

Southern Zone Abalone
(*Haliotis rubra* & *H. laevigata*)
Fishery

Fishery Status Report for PIRSA

June 2006

Mayfield, S., Hogg, A., Saunders, T.M., Carlson, I.J. and R.C. Chick

SARDI Aquatic Sciences Publication No. RD04/0091-3
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EXECUTIVE SUMMARY

1. This status report updates the 2005 stock assessment report and assesses the current status of (1) blacklip abalone in the 'fish-down' (FDA) areas, (2) blacklip abalone in the non-'fish-down' (non-FDA) areas, and greenlip abalone in the Southern Zone (SZ) abalone fishery.
2. The assessment is based primarily on the interpretation of commercial catch and effort data.
3. Fishing is concentrated in four of the seven fishing areas comprising the SZ. In 2004/05, 45% of the catch was harvested from one of these areas (fishing area 39).
4. Data for blacklip abalone in the non-FDA suggests that these populations are being fished within sustainable limits. This conclusion was supported by several lines of evidence including long-term stable catches, reductions in effort since 1982/83, increases in CPUE since 1993/94 and the triggering of six performance indicators in a positive direction.
5. However, in fishing area 39, the mean size, percentage of large blacklip abalone in the catch and the density of blacklip abalone all decreased between 2003/04 and 2004/05.
6. Unambiguous assessment of blacklip abalone in each of the four FDA was not possible because the inferences of stock status derived from the different data sets were inconsistent.
7. Contrasting patterns were observed in each FDA. Consequently, catch, effort, CPUE, size-frequency distribution of the catch, and abalone abundance and size-frequency distribution from fishery-independent surveys should continue to be monitored in all FDA in forthcoming years.
8. Future assessment of this fishery will be enhanced by expanding the fishery-independent survey program, continuing to develop a range of numerical models (*e.g.* effort standardisation and integrated length-based assessment models), increasing commercial catch sampling and determining the effects of tagging on growth rates.

1. INTRODUCTION

1.1 Report structure and content

This status report for the Southern Zone (SZ) of the South Australian abalone fishery (SAAF; Figure 1.1 and 1.2) complements the most recent assessment report (Mayfield *et al.* 2005), and will be updated by the 2007 assessment report (due 30 June 2007). This report differs from the previous reports in that not all of the information available for assessment of the fishery is provided. The report covers the period 1 September 1968 to 31 August 2005.

Following the Introduction, the report consists of three sections. Section two provides summaries, analyses and assessment of the fishery-dependent and fishery-independent data for the blacklip abalone (*Haliotis rubra*; hereafter referred to as blacklip) and greenlip abalone (*Haliotis laevigata*; hereafter referred to as greenlip; section 2.3) fisheries from 1968/69 to 2004/05. For blacklip, data are provided separately for the non-‘fish-down’ (non-FDA; section 2.1) and four ‘fish-down’ (FDA; section 2.2) areas. In Section 3, fishery performance is assessed against the performance indicators identified in the SA Abalone Fishery Management Plan (Nobes *et al.* 2004). Section 4, the General Discussion, synthesises the information presented in the previous sections, and summarises the current status of the SZ abalone fishery.

1.2 Data analysis

Commercial catch and effort data have been collected since 1968 in the form of daily entries into commercial logbooks submitted to SARDI. The logbook data were used to provide the spatial and temporal analyses of catch, effort and catch-per-unit-effort (CPUE). CPUE was computed using the mean ratio estimator (after Rice 1995). Data on the size-frequency distribution of the commercial catch were obtained from samples provided by commercial fishers. Estimates of abalone abundance were obtained from fishery-independent, diver surveys. Values presented for fishing areas 36, 39 and 40 and for FDA 1, 2 and 3 (1978/79 to 2002/03), are estimates only. This is because FDA 1, 2 and 3 comprise portions of mapcodes 39F, 40B and 36B, respectively, and catch records prior to 1997/98 provide no information on whether catch extracted from or effort expended in these mapcodes occurred within the FDA, or elsewhere. Estimates of the historical catch were obtained by determining the proportion of the total catch for each of the mapcodes harvested from the FDA (1997/98 to 2002/03), and applying a simple back-calculation. Estimates of fishing effort within and outside these two FDA were similarly derived. In general, data are presented as mean \pm 1 standard error (SE). A more thorough description of the data analyses is provided in Mayfield *et al.* (2005).



Figure 1.1: Fishing areas of the Southern Zone abalone fishery.

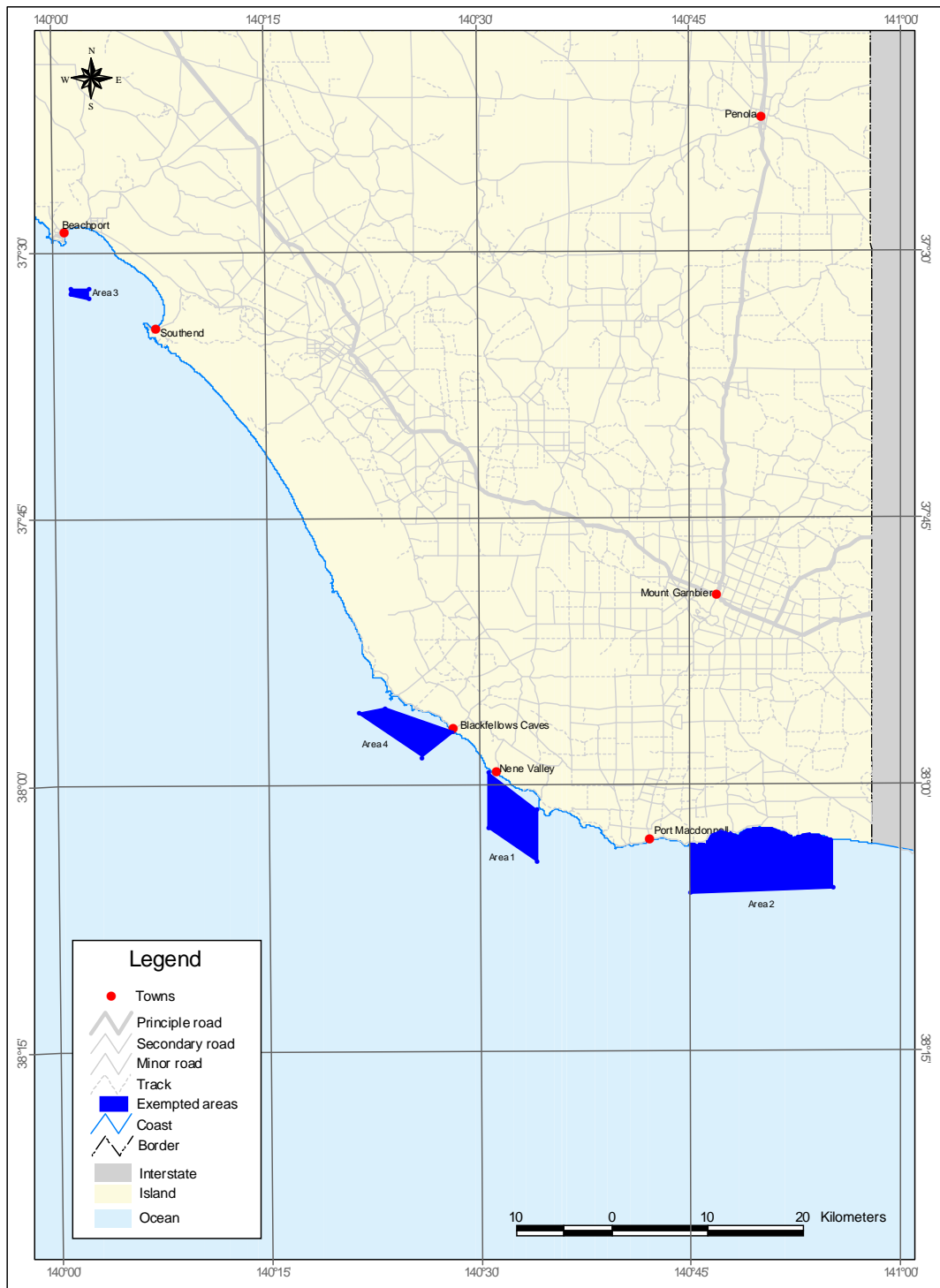


Figure 1.2: Locations of the four ‘fish-down’ areas of the Southern Zone.

2. FISHERY STATISTICS

2.1 Blacklip abalone – non-‘fish-down’ areas

2.1.1 Catch

Total annual catch of blacklip increased from <30 t in 1968/69 and 1969/70 to 117.8 t in 1987/88 (Figure 2.1a). From 1988/89 to 2004/05 total annual catch of blacklip has remained relatively stable. Catches have fluctuated inter-annually within fishing areas, with few clear trends evident (Figure 2.2). However, catches from fishing area 40 have declined substantially over the last eight seasons.

2.1.2 Effort

Effort was 1,102 hr in 1968/69, whereafter it declined sharply to <500 hr in 1969/70. Between 1970/71 and 1981/82 effort increased substantially, reaching 1,532 hr (Figure 2.1b). Effort has declined substantially since 1981/82, and was 874 hr in 2004/05.

2.1.3 Catch-per-unit effort (CPUE)

CPUE declined rapidly between 1978/79 and 1983/84, whereafter it has generally increased steadily (Figure 2.1c). In 2004/05 CPUE was >112 kg.hr⁻¹, the highest value in the history of the fishery. Similar patterns were observed in many of the main fishing areas (Figure 2.3).

2.1.4 Size-frequency distribution of the catch

There were no obvious changes in the size-frequency distributions of commercial catches in either the SZ generally, or fishing area 37 specifically, between 2001/02 and 2004/05 (Figure 2.4). However, in fishing area 39, between 2003/04 and 2004/05, the mean size decreased by >3 mm SL, and the percentage of the catch <140 mm SL increased from 60.3 to 78.3%. These changes suggest that the exploitation rate in this area was greater during 2004/05 when compared to 2003/04.

2.1.5 Fishery-independent surveys

Fishery-independent surveys have been undertaken at three sites since 2002/03. Density of blacklip was lower at all three sites in 2004/05 when compared with that in 2003/04 (Figure 2.5). The largest decrease in density was observed at Middle Point (23.4%). There were no obvious differences in population structure between 2002/03 and 2004/05 at any of the three sites (Figure 2.6).

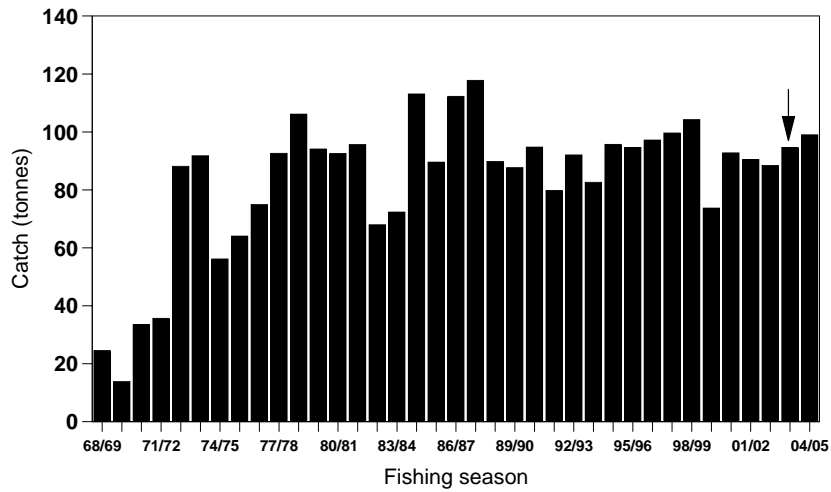


Figure 2.1a: Estimated catch (t) of blacklip in the non-FDA, from 1968/69 to 2004/05. ↓ indicates implementation of TACC.

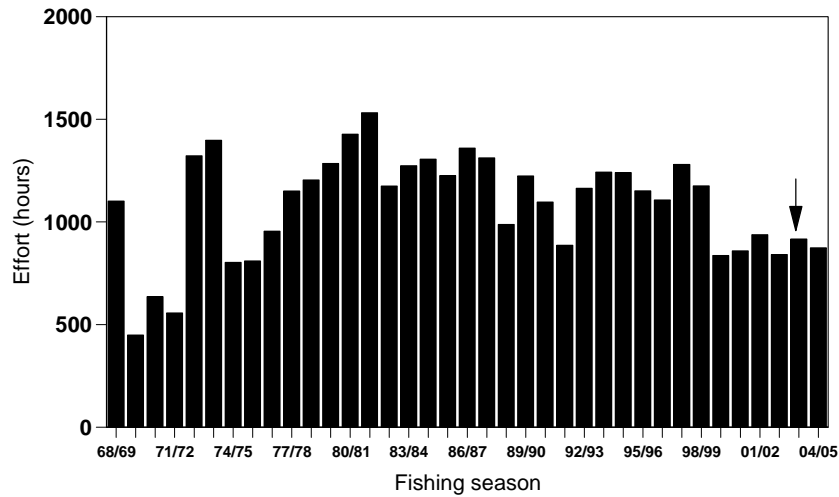


Figure 2.1b: Estimated effort (hours) on blacklip in the non-FDA, from 1968/69 to 2004/05. ↓ indicates implementation of TACC.

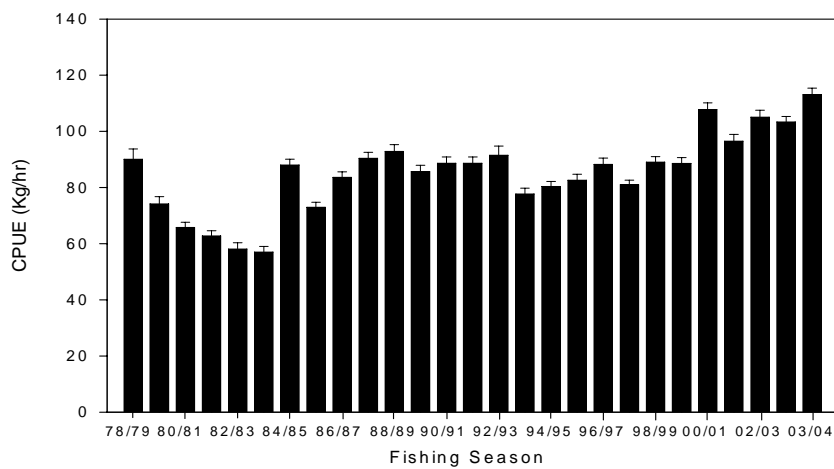


Figure 2.1c: Estimated CPUE ($\text{kg}\cdot\text{hr}^{-1}$) on blacklip in the non-FDA, from 1978/79 to 2004/05.

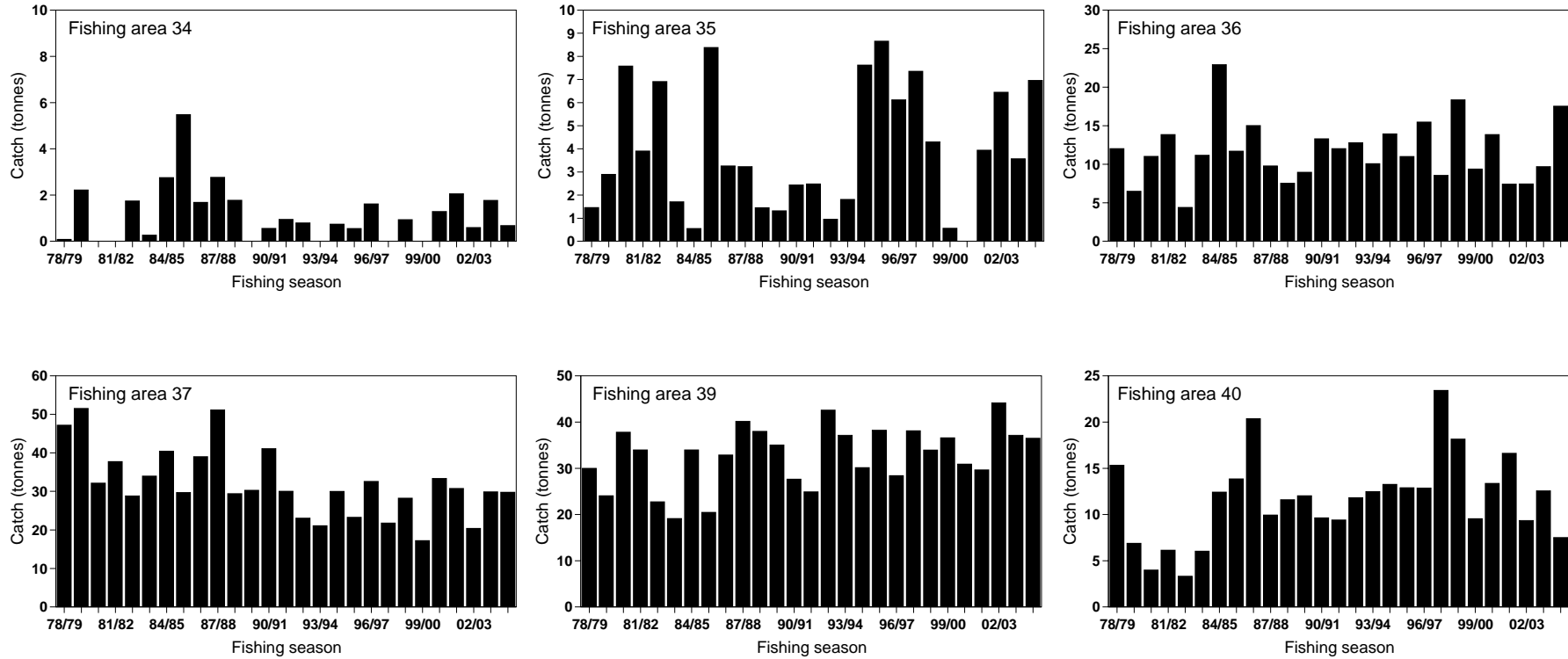


Figure 2.2. Estimated (fishing areas 36, 39 and 40) and reported (fishing areas 34, 35 and 37) catch of blacklip (t) in the non-FDA from 1978/79 to 2004/05.

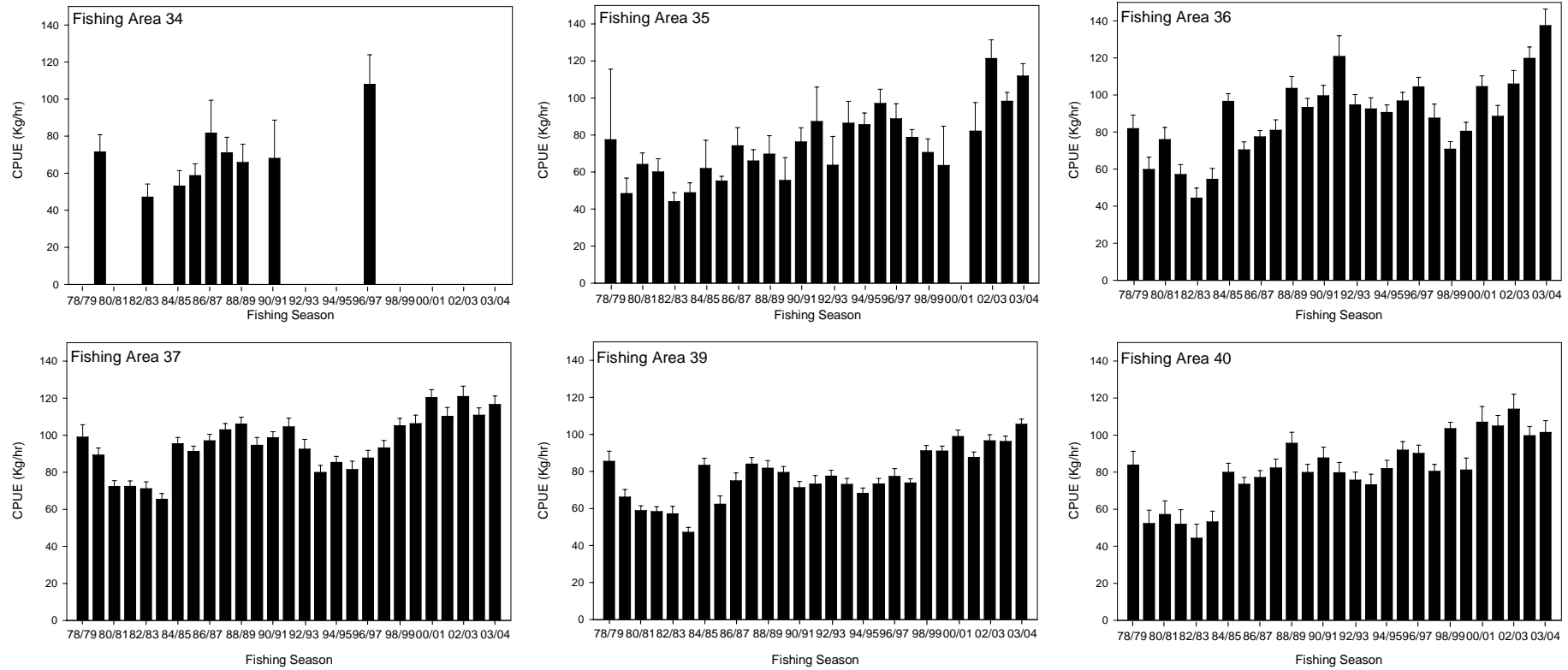


Figure 2.3: Estimated (fishing areas 36, 39 and 40) and reported (fishing areas 34, 35 and 37) CPUE (kg.hr⁻¹) on blacklip abalone in the non-FDA from 1978/79 to 2003/04. There were too few data to enable CPUE to be calculated in fishing area 34 during most seasons.

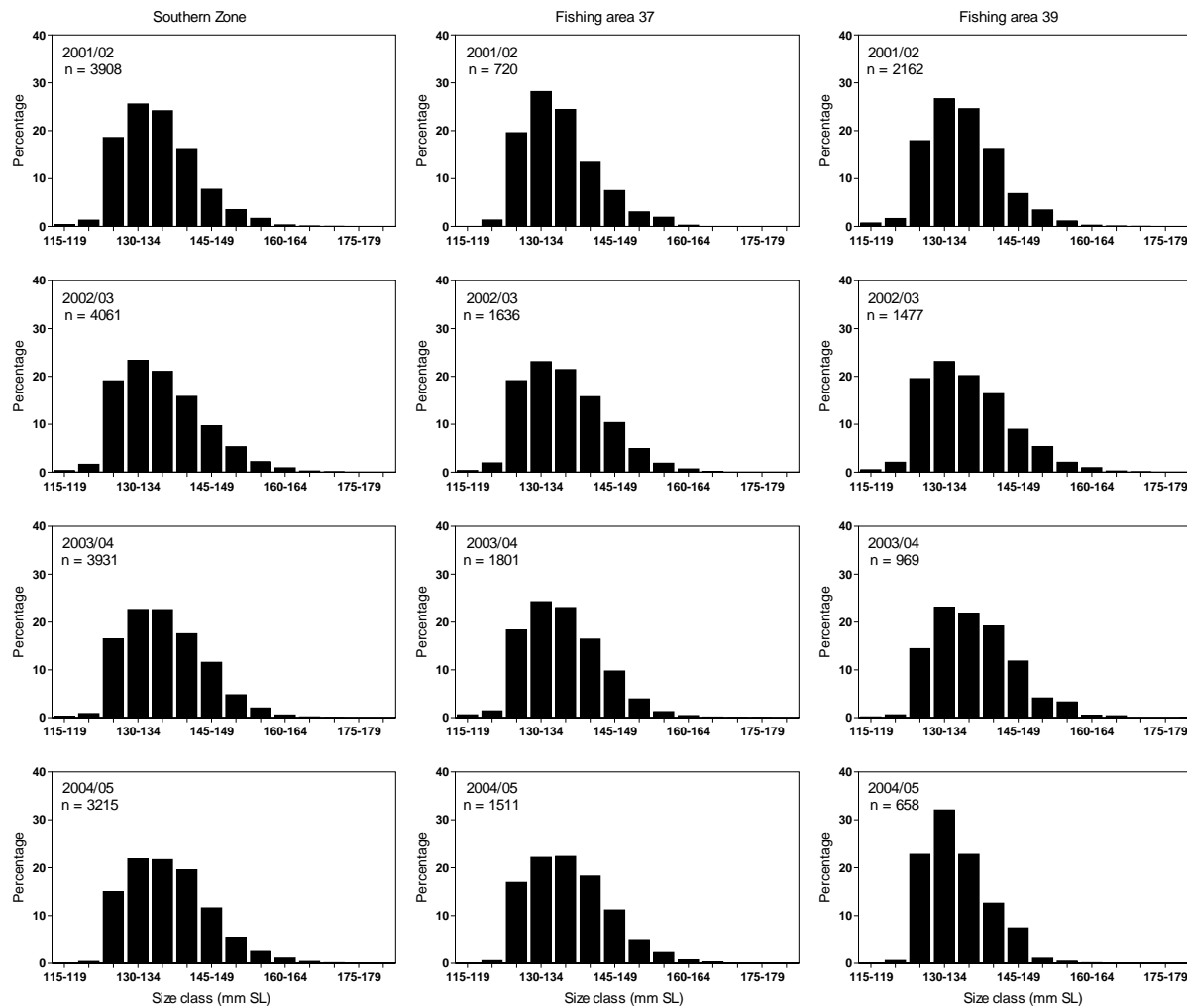


Figure 2.4: Size-frequency distribution obtained from measuring blacklip commercial shell samples from 2001/02 to 2004/05 (non-FDA only) for the Southern Zone (all fishing areas combined) and separately for fishing areas 37 and 39.

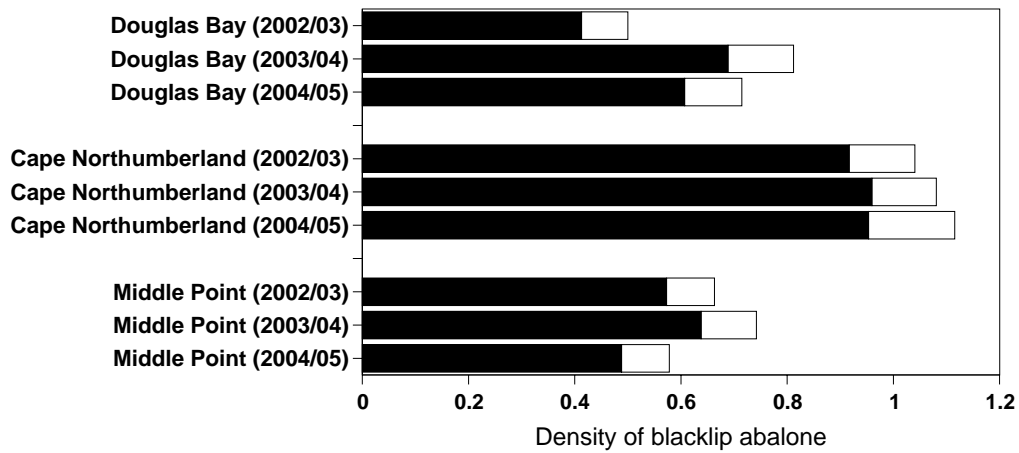


Figure 2.5: Density (abalone.m⁻²) of blacklip counted in transects during fishery-independent surveys at Middle Point (mapcode 39G), Douglas Bay (mapcode 39F) and Cape Northumberland (mapcode 40A) from 2002/03 to 2004/05. Clear bars show 1 SE.

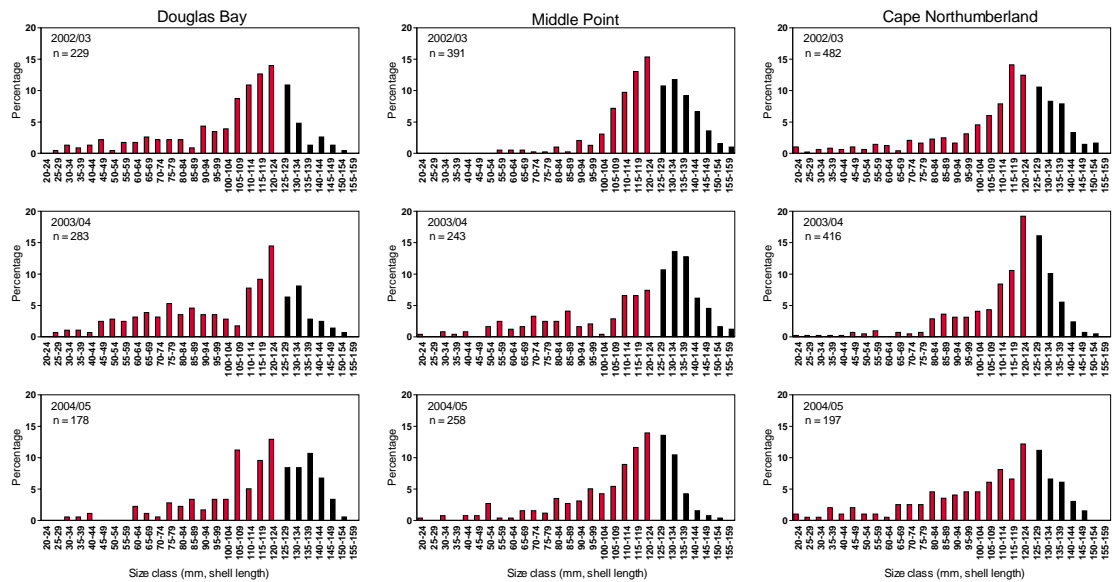


Figure 2.6: Fishery-independent length-frequency distribution (mm, SL) of blacklip at Douglas Bay, Middle Point and Cape Northumberland from 2002/03 to 2004/05 (red bars: <125 mm SL; black bars: >125 mm SL).

2.2 Blacklip abalone – ‘fish-down’ areas

2.2.1 Catch

Blacklip catch increased from <10 t in 1968/69 and 1969/70 to >90 t in 1992/93 (Figure 2.7a). From 1993/94 to 2004/05, total annual catch of blacklip has varied among years, but there was no evidence of a long-term trend (Figure 2.7a). Catches have fluctuated inter-annually within the FDA. Over the last decade, most of the catch has been obtained from FDA 3 and 4 (Figure 2.8). Notably, catch from FDA 3 declined substantially (~20 t) after 2002/03; catches from FDA 4 increased over the same period (Figure 2.8).

2.2.2 Effort

Effort increased substantially from 187 hr in 1969/70 to 866 hr in 1992/93 (Figure 2.7b). Effort has declined substantially over the last four seasons. In 2004/05, it was 502 hr, the lowest level since the formal implementation of the FDA in 1993/94.

2.2.3 Catch-per-unit effort (CPUE)

The CPUE in FDA 1, 3 and 4 has generally increased since 1978/79, and in 2004/05 it was amongst the highest recorded. In FDA 2, the CPUE has varied substantially among seasons, with no evidence of any long-term trend either since 1978/79 or over about the last 10 fishing seasons (Figure 2.9).

2.2.4 Size-frequency distribution of the catch

There were no obvious changes in the size-frequency distributions of commercial catches in FDA 4 between 2001/02 and 2004/05 (Figure 2.10). However, between 2003/04 and 2004/05, in FDA 3 (1) the mean size decreased by ~7 mm SL from 130 mm SL, (2) the percentage of the catch <135 mm SL increased from 66.8 to 88.3%, and (3) the modal size class decreased from 130–134 to 120–124 mm SL. These changes indicated that fishing pressure in this area was substantially greater during 2004/05 when compared to 2003/04, and are indicative of a trend towards ‘knife-edged’ fishing. The opposite patterns were observed in FDA 1 and 2.

2.2.5 Fishery-independent surveys

Fishery-independent surveys have been undertaken at three sites since 2002/03. Blacklip density decreased successively at Gerloffs Bay (FDA 4) between 2002/03 and 2004/05, and between 2003/04 and 2004/05 at Jones Bay (FDA 1; Figure 2.11). The opposite pattern (*i.e.* increases in blacklip density) was observed at Ringwood Reef (FDA 3; Figure 2.10). There were no obvious differences in population structure between 2002/03 and 2004/05 at Gerloffs Bay or Ringwood Reef, or between 2003/04 and 2004/05 at Jones Bay (Figure 2.12).

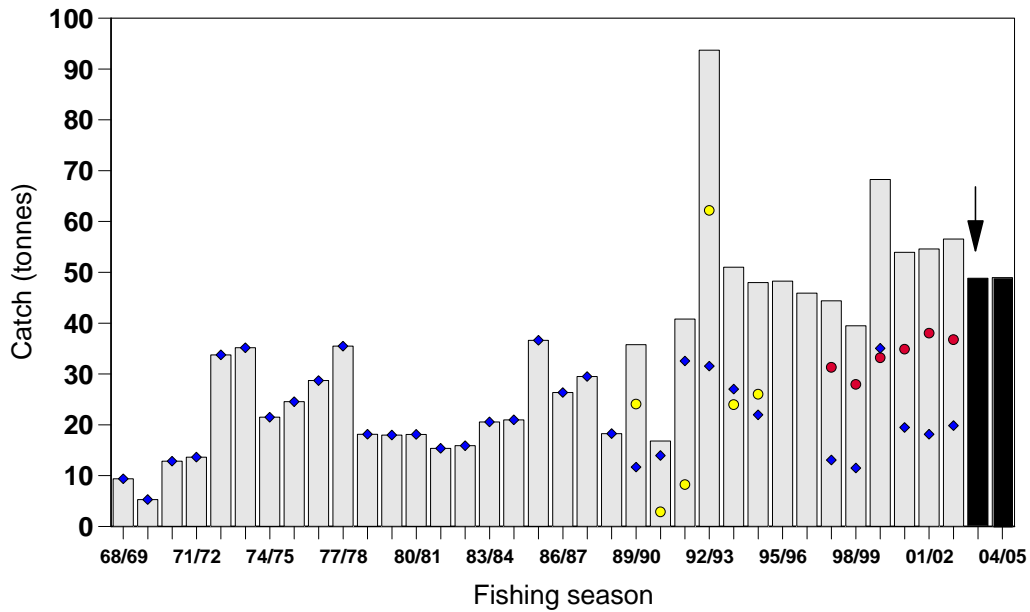


Figure 2.7a: Estimated total (light grey bars), 'normal' (blue diamonds), 'fish-down' (yellow circles) catch (t) of blacklip and reported total (black bars) and 'fish-down' (red circles) catch of blacklip (t) in all FDA combined from 1968/69 to 2004/05. ↓ indicates implementation of TACC.

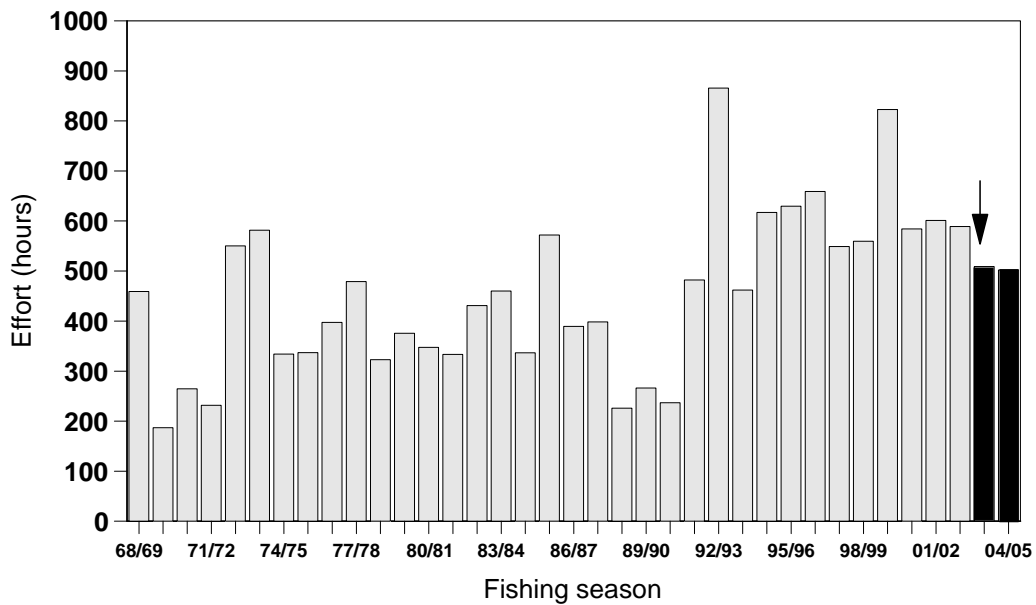


Figure 2.7b: Estimated (light grey bars) and reported (black bars) effort (hr) on blacklip in all FDA combined from 1968/69 to 2004/05. ↓ indicates implementation of TACC.

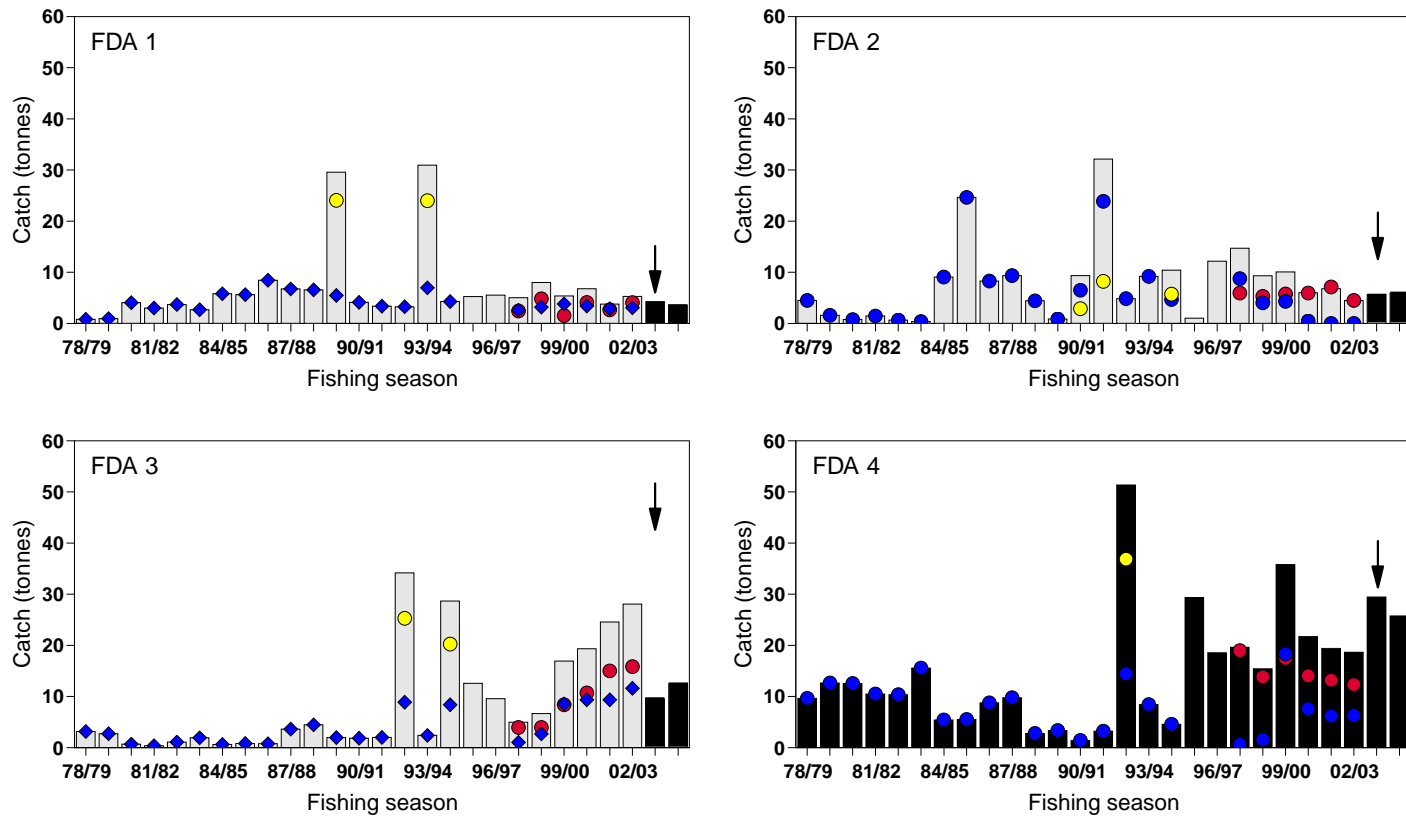


Figure 2.8: Estimated total (grey bars), 'normal' (blue diamonds), 'fish-down' (yellow circles) catch (t) of blacklip and reported total (black bars), normal (blue circles) and 'fish-down' (red circles) catch of blacklip (t) in FDA 1, 2, 3 and 4 from 1968/69 to 2004/05. ↓ indicates implementation of TACC.

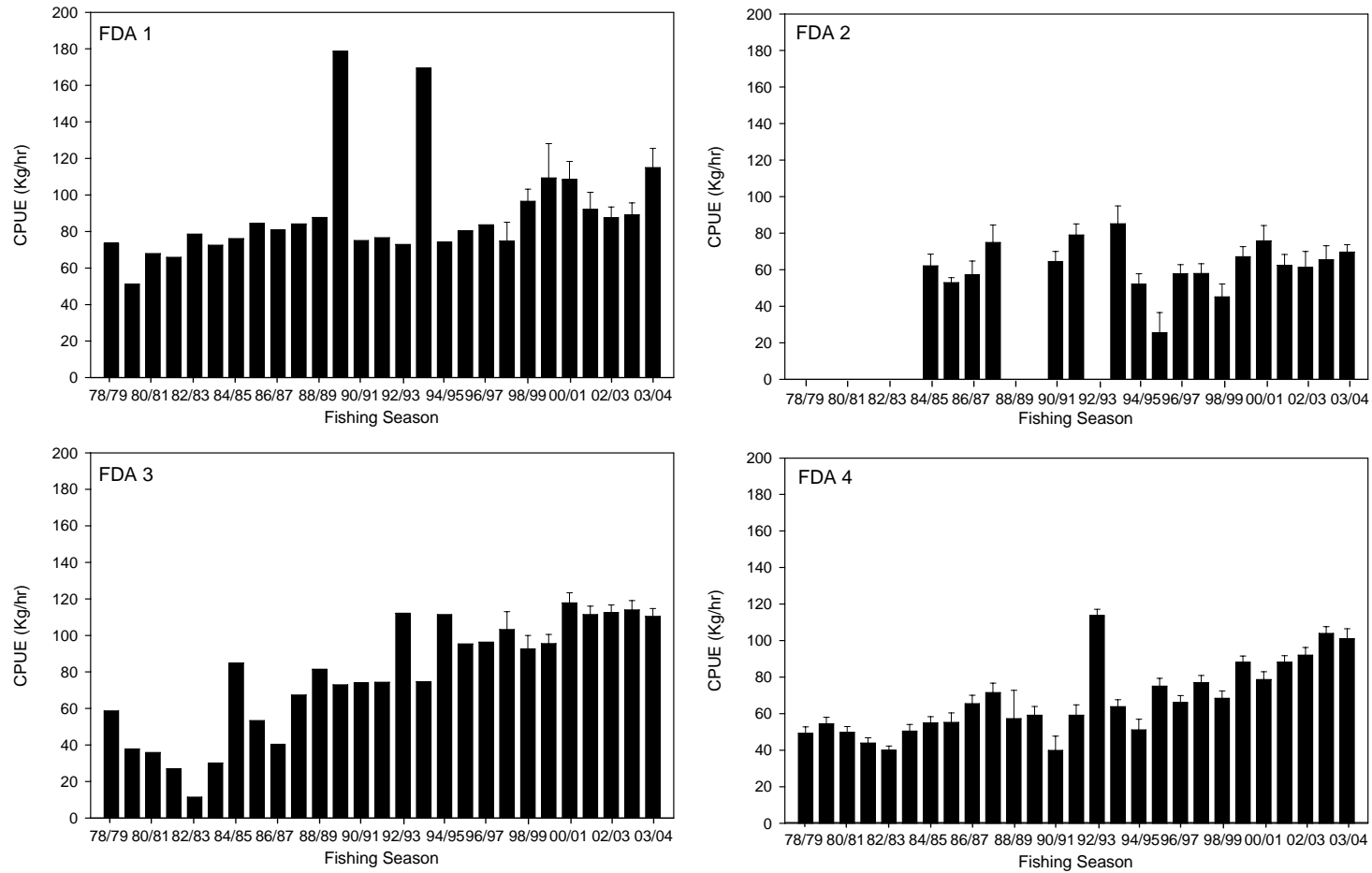


Figure 2.9: Estimated CPUE ($\text{kg}\cdot\text{hr}^{-1}$) on blacklip in FDA 1, 2, 3 and 4 from 1978/79 to 2004/05. Error bars show 1 SE.

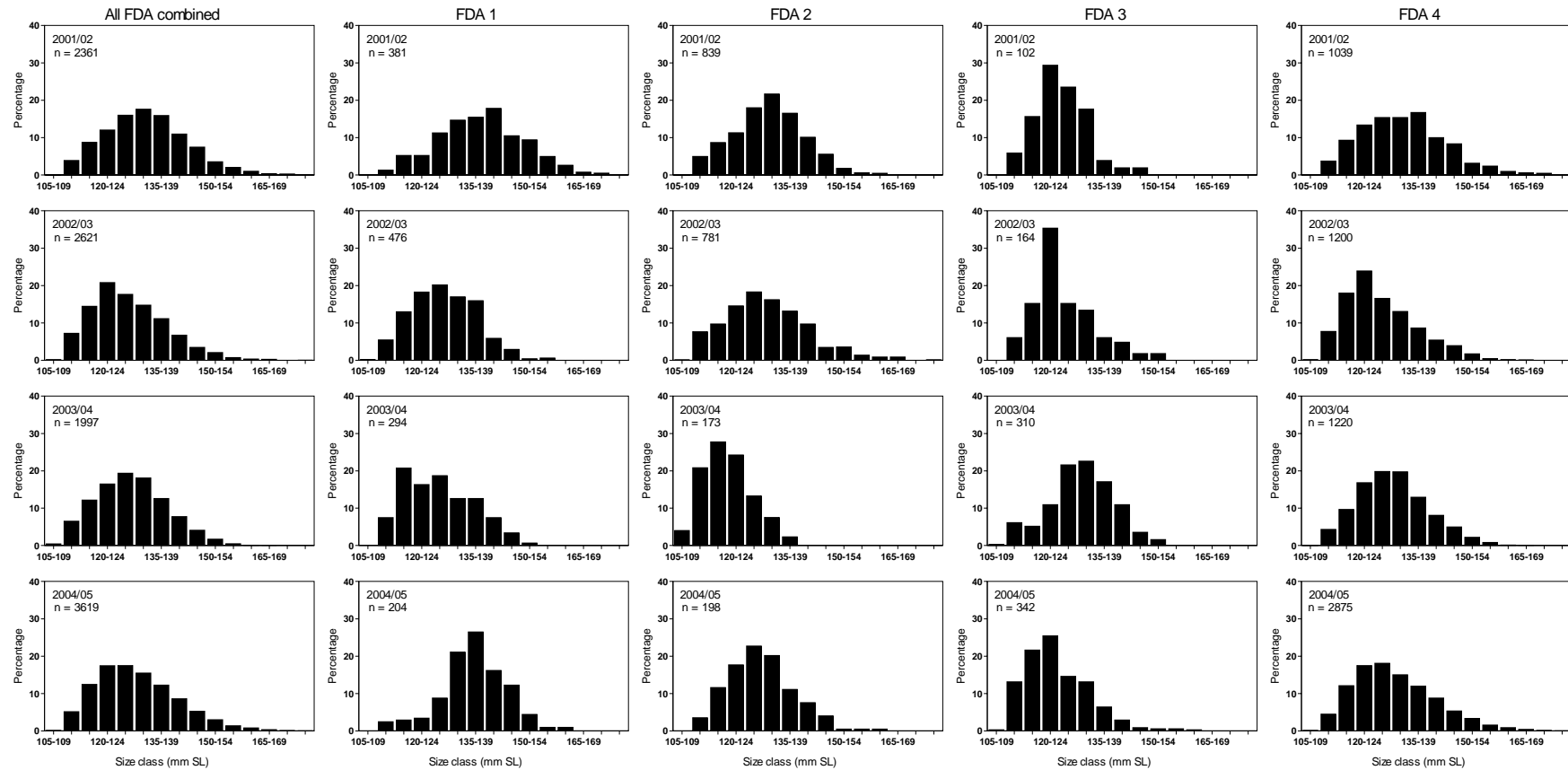


Figure 2.10: Size-frequency distribution obtained from measuring blacklip commercial shell samples in all FDA (combined) and in FDA 1, 2, 3 and 4 separately from 2001/02 to 2004/05.

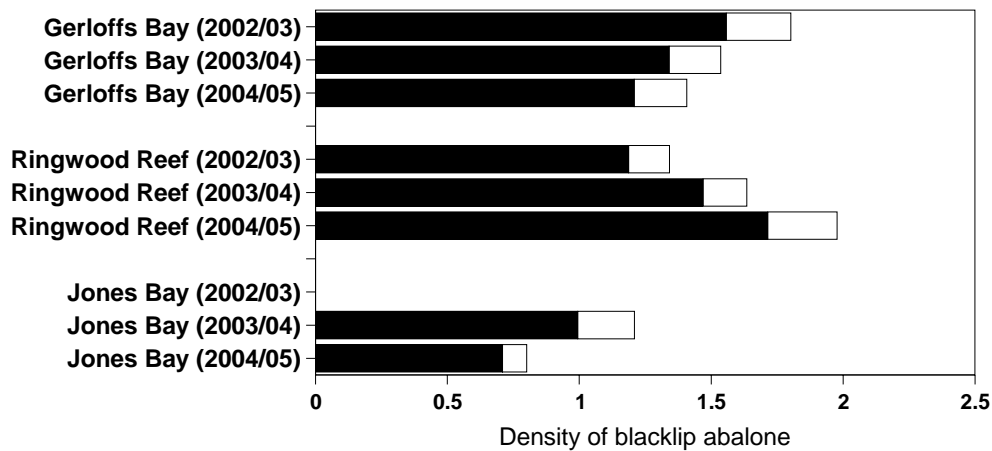


Figure 2.11: Density (abalone.m⁻²) of blacklip counted in transects during fishery-independent surveys at Gerloffs Bay (FDA 4), Ringwood Reef (FDA 3) and Jones Bay (FDA 1) from 2002/03 to 2004/05. Clear bars show 1 SE.

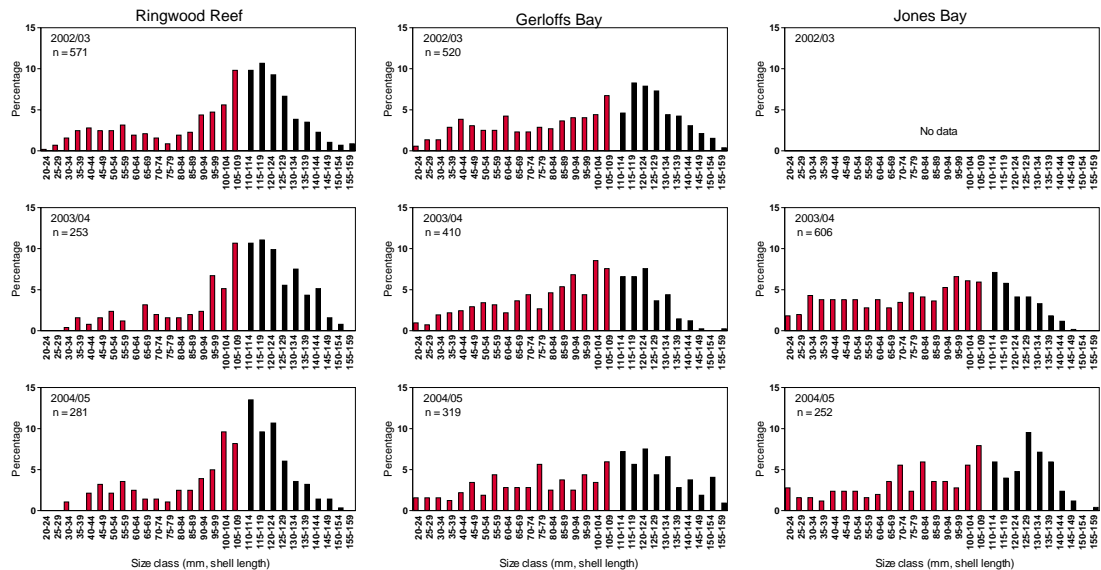


Figure 2.12: Fishery-independent length-frequency distribution (mm, SL) of blacklip at Ringwood Reef, Gerloffs Bay and Jones Bay from 2002/03 to 2004/05 (red bars: <110 mm SL; black bars: >110 mm SL).

2.3 Greenlip

2.3.1 Catch

Greenlip landings in the SZ only exceeded 7 t in 1968/69. Since then, the catch has been low, seldom exceeding 5 t.yr⁻¹ (Figure 2.13). Since 1988/89, the catch has increased in fishing area 39 (Figure 2.14). Catches from fishing areas 36 and 40 have declined substantially over the last decade (Figure 2.14).

2.3.2 Size-frequency distribution of the catch

Data on the size-frequency distribution of the commercial catch in the SZ are available from 2001/02 (Figure 2.15). The mean size of greenlip harvested declined substantially and sequentially from 151.2 mm SL in 2001/02 to 145.9 mm SL in 2003/04. In 2004/05 the mean size increased marginally to 146.9 mm SL. These changes were also reflected in the shape of the size-frequency distribution that varied among years.

2.3.3 Fishery-independent surveys

Fishery-independent surveys have been undertaken at six sites since 2002/03. No greenlip have been observed at Middle Point, Douglas Bay or Cape Northumberland during these surveys. Density of greenlip is commonly very low. The highest density was observed at Ringwood Reef in 2004/05 (0.12 greenlip.m⁻²). Notably, density increased between 2003/04 and 2004/05 at Gerloffs Bay and Ringwood Reef, but declined at Jones Bay over the same period (Figure 2.16).

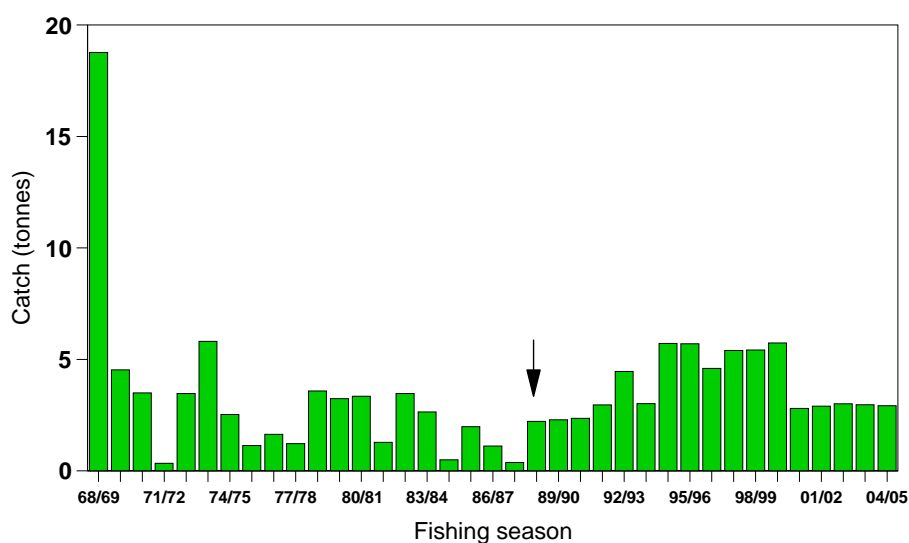


Figure 2.13: Catch of greenlip (t) from 1968/69 to 2004/05. ↓ indicates implementation of TACC.

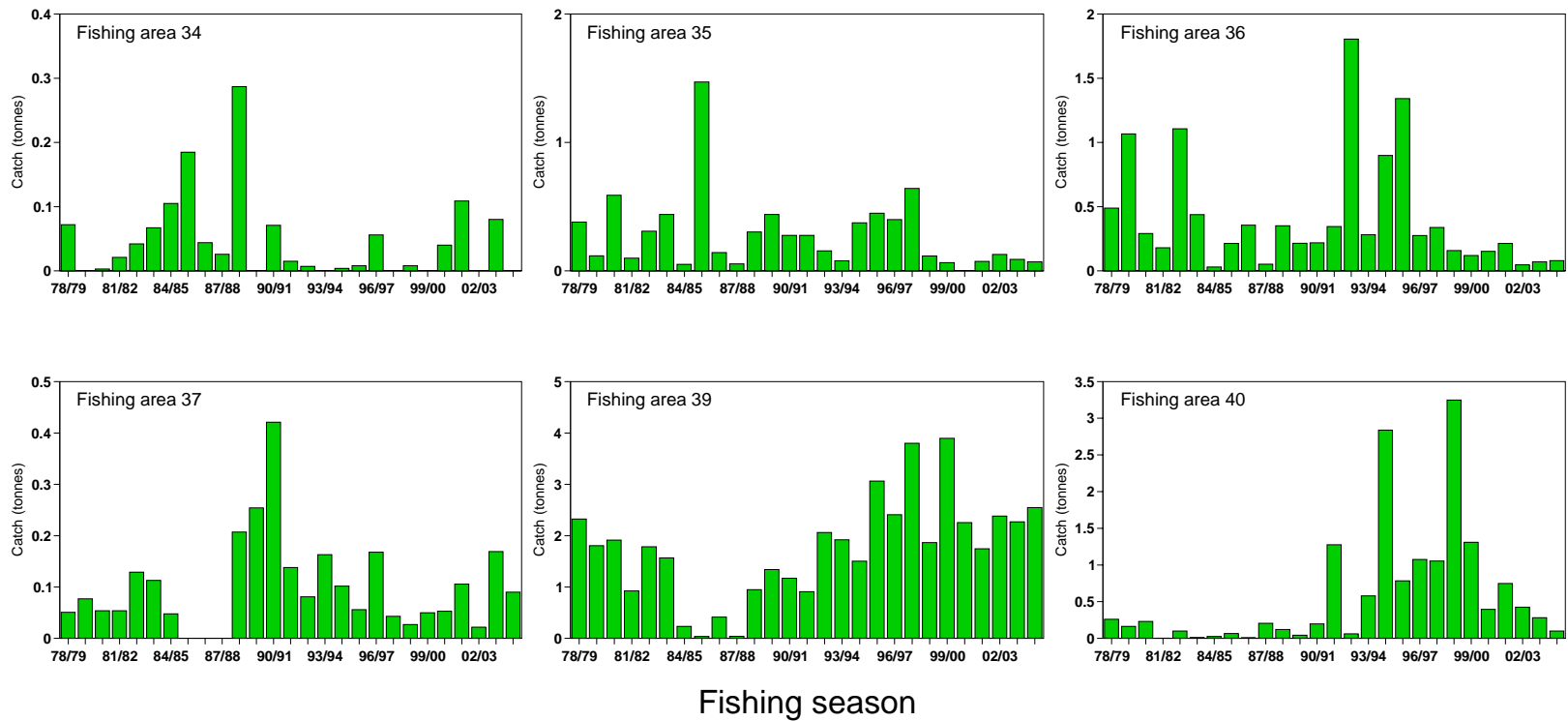


Figure 2.14: Catch of greenlip (t) from fishing areas 34, 35, 36, 37, 39 and 40 between 1978/79 and 2004/05.

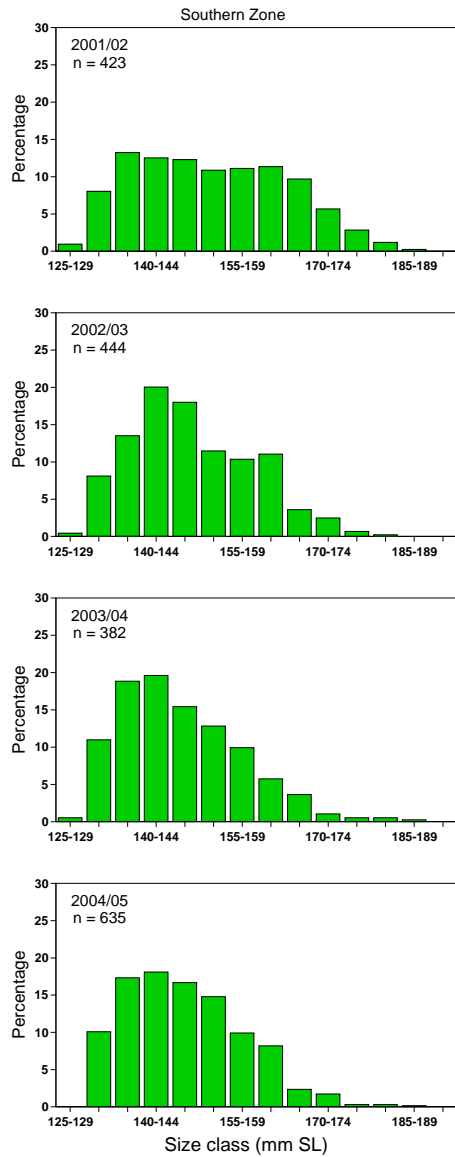


Figure 2.15: Size-frequency distribution obtained from measuring greenlip commercial shell samples (all areas of the Southern Zone combined) from 2001/02 to 2004/05.

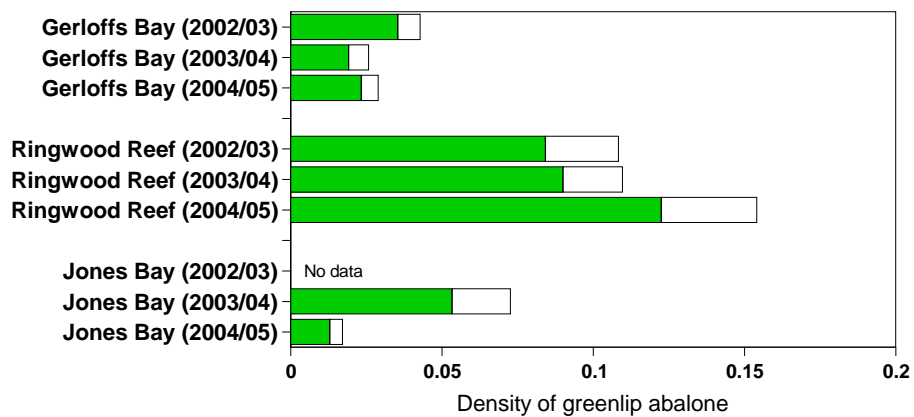


Figure 2.16: Abundance of greenlip (abalone.m⁻²) at Ringwood Reef, Gerloffs Bay and Jones Bay from 2002/03 to 2004/05. Error bars are 1 SE.

3. PERFORMANCE INDICATORS

3.1 General

Commercial logbooks from all licence holders for the period ending 31 August 2005 were received and the data entered into the database. Total fishing effort has not changed significantly since 2000/01.

3.2 Blacklip abalone – non-‘fish-down’ areas

There are 72 biological performance indicators (PI) specified for blacklip in the non-FDA in 2004/05. Of these, 64 are addressed in this report. Data were available to assess fishery performance against 42 of these 64 (66%) PI. Nine of the 42 PI (21%) have triggered (Table 3.1). Six of these (*i.e.* increase in mean daily catch and CPUE in fishing area 36 from 2000/01 to 2004/05, the increase in mean daily catch and CPUE in fishing area 39 between 2003/04 and 2004/05, and the increase in the mean size of the commercial catch in fishing areas 35 and 37 between 2003/04 and 2004/05) may be considered positive for the fishery. The three negative triggers were: a change in the spatial distribution of the catch; the reduction in the mean size of the catch in fishing area 39 between 2003/04 and 2004/05; and the reduction in the density of legal-sized blacklip at Middle Point (fishing area 39) between 2003/04 and 2004/05.

3.3 Blacklip abalone – ‘fish-down’ areas

There are 56 biological PI specified for blacklip abalone in the FDA. Of these, 52 are addressed in this report. Data were available to assess fishery performance against 39 of these 52 (75%) PI. Six of the 39 PI (15%) have triggered (Table 3.2). Three of these (*i.e.* increase in mean daily catch in FDA 4 from 2000/01 to 2004/05 and the increase in the mean size of the commercial catch in FDA 1 and 2 between 2003/04 and 2004/05) may be considered positive for the fishery. The three negative triggers were: the increase in mean daily effort in FDA 3 between 2000/01 and 2004/05; the reduction in the mean size of the catch in FDA 3 between 2003/04 and 2004/05; and the reduction in the density of sub-legal-sized blacklip at Jones Bay (FDA 1) between 2003/04 and 2004/05.

3.4 Greenlip abalone

There are 13 biological PI specified for greenlip in 2004/05. Of these, nine are addressed in this report. Data were available to assess fishery performance against six of the nine (67%) PI. None of these have triggered (Table 3.3).

Table 3.1: Assessment of the performance of the blacklip fishery (non-FDA). MP, DB and CN refer to Middle Point, Douglas Bay and Cape Northumberland, respectively.

Performance indicator	Temporal scale	Zone	Area 35	Area 36	Area 37	Area 39	Area 40
Commercial catch	Annual						
Spatial distribution of catch	Inter-annual						
Mean daily catch	Inter-annual						
	5-year trend						
Mean daily effort	Inter-annual						
	5-year trend						
CPUE	Inter-annual						
	5-year trend						
Mean size	Inter-annual						
	5-year trend						
Egg production/pristine	Annual						

Performance indicator	Temporal scale	MP	DB	CN
Legal-sized abundance	Inter-annual			
	5-year trend			
Sub-legal-sized abundance	Inter-annual			
	5-year trend			
Abundance of abalone >L ₅₀	Inter-annual			
	5-year trend			



Table 3.2: Assessment of the performance of the blacklip fishery (FDA). RR, GB and JB refer to Ringwood Reef (FDA 3), Gerloffs Bay (FDA 2) and Jones Bay (FDA 1), respectively.

Performance indicator	Temporal scale	FDA 1	FDA 2	FDA 3	FDA 4
Mean daily catch	Inter-annual				
	5-year trend				
Mean daily effort	Inter-annual				
	5-year trend				
CPUE	Inter-annual				
	5-year trend				
Mean size	Inter-annual				
	5-year trend				
Egg production/pristine	Annual				

Performance indicator	Temporal scale	JB	RR	GB
Legal-sized abundance	Inter-annual			
	5-year trend			
Sub-legal-sized abundance	Inter-annual			
	5-year trend			
Abundance of abalone >L ₅₀	Inter-annual			
	5-year trend			



Table 3.3: Assessment of the performance of the greenlip fishery.

Performance indicator	Temporal scale	Zone	Area 39
Commercial catch	Annual		
Catch ratio	Inter-annual		
	5-year trend		
Mean size	Inter-annual		
	5-year trend		


Performance indicator	Temporal scale	Gerloffs Bay
Abundance	Inter-annual	
	5-year trend	
Abundance ratio	Inter-annual	35% increase
	5-year trend	


 Trigger Point exceeded

 Significant increase

 No data

 Trigger Point not exceeded

 Significant decrease

 PI not applicable

4. DISCUSSION

Much of the data available for the blacklip stocks in the non-FDA suggests that these populations are being fished within sustainable limits: stable catches since 1988/89; significant reductions in fishing effort since 1982/83; consistent spatial distribution of catch and effort for >10 seasons; substantial increases in raw (observed) CPUE since 1993/94 and; more than half of those performance indicators triggering were positive for the fishery. However, the mean size and the percentage of large blacklip in the catch and the density of blacklip all decreased between 2003/04 and 2004/05 in fishing area 39. This suggests that the exploitation rate in this area increased between 2003/04 and 2004/05.

Unambiguous assessment of blacklip in the FDA was not possible because the inferences of stock status derived from the different data sets are inconsistent. In FDA 1, stable levels of catch (1998/99 onwards), recent increases in CPUE and the significant increase in the mean size of the catch between 2003/04 and 2004/05 indicate increases in the abundance of blacklip in recent years. This inference was also supported by the fishery-independent length-frequency data. Reductions in the density of sub-legal-sized blacklip at Jones Bay between 2003/04 and 2004/05 suggest this pattern may not persist. In FDA 2, declining total and 'fish-down' catch since 1998/99 suggest the blacklip stocks have declined. However, an alternative inference is drawn from the length-frequency distribution of the catch. In FDA 3, the reductions in catch and significant increases in mean daily effort since 2002/03, and the reduction in the mean size of the catch between 2003/04 and 2004/05 suggest reductions in legal-sized blacklip abundance. This inference was also supported by the fishery-independent length-frequency data. Conversely, data from the fishery-independent surveys suggest blacklip density has increased steadily at Ringwood Reef since 2002/03. In FDA 4, steady reductions in blacklip density seemingly contrast with increasing catches, CPUE and significant increases in mean daily catch. Thus, while the abundance of legal-sized blacklip has probably increased, the persistence of this trend is unlikely. As a consequence of the current patterns representing contrasting interpretations of the status of blacklip in the FDA, catch, effort, CPUE and data from the fishery-independent surveys should be closely monitored in forthcoming years to enable stock status to be evaluated following the changed management arrangements from 2003/04.

Assessment of the greenlip stocks is challenging because few data are available. The data available suggest that this species occurs at a low density in the SZ and is patchily distributed. Continued monitoring of the limited data will be required to ascertain the effect of the increase in the TACC, in place from 2004/05.

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