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Taihoro Nukurangi

Commercial catch sampling of red gurnard in GUR 2 for 2003–04

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Objective 5

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1	**Report Title**	Commercial catch sampling of red gurnard in GUR 2 for 2003–04
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9 Executive summary

This report describes sampling of commercial bottom trawl landings of red gurnard (*Chelidonichthys kumu*) in GUR 2 during the 2003–04 fishing year, and the subsequent estimates of catch-at-age for this fishery.

This was the first year of a two year program to sample red gurnard in QMA 2. Ten samples were taken between October 2003 and April 2004. The target number of 15 samples was not achieved. Within each sample, up to 50 fish were randomly selected, measured to the nearest centimetre below the fork length, sexed, and otoliths taken and read.

The mean weighted c.v. over all age classes was 42%, which was higher than the target value of 30%. Most fish were aged from 1 to 7 years, with 3 year old fish the most common year class for both males and females.

Assessment of the sampling coverage suggests that sampling should take place throughout the fishing year. Stratification by area would not be practical as the locations of the sampled fish could not be determined, because the catch was a collection of several tows from different areas within a trip. However stratification of port/month/season my be possible. Stratification by target species would also not be practical as fishers tend to target a range of species within a single trip.

10 Objective

To conduct sampling in fish processing sheds and determine the length and age composition of the commercial catch of red gurnard in GUR 2 during the 2003/2004 fishing year. The target coefficient of variation (c.v.) for the catch-at-age is 30 % (mean weighted c.v. across all age classes).

11 Introduction

This project aims to provide a time series of proportion-at-age estimates from commercial catches of red gurnard in GUR 2 which can eventually be used in future stock assessments. Information from sampling the commercial catch can be used in various ways to better understand the status of major fish stocks. Length and/or age information could be used to provide age specific selectivity information, and other biological parameters for quantitative stock assessment.

GUR 2 has the third-highest red gurnard landings in New Zealand. GUR 2 landings have been relatively stable since 1986–87 at around 500–600 t per annum. The GUR 2 area extends from Cape Runaway on the east coast of the North Island to Cook Strait (Figure 1).

Red gurnard is a common species and is present in a high proportion of catches from inshore trawl fisheries in QMA 2. Red gurnard is taken throughout the year, but higher catches occur over the spring months September to November. Red gurnard was caught as the main target species but(Kendrick & Walker 2003). Red gurnard were mostly caught as target species (59 % of the catch), but was also taken as bycatch for the target tarakihi, snapper and flatfish fisheries (Kendrick & Walker 2003).

12 Methods

No catch sampling of commercial landings of red gurnard in QMA 2 has taken place previously, the sample design was based upon the number of age classes likely to occur in commercial landings, the size of the landings, and the target mean weighted coefficient of variation (c.v.) of 0.30. It was decided to sample 15 red gurnard landings. This was based on the target number of landings sampled from the gemfish fishery in QMA 2 was 15 and the target mean weighted c.v. for gemfish was also 0.30. It was assumed that gemfish natural mortality is lower than red gurnard (more age classes), so it was decided also to sample 15 red gurnard landings

Catch effort data from the last three years showed landings of red gurnard in GUR 2 occurred throughout the year, but were most common between October and February when most trawling for more preferred target species such as snapper takes place. Sampling was therefore planned for those months, however due to the low number of landings sampled, the sampling period was extended to the end of April.

Within each sample, up to 50 fish were randomly selected, measured to the nearest centimetre below fork length, sexed, and otoliths taken. Macroscopic gonad development was recorded using the five stage scale: 1, immature/resting (gonads small and ribbon or thread like, no eggs/milt visible); 2, maturing/developing (small eggs/milt visible); 3, mature (some hyaline eggs present, milt extrudable); 4, running ripe (milt/eggs flow freely); 5, spent (gonads reduced in size, ovaries red and flaccid, testis may be red or blackish with little or no milt present).

Landings data from 1997–98 to 2001–02 indicated that about 90% of the GUR 2 catch was from bottom trawl vessels, therefore only bottom trawl landings were sampled. Sampling strata were based on an analysis of the 2000–01 to the 2002–03 catch by vessel. A set of 19 trawlers that accounted for around 70% of the GUR 2 catch were identified and allocated as a single stratum ("BT1"). All other vessels catching red gurnard by bottom trawl were collectively grouped in a second stratum ("OTH").

The preparation of otoliths followed the method used by Sutton (1997). Otoliths (sagittae) were baked at 275°C for approximately four minutes, after which they become amber coloured, then embedded in clear epoxy resin (Araldite K142), and cut transversely through the nuclear region with a Struers Accutom-2 diamond-edged saw. The cut surface of the block was polished with P1200 grade carborundum polishing pager and coated with paraffin oil. Otoliths were examined under a binocular microscope (x30) illuminated by reflected light at an incident angle of about 30°. Estimation of the age of red gurnard was relatively straight forward, as the zonation pattern of dark hyaline and light opaque zones was easily discerned. Two readers separately read all the otoliths without prior knowledge of sex and length of the fish.

Catch-at-age and catch-at-length estimates were produced using the 'catch-at-age' software. This software scaled both the age and length frequencies of fish from each landing up to the landing weight, and these were then summed over landings in each stratum and then scaled up to the total stratum catch, to yield a scaled age frequency of the commercial catch by year. The precision of each age frequency was measured by the mean weighted c.v., which was calculated as the average of the c.v.s for the individual age classes weighted by the proportion of fish in each class. Bootstrapping was used to calculate c.v.s where fish were resampled within each landing and landings were resampled within each stratum.

To assess sampling coverage, the samples were matched (where possible) to landing returns i.e., Catch Landing Returns (CLR) and the bottom section of the Catch Effort Landing Returns (CELR). The landing returns were matched by trip number to the corresponding effort returns, Trawl Catch Effort Process Returns (TCEPR) and the top section of the CELR returns. This allowed information regarding location of catches, target species, and timing of catch to be obtained. Not all samples could be matched to the CELR landed or the CLR returns as there were many records that landed similar catches on the same day, and due to confidentiality agreements vessel names could not be released.

13 Results

In the 2003–04 season, 512 t of red gurnard for GUR 2 was landed (Ministry of Fisheries data) of which 504 t was taken by the bottom trawl fishery. Of the bottom trawl catch, 70% (353 t) was taken by BT1 vessels, and 30% was taken by OTH vessels (Table 1).

The samples were collected from the ports of Napier (2), Gisborne (7), and Wellington (1). The target was ffifteen samples, but only 10 samples were collected (Table 1). The target number of samples was not achieved because landings by these vessels were erratic and quantities of red gurnard were sometimes small. Also one of the main fish processing plants closed down, and fish were transported to Auckland. These fish were unable to be sampled as they were mixed with other landings from different vessels. The total weight of red gurnard landings sampled (6.4 t) from GUR 2 represented 1.3% of the total GUR 2 bottom trawl landings. A total of 496 fish were measured and 480 otoliths read (Table 1).

The gonad stages are summarised in Table 2. A total of 260 males and 234 females were staged. 67% of males and 66% of females sampled were in the immature/resting stage (stage 1), with the remainder being maturing/developing (stage 2) or spent (stage 5).

The between reader IAPE and mean CV were 6.07% and 8.58% for otoliths from red gurnard from GUR 2 (Table 3). Diagnostic bias plots following Campana et al. (1995) are given in Figure 2. The symmetry of the histograms in Figure 2 (A), the relatively even distribution of plotted points about the zero-line in Figure 2 (B), the position of the error bars about the 1:1 line in Figure 2 (C), and the APE profile plot in Figure 2 (D) all suggest that no systematic bias exists between readers. The results produced by reader 1 were used in all following analyses. No attempt was made to resolve disagreements between-readers for particular otoliths prior to the following analyses.

The estimated scaled numbers-at-length were some what unimodal with length modes peaking at 36 cm for males and 35 cm females (Figure 3). The length distribution ranged from 28–50 cm. The length frequencies do not show any distinct modes of smaller fish entering the commercial catch. This is probably due to a combination of trawl gear selectivity and commercial tows trying to avoid smaller red gurnard due to economic reasons. Trawl surveys of the east coast of the North Island (Stevenson & Hanchet 2000) by RV *Kaharoa* towing bottom trawl gear with a small-mesh codend (80 mm inside-mesh), observed 20–25 cm fork length pre-recruit and recruiting red gurnard that appear to be absent from the commercial catch.

The estimated scaled numbers-at-age are listed in Table 4 and plotted in Figure 4. The distributions also appear somewhat unimodal, however there was a right hand skew. Most of the catch was aged 1–7 years old, i.e., spawned between 1996 and 2003. For both males and females, 3 year-old fish were the most common year-class (Figure 4), but there was a strong year class for the 1 year old female fish. There were very few fish of either sex that were older than 11 years in the catch. Sex ratios derived from the scaled catch-at-age are 1:1.06 (males:females) and appear to be consistent with the sex ratios from the inshore trawl surveys carried out in 1993–1996 (Table 5).

The mean weighted c.v. over all age classes was 41.7%, which was higher than the target value of 30% (Table 4).

Sixty-one percent of the catch occurred in the sampling period from October to April (Table 6), but the samples only accounted for 1.3% of the total catch. The was due to 60% of landings (total of 1697 landings) of red gurnard were small, less than 490 kg.

During the 2003–04 fishing year, 31% of trips contain tows that targeted only red gurnard (Table 7), accounting for just over 40% of the total red gurnard catch. Twelve percent of trips had tows that targeted both red gurnard and some other species. The remaining trips (57%) had tows that did not target red gurnard but still landed 27% of the total red gurnard catch.

For vessels that recorded catches on CELR records, 71% of the CELR landed catch came from Statistical Area 013, 16% from Statistical Area 014, and 12% from other Statistical Areas (Table 8). Two samples from vessels that recorded on CELR records were taken from Statistical Area 013, 1 sample from Statistical Area 014, however the statistical area where the fish from 4 samples could not be determined as the sample record could not be matched to the CELR landed or catch effort data.

For vessels that filled out TCEPR and CLR records, most of the red gurnard catch was taken from 3 main areas: Wairarapa coast, Hawke Bay, and Tolaga Bay (Figure 5). Most of the tows from trips where red gurnard was sampled also came from the Wairarapa Coast and Hawke Bay, however no samples were taken from the area Tolaga Bay. A number of trips had tows in both the Wairarapa Coast and Hawke Bay areas.

14 Discussion

Prior to this study, no commercial catch sampling of red gurnard had been carried out in GUR 2, and there was no data on the number of year classes in the commercial catch, or on between-landing variability in the catch-at-length or catch at-age were available with which to determine the sampling design. Unfortunately, the number of landings sampled was less than target number; therefore the target mean weighted c.v. for the overall catch-at-age for red gurnard in GUR 2 was not achieved.

The fairly-even male to female sex ratios can be explained by migration behaviour. Females are thought to migrate to join resident males on spawning grounds. Kendrick & Walker (2003) commented that the availability of red gurnard is lower in winter when females may migrate back to shallower water after an extended spawning season. Even though the catch sampling program was concentrated in spring/summer, the gonads of females were mainly stage 2 (developing) or 3 (maturing). There were also a small number of stage 5 (spent) females landed in February. Three of the four trawl surveys occurred in February to March (Stevenson & Hanchet 1999), but only the 1994 survey staged red gurnard. The results from this showed that 88% of males were developing (stage 2) and 79% of females were maturing (stage 3). This suggests spawning may not occur in spring/summer as suggested by Kendrick & Walker (2003) but may occur later in the year and therefore were not sampled.

Comments made in the Inshore Working Group suggested sampling should be stratified according to target species and location. However, red gurnard is a common species observed in most commercial tows within its broad habitat (Kendrick & Walker 2003). During most trips (69%) fishers target a range of inshore species to meet their quota species mix. Trying to stratify sampling by target species would not be easy and might not be meaningful. Although red gurnard can be effectively targeted, it is a low value species. It is not considered financially viable by operators to target and land red gurnard exclusive of higher value species (Kendrick & Walker 2003). Furthermore, Paul & Bradford (2000) noted that target species is recorded by fishers in several ways: the single species targeted, the main species of several species targeted, the species for which most quota is still held, the main species actually caught (whether it was targeted or not), the species that legalises a subsequent bycatch trade, or simply just a logical species for that area and fishery.

Locations of red gurnard catches appear in 3 distinct areas: Hawkes Bay, Wairarapa coast, and Tolaga Bay. However from the TCEPR and CELR data, catches of red gurnard from a trip can come from two or more areas, and determining the area where the sampled fish came from would be difficult unless catches are observed at sea.

Kendrick & Walker (2003) concluded that red gurnard were available to the fishery all year, with most of the red gurnard catch occurring from September to the end of summer. From the 2004 fishing year, catches of red gurnard appeared to be consistent all year. Red gurnard catches tend to fluctuate with good and bad years. Sampling occurred from October to April, however not enough samples were collected, and therefore sampling should occur over the entire fishing year, with stratification by season, month and/or port of landing. However there has been some reluctance by fish processing companies to have fish sampled. Other considerations may need to be made, for example purchasing the sampled fish. The direct-purchase of sampled fish could be investigated; however this will lead to increased costs and may also lead to problems with quality control. The optimum number of otoliths to be collected, prepared, and read to meet the target MWCVs should be investigated using simulation methods.

15 References

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Table 1: Summary of catch sampling for red gurnard from GUR 2 in the 2003–04 fishing year

	Stratum		
	BT1	OTH	Total
Planned	10	5	15
Achieved	6	4	10
Fish measured	298	198	496
Fish aged	287	193	480
Sample laindings (t)	4.6	1.8	6.4
Landed BT catch (t)	352.8	151.2	504.1

Table 2: Gonad stage (%) of male and female red gurnard from GUR 2. *n*, number of fish staged

Stage	Male	Female
1	14	6
2	67	66
3	19	24
4	0	0
5	0	4
n	260	234

Table 3: Results of between-reader comparison tests.

Statistic	Precision (%)
IAPE	6.07
CV	8.58

Table 4: Estimated catch-at-age (numbers and percentage) and calculated c.v.s from catch sampling in GUR 2 in 2003–04. The estimated mean weighted c.v.s, are also presented.

	Male			Female		
Age (y)	Number	Percentage	c.v.	Number	Percentage	c.v.
0	0	0.00	0.00	0	0.00	0.00
1	42 087	3.97	0.81	136 928	12.90	0.74
2	122 536	11.55	0.55	57 442	5.41	0.56
3	138 211	13.03	0.22	168 168	15.85	0.39
4	48 484	4.57	0.35	91 584	8.63	0.27
5	42 355	3.99	0.37	50 327	4.74	0.35
6	22 104	2.08	0.58	19 233	1.81	0.60
7	17 319	1.63	0.64	17 184	1.62	0.66
8	41 038	3.87	0.78	2 110	0.20	1.03
9	2 508	0.24	1.36	663	0.06	1.44
10	958	0.09	1.27	1 870	0.18	1.26
11	14 713	1.39	0.79	0	0.00	0.00
12	3 324	0.31	1.45	1 092	0.10	2.04
13	0	0.00	0.00	0	0.00	0.00
14	2 183	0.21	1.48	0	0.00	0.00
15	1 140	0.11	1.73	0	0.00	0.00
16	1 092	0.10	1.78	0	0.00	0.00
17	1 092	0.10	1.81	49	0.00	2.17
18	6 777	0.64	1.35	0	0.00	0.00
19	5 458	0.51	1.32	1 092	0.10	1.80
20	0	0.00	0.00	0	0.00	0.00
Mean weighted c.v. (by sex)			52.10			50.00
Mean weighted c.v. (both sexes)						41.70

Table 5: Sex ratio (male:female) of red gurnard from the inshore trawl surveys in 1993, 1994, 1995, 1996).

Survey	Sex ratio
KAH9304	1:0.93
KAH 9402	1:0.80
KAH 9502	1:0.82
KAH 9602	1:0.67
All surveys	1:0.78

Table 6: Summary of all bottom trawl red gurnard landings, sampled landings, and the percentage sampled by month

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Landed catch (t)	57	55	38	39	29	40	49	39	36	38	34	51	504
Sampled catch (t)	0.23	0	0.56	0	1.86	0.16	3.63	0	0	0	0	0	6.43
Percentage sampled	0.4	–	1.5	–	6.5	–	7.4	–	–	–	–	–	1.3

Table 7: Summary of the number of trips and the resulting catch of red gurnard from 2003–04 that only target red gurnard, targeted red gurnard and other species, or caught gurnard as bycatch.

	Trips	Catch (t)
Targeted red gurnard only	539	201
Targeted red gurnard and other species	199	166
Non red gurnard target	975	138
Total	1 713	505
Red gurnard target only (%)	31	40

Table 8: Summary of the total catch and sampled catch by Statistical area (see Figure 1 for definitions) for vessels that filled out CELR landed records only (linked to CELR effort to derive Statistical area). Unknown, stat area could not be determined as the sample number could not be linked to the CELR landed record.

Statistical area	Total catch (t)	Sampled catch (t)
011	1.4	–
012	20.2	0.20
013	255.5	0.35
014	58.4	
015	2.0	–
016	19.8	–
Unknown location		1.67

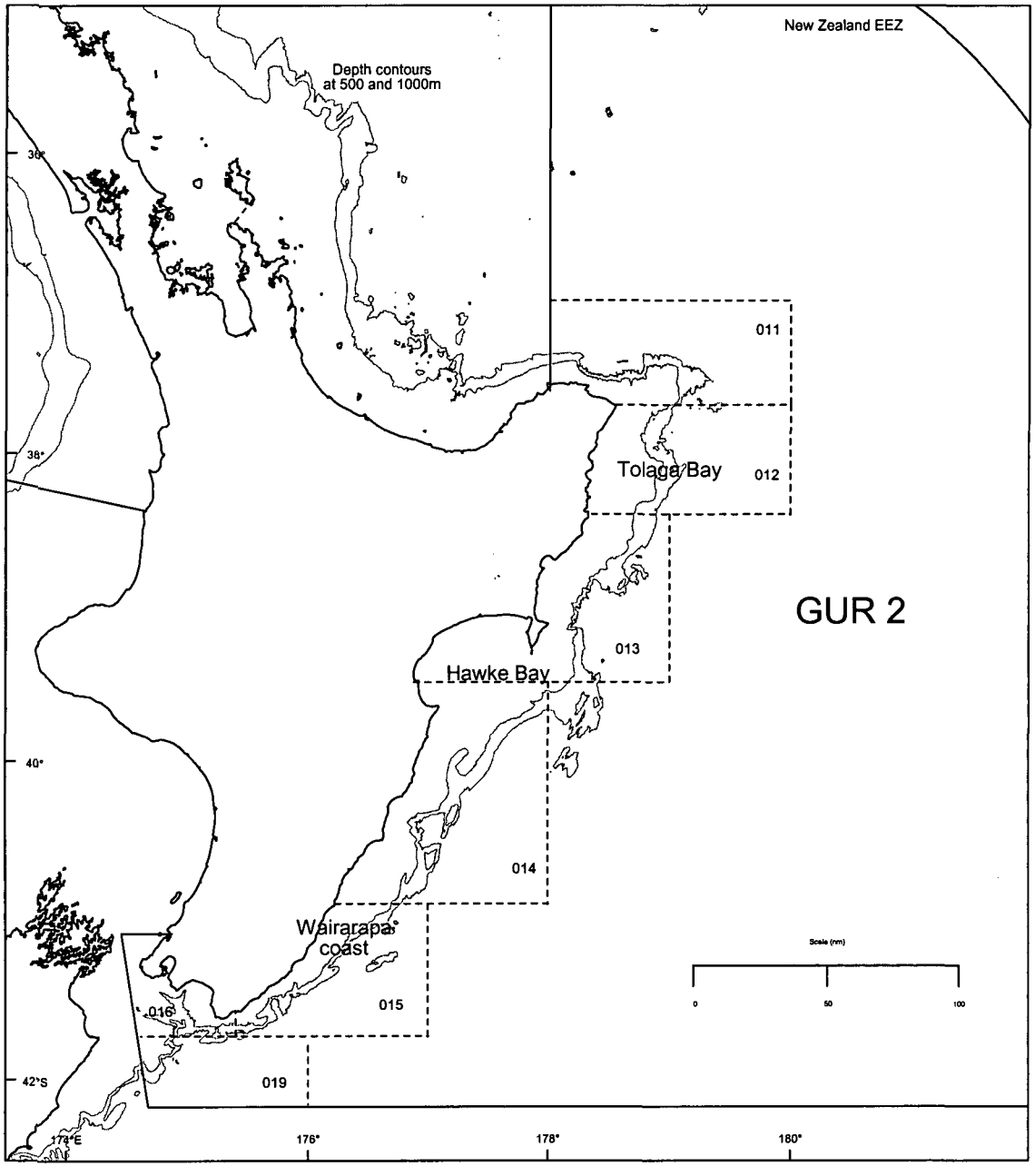

Figure 1: Management, statistical areas for the red gurnard fisheries, and locations used in this report.

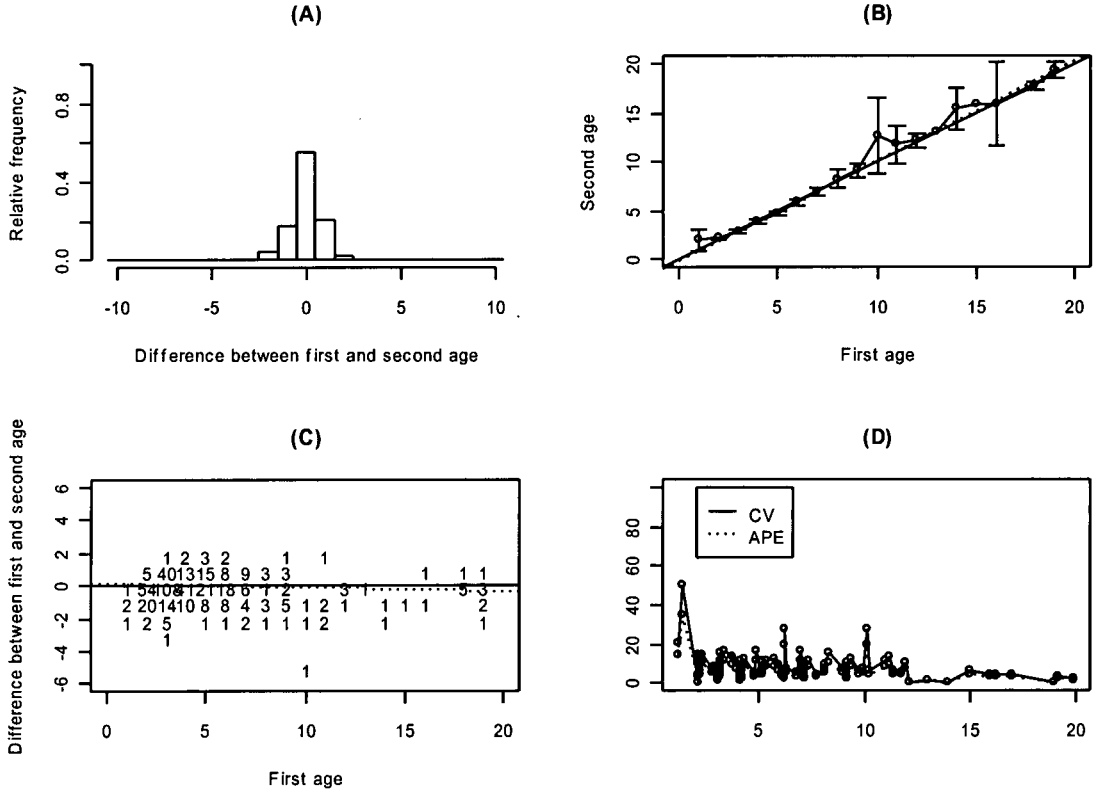

Figure 2: Results of between-reader comparisons: (A) histograms of differences between readers, (B) bias plot, (C) differences between the first and second reader as a function of the age produced by the first reader, and (D) c.v. and APE profiles. The expected 1:1 (solid line) and actual relationship (dashed line) between ages produced by both readers are overlaid on (B) and (C).

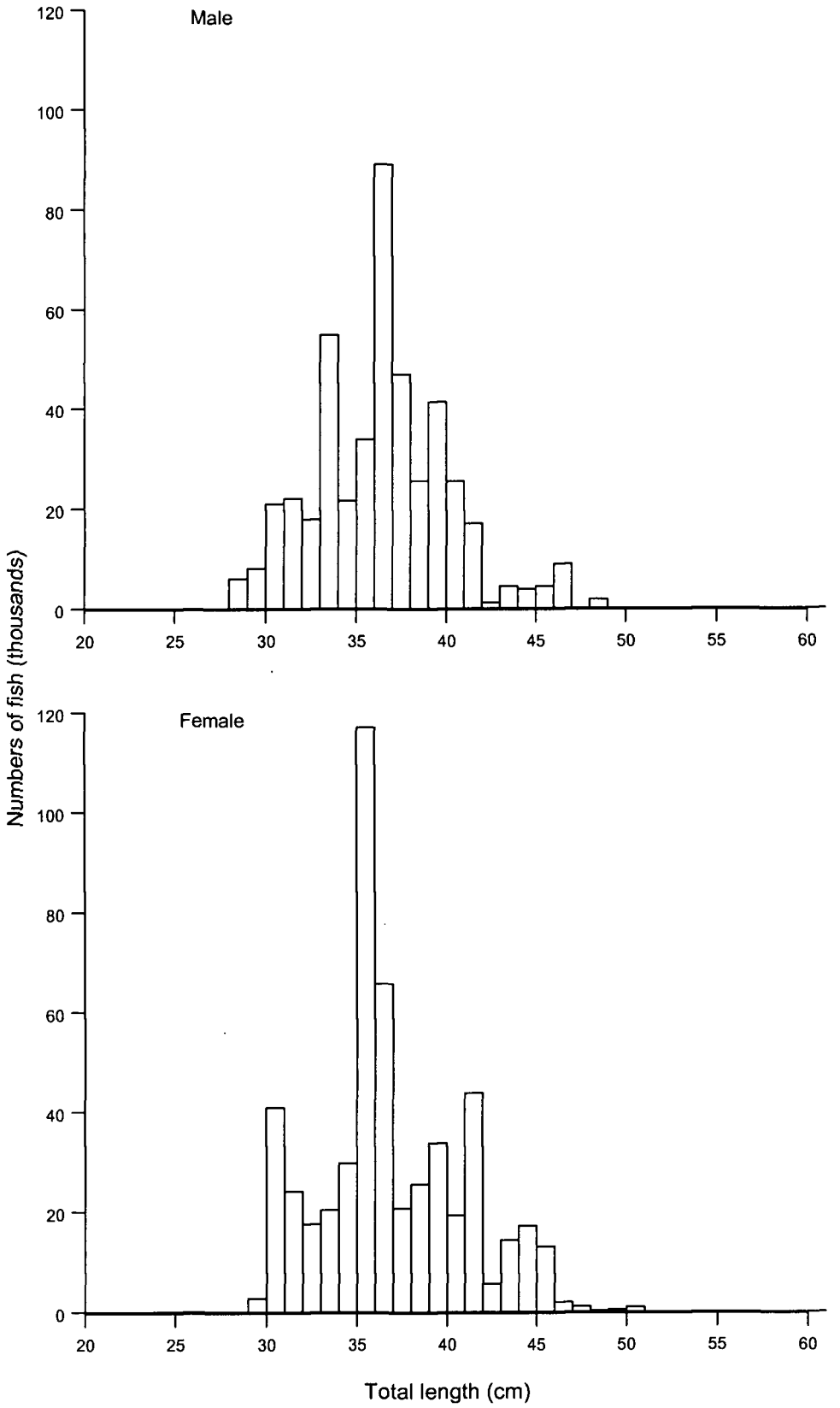

Figure 3: Estimated length-frequency distributions, by sex, of the red gurnard catch from GUR 2.

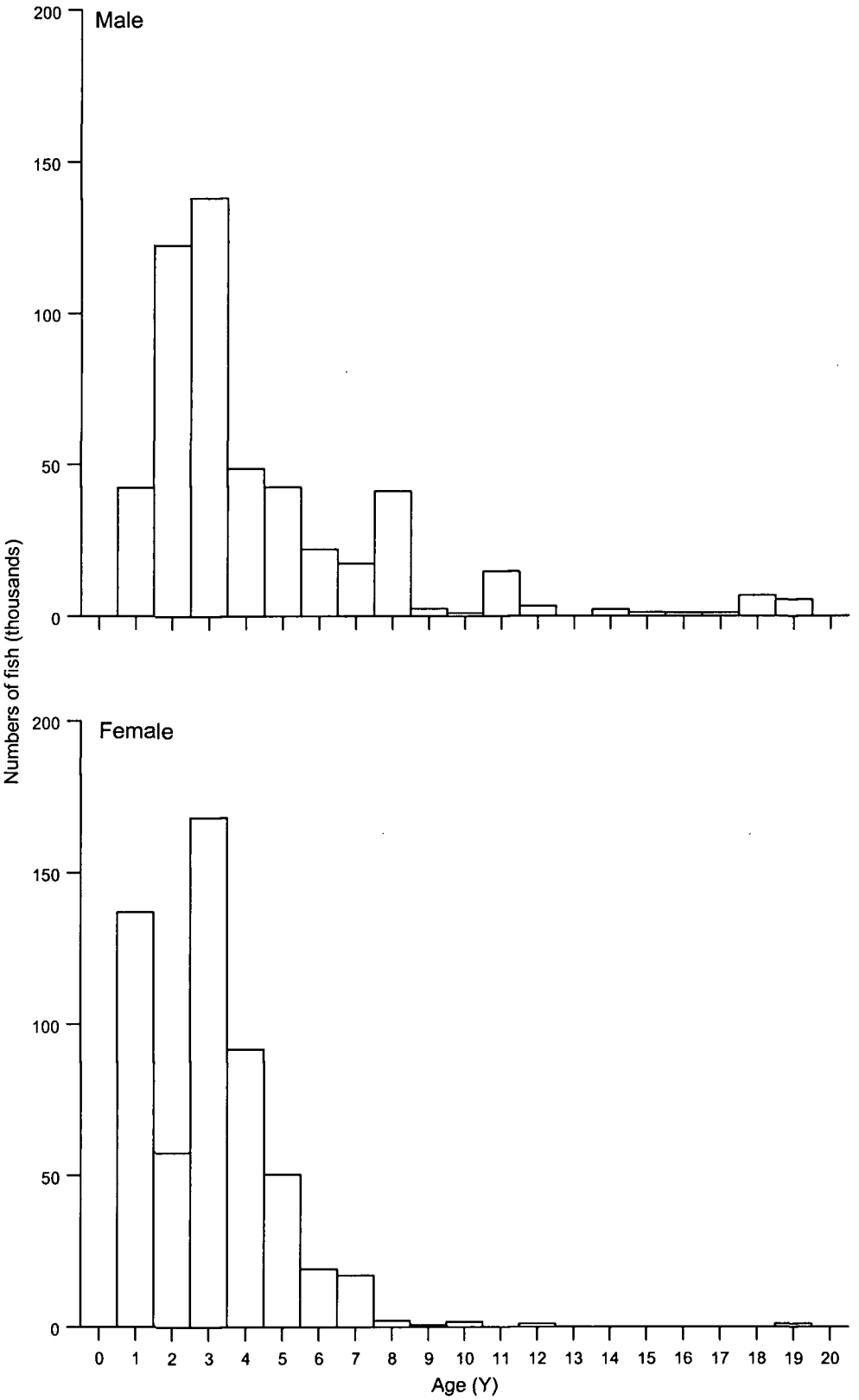

Figure 4: Estimated age-frequency distributions, by sex, of the red gurnard catch from GUR 2.

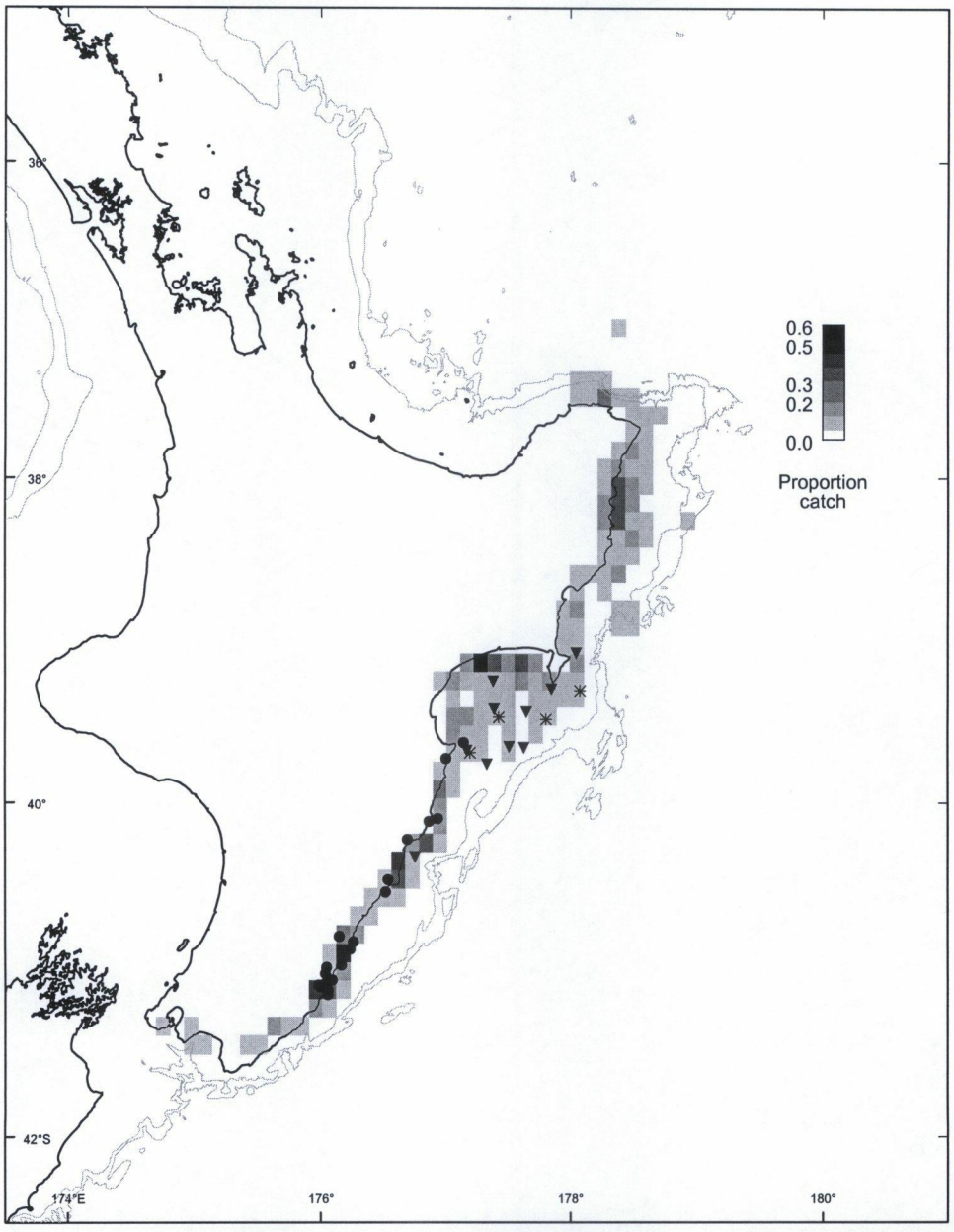

Figure 5: Red gurnard catch density by 0.1^0 squares and tow locations from different trips (symbols) of the sampled catch from vessels that filled out TCEPR records (linked to the CLR records by trip number).