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Age composition of commercial snapper landings in SNA 1 and SNA 2, 2019–20

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EXECUTIVE SUMMARY

Walsh, C.[1]; Parsons, D.; Bian, R.; McKenzie, J.; Armiger, H.; Taylor, R.; Evans, O.; Buckthought, D.; Smith, M.; Spong, K. (2022). Age composition of commercial snapper landings in SNA 1 and SNA 2, 2019–20.

New Zealand Fisheries Assessment Report 2022/24. **136 p.**

This report presents the results of Objectives 2–4 of Fisheries New Zealand project SNA2019-01. The general objective was to determine the age structure of commercial landings from the three snapper (*Chrysophrys auratus*) stocks that constitute SNA 1 (East Northland, Hauraki Gulf, and Bay of Plenty) and the northern stock of SNA 2 (SNA 2 North) by land-based sampling. An additional objective was included to describe the length-weight relationship for snapper by season and sub-stock within SNA 1.

The random age frequency sampling approach was employed over four seasons from spring 2019 to winter 2020 to estimate catch-at-age from the three bottom longline fisheries in SNA 1 and over two seasons from spring-summer to autumn-winter for the bottom trawl fishery in northern SNA 2. A length frequency and age-length key sampling approach was employed over spring-summer and autumn-winter to estimate catch-at-length and -age for a range of power method fisheries operating in SNA 1, including bottom trawl, Danish seine, and modular harvest system (MHS).

Target sample sizes for numbers of landings by fishing year were achieved, or close to, for most fisheries, although targeted samples fell short for MHS from East Northland and Bay of Plenty. Overall, spatio-temporal comparisons revealed good sample representativeness despite minor disproportionality in the number of sampled landings in some months and in relation to vessel selection and landing size.

Catch-at-age distributions for East Northland and Hauraki Gulf bottom longline fisheries in 2019–20 have remained broad since the previous sampling year in 2017–18. There was good representation across all year classes up to 20 years, resulting in high estimates of mean age: East Northland (10.0 years); Hauraki Gulf (10.8 years). A lower mean age (8.0 years) was evident in the Bay of Plenty longline fishery; the age composition was dominated by young snapper, those 11 years of age and younger making up 85% of the landed catch by number. The East Northland longline fishery was dominated by the 2014 and 2011 year classes (6 and 9 year olds), that collectively accounted for almost one in every three snapper landed in 2019–20. The 2011 year class is one of the strongest year classes seen in over a decade. East Northland remains the only stock with a high proportion of snapper 20 years or older. Hauraki Gulf longline landings were largely dominated by the 2014–2007 year classes (6 to 13 year olds).

The relative year class strengths inferred from sampling of the SNA 1 power methods (bottom trawl, Danish seine, and MHS) were generally consistent with catch-at-age distributions observed in the respective bottom longline samples. Snapper caught in the Hauraki Gulf Danish seine fishery had the broadest proportion-at-age distribution across all SNA 1 methods in 2019–20, with a mean age of 11.9 years. East Northland modular harvest system had a higher proportion of young snapper and a marginally lower mean age of 9.0 years. Proportions-at-age from Bay of Plenty power method fisheries were dominated by small young snapper, those below 10 years of age making up 78–84% of the landed catch by number, with mean age estimates ranging from 7.2–7.8 years—the lowest across SNA 1 and consistent with mean age in Bay of Plenty bottom longline and SNA 2 North bottom trawl fisheries. Mean weighted coefficients of variation (MWCV from bootstrap estimates) for the age compositions of SNA 1 bottom longline, Hauraki Gulf and Bay of Plenty power method, and SNA 2 bottom trawl fisheries were at or below the target of 20%, inferring a good level of precision. The MWCV for East Northland modular harvest system was 34% due to the low number of samples.

[1] All authors: National Institute of Water and Atmospheric Research (NIWA), New Zealand.

With perpetuating slow growth rates, the mean size across SNA 1 bottom longline fisheries in 2019–20 has continued to remain low (ranging between 33–34 cm or about 0.778 –0.846 kg). These are close to the lowest ever recorded in three decades. Similar (low) mean lengths were observed for power method fisheries, ranging from 31 cm (Bay of Plenty modular harvest system) to 35 cm (Hauraki Gulf Danish seine).

A total of 6418 length-weight records were collected from 77 vessel landings and across four different fishing methods in SNA 1 2019–20 with sample sizes exceeding stock and season targets. A General Linear Model approach suggested significant statistical differences in length-weight relationships between stocks and seasons. A linear regression with bias correction approach showed marked differences in seasonal length-weight relationships (spring-summer versus autumn-winter) for East Northland and Bay of Plenty, but not for the Hauraki Gulf.

1. INTRODUCTION

Snapper (*Chrysophrys auratus*, SNA) is New Zealand's most important commercial inshore fish species. In 2019–20, 70% and 5% of the national Total Allowable Commercial Catch (TACC) of 6397 t was apportioned to SNA 1 (4500 t) and SNA 2 (315 t), respectively, encompassing the entire east coast of the North Island (Figures 1–3). In the past five years the greatest proportion (98%) of the SNA 1 commercial catch has been taken by four methods (bottom longline (41%), bottom trawl (25%), Danish seine (about 18%), and modular harvest system (14%)), mostly targeting snapper, but also as a bycatch when targeting other species, particularly trevally (*Pseudocaranx dentex*, TRE*),* with bottom trawl and modular harvest system. For the SNA 2 fishery, bottom trawl dominates as the main commercial method, with snapper primarily a bycatch to the tarakihi (*Nemadactylus macropterus*, TAR) target fishery, although some snapper targeting does occur. The annual SNA 1 catch over the past two decades has, on average, been closely aligned to the TACC, while that for SNA 2 has regularly exceeded the TACC (Figures 2 and 3, Fisheries New Zealand 2021).

SNA 1 has been one of the most researched inshore finfish fisheries in New Zealand. Staff of the National Institute of Water and Atmospheric Research (NIWA), and formerly MAF Fisheries, have sampled the length and age compositions of snapper from commercial landings in port (land-based 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 dominant fishing methods in SNA 1 and SNA 8. Because of heterogeneity in snapper biology and fishing patterns, SNA 1 is often further subdivided into three substocks (referred to herein as stocks): East Northland, Hauraki Gulf, and Bay of Plenty (Figure 1). The time series of length and age information from the SNA 1 bottom longline fishery continued uninterrupted for a period of 21 years up until 2009–10. Triennial sampling was adopted after 2009–10 based on research investigating the optimum frequency for land-based sampling (Bian et al. 2009); the last sampling programme being undertaken in 2017–18 (Walsh et al. 2019b).

Davies et al. (1993) investigated the relative benefit of catch-at-age precision associated with length frequency and otolith sample sizes in snapper landings to optimise sampling resources. They concluded that there was no major benefit from collecting large length frequency samples. In light of this work, a random age frequency (RAF) sampling approach was trialled for the SNA 1 bottom longline fishery over spring-summer 1997–98 (Walsh et al. 1999). In 2003–04 the approach for sampling SNA 1 longline landings for length and age data was modified from a spring and summer sampling programme to one that encompassed the entire year (see Walsh et al. 2006). This change was introduced so that sampling reflected the seasonal characteristics of the longline fleet and its fishing operations in recent years, in which the snapper catch is landed year-round, rather than predominantly over spring and summer. The sampling undertaken in 2019–20 continued with the year-round RAF approach for SNA 1 bottom longline.

Although bottom longline has been the primary means for monitoring the population age structure of SNA 1, Fisheries New Zealand proposed, that due to the steady decline in Hauraki Gulf and Bay of Plenty snapper growth rates over the past two decades (Walsh et al. 2011a, 2011b, 2014b, 2019b), it would be timely to also sample SNA 1 power method fisheries (i.e., bottom trawl, Danish seine, and modular harvest system) for length and age data in 2019–20, to estimate selectivity (NINSWG-2019/25b). SNA 1 power methods (bottom trawl and Danish seine) were last sampled in Bay of Plenty and Hauraki Gulf in the mid-1990s (Walsh et al. 1995, 1997). The length frequency and age-length key approach (ALK) was the method used for sampling SNA 1 power method landings because this was deemed to be more cost effective since age-length samples collected from the SNA 1 longline fisheries could be used to construct the required area-season specific age-length keys.

Catch-at-age sampling of the SNA 2 bottom trawl fishery was first instigated in 1991–92 (Ryan 1993), followed by an intermittent time series of seven further collections, the last in 2008–09 (Walsh et al. 2012). A random age frequency approach was used for sampling SNA 2 in 2019–20, similar to that for SNA 1 bottom longline.

Fisheries New Zealand also requested spatial-seasonal length-weight data be collected under the SNA2019-01 project. The purpose of this additional objective was to establish whether any change in the length-weight ratio may have occurred over time due to a slowing growth rate in some stocks and the concern relating to the condition of fish (Walsh et al. 2019b). Length-weight relationships are an important input to stock assessment models. The current length-weight relationship, used across all snapper research until 2020, is derived from data collected from a number of stocks and seasons over 50 years ago (Paul 1976).

The aim of the present study was to estimate the age and length compositions of commercial snapper catches from the main methods operating in each of the snapper stocks in SNA 1 and SNA 2 during the 2019–20 fishing year. The age composition data are an important input to SNA 1 and SNA 2 stock assessments, where they are used to estimate selectivity and relative year class strength.

This report presents the results of land-based sampling between October 2019 and August 2020 (Fisheries New Zealand project SNA2019-01).

The specific objectives of this project for 2019–20 were:

1. To characterise the SNA 1 fishery by analysing existing commercial catch and effort data to the end of 2018/19 fishing year.

2. To carry out sampling and estimate the relative proportion at age and length of recruited snapper sampled from the commercial catch in SNA 1 throughout the fishing year 2019/20. The target coefficient of variation (CV) for the catch-at-age will be 20% (mean weighted CV across all age classes).

3. To carry out sampling and estimate the relative proportion at age and length of recruited snapper sampled from the commercial catch in SNA 2 throughout the fishing year 2019/20. The target coefficient of variation (CV) for the catch-at-age will be 30% (mean weighted CV across all age classes).

4. To describe the length-weight relationship for snapper by season and sub-stock within SNA 1.

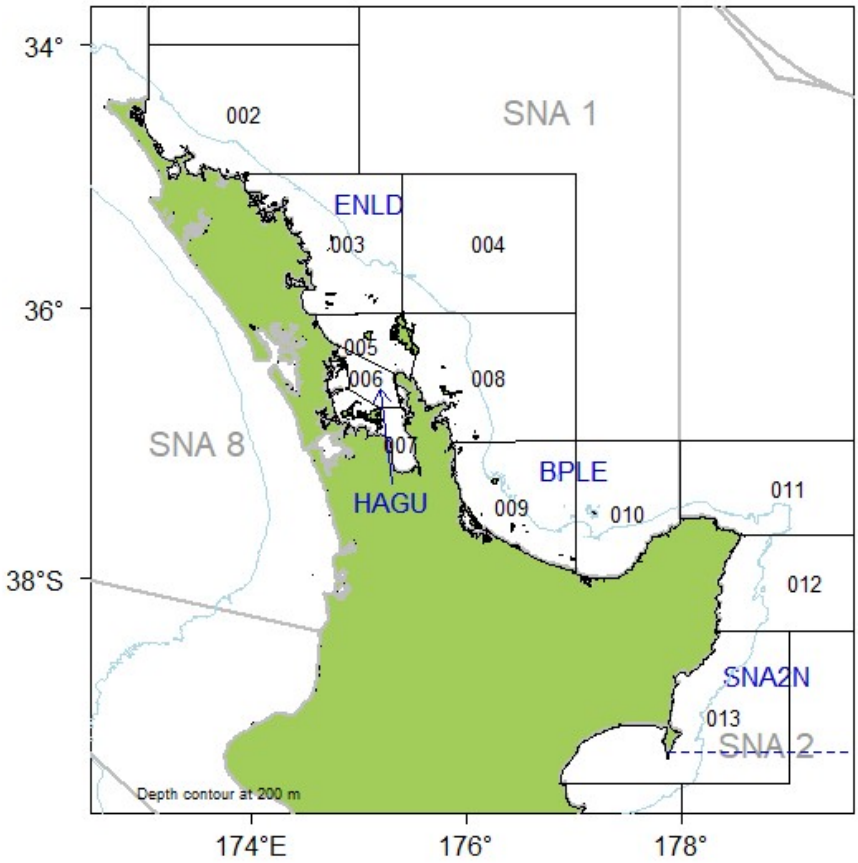

Figure 1: Quota management area for the north east North Island snapper stock, SNA 1, and the northern subarea component of SNA 2. The spatial dimensions of the SNA 1 and SNA 2 substocks are: East Northland (ENLD, Statistical Areas 002 and 003); Hauraki Gulf (HAGU, Statistical Areas 005 to 007); Bay of Plenty (BPLE, Statistical Areas 008 to 010); and SNA 2 North (SNA2N, Statistical Areas 011, 012, and northern part of 013 to the southern-most tip of Mahia Peninsula (39.264° S 177.866° E), blue dotted line.

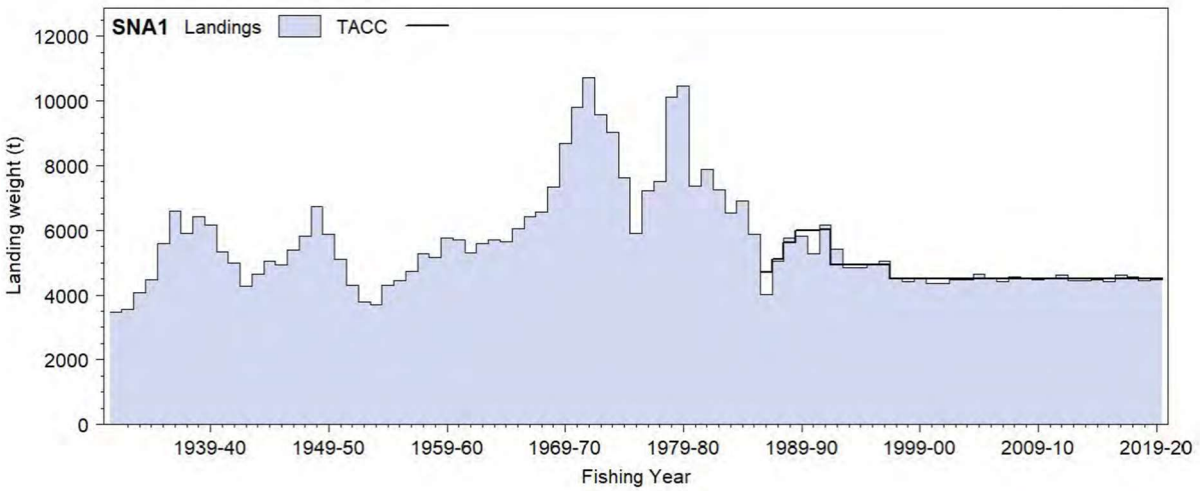

Figure 2: Reported landings of snapper in SNA 1 and TACCs to 2019–20 (Fisheries New Zealand 2021).

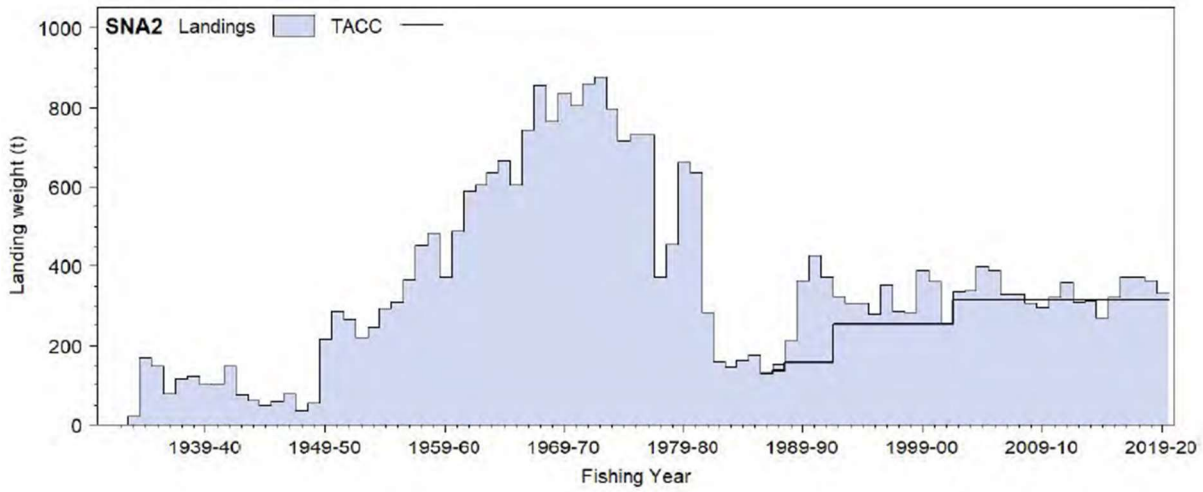

Figure 3: Reported landings of snapper in SNA 2 and TACCs to 2019–20 (Fisheries New Zealand 2021).

2. METHODS

2.1 Characterisation of fishery data

Two characterisations of the spatial, temporal, and operational patterns in the SNA 1 and SNA 2 fisheries were carried out using data extracted from the Fisheries New Zealand commercial catch reporting system. The first, over the period October 2013 to September 2018 (spanning five fishing years), was undertaken to inform the design of a catch sampling programme in 2019–20. The second was over the period October 2015 to September 2020 to provide a comparison of the recent catch with that of the catch sampling programme in 2019–20.

All effort details and associated catch weights (all species including snapper) from all trips landing from SNA 1 were extracted. Data obtained from Fisheries New Zealand were groomed and checked for obvious reporting errors. The data used to inform the characterisation were compiled in two tables:

1. Landed catch weight: A file containing the verified green (unprocessed) landed weight of all SNA 1 and SNA 2 trips.
2. Trip-specific data: A file containing demographic information (location, method, target species, estimated catch, etc.).

Although the trip effort data table provided information on catch, these weights were based on fisher estimates rather than measured weights. The process followed was to prorate the actual trip landed weight totals across the effort information (location, method, target species) based on the estimated catch ratios. The link between the two data tables was the common trip number field (trip_key).

Operational aspects such as fishery timing, gear type, target species, statistical area, fine scale spatial distribution, port of landing, and annual number of vessels and landings were summarised.

2.2 Design of SNA 1 and SNA 2 sampling in 2019–20

SNA 1

The SNA 1 Quota Management Area (QMA) encompasses the northeast coast of the North Island (North Cape to Cape Runaway) and for sampling purposes is divided into three biological stocks: East Northland, Hauraki Gulf, and Bay of Plenty (Figure 1). Although four fishing methods (bottom longline, bottom trawl, Danish seine, and modular harvest system) are currently important in SNA 1, to be consistent with sampling over the past three decades, bottom longline was again chosen as the main fishery to be sampled in 2019–20. Bottom longline operates year-round in each stock with few spatial restrictions and has logistic selectivity, providing a better indication of the recruited population age structure than other methods, and most often catches proportionally more snapper overall. However, noticeable density dependent growth trends in relation to changes in biomass (using derived mean weight-at-age) have been apparent in the Hauraki Gulf and Bay of Plenty fisheries for more than a decade (Walsh et al. 2011a, 2011b, 2014b, 2019b), meaning that more snapper are now landed than 20–30 years ago to achieve the same harvest weight. As a result, Fisheries New Zealand proposed that power methods (i.e., bottom trawl, Danish seine, and modular harvest system) also be sampled from SNA 1 for length and age in 2019–20 to update selectivity estimates, last determined in the mid-1990s.

Bottom longline and power method landings from SNA 1 were stratified by stock and season (e.g., Bay of Plenty–spring). Quarterly seasonal splits for bottom longline were: spring (October–November); summer (December–February); autumn (March–May); and winter (June–August). Seasonal splits were consistent with the time series. Biannual seasonal splits were chosen for power methods: spring-summer (October–February) and autumn–winter (March–August). September was not included in the seasonal stratification. Because limited fishing occurs in September (the last month of the fishing year), its absence from the spring/spring-summer sampling strata was deemed to have a minimal effect on the final results.

SNA 2

The SNA 2 QMA encompasses the central and south east coast and lower west coast of the North Island (Cape Runaway to Mana Island) and for sampling purposes has been divided into two biological stocks: northern and southern. In 2019, a Northern Inshore Finfish Working Group meeting (NINSWG-2019/25b) recommended the northern subarea (Cape Runaway to Mahia Peninsula) of SNA 2 (see Figure 1) be sampled alongside the proposed SNA 1 catch-at-age sampling project in 2019–20 because, despite growth differences, year class strengths for ‘SNA 2 North’ sampled from bottom trawl were significantly correlated with those from Bay of Plenty bottom longline snapper in 2007–08 and 2008–09 (Walsh et al. 2012). Further, sampling SNA 2 North allows for a complete catch-at-age description of the ‘biological stock’ and can be used as an input for the upcoming SNA 1 stock assessment in 2021–22.

To be consistent with previous SNA 2 catch-at-age sampling programmes only bottom trawl landings were selected in 2019–20, this being the main fishing method operating year-round. Similar to power method samples in SNA 1, bottom trawl landings from SNA 2 were also stratified biannually with seasonal splits over spring-summer (October–February) and autumn–winter (March–August), with no samples collected in September (see Section 2.2 SNA 1).

SNA 1 length-weight relationship study

SNA 1 length-weight relationships were derived in 2019–20 by measuring and weighing commercially caught snapper over a broad size range. Length-weight relationships were stratified by stock and biannual seasons (October–February and March–August) following the same spatio-temporal design as SNA 1 power method catch sampling, and in doing so, did not include September in the seasonal stratification.

2.3 Sampling landings

Length and age frequency samples were collected from the SNA 1 and SNA 2 fisheries using a two-stage sampling procedure, similar to that described by West (1978). The random selection of landings and a random sample of bins within landings represent the first and second stages, respectively. In previous years the sampling procedure needed to account for the grading of fish according to length and quality (within-landing strata) by taking a stratified random sample of bins within a landing (Davies et al. 1993), but this was not required in 2019–20. Similarly, because snapper show no differential growth between sexes (Paul 1976), sex was not determined.

Sampling of snapper landings for length frequency and otolith extraction in 2019–20 was conducted at Leigh, Auckland, Tauranga, Gisborne, and Napier by experienced NIWA science staff or trained sub-contractors with scientific backgrounds.

SNA 1 bottom longline: Random age frequency sampling method (RAF)

The random age frequency sampling method was used for collecting otoliths from each SNA 1 bottom longline landing by taking random otolith samples using a systematic selection interval. This involved taking a random sample of bins from each landing that was roughly proportional to the total number of bins in a landing, hence large samples were taken from large landings and small samples from small landings. A systematic selection of every tenth fish was taken from the sampled bins by counting in a continuous sequence. Unlike most other species, longline caught snapper are 'soldier packed' (upright on their abdomen) in 'iki' bins making the selection of exactly every 10th fish an unequivocal process. The optimum selection interval was determined from simulations using data from historical length and age samples that achieved a desired level of catch-at-age precision, a mean weighted coefficient of variation (MWCV) over all age classes of less than or equal to 20%. This range took account of the expected mean number of fish in a bin and the total number of bins in landings. Sample sizes typically ranged from 20 fish being collected from landings having a total of 15 bins, to 40 fish from landings of over 100 bins. All fish making up the sample were to be measured to the nearest centimetre below the fork length.

A total sample size of 800 otoliths across forty landings was targeted from each of the East Northland and Bay of Plenty bottom longline fisheries over the entire year, with about 200 otoliths from 10 landings collected per season (Table 1). The East Northland stock was sub-stratified by the Statistical Areas 002 and 003 (Figure 1) to improve the precision on catch-at-age estimates (Davies & Walsh 2003). One thousand otoliths across 40 landings were targeted from the Hauraki Gulf bottom longline fishery with about 250 otoliths from 10 landings collected per season.

Table 1: Level of sampling proposed to describe the SNA 1 bottom longline (BLL) fishery in 2019–20 based on historical sampling for catch-at-age data that derived MWCVs below 20%.

Stock area	Method	Annual target number of landings (per season)	Annual target number of otoliths (per season)
East Northland (002)	BLL	20 (5)	400 (100)
East Northland (003)	BLL	20 (5)	400 (100)
Hauraki Gulf	BLL	40 (10)	1000 (250)
Bay of Plenty	BLL	40 (10)	800 (200)

SNA 1 power method: Length frequency and age-length key sampling method (ALK)

The length frequency and age-length key sampling method was used for collecting length and age information from the SNA 1 power method fisheries (bottom trawl, Danish seine, and MHS). Optimisation of sample sizes (from historical SNA 8 landings) had previously been investigated using simulation with the aim of achieving a target level of catch-at-age precision with a MWCV over all age classes, of less than or equal to 0.20. The optimisation results indicated that the MWCV was more sensitive to changes in the otolith sample size than the number of landings sampled from the fishery and proposed that a sample size of 15 landings and 300–500 otoliths would adequately achieve a MWCV of

about 0.15. A similar approach was planned for sampling SNA 1 power method fisheries in 2019–20 with a total target of 15 landings sampled for length frequency (per stock-method-season) in combination with a 500–600 otolith pair age-length key. It was expected that a sample size of about 300 fish would adequately describe the length distribution of each sampled landing and that all fish in bins making up the sample were to be measured to the nearest centimetre below the fork length.

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 an age-length key was made according to the broadest proportion-at-length distribution of the main fishing method. For the SNA 1 fisheries, the length distribution of the bottom longline random age frequency collection for each stock in 2017–18 (Walsh et al. 2019b) was the most recent and was chosen to determine the sample allocation for the respective stock (power method) age-length keys. However, because large snapper in particular were often poorly represented or absent in random age frequency length distributions from previous bottom longline collections, it was felt that 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. Instead, the sample age-length key collection in 2009–10 was altered to a semi-fixed allocation design, successfully employed in SNA 8 catch sampling for more than two decades (see Figure 4).

Power method age-length keys for each SNA 1 stock half-year (i.e., Hauraki Gulf Danish seine spring-summer) were generated from 400–500 bottom longline spring-summer otoliths from the same stock and expected to suitably describe the mid-range of cohorts currently present in the fishery and, at the same time, reduce the inefficiency of collecting, preparing, and ageing additional otoliths. This sample was supplemented with approximately 125–150 additional power method otoliths to ensure the far left- (below 28 cm) and right-hand (above 39 cm) tails of the distribution, comprising small and large snapper, were adequately represented (see Table 2 and Figure 4). It was proposed that roughly 5–10 otoliths would be subsampled from each power method sampling event to ensure temporal representativeness in the half-year age-length key collection.

The collection of two independent age-length keys, temporally stratified by half-years (spring-summer and autumn-winter) was expected to reduce growth bias compared to an age-length key collected over a full year. Each age-length key derived from the age data is assumed to be representative of the temporal period it was collected from. 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).

A total sample size of 9000 length measurements and 250–300 otoliths across thirty landings was targeted from each of the East Northland modular harvest system and Hauraki Gulf Danish seine fisheries over the entire year, and twenty-seven thousand length measurements and 250–300 otoliths across ninety landings was targeted from the Bay of Plenty bottom trawl, Danish seine, and modular harvest system fisheries (Table 2).

Table 2: Level of sampling proposed to describe the SNA 1 power method fisheries in 2019–20 based on historical sampling for catch-at-age data that derived MWCVs below 20%.

Stock area	Method*	Annual target number of landings per method (per season)	Annual target number of snapper measured per method (per season)	Annual target number of otoliths per substock (per season)†
East Northland	MHS	30 (15)	9 000 (4 500)	250–300 (125–150)
Hauraki Gulf	DS	30 (15)	9 000 (4 500)	250–300 (125–150)
Bay of Plenty	BT, DS, MHS	30 (15)	9 000 (4 500)	250–300 (125–150)

* BT, Bottom trawl; DS, Danish seine; MHS, Modular harvest system.

† Represents total power method age-length key target otoliths from each stock area.

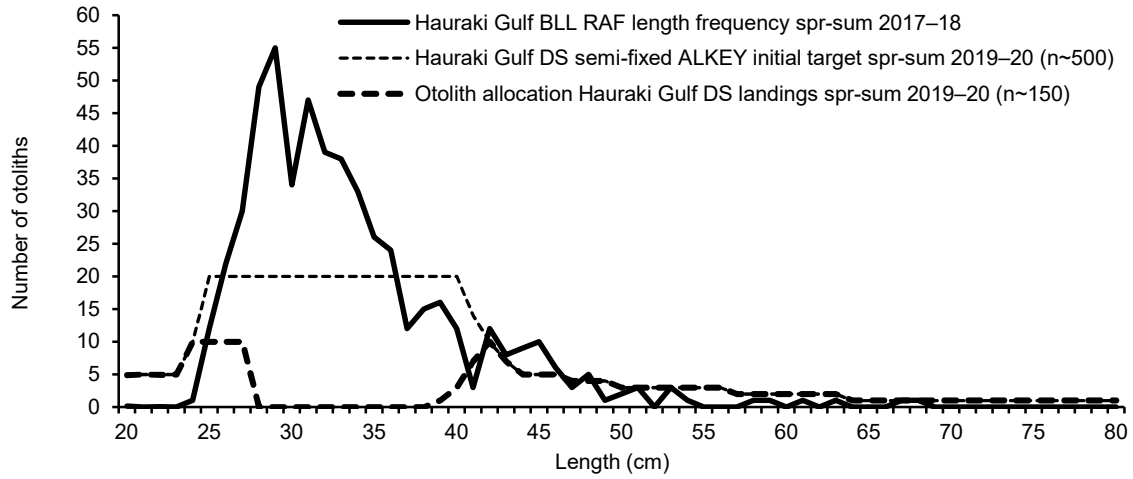

Figure 4: Proposed semi-fixed age-length key collection example for Hauraki Gulf Danish seine spring-summer strata in 2019–20. Note that the majority of otoliths derived from bottom longline otolith spring-summer samples for 2019–20 are incorporated with a power-method otolith allocation collected from Hauraki Gulf Danish seine spring-summer samples for 2019–20 to form the overall spring-summer Hauraki Gulf age-length key (BLL, bottom longline; RAF, Random age frequency; spr-sum, spring-summer; DS, Danish seine; ALKEY, age-length key).

SNA 2 North bottom trawl: Random age frequency sampling method

The random age frequency sampling method was used for collecting otoliths from each SNA 2 North bottom trawl landing by taking random otolith samples using a unique random selection process (described by Parsons et al. 2022), a slight deviation from that described for SNA 1 bottom longline above. Essentially, 15 bulked bins of snapper (i.e., not soldier packed) were chosen from a landing. A sampler would then count through 300 fish from 15 bins and be blindly prompted to select a fish for otolith extraction by another sampler. This sampling process was conducted according to a random sampling form which had 60 of 300 lines randomly highlighted. A unique random sampling form was used for each sampling event, therefore making the selection process unequivocal and without bias, both within and between sampled landings. If the 15 bins selected did not contain 300 fish, the samplers returned to the first bin and began recounting fish until they reached 300 and, in doing so, had set aside the 60 fish required for otoliths. It was expected that the sampling design should adequately achieve a catch-at-age MWCV approximating 0.20, despite the target being 0.30. All fish making up the otolith sample were measured to the nearest centimetre below the fork length.

Although a total sample size of 1800 otoliths across thirty landings was initially targeted from the SNA 2 North bottom trawl fishery over the entire year, only 1200 of these was proposed for ageing, with 600 otoliths from 15 landings collected per half-year season (Table 3).

Table 3: Level of sampling proposed to describe the SNA 2 North bottom trawl fishery in 2019–20 based on historical sampling for catch-at-age data that derived MWCVs below 20%.

Stock	Annual target number of landings (per season)	Annual target number of otoliths (per season)
SNA 2	30 (15)	1 200 (600)

SNA 1 length-weight relationship study sampling

A total of 400 snapper was targeted in six SNA 1 spatio-temporal strata for measurement (800 per stock fishing year), accurately to the nearest centimetre below the fork length, and weight (using a waterproof scale) to the nearest 5 g, across multiple fishing methods (i.e., bottom longline, bottom trawl, Danish seine, and modular harvest system). The attempt was to cover the full size range (> 24 cm) of snapper available to licensed fish receiver landings spread throughout the 2019–20 fishing year.

2.4 Quality assurance of sampling processes

A total of 19 NIWA trained staff or scientific contractors were tasked with the collection of length and age samples from the SNA 1 and SNA 2 fisheries in 2019–20. All sampling events were conducted by two samplers, one measuring fish length and extracting otoliths and the other recording the relevant information and nominating snapper for otolith removal. Five NIWA trained staff undertook quality assurance visits to review the sampling process; the number of mentoring visits a sampler received was based on their level of catch sampling experience. Overall, trained samplers, across six licensed fish receiver premises, received forty-five training and mentoring sessions or length frequency checks. These involved: completion of forms, correct measurements (300 fish) for power method length frequency samples, diligence obtaining otolith material, SNA 1 bottom longline random age frequency sample selection—every 10th fish, SNA 2 random age frequency sample selection—60 fish from a total of 300. For the latter, a Kernel Density Estimation non-parametric test (Anderson et al. 1994) was used to compare the shape and location of these two length frequency distributions. If the fish selection conducted by a sampler failed this test, they received guidance about the fish selection process and repeated the test until it was passed.

2.5 Age determination

All snapper otoliths were prepared using the break and burn technique (Chugunova 1963) and a standardised procedure for reading otoliths was followed, outlined in the age determination protocol for snapper (Walsh et al. 2014a). Five readers were used in ageing SNA 1 and SNA 2 otolith samples in 2019–20, with reader 1 ageing all four fishery collections and readers 2 to 5 each ageing one. Each reader had no prior knowledge of each other's zone count obtained or of the fish length. For otoliths from each fishery where both readers agreed on the zone count, the age was determined from this count. When readers disagreed, the otolith was re-read together to determine the likely source of error and the count agreed upon. The forced margin method was implemented to anticipate the otolith margin type (wide, line, narrow) *a priori* in the month in which the fish was sampled to provide guidance in determining age. To determine the 'fishing year age class' of fish using the forced margin, 'wide' readings were increased by 1 year (e.g., 3W is aged as a 4 year old) and 'line' and 'narrow' readings remain the same as the zone count (e.g., 4L or 4N are aged as a 4 year old), meaning that regardless of whether the fish was caught before or after the nominal birth date of 1 January, age remains the same throughout, unlike that which would be used for age groups/age classes or in growth rate estimation (see Walsh et al. 2014a).

Otolith reading precision was quantified by carrying out between-reader comparison tests after Campana et al. (1995), including those between each reader and the agreed age. The Index of Average Percentage Error, IAPE (Beamish & Fournier 1981), and mean coefficient of variation (CV) (Chang 1982), were calculated for each test.

2.6 Catch-at-age analysis

NIWA's catch-at-length and -age analysis software tool CALA (catch-at-length and -age, Francis & Bian 2011) was used in the calculation of proportion-at-age and variance (bootstrap) estimates for the SNA 1 bottom longline fisheries and the SNA 2 North bottom trawl fishery, from the random age frequency samples collected from each landing. Proportions-at-age for all landings within a season were estimated from sample proportions, weighted by the estimated number of fish in each landing. The weighted mean proportion-at-age and variance across temporal (seasons) and spatial (East Northland only) strata for each fishery was calculated following Blackwell et al. (1999). CALA was also used in the calculation of proportion-at-length and -age and variance (bootstrap) estimates for SNA 1 bottom trawl, Danish seine, and modular harvest system fisheries from the length frequency samples collected from each landing and the age-length key samples collected from each stock.

Calculation of mean weight-at-age was based on the following length-weight relationship: w (g) = $0.04467l^{2.793}$ (cm) (Paul 1976). While utilising the length and weight parameters determined in the current study would have been ideal, calculation of mean weight-at-age was conducted prior to the establishment of these length weight parameters due to time constraints. Mean weight-at-age estimates were calculated as a weighted mean with respect to the total number of fish estimated within each landing sampled (Walsh et al. 2006) and is directly analogous to estimating proportion catch-at-age (Davies et al. 2003). Landing-specific weight-at-age was scaled up to the season-fishery stratum and combined over all seasons (and spatial strata in East Northland). The calculation of estimates of mean length-at-age followed those procedures for estimating weight-at-age outlined by Davies et al. (2003).

Proportions-at-age, mean length-at-age, and derived mean weight-at-age were calculated for the range of fishing year age classes (herein referred to as 'age classes'). The maximum age was a plus group, being an aggregate of all age classes over 29 years, which were assigned an age of 30.

Random age frequency data (i.e., SNA 1 bottom longline fisheries and SNA 2 North bottom trawl) were collected primarily to derive catch-at-age estimates. However, it can be assumed that fish sampled randomly for age were also random observations from within each length interval. Consequently, age-length keys could be derived from the random age frequency otolith samples. However, fish in the larger length classes, collected by the random age frequency method, were infrequently sampled and are likely to be poorly described in the age-length key. Age-length keys are assumed to be representative of the seasonal strata of the samples, that being the entire year, and may not be directly comparable with collections in years when only spring and summer were usually sampled. The main assumption that must 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). Age-length keys are included to give the reader an appreciation of the age-at-length differences between the stocks.

Snapper length and age data and landing details were stored on the Fisheries New Zealand *market* and *age* databases, administered by NIWA.

2.7 SNA 1 length-weight relationship study analysis

The length-weight relationship is defined by estimating a and b growth parameters in the power function: Weight = aLength^b. General Linear Model (GLM) methods were initially performed with log length as a predictive variable and log weight as the response variable. Additional categorical effects of stock, season, and various interaction terms were also offered to the GLMs to test if these factors had statistically significant additional explanatory power.

Separate linear models (also performed on log transformed length and weight data) for various season-stock combinations were subsequently produced to enable the fit of each individual relationship to the data to be assessed and also to enable visual comparison of any differences between length-weight relationships for various season-stock combinations (Appendix 1). Data points with a standardised residual of less than -3 or greater than 3 were determined as outliers and removed from the dataset for each season-stock combination. The a parameter for each linear model was corrected for bias due to taking the mean of logs before each linear model was exponentiated, so that it could be plotted with the observed data in its raw form.

3. RESULTS

3.1 Updated fishery characterisation: 2015–16 to 2019–20

In 2019–20, the Bay of Plenty contributed 42% (1884 t) of the overall SNA 1 commercial catch, East Northland 34% (1487 t), and Hauraki Gulf 24% (1059 t). Significant spatial change in the SNA 1 catch over the last five years has occurred with Hauraki Gulf declining by 31% (472 t) and Bay of Plenty and East Northland increasing by about 20% (313 and 251 t, respectively).

The bottom longline catch from East Northland, the largest across all area-method fisheries, has increased significantly from 699 t in 2015–16 to 886 t in 2019–20 (Figure 5a). The relatively new trawl method, modular harvest system (MHS), recently operated in the SNA 1 fishery and accounted for the second largest method catch (284 t) in East Northland in 2019–20, effectively replacing fishing effort of conventional bottom trawl.

Despite a gradual decline in the bottom longline catch of snapper from the Hauraki Gulf in 2019–20, longline remained the most dominant method with a 47% share (473 t) of the total fishing year catch, with Danish seine having the second largest landings (277 t) (Figure 5b). The Hauraki Gulf bottom trawl catch increased from 79 t in 2017–18, its lowest catch in decades, to 253 t in 2019–20. Unlike the previous four years, no snapper were caught in the Hauraki Gulf by modular harvest system in 2019–20.

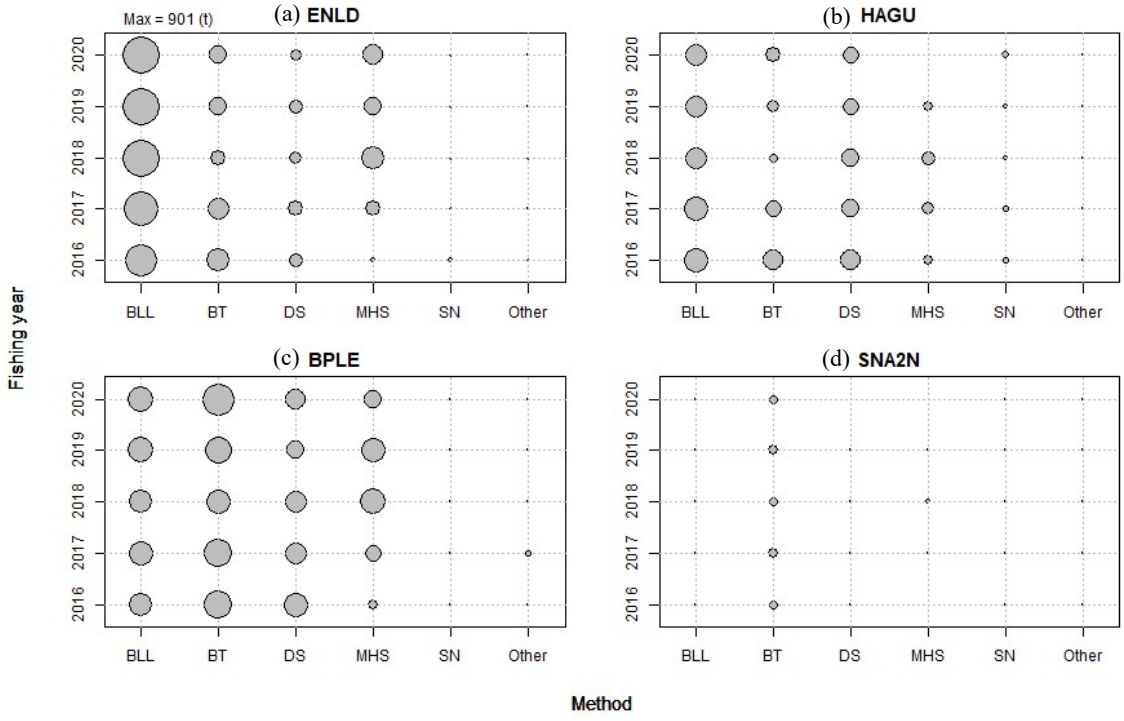

Figure 5: Catch of snapper (t) in SNA 1 and SNA 2N stocks by gear type from fishing years 2015–16 to 2019–20. ((a) ENLD, East Northland; (b) HAGU, Hauraki Gulf; (c) BPLE, Bay of Plenty (d) SNA2N, SNA 2 North; BLL, Bottom longline; BT, Bottom trawl; DS, Danish seine; MHS, Modular harvest system; SN, Set net).

Four main methods operate in the Bay of Plenty snapper fishery, contributing to the largest overall area catch in SNA 1 for the past five years (Figure 5c). The bottom trawl catch increased significantly from 598 t in 2015–16 to 780 t in 2019–20, the second largest catch across all area-method fisheries and considerably larger than those from bottom longline (520 t) and Danish seine (330 t) (Figure 5c). Aside from the recent introduction of modular harvest system, all other methods showed a consistent annual pattern in the volume of snapper taken in the Bay of Plenty over the past five years.

The SNA 2 North catch, although small, has remained relatively consistent over time with an average take of 236 t, equating to 75% of the SNA 2 TACC (315 t), 93% caught by bottom trawl (Figure 5d).

3.2 Relative SNA 1 and SNA 2 catch by bottom longline

From 2015–16 to 2019–20, bottom longline operated across seven main coastal Statistical Areas (002–003, East Northland; 005–007, Hauraki Gulf; 008–009, Bay of Plenty) (Figure 6). The catch from Statistical Area 003 has consistently been the largest across all years followed closely by Statistical Area 002. The 2019–20 catch for Statistical Area 003 was 450 t and for Statistical Area 002 was 433 t (Figure 6a).

A decline in the bottom longline catch over time was apparent in central and inner Hauraki Gulf (Statistical Areas 006 and 007) with the 2019–20 estimates, 93 and 75 t, respectively (Figure 6b). In contrast, the snapper catch from northern and central Bay of Plenty, Statistical Areas 008 and 009, have remained relatively consistent over the same period (Figure 6c).

Negligible bottom longline catch was taken from offshore East Northland (Statistical Area 004), Eastern Bay of Plenty (Statistical Area 010), and SNA 2 North (Statistical Areas 011–013N) (Figures 6a, c, and d).

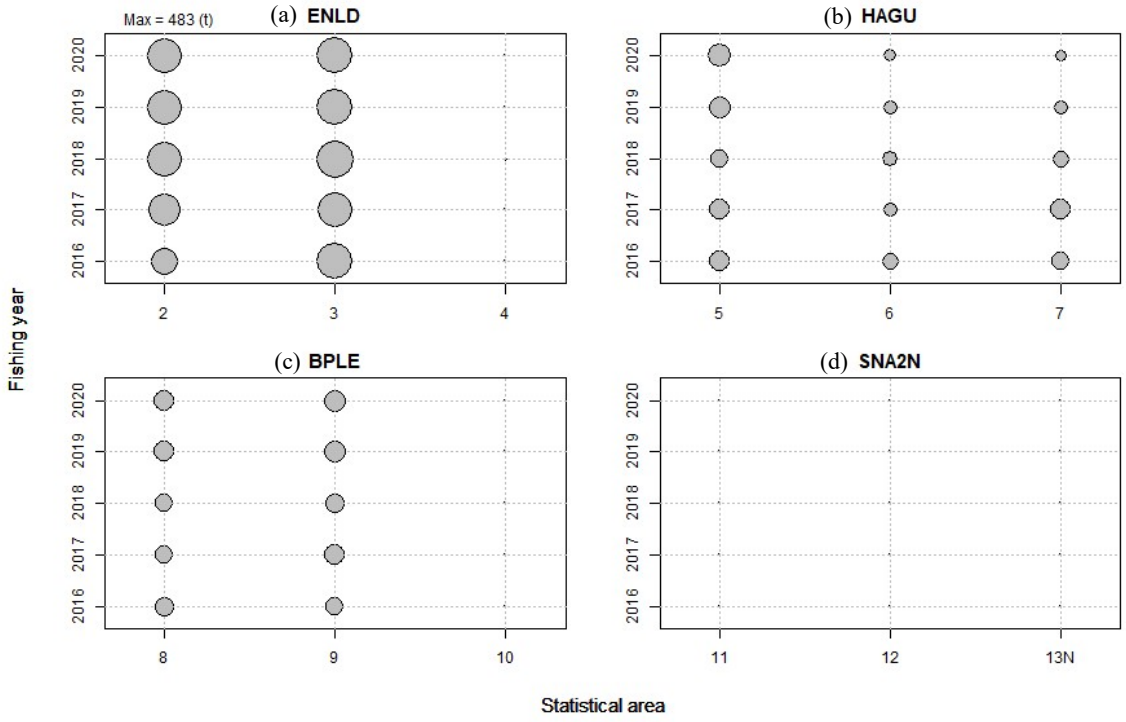

Figure 6: Bottom longline catch of snapper in SNA 1 and SNA 2N stocks by statistical area from fishing years 2015–16 to 2019–20 ((a) ENLD, East Northland; (b) HAGU, Hauraki Gulf; (c) BPLE, Bay of Plenty; (d) SNA2N, SNA 2 North). Note: Statistical Area 002 is represented by '2', Statistical Area 003 is represented by '3', etc.

Despite a declining spring-summer trend over the 5-year period and a 'mopping up' of year-end quota in August 2019–20 within the Hauraki Gulf bottom longline fishery, the monthly pattern of the East Northland and Bay of Plenty catches was generally consistent (Figures 7a–c). Bottom longline from East Northland tends to operate year-round with fairly uniform monthly catches throughout, although a slight increase in volumes over time during spring-summer is apparent. The largest Hauraki Gulf volumes were taken from October to January and the smallest in the Bay of Plenty, mainly November to January, reflecting vessels following the school fish migration into the Hauraki Gulf (Figures 7a–c).

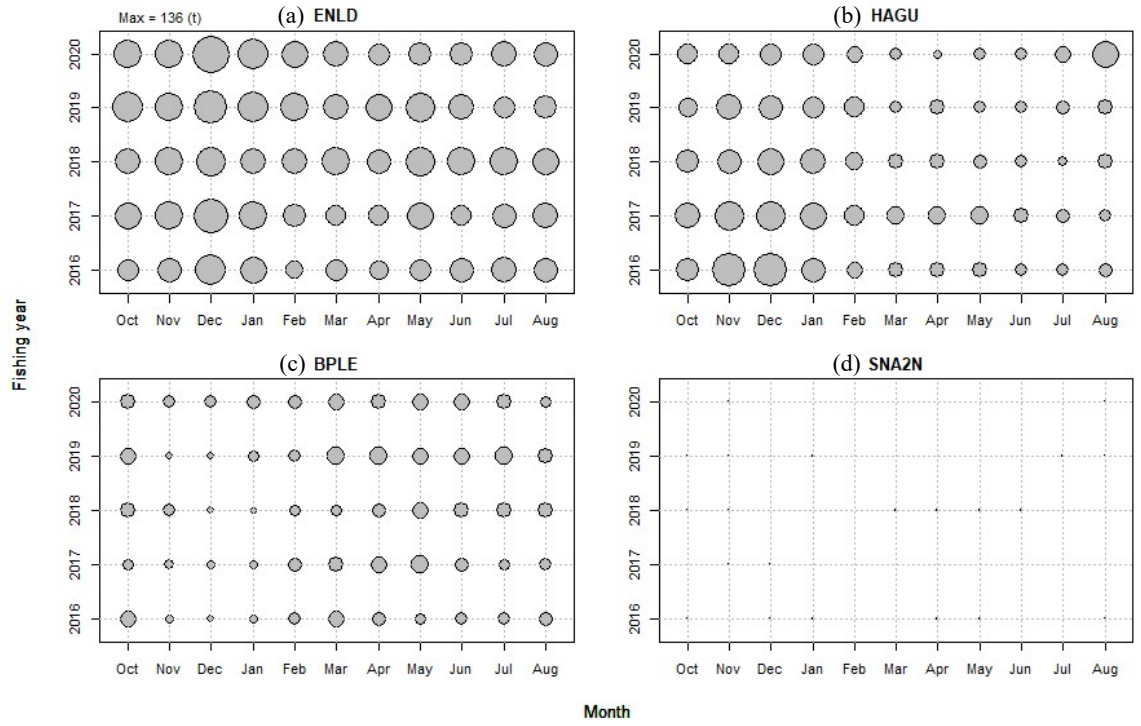

Figure 7: Bottom longline catch of snapper in SNA 1 and SNA 2N stocks by month from fishing years 2015–16 to 2019–20 ((a) ENLD, East Northland; (b) HAGU, Hauraki Gulf; (c) BPLE, Bay of Plenty; (d) SNA2N, SNA 2 North).

3.3 Sampling the SNA 1 bottom longline fishery 2019–20

Sample collections

Summaries of the bottom longline sample sizes for stock-season strata are given in Table 4 and summaries of the otolith sample collections, in Table 5. A total of 120 bottom longline landings were sampled from SNA 1 in 2019–20, with 3060 snapper selected randomly for age information. In all, 28 vessels from a fleet of 29 that landed in excess of 5 t of snapper during 2019–20 were sampled, and these vessels were collectively responsible for 94% of the total SNA 1 longline catch. Proportional sampling across the fleet relative to catch was generally good. For example, the highest number of samples taken from a single vessel during the study for each of the respective stocks was: 6 times, East Northland (15 vessels available); 11 times, Hauraki Gulf (8 vessels available); 6 times, Bay of Plenty (9 vessels available). Many of these vessels also fished in adjacent SNA 1 stocks.

Although sample sizes for targeted numbers of landings were achieved across the SNA 1 stocks, otolith sample sizes exceeded the annual targets by 9% (Hauraki Gulf) to 29% (Bay of Plenty), mainly due to an increase in the average landing size of snapper across SNA 1.

Table 4: Summary of the bottom longline catch (total number and weight of landings) and samples (number of landings and weight sampled, and number of fish sampled for otoliths) in stock–method-season strata for the SNA 1 and SNA 2 fisheries from spring 2019 to winter 2020. (Note: ENLD BLL data presented for Statistical Areas 002, 003, and combined).

			Number of landings			No. of fish	Weight of landings (t)		
Stock*	Method†	Season	Total	Sampled	% total	sampled	Total	Sampled	% total
ENLD (002)	BLL	Spring	200	5	2.5	120	88	3	3.4
		Summer	297	5	1.7	125	152	3	2.0
		Autumn	241	5	2.1	127	89	3	3.4
		Winter	172	5	2.9	111	69	2	2.9
ENLD (003)	BLL	Spring	110	5	4.5	119	71	2	2.8
		Summer	218	5	2.3	120	150	3	2.0
		Autumn	134	5	3.7	110	74	2	2.7
		Winter	173	5	2.9	121	108	3	2.8
ENLD (comb.)	BLL	Spring	310	10	3.2	239	159	5	3.1
		Summer	515	10	1.9	245	302	6	2.0
		Autumn	375	10	2.7	237	163	5	3.1
		Winter	345	10	2.9	232	177	4	2.3
HAGU	BLL	Spring	131	10	7.6	282	96	10	10.4
		Summer	169	10	5.9	291	139	9	6.5
		Autumn	95	10	10.5	250	48	6	12.5
		Winter	181	10	5.5	255	132	7	5.3
BPLE	BLL	Spring	129	9	7.0	202	76	5	6.6
		Summer	195	10	5.1	257	118	6	5.1
		Autumn	179	11	6.1	319	156	14	9.0
		Winter	181	10	5.5	251	134	7	5.2

* ENLD, East Northland; HAGU, Hauraki Gulf; BPLE, Bay of Plenty.
† BLL, bottom longline.

Table 5: Details of snapper otolith samples collected in 2019–20 from the bottom longline stock areas of SNA 1 (Note: ENLD BLL data presented for Statistical Areas 002, 003, and both combined).

Stock*	Method†	Sampling period	Sampling method‡	Length range (cm)	Otoliths
ENLD (002)	BLL	Spring-winter	R	25–71	483
ENLD (003)	BLL	Spring-winter	R	25–75	470
ENLD (comb.)	BLL	Spring-winter	R	25–75	953
HAGU	BLL	Spring-winter	R	25–61	1 078
BPLE	BLL	Spring-winter	R	25–58	1 029

* ENLD, East Northland; HAGU, Hauraki Gulf; BPLE, Bay of Plenty.
† BLL, bottom longline.
‡ R, random sample.

Representativeness

The weight and number of bottom longline landings sampled throughout the 2019–20 fishing year were relatively representative of temporal catch trends of each stock (Figures 8–10).

East Northland accounted for almost half (47%) the 2019–20 SNA 1 longline catch, with a high proportion taken during spring-summer (Figure 8). December experienced the largest monthly catch (136 t) across SNA 1, followed in succession by the four surrounding months, October to February (Figure 8). The temporal spread of sampled landings was reasonably well distributed over all months with the exception of April, when COVID19 restrictions were introduced, and limited, or no sampling, was possible. The sampled catch represented 3% by weight and 3% by number of landings of the total bottom longline catch in East Northland. The average landing size selected for sampling (504 kg) was closely aligned with the average landing in the fishery (517 kg).

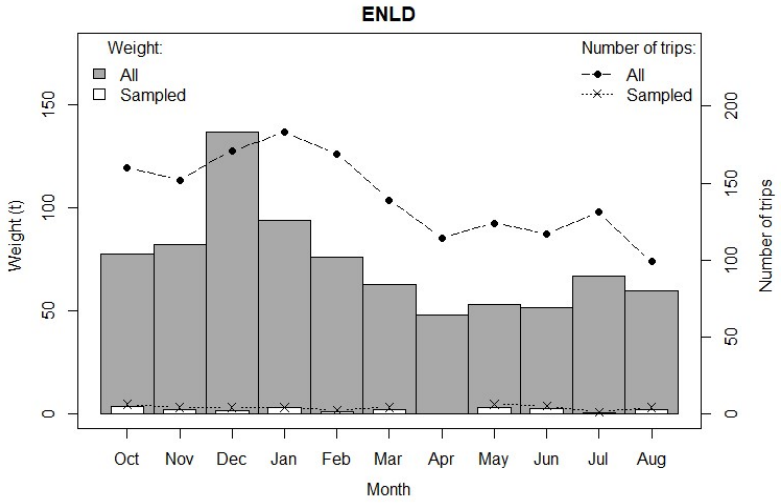

Figure 8: Comparison of the monthly distribution of landed weight (grey bars) and numbers of landings (dashed line) of snapper in the East Northland bottom longline fishery for all landings where snapper was caught for the period October to August 2019–20. Included are corresponding estimates for all sampled landings (white bars and dotted line) to show representativeness of collections.

Hauraki Gulf landings accounted for almost a quarter (24%) of the overall SNA 1 bottom longline catch in 2019–20, the lowest in three decades (Figure 9). Despite a steady catch over spring and early summer, the operation of the Hauraki Gulf fishery was at times inconsistent, a consequence of the COVID19 pandemic. Similar to East Northland, April was the Hauraki Gulf's lowest monthly longline catch (9 t), and the only month not sampled. Although neighbouring months displayed what appears to be restricted catches, by August a significant recovery emerged with the highest overall (81 t) monthly catch in 2019–20, a likely reflection of 'mopping up' uncaught quota (Figure 9). Although slight disproportionality was evident in the temporal spread of sampled landings, most months were well represented (Figure 9). The sampled catch accounted for 8% by weight and 7% by number of landings of the total bottom longline catch in the Hauraki Gulf. The average landing size selected for sampling (801 kg) was marginally larger than the average landing in the fishery (720 kg).

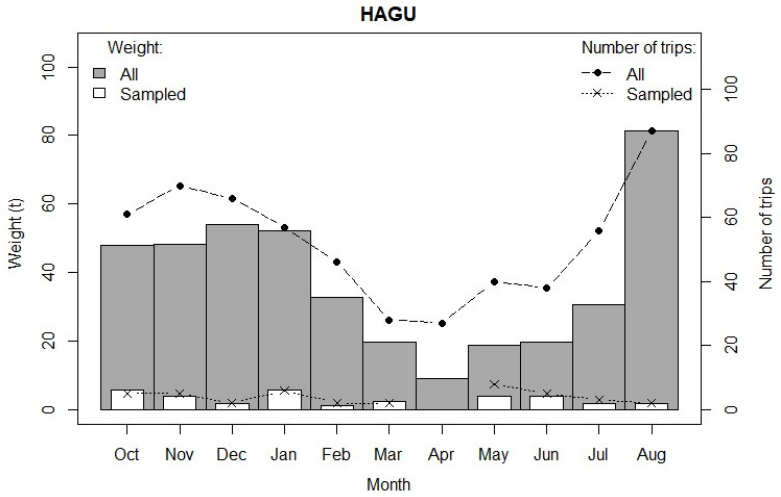

Figure 9: Comparison of the monthly distribution of landed weight (grey bars) and numbers of landings (dashed line) of snapper in the Hauraki Gulf bottom longline fishery for all landings where snapper was caught for the period October to August 2019–20. Included are corresponding estimates for all sampled landings (white bars and dotted line) to show representativeness of collections.

Bay of Plenty landings accounted for just over one quarter (28%) of the overall SNA 1 bottom longline catch in 2019–20. Bottom longline volumes were mostly lowest in late spring though summer and highest during autumn and early winter (Figure 10). Although the temporal spread of sampled landings in the fishery appears slightly disproportionate to the fishery, each month was represented (Figure 10). The sampled catch accounted for 6% by weight and 6% by number of landings of the total bottom longline catch in the Bay of Plenty. The average landing size selected for sampling (779 kg) was marginally larger than the average landing in the fishery (707 kg).

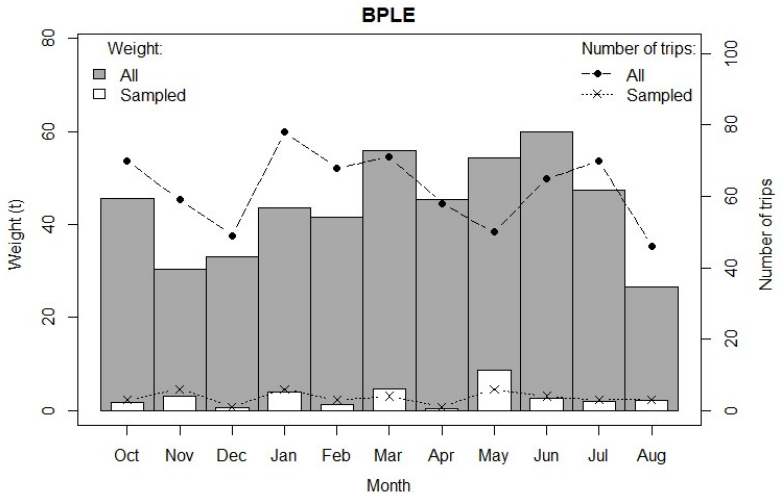

Figure 10: Comparison of the monthly distribution of landed weight (grey bars) and numbers of landings (dashed line) of snapper in the Bay of Plenty bottom longline fishery for all landings where snapper was caught for the period October to August 2019–20. Included are corresponding estimates for all sampled landings (white bars and dotted line) to show representativeness of collections.

The sampling performance relative to the cumulative proportion of the total number (top) and catch weight (bottom) of landings throughout the sampling period is illustrated in Figure 11. Sampling appears reasonably well distributed in proportion to, and representative of, the bottom longline fisheries in SNA 1.

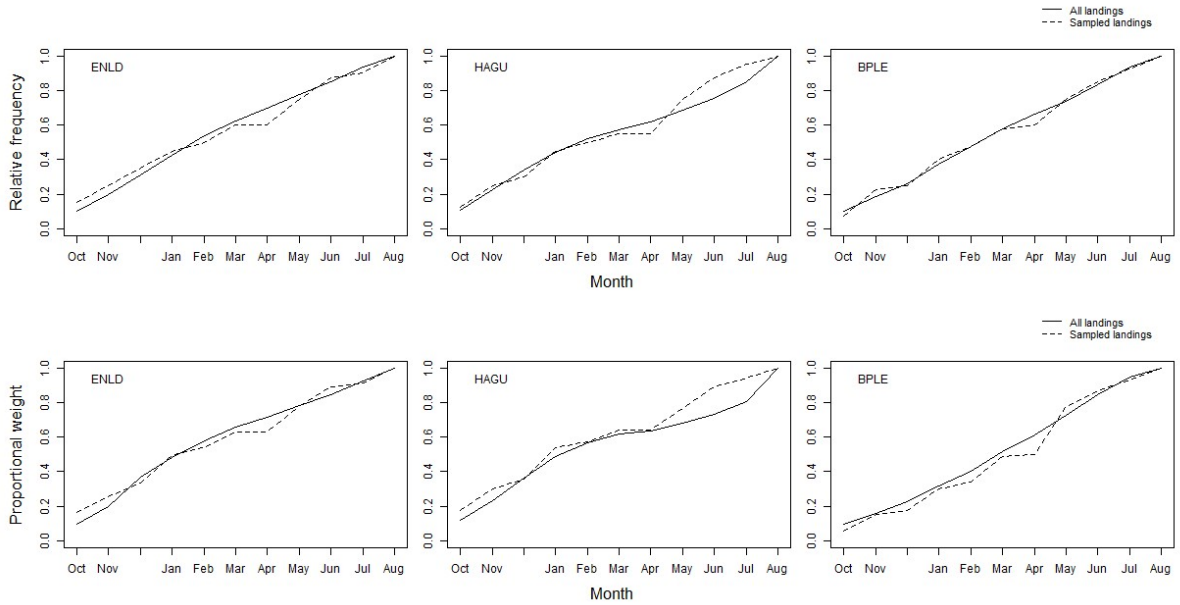

Figure 11: Comparison of the cumulative proportion of the number of landings (top row) and catch weight of landings (bottom row) with cumulative proportions of samples taken from the SNA 1 stock bottom longline fisheries in 2019–20. ENLD, East Northland; HAGU, Hauraki Gulf; BPLE, Bay of Plenty.

Spatial comparisons (0.1 degree blocks) of the SNA 1 bottom longline fishery catch and sampled catch for 2019–20 are presented in Figure 12 and by statistical area in Figure 13.

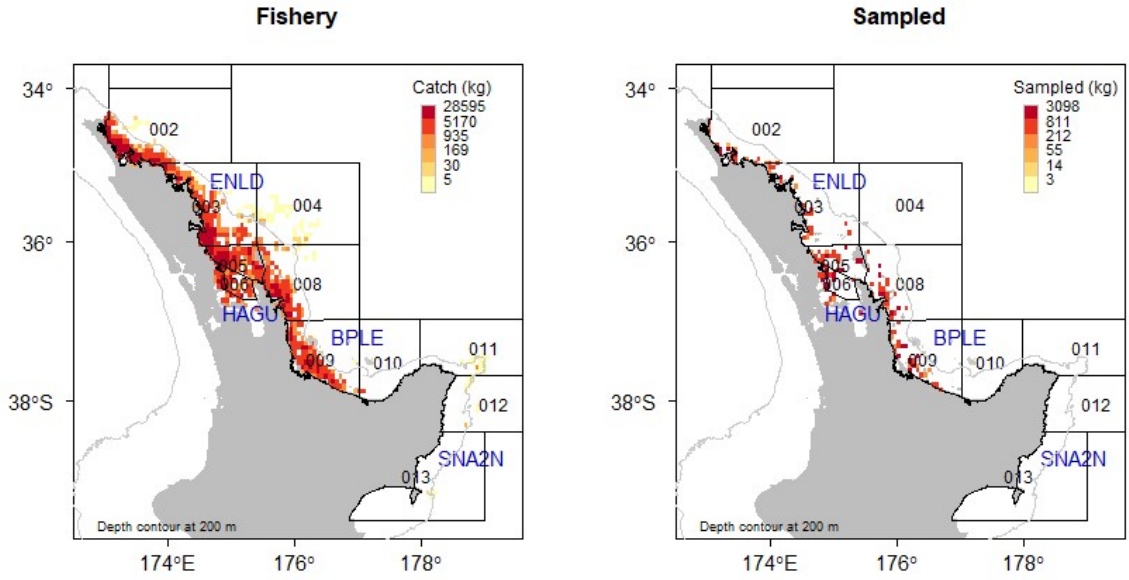

Figure 12: Comparison of the spatial distribution of the bottom longline catch and the sampled component for the SNA 1 stocks in 2019–20.

Almost the entire bottom longline catch (99.7%) in 2019–20 was taken from the coastal regions between North Cape and the Tarawera River entrance, west of Whakatane (Statistical Areas 002–003 and 005–009, Figure 12). Sampling was broadly representative of SNA 1 statistical area catch (Figures 12 and 13).

Although the SNA 1 longline catch in 2019–20 was taken targeting six species, snapper targeting accounted for 98% of the total catch (Figure 13). Sampling in relation to target species was representative.

Aside from slight under- and over-sampling issues within the Hauraki Gulf statistical areas, the proportionality of the sampled component to that of the fishery suggests that the sampled landings, by and large, were representative of the operation of the SNA 1 bottom longline fleet as a whole (Figure 13).

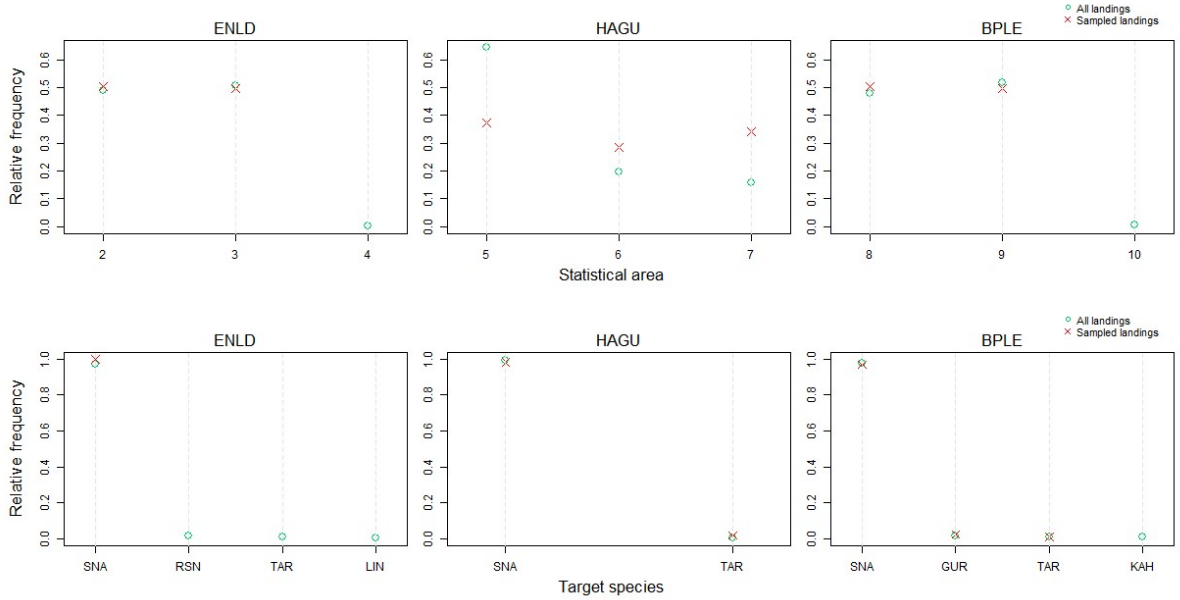

Figure 13: Comparison of the proportional distribution of the estimated bottom longline catch and the sampled component by statistical area (top row) and target species (bottom row) over the sampling period for the SNA 1 stocks in 2019–20. ENLD, East Northland; HAGU, Hauraki Gulf; BPLE, Bay of Plenty. Note: Statistical Area 002 is represented by '2', Statistical Area 003 is represented by '3', etc. SNA, Snapper; RSN, Red snapper (*Centroberyx affinis*); TAR, Tarakihi; LIN, Ling (*Geypterus blacodes*); GUR, Red gurnard, (*Chelidonichthys kumu*); KAH, Kahawai (*Arripis trutta*).

3.4 Relative SNA 1 and SNA 2 catch by bottom trawl

From 2015–16 to 2019–20, bottom trawl fisheries operated across seven main SNA 1 Statistical Areas (002–003, East Northland; 005–006, Hauraki Gulf; 008–010, Bay of Plenty) and all three SNA 2 North Statistical Areas (011–013N) (Figure 14). The largest catches in SNA 1 in recent years have occurred in the central and eastern Bay of Plenty Statistical Areas 009 and 010 (Figure 14c). The 2019–20 catch for Statistical Area 009 was 341 t and for Statistical Area 010 was 302 t (Figure 14c).

A decline in the snapper catch over the past five years was apparent in central Hauraki Gulf (Statistical Area 006) and to a lesser degree in southern East Northland (Statistical Area 003) (Figures 14a and b). In contrast, the high catch from Statistical Area 010 and the low catch from SNA 2 (Statistical Areas 011–013N) have remained consistent over the same period (Figure 14c and d).

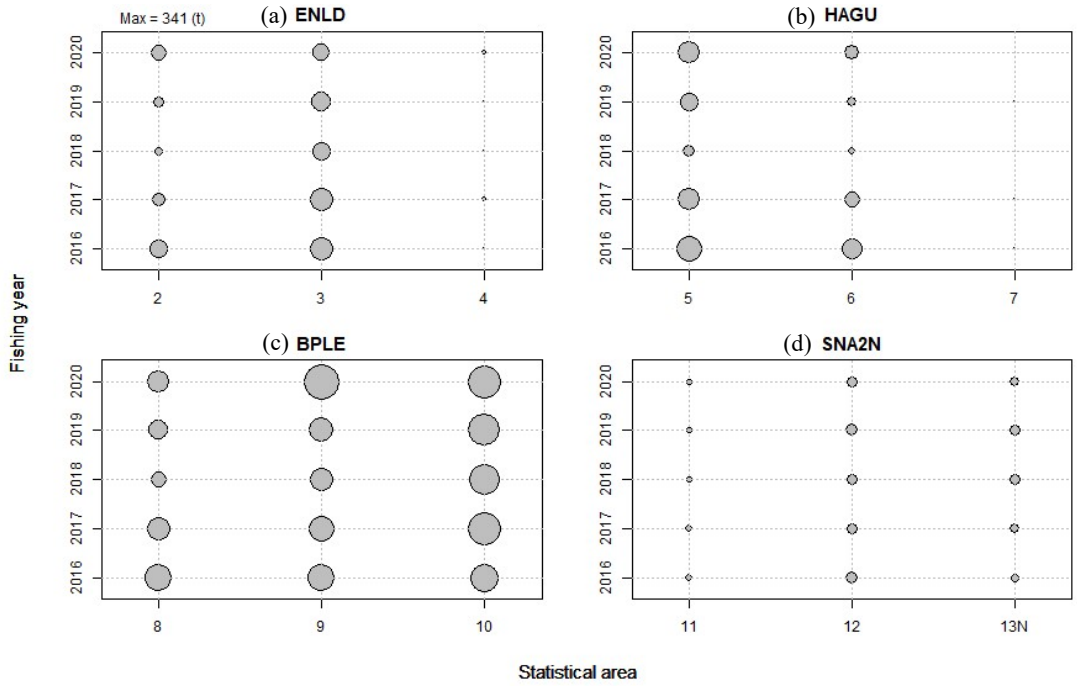

Figure 14: Bottom trawl catch (t) of snapper in SNA 1 and SNA 2 stocks by statistical area from fishing years 2015–16 to 2019–20 ((a) ENLD, East Northland; (b) HAGU, Hauraki Gulf; (c) BPLE, Bay of Plenty; (d) SNA2N, SNA 2 North). Note: Statistical Area 002 is represented by '2', Statistical Area 003 is represented by '3', etc.

Despite variability in the overall annual catch within each stock area, a level of consistency across monthly patterns was evident for some, particularly in the Bay of Plenty and SNA 2 North (Figures 15a–d). In contrast, monthly volumes for East Northland and Hauraki Gulf at times appeared sporadic over the five-year period, primarily due to a decline in catch around 2017–18 and 2018–19, making comparisons between years challenging (Figures 15a–b).

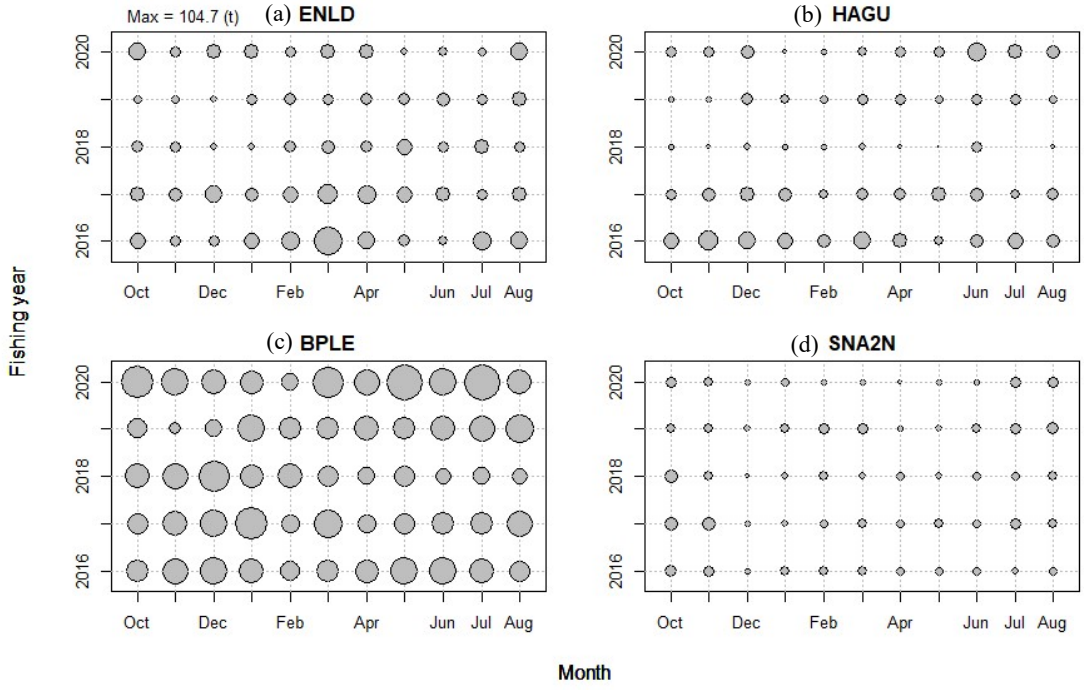

Figure 15: Bottom trawl catch (t) of snapper in SNA 1 and SNA 2 stocks by month from fishing years 2015–16 to 2019–20 ((a) ENLD, East Northland; (b) HAGU, Hauraki Gulf; (c) BPLE, Bay of Plenty; (d) SNA2N, SNA 2 North).

3.5 Sampling the SNA 1 and SNA 2 bottom trawl fisheries 2019–20

Sample collections

Summaries of the Bay of Plenty and SNA 2 North bottom trawl sample sizes for stock-season strata are given in Table 6 and summaries of the otolith sample collections are given in Table 7.

A target of 30 landings for Bay of Plenty bottom trawl was achieved with almost 10 000 length measurements recorded and 196 otolith pairs[2] collected using the length frequency and age-length key sampling design. In all, four vessels from a fleet of eight that landed in excess of 20 t of snapper during 2019–20 were sampled, and these vessels were responsible for three-quarters (74%) of the total Bay of Plenty bottom trawl catch.

For SNA 2 North, 1200 otolith pairs were successfully sampled (1171 aged) from 28 landings using the random age frequency design, falling just short of the initial target of 30 landings (Table 6). A total of seven vessels from a fleet of 15 that landed in excess of 3 t of snapper during 2019–20 were sampled—the sampled vessels were responsible for half (53%) the total catch. Some vessels fished both SNA 1 and SNA 2 stocks and the bins at sea were marked to ensure a SNA 2 North sample was identified.

Table 6: Summary of the bottom trawl catch (total number and weight of landings) and samples (number of landings and weight sampled, and number of fish sampled for length frequency) in stock-method-season strata for the SNA 1 and SNA 2 fisheries from spring-summer 2019–20 to autumn-winter 2020.

			Number of landings			No. of fish	Weight of landings (t)		
Stock*	Method†	Season	Total	Sampled	% total	measured	Total	Sampled	% total
ENLD	BT	Spr-sum	51	0	0	0	104	0	0
		Aut-win	78	4	5.1	1 238	100	17	17.0
BPLE	BT	Spr-sum	95	13	13.7	4 239	262	37	14.1
		Aut-win	150	17	11.3	5 714	456	74	16.2
SNA 2N	BT	Spr-sum	117	13	11.1	600	80	13	16.3
		Aut-win	121	15	12.4	600	84	11	13.1

* ENLD, East Northland; BPLE, Bay of Plenty; SNA 2N, SNA 2 North.
† BT, bottom trawl.

Table 7: Details of snapper otolith samples collected in 2019–20 from the bottom trawl stock areas of SNA 1 and SNA 2.

Stock*	Method†	Season	Sampling method	Length range (cm)	Otoliths
ENLD	BT	Spr-sum	LF+ALK‡	–	–
		Aut-win		25–48	22
BPLE	BT	Spr-sum	LF+ALK‡	24–67	35
		Aut-win		22–66	161
SNA 2N	BT	Spr-sum	RAF§	25–72	572
		Aut-win		25–63	599

* ENLD, East Northland; BPLE, Bay of Plenty; SNA 2N, SNA 2 North.
† BT, bottom trawl.
‡ LF+ALK, length frequency and age-length key.
§ RAF, random age frequency.

Use of modular harvest system in the autumn-winter East Northland fishery was low in 2019–20 and hence sampling was curtailed after two landings. As a substitute, Fisheries New Zealand requested that bottom trawl effort be sampled over the remaining months of the autumn-winter season.

[2] Otolith samples collected from the length frequency and age-length key sampling design are specific to each stock and may be a combination of otoliths from more than one fishing method. (i.e., Bay of Plenty bottom trawl, Danish seine, modular harvest system; see Section 2.3)

However, sampling the East Northland autumn-winter bottom trawl fishery also proved problematic, with only 4 of the target 15 landings sampled; hence age sampling was likely inadequate to describe the age structure of the fishery.

Representativeness

The weight and number of Bay of Plenty and SNA 2N bottom trawl landings sampled throughout 2019–20 were relatively representative of temporal catch trends of each stock whereas that for East Northland, as expected, were not (Figures 16–18).

Bay of Plenty accounted for just under two-thirds (62%) of the 2019–20 SNA 1 bottom trawl catch, with a high proportion taken during autumn-winter (Figure 17). May and July experienced the largest monthly catches, 105 t and 103 t respectively, in SNA 1 followed closely by October and March (Figure 17). The temporal spread of sampled landings was reasonably representative of the fishery over all months, with the exception of October. The sampled catch accounted for 15% by weight and 12% by number of landings of the total bottom trawl catch in Bay of Plenty. The average landing size selected for sampling (3708 kg) was slightly larger than the average landing in the fishery (2933 kg).

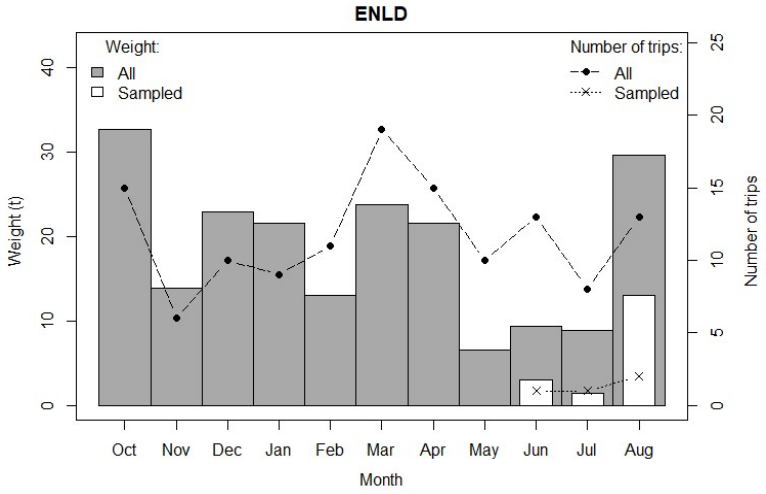

Figure 16: Comparison of the monthly distribution of landed weight (grey bars) and numbers of landings (dashed line) of snapper in the East Northland bottom trawl fishery for all landings where snapper was caught for the period October to August 2019–20. Included are corresponding estimates for all sampled landings (white bars and dotted line) to show representativeness of collections.

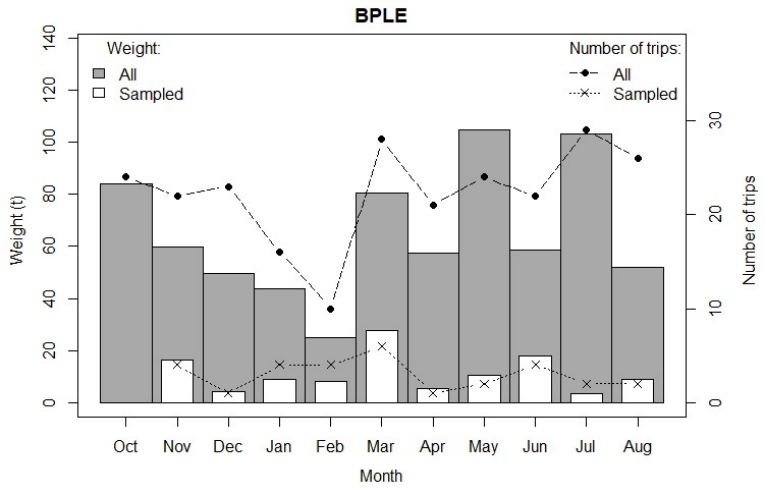

Figure 17: Comparison of the monthly distribution of landed weight (grey bars) and numbers of landings (dashed line) of snapper in the Bay of Plenty bottom trawl fishery for all landings where snapper was caught for the period October to August 2019–20. Included are corresponding estimates for all sampled landings (white bars and dotted line) to show representativeness of collections.

SNA 2N landings accounted for three-quarters (74%) of the overall SNA 2 bottom trawl catch in 2019–20, with a high proportion of snapper taken during spring and winter months. The temporal spread of sampled landings, although slightly disproportionate to the fishery operation, were represented throughout all but two months, one being April, the consequence of the COVID19 pandemic affecting both fishing and research (Figure 18). The sampled catch accounted for 15% by weight and 12% by number of landings of the total bottom trawl catch in the SNA 2N. The average landing size selected for sampling (851 kg) was slightly larger than the average landing in the fishery (688 kg).

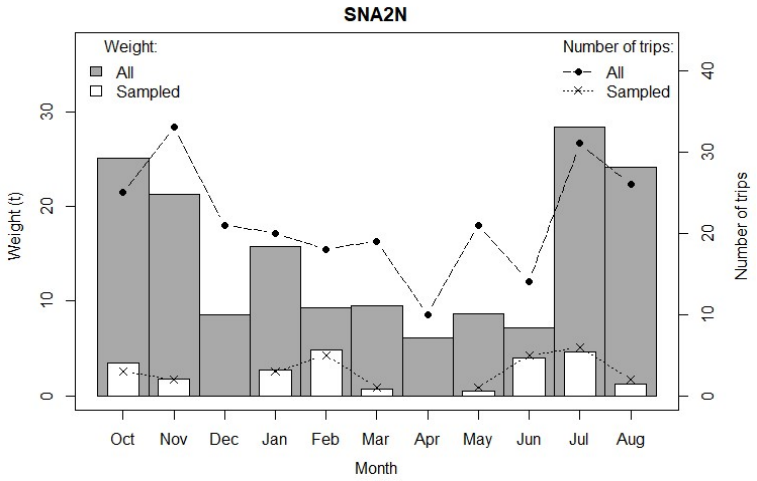

Figure 18: Comparison of the monthly distribution of landed weight (grey bars) and numbers of landings (dashed line) of snapper in the SNA 2N bottom trawl fishery for all landings where snapper was caught for the period October to August 2019–20. Included are corresponding estimates for all sampled landings (white bars and dotted line) to show representativeness of collections.

The sampling performance relative to the cumulative proportion of the total number (top) and catch weight (bottom) of landings throughout the sampling period is illustrated in Figure 19. Sampling appears reasonably representative of the Bay of Plenty and SNA 2 North bottom trawl fisheries but not for East Northland, due to insufficient samples (see Section 3.5 Sample collections).

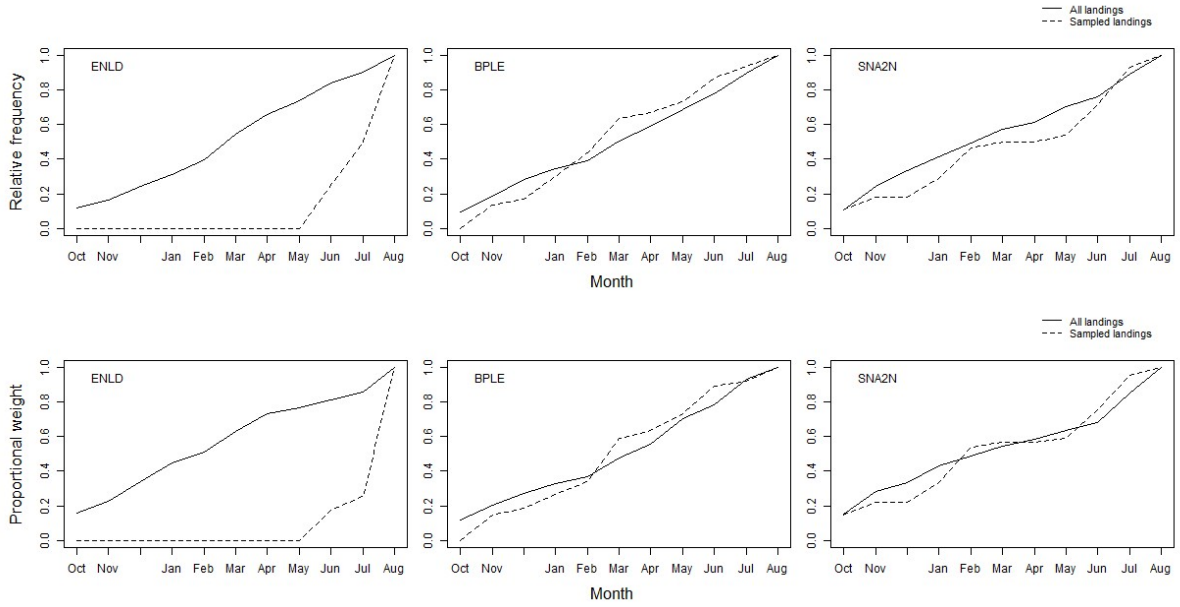

Figure 19: Comparison of the cumulative proportion of the number of landings (top row) and catch weight of landings (bottom row) with cumulative proportions of samples taken from the SNA 1 and SNA 2 stock bottom trawl fisheries in 2019–20. ENLD, East Northland; BPLE, Bay of Plenty; SNA2N, SNA 2 North.

Spatial comparisons (0.1 degree blocks) of the SNA 1 and SNA 2 North bottom trawl fisheries catch and sampled catch for 2019–20 are presented in Figure 20 and by statistical area in Figure 21.

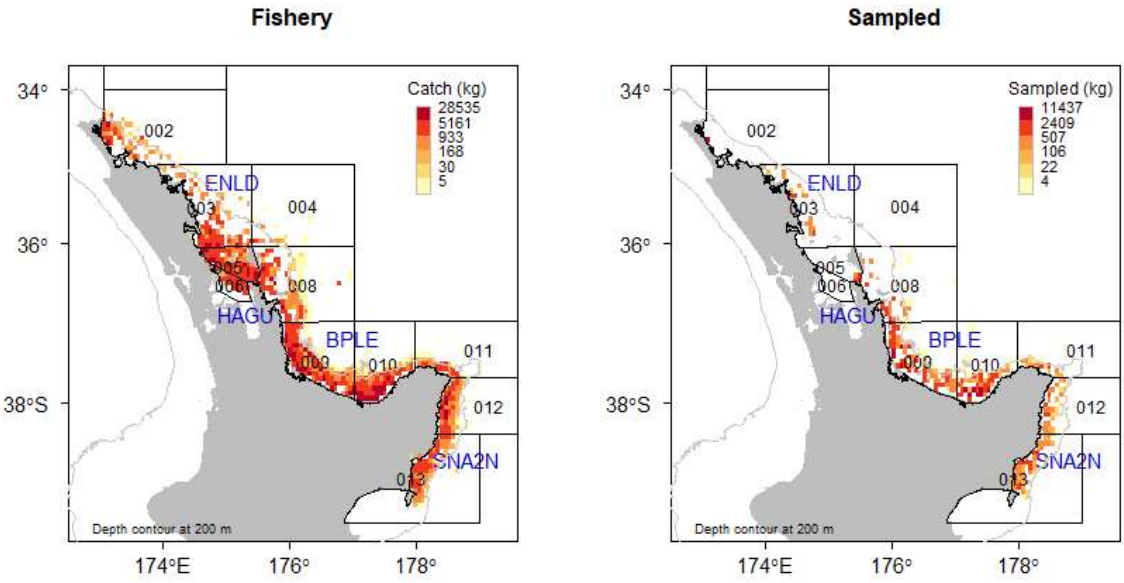

Figure 20: Comparison of the spatial distribution of the bottom trawl catch and the sampled component for the SNA 1 stocks in 2019–20.

The SNA 1 and SNA 2 North bottom trawl catch in 2019–20 was taken throughout coastal regions between North Cape and Mahia Peninsula (Statistical Areas 002–006, 008–013; Figure 20). For those stocks where sampling for bottom trawl was targeted (East Northland, Bay of Plenty, SNA 2 North), sampling was representative of the Bay of Plenty statistical area catches, but slightly less so of the East Northland and SNA 2 North statistical area catches (Figures 20 and 21).

The combined East Northland and Bay of Plenty bottom trawl snapper catch in 2019–20 was taken targeting six species, with snapper targeting accounting for 49% of the total catch (Figure 21). Sampling in relation to target species was representative for the Bay of Plenty but less so for East Northland. For SNA 2 North bottom trawl, the snapper catch was taken targeting five species with snapper as the target accounting for just 13% (Figure 21).

Aside from slight under- and over-sampling issues within the East Northland and SNA 2 North statistical areas, and in relation to target species for East Northland, the proportionality of the sampled component to that of the fishery suggests that the sampled landings, by and large, were representative of the operation of the East Northland, Bay of Plenty, and SNA 2 North bottom trawl fleets as a whole (Figure 21).

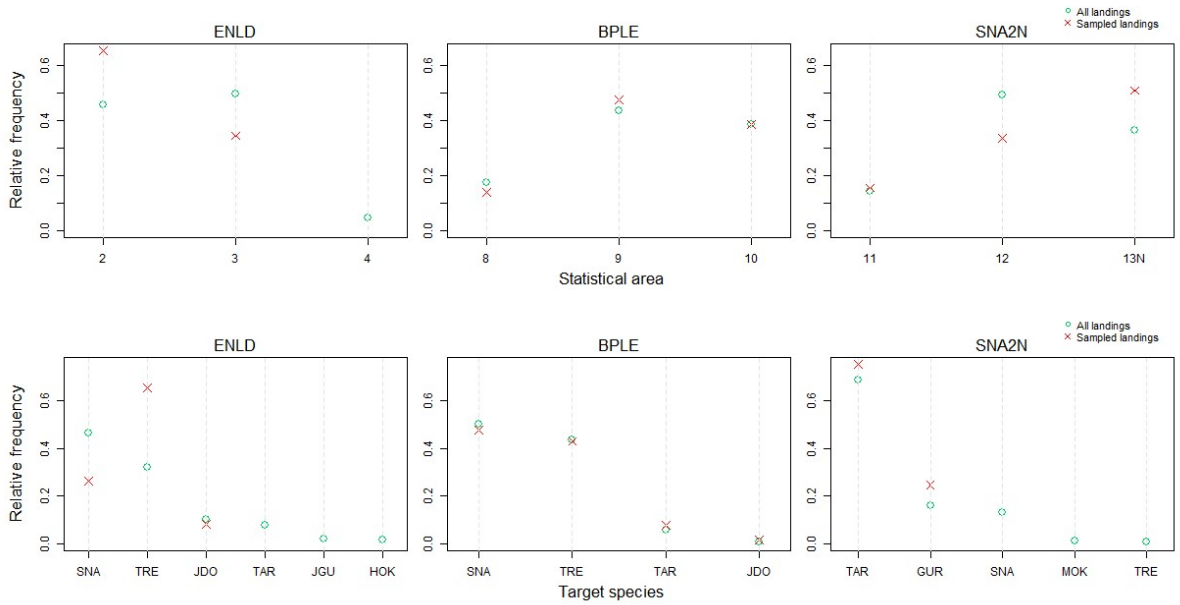

Figure 21: Comparison of the proportional distribution of the estimated bottom trawl catch and the sampled component by statistical area (top row) and target species (bottom row) over the sampling period for the SNA 1 and SNA 2 stocks in 2019–20. ENLD, East Northland; BPLE, Bay of Plenty; SNA2N, SNA 2 North. Note: Statistical Area 002 is represented by '2', Statistical Area 003 is represented by '3', etc. SNA, Snapper; TRE, Trevally; JDO, John dory (*Zeus faber*); TAR, Tarakihi; JGU, Spotted gurnard (*Pterygotrigla picta*); HOK, Hoki (*Macruronus novaezelandiae*); GUR, Red gurnard; MOK, Blue moki (*Latridopsis ciliaris*).

3.6 Relative SNA 1 and SNA 2 catch by Danish seine

From 2015–16 to 2019–20, Danish seine fisheries operated in six main coastal Statistical Areas (003, East Northland; 005–006, Hauraki Gulf; 008–010, Bay of Plenty) (Figure 22). The snapper catch from central Hauraki Gulf and Bay of Plenty, Statistical Areas 006 and 009, has consistently been the largest in all five years, and the 2019–20 catch was 160 t and 223 t, respectively (Figures 22b and c).

A steady decline over time is also evident in central Hauraki Gulf (Statistical Area 006) with the 2019–20 estimate (160 t) roughly half of that caught in the previous five years (Figure 22b). Catches from Statistical Area 008 in the Bay of Plenty have also declined, but the catch from other Statistical Areas (003, 005, 009, and 010) have remained relatively consistent over the same period (Figures 22a–d).

Limited, or no catch, was taken by Danish seine from Far North or offshore East Northland (Statistical Areas 002 and 004) and SNA 2 North (Statistical Areas 011–013N).

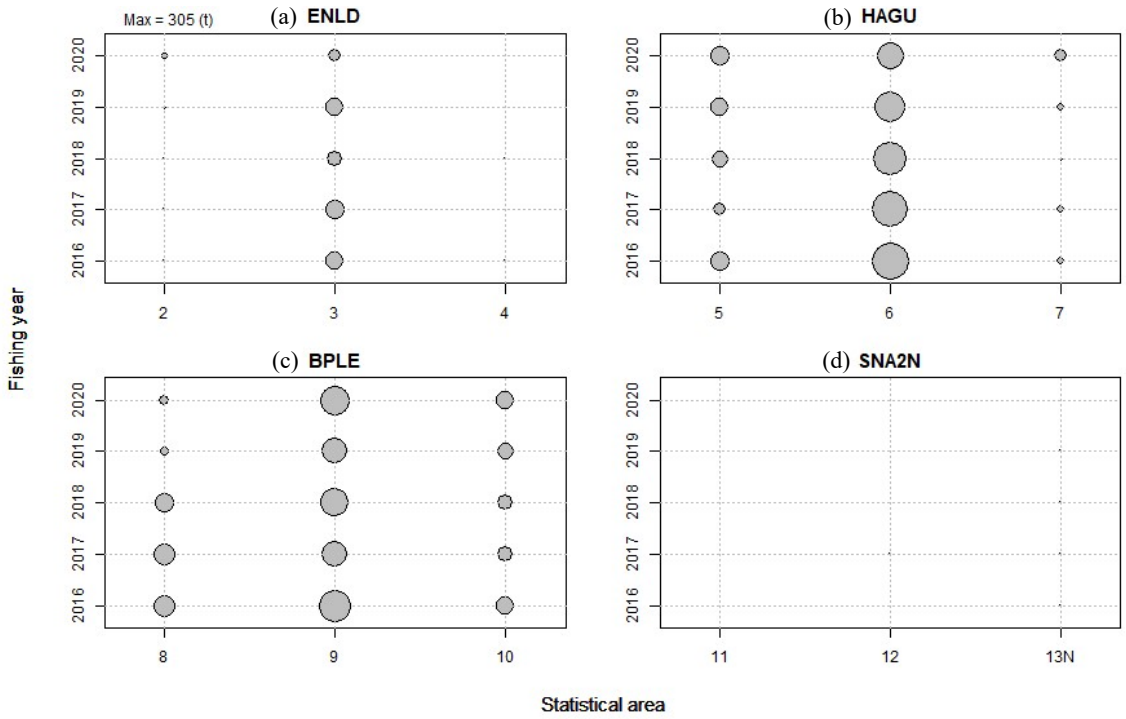

Figure 22: Danish seine catch of snapper in SNA 1 and SNA 2 stocks by statistical area from fishing years 2015–16 to 2019–20 ((a) ENLD, East Northland; (b) HAGU, Hauraki Gulf; (c) BPLE, Bay of Plenty; (d) SNA2N, SNA 2 North). Note: Statistical Area 002 is represented by '2', Statistical Area 003 is represented by '3', etc.

The monthly Danish seine snapper catch in East Northland, although small in size, was generally consistent across most months from 2015–16 and 2019–20 (Figure 23a). In contrast, large monthly volumes were taken from Hauraki Gulf and Bay of Plenty Danish seine fisheries; those from the Bay of Plenty were more uniform across months than from the Hauraki Gulf, which had lower catches in autumn (Figures 23b and c).

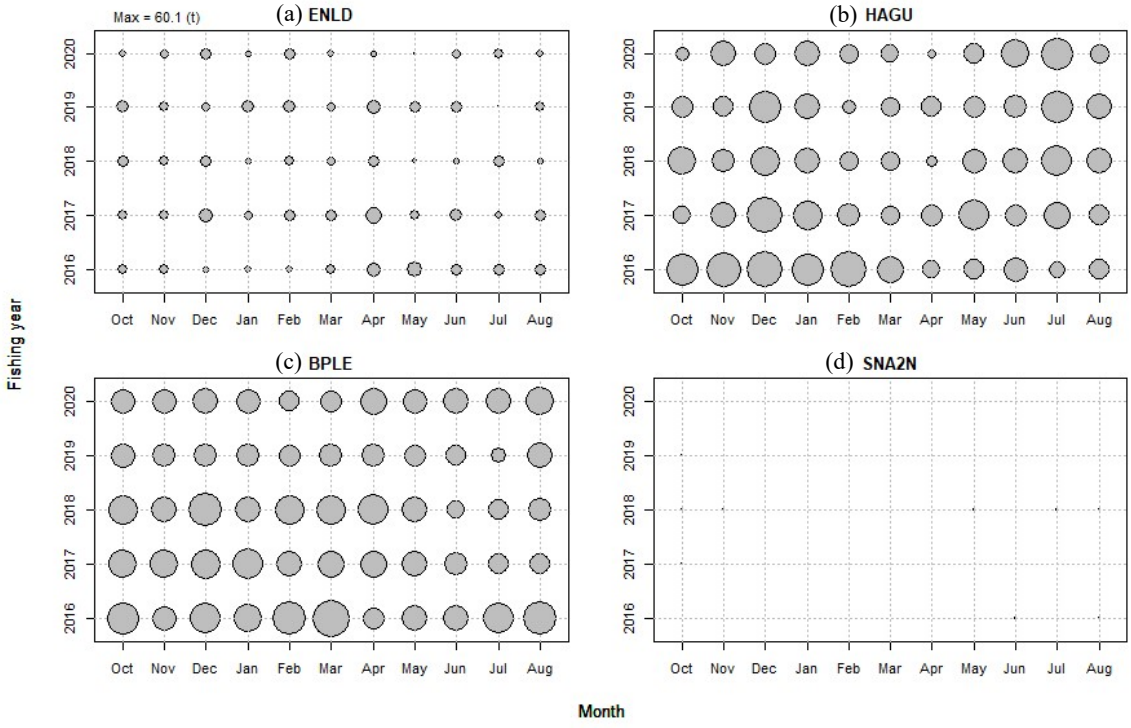

Figure 23: Danish seine catch of snapper in SNA 1 and SNA 2 stocks by month from fishing years 2015–16 to 2019–20 ((a) ENLD, East Northland; (b) HAGU, Hauraki Gulf; (c) BPLE, Bay of Plenty; (d) SNA2N, SNA 2 North).

3.7 Sampling the SNA 1 Danish seine fishery 2019–20

Sample collections

Summaries of the Danish seine sample sizes for stock-season strata are given in Table 8, and summaries of the otolith sample collections are given in Table 9. A combined total of 60 Danish seine landings were sampled from SNA 1 (Hauraki Gulf, 29; and Bay of Plenty, 31) in 2019–20, with almost 20 000 snapper measured for length frequency and 338 otoliths collected for age-length keys. In all, three vessels from a Hauraki Gulf fleet of four that landed in excess of 10 t of snapper during 2019–20 were sampled and these vessels were responsible for almost two-thirds (63%) of the total seine catch. For Bay of Plenty, the three sampled vessels dominated the fishery and collectively caught almost all (99%) the total Danish seine catch. Proportional sampling across the fleet relative to catch was generally good, given the availability of vessels. For example, the highest number of samples taken from a single vessel during the study for each of the respective sampled stocks was: 17 times, Hauraki Gulf (3 vessels available); 12 times, Bay of Plenty (3 vessels available). Many of these vessels also fished in adjacent stocks.

Table 8: Summary of the Danish seine catch (total number and weight of landings) and samples (number of landings and weight sampled, and number of fish sampled for otoliths) in stock-method-season strata for the SNA 1 fisheries from spring-summer 2019–20 to autumn-winter 2020.

			Number of landings			No. of fish	Weight of landings (t)		
Stock*	Method†	Season	Total	Sampled	% total	measured	Total	Sampled	% total
HAGU	DS	Spr-sum	54	16	29.6	4 817	105	34	32.4
		Aut-win	59	15	25.4	4 699	134	31	23.1
BPLE	DS	Spr-sum	76	14	18.4	4 671	122	24	19.7
		Aut-win	91	15	16.5	4 574	174	30	17.2

* HAGU, Hauraki Gulf; BPLE, Bay of Plenty.
† DS, Danish seine.

Table 9: Details of snapper otolith samples collected in 2019–20 from the Danish seine stock areas of SNA 1.

Stock*	Method†	Season	Sampling method	Length range (cm)	Otoliths
HAGU	DS	Spr-sum	LF+ALK‡	24–74	156
		Aut-win		24–69	131
BPLE	DS	Spr-sum	LF+ALK‡	25–69	33
		Aut-win		24–66	18

* HAGU, Hauraki Gulf; BPLE, Bay of Plenty.
† DS, Danish seine.
‡ LF+ALK, length frequency and age-length key.

Representativeness

The weight and number of Danish seine landings sampled throughout the 2019–20 fishing year were generally representative of temporal catch trends of each stock (Figures 24–25).

Hauraki Gulf landings accounted for 40% of the overall SNA 1 Danish seine catch in 2019–20 with a high proportion taken during winter months—the largest catch (44 t) was in July (Figure 24). The operation of the Hauraki Gulf Danish seine fishery was, at times, inconsistent, with variable monthly catches throughout the year (Figure 24). The temporal spread of sampled landings was reasonably representative of the fishery, with the exception of April when COVID19 restrictions were introduced, affecting both commercial fishing and research. The sampled catch was 27% by weight and number of landings of the total Danish seine fishery in the Hauraki Gulf. The average landing size selected for sampling (2113 kg) was close to the average landing in the fishery (2090 kg).

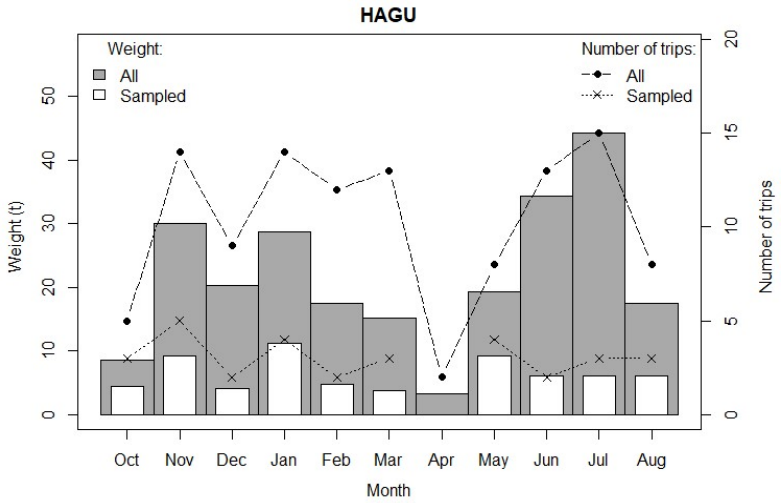

Figure 24: Comparison of the monthly distribution of landed weight (grey bars) and numbers of landings (dashed line) of snapper in the Hauraki Gulf Danish seine fishery for all landings where snapper was caught for the period October to August 2019–20. Included are corresponding estimates for all sampled landings (white bars and dotted line) to show representativeness of collections.

Bay of Plenty landings accounted for 48% of the overall SNA 1 Danish seine catch in 2019–20. The operation of the Bay of Plenty fishery was generally consistent throughout the half-year seasons, with monthly catches in autumn and winter most often larger than in spring and summer (Figure 25). The temporal spread of sampled landings was reasonably well distributed to the fishery over all months with the exception of March when no sampling was conducted (Figure 25). The sampled catch accounted for 18% by weight and 17% by number of landings of the total Danish seine catch in the Bay of Plenty. The average landing size selected for sampling (1877 kg) was marginally larger than the average landing in the fishery (1775 kg).

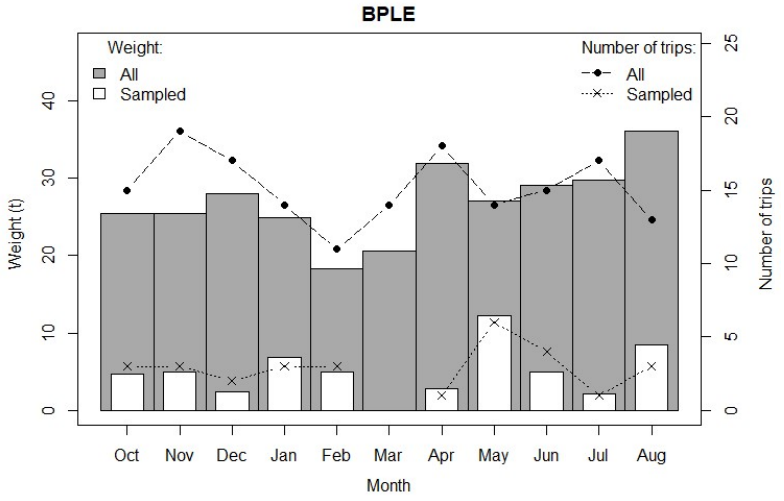

Figure 25: Comparison of the monthly distribution of landed weight (grey bars) and numbers of landings (dashed line) of snapper in the Bay of Plenty Danish seine fishery for all landings where snapper was caught for the period October to August 2019–20. Included are corresponding estimates for all sampled landings (white bars and dotted line) to show representativeness of collections.

The sampling performance relative to the cumulative proportion of the total number (top) and catch weight (bottom) of landings throughout the sampling period is illustrated in Figure 26. Sampling generally appears well distributed in proportion to, and representative of, the Hauraki Gulf and Bay of Plenty Danish seine fisheries.

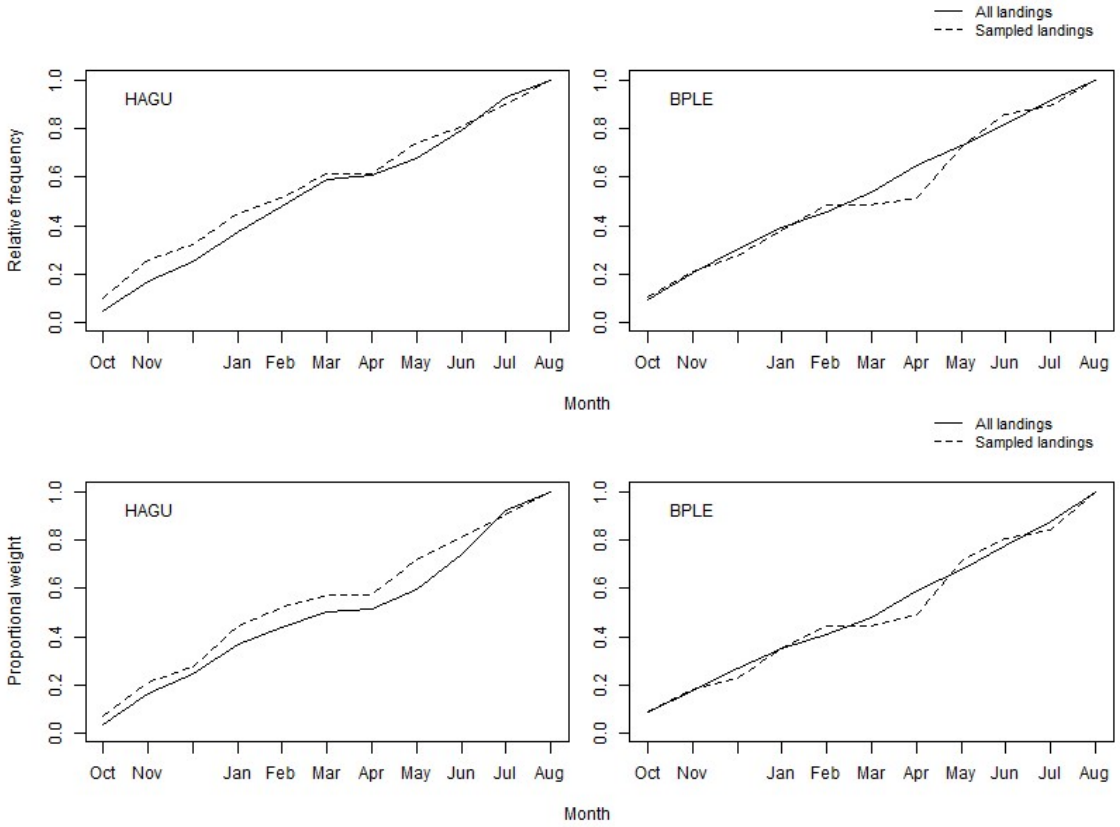

Figure 26: Comparison of the cumulative proportion of the number of landings (top row) and catch weight of landings (bottom row) with cumulative proportions of samples taken from the SNA 1 stock Danish seine fisheries in 2019–20. HAGU, Hauraki Gulf; BPLE, Bay of Plenty.

Spatial comparisons (0.1 degree blocks) of the SNA 1 Danish seine fishery catch and sampled catch for 2019–20 are presented in Figure 27 and by statistical area in Figure 28.

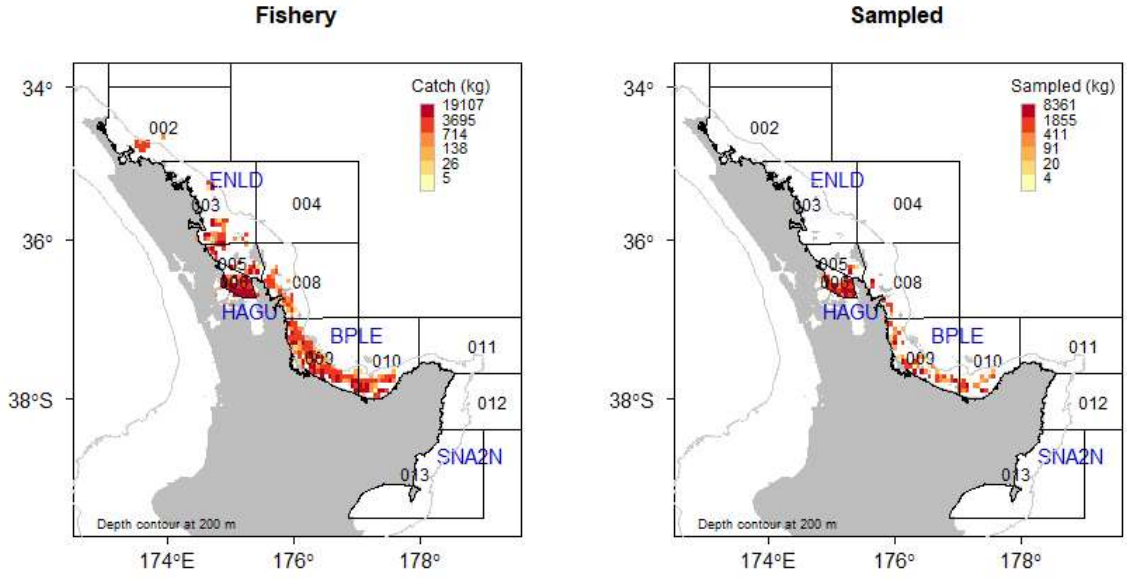

Figure 27: Comparison of the spatial distribution of the Danish seine catch and the sampled component for the SNA 1 stocks in 2019–20.

Almost the entire Danish seine catch (99.2%) in 2019–20 was taken from the coastal regions between Ngunguru Bay and the Whitianga Bay, west of Te Kaha (Statistical Areas 003 and 005–010; Figure 27). For those stocks where sampling for Danish seine was targeted (Hauraki Gulf, Bay of

Plenty), sampling representativeness was good for Bay of Plenty statistical area catches, but less so for Hauraki Gulf statistical area catches (Figures 27 and 28).

Although the combined Hauraki Gulf and Bay of Plenty Danish seine catch in 2019–20 was taken targeting four species, snapper targeting accounted for 94% of the total catch (Figure 28). Sampling in relation to target species was representative.

Aside from slight under- and over-sampling issues within the Hauraki Gulf statistical areas, the proportionality of the sampled component to that of the fishery suggests that the sampled landings, by and large, were representative of the operation of the Hauraki Gulf and Bay of Plenty Danish seine fleets as a whole (Figure 28).

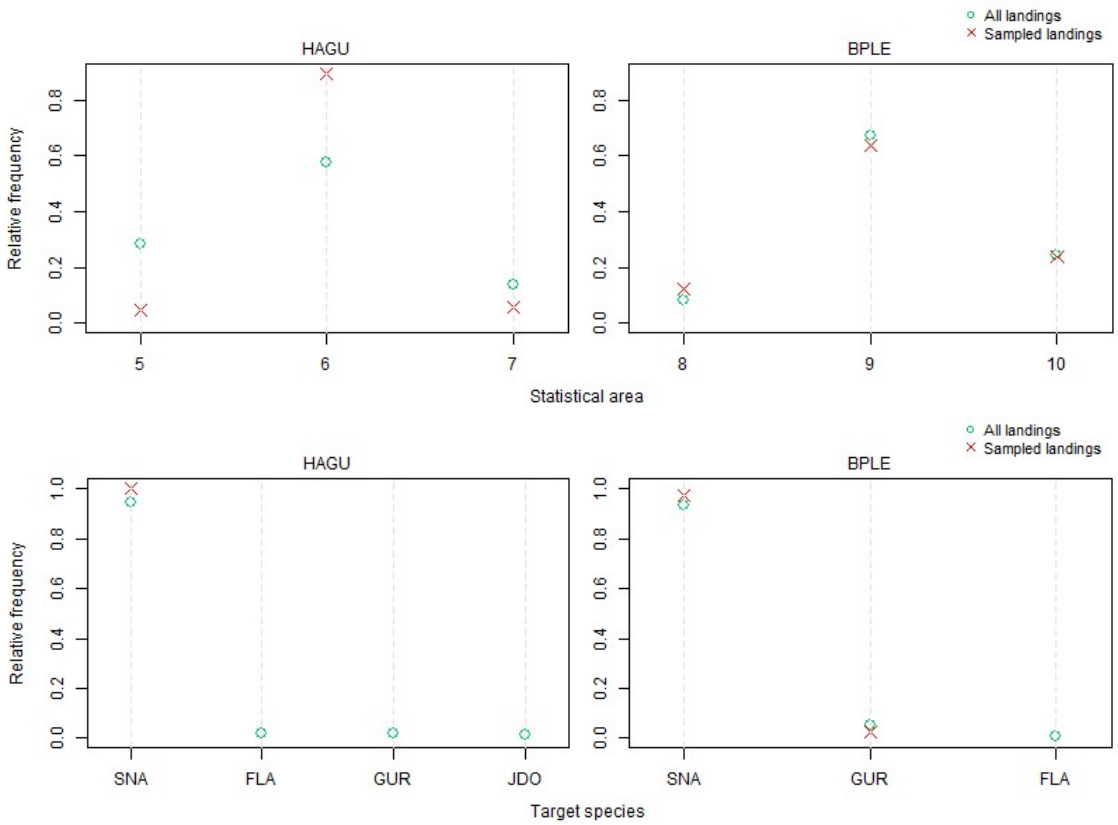

Figure 28: Comparison of the proportional distribution of the estimated Danish seine catch and the sampled component by statistical area (top row) and target species (bottom row) over the sampling period for the SNA 1 and SNA 2 stocks in 2019–20. HAGU, Hauraki Gulf; BPLE, Bay of Plenty. Note: Statistical Area 005 is represented by '5', Statistical Area 006 is represented by '6', etc. SNA, Snapper; FLA, Flatfish; GUR, Red gurnard; JDO, John dory).

3.8 Relative SNA 1 and SNA 2 catch by modular harvest system

From 2015–16 to 2019–20, the modular harvest system was used intermittently across eight Statistical Areas (002–004, East Northland; 005–006, Hauraki Gulf; 008–010, Bay of Plenty) (Figure 29). Despite inconsistencies, annual catches from the Bay of Plenty and East Northland Statistical Areas 002–003 and 008–010 have been the most significant, often ranging between 100 to almost 300 t (Figure 29). For the 2019–20 fishing year, the modular harvest system fishery only operated within these two stock areas. Limited or no MHS catch was taken from SNA 2 North (Statistical Areas 011–013N).

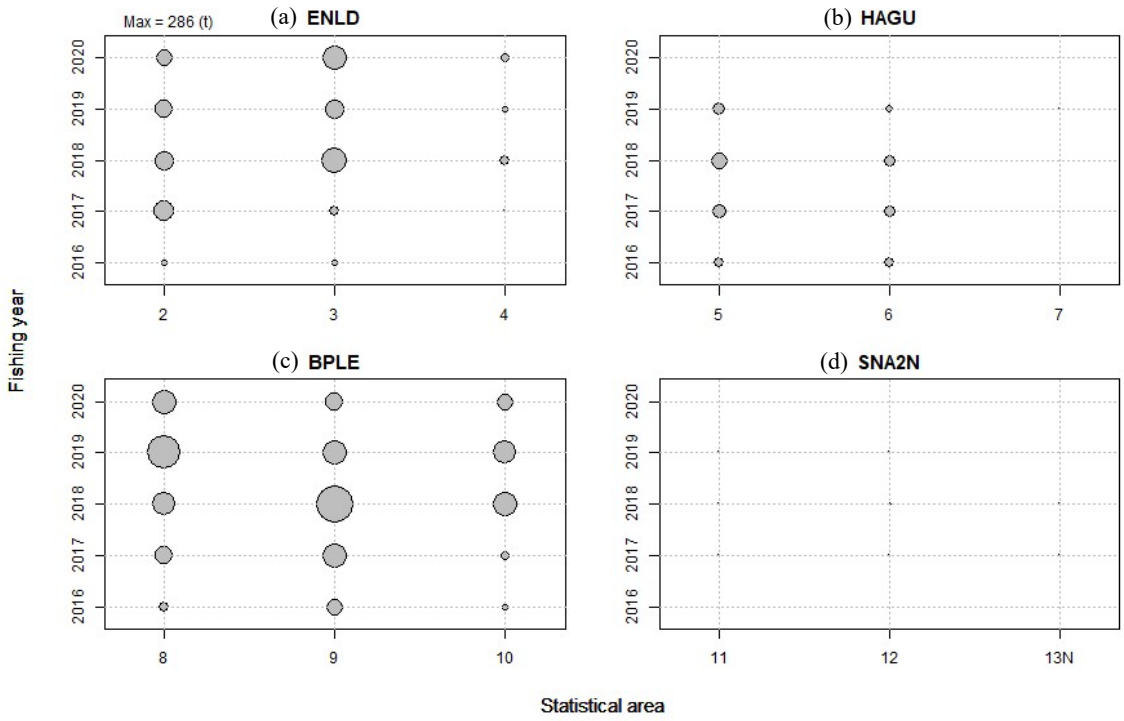

Figure 29: Modular harvest system catch of snapper in SNA 1 and SNA 2 stocks by statistical area from fishing years 2015–16 to 2019–20 ((a) ENLD, East Northland; (b) HAGU, Hauraki Gulf; (c) BPLE, Bay of Plenty; (d) SNA2N, SNA 2 North). Note: Statistical Area 002 is represented by '2', Statistical Area 003 is represented by '3', etc.

Due to its recent introduction, combined with sporadic fishing effort, few visible monthly trends are apparent in the SNA 1 modular harvest system fisheries; the exception being a relatively consistent, but small Hauraki Gulf catch (Figures 30a–c). For East Northland, large catches were most common over autumn-winter months, whereas those in Bay of Plenty in recent years appear more broadly distributed (Figures 30a–c).

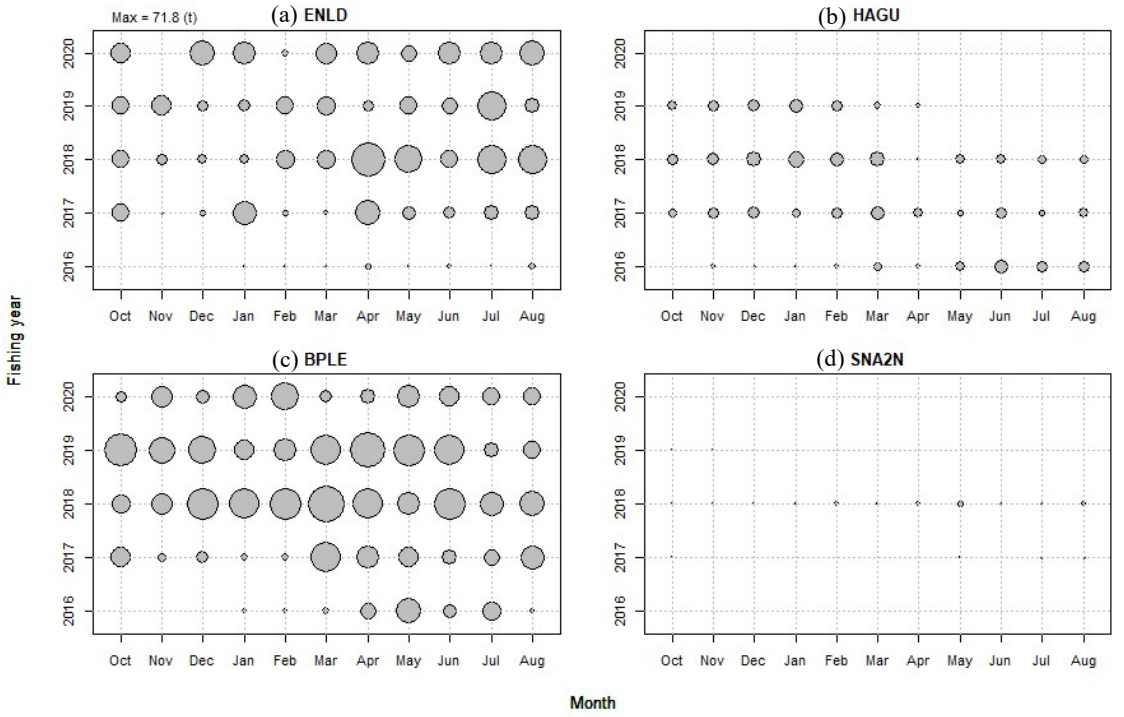

Figure 30: Modular harvest system catch of snapper in SNA 1 and SNA 2 stocks by month from fishing years 2015–16 to 2019–20 ((a) ENLD, East Northland; (b) HAGU, Hauraki Gulf; (c) BPLE, Bay of Plenty; (d) SNA2N, SNA 2 North).

3.9 Sampling the SNA 1 modular harvest system fishery 2019–20

Sample collections

Summaries of the modular harvest system sample sizes for stock-season strata are given in Table 10, and summaries of the otolith sample collections are given in Table 11. A total of 39 modular harvest system landings were sampled from SNA 1 in 2019–20, with almost 13 000 snapper measured for length frequency and 280 otoliths collected for age-length keys. Two vessels from an East Northland fleet of three that landed in excess of 20 t of snapper during 2019–20 were sampled and collectively contributed to over two-thirds (71%) of the total modular harvest system catch, and all three MHS vessels that operated in the Bay of Plenty fishery were sampled. Proportional sampling across the fleet relative to catch was generally good, given the availability of vessels and clean East Northland and Bay of Plenty[3] catches. The highest number of samples taken from a single vessel during the study for each of the respective sampled stocks was: 12 times, East Northland (2 vessels available); 13 times, Bay of Plenty (3 vessels available). These vessels also fished in adjacent stocks.

Although spring-summer sample sizes for target number of landings were nearly achieved in both East Northland and Bay of Plenty, during autumn-winter, targets fell short in East Northland where the main vessel changed to bottom trawl and fished in the Hauraki Gulf on the same trips, making mixed area landings invalid for sampling (Tables 10 and 11).

Table 10: Summary of the modular harvest system catch (total number and weight of landings) and samples (number of landings and weight sampled, and number of fish sampled for otoliths) in stock-method-season strata for the SNA 1 fisheries from spring-summer 2019–20 to autumn-winter 2020.

			Number of landings			No. of fish	Weight of landings (t)		
Stock*	Method†	Season	Total	Sampled	% total	measured	Total	Sampled	% total
ENLD	MHS	Spr-sum	26	14	53.8	4 542	92	60	65.2
		Aut-win	42	2	4.8	633	166	10	6.0
BPLE	MHS	Spr-sum	23	14	60.9	4 789	114	85	74.6
		Aut-win	33	9	27.3	2 768	104	44	42.3

* ENLD, East Northland; BPLE, Bay of Plenty.
† MHS, modular harvest system.

Table 11: Details of snapper otolith samples collected in 2019–20 from the modular harvest system stock areas of SNA 1.

Stock*	Method†	Season	Sampling method	Length range (cm)	Otoliths
ENLD	MHS	Spr-sum	LF+ALK‡	23–74	150
		Aut-win		25–56	52
BPLE	MHS	Spr-sum	LF+ALK‡	23–63	41
		Aut-win		24–59	37

* ENLD, East Northland; BPLE, Bay of Plenty.
† MHS, modular harvest system.
‡ LF+ALK, length frequency and age-length key.

[3] There is uncertainty in the method used on each trip (Modular harvest system vs. bottom trawl) because restrictions are imposed for modular harvest system in shallow water and cod-end changes may be made on a single trip when targeting different species.

Representativeness

The weight and number of modular harvest system landings sampled throughout the 2019–20 fishing year were relatively representative of temporal catch trends of each stock (Figures 31–32), the exception being that for East Northland where sampling ceased in May 2019 (see Section 3.9 Sample collections).

East Northland landings accounted for over half (54%) the 2019–20 SNA 1 modular harvest system catch, with high monthly volumes taken during early summer, early autumn, and winter (Figure 31). The fishery operation, however, was at times highly variable, with December and August experiencing the largest monthly catches (~35 t) in comparison with no catch made in November and 4 t landed in February (Figure 31). The temporal spread of sampled landings across the first half year was representative of the fishery, while late March and April experienced COVID19 restrictions followed by the main vessel moving into the Hauraki Gulf from mid-May, ceasing sampling opportunities (Figure 31). The sampled catch was 27% by weight and 24% by number of landings of the MHS fleet in East Northland. The average landing size selected for sampling (4387 kg) was slightly larger than the average landing in the fishery (3789 kg).

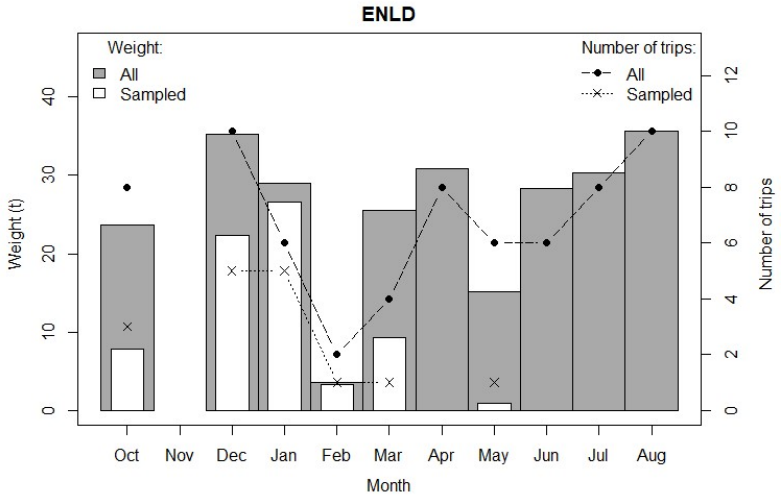

Figure 31: Comparison of the monthly distribution of landed weight (grey bars) and numbers of landings (dashed line) of snapper in the East Northland modular harvest system fishery for all landings where snapper was caught for the period October to August 2019–20. Included are corresponding estimates for all sampled landings (white bars and dotted line) to show representativeness of collections.

Bay of Plenty landings accounted for just under half (46%) of the overall SNA 1 modular harvest system catch in 2019–20 with variable monthly volumes, the largest taken in February (Figure 32). Although the temporal spread of sampled landings appears slightly disproportionate to the fishery, there was good representation of the six months with highest catches (Figure 32). The sampled catch accounted for 59% by weight and 41% by number of landings of the total modular harvest system catch in the Bay of Plenty, indicative of a high proportion of landings sampled relative to the fishery operation, particularly during spring-summer (Figure 32, Table 10). The average landing size selected for sampling (5637 kg) was considerably larger than the average landing in the fishery (3901 kg).

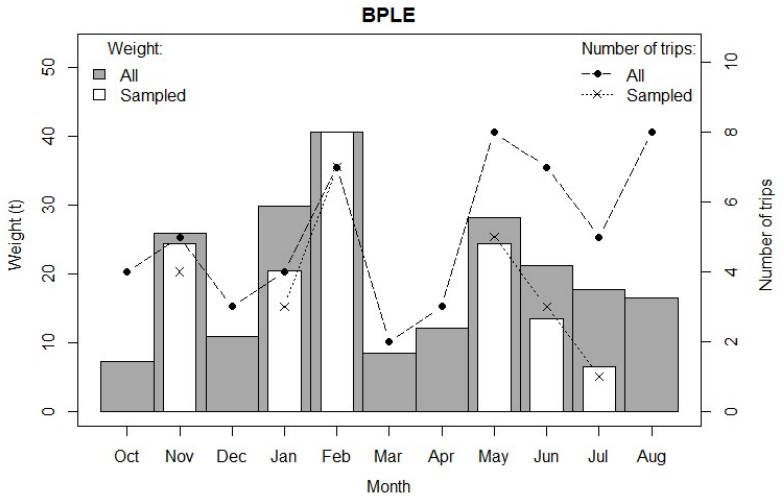

Figure 32: Comparison of the monthly distribution of landed weight (grey bars) and numbers of landings (dashed line) of snapper in the Bay of Plenty modular harvest system fishery for all landings where snapper was caught for the period October to August 2019–20. Included are corresponding estimates for all sampled landings (white bars and dotted line) to show representativeness of collections.

The sampling performance relative to the cumulative proportion of the total number (top) and catch weight (bottom) of landings throughout the sampling period is illustrated in Figure 33. Sampling appears reasonably well distributed in proportion to, and representative of, the Bay of Plenty fishery. Good sampling representativeness of the East Northland modular harvest system fishery was achieved in the spring-summer but unachievable in autumn-winter (Figure 33).

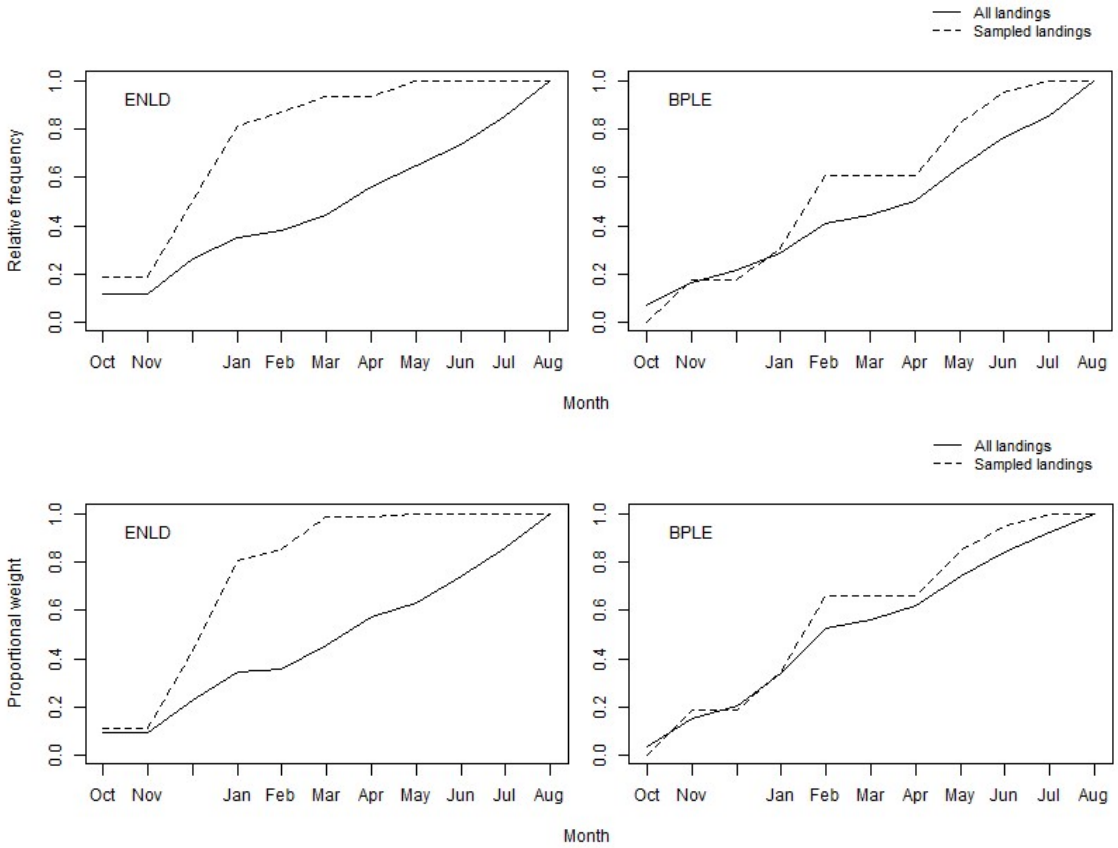

Figure 33: Comparison of the cumulative proportion of the number of landings (top row) and catch weight of landings (bottom row) with cumulative proportions of samples taken from the SNA 1 stock modular harvest system fisheries in 2019–20. ENLD, East Northland; BPLE, Bay of Plenty.

Spatial comparisons (0.1 degree blocks) of the SNA 1 modular harvest system fishery catch and sampled catch for 2019–20 are presented in Figure 34 and by statistical area in Figure 35.

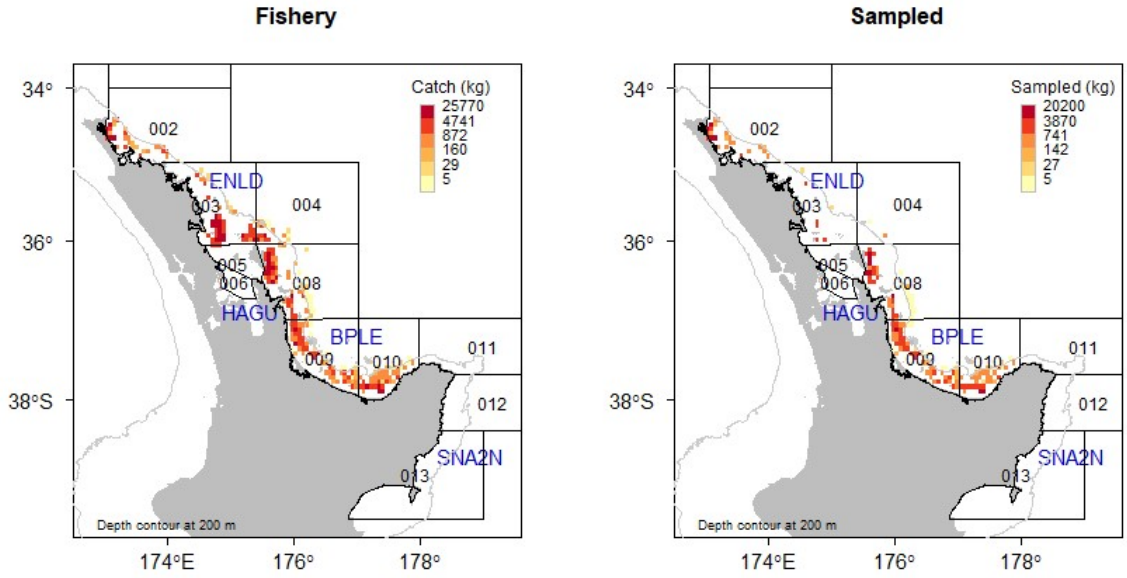

Figure 34: Comparison of the spatial distribution of the modular harvest system catch and the sampled component for the SNA 1 stocks in 2019–20.

With voluntary exclusion of modular harvest system operations in the Hauraki Gulf fishery (Statistical Areas 005–007) in 2019–20, the catch was entirely taken from East Northland and Bay of Plenty between North Cape and Cape Runaway (Statistical Areas 002–004 and 008–010; Figure 34). Sampling representativeness for East Northland was good for the Far North (Statistical Area 002), but relatively poor for Statistical Area 003, and that for Bay of Plenty Statistical Areas 008–010 was very good (Figures 34 and 35).

Although the modular harvest system catch in 2019–20 was taken targeting four species, snapper targeting accounted for the vast majority: 78% in East Northland and 92% in Bay of Plenty (Figure 35). Sampling in relation to target species was representative for the Bay of Plenty fishery but less so for East Northland where under- and over-sampling issues were present when snapper or trevally was targeted (Figure 35).

Although proportionality of the sampled component to that of the fishery suggest sampled landings were generally representative of the operation of the Bay of Plenty modular harvest system fleet, it is clear that sampling representativeness for East Northland was relatively poor (Figure 35).

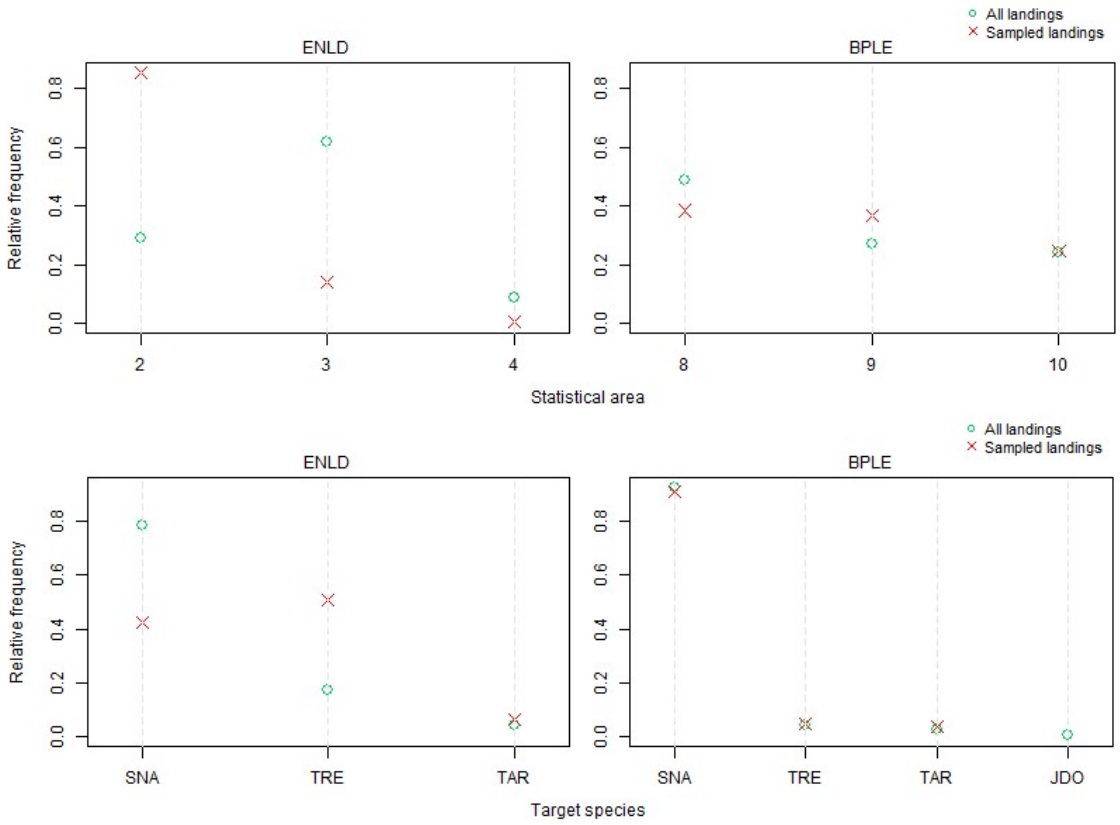

Figure 35: Comparison of the proportional distribution of the estimated modular harvest system catch and the sampled component by statistical area (top row) and target species (bottom row) over the sampling period for the SNA 1 stocks in 2019–20. ENLD, East Northland; BPLE, Bay of Plenty. Note: Statistical Area 002 is represented by '2', Statistical Area 003 is represented by '3', etc. SNA, Snapper; TRE, Trevally; TAR, Tarakihi; JDO, John dory.

3.10 Snapper otolith readings: reader comparison tests for reference readings

To assess reader competency in ageing snapper otoliths in 2019–20, each of the five selected readers aged a subsample of 50 reference otolith preparations with the aim of achieving a score for Index of Average Percentage Error, IAPE (Beamish & Fournier 1981) and mean coefficient of variation (CV) (Chang 1982) of below 1.50 % and 2.12 %, respectively (Walsh et al. 2014a). Four readers achieved CV and IAPE scores below the targets and one reader marginally exceeded in the 3rd attempt (Table 12).

Table 12: **Reader comparison scores determined from ageing 50 randomly selected snapper reference otolith samples ranging in age from 3 to 56 years.**

	IAPE	CV	Agreed age	Pass/Fail
Target	1.50%	2.12%	–	–
Reader 1	0.23%	0.33%	92%	Pass (1st attempt)
Reader 2	0.36%	0.51%	90%	Pass (1st attempt)
Reader 3	0.92%	1.30%	80%	Pass (1st attempt)
Reader 4	1.58%	2.23%	68%	Pass (3rd attempt)
Reader 5	0.70%	0.99%	72%	Pass (3rd attempt)

3.11 Reader comparison tests for SNA 1 readings

More than 6500 otolith pair samples were collected from the SNA 1 and SNA 2 stocks in 2019–20 (from random age frequency and age-length key sampling methods) with 5067[4] aged successfully by five readers; reader 1 reading all stock samples and readers 2 to 5, each reading a single stock sample. Between-reader tests, based on graphical comparisons, are shown in Figures 36–39 and depict a good level of consistency between readers. The overall percentage agreement between readers was 89% for East Northland, 77% for Hauraki Gulf, 85% for the Bay of Plenty, and 75% for the SNA 2 North, with only minor systematic differences (bias) in first counts of snapper otoliths between the readers. The slight positive weighting of the histogram, the relative clustering of plotted points about the zero line, and the slight deviation from the one-to-one line on the age-bias plots for Hauraki Gulf (Figures 37a–c) indicate that reader 3, at times, often underestimated age, particularly for older fish. The between-reader CVs ranged from 0.67 to 2.81% and IAPE ranged from 0.48 to 1.99% (Figures 36c–39c) and the profiles show that precision varied across age classes in all stock collections, most often lowest for East Northland and highest for the SNA 2 North (Figures 36d–39d), the latter mainly due to overestimated age for two- and three-year olds. Comparisons of the age-bias plots for all five readers with the agreed age indicate that readers 1 and 2 showed a high level of precision and consistency in estimating age with CV and IAPE estimates less than 1.00% (Figures 36e,f–39e,f). For readers 3 to 5, precision was slightly lower, with CVs and IAPEs almost identical to the between-reader estimates (Figures 37c–39c), ranging from 1.42 to 2.8% (CV) and 1.01 to 1.98% (IAPE) (Figures 37f–39f).

[4] Approximately 300 SNA 1 and 600 SNA 2N otoliths were not aged in 2019–20 because they were rejected due to cross contamination of samples from vessels fishing across stock boundaries or superfluous to the collection.

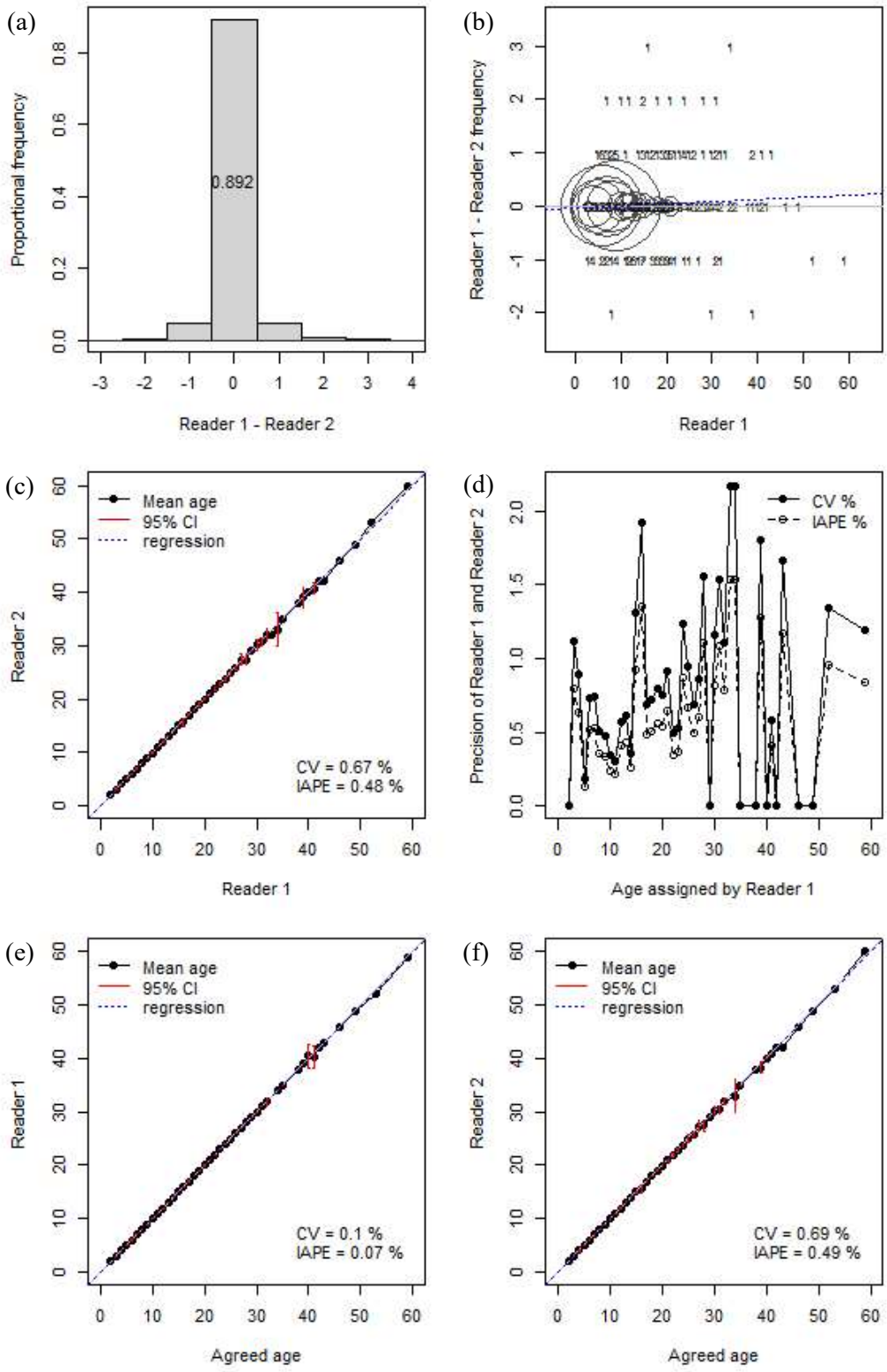

Figure 36: Results of between-reader comparison test (reader 1 and 2) for East Northland otoliths collected in 2019–20 (n = 1177): (a) histogram of differences between readings for the same otolith; (b) differences between readers for a given age assigned by reader 1; (c) bias plot between readers; (d) CV and IAPE profiles (precision) relative to the age assigned by reader 1; (e) bias plot between reader 1 ((f) reader 2) and agreed age. The expected one-to-one (solid line) and actual relationship (dashed line) between readers are overlaid on (b) and (c), and between reader 1 and 2 and the agreed age on (e) and (f).

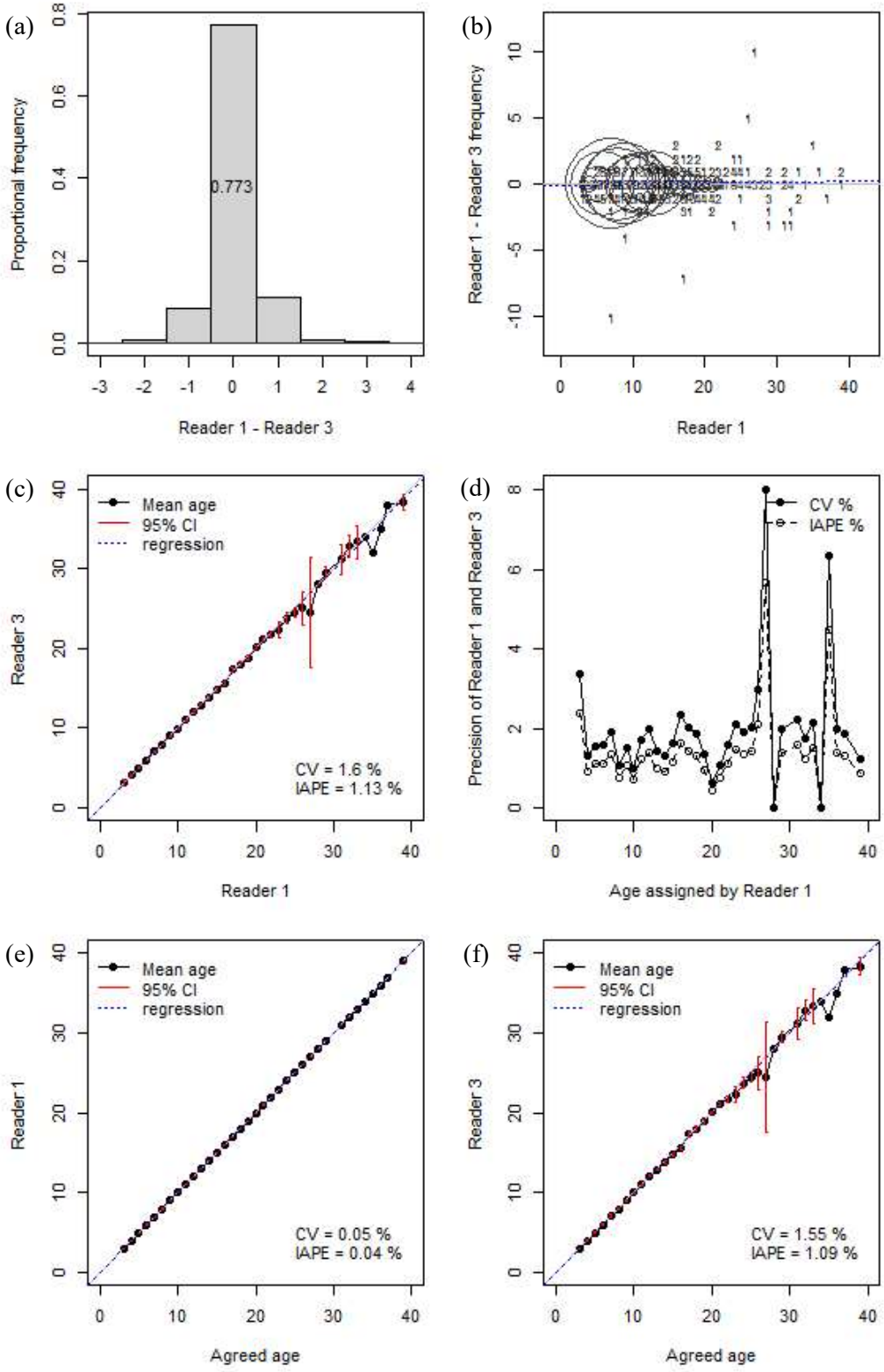

Figure 37: Results of between-reader comparison test (reader 1 and 3) for Hauraki Gulf otoliths collected in 2019–20 (n = 1365): (a) histogram of differences between readings for the same otolith; (b) differences between readers for a given age assigned by reader 1; (c) bias plot between readers; (d) CV and IAPE profiles (precision) relative to the age assigned by reader 1; (e) bias plot between reader 1 ((f) reader 3) and agreed age. The expected one-to-one (solid line) and actual relationship (dashed line) between readers are overlaid on (b) and (c), and between reader 1 and 3 and the agreed age on (e) and (f).

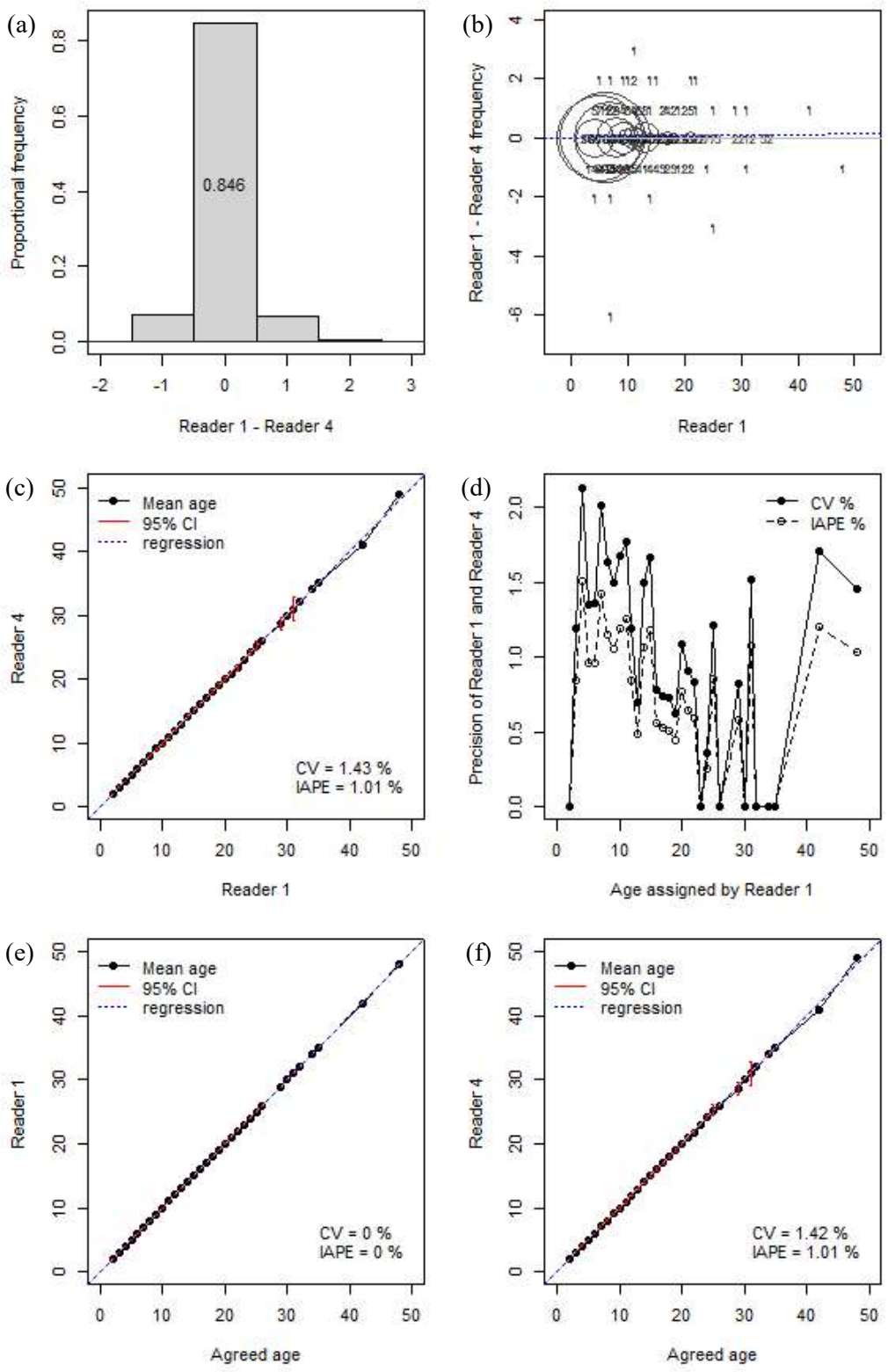

Figure 38: Results of between-reader comparison test (reader 1 and 4) for Bay of Plenty otoliths collected in 2019–20 (*n* = 1354): (a) histogram of differences between readings for the same otolith; (b) differences between readers for a given age assigned by reader 1; (c) bias plot between readers; (d) CV and IAPE profiles (precision) relative to the age assigned by reader 1; (e) bias plot between reader 1 ((f) reader 4) and agreed age. The expected one-to-one (solid line) and actual relationship (dashed line) between readers are overlaid on (b) and (c), and between reader 1 and 4 and the agreed age on (e) and (f).

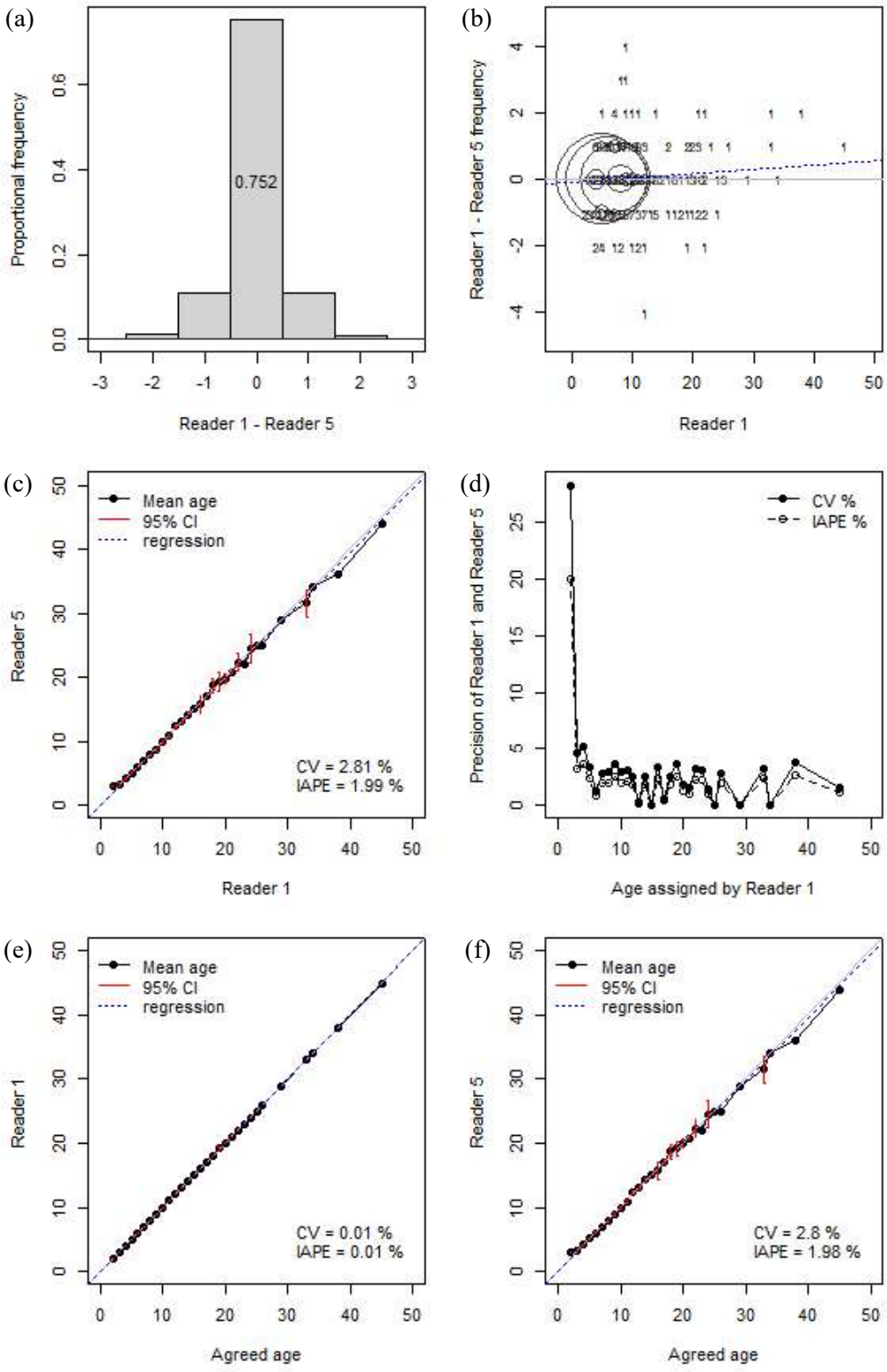

Figure 39: Results of between-reader comparison test (reader 1 and 5) for northern SNA 2 otoliths collected in 2019–20 (n = 1171): (a) histogram of differences between readings for the same otolith; (b) differences between readers for a given age assigned by reader 1; (c) bias plot between readers; (d) CV and IAPE profiles (precision) relative to the age assigned by reader 1; (e) bias plot between reader 1 ((f) reader 5) and agreed age. The expected one-to-one (solid line) and actual relationship (dashed line) between readers are overlaid on (b) and (c), and between reader 1 and 5 and the agreed age on (e) and (f).

3.12 SNA 1 bottom longline catch-at-age estimates

Bottom longline catch-at-age compositions (sampled using the random age frequency sampling approach) with bootstrap variance estimates were derived for each stock and season, and then combined over all seasons (spring to winter) to produce annual compositions (Figure 40). Age distributions are used to compare differences in the age structure of each stock and season stratum and to gauge relative year class strengths (Figures 40 and 41, Appendix 2).

Age-at-length scatterplots (using decimalised ages and not fishing year ages) are given in Appendix 3 to document the stock and fishing method of otolith collections that make up the bottom longline random age frequency samples (Appendix 2).

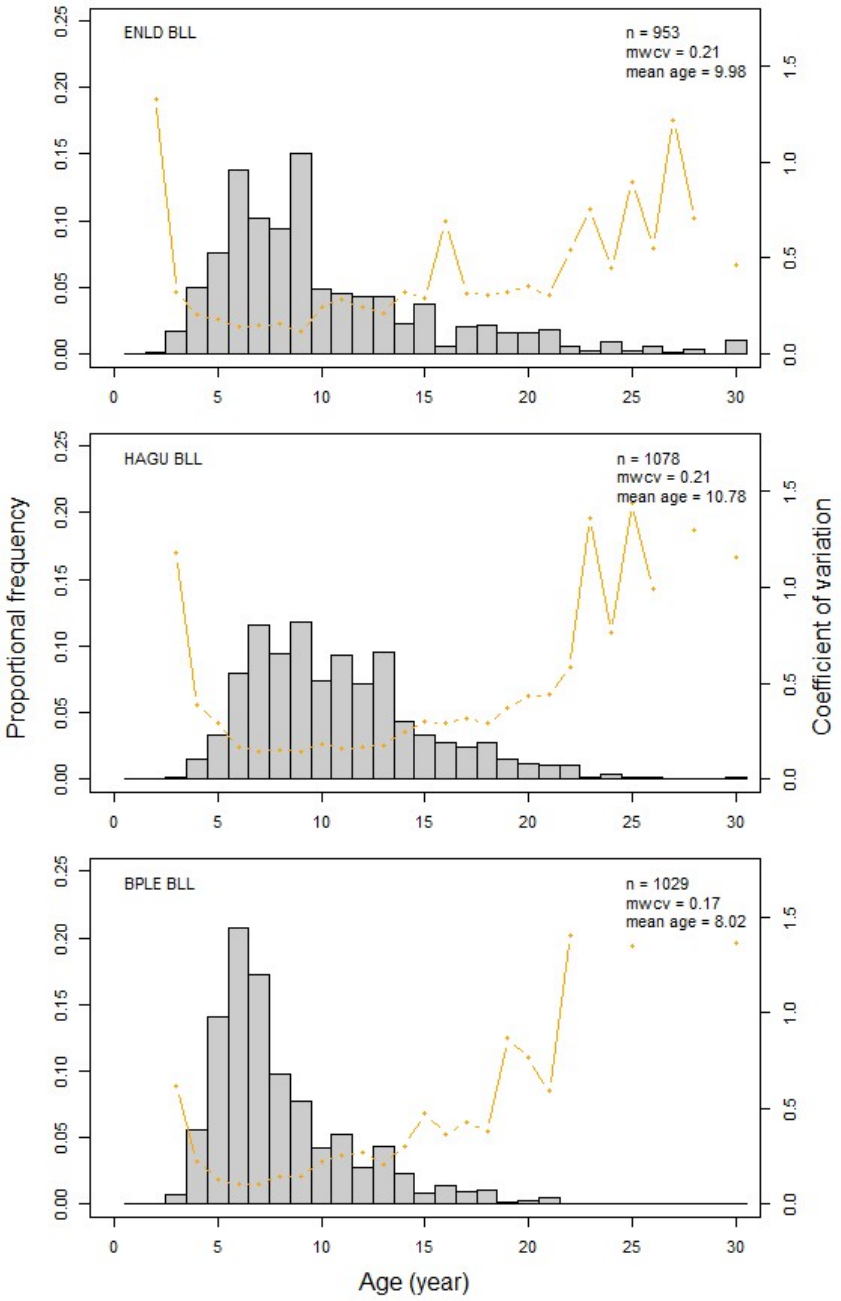

Figure 40: Proportion-at-age distributions (histograms) and CVs (lines) determined from snapper landings sampled from the three SNA 1 stock bottom longline fisheries in 2019–20 (ENLD, East Northland; HAGU, Hauraki Gulf; BPLE, Bay of Plenty amalgamated across all four seasons; *n*, sample size; MWCV, mean weighted CV).

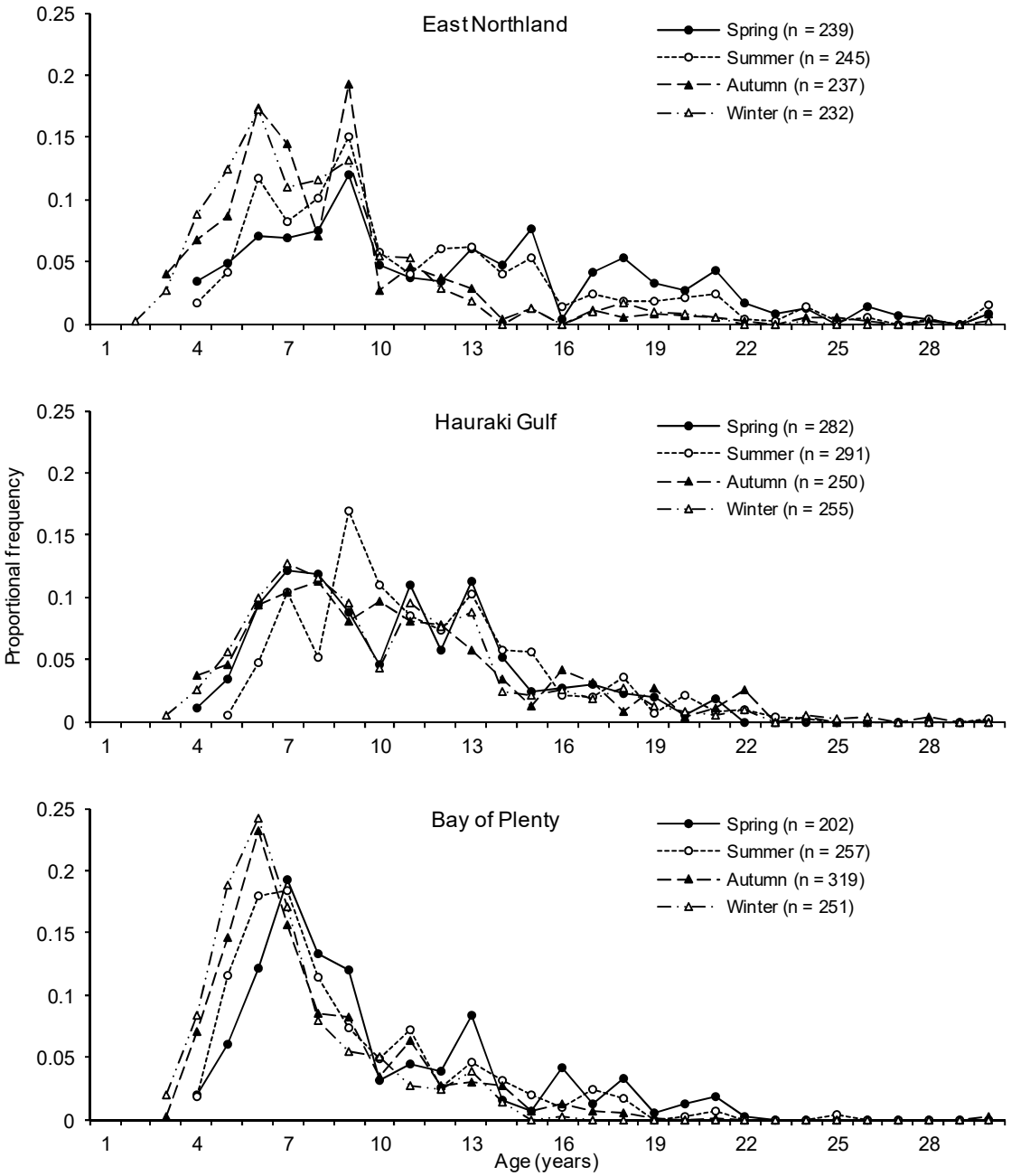

Figure 41: Proportion-at-age by season for SNA 1 bottom longline landings in 2019–20 (*n*, otolith sample size).

East Northland bottom longline

The East Northland bottom longline age distribution in 2019–20 consisted mainly of young to moderate aged fish: those 15 years of age and younger made up 87% of the landed catch by number (Figure 40, see Appendix 2). However, there was representation across almost all recruited age classes up to 30 or more years. Fish 20 years and older accounted for 7% of the landed catch, the highest proportion in SNA 1, most of which were from the northern half of the stock, Statistical Area 002 (see Appendix 2). The oldest fish sampled from the bottom longline fishery during 2019–20 was 38 years (Appendix 3). The 2014 and 2011 year classes (6 and 9 year olds), the most dominant, accounted for 14% and 15%, respectively, of all snapper in East Northland landings in 2019–20. Only those age classes over 8 years of age in East Northland are considered fully recruited (here we consider fish > 27 cm as fully recruited), because fish in the 25–27 cm length interval were infrequent in the catch (see age-length key, Appendix 4). The mean age of the East Northland distribution was 10.0 years, the third highest equal recorded estimate in three decades, and the MWCV was 0.21.

East Northland longline catch-at-age samples showed reasonable seasonal consistency in the relative strengths of the common age classes, despite spring and summer comprising proportionally more old fish (over 11 years) and autumn and winter, more young fish (under 8 years) (Figure 41). The seasonal differences seen in the relative year class strengths for the 2017 to 2013 year classes (3 to 7 year olds) between spring and summer, and autumn and winter, is likely to be due to the recruitment of these small young fish into the fishery later in the fishing year (Figure 41).

Hauraki Gulf bottom longline

The Hauraki Gulf bottom longline age distribution in 2019–20 consisted mainly of young to moderate aged fish with reasonable representation in age classes up to 22 years (Figure 40, see Appendix 2). Collectively, the 2014–2007 year classes (6 to 13 year olds) made up almost three-quarters (74%) of the landed catch by number in 2019–20. The 2013 and 2011 year classes (7 and 9 year olds) were the most prominent, each at 12%, whereas those fish over 22 years contributed to only 1%. The oldest fish sampled during 2019–20 was 32 years (Appendix 3). Only those age classes over 10 years of age can be considered fully recruited to the fishery because they no longer contain a noticeable proportion of fish in the 25–27 cm length intervals (see age-length key, Appendix 4). The mean age of snapper in the Hauraki Gulf fishery was 10.8 years, the second highest ever recorded estimate for the stock, and the MWCV was 0.21.

Hauraki Gulf longline catch-at-age samples showed some seasonal consistency in the relative strengths of some common age classes, and variations in proportions were evident for others, most notably 8 and 9 year old snapper from summer samples (Figure 41). Summer samples also contained proportionally fewer young fish (under 7 years) than all other seasons.

Bay of Plenty bottom longline

The Bay of Plenty bottom longline age distribution in 2019–20 was largely dominated by young fish; those 11 years of age and younger made up 85% of the landed catch by number (Figure 40, see Appendix 2). The oldest fish sampled during 2019–20 was 32 years (Appendix 3). The 2014 year class (6 year olds) was the most dominant year class in the fishery accounting for 21% of the longline catch by number, followed closely by the 2013 and 2015 year class (7 and 5 year olds) making up 17% and 14%, respectively. The combined total for fish over 20 years made up just 1% of the landed catch, the lowest estimate in SNA 1. Only age classes greater than 7 years of age appear fully recruited to the fishery, because they no longer contain a proportion of fish in the 25–27 cm length intervals (see age-length key, Appendix 4). The mean age of snapper in the Bay of Plenty fishery was 8.0 years and the MWCV was 0.17.

Spring samples from the Bay of Plenty longline fishery contained proportionally more old fish than other seasons (Figure 41). The seasonal differences seen in the relative year class strengths for the 2016 to 2014 year classes (4 to 6 year olds), particularly for autumn and winter seasons is likely to be due to the recruitment of these small young fish into the fishery later in the fishing year (Figure 41).

SNA 1 bottom longline stock comparisons

Despite proportionality differences due to exploitation, a number of broad similarities in relative year class strengths appear to exist between the three regions in the 2019–20 SNA 1 bottom longline catch-at-age proportions. For example, relative year class strengths occupying the mid-age range of the distributions (i.e., 2011 to 2006 year classes; 9 to 14 year olds) appear proportionally more aligned between Hauraki Gulf and Bay of Plenty, than East Northland (Figure 42). In contrast, the 2005 year class (15 year olds) for East Northland bottom longline, of above average strength, appears more dominant than for both the other stocks (Figure 42). Comparable findings (including 2019–20 samples) in a three decadal time series of bottom longline catch-at-age distributions for each of the three SNA 1 stocks are presented in Appendix 5 and as bubble plots in Appendix 6.

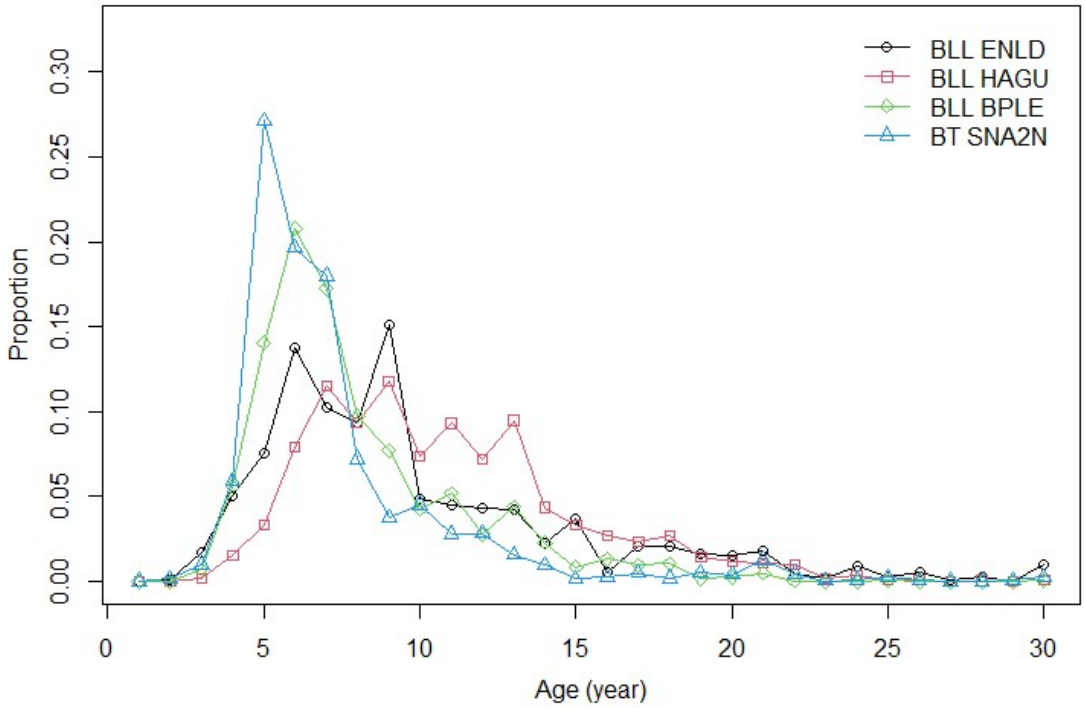

Figure 42: Comparison of proportion-at-age distributions (lines) determined from snapper landings sampled from the three SNA 1 bottom longline fisheries in 2019–20 (BLL, bottom longline; BT, bottom trawl; ENLD, East Northland; HAGU, Hauraki Gulf; BPLE, Bay of Plenty; SNA2N, SNA 2 North). Note: data presented for SNA 2 North bottom trawl included to complete a North-South stock comparison.

SNA 1 bottom longline mean length-at-age and mean weight-at-age estimates

Although a trend of increasing mean length-at-age and mean weight-at-age over successive age classes up to around 20 years of age was generally evident in year-round data collected from the SNA 1 bottom longline fisheries in 2019–20, those estimates for East Northland and Bay of Plenty were on average about 8% longer and 20% heavier than for Hauraki Gulf snapper (Figure 43, Appendices 7 and 8).

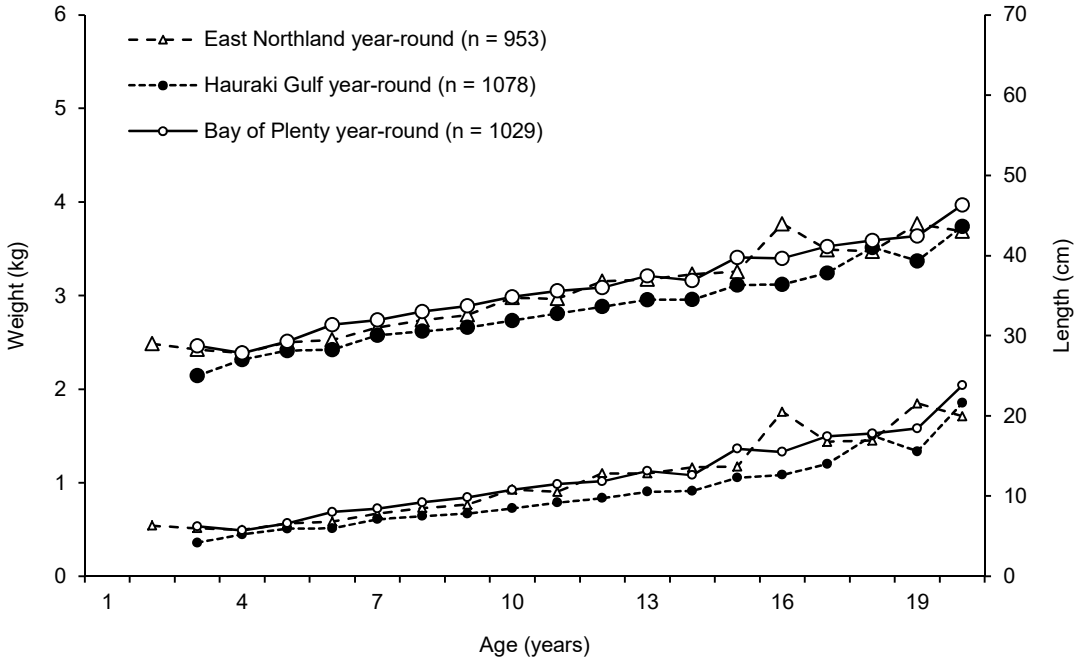

Figure 43: Observed mean length-at-age (large symbols) and mean weight-at-age (small symbols) estimates from snapper landings sampled from the three SNA 1 stock bottom longline fisheries in 2019–20 (*n*, sample size). Note: data presented for ages 2–20 years only.

SNA 1 bottom longline mean weight-at-age time series comparisons

Time series comparisons of spring-summer mean weight-at-age estimates derived from sampling the SNA 1 bottom longline fisheries over the past three decades show a gradual long-term decrease in the mean weight-at-age for snapper for most of the common age classes, particularly in the Hauraki Gulf and Bay of Plenty stocks, these being indicative of a temporal decline in growth rates (Figures 44–46). Note, annual mean weight-at-age estimates for many of the older age classes (i.e., over 13 years of age) appear highly variable from year to year and unlikely to provide realistic estimates due to the low number of individuals present.

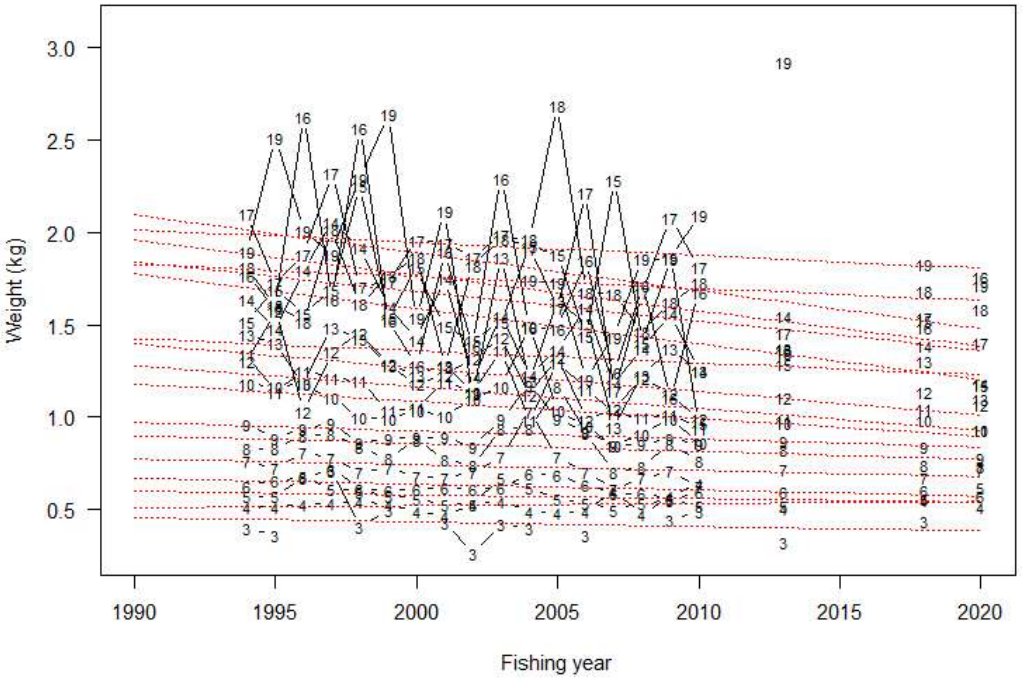

Figure 44: Mean weight-at-age estimates for 3- to 19-year-old snapper sampled from the East Northland bottom longline fishery (during spring-summer) between 1993–94 and 2019–20 with fitted trend lines (dotted) for each age class depicting long-term changes in growth rates over the 27 year period.

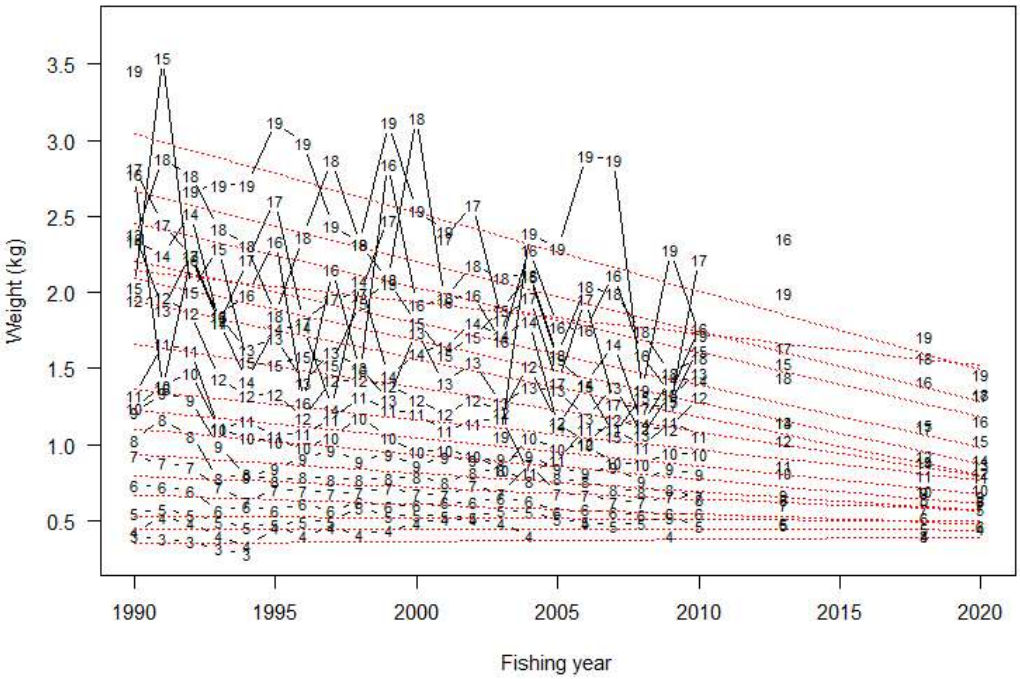

Figure 45: Mean weight-at-age estimates for 3- to 19-year-old snapper sampled from the Hauraki Gulf bottom longline fishery (during spring-summer) between 1989–90 and 2019–20 with fitted trend lines (dotted) for each age class depicting long-term changes in growth rates over the 31 year period.

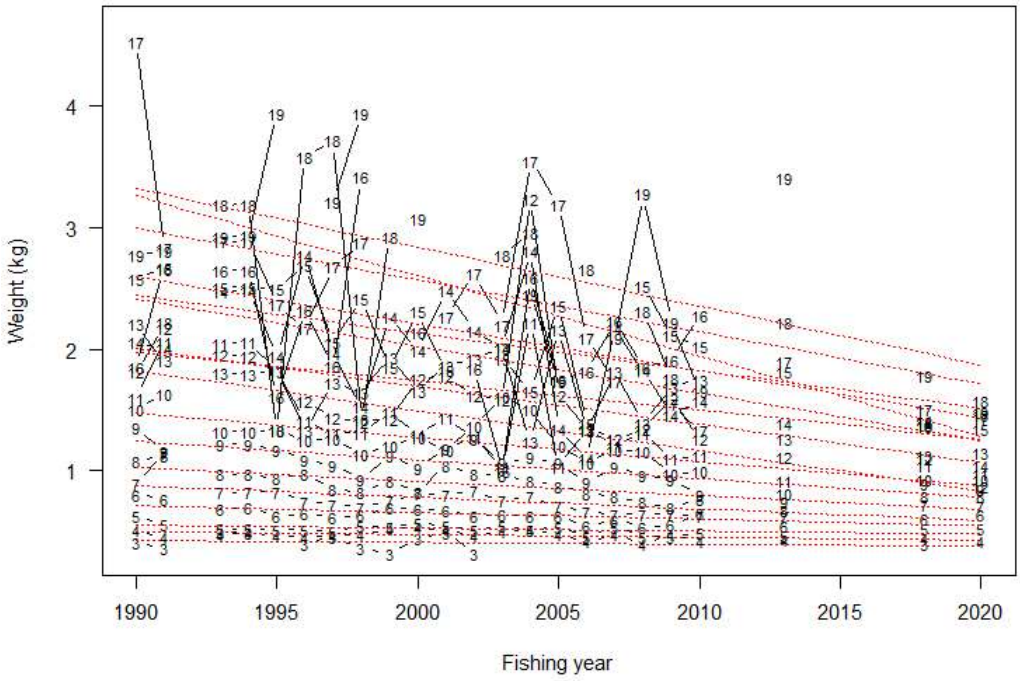

Figure 46: Mean weight-at-age estimates for 3- to 19-year-old snapper sampled from the Bay of Plenty bottom longline fishery (during spring-summer) between 1989–90 and 2019–20 with fitted trend lines (dotted) for each age class depicting long-term changes in growth rates over the 31 year period.

Comparisons of stock mean weight-at-age (spring-summer) estimates for snapper comprising the average of three decadal collections (1990s, 2000s, and 2010s) are presented in Figure 47.

Mean weight-at-age of the common age classes for East Northland snapper have marginally declined in the recent 2010 decade across most age classes, and estimates from the Hauraki Gulf and Bay of Plenty fisheries over the past two decades have continued to decline substantially, notably those six years and older (Figure 47).

The difference in mean weight-at-age between the first (1990s) and last (2010s) decades indicates the overall net weight loss/gain to the respective fisheries, estimated conservatively at around -30% for most of the common age classes (i.e., 4 to 19 year olds) in the Hauraki Gulf and Bay of Plenty fisheries, and -11% for East Northland. Only 19-year-old snapper from East Northland demonstrated a positive gain in the three decadal comparison (Figure 47).

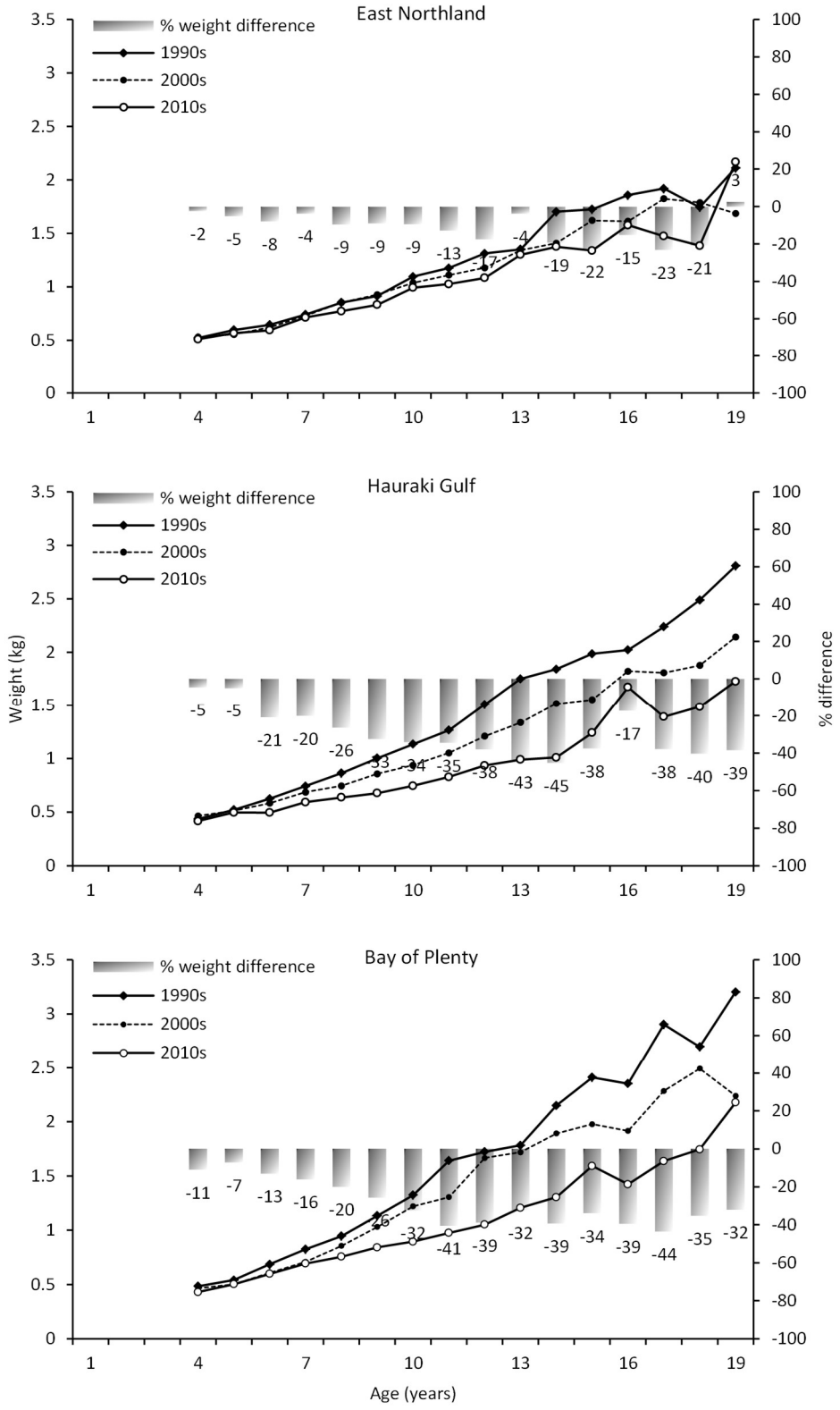

Figure 47: Mean weight-at-age estimates for snapper sampled from the three SNA 1 stock bottom longline fisheries from three distinct decadal time periods and where each period reflects the average mean weight-at-age for those years. The percentage weight difference for each age class (positive or negative) is the difference between the first decade (1990s) and last decade (2010s), and indicative of a net weight gain or loss in mean weight-at-age through time. Note: For comparative purposes over time, only spring-summer samples with age ranging from 4–19 years have been presented.

3.13 SNA 1 and SNA 2 power method catch-at-length and -age estimates

SNA 1 power method catch-at-length and -age compositions (using the length frequency and age-length key sampling approach) and SNA 2 bottom trawl catch-at-age compositions (sampled using the random age frequency sampling approach) were derived for each stock and season, and then combined over seasons (spring-summer and autumn-winter) to produce annual compositions (Figures 48 to 55, Appendices 9 and 10). Age distributions are used to compare differences in the age structure of each stock and season stratum and to gauge relative year class strengths.

Age-at-length scatterplots (using decimalised ages and not fishing year ages) are given in Appendix 3 to document the stock and fishing method of otolith collections that make up power method age-length keys (Appendix 11).

3.14 SNA 1 bottom trawl catch-at-length and -age estimates

East Northland bottom trawl

The East Northland bottom trawl length distribution in 2019–20 was solely based on 1238 measured snapper from four landings collected during winter (June–August) and is unlikely to provide adequate representation of the annual snapper catch. The length distribution, although substantially broad in length range, was characterised by at least three modes centred at 30, 34, and 39 cm (Figure 48, Appendix 9). The corresponding age distribution was also broad and characterised by substantial inter-age class variability (Figure 48, Appendix 10). Mean length and mean age of the distributions were 35.0 cm and 10.4 years, respectively, with MWCVs of 0.42 and 0.37, inferring of low precision in sample results.

Bay of Plenty bottom trawl

Landings from the Bay of Plenty bottom trawl fishery comprised a high proportion of small to moderate sized snapper from 25 to 39 cm, characterised by one main mode, centred around 29 cm, with a tail extending to over 50 cm (Figure 48, Appendix 9). The catch comprised mainly young fish, those up to nine years of age exceeding three-quarters (78%) of the number of snapper landed (Figure 48, Appendix 10). The 2015–2013 year classes (5 to 7 year olds) were dominant in the fishery, accounting for over half (55%) the landed catch. The combined total of fish 15 years and older made up just 6% of the catch, one of the lowest power method estimates in SNA 1, 2019–20. Only age classes greater than 6 years of age appear fully recruited to the fishery, because they no longer contain a noticeable proportion of fish in the 25–27 cm length intervals (see age-length key, Appendix 11). The mean length and mean age of the Bay of Plenty bottom trawl distributions were 32.4 cm and 7.9 years, respectively, and the MWCVs were 0.12 and 0.12.

Slight temporal differences were evident in the seasonal length and age distributions for Bay of Plenty bottom trawl (Figure 49, Appendices 9 and 10). The mean length and age of snapper landed over the spring-summer period were 32.0 cm and 8.2 years and, during autumn-winter 32.7 cm and 7.7 years. Seasonal catch-at-length and -age MWCVs ranged between 0.14 and 0.19.

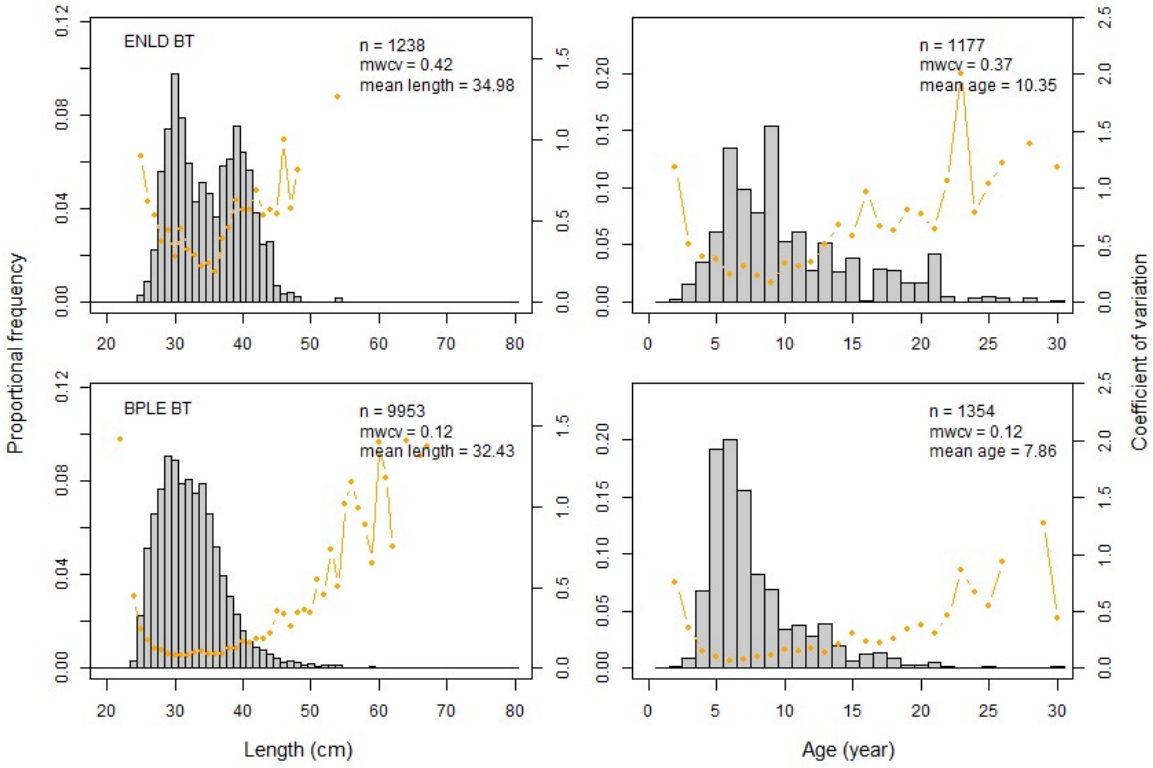

Figure 48: Proportion-at-length and -age distributions (histograms) and CVs (lines) determined from snapper landings sampled from East Northland and Bay of Plenty bottom trawl fisheries in 2019–20 (ENLD, East Northland; BPLE, Bay of Plenty amalgamated across both seasons for BPLE and autumn-winter only for ENLD; n, sample size; mwcv, mean weighted CV).

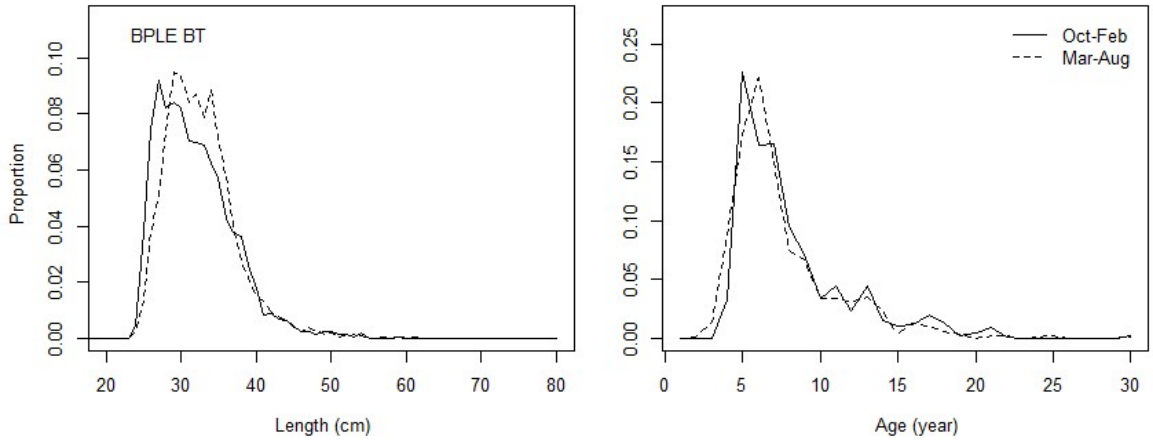

Figure 49: Seasonal proportions-at-length and -age distributions (lines) determined from snapper landings sampled from East Northland and Bay of Plenty bottom trawl fisheries in 2019–20 (ENLD, East Northland; BPLE, Bay of Plenty).

SNA 2 North bottom trawl

The SNA 2 North bottom trawl age distribution in 2019–20, sampled using the random age frequency method, comprised mainly young snapper: those 10 years of age and younger made up 87% of the landed catch by number (Figure 50, Appendix 10). The 2015 year class (5 year olds) was dominant (27%) and, when combined with the 2014 and 2013 years classes (6 and 7 year olds) accounted for two-thirds (65%) of the total commercial SNA 2 North bottom trawl catch (Figure 50, Appendix 10). Representation of age classes over 14 years was relatively poor, the combined total making up just 5% of the landed catch. Only age classes greater than 5 years of age appear fully recruited to the fishery, because they no longer contain a proportion of fish in the 25–27 cm length intervals (see age-length

key, Appendix 11). The mean age of the SNA 2 North distribution was 7.4 years and the MWCV was 0.17, inferring good precision in catch-at-age estimates.

Slight temporal differences were evident in the seasonal age distributions for SNA 2 North bottom trawl due to the recruitment of young snapper over autumn-winter (Figure 51, Appendix 10). The mean age of snapper landed over the spring-summer period was 8.1 years and during autumn-winter 6.8 years. Seasonal catch-at-age MWCVs ranged between 0.23 and 0.25.

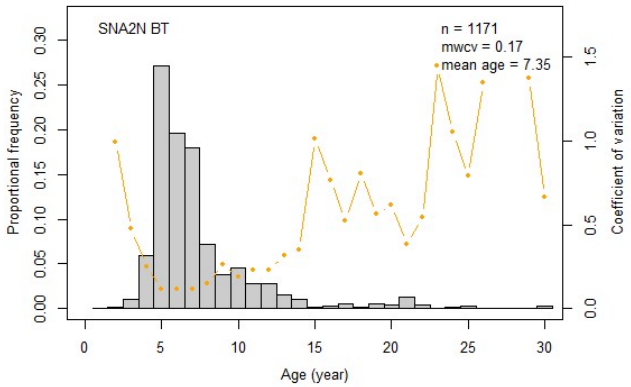

Figure 50: Proportion-at-age distributions (histograms) and CVs (lines) determined from snapper landings sampled from SNA 2N bottom trawl fishery in 2019–20 (SNA2N, SNA 2 North amalgamated across both seasons; n, sample size; mwcv, mean weighted CV).

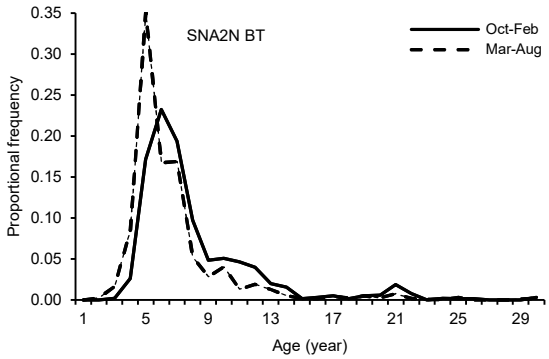

Figure 51: Seasonal proportions-at-age distributions (lines) determined from snapper landings sampled from SNA 2 North bottom trawl fishery in 2019–20 (SNA 2N, SNA 2 North).

SNA 1 and SNA 2 bottom trawl stock comparisons

Despite exploitation differences between stocks, relative year class strengths were more consistent between Bay of Plenty and SNA 2 North bottom trawl catch-at-age estimates, than with East Northland (Figures 48 and 50). For example, the 2015 to 2013 year classes (5 to 7 year olds) were similarly dominant in both Bay of Plenty and SNA 2 North fisheries, but not as consistent with East Northland. Both Bay of Plenty and SNA 2 North also shared similarities in the right-hand limb, with a weak 2005 year class (15 year olds) and an above average 1999 year class (21 year olds), the latter also very strong in East Northland (Figures 48 and 50).

3.15 SNA 1 Danish seine catch-at-length and -age estimates

Hauraki Gulf Danish seine

The length distribution from the Hauraki Gulf Danish seine fishery consisted of some small but predominantly moderate sized snapper, ranging from 27 to 40 cm, characterised by one main mode, centred around 35 cm, with a tail extending well over 50 cm (Figure 52, Appendix 9). The catch comprised some young, but mostly moderate aged fish, those 6 to 14 years of age, of similar relative strength, making up almost three-quarters (74%) of the number of snapper landed in 2019–20 (Figure 52, Appendix 10). Although representation up to 14 years of age was good, there was also significant presence in the proportion of fish occupying age classes up to, and over, 20 years. Only age classes greater than 11 years of age appear fully recruited to the fishery, because they no longer contain a noticeable proportion of fish in the 25–27 cm length intervals (see age-length key, Appendix 11). The mean length and mean age of the Hauraki Gulf Danish seine distributions were 35.2 cm and 11.9 years and the MWCVs were 0.13 and 0.15, respectively. Both mean length and mean age were the highest recorded estimates across all sampled fishing methods in SNA 1 in 2019–20.

Slight temporal differences were evident in the seasonal length and age distributions for Hauraki Gulf Danish seine (Figure 53, Appendices 9 and 10). The mean length and age of snapper landed over the spring-summer period was 34.5 cm and 12.1 years and, during autumn-winter, 35.8 cm and 11.7 years. Seasonal catch-at-length and -age MWCVs ranged between 0.14 and 0.22.

Bay of Plenty Danish seine

Landings from the Bay of Plenty Danish seine fishery comprised mainly small snapper and a lesser proportion of moderate size fish, ranging from 26 to 36 cm, characterised by one mode, centred around 30 cm, with a tail extending to 45 cm (Figure 52, Appendix 9). The catch was dominated by young fish, those up to 9 years of age making up 82% of the number of snapper landed (Figure 52, Appendix 10). The most notable of these were the 2015–2013 year classes (5 to 7 year olds) accounting for 60% of the landed catch. Although representation in the age distribution up to 14 years of age was reasonable, the combined total of fish 15 years and older made up just 4% of the catch, the lowest of the power method estimates in SNA 1 in 2019–20. Only age classes greater than 6 years of age appear fully recruited to the fishery, because they no longer contain a noticeable proportion of fish in the 25–27 cm length intervals (see age-length key, Appendix 11). The mean length and mean age for snapper from the Bay of Plenty Danish seine distributions was 31.9 cm and 7.5 years and the MWCVs were 0.10 and 0.14, respectively.

Seasonal length and age distributions for Bay of Plenty Danish seine showed little temporal variability (Figure 53, Appendices 9 and 10). The mean length and age of snapper landed over the spring-summer period were 31.5 cm and 7.8 years and, during autumn-winter, 32.2 cm and 7.3 years. Seasonal catch-at-length and -age MWCVs ranged between 0.13 and 0.17.

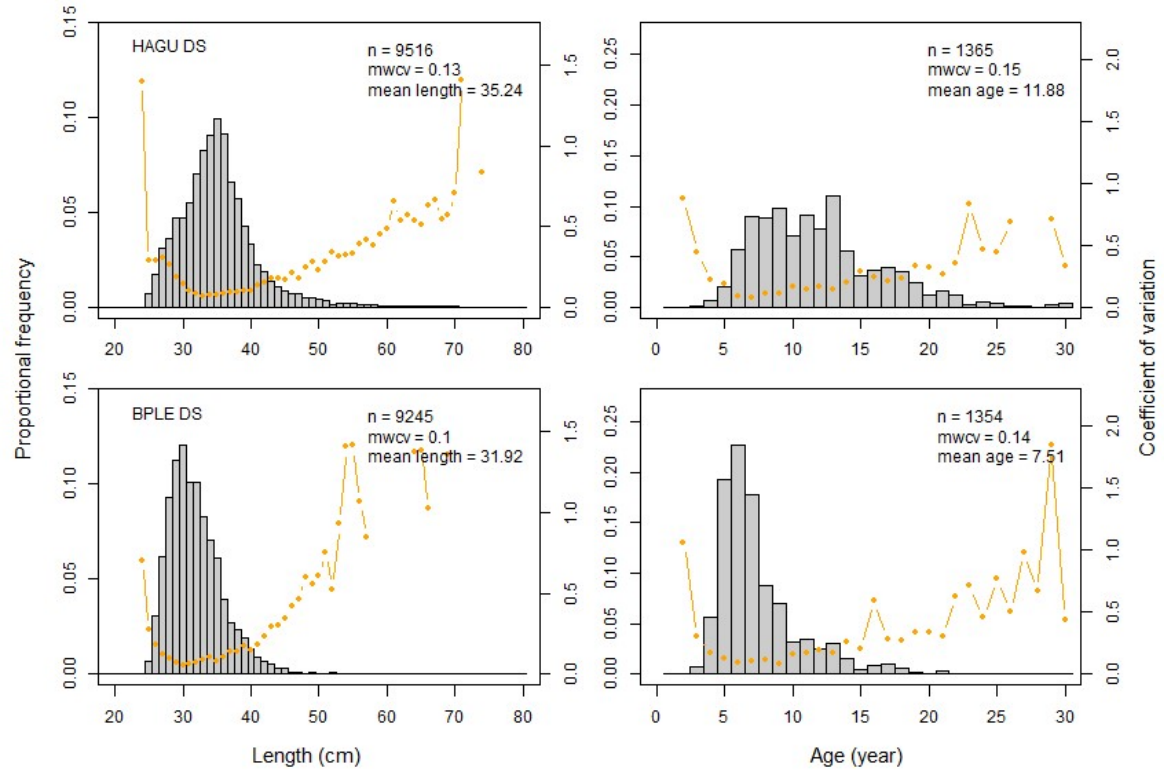

Figure 52: Proportion-at-length and -age distributions (histograms) and CVs (lines) determined from snapper landings sampled from the Hauraki Gulf and Bay of Plenty Danish seine fisheries in 2019–20 (HAGU, Hauraki Gulf; BPLE, Bay of Plenty amalgamated across both seasons; *n*, sample size; MWCV, mean weighted CV).

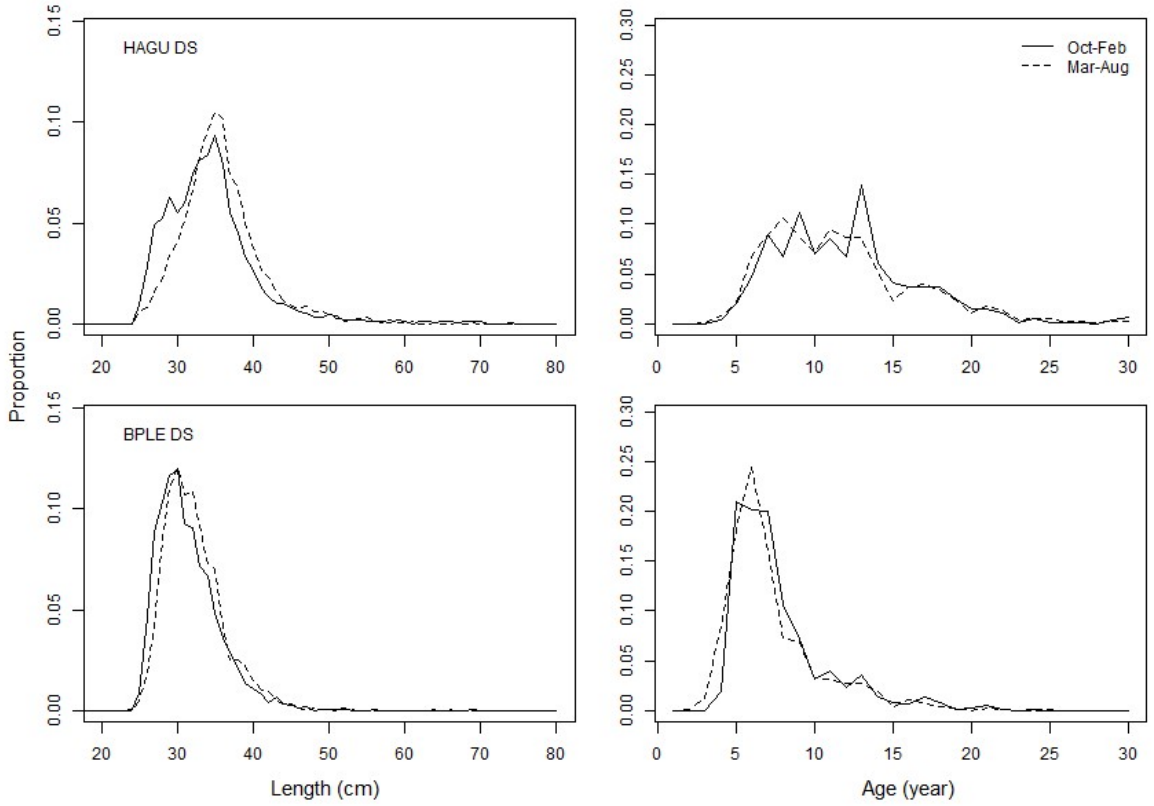

Figure 53: Seasonal proportions-at-length and -age distributions (histograms) and CVs (lines) determined from snapper landings sampled from the Hauraki Gulf and Bay of Plenty Danish seine fisheries in 2019–20 (HAGU, Hauraki Gulf; BPLE, Bay of Plenty).

SNA 1 Danish seine stock comparisons

Although age compositions appear different between the Hauraki Gulf and Bay of Plenty Danish seine catches in 2019–20, similarities in relative year class strengths were evident, particularly for fully recruited age classes. For example, there are consistencies in relative year class strengths, albeit proportionally on different scales, from the 2011 year class (9 year olds) to the 2009 year class (21 year olds) between Hauraki Gulf and Bay of Plenty Danish seine landings (Figure 52).

3.16 SNA 1 modular harvest system catch-at-length and -age estimates

East Northland modular harvest system

The length distribution from the East Northland modular harvest system was broad, comprising a high proportion of small to moderate size snapper, ranging from 25–39 cm, characterised by a number of modes, with a tail extending to over 50 cm (Figure 54, Appendix 9). Although the catch was dominated by young fish, those up to nine years of age accounting for more than two-thirds (69%) of the number of snapper landed, there was significant representation in the distribution to over 20 years (Figure 54, Appendix 10). The 2014 and 2011 year classes (6 and 9 year olds) were the most dominant year classes in the East Northland modular harvest system catch. Only age classes greater than 8 years of age appear fully recruited to the fishery, because they no longer contain a noticeable proportion of fish in the 25–27 cm length intervals (see age-length key, Appendix 11). The mean length and mean age of the East Northland modular harvest system catch-at-length and -age compositions were 32.6 cm and 9.0 years, respectively, with MWCVs of 0.41 and 0.34 indicative of relatively poor precision in sample results, largely due to a poor length frequency sample size (n = 633) during autumn-winter (see Table 10).

Marked temporal differences were evident in the seasonal length and age distributions for East Northland modular harvest system with much larger and older snapper on average being caught during spring-summer (Figure 55, Appendices 9 and 10). The mean length and age of snapper landed over the spring-summer period was 36.2 cm and 12.2 years and, during autumn-winter, 31.3 cm and 7.9 years. Seasonal catch-at-length and -age MWCVs ranged between 0.14 and 0.49.

Bay of Plenty modular harvest system

Landings from the Bay of Plenty modular harvest system fishery comprised mainly small snapper and a lesser proportion of moderate size snapper, ranging from 25 to 36 cm, characterised by one mode, centred around 28 cm, with a tail extending to about 45 cm (Figure 54, Appendix 9). The catch was dominated by young fish, those up to 9 years of age making up 84% of the number of snapper landed (Figure 54, Appendix 10). The 2015–2013 year classes (5 to 7 year olds) were dominant in the fishery, accounting for 61% of the landed catch. The combined total of fish 15 years and older made up just 4% of the catch, marginally the second lowest power method estimate in SNA 1 in 2019–20. Only age classes greater than 6 years of age appear fully recruited to the fishery, because they no longer contain a noticeable proportion of fish in the 25–27 cm length intervals (see age-length key, Appendix 11). The mean length and mean age for snapper from the Bay of Plenty modular harvest system catch were 31.0 cm and 7.2 years, the lowest recorded estimates in SNA 1, and the MWCVs of the distributions were 0.11 and 0.11, respectively.

Seasonal length and age distributions for Bay of Plenty modular harvest system showed little temporal variability (Figure 55, Appendix 9 and 10). The mean length and age of snapper landed over the spring-summer period were 31.0 cm and 7.6 years and, during autumn-winter, 31.1 cm and 6.8 years. Seasonal catch-at-length and -age MWCVs ranged between 0.14 and 0.17.

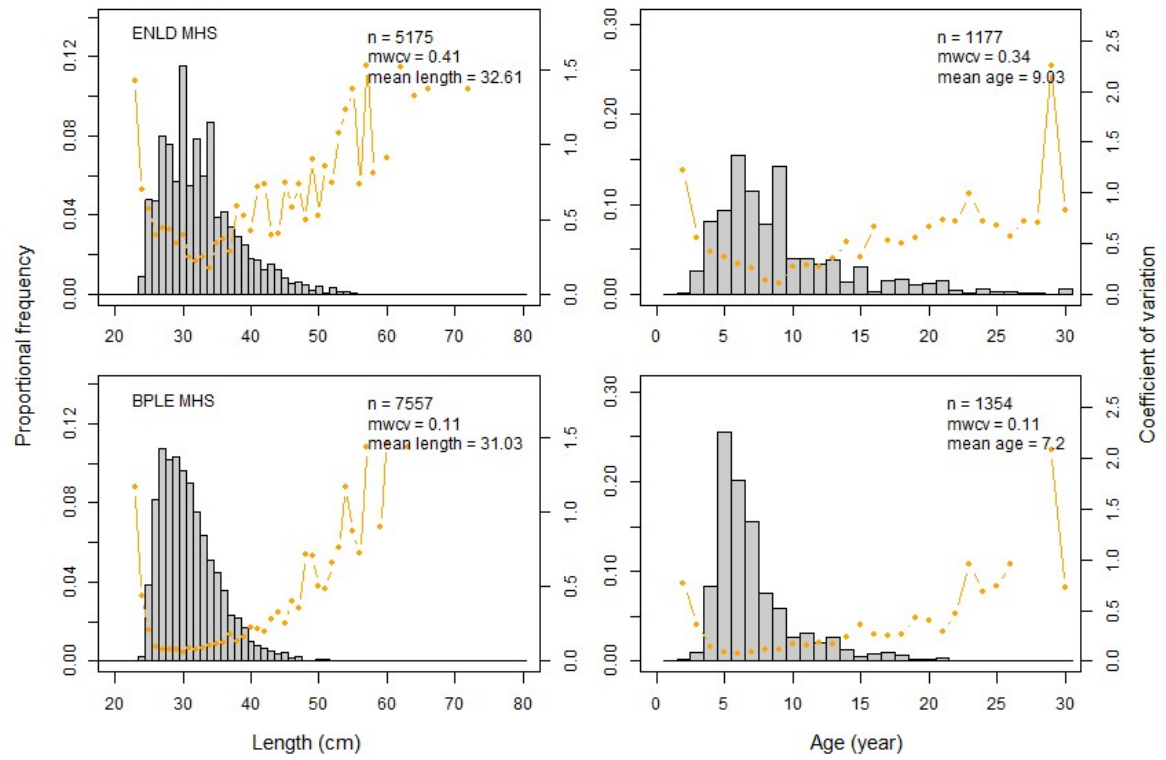

Figure 54: Proportion-at-length and -age distributions (histograms) and CVs (lines) determined from snapper landings sampled from the East Northland and Bay of Plenty modular harvest system fisheries in 2019–20 (ENLD, East Northland; BPLE, Bay of Plenty amalgamated across both seasons for BPLE and spring-summer only for ENLD; *n*, sample size; MWCV, mean weighted CV).

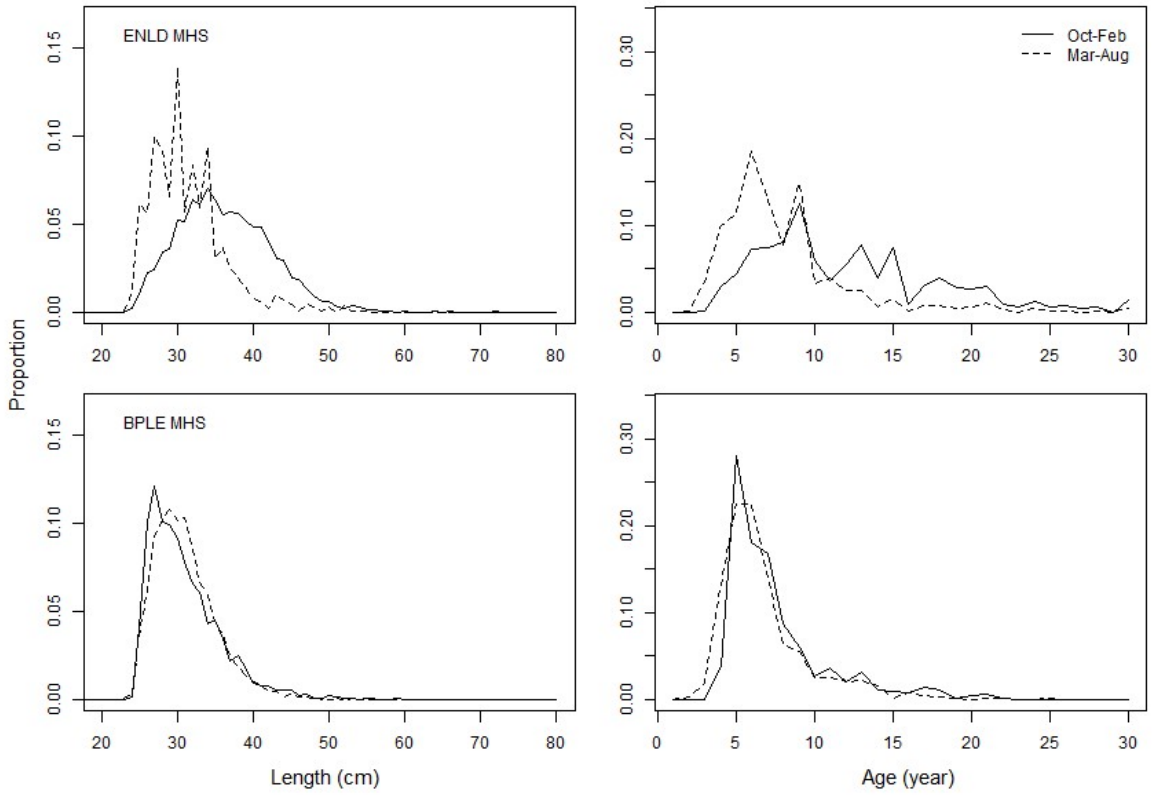

Figure 55: Seasonal proportions-at-length and -age distributions (histograms) and CVs (lines) determined from snapper landings sampled from the East Northland and Bay of Plenty modular harvest system fisheries in 2019–20 (ENLD, East Northland; BPLE, Bay of Plenty).

SNA 1 modular harvest system stock comparisons

Few similarities in relative year class strengths exist between East Northland and Bay of Plenty modular harvest system catch-at-age estimates other than a similar decline in proportions for age classes over 9 years of age (Figure 54).

3.17 SNA 1 and SNA 2 power method stock comparisons

Despite differences in catch-at-age proportions due to exploitation and method selectivity, a number of broad similarities in relative year class strengths exist between regions for the main power methods operating across the SNA 1 and SNA 2 stocks in 2019–20. For example, SNA 1 power method year classes occupying the mid-age range of the distributions (i.e., 2011 to 2006 year classes; 9 to 14 year olds) have similar patterns of relative year class strength across methods and stocks (Figure 56). Conversely, relative year class strengths for young snapper (i.e., 2016 to 2010 year classes; 4 to 8 year olds) from SNA 2 bottom trawl appeared more consistent with patterns from the Bay of Plenty bottom trawl fishery (Figure 56).

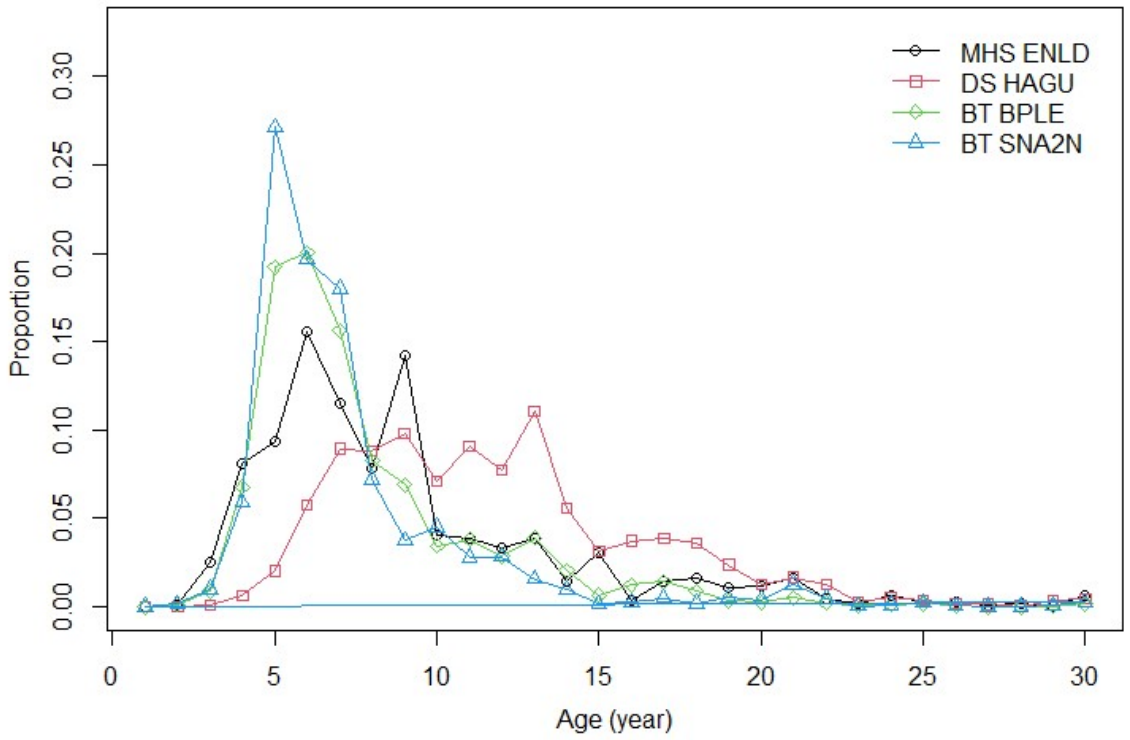

Figure 56: Comparison of proportion-at-age distributions (lines) determined from snapper landings sampled from the SNA 1 and SNA 2 power method fisheries in 2019–20 (BT, bottom trawl; DS, Danish seine; MHS, modular harvest system; ENLD, East Northland; HAGU, Hauraki Gulf; BPLE, Bay of Plenty; SNA2N, SNA 2 North). Note: data presented for BPLE BT are included as comparison over BPLE DS and MHS.

3.18 SNA 1 power method mean weight-at-age and mean length-at-age estimates

Within-method comparisons of mean weight-at-age and mean length-at-age over successive age classes up to 20 years for year-round SNA 1 and SNA 2 power method fishery collections are presented in Figure 57. Few differences exist between East Northland and Bay of Plenty modular harvest system estimates, whereas snapper 10 years and older caught from the Bay of Plenty Danish seine fishery in 2019–20 were marginally heavier and longer at a given age than those caught in the Hauraki Gulf. The most obvious disparity in mean weight-at-age and mean length-at-age in the SNA 1 and SNA 2 power method fisheries was determined from SNA 2 North bottom trawl estimates, where snapper on average were 24% heavier and 10% longer than those from Bay of Plenty bottom trawl (Figure 57, Appendices 12 and 13).

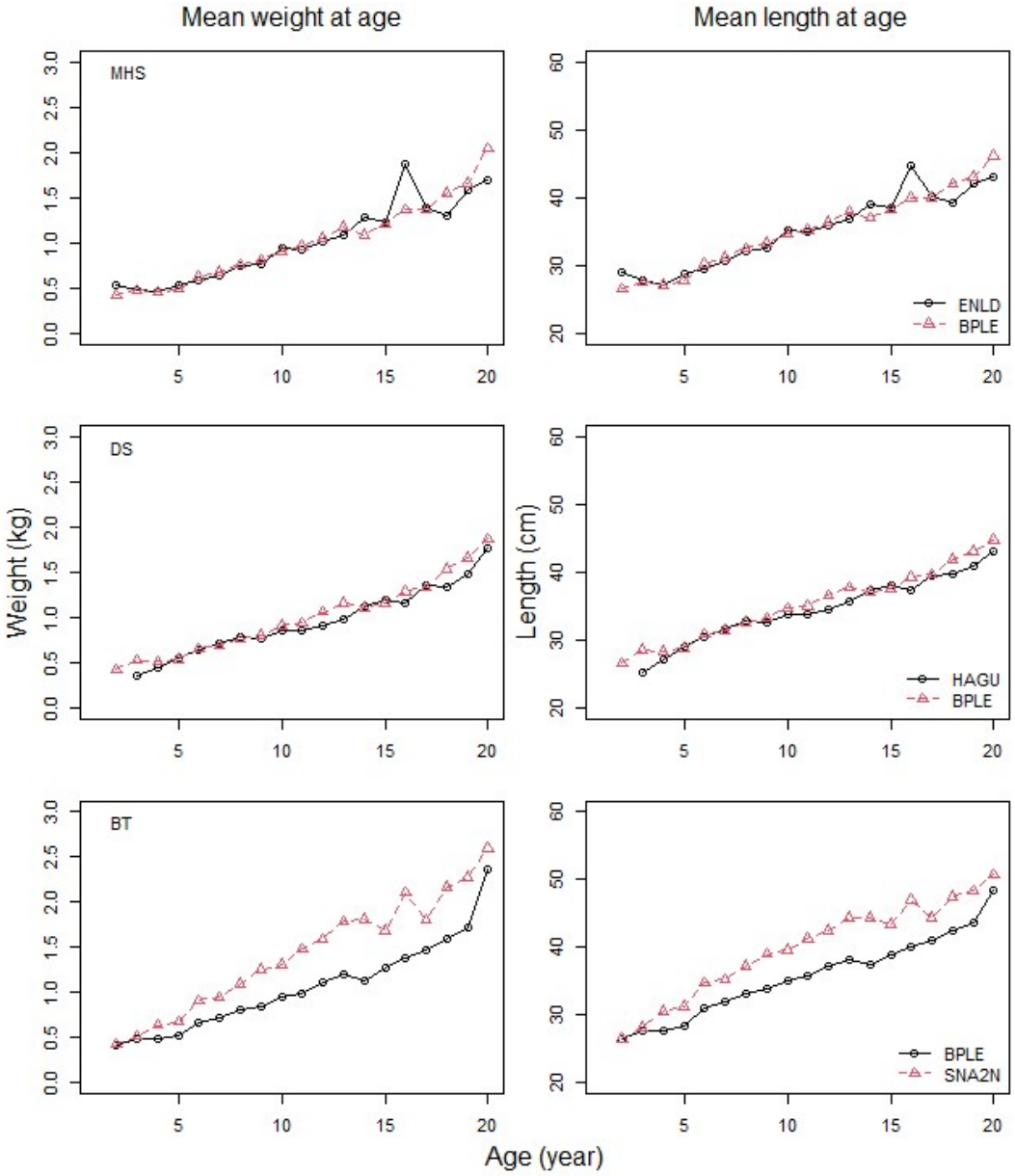

Figure 57: Observed mean length-at-age and mean weight-at-age estimates from snapper landings sampled from the three SNA 1 and SNA 2 stock power method fisheries in 2019–20 (BT, bottom trawl; DS, Danish seine; MHS, modular harvest system; ENLD, East Northland; HAGU, Hauraki Gulf; BPLE, Bay of Plenty; SNA2N, SNA 2 North). Note: data presented for ages 2–20 years only.

3.19 SNA 1 length-weight relationship study

A total of 6418 length-weight records were collected from 77 vessel landings (East Northland, 25; Hauraki Gulf, 27; Bay of Plenty, 25) for four different fishing methods in SNA 1 in 2019–20 (Table 13, Figure 58) with sample sizes far exceeding stock and season targets. Data comprised a broad length and weight range from the respective stock fisheries, but those from the Bay of Plenty were considerably narrower than East Northland and Hauraki Gulf (Table 13, Figures 58 & 59). Samples taken from each vessel landing ranged from 1 to 290 snapper measured and weighed, with an overall mean of 83.

Table 13: Summary of seasonal and year-round numbers and range of length (cm) and weight (g) measurements making up sample collections from SNA 1 stocks, 2019–20.

Stock*	Method†	Season	No. of fish measured	Length range (cm)	Weight range (g)
ENLD	BLL, DS, MHS	Spr-sum	922	23–84	290–11 775
		Aut-win	1 067	25–81	350–10 175
		Spr-win	1 989	23–84	290–11 775
HAGU	BLL, DS	Spr-sum	959	25–76	375–8 325
		Aut-win	1 592	25–80	345–11 145
		Spr-win	2 551	25–80	345–11 145
BPLE	BLL, BT, MHS	Spr-sum	868	24–72	310–6 380
		Aut-win	1 010	24–68	330–6 985
		Spr-win	1 878	24–72	310–6 985

* ENLD, East Northland; HAGU, Hauraki Gulf; BPLE, Bay of Plenty.
† BLL, bottom longline; BT, bottom trawl; DS, Danish seine; MHS, modular harvest system.

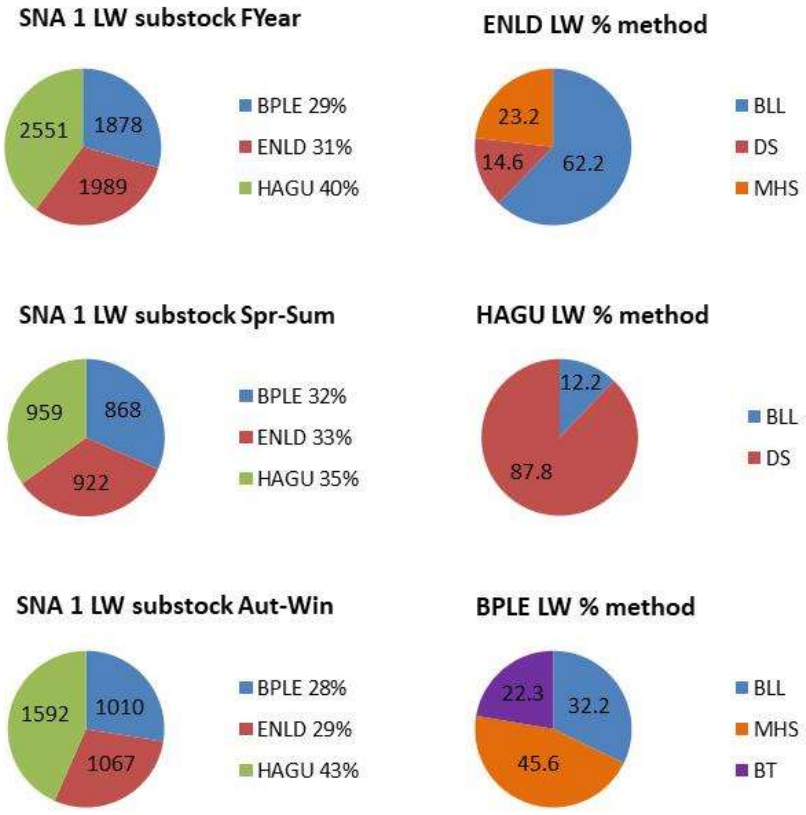

Figure 58: Percentage length-weight sample collections from SNA 1 stocks by season and method, 2019–20 (BLL, bottom longline; BT, bottom trawl; DS, Danish seine; MHS, modular harvest system; ENLD, East Northland; HAGU, Hauraki Gulf; BPLE, Bay of Plenty).

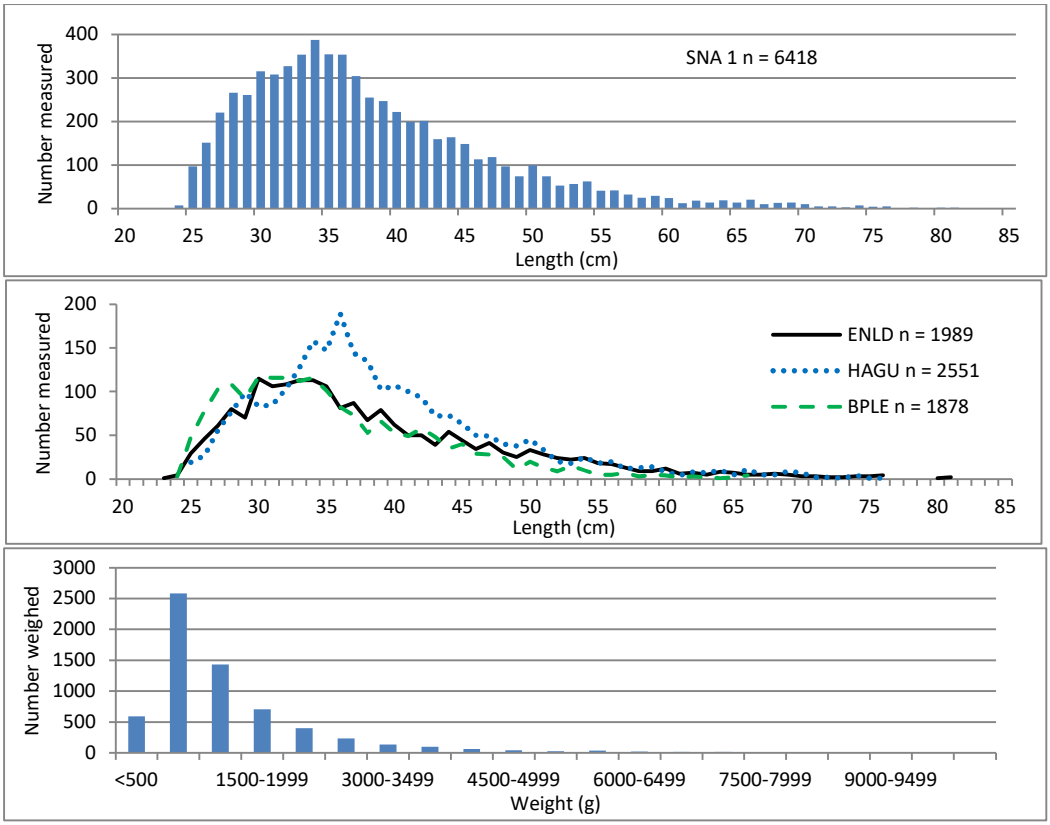

Figure 59: Frequency distributions for length-weight collections from SNA 1, 2019–20. Top: overall length distribution of the combined SNA 1 stock samples; Middle: length distribution comparisons of stock samples; Bottom: overall weight frequency distribution (500 g weight classes) of the combined SNA 1 stock samples.

The spatial distribution of snapper length-weight collections varied across the SNA 1 stocks. Those samples from East Northland landings were disproportionally associated with Statistical Area 002 and those from the Hauraki Gulf with Statistical Area 006, and Bay of Plenty collections were spread relatively evenly throughout the snapper range (Figure 60).

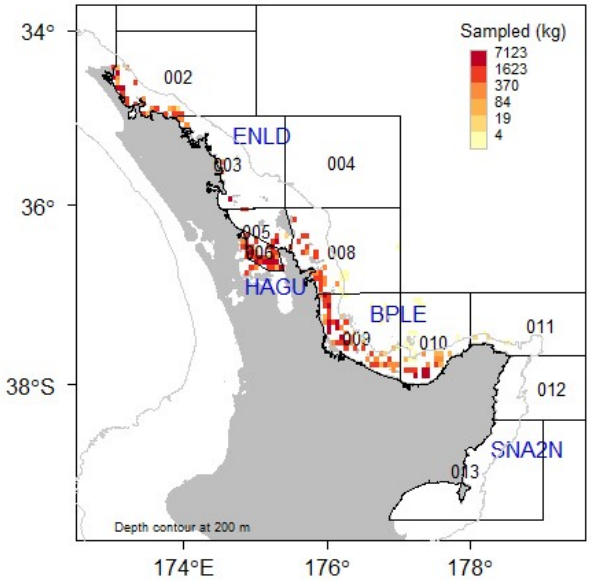

Figure 60: Spatial distribution of length-weight sample collections for the SNA 1 stocks in 2019–20.

Initial GLM analysis of length-weight data from 2019–20

GLM analysis of the SNA 1 season-stock length-weight collections from 2019–20 showed statistically significant differences between several season-stock combinations (Figure 61, Table 14). It was not clear if these differences were large enough to justify separate season-stock parameters to be incorporated into the SNA 1 stock assessment.

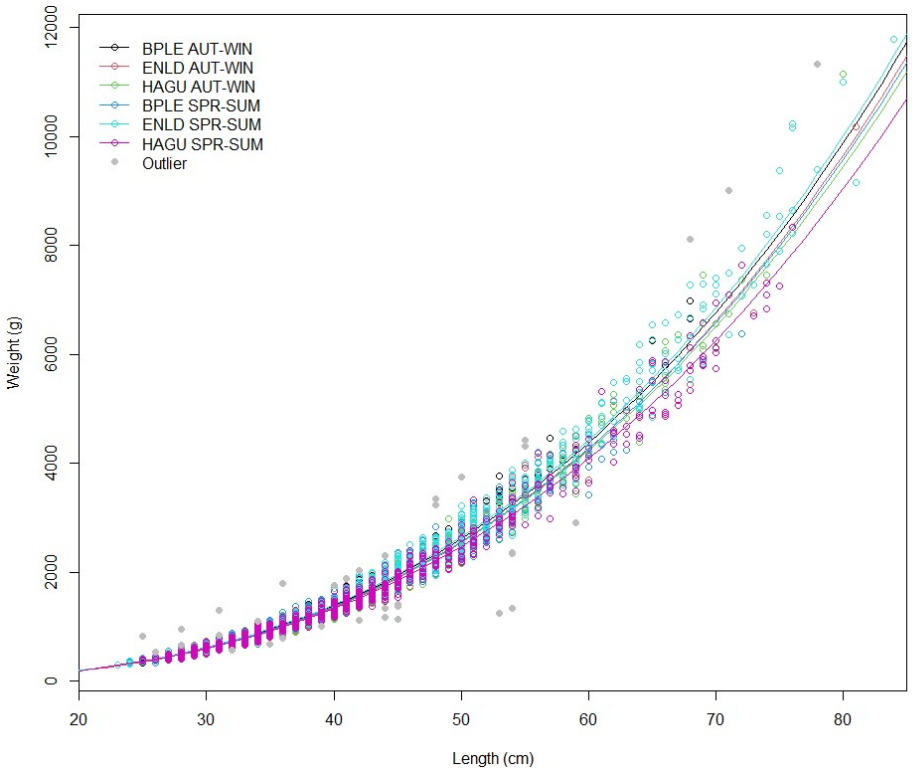

Figure 61: Fitted length-weight curves and observed data for SNA 1 stock-season collections in 2019–20 (BPLE, Bay of Plenty; ENLD, East Northland; HAGU, Hauraki Gulf; SPR-SUM, spring-summer; AUT-WIN, autumn-winter).

Table 14: GLM analysis results of the effect of season, stock, and interactions for all of the SNA 1 length-weight data. P value symbols as follows: . > 0.1, * < 0.05 , ** < 0.01, * < 0.001.**

	Coefficient	Estimate	t value	Pr(>|t|)
1	(Intercept)	-3.199	< 2.00E-16	***
2	RegionENLD	-0.064	0.093117	.
3	RegionHAGU	0.140	1.31E-04	***
4	Season2SPR-SUM	0.076	0.011668	*
5	RegionBPLE:X	2.829	< 2.00E-16	***
6	RegionENLD:X	2.838	< 2.00E-16	***
7	RegionHAGU:X	2.787	< 2.00E-16	***
8	Season2SPR-SUM:X	-0.024	0.00417	**
9	RegionENLD:Season2SPR-SUM:X	0.015	< 2.00E-16	***
10	RegionHAGU:Season2SPR-SUM:X	-0.003	0.013239	*

Revised analysis of various season-stock combinations of length-weight data from 2019–20

Following on from the GLM analysis above, the Inshore Finfish Working Group (INSWG) (16th December 2021) subsequently recommended that various season-stock combinations be plotted to assess the fit of the data to the derived relationships and to assess whether these season-stock combinations were materially different from one another. Individual plots of the observed data and associated fitted relationships, for just the season-stock combinations suggested by the INSWG, are presented in Figure 62 and 63. Figures 64 and 65 then illustrate various comparisons of these fitted relationships. The INSWG noted that there were marked differences in seasonal length-weight relationships (i.e., spring-summer vs. autumn-winter) for East Northland and Bay of Plenty, but not for the Hauraki Gulf. These differences appeared to be driven by higher than expected weight-at-length for East Northland snapper in spring-summer and for Bay of Plenty snapper in autumn-winter. Parameters associated with all of the length-weight relationships considered (not including outliers) are presented in Table 15.

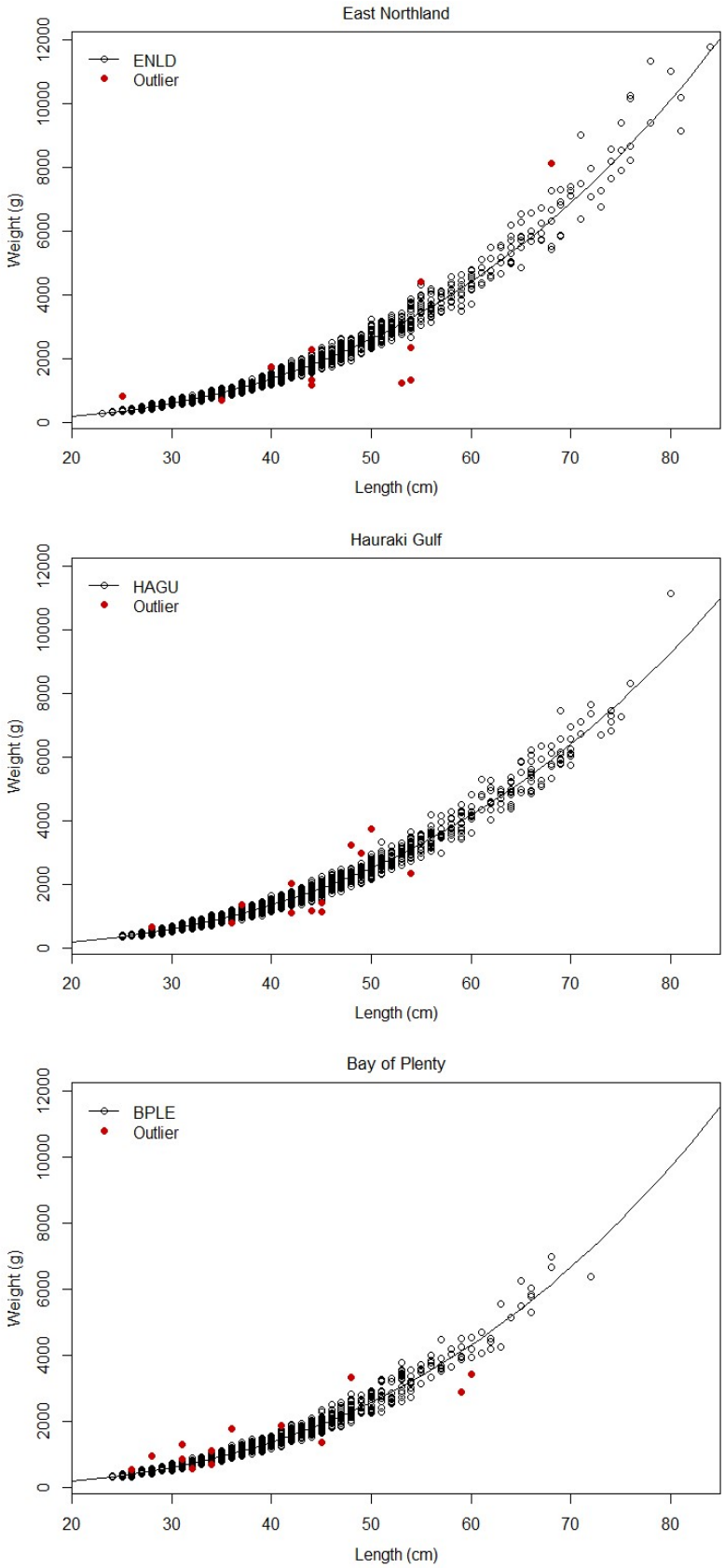

Figure 62: Fitted length-weight curves and observed data for SNA 1 stocks (spring-summer and autumn-winter seasons combined), 2019–20 (BPLE, Bay of Plenty; ENLD, East Northland; HAGU, Hauraki Gulf).

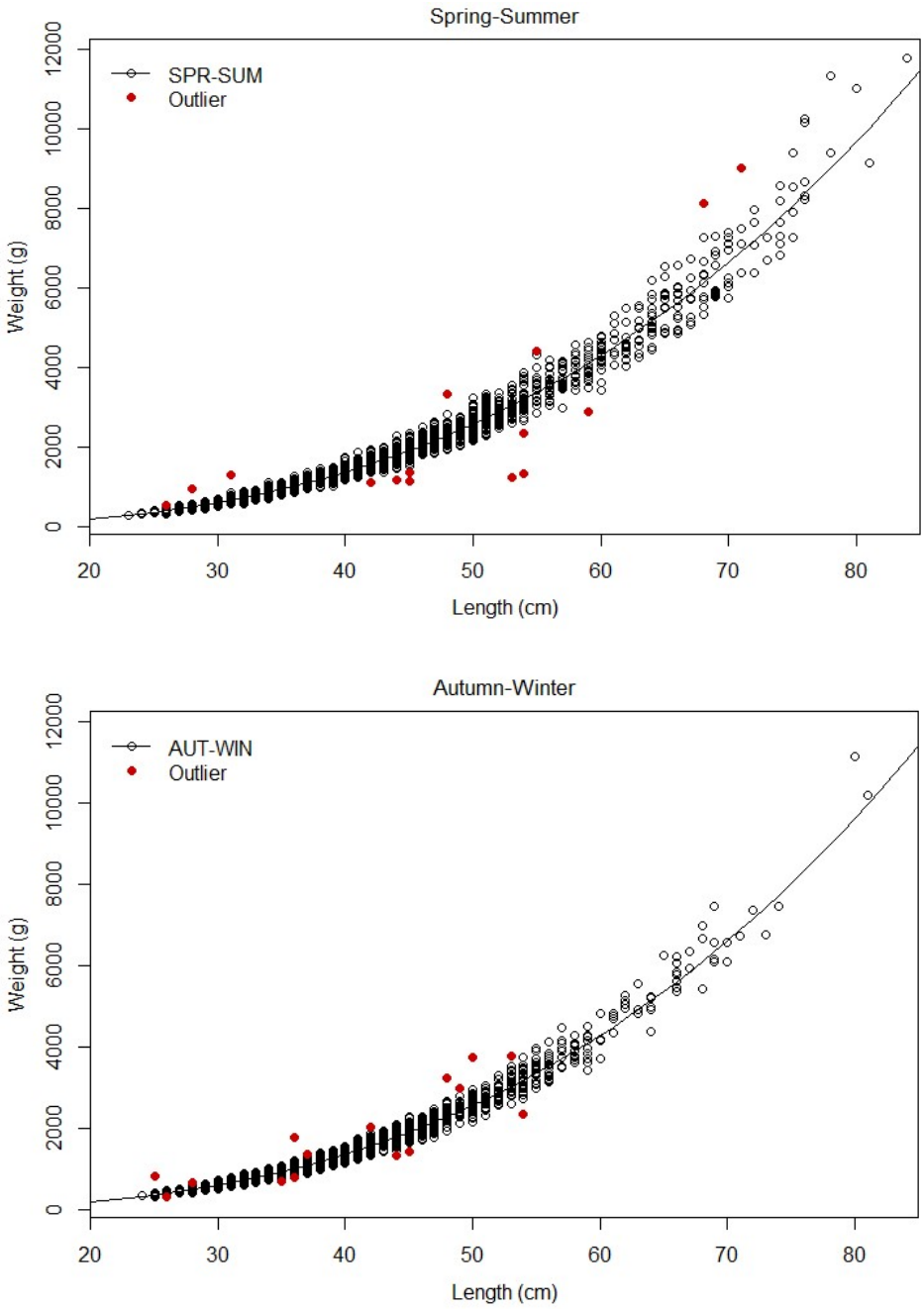

Figure 63: Fitted length-weight curves and observed data for the spring-summer and autumn-winter (East Northland, Hauraki Gulf and Bay of Plenty combined), 2019–20 (SPR-SUM, spring-summer; AUT-WIN, autumn-winter).

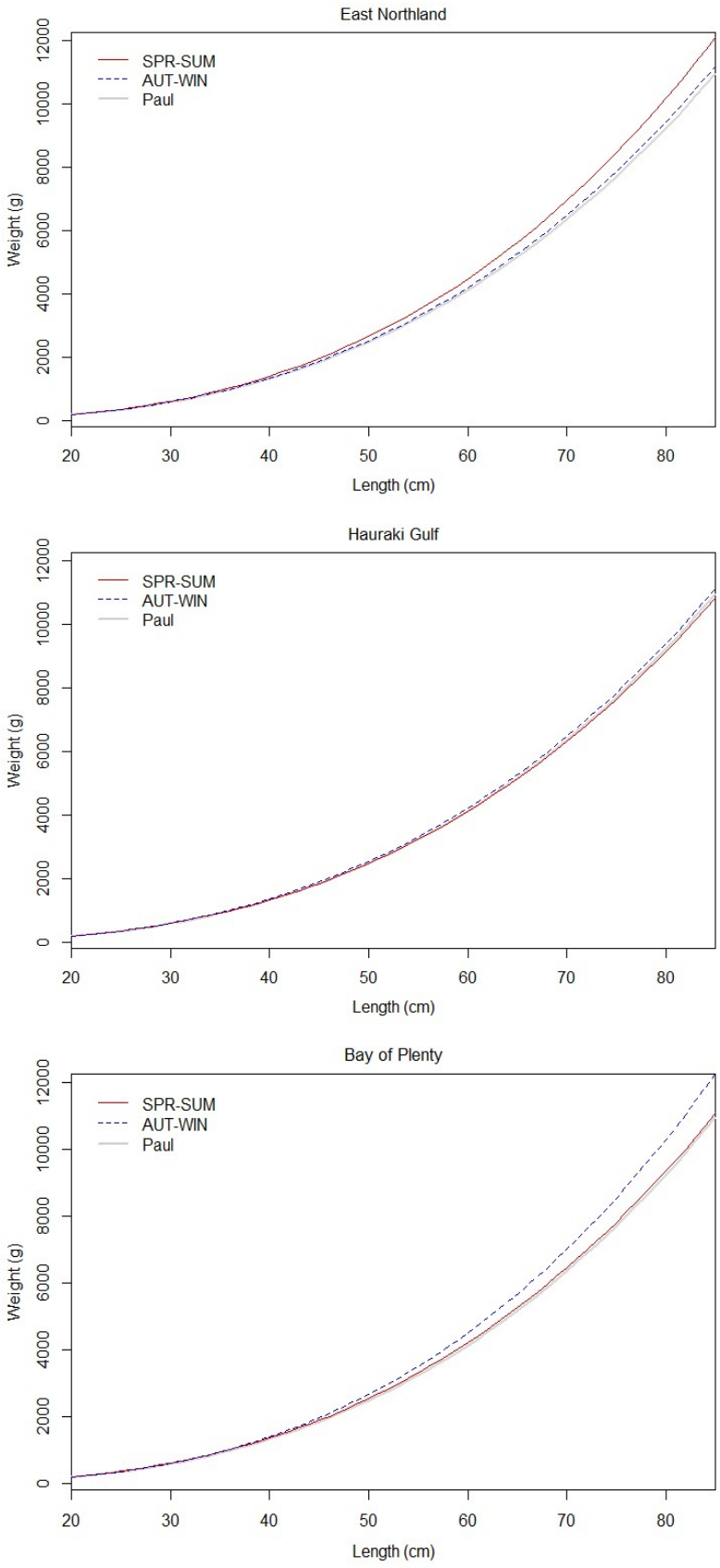

Figure 64: Fitted length-weight curve comparisons by seasons within each stock for SNA 1 in 2019–20 (SPR-SUM, spring-summer; AUT-WIN, autumn-winter). The grey 'Paul' line is the length-weight relationship produced by Paul (1976), which has been the accepted snapper length-weight relationship until this point.

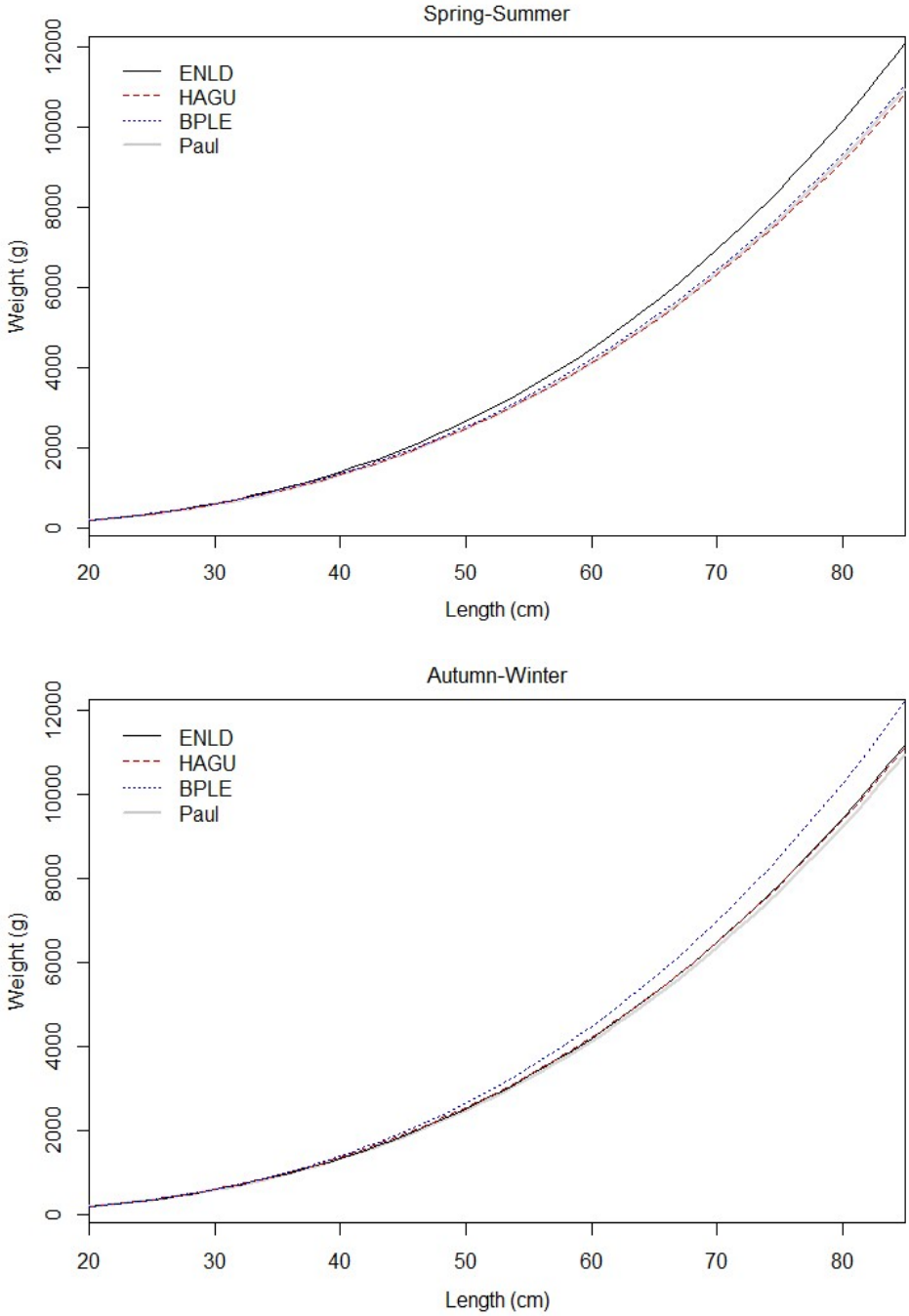

Figure 65: Fitted length-weight curve comparisons by stocks within each season for SNA 1 in 2019–20 (BPLE, Bay of Plenty; ENLD, East Northland; HAGU, Hauraki Gulf). The grey 'Paul' line is the length-weight relationship produced by Paul (1976), which has been the accepted snapper length-weight relationship until this point.

Table 15: Snapper length and weight parameter estimates (exclusive of outliers) for season and area derived from sample collections from the SNA 1 fishery in 2019–20 using log-log linear regression (see Appendix 1).

Data	ln(a)	*a*	*b*	*n*	Length range (cm)	Weight range (g)
Spring-summer	-3.1473	0.0431	2.8115	2 734	23–84	290–11 775
Autumn-winter	-3.1476	0.0430	2.8105	3 654	25–81	330–11 145
East Northland	-3.3580	0.0349	2.8701	1 978	23–84	290–11 775
Hauraki Gulf	-3.0111	0.0494	2.7712	2 539	25–80	345–11 145
Bay of Plenty	-3.1480	0.0430	2.8133	1 865	24–72	310–6 985
East Northland spring-summer	-3.2622	0.0384	2.8495	914	23–84	290–11 775
East Northland autumn-winter	-3.1549	0.0427	2.8080	1 064	25–81	350–10 175
Hauraki Gulf spring-summer	-3.0285	0.0485	2.7718	956	25–76	375–8 325
Hauraki Gulf autumn-winter	-3.0189	0.0489	2.7758	1 583	25–80	345–11 145
Bay of Plenty spring-summer	-2.9956	0.0501	2.7693	856	24–72	310–6 380
Bay of Plenty autumn-winter	-3.3620	0.0347	2.8751	1 009	24–68	330–6 985
SNA 1	-3.1523	0.0429	2.8123	6 382	23–84	290–11 775

4. DISCUSSION

SNA 1 bottom longline random age frequency sampling

Although considerable developments within the fishing industry have occurred over the past two decades, with downsizing and rationalisation of the commercial inshore fleet, the SNA 1 bottom longline fishery has remained relatively consistent. In 2019–20, bottom longline was again the dominant method in the SNA 1 fishery, catching as much snapper (just under 1900 t) as bottom trawl (~1260 t) and Danish seine (~690 t) combined. Unlike other methods, longlining operates extensively in most spatial strata of SNA 1 (with the exception of the eastern Bay of Plenty), across a wide range of habitats (soft and hard substrates), and has few fine-scale management (area and effort) restrictions imposed on its use. Importantly, catch-at-age data from the longline fishery provide a particularly useful tool for stock monitoring, believed to be the most uniform of all the fishing methods in its selection of fish across both size and age.

The relative year class strengths inferred from the bottom longline age distributions sampled from the SNA 1 fisheries in the 2019–20 fishing year are generally consistent with trends observed over the previous decade (Walsh et al. 2011a, 2011b, 2014b, 2019b).

East Northland bottom longline

Although not as large as the Hauraki Gulf stock (Francis & McKenzie 2015), East Northland has remained in a healthy state, comprising about 7% of snapper 20 years of age and older, more than any other New Zealand snapper stock. However, the average size in East Northland remains comparatively small at about 34 cm (about 0.846 kg), due to relatively slow growth rates in the fishery. The 2013 SNA 1 assessment predicted the East Northland stock to be at 22% B_0 (est. 75 000 t) in 2012–13 (Francis & McKenzie 2015) above the soft limit of 20% B_0 but below the target of 40% B_0.

Hauraki Gulf bottom longline

In the past, the Hauraki Gulf has been regarded as the mainstay of the SNA 1 fishery, comprising the largest biomass and most often producing the largest commercial and recreational harvest (Walsh et al. 2014b, Francis & McKenzie 2015). More recently however, commercial fishing in the Hauraki Gulf has declined with landings between 2015–16 and 2019–20 dropping by 30% and now contributing the lowest proportional catch (~24%) in SNA 1. In 2019–20, significant fishing effort has instead been directed toward the East Northland and Bay of Plenty stocks where snapper are of larger average size and better quality (colour and condition[5]) than in the Hauraki Gulf, and (anecdotally)

[5] See images of poor conditioned snapper from the inner Hauraki Gulf fishery (Appendix 14).

valuable bycatch species (i.e., tarakihi (*Nemadactylus macropterus*) and red gurnard (*Chelidonichthys kumu*)) are more readily available. It could be assumed that resident snapper that occupy parts of the inner Hauraki Gulf year-round may be more condition-susceptible (Appendix 14) than school fish (pers. comm. commercial fishers and managers) that migrate seasonally. However, this may not be anything new. Albert Sanford (founder Sanford Ltd) bought land on Pakatoa Island in 1872, building a curing plant for smoking snapper. However, the scheme proved unprofitable due to the poor condition of snapper in the Firth of Thames due to a lack of food as a result of the abundance of fish in the area (Titchener 1980).

The 2013 SNA 1 assessments predicted the Hauraki Gulf stock to be stable at 24% B_0 (est. 208 000 t) in 2012–13 (Francis & McKenzie 2015) above the soft limit of 20% B_0 but below the target of 40% B_0.

Bay of Plenty bottom longline

Similar to the Hauraki Gulf, recruitment into the Bay of Plenty snapper fishery in recent years has been delayed by a slowing growth rate (Walsh et al. 2011b, 2014b, 2019b); the current average size landed by bottom longline in 2019–20 has remained comparatively small at about 33 cm (about 0.778 kg).

For more than a decade, Walsh et al. (2011a, 2011b, 2014b, 2019b) have reported a noticeable and consistent broadening in the Bay of Plenty age distribution over successive sampling years (2008–09, 2009–10, 2012–13, and 2017–18) coupled with an increasing trend of catch per unit effort (CPUE) for bottom longline (McKenzie & Parsons 2012). It was suggested that the biomass of snapper in the Bay of Plenty may be rebuilding to a size not seen for over three decades, should fishing pressure remain stable, and recruitment, average or better (Walsh et al. 2019b). Two years later in the current study (2019–20) the bottom longline age composition was largely dominated by young snapper, those 11 years of age and younger making up 85% of landed catch by number. Four main methods (bottom longline, bottom trawl, Danish seine, modular harvest system) operate in the Bay of Plenty snapper fishery and for the past five fishing years have contributed to the largest overall area catch in SNA 1. Increasing incrementally from ~1600 t in 2015–16 to ~1900 t in 2019–20, the current total approximates 42% of the SNA 1 TACC (4500 t), 21% and 29% more tonnage than that taken from East Northland and Hauraki Gulf stocks, respectively, and proportionally more fish caught per tonne, given the small average size of snapper (31–33 cm, 0.654–0.778 kg) in all four Bay of Plenty methods. The proportionality of catch-at-age estimates of the four sampled methods in the Bay of Plenty in 2019–20 appeared very similar selectively (see Appendix 15), inferring that samples in the current study may be representative, or close to, the recruited population age structure.

Although intensively fished historically, the Bay of Plenty has characteristically always been recognised as the smallest stock in SNA 1. The 2013 SNA 1 assessments predicted the Bay of Plenty stock to be at 6% B_0 (est. 93 000 t) in 2012–13 (Francis & McKenzie 2015) below the hard limit of 10% B_0.

Variability in catch-at-age between stocks

Since 1989–90, broad similarities in relative year class strengths and recruitment patterns have been evident between the SNA 1 stocks, particularly for extremely strong and weak year classes. Variability in relative year class proportions between the SNA 1 stocks has mostly been associated with the variable recruitment (a reflection of unique environmental conditions), growth differences, and fishing mortality differences (Walsh et al. 2003). The most notable year class strength consistencies between SNA 1 stocks for bottom longline and power method fisheries in 2019–20 was the 2011 year class (9 year olds) of above average strength in East Northland and Hauraki Gulf landings and the 2014 year class (6 year olds) of above average strength in East Northland and Bay of Plenty landings, possibly delayed in the Hauraki Gulf fishery due to slower growth and therefore delayed recruitment (Appendix 15). SNA 2 North year class strength (for young fish) correlated well with Bay of Plenty power method estimates. It is also worth noting that mean age in SNA 2 North was virtually the same as previous estimates (7.4 years in 2019–20 compared with 6.8 and 7.4 years in 2007–08 and 2008–09).

Although some differences in relative year class strengths were present between SNA 1 stocks, comparisons between methods within stocks (using random age frequency and length frequency age-length key sampling designs), nevertheless, demonstrate a high level of consistency between estimates (Appendix 15). However, it is worth noting that of all the stocks and methods sampled, Danish seine from the Hauraki Gulf had the highest estimate of mean age. This could potentially be due to an increase in cod-end (on-the-square or -diamond) mesh size from 5 to 6 inches (7 inches rarely) in recent years (pers. comm. with fishers) by some Hauraki Gulf (and Northland) Danish seine fishers. Alternatively, the mesh size used by Bay of Plenty Danish seine fishers has largely remained at 5 inches.

Seasonal differences in catch-at-age

For bottom longline quarterly seasons, older and larger fish were found to be more common during spring in Bay of Plenty and East Northland, and summer in the Hauraki Gulf. High numbers of small young snapper were most common during autumn-winter, reflecting a time of strong seasonal recruitment into the commercial fisheries.

For all power method fisheries in SNA 1 and SNA 2, older snapper were only marginally more common in spring-summer landings than those from autumn-winter, the exception being estimates derived from East Northland modular harvest system, where no winter sampling was undertaken and spring-summer landings comprised substantially more old fish.

Precision in catch-at-age

The bootstrap MWCV estimates for the age distributions sampled from the SNA 1 bottom longline fisheries in 2019–20 ranged between 0.17 and 0.21, inferring a good level of precision. Although approximating the target MWCVs of 20%, precision in 2019–20 catch-at-age estimates was aided by an increase in otolith sample size which exceeded the annual targets, similar to that in recent years (Walsh et al. 2014b, 2019b). To achieve a target catch-at-age precision (MWCV) of 20% for the three SNA 1 bottom longline stocks in future years, given that the respective fisheries may continue to populate and likely broaden, year-round otolith sample sizes will need to be increased from 800 to 1000 otoliths for East Northland and Bay of Plenty stocks and from 1000 to 1200 otoliths for the Hauraki Gulf.

In the two decades preceding 2009–10, sampling of the SNA 1 longline fisheries was conducted over successive years, and comparisons of inter-annual catch-at-age estimates indicated a high level of consistency in relative year class strength, where cohorts were easily tracked from one year to the next, providing many ‘looks’ at a year class (see Appendices 5 and 6). However, relative year class strength estimates in recent sampling years (including 2019–20) were less consistent with previous estimates, largely due to the less frequent one in three year, or more, sampling events.

Bootstrap MWCV estimates for length and age distributions sampled from the SNA 1 power method fisheries in 2019–20 ranged between 0.10 and 0.42, and that for SNA 2 bottom trawl catch-at-age was 0.17. The Bay of Plenty power method fisheries (bottom trawl, Danish seine, modular harvest system) comprised the narrowest length and age range of all SNA 1 methods, resulting in low MWCVs (0.10 to 0.14), similar to Hauraki Gulf Danish seine (0.13 and 0.15). High precision would also be influenced by the homogeneity between sampled landings and achievement of targeted sample sizes. In contrast, samples from East Northland modular harvest system fell short of sample targets (landings and length measurements) resulting in length and age distribution MWCVs of 0.42 and 0.37.

Recent change in snapper growth rates

Using the time series of bottom longline catch sampling data available from SNA 1, Walsh et al. (2011a, 2011b, 2014b, 2019b) documented temporal trends in the growth rates of snapper by comparing changes in mean weight-at-age over time. They found that growth rates for Hauraki Gulf and Bay of Plenty snapper were fastest during the 1990s and steadily declined throughout the 2000 and 2010 decades, the trend correlating with a perceived increase in stock size supported by broadening age distributions. By 2012–13, the decline in growth rates had continued and was deemed

to be more likely due to compensatory density dependence (Rose et al. 2001) because the recent Hauraki Gulf and Bay of Plenty assessments suggest biomass had increased over this period (Francis & McKenzie 2015), rather than temperature related effects or bias in the sampling design or fishing method selectivity (Walsh et al. 2019b). In 2019–20, mean weight-at-age estimates for the common age classes (i.e., 4 to 19 year olds) in the Hauraki Gulf and Bay of Plenty bottom longline fisheries were found to be similar to those in 2017–18 and close to the lowest records in three decades of catch sampling, an overall net weight loss conservatively estimated at around -30%. After two decades (1990s and 2000s) of little change in East Northland mean weight-at-age estimates, a slight but notable decline across the common age classes has recently become evident, resulting in an overall net weight loss of around -11%.

The reduced growth rate observed in the Hauraki Gulf and Bay of Plenty fisheries (and to a lesser degree in East Northland) in recent years, and the resulting drop in yield-per-recruit compared with the 1990s, and the impact on productivity of the stock have been reported a number of times (Walsh et al. 2007, 2008, 2009, 2011a, 2011b, 2014b, 2019b) and mean that the fishery will now land considerably more snapper than it did 10–30 years ago to achieve the same harvest weight. Similar density-dependent growth trends in relation to changes in biomass have recently been documented for SNA 8 (Walsh et al. 2014c, 2017, 2019a and Langley 2020).

Snapper were on average about 20% heavier (and 8% longer) in East Northland and Bay of Plenty than in the Hauraki Gulf in 2019–20.

SNA 1 length-weight relationship study

Two previously documented studies have investigated length-weight relationship for snapper in New Zealand. The first, undertaken mainly during spring and summer in the early 1950s in the Hauraki Gulf, found that 'condition factor' for snapper peaked in October, just before the commencement of spawning (Cassie 1957). An analysis of covariance employed to make tests of significance of seasonal variations in mean weight found that heterogeneity of variances suggested more than one population of fish entered the samples and that seasonal trends are not necessarily due to changes in mean condition of a single population. The behaviour and life history traits of school fish and resident fish (particularly associated with Hauraki Gulf snapper) has long been a topical point (Longhurst 1958, Paul 1974, 1976, Crossland 1976, Vooren & Coombs 1977, Sullivan & Gilbert 1978) and well known to commercial fishers (Walsh et al. 2006) and almost certainly influences the variability seen in length-weight relationship comparisons in the current study. A more comprehensive length-weight relationship investigation was undertaken by Paul (1976). It comprised 780 snapper: 242 juveniles (8–28 cm) collected from Hauraki Gulf during winter and 538 recruited adult snapper (19–71 cm) taken in East Northland, Bay of Plenty, and Tasman Bay, most likely during spring-summer. The length-weight relationship derived from this collection has been utilised in New Zealand snapper research for the past 50 years.

In the current 2019–20 study, a total of 6418 length-weight records were collected across seventy-seven SNA 1 commercial landings. Overall, length-weight collections resulted in only a handful of outliers, due to the considerable time and effort taken to ensure quality assurance in length and weight data recording. These included regular scale calibrations (5 kg weight) during sampling and 'rabbiting' back measurements by the recorder (to the sampler) confirming each length and weight event, ensuring rigour in the sampled data. Furthermore, a considerable proportion of length-weight samples were achieved opportunistically (with the help of licensed fish receiver packing staff) outside the normal catch sampling programme, particularly those for very large snapper that are often infrequent in landings (Figure 66). The example in Figure 66 exemplifies the variation present in length and weight estimates, whereby the 61 cm smaller snapper weighs approximately 20% more than the larger 64 cm snapper.

Figure 66: Large snapper (over 60 cm) were uncommon in most commercial SNA 1 stock landings in 2019–20 and were often targeted to boost length-weight sample collections.

A GLM approach for analysing SNA 1 season-area, length-weight collections from 2019–20 showed significant statistical differences between several stock-season combinations, but it was not clear if the differences were large enough to be material in stock assessments. A linear regression with bias correction approach was subsequently implemented and determined marked differences in seasonal length-weight relationships (spring-summer versus autumn-winter) exist for East Northland and Bay of Plenty, but not for Hauraki Gulf. Unlike Paul (1976), no juvenile snapper were included in the length-weight relationship analysis in this study. Although juvenile length-weight data were available from the successive Hauraki Gulf and Bay of Plenty trawl surveys in the 2019–20 and 2020–21 fishing years, the samples explicitly came from a single month period in spring or summer and did not include East Northland samples and were therefore disregarded for inclusion with the year-round 2019–20 commercial length-weight samples. Length and weight parameter estimates derived from the current study will be utilised in future SNA 1 catch sampling programmes.

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7. APPENDICES

Appendix 1: Derivation of season-area specific length-weight parameters by linear model fit to log-log length-weight data.

The relationship between weight (Wt) and length (Ln) is assumed by the following power functions where E denotes the expected value or mean

$E[Wt] = E[aLn^b]$ *Equation 1*

$\mathrm{E}[\log(wt)] = \mathrm{E}[\log(aLn^b)]$

$\mathrm{E}[\log(wt)] = \mathrm{E}[\log(a) + bLog(Ln)]$ *Equation 2*

Given Wt **log-normally** distributed about Ln in *Equation 1* then log(Wt) will be **normally** distributed about log(Ln) in *Equation 2.*

Given these distributional assumptions it is computational more straightforward to estimate the a and b parameters in Equation 1 using a linear model fit to log data under Equation 2 (i.e. easier to test the normality and homogeneity of variance assumptions are not violated such that Equation 1 is an appropriate model). However:

$$E[wt] \neq e^{(\mathrm{E}[\log(wt)])}$$

A bias correction is needed to derive parameter estimates in natural space as follows:

Let:

$\mathrm{VAR}[\log(Wt)] = \text{variance of } \log(Wt)$

Then the bias correction on $\mathrm{E}[\log(\mathrm{Wt})]$ to derive $\mathrm{E}[\mathrm{Wt}]$ is:

$$E[Wt] = e^{\left(\mathrm{E}[\log(Wt)] + \frac{\mathrm{VAR}[\log(Wt)]}{2}\right)} = E[aLn^b]$$

Where

$$b_{eq\,1} = b_{eq\,2}$$

$$a_{eq1} = e^{\left(\log(a_{eq2}) + \frac{\mathrm{VAR}[\log(Wt)]}{2}\right)}$$

Appendix 2: Estimated seasonal proportion at age and coefficients of variation (CVs) for snapper bottom longline fisheries in SNA 1 in 2019–20.

Estimates of proportion at age with coefficients of variation for snapper from the East Northland bottom longline fishery in 2019–20.

	Random age frequency Longline									
Age	Spring		Summer		Autumn		Winter		Spr-win	
(years)	*P.j.*	CV	*P.j.*	CV	*P.j.*	CV	*P.j.*	CV	*P.j.*	CV
1	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
2	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0026	1.34	0.0007	1.33
3	0.0000	0.00	0.0000	0.00	0.0406	0.41	0.0281	0.49	0.0169	0.32
4	0.0343	0.63	0.0168	0.62	0.0681	0.36	0.0877	0.28	0.0502	0.20
5	0.0485	0.56	0.0426	0.46	0.0865	0.29	0.1241	0.28	0.0753	0.18
6	0.0714	0.50	0.1169	0.36	0.1735	0.17	0.1728	0.19	0.1378	0.14
7	0.0690	0.34	0.0821	0.31	0.1448	0.26	0.1105	0.23	0.1022	0.14
8	0.0751	0.31	0.1007	0.30	0.0706	0.36	0.1158	0.24	0.0937	0.16
9	0.1197	0.27	0.1511	0.24	0.1922	0.16	0.1316	0.25	0.1506	0.11
10	0.0476	0.35	0.0582	0.46	0.0271	0.52	0.0544	0.42	0.0483	0.24
11	0.0376	0.61	0.0406	0.72	0.0462	0.40	0.0536	0.42	0.0449	0.29
12	0.0349	0.41	0.0613	0.41	0.0369	0.47	0.0290	0.54	0.0429	0.24
13	0.0610	0.40	0.0616	0.32	0.0293	0.56	0.0181	0.61	0.0425	0.21
14	0.0471	0.45	0.0403	0.43	0.0039	1.41	0.0000	0.00	0.0222	0.32
15	0.0764	0.39	0.0534	0.51	0.0126	0.76	0.0135	0.69	0.0369	0.29
16	0.0038	1.33	0.0149	0.78	0.0000	0.00	0.0000	0.00	0.0058	0.69
17	0.0422	0.46	0.0251	0.59	0.0113	0.87	0.0101	0.73	0.0206	0.32
18	0.0532	0.50	0.0189	0.58	0.0059	0.93	0.0179	0.65	0.0210	0.31
19	0.0333	0.45	0.0187	0.56	0.0087	0.81	0.0098	1.00	0.0163	0.32
20	0.0279	0.58	0.0215	0.56	0.0064	0.89	0.0082	0.88	0.0155	0.35
21	0.0433	0.49	0.0250	0.46	0.0062	1.17	0.0058	0.88	0.0184	0.30
22	0.0173	0.62	0.0048	1.18	0.0028	1.40	0.0000	0.00	0.0050	0.54
23	0.0084	0.90	0.0024	1.39	0.0000	0.00	0.0000	0.00	0.0021	0.75
24	0.0126	0.80	0.0145	0.62	0.0054	1.25	0.0032	1.33	0.0091	0.45
25	0.0000	0.00	0.0035	1.37	0.0056	1.15	0.0000	0.00	0.0025	0.89
26	0.0141	0.80	0.0063	0.86	0.0031	1.32	0.0000	0.00	0.0051	0.55
27	0.0076	1.21	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0012	1.22
28	0.0046	1.25	0.0038	1.08	0.0034	1.27	0.0000	0.00	0.0028	0.71
29	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
>29	0.0090	0.89	0.0151	0.70	0.0092	0.90	0.0032	1.35	0.0096	0.46
n	239		245		237		232		953	

Appendix 2 – continued:
Estimates of proportion at age with coefficients of variation for snapper from the East Northland bottom longline fishery (statistical area 002) in 2019–20.

	Random age frequency Longline									
Age	Spring		Summer		Autumn		Winter		Spr-win	
(years)	*P.j.*	CV	*P.j.*	CV	*P.j.*	CV	*P.j.*	CV	*P.j.*	CV
1	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
2	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0077	1.36	0.0015	1.29
3	0.0000	0.00	0.0000	0.00	0.0352	0.73	0.0054	1.47	0.0094	0.67
4	0.0384	0.75	0.0274	0.63	0.0626	0.64	0.0690	0.46	0.0457	0.32
5	0.0481	0.73	0.0918	0.47	0.0990	0.37	0.1135	0.32	0.0904	0.23
6	0.0405	0.47	0.0478	0.55	0.0884	0.32	0.2070	0.31	0.0872	0.23
7	0.0530	0.58	0.0949	0.38	0.1721	0.33	0.1011	0.39	0.1074	0.21
8	0.0573	0.50	0.0736	0.40	0.0493	0.62	0.0707	0.54	0.0646	0.26
9	0.1016	0.32	0.1347	0.29	0.2102	0.20	0.1454	0.31	0.1491	0.15
10	0.0454	0.49	0.0343	0.96	0.0100	1.31	0.0451	0.51	0.0325	0.47
11	0.0290	1.09	0.0042	1.56	0.0430	0.56	0.0563	0.56	0.0277	0.37
12	0.0223	0.81	0.0540	0.56	0.0347	0.68	0.0172	0.91	0.0369	0.38
13	0.0513	0.54	0.0667	0.41	0.0592	0.58	0.0062	1.40	0.0505	0.29
14	0.0470	0.57	0.0215	0.83	0.0000	0.00	0.0000	0.00	0.0165	0.50
15	0.1057	0.41	0.0679	0.57	0.0163	0.91	0.0247	0.76	0.0536	0.34
16	0.0076	1.31	0.0052	1.59	0.0000	0.00	0.0000	0.00	0.0033	1.08
17	0.0752	0.48	0.0488	0.65	0.0135	1.12	0.0302	0.76	0.0413	0.37
18	0.0694	0.55	0.0127	1.00	0.0119	0.95	0.0320	0.64	0.0258	0.36
19	0.0514	0.53	0.0274	0.64	0.0175	0.84	0.0077	1.35	0.0252	0.36
20	0.0286	0.84	0.0532	0.55	0.0130	0.90	0.0245	0.92	0.0340	0.40
21	0.0589	0.53	0.0486	0.50	0.0124	1.18	0.0172	0.93	0.0356	0.34
22	0.0189	0.87	0.0119	1.21	0.0056	1.42	0.0000	0.00	0.0093	0.75
23	0.0168	0.90	0.0059	1.41	0.0000	0.00	0.0000	0.00	0.0052	0.79
24	0.0000	0.00	0.0222	0.69	0.0108	1.26	0.0095	1.36	0.0133	0.58
25	0.0000	0.00	0.0086	1.37	0.0113	1.17	0.0000	0.00	0.0061	0.88
26	0.0097	1.28	0.0093	1.08	0.0062	1.33	0.0000	0.00	0.0068	0.76
27	0.0152	1.18	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0025	1.28
28	0.0000	0.00	0.0093	1.09	0.0068	1.27	0.0000	0.00	0.0053	0.84
29	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
>29	0.0087	1.21	0.0184	1.00	0.0108	1.25	0.0095	1.37	0.0133	0.63
n	120		125		127		111		483	

Appendix 2 – continued:
Estimates of proportion at age with coefficients of variation for snapper from the East Northland bottom longline fishery (statistical area 003) in 2019–20.

	Random age frequency									
									Longline	
Age	Spring		Summer		Autumn		Winter		Spr-win	
(years)	*P.j.*	CV	*P.j.*	CV	*P.j.*	CV	*P.j.*	CV	*P.j.*	CV
1	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
2	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
3	0.0000	0.00	0.0000	0.00	0.0458	0.44	0.0395	0.51	0.0267	0.37
4	0.0302	1.05	0.0096	1.33	0.0735	0.37	0.0972	0.35	0.0611	0.25
5	0.0490	0.82	0.0093	1.34	0.0742	0.43	0.1295	0.38	0.0752	0.29
6	0.1022	0.65	0.1636	0.40	0.2569	0.21	0.1556	0.24	0.1786	0.15
7	0.0849	0.42	0.0734	0.45	0.1180	0.39	0.1153	0.29	0.1020	0.20
8	0.0928	0.38	0.1190	0.39	0.0914	0.44	0.1385	0.28	0.1156	0.18
9	0.1377	0.38	0.1623	0.34	0.1745	0.24	0.1247	0.35	0.1490	0.16
10	0.0497	0.48	0.0744	0.51	0.0439	0.59	0.0591	0.55	0.0577	0.30
11	0.0461	0.72	0.0653	0.77	0.0494	0.59	0.0522	0.56	0.0540	0.33
12	0.0476	0.44	0.0662	0.54	0.0391	0.64	0.0350	0.64	0.0453	0.30
13	0.0707	0.55	0.0581	0.47	0.0000	0.00	0.0241	0.68	0.0316	0.32
14	0.0472	0.70	0.0531	0.53	0.0077	1.40	0.0000	0.00	0.0208	0.40
15	0.0472	0.73	0.0436	0.81	0.0090	1.31	0.0078	1.34	0.0217	0.48
16	0.0000	0.00	0.0215	0.89	0.0000	0.00	0.0000	0.00	0.0054	0.84
17	0.0093	1.32	0.0091	1.36	0.0090	1.31	0.0000	0.00	0.0058	0.81
18	0.0371	0.94	0.0232	0.71	0.0000	0.00	0.0108	1.34	0.0141	0.54
19	0.0152	0.96	0.0129	0.96	0.0000	0.00	0.0108	1.26	0.0089	0.71
20	0.0272	0.77	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0032	0.73
21	0.0278	0.98	0.0091	1.31	0.0000	0.00	0.0000	0.00	0.0055	0.77
22	0.0158	0.82	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0019	0.86
23	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
24	0.0251	0.81	0.0093	1.26	0.0000	0.00	0.0000	0.00	0.0053	0.73
25	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
26	0.0186	1.07	0.0043	1.40	0.0000	0.00	0.0000	0.00	0.0032	0.79
27	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
28	0.0093	1.26	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0011	1.25
29	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
>29	0.0093	1.30	0.0129	0.98	0.0077	1.26	0.0000	0.00	0.0064	0.66
n	119		120		110		121		470	

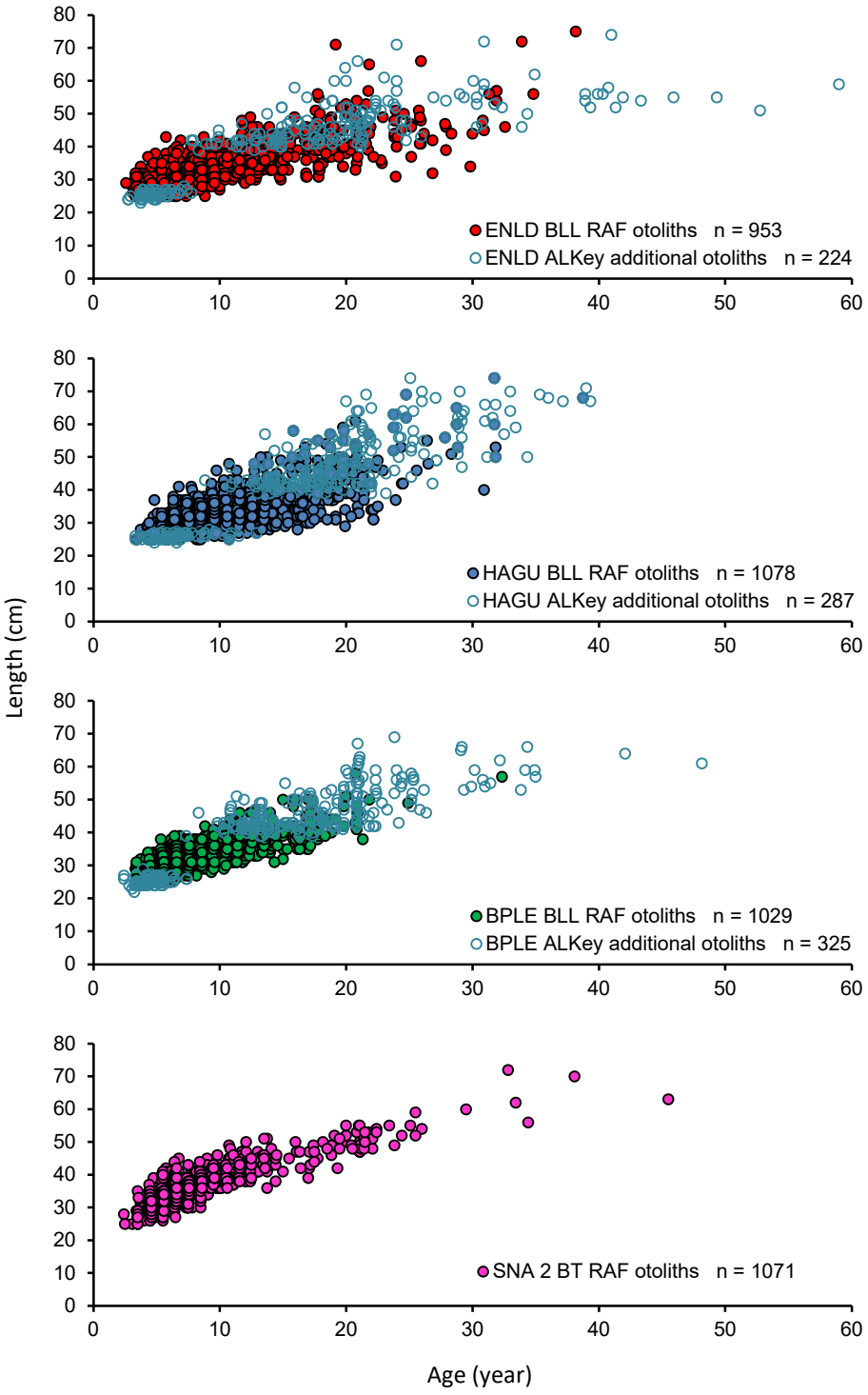
Appendix 2 – continued:
Estimates of proportion at age with coefficients of variation for snapper from the Hauraki Gulf bottom longline fishery in 2019–20.

	Random age frequency Longline									
Age	Spring		Summer		Autumn		Winter		Spr-win	
(years)	*P.j.*	CV	*P.j.*	CV	*P.j.*	CV	*P.j.*	CV	*P.j.*	CV
1	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
2	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
3	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0055	1.17	0.0017	1.18
4	0.0119	0.86	0.0000	0.00	0.0381	0.48	0.0256	0.64	0.0153	0.39
5	0.0349	0.50	0.0062	1.24	0.0459	0.51	0.0567	0.45	0.0331	0.29
6	0.0937	0.31	0.0471	0.40	0.0938	0.38	0.0998	0.27	0.0794	0.17
7	0.1216	0.24	0.1050	0.31	0.1042	0.33	0.1269	0.27	0.1153	0.15
8	0.1193	0.27	0.0515	0.35	0.1124	0.24	0.1158	0.30	0.0938	0.15
9	0.0883	0.32	0.1694	0.20	0.0813	0.34	0.0959	0.32	0.1180	0.14
10	0.0460	0.40	0.1099	0.32	0.0970	0.23	0.0434	0.39	0.0738	0.18
11	0.1097	0.38	0.0852	0.26	0.0817	0.30	0.0952	0.29	0.0932	0.16
12	0.0586	0.38	0.0738	0.28	0.0785	0.36	0.0766	0.33	0.0720	0.16
13	0.1123	0.30	0.1024	0.30	0.0579	0.38	0.0889	0.36	0.0947	0.18
14	0.0523	0.49	0.0581	0.40	0.0353	0.50	0.0246	0.51	0.0435	0.24
15	0.0244	0.58	0.0565	0.43	0.0131	0.87	0.0214	0.66	0.0332	0.30
16	0.0280	0.53	0.0215	0.63	0.0416	0.70	0.0262	0.53	0.0269	0.29
17	0.0299	0.59	0.0206	0.60	0.0324	0.61	0.0191	0.74	0.0236	0.32
18	0.0226	0.54	0.0354	0.46	0.0090	1.16	0.0275	0.58	0.0269	0.29
19	0.0201	0.58	0.0066	1.02	0.0281	0.87	0.0134	0.68	0.0143	0.37
20	0.0059	1.29	0.0220	0.57	0.0038	1.34	0.0079	0.82	0.0119	0.43
21	0.0194	0.62	0.0089	0.88	0.0117	0.93	0.0061	1.23	0.0106	0.44
22	0.0000	0.00	0.0100	0.90	0.0265	0.92	0.0106	1.17	0.0101	0.58
23	0.0000	0.00	0.0046	1.36	0.0000	0.00	0.0000	0.00	0.0016	1.36
24	0.0000	0.00	0.0027	1.48	0.0038	1.34	0.0062	1.04	0.0033	0.76
25	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0029	1.48	0.0009	1.44
26	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0037	1.02	0.0012	0.99
27	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
28	0.0000	0.00	0.0000	0.00	0.0038	1.32	0.0000	0.00	0.0005	1.30
29	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
>29	0.0011	1.55	0.0027	1.36	0.0000	0.00	0.0000	0.00	0.0012	1.16
n	282		291		250		255		1 078	

Appendix 2 – continued:
Estimates of proportion at age with coefficients of variation for snapper from the Bay of Plenty bottom longline fishery in 2019–20.

	Random age frequency Longline									
Age	Spring		Summer		Autumn		Winter		Spr-win	
(years)	*P.j.*	CV	*P.j.*	CV	*P.j.*	CV	*P.j.*	CV	*P.j.*	CV
1	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
2	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
3	0.0000	0.00	0.0000	0.00	0.0026	1.49	0.0205	0.68	0.0071	0.62
4	0.0206	0.90	0.0188	0.87	0.0716	0.33	0.0839	0.34	0.0558	0.22
5	0.0611	0.59	0.1158	0.28	0.1467	0.27	0.1889	0.18	0.1404	0.13
6	0.1223	0.24	0.1799	0.23	0.2321	0.18	0.2422	0.16	0.2077	0.10
7	0.1925	0.18	0.1844	0.18	0.1562	0.23	0.1717	0.21	0.1726	0.10
8	0.1329	0.27	0.1149	0.27	0.0857	0.22	0.0794	0.37	0.0972	0.14
9	0.1196	0.27	0.0740	0.26	0.0823	0.26	0.0551	0.40	0.0772	0.15
10	0.0319	0.62	0.0496	0.34	0.0346	0.50	0.0507	0.39	0.0426	0.22
11	0.0444	0.45	0.0717	0.26	0.0638	0.53	0.0272	0.57	0.0519	0.25
12	0.0391	0.64	0.0256	0.58	0.0272	0.48	0.0240	0.50	0.0275	0.27
13	0.0837	0.37	0.0459	0.41	0.0308	0.51	0.0384	0.46	0.0439	0.21
14	0.0156	0.99	0.0322	0.45	0.0273	0.54	0.0145	0.68	0.0230	0.30
15	0.0078	0.88	0.0208	0.62	0.0077	1.00	0.0000	0.00	0.0085	0.47
16	0.0415	0.56	0.0107	0.87	0.0129	0.65	0.0035	1.38	0.0135	0.37
17	0.0126	0.77	0.0245	0.60	0.0069	0.84	0.0000	0.00	0.0098	0.43
18	0.0335	0.51	0.0169	0.58	0.0062	1.15	0.0000	0.00	0.0106	0.38
19	0.0064	1.09	0.0000	0.00	0.0018	1.49	0.0000	0.00	0.0014	0.86
20	0.0135	0.93	0.0034	1.36	0.0000	0.00	0.0000	0.00	0.0027	0.76
21	0.0187	0.73	0.0073	1.14	0.0015	1.51	0.0000	0.00	0.0048	0.59
22	0.0023	1.42	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0003	1.40
23	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
24	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
25	0.0000	0.00	0.0036	1.36	0.0000	0.00	0.0000	0.00	0.0009	1.35
26	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
27	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
28	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
29	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
>29	0.0000	0.00	0.0000	0.00	0.0022	1.37	0.0000	0.00	0.0007	1.37
n	202		257		319		251		1 029	

Appendix 3: Scatterplots of age-at-length data for snapper sampled from the SNA 1 bottom longline (Random age frequency samples) and power method (Age-length key samples) fisheries and the SNA 2 bottom trawl (Random age frequency samples) fishery in 2019–20. Age is decimalised as of the month of collection relative to an assumed January 1 "birthdate" (ENLD, East Northland; HAGU, Hauraki Gulf; BPLE, Bay of Plenty; SNA 2N, SNA 2 North; BLL, bottom longline; BT, bottom trawl; RAF, Random age frequency; ALKey, Age-length key; *n*, sample size).



Appendix 4: Age-length keys derived from snapper otolith samples collected from bottom longline fisheries in SNA 1 in 2019–20.

Estimates of proportion of length at age for snapper sampled from East Northland bottom longline fishery (Statistical Areas 002 and 003 combined), spring-winter 2019–20. (Note: Aged to 01/01/20)

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0.11	0.42	0.11	0.26	0.05	0	0.05	0	0	0	0	0	0	0	0	0	0	0	19
26	0	0	0.09	0.21	0.27	0.33	0.09	0	0	0	0	0	0	0	0	0	0	0	0	0	33
27	0	0	0.05	0.21	0.16	0.35	0.07	0.14	0	0.02	0	0	0	0	0	0	0	0	0	0	43
28	0	0	0.03	0.07	0.20	0.29	0.22	0.07	0.10	0.02	0	0	0	0	0	0	0	0	0	0	59
29	0	0.01	0.01	0.11	0.15	0.24	0.13	0.11	0.21	0	0	0.01	0	0	0	0	0	0	0	0	71
30	0	0	0.01	0.03	0.14	0.22	0.23	0.08	0.20	0.03	0.01	0.03	0.01	0	0.01	0	0	0	0	0	74
31	0	0	0.03	0.03	0.07	0.17	0.15	0.14	0.21	0.06	0.01	0.04	0.01	0	0.01	0	0.03	0.03	0	0.01	72
32	0	0	0.02	0.02	0.04	0.09	0.16	0.20	0.26	0.05	0.09	0.02	0.02	0	0	0	0.01	0	0	0.01	81
33	0	0	0	0	0.08	0.08	0.06	0.10	0.34	0.01	0.10	0.04	0.05	0.04	0.05	0	0	0.03	0	0.01	77
34	0	0	0	0.03	0.03	0.10	0.10	0.09	0.17	0.12	0.05	0.05	0.07	0.05	0.05	0	0	0.02	0	0.05	58
35	0	0	0	0	0.04	0	0.16	0.04	0.36	0.04	0.07	0.07	0.11	0	0.02	0	0	0.04	0	0.04	45
36	0	0	0	0	0	0.08	0.04	0.10	0.14	0.10	0.10	0.08	0.12	0.08	0.10	0	0.02	0	0	0.02	49
37	0	0	0	0.03	0	0	0.05	0.10	0.13	0.10	0.10	0.05	0.08	0.03	0.10	0.03	0.05	0.05	0.05	0.08	40
38	0	0	0	0	0.03	0.06	0.06	0.10	0.10	0.13	0.10	0.10	0.19	0	0.06	0	0	0.03	0	0.03	31
39	0	0	0	0	0	0.06	0.03	0.03	0.06	0.06	0.08	0.14	0.08	0.06	0.11	0	0.08	0.08	0.06	0.08	36
40	0	0	0	0	0	0.04	0	0.11	0.11	0.07	0.04	0	0.07	0.04	0.11	0	0.11	0.07	0.07	0.15	27
41	0	0	0	0	0	0	0	0	0	0.19	0	0.05	0.05	0	0.24	0	0	0.10	0.05	0.33	21
42	0	0	0	0	0	0	0.06	0	0	0.06	0	0	0.13	0	0.13	0	0.19	0.06	0.06	0.31	16
43	0	0	0	0	0	0.09	0	0	0.09	0	0	0.09	0.09	0.18	0.09	0	0	0.09	0.09	0.18	11
44	0	0	0	0	0	0	0	0	0	0	0	0.06	0.06	0.13	0.06	0.06	0.06	0.06	0	0.50	16
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0.09	0	0.18	0.18	0	0.18	0.36	11
46	0	0	0	0	0	0	0	0	0	0	0	0.07	0.13	0.07	0	0	0.20	0.07	0.07	0.40	15
47	0	0	0	0	0	0	0	0	0	0	0	0.33	0	0	0	0	0	0	0	0.67	3
48	0	0	0	0	0	0	0	0	0	0	0	0.09	0	0	0	0	0	0.09	0.27	0.55	11
49	0	0	0	0	0	0	0	0	0	0	0	0.13	0	0	0	0.13	0	0	0.13	0.63	8
50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0.75	4
51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.20	0	0	0.80	5
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	1
53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	2
54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	2
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	1
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0	0.67	3
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	3
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	1
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	1.00	1
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																					953

Appendix 4 – continued:

Estimates of proportion of length at age for snapper sampled from East Northland bottom longline fishery (Statistical Area 002), spring-winter 2019–20. (Note: Aged to 01/01/20)

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0.50	0	0	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	2
26	0	0	0.07	0.33	0.27	0.20	0.13	0	0	0	0	0	0	0	0	0	0	0	0	0	15
27	0	0	0	0.17	0.08	0.58	0.08	0.08	0	0	0	0	0	0	0	0	0	0	0	0	12
28	0	0	0.05	0.05	0.29	0.19	0.29	0	0.14	0	0	0	0	0	0	0	0	0	0	0	21
29	0	0.03	0.03	0.17	0.24	0.07	0.14	0.10	0.21	0	0	0	0	0	0	0	0	0	0	0	29
30	0	0	0	0.03	0.24	0.19	0.22	0.03	0.24	0	0	0.03	0	0	0.03	0	0	0	0	0	37
31	0	0	0.03	0.06	0.09	0.16	0.16	0.09	0.13	0.03	0	0.06	0	0	0.03	0	0.06	0.06	0	0.03	32
32	0	0	0.03	0.06	0.06	0.06	0.17	0.14	0.28	0.06	0.08	0	0.03	0	0	0	0.03	0	0	0.03	36
33	0	0	0	0	0.14	0.11	0.03	0.11	0.36	0	0.06	0	0.03	0	0.08	0	0	0.06	0	0.03	36
34	0	0	0	0.06	0.06	0.09	0.09	0.09	0.16	0.09	0	0.09	0.06	0.03	0.06	0	0	0	0	0.09	32
35	0	0	0	0	0	0	0.28	0	0.40	0	0.04	0.04	0.08	0	0	0	0	0.08	0	0.08	25
36	0	0	0	0	0	0.04	0.04	0.12	0.24	0.04	0.16	0.08	0.08	0	0.16	0	0	0	0	0.04	25
37	0	0	0	0.04	0	0	0.09	0.09	0.09	0.04	0.09	0.04	0.09	0	0.13	0	0.09	0.09	0	0.13	23
38	0	0	0	0	0.05	0.05	0.11	0	0.16	0.21	0.16	0	0.21	0	0	0	0	0	0	0.05	19
39	0	0	0	0	0	0.08	0	0.04	0.08	0.08	0	0.12	0.08	0.08	0.12	0	0.12	0.08	0.04	0.12	26
40	0	0	0	0	0	0.07	0	0.14	0.14	0.07	0	0	0.07	0.07	0.07	0	0.14	0	0.14	0.07	14
41	0	0	0	0	0	0	0	0	0	0.12	0	0.06	0.06	0	0.24	0	0	0.12	0.06	0.35	17
42	0	0	0	0	0	0	0.08	0	0	0	0	0	0.15	0	0.15	0	0.23	0	0.08	0.31	13
43	0	0	0	0	0	0.25	0	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	0	4
44	0	0	0	0	0	0	0	0	0	0	0	0	0.13	0.13	0	0	0.13	0.13	0	0.50	8
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0.11	0	0.11	0.22	0	0.22	0.33	9
46	0	0	0	0	0	0	0	0	0	0	0	0.08	0.17	0	0	0	0.17	0.08	0	0.50	12
47	0	0	0	0	0	0	0	0	0	0	0	0.50	0	0	0	0	0	0	0	0.50	2
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.13	0.38	0.50	8
49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.17	0	0	0.17	0.67	6
50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	3
51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.20	0	0	0.80	5
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	1
53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	2
54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	1
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0	0.67	3
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	3
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	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	0	0
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																					483

Appendix 4 – continued:

Estimates of proportion of length at age for snapper sampled from East Northland bottom longline fishery (statistical area 003), spring-winter 2019–20. (Note: Aged to 01/01/20)

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0.12	0.41	0.12	0.29	0	0	0.06	0	0	0	0	0	0	0	0	0	0	0	17
26	0	0	0.11	0.11	0.28	0.44	0.06	0	0	0	0	0	0	0	0	0	0	0	0	0	18
27	0	0	0.06	0.23	0.19	0.26	0.06	0.16	0	0.03	0	0	0	0	0	0	0	0	0	0	31
28	0	0	0.03	0.08	0.16	0.34	0.18	0.11	0.08	0.03	0	0	0	0	0	0	0	0	0	0	38
29	0	0	0	0.07	0.10	0.36	0.12	0.12	0.21	0	0	0.02	0	0	0	0	0	0	0	0	42
30	0	0	0.03	0.03	0.03	0.24	0.24	0.14	0.16	0.05	0.03	0.03	0.03	0	0	0	0	0	0	0	37
31	0	0	0.03	0	0.05	0.18	0.15	0.18	0.28	0.08	0.03	0.03	0.03	0	0	0	0	0	0	0	40
32	0	0	0.02	0	0.02	0.11	0.16	0.24	0.24	0.04	0.09	0.04	0.02	0	0	0	0	0	0	0	45
33	0	0	0	0	0.02	0.05	0.10	0.10	0.32	0.02	0.15	0.07	0.07	0.07	0.02	0	0	0	0	0	41
34	0	0	0	0	0	0.12	0.12	0.08	0.19	0.15	0.12	0	0.08	0.08	0.04	0	0	0.04	0	0	26
35	0	0	0	0	0.10	0	0	0.10	0.30	0.10	0.10	0.10	0.15	0	0.05	0	0	0	0	0	20
36	0	0	0	0	0	0.13	0.04	0.08	0.04	0.17	0.04	0.08	0.17	0.17	0.04	0	0.04	0	0	0	24
37	0	0	0	0	0	0	0	0.12	0.18	0.18	0.12	0.06	0.06	0.06	0.06	0.06	0	0	0.12	0	17
38	0	0	0	0	0	0.08	0	0.25	0	0	0	0.25	0.17	0	0.17	0	0	0.08	0	0	12
39	0	0	0	0	0	0	0.10	0	0	0	0.30	0.20	0.10	0	0.10	0	0	0.10	0.10	0	10
40	0	0	0	0	0	0	0	0.08	0.08	0.08	0.08	0	0.08	0	0.15	0	0.08	0.15	0	0.23	13
41	0	0	0	0	0	0	0	0	0	0.50	0	0	0	0	0.25	0	0	0	0	0.25	4
42	0	0	0	0	0	0	0	0	0	0.33	0	0	0	0	0	0	0	0.33	0	0.33	3
43	0	0	0	0	0	0	0	0	0.14	0	0	0.14	0	0.14	0	0	0	0.14	0.14	0.29	7
44	0	0	0	0	0	0	0	0	0	0	0	0.13	0	0.13	0.13	0.13	0	0	0	0.50	8
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.50	0	0	0	0.50	2
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0	0	0.33	0	0.33	0	3
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
48	0	0	0	0	0	0	0	0	0	0	0	0.33	0	0	0	0	0	0	0	0.67	3
49	0	0	0	0	0	0	0	0	0	0	0	0.50	0	0	0	0	0	0	0	0.50	2
50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	1
51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	1.00	1
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																					470

Appendix 4 – continued:

Estimates of proportion of length at age for snapper sampled from the Hauraki Gulf bottom longline fishery, spring-winter 2019–20. (Note: Aged to 01/01/20)

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0.18	0.09	0.09	0.27	0.09	0.27	0	0	0	0	0	0	0	0	0	0	0	0	11
26	0	0	0	0.14	0.29	0.29	0.11	0.09	0.06	0.03	0	0	0	0	0	0	0	0	0	0	35
27	0	0	0	0.10	0.13	0.26	0.18	0.11	0.07	0.08	0.03	0.02	0.02	0	0	0	0	0	0	0	61
28	0	0	0	0.03	0.09	0.21	0.13	0.13	0.14	0.04	0.14	0.01	0.04	0.01	0	0.01	0	0	0	0	70
29	0	0	0	0.03	0.03	0.12	0.23	0.17	0.17	0.06	0.05	0.05	0.03	0.02	0.01	0	0	0	0	0.01	98
30	0	0	0	0.01	0.03	0.08	0.30	0.15	0.16	0.09	0.04	0.04	0.03	0.02	0.01	0	0.03	0	0	0	93
31	0	0	0	0	0.02	0.06	0.07	0.15	0.16	0.14	0.16	0.07	0.10	0.02	0	0.01	0.01	0.01	0.02	0.02	102
32	0	0	0	0	0.03	0.04	0.17	0.12	0.13	0.12	0.15	0.08	0.07	0.01	0.04	0.04	0	0.01	0.01	0.01	103
33	0	0	0	0	0.02	0.08	0.07	0.08	0.18	0.08	0.11	0.11	0.10	0.07	0.02	0.01	0.01	0.02	0	0.02	88
34	0	0	0	0	0	0.04	0.04	0.03	0.09	0.09	0.22	0.09	0.18	0.04	0.05	0.08	0.01	0.03	0	0.04	79
35	0	0	0	0	0	0	0.03	0.12	0.11	0.08	0.07	0.25	0.16	0.05	0.01	0.04	0.04	0	0	0.03	73
36	0	0	0	0	0	0.02	0.09	0.09	0.09	0.07	0.02	0.07	0.30	0.15	0.04	0.04	0	0.02	0	0	46
37	0	0	0	0	0.02	0.02	0.13	0	0.07	0.07	0.04	0.07	0.20	0.07	0.04	0.02	0.07	0.07	0.07	0.04	45
38	0	0	0	0	0	0.03	0	0.13	0.06	0.03	0.06	0.06	0.16	0.09	0.03	0.13	0.06	0.06	0.06	0.03	32
39	0	0	0	0	0	0	0	0	0.04	0.11	0.07	0.04	0.11	0.04	0.11	0	0.18	0.18	0.04	0.11	28
40	0	0	0	0	0	0	0	0.04	0.04	0	0.13	0.13	0.13	0.04	0.17	0.04	0.04	0.13	0.08	0.04	24
41	0	0	0	0	0	0	0.08	0.08	0	0.25	0.08	0	0.25	0	0	0	0.08	0.08	0.08	0	12
42	0	0	0	0	0	0	0	0	0.06	0	0.11	0.11	0.06	0.11	0.11	0	0.11	0.06	0	0.28	18
43	0	0	0	0	0	0	0	0	0	0.14	0.29	0	0	0.14	0	0	0	0.14	0.14	0.14	7
44	0	0	0	0	0	0	0	0	0	0	0	0	0.20	0.20	0	0	0	0	0.40	0.20	5
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0	0.33	0	0	0	0.33	3
46	0	0	0	0	0	0	0	0	0	0	0.09	0	0.09	0	0	0	0.18	0.18	0.18	0.18	11
47	0	0	0	0	0	0	0	0	0	0	0	0	0.14	0	0.14	0.14	0	0.14	0	0.43	7
48	0	0	0	0	0	0	0	0	0	0	0.20	0	0	0	0.20	0	0	0	0.20	0.40	5
49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.14	0.29	0.14	0.14	0	0.29	7
50	0	0	0	0	0	0	0	0	0	0	0	0	0.17	0.17	0	0.17	0.17	0	0.17	0.17	6
51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0.75	4
54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	1
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	0	0
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																					1078

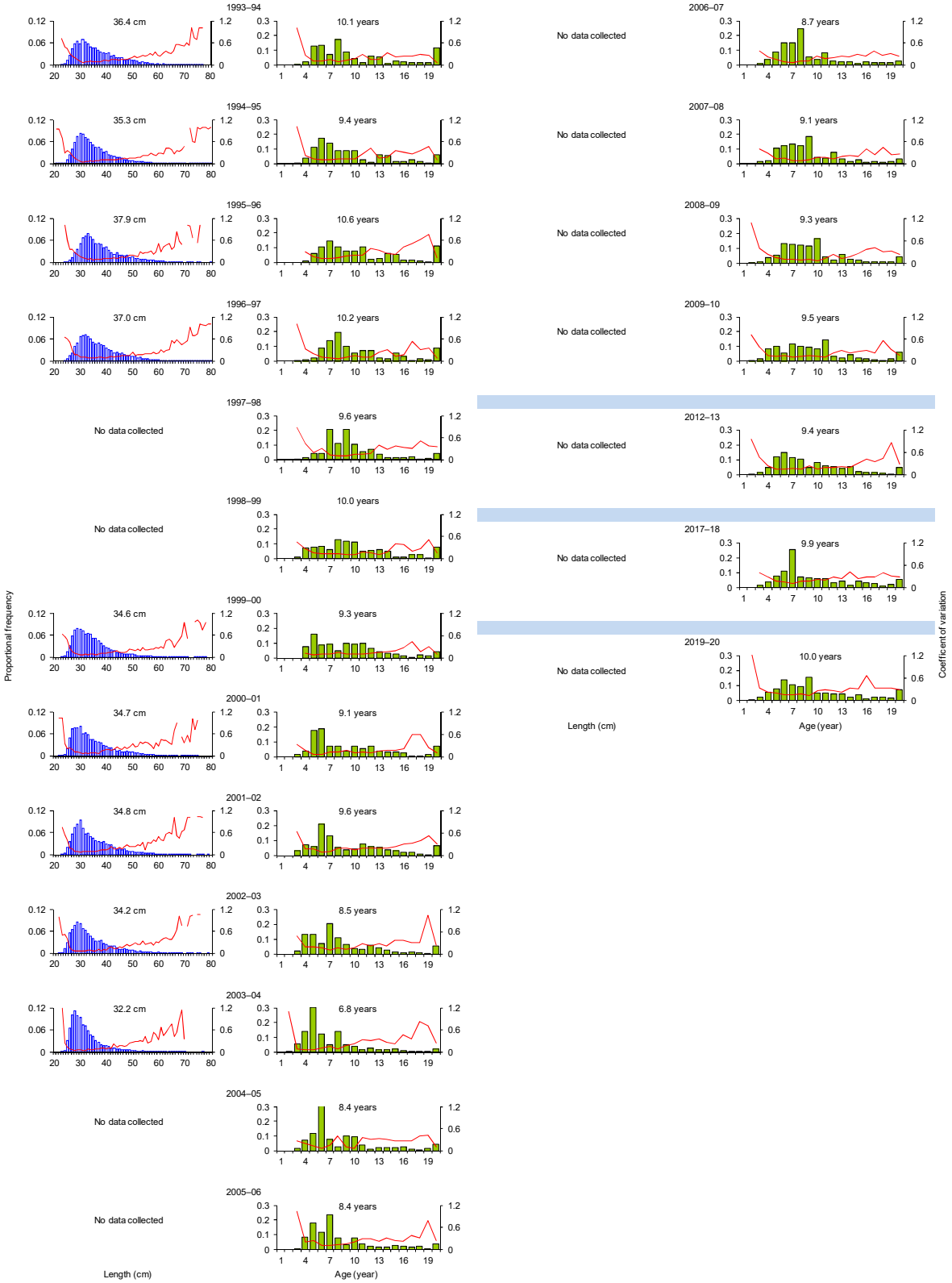
Appendix 4 – continued:

Estimates of proportion of length at age for snapper sampled from the Bay of Plenty bottom longline fishery, spring-winter 2019–20. (Note: Aged to 01/01/20)

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0.60	0.30	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
26	0	0	0.05	0.37	0.37	0.21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
27	0	0	0	0.24	0.49	0.18	0.07	0.02	0	0	0	0	0	0	0	0	0	0	0	0	45
28	0	0	0.03	0.19	0.36	0.22	0.15	0.03	0.02	0	0	0	0	0	0	0	0	0	0	0	59
29	0	0	0.01	0.08	0.28	0.28	0.25	0.03	0.04	0.01	0	0	0	0	0	0	0	0	0	0	71
30	0	0	0.01	0.08	0.21	0.34	0.16	0.14	0.05	0.02	0	0	0	0	0	0	0	0	0	0	102
31	0	0	0.01	0.01	0.19	0.31	0.19	0.08	0.10	0.03	0.06	0.02	0	0.01	0	0	0	0	0	0	107
32	0	0	0	0.03	0.09	0.28	0.31	0.10	0.09	0.01	0.03	0.02	0	0	0.01	0	0	0	0	0	86
33	0	0	0	0	0.07	0.25	0.30	0.12	0.13	0.02	0.06	0.02	0.02	0	0	0	0	0	0	0	89
34	0	0	0	0.01	0.07	0.18	0.27	0.21	0.05	0.05	0.04	0.04	0.06	0.03	0	0	0	0	0	0	101
35	0	0	0	0	0.01	0.18	0.13	0.10	0.17	0.13	0.10	0.06	0.02	0.03	0.02	0.02	0.02	0	0	0	88
36	0	0	0	0	0	0.12	0.14	0.20	0.08	0.12	0.09	0.05	0.14	0.06	0	0	0.02	0	0	0	66
37	0	0	0	0	0	0.03	0.08	0.16	0.18	0.05	0.08	0.05	0.18	0.11	0	0	0.08	0	0	0	38
38	0	0	0	0	0.03	0.03	0.08	0.13	0.13	0.11	0.13	0.11	0.08	0.03	0	0.08	0.03	0.03	0	0.03	38
39	0	0	0	0	0	0.04	0.04	0	0.19	0.04	0.11	0.07	0.15	0.11	0.07	0.07	0.04	0.07	0	0	27
40	0	0	0	0	0	0	0	0	0	0.10	0.10	0	0.25	0.05	0.05	0.15	0.10	0.15	0.05	0	20
41	0	0	0	0	0	0	0	0	0.06	0	0.13	0.13	0.38	0	0.06	0.06	0.06	0	0	0.13	16
42	0	0	0	0	0	0	0	0	0.10	0.10	0	0	0.30	0	0.20	0.10	0	0.10	0	0.10	10
43	0	0	0	0	0	0	0	0	0	0	0.11	0.11	0.11	0	0	0	0.11	0.33	0	0.22	9
44	0	0	0	0	0	0	0	0	0	0	0.20	0	0	0.20	0	0	0	0.20	0.40	0	5
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.50	0.50	0	0	4
46	0	0	0	0	0	0	0	0	0	0	0.17	0.33	0	0.17	0	0	0.17	0	0	0.17	6
47	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	1
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0	0	0	0.67	3
49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.50	0	0	0.50	2
50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0.25	0.25	0	0	0.25	4
51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	0	0
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																					1029

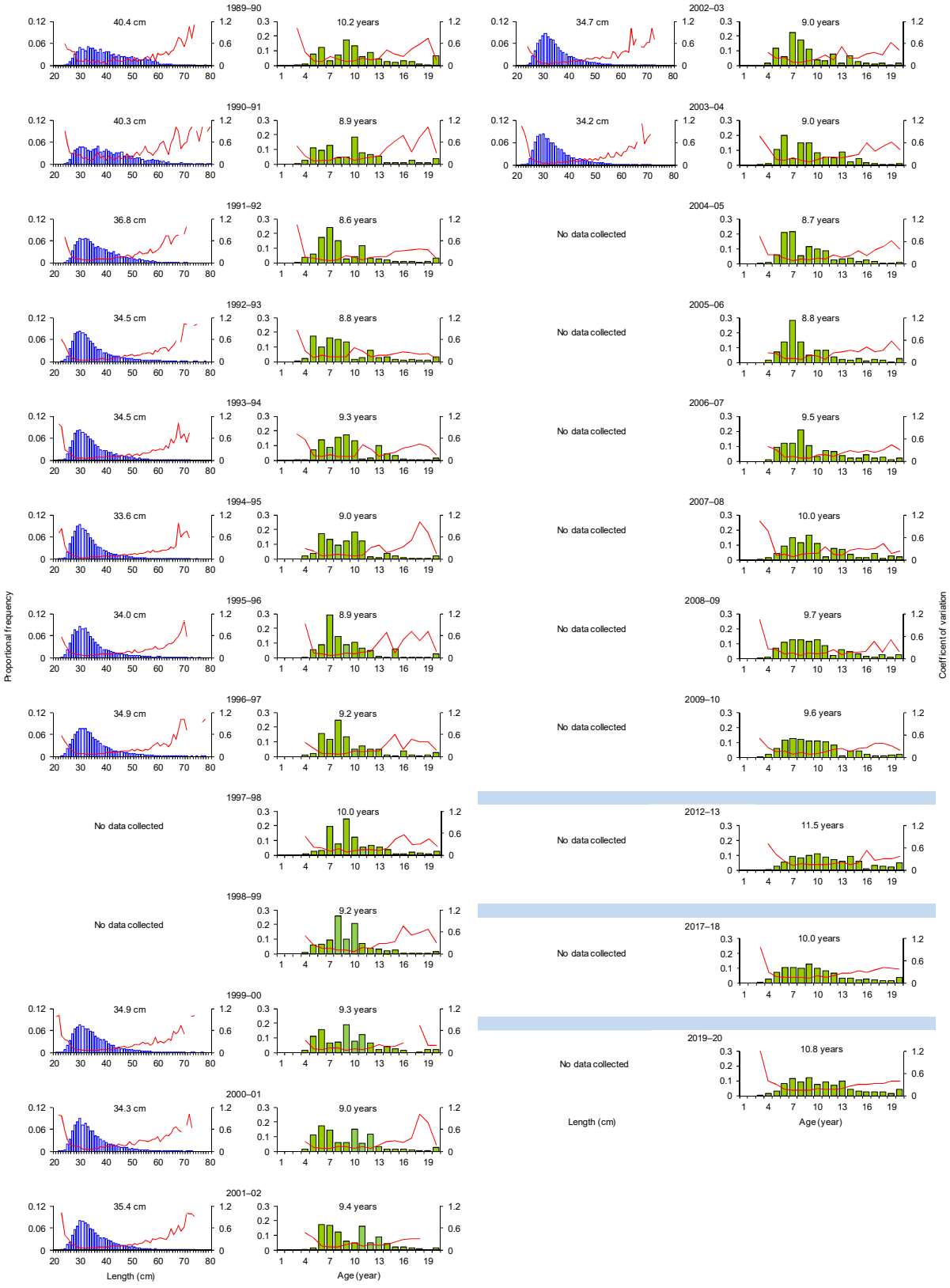
Appendix 5: Time series of proportion at length and age distributions for the snapper bottom longline fisheries in SNA 1. Length frequency sampling was not conducted after 2003–04.

Proportion at length and age distributions and CVs for snapper from the East Northland bottom longline fishery, 1993–94 to 2019–20. Data are from spring-summer up until 2002–03 and year-round thereafter. Plots are annotated with estimates of mean length and/or mean age. The blue line indicates a break in the continuous time series of data.



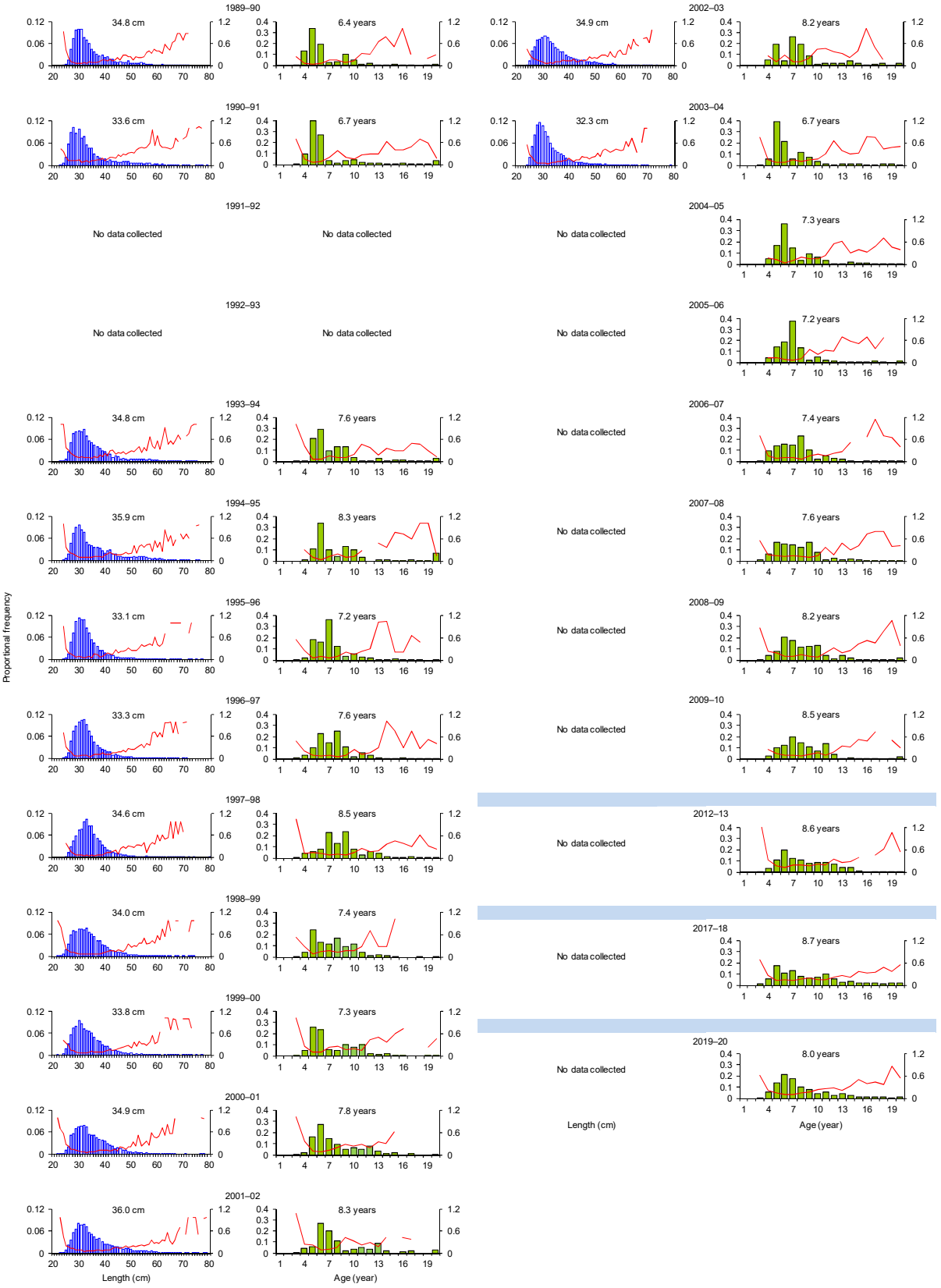
Appendix 5 – continued:

Proportion at length and age distributions and CVs for snapper from the Hauraki Gulf bottom longline fishery, 1989–90 to 2019–20. Data are from spring-summer up until 2002–03 and year-round thereafter. Plots are annotated with estimates of mean length and/or mean age. The blue line indicates a break in the continuous time series of data.



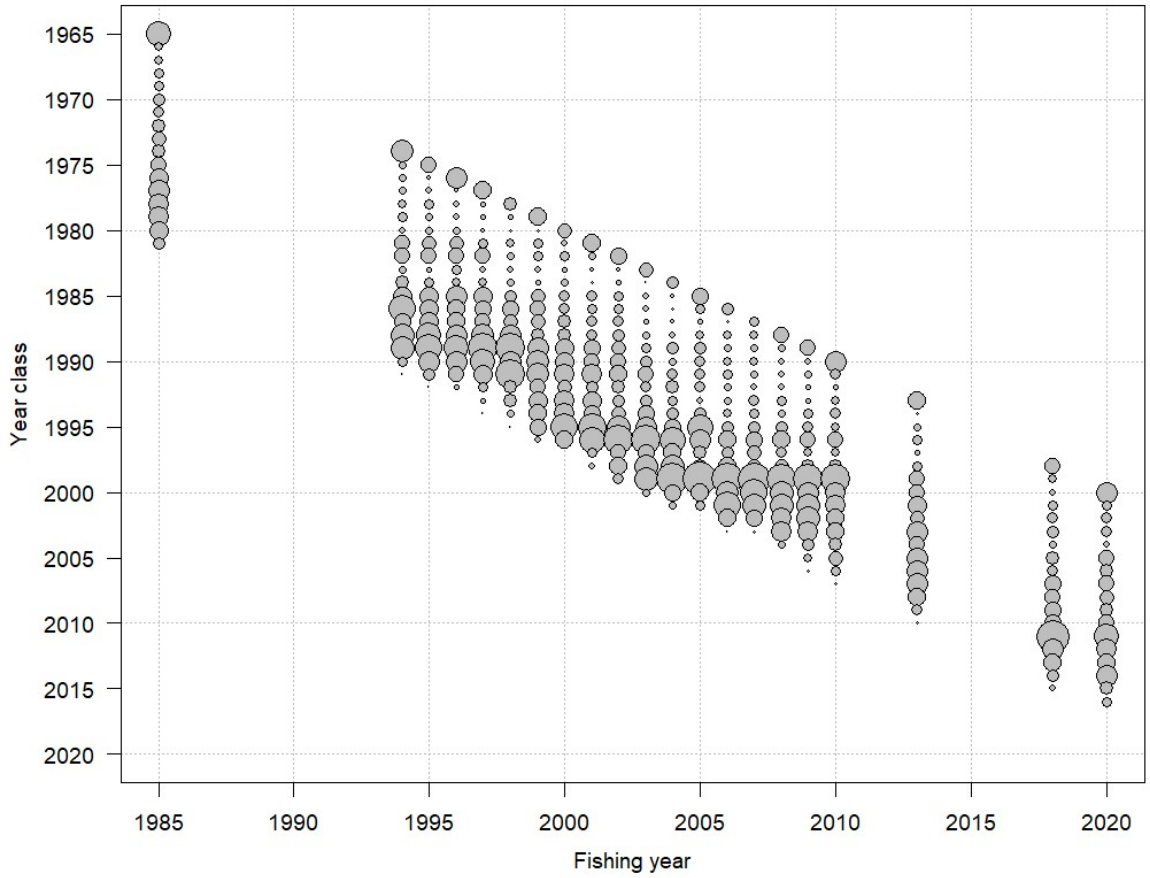
Appendix 5 – continued:

Proportion at length and age distributions and CVs for snapper from the Bay of Plenty bottom longline fishery, 1989–90 to 2019–20. Data are from spring-summer up until 2002–03 and year-round thereafter. Plots are annotated with estimates of mean length and/or mean age. The blue line indicates a break in the continuous time series of data.

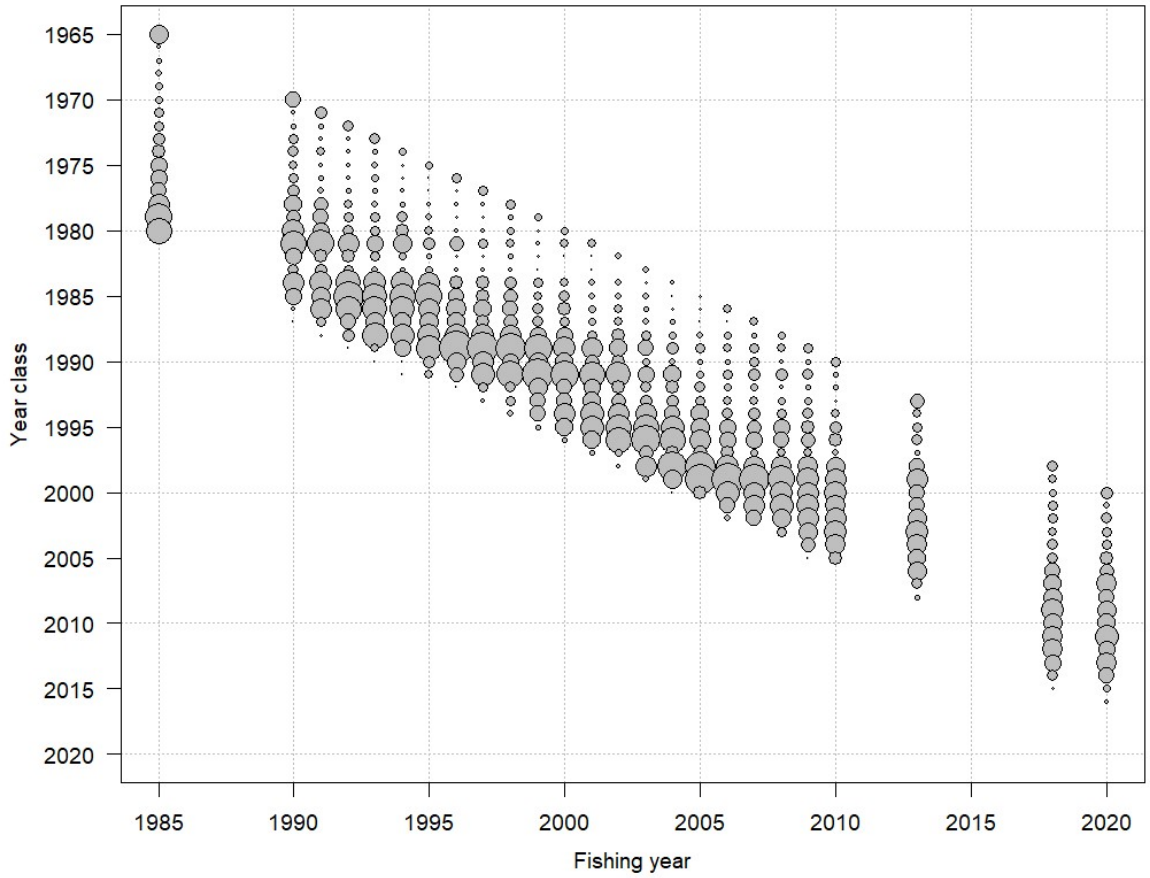


Appendix 6: Time series of age frequency distributions by year class and year from the SNA 1 bottom longline fisheries.

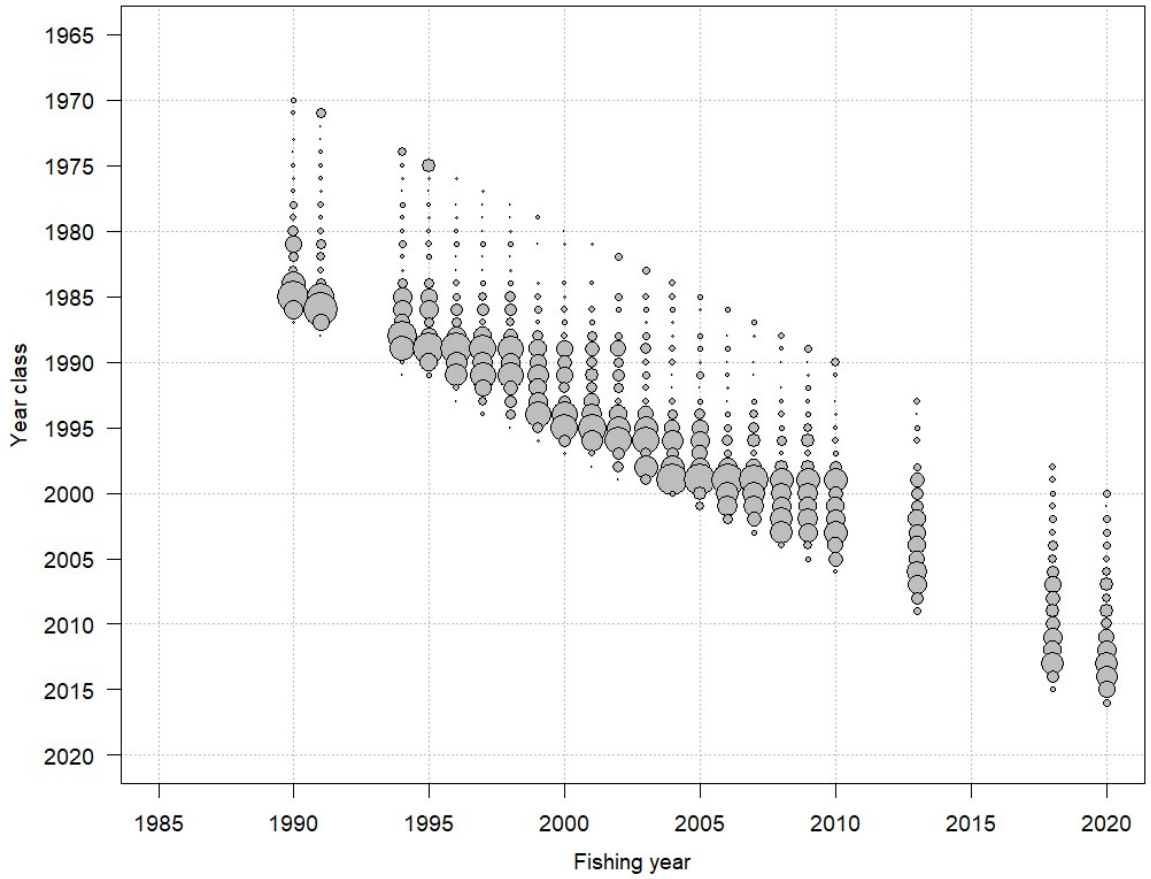
Time series of age frequency distributions by year class and year from the East Northland bottom longline spring-summer fishery, 1984–85 to 2019–20. Symbol area is proportional to the proportion at age. The proportion of the oldest year class in each year is represented by an aggregate (over 19 years) age group.



Appendix 6 – continued:
Time series of age frequency distributions by year class and year from the Hauraki Gulf bottom longline spring-summer fishery, 1984–85 to 2019–20. Symbol area is proportional to the proportion at age. The proportion of the oldest year class in each year is represented by an aggregate (over 19 years) age group.



Appendix 6 – continued:
Time series of age frequency distributions by year class and year from the Bay of Plenty bottom longline spring-summer fishery, 1989–90 to 2019–20. Symbol area is proportional to the proportion at age. The proportion of the oldest year class in each year is represented by an aggregate (over 19 years) age group.



Appendix 7: Estimated mean weight-at-age (kg) and coefficients of variation (CVs) for snapper bottom longline fisheries in SNA 1 in 2019–20.

Estimates of mean weight-at-age (kg) with coefficients of variation for snapper from the East Northland bottom longline fishery in 2019–20.

Age	Spring		Summer		Autumn		Winter		Spr-win	
(years)	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–	–	–	–	–
2	–	–	–	–	–	–	0.54	0.99	0.54	0.99
3	–	–	–	–	0.52	0.13	0.50	0.17	0.51	0.09
4	0.58	0.24	0.46	0.24	0.52	0.14	0.47	0.07	0.49	0.06
5	0.65	0.17	0.60	0.24	0.54	0.09	0.54	0.08	0.56	0.05
6	0.77	0.19	0.52	0.10	0.59	0.06	0.60	0.08	0.59	0.05
7	0.81	0.11	0.68	0.10	0.63	0.10	0.65	0.06	0.67	0.05
8	0.90	0.10	0.68	0.10	0.73	0.08	0.72	0.07	0.73	0.05
9	0.83	0.11	0.76	0.07	0.73	0.07	0.78	0.06	0.77	0.04
10	1.08	0.12	0.88	0.19	0.82	0.19	0.96	0.15	0.93	0.09
11	0.90	0.26	0.95	0.20	0.87	0.08	0.88	0.08	0.90	0.05
12	1.25	0.23	1.02	0.13	1.01	0.16	1.32	0.33	1.10	0.09
13	1.03	0.13	1.13	0.11	1.14	0.16	1.01	0.22	1.10	0.06
14	1.25	0.17	1.15	0.18	0.78	1.04	–	–	1.17	0.12
15	1.08	0.11	1.23	0.13	1.02	0.37	1.30	0.25	1.17	0.06
16	1.85	0.97	1.75	0.39	–	–	–	–	1.76	0.29
17	1.45	0.17	1.36	0.23	1.43	0.56	1.67	0.51	1.44	0.09
18	1.64	0.24	1.51	0.23	1.07	0.57	1.16	0.25	1.45	0.11
19	1.86	0.14	1.60	0.19	3.04	0.76	1.52	0.77	1.85	0.15
20	1.25	0.24	1.86	0.31	1.84	0.63	2.05	0.50	1.71	0.13
21	2.03	0.17	1.69	0.10	1.48	0.81	2.10	0.64	1.83	0.08
22	2.74	0.46	1.97	0.77	1.07	1.01	–	–	2.27	0.34
23	0.96	0.54	2.35	1.01	–	–	–	–	1.50	0.51
24	1.82	0.47	1.55	0.34	1.85	0.99	2.48	1.01	1.74	0.15
25	–	–	2.09	1.02	1.52	0.83	–	–	1.79	0.52
26	2.14	0.51	3.29	0.61	1.74	0.98	–	–	2.58	0.33
27	1.12	0.85	–	–	–	–	–	–	1.12	0.85
28	2.09	0.99	1.57	0.61	1.74	0.98	–	–	1.75	0.27
29	–	–	–	–	–	–	–	–	–	–
>29	2.17	0.58	3.18	0.45	5.21	0.71	1.97	1.03	3.38	0.27

Appendix 7 – continued:
Estimates of mean weight-at-age (kg) with coefficients of variation for snapper from the East Northland (statistical area 002) bottom longline fishery in 2019–20.

Age	Spring		Summer		Autumn		Winter		Spr-win	
(years)	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–	–	–	–	–
2	–	–	–	–	–	–	0.54	0.99	0.54	0.97
3	–	–	–	–	0.54	0.40	0.71	1.02	0.56	0.30
4	0.65	0.41	0.51	0.32	0.66	0.26	0.48	0.19	0.57	0.10
5	0.65	0.42	0.63	0.29	0.60	0.13	0.59	0.10	0.61	0.07
6	0.92	0.34	0.74	0.22	0.69	0.20	0.60	0.13	0.68	0.09
7	0.92	0.22	0.82	0.15	0.64	0.16	0.68	0.10	0.73	0.09
8	0.95	0.27	0.88	0.10	0.75	0.21	0.68	0.22	0.83	0.07
9	0.88	0.15	0.88	0.12	0.73	0.08	0.82	0.09	0.82	0.06
10	1.07	0.24	1.05	0.43	0.71	0.99	1.10	0.17	1.04	0.08
11	0.81	0.77	1.15	1.03	0.97	0.14	0.98	0.22	0.96	0.07
12	0.96	0.52	1.24	0.23	0.89	0.26	1.43	0.62	1.15	0.12
13	1.24	0.24	1.38	0.12	1.14	0.16	0.78	0.99	1.28	0.09
14	1.38	0.30	1.54	0.58	–	–	–	–	1.46	0.19
15	1.07	0.14	1.26	0.24	0.99	0.56	1.23	0.32	1.18	0.09
16	1.85	0.97	2.35	1.03	–	–	–	–	2.16	0.62
17	1.51	0.19	1.36	0.31	1.07	0.77	1.67	0.51	1.43	0.11
18	1.84	0.31	1.21	0.62	1.07	0.57	1.16	0.34	1.47	0.16
19	2.00	0.20	1.51	0.31	3.04	0.76	2.77	1.02	2.00	0.17
20	1.17	0.58	1.86	0.31	1.84	0.63	2.05	0.50	1.79	0.16
21	1.97	0.22	1.67	0.12	1.48	0.81	2.10	0.64	1.78	0.09
22	2.38	0.73	1.97	0.77	1.07	1.01	–	–	1.98	0.38
23	0.96	0.54	2.35	1.01	–	–	–	–	1.60	0.52
24	–	–	1.51	0.52	1.85	0.99	2.48	1.01	1.71	0.31
25	–	–	2.09	1.02	1.52	0.83	–	–	1.84	0.51
26	2.63	1.00	1.86	0.61	1.74	0.98	–	–	2.02	0.32
27	1.12	0.85	–	–	–	–	–	–	1.12	0.91
28	–	–	1.57	0.61	1.74	0.98	–	–	1.62	0.39
29	–	–	–	–	–	–	–	–	–	–
>29	2.13	0.91	2.91	0.50	3.41	1.00	1.97	1.03	2.79	0.23

Appendix 7 – continued:
Estimates of mean weight-at-age (kg) with coefficients of variation for snapper from the East Northland (statistical area 003) bottom longline fishery in 2019–20.

Age	Spring		Summer		Autumn		Winter		Spr-win	
(years)	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–	–	–	–	–
2	–	–	–	–	–	–	–	–	–	–
3	–	–	–	–	0.51	0.19	0.49	0.19	0.50	0.12
4	0.49	0.73	0.36	1.00	0.39	0.06	0.47	0.07	0.44	0.05
5	0.64	0.42	0.44	1.00	0.46	0.08	0.52	0.11	0.51	0.08
6	0.71	0.34	0.48	0.08	0.56	0.05	0.59	0.11	0.56	0.05
7	0.75	0.15	0.56	0.11	0.62	0.10	0.64	0.07	0.63	0.05
8	0.86	0.11	0.59	0.12	0.72	0.11	0.73	0.08	0.71	0.05
9	0.80	0.16	0.70	0.07	0.73	0.10	0.76	0.09	0.74	0.05
10	1.09	0.14	0.83	0.29	0.85	0.25	0.91	0.21	0.89	0.11
11	0.96	0.41	0.94	0.27	0.78	0.22	0.83	0.21	0.86	0.06
12	1.38	0.26	0.90	0.19	1.12	0.34	1.29	0.49	1.12	0.15
13	0.88	0.13	0.94	0.14	–	–	1.04	0.30	0.95	0.06
14	1.12	0.47	1.04	0.24	0.78	1.04	0.00	0.00	1.03	0.16
15	1.10	0.41	1.20	0.44	1.07	0.97	1.43	1.05	1.19	0.12
16	–	–	1.65	0.51	–	–	–	–	1.65	0.49
17	0.99	1.03	1.33	1.03	1.97	0.99	–	–	1.54	0.45
18	1.26	0.71	1.63	0.38	–	–	1.15	1.05	1.38	0.21
19	1.39	0.60	1.73	0.60	–	–	1.07	1.02	1.37	0.26
20	1.33	0.44	–	–	–	–	–	–	1.33	0.42
21	2.15	0.77	1.74	1.01	–	–	–	–	1.98	0.46
22	3.16	0.74	–	–	–	–	–	–	3.16	0.77
23	–	–	–	–	–	–	–	–	–	–
24	1.82	0.47	1.63	0.98	–	–	–	–	1.74	0.32
25	–	–	–	–	–	–	–	–	–	–
26	1.89	0.83	5.40	1.04	–	–	–	–	3.04	0.67
27	–	–	–	–	–	–	–	–	–	–
28	2.09	0.99	–	–	–	–	–	–	2.09	1.00
29	–	–	–	–	–	–	–	–	–	–
>29	2.22	1.02	3.44	0.84	7.71	1.02	–	–	4.61	0.51

Appendix 7 – continued:
Estimates of mean weight-at-age (kg) with coefficients of variation for snapper from the Hauraki Gulf bottom longline fishery in 2019–20.

Age	Spring		Summer		Autumn		Winter		Spr-win	
(years)	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–	–	–	–	–
2	–	–	–	–	–	–	–	–	–	–
3	–	–	–	–	–	–	0.36	0.78	0.36	0.78
4	0.45	0.57	–	–	0.45	0.07	0.45	0.28	0.45	0.05
5	0.55	0.23	0.66	0.86	0.48	0.08	0.48	0.12	0.51	0.08
6	0.46	0.07	0.46	0.10	0.65	0.10	0.52	0.06	0.51	0.04
7	0.58	0.08	0.61	0.06	0.67	0.09	0.61	0.07	0.61	0.04
8	0.66	0.09	0.58	0.09	0.65	0.13	0.66	0.08	0.64	0.05
9	0.71	0.07	0.64	0.06	0.75	0.09	0.68	0.09	0.67	0.04
10	0.85	0.14	0.67	0.06	0.75	0.16	0.78	0.10	0.73	0.05
11	0.83	0.13	0.75	0.09	0.73	0.16	0.81	0.09	0.79	0.05
12	0.86	0.07	0.80	0.06	0.73	0.12	0.91	0.06	0.84	0.04
13	0.94	0.08	0.83	0.06	0.87	0.25	0.98	0.10	0.90	0.04
14	1.11	0.20	0.78	0.08	0.88	0.21	1.00	0.30	0.91	0.09
15	1.24	0.29	0.97	0.10	0.91	0.76	1.20	0.35	1.05	0.10
16	1.41	0.18	0.95	0.22	0.77	0.46	1.17	0.34	1.09	0.14
17	1.69	0.17	0.99	0.27	1.05	0.29	1.03	0.39	1.20	0.12
18	1.48	0.26	1.28	0.18	1.16	0.85	1.89	0.29	1.51	0.15
19	1.47	0.21	1.46	0.51	0.75	0.58	1.62	0.25	1.34	0.14
20	3.94	1.02	1.66	0.34	1.24	0.96	1.52	0.51	1.85	0.25
21	2.30	0.38	0.82	0.49	1.60	0.63	1.47	0.82	1.62	0.25
22	–	–	1.16	0.67	0.87	0.76	1.63	0.94	1.22	0.32
23	–	–	1.97	1.08	–	–	–	–	1.97	1.08
24	–	–	1.07	1.08	2.92	1.01	1.53	0.55	1.60	0.37
25	–	–	–	–	–	–	1.97	1.05	1.97	1.05
26	–	–	–	–	–	–	2.78	0.61	2.78	0.61
27	–	–	–	–	–	–	–	–	–	–
28	–	–	–	–	2.63	0.99	–	–	2.63	0.99
29	–	–	–	–	–	–	–	–	–	–
>29	2.92	1.06	1.33	1.01	–	–	–	–	1.65	0.76

Appendix 7 – continued:
Estimates of mean weight-at-age (kg) with coefficients of variation for snapper from the Bay of Plenty bottom longline fishery in 2019–20.

Age	Spring		Summer		Autumn		Winter		Spr-win	
(years)	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–	–	–	–	–
2	–	–	–	–	–	–	–	–	–	–
3	–	–	–	–	0.54	1.04	0.53	0.29	0.53	0.21
4	0.42	0.58	0.41	0.45	0.54	0.05	0.46	0.06	0.49	0.04
5	0.55	0.13	0.51	0.05	0.61	0.05	0.56	0.06	0.57	0.03
6	0.62	0.05	0.65	0.05	0.74	0.05	0.68	0.07	0.69	0.03
7	0.71	0.07	0.71	0.06	0.76	0.06	0.71	0.09	0.72	0.04
8	0.80	0.09	0.77	0.06	0.83	0.07	0.75	0.08	0.79	0.04
9	0.87	0.12	0.81	0.08	0.80	0.08	0.92	0.11	0.84	0.05
10	1.01	0.12	0.90	0.09	0.94	0.22	0.91	0.08	0.92	0.07
11	1.11	0.12	0.92	0.08	0.87	0.10	1.31	0.19	0.98	0.07
12	0.90	0.24	0.83	0.19	1.04	0.12	1.21	0.16	1.01	0.07
13	1.17	0.10	1.12	0.12	1.10	0.12	1.10	0.09	1.13	0.05
14	0.94	0.61	1.08	0.19	1.08	0.18	1.15	0.26	1.08	0.09
15	1.40	0.36	1.33	0.38	1.41	0.60	–	–	1.36	0.18
16	1.37	0.20	1.67	0.53	1.05	0.25	1.43	1.00	1.33	0.11
17	1.33	0.26	1.46	0.29	1.71	0.36	–	–	1.50	0.15
18	1.43	0.11	1.75	0.22	1.31	0.59	–	–	1.53	0.06
19	1.48	0.58	–	–	1.74	1.05	–	–	1.58	0.37
20	1.79	0.61	2.63	1.01	–	–	–	–	2.04	0.42
21	2.10	0.32	1.80	0.80	1.15	1.00	–	–	1.90	0.21
22	2.48	1.02	–	–	–	–	–	–	2.48	1.02
23	–	–	–	–	–	–	–	–	–	–
24	–	–	–	–	–	–	–	–	–	–
25	–	–	2.35	1.02	–	–	–	–	2.35	1.02
26	–	–	–	–	–	–	–	–	–	–
27	–	–	–	–	–	–	–	–	–	–
28	–	–	–	–	–	–	–	–	–	–
29	–	–	–	–	–	–	–	–	–	–
>29	–	–	–	–	3.58	1.04	–	–	3.58	1.04

Appendix 8: Estimated mean length-at-age (cm) and coefficients of variation (CVs) for snapper bottom longline fisheries in SNA 1 in 2019–20.

Estimates of mean length-at-age (cm) with coefficients of variation for snapper from the East Northland bottom longline fishery in 2019–20.

Age	Spring		Summer		Autumn		Winter		Spr-win	
(years)	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–	–	–	–	–
2	–	–	–	–	–	–	29.00	0.99	29.00	0.99
3	–	–	–	–	28.44	0.06	28.08	0.10	28.28	0.03
4	29.53	0.21	27.16	0.20	28.07	0.05	27.44	0.02	27.83	0.02
5	30.71	0.15	29.86	0.15	28.70	0.03	28.83	0.03	29.18	0.02
6	32.35	0.07	28.35	0.03	29.59	0.02	29.67	0.03	29.47	0.02
7	33.22	0.04	31.13	0.03	30.36	0.04	30.81	0.02	31.00	0.02
8	34.43	0.04	31.06	0.04	32.15	0.03	31.91	0.02	31.95	0.02
9	33.41	0.04	32.54	0.02	32.09	0.02	32.82	0.02	32.58	0.01
10	36.82	0.04	33.95	0.08	33.57	0.16	35.25	0.05	34.73	0.03
11	34.51	0.21	35.17	0.15	34.16	0.03	34.44	0.06	34.61	0.02
12	38.19	0.09	36.03	0.05	36.01	0.08	38.73	0.16	36.78	0.03
13	36.08	0.04	37.37	0.04	37.66	0.09	36.18	0.21	37.00	0.02
14	38.75	0.07	37.43	0.08	33.00	1.04	–	–	37.68	0.04
15	36.87	0.04	38.64	0.08	36.27	0.36	39.53	0.22	37.97	0.02
16	45.00	0.97	43.85	0.34	–	–	–	–	43.96	0.24
17	40.76	0.08	40.08	0.17	40.64	0.50	42.82	0.44	40.73	0.03
18	41.80	0.12	41.51	0.12	36.90	0.56	37.98	0.24	40.52	0.04
19	44.81	0.08	42.52	0.16	50.02	0.49	40.96	0.64	43.93	0.04
20	38.75	0.16	44.30	0.23	44.27	0.55	46.33	0.46	43.02	0.05
21	45.77	0.09	43.38	0.05	41.50	0.81	46.35	0.56	44.36	0.03
22	50.02	0.28	46.00	0.77	37.00	1.01	–	–	47.00	0.16
23	35.55	0.54	49.00	1.01	–	–	–	–	40.78	0.37
24	44.67	0.45	41.68	0.21	45.00	0.99	50.00	1.01	43.56	0.07
25	–	–	47.00	1.02	41.50	0.79	–	–	44.14	0.49
26	47.06	0.48	53.41	0.42	44.00	0.98	–	–	49.35	0.15
27	37.00	0.80	–	–	–	–	–	–	37.00	0.80
28	47.00	0.99	42.13	0.57	44.00	0.98	–	–	43.90	0.24
29	–	–	–	–	–	–	–	–	–	–
>29	46.55	0.50	52.87	0.24	63.95	0.61	46.00	1.03	53.82	0.10

Appendix 8 – continued:
Estimates of mean length-at-age (cm) with coefficients of variation for snapper from the East Northland (statistical area 002) bottom longline fishery in 2019–20.

Age	Spring		Summer		Autumn		Winter		Spr-win	
(years)	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–	–	–	–	–
2	–	–	–	–	–	–	29.00	0.99	29.00	0.97
3	–	–	–	–	28.85	0.38	32.00	1.02	29.20	0.26
4	30.73	0.40	28.28	0.29	30.77	0.20	27.46	0.10	29.19	0.03
5	30.83	0.40	30.29	0.19	29.82	0.05	29.81	0.03	30.10	0.03
6	33.95	0.14	32.23	0.20	30.93	0.07	29.81	0.04	30.93	0.03
7	34.77	0.15	33.27	0.08	30.42	0.06	31.18	0.03	31.93	0.03
8	35.01	0.20	34.40	0.07	32.53	0.19	31.23	0.15	33.47	0.02
9	34.07	0.05	34.22	0.04	32.12	0.03	33.50	0.03	33.36	0.02
10	36.58	0.15	36.65	0.42	32.00	0.99	37.12	0.11	36.42	0.03
11	33.33	0.76	38.00	1.03	35.55	0.11	35.77	0.21	35.39	0.02
12	34.95	0.40	38.76	0.14	34.63	0.26	40.46	0.54	37.61	0.04
13	38.49	0.13	40.28	0.04	37.66	0.09	33.00	0.99	39.08	0.03
14	40.19	0.24	42.01	0.56	–	–	–	–	41.14	0.13
15	36.71	0.05	39.05	0.20	35.85	0.55	38.62	0.29	38.01	0.03
16	45.00	0.97	49.00	1.03	–	–	–	–	47.48	0.61
17	41.35	0.11	40.10	0.24	37.00	0.77	42.82	0.44	40.63	0.04
18	43.30	0.17	38.38	0.56	36.90	0.56	37.96	0.32	40.34	0.06
19	46.11	0.17	41.71	0.29	50.02	0.49	52.00	1.02	45.19	0.05
20	37.55	0.47	44.30	0.23	44.27	0.55	46.33	0.46	43.63	0.06
21	45.18	0.13	43.21	0.07	41.50	0.81	46.35	0.56	43.91	0.04
22	47.78	0.58	46.00	0.77	37.00	1.01	–	–	45.31	0.23
23	35.55	0.54	49.00	1.01	–	–	–	–	41.71	0.37
24	–	–	40.87	0.35	45.00	0.99	50.00	1.01	42.94	0.19
25	–	–	47.00	1.02	41.50	0.79	–	–	44.60	0.48
26	51.00	1.00	44.87	0.58	44.00	0.98	–	–	46.15	0.28
27	37.00	0.80	–	–	–	–	–	–	37.00	0.86
28	–	–	42.13	0.57	44.00	0.98	–	–	42.69	0.36
29	–	–	–	–	–	–	–	–	–	–
>29	45.00	0.78	52.46	0.45	56.00	1.00	46.00	1.03	51.42	0.15

Appendix 8 – continued:
Estimates of mean length-at-age (cm) with coefficients of variation for snapper from the East Northland (statistical area 003) bottom longline fishery in 2019–20.

Age	Spring		Summer		Autumn		Winter		Spr-win	
(years)	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–	–	–	–	–
2	–	–	–	–	–	–	–	–	–	–
3	–	–	–	–	28.13	0.11	27.80	0.14	27.96	0.05
4	28.00	0.73	25.00	1.00	25.82	0.04	27.43	0.02	26.85	0.02
5	30.59	0.41	27.00	1.00	27.23	0.04	28.40	0.04	28.21	0.03
6	31.72	0.30	27.58	0.03	29.13	0.02	29.58	0.04	29.09	0.02
7	32.25	0.05	29.25	0.08	30.26	0.05	30.65	0.02	30.44	0.02
8	34.07	0.04	29.67	0.05	31.94	0.04	32.09	0.03	31.62	0.02
9	32.92	0.05	31.59	0.02	32.05	0.04	32.42	0.05	32.13	0.02
10	37.05	0.07	33.10	0.16	33.93	0.23	34.52	0.11	34.20	0.04
11	35.25	0.36	35.05	0.23	32.97	0.22	33.72	0.20	34.09	0.02
12	39.71	0.12	34.53	0.12	37.22	0.26	38.31	0.31	36.85	0.05
13	34.34	0.11	35.11	0.06	–	–	36.59	0.30	35.32	0.02
14	37.32	0.40	36.17	0.12	33.00	1.04	–	–	36.16	0.07
15	37.25	0.40	38.22	0.42	37.00	0.97	41.00	1.05	38.20	0.09
16	–	–	43.01	0.47	–	–	–	–	43.01	0.45
17	36.00	1.03	40.00	1.03	46.00	0.99	–	–	41.77	0.40
18	39.00	0.70	42.68	0.30	–	–	38.00	1.05	40.23	0.13
19	40.42	0.57	43.68	0.57	–	–	37.00	1.02	40.09	0.20
20	40.00	0.44	–	–	–	–	–	–	40.00	0.42
21	47.00	0.74	44.00	1.01	–	–	–	–	45.78	0.43
22	52.68	0.57	–	–	–	–	–	–	52.68	0.60
23	–	–	–	–	–	–	–	–	–	–
24	44.67	0.45	43.00	0.98	–	–	–	–	43.94	0.30
25	–	–	–	–	–	–	–	–	–	–
26	45.00	0.80	66.00	1.04	–	–	–	–	51.88	0.50
27	–	–	–	–	–	–	–	–	–	–
28	47.00	0.99	–	–	–	–	–	–	47.00	1.00
29	–	–	–	–	–	–	–	–	–	–
>29	48.00	1.02	53.27	0.61	75.00	1.02	–	–	59.41	0.30

Appendix 8 – continued:
Estimates of mean length-at-age (cm) with coefficients of variation for snapper from the Hauraki Gulf bottom longline fishery in 2019–20.

Age	Spring		Summer		Autumn		Winter		Spr-win	
(years)	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–	–	–	–	–
2	–	–	–	–	–	–	–	–	–	–
3	–	–	–	–	–	–	25.00	0.78	25.00	0.78
4	27.01	0.56	–	–	26.99	0.03	27.06	0.27	27.03	0.02
5	28.74	0.07	31.00	0.84	27.67	0.05	27.68	0.05	28.13	0.03
6	27.30	0.02	27.26	0.05	30.62	0.04	28.51	0.02	28.26	0.01
7	29.41	0.03	30.04	0.02	30.99	0.03	30.15	0.02	30.04	0.01
8	30.78	0.03	29.56	0.03	30.41	0.05	30.91	0.03	30.54	0.02
9	31.68	0.02	30.53	0.02	32.20	0.03	31.18	0.03	31.02	0.02
10	33.58	0.05	31.09	0.02	32.03	0.06	32.75	0.03	31.88	0.02
11	33.24	0.04	32.32	0.03	31.80	0.05	33.15	0.03	32.76	0.02
12	33.95	0.03	33.06	0.02	31.91	0.04	34.76	0.02	33.62	0.01
13	34.99	0.03	33.56	0.02	33.44	0.09	35.44	0.03	34.47	0.02
14	37.14	0.08	32.88	0.06	34.03	0.11	35.18	0.15	34.50	0.03
15	38.47	0.15	35.42	0.03	33.39	0.54	37.93	0.24	36.31	0.03
16	40.07	0.07	35.39	0.21	32.36	0.22	37.19	0.14	36.40	0.05
17	42.90	0.09	35.69	0.21	36.17	0.22	36.06	0.32	37.83	0.04
18	40.88	0.13	38.96	0.08	38.00	0.84	44.41	0.14	41.01	0.05
19	41.00	0.11	41.10	0.50	32.40	0.52	42.51	0.20	39.34	0.05
20	59.00	1.02	42.28	0.19	39.00	0.96	40.86	0.40	43.63	0.11
21	47.47	0.22	33.60	0.48	42.65	0.62	41.00	0.80	41.62	0.09
22	–	–	37.63	0.61	33.64	0.55	42.00	0.86	37.75	0.19
23	–	–	46.00	1.08	–	–	–	–	46.00	1.08
24	–	–	37.00	1.08	53.00	1.01	42.00	0.55	42.18	0.26
25	–	–	–	–	–	–	46.00	1.05	46.00	1.05
26	–	–	–	–	–	–	51.81	0.58	51.81	0.58
27	–	–	–	–	–	–	–	–	–	–
28	–	–	–	–	51.00	0.99	–	–	51.00	0.99
29	–	–	–	–	–	–	–	–	–	–
>29	53.00	1.06	40.00	1.01	–	–	–	–	42.56	0.66

Appendix 8 – continued:
Estimates of mean length-at-age (cm) with coefficients of variation for snapper from the Bay of Plenty bottom longline fishery in 2019–20.

Age	Spring		Summer		Autumn		Winter		Spr-win	
(years)	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–	–	–	–	–
2	–	–	–	–	–	–	–	–	–	–
3	–	–	–	–	29.00	1.04	28.70	0.28	28.73	0.19
4	26.26	0.49	26.19	0.44	28.90	0.02	27.36	0.02	27.85	0.02
5	29.03	0.06	28.38	0.02	30.00	0.02	29.13	0.02	29.27	0.01
6	30.33	0.02	30.78	0.02	32.19	0.02	31.11	0.03	31.37	0.01
7	31.65	0.02	31.71	0.02	32.55	0.02	31.71	0.03	31.95	0.01
8	33.16	0.03	32.76	0.02	33.61	0.03	32.42	0.03	32.99	0.01
9	34.07	0.04	33.31	0.03	33.08	0.03	34.71	0.04	33.70	0.02
10	36.11	0.10	34.57	0.03	34.73	0.10	34.75	0.03	34.83	0.02
11	37.32	0.06	34.81	0.03	34.14	0.05	39.39	0.11	35.57	0.02
12	34.44	0.15	33.75	0.17	36.48	0.07	38.40	0.09	35.99	0.02
13	37.98	0.04	37.39	0.07	37.14	0.08	37.27	0.03	37.46	0.02
14	35.26	0.61	36.71	0.07	36.82	0.07	37.95	0.25	36.85	0.03
15	40.65	0.35	39.14	0.24	40.65	0.55	–	–	39.78	0.06
16	40.21	0.13	42.75	0.46	36.69	0.23	41.00	1.00	39.66	0.04
17	39.75	0.22	40.70	0.16	43.28	0.31	–	–	41.12	0.05
18	40.96	0.08	44.04	0.22	39.72	0.58	–	–	41.88	0.02
19	41.45	0.57	–	–	44.00	1.05	–	–	42.45	0.36
20	44.26	0.59	51.00	1.01	–	–	–	–	46.31	0.38
21	46.29	0.22	44.50	0.79	38.00	1.00	–	–	44.81	0.11
22	50.00	1.02	–	–	–	–	–	–	50.00	1.02
23	–	–	–	–	–	–	–	–	–	–
24	–	–	–	–	–	–	–	–	–	–
25	–	–	49.00	1.02	–	–	–	–	49.00	1.02
26	–	–	–	–	–	–	–	–	–	–
27	–	–	–	–	–	–	–	–	–	–
28	–	–	–	–	–	–	–	–	–	–
29	–	–	–	–	–	–	–	–	–	–
>29	–	–	–	–	57.00	1.04	–	–	57.00	1.04

Appendix 9: Estimated seasonal proportion at length and coefficients of variation (CVs) for snapper power method fisheries in SNA 1 in 2019–20.

Estimates of proportion at length with CVs (bootstrap estimates) for snapper from the East Northland bottom trawl fishery in 2019–20.

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

Length	Spring-summer		Autumn-winter		Spring-winter	
(cm)	*P.j.*	CV	*P.j.*	CV	*P.j.*	CV
20	–	–	0.0000	0.00	–	–
21	–	–	0.0000	0.00	–	–
22	–	–	0.0000	0.00	–	–
23	–	–	0.0000	0.00	–	–
24	–	–	0.0000	0.00	–	–
25	–	–	0.0032	0.89	–	–
26	–	–	0.0089	0.65	–	–
27	–	–	0.0222	0.55	–	–
28	–	–	0.0557	0.39	–	–
29	–	–	0.0740	0.46	–	–
30	–	–	0.0976	0.28	–	–
31	–	–	0.0786	0.46	–	–
32	–	–	0.0595	0.33	–	–
33	–	–	0.0428	0.29	–	–
34	–	–	0.0512	0.23	–	–
35	–	–	0.0464	0.23	–	–
36	–	–	0.0364	0.19	–	–
37	–	–	0.0584	0.40	–	–
38	–	–	0.0612	0.47	–	–
39	–	–	0.0751	0.65	–	–
40	–	–	0.0641	0.59	–	–
41	–	–	0.0566	0.58	–	–
42	–	–	0.0383	0.71	–	–
43	–	–	0.0246	0.54	–	–
44	–	–	0.0261	0.58	–	–
45	–	–	0.0072	0.54	–	–
46	–	–	0.0036	1.01	–	–
47	–	–	0.0040	0.54	–	–
48	–	–	0.0025	0.84	–	–
49	–	–	0.0000	0.00	–	–
50	–	–	0.0000	0.00	–	–
51	–	–	0.0000	0.00	–	–
52	–	–	0.0000	0.00	–	–
53	–	–	0.0000	0.00	–	–
54	–	–	0.0018	1.28	–	–
55	–	–	0.0000	0.00	–	–
56	–	–	0.0000	0.00	–	–
57	–	–	0.0000	0.00	–	–
58	–	–	0.0000	0.00	–	–
59	–	–	0.0000	0.00	–	–
60	–	–	0.0000	0.00	–	–
61	–	–	0.0000	0.00	–	–
62	–	–	0.0000	0.00	–	–
63	–	–	0.0000	0.00	–	–
64	–	–	0.0000	0.00	–	–
65	–	–	0.0000	0.00	–	–
66	–	–	0.0000	0.00	–	–
67	–	–	0.0000	0.00	–	–
68	–	–	0.0000	0.00	–	–
69	–	–	0.0000	0.00	–	–
70	–	–	0.0000	0.00	–	–
71	–	–	0.0000	0.00	–	–
72	–	–	0.0000	0.00	–	–
73	–	–	0.0000	0.00	–	–
74	–	–	0.0000	0.00	–	–
75	–	–	0.0000	0.00	–	–
76	–	–	0.0000	0.00	–	–
77	–	–	0.0000	0.00	–	–
78	–	–	0.0000	0.00	–	–
79	–	–	0.0000	0.00	–	–
80	–	–	0.0000	0.00	–	–
Nt	–	–	103 248		–	–
n	–	–	1 238		–	–

Appendix 9 – continued:
Estimates of proportion at length with CVs (bootstrap estimates) for snapper from the Bay of Plenty bottom trawl fishery in 2019–20.

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

Length	Spring-summer		Autumn-winter		Spring-winter	
(cm)	*P.j.*	CV	*P.j.*	CV	*P.j.*	CV
20	0.0000	0.00	0.0000	0.00	0.0000	0.00
21	0.0000	0.00	0.0000	0.00	0.0000	0.00
22	0.0000	0.00	0.0003	1.38	0.0002	1.43
23	0.0000	0.00	0.0000	0.00	0.0000	0.00
24	0.0046	0.55	0.0027	0.68	0.0034	0.45
25	0.0377	0.27	0.0133	0.44	0.0226	0.24
26	0.0742	0.23	0.0375	0.25	0.0515	0.17
27	0.0917	0.19	0.0508	0.15	0.0664	0.12
28	0.0821	0.19	0.0736	0.13	0.0769	0.11
29	0.0841	0.13	0.0951	0.12	0.0909	0.09
30	0.0820	0.12	0.0936	0.09	0.0892	0.07
31	0.0701	0.12	0.0839	0.10	0.0787	0.08
32	0.0700	0.13	0.0870	0.09	0.0805	0.08
33	0.0688	0.14	0.0785	0.12	0.0748	0.09
34	0.0624	0.18	0.0884	0.12	0.0785	0.10
35	0.0572	0.15	0.0712	0.12	0.0659	0.09
36	0.0427	0.18	0.0574	0.11	0.0518	0.09
37	0.0377	0.18	0.0405	0.10	0.0394	0.09
38	0.0363	0.20	0.0272	0.16	0.0307	0.12
39	0.0259	0.18	0.0219	0.16	0.0234	0.12
40	0.0175	0.18	0.0152	0.23	0.0161	0.16
41	0.0087	0.29	0.0135	0.18	0.0117	0.15
42	0.0090	0.31	0.0096	0.23	0.0094	0.19
43	0.0067	0.30	0.0082	0.23	0.0076	0.18
44	0.0064	0.33	0.0064	0.28	0.0064	0.21
45	0.0044	0.52	0.0040	0.47	0.0041	0.36
46	0.0028	0.52	0.0026	0.44	0.0026	0.32
47	0.0026	0.49	0.0041	0.29	0.0035	0.25
48	0.0018	0.56	0.0029	0.42	0.0025	0.33
49	0.0023	0.54	0.0014	0.48	0.0017	0.35
50	0.0023	0.58	0.0021	0.43	0.0022	0.36
51	0.0016	0.68	0.0004	1.10	0.0009	0.59
52	0.0016	0.69	0.0011	0.58	0.0013	0.44
53	0.0006	0.87	0.0016	0.89	0.0012	0.72
54	0.0019	0.60	0.0011	0.84	0.0014	0.50
55	0.0000	0.00	0.0002	1.05	0.0001	1.06
56	0.0001	1.49	0.0003	1.39	0.0003	1.13
57	0.0001	1.44	0.0004	1.21	0.0003	1.01
58	0.0001	1.35	0.0003	1.02	0.0002	0.92
59	0.0006	0.87	0.0006	0.93	0.0006	0.65
60	0.0003	1.46	0.0000	0.00	0.0001	1.35
61	0.0000	0.00	0.0004	1.18	0.0003	1.29
62	0.0003	1.08	0.0003	1.02	0.0003	0.75
63	0.0000	0.00	0.0000	0.00	0.0000	0.00
64	0.0002	1.40	0.0000	0.00	0.0001	1.38
65	0.0000	0.00	0.0000	0.00	0.0000	0.00
66	0.0000	0.00	0.0002	1.38	0.0001	1.40
67	0.0003	1.41	0.0000	0.00	0.0001	1.38
68	0.0000	0.00	0.0000	0.00	0.0000	0.00
69	0.0000	0.00	0.0000	0.00	0.0000	0.00
70	0.0000	0.00	0.0000	0.00	0.0000	0.00
71	0.0000	0.00	0.0000	0.00	0.0000	0.00
72	0.0000	0.00	0.0000	0.00	0.0000	0.00
73	0.0000	0.00	0.0000	0.00	0.0000	0.00
74	0.0000	0.00	0.0000	0.00	0.0000	0.00
75	0.0000	0.00	0.0000	0.00	0.0000	0.00
76	0.0000	0.00	0.0000	0.00	0.0000	0.00
77	0.0000	0.00	0.0000	0.00	0.0000	0.00
78	0.0000	0.00	0.0000	0.00	0.0000	0.00
79	0.0000	0.00	0.0000	0.00	0.0000	0.00
80	0.0000	0.00	0.0000	0.00	0.0000	0.00
Nt	343 831		568 858		911 887	
n	4 239		5 714		9 953	

Appendix 9 – continued:
Estimates of proportion at length with CVs (bootstrap estimates) for snapper from the Hauraki Gulf Danish seine fishery in 2019–20.

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

Length	Spring-summer		Autumn-winter		Spring-winter	
(cm)	*P.j.*	CV	*P.j.*	CV	*P.j.*	CV
20	0.0000	0.00	0.0000	0.00	0.0000	0.00
21	0.0000	0.00	0.0000	0.00	0.0000	0.00
22	0.0000	0.00	0.0000	0.00	0.0000	0.00
23	0.0000	0.00	0.0000	0.00	0.0000	0.00
24	0.0000	0.00	0.0002	1.46	0.0001	1.40
25	0.0094	0.41	0.0058	0.40	0.0074	0.29
26	0.0289	0.34	0.0081	0.44	0.0176	0.29
27	0.0492	0.39	0.0153	0.36	0.0309	0.31
28	0.0526	0.36	0.0226	0.32	0.0364	0.27
29	0.0627	0.28	0.0339	0.22	0.0471	0.19
30	0.0551	0.21	0.0405	0.20	0.0472	0.15
31	0.0600	0.15	0.0511	0.14	0.0552	0.10
32	0.0745	0.10	0.0659	0.14	0.0699	0.09
33	0.0810	0.11	0.0835	0.09	0.0823	0.07
34	0.0839	0.15	0.0962	0.07	0.0905	0.08
35	0.0933	0.16	0.1047	0.07	0.0995	0.08
36	0.0790	0.16	0.1019	0.09	0.0914	0.08
37	0.0552	0.17	0.0746	0.10	0.0657	0.09
38	0.0450	0.17	0.0675	0.10	0.0572	0.09
39	0.0334	0.18	0.0501	0.13	0.0425	0.11
40	0.0268	0.20	0.0384	0.12	0.0331	0.10
41	0.0177	0.26	0.0266	0.16	0.0225	0.14
42	0.0133	0.29	0.0234	0.17	0.0188	0.15
43	0.0104	0.35	0.0162	0.19	0.0135	0.17
44	0.0099	0.29	0.0114	0.23	0.0107	0.18
45	0.0081	0.25	0.0087	0.24	0.0084	0.17
46	0.0059	0.29	0.0081	0.31	0.0071	0.22
47	0.0055	0.27	0.0089	0.25	0.0073	0.18
48	0.0036	0.36	0.0060	0.33	0.0049	0.24
49	0.0032	0.39	0.0061	0.37	0.0048	0.28
50	0.0045	0.37	0.0046	0.32	0.0046	0.23
51	0.0042	0.37	0.0026	0.42	0.0033	0.28
52	0.0013	0.56	0.0019	0.44	0.0017	0.34
53	0.0020	0.43	0.0019	0.49	0.0020	0.32
54	0.0026	0.45	0.0019	0.50	0.0022	0.33
55	0.0015	0.54	0.0030	0.41	0.0023	0.33
56	0.0010	0.65	0.0015	0.49	0.0013	0.39
57	0.0016	0.49	0.0007	0.76	0.0011	0.41
58	0.0009	0.70	0.0022	0.47	0.0016	0.38
59	0.0017	0.54	0.0005	0.94	0.0011	0.45
60	0.0013	0.53	0.0004	1.11	0.0008	0.48
61	0.0001	1.46	0.0009	0.72	0.0006	0.66
62	0.0012	0.59	0.0002	1.32	0.0007	0.53
63	0.0009	0.64	0.0002	1.45	0.0005	0.57
64	0.0007	0.78	0.0008	0.71	0.0008	0.54
65	0.0012	0.53	0.0000	0.00	0.0006	0.51
66	0.0013	0.63	0.0000	0.00	0.0006	0.63
67	0.0003	1.02	0.0005	0.86	0.0004	0.67
68	0.0015	0.56	0.0000	0.00	0.0007	0.54
69	0.0009	0.71	0.0004	0.95	0.0006	0.57
70	0.0010	0.71	0.0000	0.00	0.0005	0.71
71	0.0002	1.37	0.0000	0.00	0.0001	1.40
72	0.0000	0.00	0.0000	0.00	0.0000	0.00
73	0.0000	0.00	0.0000	0.00	0.0000	0.00
74	0.0004	0.84	0.0000	0.00	0.0002	0.84
75	0.0000	0.00	0.0000	0.00	0.0000	0.00
76	0.0000	0.00	0.0000	0.00	0.0000	0.00
77	0.0000	0.00	0.0000	0.00	0.0000	0.00
78	0.0000	0.00	0.0000	0.00	0.0000	0.00
79	0.0000	0.00	0.0000	0.00	0.0000	0.00
80	0.0000	0.00	0.0000	0.00	0.0000	0.00
Nt	108 896		128 806		237 618	
n	4 817		4 699		9 516	

Appendix 9 – continued:
Estimates of proportion at length with CVs (bootstrap estimates) for snapper from the Bay of Plenty Danish seine fishery in 2019–20.

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

Length	Spring-summer		Autumn-winter		Spring-winter	
(cm)	*P.j.*	CV	*P.j.*	CV	*P.j.*	CV
20	0.0000	0.00	0.0000	0.00	0.0000	0.00
21	0.0000	0.00	0.0000	0.00	0.0000	0.00
22	0.0000	0.00	0.0000	0.00	0.0000	0.00
23	0.0000	0.00	0.0000	0.00	0.0000	0.00
24	0.0006	0.79	0.0002	1.37	0.0004	0.70
25	0.0090	0.32	0.0049	0.47	0.0066	0.27
26	0.0465	0.23	0.0188	0.23	0.0306	0.18
27	0.0887	0.15	0.0421	0.19	0.0619	0.12
28	0.1036	0.13	0.0855	0.13	0.0932	0.10
29	0.1165	0.11	0.1096	0.10	0.1126	0.07
30	0.1191	0.09	0.1211	0.07	0.1203	0.06
31	0.0931	0.10	0.1074	0.09	0.1013	0.07
32	0.0911	0.09	0.1086	0.10	0.1011	0.07
33	0.0717	0.14	0.0914	0.10	0.0830	0.09
34	0.0669	0.18	0.0730	0.11	0.0704	0.10
35	0.0486	0.15	0.0704	0.09	0.0611	0.08
36	0.0360	0.18	0.0416	0.13	0.0392	0.11
37	0.0293	0.21	0.0249	0.17	0.0268	0.14
38	0.0211	0.25	0.0253	0.16	0.0235	0.14
39	0.0136	0.24	0.0227	0.22	0.0188	0.18
40	0.0111	0.24	0.0151	0.18	0.0134	0.15
41	0.0084	0.22	0.0100	0.27	0.0093	0.19
42	0.0038	0.43	0.0093	0.27	0.0070	0.24
43	0.0066	0.29	0.0047	0.46	0.0055	0.30
44	0.0032	0.38	0.0034	0.42	0.0033	0.30
45	0.0025	0.45	0.0032	0.45	0.0029	0.34
46	0.0016	0.51	0.0013	0.64	0.0014	0.42
47	0.0019	0.59	0.0008	0.78	0.0012	0.46
48	0.0001	1.40	0.0010	0.62	0.0007	0.60
49	0.0008	0.77	0.0008	0.81	0.0008	0.56
50	0.0007	0.71	0.0007	0.92	0.0007	0.61
51	0.0007	0.87	0.0002	1.41	0.0004	0.76
52	0.0012	0.59	0.0004	1.09	0.0007	0.53
53	0.0003	0.97	0.0003	1.42	0.0003	0.93
54	0.0001	1.39	0.0000	0.00	0.0001	1.41
55	0.0001	1.36	0.0000	0.00	0.0001	1.41
56	0.0005	1.06	0.0000	0.00	0.0002	1.07
57	0.0003	1.00	0.0003	1.39	0.0003	0.85
58	0.0000	0.00	0.0000	0.00	0.0000	0.00
59	0.0000	0.00	0.0000	0.00	0.0000	0.00
60	0.0000	0.00	0.0000	0.00	0.0000	0.00
61	0.0000	0.00	0.0000	0.00	0.0000	0.00
62	0.0000	0.00	0.0000	0.00	0.0000	0.00
63	0.0000	0.00	0.0000	0.00	0.0000	0.00
64	0.0000	0.00	0.0003	1.35	0.0002	1.37
65	0.0002	1.34	0.0000	0.00	0.0001	1.39
66	0.0000	0.00	0.0006	1.05	0.0003	1.02
67	0.0000	0.00	0.0000	0.00	0.0000	0.00
68	0.0000	0.00	0.0000	0.00	0.0000	0.00
69	0.0003	1.36	0.0000	0.00	0.0001	1.35
70	0.0000	0.00	0.0000	0.00	0.0000	0.00
71	0.0000	0.00	0.0000	0.00	0.0000	0.00
72	0.0000	0.00	0.0000	0.00	0.0000	0.00
73	0.0000	0.00	0.0000	0.00	0.0000	0.00
74	0.0000	0.00	0.0000	0.00	0.0000	0.00
75	0.0000	0.00	0.0000	0.00	0.0000	0.00
76	0.0000	0.00	0.0000	0.00	0.0000	0.00
77	0.0000	0.00	0.0000	0.00	0.0000	0.00
78	0.0000	0.00	0.0000	0.00	0.0000	0.00
79	0.0000	0.00	0.0000	0.00	0.0000	0.00
80	0.0000	0.00	0.0000	0.00	0.0000	0.00
Nt	170 663		229 780		400 578	
n	4 671		4 574		9 245	

Appendix 9 – continued:
Estimates of proportion at length with CVs (bootstrap estimates) for snapper from the East Northland modular harvest system fishery in 2019–20.

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

Length	Spring-summer		Autumn-winter		Spring-winter	
(cm)	*P.j.*	CV	*P.j.*	CV	*P.j.*	CV
20	0.0000	0.00	0.0000	0.00	0.0000	0.00
21	0.0000	0.00	0.0000	0.00	0.0000	0.00
22	0.0000	0.00	0.0000	0.00	0.0000	0.00
23	0.0002	1.41	0.0000	0.00	0.0000	1.45
24	0.0026	0.43	0.0117	0.78	0.0093	0.69
25	0.0098	0.32	0.0614	0.62	0.0476	0.57
26	0.0222	0.26	0.0562	0.47	0.0471	0.39
27	0.0243	0.17	0.1002	0.48	0.0799	0.44
28	0.0345	0.16	0.0911	0.53	0.0760	0.43
29	0.0362	0.15	0.0651	0.45	0.0574	0.34
30	0.0525	0.15	0.1385	0.47	0.1155	0.39
31	0.0515	0.12	0.0566	0.37	0.0553	0.24
32	0.0640	0.12	0.0837	0.31	0.0785	0.22
33	0.0610	0.10	0.0594	0.41	0.0598	0.24
34	0.0699	0.08	0.0935	0.22	0.0872	0.17
35	0.0642	0.11	0.0300	0.55	0.0391	0.35
36	0.0550	0.11	0.0367	0.55	0.0416	0.36
37	0.0571	0.12	0.0260	0.46	0.0343	0.30
38	0.0562	0.13	0.0193	0.95	0.0292	0.58
39	0.0519	0.11	0.0150	0.92	0.0249	0.53
40	0.0485	0.13	0.0074	0.94	0.0184	0.42
41	0.0481	0.12	0.0063	1.35	0.0174	0.72
42	0.0404	0.13	0.0023	1.58	0.0125	0.73
43	0.0306	0.14	0.0101	0.68	0.0156	0.39
44	0.0292	0.14	0.0069	0.77	0.0129	0.39
45	0.0191	0.16	0.0047	1.25	0.0086	0.76
46	0.0189	0.16	0.0006	1.66	0.0055	0.60
47	0.0129	0.22	0.0043	1.19	0.0066	0.74
48	0.0094	0.24	0.0034	0.85	0.0050	0.49
49	0.0062	0.25	0.0005	1.70	0.0020	0.86
50	0.0060	0.25	0.0032	0.77	0.0040	0.49
51	0.0030	0.44	0.0002	1.97	0.0009	0.93
52	0.0023	0.38	0.0035	0.90	0.0032	0.76
53	0.0036	0.50	0.0005	1.74	0.0013	1.11
54	0.0031	0.51	0.0008	1.65	0.0014	1.27
55	0.0015	0.70	0.0008	1.65	0.0010	1.39
56	0.0012	0.75	0.0000	0.00	0.0003	0.75
57	0.0006	0.81	0.0002	2.06	0.0003	1.58
58	0.0007	0.77	0.0000	0.00	0.0002	0.84
59	0.0000	0.00	0.0000	0.00	0.0000	0.00
60	0.0004	0.90	0.0000	0.00	0.0001	0.97
61	0.0000	0.00	0.0000	0.00	0.0000	0.00
62	0.0002	1.41	0.0000	0.00	0.0001	1.44
63	0.0000	0.00	0.0000	0.00	0.0000	0.00
64	0.0003	1.37	0.0000	0.00	0.0001	1.41
65	0.0000	0.00	0.0000	0.00	0.0000	0.00
66	0.0003	1.41	0.0000	0.00	0.0001	1.39
67	0.0000	0.00	0.0000	0.00	0.0000	0.00
68	0.0000	0.00	0.0000	0.00	0.0000	0.00
69	0.0000	0.00	0.0000	0.00	0.0000	0.00
70	0.0000	0.00	0.0000	0.00	0.0000	0.00
71	0.0000	0.00	0.0000	0.00	0.0000	0.00
72	0.0003	1.39	0.0000	0.00	0.0001	1.41
73	0.0000	0.00	0.0000	0.00	0.0000	0.00
74	0.0000	0.00	0.0000	0.00	0.0000	0.00
75	0.0000	0.00	0.0000	0.00	0.0000	0.00
76	0.0000	0.00	0.0000	0.00	0.0000	0.00
77	0.0000	0.00	0.0000	0.00	0.0000	0.00
78	0.0000	0.00	0.0000	0.00	0.0000	0.00
79	0.0000	0.00	0.0000	0.00	0.0000	0.00
80	0.0000	0.00	0.0000	0.00	0.0000	0.00
Nt	84 547		233 793		318 079	
n	4 542		633		5 175	

Appendix 9 – continued:
Estimates of proportion at length with CVs (bootstrap estimates) for snapper from the Bay of Plenty modular harvest system fishery in 2019–20.

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

Length	Spring-summer		Autumn-winter		Spring-winter	
(cm)	*P.j.*	CV	*P.j.*	CV	*P.j.*	CV
20	0.0000	0.00	0.0000	0.00	0.0000	0.00
21	0.0000	0.00	0.0000	0.00	0.0000	0.00
22	0.0000	0.00	0.0000	0.00	0.0000	0.00
23	0.0001	1.53	0.0005	1.35	0.0003	1.16
24	0.0013	0.73	0.0031	0.57	0.0021	0.41
25	0.0405	0.24	0.0367	0.34	0.0386	0.20
26	0.1004	0.13	0.0616	0.15	0.0813	0.10
27	0.1209	0.12	0.0923	0.09	0.1068	0.08
28	0.1006	0.09	0.1025	0.11	0.1015	0.07
29	0.0989	0.09	0.1076	0.12	0.1032	0.08
30	0.0911	0.08	0.1017	0.09	0.0963	0.07
31	0.0777	0.08	0.1031	0.14	0.0902	0.09
32	0.0659	0.09	0.0863	0.12	0.0760	0.08
33	0.0606	0.11	0.0662	0.12	0.0634	0.08
34	0.0432	0.14	0.0602	0.14	0.0516	0.11
35	0.0455	0.16	0.0445	0.15	0.0450	0.11
36	0.0344	0.20	0.0370	0.16	0.0357	0.13
37	0.0215	0.22	0.0252	0.26	0.0233	0.18
38	0.0247	0.16	0.0183	0.21	0.0216	0.13
39	0.0190	0.23	0.0143	0.25	0.0167	0.17
40	0.0096	0.29	0.0102	0.32	0.0099	0.22
41	0.0077	0.27	0.0076	0.34	0.0077	0.22
42	0.0081	0.23	0.0048	0.39	0.0065	0.21
43	0.0051	0.34	0.0046	0.43	0.0049	0.28
44	0.0051	0.35	0.0019	0.67	0.0035	0.31
45	0.0052	0.29	0.0036	0.46	0.0044	0.26
46	0.0020	0.52	0.0014	0.61	0.0017	0.40
47	0.0029	0.42	0.0013	0.69	0.0021	0.36
48	0.0006	0.80	0.0004	1.37	0.0005	0.74
49	0.0011	0.72	0.0000	0.00	0.0006	0.73
50	0.0021	0.51	0.0003	1.43	0.0012	0.49
51	0.0015	0.57	0.0007	0.93	0.0012	0.48
52	0.0009	0.73	0.0003	1.40	0.0006	0.65
53	0.0005	0.87	0.0004	1.36	0.0005	0.77
54	0.0001	1.45	0.0002	1.36	0.0001	1.11
55	0.0006	0.89	0.0000	0.00	0.0003	0.87
56	0.0003	1.15	0.0006	0.99	0.0005	0.74
57	0.0001	1.36	0.0000	0.00	0.0000	1.42
58	0.0000	0.00	0.0000	0.00	0.0000	0.00
59	0.0004	0.84	0.0000	0.00	0.0002	0.92
60	0.0000	0.00	0.0002	1.51	0.0001	1.33
61	0.0000	0.00	0.0000	0.00	0.0000	0.00
62	0.0000	0.00	0.0000	0.00	0.0000	0.00
63	0.0001	1.54	0.0000	0.00	0.0000	1.45
64	0.0000	0.00	0.0000	0.00	0.0000	0.00
65	0.0000	0.00	0.0000	0.00	0.0000	0.00
66	0.0000	0.00	0.0000	0.00	0.0000	0.00
67	0.0000	0.00	0.0000	0.00	0.0000	0.00
68	0.0000	0.00	0.0000	0.00	0.0000	0.00
69	0.0000	0.00	0.0000	0.00	0.0000	0.00
70	0.0000	0.00	0.0000	0.00	0.0000	0.00
71	0.0000	0.00	0.0000	0.00	0.0000	0.00
72	0.0000	0.00	0.0000	0.00	0.0000	0.00
73	0.0000	0.00	0.0000	0.00	0.0000	0.00
74	0.0000	0.00	0.0000	0.00	0.0000	0.00
75	0.0000	0.00	0.0000	0.00	0.0000	0.00
76	0.0000	0.00	0.0000	0.00	0.0000	0.00
77	0.0000	0.00	0.0000	0.00	0.0000	0.00
78	0.0000	0.00	0.0000	0.00	0.0000	0.00
79	0.0000	0.00	0.0000	0.00	0.0000	0.00
80	0.0000	0.00	0.0000	0.00	0.0000	0.00
Nt	164 793		151 099		316 171	
n	4 789		2 768		7 557	

Appendix 10: Estimated seasonal proportion at age and coefficients of variation (CVs) for snapper power method fisheries in SNA 1 and SNA 2 in 2019–20.

Estimates of proportion at age with CVs (bootstrap estimates) for snapper from the East Northland bottom trawl fishery in 2019–20.

P.j., proportion of fish in age class; CV, coefficient of variation; *n* , otolith sample size

Age	Spring-summer			Autumn-winter			Spring-winter		
(years)	*P.j.*	CV	*n*	*P.j.*	CV	*n*	*P.j.*	CV	*n*
1	–	–	–	0.0000	0.00	–	–	–	–
2	–	–	–	0.0019	1.18	1	–	–	–
3	–	–	–	0.0158	0.51	15	–	–	–
4	–	–	–	0.0350	0.40	39	–	–	–
5	–	–	–	0.0616	0.38	52	–	–	–
6	–	–	–	0.1354	0.24	83	–	–	–
7	–	–	–	0.0988	0.31	61	–	–	–
8	–	–	–	0.0785	0.23	40	–	–	–
9	–	–	–	0.1547	0.17	79	–	–	–
10	–	–	–	0.0534	0.34	19	–	–	–
11	–	–	–	0.0619	0.32	25	–	–	–
12	–	–	–	0.0282	0.35	14	–	–	–
13	–	–	–	0.0522	0.50	15	–	–	–
14	–	–	–	0.0267	0.68	8	–	–	–
15	–	–	–	0.0389	0.57	12	–	–	–
16	–	–	–	0.0013	0.97	2	–	–	–
17	–	–	–	0.0293	0.67	10	–	–	–
18	–	–	–	0.0278	0.63	8	–	–	–
19	–	–	–	0.0175	0.81	7	–	–	–
20	–	–	–	0.0168	0.77	10	–	–	–
21	–	–	–	0.0418	0.64	16	–	–	–
22	–	–	–	0.0042	1.06	4	–	–	–
23	–	–	–	0.0006	2.00	1	–	–	–
24	–	–	–	0.0042	0.78	4	–	–	–
25	–	–	–	0.0042	1.03	2	–	–	–
26	–	–	–	0.0037	1.21	1	–	–	–
27	–	–	–	0.0000	0.00	–	–	–	–
28	–	–	–	0.0037	1.39	1	–	–	–
29	–	–	–	0.0000	0.00	1	–	–	–
>29	–	–	–	0.0018	1.18	13	–	–	–

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Appendix 10 – continued:
Estimates of proportion at age with CVs (bootstrap estimates) for snapper from the Bay of Plenty bottom trawl fishery in 2019–20.

P.j., proportion of fish in age class; CV, coefficient of variation; *n* , otolith sample size

Age	Spring-summer			Autumn-winter			Spring-winter		
(years)	*P.j.*	CV	*n*	*P.j.*	CV	*n*	*P.j.*	CV	*n*
1	0.0000	0.00	–	0.0000	0.00	–	0.0000	0.00	–
2	0.0000	0.00	–	0.0020	0.75	2	0.0012	0.75	2
3	0.0005	1.26	1	0.0139	0.36	16	0.0089	0.36	17
4	0.0329	0.37	14	0.0885	0.16	76	0.0677	0.15	90
5	0.2267	0.18	65	0.1720	0.10	128	0.1924	0.10	193
6	0.1642	0.12	74	0.2216	0.09	136	0.2001	0.07	210
7	0.1656	0.12	84	0.1505	0.10	93	0.1561	0.08	177
8	0.0948	0.16	53	0.0752	0.14	50	0.0825	0.11	103
9	0.0720	0.18	40	0.0673	0.15	44	0.0691	0.11	84
10	0.0346	0.24	24	0.0345	0.21	24	0.0346	0.16	48
11	0.0450	0.22	32	0.0338	0.20	29	0.0380	0.15	61
12	0.0235	0.27	19	0.0317	0.21	31	0.0286	0.17	50
13	0.0447	0.22	35	0.0356	0.19	38	0.0390	0.14	73
14	0.0158	0.34	12	0.0232	0.26	18	0.0204	0.21	30
15	0.0110	0.41	9	0.0042	0.45	8	0.0067	0.30	17
16	0.0117	0.36	13	0.0131	0.32	15	0.0126	0.24	28
17	0.0202	0.32	16	0.0109	0.33	18	0.0144	0.23	34
18	0.0136	0.35	16	0.0058	0.38	11	0.0087	0.26	27
19	0.0026	0.62	4	0.0036	0.42	8	0.0033	0.34	12
20	0.0055	0.41	12	0.0007	1.15	2	0.0025	0.38	14
21	0.0091	0.34	26	0.0028	0.64	7	0.0052	0.31	33
22	0.0016	0.77	4	0.0023	0.58	8	0.0020	0.46	12
23	0.0005	1.25	1	0.0006	1.10	1	0.0005	0.86	2
24	0.0008	1.01	4	0.0012	0.84	4	0.0010	0.67	8
25	0.0005	1.32	1	0.0024	0.59	8	0.0017	0.55	9
26	0.0005	1.17	1	0.0007	1.24	2	0.0007	0.93	3
27	0.0000	0.00	–	0.0000	0.00	–	0.0000	0.00	–
28	0.0000	0.00	–	0.0000	0.00	–	0.0000	0.00	–
29	0.0000	0.00	1	0.0007	1.33	2	0.0004	1.27	3
>29	0.0020	0.61	7	0.0013	0.64	7	0.0016	0.44	14
			568			786			1354

Appendix 10 – continued:
Estimates of proportion at age with CVs (bootstrap estimates) for snapper from the Hauraki Gulf Danish seine fishery in 2019–20.

P.j., proportion of fish in age class; CV, coefficient of variation; *n* , otolith sample size

Age	Spring-summer			Autumn-winter			Spring-winter		
(years)	*P.j.*	CV	*n*	*P.j.*	CV	*n*	*P.j.*	CV	*n*
1	0.0000	0.00	–	0.0000	0.00	–	0.0000	0.00	–
2	0.0000	0.00	–	0.0000	0.00	–	0.0000	0.00	–
3	0.0000	0.00	–	0.0016	0.59	5	0.0009	0.60	5
4	0.0041	0.68	4	0.0087	0.38	20	0.0066	0.33	24
5	0.0203	0.33	18	0.0207	0.30	36	0.0205	0.23	54
6	0.0467	0.34	42	0.0669	0.19	60	0.0576	0.17	102
7	0.0899	0.21	70	0.0889	0.17	65	0.0894	0.13	135
8	0.0669	0.20	50	0.1065	0.16	60	0.0883	0.13	110
9	0.1115	0.14	78	0.0867	0.17	49	0.0981	0.11	127
10	0.0706	0.15	48	0.0718	0.19	37	0.0712	0.13	85
11	0.0856	0.14	61	0.0951	0.15	47	0.0907	0.11	108
12	0.0670	0.18	38	0.0862	0.17	38	0.0774	0.13	76
13	0.1386	0.14	77	0.0865	0.19	36	0.1104	0.11	113
14	0.0604	0.21	35	0.0521	0.25	24	0.0559	0.16	59
15	0.0411	0.24	26	0.0239	0.31	15	0.0318	0.19	41
16	0.0369	0.26	23	0.0376	0.28	19	0.0372	0.19	42
17	0.0372	0.27	28	0.0403	0.25	21	0.0389	0.19	49
18	0.0376	0.26	26	0.0342	0.26	19	0.0358	0.19	45
19	0.0242	0.32	22	0.0235	0.32	14	0.0238	0.23	36
20	0.0147	0.32	17	0.0111	0.41	10	0.0127	0.26	27
21	0.0152	0.34	17	0.0177	0.35	15	0.0166	0.25	32
22	0.0106	0.36	13	0.0140	0.39	10	0.0125	0.28	23
23	0.0005	1.06	1	0.0046	0.79	2	0.0027	0.73	3
24	0.0055	0.58	7	0.0049	0.43	7	0.0052	0.35	14
25	0.0017	0.77	3	0.0058	0.50	7	0.0039	0.42	10
26	0.0005	1.12	2	0.0030	0.57	4	0.0018	0.50	6
27	0.0010	0.84	2	0.0020	0.79	2	0.0016	0.60	4
28	0.0003	1.28	1	0.0007	1.21	1	0.0005	0.92	2
29	0.0043	0.54	7	0.0025	0.63	5	0.0033	0.41	12
>29	0.0069	0.47	13	0.0028	0.51	8	0.0047	0.35	21
			729			636			1365

Appendix 10 – continued:
Estimates of proportion at age with CVs (bootstrap estimates) for snapper from the Bay of Plenty Danish seine fishery in 2019–20.

P.j., proportion of fish in age class; CV, coefficient of variation; *n* , otolith sample size

Age	Spring-summer			Autumn-winter			Spring-winter		
(years)	*P.j.*	CV	*n*	*P.j.*	CV	*n*	*P.j.*	CV	*n*
1	0.0000	0.00	–	0.0000	0.00	–	0.0000	0.00	–
2	0.0000	0.00	–	0.0013	0.74	2	0.0008	0.75	2
3	0.0001	1.55	1	0.0130	0.41	16	0.0075	0.41	17
4	0.0194	0.39	14	0.0845	0.16	76	0.0568	0.15	90
5	0.2092	0.15	65	0.1803	0.10	128	0.1926	0.09	193
6	0.2008	0.12	74	0.2449	0.08	136	0.2261	0.06	210
7	0.2001	0.11	84	0.1617	0.11	93	0.1781	0.08	177
8	0.1066	0.15	53	0.0730	0.15	50	0.0873	0.10	103
9	0.0717	0.17	40	0.0695	0.16	44	0.0704	0.12	84
10	0.0312	0.24	24	0.0328	0.21	24	0.0321	0.16	48
11	0.0394	0.22	32	0.0318	0.22	29	0.0350	0.16	61
12	0.0238	0.29	19	0.0272	0.22	31	0.0257	0.18	50
13	0.0353	0.24	35	0.0279	0.21	38	0.0311	0.16	73
14	0.0131	0.34	12	0.0186	0.27	18	0.0162	0.22	30
15	0.0078	0.43	9	0.0034	0.57	8	0.0053	0.35	17
16	0.0067	0.40	13	0.0112	0.36	15	0.0093	0.28	28
17	0.0138	0.35	16	0.0067	0.40	18	0.0097	0.27	34
18	0.0086	0.32	16	0.0039	0.49	11	0.0059	0.27	27
19	0.0014	0.67	4	0.0022	0.50	8	0.0019	0.40	12
20	0.0026	0.47	12	0.0000	0.00	2	0.0011	0.46	14
21	0.0054	0.33	26	0.0023	0.70	7	0.0036	0.33	33
22	0.0007	0.81	4	0.0012	0.62	8	0.0010	0.50	12
23	0.0002	1.45	1	0.0001	1.35	1	0.0001	0.99	2
24	0.0009	0.92	4	0.0003	1.03	4	0.0006	0.67	8
25	0.0002	1.44	1	0.0007	0.83	8	0.0005	0.74	9
26	0.0004	1.35	1	0.0002	1.29	2	0.0003	0.96	3
27	0.0000	0.00	–	0.0000	0.00	–	0.0000	0.00	–
28	0.0000	0.00	–	0.0000	0.00	–	0.0000	0.00	–
29	0.0002	2.12	1	0.0005	1.21	2	0.0004	1.08	3
>29	0.0005	0.82	7	0.0006	1.10	7	0.0005	0.72	14
			568			786			1354

Appendix 10 – continued:
Estimates of proportion at age with CVs (bootstrap estimates) for snapper from the East Northland modular harvest system fishery in 2019–20.

P.j., proportion of fish in age class; CV, coefficient of variation; *n* , otolith sample size

Age	Spring-summer			Autumn-winter			Spring-winter		
(years)	*P.j.*	CV	*n*	*P.j.*	CV	*n*	*P.j.*	CV	*n*
1	0.0000	0.00	–	0.0000	0.00	–	0.0000	0.00	–
2	0.0000	0.00	–	0.0016	1.19	1	0.0012	1.22	1
3	0.0010	0.70	3	0.0342	0.55	15	0.0253	0.56	18
4	0.0294	0.24	32	0.1002	0.49	39	0.0812	0.42	71
5	0.0440	0.21	34	0.1121	0.45	52	0.0939	0.37	86
6	0.0727	0.16	53	0.1855	0.34	83	0.1553	0.29	136
7	0.0749	0.16	40	0.1300	0.34	61	0.1153	0.26	101
8	0.0806	0.15	45	0.0775	0.20	40	0.0784	0.14	85
9	0.1247	0.12	69	0.1490	0.14	79	0.1425	0.11	148
10	0.0602	0.19	28	0.0330	0.41	19	0.0403	0.27	47
11	0.0363	0.24	18	0.0402	0.41	25	0.0391	0.29	43
12	0.0545	0.20	28	0.0253	0.42	14	0.0331	0.27	42
13	0.0775	0.17	36	0.0250	0.62	15	0.0390	0.36	51
14	0.0389	0.22	21	0.0056	1.10	8	0.0145	0.52	29
15	0.0735	0.17	38	0.0154	0.72	12	0.0309	0.37	50
16	0.0087	0.41	7	0.0016	1.36	2	0.0035	0.67	9
17	0.0321	0.23	21	0.0083	0.93	10	0.0147	0.53	31
18	0.0391	0.22	24	0.0080	0.97	8	0.0163	0.50	32
19	0.0283	0.26	21	0.0043	1.13	7	0.0107	0.55	28
20	0.0269	0.28	19	0.0063	1.16	10	0.0118	0.66	29
21	0.0306	0.23	24	0.0106	1.13	16	0.0160	0.73	40
22	0.0087	0.41	9	0.0026	1.24	4	0.0042	0.72	13
23	0.0061	0.61	5	0.0003	2.36	1	0.0018	0.99	6
24	0.0129	0.35	13	0.0040	1.22	4	0.0064	0.72	17
25	0.0055	0.56	4	0.0017	1.17	2	0.0027	0.68	6
26	0.0083	0.47	7	0.0010	1.44	1	0.0029	0.57	8
27	0.0039	0.66	3	0.0000	0.00	–	0.0011	0.72	3
28	0.0055	0.57	4	0.0010	1.49	1	0.0022	0.71	5
29	0.0002	1.34	1	0.0003	2.46	1	0.0002	2.26	2
>29	0.0148	0.31	27	0.0038	1.31	13	0.0067	0.83	40
			634			543			1177

Appendix 10 – continued:
Estimates of proportion at age with CVs (bootstrap estimates) for snapper from the Bay of Plenty modular harvest system fishery in 2019–20.

P.j., proportion of fish in age class; CV, coefficient of variation; *n* , otolith sample size

Age	Spring-summer			Autumn-winter			Spring-winter		
(years)	*P.j.*	CV	*n*	*P.j.*	CV	*n*	*P.j.*	CV	*n*
1	0.0000	0.00	–	0.0000	0.00	–	0.0000	0.00	–
2	0.0000	0.00	–	0.0034	0.76	2	0.0016	0.76	2
3	0.0001	1.54	1	0.0196	0.36	16	0.0094	0.36	17
4	0.0376	0.35	14	0.1337	0.14	76	0.0836	0.14	90
5	0.2814	0.12	65	0.2252	0.09	128	0.2545	0.08	193
6	0.1809	0.12	74	0.2248	0.08	136	0.2019	0.07	210
7	0.1679	0.12	84	0.1418	0.11	93	0.1554	0.08	177
8	0.0865	0.15	53	0.0628	0.16	50	0.0752	0.11	103
9	0.0609	0.17	40	0.0561	0.16	44	0.0586	0.12	84
10	0.0274	0.25	24	0.0255	0.24	24	0.0265	0.17	48
11	0.0358	0.22	32	0.0253	0.23	29	0.0308	0.16	61
12	0.0198	0.27	19	0.0203	0.26	31	0.0201	0.18	50
13	0.0323	0.22	35	0.0219	0.24	38	0.0273	0.17	73
14	0.0117	0.34	12	0.0152	0.31	18	0.0134	0.24	30
15	0.0087	0.42	9	0.0023	0.55	8	0.0056	0.36	17
16	0.0080	0.39	13	0.0078	0.36	15	0.0079	0.27	28
17	0.0141	0.30	16	0.0049	0.46	18	0.0097	0.25	34
18	0.0108	0.31	16	0.0029	0.47	11	0.0070	0.27	27
19	0.0019	0.61	4	0.0014	0.54	8	0.0017	0.43	12
20	0.0040	0.41	12	0.0001	2.15	2	0.0022	0.40	14
21	0.0063	0.34	26	0.0020	0.67	7	0.0043	0.29	33
22	0.0016	0.66	4	0.0012	0.64	8	0.0014	0.47	12
23	0.0002	1.33	1	0.0002	1.28	1	0.0002	0.95	2
24	0.0005	0.97	4	0.0004	0.98	4	0.0005	0.69	8
25	0.0002	1.42	1	0.0007	0.88	8	0.0005	0.74	9
26	0.0006	1.22	1	0.0003	1.21	2	0.0004	0.95	3
27	0.0000	0.00	–	0.0000	0.00	–	0.0000	0.00	–
28	0.0000	0.00	–	0.0000	0.00	–	0.0000	0.00	–
29	0.0000	0.00	1	0.0001	2.13	2	0.0001	2.08	3
>29	0.0005	0.82	7	0.0002	1.50	7	0.0003	0.73	14
			568			786			1354

Appendix 10 – continued:
Estimates of proportion at age with CVs (bootstrap estimates) for snapper from the SNA 2N bottom trawl fishery in 2019–20.

P.j., proportion of fish in age class; CV, coefficient of variation; *n* , otolith sample size

Age	Spring-summer			Autumn-winter			Spring-winter		
(years)	*P.j.*	CV	*n*	*P.j.*	CV	*n*	*P.j.*	CV	*n*
1	0.0000	0.00	–	0.0000	0.00	–	0.0000	0.00	–
2	0.0000	0.00	–	0.0026	1.00	2	0.0014	0.99	2
3	0.0019	1.48	1	0.0168	0.50	12	0.0101	0.47	13
4	0.0259	0.59	12	0.0853	0.27	56	0.0590	0.25	68
5	0.1716	0.18	95	0.3510	0.15	185	0.2714	0.12	280
6	0.2327	0.19	129	0.1674	0.13	98	0.1964	0.12	227
7	0.1936	0.17	116	0.1692	0.15	104	0.1800	0.11	220
8	0.0971	0.19	58	0.0522	0.24	34	0.0721	0.15	92
9	0.0486	0.26	29	0.0285	0.48	21	0.0374	0.26	50
10	0.0508	0.26	29	0.0406	0.27	23	0.0451	0.19	52
11	0.0464	0.26	27	0.0133	0.51	11	0.0280	0.23	38
12	0.0399	0.29	23	0.0191	0.40	12	0.0283	0.23	35
13	0.0197	0.39	11	0.0127	0.50	7	0.0158	0.31	18
14	0.0154	0.42	9	0.0054	0.62	5	0.0098	0.35	14
15	0.0016	1.44	1	0.0019	1.41	1	0.0018	1.02	2
16	0.0031	1.04	2	0.0019	1.16	2	0.0024	0.77	4
17	0.0051	0.78	3	0.0048	0.72	4	0.0049	0.53	7
18	0.0017	1.46	1	0.0022	0.98	2	0.0019	0.81	3
19	0.0050	0.76	3	0.0051	0.79	3	0.0051	0.56	6
20	0.0060	0.74	3	0.0026	1.00	2	0.0041	0.62	5
21	0.0185	0.48	11	0.0078	0.68	5	0.0126	0.39	16
22	0.0079	0.62	4	0.0019	1.02	2	0.0046	0.54	6
23	0.0000	0.00	–	0.0007	1.46	1	0.0004	1.45	1
24	0.0018	1.38	1	0.0007	1.42	1	0.0012	1.05	2
25	0.0015	1.44	1	0.0030	0.97	2	0.0023	0.79	3
26	0.0014	1.35	1	0.0000	0.00	–	0.0006	1.35	1
27	0.0000	0.00	–	0.0000	0.00	–	0.0000	0.00	–
28	0.0000	0.00	–	0.0000	0.00	–	0.0000	0.00	–
29	0.0000	0.00	–	0.0011	1.38	1	0.0006	1.37	1
>29	0.0029	0.96	2	0.0024	0.91	3	0.0026	0.66	5
			572			599			1171

Appendix 11: Age-length keys derived from snapper otolith samples collected from bottom longline and power method fisheries in SNA 1 and SNA 2 in 2019–20.

Estimates of proportion of length at age for snapper sampled from East Northland bottom longline, modular harvest system and bottom trawl fisheries, spring-winter 2019–20. (Note: Aged to 01/01/20)

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	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
24	0	0	0.20	0.40	0.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
25	0	0	0.08	0.47	0.21	0.18	0.03	0	0.03	0	0	0	0	0	0	0	0	0	0	0	38
26	0	0	0.06	0.24	0.24	0.35	0.09	0.02	0	0	0	0	0	0	0	0	0	0	0	0	54
27	0	0	0.04	0.25	0.16	0.34	0.09	0.11	0	0.02	0	0	0	0	0	0	0	0	0	0	56
28	0	0	0.03	0.07	0.20	0.28	0.23	0.07	0.10	0.02	0	0	0	0	0	0	0	0	0	0	60
29	0	0.01	0.01	0.11	0.15	0.24	0.13	0.11	0.21	0	0	0.01	0	0	0	0	0	0	0	0	71
30	0	0	0.01	0.03	0.14	0.22	0.23	0.08	0.20	0.03	0.01	0.03	0.01	0	0.01	0	0	0	0	0	74
31	0	0	0.03	0.03	0.07	0.17	0.15	0.14	0.21	0.06	0.01	0.04	0.01	0	0.01	0	0.03	0.03	0	0.01	72
32	0	0	0.02	0.02	0.04	0.09	0.16	0.20	0.26	0.05	0.09	0.02	0.02	0	0	0	0.01	0	0	0.01	81
33	0	0	0	0	0.08	0.08	0.06	0.10	0.34	0.01	0.10	0.04	0.05	0.04	0.05	0	0	0.03	0	0.01	77
34	0	0	0	0.03	0.03	0.10	0.10	0.09	0.17	0.12	0.05	0.05	0.07	0.05	0.05	0	0	0.02	0	0.05	58
35	0	0	0	0	0.04	0	0.16	0.04	0.36	0.04	0.07	0.07	0.11	0	0.02	0	0	0.04	0	0.04	45
36	0	0	0	0	0	0.08	0.04	0.10	0.14	0.10	0.10	0.08	0.12	0.08	0.10	0	0.02	0	0	0.02	49
37	0	0	0	0.03	0	0	0.05	0.10	0.13	0.10	0.10	0.05	0.08	0.03	0.10	0.03	0.05	0.05	0.05	0.08	40
38	0	0	0	0	0.03	0.06	0.06	0.10	0.10	0.13	0.10	0.10	0.19	0	0.06	0	0	0.03	0	0.03	31
39	0	0	0	0	0	0.05	0.03	0.05	0.05	0.05	0.08	0.13	0.11	0.05	0.11	0	0.08	0.08	0.05	0.08	38
40	0	0	0	0	0	0.03	0	0.09	0.09	0.06	0.06	0.03	0.09	0.03	0.15	0	0.09	0.06	0.06	0.15	33
41	0	0	0	0	0	0	0	0	0.06	0.14	0.03	0.03	0.03	0.06	0.17	0	0.06	0.09	0.09	0.26	35
42	0	0	0	0	0	0	0.03	0.06	0	0.03	0.06	0.06	0.11	0.11	0.09	0	0.09	0.11	0.06	0.20	35
43	0	0	0	0	0	0.05	0	0	0.05	0.05	0	0.05	0.09	0.14	0.14	0	0.09	0.05	0.09	0.23	22
44	0	0	0	0	0	0	0	0	0	0	0	0.04	0.12	0.12	0.12	0.04	0.08	0.04	0.04	0.42	26
45	0	0	0	0	0	0	0	0	0	0.05	0	0	0	0.05	0	0.16	0.16	0.05	0.11	0.42	19
46	0	0	0	0	0	0	0	0	0	0	0	0.05	0.09	0.05	0.05	0	0.18	0.05	0.09	0.45	22
47	0	0	0	0	0	0	0	0	0	0	0	0.15	0	0	0.08	0.08	0	0.08	0	0.62	13
48	0	0	0	0	0	0	0	0	0	0	0	0.05	0	0	0.05	0.05	0.05	0.05	0.16	0.58	19
49	0	0	0	0	0	0	0	0	0	0	0	0.07	0	0	0	0.07	0	0	0.14	0.71	14
50	0	0	0	0	0	0	0	0	0	0	0	0	0	0.13	0	0	0	0.13	0	0.75	8
51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.11	0	0	0.89	9
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.20	0	0	0	0.10	0.70	10
53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.13	0	0.88	8
54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.22	0.78	9
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.13	0.13	0	0.75	8
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.14	0	0.86	7
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	5
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.50	0	0	0	0.50	2
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	2
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0.75	4
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	2
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.50	0.50	2
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	2
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
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																					1177

Appendix 11 – continued:

Estimates of proportion of length at age for snapper sampled from the Hauraki Gulf bottom longline and Danish seine fisheries, spring-winter 2019–20. (Note: Aged to 01/01/20)

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	0	0	0.50	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
25	0	0	0.13	0.16	0.22	0.31	0.06	0.09	0	0	0.03	0	0	0	0	0	0	0	0	0	32
26	0	0	0.02	0.12	0.19	0.26	0.19	0.07	0.09	0.02	0.04	0	0	0	0	0	0	0	0	0	57
27	0	0	0	0.07	0.18	0.23	0.20	0.10	0.07	0.07	0.04	0.01	0.02	0	0	0	0	0	0	0	82
28	0	0	0	0.03	0.08	0.21	0.13	0.13	0.15	0.04	0.14	0.01	0.04	0.01	0	0.01	0	0	0	0	71
29	0	0	0	0.03	0.03	0.12	0.23	0.17	0.17	0.06	0.05	0.05	0.03	0.02	0.01	0	0	0	0	0.01	98
30	0	0	0	0.01	0.03	0.08	0.30	0.15	0.16	0.09	0.04	0.04	0.03	0.02	0.01	0	0.03	0	0	0	93
31	0	0	0	0	0.02	0.06	0.07	0.15	0.16	0.14	0.16	0.07	0.10	0.02	0.00	0.01	0.01	0.01	0.02	0.02	102
32	0	0	0	0	0.03	0.04	0.17	0.12	0.13	0.12	0.15	0.08	0.07	0.01	0.04	0.04	0	0.01	0.01	0.01	103
33	0	0	0	0	0.02	0.08	0.07	0.08	0.18	0.08	0.11	0.11	0.10	0.07	0.02	0.01	0.01	0.02	0	0.02	88
34	0	0	0	0	0	0.04	0.04	0.03	0.09	0.09	0.22	0.09	0.18	0.04	0.05	0.08	0.01	0.03	0	0.04	79
35	0	0	0	0	0	0	0.03	0.12	0.11	0.08	0.07	0.25	0.16	0.05	0.01	0.04	0.04	0	0	0.03	73
36	0	0	0	0	0	0.02	0.09	0.09	0.09	0.07	0.02	0.07	0.30	0.15	0.04	0.04	0	0.02	0	0	46
37	0	0	0	0	0.02	0.02	0.13	0	0.07	0.07	0.04	0.07	0.20	0.07	0.04	0.02	0.07	0.07	0.07	0.04	45
38	0	0	0	0	0	0.03	0	0.13	0.06	0.03	0.06	0.06	0.16	0.09	0.03	0.13	0.06	0.06	0.06	0.03	32
39	0	0	0	0	0	0	0	0	0.03	0.09	0.06	0.03	0.11	0.09	0.09	0	0.14	0.20	0.03	0.14	35
40	0	0	0	0	0	0	0	0.03	0.03	0	0.10	0.10	0.10	0.07	0.17	0.07	0.07	0.10	0.07	0.07	29
41	0	0	0	0	0	0	0.03	0.03	0	0.10	0.07	0	0.14	0.07	0.07	0.07	0.17	0.07	0.07	0.10	29
42	0	0	0	0	0	0	0	0	0.02	0	0.07	0.05	0.07	0.16	0.09	0.09	0.05	0.07	0.09	0.23	43
43	0	0	0	0	0	0	0	0	0.05	0.05	0.09	0.05	0.05	0.14	0.09	0.09	0.14	0.18	0.05	0.05	22
44	0	0	0	0	0	0	0	0	0	0	0	0	0.07	0.27	0.07	0	0.20	0.07	0.13	0.20	15
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0.08	0	0.08	0.23	0.08	0.23	0.31	13
46	0	0	0	0	0	0	0	0	0	0.05	0.05	0	0.10	0	0.05	0.05	0.19	0.19	0.10	0.24	21
47	0	0	0	0	0	0	0	0	0	0	0.07	0	0.07	0	0.07	0.07	0	0.27	0	0.47	15
48	0	0	0	0	0	0	0	0	0	0	0.08	0	0.08	0.08	0.15	0	0	0	0.08	0.54	13
49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.06	0.13	0.13	0.13	0.19	0.38	16
50	0	0	0	0	0	0	0	0	0	0	0	0	0.08	0.08	0	0.15	0.08	0	0.15	0.46	13
51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.14	0.14	0	0.14	0.57	7
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0.17	0	0	0	0	0	0.83	6
53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.10	0	0.10	0	0.10	0.70	10
54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.43	0.14	0.14	0.29	7
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.13	0	0.88	8
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.17	0.83	6
57	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0.25	0.50	4
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0.75	4
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	6
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	4
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	4
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	3
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	3
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	6
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	2
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	2
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	4
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	3
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	3
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	3
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	0	0
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	2
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																					1365

Appendix 11 – continued:

Estimates of proportion of length at age for snapper sampled from the Bay of Plenty bottom longline, bottom trawl, Danish seine and modular harvest system fisheries, spring-winter 2019–20. (Note: Aged to 01/01/20)

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	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
23	0	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
24	0	0	0.33	0.33	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
25	0	0	0.05	0.50	0.38	0.07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42
26	0	0	0.02	0.25	0.58	0.09	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	53
27	0	0	0.01	0.25	0.51	0.15	0.04	0.01	0	0	0	0	0	0	0	0	0	0	0	0	67
28	0	0	0.03	0.19	0.36	0.22	0.15	0.03	0.02	0	0	0	0	0	0	0	0	0	0	0	59
29	0	0	0.01	0.10	0.28	0.28	0.25	0.03	0.04	0.01	0	0	0	0	0	0	0	0	0	0	72
30	0	0	0.01	0.08	0.21	0.34	0.16	0.14	0.05	0.02	0	0	0	0	0	0	0	0	0	0	102
31	0	0	0.01	0.01	0.19	0.31	0.19	0.08	0.10	0.03	0.06	0.02	0	0.01	0	0	0	0	0	0	107
32	0	0	0	0.03	0.09	0.28	0.31	0.10	0.09	0.01	0.03	0.02	0	0	0.01	0	0	0	0	0	86
33	0	0	0	0	0.07	0.25	0.30	0.12	0.13	0.02	0.06	0.02	0.02	0	0	0	0	0	0	0	89
34	0	0	0	0.01	0.07	0.18	0.27	0.21	0.05	0.05	0.04	0.04	0.06	0.03	0	0	0	0	0	0	101
35	0	0	0	0	0.01	0.18	0.13	0.10	0.17	0.13	0.10	0.06	0.02	0.03	0.02	0.02	0.02	0	0	0	88
36	0	0	0	0	0	0.12	0.14	0.20	0.08	0.12	0.09	0.05	0.14	0.06	0	0	0.02	0	0	0	66
37	0	0	0	0	0	0.03	0.08	0.16	0.18	0.05	0.08	0.05	0.18	0.11	0	0	0.08	0	0	0	38
38	0	0	0	0	0.03	0.03	0.08	0.13	0.13	0.11	0.13	0.11	0.08	0.03	0	0.08	0.03	0.03	0	0.03	38
39	0	0	0	0	0	0.03	0.06	0	0.16	0.03	0.09	0.06	0.19	0.09	0.06	0.09	0.06	0.06	0	0	32
40	0	0	0	0	0	0	0	0	0	0.11	0.07	0.07	0.19	0.11	0.04	0.15	0.11	0.11	0.04	0	27
41	0	0	0	0	0	0	0	0	0.03	0.03	0.09	0.29	0.23	0.06	0.03	0.06	0.03	0.06	0.03	0.09	35
42	0	0	0	0	0	0	0	0	0.03	0.06	0.09	0.09	0.23	0.03	0.11	0.09	0	0.06	0.06	0.17	35
43	0	0	0	0	0	0	0	0	0	0.06	0.06	0.16	0.10	0.03	0.10	0.06	0.06	0.16	0.03	0.16	31
44	0	0	0	0	0	0	0	0	0	0	0.11	0	0.22	0.11	0	0	0.22	0.11	0.17	0.06	18
45	0	0	0	0	0	0	0	0	0	0	0	0.08	0.15	0	0	0.08	0.15	0.38	0	0.15	13
46	0	0	0	0	0	0	0	0.05	0	0	0.11	0.11	0.11	0.11	0	0	0.05	0.16	0.05	0.26	19
47	0	0	0	0	0	0	0	0	0	0	0.08	0	0.33	0	0	0.17	0.17	0	0	0.25	12
48	0	0	0	0	0	0	0	0	0	0	0.11	0	0	0	0	0.11	0.11	0.11	0	0.56	9
49	0	0	0	0	0	0	0	0	0	0	0	0	0.17	0	0.08	0	0.25	0	0.08	0.42	12
50	0	0	0	0	0	0	0	0	0	0	0	0.07	0	0	0.07	0.29	0.21	0	0.07	0.29	14
51	0	0	0	0	0	0	0	0	0	0	0.13	0	0	0	0	0	0.25	0	0	0.63	8
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.13	0.13	0.13	0	0.63	8
53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.17	0.83	6
54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	5
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.20	0	0	0	0	0.80	5
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	6
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	6
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	3
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	6
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	2
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	3
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	2
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	0	0
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																					1354

Appendix 11 – continued:
Estimates of proportion of length at age for snapper sampled from the SNA 2N bottom trawl fishery, spring-winter 2019–20. (Note: Aged to 01/01/20)

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0.25	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
26	0	0	0	0.75	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
27	0	0	0.21	0.29	0.43	0.07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
28	0	0.04	0.04	0.28	0.64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
29	0	0	0.08	0.13	0.75	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48
30	0	0	0	0.13	0.69	0.10	0.05	0.03	0	0	0	0	0	0	0	0	0	0	0	0	78
31	0	0	0	0.15	0.63	0.11	0.11	0	0	0	0	0	0	0	0	0	0	0	0	0	81
32	0	0	0	0.10	0.48	0.31	0.09	0.01	0	0	0	0	0	0	0	0	0	0	0	0	89
33	0	0	0.01	0.08	0.41	0.27	0.20	0.02	0	0	0	0	0	0	0	0	0	0	0	0	95
34	0	0	0	0.05	0.17	0.26	0.40	0.10	0.02	0	0	0	0	0	0	0	0	0	0	0	102
35	0	0	0.01	0.03	0.07	0.43	0.42	0.04	0.01	0	0	0	0	0	0	0	0	0	0	0	108
36	0	0	0	0	0.03	0.31	0.37	0.15	0.06	0.07	0	0	0	0.01	0	0	0	0	0	0	89
37	0	0	0	0.01	0	0.17	0.43	0.24	0.09	0.03	0.03	0	0	0	0	0	0	0	0	0	75
38	0	0	0	0	0.01	0.20	0.24	0.19	0.11	0.13	0.06	0.04	0	0.01	0	0	0	0	0	0	79
39	0	0	0	0	0.03	0.17	0.11	0.23	0.14	0.17	0.11	0.05	0	0	0	0	0.02	0	0	0	66
40	0	0	0	0	0.08	0.24	0	0.20	0.04	0.36	0.04	0.04	0	0	0	0	0	0	0	0	25
41	0	0	0	0	0.03	0.09	0.03	0.11	0.09	0.11	0.20	0.23	0.06	0.03	0.03	0	0	0	0	0	35
42	0	0	0	0	0	0.06	0	0.06	0.27	0.18	0.12	0.12	0.09	0	0	0.03	0.03	0	0.03	0	33
43	0	0	0	0	0	0	0.05	0	0.14	0.05	0.19	0.19	0.14	0.19	0	0	0.05	0	0	0	21
44	0	0	0	0	0	0.07	0.00	0.07	0	0.14	0.14	0.29	0.21	0	0	0	0.07	0	0	0	14
45	0	0	0	0	0	0	0.07	0	0.07	0	0.20	0.20	0.20	0.13	0.07	0	0	0.07	0	0	15
46	0	0	0	0	0	0	0	0	0	0.11	0.11	0.11	0.22	0.33	0	0	0	0	0.11	0	9
47	0	0	0	0	0	0	0	0	0	0	0	0.27	0.09	0	0	0.18	0.18	0	0	0.27	11
48	0	0	0	0	0	0	0	0	0	0	0.13	0	0	0.13	0	0	0	0.13	0.13	0.50	8
49	0	0	0	0	0	0	0	0	0	0	0.11	0	0	0	0	0	0.11	0	0.11	0.67	9
50	0	0	0	0	0	0	0	0	0	0	0	0.17	0	0	0	0.17	0.00	0.17	0	0.50	6
51	0	0	0	0	0	0	0	0	0	0	0	0	0.17	0.17	0	0	0	0	0.17	0.50	6
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0.75	4
53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	4
54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	2
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	5
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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																					1171

Appendix 12: Estimated mean weight-at-age (kg) and coefficients of variation (CVs) for snapper power method fisheries in SNA 1 and SNA 2 in 2019–20.

Estimates of mean weight-at-age (kg) with coefficients of variation for snapper from the East Northland bottom trawl fishery in 2019–20.

Age	Spring-summer		Autumn-winter		Spring-winter	
(years)	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–
2	–	–	0.54	0.78	–	–
3	–	–	0.58	0.05	–	–
4	–	–	0.60	0.12	–	–
5	–	–	0.59	0.04	–	–
6	–	–	0.74	0.15	–	–
7	–	–	0.67	0.06	–	–
8	–	–	0.81	0.11	–	–
9	–	–	0.85	0.10	–	–
10	–	–	1.08	0.12	–	–
11	–	–	1.08	0.10	–	–
12	–	–	1.07	0.13	–	–
13	–	–	1.24	0.09	–	–
14	–	–	1.51	0.09	–	–
15	–	–	1.33	0.08	–	–
16	–	–	2.15	0.47	–	–
17	–	–	1.38	0.08	–	–
18	–	–	1.22	0.08	–	–
19	–	–	1.30	0.16	–	–
20	–	–	1.50	0.13	–	–
21	–	–	1.52	0.07	–	–
22	–	–	1.35	0.82	–	–
23	–	–	3.08	1.49	–	–
24	–	–	1.91	0.28	–	–
25	–	–	1.20	0.60	–	–
26	–	–	1.74	0.73	–	–
27	–	–	–	–	–	–
28	–	–	1.74	0.82	–	–
29	–	–	–	–	–	–
>29	–	–	2.34	0.80	–	–

Appendix 12 – continued:
Estimates of mean weight-at-age (kg) with coefficients of variation for snapper from the Bay of Plenty bottom trawl fishery in 2019–20.

Age	Spring-summer		Autumn-winter		Spring-winter	
(years)	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–
2	–	–	0.42	0.40	0.42	0.40
3	0.32	0.76	0.49	0.07	0.49	0.07
4	0.42	0.07	0.50	0.03	0.48	0.03
5	0.46	0.02	0.57	0.03	0.52	0.02
6	0.60	0.03	0.70	0.02	0.67	0.02
7	0.68	0.03	0.75	0.03	0.72	0.02
8	0.77	0.04	0.83	0.03	0.81	0.03
9	0.88	0.04	0.84	0.04	0.85	0.03
10	0.96	0.04	0.94	0.05	0.95	0.04
11	1.01	0.05	0.99	0.05	1.00	0.04
12	0.95	0.07	1.20	0.04	1.12	0.04
13	1.15	0.04	1.24	0.04	1.20	0.03
14	1.06	0.08	1.17	0.05	1.14	0.04
15	1.20	0.10	1.39	0.16	1.27	0.08
16	1.40	0.09	1.37	0.09	1.38	0.06
17	1.28	0.07	1.70	0.09	1.48	0.06
18	1.47	0.06	1.75	0.08	1.59	0.05
19	1.63	0.24	1.76	0.08	1.72	0.06
20	2.17	0.11	3.24	0.56	2.36	0.11
21	2.31	0.10	1.63	0.25	2.08	0.11
22	1.84	0.32	2.35	0.19	2.20	0.16
23	2.35	0.75	2.09	0.74	2.17	0.41
24	3.12	0.38	2.53	0.32	2.70	0.20
25	2.35	0.79	2.62	0.12	2.59	0.10
26	2.09	0.70	2.67	0.44	2.50	0.28
27	–	–	–	–	–	–
28	–	–	–	–	–	–
29	–	–	3.37	0.65	3.37	0.59
>29	3.39	0.12	4.26	0.09	3.84	0.08

Appendix 12 – continued:
Estimates of mean weight-at-age (kg) with coefficients of variation for snapper from the Hauraki Gulf Danish seine fishery in 2019–20.

Age	Spring-summer		Autumn-winter		Spring-winter	
(years)	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–
2	–	–	–	–	–	–
3	–	–	0.37	0.09	0.37	0.09
4	0.43	0.19	0.47	0.05	0.46	0.04
5	0.58	0.15	0.55	0.07	0.56	0.08
6	0.48	0.04	0.74	0.06	0.64	0.07
7	0.62	0.07	0.80	0.05	0.72	0.05
8	0.67	0.07	0.85	0.04	0.79	0.04
9	0.70	0.06	0.86	0.04	0.78	0.04
10	0.77	0.06	0.94	0.05	0.86	0.04
11	0.81	0.07	0.90	0.04	0.86	0.04
12	0.86	0.04	0.94	0.04	0.91	0.03
13	0.95	0.04	1.03	0.04	0.99	0.03
14	1.03	0.05	1.24	0.06	1.13	0.04
15	1.08	0.05	1.37	0.09	1.20	0.05
16	1.17	0.07	1.14	0.09	1.16	0.05
17	1.43	0.09	1.30	0.07	1.36	0.06
18	1.23	0.06	1.46	0.07	1.35	0.04
19	1.66	0.10	1.34	0.09	1.49	0.07
20	1.80	0.15	1.73	0.18	1.77	0.11
21	1.61	0.17	1.92	0.15	1.79	0.11
22	1.96	0.19	1.37	0.19	1.60	0.15
23	1.97	0.74	1.41	0.43	1.45	0.27
24	2.37	0.33	2.38	0.19	2.37	0.19
25	5.72	0.31	2.72	0.18	3.32	0.18
26	6.12	0.51	2.82	0.16	3.22	0.20
27	3.56	0.64	2.35	0.39	2.71	0.33
28	3.41	0.77	2.63	0.78	2.86	0.39
29	3.91	0.15	3.35	0.25	3.69	0.12
>29	3.89	0.22	3.72	0.19	3.84	0.16

Appendix 12 – continued:
Estimates of mean weight-at-age (kg) with coefficients of variation for snapper from the Bay of Plenty Danish seine fishery in 2019–20.

Age	Spring-summer		Autumn-winter		Spring-winter	
(years)	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–
2	–	–	0.43	0.37	0.43	0.37
3	0.32	0.90	0.53	0.05	0.53	0.05
4	0.48	0.09	0.52	0.03	0.52	0.03
5	0.49	0.02	0.59	0.02	0.54	0.02
6	0.60	0.03	0.69	0.02	0.66	0.02
7	0.66	0.03	0.73	0.03	0.70	0.02
8	0.74	0.04	0.79	0.04	0.77	0.03
9	0.81	0.05	0.81	0.04	0.81	0.03
10	0.92	0.05	0.91	0.06	0.91	0.04
11	0.94	0.05	0.95	0.05	0.95	0.04
12	0.89	0.06	1.18	0.05	1.06	0.04
13	1.11	0.05	1.22	0.04	1.16	0.03
14	1.01	0.07	1.16	0.06	1.11	0.05
15	1.09	0.13	1.30	0.17	1.16	0.10
16	1.36	0.07	1.26	0.08	1.29	0.06
17	1.22	0.07	1.53	0.10	1.34	0.06
18	1.47	0.05	1.64	0.09	1.54	0.05
19	1.60	0.24	1.69	0.07	1.66	0.07
20	1.87	0.11	–	–	1.87	0.11
21	2.00	0.10	1.52	0.27	1.83	0.11
22	1.80	0.28	1.81	0.22	1.81	0.13
23	2.35	0.86	2.09	0.79	2.22	0.45
24	4.14	0.51	2.00	0.69	3.40	0.38
25	2.35	0.87	2.49	0.27	2.47	0.19
26	2.09	0.78	2.49	0.67	2.26	0.37
27	–	–	–	–	–	–
28	–	–	–	–	–	–
29	5.17	1.68	4.72	0.74	4.82	0.58
>29	3.30	0.34	5.01	0.56	4.37	0.21

Appendix 12 – continued:
Estimates of mean weight-at-age (kg) with coefficients of variation for snapper from the East Northland modular harvest system fishery in 2019–20.

Age	Spring-summer		Autumn-winter		Spring-winter	
(years)	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–
2	–	–	0.54	0.74	0.54	0.74
3	0.34	0.23	0.49	0.09	0.49	0.08
4	0.50	0.07	0.46	0.17	0.46	0.11
5	0.62	0.08	0.53	0.09	0.54	0.08
6	0.65	0.08	0.57	0.20	0.58	0.14
7	0.77	0.05	0.62	0.12	0.65	0.09
8	0.84	0.05	0.71	0.15	0.75	0.10
9	0.83	0.04	0.74	0.12	0.76	0.08
10	1.06	0.05	0.88	0.12	0.95	0.07
11	0.98	0.06	0.90	0.09	0.92	0.07
12	1.15	0.07	0.92	0.15	1.02	0.08
13	1.12	0.05	1.06	0.08	1.09	0.05
14	1.26	0.08	1.36	0.17	1.29	0.07
15	1.22	0.04	1.24	0.14	1.23	0.06
16	1.74	0.14	2.16	0.38	1.87	0.10
17	1.41	0.06	1.35	0.11	1.39	0.06
18	1.39	0.08	1.15	0.11	1.30	0.06
19	1.65	0.06	1.46	0.25	1.59	0.07
20	1.57	0.10	1.90	0.12	1.70	0.08
21	1.68	0.08	1.82	0.07	1.75	0.06
22	1.92	0.12	1.74	0.44	1.84	0.18
23	1.22	0.39	3.08	1.04	1.41	0.39
24	1.77	0.12	2.05	0.17	1.90	0.08
25	1.87	0.15	1.12	0.56	1.52	0.18
26	1.75	0.16	1.74	0.78	1.75	0.12
27	1.27	0.51	–	–	1.27	0.51
28	1.85	0.23	1.74	0.79	1.81	0.15
29	3.41	0.84	3.24	1.03	3.29	0.54
>29	2.37	0.14	2.79	0.13	2.54	0.10

Appendix 12 – continued:
Estimates of mean weight-at-age (kg) with coefficients of variation for snapper from the Bay of Plenty modular harvest system fishery in 2019–20.

Age	Spring-summer		Autumn-winter		Spring-winter	
(years)	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–
2	–	–	0.42	0.42	0.42	0.42
3	0.32	0.84	0.48	0.07	0.47	0.07
4	0.42	0.06	0.47	0.03	0.46	0.03
5	0.46	0.02	0.54	0.02	0.49	0.02
6	0.58	0.03	0.66	0.02	0.62	0.02
7	0.66	0.03	0.70	0.03	0.68	0.02
8	0.74	0.04	0.79	0.04	0.76	0.03
9	0.84	0.04	0.79	0.04	0.82	0.03
10	0.94	0.04	0.89	0.07	0.92	0.04
11	0.98	0.05	0.93	0.06	0.96	0.04
12	0.93	0.07	1.19	0.05	1.06	0.05
13	1.16	0.05	1.20	0.05	1.18	0.03
14	1.06	0.07	1.12	0.06	1.09	0.05
15	1.19	0.12	1.30	0.17	1.21	0.09
16	1.42	0.09	1.30	0.09	1.37	0.06
17	1.32	0.08	1.51	0.12	1.37	0.07
18	1.52	0.06	1.66	0.10	1.55	0.05
19	1.66	0.24	1.65	0.08	1.66	0.09
20	2.02	0.11	3.08	1.51	2.05	0.11
21	2.06	0.09	1.62	0.27	1.96	0.08
22	1.95	0.30	2.37	0.21	2.12	0.14
23	2.35	0.77	2.09	0.78	2.24	0.41
24	3.21	0.33	2.05	0.61	2.76	0.22
25	2.35	0.78	2.99	0.41	2.83	0.26
26	2.09	0.75	2.50	0.61	2.21	0.34
27	–	–	–	–	–	–
28	–	–	–	–	–	–
29	–	–	2.92	1.39	2.92	1.33
>29	3.39	0.21	4.13	1.04	3.58	0.17

Appendix 12 – continued:
Estimates of mean weight-at-age (kg) with coefficients of variation for snapper from the SNA 2N bottom trawl fishery in 2019–20.

Age	Spring-summer		Autumn-winter		Spring-winter	
(years)	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–
2	–	–	0.42	0.60	0.42	0.60
3	0.36	1.07	0.53	0.11	0.52	0.11
4	0.55	0.14	0.66	0.06	0.64	0.05
5	0.65	0.04	0.69	0.03	0.68	0.02
6	0.92	0.04	0.91	0.05	0.91	0.03
7	0.95	0.03	0.94	0.03	0.95	0.02
8	1.09	0.03	1.10	0.05	1.10	0.03
9	1.27	0.07	1.23	0.05	1.26	0.04
10	1.30	0.05	1.32	0.04	1.31	0.03
11	1.51	0.07	1.39	0.10	1.48	0.06
12	1.63	0.07	1.52	0.05	1.59	0.05
13	1.70	0.05	1.90	0.15	1.79	0.06
14	1.86	0.14	1.69	0.19	1.81	0.10
15	1.43	1.10	1.85	1.02	1.68	0.64
16	2.26	0.64	1.89	0.65	2.10	0.32
17	1.64	0.44	1.94	0.27	1.80	0.15
18	1.85	1.05	2.35	0.59	2.16	0.42
19	2.37	0.38	2.21	0.44	2.28	0.19
20	2.77	0.42	2.28	0.58	2.60	0.23
21	2.50	0.10	2.38	0.24	2.46	0.06
22	2.63	0.27	2.98	0.60	2.71	0.15
23	–	–	3.24	1.05	3.24	1.05
24	2.35	1.05	2.77	1.06	2.48	0.63
25	3.24	1.09	3.53	0.63	3.45	0.42
26	3.08	1.02	–	–	3.08	1.02
27	–	–	–	–	–	–
28	–	–	–	–	–	–
29	–	–	4.13	1.04	4.13	1.04
>29	6.61	0.60	4.31	0.51	5.44	0.28

Appendix 13: Estimated mean length-at-age (kg) and coefficients of variation (CVs) for snapper power method fisheries in SNA 1 and SNA 2 in 2019–20.

Estimates of mean length-at-age (cm) with coefficients of variation for snapper from the East Northland bottom trawl fishery in 2019–20.

Age	Spring-summer		Autumn-winter		Spring-winter	
(years)	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–
2	–	–	29.00	0.78	–	–
3	–	–	29.55	0.02	–	–
4	–	–	29.69	0.04	–	–
5	–	–	29.65	0.01	–	–
6	–	–	31.82	0.05	–	–
7	–	–	31.07	0.02	–	–
8	–	–	33.19	0.04	–	–
9	–	–	33.72	0.03	–	–
10	–	–	36.78	0.04	–	–
11	–	–	36.82	0.04	–	–
12	–	–	36.61	0.04	–	–
13	–	–	38.81	0.03	–	–
14	–	–	41.69	0.04	–	–
15	–	–	39.80	0.03	–	–
16	–	–	47.48	0.47	–	–
17	–	–	40.37	0.03	–	–
18	–	–	38.68	0.03	–	–
19	–	–	39.63	0.14	–	–
20	–	–	41.58	0.07	–	–
21	–	–	41.90	0.02	–	–
22	–	–	39.37	0.61	–	–
23	–	–	54.00	1.49	–	–
24	–	–	45.44	0.28	–	–
25	–	–	38.26	0.53	–	–
26	–	–	44.00	0.73	–	–
27	–	–	–	–	–	–
28	–	–	44.00	0.82	–	–
29	–	–	–	–	–	–
>29	–	–	48.67	0.77	–	–

Appendix 13 – continued:
Estimates of mean length-at-age (cm) with coefficients of variation for snapper from the Bay of Plenty bottom trawl fishery in 2019–20.

Age	Spring-summer		Autumn-winter		Spring-winter	
(years)	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–
2	–	–	26.52	0.39	26.52	0.39
3	24.00	0.76	27.79	0.03	27.70	0.03
4	26.26	0.02	27.99	0.01	27.67	0.01
5	27.24	0.01	29.36	0.01	28.43	0.01
6	29.92	0.01	31.51	0.01	31.02	0.01
7	31.29	0.01	32.30	0.01	31.90	0.01
8	32.75	0.01	33.60	0.01	33.24	0.01
9	34.20	0.02	33.67	0.01	33.88	0.01
10	35.40	0.02	35.03	0.02	35.17	0.01
11	35.90	0.02	35.65	0.02	35.76	0.01
12	35.04	0.02	38.29	0.02	37.29	0.01
13	37.65	0.01	38.64	0.02	38.22	0.01
14	36.60	0.02	37.99	0.02	37.59	0.01
15	38.18	0.04	40.18	0.06	38.96	0.03
16	40.48	0.03	39.99	0.03	40.16	0.02
17	39.06	0.02	43.18	0.04	41.02	0.02
18	41.31	0.02	43.92	0.03	42.40	0.02
19	42.71	0.17	44.02	0.03	43.63	0.02
20	47.11	0.04	54.94	0.55	48.49	0.04
21	47.89	0.03	42.40	0.11	46.01	0.04
22	44.70	0.22	48.39	0.07	47.31	0.05
23	49.00	0.75	47.00	0.74	47.65	0.41
24	54.09	0.34	49.75	0.24	51.00	0.10
25	49.00	0.79	50.76	0.06	50.58	0.05
26	47.00	0.70	51.12	0.41	49.91	0.25
27	–	–	–	–	–	–
28	–	–	–	–	–	–
29	–	–	55.34	0.59	55.34	0.53
>29	55.71	0.06	60.54	0.05	58.23	0.03

Appendix 13 – continued:
Estimates of mean length-at-age (cm) with coefficients of variation for snapper from the Hauraki Gulf Danish seine fishery in 2019–20.

Age	Spring-summer		Autumn-winter		Spring-winter	
(years)	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–
2	–	–	–	–	–	–
3	–	–	25.19	0.09	25.19	0.09
4	26.59	0.17	27.41	0.02	27.18	0.01
5	29.20	0.05	29.02	0.02	29.10	0.03
6	27.56	0.01	32.10	0.02	30.41	0.02
7	30.10	0.02	33.04	0.02	31.68	0.02
8	31.00	0.02	33.84	0.01	32.85	0.02
9	31.53	0.02	34.00	0.02	32.71	0.02
10	32.58	0.02	34.99	0.02	33.89	0.02
11	33.00	0.03	34.48	0.01	33.84	0.02
12	34.02	0.01	35.09	0.01	34.66	0.01
13	35.21	0.01	36.24	0.01	35.64	0.01
14	36.13	0.02	38.57	0.02	37.36	0.01
15	36.80	0.02	39.90	0.03	38.06	0.02
16	37.72	0.02	37.29	0.03	37.49	0.02
17	40.35	0.03	39.14	0.03	39.67	0.02
18	38.48	0.02	40.93	0.02	39.75	0.02
19	42.58	0.03	39.55	0.03	40.96	0.02
20	43.21	0.06	42.99	0.06	43.11	0.04
21	41.40	0.06	44.55	0.05	43.22	0.04
22	44.48	0.07	39.18	0.07	41.25	0.05
23	46.00	0.74	40.63	0.40	41.08	0.22
24	46.91	0.14	48.31	0.07	47.63	0.07
25	67.19	0.28	51.00	0.08	54.24	0.07
26	69.04	0.51	52.14	0.13	54.20	0.08
27	54.16	0.44	49.00	0.39	50.56	0.16
28	56.00	0.77	51.00	0.78	52.50	0.38
29	58.21	0.05	54.90	0.15	56.89	0.05
>29	56.57	0.10	56.93	0.09	56.69	0.07

Appendix 13 – continued:
Estimates of mean length-at-age (cm) with coefficients of variation for snapper from the Bay of Plenty Danish seine fishery in 2019–20.

Age	Spring-summer		Autumn-winter		Spring-winter	
(years)	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–
2	–	–	26.64	0.36	26.64	0.36
3	24.00	0.90	28.69	0.02	28.67	0.02
4	27.55	0.03	28.50	0.01	28.36	0.01
5	27.77	0.01	29.76	0.01	28.84	0.01
6	30.02	0.01	31.39	0.01	30.87	0.01
7	30.98	0.01	32.04	0.01	31.53	0.01
8	32.24	0.01	33.04	0.01	32.63	0.01
9	33.30	0.02	33.23	0.01	33.26	0.01
10	34.84	0.02	34.62	0.02	34.71	0.02
11	35.05	0.02	35.13	0.02	35.09	0.01
12	34.35	0.02	38.06	0.02	36.60	0.02
13	37.17	0.02	38.48	0.02	37.85	0.01
14	36.05	0.02	37.85	0.02	37.23	0.02
15	36.83	0.05	39.24	0.07	37.72	0.04
16	40.10	0.02	38.98	0.03	39.33	0.02
17	38.43	0.02	41.62	0.04	39.69	0.02
18	41.35	0.02	42.93	0.03	41.94	0.02
19	42.45	0.17	43.46	0.02	43.14	0.02
20	44.85	0.04	–	–	44.85	0.04
21	45.80	0.03	41.46	0.13	44.22	0.04
22	44.46	0.23	44.32	0.13	44.36	0.04
23	49.00	0.86	47.00	0.79	48.00	0.44
24	59.13	0.42	45.62	0.59	54.48	0.20
25	49.00	0.87	49.89	0.25	49.77	0.16
26	47.00	0.78	49.79	0.64	48.22	0.35
27	–	–	–	–	–	–
28	–	–	–	–	–	–
29	65.00	1.68	62.51	0.70	63.08	0.55
>29	55.31	0.33	64.19	0.54	60.87	0.15

Appendix 13 – continued:
Estimates of mean length-at-age (cm) with coefficients of variation for snapper from the East Northland modular harvest system fishery in 2019–20.

Age	Spring-summer		Autumn-winter		Spring-winter	
(years)	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–
2	–	–	29.00	0.74	29.00	0.74
3	24.47	0.22	27.77	0.03	27.73	0.03
4	27.89	0.02	27.10	0.05	27.18	0.04
5	30.08	0.03	28.51	0.03	28.71	0.03
6	30.50	0.02	29.32	0.06	29.47	0.05
7	32.42	0.02	30.26	0.04	30.64	0.03
8	33.47	0.02	31.74	0.05	32.22	0.03
9	33.42	0.01	32.29	0.04	32.56	0.03
10	36.41	0.02	34.26	0.04	35.12	0.03
11	35.63	0.02	34.66	0.03	34.90	0.02
12	37.47	0.02	34.79	0.05	35.97	0.03
13	37.22	0.02	36.69	0.03	36.97	0.02
14	38.73	0.03	39.85	0.10	39.05	0.03
15	38.43	0.02	38.53	0.05	38.47	0.02
16	43.48	0.05	47.54	0.38	44.82	0.04
17	40.34	0.03	40.04	0.05	40.22	0.02
18	40.02	0.03	37.77	0.03	39.21	0.02
19	42.88	0.02	40.70	0.11	42.24	0.03
20	41.71	0.03	45.06	0.05	43.02	0.03
21	42.87	0.03	44.54	0.03	43.69	0.02
22	45.23	0.04	42.80	0.29	44.14	0.07
23	38.02	0.18	54.00	1.04	39.64	0.17
24	43.51	0.05	46.63	0.15	44.95	0.03
25	45.05	0.13	37.53	0.49	41.57	0.10
26	43.69	0.06	44.00	0.78	43.77	0.04
27	38.20	0.26	–	–	38.20	0.26
28	44.56	0.15	44.00	0.79	44.38	0.09
29	56.00	0.84	55.00	1.03	55.26	0.54
>29	47.92	0.06	52.00	0.12	49.61	0.04

Appendix 13 – continued:
Estimates of mean length-at-age (cm) with coefficients of variation for snapper from the Bay of Plenty modular harvest system fishery in 2019–20.

Age	Spring-summer		Autumn-winter		Spring-winter	
(years)	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–
2	–	–	26.55	0.41	26.55	0.41
3	24.00	0.84	27.52	0.03	27.50	0.03
4	26.30	0.02	27.49	0.01	27.22	0.01
5	27.17	0.01	28.72	0.01	27.83	0.01
6	29.62	0.01	30.83	0.01	30.26	0.01
7	30.86	0.01	31.63	0.01	31.20	0.01
8	32.26	0.01	32.89	0.02	32.51	0.01
9	33.62	0.02	32.94	0.02	33.31	0.01
10	35.07	0.02	34.31	0.03	34.72	0.02
11	35.47	0.02	34.92	0.02	35.26	0.01
12	34.82	0.02	38.16	0.02	36.44	0.02
13	37.76	0.02	38.30	0.02	37.96	0.01
14	36.60	0.02	37.42	0.02	37.05	0.02
15	38.03	0.05	39.29	0.09	38.27	0.04
16	40.68	0.03	39.39	0.03	40.07	0.02
17	39.50	0.03	41.45	0.04	39.97	0.02
18	41.80	0.02	43.14	0.05	42.07	0.02
19	43.06	0.17	43.06	0.05	43.06	0.03
20	46.00	0.04	54.00	1.51	46.20	0.04
21	46.31	0.03	42.42	0.17	45.43	0.03
22	45.47	0.21	48.53	0.11	46.68	0.06
23	49.00	0.77	47.00	0.78	48.14	0.40
24	54.64	0.31	46.19	0.53	51.34	0.14
25	49.00	0.78	53.22	0.39	52.20	0.23
26	47.00	0.75	49.92	0.58	47.84	0.32
27	–	–	–	–	–	–
28	–	–	–	–	–	–
29	–	–	53.00	1.38	53.00	1.31
>29	55.79	0.19	60.00	1.04	56.89	0.14

Appendix 13 – continued:
Estimates of mean length-at-age (cm) with coefficients of variation for snapper from the SNA 2N bottom trawl fishery in 2019–20.

Age	Spring-summer		Autumn-winter		Spring-winter	
(years)	Mean	CV	Mean	CV	Mean	CV
1	–	–	–	–	–	–
2	–	–	26.48	0.59	26.48	0.59
3	25.00	1.07	28.52	0.05	28.23	0.04
4	29.05	0.11	30.95	0.02	30.58	0.02
5	30.78	0.02	31.43	0.01	31.25	0.01
6	34.88	0.01	34.64	0.02	34.77	0.01
7	35.32	0.01	35.22	0.01	35.27	0.01
8	37.17	0.01	37.22	0.02	37.19	0.01
9	39.15	0.02	38.82	0.03	39.01	0.01
10	39.54	0.02	39.76	0.01	39.65	0.01
11	41.64	0.02	40.56	0.08	41.36	0.02
12	42.85	0.02	41.85	0.02	42.48	0.02
13	43.61	0.02	45.23	0.11	44.34	0.02
14	44.75	0.07	43.44	0.17	44.35	0.03
15	41.00	1.10	45.00	1.02	43.43	0.63
16	48.31	0.64	45.21	0.64	46.99	0.30
17	42.89	0.40	45.69	0.25	44.40	0.11
18	45.00	1.05	49.03	0.59	47.51	0.41
19	49.03	0.37	47.74	0.41	48.31	0.16
20	51.94	0.41	48.49	0.58	50.72	0.22
21	49.98	0.08	49.21	0.22	49.71	0.04
22	51.01	0.26	53.35	0.60	51.55	0.14
23	–	–	55.00	1.05	55.00	1.05
24	49.00	1.05	52.00	1.06	49.95	0.63
25	55.00	1.09	56.53	0.61	56.09	0.41
26	54.00	1.02	–	–	54.00	1.02
27	–	–	–	–	–	–
28	–	–	–	–	–	–
29	–	–	60.00	1.04	60.00	1.04
>29	70.95	0.59	60.77	0.50	65.76	0.24

Appendix 14: Depiction of poor conditioned "skinny" snapper caught from the inner Hauraki Gulf fishery (April 2019, November 2021). Commercial fishermen state that such emaciated fish have become a more regular catch in recent years.

Appendix 15: Comparison of area-method proportion-at-age distributions (lines) determined from snapper landings sampled from the SNA 1 stock fisheries in 2019–20 (BLL, bottom longline; BT, bottom trawl; DS, Danish seine; MHS, modular harvest system).