(HAK 1&7) and ling (LIN 3–7) from commercial fisheries in 2023–24 and trawl surveys in 2024

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PLAIN LANGUAGE SUMMARY

This report provides catch-at-age for hake (*Merluccius australis*) in HAK 1&7 and ling (*Genypterus blacodes*) in LIN 3&4, 5&6 and 7 from commercial fisheries during the 2023–24 fishing year and research trawl surveys in the 2024 calendar year to update ongoing time series.

These estimates are based on biological data and otoliths (ear bones used for ageing fish) sampled by observers and survey staff. The sampled ages are extrapolated via broader fishery or survey information (length frequencies scaled to total catch or survey biomass) to form representative estimates of catch-at-age.

Catch-at-age estimates of exploited stocks are important for stock assessment and management because they provide information on the selectivity of fishing gear, magnitude of a given year class, and productivity (i.e. growth rate, age at reproduction, and natural mortality).

To further improve the precision of the hake and ling catch-at-age estimates, increased observer sampling of hake and ling biological data and otoliths, in key areas and times, would be required.

EXECUTIVE SUMMARY

Barnes, T.C. [1]**; Ballara, S.L.**[1]**; Spong, K.** [1]**; Sutton, C.** [1]**; Davey, N.** [1]**; Carter, M.**[1] **(2026). Catch-at-age estimates for hake (HAK 1&7) and ling (LIN 3–7) from commercial fisheries in 2023–24 and trawl surveys in 2024.**

This report provides catch-at-age for hake (*Merluccius australis*) in HAK 1&7 and ling (*Genypterus blacodes*) in LIN 3&4, 5&6 and 7 from commercial fisheries during the 2023–24 fishing year. Catch-at-age from discrete fisheries (within quota management areas) were estimated for both species using biological data and otoliths sampled at sea by observers, and from bottom trawl research surveys on the west coast South Island (WCSI) in Jul–Aug 2024 (TAN2407) and the Sub-Antarctic in Nov–Dec 2024 (TAN2413). The target mean weighted coefficient of variation (mwCV) for estimated catch-at-age was 30% across all age classes, for both species and all fisheries.

For hake commercial trawl fisheries, the target mwCV was achieved for the Sub-Antarctic (HAK 1) and WCSI (HAK 7). The target mwCV was not achieved for hake captured on research trawl surveys. For ling commercial trawl fisheries, the target mwCV was achieved for the Sub-Antarctic (LIN 5&6) and WCSI (LIN 7) but not for the Chatham Rise (LIN 3&4). For ling longline fisheries, the target mwCV was achieved for the Chatham Rise (LIN 3&4) but not Sub-Antarctic (LIN 5&6). The target mwCV for the ling trawl surveys was achieved only for the Sub-Antarctic.

Where target mwCVs were not achieved, the precision could not be improved via more ageing (i.e., increasing the sample size) because all available otoliths were aged. To further increase the precision of catch-at-age time series for the assessment of these two species, more targeted observer coverage would be required. Such sampling of biological data and otoliths would need to be focused on the key spatiotemporal strata required for continuing the existing time series of catch-at-age estimates for hake and ling.

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1. INTRODUCTION

Catch-at-age estimates are derived from commercial fisheries (herein fisheries) and fishery independent bottom trawl research surveys (herein surveys) within the New Zealand (NZ) Exclusive Economic Zone (EEZ) for certain species. Such estimates are important for the stock assessment process as they provide data on the year class strength of recruited cohorts, stock productivity, and selectivity ogives. This report provides the catch-at-age estimates for the 2023–24 fishing year for hake (*Merluccius australis*) for fisheries within quota management areas (QMAs) HAK 1&7 and ling (*Genypterus blacodes*) QMAs LIN 3&4, 5&6 and 7 as derived from fisherycatch sampling and trawl surveys. The target mean weighted coefficient of variation (mwCV) for each catch-at-age analysis was 30% (mwCV across all age classes) for both species and their respective discrete fisheries. Note that year depicted as xxxx-xx (e.g. 2023–24) refers to fishing year and xxxx (e.g. 2024) is a calendar year.

Sampling of biological data and otoliths to develop the fishery catch-at-age estimates is often stratified spatiotemporally and by target species. Also, the actual catch-at-age estimates are themselves sometimes stratified spatiotemporally. Descriptions of strata and extrapolative methods are provided in this report. This report also provides, and briefly discusses, time series of catch-at-age estimates for the target species (by fisheries) but only for those that were relevant to work pertaining to the 2023–24 fishing year.

This report fulfils the reporting requirements for hake and ling in Objective 1 in year four of Fisheries New Zealand research project MID2021-01 and year one of project MID2024-01 "Routine age determination of middle depth and deepwater species from commercial fisheries and resource surveys", funded by Fisheries New Zealand. The overall objective was:

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

2. FISHERIES DESCRIPTIONS

2.1 Hake trawl fisheries

Hake within the NZ EEZ are managed as three geographically separate QMAs: the Challenger Plateau and WCSI (HAK 7); the eastern Chatham Rise (HAK 4); and the remainder of the EEZ (HAK 1) which includes waters around the North Island, east coast of the South Island, and Sub-Antarctic but excludes the Kermadec area (Figure 1).

For easy reference, and consistency with previous years, all major fisheries are described below, regardless of whether catch-at-age estimates were generated for 2023–24.
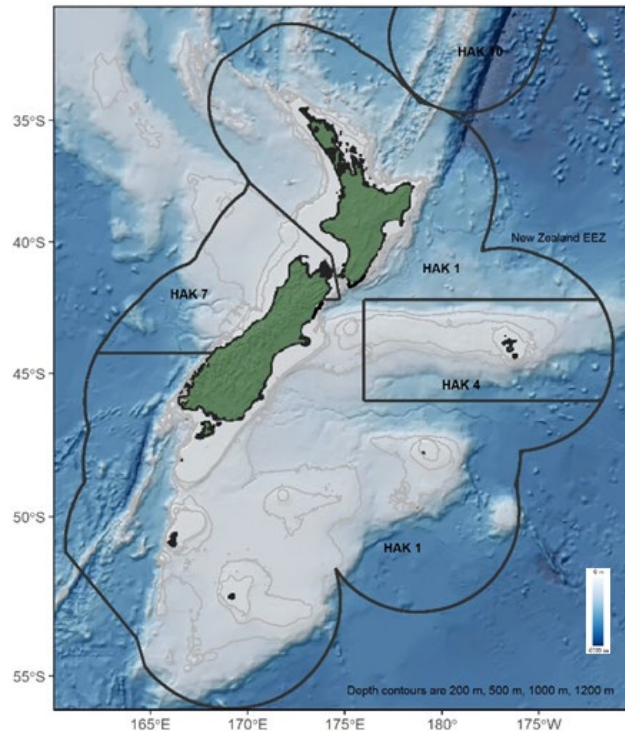
Figure 1: Hake quota management areas within the 200 n. mile EEZ. Grey lines indicate depth contours for 200 m, 500 m, 1000 m, and 1200 m.

2.1.1 Chatham Rise (HAK 4)

For the Chatham Rise catch-at-age estimates were previously developed for four separate fisheries (e.g., Horn & Sutton 2009) as shown in Figure 2, and defined as follows:

1. West shallow (west of 178.1° E and bottom depth equal to or less than 530 m)
2. West deep (west of 178.1° E and bottom depth greater than 530 m)
3. East excluding Area 404 (east of 178.1° E, excluding Statistical Area 404)
4. Area 404 (178° W to 179.5° W, 42° S to 43.75° S)
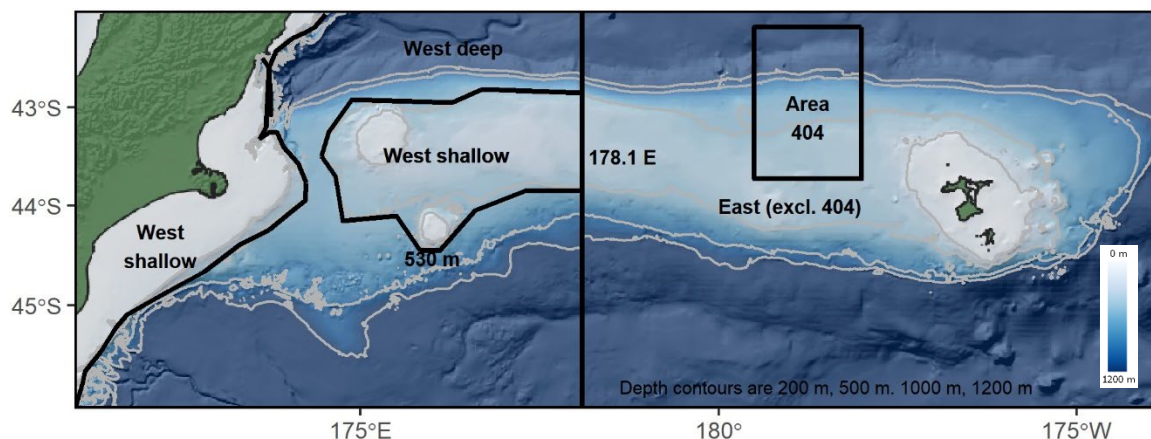
Figure 2: Sampling and catch-at-age strata defined for the Chatham Rise hake fishery. The west stratum boundary defined by depth (530 m) is shown only approximately. Grey lines indicate depth contours for 200 m, 500 m, 1000 m, and 1200 m.

A later assessment of the Chatham Rise hake stock (Horn & Francis 2010) concluded that splitting the estimates into two fisheries at longitude 178.1° E. (i.e., west and east), rather than four was statistically robust. Therefore, two series have been developed (for each year with sufficient data). The raw data were still stratified, i.e. each Chatham Rise catch-at-age fishery comprised two strata for sampling purposes. In years when there were sufficient raw data and contract requirements to estimate catch-at-age for both fisheries, the same (combined) age-length key (ALK) was used for east and west, because Horn & Dunn (2007) showed that mean age-at-length did not differ (between fisheries).

Catch-at-age was estimated on the condition the raw data contained at least 400 or 300 length measurements (west and east fisheries respectively) from sampling between 1 Oct and 30 Apr. This fishery was not included in project catch-at-age work this season; see Ballara & Barnes (2024) for most recent results.

2.1.2 Sub-Antarctic (HAK 1)

For the Sub-Antarctic a catch-at-age was estimated using a single ALK and the four raw data sampling strata shown in Figure 3 (determined by Horn 2008a) and defined as follows:
1. Puysegur Bank (east of 165° E to 168° E, south of 46° S to 48° S)
2. Snares-Pukaki (east of 165° E to 175° E, south of 46° S to 50.25° S, but excluding the Puysegur Bank stratum and the area north of 48° S and east of 171.6° E)
3. Auckland Island (east of 165° E to 169° E, south of 50.25° S to 54° S)
4. Campbell Island (east of 169° E to 174° E, south of 50.25° S to 54° S)
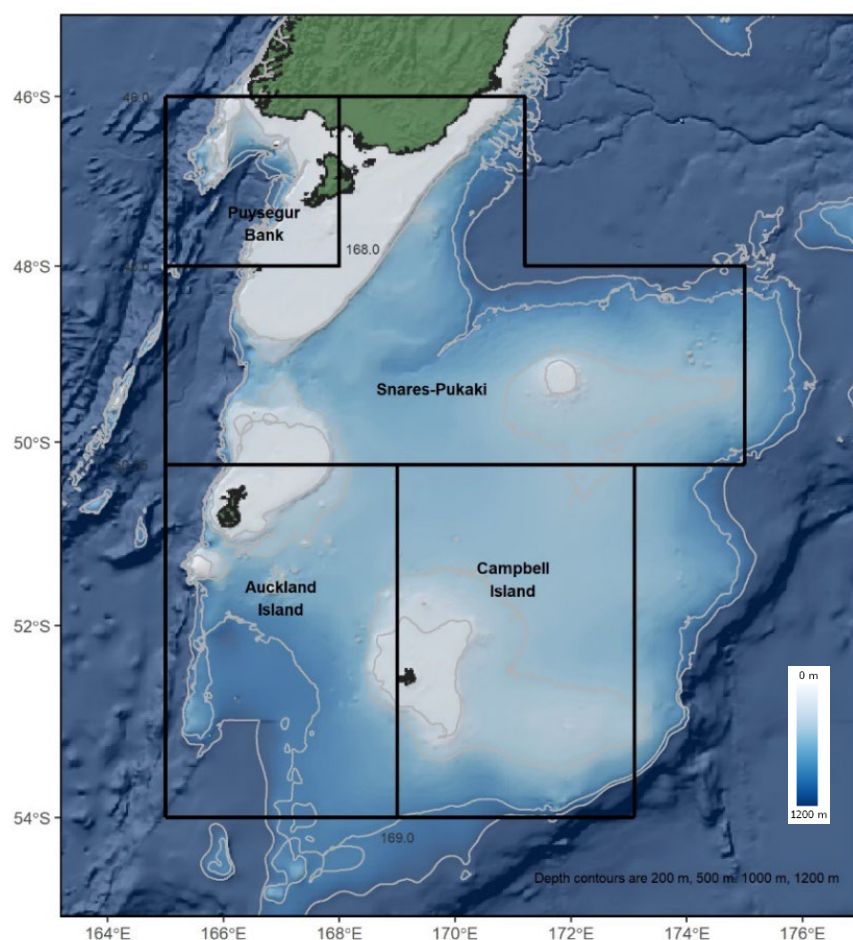
Figure 3: **Sampling strata defined for the Sub-Antarctic hake fishery. Grey lines indicate depth contours for 200 m, 500 m, 1000 m, and 1200 m.**

Catch-at-age was estimated on the condition that the raw data contained at least 700 length measurements (and a sufficient number of otoliths were sampled) from sampling between 1 Sept and 30 Apr which is the peak catch period historically (Devine 2008). Sufficient data were available to estimate catch-at-age for HAK 1 in 2023–24.

2.1.3   West coast South Island (HAK 7)

For the WCSI, catch-at-age was estimated using a single ALK and the three raw data sampling strata following Horn & Sutton (2008) and shown in Figure 4 and defined as follows:
1.   Deep (bottom depth equal to or greater than 629 m).
2.   North shallow (bottom depth less than 629 m and north of 42.55° S)
3.   South shallow (bottom depth less than 629 m and south of 42.55° S)
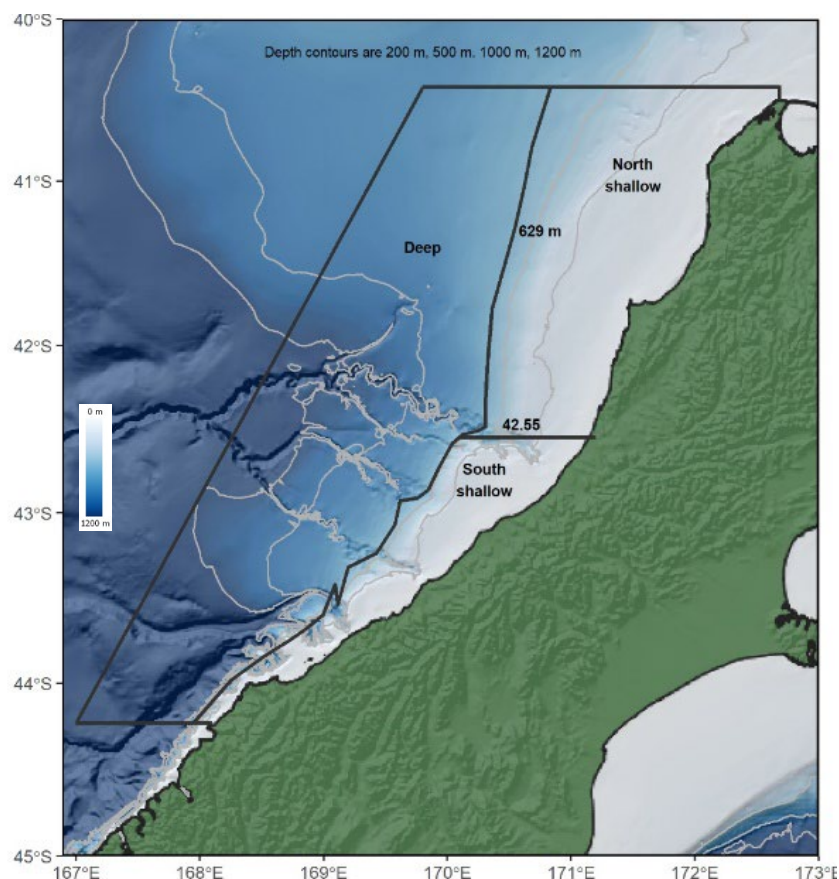
Figure 4:   Sampling strata defined for the west coast South Island hake fishery. Grey lines indicate depth contours for 200 m, 500 m, 1000 m, and 1200 m.

Catch-at-age was estimated only from raw data sampled between 1 May and 30 Sept. Sufficient data were available to estimate catch-at-age for HAK 7 in 2023–24.

2.2   Ling trawl fisheries

Ling are managed as eight administrative QMAs (Figure 5), although five of these (LIN 3, 4, 5, 6, and 7) currently produce about 95% of the NZ catch. Research has indicated that there are at least five major ling biological stocks in NZ waters (Horn 2005) and these are defined as: Chatham Rise (LIN 3 and LIN 4); the Sub-Antarctic incorporating Campbell Plateau and Stewart-Snares shelf (LIN 5, and LIN 6 west of 176º E); Bounty Plateau (LIN 6 east of 176º E); west coast South Island (LIN 7 west of Cape Farewell); and Cook Strait (those parts of LIN 2 and LIN 7 between latitudes 41° S and 42° S and longitudes 174° E and 175.4° E, equating approximately to Statistical Areas 016 and 017) (Table 1). These stocks are referred to as LIN 3&4, LIN 5&6, LIN 6 B, LIN 7 WC, and LIN 7 CK fisheries, respectively. Again, all major

fisheries are described below, regardless of whether catch-at-age estimates were generated for 2023–24. Most ling temporal strata for catch-at-age estimation from trawl fisheries were changed in 2024. The new strata are described below, for details on strata used in 2023 (and earlier) refer to Ballara & Barnes (2024).
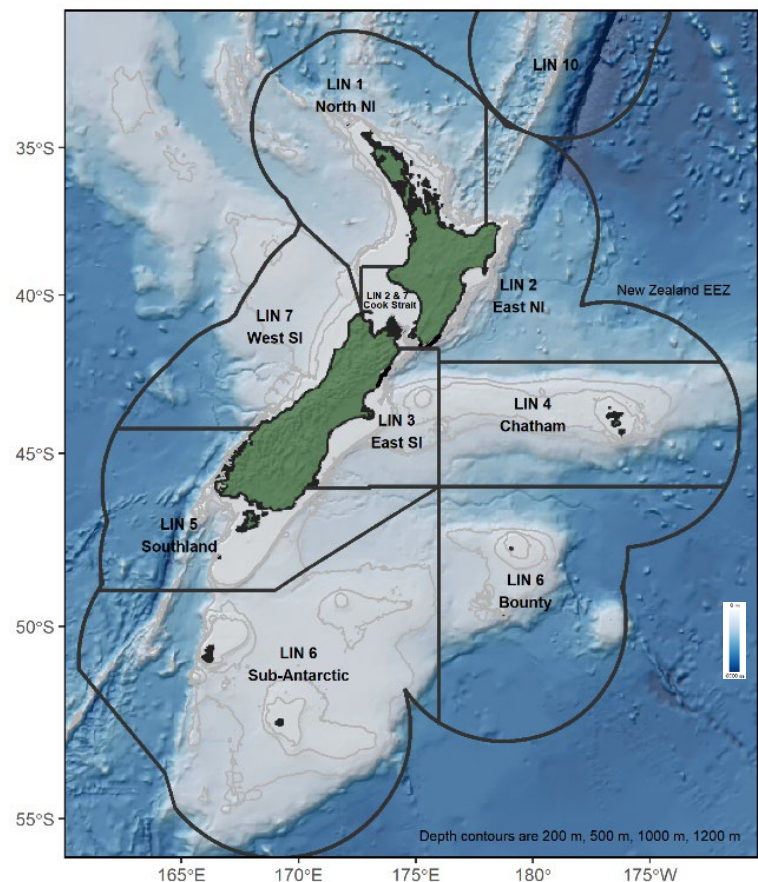
Figure 5: **Ling quota management areas. Grey lines indicate depth contours for 200 m, 500 m, 1000 m, and 1200 m.**

Table 1: **Definitions of geographical areas used in the ling catch-at-age estimates, based on statistical areas, and the administrative ling stocks they approximate.**

Area	Statistical Areas	Approximate ling stock
Northern North Island	041–048, 001–010, 101–110, 801	LIN 1
East North Island	011–015, 201–206	LIN 2
East South Island	018–024, 301	LIN 3
Chatham	049–052, 401–412	LIN 4
Southland	025–031, 302, 303, 501–504	LIN 5
Sub-Antarctic	601–606, 610–612, 616–620, 623–625	Part of LIN 6
Bounty	607–609, 613–615, 621, 622	Part of LIN 6 (LIN 6 B)
West Coast South Island	032–036, 701–706	Part of LIN 7 (LIN 7 WC)
Cook Strait	016, 017, 037–040	Parts of LIN 2&7 (LIN 7 CK)

2.2.1 Chatham Rise (LIN 3&4)

For the Chatham Rise, raw data sampling was stratified (spatiotemporally and/or by target species) following Horn & Sutton (2008) and shown in Figure 6 and defined as follows:

1. Coast (west of 174° E and the target not scampi *Metanephrops challengeri*)
2. Scampi (all trawl tows [tows] targeting scampi)
3. North Rise (north of 43.55° S, east of 174° E and the target not scampi)
4. South Rise (south of 43.55° S, east of 174° E and the target not scampi)
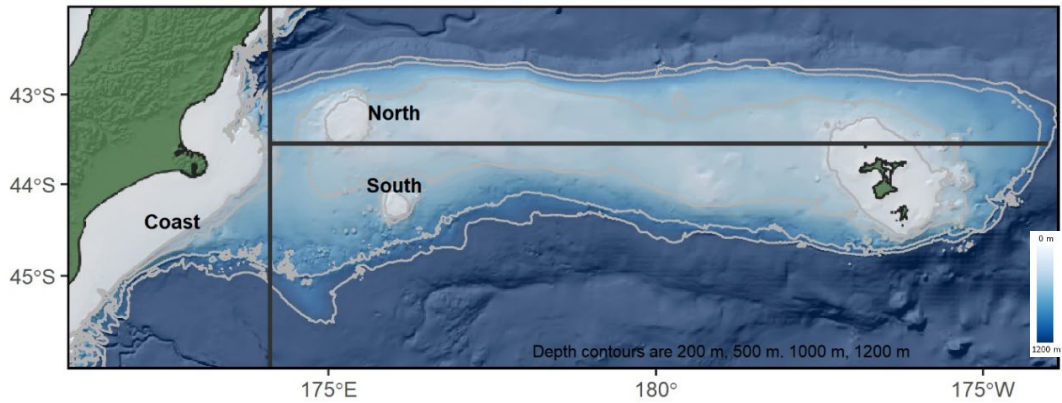
Figure 6: **Sampling strata defined for the Chatham Rise LIN 3&4 fishery (excludes target scampi stratum). Grey lines indicate depth contours for 200 m, 500 m, 1000 m, and 1200 m.**

Scampi target tows were sampled as a separate stratum because the gear used usually catches ling of a smaller average size than that used to target finfish. Catch-at-age was estimated only from raw data sampled between 1 Nov and 31 May. Sufficient data were available to estimate catch-at-age for LIN 3&4 in 2023–24.

2.2.2 Sub-Antarctic (LIN 5&6)

For the Sub-Antarctic, raw data sampling was stratified (spatiotemporally, including depth and/ or target species) following Horn & Sutton (2008) and shown in Figure 7 and defined as follows:
1. Scampi (all tows targeting scampi)
2. Shallow (bottom depth less than or equal to 450 m and the target not scampi)
3. Deep (bottom depth greater than 450 m and the target not scampi)
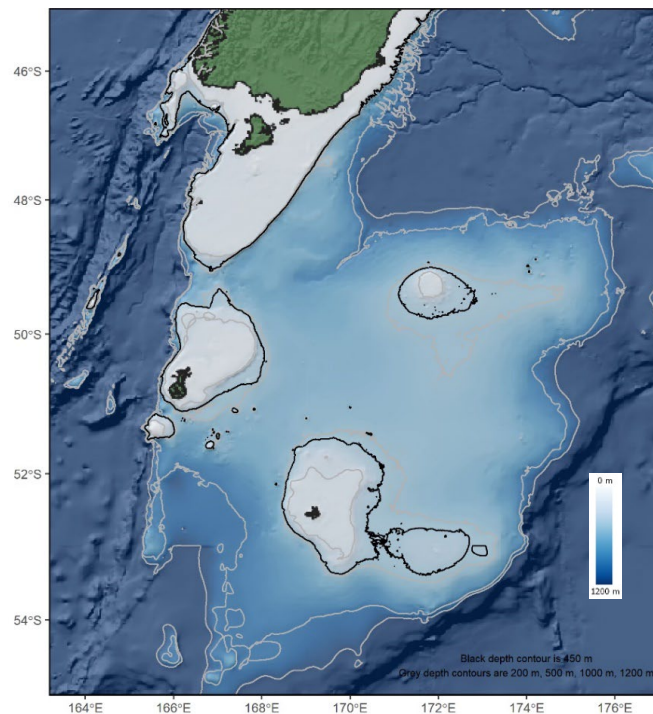
Figure 7: **Sub-Antarctic ling sampling strata, defined by the 450 m contour (black contour line), for data where scampi is not the target. Grey lines indicate depth contours for 200 m, 500 m, 1000 m, and 1200 m.**

Catch-at-age was estimated only from raw data sampled between 1 Sept to 31 Dec. Sufficient data were available to estimate catch-at-age for LIN 5&6 in 2023–24.

2.2.3 West coast South Island (LIN 7)

For the WCSI, raw data sampling was stratified (spatiotemporally, including depth) following Horn & Sutton (2008) and Horn (2008b) and shown in Figure 8 and defined as follows:
1. Deep (bottom depth equal to or greater than 498 m)
2. North shallow (bottom depth less than 498 m and north of 42.42° S)
3. South shallow (bottom depth less than 498 m and south of 42.42° S)
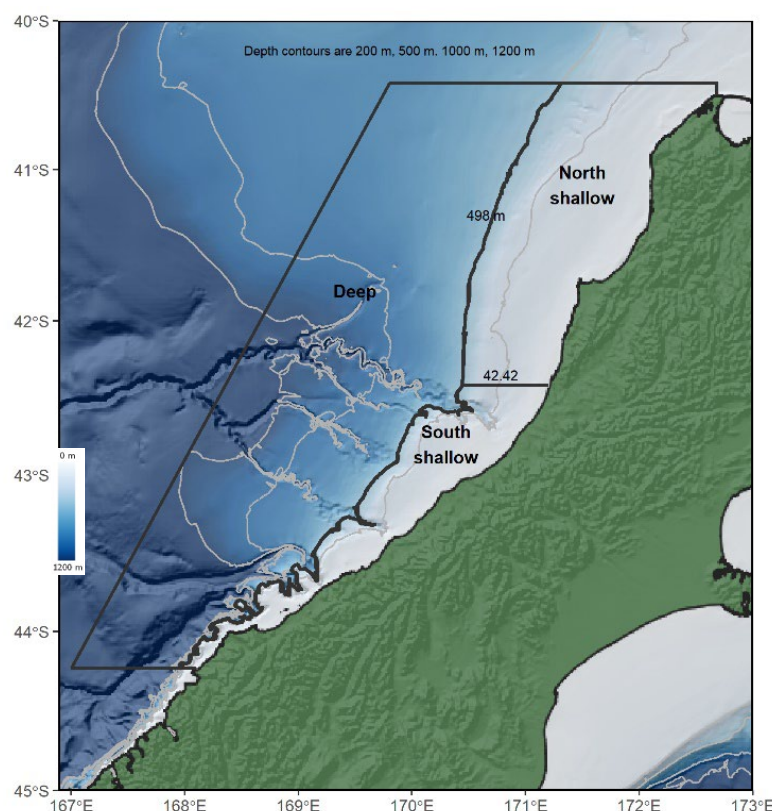
Figure 8: **West coast South Island ling sampling strata. Grey lines indicate depth contours for 200 m, 500 m, 1000 m, and 1200 m.**

Catch-at-age was estimated only from raw data sampled between 1 Aug and 30 Sept. Sufficient data were available to estimate catch-at-age for LIN 7 in 2023–24.

2.2.4 Cook Strait (LIN 2&7 CK)

For the Cook Strait, raw data sampling was from a single area stratum which is those parts of QMAs 2, 7, and 8 between 41° and 42° S and 174° and 175.4° E, equating approximately to Statistical Areas 016 and 017, Figure 5, and a temporal stratum of 1 June to 30 September with an update of this period possible in the future. Catch-at-age estimation for Cook Strait was not part of project work for this reporting period.

2.3 Ling longline fisheries

The raw data sampling and/or catch-at-age estimation were traditionally done for bottom longline (longline) fisheries according to established strata (recently reported in Ballara & Barnes (2024)). As for the ling trawl fisheries, most temporal strata were changed prior to 2023–24 along with the geographical strata in the Sub-Antarctic (see Ballara & Barnes (2024) for old strata definitions).

2.3.1 Chatham Rise (LIN 3&4)

For Chatham Rise a single spatiotemporal stratum (i.e., QMAs 3 and 4 between 42° and 46° S and 1 Jul to 31 Nov) was used. Catch-at-age estimation for the Chatham Rise (LIN 3&4) longline fishery is a year behind due to boats still being at sea during the critical time for otolith selection (spring at the start of any fishing year). Hence in 2024, 481 otoliths were aged from the 2022–23 fishing year (not the 2023–24 fishing year).

2.3.2 Sub-Antarctic (LIN 5&6)

The Sub-Antarctic raw data is now sampled and catch-at-age estimated as a single fishery (see Ballara & Barnes 2024). The sampling strata comprise QMAs 5 and 6, excluding Statistical Area 030 and the Bounty Plateau, between 1 Mar to 30 Jun. Sufficient data were available to estimate catch-at-age for LIN 5&6 in 2023–24.

2.3.3 Bounty Plateau (LIN 6B)

The Bounty Plateau is considered separately to the Sub-Antarctic because of the geo-biological stock structure (Horn 2005). Bounty Plateau raw data were sampled and catch-at-age estimated using a single stratum (i.e., that part of QMA 6 east of 176° E and any temporal period that has sufficient data). Catch-at-age estimation for Bounty Plateau was not part of project work for this reporting period.

2.3.4 West coast South Island (LIN 7)

Raw data from the WCSI are sampled and catch-at-age estimated using a single stratum between 1 Jan to 31 Oct. Lack of raw data (otoliths) from the 2002–03, 2005–06, and 2006–07 longline fishing resulted in ALKs developed using age data from the WCSI trawl fisheries from those years. This relied on the assumption that both fleets were fishing the same population. The 2005–06 and 2006–07 raw data were sampled under the SeaFIC ling longline logbook programme (Langley 2001). Sufficient data were available to estimate catch-at-age for LIN 7 in 2023–24. However, catch-at-age estimation for the WCSI ling longline fishery was not part of project work for this reporting period.

2.3.5 Cook Strait (LIN 2&7 CK)

Cook Strait raw data are sampled and catch-at-age estimated using a single stratum (i.e., those parts of QMAs 2, 7, and 8 between 41° and 42° S and 174° and 175.4° E, equating approximately to Statistical Areas 016 and 017 and 1 Jun to 30 Sept). The Cook Strait ALK in 2001 (Langley 2001) used all otoliths sampled from the longline fishery ($n = 57$), supplemented by otoliths sampled from the trawl fishery in the same area and year. Catch-at-age estimation for Cook Strait was not part of project work for this reporting period.

2.4 Ling potting fisheries

The pot fishery is relatively new, has increased rapidly, and in 2023–24 accounted for roughly one third of ling catch (Holmes et al. 2025). Catch-at-age estimation for ling potting fisheries was not part of project work for this reporting period.

2.5 Hake and ling trawl surveys

For ease of reference and consistency with previous reports, all surveys that form an ongoing hake and ling catch-at-age series are described below regardless of occurrence in the period relevant to this report.

2.5.1 Chatham Rise

The Chatham Rise survey began in the early 1990s, with surveys in most years until 2014, when surveys became biennial with the most recent occurring in Jan 2024. Prior to 2010, survey catch-at-age estimates

were extrapolated from the numbers of hake and ling available to the trawl between 200 and 800 m (core strata). Since 2010, additional deeper strata (800–1300 m) have been surveyed, but few ling are caught deeper than 800 m. Catch at age for hake and ling up to and including 2024 were reported by Ballara & Barnes (2024) for this survey area and hence, are not updated here.

2.5.2 Sub-Antarctic

A survey of the Sub-Antarctic was completed during the period relevant to this report (TAN2413 in Nov–Dec 2024). This survey series began in the early 1990s, was annual during the 2000s, and became biennial from 2012. The main survey series has been typically in summer, although some surveys were in autumn and spring. Survey catch-at-age estimates were extrapolated from the numbers of hake and ling available to the trawl for depths of 300–800 m, an 800–1000 m stratum at Puysegur, and, in some years, other 800–1000 m strata off the Campbell Plateau (as above, few ling are caught deeper than 800 m). To ensure comparability, samples from the core 300–800 m strata plus the deep Puysegur stratum only were used to estimate catch-at-age.

2.5.3 West coast South Island

A survey of the WCSI was also completed during the period relevant to this report (TAN2407 in Jul–Aug 2024). Hake survey catch-at-age estimates were produced for the 'core' (depths 200–650 m) and 'all' (200–800 m) strata whereas ling survey catch-at-age estimates were from the core area only.

3.   METHODS

3.1   Catch at-age estimation

The catch-at-age estimation for each fishery and survey were derived in the same manner as previous years (most recently by Ballara & Barnes 2024) by application of sex-specific ALKs. All hake and ling sampled have their total length (reported here in centimetres) and sex recorded with a sample or sub sample (i.e. for fishery sampling) also having their otoliths extracted. For each ALK, otoliths were selected from each 1 cm length class roughly in proportion to their occurrence in the scaled length frequency samples, with the constraint that the number of otoliths in each length class (where available) was at least one. Commercial tows and longline shots (herein shots) have the constraint that ≥5 hake or ling need to be sampled for length (by observers) for that tow or shot to be included in the length frequency and otolith subsample analyses. Where fewer than the contracted target number of otolith were achieved by observer sampling then the ≥5 rule does not apply (to provide all available otoliths to the ALK). This rule does not apply to surveys, for example if only 3 hake or ling were caught in a biomass survey tow then these fish would still be available for ageing. Otoliths were prepared and read using the validated ageing technique for hake (Horn 1997) and ling (Horn 1993, Horn 2021). Catch-at-age was estimated by constructing ALKs separately for each sex and applying them to the scaled length frequency data derived from each fishery or survey using software developed specifically for this task by Earth Sciences New Zealand (ESNZ [formerly NIWA]) (Bull & Dunn 2012).

Fishery catch-at-age estimates were derived by scaling the sample age frequency estimates to the total catch from each fishery in the time period sampled. For fisheries with multiple sampling strata (but a single fishery catch-at-age), length frequency data from each stratum were first scaled to the total catch from that stratum, and then the scaled length frequencies from all strata were summed, and the resulting ALK was applied to the entire scaled length frequency. Trawl survey catch-at-age estimates were scaled to total estimated relative biomass available in the survey area.

In some previous years, surveys occurred around the middle of the periods sampled for fishery catch-at-age estimates (e.g., the Jan Chatham Rise survey occurred in the middle of the Oct to Apr hake fishery and the Oct to May ling trawl fishery). This meant that fishery catch-at-age could be estimated

using ALKs developed for the relevant survey. It was sometimes necessary, however, to age some additional fish from the fisheries to develop length-sex combinations that were inadequately sampled by the survey. For the current reporting period a combined fishery and survey ALK was used for WCSI ling (LIN 7 [see Section 3.3 below]) which was facilitated by the survey being done during the main fishery period.

The target mwCV for hake catch-at-age from trawl surveys is often not achieved. To maximise the chances of achieving the target, all hake from the tows used to estimate survey biomass were sampled (raw data including otoliths). Any hake caught in survey tows not used for biomass calculations (i.e., foul, midwater, or night tows) were also sampled. These extra fish were aged and incorporated into the ALK. Consequently, in the summaries shown below, the number of aged hake from the surveys was often greater than the number of measured fish (i.e., more hake aged than the number of fish used to generate the length frequencies).

3.2   Hake ageing design

For hake, ageing of the following samples was proposed for the 2023–24 fishing year (but to be sampled during the specific months listed below), with the target number of otoliths to be aged given in square brackets:

HAK 1
- Sub-Antarctic trawl fishery (September 2023–May 2024) [500]
- Sub-Antarctic trawl survey (December 2024) [400]

HAK 7
- WCSI trawl fishery (May–September 2024) [600]
- WCSI trawl survey (July 2024) [600]

3.3   Ling ageing design

For ling, ageing of the following samples was proposed for the 2023–24 fishing year (but to be sampled during the specific months listed below), with the target number of aged otoliths in square brackets:

LIN 3&4
- Chatham Rise trawl fishery (November 2023–May 2024) [500]
- Chatham Rise bottom longline fishery (July–November 2023) [500]

LIN 5&6
- Sub-Antarctic trawl fishery (September–December 2023) [500]
- Sub-Antarctic bottom longline (March–June 2024) [500]
- Sub-Antarctic trawl survey (December 2024) [600]

LIN 7
- WCSI trawl fishery (August–September 2024) [250]
- WCSI trawl survey (July 2024) [250]
  The WCSI fishery and survey samples were combined to make an ALK based on ages from 500 otoliths.

4. RESULTS

4.1 Hake trawl fishery catch-at-age

4.1.1 Sub-Antarctic (HAK 1)

In 2023–24, 323 otoliths were available between 1 Sept and 31 May, thus achieving the inclusion criteria of at least 300 otoliths. All 323 otoliths were selected and 317 provided age estimates (e.g. after problematic otoliths were removed etc.). The derived mwCV was 24.8%. Table 2 provides the data used since 1990 to produce the catch-at-age estimates and mwCVs. Details of the estimated catch-at-age distribution are given in Table 3 with graphical representation of distributions in Appendix A.

Table 2: **Numbers of measured and aged hake by fishing year, sex, tows sampled, and the estimated mean weighted CV (%) for the Sub-Antarctic (HAK 1) trawl fishery. –: no data.**

Fishing year	Males Measured	Aged	Females Measured	Aged	Tows	mwCV
1990	269	47	548	71	74	42.0
1991	175	–	588	–	64	–
1992	557	215	1 363	409	151	24.9
1993	833	183	1 218	518	171	27.6
1994	512	87	609	173	119	47.8
1995	167	–	597	–	92	–
1996	289	65	435	110	75	50.0
1997	84	–	219	–	54	–
1998	390	82	1 018	193	154	37.7
1999	463	174	1 077	322	199	27.4
2000	3 007	259	2 526	421	307	22.5
2001	527	388	1 648	698	216	29.6
2002	921	333	2 026	874	320	23.4
2003	271	258	908	739	197	40.4
2004	1 309	350	969	518	165	24.7
2005	179	185	424	305	82	40.1
2006	1 906	218	1 094	506	153	23.2
2007	547	224	666	351	73	38.5
2008	891	325	592	682	89	23.2
2009	1 221	311	893	498	109	23.9
2010	1 879	418	1 029	611	91	18.2
2011	3 738	296	1 212	282	117	20.2
2012	4 098	581	1 597	605	109	15.0
2013	2 555	412	1 306	666	100	19.5
2014	4 027	316	1 443	146	90	19.4
2015	2 907	256	800	210	94	22.9
2016	2 125	217	931	166	64	26.4
2017	2 409	203	777	143	67	23.2
2018	2 067	215	1 090	175	75	22.4
2019	759	105	389	240	25	34.8
2020	784	122	388	140	45	28.1
2021	2 005	166	469	57	40	29.2
2022	2 699	164	1 292	344	83	24.6
2023	1 680	256	980	241	73	22.1
2024	1 623	209	893	108	40	24.8

Table 3: **Hake calculated numbers-at-age by sex and the estimated CV (proportion) for the Sub-Antarctic (HAK 1) trawl fishery, September 2023 to May 2024. Age is in years. –: no data.**

Age	Male	CV	Female	CV	Age	Male	CV	Female	CV
3	808	0.9	-	-	15	3 910	0.5	1 305	0.7
4	-	-	1 855	0.5	16	-	-	2 662	0.5
5	2 010	0.6	-	-	17	2 227	0.6	2 619	0.7
6	17 924	0.2	874	1.1	18	2 809	0.6	912	0.9
7	30 813	0.2	7 848	0.3	19	896	1.0	-	-
8	35 978	0.2	11 544	0.3	20	1 755	0.7	1 350	1.0
9	16 538	0.2	14 559	0.2	21	1 917	0.8	1 275	0.8
10	11 809	0.3	5 148	0.4	22	2 272	0.6	763	0.8
11	6 995	0.3	8 182	0.4	23	1 047	1.0	-	-
12	3 697	0.5	6 225	0.4	24	896	1.1	-	-
13	4 941	0.5	3 513	0.5	25	563	1.1	-	-
14	-	-	2 486	0.4	26	-	-	-	-

4.1.2 West coast South Island (HAK 7)

In 2023–24, 1043 otoliths were available from between 1 May and 30 Sept 2024 and 605 selected (subsampled) for ageing. Post removal of problematic otoliths there were 602 ages available for catch-at-age estimation. The derived mwCV was 19.0%. Table 4 provides the data used since 1990 to produce the catch-at-age estimates and the mwCVs. Details of the estimated catch-at-age distribution are given in Table 5 with graphical representation of distributions in Appendix A.
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Table 4: **Numbers of measured and aged hake by fishing year, sex, tows sampled, and the estimated mean weighted CV (%) for the west coast South Island (HAK 7) trawl fishery.**

Fishing year	Males Measured	Aged	Females Measured	Aged	Tows	mwCV
1990	578	210	567	261	57	23.1
1991	2 288	286	1 653	358	146	18.4
1992	2 592	196	1 193	261	121	22.5
1993	2 129	188	979	163	93	29.1
1994	1 598	151	1 643	272	174	32.5
1995	2 528	271	2 769	342	152	29.2
1996	2 862	287	1 753	326	193	28.9
1997	3 286	262	1 720	198	234	21.3
1998	2 339	257	1 497	253	237	21.4
1999	4 186	270	3 744	240	307	18.3
2000	2 705	258	2 330	269	285	18.9
2001	1 529	176	1 723	280	192	23.9
2002	2 281	93	2 434	385	380	33.8
2003	1 917	227	2 063	234	296	20.0
2004	2 702	303	2 181	193	353	16.5
2005	2 305	238	2 324	280	217	23.8
2006	5 502	276	4 231	298	395	16.3
2007	3 385	248	3 258	257	132	16.7
2008	4 682	321	2 416	266	147	17.7
2009	5 773	301	3 610	301	178	18.8
2010	2 454	130	1 877	134	76	25.4
2011	2 489	260	2 489	353	104	16.8
2012	2 535	357	2 061	381	140	14.4
2013	12 352	325	8 417	443	493	14.3
2014	8 128	320	7 242	384	360	13.1
2015	12 334	329	10 173	363	498	13.6
2016	5 304	461	4 589	449	240	13.2
2017	9 019	363	6 572	382	362	13.3
2018	4 242	419	4 758	434	392	13.6
2019	1 027	185	2 144	450	88	19.7
2020	3 481	209	3 734	413	197	21.6
2021	1 571	206	2 067	422	120	36.9
2022	1 416	193	1 887	351	134	22.5
2023	5 440	279	4 220	322	230	14.3
2024	949	280	2 466	322	149	19.0

Table 5: **Hake calculated numbers-at-age by sex and the estimated CV (proportion) for the west coast South Island (HAK 7) trawl fishery, May to September 2024. Age is in years. −: no data.**

Age	Male	CV	Female	CV	Age	Male	CV	Female	CV
1	11 511	0.5	9 301	0.7	12	4 360	0.6	6 600	0.4
2	8 638	0.5	7 280	0.7	13	2 430	0.8	8 028	0.3
3	2 857	0.7	2 478	0.5	14	1 778	0.9	7 592	0.4
4	24 681	0.2	574	1.0	15	791	1.1	3 646	0.6
5	79 114	0.1	29 796	0.2	16	188	1.6	2 675	0.6
6	43 233	0.2	72 139	0.1	17	726	1.1	5 563	0.4
7	12 135	0.3	71 196	0.1	18	1 897	0.9	2 653	0.5
8	905	1.2	27 419	0.2	19	-	-	3 143	0.5
9	2 195	0.8	15 021	0.3	20	-	-	550	1.2
10	3 077	0.6	12 407	0.3	21	867	1.1	-	-
11	764	1.1	5 685	0.4	22	-	-	1 340	1.0

4.2 Trawl survey catch-at-age for hake

4.2.1 Sub-Antarctic (HAK 1)

A trawl survey of the Sub-Antarctic was carried out in Nov-Dec 2024, 340 otoliths were available and all were aged. The mwCV was 49%. Table 6 summarises the data used each year to produce the catch-at-age estimates and the mwCVs. Details of the estimated catch-at-age distribution for hake caught in the survey are given in Table 7 with graphical representation of distributions in Appendix A.

Table 6: **Numbers of measured and aged hake by survey, year, sex, tows sampled, and the estimated mean weighted CV (%) for the Sub-Antarctic (HAK 1) trawl surveys. Number of aged fish exceeds the number measured in some years, because hake caught outside the core trawl survey area were also aged. −: no data.**

| Survey code | Year | Males | | Females | | Tows | mwCV |
		Measured	Aged	Measured	Aged		
Summer							
AEX8902	1989	45	43	76	66	34	52.7
TAN9105	1991	337	117	332	217	61	65.1
TAN9211	1992	14	46	133	168	48	48.6
TAN9310	1993	57	93	181	182	59	47.2
TAN0012	2000	348	239	392	352	56	37.3
TAN0118	2001	219	212	351	349	44	35.6
TAN0219	2002	331	191	490	377	38	36.1
TAN0317	2003	126	186	175	220	30	41.0
TAN0414	2004	178	245	225	283	39	42.8
TAN0515	2005	88	146	265	274	39	39.9
TAN0617	2006	188	190	487	460	39	33.6
TAN0714	2007	166	217	352	423	47	35.4
TAN0813	2008	289	188	808	412	39	30.9
TAN0911	2009	152	164	382	436	37	36.3
TAN1117	2011	405	238	423	357	37	37.3
TAN1215	2012	155	222	359	537	36	39.1
TAN1412	2014	41	41	169	176	29	47.7
TAN1614	2016	1	-	32	-	15	-
TAN1811	2018	61	64	204	218	31	52.1
TAN2014	2020	54	53	147	145	26	45.9
TAN2215	2022	110	112	222	226	29	45.7
TAN2413	2024	173	173	167	167	36	49.0

Table 7: Hake calculated numbers-at-age by sex and the estimated CV (proportion) for the trawl survey of the Sub-Antarctic (HAK 1) in November and December 2024 (TAN2413). Age in years. –: no data.

Age	Male	CV	Female	CV	Age	Male	CV	Female	CV
1					15	-	-	7 040	0.8
2	557	1.5	564	2.3	16	-	-	4 439	1.1
3	34 845	0.4	29 846	0.5	17	-	-	1 000	1.6
4	48 690	0.3	36 885	0.4	18	-	-	-	-
5	13 285	0.4	24 356	0.4	19	-	-	17 360	0.7
6	4 938	0.5	5 879	0.8	20	-	-	402	2.0
7	1 328	1.7	12 200	0.6	21	294	1.3	5 155	1.0
8	564	1.5	39 554	0.4	22	1 000	1.5	4 439	1.1
9	-	-	10 388	0.8	23	-	-	-	-
10	-	-	14 654	0.6	24	-	-	-	-
11	2 522	0.9	8 367	0.8	25	-	-	-	-
12	-	-	4 724	1.0	26	-	-	-	-
13	-	-	5 694	1.0	27	-	-	10 126	1.3
14	-	-	10 647	0.6	28	-	-	-	-

4.2.2 West coast South Island (HAK 7)

A trawl survey of the WCSI was carried out in Jul-Aug 2024, 604 otoliths were available and all were aged. The mwCV was 58.0% and 46.5% for core and all sampling strata respectively. Table 8 summarises the data used each year to produce the catch-at-age estimates and the mwCVs. Details of the estimated catch-at-age distribution for hake caught in the survey are given in Table 9 with graphical representation of distributions in Appendix A.

Table 8: Numbers of measured and aged hake by survey, year, sex, tows sampled and the estimated mean weighted CV (%) for the for the 'core' strata (300–650 m) and 'all' strata (200–800 m) from the west coast South Island (HAK 7) trawl surveys. Number of aged fish exceeds the number measured in some years, because hake caught outside the core or all trawl survey areas were also aged.

Survey	Year	Males Measured	Males Aged	Females Measured	Females Aged	Tows	mwCV
'Core' strata							
TAN0007	2000	331	230	407	255	36	26.4
TAN1210	2012	211	330	228	332	36	26.6
TAN1308	2013	94	255	213	371	34	33.7
TAN1609	2016	43	168	71	210	17	59.3
TAN1807	2018	27	356	42	277	15	60.0
TAN2107	2021	94	493	127	290	12	49.6
TAN2407	2024	22	281	35	323	8	58.0
'All' strata							
TAN1210	2000	371	330	335	332	41	23.8
TAN1308	2013	212	255	302	371	39	30.0
TAN1609	2016	176	168	169	210	25	34.4
TAN1807	2018	174	356	158	277	22	33.0
TAN2107	2021	321	493	343	290	20	35.6
TAN2407	2024	341	281	339	323	27	46.5

Table 9: **Hake calculated numbers-at-age by stratum (core and all) sex and the estimated CV (proportion), for the trawl survey of the west coast South Island (HAK 7) in July and August 2024 (TAN2407). Age in years; -: no data.**

Core:

Age	Male	CV	Female	CV	Age	Male	CV	Female	CV
1	1 658	0.9	311	1.4	12	648	0.9	79	1.0
2	-	-	724	1.4	13	823	0.9	321	1.2
3	-	-	-	-	14	265	1.3	698	0.8
4	1 562	0.8	-	-	15	197	1.6	185	1.1
5	4 993	0.5	3 016	0.7	16	-	-	982	0.9
6	1 631	0.6	4 345	0.5	17	175	1.3	1 026	0.9
7	717	0.9	3 542	0.4	18	-	-	66	1.9
8	394	0.9	2 024	0.6	19	-	-	627	1.2
9	177	1.4	940	0.5	20	66	2.2	-	-
10	388	1.4	529	0.9	21	-	-	-	-
11	355	1.0	625	0.7					

All:

Age	Male	CV	Female	CV	Age	Male	CV	Female	CV
1	1 658	0.8	765	1.1	13	6 417	0.6	2 440	0.6
2	1 609	0.8	1 500	0.8	14	2 846	0.7	3 639	0.6
3	1 574	1.0	1 470	0.8	15	3 412	0.7	2 460	0.6
4	6 581	0.4	1 114	0.8	16	1 457	1.2	1 929	0.6
5	31 054	0.4	11 461	0.4	17	1 199	0.9	3 129	0.5
6	15 390	0.5	26 079	0.4	18	915	1.0	502	1.2
7	8 607	0.6	19 800	0.4	19	-	-	974	0.9
8	4 073	0.6	15 219	0.4	20	524	1.1	-	-
9	2 814	0.7	8 073	0.6	21	547	1.7	-	-
10	3 103	0.7	4 313	0.5	22	-	-	-	-
11	3 519	0.6	5 765	0.5	23	-	-	-	-
12	4 934	0.6	1 527	0.7	24	-	-	736	1.0

4.3 Ling trawl fishery catch-at-age

4.3.1 Chatham Rise (LIN 3&4)

In 2023–24, 402 otoliths were available and all were aged. The derived mwCV was 30.8%. Table 10 provides the data used since 1991–92 to produce the catch-at-age estimates and the mwCVs. Details of the estimated catch-at-age distribution are given in Table 11 with graphical representation of distributions in Appendix B.

Table 10: Numbers of measured and aged ling by fishing year, sex, tows sampled and estimated mean weighted CV (%) for the Chatham Rise (LIN 3&4) trawl fishery.

	Males		Females			
Fishing year	Measured	Aged	Measured	Aged	Tows	mwCV
1992	2 151	252	2 653	281	143	27.0
1994	1 127	302	768	302	126	32.9
1995	359	236	302	201	59	45.1
1996	453	306	399	284	87	30.0
1997	162	317	240	242	31	41.1
1998	3 463	348	3 117	280	497	18.7
1999	3 306	336	2 469	318	312	20.0
2000	887	322	1 013	326	161	24.8
2001	1 000	312	988	341	188	21.0
2002	642	294	708	334	129	23.8
2003	694	317	764	347	114	24.3
2004	356	303	600	302	99	30.1
2005	869	310	666	326	194	27.9
2006	251	328	291	330	54	34.5
2007	699	310	687	330	135	22.9
2008	2 755	317	2 070	325	276	20.9
2009	1 034	323	1 120	298	141	32.4
2010	526	318	571	309	87	28.9
2011	492	308	521	293	74	27.3
2012	739	257	767	297	82	26.4
2013	981	278	1 083	315	130	24.1
2014	1 385	314	1 674	258	164	29.7
2015	330	102	499	176	47	33.4
2016	371	287	423	292	47	32.8
2017	853	220	719	171	76	28.9
2018	745	357	773	343	75	24.9
2019	724	186	831	221	82	26.6
2020	732	160	823	239	78	29.2
2021	1 584	253	990	202	88	32.3
2022	630	179	1 018	314	91	25.5
2023	550	142	630	189	68	34.5
2024	554	156	767	246	79	30.8

Table 11: Ling calculated numbers-at-age by sex and the estimated CV (proportion) for the Chatham Rise (LIN 3&4) trawl fishery during November 2023 to May 2024. Age in years. −: no data.

Age	Male	CV	Female	CV	Age	Male	CV	Female	CV
3	3 317	0.6	1 113	1.1	20	1 002	1	3 277	0.5
4	2 119	1.0	7 706	0.6	21	105	1.7	-	-
5	5 418	0.5	5 879	0.5	22	-	-	240	1.6
6	6 080	0.4	7 544	0.6	23	364	1.3	342	1
7	5 356	0.4	11 627	0.4	24	-	-	620	1
8	6 224	0.4	12 160	0.4	25	-	-	102	1.3
9	5 626	0.4	9 252	0.3	26	488	1.2	426	1.2
10	12 754	0.3	12 173	0.3	27	-	-	193	1.5
11	6 984	0.4	11 653	0.3	28	-	-	538	1.2
12	2 577	0.5	9 943	0.2	29	1 007	0.8	-	-
13	3 475	0.4	7 405	0.3	30	37	2.3	-	-
14	6 627	0.4	10 928	0.3	31	260	1.3	478	1.2
15	3 790	0.4	8 637	0.3	32	-	-	-	-
16	3 524	0.4	4 191	0.4	33	-	-	-	-
17	893	0.8	3 292	0.5	34	583	1.3	-	-
18	849	0.8	1 505	0.6	35	-	-	-	-
19	1 443	0.7	2 072	0.7	36	164	1.3	-	-

4.3.2 Sub-Antarctic (LIN 5&6)

In 2023–24, 501 otoliths were available and aged. The mwCV was 19.7%. Table 12 provides the data used since 1991–92 to produce the catch-at-age estimates and mwCVs. Details of the estimated catch-at-age distribution are given in Table 13 with graphical representation of distributions in Appendix B.

Table 12: Numbers of measured and aged ling by fishing year, sex, tows sampled, and the estimated mean weighted CV (%) for the Sub-Antarctic (LIN 5&6) trawl fishery.

	Males		Females			
Source	Measured	Aged	Measured	Aged	Tows	mwCV
1992	1 466	437	1 652	667	141	22.0
1993	1 337	235	1 615	363	164	28.3
1994	686	256	1 059	357	129	29.2
1996	881	366	779	297	83	24.5
1998	1 408	274	1 717	302	218	29.0
2001	2 192	247	1 947	351	267	28.1
2002	1 887	264	2 579	327	424	24.8
2003	1 164	434	1 828	625	263	20.9
2004	853	246	1 397	337	202	22.9
2005	2 324	254	2 415	339	218	21.5
2006	2 739	288	2 618	305	252	20.4
2007	1 644	225	1 446	382	191	24.3
2008	4 104	229	3 258	353	183	23.3
2009	2 877	245	3 803	324	184	19.4
2010	2 899	226	3 266	336	121	21.7
2011	2 212	236	2 630	279	215	21.4
2012	2 826	260	2 398	316	131	21.9
2013	4 565	286	5 542	317	275	21.6
2014	2 236	232	2 716	311	147	20.3
2015	3 920	264	3 274	363	229	19.2
2016	5 419	307	3 637	306	198	18.0
2017	4 207	344	3 190	404	218	16.7
2018	6 509	316	7 639	358	325	17.3
2019	7 002	365	6 555	425	329	16.2
2020	5 292	233	6 681	306	243	18.7
2021	2 998	224	3 747	283	112	20.6
2022	6 182	236	5 819	268	232	20.1
2023	9 947	234	11 469	266	352	20.5
2024	5 873	235	5 178	266	166	19.7

Table 13: Ling calculated numbers-at-age by sex and the estimated CV (proportion) for the Sub-Antarctic (LIN 5&6) trawl fishery, September to December 2023. Age in years. –: no data.

Age	Male	CV	Female	CV	Age	Male	CV	Female	CV
3	-	-	-	-	18	9 689	0.7	28 348	0.3
4	2 771	1.0	-	-	19	12 412	0.7	14 090	0.4
5	20 949	0.4	8 948	0.6	20	12 794	0.6	13 526	0.5
6	43 154	0.3	23 723	0.3	21	21 133	0.4	4 622	0.8
7	115 134	0.2	69 141	0.2	22	4 015	0.9	5 145	0.8
8	143 318	0.2	98 947	0.2	23	7 253	0.7	7 027	0.7
9	123 839	0.2	83 665	0.2	24	6 911	0.7	-	-
10	86 755	0.2	77 860	0.2	25	4 045	1.0	-	-
11	51 146	0.3	62 413	0.2	26	3 480	1.1	-	-
12	66 483	0.3	62 111	0.2	27	3 447	1.0	-	-
13	45 991	0.3	63 282	0.2	28	-	-	-	-
14	58 908	0.2	41 132	0.3	29	2 163	1.1	-	-
15	56 693	0.3	61 503	0.2	30	-	-	-	-
16	11 584	0.5	22 491	0.4	31	-	-	-	-
17	10 097	0.6	16 346	0.4	32	-	-	-	-

4.3.3   West coast South Island (LIN 7)

In 2023–24, 501 otoliths were aged. The mwCV was 27.8%. Table 14 provides the data used since 1990–91 to produce the catch-at-age estimates and mwCVs. Details of the estimated catch-at-age distribution are given in Table 15 with graphical representation of distributions in Appendix B.

Table 14: Numbers of measured and aged ling by fishing year, sex, tows sampled, and the estimated mean weighted CV (%) for the west coast South Island (LIN 7) trawl fishery.

Year	Males Measured	Males Aged	Females Measured	Females Aged	Tows	mwCV
1991	563	176	440	220	65	34.8
1994	873	172	1 096	221	141	27.9
1995	1 051	238	794	268	111	24.3
1996	485	247	448	201	83	28.0
1997	1 532	442	901	399	173	19.5
1998	1 063	349	700	279	155	23.6
1999	1 862	285	1 126	263	221	23.7
2000	829	269	783	264	168	26.8
2001	1 106	256	924	307	178	29.6
2002	1 401	283	1 405	321	332	21.4
2003	1 157	293	1 290	302	286	23.3
2004	1 003	243	1 540	352	334	21.4
2005	908	282	899	355	184	24.9
2006	763	276	844	361	154	29.0
2007	228	148	258	158	65	38.7
2008	805	209	824	251	98	24.1
2012	686	321	576	345	83	31.8
2013	1 270	283	1 302	376	153	23.9
2014	619	183	692	202	95	31.6
2015	3 684	292	3 822	363	417	21.2
2016	2 220	336	2 374	367	267	20.1
2017	1 722	296	1 862	319	195	23.6
2018	2 029	363	2 059	390	231	22.5
2019	1 323	319	1 371	352	137	21.1
2020	1 209	244	1 307	279	133	24.3
2021	607	346	440	312	53	31.7
2022	948	146	886	99	68	32.1
2023	1 284	227	1 492	272	92	31.1
2024[1]	1 140	284	865	217	52	27.8

[1]Otoliths to build the ALK were sourced from the relevant commercial trawl fishery and the survey.

Table 15: Ling calculated numbers-at-age by sex and the estimated CV (proportion) for the west coast South Island (LIN 7) trawl fishery, August to September 2024. Age in years. −: no data.

Age	Male	CV	Female	CV	Age	Male	CV	Female	CV
3	5	2.7	-	-	16	2 030	0.3	3 822	0.4
4	186	0.9	230	1.6	17	345	0.9	2 802	0.4
5	1 282	1.2	488	1.2	18	1 107	0.6	1 464	0.6
6	620	0.7	1 211	0.8	19	292	0.8	679	0.7
7	493	0.6	2 943	0.5	20	516	0.6	718	0.9
8	4 138	0.3	2 036	0.6	21	-	-	1 354	0.6
9	5 349	0.3	3 989	0.5	22	187	0.9	695	0.7
10	6 827	0.2	3 190	0.3	23	195	0.9	61	1.4
11	6 743	0.2	3 575	0.3	24	186	0.9	182	1.3
12	5 610	0.3	6 193	0.3	25	-	-	-	-
13	4 737	0.3	6 794	0.3	26	-	-	4	2.4
14	3 188	0.3	3 226	0.4					
15	1 741	0.4	2 663	0.4					

4.4   Ling longline fishery catch-at-age

4.4.1   Chatham Rise (LIN 3&4)

Catch-at-age estimation for the Chatham Rise (LIN 3&4) longline fishery is a year behind due to boats still being at sea during the critical time for otolith selection (spring at the start of any fishing year). Hence in 2023–24, 481 otoliths were aged from the 2022–23 fishing season (not the 2023–24 fishing year). The derived mwCV was 24.9%. Table 16 provides the data used since 2001–02 to produce the catch-at-age estimates and mwCVs. Details of the estimated catch-at-age distribution are given in Table 17 with graphical representation of distributions in Appendix B.

Table 16:   Numbers of measured and aged ling by fishing year, sex, trips and shots sampled, and the estimated mean weighted CV (%) for the Chatham Rise (LIN 3&4) longline fishery. There was insufficient raw data sampled from the fishery in 2010–2012.

Fishing year	Males		Females		Trips	Shots	mwCV
	Measured	Aged	Measured	Aged			
2002	4 966	284	2 998	309	5	538	20.4
2003	3 038	337	2 071	289	5	429	19.1
2004	1 066	302	747	293	2	139	21.8
2005	889	356	479	234	1	137	21.6
2006	266	95	294	141	1	48	36.6
2007	351	174	268	139	4	62	31.1
2008	574	216	570	262	4	84	25.9
2009	619	283	798	413	3	147	21.5
2013	314	112	655	252	1	50	25.9
2014	789	288	801	284	3	156	21.9
2015	598	179	778	256	3	116	25.1
2016	799	396	722	368	3	152	21.5
2017	959	230	768	250	5	120	27.0
2018	1 192	273	903	216	4	196	26.3
2019	745	172	792	126	2	68	28.6
2020	285	136	241	109	2	40	44.7
2021	163	81	397	200	1	57	37.7
2022	606	233	935	272	3	126	27.1
2023	367	226	640	255	3	46	38.5

Table 17:   Ling calculated numbers-at-age, by sex and the estimated CV (proportion), for the Chatham Rise (LIN 3&4) longline fishery, July to November 2023. Age in years. –: no data.

Age	Male	CV	Female	CV	Age	Male	CV	Female	CV
6	-	-	198	1.5	22	2 396	0.4	1 584	0.5
7	1 087	0.7	-	-	23	1 940	0.4	627	0.7
8	1 539	0.6	419	0.8	24	1 443	0.5	1 677	0.5
9	3 108	0.3	1 546	0.5	25	1 227	0.6	994	0.5
10	2 137	0.4	4 493	0.3	26	1 570	0.4	1 028	0.8
11	5 713	0.3	4 244	0.3	27	850	0.6	867	0.6
12	6 991	0.2	6 558	0.2	28	-	-	441	0.9
13	6 170	0.2	5 588	0.2	29	-	-	-	-
14	5 225	0.2	5 666	0.2	30	446	0.9	196	1.3
15	4 311	0.3	5 151	0.3	31	232	1.2	-	-
16	3 117	0.3	6 699	0.2	32	198	1.2	-	-
17	1 562	0.4	3 910	0.3	33	-	-	-	-
18	2 174	0.4	3 081	0.3	34	-	-	-	-
19	1 117	0.5	1 714	0.5	35	-	-	-	-
20	2 042	0.4	1 932	0.4	36	156	1.3	-	-
21	2 344	0.4	2 913	0.3					

4.4.2 Sub-Antarctic (LIN 5&6)

In 2023–24, only 365 otoliths were available and all were aged. The mwCV was 33.7%. Table 18 provides the data used since 1997–98 to produce the catch-at-age estimates and mwCVs for this fishery. Details of the estimated catch-at-age distribution are given in Table 19 with graphical representation of distributions in Appendix B. Note the new 2024 strata was used to generate the catch-at-age but is temporally compared to the very similar 'non-spawning' fishery.

Table 18: **Numbers of measured and aged ling by fishing year, sex, trips and shots sampled, and the estimated mean weighted CV (%) for the Sub-Antarctic (LIN 5&6) non-spawning longline fisheries. Note that fishing year is not contiguous but includes gaps in observer coverage and that the new geographical strata has been used for 2024.**

Fishery and fishing year	Males Measured	Aged	Females Measured	Aged	Trips	Shots	mwCV
Non-spawning							
1998	608	73	2 763	395	1	34	23.1
1999	3 316	214	7 535	428	2	136	18.3
2001	674	103	2 040	235	2	58	25.3
2003	304	128	611	273	2	43	29.3
2005	413	114	716	307	2	113	25.9
2009	165	61	454	196	1	49	28.0
2010	151	78	424	214	1	49	29.0
2011	180	60	823	267	1	64	27.3
2012	316	109	979	320	2	91	23.7
2014	156	57	782	258	2	59	29.8
2018	383	136	1 256	531	1	82	21.2
2020	606	73	441	138	2	67	40.1
2022	609	45	1 560	202	3	73	33.2
2023	426	125	1 277	376	3	117	23.8
2024	367	114	640	251	2	46	33.7

Table 19: **Ling calculated numbers-at-age by sex and the estimated CV (proportion) for the Sub-Antarctic (LIN 5&6) longline fishery, March and June 2024. Age is in years. –: no data.**

Age	Male	CV	Female	CV	Age	Male	CV	Female	CV
6	279	1.5	1 554	0.8	22	228	1.6	273	1.1
7	559	1.1	4 064	0.5	23	2 331	0.7	1 965	0.6
8	3 005	0.6	4 972	0.4	24	749	0.9	1 139	0.7
9	2 424	0.6	2 602	0.5	25	693	1.2	1 354	0.7
10	2 274	0.5	7 522	0.3	26	1 459	0.6	-	-
11	291	1.3	4 714	0.4	27	939	0.9	451	1.2
12	1 320	0.7	10 549	0.2	28	853	0.9	-	-
13	1 016	0.7	6 579	0.3	29	776	0.8	152	1.3
14	2 962	0.5	7 704	0.3	30	1 074	0.7	647	0.9
15	1 249	0.7	9 901	0.2	31	490	1.0	346	1.2
16	2 488	0.4	8 866	0.2	32	857	0.8	577	1.1
17	6 182	0.4	4 849	0.3	33	440	1.1	422	1.0
18	1 956	0.6	4 826	0.3	34	886	0.8	-	-
19	3 932	0.4	4 988	0.3	35	-	-	-	-
20	3 419	0.4	2 373	0.4	36	165	1.5	-	-
21	2 051	0.7	1 901	0.5	37	615	0.8	-	-

4.5 Trawl survey catch-at-age for ling

4.5.1 Sub-Antarctic (LIN 5&6)

In 2024, there were 600 otoliths available from the Sub-Antarctic survey (TAN2413) with 578 being aged after problematic otolith removal. The mwCV was 21.9%. Table 20 summarises the data used

each year to produce the catch-at-age estimates and the mwCVs. Details of the estimated catch-at-age distribution for ling caught in the survey are given in Table 21 with graphical representation of distributions in Appendix B.

Table 20: **Numbers of measured and aged ling by survey, year, sex, tows sampled and the estimated mean weighted CV (%) for the core and Puysegur Sub-Antarctic summer and autumn trawl surveys.**

Survey code	Year	Males		Females		Tows	mwCV
		Measured	Aged	Measured	Aged		
Summer surveys							
AEX8902	1989	760	160	1 067	234	133	28.8
TAN9105	1991	1 563	213	2 079	348	151	19.8
TAN9211	1992	1 249	227	1 668	354	146	20.7
TAN9310	1993	1 520	254	1 894	351	127	22.2
TAN0012	2000	1 761	244	1 696	351	85	19.2
TAN0118	2001	1 316	268	1 290	326	95	19.8
TAN0219	2002	1 661	224	1 606	350	88	20.8
TAN0317	2003	1 270	243	1 156	333	70	22.1
TAN0414	2004	1 433	256	1 146	339	79	26.7
TAN0515	2005	1 095	279	988	300	82	22.4
TAN0617	2006	969	250	1 011	355	80	22.6
TAN0714	2007	1 014	229	1 288	353	79	21.4
TAN0813	2008	1 162	250	994	327	80	26.6
TAN0911	2009	830	232	882	339	70	22.8
TAN1117	2011	1 264	266	1 321	322	80	23.6
TAN1215	2012	1 391	289	1 555	316	80	25.5
TAN1412	2014	1 175	262	1 261	365	76	21.1
TAN1614	2016	767	225	829	367	55	22.7
TAN1811	2018	1 011	260	870	360	65	24.6
TAN2014	2020	832	270	933	325	65	25.0
TAN2215	2022	864	284	883	323	64	25.2
TAN2413	2024	1098	272	1007	306	66	21.9
Autumn surveys							
TAN9204	1992	1 570	221	1 498	310	90	21.5
TAN9304	1993	1 353	261	1 344	373	97	21.1
TAN9605	1996	1 129	325	902	303	88	21.9
TAN9805	1998	809	271	765	296	64	22.9

Table 21: **Ling calculated numbers-at-age by sex, and the estimated CV (proportion), for the trawl survey of the Sub-Antarctic in November and December 2024 (TAN2413). Age in years. −: no data.**

Age	Male	CV	Female	CV	Age	Male	CV	Female	CV
2	-	-	-	-	19	86 929	0.5	145 095	0.4
3	8 255	1.7	21 761	1.0	20	81 590	0.5	35 510	0.8
4	90 222	0.6	80 792	0.6	21	64 615	0.5	25 212	1.0
5	267 785	0.3	202 511	0.4	22	-	-	73 747	0.5
6	442 131	0.2	443 437	0.3	23	-	-	33 930	0.9
7	552 516	0.2	590 179	0.2	24	12 612	1.5	30 341	0.9
8	495 790	0.2	590 200	0.2	25	-	-	-	-
9	325 176	0.3	560 169	0.2	26	-	-	-	-
10	320 963	0.2	366 755	0.3	27	12 909	1.2	-	-
11	183 820	0.3	392 528	0.2	28	-	-	-	-
12	133 748	0.3	414 777	0.2	29	-	-	896	1.9
13	136 428	0.4	186 116	0.4	30	-	-	-	-
14	158 521	0.3	231 223	0.3	31	-	-	757	2.4
15	175 248	0.3	352 468	0.2	32	-	-	-	-
16	115 773	0.4	282 589	0.3	33	-	-	-	-
17	127 519	0.4	124 110	0.4	34	-	-	-	-
18	110 514	0.4	223 833	0.3	35	-	-	-	-

4.5.2 West Coast South Island (LIN 7)

In 2024, there were 500 otoliths available from the WCSI survey (TAN2407), and commercial trawl fishery combined with 470 being aged. The mwCV was 42.4%. Table 22 summarises the data used each year to produce the catch-at-age estimates and the mwCVs. Details of the estimated catch-at-age distribution for ling caught in the survey and commercial fishery combined are given in Table 23 with graphical representation of distributions in Appendix B.

Table 22: Numbers of measured and aged ling by survey, year, sex, tows sampled and the estimated mean weighted CV (%) for the core area west coast South Island trawl surveys.

		Males		Females			
Survey	Year	Measured	Aged	Measured	Aged	Tows	mwCV
TAN0007	2007	784	284	637	276	45	29.5
TAN1210	2012	962	305	722	308	48	26.7
TAN1308	2013	1 026	224	768	298	53	30.1
TAN1609	2016	694	267	429	200	32	30.8
TAN1807	2018	810	261	466	226	35	33.7
TAN2107	2021	479	198	518	180	34	34.3
TAN2407	2024	273	222	208	248	36	42.4

Table 23: Ling calculated numbers-at-age by sex and the estimated CV (proportion), for the trawl survey of the west coast South Island in July and August 2024 (TAN2407). Age in years. −: no data.

Age	Male	CV	Female	CV	Age	Male	CV	Female	CV
2	-	-	-	-	16	3 366	0.5	3 151	0.4
3	1 601	1.2	1 748	1.6	17	743	0.8	1 573	0.6
4	2 061	1.1	587	2.2	18	2 283	0.5	1 242	0.6
5	748	1.1	1 077	1.7	19	642	0.9	547	0.8
6	2 468	0.7	4 957	1.2	20	1 530	0.7	661	0.8
7	1 801	0.7	1 888	0.7	21	-	-	621	0.8
8	5 525	0.5	3 198	0.5	22	365	1.2	1 675	0.6
9	6 783	0.4	3 122	0.9	23	309	1.0	1 314	1.0
10	7 565	0.4	2 592	0.5	24	674	0.9	882	1.5
11	6 353	0.3	5 205	0.3	25	-	-	-	-
12	4 909	0.4	5 931	0.3	26	-	-	145	1.6
13	5 915	0.3	6 080	0.3					
14	4 247	0.3	3 918	0.4					
15	2 380	0.4	3 336	0.4					

5. DISCUSSION

5.1 Hake

Sufficient raw data (e.g. biologicals and otoliths) were available, and therefore catch-at-age was estimated, for the 2023–24 Sub-Antarctic (HAK 1) trawl fishery which continues a 26-year time series. The number aged was slightly greater than the target number of otoliths, and the mwCV achieved the 30% target. Most hake caught were 6 to 12 years old with the males more abundant. There were few fish older than 15 years, although the female estimate has a relatively long right-hand tail to 24 years old. Year class progressions are generally evident in this series, particularly for males. However, in 2023–24 there were no obvious progressions for fish older than 8 years old but there is a new dominant year class for males aged 6 and females aged 6–7 years of age (Figure A1). Figure A1 shows the progressions of hake aged 9 in 1989–90 to age 13 in 1993–94, aged 6 in 1997–98 to age 12 in 2003–04, and aged 5 in 2008–09 to age 11 years in 2014–15. Contemporary age classes greater than 10 years are less dominant than those from the early 1990s (both sexes, Figure A1).

The target mwCVs for hake from the Sub-Antarctic survey series (HAK 1) was not achieved in the 2024 survey or any of the other 22 summer surveys due to low numbers of hake being caught. Most hake caught in this entire survey series were aged 3 to 5 for males and 3 to 10 for females, with approximately double the number of females. There were few hake caught older than 20 years in 2024. Year class progression is evident in the summer survey series, and this continues into older ages more regularly in females (Figure A2). For example, females aged 3 in 2000 can be tracked to age 9 in 2006 and aged 2 in 2008 to age 8 in 2014.

Sufficient raw data were available to produce catch-at-age estimations for the WCSI (HAK 7) fishery in 2023–24. The derived mwCV easily achieved the target. The time series is complete for all years since 1990. In 2023–24, most hake caught were aged 5 to 8 years, with right tails in the estimates for both sexes extending out to about age 20. There were a few hake caught less than age 4. Year class progression is unclear after the year 1999–00 especially into older classes (greater than 10 years old, Figure A3). Since 1999–00, hake older than age 10 appeared to be less abundant in the catch than in most previous years. The catch in most years since 2010–11 has been dominated by males aged 5 to 7 and females aged 6 to 8 years.

Hake from the WCSI (HAK 7) survey series since 2000 show age estimates broadly similar to those from the fisheries (Figure A4). A high proportion of hake were taken in strata deeper than 650 m, and, in 2023–24, there was a high proportion of young hake (less than 5 years) in 650–800 m strata (Figure A5). In the 2016 survey the dominant year class were 2 year olds for both sexes which is the first time a less than 5 year old year class has dominated in the history of this survey. Recently, numbers of hake caught has been slightly biased towards females for this survey series.

5.2 Ling

Ling catch-at-age sampling from the Chatham Rise trawl fishery (LIN 3&4) in 2023–24 was insufficient to meet the target mwCV of 30% due to low numbers of fish being sampled by observers which is atypical of this catch-at-age series. Catch-at-age estimates for the last 31 years for this fishery show that the dominant age classes tend to be from ages 5 to 15. Fish appear to recruit to the fishery at ages 3 and 4 and again the distribution tends to have a long right-hand tail. Year class progression is evident in both sexes (Figure B1), for example, ling aged 5 in 1993–94, 1999–00, 2004–05, 2011–12, and 2013–14.

Sufficient ling were sampled from the Chatham Rise (LIN 3&4) longline fishery in 2022–23 to meet the target mwCV with the numbers of ling caught unbiased in terms of sex. Estimates are available for all but four years since 2001–02, although raw data are available for only one of these missing years. Historically, the dominant year classes are about age 9 to 17 (both sexes). Estimates tend to have a long right-hand tail. The clearest evidence of year class progression for the fishery was prior to 2009–

10, with both sexes showing trackability of ling aged 7 in 2001–02 to age 14 in 2008–09 (Figure B2). A strong class of 16 year-olds in the 2021–22 catch-at-age can be tracked from dominant 15 year-olds in the previous year but not prior to that.

Sufficient ling were sampled from the Sub-Antarctic (LIN 5&6) trawl fishery in 2023–24 for catch-at-age estimation with the target mwCV achieved. The numbers of ling caught was biased slightly towards males in 2023–24. This time series began in 1991–92 and is available for all years since 2000–01. The 2023–24 estimates show fish beginning to recruit at age 5 and the main age classes are from 7 to 15 for both sexes. The distribution has a long right tail to approximately age 30. The presence of fish aged 6 and under is slightly reduced in the last four years. Strong year class progression is occasionally evident, for example, age 4 fish entering the fishery in 1997–98 can be tracked to age 12 in 2005–06 (Figure B3).

The ling catch in the 2023–24 sub-Antarctic (LIN 5&6) longline fishery was biased towards females. The catch-at-age series began in 1997–98 and is available sporadically. The 2023–24 estimate continues the typical (approximate) unimodal shape compared to the bimodal 2020–21 ages which included a cohort of 20–25-year-olds (both sexes). The 2023–24 estimate has a range of ages from 6 to the early-mid-30s (males and females, respectively). Old ling (30 years and over) have only been present in the estimates in the last four years sampled. Strong year classes often appear, but spasmodic sampling means that progression is hard to ascertain (Figure B4).

Summer sub-Antarctic surveys (LIN 5&6) have been conducted since 1991 and biennially since 2012. This survey series has caught ling as young as 2 years old but these age classes were not seen in 2024. Recent surveys are now catching older fish than was typical for this survey (e.g. fish older than age 20 years). Strong year class progression is evident throughout the survey period (Figure B5).

Sufficient ling were sampled from the 2023–24 WCSI (LIN 7) trawl fishery for catch-at-age estimation with the mwCV achieving the target. The numbers of male and female ling caught were relatively even. Estimates have been produced since 1993–94 except for three years. The estimates appear unimodal in recent years with a shift to an older age. Since 2018–19 there has been a trend of very young fish (5 years and under) not appearing in the estimate but this year there was a small number of 4-year-olds. Year class progression can be most easily seen for females. For example, females entering the fishery aged 5 in 1993–94 can be easily tracked to age 18 in 2006–07 (Figure B6).

The 2024 WCSI survey (LIN 7) was typical for the series. For example, there was a lack of ling older than 25 (Figure B7). Surveys of ling in this area have generally been dominated by fish in their early to mid-teens for females and pre-teens for males.

No catch-at-age estimates are available from the emerging pot fishery.

6. FULFILMENT OF BROADER OUTCOMES

As required under Government Procurement rules[2], 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

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[2] https://www.procurement.govt.nz/procurement/principles-charter-and-rules/government-procurement-rules/planning-your-procurement/broader-outcomes/

expertise and grew institutional knowledge of NZ 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 NZ 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.

7. ACKNOWLEDGEMENTS

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9.   APPENDICES

### Appendix A: Summaries of the proportions and numbers-at-age series for hake catches
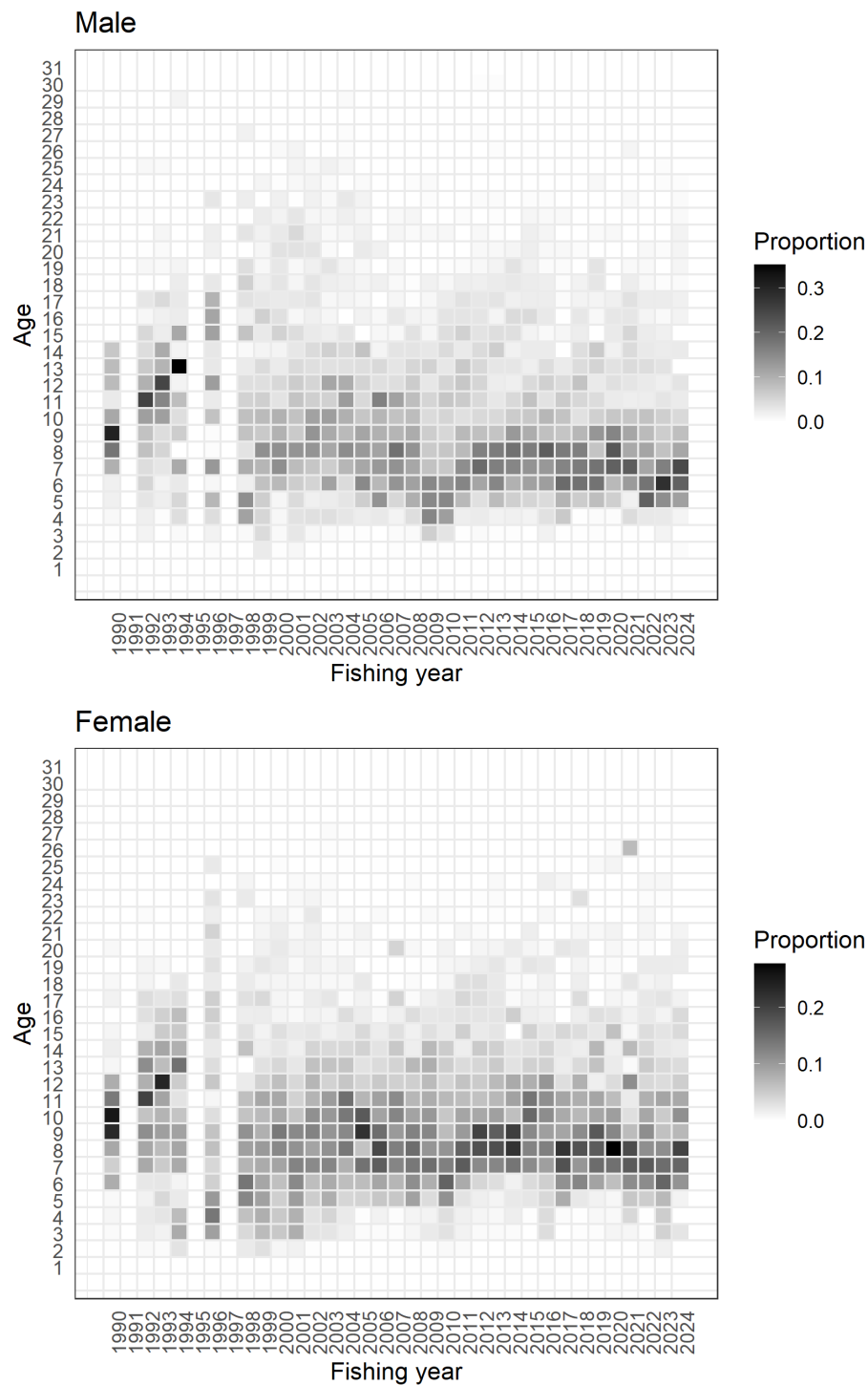
Figure A1: Age frequency distributions of hake from observed commercial catch-at-age data in the Sub-Antarctic trawl fishery (HAK 1), 1990 to 2024 (where sufficient data are available).
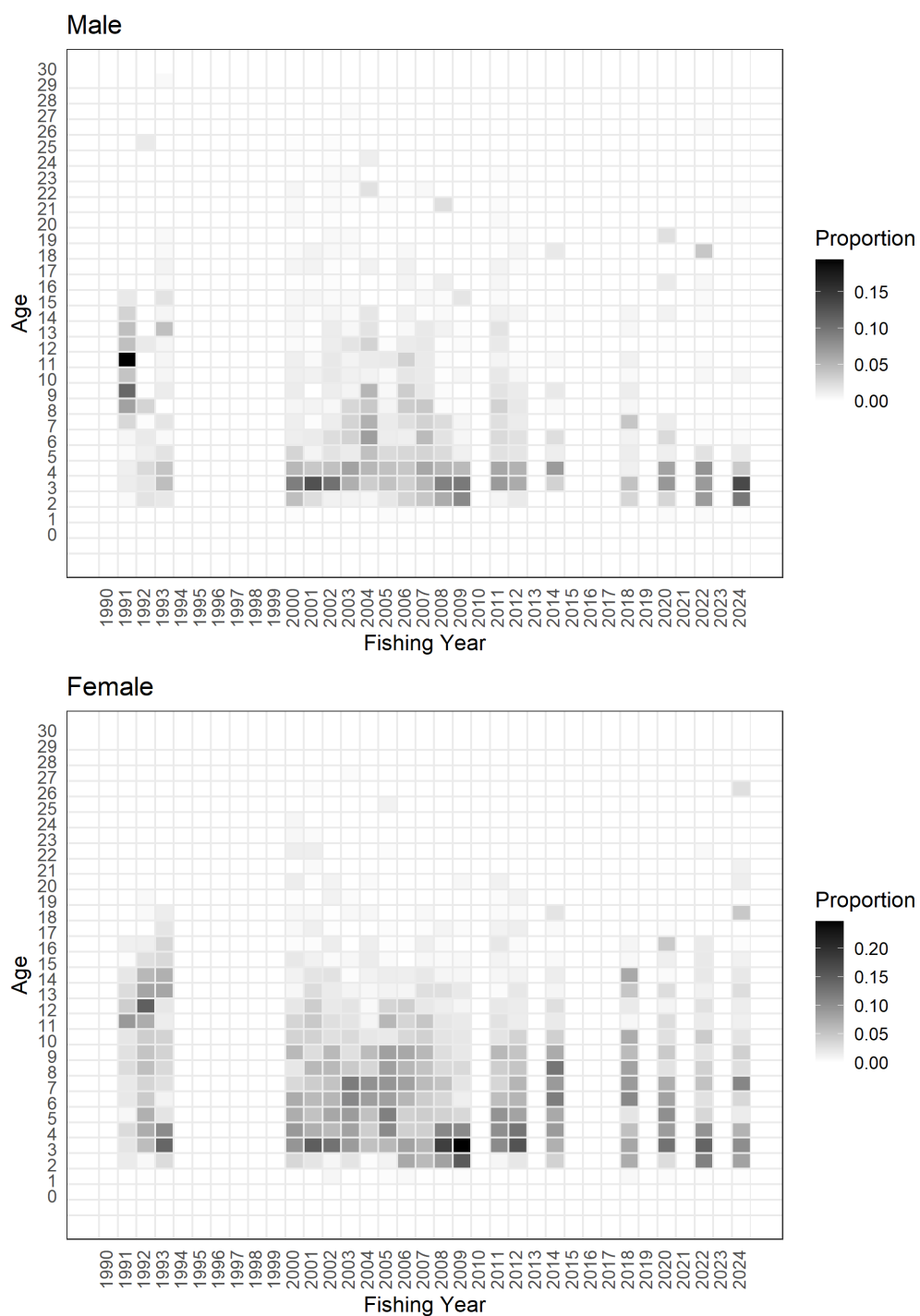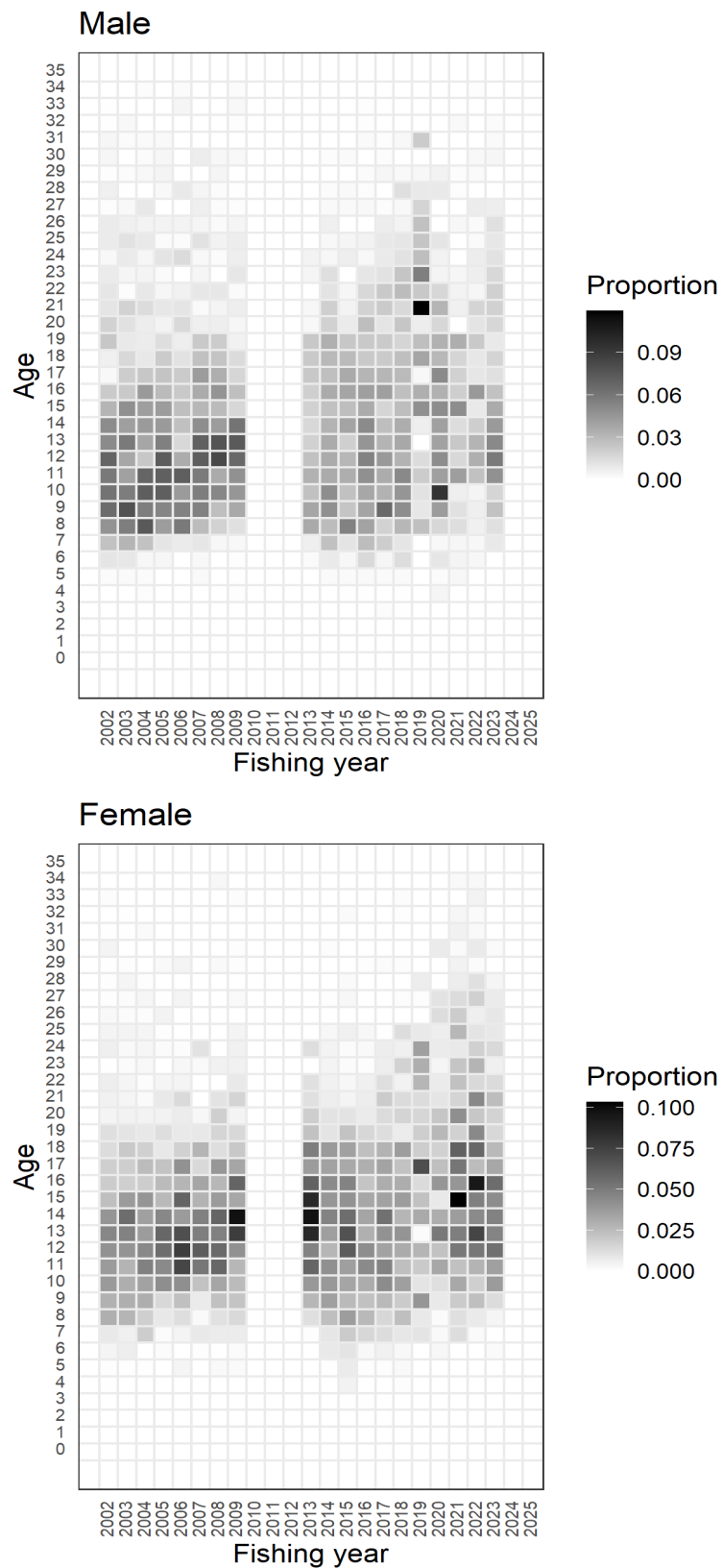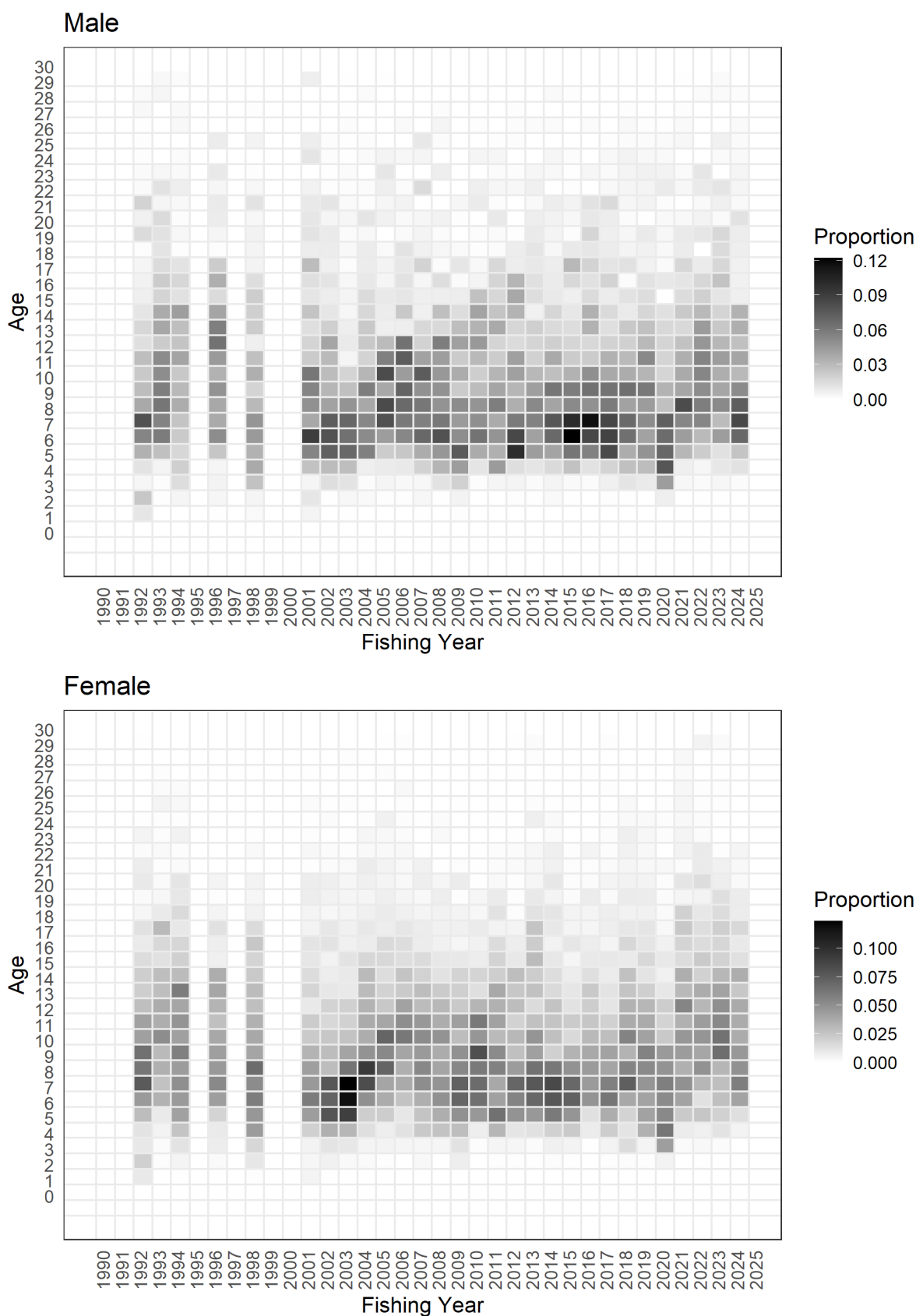
Figure A2: Age frequency distributions of hake from summer trawl surveys of the Sub-Antarctic (HAK 1), 1989 to 2024.
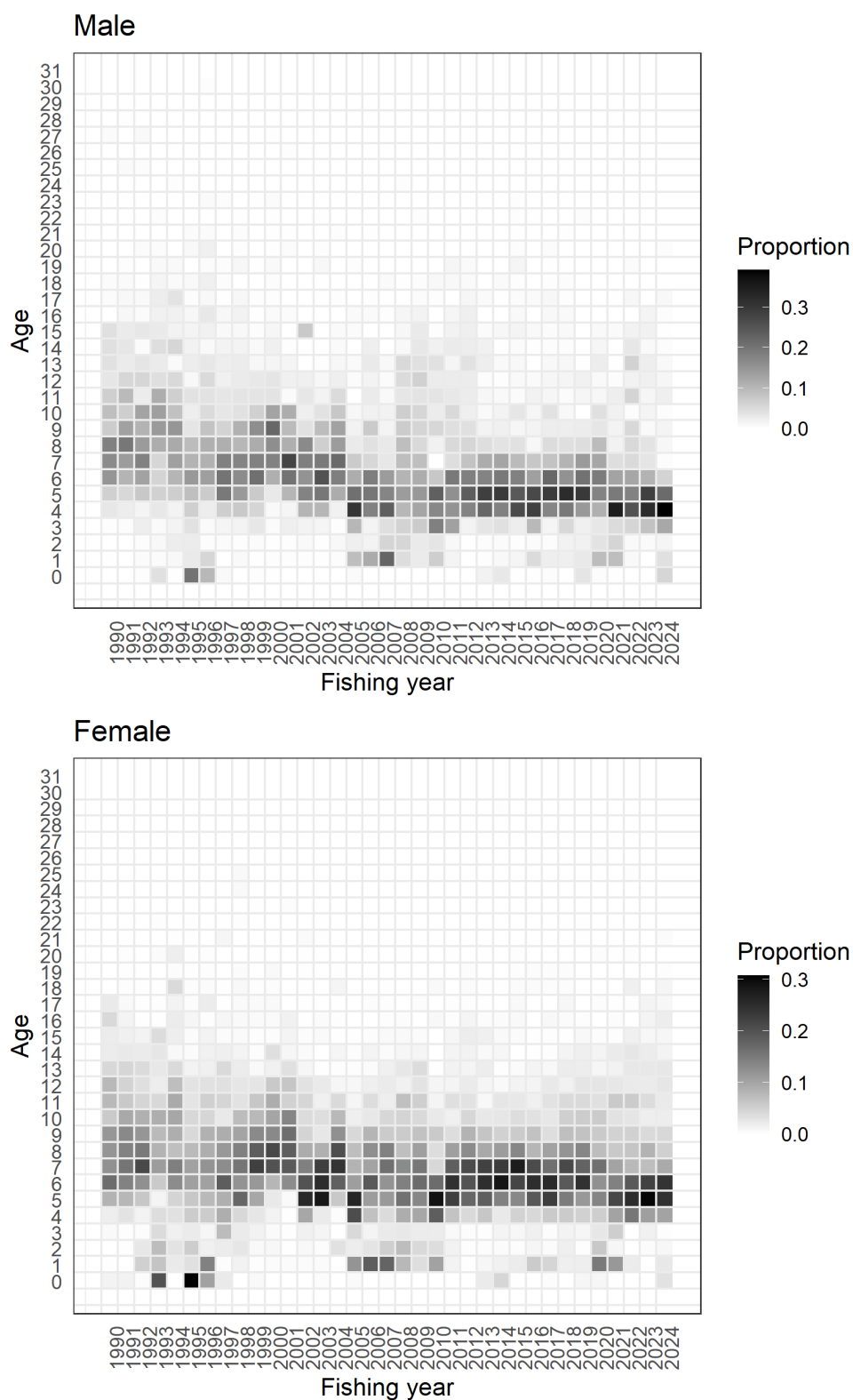
Figure A3: Age frequency distributions of hake from commercial catch-at-age data in the WCSI trawl fishery (HAK 7), 1990 to 2024 (where sufficient data are available).
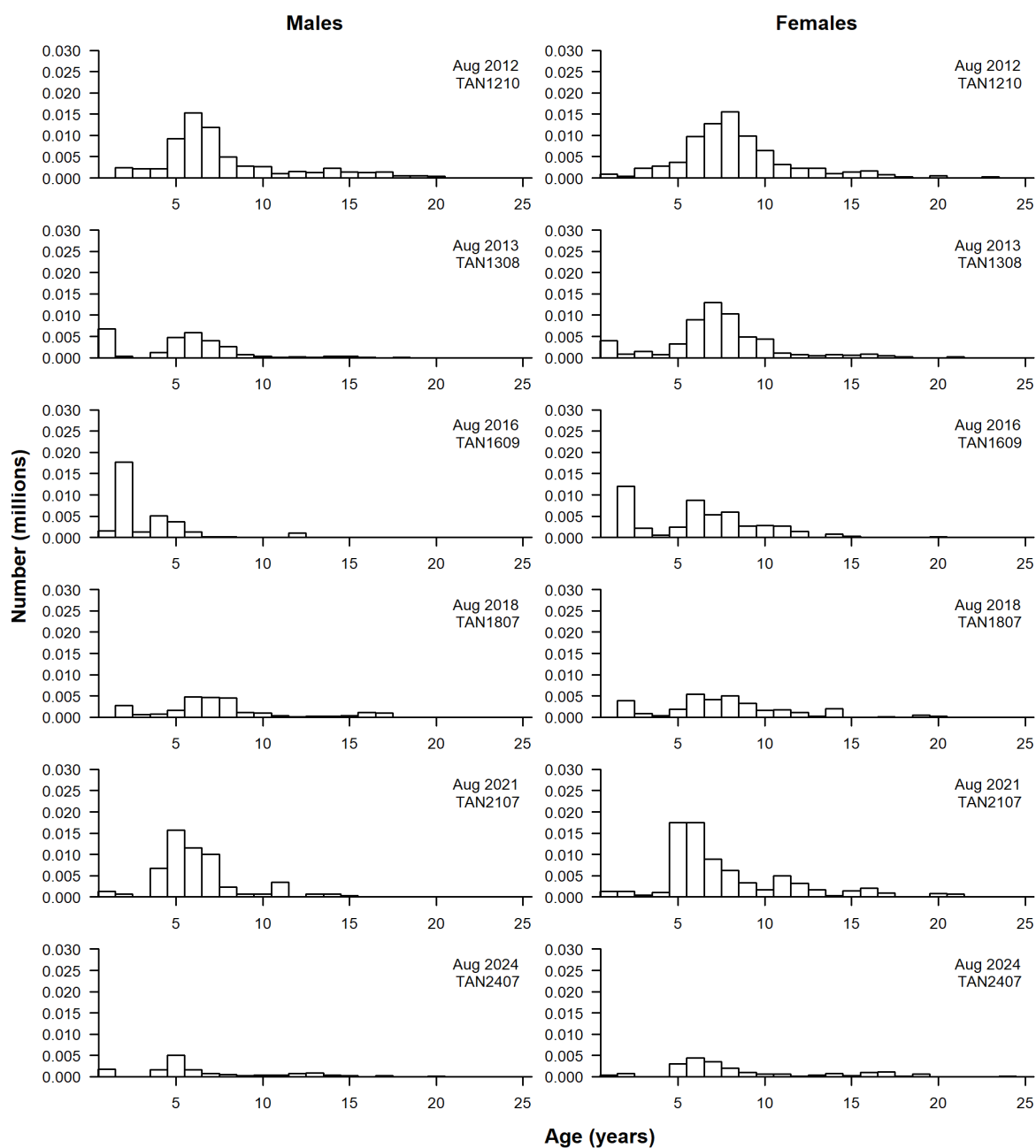
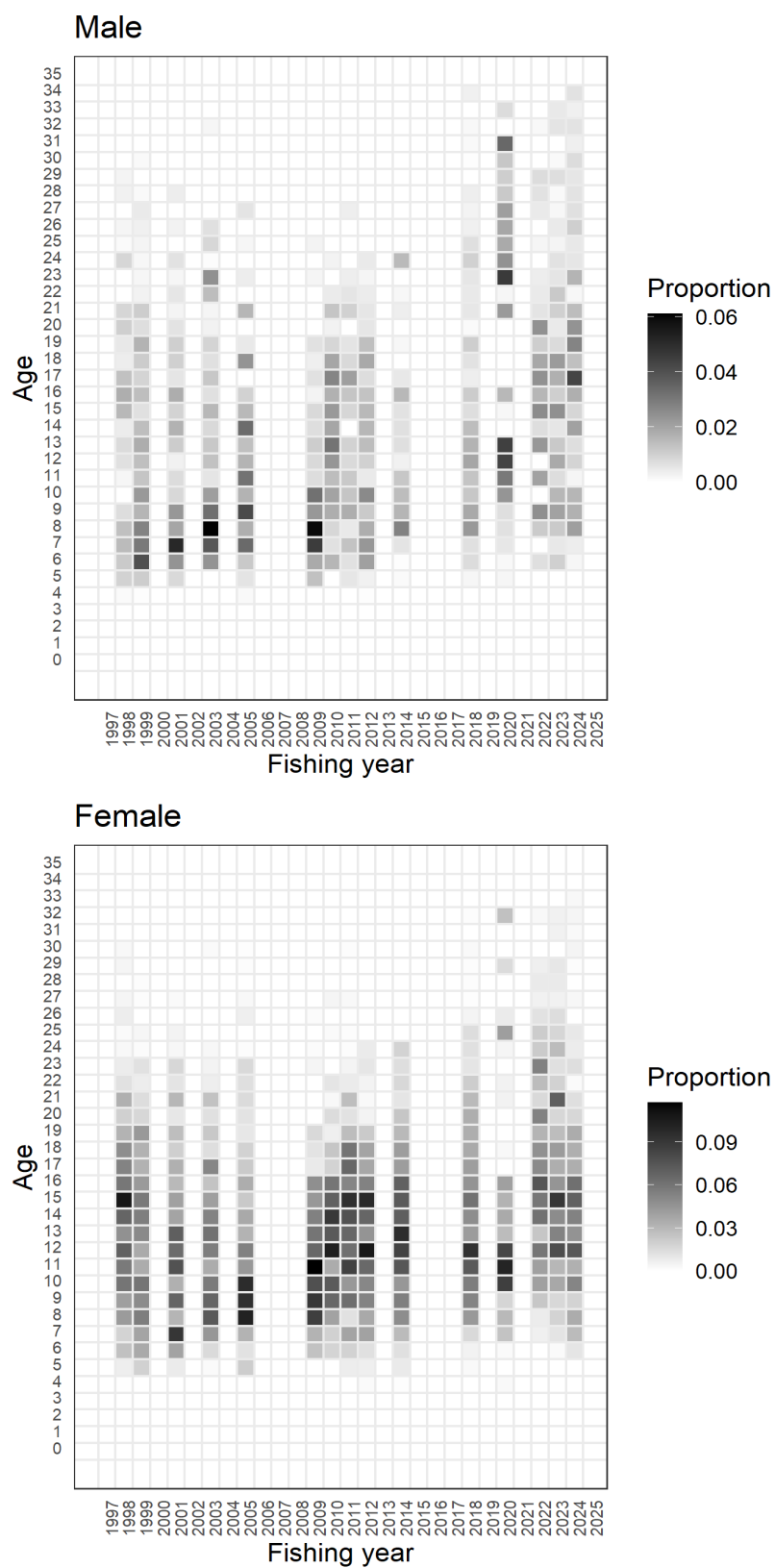**Figure A4: Age frequency distributions of hake (scaled numbers-at-age, x axis limited to ages 1 to 25) from trawl surveys of the WCSI (HAK 7, 'core' strata only), from 2012 to 2024.**
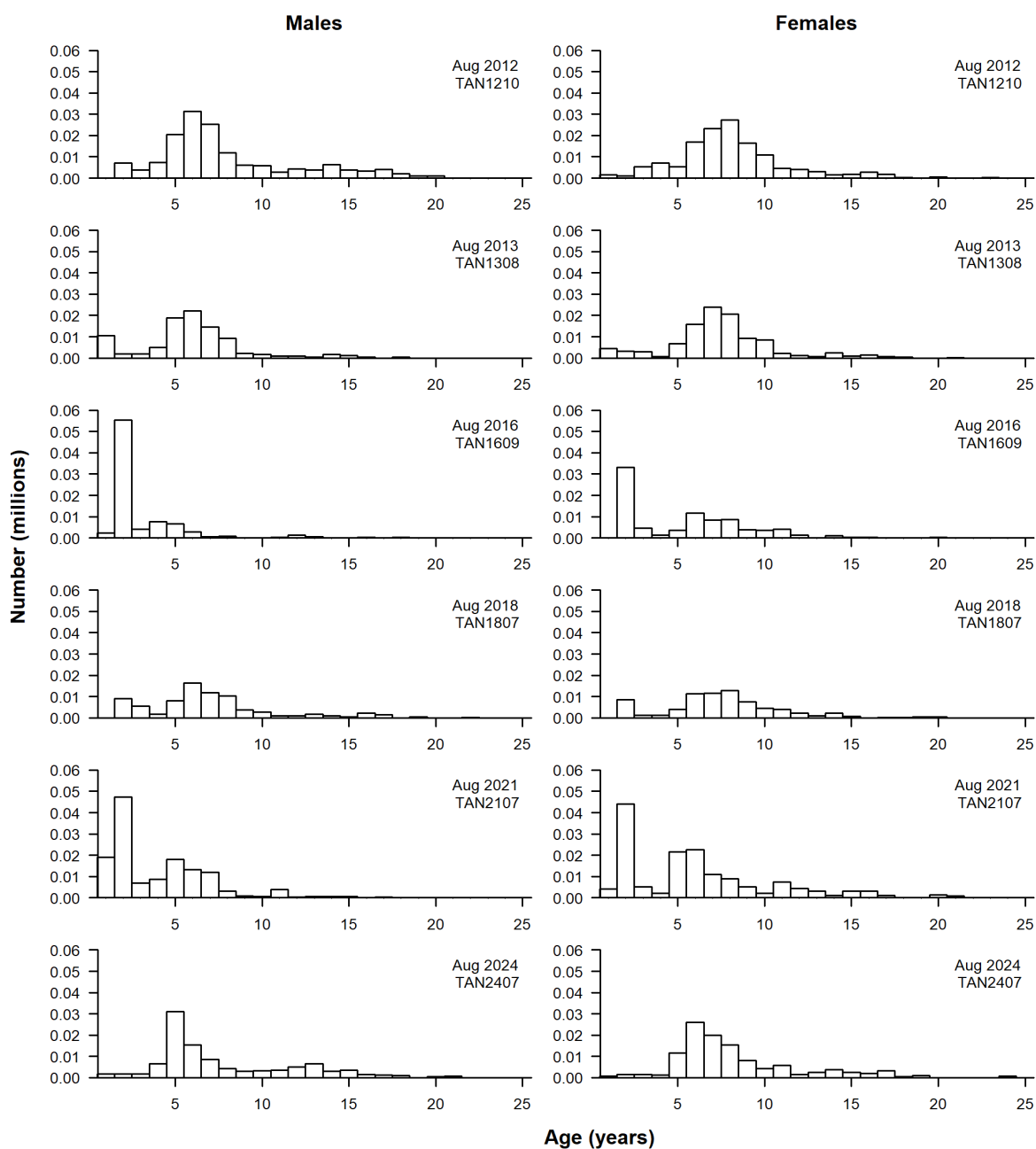
Figure A5: Age frequency distributions of hake (scaled numbers-at-age, x axis limited ages 1 to 25) from trawl surveys of the WCSI (HAK 7, 'all' strata), from 2012 to 2024.

Appendix B: Summaries of the proportions-at-age series for ling catches

Male

Female
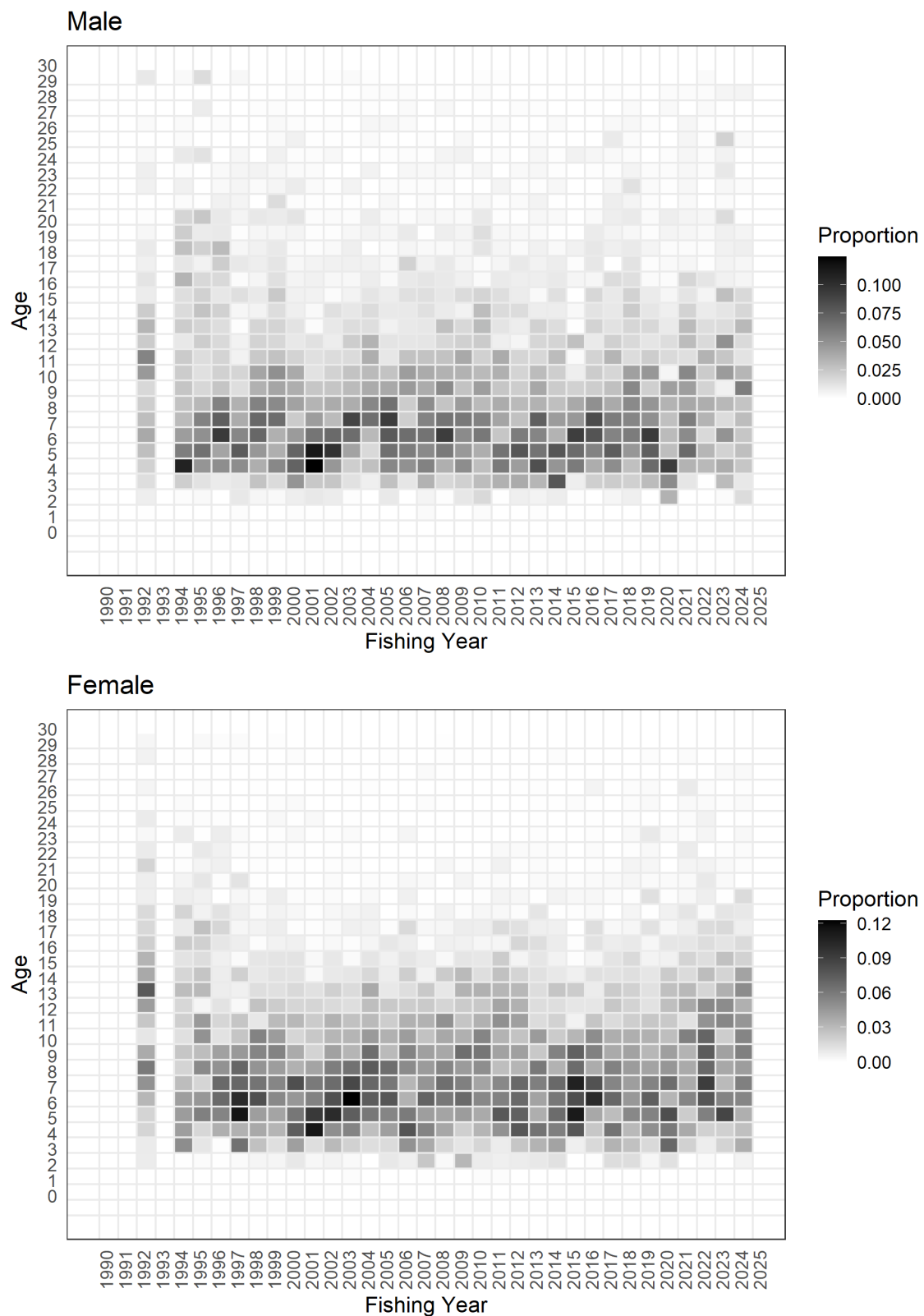
Figure B1: Age frequency distributions of ling from observed commercial catch-at-age data in the Chatham Rise trawl fishery (LIN 3&4), 1990 to 2024 (where sufficient data are available).

Figure B2: Age frequency distributions of ling from observed commercial catch-at-age data in the Chatham Rise longline fishery (LIN 3&4), 2002 to 2023 (where sufficient data are available).

Figure B3: Age frequency distributions of ling from observed commercial catch-at-age data in the Sub-Antarctic trawl fishery (LIN 5&6), 1992 to 2024 (where sufficient data are available).

Figure B4: Age frequency distributions of ling from observed commercial catch-at-age data in the Sub-Antarctic (non-spawning season or new strata) ling longline fishery (LIN 5&6), 1997 to 2024 (where sufficient data are available).
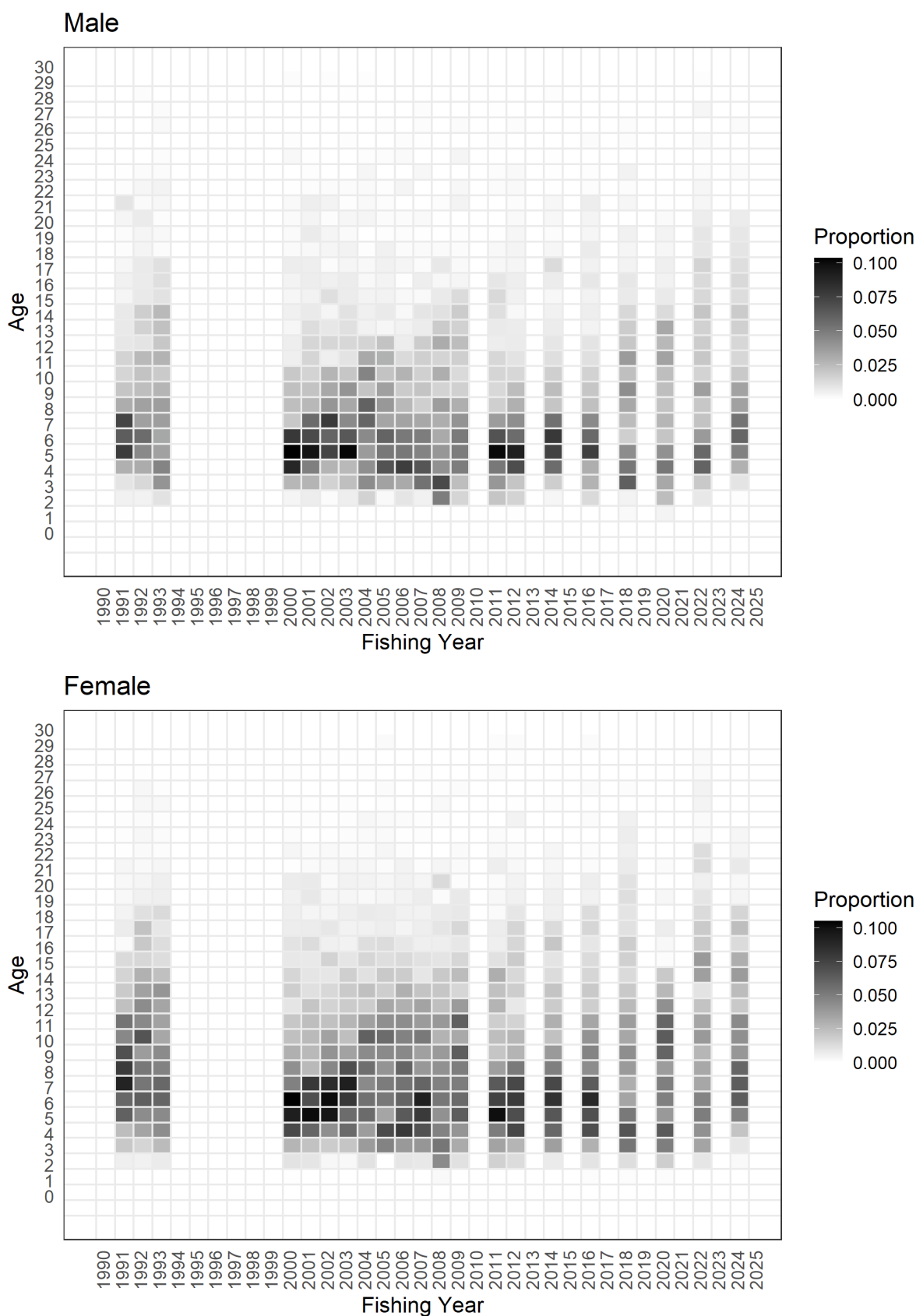
Figure B5: Age frequency distributions of ling (proportions-at-age, ages 1 to 30) from summer trawl surveys of the Sub-Antarctic (LIN 5&6), 1990 to 2024.
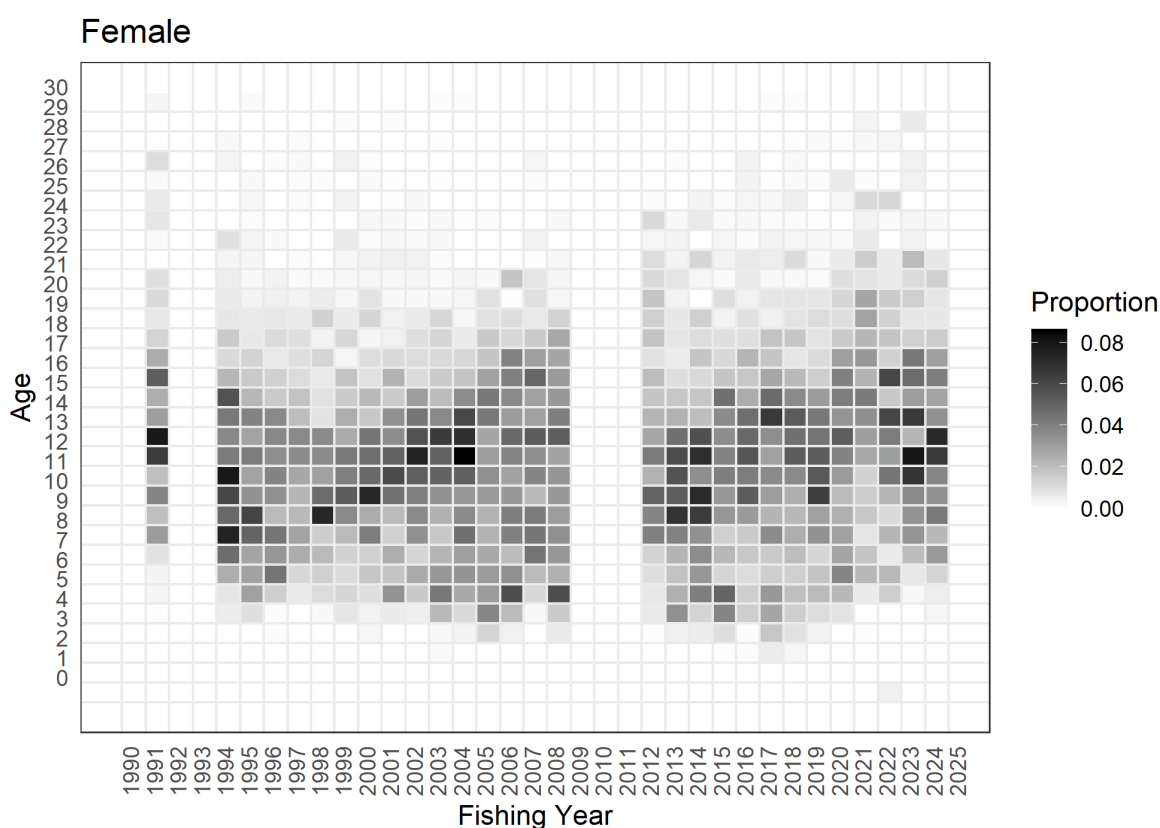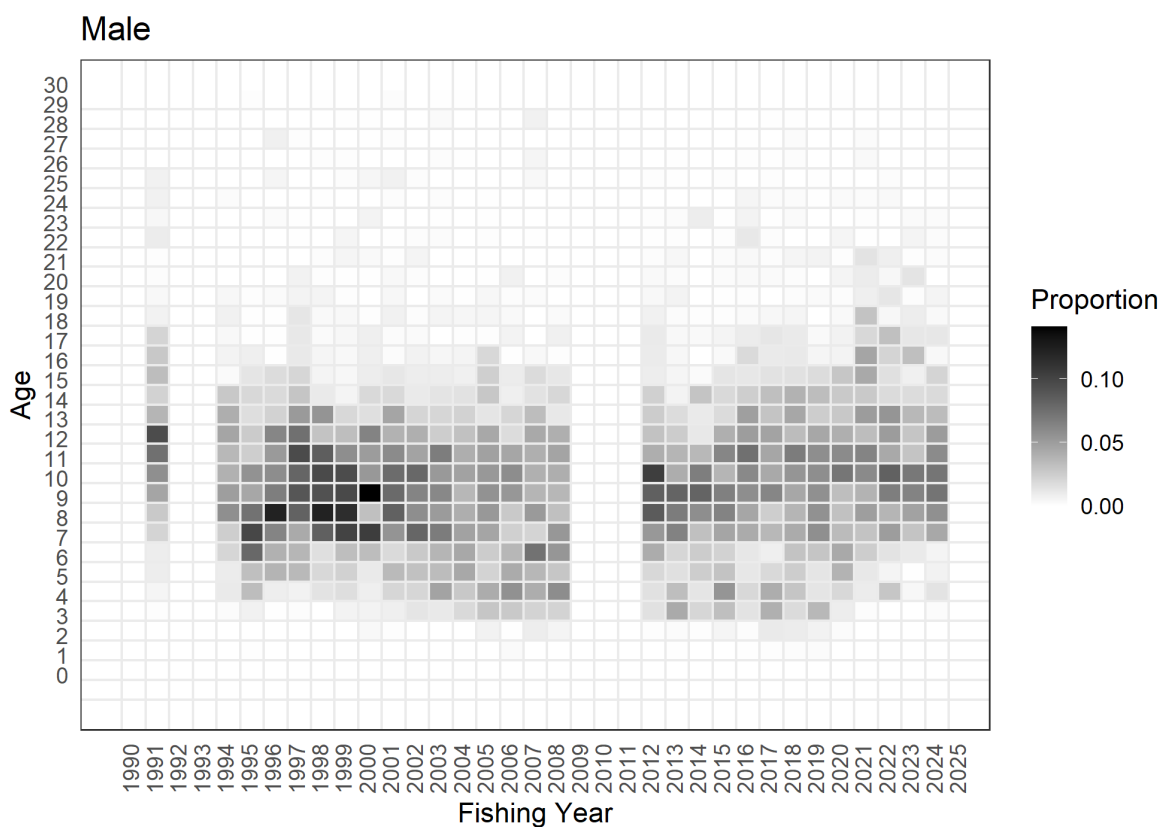
Figure B6: Age frequency distributions of ling from observed commercial catch-at-age data in the WCSI trawl fishery (LIN 7), 1991 to 2024 (where sufficient data are available).
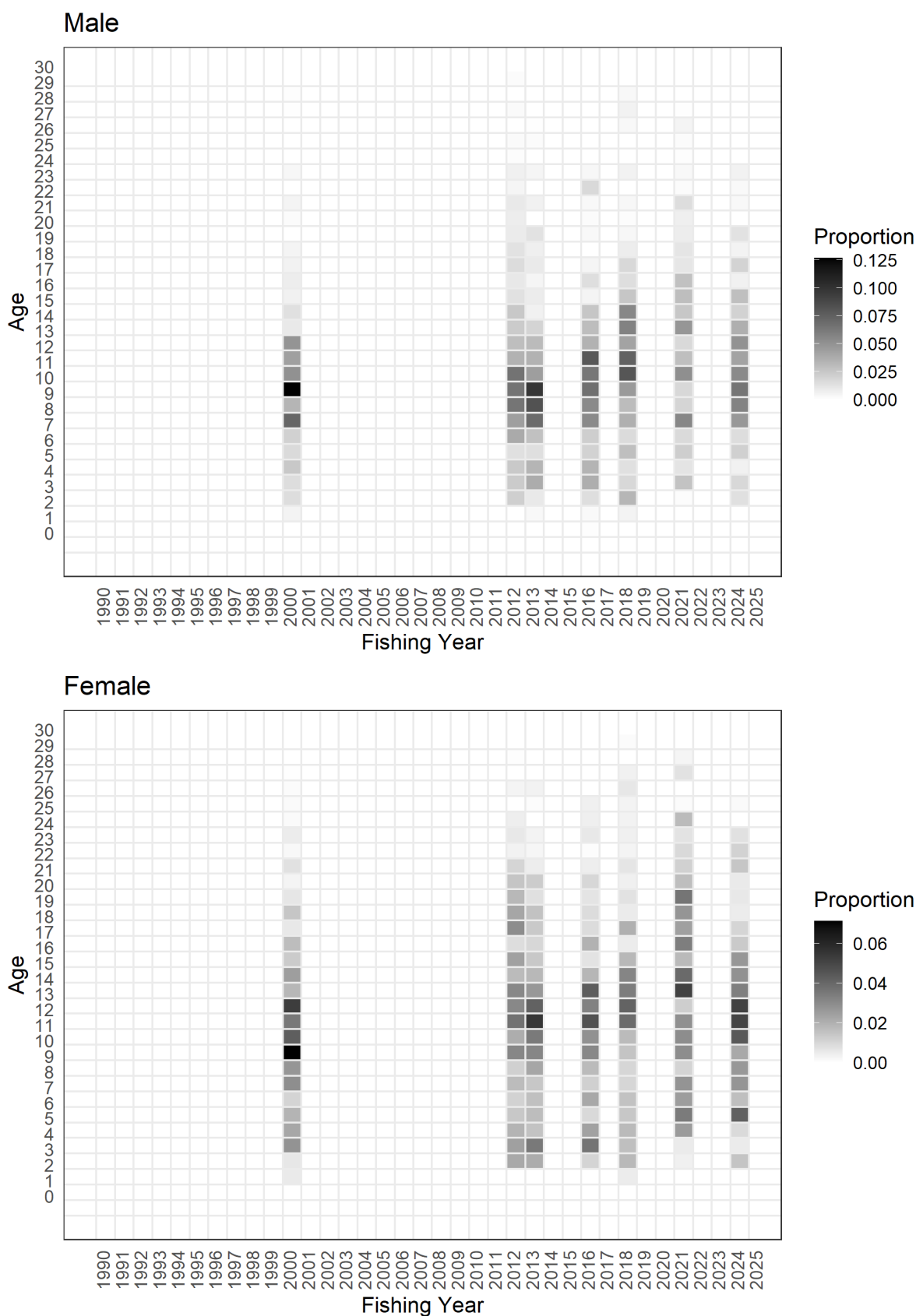
Figure B7: Age frequency distributions of ling (proportions-at-age, ages 1 to 25) from winter trawl surveys ('core' strata only) of the WCSI (LIN 7), 2000 to 2024.