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Commercial catch sampling of John dory in JDO 1 for 2002–03, gemfish in SKI 2 for 2002–03 and aging of bluenose otoliths from 1998–99 to 2000–01

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Final Research Report for
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Objectives 2, 3, & 4.

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7. Executive summary

This report describes the sampling programme carried out on commercial landings of John dory *(Zeus faber)* in QMA 1, and gemfish (*Rexea solandri*) in QMA 2 during the 2002–03 fishing year. This report also describes the aging of bluenose otoliths obtained in 1998–99 to 2000–01.

JDO 1 is managed as a single stock, but it is believed it consists of two separate stocks, an eastern stock (JDO 1 East) and western stock (JDO 1 West). Therefore, this report also treats the east and west coasts as separate stocks. Most of the John dory catch was taken between October and February for both stocks. Sampling also occurred during the same period, but the target number of samples was not achieved (22 landings sampled out of 34), although the overall mean weighted c.v. of 18% for the eastern stock and 19% for the western was below the target c.v. of 30%. Two hundred fish were randomly sampled for length, with every fourth fish sexed and otolithed. This sampling procedure was carried out as there was some reluctance by the fish receivers to cut fish, and to keep costs to a minimum. The JDO East trawl fishery was dominated with 2–5 year old fish, while 3–5 year old fish dominated JDO 1 West trawl fishery.

Gemfish

The SKI 2 target fishery during the 2002–03 fishing year was of short duration, and most of the catch was taken between October and February (normally the season lasts from October to April). This meant that the target number of samples was not achieved, although the overall mean weighted c.v. of 26% achieved by the sampling programme was below the target of 30%. The commercial fishery was dominated by fish aged between 3 and 8 years, which is consistent with previous years. It appears that the 1999 year class (i.e., fish aged 4 in 2003) may be the strongest year class observed since the 1991 year class.

Bluenose

Bluenose from BNS 2 sampled from 1998–99 to 2000–01 were aged using the method of Morison & Robertson (1995). There were marked differences in the catch-at-age distributions between years. In particular there was a very strong 3 year-age class apparent in 1999–2000, which was still apparent as a strong 4-year age class the following year. A strong 3-year age class was also present in 2000–01. The proportion of older fish (i.e., those 13 years or more) is markedly lower in 2000–01 than in the previous two years. Some of the differences probably relate to recruitment into the fishery of cohorts with different year class strengths. Differences in the relative abundances of the older age classes are more likely to be related to differences in fishing practice between years (e.g., different grounds, depths, target species), rather than an effect of fishing down the larger/older fish.

8. Introduction

Objective 2: Sampling of John dory for length and age.

The JDO 1 fishery is the largest John dory fishery in New Zealand and combines QMAs 1 and 9. It extends around the North Island from Cape Runaway in the east to Tirua Point in the west (Figure 1). John Dory is thought to have separate stocks on the east (JDO 1 East) and west coasts (JDO 1 West) (Horn et al. 1999, Hanchet et al. 2001). On the west coast, over 70% of the species was caught as single trawl bycatch. On the east coast, at least 65% of John dory was caught by single trawl, with a further 25% caught by Danish seine. To date, there has been no sampling of commercial catches of John dory in JDO 1. This report also treats the east and west coasts as separate stocks.

Objective 3: Sampling of gemfish for length and age.

Gemfish are caught in coastal waters around mainland New Zealand in depths ranging from 50 to 550 m. SKI 2 (Figure 5) has supported important trawl fisheries with gemfish TACCs over 1000 t, but this was reduced in 1997–98, and again in 2000–01 to 240 t as the stock assessment indicated declining abundance. The SKI 2 fishery occurs primarily on nonspawning fish from October to April. Gemfish catches are minimal from May to September and it is assumed that adult fish migrate at this time to spawn in the northern waters of SKI 1 (Horn & Hurst 1999). This report presents the length and age structure of gemfish caught commercially during the 2002–03 fishing year in SKI 2, and compares these results with previous years.

Objective 4: Ageing of bluenose otoliths

Bluenose otoliths from BNS 2 were collected in previous QMA 2 catch-sampling projects in 1998–99, 1999–00 and 2000–01 (Blackwell et al. 2002). Determination of catch-at-age data was postponed because the previous age estimation (Horn 1988a) is now considered invalid (Annala et al. 2001). This previous interpretation was based on grouping of zones based on gross patterns in the otolith to determine age estimates. It is now considered that each of these individual zones is an annual zone (P. Horn pers. comm. 2002).

9. Methods

Objective 2: Sampling of John dory for length, sex, and age.

As no catch sampling of commercial landings of John dory has taken place previously, the sample design was based upon the number of age classes likely to be present in commercial landings, the size of the landings, and the target mean weighted c.v. of 0.30. It was proposed to sample 12 landings each from the east and west coast bottom trawl fisheries, and 10 landings from the east coast danish seine fishery. Landings of John dory were collected from October and February, when most trawling and seining for target species such as snapper takes place.

Stratification was by fishing method for the east coast stock as 70% of the landed John dory catch was caught by bottom trawl, with a further 25% caught by Danish seine. It was decided not to stratify either the east or west coast stocks by date, as the number of samples per month was low.

Within each sample, up to 200 fish were randomly selected, measured to the nearest centimetre below the total length. Every fourth fish was also sexed and their otoliths taken (totalling 50 fish sexed and otolithed per sample). This sampling procedure was carried out, as there was some reluctance by the fish receivers to allow fish to be cut.

All collected otoliths were read whole and untreated using the methods of Horn et al. (2001).

Catch-at-age and catch-at-length estimates were produced using the 'catch-at-age' software developed by NIWA (Bull & Dunn 2002). The software scaled the length frequency of fish from each landing up to the landing weight for each stock, to yield length frequencies by stock. The age-length-sex data was used to generate an age-length-sex key for each stock, through which length data was passed to produce numbers at age by sex.

The precision of each length or age frequency for each stock was measured by the mean weighted c.v. This was calculated as the average of the c.v.s for the individual length or age classes weighted by the proportion of fish in each class. The c.v.s were calculated by bootstrapping: fish were resampled 300 times with replacement within each landing, and otoliths were randomly resampled from the entire set.

Objective 3: Sampling of gemfish for length, sex, and age.

Data from 10 years of sampling SKI 1 (east), 5 years of sampling SKI 1 (west), and 6 years of sampling SKI 2 were used to estimate the required sampling effort to achieve a mean weighted target c.v. of 30% for the numbers at age. Inclusion of SKI 1 and SKI 2 data was felt to be warranted, as the stock hypothesis assumes that fish from these areas represent one stock (Horn & Hurst 1999), and there are relatively few samples available from only SKI 2.

The proposed number of landings to be sampled was estimated as follows (D. Gilbert, NIWA, pers. com):

$$\sqrt{\frac{n}{n^*}} = \frac{C^*}{C}$$

$$\therefore n = \frac{n^* C^{*2}}{C^2}$$

Where C is the target mean weighted coefficient of variation (m.w.c.v.); C^* is the estimated mean weighted coefficient of variation for sample of size n^*.

The estimated mean sampling effort required was 8 samples (range 4–15) and 286 otoliths (range 154–511, males and females combined).

The catch sampling programme aimed to collect 15 samples and 500 otoliths from the SKI 2 fishery. The number of samples and otoliths was chosen from the upper end the estimates for two reasons: a) the mean sample size of 8 samples would only achieve the 30% c.v. on average and cannot be guaranteed to achieve the 30% c.v. in any one individual year; and b) the taking of a few more samples and otoliths (particularly of larger fish) ensures that more year classes will be estimated with acceptable precision for inclusion in the model to estimate year class strengths.

Within each sample, up to 50 fish were randomly selected, measured to the nearest centimetre below the fork length, sexed, and otoliths taken. Gonad development was recorded using the 5 stage scale used previously: 1, immature/resting (gonads small and ribbon or thread like, no eggs/milt visible); 2, maturing/developing (small eggs/milt visible); 3, mature (some hyaline eggs present, milt extrudable); 4, running ripe (milt/eggs flow freely); 5, spent (gonads reduced in size, ovaries red and flaccid, testis may be red or blackish with little or no milt present).

Sampling strata were based on vessels catches. A set of ten trawlers that accounted for around two thirds of the SKI 2 catch were identified and allocated as a single stratum ("BT1" stratum). All other vessels catching gemfish by any method were collectively grouped as a single stratum ("OTH" stratum).

Ageing was carried out using the methods of Horn & Hurst (1999). Prior to reading, otoliths were soaked in water for up to 2 hours to clarify the banding pattern. Otoliths immersed in water against a dark background were illuminated by reflected light and examined under a

binocular microscope at x10 magnification. The number of hyaline zones (which appear dark using this examination technique) was counted wherever the pattern was clearest on the posterior end of the distal otolith surface. Gemfish probably spawn off Northland in about July, and a "birthday" of 1 August was used. The number of complete hyaline zones, plus a correction for the time elapsed between 1 August and the date of sampling was taken as the age of the fish. Otoliths (from each sex separately) from each 1 cm length class were selected approximately proportionally to their occurrence in the scaled length frequency, with a constraint that at least one otolith from each length class was selected.

Catch-at-age and catch-at-length estimates were again produced using NIWA's 'catch-at-age' software as with John dory (Objective 2). Previous years were also recalculated using the 'catch at age' software to ensure consistency between years.

Objective 4: Aging of bluenose otoliths collected from commercial catch sampling in BNS 2 in 1998–99, 1999–00, and 2001–02.

Catch sampling was carried out at the ports of Napier, Wellington, and Nelson. Each fishing year was divided into two time strata (October–December, January–September). There were also three vessel strata: T1, a set of 10 high-catch trawlers; T2, all other trawlers; OTH, all catches by methods other than trawl. The development of the sampling strata is described by Blackwell et al. (2002).

Proportion-at-length estimates scaled to the commercial catch by stratum were produced for each species, using the 'catch-at-age' software mentioned earlier. The length frequency of fish from each landing was scaled up to the landing weight, and these were then summed over landings in each stratum and then scaled up to the total stratum catch.

An age-length key was constructed from otolith age data and applied to the scaled length frequency derived as described above to yield an age frequency,. The precision of each age frequency was measured by a mean weight c.v., which was calculated as the average of the c.v.s for the individual age classes weighted by the proportion of fish in each class. Bootstrapping was used to calculate c.v.s.

Otoliths (from each sex separately) from each 1 cm length class were selected approximately proportionally to their occurrence in the scaled length frequency, with a constraint that at least one otolith from each length class was selected. In addition, all otoliths from fish in the extreme right hand tail of the scaled length frequency (constituting about 2% of that distribution) were fully selected. Bluenose samples from BNS 2 had previously been aged using the method described by Horn (1988), producing maximum ages of about 15 years. An alternative ageing method described by Morison & Robertson (1995) produced maximum ages of about 40 years for bluenose from Australia. Recent investigations of bomb radiocarbon in bluenose otoliths (Paul et al. 2003) indicated that the ageing method of Morison & Robertson (1995) was the more likely of the two to be correct. However, Paul et al. (2003) did indicate that there were still uncertainties about the chronology of zone formation in bluenose otoliths. The age estimations presented here were derived using the method of Morison & Robertson (1995).

10. Results

Objection 2: Sampling of John dory for length, sex, and age.

The landed catch from JDO 1 was determined from an extract provided by Ministry of Fish in November 2003 (NIWA, unpublished data). In the 2002–03 season, 230 t was landed, in which 50% (116 t) was taken by trawl vessels fishing in JDO 1E, 40% (93 t) was taken by trawl vessels fishing in JDO 1W, and the remaining 10% (21 t) was taken by danish seine vessels fishing in JDO 1E (Table 1).

Twenty-two samples were collected out of the planned 34 (Table 1). The target number could not be achieved for the east coast Danish seine stratum, as the landings were infrequent and the quantities of John dory were small. The samples were collected from the ports of Auckland and Tauranga. The total weight of John Dory sampled from the east coast stock represented 7% of the east coast landings. The total weight of John Dory sampled from the west coast stock represented 10% of the west coast landings. This resulted in a total of 4 749 fish measured and 1 093 fish otolithed and sexed for both stocks combined (Table 1).

Length frequencies for the unsexed fish from the eastern and western stocks for 2002–03 are shown in Figure 2. The distribution ranges from 20–56 cm for both stocks. The eastern stock appears more normally distributed than the western stock with the mode around 35 cm. The western stock appears almost bimodal with the larger mode at 37 cm, and a smaller secondary mode at 25 cm.

Numbers at age, by sex, for both stocks in 2001–02 are listed in Tables 2 and 3, and are plotted in Figures 3 and 4. Ages 2–4 dominated for both males and females, with 3-year-old fish being the most frequent age class for the eastern stock. For the western stock, ages 3–6 dominated for both males and females, with 3-year-old fish being the most frequent age class.

The mean weighted c.v. across all age classes for the eastern stock was 19.4%, and 18.3% for the western stock. Both of these values were under the target c.v. of 30% (Tables Table 6 and 3).

Objective 3: Sampling of gemfish for length, sex, and age.

The landed catch from SKI 2 was determined from an extract provided by Ministry of Fisheries in November 2003 (NIWA, unpublished data). In the 2002–03 season, 304 t was landed, in which 56% (170t) was taken by BT1 vessels, and the remaining 44% of the landed catch was taken by "OTH" vessels.

Thirteen samples were collected out of the planned 15 (Table 4). The target number could not be achieved, as "BT1" vessels did not land sufficient quantities of gemfish. The samples were collected from the ports of Napier, Gisborne, and Wellington. The total weight of gemfish sampled (68 t) from SKI 2 represented 22.5% of the total SKI 2 landings. A total of 636 fish measured and otolithed (Table 4).

The gonad stages are summarised in Table 5. A total of 235 males and 372 females were staged. Sixty seven percent of males and 63% of females sampled were in the immature/resting stage (stage 1), with the remainder in the maturing/developing (stage 2), mature stages (stage 3) or spent (stage 5).

Length frequencies from SKI 2 for 2001/02 are shown in Figure 6. The distribution ranges from 35–110 cm with the main mode at around 55 cm for males and 65 cm females. There appears to be a larger proportion of smaller females (approximately 45cm) than males.

Numbers at age, by sex, for 2001–02 are listed in Table 6. Ages 3–7 dominated for both males and females, with 4-year-old fish being the most dominant age class. The mean weighted c.v. across all age classes was 25.9%, under the target c.v. of 30% (Table 6).

Plots of the age frequencies for the 2002–03 fishing year and previous years are presented in Figure 7. Most captured fish appear to be less than 8 years old, which can be explained by the nature of the fishery. The SKI 2 fishery targets non-spawning gemfish and includes young fish that are immature.
The strong 1984 and 1991 year classes have all but disappeared in the 2003 fishing year.

Objective 4: Aging of bluenose otoliths collected from commercial catch sampling in BNS 2 in 1998–99, 1999–00, and 2001–02.

Details of the sampling programme and scaled length-frequencies have previously been presented for fishing years 1998–99 (McMillan et al. 2000), 1999–2000 (Blackwell et al. 2001), and 2000–01 (Blackwell et al. 2002). Sampling and estimated catch data are summarised in Table 7, and the scaled length-frequencies are presented, by sex, in Figure 8. An age-length key was constructed, and scatter plots of length and age by sex is given in Appendix A, Figure A1. Two trends are apparent over the time period examined. The proportion of males in the catch increased over time, being 52%, 55%, and 64%, respectively, and the mean size of fish in the catch decreased over time. The modal length was about 54 cm in 1998–99, but 49–50 cm in 1999–2000 and 2000–01.

Estimates of numbers-at-age and percentage-at-age in the commercial catch in each fishing year are given in Tables 8–10, along with sample details and c.v.s. The percentage-at-age distributions from the 1998–99 to 2000–01 fishing years are plotted in Figure 9. A decline in the mean fish size over time (noted above) manifests in the age distributions as a declining mean age over time. The 1998–99 catch is dominated by 5–10 year old fish, and has 5.4% of fish 20 years or older. In 1999–2000, 3 and 4 year old fish are the most abundant age classes, and 4.6% of fish are 20 years or older. The 2000–01 catch is dominated by 3 and 4 year old fish, has few fish older than 12 years, and only 1.2% 20 years or older. Males appear to recruit to the fishery about a year earlier than females. The trawl fishery has caught larger (older) fish than the line fishery over the 3-year period (Figure 10). This is probably a reflection of the ground fished and depth, rather than a consistent fishery (i.e., selectivity) effect.

11. Conclusions

This is the first year for the commercial catch sampling of John Dory from JDO 1. Most of the catch was taken between October and February in 2002–03. This meant that the target number of samples was not reached, although the overall mean weighted c.v. of 18% for the eastern stock and 19% for the western achieved by the sampling programme was below the target of 30%. Two to five year old fish dominated the east coast fishery, while 3–6 year old fish dominated west coast fishery.

The SKI 2 target fishery during the 2002–03 fishing year was of relatively short duration due to the size of the quota, and most of the catch was taken between October and February. This meant that the target number of samples was not reached, although the overall mean weighted c.v. of 26% achieved by the sampling programme was below the target of 30%. Male and female fish aged between 3 and 8 years dominated the commercial fishery, which is consistent with previous years. It appears that the 1999 year class (i.e., fish aged 4 in 2003) may the strongest year class observed since the 1991 class.

Bluenose from BNS 2 sampled in fishing years 1998–99 to 2000–01 have been aged using the method of Morison & Robertson (1995). This method produces higher ages than that developed by Horn (1988), but is believed to be more accurate (Paul et al. 2003). There were marked differences in the catch-at-age distributions between years. In particular there was a very strong 3-year age class apparent in 1999–2000, which is still apparent as a strong 4-year age class the following year. A strong 3-year age class is also present in 2000–01. The proportion of older fish (i.e., those 13 years or more) was markedly lower in 2000–01 than in the previous two years. Some of the differences probably relate to recruitment into the fishery of cohorts with different year class strengths. However, it is also well known that the length-frequency distributions of bluenose catches can vary markedly between and within grounds (Horn & Massey 1989). For example, the modal length of trawl-caught bluenose from the Palliser Bank was about 65 cm in November 1985 and 1986, but between 50 and 60 cm in several samples from the intervening months. Landings from the Paoanui Ridge were dominated by fish larger than 60 cm, while those from the Motukura Bank were generally smaller than 60 cm; these two grounds are less than 50 n.miles apart. The length-frequency distributions in Figure 8 are generally similar to those obtained from a number of grounds from 1984 to 1987 by Horn & Massey (1989). Annual landings from BNS 2 in the 10 years up to 1999–2000 have been relatively consistent and averaged over 1000 t. Given the previous consistency of the fishery, it is considered unlikely that fishing is the sole cause of the reduction, between 1998–99 and 2000–01, of larger and older fish in the samples. Consequently, differences in the relative abundances of the older age classes are believed more likely to be related to differences in fishing practice between years (e.g., different grounds, depths, target species), rather than an effect of fishing down the larger/older fish.

12. Publications

Nil.

13. Data storage

All catch sampling data up to 30 September 2002 are stored on the *market* database, and all age data are stored on the *age* database. Both databases are administered by NIWA for the Ministry of Fisheries.

14. References

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Table 1: Summary of catch sampling for JDO 1 from October to February in the 2002–03 fishing year.

						Catch (t)	
Stock	Method	Planned	Achieved	Fish measured	No fish otolithed	Sampled	Landed
East coast	Bottom trawl	12	10	2 164	495	8	116
	Danish seine	10	0	0	0	0	21
West coast	Bottom trawl	12	12	2 585	598	9	93

Table 2: Scaled numbers-at-age and calculated c.v.s (%) from catch sampling in JDO 1 East in 2002–03. The numbers of fish measured and aged and, the estimated mean weighted c.v. for both sexes are also presented.

	Male		Female	
Age (y)	Number	c.v.	Number	c.v.
0	0	–	0	–
1	5 702	61	2 212	104
2	34 280	17	23 251	19

3	63 601	12	35 019	12
4	36 295	12	25 452	17
5	10 472	24	13 278	21
6	2 584	53	4 416	39
7	539	118	1 029	83
8	0	–	833	112
9	0	–	0	–
10	0	–	0	–

Mean weighted c.v. 19.4

Table 3: Scaled numbers-at-age and calculated c.v.s (%) from catch sampling in JDO 1 West in 2002–03. The numbers of fish measured and aged and, the estimated mean weighted c.v. for both sexes are also presented.

	Male		Female	
Age (y)	Number	c.v.	Number	c.v.
0	0	–	0	–
1	2 570	40	2 154	43
2	4 688	18	3 566	25
3	18 805	13	10 604	16
4	14 156	10	8 482	17
5	10 879	12	4 488	19
6	5 138	20	825	40
7	2 505	31	158	108
8	1 088	46	264	77
9	278	68	0	–
10	227	119	0	–
Mean weighted c.v.		18.3		

Table 4: Summary of catch sampling for SKI 2 for the 2002–03 fishing year.

Strata	Period	Planned	Achieved	Fish measured	No fish otolithed	Sampled catch (t)	Landed catch (t)
BT1	Nov–May	10	6	297	297	66	170
OTH	Nov–May	5	7	339	339	2	134

Table 5: Gonad stage (%) of male and female gemfish from SKI 1 & 2. *n*, is the number of fish staged.

	SKI 2	
Stage	Male	Female
1	67	63
2	28	31
3	2	0
4	0	0
5	3	6
N	235	372

Table 6: Scaled numbers-at-age and calculated c.v.s (%) from catch sampling in SKI 2 in 2002–03. The numbers of fish measured and aged and, the estimated mean weighted c.v. for both sexes are also presented.

	Male		Female	
Age (years)	Number	c.v.	Number	c.v.
2	0	2.35	213	2.28
3	12 551	0.39	22 607	0.41
4	66 596	0.19	123 205	0.22
5	43 783	0.25	55 887	0.25
6	9 201	0.46	22 206	0.29
7	23 459	0.36	23 763	0.30
8	7 955	0.63	9 070	0.51
9	1 478	1.13	2 596	0.95
10	5 867	0.79	3 061	0.79
11	3 992	0.83	11 295	0.56
12	521	2.11	1 203	1.31
13	3 642	0.88	3 947	0.74
14	2 511	1.19	5 076	0.82
15	0	2.83	949	1.90
16	0	–	3 224	0.95
17	0	–	785	1.69
18	0	–	0	–
19	0	0	785	1.59
Total measured	311		372	
Total aged	239		341	
Mean weighted c.v.		25.9		

Table 7: Number of bluenose samples and estimated commercial catch, by stratum and fishing year.

	Strata						Total
Vessel type	T1	T1	T2	T2	OTH	OTH	
Months	Oct-Dec	Jan-Sep	Oct-Dec	Jan-Sep	Oct-Dec	Jan-Sep	
1998–99							
No. of samples	8	6	3	6	4	5	32
Estimated catch (t)	135	202	15	135	123	233	843
1999–2000							
No. of samples	4	7	5	9	3	4	32
Estimated catch (t)	114	254	56	224	108	253	1 010
2000–01							
No. of samples	7	3	7	9	0	4	30
Estimated catch (t)	174	207	58	164	118	356	1 077

Table 8: Estimated numbers-at-age (No., scaled to total reported catch), proportions-at-age (%), and coefficients of variation (c.v., %), from commercial catches in BNS 2 in the 1998–99 fishing year.

	Male			Female		
Age	No.	%	c.v.	No.	%	c.v.
1	0	0.00	–	0	0.00	–
2	0	0.00	–	0	0.00	–
3	5 908	2.80	0.273	517	0.25	0.915
4	11 135	5.28	0.219	2 193	1.04	0.462
5	12 056	5.72	0.229	10 495	4.98	0.211
6	9 759	4.63	0.244	11 792	5.59	0.220
7	12 815	6.08	0.192	8 162	3.87	0.238
8	7 984	3.79	0.236	11 161	5.29	0.212
9	6 545	3.10	0.221	9 813	4.65	0.206
10	6 802	3.23	0.214	8 813	4.18	0.218
11	6 388	3.03	0.220	7 423	3.52	0.218
12	4 611	2.19	0.259	6 363	3.02	0.235
13	3 933	1.86	0.266	5 849	2.77	0.272
14	4 691	2.22	0.249	5 263	2.50	0.274
15	4 511	2.14	0.262	2 445	1.16	0.372
16	2 138	1.01	0.344	2 673	1.27	0.393
17	1 528	0.72	0.400	1 154	0.55	0.474
18	1 783	0.85	0.363	753	0.36	0.724
19	781	0.37	0.470	1 319	0.63	0.468
20	1 096	0.52	0.466	774	0.37	0.478
21	641	0.30	0.557	792	0.38	0.451
22	354	0.17	0.624	393	0.19	0.596
23	587	0.28	0.461	497	0.24	0.529
24	277	0.13	0.630	704	0.33	0.445
25	216	0.10	0.648	765	0.36	0.436
26	763	0.36	0.518	296	0.14	0.552
27	376	0.18	0.625	252	0.12	0.700
28	317	0.15	0.552	64	0.03	0.949
29	254	0.12	0.643	369	0.17	0.562
30	232	0.11	0.696	256	0.12	0.639
31	0	0.00	–	190	0.09	0.835
32	85	0.04	1.057	73	0.03	1.183
33	200	0.09	0.900	143	0.07	0.844
34	0	0.00	–	18	0.01	1.762
35	61	0.03	1.236	98	0.05	1.260
36	0	0.00	–	0	0.00	–
37	55	0.03	1.181	0	0.00	–
38	71	0.03	1.101	16	0.01	1.601
39	0	0.00	–	19	0.01	2.041
40	0	0.00	–	39	0.02	1.384
Measured			2 947			2 784
Aged			384			368
Mean weighted c.v.			25.8			27.1
Total mean weighted c.v.			20.0			

Table 9: Estimated numbers-at-age (No., scaled to total reported catch), proportions-at-age (%), and coefficients of variation (c.v., %), from commercial catches in BNS 2 in the 1999–2000 fishing year.

	Male			Female		
Age	No.	%	c.v.	No.	%	c.v.
1	0	0.00	–	0	0.00	–
2	9 664	3.97	0.343	4 450	1.83	0.621
3	46 233	19.02	0.183	17 094	7.03	0.247
4	12 965	5.33	0.239	10 214	4.20	0.290
5	7 212	2.97	0.250	8 974	3.69	0.263
6	6 360	2.62	0.301	8 115	3.34	0.306
7	6 771	2.78	0.270	7 290	3.00	0.264
8	7 441	3.06	0.207	6 790	2.79	0.238
9	6 447	2.65	0.234	6 588	2.71	0.230
10	5 377	2.21	0.269	7 500	3.08	0.201
11	6 055	2.49	0.236	6 009	2.47	0.246
12	4 249	1.75	0.249	5 292	2.18	0.246
13	1 401	0.58	0.468	3 056	1.26	0.350
14	1 395	0.57	0.442	3 802	1.56	0.300
15	1 295	0.53	0.424	2 971	1.22	0.342
16	1 413	0.58	0.406	2 325	0.96	0.378
17	2 094	0.86	0.330	1 060	0.44	0.579
18	1 007	0.41	0.506	1 058	0.44	0.536
19	764	0.31	0.647	1 046	0.43	0.534
20	609	0.25	0.598	186	0.08	1.124
21	1 035	0.43	0.548	599	0.25	0.839
22	1 226	0.50	0.518	900	0.37	0.571
23	149	0.06	0.987	730	0.30	0.634
24	449	0.18	0.669	375	0.15	0.906
25	67	0.03	1.519	535	0.22	0.920
26	471	0.19	0.750	1 553	0.64	0.481
27	132	0.05	1.143	575	0.24	0.843
28	71	0.03	1.863	322	0.13	1.032
29	207	0.09	0.963	275	0.11	0.937
30	0	0.00	–	162	0.07	1.261
31	177	0.07	1.165	0	0.00	–
32	0	0.00	–	113	0.05	1.525
33	0	0.00	–	0	0.00	–
34	132	0.05	1.278	0	0.00	–
35	0	0.00	–	0	0.00	–
36	0	0.00	–	0	0.00	–
37	0	0.00	–	213	0.09	1.763
38	0	0.00	–	0	0.00	–
39	0	0.00	–	0	0.00	–
40	0	0.00	–	0	0.00	–
Measured			873			797
Aged			385			360
Mean weighted c.v.			26.3			31.8
Total mean weighted c.v.			21.2			

Table 10: Estimated numbers-at-age (No., scaled to total reported catch), proportions-at-age (%), and coefficients of variation (c.v., %), from commercial catches in BNS 2 in the 2000–01 fishing year.

	Male			Female		
Age	No.	%	c.v.	No.	%	c.v.
1	0	0.00	–	0	0.00	0
2	4 384	1.27	0.596	751	0.22	1.416
3	57 871	16.82	0.149	16 496	4.80	0.305
4	57 754	16.79	0.143	28 568	8.30	0.199
5	30 915	8.99	0.173	18 754	5.45	0.218
6	15 695	4.56	0.231	19 067	5.54	0.193
7	14 850	4.32	0.221	15 947	4.64	0.233
8	14 247	4.14	0.210	7 724	2.25	0.240
9	6 253	1.82	0.309	5 488	1.60	0.349
10	4 972	1.45	0.338	2 878	0.84	0.401
11	4 050	1.18	0.348	1 429	0.42	0.483
12	2 735	0.80	0.424	1 558	0.45	0.500
13	1 266	0.37	0.423	670	0.19	0.713
14	832	0.24	0.548	394	0.11	0.748
15	198	0.06	0.906	210	0.06	0.924
16	445	0.13	0.703	928	0.27	0.690
17	1 092	0.32	0.450	237	0.07	0.932
18	323	0.09	0.628	307	0.09	0.891
19	612	0.18	0.559	120	0.03	1.085
20	624	0.18	0.586	365	0.11	0.998
21	355	0.10	0.790	193	0.06	0.942
22	462	0.13	0.635	275	0.08	1.108
23	205	0.06	0.782	0	0.00	–
24	103	0.03	1.104	531	0.15	0.656
25	97	0.03	1.220	46	0.01	1.418
26	118	0.03	1.195	0	0.00	–
27	0	0.00	–	178	0.05	1.736
28	49	0.01	1.741	74	0.02	1.595
29	62	0.02	1.364	68	0.02	1.176
30	0	0.00	–	33	0.01	1.609
31	0	0.00	–	17	0.00	1.701
32	0	0.00	–	0	0.00	–
33	96	0.03	1.203	48	0.01	1.892
34	0	0.00	–	0	0.00	–
35	0	0.00	–	0	0.00	–
36	0	0.00	–	0	0.00	–
37	0	0.00	–	0	0.00	–
38	0	0.00	–	0	0.00	–
39	0	0.00	–	0	0.00	–
40	0	0.00	–	0	0.00	–
Measured			874			612
Aged			409			334
Mean weighted c.v.			20.5			27.4
Total mean weighted c.v.			17.3			

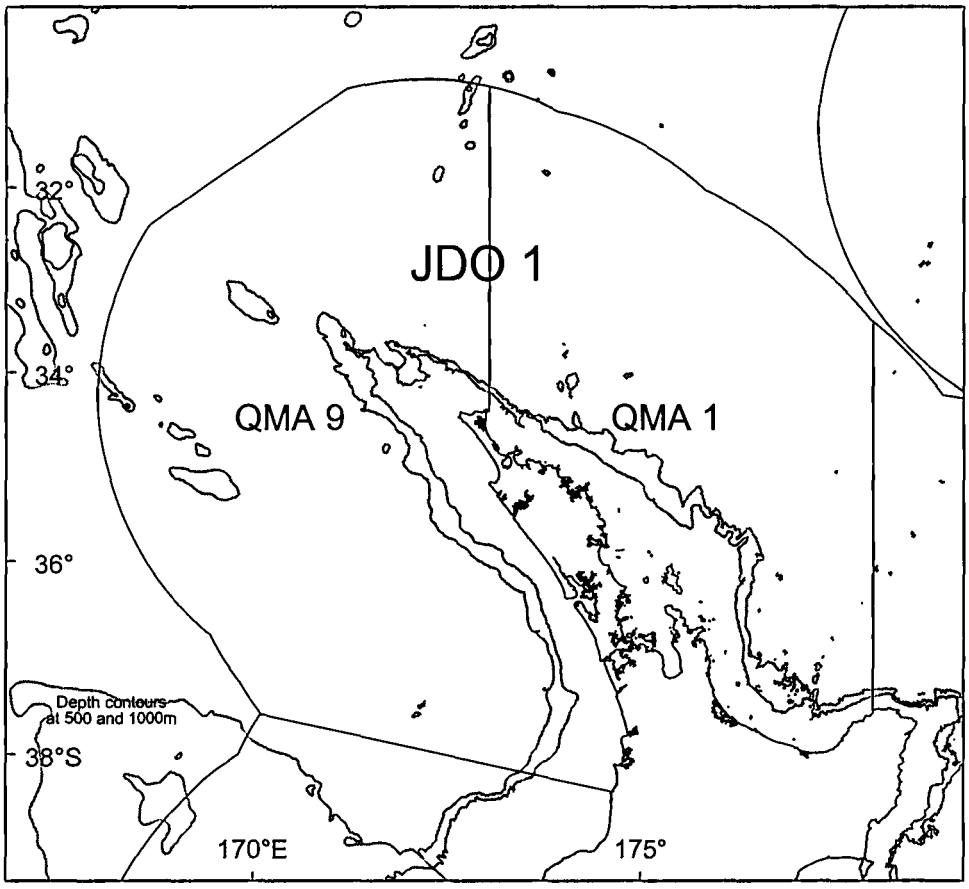

Figure 1: Definitions for the JDO 1 fishery used in this report.

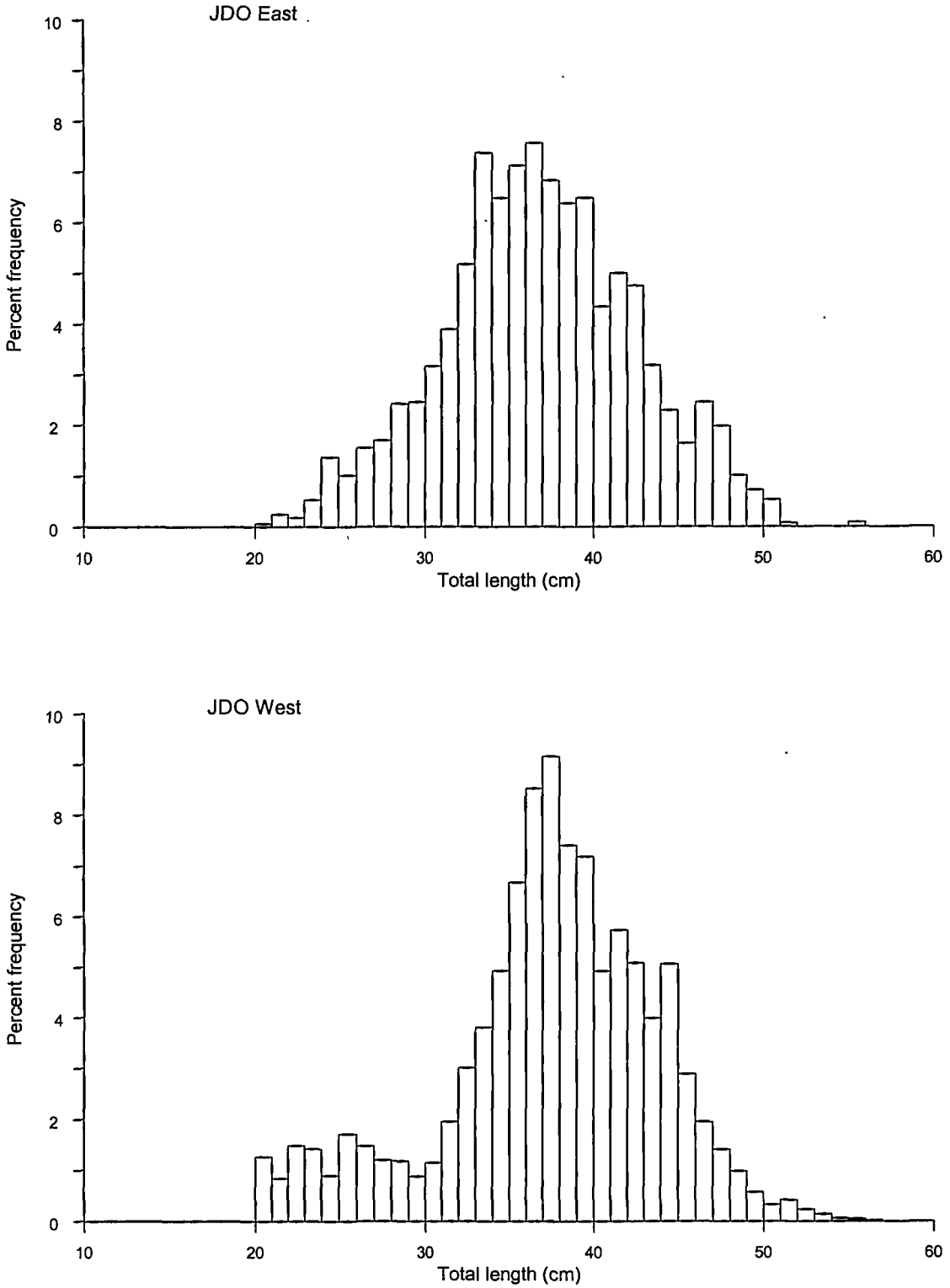

Figure 2: Length frequencies of unsexed John Dory from the east and west coasts bottom trawl fisheries, 2002–03.

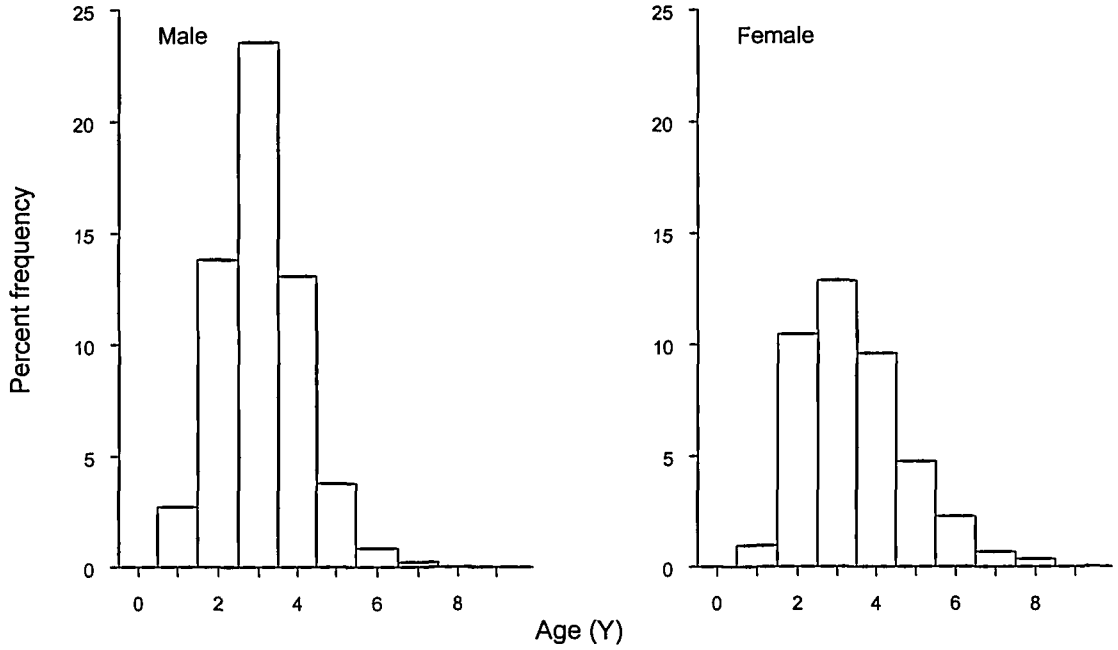

Figure 3: Proportions at age of male and female John dory from East coast bottom trawl fishery, 2002–03.

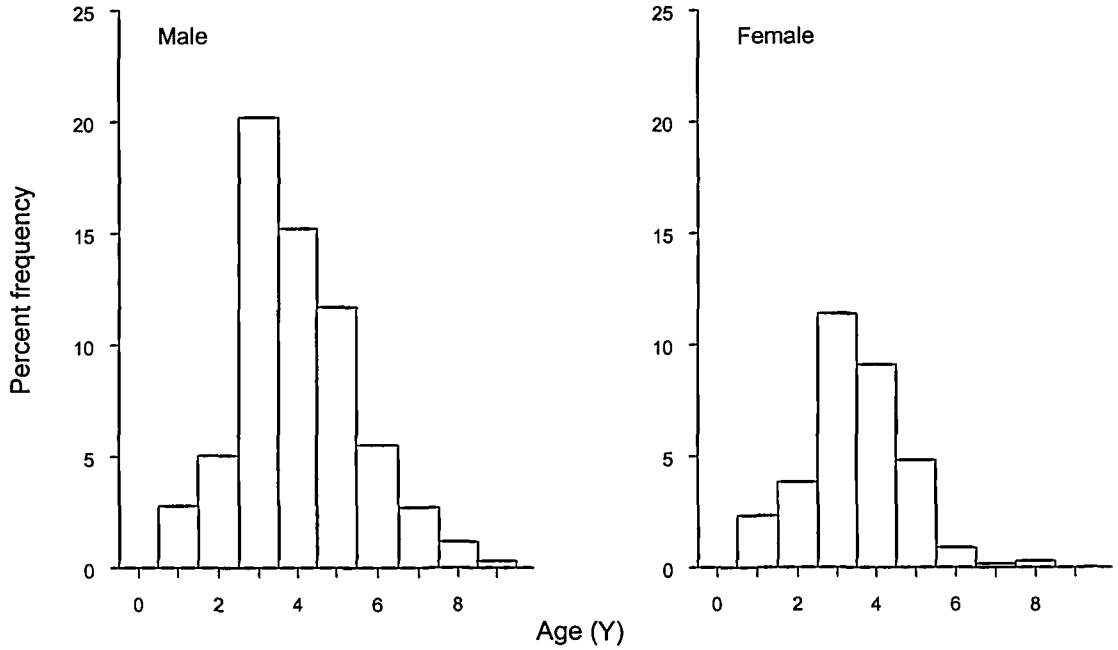

Figure 4: Proportions at age of male and female john dory from West coast bottom trawl fishery, 2002–03.

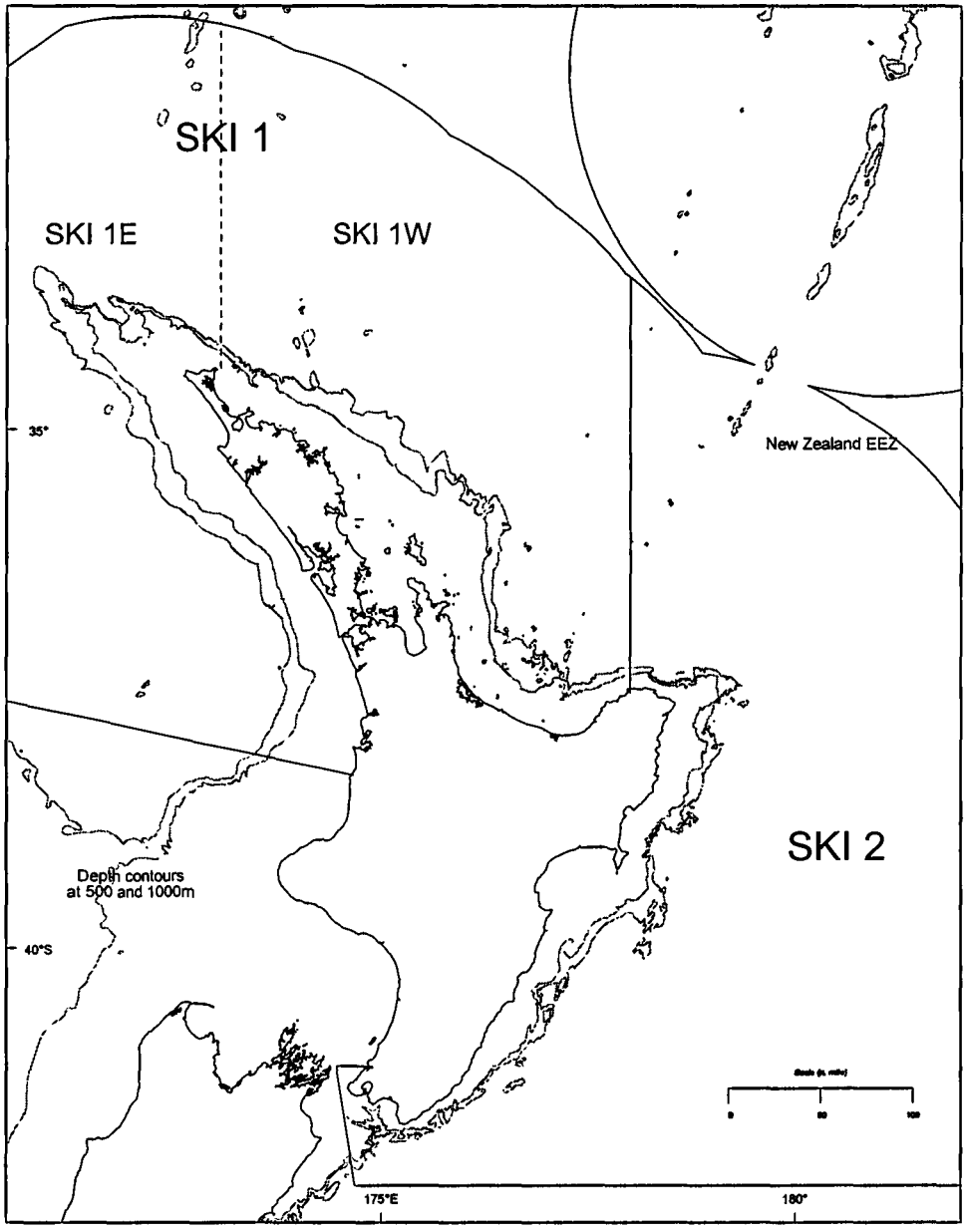

Figure 5: Definitions for the northern gemfish fisheries used in this report.

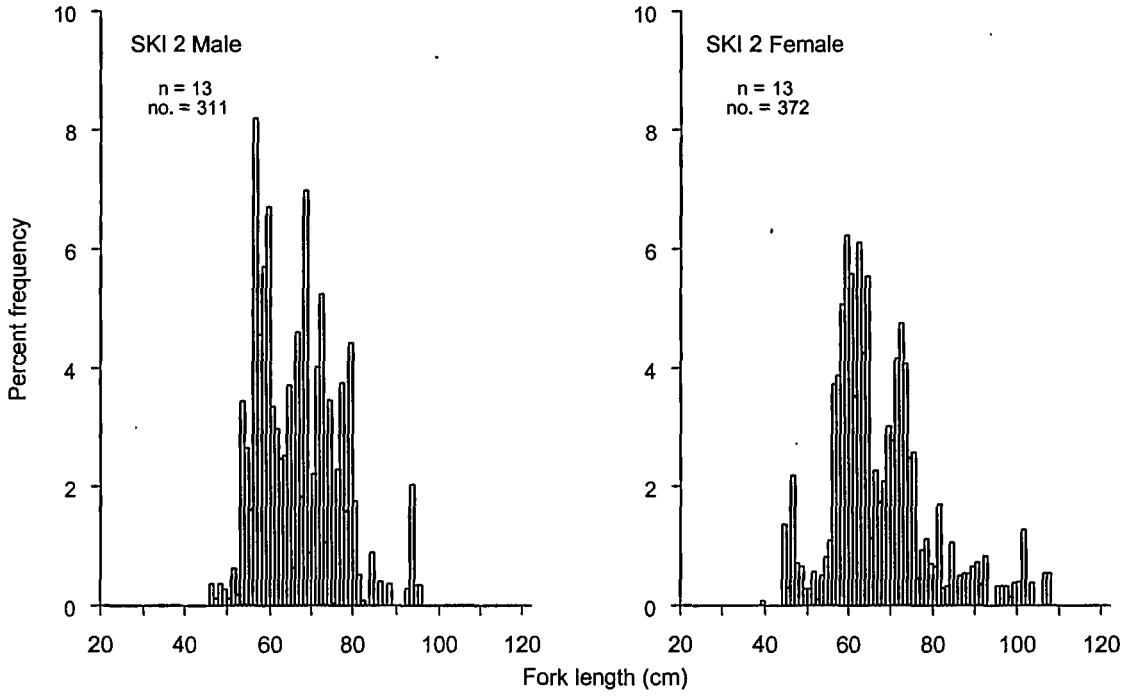

Figure 6: Length frequencies of male and female gemfish from SKI 2, 2002–03. (*n*= number of landings sampled, *no*= number of fish measured).

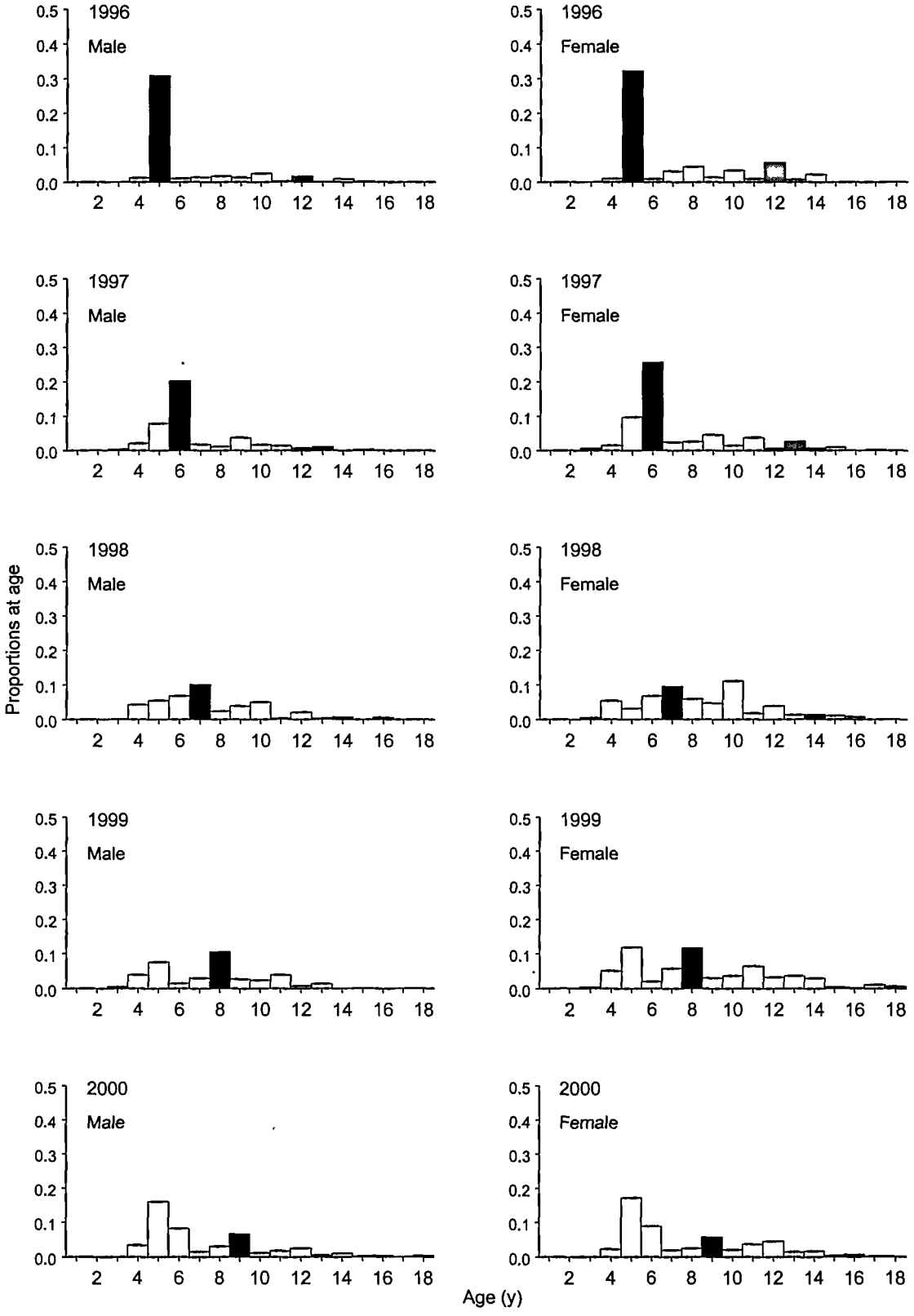

Figure 7: Age frequencies of gemfish from shed sampling catch at age data in SKI 2. Age 18 is a plus group. Shaded bars show the 1984 (grey) and 1991 (black) year classes.

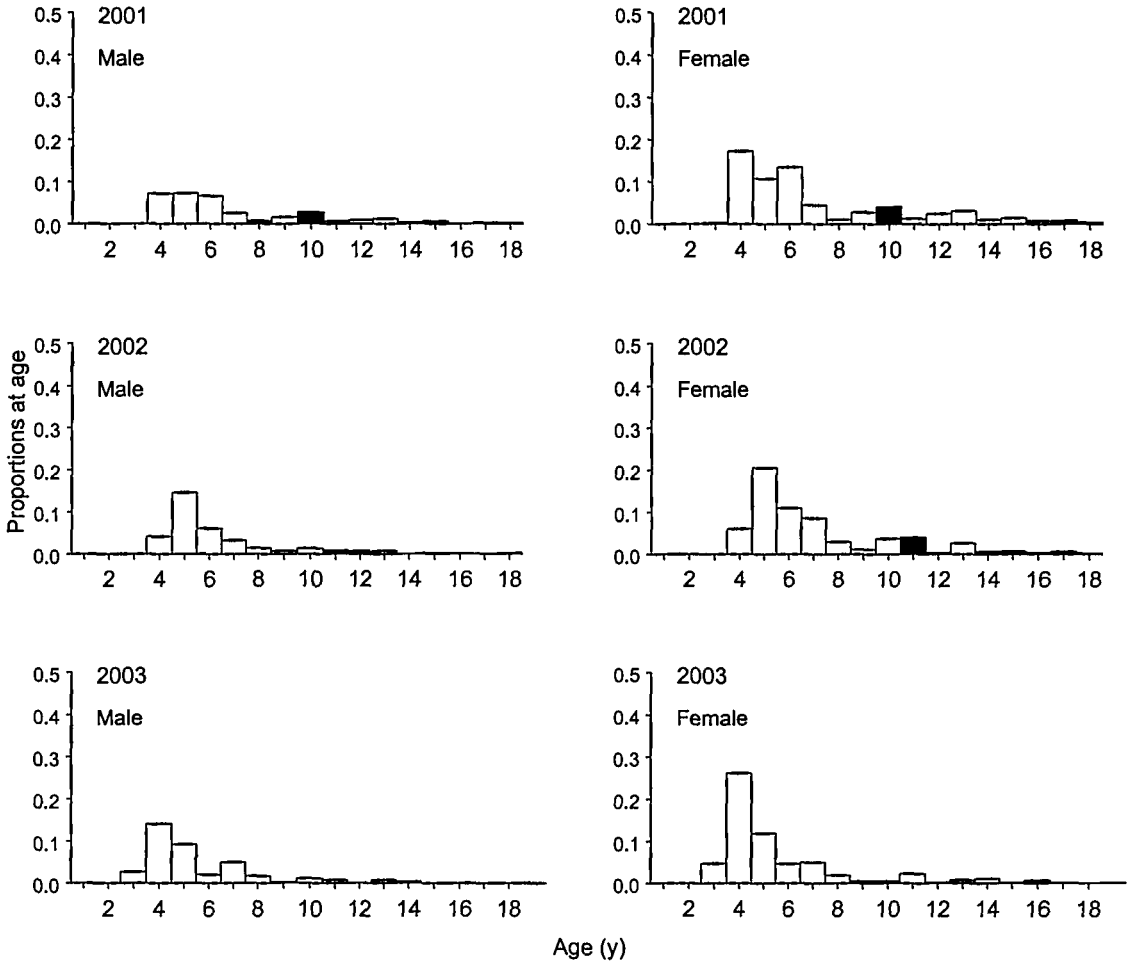

Figure 7: ***Continued.***

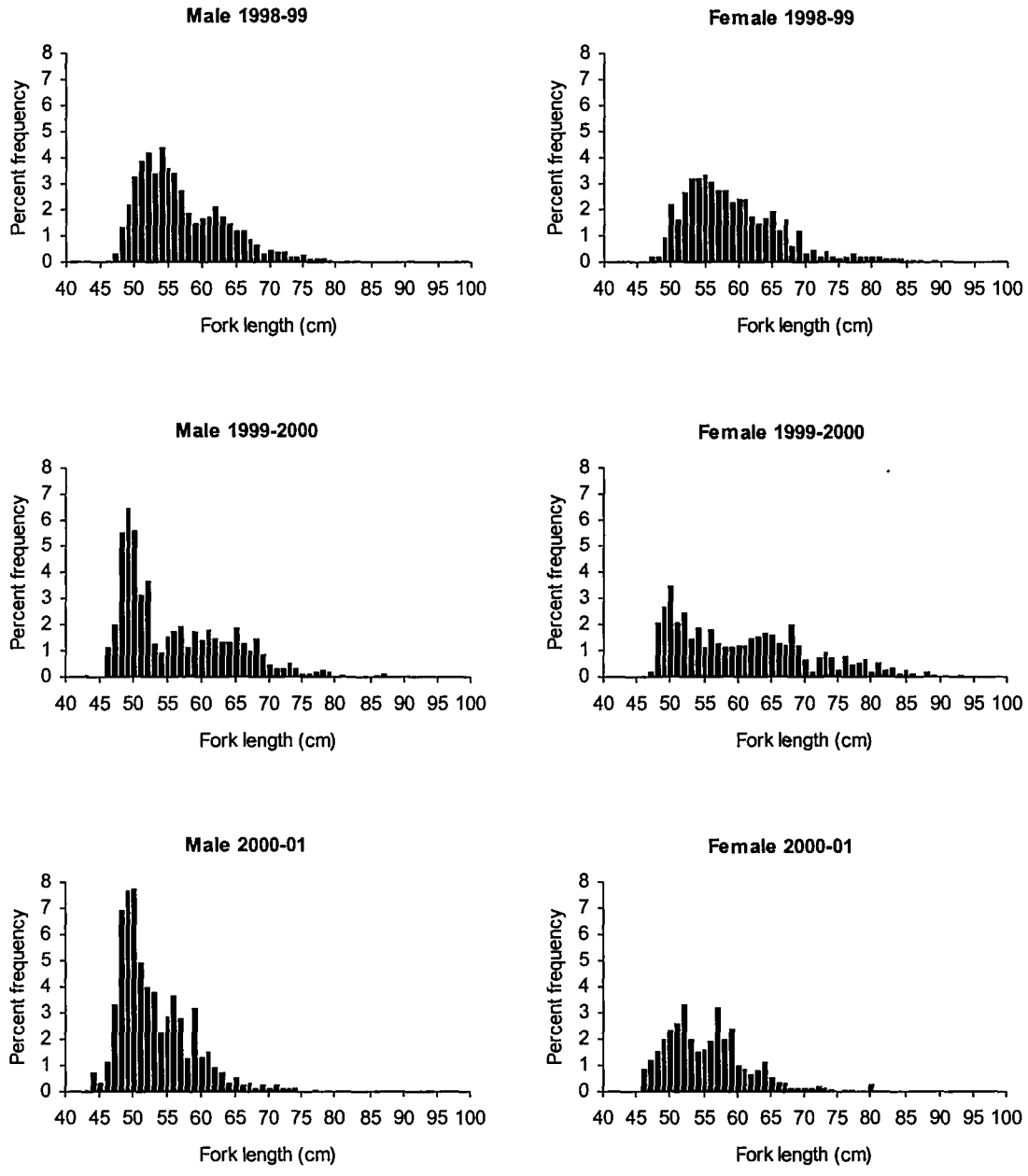

Figure 8: Bluenose length frequency distributions by sex, scaled to the total commercial catch from BNS 2 in each fishing year.

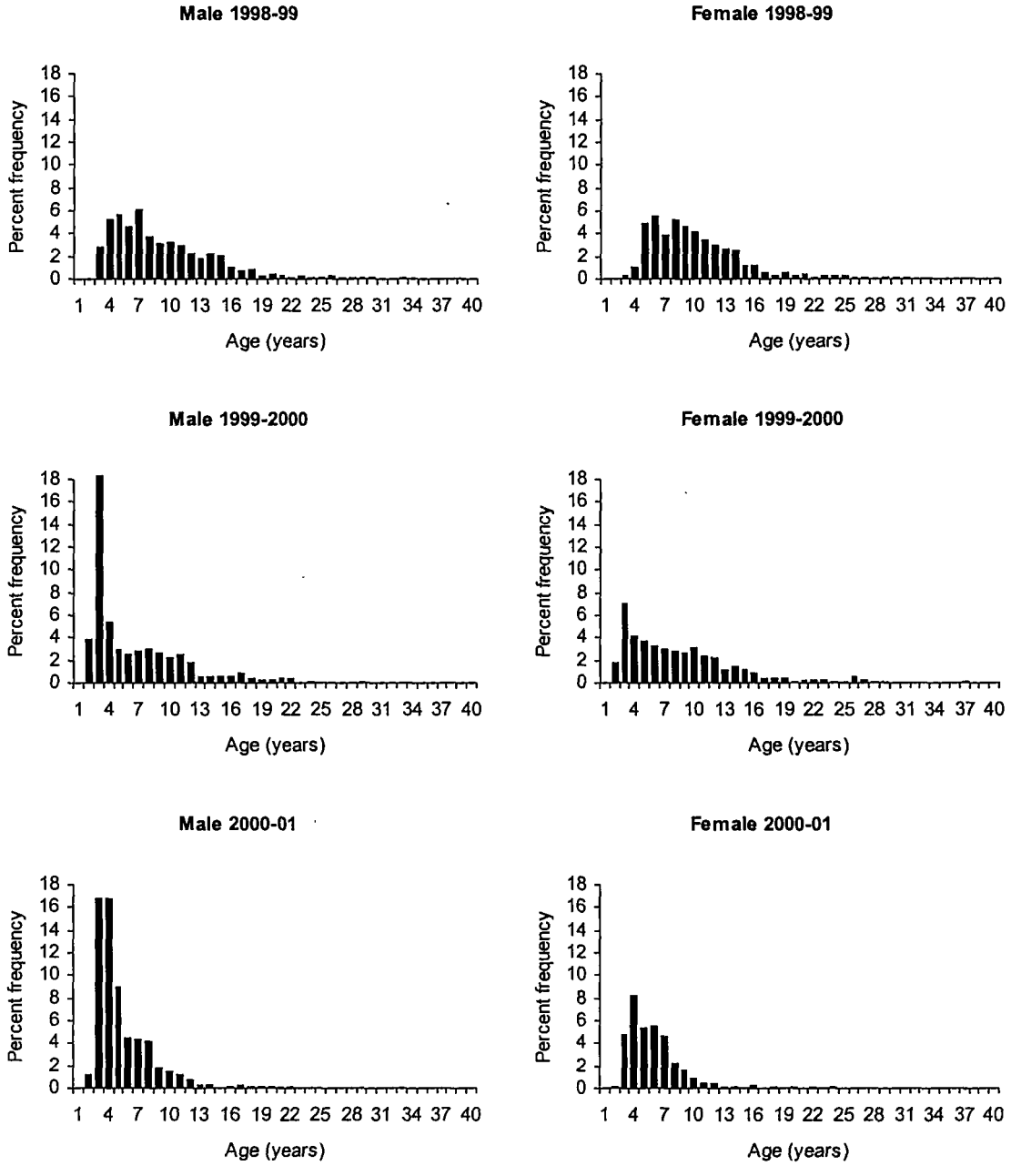

Figure 9: Bluenose age frequency distributions by sex, scaled to the total commercial catch from BNS 2 in each fishing year.

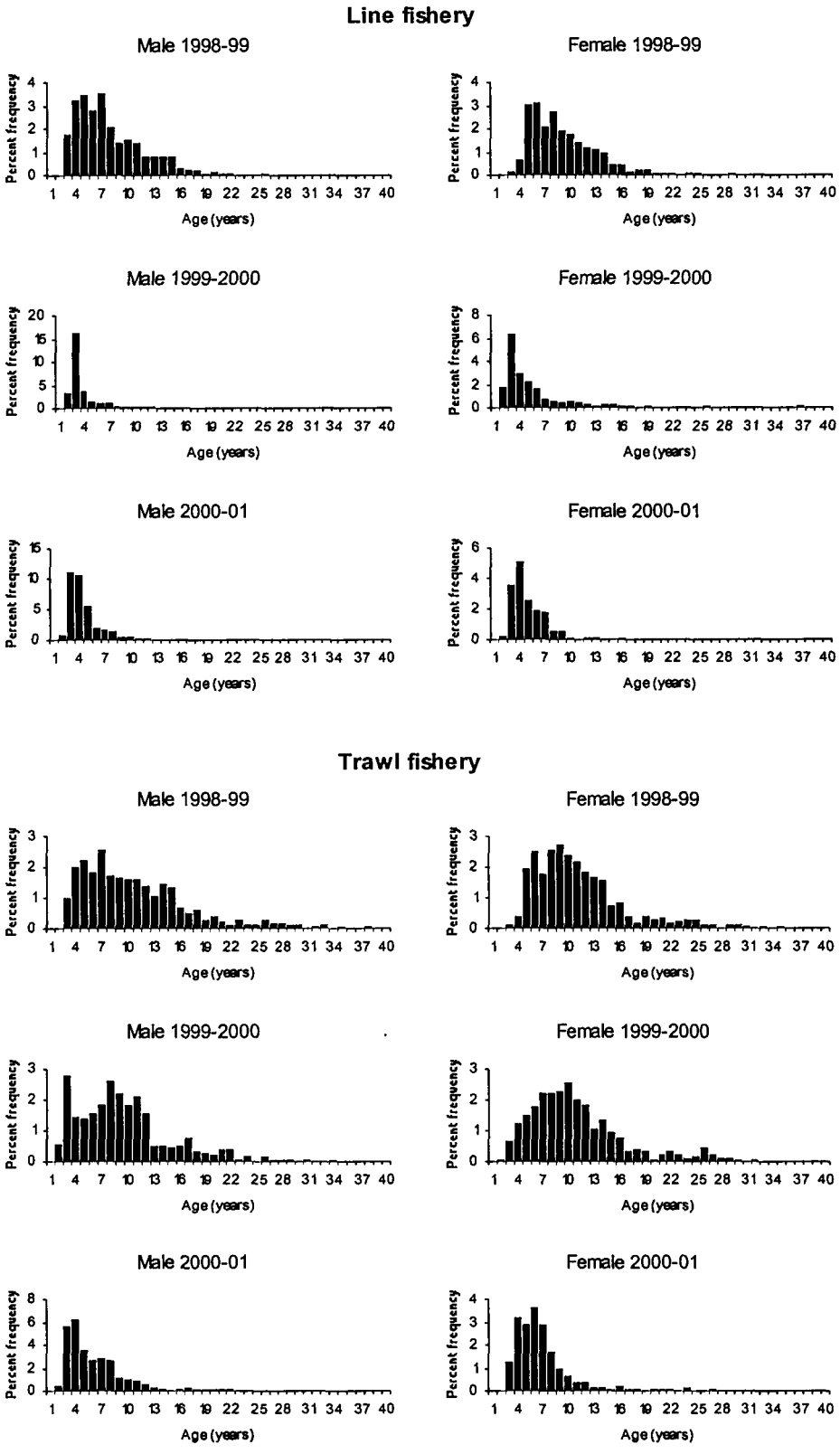

Figure 10: Bluenose age frequency distributions by sex, scaled to the total commercial catch from the line and trawl fisheries separately in BNS 2, in each fishing year. In the three sampled years, the trawl fishery has tended to catch larger (older) fish than the line fishery.

Appendix A

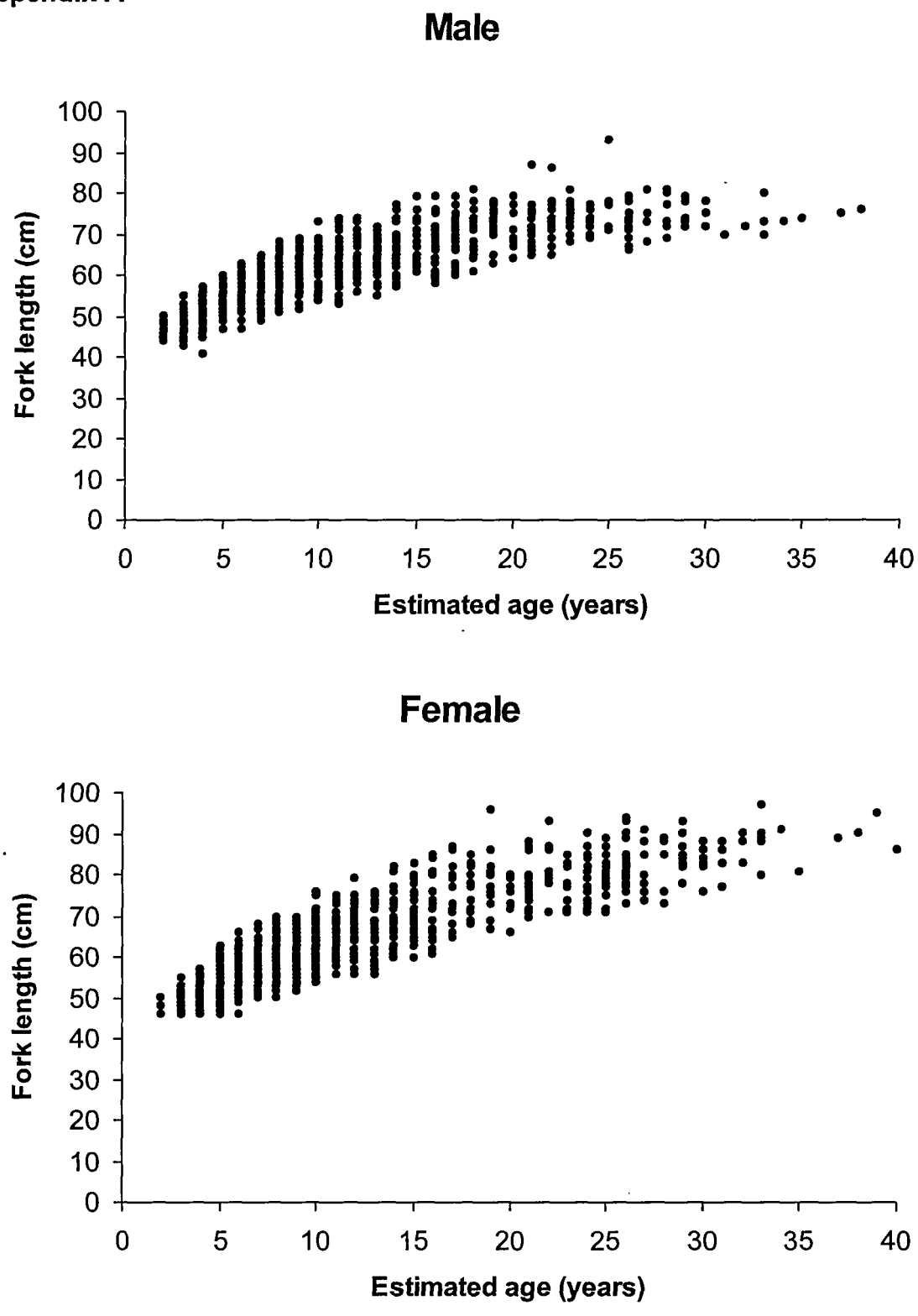

Figure A1: Raw age data for bluenose, separately by sex, from all three sampled years combined.