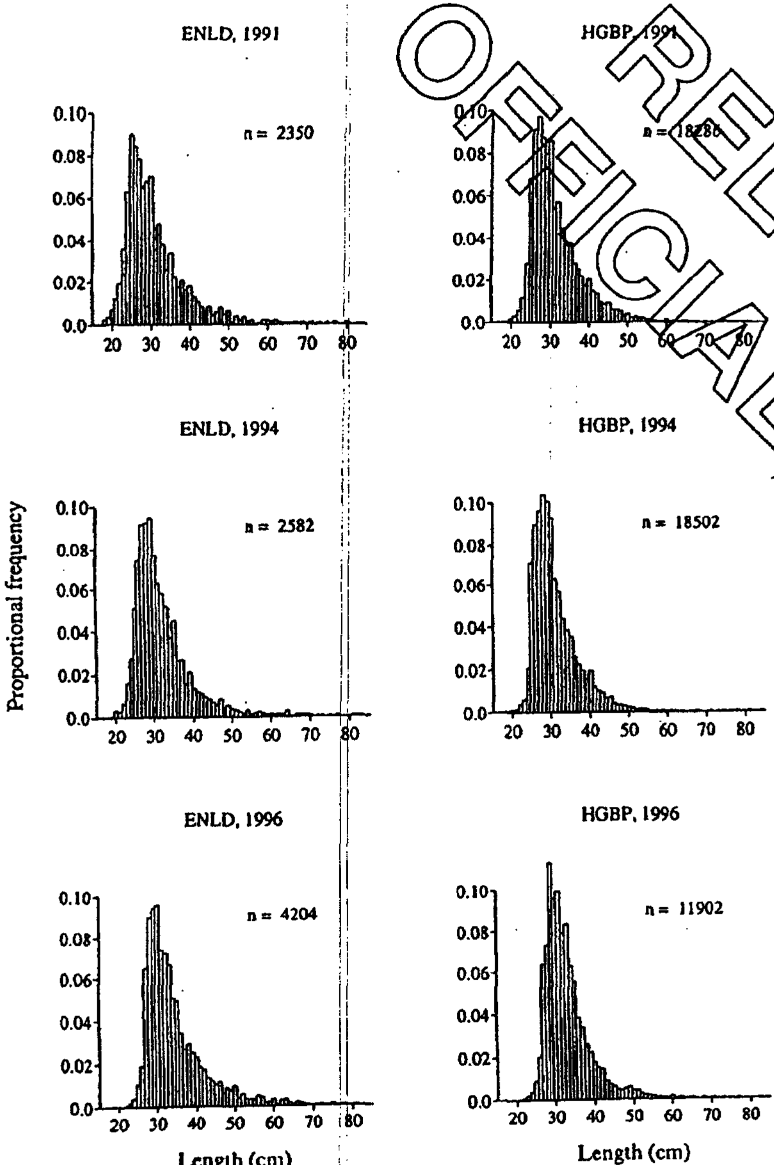

Figure 12: Snapper length frequencies from East Northland (ENLD) and from the Hauraki Gulf and the Bay of Plenty (HGBP) measured at boat ramps in the North region in 1991, 1994, and 1996. Data collected between January and December are used. The mini[illegible] legal size increased from 25 cm to 27 cm on 1 December 1994.

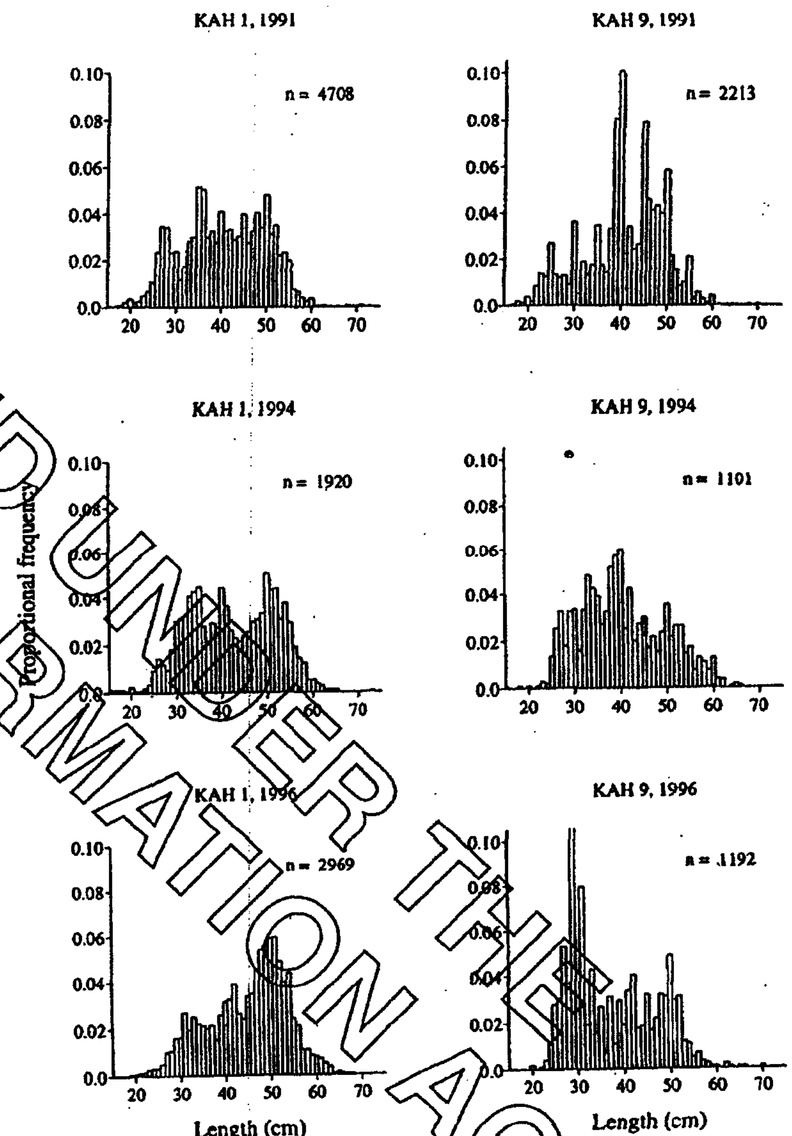

Figure 13: Kahawai length frequencies from KAH 1 and KAH 9 measured at boat ramps in the North region in 1991, 1994, and 1996. Data collected between January and June are used.

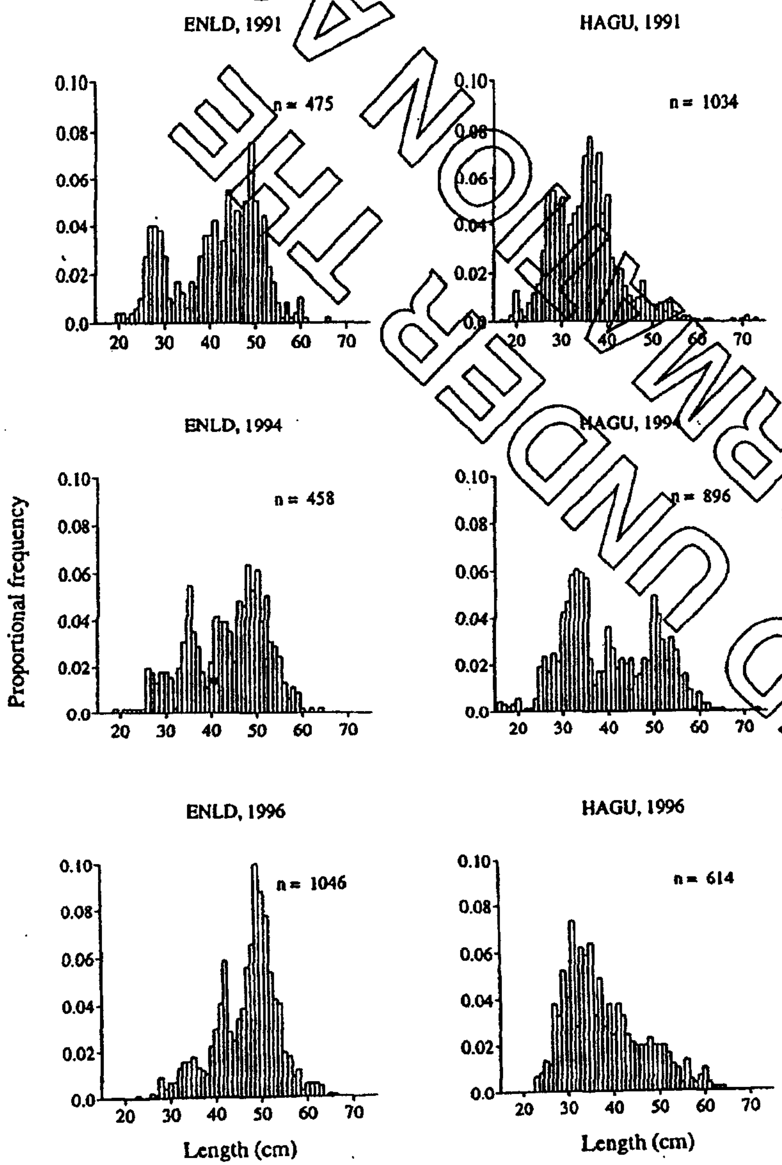

Figure 14: Kahawai length frequencies from East Northland (ENLD) and the Hauraki Gulf (HAGU) measured at boat ramps in the North region in 1991, 1994, and 1996. Data collected

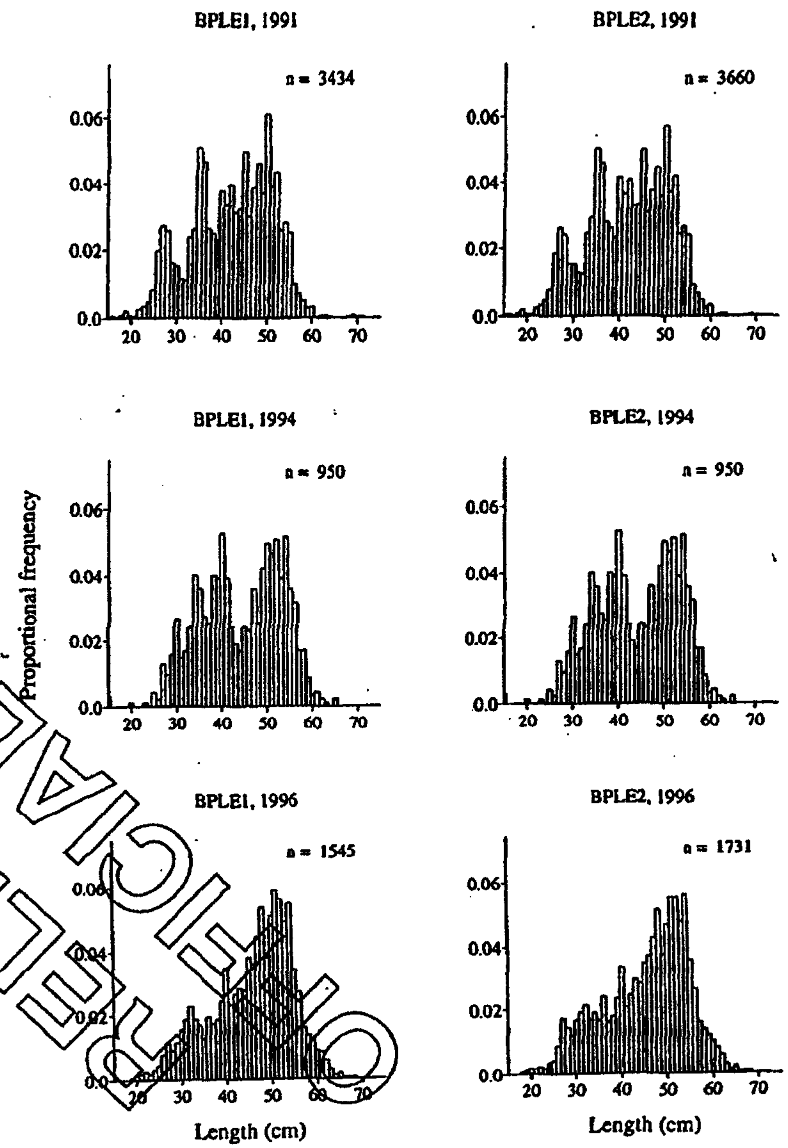

Figure 15: Kahawai length frequencies from the Bay of Plenty measured at boat ramps in the North region in 1991, 1994, and 1996. Data collected

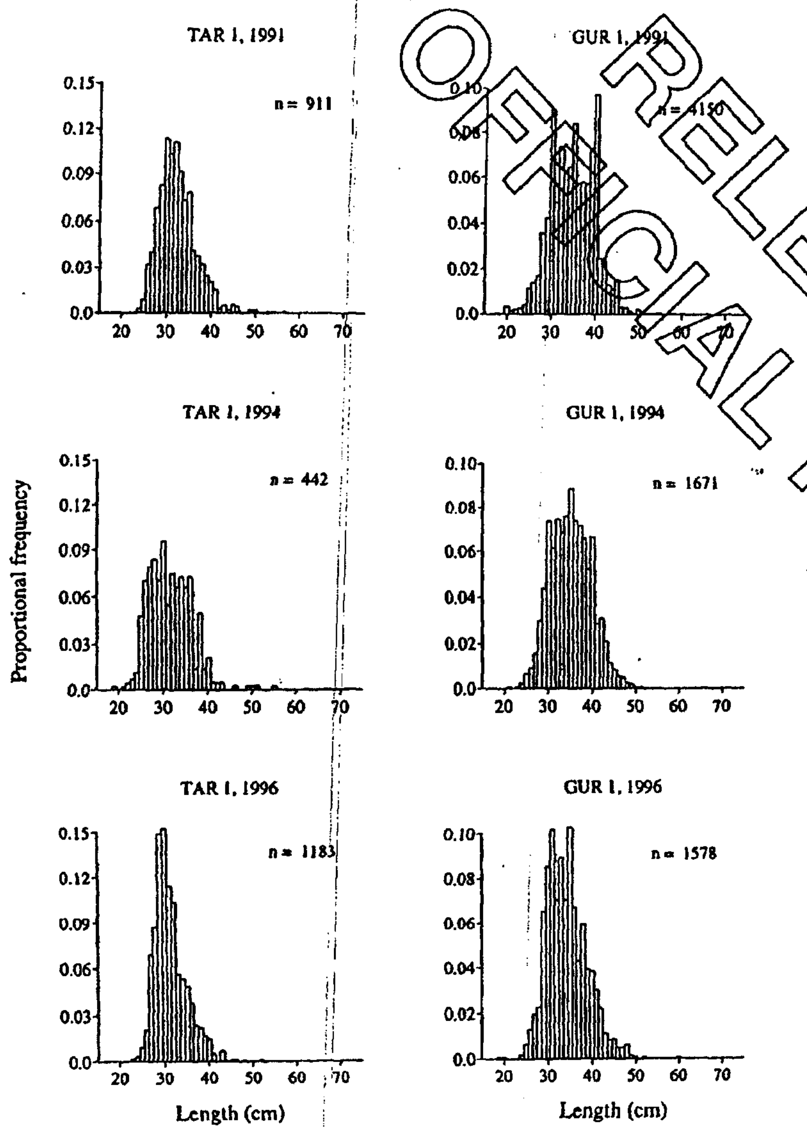

Figure 16: Tarakihi length frequencies from TAR 1 and red gurnard length frequencies from GUR 1 measured at boat ramps in the North region in 1991, 1994, and 1996.

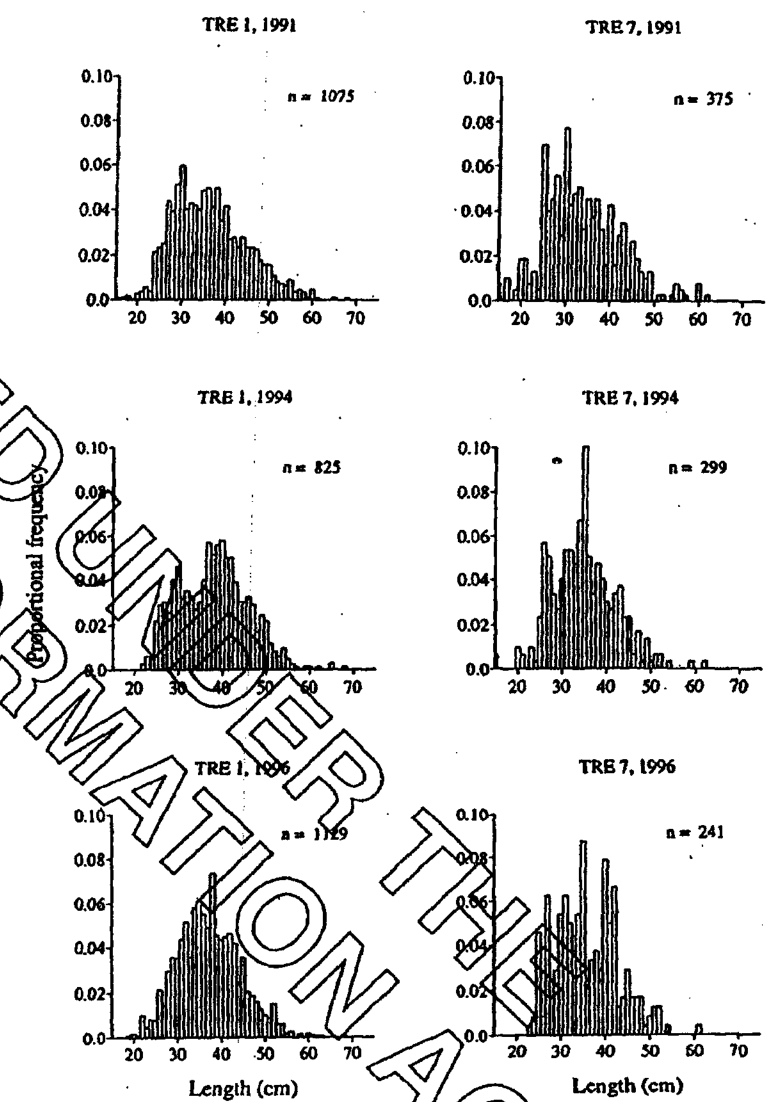

Figure 17: Trevally length frequencies from TRE 1 and TRE 7 measured at boat ramps in the North region in 1991, 1994, and 1996.

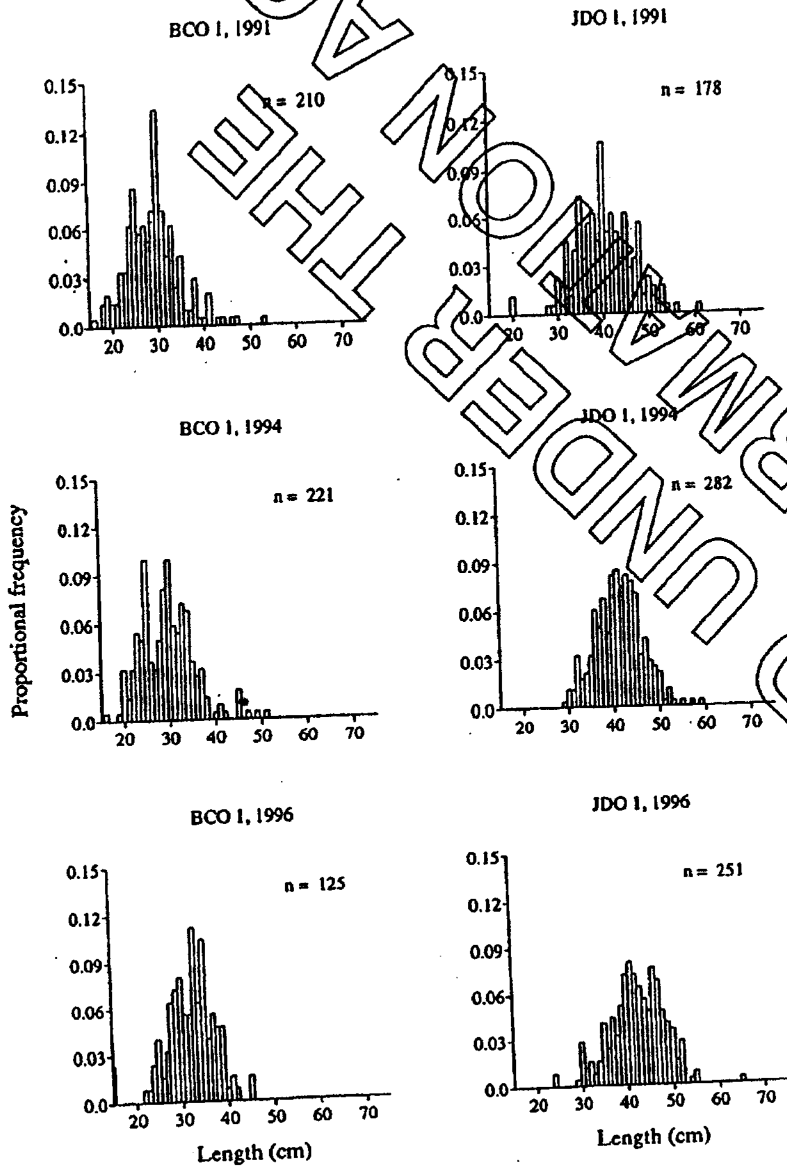

Figure 18: Blue cod length frequencies from BCO 1 and John dory length fr...encies from JDO 1 measured at boat ramps in the North region in 1991, 1994, and 1996.

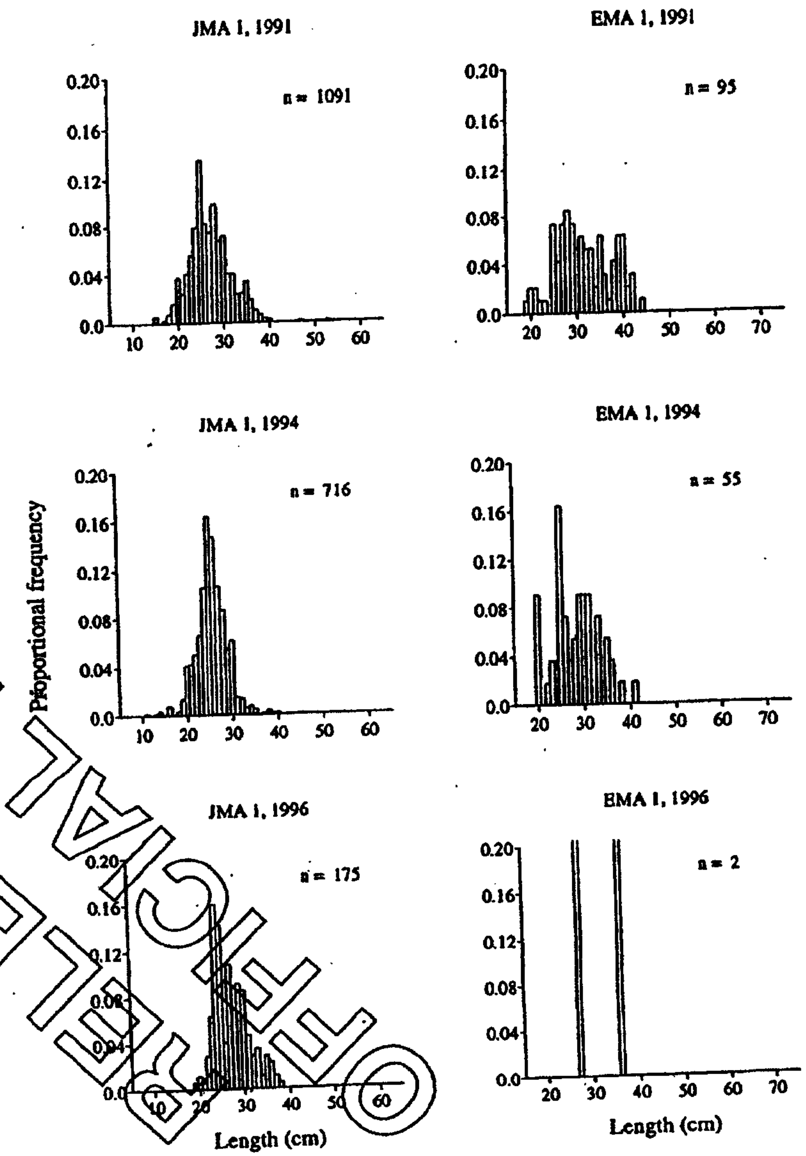

Figure 19: Jac...ckerel length frequencies from JMA 1 and blue mackerel length frequencies from QMA 1 measured at boat ramps in the North region in 1991, 1994, and 1996.

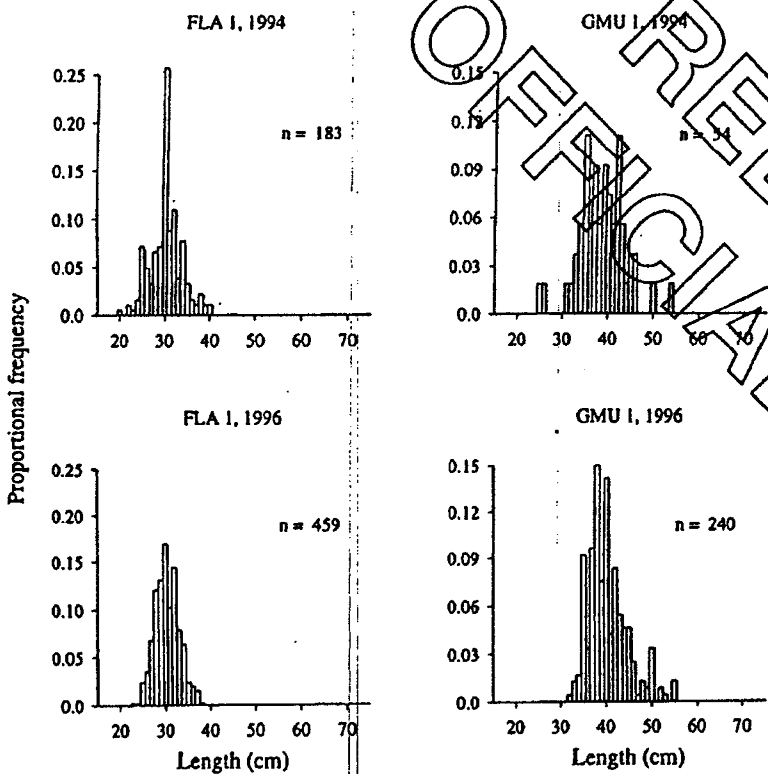

Figure 20: Flatfish length frequencies from FLA 1 and grey mullet length frequencies from GMU 1 measured at boat ramps in the North region in 1994 and 1996.

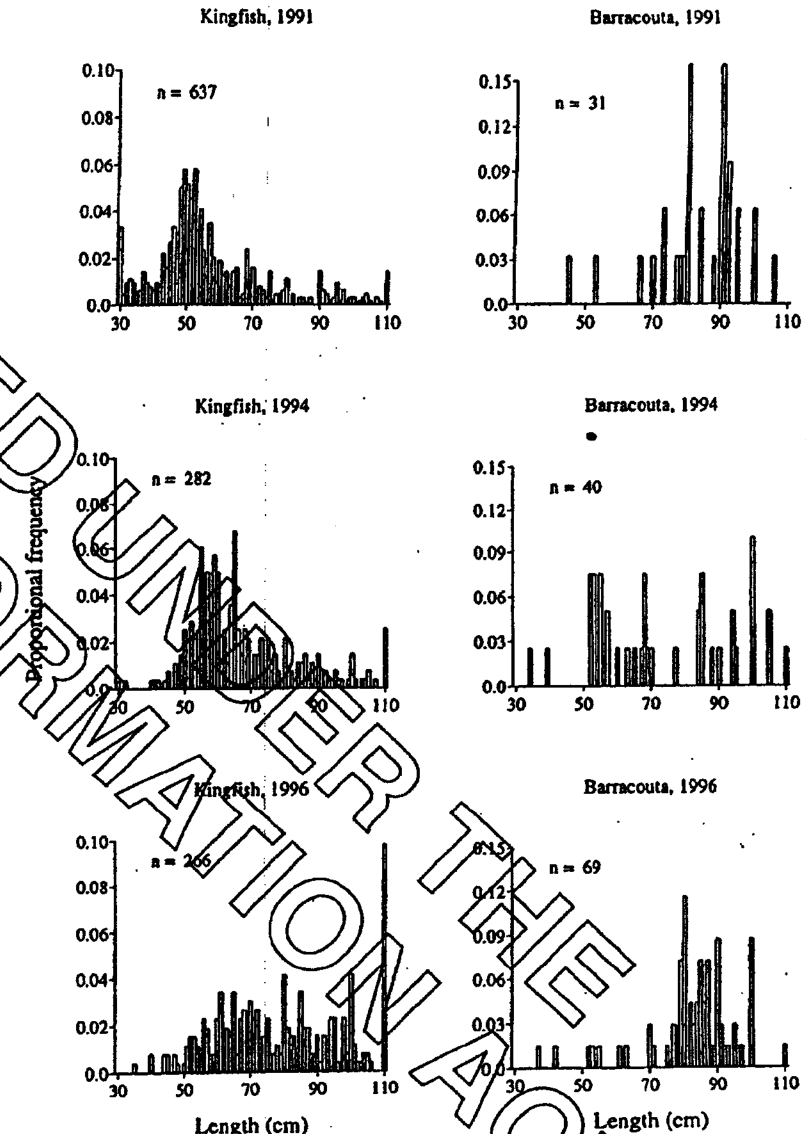

Figure 21: Kingfish and barracouta length frequencies from QMA 1 and QMA 9 measured at boat ramps in the North region in 1991, 1994, and 1996. Fish less than 30 cm are plotted as if they were 30 cm and fish er than 110 cm are plotted as if they were 110 cm.

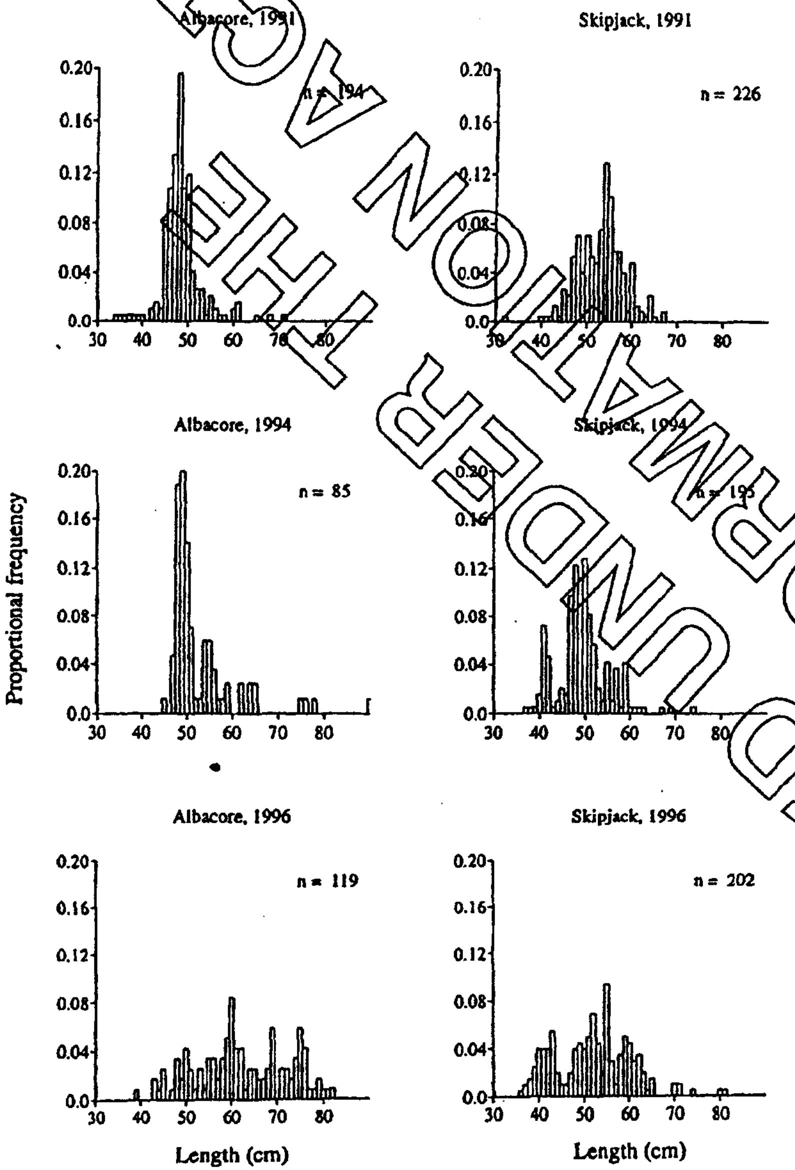

Figure 22: Albacore and skipjack tuna length frequencies from QMA 1 and QMA 9 measured at boat ramps in the North region in 1991, 1994, and 1996.

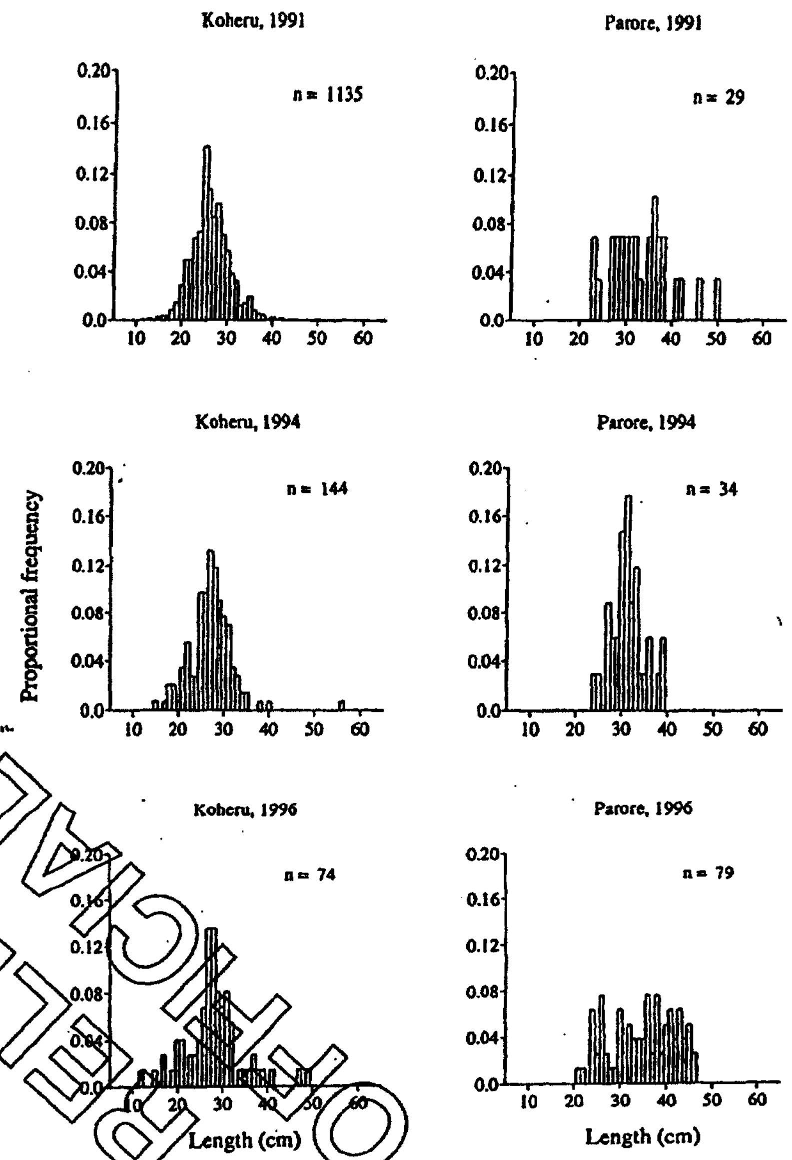

Figure 23: Koheru and parore length frequencies from QMA 1 and QMA 9 measured at boat ramps in the N region in 1991, 1994, and 1996.

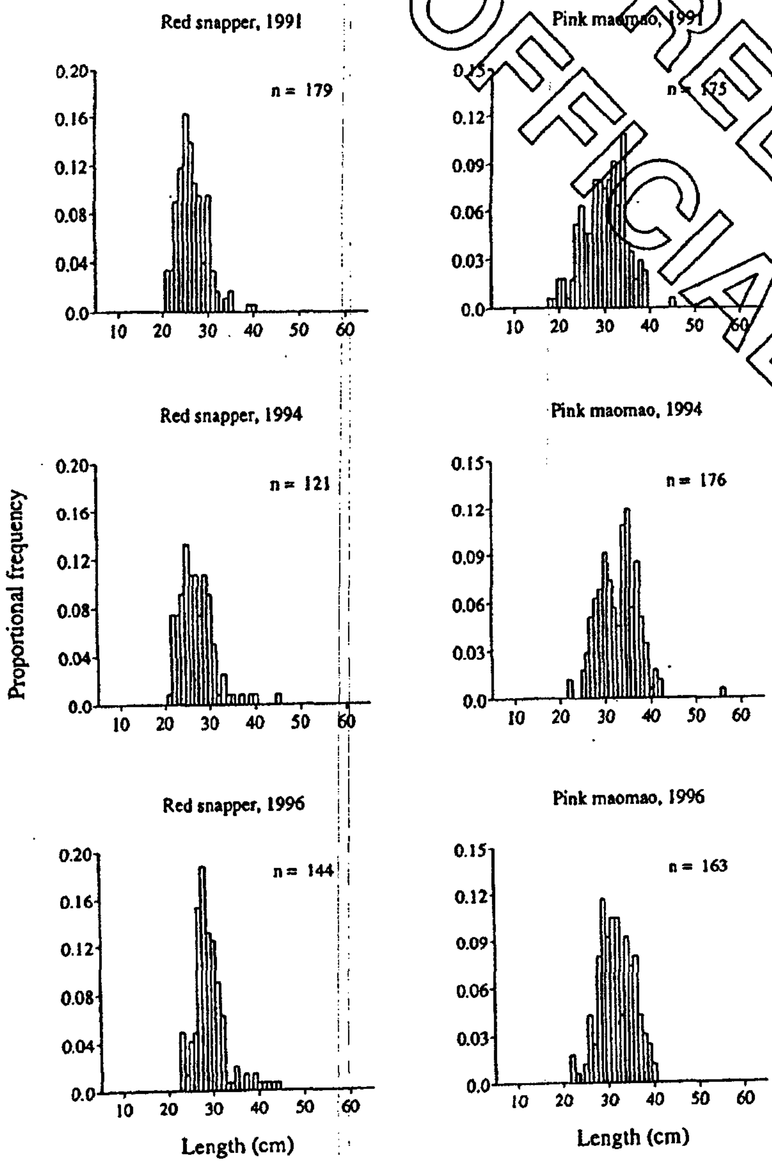

Figure 24: Red snapper and pink maomao length frequencies from QMA 1 and QMA 9 measured at boat ramps in the North region in 1991, 1994, and 1996.

Appendix 1. Mathematical definitions of harvest rates and related quantities

Definitions

Let $i = 1,2, \ldots, N$, x_i = trip length of the ith angler or party in hours (fishing effort), y_i = harvest by the ith angler or party, n = number of anglers or parties interviewed, and N = number of anglers or parties in the fishery on a given day. The following definitions are used where approximations involving the number of anglers sampled are given. This appendix is based on material in Jones *et al.* (1995).

$\bar{x} = \sum_{i=1}^{n} x_i \big/ n$ = sample mean of angler or party effort;

$\bar{y} = \sum_{i=1}^{n} y_i \big/ n$ = sample mean of angler or party harvest;

$s_x^2 = \sum_{i=1}^{n} (x_i - \bar{x})^2 \big/ (n-1)$ = sample variance of angler or party effort;

$s_y^2 = \sum_{i=1}^{n} (y_i - \bar{y})^2 \big/ (n-1)$ = sample variance of angler or party catch;

$c_x = s_x / \bar{x}; c_y = s_y / \bar{y}$; *c.v.*s of the effort and catch;

$h_i = x_i \big/ y_i$ = harvest rate of angler or party;

$\hat{H}_1 = \sum_{i=1}^{n} h_i \big/ n$ = per-angler or per-party estimator of mean harvest rate. This is the mean-of-ratios estimator which is an estimator of

$$H_1 = \sum_{i=1}^{N} h_i \big/ N$$

The estimator used for the variance of $\hat{H}_1$ is

$$\hat{V}(\hat{H}_1) = \frac{\sum_{i=1}^{n} (h_i - \hat{H}_1)^2}{n(n-1)}$$, and its *c.v.* is

$$c.v.(\hat{H}_1)^2 = \hat{V}(\hat{H}_1) / \hat{H}_1^2.$$

The ratio-of-means harvest rate is

$H_2 = \sum_{i=1}^{N} y_i \big/ \sum_{i=1}^{N} x_i$; the means are implicit as the sample sizes cancel out.

The estimator used for the ratio-of-means harvest rate is

$$\hat{H}_2 = \sum_{i=1}^{n} y_i \big/ \sum_{i=1}^{n} x_i .$$

$\hat{H}_2$ is a biased estimator of H_2 when fishers are sampled at the end of their trips (Jones *et al.* 1995).

The approximation used for the estimate of the $c.v.$ of $\hat{H}_2$ is

$$c.v.(\hat{H}_2)^2 = c.v.(\bar{x})^2 + c.v.(\bar{y})^2.$$

This expression ignores any correlation between $\bar{x}$ and $\bar{y}$. The correlation between effort and harvest should be positive and would act to reduce $c.v.(\hat{H}_2)$ and the expression used should be conservative, that is to overestimate the $c.v.$ The correlation term appears to be small. Some simple bootstrap calculations suggest that this expression for the $c.v.$ is not grossly wrong in magnitude. The distributions of the harvest rates mean that the bootstrap confidence intervals are somewhat skewed.

More sophisticated analyses by Jones *et al.* (1995) and Bradford (unpublished results, Project REC9702 report for Objective 2) suggest that the confidence intervals for all harvest rate estimators are likely to be skewed (badly so for small sample sizes), and larger than the target coverage would suggest. Obtaining the "best" estimator of the variance of the ratio-of-means estimator is an active area of research.

The true harvest rate required could be either H_1 or H_2 depending upon circumstances.

Appendix 2. Other possible estimators of harvest rate

The ratio-of-means and mean-of-ratios estimators give substantially different results for the kahawai target fishery. Some problems may have been introduced by the mixed methods allowed in the definition of the kahawai target fishery. The use of a mixture of methods was made necessary by the small number of kahawai target trips that are actually made.

Two further estimators are examined. The first, which is based on the "combined" estimator used in some GLM analyses of catch rates in commercial rates, is defined as:

$$\hat{H}_{com} = H_2^{+}(1 - p_0)$$

where H_2^{+} is the ratio-of-means estimator using only those trips where there was a kahawai catch and $(1 - p_0)$ is the probability of making a catch. The mean-of-ratios estimator could also have been used. The second (H_1^{adj}), which is based on an idea proposed by Pollock *et al.* (1997), uses the mean-of-ratios estimator adjusted so that all trips of less than half an hour are ignored. The results are given below for the kahawai target fishery using data from throughout 1996 and subdivided by region.

The rationale for removing short trips from the mean-of-ratios estimator is that estimating the time of a fishing trip is difficult, especially for short trips. First, how is a fishing trip defined? For example, what preparation and tidy up operations are included. Second, the fishing times are estimates by the fishers recalled after the event and will contain some error. When several fish can be caught in a short time, the individual harvest rates will be large with potentially a large error which can introduce bias into the mean-of-ratios estimator. Trips targeting kahawai once a school has been sighted can be short as catching kahawai can be fairly easy once a school is found. However, kahawai may be becoming wary of the sounds of recreational fishing boats and consequently becoming more difficult to catch, thus reducing the catch rate (Mark Feldman, Recreational Fishing Council, pers. comm.).

Additional estimates of harvest rates for the kahawai target fishery (any method with kahawai as target species) by region in 1996. Some of the numbers are repeated from Table 22. *c.v.*s are not repeated from Table 22. The *c.v.*s are expressed as percentages

Area	H_2	H_2^+	*c.v.*	p_0	H_{com}	*c.v.*	H_I	H_I^{adj}	*c.v.*
Bay of Plenty	0.779	1.319	9.9	0.514	0.641	12.3	1.215	0.840	8.4
East Northland	0.916	1.828	7.1	0.519	0.880	10.0	1.381	0.797	5.9
Hauraki Gulf	0.774	1.404	14.6	0.520	0.674	20.0	0.879	1.057	18.3
West coast	0.682	1.321	12.2	0.549	0.595	15.5	1.556	1.025	13.2

The values of H_{com} are less than those of the ratio-of-means estimator. If the mean-of-ratios estimator had been used to estimate the mean harvest rate for the successful trips, H_{com} would almost certainly become larger. Ignoring the short trips when calculating the mean-of-ratios estimator gives lower estimates of the harvest rate than when all trips are included except in the Hauraki Gulf. And except in East Northland, the estimates of H_I^{ad} are greater than those from the mean-of-ratios estimator.

One conclusion is that there are several possible definitions of the harvest rate in the kahawai target fishery.

Some simple bootstrap calculations were made using the harvest rates from the kahawai target fishery. The ratio-of-means estimator had little bias (the bootstrap mean differed little from the ratio-of-means estimate from the data). The mean-of-ratios estimator had little bias if the catches and fishing times were sampled using the same sampling index and was biased (in either direction) if they were sampled separately. Sampling the catch and the effort separately presumably changes the probability of associating a particular catch and effort. The bootstrap distributions tend to be skewed. As stated above, estimates of *c.v.* from the bootstrap calculations were not wildly different from the estimates made using the formulae in Appendix 1.

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RELEASED UNDER THE OFFICIAL INFORMATION ACT

Length and age compositions of recreational landings of kahawai in KAH 1 in 2000–01, 2001–02, and 2002–03

Bruce Hartill, Helena Armiger, Robert Tasker,
Crispin Middleton, David Fisher

Final Research Report for
Ministry of Fisheries Research Project KAH2000/01
Objective 1

This is the paperwriting marked "B" mentioned and referred to in the annexed Affidavit of **Jonathan Clive Holdsworth** sworn at Auckland this 19th day of October 2006 before me: [signature]

A Solicitor of the High Court of New Zealand

National Institute of Water and Atmospheric Research
August 2003

Final Research Report

Report title:	Length and age compositions of recreational landings of kahawai in KAH 1 in 2000–01, 2001–02, and 2002–03
Authors:	Bruce Hartill, Helena Armiger, Robert Tasker, Crispin Middleton, David Fisher
1. Date:	31 August 2003
2. Contractor:	National Institute of Water & Atmospheric Research Ltd
3. Project Title:	Monitoring the length and age composition of recreational landings of kahawai
4. Project Code:	KAH2000/01
5. Project Leader:	Bruce Hartill
6. Duration of Project:	
Start date:	1 December 2000
Expected completion date:	30 September 2003

7–11. See attached draft Fisheries Assessment Report.

12. Publications:

Hartill, B. 2001: Monitoring the length and age composition of recreational landings in 2001–02. Research Progress Report for Ministry of Fisheries Research Project KAH2000/01: Objectives. 1. 8 p.

Hartill, B., Cadenhead, H., Tasker, R. and Smith, M. 2001: Monitoring the length and age composition of recreational landings of kahawai in KAH 1 in 2000–2001. Final Research Report for Ministry of Fisheries Research Project KAH2000/01 Objective 1. 11 p.

Hartill, B. 2002: Monitoring the length and age composition of recreational landings in 2001–02. Research Progress Report for Ministry of Fisheries Research Project KAH2000/01: Objectives. 1. 6 p.

Hartill, B., Cadenhead, H., Tasker, B., Middleton, C. 2002: Monitoring the length and age composition of recreational landings of kahawai in KAH 1 in 2000–2001 and 2001–02. Final Research Report for Ministry of Fisheries Research Project KAH2000/01 Objective 1. 35 p.

Hartill, B. 2002: Monitoring the length and age composition of recreational landings in 2002–03. Research Progress Report for Ministry of Fisheries Research Project KAH2000/01: Objectives. 1. 6 p.

13. Data Storage:

All interview, length frequency and ageing data relating to recreational landings of kahawai have been entered onto the MFish relational *rec_data* and *age* databases with adherence to its quality assurance standards administered by NIWA. Data from catches which do not include kahawai were stored but not checked or entered onto the database. The collection and databasing of non-kahawai related data was not covered under the contract for KAH2000/01, but has been collected incidentally and may prove useful in the future.

EXECUTIVE SUMMARY

Hartill, B., Armiger, H., Tasker, R., Middleton, C., Fisher, D. (2003). Length and age compositions of recreational landings of kahawai in KAH 1 in 2000–01, 2001–02, and 2002–03.

New Zealand Fisheries Assessment Report 2003/xx. Xx p.

Due to the widespread and comparatively random nature of recreational fishing effort, the kahawai length and age distributions described in this report are more likely to be representative of the underlying population than those derived previously from commercial purse seine and single trawl landings (Bradford 1999, McKenzie and Trusewich 1996). As kahawai school by size, and commercial landings are usually comprised of fish from only one or two schools, the age distributions of commercial catches tend to be both highly variable and narrow. Distributions derived from amalgamating these commercial landings are therefore usually multimodal, as there are generally insufficient catches sampled to describe more than a few schools of kahawai. Further, as a small number of purse seine fishing events account for a large proportion of the annual commercial catch, only a fraction of a population's spatial range is fished. In contrast, a recreational fishery is comprised of thousands of trips, which sample a greater number of schools at a much lower level of intensity, and is therefore likely to be more random and representative. Resultant length frequency distributions tend to be more unimodal, with any secondary peaks probably reflecting strong year classes rather than the influence of individual schools. There is no minimum legal size for kahawai and recreational fishers therefore tend to land a greater size range of kahawai, in addition to providing a broader description of the population in the area fished.

This report summarises the results of the first three years of sampling of recreational kahawai landings in 2000–01, 2001–02 and 2002–03, from three regions in KAH 1: East Northland, Hauraki Gulf and the Bay of Plenty, and is essentially an update of the Final Research Reports summarising the first two surveys (Hartill et al. 2001, Hartill et al. 2002).

Bradford (2000) recommended that 400–500 kahawai be aged to provide a reasonable approximation of a population's age structure. Recreational fishers were generally willing to let NIWA staff remove the heads of their landed kahawai, and adequate age sample sizes were obtained in all three regions. Bradford (2001) also recommended that approximately 1500 kahawai length measurements were required to provide a description of the less common length classes in a regional length frequency distribution. This target was not achieved in any of the three regions, as levels of sampling effort were based on historical boat ramp data, and there appears to have been a subsequent decrease in the number of kahawai landed per hour of interviewing. It is not clear whether decrease this is due to a reduction in overall fishing effort and/or reduced kahawai catch rates by recreational fishers. Anecdotal evidence suggests that kahawai catch rates have fallen in recent years. Although fewer kahawai have been measured than intended, analytically-derived mean weighted coefficients of variation (c.v.s) indicate the length and age compositions of the regional populations have been estimated with reasonable precision (<0.2).

Ramp-specific age distributions were spatially and temporally variable, which probably reflects the heterogeneous distribution of a species which schools by size, and hence age. Clearer and more consistent patterns emerge however, when data are combined at a regional level, especially across years. The Hauraki Gulf catch distribution was largely comprised of relatively small, younger fish, with the East Northland region having a broader length distribution dominated by fish of less than 7 years of age, while the Bay of Plenty catch distribution was mainly comprised of larger fish, reflecting a broader underlying age distribution. These length and age distributions are broadly consistent with those derived from boat ramp survey data from the early 1990s (Bradford 2000).

A broadening of age distributions and increased numbers of kahawai encountered by boat ramp interviewers in the second half of each annual survey suggests a possible onshore movement of sexually mature kahawai following spawning in deeper waters. The timing of these behaviours is probably influenced by prevailing environmental conditions that vary from year to year. The relationship between the size and abundance of kahawai caught relative to distance offshore was examined in East Northland and the Bay of Plenty, and there is some evidence of a trend of increasing fish size with distance offshore.

1. INTRODUCTION

Random representative sampling of kahawai (*Arripis trutta*) populations for length and age is problematic given the species' size-specific schooling behaviour. For example, amalgamated length frequencies collected from commercial purse seine landings in 1990–91 and 1991–92 were multimodal, and McKenzie & Trusewich (1996) concluded that this was probably an artefact of the way the purse seine fleet operated, rather than an intrinsic feature of the Bay of Plenty population. While comprehensive sampling of commercial catches can be used to characterise commercial extraction, these samples cannot be considered indicative of the underlying population length and age structure, as the fishery operates non-randomly in space and time.

Recreational fishers however, are thought to fish kahawai in a more random and representative manner than the commercial fishery (Bradford 2000). Recreational fishers catch, and tend to land, a wider size range of fish than that taken by the main commercial fisheries (Bradford 1999). A time series of recreational catch-at-age estimates should therefore provide a more accurate representation of population age composition, which may be used to monitor the fishery. This report summarises the results of the first three years of recreational catch sampling carried out in KAH 1. The objective of this study (KAH2000/01 – Monitoring the length and age composition of recreational landings of kahawai) was:

> To conduct the sampling and determine the length and age composition of the recreational landings of kahawai in KAH 1 during the fishing years 2000–01, 2001–02 and 2002–03.

2. METHODS

2.1 Previous boat ramp surveys

In 1990–91 a survey was conducted to collect baseline information on harvest rates by recreational fishers interviewed at boat ramps throughout the Auckland Fisheries Management Area (AFMA; Sylvester 1993). Most interviewing occurred on weekends between Boxing Day 1990 to June 1991. The main objective of a further survey in 1994 was to verify aspects of a concurrent recreational fisher diary survey. The length compositions of recreational catches measured during boat ramp interviews were compared with those reported by diarists. These boat ramp data were also used in conjunction with an aerial survey to estimate harvest from the Hauraki Gulf, which was compared with that derived from the diary programme (Sylvester 1994). In 1996 a nation-wide boat ramp survey was carried out to estimate the mean weights of fish species caught by recreational fishers (Hartill et al. 1998). These mean weights were used in conjunction with estimates of the numbers of fish taken, derived from a telephone diary survey, to provide estimates of the national recreational harvest of key species (Bradford 1998a).

Although kahawai length frequency data are available from these boat ramp interviews, the underlying survey designs differed both spatially and temporally, and no age data were collected concurrently. Nonetheless, in a review of data collected from these surveys, Bradford (2000) suggested that sufficient kahawai were landed by recreational fishers to support a length and age catch sampling programme in KAH 1.

2.2 Sample design

The sample design for the 2000–01, 2001–02 and 2002–03 surveys was based on data collected from boat ramp surveys conducted in 1991, 1994, and 1996. Kahawai length data from these surveys suggested that there were substantive regional differences in the length frequency compositions of kahawai caught by recreational fishers in East Northland, the Hauraki Gulf and Bay of Plenty (Bradford 1999, Hartill et al. 1998). Separate recreational boat ramp surveys were therefore conducted in each of these regions (Figure 1), with concurrent collection of length and age samples from recreational landings of kahawai.

Sampling of recreational catches was restricted to a four-month season, 1 January to 30 April 2001, which corresponds approximately to the peak of the recreational fishing season, when kahawai landings were likely to be most abundant. Restriction of sampling to a four-month season was also desirable, as a longer collection period would have increased the likelihood of growth distorting an age-length-key. Further, as otolith ring deposition occurs during the onset of winter (Stevens & Kalish 1998), collection of otoliths in early winter should be avoided, as ambiguous structures on the edge of the otolith may result in ageing error.

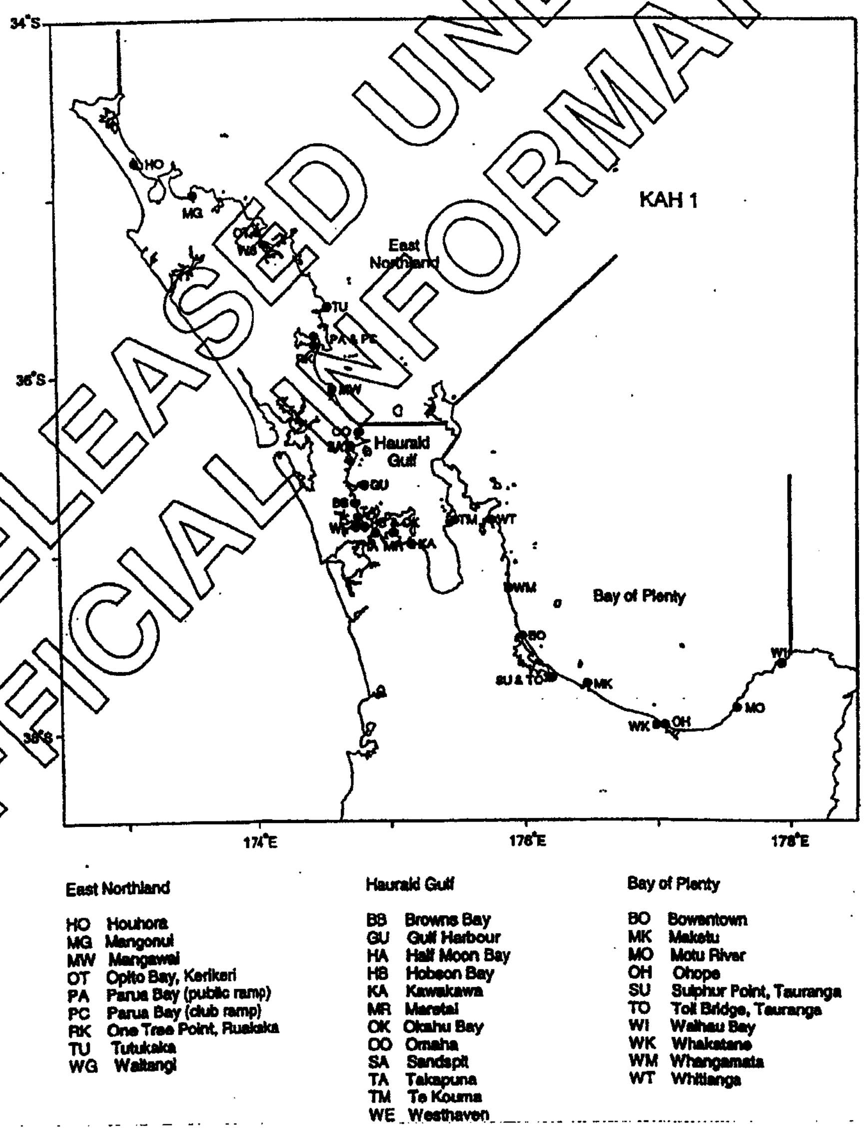


Figure 1: Location of boat ramp interview sites.

Sampling took place solely on weekends and holidays when most recreational fishing usually occurs. Results from the 1996 boat ramp survey demonstrated that for the most commonly caught species, there were no substantive differences between length frequencies of fish caught during weekdays and weekends (Hartill et al. 1998).

Bradford (2000) recommended that 400–500 kahawai should be aged to give a reasonable approximation of the relationship between length and age, and hence, a population's age structure. A further recommendation from this study was that as many fish as possible, preferably 1500 (E. Bradford *pers comm.*), should be measured to provide a reliable length frequency distribution. The timing and intensity of recreational landings of kahawai is, however, difficult to predict given interannual variability in fishing effort and the spatially dynamic nature of kahawai schooling behaviour. A reasonable intensity of sampling effort was therefore required in space and time to intercept appreciable landings of kahawai when they occurred. The sample design used in 2000–01, 2001–02, 2002–03 was based on the number of kahawai landed and measured per hour at selected key ramps, during weekends and holidays during the 1991, 1994 and 1996 boat ramp surveys (Table 1). Regional estimates of the average of the number of fish landed per hour of interviewing given in Table 1 are weighted averages across survey years, where the relative weighting was based on the number of interview hours (i.e. sampling effort) taking place on weekends or statutory holidays.

Table 1: Sample design used to estimate how many hours of boat ramp interviewing would be required to obtain measurements of 1500 kahawai in 2000–01, 2001–02, and 2002–03. Estimates were based on the average number of kahawai landed by recreational fishers per hour, on weekends and statutory holidays, during the 1991, 1994 and 1996 boat ramp surveys.

Region	Average no. of fish landed/interview hr	Number of ramps	Session length (hrs)	Number of sessions	Estimated number of kahawai measured
East Northland	1.3	7	6	28	1 558
Hauraki Gulf	1.1	11	6	21	1 553
Bay of Islands	3.5	9	4	12	1 498

Sampling sessions at each ramp were randomly assigned to weekend/holiday days between 1 January and 30 April. If an interviewer found that there were strong onshore winds or local competitions on any of these dates, sampling took place on the next available weekend/holiday day. Interviews followed the format of those undertaken in 1991, 1994 and 1996 to ensure that the data were collected in a consistent manner. When more than one vessel approached a ramp simultaneously, a vessel was chosen randomly prior to landing. When fishers landing kahawai were encountered, all fish, including kahawai, were measured. During interview sessions, recreational fishers who had not caught kahawai were also interviewed when this did not interfere with the interviewing of other fishers landing kahawai. These incidental data were stored but not checked for errors or entered into the database, as this was not an objective of this study. However, these data may prove useful for other purposes in the future, and there was no additional cost in their collection.

For ageing purposes, kahawai were selected at random from each vessel's catch, from which no more than four fish were taken. As age samples were collected randomly, the length distribution of the age sample should broadly reflect the length distribution of the landed catch. Kahawai otoliths are fragile and time consuming to extract and interviewers therefore asked permission to cut the head off at the gills. Generally, in excess of 90% of recreational fishers permitted the interviewer to remove heads from their kahawai. These heads were retained by the interviewer together with a record of the fish's length, and a code linking the head to other data collected during the interview. Kahawai were not sexed, as there is no apparent sexual dimorphism in growth rates (Bradford 1998b). Otoliths were extracted from these heads at a later date.

2.3 Ageing of kahawai otoliths

Kahawai otoliths were prepared using the thin section method described by Stevens & Kalish (1998). Each otolith was marked across an intended sectioning plane passing through the nucleus. Each otolith was then imbedded in a disposable epoxy mould with three other otoliths so that their nuclei were at the same level. Once the resin hardened, a thin transverse section was cut out of each epoxy block with a Struers Accutom-2 low speed saw. One side of this section was then ground, polished and mounted polished side down on a slide using 5-minute epoxy resin. After at least 1 hour, each slide was ground with a series of progressively finer carborundum papers (400, 1200, and 4000 grit) to a thickness of 250 to 350 μm depending on ring increment clarity. A suspension of 1.0 μm alumina powder (Linde A) was used for the final polish.

To improve clarity, a thin layer of immersion oil was brushed over each slide and reading took place under transmitted light. Three readers were used to interpret the thin sectioned otoliths and disagreements in interpretation were resolved using a method similar to that used for snapper (Davies & Walsh 1995) which was as follows:

- each reader independently read all otoliths collected from a region.
- disagreements between the three reader's initial age estimates were identified and where one or more readers failed to agree in their initial interpretation of an otolith, those readers reread the otolith with no knowledge of any prior age estimates.
- remaining disagreements were resolved by discussing images of otoliths projected onto a video screen until a consensus was reached.
- if no consensus could be reached, the otolith was discarded from the dataset.

Very few otoliths were discarded in practice, and when this occurred, both otoliths were usually deformed and hence, unreadable.

2.4 Data analysis

Proportional catch-at-length and catch-at-age distributions and analytical variance estimates where calculated for each region using a FORTRAN program developed for a snapper market sampling programme (Davies & Walsh 1995). Vessels landing kahawai were regarded as individual strata, which were weighted on the basis of the number of kahawai landed. The distribution of fish at age within length classes (an age-length key) was derived for each region, and used to translate the regional length distributions into estimates of recreational catch-at-age. Proportional catch-at-age estimates were calculated for the range of age classes recruited, with the maximum age being an aggregate of all age classes greater than 19 years. Recreational catch-at-age and length frequency distributions and their associated variances were presented in the form of histograms and tables. Age data were collected in a random manner with respect to length, and von Bertalanffy growth curves were therefore fitted to unscaled regional length and age data iteratively, by least squares regression. Growth curves were compared visually.

For each region, catch-at-age distributions were derived for each ramp, and for each of the four months sampled using the same analytical approach used to derive regional distributions. Regional, and not ramp (or month) specific, age-length-keys were used to derive these age distributions, as the number of kahawai aged from each ramp (or month) was considered insufficient to describe the underlying length-age relationship. This assumes that the location of a ramp (or time of sampling, given the four month sampling period) has little influence on the relationship between length and age within a region. Spatial and temporal trends in the underlying age composition of the regional kahawai populations fished by recreational fishers were then inferred from these histograms. Coefficients of variation (c.v.s) were not calculated for these distributions due to the low sample sizes of the component strata. Comparisons were made between ramps rather than the location at which they were caught, because in most areas there is little overlap between the areas fished from two or more ramps.

During the 2001–02 and 2002–03 sampling seasons recreational fishers were asked to estimate how far offshore they had fished. This information was used to plot the relationship between the size of fish caught, month of capture and distance offshore.

3. RESULTS

3.1 The 2000–01 sampling season

A network of interviewers was established at 28 key boat ramps in East Northland, the Hauraki Gulf and the Bay of Plenty (Figure 1). Sampling ceased at Houhora in early February due to consistently low numbers of recreational vessels using the ramp and the low numbers of kahawai consequently measured. Interviewing activity was transferred to a second ramp at Parua Bay, in Whangarei Harbour, where fishing activity was far greater. In East Northland and the Hauraki Gulf, the number of kahawai landed per hour in 2001 (Table 2a) was less than predicted from previous surveys (*see* Table 1). At the Whakatane ramp, two of the interview sessions took place during a competition. Prior to the competition starting, fishers were advised that a spot prize was offered for kahawai and that all kahawai should therefore be landed. Proportional length frequencies created with, and without, length data from this competition were compared and found to be similar. No other competitions were sampled in 2001.

Table 2a: Summary statistics by region of the number of interview sessions, hours surveyed, vessels with measurable kahawai, kahawai measured, kahawai measured per hour and kahawai aged in 2000–01.

Region	Ramp	Number of sessions	Number of hours	Boats with measurable kahawai	Kahawai measured	Kahawai measured per hour	Kahawai aged
East Northland	Houhora	11	66	5	10	0.2	10
	Mangonui	26	150	92	302	2.0	79
	Opito Bay	24	145	62	226	1.6	73
	Waitangi	26	144	78	201	1.4	79
	Tutukaka	24	144	42	95	0.7	88
	Parua Bay (public)	27	163	62	121	0.7	71
	Parua Bay (club)	20	118	86	169	1.4	49
	One Tree Point	13	73	11	30	0.4	25
	Mangawai	25	126	36	82	0.7	43
	Total	196	1129	474	1236	1.1	517
Hauraki Gulf	Omaha	18	109	18	26	0.2	23
	Gulf Harbour	22	121	47	81	0.7	71
	Browns Bay	12	72	10	16	0.2	14
	Takapuna	20	114	40	93	0.8	49
	Westhaven	15	103	15	23	0.2	22
	Hobson Bay	20	114	17	30	0.3	30
	Okahu Bay	10	47	7	10	0.2	0
	Half Moon Bay	29	173	132	260	1.5	98
	Maretai	19	97	60	170	1.8	103
	Kawakawa Bay	26	120	63	139	1.2	52
	Te Kouma	21	103	26	44	0.4	38
	Total	212	1174	435	892	0.8	500
Bay of Plenty	Whitianga	10	40	8	24	0.6	16
	Bowentown	12	48	30	86	1.8	60
	Sulphur Point	13	52	49	107	2.1	94
	Toll Bridge	4	16	0	0	0.0	0
	Maketu	10	13	18	50	3.8	38
	Whakatane	3	11	68	315	*28.6	54
	Ohope	17	69	43	164	2.4	81
	Motu River	11	28	29	185	6.6	0
	Waihau Bay	20	42	49	173	4.1	114
	Total	100	319	294	1104	3.5	457

* Two of these sampling events took place during a competition

3.2 The 2001–02 sampling season

The boat ramps used and sampling design employed in 2001–02 was based largely upon that used in 2000–01. In the Hauraki Gulf, sampling effort at one ramp, Hobson Bay, was transferred to Halfmoon Bay where vessel traffic volumes necessitated the employment of two interviewers, and effort at Omaha was transferred to the nearby Sandspit boat ramp. In the Bay of Plenty, sampling effort at Toll Bridge, Tauranga was transferred to Whangamata where landings of kahawai were thought to be higher. These changes in sampling locality are unlikely to introduce between year variability for two reasons. Firstly, relatively few kahawai were encountered at the ramps concerned, and secondly, as sampling effort was shifted to a nearby ramp, those fishers encountered would have fished similar areas. The number of kahawai landed per hour was less than that observed in the 1991, 1994 and 1996 surveys (Table 2b), however, sufficient kahawai were sampled to describe regional catch-at-length and catch-at-age distributions.

Table 2b: Summary statistics by region of the number of interview sessions, hours surveyed, vessels with measurable kahawai, kahawai measured, kahawai measured per hour and kahawai aged in 2001–02.

Region	Ramp	Number of sessions	Number of hours	Boats with measurable kahawai	Kahawai measured	Kahawai measured per hour	Kahawai aged
East Northland	Mangonui	23	138	78	290	2.1	23
	Opito Bay	23	138	94	238	1.7	105
	Waitangi	24	141	65	203	1.4	92
	Tutukaka	24	145	52	107	0.7	70
	Parua Bay (public)	27	146	54	106	0.7	64
	Parura Bay (club)	27	146	100	252	1.7	102
	One Tree Point	24	143	22	62	0.4	26
	Mangawai	27	113	26	60	0.5	44
	Total	199	1110	491	1318	1.2	526
Hauraki Gulf	Sandspit	15	90	8	11	0.1	10
	Gulf Harbour	18	98	19.	43	0.4	33
	Browns Bay	7	40	3	10	0.3	4
	Takapuna	24	138	62	130	0.9	80
	Westhaven	15	91	26	65	0.7	46
	Okahu Bay	20	114	12	23	0.2	16
	Half Moon Bay*	38	219	97	231	1.1	143
	Maraetai	20	120	26	56	0.5	25
	Kawakawa Bay	27	120	48	91	0.8	60
	Te Kouma	20	108	38	126	1.2	83
	Total	204	1138	339	786	0.7	500
Bay of Plenty	Whitianga	14	55	25	66	1.2	62
	Whangamata	17	59	16	49	0.8	36
	Bowentown	14	56	49	98	1.8	75
	Sulphur Point	16	60	64	140	2.3	74
	Maketu	13	48	15	16	0.3	8
	Whakatane	16	54	164	588	28.6	79
	Ohope	20	53	27	99	1.9	64
	Motu River	11	17	37	245	14.4	17
	Waihau Bay	20	72	60	175	2.4	80
	Total	141	474	457	1476	3.1	495

* Two interviewers used at this ramp, due to high volumes of traffic

3.3 The 2002–03 sampling season

The ramps sampled, and the target number of hours of surveying were the same as those outlined in the 2001–02 survey (Tables 2c and 2d). The number of kahawai measured per hour of interviewing at East Northland and Hauraki Gulf ramps was generally similar to that in 2000–01 and 2001–02, but in the Bay of Plenty, there has been a noticeable decline in the rate of kahawai landings since 2000–01. The number of kahawai landed per hour in all three regions were lower than those observed in boat ramp surveys conducted in the early to mid 1990s (see Table 1). Nonetheless, sufficient kahawai were measured and aged from each region to characterise catch-at-length and catch-at-age distributions.

Table 2c: Summary statistics by region of the number of interview sessions, hours surveyed, vessels with measurable kahawai, kahawai measured, kahawai measured per hour and kahawai aged in 2002–03.

Region	Ramp	Number of sessions	Number of hours	Boats with measurable kahawai	Kahawai measured	Kahawai measured per hour	Kahawai aged
East Northland	Mangonui	21	125	100	266	2.1	112
	Opito Bay	27	162	90	299	1.8	83
	Waitangi	32	175	93	281	1.6	94
	Tutukaka	22	116	22	37	0.3	31
	Parua Bay (public)	20	118	39	114	1.0	85
	Parura Bay (club)	23	133	71	137	1.0	79
	One Tree Point	16	94	3	11	0.1	7
	Mangawai	25	127	18	26	0.2	13
	Total	186	1 049	436	1 171	1.1	504
Hauraki Gulf	Sandspit	20	120	17	49	0.4	28
	Gulf Harbour	20	120	34	47	0.4	27
	Browns Bay	20	117	9	31	0.3	31
	Takapuna	22	116	30	67	0.6	62
	Westhaven	20	120	26	46	0.4	43
	Okahu Bay	20	120	11	16	0.1	11
	Half Moon Bay*	41	231	116	254	1.1	166
	Maraetai	20	120	22	41	0.3	24
	Kawakawa Bay	32	144	119	311	2.2	118
	Te Kouma	16	92	11	18	0.2	17
	Total	231	1 301	395	880	0.7	527
Bay of Plenty	Whitianga	16	64	25	86	1.3	57
	Whangamata	14	54	5	21	0.4	7
	Bowentown	13	52	17	47	0.9	40
	Sulphur Point	16	64	44	118	1.8	52
	Maketu	14	56	49	106	1.9	48
	Whakatane	13	57	129	377	6.6	160
	Ohope	17	64	32	79	1.2	69
	Motu River	4	19	33	228	12.3	0
	Waihau Bay	13	33	23	71	2.2	44
	Total	120	462	357	1 133	2.5	477

* Two interviewers used at this ramp, due to high volumes of traffic

3.4 Length and age distributions

East Northland

In all three year the length distributions of East Northland recreational kahawai landings were broad, with a mode of three year olds (predominantly 30 to 40 cm; Appendix 3) generally evident (Figure 2). Age distributions were dominated by 3 to 7 year old fish, which accounted for 77–80% of all fish landed. There was little change in the average age of fish landed between years (5.4–5.5 years). Cursory examination of proportional year class strengths through time, suggests that kahawai do not approach full recruitment to the East Northland recreational fishery until about 4 years of age (mostly greater than 35 cm), after which the abundance of each year class is usually less than that which follows. Length and age distributions were both described with reasonable precision, with c.v.s of 0.17–0.18 (Appendix 1) and 0.12–0.13 (Appendix 2) respectively.

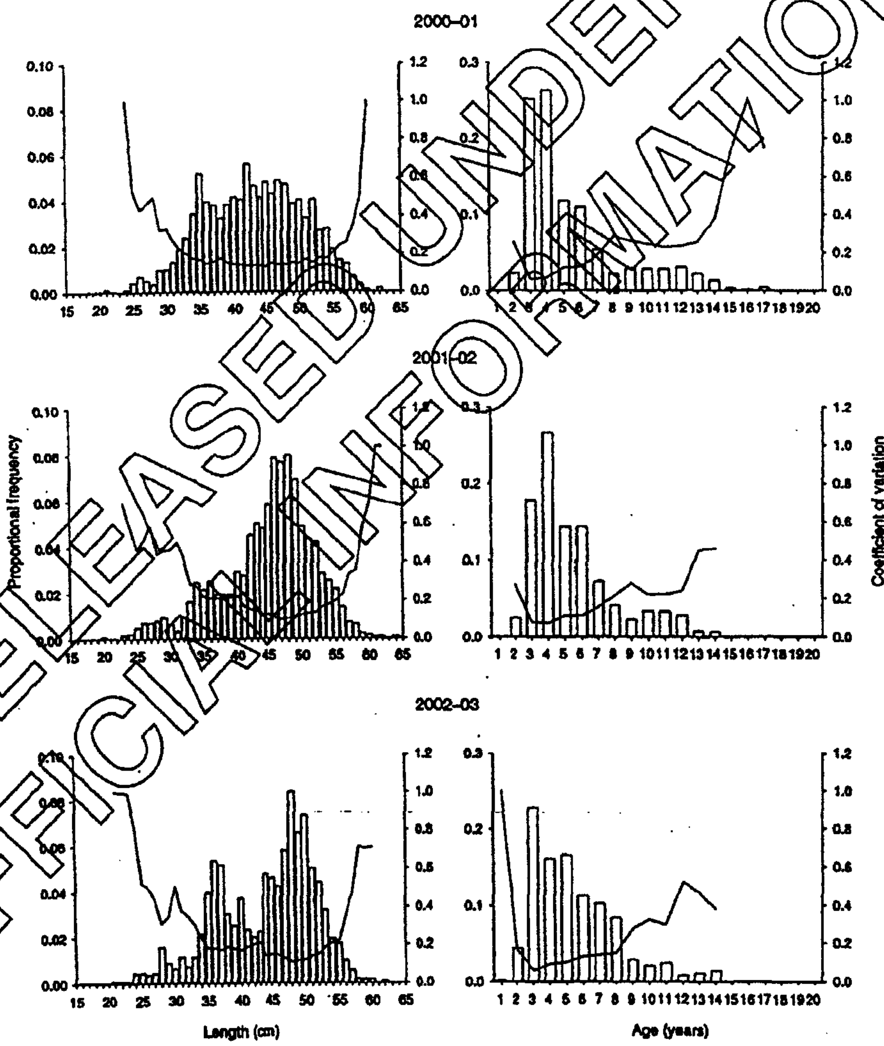


Figure 2: Length and age distributions (histograms) and c.v.s (solid line) of recreational landings of kahawai in East Northland in 2000–01, 2001–02 and 2002–03.

No latitudinal trends were evident in catch-at-age from East Northland ramps (Figure 3). With the exception of Ruakaka and Parua Bay (club ramp), there were no strong between-year differences, and any differences probably reflect variability caused by the low sample sizes. Some temporal changes are evident when monthly age distributions (across all ramps) are compared (Figure 4). In all years, three year old fish were more predominant in January landings, with 4 to 6 year old fish becoming more prevalent in the later months. The consistent nature of this temporal pattern suggests that changes in the age composition of recreational landing may be due to a mechanism such as onshore movement of schools of older fish in later months. Further evidence for such a mechanism is seen in the marked increase in the number of kahawai encountered by interviewers in March and April (Figure 4).

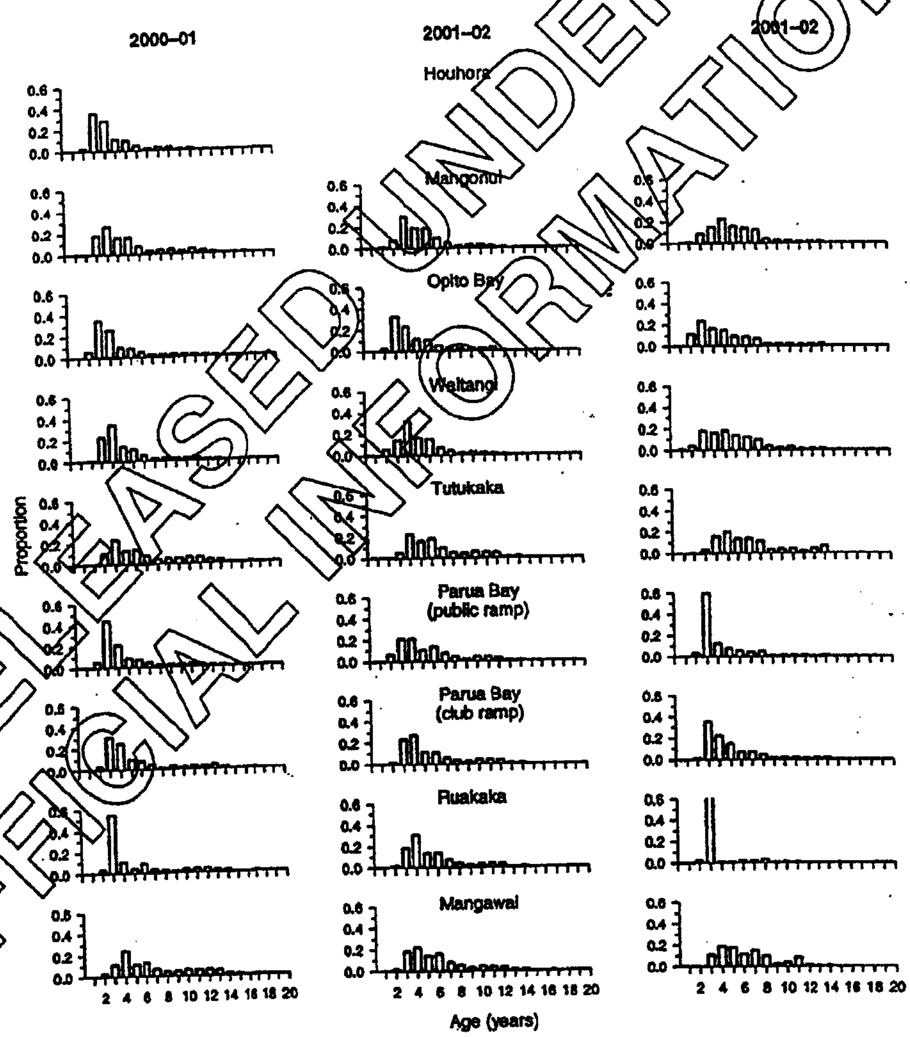


Figure 3: Age distributions by ramp in East Northland in 2000–01, 2001–02 and 2002–03 (see Tables 2a, 2b & 2c for sample sizes).

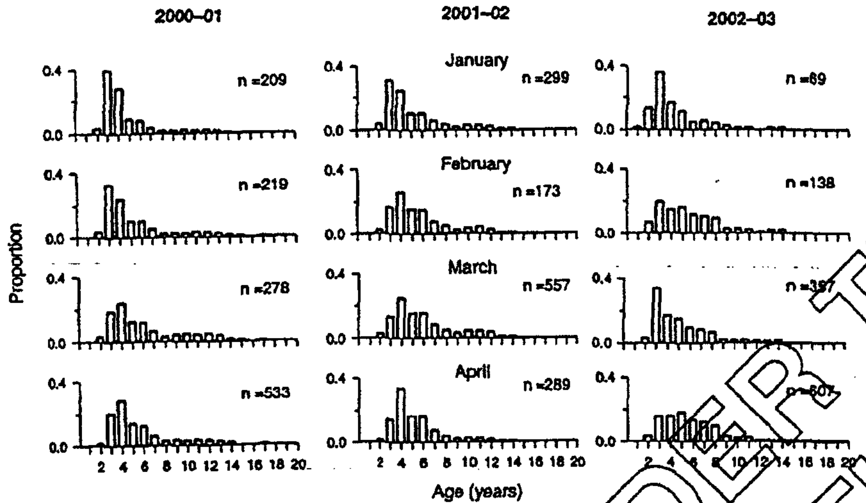


Figure 4: Age distributions by month in East Northland in 2000–01, 2001–02 and 2002–03. The number of fish measured is given for each month.

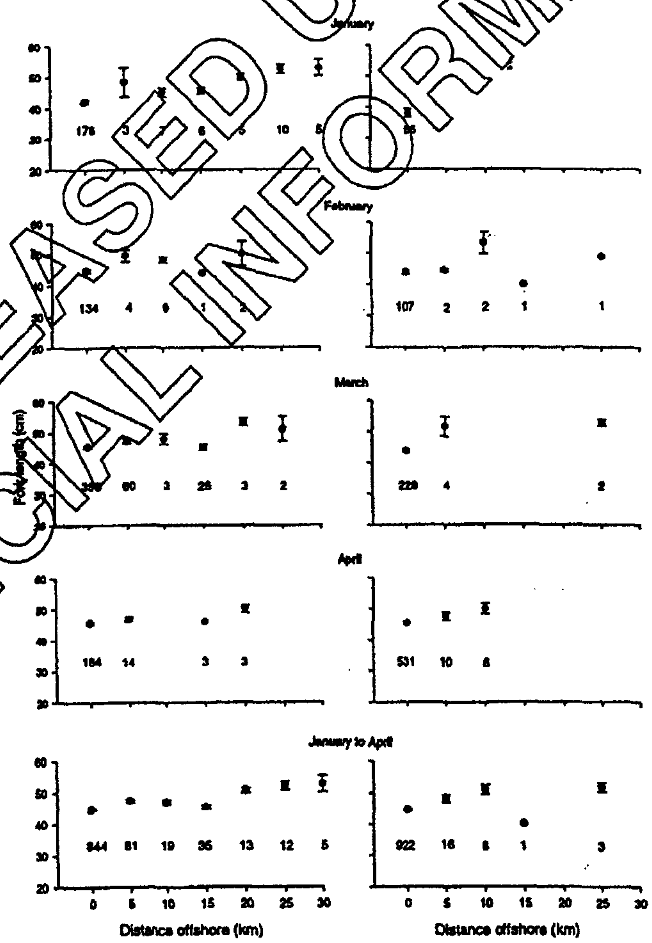


Figure 5: Average size of kahawai caught in relation to distance offshore (in 5 kilometre bins) by month in East Northland in 2001–02 and 2002–03. Error bars denote standard errors and numbers denote number of kahawai measured.

Estimates of the distance offshore at which kahawai were caught were available for 1009 fish measured in 2001–02 and 950 fish in 2002–03 (Figure 5). Of these, 84% and 97% respectively, were caught less than 5 kilometres offshore, with the majority of the remainder caught within 10 kilometres of the shore. Despite the limited number of offshore observations, there is some indication that the average size of kahawai increases with increasing distance offshore.

Hauraki Gulf

Marked differences in annual length compositions of Hauraki Gulf landings reflect the relative strengths of underlying component age classes (Figure 6). Landings in 2000–01, and to a lesser extent 2002–03, were strongly dominated by the 3 year old age class, evident as a length mode peaking at around 35 cm. In 2001–02, a 3 year old age class was once again dominant, but to a far lesser extent than in the previous year, and the resulting length distribution was more multimodal. The Hauraki Gulf fishery is however, the most poorly described of the three regions sampled, as the number of kahawai landed per hour of interviewing has declined steadily since the early 1990s, resulting in reduced length and age sample sizes (Tables 1, 2a, 2b and 2c). Length compositions were estimated with mean weighted c.v.s ranging from 0.22 to 0.25. The age distributions were more precisely described with mean weighted c.v.s of 0.11 to 0.13 (Appendices 1 and 2), which is probably due to the high abundance of a single age class.

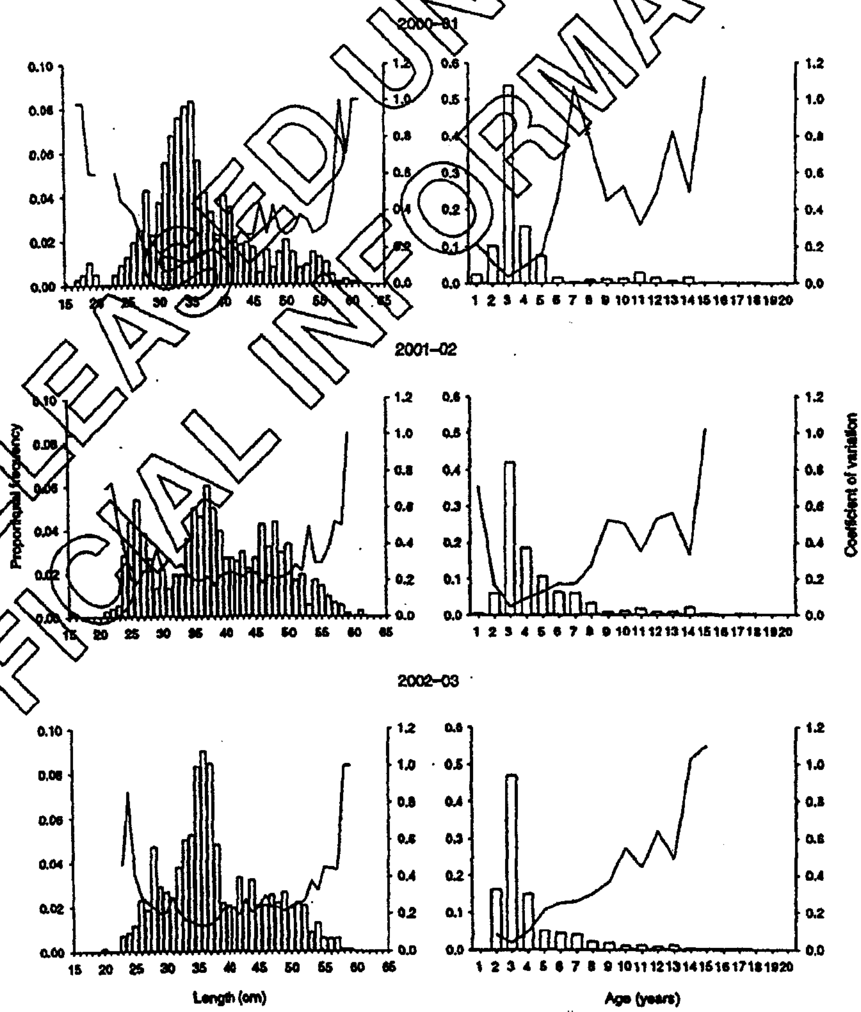


Figure 6: Length and age distributions (histograms) and c.v.s (solid line) of recreational landings of kahawai in the Hauraki Gulf in 2000–01, 2001–02 and 2002–03.

The predominance of 3 to 5 year old kahawai suggests that the Hauraki Gulf may act as a nursery area. Further, this is the only region in which 1 year old fish were landed in any number. The presence of small kahawai in Hauraki Gulf landings may also reflect region-specific differences in fisher behaviour and the methods they employ. Lower catch rates in the Hauraki Gulf may increase the probability that small fish are landed by fishers compared to other regions.

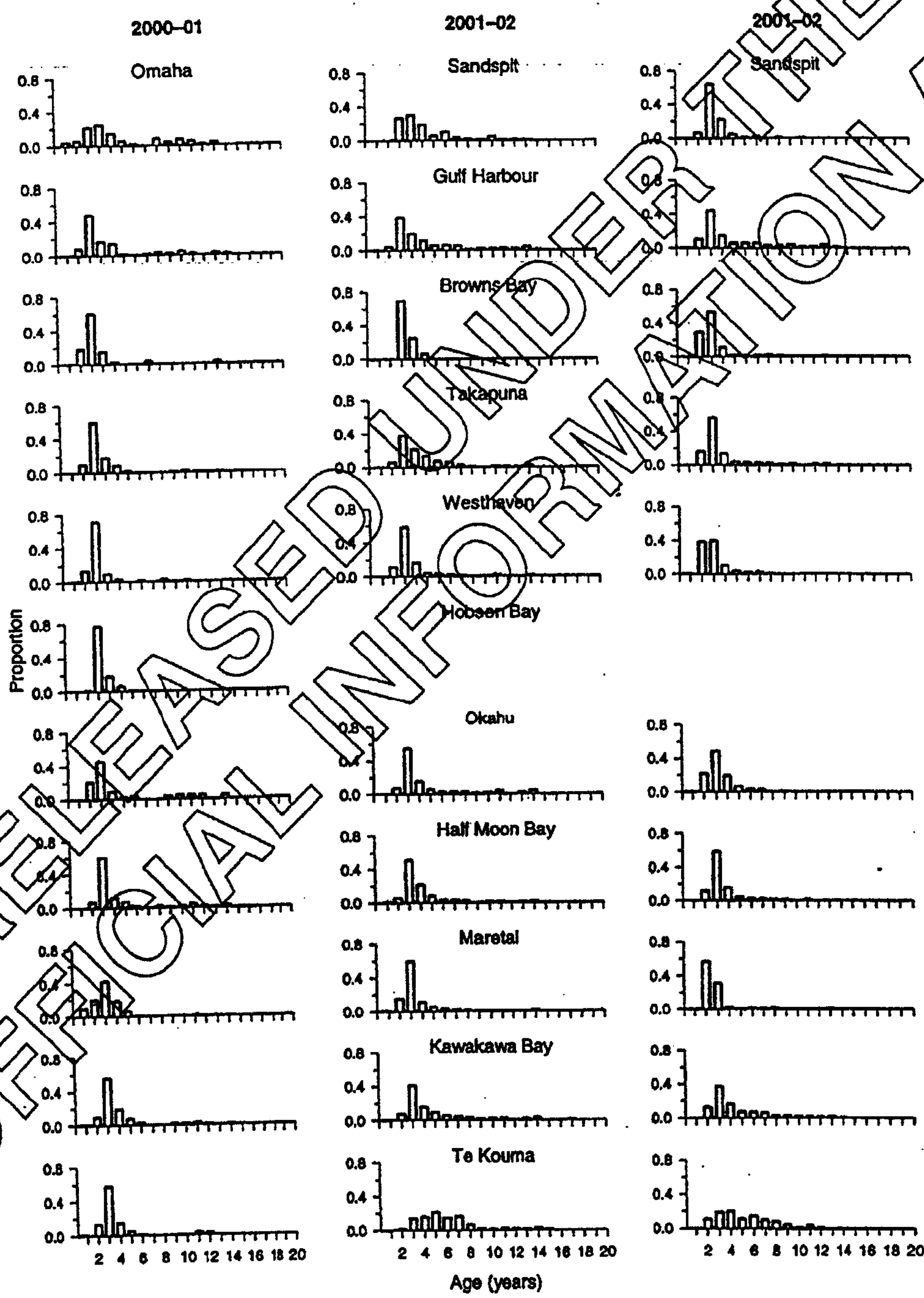


Figure 7: Age distributions by ramp in the Hauraki Gulf in 2000–01, 2001–02 and 2002–03 (see Tables 2a, 2b & 2c for sample sizes).

Ramp-specific age distributions were characteristically dominated by 3 year olds, except for Te Kouma in later years (Figure 7). Those ramps at the head of the Hauraki Gulf showed a greater similarity to neighbouring ramps in East Northland and the Bay of Plenty (see Figures 3 and 10). In contrast to the other two regions, ramp-specific age distributions in the Hauraki Gulf show marked differences between years, although this may be due to variability arising from the small sample sizes obtained (Tables 2a, 2b and 2c), and movements by kahawai schools in relation of variable climatic conditions. Cursory examination of monthly age distributions through time, suggest that the age structure became increasingly broad as the sampling season progressed (Figure 8). In the last two years, there is some suggestion of an increase in the number of kahawai landed by recreational fishers in later months.

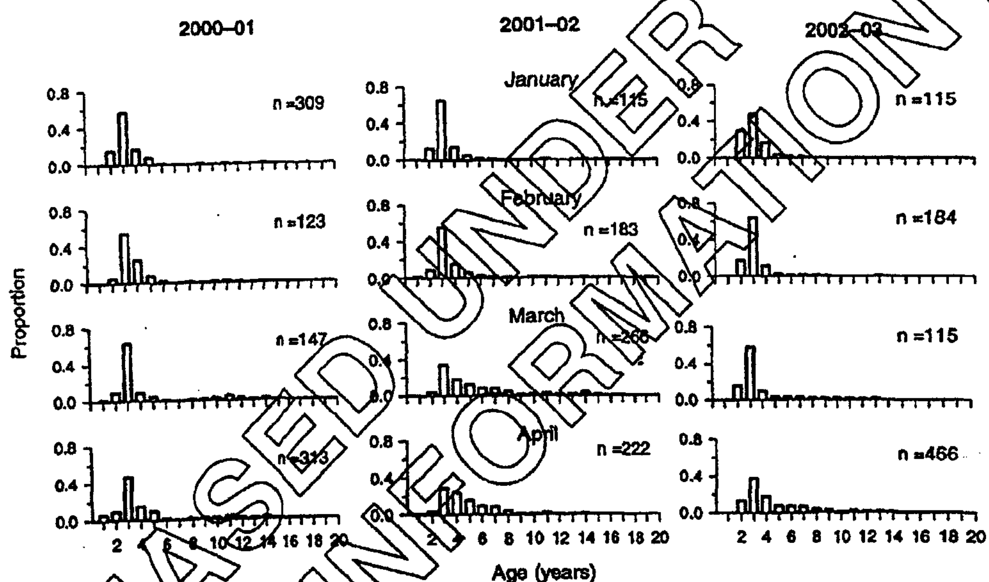


Figure 8: Age distributions by month in the Hauraki Gulf in 2000–01, 2001–02 and 2002–03. The number of fish measured is given for each month.

The relationship between the abundance and size of kahawai landed with respect to distance offshore was not assessed, as the shape of the coastline, and abundance of islands makes any such interpretation difficult.

Bay of Plenty

Bay of Plenty length distributions were characteristically dominated by fish in the larger length classes with a peak at around 50 cm (Figure 9). In 2000–01 the Bay of Plenty age distribution was more broadly distributed than elsewhere, with over 44% of the kahawai landed being 7 years or older. As the relatively strong 8 to 11 year old age classes (in 2000–01) declined in the later two years, the average age of kahawai has also declined, from 6.6 to 5.8 years of age. While kahawai catch rates in the Bay of Plenty are relatively high, compared to elsewhere, the number of kahawai landed per hour of interviewing has declined markedly over the survey period, which may indicate a decline in local abundance (Tables 2a, 2b and 2c). The precision of annual length and age compositions ranged from 0.14 to 0.18 (Appendices 1 and 2).

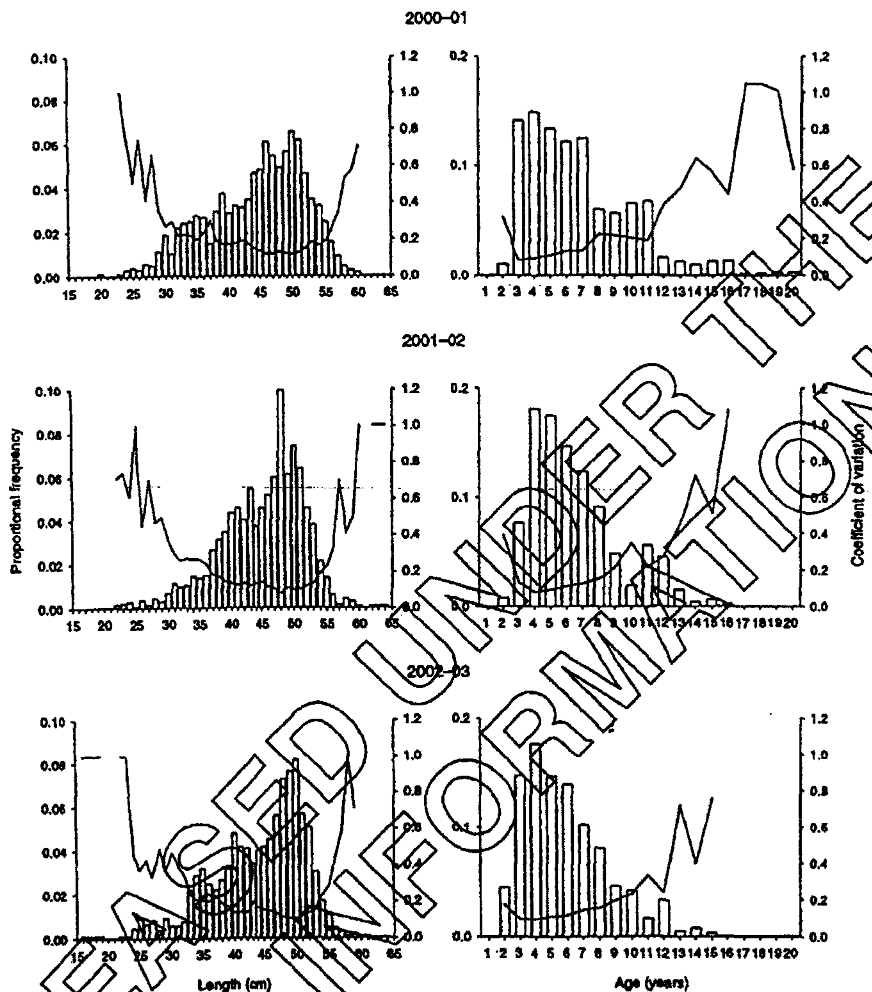


Figure 9: Length and age distributions (histograms) and c.v.s (solid line) of recreational landings of kahawai in the Bay of Plenty in 2000–01, 2001–02 and 2002–03.

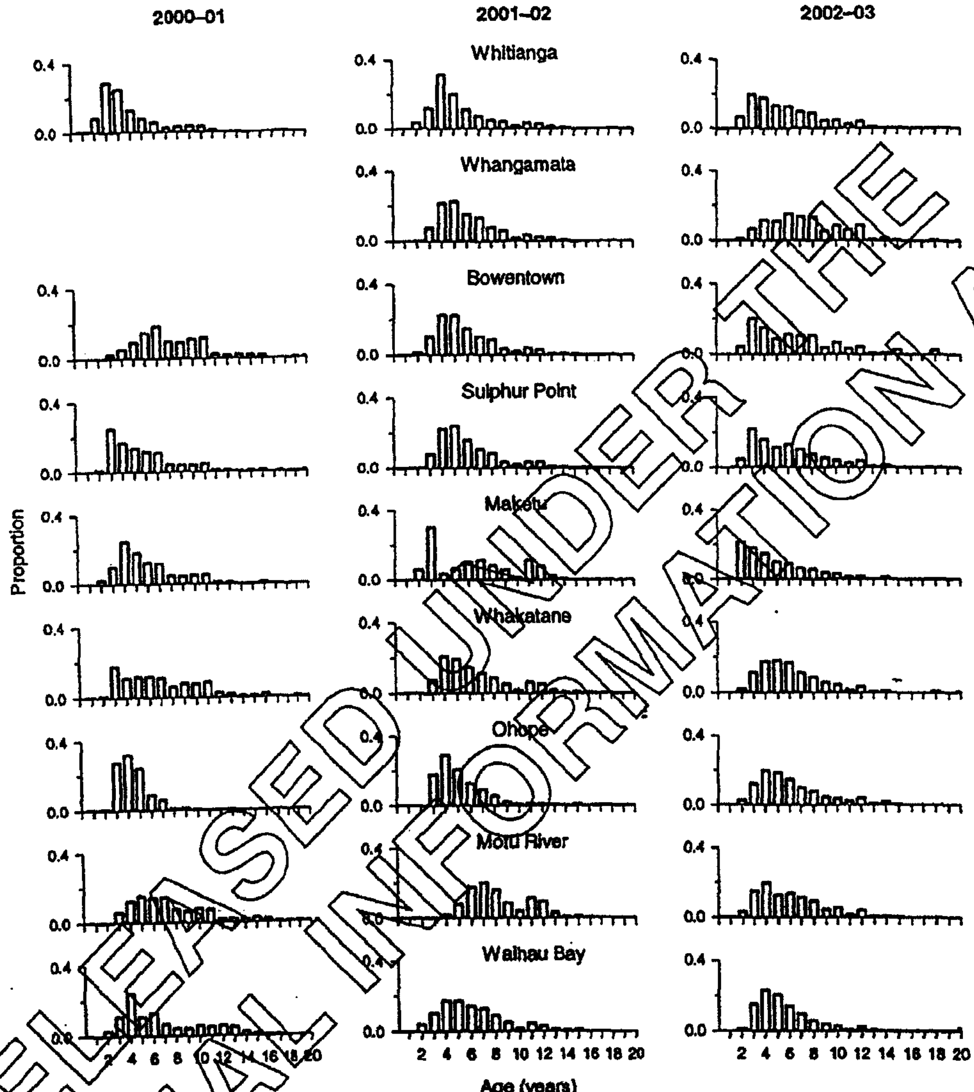


Figure 10: Age distributions by ramp in the Bay of Plenty in 2000–01, 2001–02 and 2002–03 (see Tables 2a, 2b & 2c for sample sizes).

No clear temporal or spatial trends are evident in ramp-specific age distributions (Figure 10). The age distribution of kahawai landed at neighbouring ramps often differed markedly during the same survey year, possibly reflecting differing degrees of mobility by the local fishing community, or high spatial heterogeneity in the kahawai population. Although no consistent trends are evident in monthly age distributions, the number of kahawai landed and measured by boat ramp interviewers was generally greater in March and April (Figure 11).

Estimates of the distance offshore that kahawai were caught were available for 1385 fish in 2001–02 and 817 fish in 2002–03 (Figure 5). Of these, 72% and 80% respectively, were caught less than 5 kilometres offshore, with the much of the remainder caught within 10 kilometres of the shore. There was some indication of an increase in the size of kahawai landed with increasing distance offshore.

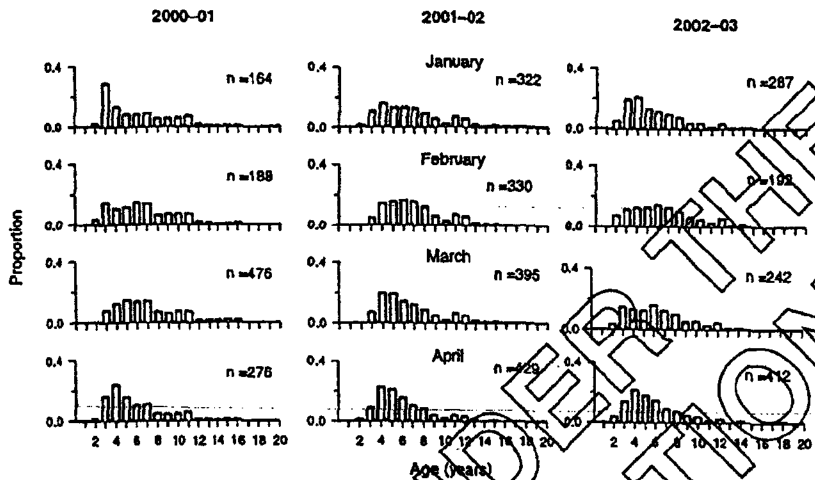


Figure 11: Age distributions by month in the Bay of Plenty in 2000–01, 2001–02 and 2002–03. The number of fish measured is given for each month.

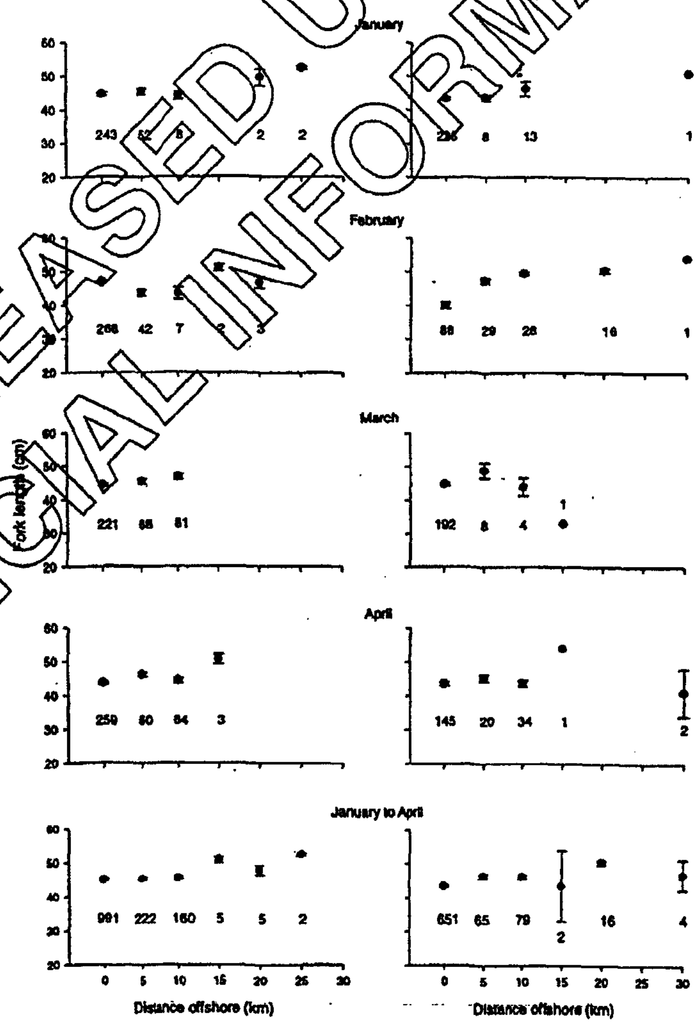


Figure 12: Average size of kahawai caught in relation to distance offshore (in 5 kilometre bins) by month in the Bay of Plenty in 2001–02 and 2002–03. Error bars denote standard errors and numbers denote number of kahawai measured.

3.5 Growth rate estimates

On a regional basis, there is a marked similarity between the growth curves derived from each of the annual surveys (Figure 13, Table 3). Slight differences are evident when regional growth curves are compared however, for example the East Northland curves are steeper. To some extent the shape of these growth curves will be determined by the availability of the smaller and larger length classes, which influence the fitting of von Bertalanffy parameters. In the Hauraki Gulf for instance, where juvenile fish are more common, the ascendant left hand limb of the curve will be described more accurately and precisely than in other regions, where fewer small kahawai are landed. All von Bertalanffy growth curves derived from the last three years are steeper than those previously documented for males and females in KAH 1 (McKenzie et al 1992).

Table 3: Von Bertalanffy growth parameters derived from kahawai sampled from recreational catches in East Northland, the Hauraki Gulf and the Bay of Plenty in 2000–01, 2001–02 and 2002–03. Parameter estimates previously reported for KAH 1, and currently used in the 2002 plenary (Annala et al. 2003) are given for comparison (McKenzie et al 1992).

Region	Year	T_0	K	Linf	n
East Northland	2000–01	-0.08	0.34	54.5	517
	2001–02	0.51	0.46	53.2	526
	2002–03	0.09	0.38	53.8	504
Hauraki Gulf	2000–01	-0.48	0.26	56.4	500
	2001–02	0.25	0.33	55.2	500
	2002–03	-0.39	0.29	55.8	527
Bay of Plenty	2000–01	-0.23	0.28	55.1	457
	2001–02	-0.33	0.31	53.6	495
	2002–03	-0.17	0.34	53.1	477
Plenary KAH 1 (female)	1991–92	-0.18	0.24	56.9	
Plenary KAH 1 (male)	1991–92	-0.20	0.24	55.6	

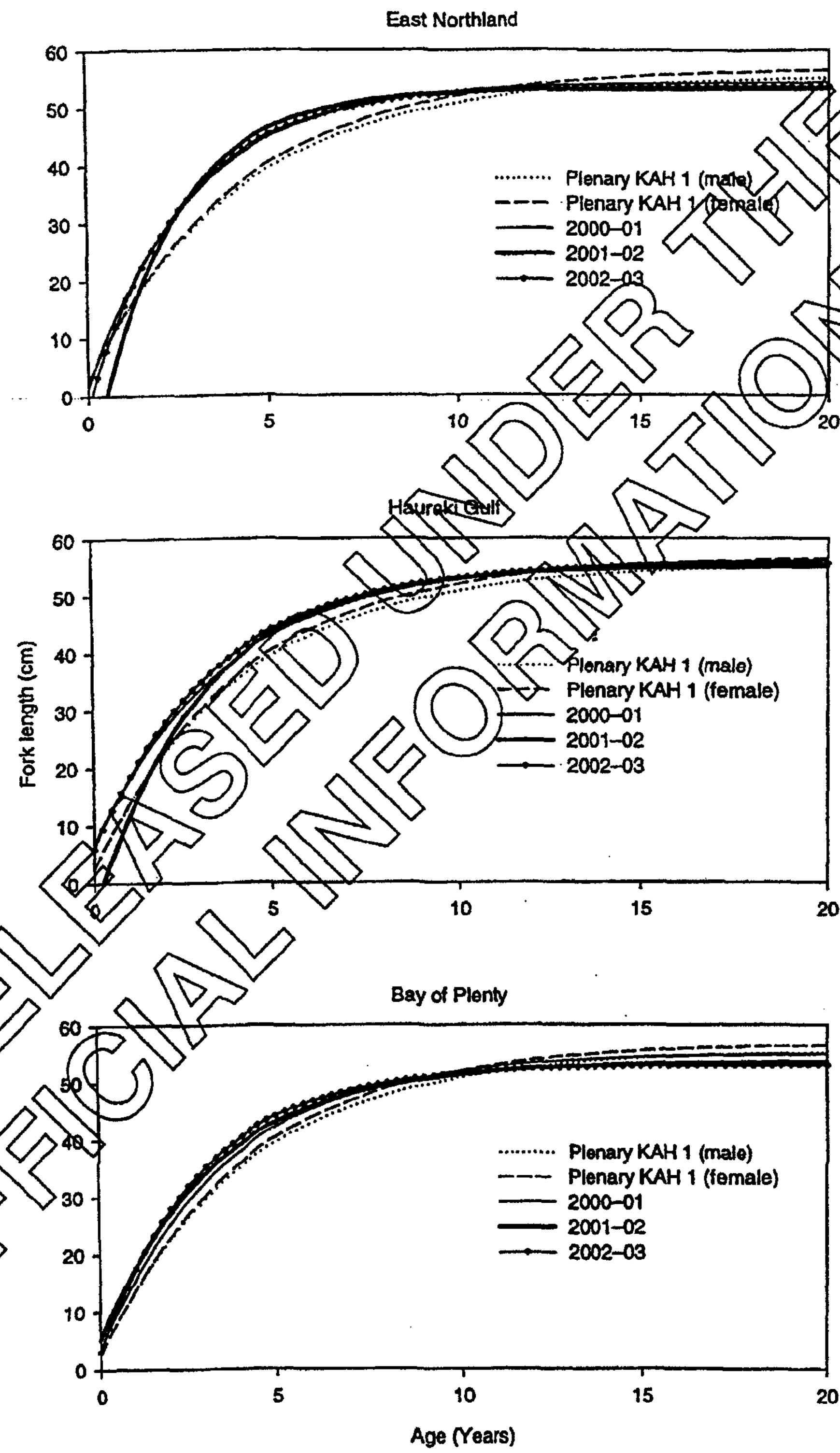


Figure 13: Comparison of von Bertalanffy growth curves derived from kahawai sampled from recreational catches in East Northland, the Hauraki Gulf and the Bay of Plenty (unsexed) in 2000–01, 2001–02 and 2002–03, with those previously reported for males and females in KAH 1 (McKenzie et al. 1992).

4. Discussion

Obtaining sufficient length at age samples from a region's recreational fishery is an uncertain process. Unlike commercial fisheries, where annual catch levels are largely determined by TACCs, recreational fishing effort, and kahawai landings vary depending on prevailing weather patterns and local catch rates. In East Northland and the Hauraki Gulf, the number of kahawai landed per hour of interviewing was consistently lower than experienced on average during the 1991, 1994 and 1996 boat ramp surveys. It is not clear whether this is due to a reduction in overall fishing effort and/or reduced kahawai catch rates by recreational fishers, although anecdotal evidence also suggests that kahawai catch rates have fallen in recent years. Although fewer kahawai were measured than the preferred target sample of 1500 fish, analytically derived mean weighted c.v.s suggest that the length and age compositions of the regional populations have still been described with reasonable precision (<0.2).

There are clear regional differences in the length and age compositions of recreational kahawai catches, and these differences are consistent across years. The Hauraki Gulf population was largely comprised of relatively, small younger fish, with the East Northland region having the broadest kahawai length distribution, dominated by fish of less than 7 years of age, while the Bay of Plenty distribution was mainly comprised of larger fish reflecting a broader underlying age distribution. These patterns are broadly consistent with those derived from boat ramp survey data from the early 1990s (Bradford 2000; Figures 1 to 3). Over the past three years, the East Northland age distributions have become increasingly similar to those of the Bay of Plenty.

In all three regions, localised age distributions derived from landings at individual ramps were variable, both spatially and temporally. This is perhaps not surprising given the size-specific schooling behaviour of kahawai, and the low number of fish measured at individual ramps. Over small spatial scales of kilometres, and temporal scales of one or two weeks, fish of a similar size (and hence age) from one school can dominate landings at a given ramp. When catch data from all ramps within each region are combined, however, consistent age distributions emerge, as discussed above. Comparison of ramp distributions across all three regions suggest that the regional boundaries have some biological as well as geographic basis, although there is still some cross-boundary similarity e.g. East Northland and the Bay of Plenty.

In East Northland and the Bay of Plenty, the age distribution of landed kahawai appeared to broaden over the three years surveyed. Further, in all three regions the number of kahawai encountered by boat ramp interviewers was noticeably greater in the second half of the survey. These observations are consistent with an onshore migration of sexually mature kahawai in the autumn, following spawning in deeper waters in January and February (60–100 m; Annala et al. 2003). Interannual variability in regional climates probably influences spawning and schooling behaviour. Over the last three years, New Zealand's northeastern coastal climate has gone from mild La Nina conditions (onshore north-easterly winds predominating with associated warmer than average water temperatures) to those associated with El Nino conditions (offshore south-westerly winds predominating and colder than average waters). Although interannual variability in the timing of onshore migrations may affect the comparability of age distributions between regions and years, future surveys should still take place over the same four-month period to help maintain consistency. Recreational fishing activity before January is too low and erratic, and the ageing of kahawai collected after April is problematic given the timing of otolith ring deposition.

When regional growth rates are compared between years, they appear to be similar, which suggests that length and age data from all three regions could potentially be combined to provide a more comprehensive age-length key. However, if kahawai movements between areas are size related, and year-specific, as suggested by the differences between regional length and age distributions, the use of a combined age-length key may introduce bias to the age distributions, which is highly undesirable.

As in all ageing studies, the possibility and likelihood of ageing error should be considered when interpreting age distributions and growth rates. Although consistent relative year class strengths and growth rates suggest that ageing error is not excessive, the magnitude of this issue remains uncertain. Stevens and Kalish (1998) used repeated readings from a single reader to infer possible levels of reader error when interpreting structures in this sectioned otoliths. In this study, we used three independent readers to reduce the probability of reader error, but it is highly unlikely ageing error has been totally eliminated. Further, we used the thin sectioning otolith preparation technique, as Stevens and Kalish (1998) concluded that this approach gave the most reliable and consistent results. Difficulty was experienced, when interpreting growth structures on the margin of otoliths collected in late April, as ring deposition appears to occur in some, but not all fish, at this time of year. Ageing of kahawai collected later than early April should therefore be avoided when sufficient otoliths are already available.

The von Bertalanffy curves derived from the last three years are all steeper than those reported in the Annala (2003), possibly more so in East Northland. Growth estimates currently used for KAH 1 stock assessment purposes are those obtained by McKenzie et al. (1992). These estimates were derived from the more selective commercial purse seine and single trawl fisheries, are therefore probably less representative than those derived from this study. Further, these earlier growth estimates are sex-specific, yet Bradford (1998), found little evidence for sexual dimorphism in growth rates.

The relationship between the size and abundance of kahawai landed relative to estimates of the distance offshore, by month, was investigated using data from East Northland and the Bay of Plenty in 2001–02 and 2002–03. There is some evidence of an increase in the size of fish landed with increasing distance offshore. However, this trend may be partially influenced by fisher effects, such as the tendency for experienced fishers to fish further offshore, and not land juvenile kahawai, which are only used for live bait, when targeting larger fish. A further limitation of these results is the lack data relating to kahawai caught further offshore, especially off East Northland. The relationship between the distance offshore and the size of kahawai caught for all regions combined was not examined because region-specific length frequency distributions differ, and a suitable means of weighting these datasets together was not available. These apparent trends should therefore be interpreted cautiously.

5. Acknowledgements

We thank Matt Smith and Cameron Walsh for their skill and care in ageing the otoliths and the numerous boat ramp interviewers, most of whom took part in all three surveys. Thanks are also due to Nick Davies, who provided a thorough and constructive review of an earlier draft, and to members of the Pelagic Working Group who attended presentations on the results of the 2001 and 2002 surveys, and made many useful comments. Funding for this project, KAH2000/01, was provided by the Ministry of Fisheries.

6. References

Annala, J.H.; Sullivan, K.J.; O'Brien, C.J.; Smith, N.W.McL., and Grayling, S.M. (Comps.) 2003: Report from the Fishery Assessment Plenary, May 2003: stock assessments and yield estimates. 616 p. (Unpublished report held in NIWA library, Wellington.)

Bradford, E. 1998a: Harvest estimates from the 1996 national marine recreational fishing surveys. New Zealand Fisheries Assessment Research Document 98/16 27 p. (Unpublished report held in NIWA library, Wellington.)

Bradford, E. 1998b: Unified kahawai growth parameters. *NIWA Technical Report 9*. 50 p.

Bradford, E. 1999: Size distribution of kahawai in commercial and recreational catches. *NIWA Technical Report 61*. 51 p.

Bradford, E. 2000: Feasibility of sampling the recreational fishery to monitor the kahawai stock. *New Zealand Fisheries Assessment Report 2000/11.* 34 p.

Bradford, E. 2001: Further considerations on the feasibility of sampling the recreational fishery to monitor the kahawai stock. *New Zealand Fisheries Assessment Report 2001/05.* 27 p.

Davies, N. M.; Walsh, C. 1995: Length and age composition of commercial snapper landings in the Auckland Fisheries Management Area 1988–94. *New Zealand Fisheries Data Report No. 58.* 85 p.

Hartill, B.; Blackwell, R.; & Bradford, E. 1998: Estimation of mean fish weights from the recreational catch landed at boat ramps in 1996. *NIWA Technical Report 31.* 40 p.

Hartill, B.; Cadenhead, H.; Tasker, R. and Smith, M. 2001: Monitoring the length and age composition of recreational landings of kahawai in KAH 1 in 2000–2001. Final research report Final Research Report for Ministry of Fisheries Research Project KAH2000/01 Objective 1. 11 p.

Hartill, B.; Cadenhead, H.; Tasker, R.; Middleton, C. 2002: Monitoring the length and age composition of recreational landings of kahawai in KAH 1 in 2000–2001 and 2001–02. Final Research Report for Ministry of Fisheries Research Project KAH2000/01 Objective 1. 35 p.

McKenzie, J. R.; Hartill, B.; Trusewich, W. 1992: A summary report on commercial kahawai market sampling in the Auckland Fisheries Management Area (1991–1992). Northern Fisheries Region Internal Report 9. 39 p.

McKenzie, J. R.; Trusewich, W. 1996: Analysis of kahawai (*Arripis trutta* Family: Arripidae) commercial catch sampling from northern New Zealand purse seine and trawl fisheries (KAH9 KAH1) between 1991–1993. Draft *New Zealand Fisheries Assessment Research Document* 70 p.

Stevens, D. W.; Kalish, J. M. 1998: Validated age and growth of kahawai (*Arripis trutta*) in the Bay of Plenty and Tasman Bay. *NIWA Technical Report 11.* 33 p.

Sylvester, T. 1993: Recreational fisheries catch per unit effort trends in the North region (1990/91). Northern Fisheries Region Internal Report No. 14. 23 p. (Unpublished report held in Ministry of Fisheries, Auckland.)

Sylvester, T. 1994: Recreational Fisheries research in the North region. *Seafood New Zealand* February 1994: 27–28.

Appendix 1: Estimated proportions at length and c.v.s fof kahawai sampled from recreational fishers in East Northland, Hauraki Gulf and the Bay of Plenty in 2000–01, 2001–02 and 2002–03

P.i. = proportion of fish in length class. *n* = total number of fish sampled.
c.v. = coefficient of variation. *m.w.c.v.* = mean weighted c.v.

Estimates of the proportion at length of kahawai from East Northland in 2000–01, 2001–02 and 2002–03

Length	2000–01		2001–02		2002–03	
(cm)	*P.i.*	*c.v.*	*P.i.*	*c.v.*	*P.i.*	*c.v.*
10	0.0000	0.00	0.0000	0.00	0.0000	0.00
11	0.0000	0.00	0.0000	0.00	0.0000	0.00
12	0.0000	0.00	0.0000	0.00	0.0000	0.00
13	0.0000	0.00	0.0000	0.00	0.0000	0.00
14	0.0000	0.00	0.0000	0.00	0.0000	0.00
15	0.0000	0.00	0.0000	0.00	0.0000	0.00
16	0.0000	0.00	0.0000	0.00	0.0000	0.00
17	0.0000	0.00	0.0000	0.00	0.0000	0.00
18	0.0000	0.00	0.0000	0.00	0.0000	0.00
19	0.0000	0.00	0.0000	0.00	0.0000	0.00
20	0.0000	0.00	0.0008	1.00	0.0000	0.00
21	0.0008	1.00	0.0000	0.00	0.0009	1.00
22	0.0000	0.00	0.0000	0.00	0.0009	1.00
23	0.0000	0.00	0.0015	0.71	0.0009	1.00
24	0.0008	1.00	0.0023	0.58	0.0043	0.82
25	0.0040	0.53	0.0046	0.46	0.0043	0.52
26	0.0065	0.43	0.0068	0.52	0.0034	0.50
27	0.0048	0.46	0.0068	0.58	0.0043	0.44
28	0.0032	0.50	0.0076	0.44	0.0155	0.31
29	0.0097	0.32	0.0091	0.46	0.0086	0.35
30	0.0097	0.33	0.0061	0.47	0.0060	0.51
31	0.0129	0.27	0.0030	0.50	0.0112	0.38
32	0.0186	0.22	0.0091	0.42	0.0069	0.35
33	0.0234	0.20	0.0159	0.28	0.0112	0.31
34	0.0339	0.17	0.0243	0.27	0.0215	0.23
35	0.0517	0.17	0.0212	0.22	0.0396	0.18
36	0.0395	0.15	0.0250	0.21	0.0534	0.18
37	0.0379	0.16	0.0175	0.23	0.0517	0.17
38	0.0323	0.18	0.0182	0.23	0.0301	0.19
39	0.0379	0.15	0.0190	0.21	0.0250	0.18
40	0.0412	0.15	0.0288	0.22	0.0370	0.17
41	0.0404	0.14	0.0273	0.17	0.0233	0.19
42	0.0557	0.13	0.0448	0.15	0.0198	0.20
43	0.0460	0.14	0.0501	0.14	0.0224	0.21
44	0.0412	0.14	0.0478	0.12	0.0474	0.14
45	0.0476	0.13	0.0577	0.12	0.0457	0.15
46	0.0428	0.15	0.0781	0.10	0.0422	0.15
47	0.0484	0.14	0.0766	0.10	0.0577	0.13
48	0.0468	0.14	0.0797	0.11	0.0835	0.11
49	0.0387	0.15	0.0690	0.11	0.0655	0.12
50	0.0404	0.15	0.0486	0.13	0.0732	0.12
51	0.0323	0.17	0.0432	0.13	0.0500	0.14
52	0.0404	0.15	0.0417	0.13	0.0439	0.15
53	0.0266	0.18	0.0281	0.17	0.0319	0.19
54	0.0274	0.17	0.0250	0.18	0.0189	0.21
55	0.0186	0.20	0.0212	0.20	0.0172	0.22
56	0.0137	0.24	0.0137	0.23	0.0095	0.35
57	0.0121	0.26	0.0068	0.33	0.0052	0.47
58	0.0065	0.35	0.0061	0.35	0.0017	0.71
59	0.0032	0.50	0.0023	0.58	0.0017	0.70
60	0.0008	1.00	0.0015	0.71	0.0017	0.71
61	0.0000	0.00	0.0008	1.00	0.0000	0.00
62	0.0016	0.71	0.0008	1.00	0.0009	1.00
63	0.0000	0.00	0.0000	0.00	0.0000	0.00
64	0.0000	0.00	0.0008	1.00	0.0000	0.00
65	0.0000	0.00	0.0000	0.00	0.0000	0.00
66	0.0000	0.00	0.0000	0.00	0.0000	0.00
67	0.0000	0.00	0.0008	1.00	0.0000	0.00
68	0.0000	0.00	0.0000	0.00	0.0000	0.00
69	0.0000	0.00	0.0000	0.00	0.0000	0.00
70	0.0000	0.00	0.0000	0.00	0.0000	0.00
n	1 239		1 318		1 171	
m.w.c.v.		0.17		0.17		0.18

Appendix 1 – continued:
Estimates of the proportion at length of kahawai from the Hauraki Gulf in 2000–01, 2001–02 and 2002–03

Length	2000–01		2001–02		2002–03	
(cm)	*P.i.*	*c.v.*	*P.i.*	*c.v.*	*P.i.*	*c.v.*
10	0.0000	0.00	0.0000	0.00	0.0000	0.00
11	0.0000	0.00	0.0000	0.00	0.0000	0.00
12	0.0000	0.00	0.0000	0.00	0.0000	0.00
13	0.0000	0.00	0.0000	0.00	0.0000	0.00
14	0.0000	0.00	0.0000	0.00	0.0000	0.00
15	0.0011	1.00	0.0013	1.00	0.0000	0.00
16	0.0000	0.00	0.0013	1.00	0.0000	0.00
17	0.0022	0.99	0.0000	0.00	0.0000	0.00
18	0.0045	0.99	0.0000	0.00	0.0000	0.00
19	0.0101	0.61	0.0000	0.00	0.0000	0.00
20	0.0045	0.60	0.0000	0.00	0.0011	1.00
21	0.0000	0.00	0.0025	0.71	0.0000	0.00
22	0.0000	0.00	0.0038	0.74	0.0000	0.00
23	0.0045	0.61	0.0051	0.50	0.0068	0.47
24	0.0090	0.46	0.0280	0.37	0.0080	0.86
25	0.0123	0.42	0.0433	0.20	0.0114	0.41
26	0.0191	0.38	0.0534	0.19	0.0227	0.29
27	0.0247	0.26	0.0382	0.25	0.0182	0.26
28	0.0426	0.19	0.0267	0.25	0.0466	0.23
29	0.0224	0.23	0.0127	0.37	0.0284	0.20
30	0.0370	0.18	0.0216	0.27	0.0261	0.21
31	0.0549	0.15	0.0127	0.32	0.0239	0.29
32	0.0673	0.15	0.0191	0.27	0.0375	0.21
33	0.0751	0.13	0.0191	0.29	0.0500	0.17
34	0.0807	0.12	0.0356	0.22	0.0523	0.16
35	0.0830	0.13	0.0496	0.20	0.0830	0.14
36	0.0561	0.15	0.0458	0.20	0.0898	0.13
37	0.0415	0.17	0.0598	0.22	0.0841	0.15
38	0.0325	0.19	0.0496	0.17	0.0477	0.17
39	0.0224	0.25	0.0394	0.23	0.0216	0.23
40	0.0404	0.19	0.0267	0.24	0.0205	0.24
41	0.0348	0.23	0.0267	0.24	0.0193	0.23
42	0.0213	0.23	0.0254	0.23	0.0330	0.19
43	0.0179	0.29	0.0293	0.22	0.0216	0.28
44	0.0191	0.27	0.0216	0.24	0.0318	0.21
45	0.0168	0.27	0.0267	0.24	0.0205	0.23
46	0.0056	0.45	0.0420	0.18	0.0205	0.30
47	0.0157	0.38	0.0318	0.23	0.0250	0.24
48	0.0078	0.43	0.0433	0.21	0.0216	0.23
49	0.0146	0.30	0.0293	0.21	0.0261	0.21
50	0.0202	0.27	0.0331	0.23	0.0193	0.24
51	0.0146	0.30	0.0165	0.29	0.0216	0.26
52	0.0078	0.38	0.0191	0.25	0.0205	0.27
53	0.0090	0.35	0.0051	0.49	0.0080	0.38
54	0.0146	0.28	0.0165	0.29	0.0125	0.32
55	0.0123	0.30	0.0140	0.29	0.0057	0.45
56	0.0101	0.33	0.0089	0.37	0.0057	0.45
57	0.0045	0.50	0.0064	0.53	0.0057	0.44
58	0.0011	1.00	0.0051	0.50	0.0011	1.00
59	0.0022	0.71	0.0013	1.00	0.0011	1.00
60	0.0011	1.00	0.0000	0.00	0.0000	0.00
61	0.0011	1.00	0.0025	0.71	0.0000	0.00
62	0.0000	0.00	0.0000	0.00	0.0000	0.00
63	0.0000	0.00	0.0000	0.00	0.0000	0.00
64	0.0000	0.00	0.0000	0.00	0.0000	0.00
65	0.0000	0.00	0.0000	0.00	0.0000	0.00
66	0.0000	0.00	0.0000	0.00	0.0000	0.00
67	0.0000	0.00	0.0000	0.00	0.0000	0.00
68	0.0000	0.00	0.0000	0.00	0.0000	0.00
69	0.0000	0.00	0.0000	0.00	0.0000	0.00
70	0.0000	0.00	0.0000	0.00	0.0000	0.00
n	892		786		880	
m.w.c.v.		0.22		0.25		0.22

Appendix 1 – continued:
Estimates of the proportion at length of kahawai from the Bay of Plenty in 2000–01, 2001–02 and 2002–03

Length (cm)	2000–01 *P.i.*	2000–01 *c.v.*	2001–02 *P.i.*	2001–02 *c.v.*	2002–03 *P.i.*	2002–03 *c.v.*
10	0.0000	0.00	0.0000	0.00	0.0000	0.00
11	0.0000	0.00	0.0000	0.00	0.0000	0.00
12	0.0000	0.00	0.0000	0.00	0.0000	0.00
13	0.0000	0.00	0.0000	0.00	0.0000	0.00
14	0.0000	0.00	0.0000	0.00	0.0009	1.00
15	0.0000	0.00	0.0000	0.00	0.0000	0.00
16	0.0000	0.00	0.0000	0.00	0.0009	1.00
17	0.0000	0.00	0.0000	0.00	0.0009	1.00
18	0.0000	0.00	0.0000	0.00	0.0009	1.00
19	0.0000	0.00	0.0000	0.00	0.0009	1.00
20	0.0009	1.00	0.0000	0.00	0.0000	0.00
21	0.0000	0.00	0.0000	0.00	0.0000	0.00
22	0.0000	0.00	0.0014	0.71	0.0009	1.00
23	0.0009	1.00	0.0020	0.74	0.0009	1.00
24	0.0027	0.75	0.0027	0.61	0.0044	0.45
25	0.0036	0.50	0.0007	1.00	0.0088	0.37
26	0.0027	0.74	0.0034	0.45	0.0062	0.43
27	0.0054	0.41	0.0014	0.70	0.0079	0.33
28	0.0045	0.66	0.0041	0.47	0.0035	0.49
29	0.0109	0.35	0.0027	0.50	0.0088	0.37
30	0.0181	0.27	0.0068	0.37	0.0053	0.47
31	0.0100	0.30	0.0108	0.29	0.0053	0.40
32	0.0217	0.22	0.0095	0.26	0.0071	0.34
33	0.0236	0.22	0.0102	0.27	0.0221	0.24
34	0.0245	0.22	0.0142	0.27	0.0282	0.21
35	0.0272	0.19	0.0136	0.27	0.0318	0.20
36	0.0263	0.23	0.0149	0.24	0.0247	0.20
37	0.0145	0.30	0.0264	0.18	0.0221	0.23
38	0.0290	0.19	0.0512	0.17	0.0265	0.19
39	0.0371	0.17	0.0346	0.14	0.0318	0.17
40	0.0281	0.17	0.0434	0.13	0.0477	0.14
41	0.0317	0.18	0.0454	0.13	0.0415	0.14
42	0.0308	0.19	0.0400	0.13	0.0406	0.14
43	0.0344	0.17	0.0542	0.12	0.0335	0.20
44	0.0462	0.15	0.0373	0.13	0.0397	0.16
45	0.0480	0.14	0.0454	0.14	0.0415	0.15
46	0.0607	0.12	0.0515	0.11	0.0450	0.15
47	0.0543	0.12	0.0596	0.10	0.0556	0.13
48	0.0489	0.13	0.0996	0.08	0.0724	0.11
49	0.0562	0.12	0.0610	0.11	0.0759	0.10
50	0.0652	0.12	0.0738	0.10	0.0812	0.10
51	0.0616	0.13	0.0637	0.10	0.0565	0.12
52	0.0462	0.15	0.0454	0.12	0.0503	0.14
53	0.0344	0.18	0.0379	0.13	0.0300	0.17
54	0.0317	0.16	0.0210	0.19	0.0168	0.24
55	0.0245	0.19	0.0136	0.23	0.0106	0.29
56	0.0154	0.26	0.0061	0.33	0.0044	0.45
57	0.0091	0.34	0.0014	0.70	0.0026	0.58
58	0.0045	0.53	0.0041	0.41	0.0009	1.00
59	0.0027	0.57	0.0027	0.50	0.0018	0.71
60	0.0018	0.71	0.0007	1.00	0.0000	0.00
61	0.0000	0.00	0.0000	0.00	0.0009	1.00
62	0.0000	0.00	0.0007	1.00	0.0000	0.00
63	0.0000	0.00	0.0007	1.00	0.0000	0.00
64	0.0000	0.00	0.0007	1.00	0.0000	0.00
65	0.0000	0.00	0.0000	0.00	0.0000	0.00
66	0.0000	0.00	0.0000	0.00	0.0000	0.00
67	0.0000	0.00	0.0000	0.00	0.0000	0.00
68	0.0000	0.00	0.0000	0.00	0.0000	0.00
69	0.0000	0.00	0.0000	0.00	0.0000	0.00
70	0.0000	0.00	0.0000	0.00	0.0000	0.00
n	1 104		1 476		1 133	
m.w.c.v.		0.18		0.15		0.17

Appendix 2: Estimated proportions at age and c.v.s of kahawai sampled from recreational fishers in East Northland, Hauraki Gulf and the Bay of Plenty in 2000–01, 2001–02 and 2002–03

P.j. = proportion of fish in age class. *n* = total number of fish sampled.
c.v. = coefficient of variation. *m.w.c.v.* = mean weighted c.v.

Estimates of the proportion at age of kahawai from East Northland in 2000–01, 2001–02 and 2002–03

Age (years)	2000–01 *P.j.*	2000–01 *c.v.*	2001–02 *P.j.*	2001–02 *c.v.*	2002–03 *P.j.*	2002–03 *c.v.*
1	0.0000	0.00	0.0000	0.00	0.0009	1.00
2	0.0223	0.26	0.0241	0.27	0.0430	0.16
3	0.2511	0.06	0.1780	0.08	0.2277	0.06
4	0.2629	0.07	0.2663	0.07	0.1599	0.09
5	0.1182	0.12	0.1430	0.11	0.1649	0.10
6	0.1091	0.12	0.1426	0.11	0.1119	0.13
7	0.0537	0.18	0.0713	0.15	0.1021	0.14
8	0.0221	0.29	0.0410	0.21	0.0832	0.15
9	0.0287	0.26	0.0222	0.28	0.0278	0.27
10	0.0279	0.25	0.0334	0.22	0.0204	0.32
11	0.0281	0.23	0.0327	0.22	0.0236	0.30
12	0.0304	0.23	0.0276	0.24	0.0077	0.52
13	0.0230	0.25	0.0070	0.45	0.0103	0.47
14	0.0127	0.38	0.0062	0.46	0.0140	0.38
15	0.0032	0.74	0.0000	0.00	0.0000	0.00
16	0.0013	1.01	0.0000	0.00	0.0000	0.00
17	0.0039	0.75	0.0000	0.00	0.0000	0.00
18	0.0000	0.00	0.0000	0.00	0.0000	0.00
19	0.0000	0.00	0.0000	0.00	0.0000	0.00
>19	0.0000	0.00	0.0000	0.00	0.0000	0.00
n	517		526			504
m.w.c.v.		0.13		0.12		0.13

Estimates of the proportion at age of kahawai from the Hauraki Gulf in 2000–01, 2001–02 and 2002–03

Age (years)	2000–01 *P.j.*	2000–01 *c.v.*	2001–02 *P.j.*	2001–02 *c.v.*	2002–03 *P.j.*	2002–03 *c.v.*
1	0.0224	0.22	0.0025	0.71	0.0000	0.00
2	0.1029	0.12	0.0581	0.17	0.1618	0.08
3	0.5377	0.03	0.4188	0.05	0.4677	0.03
4	0.1548	0.10	0.1835	0.09	0.1498	0.10
5	0.0748	0.16	0.1067	0.13	0.0514	0.21
6	0.0137	0.46	0.0615	0.17	0.0430	0.25
7	0.0020	1.07	0.0591	0.17	0.0397	0.26
8	0.0070	0.77	0.0313	0.27	0.0210	0.30
9	0.0103	0.45	0.0080	0.52	0.0177	0.36
10	0.0114	0.52	0.0098	0.50	0.0096	0.55
11	0.0268	0.32	0.0164	0.35	0.0119	0.44
12	0.0128	0.49	0.0083	0.53	0.0076	0.64
13	0.0048	0.83	0.0084	0.56	0.0113	0.49
14	0.0149	0.50	0.0207	0.33	0.0029	1.03
15	0.0015	1.12	0.0028	1.02	0.0011	1.09
16	0.0000	0.00	0.0000	0.00	0.0000	0.00
17	0.0000	0.00	0.0015	1.07	0.0011	1.09
18	0.0000	0.00	0.0000	0.00	0.0000	0.00
19	0.0000	0.00	0.0000	0.00	0.0000	0.00
>19	0.0000	0.00	0.0000	0.00	0.0000	0.00
n	500		500		527	
m.w.c.v.		0.11		0.13		0.12

Appendix 2 – continued:
Estimates of the proportion at age of kahawai from the Bay of Plenty in 2000–01, 2001–02 and 2002–03

Age (years)	2000–01 *P.j.*	2000–01 *c.v.*	2001–02 *P.j.*	2001–02 *c.v.*	2002–03 *P.j.*	2002–03 *c.v.*
1	0.0000	0.00	0.0000	0.00	0.0000	0.00
2	0.0101	0.32	0.0075	0.39	0.0446	0.17
3	0.1405	0.08	0.0768	0.13	0.1469	0.09
4	0.1482	0.09	0.1807	0.08	0.1762	0.09
5	0.1331	0.11	0.1747	0.09	0.1481	0.11
6	0.1217	0.13	0.1464	0.11	0.1387	0.11
7	0.1244	0.13	0.1234	0.12	0.1019	0.14
8	0.0596	0.22	0.0913	0.15	0.0806	0.16
9	0.0558	0.21	0.0482	0.22	0.0457	0.20
10	0.0650	0.20	0.0187	0.35	0.0419	0.23
11	0.0669	0.19	0.0556	0.22	0.0158	0.33
12	0.0158	0.38	0.0448	0.27	0.0327	0.24
13	0.0123	0.47	0.0147	0.45	0.0046	0.72
14	0.0098	0.64	0.0037	0.72	0.0076	0.40
15	0.0120	0.56	0.0061	0.51	0.0028	0.76
16	0.0130	0.44	0.0020	1.08	0.0000	0.00
17	0.0015	1.05	0.0000	0.00	0.0000	0.00
18	0.0015	1.05	0.0000	0.00	0.0034	0.62
19	0.0026	1.01	0.0000	0.00	0.0000	0.00
>19	0.0027	0.58	0.0000	0.00	0.0026	0.75
n	457		495		477	
m.w.c.v.		0.16		0.14		0.14

Appendix 3: Age–length keys derived from otolith samples collected from recreational fishers from East Northland in 2000–01, 2001–02 and 2002–03.

Estimates of proportion of length at age for kahawai sampled from the East Northland recreational fishery, January to April 2000–01. (Note: Aged to 01/01/01)

Length (cm)	Age (years) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	>19	No. aged
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
25	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
26	0	0.25	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
27	0	0.50	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
28	0	0.50	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
29	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
30	0	0.33	0.50	0.17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
31	0	0.14	0.86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
32	0	0.10	0.70	0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
33	0	0	0.91	0.09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
34	0	0	0.76	0.24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
35	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13
36	0	0	0.86	0.09	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
37	0	0	0.65	0.29	0.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17
38	0	0	0.65	0.35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
39	0	0	0.10	0.75	0.10	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
40	0	0	0.11	0.68	0.16	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
41	0	0	0.12	0.88	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
42	0	0	0.09	0.50	0.23	0.14	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	22
43	0	0	0.05	0.62	0.24	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
44	0	0	0.16	0.53	0.21	0.11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
45	0	0	0.07	0.45	0.21	0.21	0.07	0	0	0	0	0	0	0	0	0	0	0	0	0	29
46	0	0	0	0.22	0.30	0.39	0.09	0	0	0	0	0	0	0	0	0	0	0	0	0	23
47	0	0	0	0.18	0.27	0.18	0.27	0.05	0.05	0	0	0	0	0	0	0	0	0	0	0	22
48	0	0	0	0	0.34	0.34	0.17	0.03	0.07	0.03	0	0	0	0	0	0	0	0	0	0	29
49	0	0	0	0.07	0.27	0.13	0.20	0.07	0.20	0	0.07	0	0	0	0	0	0	0	0	0	15
50	0	0	0	0.12	0.18	0.24	0	0.06	0.06	0.24	0	0.12	0	0	0	0	0	0	0	0	17
51	0	0	0	0.06	0.06	0.41	0.06	0.12	0	0.06	0.12	0	0.06	0.06	0	0	0	0	0	0	17
52	0	0	0	0.06	0	0.16	0.13	0.16	0.06	0.09	0.22	0.06	0	0.03	0	0.03	0	0	0	0	32
53	0	0	0	0	0	0.11	0.06	0	0.06	0.06	0.11	0.28	0.17	0.11	0	0	0.06	0	0	0	18
54	0	0	0	0	0	0	0.06	0.06	0.13	0.13	0.13	0.25	0.25	0	0	0	0	0	0	0	16
55	0	0	0	0	0	0	0.08	0.08	0.08	0.33	0.08	0.17	0.08	0	0.08	0	0	0	0	0	12
56	0	0	0	0	0	0	0.25	0	0.13	0	0.13	0.13	0.25	0.13	0	0	0	0	0	0	8
57	0	0	0	0	0	0	0	0	0.20	0	0	0.20	0	0.40	0	0	0.20	0	0	0	5
58	0	0	0	0	0	0	0	0	0	0	0	0.25	0.50	0	0.25	0	0	0	0	0	4
59	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	0	0	1
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	1
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total																					517

Appendix 3 – continued:

Estimates of proportion of length at age for kahawai sampled from the East Northland recreational fishery, January to April 2001–02. (Note: Aged to 01/01/02)

Length (cm)	Age (years) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	>19	No. aged
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
24	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
25	0	0.50	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
26	0	0.50	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
27	0	0.67	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
28	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
29	0	0.60	0.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
30	0	0.20	0.80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
31	0	0.50	0	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
32	0	0.13	0.88	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
33	0	0	0.86	0.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
34	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
35	0	0	0.92	0.08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
36	0	0	0.91	0.09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
37	0	0	0.60	0.30	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
38	0	0	0.77	0.23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13
39	0	0	0.27	0.73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
40	0	0	0.05	0.86	0.09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
41	0	0	0.35	0.65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17
42	0	0	0.17	0.61	0.17	0.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
43	0	0	0.12	0.46	0.31	0.12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
44	0	0	0.11	0.42	0.26	0.21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
45	0	0	0	0.62	0.19	0.10	0.05	0.05	0	0	0	0	0	0	0	0	0	0	0	0	21
46	0	0	0.09	0.26	0.32	0.21	0.06	0.06	0	0	0	0	0	0	0	0	0	0	0	0	34
47	0	0	0	0.31	0.17	0.34	0.14	0.03	0	0	0	0	0	0	0	0	0	0	0	0	35
48	0	0	0	0.24	0.13	0.32	0.18	0.05	0.05	0.03	0	0	0	0	0	0	0	0	0	0	38
49	0	0	0	0.14	0.27	0.30	0.14	0.11	0.02	0.02	0	0	0	0	0	0	0	0	0	0	44
50	0	0	0	0.18	0.23	0.09	0.14	0.14	0	0.09	0.09	0.05	0	0	0	0	0	0	0	0	22
51	0	0	0	0.07	0.24	0.21	0.07	0.03	0.10	0.07	0.10	0.10	0	0	0	0	0	0	0	0	29
52	0	0	0	0.04	0.07	0.18	0.32	0.07	0.04	0.07	0.11	0.04	0.07	0	0	0	0	0	0	0	28
53	0	0	0	0	0	0.12	0.12	0.12	0	0.18	0.29	0.12	0	0.06	0	0	0	0	0	0	17
54	0	0	0	0	0	0.11	0.11	0.11	0.05	0.21	0.16	0.11	0.05	0.11	0	0	0	0	0	0	19
55	0	0	0	0	0	0.11	0	0.11	0.22	0.11	0.22	0.22	0	0	0	0	0	0	0	0	9
56	0	0	0	0	0	0	0	0	0.20	0.30	0.10	0.20	0.20	0	0	0	0	0	0	0	10
57	0	0	0	0	0	0.25	0	0	0.25	0.25	0	0.25	0	0	0	0	0	0	0	0	4
58	0	0	0	0	0	0	0	0	0	0.17	0.17	0.33	0	0.33	0	0	0	0	0	0	6
59	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	0	1
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total																					526

Appendix 3 – continued:

Estimates of proportion of length at age for kahawai sampled from the East Northland recreational fishery, January to April 2002–03. (Note: Aged to 01/01/03)

Length (cm)	Age (years) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	>19	No. aged
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
22	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
23	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
24	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
25	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
26	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
27	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
28	0	0.60	0.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
29	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
30	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
31	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
32	0	0.13	0.88	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
33	0	0.14	0.86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
34	0	0	0.93	0.07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
35	0	0	0.86	0.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
36	0	0.06	0.94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35
37	0	0.03	0.94	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34
38	0	0	0.75	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
39	0	0	0.36	0.64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
40	0	0	0.05	0.63	0.32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
41	0	0	0	0.64	0.36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
42	0	0	0.11	0.67	0.22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
43	0	0	0	0.64	0.36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
44	0	0	0	0.46	0.42	0.04	0.08	0	0	0	0	0	0	0	0	0	0	0	0	0	24
45	0	0	0	0.38	0.34	0.17	0.07	0.03	0	0	0	0	0	0	0	0	0	0	0	0	29
46	0	0	0	0.35	0.40	0.05	0.10	0	0.05	0.05	0	0	0	0	0	0	0	0	0	0	20
47	0	0	0	0.04	0.30	0.26	0.15	0.15	0.11	0	0	0	0	0	0	0	0	0	0	0	27
48	0	0	0	0.07	0.21	0.29	0.25	0.14	0.04	0	0	0	0	0	0	0	0	0	0	0	28
49	0	0	0	0	0.18	0.39	0.11	0.29	0	0	0	0.04	0	0	0	0	0	0	0	0	28
50	0	0	0	0	0.34	0.13	0.09	0.28	0.03	0.06	0.03	0.03	0	0	0	0	0	0	0	0	32
51	0	0	0	0	0.09	0.13	0.48	0.04	0.13	0.04	0.09	0	0	0	0	0	0	0	0	0	23
52	0	0	0	0	0.08	0.21	0.17	0.33	0.08	0.08	0.04	0	0	0	0	0	0	0	0	0	24
53	0	0	0	0	0	0.27	0.27	0	0	0.09	0.18	0	0.09	0.09	0	0	0	0	0	0	11
54	0	0	0	0	0	0.10	0.40	0.10	0	0.10	0.20	0.10	0	0	0	0	0	0	0	0	10
55	0	0	0	0	0	0	0	0.11	0.22	0.11	0.22	0	0.11	0.22	0	0	0	0	0	0	9
56	0	0	0	0	0	0	0	0.13	0	0.13	0	0.13	0.13	0.50	0	0	0	0	0	0	8
57	0	0	0	0	0	0	0	0	0	0	0	0	0.50	0.50	0	0	0	0	0	0	2
58	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	1
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	0	0	1
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total																					504

Appendix 4: Age–length keys derived from otolith samples collected from recreational fishers from the Hauraki Gulf in 2000–01, 2001–02 and 2002–03.

Estimates of proportion of length at age for kahawai sampled from the Hauraki Gulf recreational fishery, January to April 2000–01. (Note: Aged to 01/01/01)

Length	Age (years)																				No.
(cm)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	>19	aged
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
18	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
19	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
20	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
24	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
25	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
26	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
27	0	0.63	0.38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
28	0	0.44	0.56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
29	0	0.55	0.45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
30	0	0.19	0.81	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
31	0	0.09	0.88	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34
32	0	0	0.90	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41
33	0	0	0.88	0.10	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50
34	0	0	0.93	0.07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42
35	0	0	0.98	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44
36	0	0	0.87	0.10	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31
37	0	0	0.70	0.20	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
38	0	0	0.38	0.44	0.19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
39	0	0	0.42	0.42	0.17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
40	0	0	0.35	0.35	0.25	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
41	0	0	0.13	0.81	0.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
42	0	0	0.10	0.70	0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
43	0	0	0.30	0.50	0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
44	0	0	0.25	0.63	0.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
45	0	0	0.17	0.33	0.33	0.17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
46	0	0	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
47	0	0	0	0.50	0.17	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
48	0	0	0	0.33	0.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
49	0	0	0	0	0.75	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
50	0	0	0	0	0.25	0	0	0.13	0	0.13	0.38	0.13	0	0	0	0	0	0	0	0	8
51	0	0	0	0	0	0	0	0	0.33	0.17	0.17	0.17	0	0.17	0	0	0	0	0	0	6
52	0	0	0	0	0	0	0.25	0	0.50	0	0.25	0	0	0	0	0	0	0	0	0	4
53	0	0	0	0	0	0	0	0.50	0	0	0	0	0	0.50	0	0	0	0	0	0	2
54	0	0	0	0	0	0	0	0	0	0	0.50	0.25	0.25	0	0	0	0	0	0	0	4
55	0	0	0	0	0	0	0	0	0	0.25	0.25	0.25	0	0.25	0	0	0	0	0	0	4
56	0	0	0	0	0	0	0	0	0	0.33	0.33	0	0	0.33	0	0	0	0	0	0	3
57	0	0	0	0	0	0	0	0	0.33	0	0	0	0	0.33	0.33	0	0	0	0	0	3
58	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	0	1
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	1
61	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	0	0	1
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total																					500

Appendix 4 – continued:

Estimates of proportion of length at age for kahawai sampled from the Hauraki Gulf recreational fishery, January to April 2001–02. (Note: Aged to 01/01/02)

Length	Age (years)																				No.
(cm)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	>19	aged
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
16	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
23	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
24	0	0.15	0.85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13
25	0	0.23	0.77	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
26	0	0.23	0.77	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31
27	0	0.33	0.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
28	0	0.14	0.86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
29	0	0	0.33	0.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
30	0	0.44	0.56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
31	0	0.14	0.71	0.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
32	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
33	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
34	0	0	0.71	0.21	0.07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
35	0	0	0.78	0.19	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32
36	0	0	0.68	0.26	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
37	0	0	0.59	0.37	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27
38	0	0	0.67	0.25	0.04	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24
39	0	0	0.50	0.31	0.19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
40	0	0	0.50	0.40	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
41	0	0	0.14	0.71	0.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
42	0	0	0.10	0.40	0.10	0.30	0	0.10	0	0	0	0	0	0	0	0	0	0	0	0	10
43	0	0	0	0.76	0.19	0	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	21
44	0	0	0	0.50	0.42	0.08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
45	0	0	0	0.40	0.33	0.13	0.07	0	0	0	0	0.07	0	0	0	0	0	0	0	0	15
46	0	0	0	0.23	0.32	0.14	0.25	0.05	0.05	0	0	0	0	0	0	0	0	0	0	0	22
47	0	0	0	0	0.50	0.22	0.17	0.11	0	0	0	0	0	0	0	0	0	0	0	0	18
48	0	0	0	0	0.25	0.38	0.29	0.08	0	0	0	0	0	0	0	0	0	0	0	0	24
49	0	0	0	0.07	0.36	0.07	0.29	0.07	0.07	0	0.07	0	0	0	0	0	0	0	0	0	14
50	0	0	0	0	0.17	0.17	0.25	0.17	0.08	0	0	0.08	0	0	0.08	0	0	0	0	0	12
51	0	0	0	0	0	0.30	0.40	0.20	0	0	0	0	0	0.10	0	0	0	0	0	0	10
52	0	0	0	0.10	0	0.10	0.10	0.10	0	0.10	0.30	0	0.10	0.10	0	0	0	0	0	0	10
53	0	0	0	0	0	0.25	0	0.25	0	0.25	0.25	0	0	0	0	0	0	0	0	0	4
54	0	0	0	0	0	0.10	0.20	0	0	0.10	0.20	0.10	0	0.30	0	0	0	0	0	0	10
55	0	0	0	0	0	0	0	0.25	0	0.25	0	0	0.25	0.25	0	0	0	0	0	0	4
56	0	0	0	0	0	0	0	0	0	0.17	0.17	0	0.33	0.17	0	0	0.17	0	0	0	6
57	0	0	0	0	0	0	0	0.33	0	0	0	0.33	0	0.33	0	0	0	0	0	0	3
58	0	0	0	0	0	0	0	0	0	0	0.50	0	0	0.50	0	0	0	0	0	0	2
59	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	1
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total																					500

Appendix 4 – continued:

Estimates of proportion of length at age for kahawai sampled from the Hauraki Gulf recreational fishery, January to April 2002–03. (Note: Aged to 01/01/03)

Length (cm)	Age (years) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	>19	No aged
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
24	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
25	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
26	0	0.75	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
27	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
28	0	0.88	0.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32
29	0	0.81	0.19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
30	0	0.31	0.69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
31	0	0.38	0.63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
32	0	0.16	0.68	0.16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
33	0	0.07	0.90	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30
34	0	0.09	0.79	0.12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33
35	0	0.02	0.93	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	55
36	0	0	0.92	0.08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48
37	0	0.02	0.93	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42
38	0	0.04	0.85	0.08	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
39	0	0	0.55	0.45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
40	0	0	0.50	0.40	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
41	0	0	0.20	0.50	0.30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
42	0	0	0.08	0.75	0.08	0.08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
43	0	0	0	0.88	0.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
44	0	0	0	0.80	0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
45	0	0	0	0.70	0.20	0	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	10
46	0	0	0	0.25	0	0.50	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	4
47	0	0	0	0	0.43	0.29	0.14	0	0	0	0	0.14	0	0	0	0	0	0	0	0	7
48	0	0	0	0	0.30	0.20	0.40	0	0.10	0	0	0	0	0	0	0	0	0	0	0	10
49	0	0	0	0	0.17	0.17	0.17	0.42	0.08	0	0	0	0	0	0	0	0	0	0	0	12
50	0	0	0	0	0.22	0.11	0.22	0.22	0.11	0	0	0	0.11	0	0	0	0	0	0	0	9
51	0	0	0	0	0	0.38	0.25	0	0.13	0.13	0.13	0	0	0	0	0	0	0	0	0	8
52	0	0	0	0	0	0	0.14	0	0.14	0.14	0.14	0.14	0.14	0.14	0	0	0	0	0	0	7
53	0	0	0	0	0	0.50	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	4
54	0	0	0	0	0	0	0	0.17	0.33	0	0.50	0	0	0	0	0	0	0	0	0	6
55	0	0	0	0	0	0	0	0	0	0.50	0	0	0.50	0	0	0	0	0	0	0	2
56	0	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0.25	0	0	0	0	0	0	0	4
57	0	0	0	0	0	0	0	0.40	0	0	0	0.20	0	0	0.20	0	0.20	0	0	0	5
58	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	0	0	0	1
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total																					527

Appendix 5: Age–length keys derived from otolith samples collected from recreational fishers from the Bay of Plenty in 2000–01, 2001–02 and 2002–03.

Estimates of proportion of length at age for kahawai sampled from the Bay of Plenty recreational fishery, January to April 2000–01. (Note: Aged to 01/01/01)

Length (cm)	Age (years) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	>19	No. aged
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0.50	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
24	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
25	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0.20	0.60	0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
28	0	0.25	0.25	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
29	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
30	0	0.06	0.88	0.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17
31	0	0	0.86	0.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
32	0	0	0.90	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
33	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
34	0	0	0.75	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
35	0	0	0.63	0.31	0.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
36	0	0	0.35	0.59	0.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17
37	0	0	0.25	0.67	0.08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
38	0	0	0.06	0.71	0.24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17
39	0	0	0.08	0.68	0.24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
40	0	0	0.06	0.61	0.22	0.11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
41	0	0	0.08	0.42	0.33	0.08	0.08	0	0	0	0	0	0	0	0	0	0	0	0	0	12
42	0	0	0	0.17	0.58	0.17	0.08	0	0	0	0	0	0	0	0	0	0	0	0	0	12
43	0	0	0	0.15	0.54	0.15	0.08	0.08	0	0	0	0	0	0	0	0	0	0	0	0	13
44	0	0	0	0.20	0.52	0.12	0.12	0	0.04	0	0	0	0	0	0	0	0	0	0	0	25
45	0	0	0	0.04	0.35	0.35	0.13	0.04	0.04	0.04	0	0	0	0	0	0	0	0	0	0	23
46	0	0	0	0.04	0.17	0.39	0.22	0.09	0.04	0.04	0	0	0	0	0	0	0	0	0	0	23
47	0	0	0	0	0.05	0.47	0.32	0.05	0.05	0.05	0	0	0	0	0	0	0	0	0	0	19
48	0	0	0	0	0.11	0.11	0.50	0.11	0.06	0.06	0.06	0	0	0	0	0	0	0	0	0	18
49	0	0	0	0	0	0.23	0.36	0.09	0.05	0.05	0.18	0.05	0	0	0	0	0	0	0	0	22
50	0	0	0	0	0	0.12	0.24	0.24	0.06	0.29	0.06	0	0	0	0	0	0	0	0	0	17
51	0	0	0	0	0	0.06	0.11	0.11	0.22	0.11	0.28	0.06	0.06	0	0	0	0	0	0	0	18
52	0	0	0	0	0	0.05	0.16	0.05	0.21	0.21	0.21	0.05	0.05	0	0	0	0	0	0	0	19
53	0	0	0	0	0	0.06	0	0.12	0.24	0.18	0.29	0.12	0	0	0	0	0	0	0	0	17
54	0	0	0	0	0	0	0	0.08	0.08	0.08	0.42	0	0.08	0	0	0.17	0	0	0.08	0	12
55	0	0	0	0	0	0	0	0.20	0	0	0	0	0	0.40	0.40	0	0	0	0	0	5
56	0	0	0	0	0	0	0	0	0.20	0.40	0	0	0	0	0	0.40	0	0	0	0	5
57	0	0	0	0	0	0	0	0	0	0.17	0	0.17	0.17	0	0	0.17	0.17	0.17	0	0	6
58	0	0	0	0	0	0	0	0	0	0	0	0	0.50	0	0.50	0	0	0	0	0	2
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
60	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	0	2
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total																					457

Appendix 5 – continued:

Estimates of proportion of length at age for kahawai sampled from the Bay of Plenty recreational fishery, January to April 2001–02. (Note: Aged to 01/01/02)

Length (cm)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	>19	No. aged
																		Age (years)			
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
25	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
26	0	0.60	0.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
27	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
28	0	0.50	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
29	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
30	0	0	0.50	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
31	0	0	0.86	0.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
32	0	0	0.86	0.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
33	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
34	0	0	0.67	0.22	0.11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
35	0	0	0.20	0.80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
36	0	0	0.13	0.75	0.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
37	0	0	0.20	0.50	0.30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
38	0	0	0.12	0.59	0.29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17
39	0	0	0.14	0.77	0.09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
40	0	0	0.04	0.61	0.32	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
41	0	0	0.00	0.61	0.35	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23
42	0	0	0.04	0.29	0.54	0.04	0	0.08	0	0	0	0	0	0	0	0	0	0	0	0	24
43	0	0	0.04	0.15	0.48	0.26	0.04	0.04	0	0	0	0	0	0	0	0	0	0	0	0	27
44	0	0	0.04	0.12	0.40	0.32	0.08	0.04	0	0	0	0	0	0	0	0	0	0	0	0	25
45	0	0	0.09	0.13	0.22	0.30	0.09	0.13	0.04	0	0	0	0	0	0	0	0	0	0	0	23
46	0	0	0	0	0.25	0.29	0.29	0.14	0	0.04	0	0	0	0	0	0	0	0	0	0	28
47	0	0	0	0	0.19	0.43	0.24	0.08	0.05	0	0	0	0	0	0	0	0	0	0	0	37
48	0	0	0	0.02	0.16	0.20	0.33	0.18	0.09	0	0.02	0	0	0	0	0	0	0	0	0	45
49	0	0	0	0	0.06	0.25	0.25	0.38	0	0	0	0.06	0	0	0	0	0	0	0	0	16
50	0	0	0	0.04	0.04	0.18	0.32	0.11	0.07	0.04	0.11	0.07	0.04	0	0	0	0	0	0	0	28
51	0	0	0	0.03	0	0.06	0.13	0.13	0.16	0.10	0.26	0.10	0	0.03	0	0	0	0	0	0	31
52	0	0	0	0	0.06	0.12	0.00	0.18	0.06	0.18	0.12	0.18	0.06	0	0.06	0	0	0	0	0	17
53	0	0	0	0	0	0.08	0.08	0	0.25	0	0.17	0.25	0.17	0	0	0	0	0	0	0	12
54	0	0	0	0	0	0	0	0	0	0	0.67	0.33	0	0	0	0	0	0	0	0	3
55	0	0	0	0	0	0	0.13	0.13	0.25	0	0.25	0.13	0	0.13	0	0	0	0	0	0	8
56	0	0	0	0	0	0	0	0	0.50	0	0	0	0.50	0	0	0	0	0	0	0	2
57	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	0	1
58	0	0	0	0	0	0	0	0	0	0	0	0.50	0	0	0	0.50	0	0	0	0	2
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	1
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	1
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total																					495

Appendix 5 – continued:

Estimates of proportion of length at age for kahawai sampled from the Bay of Plenty recreational fishery, January to April 2002–03.
(Note: Aged to 01/01/03)

Length (cm)	Age (years) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	>19	No. aged
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
24	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
25	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
26	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
27	0	0.86	0.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
28	0	0.50	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
29	0	0.40	0.60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
30	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
31	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
32	0	0.33	0.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
33	0	0.14	0.86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
34	0	0.05	0.75	0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
35	0	0.08	0.67	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
36	0	0	0.64	0.36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
37	0	0	0.58	0.42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
38	0	0.10	0.40	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
39	0	0	0.18	0.64	0.18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
40	0	0	0.13	0.79	0.08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24
41	0	0	0.05	0.53	0.37	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
42	0	0	0.12	0.42	0.35	0	0.04	0.04	0.04	0	0	0	0	0	0	0	0	0	0	0	26
43	0	0	0	0.08	0.46	0.33	0.08	0.04	0	0	0	0	0	0	0	0	0	0	0	0	24
44	0	0	0.06	0.38	0.19	0.25	0.06	0	0	0.06	0	0	0	0	0	0	0	0	0	0	16
45	0	0	0.04	0	0.48	0.36	0.04	0.04	0.04	0	0	0	0	0	0	0	0	0	0	0	25
46	0	0	0	0.20	0.40	0.13	0.20	0	0	0.07	0	0	0	0	0	0	0	0	0	0	15
47	0	0	0	0.09	0.26	0.26	0.18	0.12	0.03	0.03	0.03	0	0	0	0	0	0	0	0	0	34
48	0	0	0	0	0.26	0.26	0.30	0.11	0	0.04	0	0.04	0	0	0	0	0	0	0	0	27
49	0	0	0	0.04	0	0.41	0.30	0.11	0.11	0.04	0	0	0	0	0	0	0	0	0	0	27
50	0	0	0	0	0.13	0.19	0.13	0.23	0.10	0.13	0	0.06	0.03	0	0	0	0	0	0	0	31
51	0	0	0	0	0.04	0.17	0.17	0.29	0	0.21	0.08	0.04	0	0	0	0	0	0	0	0	24
52	0	0	0	0	0	0.04	0.15	0.23	0.15	0.08	0.04	0.23	0.04	0	0.04	0	0	0	0	0	26
53	0	0	0	0	0	0.10	0.10	0.05	0.15	0.05	0.25	0.25	0	0.05	0	0	0	0	0	0	20
54	0	0	0	0	0	0	0	0.30	0.10	0.10	0	0.20	0	0.10	0	0	0	0.10	0	0.10	10
55	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	1
56	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	2
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	1
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	1
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total																					477

C

Length and age compositions of recreational landings of kahawai in KAH 1 in January to April 2003–04 and 2004–05

Helena Armiger, Bruce Hartill, Robert Tasker and Matt Smith

Final Research Report for
Ministry of Fisheries Research Project KAH2003/01
Objectives 1 & 2

This is the paperwriting marked "**C**" mentioned and referred to in the annexed Affidavit of **Jonathan Clive Holdsworth** sworn at Auckland this 19th day of October 2006 before me: MARK SMITH

A Solicitor of the High Court of New Zealand

National Institute of Water and Atmospheric Research
April 2006

EXECUTIVE SUMMARY

Armiger, H.; Hartill, B.; Tasker, R.; Smith, M.; Griggs, L. (2005). Length and age compositions of recreational landings of kahawai in KAH 1 in January to April 2003–04 and 2004–05.

***New Zealand Fisheries Assessment Report 2006/xx.* 37 p.**

Landing sampling programmes are often used to provide length and age data for fisheries assessments. Usually, commercial landings are sampled as they provide the most insight into changes in length and age structure through time. Kahawai school by size, however, and commercial landings are usually composed of fish from only one or two schools. Length and age distributions sampled from individual landings therefore tend to be narrow and highly variable between landings, and are therefore limited in their utility. Recreational fisheries, however, are composed of thousands of trips, which sample a greater number of schools at a much lower level of intensity, and are therefore more likely to reflect changes in the underlying population. Resultant length frequency distributions tend to be more unimodal, with any secondary peaks probably reflecting strong year classes rather than the influence of individual schools. Further, there is no minimum legal size for kahawai and recreational fishers therefore tend to land a greater size range of kahawai, in addition to providing a more accurate insight into the population in the area fished.

Dedicated sampling of recreational landings of kahawai was initiated (as part of the Ministry of Fisheries programme KAH2000/01) in the summer of 2000–01, and continued for a further two years. This report documents the results of an additional two years sampling, undertaken as part of the Ministry of Fisheries programme KAH2003/01. The methods and sample design used in 2003–04 and 2004–05 were closely based on that used in the preceding three years. Noticeably fewer kahawai were encountered by boat ramp interviewers in the Hauraki Gulf and Bay of Plenty, despite far more intensive sampling effort resulting from another two concurrent programmes (REC2002/02 and REC2004/01). Sampling in the eastern Bay of Plenty in 2004 was also hampered by a rahui (fishery closure by local iwi) which halted fishing for several months, and also by staff shortages. Despite these problems, regional kahawai length and age compositions were described with satisfactory precision.

Regional length and age compositions derived from recreational landings sampled in both 2003–04 and 2004–05 are broadly consistent with patterns and trends seen in previous years. The East Northland population has become increasingly dominated by larger, older fish, and the age composition is now far more similar to that of the Bay of Plenty than it was five years ago. In contrast, the Hauraki Gulf population is composed of smaller, younger fish, with poor representation of the older age classes seen elsewhere. Probably the most abundant component of the KAH 1 population is that found in the Bay of Plenty, which now has a broad age distribution, predominantly composed of 3 to 11 year old fish.

When the results from this survey are combined with those of the previous three years, a time series of regional length and age distributions emerges which provides a key component of any future stock assessment of KAH 1. The manner in which these data will be used is partially dependent on our understanding of movement by a species which is commonly regarded as highly mobile. A cursory examination of data available from tagging programmes conducted in the early 1980s and in 1991 suggest that despite this mobility, 80–90% of kahawai remain resident within KAH 1, and that emigration within and between stocks/substocks is at least partially size dependent. If future stock assessments move away from the single stock approach used previously, and focus on KAH 1 (the only Quota Management Area for which an age structured modelling approach is currently possible), the possible influence of size-dependent movement should be explicitly considered. This may involve a more detailed analysis of the available tag/recapture data, which should consider the relative exploitation rates of substocks, and non-independence of observations arising from recapture events involving more than one fish, that were tagged during the same release event.

1. INTRODUCTION

Many fisheries are monitored using catch-at-age and catch-at-length data, which have been collected from commercial landings. Kahawai (*Arripis trutta*) school by size, however, and individual commercial landings, composed of fish from only one or two schools, can provide a very misleading description of the wider population structure when a limited number of landings are sampled. For example, amalgamated length frequencies collected from commercial purse seine landings in 1990–91 and 1991–92 were multimodal, and McKenzie & Trusewich (NIWA, Auckland, unpublished results) concluded that this was probably an artefact of the way the purse seine fleet operated, rather than an intrinsic feature of the Bay of Plenty population. While comprehensive sampling of commercial catches can be used to characterise commercial extraction, these samples cannot be considered indicative of the underlying population length and age structure, as the fishery operates non-randomly in space and time.

Recreational fisheries probably provide a more representative description of the local kahawai population, as a wider range of schools is sampled at a far lower intensity, thus lessening the influence of any single school (Bradford 2000). Further, recreational fishers catch, and tend to land, a wider size range of fish than their commercial counterparts (Bradford 1999). A time series of recreational catch-at-age estimates should therefore provide better insight into changes in population age composition, which may be used to monitor the fishery. For this reason, dedicated sampling of recreational landings of kahawai was initiated in the summer of 2000–01, and continued for a further two years, as part of the Ministry of Fisheries programme KAH2002/02 (Hartill et al. 2004). This report documents the results of a further two years sampling, undertaken as part of the Ministry of Fisheries programme KAH2003/01.

Overall Objective

1. To monitor the status of the kahawai (*Arripis trutta*) stocks.

Specific Objectives

1. To conduct the sampling and determine the length and age composition of the recreational landings of kahawai in KAH 1 for the 2003/04 fishing year. The target coefficient of variation (c.v.) for the catch at age will be 30% (mean weighted c.v. across all age classes).

2. To conduct the sampling and determine the length and age composition of the recreational landings of kahawai in KAH 1 for the 2004/05 fishing year. The target coefficient of variation (c.v.) for the catch at age will be 30% (mean weighted c.v. across all age classes).

3. To assess the feasibility of using recreational CPUE as an index of kahawai abundance.

Work associated with the third specific objective is documented in a Final Research Report for KAH200401, which characterises New Zealand's fisheries (Hartill & Walsh 2005).

2. METHODS

2.1 Previous boat ramp surveys

In 1990–91, a survey was conducted to collect baseline information on harvest rates by recreational fishers interviewed at boat ramps throughout the Auckland Fisheries Management Area (Sylvester 1993). Most interviewing occurred on weekends between Boxing Day 1990 and June 1991. The main objective of a further survey in 1994 was to verify aspects of a concurrent recreational fisher diary

Comment [n w m1]: The AFMA acronym is not needed or useful survey. The length compositions of recreational catches measured during boat ramp interviews were compared with those reported by diarists. These boat ramp data were also used in conjunction with an aerial survey to estimate harvest from the Hauraki Gulf, which was compared with that derived from the diary programme (Sylvester 1994). In 1996, a nationwide boat ramp survey was carried out to estimate the mean weights of fish species caught by recreational fishers (Hartill et al. 1998). These mean weights were used in conjunction with estimates of the numbers of fish taken, derived from a telephone diary survey, to provide estimates of the national recreational harvest of key species (Bradford 1998a).

Although kahawai length frequency data are available from these boat ramp interviews, the underlying survey designs differed both spatially and temporally, and no age data were collected concurrently. Nonetheless, in a review of data collected from these surveys, Bradford (2000) suggested that sufficient kahawai were landed by recreational fishers to support a length and age catch sampling programme in KAH 1. Consequently, a three year recreational catch sampling programme was initiated in January 2001 (KAH2000/01; Hartill et al. 2004). In the first four months of each year, when fishing effort peaked, recreational landings of kahawai were sampled at key boat ramps throughout KAH 1. All available kahawai were measured, and otoliths were collected from a sizeable proportion of these fish. These data were then used to derive length and age distributions for three putative KAH 1 substocks: East Northland, Hauraki Gulf, and the Bay of Plenty.

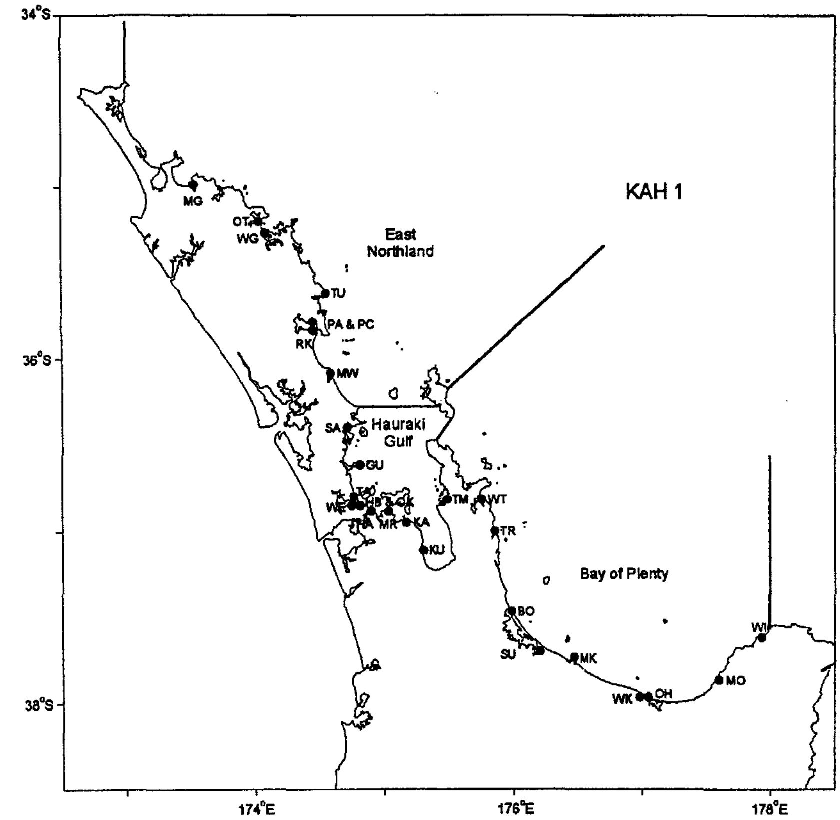
This programme is essentially a two year extension of the previous three year programme. The methods used in this programme are therefore essentially the same as those used previously (KAH2000/01) and are discussed below.

2.2 Sample design

The sample design used in the 2003–04 and 2004–05 surveys was based on data collected from boat ramp surveys conducted in 2000–01, 2001–02, and 2002–03. Kahawai length data and age distributions from these surveys (and length data from previous surveys in 1991, 1994, and 1996) strongly suggest that there were substantive regional differences in the length frequency compositions of kahawai caught by recreational fishers in East Northland, the Hauraki Gulf, and Bay of Plenty (Bradford 1999, Hartill et al. 1998, 2004). Separate boat ramp surveys were therefore conducted in each of these regions (Figure 1) with concurrent collection of length and age samples from recreational landings of kahawai.

Sampling of recreational catches was restricted to a four-month season, 1 January to 30 April, which corresponds approximately to the peak of the recreational fishing season, when kahawai landings were likely to be most abundant. Restriction of sampling to a four-month season was also desirable, as a longer collection period would have increased the likelihood of growth distorting an age-length-key. Further, as otolith ring deposition occurs during the onset of winter (Stevens & Kalish 1998) collection of otoliths in early winter should be avoided, as ambiguous structures on the edge of the otolith may result in ageing error.

Target levels of sampling effort (excluding synergies arising from REC2002/02 and REC 2004/01 as discussed below) were based on those used in the three previous years, and are given in Table 1. The basis for these targets is a recommendation by Bradford (2000) that 400–500 kahawai should be aged to give a reasonable approximation of the relationship between length and age, and hence, potentially, a population's age structure. A further recommendation from this study was that as many fish as possible, preferably 1500 (E. Bradford pers comm.) should be measured to provide a reliable length frequency distribution. The timing and intensity of recreational landings of kahawai is, however, difficult to predict given interannual variability in fishing effort and the spatially dynamic nature of kahawai schooling behaviour. A reasonable intensity of sampling effort was therefore required in space and time so that appreciable landings of kahawai can be sampled, if and when they occur. In 2000–01, 2001–02, and 2002–03 this level of sampling yielded sufficient length and age data to characterise catch distributions with mean weighted coefficients of variation (mwcvs) of generally less than 0.20, which is considered an acceptable level of precision. The required level of precision for catch-at-age distributions generated from this programme is 0.30, as specified in the objectives.



East Northland

MG Mangonui
MW Mangawai
OT Opito Bay, Kerikeri
PA Parua Bay (public ramp)
PC Parua Bay (club ramp)
RK One Tree Point, Ruakaka
TU Tutukaka
WG Waitangi

Hauraki Gulf

GU Gulf Harbour
HA Half Moon Bay
HB Hobson Bay
KA Kawakawa
KU Kaiaua
MR Maraetai
OK Okahu Bay
SA Sandspit
TA Takapuna
TM Te Kouma
WE Westhaven

Bay of Plenty

BO Bowentown
MK Maketu
MO Motu River
OH Ohope
SU Sulphur Point, Tauranga
TR Tairua
WI Waihau Bay
WK Whakatane
WT Whitianga

Figure 1: KAH 1 substock boundaries and location of boat ramp interview sites.

Sampling sessions at each ramp were randomly assigned to weekends and public holidays between 1 January and 30 April. In 2003–04, interviewing in East Northland and the Bay of Plenty took place solely on weekends and public holidays, when most recreational fishing usually occurs. If East Northland and Bay of Plenty based interviewers found that there were strong onshore winds or local competitions on any of the randomly preassigned dates, sampling took place on the next available weekend/holiday day. In the Hauraki Gulf, however, sampling effort was augmented by a concurrent recreational harvest programme in the Hauraki Gulf in 2003–04 (REC2002/02) which involved intensive boat ramp interviewing.

Table 1: Sample design used in KAH 1 recreational fishery sampling programmes since 2000–01.

Region	Number of ramps	Session length (h)	Number of sessions	Total hours interviewing	Target no. measured	Target age sample
East Northland	8	6	28	1 344	1 500	500
Hauraki Gulf	11	6	21	1 386	1 500	500
Bay of Plenty	9	4	12	432	1 500	500

In 2004–05, the number of hours of interviewing in all three areas greatly exceeded the sampling design because of a large scale concurrent recreational harvest estimation programme (REC200401). Boat ramp interviewers were therefore present on randomly preassigned days only, regardless of the prevailing weather conditions. Nonetheless, more fishers were interviewed than in previous years, although much of this additional interviewing took place during the working week. The introduction of weekday sampling in the Hauraki Gulf in 2003–04 and all three areas in 2004–05 is unlikely to influence the size and age composition of landings, as results from the 1996 boat ramp survey demonstrated that there were no substantive differences between length frequencies of commonly caught species during weekdays and weekends (Hartill et al. 1998).

Interviews followed the format of those undertaken in all previous surveys to ensure that the data were collected in a consistent manner. When more than one vessel approached a ramp simultaneously, a vessel was chosen randomly before landing. When fishers landing kahawai were encountered, all fish, including kahawai, were measured. For ageing purposes, kahawai were selected at random from each vessel's catch, from which no more than four fish were taken. As age samples were collected randomly, the length distribution of the age sample should broadly reflect the length distribution of the landed catch. Kahawai otoliths are fragile and time consuming to extract and interviewers therefore asked permission to cut the head off at the gills. Most of recreational fishers permitted the interviewer to remove heads from their kahawai. These heads were retained by the interviewer together with a record of the fish's length, and a code linking the head to other data collected during the interview. Kahawai were not sexed, as there is no apparent sexual dimorphism in growth rates (Bradford 1998b). Otoliths were extracted from these heads at a later date.

2.3 Ageing of kahawai otoliths

Kahawai otoliths were prepared using the thin section method described by Stevens & Kalish (1998). Each otolith was marked across an intended sectioning plane passing through the nucleus. Each otolith was then imbedded in a disposable epoxy mould with three other otoliths so that their nuclei were at the same level. Once the resin hardened, a thin transverse section was cut out of each epoxy block with a Struers Accutom-2 low speed saw. One side of this section was then ground, polished, and mounted polished side down on a slide using 5-minute epoxy resin. After at least 1 hour, the material attached to each slide was sectioned again (to a thickness of approximately 250 to 350 μm) and briefly polished with 400 grit carborundum paper. These slides were then sprayed with artists lacquer.

To improve clarity, a thin layer of immersion oil was brushed over each slide and reading took place under transmitted light. Three readers were used to interpret the thin sectioned otoliths and disagreements in interpretation were resolved using a method similar to that used for snapper (Davies & Walsh 1995) which was as follows:

- each reader independently read all otoliths collected from a region;

- disagreements between the three readers' initial age estimates were identified and where one or more readers failed to agree in their initial interpretation of an otolith, those readers reread the otolith with no knowledge of any prior age estimates;
- remaining disagreements were resolved by discussing images of otoliths projected onto a video screen until a consensus was reached; and
- if no consensus could be reached, the otolith was discarded from the dataset.

Very few otoliths were discarded in practice, and when this occurred, both otoliths were usually deformed and, hence, unreadable.

2.4 Data analysis

Proportional catch-at-length and catch-at-age distributions and analytical variance estimates were calculated for each region using a FORTRAN program developed for a snapper market sampling programme (Davies & Walsh 1995). Vessels landing kahawai were regarded as individual strata, which were weighted on the basis of the number of kahawai landed. The distribution of fish at age within length classes (an age-length key) was derived for each region, and used to translate the regional length distributions into estimates of recreational catch-at-age. Proportional catch-at-age estimates were calculated for the range of age classes recruited, with the maximum age being an aggregate of all age classes greater than 19 years. Recreational catch-at-age and length frequency distributions and their associated variances were presented in the form of histograms and tables.

For each region, catch-at-age distributions were derived for each of the four months sampled using the same analytical approach used to derive regional distributions. Regional age-length-keys were used to derive these age distributions, as the number of kahawai aged from each month was considered insufficient to describe the underlying length-age relationship. This assumes that the month of sampling has little influence on the relationship between length and age within a region. Temporal trends in the underlying age composition of the regional kahawai populations fished by recreational fishers were then inferred from these histograms. Estimates of precision (mwcvs) were not calculated for monthly distributions due to the low sample sizes of the component strata.

3. RESULTS

3.1 The 2003–04 sampling season

A network of interviewers was established at 28 key boat ramps in East Northland, the Hauraki Gulf, and the Bay of Plenty (Figure 1). During the 2003–04 sampling season in the Hauraki Gulf the number of hours spent interviewing recreational fishers was almost twice that of previous years, yet far fewer kahawai were encountered than in previous years (Table 2). In same year in the eastern Bay of Plenty there was a rahui in place which halted all fishing effort at the Motu River and Waihau Bay. Very few hours of interviewing therefore took place at these ramps, although good numbers of kahawai were measured when fishing took place.

3.2 The 2004–05 sampling season

In 2004–05, the number of hours of interviewing in all three regions greatly exceeded the sampling design because of a parallel large scale recreational harvest survey (REC2004/01). Again, far fewer kahawai were encountered, especially in the Hauraki Gulf and Bay of Plenty regions (Table 2). In the eastern Bay of Plenty, lack of suitable interviewers at the Motu River, and to a lesser extent Waihau Bay, limited the data that could be collected from these areas.

3.3 Length and age distributions

3.3.1 East Northland

The length distribution of East Northland recreational kahawai landings in both 2003–04 and 2004–05 was typically broad, and dominated by a mode at about 50 cm, which has been progressing through length compositions described over the last five years (Figure 2). This progression has resulted in an increasingly even and broad age distribution, reflecting either better than average year class strengths 9 or 10 years ago, or poor recruitment in recent years relative to that of the older age classes. Length and age distributions were both described with reasonable precision, with mwcvs of 0.20 in 2003–04 and 0.19 in 2004–05 (Appendix 1) and 0.14 for both years (Appendix 2). In this region, most kahawai recruit into the fishery at about 3 years of age, which corresponds to a length mode of about 30 to 40 cm (Appendix 3).

Comparisons of monthly age distributions (across all ramps) suggest that there are some temporal changes in the age composition of kahawai landings during the survey (Figure 3). In all years, 2 to 4 year old fish were more predominant at the beginning of the survey, in January, than later, in April. There was usually a marked increase in the number of kahawai encountered by boat ramp interviewers in March and April, which suggests that changes in the age composition of recreational landing may be due to a mechanism such as onshore movement of schools of older fish in later months.

As in previous years, most kahawai were caught within 5 km of the mainland coast, where most fishing effort occurs: 84% in 2001–02, 97% in 2002–03, and 83% in 2003–04 (Figure 4). Most of recreational fishing effort takes place close to shore, however, and it is possible that numerous schools of offshore kahawai were not encountered. Despite the paucity of information on offshore catches, there appears to be some evidence of increasing fish size with increasing distance offshore. These data were not collected in the 2004–05 fishing year.

Table 2: Summary statistics by region of the number of interview sessions, hours surveyed, vessels with measurable kahawai, kahawai measured, kahawai measured per hour, and kahawai aged in 2003–04 and 2004–05. Regional summary statistics from previous survey years are given for comparative purposes.

Region	Year	Ramp	Number of sessions	Number of hours	Boats interviewed (fishing)	Boats with measurable kahawai	Kahawai measured	Kahawai aged
East Northland	2005	Mangonui	62	411	462	129	309	104
		Opito Bay	31	192	280	52	111	60
		Waitangi	31	390	506	99	261	132
		Tutukaka	32	193	170	23	55	43
		Parua Bay (public)	63	415	398	40	67	40
		Parua Bay (club)	62	412	558	83	137	88
		Ruakaka	32	196	185	10	12	11
		Mangawhai	31	197	193	23	41	36
		Total	344	2 407	2 752	459	993	514
	2004	Mangonui	19	123	367	78	154	72
		Opito Bay	21	109	204	54	97	64
		Waitangi	24	140	259	89	269	90
		Tutukaka	23	120	219	45	106	73
		Parua Bay (public)	26	150	339	47	111	62
		Parua Bay (club)	28	158	478	81	178	90
		Ruakaka	26	156	254	9	18	12
		Mangawhai	23	139	307	36	82	54
		Total	190	1 096	2 427	439	1 015	517
	2003		186	1 049	2 089	436	1 171	504
	2002		199	1 110	1 878	491	1 318	526
	2001		196	1 129	2 233	474	1 236	517
Hauraki Gulf	2005	Sandspit	35	228	143	8	9	3
		Gulf Harbour	63	404	499	24	39	12
		Takapuna	62	399	849	40	94	36
		Westhaven	64	406	836	28	44	32
		Hobson Bay	20	121	118	2	2	1
		Okahu Bay	25	150	308	11	19	11
		Half Moon Bay	97	611	1 458	51	94	25
		Maraetai	30	181	256	2	6	6
		Kawakawa Bay	64	414	993	71	214	93
		Kaiaua	32	193	181	–	–	–
		Te Kouma	63	411	761	56	85	70
		Total	557	3 529	6 402	293	606	289
	2004	Sandspit	20	124	139	11	26	26
		Gulf Harbour	44	267	426	26	44	23
		Takapuna	44	290	814	39	146	52
		Westhaven	46	278	744	33	56	32
		Hobson Bay	22	133	344	11	23	15
		Okahu Bay	16	96	277	12	18	11
		Half Moon Bay	85	505	1 637	89	187	91
		Maraetai	23	139	299	11	15	14
		Kawakawa Bay	47	278	889	86	193	47
		Kaiaua	23	135	193	4	11	–
		Te Kouma	38	230	460	23	45	39
	2004	Total	408	2 475	6 222	345	764	350
	2003		231	1 301	3 432	395	880	527
	2002		204	1 138	3 348	339	786	500
	2001		212	1 174	2 706	435	892	500
Bay of Plenty	2005	Whitianga	50	346	358	51	116	60
		Tairua	32	209	269	32	54	10
		Bowentown	62	419	603	65	116	66
		Sulphur Point	121	780	1 476	226	613	78
		Maketu	26	157	242	58	136	29
		Whakatane	64	415	441	74	294	86
		Ohope	27	164	111	37	107	64
		Motu	15	94	11	9	28	–
		Waihau Bay	9	54	100	13	19	–
		Total	406	2 636	3 611	565	1 483	393
	2004	Whitianga	15	60	170	26	67	47
		Tairua	14	47	131	19	37	19
		Bowentown	16	68	111	18	46	37
		Sulphur Point	16	65	177	60	155	113
		Maketu	15	63	62	34	77	34
		Whakatane	10	39	201	85	326	74
		Ohope	16	61	54	24	58	57
		Motu	5	23	41	35	198	–
		Waihau Bay	1	5	5	5	31	31
		Total	108	429	952	306	995	412
	2003		120	462	1 246	357	1 133	477
	2002		141	474	1 197	457	1 476	495
	2001		100	319	934	294	1 104	457

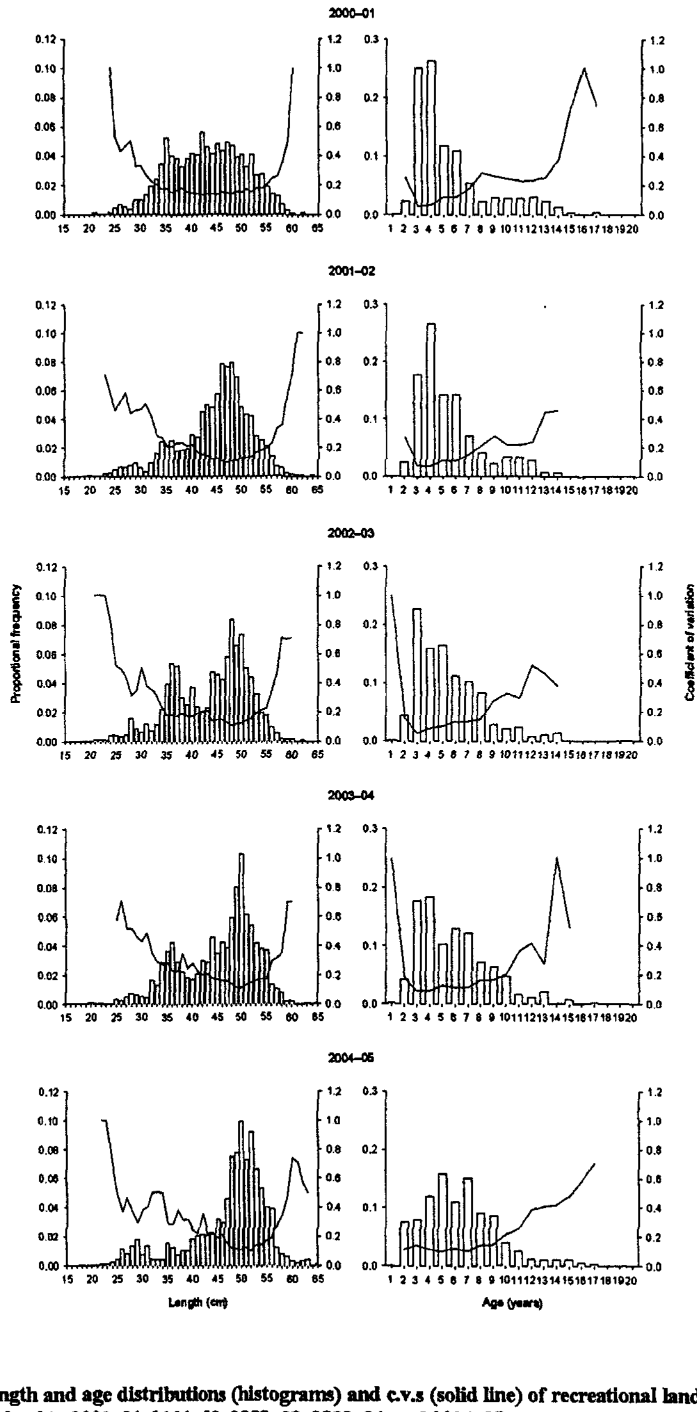


Figure 2: Length and age distributions (histograms) and c.v.s (solid line) of recreational landings of kahawai in East Northland in 2000–01, 2001–02, 2002–03, 2003–04, and 2004–05.

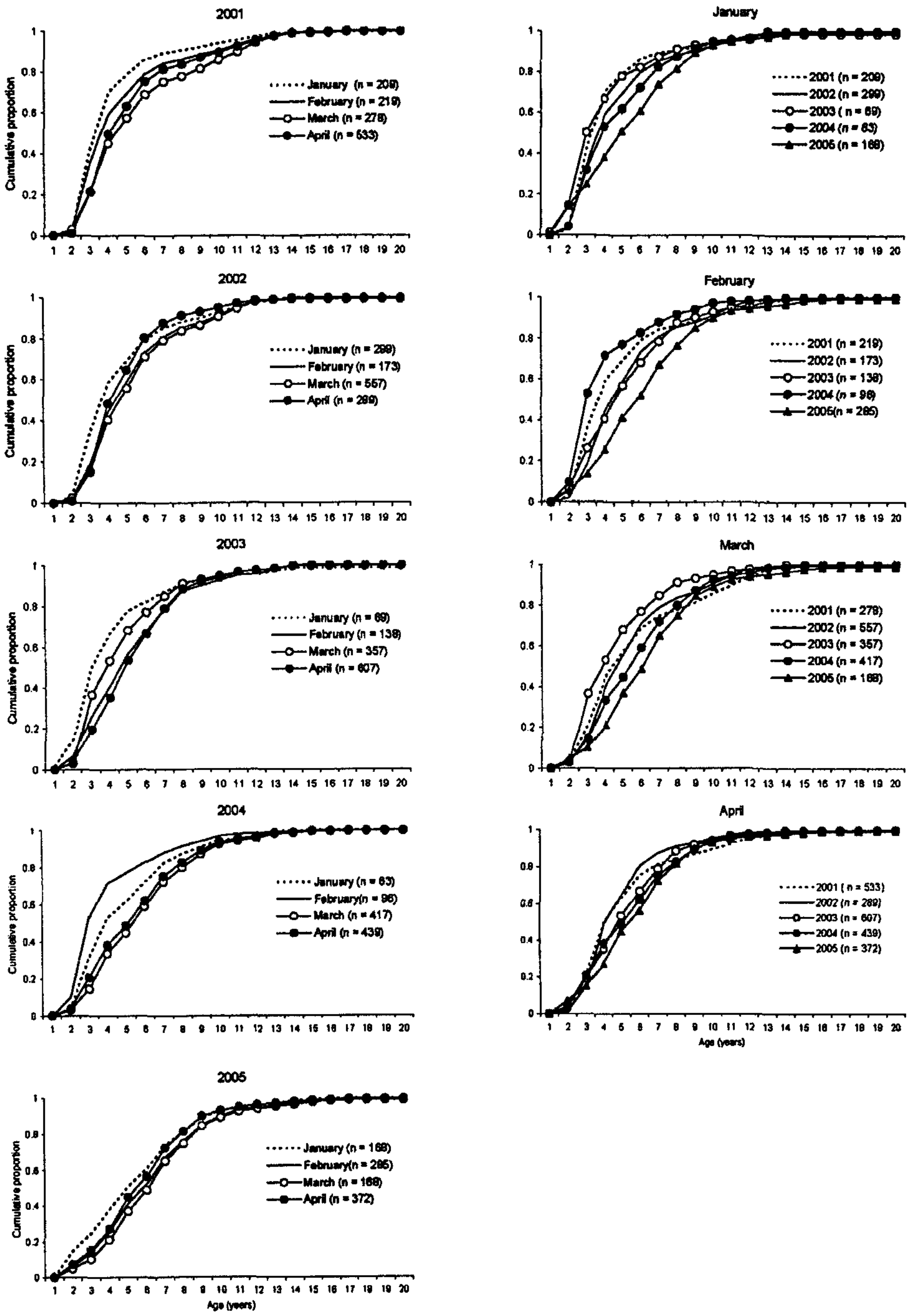


Figure 3: Cumulative age distributions by month for East Northland in 2000–01, 2001–02, 2002–03, 2003–04, and 2004–05. Left hand panels compare monthly age distributions within fishing years and right hand panels compare annual age distributions for each of the four months. The number of fish measured is given for each month.

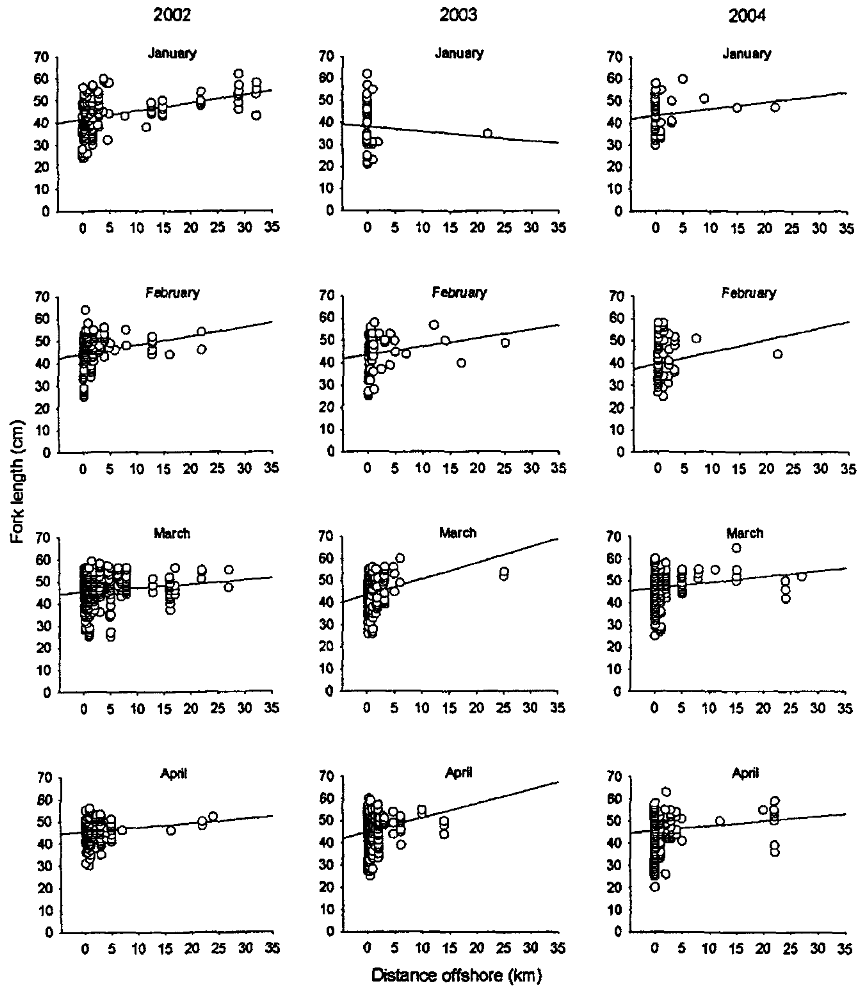


Figure 4: Length of landed kahawai relative to the estimated distance off the East Northland coastline at which they were caught. Results from the previous two years are also given for comparison. Data on the distance fished offshore were not collected in 2004–05.

3.3.2 Hauraki Gulf

Fewer kahawai were encountered by boat ramp interviewers in the Hauraki Gulf than in previous years, despite an almost doubling of the number of hours that interviewers were present at ramps (Table 2). The length and age compositions were still described to a reasonable level of precision, however, with respective mwcvs of 0.22 and 0.10 in 2003–04 and 0.28 and 0.18 in 2004–05 (Appendices 1 & 2).

As in previous years, the 2003–04 length composition was dominated by 30 to 40 cm kahawai, although the proportion of larger fish was much lower than seen before. This is reflected in the age distribution, which is composed almost entirely of 2 to 4 year old fish. The results from this year's sampling therefore support a previous suggestion that the Hauraki Gulf is a juvenile fishery (Hartill et al. 2004). The relative strength of the 2 year old age class was the strongest observed to date, which is clearly evident as a mode of 25 to 35 cm fish in the length frequency distribution (Figure 5, Appendix 3). It is unclear whether the relative strength of the 2 year age class is due to a year of strong recruitment, or the low abundance of older fish. Low catch rates suggest the latter.

The 2004–05 length composition is multimodal with a greater proportion of larger fish than seen in previous years. The strength of the 50 to 55 cm cohort, coupled with the decreased incidence of kahawai landings generally, suggests that in the last two years, recruitment in the Gulf has been poor. The corresponding age distribution is still largely dominated by three year old age class, however, which indicates that the Hauraki Gulf remains a juvenile fishery.

In 2003–04, there was very little difference in the monthly age distribution of kahawai landings (Figure 6). The age distributions of kahawai landed in March and April in 2004–05 are markedly broader than seen in previous years, however, possibly due to an influx of larger, older fish coupled with lower levels of recruitment by juveniles. The relationship between the abundance and size of kahawai landed with respect to distance offshore was not assessed, as the shape of the coastline, and abundance of islands makes any such interpretation difficult.

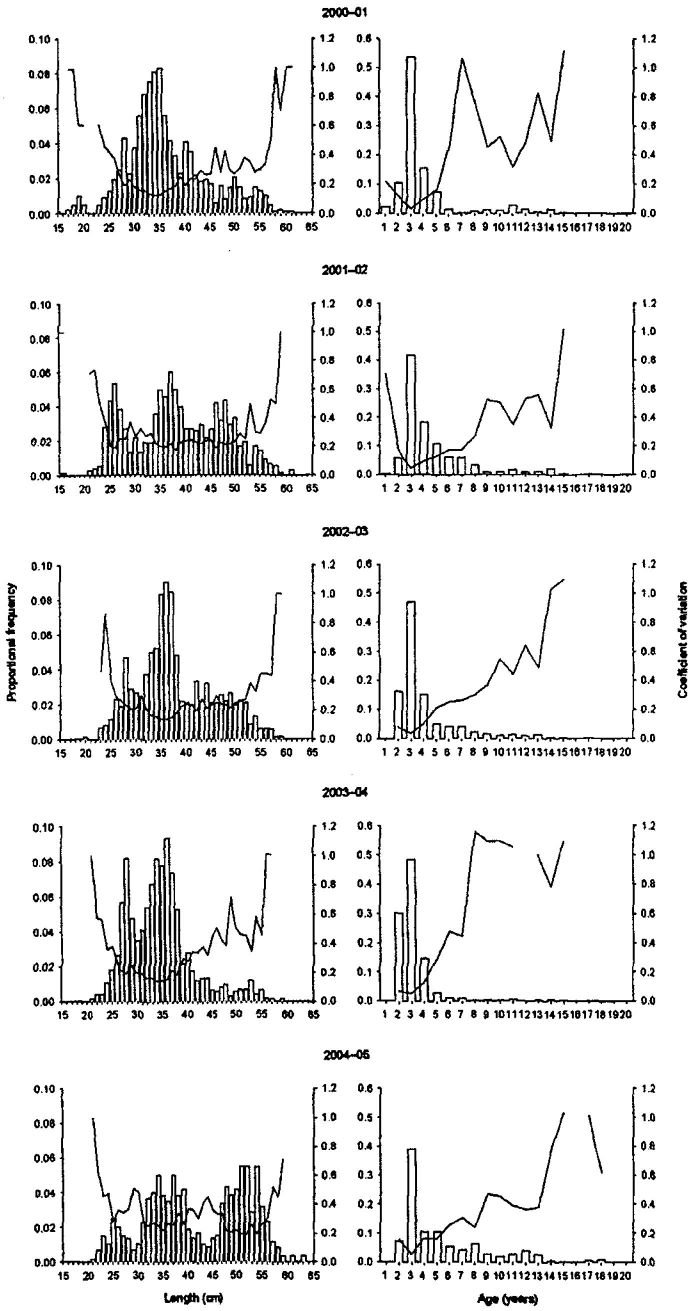


Figure 5: Length and age distributions (histograms) and c.v.s (solid line) of recreational landings of kahawai in the Hauraki Gulf in 2000–01, 2001–02, 2002–03, 2003–04, and 2004–05.

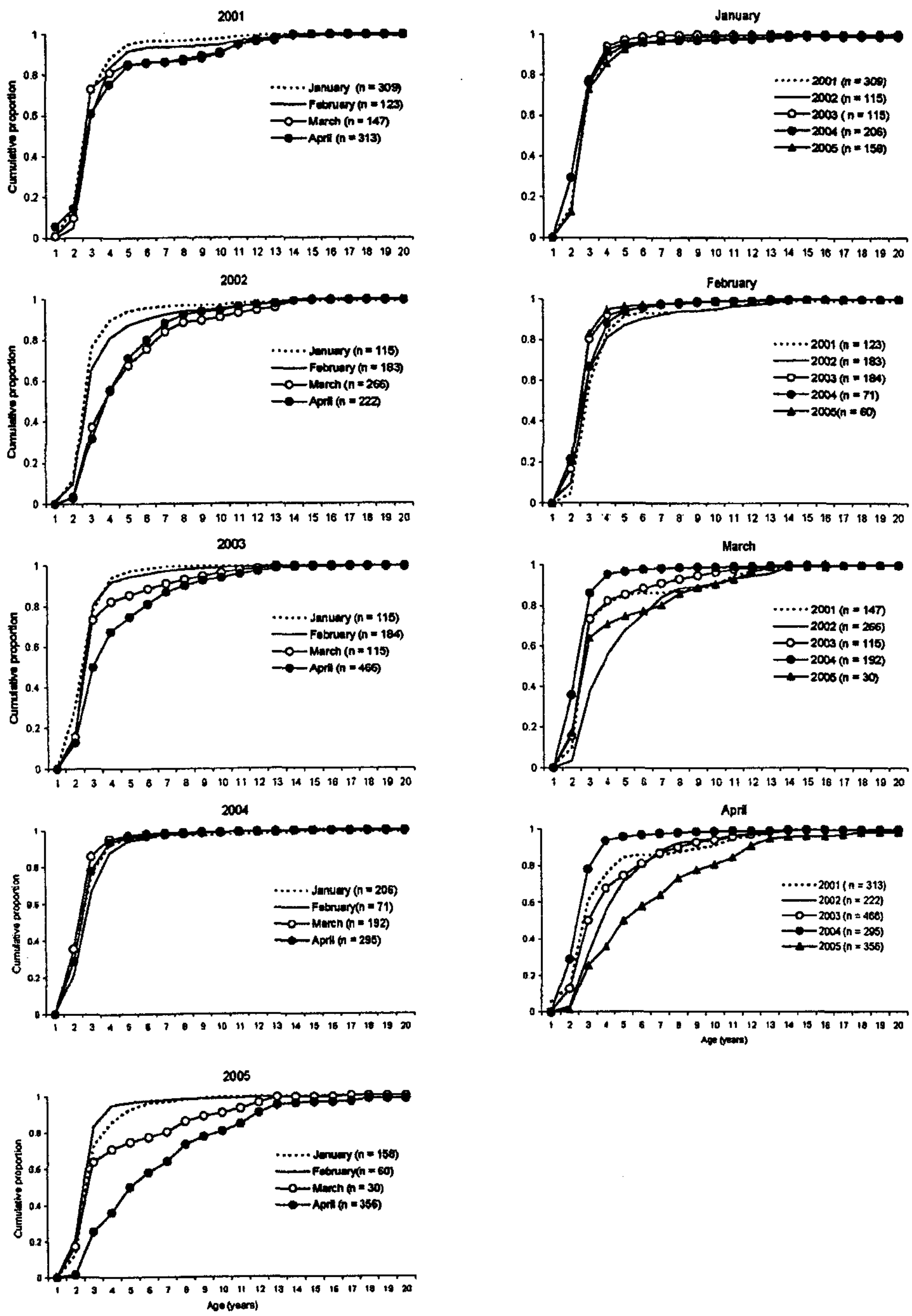


Figure 6: Cumulative age distributions by month for the Hauraki Gulf in 2000–01, 2001–02, 2002–03, 2003–04, and 2004–05. Left hand panels compare monthly age distributions within fishing years and right hand panels compare annual age distributions for each of the four months. The number of fish measured is given for each month.

3.3.3 Bay of Plenty

The Bay of Plenty length distribution has been consistently dominated by larger length classes over the last five years, although a secondary mode of 50–45 cm is clearly evident in 2004–05 (Figure 7). The availability of larger fish in the Bay of Plenty may influence fisher selectivity, however, with a greater likelihood that smaller kahawai will be released, and hence not measured. The age distribution remains broader than in the other two regions, and there is evidence of a strong recruitment of 3, 4, and 5 year olds in 2004–05.

The number of kahawai encountered by boat ramp interviewers per hour remains far higher in the Bay of Plenty than in the other two regions (Table 2), but the number of kahawai measured in a season can fall well short of 1500 fish, as low as 995 in 2003–04. In the last two years only about 400 kahawai heads were collected during interviews, largely because of a lack of suitable staff in the far eastern Bay of Plenty. Nonetheless, the precision of the length (mwcvs of 0.17 and 017) and age (0.17 and 0.17) distributions were within acceptable levels (Appendix 1 and 2). Comparison of cumulative monthly age distributions from the Bay of Plenty suggests that there is very little change in age compositions in this region between January and April (Figure 8). This is in contrast to East Northland and the Hauraki Gulf, where marked changes can occur over the survey period (see Figures 3 & 6).

In 2003–04, almost all (97%) of kahawai were caught within 5 km of the mainland, and consequently, the relationship between fish size and the distance they were caught from the mainland is poorly defined (Figure 9). Nonetheless, results from the previous two years suggest that no clear trend exists. These data were not collected in the 2004–05 fishing season.

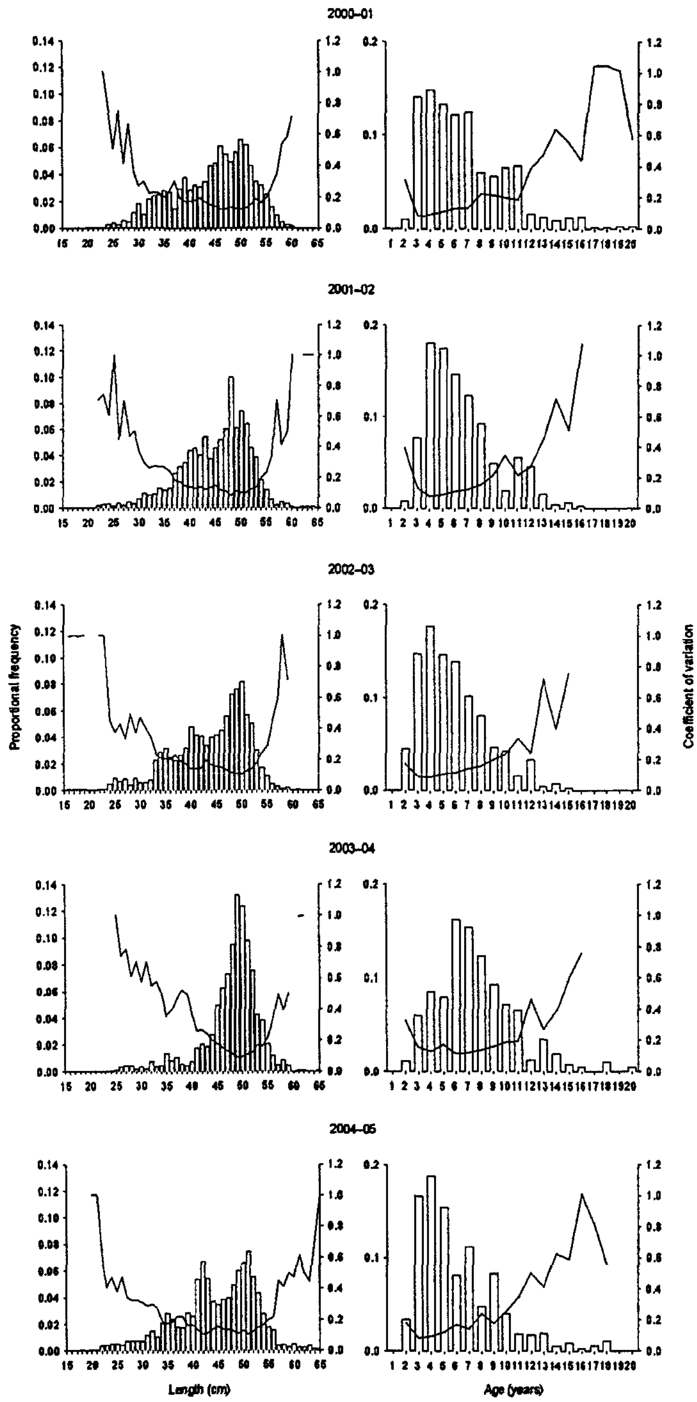


Figure 7: Length and age distributions (histograms) and c.v.s (solid line) of recreational landings of kahawai in the Bay of Plenty in 2000–01, 2001–02, 2002–03, 2003–04, and 2004–05.

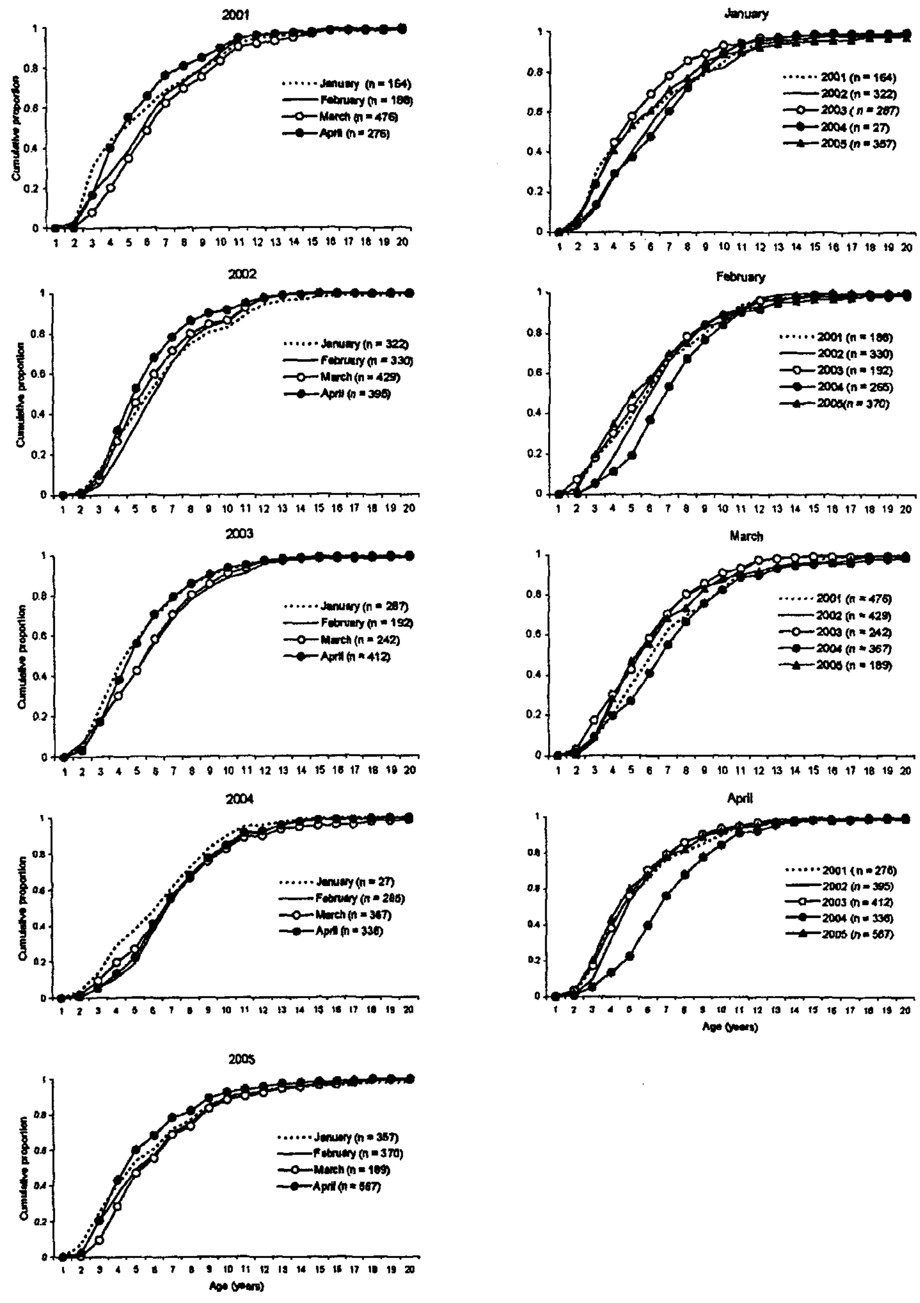


Figure 8: Cumulative age distributions by month for the Bay of Plenty in 2000–01, 2001–02, 2002–03, 2003–04, and 2004–05. Left hand panels compare monthly age distributions within fishing years and right hand panels compare annual age distributions for each of the four months. The number of fish measured is given for each month.

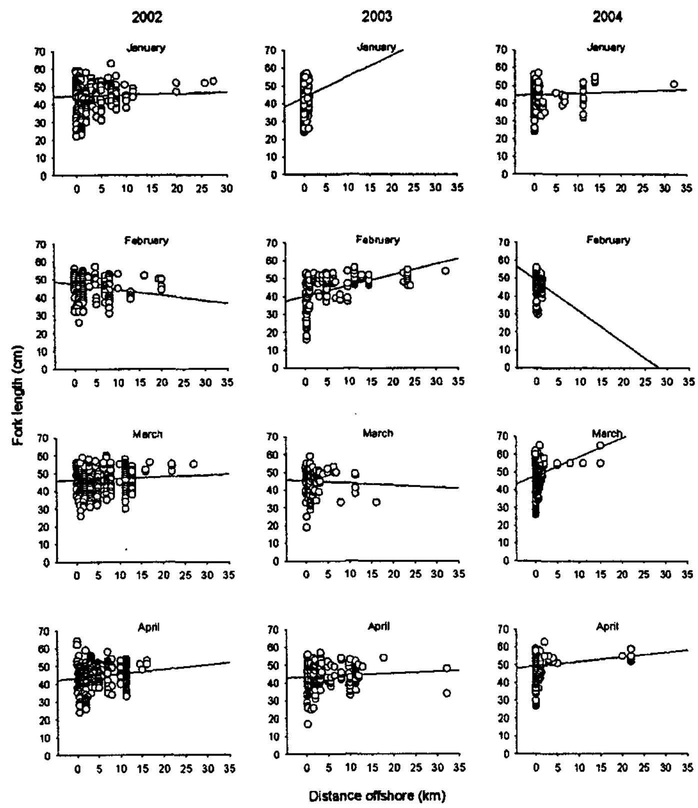


Figure 9: Length of landed kahawai relative to the estimated distance off the Bay of Plenty coastline at which they were caught. Results from the previous two years are also given for comparison.

3.4 Comparison of analytical and bootstrap variance estimation techniques

Since the inception of this time series, all length-based and age-based variance estimates have been calculated using analytical techniques, but it has been suggested that a bootstrapping approach could provide more appropriate variance estimates. Analytical and bootstrap variance estimates were therefore calculated for two data sets: Hauraki Gulf 2004–05 and Bay of Plenty 2004–05. These data sets were chosen because of the marked differences in their length and age compositions, and because their age-length keys were based on comparatively low sample sizes.

In both cases, there was very little difference between the variances estimated by the analytical and bootstrapping techniques (Figure 10). The length-based variance estimates were very similar across the entire length range, but there were subtle differences between the age-based variance estimates for both sets. The bootstrapping approach gave slightly higher variance estimates for the younger, more common age classes, but higher estimates for the older, less common age classes. The mean weighted c.v.s were almost identical for the length distributions, but the age-based bootstrap estimates were lower than their length-based counterparts. These results suggest that there is little merit in recalculating bootstrap c.v.s for all of the kahawai length and age data sampled from recreational fishers since 2001.

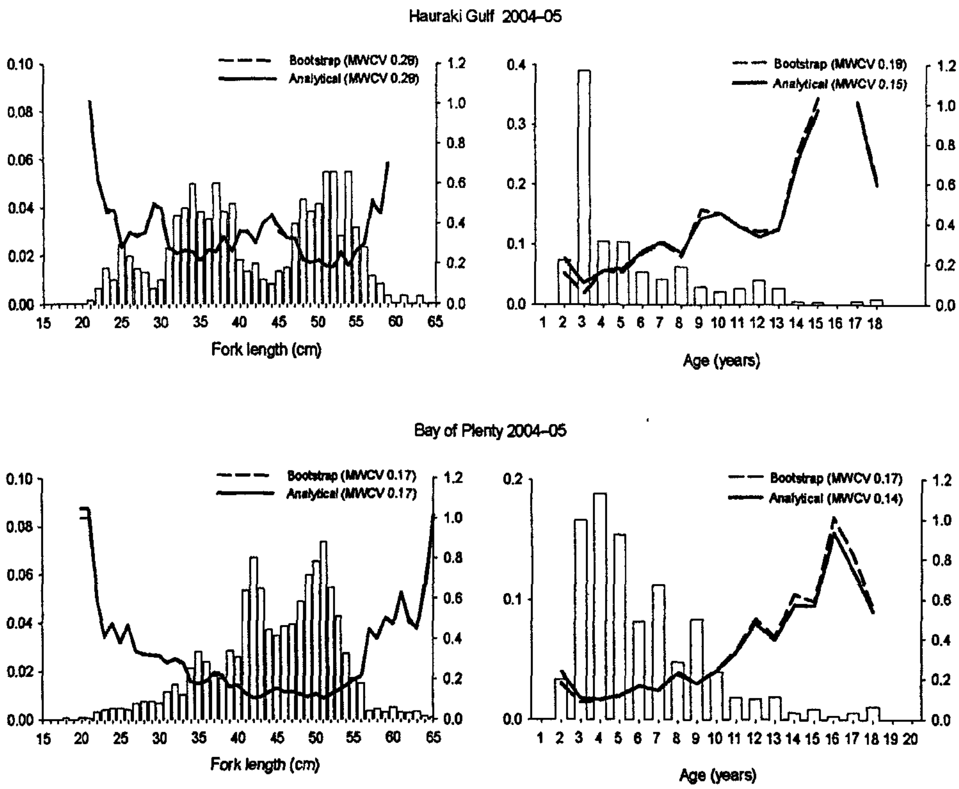


Figure 10: Comparison of analytical and bootstrap variance estimates calculated for recreational landings of kahawai in the Hauraki Gulf and Bay of Plenty in 2004–05.

Variance can be underestimated when boats fish in a non-independent manner, leading to correlated landings in space and/or time. We examined catch data collected in the Bay of Plenty in 2005 for evidence of such correlations. Cursory examination of the average size of fish landed by ramp, by survey day, suggested that there was no pattern in catches across ramps, within a survey day, or with any given ramp throughout the sampling season. It is perhaps not surprising that there was no marked similarity between the average size of fish landed across ramps on any given survey day, as in most cases there is a marked distance between ramps, and the number of kahawai encountered at most ramps is very low. Of those boats that land kahawai, 70% land between one and three fish.

Over 40% of the kahawai landed in the Bay of Plenty in 2005 were landed at Sulphur Point, and we tested these landings for autocorrelation. Landings were chronologically sorted and autocorrelation functions were calculated on the average size of the kahawai measured from each boat, at different lags between observations (Figure 11). Significant autocorrelation only occurs at a lag of every seventh boat, and this is probably due to chance given the non-significance of other lag statistics calculated. This suggests that, in this case at least, there is no significant correlation between landings, and hence no concomitant underestimation of variance.

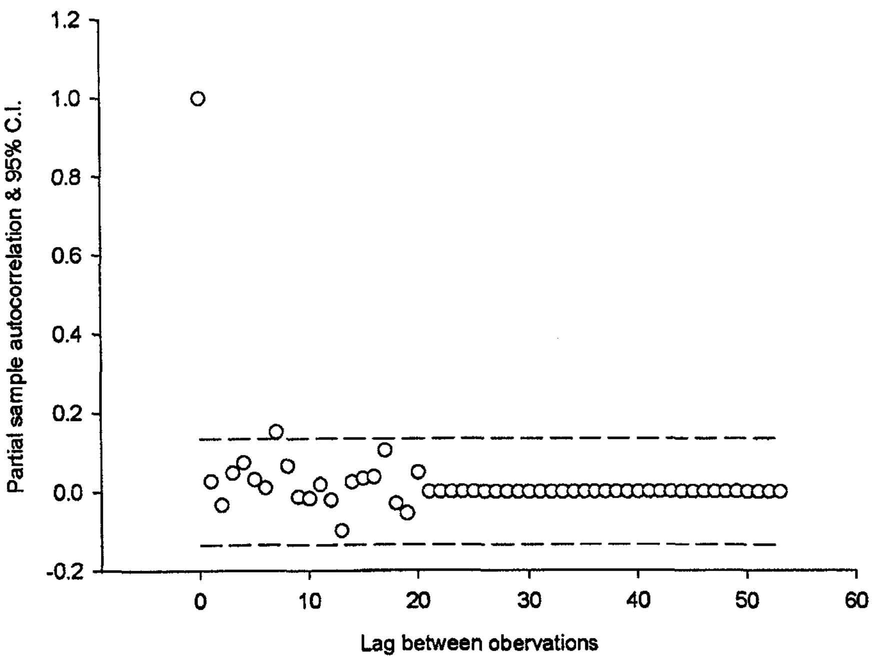


Figure 11: Autocorrelation between the average length of kahawai landed by boats at Sulphur Point, in the Bay of Plenty in 2005. Dashed lines denote 95% confidence intervals.

3.5 Total mortality estimates

One of the original reasons for collecting a time series of catch-at-age data was to monitor changes in associated fisheries. One way of doing this is to monitor changes in total mortality estimates (Z). Chapman & Robson (1960) estimates of Z were calculated for all of the age distributions sampled from the East Northland and Bay of Plenty since 2001 (Table 3). Age distributions from the Hauraki Gulf were not considered, as this is essentially a juvenile fishery, with recruitment, and presumably emigration, largely determining the age composition of landings in this region, not post-recruitment mortality. The Chapman Robson estimator is sensitive to the assumed age at recruitment, which we assume to be at 4 years of age, although estimates associated with recruitment ages of 3 to 6 years are given for comparison. These estimates suggest that mortality rates are generally higher in East Northland than in the Bay of Plenty. Size-dependent movement between the areas could, however, influence respective age structures, and consequently this could result in misleading estimates of total mortality. Unfortunately, our understanding of the nature and magnitude of movement between areas is very limited, and these estimates should be treated with some caution. Natural mortality is assumed to be about of 0.18.

Table 3: Estimates of Z derived from recreational catch sampling in East Northland and the Bay of Plenty, by survey year by assumed age at recruitment.

Age at	East Northland					Bay of Plenty				
recruitment	2001	2002	2003	2004	2005	2001	2002	2003	2004	2005
3	0.33	0.33	0.32	0.28	0.24	0.23	0.25	0.28	0.20	0.27
4	0.34	0.38	0.35	0.31	0.28	0.26	0.30	0.32	0.23	0.29
5	0.30	0.37	0.39	0.33	0.33	0.28	0.33	0.34	0.26	0.30
6	0.30	0.40	0.41	0.38	0.36	0.30	0.36	0.38	0.32	0.30

4. DISCUSSION

Obtaining sufficient length-at-age samples from a region's recreational fishery to adequately describe catch compositions will always be an uncertain process. Unlike commercial fisheries, where annual catch levels are largely determined by TACCs, recreational fishing effort and kahawai landings vary interannually depending on prevailing weather patterns and local catch rates. In 2003–04, in the Hauraki Gulf, and in 2004–05, throughout KAH 1, fewer kahawai were encountered than in previous years despite heightened levels of sampling effort resulting from synergies with other programmes (REC2002/02 and REC2004/01). In the eastern Bay of Plenty, very little sampling took place in 2004 due to a rahui, which closed fishing areas off the Motu River and Waihau Bay for several months. Similarly, little sampling took place at these two ramps, because of a lack of suitable applicants for interviewing positions. Although fewer kahawai were encountered than desired, the length and age compositions of the regional populations were still described with reasonable precision (mwcvs mostly below 0.20, with the exception of Hauraki Gulf length distributions with mwcvs of 0.22 in 2003–04 and 0.28 in 2004–05), well within the target level of precision of 0.30. We have compared our analytical variance estimates with bootstrapped estimates in two instances, which suggest that there is very little difference whichever approach is used.

Regional length and age compositions derived from recreational landings sampled in 2003–04 and 2004–05 are broadly consistent with patterns and trends seen in previous years (see Bradford 1999, Hartill et al. 2004). The East Northland population has become increasingly dominated by larger, older fish, and the age composition is now more similar to that of the Bay of Plenty than it was 5 years ago. In contrast, the Hauraki Gulf population has become composed of increasingly smaller, younger fish, with poor representation of the older age classes seen elsewhere. The only year in which appreciable proportions of older kahawai were observed was in 2004–05 when catch rates were low. This suggests lower recruitment than usual, which would increase the relative dominance of older fish. The broadest age distribution is found in the Bay of Plenty, which is usually composed of 3 to 11 year old fish. Although part of the recreational kahawai catch is used for bait, or returned to the sea, the landed catch in East Northland and the Hauraki Gulf should broadly reflect the overall catch, as discard rates are very low in this area (Hartill & Walsh 2005). Discard rates are higher in the Bay of Plenty, and these, coupled with a possible tendency to release smaller fish, may result in some bias towards older fish in this region.

The division of KAH 1 into three regions/substocks was based upon current research conventions and geographical boundaries, but consistent differences in regional kahawai population compositions, as seen in this and previous years, suggest that these divisions have some biological relevance. Nonetheless, regional population compositions should not be regarded in isolation, as some inter-regional exchange is inevitable given the mobility of this species. This is evident in the Hauraki Gulf, for example, where the low availability of fish longer than 40 cm strongly suggests that schools of larger fish tend to emigrate to more open waters after 3–4 years of age. The low proportion of sexually mature fish in the Hauraki Gulf suggests, however, that at least some of the predominantly juvenile kahawai caught in this area must have been spawned elsewhere.

The manner in which the current time series of regional length and age data are used will be partially dependent on our understanding of the nature and degree of movement patterns. Some information on kahawai movement patterns can be inferred from tagging programmes conducted throughout New Zealand waters in the early 1980s (Wood et al. 1990) and in the Bay of Plenty and Tasman Bay in 1991 (Griggs et al. 1998). Between 1981 and 1984, 13 911 kahawai were tagged from a range of fisheries, resulting in 1105 returns for which the area of recapture was known. Of the 199 fish tagged and released in KAH 1 and subsequently caught, 80% were recaptured in KAH 1, with the majority of the remainder caught in the Hawke Bay/Gisborne area. Conversely, only 1–2% of fish tagged in other areas appear to have emigrated to KAH 1.

Of the 4622 kahawai tagged in the Bay of Plenty, and 4984 in Tasman Bay, recapture locations were known for 351 and 702 fish respectively. These data suggest that 90% of fish in the Bay of Plenty were resident over the next 7 years, and 98% in Tasman Bay, although a lower proportion were recaptured in this area after 3 years.

Both these studies suggest that "residency" at the scale of the Quota Management Area ranges from 70–100% depending on the population length composition. In KAH 1, a cursory examination of the data suggests that 80–90% of fish remain resident in this area. Larger fish appear to be more mobile, and those that emigrate from KAH 1 have a tendency to migrate towards the Hawke Bay/Gisborne Area. These studies therefore provide only a limited insight into the nature and extent of large-scale movements, but enough to suggest that seasonal migrations along the New Zealand coastline, as exhibited by species such as gemfish (Hurst & Bagley 1998) and blue moki (Francis 1981), are unlikely for this species. Previous stock assessments (Bradford 1996, Bradford 1997) have regarded New Zealand's kahawai as belonging to a single stock. We suggest that an assessment of solely the KAH 1 stock is feasible given this degree of emigration, and minimal evidence of immigration from other Quota Management Areas. Such an assessment should, however, consider size-specific movement both between KAH 1 substocks and from KAH 1. Size-specific movement within KAH 1 could also influence the reliability of the total mortality estimates as discussed earlier. A more detailed analysis of the available tag/recapture data is required to do this, which should consider the relative exploitation rates of localised fishstocks, and non-independence of observations arising from recapture events involving more than one fish, which were tagged during the same release event. A review of this nature may well suggest that we have insufficient data to describe movement patterns in a meaningful way, and any modelling based on currently available data may involve some broad assumptions about this behaviour.

There is some suggestion of smaller scale behavioural movement patterns. In all three regions, in most years, the number of kahawai encountered by boat ramp interviewers was noticeably greater in the second half of the survey. These observations are consistent with either an onshore migration of sexually mature kahawai in the autumn or increased catachability, following spawning in deeper waters in January and February (60–100 m; Annala et al. 2003). This suggestion is further supported by evidence of an increase in the average size of fish caught off the East Northland as the distance from the mainland increases. In the Bay of Plenty, however, this trend is not clearly evident, despite a greater number of kahawai caught further offshore in 2001–02 and 2002–03.

The issue of ageing error was discussed at the Pelagic Working Group, and, as a result, we compared regional mean length-at-age estimates collected between 2001 and 2005. There were clear trends of progressively increasing mean length-at-age in all three regions, for which there are at least four possible reasons: ageing error, changes in the timing of otolith collection, changes in selectivity, and increasing growth rates through time.

Ageing error will occur in most, if not all, stock monitoring programmes, but the progressive nature of the trends observed suggest that this is not the case, as ageing error is more likely to be a random process. Changes in readers can influence results, but most readers have read at least three years of data, and the trends were still clearly evident in the ages determined by the most experienced and proficient reader, who has read all sets to date. There has been no progressive change in the timing of otolith collecting, so this explanation is unlikely, especially given the short sampling season. There is also no evidence to suggest that recreational selectivity would have changed to any extent through time. The final explanation, of changes in growth rates through time, is possible, as it has been clearly shown for snapper (Davies et al. 2003), which is a comparatively easy species to age. Nonetheless, further work will be required if we are to determine whether the putative changes in growth rates are biologically real, or if they are an artefact of our sampling programme. As a first step, otoliths collected over several years should be selected at random and read over a short period by a single experienced reader, to test the proposition that ageing error has taken place in a progressive manner.

5. ACKNOELEDGMENTS

We thank the numerous boat ramp interviewers, most of whom took part in all three surveys. The Pelagic Working Group, and particularly, Paul Taylor, provided some useful comments on an earlier draft. Funding for this project, KAH2003/01, was provided by the Ministry of Fisheries.

6. REFERENCES

Annala, J.H.; Sullivan, K.J.; O'Brien, C.J.; Smith, N.W.McL.; Grayling, S.M. (Comps.) (2003). Report from the Fishery Assessment Plenary, May 2003: stock assessments and yield estimates. 616 p. (Unpublished report held in NIWA library, Wellington.)

Bradford, E. (1996). Preliminary simulation modelling of kahawai stocks. New Zealand Fisheries Assessment Research Document 96/7. 26 p.

Bradford, E. (1997). Update of kahawai simulation model for the 1997 assessment and sensitivity analysis. New Zealand Fisheries Assessment Research Document 97/20. 12 p.

Bradford, E. (1998a). Harvest estimates from the 1996 national marine recreational fishing surveys. New Zealand Fisheries Assessment Research Document 98/16 27 p. (Unpublished report held in NIWA library, Wellington.)

Bradford, E. (1998b). Unified kahawai growth parameters. *NIWA Technical Report 9*. 50 p.

Bradford, E. (1999). Size distribution of kahawai in commercial and recreational catches. *NIWA Technical Report 61*. 51 p.

Bradford, E. 2000: Feasibility of sampling the recreational fishery to monitor the kahawai stock. *New Zealand Fisheries Assessment Report 2000/11*. 34 p.

Chapman, D.G.; Robson, D.S. (1960). The analysis of a catch curve. *Biometrics 16*: 354–368.

Davies, N. M.; Hartill, B.; Walsh, C. (2003). A review of methods used to estimate snapper catch-at-age and growth in SNA 1 and SNA 8. *New Zealand Fisheries Assessment Report 2003/10*. 63 p.

Davies, N.M.; Walsh, C. (1995). Length and age composition of commercial snapper landings in the Auckland Fisheries Management Area 1988–94. *New Zealand Fisheries Data Report No. 58*. 85 p.

Francis, M.P. (1981). Spawning migration of moki (*Latridopsis ciliaris*) off eastern New Zealand). *New Zealand Journal of Marine and Freshwater Research 15*: 267–273.

Griggs, L.; Bradford, E.; Jones, B.; Drummond, K. (1998). Growth and movement of tagged kahawai in New Zealand waters. *NIWA Technical Report 10*. 37 p.

Hartill, B.; Armiger, H.; Tasker, R.; Middleton, C.; Fisher, D. (2004). Monitoring the length and age composition of recreational landings of kahawai in KAH 1 in 2000–01, 2001–02 and 2002–

03. Final Research Report for Ministry of Fisheries Research Project KAH2000/01 Objective 1. 38 p. (Unpublished report held by MFish, Wellington)

Hartill, B.; Blackwell, R.; Bradford, E. (1998). Estimation of mean fish weights from the recreational catch landed at boatramps in 1996. *NIWA Technical Report 31*. 40 p.

Hartill, B.; Walsh, C. (2005). Characterisation of the kahawai fisheries of New Zealand and review of biological knowledge. Final Research Report for Ministry of Fisheries Research Project KAH2004/01 Objective 1. 160 p. (Unpublished report held by MFish, Wellington)

Hurst, R.J.; Bagley, N.W. (1998). A summary of the biology and commercial landings, and a stock assessment of southern (SKI 3 and SKI 7) gemfish *Rexea solandri* (Gempylidae) in New Zealand waters. New Zealand Fisheries Assessment Research Document 98/3. 51 p.

Stevens, D.W.; Kalish, J. M. (1998). Validated age and growth of kahawai (*Arripis trutta*) in the Bay of Plenty and Tasman Bay. *NIWA Technical Report 11*. 33 p.

Sylvester, T. 1993: Recreational fisheries catch per unit effort trends in the North region (1990/91). Northern Fisheries Region Internal Report No. 14. 23 p. (Unpublished report held in Ministry of Fisheries, Auckland.)

Sylvester, T. (1994). Recreational fisheries research in the North region. *Seafood New Zealand* February 1994: 27–28.

Wood, B.A.; Bradstock, M.A.; James, G.D. (1990). Tagging of kahawai, *Arripis trutta*, in New Zealand, 1981–84. *New Zealand Fisheries Technical Report 19*. 16 p.

Appendix 1: Estimated proportions at length and c.v.s for kahawai sampled from recreational fishers in East Northland, Hauraki Gulf and the Bay of Plenty in 2003–04 and 2004–05

P.i. = proportion of fish in length class. *n* = total number of fish sampled.
c.v. = coefficient of variation. *m.w.c.v.* = mean weighted c.v.

Estimates of the proportion at length of kahawai from East Northland in 2003–04 and 2004–05

Length	2003–04		2004–05	
(cm)	*P.i.*	*c.v.*	*P.i.*	*c.v.*
10	0.0000	0.00	0.0000	0.00
11	0.0000	0.00	0.0000	0.00
12	0.0000	0.00	0.0000	0.00
13	0.0000	0.00	0.0000	0.00
14	0.0000	0.00	0.0000	0.00
15	0.0000	0.00	0.0000	0.00
16	0.0000	0.00	0.0000	0.00
17	0.0000	0.00	0.0000	0.00
18	0.0000	0.00	0.0000	0.00
19	0.0000	0.00	0.0000	0.00
20	0.0010	1.00	0.0000	0.00
21	0.0000	0.00	0.0000	0.00
22	0.0000	0.00	0.0010	1.00
23	0.0000	0.00	0.0010	1.00
24	0.0000	0.00	0.0020	0.71
25	0.0030	0.58	0.0040	0.50
26	0.0020	0.71	0.0111	0.37
27	0.0049	0.52	0.0081	0.46
28	0.0069	0.51	0.0131	0.36
29	0.0059	0.46	0.0171	0.29
30	0.0049	0.43	0.0070	0.38
31	0.0039	0.48	0.0131	0.40
32	0.0158	0.34	0.0040	0.50
33	0.0128	0.29	0.0040	0.50
34	0.0286	0.27	0.0040	0.50
35	0.0365	0.29	0.0151	0.29
36	0.0424	0.23	0.0121	0.28
37	0.0286	0.22	0.0070	0.38
38	0.0217	0.35	0.0101	0.31
39	0.0177	0.24	0.0101	0.31
40	0.0167	0.28	0.0181	0.24
41	0.0207	0.22	0.0201	0.22
42	0.0296	0.20	0.0211	0.35
43	0.0286	0.21	0.0201	0.22
44	0.0453	0.17	0.0211	0.22
45	0.0345	0.17	0.0312	0.19
46	0.0424	0.16	0.0292	0.21
47	0.0384	0.16	0.0453	0.16
48	0.0591	0.14	0.0745	0.12
49	0.0798	0.11	0.0775	0.11
50	0.1025	0.11	0.0987	0.11
51	0.0611	0.13	0.0725	0.12
52	0.0532	0.14	0.0916	0.09
53	0.0414	0.16	0.0655	0.14
54	0.0374	0.17	0.0524	0.14
55	0.0365	0.17	0.0393	0.16
56	0.0128	0.29	0.0383	0.18
57	0.0099	0.31	0.0121	0.28
58	0.0079	0.35	0.0081	0.35
59	0.0020	0.70	0.0060	0.47
60	0.0020	0.70	0.0030	0.74
61	0.0000	0.00	0.0020	0.71
62	0.0000	0.00	0.0030	0.58
63	0.0010	1.00	0.0040	0.50
64	0.0000	0.00	0.0000	0.00
65	0.0010	1.00	0.0010	1.00
66	0.0000	0.00	0.0000	0.00
67	0.0000	0.00	0.0000	0.00
68	0.0000	0.00	0.0000	0.00
69	0.0000	0.00	0.0000	0.00
70	0.0000	0.00	0.0000	0.00
n	1 015		993	
m.w.c.v.		0.20		0.19

Appendix 1 – continued:
Estimates of the proportion at length of kahawai from the Hauraki Gulf in 2003–04 and 2004–(

Length (cm)	2003–04 *P.i.*	2003–04 *c.v.*	Length (cm)	2004–05 *P.i.*	2004–05 *c.v.*
10	0.0000	0.00	10	0.0000	0.00
11	0.0000	0.00	11	0.0000	0.00
12	0.0000	0.00	12	0.0000	0.00
13	0.0000	0.00	13	0.0000	0.00
14	0.0000	0.00	14	0.0000	0.00
15	0.0000	0.00	15	0.0000	0.00
16	0.0000	0.00	16	0.0000	0.00
17	0.0000	0.00	17	0.0000	0.00
18	0.0000	0.00	18	0.0000	0.00
19	0.0000	0.00	19	0.0000	0.00
20	0.0000	0.00	20	0.0000	0.00
21	0.0013	1.00	21	0.0017	1.00
22	0.0039	0.57	22	0.0066	0.61
23	0.0039	0.56	23	0.0149	0.45
24	0.0105	0.35	24	0.0099	0.47
25	0.0183	0.38	25	0.0248	0.28
26	0.0262	0.26	26	0.0199	0.36
27	0.0563	0.21	27	0.0149	0.33
28	0.0812	0.19	28	0.0132	0.36
29	0.0471	0.25	29	0.0066	0.50
30	0.0340	0.19	30	0.0099	0.48
31	0.0406	0.19	31	0.0232	0.28
32	0.0537	0.16	32	0.0364	0.25
33	0.0668	0.16	33	0.0397	0.27
34	0.0812	0.14	34	0.0497	0.25
35	0.0772	0.14	35	0.0381	0.22
36	0.0929	0.15	36	0.0348	0.26
37	0.0733	0.21	37	0.0497	0.25
38	0.0524	0.18	38	0.0381	0.33
39	0.0209	0.29	39	0.0414	0.26
40	0.0275	0.27	40	0.0182	0.36
41	0.0170	0.34	41	0.0132	0.35
42	0.0118	0.33	42	0.0166	0.30
43	0.0131	0.37	43	0.0099	0.41
44	0.0131	0.32	44	0.0083	0.44
45	0.0065	0.45	45	0.0132	0.35
46	0.0052	0.50	46	0.0149	0.33
47	0.0079	0.41	47	0.0331	0.33
48	0.0092	0.38	48	0.0430	0.21
49	0.0026	0.71	49	0.0381	0.20
50	0.0052	0.50	50	0.0414	0.21
51	0.0065	0.45	51	0.0546	0.19
52	0.0065	0.45	52	0.0546	0.18
53	0.0118	0.34	53	0.0281	0.25
54	0.0039	0.58	54	0.0546	0.19
55	0.0065	0.45	55	0.0315	0.26
56	0.0013	1.00	56	0.0232	0.30
57	0.0013	1.00	57	0.0116	0.52
58	0.0000	0.00	58	0.0083	0.45
59	0.0013	1.00	59	0.0033	0.71
60	0.0000	0.00	60	0.0000	0.00
61	0.0000	0.00	61	0.0033	0.71
62	0.0000	0.00	62	0.0000	0.00
63	0.0000	0.00	63	0.0033	0.70
64	0.0000	0.00	64	0.0000	0.00
65	0.0000	0.00	65	0.0000	0.00
66	0.0000	0.00	66	0.0000	0.00
67	0.0000	0.00	67	0.0000	0.00
68	0.0000	0.00	68	0.0000	0.00
69	0.0000	0.00	69	0.0000	0.00
70	0.0000	0.00	70	0.0000	0.00
n	764			606	
m.w.c.v.		0.22			0.28

Appendix 1 – continued:
Estimates of the proportion at length of kahawai from the Bay of Plenty in 2003–04 and 2004–05

Length (cm)	2003–04 *P.i.*	2003–04 *c.v.*	Length (cm)	2004–05 *P.i.*	2004–05 *c.v.*
10	0.0000	0.00	10	0.0000	0.00
11	0.0000	0.00	11	0.0000	0.00
12	0.0000	0.00	12	0.0000	0.00
13	0.0000	0.00	13	0.0000	0.00
14	0.0000	0.00	14	0.0000	0.00
15	0.0000	0.00	15	0.0000	0.00
16	0.0000	0.00	16	0.0000	0.00
17	0.0000	0.00	17	0.0000	0.00
18	0.0000	0.00	18	0.0007	1.00
19	0.0000	0.00	19	0.0000	0.00
20	0.0000	0.00	20	0.0007	1.00
21	0.0000	0.00	21	0.0007	1.00
22	0.0000	0.00	22	0.0034	0.60
23	0.0000	0.00	23	0.0040	0.41
24	0.0000	0.00	24	0.0047	0.47
25	0.0010	1.00	25	0.0047	0.38
26	0.0030	0.74	26	0.0040	0.47
27	0.0040	0.78	27	0.0067	0.34
28	0.0040	0.60	28	0.0074	0.32
29	0.0020	0.70	29	0.0074	0.32
30	0.0030	0.57	30	0.0067	0.31
31	0.0020	0.70	31	0.0115	0.29
32	0.0070	0.55	32	0.0142	0.30
33	0.0030	0.57	33	0.0101	0.27
34	0.0040	0.50	34	0.0209	0.19
35	0.0131	0.36	35	0.0276	0.18
36	0.0080	0.39	36	0.0236	0.19
37	0.0101	0.46	37	0.0175	0.22
38	0.0050	0.52	38	0.0169	0.22
39	0.0040	0.50	39	0.0283	0.16
40	0.0070	0.37	40	0.0256	0.16
41	0.0171	0.26	41	0.0533	0.13
42	0.0201	0.27	42	0.0668	0.10
43	0.0181	0.24	43	0.0539	0.11
44	0.0271	0.20	44	0.0371	0.14
45	0.0492	0.18	45	0.0344	0.15
46	0.0623	0.15	46	0.0384	0.14
47	0.0724	0.13	47	0.0391	0.14
48	0.0945	0.11	48	0.0486	0.12
49	0.1317	0.09	49	0.0593	0.11
50	0.1236	0.09	50	0.0654	0.13
51	0.0975	0.10	51	0.0735	0.10
52	0.0754	0.12	52	0.0546	0.12
53	0.0422	0.17	53	0.0425	0.15
54	0.0382	0.16	54	0.0270	0.16
55	0.0201	0.22	55	0.0169	0.20
56	0.0111	0.33	56	0.0148	0.21
57	0.0040	0.49	57	0.0034	0.45
58	0.0080	0.39	58	0.0040	0.41
59	0.0040	0.50	59	0.0027	0.50
60	0.0000	0.00	60	0.0047	0.47
61	0.0010	0.99	61	0.0027	0.61
62	0.0010	1.00	62	0.0027	0.50
63	0.0000	0.00	63	0.0034	0.45
64	0.0000	0.00	64	0.0013	0.71
65	0.0010	1.00	65	0.0007	1.00
66	0.0000	0.00	66	0.0000	0.00
67	0.0000	0.00	67	0.0000	0.00
68	0.0000	0.00	68	0.0007	1.00
69	0.0000	0.00	69	0.0000	0.00
70	0.0000	0.00	70	0.0007	1.00
n	995			1483	
m.w.c.v.		0.17			0.17

Appendix 2: Estimated proportions at age and c.v.s of kahawai sampled from recreational fishers in East Northland, Hauraki Gulf and the Bay of Plenty in 2003–04 and 2004–05.

P.j. = proportion of fish in age class. *n* = total number of fish sampled.
c.v. = coefficient of variation. *m.w.c.v.* = mean weighted c.v.

Estimates of the proportion at age of kahawai from East Northland in 2003–04 and 2004–05.

Age	2003–04		2004–05	
(years)	*P.j.*	*c.v.*	*P.j.*	*c.v.*
1	0.0010	1.00	0.0000	0.00
2	0.0418	0.18	0.0752	0.11
3	0.1766	0.09	0.0787	0.14
4	0.1838	0.09	0.1191	0.11
5	0.1026	0.13	0.1576	0.10
6	0.1290	0.11	0.1101	0.12
7	0.1214	0.12	0.1509	0.10
8	0.0711	0.16	0.0896	0.14
9	0.0628	0.17	0.0854	0.14
10	0.0472	0.20	0.0396	0.21
11	0.0159	0.36	0.0263	0.25
12	0.0112	0.41	0.0123	0.38
13	0.0218	0.28	0.0108	0.41
14	0.0016	1.01	0.0102	0.42
15	0.0079	0.52	0.0105	0.48
16	0.0000	0.00	0.0051	0.58
17	0.0022	1.01	0.0035	0.71
18	0.0000	0.00	0.0000	0.00
19	0.0000	0.00	0.0000	0.00
>19	0.0000	0.00	0.0000	0.00
n	517		514	
m.w.c.v.		0.14		0.14

Estimates of the proportion at age of kahawai from the Hauraki Gulf in 2003–04 and 2004–05.

Age	2003–04		2004–05	
(years)	*P.j.*	*c.v.*	*P.j.*	*c.v.*
1	0.0000	0.00	0.0000	0.00
2	0.3013	0.07	0.0730	0.16
3	0.4835	0.05	0.3894	0.05
4	0.1454	0.12	0.1049	0.17
5	0.0274	0.29	0.1044	0.16
6	0.0110	0.48	0.0538	0.25
7	0.0087	0.44	0.0412	0.30
8	0.0020	1.15	0.0621	0.24
9	0.0033	1.09	0.0289	0.47
10	0.0022	1.09	0.0203	0.45
11	0.0029	1.05	0.0259	0.39
12	0.0000	0.00	0.0389	0.36
13	0.0013	1.00	0.0265	0.38
14	0.0049	0.78	0.0051	0.77
15	0.0022	1.09	0.0033	1.03
16	0.0000	0.00	0.0000	0.00
17	0.0000	0.00	0.0042	1.01
18	0.0000	0.00	0.0084	0.62
19	0.0000	0.00	0.0000	0.00
>19	0.0000	0.00	0.0000	0.00
n	350		289	
m.w.c.v.		0.10		0.18

Appendix 2 – *continued*:
Estimates of the proportion at age of kahawai from the Bay of Plenty in 2003–04 and 2004–05.

Age	2003–04		2004–05	
(years)	$P_{j}.$	*c.v.*	$P_{j}.$	*c.v.*
1	0.0000	0.00	0.0000	0.00
2	0.0106	0.33	0.0332	0.18
3	0.0601	0.16	0.1660	0.08
4	0.0855	0.13	0.1877	0.10
5	0.0792	0.17	0.1542	0.12
6	0.1619	0.11	0.0813	0.17
7	0.1541	0.12	0.1115	0.14
8	0.1228	0.14	0.0474	0.24
9	0.0932	0.16	0.0827	0.18
10	0.0709	0.19	0.0393	0.25
11	0.0648	0.19	0.0181	0.34
12	0.0121	0.46	0.0165	0.50
13	0.0340	0.27	0.0189	0.41
14	0.0182	0.38	0.0055	0.63
15	0.0071	0.59	0.0088	0.59
16	0.0048	0.76	0.0025	1.01
17	0.0000	0.00	0.0056	0.82
18	0.0096	0.34	0.0107	0.56
19	0.0000	0.00	0.0000	0.00
>19	0.0042	0.81	0.0000	0.00
n	412		393	
m.w.c.v.		0.17		0.17

Appendix 3: Age–length keys derived from otolith samples collected from recreational fishers from East Northland in 2003–04 and 2004–05.

Estimates of proportion of length at age for kahawai sampled from the East Northland recreational fishery, January to April 2004. (Note: Aged to 01/01/04)

Length (cm)	Age (years) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	>19	No. aged
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
26	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
27	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
28	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
29	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
30	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
31	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
32	0	0.20	0.80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
33	0	0.14	0.86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
34	0	0.15	0.46	0.38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13
35	0	0.13	0.80	0.07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
36	0	0	0.89	0.11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
37	0	0	0.62	0.23	0.15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13
38	0	0	0.67	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
39	0	0	0.60	0.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
40	0	0	0.13	0.75	0	0.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
41	0	0	0.25	0.56	0.06	0.06	0	0.06	0	0	0	0	0	0	0	0	0	0	0	0	16
42	0	0	0.12	0.53	0.18	0.18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17
43	0	0	0.11	0.67	0.17	0.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
44	0	0	0.04	0.65	0.23	0.08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
45	0	0	0.11	0.33	0.28	0.11	0.11	0.06	0	0	0	0	0	0	0	0	0	0	0	0	18
46	0	0	0.08	0.38	0.29	0.13	0.04	0.04	0	0.04	0	0	0	0	0	0	0	0	0	0	24
47	0	0	0.09	0.26	0.17	0.17	0.22	0.04	0	0	0	0	0.04	0	0	0	0	0	0	0	23
48	0	0	0	0.20	0.20	0.27	0.23	0.07	0.03	0	0	0	0	0	0	0	0	0	0	0	30
49	0	0	0	0.06	0.14	0.22	0.24	0.06	0.16	0.04	0.02	0.02	0.02	0.02	0	0	0	0	0	0	50
50	0	0	0	0.02	0.13	0.22	0.30	0.15	0.04	0.07	0.04	0	0.02	0	0	0	0	0	0	0	46
51	0	0	0	0	0.07	0.14	0.29	0.11	0.11	0.14	0.04	0.04	0.07	0	0	0	0	0	0	0	28
52	0	0	0	0	0.04	0.21	0.13	0.17	0.21	0.13	0	0.04	0	0	0.04	0	0.04	0	0	0	24
53	0	0	0	0	0.12	0.24	0.12	0.16	0.08	0.16	0.04	0.04	0.04	0	0	0	0	0	0	0	25
54	0	0	0	0	0	0.21	0.21	0.26	0.16	0.05	0.05	0.05	0	0	0	0	0	0	0	0	19
55	0	0	0	0	0	0.17	0.13	0.04	0.30	0.13	0	0.04	0.13	0	0.04	0	0	0	0	0	23
56	0	0	0	0	0	0	0.13	0.13	0.25	0.13	0.13	0	0.13	0	0.13	0	0	0	0	0	8
57	0	0	0	0	0	0	0	0.25	0.25	0	0.25	0	0	0	0.25	0	0	0	0	0	4
58	0	0	0	0	0	0	0	0.33	0	0.67	0	0	0	0	0	0	0	0	0	0	3
59	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	1
60	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	1
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total																					517

Appendix 3 continued:

Estimates of proportion of length at age for kahawai sampled from the East Northland recreational fishery, January to April 2005. (Note: Aged to 01/01/05)

Length (cm)	Age (years) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	>19	No. aged
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
25	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
26	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
27	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
28	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
29	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
30	0	0.67	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
31	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
32	0	0.50	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
33	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
34	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
35	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
36	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
37	0	0	0.50	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
38	0	0	0.60	0.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
39	0	0	0.67	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
40	0	0	0.33	0.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
41	0	0	0.08	0.77	0.15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13
42	0	0	0.40	0.60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
43	0	0	0.33	0.11	0.56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
44	0	0	0	0.62	0.23	0.08	0.08	0	0	0	0	0	0	0	0	0	0	0	0	0	13
45	0	0	0	0.44	0.28	0.11	0	0.11	0.06	0	0	0	0	0	0	0	0	0	0	0	18
46	0	0	0	0.26	0.16	0.32	0.11	0.11	0.05	0	0	0	0	0	0	0	0	0	0	0	19
47	0	0	0	0.22	0.37	0.07	0.22	0.04	0	0.07	0	0	0	0	0	0	0	0	0	0	27
48	0	0	0	0.14	0.36	0.11	0.22	0.11	0.03	0.03	0	0	0	0	0	0	0	0	0	0	36
49	0	0	0	0.11	0.33	0.18	0.13	0.09	0.11	0.02	0.02	0	0	0	0	0	0	0	0	0	45
50	0	0	0	0	0.27	0.13	0.25	0.17	0.13	0.02	0	0.02	0	0.02	0	0	0	0	0	0	48
51	0	0	0	0.03	0.14	0.26	0.20	0.14	0.20	0	0	0	0	0	0.03	0	0	0	0	0	35
52	0	0	0	0	0.09	0.20	0.20	0.11	0.20	0.09	0.04	0.02	0	0.04	0	0	0	0	0	0	45
53	0	0	0	0	0.11	0.14	0.38	0.11	0.11	0	0.03	0.05	0.03	0	0	0	0.05	0	0	0	37
54	0	0	0	0	0.03	0.14	0.14	0.07	0.14	0.14	0.10	0.03	0.10	0	0.03	0.07	0	0	0	0	29
55	0	0	0	0	0	0.05	0.21	0.32	0.05	0.16	0.11	0	0.05	0	0.05	0	0	0	0	0	19
56	0	0	0	0	0.04	0.04	0.16	0.16	0.04	0.16	0.24	0.04	0.04	0	0.04	0.04	0	0	0	0	25
57	0	0	0	0	0	0	0.33	0	0.11	0.22	0	0.11	0	0.22	0	0	0	0	0	0	9
58	0	0	0	0	0	0.17	0.17	0	0.50	0	0	0	0	0.17	0	0	0	0	0	0	6
59	0	0	0	0	0	0	0	0	0.50	0	0	0	0	0	0.50	0	0	0	0	0	2
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total																					514

Appendix 4: Age–length keys derived from otolith samples collected from recreational fishers from the Hauraki Gulf in 2003–04 and 2004–05.

Estimates of proportion of length at age for kahawai sampled from the Hauraki Gulf recreational fishery, January to April 2004 (Note: Aged to 01/01/04)

Length	Age (years)																				No.
(cm)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	>19	aged
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
23	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
24	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
25	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
26	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
27	0	0.84	0.16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
28	0	0.79	0.21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29
29	0	0.69	0.31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
30	0	0.50	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
31	0	0.27	0.73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
32	0	0.10	0.81	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
33	0	0.24	0.72	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
34	0	0.19	0.77	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31
35	0	0.14	0.77	0.09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
36	0	0.21	0.74	0.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34
37	0	0	0.67	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
38	0	0	0.82	0.18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17
39	0	0	0.17	0.83	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
40	0	0	0.33	0.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
41	0	0	0.13	0.63	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
42	0	0	0.17	0.83	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
43	0	0	0.40	0.60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
44	0	0	0	0.57	0.43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
45	0	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
46	0	0	0	0.67	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
47	0	0	0	0.33	0.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
48	0	0	0	0.50	0	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
49	0	0	0	0	0	0.50	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	2
50	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	1
51	0	0	0	0	0.67	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
52	0	0	0	0	0.50	0	0	0	0.50	0	0	0	0	0	0	0	0	0	0	0	2
53	0	0	0	0	0.25	0.25	0	0	0	0	0.25	0	0	0.25	0	0	0	0	0	0	4
54	0	0	0	0	0	0	0	0.50	0	0	0	0	0	0.50	0	0	0	0	0	0	2
55	0	0	0	0	0	0	0.33	0	0	0.33	0	0	0	0	0.33	0	0	0	0	0	3
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	1
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total																					350

Appendix 4 – continued:

Estimates of proportion of length at age for kahawai sampled from the Hauraki Gulf recreational fishery, January to April 2005
(Note: Aged to 01/01/05)

Length																			Age (years)		No.
(cm)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	>19	aged
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
22	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
23	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
24	0	0.83	0.17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
25	0	0.70	0.30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
26	0	0.50	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
27	0	0.25	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
28	0	0.38	0.63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
29	0	0.33	0.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
30	0	0	0.80	0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
31	0	0.14	0.71	0.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
32	0	0	0.94	0.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
33	0	0	0.85	0.15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13
34	0	0	0.82	0.18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17
35	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
36	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
37	0	0	0.80	0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
38	0	0	0.83	0.17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
39	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
40	0	0	0.75	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
41	0	0	0.80	0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
42	0	0	0.20	0.40	0.20	0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
43	0	0	0	0.75	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
44	0	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
45	0	0	0	0.67	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
46	0	0	0	0.60	0.20	0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
47	0	0	0	0.40	0.40	0	0.10	0	0.10	0	0	0	0	0	0	0	0	0	0	0	10
48	0	0	0	0.17	0.42	0.25	0	0.08	0	0.08	0	0	0	0	0	0	0	0	0	0	12
49	0	0	0	0.08	0.31	0.31	0	0.15	0.08	0	0.08	0	0	0	0	0	0	0	0	0	13
50	0	0	0	0	0.82	0	0	0.18	0	0	0	0	0	0	0	0	0	0	0	0	11
51	0	0	0	0	0.18	0.18	0.27	0.09	0	0.09	0.18	0	0	0	0	0	0	0	0	0	11
52	0	0	0	0	0	0	0	0.38	0.08	0.15	0.15	0	0.15	0	0	0	0.08	0	0	0	13
53	0	0	0	0	0	0.14	0.14	0.29	0.14	0	0	0.14	0.14	0	0	0	0	0	0	0	7
54	0	0	0	0	0	0.14	0.29	0.14	0.07	0	0	0.14	0.21	0	0	0	0	0	0	0	14
55	0	0	0	0	0	0	0	0	0.33	0	0	0.67	0	0	0	0	0	0	0	0	3
56	0	0	0	0	0	0.14	0.14	0.14	0	0.14	0	0.14	0	0	0.14	0	0	0.14	0	0	7
57	0	0	0	0	0	0	0	0	0	0	0.40	0	0.20	0.20	0	0	0	0.20	0	0	5
58	0	0	0	0	0	0	0	0	0	0	0	0.33	0	0.33	0	0	0	0.33	0	0	3
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total																					289

Appendix 5: Age–length keys derived from otolith samples collected from recreational fishers from the Bay of Plenty in 2003–04 and 2004–05.

Estimates of proportion of length at age for kahawai sampled from the Bay of Plenty recreational fishery, January to April 2004 (Note: Aged to 01/01/04)

Length																			Age (years)		No.
(cm)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	>19	aged
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
28	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0.50	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
31	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
32	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
33	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
34	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
35	0	0	0.88	0.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
36	0	0	0.57	0.43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
37	0	0	0.67	0	0	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
38	0	0	0	0.60	0.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
39	0	0	0	0.33	0.33	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
40	0	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
41	0	0	0.14	0.79	0.07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
42	0	0	0	0.77	0.15	0	0	0	0.08	0	0	0	0	0	0	0	0	0	0	0	13
43	0	0	0.20	0.30	0.30	0	0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	10
44	0	0	0	0.47	0.16	0.26	0.11	0	0	0	0	0	0	0	0	0	0	0	0	0	19
45	0	0	0.28	0.17	0.11	0.33	0.06	0.06	0	0	0	0	0	0	0	0	0	0	0	0	18
46	0	0	0	0.14	0.14	0.50	0.18	0	0.05	0	0	0	0	0	0	0	0	0	0	0	22
47	0	0	0	0.07	0.14	0.29	0.29	0.18	0	0	0.04	0	0	0	0	0	0	0	0	0	28
48	0	0	0	0	0.13	0.29	0.26	0.10	0.06	0.06	0.06	0	0.03	0	0	0	0	0	0	0	31
49	0	0	0	0	0.07	0.21	0.21	0.19	0.14	0.09	0.07	0.02	0	0	0	0	0	0	0	0	43
50	0	0	0	0	0.02	0.12	0.24	0.25	0.20	0.10	0.04	0	0.04	0	0	0	0	0	0	0	51
51	0	0	0	0	0.05	0.10	0.17	0.17	0.17	0.17	0.12	0.02	0	0.02	0.02	0	0	0	0	0	42
52	0	0	0	0	0.12	0.04	0.16	0.12	0.16	0.12	0.08	0	0.08	0.08	0.04	0	0	0	0	0	25
53	0	0	0	0	0	0	0.08	0.17	0.17	0.17	0.04	0.08	0.17	0.08	0.04	0	0	0	0	0	24
54	0	0	0	0	0	0	0	0.17	0.08	0.08	0.17	0.08	0.08	0.17	0.00	0.08	0	0	0	0.08	12
55	0	0	0	0	0	0	0	0.17	0	0.17	0.33	0	0.33	0	0	0	0	0	0	0	6
56	0	0	0	0	0	0	0	0	0.14	0.14	0.14	0	0.29	0	0	0.14	0	0.14	0	0	7
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	1
58	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	0	0	1
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	1
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total																					412

Appendix 5 – continued:

Estimates of proportion of length at age for kahawai sampled from the Bay of Plenty recreational fishery, January to April 2005 (Note: Aged to 01/01/05)

Length	Age (years)																				No.
(cm)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	>19	aged
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
23	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
24	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
25	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
26	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
27	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
28	0	0.25	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
29	0	0.50	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
30	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
31	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
32	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
33	0	0	0.60	0.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
34	0	0	0.77	0.23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13
35	0	0	0.89	0.11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
36	0	0	0.89	0	0.11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
37	0	0	0.91	0.09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
38	0	0	0.25	0.63	0.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
39	0	0	0.63	0.25	0.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
40	0	0	0.18	0.64	0.18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
41	0	0	0.11	0.67	0.11	0.11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
42	0	0	0.08	0.53	0.33	0.03	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	36
43	0	0	0	0.56	0.38	0.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
44	0	0	0.07	0.36	0.36	0.14	0.07	0	0	0	0	0	0	0	0	0	0	0	0	0	14
45	0	0	0	0.43	0.19	0.29	0.05	0	0.05	0	0	0	0	0	0	0	0	0	0	0	21
46	0	0	0	0.07	0.20	0.33	0.27	0.07	0.07	0	0	0	0	0	0	0	0	0	0	0	15
47	0	0	0	0	0.20	0.25	0.15	0.30	0.05	0.05	0	0	0	0	0	0	0	0	0	0	20
48	0	0	0	0.08	0.29	0.25	0.21	0	0.13	0.04	0	0	0	0	0	0	0	0	0	0	24
49	0	0	0	0.08	0.15	0.12	0.38	0.04	0.15	0.04	0.04	0	0	0	0	0	0	0	0	0	26
50	0	0	0	0	0.17	0.04	0.30	0.17	0.09	0.22	0	0	0	0	0	0	0	0	0	0	23
51	0	0	0	0	0.19	0.06	0.23	0.03	0.23	0.13	0.10	0	0	0.03	0	0	0	0	0	0	31
52	0	0	0	0	0.06	0.06	0.19	0.13	0.25	0.06	0	0.06	0.13	0	0.06	0	0	0	0	0	16
53	0	0	0	0	0.13	0	0.13	0.13	0.25	0	0	0.25	0	0	0	0	0	0.13	0	0	8
54	0	0	0	0	0	0.09	0	0.18	0.09	0	0.18	0.09	0.18	0	0.09	0.09	0	0	0	0	11
55	0	0	0	0	0	0	0.25	0	0.25	0	0	0	0.25	0	0	0	0.25	0	0	0	4
56	0	0	0	0	0	0	0	0	0.20	0.40	0	0	0.20	0	0.20	0	0	0	0	0	5
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	1
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0.50	0	0	0	0.50	0	0	2
59	0	0	0	0	0	0	0	0	0	0	0.50	0	0	0	0	0	0.50	0	0	0	2
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	1
62	0	0	0	0	0	0	0	0	0.50	0	0.50	0	0	0	0	0	0	0	0	0	2
63	0	0	0	0	0	0	0	0	0.33	0	0.33	0	0	0.33	0	0	0	0	0	0	3
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total																					393