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Species proportions and ages of jack mackerels (*Trachurus* spp.) from JMA 7 catches during the 2023–24 fishing year

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PLAIN LANGUAGE SUMMARY

Jack mackerels (JMA) support significant commercial fisheries in New Zealand, with over 75% of the total jack mackerel catch taken by trawl fisheries off the west coasts of the North Island and South Island, in the JMA 7 Quota Management Area. Three jack mackerel species are caught in New Zealand waters, namely *Trachurus declivis*, *T. murphyi*, and *T. novaezelandiae*. However, *T. murphyi* are now caught in relatively low numbers and mainly in JMA 3 and due to the low catches are not aged in the current project (MID2024-01).

New Zealand commercial catches of jack mackerels have been recorded against the generic species code JMA. Therefore, species-specific catch information is not available from the fishery data. Estimates of proportions of *T. declivis* and *T. novaezelandiae* in the catch, based on species code specific observer data are used to derive species-specific catch estimates from the JMA catch data.

This report updates the data collected by the New Zealand observer sampling programme from trawl landings of jack mackerels in JMA 7 with the data collected during the 2023–24 fishing year, including estimates of species proportions and sex ratios in the landings, corroboration of observer species identification via otolith shape analysis, catch-at-length (fork length, cm), and catch-at-age for both species.

Estimated proportions of catch by species based on observer data have historically shown that *T. declivis* comprises 61–80% of the catch for all statistical areas, and *T. novaezelandiae* at 20–33%. *T. murphyi* make up a small percentage of the catch (<10%, see above). In 2023–24, proportions of *T. declivis*, and *T. novaezelandiae*, were approximately 80%, and 19%, respectively.

In 2023–24, sampled sex ratios of *T. declivis* and *T. novaezelandiae* were close to a sex ratio of 1:1.

For *T. declivis* and *T. novaezelandiae*, observer data indicate decreasing proportions of larger and older fish in the commercial catch in recent years.

EXECUTIVE SUMMARY

Barnes, T.C.; Ó Maolagáin, C.; Spong, K., Moore, B.R. (2026). Species proportions and ages of jack mackerels (*Trachurus* spp.) from JMA 7 catches during the 2023-24 fishing year.

New Zealand Fisheries Assessment Report 2026/07. 32 p.

This report describes data collected by the New Zealand observer sampling programme from trawl catches of two jack mackerel species (*Trachurus declivis*, and *T. novaezelandiae*) in JMA 7 (central west coast) during the 2023–24 fishing year. Another species, *T. murphyi*, are caught in low numbers in recent times and are therefore no longer part of catch-at-age project work. Analyses include estimates of species proportions and sex ratios in the catches, corroboration of observer species identification via otolith shape analysis, catch-at-length (fork length), and catch-at-age for both species.

Spatiotemporal stratum and species-specific catch estimates were derived from estimated commercial catch data given the proportions (by weight) of each species identified by observers from a random sample taken from observed tows. Stratification of the data was required because the observer coverage and catch composition varied with both month and statistical area. Approximately 70% of the 2023–24 catch was sampled by observers (observer estimated greenweight vs fisher reported catch weight), and spatiotemporal sampling was generally representative of the catch. However, the rate of species misidentification by observers, as determined by otolith shape analysis and patterns in length-at-age data, was approximately 12% for *T. declivis* and 10% for *T. novaezelandiae*. The shape analysis screened 99% of the misidentifications reported here before otoliths were prepared for ageing (i.e. before thin sectioned etc.).

Estimated proportions of catch by species based on observer data have historically shown that *T. declivis* comprises 61–80% of the catch for all statistical areas, and *T. novaezelandiae* at 20–33%. *T. murphyi* make up a small percentage of the catch (<10%). In 2023–24, proportions of *T. declivis*, and *T. novaezelandiae* were approximately 80% and 19%, respectively.

Sampled sex ratios of *T. declivis* and *T. novaezelandiae* have generally been skewed slightly toward females; however, both were close to a sex ratio of 1:1 in the 2023–24 fishing year (50% female for *T. declivis* and 48% for *T. novaezelandiae*).

The medians of the scaled length frequency distributions for both *T. declivis* and *T. novaezelandiae* have been decreasing since 2015–16, including in the most recent year. Decreases in the proportion of older fish in the catch from around 2015–16 onwards were also evident in both species, with fewer fish older than 10 years present in the scaled catch-at-age frequency distributions than earlier in the time series. The scaled age frequency distributions for these two species in 2023–24 had mean weighted CVs of 14% and 15%, respectively, which are more precise than the 30% target threshold specified by Fisheries New Zealand.

1. INTRODUCTION

Jack mackerels (Family Carangidae, genus *Trachurus*) support significant commercial fisheries in New Zealand, with landings of more than 30 000 t annually since 2002, peaking at over 50 000 t in 2014 (Fisheries New Zealand 2024). Over 75% of the total jack mackerel catch has been taken by trawl fisheries off the west coasts of the North Island and South Island in most years, from the JMA 7 Quota Management Area (QMA) (Figure 1). These fisheries have harvested all three jack mackerel species found in New Zealand waters, namely *Trachurus declivis* (Jenyns, 1841), *T. murphyi* (Nichols, 1920), and *T. novaezelandiae* (Richardson, 1843). *Trachurus declivis* and *T. novaezelandiae* are endemic to New Zealand waters. *Trachurus murphyi* was first reported in New Zealand waters in the mid-1980s following inferred immigration from the eastern Pacific (Kawahara et al. 1988) but due to low numbers this species is now not part of the MID2024-01 catch-at-age work contract and hence, are not reported on here.

Since the mid-2000s, JMA 7 has been primarily a trawl fishery, with a small proportion of catches taken by purse seine or set net.

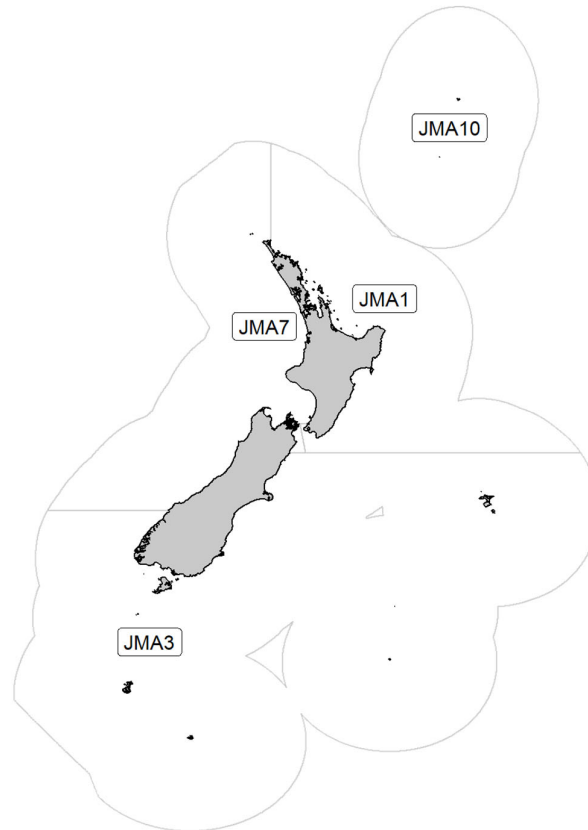


Figure 1: Jack mackerel Quota Management Areas (QMAs).

As New Zealand commercial catches of jack mackerels have been recorded as an aggregate of the three species under the general code JMA; species-specific catch information is not available from Fisheries New Zealand databases. However, estimates of proportions of the three *Trachurus* species in the catch are essential for assessment of the individual stocks. Species proportion estimates are therefore necessary to derive catch histories for each species from aggregated catch data. Proportion estimates can be used to scale numbers and weight of fish in age samples up to total species-specific catch estimates for the various fisheries.

This report provides estimates of relative species proportions, sex ratios, catch-at-length, and catch-at-age for *T. declivis* and *T. novaezelandiae* species in the commercial JMA 7 catch for the 2023–24 fishing year (defined as 1 October 2023 to 30 September 2024) based on data and otolith samples collected onboard vessels by observers. The resulting catch-at-age distributions derived from aged otoliths for the two species extend the existing series of catch-at-length and catch-at-age data previously described by others (see Moore et al. 2024b).

This work fulfils the reporting requirements for jack mackerels in Objective 1 of Fisheries New Zealand Project MID2024-01 “Routine age determination of middle depth and deepwater species from commercial fisheries and resource surveys”, funded by Fisheries New Zealand. That objective is:

1. To determine catch-at-age for commercial catches and resource surveys of specified middle depth and deepwater fish stocks.

2. METHODS

Catch sampling for length (fork length in centimetres), sex, age, and species composition was carried out by observers primarily working onboard trawl vessels targeting jack mackerels. Sampling was generally carried out according to instructions provided in the Fisheries New Zealand JMA 7 sampling protocol (available as appendices given by Middleton 2022). Most tows in the observer data set included total jack mackerel catch estimates (made by the fisher) and observer-measured sample weights by species. All observer data on jack mackerels sampled from JMA 7 in the 2023–24 fishing year were extracted from the Centralised Observer Database (*cod*) for the analyses (Sanders & Fisher 2022). The observer data were examined for spatiotemporal variability, and this was compared with the spatiotemporal distribution of the commercial JMA 7 catch.

Commercial catch and effort data extracted from the Fisheries New Zealand Enterprise Data Warehouse (replug 16609 on 22 Apr 2025) were used in these analyses. The data comprised estimated catch and associated date, geographic position, fished depth, and fishing method data from all fishing events that recorded catches of jack mackerel from JMA 7 in 2023–24.

As with previous analyses, stratification of the data was required because: 1) the observer coverage varied with both month and statistical area; 2) the location and timing of fishing effort varied throughout the year; and 3) the MID2024-01 project target *T. declivis* and *T. novaezelandiae* species composition varied across area and depth. Stratification was revisited in 2016 (Horn et al. 2017) and was slightly adjusted (see Moore et al. 2024a). Each fishing event from the catch and effort data set and the observer data set was allocated to one of the five strata:

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

Annual catches for *T. declivis* and *T. novaezelandiae* in JMA 7 were derived from observed samples of species-specific weights per tow, and from the estimated catches of jack mackerel (recorded as JMA) from fisher logbooks. There are two possible sources of species-specific weights per tow available from observer samples. In the first instance, observers directly estimated the weight of each species from a randomly selected sample (or samples) of the tow (‘sample weights’). In the second instance, observers measured all individuals in a randomly selected sample (or samples) to 1-cm length classes by species (with the number of samples per tow dependent on the catch weight of the tow). These length classes were then converted to weights, based on species-specific length-weight relationships (Fisheries New Zealand, 2024), multiplied by the number of fish in each length class and summed across all length

classes to obtain an alternate estimate of species-specific weight for the sample in the tow (“length-based sampled weights”).

Until recently catch-at-age analyses for JMA 7 have used ‘sample weights’ to estimate the proportion of each species caught in a catch. At the recommendation of Middleton et al. (2022), since the 2022–23 analysis, a second approach was used, as the authors deemed weight estimates derived from measured lengths (‘length-based sampled weights’) to be more accurate than overall estimates of weight by species for the observed sample. Moreover, this approach allows for sample weight values to be adjusted should specific length classes be removed for a given species during data grooming. As in previous analyses, the estimated species proportions in each sampled tow were assumed to be the same as the proportions derived from the length frequency and count data of the randomly selected observer sample(s) from the same tow (Taylor et al. 2011).

The catch by weight for each species in the tow was then estimated by multiplying the proportion of each species in the observed sample (from the length-based sampled weights) by the observer-estimated jack mackerel (all species) total catch for the tow (the ‘observer species-specific tow weight’). The proportions of the three species in the jack mackerel catch for each stratum was then obtained by summing across all observer species-specific tow weights in each stratum and dividing these quantities by their sum to derive ‘species-specific observer-derived proportions’ per stratum. Separately, the total jack mackerel catch in each stratum was obtained by summing the reported estimated catch weights of all tows from the commercial catch and effort data set in the stratum. Species-specific catch estimates by stratum were then calculated by multiplying the species-specific observer-derived proportions per stratum and the logbook-derived total jack mackerel catch per stratum. These estimates were used in subsequent catch-at-length and catch-at-age analyses. The estimated species-specific annual catch totals for JMA 7 were obtained by summing across the estimated catches by stratum.

Ageing was completed for *T. declivis* and *T. novaezelandiae* caught by trawl in Statistical Areas 033–047 and 801 of JMA 7 (Figure 2) during the 2023–24 fishing year, based on data and otoliths collected by observers. For both species, samples of otoliths (for each sex separately) from each 1-cm length class were selected approximately in proportion to their occurrence in the length frequency data, 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 length frequency distribution (constituting about 2% of that length frequency) were over-sampled because of low numbers of available otoliths and a higher potential number of age classes per length class. Target sample sizes were 600 individuals per species, where available.

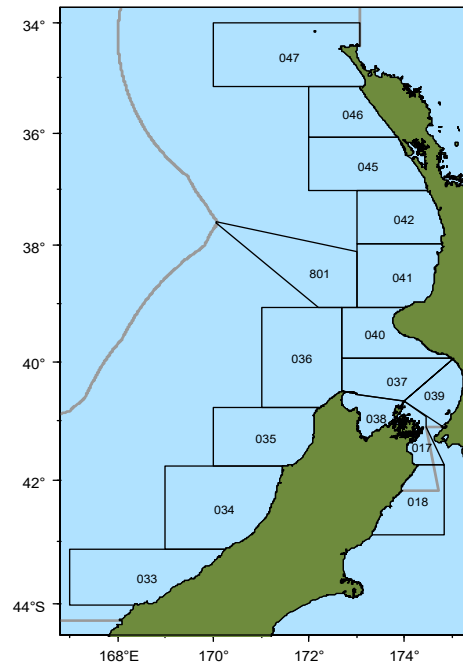


Figure 2: Inshore Statistical Areas within the JMA 7 Quota Management Area.

Prior to preparation for ageing (i.e., before slicing into thin sections) the selected otoliths were used to corroborate the observer identification of the individual JMA to species via the otolith shape. The methodology (Moore et al. 2022) was ratified by the Deepwater Working Group.

Briefly, the selected otoliths are imaged, and multivariate shape indices generated (by software) from the image outline (Figure 3). The multivariate shape data is then fitted to two different pre-parameterised classification models (Support vector machine and Linear discriminant analysis) for identification (i.e. a classification matrix is extracted from the model output). Here the models have been parameterised using otoliths from expertly identified *Trachurus* spp. Where the two models agreed with the observer identification (i.e. the otoliths selected as a given species) then these otoliths were retained for ageing. Alternatively, if one or both models did not agree with the observer identification the otolith was removed from the selection (sample). As there were a substantial number of otoliths removed ($n = \sim 60$ and 80) additional otoliths were selected ($n = 48$ and 70 for *T. novaezelandiae* and *T. declivis* respectively) from the previously sampled tows. Then the otolith shape process was repeated to top up the sample to target size of known species individuals ($n = \sim 600$ per species). While reselection was spread across the lengths for *T. declivis* (as the removed otoliths were spread evenly across most length classes), for *T. novaezelandiae* it was focussed on only large specimens (as the removed otoliths were all from large specimens). The second shape analysis then reduced the otolith top up to 14 and 50 from *T. novaezelandiae* and *T. declivis* respectively.

In previous analyses all length and otolith data from tows where the percentage of misidentifications, (identified by the shape analysis) was greater than 20% have been removed from the catch-at-age analyses (e.g. the length frequencies and otolith samples). Where the tow level misidentification was less than 20%, the tow length frequencies have been retained in the analysis but not the otoliths (as described above). For 2023–24 the tow level JMA observer species misidentification rate was found to be very low (mainly less than 5%) with a maximum of 12%. Thus, samples (i.e. all length frequency and most otoliths) from all tows were retained for further analyses.

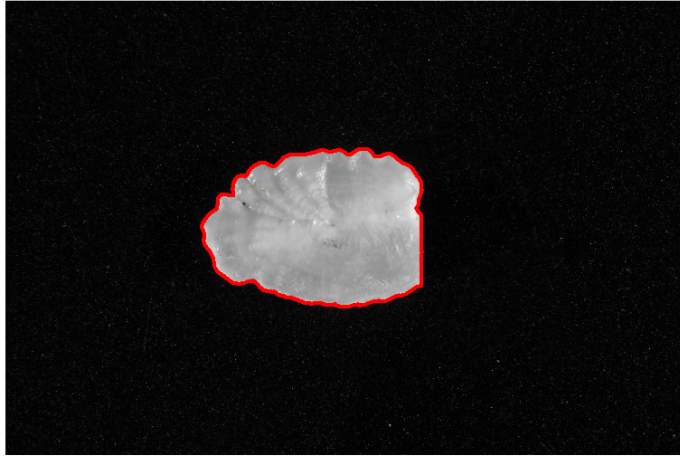


Figure 3: *Trachurus declivis* otolith image with software generated outline (red) to quantify multivariate indices used in model fits to corroborate observer classification to species.

Sets of four otoliths were embedded in blocks of clear epoxy resin and cured at 50 °C. Once hardened, an approximately 380 µm thin transverse section was cut from each block through the primordia using a high-speed saw. Each thin section was then washed, dried, and embedded under a cover slip on a glass microscopic slide. Thin sections were read with a compound microscope under reflected light 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. Prior to reading, otolith readers re-trained on otolith preparations from the 2016–17 fishing year, culminating in an examination requiring a precision score based on the exam age interpretations compared to the agency accepted ages of less than 5% before moving to the routine ageing. Otoliths of *T. declivis* and *T. novaezelandiae* from 2023–24 were then read following the validated methods of Horn (1993) and Lyle et al. (2000), described in detail by Horn & Ó Maolagáin (2020).

Following ageing, length-at-age data for each of the three species were plotted over the ‘best fitting’ growth curves derived from von Bertalanffy Growth Function (VBGF) parameters for JMA 7 (Fisheries New Zealand 2024). Following Moore et al. (2024b), outliers were identified based on the following decision rules related to absolute residuals (difference between observed length and predicted length from the best fitting growth curve):

- Any *T. declivis* aged 10 years or younger with a residual of greater than 15 or less than -10 cm were excluded.
- Any *T. declivis* aged over 10 years with a residual of greater than 6 or less than -8 cm were excluded.
- Any *T. novaezelandiae* aged four years or younger with a residual of greater than 8 or less than -10 cm were excluded.
- Any *T. novaezelandiae* aged five years or older with a residual of greater than 6 or less than -10 cm were excluded.

Through this process less than 1% of aged *T. declivis*, and *T. novaezelandiae* were removed from the data set (Appendix A). This removed subset included one *T. novaezelandiae* greater than 45 cm which would have also been removed by post ageing grooming based on its length being greater than expected. In addition, *T. novaezelandiae* greater than 45 cm (n = 10 in 2023–24) and any *T. declivis* greater than 60 cm (n = 0 in 2023–24) were removed from the length data set.

The groomed length-at-age data were then 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 Earth Sciences New Zealand (ESNZ [formerly NIWA]) *catchatage* software (Bull & Dunn 2012). This software also provided estimates of CVs-at-age using a bootstrap procedure. The threshold mean-

weighted coefficient of variation (MWCV) for the estimated catch-at-age distributions for *T. declivis* and *T. novaezelandiae* was 30%. Sex ratios by species were derived from the *catchatage* outputs. The fishery has consistently had two distinct intra-annual peaks (see Figure 4, Table 1), so the fishing year was split into two equal length temporal periods (i.e., October–March and April–September). To account for variability in growth of fish at different times of the year and at different life-stages, separate age-length keys were used for each period and for specific length ranges for *T. declivis* and *T. novaezelandiae*. For *T. novaezelandiae*, all age data from fish 28 cm or longer were used in both the October–March and April–September age-length keys, because the annual growth increment is slight or negligible for these larger fish (Hartill et al. 2022). Age data from *T. novaezelandiae* shorter than 28 cm were applied only in the age-length key applicable to their sampling date. For *T. declivis*, a similar procedure was used, but with the annual age-length key length cut-off at 38 cm or greater.

3. RESULTS

3.1 Catch sampling

The temporal commercial catch distribution in 2023–24 showed that most of the catch was taken from October to January with a secondary mode from April to June (Figure 4, Table 1). Most of the catch came from areas 037, 040 and 041 with smaller catches in 042 and 801 with other areas less than 1000 t. Overall, the spatial-temporal distribution of the JMA7 trawl fishery in 2023–24 was ‘adequately’ represented by the Observer sampling (Figure 4, Table 1). The presence of two quite widely separated fishing periods in 2023–24 (Figure 4) is consistent with that observed in 2022–23 (Appendix B) and previous years.

In 2023–24, approximately 70% (increase of 4% on last year) of the catch was sampled by observers (Table 1). The proportion of the catch sampled in the five months with the highest commercial catches ranged from 13% in November to 95% in January (Table 1). The estimated catch weights sampled by observers were less than the estimated total catch reported by the fishery (Table 1) because observer coverage was always less than 100% for both spatial and temporal sampling (Horn et al. 2017). Numbers of fish sampled by strata was comparable with previous years, with the majority of fish sampled from Stratum 5, consistent with patterns in sampled catch data (Figure 5) and magnitude of fisher reported catches (not shown).

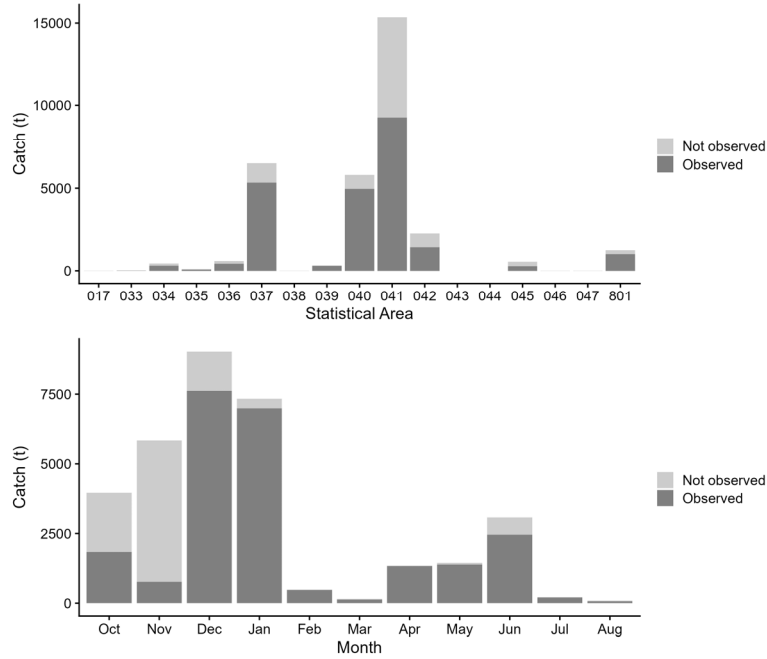


Figure 4: Jack mackerel fisher estimated catches and observed estimated catches by Statistical Area, where '017' is 'Statistical Area 017' (top) and by month (bottom) in 2023–24 for the JMA 7 trawl fishery.

Table 1: Distribution of estimated total catch (t, rounded to the nearest tonne) as reported by fishers (top) and observer sampled catches (bottom) of jack mackerels, by month and Statistical Area (Stat Area), in the 2023–24 fishing year for the JMA 7 trawl fishery. Values of 0 indicate catches from 1 to 499 kg; ‘-’ indicates zero landings or samples. %, percentage of estimated total catch that was sampled by observers.

Fisher estimated total catch (t) 2023–24

Stat Area	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	All
017	0	1	1	1	-	0	1	1	1	0	0	0	6
033	11	3	4	3	2	3	1	1	4	1	0	3	36
034	1	4	1	2	2	1	5	1	148	187	82	4	437
035	1	1	0	24	-	0	0	1	51	1	6	0	87
036	1	2	4	114	-	-	-	24	448	-	-	-	592
037	860	399	739	1 648	211	30	1 168	1 046	371	6	0	0	6 479
038	2	0	0	0	0	2	0	0	1	1	0	0	8
039	44	0	0	0	0	0	7	222	34	2	0	0	310
040	596	251	820	3 136	296	112	177	160	238	0	0	0	5 786
041	1 716	4 554	6 284	1 927	0	0	1	2	862	0	0	0	15 347
042	116	458	863	345	0	0	0	0	427	36	0	0	2 245
043	0	0	-	0	0	0	0	0	0	0	0	0	0
044	0	0	-	-	-	-	-	-	-	0	-	0	0
045	222	186	55	0	0	0	1	-	80	0	-	0	545
046	0	0	0	-	0	0	-	0	0	0	0	-	2
047	1	0	0	0	0	0	0	0	-	0	1	0	3
801	402	-	269	135	-	-	-	-	440	-	-	-	1 246
All	3 972	5 861	9 040	7 337	512	150	1 359	1 457	3 104	235	91	9	33 128

Observer sampled catch (t) 2023–24

Stat Area	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	All	%
017	-	-	-	-	-	-	-	-	-	-	-	-	0	0
033	-	-	-	-	-	-	-	-	-	-	-	-	0	0
034	-	-	-	-	-	-	-	0	87	151	62	0	300	69
035	-	-	-	24	-	-	-	-	53	1	6	0	84	97
036	-	2	2	91	-	-	-	22	302	-	-	-	419	71
037	366	120	690	1 492	207	26	1 165	1 013	230	6	-	7	5 322	82
038	-	-	-	-	-	-	-	-	-	-	-	-	0	0
039	39	-	-	-	-	-	6	226	28	-	-	-	300	97
040	322	5	758	2 967	290	96	176	138	204	-	-	-	4 956	86
041	622	661	5 363	1 965	-	-	1	5	648	-	-	-	9 264	60
042	59	-	536	334	-	-	-	-	449	40	-	-	1 418	63
043	-	-	-	-	-	-	-	-	-	-	-	-	0	0
044	-	-	-	-	-	-	-	-	-	-	-	-	0	0
045	192	-	-	-	-	-	-	-	89	-	-	-	281	52
046	-	-	-	-	-	-	-	-	-	-	-	-	0	0
047	-	-	-	-	-	-	-	-	-	-	-	-	0	0
801	249	-	271	120	-	-	-	-	365	-	-	-	1 004	81
All	1 848	788	7 620	6 993	497	122	1 348	1 404	2 456	198	68	7	23 348	70
%	46	13	84	95	97	81	99	96	79	84	74	85	70	-

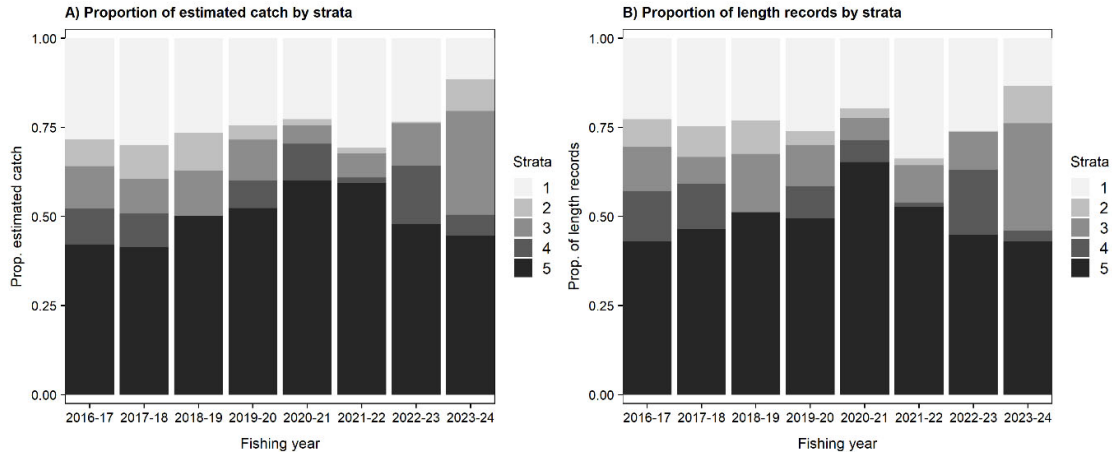


Figure 5: Overall proportions of jack mackerel: sampled catch (A); and length records (B); by strata, 2016–17 to 2023–24.

3.2 Species proportions

Trachurus declivis is the dominant species representing 61–80% of estimated catches with the highest proportion in the most recent fishing year (Table 2). *Trachurus novaezelandiae* (JMN) has accounted for 20–33% of the historical catch with the most recent fishing year being the lowest contribution of this species to the catch.

Table 2: Estimated species proportions (by length and weight) and catch weights by species in the JMA 7 trawl fishery since 2006–07. ‘Sampled catch’ is the sum of all the tow-by-tow sample weight estimates (sample weights until 2021–22 and length-based sampled weights thereafter) of jack mackerel catch. ‘Estimated catch’ results from applying the species proportions to the total fisher reported estimated catches (‘landed catch’ as defined in Saunders et al. 2022). JMD = *Trachurus declivis*, JMN = *Trachurus novaezelandiae*. * = new length-based sampled weights methodology. Note: 100% less the JMD+JMN % in table is the percentage of *Trachurus murphyi* in the catch (e.g. 0.5% in 2023–24).

Fishing year	Species proportions (%)		Sampled catch (t)		Estimated catch (t)	
	JMD	JMN	JMD	JMN	JMD	JMN
2006–07	69.5	26.8	21 248	8 188	22 273	8 583
2007–08	64.8	27.0	21 033	8 763	22 064	9 193
2008–09	66.4	25.3	17 943	6 826	19 154	7 287
2009–10	65.9	27.6	19 487	8 155	20 526	8 590
2010–11	70.6	26.9	18 679	7 123	19 897	7 587
2011–12	68.6	28.1	18 184	7 456	19 381	7 497
2012–13	67.3	29.7	19 525	8 638	21 311	9 428
2013–14	70.7	24.3	23 144	7 961	24 872	8 555
2014–15	60.7	33.0	19 231	10 447	20 623	11 204
2015–16	65.0	28.4	18 312	7 999	20 080	8 771
2016–17	69.0	26.3	21 106	8 051	22 671	8 649
2017–18	64.0	29.8	20 464	9 528	21 896	10 194
2018–19	72.5	20.9	21 774	6 284	23 031	6 647
2019–20	71.6	21.7	21 109	6 401	22 030	6 681
2020–21	72.8	25.6	14 442	5 075	22 228	7 811
2021–22	76.7	22.7	16 165	4 783	20 096	5 946
2022–23	63.8	35.7	15 804*	8 842*	21 470	12 013
2023–24	80.0	19.5	26 502*	11 521*	22 953	5 603

3.3 Sex ratios

Sex ratios have been around 1:1 for *T. declivis* in most years, including in 2023–24 (Table 3). Sex ratios of *T. novaezelandiae* have been slightly skewed towards females in most years but were slightly skewed towards males in 2022–23 but have returned to female skewed in 2023–24.

Table 3: Estimated sex ratios (%) in the JMA 7 trawl fishery catch by species and fishing year. JMD = *Trachurus declivis*, JMN = *Trachurus novaezelandiae*.

Fishing year	JMD		JMN	
	Males	Females	Males	Females
2006–07	56.8	43.2	49.9	50.1
2007–08	51.7	48.3	43.4	56.6
2008–09	52.5	47.5	45.7	54.3
2009–10	51.5	48.5	49.1	50.9
2010–11	46.8	53.2	43.4	56.6
2011–12	47.7	52.3	48.0	52.0
2012–13	50.8	49.2	50.0	50.0
2013–14	51.2	48.8	45.4	54.6
2014–15	46.2	53.8	44.4	55.6
2015–16	50.7	49.3	46.2	53.8
2016–17	51.3	48.7	51.8	48.2
2017–18	52.8	47.2	54.8	45.2
2018–19	48.4	51.6	46.9	53.1
2019–20	49.6	50.4	51.3	48.7
2020–21	43.8	56.2	43.3	56.7
2021–22	49.9	50.1	48.2	51.8
2022–23	50.9	49.1	52.7	47.3
2023–24	49.7	50.1	43.1	56.9

3.4 Catch-at-length

Post data grooming, paired length and sex data were available for a total of 36 133 *T. declivis*, and 20 973 *T. novaezelandiae* for inclusion in the sex-specific catch-at-length analyses. The resulting estimated scaled catch-at-length distributions by species and sex for trawl-caught target jack mackerel from JMA 7 in 2023–24 are provided in Figure 6. For male *T. declivis* there was a slight bimodality in the length distribution, with a main mode at 34–42 cm, and a secondary mode at around 19–29 cm for both sexes. For *T. novaezelandiae* there was a dominant length mode at 25–32 cm for both sexes (Figure 6).

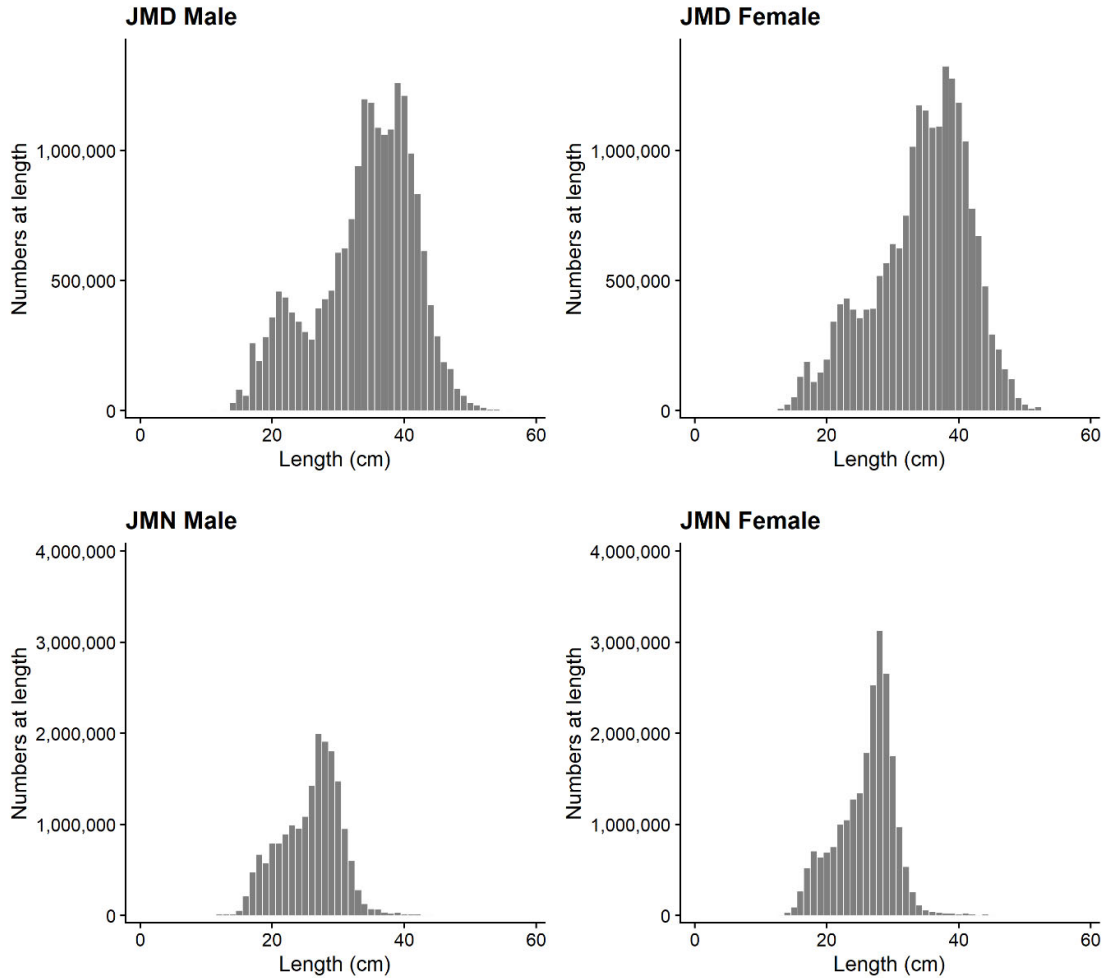


Figure 6: Estimated scaled catch-at-length distributions, by species and sex, for the JMA 7 trawl fishery in 2023–24. JMD = *Trachurus declivis*, JMN = *Trachurus novaezelandiae*.

3.5 Catch-at-age

The details of the estimated catch-at-age distributions for trawl-caught jack mackerel from JMA 7 in 2023–24 are presented in

Table 4 for *T. declivis*, and Table 5 for *T. novaezelandiae*, and plotted in Figure 7. The MWCVs for *T. declivis* (14%) and *T. novaezelandiae* (15%) were well below the target threshold value of 30%. In 2023–24, the catch of *T. declivis* had abundant fish aged 1–6 years, but with relatively few fish older than 12 years for both sexes. The catch of *T. novaezelandiae* was dominated by fish aged 2–6 years, with a dominant mode of 6 years, and very few fish older than 10 years (Figure 7).

Table 4: Estimated numbers-at-age, separately by sex and both sexes combined, with CVs, for *Trachurus declivis* caught during commercial trawl operations in JMA 7 during the 2023–24 fishing year. Summary statistics for the sample are also presented.

Age (years)	Male	CV	Female	CV	Total	CV
0	0	0	0	0	0	0
1	3 057 047	0.22	2 110 880	0.27	5 167 927	0.20
2	2 075 727	0.17	2 964 870	0.18	5 040 597	0.14
3	2 125 771	0.17	2 486 012	0.15	4 611 783	0.12
4	3 991 023	0.09	3 441 527	0.12	7 432 550	0.08
5	3 071 131	0.12	2 643 322	0.13	5 714 454	0.09
6	1 825 789	0.13	2 227 169	0.13	4 052 958	0.09
7	1 258 449	0.18	1 141 474	0.21	2 399 923	0.13
8	493 385	0.30	806 600	0.24	1 299 985	0.17
9	678 984	0.27	872 663	0.24	1 551 647	0.17
10	354 411	0.42	291 584	0.46	645 995	0.31
11	0	0	168 396	0.69	168 396	0.69
12	123 944	0.62	246 014	0.55	369 958	0.42
13	50 806	0.97	0	0	50 806	0.97
14	32 814	1.17	71 137	0.79	103 951	0.65
15	0	0	0	0	0	0
16	0	0	90 857	0.89	90 857	0.89
17	0	0	47 767	0.98	47 767	0.98
18	10 782	1.69	60 964	1.16	71 747	0.94
19	100 986	1.01	0	0	100 986	1.01
20	0	0	0	0	0	0
21	0	0	0	0	0	0
22	0	0	60 964	0.96	60 964	0.96
23	0	0	0	0	0	0
24	0	0	7 125	1.37	7 125	1.37
25	0	0	0	0	0	0
26	0	0	0	0	0	0
27	0	0	0	0	0	0
28	0	0	0	0	0	0
No. measured*	18 186		17 947		36 133	
No. aged*	289		289		578	
No. of tows sampled*						413
Mean weighted CV (%)						14.0

* Following data grooming.

Table 5: Estimated numbers-at-age, separately by sex and both sexes combined, with CVs, for *Trachurus novaezelandiae* caught during commercial trawl operations in JMA 7 during the 2023–24 fishing year. Summary statistics for the sample are also presented.

Age (years)	Male	CV	Female	CV	Total	CV
0	0	0	0	0	0	0
1	384 941	0.80	247 930	0.72	632 871	0.59
2	3 198 274	0.18	2 847 162	0.19	6 045 437	0.16
3	1 194 720	0.31	734 774	0.44	1 929 493	0.26
4	2 997 648	0.17	4 438 944	0.15	7 436 591	0.12
5	2 284 401	0.14	2 470 386	0.19	4 754 786	0.11
6	3 547 050	0.12	6 373 711	0.09	9 920 762	0.07
7	1 298 313	0.22	1 300 045	0.21	2 598 358	0.16
8	1 127 013	0.23	936 219	0.23	2 063 232	0.16
9	623 495	0.26	963 459	0.24	1 586 954	0.18
10	639 275	0.28	666 677	0.27	1 305 952	0.20
11	337 690	0.45	230 194	0.44	567 883	0.33
12	180 687	0.57	312 218	0.36	492 905	0.32
13	105 492	0.66	132 869	0.64	238 360	0.46
14	158 404	0.68	73 556	0.84	231 960	0.54
15	33 421	0.83	0	0	33 421	0.83
16	0	0	0	0	0	0
17	0	0	46 209	0.81	46 209	0.81
18	26 587	0.88	0	0	26 587	0.88
19	0	0	0	0	0	0
20	34 388	0.84	0	0	34 388	0.84
21	0	0	0	0	0	0
22	0	0	0	0	0	0
23	0	0	0	0	0	0
24	0	0	0	0	0	0
25	0	0	0	0	0	0
26	0	0	0	0	0	0
No. measured*	9 270		11 703		20 973	
No. aged*	241		302		543	
No. of tows sampled*						301
Mean weighted CV (%)						14.8

* Following data grooming.

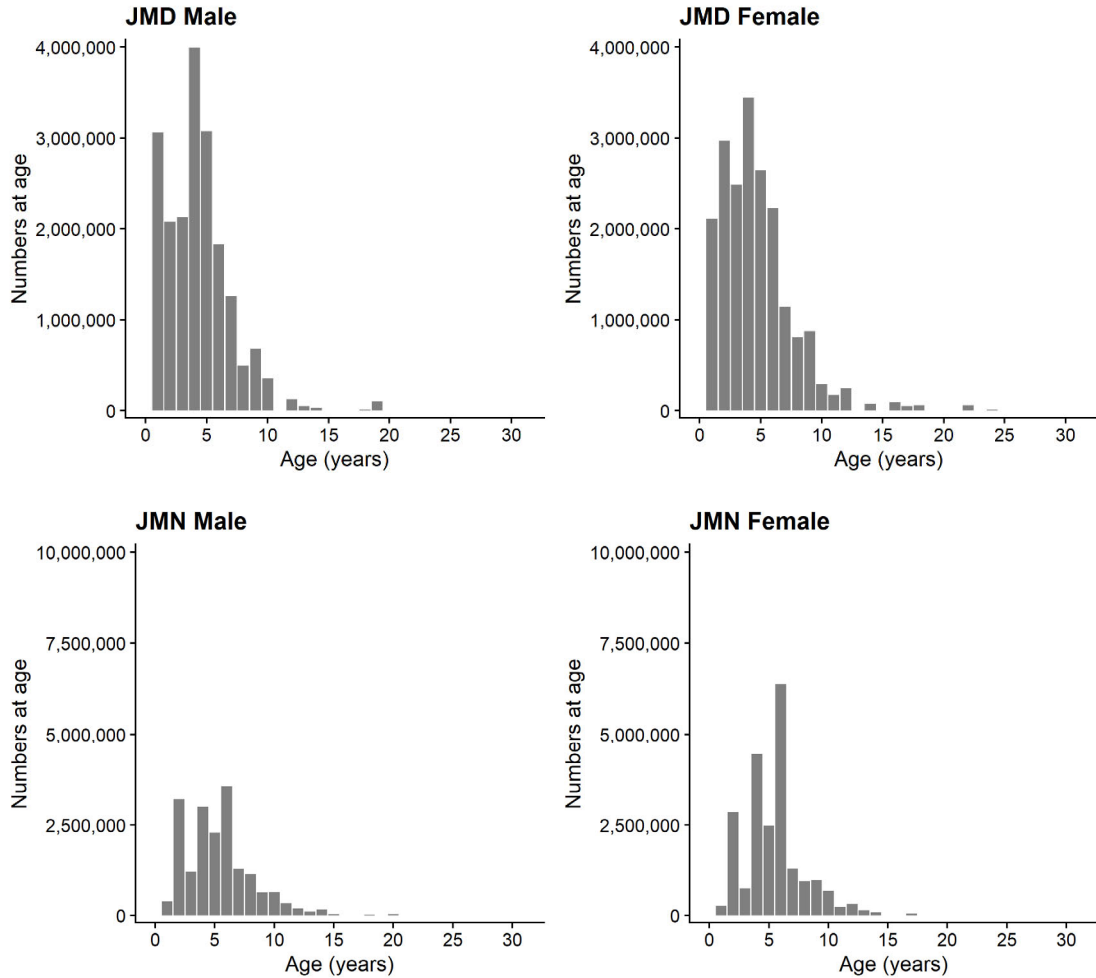


Figure 7: Estimated scaled catch-at-age distributions, by species and sex, for the JMA 7 trawl fishery in 2023–24. JMD = *Trachurus declivis*, JMN = *Trachurus novaezelandiae*.

3.6 Data summaries

Catch-at-length and catch-at-age data from the JMA 7 fishery are available for 2006–07 to the current fishing year (2023–24). Mean weighted CVs for the length and age distributions, by sex and year, are listed for each species in Table 6. CVs less than the maximum threshold of 30% were achieved for *T. declivis* and *T. novaezelandiae* in all years (Table 6).

Total (i.e., sexes combined) scaled length and age distributions, by species and fishing year, since 2006–07 are shown in Figures 8–11. The data used to produce these catch-at-age distributions by proportion are listed in Appendix C.

Trachurus declivis

Scaled catch-at-length and catch-at-age frequencies for *T. declivis* by proportion and number by fishing year since 2006–07 are shown in Figure 8 and Figure 9, respectively. Most variation in abundance has occurred for the fish shorter than 37 cm, presumably related to the relative strengths of juvenile year classes. Since approximately 2015–16, there has been a noticeable increase in the proportion of smaller fish and flattening of the scaled catch-at-length frequencies for *T. declivis*, with modal lengths changing from over 40 cm before 2015–16 to under 40 cm recently. This is also evident in the scaled catch-at-age frequencies, with fewer fish over 10 years old present in the distribution from around 2015–16

onwards (Figure 8). Plots of catch-at-length and catch-at-age distributions by numbers of fish indicated that this increase in proportion of smaller/younger fish was due to their greater relative numbers (Figure 9).

Trachurus novaezelandiae

Scaled catch-at-length and catch-at-age frequency distributions for *T. novaezelandiae* by proportion and number by fishing year are shown in Figure 10 and Figure 11, respectively. Most variation in abundance occurred for fish shorter than 25 cm, presumably related to the relative strengths of juvenile year classes. As with *T. declivis*, there has been a noticeable increase in the proportion of smaller fish and ‘flattening out’ of the scaled catch-at-length frequencies for *T. novaezelandiae* from approximately 2015–16, with a larger proportion of fish less than 30 cm observed from 2015–16 through to 2023–24. This is also evident in the scaled catch-at-age frequencies, with far fewer fish over 10 years old present in the distribution from around 2015–16 onwards. Plots of catch-at-length and catch-at-age distributions by numbers of fish indicated that this increase in proportion of smaller/younger fish was due to their greater relative numbers. The large peak in 5-year-olds observed in 2018–19 was evident as 7-year-olds in 2020–21, although this year class made only a minor contribution to the catch in 2022–23 and 2023–24. The strong 6+ age class observed in 2023–24 follows strong 5+, 4+ and 3+ age classes observed in 2022–23, 2021–22, and 2020–21 respectively.

Table 6: Mean weighted CVs (MWCV) for catch-at-age and catch-at-length distributions, by species, sex, and fishing year for the JMA 7 trawl fishery, 2006–07 to 2023–24. ‘Total’ in this table refers to males and females combined, and excludes unsexed individuals.

Species	Fishing year	Catch-at-age MWCV (%)			Catch-at-length MWCV (%)		
		Males	Females	Total	Males	Females	Total
<i>T. declivis</i>	2006–07	31	38	26	12	12	9
	2007–08	26	34	23	13	13	12
	2008–09	35	40	28	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	21	20	16	17	15	14
	2015–16	27	24	20	19	15	15
	2016–17	19	19	14	15	14	12
	2017–18	20	21	16	15	15	13
	2018–19	22	24	17	13	14	11
	2019–20	17	24	16	14	15	13
	2020–21	19	18	14	16	17	12
	2021–22	17	21	14	14	16	13
	2022–23	22	21	16	15	14	13
2023–24	18	20	14	13	13	11	
<i>T. novaezelandiae</i>	2006–07	26	25	20	17	16	14
	2007–08	28	27	22	17	12	13
	2008–09	39	40	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
	2016–17	20	21	15	16	14	13
	2017–18	19	20	14	15	14	11
	2018–19	26	27	19	12	11	9
	2019–20	17	15	13	16	14	13
	2020–21	21	20	16	18	19	20
	2021–22	19	19	15	17	18	14
	2022–23	19	20	15	12	13	11
2023–24	21	19	15	13	12	10	

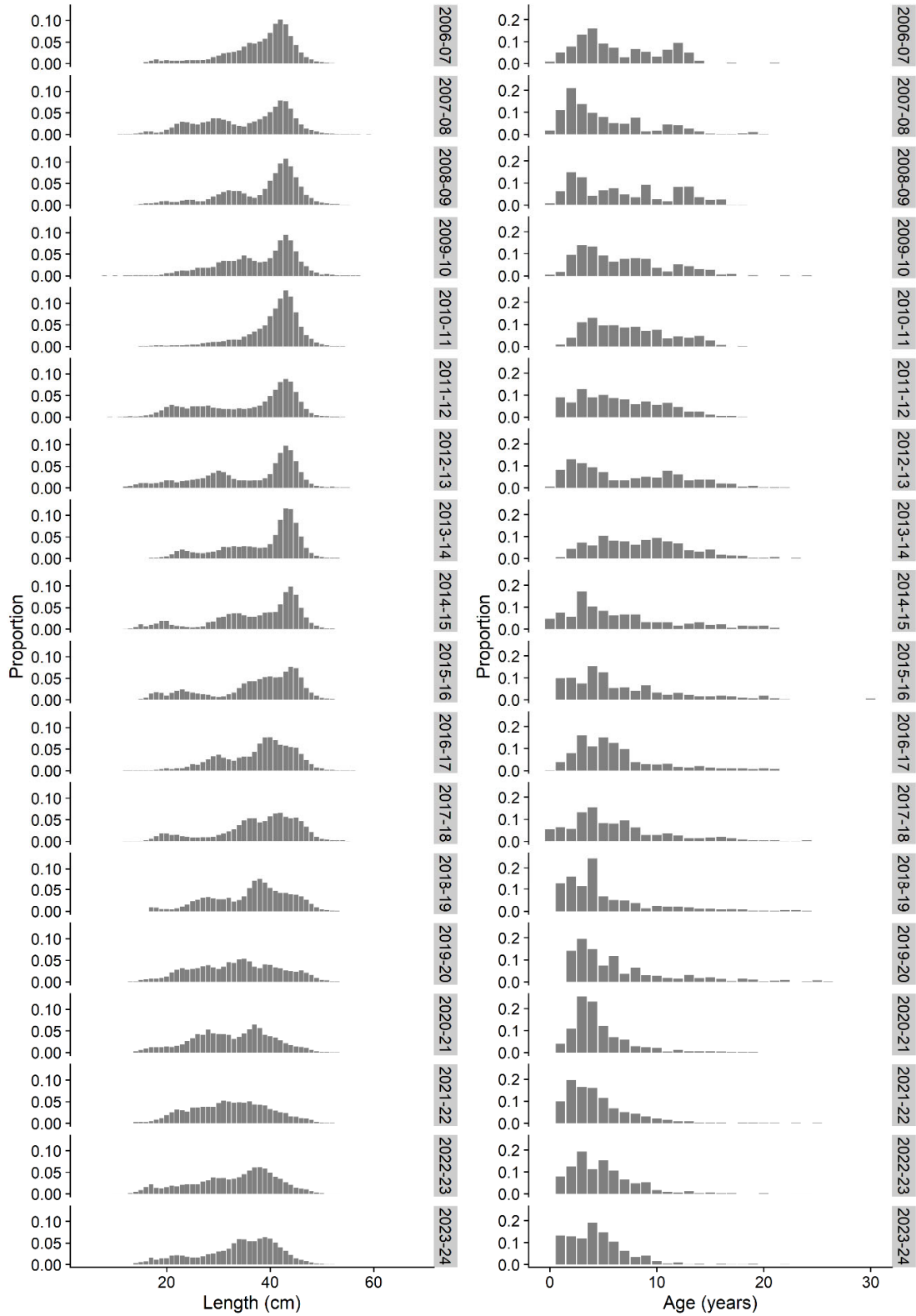


Figure 8: Scaled catch-at-length (left panel) and catch-at-age (right panel) frequency distributions in proportion-at-age for *Trachurus declivis* sampled between the 2006–07 and 2023–24 fishing years for the JMA 7 trawl fishery. Note that the catch-at-age plots here are based on estimated numbers of males and females combined in observed age classes only.

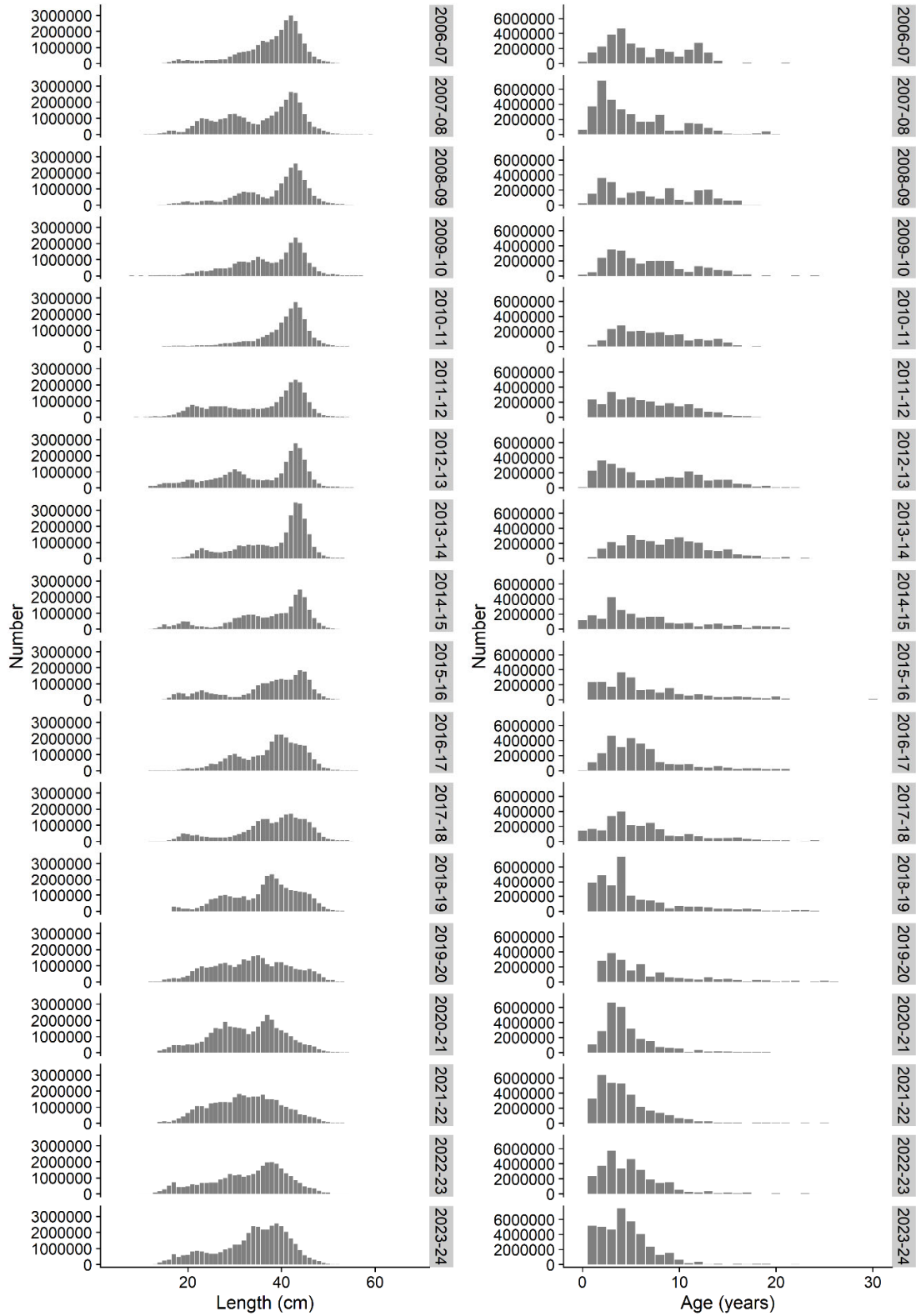


Figure 9: Scaled catch-at-length (left panel) and catch-at-age (right panel) frequency distributions in numbers-at-age for *Trachurus declivis* sampled between the 2006–07 and 2023–24 fishing years for the JMA 7 trawl fishery. Note that the catch-at-age plots here are based on estimated numbers of males and females combined in observed age classes only.

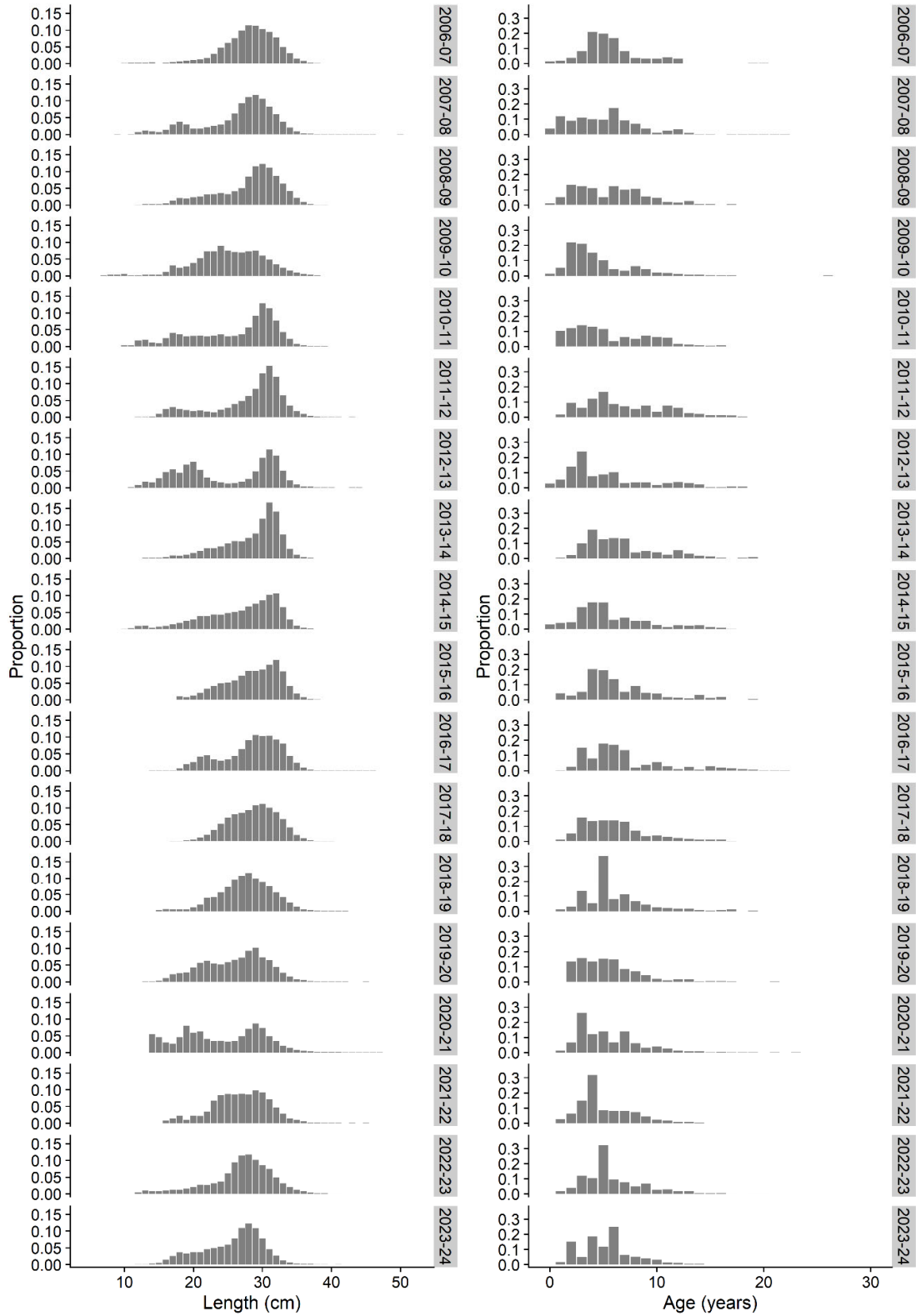


Figure 10: Scaled catch-at-length (left panel) and catch-at-age (right panel) frequency distributions in proportion-at-age for *Trachurus novaehelandiae* sampled between the 2006–07 and 2023–24 fishing years for the JMA 7 trawl fishery. Note that the catch-at-age plots here are based on estimated numbers of males and females combined in observed age classes only.

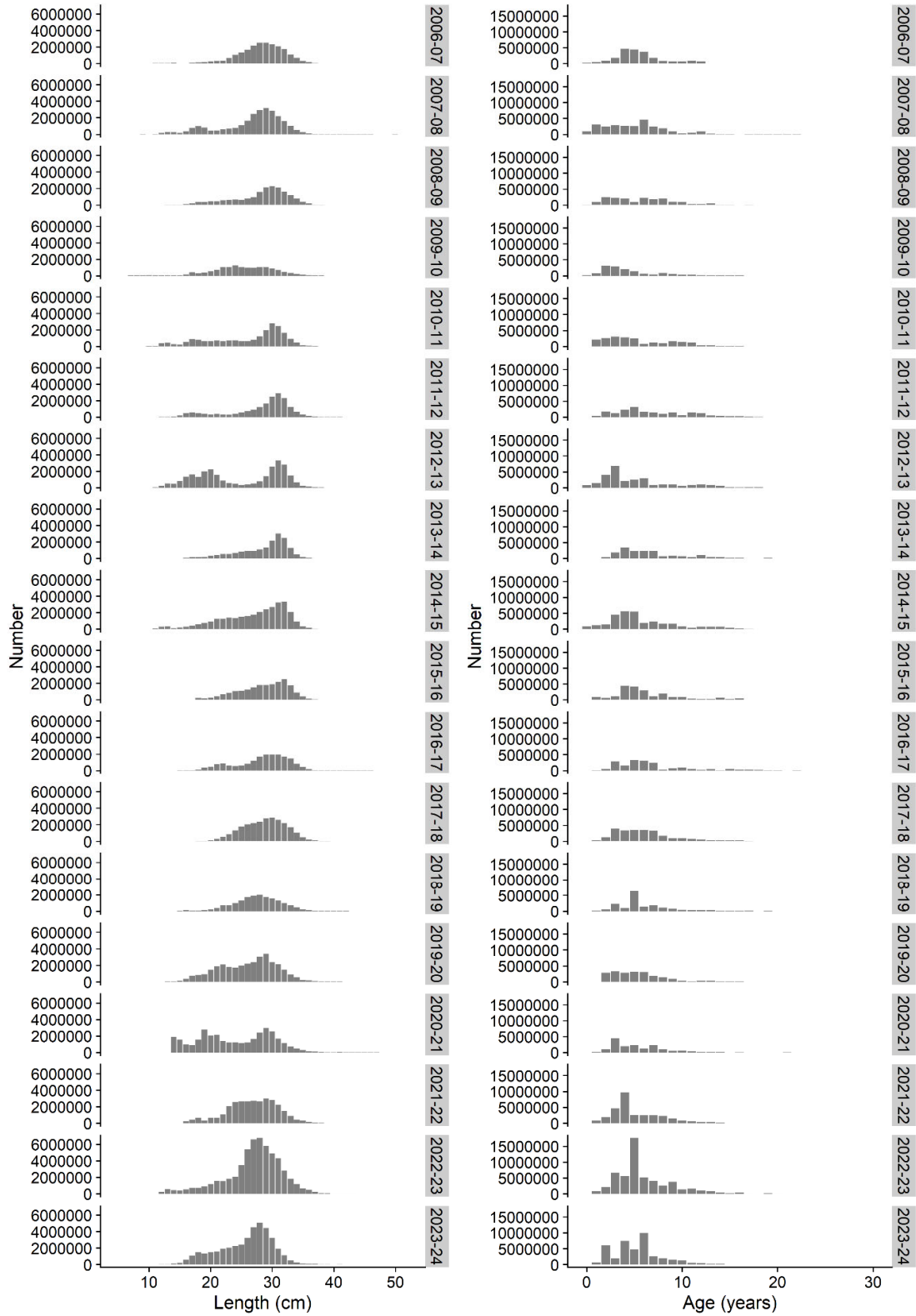


Figure 11: Scaled catch-at-length (left panel) and catch-at-age (right panel) frequency distributions in numbers-at-age for *Trachurus novaezelandiae* sampled between the 2006–07 and 2023–24 fishing years for the JMA 7 trawl fishery. Note that the catch-at-age plots here are based on estimated numbers of males and females combined in observed age classes only.

4. DISCUSSION

The 2023–24 jack mackerel trawl fishery in JMA 7 was well sampled with respect to the spatial and temporal distribution of the fishery (as it was in all years since at least 2006–07) with good coverage of catch in the most fished Statistical Areas (034–037 and 039–042). Estimates of the 2023–24 catch-at-age for the two target species (*T. declivis* and *T. novaezelandiae*) had mean weighted CVs over all age classes of less than 20%, well below the target threshold of 30%.

Estimates of species proportions, based on observer identifications, indicated a consistent predominance of *T. declivis* in terms of total catch weight (80% in 2023–24) in the 17 fishing years for which data were available. Approximately 19.5% of the catch in 2023–24 was comprised of *T. novaezelandiae*, the lowest in the time series (34% in 2022–23 which was the highest). The predominance of *T. declivis* overall is expected as this species generally occurs deeper and further offshore than *T. novaezelandiae* and because most of the vessels targeting jack mackerels were restricted to fishing at least 12 n. miles, and often 25 n. miles off the coast. The high proportions of *T. novaezelandiae* in 2014–15 and 2022–23 potentially relates to relatively low catches in the autumn-winter fishery in these years, which are usually strongly dominated by landings of *T. declivis* off the west coast of the South Island. Observer misidentifications could be a factor contributing to the fluctuating species proportions, however, the otolith shape analyses used to corroborate the observer identification this fishing year suggested that misidentifications were relatively low.

It is unclear from the current study whether the increase in proportions of smaller fish in the scaled catch-at-length estimates (in terms of both proportions at length and numbers-at-length) evident for *T. declivis* and *T. novaezelandiae* from 2015–16 onwards results from changes in the way the fishery operates or in the underlying stock being fished. While the consistency between the spatial and temporal patterns in the fishery and observer sampling presented here and in previous analyses (e.g., Saunders et al. 2022) suggest the former is unlikely, a more in-depth characterisation of the JMA 7 fishery would be required to explore these spatiotemporal trends.

Species identification has been an ongoing problem in the JMA fishery (Horn et al. 2019, Saunders et al. 2021, 2022). An approach to identify species through an examination of the shape of otoliths themselves is now integrated into the routine ageing work for the target species. A result of this work has been less reliance on grooming post age data generation (i.e. before the otolith picking for thin sectioning) meaning that less resource has been wasted on misidentified jack mackerels.

The otolith morphology approach could potentially be retrospectively applied to previously collected otoliths to identify and resolve misidentifications in historical data, or to assess the accuracy of species identifications by individual observers to identify training needs. It could also be extended to resolve spatial stock structure at the species level to enhance the precision of stock assessments (i.e. lack of stock boundary information is potentially confounding JMA stock assessment, personal communication with D. Middleton).

The length-at-age decision rules used to identify and remove likely species identification errors from the age-length key found a very small number of likely misidentifications, suggesting that the otolith shape scrutiny was very effective (but not perfect). Hence, this length-at-age step is still an important final gatekeeper. Further examination of the degree of variation in length-at-age distributions of the two species, achieved through ageing known-ID samples, is required to improve this approach. Previously, the errors for smaller and mid-sized fish were identified as not readily identifiable due to convergence of length-at-age data and growth curves for the species complex. Moreover, misidentifications in the length frequency information are not readily apparent (beyond removing those length classes that extend beyond the maximum reported lengths for a given species), meaning that the reported catch-at-length distributions likely contain a small amount of error. It is worth noting that the otolith shape identification process has very likely improved this situation. To help resolve the issues concerning species misidentification, ongoing training in species identification should be provided to observers to ensure best-quality data are collected.

5. FULFILMENT OF BROADER OUTCOMES

As required under Government Procurement rules¹, Fisheries New Zealand considered broader outcomes (secondary benefits such as environmental, social, economic or cultural benefits) that would be generated by this project.

As part of this project, the team has continued to build capacity and capability in fisheries science and stock assessment, by using both experienced researchers from ESNZ and independent consultants. By using a broader team approach, we promoted a more diverse use of staff; and importantly shared expertise and grew institutional knowledge of New Zealand fisheries and stock assessments amongst these staff. This will reduce the risk of such knowledge being lost in the future and potentially benefit a wide range of future fisheries research projects. ESNZ staff working on this project were a combination of senior and mid-career scientists, more than half of whom were women.

The broader outcomes specific to this project involved building capacity, collaborations, capability, and diversity in the research sector. The project fostered collaboration between ESNZ, the fishing industry, and other New Zealand research providers. The catch-at-age process successfully provided opportunities for fishing industry stakeholders to contribute their unique observations and knowledge to the research process.

6. ACKNOWLEDGEMENTS

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7. REFERENCES

- Bull, B.; Dunn, A. (2012). *catchatage*: NIWA catch-at-age package. R package version 2.01.
- Fisheries New Zealand (2024). *Fisheries Assessment Plenary, May 2024: stock assessments and stock status*. Compiled by the Fisheries Science Team, Fisheries New Zealand, Wellington, New Zealand. 1941 p.
- Hartill, B.; Middleton, D.A.J.; Walsh, C.; Spong, K.; Ó Maolagáin, C. (2022). Catch-at-age sampling of *Trachurus novaezelandiae* from JMA 1 in 2019–20 and 2020–21. *New Zealand Fisheries Assessment Report 2022/37*. 16 p.
- Horn, P.L. (1993). Growth, age structure, and productivity of jack mackerels (*Trachurus* spp.) in New Zealand waters. *New Zealand Journal of Marine and Freshwater Research* 27: 145–155.
- Horn, P.L.; Ó Maolagáin, C. (2020). Age determination protocols for jack mackerels (*Trachurus* spp.) in New Zealand waters. *New Zealand Fisheries Assessment Report 2020/07*. 22 p.
- Horn, P.L.; Ó Maolagáin, C.; Hulston, D. (2019). Commercial catch sampling for species proportion, sex, length, and age of jack mackerels in JMA 7 in the 2017–18 fishing year, with a summary of all available data sets. *New Zealand Fisheries Assessment Report 2019/43*. 28 p.

¹ <https://www.procurement.govt.nz/procurement/principles-charter-and-rules/government-procurement-rules/planning-your-procurement/broader-outcomes/>

- Horn, P.L.; Ó Maolagáin, C.; Hulston, D.; Ballara, S.L. (2017). Commercial catch sampling for species proportion, sex, length, and age of jack mackerels in JMA 7 in the 2014–15 fishing year, with a summary of all available data sets. *New Zealand Fisheries Assessment Report 2017/39*. 29 p.
- Kawahara, S.; Uozumi, Y.; Yamada, H. (1988). First record of a carangid fish, *Trachurus murphyi* from New Zealand. *Japanese Journal of Ichthyology* 35: 212–214.
- Lyle, J.M.; Krusic-Golub, K.; Morison, A.K. (2000). Age and growth of jack mackerel and the age structure of the jack mackerel purse seine catch. *FRDC Final Report on Project 1995/034*. Tasmanian Aquaculture and Fisheries Institute, Marine Research Laboratories, Taroona, Tasmania 7053, Australia. 49 p.
- Middleton, D.A.J. (2022). An evaluation of species composition sampling in the JMA 7 trawl fishery. *New Zealand Fisheries Assessment Report 2022/20*. 39 p.
- Moore, B.R.; Hamill, J.; Hart, A.; Saunders, R.J. (2022). Use of otolith morphology to differentiate jack mackerel species in New Zealand. Draft New Zealand Fisheries Assessment Report held by Fisheries New Zealand.
- Moore, B.R.; Ó Maolagáin, C.; Spong, K.; Barnes, T. (2024a). Commercial catch sampling for species proportion, sex, length, and age of jack mackerels in JMA 7 in the 2021–22 fishing year, with a summary of all available data sets. *New Zealand Fisheries Assessment Report 2024/08*. 33 p.
- Moore, B.R.; Ó Maolagáin, C.; Spong, K. (2024b). Commercial catch sampling for species proportion, sex, length, and age of jack mackerels in JMA 7 in the 2022–23 fishing year, with a summary of all available data sets. *New Zealand Fisheries Assessment Report 2024/80*. 37 p.
- Sanders, B.M.; Fisher, D.O. (2022). Database documentation for the Ministry of Primary Industries Centralised Observer Database cod. *NIWA Fisheries Data Management Database Documentation Series*. 697 p.
- Saunders, R.; Horn, P.L.; Ó Maolagáin, C.; Hulston, D. (2021). Commercial catch sampling for species proportion, sex, length, and age of jack mackerels in JMA 7 in the 2018–19 fishing year, with a summary of all available data sets. *New Zealand Fisheries Assessment Report 2021/05*. 33 p.
- Saunders, R.J.; Ó Maolagáin, C.; Hulston, D.; Spong, K. (2022). Commercial catch sampling for species proportion, sex, length, and age of jack mackerels in JMA 7 in the 2019–20 fishing year, with a summary of all available data sets. *New Zealand Fisheries Assessment Report 2022/52*. 30 p.
- Taylor, P.R.; Smith, M.H.; Horn, P.L.; Ó Maolagáin, C. (2011). Commercial catch sampling for species proportion, sex, length, and age of jack mackerels in JMA 7 in the 2006–07, 2007–08 and 2008–09 fishing years. Final Research Report for Ministry of Fisheries Project JMA2006-01 & JMA2009-02. 57 p. (Unpublished report available from Fisheries New Zealand, Wellington.)

APPENDIX A: Length-at-age plot

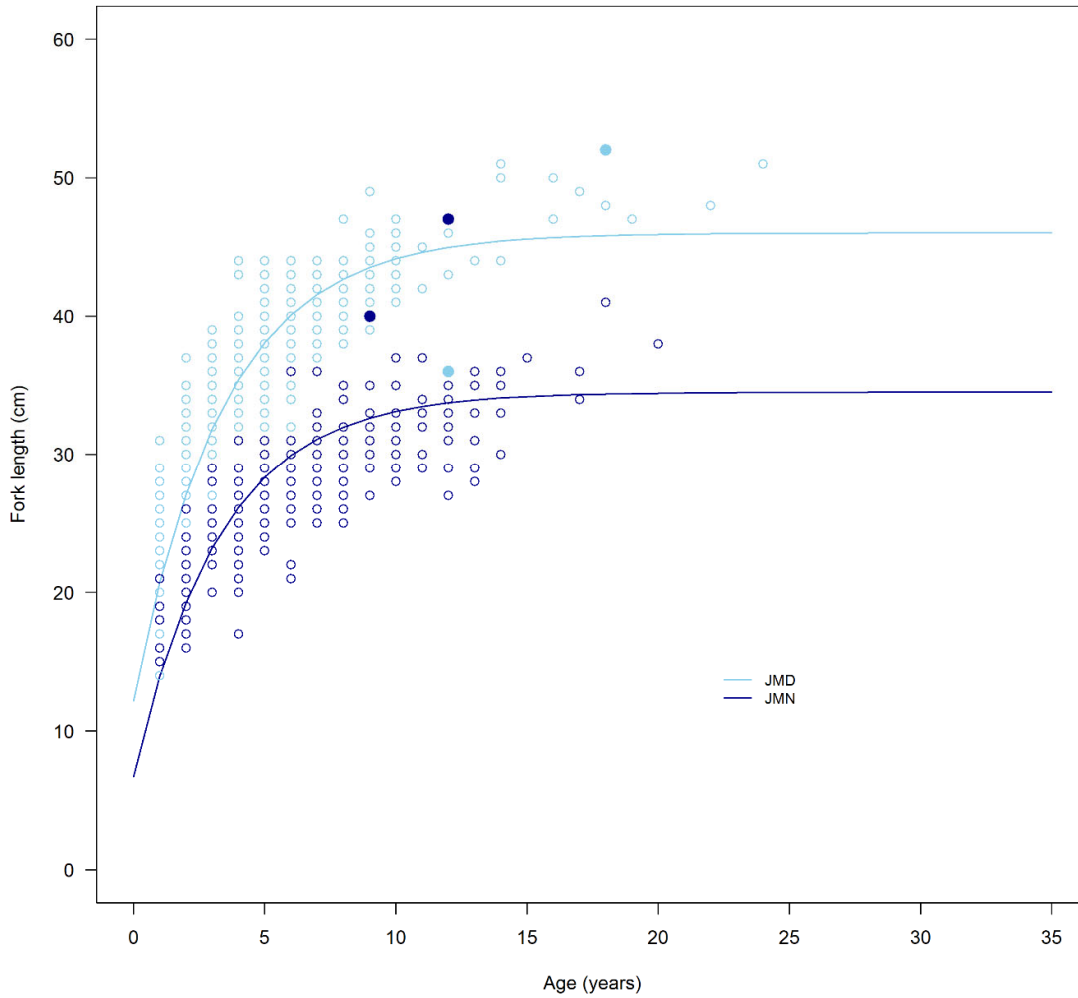


Figure A1: Length-at-age data for the two target species (light blue denotes JMD [*Trachurus declivis*] and dark blue denotes JMN [*Trachurus novaezelandiae*]) with open circles and closed circles representing remaining and removed points (respectively) post the residual decision rule run. The residuals were based on current best fitting von Bertalanffy growth models (Fisheries New Zealand 2024) depicted by the respective lines.

APPENDIX B: Jack mackerel catches by Statistical Area

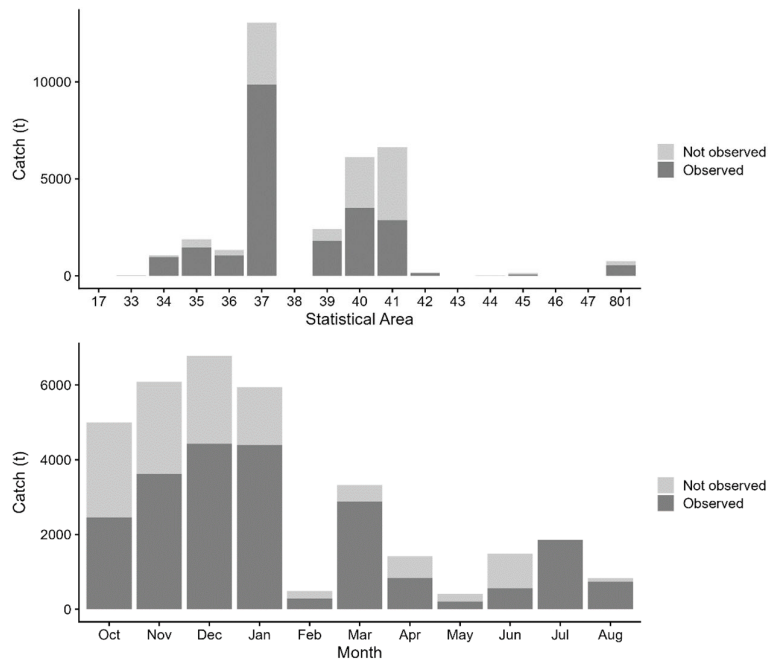


Figure B1: Jack mackerel fisher estimated catches and observed estimated catches by Statistical Area, where '17' is 'Statistical Area 017' (top) and by month (bottom) in 2022–23 for the JMA 7 trawl fishery.

APPENDIX C: Estimated proportions-at-age data

This appendix lists the estimated proportions-at-age and CVs in the JMA 7 trawl fishery, by species and fishing year between 2006–07 and 2023–24. Data are presented with sexes combined, in a format that can easily be converted to a CASAL/CASAL2 input file in a single-sex model. In the proportions-at-age tables, “0” indicates that there were no fish of that age, “0.00000” indicates that there were fish of that age but that they accounted for less than $5e^{-4}$ % of the sample.

Table C1: Estimated proportions-at-age (in years; males and females combined) for *Trachurus declivis*, by fishing year in the JMA 7 trawl fishery.

Age	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
0	0.0089	0.0178	0.0081	0.0054	0	0	0.0041	0.0002	0.0478	0	0.0012	0.0538	0	0	0	0.0003	0	0
1	0.0515	0.1106	0.0622	0.018	0.0092	0.0889	0.0813	0.0066	0.0754	0.0983	0.0376	0.0632	0.1271	0	0.0409	0.0987	0.0795	0.1325
2	0.0772	0.2107	0.1488	0.0942	0.039	0.0659	0.129	0.0437	0.0563	0.0996	0.0794	0.0557	0.1612	0.1406	0.1087	0.1961	0.1239	0.1293
3	0.1315	0.1363	0.1266	0.1387	0.1091	0.1261	0.1118	0.0729	0.1713	0.0739	0.1598	0.1307	0.1133	0.1951	0.2539	0.1643	0.1914	0.1183
4	0.1585	0.0974	0.0403	0.1327	0.1301	0.0886	0.0933	0.0589	0.1025	0.1522	0.1092	0.1527	0.2431	0.148	0.2315	0.1602	0.1111	0.1906
5	0.0911	0.0785	0.0679	0.0923	0.0949	0.1004	0.0718	0.1042	0.083	0.1253	0.149	0.0813	0.0672	0.0745	0.1208	0.1152	0.1532	0.1466
6	0.0714	0.0493	0.0763	0.0629	0.0963	0.0859	0.0341	0.0816	0.0617	0.0543	0.1245	0.0802	0.0498	0.1185	0.0692	0.0664	0.1055	0.1039
7	0.0285	0.0492	0.0476	0.0767	0.0851	0.0796	0.0351	0.0779	0.0672	0.0569	0.0984	0.0951	0.0478	0.0361	0.0584	0.0511	0.0648	0.0616
8	0.0655	0.0756	0.0343	0.0801	0.0883	0.0575	0.0429	0.0623	0.0666	0.0409	0.0393	0.0626	0.0371	0.0632	0.0283	0.0422	0.0486	0.0333
9	0.055	0.0131	0.0908	0.0768	0.0701	0.07	0.0503	0.0845	0.0325	0.0665	0.029	0.0279	0.0121	0.0294	0.0236	0.0319	0.052	0.0398
10	0.0316	0.0154	0.027	0.0345	0.075	0.0556	0.0469	0.0936	0.0309	0.0336	0.0273	0.0275	0.023	0.028	0.0216	0.0203	0.0176	0.0166
11	0.0619	0.0444	0.016	0.0192	0.0354	0.0642	0.0771	0.0768	0.0316	0.0236	0.0303	0.0364	0.0199	0.019	0.0038	0.0158	0.0088	0.0043
12	0.093	0.0423	0.0824	0.0507	0.0458	0.0454	0.0605	0.0689	0.0151	0.0315	0.0171	0.0257	0.0197	0.0144	0.0116	0.0074	0.0068	0.0095
13	0.0497	0.026	0.0837	0.0435	0.0391	0.0256	0.033	0.0367	0.0244	0.0226	0.0143	0.0142	0.0176	0.0312	0.0048	0.0083	0.0128	0.0013
14	0.0138	0.0137	0.0351	0.0299	0.0478	0.0254	0.0363	0.0325	0.0315	0.0173	0.0209	0.0146	0.0109	0.0166	0.0052	0.0031	0.0038	0.0027
15	0.0015	0.0024	0.024	0.0264	0.0256	0.0099	0.0372	0.0408	0.0195	0.017	0.0132	0.0172	0.0108	0.0194	0.0049	0.0028	0.0059	0
16	0	0.0004	0.0251	0.0057	0.0068	0.0055	0.0193	0.0173	0.0231	0.0183	0.0086	0.0192	0.0072	0.0134	0.0039	0.0032	0.0033	0.0023
17	0.0031	0.0017	0.0022	0.0075	0.0004	0.0051	0.0172	0.0138	0.0068	0.0166	0.0088	0.0125	0.0095	0.0037	0.0028	0	0.0046	0.0012
18	0.0013	0.0042	0.0016	0	0.002	0.0005	0.0048	0.0115	0.0164	0.0105	0.0091	0.0085	0.0069	0.0137	0.0034	0.003	0	0.0018
19	0	0.0104	0	0.0023	0	0	0.0094	0.0028	0.014	0.0073	0.0061	0.0054	0.0029	0.0099	0.0029	0.0029	0.0004	0.0026
20	0.0005	0.0008	0	0	0	0	0.0011	0.0031	0.0154	0.0186	0.0086	0.0036	0.0024	0.0022	0	0.0012	0.0031	0
21	0.0046	0	0	0	0	0	0.0021	0.0072	0.0069	0.0072	0.0082	0.0042	0.0019	0.0045	0	0.0016	0	0
22	0	0	0	0.0023	0	0	0.0013	0	0	0.0017	0	0.0007	0.0036	0.0072	0	0	0	0.0016
23	0	0	0	0	0	0	0	0.002	0	0.0004	0	0.0026	0.0047	0	0	0.0016	0.0015	0
24	0	0	0	0.0003	0	0	0	0	0	0	0	0.0046	0.0004	0.0025	0	0	0.0014	0.0002
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0066	0	0.0016	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0021	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0002	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0007	0	0
29	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	0.0058	0	0	0	0	0	0	0	0

Table C2: CVs for estimated proportions-at-age (in years; males and females combined) for *Trachurus declivis* by fishing year in the JMA 7 trawl fishery.

Age	2006–07	2007–08	2008–09	2009–10	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	2020–21	2021–22	2022–23	2023–24
0	0.465	0.320	0.354	0.428			0.793	1.197	0.337		0.756	0.375				1.775		
1	0.230	0.193	0.198	0.326	0.355	0.267	0.238	0.441	0.190	0.464	0.341	0.218		0.194	0.232	0.171	0.295	0.202
2	0.175	0.138	0.140	0.207	0.191	0.229	0.199	0.409	0.188	0.218	0.157	0.157	0.186	0.115	0.201	0.141	0.173	0.140
3	0.145	0.128	0.145	0.141	0.134	0.162	0.161	0.222	0.104	0.147	0.119	0.119	0.143	0.231	0.111	0.106	0.120	0.117
4	0.121	0.170	0.293	0.130	0.113	0.182	0.161	0.191	0.098	0.101	0.117	0.104	0.109	0.123	0.079	0.097	0.121	0.076
5	0.237	0.195	0.264	0.160	0.143	0.115	0.153	0.129	0.100	0.104	0.083	0.121	0.067	0.106	0.117	0.104	0.090	0.086
6	0.328	0.324	0.340	0.190	0.153	0.114	0.170	0.114	0.120	0.122	0.080	0.113	0.106	0.159	0.122	0.113	0.099	0.088
7	0.452	0.264	0.424	0.168	0.169	0.117	0.149	0.136	0.114	0.127	0.095	0.087	0.147	0.131	0.154	0.129	0.121	0.134
8	0.324	0.344	0.436	0.186	0.175	0.140	0.135	0.123	0.111	0.178	0.161	0.112	0.126	0.218	0.197	0.139	0.154	0.172
9	0.310	0.471	0.268	0.177	0.176	0.124	0.125	0.099	0.167	0.118	0.184	0.176	0.153	0.198	0.212	0.161	0.138	0.174
10	0.497	0.486	0.488	0.300	0.184	0.137	0.140	0.093	0.184	0.180	0.182	0.177	0.256	0.272	0.203	0.201	0.274	0.307
11	0.266	0.286	0.682	0.367	0.230	0.127	0.099	0.108	0.169	0.240	0.173	0.150	0.189	0.292	0.447	0.240	0.370	0.687
12	0.241	0.289	0.307	0.214	0.216	0.158	0.113	0.111	0.258	0.191	0.223	0.174	0.201	0.215	0.293	0.376	0.467	0.425
13	0.360	0.448	0.293	0.236	0.237	0.208	0.149	0.142	0.201	0.208	0.244	0.242	0.218	0.294	0.494	0.346	0.302	0.971
14	0.564	0.466	0.458	0.268	0.209	0.183	0.143	0.146	0.182	0.281	0.200	0.252	0.226	0.279	0.412	0.584	0.687	0.650
15	0.921	0.851	0.386	0.273	0.295	0.339	0.149	0.138	0.218	0.249	0.260	0.233	0.269	0.369	0.403	0.663	0.502	0.000
16		0.747	0.312	0.469	0.545	0.472	0.211	0.221	0.200	0.242	0.328	0.209	0.283	0.626	0.515	0.585	0.714	0.890
17	1.019	1.015	0.636	0.647	1.049	0.438	0.243	0.230	0.358	0.295	0.282	0.263	0.294	0.356	0.582		0.487	0.980
18	1.056	0.376	0.841		1.091	0.690	0.399	0.254	0.251	0.315	0.324	0.335	0.307	0.400	0.495	0.629		0.939
19		0.784		1.020			0.292	0.456	0.254	0.383	0.373	0.388	0.327	0.829	0.466	0.637	1.072	1.007
20	1.052	1.018					0.868	0.409	0.277	0.234	0.329	0.406	0.568	0.629		0.728	0.633	0.000
21	1.006						0.701	0.335	0.369	0.334	0.355	0.415	0.561	0.512		0.941		0.000
22				0.963			0.801			0.537		0.769	0.436					0.955
23								0.624		1.031		0.472	0.467	0.838		0.935	1.096	0.000
24				1.254								0.425	0.419	0.553		0.957	1.366	
25													0.695	0.839		0.934		
26	0.465	0.320	0.354	0.428			0.793	1.197	0.337		0.756	0.375						

Table C3: Estimated proportions-at-age (in years; males and females combined) for *Trachurus novaezelandiae*, by fishing year in the JMA 7 trawl fishery.

Age	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
0	0.0132	0.0373	0.0094	0.0127	0.0007	0	0.0284	0	0.0297	0	0	0.0007	0	0	0	0	0	0
1	0.0209	0.118	0.0512	0.051	0.1021	0.0168	0.0531	0.0056	0.0397	0.0442	0.0008	0.0114	0.012	0	0.0128	0.0275	0.0165	0.0158
2	0.0392	0.0895	0.1346	0.2183	0.1216	0.0934	0.1399	0.0216	0.0458	0.0285	0.0265	0.0503	0.0299	0.134	0.0656	0.0638	0.0386	0.1513
3	0.0823	0.1098	0.123	0.2108	0.1408	0.0598	0.238	0.1004	0.1441	0.0528	0.1524	0.1574	0.1335	0.1553	0.263	0.1502	0.1202	0.0483
4	0.209	0.0988	0.1117	0.1517	0.1312	0.121	0.0765	0.189	0.1777	0.2024	0.0809	0.1344	0.0531	0.1348	0.1199	0.3178	0.1024	0.1862
5	0.1982	0.096	0.051	0.102	0.1137	0.1668	0.0875	0.1268	0.1751	0.1944	0.1787	0.1384	0.3688	0.1523	0.1374	0.0865	0.322	0.119
6	0.1697	0.1731	0.1246	0.0443	0.0367	0.0868	0.1012	0.1342	0.0615	0.135	0.1702	0.138	0.0781	0.1467	0.0676	0.0802	0.0942	0.2484
7	0.0823	0.0914	0.0992	0.0319	0.0604	0.0712	0.032	0.1314	0.0749	0.0531	0.1343	0.1297	0.1092	0.0851	0.1376	0.0817	0.0755	0.065
8	0.036	0.0713	0.1081	0.0639	0.0503	0.0523	0.036	0.0388	0.0536	0.0917	0.0184	0.068	0.0644	0.0681	0.0599	0.0736	0.0484	0.0517
9	0.0336	0.0358	0.0558	0.0426	0.0722	0.0739	0.037	0.0478	0.0539	0.0454	0.0373	0.0347	0.0412	0.0431	0.0317	0.0463	0.069	0.0397
10	0.0319	0.0121	0.0486	0.0206	0.0631	0.0334	0.0199	0.0424	0.0283	0.0421	0.0547	0.0375	0.0238	0.0192	0.0382	0.0239	0.0262	0.0327
11	0.0406	0.0221	0.0181	0.0181	0.0586	0.0757	0.0321	0.0243	0.0139	0.017	0.0294	0.0295	0.022	0.0095	0.0266	0.0172	0.0294	0.0142
12	0.0328	0.032	0.0168	0.0115	0.016	0.0609	0.0379	0.0564	0.0257	0.0135	0.0083	0.0225	0.0145	0.0163	0.0141	0.0095	0.0183	0.0123
13	0.001	0.0082	0.0269	0.0058	0.0131	0.0277	0.0323	0.0303	0.0239	0.0092	0.0237	0.0155	0.0161	0.0178	0.0082	0.0102	0.0165	0.006
14	0.0012	0.0006	0.0063	0.0066	0.0071	0.02	0.0224	0.0189	0.0253	0.0308	0.0054	0.0092	0.0065	0.004	0.0075	0.0059	0.0068	0.0058
15	0	0.0002	0.0081	0.0046	0.0051	0.0143	0.0053	0.0123	0.0127	0.0129	0.0284	0.0093	0.0039	0.0044	0.0013	0.0012	0.0041	0.0008
16	0.0004	0	0.0003	0.0027	0.0067	0.0127	0.0038	0.006	0.0081	0.0197	0.0182	0.0094	0.0079	0.0053	0.0043	0.001	0.0068	0
17	0.0007	0.0012	0.0049	0.0005	0.0006	0.011	0.0087	0.0015	0.0029	0.0019	0.0162	0.0032	0.0105	0.0019	0.0009	0.0005	0.0018	0.0012
18	0.0006	0.0005	0.0004	0.0001	0.0001	0.0024	0.0062	0.0038	0	0	0.0088	0.0002	0.0003	0.0006	0.0006	0.0011	0	0.0007
19	0.0026	0.0011	0.0002	0.0001	0	0	0.0011	0.0077	0.0009	0.004	0.0055	0	0.0045	0	0.0006	0.0013	0.002	0
20	0.0024	0.0006	0	0	0	0	0	0.0008	0.0009	0.0012	0.0008	0.0002	0	0	0	0.0007	0.0011	0.0009
21	0	0.0003	0.0008	0	0	0	0	0	0.0014	0	0.0001	0	0	0.0015	0.0017	0	0	0
22	0	0.0002	0	0	0	0	0	0	0	0	0.0011	0	0	0	0	0	0	0
23	0.001	0	0	0	0	0	0.0005	0	0	0	0	0.0002	0	0	0.0006	0	0	0
24	0.0006	0	0	0.0001	0	0	0.0002	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0.0003	0	0	0	0	0	0	0	0	0.0003	0	0	0	0	0	0
26	0	0	0	0.0002	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
28	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
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table C4: CVs for estimated proportions-at-age (in years; males and females combined) for *Trachurus novaezelandiae*, by fishing year in the JMA 7 trawl fishery.

Age	2006–07	2007–08	2008–09	2009–10	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	2020–21	2021–22	2022–23	2023–24
0	0.488	0.460	0.759	0.913	2.006		0.524	1.709				0.712						
1	0.515	0.305	0.297	0.389	0.378	0.487	0.463	0.516	0.481	0.525	1.064	0.273	0.448		0.642	0.361	0.468	0.593
2	0.347	0.134	0.184	0.213	0.249	0.209	0.244	0.349	0.355	0.435	0.415	0.247	0.365	0.225	0.267	0.246	0.329	0.156
3	0.218	0.147	0.175	0.186	0.185	0.219	0.151	0.201	0.274	0.296	0.190	0.122	0.160	0.125	0.147	0.167	0.171	0.263
4	0.134	0.182	0.316	0.172	0.114	0.109	0.179	0.117	0.133	0.121	0.170	0.137	0.245	0.115	0.140	0.093	0.154	0.119
5	0.118	0.198	0.397	0.209	0.124	0.097	0.101	0.108	0.084	0.085	0.092	0.114	0.063	0.103	0.122	0.132	0.071	0.114
6	0.130	0.135	0.278	0.281	0.228	0.133	0.089	0.083	0.070	0.099	0.093	0.104	0.151	0.108	0.177	0.129	0.128	0.069
7	0.195	0.210	0.314	0.227	0.193	0.176	0.183	0.093	0.138	0.169	0.092	0.098	0.125	0.126	0.127	0.105	0.138	0.156
8	0.281	0.216	0.272	0.211	0.189	0.187	0.172	0.167	0.123	0.123	0.268	0.154	0.158	0.134	0.148	0.125	0.147	0.165
9	0.335	0.253	0.336	0.204	0.141	0.157	0.159	0.163	0.135	0.177	0.157	0.186	0.204	0.170	0.165	0.154	0.121	0.176
10	0.304	0.451	0.398	0.230	0.160	0.252	0.226	0.174	0.144	0.172	0.153	0.146	0.255	0.236	0.158	0.188	0.175	0.200
11	0.265	0.331	0.432	0.274	0.170	0.145	0.163	0.247	0.208	0.265	0.191	0.179	0.254	0.302	0.220	0.223	0.183	0.334
12	0.288	0.313	0.527	0.252	0.328	0.166	0.144	0.147	0.289	0.324	0.374	0.185	0.283	0.277	0.223	0.312	0.193	0.316
13	1.023	0.320	0.321	0.327	0.316	0.222	0.165	0.163	0.225	0.374	0.206	0.213	0.342	0.257	0.260	0.259	0.218	0.458
14	0.949	1.264	0.480	0.367	0.429	0.272	0.179	0.199	0.187	0.221	0.378	0.268	0.430	0.453	0.257	0.315	0.374	0.538
15		1.348	0.625	0.336	0.392	0.305	0.358	0.232	0.180	0.313	0.184	0.288	0.595	0.477	0.601	0.593	0.482	0.834
16	1.059		1.035	0.494	0.451	0.311	0.458	0.275	0.296	0.232	0.238	0.261	0.440	0.371	0.383	0.656	0.384	0.000
17	0.731	1.006	1.042	0.594	1.160	0.374	0.280	0.512	0.325	0.503	0.244	0.461	0.326	0.626	0.783	0.834	0.600	0.815
18	0.818	1.092	1.148	2.105	1.712	0.565	0.317	0.385	0.512	0.000	0.294	0.791	1.088	0.954	0.817	0.715	0.000	0.875
19	0.702	1.023	0.972	1.916			0.769	0.287	0.000	0.528	0.349		0.473		0.767	0.716	0.704	0.000
20	0.896	0.940		1.253				0.673	0.434	0.569	0.581	0.978			0.000	0.739	0.936	0.836
21		0.869	0.832						0.862		1.016			0.751	0.489			
22		1.138									0.550				0.000			
23	1.079			1.134			0.835					0.941			0.762			
24	1.065			0.887			0.903											
25			1.037	2.166								1.041						
26				1.049														