# Length and age composition of commercial snapper landings in SNA 8, 2008–09

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## EXECUTIVE SUMMARY

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This report presents the results of Objective 1 of the Ministry of Fisheries project "Estimation of snapper year class strength in SNA 8" (SNA2007/04B, Objective 1). The general objective was to determine the length frequency and age structure of commercial landings from SNA 8 for use in stock assessment models by market sampling.

The length frequency and age-length key sampling approach was employed during spring and summer 2008–09 to estimate catch-at-age for snapper for the main fishing methods in SNA 8. Length frequency samples were collected from the SNA 8 single trawl fishery, and age data were collected randomly in the form of a semi-fixed allocation age-length key, mainly to ensure fish in the large length intervals were well accounted for. A total sample size of 15 landings was sampled for length frequency from the single trawl fishery, with an age-length key collection of 511 otoliths. Unlike most previous years, no length frequency samples were obtained from the pair trawl fishery in 2008–09, largely due to a rationalisation of the Auckland based inshore trawl fleet, which resulted in fewer trawlers operating and a reduction in pair trawl landings in SNA 8.

Although relative year class strengths inferred in 2008–09 from the SNA 8 stock were generally similar to those estimates from recent years, the age distribution was dominated by the recent strong recruitment of the 2005 year class, making up almost one in every three (30%) snapper landed, and likely to be important for the short term rebuilding of the fishery. A high proportion (85%) of the 2008–09 single trawl catch was dominated by fish below 8 years of age, characteristic of landings from the SNA 8 fishery for the past 20 years. Those previously dominant year classes (1998 and 1996) now make up only 4% of the catch, although these year classes in particular may not be as well represented in catch-at-age estimates because a proportion of fish in these cohorts now exceed the optimum selectivity of the single trawl method. There is a very low proportion (2%) of fish over 11 years of age, with no appreciable growth apparent in the right hand limb of the age distribution. As a result, the aggregate (over 19) age group has remained very low (0.3%), the lowest estimate for any New Zealand snapper stock, and largely dominated by previously strong year classes from the mid 1980s. The newly recruited 2006 year class, although not yet fully recruited to the fishery, contains an appreciable proportion of fish in the smaller size classes, and appears to be of above average strength, making up about 11% of the single trawl catch by number in 2008–09.

A mean weighted coefficient of variation for SNA 8 single trawl age composition was 11% (analytical estimate calculated across all age classes).

# 1. INTRODUCTION

Staff of the National Institute of Water and Atmospheric Research (NIWA) and, formerly, MAF Fisheries have sampled the length and age compositions of snapper (*Pagrus auratus*) from commercial landings in port (market sampling) intermittently since 1963 (Davies et al. 1993). In the 1988–89 fishing year, a structured sampling programme was designed to establish a time series of length and age composition data for the main snapper fisheries in the east and west coast North Island stocks, SNA 1 and SNA 8 respectively. The time series of length and age information has been summarised in previous reports (Davies & Walsh 1995, Walsh et al. 1995, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2006a, 2006b, 2009a, 2009b, Walsh & Davies 2004). This report presents the results of market sampling from the SNA 8 stock between October 2008 and February 2009, thus continuing the time series. Funding for this project, SNA2007/04B (Objective 1), was provided by the Ministry of Fisheries.

The specific objective of this project for 2008–09 was:

1. To carry out sampling and estimate the relative proportion at age and length of recruited snapper sampled from the commercial trawl catch in SNA 8 during spring and summer 2008–09. The target coefficient of variation (c.v.) for the catch-at-age will be 20% (mean weighted c.v. across all age classes).

# 2. METHODS

The SNA 8 stock encompasses almost all the west coast of New Zealand's North Island (Figure 1). Landings from the SNA 8 fishery were stratified by fishing method and quarter, e.g., single trawl – spring. The fishing method sampled was single trawl (BT) over the spring (September–November) and summer (December–February) quarters only. In most recent years the pair trawl (BPT) method was also sampled. However, a rationalisation of the SNA 8 trawl fleet in 2006–07 resulted in a reduction in the number of vessels operating in the fishery, with the relative pair trawl effort being insufficient to be considered useful for sampling (Walsh et al. 2009a).

Details of the sampling design were described by Davies & Walsh (1995). Length frequency samples were collected from the SNA 8 single trawl fishery using a two-stage sampling procedure (West 1978). The random selection of landings and a random sample of bins within landings represent the first and second stages respectively. The sampling procedure was modified to account for the grading of fish according to length and quality by taking a stratified random sample of bins within a landing (Davies et al. 1993). All fish in bins making up the sample were measured to the nearest centimetre below the fork length. As snapper show no differential growth between sexes (Paul 1976), sex was not determined.

The age-length key method was used for collecting otoliths as described by Davies & Walsh (1995). In previous years the sample allocation for each length class interval for the age-length key was made according to the broadest proportion-at-length distribution of either the single trawl or pair trawl collection from the year before. However, as large snapper (i.e., those over 65 cm) were often poorly represented or absent in proportion-at-length distributions from SNA 8 collections in recent years, it was felt a proportional allocation age-length key design may under-represent fish in the large length class intervals and over-represent those in the mid-range. To determine whether a broadening of the age-length key collection had any real effect on resulting catch-at-age estimates, the sample collection in 2007–08 was altered to a semi-fixed allocation design, the same design implemented for sampling in 2008–09 (see Appendix 1). This would ensure the right hand tail of the distribution, comprising the large and old snapper, was adequately sampled. A step-wise sample size of around five fish for length intervals greater than 50 cm, three fish over 61 cm, two fish over 67 cm, and one fish for all length classes 70 cm and above was specified for collection. To allow for annual variability in the abundance of fish in the 25–28 cm size range, a fixed sample size of about 10 otoliths was targeted for collection from each of these length intervals. It was thought that a broad, but slightly less dominant, mode (capped at 25 samples for the most common length intervals) based on the length distribution of the single trawl sample from 2007–08 that covered the mid-length class intervals of the age-length key collection would suitably describe the mid-range of cohorts currently present in the fishery. As in more recent years, otolith samples for fish over 70 cm were difficult to obtain because of their rarity in landings. The otolith sample size for the west coast collection ($n$ = 511) was based on previous SNA 8 catch-at-age simulations using past length and age data that produce mean weighted coefficients of variation (MWCV) of below 20% for catch-at-age estimates.

A standardised procedure for reading otoliths was followed (Davies & Walsh 1995). Age was defined as the rounded whole year from a nominal birth date of 1 January, e.g., in 2008–09, the 2005 year class was 4 years old, whether sampled in December 2008 or February 2009.

The age-length key derived from the age data is assumed to be representative of the spring-summer period. The main assumption to be satisfied for an age-length key is that the sample was taken randomly with respect to age from within each length interval (Southward 1976).

Calculation of proportions at length and age, and variances from length frequency samples and age-length keys, followed that of Davies & Walsh (1995). Bootstrap variances have been determined for the combined spring and summer proportion-at-length and age estimates. The calculation of mean weight-at-age and variances followed Quinn II et al. (1983), with a length-weight relationship: w (g) = $0.04467 l^{2.793}$(cm) (Paul 1976). Proportions at age and mean weight-at-age (with analytical estimates of coefficient of variation, c.v.) were calculated for the range of age classes recruited, with the maximum age being an aggregate of all age classes over 19 years.

Snapper length and age data were stored on the Ministry of Fisheries *market* and *age* databases respectively, administered by NIWA.

## 3. RESULTS

### 3.1 Sample collections

Summaries of the length frequency sample sizes for method-season strata are given in Table 1, and summaries of the otolith sample collection in Table 2. Catch data from autumn 2008 to summer 2008–09 are provided in Table 1, displaying seasonal patterns in the fisheries. Single trawl was the dominant method, operating mainly over spring and summer, catching substantially more snapper than in the previous year. Although there may have been a broadening of the fishing season in SNA 8 in recent years, the greater proportion of the TACC (1300 t) in 2008–09 was still taken over the spring and summer period. The pair trawl fishery in SNA 8 has continued to diminish with low catches over spring and summer, now equal to that caught by Danish seine, a method used largely to target other mixed species, e.g., red gurnard (*Chelidonichthys kumu*), taking snapper mainly as a bycatch. The total percentage catch by the main methods in SNA 8 over the period of sampling (October 2008 to February 2009) was as follows; single trawl 81%, pair trawl 7%, Danish seine 7%. Considerable differences are still apparent between the percentage of number of landings sampled and the percentage of weight of landings sampled in the west coast single trawl fishery (Table 1). Similar to 2007–08, a moderate shift in the target species sought has continued into 2008–09. While snapper was the target species in almost all previous spring samples, in 2008–09 trevally (*Pseudocaranx dentex*) was the target for three of the seven spring landings. Over summer, trevally was exclusively the target species in seven sampled landings and red gurnard in one other, although snapper still made up a reasonable proportion of the overall catch in all but the latter. The summarised information in Table 1 is for all single trawl, pair trawl, and Danish seine landings containing snapper (target and bycatch) caught from SNA 8. The average sampled landing weight of snapper from single trawl catches in spring was about 8 t (range 6–10 t), while that for summer was not dissimilar at about 7 t (range 2–14 t).

A total of 15 landings was sampled for length frequency from the single trawl fishery in 2008–09, meeting the required target. Because of the rationalisation of the fishing fleet in recent years, only limited pair trawl fishing was undertaken in 2008–09 and as such no catch sampling of this fishery could be made. The cumulative proportion of the total number of landings and those sampled from the SNA 8 single trawl fishery from October 2008 to February 2009 is given in Appendix 2, showing the sampling effort was distributed reasonably uniformly over landings in the sampling period. A temporal comparison using the monthly catch of snapper and of that sampled (weight and number of landings) for the single trawl method (for all landings and for those over 3 tonnes) from October 2008 to February 2009 is presented in Appendices 3 and 4 to display patterns in the fishery and the representiveness of the sample collections. Similarly, a spatial comparison for the same period using the proportional distribution of the estimated single trawl catch with that sampled for the statistical areas that make up SNA 8 is given in Appendix 5a. As expected, the largest part of the single trawl catch occurred in the northern half of SNA 8 between Ninety Mile Beach and North Taranaki Bight, with the greater proportion of the fishery and samples coming from those areas adjacent to the Kaipara and Manukau Harbours (see Appendix 5a). A similar comparison depicting the single trawl catch by target species is given in Appendix 5b, with over two-thirds (68%) of the landed snapper catch coming from trevally targeted tows, 19% where snapper was the target, and 10% for gurnard, far outweighing all other minor target species in SNA 8, most of which were exclusive to South Taranaki Bight.

### 3.2 Length and age distributions

For the SNA 8 single trawl fishery in 2008–09, a catch-at-age composition (using the length frequency and age-length key approach) was derived from the combined spring and summer length distributions, and used to identify year class strengths. Although otolith samples were collected from each sampled landing, they were not collected consistently across the entire spring or summer period. In combining the seasonal data, it is assumed that an age-length key collected from spring and/or summer can be applied to the combined spring and summer length data. Because the growth of snapper over 25 cm long is not great between spring and summer, this assumption is reasonable. This assumption has been accepted for other species with growth rates comparable to those of snapper (Westrheim & Ricker 1978).

Sample length and age distributions for the SNA 8 single trawl fishery in 2008–09 are presented as histograms and line graphs (Figures 2–5). The estimated proportions at length, age, and mean weight-at-age are tabulated in Appendices 6–8. The age-length key is presented in Appendix 9 and an age-at-length scatterplot for the full range of age classes present in the fishery is given in Appendix 10. For comparison, a time series of proportional catch-at-length and catch-at-age distributions from the SNA 8 single trawl and pair trawl fisheries is presented in Appendices 11 and 12.

The estimated total number of fish caught in each season stratum was calculated from the reported total weight landed and the mean fish weight derived from stratum length compositions (Appendix 6). The estimated total number of fish caught for the spring-summer combined stratum may not correspond exactly to the sum of the individual season estimates because of differences in mean fish weight when spring and summer are treated separately.

## 3.3 Catch-at-length and catch-at-age

The length distribution of the single trawl catch in 2008–09 was characterised by three closely aligned modes at 31, 34, and 36 cm, and a fourth at about 43 cm (Figure 2). The tail of the distribution extended to over 65 cm. The mean length of snapper sampled from the fishery was 35.2 cm, and the proportion-at-length analytical and bootstrap MWCVs were 0.14 and 0.16, respectively.

The age distribution for the SNA 8 single trawl fishery in 2008–09 was dominated by the 2005 year class (4-year-olds) making up almost one-third (30%) the number of snapper landed (Figure 3). Combined with the other most noticeable and dominant year classes in the fishery, 2006 (3- year-olds), and 2004 to 2002 year classes (5- to 7-year-olds), this group accounts for 85% of the landed catch. With the exception of the 1998 year class (11-year-olds), the proportion of most other age classes, especially those over 11 years of age, is now very low, making up only about 2% of the single trawl catch. The 1992 year class (17-year-olds) was absent from the age-length key collection, and the 1997 and 1990 year classes (12- and 19-year-olds) were based on only one fish respectively. Similarly, the aggregate (over 19) age group now makes up about 0.3% of the overall catch, reflecting the low number of fish of this age range available in the fishery. Of the 23 fish over 19 years old, over half (52%) were from the 1986, 1985, or 1984 year classes (23-, 24-, and 25-year-olds) that dominated landings in the early 1990s.

The 2005 year class appears fully recruited as it contains no fish under 27 cm (see Appendix 9). The 2006 year class appears to be of above average strength and is not yet fully recruited as it contains a considerable proportion of fish under 27 cm. The mean age of snapper from the single trawl fishery was 5.7 years, and the catch-at-age analytical and bootstrap MWCVs were 0.11 and 0.17.

The spring and summer catch-at-length and catch-at-age samples for the single trawl fishery were very similar over both seasons, with spring samples containing a slightly higher proportion of fish in the large length and old age ranges compared to summer samples which contained a slightly higher proportion of small young fish (Figures 4 & 5).

# 4. DISCUSSION

The relative year class strengths inferred in the length and age distributions sampled from the SNA 8 single trawl fishery in the 2008–09 are generally consistent with trends observed in recent years (Walsh et al. 2002, 2003, 2004, 2006a, 2006b, 2009a, 2009b, Walsh & Davies 2004).

Single trawl landings from the SNA 8 fishery in 2008–09 were largely dominated by young fish, 7 to 3 years of age from the 2002–2006 year classes, making up 85% of the number of snapper landed, one-third of these solely attributable to dominant 2005 year class (4-year-olds). Consequently, the combined total proportion of older fish in the single trawl catch, especially the previously dominant 1998 and 1996 year classes (11- and 13-year-olds), has diminished considerably to about half that of the year before, and now accounts for only 4%. As indicated in most recent years, there continues to be a low to very low relative abundance of older fish in the fishery, some year classes below 20 years either absent of fish or represented by only one individual in the age-length key. The combined total for fish over 11 years of age was only 2% of the single trawl catch-at-age distribution in 2008–09, not dissimilar to most estimates from this fishery in the past 20 years. Similarly, the aggregate (over 19) age group accounts for only 0.3% of the catch, and continues to be the lowest proportion for any New Zealand snapper stock. In 2004–05, Walsh et al. (2006b) reported that the aggregate age group in SNA 8 was unlikely to increase substantially for at least another 10 years, and based on current catch-at-age estimates for 2008–09, this may conceivably take even longer, despite a TACC reduction from

1500 to 1300 t in 1 October 2005. The implementation of a semi-fixed allocation otolith design for the age-length key was expected to increase the total number of fish for many of the larger length intervals, especially the aggregate (over 19 years) age group, compared to a proportional allocation otolith sample used in most previous years. Although 23 fish (5%) were allocated to the aggregate age group in the age-length key, this (as expected) had no obvious effect on increasing the proportion at age estimate (0.3%) after scaling with the proportion at length distribution, resulting in similar estimates to those derived in SNA 8 for the past 20 years. In fact, snapper from the very large length intervals in 2008–09 were generally infrequent in landings and therefore difficult to obtain (see Appendix 10). Those individuals making up the aggregate age group were most often large and ranged in size from 59 to 73 cm (see Appendix 9), over half of these from the previously dominant 1986, 1985, or 1984 year classes (23- to 25-year-olds) (see Appendix 10).

In 2005–06, Walsh et al. (2006a) reported an apparent broadening of the age distribution in SNA 8, compared to that seen a decade before when the population model estimated a decreasing population size (Davies et al. 2006). Walsh et al. (2009a) stated that the broadening of the age distribution appeared to be continuing in 2006–07, although the relative strengths of some previously dominant year classes (i.e., 1998, 1996, and 1995) that occupied the mid-age range, seemed less apparent, and may be a reflection of the selectivity of the single trawl method. In 2007–08, Walsh et al. (2009b) reported proportion at length and age estimates to be the narrowest seen for the last five years, and with current mean length and age at 35.2 cm and 5.7 years respectively in 2008–09, identical to the year before, suggests minimal change in the overall fishery population structure. Either historically high fishing mortality has reduced the relative abundance of the large and old fish, as has been observed in previous years (Davies & Walsh 1995), or recent year classes have recruited into the fishery with above average strength to dominate age distributions, as reported by Walsh et al. (2001, 2002). However, as proportional catch-at-age data are not a direct index of absolute abundance, inferences from these data in respect to changes in stock size are not totally reliable and should be treated with some care.

Two absolute stock biomass estimates derived from tagging programmes in the past 20 years and comprehensive catch-at-age based models (Davies 1997, Davies et al. 2006) have all pointed to the SNA 8 stock being of a size well below a biomass that would achieve the maximum sustainable yield. It is generally inferred that a long time series of catch-at-age data may also reveal consistent trends in the age composition of a stock, where a lightly fished population would likely contain a high proportion of older age classes and a heavily exploited population mainly young fish, for a moderate to long-lived species. The latter scenario is indicative of catch-at-age data collections made from the SNA 8 stock over the last 20 years, where proportion at age estimates are largely narrow, recruitment driven, based on only a few age classes, often where one or two dominate exclusively, and have a distinct lack of accumulation of fish in the older age classes. Although proportional catch-at-age data may not be a direct index of absolute abundance as mentioned above, the consistency seen in the long-term catch-at-age time series from SNA 8 implies that the biomass is low and has remained that way for the past two decades, consistent with the tagging programme absolute abundance estimates.

In 2007–08, Walsh et al. (2009b) predicted the newly recruited 2005 year class (3-year-olds at that time) to be of above average strength, and now fully recruited as 4-year-olds in 2008–09, a comparison relative to other year classes has further confirmed this. The 2005 year class is the singularly most dominant year class in the SNA 8 fishery in 2008–09, accounting for almost one in every three fish landed, and although unlikely to be as dominant as the previously strong 1998 year class with a relative strength predicted to be almost twice that of the mean (Davies et al. 2006), the 2005 year class will undoubtedly be important for the short term rebuilding of the SNA 8 stock.

The newly recruited 2006 year class (3-year-olds), although not yet fully recruited to the fishery, contains an appreciable proportion of fish in the smaller size classes, and appears to be of above average strength (perhaps slightly less dominant than the 2005 year class), making up about 11% of the single trawl catch by number in 2008–09. Those year classes that recruit at well above average strength as three year olds (i.e., more than 10% of the total age distribution) into the fishery (e.g. 1996, 1998, and 2005 year classes) most often appear in the length frequency distribution, either by broadening the distribution below 30 cm or appearing independently as a strong length mode dominating the 25–30 cm size classes (see Walsh et al. 2000, 2002, 2009b). This was also apparent for the 2006 year class in 2008–09 and may be the main reason for the little change in proportion at length and age distributions from that in 2007–08. A comparison of a fully recruited 2006 year class (as 4 year olds) relative to other year classes in 2009–10 will further confirm this.

As always, length and age collections were made over the spring and summer seasons, a period when the greatest proportion of snapper is usually caught, estimated at about 70% of the TACC for 2008–09. This was a considerable increase from the previous year, 2007–08, when the landed catch over the same period was estimated to be less than 50% of the TACC, possibly the lowest seen in SNA 8. This change could be directly attributed to a broadening of the fishing season in SNA 8 and a rationalisation (and subsequent decline in the number of vessels) of the Auckland-based inshore trawl fleet in response to the TACC reduction (October 2005), and economic and market related factors (Walsh et al. 2009a). In 2008–09, and similar to recent years, there continues to be an importance in the targeting of other species (i.e., trevally and red gurnard), over a longer period to provide better financial returns, where snapper is more regularly now taken as a bycatch or secondary catch to another species (see Appendix 5b). There has also been a noticeable shift in the fishing methods used in SNA 8, with single trawl now by far the dominant method, and a considerable reduction in the pair trawl effort in 2008–09 to a level that now equals the catch of a small but steadily developing west coast Danish seine fishery, largely based on targeting species other than snapper.

The 15 sampled single trawl landings in the spring and summer of 2008–09 came from five different vessels fishing out of Onehunga. Sample collections generally reflected the temporal fishing activity of the sampling period, with seven and eight samples made over spring and summer seasons respectively. The average sampled landing weight over spring 2008–09 was about 8 t, down from the 2007–08 estimate of 11 t, and much less than that seen in 2006–07 and years before this, when landings over 20 t were common place. The average landing sampled over summer was about 6 t. Similar to previous years, most of the spring sampled landings in 2008–09 were from vessels operating mainly in an area off the Kaipara and Manukau Harbours (source: TCEPR reports) and contained a slightly higher proportion of fish in the mid-length and age ranges compared to summer samples, which contained a slightly higher proportion of small young fish. Length summaries from single trawl vessels operating over summer contained a greater proportion of catches from other areas, especially North Taranaki Bight, where a high proportion of smaller fish are known to be more frequent (Reid 1969, Walsh et al. 2006c), although the greatest effort was still from around the greater Kaipara and Manukau Harbour area. Although spring landings contained some catches where snapper was the primary target, summer landings, as seen in past years, were almost exclusively the bycatch of a trevally target fishery. Walsh et al. (2006c) found that the similarity in the length distributions within a season is almost certainly related to the area that the vessels fished rather than a reflection of any seasonal or bycatch aspect of the fishery. However, as the areas fished were generally similar between the seasons, the minor differences seen in the length samples for spring and summer in 2008–09 may in part reflect a combination of all these factors. Many vessel landings were made up of individual long range fishing events that covered a number of sub-area strata on a single trip, therefore comprising catches of snapper from many parts of SNA 8, albeit largely north of New Plymouth. It is expected that the derived proportional length and age estimates from these landings are adequate and representative descriptions of the temporal and spatial spread of catches from the SNA 8 fishery for 2008–09, and are therefore comparable to those collections from past years over the 'school season', although snapper may have been more frequently used as the target species before the TACC reduction in October 2005.

The MWCV (analytical and bootstrap estimates) for the length and age distributions sampled from the SNA 8 single trawl fishery in 2008–09 ranged between 0.11 and 0.17, with all analytical estimates being below 0.20. Differences were apparent between the analytical and bootstrap variances of proportion-at-length and proportion-at-age estimates with the bootstrap variances being higher, particularly in the less abundant length and age classes respectively, i.e., small and large, young and old. The bootstrap solutions probably provide more accurate variance estimates (Davies et al. 2003). The level of precision in the catch-at-age estimates has been similar in recent years and reflects the rigorous sampling methodology and precise and accurate ageing currently in place.

## 5. CONCLUSIONS

1. The length and age distributions sampled from the SNA 8 single trawl fishery in 2008–09 were generally consistent with trends observed in recent years.

2. Single trawl landings from the SNA 8 fishery in 2008–09 were largely dominated by young fish, 3 to 7 years of age from the 2002–2006 year classes, making up 85% of the number of snapper landed. Almost one-third (30%) of the total landed catch was solely attributable to the dominant 2005 year class (4-year-olds), which is likely to be important for the short term rebuild of the fishery.

3. The combined total for fish over 11 years of age made up only 2% of the single trawl catch-at-age distribution in 2008–09. The previously dominant 1998 and 1996 year classes (11- and 13-year-olds) are now poorly represented in catch-at-age estimates for two main reasons: 1) a high proportion of fish in these cohorts now exceed the optimum selectivity of the single trawl method, and 2) lower relative abundance in the fishery as a result of fishing mortality.

4. Despite efforts to fill out the right hand limb of the age-length key collection large, old fish have progressively become more difficult to obtain, resulting in the relative proportion of fish in the aggregate (over 19) age group being very low (0.3%), the lowest estimate for any New Zealand snapper stock.

5. The newly recruited 2006 year class (3-year-olds), although not yet fully recruited to the fishery, contains an appreciable proportion of fish in the smaller size classes, and appears to be of above average strength, making up about 11% of the single trawl catch by number in 2008–09.

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Walsh, C.; Hartill, B.; Davies, N.M. (2000). Length and age composition of commercial snapper landings in SNA 1 and SNA 8, 1998–99. *NIWA Technical Report 78.* 30 p.

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**Table 1: Summary of the catch (total number and weight of landings) and samples (number of landings and weight sampled, and number of fish measured) in method–season strata for the SNA 8 snapper fisheries from autumn 2008 to summer 2008–09.***

| | | Number of landings | | | No. of fish | Weight of landings (t) | | |
|---|---|---|---|---|---|---|---|---|
| Method | Season | Total | Sampled | % of total | measured | Total | Sampled | % of total |
| BPT | Autumn | 19 | 0 | 0 | 0 | 25 | 0 | 0 |
| | Winter | 20 | 0 | 0 | 0 | 33 | 0 | 0 |
| | Spring | 12 | 0 | 0 | 0 | 23 | 0 | 0 |
| | Summer | 16 | 0 | 0 | 0 | 37 | 0 | 0 |
| BT | Autumn | 103 | 0 | 0 | 0 | 214 | 0 | 0 |
| | Winter | 89 | 0 | 0 | 0 | 185 | 0 | 0 |
| | Spring | 94 | 7 | 7.4 | 5 906 | 362 | 54 | 14.9 |
| | Summer | 103 | 8 | 7.8 | 5 604 | 347 | 55 | 15.9 |
| DS | Autumn | 21 | 0 | 0 | 0 | 27 | 0 | 0 |
| | Winter | 8 | 0 | 0 | 0 | 10 | 0 | 0 |
| | Spring | 23 | 0 | 0 | 0 | 29 | 0 | 0 |
| | Summer | 22 | 0 | 0 | 0 | 32 | 0 | 0 |

* BPT, pair trawl; BT, single trawl, DS, Danish seine.

**Table 2: Details of snapper otolith samples collected in 2008–09 from SNA 8.**

| Area | Fishing method † | Sampling period | Sample method †† | Length range (cm) | No. aged |
|---|---|---|---|---|---|
| SNA 8 | BT | Spring, summer | SR | 24–73 | 511 |

† BT, single trawl.
†† SR, stratified random sample.

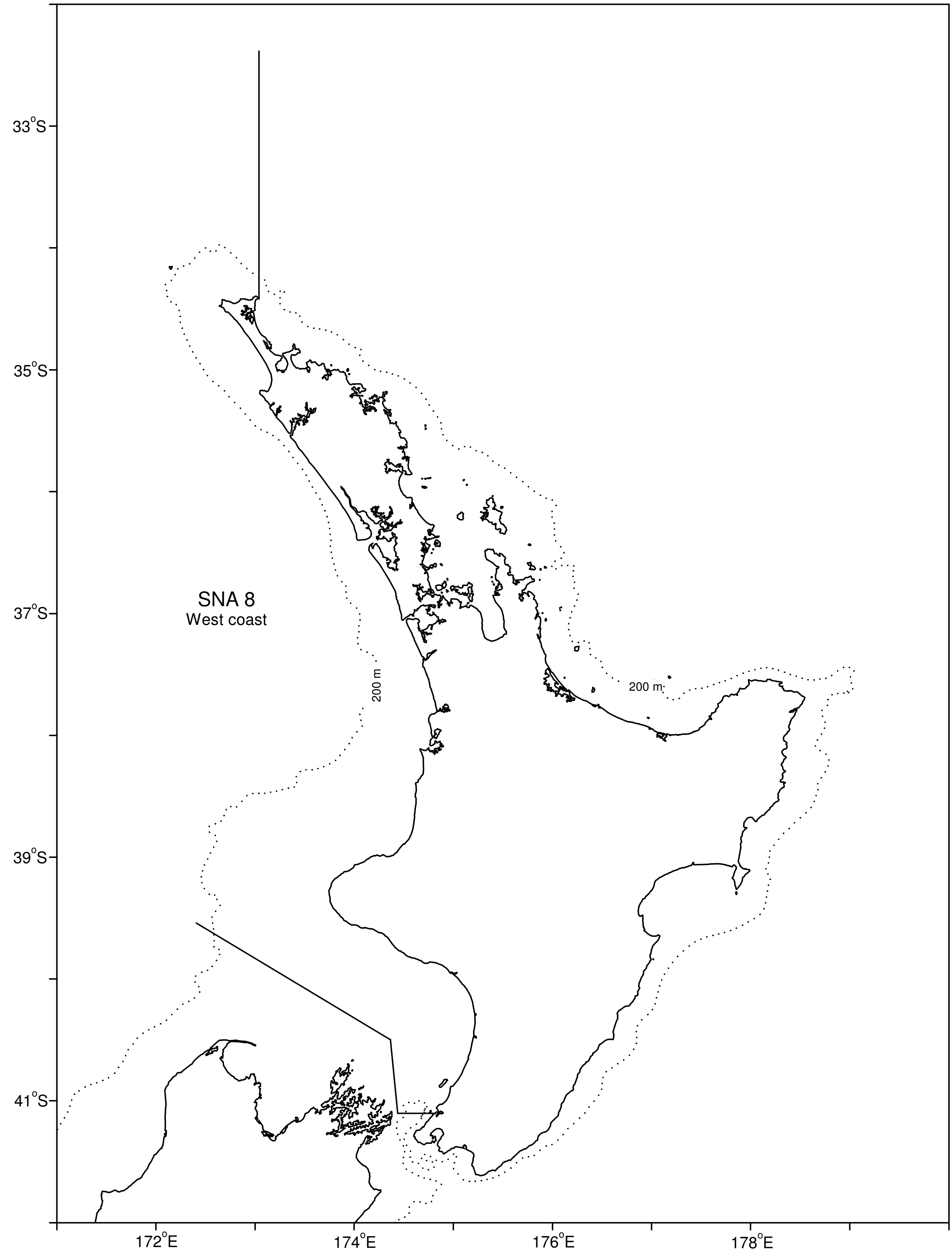



**Figure 1: Quota management area for the west coast North Island snapper stock, SNA 8.**

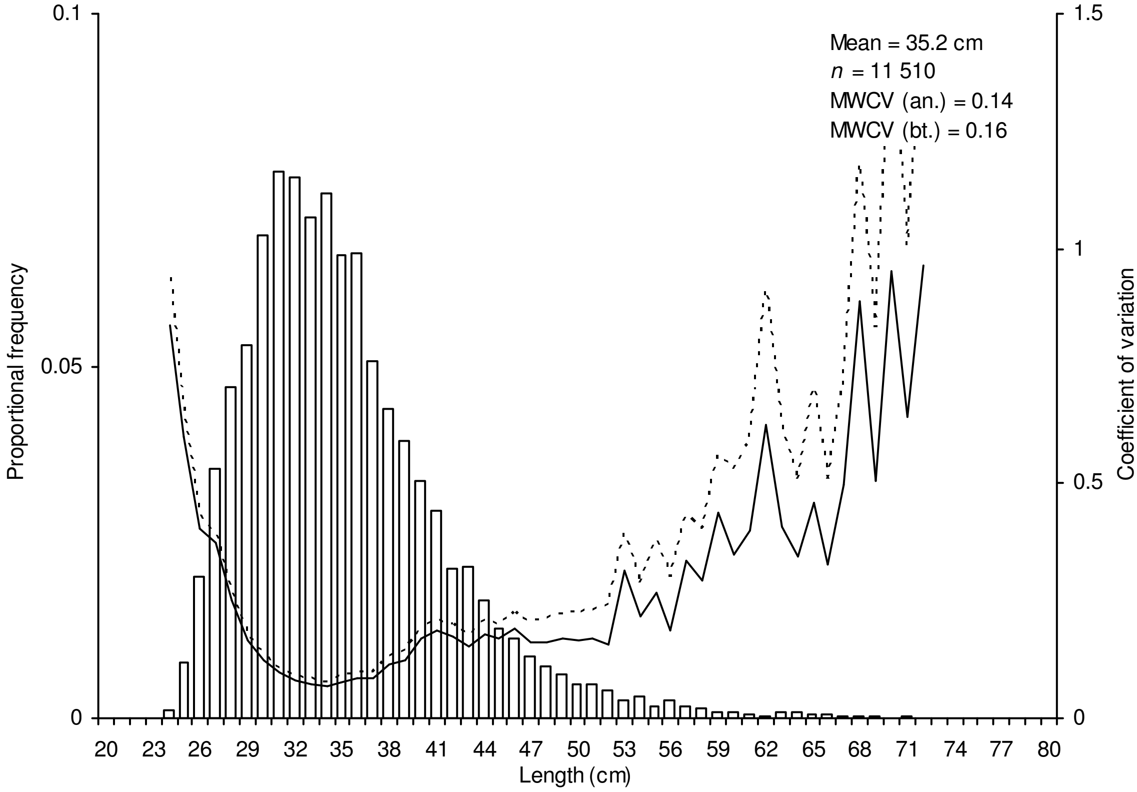



**Figure 2: Proportion at length distribution (histogram) and analytical (solid line) and bootstrap (dashed line) c.v.s determined from snapper landings sampled from the SNA 8 single trawl fishery in 2008–09 (n, length sample size; MWCV, mean weighted c.v.).**

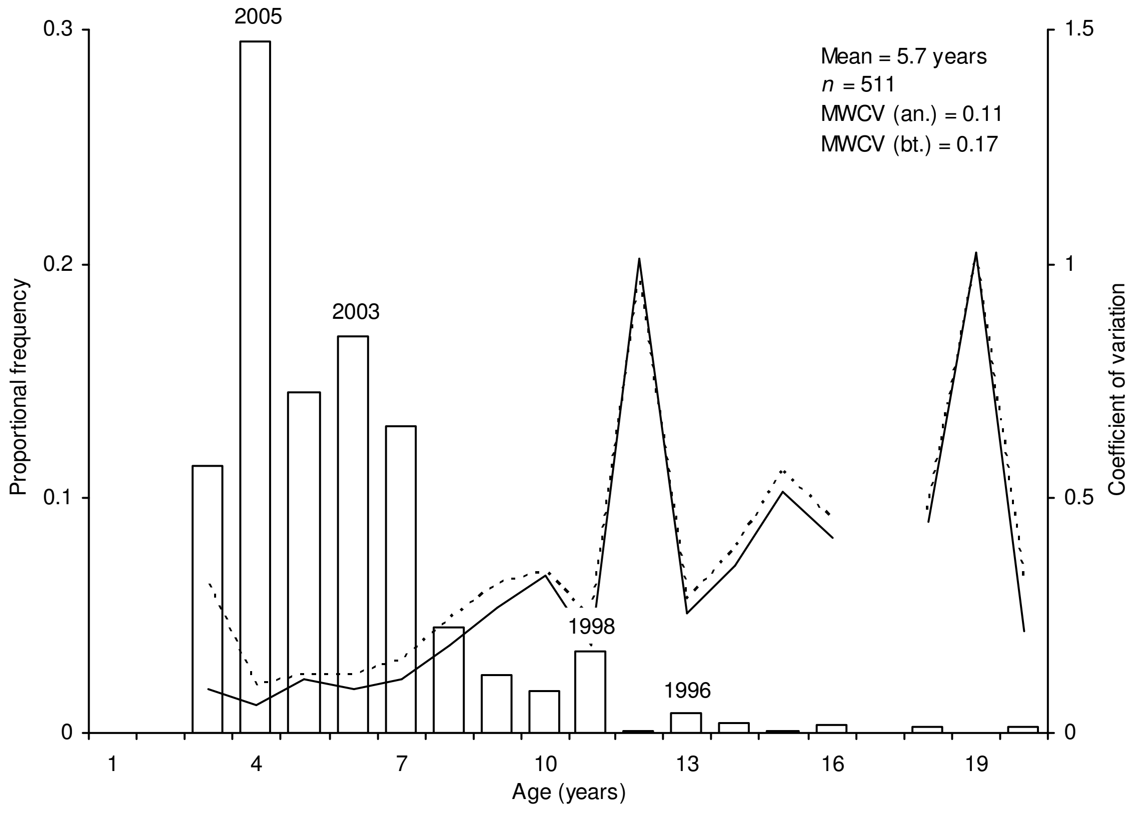



**Figure 3: Proportion at age distribution (histogram) and analytical (solid line) and bootstrap (dashed line) c.v.s determined from snapper landings sampled from the SNA 8 single trawl fishery in 2008–09 using the age-length key approach (*n,* otolith sample size; MWCV, mean weighted c.v.).**

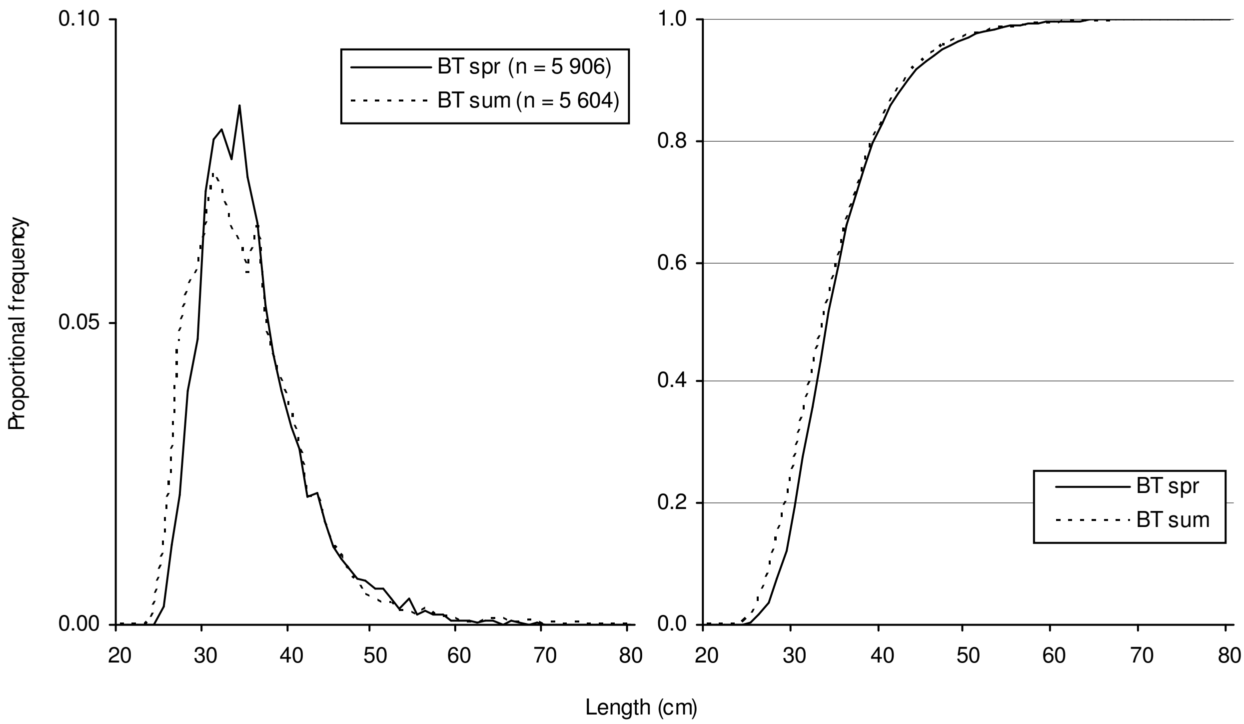



**Figure 4: Comparison of the proportion and cumulative proportion at length distributions determined from snapper landings sampled over the spring and summer seasons from the SNA 8 single trawl fishery in 2008–09 (*n*, sample size).**

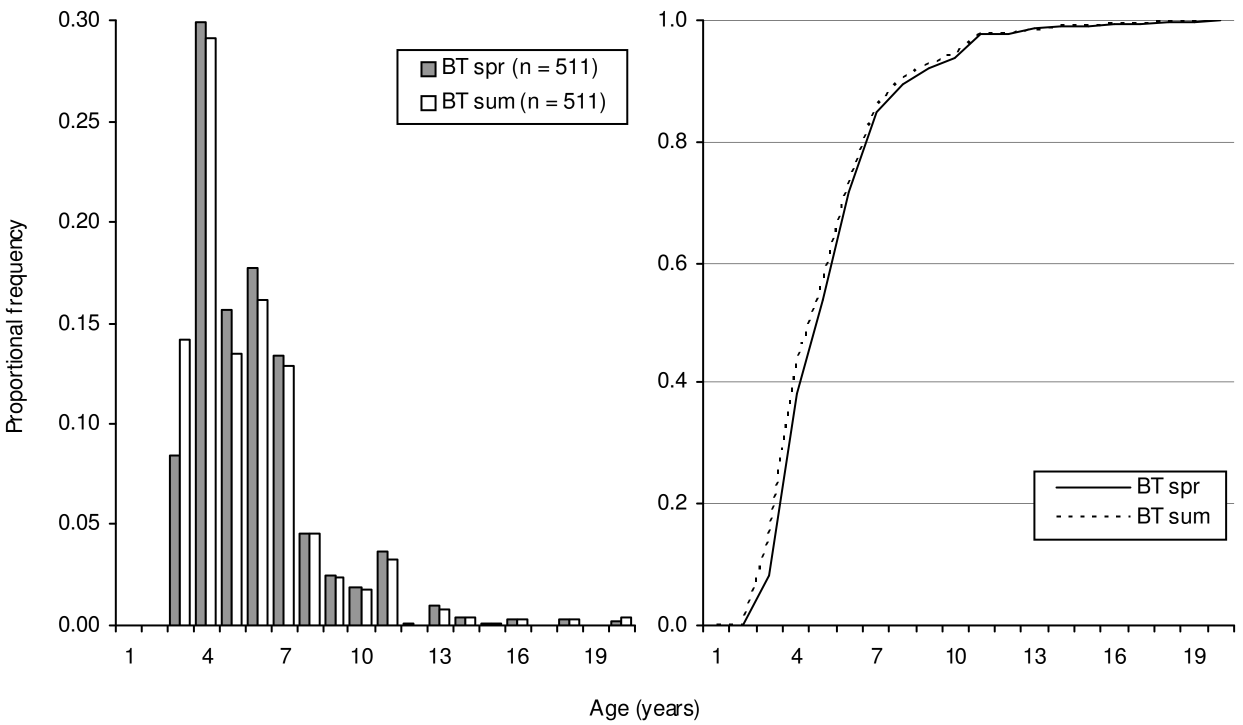
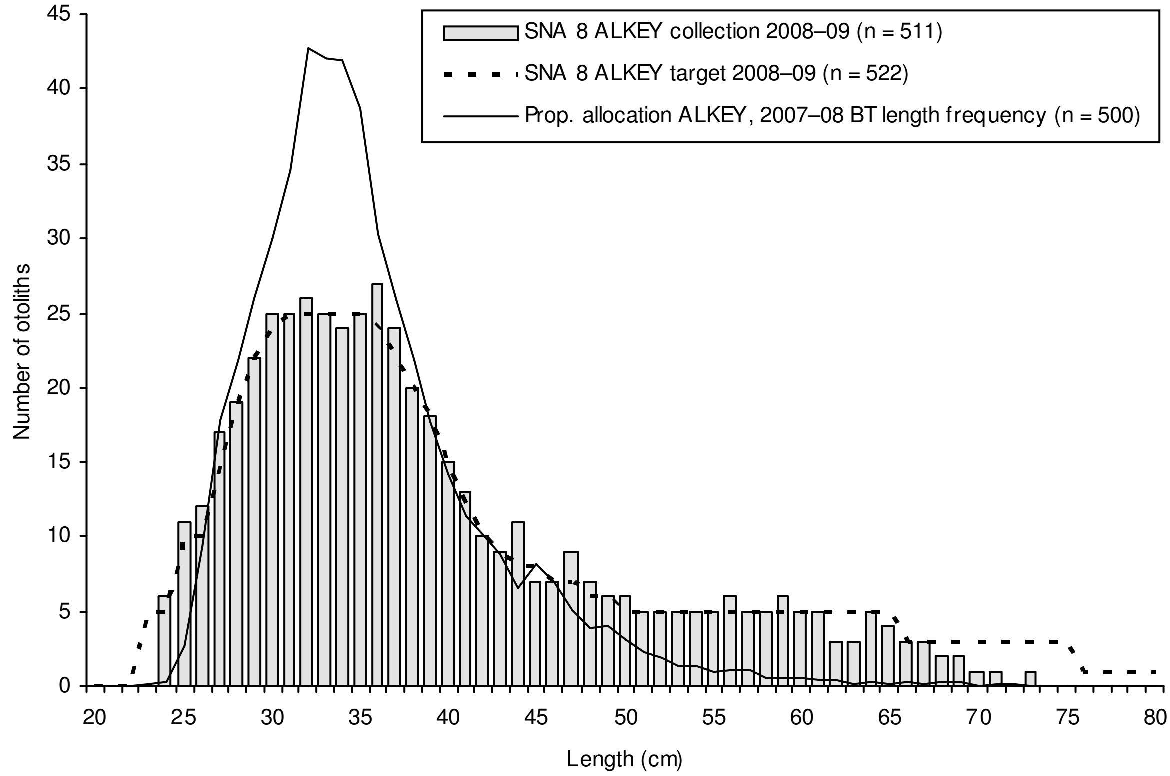
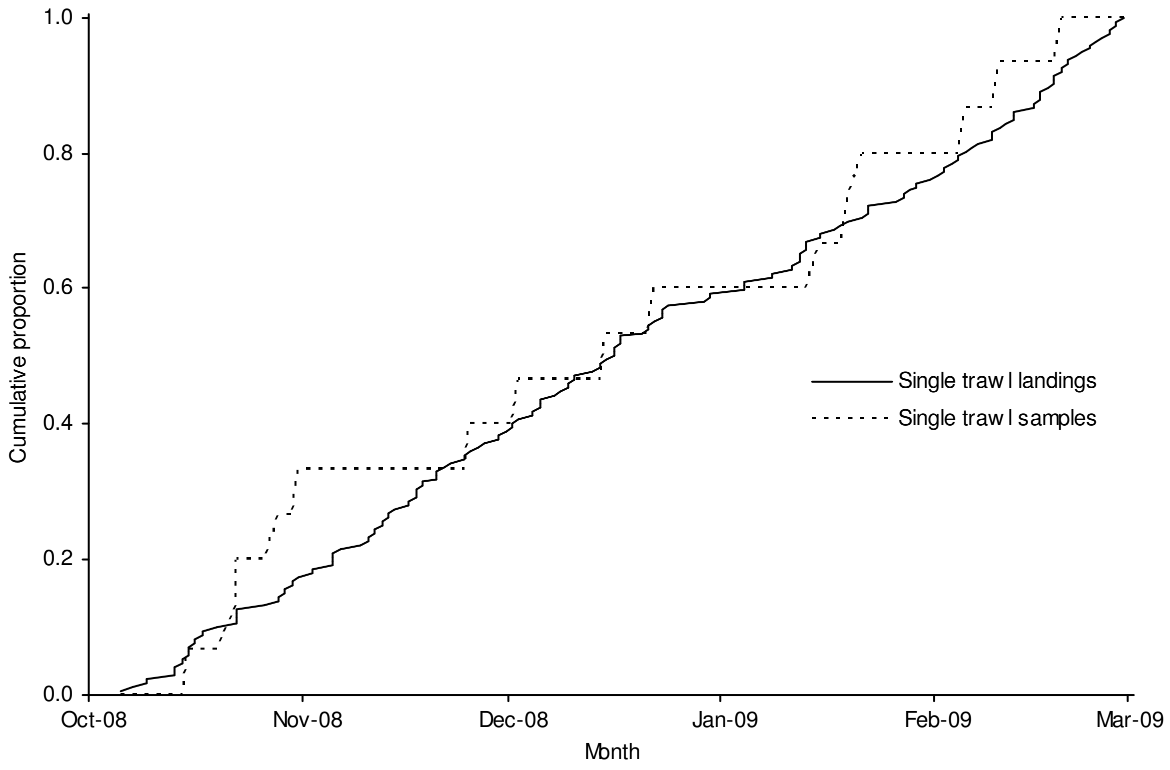



**Figure 5: Comparison of the proportion and cumulative proportion at age distributions determined from snapper landings sampled over the spring and summer seasons from the SNA 8 single trawl fishery in 2008–09 (*n*, age-length key sample size).**

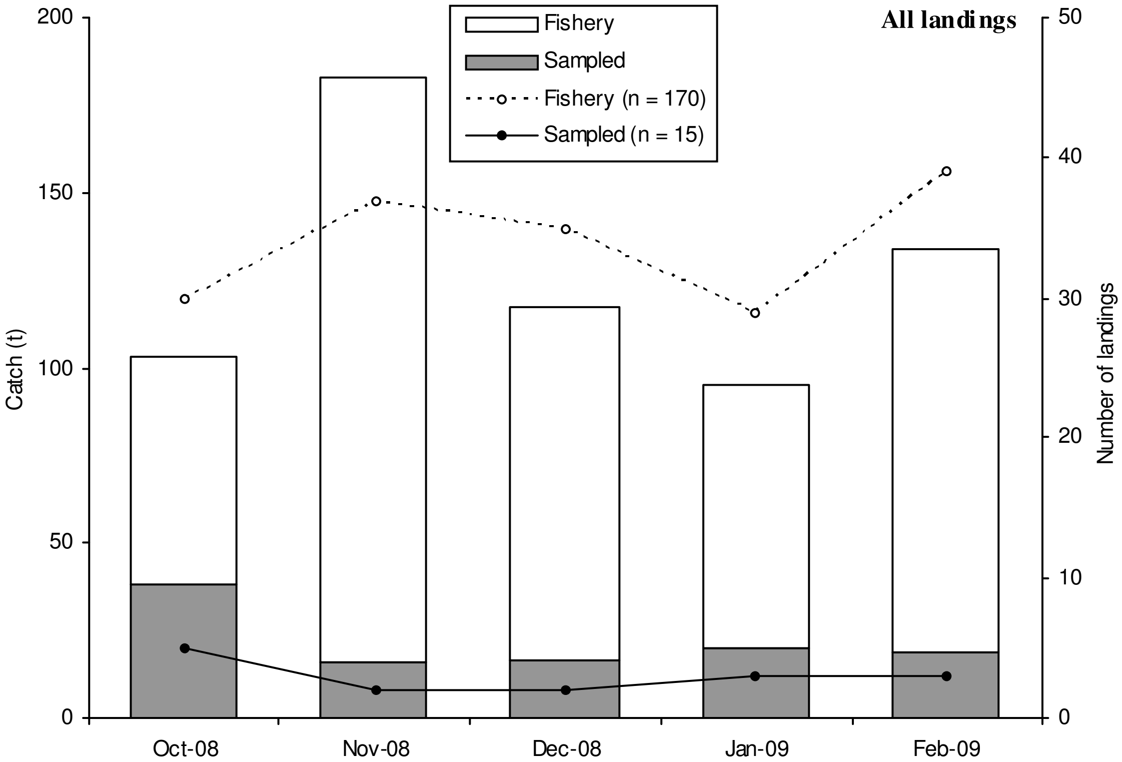
**Appendix 1: Length distributions of the target semi-fixed allocation otolith sample (dashed line) and the achieved otolith collection (histogram) from SNA 8 in 2008–09. For comparison, the proportional allocation otolith sample of 500 fish based on the single trawl length distribution from 2007–08 is also given (solid line).**



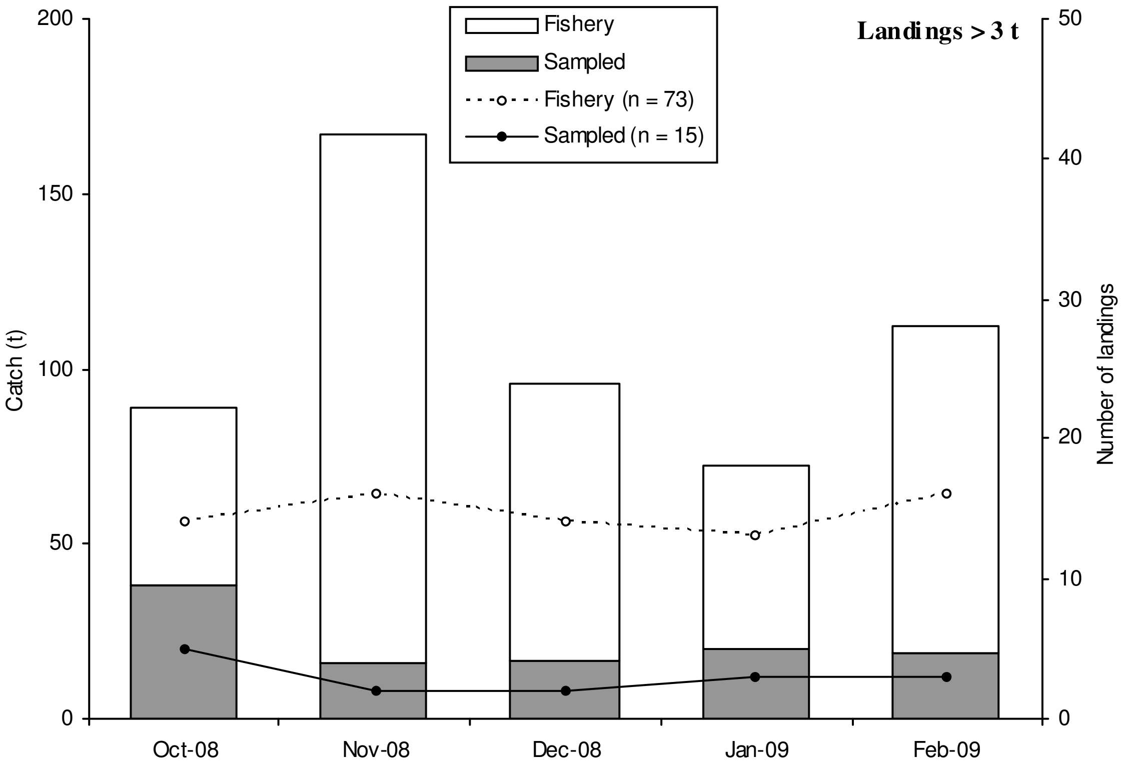

**Appendix 2: The cumulative proportion of the number of landings and samples taken from the SNA 8 single trawl fishery in 2008–09.**



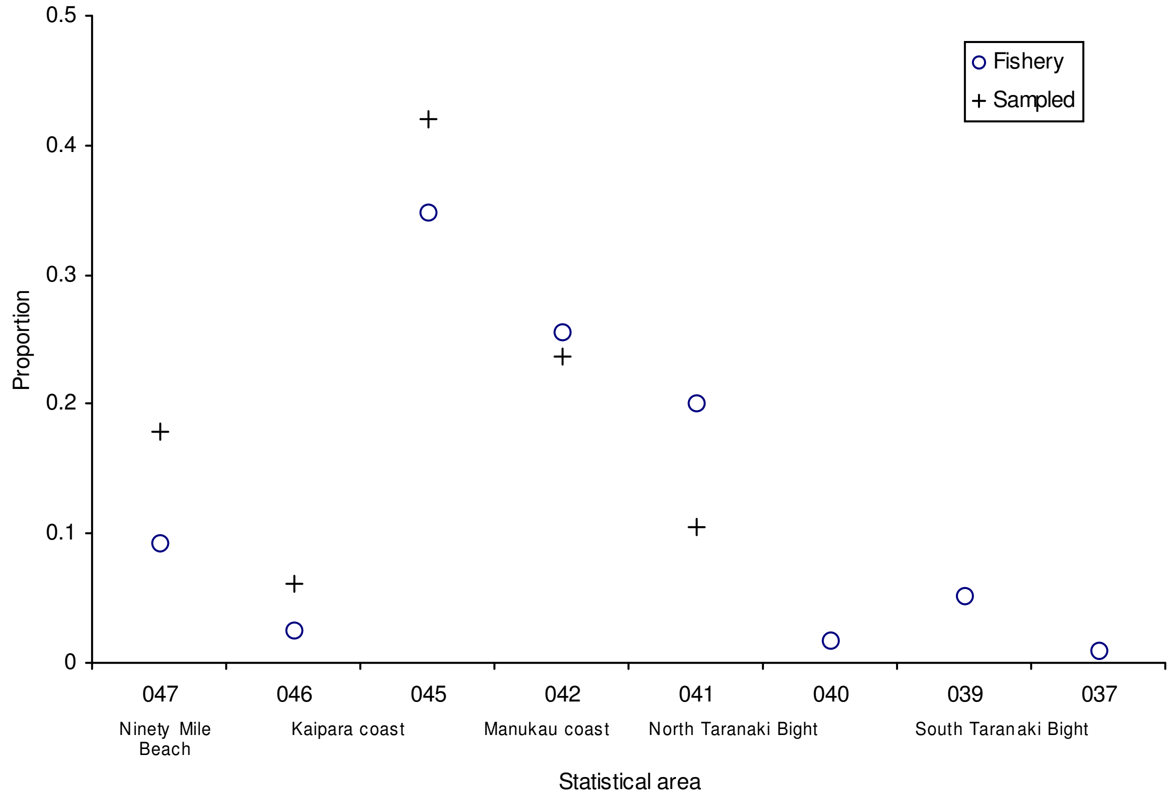
**Appendix 3: Comparison of the monthly distribution of landed weight (histograms) and numbers of landings (lines) of snapper in the SNA 8 single trawl fishery from October 2008 to February 2009 for all landings where snapper was caught. Included are corresponding estimates for all sampled landings to show representivity of collections.**



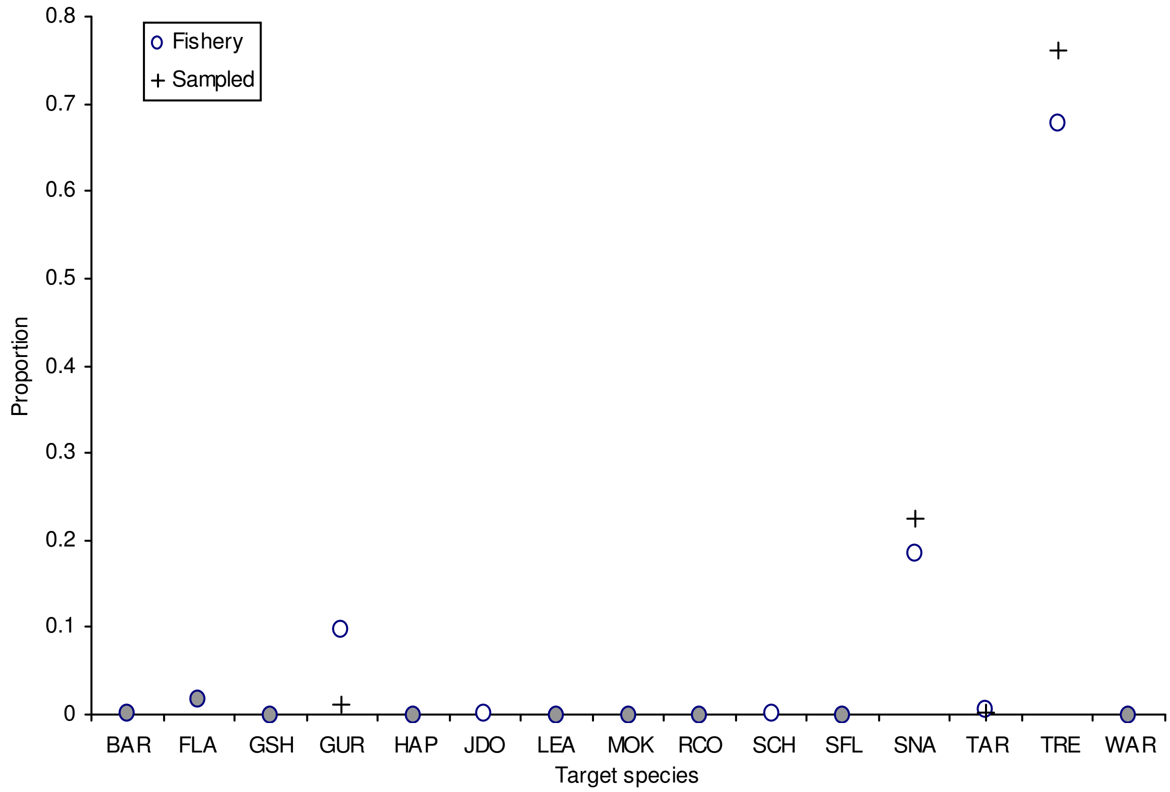

**Appendix 4: Comparison of the monthly distribution of landed weight (histograms) and numbers of landings (lines) of snapper in the SNA 8 single trawl fishery from October 2008 to February 2009 for all landings > 3 tonnes. Included are corresponding estimates for all sampled landings to show representivity of collections.**



**Appendix 5a: Comparison of the proportional distribution of the estimated single trawl catch and the sampled component by statistical area (with annotated spatial strata) over the sampling period for the SNA 8 stock in 2008–09.**




**Appendix 5b: Comparison of the proportional distribution of the estimated single trawl catch and the sampled component by target species over the sampling period for the SNA 8 stock in 2008–09. Shaded circles designate target species almost exclusively used in South Taranaki Bight stratum (statistical areas 037, 039, 040).**



**Appendix 6: Estimates of proportion at length with c.v.s (analytical and bootstrap estimates) for snapper from the SNA 8 single trawl fishery in 2008–09.**
**Spr-sum estimates are based on a combined stratum, not the sum of spring and summer values.**

*P.i.* = proportion of fish in length class. *Nt* = total number of fish caught.
c.v. = coefficient of variation. *n* = total number of fish sampled.

| | | | | | Single trawl | | |
|---|---|---|---|---|---|---|---|
| Length | Spring | | Summer | | Spr-sum | | |
| (cm) | *P.i.* | c.v. (an) | *P.i.* | c.v. (an) | *P.i.* | c.v. (an) | c.v. (bt) |
| 20 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.00 |
| 21 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.00 |
| 22 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.00 |
| 23 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.00 |
| 24 | 0.0000 | 0.00 | 0.0022 | 0.81 | 0.0011 | 0.84 | 0.94 |
| 25 | 0.0030 | 0.30 | 0.0128 | 0.71 | 0.0080 | 0.60 | 0.65 |
| 26 | 0.0133 | 0.23 | 0.0266 | 0.58 | 0.0201 | 0.40 | 0.43 |
| 27 | 0.0215 | 0.22 | 0.0483 | 0.51 | 0.0352 | 0.37 | 0.39 |
| 28 | 0.0383 | 0.19 | 0.0556 | 0.40 | 0.0472 | 0.25 | 0.27 |
| 29 | 0.0470 | 0.17 | 0.0590 | 0.27 | 0.0532 | 0.16 | 0.18 |
| 30 | 0.0719 | 0.09 | 0.0655 | 0.24 | 0.0686 | 0.12 | 0.14 |
| 31 | 0.0804 | 0.05 | 0.0751 | 0.19 | 0.0777 | 0.10 | 0.11 |
| 32 | 0.0820 | 0.07 | 0.0719 | 0.14 | 0.0768 | 0.08 | 0.09 |
| 33 | 0.0769 | 0.06 | 0.0656 | 0.13 | 0.0711 | 0.07 | 0.08 |
| 34 | 0.0860 | 0.06 | 0.0636 | 0.10 | 0.0745 | 0.07 | 0.08 |
| 35 | 0.0739 | 0.09 | 0.0583 | 0.12 | 0.0659 | 0.08 | 0.09 |
| 36 | 0.0664 | 0.06 | 0.0660 | 0.16 | 0.0662 | 0.09 | 0.10 |
| 37 | 0.0530 | 0.08 | 0.0486 | 0.16 | 0.0507 | 0.08 | 0.10 |
| 38 | 0.0444 | 0.04 | 0.0433 | 0.23 | 0.0438 | 0.11 | 0.13 |
| 39 | 0.0385 | 0.08 | 0.0399 | 0.23 | 0.0392 | 0.12 | 0.14 |
| 40 | 0.0325 | 0.07 | 0.0344 | 0.32 | 0.0335 | 0.17 | 0.19 |
| 41 | 0.0289 | 0.16 | 0.0297 | 0.33 | 0.0293 | 0.18 | 0.21 |
| 42 | 0.0211 | 0.06 | 0.0211 | 0.34 | 0.0211 | 0.17 | 0.20 |
| 43 | 0.0216 | 0.13 | 0.0214 | 0.28 | 0.0215 | 0.15 | 0.18 |
| 44 | 0.0167 | 0.10 | 0.0165 | 0.34 | 0.0166 | 0.18 | 0.21 |
| 45 | 0.0127 | 0.14 | 0.0127 | 0.31 | 0.0127 | 0.17 | 0.20 |
| 46 | 0.0110 | 0.16 | 0.0113 | 0.35 | 0.0112 | 0.19 | 0.22 |
| 47 | 0.0091 | 0.13 | 0.0083 | 0.32 | 0.0087 | 0.16 | 0.20 |
| 48 | 0.0075 | 0.14 | 0.0072 | 0.30 | 0.0074 | 0.16 | 0.21 |
| 49 | 0.0074 | 0.17 | 0.0050 | 0.33 | 0.0061 | 0.17 | 0.22 |
| 50 | 0.0058 | 0.24 | 0.0040 | 0.24 | 0.0049 | 0.17 | 0.23 |
| 51 | 0.0058 | 0.14 | 0.0037 | 0.37 | 0.0047 | 0.17 | 0.23 |
| 52 | 0.0043 | 0.15 | 0.0035 | 0.30 | 0.0039 | 0.16 | 0.24 |
| 53 | 0.0027 | 0.38 | 0.0023 | 0.54 | 0.0025 | 0.31 | 0.39 |
| 54 | 0.0042 | 0.29 | 0.0022 | 0.29 | 0.0032 | 0.22 | 0.29 |
| 55 | 0.0015 | 0.34 | 0.0017 | 0.42 | 0.0016 | 0.27 | 0.38 |
| 56 | 0.0023 | 0.27 | 0.0027 | 0.28 | 0.0025 | 0.19 | 0.30 |
| 57 | 0.0016 | 0.39 | 0.0017 | 0.55 | 0.0017 | 0.33 | 0.43 |
| 58 | 0.0018 | 0.14 | 0.0013 | 0.69 | 0.0015 | 0.29 | 0.40 |
| 59 | 0.0006 | 0.76 | 0.0014 | 0.53 | 0.0010 | 0.43 | 0.56 |
| 60 | 0.0008 | 0.38 | 0.0007 | 0.63 | 0.0008 | 0.35 | 0.53 |
| 61 | 0.0007 | 0.35 | 0.0004 | 0.89 | 0.0006 | 0.40 | 0.59 |
| 62 | 0.0004 | 0.59 | 0.0000 | 0.00 | 0.0002 | 0.62 | 0.92 |
| 63 | 0.0007 | 0.35 | 0.0008 | 0.69 | 0.0007 | 0.41 | 0.62 |
| 64 | 0.0007 | 0.48 | 0.0009 | 0.51 | 0.0008 | 0.34 | 0.50 |
| 65 | 0.0000 | 0.00 | 0.0008 | 0.43 | 0.0004 | 0.46 | 0.70 |
| 66 | 0.0005 | 0.48 | 0.0006 | 0.47 | 0.0005 | 0.33 | 0.50 |
| 67 | 0.0003 | 0.61 | 0.0003 | 0.85 | 0.0003 | 0.49 | 0.73 |
| 68 | 0.0000 | 0.00 | 0.0005 | 0.85 | 0.0003 | 0.89 | 1.18 |
| 69 | 0.0002 | 0.89 | 0.0004 | 0.63 | 0.0003 | 0.50 | 0.83 |
| 70 | 0.0000 | 0.00 | 0.0001 | 0.99 | 0.0001 | 0.96 | 1.44 |
| 71 | 0.0002 | 0.96 | 0.0002 | 0.89 | 0.0002 | 0.64 | 1.01 |
| 72 | 0.0000 | 0.00 | 0.0001 | 1.01 | 0.0000 | 0.97 | 1.46 |
| 73 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.00 |
| 74 | 0.0000 | 0.00 | 0.0003 | 0.85 | 0.0001 | 0.89 | 1.35 |
| 75 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.00 |
| 76 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.00 |
| 77 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.00 |
| 78 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.00 |
| 79 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.00 |
| 80 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.00 |
| *Nt* | 352 267 | | 349 378 | | 702 020 | | |
| *n* | 5 906 | | 5 604 | | 11 510 | | |

**Appendix 7: Estimates of proportion at age with c. v.s (analytical and bootstrap estimates) for snapper from the SNA 8 single trawl fishery in 2008–09.**

*P.j.,* proportion of fish in age class; c.v., coefficient of variation; otolith sample size = 511

| Age | Single trawl | | | | | | |
|---|---|---|---|---|---|---|---|
| | Spring | | Summer | | Spr-sum | | |
| (years) | *P.j.* | c.v. (an) | *P.j.* | c.v. (an) | *P.j.* | c.v. (an) | c.v. (bt) |
| 1 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.00 |
| 2 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.00 |
| 3 | 0.0837 | 0.12 | 0.1425 | 0.08 | 0.1139 | 0.09 | 0.32 |
| 4 | 0.2989 | 0.06 | 0.2913 | 0.06 | 0.2950 | 0.06 | 0.10 |
| 5 | 0.1572 | 0.11 | 0.1347 | 0.11 | 0.1456 | 0.11 | 0.12 |
| 6 | 0.1775 | 0.10 | 0.1614 | 0.10 | 0.1692 | 0.09 | 0.12 |
| 7 | 0.1328 | 0.12 | 0.1279 | 0.11 | 0.1303 | 0.11 | 0.16 |
| 8 | 0.0454 | 0.19 | 0.0452 | 0.19 | 0.0453 | 0.19 | 0.24 |
| 9 | 0.0247 | 0.27 | 0.0240 | 0.27 | 0.0243 | 0.27 | 0.32 |
| 10 | 0.0187 | 0.34 | 0.0173 | 0.34 | 0.0180 | 0.33 | 0.34 |
| 11 | 0.0366 | 0.18 | 0.0324 | 0.19 | 0.0344 | 0.19 | 0.24 |
| 12 | 0.0008 | 1.02 | 0.0004 | 1.04 | 0.0006 | 1.01 | 0.97 |
| 13 | 0.0096 | 0.26 | 0.0079 | 0.26 | 0.0087 | 0.25 | 0.28 |
| 14 | 0.0043 | 0.38 | 0.0038 | 0.35 | 0.0040 | 0.36 | 0.39 |
| 15 | 0.0011 | 0.52 | 0.0012 | 0.55 | 0.0012 | 0.51 | 0.56 |
| 16 | 0.0028 | 0.46 | 0.0032 | 0.40 | 0.0030 | 0.41 | 0.45 |
| 17 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.0000 | 0.00 | 0.00 |
| 18 | 0.0031 | 0.50 | 0.0026 | 0.42 | 0.0029 | 0.45 | 0.48 |
| 19 | 0.0003 | 1.05 | 0.0003 | 1.05 | 0.0003 | 1.03 | 1.01 |
| >19 | 0.0023 | 0.29 | 0.0036 | 0.24 | 0.0029 | 0.22 | 0.32 |

**Appendix 8: Estimated mean weight-at-age (kg) and c.v.s for snapper from the SNA 8 single trawl fishery in 2008–09.**

c.v., coefficient of variation; otolith sample size = 511

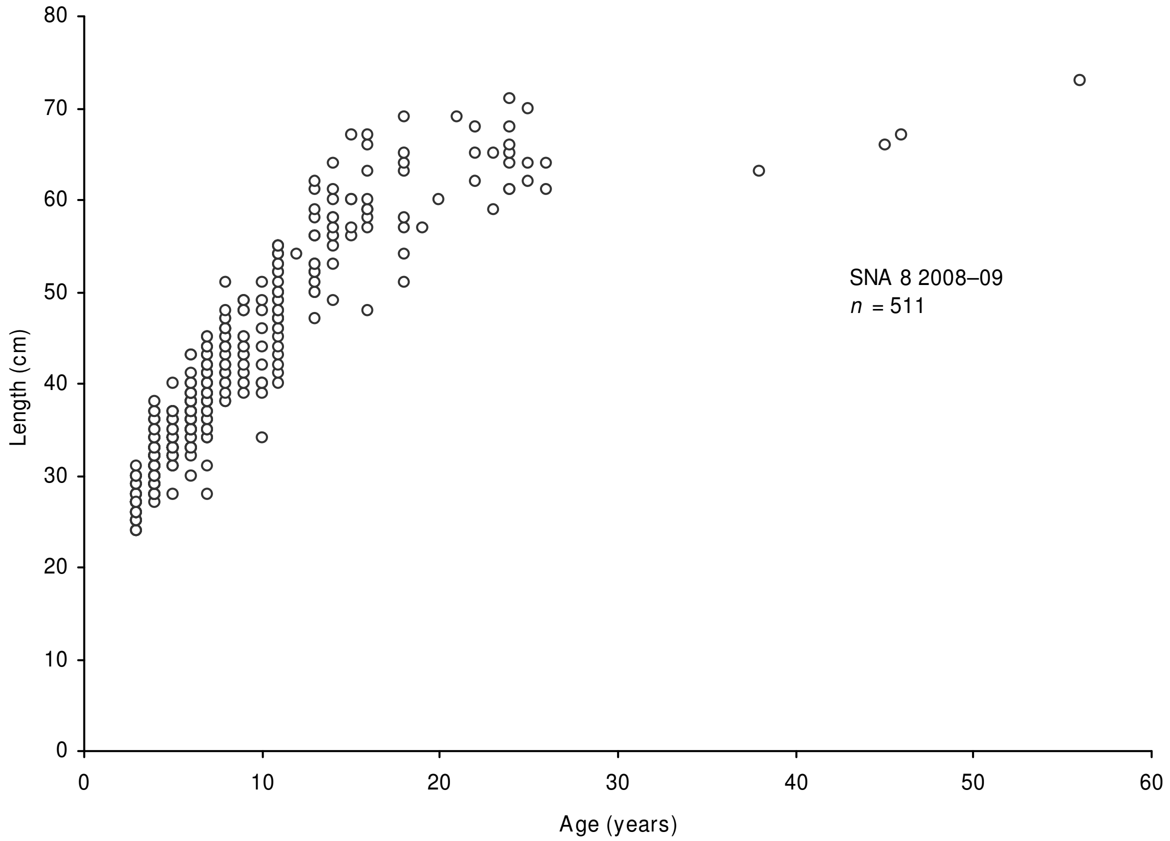
| Age | Single trawl | | | | | | |
|---|---|---|---|---|---|---|---|
| | Spring | | Summer | | Spr-sum | | |
| (years) | Mean | c.v. | Mean | c.v. | Mean | c.v. | *n* |
| 1 | – | – | – | – | – | – | – |
| 2 | – | – | – | – | – | – | – |
| 3 | 0.50 | 0.02 | 0.46 | 0.02 | 0.48 | 0.02 | 65 |
| 4 | 0.68 | 0.02 | 0.67 | 0.02 | 0.67 | 0.02 | 107 |
| 5 | 0.85 | 0.02 | 0.85 | 0.02 | 0.85 | 0.02 | 53 |
| 6 | 1.02 | 0.02 | 1.04 | 0.02 | 1.03 | 0.02 | 70 |
| 7 | 1.22 | 0.03 | 1.23 | 0.03 | 1.22 | 0.03 | 57 |
| 8 | 1.65 | 0.04 | 1.63 | 0.04 | 1.64 | 0.04 | 26 |
| 9 | 1.71 | 0.05 | 1.68 | 0.05 | 1.70 | 0.05 | 14 |
| 10 | 1.53 | 0.11 | 1.52 | 0.10 | 1.53 | 0.10 | 10 |
| 11 | 2.15 | 0.05 | 2.09 | 0.05 | 2.12 | 0.05 | 33 |
| 12 | 3.08 | – | 3.08 | – | 3.08 | – | 1 |
| 13 | 2.81 | 0.04 | 2.84 | 0.04 | 2.82 | 0.04 | 16 |
| 14 | 3.22 | 0.09 | 3.28 | 0.07 | 3.25 | 0.08 | 11 |
| 15 | 3.88 | 0.07 | 3.81 | 0.07 | 3.84 | 0.07 | 5 |
| 16 | 3.44 | 0.15 | 3.54 | 0.13 | 3.50 | 0.14 | 11 |
| 17 | – | – | – | – | – | – | – |
| 18 | 3.34 | 0.10 | 3.77 | 0.12 | 3.54 | 0.11 | 8 |
| 19 | 3.58 | – | 3.58 | – | 3.58 | – | 1 |
| >19 | 4.93 | 0.04 | 5.24 | 0.03 | 5.12 | 0.03 | 23 |

**Appendix 9: Age-length key derived from otolith samples collected from snapper fisheries in SNA 8 in 2008–09.**

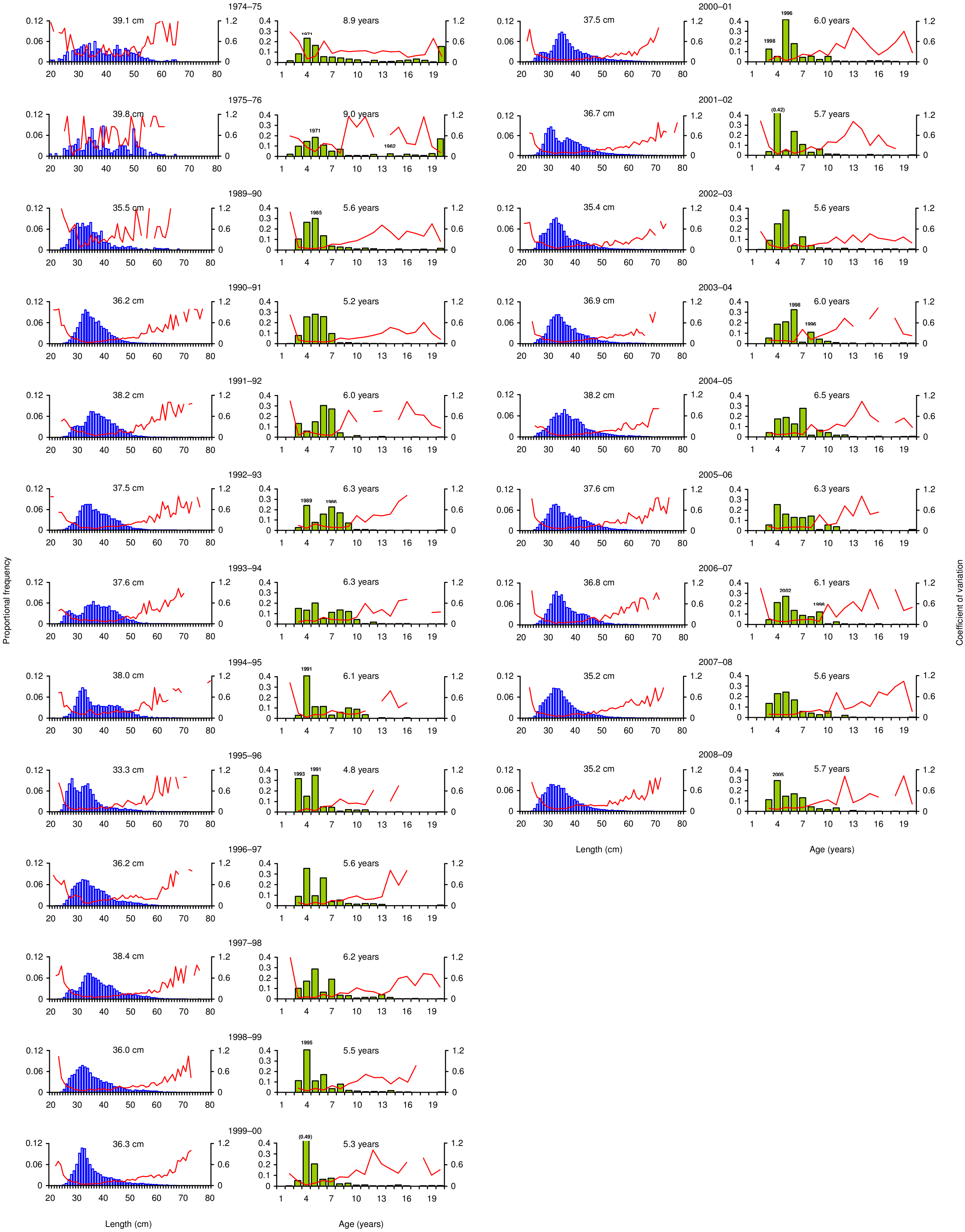
**Estimates of proportion of age at length for snapper sampled from SNA 8, spring and summer 2008–09. (Note: Aged to 01/01/2009)**

| Length | Age (years) | | | | | | | | | | | | | | | | | | | | No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (cm) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | >19 | aged |
| 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 | 0 | 0 | 1.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| 25 | 0 | 0 | 1.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| 26 | 0 | 0 | 1.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| 27 | 0 | 0 | 0.94 | 0.06 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 |
| 28 | 0 | 0 | 0.42 | 0.47 | 0.05 | 0 | 0.05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 19 |
| 29 | 0 | 0 | 0.23 | 0.77 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22 |
| 30 | 0 | 0 | 0.24 | 0.72 | 0 | 0.04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 |
| 31 | 0 | 0 | 0.04 | 0.80 | 0.12 | 0 | 0.04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 |
| 32 | 0 | 0 | 0 | 0.73 | 0.23 | 0.04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 26 |
| 33 | 0 | 0 | 0 | 0.32 | 0.48 | 0.20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 |
| 34 | 0 | 0 | 0 | 0.21 | 0.50 | 0.08 | 0.17 | 0 | 0 | 0.04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24 |
| 35 | 0 | 0 | 0 | 0.08 | 0.16 | 0.60 | 0.16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 |
| 36 | 0 | 0 | 0 | 0.15 | 0.26 | 0.44 | 0.15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 |
| 37 | 0 | 0 | 0 | 0.13 | 0.29 | 0.46 | 0.13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24 |
| 38 | 0 | 0 | 0 | 0.05 | 0 | 0.55 | 0.30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 |
| 39 | 0 | 0 | 0 | 0 | 0 | 0.33 | 0.50 | 0.06 | 0.06 | 0.06 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 |
| 40 | 0 | 0 | 0 | 0 | 0.07 | 0.20 | 0.33 | 0.13 | 0.07 | 0.13 | 0.07 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 |
| 41 | 0 | 0 | 0 | 0 | 0 | 0.08 | 0.54 | 0.23 | 0.08 | 0 | 0.08 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |
| 42 | 0 | 0 | 0 | 0 | 0 | 0 | 0.50 | 0.20 | 0.10 | 0.10 | 0.10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| 43 | 0 | 0 | 0 | 0 | 0 | 0.22 | 0.33 | 0.11 | 0.22 | 0 | 0.11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| 44 | 0 | 0 | 0 | 0 | 0 | 0 | 0.27 | 0.36 | 0.18 | 0.09 | 0.09 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| 45 | 0 | 0 | 0 | 0 | 0 | 0 | 0.29 | 0.29 | 0.29 | 0 | 0.14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| 46 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.57 | 0 | 0.14 | 0.29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| 47 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.33 | 0 | 0 | 0.56 | 0 | 0.11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| 48 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.14 | 0.29 | 0.14 | 0.29 | 0 | 0 | 0 | 0 | 0.14 | 0 | 0 | 0 | 0 | 7 |
| 49 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.33 | 0.17 | 0.33 | 0 | 0 | 0.17 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.67 | 0 | 0.33 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| 51 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.20 | 0 | 0.20 | 0.20 | 0 | 0.20 | 0 | 0 | 0 | 0 | 0.20 | 0 | 0 | 5 |
| 52 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.40 | 0 | 0.60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| 53 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.40 | 0 | 0.40 | 0.20 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| 54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.60 | 0.20 | 0 | 0 | 0 | 0 | 0 | 0.20 | 0 | 0 | 5 |
| 55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.80 | 0 | 0 | 0.20 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| 56 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.50 | 0.33 | 0.17 | 0 | 0 | 0 | 0 | 0 | 6 |
| 57 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.20 | 0.20 | 0.20 | 0 | 0.20 | 0.20 | 0 | 5 |
| 58 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.20 | 0.40 | 0 | 0.20 | 0 | 0.20 | 0 | 0 | 5 |
| 59 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.17 | 0 | 0 | 0.67 | 0 | 0 | 0 | 0.17 | 6 |
| 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.20 | 0.40 | 0.20 | 0 | 0 | 0 | 0.20 | 5 |
| 61 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.20 | 0.20 | 0 | 0 | 0 | 0 | 0 | 0.60 | 5 |
| 62 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.33 | 0 | 0 | 0 | 0 | 0 | 0 | 0.67 | 3 |
| 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.33 | 0 | 0.33 | 0 | 0.33 | 3 |
| 64 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.20 | 0 | 0 | 0 | 0.20 | 0 | 0.60 | 5 |
| 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.25 | 0 | 0.75 | 4 |
| 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.33 | 0 | 0 | 0 | 0.67 | 3 |
| 67 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.33 | 0.33 | 0 | 0 | 0 | 0.33 | 3 |
| 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.00 | 2 |
| 69 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.50 | 0 | 0.50 | 2 |
| 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.00 | 1 |
| 71 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.00 | 1 |
| 72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 73 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.00 | 1 |
| 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 75 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 77 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 78 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 79 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | | | | | | | | | | | | | | | | | | | | | 511 |

**Appendix 10: Scatterplot of age-at-length data for snapper sampled from the SNA 8 single trawl fishery in 2008–09 (*n*, sample size).**



**Appendix 11: Time series of proportion at length and age distributions and c.v.s for snapper from the SNA 8 single trawl fishery from 1974–75 to 1975–76 and 1989–90 to 2008–09. Note: Data are from spring-summer with estimates of mean length and age.**



**Appendix 12: Time series of proportion at length and age distributions and c.v.s for snapper from the SNA 8 pair trawl fishery from 1974–75 to 1979–80, 1985–86 to 1986–87, 1988–89 to 1991–92, and 2000–01 to 2005–06. Note: Data are from spring-summer with estimates of mean length and age.**