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Landed catch sampling of snapper in SNA 7 in the 2013–14 fishing year

S.J. Parker
D. Parsons
M. Stevenson
C. Sutton
C. Walsh

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A programme to estimate the age composition of snapper (SNA) caught by bottom trawl fisheries targeting snapper (SNA 7) and flatfish (FLA 7) was conducted during the 2013–14 fishing year. The original sampling design required the sampling of 31 landings (each greater than 200 kg), divided approximately evenly between SNA 7 and FLA 7 target landings, from statistical areas 037/038 (Tasman Bay / Golden Bay) and landed at Talley's Seafoods in Nelson and Motueka.

Operational aspects of the fishery changed in 2014, relative to the characterisation conducted with data from 2008 to 2012. By December 2014, most landings were not qualifying for sampling based on the agreed criteria. Discussions with fishers indicated that the change was due to active avoidance of snapper catch, especially as bycatch. Therefore, beginning in January, every landing containing more than 100 kg of snapper from statistical areas 037/038 was sampled in an attempt to representatively sample the fishery without prior expectations of the pattern in landings.

A total of 24 landings were sampled from October through to early April with otoliths collected from a total of 1319 snapper mostly from reported SNA target bottom trawl landings. Data collected were entered into the Ministry for Primary Industries (MPI) Market database and the otoliths stored at National Institute of Water and Atmospheric Research (NIWA) for age determination.

A second objective was to document the length distributions of ten species associated with snapper landings in Tasman Bay / Golden Bay. The main species chosen by the Southern Inshore Working Group for measurement were snapper, John Dory, sand flounder, and red gurnard. A total of 6710 fish were measured from 11 landings.

A comparison of box count data and length composition from the same landings indicated that while box count data may index the size of the majority of the fish landed, it is heavily influenced by the decisions the processor makes regarding the size and numbers of fish sorted for box packing.

A subsample of 850 otoliths from 1260 random age frequency samples across twenty-one SNA 7 landings was selected for ageing. Landings in 2013–14 were dominated by young snapper, with those six years or less collectively making up 96% of the landed catch by number. The 2008 year class (6-year-olds) was singularly the most dominant in the fishery, accounting for at least two in every three (69%) fish landed, and is likely to be significant to the fishery for a number of years. The mean weighted coefficient of variation for the SNA 7 age composition was 24%, and well within the target of 30%.

1. INTRODUCTION

The purpose of this project was to estimate the relative year class strengths of snapper (*Pagrus auratus*) in the SNA 7 commercial catch by sampling landings at the major SNA 7 licenced fish receivers (LFRs) during the 2013/14 fishing year. Sampling involved the collection of length and age composition samples and data from commercial landings before fish were processed. This provides relative catch-at-age information that may be combined with estimates of selectivity-at-age within an age-structured population model to estimate stock age composition and to determine year class strengths of cohorts recruited to the exploitable stock. Snapper stocks characteristically show large inter-annual variability in year class strength, therefore catch-at-age information is an important input into models used for their assessment.

The status of the SNA 7 stock is currently assessed using a standardized CPUE analysis. The previous attempt at an integrated stock assessment was rejected by the working group, which concluded that the model needed a reliable index of abundance (Ministry of Fisheries 2012). In 2011, Hartill & Sutton (2011) developed a standardized CPUE index through to 2009 using data from Statistical Areas 037 and 038, and target SNA, FLA, and BAR single trawl catch data but it was considered uninformative. In 2013, Langley updated the analysis which showed that the 2010 and 2011 CPUE index values increased dramatically. However, the analysis could not distinguish the influences of a strong recruitment event from confounding changes in fishing pattern or targeting, environmental conditions that increased catchability, or biases due to changes in reporting forms. Therefore, an updated catch-at-age sampling programme was suggested to document the current age composition in Statistical Area 038 (Tasman Bay / Golden Bay (TBGB)) and to provide data for a possible updated stock assessment model.

The objectives of the project, as described in the MPI tender document, were:

1. To conduct representative sampling to determine the length, sex and age structure of the commercial catch of snapper in SNA 7 during the 2013/14 and 2014/15 fishing years. The target coefficient of variation (CV) for the catch-at-age is 30% (mean weighted CV across all age classes).
2. To conduct representative sampling to determine the length and species composition of the other species associated with SNA 7 landings from Tasman and Golden Bays.

However, as the catch sampling portion of this project was direct funded by the Southern Inshore Fisheries Management Company, the scope of the project was reduced and split into five key tasks:

1. Characterise the fishery
2. Develop a catch sampling design
3. Present the catch sampling design to a meeting of the MPI Inshore Stock Assessment Working Group on 17 September 2013.
4. Conduct catch sampling Oct 2013 – March 2014 following designated working group design.
5. Determine ages for a representative subset of otoliths collected.

2. METHODS

2.1 Fishery Characterisation

The spatial, temporal and operational details of the SNA 7 fishery were summarised for the period 2008–2012 to inform the design of a catch sampling programme to estimate the size and age composition of the landed catch in fishing year 2013–14. The characterisation was based on an extract from the Ministry for Primary Industry's (MPI) Catch and Effort Database and analysed using procedures developed for this purpose by NIWA (NIWA 2011, R core development Team 2013).

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. Because bottom pair trawl had been a consistent component of the fishery, the characterisation included summarizing data for this gear type, but the catch sampling design specifically excluded this gear type as no landings were expected using bottom pair trawl in the 2013–14 fishing year.

2.2 Catch-at-age Sample Design

The catch sampling design was developed based on the operational details from the fishery characterisation and also included the rationale for deciding which factors to consider in identifying strata to sample while adequately representing the majority of the landed catch.

For each significant component of the fishery that may be considered to have a different selectivity of the age composition of the population, a separate sampling stratum was required. This is because differences in gear type, fishing location, or fishery timing may influence the age of the fish landed. Therefore the age composition for each group must be estimated separately and then combined with the proper weighting for an overall age composition estimate.

An age composition for snapper, which may contain more than 30 age classes, requires more than 400 otoliths to be aged in each stratum to achieve a mean weighted coefficient of variation (MWCV) of 0.30 for the age composition as a whole (Blackwell & Gilbert 2008). Only a single stratum was used for this sampling programme (all months and combined Statistical Areas 037 and 038), while attempting to spread samples temporally throughout the six-month period of October to March. Using the random age frequency approach, fish were selected at random from the catch for sampling, and subsequently otoliths selected for ageing in proportion to the relative weight of the landings (Davies & Walsh 2003). Therefore more otoliths are collected for each stratum and a smaller number chosen from that set to age. Collecting 60 fish per landing required about 15 landings to be sampled per stratum for a robust age estimate in each stratum.

Within each stratum sampled, criteria for how many landings to sample were developed. This entailed balancing the number of landings sampled with the distribution of the total snapper weights of these landings. For example, to characterise the landed catch, large landings are more indicative of the catch than smaller landings. However, large landings are not as common as small landings. The balance of indexing the most catch from the fewest landings was determined graphically and used to set a threshold of landing weight to qualify a landing for sampling.

Finally, because landings were sampled only at major fish processors, the processing facilities where the vessels actually land fish were identified and the number of landings from each stratum were allocated to a processing facility to enable coordination between the processor and the samplers for access to fish in a timely manner.

The agreed catch sampling programme design was implemented from October 2013 – March 2014, with the intention that the catch sampling should match the seasonal pattern in landings. Minor adjustments in the numbers of samples and their timing were expected in order to match the fishery operations in a given year.

All sampling was designed, conducted and analysed following recommended practices documented in “Guidelines to the design, implementation and reporting of catch sampling” (Ministry of Fisheries 2008).

Fish were sampled using the following procedure:

1. Details were obtained from each processor to complete the Landing record: i.e., the vessel, landing weight (all fish), landed weight of SNA, landing date, statistical area relating to the capture of fish in a landing.
2. The sample was assigned a Ministry for Primary Industries market database landing number. This is typically the calendar year, the code for the sampling programme, and a two-digit sample sequence.

3. Approximately 12 bins of fish were chosen from which 60 individuals were selected by removing the 5 fish with their heads closest to the corner nearest to the sampler of each bin.
4. Length (FL), sex, and gonad stage (5 stage method, see Beentjes et al. 2012) were recorded, and both otoliths were removed, cleaned of adhering tissue, dried, and placed in otolith envelopes.
5. The landing number, species, fish number, date, length, sex and sampler initials were recorded on the otolith envelope.
6. Data were recorded on a waterproof Otolith Inventory form
7. A Landing Record form was completed at the end of the sampling.

Two additional components of the catch sampling programme were conducted; length composition sampling of associated species, and a comparison of box packing data with landed catch.

Consistent with the original MPI Objective 2, length data were collected from the major species associated with snapper for each landing sampled during the catch sampling programme. The Southern Inshore Working Group agreed that length composition sampling of species associated with landings containing snapper would include red gurnard, snapper, flatfish complex (speciated), barracouta, John dory, red cod, sand flounder, leather jacket and trevally. For each of these species or species complex codes, bins were selected at random by species and all individuals in each bin measured until either the entire catch of that species was measured or more than 100 fish were measured.

In years when no catch sampling occurs, no information about the size or age composition of the catch is available. However, some information about fish size may be available through the data that licensed fish receivers record (Langley 2013). For example, Talley's Seafoods packs snapper into standard weight boxes (10 kg). They also record how many fish were packed in each box. The general relationship between the length of fish and the number of fish in a box holding 10 kg may provide some coarse information about fish size. To assist in interpreting box count data, we obtained raw box count data from Talley's Motueka for landings sampled for snapper, and compared the length distribution of the sampled fish from those landings with the size distribution inferred from the box count data.

2.3 Snapper age determination

A standardised procedure for reading otoliths was followed, outlined in the age determination protocol for snapper (Walsh et al. 2014a). Two readers were used in ageing SNA 7 otolith samples in 2013–14, with neither reader having any prior knowledge of the other's zone count obtained, or of the fish length. For otoliths where both readers agreed on the zone count, the age was determined from this count. When readers disagreed, the otolith was re-examined to determine the likely source of disagreement, and a final count agreed upon. The forced margin method was implemented to anticipate the otolith margin type (wide, line, narrow) *a priori* based on 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 are increased by 1 year (e.g., 3W is aged as a 4 year old) while '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 with 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.

2.4 Snapper 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 7 bottom trawl fishery from the random age frequency samples collected from each landing. Proportions at age across all landings within the sampling period were estimated from sample proportions, weighted by the estimated number of fish in each landing. Proportions-at-age were calculated for the range of fishing year age classes (herein referred to as “age classes” encompassing October 2013 to March 2014) recruited, with the maximum age being an aggregate of all age classes over 29 years. Estimates of mean age were calculated such that all fish comprising the aggregate (over 29 years) age group were assigned an age of 30. (Appendix I)

3. RESULTS

3.1 Fishery Characterisation

A characterisation of the SNA 7 fishery, spanning fishing years 2007–08 to 2011–12, was conducted to provide the context for designing a catch sampling programme for the 2013–14 fishing year.

The SNA 7 fishery has been a 180–200 t fishery with landings dominated by bottom trawl (78%, Figure 1a). Bottom pair trawl landings comprised about 17% of the landings up to 2012, but this gear type was not used in 2013. The characterisation was therefore focused on bottom trawl landings only.

The majority of bottom trawl catch occurred in Statistical Area 038 (Tasman Bay/ Golden Bay), with minor landings from Statistical Areas 017, 035–037 and 039 (Figure 1b). Many trips (73% of BT catch) straddled Statistical Areas 037 and 038. No time trend in the spatial location of fishing effort or catch was noted.

The monthly pattern in landings was similar for 2008–2012, with most catch occurring in October through to December, significant catch continuing monthly through to April, and a diminishing trend for the remainder of the fishing year (Figure 1c). An average of 68% of the bottom trawl landings occurred between October and March.

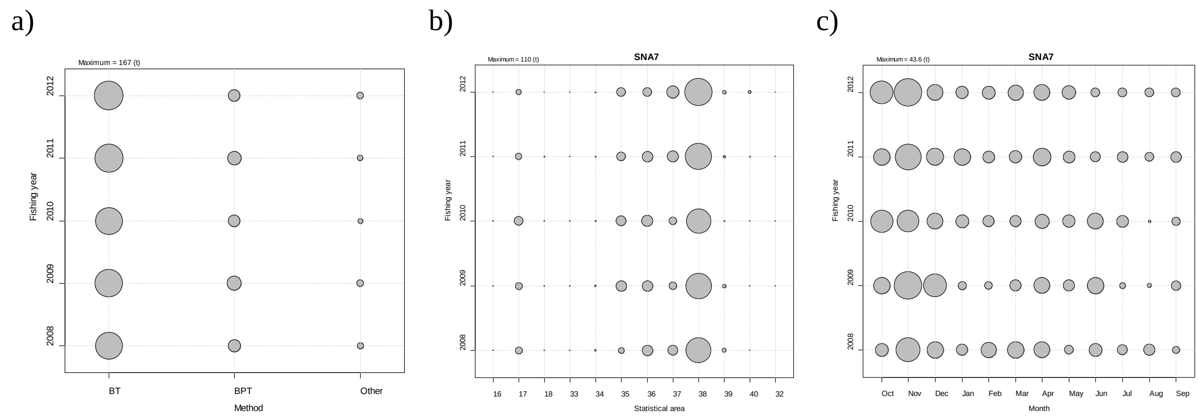

Figure 1: a) Landings of snapper in SNA 7 by gear type; b) Statistical Area for bottom trawl only, and c) by month from fishing years 2008–2012.

3.2 Sampling Design

Based on the brief characterisation described above, the Southern Inshore Working Group (17 September 2013) agreed to constrain sampling to the bottom trawl landings occurring in Statistical Areas 037 and 038, with target species of SNA or FLA during October – March. If the fishery performed as it did in 2008–2012, the sampling programme would have had access to approximately 70 t of SNA 7 catch and 220 landings (Table 1).

Table 1: Number of annual landings and associated catch based on progressively constraining SNA fishery landings by fishery operational details in 2008–2012.BT = Bottom Trawl, SNA =snapper target trips, FLA = flatfish target trips.

Constraint	5 year mean number of landings	5 year mean catch (t)	2012 catch (t)
All SNA 7	2 011	196	208
BT only	1 695	154	167
BT+ (037,038)	826	133	113
BT+037,038+SNA,FLA	402	84	92
BT+037,038+SNA,FLA+Oct-Mar	220	76	68

A landing weight criterion of 300 kg was chosen as it reduced the number of landings available to sample by more than 70%, while only reducing the total amount of catch qualifying as sampling by 16% (Figure 2a). The working group agreed to sample 31 landings between October and March, following the expected seasonal pattern of the fishery. As most SNA 7 catch had been landed at Talley's Nelson from 2008–2012, about two-thirds of the landings were expected to be sampled in Nelson (Figure 2b).

a) b)

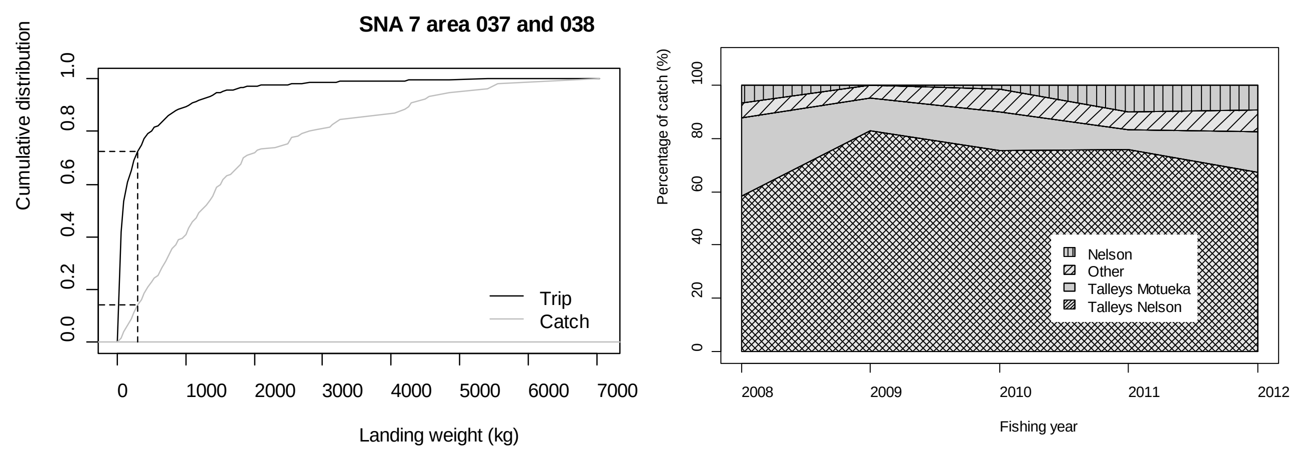

Figure 2: a) Cumulative distribution of SNA 7 landings by number of trips and weight of catch. Dashed lines indicate the proportion of trip and proportion of catch excluded with a landing weight criterion of more than 300 kg. b) Percentage of the catch landed into the main Nelson region processors 2008–2012.

3.3 Sample Representativeness

Landings were sampled from October 2013 through to April 2014. A total of 24 landings were sampled. However, due to inadequate information available at landing, one landing was sampled in error as it was from a non-qualifying statistical area, and one was discovered to be from a non-qualifying gear type (Appendix II).

The updated characterisation showed some changes in the fishery operations in the 2014 fishing year (through to April 2014). No bottom pair trawling was conducted in SNA 7 during the 2013 or 2014 fishing years (Figure 3a). The amount of landed snapper from target SNA fishing was reduced while targeting of GUR, WAR and BAR increased compared with 2013 (Figure 3b). Further, compared to 2013, the overall catches by month in 2014 were lower in the first quarter of the fishing year, and higher in the second quarter (Figure 3c). In addition, although the FLA target landings of SNA 7 was the same or larger in 2014 than in previous years, processors identified these catches as SNA target landings, as processors often do not know the target species of a trip at landing. The combination of these changes led to few samples qualifying as FLA target landings, with most landings either being SNA target, or landing well less than 300 kg of SNA. To ensure that sufficient samples were obtained, and that these were representative of the fishery, all landings greater than 100 kg were sampled from January through to April 2014.

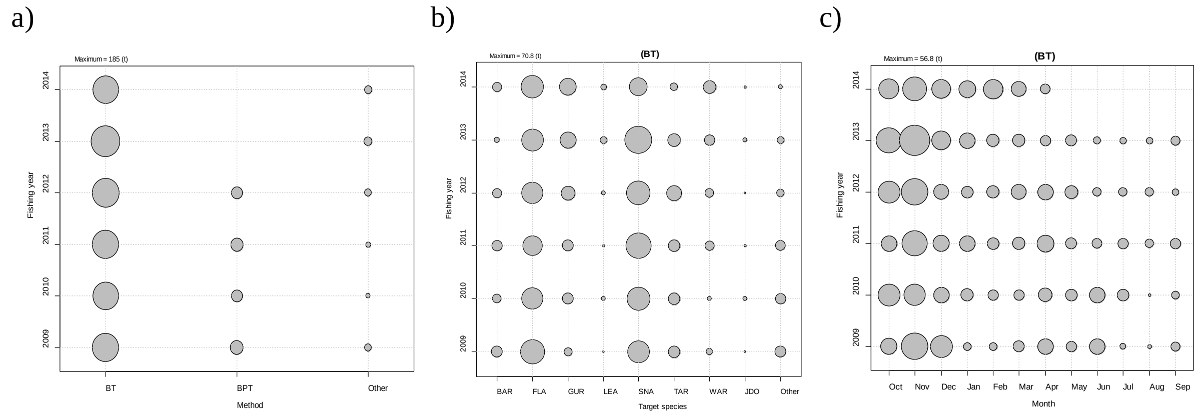

Figure 3: a) Landings of snapper in SNA 7 by gear type; b) Target species for bottom trawl only, and c) by month from fishing years 2009–2014. NB: 2014 includes data only through to April of 2014.

There was no detectable shift in the spatial distribution of catch during the 2013/14 fishing year to April, compared with previous years (Figure 4). Anecdotally, some vessels moved their operations to the West Coast of the South Island, and some fishers indicated that they were adapting their gear and fishing behaviour to avoid snapper, so that their limited quota did not interfere with their ability to fish for gurnard or flatfish.

The number of landings sampled showed a similar pattern to the number of landings in the fishery except for December and January (Figure 5a). In December, no landings qualified as FLA target landings as described above, so the proportion sampled was low relative to the number of trips. In January, the switch to sampling all landings resulted in sampling a higher proportion of landings. Sampling representativeness progressively improved through April as the number of landings in the fishery declined. This pattern was also observed in the landings targeted by month versus samples achieved (Figure 5b).

The scaled length composition for the sampled catch indicated two size modes: 26 cm and 36 cm (Figure 6). Because snapper smaller than 25 cm may be discarded, the 26 cm mode may actually indicate a smaller size mode selected by the fishery.

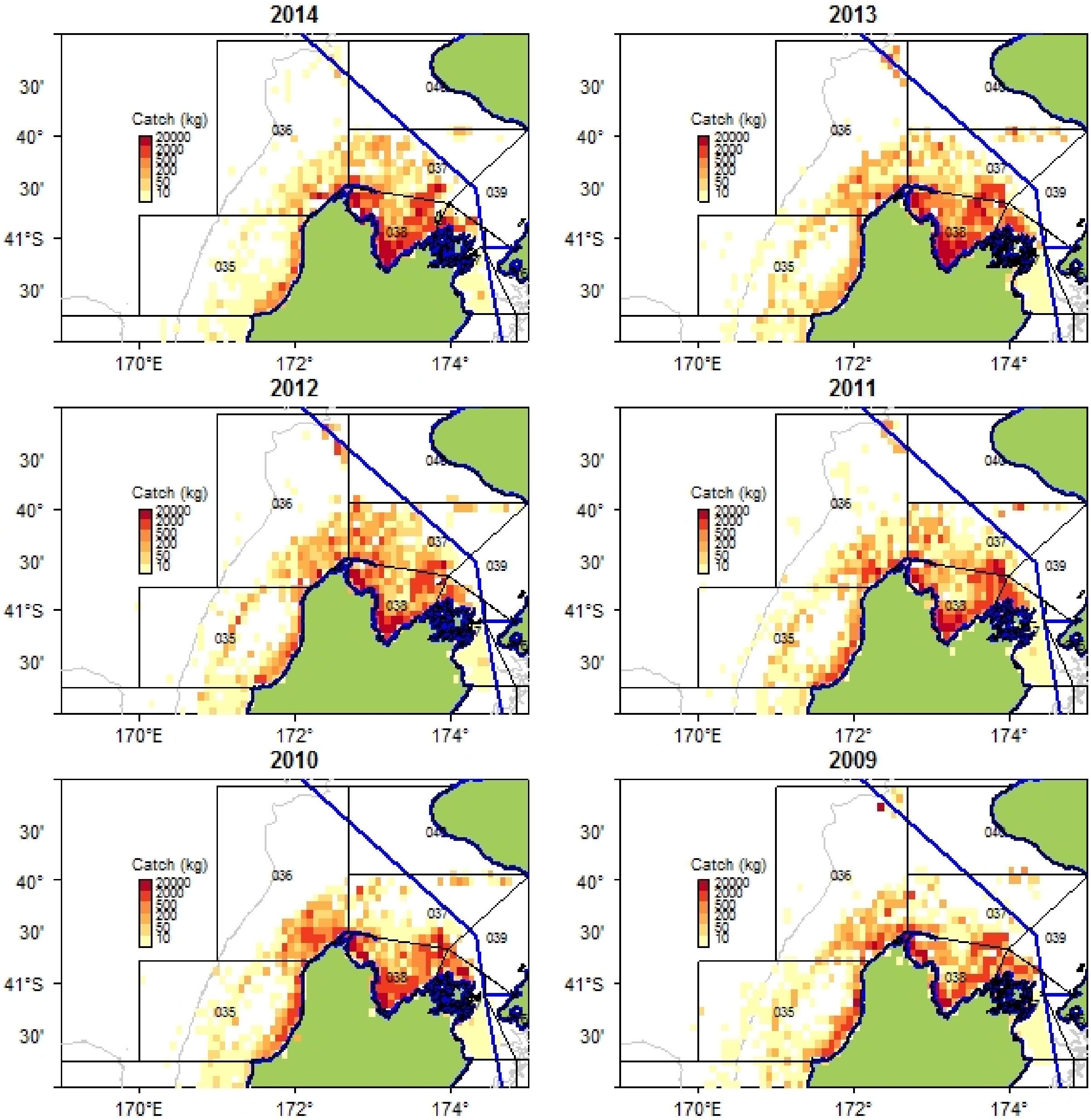

Figure 4: Spatial distribution of reported SNA 7 catch around the northern South Island, 2009–2014. Black lines delineate Statistical Areas and blue lines indicate boundaries of Quota Management Areas.

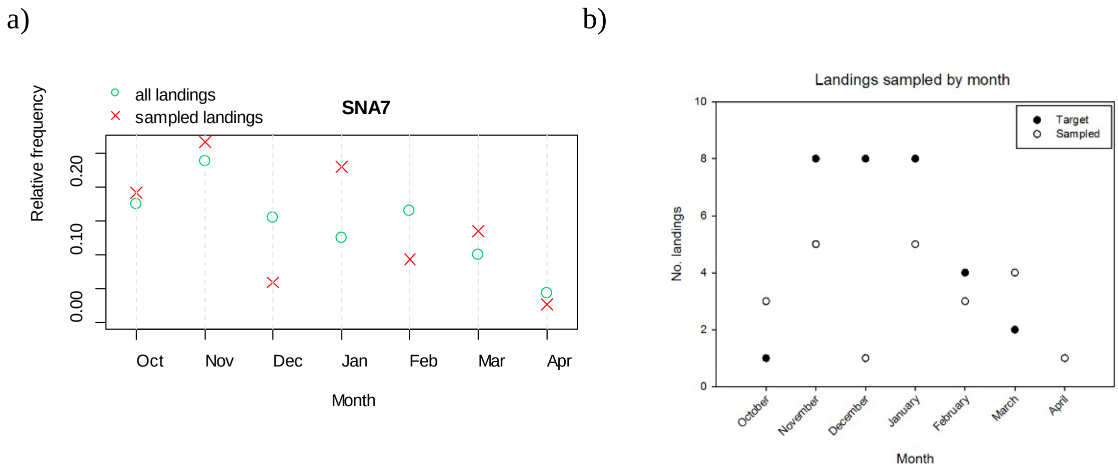

Figure 5: a) Relative proportions of landings sampled by the catch sampling programme compared with the relative frequency of landings of SNA 7 in the 2014 fishing year. b) Number of landings targeted by month (combined SNA and FLA target) versus number of landings sampled.

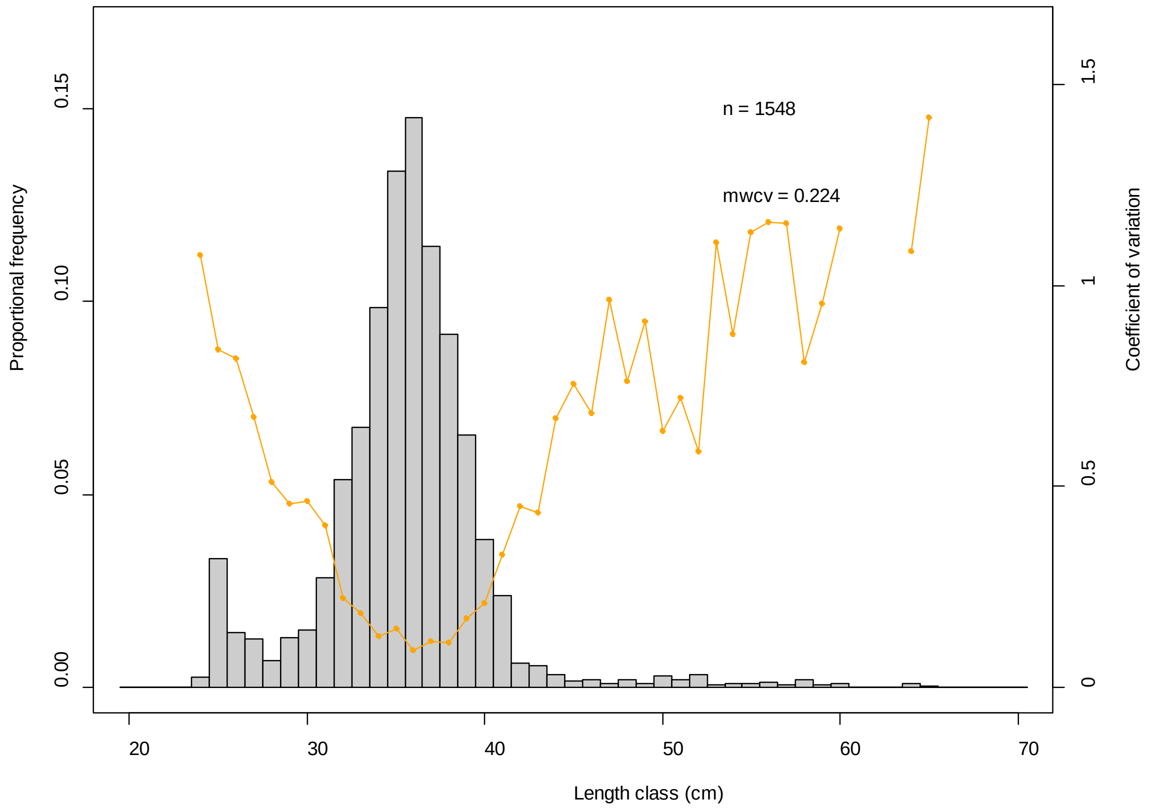

Figure 6: Scaled length composition for SNA and FLA bottom trawl landings in Statistical Areas 037/038 for the 2014 fishing year through to April 2014. Orange points indicate the coefficient of variation for each length class.

3.4 Length Composition of other species

Length compositions were recorded for the main non-elasmobranch species in the sampled landings. These length data were entered into the *Market* database. A summary of the number of fish measured by species and landing is presented in (Table 2). Fish landed as FLA were split into component species where possible.

Table 2: Number of fish of each selected species measured from landings sampled for snapper during the 2014 catch sampling programme. SNA= snapper, JDO = John dory, SFL = sand flounder, GUR =red gurnard, BAR = barracouta, LEA =leather jacket, RCO = red cod, ESO = English sole, NMP = terakihi, LSO = lemon sole, YBF = yellow-bellied flounder, FLA = unspecified flatfish, TRE = trevally, GFL = green flounder.

Sample no.	Date	SNA	JDO	SFL	GUR	BAR	LEA	RCO	ESO	NMP	LSO	YBF	FLA	TRE	GFL
20131301	24/10/2013	209	100	112	121	106	104	44		108					
20131302	31/10/2013	136	103	13	114	102	105	34		149	22			2	
20131303	31/10/2013	124	115	124	119	109	129	5		122			28		
20131304	5/11/2013	216													
20131305	5/11/2013	134	4	21	54				9		1	52			
20131306	5/11/2013	123	56	168	126	6		12	33		4	17			
20131307	11/11/2013	154	52	117		2			3			3			
20131308	19/11/2013	140													
20131310	5/12/2013	130	10	204	107	6	1		48		5				5
20141311	10/01/2014	60													
20141312	11/01/2014	60			146										
20141313	17/01/2014	60		111	105				21		5	23			
20141314	30/01/2014	104	12	99	100	3			13		29	67	28		
20141315	29/01/2014	124													
20141316	13/02/2014	60													
20141317	18/02/2014	100													
20141318	18/02/2014	102													
20141319	13/03/2014	119													
20141320	25/03/2014	125													
20141321	24/03/2014	133													
20141422	28/03/2014	100	99												
20141423	4/04/2014	120													

3.5 Snapper measured length compared with box count data

Length compositions of snapper from individual sampled landings were compared with box count data as provided by Talley's Seafoods Motueka (Figure 7). Box count data generally reflected the main mode of the landed catch because most of the fish packed in boxes would be from the main size mode of the landing. For some landings with more than one mode, the box count data did not replicate both modes, and often missed the tails of the distribution (e.g. large fish). One category in the box count data is a "> 25 cm" category, which indicates un-sized fish. The proportion of the catch in this category varied greatly among landings.

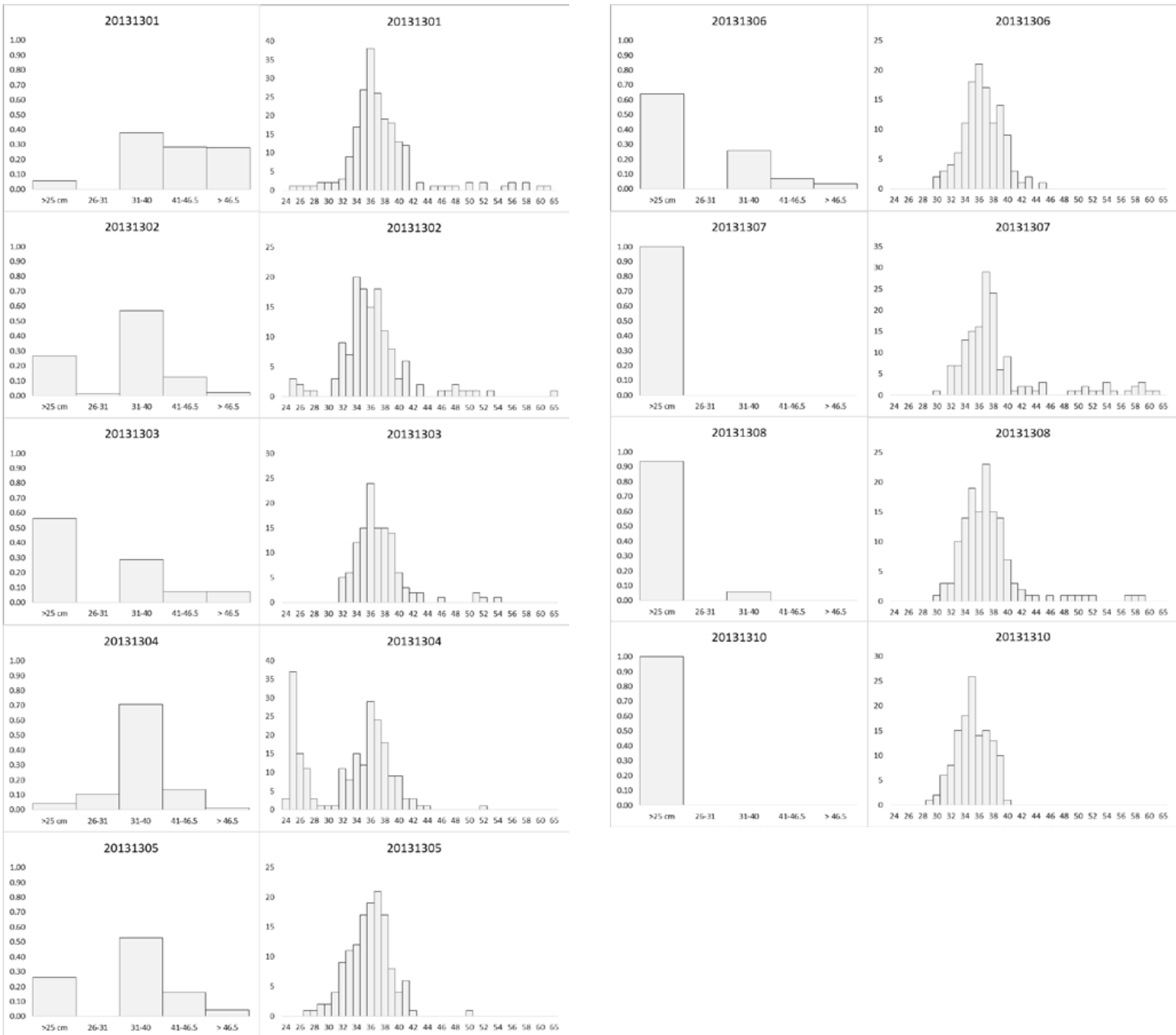

Figure 7: Box count data (see text for explanation) and associated length composition of snapper sampled from the corresponding landing from nine SNA 7 target landings.

3.6 Snapper otolith readings

Reader comparison tests for reference readings

To assess reader competency in ageing snapper otoliths in 2013–14, each of the two 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). Both readers 1 and 2 achieved CV and IAPE scores below the targets of 1.5% for IAPE and 2.12% for CV (Table 3).

Table 3: Reader comparison scores determined from ageing 50 randomly selected snapper reference otolith samples ranging in age from 3 to 49 years.

	CV	IAPE	Agreed age	Pass/Fail
Target	2.12%	1.50%	–	–
Reader 1	0.15%	0.11%	92%	Pass
Reader 2	0.79%	0.56%	80%	Pass

3.7 Ageing SNA 7 otolith samples from 2013–14

A subsample of 850 otoliths from 1260 random age frequency samples across twenty-one SNA 7 landings was selected for ageing. The length distribution of the subsampled fish was representative of the larger random age frequency sample (Figures 8 and 9).

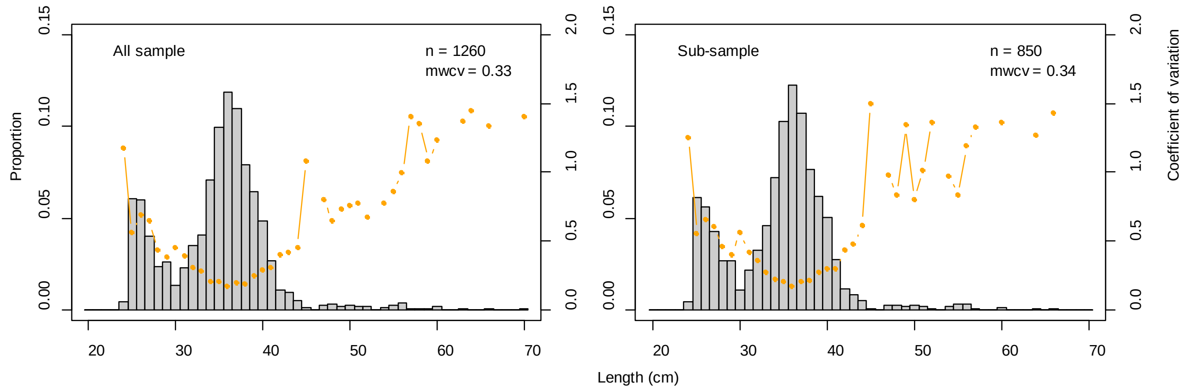

Figure 8: Proportion at length distributions (histograms) and CVs (lines) of the random age frequency sample (and subsample) determined from snapper landings sampled from the SNA 7 bottom trawl fishery in 2013–14 over October–March (n, sample size; mwcv, mean weighted CV).

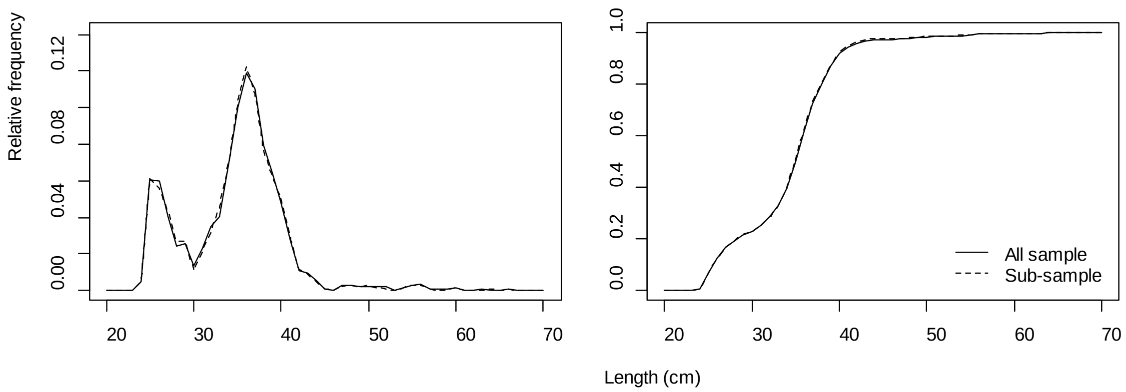

Figure 9: Comparison of the proportion and cumulative proportion at length distributions of the random age frequency sample (solid line), and subsample (dashed line) determined from snapper landings sampled from the SNA 7 bottom trawl fishery in 2013–14 over October–March.

3.8 Reader comparison tests for SNA 7 readings

Of the total subsample of 850 otoliths selected for ageing, all but two otoliths were successfully aged. Between-reader tests from reading these 848 otoliths showed a high level of consistency between readers (Figure 10). Overall there was a high level of agreement (99.4%) between the readers and only very minor systematic differences (bias) in the counts of first annuli of the otoliths (Figures 10a–c). Between-reader CV and IAPE scores were less than 0.1% (Figure 10c) and the analyses show that precision was high across almost all age classes (Figure 10d). Comparisons of age-bias plots for readers 1 and 2 with the agreed age show that overall agreement was excellent (100% and 99.4%) and precision was high, with CV and IAPE estimates less than 0.1% (Figures 10e and f).

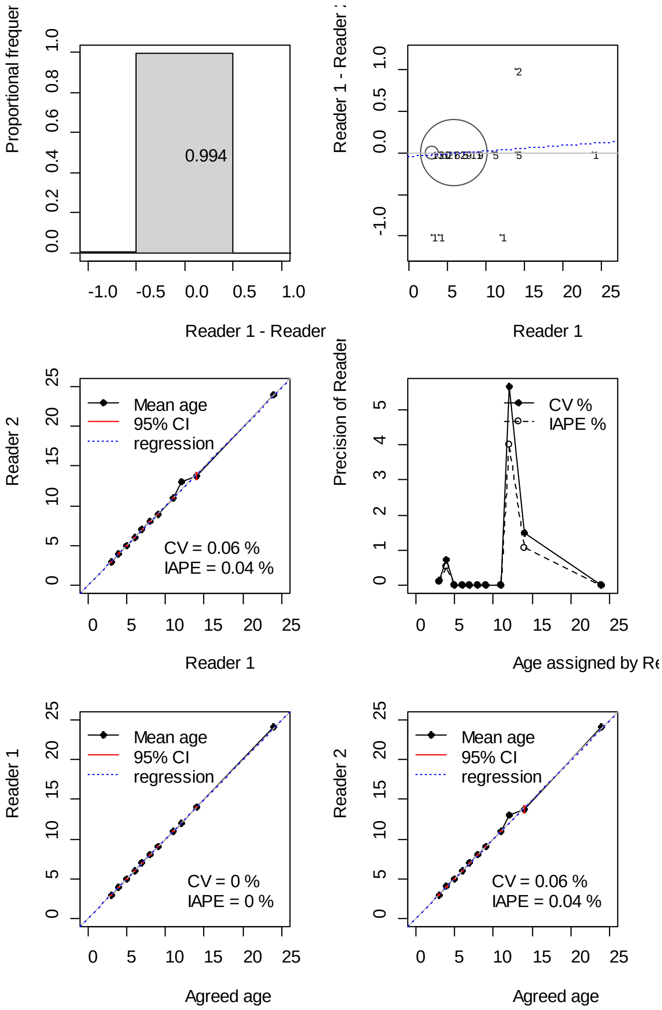

Figure 10: Results of between-reader comparison tests (reader 1 and 2) for SNA 7 otoliths collected in 2013–14 (n = 848): (a) histogram of differences between readings for the same otolith; (b) differences between readers for a given age assigned by reader 1; (c) bias plot between readers; (d) CV and IAPE profiles (precision) relative to the age assigned by reader 1; (e, f) bias plot between reader 1 and reader 2 and agreed age. The expected perfect agreement (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).

3.9 SNA 7 bottom trawl catch-at-age estimates

Catch-at-age compositions with bootstrapped variance estimates were derived for two periods; October to March and October to January (Figure 11, Appendix III). Cumulative proportion-at-age comparisons for these two periods are given in Figure 12.

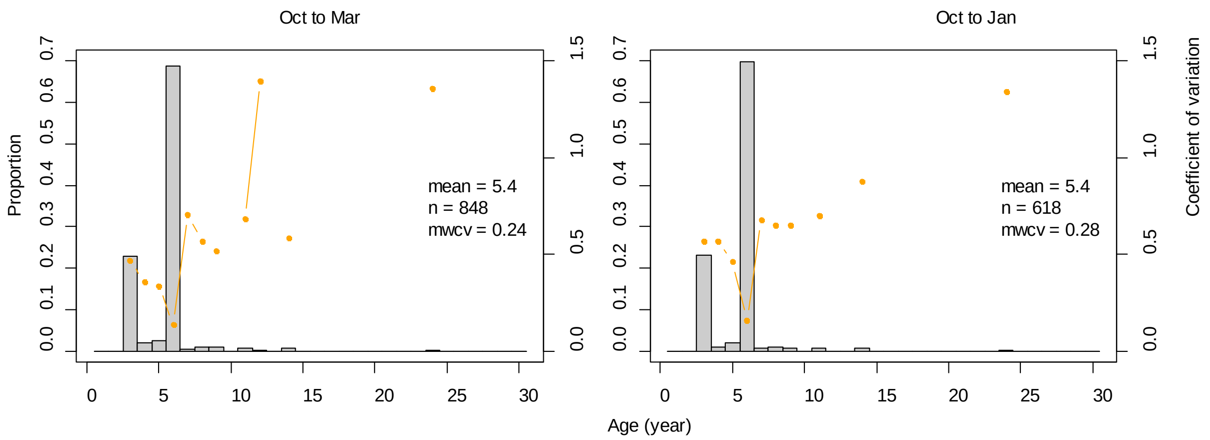

Figure 11: Proportion-at-age distributions (histograms) and CVs (lines) determined from snapper landings sampled from the SNA 7 bottom trawl fishery in 2013–14 over October–March and October–January (n, sample size; mwcv, mean weighted CV).

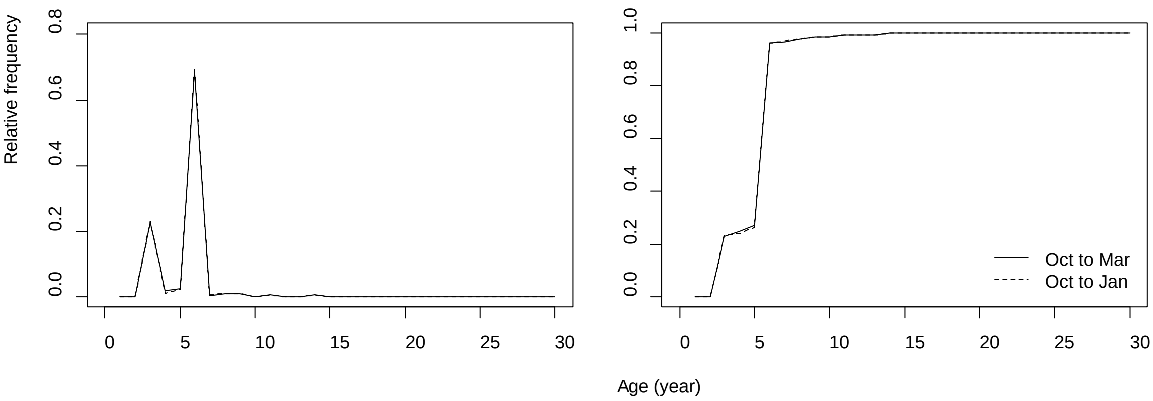

Figure 12: Comparison of the proportion and cumulative proportion-at-age distributions determined from snapper landings sampled from the SNA 7 bottom trawl fishery in 2013–14 over October–March (solid line) and October–January (dashed line).

The 2008 year class (6-year-olds) was overwhelmingly the dominant year class in the SNA 7 fishery in 2013–14 and accounted for approximately two in every three (69%) fish landed by bottom trawl over the October to March period (Figure 11, Appendix 3). The 2011 year class (3-year-olds), the only other prominent year class in the fishery, made up 23% of the catch by number, but was unlikely to be fully recruited as it contained a proportion of fish in the 25–27 cm length intervals (see age-length key, Appendix 1), and a distribution which appeared knife-edged at 25 cm, as a result of the minimum legal commercial size limit (see Figure 8). As the 2008 and 2011 year classes combined accounted for a total of 92% of all snapper landed, largely represented in the length composition by the two main modes at 36 and 26 cm, respectively (see Figure 6), all other year classes were based on relatively low numbers of fish and appear weak in comparison. The oldest fish sampled from the fishery in 2013–14 was 24 years, the only fish over 20 years of age in the subsample of 848 fish that were aged (Figure 11). The mean age of snapper in the SNA 7 fishery over October to March was 5.4 years and the MWCV was 0.24, the precision indicative of moderately high between-landing variability. There was a high level of consistency in the proportion-at-age estimates derived for the two periods; October to March, and October to January (Figures 11 and 12, Appendix III).

4. DISCUSSION

The SNA 7 bottom trawl fishery targeting SNA and FLA in statistical areas 037 and 038 was sampled for length and otoliths during the first half of the 2014 fishing year. A total of 22 landings were sampled and 1319 pairs of otoliths collected. These otoliths are available for processing to estimate age composition of the landed catch.

The number of samples achieved in December and January 2014 was low relative to predicted landings from the 2008–2012 characterisation. Taken together, these plots indicate that early in the programme, the sampling programme was effectively tracking the fishery, but changes in the pattern of fishery landings resulted in undersampling in December and oversampling in January. The effect of this on the subsequent age composition analysis will be minor as month is not a stratum in the sampling design and therefore all samples were pooled for the age composition analysis. The samples used here to derive proportional length and age distributions are representative descriptions of commercial bottom trawl landings from SNA 7 in 2013–14, and should therefore be comparable to those collections from past years. The purpose of describing the sampling design issues was to highlight that in small fisheries, small changes in fishery operations can dramatically alter the applicability of a fishery characterisation to future fishing years and therefore sampling programme designs that are flexible with respect to changes in the fishery, including changes in target species, are needed if defined strata within programmes are to be maintained.

Fish from 14 species codes were measured as associated species landed with snapper from 11 of the 24 sampled landings. However, obtaining this information presented several issues to be considered if these types of data are to be requested in the future. First, when fish are landed they are often transported very quickly to another site and often by species. Requiring a sample from up to ten species creates logistical problems for processor staff needed to ferry the pallets of samples to the measuring station, and it prevents shipments from departing while couriers wait for catch to be measured. Second, when fish is not immediately transported, it is often stored by species in a cold store. Because bins of fish are aggregated by species and not by landing, it is often difficult to identify which bins are from a specific landing. And lastly, the fork lift drivers and managers often do not have paperwork on all the associated catch from a particular landing, and those are the staff coordinating the sampling on site. Information about the total landed catch by species is often not available until after the catch is sampled. Discovering that a species has been left out is often too late to remedy. In the last few months of the programme, most sampling occurred in Motueka on fish that had been transported from Nelson. This typically made identifying and locating associated species from that landing impossible, and hence not all sampled landings had associated species measured for length (Table 2). The logistical difficulties in sampling many species from a given landing are not insurmountable, but would require more sampling staff to increase speed, a greater commitment and communication process with processors, and more time to organise and verify catch.

Box count data often characterised the main size mode of snapper within a landing, but presented several issues that impact the ability to use the data as an index of the length distribution of the landed catch. Firstly, only landings where very little of the catch is categorised as "> 25 cm" should be used because there is no information concerning the representativeness of the catch in the remaining categories, and the proportion of the landings in the "> 25 cm" category vary dramatically among landings. Second, there is no information about other components of the catch being diverted to other destinations. For example, if a processor grades out large fish for a particular market and only packs smaller fish in boxes, then a biased size distribution would result. And lastly, there is no information about the potential for processors to change how they box grade fish through time. Time trends in box count data may simply reflect the development or diminishing of a market for a certain size class of fish. Therefore, although box count data may in fact represent coarse changes in the size composition of landed snapper through time, it may do so only for uni-modal size distributions and is likely only to index the most common sized fish present in the landing.

Snapper catch-at-age samples collected in 2013–14 provide the first opportunity to view the age composition of the Tasman Bay/Golden Bay substock of the SNA 7 fishery for seven years, as sampling was last conducted in 2006–07 (Blackwell & Gilbert 2008). Although snapper can be considered a long lived species, the current age structure of SNA 7 depicts two young year classes, 2008 and 2011 (6- and 3-year-olds) that dominate the fishery, with few older age classes present. In 2013–14, 96% of snapper landed by bottom trawl in SNA 7 were six years or less.

Although recruitment strength may vary widely for snapper with strong and weak year classes entering a stock (Smith & Francis 1991) and be positively correlated to sea surface temperature (Francis 1993), SNA 7 is at the southern limit of snapper distribution, is a small stock in comparison to others in New Zealand, and is particularly prone to variable recruitment (Blackwell et al. 1999, 2000, Blackwell & Gilbert 2001, 2002, 2005, 2008, Walsh et al. 2012). The catch-at-age composition of the SNA 7 fishery in 2013–14 is a good example, depicting significant variation in the relative strengths among year classes. Furthermore, although the fishery currently comprises a high abundance of young fish, there also appears to have been a significant decline in relative abundance of old fish (i.e., those 20 years and older) in the catch-at-age time series, and most obvious in recent years (Blackwell & Gilbert 2005, 2008). Nevertheless, South Island snapper generally exhibit the fastest growth rates (Longhurst 1958, Paul & Tarring 1980, Walsh et al. 2012). It is highly likely that if the 2008 year class (6-year-olds) remains as strong as it appears in 2013–14, relative to other year classes, then its relative contribution in terms of weight will be of considerable importance to the fishery for a number of years.

The SNA 7 MWCV of 0.24 was well below the target objective of 0.30 for the project. However, this estimate appears high compared to those MWCVs reported for SNA 1 sampling (Walsh et al. 2014b) given that the SNA 7 fishery is largely based on young snapper and has an age sample in excess of 800 otoliths. Moderate precision estimates for SNA 7 age compositions in 2013–14 are most likely due to the between-landing variability in the relative proportions of the 2008 and 2011 year classes across sampled landings (Appendix IV). A total of 18 landings were dominated by the 2008 year class comprising 47–100% by number of 6-year-olds, the remaining other three landings dominated by the 2011 year class comprising 52–91% by number of 3-year-olds. It is possible that some landings may be represented by schools of snapper that are spatially disaggregated by year class (or cohorts) within the SNA 7 fishery, or that those particular landings represented snapper from different locations within the statistical area.

5. MANAGEMENT IMPLICATIONS

The catch at age in 2013–14 was dominated by a single 6-year old year class. A second year class may also be strong, although it was only partially recruited in the 2013–14 fishing year and may be the result of a spatial effect of fishing. Few old fish were observed in the catch. The presence of only a single strong year class and the lack of old fish in the catch may have implications for future stock status, resulting from the combination of growth, maturation, and fishing mortality.

We recommend that the SNA 7 bottom trawl catch be sampled in 2015–16 to determine if a second strong year class is entering the fishery.

6. ACKNOWLEDGMENTS

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Appendix 1. **Estimates of proportion of length-at-age for snapper sampled from the SNA 7 bottom trawl fishery, October–March 2013–14. (Note: Aged to 01/01/14).**

Length																				Age (years)	No.
(cm)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	>19	aged
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
25	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30
26	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27
27	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
28	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
29	0	0	0.90	0.05	0	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
30	0	0	0.70	0	0.10	0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
31	0	0	0.35	0.10	0.15	0.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
32	0	0	0.04	0.07	0.04	0.85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27
33	0	0	0	0.11	0.07	0.82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44
34	0	0	0	0.03	0.06	0.90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	63
35	0	0	0	0.03	0.02	0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	94
36	0	0	0	0.02	0.02	0.95	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	110
37	0	0	0	0.03	0.04	0.93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	104
38	0	0	0	0.01	0.03	0.95	0	0.01	0	0	0	0	0	0	0	0	0	0	0	0	74
39	0	0	0	0	0.03	0.94	0.02	0.02	0	0	0	0	0	0	0	0	0	0	0	0	64
40	0	0	0	0	0	0.98	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	43
41	0	0	0	0	0.08	0.72	0.04	0.08	0.08	0	0	0	0	0	0	0	0	0	0	0	25
42	0	0	0	0	0	0.93	0.07	0	0	0	0	0	0	0	0	0	0	0	0	0	14
43	0	0	0	0	0.13	0.63	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	8
44	0	0	0	0	0	0.40	0	0.20	0.40	0	0	0	0	0	0	0	0	0	0	0	5
45	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	1
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	0	0	0	0	0	0.50	0	0	0.50	0	0	0	0	0	0	0	0	0	0	0	2
48	0	0	0	0	0	0	0	0.33	0.67	0	0	0	0	0	0	0	0	0	0	0	3
49	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	1
50	0	0	0	0	0	0	0	0.33	0.33	0	0.33	0	0	0	0	0	0	0	0	0	3
51	0	0	0	0	0	0	0	0.50	0	0	0.50	0	0	0	0	0	0	0	0	0	2
52	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	1
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	0.50	0.50	0	0	0	0	0	0	0	0	2
55	0	0	0	0	0	0	0	0	0	0	0.33	0	0	0.67	0	0	0	0	0	0	3
56	0	0	0	0	0	0	0	0	0	0	0.50	0	0	0.50	0	0	0	0	0	0	2
57	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	1
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	1.00	0	0	0	0	0	0	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	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	1.00	1
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	1.00	0	0	0	0	0	0	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	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																					848

***Appendix 2*. Landings sampled for SNA 7 age composition and bycatch length frequency samples under project SNA201302. Note that samples 20131309 and 20141424 were disqualified due to non-qualifying statistical area and gear type, respectively. Note that target species is that recorded in the logbook, not reported at the time of sampling.**

Sample number	Date sampled	Location sampled	Target species	Landing weight (kg)	Sample weight (kg)	Statistical Area	Number sampled	Number of otoliths
20131301	24/10/2013	Nelson	SNA	1951.5	304.5	038	209	60
20131302	31/10/2013	Nelson	SNA	648	184	038	136	60
20131303	31/10/2013	Nelson	SNA	665.5	177	038	124	60
20131304	5/11/2013	Nelson	SNA	1698.5	194.5	038	216	60
20131305	6/11/2013	Nelson	SNA	1057	150	038	134	60
20131306	6/11/2013	Nelson	SNA	859.5	143	038	123	60
20131307	12/11/2013	Motueka	SNA	308	227	038	154	60
20131308	20/11/2013	Motueka	SNA	627.5	175.5	038	140	60
20131309	26/11/2013	Motueka	NMP	483.5	152	040	88	60
20131310	6/12/2013	Motueka	SNA	1012	132	038	130	60
20141411	13/01/2014	Nelson	SNA	684.5	NA	038	60	60
20131412	13/01/2014	Motueka	SNA	1130.5	57.1	038	60	60
20141413	17/01/2014	Motueka	SNA	405	56.5	038	60	60
20141414	30/01/2014	Nelson	SNA	1136.5	52	038	104	60
20141415	30/01/2014	Motueka	SNA	571	196	038	124	60
20141416	14/02/2014	Nelson	SNA	442.5	76.6	038	60	60
20141417	18/02/2014	Motueka	SNA	784	145.2	038	100	60
20141418	18/02/2014	Motueka	SNA	352	86.2	038	102	60
20141419	14/03/2014	Motueka	SNA	725.5	151.3	038	119	60
20141420	26/03/2014	Motueka	GUR	677	133.5	038	133	60
20141421	26/03/2014	Motueka	FLA	264	119	038	125	60
20141422	28/03/2014	Motueka	SNA	627	128.5	038	100	60
20141423	4/04/2014	Motueka	FLA	461.5	151	038	120	59
20141424	14/04/2014	Motueka	NA	NA	187	038	135	60

***Appendix 3*. Estimated proportion-at-age and CVs for snapper sampled from the SNA 7 bottom trawl fishery, October–March and October–January 2013–14.**

	Random age frequency from bottom trawl			
Age	Oct–Mar		Oct–Jan	
(years)	*P.j.*	CV	*P.j.*	CV
1	0.0000	0.00	0.0000	0.00
2	0.0000	0.00	0.0000	0.00
3	0.2282	0.47	0.2318	0.57
4	0.0191	0.36	0.0105	0.57
5	0.0253	0.33	0.0203	0.46
6	0.6891	0.13	0.6995	0.16
7	0.0045	0.70	0.0057	0.68
8	0.0092	0.57	0.0100	0.65
9	0.0103	0.52	0.0081	0.65
10	0.0000	0.00	0.0000	0.00
11	0.0059	0.68	0.0075	0.70
12	0.0008	1.40	0.0000	0.00
13	0.0000	0.00	0.0000	0.00
14	0.0070	0.59	0.0058	0.88
15	0.0000	0.00	0.0000	0.00
16	0.0000	0.00	0.0000	0.00
17	0.0000	0.00	0.0000	0.00
18	0.0000	0.00	0.0000	0.00
19	0.0000	0.00	0.0000	0.00
20	0.0000	0.00	0.0000	0.00
21	0.0000	0.00	0.0000	0.00
22	0.0000	0.00	0.0000	0.00
23	0.0000	0.00	0.0000	0.00
24	0.0006	1.36	0.0008	1.34
25	0.0000	0.00	0.0000	0.00
26	0.0000	0.00	0.0000	0.00
27	0.0000	0.00	0.0000	0.00
28	0.0000	0.00	0.0000	0.00
29	0.0000	0.00	0.0000	0.00
>29	0.0000	0.00	0.0000	0.00
n	848		618	

Appendix 4. **Summary of the number (and proportion) of the subsample of otoliths at age used in the analysis to determine catch-at-age for the SNA 7 bottom trawl fishery, October–March 2013–14. Note: shaded cells represent the highest proportion for a particular age class, either 3 or 6 years of age.**

Mth-yr	Oct-13	Oct-13	Oct-13	Nov-13	Nov-13	Nov-13	Nov-13	Nov-13	Dec-13	Jan-14	Jan-14	Jan-14	Jan-14	Jan-14	Feb-14	Feb-14	Feb-14	Mar-14	Mar-14	Mar-14	Mar-14	
																					Landing number	
Age	**20131301**	**20131302**	**20131303**	**20131304**	**20131305**	**20131306**	**20131307**	**20131308**	**20131310**	**20141311**	**20141312**	**20141313**	**20141314**	**20141315**	**20141316**	**20141317**	**20141318**	**20141319**	**20141320**	**20141321**	**20141322**	**Total**
3	2	4		20					1	3	5	3	53		1		13		16	11		**132**
4	1						1		2	2	2			1	3	1	1	2	2	1	2	**21**
5	3	2			2			1	1	2	4	1			2	3	2		1		3	**27**
6	47	26	36	39	51	45	19	31	46	30	47	21	5	29	21	35	9	36	18	8	30	**629**
7	1						2	1				1										**5**
8		3							1			1		4		1			1			**11**
9	2	1	1					1		1								2		1		**9**
11	2	1	1		1																	**5**
12																1						**1**
14	2							2							1	1					1	**7**
24							1															**1**
Total	**60**	**37**	**38**	**59**	**54**	**45**	**23**	**36**	**51**	**38**	**58**	**27**	**58**	**34**	**28**	**42**	**25**	**40**	**38**	**21**	**36**	**848**

																					Landing number	
Age	**20131301**	**20131302**	**20131303**	**20131304**	**20131305**	**20131306**	**20131307**	**20131308**	**20131310**	**20141311**	**20141312**	**20141313**	**20141314**	**20141315**	**20141316**	**20141317**	**20141318**	**20141319**	**20141320**	**20141321**	**20141322**	**Total**
3	0.033	0.108	0.000	0.339	0.000	0.000	0.000	0.000	0.020	0.079	0.086	0.111	0.914	0.000	0.036	0.000	0.520	0.000	0.421	0.524	0.000	**0.156**
4	0.017	0.000	0.000	0.000	0.000	0.000	0.043	0.000	0.039	0.053	0.034	0.000	0.000	0.029	0.107	0.024	0.040	0.050	0.053	0.048	0.056	**0.025**
5	0.050	0.054	0.000	0.000	0.037	0.000	0.000	0.028	0.020	0.053	0.069	0.037	0.000	0.000	0.071	0.071	0.080	0.000	0.026	0.000	0.083	**0.032**
6	0.783	0.703	0.947	0.661	0.944	1.000	0.826	0.861	0.902	0.789	0.810	0.778	0.086	0.853	0.750	0.833	0.360	0.900	0.474	0.381	0.833	**0.742**
7	0.017	0.000	0.000	0.000	0.000	0.000	0.087	0.028	0.000	0.000	0.000	0.037	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.006**
8	0.000	0.081	0.000	0.000	0.000	0.000	0.000	0.000	0.020	0.000	0.000	0.037	0.000	0.118	0.000	0.024	0.000	0.000	0.026	0.000	0.000	**0.013**
9	0.033	0.027	0.026	0.000	0.000	0.000	0.000	0.028	0.000	0.026	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.050	0.000	0.048	0.000	**0.011**
11	0.033	0.027	0.026	0.000	0.019	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.006**
12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.024	0.000	0.000	0.000	0.000	0.000	**0.001**
14	0.033	0.000	0.000	0.000	0.000	0.000	0.000	0.056	0.000	0.000	0.000	0.000	0.000	0.000	0.036	0.024	0.000	0.000	0.000	0.000	0.028	**0.008**
24	0.000	0.000	0.000	0.000	0.000	0.000	0.043	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.001**