NIWA

Taihoro Nukurangi

Length and age composition of recreational landings of kahawai in KAH 1 in 2000–01 and 2001–02

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Final Research Report for
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Objective 1 – 2001 and 2002 seasons

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7. **Executive Summary:**

Recreational landings of schooling species such as kahawai provide a better description of the underlying population structure than commercial landings due to the widespread and comparatively random nature of recreational fishing effort. This report summarises the results of the first two years of sampling of recreational catches of kahawai in 2000–01 and 2001–02, from three regions in KAH 1: East Northland, Hauraki Gulf and the Bay of Plenty, and is essentially an update of the Final Research Report from the previous season (Hartill et al. 2001).

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 boatramp data, and there appears to have been a subsequent decrease the number of kahawai landed per hour of interviewing. It is not clear whether this is due to a reduction in overall fishing effort and/or reduced kahawai catch rates by recreational fishers. Anecdotal evidence also suggests that kahawai catch rates have fallen in recent years. While fewer kahawai than recommended have consequently been measured, analytically derived mean weighted c.v.s suggest that the length and age compositions of the regional populations have been described with reasonable precision.

There are clear regional differences in the length and age compositions of recreational catches of kahawai sampled in 2000–01 and 2001–02. The Hauraki Gulf population was largely comprised of relatively small, younger fish, with the East Northland region having a broader length distribution which was dominated by fish of less than 6 years of age, while the Bay of Plenty 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.

Spatial or temporal trends were evident in regional age distributions but no consistent trend is evident across the whole of KAH 1. In East Northland the mean age of kahawai landed by recreational fishers increased throughout the four months sampled and this may be indicative of onshore movement by schools of older fish. In the Hauraki Gulf, the age distribution of kahawai landed by recreational fishers increased as autumn progressed. In the Bay of Plenty, in 2000–01, there was a marked longitudinal trend in the age distributions of kahawai landed at boat ramps, with the older age classes becoming increasing prevalent in the east, but this trend was not evident in 2001–02. The boundaries between these regions are arbitrary however, with the age distributions of the northern ramps in the Hauraki Gulf and Bay of Plenty showing some similarity to those in southern East Northland. Recreational fishers are also more likely to sample from inshore schools than those found in deeper offshore waters. The relationship between the size and abundance of kahawai landed with respect to estimates of the distance offshore, by month, was investigated using data from East Northland and the Bay of Plenty.

8. Objective:

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.

9. Methods:

Previous surveys

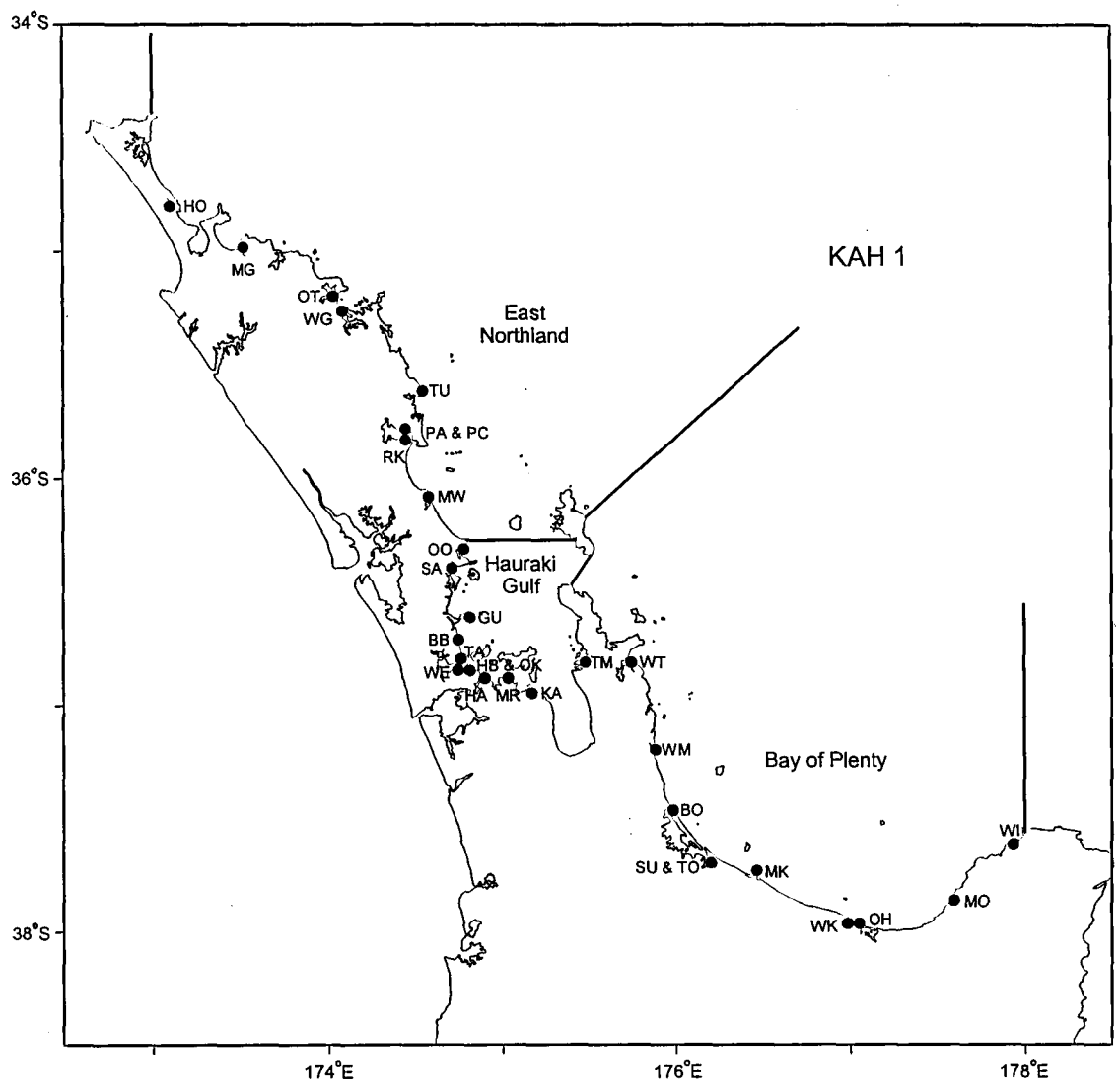
In 1991 a survey was designed to collect baseline information on harvest rates by recreational fishers interviewed at boat ramps throughout the Auckland Fisheries Management Area (AFMA). Most interviewing occurred at weekends and the survey went from Boxing Day 1990 to June 1991 (Sylvester 1993). The main objective of a survey in 1994 was to verify aspects of a concurrent diary survey. Catches observed from boat ramp interviews were compared with those reported by diarists. Boat ramp data were also used in conjunction with an aerial survey to estimate harvest from the Hauraki Gulf. This estimate was compared with that 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 caught to provide estimates of the national recreational harvest of key species (Bradford 1998).

Sample design

The sample design for the 2000–01 and 2001–02 surveys were based on data collected from boat ramp surveys conducted in 1991, 1994, and 1996. Although similar questions were asked in these early surveys, and there was little change in the ramps used, the objectives and sample designs were different.

The 1991, 1994, and 1996 surveys indicated that there were substantive regional differences in the length frequency compositions of kahawai caught by recreational fishers in East Northland, Hauraki Gulf and the Bay of Plenty (Bradford 1999, Hartill et al. 1998). Separate recreational boat ramp surveys were therefore conducted in each of these three regions

(Figure 1), from which concurrent length and age samples were collected from recreational landings of kahawai.



East Northland

HO Houhora
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

BB Browns Bay
GU Gulf Harbour
HA Half Moon Bay
HB Hobson Bay
KA Kawakawa
MR Maretai
OK Okahu Bay
OO Omaha
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
TO Toll Bridge, Tauranga
WI Waihau Bay
WK Whakatane
WM Whangamata
WT Whitianga

Figure 1: Location of Boatramp interview sites.

To minimise the "blurring" of length distributions due to growth, sampling of recreation catches was restricted to a four month season, 1 January to 30 April 2001. Sampling therefore ceased before winter, when otolith ring deposition occurs, which potentially leads to misinterpretation of a fish's age (Stevens & Kalish 1998), and coincides with the peak season for recreational kahawai catch rates in KAH 1. Sampling took place on weekends and holidays when most recreational fishing usually occurs. The 1996 boatramp survey indicated 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 be aged to give a reasonable approximation of a population's age structure and age-length relationship, but suggested that as many fish as possible should be measured to provide a reliable length frequency distribution. The recommended number of kahawai required to describe a regional length frequency was thought to be approximately 1500 (E. Bradford *pers comm.*), although there is no analytical basis for this estimate. The sample design used in 2000–01 and 2001–02 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 boatramp surveys (Table 1).

Table 1: Sample design required to obtain measurements of 1500 kahawai per region in 2000–01 and 2001–02 based on the average number of kahawai landed by recreational fishers per hour during weekends and holidays during the 1991, 1994 and 1996 boatramp 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	1558
Hauraki Gulf	1.1	11	6	21	1553
Bay of Plenty	3.5	9	4	12	1498

The regional averages of the number of fish landed per hour of interviewing are weighted averages across survey years, where the weighting is based on the number of weekend or holiday hours of interviewing which took place in each survey year.

Sampling sessions at each ramp were randomly pre-assigned to weekend/holiday days between 1 January and 30 April before sampling began. Interviews followed the format of those undertaken in 1991, 1994 and 1996 to ensure that the data were consistent with those from previous surveys. During interview sessions, recreational fishers who had not caught kahawai were also interviewed when this did not interfere with interviewing of other fishers landing kahawai. All data not involving catches of kahawai were stored but not checked for errors or entered into the database as this was not an objective of this study. These data may be useful for other purposes in the future and there was no additional cost in their collection. When more than one boat approached a ramp, the vessel was chosen randomly prior to landing.

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 sexual dimorphism

in growth rates. Otoliths were extracted from these heads by NIWA staff at a later date. Kahawai were selected at random from each boat'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 reflect the length distribution of the landed catch.

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 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 before reading. Thin sections were read under reflected light and or transmitted light, depending on the readers preference. 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 (SNA2000/02) which was a 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.

Data Analysis

Regional, proportions and analytical variances at length and age where calculated using a FORTAN programme developed for snapper market samples (Davies & Walsh 1995). Boats landing kahawai were regarded as strata, which were weighted together on the basis of the number of kahawai landed by each boat. Proportions at age were calculated for the range of age classes recruited to each stratum with the maximum age being an aggregate of all age classes greater than 19 years. The distribution at age within length classes, (age-length keys) was used to translate the regional length distributions into estimates of recreational catch-at-age. Recreational catch-at-age and length frequency distributions and their associated variances were produced in the form of histograms and tables. Von Bertalanffy growth curves were fitted to regional age data by least squares regression.

For each region, age distributions were derived both for each ramp, and for each of the four months sampled using the same analytical approach used to derive regional distributions. 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 were not calculated for these distributions due to the low sample sizes of the strata involved. Kahawai were assigned to the ramp at which they were sampled rather than the location at which they were caught, as outside of Auckland there is little overlap between the areas fished from two or more ramps.

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

10. Results:

2000–01 sampling season

Sampling took place between 1 January and 28 February 2001. A network of interviewers was established at 28 key boatramps in East Northland, the Hauraki Gulf and the Bay of Plenty (Figure 1). Sampling was initiated at each ramp as appropriate interviewers were found and trained, with the last interviewer recruited on the 19th of January. Sampling ceased at Houhora in early February due to consistently low numbers of recreational vessels using the ramp and resultant low numbers of kahawai measured. Interviewing activity was transferred to a second, club ramp at Parua Bay, in Whangarei Harbour, where fishing activity was much higher. 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.

In East Northland and the Hauraki Gulf, the number of kahawai landed per hour in 2001 (Table 2a) was less than predicted from data collected from comparable surveys in 1991, 1994 and 1996 (see Table 1). At Whakatane, two of the 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 very similar. No other competitions were sampled in 2001.

2001–02 sampling season

Sampling took place between 1 January and 28 February 2002. The sampling design employed in the 2001–02 season was broadly based upon that used in 2000–01. In East Northland, the same ramps were sampled as in the previous year, but in the Hauraki Gulf, sampling effort at one ramp, Hobson Bay, was transferred to Halfmoon Bay, where boat traffic volumes necessitated the employment of two interviewers and effort at Omaha was transferred to nearby Sandspit. In the Bay of Plenty, sampling effort at Toll Bridge, Tauranga was transferred to Whangamata, where landings of kahawai were higher.

Table 2a: Summary statistics by region of the number of interview sessions, hours surveyed, boats 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
	Parura 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

* 2 of these sampling events took place during a competition

All interviewers were selected and trained prior to Christmas 2001, enabling sampling to commence at all 27 ramps on 1 January 2002.

Trends in catch rates

In all three regions, the number of kahawai landed per hour in 2001–02 (Table 2b) was generally similar that observed in 2000–01 (see Table 2a), but lower than in 1991, 1994 and 1996 (see Table 1) suggesting that recreational landings of kahawai have fallen in recent years. It is not clear whether this is due to a reduction in overall fishing effort and/or reduced kahawai catch rates by recreational fishers. The similarity in the numbers of kahawai landed by recreational fishers in the last two seasons may be a reflection of similar climatic

conditions, a weak la Nina in 2001 and neutral in 2002 (Jim Salinger, NIWA climate scientist, pers comm.).

Table 2b: Summary statistics by region of the number of interview sessions, hours surveyed, boats 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
	Maretai	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

East Northland

In both years, the length distributions of East Northland recreational kahawai landings were broad, although in 2001–02, a lower proportion of sub 40 cm kahawai was landed (Figure 2). This may be a reflection of lower recruitment of 3 year olds, which were more evident in the 2000–01 age distribution. Despite differences in the overall shape of the length distributions, two recruiting modes are evident in both years, peaking at around 27 and 35 cm, which are largely

comprised of 2 and 3 year old fish (Appendix 3). Both length distributions were described with reasonable precision, with mean weighted c.v.s of 0.17 (Appendix 1).

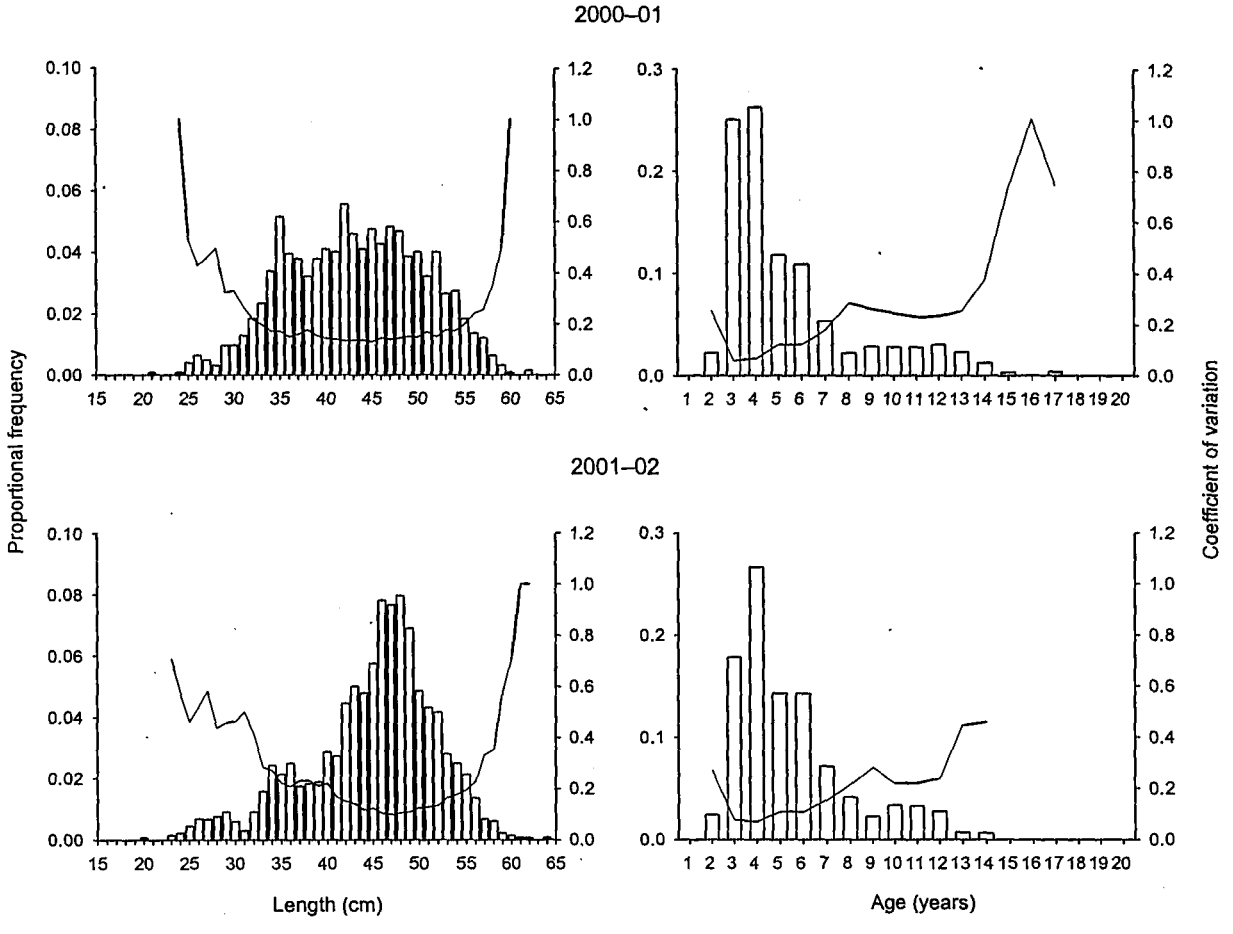


Figure 2: Length and age distributions (histograms) and c.v.s (solid line) of recreational landings of kahawai in East Northland in 2000–01 and 2001–02.

There is a greater similarity in the two years age distributions, which were dominated by 3 to 6 year olds, accounting for over 70% of the kahawai landed (Appendix 2). The mean ages of kahawai landed in 2000–01 and 2001–02 were very similar, 5.47 and 5.44 years respectively. In both years, the age distributions were described with reasonable precision, with mean weighted c.v.s of 0.13 and 0.12 in 2000–01 and 2001–02 respectively.

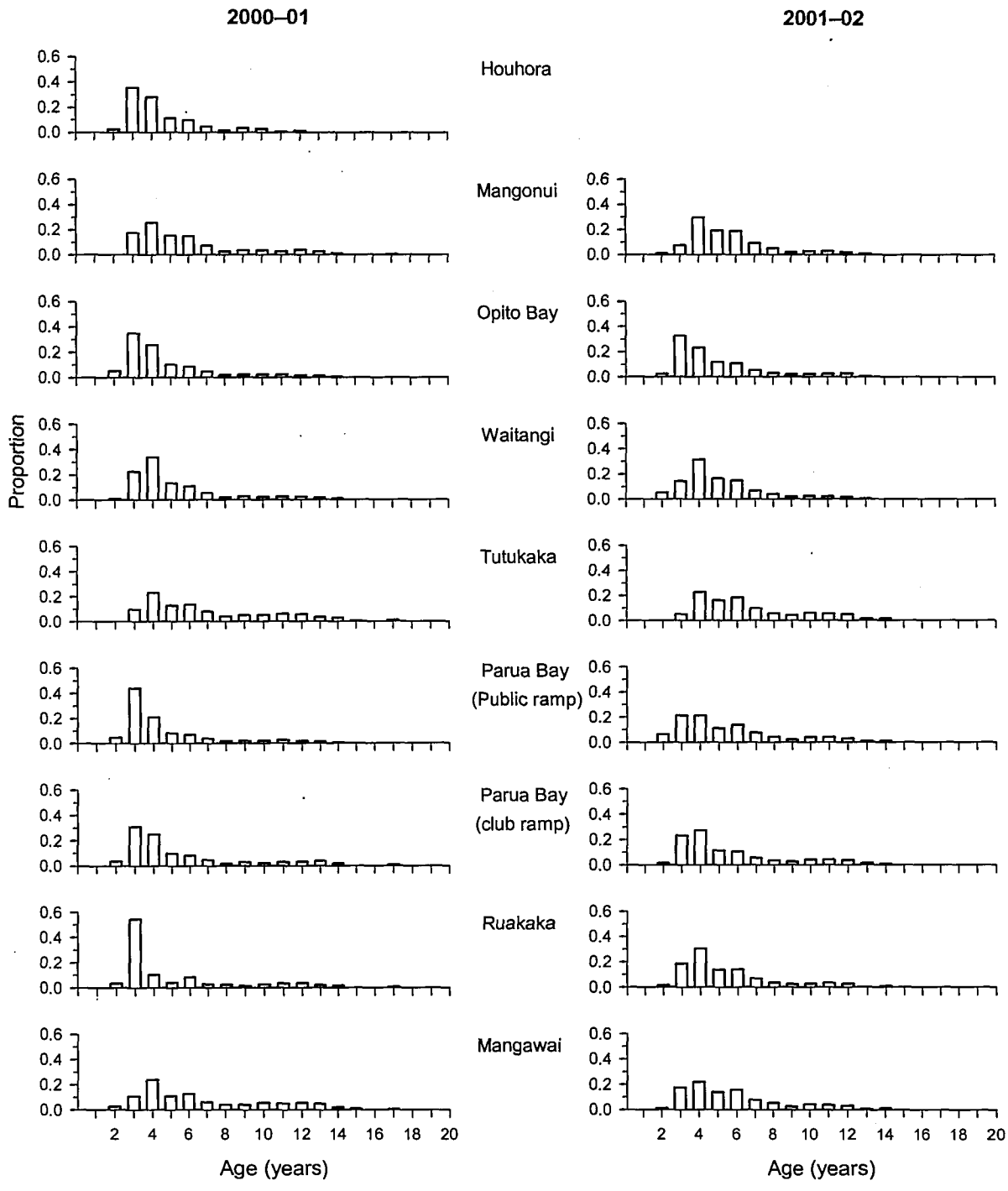


Figure 3: Age distributions by ramp in East Northland in 2000–01 and 2001–02 (see Tables 2a & 2b for sample sizes).

No latitudinal trends were evident in the age distributions of kahawai landed at East Northland ramps (Figure 3), although those obtained from landings at Tutukaka, were broader than experienced elsewhere, possibly reflecting kahawai caught at offshore islands. With the exception of Ruakaka, there were no strong between year differences in ramp age distributions.

Some temporal changes are evident when monthly age distributions (across all ramps) are compared (Figure 4). In both 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. When compared across years, monthly distributions are broadly similar, suggesting that changes in the age composition of recreational landing may be due to some consistent mechanism such as onshore movement of schools of older fish.

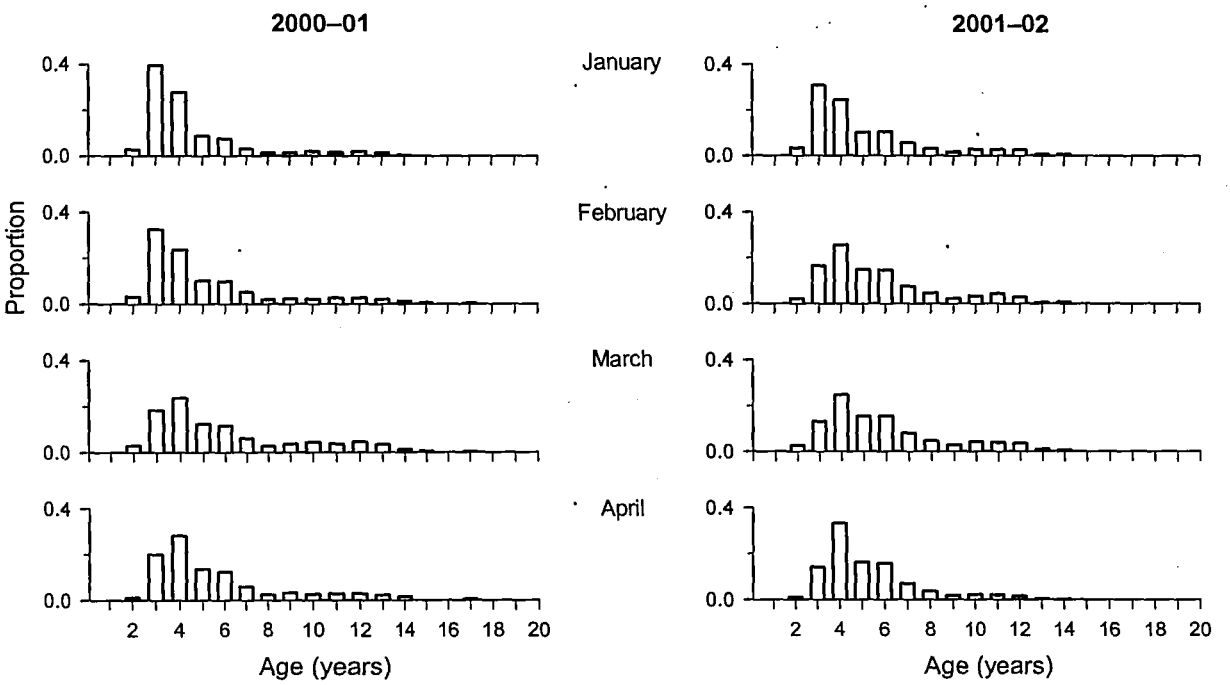


Figure 4: Age distributions by month in East Northland in 2000–01 and 2001–02.

Estimates of the distance offshore that kahawai were caught were available for 1009 fish (Figure 5). Of these, 84% were caught less than 5 kilometres from the mainland, with a further 8 % within 10 kilometres. When data from all four months are combined there was some evidence of increasing fish size with distance offshore.

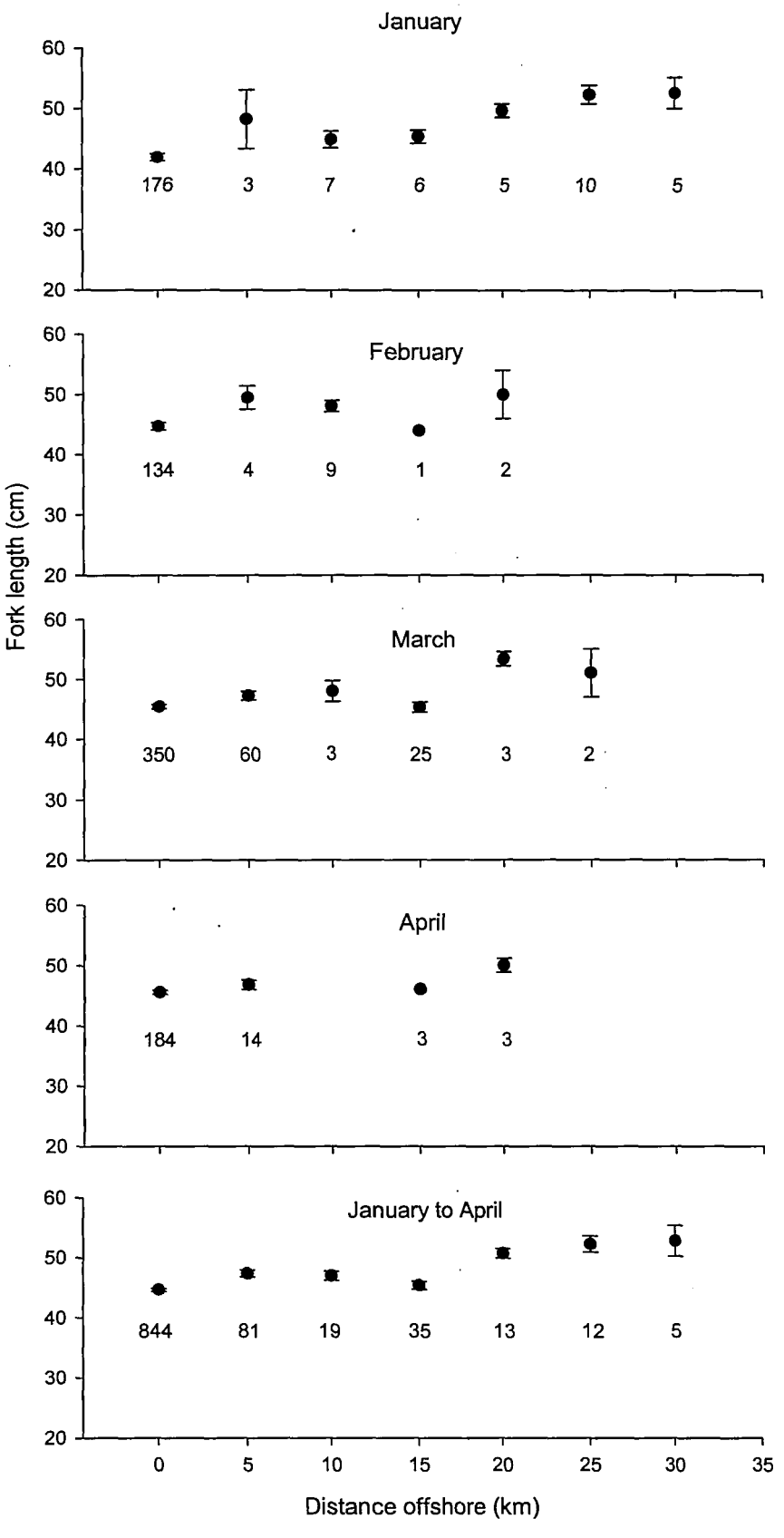


Figure 5: Average size of kahawai caught in relation to distance offshore (in 5 kilometre bins) by month in East Northland in 2001–02. Error bars denote standard errors and numbers denote numbers caught.

Hauraki Gulf

Marked differences are evident when the length compositions of the 2000–01 and 2001–02 Hauraki Gulf landings are compared, which reflect the relative strengths of the underlying age distributions (Figure 6). Landings in 2000–01 were dominated by a cohort of 3 year olds, 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 2001–02 age distribution was also far broader, suggesting greater availability of older fish to recreational fishers than in the previous year. 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 (Tables 1,2a and 2b). Length compositions were estimated with mean weighted c.v.s of 0.22 and 0.25 respectively, although the age distributions were more precisely described with mean weighted c.v.s of 0.14 and 0.13 (Appendices 1 and 2).

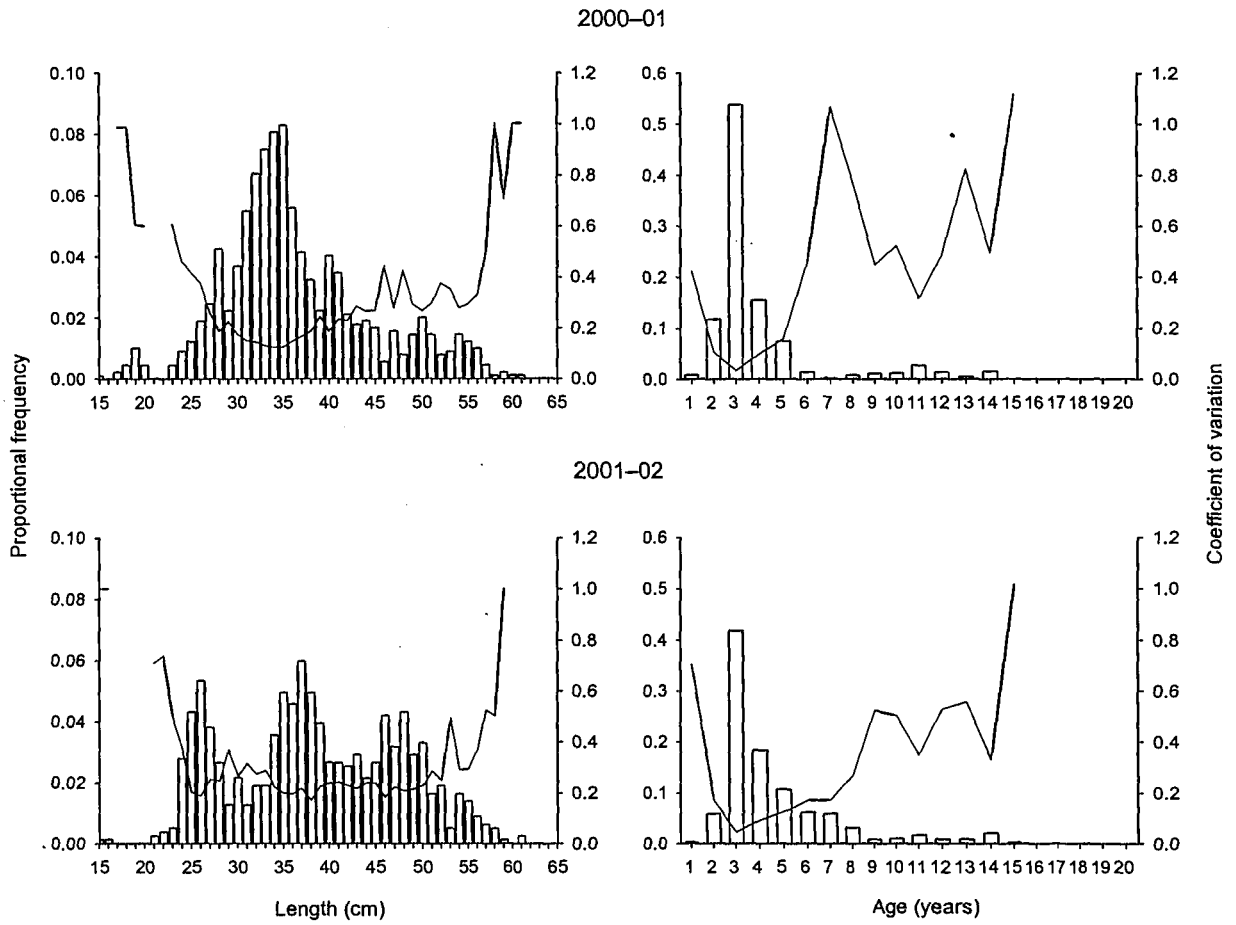


Figure 6: Length and age distributions (histograms) and c.v.s (solid line) of recreational landings of kahawai in the Hauraki Gulf in 2000–01 and 2001–02.

The predominance of 3 to 5 year old kahawai suggests that the Hauraki Gulf acts as a nursery area, which may explain why this is the only region in which 1 year old fish were caught. The presence of small kahawai in Hauraki Gulf landings may also reflect region specific differences in fisher behaviour, as lower catch rates may increase the probability that a small fish is landed when caught.

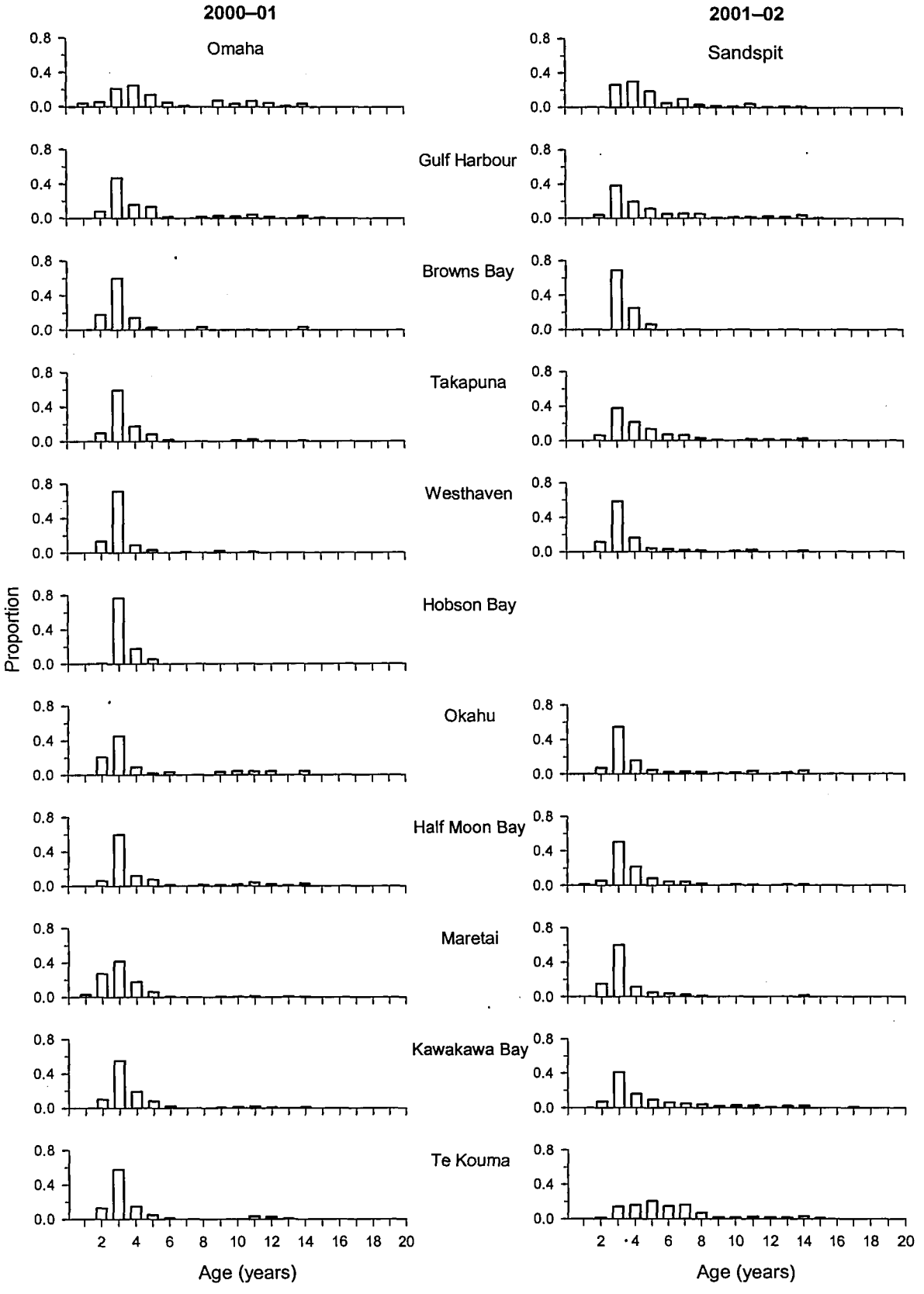


Figure 7: Age distributions by ramp in the Hauraki Gulf in 2000–01 and 2001–02 (see Tables 2a & 2b for sample sizes).

With the exception of Omaha, Sandspit and Te Kouma, which are at the head of the Hauraki Gulf, ramp specific age distributions were characteristically dominated by 3 year olds, in both 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 the generally small sample sizes obtained (Tables 2a and 2b). In 2000–01 there was little change in monthly age distributions through time, but in 2001–02, age distributions became increasingly broad as the sampling season progressed (Figure 8).

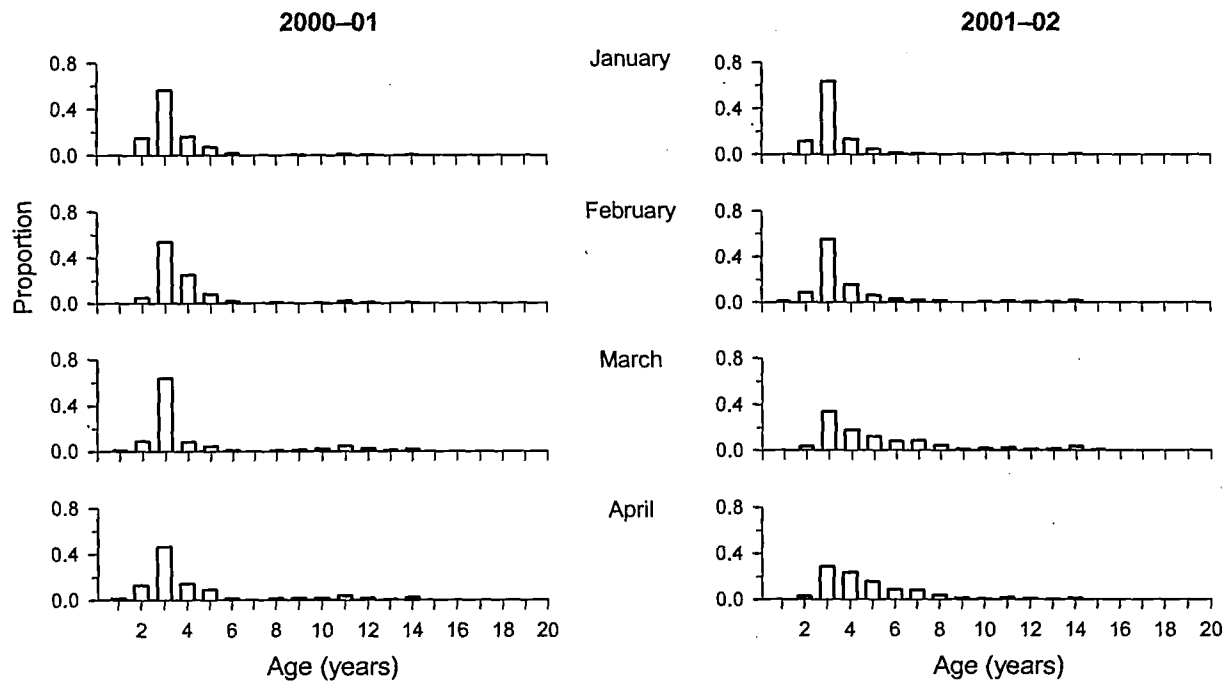


Figure 8: Age distributions by month in the Hauraki Gulf in 2000–01 and 2001–02.

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 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). As five dominant age classes have grown (3 to 7 year olds in 2000–01), the length distribution has become increasingly skewed to the right. Age distributions in the Bay of Plenty were more evenly distributed than elsewhere, with over 40% of the kahawai landed being 7 years or older. The number of kahawai landed per hour of interviewing in the Bay of Plenty strongly suggests that they are generally more abundant than elsewhere, and this is the only region in which target sample sizes of 500 fish aged and 1500 measured were approached (Table 2b). Consequently, despite the breadth of the length and age compositions, the precision of these distributions was the best achieved, ranging from 0.14 to 0.18 (Appendices 1 and 2).

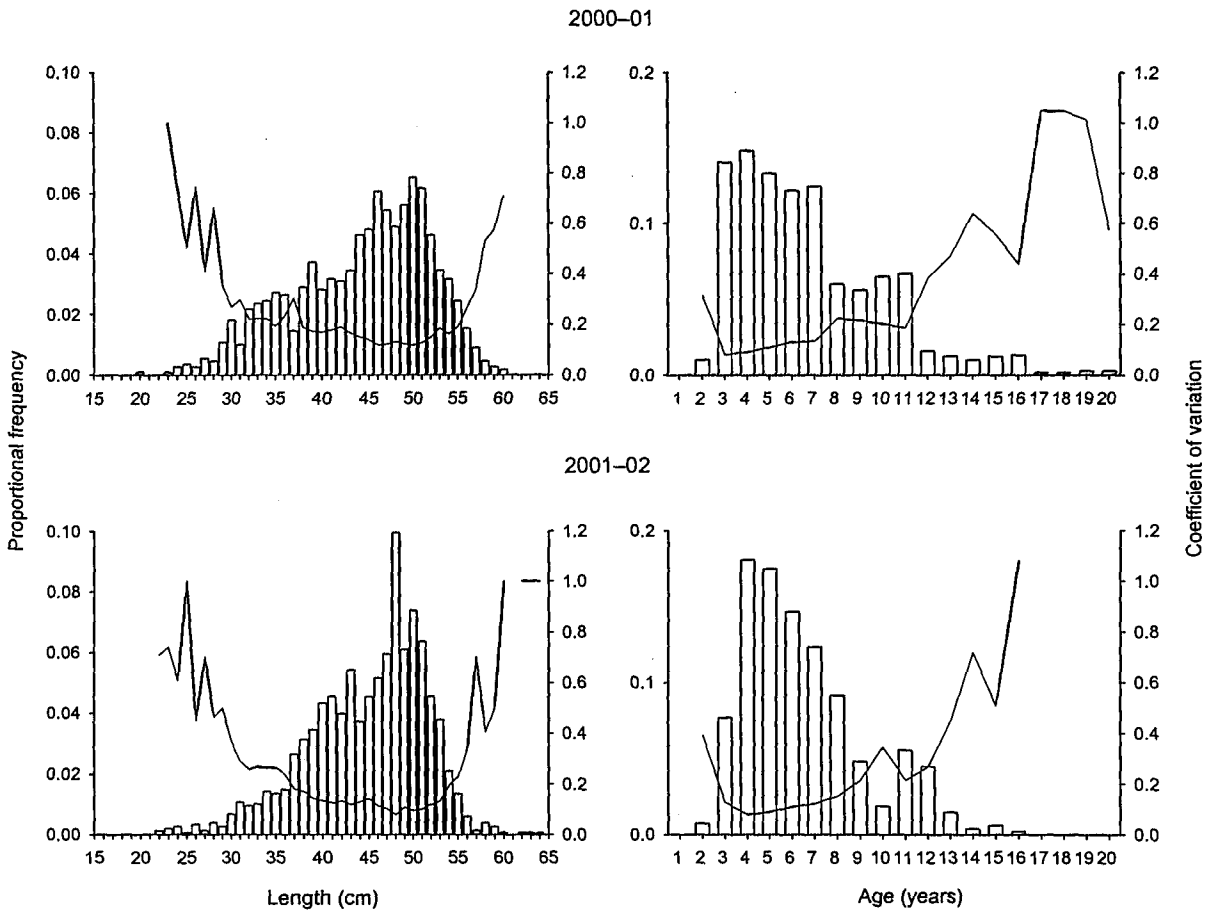


Figure 9: Length and age distributions (histograms) and c.v.s (solid line) of recreational landings of kahawai in the Bay of Plenty in 2000–01 and 2001–02.

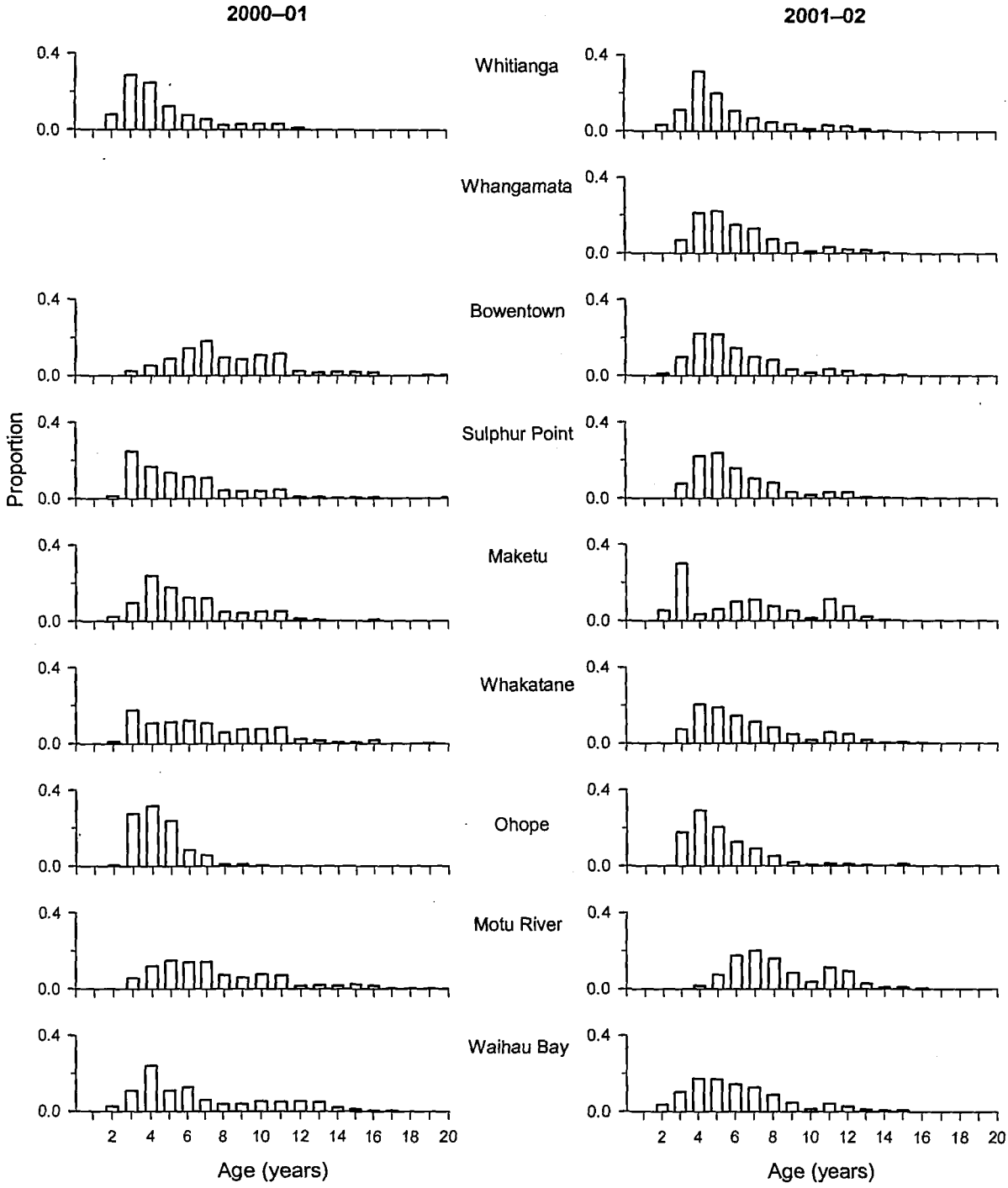


Figure 10: Age distributions by ramp in the Bay of Plenty in 2000–01 and 2001–02 (see Tables 2a & 2b for sample sizes).

In 2000–01 there was some indication of a longitudinal trend in the age distributions of kahawai landed at boat ramps, with the older age classes becoming increasing prevalent in the eastern Bay of Plenty, but this was not evident in 2001–02 (Figure 10). No clear trends are evident in monthly age distributions (Figure 11).

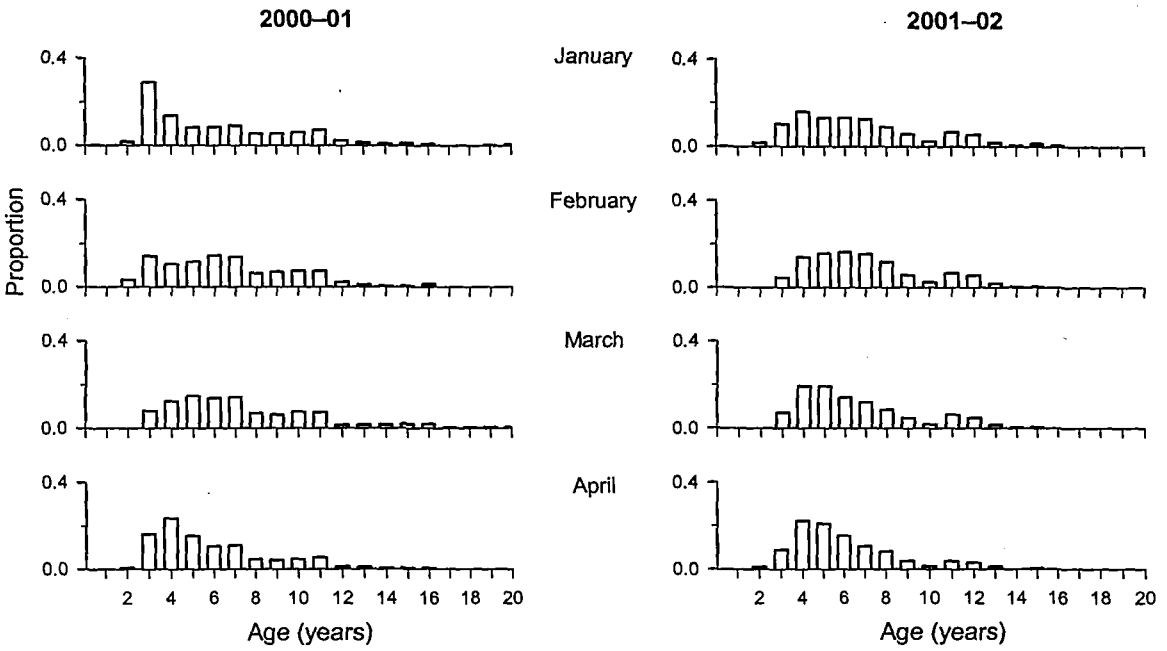


Figure 11: Age distributions by month in the Bay of Plenty in 2000–01 and 2001–02.

Estimates of the distance offshore that kahawai were caught were available for 1385 fish in the Bay of Plenty in 2001–02 (Figure 11). Of these, 72% were caught less than 5 kilometres from the mainland, with a further 16 % within 10 kilometres. There was some evidence of an increase in the size of kahawai landed with increasing distance offshore. There was however a marked increase in the proportion of fish caught between 10 and 15 kilometres offshore in the second half of the survey period. .

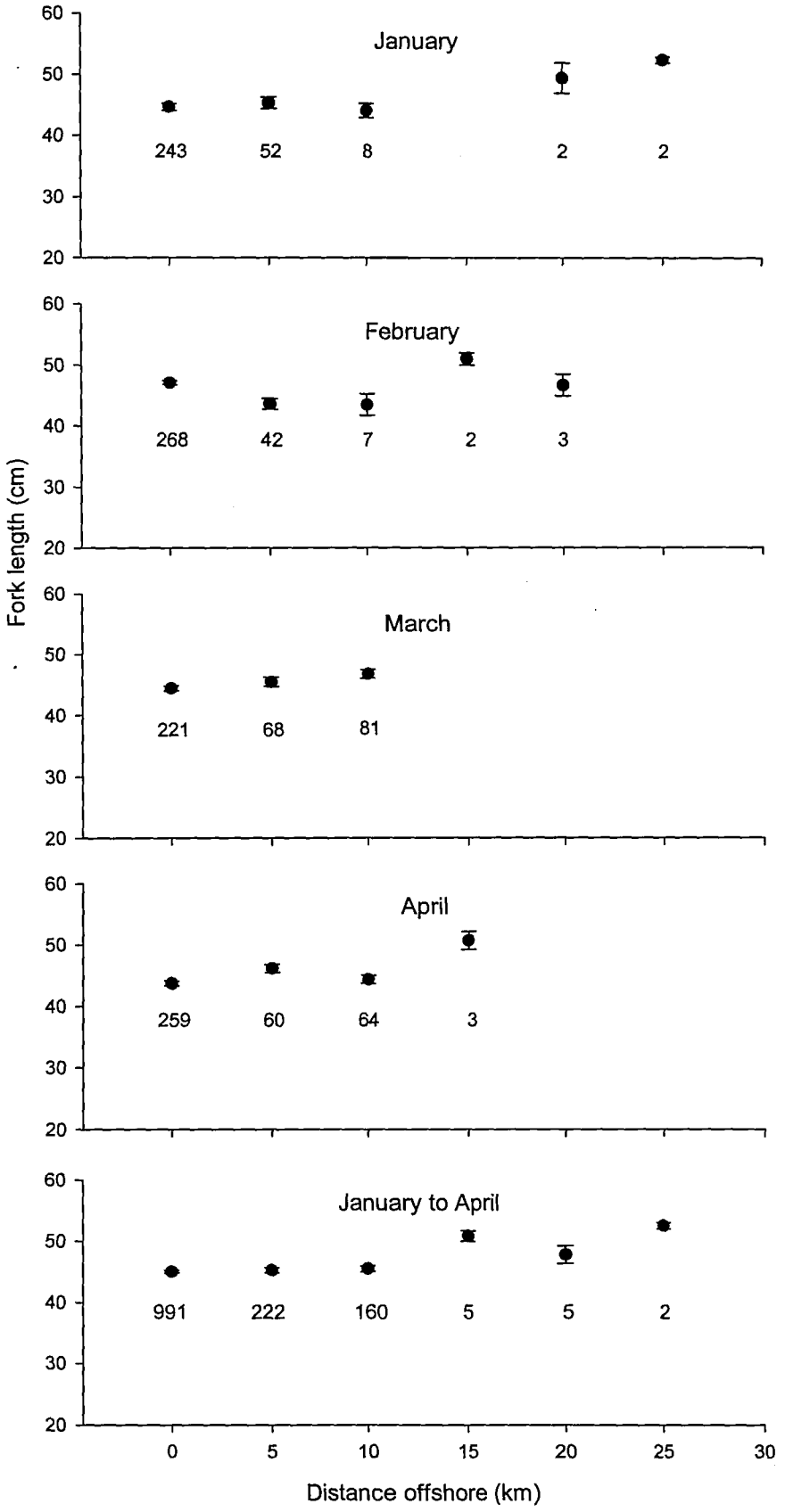


Figure 12: Average size of kahawai caught in relation to distance offshore (in 5 kilometre bins) by month in the Bay of Plenty in 2001–02. Error bars denote standard errors and numbers denote numbers caught.

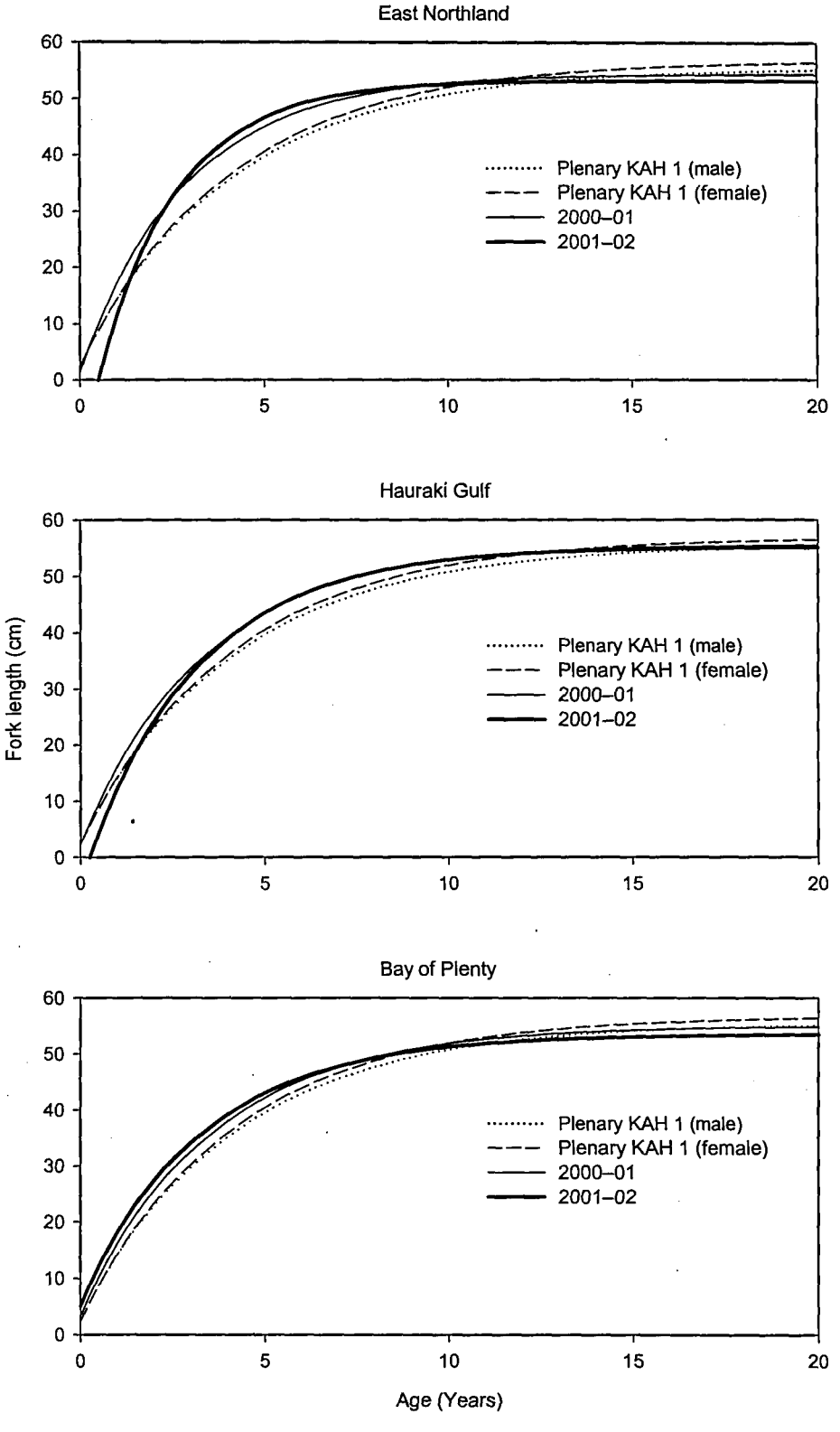


Figure 13: Comparison of von Bertalanffy growth curves derived from kahawai sampled from recreational catches in East Northland, the Hauraki Gulf and the Bay of Plenty (unsexed), with those reported for males and females in KAH 1 in the 2001–02 plenary.

Growth rates

Despite different underlying age distributions, regional von Bertalanffy growth curves appear similar when compared with those previously documented for males and females in KAH 1 (Annala et al. 2002). When growth curves from the same region in 2000–01 and 2001–02 are compared, they are generally very similar, and are unlikely to be significantly different (Figure 10, Table 3).

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 and 2001–02.

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
Hauraki Gulf	2000–01	-0.14	0.30	55.7	500
	2001–02	0.25	0.33	55.2	500
Bay of Plenty	2000–01	-0.23	0.28	55.1	457
	2001–02	-0.33	0.31	53.6	495

11. Conclusions:

Due to the widespread and comparatively random nature of recreational fishing effort, the length and age distributions described in this report are more likely to be representative of the underlying population than those observed from commercial kahawai catches in the past (Bradford 1999, McKenzie and Trusewich 1996). As kahawai school by size, a commercial catch tends to be comprised of fish from only one or two schools. Distributions derived from amalgamating these commercial catches are therefore usually multi modal as there are generally insufficient catches sampled to describe more than a few schools of kahawai. In contrast, a recreational fishery is comprised of hundreds of trips which sample a greater number of schools at a much lower level of intensity, and therefore sample fish from a population of schools in a more random and representative manner. 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 thus providing a broader description of the population being fished.

Obtaining sufficient length at age samples from a region's recreational fishery is an uncertain process however. Unlike commercial fisheries, where annual catch levels are largely determined by TACCs, recreational 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 lower than experienced on average during the 1991, 1994 and 1996 boatramp 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. While fewer kahawai have consequently been measured, analytically derived mean weighted *c.v.*s suggest that the length and age compositions of the regional populations have been described with reasonable precision.

There are clear regional differences in the length and age compositions of recreational catches of kahawai 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 6 years of age, while the Bay of Plenty 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; Figures 1 to 3).

Spatial or temporal trends were evident in regional age distributions but no consistent trend is evident across the whole of KAH 1. In East Northland and the Hauraki Gulf, the mean age of kahawai landed by recreational fishers increased throughout the four months sampled and this may be indicative of onshore movement by schools of older fish. In the Bay of Plenty there was a marked longitudinal trend in the age distributions of kahawai landed at boat ramps, with the older age classes becoming increasing prevalent in the east in 2000–01, but this was not evident in 2001–02. The boundaries between these regions are arbitrary however, with the age distributions of the northern ramps in the Hauraki Gulf and Bay of Plenty showing some similarity to those in southern East Northland. When age distributions obtained from ramps in consecutive years are compared, they are usually similar, suggesting that there is little change in local population composition through time.

When regional growth rates are compared between years, they appear to be similar which suggests that 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 as suggested by the differences between regional length and age distributions, the use of a combined age-length key may result in distorted age distributions and this should be avoided.

The relationship between the size and abundance of kahawai landed with respect to estimates of the distance offshore, by month, was investigated using data from East Northland and the Bay of Plenty in 2001–02. There was a slight indication of an increase in the size of fish landed with increasing distance offshore in East Northland, although any trend may be partially influenced by the likelihood of fishers who fish far offshore landing small kahawai, as experienced fishers often use this species for livebaiting. Furthermore, between month comparisons of how far offshore kahawai were caught should take into account the distribution of fishing effort with respect to distance from the mainland. No information on the distribution of fishing effort is available however, and it is likely to be influenced by weather conditions, which vary from month to month. These results should therefore be interpreted cautiously.

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. 11p.

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.

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.

14. References:

Bradford, E. 1998: 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.; Fisher, D.; Bell, J. 1998: National marine recreational fishing survey 1996: overview of catch and effort results. *NIWA Technical Report 18.* 55 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 boatramps 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.

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 and 2001–02

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 and 2001–02

Length	2000–01		2001–02	
(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	0.0000	0.00	0.0008	1.00
21	0.0008	1.00	0.0000	0.00
22	0.0000	0.00	0.0000	0.00
23	0.0000	0.00	0.0015	0.71
24	0.0008	1.00	0.0023	0.58
25	0.0040	0.53	0.0046	0.46
26	0.0065	0.43	0.0068	0.52
27	0.0048	0.46	0.0068	0.58
28	0.0032	0.50	0.0076	0.44
29	0.0097	0.32	0.0091	0.46
30	0.0097	0.33	0.0061	0.47
31	0.0129	0.27	0.0030	0.50
32	0.0186	0.22	0.0091	0.42
33	0.0234	0.20	0.0159	0.28
34	0.0339	0.17	0.0243	0.27
35	0.0517	0.17	0.0212	0.22
36	0.0395	0.15	0.0250	0.21
37	0.0379	0.16	0.0175	0.23
38	0.0323	0.18	0.0182	0.23
39	0.0379	0.15	0.0190	0.21
40	0.0412	0.15	0.0288	0.22
41	0.0404	0.14	0.0273	0.17
42	0.0557	0.13	0.0448	0.15
43	0.0460	0.14	0.0501	0.14
44	0.0412	0.14	0.0478	0.12
45	0.0476	0.13	0.0577	0.12
46	0.0428	0.15	0.0781	0.10
47	0.0484	0.14	0.0766	0.10
48	0.0468	0.14	0.0797	0.11
49	0.0387	0.15	0.0690	0.11
50	0.0404	0.15	0.0486	0.13
51	0.0323	0.17	0.0432	0.13
52	0.0404	0.15	0.0417	0.13
53	0.0266	0.18	0.0281	0.17
54	0.0274	0.17	0.0250	0.18
55	0.0186	0.20	0.0212	0.20
56	0.0137	0.24	0.0137	0.23
57	0.0121	0.26	0.0068	0.33
58	0.0065	0.35	0.0061	0.35
59	0.0032	0.50	0.0023	0.58
60	0.0008	1.00	0.0015	0.71
61	0.0000	0.00	0.0008	1.00
62	0.0016	0.71	0.0008	1.00
63	0.0000	0.00	0.0000	0.00
64	0.0000	0.00	0.0008	1.00
65	0.0000	0.00	0.0000	0.00
66	0.0000	0.00	0.0000	0.00
67	0.0000	0.00	0.0008	1.00
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	1 239		1 318	
m.w.c.v.		0.17		0.17

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

Length	2000–01		2001–02	
(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	0.0011	1.00	0.0013	1.00
16	0.0000	0.00	0.0013	1.00
17	0.0022	0.99	0.0000	0.00
18	0.0045	0.99	0.0000	0.00
19	0.0101	0.61	0.0000	0.00
20	0.0045	0.60	0.0000	0.00
21	0.0000	0.00	0.0025	0.71
22	0.0000	0.00	0.0038	0.74
23	0.0045	0.61	0.0051	0.50
24	0.0090	0.46	0.0280	0.37
25	0.0123	0.42	0.0433	0.20
26	0.0191	0.38	0.0534	0.19
27	0.0247	0.26	0.0382	0.25
28	0.0426	0.19	0.0267	0.25
29	0.0224	0.23	0.0127	0.37
30	0.0370	0.18	0.0216	0.27
31	0.0549	0.15	0.0127	0.32
32	0.0673	0.15	0.0191	0.27
33	0.0751	0.13	0.0191	0.29
34	0.0807	0.12	0.0356	0.22
35	0.0830	0.13	0.0496	0.20
36	0.0561	0.15	0.0458	0.20
37	0.0415	0.17	0.0598	0.22
38	0.0325	0.19	0.0496	0.17
39	0.0224	0.25	0.0394	0.23
40	0.0404	0.19	0.0267	0.24
41	0.0348	0.23	0.0267	0.24
42	0.0213	0.23	0.0254	0.23
43	0.0179	0.29	0.0293	0.22
44	0.0191	0.27	0.0216	0.24
45	0.0168	0.27	0.0267	0.24
46	0.0056	0.45	0.0420	0.18
47	0.0157	0.28	0.0318	0.23
48	0.0078	0.43	0.0433	0.21
49	0.0146	0.30	0.0293	0.21
50	0.0202	0.27	0.0331	0.23
51	0.0146	0.30	0.0165	0.29
52	0.0078	0.38	0.0191	0.25
53	0.0090	0.35	0.0051	0.49
54	0.0146	0.28	0.0165	0.29
55	0.0123	0.30	0.0140	0.29
56	0.0101	0.33	0.0089	0.37
57	0.0045	0.50	0.0064	0.53
58	0.0011	1.00	0.0051	0.50
59	0.0022	0.71	0.0013	1.00
60	0.0011	1.00	0.0000	0.00
61	0.0011	1.00	0.0025	0.71
62	0.0000	0.00	0.0000	0.00
63	0.0000	0.00	0.0000	0.00
64	0.0000	0.00	0.0000	0.00
65	0.0000	0.00	0.0000	0.00
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	892		786	
m.w.c.v.		0.22		0.25

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

Length	2000–01		2001–02	
(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	0.0009	1.00	0.0000	0.00
21	0.0000	0.00	0.0000	0.00
22	0.0000	0.00	0.0014	0.71
23	0.0009	1.00	0.0020	0.74
24	0.0027	0.75	0.0027	0.61
25	0.0036	0.50	0.0007	1.00
26	0.0027	0.74	0.0034	0.45
27	0.0054	0.41	0.0014	0.70
28	0.0045	0.66	0.0041	0.47
29	0.0109	0.35	0.0027	0.50
30	0.0181	0.27	0.0068	0.37
31	0.0100	0.30	0.0108	0.29
32	0.0217	0.22	0.0095	0.26
33	0.0236	0.22	0.0102	0.27
34	0.0245	0.22	0.0142	0.27
35	0.0272	0.19	0.0136	0.27
36	0.0263	0.23	0.0149	0.24
37	0.0145	0.30	0.0264	0.18
38	0.0290	0.19	0.0312	0.17
39	0.0371	0.17	0.0346	0.14
40	0.0281	0.17	0.0434	0.13
41	0.0317	0.18	0.0454	0.13
42	0.0308	0.19	0.0400	0.13
43	0.0344	0.17	0.0542	0.12
44	0.0462	0.15	0.0373	0.13
45	0.0480	0.14	0.0454	0.14
46	0.0607	0.12	0.0515	0.11
47	0.0543	0.12	0.0596	0.10
48	0.0489	0.13	0.0996	0.08
49	0.0562	0.12	0.0610	0.11
50	0.0652	0.12	0.0738	0.10
51	0.0616	0.13	0.0637	0.10
52	0.0462	0.15	0.0454	0.12
53	0.0344	0.18	0.0379	0.13
54	0.0317	0.16	0.0210	0.19
55	0.0245	0.19	0.0136	0.23
56	0.0154	0.26	0.0061	0.33
57	0.0091	0.34	0.0014	0.70
58	0.0045	0.53	0.0041	0.41
59	0.0027	0.57	0.0027	0.50
60	0.0018	0.71	0.0007	1.00
61	0.0000	0.00	0.0000	0.00
62	0.0000	0.00	0.0007	1.00
63	0.0000	0.00	0.0007	1.00
64	0.0000	0.00	0.0007	1.00
65	0.0000	0.00	0.0000	0.00
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	1 104		1 476	
m.w.c.v.		0.18		0.15

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 and 2001–02

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 and 2001–02

Age	2000–01		2001–02	
(years)	*P.j.*	*c.v.*	*P.j.*	*c.v.*
1	0.0000	0.00	0.0000	0.00
2	0.0223	0.26	0.0241	0.27
3	0.2511	0.06	0.1780	0.08
4	0.2629	0.07	0.2663	0.07
5	0.1182	0.12	0.1430	0.11
6	0.1091	0.12	0.1426	0.11
7	0.0537	0.18	0.0713	0.15
8	0.0221	0.29	0.0410	0.21
9	0.0287	0.26	0.0222	0.28
10	0.0279	0.25	0.0334	0.22
11	0.0281	0.23	0.0327	0.22
12	0.0304	0.23	0.0276	0.24
13	0.0230	0.25	0.0070	0.45
14	0.0127	0.38	0.0063	0.46
15	0.0032	0.74	0.0000	0.00
16	0.0013	1.01	0.0000	0.00
17	0.0039	0.75	0.0000	0.00
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		526	
m.w.c.v.		0.13		0.12

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

Age	2000–01		2001–02	
(years)	*P.j.*	*c.v.*	*P.j.*	*c.v.*
1	0.0101	0.56	0.0025	0.71
2	0.1216	0.27	0.0581	0.17
3	0.5133	0.09	0.4188	0.05
4	0.1687	0.07	0.1835	0.09
5	0.0761	0.12	0.1067	0.13
6	0.0167	0.27	0.0615	0.17
7	0.0024	0.41	0.0591	0.17
8	0.0041	0.50	0.0313	0.27
9	0.0140	0.52	0.0080	0.52
10	0.0121	0.28	0.0098	0.50
11	0.0259	0.23	0.0164	0.35
12	0.0137	0.34	0.0083	0.53
13	0.0045	0.23	0.0084	0.56
14	0.0139	0.28	0.0207	0.33
15	0.0011	0.60	0.0028	1.02
16	0.0000	0.00	0.0000	0.00
17	0.0000	0.00	0.0015	1.07
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	500		500	
m.w.c.v.		0.14		0.13

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

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

Appendix 3: Age–length keys derived from otolith samples collected from recreational fishers from East Northland, Hauraki Gulf and the Bay of Plenty in 2000–01

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	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	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 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	0.50	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
18	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
19	0.25	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
20	0.67	0.33	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 3 – continued:

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	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	0.50	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 4: Age–length keys derived from otolith samples collected from recreational fishers from East Northland, Hauraki Gulf and the Bay of Plenty in 2001–02

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	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	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 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	0.23	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 Bay of Plenty 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	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