New Zealand Fisheries
Assessment Report
2008/63
November 2008
ISSN 1175-1584

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Published by Ministry of Fisheries
Wellington
2008

ISSN 1175-1584

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New Zealand Fisheries Assessment Report 2008/63. 40 p.

This series continues the informal
New Zealand Fisheries Assessment Research Document series
which ceased at the end of 1999.

EXECUTIVE SUMMARY

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This report documents a seventh consecutive year of recreational catch sampling in KAH 1. These data are used to both describe the length and age composition of recreational landings and to monitor the wider KAH 1 stock. Recreational landings have been sampled instead of those from the commercial sector because amateur fishers land a wider size range of kahawai, from a far greater number of geographically dispersed schools, than any other fishery. This is desirable, as kahawai school by size and, therefore, in a highly non-random manner. This schooling behaviour, and the mobility of schools in response to biological and environmental influences, limits the extent to which landings from any fishery represent the wider population structure.

The number of kahawai measured and aged in the Hauraki Gulf was similar to that encountered in previous years, with the exception of 2005–06, when kahawai landings were atypically high. In East Northland and the Bay of Plenty, however, the number of fish measured was slightly more than in the previous year. Nonetheless, the regional results obtained in 2006–07 are broadly similar to those obtained in previous years. In East Northland, the length and age compositions are very similar to those collected in the previous year, which reflects an age distribution which has broadened since 2000–01. The Hauraki Gulf is dominated by 3 and 4 year olds, although the 3 year old fish are not as prevalent as in the previous year. However, good catch rates of 4 year old fish suggest that the recruitment of previous year's 3 year old fish had been particularly good. In the Bay of Plenty the length and age distributions remain typically broad. There is a marked pulse of 4 year old fish in the Bay, which corresponds to the strong three year old year class seen in the Hauraki Gulf in the previous year.

We assume that recreational fishers were sampled in a representative manner, but demonstrating that this was the case is problematic given the lack of information on the wider recreational fishery. An examination of monthly length frequency distributions obtained from longer term boat ramp surveys suggests that, in the Hauraki Gulf and in the Bay of Plenty, there is little change in the size composition of kahawai landed throughout the year. In East Northland, however, there is some evidence of a shift to smaller fish being landed in the winter months, although an aerial overflight survey suggests that only about 25% of the annual kahawai harvest in this area is taken during the winter.

The overall objective of this programme is to monitor the status of kahawai stocks, and one means of doing this is to monitor changes in total mortality estimates derived from age frequency distributions. Total mortality estimates are relatively constant through time, and do not generally exceed those which yield per recruit and spawner per recruit analyses suggest are theoretically optimal.

Trends in increasing mean length-at-age appear to be real, and not an artefact of ageing error, changes in the timing of catch sampling, or changes in fish/fisher behaviour. The latter always remains a possibility, however.

The levels of precision routinely achieved by these sampling programmes are usually well within target levels. This is probably because of the large number of landings which are sampled and the fact that the data are stratified at the level of the individual landing. An alternative, coarser level of stratification was investigated, in which data were grouped at the level of the ramp survey session, during which several boats landing kahawai may be encountered. There was only a slight decrease in precision when data were restratified at this level, however. In future surveys we will continue to stratify data at the vessel level, giving estimates which are consistent with those previously reported.

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, given the manner in which the recreational fishery interacts with kahawai in KAH 1.

Dedicated sampling of recreational landings of kahawai was initiated in the summer of 2000–01, and continued for a further six years, as part of the Ministry of Fisheries programmes KAH2002/02 (Hartill et al. 2007a), KAH2003/01 (Armiger et al. 2006) and KAH2005/02 (Hartill et al. 2007c). This report documents the results of a further year of sampling, undertaken as part of the Ministry of Fisheries programme KAH2006/02. In recent years several issues surrounding this programme have been raised in the Pelagic Working Group. These are also addressed in this report.

Overall objective

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

Specific objectives

1. To conduct representative sampling and determine the length and age composition of the recreational landings of kahawai in KAH 1 for the 2006/07 fishing year to monitor the KAH 1 stock. The target coefficient of variation (c.v.) for the catch at age will be 30% (mean weighted c.v. across all age classes), including demonstrating that the sampling was representative of the fishery.

2. To explore the times series of catch sampling data, in particular, for any significant changes in the length and age composition of recreational catches and any indications of change in stock status in KAH 1.

This report also includes sections on an exploration of possible reasons for a previously observed trend in increasing mean length-at-age, and an examination of precision estimates associated with two alternative levels of stratification.

2. METHODS

2.1 Overview of recreational kahawai catch sampling programmes

In the 1990s, recreational fishers in QMA 1 were interviewed at boat ramps to monitor aspects of the recreational fishery (see Sylvester[n w m1] 1993, Hartill et al. 1998). An incidental outcome of these surveys was the realisation that recreational fishers potentially provided a much more random means of sampling kahawai populations than the conventional commercial port sampling approach (given selectivity and spatial availability). Although recreational kahawai length frequency data were collected during the 1990s, underlying survey designs differed both spatially and temporally, and no age data were collected concurrently with length data. 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. 2007a).

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. Kahawai were measured, where possible, 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. A further three years of sampling were conducted in 2004 and 2005 as part of KAH2003/01 (Armiger et al. 2006) and in 2006 as part of KAH2005/02 (Hartill et al. 2007c).

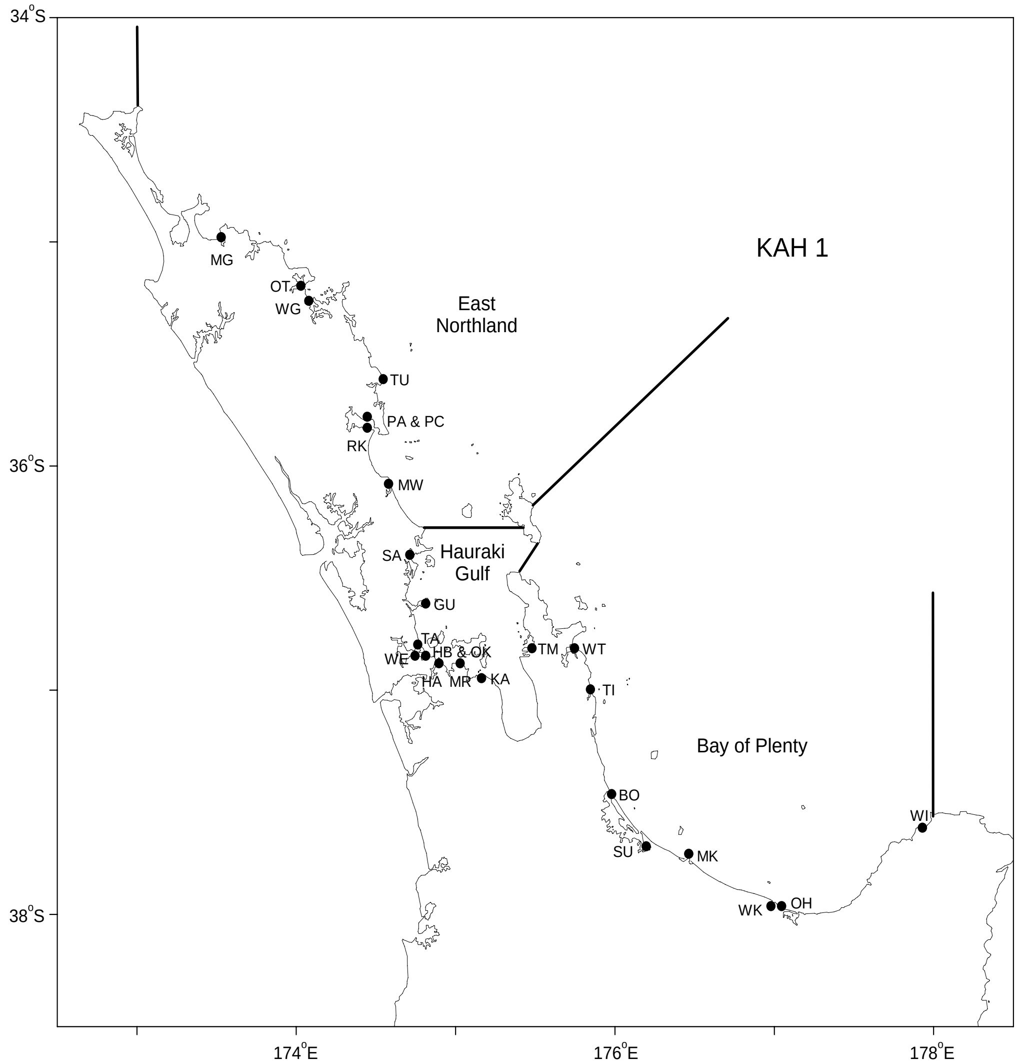
This programme provides recreational catch at age data from KAH 1 for a seventh consecutive year. The methods used in this programme are, therefore, essentially the same as those used since 2001, and are discussed below.

2.2 Sample design

The sample design used in this survey was based on data collected from boat ramp surveys conducted between 2001 and 2006. Kahawai length data and age distributions from these surveys (and length data from previous surveys in 1991, 1994, and 1996) strongly suggest that there continue to be 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, Hartill & Walsh 2005). 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 were based on those used in the 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 spatial dynamics 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 the six previous years surveyed, 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 objective above.



East Northland		Hauraki Gulf		Bay of Plenty	
MG	Mangonui	GU	Gulf Harbour	BO	Bowentown
MW	Mangawai	HA	Half Moon Bay	MK	Maketu
OT	Opito Bay, Kerikeri	HB	Hobson Bay	OH	Ohope
PA	Parua Bay (public ramp)	KA	Kawakawa	SU	Sulphur Point, Tauranga
PC	Parua Bay (club ramp)	MR	Maretai	TI	Tairua
RK	One Tree Point, Ruakaka	OK	Okahu Bay	WI	Waihau Bay
TU	Tutukaka	SA	Sandspit	WK	Whakatane
WG	Waitangi	TA	Takapuna	WT	Whitianga
		TM	Te Kouma		
		WE	Westhaven		

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

Where possible, the same ramps have been surveyed since 2001. Sampling sessions at each ramp were randomly assigned to weekend and public holiday days between 1 January and 30 April. If 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. Additional midweek interviewing took place at four ramps in the inner Hauraki Gulf in 2007, as part of an overlapping FRST funded programme (Marine Recreation – CO1X0506). These data have been excluded from Tables 1 and 2 in the interests of consistency with previous years.

Estimates of the number of kahawai landed which are given in the “Design” block of Table 1 are based on survey data collected in the early to mid 1990s. The spatial and temporal allocation of sampling effort in those surveys differs from that used since 2001, as sampling during the 1990s was concentrated at a lower number of more productive ramps. Additional sampling at less productive ramps since 2001 was necessary, however, to increase the number and spatial range of kahawai which we could potentially encounter and sample. The “Design” statistics are presented in each year’s report, as they were the basis of the survey design used in 2001 when no other data were available on which to base a survey design. Nonetheless, the levels of precision achieved since 2001 have been within that specified by the Ministry of Fisheries in any survey year, and we continue to survey the fishery at this level of effort.

It should be noted that changes in regional estimates of the number of kahawai landed per interview hour, as given in Table 1 of this and previous reports in this time series, should not be used to infer trends in the kahawai stock status. The main reason for this is that a key determinant of the number of kahawai landed per hour is the number of boats returning to the ramp during the interview session, which is not dependent on the local availability of a single species such as kahawai. Levels of fishing effort on a given day, or season, are strongly influenced by prevailing weather conditions, which are not constant through time. Indices of recreational CPUE are a more appropriate means of assessing changes in local availability to recreational fishers, and possibly stock status, as given by Hartill & Walsh (2005).

Table 1: Numbers of hours worked and kahawai encountered, measured, and aged relative to the survey design.

Region				Design
	Number of hours	Average no. of fish landed/interview h	Estimated no. of kahawai measured	Kahawai aged
East Northland	1 152	1.3	1 498	500
Hauraki Gulf	1 200	1.1	1 320	500
Bay of Plenty	512	3.5	1 792	500
				Actual
Region	Number of hours	Average no. of fish landed/interview h	Estimated no. of kahawai measured	Kahawai aged
East Northland	1 049	0.6	726	471
Hauraki Gulf	1 391	0.5	632	398
Bay of Plenty	485	2.2	1 072	472

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, where possible. For ageing 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 recreational fishers allowed 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 1998). 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 artist's 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.
- 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 as 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, because 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.

Fishers from East Northland and the Bay of Plenty were asked how far they were offshore when they caught their kahawai. These data were plotted and regressed against fish length to explore ontogenetic shifts in habitat usage. Fishers from the Hauraki Gulf were not asked this question as the u-shaped coastline and presence of islands makes interpretation of this variable meaningless.

3. RESULTS

3.1 East Northland

The number of hours interviewers were present at ramps in East Northland was similar to that in 2000–01 to 2003–04 and 2005–06 (Table 2). As with previous years, most kahawai were landed at the northern ramps, but the number of kahawai landed throughout the region on survey days was similar to that in 2005–06 and less than in previous years. The number of kahawai measured and encountered was 726 in East Northland, which is slightly up on the number measured in the previous year but lower than in earlier survey years.

The length and age distributions in 2006–07 are similar to those obtained in previous years (Figure 2). The length distribution is typically broad, peaking at about 49–51 cm, with a secondary smaller peak corresponding to a cohort of 3 year old fish (Figure 2). The age distribution remains broad, with most fish between 3 and 10 years of age, although older fish are not as evident in this year's landings. The length and age distributions were both described with reasonable precision, with mwcvs of 0.23 (Appendix 1) and 0.14 (Appendix 2) respectively. The estimate of precision for length is similar to last year, reflecting both the low sample size and the broad distribution. However, the estimate of precision for age is more in line with earlier years. 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). As with previous years, 2 to 4 year old fish were more predominant at in January, and in this year, February (Figure 3).

As usual, most kahawai were caught within 5 km of the mainland coast, where most fishing effort occurs: 84% in 2001–02, 97% in 2002–03, 83% in 2003–04, 92% in 2005–06, and 86% in 2006–07 (Figure 4). Fishers were not asked how far they fished offshore in 2004–05. Most recreational fishing effort takes place close to shore, however, and it is possible that numerous schools of offshore kahawai were not encountered. These data do, however, provide a description of where recreational catches of kahawai took place. Despite the paucity of information on offshore catches, there appears to be some evidence of increasing fish size with increasing distance offshore.

3.2 Hauraki Gulf

A lower proportion of the kahawai landed in the Hauraki Gulf in 2006–07 was measured than in previous years (Table 2). The reason for this is not clear. There are anecdotal reports of an increased incidence of kahawai being landed in an unmeasureable state (such as with the head removed) and cooperation by fishers in this area is declining due to the ongoing and intensive levels of interviewing in recent years (largely because of a shift to all day sampling spread throughout the year as part of harvest estimation surveys: REC200202 – Hauraki Gulf; MFish project, REC200401 – QMA 1; MFish, and CO1X0506 – inner Hauraki Gulf; FRST). It is also possible that some of the inner Gulf interviewers may have been confused about the purpose of the survey as they were also conducting interviewing in relation to a FRST funded programme, which solely considered the snapper fishery. Nonetheless, the levels of precision achieved in this area are within that specified in Objective 1 of this programme.

The length distribution is similar to that collected in 2001–02, when the dominance of 3 year old fish was also less dominant than in other years (Figure 5). The 3 year old year class in 2006–07 is dominated by a stronger 4 year old cohort which was also particularly dominant in 2005–06 (when it was the 3 year old cohort). The precision (mwcvs) of the length and age distributions was 0.25 and 0.14 respectively (Appendices 1 & 2).

Monthly age distributions from 2006–07 once again indicate that there is a tendency for larger fish to be landed in in the Hauraki Gulf in April (Figure 6).

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 2005–06. Regional summary statistics from previous survey years are given for comparison.

Region	Year	Ramp	Number of sessions	Number of hours	Boats interviewed (fishing)	Measurable kahawai landed*	Boats with measured kahawai	Kahawai measured	Kahawai aged
East Northland	2006-07	Mangonui	22	128	270	104	47	98	71
		Opito Bay	24	135	269	194	82	178	135
		Waitangi	19	111	74	89	29	89	0
		Tutukaka	20	121	179	55	39	53	42
		Parua Bay (public)	26	157	363	179	57	160	119
		Parua Bay (club)	21	121	247	107	51	107	80
		Ruakaka	23	138	161	12	9	12	5
		Mangawhai	23	138	273	29	17	29	19
		Total	178	1 049	1 836	769	331	726	471
	2005–06		183	1 083	1 714	619	274	537	321
	2004–05		344	2 407	2 752	1 134	459	993	514
	2003–04		190	1 096	2 427	1 119	439	1 015	517
	2002–03		186	1 049	2 089	1 316	436	1 171	504
	2001–02		199	1 110	1 878	1 437	491	1 318	526
	2000–01		196	1 129	2 233	1 377	474	1 236	517
Hauraki Gulf	2006–07	Sandspit	19	124	91	55	17	53	12
		Gulf Harbour	20	120	380	101	45	89	30
		Takapuna	21	132	350	63	6	9	8
		Westhaven	24	147	417	68	13	23	20
		Hobson Bay	21	126	244	40	18	32	19
		Okahu Bay	13	82	278	56	31	55	42
		Half Moon Bay	45	294	590	245	37	83	71
		Maraetai	15	90	330	185	39	74	52
		Kawakawa Bay	24	156	495	279	54	91	48
		Te Kouma	21	121	368	124	72	123	96
		Total	223	1 391	3 543	1 216	332	632	398
	2005–06		229	1 317	4 034	1 556	530	1 170	526
	2004–05		557	3 529	6 402	899	293	606	289
	2003–04		408	2 475	6 222	1 015	345	764	350
	2002–03		231	1 301	3 432	1 035	395	880	527
	2001–02		204	1 138	3 348	924	339	786	500
	2000–01		212	1 174	2 706	1 081	435	892	500
Bay of Plenty	2006–07	Whitianga	17	68	89	75	33	67	51
		Tairua	14	55	95	31	15	26	17
		Bowentown	18	76	247	144	49	133	79
		Sulphur Point	18	72	392	358	99	271	78
		Maketu	21	81	94	127	39	105	79
		Whakatane	20	81	247	710	152	445	147
		Ohope	10	41	31	22	7	22	21
		Waihau Bay	3	12	31	6	3	3	0
		Total	121	485	1 226	1 473	397	1 072	472
	2005–06		106	497	678	982	232	656	497
	2004–05		406	2 636	3 611	2 703	565	1 483	393
	2003–04		108	429	952	1 256	306	995	412
	2002–03		120	462	1 246	1 260	357	1 133	477
	2001–02		141	474	1 197	1 746	457	1 476	495
	2000–01		100	319	934	1 277	294	1 104	457

* Excludes kahawai which were released, used for bait, or landed filleted.

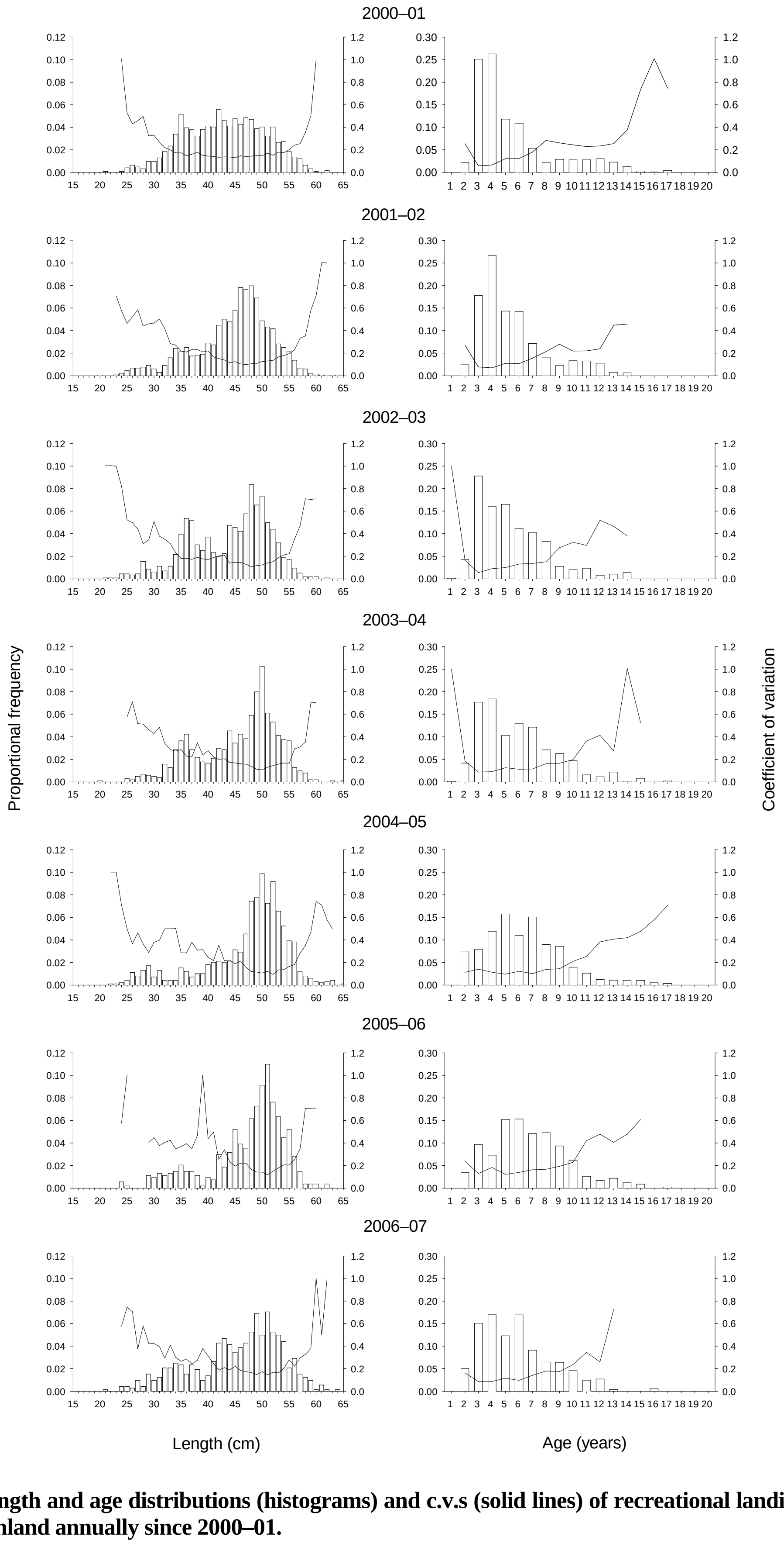


Figure 2: Length and age distributions (histograms) and c.v.s (solid lines) of recreational landings of kahawai in East Northland annually since 2000–01.

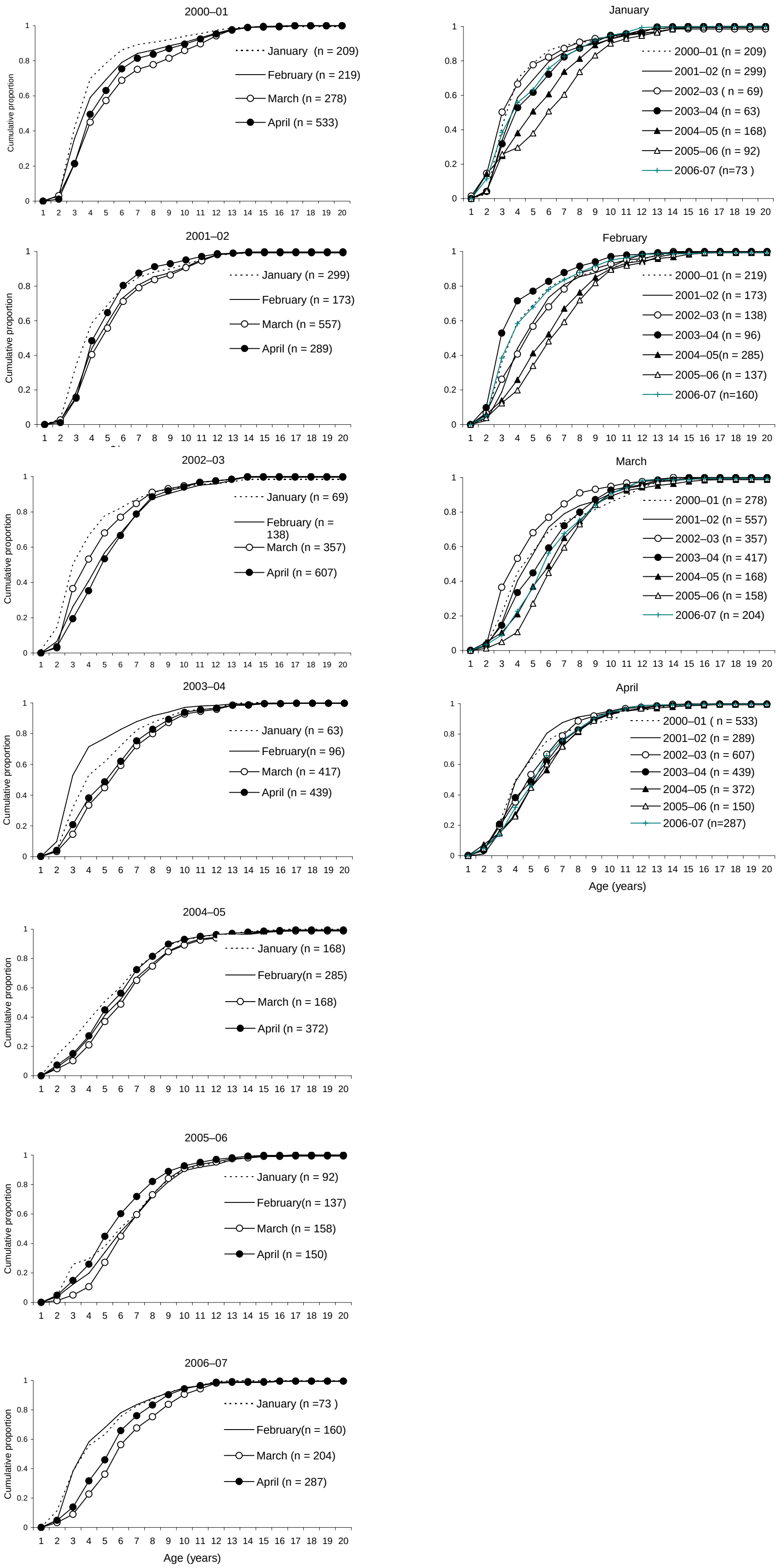


Figure 3: Cumulative age distributions by month for East Northland since 2000–01. Left hand panels compare monthly age distributions within fishing years and right hand panels compare annual age distributions for each of the four months. The number of fish measured is given for each month.

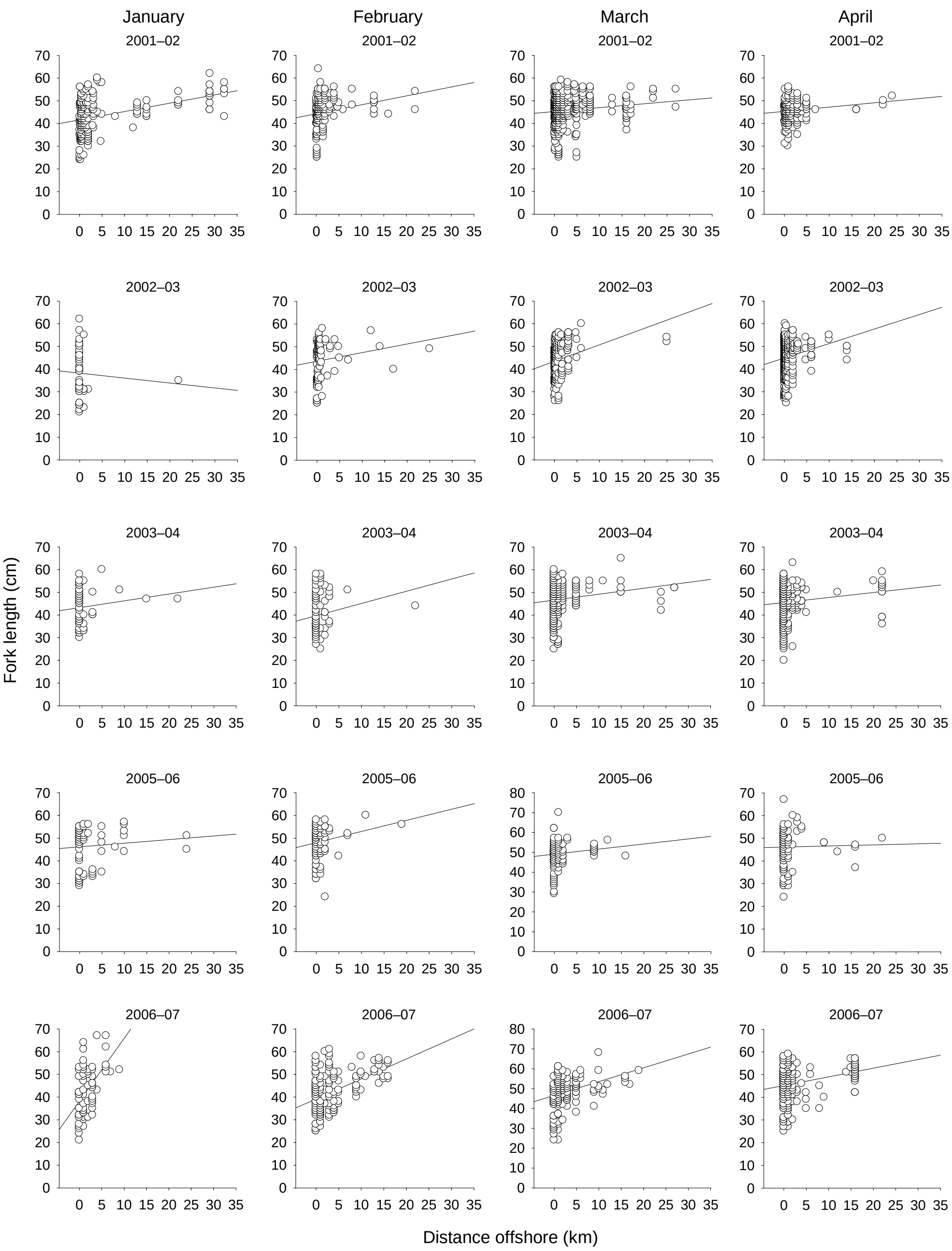


Figure 4: Length of landed kahawai relative to the estimated distance off the East Northland coastline at which they were caught. Results from four previous years are given for comparison. Data on the distance fished offshore were not collected in 2004–05.

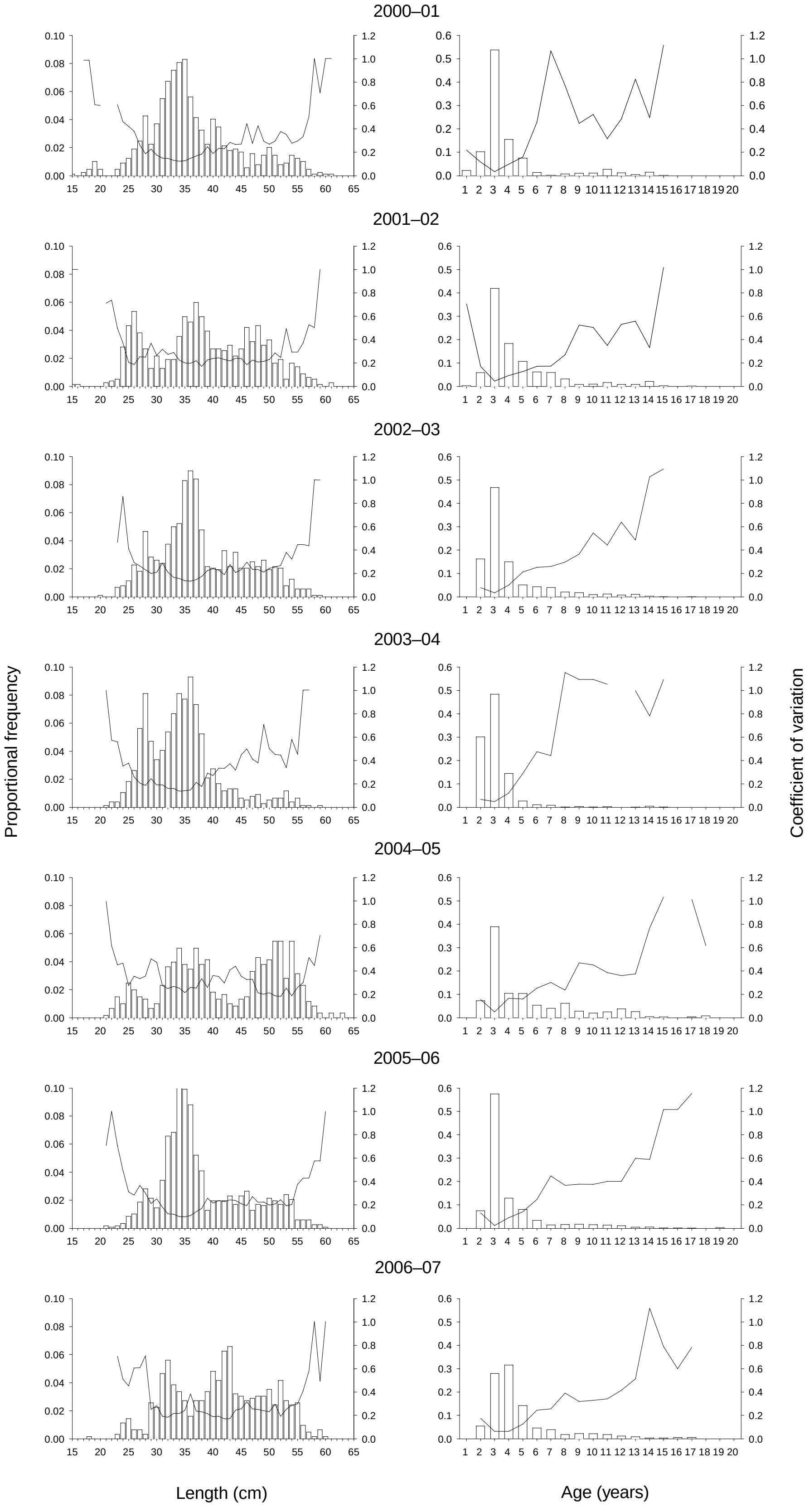


Figure 5: Length and age distributions (histograms) and c.v.s (solid lines) of recreational landings of kahawai in the Hauraki Gulf since 2000–01.

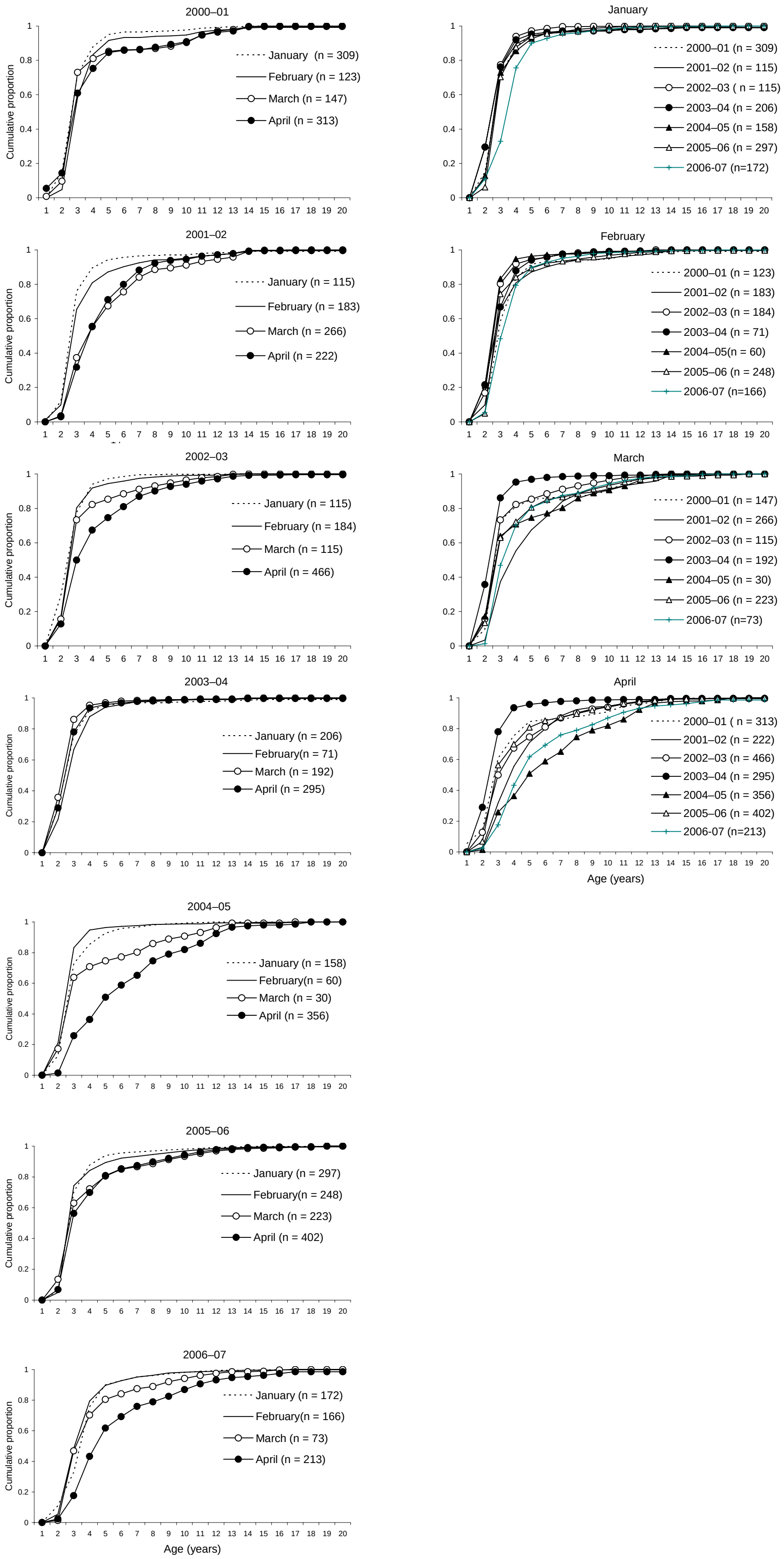


Figure 6: Cumulative age distributions by month for the Hauraki Gulf since 2000–01. Left hand panels compare monthly age distributions within fishing years and right hand panels compare annual age distributions for each of the four months. The number of fish measured is given for each month.

3.3 Bay of Plenty

The number of kahawai measured by boat ramp interviewers in the Bay of Plenty was 1072, which is an increase on the 656 measured in the previous year. The increased incidence of landed kahawai meant that the target sample size of 500 otoliths was almost reached (Table 2). The precision of the length and age distributions were similar to those in previous years (mwcvs of 0.19 and 0.15 respectively) (Appendices 1 and 2). As with previous years, a dominant mode of 45–55 cm fish dominates the Bay of Plenty length distribution (Figure 7). The age distribution is also characteristically broad, although there is clear evidence of a strong 4 year old year class which was seen as a cohort of 3 year olds in the adjacent Hauraki Gulf in the previous year. There is a higher proportion of younger fish in February and March age distributions than in previous years (Figure 8).

The relationship between the size of fish and the distance they were caught from the mainland is poorly defined, despite the fact that a significant proportion of kahawai were caught some distance offshore (Figure 9).

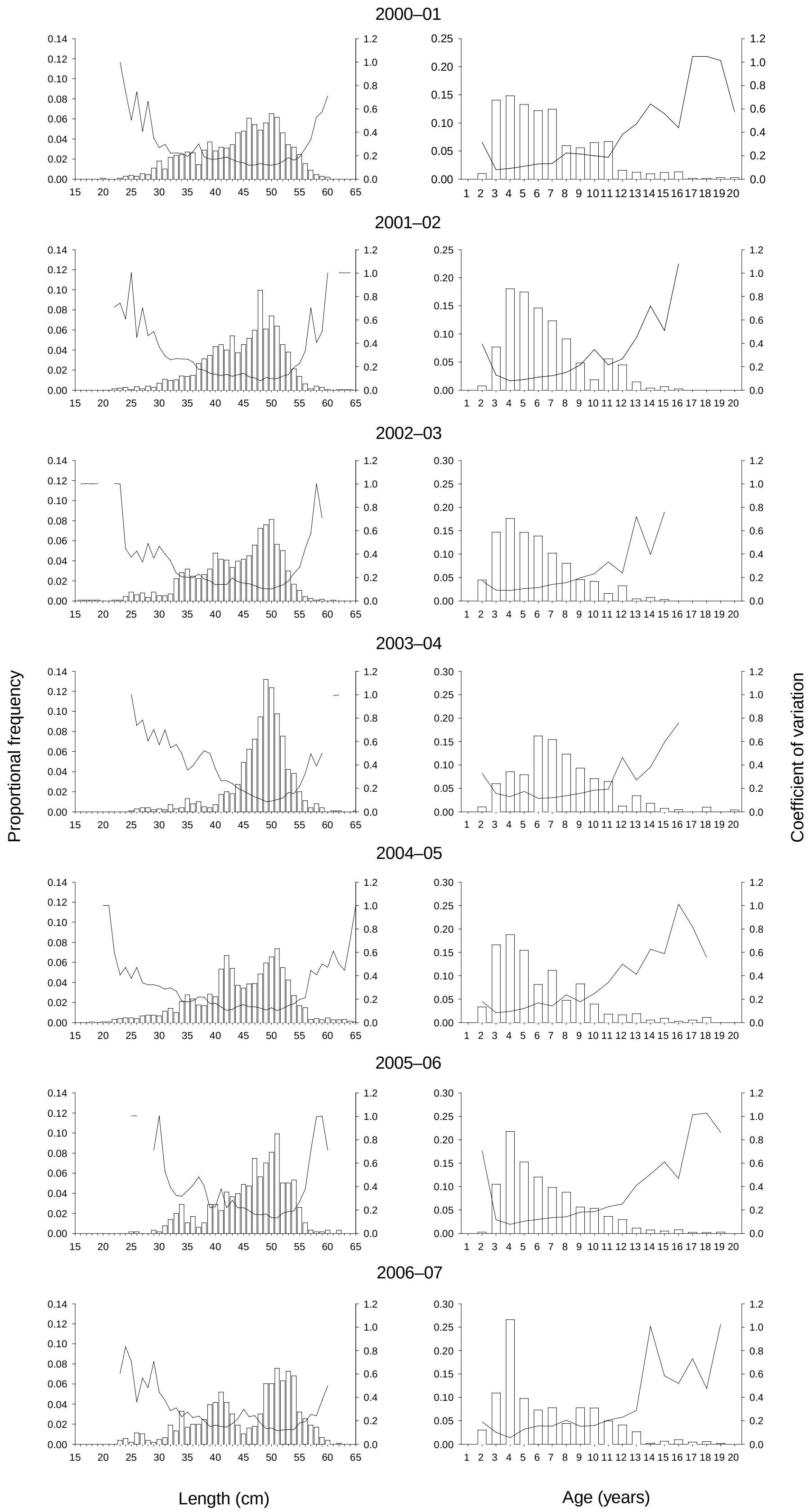


Figure 7: Length and age distributions (histograms) and c.v.s (solid lines) of recreational landings of kahawai in the Bay of Plenty since 2000–01.

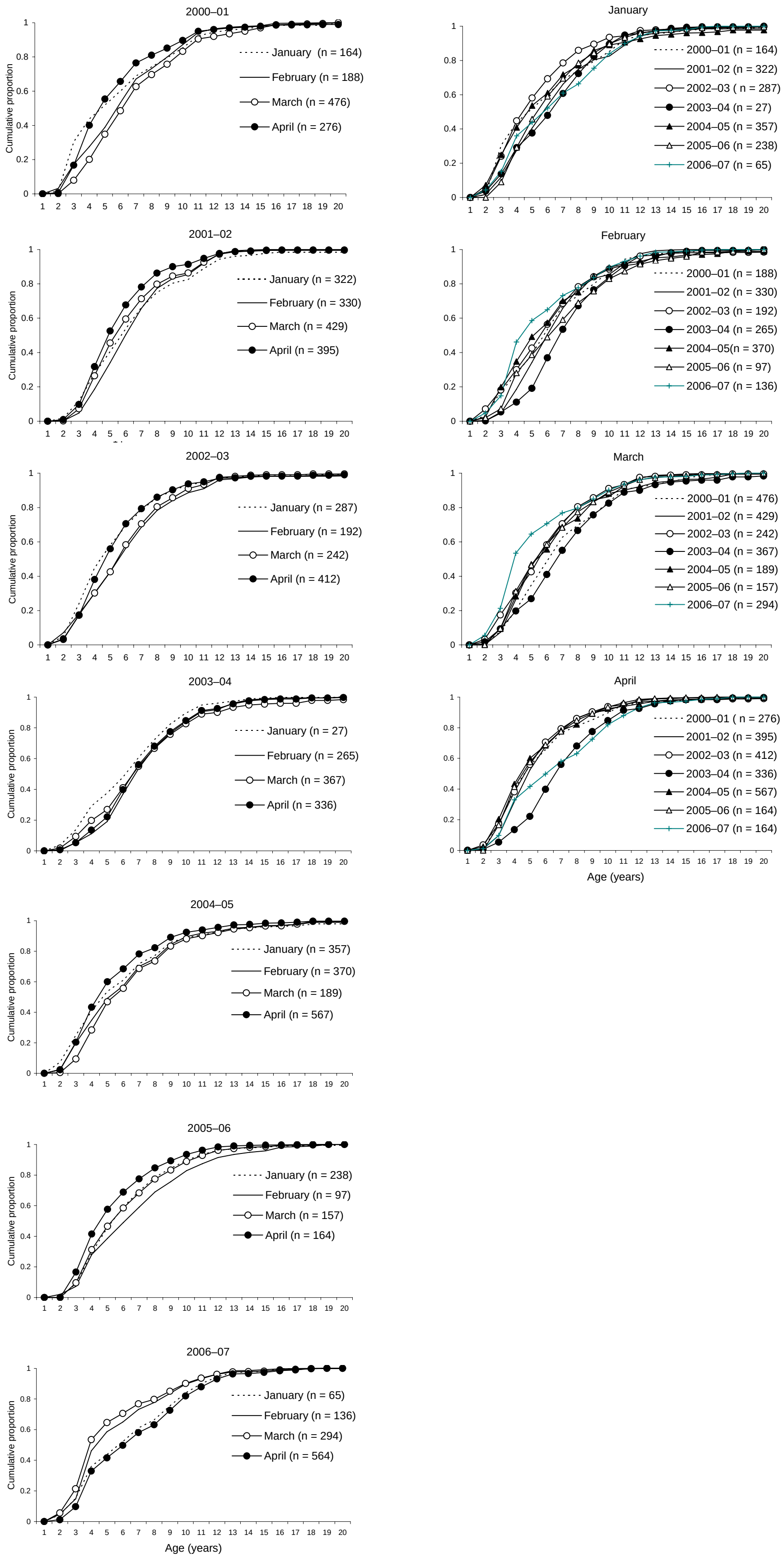


Figure 8: Cumulative age distributions by month for the Bay of Plenty since 2000–01. Left hand panels compare monthly age distributions within fishing years and right hand panels compare annual age distributions for each of the four months. The number of fish measured is given for each month.

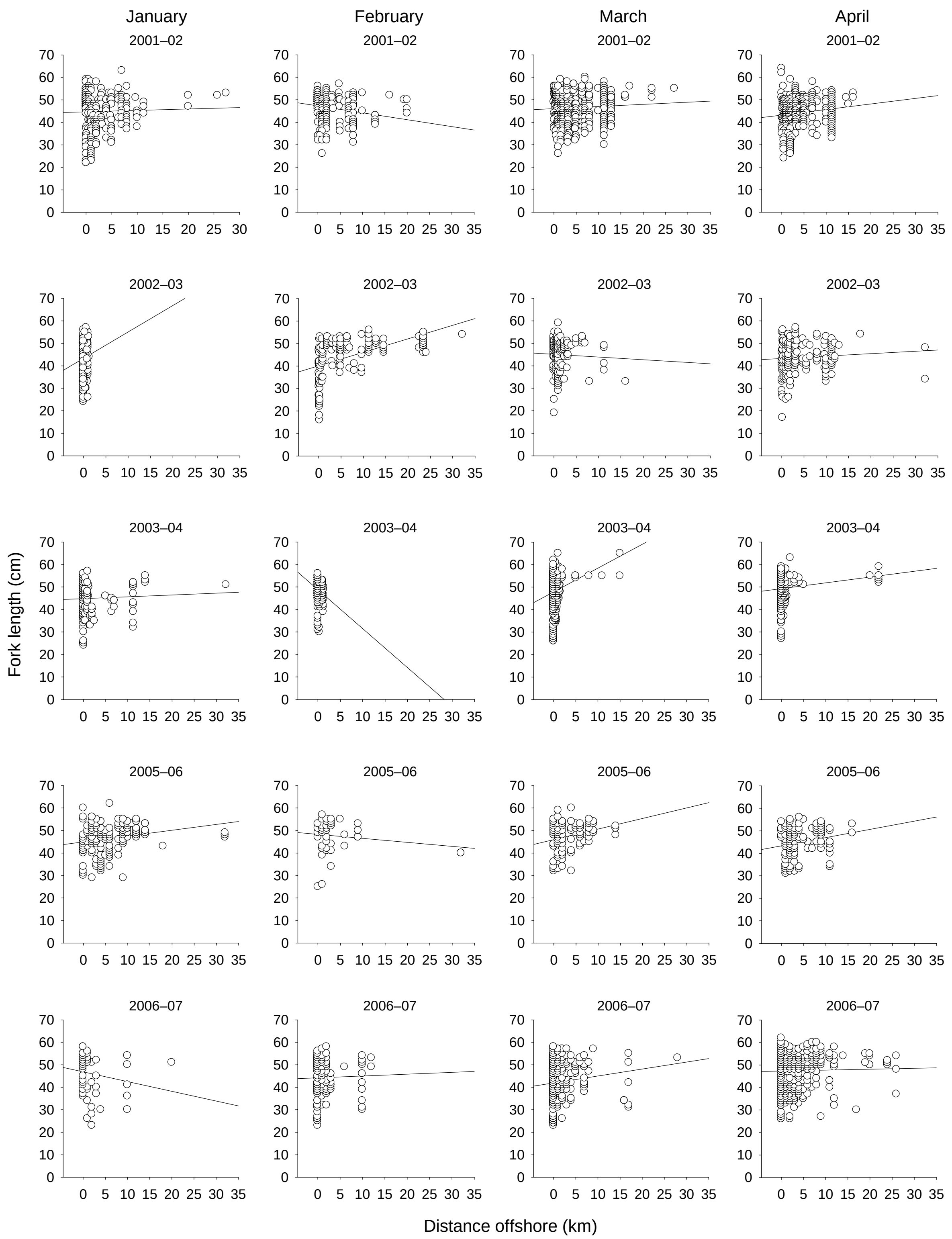


Figure 9: Length of landed kahawai relative to the estimated distance off the Bay of Plenty coastline at which they were caught. Results from four previous years are given for comparison. Data on the distance fished offshore were not collected in 2004–05.

3.4 Representativeness of sampling

Part of the first objective of this programme was the requirement to demonstrate that the sampling was representative of the fishery. This requires a reasonably accurate understanding of the nature and extent of the fishery in question. A description of the fishery is easily obtained when examining commercial fisheries as most, if not all, of the catch and effort is theoretically reported by all participants. In recreational fisheries, however, this stipulation is far more problematic. Recreational surveys have been conducted intermittently in KAH 1 since 1990, but most of these have only been for part of the year, and there has only been one 12 month observational survey conducted in this area, the aerial overflight survey undertaken in 2004–05 (Hartill et al. 2007b). Another issue is that all catch sampling undertaken as part of these surveys has taken place at boat ramps, where shore-based fishers and those fishing from charter boats, launches, and yachts are rarely encountered. Further, most surveys considered only weekend fishing, as there was a greater chance of encountering fishers on these days. Our understanding of the nature and extent of recreational fisheries in KAH 1, is therefore, relatively limited, more so given the lack of information on interannual variability in catch and effort.

There are two primary sources of information on the recreational fishery in KAH 1 which can be used to infer the degree to which catch sampling from this fishery has been representative. These are the most recent (and observationally obtained) harvest estimates for the KAH 1 fishery, and the monthly composition of catches landed at boat ramps during the four surveys since 1990–91, which spanned at least 6 months.

Seasonal and regional kahawai harvest estimates were generated as part of an aerial overflight survey of QMA 1 in 2004–05 (Hartill et al. 2007b) (Table 3). These estimates are for the catch from stationary fishing vessels only, and do not allow for the catch from the shore or from trolling (which were considered indirectly by Hartill et al.(2007b)). The summer season was defined as 1 December 2004 to 30 April 2005 (which is broadly similar to the 1 January to 30 April season used in this time series) and winter covered the period 1 May to 30 November 2005.

Table 3: Seasonal and regional estimates of the recreational harvest from stationary fishing vessels in KAH 1 in 2004–05.

	Summer	Winter	KAH 1
East Northland	45.7	14.2	59.9
Hauraki Gulf	36.1	36.2	72.3
Bay of Plenty	78.0	67.2	145.2
KAH 1	159.8	117.7	277.5

These estimates suggest that over half of the recreational harvest (by weight) was (and probably is) taken from the Bay of Plenty. The time series of catch data given in this report was taken over four of the five months of the calendar year which were used to define the summer season in Table 3. Therefore, if the regional and seasonal split of catch observed in 2004–05 is broadly indicative of that in other years, then the catch compositions given in this reported time series would account for about 75% of the annual harvest from East Northland, and about half of that taken in the Hauraki Gulf and the Bay of Plenty.

The second source of information which can be used to infer the representativeness of our sampling from the recreational fishery is historical data monthly catch compositions. These data can be used to determine whether the size composition of fish sampled between January and April reflects that landed during other times of the year (Figures 10, 11, and 12). Only four surveys in KAH 1 have sampled recreational landings over a period of at least six months. The number of kahawai measured collected during each survey month are given in Table 4. The length composition during sampled summer months differs from that seen in winter months only in East Northland, yet the results given

Table 4: The monthly number of kahawai measured during four large scale surveys in QMA 1 since 1990.

East Northland

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
1990–91	18	116	4	148	104	79	54	–	–	–	–	–
1995–96	12	76	105	267	356	134	53	16	28	7	–	15
1999–00	48	106	94	131	160	38	29	48	50	50	57	57
2004–05	48	168	172	281	372	17	56	40	26	12	46	34

Hauraki Gulf

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
1990–91	22	252	87	266	216	117	36	–	–	–	–	–
1995–96	–	43	59	63	232	146	103	54	23	19	5	8
1999–00	65	55	108	302	643	139	36	16	2	41	56	96
2004–05	36	156	37	51	357	17	60	34	18	14	69	85

Bay of Plenty

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
1990–91	148	560	110	1 229	893	642	175	78	–	–	–	–
1995–96	–	207	233	403	461	229	82	44	62	47	22	8
1999–00	379	532	537	648	698	275	160	136	271	119	103	77
2004–05	68	357	255	304	567	41	141	97	46	27	52	64

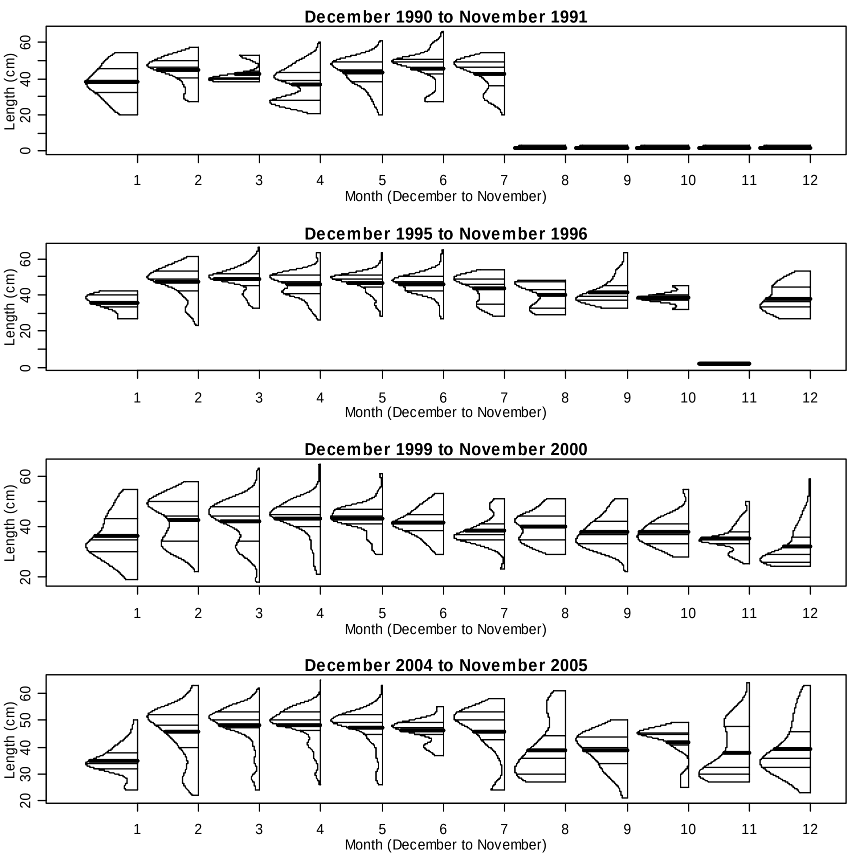


Figure 10: Monthly length composition of landings in East Northland.

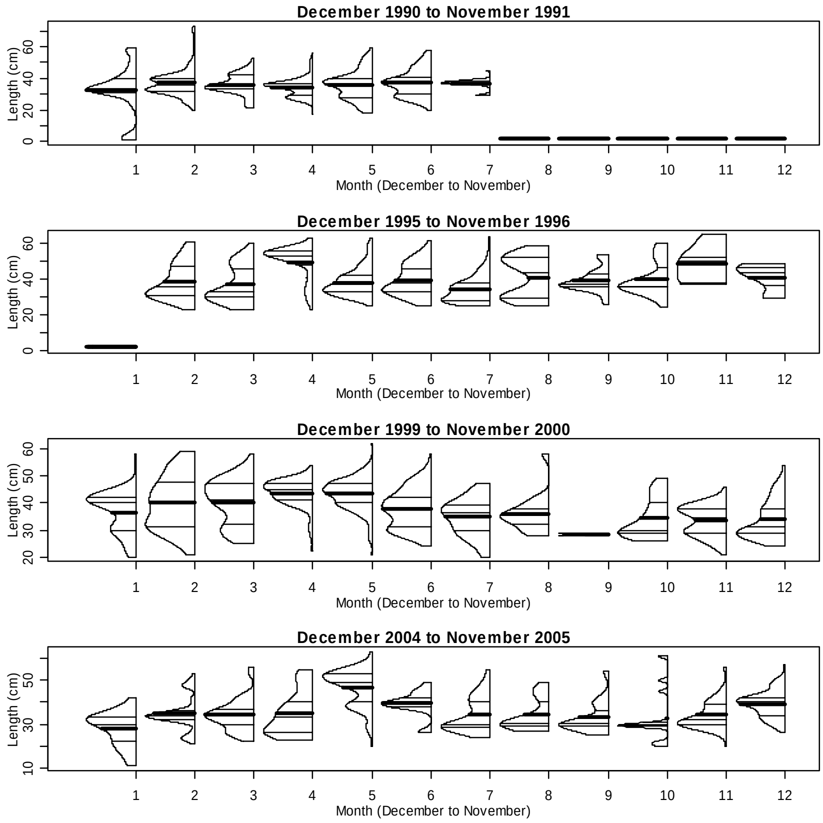


Figure 11: Monthly length composition of landings in Hauraki Gulf.

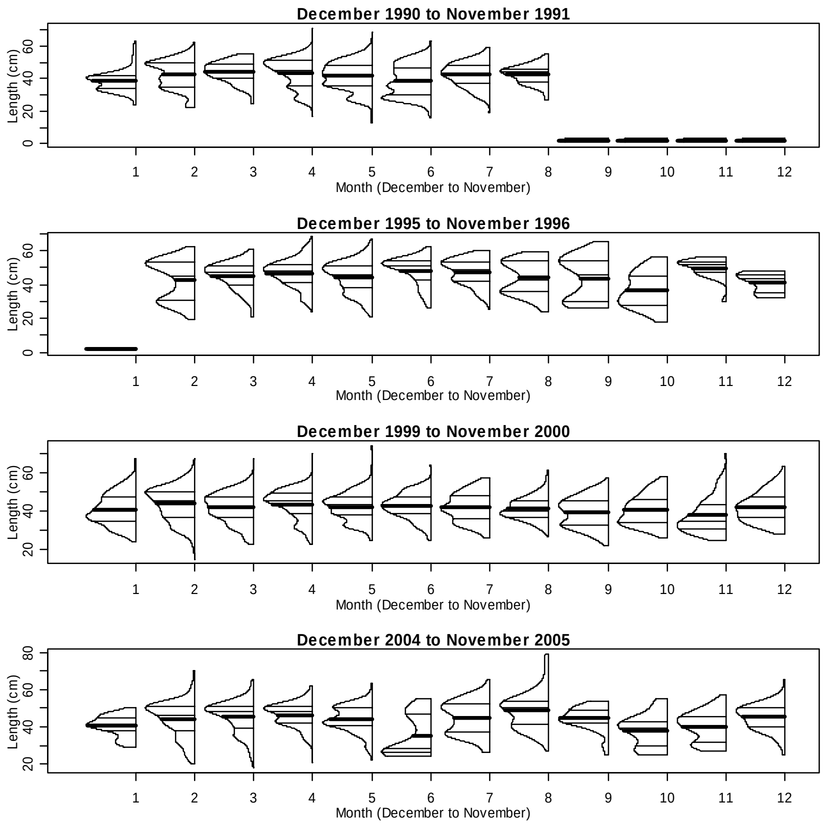


Figure 12: Monthly length composition of landings in Bay of Plenty.

in Table 4 suggest that the winter catch accounts for only about 25% of the annual landed catch in this area. This suggests, therefore, that the length structure of kahawai landed between January and April broadly reflects that landed during other times of the year.

3.5 Use of total mortality estimates to monitor stock status

The second objective of this programme was to examine the time series for indications of change in catch composition and stock status. One way of doing this is to monitor changes in annual estimates of total mortality (Z). Chapman & Robson (1960) estimates of Z were calculated for all the age distributions sampled from the East Northland and Bay of Plenty since 2000–01 (Table 5). Age distributions from the Hauraki Gulf were not considered, as this is essentially a juvenile fishery (see Figure 5) with recruitment, and 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.

Table 5: 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					
recruitment	2001	2002	2003	2004	2005	2006
3	0.33	0.33	0.32	0.28	0.24	0.28
4	0.34	0.38	0.35	0.31	0.28	0.32
5	0.30	0.37	0.39	0.33	0.33	0.35
6	0.30	0.40	0.41	0.38	0.36	0.41

Age at	Bay of Plenty					
recruitment	2001	2002	2003	2004	2005	2006
3	0.23	0.25	0.28	0.20	0.27	0.24
4	0.26	0.30	0.32	0.23	0.29	0.27
5	0.28	0.33	0.34	0.26	0.30	0.24
6	0.30	0.36	0.38	0.32	0.30	0.26

Interannual variability in these mortality rate estimates is an artefact of our ability to obtain a representative sample from the wider kahawai population via recreational landings. Kahawai are a relatively mobile inshore species, and it is unlikely that all size classes are equally and consistently vulnerable to the recreational fishery over time. Catch rates also fluctuate partially in response to these movements, and the variability surrounding these mortality estimates should be considered when they are used to monitor stock status. We assessed the variability associated with our estimates of total mortality via bootstrapped age distributions (Figure 13). Both catch curve and Chapman Robson estimates were calculated, and for the latter, the assumed age at recruitment was 4 years of age (Hartill & Walsh 2005). Both the East Northland and Bay of Plenty catch curve distributions suggest that there has been little consistent trend in total mortality over the period assessed, given the variability associated with these estimates. The Chapman Robson estimates tend to be more precise but have a greater degree of interannual variability than those calculated using the catch curve method. The bimodality seen in the 2007 Bay of Plenty distribution is due to the similar strengths of the 5 to 7 and 9 to 10 year old age classes, which will randomly dominate each other by chance in each bootstrap. Estimates taken from a single year should, therefore, be taken with great caution, although longer term averages can still be used to broadly monitor the fishery.

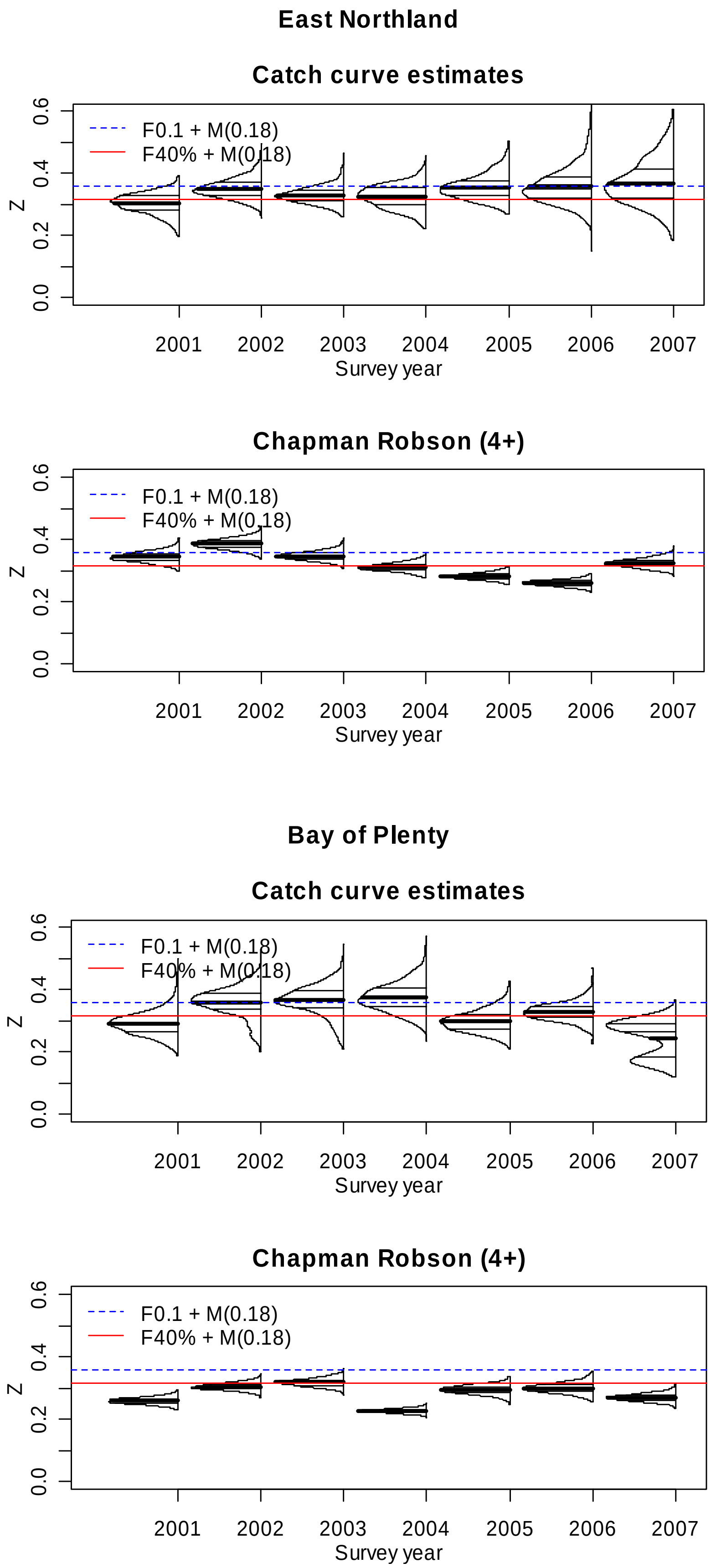


Figure 13: The distribution of bootstrap estimates of total mortality (Z) by survey year for East Northland (top two panels) and the Bay of Plenty (lower two panels). Theoretical optimal levels of Z derived from the YPR and SPR curves given in Figure 11 are denoted as horizontal line, for reference purposes.

Bootstrapped total mortality rate estimates were compared with optimal harvest rate estimates derived from Yield per Recruit and Spawner per Recruit (YPR/SPR) curves, to assess the status of observed levels of mortality, irrespective of any associated trend since the beginning of the time series in 2001. The YPR and SPR curves were generated from an age-structured assessment of the KAH 1 stock which was implemented in CASAL (Bull et al. 2005), in which M was assumed to be 0.18 and the annual recreational harvest was assumed to be 800 t (Hartill 2007) (Figure 14). These theoretical harvest rate estimates suggest that the current levels of total mortality generally do not exceed those which are considered optimal.

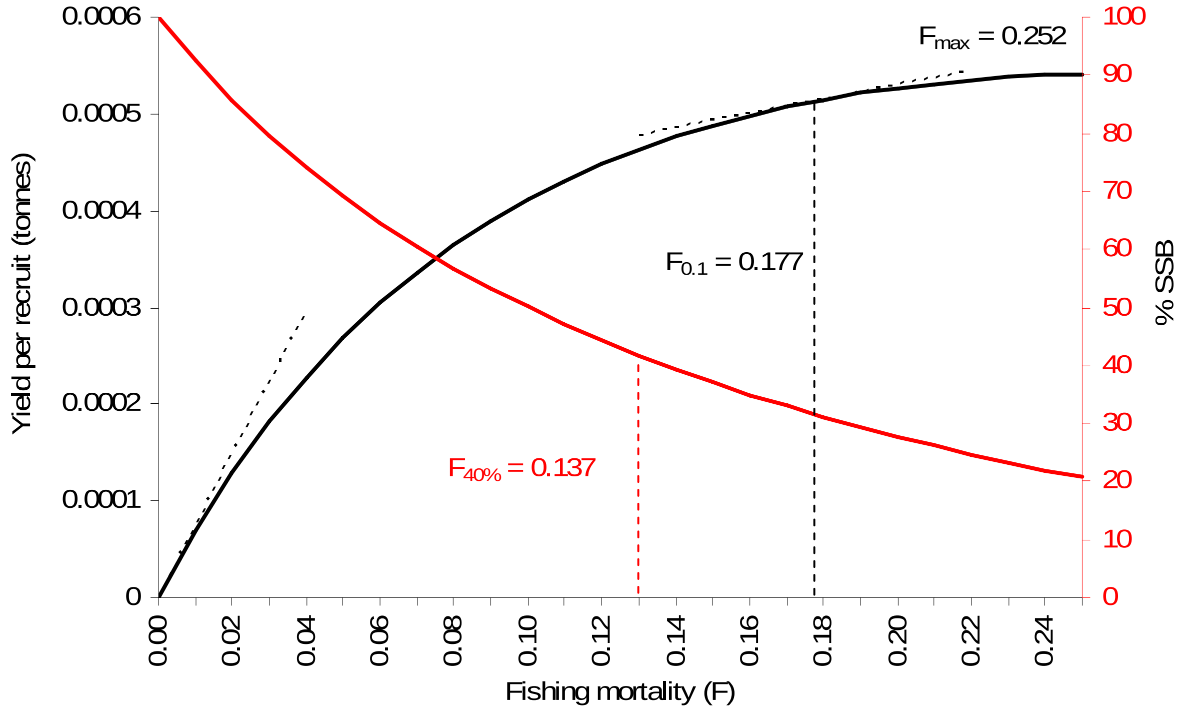


Figure 14: Yield per Recruit and Spawner per Recruit curves generated from a CASAL stock assessment where M was assumed to be 0.18 and the annual recreational harvest was assumed to be 800 t. The estimates of $F_{0.1}$ and $F_{40\%}$ given here were combined with an assumed M of 0.18 to generate optimal estimates of Z, which are plotted in Figure 10.

Comparing total mortality estimates with reference points derived from equilibrium based methods (such as YPR/SPR curves) is an inferior means of assessing stock status (relative to the recent integrated stock assessment). It is, however, a relatively quick and inexpensive means of fulfilling the overall objective of this programme, which can be used to monitor stock status between iterations of more formal stock assessments.

3.6 Trends in mean length-at-age

When age distributions for 2001 to 2005 were compared in 2006, the Pelagic Working Group noted that strong and weak year classes were not consistently evident, as is often seen with snapper. Estimates of mean length-at-age were compared through time to explore the potential for progressive ageing error. These comparisons suggested that estimates of mean length-at-age had increased through time in KAH 1, and NIWA was asked to examine this issue further.

Four explanations for an increase in mean length-at-age through time are:

- ageing error acting in a progressive fashion;
- progressive changes in temporal fishing or catch sampling intensity;
- a shift in behaviour (by fish or fishers) leading to a increasing vulnerability of larger fish;
- changing growth rates through time (as seen in snapper and bluefin tuna).

Progressively increasing mean length-at-age estimates were evident in both the final ages agreed by all three readers (Figure 15a), and in the initial readings recorded by the most experienced reader (who had read all sets across all five years) (Figure 15b). Readers are not given any indication of how big a fish is when they interpret an otolith. Nonetheless, progressive changes in apparent growth rates can take place when readers display a progressive tendency to under, or over, age fish through time. The potential for this progressive bias in ageing was explored by getting the most experienced reader to reread a random selection of otoliths from the five years in a random order, over a one week period. As before, this reader was given no indication of individual fish lengths when reading the otoliths set. Otoliths from the Bay of Plenty were used as the age structure in this region is broad. Only fish previously estimated to be between 2 to 8 years of age were considered to avoid the less commonly encountered age classes, which could have led to an unbalanced design. Otoliths were randomly selected from each year subject to the sample size allocations given in Table 6.

Table 6: Sample size allocations used for the random selection and comparison of otoliths used when testing an experienced reader for progressive ageing bias.

Previous age	Survey year				
estimate	2001	2002	2003	2004	2005
2	5	5	5	5	5
3	10	10	10	10	10
4	10	10	10	10	10
5	10	10	10	10	10
6	10	10	10	10	10
7	10	10	10	10	10
8	5	5	5	5	5

The results of this test are given in Figure 15c, and the generally progressive increase in mean length-at-age remains evident. This suggests that the trend observed in our time series is not an artefact of progressive ageing error (although the possibility of a progressively biased sampling of otoliths from the population remains a possibility which is explored below). Understandably, the reader took great care when reading this test set, as he was aware of its purpose. A comparison of the test set estimates with the original estimates recorded by that reader over the previous five years gives us an opportunity to examine how consistent he have been through time on an otolith by otolith basis. Age bias plots are given for the five years in Figure 16. The only year in which there is a detectable difference is in 2003, when the reader tended towards higher age estimates when reading the test set.

A second explanation for this progressive trend is that in the earlier years a greater proportion of the kahawai were encountered earlier on in the sampling season, and in later years they were more likely to have been collected in later months, when further growth will have occurred. A comparative plot of the cumulative rate at which kahawai were collected over each four month season (Figure 17) suggests that this was not the case.

A possible third explanation is that there has been a shift in fisher, or fish, behaviour leading to increased vulnerability of larger fish to the fishery through time. Information provided by fishers on the distance that they have fished from the shore suggests that there has been little change in the spatial distribution of

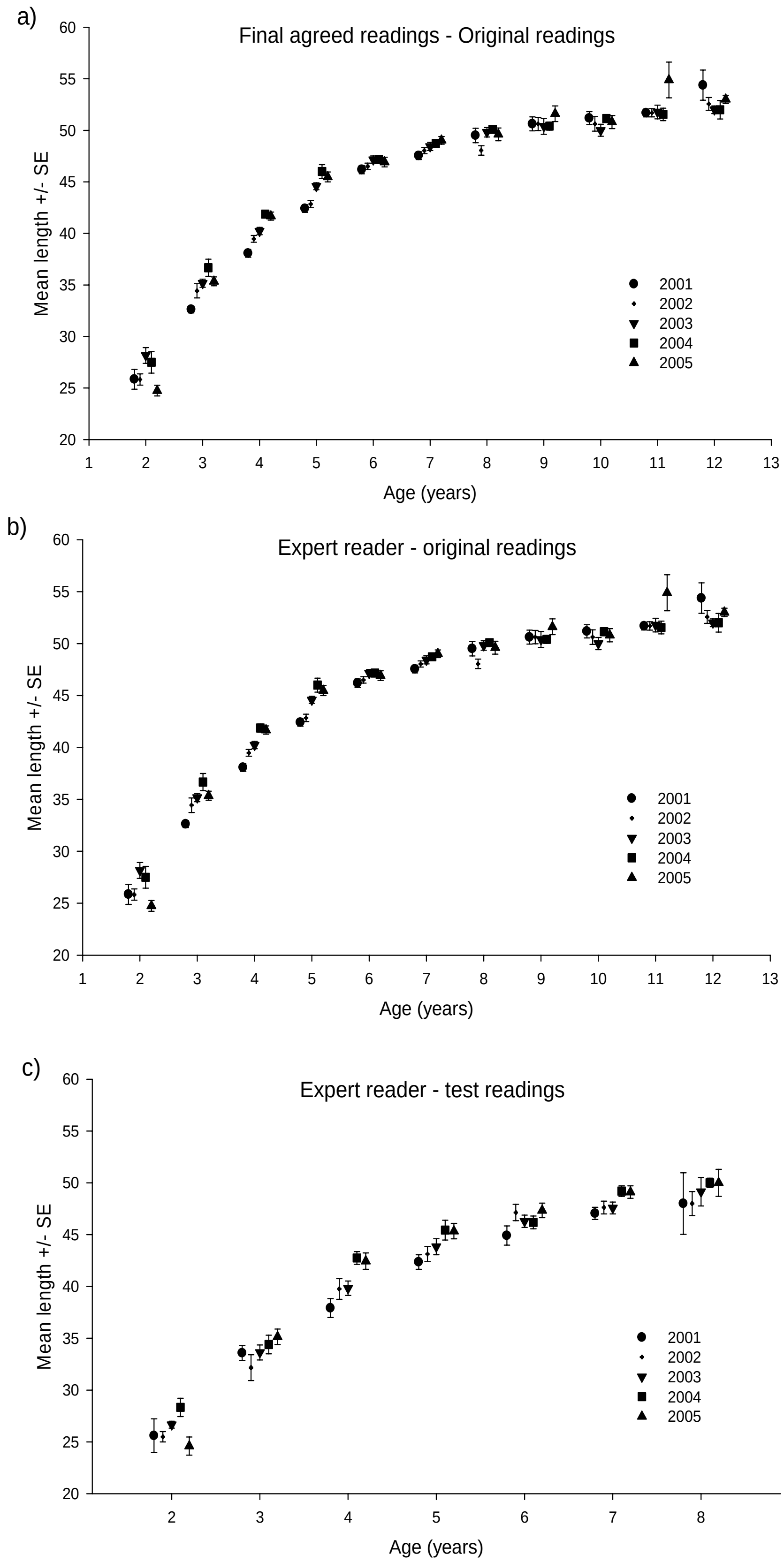


Figure 15: Comparison of mean length-at-age estimates based on a) the original ages agreed by all three readers, as read over a five year period, b) the original ages as estimated by the most experienced reader, as read over a five year period, and c) readings by the most experienced reader when they read a random selection of otoliths from all five years but in a random order over a one week period.

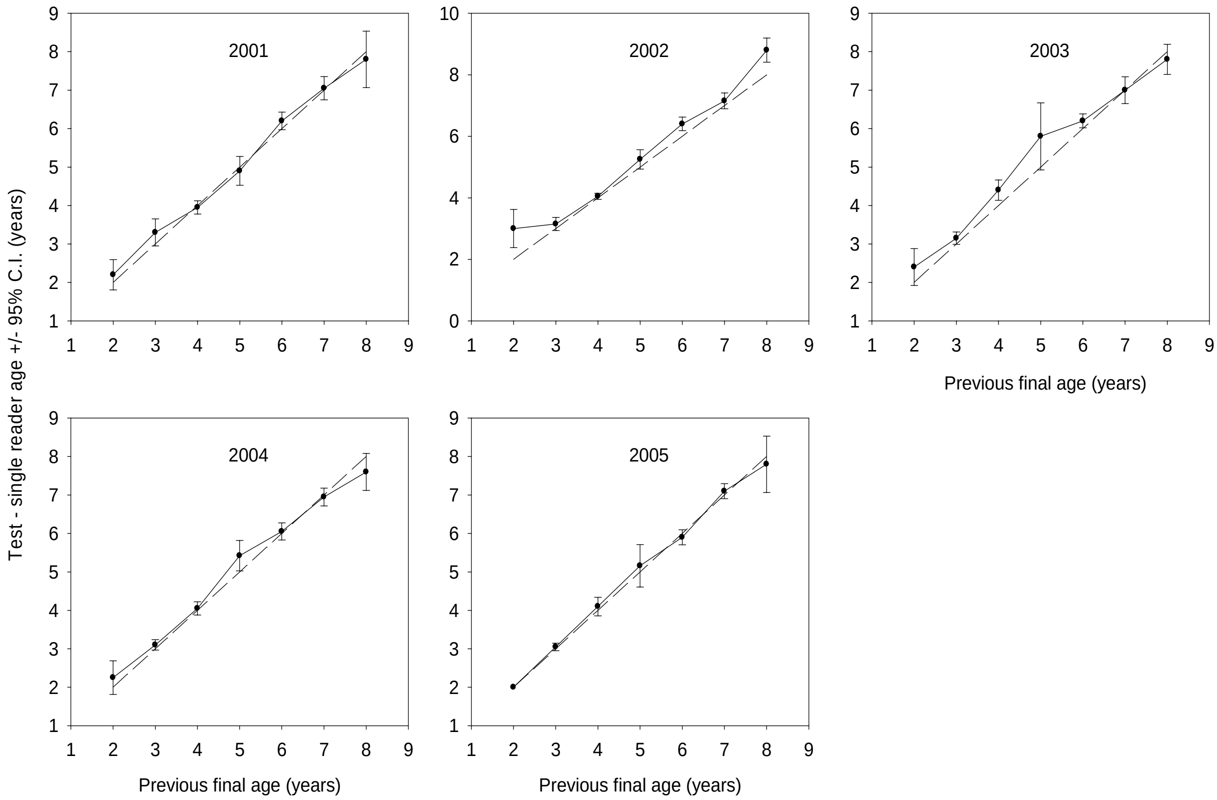


Figure 16: Age bias plots comparing the original age estimates recorded by the most experienced otolith reader with those they reread the five year test set selection over a one week period.

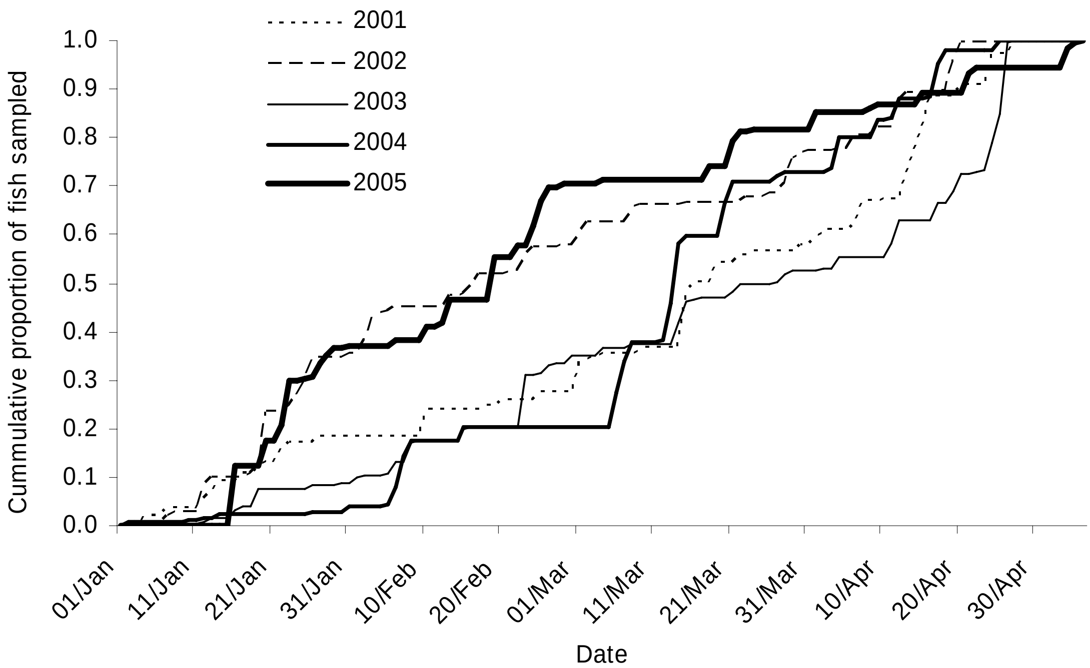


Figure 17: Comparison of relative rate at which kahawai were sampled from recreational landings in the Bay of Plenty over each four month season.

their effort over the time assessed (Figures 4 & 9). There is some evidence for a trend towards larger fish being landed in East Northland (see Figure 2), but this is not evident in the Bay of Plenty (see Figure 7).

It is, therefore, likely that growth rates are not constant through time, although the environmental drivers behind this are not clear. There is no reason to assume that growth rates should remain constant, although this is usually assumed to be the case. Dynamic growth rates have also been observed in the sampling time series for snapper, a species which is among the easiest to age (Davies et al. 2003).

3.7 Precision relative to the level of stratification

The levels of precision routinely achieved during these sampling programmes are well within the target mwcv of 0.30. It has been suggested, however, that the generated precision estimates do not reflect the true variance that should be expected from catch sampling programmes of this nature. During a previous exploration of auto-correlation in the mean length of kahawai landed by vessels (there wasn't any) it was suggested that we should stratify by boat ramp session rather than by vessel, which would in effect reduce the number of strata and increase the mwcv estimate. Precision estimates calculated for vessel and ramp session stratified data sets are compared in Figure 18. The difference in the degree of precision is negligible. This is because most of the variance is driven by the common age-length key which was applied to both forms of stratified data, and that, in many cases, only one vessel landing kahawai will be encountered during a ramp interview session. The incidence of boats landing kahawai during each boat ramp interview session is highest in the Bay of Plenty (Table 7).

Table 7: The percentage of boats landing kahawai during a boat ramp interview session in 2006–2007 by region.

	Percentage of Boats						
Region	1	2	3	4	5	6	6+
East Northland	36	20	15	11	6	6	5
Hauraki Gulf	41	14	18	13	6	3	6
Bay of Plenty	23	13	10	11	10	8	25

4. CONCLUSIONS

- Regional length and age compositions derived from recreational landings sampled in 2006–07 are broadly consistent with patterns and trends seen in previous years.
- The levels of precision associated with these distributions are well within the target level.
- The East Northland age distribution is broadly dominated once again by 3 to 7 year old fish.
- Most of the kahawai landed in the Hauraki Gulf by recreational fishers in 2006–07 were 3 and 4 year olds, with the latter dominating for the first time since 2000–01. This appears to be a particularly strong year class.
- The Bay of Plenty age distribution remains typically broad, but is atypically dominated by the 4 year old age class, which was particularly strong in the Hauraki Gulf in the previous year.
- An examination of monthly length frequency distributions from long-term boat ramp surveys suggests that the size composition of fish measured during surveys in this time series broadly reflects that landed during other times of the year. The only exception is in East Northland,

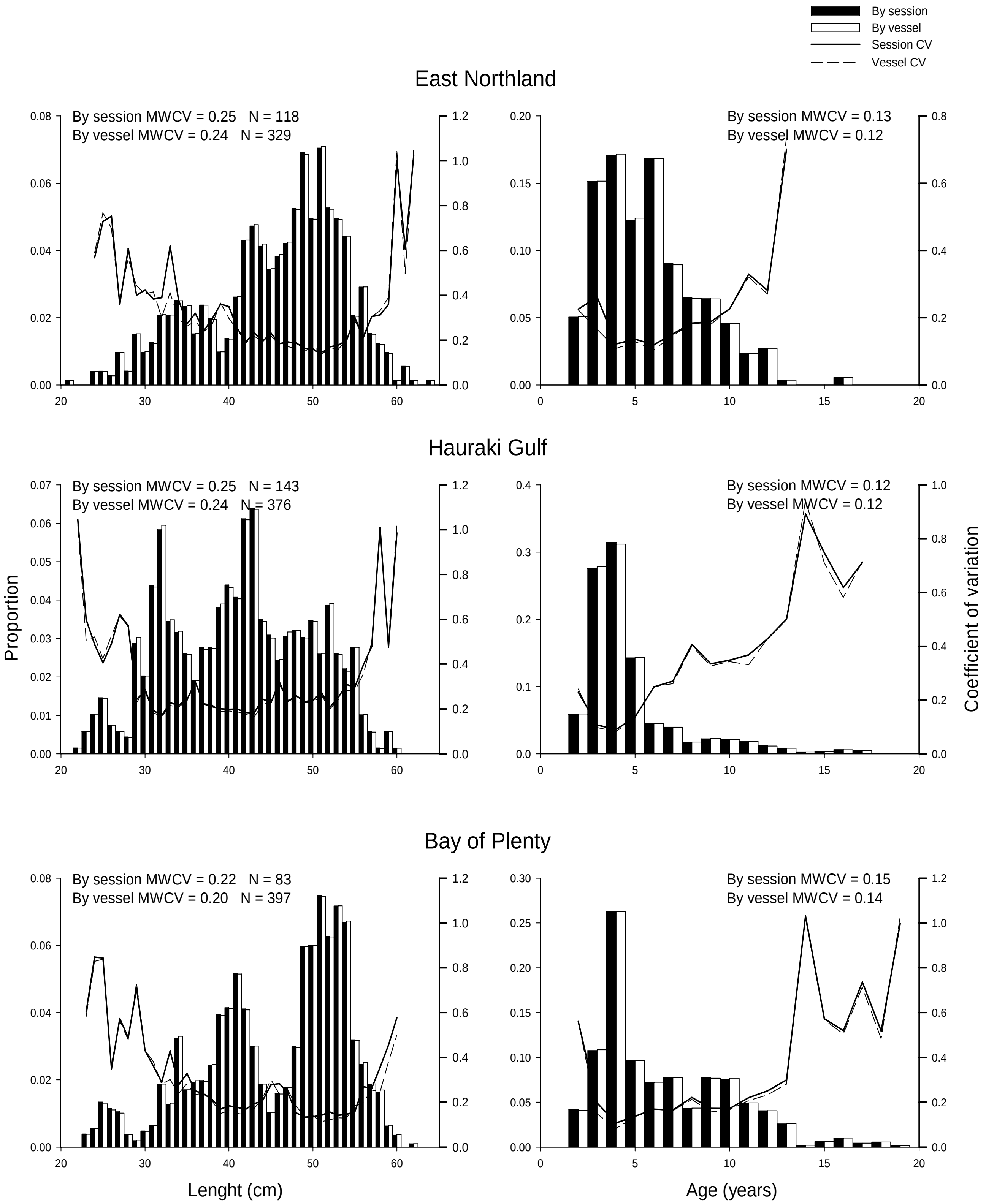


Figure 18: Comparison of estimates of precision associated with length and age data stratified both by vessel and by boat ramp session, for East Northland, the Hauraki Gulf and the Bay of Plenty. N is the number of strata associated which each form of stratification.

although a recent recreational harvest survey suggests that most of the harvest landed in the region is taken during the four months we surveyed.

- Total mortality estimates are relatively constant through time, and do not generally exceed those which yield per recruit and spawner per recruit analyses suggest are theoretically optimal.

- Trends in increasing mean length-at-age appear to be real, and not an artefact of ageing error, changes in the timing of catch sampling, or changes in fish/fisher behaviour. The latter always remains a possibility, however.

- Levels of precision associated with two levels of stratification were compared at the vessel level and at the ramp interview session level. There is very little difference in the levels of precision achieved and in we will continue to stratify at the vessel level.

5. ACKNOWLEDGMENTS

We thank the numerous boat ramp interviewers, most of whom took part in all three surveys. Funding for this project, KAH2006/02, was provided by the Ministry of Fisheries.

6. REFERENCES

Armiger, H.; Hartill, B.; Tasker, R.; Smith, M.; Griggs, L. (2006). 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 2006/57*. 37 p.

Bradford, E. (1998). 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.

Bull, B.; Francis, R.I.C.C.; Dunn, A.; McKenzie, A.; Gilbert, D.J.; Smith, M.H. (2005). CASAL (C++ algorithmic stock assessment laboratory): CASAL User Manual v2.07-2005/08/21. *NIWA Technical Report 127*. 227 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.

Hartill, B. (2007). Assessment of the KAH 1 stock for 2006. Draft Final Research Report for Ministry of Fisheries project KAH200501 Objectives 2 & 3. 33 p. (Unpublished report held by MFish, Wellington.)

Hartill, B.; Armiger, H.; Tasker, R.; Middleton, C.; Fisher, D. (2007a). Monitoring the length and age composition of recreational landings of kahawai in KAH 1 in 2000–01, 2001–02 and 2002–03. *New Zealand Fisheries Assessment Report 2007/6*. 38 p.

Hartill, B.; Bian, R.; Armiger, H.; Vaughan, M.; Rush, N. (2007b). Recreational marine harvest estimates of snapper, kahawai and kingfish in QMA 1 in 2004–05. *New Zealand Fisheries Assessment Report 2007/26*. 44 p.

Hartill, B.; Smith, M.; Rush, N.; Vaughan, M.; Armiger, H. (2007c). Length and age composition of recreational landings of kahawai in KAH 1 from January to April 2005–06. *New Zealand Fisheries Assessment Report 2007/28*. 29 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 Project KAH2004/01 160 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.

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 by Ministry of Fisheries, Auckland.)

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 2006–07

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 2006–07

Length	2006–07	
(cm)	*P.i.*	c.v.
10	0.0000	0.00
11	0.0000	0.00
12	0.0000	0.00
13	0.0000	0.00
14	0.0000	0.00
15	0.0000	0.00
16	0.0000	0.00
17	0.0000	0.00
18	0.0000	0.00
19	0.0000	0.00
20	0.0000	0.00
21	0.0014	1.00
22	0.0000	0.00
23	0.0000	0.00
24	0.0041	0.58
25	0.0041	0.75
26	0.0028	0.71
27	0.0097	0.38
28	0.0041	0.58
29	0.0152	0.43
30	0.0097	0.42
31	0.0124	0.40
32	0.0207	0.29
33	0.0207	0.41
34	0.0249	0.30
35	0.0235	0.26
36	0.0152	0.29
37	0.0235	0.24
38	0.0193	0.28
39	0.0097	0.38
40	0.0138	0.31
41	0.0262	0.25
42	0.0428	0.19
43	0.0470	0.21
44	0.0414	0.19
45	0.0345	0.22
46	0.0387	0.18
47	0.0428	0.17
48	0.0525	0.16
49	0.0691	0.15
50	0.0497	0.17
51	0.0704	0.15
52	0.0525	0.17
53	0.0497	0.16
54	0.0442	0.20
55	0.0207	0.28
56	0.0290	0.22
57	0.0152	0.30
58	0.0124	0.33
59	0.0097	0.38
60	0.0014	1.00
61	0.0055	0.50
62	0.0014	1.00
63	0.0000	0.00
64	0.0014	1.00
65	0.0000	0.00
66	0.0000	0.00
67	0.0028	0.71
68	0.0014	1.00
69	0.0000	0.00
70	0.0000	0.00
n	724	
m.w.c.v.		0.23

Appendix 1 – continued:
Estimates of the proportion at length of kahawai from the Hauraki Gulf in 2006–07

Length	2006–07	
(cm)	*P.i.*	c.v.
10	0.0000	0.00
11	0.0000	0.00
12	0.0000	0.00
13	0.0000	0.00
14	0.0000	0.00
15	0.0000	0.00
16	0.0000	0.00
17	0.0000	0.00
18	0.0016	1.00
19	0.0000	0.00
20	0.0000	0.00
21	0.0000	0.00
22	0.0000	0.00
23	0.0032	0.71
24	0.0112	0.51
25	0.0144	0.45
26	0.0064	0.61
27	0.0064	0.61
28	0.0032	0.71
29	0.0256	0.25
30	0.0224	0.28
31	0.0465	0.19
32	0.0561	0.18
33	0.0385	0.22
34	0.0337	0.22
35	0.0272	0.24
36	0.0160	0.38
37	0.0272	0.24
38	0.0272	0.23
39	0.0337	0.21
40	0.0481	0.19
41	0.0417	0.19
42	0.0625	0.17
43	0.0657	0.17
44	0.0321	0.24
45	0.0304	0.26
46	0.0272	0.31
47	0.0288	0.26
48	0.0304	0.25
49	0.0304	0.24
50	0.0353	0.23
51	0.0240	0.29
52	0.0417	0.19
53	0.0272	0.25
54	0.0240	0.29
55	0.0256	0.30
56	0.0096	0.41
57	0.0048	0.58
58	0.0016	1.00
59	0.0064	0.49
60	0.0016	1.00
61	0.0000	0.00
62	0.0000	0.00
63	0.0000	0.00
64	0.0000	0.00
65	0.0000	0.00
66	0.0000	0.00
67	0.0000	0.00
68	0.0000	0.00
69	0.0000	0.00
70	0.0000	0.00
n	624	
m.w.c.v.		0.25

Appendix 1 – continued:
Estimates of the proportion at length of kahawai from the Bay of Plenty in 2006–07

Length	2006–07	
(cm)	*P.i.*	c.v.
10	0.0000	0.00
11	0.0000	0.00
12	0.0000	0.00
13	0.0000	0.00
14	0.0000	0.00
15	0.0000	0.00
16	0.0000	0.00
17	0.0000	0.00
18	0.0000	0.00
19	0.0000	0.00
20	0.0000	0.00
21	0.0000	0.00
22	0.0000	0.00
23	0.0038	0.61
24	0.0057	0.83
25	0.0019	0.71
26	0.0113	0.36
27	0.0104	0.57
28	0.0038	0.48
29	0.0019	0.71
30	0.0047	0.44
31	0.0066	0.38
32	0.0189	0.29
33	0.0132	0.31
34	0.0331	0.24
35	0.0170	0.28
36	0.0198	0.23
37	0.0198	0.24
38	0.0246	0.20
39	0.0397	0.15
40	0.0415	0.16
41	0.0519	0.15
42	0.0415	0.15
43	0.0302	0.18
44	0.0189	0.22
45	0.0104	0.30
46	0.0161	0.24
47	0.0179	0.24
48	0.0302	0.18
49	0.0604	0.13
50	0.0604	0.14
51	0.0755	0.12
52	0.0633	0.12
53	0.0727	0.13
54	0.0680	0.12
55	0.0321	0.18
56	0.0255	0.19
57	0.0189	0.25
58	0.0170	0.24
59	0.0066	0.38
60	0.0038	0.50
61	0.0000	0.00
62	0.0009	1.00
63	0.0000	0.00
64	0.0000	0.00
65	0.0000	0.00
66	0.0000	0.00
67	0.0000	0.00
68	0.0000	0.00
69	0.0000	0.00
70	0.0000	0.00
n	1059	
m.w.c.v.		0.19

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 2006–07.

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 2006–07.

Age	2006–07	
(years)	*P.j.*	c.v.
1	0.0000	0.00
2	0.0506	0.16
3	0.1506	0.09
4	0.1700	0.09
5	0.1229	0.12
6	0.1693	0.10
7	0.0911	0.14
8	0.0645	0.18
9	0.0642	0.18
10	0.0458	0.24
11	0.0235	0.34
12	0.0274	0.26
13	0.0036	0.73
14	0.0000	0.00
15	0.0000	0.00
16	0.0057	0.81
17	0.0000	0.00
18	0.0000	0.00
19	0.0000	0.00
>19	0.0000	0.00
n	471	
m.w.c.v.		0.14

Estimates of the proportion at age of kahawai from the Hauraki Gulf in 2006–07.

Age	2006–07	
(years)	*P.j.*	c.v.
1	0.0000	0.00
2	0.0545	0.17
3	0.2795	0.06
4	0.3156	0.06
5	0.1420	0.13
6	0.0459	0.25
7	0.0396	0.25
8	0.0176	0.39
9	0.0228	0.32
10	0.0216	0.33
11	0.0179	0.34
12	0.0119	0.41
13	0.0085	0.51
14	0.0032	1.12
15	0.0035	0.79
16	0.0056	0.60
17	0.0054	0.78
18	0.0000	0.00
19	0.0000	0.00
>19	0.0000	0.00
n	398	
m.w.c.v.		0.14

Appendix 2 – continued:
Estimates of the proportion at age of kahawai from the Bay of Plenty in 2006–07.

Age	2006–07	
(years)	*P.j.*	c.v.
1	0.0000	0.00
2	0.0305	0.19
3	0.1090	0.10
4	0.2658	0.06
5	0.0977	0.13
6	0.0731	0.16
7	0.0779	0.15
8	0.0442	0.21
9	0.0781	0.15
10	0.0770	0.16
11	0.0497	0.21
12	0.0411	0.23
13	0.0263	0.29
14	0.0021	1.01
15	0.0061	0.58
16	0.0096	0.52
17	0.0043	0.73
18	0.0057	0.48
19	0.0019	1.02
>19	0.0000	0.00
n	472	
m.w.c.v.		0.15

Appendix 3: Age–length keys derived from otolith samples collected from recreational fishers from East Northland in 2006–07.

Estimates of proportion of length at age for kahawai sampled from the East Northland recreational fishery, January to April 2007. (Note: Aged to 01/01/07)

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	1
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	3
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	1
27	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
28	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
29	0	0.80	0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
30	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
31	0	0.20	0.80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
32	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
33	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
34	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
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	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
37	0	0	0.90	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
38	0	0	0.43	0.57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
39	0	0	0.33	0.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
40	0	0	0.14	0.86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
41	0	0	0	0.88	0.06	0.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
42	0	0	0	0.80	0.15	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
43	0	0	0	0.80	0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
44	0	0	0	0.62	0.19	0.10	0.05	0	0.05	0	0	0	0	0	0	0	0	0	0	0	21
45	0	0	0	0.19	0.43	0.33	0	0.05	0	0	0	0	0	0	0	0	0	0	0	0	21
46	0	0	0	0.12	0.47	0.18	0.12	0.06	0.06	0	0	0	0	0	0	0	0	0	0	0	17
47	0	0	0	0.11	0.44	0.33	0	0	0.06	0	0.06	0	0	0	0	0	0	0	0	0	18
48	0	0	0	0	0.42	0.29	0.21	0.04	0.04	0	0	0	0	0	0	0	0	0	0	0	24
49	0	0	0	0	0.24	0.29	0.27	0.12	0.02	0.05	0	0	0	0	0	0	0	0	0	0	41
50	0	0	0	0	0	0.71	0.05	0.14	0.05	0	0	0.05	0	0	0	0	0	0	0	0	21
51	0	0	0	0	0.06	0.38	0.19	0.19	0.13	0.06	0	0	0	0	0	0	0	0	0	0	32
52	0	0	0	0	0.05	0.27	0.23	0.05	0.18	0.09	0.09	0.05	0	0	0	0	0	0	0	0	22
53	0	0	0	0	0	0.13	0.25	0.13	0.19	0.09	0.06	0.09	0.03	0	0	0.03	0	0	0	0	32
54	0	0	0	0	0	0.10	0.19	0.19	0.29	0.10	0.14	0	0	0	0	0	0	0	0	0	21
55	0	0	0	0	0	0.13	0.13	0.13	0.25	0.25	0	0.13	0	0	0	0	0	0	0	0	8
56	0	0	0	0	0	0.14	0.14	0.07	0.07	0.29	0.07	0.14	0.07	0	0	0	0	0	0	0	14
57	0	0	0	0	0	0	0	0.25	0.25	0.13	0	0.38	0	0	0	0	0	0	0	0	8
58	0	0	0	0	0	0	0	0.33	0	0.33	0	0	0	0	0	0.33	0	0	0	0	3
59	0	0	0	0	0	0	0	0	0	0.50	0.50	0	0	0	0	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	1.00	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																					471

Appendix 4: Age–length keys derived from otolith samples collected from recreational fishers from the Hauraki Gulf in 2006–07.

Estimates of proportion of length at age for kahawai sampled from the Hauraki Gulf recreational fishery, January to April 2007 (Note: Aged to 01/01/07)

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	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
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	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	1
29	0	0.38	0.63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
30	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
31	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
32	0	0	0.91	0.09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
33	0	0	0.93	0.07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
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	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
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	0.50	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
38	0	0	0.33	0.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
39	0	0	0.16	0.84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
40	0	0	0.05	0.91	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
41	0	0	0	0.95	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
42	0	0	0.05	0.86	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
43	0	0	0	0.86	0.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29
44	0	0	0	0.64	0.36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
45	0	0	0	0.50	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
46	0	0	0	0.20	0.60	0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
47	0	0	0	0.08	0.83	0.08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
48	0	0	0	0.13	0.50	0.13	0.13	0.13	0	0	0	0	0	0	0	0	0	0	0	0	8
49	0	0	0	0	0.33	0.11	0.33	0	0.11	0.11	0	0	0	0	0	0	0	0	0	0	9
50	0	0	0	0.06	0.18	0.41	0	0.12	0.12	0	0.06	0	0.06	0	0	0	0	0	0	0	17
51	0	0	0	0.11	0.22	0.22	0.33	0.11	0	0	0	0	0	0	0	0	0	0	0	0	9
52	0	0	0	0	0.29	0.06	0.18	0.12	0.24	0.06	0	0	0.06	0	0	0	0	0	0	0	17
53	0	0	0	0	0.08	0.15	0.23	0.08	0	0.23	0.08	0.15	0	0	0	0	0	0	0	0	13
54	0	0	0	0	0.09	0.18	0.09	0	0	0.09	0.27	0.09	0.09	0	0	0	0.09	0	0	0	11
55	0	0	0	0	0.07	0	0.07	0	0.21	0.07	0.14	0.21	0.07	0	0	0.14	0	0	0	0	14
56	0	0	0	0	0	0	0	0	0	0.40	0.20	0	0	0	0.20	0.20	0	0	0	0	5
57	0	0	0	0	0	0	0	0	0	0.33	0.33	0	0	0	0.33	0	0	0	0	0	3
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	0	0.50	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	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																					398

Appendix 5: Age–length keys derived from otolith samples collected from recreational fishers from the Bay of Plenty in 2006–07.

Estimates of proportion of length at age for kahawai sampled from the Bay of Plenty recreational fishery, January to April 2007 (Note: Aged to 01/01/07)

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	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	1
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	0.83	0.17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
27	0	0.75	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
28	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
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	2
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	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
33	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
34	0	0	0.90	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
35	0	0	0.60	0.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
36	0	0	0.56	0.44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
37	0	0	0.25	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
38	0	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
39	0	0	0.04	0.89	0.07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
40	0	0	0	0.89	0.11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
41	0	0	0	0.88	0.12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17
42	0	0	0	0.87	0.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23
43	0	0	0	0.82	0.09	0.09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
44	0	0	0	0.82	0.09	0.09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
45	0	0	0	0.75	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
46	0	0	0	0.10	0.60	0	0.10	0	0.10	0.10	0	0	0	0	0	0	0	0	0	0	10
47	0	0	0	0.20	0.60	0	0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	10
48	0	0	0	0	0.63	0.19	0	0.06	0.06	0	0.06	0	0	0	0	0	0	0	0	0	16
49	0	0	0	0	0.34	0.14	0.31	0	0.03	0.03	0.03	0.03	0.07	0	0	0	0	0	0	0	29
50	0	0	0	0	0.03	0.24	0.29	0	0.09	0.18	0.03	0.06	0.06	0	0.03	0	0	0	0	0	34
51	0	0	0	0	0.10	0.23	0.13	0.10	0.10	0.15	0.10	0.05	0.03	0	0	0	0	0	0	0	39
52	0	0	0	0	0.03	0.16	0.10	0.23	0.16	0.13	0.06	0.06	0.03	0	0	0.03	0	0	0	0	31
53	0	0	0	0	0	0.06	0.06	0.25	0.19	0.16	0.09	0.09	0.06	0	0.03	0	0	0	0	0	32
54	0	0	0	0	0	0.12	0.09	0.03	0.18	0.21	0.15	0.12	0.03	0.03	0.03	0	0	0	0	0	33
55	0	0	0	0	0	0	0.20	0	0.40	0.10	0.10	0.10	0	0	0	0.10	0	0	0	0	10
56	0	0	0	0	0	0	0.13	0	0	0.38	0.13	0.25	0.13	0	0	0	0	0	0	0	8
57	0	0	0	0	0	0	0	0	0.20	0.10	0.20	0.10	0	0	0	0.10	0.10	0.10	0.10	0	10
58	0	0	0	0	0	0	0	0	0	0.14	0.29	0	0.29	0	0	0.14	0.14	0	0	0	7
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	1.00	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	1.00	0	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																					472