MINISTRY OF FISHERIES

Te Tautiaki i nga tini a Tangaroa

Length and age composition of trevally (*Pseudocaranx georgianus*) in commercial landings from the TRE 1 purse-seine fishery, 2001–02

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EXECUTIVE SUMMARY

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During 2001–02, the trevally catch from the TRE 1 purse-seine fishery in the Bay of Plenty and east Northland was sampled to estimate the length and age composition from the fishery.

The length composition of the catch was characterised by a negatively skewed unimodal distribution, occupying the 35–50 cm F.L. length range with a modal peak at 45 cm F.L. The age composition comprised a wide range of age classes, dominated by 5–16 year age classes and a relatively high proportion of older fish (20+ years).

The results of sampling from 2001–02 are compared with the length and age compositions derived from the TRE 1 purse-seine catch from 1997–98 to 2000–01. The time series reveals a high level of inter-annual variability in the age composition of the catch. Nevertheless, the annual age compositions all include a relatively high proportion of older fish, suggesting that exploitation rates in recent years have not been high enough to affect this portion of the TRE 1 stock. The current time series of age frequency data will provide an important reference to compare future trends in the age composition of the catch from the fishery.

1. INTRODUCTION

The TRE 1 fishstock supports an important inshore fishery for trevally off northeastern North Island (Figure 1). The current TACC for TRE 1 is 1506 t and most of the catch is taken as either a bycatch of the snapper trawl fishery or by the target purse-seine fishery (Annala et al. 2002).

In 1997–98, the Ministry of Fisheries instigated a catch sampling programme to monitor the length and age composition of the main commercial trevally fisheries in TRE 1 and TRE 7. The programme initially included the single trawl and purse-seine fisheries in TRE 1 and the single trawl (peak season and off-peak) and pair trawl fisheries in TRE 7 (Walsh et al. 1999). The four method fisheries were resampled during the 1998–99 fishing year, though sampling of the off-peak TRE 7 fishery was discontinued (Walsh et al. 2000).

For the 1999–2000 fishing year, catch sampling was continued in the single trawl and purse-seine fisheries in TRE 1 and the peak-season single trawl fishery in TRE 7 (Langley 2001). In 2000–01, the TRE 1 purse-seine fishery and the TRE 7 single trawl fishery were sampled (Langley 2002). The time-series of age frequency data collected from the TRE 7 fishery represents an important input to the stock assessment for TRE 7 (Hanchet 1999, Maunder & Langley, unpublished results).

There is currently no stock assessment for the TRE 1 fishery (Annala et al. 2002). The Pelagic Working Group considered that in the absence of a reliable index of abundance for this fishstock the most appropriate approach for the monitoring of the fishery was to routinely determine the age composition of the catch from the commercial fishery. The three years of sampling from the TRE 1 single trawl fishery revealed a high level of inter-annual variability in the age composition of the catch that was attributed to the variability in the temporal and spatial distribution of the target trawl fisheries in TRE 1 (Langley 2001). Sampling of the single trawl fishery was discontinued in 2000–01, although annual sampling of the TRE 1 purse-seine fishery has been maintained to establish a time-series of age frequency data from the fishery.

This report provides a summary of the catch sampling data collected from the TRE 1 purse-seine fishery during the 2001–02 fishing year under the Ministry of Fisheries contract TRE2001/01. The report also provides a comparison of the time-series of length and age compositions derived from the fishery from 1997–98 to 2000–01.

2. METHODS

2.1 Sample collection

A two-stage sampling procedure was used to determine the length composition of the landed catch from the purse-seine fishery. The first stage in the sampling selection was the selection of all significant landed catches of trevally by purse-seine vessels. The target purse-seine fishery is essentially conducted by a single vessel and all catch is discharged to the Sanford Limited processing plant in Tauranga. The sampling regime required the sampling of all trevally purse-seine landings exceeding 10 t.

The second stage of the sampling procedure was the random selection of a sub-sample of the catch from each stratum within the individual landing. A stratum was defined as the catch held within one of the four separate fish holds (wells) used to store the catch on board the vessel. A random sample of two bins of trevally was selected from the top, middle, and bottom of each hold during discharge. All fish in the selected bins were measured to the nearest centimetre below the fork length F.L. The growth rate of trevally is comparable between sexes (James 1984) and, consequently, it was not necessary to determine the sex of the fish sampled.

Where possible, the individual landings were assigned to one of the two sub-areas of the TRE 1 fishery (east Northland and Bay of Plenty) (Figure 1). Landings were assigned to these areas based on the location of the trevally catch recorded on the Ministry of Fisheries catch and effort returns.

For each landing, the total weight of the landed catch of trevally and the sampled fraction were recorded.

2.2 Otolith collections and ageing

Otoliths were collected from two landings only due to the late notification of funding of the project by the Ministry of Fisheries. The otolith samples were taken from catches in the two separate fishery areas, the Bay of Plenty and east Northland, and there was eight months between the collection of the two samples.

The otolith sample was collected in accordance with a fixed allocation per length interval, with the allocation skewed towards the dominant length classes in the length composition. An initial target of 544 pairs of otoliths was required from the TRE 1 fishery, with 20 pairs of otoliths required per centimetre length class for the 32–50 cm main length range and 8 otoliths per length class for the peripheral length classes.

Ageing of the otolith collection was conducted by NIWA Ltd, in accordance with the procedures documented by Walsh et al. (1999). All otoliths were assigned an age at the assumed anniversary date of 1 January 2002.

2.3 Data analysis

Catch and effort data from each fishery-method were summarised to determine the total number of landings and cumulative weight of landings in the purse-seine fishery. These data were provided by the Information Group of the Ministry of Fisheries (Report No.4636).

Combined length compositions were determined for the fishery-method by scaling the individual samples by the weight of the landing. The c.v. of the estimate of the proportion at length for each length interval was determined following the statistical approach described by Davies & Walsh (1995). Separate amalgamated length compositions were also determined for the individual sub-areas of the fishery.

An age-length key was derived from the age readings of the TRE 1 otolith collection. The age-length key determines the proportion of fish at each age in each length interval (Gavaris & Gavaris 1983). The age-length key was applied to the amalgamated length frequency distribution to determine the estimate of the age composition for the individual method fishery. All fish older than 19 years were amalgamated in a single age class ("plus group"). The c.v. of the individual age classes was determined following the approach of Southward (1976). The overall precision of the age composition was calculated as the average coefficient of variation for each age class, weighted by the proportion of the fish in the interval (MWCV).

Von Bertalanffy growth parameter estimates were determined by least squares minimisation of the age-length dataset.

3. RESULTS

3.1 Sampling coverage

Eight landings were sampled from the TRE 1 purse-seine fishery during 2001-02. The sampled landings represented most of the significant landings (over 10 t) of trevally from the TRE 1 purse-seine fishery and accounted for 71% of the total TRE 1 catch taken by this method. A total of 3772 fish were measured from the sampled catch of 398 t. Otoliths were collected from two landings and 360 otoliths were aged (Appendix 1).

The sampled catch was all taken by a single vessel operating from the Tauranga branch of Sanford Limited (Appendix 1). Most of the landings were taken during October–November 2001 with two further landings sampled in January and September 2002. The final landing sampled was from a single catch from off the east Northland coast and the remainder of the sampled catches were taken in the Bay of Plenty (Appendix 1).

The fixed allocation otolith sample from the TRE 1 fishery required the collection of 20 otoliths per centimetre length class from the 32–50 cm F.L. length range, the length range that made up most of the sampled catch. For length classes beyond the extremes of this range, a target of 8 otoliths were to be collected from each length class. The target otolith sample was achieved for each length class within the 32–49 cm length range, although only a few otoliths were collected from the length classes beyond this range (Figure 2). All the otoliths collected were subsequently aged (see Appendix 4).

3.2 Length and age composition

The length composition of the 2001–02 TRE 1 purse-seine catch was characterised by a negatively skewed unimodal distribution, occupying the 35–50 cm F.L. length range with a modal peak at about 45 cm F.L. (Figure 3). The length composition was determined with moderate precision, with coefficients of variation of 10–25% for the main length classes (40–48 cm) and a MWCV of 27%. The level of variance in the estimates of the proportion at length is consistent with the observed variation in length composition between the individual landings sampled (see Appendix 5).

The Von Bertalanffy growth parameters derived from the TRE 1 otolith collection were: L_{inf}, 50.3 (standard error 0.697); k, 0.097 (s.e. 0.009); t_0, -8.2 (s.e. 0.906). The growth function is poorly defined at the younger age classes due to the absence of data from the 1 and 2 year age classes. The growth parameters are also strongly influenced by the relative weighting of the number of otoliths collected from each length class as determined by the fixed otolith sample allocation. Consequently, the resulting growth parameters should not be interpreted as defining the underlying growth function of the TRE 1 stock, but rather the best fit to the data from the otolith collection (Figure 4).

The estimated age composition of the 2001–02 TRE 1 purse-seine catch included a wide range of age classes and was dominated by 5–16 year age classes and a relatively high proportion of older fish (20+ years) (Figure 5). The age composition reveals the presence of a weak 1988 year class (age 13 years). The c.v. associated with the estimate of proportion at age is about 20–30% for the dominant 5–16 year age classes (Figure 5). The MWCV for the entire age composition is 28%.

4. DISCUSSION

This report summarises the results of the fifth successive year of length and age sampling of the purse-seine fishery in TRE 1. The programme sampled virtually all the catch from the fishery. However, the precision of the resulting estimates of the length and age frequency was slightly less than the target level of precision (MWCVs of 20%). The lower precision of the length frequency distribution was directly attributable to the high variation in the length structure between individual landings. However, the empirically determined measure of precision does not recognise the fact that
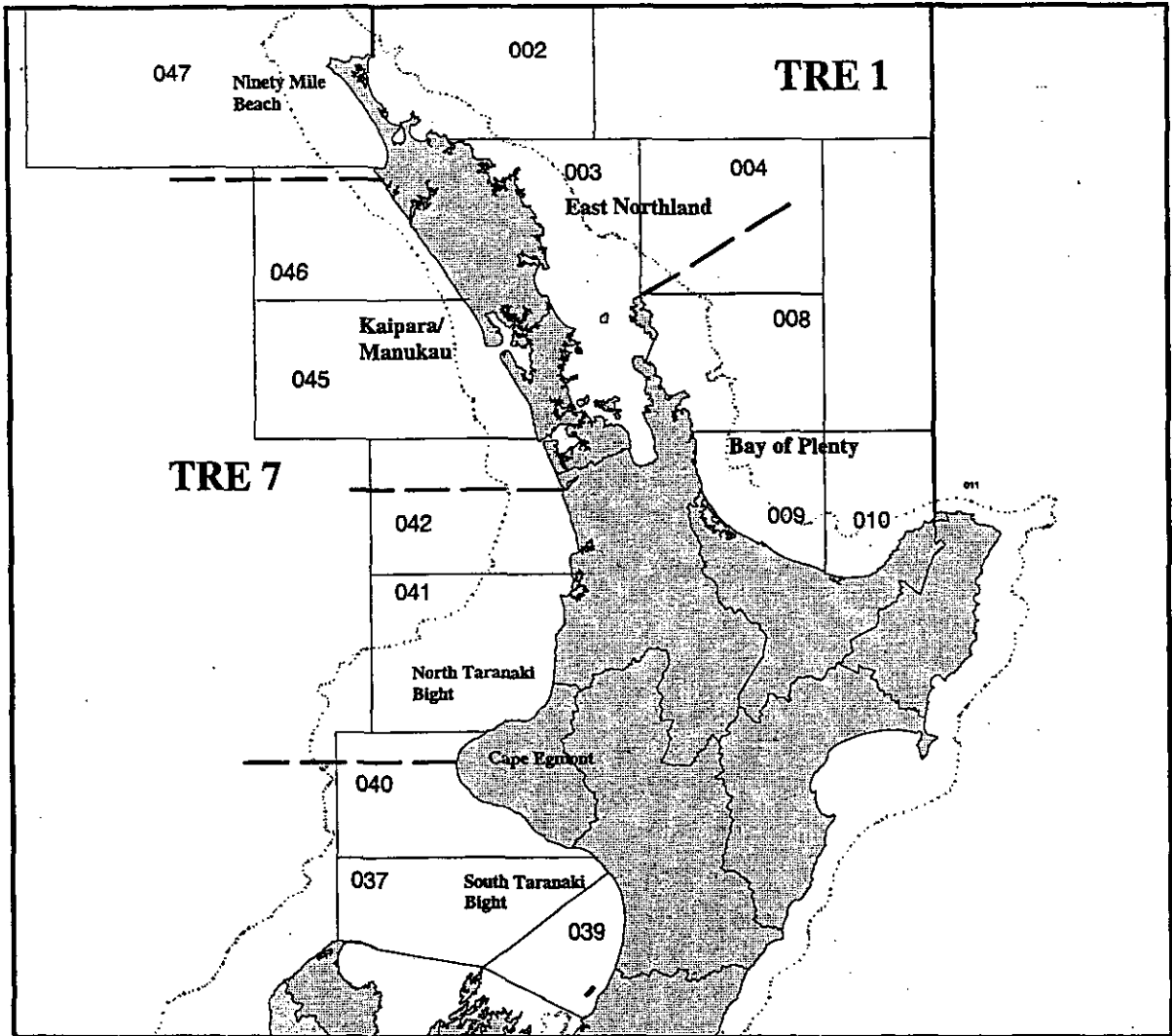
Figure 1: Map of the TRE 1 and TRE 7 fishstock areas including the sub-areas of each fishery and the Ministry of Fisheries statistical areas. The grey dotted line represents the 200 m depth contour.
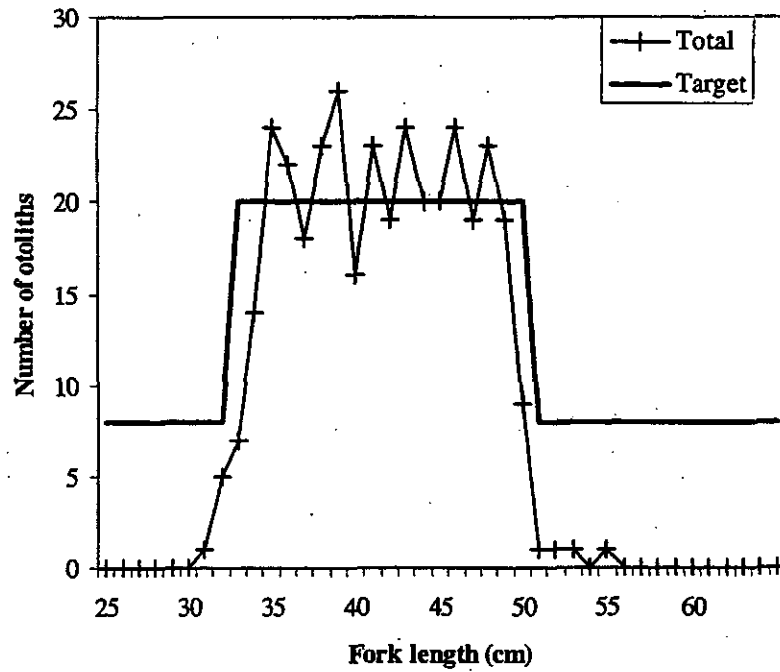
Figure 2: Length distribution of the target fixed allocation otolith sample (solid line) and the achieved otolith collection (crosses) for the 2001–02 TRE 1 purse-seine fishery.

virtually all the catch was sampled and, consequently, the actual length composition of the total fishery is known with a high level of certainty.

The level of precision for the age composition was less than from the previous year's sampling. This is mainly due to the smaller otolith sample, particularly for larger fish. The older age classes (17–19 and 20+ years) represented a significant component of the catch, although the precision of the estimates of the proportion in each age class was less than the target level. The required number of otoliths were collected from most of the main length classes comprising the aggregated length composition, although only a limited number of otoliths were collected from the larger (older) fish.

Otoliths were collected from two samples only and a high proportion of otoliths were collected from the single landing sampled from the east Northland area of TRE 1. This could introduce a bias to the resulting age composition if differences exist in the growth rate and/or relative year class strength between areas.

The annual length frequency distributions of the catch sampled from the TRE 1 purse-seine fishery from the five-year period were similar, with a strong unimodal distribution occupying the 30–50 cm F.L. length range and a modal peak at about 40–45 cm F.L. (Appendix 6).

Although there was no apparent trend in the amalgamated length composition of the purse-seine catch between years, there was a considerable inter-annual variation in the estimated age composition. From 1997–98 to 1999–2000, the proportion of fish in the 5–7 year age classes increased with a corresponding decline in the proportion of fish in the 10–13 year age classes (Appendix 6). However, the age compositions from 2000–01 and, in particular, 2001–02 were characterised by a broader distribution of age classes and a higher proportion of older fish. A decline in the proportion of fish with increasing age was evident in the 1999–2000 and 2000–01 age compositions but absent from the 2001–02 distribution. Further, while there is apparent variation in year class strength in the age compositions derived for each year, these variations in year class strength do not persist through consecutive years.

The monitoring of the length and age composition of the purse-seine catch from TRE 1 continued in 2002–03 under MFish project TRE2002/01. It was intended that monitoring the time series of age frequency data from the fishery would enable a qualitative assessment of the state of the TRE 1 stock. However, the high level of inter-annual variability in the age compositions from the purse-seine fishery, as previously observed for the single trawl fishery, limits the utility of these data to monitor short-term changes in the status of the fishery. Nevertheless, the relatively high proportion of older fish observed in all years suggests that recent and current exploitation rates for TRE 1 are not high. The current time series of age frequency data will provide an important reference to compare future trends in the age composition of the catch from the fishery. However, the frequency of future sampling should be reviewed with respect to the utility of the sampling data and the current management of the fishery.

5. ACKNOWLEDGMENTS

6. REFERENCES

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Appendix 1. Summary of individual landings sampled from the TRE 1 purse-seine fishery during 2001–02 fishing year

Sample number	Sampling date	No. fish measured	No. otoliths	Area(s) fished
1	08-Oct-01	316	-	Bay of Plenty
2	18-Oct-01	266	-	Bay of Plenty
3	25-Oct-01	668	-	Bay of Plenty
4	29-Oct-01	530	-	Bay of Plenty
5	19-Nov-01	491	-	Bay of Plenty
6	20-Nov-01	345	-	Bay of Plenty
7	08-Jan-02	318	176	Bay of Plenty
8	06-Sep-02	838	184	East Northland
Total		3 772	360	

Appendix 2. Estimates of the proportion at length of trevally from the TRE 1 purse-seine fishery in 2001–02.

Length (cm)	Prop.	c.v. (%)
20	0.0000	0.00
21	0.0000	0.00
22	0.0000	0.00
23	0.0000	0.00
24	0.0000	0.00
25	0.0000	0.00
26	0.0000	0.00
27	0.0000	0.00
28	0.0000	0.00
29	0.0000	0.00
30	0.0003	90.80
31	0.0002	95.06
32	0.0012	65.47
33	0.0042	54.13
34	0.0141	50.79
35	0.0254	51.87
36	0.0357	49.71
37	0.0456	51.77
38	0.0510	41.08
39	0.0495	34.85
40	0.0689	24.10
41	0.0679	13.84
42	0.0835	8.38
43	0.0936	17.96
44	0.1256	22.26
45	0.1005	25.80
46	0.0949	27.02
47	0.0546	30.14
48	0.0411	26.87
49	0.0176	25.22
50	0.0110	29.33
51	0.0061	40.34
52	0.0057	50.27
53	0.0009	54.21
54	0.0000	0.00
55	0.0011	48.19
56	0.0000	0.00
57	0.0000	0.00
58	0.0000	0.00
59	0.0000	0.00
60	0.0000	0.00
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
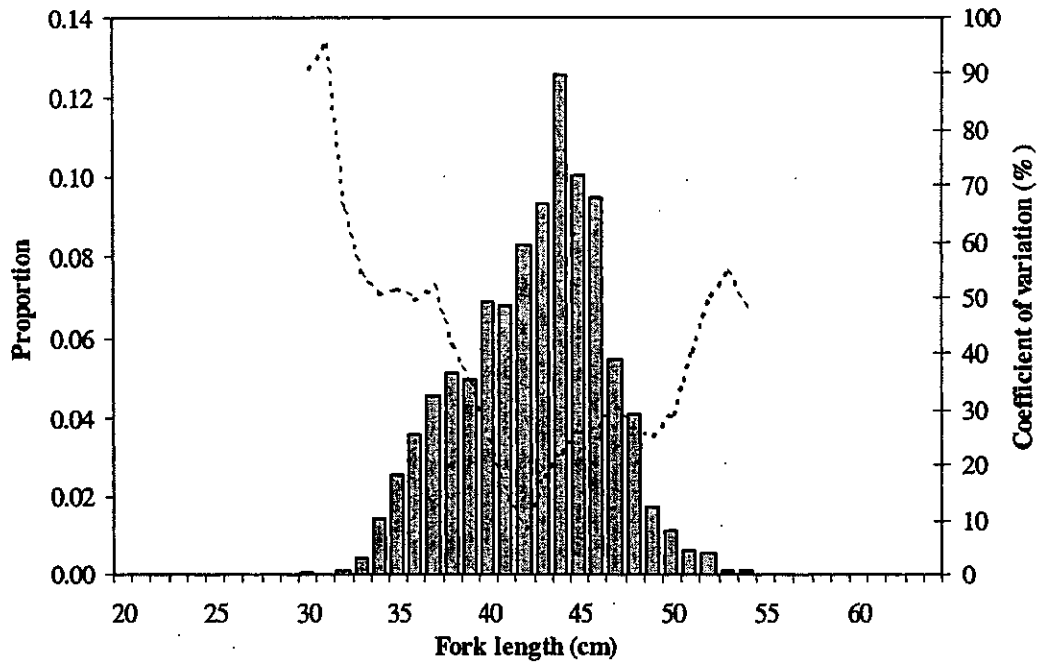
Figure 3: Length composition of the TRE 1 purse-seine catch from the 2001–02 fishing year. The dashed line represents the coefficient of variation associated with the estimates of proportion at length. Number of samples, 8; number of fish measured, 3772; MWCV, 27.4%.
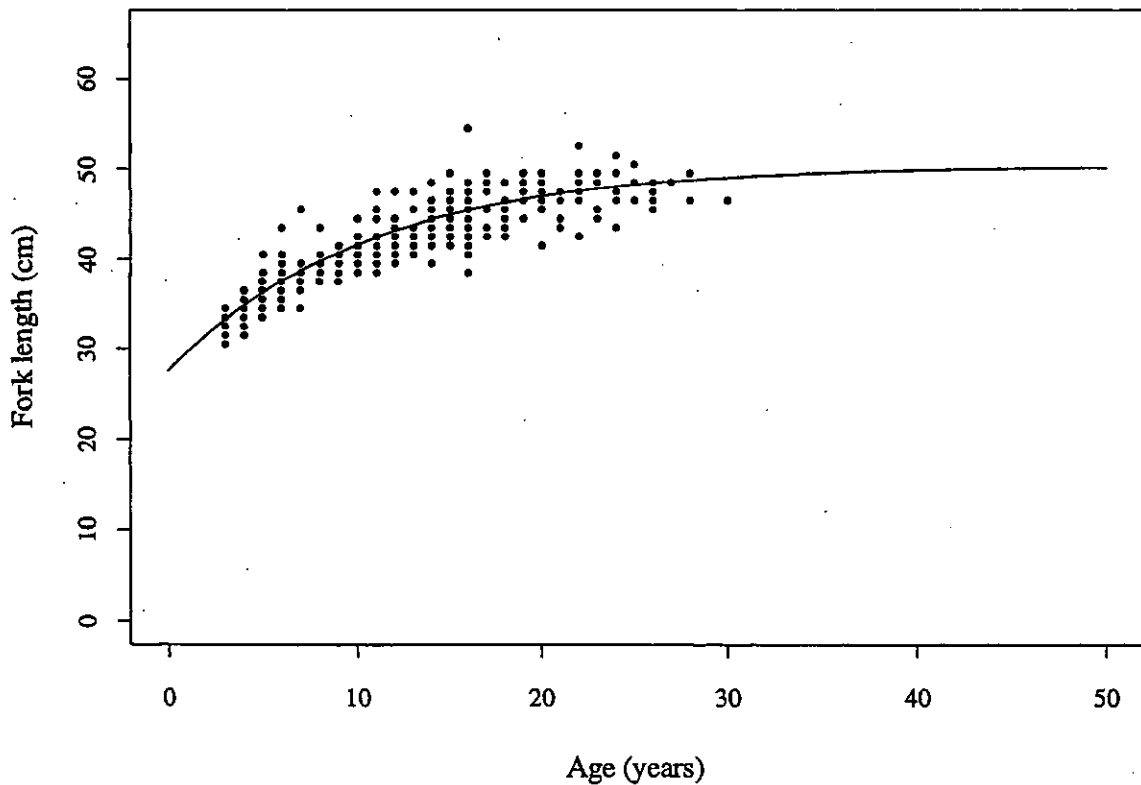
Figure 4: Relationship between age and length for trevally sampled from the 2001–02 TRE 1 fishery. The line represents the Von Bertalanffy growth function fitted to the data.
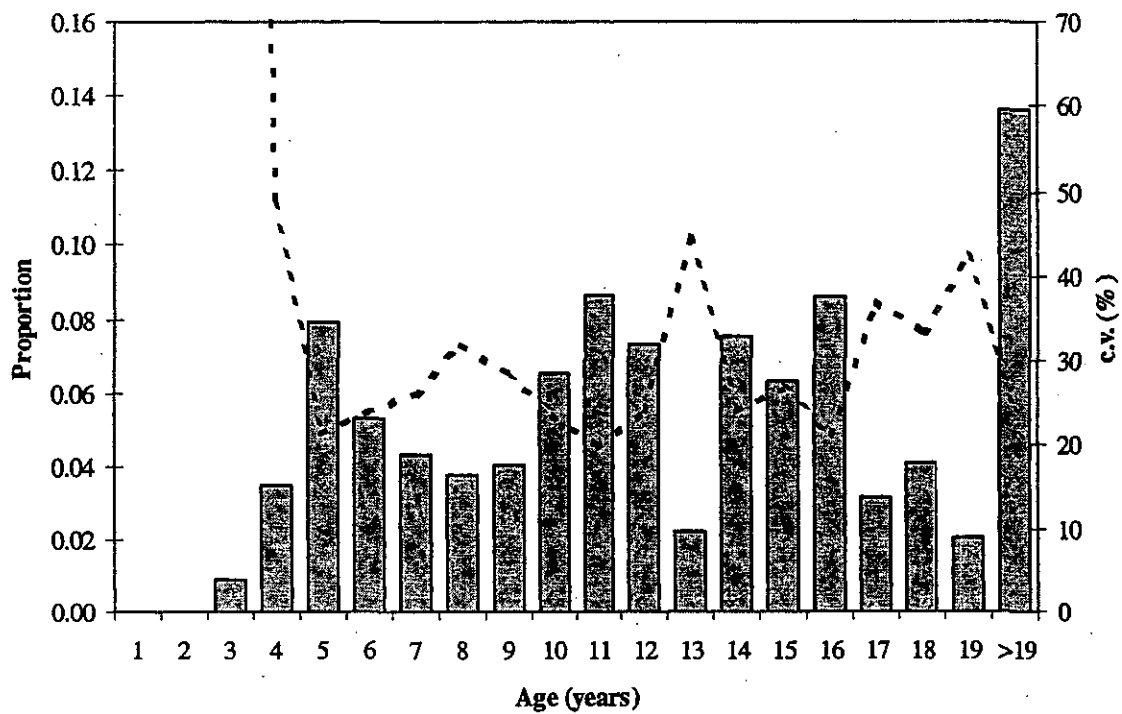
Figure 5: Age composition of the TRE 1 purse-seine catch for 2001–02. The dashed line represents the coefficient of variation associated with the estimates of proportion at age. Number of otoliths in the sample, 360; MWCV, 28.8%.

Appendix 3. Estimates of proportion at age trevally from the TRE 1 purse-seine fishery in 2001–02.

Age (years)	Prop.	c.v (%)
1	0.000	0.0
2	0.000	0.0
3	0.009	311.3
4	0.035	48.7
5	0.079	21.2
6	0.053	24.0
7	0.043	26.2
8	0.038	32.0
9	0.040	28.5
10	0.065	23.8
11	0.086	20.0
12	0.073	24.1
13	0.022	44.6
14	0.075	23.9
15	0.063	26.6
16	0.086	21.2
17	0.031	37.1
18	0.041	33.5
19	0.021	42.4
>19	0.136	23.4

Appendix 4. TRE 1 age-length key for the 2001–02 fishing year.

Length (cm)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	>19	No. Aged
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
32	0	0	0.80	0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
33	0	0	0.57	0.43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
34	0	0	0.29	0.57	0.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
35	0	0	0.04	0.79	0.08	0.04	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	24
36	0	0	0	0.05	0.77	0.18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
37	0	0	0	0.06	0.61	0.22	0.11	0	0	0	0	0	0	0	0	0	0	0	0	0	18
38	0	0	0	0	0.26	0.30	0.26	0.04	0.13	0	0	0	0	0	0	0	0	0	0	0	23
39	0	0	0	0	0.08	0.15	0.23	0.19	0.15	0.08	0.08	0	0	0	0	0.04	0	0	0	0	26
40	0	0	0	0	0	0.06	0.13	0.25	0.19	0.19	0.06	0.06	0	0.06	0	0	0	0	0	0	16
41	0	0	0	0	0.04	0.04	0	0.04	0.13	0.13	0.39	0.09	0.04	0	0	0.09	0	0	0	0	23
42	0	0	0	0	0	0	0	0	0.05	0.32	0.11	0.21	0.05	0.05	0.05	0.11	0	0	0	0.05	19
43	0	0	0	0	0	0	0	0	0	0.08	0.25	0.17	0.04	0.17	0.04	0.13	0.04	0.04	0	0.04	24
44	0	0	0	0	0	0.05	0.00	0.05	0	0	0	0.10	0.05	0.20	0.20	0.05	0.10	0.10	0	0.10	20
45	0	0	0	0	0	0	0	0	0	0.05	0.10	0.15	0	0.05	0.10	0.25	0	0.10	0.10	0.10	20
46	0	0	0	0	0	0	0.04	0	0	0	0.08	0	0.04	0.17	0.13	0.21	0.08	0.08	0	0.17	24
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0.05	0.05	0.05	0	0.11	0.05	0.68	19
48	0	0	0	0	0	0	0	0	0	0	0.04	0.04	0.04	0	0.09	0.04	0.13	0	0.09	0.52	23
49	0	0	0	0	0	0	0	0	0	0	0	0	0	0.11	0	0.05	0.05	0.05	0.16	0.58	19
50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.11	0	0.11	0	0.11	0.67	9
51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	1
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	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
Total	0	0	14	33	41	23	18	12	14	17	25	17	6	18	15	23	10	10	9	55	360

Appendix 5. Length frequency distributions for individual landing sampled from the TRE 1 purse seine fishery.

Proportion at length

Length (F.L.) cm
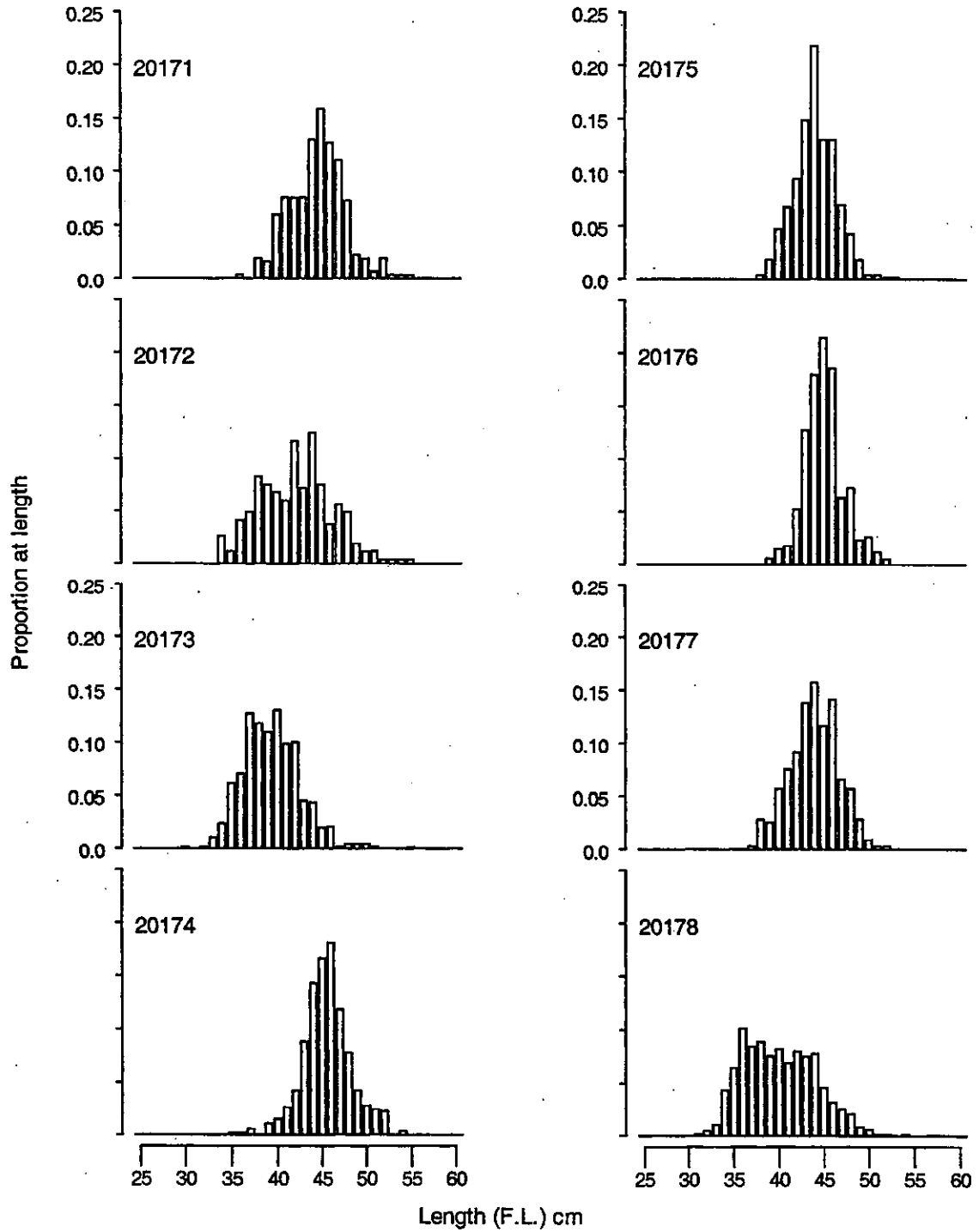
Appendix 6. Estimates of length and age composition of the catch from the TRE 1 purse-seine fishery for the 1997–98 to 2001–02 fishing years. Data from 1997–98 and 1998–99 were sourced from Walsh et al. (1999, 2000), and 1999–2000 and 2000–01 are from Langley (2001, 2002).