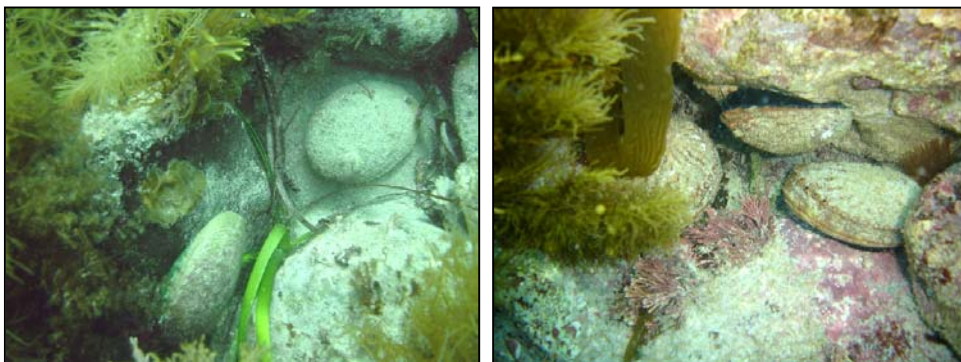


**Western Zone Abalone
(*Haliotis laevis* & *H. rubra*) Fishery
(Region B)**

Fishery Status Report to PIRSA



SARDI Aquatic Sciences Publication No. F2007/000563-1

SARDI Research Report Series No. 240

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SARDI Aquatic Sciences – Wild Fisheries

PO Box 120 Henley Beach SA 5022

September 2007

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EXECUTIVE SUMMARY

1. This fishery status report updates the 2006 stock assessment report and assesses the current status of the abalone stocks in Region B of the Western Zone abalone fishery.
2. This assessment is entirely dependent on fishery-dependent data that includes catch, effort, catch-per-unit-effort (CPUE, $\text{kg}\cdot\text{hr}^{-1}$) and catch length-frequency.
3. The total allowable commercial catch (TACC) in Region B has been $41.4 \text{ t}\cdot\text{yr}^{-1}$ since 1994. This TACC is set for greenlip and blacklip combined and is $>25\%$ greater than the mean total catch from 1968 – 1990.
4. Since 1994, at least 50% of the total catch has been obtained from fishing area 2. This percentage has increased sharply since 2003, reaching $>80\%$ in 2006.
5. Catch of greenlip has declined rapidly over the last 2 years to 22.8 t in 2006, the lowest catch since 1997. Over 18 t (80%) was harvested from fishing area 2 in 2006.
6. Mean daily catch of greenlip has decreased substantially since 2002.
7. CPUE for greenlip has declined significantly since 2002. In 2006 it was $44 \text{ kg}\cdot\text{hr}^{-1}$. This was the lowest value since 1998, and $>30\%$ below the maximum observed (1982).
8. The mean length of greenlip sampled from the commercial catch in 2006 was $\sim 5 \text{ mm SL}$ less than that in 2005.
9. Two performance indicators triggered for greenlip. Both would be considered negative for the status of the fishery.
10. The catch of blacklip has increased successively since 2003. In 2006 it was 18.4 t, the highest level since 1997. Over 14 t (81%) was harvested from fishing area 2.
11. CPUE for blacklip has increased since 2004, reaching $56.8 \text{ kg}\cdot\text{hr}^{-1}$ in 2006, but remains $>20\%$ below the maximum observed in 1993. The mean CPUE in fishing area 2 in 2006 was $58.4 \text{ kg}\cdot\text{hr}^{-1}$, the highest since 1993.
12. The mean length of blacklip sampled from the commercial catch in 2006 was $\sim 2 \text{ mm SL}$ less than that in 2005.
13. One performance indicator triggered for blacklip. It would be considered negative for the status of the fishery.

Conclusions

1. Current data to assess the status of greenlip in Region B generally support the conclusion that stocks are in decline. This is because the recent declines in catch, CPUE and the mean size of the commercial catch are consistent with declining stock abundance. However, the extent to which the fishable biomass may have declined is poorly understood.
2. Current data to assess the status of blacklip in Region B generally support the conclusion that stocks are stable or increasing. However, the rapid recent change in the patterns of the catch and CPUE, in combination with the decrease in mean size of blacklip between 2005 and 2006 suggest that continuation of these patterns may not be sustainable and warrant careful monitoring.
3. The contrast in the assessment for greenlip and blacklip suggest that consideration of species-specific TACCs are warranted in this fishery.

ACKNOWLEDGEMENTS

Funds for this research were provided by PIRSA, obtained through fees paid by license holders in the South Australian commercial abalone fisheries. SARDI Aquatic Sciences provided substantial in-kind support. The Abalone Industry Association of South Australia (AIASA) has provided data on the length frequency distributions of the commercial catch since 2005. Dr Richard McGarvey provided statistical advice, that included development of the ratio estimator. This report was formally reviewed by Dr David Currie and Dr Simon Goldsworthy (SARDI Aquatic Sciences) and Dr Craig Noell (PIRSA Fisheries). It was formally approved for release by Dr Tim Ward, Wild Fisheries Principal Scientist, SARDI Aquatic Sciences.

1. INTRODUCTION

1.1 Report structure and content

This status report assesses the current status of the abalone stocks in Region B of the Western Zone of the South Australian abalone fishery (hereafter referred to as Region B, see Figure 1.1). This report complements, and should be considered in association with, the 2006 assessment report (Chick and Mayfield 2006). This is because this status report does not provide a detailed description of the methodology or provide a full assessment of the fishery; rather, data are presented with a brief description of recent (~5 years) spatial and/or temporal patterns.

Following the Introduction this report consist of 3 sections. Section 2, Fishery Statistics, provides summaries, analyses and an assessment of the fishery-dependent data from 1 January 1968 to 31 December 2006. Data and information provided includes commercial catch, effort, catch-per-unit-effort (CPUE, kg hr^{-1}) and the length-frequency distributions of the commercial catch. Where appropriate, these data are presented for all abalone combined and for greenlip and blacklip abalone separately (hereafter referred to as greenlip and blacklip, respectively). Data are presented at two spatial scales: 1) the whole of Region B; and 2) individual fishing areas. Section 3, Performance Indicators, provides an assessment of the greenlip and blacklip fisheries against the performance indicators identified in the South Australian (SA) Abalone Fishery Management Plan (Nobes *et al.* 2004). Section 4, Discussion, summarises the current status of the Region B 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 length-frequency distribution of both greenlip and blacklip in the commercial catch are available since 2004, although those data for 2005 poorly represent the commercial catch. Data were analysed as described in Chick & Mayfield (2006) and are presented as mean \pm 1 standard error (SE) unless otherwise stated.

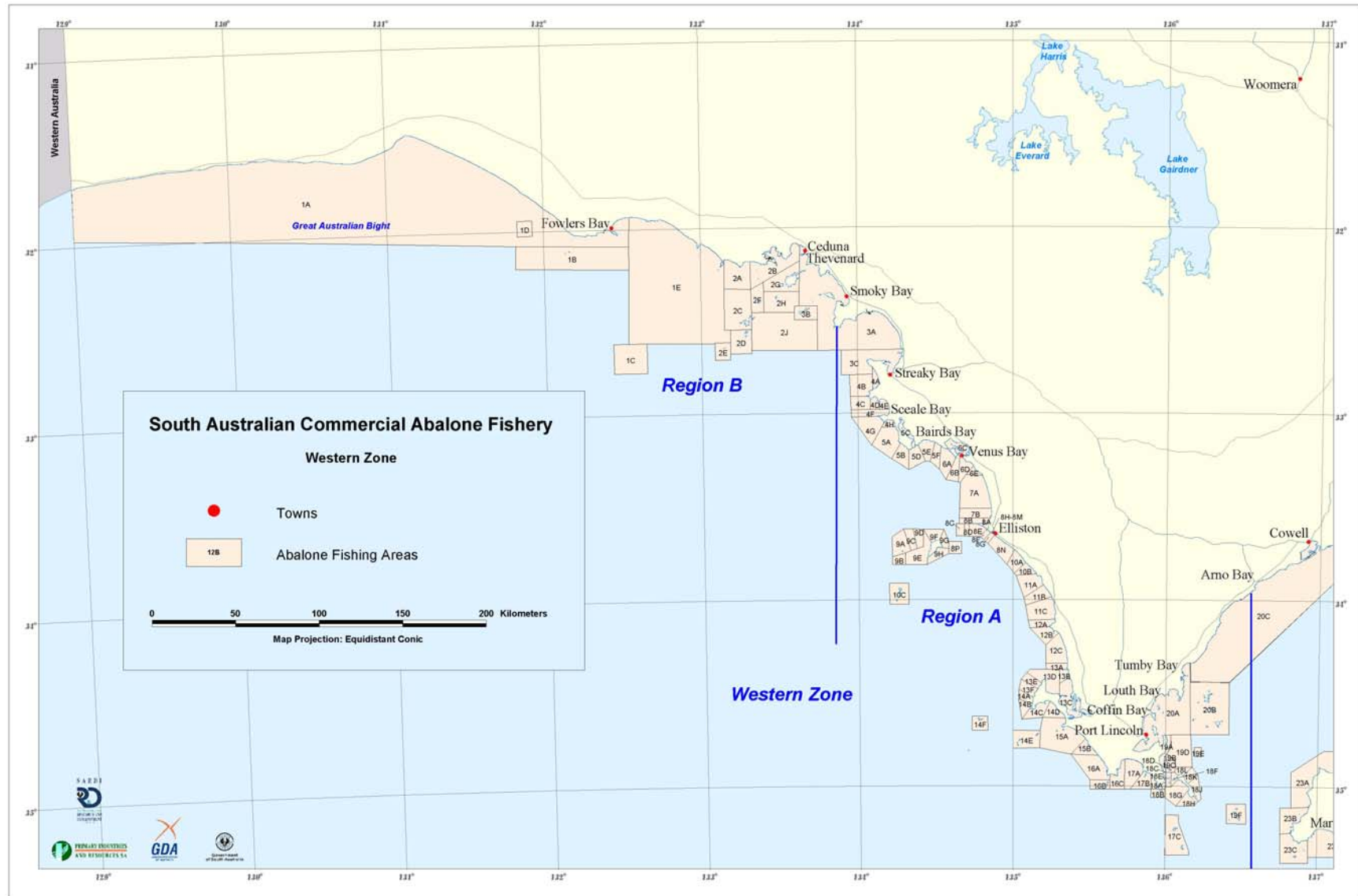


Figure 1.1 Fishing areas of the Western Zone of the South Australian abalone fishery.

2. FISHERY STATISTICS

2.1 Whole fishery

Total catch from Region B has closely reflected the TACC that increased from 27.6 t (1991 and 1992) to 34.5 t (1993) and to 41.4 t (1994 – 2006). Total catch in 2006 was 41.1 t (Figure 2.1). In 2006, the ratio of blacklip to greenlip in the total catch was at the highest level since 1997 (Figure 2.1). Effort has closely reflected the pattern of catch since 1968. Total effort in 2006 was 672 hrs. This was similar to the mean total effort for the last 5 years (670 hrs). The mean CPUE ($\text{kg}\cdot\text{hr}^{-1}$) has remained relatively stable ($\sim 60 \text{ kg}\cdot\text{hr}^{-1}$) since the introduction of the current TACC (1994). In 2006, the CPUE was $61.3 \pm 2.2 \text{ kg}\cdot\text{hr}^{-1}$ (Figure 2.1). The distribution of the total catch among fishing areas has changed substantially since 2003 (Figure 2.2). The percentage of the catch taken from fishing area 2 has increased to 80%, the highest level since 1980. The percentage of the catch taken from fishing areas 1 and 3 have generally declined since 2003, and in the last 2 years are at the lowest levels since 1987.

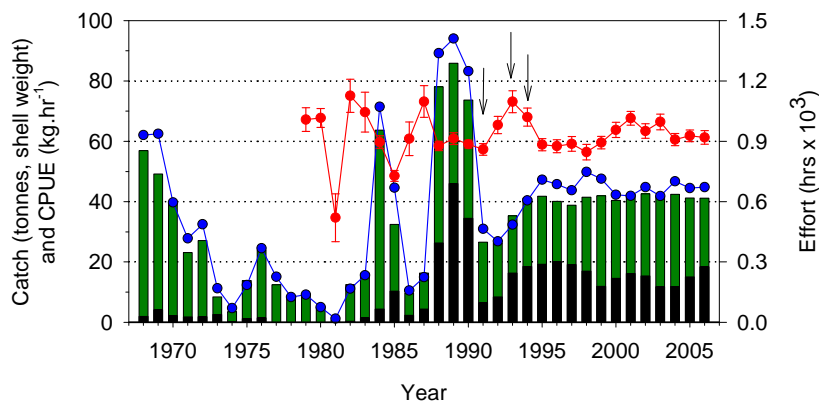


Figure 2.1 Total catch (t, shell weight) of greenlip (green bars) and blacklip (black bars), mean CPUE ($\text{kg}\cdot\text{hr}^{-1}$, red circles and line) and total effort (hrs $\times 10^3$; blue circles and line) for all abalone in Region B from 1968 to 2006. \downarrow indicates implementation and changes to TACCs. CPUE is only from 1979 to 2006.

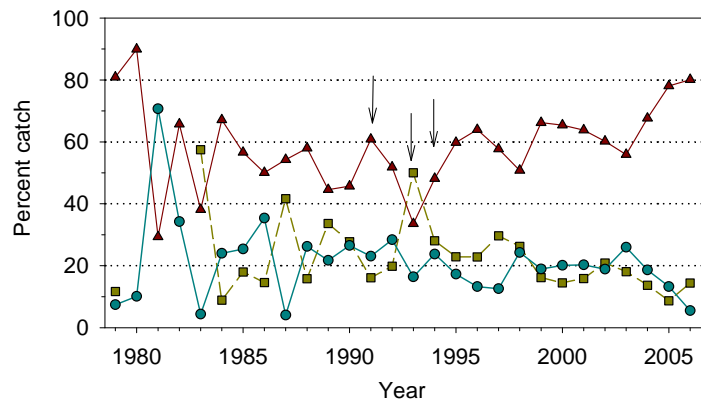


Figure 2.2 Percent of total catch in each fishing area (FA 1: yellow squares and line; FA 2: purple triangles and line and; FA 3: blue circles and line) in Region B from 1979 to 2006. \downarrow indicates implementation and changes to TACCs.

2.2 Greenlip

2.2.1 Catch and CPUE

Greenlip catch in Region B has declined over the last 2 years from 30.5 t in 2004 to 22.8 t in 2006, the lowest catch since 1997 (Figure 2.3). Similar temporal patterns are evident in fishing area 2 (Figure 2.4). Nevertheless, the percentage of the total greenlip catch harvested from fishing area 2 in 2006 was ~ 80%. Catches of greenlip have remained relatively constant at ~3 t.yr⁻¹ in fishing area 1. In fishing area 3 catches have declined by 78% over the last 3 years, from >8 t in 2003 to <2 t in 2006. The catch in fishing area 3 in 2006 was the lowest since 1987.

The mean CPUE for greenlip in Region B has declined annually from 55.1 ± 2.2 kg.hr⁻¹ in 2003 to 44.1 ± 1.9 kg.hr⁻¹ in 2006 (Figure 2.5). This represents a decrease of >10 kg.hr⁻¹ (20%) to the lowest value since 1998 and to below the average CPUE for greenlip (47.5 kg.hr⁻¹) since the introduction of the current TACC (1994). Similar patterns were observed in fishing area 2.

2.2.2 Length-frequency distribution of the catch

In 2006, the mean shell length (SL; 164.9 ± 0.2 mm) of greenlip in the commercial catch from Region B was 5 mm smaller than in 2005 (169.9 ± 0.4 mm SL). In addition, the modal length class in 2006 was 160 – 164 mm SL, 10 mm smaller than in 2005 (170 – 174 mm SL; Figure 2.6). These changes are not consistent with observations between 2004 and 2006 where the modal length class has increased by ~5 mm and the mean size in 2006 was ~1 mm larger than in 2004. Despite the changes in the length-frequency distribution for greenlip between 2005 and 2006, there was no evidence of individuals having a high probability of capture as they attain the MLL (i.e. knife-edged fishing) on greenlip in Region B in 2006.

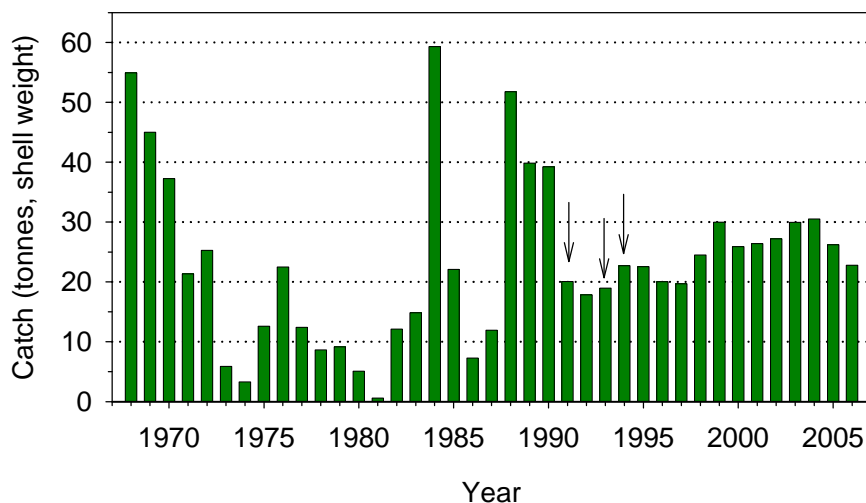


Figure 2.3 Catch (t, shell weight) of greenlip in Region B from 1968 to 2006. ↓ indicates implementation and changes to TACCs.

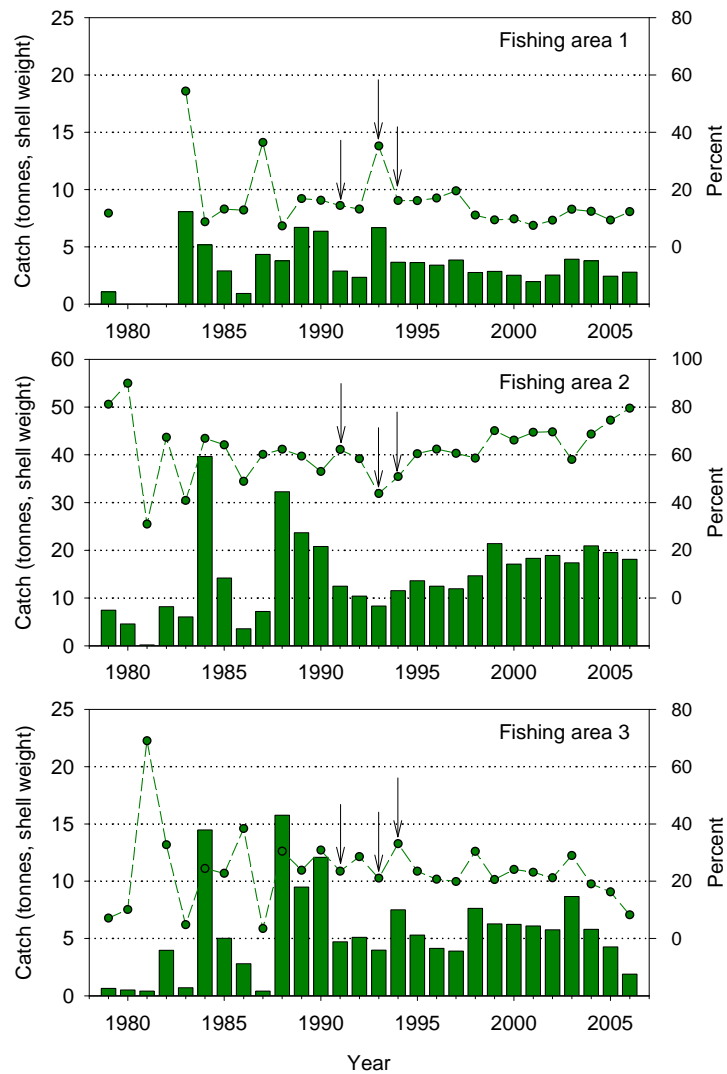


Figure 2.4 Catch of greenlip (t, shell weight; solid bars) and percent of total greenlip catch in Region B (circles and line) in each of the fishing areas comprising Region B from 1979 to 2006. ↓ indicates implementation and changes to TACCs.

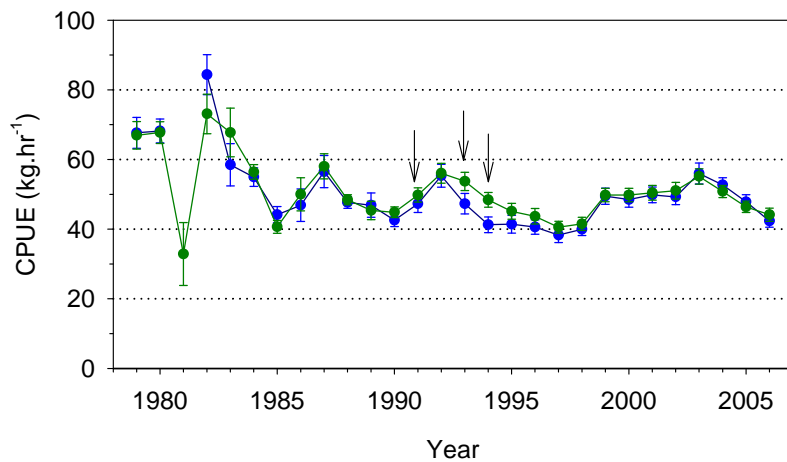


Figure 2.5 Catch-per-unit-effort (CPUE, $\text{kg}\cdot\text{hr}^{-1}$) for greenlip in Region B (green circles and line), and in fishing area 2 (blue circles and line) from 1979 to 2006. ↓ indicates implementation and changes to TACCs.

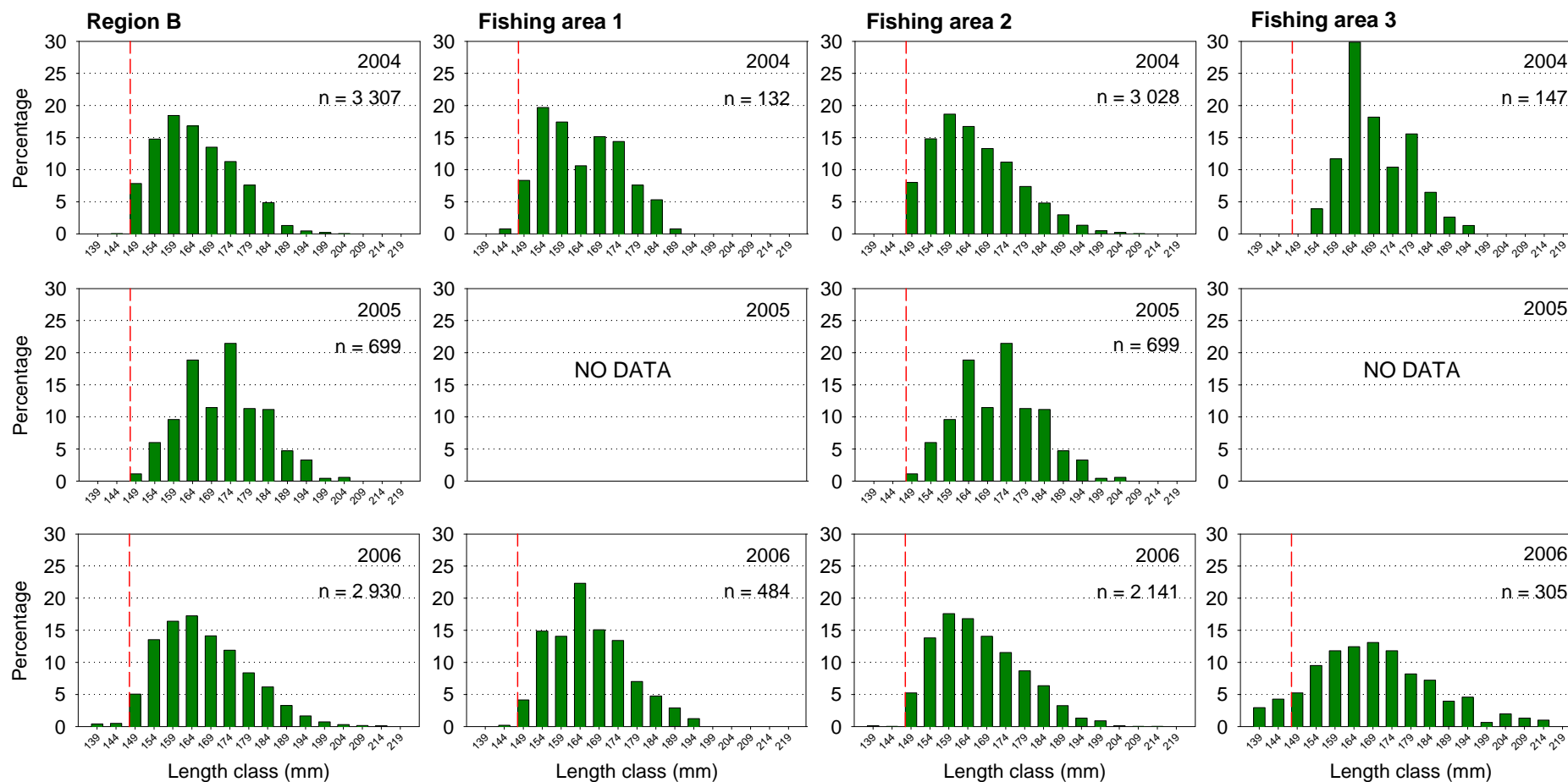


Figure 2.6 Length-frequency distribution of a proportion of the greenlip commercial catch from Region B, and in fishing areas 1, 2 and 3 from 2004 to 2006 (where data is available). Dashed red line indicates the current minimum legal length, dotted horizontal lines are for reference. Numbers on the x-axis are the upper limit of each length class.

2.3 Blacklip

2.3.1 Catch and CPUE

Blacklip catch in Region B increased over the last 3 years to 18.4 t in 2006, the highest catch since 1997 (Figure 2.7). Notably, this catch was also >10 t above the average annual catch (6.4 t) prior to the introduction of a TACC (1991). More than 80% of the blacklip catch in 2006 was harvested from fishing area 2 (Figure 2.8). Importantly, catches of blacklip in fishing area 2 have more-than doubled over the last 4 years, from 6.0 t in 2003 to 14.8 t in 2006. This was the highest recorded catch from this fishing area in the history of the fishery. Catches of blacklip in fishing areas 1 and 3 have fluctuated between 6 t and ~0.5 t over the last 5 years (Figure 2.8).

The mean CPUE for blacklip has fluctuated between $48.3 \pm 3.2 \text{ kg.hr}^{-1}$ (2004) and $68.5 \pm 6.9 \text{ kg.hr}^{-1}$ (1994) since the introduction of the current TACC (Figure 2.9). In 2006 the mean CPUE for blacklip was $56.8 \pm 4.1 \text{ kg.hr}^{-1}$. CPUE increased between 2004 and 2005 and between 2005 and 2006, but remains below contemporary (2002) and historical (1993) maximum levels. Similar patterns were observed in fishing area 2. The mean CPUE in fishing area 2 in 2006 was $58.4 \pm 4.9 \text{ kg.hr}^{-1}$, the highest level since 1993.

2.3.2 Length frequency distribution of the catch

In 2006, the mean length ($148.7 \pm 0.3 \text{ mm SL}$) of blacklip in the commercial catch from Region B was ~2 mm smaller than in 2005 ($150.4 \pm 0.5 \text{ mm SL}$; Figure 2.10). In addition, the modal length class in 2006 was 140 – 144 mm SL, 10 mm smaller than in 2005 (150 – 154 mm SL). These changes are not consistent with observations between 2004 and 2006 where the modal length class has remained unchanged and the mean size in 2006 was ~3 mm larger than in 2004. Despite the changes in the length-frequency distribution for blacklip between 2005 and 2006, there was no evidence of knife-edged fishing on blacklip in Region B in 2006.

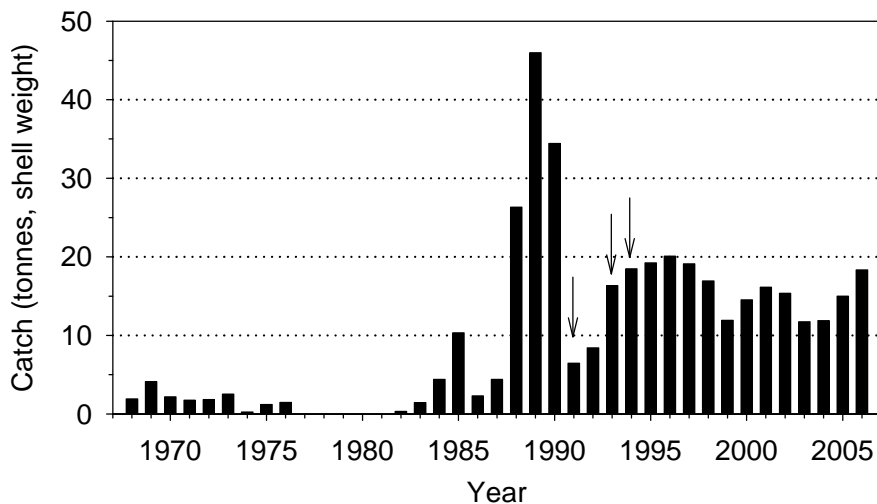


Figure 2.7 Catch (t, shell weight) of blacklip in Region B from 1968 to 2006. ↓ indicates implementation and changes to TACCs.

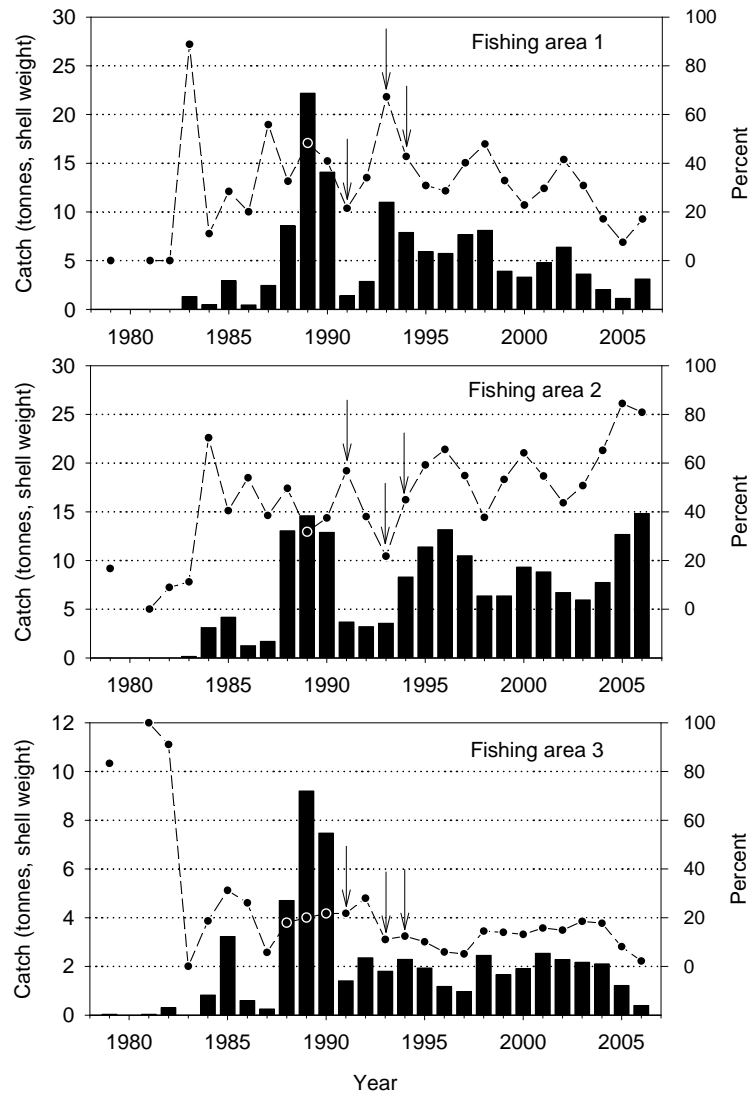


Figure 2.8 Catch of blacklip (t, shell weight; solid bars) and percent of total blacklip catch in Region B (circles and line) in each of the fishing areas comprising Region B from 1979 to 2006. ↓ indicates implementation and changes to TACCs.

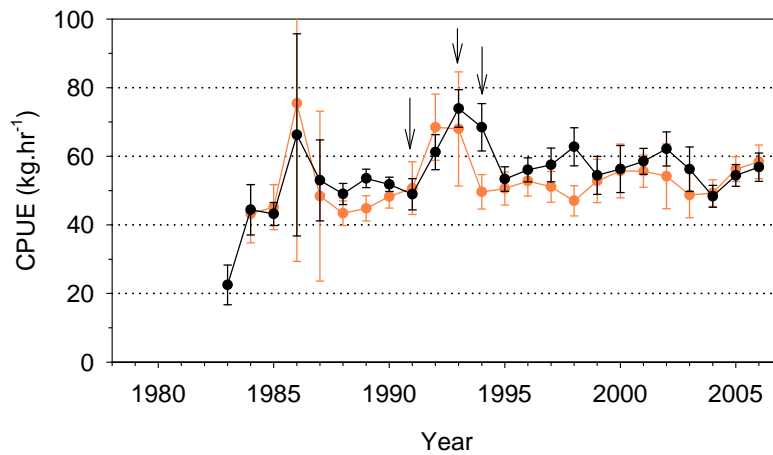


Figure 2.9 Catch-per-unit-effort (CPUE, kg.hr⁻¹) for blacklip in Region B (black circles and line), and in fishing area 2 (orange circles and line) from 1979 to 2006. ↓ indicates implementation and changes to TACCs.

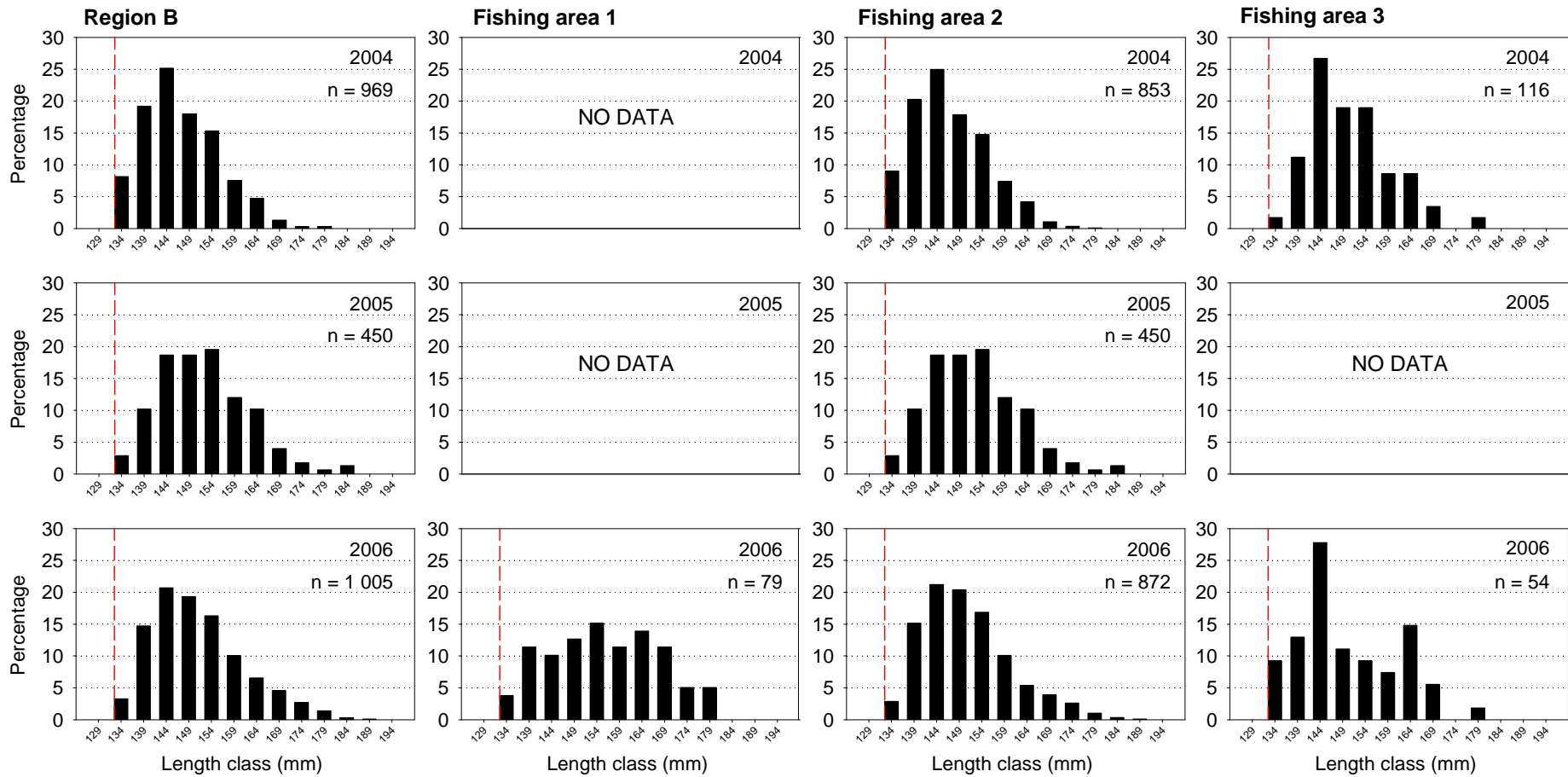


Figure 2.10 Length-frequency distribution of a proportion of the blacklip commercial catch from Region B, and in fishing areas 1, 2 and 3 from 2004 to 2006 (where data is available). Dashed red line indicates the minimum legal length, dotted horizontal lines are for reference. Numbers on the x-axis are the upper limit of each length class.

3. PERFORMANCE INDICATORS

Commercial logbooks from all licence holders for the period ending 31 December 2006 were received and the data entered into the database.

The reported catch for 2006 was 13.74 t (meat weight). This exceeds 90% of the TACC (13.8 t) and therefore did not trigger the performance indicator (PI).

3.1 Greenlip

Data were available to assess fishery performance against 7 of the 9 PIs to be addressed in this status report. Two of these 9 PIs triggered (Table 3.1; Appendix 1): the CPUE for greenlip decreased significantly from 2002 to 2006 and the mean size of greenlip sampled from the commercial catch decreased significantly between 2005 and 2006. Both may be considered negative for the status of the fishery.

3.2 Blacklip

Data were available to assess fishery performance against 7 of the 9 PIs to be addressed in this report. One of these 9 PIs triggered (Table 3.1; Appendix 2): the mean size of blacklip sampled from the commercial catch decreased significantly between 2005 and 2006. This may be considered negative for the status of the fishery.

Table 3.1 Assessment of the performance of the greenlip and blacklip abalone fisheries in Region B against the PIs prescribed in the management plan (inter-annual: 2005 – 2006; 5-year trend: 2002 – 2006).

Performance indicator	Temporal scale	Greenlip	Blacklip
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		



4. DISCUSSION

Region B is unique within Australian abalone fisheries in that the TACC is not differentiated between species, thus permitting a harvest choice for fishers. This complicates interpretation of changes in species-specific, fishery-dependent measures of the status of the stock.

Total effort in 2006 was similar to mean effort over the last 5 years (670 hrs). Total catch has remained relatively stable since the introduction of the current TACC (41.4 t, 1994). This stability in total catches and effort have resulted in a stable CPUE series since 1995. However, the percentage of total catch taken from fishing area 2 has increased substantially since 2003 (56%). In 2006 it was >80% and indicates an increased reliance on the stocks in this fishing area to sustain current catches. Moreover, the proportion of greenlip in the total catch increased between 1996 and 2004, but has decreased sharply over the last 2 years suggesting that there has been a shift in fisher behaviour towards harvesting a greater proportion of blacklip, a decline in the abundance of greenlip or a combination of these. This instability is also reflected in the CPUE on greenlip and blacklip separately, further indicating that stock status differs between these species.

4.1 Greenlip

Assessment of greenlip stocks in Region B is hampered by limited information. Nevertheless, patterns in fishery-dependent measures of stock status consistently suggest that the greenlip stocks have weakened over the last few years. The evidence of a decline in abundance includes: 1) declining catch in the region and in fishing areas 2 and 3 from 2004; 2) a substantial decline in mean daily catch since 2002; 3) a significant decline in CPUE in the region since 2002; 4) annual declines in CPUE in fishing area 2 from 2003; 5) a significant decrease in the mean size of greenlip in the commercial catch from 2005 to 2006; and 6) a 10 mm reduction in the modal size class of greenlip in the commercial catch from 2005 to 2006.

4.2 Blacklip

As with greenlip, assessment of blacklip stocks in Region B is impeded by limited information. Much of the fishery-dependent data within the last 2 years indicate that blacklip stocks are stable or increasing. This inference is supported by: 1) increasing catch in the region and a doubling of catch from fishing area 2 in the last 2 years, to the highest level in the history of the fishery; and 2) increasing CPUE in the region and fishing area 2 since 2004 and 2003, respectively. However, the magnitude of the changes in the proportion of catch from fishing area 2 and the significant reduction in the mean size of blacklip in the commercial catch, suggest that these short term patterns of increasing catch and increasing reliance on fishing area 2 may not be sustainable. Consequently, these fishery-dependent measures warrant careful consideration and monitoring in forthcoming years.

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- Rice, J. A. 1995. Mathematical Statistics and Data Analysis. Pages 594pp *in*. Duxbury Press, Belmont, California.

Appendix 1. Assessment of the greenlip fishery in Region B of the Western Zone of the South Australian abalone fishery against the biological performance indicators in the management plan. Values are mean \pm SE. Statistical analyses for relevant performance indicators are described in (Nobes et al. 2004). Red text indicates statistical significance.

Performance Indicator	Units	Spatial Scale	2002	2003	2004	2005	2006	Inter-annual change	5-year trend
Mean daily catch	kg.day ⁻¹	Region B	240.2 \pm 13.2	248.0 \pm 12.9	243.4 \pm 11.3	227.5 \pm 10.9	209.4 \pm 11.2	$t = 1.16, df = 181$ $p > 0.05$	$F_{1,507} = 4.16$ $p > 0.05$
Mean daily effort	hr.day ⁻¹	Region B	4.7 \pm 0.2	4.5 \pm 0.2	4.8 \pm 0.2	4.9 \pm 0.2	4.8 \pm 0.2	$t = 0.57, df = 181$ $p > 0.05$	$F_{1,507} = 0.89$ $p > 0.05$
CPUE	kg.hr ⁻¹	Region B	51.0 \pm 2.4	55.1 \pm 2.2	50.8 \pm 1.8	46.4 \pm 1.6	44.1 \pm 1.2	¹ $t = 0.92, df = 173.6$ $p > 0.05$	² $F_{1,507} = 13.36$ $P < 0.01$
Mean size	mm SL	Region B	No data	No data	163.7 \pm 0.2	169.8 \pm 0.4	164.9 \pm 0.2	$t = 10.42, df = 3627$ $p < 0.01$	-

¹ based on the ratio estimator (after Rice 1995)

² based on daily CPUE

Appendix 2. Assessment of the blacklip fishery in Region B of the Western Zone of the South Australian abalone fishery against the biological performance indicators in the management plan. Values are mean \pm SE. Statistical analyses for relevant performance indicators are described in (Nobes et al. 2004). Red text indicates statistical significance.

Performance Indicator	Units	Spatial Scale	2002	2003	2004	2005	2006	Inter-annual change	5-year trend
Mean daily catch	kg.day ⁻¹	Region B	331.1 \pm 30.8	277.5 \pm 39.2	226.1 \pm 19.7	281.6 \pm 22.5	299.4 \pm 25.5	$t = 0.51$, $df = 85$ $p > 0.05$	$F_{1,182} = 0.27$ $p > 0.05$
Mean daily effort	hr.day ⁻¹	Region B	5.3 \pm 0.3	4.9 \pm 0.3	4.7 \pm 0.3	5.2 \pm 0.3	5.3 \pm 0.3	$t = 0.26$, $df = 85$ $p > 0.05$	$F_{1,182} = 0.67$ $p > 0.05$
CPUE	kg.hr ⁻¹	Region B	62.2 \pm 5.0	56.2 \pm 6.5	48.3 \pm 3.2	54.4 \pm 3.2	56.8 \pm 4.1	¹ $t = 0.46$, $df = 83.8$ $p > 0.05$	² $F_{1,182} = 0.71$ $p > 0.05$
Mean size	mm SL	Region B	No data	No data	145.1 \pm 0.3	150.3 \pm 0.5	148.7 \pm 0.3	$t = 2.92$ $df = 1453$ $p < 0.01$	-

¹ based on the ratio estimator (after Rice 1995)

² based on daily CPUE