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**Te Tautiaki i nga tini a Tangaroa**

**Age composition of commercial snapper landings in  
Tasman Bay/Golden Bay (SNA 7), 2003-04**

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## EXECUTIVE SUMMARY

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*New Zealand Fisheries Assessment Report 2005/46. 22 p.*

This report is in fulfilment of the requirements for Objective 1 of Project SNA2003/04, "To estimate the year class strengths of snapper, *Pagrus auratus*, in SNA 7." It summarises the estimates of commercial catch at age for the Tasman Bay/Golden Bay portion of the SNA 7 stock (excluding the Marlborough Sounds substock) for the 2003–04 fishing year, and compares relative year class strengths with previous estimates.

The 2003–04 catch at age estimates for Tasman Bay/Golden Bay indicate that the fishery is dominated by a number of exceptionally strong recent year classes. This fishery was previously characterised by a strong dependence on fish over 20 y, following weak recruitment in the early to mid 1980s. The 2000, 1999, and 1998 year classes (4–6 year olds) appear to be particularly strong, and about one third of the total catch now comes from four year old fish. The moderately strong 1986, 1988, 1990, and 1996 year classes (18, 16, 14, and 8 y) are still present, but their relative influence has lessened due to stronger recent recruitment. The low mean weight of 1.5 kg contrasts with the mean weight of 3.0 kg determined in the 2002 analysis, and reflects the high proportion of younger age classes in this fishery.

The SNA 7 fishery is relatively small, but the stock appears to be continuing to rebuild. The 2003–04 commercial catch (220 t) exceeded the TACC of 200 t for the first time, and represents a 37% increase on the average catch between 2000–01 and 2002–03 (160 t). The recent years of strong recruitment coincided with a period of warm summers in Tasman Bay/Golden Bay (from 1994 to 2004), and are consistent with results from the SNA 1 and SNA 8 fisheries. The years of weak recruitment in the early 1990s are consistent with trawl survey results from Tasman Bay/Golden Bay in 1995 and 1996.

## 1. INTRODUCTION

### 1.1 Overview

Snapper (*Pagrus auratus*) is an inshore demersal species of the family Sparidae, commonly found in depths of 10–200 m throughout the northern and central areas of the New Zealand EEZ (QMAs 1, 2, 7, 8, & 9). The number of juveniles that result from a spawning may vary widely, which results in strong or weak year classes entering the stock (Smith & Francis 1991). A high positive correlation between year class strength and sea surface temperature was found in the Hauraki Gulf (Francis 1993, Gilbert et al. 2000), and similar results have been shown for SNA 2, SNA 8, and for the Tasman Bay/Golden Bay (SNA 7) substock (Davies & McKenzie 2001, Gilbert & Taylor 2001).

This report describes the results of the fifth year of a commercial catch sampling programme to estimate catch at age from the Tasman Bay/Golden Bay substock (Figure 1) of SNA 7, during the 2003–04 fishing year. It supplements and extends previous age structure data collected during the 1997–98 (Blackwell et al. 1999), 1998–99 (Blackwell et al. 2000), 1999–2000 (Blackwell et al. 2001), and 2000–01 (Blackwell & Gilbert 2002) fishing years (1 October to 30 September). This series supplements data from several previous estimates for the Tasman Bay/Golden Bay substock (Mace & Drummond 1982a, 1982b, Drummond & Kirk 1986, Kirk et al. 1988, Drummond 1994, Annala & Sullivan 1996). Catch at age is not estimated for the Marlborough Sounds substock of SNA 7.

### 1.2 Description of the fisheries

A small-medium sized commercial snapper fishery has operated in Tasman Bay/Golden Bay since at least 1945, but landings have varied widely. Landings ranging from 500 to 1500 t were taken from the 1960s to the late 1970s (Mace & Drummond 1982a, Annala et al. 2001). They quickly increased during the late 1970s and early 1980s, after the identification of near-surface schools of spawning snapper by aerial spotting, and the introduction of pair trawling and purse-seine methods into the fishery (Drummond 1994). Landings peaked at 2700 t in the 1978 calendar year, but declined throughout the 1980s (Annala et al. 2001).

SNA 7 (including the Tasman/Golden Bays and Marlborough Sounds substocks) was introduced into the QMS in 1986. The initial TACC of 330 t was set to allow the stock to rebuild (Colman et al. 1985), but increased to 372 t following quota appeals. Landings remained below the TACC during the late 1980s. The biomass estimates determined from the 1987 tagging study in SNA 7 were low (Annala et al. 2001), and the TACC was reduced to 160 t in 1989–90. The TACC was subsequently increased from 160 t to 200 t in 1996–97, but landings have remained lower than or equal to the TACC (Table 1).

The 2003–04 landings of 220 t represent a modest 37% increase over recent landings, which averaged 160 t between 2000–01 and 2002–03. Snapper move inshore to spawn during spring-summer, and there has been some targeting of spawning aggregations since 2000–01. Landings of 30–60 t have been taken by longline, single trawlers, and two sets of pair trawlers (Table 2), but insufficient quota is available to support a larger target fishery (D. Loder, Talley's Fisheries, pers. comm. 2005).

Most snapper in SNA 7 continues to be taken as bycatch of trawl fishing, particularly for red gurnard and flatfish during late summer, autumn, and winter (Tables 2 and 3). Effort in these trawl fisheries appears to be inversely related to the relative strength of the fisheries for albacore tuna and dredge oysters in QMA 7 (D. Loder, pers. comm. 2005). Snapper are also a minor bycatch of set netting for rig, warehou, and school shark and of line fishing for school

shark during the summer (Table 2). The stock appears to be continuing to rebuild. Input controls remain, including regulatory and voluntary closed areas (Anon. 1994).

### 1.3 Previous research

As snapper prefer warm-temperate waters, Tasman Bay and Golden Bay are at the southern limit of their distribution. The SNA 7 stock is recognised as separate from the larger SNA 8 (Auckland-west coast North Island) stock, based on tagging recovery data (Drummond 1994). Within SNA 7, two separate substocks are recognised (Tasman Bay/Golden Bay and Marlborough Sounds/Cloudy Bay), based on stock separation studies carried out during 1978–81, 1984, and 1986–87 (Drummond 1994). The small catch taken on the north of the west coast of the South Island is considered to be part of the Tasman Bay/Golden Bay substock. Fishers commonly follow snapper schools as they move around Farewell Spit, particularly in midsummer (D. Loder, pers. comm. 2003).

Harley & Gilbert (2000) modelled the Tasman Bay/Golden Bay substock using an age-structured population model fitted to a tag-recapture biomass estimate and commercial and research proportion at age estimates from samples taken between 1968–69 and 1997–98. They estimated current stock biomass at the start of 1998–99 to be  $1.43B_{MSY}$  and MSY to be 650 t. The latter included an assumed recreational catch of 84 t and commercial under-reporting of 10% (Hartill et al. 1998). Gilbert & Phillips (2002) updated this model to include the 2001–02 fishing year, and reached similar, but more optimistic, estimates of stock biomass to be 1.43 to  $2.71B_{MSY}$ , and predicted  $B_{2006}$  to be between 14 032 and 32 016 t. These estimates were considered unreliable and were not accepted by the Inshore Working Group (Sullivan et al. 2005).

The previous catch-at-age estimates (Blackwell & Gilbert 2002) recorded the presence of a strong 1998 year class (now 6 year olds), and the continued presence of the 1986, 1988, 1990, 1995, and 1996 year classes in the fishery, as well as the 20+ group. Recruitment had been particularly poor between 1991 and 1994, and the 1997 year class appeared to be weak.

## 2. METHODS

Sampling in SNA 7 was restricted to the Tasman Bay/Golden Bay substock. The Marlborough Sounds/Cloudy Bay substock was not sampled.

### 2.1 Stratification

The purpose of stratification is to increase the precision of the catch-at-age estimates and to reduce the effects of departure from strictly random sampling. Sampling theory shows that this will be achieved if the strata are well chosen, i.e., if variability between strata is larger than within strata. Estimation requires the sampling of landings to be random. Strict adherence to this is impractical. However, departure from strict randomness has less effect under a stratified sampling regime, if the strata are well chosen. We used the same stratification with the same planned numbers of samples per stratum as had been used in the previous SNA 7 catch sampling programme.

Trawlers were ranked by mean landing size during 2000–01 to 2002–03. The higher landings class, BT1, was defined by a list of vessels (not given here) that had together landed 50% of the total snapper catch during this period. They landed a lower percentage (34%) in 2003–04 (Table 3). As the non-trawl component of this fishery was small, the other trawlers were

combined with the non-trawl methods to form the OTH strata. Seasonal catches by vessel class were defined as six strata: BT1-spring (October/December 2003); BT1-summer (January/March 2004); BT1-autumn/winter (April/September 2004); OTH-spring (October/December 2004); OTH-summer (January/March 2004); OTH-autumn/winter (April/September 2004).

## 2.2 Sampling

The 2003–04 actual catch for SNA 7 (all) of 215 t is close to the estimated catch for SNA 7 (all) of 197 t (see Tables 1 and 2). From this, 164 t was estimated to be taken from the Tasman Bay/Golden Bay substock, and 27 t was estimated to be taken from the Marlborough Sounds substock (statistical area 17). The Tasman/Golden Bay estimated catch total does not include a further catch of 5.7 t reported from statistical area 37, as these landings cannot be separated from the SNA 8 stock.

The planned number of landings was sampled in all strata except BT1-autumn/winter (Table 4). Sampling started in October, and extra samples were taken largely in the OTH strata to correspond to an apparent increase in fishing by these vessels. Landings in the OTH-summer and OTH-autumn/winter strata were particularly high, and in response to this we increased the sample numbers during these periods when landings were numerous. The large changes in the timing of the fishery from year to year make it difficult to sample the strata optimally.

## 2.3 Sampling procedure

A random sample of about 30 fish (more or less for larger or smaller landings) was collected from each landing from a random selection of fish bins, as described by Blackwell & Gilbert (2002). The sagittal otoliths were collected from each fish and the length (to the nearest centimetre below the fork length) was measured. The sex was not determined, as snapper show no differential growth between sexes (Paul 1976). The otoliths were inventoried and stored in the otolith collection maintained by NIWA.

## 2.4 Ageing

The numbers of otoliths collected exceeded the target number of 1000, so random subsamples were selected for ageing. Subsample sizes were chosen to bring the number of fish towards proportionality with the landing weight (with a minimum of 10 otoliths per landing).

Snapper otoliths collected were processed individually following the methods described by Davies & Walsh (1995). Each otolith was prepared by cutting dorsal-ventrally through the nucleus, then the cut surface was polished by wet grinding using 400 grit and 1200 grit diamond polishing wheels, and read under a binocular dissecting microscope at 20–30x magnification, as described by Blackwell & Gilbert (2002).

A standardised procedure for reading the otoliths and ageing the snapper was followed (after Davies & Walsh 1995). Ages were defined from a nominal birthday at 1 January. Age was recorded to one decimal place, based on the date of sampling, e.g., a 1989 year class fish would be aged 8.7 years if sampled in early October 1997, 8.9 years in December and 9.4 years in May 1998. Because sampling was from October to September, fish were

combined into an age class by rounding down to the nearest year and adding an extra year to the ages of the fish sampled between October and December 2003.

Proportions at age,  $\hat{p}_i$ , were calculated for each stratum and combined using the total stratum landings for 2003–04 (Table 4). The coefficients of variation for the proportion at age estimates, with a finite population correction,  $\hat{c}\hat{v}(\hat{p}_i)$ , were calculated by bootstrapping, as described by Blackwell et al. (2000: appendix A1). The sampled landings and age data were stored on the Ministry of Fisheries *market* and *age* databases, respectively, maintained by NIWA.

### 3. RESULTS

The numbers of snapper aged from each stratum are given in Table 5, and the proportions at age,  $\hat{p}_i$ , and the estimated coefficients of variation,  $\hat{c}\hat{v}(\hat{p}_i)$ , are presented in Figures 2 and 3. Values are given in Appendices A1 and A2. The mean weighted c.v. for Tasman Bay/Golden Bay snapper was 0.21 (0.20 for 1–20+ years) from 59 samples, which is close to the target c.v. of 0.20 from a planned 55 samples. Numbers sampled by age and length are given in Appendix A3 and the estimated proportions by age and length are given in Appendix A4.

The fishery is dominated numerically by the recent 1998, 1999, and 2000 year classes (4–6-year-olds), and the strong 2000 year class represents over 45% of the 2003–04 landings by numbers of fish. The previously dominant 1986, 1988, 1990, 1995, 1996, and 1998 year classes can still be seen, while the influence of the 20+ y age classes has declined. The weakness of the 1991 to 1994 year classes, which correspond to the cold El Niño years, continues to be apparent.

Comparison of proportions at age and mean weights (Figure 3 and Table 6) indicates that some differences in the age distributions occur between strata. There is a tendency for older fish (over 10 yrs) to be caught in spring-summer and for younger fish to be caught in autumn-winter, although this is less marked than in previous years. The 2000 year class dominated catch in the OTH-spring stratum, and all strata sampled in autumn/winter. The mean fish weight was 1.5 kg.

### 4. DISCUSSION

Samples were collected from a representative cross section of the fishery, including both targeting and bycatch fishing in SNA 7. This fishery comprises a wide range of age classes, and variability occurs in age distributions of landings within strata and between strata. The actual number of samples was increased from 55 to 59, and the achieved c.v. of 21% (20% for the 0–20+ year classes) is close to the planned c.v. of 20%. This compares favourably to the c.v. of 0.29 (0.27 for age classes 0–20+) achieved in sampling during 2000–01 (Blackwell & Gilbert 2002), and reflects the relative importance of recent recruitment into the fishery. In addition to achieving the required number of samples, we increased sampling in the OTH autumn/winter stratum where catches were higher than expected. This variability in the landings pattern between years and among strata is essentially unpredictable, and our planned but dynamically adjustable sampling regime appears to be the best method of sample allocation available.



The Tasman/Golden Bay snapper fishery had much lower variability in mean size between strata (from 1.8 kg in the OTH-spring stratum, to 1.0 kg in the BT1-autumn/winter stratum), compared to the 2000–01 analysis where mean weight varied from 4.0 kg (OTH-spring), to 1.9 kg (OTH-autumn/winter). Overall mean weight has increased from 2.5 kg (1998–99), to 3.2 kg (1999–2000), then declined to 3.0 kg (2000–01) and to 1.5 kg in 2003–04 (see Blackwell et al. 1999, 2000, Blackwell & Gilbert 2002). We presume that the variability between strata is due to spatial heterogeneity and variable targeting in the fishery, and represents normal variability in fishing patterns.

The weakness of the 1991–94 year classes in the Tasman Bay/Golden Bay substock is consistent with the results of trawl surveys in Tasman Bay/Golden Bay during 1995 and 1996 in which the catches of juveniles were extremely low (Stevenson 1996, Blackwell & Stevenson 1997).

The Tasman Bay/Golden Bay substock appears to have experienced strong recruitment during the 1998–2000 calendar years (4–6-year-old fish), consistent with warm summers during this period (see Figure 2), and over half of the 2003–04 fishery was derived from fish less than 5 years old. This represents a substantial change in a fishery which has consistently shown the highest proportions of 20+-year-old fish of any New Zealand snapper stock (Appendix A5) (Blackwell et al. 2001, Walsh et al. 2001). The increase in the relative proportions of younger fish, and the fact that the fishery achieved the 200 t TACC for the first time in 7 years, suggest that stock may be rebuilding as predicted by the model of Gilbert & Phillips (2002).

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**Table 1: Reported landings (t) of snapper by stock from 1983–84 to 2003–04 and gazetted and actual TACCs (t) for 1986–87 to 2003–04 (after Sullivan et al. 2005).**

Fishstock QMA	SNA 1	SNA 2	SNA 3	SNA 7	SNA 8	SNA 10	Total	TACC	Landings	TACC	Landings	TACC	Landings§	TACC
	1	2	3,4,5,6	7	8,9	10								
1983–84†	6 539	–	145	–	2	–	375	–	1 725	–	0	–	9 153	–
1984–85†	6 898	–	163	–	2	–	255	–	1 546	–	0	–	9 228	–
1985–86†	5 876	–	177	–	0	–	188	–	1 828	–	0	–	8 653	–
1986–87‡	4 016	4 710	130	130	0	30	257	330	893	1 330	0	10	5 314	6 540
1987–88‡	5 061	5 098	152	137	1	30	256	363	1 401	1 383	0	10	6 900	7 021
1988–89‡	5 793	5 614	210	157	1	30	176	372	1 526	1 508	0	10	7 706	7 691
1989–90‡	5 826	5 981	364	157	<1	30	294	160	1 550	1 594	0	10	8 034	7 932
1990–91‡	5 315	6 002	427	157	<1	31	160	160	1 658	1 594	0	10	7 570	7 944
1991–92‡	6 191	6 010	373	157	<1	31	148	160	1 464	1 594	0	10	8 176	7 962
1992–93‡	5 423	4 904	316	252	2	32	165	160	1 543	1 500	0	10	7 448	6 858
1993–94‡	4 846	4 928	307	252	<1	32	147	160	1 542	1 500	0	10	6 842	6 883
1994–95‡	4 831	4 938	307	252	<1	32	150	160	1 434	1 500	0	10	6 723	6 893
1995–96‡	4 941	4 938	279	252	<1	32	146	160	1 558	1 500	0	10	6 924	6 893
1996–97‡	5 049	4 938	352	252	<1	32	162	160	1 613	1 500	0	10	7 176	6 893
1997–98‡	4 524	4 500	286	252	<1	32	182	200	1 589	1 500	0	10	6 583	6 494
1998–99‡	4 411	4 500	283	252	3	32	142	200	1 636	1 500	0	10	6 475	6 494
1999–00‡	4 500	4 500	391	252	<1	32	174	200	1 604	1 500	0	10	6 669	6 494
2000–01‡	4 347	4 500	360	252	<1	32	156	200	1 630	1 500	0	10	6 496	6 494
2001–02‡	4 372	4 500	252	252	1	32	141	200	1 577	1 500	0	10	6 342	6 494
2002–03‡	4 484	4 500	339	315	<1	32	187	200	1 558	1 500	0	10	6 563	6 557
2003–04‡	4 466	4 500	339	315	<1	32	215	200	1 666	1 500	0	10	6 686	6 557

† FSU data. SNA 1 = stat areas 1–10; SNA 2 = stat areas 11–16; SNA 3 = stat areas 18–32; SNA 7 = stat areas 17, 33–36, 38; SNA 8 = stat areas 37, 39–48.

‡ QMS data.

§ Includes landings from unknown areas before 1986–87.

**Table 2: Summary of estimated catch (kg) by category (BT1, Other), method (BPT=bottom pair trawl, BT=bottom trawl, SN=set net, Other=all other methods), and month in the SNA 7 fishery for the 2003–04 fishing year. Source: Ministry of Fisheries data extract May 2005.**

Category	Month	Method				All
		BPT	BT	SN	Other	
BT1	Oct	0	4 135	0	0	4 135
	Nov	355	9 026	0	0	9 381
	Dec	7 353	3 771	0	0	11 124
	Jan	2 960	1 260	0	0	4 220
	Feb	2 200	2 855	0	0	5 055
	Mar	5 855	10 140	0	0	15 995
	Apr	0	14 310	0	0	14 310
	May	12	5 445	0	0	5 457
	Jun	0	732	0	0	732
	Jul	0	0	0	0	0
Aug	0	430	0	0	430	
Sep	0	1 771	0	0	1 771	
Total		18 735	53 875	0	0	72 610
Others	Oct	0	2 455	25	7 030	9 150
	Nov	325	9 437	167	0	9 931
	Dec	10 275	11 095	145	50	21 565
	Jan	3 655	8 292	303	205	12 455
	Feb	0	2 753	596	16	3 347
	Mar	0	13 708	697	314	14 719
	Apr	0	17 789	201	3	17 993
	May	12	20 407	160	27	20 606
	Jun	0	2 679	354	25	3 066
	Jul	0	2 067	544	0	2 611
Aug	200	3 185	96	0	3 481	
Sep	2 000	3 101	0	0	5 101	
Total		16 475	96 952	3 288	7 670	124 384
All	Total	35 210	150 827	3 288	7 670	196 994

**Table 3: Summary of estimated catch by category (BT1, Other) , subregion (Tasman/Golden Bay, Rest of SNA 7), statistical area, and month in the 2003–04 fishing year. Source: Ministry of Fisheries data extract May 2005.**

Vessel class	Month	Rest of SNA 7			Tasman/Golden Bay						SNA 7 total
		017	037	Total	033	034	035	036	038	Total	
BT1	Oct	630	630	1 260				90	2 785	2 875	4 135
	Nov	1 030	840	1 870			448	1 750	5 313	7 511	9 381
	Dec	448	390	838			476	90	9 720	10 286	11 124
	Jan	2 000		2 000				870	1 350	2 220	4 220
	Feb	2 000	60	2 060					2 995	2 995	5 055
	Mar	5 230		5 230			2 125	25	8 615	10 765	15 995
	Apr	2 550	530	3 080				90	11 140	11 230	14 310
	May	30	100	130			2 215	975	2 137	5 327	5 457
	Jun	10		10			270	392	60	722	0 732
	Jul										0 000
Aug						430			430	0 430	
Sep	130		130				1 333	308	1 641	1 771	
<b>BT1 total</b>		<b>14 058</b>	<b>2 550</b>	<b>16 608</b>			<b>5 964</b>	<b>5 615</b>	<b>44 423</b>	<b>56 002</b>	<b>72 610</b>
Other vessels	Oct	95		95			60	8 260	1 095	9 415	9 510
	Nov	530	233	763		50	145	130	8 843	9 168	9 931
	Dec	1 141		1 141					20 424	20 424	21 565
	Jan	1 515	310	1 825	200				10 430	10 630	12 455
	Feb	385	40	425					2 922	2 922	3 347
	Mar	2 765	1 400	4 165		30	420	125	9 979	10 554	14 719
	Apr	3 103	215	3 318			160	300	14 215	14 675	17 993
	May	1 401	390	1 791			5 630	160	13 035	18 825	20 616
	Jun	110	25	135			581	760	501	1 842	1 977
	Jul	559	40	599			1 000	740	272	2 012	2 611
Aug	161	60	221		300	644	665	1 651	3 260	3 481	
Sep	150	480	630		10	580	570	3 311	4 471	5 101	
<b>Other vessels total</b>		<b>13 004</b>	<b>3 183</b>	<b>16 187</b>	<b>200</b>	<b>390</b>	<b>9 220</b>	<b>11 710</b>	<b>86 678</b>	<b>108 198</b>	<b>124 385</b>
<b>All vessels total</b>		<b>27 062</b>	<b>5 733</b>	<b>32 795</b>	<b>200</b>	<b>390</b>	<b>15 184</b>	<b>17 325</b>	<b>131 101</b>	<b>164 200</b>	<b>196 995</b>

**Table 4: Proportion of estimated landings in Tasman Bay/Golden Bay (SNA 7) and planned and actual number of samples for 2003–04. Source: Ministry of Fisheries data extract May 2005.**

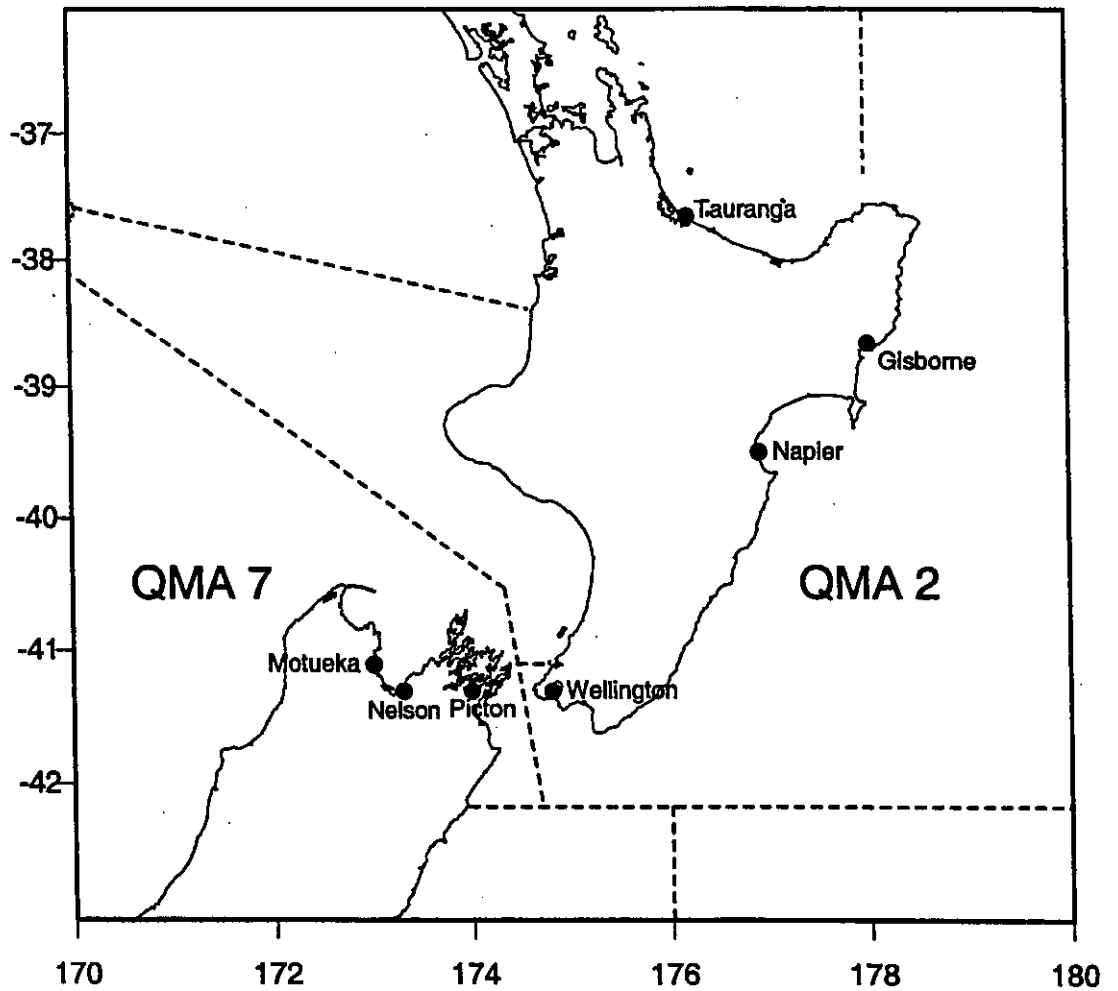
2003–04 stratum	Planned number of landings to sample	2000–01 to 2002–03 proportion of catch in stratum by weight	2003–04 proportion of catch in stratum by weight	Number of landings sampled
BT1-spr	12	0.25	0.12	12
BT1-sum	10	0.20	0.13	10
BT1-aut/win	7	0.10	0.11	5
OTH-spr	8	0.16	0.16	8
OTH-sum	7	0.15	0.12	9
OTH-aut/win	11	0.14	0.35	15
<b>Total</b>	<b>55</b>	<b>145 806 (kg)</b>	<b>164 199 (kg)</b>	<b>59</b>

**Table 5: Summary of snapper otolith samples, in Tasman Bay/Golden Bay (SNA 7), 2003–04.**

Stratum	Length range (cm)	Mean length (cm)	Number aged
BT1-spring	25–82	41.6	279
BT1-summer	25–78	43.0	175
BT1-autumn/winter	27–68	34.7	165
OTH-spring	23–73	38.3	87
OTH-summer	30–74	45.1	76
OTH-autumn/winter	24–67	36.8	225
Total			1 007

**Table 6: Summary of estimates for 2003–04 by sampling stratum in Tasman Bay/Golden Bay (SNA 7).**

Stratum	BT1 spring	BT1 summer	BT1 autumn/winter	OTH spring	OTH summer	OTH autumn/winter	Total
Landings sampled	12	10	5	8	9	15	59
Mean weight, $\hat{w}_j$ (kg)	1.7	1.6	1.0	1.7	1.8	1.5	1.5
Weight sampled landings, $t_j$ (t)	19.3	12.3	4.4	3.0	5.5	12.7	47.9
Total landings, $T_j$ (t)	20.7	16.0	19.4	39.0	24.1	45.0	164.2
Mean weighted c.v. of proportions at age (1–20+ y)	0.01	0.01	0.04	0.09	0.05	0.11	0.20



**Figure 1: QMA 7, showing main ports of landing in the fishery. Tasman Bay is the large bay in which Motueka and Nelson are situated and Golden Bay is the large bay immediately to its northwest.**

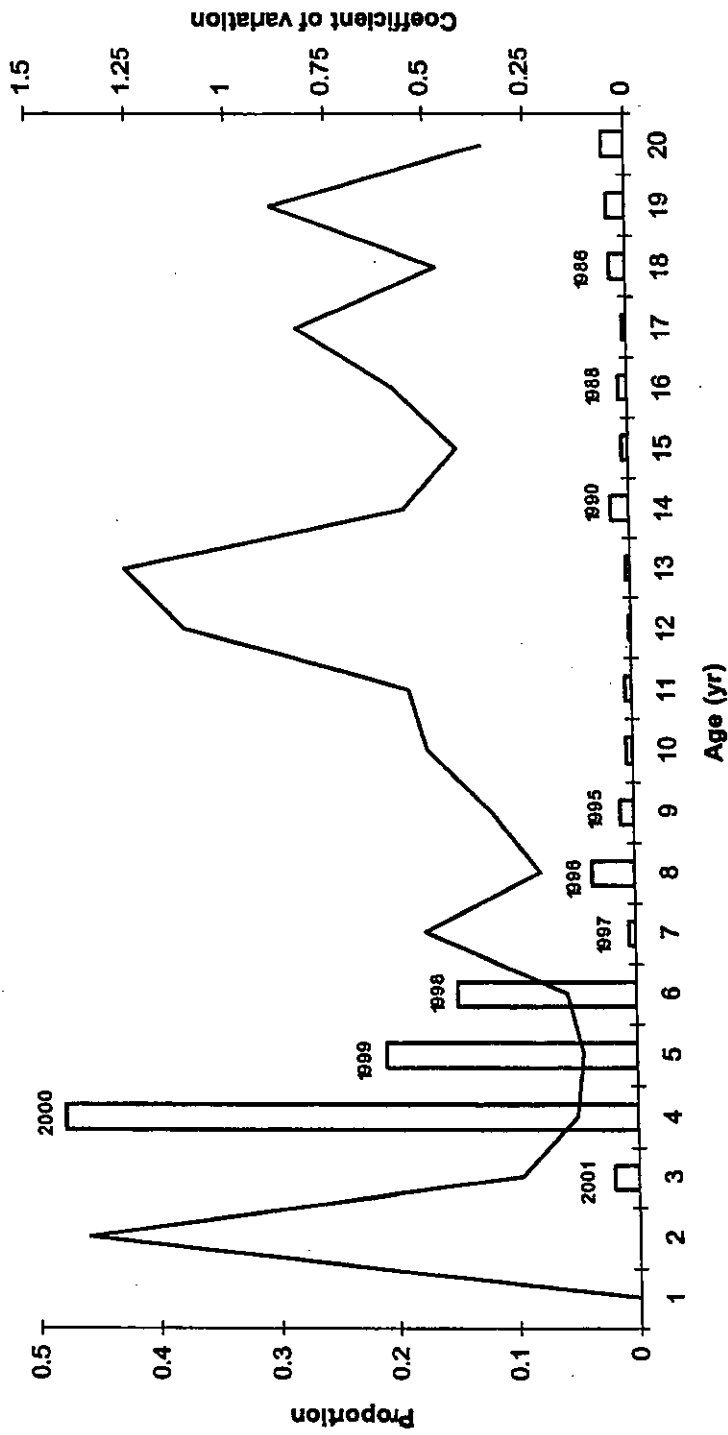
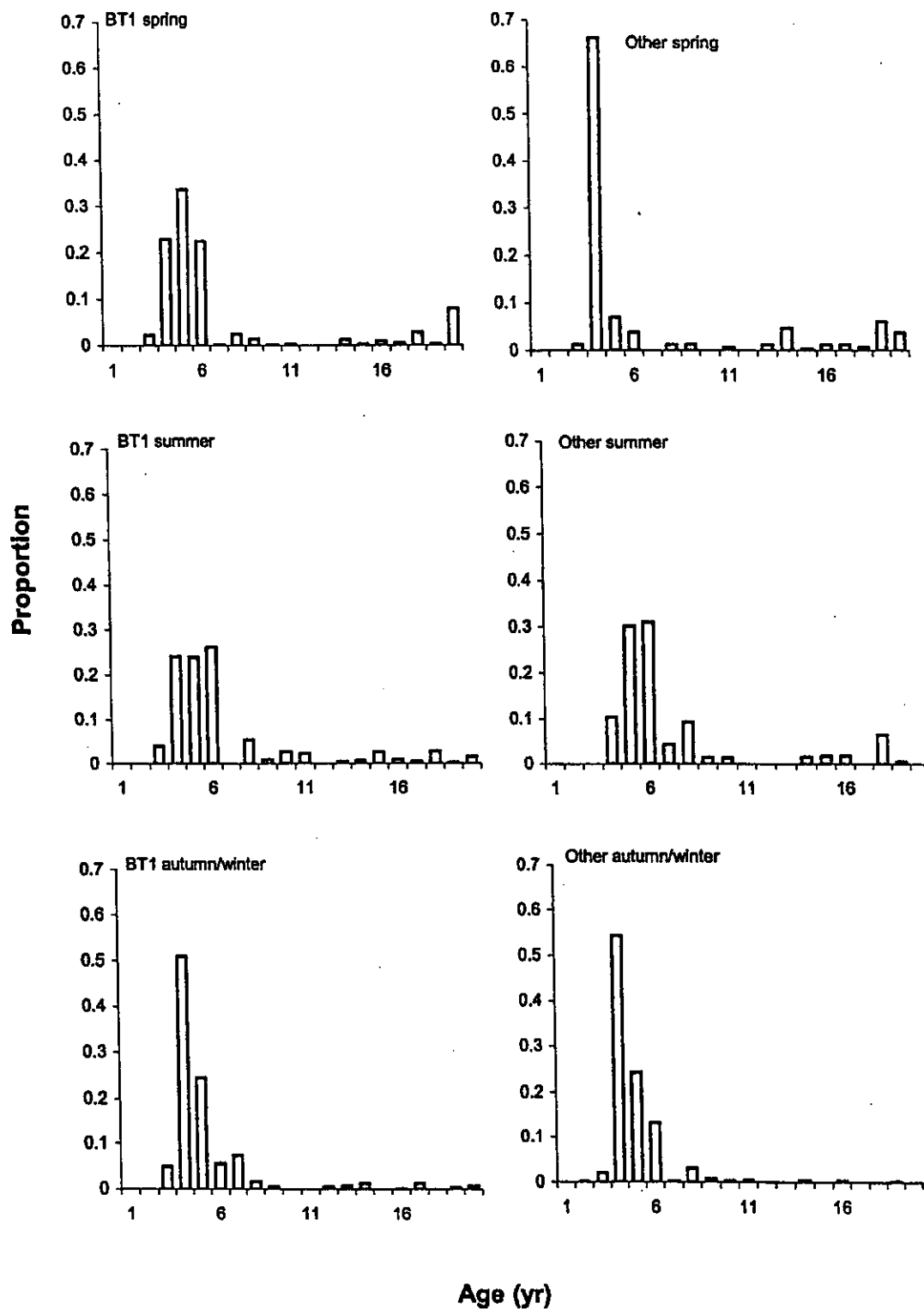


Figure 2: Proportion at age estimates (histogram) and c.v.s (line) for Tasman Bay/Golden Bay (SNA 7) landings, fishing year 2003-04. Years indicate calendar years of recruitment standardised to 1 January.





**Figure 3: Proportion at age estimates for Tasman Bay/Golden Bay (SNA 7) landings, fishing year 2003–04 by sampling stratum (see text for stratum definitions).**

**Appendix A1: Estimated proportion at-age for 2003–04 Tasman Bay/Golden Bay (SNA 7) landings.**

Age	Stratum						Overall
	BT1 spring	Other spring	BT1 summer	Other summer	BT1 autumn/winter	Other autumn/winter	
1							
2						0.00033	0.00011
3	0.02237	0.01211	0.04097		0.02967	0.02123	0.02016
4	0.23049	0.66203	0.24119	0.10302	0.65871	0.54334	0.47804
5	0.33572	0.06977	0.24020	0.30114	0.14134	0.24410	0.20900
6	0.22571	0.03689	0.26170	0.30971	0.09778	0.13135	0.14819
7	0.00228			0.04369		0.00284	0.00616
8	0.02391	0.01219	0.05400	0.09295	0.02556	0.03188	0.03493
9	0.01379	0.01219	0.00890	0.01453	0.01278	0.00745	0.01082
10	0.00222		0.02767	0.01319		0.00359	0.00524
11	0.00269	0.00619	0.02327			0.00404	0.00479
12					0.00639		0.00104
13		0.01219	0.00539				0.00282
14	0.01264	0.04603	0.00714	0.01624		0.00404	0.01411
15	0.00269	0.00271	0.02814	0.01766	0.00429		0.00583
16	0.00876	0.01219	0.00934	0.01828		0.00341	0.00730
17	0.00577	0.01219	0.00450		0.00639		0.00439
18	0.02798	0.00585	0.02886	0.06402			0.01367
19	0.00411	0.06096	0.00271	0.00558		0.00239	0.01400
20	0.00269		0.00450		0.00429		0.00135
21							
22		0.00596					0.00116
23							
24							
25	0.00270	0.00619					0.00149
26	0.01013	0.00314	0.00042				0.00170
27	0.00110						0.00011
28			0.00045				0.00004
29	0.01318	0.01851	0.00527				0.00541
30		0.00271					0.00053
31			0.00045				0.00004
32	0.00997				0.00639		0.00207
33	0.02210		0.00450		0.00639		0.00370
34	0.00429						0.00044
35	0.00429						0.00044
36							
37							
38							
39							
40							
41							
42	0.00429						0.00044
43	0.00227						0.00024
44			0.00042				0.00003
45							
46							
47							
48							
49							
50							
51							
52							
53							
54	0.00189						0.00020
55							
56							
57							
58							
59							
60							

**Appendix A2: Stratum variances and overall c.v. of proportion at age, both with finite population correction, estimated by simulation for 2003–04 Tasman Bay/Golden Bay (SNA 7) landings.**

Age	Stratum						C.v. of overall proportion
	BT1 spring	Other spring	BT1 summer	Other summer	BT1 autumn/winter	Other autumn/winter	
1							
2						0.00015	1.37615
3	0.00041	0.00109	0.00182		0.00455	0.00429	0.32053
4	0.00221	0.01503	0.00544	0.00827	0.03802	0.05030	0.14941
5	0.00205	0.00318	0.00352	0.01440	0.01673	0.02111	0.13396
6	0.00167	0.00264	0.00348	0.01616	0.01179	0.02101	0.17691
7	0.00011			0.00496		0.00125	0.52008
8	0.00034	0.00128	0.00180	0.00720	0.00451	0.00572	0.25201
9	0.00030	0.00135	0.00070	0.00331	0.00248	0.00232	0.47256
10	0.00012		0.00095	0.00350		0.00155	0.51106
11	0.00011	0.00078	0.00089			0.00157	0.55589
12					0.00147		1.11812
13		0.00136	0.00047				1.27021
14	0.00035	0.00282	0.00055	0.00361		0.00155	0.55918
15	0.00011	0.00037	0.00098	0.00327	0.00127		0.42581
16	0.00025	0.00128	0.00062	0.00356	0.00000	0.00150	0.58647
17	0.00016	0.00131	0.00041		0.00151		0.83208
18	0.00056	0.00053	0.00132	0.01051			0.47289
19	0.00015	0.00470	0.00024	0.00153		0.00101	0.88792
20	0.00011		0.00039		0.00148		0.89601
21							
22		0.00078					1.76777
23							
24							
25	0.00010	0.00068					1.20299
26	0.00024	0.00035	0.00005				0.55736
27	0.00005						0.40471
28			0.00004				0.72609
29	0.00029	0.00185	0.00044				0.90186
30		0.00031					1.54816
31			0.00005				0.80345
32	0.00021				0.00159		0.61513
33	0.00045		0.00039		0.00154		0.36017
34	0.00015						0.34884
35	0.00015						0.34074
36							
37							
38							
39							
40							
41							
42	0.00016						0.35485
43	0.00010						0.43442
44			0.00005				0.88270
45							
46							
47							
48							
49							
50							
51							
52							
53							
54	0.00008						0.38846
55							
56							
57							
58							
59							
60							

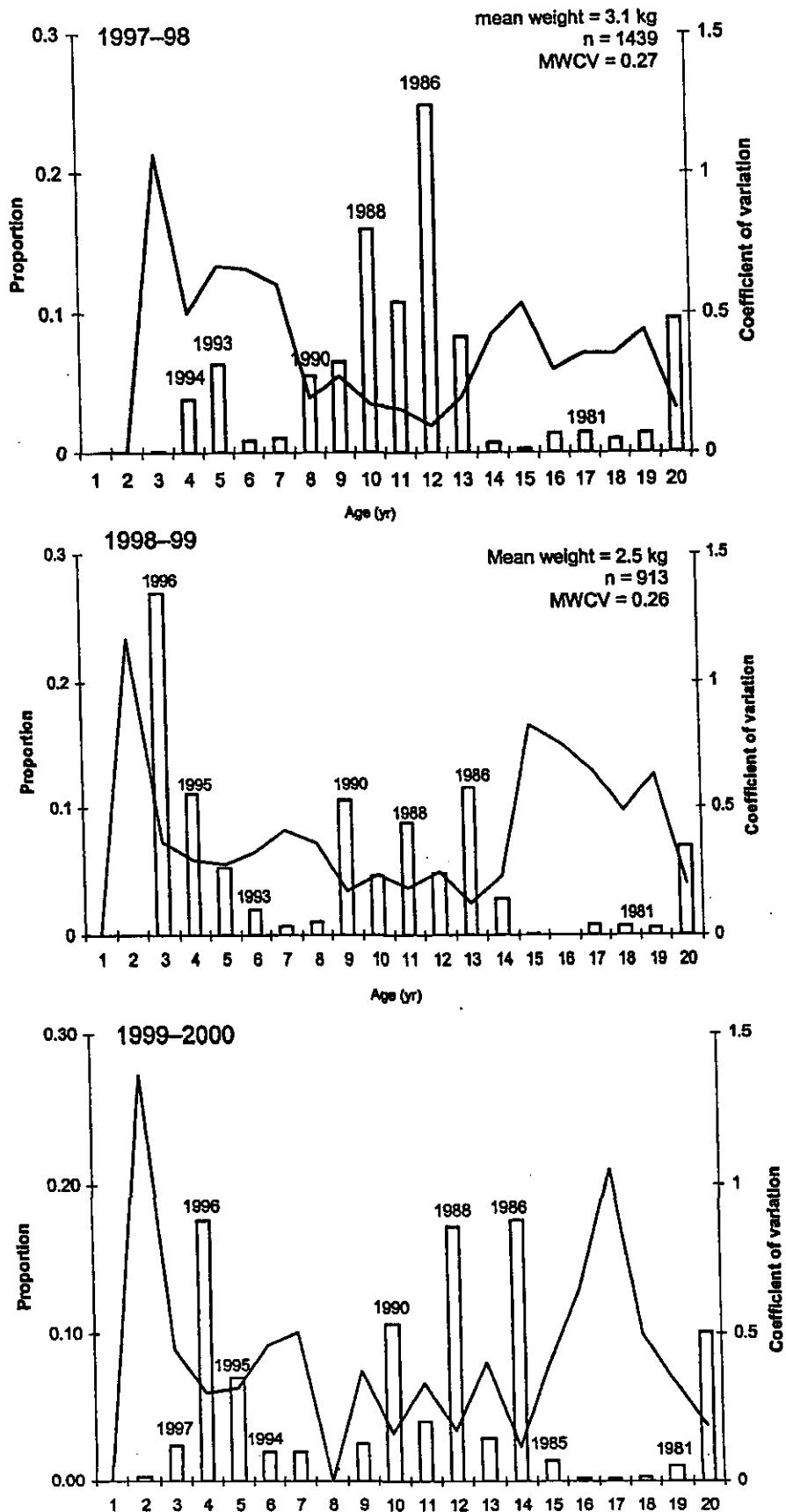
Appendix A3: Numbers of otoliths examined by age and length, for 2003–04 Tasman Bay/Golden Bay (SNA 7) landings (standardised to 1 January birthday).

Length (cm)	Age (years)																				No. aged	
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	20+		
23			1																		1	
24	1		1																		2	
25			9																		9	
26		1	10																		11	
27		2	30																		32	
28			43																		43	
29		2	46																		48	
30		4	54	1																	59	
31		4	36	6																	46	
32		2	22	7																	31	
33		4	26	11	1																42	
34		4	32	23																	59	
35			35	27	3																65	
36			23	28	1																52	
37			12	24	11																47	
38			1	29	18																48	
39			2	26	33																61	
40			1	17	31	1															50	
41			1	12	30	1	1														45	
42				3	14	1	1														19	
43				7	16	1	2	1													27	
44				1	8		4														13	
45				2	4		2	1													9	
46				1	2		4		1												8	
47						3	3	1													7	
48							7	3													10	
49				1		1	6	1													9	
50							4							1							5	
51				1			2	1	1												5	
52							1							2			1				4	
53									1	3											4	
54									2												2	
55								1						1							2	
56								1					1								2	
57										1			1	1				1		1	5	
58										1	1						1			1	4	
59													1	2			1				4	
60									1			1	2	1	1			1			7	
61												3	2		3						8	
62											2	1	1	2	1	4	1		1		13	
63									1			2	1	1	1	1	2		1		10	
64												1				5	2		3		11	
65																1	4		2	3	10	
66												1	2			4				2	9	
67																2	1	1		3	7	
68																2	1	2	1	1	7	
69																2	1	2		4	9	
70																	2				2	
71																1	2	2		1	6	
72																		1			1	
73																	1			4	5	
74																	1			1	2	
75																				2	2	
76																				1	1	
77																				3	3	
78																				1	1	
79																				2	2	
82																				1	1	
Total	1	23	385	227	175	5	37	10	7	7	7	1	2	14	10	11	6	34	11	3	38	1007

**Appendix A4: Estimates of the percentage at length and age for commercially caught snapper in Tasman Bay/Golden Bay (SNA 7) in 2003–04. Table sums to 100. (The estimated percentage of 76 cm fish was less than 0.005% because the single fish of this size came from a landing that carried a low weighting).**

Length (cm)	Age (years)																			
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+	
23			0.31																	
24	0.01		0.31																	
25			1.53																	
26		0.26	2.13																	
27		0.09	3.96																	
28			4.72																	
29		0.11	5.18																	
30		0.33	5.27	0.05																
31		0.31	3.29	0.27																
32		0.17	1.91	0.34																
33		0.29	4.59	0.63	0.16															
34		0.43	4.00	1.66																
35			5.48	1.71	0.13															
36			2.15	2.52	0.04															
37			2.52	2.03	0.67															
38			0.13	2.93	1.67															
39			0.71	3.24	2.69															
40			0.07	1.81	2.70	0.13														
41			0.04	1.22	2.83	0.19	0.05													
42				0.78	1.04	0.16	0.03													
43				0.63	1.13	0.09	0.20	0.16												
44				0.12	0.74		0.37													
45				0.21	0.30		0.06	0.05												
46				0.13	0.24		0.42		0.04											
47					0.20		0.36	0.04												
48							0.61	0.31												
49				0.13		0.02	0.74	0.26												
50							0.32							0.16						
51				0.11			0.24	0.10	0.12											
52							0.04								0.13		0.03			
53									0.07	0.21										
54									0.11											
55								0.11						0.03						
56								0.05					0.40							
57										0.07			0.13	0.03				0.01	0.06	
58										0.04	0.10					0.04			0.04	
59												0.07	0.14				0.06			
60									0.15			0.04	0.30	0.02	0.04			0.04		
61													0.19	0.03			0.11			
62										0.16			0.03	0.04	0.35	0.02	0.25	0.26	0.10	
63									0.02				0.05	0.03	0.08	0.10	0.02	0.53	0.07	
64													0.04				0.19	0.34	0.07	
65																0.26	0.20		0.15	
66																	0.10		0.44	
67																	0.14	0.01	0.13	
68																		0.03	0.06	
69																	0.07	0.02	0.24	
70																		0.02	0.16	
71																		0.12		
72																	0.03	0.15	0.28	
73																		0.02	0.33	
74																		0.03		
75																			0.04	
76																			0.04	
77																			0.05	
78																			0.05	
79																			0.05	
82																			0.04	

**Appendix A5: Proportion at age estimates for Tasman Bay/Golden Bay by fishing year, 1997–98 to 2003–04 (after Blackwell et al. 1999, 2000, 2001, Blackwell & Gilbert 2002).**



Appendix A5: – continued

