Fisheries New Zealand

Tini a Tangaroa

Age composition of orange roughy from Cook Canyon (ORH 7B) in 2019 and 2020

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EXECUTIVE SUMMARY

Age frequency distributions were estimated for orange roughy (*Hoplostethus atlanticus*) from Cook Canyon (ORH 7B) using otoliths sampled from acoustic surveys conducted in 2019 and 2020. Two strata were surveyed: the Cook Canyon main aggregation (Cook Canyon Plume), which was surveyed in both 2019 and 2020; and Cook Canyon Pinnacle, which was surveyed in 2020. Otoliths were prepared and read by one reader following the accepted ageing protocol methods. Age estimates from 492 otoliths were used in the analyses for the Cook Canyon Plume in 2019, and from 442 and 445 otoliths for the Cook Canyon Plume and Cook Canyon Pinnacle strata, respectively, in 2020. The age distribution of the Cook Canyon Plume in 2019 was dominated by middle-aged fish with ages ranging mainly from 30 to 65 years, but with a relatively large number of fish aged over 100 years. In 2020, estimated age frequency compositions were similar between the two strata, with ages ranging mainly from ~30 to ~55 years, few fish greater than 100 years old, and few young fish. The Cook Canyon Plume sample contained slightly older fish and a greater proportion of fish greater than 50 years than the Cook Canyon Pinnacle sample. For both strata, the modal age of females was greater than that of males.

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1.   INTRODUCTION

This report fulfils the reporting requirements relating to orange roughy (*Hoplostethus atlanticus*) for Objective 1 of Fisheries New Zealand project MID2020-01; 'To determine catch-at-age for commercial catches and resource surveys of specified middle depth and deepwater fishstocks'. The research in 2020–21 was the preparation and ageing of otoliths of orange roughy sampled from Cook Canyon (ORH 7B), from an acoustic survey conducted in June–July 2019 and 2020 aboard FV *Amaltal Mariner*. These data enabled the estimation of ORH 7B age frequency for the 2019–20 fishing years, 13 years after the fishery had been closed. The derived age distribution will be used in the next ORH 7B stock assessment.

Recognising that orange roughy age estimates produced by New Zealand and Australian readers had poor comparability (Francis 2005, 2006, Hicks 2005), an Orange Roughy Ageing Workshop was held in 2007 to improve otolith preparation and zone interpretation between agencies. A revised protocol for ageing orange roughy was developed during the workshop (Tracey et al. 2007) and later this protocol was tested by two scientists from National Institute of Water and Atmospheric Research Ltd (NIWA) and two scientists from Fish Ageing Services Pty. Ltd. (FAS, Victoria, Australia). The revised ageing protocol solved the inter-agency between-reader problems and provided a consistent and documented method for the interpretation of growth zones in orange roughy otoliths for the region (Tracey et al. 2009, Horn et al. 2016).

The growth of juvenile orange roughy was validated by examining the otolith marginal increment type and by length frequency analysis (Mace et al. 1990). Later, Andrews et al. (2009) applied an improved lead-radium dating technique to orange roughy otolith cores, grouped by growth zone counts from thin sections to validate age data. Results showed a high degree of correlation between the growth zone counts and the expected lead-radium growth curve and provided support for both a centenarian life span for orange roughy and for the age estimation procedures using thin otolith sectioning.

1.1   The Cook Canyon fishery and relevant research

This fishery commenced in 1983 in an area near Cook Canyon in ORH 7B (Figure 1). Up to 1996–97, about 80% of catches were taken in winter (June–July) when orange roughy aggregate for spawning. The Total Allowable Commercial Catch (TACC) peaked at 1708 t between 1988–89 and 1994–95, was reduced in 1995–96, and reduced again in 2001–02 until the fishery was effectively closed from 1 October 2007 (with a TACC of 1 t). Since 2015, acoustic surveys have been conducted in Cook Canyon aimed at locating and surveying spawning plumes. In 2015, an orange roughy plume was identified. However, due to its transitory nature, the plume was not acoustically surveyed (Ryan & Tilney 2016). Another acoustic survey was attempted in 2016, and, although a plume was identified, the survey was unsuccessful due to bad weather. In 2017, a successful acoustic survey was conducted on FV *Amaltal Explorer*, when the towed acoustic optical system (AOS) captured three snapshots of a single spawning plume in Cook Canyon, giving an average biomass estimate of 824 t (Ryan & Tilney 2017). However, the timing of the snapshots was late relative to the spawning cycle, because 40–50% of sampled fish had spent gonads (Ryan & Tilney 2017).

The 2019 and 2020 surveys were the fourth and fifth acoustic biomass surveys of orange roughy for Cook Canyon (Ryan & Tilney 2019, 2020). The objectives of the surveys were to: 1) provide acoustic estimates of the abundance of spawning orange roughy at the Cook Canyon main aggregation site (hereafter Cook Canyon Plume); 2) to conduct searches in specified canyon areas, including pinnacles to the north of the main aggregation (hereafter Cook Canyon Pinnacle, 2020 survey only); and 3) to undertake targeted trawls of aggregations to collect otolith samples and biological data for population age structure determination (Ryan & Tilney 2020).

This report presents the results of the ageing analyses and population age structure estimates for use in stock assessments of orange roughy in the region. Age distributions from the 2019 survey in Cook Canyon were reported by Dutilloy et al. (2020). However, due to error in the analyses in that report, the 2019 data are reanalysed here. Accordingly, this report supersedes that of Dutilloy et al. (2020).

2.   METHODS

2.1   Survey design

The 2019 and 2020 Cook Canyon surveys were conducted on the FV *Amaltal Mariner*. The 2019 voyage was conducted from 26 June to 16 July 2019 (Ryan & Tinley 2019) and focused on a single stratum – the main spawning aggregation (Cook Canyon Plume; CCPL) – as identified in the 2015, 2016, and 2017 surveys. The 2020 survey was conducted from 19 June to 7 July 2020. Two strata were surveyed in 2020: CCPL and Cook Canyon Pinnacle (CCPI). A demersal trawl was used to collect samples for catch composition. Otoliths and associated biological data, including length, weight, sex, and gonad stage, were collected from a randomly-selected subsample of orange roughy from each tow.
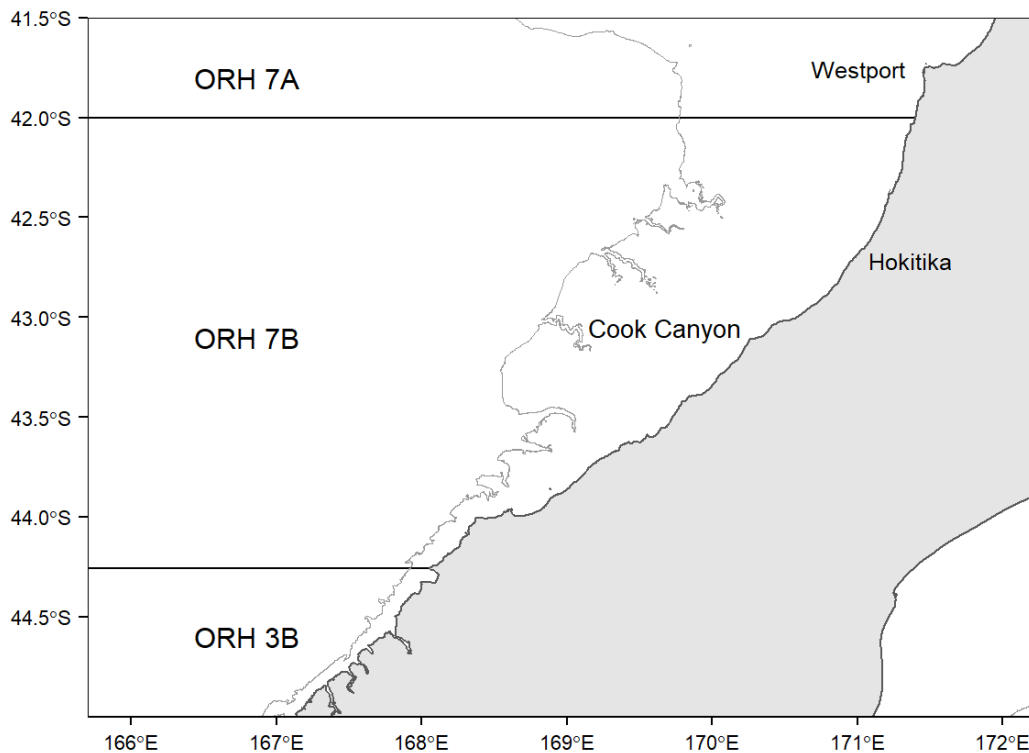
Figure 1:   Location of the Cook Canyon in ORH 7B.

2.2   Otolith selection

Selection of otoliths for ageing followed that of Dutilloy et al. (2019) for ORH 7A orange roughy. For each survey year-stratum combination, otoliths were selected with replacement until a specified total number of unique otoliths (n_{unique}) was reached. The procedure was continued to provide a selection of spare otoliths which were used to replace damaged or lost samples. The spares were used in the order of their selection. The selection probabilities for individual otoliths are proportional to the numbers of fish caught in each tow (or total orange roughy catch from the tow, if mean fish weights are similar across all tows) divided by the number of otoliths in the tow. This selection probability was based on all otoliths that were available and that the otolith sampling was random. If the same otolith was selected more than once, its age was repeated in estimating the mean age and age frequency. Since an age estimate may be used more than once, the number of ages, n_{ages}, is likely to be greater than the number of otoliths prepared, n_{unique}.

In total, 699 otoliths were sampled from the six tows in CCPL in 2019, and 1092 otoliths were sampled in 2020: 580 otoliths sampled from five tows in CCPL, and 512 otoliths sampled from four tows in CCPI

(Tables A1–A3 in Appendix A). A target of 500 unique otoliths were selected for ageing from the CCPL strata in 2019, and 450 unique otoliths were selected from each stratum in 2020. A further 50 otoliths were selected as spares in each instance.

2.3 Ageing of orange roughy

Selected orange roughy otoliths were prepared using the NIWA preparation method described by Horn et al. (2016). One whole otolith from each selected fish was embedded in resin and cured in an oven. A thin section was cut along a line from the primordium (otolith nucleus region) through the most uniform posterior-dorsal axis using a sectioning saw with dual diamond-impregnated wafering blades separated by a 380-μm spacer. The section was mounted on a glass microscope slide under a glass cover slip.

All otoliths were read once by one experienced reader, in accordance with the otolith interpretation and reading protocols described in the ageing methodology document (Horn et al. 2016). Although the ageing protocols suggest that two readers are the ideal, inter-agency calibrations continue at regular intervals between NIWA and FAS scientists to ensure that there are on-going and consistent zone interpretations and no reader drift, so these single reader age readings were therefore considered acceptable (P.L. Horn, NIWA, pers. comm.). The data produced included counts of zones from the primordium to the transition zone (TZ, the zone that marks the onset of orange roughy maturity, Francis & Horn 1997) and from the TZ to the otolith margin, and readability codes for those readings provided on a 5-stage readability scale. Otolith data with a readability code of 5 (i.e., unreadable) for either the pre- or post-TZ readings were excluded from the analyses. The presence of a TZ was identified, ideally by the following three criteria: a clear reduction in zone width, a marked change in the optical density of the otolith from dark to light, and a change in curvature of the posterior arm of the otolith (Horn et al. 2016). TZs were classified using a 4-stage scale, i.e.:

- 0, not yet formed (or observed),
- 1, clear and unambiguous with all three criteria met,
- 2, a gradual transition with at least two criteria met, and
- 3, a gradual transition with none or one of the criteria met.

For TZ classification 3, only a total age was recorded by the reader because the likely location of the TZ was undefined. Although pre- and post-TZ zone counts were recorded in the age determination of most otoliths examined, only the total age estimates were used in the analyses.

2.4 Data analysis

Data analyses followed that of Dutilloy et al. (2019) for orange roughy in ORH 7A. The data consisted of the age estimate from each otolith replicated by any repeat count. The mean age estimate was the sample mean. Standard error was assessed using a bootstrap analysis where tows and ages within each tow were resampled 500 times.

Three age frequency compositions were estimated for each survey year-stratum combination from the aged otoliths, using the process described above:

1. a 'raw' age frequency (i.e., from the bootstrapped repeat counts),
2. sex-specific age frequencies for each stratum, and
3. sex-combined age frequencies (assuming a 1:1 sex ratio).

For the sex-specific analysis, otoliths from each sex were used and the catch rates for each tow were converted into numbers of males and females using the sex ratio and mean weight of each tow (with the latter calculated from the length-weight relationship applied to the length distribution).

Kernel smoothing was used to show the results in the figures. Smoothing used one parameter, width, which was approximately the moving window width over which the average age was calculated. This

procedure used the 'density' function from the R statistical package (R Core Team 2020). Width was set to 10. Data of Dutilloy et al. (2020) were re-processed using the approach described above.

3.   RESULTS

In total, 500 otoliths were prepared and read from the 2019 survey, six of which were excluded because of a readability of 5 (i.e., unreadable). Nine hundred otoliths were prepared and read from the 2020 survey (450 per strata), but 13 otoliths were excluded because of a readability of 5. The station weights (i.e., relative population by station used to randomly sample otoliths) and otolith selection probabilities are listed in Appendix A (Tables A1–A3).

3.1   Cook Canyon Plume (CCPL)

The age distribution of the CCPL aggregation in 2019 was dominated by middle-aged fish with ages ranging mainly from 30 to 65 years and modes centred at 39 and 48 years. However, there was a relatively large number of fish aged over 100 years. The oldest individual was 147 years (Figures 2–4, Appendix B (Table B1–B4)). The mean weighted coefficient of variation (MWCV) across all age classes was 34.8%. Age distributions by sex differed in 2019, with sampled females being on average older than males; very few males over 70 years were observed, and a higher proportion of females aged between 70 and 130 years was evident (Figure 3, Appendix B (Tables B2–B3)).

Estimated age frequencies from the 2020 survey of the CCPL were similar to those from 2019, although greater numbers of old fish were sampled in 2019 (Figures 5–8). In 2020, the age distribution of the CCPL was dominated by younger to middle-aged fish, with ages ranging mainly from 30 to 65 years and a mode centred near 40 years (Figures 5–7). Old fish were rarely observed, with only two individuals with ages greater than 100 years sampled. The MWCV across all age classes was 36.2%. Age distributions differed by sex, with sampled females being on average older than males; very few males over 60 years were observed, and a higher proportion of females aged between 70 and 95 years was evident (Figure 6, Appendix B (Tables B5–B8)).

Figure 2: Estimated raw age frequency distribution (red bars) for CCPL in 2019 with a smoothed density through the age estimates (black line).

Figure 3: Comparisons of the age frequency distributions by sex (females – red; males – black) for CCPL in 2019. The pairwise 95% confidence limits are indicated by the shaded areas.
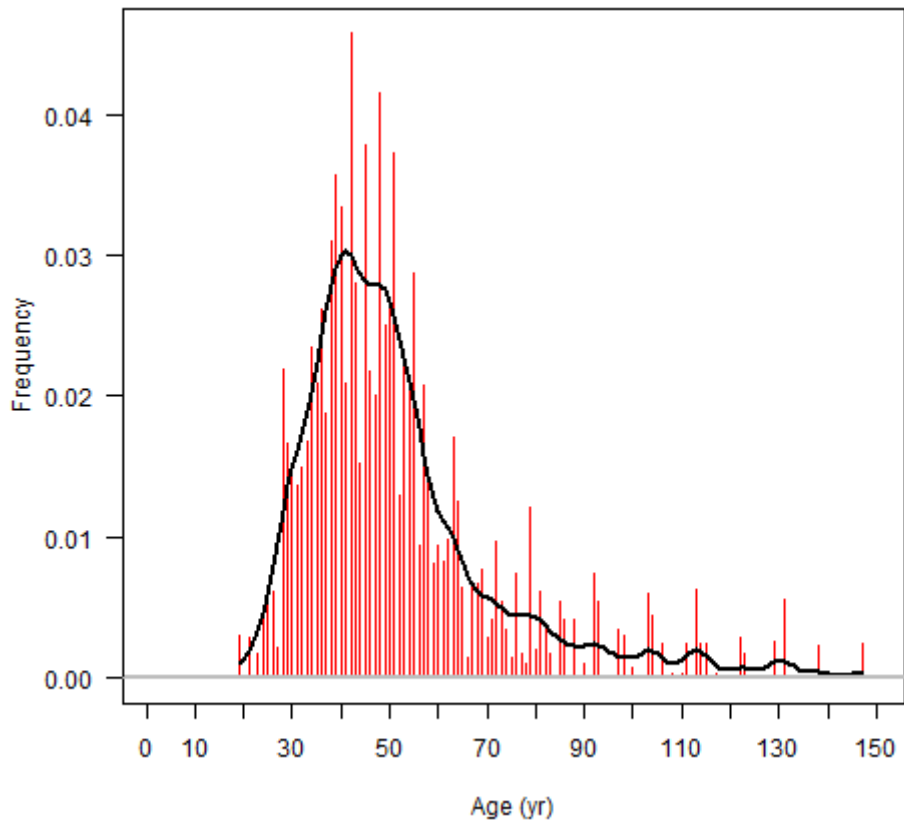
Figure 4: **Estimated sex-combined age frequency distribution (red bars) for CCPL in 2019 with a smoothed density through the age estimates (black line).**

Figure 5: **Estimated raw age frequency (red bars) for CCPL in 2020 with a smoothed density through the age estimates (black line).**
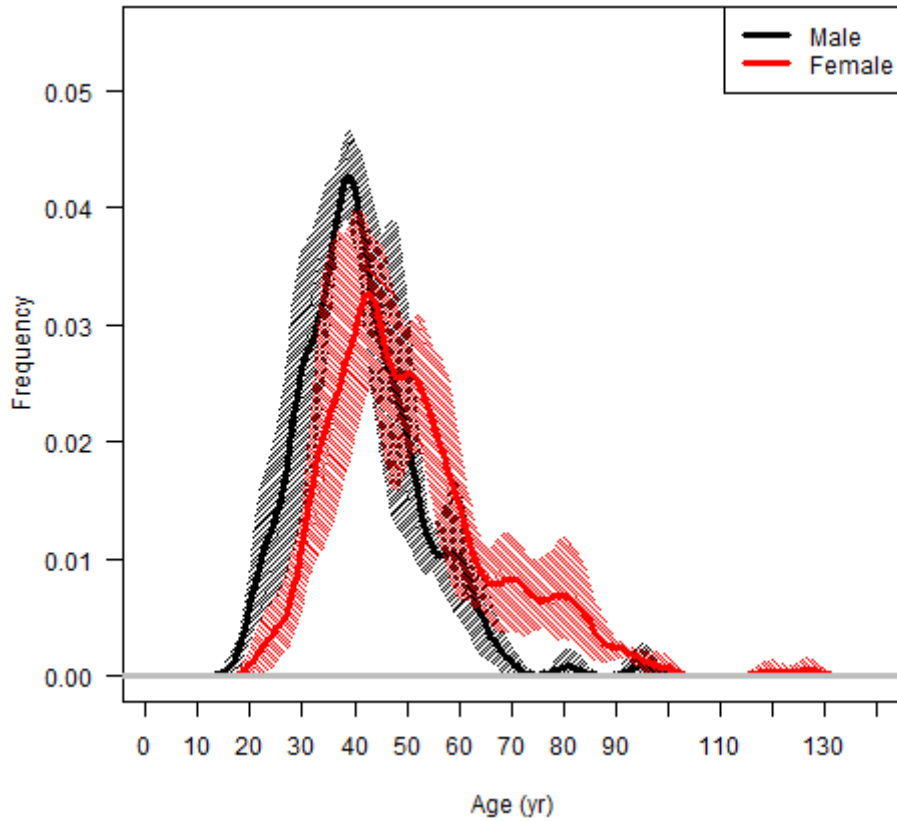
Figure 6: Comparisons of the age frequency distributions by sex (females – red; males – black) for CCPL in 2020. The pairwise 95% confidence limits are indicated by the shaded areas.

Figure 7: Estimated sex-combined age frequency distribution (red bars) for CCPL in 2020 with a smoothed density through the age estimates (black line).

Figure 8: Comparisons of the smoothed raw age frequency distributions of the Cook Canyon main aggregation (Cook Canyon Plume) from 2019 (red line) and 2020 (blue lines) acoustic surveys. The pairwise 95% confidence limits are indicated by the shaded areas.

3.2 Cook Canyon Pinnacle (CCPI)

The raw age frequency distribution for CCPI in 2020 was dominated by younger to middle-aged fish with ages ranging mainly from 25 to 50 years and a mode centred near 35 years (Figure 9–11, Appendix B (Tables B9–B12)). Overall there were few old fish, with only one individual greater than 100 years observed. The MWCV across all age classes was 30.9%. Age distributions differed between sexes, with sampled females being on average older than males, and a higher proportion of females aged between 55 and 95 years (Figure 10).

Compared with the age distribution for CCPL in 2020, the sampled population of CCPI contained slightly younger fish (i.e., the distribution was left-shifted) and a lower proportion of fish greater than 50 years (Figure 12).
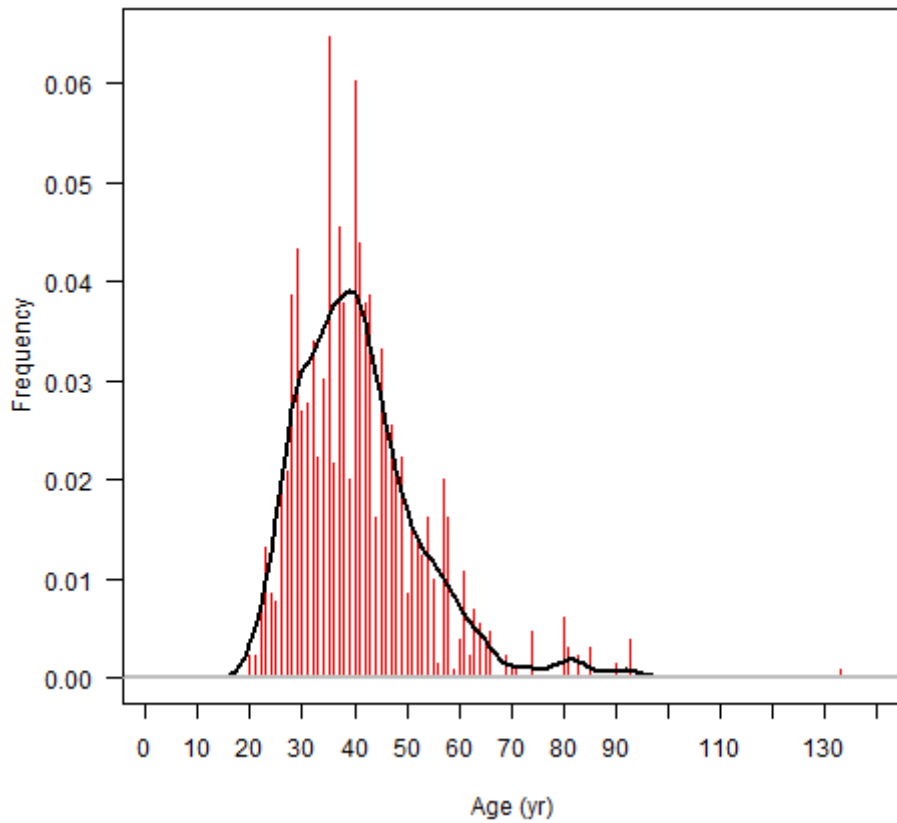
Figure 9: **Estimated raw age frequency distribution (red bars) for CCPI in 2020 with a smoothed density through the age estimates (black line).**
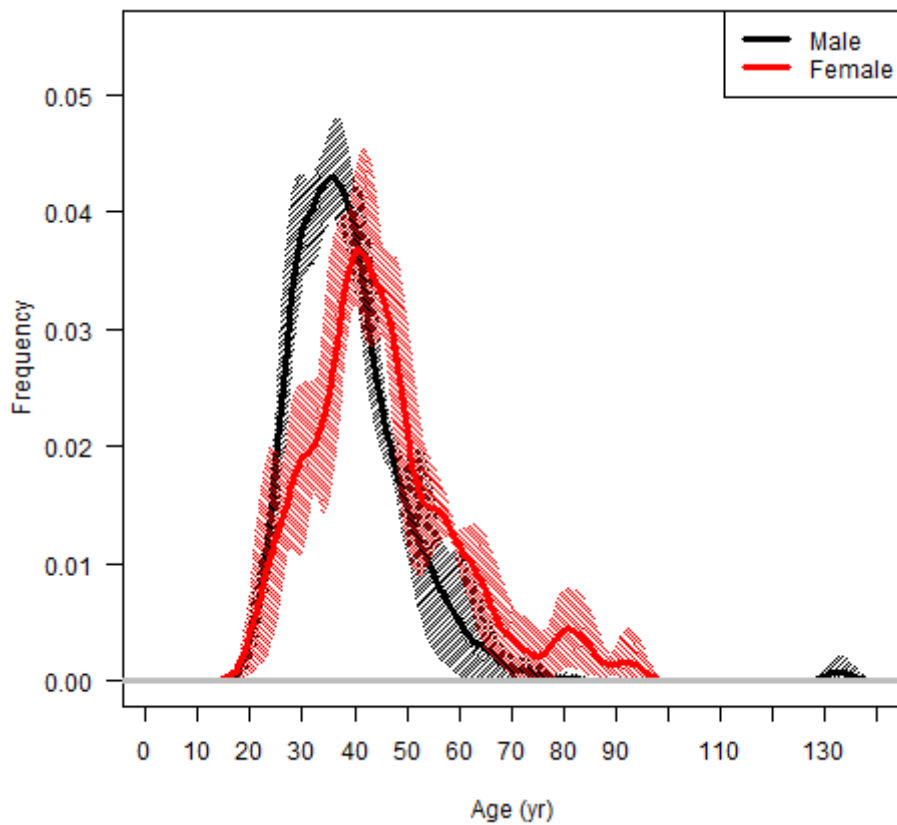
Figure 10: **Comparisons of age frequency distributions by sex (females – red; males – black) for CCPI in 2020. The pairwise 95% confidence limits are indicated by the shaded areas.**
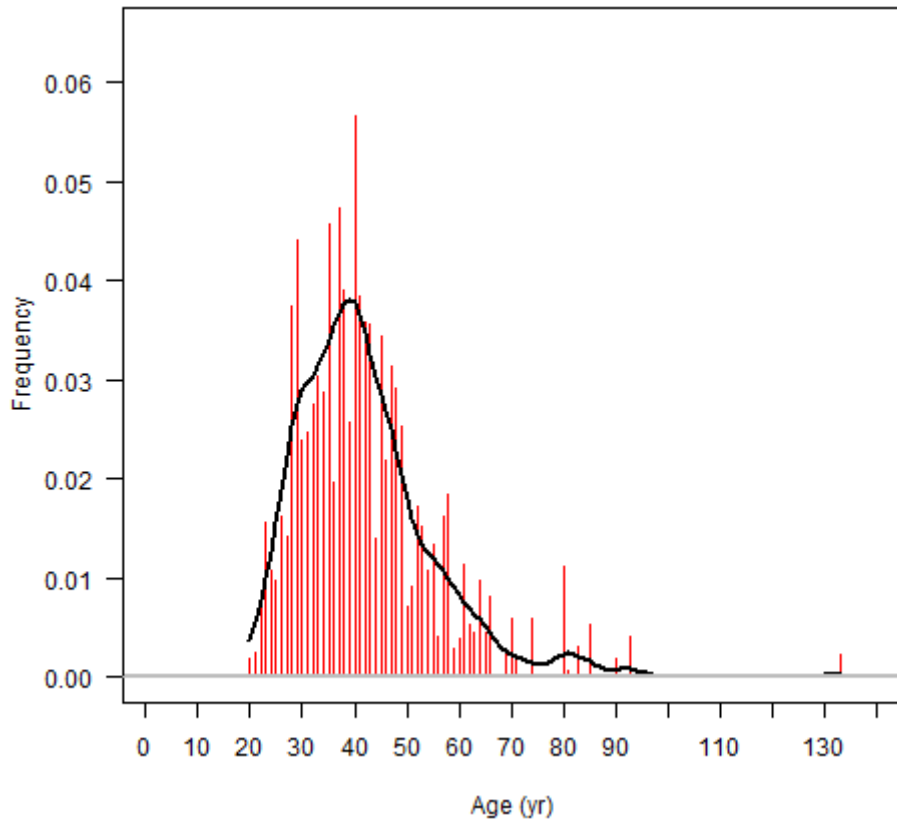
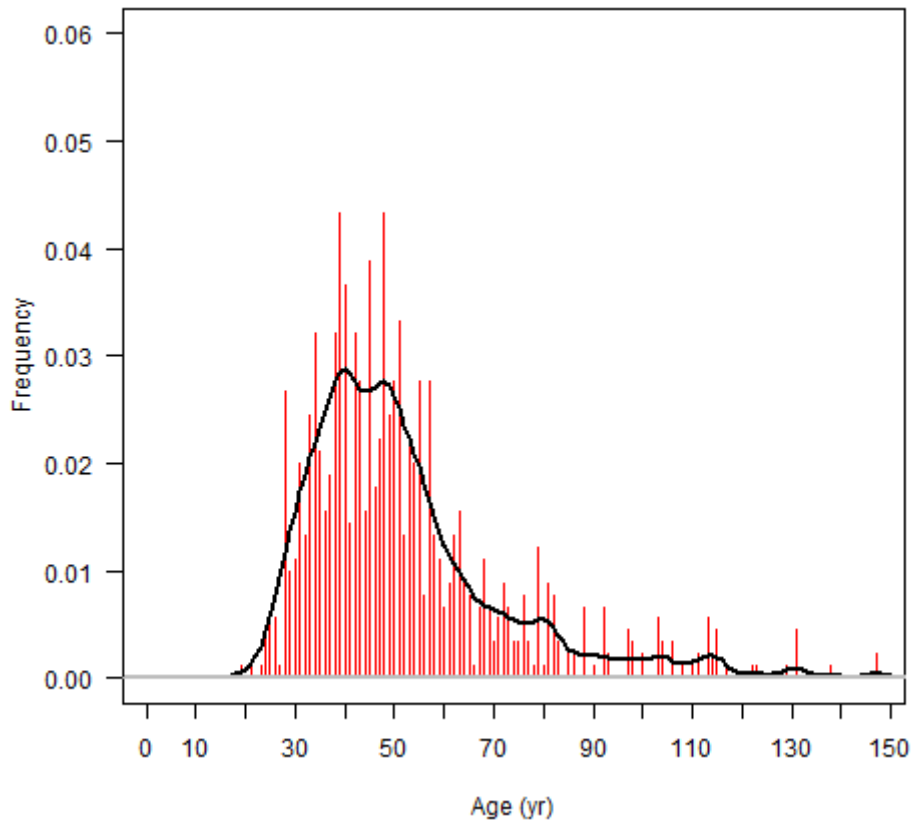**Figure 11:** **Estimated sex-combined age frequency distribution (red bars) for CCPI in 2020 with a smoothed density through the age estimates (black line).**

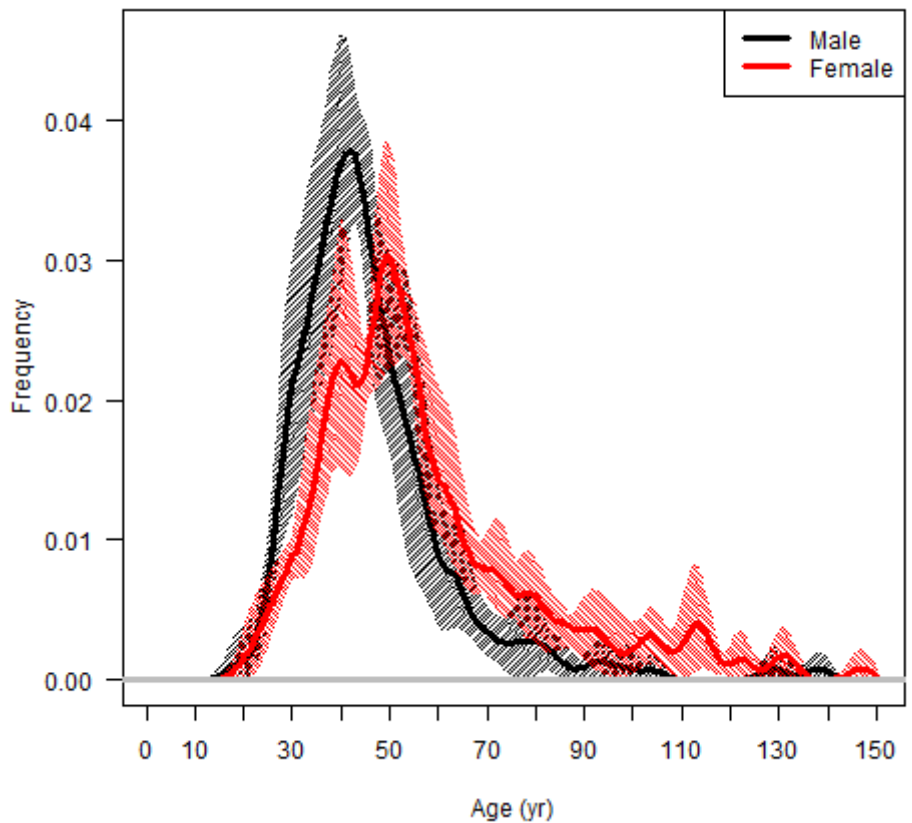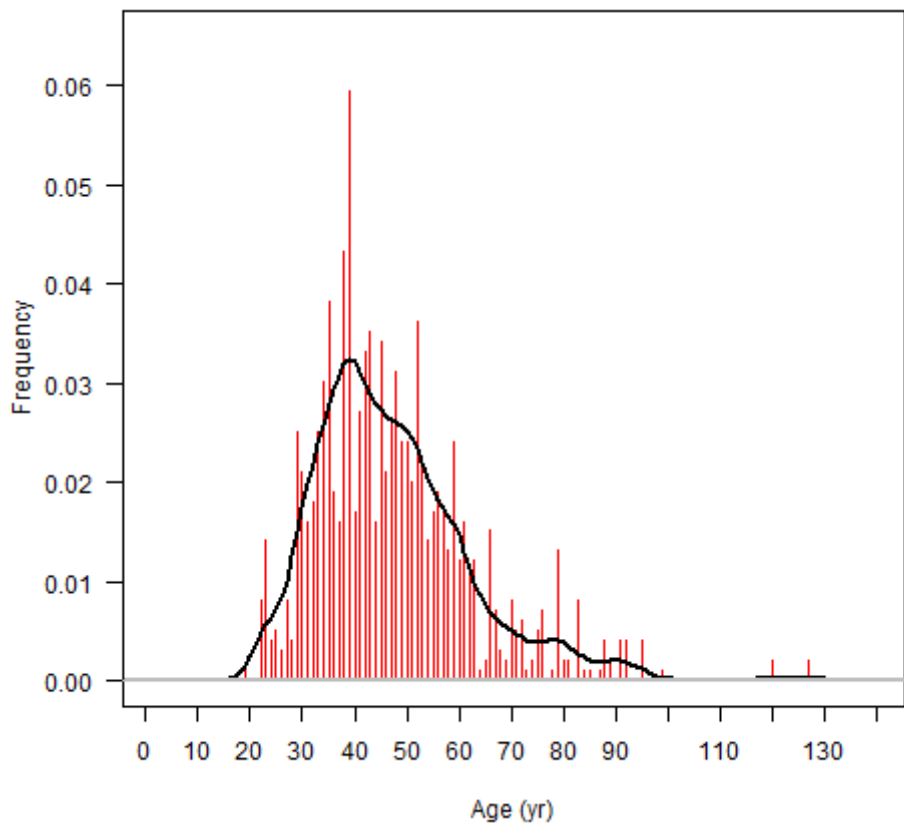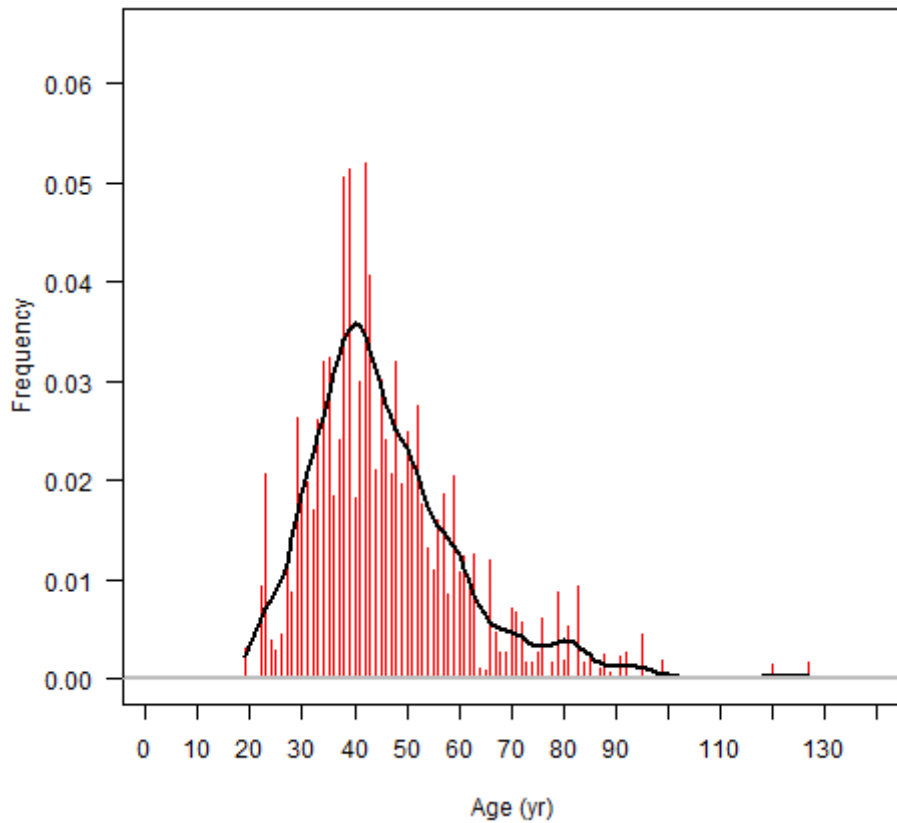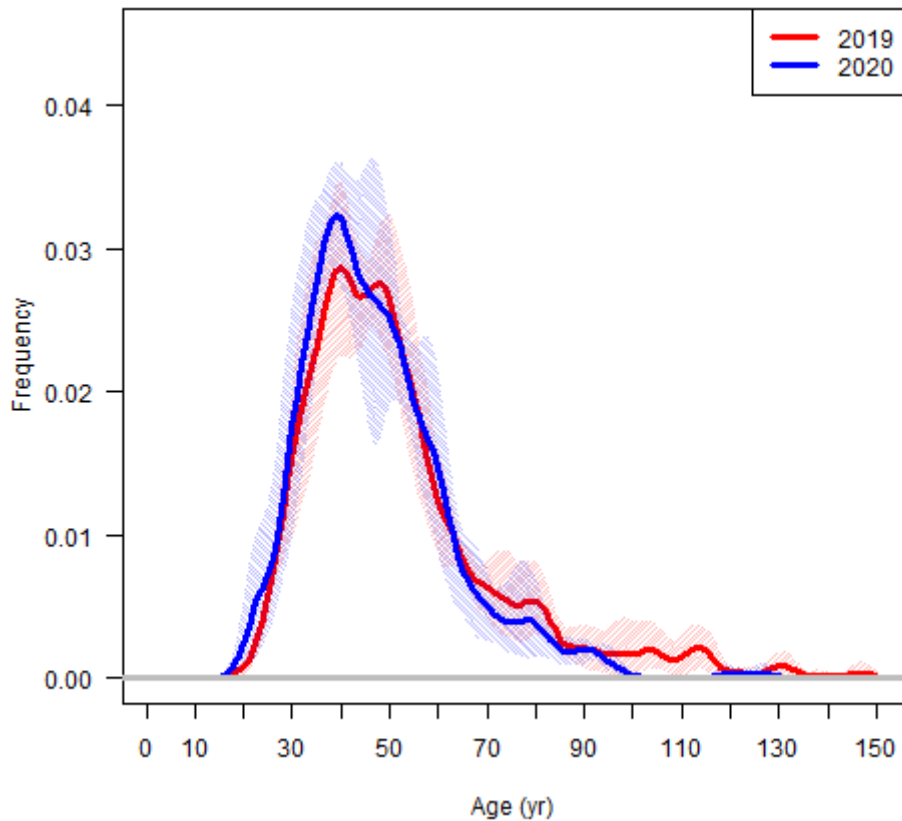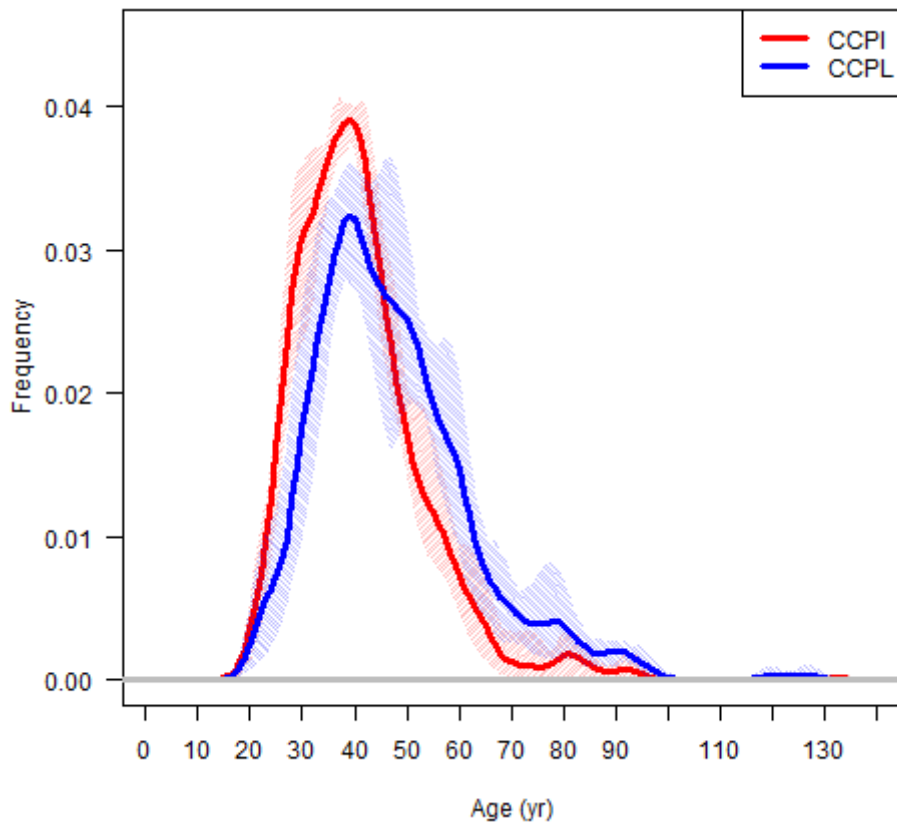**Figure 12:** **Comparisons of age frequency distributions of orange roughy from Cook Canyon Pinnacle (CCPI; red) and Cook Canyon Plume (CCPL; blue) in 2020. The pairwise 95% confidence limits are indicated by the shaded areas.**

4.   DISCUSSION

Although otoliths have been routinely collected during research surveys in Cook Canyon, only those collected as part of the 2019 and 2020 acoustic surveys have been aged. Otoliths collected in previous surveys were considered unrepresentative of the spawning population, either because they were sampled from a single tow in the spawning plume, or because sampling took place late in the spawning season (Dutilloy et al. 2020).

Age distributions by sex differed for both the main (CCPL) aggregation in both 2019 and 2020, and the pinnacles (CCPI) to the north in 2020, with sampled females being on average older than males. The consistency of these results between areas and years suggests such patterns may be a feature, either of orange roughy populations or of the sampling methodology. Differences by sex may result from: 1) different levels of historic exploitation, with males being more heavily exploited; 2) the area being transitory, with older individuals of each sex arriving at slightly different times; or 3) fish predominantly aggregating by sex and size, with the sampling not being representative of the population.

On average, fish sampled from the main Cook Canyon Plume were slightly older than those from the northern pinnacles. Further sampling and ageing of samples from both strata is required to determine whether this pattern is consistent over time.

5.   ACKNOWLEDGMENTS

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APPENDIX A: STATION WEIGHT AND OTOLITH SELECTION PROBABILITIES

Table A1: Cook Canyon Plume (CCPL): 2019 acoustic survey — stratum code and station numbers, catch (kg), relative population by station used to randomly sample otoliths, number of otoliths sampled, and probability to select one otolith.

Stratum	Station	Catch (kg)	Relative station population	Number of otoliths	Probability to select one otolith
CCPL	1	2 080	0.20472	200	0.001024
CCPL	2	1 790	0.17618	99	0.001780
CCPL	8	1 690	0.16634	100	0.001663
CCPL	13	1 240	0.12205	100	0.001220
CCPL	14	1 850	0.18209	100	0.001821
CCPL	19	1 510	0.14862	100	0.001486

Table A2: Cook Canyon Plume (CCPL): 2020 acoustic survey — stratum code and station numbers, catch (kg), relative population by station used to randomly sample otoliths, number of otoliths collected, and probability to select one otolith.

Stratum	Station	Catch (kg)	Relative station population	Number of otoliths	Probability to select one otolith
CCPL	1	1 860	0.21503	156	0.001378
CCPL	3	2 250	0.26012	150	0.001734
CCPL	6	1 750	0.20231	100	0.002023
CCPL	10	1 660	0.19191	74	0.002593
CCPL	14	1 130	0.13064	100	0.001306

Table A3: Cook Canyon Pinnacle (CCPI): 2020 acoustic survey — stratum code and station numbers, catch (kg), relative population by station used to randomly sample otoliths, number of otoliths collected, and probability to select one otolith.

Stratum	Station	Catch (kg)	Relative station population	Number of otoliths	Probability to select one otolith
CCPI	5	900	0.20833	150	0.00139
CCPI	7	1 250	0.28935	72	0.00402
CCPI	11	1 380	0.31944	140	0.00228
CCPI	15	790	0.18287	150	0.00122

APPENDIX B: ESTIMATED AGE FREQUENCIES

Table B1: Cook Canyon Plume (CCPL) — estimated raw age frequencies for orange roughy from the 2019 acoustic survey (AMA1903).

Age	Frequency	CV	Age	Frequency	CV	Age	Frequency	CV
19	0.00111	0.88699	61	0.00887	0.56061	103	0.00554	0.51618
20	0.00000	-	62	0.01330	0.46552	104	0.00333	0.58094
21	0.00111	0.91261	63	0.01552	0.42392	105	0.00000	-
22	0.00000	-	64	0.00887	0.33126	106	0.00333	0.88699
23	0.00111	0.93904	65	0.00776	0.45805	107	0.00000	-
24	0.00443	0.57683	66	0.00111	0.86053	108	0.00111	0.91261
25	0.00554	0.40006	67	0.00665	0.42630	109	0.00000	-
26	0.00554	0.42904	68	0.01109	0.32087	110	0.00111	0.88699
27	0.00111	0.94382	69	0.00665	0.42080	111	0.00222	0.86053
28	0.02661	0.18479	70	0.00333	0.61929	112	0.00000	-
29	0.00998	0.27367	71	0.00554	0.43664	113	0.00554	0.69536
30	0.01109	0.47696	72	0.00887	0.46844	114	0.00222	0.86053
31	0.01996	0.35559	73	0.00665	0.47170	115	0.00443	0.91261
32	0.01330	0.26525	74	0.00333	0.62883	116	0.00000	-
33	0.02439	0.33112	75	0.00333	0.89689	117	0.00111	0.91261
34	0.03215	0.40120	76	0.00776	0.49583	118	0.00000	-
35	0.02106	0.39668	77	0.00333	0.88699	119	0.00000	-
36	0.01552	0.14559	78	0.00111	0.89689	120	0.00000	-
37	0.01885	0.26949	79	0.01220	0.35535	121	0.00000	-
38	0.03215	0.22545	80	0.00111	0.89689	122	0.00111	0.93904
39	0.04324	0.21753	81	0.00887	0.32403	123	0.00111	0.88699
40	0.03659	0.25771	82	0.00776	0.57516	124	0.00000	-
41	0.01441	0.22877	83	0.00333	0.59440	125	0.00000	-
42	0.03215	0.08507	84	0.00000	-	126	0.00000	-
43	0.02772	0.25039	85	0.00222	0.94382	127	0.00000	--
44	0.01552	0.19093	86	0.00222	0.51942	128	0.00000	-
45	0.03880	0.18150	87	0.00000	-	129	0.00111	0.93904
46	0.01774	0.29568	88	0.00665	0.61032	130	0.00000	-
47	0.02217	0.30359	89	0.00000	-	131	0.00443	0.65779
48	0.04324	0.28507	90	0.00111	0.89689	132	0.00000	-
49	0.02439	0.14176	91	0.00000	-	133	0.00000	-
50	0.02772	0.23334	92	0.00665	0.39154	134	0.00000	-
51	0.03326	0.22827	93	0.00222	0.56851	135	0.00000	-
52	0.01330	0.23415	94	0.00000	-	136	0.00000	-
53	0.02217	0.47184	95	0.00000	-	137	0.00000	-
54	0.01996	0.29966	96	0.00000	-	138	0.00111	0.93904
55	0.02772	0.27884	97	0.00443	0.88699	139	0.00000	-
56	0.00776	0.45602	98	0.00333	0.66582	140	0.00000	-
57	0.02772	0.36617	99	0.00000	-	141	0.00000	-
58	0.01330	0.48311	100	0.00222	0.88699	142	0.00000	-
59	0.01109	0.44493	101	0.00000	-	…		
60	0.00665	0.47097	102	0.00000	-	147	0.00222	0.88699

Table B2: Cook Canyon Plume (CCPL) — estimated age frequencies for female orange roughy from the 2019 acoustic and survey (AMA1903).

Age	Frequency	CV	Age	Frequency	CV	Age	Frequency	CV
19	0.00000	-	61	0.01190	0.41188	103	0.01190	0.39327
20	0.00000	-	62	0.01961	0.44788	104	0.00490	0.95195
21	0.00560	0.84606	63	0.01611	0.50617	105	0.00000	-
22	0.00000	-	64	0.01050	0.50473	106	0.00490	0.90643
23	0.00350	0.92711	65	0.00630	0.59465	107	0.00000	-
24	0.00560	0.84606	66	0.00280	0.95195	108	0.00070	0.84606
25	0.00280	0.95195	67	0.01331	0.39716	109	0.00000	-
26	0.00630	0.62498	68	0.01331	0.42338	110	0.00070	0.90643
27	0.00420	0.89113	69	0.00000	-	111	0.00490	0.95195
28	0.01261	0.43208	70	0.00560	0.64398	112	0.00000	-
29	0.00350	0.68623	71	0.00840	0.51290	113	0.01261	0.58998
30	0.01471	0.43101	72	0.01611	0.45943	114	0.00490	0.95195
31	0.00350	0.95195	73	0.00630	0.92711	115	0.00490	0.84606
32	0.01050	0.52483	74	0.00700	0.57263	116	0.00000	-
33	0.00630	0.58606	75	0.00280	0.98287	117	0.00070	0.84606
34	0.02101	0.38178	76	0.00560	0.69401	118	0.00000	-
35	0.01261	0.69353	77	0.00350	0.90643	119	0.00000	-
36	0.01261	0.50045	78	0.00210	0.98287	120	0.00000	-
37	0.02031	0.37093	79	0.01961	0.42322	121	0.00000	-
38	0.01611	0.60463	80	0.00000	-	122	0.00560	0.92711
39	0.03501	0.26258	81	0.00840	0.47083	123	0.00350	0.90643
40	0.03571	0.30616	82	0.00490	0.90643	124	0.00000	-
41	0.01050	0.57569	83	0.00210	0.95195	125	0.00000	-
42	0.02241	0.43485	84	0.00000	-	126	0.00000	-
43	0.03151	0.22742	85	0.00630	0.89113	127	0.00000	-
44	0.00910	0.49244	86	0.00840	0.57016	128	0.00000	-
45	0.01471	0.40373	87	0.00000	-	129	0.00000	-
46	0.00910	0.56843	88	0.00840	0.56106	130	0.00000	-
47	0.02871	0.32098	89	0.00000	-	131	0.01120	0.60404
48	0.05322	0.35526	90	0.00000	-	132	0.00000	-
49	0.03221	0.30261	91	0.00000	-	133	0.00000	-
50	0.02661	0.27070	92	0.01471	0.38663	134	0.00000	-
51	0.04272	0.26296	93	0.00420	0.90643	135	0.00000	-
52	0.01331	0.60366	94	0.00000	-	136	0.00000	-
53	0.02311	0.25753	95	0.00000	-	137	0.00000	-
54	0.03081	0.41244	96	0.00000	-	138	0.00000	-
55	0.03431	0.33439	97	0.00700	0.90643	139	0.00000	-
56	0.01891	0.37156	98	0.00140	0.90643	140	0.00000	-
57	0.00770	0.70270	99	0.00000	-	141	0.00000	-
58	0.02171	0.31869	100	0.00140	0.90643	142	0.00000	-
59	0.00770	0.92711	101	0.00000	-	…		
60	0.01471	0.47334	102	0.00000	-	147	0.00490	0.90643

Table B3: Cook Canyon Plume (CCPL) — estimated age frequencies for male orange roughy from the 2019 acoustic survey (AMA1903).

Age	Frequency	CV	Age	Frequency	CV	Age	Frequency	CV
19	0.00598	0.94702	61	0.00465	0.87996	103	0.00000	-
20	0.00000	-	62	0.00000	-	104	0.00398	0.83390
21	0.00000	-	63	0.01793	0.40304	105	0.00000	-
22	0.00000	-	64	0.01461	0.94702	106	0.00000	-
23	0.00000	-	65	0.00664	0.91105	107	0.00000	-
24	0.00398	0.94702	66	0.00000	-	108	0.00000	-
25	0.00797	0.53010	67	0.00000	-	109	0.00000	-
26	0.00598	0.94702	68	0.00000	-	110	0.00000	-
27	0.00000	-	69	0.01527	0.32622	111	0.00000	-
28	0.03121	0.38879	70	0.00000	-	112	0.00000	-
29	0.02988	0.33112	71	0.00000	-	113	0.00000	-
30	0.01394	0.60923	72	0.00332	0.93010	114	0.00000	-
31	0.02390	0.18250	73	0.00465	0.55295	115	0.00000	-
32	0.01926	0.67283	74	0.00000	-	116	0.00000	-
33	0.02722	0.36663	75	0.00000	-	117	0.00000	-
34	0.02590	0.34502	76	0.00930	0.55811	118	0.00000	-
35	0.02922	0.37497	77	0.00000	-	119	0.00000	-
36	0.03984	0.26042	78	0.00000	-	120	0.00000	-
37	0.01726	0.58403	79	0.00465	0.83390	121	0.00000	-
38	0.04582	0.36820	80	0.00398	0.83390	122	0.00000	-
39	0.03652	0.35614	81	0.00398	0.93010	123	0.00000	-
40	0.03121	0.54568	82	0.00199	0.87996	124	0.00000	-
41	0.03121	0.66557	83	0.00133	0.83390	125	0.00000	-
42	0.06906	0.24299	84	0.00000	-	126	0.00000	-
43	0.02457	0.40903	85	0.00465	1.00220	127	0.00000	-
44	0.02125	0.35006	86	0.00000	-	128	0.00000	-
45	0.06109	0.24458	87	0.00000	-	129	0.00531	0.87996
46	0.03453	0.39402	88	0.00000	-	130	0.00000	-
47	0.01129	0.49046	89	0.00000	-	131	0.00000	-
48	0.02988	0.44475	90	0.00199	0.83390	132	0.00000	-
49	0.01793	0.35970	91	0.00000	-	133	0.00000	-
50	0.02590	0.23848	92	0.00000	-	134	0.00000	-
51	0.03187	0.19085	93	0.00664	0.87996	135	0.00000	-
52	0.01262	0.39223	94	0.00000	-	136	0.00000	-
53	0.02125	0.64327	95	0.00000	-	137	0.00000	-
54	0.01129	0.42244	96	0.00000	-	138	0.00465	0.87996
55	0.02324	0.45084	97	0.00000	-	139	0.00000	-
56	0.00000	-	98	0.00465	1.00220	140	0.00000	-
57	0.03386	0.29345	99	0.00000	-	141	0.00000	-
58	0.00730	0.87996	100	0.00000	-	142	0.00000	-
59	0.00863	0.55652	101	0.00000	-	…	-	-
60	0.00398	0.83390	102	0.00000	-	147	0.00000	-

Table B4: Cook Canyon Plume (CCPL) — estimated age frequencies for orange roughy (sexes combined) from the 2019 acoustic survey (AMA1903).

Age	Frequency	CV	Age	Frequency	CV	Age	Frequency	CV
19	0.00299	0.94702	61	0.00828	0.38575	103	0.00595	0.39327
20	0.00000	-	62	0.00980	0.44788	104	0.00444	0.64464
21	0.00280	0.84606	63	0.01702	0.32008	105	0.00000	-
22	0.00000	-	64	0.01256	0.58996	106	0.00245	0.90643
23	0.00175	0.92711	65	0.00647	0.54983	107	0.00000	-
24	0.00479	0.63196	66	0.00140	0.95195	108	0.00035	0.84606
25	0.00538	0.46383	67	0.00665	0.39716	109	0.00000	-
26	0.00614	0.56157	68	0.00665	0.42338	110	0.00035	0.90643
27	0.00210	0.89113	69	0.00764	0.32622	111	0.00245	0.95195
28	0.02191	0.30355	70	0.00280	0.64398	112	0.00000	-
29	0.01669	0.30500	71	0.00420	0.51290	113	0.00630	0.58998
30	0.01433	0.36996	72	0.00971	0.41275	114	0.00245	0.95195
31	0.01370	0.20033	73	0.00548	0.58293	115	0.00245	0.84606
32	0.01488	0.47312	74	0.00350	0.57263	116	0.00000	-
33	0.01676	0.31744	75	0.00140	0.98287	117	0.00035	0.84606
34	0.02345	0.25598	76	0.00745	0.43517	118	0.00000	-
35	0.02091	0.33513	77	0.00175	0.90643	119	0.00000	-
36	0.02622	0.23153	78	0.00105	0.98287	120	0.00000	-
37	0.01879	0.33498	79	0.01213	0.37760	121	0.00000	-
38	0.03096	0.31456	80	0.00199	0.83390	122	0.00280	0.92711
39	0.03577	0.22266	81	0.00619	0.43761	123	0.00175	0.90643
40	0.03346	0.30241	82	0.00345	0.69286	124	0.00000	-
41	0.02086	0.51864	83	0.00171	0.66670	125	0.00000	-
42	0.04573	0.21215	84	0.00000	-	126	0.00000	-
43	0.02804	0.22009	85	0.00548	0.66634	127	0.00000	-
44	0.01518	0.28613	86	0.00420	0.57016	128	0.00000	-
45	0.03790	0.21212	87	0.00000	-	129	0.00266	0.87996
46	0.02182	0.33360	88	0.00420	0.56106	130	0.00000	-
47	0.02000	0.26878	89	0.00000	-	131	0.00560	0.60404
48	0.04155	0.27810	90	0.00100	0.83390	132	0.00000	-
49	0.02507	0.23310	91	0.00000	-	133	0.00000	-
50	0.02625	0.18071	92	0.00735	0.38663	134	0.00000	-
51	0.03729	0.17126	93	0.00542	0.64331	135	0.00000	-
52	0.01296	0.36394	94	0.00000	-	136	0.00000	-
53	0.02218	0.33608	95	0.00000	-	137	0.00000	-
54	0.02105	0.32241	96	0.00000	-	138	0.00232	0.87996
55	0.02878	0.26998	97	0.00350	0.90643	139	0.00000	-
56	0.00945	0.37156	98	0.00302	0.79823	140	0.00000	-
57	0.02078	0.27224	99	0.00000	-	141	0.00000	-
58	0.01451	0.32548	100	0.00070	0.90643	142	0.00000	-
59	0.00817	0.52690	101	0.00000	-	…		
60	0.00934	0.41269	102	0.00000	-	147	0.00245	0.90643

Table B5: Cook Canyon Plume (CCPL) — estimated raw age frequencies for orange roughy from the 2020 acoustic survey (AMA2001).

Age	Frequency	CV	Age	Frequency	CV	Age	Frequency	CV
19	0.00101	0.87694	61	0.01610	0.31567	103	0.00000	-
20	0.00000	-	62	0.01107	0.43696	104	0.00000	-
21	0.00000	-	63	0.01207	0.26879	105	0.00000	-
22	0.00805	0.68778	64	0.00101	0.88503	106	0.00000	-
23	0.01408	0.60573	65	0.00201	0.88503	107	0.00000	-
24	0.00402	0.61629	66	0.01509	0.23536	108	0.00000	-
25	0.00503	0.52650	67	0.00704	0.87694	109	0.00000	-
26	0.00302	0.60288	68	0.00302	0.87977	110	0.00000	-
27	0.00805	0.53750	69	0.00201	0.92118	111	0.00000	-
28	0.00402	0.38629	70	0.00805	0.39426	112	0.00000	-
29	0.02515	0.47234	71	0.00503	0.50731	113	0.00000	-
30	0.02113	0.29586	72	0.00604	0.38751	114	0.00000	-
31	0.01610	0.52579	73	0.00101	0.87694	115	0.00000	-
32	0.01811	0.30358	74	0.00201	0.87977	116	0.00000	-
33	0.02515	0.42816	75	0.00503	0.53706	117	0.00000	-
34	0.03018	0.31710	76	0.00704	0.62259	118	0.00000	-
35	0.03823	0.28638	77	0.00000	-	119	0.00000	-
36	0.01911	0.14303	78	0.00101	0.88503	120	0.00201	0.87977
37	0.01610	0.59855	79	0.01308	0.68035	121	0.00000	-
38	0.04326	0.15226	80	0.00201	0.88503	122	0.00000	-
39	0.05936	0.12401	81	0.00201	0.87977	123	0.00000	-
40	0.01710	0.40081	82	0.00000	-	124	0.00000	-
41	0.02716	0.14692	83	0.00805	0.44057	125	0.00000	-
42	0.03320	0.25503	84	0.00101	0.87977	126	0.00000	-
43	0.03521	0.31029	85	0.00101	0.87977	127	0.00201	0.87694
44	0.01610	0.59579	86	0.00000	-			
45	0.03421	0.32866	87	0.00101	0.87977			
46	0.02113	0.23790	88	0.00402	0.92118			
47	0.02616	0.33219	89	0.00201	0.88503			
48	0.03119	0.30003	90	0.00000	-			
49	0.02414	0.42819	91	0.00402	0.57725			
50	0.02414	0.12718	92	0.00402	0.51050			
51	0.02012	0.42449	93	0.00000	-			
52	0.03622	0.32828	94	0.00000	-			
53	0.02213	0.25717	95	0.00402	0.87694			
54	0.01408	0.48277	96	0.00000	-			
55	0.01710	0.34530	97	0.00000	-			
56	0.01911	0.29874	98	0.00000	-			
57	0.01710	0.44074	99	0.00101	0.87977			
58	0.01308	0.32103	100	0.00000	-			
59	0.02414	0.39159	101	0.00000	-			
60	0.01207	0.45664	102	0.00000	-			

Table B6: Cook Canyon Plume (CCPL) — estimated age frequencies for female orange roughy from the 2020 acoustic survey (AMA2001).

Age	Frequency	CV	Age	Frequency	CV	Age	Frequency	CV
19	0.00000	-	61	0.01266	0.41808	103	0.00000	-
20	0.00000	-	62	0.01486	0.38396	104	0.00000	-
21	0.00000	-	63	0.01321	0.50938	105	0.00000	-
22	0.00000	-	64	0.00220	0.90877	106	0.00000	-
23	0.00771	0.95214	65	0.00165	0.90877	107	0.00000	-
24	0.00550	0.90877	66	0.01431	0.33689	108	0.00000	-
25	0.00330	0.90877	67	0.00936	0.86512	109	0.00000	-
26	0.00000	-	68	0.00550	0.85828	110	0.00000	-
27	0.00275	0.92688	69	0.00000	-	111	0.00000	-
28	0.00771	0.54834	70	0.01431	0.41308	112	0.00000	-
29	0.00936	0.58356	71	0.01321	0.61668	113	0.00000	-
30	0.00881	0.60897	72	0.01156	0.38634	114	0.00000	-
31	0.00330	0.85828	73	0.00330	0.86512	115	0.00000	-
32	0.02146	0.41942	74	0.00330	0.85828	116	0.00000	-
33	0.02697	0.51664	75	0.00550	0.57437	117	0.00000	-
34	0.02752	0.51250	76	0.01211	0.61691	118	0.00000	-
35	0.02477	0.80993	77	0.00000	-	119	0.00000	-
36	0.01156	0.67182	78	0.00330	0.90877	120	0.00275	0.85828
37	0.01486	0.60765	79	0.01761	0.67589	121	0.00000	-
38	0.04458	0.31613	80	0.00385	0.90877	122	0.00000	-
39	0.02752	0.28371	81	0.00550	0.85828	123	0.00000	-
40	0.01486	0.70088	82	0.00000	-	124	0.00000	-
41	0.02642	0.46485	83	0.01871	0.47995	125	0.00000	-
42	0.04953	0.38584	84	0.00330	0.85828	126	0.00000	-
43	0.04183	0.39075	85	0.00440	0.85828	127	0.00330	0.86512
44	0.03632	0.60035	86	0.00000	-			
45	0.03192	0.20273	87	0.00220	0.85828			
46	0.01761	0.49534	88	0.00495	0.95214			
47	0.01376	0.33183	89	0.00110	0.90877			
48	0.03853	0.25324	90	0.00000	-			
49	0.01156	0.45337	91	0.00440	0.58714			
50	0.03192	0.32190	92	0.00550	0.52265			
51	0.02477	0.44047	93	0.00000	-			
52	0.04018	0.28118	94	0.00000	-			
53	0.02256	0.32099	95	0.00385	0.86512			
54	0.01816	0.52465	96	0.00000	-			
55	0.01596	0.41149	97	0.00000	-			
56	0.02367	0.26779	98	0.00000	-			
57	0.02256	0.49548	99	0.00385	0.85828			
58	0.01321	0.39057	100	0.00000	-			
59	0.02532	0.29516	101	0.00000	-			
60	0.00605	0.40909	102	0.00000	-			

Table B7: Cook Canyon Plume (CCPL) — estimated age frequencies for male orange roughy from the 2020 acoustic survey (AMA2001).

Age	Frequency	CV	Age	Frequency	CV	Age	Frequency	CV
19	0.00595	0.91257	61	0.01190	0.52251	103	-	-
20	0.00000	-	62	0.00372	0.88805	104	-	-
21	0.00000	-	63	0.01190	0.84827	105	-	-
22	0.01859	0.55774	64	0.00000	-	106	-	-
23	0.03346	0.38794	65	0.00000	-	107	-	-
24	0.00223	0.88805	66	0.00967	0.91257	108	-	-
25	0.00223	0.83424	67	0.00000	-	109	-	-
26	0.00892	0.50706	68	0.00000	-	110	-	-
27	0.02082	0.38048	69	0.00520	0.83424	111	-	-
28	0.00967	0.88805	70	0.00000	-	112	-	-
29	0.04312	0.54031	71	0.00000	-	113	-	-
30	0.02974	0.39497	72	0.00000	-	114	-	-
31	0.03643	0.47495	73	0.00000	-	115	-	-
32	0.01264	0.55218	74	0.00000	-	116	-	-
33	0.02528	0.41606	75	0.00000	-	117	-	-
34	0.03643	0.42605	76	0.00000	-	118	-	-
35	0.04015	0.32658	77	0.00000	-	119	-	-
36	0.02528	0.19692	78	0.00000	-	120	-	-
37	0.03346	0.30013	79	0.00000	-	121	-	-
38	0.05651	0.13884	80	0.00000	-	122	-	-
39	0.07509	0.18634	81	0.00520	0.88805	123	-	-
40	0.02156	0.32657	82	-	-	124	-	-
41	0.03346	0.30979	83	-	-	125	-	-
42	0.05428	0.28258	84	-	-	126	-	-
43	0.03941	0.37577	85	-	-	127	-	-
44	0.00595	0.83424	86	-	-			
45	0.02825	0.53796	87	-	-			
46	0.03048	0.20805	88	-	-			
47	0.02751	0.41544	89	-	-			
48	0.02528	0.84827	90	-	-			
49	0.02751	0.62170	91	-	-			
50	0.01784	0.40137	92	-	-			
51	0.02007	0.42704	93	-	-			
52	0.01487	0.83424	94	-	-			
53	0.01264	0.47043	95	0.00520	0.91257			
54	0.00818	0.61810	96	-	-			
55	0.00595	0.83424	97	-	-			
56	0.00818	0.55119	98	-	-			
57	0.01487	0.88805	99	-	-			
58	0.00372	0.83424	100	-	-			
59	0.01561	0.84924	101	-	-			
60	0.01561	0.91257	102	-	-			

Table B8: Cook Canyon Plume (CCPL) — estimated age frequencies for orange roughy (sexes combined) from the 2020 acoustic survey (AMA2001).

Age	Frequency	CV	Age	Frequency	CV	Age	Frequency	CV
19	0.00297	0.91257	61	0.01228	0.33247	103	0.00000	-
20	0.00000	-	62	0.00929	0.35484	104	0.00000	-
21	0.00000	-	63	0.01255	0.48311	105	0.00000	-
22	0.00929	0.55774	64	0.00110	0.90877	106	0.00000	-
23	0.02058	0.36221	65	0.00083	0.90877	107	0.00000	-
24	0.00387	0.69555	66	0.01199	0.41927	108	0.00000	-
25	0.00277	0.63821	67	0.00468	0.86512	109	0.00000	-
26	0.00446	0.50706	68	0.00275	0.85828	110	0.00000	-
27	0.01178	0.35305	69	0.00260	0.83424	111	0.00000	-
28	0.00869	0.55075	70	0.00715	0.41308	112	0.00000	-
29	0.02624	0.45601	71	0.00660	0.61668	113	0.00000	-
30	0.01927	0.33499	72	0.00578	0.38634	114	0.00000	-
31	0.01987	0.44128	73	0.00165	0.86512	115	0.00000	-
32	0.01705	0.33401	74	0.00165	0.85828	116	0.00000	-
33	0.02612	0.33412	75	0.00275	0.57437	117	0.00000	-
34	0.03197	0.32794	76	0.00605	0.61691	118	0.00000	-
35	0.03246	0.36916	77	0.00000	-	119	0.00000	-
36	0.01842	0.25039	78	0.00165	0.90877	120	0.00138	0.85828
37	0.02416	0.27949	79	0.00881	0.67589	121	0.00000	
38	0.05054	0.15956	80	0.00193	0.90877	122	0.00000	
39	0.05131	0.15616	81	0.00535	0.61716	123	0.00000	
40	0.01821	0.34518	82	0.00000	-	124	0.00000	
41	0.02994	0.26839	83	0.00936	0.47995	125	0.00000	
42	0.05190	0.23606	84	0.00165	0.85828	126	0.00000	
43	0.04062	0.27149	85	0.00220	0.85828	127	0.00165	0.86512
44	0.02114	0.52906	86	0.00000	-			
45	0.03009	0.27453	87	0.00110	0.85828			
46	0.02405	0.22425	88	0.00248	0.95214			
47	0.02063	0.29821	89	0.00055	0.90877			
48	0.03190	0.36923	90	0.00000	-			
49	0.01953	0.45786	91	0.00220	0.58714			
50	0.02488	0.25169	92	0.00275	0.52265			
51	0.02242	0.30941	93	0.00000	-			
52	0.02752	0.30480	94	0.00000	-			
53	0.01760	0.26619	95	0.00453	0.64063			
54	0.01317	0.40951	96	0.00000	-			
55	0.01095	0.37572	97	0.00000	-			
56	0.01592	0.24423	98	0.00000	-			
57	0.01872	0.46221	99	0.00193	0.85828			
58	0.00846	0.35562	100	0.00000	-			
59	0.02046	0.37186	101	0.00000	-			
60	0.01083	0.66746	102	0.00000	-			

Table B9: Cook Canyon Pinnacle (CCPI) — estimated raw age frequencies for orange roughy from the 2020 acoustic survey (AMA2001).

Age	Frequency	CV	Age	Frequency	CV	Age	Frequency	CV
19	0.00000	-	61	0.01079	0.44864	103	0.00000	-
20	0.00231	0.82946	62	0.00231	0.82946	104	0.00000	-
21	0.00231	0.82946	63	0.00694	0.93936	105	0.00000	-
22	0.00771	0.78266	64	0.00540	0.46632	106	0.00000	-
23	0.01311	0.46825	65	0.00386	0.60164	107	0.00000	-
24	0.00848	0.69738	66	0.00463	0.41948	108	0.00000	-
25	0.00771	0.26946	67	0.00000	-	109	0.00000	-
26	0.01928	0.52689	68	0.00000	-	110	0.00000	-
27	0.02082	0.31453	69	0.00231	0.99059	111	0.00000	-
28	0.03855	0.31060	70	0.00154	0.55862	112	0.00000	-
29	0.04318	0.16038	71	0.00077	0.93936	113	0.00000	-
30	0.02699	0.39106	72	0.00000	-	114	0.00000	-
31	0.02776	0.12011	73	0.00000	-	115	0.00000	-
32	0.03392	0.38081	74	0.00463	0.99059	116	0.00000	-
33	0.02236	0.30032	75	0.00000	-	117	0.00000	-
34	0.03007	0.04384	76	0.00000	-	118	0.00000	-
35	0.06476	0.26326	77	0.00000	-	119	0.00000	-
36	0.02159	0.20858	78	0.00000	-	120	0.00000	-
37	0.04549	0.18924	79	0.00000	-	121	0.00000	-
38	0.03778	0.27598	80	0.00617	0.66872	122	0.00000	-
39	0.02005	0.35679	81	0.00308	0.93936	123	0.00000	-
40	0.06014	0.23919	82	0.00000	-	124	0.00000	-
41	0.04395	0.22746	83	0.00231	0.93936	125	0.00000	-
42	0.03778	0.37216	84	0.00000	-	126	0.00000	-
43	0.03855	0.19340	85	0.00308	0.78266	127	0.00000	-
44	0.01619	0.28894	86	0.00000	-	128	0.00000	-
45	0.03315	0.08120	87	0.00000	-	129	0.00000	-
46	0.02467	0.03556	88	0.00000	-	130	0.00000	-
47	0.02544	0.31793	89	0.00000	-	131	0.00000	-
48	0.02082	0.37141	90	0.00154	0.99059	132	0.00000	-
49	0.02236	0.36135	91	0.00000	-	133	0.00077	0.78266
50	0.00848	0.54692	92	0.00000	-			
51	0.01542	0.41097	93	0.00386	0.93936			
52	0.01388	0.17378	94	0.00000	-			
53	0.01234	0.45028	95	0.00000	-			
54	0.01619	0.30061	96	0.00000	-			
55	0.01002	0.43021	97	0.00000	-			
56	0.00154	0.59990	98	0.00000	-			
57	0.02005	0.25881	99	0.00000	-			
58	0.01619	0.28996	100	0.00000	-			
59	0.00077	0.93936	101	0.00000	-			
60	0.00386	0.71670	102	0.00000	-			

Table B10: Cook Canyon Pinnacle (CCPI) — estimated age frequencies for female orange roughy from the 2020 acoustic survey (AMA2001).

Age	Frequency	CV	Age	Frequency	CV	Age	Frequency	CV
19	0.00000	-	61	0.01791	0.49554	103	0.00000	-
20	0.00358	0.90030	62	0.01074	0.90030	104	0.00000	-
21	0.00000	-	63	0.00627	0.91885	105	0.00000	-
22	0.00806	0.83295	64	0.01522	0.59492	106	0.00000	-
23	0.01880	0.50456	65	0.00806	0.85646	107	0.00000	-
24	0.01074	0.83295	66	0.00806	0.85646	108	0.00000	-
25	0.01164	0.83295	67	0.00000	-	109	0.00000	-
26	0.00716	0.91885	68	0.00000	-	110	0.00000	-
27	0.00716	0.83295	69	0.00448	0.85646	111	0.00000	-
28	0.02596	0.70452	70	0.01164	0.47412	112	0.00000	-
29	0.02775	0.59375	71	0.00000	-	113	0.00000	-
30	0.01701	0.67937	72	0.00000	-	114	0.00000	-
31	0.02059	0.55076	73	0.00000	-	115	0.00000	-
32	0.01343	0.53909	74	0.00895	0.85646	116	0.00000	-
33	0.01970	0.58931	75	0.00000	-	117	0.00000	-
34	0.01791	0.72396	76	0.00000	-	118	0.00000	-
35	0.03133	0.80135	77	0.00000	-	119	0.00000	-
36	0.00895	0.85646	78	0.00000	-	120	0.00000	-
37	0.04118	0.14443	79	0.00000	-	121	0.00000	-
38	0.03223	0.34329	80	0.02238	0.48897	122	0.00000	-
39	0.03312	0.63236	81	0.00000	-	123	0.00000	-
40	0.06088	0.37358	82	0.00000	-	124	0.00000	-
41	0.03044	0.53222	83	0.00627	0.91885	125	0.00000	-
42	0.02775	0.47010	84	0.00000	-	126	0.00000	-
43	0.05013	0.35429	85	0.01074	0.83295	127	0.00000	-
44	0.01970	0.35030	86	0.00000	-	128	0.00000	-
45	0.04476	0.46733	87	0.00000	-	129	0.00000	-
46	0.00895	0.63040	88	0.00000	-	130	0.00000	-
47	0.05103	0.38021	89	0.00000	-	131	0.00000	-
48	0.04297	0.47550	90	0.00358	0.85646	132	0.00000	-
49	0.02417	0.25934	91	0.00000	-	133	0.00000	-
50	0.00716	0.85646	92	0.00000	-			
51	0.00895	0.90030	93	0.00806	0.918853			
52	0.02149	0.37464	94	0.00000	-			
53	0.01701	0.36313	95	0.00000	-			
54	0.00627	0.83295	96	0.00000	-			
55	0.01880	0.64710	97	0.00000	-			
56	0.00806	0.53714	98	0.00000	-			
57	0.02596	0.41038	99	0.00000	-			
58	0.02328	0.25730	100	0.00000	-			
59	0.00000	-	101	0.00000	-			
60	0.00358	0.85646	102	0.00000	-			

Table B11: Cook Canyon Pinnacle (CCPI) — estimated age frequencies for male orange roughy from the 2020 acoustic survey (AMA2001).

Age	Frequency	CV	Age	Frequency	CV	Age	Frequency	CV
19	0.00000	-	61	0.00464	0.84457	103	0.00000	-
20	0.00000	-	62	0.00000	-	104	0.00000	-
21	0.00511	0.87836	63	0.00279	0.84457	105	0.00000	-
22	0.00650	0.87405	64	0.00418	0.84457	106	0.00000	-
23	0.01253	0.43088	65	0.00093	0.84457	107	0.00000	-
24	0.01068	0.60204	66	0.00836	0.55032	108	0.00000	-
25	0.00789	0.56171	67	0.00000	-	109	0.00000	-
26	0.02507	0.51768	68	0.00000	-	110	0.00000	-
27	0.02136	0.32831	69	0.00000	-	111	0.00000	-
28	0.04875	0.30657	70	0.00000	-	112	0.00000	-
29	0.06035	0.14037	71	0.00325	0.84457	113	0.00000	-
30	0.03064	0.35557	72	0.00000	-	114	0.00000	-
31	0.02878	0.23264	73	0.00000	-	115	0.00000	-
32	0.04178	0.35327	74	0.00279	0.90351	116	0.00000	-
33	0.04085	0.36253	75	0.00000	-	117	0.00000	-
34	0.03946	0.14613	76	0.00000	-	118	0.00000	-
35	0.05989	0.22318	77	0.00000	-	119	0.00000	-
36	0.03018	0.22053	78	0.00000	-	120	0.00000	-
37	0.05339	0.24626	79	0.00000	-	121	0.00000	-
38	0.04596	0.36299	80	0.00000	-	122	0.00000	-
39	0.01811	0.39085	81	0.00139	0.84457	123	0.00000	-
40	0.05246	0.15601	82	0.00000	-	124	0.00000	-
41	0.04643	0.28025	83	0.00000	-	125	0.00000	-
42	0.04364	0.51818	84	0.00000	-	126	0.00000	-
43	0.02089	0.16450	85	0.00000	-	127	0.00000	-
44	0.00836	0.65110	86	0.00000	-	128	0.00000	-
45	0.02414	0.29003	87	0.00000	-	129	0.00000	-
46	0.03482	0.14953	88	0.00000	-	130	0.00000	-
47	0.01161	0.47371	89	0.00000	-	131	0.00000	-
48	0.01532	0.49880	90	0.00000	-	132	0.00000	-
49	0.02646	0.33262	91	0.00000	-	133	0.00464	0.87405
50	0.00696	0.60899	92	0.00000	-			
51	0.00929	0.61385	93	0.00000	-			
52	0.01300	0.40235	94	0.00000	-			
53	0.01346	0.61830	95	0.00000	-			
54	0.01532	0.41644	96	0.00000	-			
55	0.00789	0.87405	97	0.00000	-			
56	0.00000	-	98	0.00000	-			
57	0.00650	0.56817	99	0.00000	-			
58	0.01346	0.33239	100	0.00000	-			
59	0.00557	0.84457	101	0.00000	-			
60	0.00418	0.84457	102	0.00000	-			

Table B12: Cook Canyon Pinnacle (CCPI) — estimated age frequencies for orange roughy (sexes combined) from the 2020 acoustic survey (AMA2001).

Age	Frequency	CV	Age	Frequency	CV	Age	Frequency	CV
19	0.00000	-	61	0.01127	0.43022	103	0.00000	-
20	0.00179	0.90030	62	0.00537	0.90030	104	0.00000	-
21	0.00255	0.87836	63	0.00453	0.68715	105	0.00000	-
22	0.00728	0.60404	64	0.00970	0.50097	106	0.00000	-
23	0.01567	0.34835	65	0.00449	0.77291	107	0.00000	-
24	0.01071	0.51436	66	0.00821	0.50523	108	0.00000	-
25	0.00977	0.54580	67	0.00000	-	109	0.00000	-
26	0.01612	0.45146	68	0.00000	-	110	0.00000	-
27	0.01426	0.32281	69	0.00224	0.85646	111	0.00000	-
28	0.03735	0.31616	70	0.00582	0.47412	112	0.00000	-
29	0.04405	0.21030	71	0.00162	0.84457	113	0.00000	-
30	0.02383	0.33330	72	0.00000	-	114	0.00000	-
31	0.02469	0.26674	73	0.00000	-	115	0.00000	-
32	0.02761	0.29777	74	0.00587	0.68751	116	0.00000	-
33	0.03027	0.31077	75	0.00000	-	117	0.00000	-
34	0.02868	0.24731	76	0.00000	-	118	0.00000	-
35	0.04561	0.31182	77	0.00000	-	119	0.00000	-
36	0.01956	0.25947	78	0.00000	-	120	0.00000	-
37	0.04729	0.15259	79	0.00000	-	121	0.00000	-
38	0.03910	0.25603	80	0.01119	0.48897	122	0.00000	-
39	0.02562	0.43158	81	0.00070	0.84457	123	0.00000	-
40	0.05667	0.21326	82	0.00000	-	124	0.00000	-
41	0.03843	0.27032	83	0.00313	0.91885	125	0.00000	-
42	0.03570	0.36568	84	0.00000	-	126	0.00000	-
43	0.03551	0.25472	85	0.00537	0.83295	127	0.00000	-
44	0.01403	0.31322	86	0.00000	-	128	0.00000	-
45	0.03445	0.32015	87	0.00000	-	129	0.00000	-
46	0.02189	0.17542	88	0.00000	-	130	0.00000	-
47	0.03132	0.32195	89	0.00000	-	131	0.00000	-
48	0.02915	0.37424	90	0.00179	0.85646	132	0.00000	-
49	0.02532	0.21342	91	0.00000	-	133	0.00232	0.87405
50	0.00706	0.52792	92	0.00000	-			
51	0.00912	0.54128	93	0.00403	0.91885			
52	0.01724	0.27836	94	0.00000	-			
53	0.01524	0.34016	95	0.00000	-			
54	0.01079	0.38186	96	0.00000	-			
55	0.01335	0.52394	97	0.00000	-			
56	0.00403	0.53714	98	0.00000	-			
57	0.01623	0.34737	99	0.00000	-			
58	0.01837	0.20349	100	0.00000	-			
59	0.00279	0.84457	101	0.00000	-			
60	0.00388	0.60255	102	0.00000	-			