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EXECUTIVE SUMMARY

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This report is in fulfilment of the requirements for Objectives 1 and 2 of Project SNA1999/06, "To estimate the year class strengths of snapper *Pagrus auratus* in SNA 2 (Objective 1) and in SNA 7 (Objective 2)." It summarises the estimates of commercial catch at age for SNA 2 and Tasman Bay/Golden Bay (SNA 7) for the fishing year 1999–2000, and compares relative year class strengths with previous estimates.

The catch at age estimates for SNA 2 indicate that the fishery is dominated by fish less than 11 years old, following recent strong or average recruitment of the 1994, 1995, 1996, and 1997 year classes (3–6 years). The previously strong 1989, 1990, and 1991 year classes (9–12 years) continue to influence the fishery, and the remains of the 1985 and 1987 year classes can still be seen.

The catch at age estimates for Tasman Bay/Golden Bay indicate that this fishery contains a smaller number of relatively stronger year classes than SNA 2, although fish over 20 yr remain an important part of this fishery. The 1995 and 1996 year classes (4 and 5 years) are especially strong and the 1994 and 1997 year class (3 and 6 years) are at least average.

Strong or average recruitment appears to have resulted from the 1995 and 1996 year classes that correspond to the La Niña years in both stocks. The years of weak recruitment (1991–1993) in Tasman Bay/Golden Bay are consistent with trawl survey data.

1. INTRODUCTION

1.1 Overview

Snapper (*Pagrus auratus*) is an inshore demersal species of the family Sparidae, found in depths of 10–200 m throughout the northern and central areas of the New Zealand EEZ (QMAs 1, 2, 7, 8, and 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). Francis (1993) determined a high positive correlation between year class strength and sea surface temperature in the Hauraki Gulf, and a preliminary analysis suggests that a similar relationship with air temperature occurs for the Tasman Bay/Golden Bay (SNA 7) fishstock (Annala & Sullivan 1996).

This report describes the results of the third year of a commercial catch sampling programme. Sampling to estimate catch at age was carried out during 1999–2000 in SNA 2 and Tasman Bay/Golden Bay (Figure 1) and repeats the sampling described by Blackwell et al. (2000). These data add to age structure data taken in 1991–92 from SNA 2 (Ryan 1993) and to 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, Blackwell et al. 1999, Blackwell et al. 2000). Catch at age is not estimated for the Marlborough Sounds substock of SNA 7 in this report.

1.2 Description of the fisheries

SNA 2. Snapper occur throughout east coast North Island waters (southeast of Cape Runaway) with the highest densities in waters less than 70 m deep. Commercial snapper fishing in SNA 2 dates back to the 1930s (Kilner 1983). The fishery expanded during the 1960s and 1970s to peak at 878 t (1972). This increase was attributed to an increase in targeting by trawlers (Kilner 1983). Landings declined to 160 t in 1982 and 1983 and a ban on pair trawling was imposed. The 1986 TACC of 130 t was set below the 1985–86 catch level of 177 t to permit the stock to rebuild (Colman et al. 1985). In 1992–93 the TACC was increased to 252 t as a result of decisions by the Quota Appeal Authority (Annala et al. 2000). Subsequent landings have exceeded the TACC by up to 80% (1991–92), largely due to bycatch in the inshore trawl fisheries in QMA 2 (Ryan 1993). More recent landings continue to moderately exceed the current TACC of 252 t (Annala *et al.* 2000). Input controls, such as a ban on pair trawling in most of QMA 2 and closed areas remain in place.

Little targeting of snapper now occurs in QMA 2. Most snapper are taken as bycatch of inshore trawling for tarakihi, flatfish, and gurnard in the inshore areas along the Wairarapa coast, Hawke Bay, and the east coast. Minor amounts of snapper are taken by trawlers targeting gemfish, trevally, flatfish, or barracouta. Snapper are also taken as bycatch of longlining for hapuku/bass and bluenose, line fishing for school shark, and set netting for rig and blue moki (Ryan 1993).

Tasman Bay/Golden Bay. A small commercial fishery for snapper in Tasman Bay/Golden Bay has existed since at least 1945 and landings of between 500 and 1500 t were reported in the 1960s (Mace & Drummond 1982a). Landings peaked at 2700 t in the 1978 calendar year following the introduction of pair trawling, purse seining, and aerial spotting to identify near-surface schools of spawning snapper (Drummond 1994). Landings declined throughout the 1980s. A TACC of 330 t was introduced in 1986, but the decline continued and the TACC was further reduced to 160 t in 1989–90. Subsequent landings have been

lower than, or equal to, the TACC. Input controls remain, including regulatory and voluntary closed areas.

Most snapper in SNA 7 are now taken during late summer as bycatch of trawling, particularly for red gurnard and flatfish. Snapper are also taken as bycatch of set netting for rig, warehou, and school shark and line fishing for school shark during the summer. A small target fishery now occurs on the spawning stock during spring-summer, with landings by longline, single trawlers, and two sets of pair trawlers. After the 1996–97 TACC increase from 160 to 200 t, this target fishery now extends into early autumn (Blackwell et al. 1999).

1.3 Previous research

SNA 2. Early reviews of the growth and population structure in SNA 2 (Paul & Tarring 1980) found that most fish were older than 10 years (oldest 42 years), but considerable variability occurred in year class strengths. Kilner (1983) noted that the fishery in earlier years exploited 38–40 cm fish but by the late 1970s it was exploiting 25–35 cm fish. Ryan (1993) examined CPUE and catch sampling data and found that the abundance of young (4–7 year old) fish in the SNA 2 catch had increased 2–4 fold between 1983–84 and 1991–92. He also suggested that changes in fishing practices in the target tarakihi and gurnard fisheries reduced the usefulness of CPUE monitoring as an index of snapper abundance.

The previous catch-at-age estimates (Blackwell et al. 2000) suggested that the fishery was numerically dominated by fish less than 11 y, with stronger then average year classes in 1989–1991 and 1994–1996.

No estimates of current and reference biomass are available for SNA 2 (Annala et al. 2000). The estimate of MCY of 370 t is based on mean landings from 1941 to 1990 of 410 t, where M is assumed to be 0.06 y^{-1} and $c = 0.90$ (Annala & Sullivan 1996).

Tasman Bay/Golden Bay. This stock is recognised as separate from the SNA 8 stock, based on tagging recovery data (Drummond 1994). Within SNA 7, two separate substocks in Tasman Bay/Golden Bay and in the Marlborough Sounds are recognised, based on stock separation studies during 1978–81, 1984, and 1986–87 (Drummond 1994). The small catch on the west coast of the South Island is taken to be part of the Tasman Bay/Golden Bay substock.

Harley & Gilbert (2000) modelled the Tasman Bay/Golden Bay stock using an age-structured population model fitted to a tag-recapture stock 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 as $1.43B_{MSY}$ and MSY at 650 t. The latter included an assumed recreational catch of 84 t and commercial under-reporting of 10%.

The previous catch-at-age estimates (Blackwell et al. 2000) suggested that the fishery took a moderate proportion of older fish (20 y or more) and was numerically dominated by the strong 1986,1988, 1990 and 1996 year classes. Recruitment had been particularly poor between 1991 and 1994, whereas the 1996 year class had been unusually strong.

2. METHODS

Although separate substocks may occur in SNA 2 (Paul & Tarring 1980), the catch at age data were treated as coming from a single stock. For SNA 7, sampling was restricted to the Tasman Bay/Golden Bay substock. The Marlborough Sounds substock was not sampled.

2.1 Initial 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 that within strata (Cochran 1977). Estimation requires the sampling of landings to be random, but 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. Method, season, and mean vessel landing proved to be satisfactory criteria for stratification in 1998–99, and these have been used again here. The sampling stratifications were based on landings from the 1996–97, 1997–98, and 1998–99 fishing years, following methods described by Blackwell et al.(1999).

SNA 2. Trawlers were ranked by previous mean landing size and divided into two classes. The higher landings class, BT1, was defined by a list of vessels (not given here as the information is confidential) that had together landed 62% of the total snapper catch during 1996–97 to 1998–99. As non-trawl methods accounted for only a small percentage of total landings, they were combined with other trawlers to form the OTH (other) strata. Seasonal catches by vessel class were defined as sampling strata: BT1-spring (October–December 1999); BT1-summer (January–March 2000); BT1-autumn (April–June 2000); BT1-winter (July–September 2000); OTH-spring (October–December 1999); OTH-summer (January–March 2000); OTH-autumn/winter (April–September 2000).

Tasman Bay/Golden Bay. Trawlers were ranked by previous mean landing size and divided into two classes. 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 1996–97 to 1998–99. As non-trawl methods also accounted for only a small percentage of total landings, they were combined with the other trawlers to form the OTH (other) strata. Seasonal catches by vessel class were defined as sampling strata: BT1-spring (October–December 1999); BT1-summer (January–March 2000); BT1-autumn/winter (April–September 2000); OTH-spring (October–December 1999); OTH -summer (January–March 2000); OTH-autumn/winter (April–September 2000).

2.2 Revised sampling

The actual number of samples obtained in both SNA 2 and SNA 7 differed from the target number. The data were post-stratified to accommodate these differences (Tables 1 and 2).

SNA 2. Most of the stratum sampling targets were met or exceeded, but too few landings were obtained in the OTH-autumn/winter strata. Hence, these data were combined with data from the OTH-summer stratum to form a OTH summer/autumn/winter stratum. The estimated catch for SNA 2 was 392 t.

Tasman Bay/Golden Bay. The original stratification was retained, but some extra samples were taken in summer and autumn/winter to correspond to an increase in target fishing. Summaries of the numbers of landings sampled and landed weights are given in Table 2. The 1999–2000 landed catch for SNA 7 (all) was 178 t. The estimated catch for Tasman Bay/Golden Bay was 147 t and for the Marlborough Sounds was 31 t.

2.3 Sampling procedure

A random sample of about 30 fish was collected from each landing from a random selection of fish bins, as described by Blackwell et al. (1999). The saggital 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

As the numbers of otoliths collected exceeded the target numbers (800 for SNA2 and 1000 for Tasman Bay/Golden Bay), random subsamples were selected. Subsamples were chosen so that the number of fish aged from a landing was roughly proportional to the landed weight. For large landings, all collected otoliths were aged and for small landings a minimum of 10 fish was always aged.

Snapper otoliths collected during spring 1999 and summer 2000 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 200 grit and 400 grit diamond polishing wheels, and read under a binocular dissecting microscope at x20–30 magnification.

Snapper otoliths collected during autumn and winter 2000 were processed by embedding in resin and cutting dorsal-ventrally through the nucleus, as described in Blackwell *et al.* (1999). To standardise procedures between these methods, additional otolith samples from the 1998–99 fishing year were processed using both methods. A standardised procedure for reading the otoliths and ageing the snapper was followed (after Davies & Walsh 1995). Ages were defined from a nominal birthday (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 initially combined into an age class by rounding down to the nearest year. An extra year was then added to the ages of the fish sampled between October and December 1999.

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

3. RESULTS

3.1 Age distributions

The numbers of snapper aged from each stratum are given in Table 3. The proportions at age, $\hat{p}_i$, and the estimated coefficients of variation, $\mathrm{c\hat{v}}(\hat{p}_i)$, are presented in Figures 2–5. Values for SNA 2 are given in Appendix 1, and for SNA 7 in Appendix 2. The mean weighted c.v. for SNA 2 was 0.19 (0.19 for classes 1–20+ years). The mean weighted c.v. for Tasman Bay/Golden Bay was 0.28 (0.25 for 1–20+ years). The higher mean weighted c.v. obtained for Tasman Bay/Golden Bay reflects the wider spread of age classes present in this population. The Tasman Bay/Golden Bay continues to show a substantially higher proportion of 20+ fish than the SNA 2 stock.

SNA 2. The landings are numerically dominated by fish less than 11 years (Figure 2). There is a strong presence of younger (3–6 years) fish indicating strong or average 1994, 1995, 1996, and 1997 year classes. The strong 1995 and 1996 year classes correspond to warm La Niña years. The previously dominant 1989–91 year classes (now 9–11 years) are still apparent and correspond to strong year classes in the SNA 1 fishery (Walsh et al. 1998, 1999, 2000). The proportions of young fish suggest that they experienced a greater selectivity than in the previous two years.

Comparison of the proportions at age and mean weights, by stratum (Figure 3 and Table 4), indicates some differences in age distributions between strata. Both BT1 and OTH vessels appear to have taken more old fish during spring-summer, and more 3- and 4-year-old fish in autumn-winter. The mean fish weight was 1.2 kg.

Tasman Bay/Golden Bay. The fishery continues to be strongly dominated by the 1996, 1995, 1990, 1988, and 1986 year classes (Figure 4; cf. Blackwell et al. 2000). The weak 1991 to 1994 year classes that correspond to the cold El Niño years continue to be apparent. The proportion of 3-year-old fish (1997 year class) is much smaller than it was last year (1996 year class). The 20+ year class continues to form an important part of this fishery.

Comparison of proportions at age and mean weights (Figure 5 and Table 5) indicates some differences in the age distributions between strata. As for SNA 2, there is a tendency for older fish to be caught in spring-summer and younger fish to be caught in autumn-winter. The mean fish weight was 3.2 kg.

4. DISCUSSION

Samples were collected from a representative cross section of vessels to include both targeting and bycatch fishing activity in both fishstocks. Both fisheries land a wide range of age classes and show variability in age distributions between landings within strata and between strata. The SNA 2 sampling programme required post-stratification to accommodate changes in the way the fishery operated in 1999–2000.

No stratum modifications were required for sampling the SNA 7 (Tasman Bay/Golden Bay) fishstock, but unexpectedly large landings in one stratum lead to its being under-sampled. As landings in both stocks are generally taken as bycatch of other target fisheries and landings patterns are unpredictable, our planned but dynamically adjustable sampling regime appears to be the optimum for sampling these fishstocks.

Both fisheries had considerable variability in mean size between strata. Mean weight declined in SNA 2 from 1.5 to 1.2 kg and increased in Tasman Bay/Golden Bay from 2.5 to 3.2 kg (see Blackwell et al. 2000). We presume that the high variability between strata is due to spatial heterogeneity in the stock 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 stock is consistent with the 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 stock has consistently showed the highest proportions of 20+-year-old fish of any New Zealand snapper stock suggesting that it has been experiencing the lowest levels of fishing mortality. The SNA 2 stock has showed proportions of 20+-year-old fish similar to those for the Hauraki Gulf (Walsh et al. 1998, 1999, 2000) suggesting similar fishing mortalities.

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6. REFERENCES

Annala, J.H.; Sullivan, K.J. (comps.) (1996). Report from the Fishery Assessment Plenary, April-May 1996: stock assessments and yield estimates. 308 p. (Unpublished report held in NIWA library, Wellington.)

Annala, J.H.; Sullivan, K.J.; O'Brien C.J. (comps.) (2000). Report from the Fishery Assessment Plenary, May 1999: stock assessments and yield estimates. 430 p. (Unpublished report held in NIWA library, Wellington.)

Blackwell, R.G.; Gilbert, D.J.; Davies, N.M. (1999). Age composition of commercial snapper landings in SNA 2 and Tasman Bay/Golden Bay, 1997–98. New Zealand Fisheries Assessment Research Document 99/17. 23 p. (Unpublished report held in NIWA library, Wellington.)

Blackwell, R.G.; Gilbert, D.J.; Davies, N.M. (2000). Age composition of commercial snapper landings in SNA 2 and Tasman Bay/Golden Bay (SNA 7), 1998–99. *New Zealand Fisheries Assessment Report 2000/12.* 22 p.

Blackwell, R.G.; Stevenson, M.L. (1997). Trawl survey of juvenile snapper in Tasman and Golden Bays, July 1996 (KAH9608). *New Zealand Fisheries Data Report No. 87.* 12 p.

Colman, J.A.; McKoy, J.L.; Baird, G.G. (comps. and eds.) (1985). Background papers for the 1985 Total Allowable Catch Recommendations. Fisheries Research Division, Ministry of Agriculture and Fisheries. 259 p. (Unpublished report held in NIWA library, Wellington.)

Davies, N.M.; Walsh, C. (1995). Length and age composition of commercial snapper landings in the Auckland Fishery Management Area, 1988–94. *New Zealand Fisheries Data Report No. 58.* 85 p.

Drummond, K.L. (1994). Snapper. *In*: Summary of knowledge of the Tasman and Golden Bay marine environment relevant to fisheries enhancement. Report prepared for Southern Scallop Fishery Advisory Committee, Ministry of Agriculture and Fisheries (Central Region) and Tasman District Council. pp. 30–43. (Unpublished report held at Ministry of Fisheries, Nelson.)

Drummond, K.L.; Kirk, P.D. (1986). Report on 1985/86 Tasman/Golden Bay and Pelorus Sound juvenile snapper trawl survey. Challenger Fisheries Report No. 14. 14 p. (Unpublished report held at Ministry of Fisheries, Nelson.)

Francis, M.P. (1993). Does water temperature determine year class strength in New Zealand snapper (*Pagrus auratus*, Sparidae)? *Fisheries Oceanography 2(2)*: 65–72.

Harley, S.J.; Gilbert, D.J. (2000). Assessment of the Tasman and Golden Bays snapper fishery for the 1999–2000 fishing year. *New Zealand Fisheries Assessment Report 2000/28.* 42 p.

Kilner, A. (1983). A review of inshore fisheries: east coast North Island. Fisheries Management Division, Ministry of Agriculture and Fisheries. (Unpublished report held by Ministry of Fisheries, Nelson.)

Kirk, P.D.; Drummond, K.L.; Ryan, M. (1988). Interim stock size analysis: Tasman/Golden Bay snapper tagging programme. (Unpublished Fishery Assessment Meeting document, copy held at Ministry of Fisheries, Nelson.)

Mace, J.; Drummond, K.D. (1982a). Tasman Bay snapper studied. Catch *9(10):* 23–26.

Mace, J.; Drummond, K.D. (1982b). Tagging gives more answers. *Catch 9(10)*: 27.

Paul, L.J; (1976). A study on age, growth, and population dynamics of the snapper, *Chrysophrys auratus,* (Forster), in the Hauraki Gulf, New Zealand. *Fisheries Research Bulletin No. 13.* 62 p.

Paul, L.J.; Tarring, S.C. (1980). Growth rate and population structure of snapper, *Chrysophrys auratus,* in the East Cape region, New Zealand. *New Zealand Journal of Marine and Freshwater Research 14* : 237–247.

Ryan, M.P. (1993). Investigations into the lower East Coast North Island snapper fishery, 1991–92. Ministry of Agriculture and Fisheries (Central Region) Internal Report No. 21. 46 p. (Draft report held at Ministry of Fisheries, Nelson.)

Smith, P.; Francis, M.P. (1991). Snapper reseeding in the Hauraki Gulf: scientific considerations. Fisheries Research Division, Ministry of Agriculture and Fisheries, Internal Report 172. 22 p. (Unpublished report held in NIWA library, Wellington.)

Stevenson, M.L. (1996). Trawl survey of juvenile snapper in Tasman and Golden Bays, July 1995 (KAH9507). *New Zealand Fisheries Data Report No. 75.* 32 p.

Walsh, C.; Hartill, B.; Davies, N.M. (1998). Length and age composition of commercial snapper landings in SNA 1 and SNA 8, 1996–97. *NIWA Technical Report 24.* 30 p.

Walsh, C.; Hartill, B.; Davies, N.M. (1999). Length and age composition of commercial snapper landings in SNA 1 and SNA 8, 1997–98. *NIWA Technical Report 54.* 28 p.

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

Table 1: Proportion of estimated landings in SNA 2 from 1996–97 to 1998–99, by sampling strata, and the initial and revised sampling allocation for 1999–2000.

1998–99 stratum	Past proportion of catch in stratum by weight	1999–2000 Planned stratum	Planned number of landings to sample	Revised stratum	1999–00 proportion of catch in stratum by weight	Number of landings sampled
BT1-spr/sum	0.23	BT1-spr	5	BT1-spr	0.12	5
		BT1-sum	7	BT1-sum	0.16	9
BT1-aut/ win	0.26	BT1-aut	9	BT1-aut	0.19	9
		BT1-win	5	BT1-win	0.20	11
OTH-spr/sum	0.21	OTH-spr	4	OTH-spr	0.11	9
OTH-aut/ win	0.30	OTH-sum	5	OTH-sum/ aut/win	0.21	12
		OTH-aut/ win	5			
Total	244 771 (kg)		40		392 450 (kg)	55

Table 2: Proportion of estimated landings in Tasman Bay/Golden Bay (SNA 7) from 1996–97 to 1998–99, by sampling strata, and the initial and revised sampling allocation for 1999–2000.

1998–99 stratum	Past proportion of catch in stratum by weight	1999–2000 Planned stratum	Planned number of landings to sample	1999–00 proportion of catch in stratum by weight	Number of landings sampled
BT1-spr	0.49	BT1-spr	16	0.25	15
BT1-sum	0.16	BT1 sum	7	0.16	11
BT1-aut/ win	0.04	BT1 aut/win	3	0.05	3
BT2-spr	0.14	OTH-spr	14	0.16	15
BT2-sum	0.10	OTH-aut	7	0.14	6
BT2-aut/ win	0.05	OTH-aut/win	3	0.22	6
OTH-all	0.02				
Total	145 806 (kg)		50	178 102 (kg)	56

Table 3: Summary of snapper otolith samples, 1999–2000.

Stratum	Length range (cm)	Mean length (cm)	Number aged
SNA 2			
BT1-spring	27–65	37.8	87
BT1-summer	25–67	35.6	192
BT1-autumn	25–64	33.5	181
BT1-winter	26–48	31.9	116
OTH-spring	35–77	49.4	90
OTH-summer/autumn/winter	26–71	39.6	144
Total			810
Tasman Bay/Golden Bay (SNA 7)			
BT1-spring	28–78	54.3	344
BT1-summer	29–78	53.9	157
BT1-autumn/winter	26–75	56.5	69
OTH-spring	28–80	59.3	246
OTH-summer	30–73	50.3	113
OTH-autumn/winter	25–69	48.4	75
Total			1004

Table 4: Summary of estimates for 1999–2000 by sampling stratum in SNA 2.

Stratum	BT1 spring	BT1 summer	BT1 autumn	BT1 winter	OTH spring	OTH sum/aut/win	Total
Landings sampled	5	9	9	11	9	12	34
Mean weight, $\hat{w}_j$ (kg)	1.2	1.1	0.8	0.8	2.4	1.0	1.2
Weight sampled landings, t_j (t)	4.5	6.7	7.3	5.1	6.7	6.5	36.8
Total landings, T_j (t)	47.7	62.8	77.4	78.0	43.6	82.9	392.4
Mean weighted *c.v.* of proportions at age (1–20+ y)	0.05	0.06	0.07	0.10	0.02	0.07	0.19

Table 5: Summary of estimates for 1999-2000 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	15	11	3	15	6	6	56
Mean weight, $\hat{w}_j$ (kg)	3.6	3.2	3.6	4.2	2.2	2.6	3.2
Weight sampled landings, t_j (t)	21.9	12.1	4.0	10.4	2.6	3.7	23.0
Total landings, T_j (t)	44.8	29.3	9.8	29.5	25.1	39.7	178.2
Mean weighted *c.v.* of proportions at age (1–20+ y)	0.05	0.07	0.02	0.14	0.03	0.15	0.25

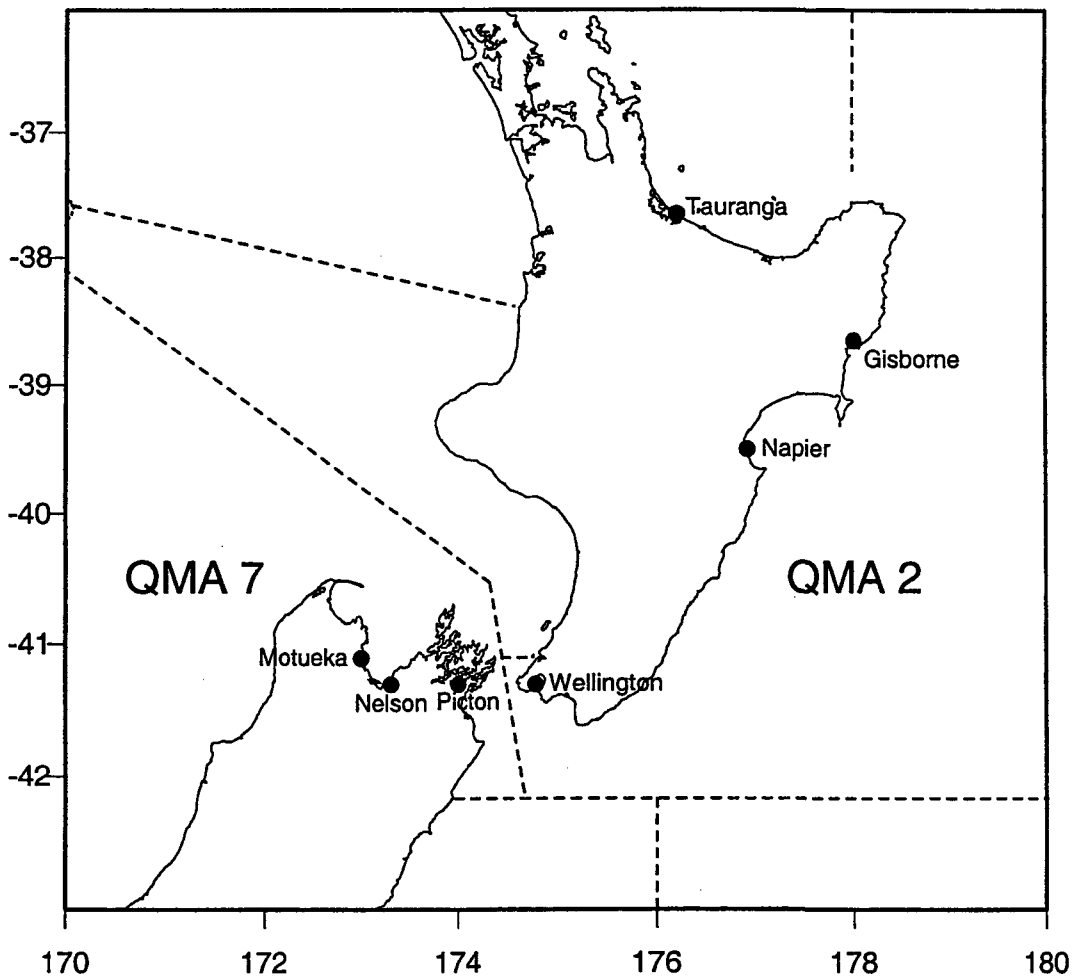

Figure 1: QMA 2 and QMA 7 showing main ports of landing in the SNA 2 and SNA 7 fisheries. Tasman Bay is the large bay in which Motueka and Nelson are situated and Golden Bay is the large bay immediately to its northwest.

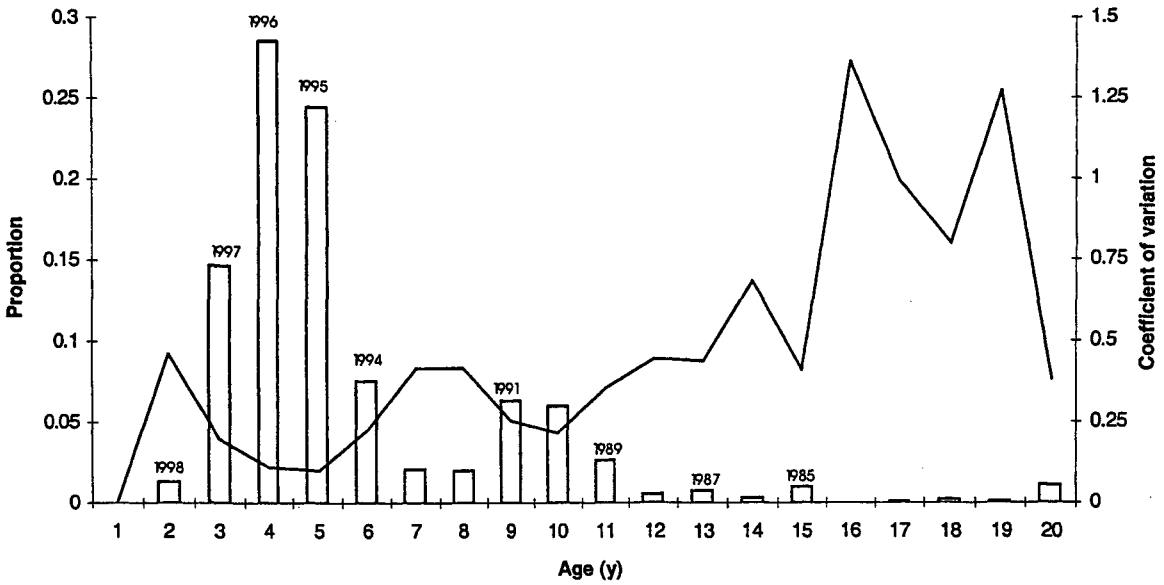

Figure 2: Proportion at age estimates (histogram) and c.v.s (line) for SNA 2 landings, fishing year 1999–2000.

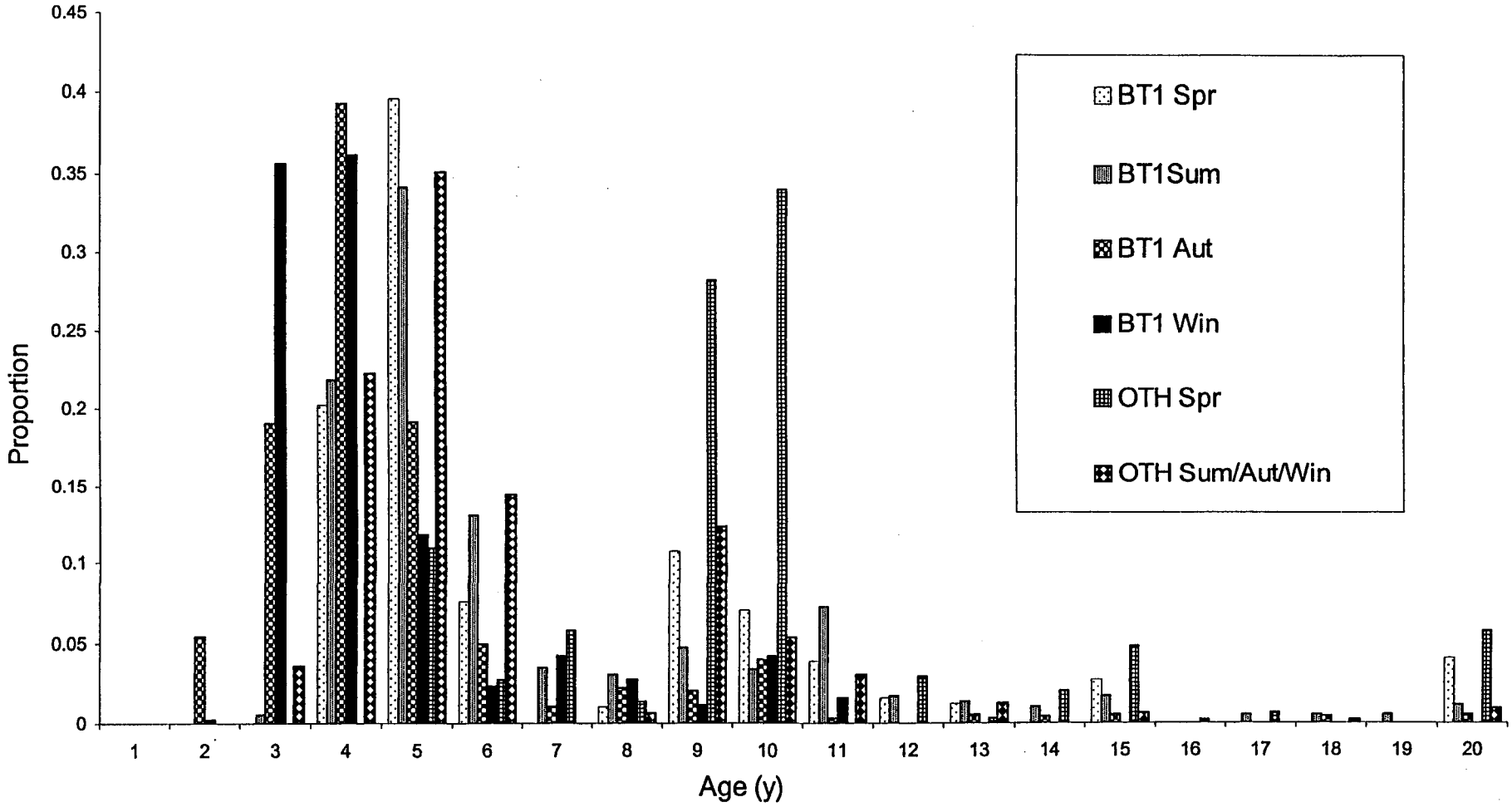

Figure 3: Proportion at age estimates for SNA 2 landings, fishing year 1999–2000 by sampling stratum (see text for stratum definitions).

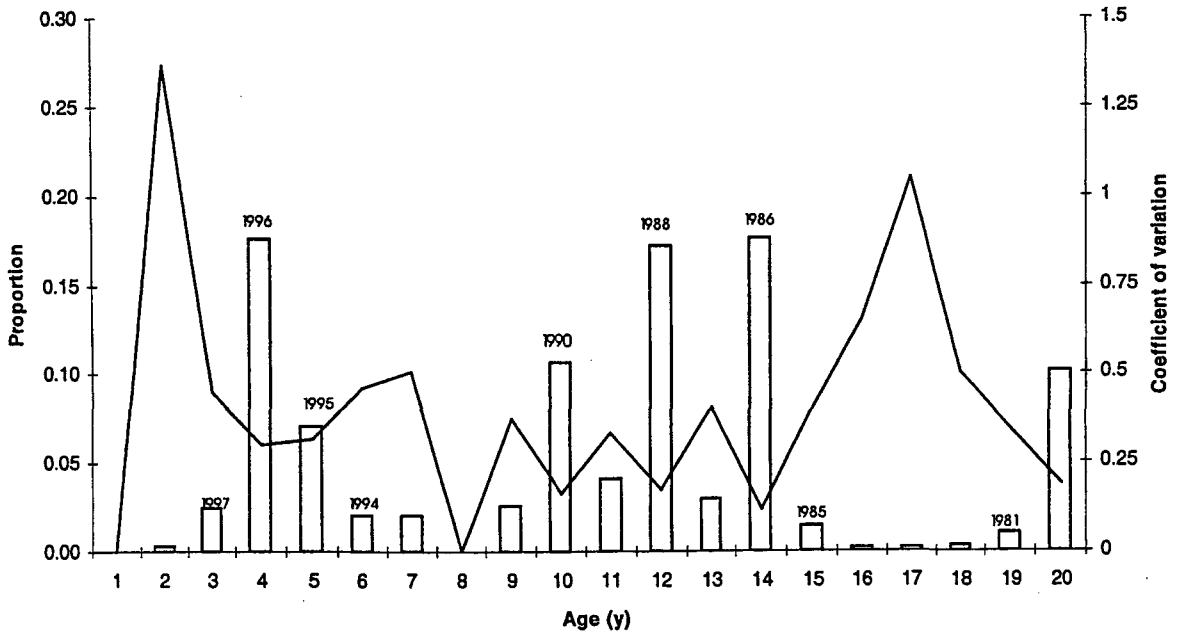

Figure 4: Proportion at age estimates (histogram) and c.v.s (line) for Tasman Bay/Golden Bay (SNA 7) landings, fishing year 1999–2000.

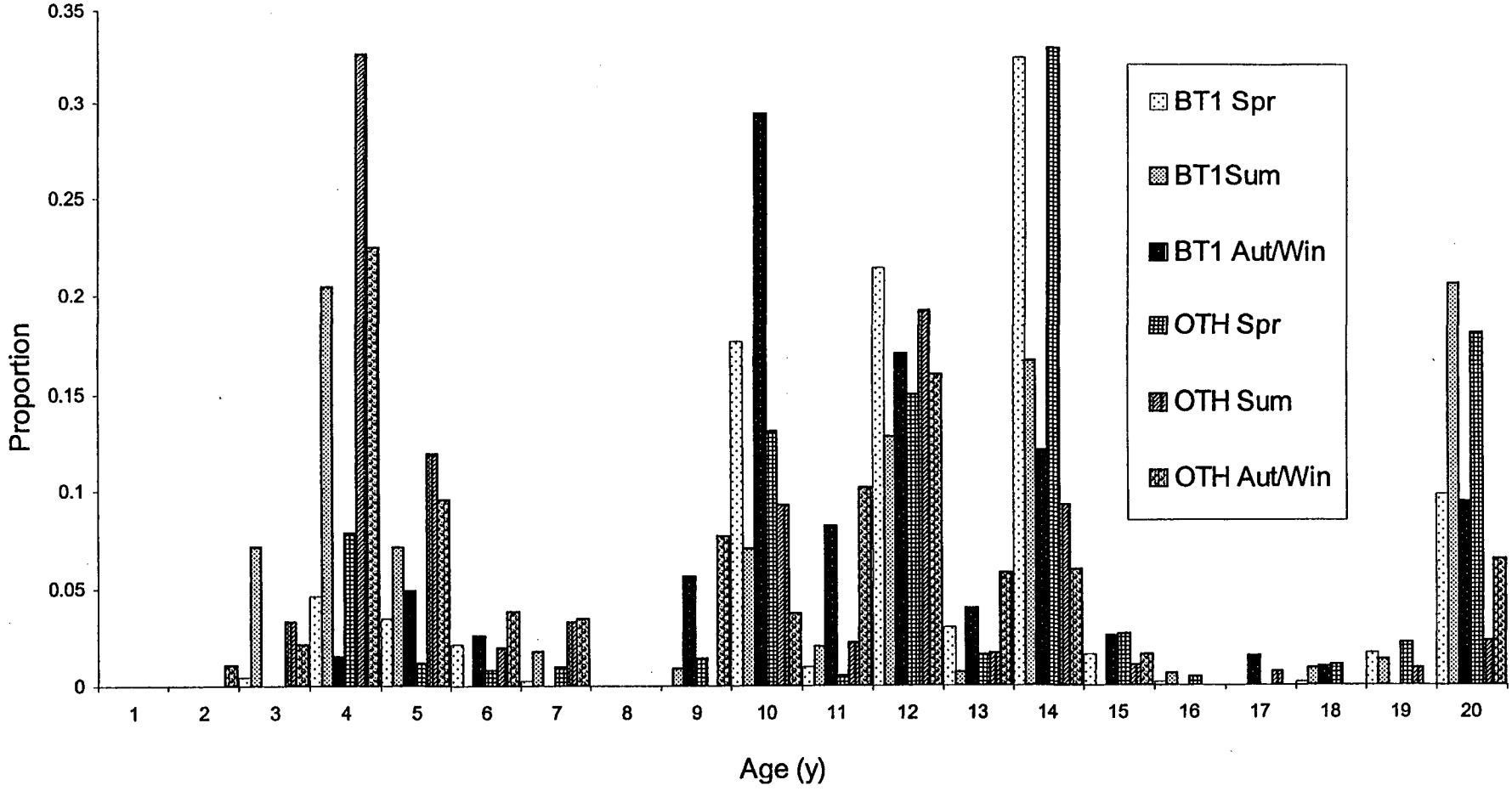

Figure 5: Proportion at age estimates for Tasman Bay/Golden Bay (SNA 7) landings, fishing year 1999–2000 by sampling stratum (see text for stratum definitions).

Appendix 1: Details of the 1999–2000 SNA 2 landings

Table A1: Estimated proportion at age for 1999–2000 SNA 2 landings.

	Stratum						
Age	BT1-spr	BT1-sum	BT1 -aut	BT1-win	OTH-spr	OTH-sum/ win	Total
1	0	0		0	0	0	0
2	0	0	0.0539602	0.0023104	0	0	0.013268
3	0	0.0050972	0.1903909	0.3561318	0	0.0360591	0.146807
4	0.2024888	0.2177307	0.3927908	0.361215	0	0.2225398	0.285903
5	0.3967281	0.341539	0.1920812	0.1184671	0.1097896	0.3512132	0.244197
6	0.0757821	0.1308085	0.0493285	0.0232221	0.02755	0.1448659	0.075779
7	0	0.035026	0.0109269	0.0416377	0.0581748	0	0.021559
8	0.0103664	0.0303844	0.0222017	0.027068	0.0138445	0.0065827	0.019956
9	0.1073855	0.0474023	0.01978	0.0115036	0.2820696	0.1229184	0.063868
10	0.0706776	0.0340251	0.0402469	0.0422101	0.3400644	0.0541976	0.05981
11	0.0392173	0.0731265	0.0028838	0.0162344	0	0.0309014	0.026189
12	0.015912	0.0164848	0	0	0.0298688	0	0.005479
13	0.0130676	0.0135194	0.0056892	0	0.0028463	0.0129724	0.007455
14	0	0.010976	0.0043965	0	0.0199721	0.0004106	0.003704
15	0.0276534	0.016464	0.0056892	0	0.0488025	0.0058048	0.01006
16	0	0	0	0	0.0023067	0	0.000108
17	0	0.005283	0	0	0.0067326	0	0.001111
18	0	0.005283	0.0043965	0	0	0.0025756	0.00235
19	0	0.005488	0	0	0	0	0.000825
20	0	0	0	0	0	0	0
21	0.0117414	0	0	0	0.0324398	0.0025756	0.003227
22	0.015912	0	0	0	0	0	0.001596
23	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0
28	0	0	0	0	0.0023067	0.0025756	0.000633
29	0	0.0029371	0	0	0	0	0.000442
30	0	0.0029371	0	0	0	0	0.000442
31	0	0	0	0	0	0	0
32	0	0	0	0	0.0067326	0	0.000316
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0
39	0	0	0	0	0.0067326	0	0.000316
40	0	0	0	0	0	0.0004106	8.36E-05
41	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0
44	0	0	0	0	0.0028463	0.0004106	0.000217
45	0	0	0	0	0	0.0025756	0.000525
46	0	0	0	0	0	0.0004106	8.36E-05
47	0	0.005488	0	0	0	0	0.000825
48	0.0130676	0	0	0	0.0023067	0	0.001419
49	0	0	0	0	0	0	0
50	0	0	0.0052377	0	0	0	0.001229
51	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0
55	0	0	0	0	0.0046133	0	0.000217
56	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0

Appendix 1: – continued

Table A2: Stratum variances and overall c.v. of proportion at age, both with finite population correction, estimated by simulation for 1999–2000 SNA 2 landings.

						Stratum	C.v of overall
Age	BT1-spr	BT1-sum	BT1-aut	BT1-win	OTH-spr	OTH-sum/win	proportion
1	0	0	0	0	0	0	0
2	0	0	0.000658	1.25351E-05	0	0	0.458834
3	0	2.63E-05	0.004011	0.008595861	0	0.001062	0.200301
4	0.006842	0.005431	0.001633	0.008648385	0	0.003802	0.112919
5	0.015212	0.003452	0.002352	0.001891829	0.004821	0.003012	0.10263
6	0.001805	0.002249	0.000608	0.000391613	0.000538	0.003993	0.227279
7	0	0.000421	0.000101	0.000892661	0.001341	0	0.415648
8	2.16E-05	0.00021	0.000258	0.000671298	0.000222	6.21E-05	0.416338
9	0.009377	0.000785	0.000179	0.0002217	0.006492	0.002712	0.254535
10	0.002017	0.000344	0.000361	0.000761699	0.005723	0.001323	0.217069
11	0.000513	0.001797	1.72E-05	0.000424049	0	0.000265	0.356846
12	5.87E-06	0.000194	0	0	0.000695	0	0.446015
13	1.76E-05	0.000113	5.43E-05	0	1.61E-05	0.000121	0.440617
14	0	0.000139	3.74E-05	0	0.000521	3.35E-07	0.680922
15	0.0004	0.000291	4.96E-05	0	0.000773	5.44E-05	0.413416
16	0	0	0	0	9.86E-06	0	1.361251
17	0	4.53E-05	0	0	8.82E-05	0	0.994076
18	0	4.4E-05	3.57E-05	0	0	1.42E-05	0.801444
19	0	4.86E-05	0	0	0	0	1.270709
20	0	0	0	0	0	0	0
21	9.2E-06	0	0	0	0.001252	1.53E-05	0.579103
22	7.51E-06	0	0	0	0	0	0.172206
23	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0
28	0	0	0	0	9.43E-06	1.36E-05	1.208227
29	0	1.35E-05	0	0	0	0	1.249255
30	0	1.49E-05	0	0	0	0	1.31618
31	0	0	0	0	0	0	0
32	0	0	0	0	7.13E-05	0	1.254542
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0
39	0	0	0	0	8.48E-05	0	1.367821
40	0	0	0	0	0	3.27E-07	1.393209
41	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0
44	0	0	0	0	1.57E-05	3.62E-07	1.025893
45	0	0	0	0	0	1.47E-05	1.489405
46	0	0	0	0	0	3.18E-07	1.372856
47	0	4.66E-05	0	0	0	0	1.243375
48	2.13E-05	0	0	0	9.96E-06	0	0.342498
49	0	0	0	0	0	0	0
50	0	0	4.05E-05	0	0	0	1.214921
51	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0
55	0	0	0	0	3.43E-05	0	1.269036
56	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0
60		0	0	0	0	0	0

Appendix 2: Details of the 1999–2000 SNA 7 landings

Table A3: Estimated proportion at age for 1999–2000 Tasman Bay/Golden Bay (SNA 7) landings

	Stratum						
Age	BT1-spr	BT1-sum	BT1-aut/win	OTH-spr	OTH-sum	OTH-aut/win	Total
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0.0108818	0.002858
3	0.0047279	0.0711217	0	0	0.0333166	0.0213603	0.024367
4	0.0458776	0.2048872	0.0154293	0.078691	0.3272029	0.2255961	0.175987
5	0.0344786	0.0708915	0.0490745	0.0119058	0.1197057	0.0953913	0.070905
6	0.0211281	0	0.0254896	0.0082238	0.019951	0.0381519	0.020682
7	0.0029615	0.0178442	0	0.0100294	0.0333166	0.0347982	0.020355
8	0	0	0	0	0	0	0
9	0	0.0089221	0.0563482	0.0145918	0	0.0764844	0.02588
10	0.176228	0.0701078	0.2945879	0.1311444	0.0925765	0.0375368	0.106687
11	0.0095377	0.0202249	0.0818378	0.0052785	0.0223373	0.1013966	0.040705
12	0.2149489	0.1278927	0.1702011	0.149286	0.192523	0.1592662	0.172174
13	0.0306992	0.0072522	0.0402411	0.0160506	0.0166803	0.0582016	0.030144
14	0.3249685	0.1666472	0.1211266	0.3301287	0.0922658	0.059764	0.175802
15	0.0158206	0	0.0254896	0.0267741	0.0110887	0.0157733	0.014168
16	0.0016976	0.0058591	0	0.0046566	0	0	0.001853
17	0	0	0.0154293	0	0.007043	0	0.002102
18	0.0013539	0.0088983	0.0100603	0.0105571	0	0	0.00344
19	0.0171738	0.0129576	0	0.0220822	0.0088536	0	0.010161
20	0	0.007809	0.0201206	0.0108769	0	0	0.003483
21	0.0204782	0.0058591	0.0154293	0.0472672	0.0018106	0	0.012146
22	0.0202927	0.0372951	0	0.0109205	0.0088536	0.0157733	0.017449
23	0.0012772	0.0058591	0	0	0.0018106	0.0157733	0.005696
24	0	0.0185378	0	0.0152202	0.0018106	0.0169255	0.009564
25	0.010297	0.0126788	0.0345975	0.0513946	0.0018106	0	0.012415
26	0.0142469	0.0123033	0	0.0119743	0	0	0.006459
27	0.0034274	0.0063756	0	0	0	0	0.001741
28	0.007858	0.0030392	0	0	0	0	0.002172
29	0.0013539	0.0337993	0	0.005075	0	0.0169255	0.010668
30	0	0.021919	0	0.0071357	0.007043	0	0.005698
31	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0
36	0	0	0.0245373	0	0	0	0.00114
37	0	0	0	0	0	0	0
38	0	0	0	0.0057739	0	0	0.000701
39	0.007858	0.0030392	0	0.0034908	0	0	0.002596
40	0	0.0126788	0	0	0	0	0.001994
41	0	0.0033812	0	0.0004184	0	0	0.000582
42	0	0.0155796	0	0	0	0	0.00245
43	0.0034508	0	0	0.0057739	0	0	0.001445
44	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0
46	0	0.0063394	0	0	0	0	0.000997
47	0	0	0	0.0052785	0	0	0.000641
48	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0
56	0.007858	0	0	0	0	0	0.001694
57	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0

Appendix 2: – continued

Table A4: Stratum variances and overall c.v. of proportion at age, both with finite population correction, estimated by simulation for 1999–2000 Tasman Bay/Golden Bay (SNA 7) landings

	Stratum						C.v. of overall
Age	BT1-spr	BT1-sum	BT1-aut/win	OTH-spr	OTH-sum	OTH-aut/win	proportion
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0.000221	1.366363
3	1.35E-05	0.001825	0	0	0.001094	0.00049	0.453065
4	0.000329	0.006209	0.000206	0.001498	0.050034	0.010581	0.303718
5	0.000158	0.000913	0.001791	6.89E-05	0.005224	0.003819	0.315477
6	7.52E-05	0	0.000227	4.49E-05	0.00033	0.001056	0.459345
7	7.83E-06	0.00022	0	6.72E-05	0.001104	0.000841	0.509354
8	0	0	0	0	0	0	0
9	0	8.22E-05	0.00081	9.58E-05	0	0.001288	0.374695
10	0.001088	0.001066	0.00458	0.001185	0.003615	0.000871	0.163492
11	2.68E-05	0.00013	0.00126	3.36E-05	0.000396	0.002292	0.330594
12	0.000664	0.002164	0.002496	0.00091	0.01239	0.004249	0.171863
13	0.000133	7.03E-05	0.000952	9.25E-05	0.000196	0.001879	0.404318
14	0.002499	0.002475	0.001179	0.001508	0.00326	0.001525	0.118421
15	4.19E-05	0	0.000242	0.000135	0.000118	0.000346	0.404934
16	2.85E-06	3.81E-05	0	2.59E-05	0	0	0.651196
17	0	0	0.000206	0	0.000114	0	1.04824
18	1.97E-06	5.01E-05	0.000103	9.71E-05	0	0	0.502029
19	5.52E-05	9.67E-05	0	9.1E-05	0.000152	0	0.343191
20	0	4.17E-05	0.000303	5.2E-05	0	0	0.449506
21	7.75E-05	3.97E-05	0.000196	0.000213	8.02E-06	0	0.23948
22	5.2E-05	0.000466	0	4.89E-05	0.000128	0.000379	0.387698
23	1.82E-06	3.57E-05	0	0	8.53E-06	0.000368	0.90718
24	0	0.000155	0	8.45E-05	8.47E-06	0.000459	0.636764
25	2.64E-05	0.000129	0.000688	0.000293	1E-05	0	0.262367
26	5.34E-05	7.51E-05	0	6.91E-05	0	0	0.358318
27	1.3E-05	4.52E-05	0	0	0	0	0.753646
28	5.24E-05	1.11E-05	0	0	0	0	0.757797
29	2.03E-06	0.000312	0	2.33E-05	0	0.000459	0.591352
30	0	0.000179	0	3.25E-05	0.000128	0	0.55067
31	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0
36	0	0	0.000622	0	0	0	1.016563
37	0	0	0	0	0	0	0
38	0	0	0	3.92E-05	0	0	1.084385
39	5.49E-05	1.1E-05	0	1.37E-05	0	0	0.670072
40	0	0.000134	0	0	0	0	0.913453
41	0	1.41E-05	0	2.42E-07	0	0	1.018936
42	0	9.71E-05	0	0	0	0	0.632519
43	1.33E-05	0	0	4.01E-05	0	0	0.761733
44	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0
46	0	4.83E-05	0	0	0	0	1.096201
47	0	0	0	3.13E-05	0	0	1.059092
48	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0
56	5.17E-05	0	0	0	0	0	0.915281
57	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0