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Tini a Tangaroa

Commercial catch sampling for species proportion, sex, length, and age of jack mackerels in JMA 7 in the 2015–16 fishing year, with a summary of all available data sets

New Zealand Fisheries Assessment Report 2018/46

P.L. Horn
D. Hulston
C. Ó Maolagáin

ISSN 1179-5352 (online)
ISBN 978-1-98-857121-8 (online)

November 2018

New Zealand Government

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EXECUTIVE SUMMARY

Horn, P.L.; Hulston, D.; Ó Maolagáin, C. (2018). Commercial catch sampling for species proportion, sex, length, and age of jack mackerels in JMA 7 in the 2015–16 fishing year, with a summary of all available data sets.

***New Zealand Fisheries Assessment Report 2018/46*. 24 p.**

This report describes the scientific observer sampling programme carried out on trawl landings of jack mackerel (*Trachurus novaezelandiae*, *T. declivis*, and *T. murphyi*) in JMA 7 (central west coast) during the 2015–16 fishing year, and the estimates of species proportions and sex ratios in the landings, catch-at-length, and catch-at-age for these species.

Each tow in the observer data set included estimated total jack mackerel catch and weights by species sampled from the tow. The sampled weights were scaled to give estimated total catch weights by species for the tow. Stratification of the data was required because the observer coverage and catch composition varied with both month and statistical area. About 90% of the 2015–16 landed catch was sampled, and sampling was found to be representative of the landings both temporally and spatially.

For all three species, the scaled length distributions from 2015–16 were similar to those from the nine previous years. The age-frequency distributions for all species in 2015–16 had mean weighted CVs of 20% or less, which more than met the target of 30%. There was clear variation in catch-at-age between years for all species probably because of the progression of year classes with different relative strengths.

Estimated species proportions showed a dominance by *T. declivis* at 61–71% in the JMA 7 TCEPR catch for all statistical areas and the ten years of sampling, while *T. novaezelandiae* was 24–33% and *T. murphyi* was 3–8%.

1. INTRODUCTION

Commercial catches of jack mackerel are recorded as an aggregate of the three species (*Trachurus declivis*, *T. murphyi*, and *T. novaezelandiae*) under the general code JMA, so catch information for the separate species is not available from Fisheries New Zealand databases for the jack mackerel quota management areas (Figure 1). Estimates of proportions of the three *Trachurus* species in the catch are essential for assessment of the individual stocks. Reliable estimates of species proportions can be used to apportion the aggregated catch histories to provide individual catch histories for each species at least back to when observer sampling began, which can in turn be used to scale age samples from the various fisheries. Since the mid-2000s the JMA 7 fishery was primarily a trawl fishery with a small proportion of catches made using purse seine or set net. Before then, larger proportions of the catch came from purse seine fishing (Taylor & Julian 2008).

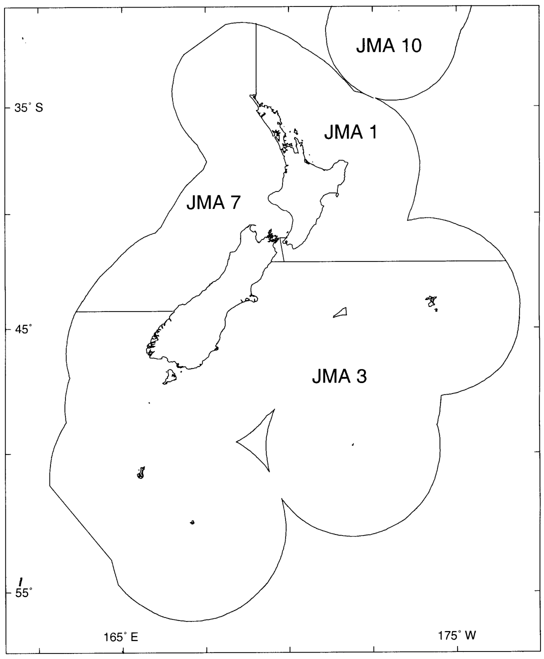

Figure 1: Jack mackerel administrative Fishstock areas.

This report provides estimates of relative proportions and catch-at-age for the three *Trachurus* species in the commercial JMA 7 catch for 2015–16 using observer data. Similar data were presented by Taylor et al. (2011) for 2006–07, 2007–08 and 2008–09, Horn et al. (2012a) for 2009–10, Horn et al. (2012b) for 2010–11, Horn et al. (2013) for 2011–12, Horn et al. (2014b) for 2012–13, Horn et al. (2015) for 2013–14, and Horn et al. (2017) for 2014–15. Summaries of the time series of catch-at-age estimates, sex ratios and species proportions for the JMA 7 catch are also presented. This document fulfils the reporting requirements relating to jack mackerels in objective 1 of Project DEE201620 "Routine age determination of hoki and middle depth species from commercial fisheries and trawl surveys", funded by the Ministry for Primary Industries (now Fisheries New Zealand). That objective is "To determine catch-at-age for commercial catches and resource surveys of specified middle depth and deepwater fishstocks".

The JMA 7 age and size structure of the commercial catch was determined annually since 2006–07. A 'one-off' estimation of the age and size structure of the commercial catch of jack mackerels in JMA 3 in the 2012–13 fishing year was reported by Horn et al. (2014a).

Age monitoring of jack mackerels was carried out previously for jack mackerel species in New Zealand by Horn (1993) who tracked strong and weak age classes of *T. declivis* and *T. novaezelandiae* through time to provide a qualitative validation for ageing these two species. There was no significant difference in growth between sexes for either species although geographical differences were evident between the Bay of Plenty and the central west coast.

2. METHODS

Catch sampling for length, sex, age, and species composition was carried out by observers primarily working on board large trawl vessels targeting jack mackerels. Sampling was generally carried out according to instructions developed at NIWA and included in the Scientific Observers Manual. Most tows in the observer dataset included estimated total jack mackerel catch and weights by species sampled from the tow. All observer data on jack mackerels sampled from JMA 7 in the 2015–16 fishing year were extracted for the analyses. As in previous analyses, estimated species proportions (by weight) in each sampled tow were assumed to be the same as the proportions in a randomly selected sample from the catch (Taylor et al. 2011). The observer data were examined for spatial and temporal variability, and this was compared with the spatial and temporal distribution of the entire commercial JMA 7 catch.

Commercial catch data extracted from the Ministry for Primary Industries catch-effort database "warehou" (Extract #11008 on 21 March 2017) were used in these analyses. The data comprised estimated catch and associated date, position, depth, and method data from all fishing events that recorded catches of jack mackerel from JMA 7 (i.e., FMAs 7, 8, and 9) in 2015–16.

Stratification of the data was required because the observer coverage varied with both month and statistical area, the fishery was not consistent throughout the year, and the species composition varied across area and depth (Taylor et al. 2011). The stratification used for years 2006–07 to 2013–14 was derived by Taylor et al. (2011) based on data from the first three years of that series (shown in appendix A of Horn et al. (2012b)). The stratification was re-evaluated in 2016 by Horn et al. (2017) and found to be little different to that developed by Taylor et al. (2011). The 2016 stratification (shown in appendix A of Horn et al. (2017)) was adopted, and was used again in the analysis of the 2015–16 data presented here. Consequently, each fishing event from the catch-effort dataset and the observer dataset was allocated to one of the five strata, i.e.,

- west of longitude 173.15° E (west coast South Island and deeper west coast North Island waters),
- Statistical Area 041 (north Taranaki Bight) shallower than 120.25 m,
- Statistical Area 041 (north Taranaki Bight) deeper than 120.25 m,
- all remaining areas in March and April,
- all remaining areas in October–February and May–September.

Proportions of the catch by species were estimated as follows. For each observed tow, the catch weight of each species was estimated based on the species weight proportions of a random sample. Each observed tow was allocated to one of the five strata. Within each stratum, the estimated landed weights of each species were summed across all observed tows. Percentages of catch by species were then calculated for each stratum. Total jack mackerel catch by stratum was obtained by summing the reported estimated landing weights of all tows (from the catch-effort dataset) in that stratum. The species percentages derived for that stratum were then applied to the total summed catch to estimate catch by species in that stratum. The estimated catch totals were then summed across strata (by species) to produce total estimated catch weight by species for the fishing year, and, consequently, total species proportions by weight.

Ageing was completed for all three *Trachurus* species caught by trawl in Statistical Areas 033–047 and 801 of JMA 7 (Figure 2) in the 2015–16 fishing year, using data and otoliths collected by observers. For each species, samples of otoliths (for each sex separately) from each 1 cm length class were selected approximately proportionally to their occurrence in the scaled length frequency, with the constraint that the number of otoliths in each length class (where available) was at least one. In addition, otoliths from fish in the extreme right hand tail of the scaled length frequency (constituting about 2% of that length frequency) were over-sampled. Target sample sizes were about 500 per species. Sets of five otoliths were embedded in blocks of clear epoxy resin and cured at 50°C. Once hardened, a 380 μm thin transverse section was cut from each block through the primordia using a high-speed saw. The thin section was washed, dried, and embedded under a cover slip on a glass microscopic slide. Thin sections were read with a bright field stereomicroscope at up to ×100 magnification. Zone counts were based on the number of complete opaque zones (i.e., opaque zones with translucent material outside them), which were counted to provide data for age estimates. Otoliths of *T. declivis* and *T. novaezelandiae* were read following the validated methods described by Horn (1993) and Lyle et al. (2000). A validated ageing method has not yet been developed for *T. murphyi* in New Zealand waters (Beentjes et al. 2013). Otoliths from this species were interpreted similarly to those of *T. declivis*. However, they are notably harder to read, with presumed annual zones often being diffuse, split, or containing considerable microstructure (Taylor et al. 2002).

The age data were used to construct age-length keys (by species and sex) which in turn were used to convert the weighted length composition of the catch to catch-at-age by sex using the NIWA catch-at-age software (Bull & Dunn 2002). This software also provided estimates of CVs-at-age using a bootstrap procedure. Sex ratios by species were also derived at this stage.

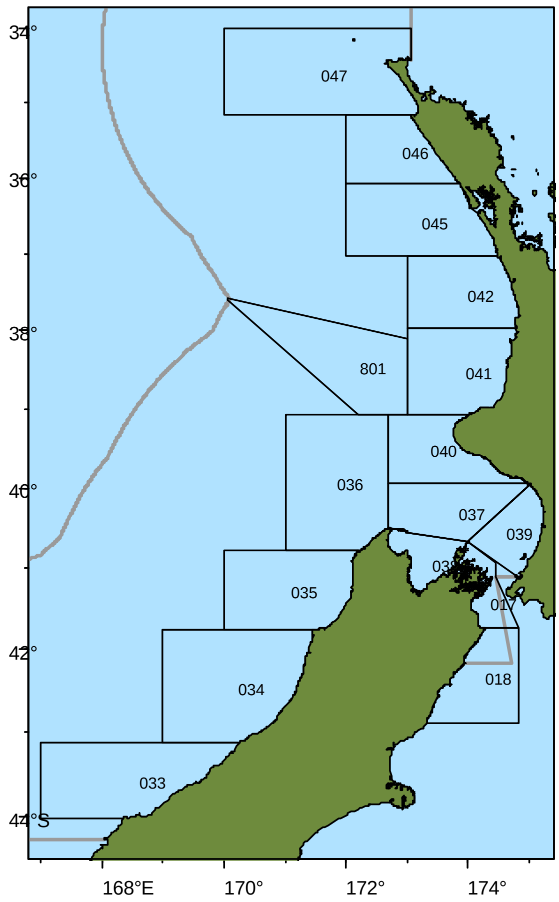

Figure 2: Statistical Areas referred to in the text.

3. RESULTS

3.1 Catch sampling

The landings distribution in 2015–16 shows that there was a fishery from October to January concentrated in Statistical Areas 037 and 040–042, followed by a secondary fishery centred around June and concentrated off the northwest South Island (Areas 034–036) in June–August and to a lesser extent in the South Taranaki Bight (Area 037) in April–June (Table 1). Because the two fishery peaks were quite widely separated in time it was considered desirable to split the year into two equal parts (i.e., a split between March and April), and use separate age-length keys for each part (to account for the growth of fish, particularly of the younger age classes). In each time period, the data were analysed in the five strata described above.

In 2015–16, about 90% of the landed weight was sampled by observers (Table 1). Most of the estimated landings were derived from five Statistical Areas (035, 037, 040–042), and these were all well sampled (Figure 3). The percentages of the catch sampled in the five most productive months were all greater than 79% (Table 1), and no months could be considered under-sampled. Clearly, the sampling of the whole fishery was satisfactory to estimate the overall catch-at-age. The estimated catch weight sampled in some months and areas was slightly greater than the estimated catch. This can occur if observers and skippers record different estimated catch weights for a tow, or if the recorded location of an individual tow differs in the two databases resulting in it being allocated to different statistical areas.

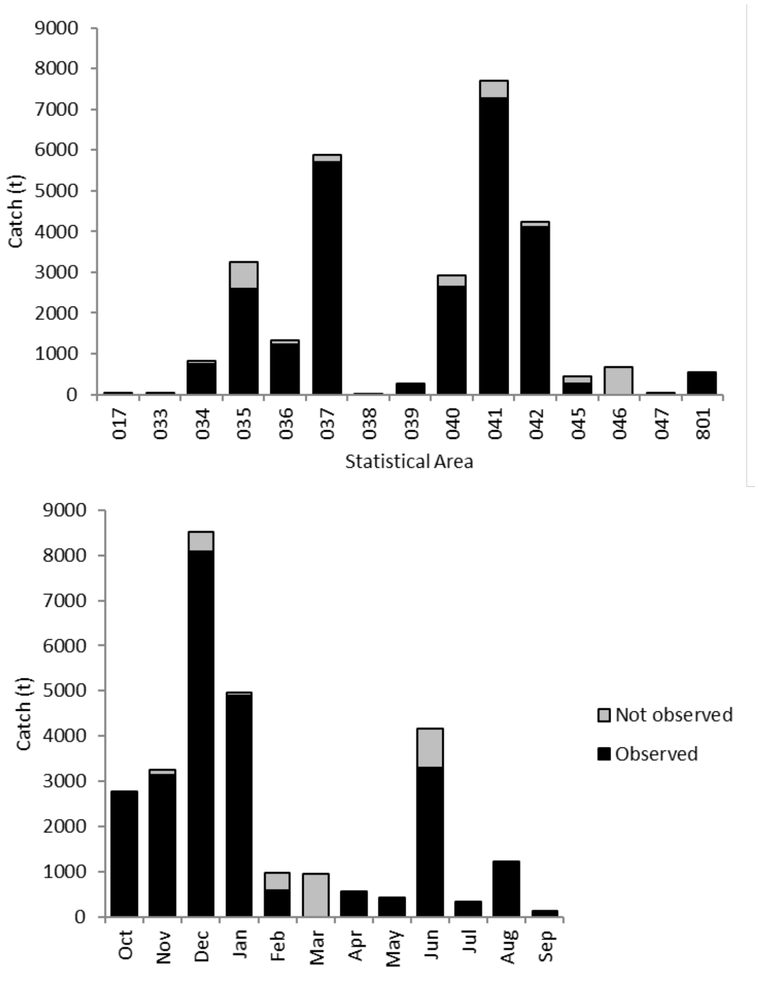

Figure 3: Jack mackerel observed landings and landings that were not observed, by Statistical Area and month, in 2015–16.

Table 1: Distribution of estimated total catch and sampled landings (t, rounded to the nearest tonne) of jack mackerels, by month and Statistical Area (Stat Area), in the 2015–16 fishing year. Values of 0 indicate landings from 1 to 499 kg; blank cells indicate zero landings or samples. %, percentage of estimated total catch that was sampled by observers, by month and statistical area.

Estimated total catch (t), 2015–16

Stat Area												Month
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	All
017	3	2	2	0	1	3	3	2	2	0	0	0	17
033	5	9	4	7	3	3	3	1	2	0	0	13	50
034	9	2	1	2	1	2	1	1	154	144	455	44	815
035	291	3	0	0	0	0	0	0	2 024	177	708	60	3 263
036	83	2	0	0	0	0	0	211	1 003	0		10	1 337
037	360	135	1 164	2 698	626	0	382	48	470			1	5 884
038	5	1	0	0	0	0	0	0	1	0	0	1	9
039	1	0	8	74	4	0	139	10	0	0	3	1	241
040	202	231	695	1 398	284	0	6	15	80	0	0	0	2 911
041	763	875	4 992	785	0	137	0	1	159	0	0	0	7 713
042	713	1 878	1 653	0	0	0	0	0	0	0	0	0	4 245
43–44	0	0	0	0			0	0	0	0	0	0	0
045	133	124	0	0	0	185	0		0	0	0	1	443
46–47	2	0	0	0	60	615	1	0	0	0	3	1	683
801			0	0		0	0	132	259	0			547
All	2 725	3 261	8 521	4 964	979	944	537	422	4 152	321	1 198	131	28 156

Sampled landings (t)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	All	%
017					0	0	3	0	0				7	41
033													0	0
034	0							2	109	140	482	22	754	93
035	274							0	1 399	173	693	51	2 590	79
036	119				0		0	202	890		14		1 235	92
037	225	126	1212	2909	404	0	393	56	387				5 713	97
038													0	0
039				71	0		137	7					263	109
040	129	205	697	1250	176	0	30	15	149				2 650	91
041	979	879	4 580	665		0	0	16					7 269	94
042	749	1 814	1 552	0	0	0	0	0	0			0	4 116	97
43–44														0
045	150	110		0	0	0	0	0			0		261	59
46–47		0					0	0			0	1	6	1
801	144		0	0		0	0	132					484	88
All	2 769	3 135	8 089	4 895	581	0	563	429	3 296	312	1 194	84	25 348	90
%	102	96	95	99	59	0	105	102	79	97	100	64	90	

3.2 Species proportions

An examination of estimated species proportions by fishing year (Table 2) shows that *T. declivis* (JMD) was the dominant species caught from 2006–07 to 2015–16, with 61–71% of landed weight in all years. *T. novaezelandiae* (JMN) was the second most frequently caught species at 24–33%. *T. murphyi* (JMM) was detected at a much lower and quite variable rate of 3–8%. The 2015–16 fishing year produced proportions of *T. declivis* and *T. novaezelandiae* that were close to the average of all years investigated.

Table 2: Estimated species proportions (by weight) and catch weights by species in JMA 7 since 2006–07. 'Estimated catch' is the sum of all the tow-by-tow estimates of jack mackerel catch.

	Species proportions (%)			Estimated catch (t)			Landed catch (t)		
Fishing year	JMD	JMN	JMM	JMD	JMN	JMM	JMD	JMN	JMM
2006–07	69.5	26.8	3.7	21 248	8 188	1 128	22 273	8 583	1 183
2007–08	64.8	27.0	8.2	21 033	8 763	2 671	22 064	9 193	2 802
2008–09	66.4	25.3	8.3	17 943	6 826	2 236	19 154	7 287	2 387
2009–10	65.9	27.6	6.5	19 487	8 155	1 933	20 526	8 590	2 036
2010–11	70.6	26.9	2.5	18 679	7 123	650	19 897	7 587	692
2011–12	68.6	28.1	3.3	18 184	7 456	880	19 381	7 497	938
2012–13	67.3	29.7	3.3	19 525	8 638	950	21 311	9 428	1 037
2013–14	70.7	24.3	5.0	23 144	7 961	1 626	24 872	8 555	1 748
2014–15	60.7	33.0	6.3	19 231	10 447	1 999	20 623	11 204	2 144
2015–16	65.0	28.4	6.6	18 312	7 999	1 845	20 080	8 771	2 024

3.3 Sex ratios

Sex ratios by fishing year since 2006–07 are shown in Table 3. Ratios were around 50% for *T. declivis* and *T. novaezelandiae*, although *T. novaezelandiae* consistently had more females than males. The sex ratios for *T. murphyi* indicate a sampled population quite strongly biased towards males (i.e., 54–62% from 2006–07 to 2013–14), although since 2014–15 the samples had almost equal proportions.

Table 3: Estimated sex ratios (%) in the JMA 7 catch by species and fishing year.

	JMD		JMN		JMM	
Fishing year	Males	Females	Males	Females	Males	Females
2006–07	51.6	48.4	49.5	50.5	54.8	45.2
2007–08	51.7	48.3	43.0	57.0	60.7	39.3
2008–09	52.5	47.5	45.7	54.3	56.9	43.1
2009–10	51.5	48.5	49.1	50.9	54.3	45.7
2010–11	46.8	53.2	43.4	56.6	56.9	43.1
2011–12	47.7	52.3	48.0	52.0	61.6	38.4
2012–13	50.8	49.2	50.0	50.0	55.3	44.7
2013–14	51.2	48.8	45.4	54.6	57.6	42.4
2014–15	46.2	53.8	44.5	55.5	50.2	49.8
2015–16	50.7	49.3	46.2	53.8	48.3	51.7

3.4 Catch-at-length

The estimated catch-at-length distributions, by species, for trawl-caught jack mackerel from JMA 7 in 2015–16 are plotted in Figure 4. For *T. novaezelandiae* there was a dominant length mode at 28–32 cm, with a minor secondary mode at 15–17 cm. For *T. declivis* there was a strong length mode at 43–45 cm, and secondary modes at about 17–19 cm and 21–25 cm. One other mode (39–41 cm) was also apparent in the male distribution. The length range of *T. murphyi* was very narrow, with most males being 48–53 cm, and most females being 47–52 cm.

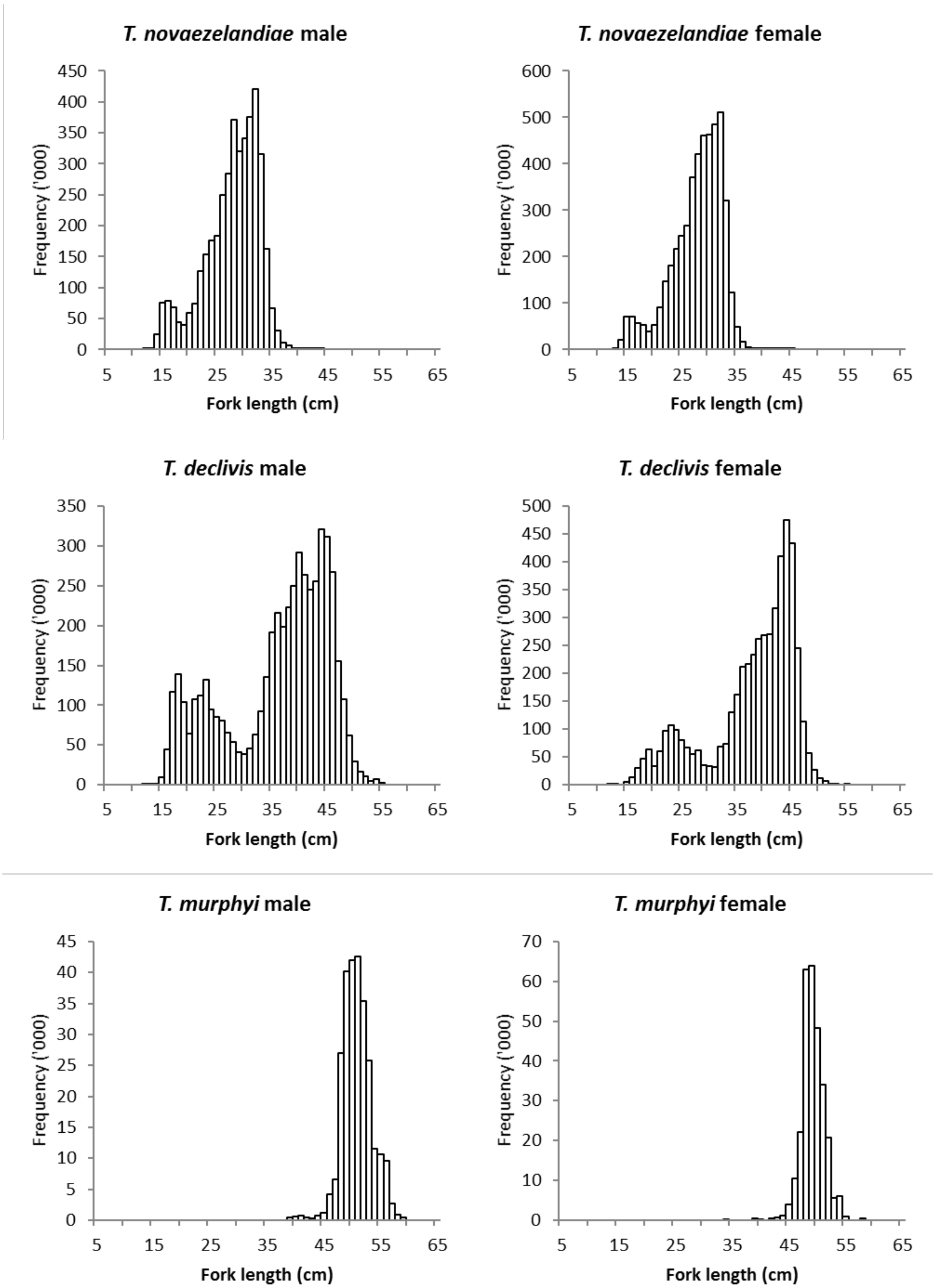

Figure 4: Estimated catch-at-length distributions, by species and sex, from JMA 7 in 2015–16.

3.5 Catch-at-age

The details of the estimated catch-at-age distributions for trawl-caught jack mackerel from JMA 7 in 2015–16 are presented for *T. novaezelandiae* in Table 4, *T. declivis* in Table 5, and *T. murphyi* in Table 6. The mean weighted CVs for *T. novaezelandiae* (19%), *T. declivis* (20%), and *T. murphyi* (19%) were all well below the target value of 30%. The estimated distributions are plotted in Figure 5. The catch of *T. novaezelandiae* was dominated by 2–11 year old fish, with very few fish older than 15 years. The catch of *T. declivis* had abundant fish aged 1–14 years old, but with a relatively strong drop-off in fish older than 15 years. The catch of *T. murphyi* was dominated by 16–23 year old fish, with very few fish younger than 13 or older than 23 years.

Table 4: Calculated numbers-at-age, separately by sex, with CVs, for *Trachurus novaezelandiae* caught during commercial trawl operations in JMA 7 during the 2015–16 fishing year. Summary statistics for the sample are also presented. –, no data.

Age (years)	Male	CV	Female	CV	Total	CV
1	28 275	0.952	23 156	1.182	51 431	0.857
2	147 003	0.659	227 406	0.536	374 409	0.500
3	211 925	0.415	135 182	0.480	347 107	0.364
4	216 459	0.313	341 771	0.256	558 230	0.219
5	284 133	0.240	331 523	0.257	615 655	0.195
6	350 473	0.215	436 876	0.209	787 349	0.154
7	475 853	0.180	599 785	0.160	1 075 638	0.119
8	587 842	0.146	623 994	0.157	1 211 835	0.104
9	389 890	0.207	626 772	0.153	1 016 662	0.123
10	441 966	0.172	394 044	0.202	836 010	0.134
11	308 663	0.201	267 751	0.200	576 413	0.142
12	96 996	0.387	232 842	0.241	329 839	0.206
13	86 658	0.377	112 396	0.309	199 054	0.242
14	83 688	0.365	69 265	0.415	152 955	0.281
15	179 446	0.252	84 340	0.378	263 786	0.212
16	68 246	0.384	51 741	0.554	119 987	0.315
17	33 336	0.596	31 242	0.501	64 577	0.409
18	26 909	0.610	71 807	0.441	98 716	0.348
19	16 859	0.912	46 266	0.488	63 125	0.419
20	20 038	0.713	25 207	0.701	45 246	0.510
21	6 676	0.771	2 528	0.729	9 203	0.606
22	0	–	0	–	0	–
23	3 464	0.813	954	0.945	4 416	0.697
24	0	–	0	–	0	–
25	0	–	2 919	1.043	2 919	1.043
26	1 155	3.131	4 023	2.277	5 178	1.853
No. measured		11 176		12 809		23 7985
No. aged		252		279		531
No. of tows sampled						311
Mean weighted CV (%)		26.1		25.0		19.1

Table 5: Calculated numbers-at-age, separately by sex, with CVs, for *Trachurus declivis* caught during commercial trawl operations in JMA 7 during the 2015–16 fishing year. Summary statistics for the sample are also presented. –, no data.

Age (years)	Male	CV	Female	CV	Total	CV
0	7 932	1.565	1 004	2.440	8 937	1.410
1	479 789	0.596	196 661	0.475	676 449	0.532
2	312 160	0.428	161 073	0.591	473 234	0.406
3	289 613	0.348	274 000	0.467	563 613	0.309
4	276 674	0.313	391 761	0.239	668 436	0.207
5	574 325	0.175	376 066	0.227	950 392	0.140
6	471 676	0.189	371 841	0.205	843 516	0.140
7	452 961	0.148	591 311	0.143	1 044 272	0.104
8	527 659	0.140	313 315	0.219	840 975	0.116
9	323 306	0.177	440 631	0.147	763 937	0.110
10	268 218	0.187	293 417	0.176	561 635	0.128
11	238 027	0.234	348 722	0.177	586 748	0.142
12	227 798	0.209	352 881	0.179	580 680	0.138
13	213 374	0.225	166 962	0.240	380 337	0.170
14	190 450	0.204	249 076	0.216	439 526	0.152
15	72 351	0.398	226 877	0.238	299 227	0.210
16	42 382	0.460	61 932	0.437	104 314	0.310
17	29 288	0.553	34 738	0.448	64 026	0.344
18	3 914	0.721	14 262	0.646	18 176	0.531
19	4 667	0.596	10 985	0.874	15 650	0.640
20	10 728	0.810	32 785	0.539	43 513	0.451
21	18 324	0.724	0	–	18 324	0.724
22	1 279	1.178	0	–	1 279	1.178
23	0	–	0	–	0	–
24	18 324	0.725	0	–	18 324	0.725
25	5 899	0.925	0	–	5 899	0.925
26	0	–	10 382	0.862	10 382	0.862
No. measured		15 475		15 856		31 331
No. aged		262		259		521
No. of tows sampled						429
Mean weighted CV (%)		26.9		24.5		19.9

Table 6: Calculated numbers-at-age, separately by sex, with CVs, for *Trachurus murphyi* caught during commercial trawl operations in JMA 7 during the 2015–16 fishing year. Summary statistics for the sample are also presented. –, no data.

Age (years)	Male	CV	Female	CV	Total	CV
4	635	1.538	94	1.780	729	1.313
5	393	1.678	393	2.149	785	1.457
6	691	1.746	196	1.782	887	1.423
7	1 365	0.865	1 142	0.996	2 507	0.684
8	1 349	1.021	0	–	1 349	1.021
9	0	–	0	–	0	–
10	0	–	1 177	1.479	1 177	1.479
11	0	–	1 317	1.200	1 317	1.200
12	0	–	2 643	0.761	2 643	0.761
13	5 680	0.473	5 902	0.484	11 582	0.346
14	3 173	0.629	5 516	0.472	8 689	0.378
15	12 382	0.343	10 412	0.326	22 794	0.243
16	10 238	0.352	16 446	0.290	26 684	0.219
17	20 076	0.251	27 320	0.210	47 396	0.152
18	37 222	0.159	38 567	0.180	75 789	0.120
19	53 390	0.151	69 913	0.142	123 303	0.095
20	49 964	0.165	32 989	0.186	82 953	0.119
21	31 761	0.198	19 305	0.275	51 065	0.160
22	12 980	0.282	16 847	0.249	29 827	0.183
23	12 543	0.306	14 844	0.304	27 386	0.215
24	2 305	0.697	3 457	0.604	5 762	0.469
25	5 034	0.491	3 766	0.514	8 800	0.353
26	883	1.113	4 271	0.542	5 154	0.498
27	1 183	0.945	1 443	0.839	2 626	0.600
28	0	–	0	–	0	–
29	0	–	984	0.988	984	0.988
30	0	–	0	–	0	–
31	603	0.975	3 089	0.533	3 692	0.464
No. measured		962		987		1 949
No. aged		250		251		501
No. of tows sampled						248
Mean weighted CV (%)		24.9		26.6		18.6

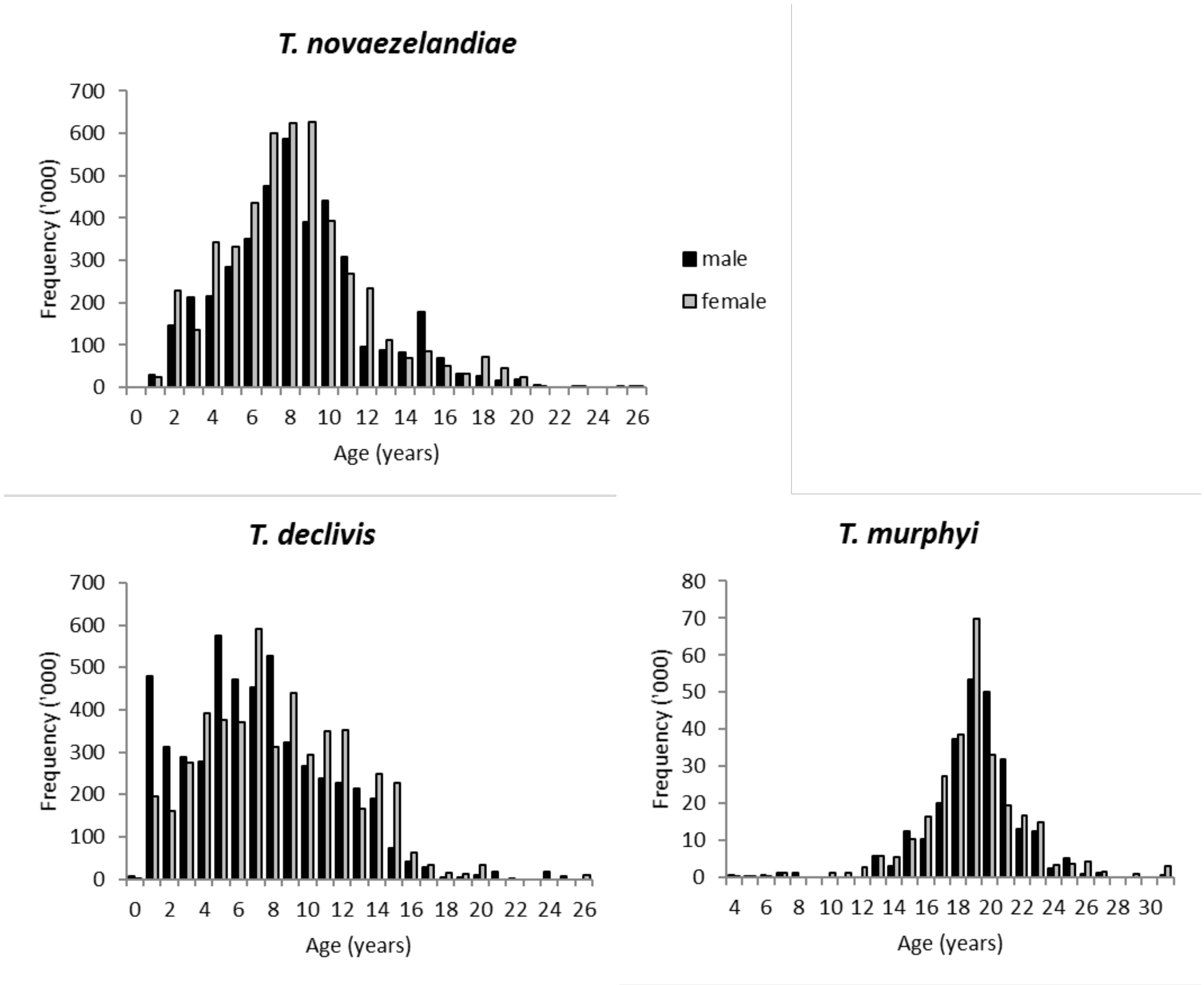

Figure 5: Estimated commercial catch-at-age distributions, by species and sex, from JMA 7 in 2015–16.

3.6 Data summaries

Catch-at-length and catch-at-age data from the JMA 7 fishery are now available from ten consecutive years since 2006–07. Mean weighted CVs for the length and age distributions, by sex and year, are listed for each species in Table 7. The CVs for the total age distributions met or exceeded the target of 30% for all species in all years, except for *Trachurus murphyi* in 2006–07.

Total (i.e., sexes combined) scaled length and age distributions, by species and fishing year are shown in Figures 6–8. The data used to produce these catch-at-age distributions are listed in Appendix B.

Table 7: Mean weighted CVs (mwCV) for catch-at-age and catch-at-length distributions, by species, sex, and fishing year.

		Catch-at-age mwCV (%)			Catch-at-length mwCV (%)		
Species	Fishing year	Males	Females	Total	Males	Females	Total
T. declivis	2006–07	31	38	25	12	12	9
	2007–08	26	34	24	13	13	12
	2008–09	34	40	27	11	10	9
	2009–10	25	28	20	13	12	10
	2010–11	25	23	18	12	11	9
	2011–12	21	20	16	15	15	13
	2012–13	22	22	17	17	16	14
	2013–14	20	21	15	16	14	13
	2014–15	22	21	16	17	15	14
	2015–16	27	24	20	19	15	15
T. novaezelandiae	2006–07	26	24	19	17	16	14
	2007–08	27	25	22	17	12	13
	2008–09	39	39	30	14	11	11
	2009–10	32	27	23	16	15	12
	2010–11	28	24	20	20	16	15
	2011–12	23	21	16	17	16	14
	2012–13	24	25	19	19	17	16
	2013–14	19	19	14	15	13	12
	2014–15	21	19	15	14	11	10
	2015–16	26	25	19	12	11	10
T. murphyi	2006–07	41	57	38	37	37	31
	2007–08	34	48	30	17	21	14
	2008–09	35	48	30	20	21	15
	2009–10	35	47	30	27	28	23
	2010–11	31	36	23	28	28	21
	2011–12	26	30	20	20	22	16
	2012–13	26	35	21	30	33	24
	2013–14	27	33	21	26	26	18
	2014–15	24	28	19	19	19	14
	2015–16	25	27	19	22	18	15

Trachurus novaezelandiae

Scaled catch-at-length frequencies by fishing year are shown in Figure 6. They had single strong modes at 28–32 cm in all distributions except 2009–10, and 2012–13 when there were second modes at 24 and 20 cm respectively. Most variation in abundance occurred with the fish shorter than 25 cm, presumably relating to the relative strengths of juvenile year classes. Scaled catch-at-age frequencies by fishing year, varied between years (Figure 6). However, some possible year class progressions can be postulated. The 1+ year class was strong in 2007–08, and maintained a relatively high abundance in all subsequent years. The 2+ year class in 2011–12 was also relatively strong, and it progressed as the dominant year class in the subsequent three years, but was not particularly strong in 2015–16. Year classes 4, 5, and 6 in 2006–07 also appeared to be relatively strong throughout the series, although there were some inconsistencies e.g., year classes 7 in 2009–10 and 10 in 2011–12 were weak.

Trachurus declivis

Scaled catch-at-length frequencies by fishing year are shown in Figure 7 with most of the fish 16–50 cm. There was a strong mode at 42–44 cm in all years, with lesser modes for smaller fish in the distributions for some years, e.g., 30 cm in 2012–13. Most variation in abundance occurred with the fish shorter than 37 cm, presumably related to the relative strengths of juvenile year classes. Scaled catch-at-age-frequencies by fishing year, are shown in Figure 7. There was a wide range of ages in the catches, and the distributions varied between years. There was evidence of two relatively strong year classes aged 1+ and 2+ years in 2007–08 that maintained a relatively high abundance up to 2011–12, but were relatively weak from 2012–13. The 2011–12 1+ and 3+ year classes appeared to be relatively strong, and both were still strong as 5+ and 7+ in 2015–16.

Trachurus murphyi

Scaled catch-at-length frequencies by fishing year, are shown in Figure 8. All the distributions were unimodal at 49–51 cm (except for the 2013–14 distribution which had a broad mode from 46–51 cm), and were generally similar with few fish smaller than 45 cm. Scaled catch-at-age frequencies by fishing year (Figure 8) exhibited a wide range of ages although few fish younger than 10 years were recorded in any year. There was evidence of relatively strong year classes at ages 11 and 12 years in 2006–07 that progressed to ages 16 and 17 in 2011–12. Since about 2012–13, the older of these two year classes had lost much of its dominance. Fish aged 19 years old dominated the 2015–16 distribution. This year class was relatively strong since 2011–12 (when it was age 15), but also contributed quite substantially to the catch throughout the entire time series.

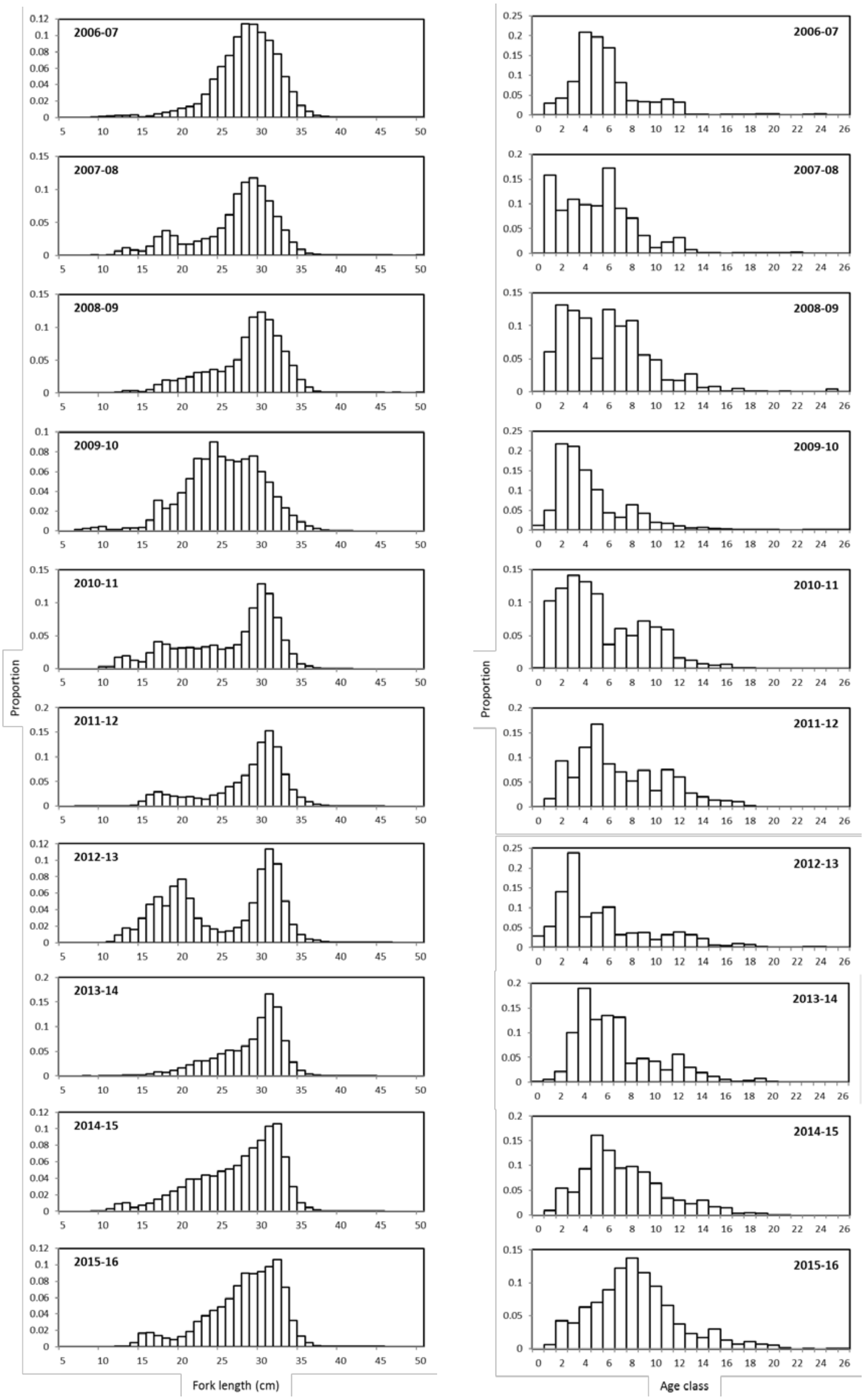

Figure 6: Scaled catch-at-length (left panel) and catch-at-age (right panel, age class in years) proportions for the catch of *Trachurus novaezelandiae* sampled from the 2006–07 to 2015–16 fishing years.

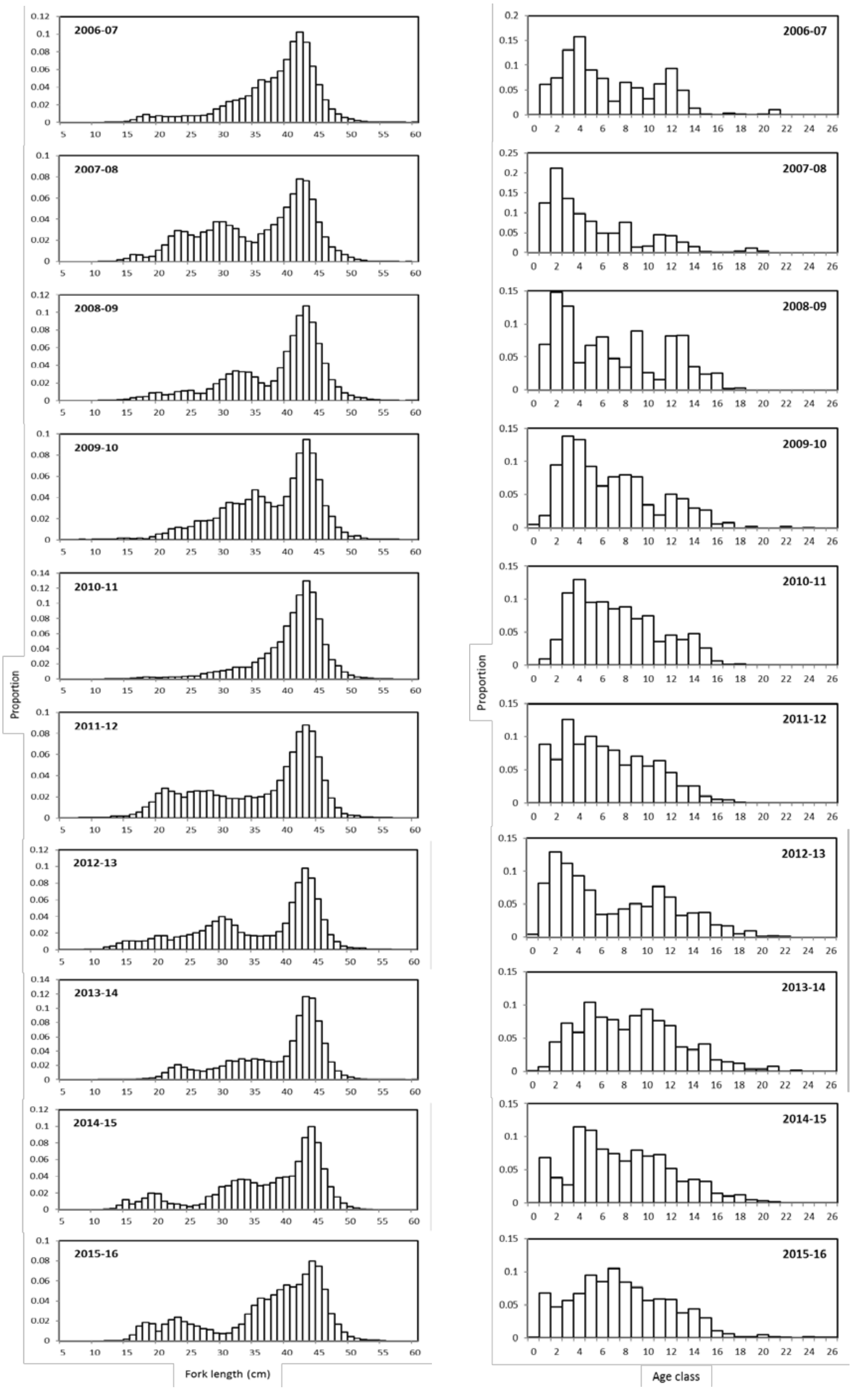

Figure 7: Scaled catch-at-length (left panel) and catch-at-age (right panel, age in years) proportions for the catch of *Trachurus declivis* sampled from the 2006–07 to 2015–16 fishing years.

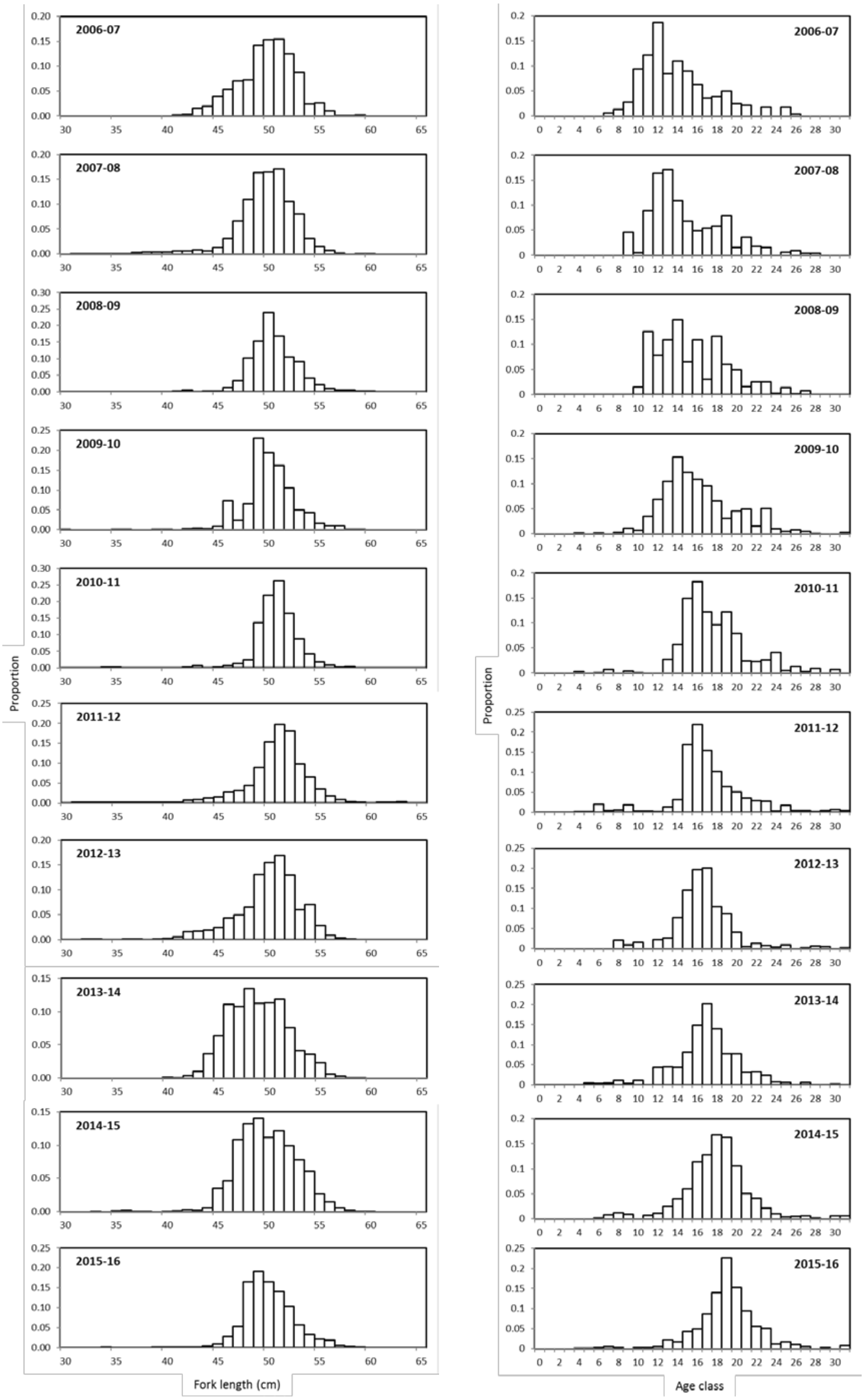

Figure 8: Scaled catch-at-length (left panel) and catch-at-age (right panel, age in years) proportions for the catch of *Trachurus murphyi* sampled from the 2006–07 to 2015–16 fishing years.

4. DISCUSSION

The 2015–16 jack mackerel trawl fishery was comprehensively sampled (as it was in all years since at least 2006–07). Sampling intensity was high in all months, and at least 79% of the catch was sampled in all months that produced substantial landings. Spatially, there was very good coverage of catch in the heavily fished Statistical Areas (035, 037, 040–042). Estimates of the 2015–16 catch-at-age for all three jack mackerel species had mean weighted CVs over all age classes of 20% or less, well below the target of 30%.

Although sampling intensity was high, there was clearly an issue (also apparent in previous years) of some misidentification of the different jack mackerel species. When the raw age data were plotted against length, 4% of the aged *T. declivis* appeared as outliers that fitted well on the growth curve for *T. novaezelandiae*, and 5% of aged *T. novaezelandiae* were outliers that fitted well on the *T. declivis* growth curve. Such misidentifications are particularly apparent for the older and larger fish of both these species (for which the growth curves are clearly divergent), but less so for smaller and younger fish because the length-at-age ranges of both species overlapped substantially for fish aged 4 years or less. So the actual misidentification percentages of *T. declivis* and *T. novaezelandiae* are likely to be higher than the values noted above. It was also possible that some misidentification occurred between *T. declivis* and *T. murphyi*, but because the length-at-age ranges for these species overlapped significantly it was difficult to estimate any percentages. However, 1.5% of the aged *T. declivis* sample comprised otoliths from large fish that were very difficult to interpret, and may have been from *T. murphyi*.

Estimates of species proportions indicated a consistent predominance of *T. declivis* at 61–71% of total catch weight in the ten fishing years from which data were available. The percentage of *T. novaezelandiae* was also consistent temporally at 24–33%. The predominance of *T. declivis* overall is expected given that this species generally occurs deeper and further offshore than *T. novaezelandiae* and because most of the vessels targeting jack mackerels are restricted to fishing at least 12 n. miles, and often 25 n. miles off the coast. The lowest proportion of *T. declivis* and highest proportion of *T. novaezelandiae* in the time series were reported in 2014–15. This probably relates to relatively low catches in the autumn–winter fishery, which is usually strongly dominated by landings of *T. declivis* off the west coast of South Island.

Most of the *T. declivis* catch in all years comprised adult fish at least 37 cm long. Differences between years in the length distributions were primarily in the abundance of fish shorter than 37 cm, and were a consequence of variation in year class strengths. The position of the mode of large *T. declivis* in JMA 7 (centred on 43–44 cm in most years) differed from the mode in JMA 3 (centred on 48 cm), and Horn et al. (2014a) proposed that this was a consequence of large *T. declivis* migrating south out of the JMA 7 area.

The mean age of *T. murphyi* in the catch generally increased over the ten sampled years. In 2006–07, most fish were 10–15 years old, compared with 15–20 years old in 2010–11 and 2011–12. This is indicative of a strong recruitment pulse, comprising several year classes, possibly as a result of immigration from international waters. These year classes are now growing through, with no evidence of any substantial new immigration or recruitment through spawning success. The age distribution in 2015–16 comprised fish mainly 17–21 years old, but the age distribution mode continued its shift to the right supporting the hypothesis of a single migration pulse. This modal shift in the age distributions has occurred despite the 2013–14, 2014–15 and 2015–16 length distributions having relatively more smaller fish (i.e. 45–48 cm) than in other sampled years. It appears likely that some of the older dominant year classes that initially recruited to New Zealand waters are now dying off and becoming much less dominant in the catch (e.g., the relatively abundant 15 year old fish in 2006–07 are now negligible in the most recent year's catch as 24 year olds). The data on sex of *T. murphyi* collected over years 2006–07 to 2013–14 indicated a population consistently biased towards males (i.e., 54–62% of sampled fish, average 57.3%). The two most recent years of sampling, however, have produced ratios closer to 50:50. *T. murphyi* can, at times, be quite difficult to sex (author's unpublished data), with deposits of fat in the body cavity often appearing like male gonads when the gonads are in a regressed state. However, in four research surveys conducted on the Stewart-Snares shelf in February each year from 1993 to 1996 males were also dominant, comprising 62–71% of the sexed fish (Hurst & Bagley 1997).

The *T. novaezelandiae* catch also had a consistent strong adult length mode (at 28–32 cm) in all sampled years, although in 2009–10 the relative abundance of 2–4 year old fish (i.e., lengths of about 20–27 cm) outweighed the adult mode. The progression of some relatively strong year classes through the time series is apparent. Taylor (2008) noted that there was a preference in the JMA 7 trawl fishery for larger jack mackerel (i.e., *T. declivis*). Vessels attempting to maximise their catch of *T. declivis* may consequently not comprehensively sample the *T. novaezelandiae* population in the area, which would result in a greater degree of between-year variation in the *T. novaezelandiae* length and age distributions. It is pleasing, therefore, that year class progressions are still apparent for *T. novaezelandiae* under this sampling regime. In fact, year class progressions in the *T. novaezelandiae* samples tended to be clearer and more consistent than those apparent for *T. declivis*.

Estimates of instantaneous total mortality (Z) for *T. novaezelandiae* and *T. declivis* from commercial trawl fishery samples in JMA 7 in 1989–1991 were 0.22–0.23 yr^{-1} for both species (Horn 1993). Re-estimates of Z for JMA 7 using data from 2007–2013 (Horn et al. 2014b) produced values slightly higher for *T. novaezelandiae* (0.30) and lower for *T. declivis* (0.2). The general similarity of Z estimates from the same fishery but separated by about 20 years, and the conclusion that Z is close to or slightly higher than the likely value of M (estimated by Horn (1993) to be 0.18 yr^{-1} for both species), suggested that *T. novaezelandiae* and *T. declivis* in JMA 7 are not over-exploited. The Z estimates were not updated in the current work.

A comparison of the age distributions for *T. novaezelandiae* and *T. declivis* shows that the numbers of older fish in the distributions for both species has not reduced over the 10 years of sampling. This further supports the hypothesis that these species in JMA 7 are not over-exploited.

5. ACKNOWLEDGMENTS

We thank the MPI Observer Programme for achieving good sampling coverage of the TCEPR fleet, and Peter McMillan for reviewing the manuscript. This work was funded by the Ministry for Primary Industries under project DEE2016-20.

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Appendix A: Proportions-at-age by species and fishing year

This appendix lists the estimated proportions-at-age in the JMA 7 trawl fishery, by species and fishing year. The columns in each table are headed so that, for example, the year 2016 refers to the 2015–16 fishing year. Data are presented with sexes combined, in a format that can easily be converted to a CASAL input file in a single-sex model.

Table A1: Proportions-at-age (male, female, and unsexed combined), with CVs, for *T. novaezelandiae*, by fishing year.

	Proportion										CV									
Age	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
0	0	0	0	0.0127	0.0007	0	0.0284	0.0001	0	0				0.913	2.006		0.524	1.709		
1	0.0294	0.1574	0.0605	0.0510	0.1021	0.0168	0.0531	0.0056	0.0095	0.0058	0.419	0.416	0.327	0.389	0.378	0.487	0.463	0.516	0.545	0.857
2	0.0422	0.0871	0.1319	0.2183	0.1216	0.0934	0.1399	0.0216	0.0548	0.0425	0.349	0.138	0.162	0.213	0.249	0.209	0.244	0.349	0.333	0.500
3	0.0846	0.1091	0.1225	0.2108	0.1408	0.0598	0.2380	0.1004	0.0456	0.0394	0.224	0.144	0.188	0.186	0.185	0.219	0.151	0.201	0.249	0.364
4	0.2088	0.0985	0.1116	0.1517	0.1312	0.1210	0.0765	0.1890	0.0932	0.0634	0.124	0.171	0.309	0.172	0.114	0.109	0.179	0.117	0.158	0.219
5	0.1970	0.0959	0.0509	0.1020	0.1137	0.1668	0.0875	0.1268	0.1608	0.0699	0.106	0.176	0.399	0.209	0.124	0.097	0.101	0.108	0.100	0.195
6	0.1693	0.1727	0.1244	0.0443	0.0367	0.0868	0.1012	0.1342	0.1301	0.0894	0.126	0.131	0.277	0.281	0.228	0.133	0.089	0.083	0.096	0.154
7	0.0819	0.0911	0.0992	0.0319	0.0604	0.0712	0.0320	0.1314	0.0946	0.1221	0.193	0.203	0.330	0.227	0.193	0.176	0.183	0.093	0.109	0.119
8	0.0358	0.0712	0.1079	0.0639	0.0503	0.0523	0.0360	0.0388	0.0981	0.1376	0.276	0.216	0.293	0.211	0.189	0.187	0.172	0.167	0.113	0.104
9	0.0334	0.0357	0.0557	0.0426	0.0722	0.0739	0.0370	0.0478	0.0874	0.1154	0.301	0.243	0.314	0.204	0.141	0.157	0.159	0.163	0.108	0.123
10	0.0316	0.0121	0.0485	0.0206	0.0631	0.0334	0.0199	0.0424	0.0643	0.0949	0.319	0.463	0.356	0.230	0.160	0.252	0.226	0.174	0.115	0.134
11	0.0404	0.0220	0.0180	0.0181	0.0586	0.0757	0.0321	0.0243	0.0345	0.0654	0.281	0.328	0.459	0.274	0.170	0.145	0.163	0.247	0.172	0.142
12	0.0324	0.0321	0.0167	0.0115	0.0160	0.0609	0.0379	0.0564	0.0306	0.0374	0.311	0.302	0.518	0.252	0.328	0.166	0.144	0.147	0.175	0.206
13	0.0010	0.0080	0.0270	0.0058	0.0131	0.0277	0.0323	0.0303	0.0226	0.0226	1.040	0.341	0.313	0.327	0.316	0.222	0.165	0.163	0.197	0.242
14	0.0012	0.0006	0.0062	0.0066	0.0071	0.0200	0.0224	0.0189	0.0301	0.0174	0.944	1.193	0.454	0.367	0.429	0.272	0.179	0.199	0.173	0.281
15	0	0.0002	0.0081	0.0046	0.0051	0.0143	0.0053	0.0123	0.0163	0.0299		1.358	0.655	0.336	0.392	0.305	0.358	0.232	0.232	0.212
16	0.0004	0	0.0003	0.0027	0.0067	0.0127	0.0038	0.0060	0.0142	0.0136	1.203		1.060	0.494	0.451	0.311	0.458	0.275	0.248	0.315
17	0.0008	0.0012	0.0048	0.0005	0.0006	0.0110	0.0087	0.0015	0.0035	0.0073	0.643	1.028	1.002	0.594	1.160	0.374	0.280	0.512	0.453	0.409
18	0.0006	0.0004	0.0004	0.0001	0.0001	0.0024	0.0062	0.0038	0.0053	0.0112	0.864	1.021	1.251	2.105	1.712	0.565	0.317	0.385	0.401	0.348
19	0.0026	0.0011	0.0003	0.0001	0	0	0.0011	0.0077	0.0034	0.0072	0.671	0.949	0.884	1.916			0.769	0.287	0.547	0.419
20	0.0025	0.0003	0	0.0000	0	0	0	0.0008	0.0003	0.0051	0.898	0.895		1.253				0.673	0.606	0.510
21	0	0.0003	0.0009	0	0	0	0	0	0.0008	0.0010		0.835	0.769						0.812	0.606
22	0	0.0029	0	0	0	0	0	0	0	0		0.572								
23	0.0010	0	0	0.0000	0	0	0.0005	0	0	0.0005	1.022			1.134			0.835			0.697
24	0.0034	0	0	0.0001	0	0	0.0002	0	0	0	0.544			0.887			0.903			
25	0	0	0.0042	0.0000	0	0	0	0	0	0.0003			0.518	2.166						1.043
26	0	0	0	0.0002	0	0	0	0	0	0.0006				1.049						1.853

Table A2: Proportions-at-age (male, female, and unsexed combined), with CVs, for *T. declivis*, by fishing year.

	Proportion										CV									
Age	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
0	0	0	0	0.0054	0	0	0.0041	0.0002	0	0.0009				0.428			0.793	1.197		1.410
1	0.0605	0.1245	0.0693	0.0180	0.0092	0.0889	0.0813	0.0066	0.0680	0.0678	0.220	0.175	0.170	0.326	0.355	0.267	0.238	0.441	0.298	0.532
2	0.0737	0.2125	0.1478	0.0942	0.0390	0.0659	0.1290	0.0437	0.0384	0.0474	0.172	0.145	0.134	0.207	0.191	0.229	0.199	0.409	0.257	0.406
3	0.1307	0.1357	0.1273	0.1387	0.1091	0.1261	0.1118	0.0729	0.0272	0.0565	0.141	0.119	0.144	0.141	0.134	0.162	0.161	0.222	0.255	0.309
4	0.1574	0.0972	0.0416	0.1327	0.1301	0.0886	0.0933	0.0589	0.1152	0.0670	0.118	0.176	0.311	0.130	0.113	0.182	0.161	0.191	0.141	0.207
5	0.0907	0.0784	0.0678	0.0923	0.0949	0.1004	0.0718	0.1042	0.1095	0.0952	0.244	0.227	0.299	0.160	0.143	0.115	0.153	0.129	0.142	0.140
6	0.0728	0.0492	0.0798	0.0629	0.0963	0.0859	0.0341	0.0816	0.0810	0.0845	0.303	0.325	0.322	0.190	0.153	0.114	0.170	0.114	0.131	0.140
7	0.0270	0.0491	0.0475	0.0767	0.0851	0.0796	0.0351	0.0779	0.0744	0.1046	0.503	0.256	0.385	0.168	0.169	0.117	0.149	0.136	0.127	0.104
8	0.0654	0.0755	0.0343	0.0801	0.0883	0.0575	0.0429	0.0623	0.0639	0.0843	0.310	0.371	0.437	0.186	0.175	0.140	0.135	0.123	0.121	0.116
9	0.0549	0.0131	0.0894	0.0768	0.0701	0.0700	0.0503	0.0845	0.0796	0.0765	0.309	0.503	0.260	0.177	0.176	0.124	0.125	0.099	0.105	0.110
10	0.0315	0.0154	0.0257	0.0345	0.0750	0.0556	0.0469	0.0936	0.0705	0.0563	0.486	0.482	0.463	0.300	0.184	0.137	0.140	0.093	0.112	0.128
11	0.0618	0.0443	0.0160	0.0192	0.0354	0.0642	0.0771	0.0768	0.0728	0.0588	0.272	0.329	0.635	0.367	0.230	0.127	0.099	0.108	0.110	0.142
12	0.0934	0.0422	0.0819	0.0507	0.0458	0.0454	0.0605	0.0689	0.0522	0.0582	0.254	0.301	0.286	0.214	0.216	0.158	0.113	0.111	0.139	0.138
13	0.0496	0.0260	0.0823	0.0435	0.0391	0.0256	0.0330	0.0367	0.0325	0.0381	0.363	0.454	0.281	0.236	0.237	0.208	0.149	0.142	0.169	0.170
14	0.0137	0.0138	0.0352	0.0299	0.0478	0.0254	0.0363	0.0325	0.0355	0.0440	0.537	0.456	0.476	0.268	0.209	0.183	0.143	0.146	0.172	0.152
15	0.0015	0.0024	0.0240	0.0264	0.0256	0.0099	0.0372	0.0408	0.0328	0.0300	0.858	0.912	0.400	0.273	0.295	0.339	0.149	0.138	0.179	0.210
16	0	0.0005	0.0251	0.0057	0.0068	0.0055	0.0193	0.0173	0.0142	0.0105		0.686	0.335	0.469	0.545	0.472	0.211	0.221	0.259	0.310
17	0.0031	0.0017	0.0023	0.0075	0.0004	0.0051	0.0172	0.0138	0.0101	0.0064	0.973	0.966	0.581	0.647	1.049	0.438	0.243	0.230	0.290	0.344
18	0.0013	0.0042	0.0028	0	0.0020	0.0005	0.0048	0.0115	0.0119	0.0018	1.050	0.395	0.633		1.091	0.690	0.399	0.254	0.310	0.531
19	0	0.0104	0	0.0023	0	0	0.0094	0.0028	0.0053	0.0016		0.762		1.020			0.292	0.456	0.450	0.640
20	0.0006	0.0038	0	0	0	0	0.0011	0.0031	0.0033	0.0044	1.101	0.975					0.868	0.409	0.559	0.451
21	0.0104	0	0	0	0	0	0.0021	0.0072	0.0016	0.0018	0.430						0.701	0.335	0.889	0.724
22	0	0	0	0.0023	0	0	0.0013	0	0	0.0001				0.963			0.801			1.178
23	0	0	0	0	0	0	0	0.0020	0	0								0.624		
24	0	0	0	0.0003	0	0	0	0	0	0.0018				1.254						0.725
25	0	0	0	0	0	0	0	0	0	0.0006										0.925
26	0	0	0	0	0	0	0	0	0	0.0010										0.862

Table A3: Proportions-at-age (male, female, and unsexed combined), with CVs, for *T. murphyi*, by fishing year.

	Proportion										CV									
Age	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
4	0	0	0	0.0020	0.0026	0.0018	0	0	0	0.0013				2.236	1.146	1.047				1.313
5	0	0	0	0	0	0.0021	0	0.0039	0	0.0014						0.747		0.766		1.457
6	0	0	0	0.0021	0.0005	0.0193	0	0.0028	0.0012	0.0016				1.423	2.163	0.420		1.105	0.848	1.423
7	0.0055	0	0	0	0.0073	0.0044	0	0.0049	0.0076	0.0046	1.041				1.841	1.093		0.741	0.632	0.684
8	0.0126	0	0	0.0026	0	0.0059	0.0201	0.0107	0.0119	0.0025	0.625			1.481		0.891	0.710	0.519	0.452	1.021
9	0.0272	0.0458	0	0.0105	0.0036	0.0180	0.0086	0.0028	0.0094	0	0.413	0.333		0.948	0.873	0.596	0.869	0.972	0.577	
10	0.0935	0.0053	0.0144	0.0071	0.0012	0.0030	0.0157	0.0111	0	0.0022	0.335	0.594	0.615	0.803	1.888	1.225	0.714	0.531		1.479
11	0.1216	0.0895	0.1258	0.0350	0	0.0030	0	0	0.0064	0.0024	0.301	0.263	0.222	0.383		1.119			0.593	1.200
12	0.1857	0.1634	0.0784	0.0692	0	0.0021	0.0219	0.0431	0.0115	0.0048	0.201	0.190	0.304	0.584		1.043	0.499	0.237	0.445	0.761
13	0.0847	0.1708	0.1092	0.1040	0.0273	0.0128	0.0252	0.0448	0.0250	0.0212	0.282	0.172	0.241	0.178	0.363	0.511	0.432	0.261	0.338	0.346
14	0.1092	0.1083	0.1499	0.1530	0.0567	0.0320	0.0779	0.0432	0.0401	0.0159	0.231	0.248	0.208	0.233	0.235	0.322	0.231	0.252	0.245	0.378
15	0.0900	0.0687	0.0657	0.1227	0.1488	0.1694	0.1466	0.0802	0.0595	0.0418	0.300	0.323	0.318	0.271	0.144	0.119	0.142	0.184	0.188	0.243
16	0.0628	0.0484	0.1092	0.1080	0.1823	0.2194	0.1972	0.1479	0.1133	0.0489	0.410	0.309	0.235	0.192	0.130	0.102	0.111	0.145	0.133	0.219
17	0.0363	0.0538	0.0305	0.0965	0.1224	0.1544	0.2004	0.2028	0.1276	0.0868	0.514	0.318	0.299	0.178	0.174	0.119	0.107	0.113	0.133	0.152
18	0.0395	0.0580	0.1163	0.0658	0.0962	0.1019	0.1044	0.1405	0.1678	0.1388	0.476	0.380	0.243	0.222	0.183	0.165	0.145	0.142	0.110	0.120
19	0.0489	0.0783	0.0606	0.0308	0.1227	0.0633	0.0860	0.0766	0.1621	0.2259	0.639	0.306	0.334	0.304	0.155	0.182	0.164	0.183	0.109	0.095
20	0.0244	0.0154	0.0486	0.0450	0.0784	0.0514	0.0417	0.0769	0.1055	0.1520	0.722	0.521	0.371	0.235	0.228	0.198	0.245	0.192	0.128	0.119
21	0.0211	0.0364	0.0159	0.0492	0.0233	0.0349	0.0055	0.0314	0.0502	0.0935	0.647	0.436	0.821	0.269	0.374	0.231	0.664	0.313	0.201	0.160
22	0	0.0180	0.0256	0.0151	0.0223	0.0288	0.0125	0.0324	0.0413	0.0546		0.770	0.406	0.433	0.392	0.267	0.479	0.312	0.220	0.183
23	0.0168	0.0160	0.0251	0.0501	0.0255	0.0270	0.0076	0.0233	0.0214	0.0502	1.119	0.755	0.541	0.273	0.340	0.298	0.487	0.368	0.301	0.215
24	0	0	0.0024	0.0103	0.0409	0.0030	0.0034	0.0068	0.0104	0.0106			0.778	0.576	0.295	0.831	0.894	0.643	0.431	0.469
25	0.0168	0.0063	0.0138	0.0048	0.0051	0.0177	0.0092	0.0055	0.0040	0.0161	1.093	1.019	0.854	0.655	0.763	0.336	0.532	0.607	0.720	0.353
26	0.0033	0.0097	0.0009	0.0076	0.0134	0.0041	0	0	0.0044	0.0094	1.247	1.032	1.217	0.564	0.543	0.788			0.679	0.498
27	0	0.0041	0.0078	0.0046	0.0031	0.0047	0.0024	0.0060	0.0060	0.0048		0.980	0.643	0.791	1.018	0.673	0.915	0.688	0.644	0.600
28	0	0.0039	0	0.0011	0.0092	0.0007	0.0063	0	0.0020	0		0.933		1.060	0.630	1.301	0.816		1.069	
29	0	0	0	0	0	0.0046	0.0049	0	0	0.0018						0.780	0.785			0.988
30	0	0	0	0	0.0073	0.0066	0	0.0023	0.0059	0					0.836	0.645		0.997	0.610	
31	0	0	0	0.0027	0	0.0039	0.0023	0	0.0057	0.0068				1.014		0.693	1.045		0.539	0.464