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FISHERY ASSESSMENT REPORT

TASMANIAN ABALONE FISHERY

2002

Compiled by David Tarbath, Craig Mundy and Malcolm Haddon

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Abalone Fishery Assessment: 2002

Executive summary

The 2002 Abalone Fishery Assessment was based primarily on commercial catch-effort statistics and size-composition data from the Tasmanian fishery for blacklip abalone (*Haliotis rubra*) and greenlip abalone (*H. laevigata*). Commercial catch-effort statistics were derived from data supplied by the Tasmanian Department of Primary Industry, Water and Environment, based upon catch dockets provided by licensed divers. Catch rates were derived from the catch-effort statistics and annual variation in catch rate was interpreted as a relative index of abalone abundance. The size-composition data were mostly collected by TAFI research staff, but some data were obtained directly from divers. Changes in size-composition from commercial catch samples were used to assess variation in levels of fishing mortality across years.

Since 2000, the Tasmanian blacklip abalone fishery has been sub-divided into geographical zones (in 2002 the Eastern, Western and Northern Zones). The purpose of zoning is to manage the distribution of effort and protect the more accessible areas from high fishing pressure and consequent over-exploitation. Each of these zones and the greenlip abalone fishery are individually managed, with their own total allowable catch (TAC), legal minimum size and in some cases, localised annual catch limits (caps).

In 2002, the TAC from all parts of the fishery was 2537.5 tonnes. This was a substantial reduction from the previous year's total of 2800 tonnes, and is a result of the reduction in the TAC in the Eastern Zone from 1120 tonnes to 857.5 tonnes. This TAC reduction was one of several controls (including a size limit increase of 4 mm and a cap on part of the fishery) implemented by managers to limit over-exploitation of east coast abalone stocks, and was the first step towards a managed recovery of these stocks.

Despite management efforts, catch rates in the Eastern Zone fishery in 2002 have continued the decline apparent in 2001. This lack of response is disturbing. Current catch rates in the Eastern Zone blocks are comparable to the historically low catch rates reported from these blocks in the mid 1980's following the historically high total catch in the early 1980's. Because the techniques used by divers to harvest abalone in 2002 are in many ways advanced compared to those used in the early 1980's, the current low catch rates are themselves significant. They suggest that the current abalone stocks are likely to be more depleted than the stocks that were being fished in the mid 1980's. If correct, this would mean that stock levels in the Eastern Zone could be at their lowest since the start of the fishery. More critically, on the East Coast between Eaglehawk Neck and Eddystone Point, the reduced levels of catch, in conjunction with falling catch rates indicate that whole populations (i.e. not just the fishable biomass) are declining. For the second successive year, commercial catches from Maria Island failed to show evidence of successful recruitment.

While there were no improvements in catch rates in the Eastern Zone in 2002, there was some evidence for positive stock response to the 4-mm size-limit increase imposed at the start of 2002. Divers from both the southern and far northern parts of the zone have reported that they saw more undersized abalone on the reefs. And, as expected, we

have been able to detect a small increase in average size among abalone sampled from divers' catches from the Actaeons (Sub-blocks 13C, 13D, and 13E).

As a response to the creation of the Western Zone and its attendant higher levels of catch, the parts of the zone most accessible to divers have experienced much greater levels of effort. For several years, catch rates have been trending downwards in the northern (north of Sandy Cape) and southern (east of South West Cape) parts of the zone. In 2002, catches were lower than in 2001 and yet catch rates continued to fall. The most optimistic interpretation of this decline is that fishable biomass has also declined in Blocks 6 and 12, and that current levels of catch are unsustainable and some management action is required to limit catches in these localities.

The more remote parts of the Western Zone (South West Cape to Sandy Cape; excepting Sub-blocks 9A and 9B) continue to support a robust fishery. There are no reasons to believe the present level of catches on this part of the coast is not sustainable. The option of transferring catch displaced from the northern and southern parts of the Western Zone into the more remote parts of the zone would entail risking the stability of the latter fishery. A risk averse and precautionary solution would be to maintain effort in the remote parts at levels similar to the 2002 fishing year until stock changes, either up or down, become apparent.

2002 was the second year of operation for the Northern Zone. The current Northern Zone TAC was set assuming that divers would shift effort into areas supporting good stocks of fishable abalone. However, it appears that Tasmanian mainland based divers have found the more remote parts, such as King Island, too difficult and costly to fish, and have concentrated instead on the more accessible parts of the fishery in the North West and North East. Consequently there appears to be an imbalance between stock levels and fishing effort, and the accessible stocks will need protection in order to prevent depletion. The potential for disproportionately high levels of effort to be applied to the more productive parts of the North West has been recognised by managers. The outcome was to place an annual catch limit on Block 5 in 2003. However, the evidence of continuously declining catch rates, and the nearly unanimous commentary from divers that this region cannot sustain the present level of catch suggests that stock levels in the remaining part of the North West are at best stable, but are probably falling. This implies that the annual catch in those blocks now needs to be limited. Fishable biomass also appears to have declined in the North East, where catch rates have fallen sharply compared with the previous year, and is unlikely to sustain continued catches at current TAC levels.

Catch rates in the Greenlip fishery indicate that stock levels are mostly stable on King Island and the Furneaux Group, but are falling in the North West and North East in a pattern similar to the Northern Zone blacklip fishery. The annual catch is limited in all these regions except King Island. The levels of fishable biomass appear to be falling in the North West and North East, and are also unlikely to sustain continued catches at current TAC levels.

From the limited information available, it appears that about 75 percent of the recreational catch (estimated at 140,000 abalone for the 2000 – 2001 season) was taken from the east and southeast coasts where fishable biomass is now substantially depleted. Of most concern is that the number of recreational abalone diving licenses

continues to grow unabated at 10 percent per annum. We are unsure how this affects levels of catch, though it seems likely to be increasing. This complicates the process of establishing safe levels of catch and setting a TAC. As the recreational catch is largely derived from the stressed portions of the Eastern Zone, we require more precise information about the size of the recreational abalone catch and distribution of effort.

A number of management options to ensure that current stock levels are fished sustainable have been carefully considered. These options included changes in TAC, changes in size limit, localised catch limits and area closures.

In summary, the major findings and associated management options of the assessment were:

- Increases in TAC in recent years have increased both effort throughout the fishery and the likelihood that all stocks around the State will be fished. One consequence of this has been an intensification of management. However, this assessment has found that the spatial scale of management is still insufficient to prevent localised stock declines. This means that fishery managers need to manage the fishery more intensively, with an increased number of controls and regulations to ensure that adequate stock levels are sustained.

- Despite a quota reduction in the Eastern Zone in 2002, the decline in catch rates continued. This suggests that whole populations and not just legal-sized abalone were affected. Further action is required to promote the recovery of these stocks. Evaluation of all options indicates that a further reduction in TAC is necessary.

- The Western Zone fishable stock levels were generally healthy, but were lower and probably falling in the most accessible parts (the south and the far north). It would be risk averse to limit the annual catch from these areas.

- In the Northern Zone, most of the catch was taken from the North West and North East and, consequently, the fishable biomass there has become reduced. In more remote regions, such as King Island, stock levels were healthy. Fishing effort either must either be diverted to the remote regions in 2003, or if this is economically unfeasible for divers, the annual catch in the North West and North East should be limited and the TAC reduced accordingly.

- Rates of exploitation of Greenlip stocks were high in all areas. They were highest in the North West and North East where falling catches and catch rates were consistent with reduced levels of fishable stock and unsustainable catches. The best option for the Greenlip fishery is to reduce the regional catch in the North West and North East, and reduce the TAC accordingly.

- Annual estimates of the size of the recreational catch for the east and southeast coasts should be developed, and an appropriate level of catch determined to ensure that recreational divers do not further impact on depleted stocks. Developing an appropriate means of monitoring this fishery is recommended.

Contents

1. Introduction

This stock assessment report represents a departure from previous reports, in that much of the material that described the biology of abalone and fishing details has been omitted in the interests of producing a document, the sole purpose of which is devoted to assessing the status of abalone stocks in the Tasmanian fishery. The omitted material is readily available from DPIWE in the form of annual explanations of zones and size limits and periodic reviews of the abalone management plans. In addition, previously published reports containing this material are available from the Tasmanian Aquaculture and Fisheries Institute web-site:
http://www.utas.edu.au/docs/tafi/TAFI_Homepage.html

The Tasmanian abalone fishery is assessed using information produced from divers' catch dockets, and the measurement of abalone from samples of divers' catches. Primarily it relies on analysis of trends in catch and catch rates over a 10 year period (at statistical block level) or a three year period (sub-block level). Previous assessments made extensive use of the comparison of current catch and catch rates with those from defined reference periods. However, because of improvements in the way divers collect abalone and the probable depletion of abalone producing reefs and consequent reduction of area in the fishery, comparison of current fishery trends with those from the past may be inappropriate and produce spurious information. These comparisons are no longer used directly.

In 2002, the blacklip abalone fishery was managed as three zones, each with a TAC (total allowable catch). The greenlip fishery was managed separately from the blacklip fishery, but also with a TAC. This assessment reviews the performance of each zone by assessing catch and catch-rate information at statistical block level, which is in turn interpreted using information gathered at sub-block level. The information used to assess performance is shown in this report in the form of charts, which deal either with catch and catch rates, or with the size-composition of divers catches. Statistical blocks are grouped by zone, then the chart for each block and sub-block is presented in numerical order.

We have included an explanation of how the charts should be read (Section 1.1). Some charts, particularly in the areas with the greatest level of catch, also include comments about aspects of the fishery. A summary of the information contained in the charts is presented at the end of each zone's section. These summaries were prepared from both the interpretation of these charts and through the specialised knowledge of a number of individuals from within the fishery, including the industry and government representatives of the Abalone Stock Assessment Group (AbSAG).

The Discussion section reviews the performance of each fishery (zone), and discusses the range of options open to fishery managers. Finally, the report concludes with a list of recommendations to managers.

This report also contains appendices including the total annual catch by block, by zone. Another appendix contains charts of catch, effort and catch per unit effort for the entire history of the fishery. The information from this appendix is not used in the preparation of this assessment.

1.1 Interpreting graphical information:

Figure 1 shows catch (left y-axis) and catch rate (right y-axis) for the last 10 years for a statistical block.

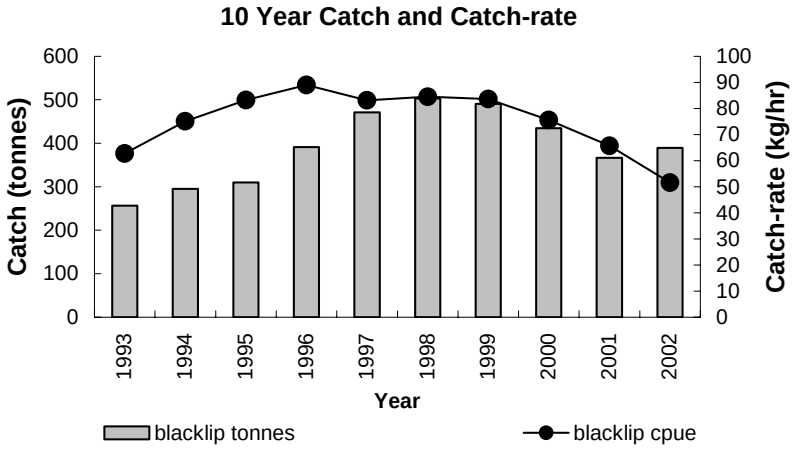


Figure 1. Example ten-year catch and catch rate, by block. Catch rates (geometric means – see below) are shown as a line with blobs marking every year. Catch data (tonnes) is shown as vertical columns.

Catch rates are expressed as geometric mean catch rates rather than arithmetic means because abalone catch rates do not tend to follow statistical normal distributions and using the geometric mean avoids biasing the estimated catch rates for all divers combined. Catch data are presented only for a ten year period because we believe divers have been fishing in much the same way for the last ten years, and therefore changes in catch rate are due to changes in abundance of abalone, not because the divers have altered the way they fish (by changes in the use of droplines, GPS, boats, equipment etc).

Figure 2 is similar to Figure 1 (i.e. shows catch and catch rate by block), but it also includes **greenlip** catch (**white** columns) as well as **grey** columns (**blackli**p catch). Note that to make the greenlip catch more easily distinguished, in some cases the greenlip columns have been bold outlined and the blacklip columns lightened.

Because of operational changes in the fishery, there are three sorts of catch rate in Figure 2:

- The catch rates between 1993 and 1999 are all the same type: lines with **grey balls** marking each year. These show the catch rate for catching both species of abalone. Because zoning was only introduced in 2000, prior to this, divers did not distinguish between time spent catching blacklip and time spent catching greenlip, meaning catch rates for each species could not be separated.

- Between 2000 and 2002, the catch rates are shown as two separate lines with **black balls** for **blacklip** and **white balls** for **greenlip**.

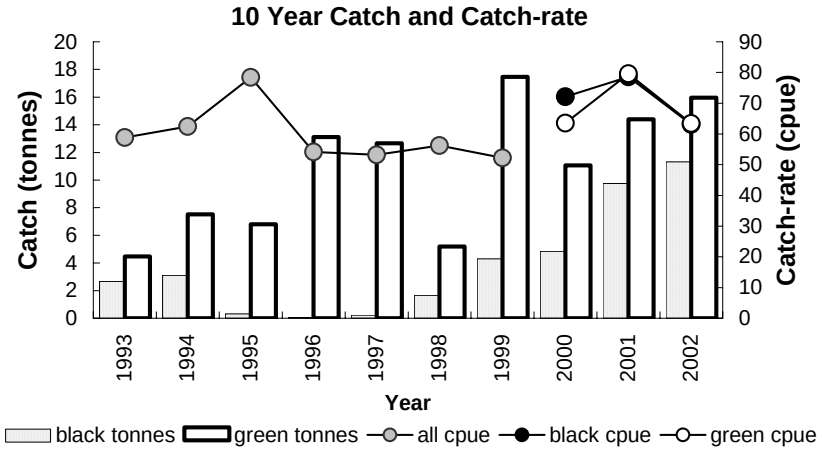


Figure 2. Example ten-year catch and catch rate – blacklip and greenlip.

Figure 3 shows catch and catch rates for the last three years for sub-blocks. Because sub-blocks have only existed since 2000, we cannot show catches (or catch rates) to sub-block level before then. While these charts generally have been limited to sub-blocks supplying 10 or more tonnes during any of the last three years, some sub-blocks with annual catches less than 10 tonnes are included if they are of particular interest.

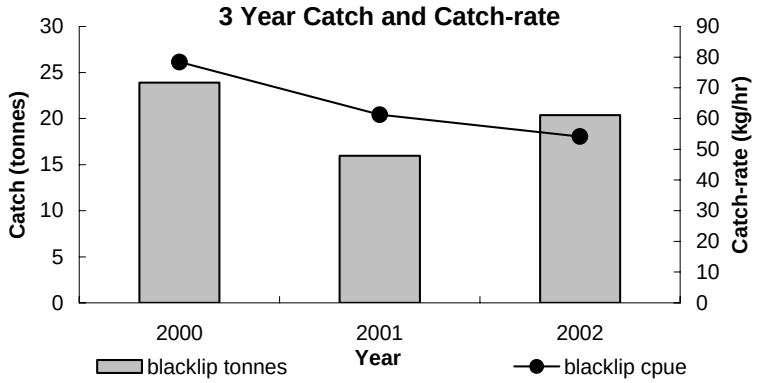


Figure 3. Example catch and catch rate at sub-block level.

Also included are monthly catch rate and catch charts at sub-block level (Figure 4, Figure 5). These are useful to compare catch rates at the time of year when the fishery was most productive, and potentially, large numbers of divers participated. They help to reduce the diver effect (i.e. when catches are small and infrequent, catch rates changes may reflect the abilities of individual divers rather than abalone abundance), and to allow for months where bad weather affected catches. They also help explain some of the changes in annual catch rates

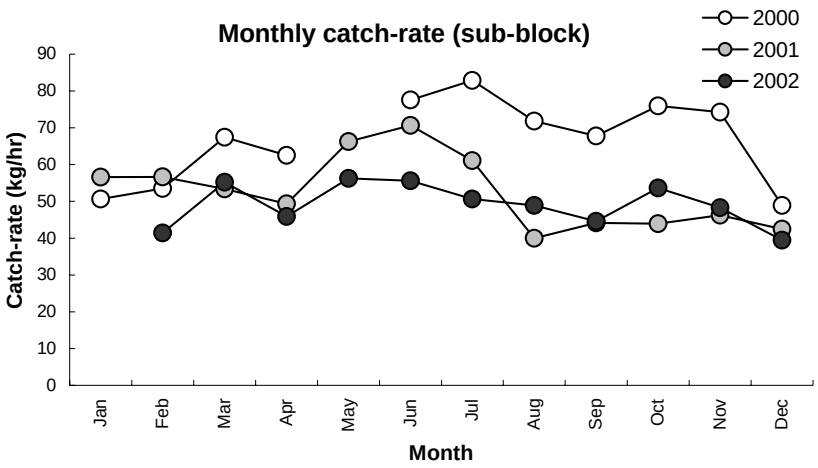


Figure 4. Example monthly catch rate, 2002 to 2002, at sub-block level.

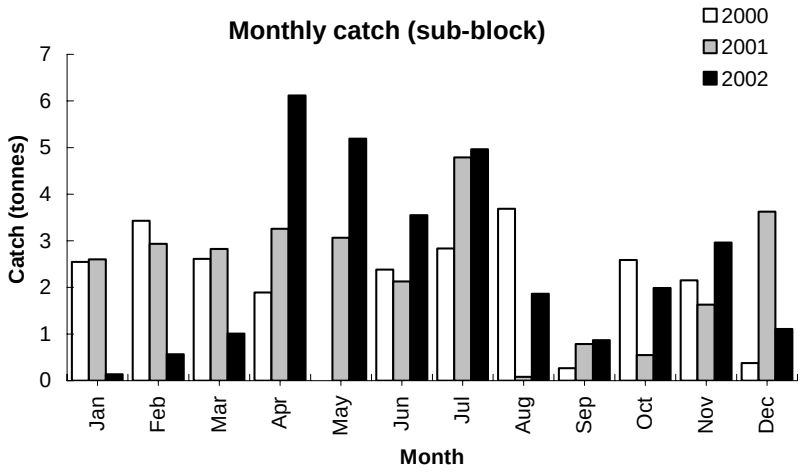


Figure 5. Example monthly catch (tonnes) 2000 to 2002 at sub-block level.

The catch charts (Figure 5) should be used in conjunction with the catch rate (Figure 4) charts so that comparisons are made across years with similar levels of catch.

Size-composition charts.

The size-composition of divers' catches is reviewed at sub-block level. At this spatial scale, there is a greater likelihood that the catches come from populations with similar growth characteristics than at larger scales. Unless the size-composition of catches from a sub-block is of particular interest, only sub-blocks with samples taken regularly throughout the year are included.

The size-composition charts contain a number of diagrams like the one below (Figure 6). They indicate the size structure of abalone catches being landed by divers.

The numbers on the left hand-side (y-axis) of the chart (0, 10, 20, 30) are levels of percentage. The numbers along the bottom (x-axis) of the chart are the size-classes into which the abalone have been grouped. The abalone are grouped into 5mm size classes

(e.g. 131 – 135mm, 136 – 140mm, etc), although there is only room to label every second size group. In the first size-class indicated by 130, all the abalone smaller and including 130 mm are grouped. It is a small size-class, only about 2 or 3 percent. The next size-class includes abalone that measure 131 to 135 mm (these abalone were caught at 132-mm size limit). In the example below, about 27% of the sample is in this size-class. The next size-class is between 136 and 140 mm, with just over 20% of the sample. As we move from left to right across the graph, the numbers of larger abalone dwindle, with only 1 or 2 abalone recorded in the 186 to 190 mm size-class.

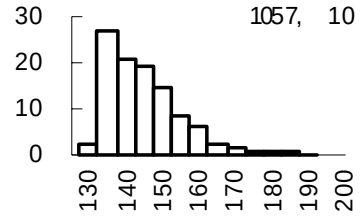


Figure 6. Example size-composition of a sample of abalone taken from a number of divers catches from a 132mm size limit zone.

The numbers in the top right hand corner show firstly the number of abalone that were measured to make up this chart (1057), and the number of divers catches that were sampled (10). Usually, approximately 100 abalone are measured from each diver's catch.

Each of these charts is arranged by month and year, and shown by sub-block (see Figure 7, over page). For some blocks samples were obtained for nearly every month, whereas for less fished blocks samples may only have been obtained on one or two occasions.

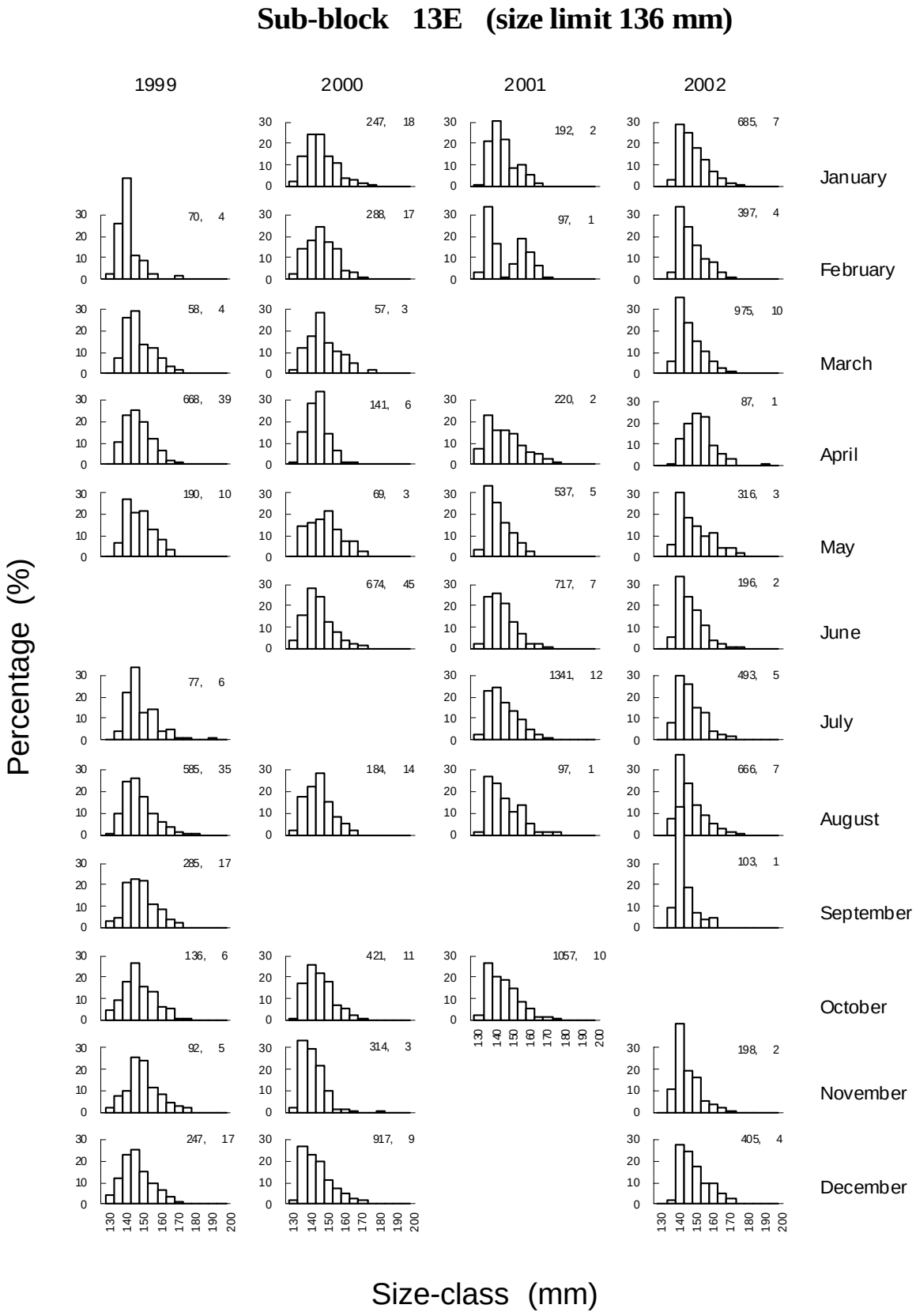


Figure 7. Example size-composition chart of the commercial catch of abalone taken from sub-block 13E, arranged by year and month. The current size limit is indicated at the top of the page. The size limit between 1999 and 2001 inclusive was 132mm.

2. Landed Catches, 2002

At the end of 2002, annual landings comprised 2396.6 tonnes of blacklip and 139.9 tonnes of greenlip (Table 1). The Eastern Zone TAC was reduced from 1120 tonnes to 857.5 tonnes in 2002.

Table 1. 2002 landings by zone, in tonnes

Zone	2002 TAC	2002 Landings
Greenlip	140.0	139.905
Eastern Blacklip	857.5	856.671
Northern Blacklip	280.0	280.008
Western Blacklip	1260.0	1259.886

Figure 8 shows the location of the zones and statistical blocks from which the 2002 commercial catch information was reported.

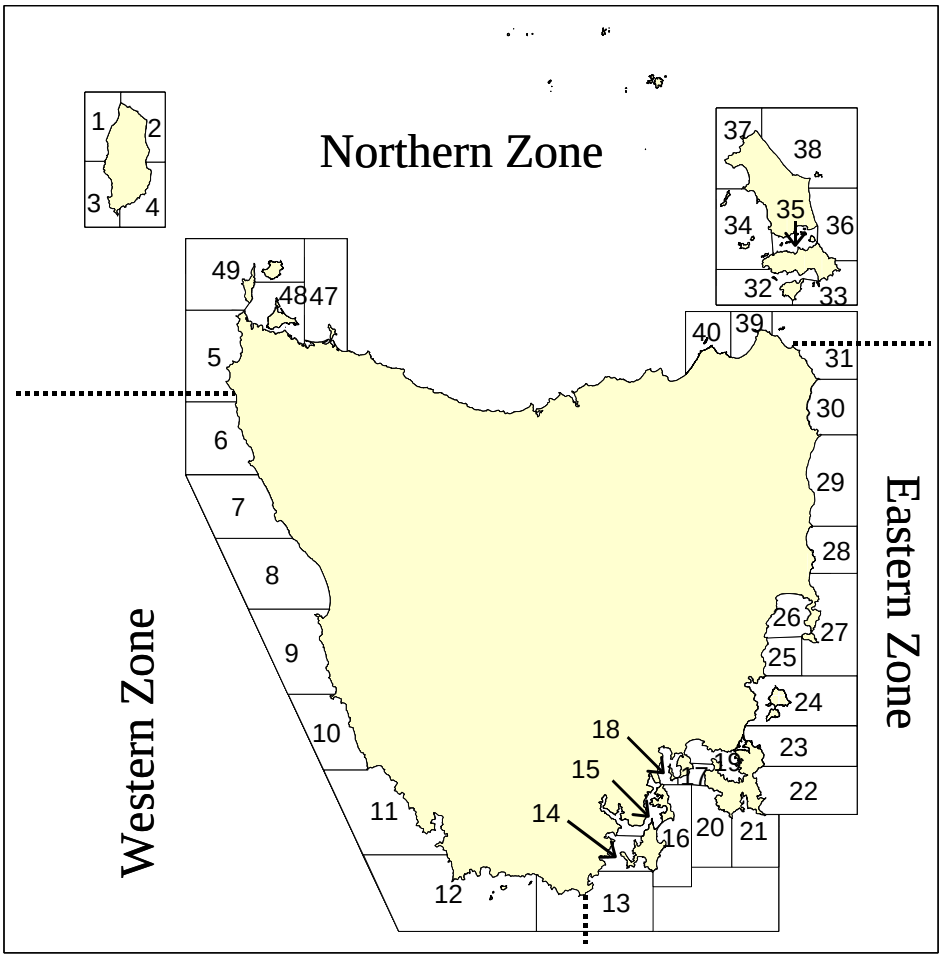


Figure 8. Statistical blocks and zones used in the Tasmanian abalone fishery in 2002. Zones and zone boundaries may change from year to year. Zone boundaries are shown as dotted lines. The Greenlip fishery is not spatially fixed, but mostly takes place on coasts included in the Northern Zone.

3. Eastern Zone Blacklip

3.1 Eastern Zone blacklip fishery – major fishing blocks

The Eastern Zone TAC was approximately three quarters of that of the previous year (857.5 tonnes, compared with 1120 tonnes in 2001), so the annual catch in most blocks could be expected to be smaller. The 2002 catch from Block 24, one of the most productive East Coast blocks, was greatly reduced. Blocks 27 and 31, recently the best performing East Coast block reported lower catches than expected, as did Blocks 14 and 16 in the South East. Blocks around the Tasman Peninsula (20, 21 and 22), and Block 13 (sub-blocks C, D and E) had higher catches than might be expected given the TAC reduction (Figure 9).

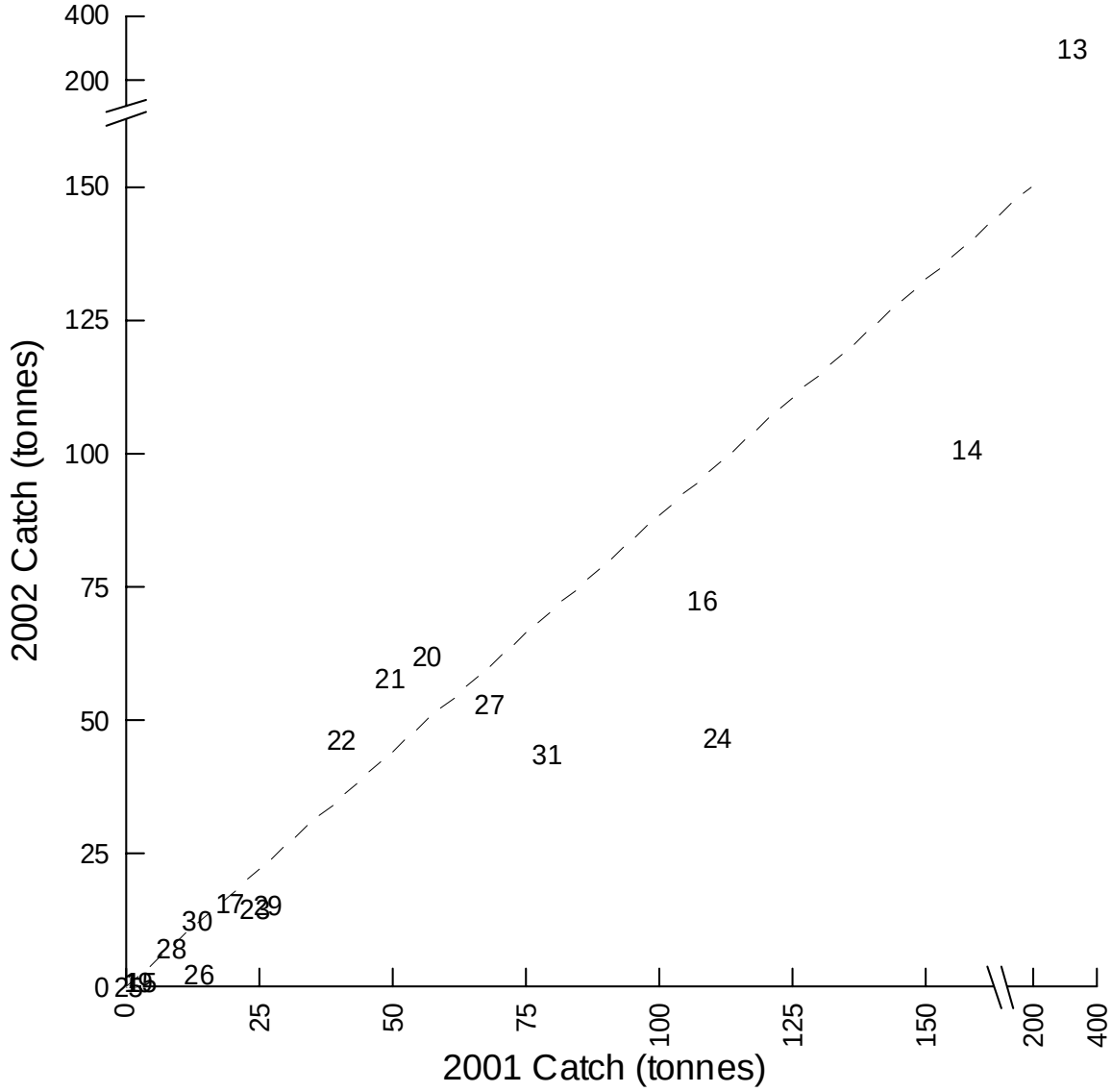
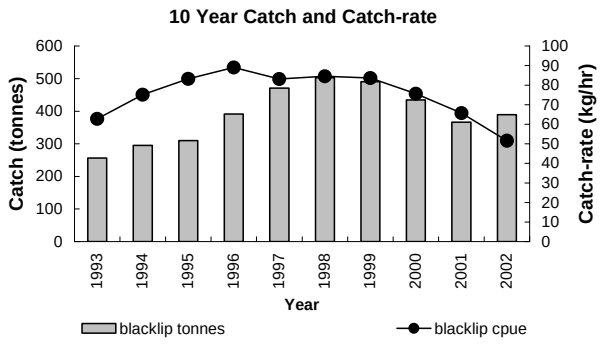


Figure 9. The change in catch between 2001 and 2002 in blacklip catch from the Eastern Zone (Block 13 (sub-blocks 13 C, D, E), Blocks 14 to 30, and Block 31 (sub-block 31 A and part of sub-block 31B). The diagonal line across the chart shows the position where catches from the Eastern Zone in 2002 should lie, given that the catch in this zone was reduced from 1120 to 857.5 tonnes in 2002. Note that the scale changes between 150 and 200 tonnes to show blocks with smaller catches.

3.2 Block 13 (Actaeons)



Because part of this block is in the Western Zone, and it has only been possible to distinguish catches from either zone since 2000, the 10-year chart below includes Western Zone catch from sub-blocks 13A and 13B. These sub-blocks are discussed separately in the Western Zone section.

- The annual catch in the Eastern Zone part of this block (sub-blocks C, D and E) fell from 324 tonnes in 2001 to 297 tonnes in 2002 (the increased 2002 catch in the histogram above is due to larger annual catches in the Western Zone sub-blocks).

- The catch from the Block 13 Eastern Zone sub-blocks was capped at 350 tonnes in 2002. The cap was never reached, probably because there were ample fishing opportunities in other parts of the Eastern Zone due to the reduced zonal TAC.

- Catch rates were generally lower in all three sub-blocks in 2002 than in 2001.

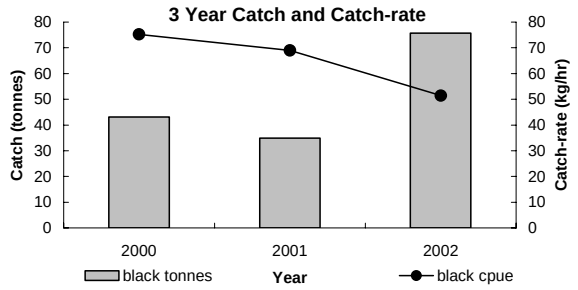
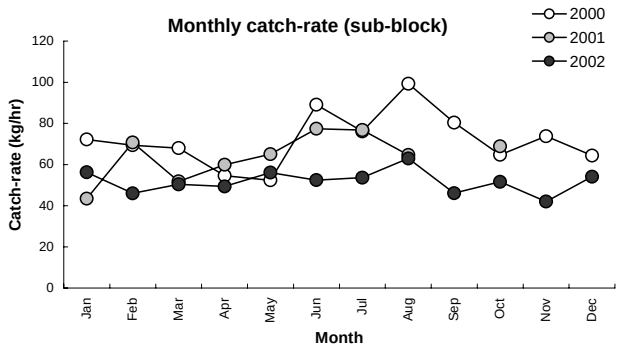
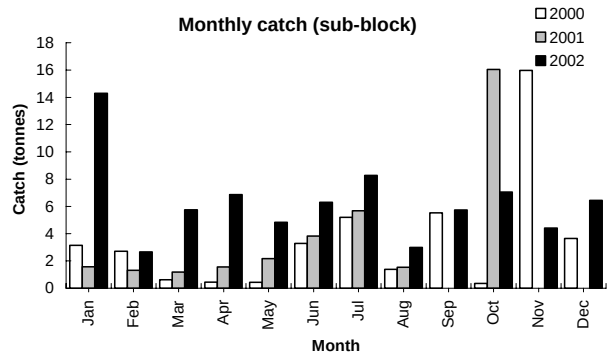
- There was a significant change ($P < 0.0001$) in the mean size of abalone landed from Block 13E compared with the previous year, up by almost 3 mm from 141.7 (1.0) mm to 144.3 (1.0) mm. Using the length-weight relationship with parameters derived from abalone caught in sub-block 13E

  $$weight = 5.60E\text{-}05 * length \wedge 3.2193$$

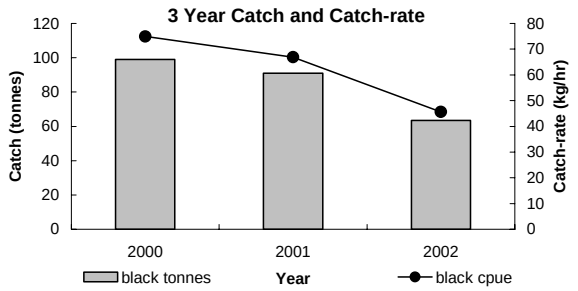
  this means that the mean weight of abalone is now 501 g, up 28 g from the previous year. This weight increase is most likely due to the increase in minimum legal size from 132 mm to 136 mm.

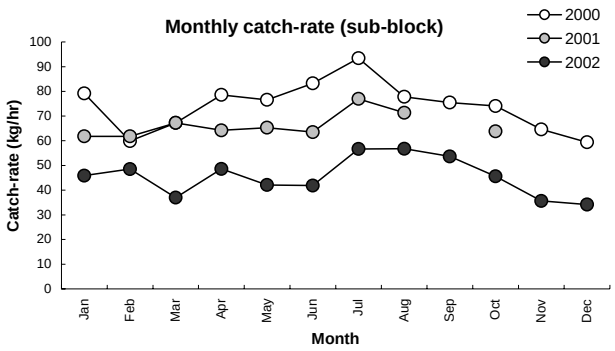
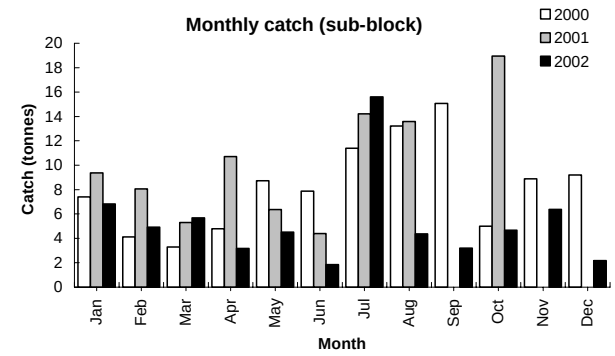
- The size composition of samples taken from sub-block 13E shows that in most months, more than 30% of the catch was between 136 and 140 mm length i.e. the first legal size-class (the smaller size classes shown usually contain abalone of legal size, but with chipped or broken shells). That such a high proportion of the catch falls within this size range implies high rates of fishing mortality. The size composition of abalone from sub-blocks 13C and D (particularly the later months) shows that abalone caught there generally grow to a larger size prior to capture. This means that the increase in the legal size limit is actually having the sought after effect.

3.2.1 Sub-block 13C
Fishers Point to Whale Head

	The 2002 annual catch was approximately twice that of past years.
	Abalone in this sub-block are relatively large, so size limit increase had little effect upon catch rates early in 2002. Catch rates fell slightly in Feb 2002 following high levels of catch in January.
	Missing catches in September and November-December 2001 reflect fishery closures.

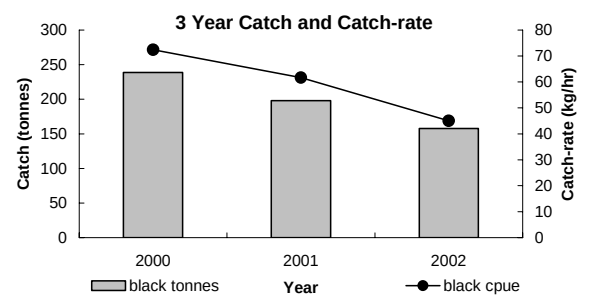
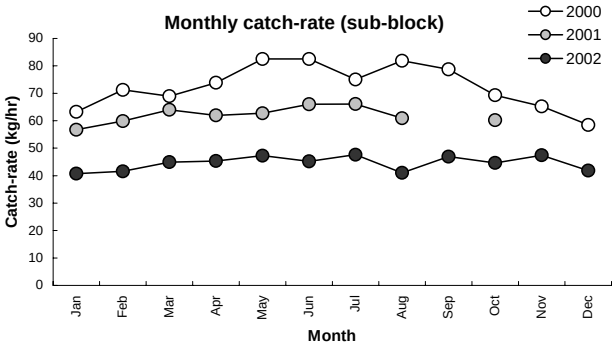
3.2.2 Sub-block 13D
Fishers Point to Southport Lagoon Beach, including Recherche Bay

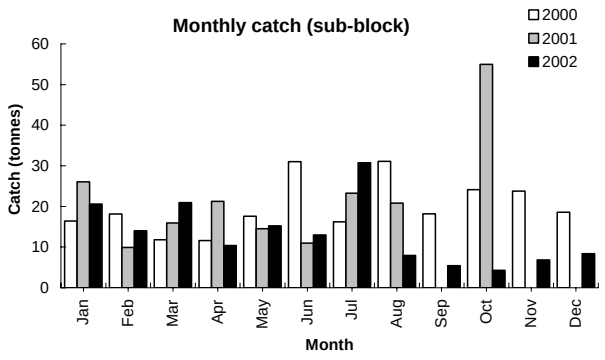
	The annual catch is substantially lower than in previous years.

	A comparison of monthly catch rates (although missing for some months in late 2001) shows that catch rates in 2002 are lower than both the previous years.
	Although the size-limit increase was probably partly responsible for reduced catch rates in the early part of the year, in the last six months the catch rates failed to recover to former levels (low stock levels? novice divers?).

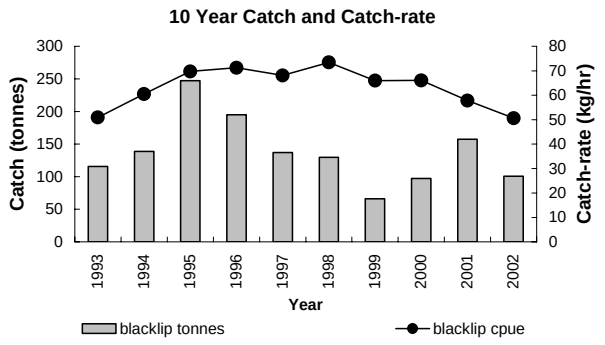
3.2.3 Sub-block 13E

Actaeon and Sterile Islands, and reefs to the south (the Breaks)

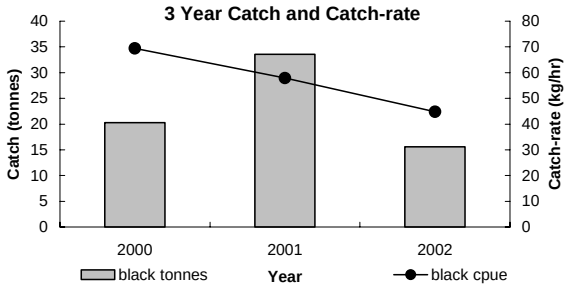
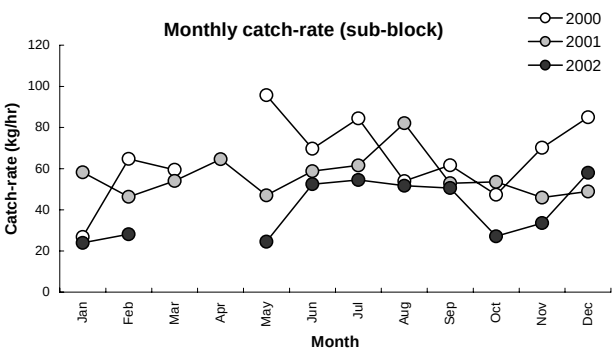
	The annual catch has declined during the past two years.
	A comparison of monthly catch rates (although missing for some months in late 2001) shows that catch rates in 2002 are substantially lower than both the previous years. Although the size-limit increase was probably partly responsible for reduced catch rates in the early part of the year, in the last six months the catch rates failed to recover.

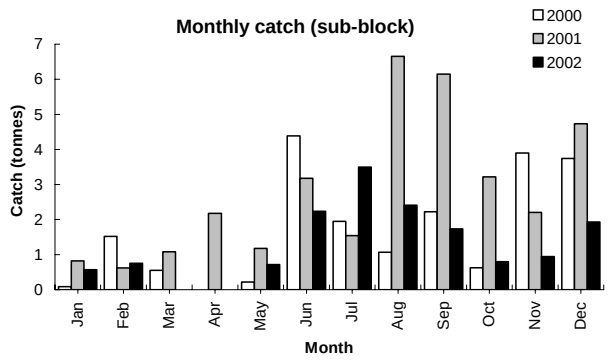
	2002 catches fell to lower levels after July.

3.3 Block 14 (Lower Channel, south Bruny Island and the Friars)

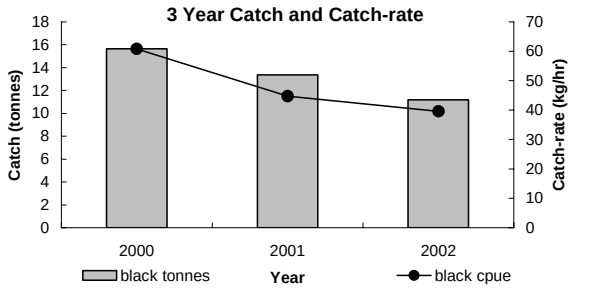
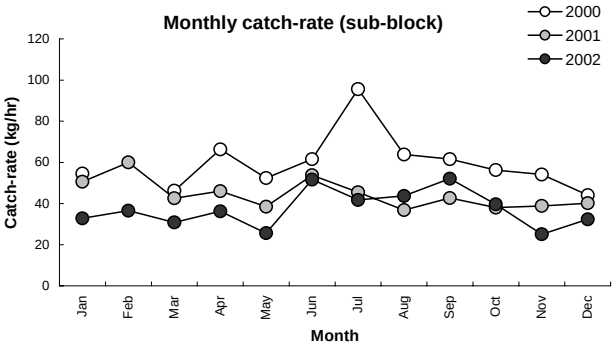
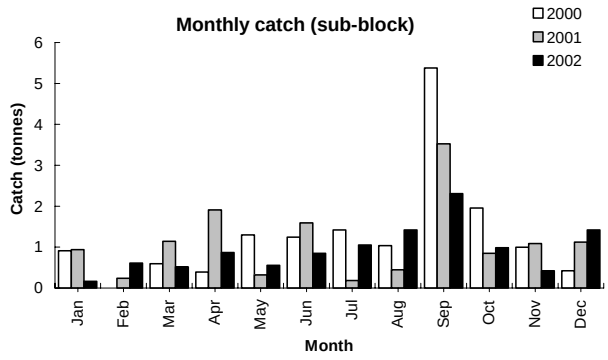
	Catch and catch rates fell in 2002. The 2002 catch was low, perhaps reflecting the reduced TAC rather than falling stock levels, although note that catch rates have now fallen for the last three years, and are well below the levels of the period 1995 to 2000.

3.3.1 Sub-block 14A
Southport Lagoon Beach to Burnett Point

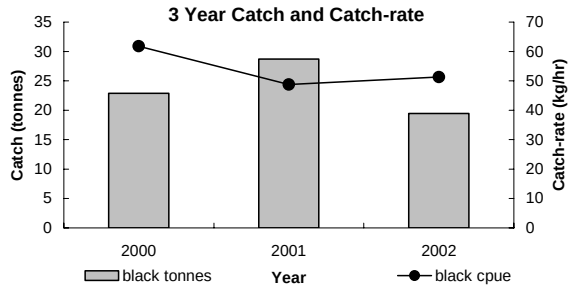
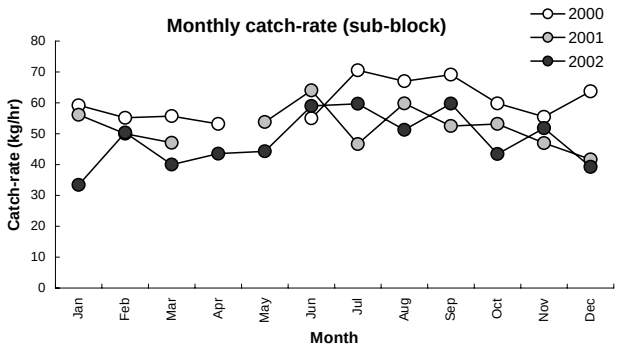
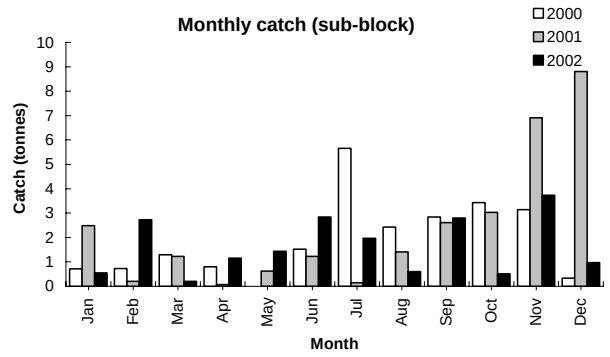
	Although the 2002 catch was reduced substantially from earlier levels (less than 50 % of 2001, 75% of 2000), catch rates are still lower than previous years.
	During winter, monthly mean catch rates are lower than those form earlier years.

	2002 catches are more moderate than in 2001, when the Block 13 closures forced divers elsewhere.

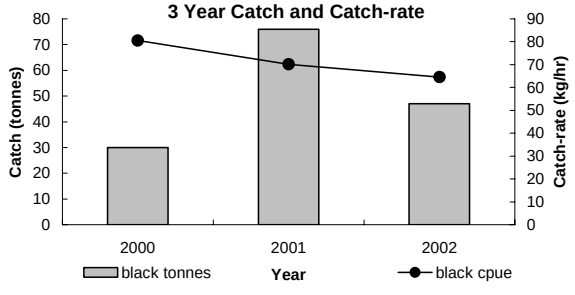
3.3.2 Sub-block 14B
Burnett Point to Blubber Head

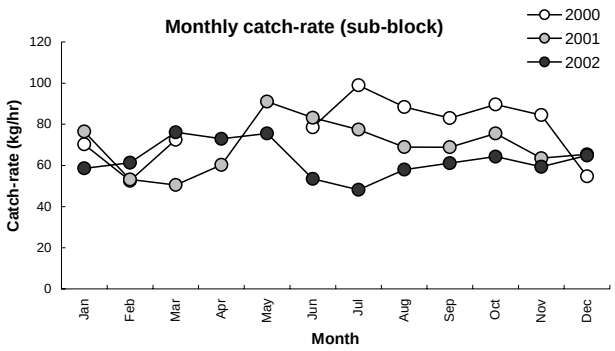
	There has been some decrease in annual catch (about 15% in both 2001 and 2002) since 2000, which could be expected to have a positive effect upon catch rates; however, this was not the case.
	Monthly catch rates from Jan to May were reduced compared with 2001 (size-limit effect?), but generally matched those of 2001 over the last seven months.
	Note that highest catches occur in September for each of the three years – it is not known why this should be so.

3.3.3 Sub-block 14D
Hopwood Point to West Cloudy Head

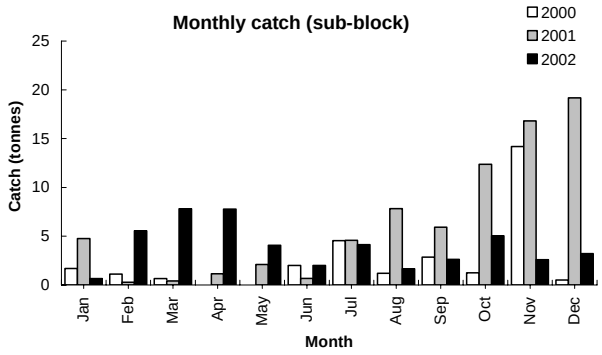
	The 2002 catch was two thirds of that of the previous year, which may have helped lift catch rates marginally.
	Monthly catch rates are very similar to those from 2001.
	Large catches at the end of 2001 reflect the Block 13 closure.

3.3.4 Sub-block 14E
West Cloudy Head to Boreel Head, including the Friars

	It is assumed that these catches came from sub-block 14E and not the Western Zone. Because there is anecdotal information that some catches attributed to this sub-block were caught elsewhere, these figures may be unreliable.

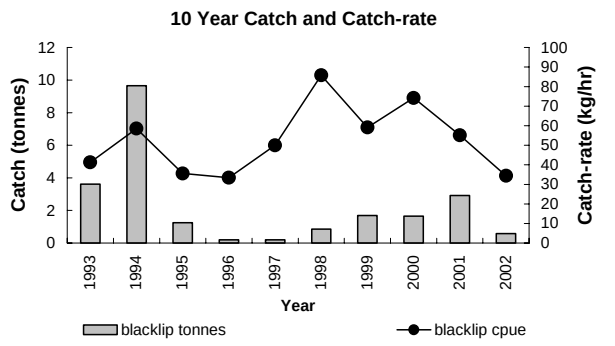


Relatively high catch rates early in the year (contrasting with the Actaeons catch rates) reflect larger-sized abalone (see size composition charts) and a fishery unaffected by the size-limit increase. Catch rates fell later in the year in the face of only moderate fishing pressure (low stock levels? unsuitable diving conditions? novice divers?).



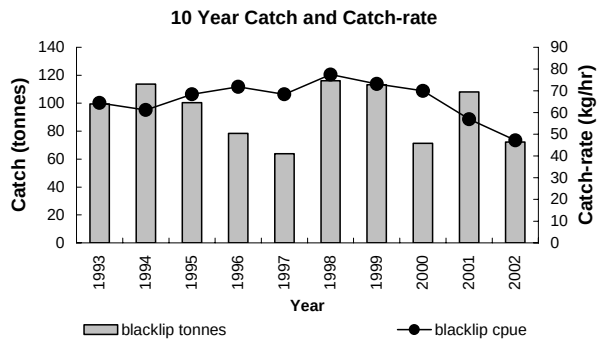
Large catches at the end of 2001 reflect the Block 13 closure, and catches of large-sized abalone attributed to this sub-block.

3.4 Block 15 (D'Entrecasteaux Channel)



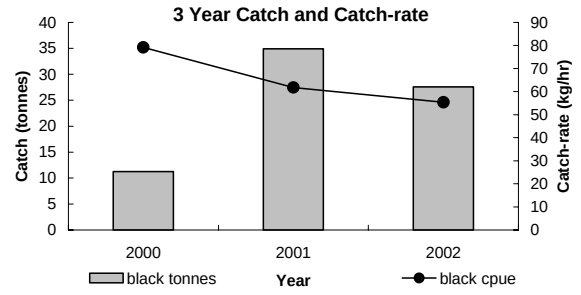
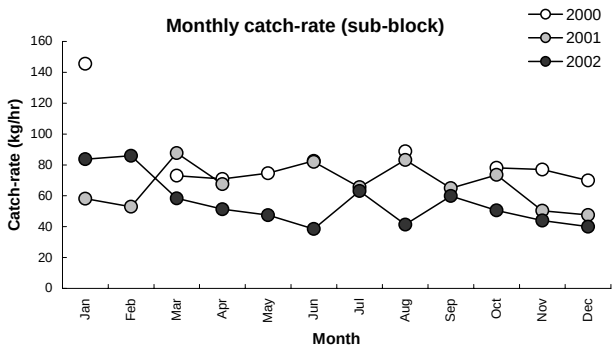
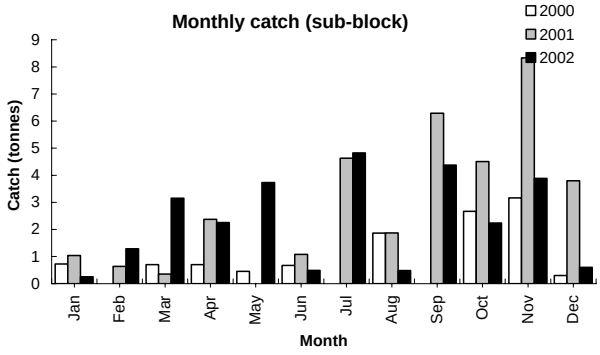
This block contains only a small area of abalone habitat and does not regularly contribute to the fishery.

3.5 Block 16 (eastern side of Bruny Island)

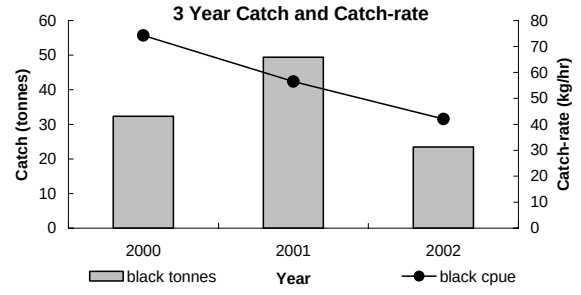


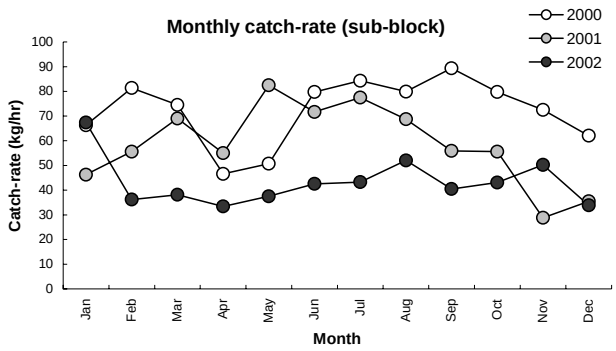
Catch and catch rates fell in 2002. Note that catches are at low levels, and catch rates have declined steadily since the 1998 peak.

3.5.1 Sub-block 16A
Boreel Head to North Mangana Bluff

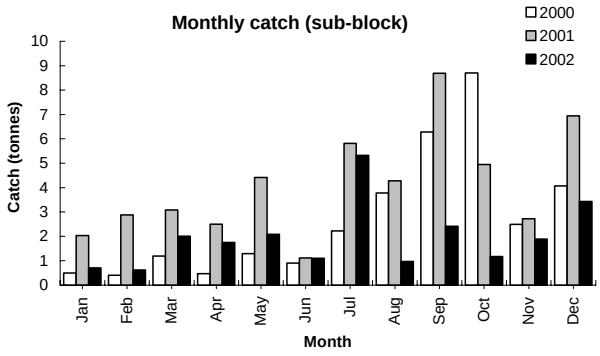
	Like sub-block 14E (particularly the Friars), abalone from the eastern shore of south Bruny are typically large and this, combined with low levels of catch helped ensure relatively high catch rates early in 2002. However, moderate levels of catch and falling catch rates later in the year suggest low stock levels.
	Catch rates from months with significant tonnages are generally lower than corresponding months from the previous year.
	As with other nearby sub-blocks, high levels of catch in 2001 were a result of diversion of effort away from the Eastern Zone part of Block 13.

3.5.2 Sub-block 16B
North Mangana Bluff to Neck Beach

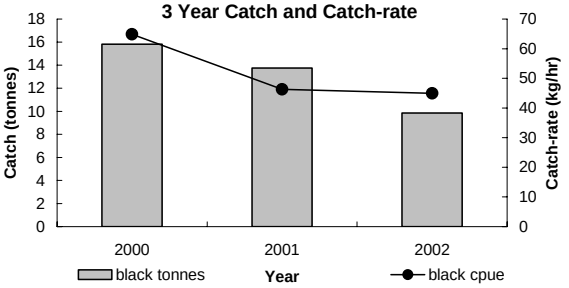
	The 2002 catch was less than half that of the previous year, and falling catch rates suggest low stock levels.



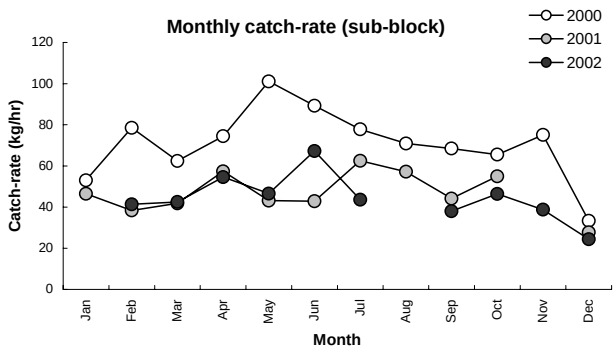
While tonnages per month were generally small, monthly catch rates, particularly over winter, were much lower than those from 2001, which, in turn were generally lower than those of the year before.

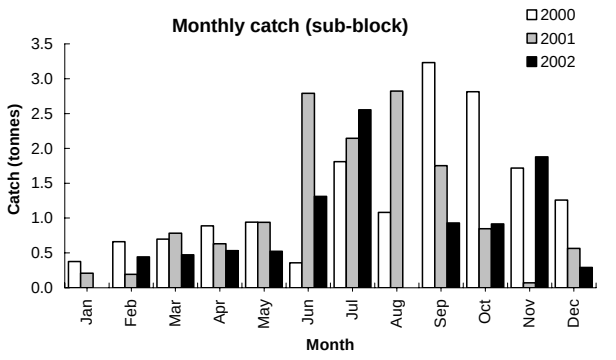


3.5.3 Sub-block 16C
Neck Beach to Trumpeter Bay

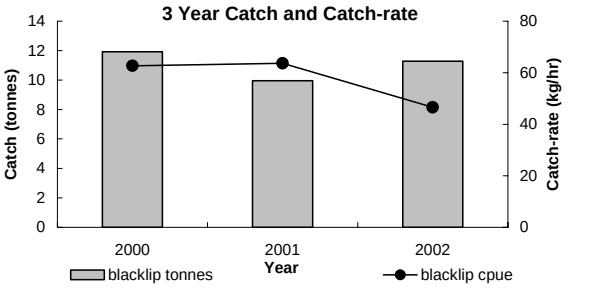


Although there has been a steady reduction in catch since 2000, catch rates do not indicate any stock recovery.

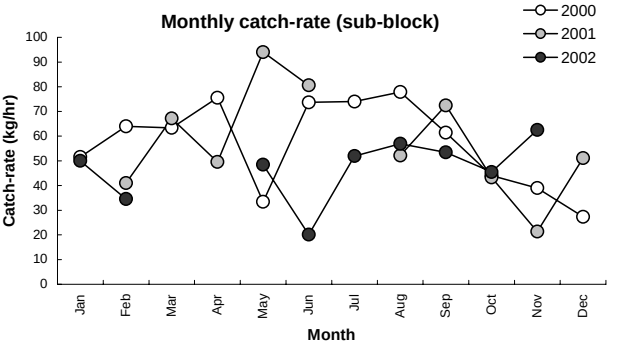


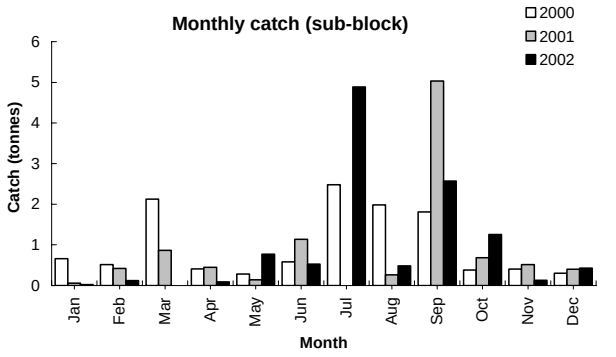


3.5.4 Sub-block 16D
Trumpeter Bay to Dennes Point

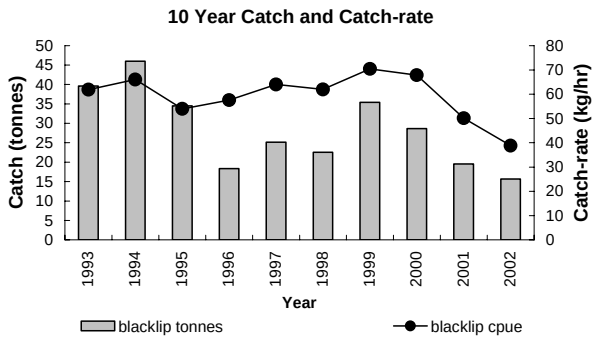


In 2002, there was a 10% increase in catch, but catch rates fell by more than 25%.



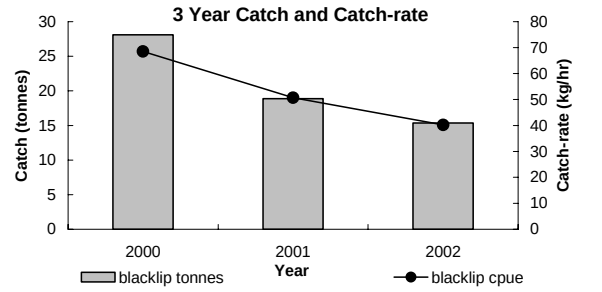
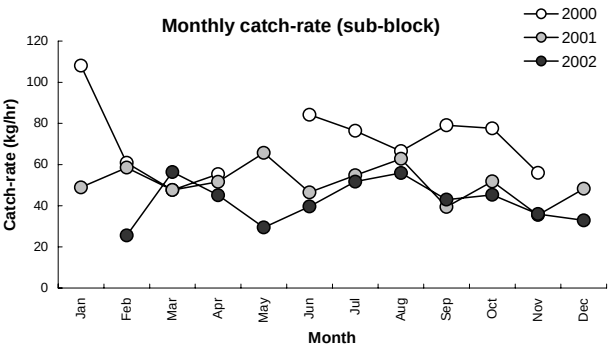
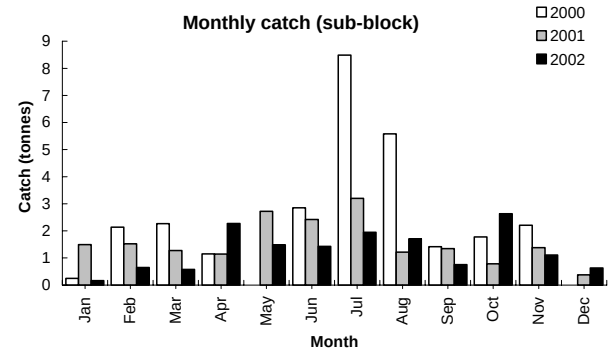


3.6 Block 17 (South Arm to Cremorne, Blackjack shoreline to Outer North Head)

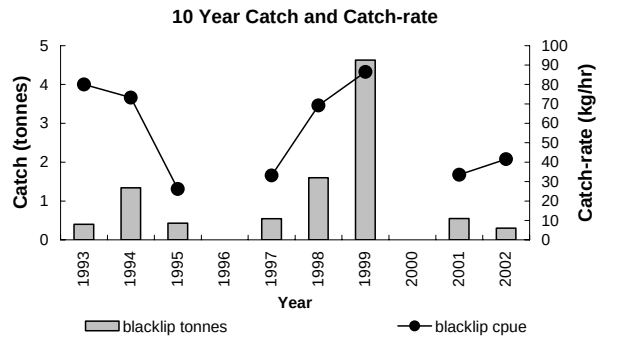
	Catches and catch rates have fallen to low levels.

3.6.1 Sub-block 17B

Blackjack shoreline from Lobster Point to Outer North Head

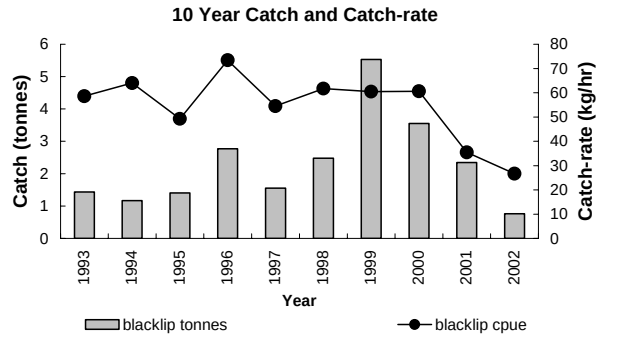
	
	While the annual catch rate continues to fall, monthly catch rates generally match those of 2001, particularly during the cooler months when the comparison is most valid. Note that monthly landings are small (~ 1.25 tonnes per month). The fall in annual catch rates may just reflect patchy sampling from within the sub-block.
	

3.7 Block 18 (Derwent River, Iron Pot)



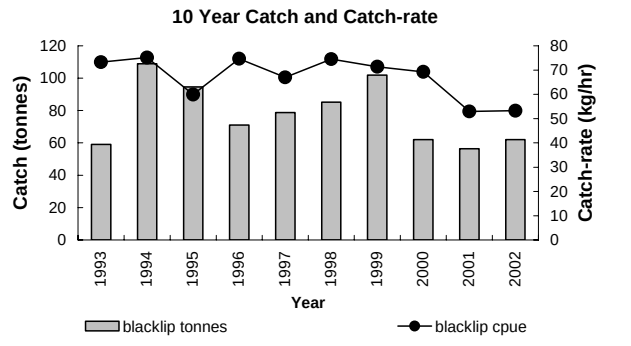
This block contains marginal abalone habitat, and is not an important part of the fishery.

3.8 Block 19 (Northern Frederick Henry Bay)



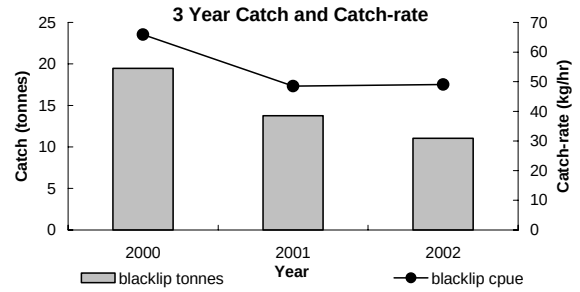
This block contains marginal abalone habitat, and is not an important part of the fishery. Nevertheless, like most blocks in the Eastern Zone, catches and catch rates are at low levels.

3.9 Block 20 (western side of Tasman Peninsula)

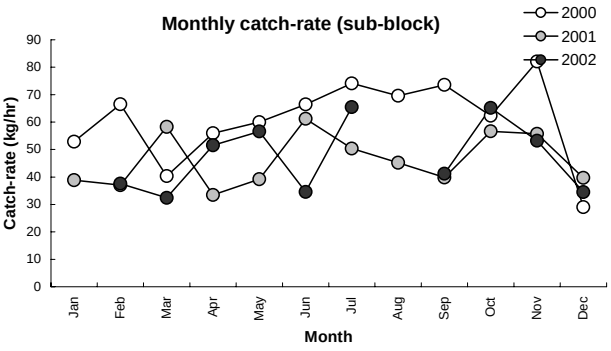


Catch rates for the last two years were approximately two thirds of those for the eight years 1993-2000, and the annual catch during the past three years has been low. This implies that while stock levels are low, they appear to be stable.

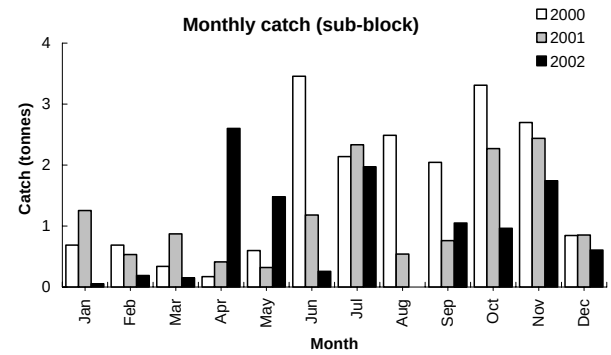
3.9.1 Sub-block 20A
Outer North Head to White Beach



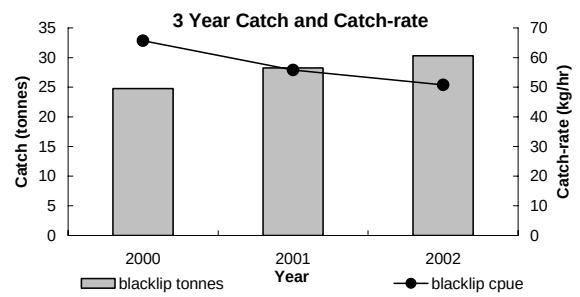
The 2002 catch is now slightly more than half of the 2000 catch.



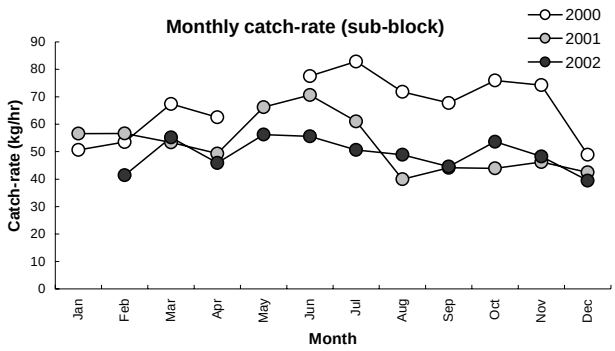
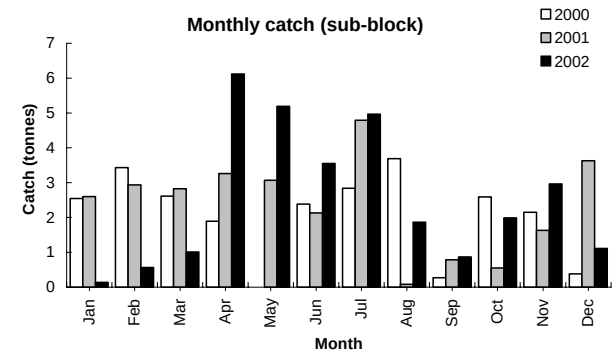
The size of 2002 monthly landings fluctuated, and prior to April, catch rates should be disregarded. Catch rates from months where landings are highest (April-November) generally matched those of previous years.



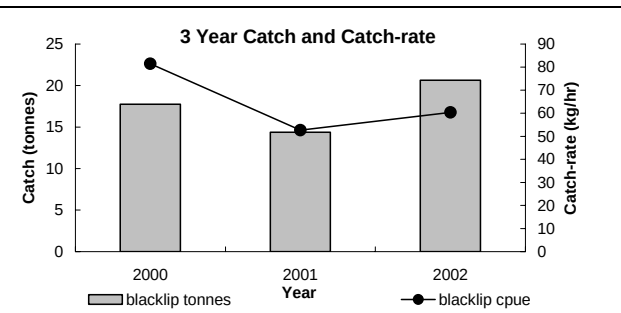
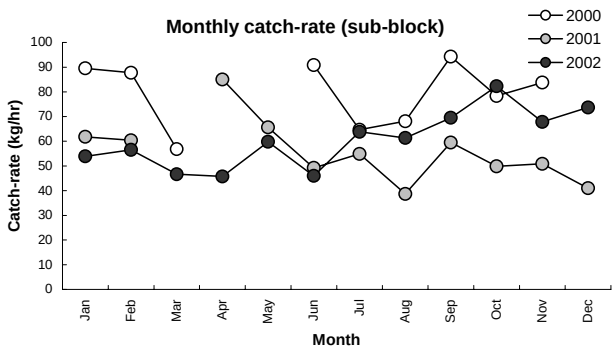
3.9.2 Sub-block 20B
White Beach to Salters Point

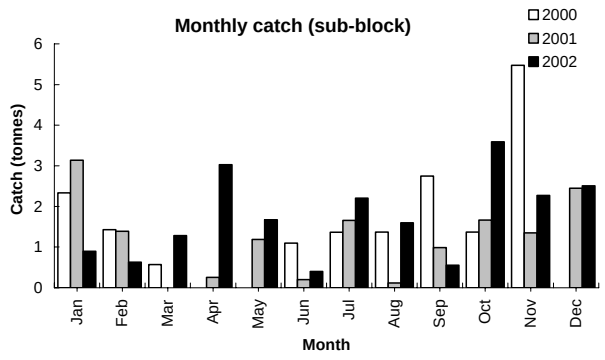


Note that since 2000, annual catches have increased and catch rates have fallen.

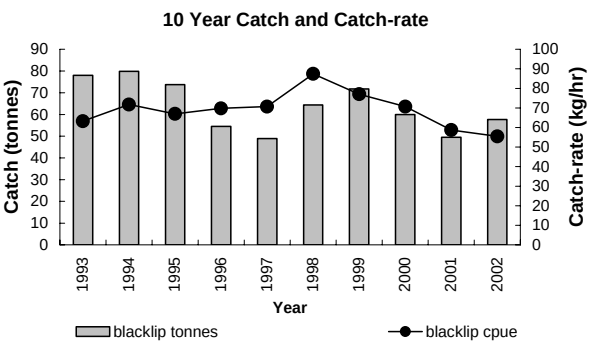
	During the months when levels of catch were highest (April to July), 2002 catch rates were lower than the two previous years.
	Because winter catches were higher than both 2000 and 2001, lower catch rates may reflect increased effort in these months, and not necessarily falling stock levels.

3.9.3 Sub-block 20C
Salters Point to Cape Raoul

	
	Catches and catch rates have improved since 2001, particularly towards the end of the year. However, monthly landings are low, and in the latter part of 2002, comprise mostly the catches of one or two divers. Differences between catch rates between 2002 and the previous years may be due more to differences between divers than improving stock levels.

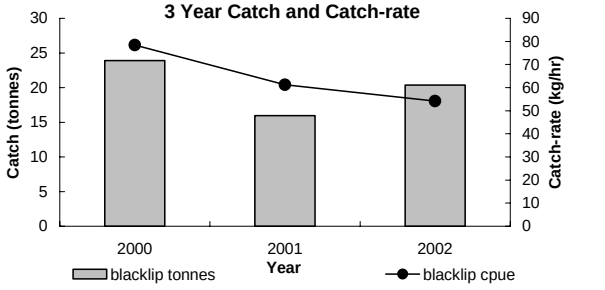


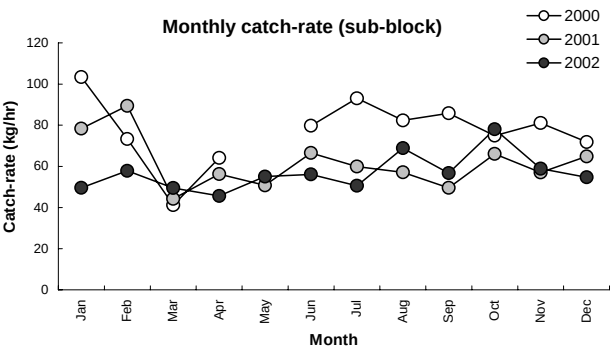
3.10 Block 21 (southern shore of Tasman Peninsula)



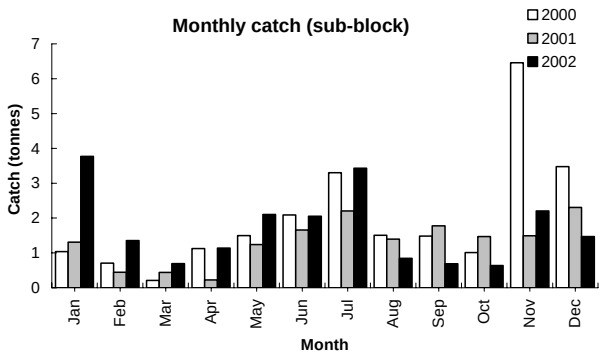
The annual catch is at moderate levels, with low catch rates.

3.10.1 Sub-block 21A
Cape Raoul to Port Arthur

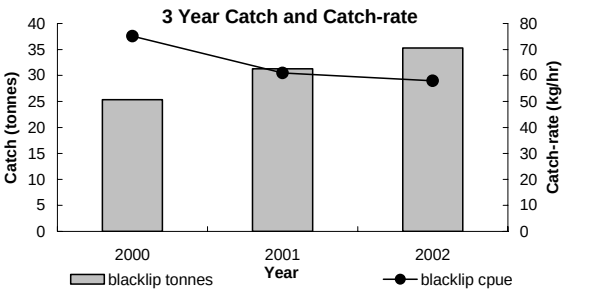




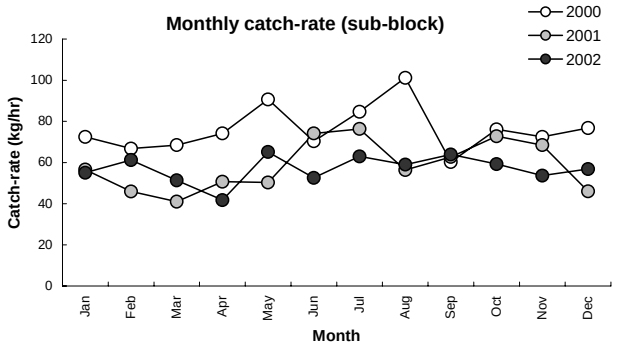
Early season catches in 2002 were relatively large, and probably suppress the annual catch rate. When catch rates are viewed monthly, they are not very different from those of the previous year.

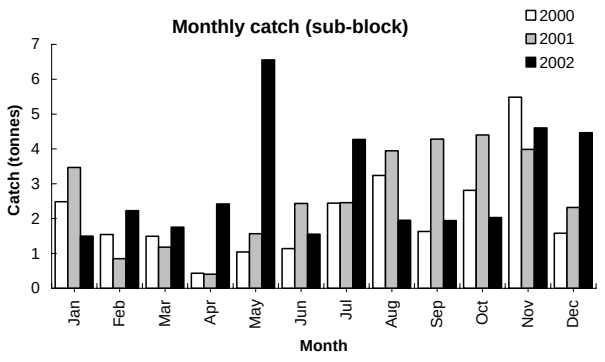


3.10.2 Sub-block 21C
Port Arthur to Cape Pillar



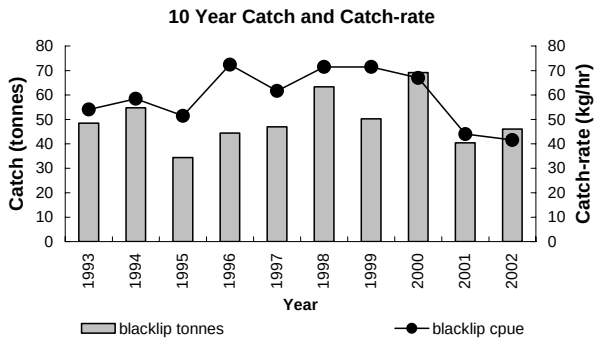
There was little change in catch rates between 2001 and 2002. Both are at reduced levels compared with 2000, probably due to levels of annual catch which increased each year since then.





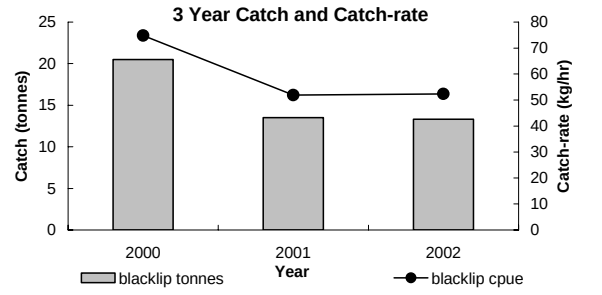
The extraordinary catch in May 2002 was due to large landings from several visiting divers who usually fish elsewhere. In November and December, local divers landed good catches.

3.11 Block 22 (east Tasman Peninsula)

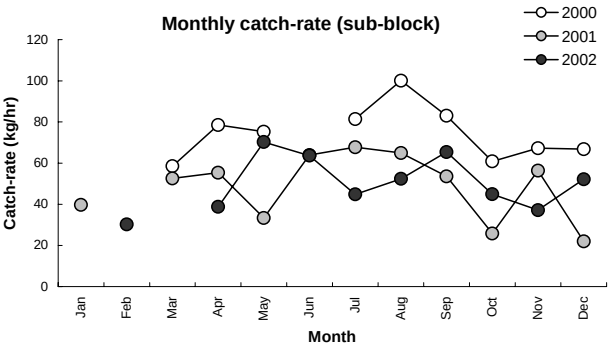


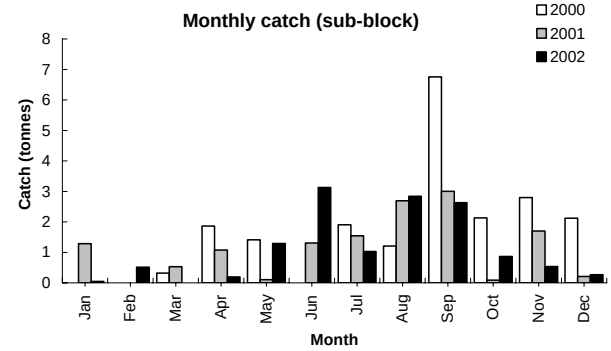
Catches are at moderate levels, catch rates appear to have stabilised, albeit at low levels.

3.11.1 Sub-block 22A
Cape Pillar to the Lanterns

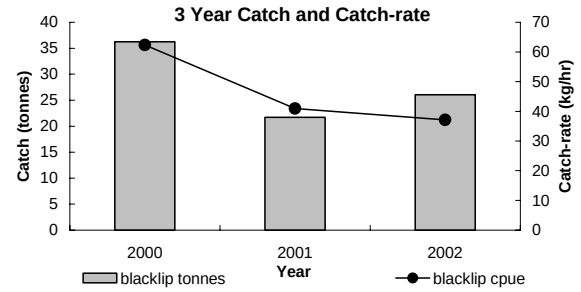


Catch and catch rates for 2001 and 2002, while considerably lower than for 2000, are static.





3.11.2 Sub-block 22B
The Lanterns to Eaglehawk Neck



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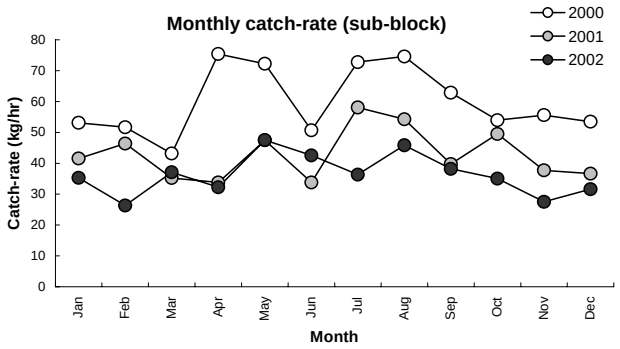
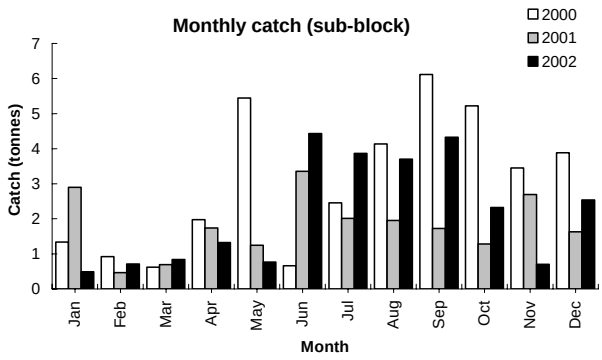
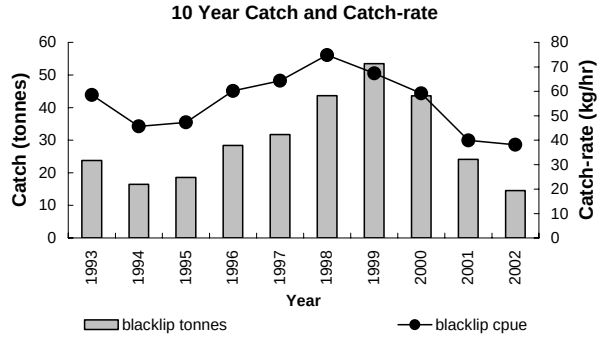


Among months when catches were greatest (June-December), catch rates fell compared with 2001. Both years are well below 2000

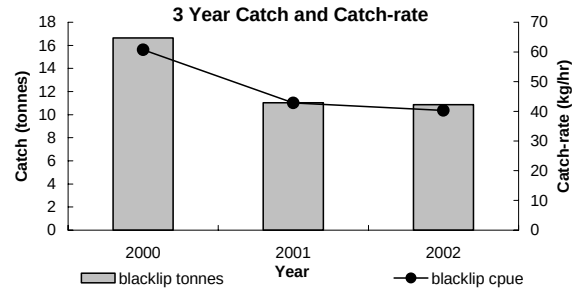


3.12 Block 23 (Forestier Peninsula)

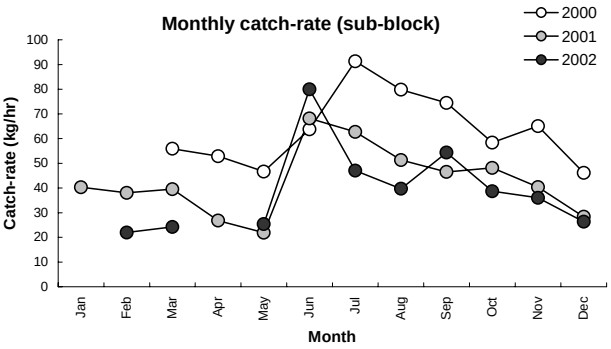


Low levels of catch, low catch rates.

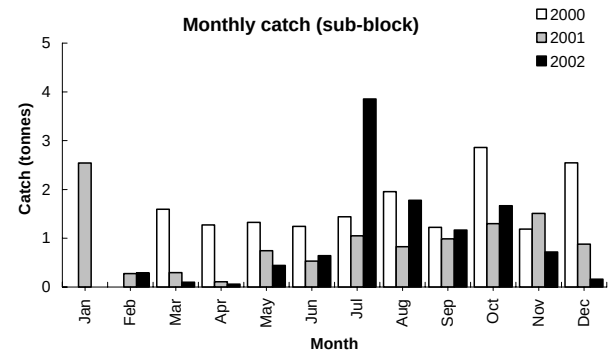
3.12.1 Sub-block 23A
Deep Glen Bay to Lagoon Bay



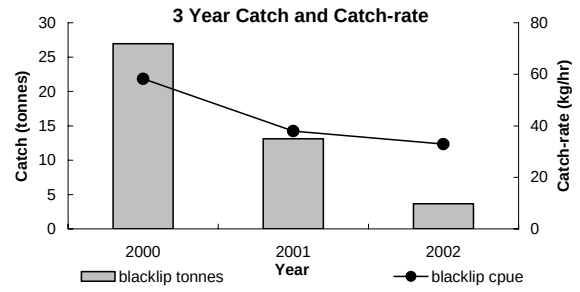
Both 2001 and 2002 catch and catch rates are similar, and show no sign of recovery to 2000 levels.



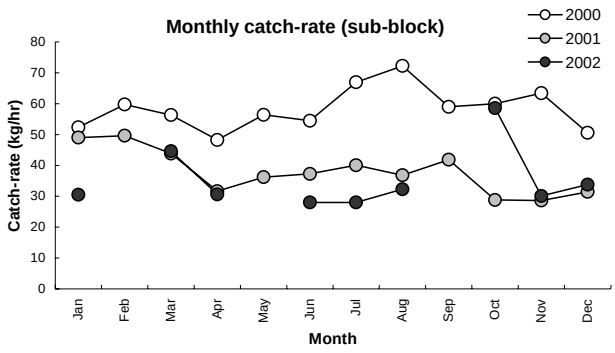
Although the June catch rate was high, it represents just two landings, and is atypical of catches from other months. The July catch rate offers better representation. Occasionally, good catches were landed from this sub-block at reasonable rates, implying that fishable stocks are very patchy.



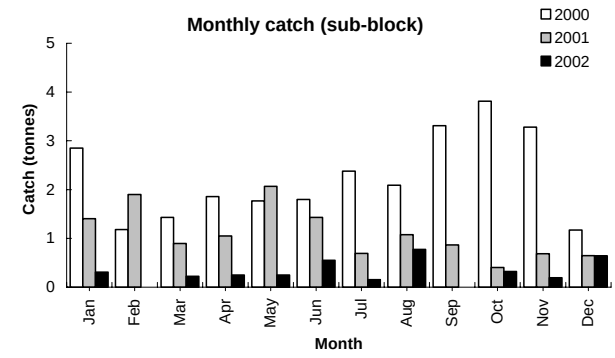
3.12.2 Sub-block 23B
Lagoon Bay to Marion Bay



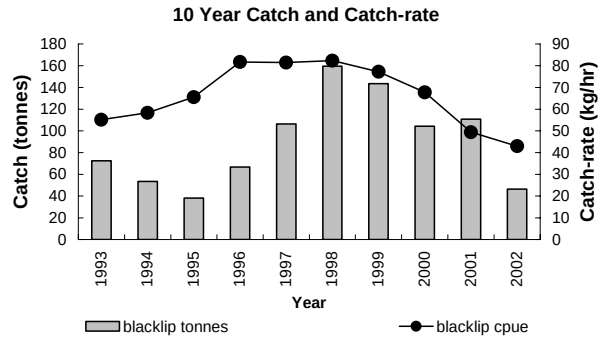
2002 catches are less than 15% of the 2000 catch. As a consequence, the level of sampling is low, and catch-rate information should be used with caution.



Catch rates show no signs of recovery to earlier levels.

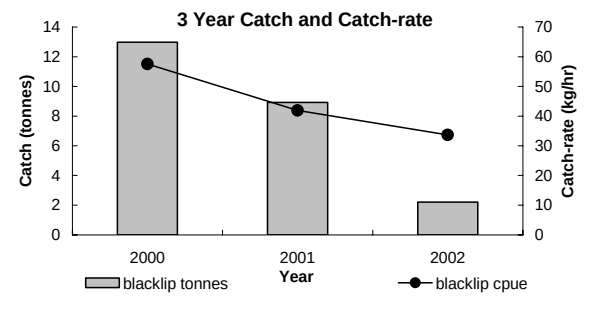


3.13 Block 24 (Maria Island, western shore of Mercury Passage)

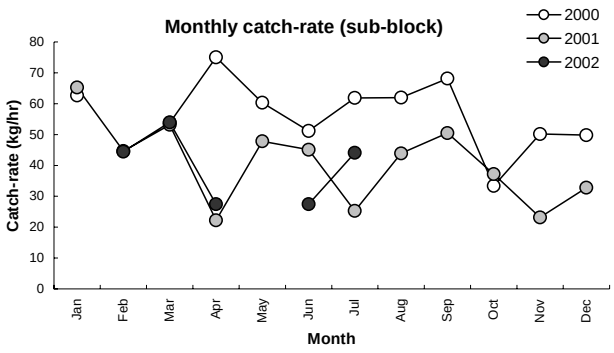


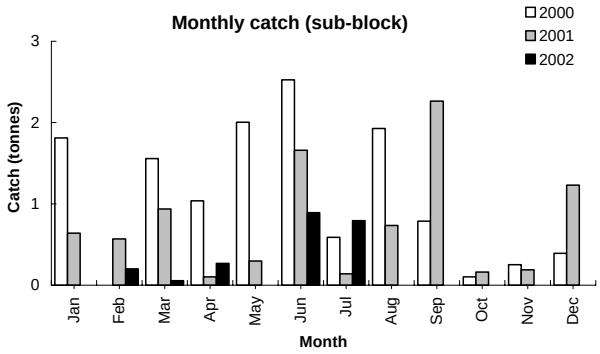
Catch and catch rates at low levels. Catch samples show few small abalone.

3.13.1 Sub-block 24A
western shore of Mercury Passage

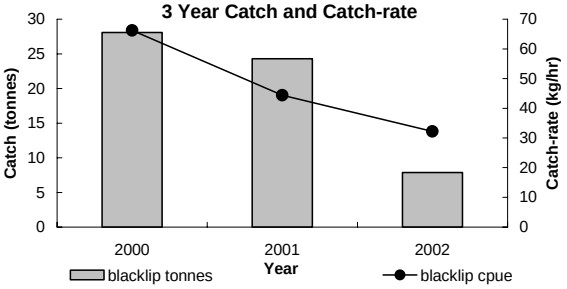


Catches have fallen to very low levels.

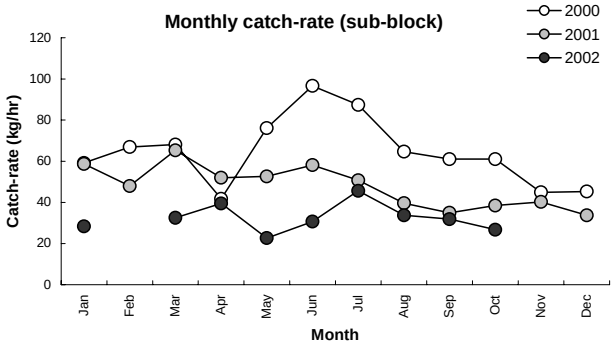


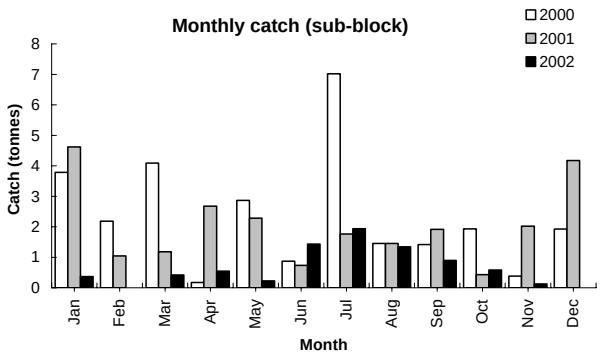


3.13.2 Sub-block 24B
western shore of Maria Island

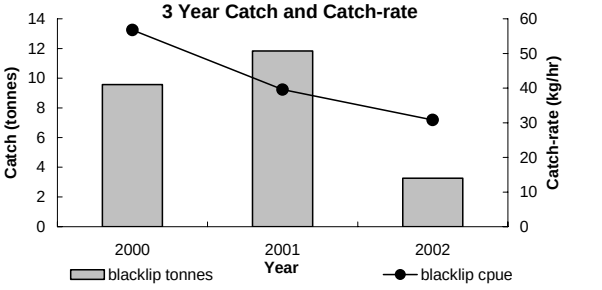


The 2002 catch is less than one third of that of previous years, and catch rates show no sign of recovery.

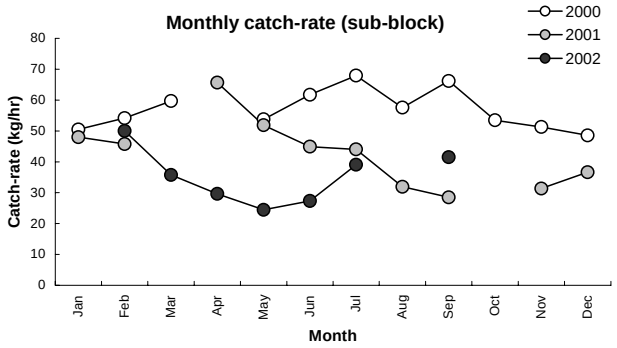


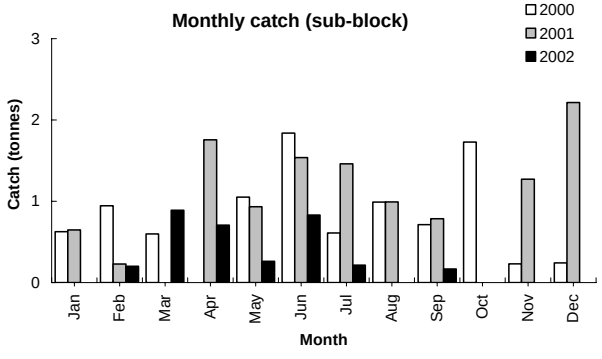


3.13.3 Sub-block 24C
Spring Bay

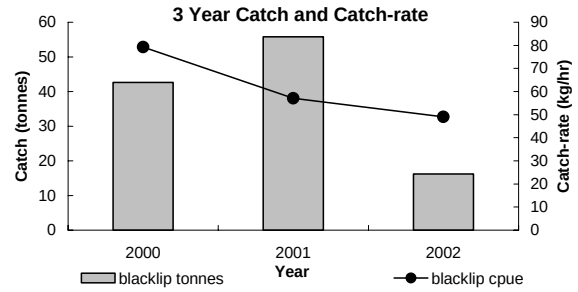


The annual catch is 25-30% of previous years, with low catch rates.

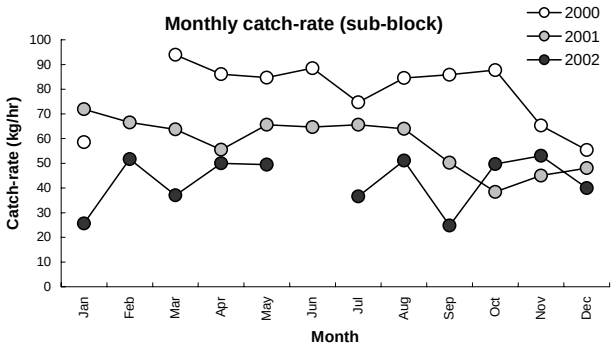


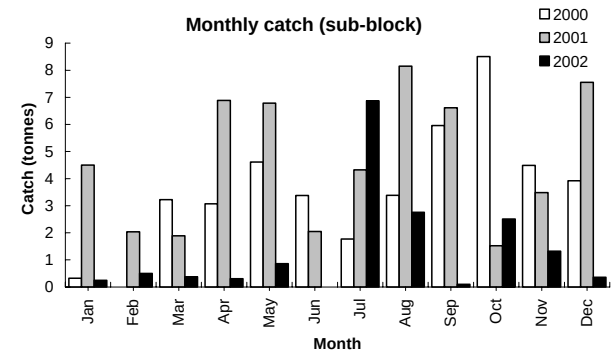


3.13.4 Sub-block 24D
north-east side of Maria Island

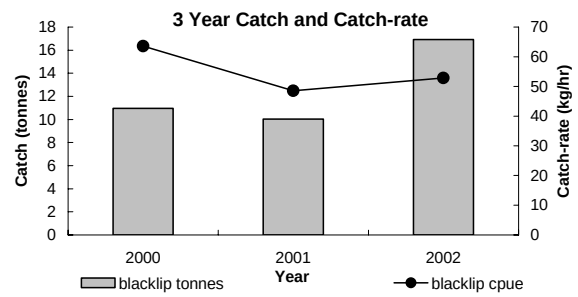


Usually one of the most productive parts of the fishery at Maria Island, the 2002 annual catch was less than 30% of the 2001 catch, with catch rates failing to improve.



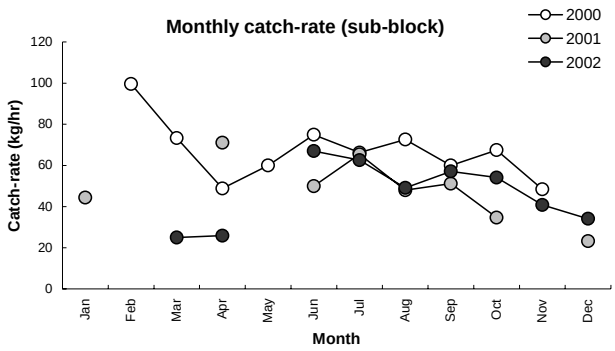


3.13.5 Sub-block 24E
south-east side of Maria Island

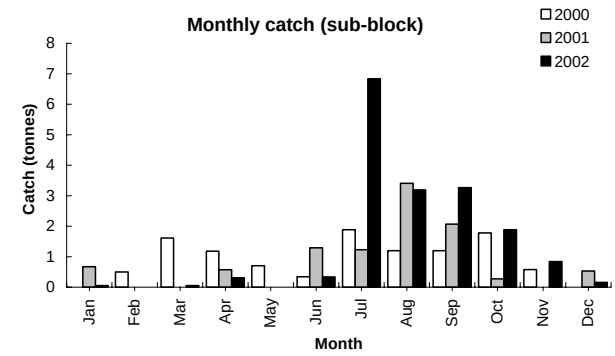


Catch and catch rates increased in 2002, which is consistent with a recovery of stocks.

In contrast to previous years, this sub-block is performing much better than the other sub-blocks in Block 24

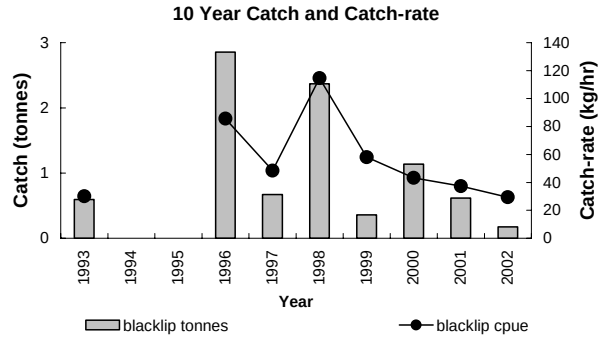


Catch rates for the period July-October (when levels of sampling are greatest) are generally similar during the three year period.



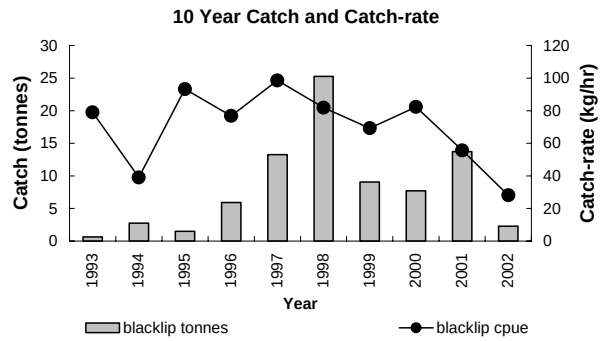
There were high levels of catch in July 2002.

3.14 Block 25 (East Coast)



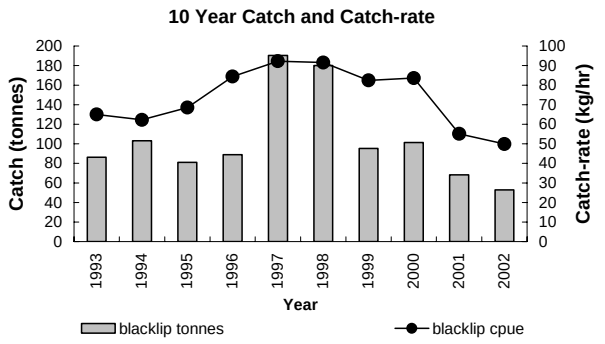
This block, although once productive, no longer contributes to the fishery.

3.15 Block 26 (East Coast)



Much of the coastline of this block is beach. The headlands and reefs, periodically produce good catches, but many years of low catches indicate that the area recovers slowly from fishing. 2002 catch rates indicate that stocks were at low levels.

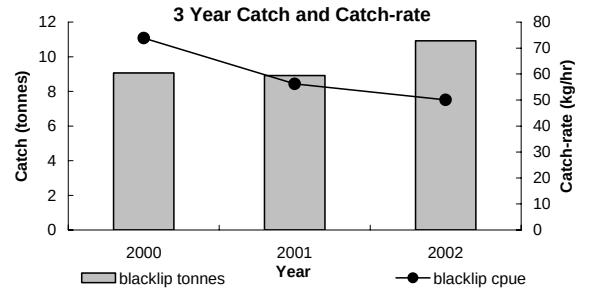
3.16 Block 27 (Eastern side of Freycinet Peninsula, Schouten Island)

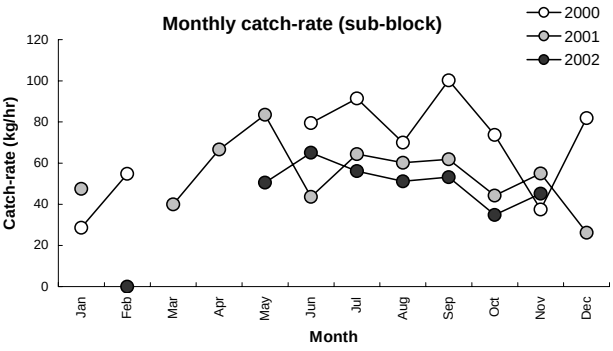


Even if the record catches from 1997 and 1998 are disregarded, the 2002 catch was very low. Catch rates give no indication of recovery.

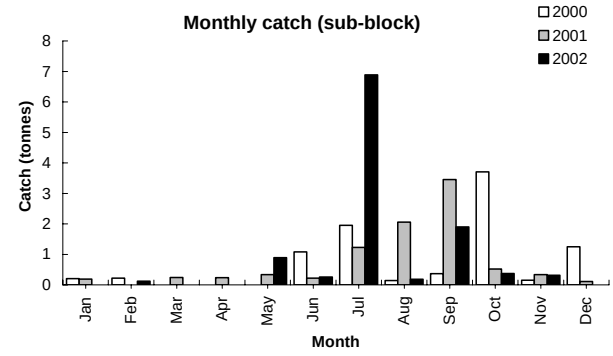
Many divers visited the block in July, but went elsewhere after that. This should have given remaining stocks some respite.

3.16.1 Sub-block 27A
south side of Schouten Island



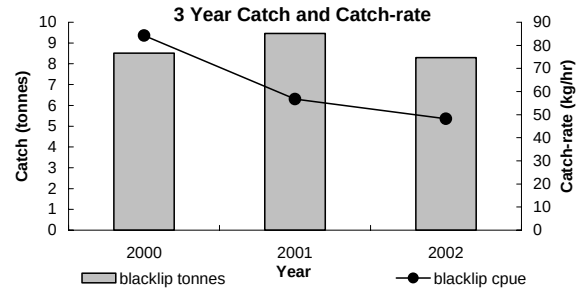


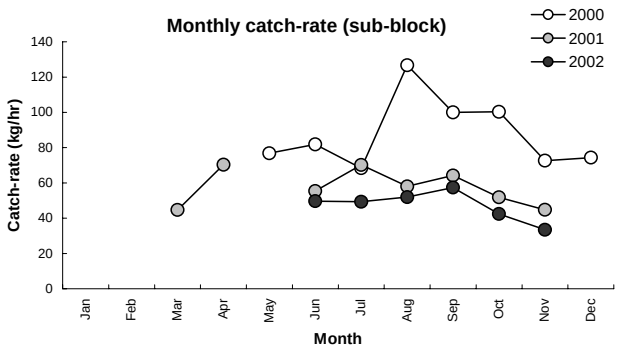
Catch rates during the period of greatest catches (May-October) were generally below those of 2001, and well below those of 2000.



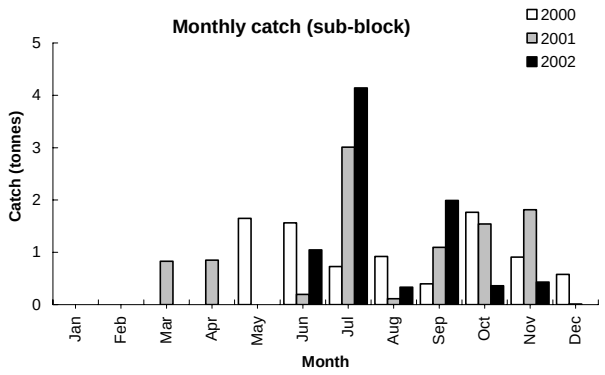
Catches increased in 2002 (particularly in July).

3.16.2 Sub-block 27B
east side of Schouten Island

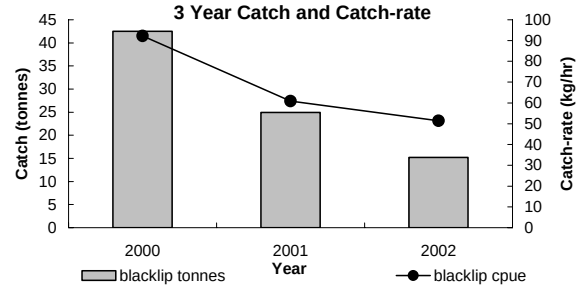




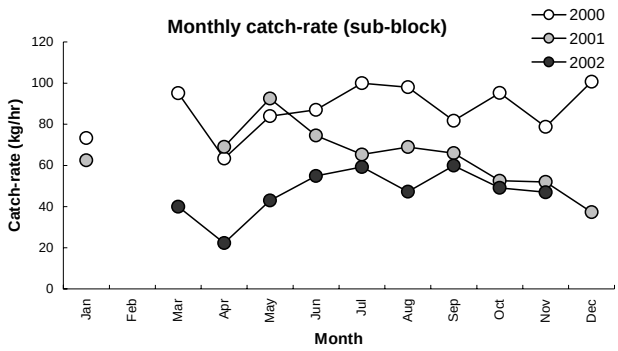
Catch rates during the months of greatest activity are generally below those of 2001, and well below those of 2000.

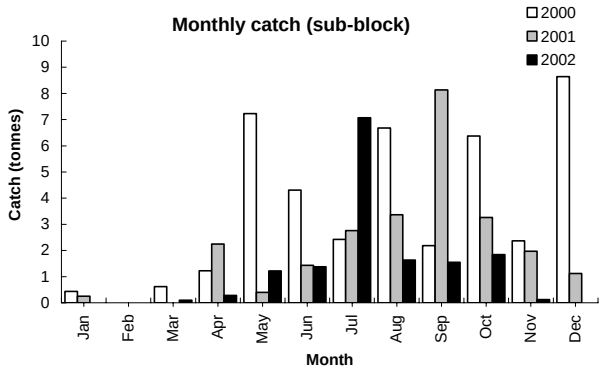


3.16.3 Sub-block 27C
Schouten Passage to Wineglass Bay

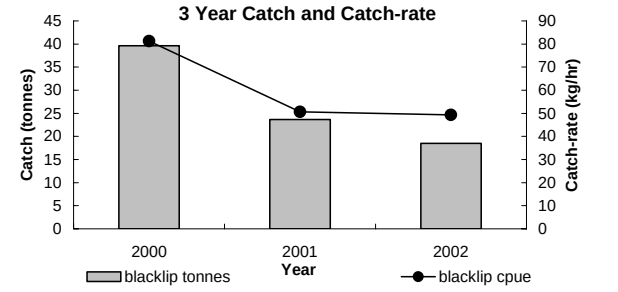


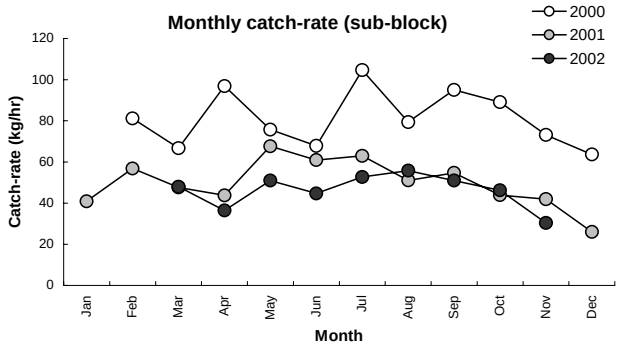
The annual catch has fallen sharply compared with that of previous years. During months of significant catches, catch rates are also lower.



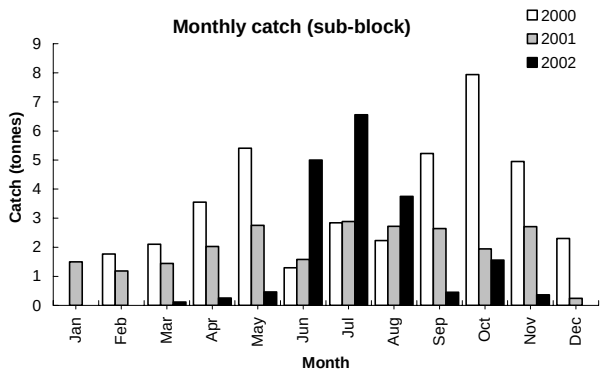


3.16.4 Sub-block 27D
Wineglass Bay to the Friendly Beaches

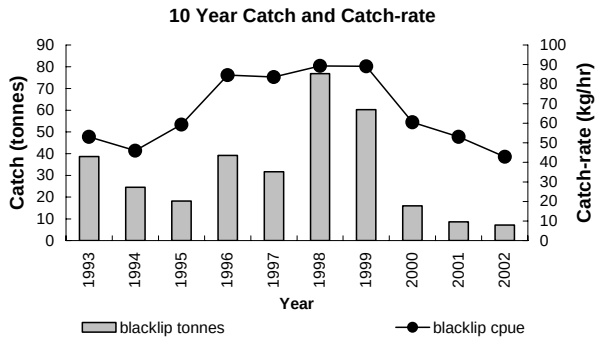




Although early (July-June) catch rates were lower, during spring, catch rates were similar to those of 2001. The 2002 catch was less than that of previous years.

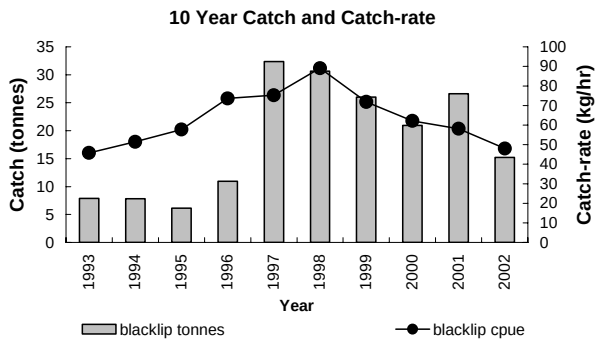


3.17 Block 28 (Friendly Beaches to Seymour, including Bicheno)



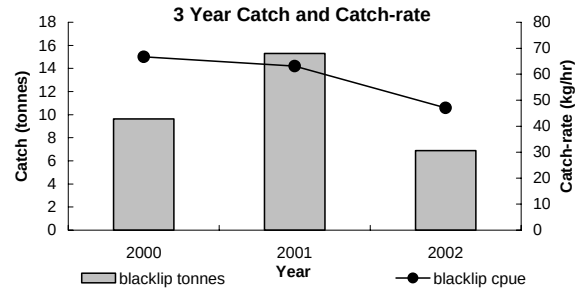
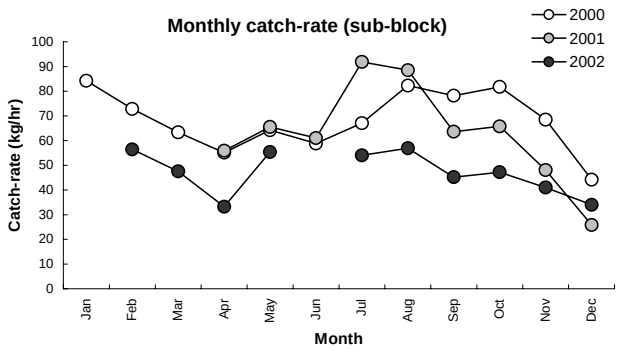
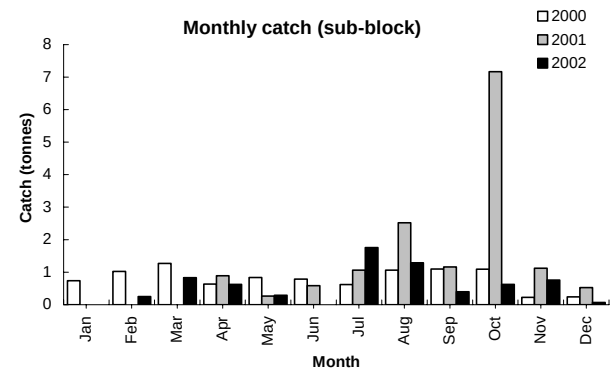
The annual catch is now at low levels, and catch rates continue to fall.

3.18 Block 29 (Seymour to St Helens Point)

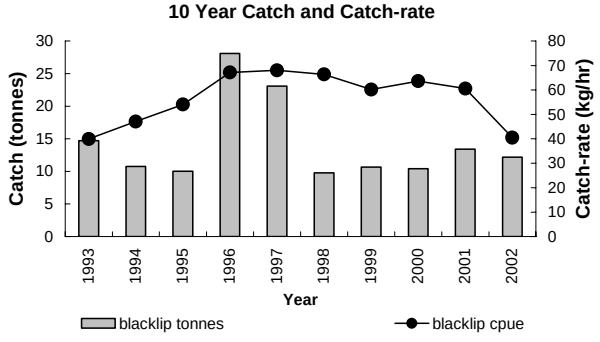


Sub-block 29 D is the remaining productive part of this block. All other sub-blocks now produce insignificant catches.

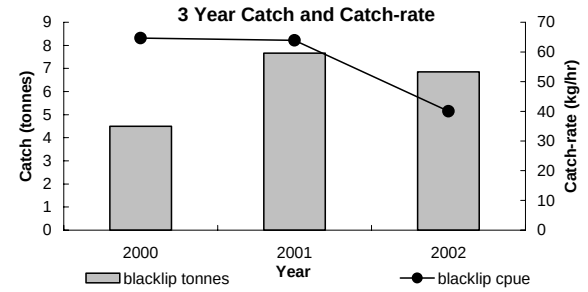
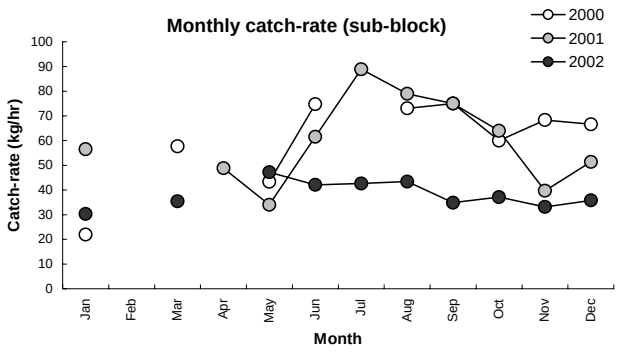
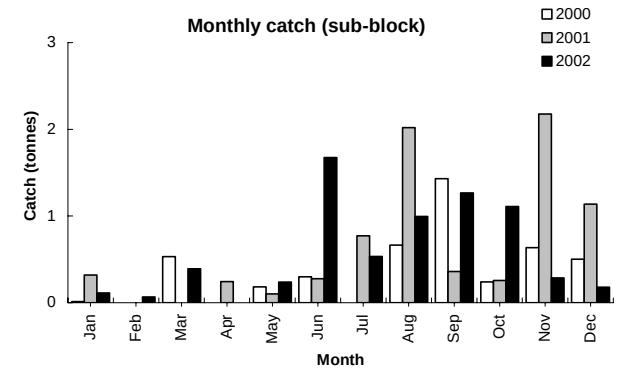
3.18.1 Sub-block 29D
Scamander to St Helens Point, including St Helens Island

	Catches and catch rates are lower than previous years.
	
	

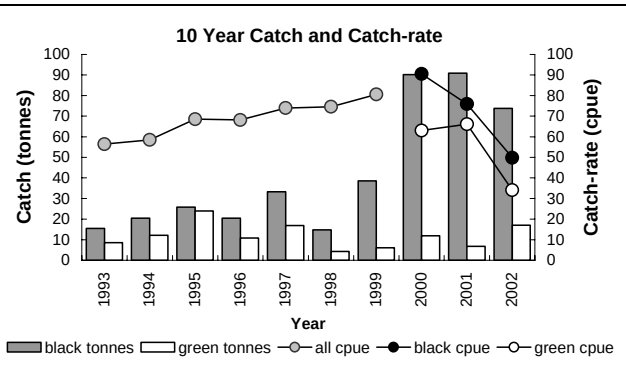
3.19 Block 30 (St Helens Point to Eddystone Point)

	Stable catches (at historically low levels), falling catch rates.

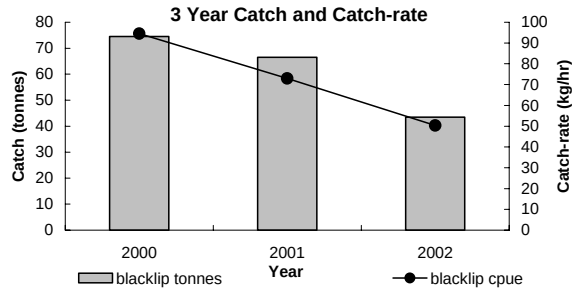
3.19.1 Sub-block 30A
St Helens Point to Taylor's Beach, including Binalong Bay

	Catch rates during the most active period (June-October) in 2002 are much lower than previous years.
	
	

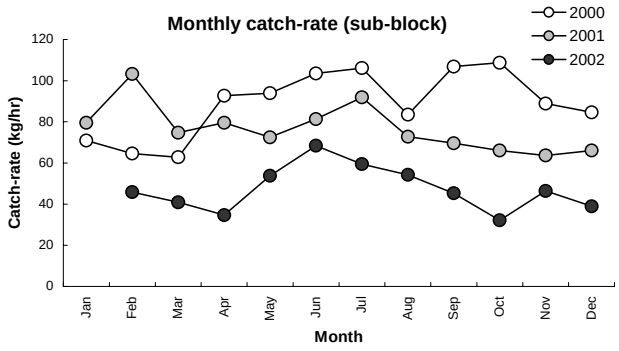
3.20 Block 31 (Eddystone to Musselroe Bay)

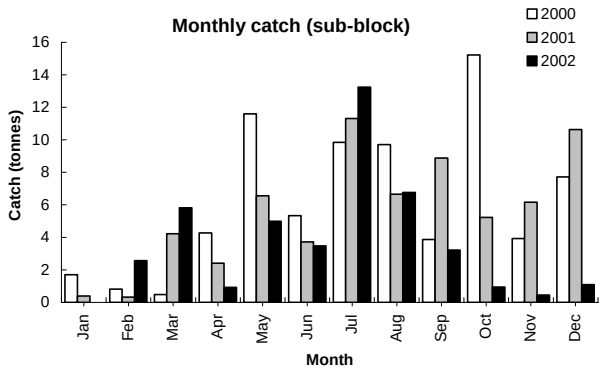
	The blacklip portion of this chart includes Northern Zone catch. Notable features include falling catches, falling catch rates.

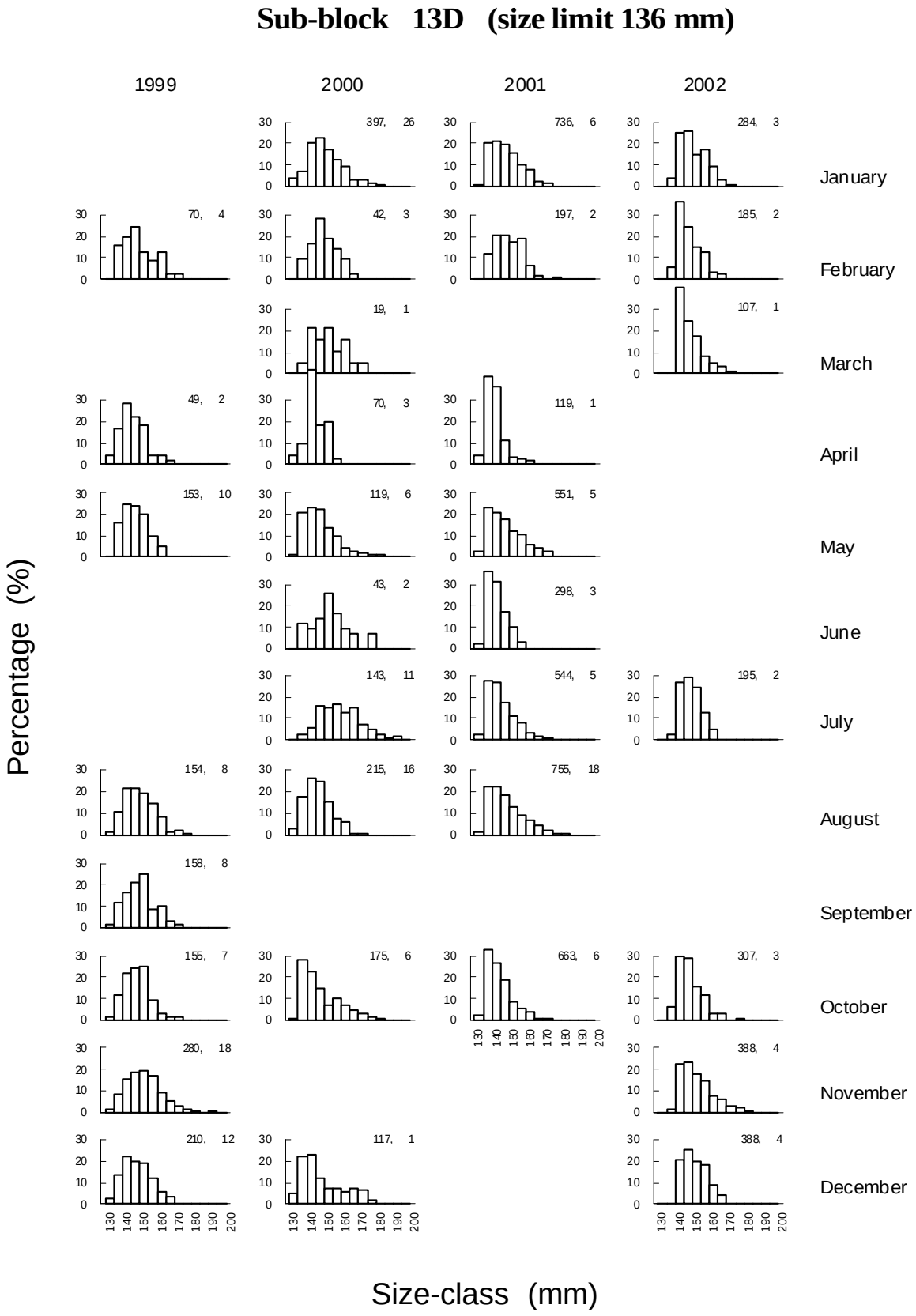
3.20.1 Sub-block 31A
Eddystone Point to Cape Naturaliste



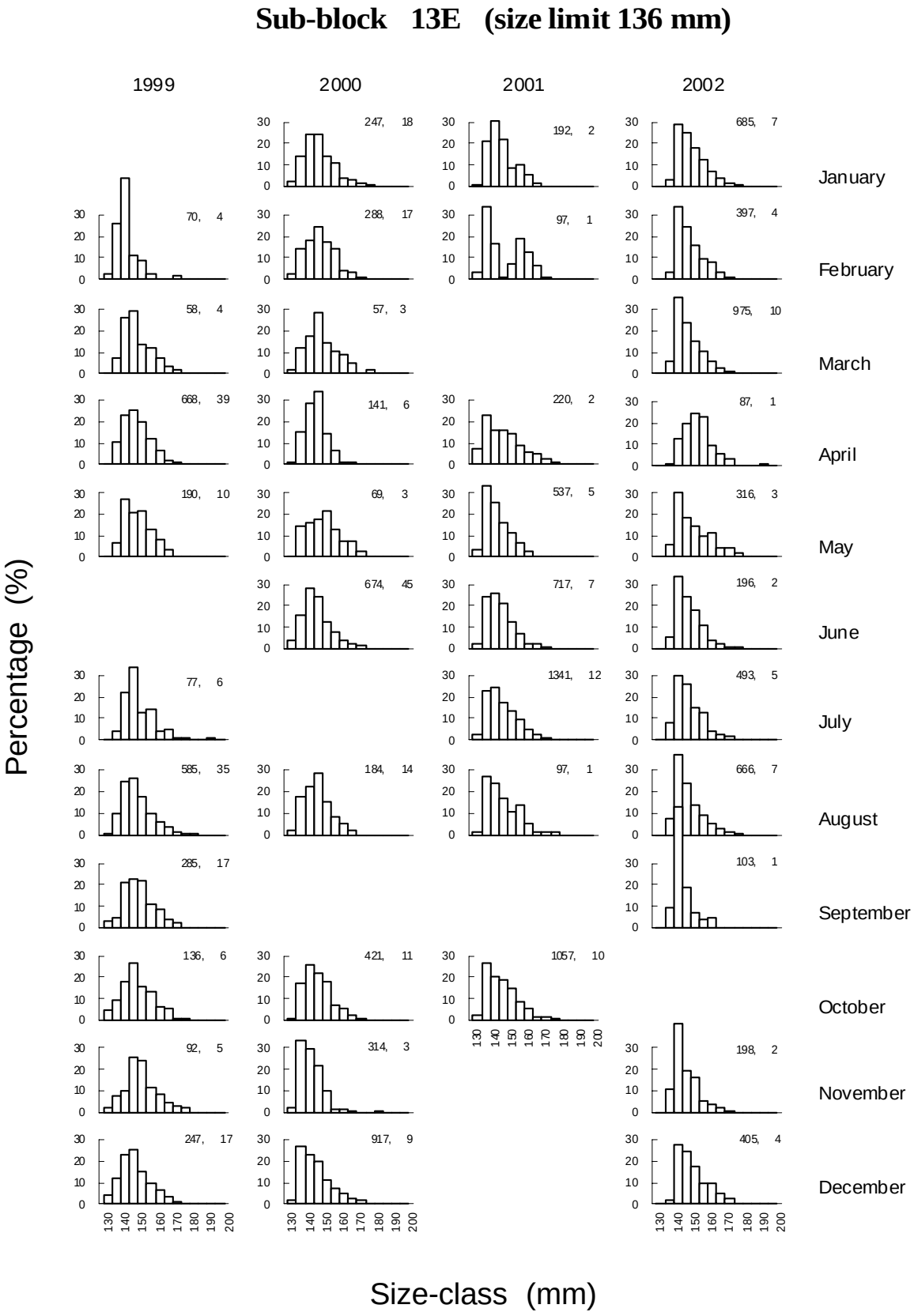
During the early months of 2002, catch rates were very low and most likely reflect high levels of fishing mortality the previous year coupled with the effects of the size limit increase. Later in the year, catch rates improved, but not to former levels. Because abalone here are thought to be smaller than those from further south, the increased size limit may potentially reduce the yield from this sub-block. However, see sub-block 31B (Northern Zone) which was unaffected by the size limit increase and performed in a remarkably similar manner.



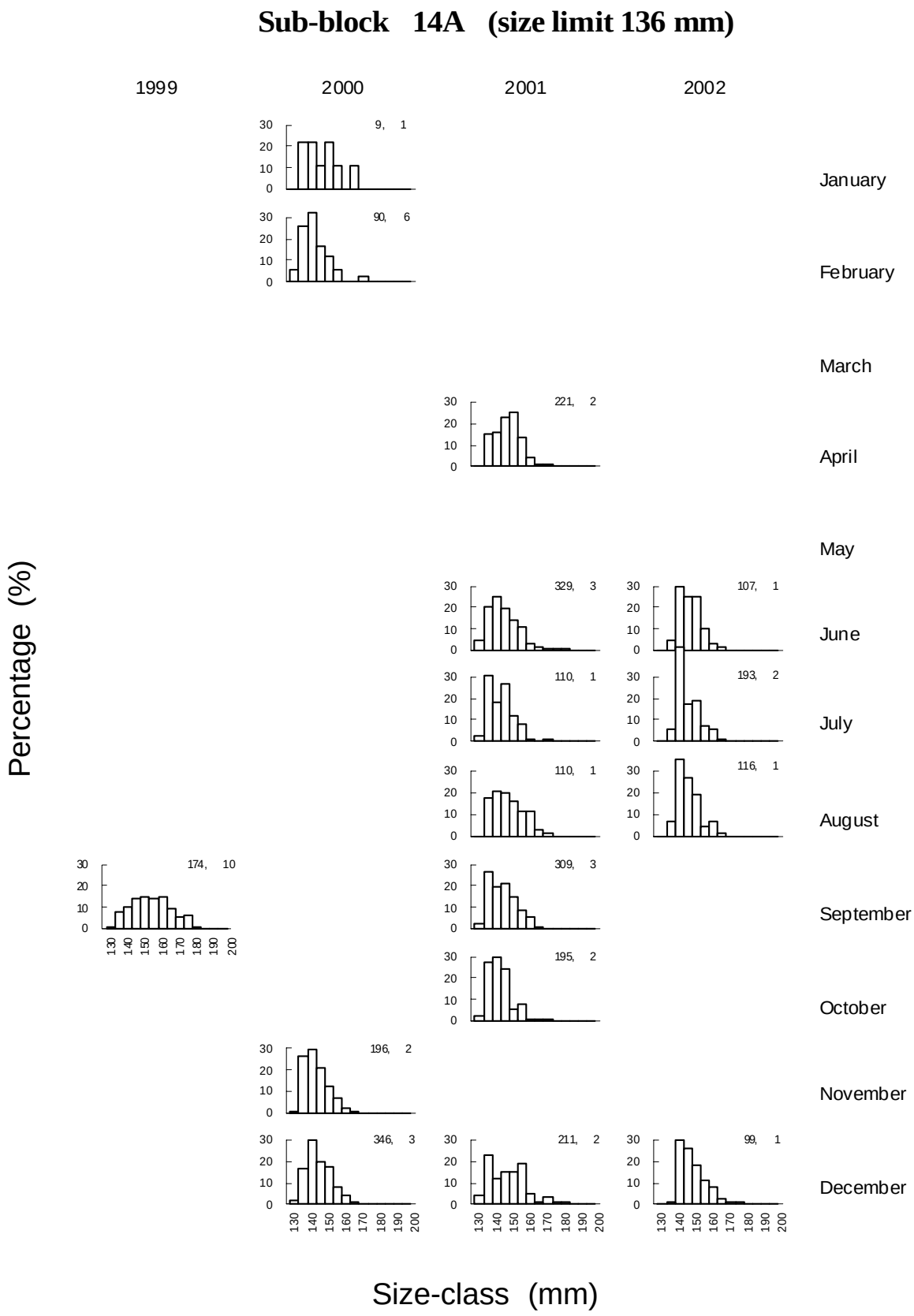




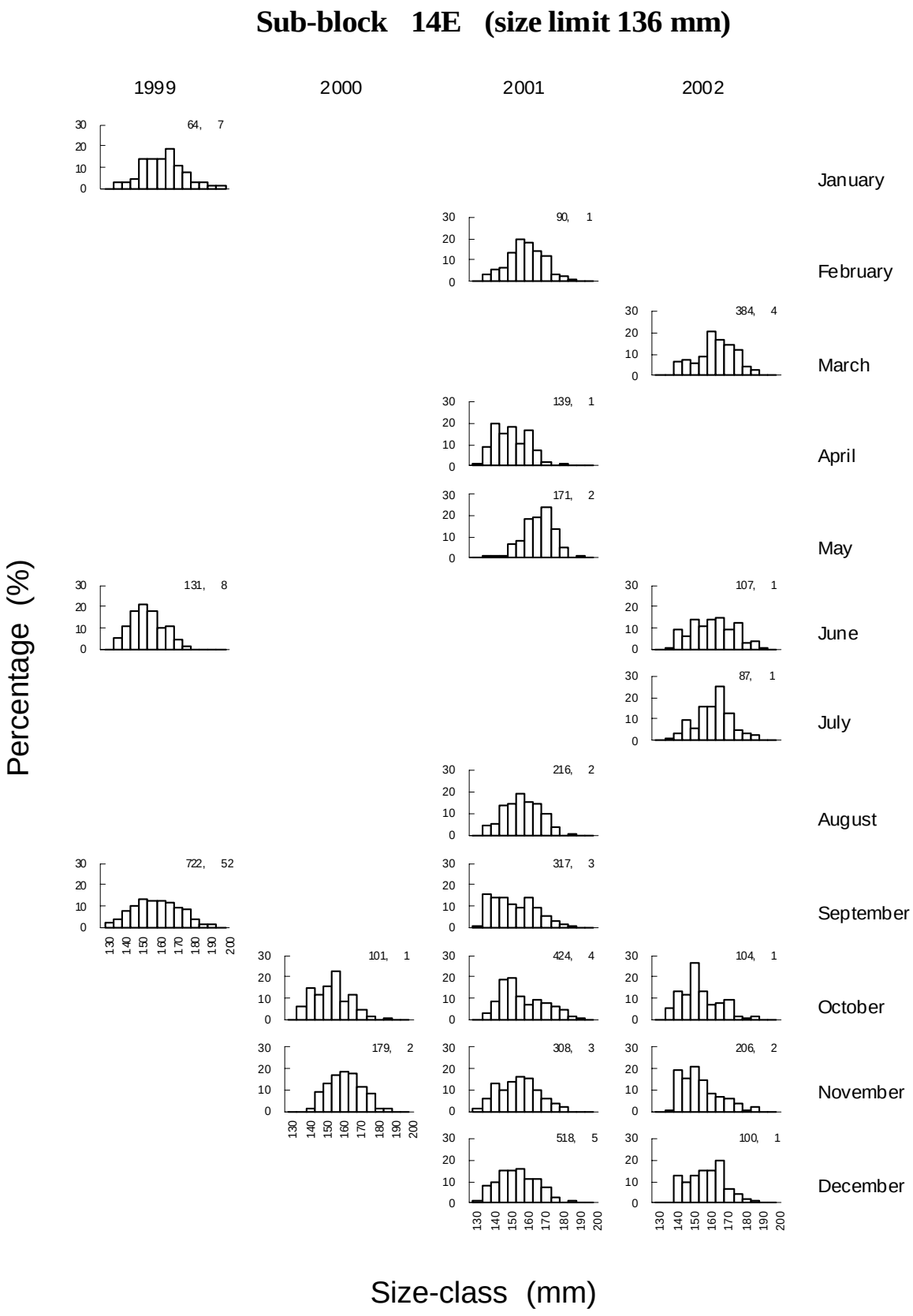
Catches from later in 2002 show a modal shift to the next largest size-class.



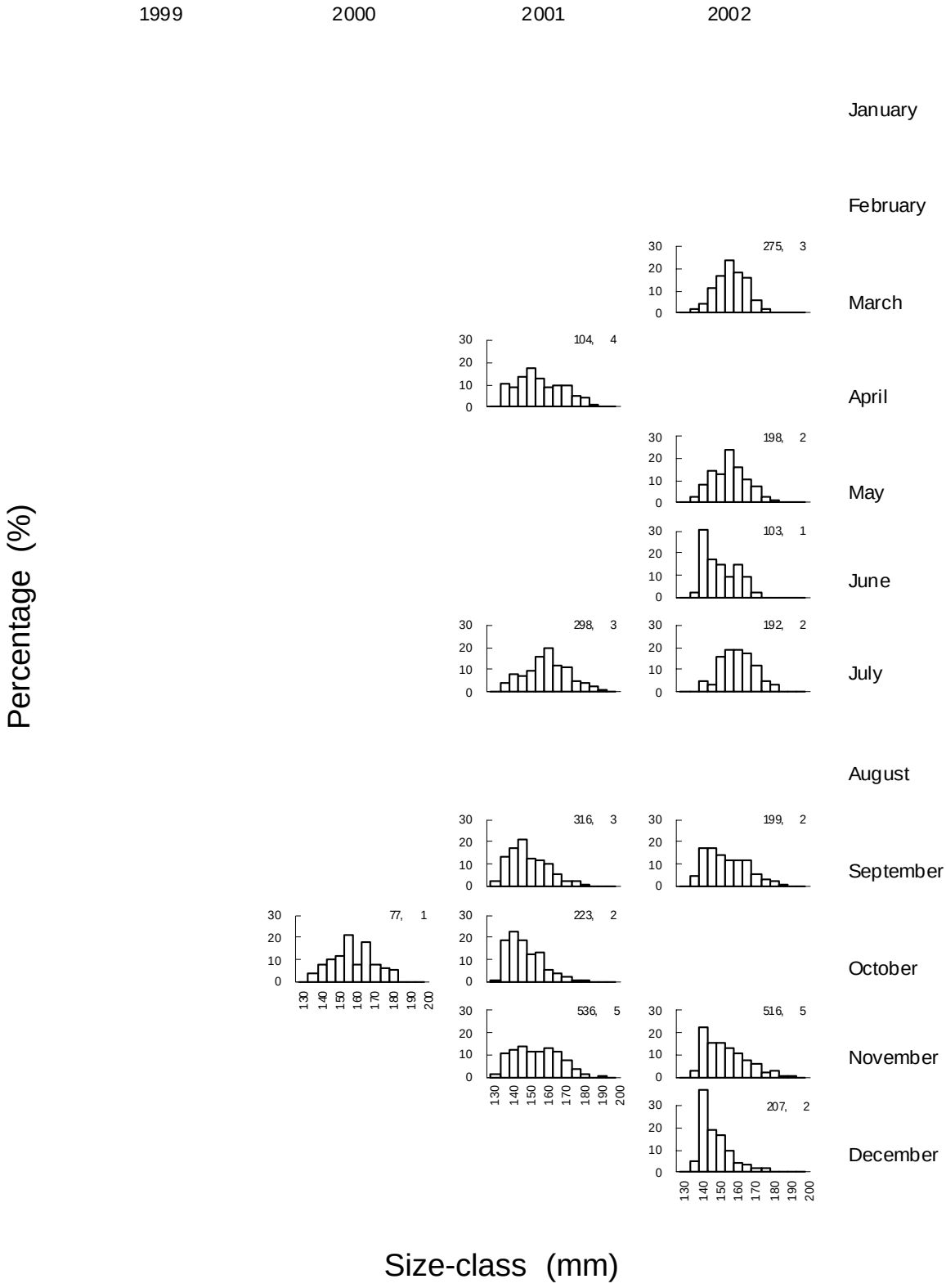
Although mean size of landed abalone is larger since the introduction of the 136 mm size limit, fishing mortality is still high, and consequently, catch samples mostly comprise abalone in the smaller size classes.



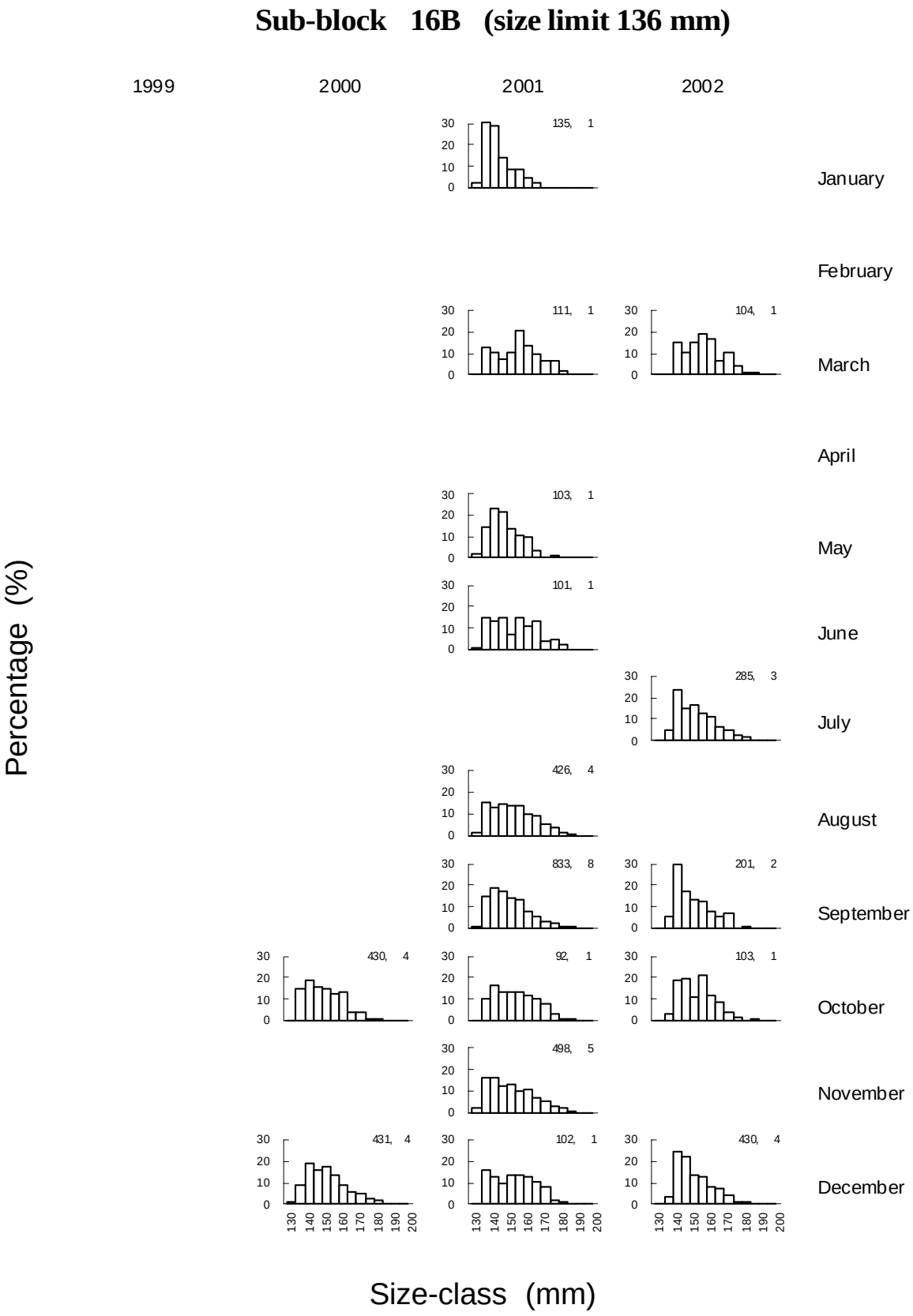
While few samples were obtained, they suggest that most abalone are now caught within 15 mm of reaching legal size, implying high rates of fishing mortality.


Sub-block 14E (size limit 136 mm)
1999
2000
2001
2002
January
February
March
April
May
June
July
August
September
October
November
December
64, 7
90, 1
384, 4
139, 1
171, 2
131, 8
107, 1
87, 1
216, 2
722, 52
317, 3
101, 1
424, 4
104, 1
179, 2
308, 3
206, 2
518, 5
100, 1
Percentage (%)
Size-class (mm)

Sub-block 16A (size limit 136 mm)

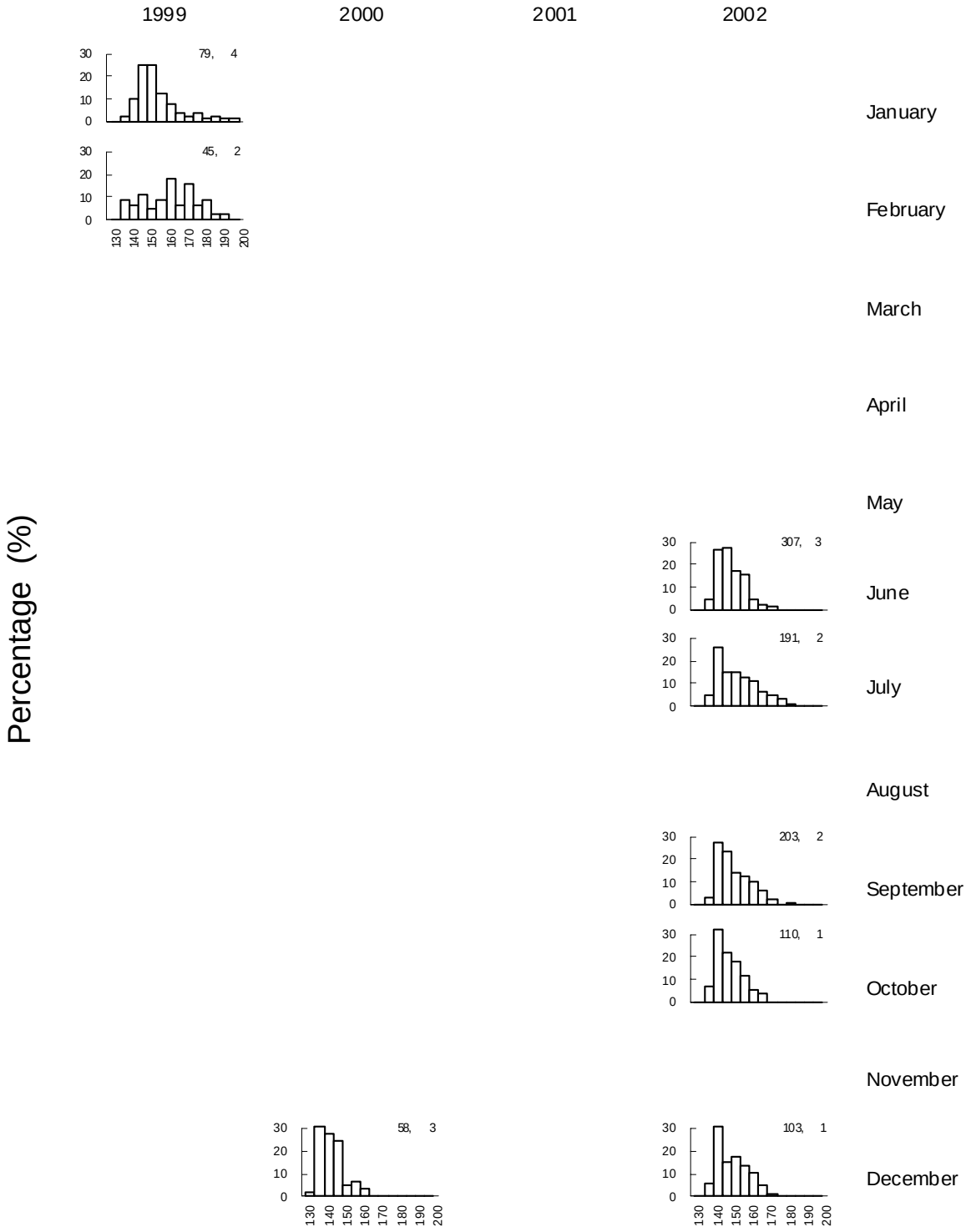


Size composition data shows catches with contrasting size ranges (i.e. the March May and July samples featured predominately larger abalone, while other samples comprised smaller abalone)



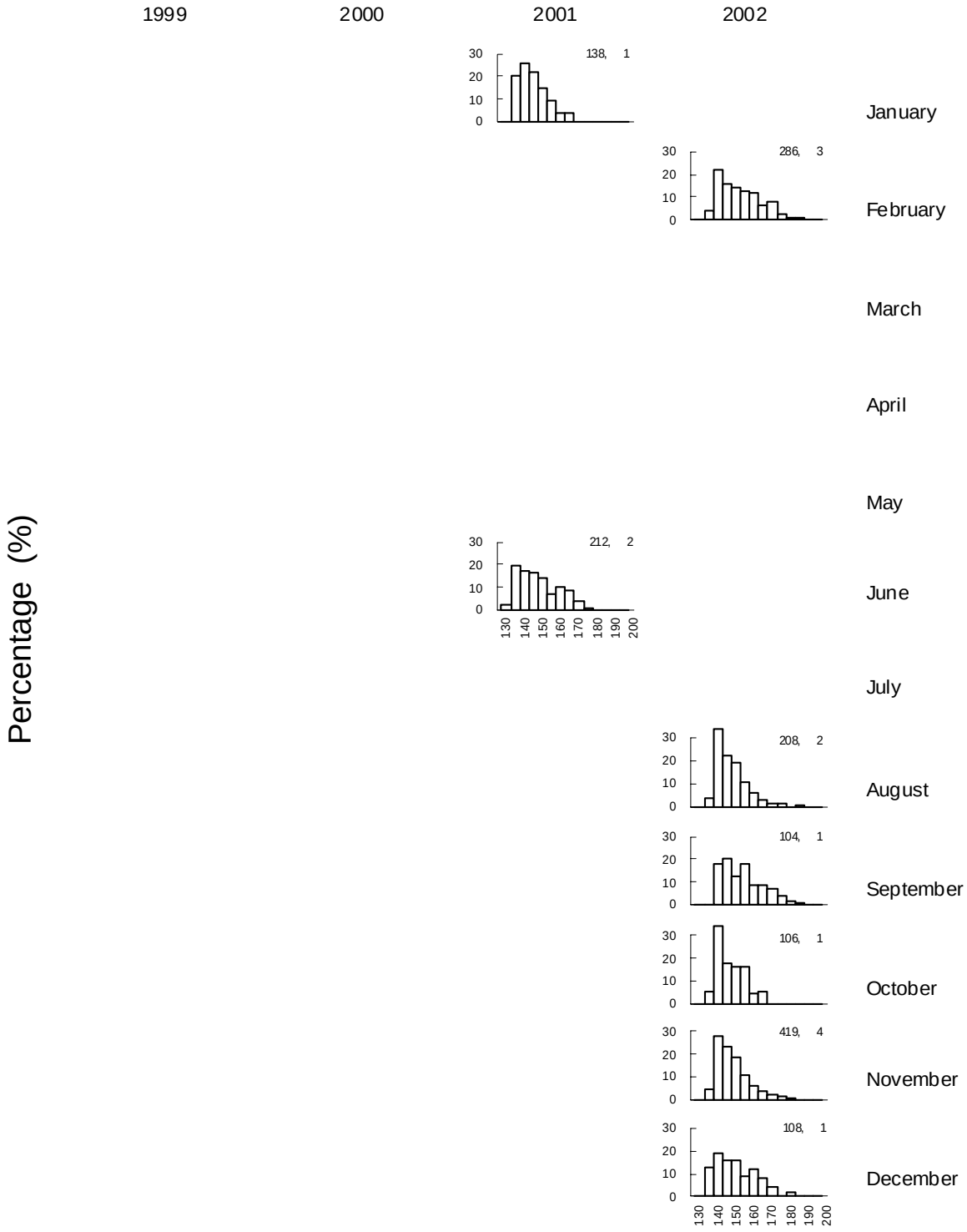
Although larger abalone are well represented in catches, there appears to be increasing numbers of smaller abalone. Increasing levels of fishing mortality would explain this transition.

Sub-block 16D (size limit 136 mm)

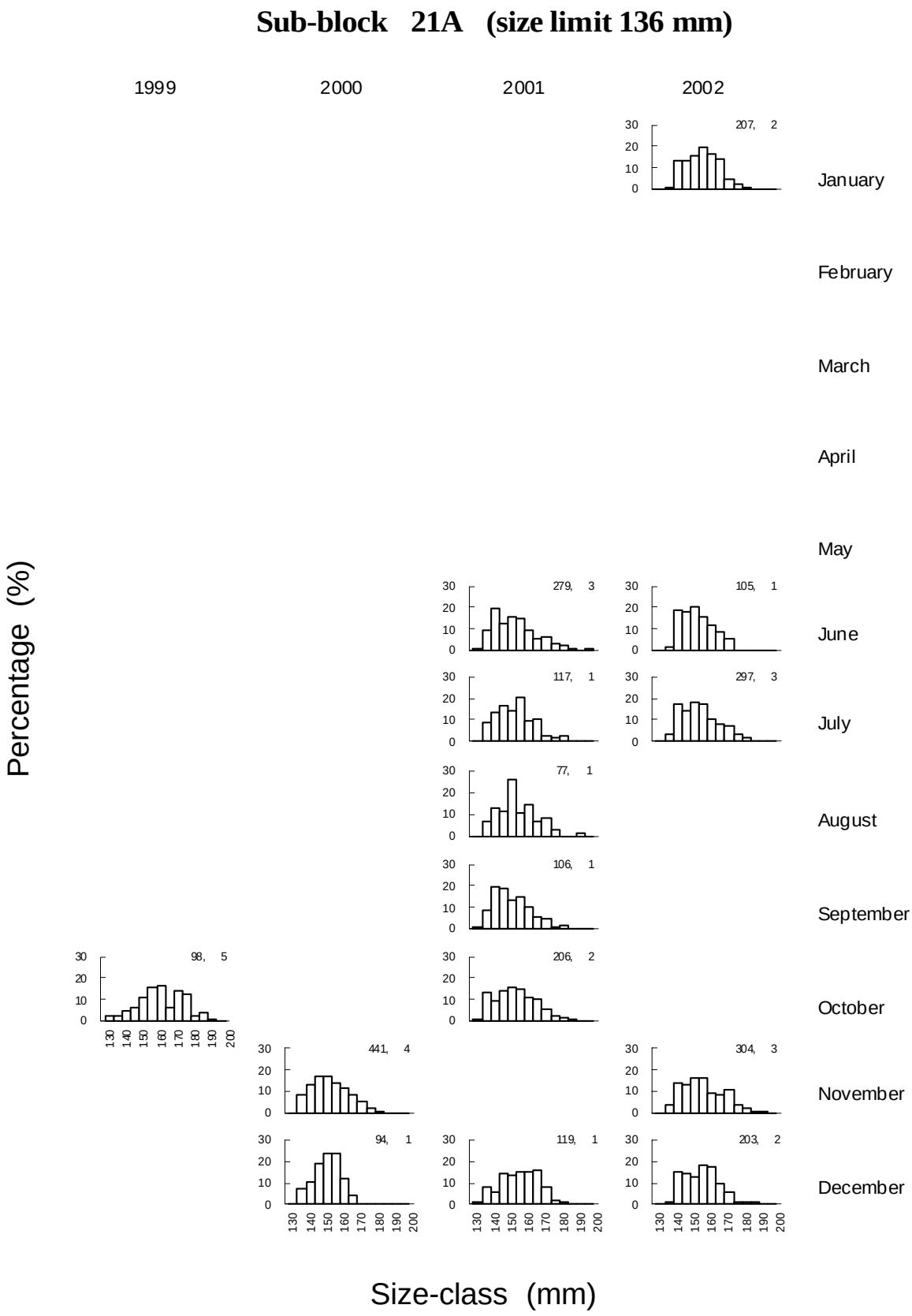


Catch samples show that the about 50% of abalone are caught within 10 mm of the size limit. While abalone are reported to grow to smaller sizes here, the catch samples indicate that fishing mortality is relatively high.

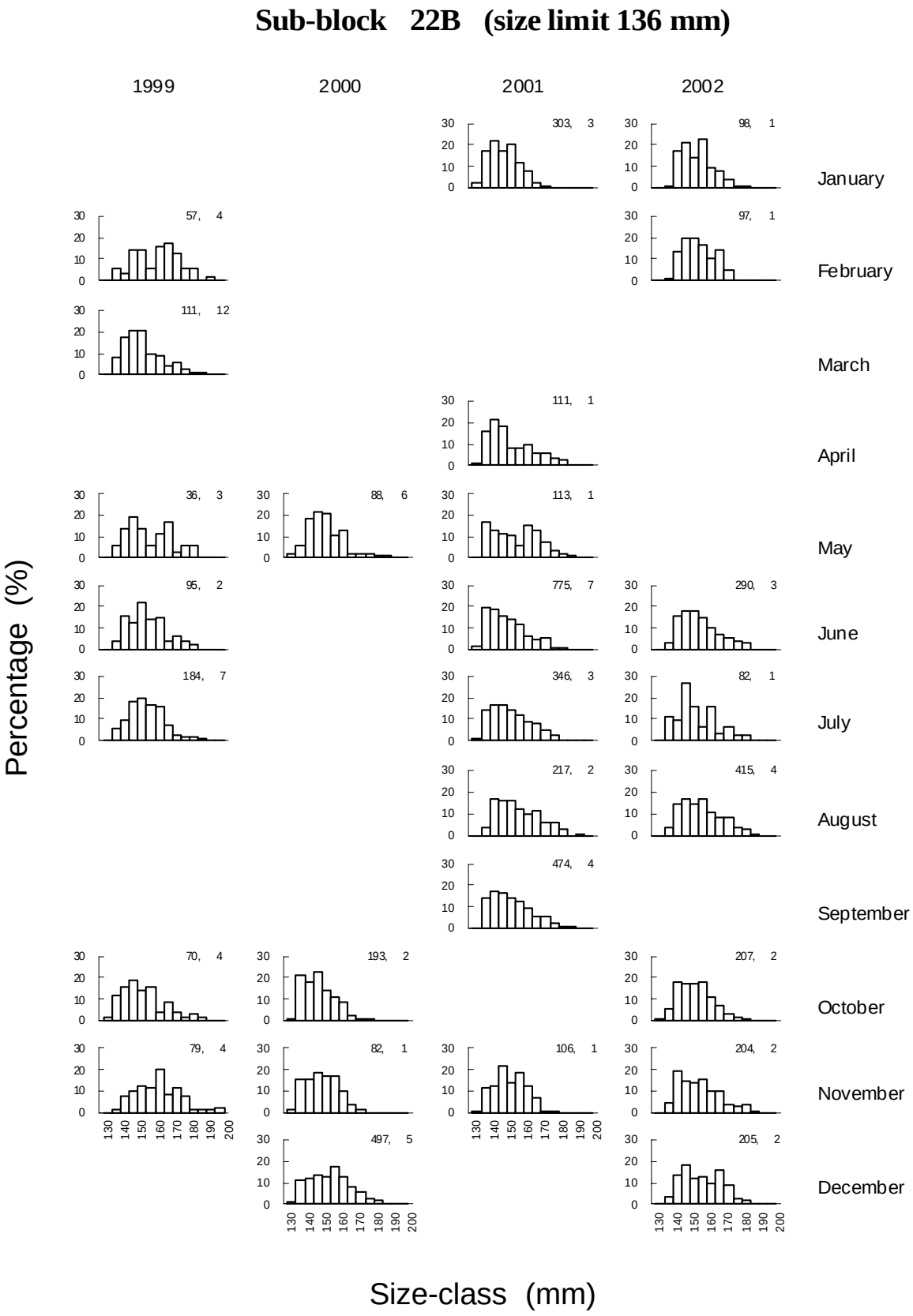
Sub-block 17B (size limit 136 mm)



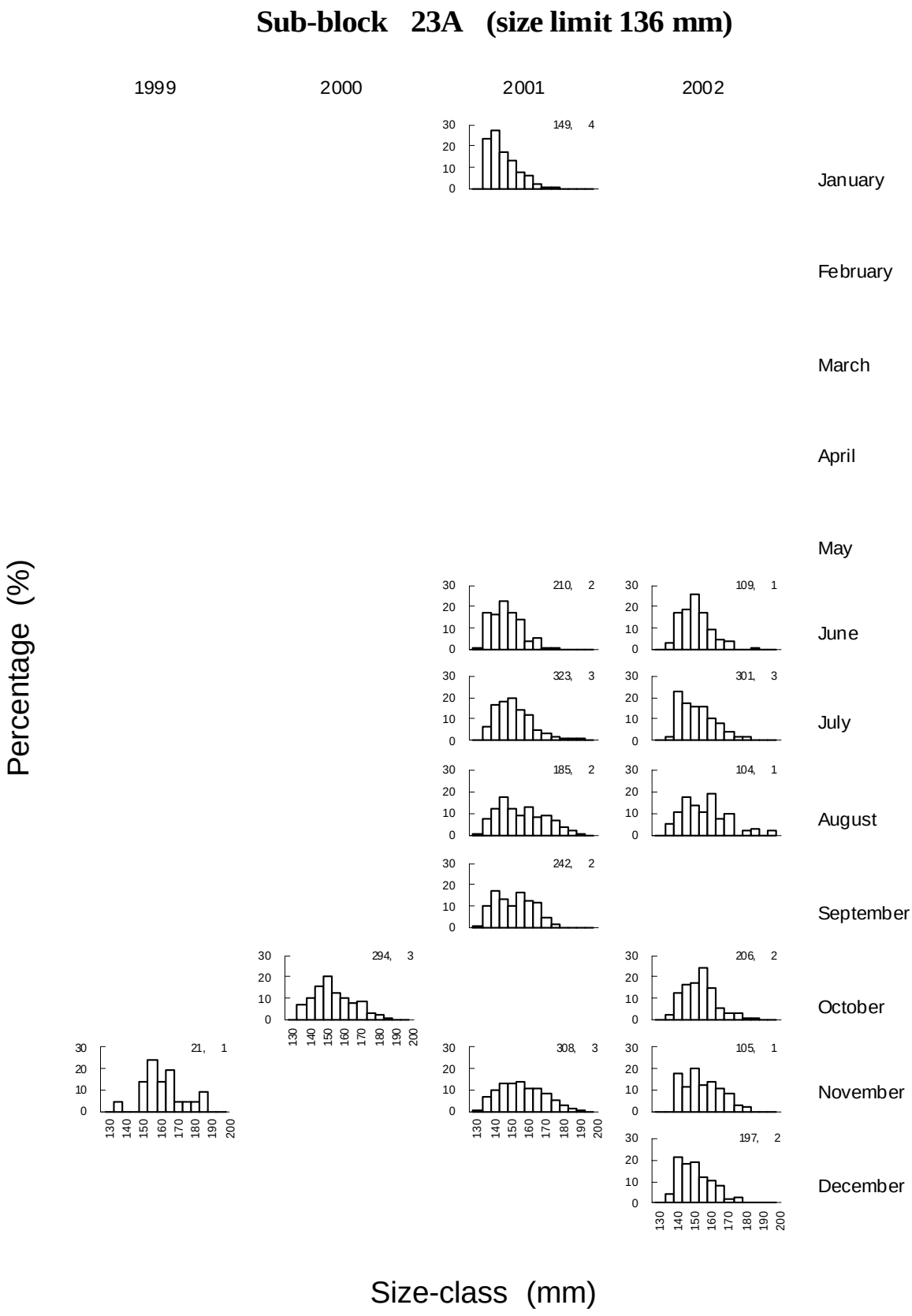
Catch samples, while containing many smaller abalone show good representation from larger abalone.

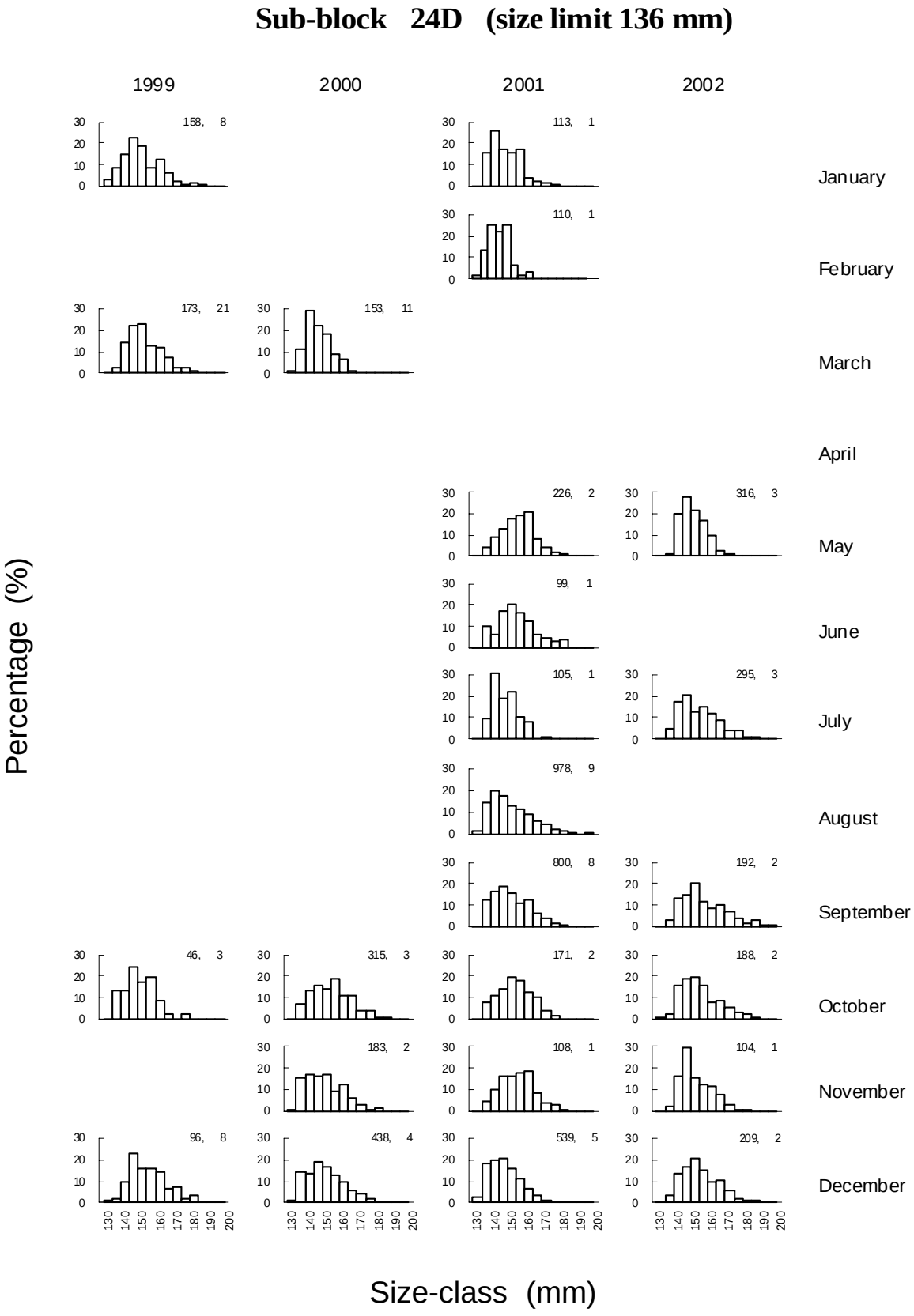


While smaller abalone are represented, Tasman Peninsula catches feature larger abalone, with modes several size classes above the legal size.



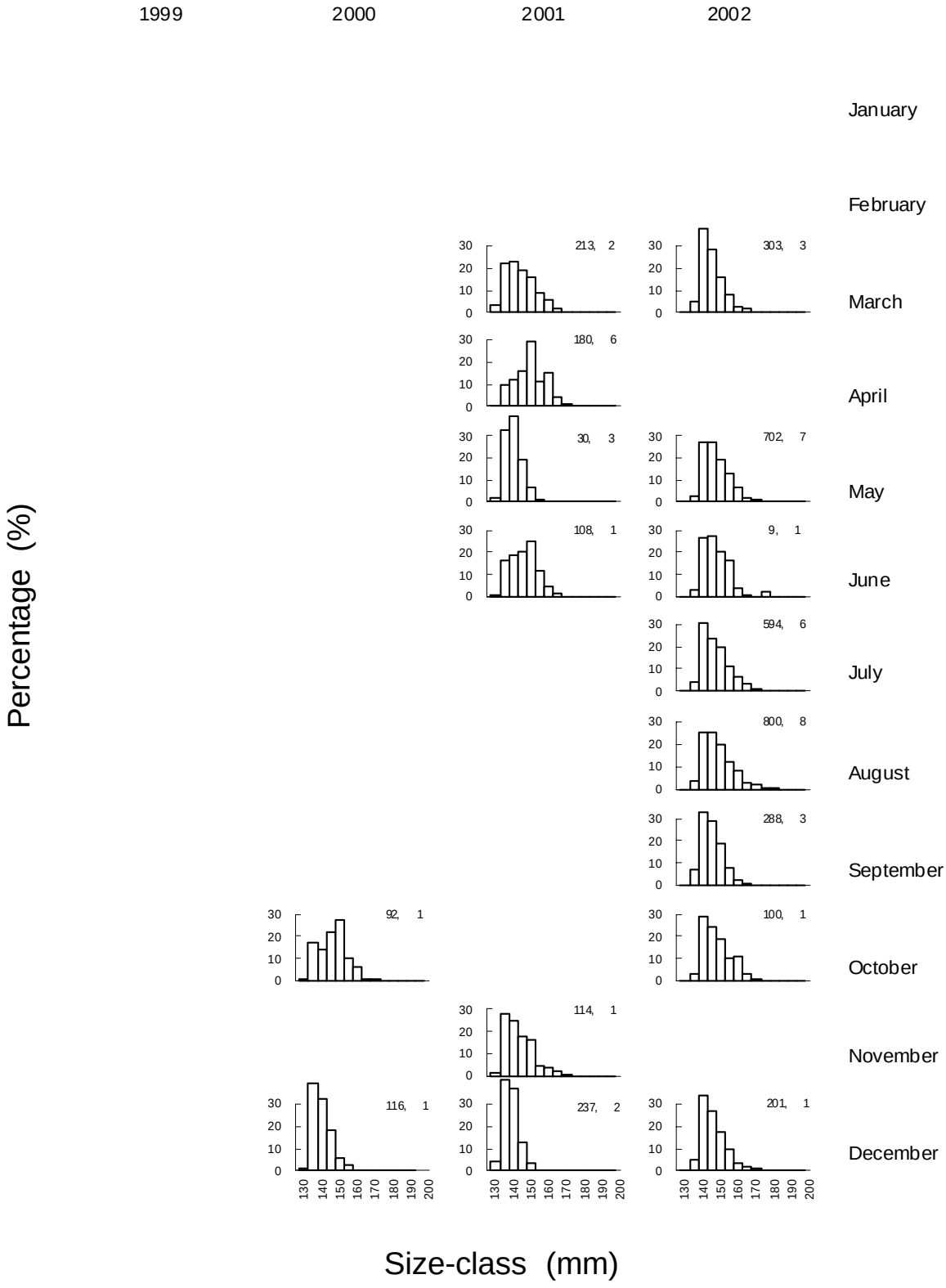
Similar to sub-block 21A, smaller abalone are represented, but large abalone predominate.


Sub-block 23A (size limit 136 mm)
1999
2000
2001
2002
January
February
March
April
May
June
July
August
September
October
November
December
Percentage (%)
Size-class (mm)
149, 4
210, 2
109, 1
323, 3
301, 3
185, 2
104, 1
242, 2
294, 3
206, 2
21, 1
308, 3
105, 1
197, 2



Small abalone are absent from samples taken from divers' catches, particularly at the end of the year when seasonal growth should ensure greater representation.

Sub-block 31A (size limit 136 mm)



3.21 Eastern Zone Summary

- In 2002, the Actaeons (Sub-blocks 13C, 13D, 13E) and South Bruny/Lower Channel (Block 14) accounted for almost half the Eastern Zone catch, with approximately another 25 percent taken from the remainder of Storm Bay east to Tasman Island (Blocks 16 to 21).

- Last year's stock assessment noted that catch rates in the Eastern Zone had fallen sharply, and were part of a sustained fall from peaks in the mid- to late-1990's. It was concluded that there was a considerable reduction in fishable stock levels, that fishing mortality was too high, and levels of catch were unsustainable. In 2002, despite management attempts that included a TAC reduction from 1120 to 857.5 tonnes, plus a 4-mm size-limit increase, catch rates continued to decline from the low levels of 2001. This indicates that fishable stock levels have not yet recovered, or may even have declined further. While sustained catch-rate declines were apparent across the entire Eastern Zone, they appear more serious in some areas, particularly in blocks that have reliably yielded large quantities of abalone in recent years. It seems that restrictions placed on the fishery by managers at the start of the 2002 fishing year were insufficient to halt the decline.

- In the areas showing major decline in fishable stocks, catch rates have declined to levels probably lower than ever previously seen (note that improved catching methods confound long term comparisons). In particular, lower catch rates and catches were reported from the East Coast north of Lagoon Bay (Sub-block 23B), including most of Maria Island (Block 24), the Freycinet Peninsula and Schouten Island (Block 27), and the coast from Bicheno to Eddystone Point (Blocks 28, 29, 30). In recent years, a few isolated populations of relatively high abundance have supported this part of the fishery. Now however, low catches and catch rates, and reported low abundance of undersized abalone imply that serial depletion of these populations has taken place. Samples of the commercial catch from parts of Maria Island show disproportionately low quantities of small abalone entering the fishery, which may indicate poor recruitment. By maintaining existing levels of fishing effort in these areas, stock recovery will at best be delayed.

- Conversely, in a few small areas, catch rates are relatively stable albeit at low levels. These areas include parts of southern and eastern Tasman Peninsula (Sub-blocks 20C, 21A, 21C and most of Block 22), and the southeast part of Maria Island (Sub-block 24E). It has been observed that growth rates south of Eaglehawk Neck are particularly fast (Nash, 1995), and consequently this area may have been sufficiently productive to sustain recent levels of fishing. Both the southeast part of Maria Island and the above mentioned Tasman Peninsula contain large areas of boulder habitat which increases cover for abalone, and makes it more difficult to fish populations to low levels of abundance.

- While catch rates at the Actaeons also were at historically low levels, this can partly be attributed to the increase in size limit, which will have reduced the amount of abalone available to be caught in the first 4 months of 2002. However, growth studies from abalone tagged at the Actaeons imply that

abalone that were previously of legal size should have reached the new size limit by winter. Because catch rates failed to reach the levels of earlier years, it can be inferred that the size of the fishable stock was smaller in 2002.

- Catches from the eastern side of Bruny Island, particularly south of the Neck (Sub-blocks 16A, 16B) were of concern. Effort here was particularly high in 2001 following the closure of Block 13, which adversely affected local populations and resulted in much lower catch rates in 2002. North of the Neck (Sub-blocks 16C, 16D), catch rates have fallen by a lesser amount.

- Much of the Actaeons (Block 13) catch is taken very close to the size limit, so the increase in minimum length has had more impact here than in many other parts of the Eastern Zone, where abalone are taken at larger sizes. This is illustrated by a significant increase ($P<0.0001$) in the mean size (2.6 mm) of abalone sampled from divers' catches in Sub-block 13E. This size increase translates to an increase in weight of about 30 g per abalone, or 123 fewer abalone/tonne.

- At Block 31 (north of Eddystone Point), previous research has shown that abalone grow slower and to smaller sizes, and the increased size limit has possibly had a greater adverse affect on catch and catch rates here than anywhere else. Both annual catch and catch rates have fallen sharply from previous years. Local divers now report leaving many more abalone because they are below the size limit. However, they are not particularly concerned about the impact of the size limit on catch rates, because they believe that the remaining abalone ensure reliable catches in future.

- The size limit increase is not the only reason for reduced catches and catch rates in Block 31. The Northern Zone part of this block (most of sub-block 31B) where in 2002, size limits remained unchanged at 127 mm, also experienced catch rates that were lower than previous years. It is apparent therefore that the fishable stock levels here have fallen, in common with the rest of the East Coast.

4. Western Zone Blacklip

4.1 Western Zone blacklip fishery – major fishing blocks

Catches fell by nearly 20% in Block 12, but were compensated for by an increase from the Block 13 sub-blocks, where the annual catch doubled. Block 11 also recorded increased catches (Figure 10).

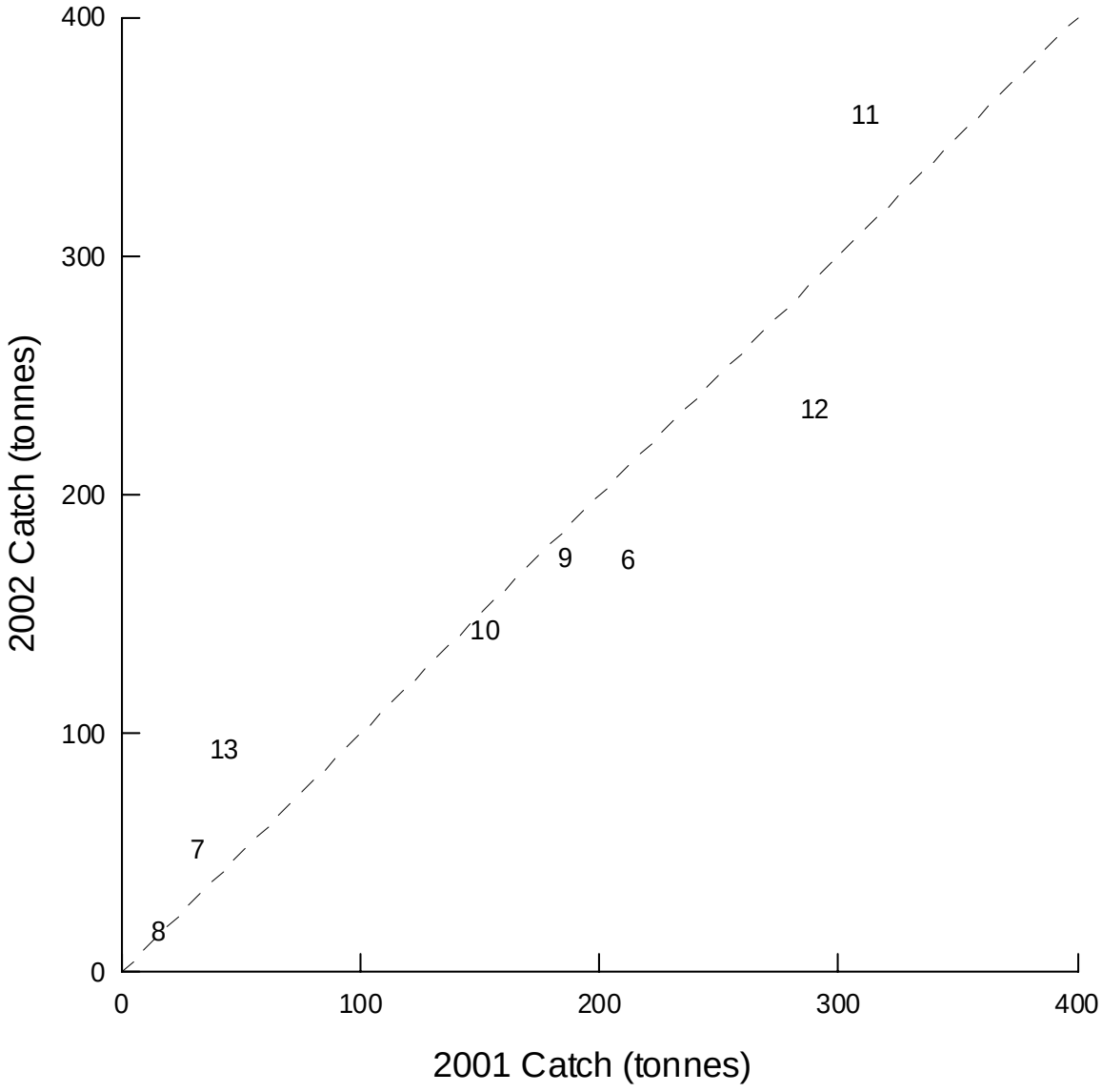
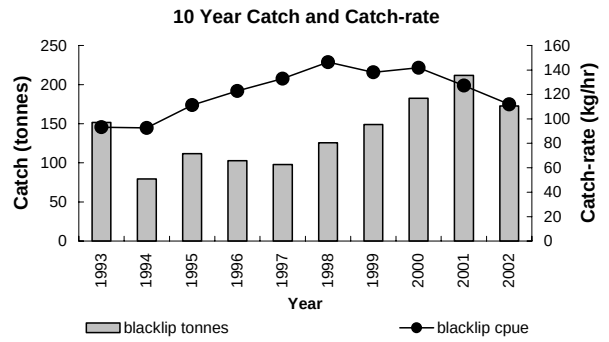


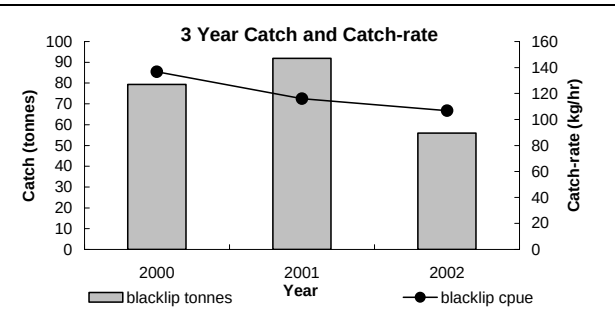
Figure 10. Blacklip catch from the Western Zone (Block 5 to Block 13 (sub-blocks 13 A, B)). In 2002, the Western Zone TAC (1260 tonnes) was unchanged from the previous year. Blocks to the left of the diagonal line reflect increased catches over 2001 levels, blocks to the right reflect falling catches.

4.2 Block 6 (Arthur Beach to Italian River, including Sundown, Couta Rocks, Temma and Sandy Cape)

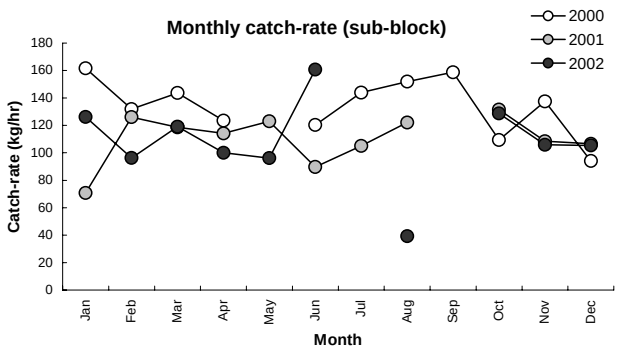


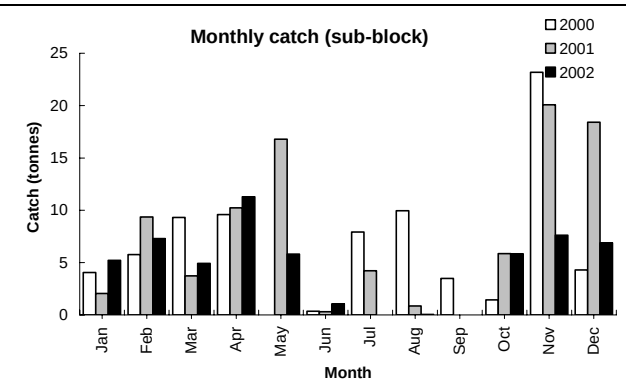
Catch rates have been falling steadily for a number of years. The 2002 catch fell, but is still at moderate to high levels.

4.2.1 Sub-block 6A
Sundown to Temma



The annual catch is 60% of that of 2001.

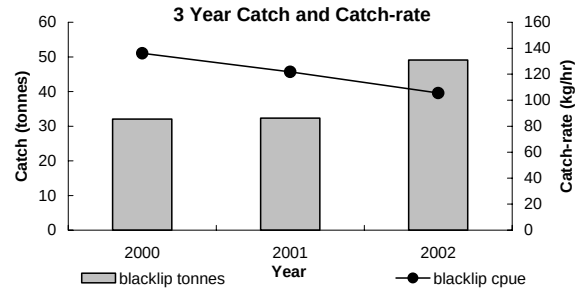
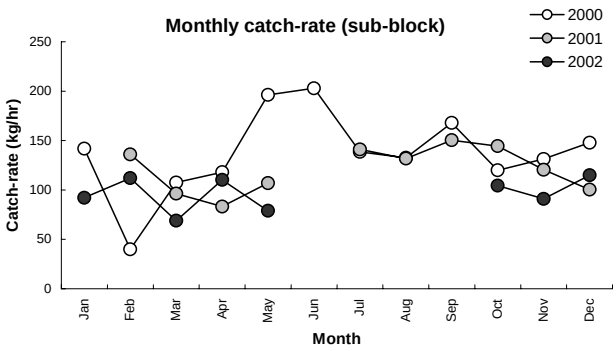
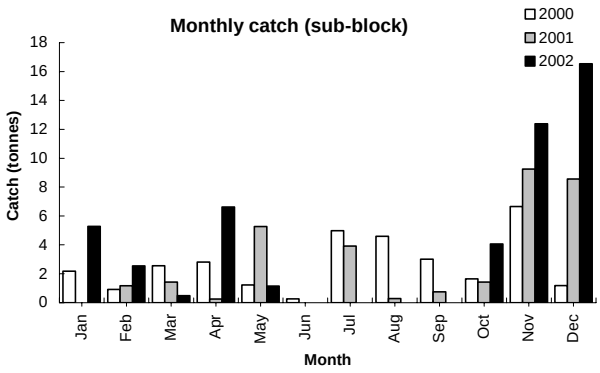




2002 monthly catch rates are generally similar to 2001, but below those of 2000.

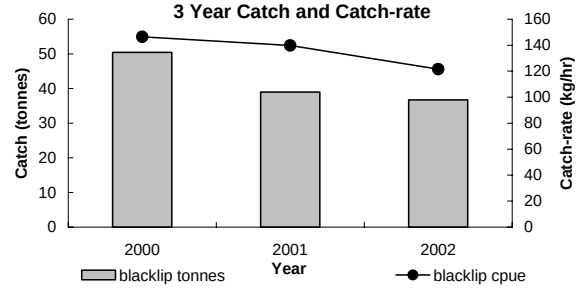
4.2.2 Sub-block 6B

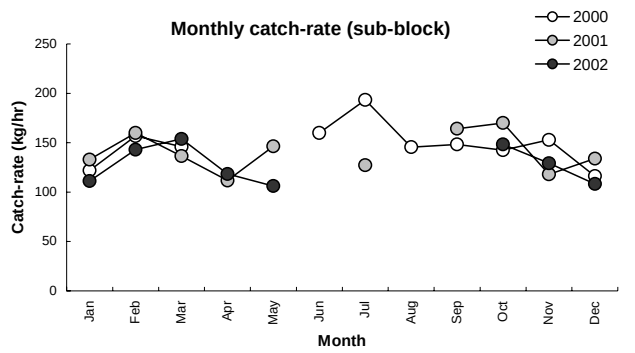
Temma Harbour to rocks north of Dawson River

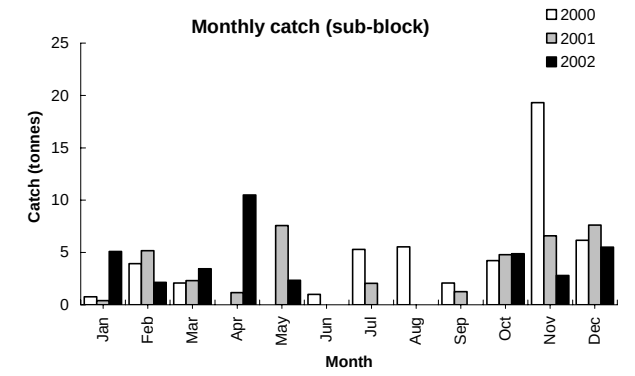
	Landings from this sub-block have increased over those from previous years, reportedly as divers move south from the more heavily fished (and depleted) sub-blocks further north.
	Monthly catch rates are generally lower than in previous years, although there was some recovery in December 2002 when 16 tonnes was caught.
	

4.2.3 Sub-block 6C

Rocks north of the Dawson River to Sandy Cape Beach – Wild Wave River

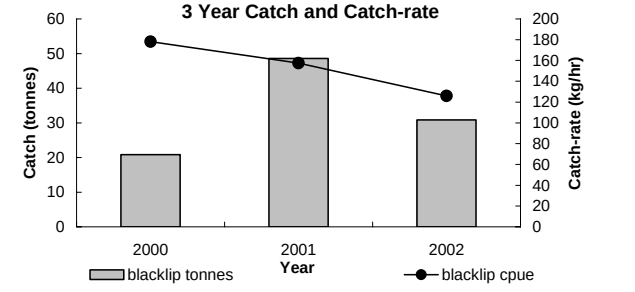
	There is a gradual decline in annual catch and catch rates over recent years.

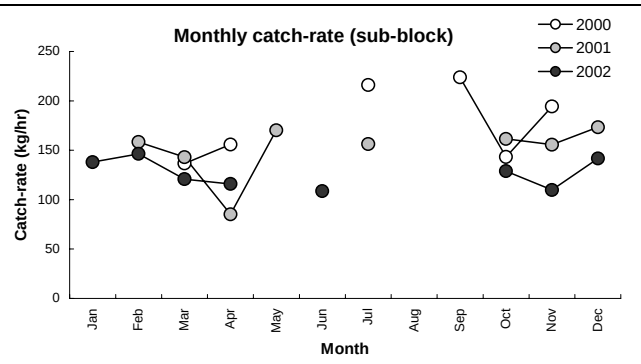




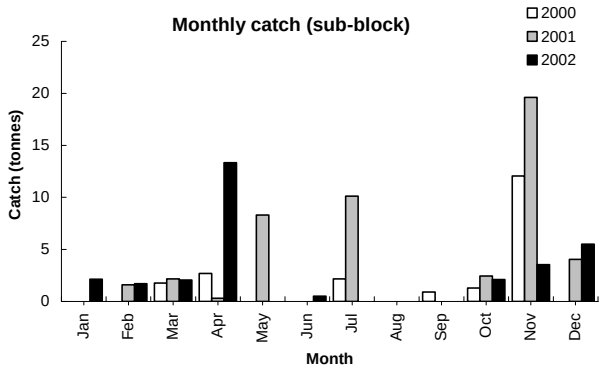
4.2.4 Sub-block 6D

Wild Wave River to Italian River, including Sandy Cape

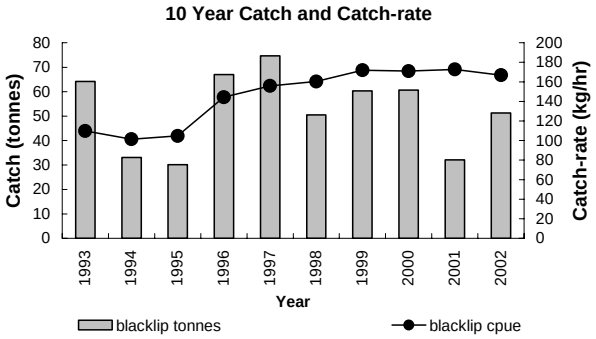




Generally, monthly catch rates have fallen over the past two years.



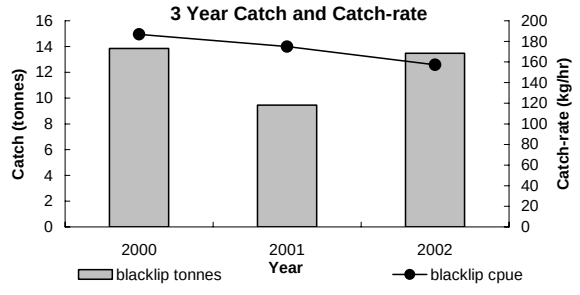
4.3 Block 7 (Italian River to Granville Harbour)



Catch rates are stable. In 2002, the annual catch was moderate compared with the 10 year range.

4.3.1 Sub-block 7A

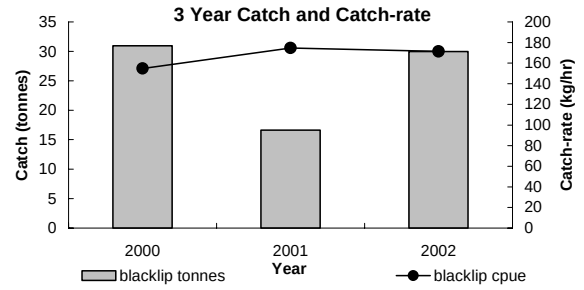
Italian River to the Pieman River, including Rupert Point



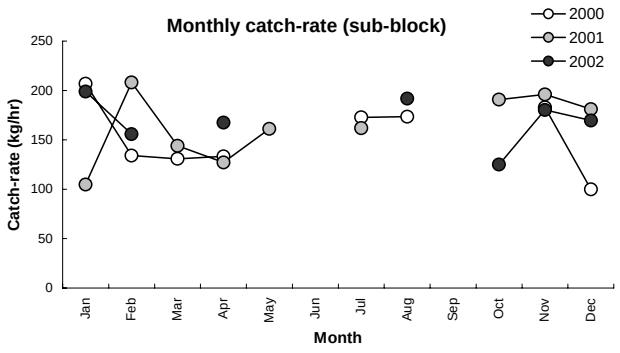
Catch rates, while falling gradually are still high and may not necessarily indicate stock reduction.

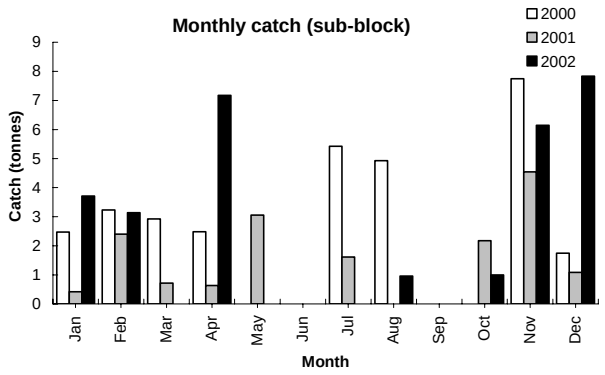
Catches are too discontinuous to provide information when broken down to monthly level.

4.3.2 Sub-block 7B
Pieman to Ahrberg Bay, including Conical Rocks

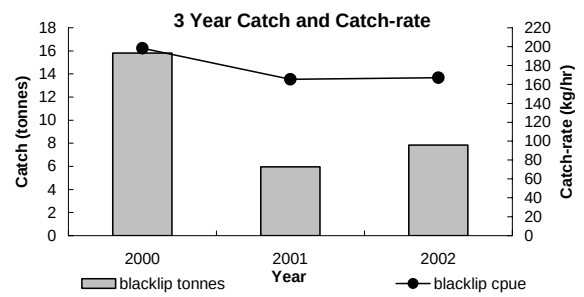


While levels of catch fluctuate between years, catch rates are consistently high.





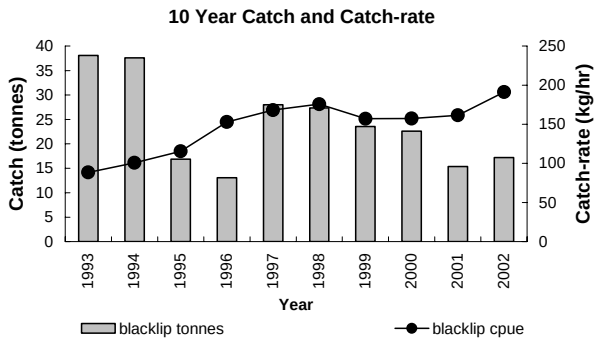
4.3.3 Sub-block 7C
Ahrberg to Granville Harbour



Although the catch has fallen, catch rates are stable at high levels.

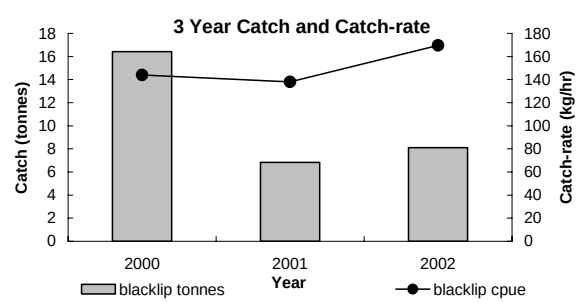
Catches are too discontinuous to provide information when broken down to monthly level.

4.4 Block 8 (Granville Harbour to Ocean Beach)



Catch rates are stable or increasing slightly, catches tend to be lower in recent years.

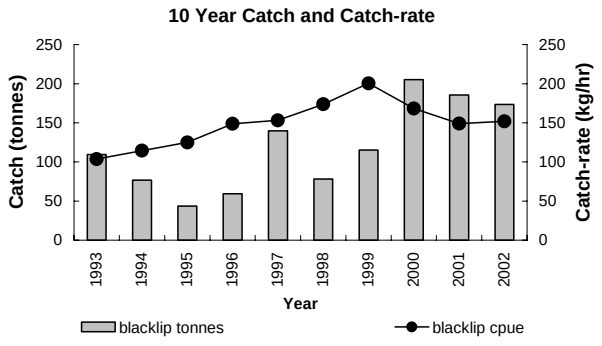
4.4.1 Sub-block 8A
Granville to Tasman Bay



Although the catch has fallen, catch rates are stable or increasing slightly at high levels.

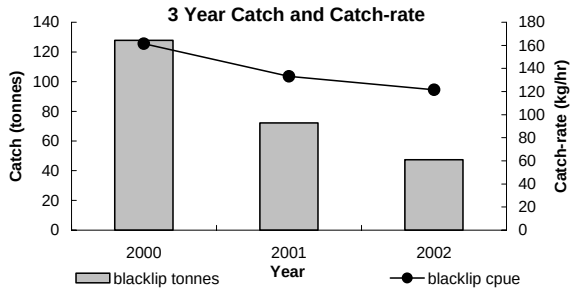
Catches are too discontinuous to provide information when broken down to monthly level.

4.5 Block 9 (Ocean Beach to Point Hibbs)

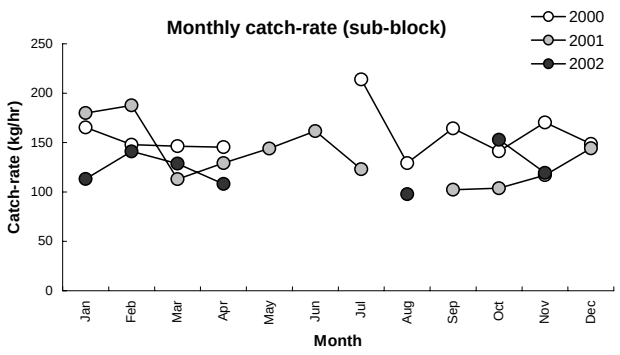


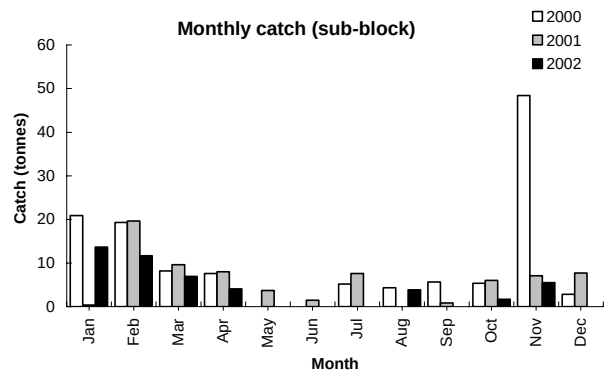
Catches and catch rates in the most distant (from Strahan) sub-block (9C) are stable, and account for most of the production from this block. In the more accessible Sub-block 9B, catch and catch rates are falling, while Sub-block 9A now produces no significant catches.

4.5.1 Sub-block 9B
Cape Sorell to Gorge Point

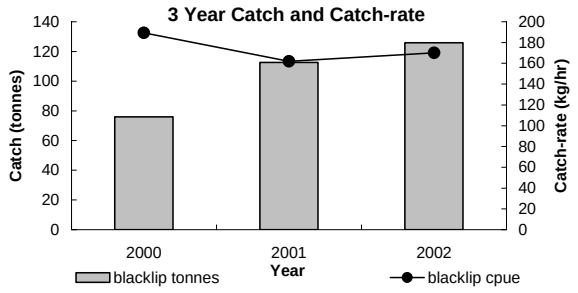


This is the most accessible coast that can be fished from Strahan. The annual catch has fallen considerably, and catch rates continue to decline. This sub-block appears to be increasingly by-passed in favour of more remote sub-blocks

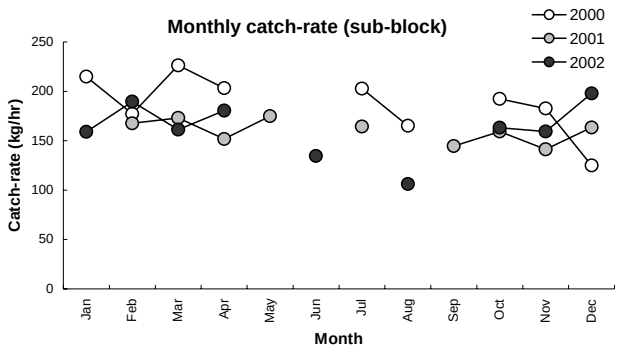




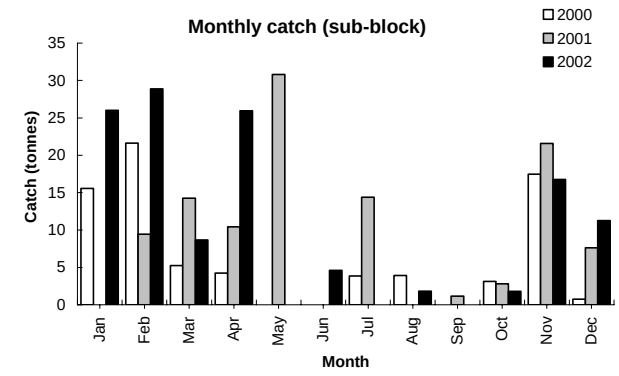
4.5.2 Sub-block 9C
Gorge Point to Point Hibbs



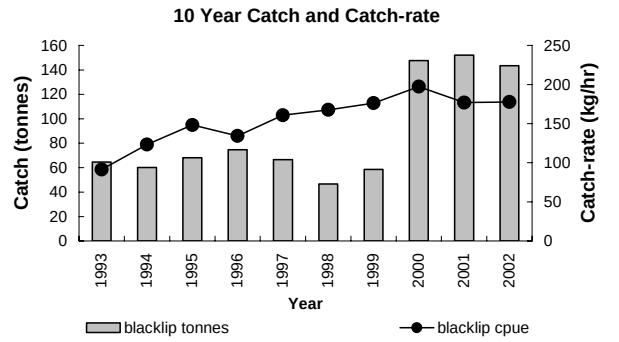
The annual catch has increased considerable since 2000 as divers move further south to fish more abundant stocks.



During the more productive months, catch rates are stable.



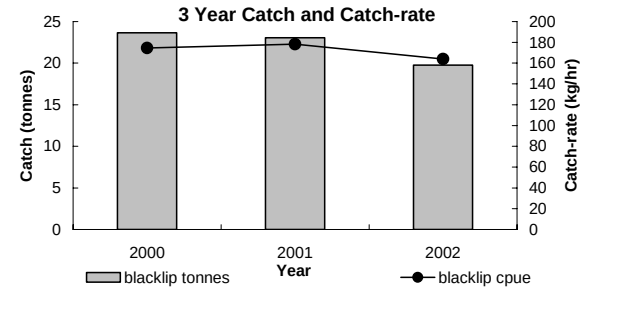
4.6 Block 10 (Point Hibbs to Low Rocky Point)



Catch rates in Block 10 are at high levels. Catches have increased by more than 50% since the introduction of zoning in 2000.

Catches and catch rates fluctuate between blocks, probably more in response to weather and sea conditions and divers preferences rather than changing abalone abundance.

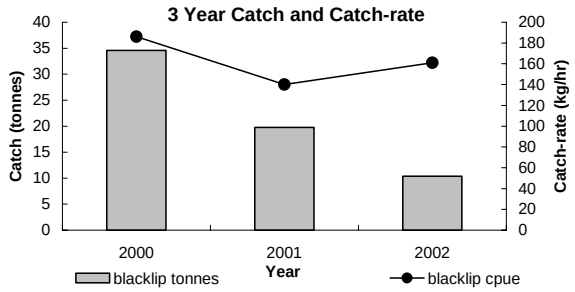
4.6.1 Sub-block 10A
Point Hibbs to Endeavour Bay



Catches and catch rates fluctuate.

Catches are too discontinuous to provide information when broken down to monthly level.

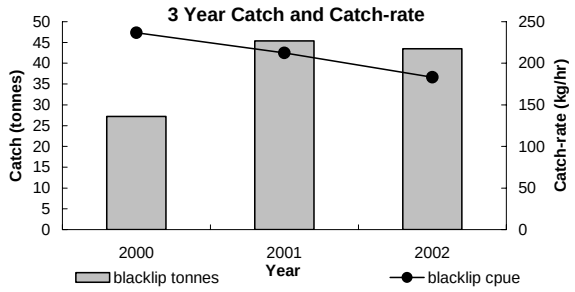
4.6.2 Sub-block 10B
Endeavour Bay to High Rocky Point



Catches and catch rates fluctuate.

Catches are too discontinuous to provide information when broken down to monthly level.

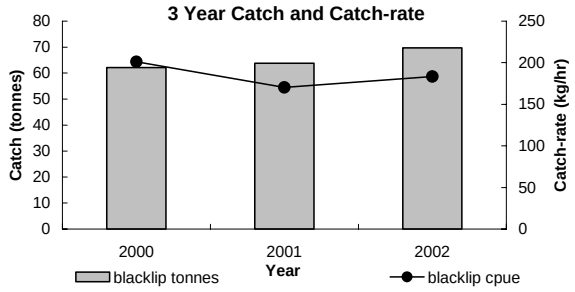
4.6.3 Sub-block 10C
High Rocky Point to Mainwaring River



Catches and catch rates fluctuate.

Catches are too discontinuous to provide information when broken down to monthly level.

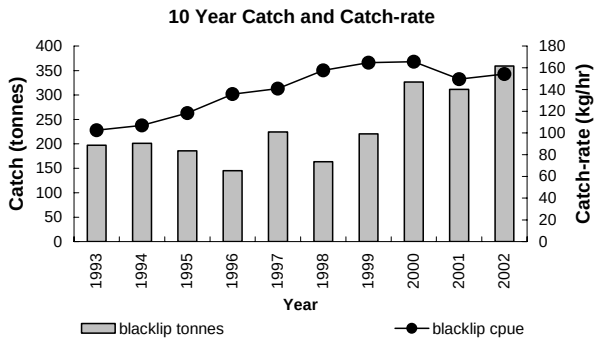
4.6.4 Sub-block 10D
Mainwaring River to Low Rocky Point



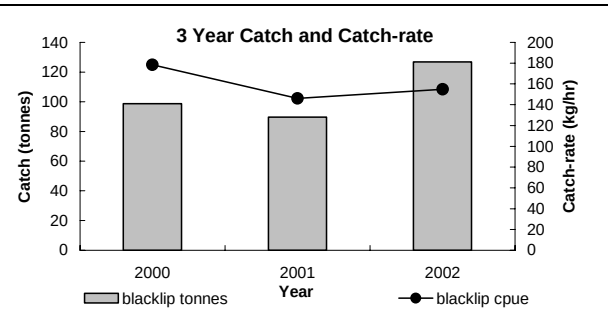
Catches and catch rates fluctuate.

Catches are too discontinuous to provide information when broken down to monthly level.

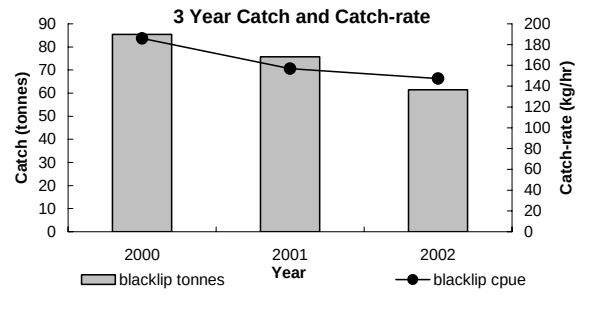
4.7 Block 11 (Low Rocky Point to Faults Bay, including Port Davey)

	Catches in Block 11 are at their highest level for many years. There is some fluctuation in catch rates between years at the sub-block level, but overall catch rates are stable or increasing slightly.

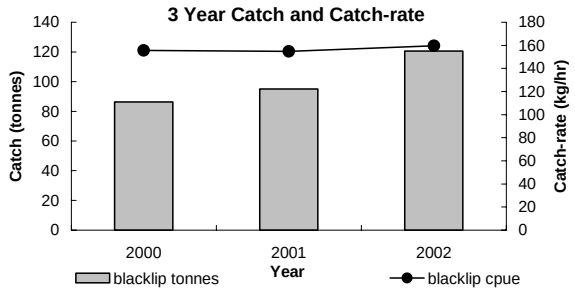
4.7.1 Sub-block 11A
Low Rocky Point to Elliott Point

	Catches and catch rates fluctuate. Catches are too discontinuous to provide information when broken down to monthly level.

4.7.2 Sub-block 11B
Elliott Point to Svenor Gulches

	Catches and catch rates fluctuate. Catches are too discontinuous to provide information when broken down to monthly level.

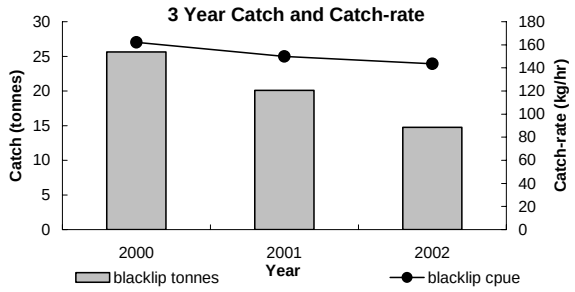
4.7.3 Sub-block 11C
Svenor Gulches to Point St Vincent



Catches and catch rates fluctuate.

Catches are too discontinuous to provide information when broken down to monthly level.

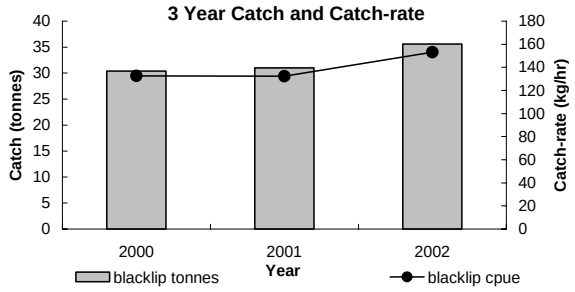
4.7.4 Sub-block 11D
Hilliard Head to Faults Bay



Catches and catch rates fluctuate.

Catches are too discontinuous to provide information when broken down to monthly level.

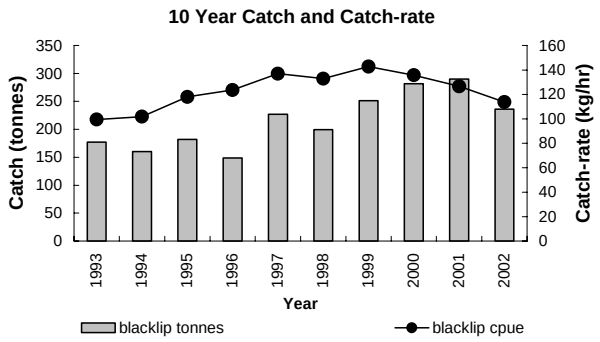
4.7.5 Sub-block 11E
Point St Vincent to Hilliard Head, including Port Davey



Catches and catch rates fluctuate.

Catches are too discontinuous to provide information when broken down to monthly level.

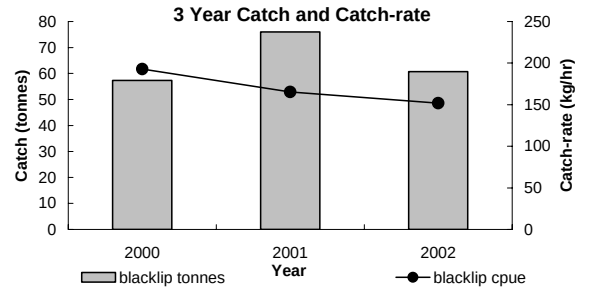
4.8 Block 12 (Faults Bay to Prion Beach, including South West Cape, Cox Bight and Maatsuyker Island)



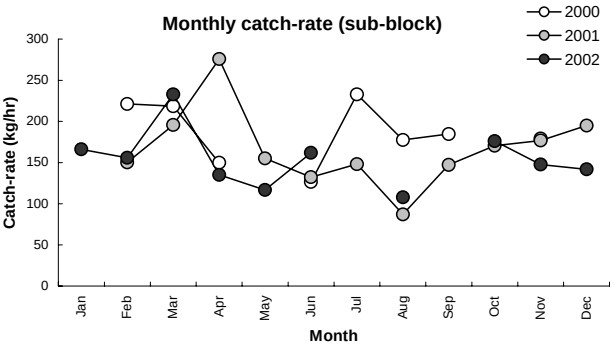
Catch rates have now declined for the past four years.

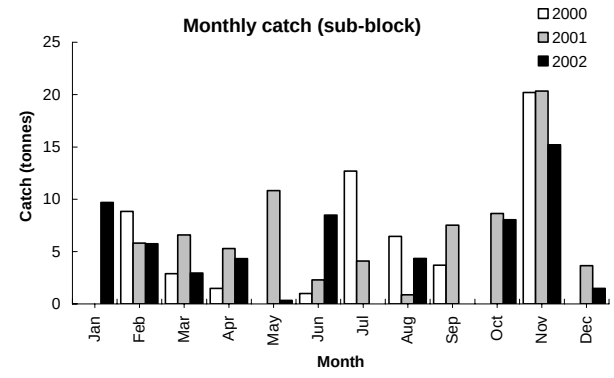
The annual catch has fallen from 2001 levels in all sub-blocks.

4.8.1 Sub-block 12A
Faults Bay to South West Cape

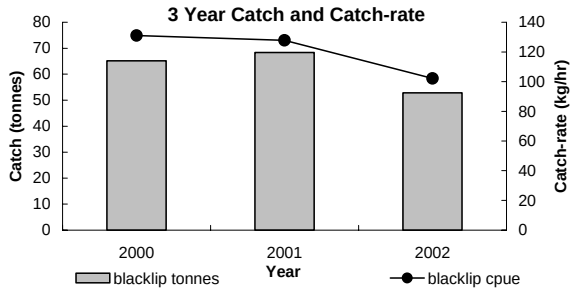
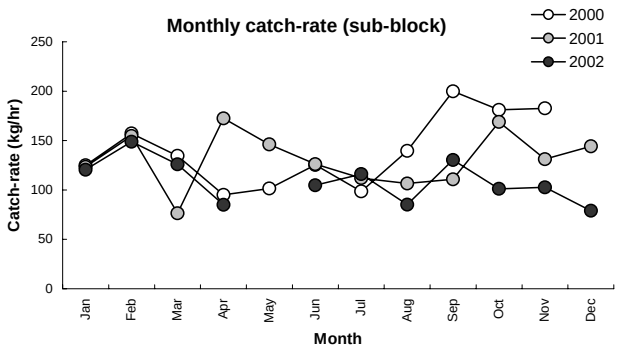
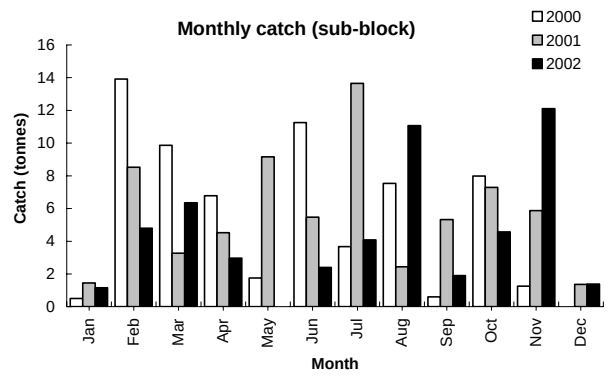


Catches fluctuate, catch rates are falling slowly, but are still at high levels.

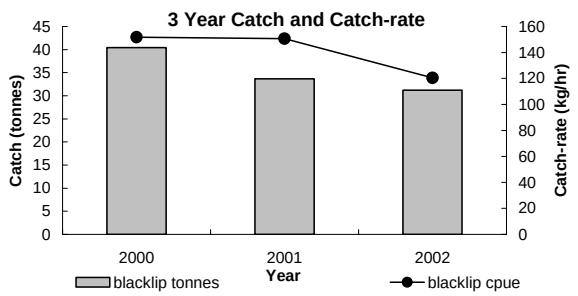


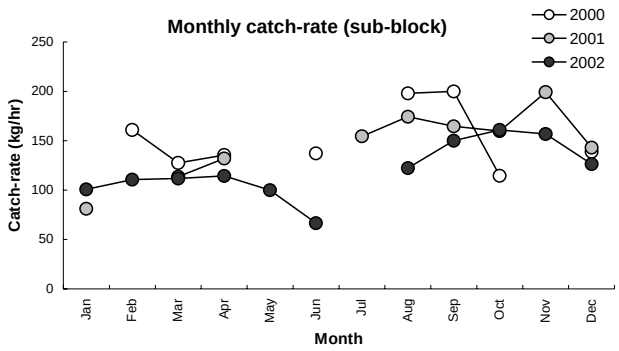


4.8.2 Sub-block 12B
South West Cape to Cox ‘s Bluff

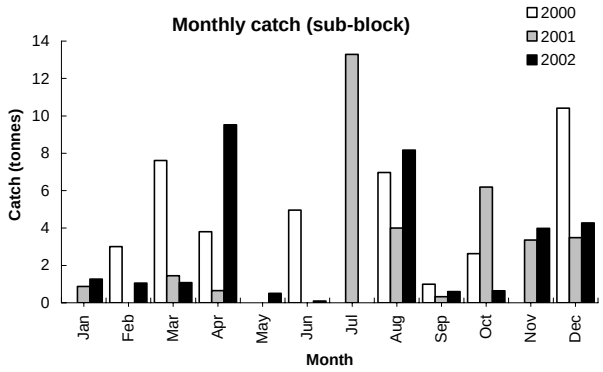
	In 2002, catches and catch rates fell. Catch rates are now approaching the 100 kg/hr level, which considering the size of South Coast abalone, indicates that stocks are becoming depleted.
	Catch rates have fallen, particularly between August and November 2002 when catches were greatest.
	

4.8.3 Sub-block 12C
Maatsuyker Group

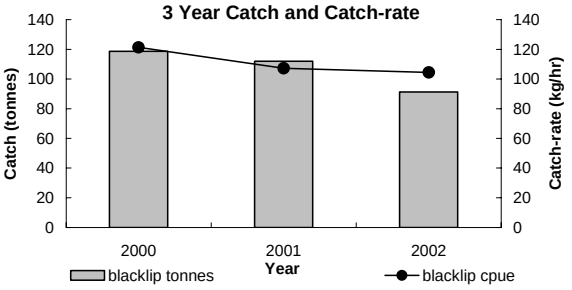
	



Catch rates improved in the later part of 2002 (November), but for much of the year were at very low levels for a Western Zone fishery.

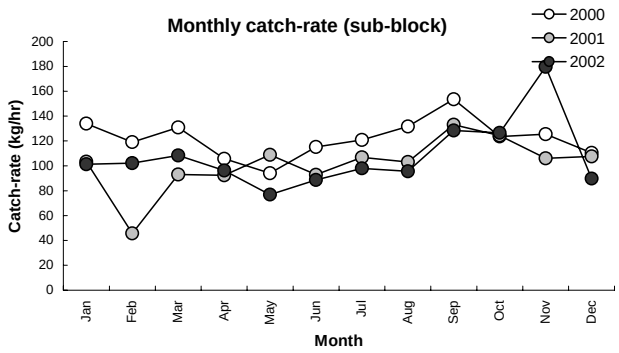


4.8.4 Sub-block 12D
Cox's Bluff to Prion Beach

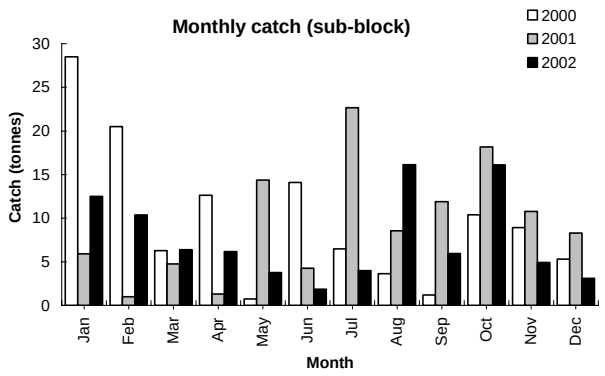


Catch and catch rates show a downwards trend.

Catch rates are at low levels for a Western Zone fishery



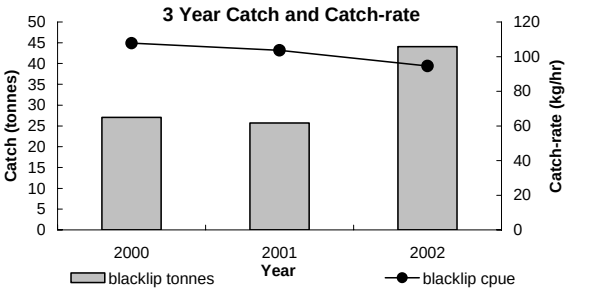
Catch rates in November and December 2002 were influenced by some extraordinary landings, and should be considered unusual.



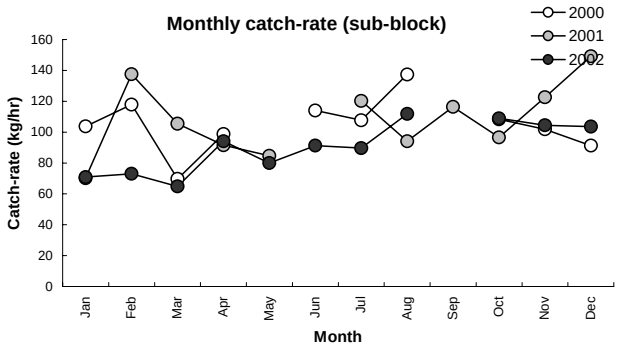
4.9 Block 13 (Prion Beach to Whale Head)

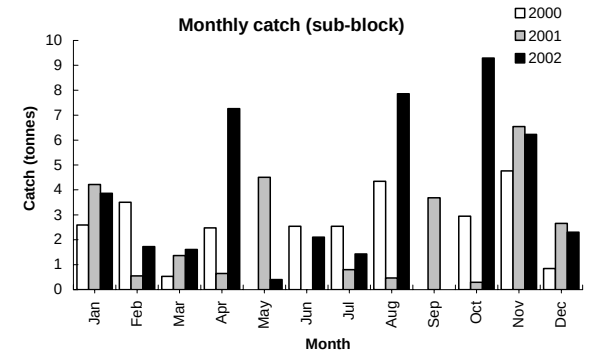
4.9.1 Sub-block 13A

Prion Beach to South Cape

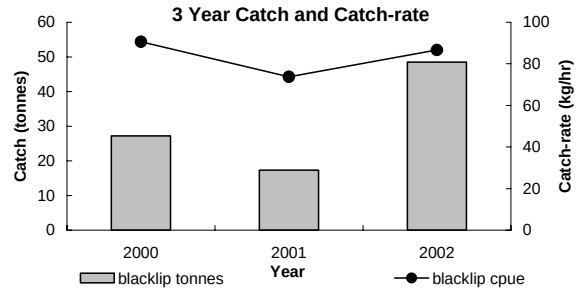
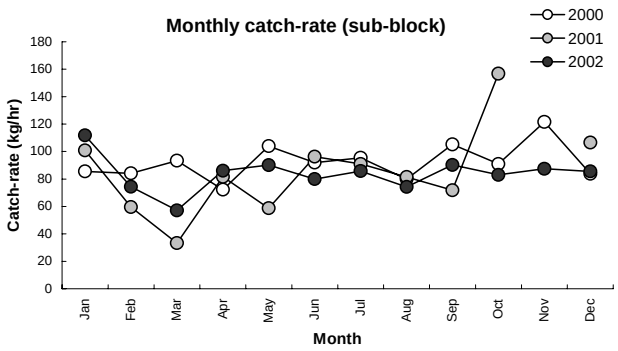
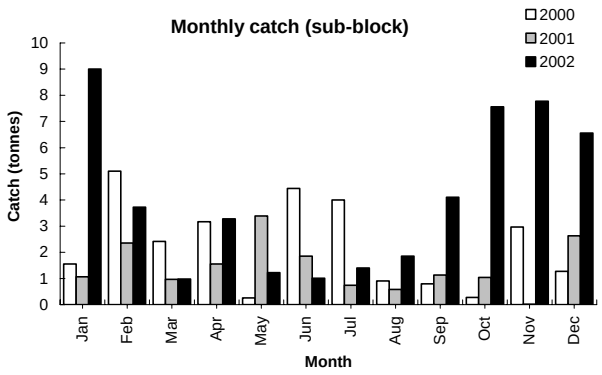


The annual catch has increased by 70%. Catch rates are falling slowly, and must be considered low by Western Zone standards.

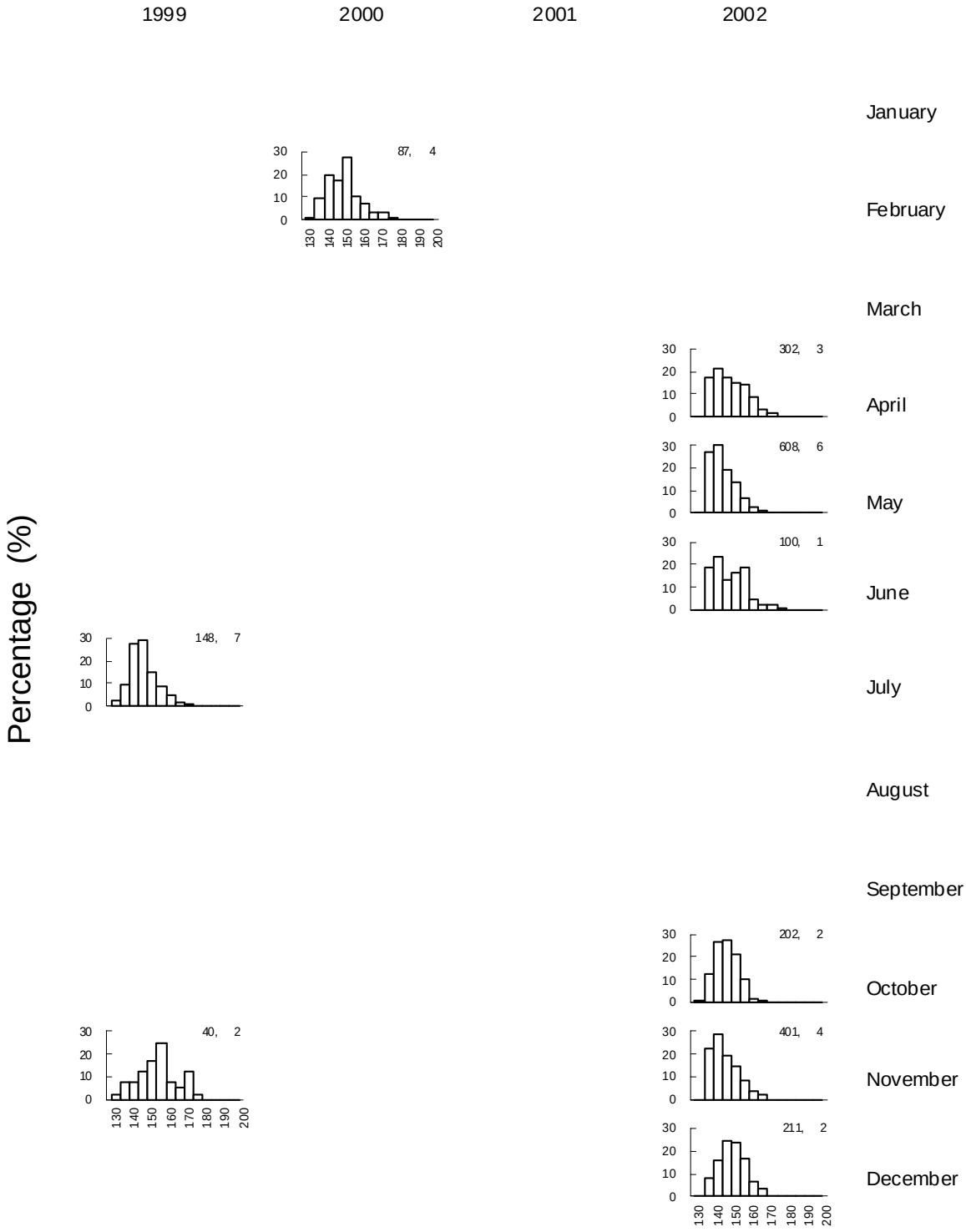




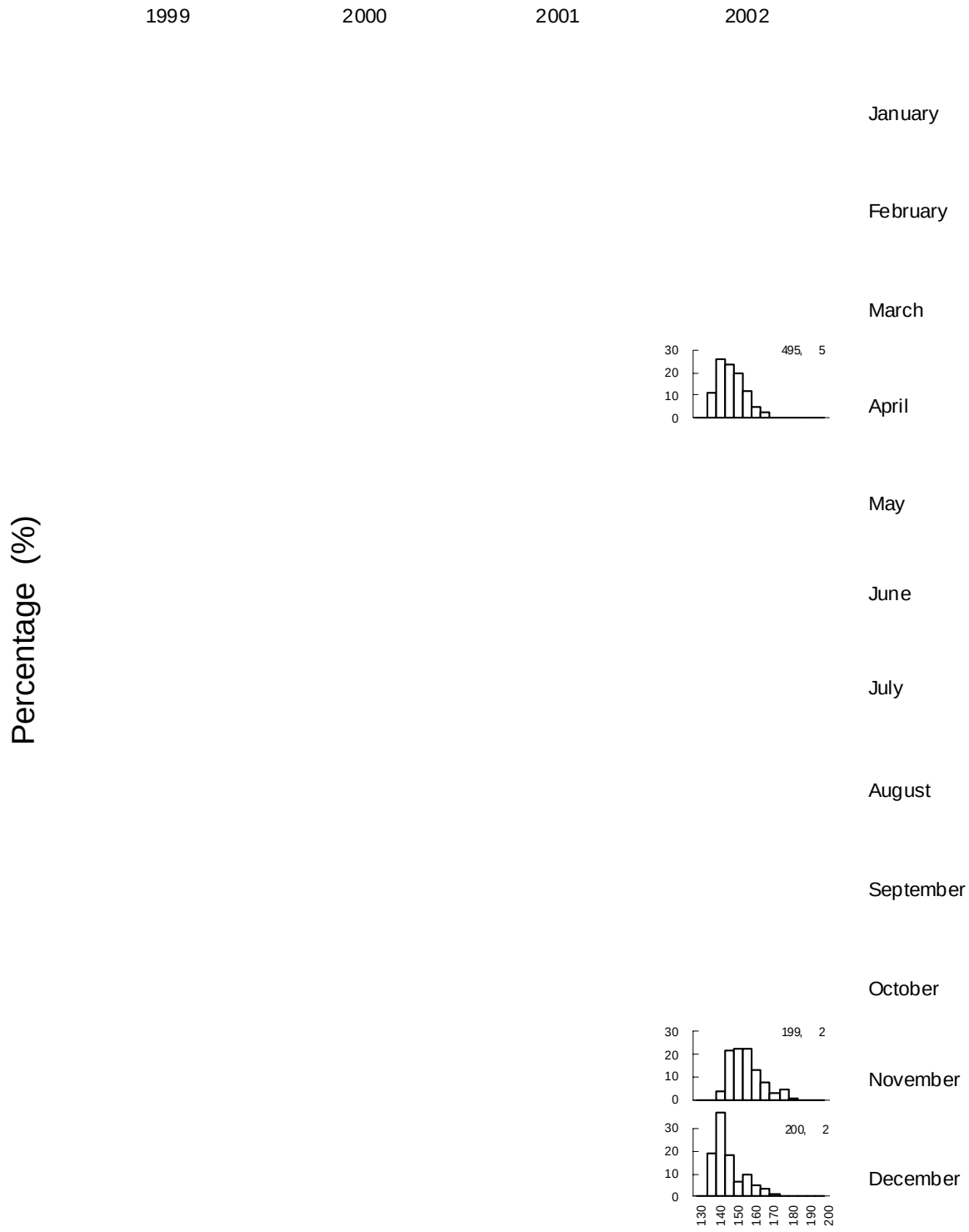
4.9.2 Sub-block 13B
South Cape to Whale Head

	The 2002 catch was almost three times that of the previous year, and almost twice the size of the 2000 catch. Catch rates are at low levels for a Western Zone fishery.
	The March 2001 catch rates are abnormal.
	Almost 9 tonnes of catch in January 2002 at comparatively high catch rates lifted the annual catch rates to higher levels than 2001. Later in the year, catch rates were mostly equivalent to or less than those of the previous year.

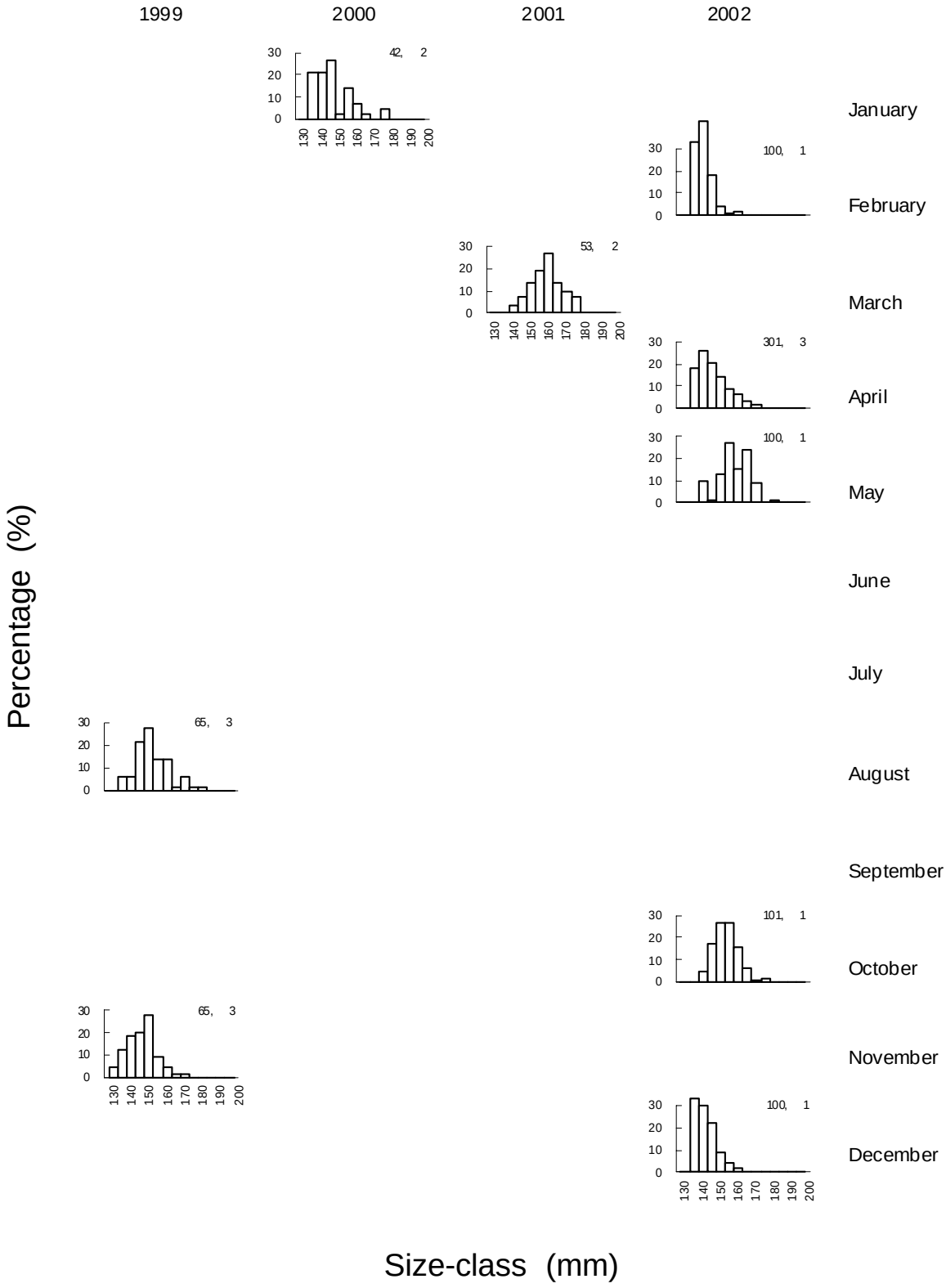
Sub-block 6A (size limit 132 mm)



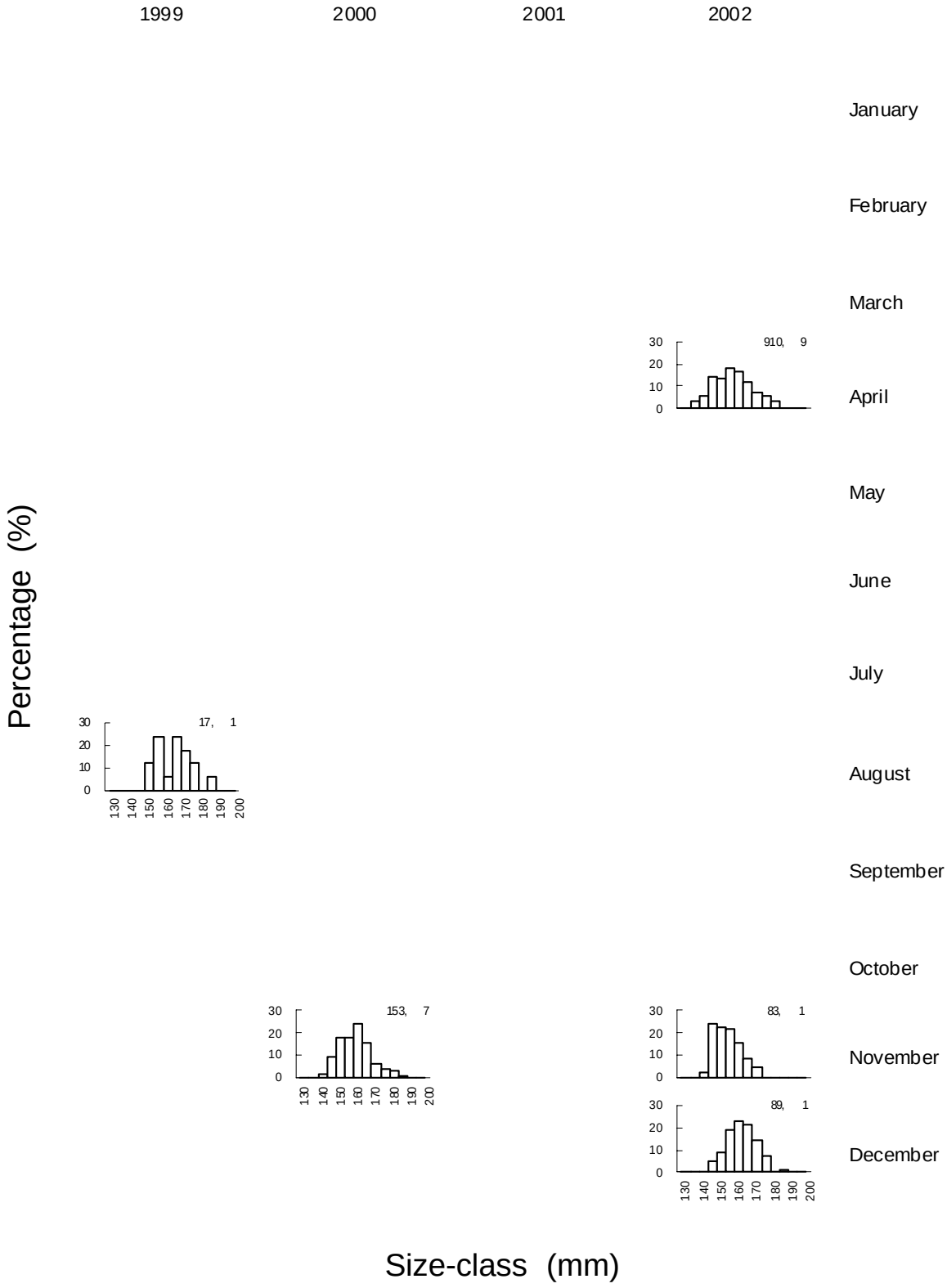
Sub-block 6B (size limit 132 mm)



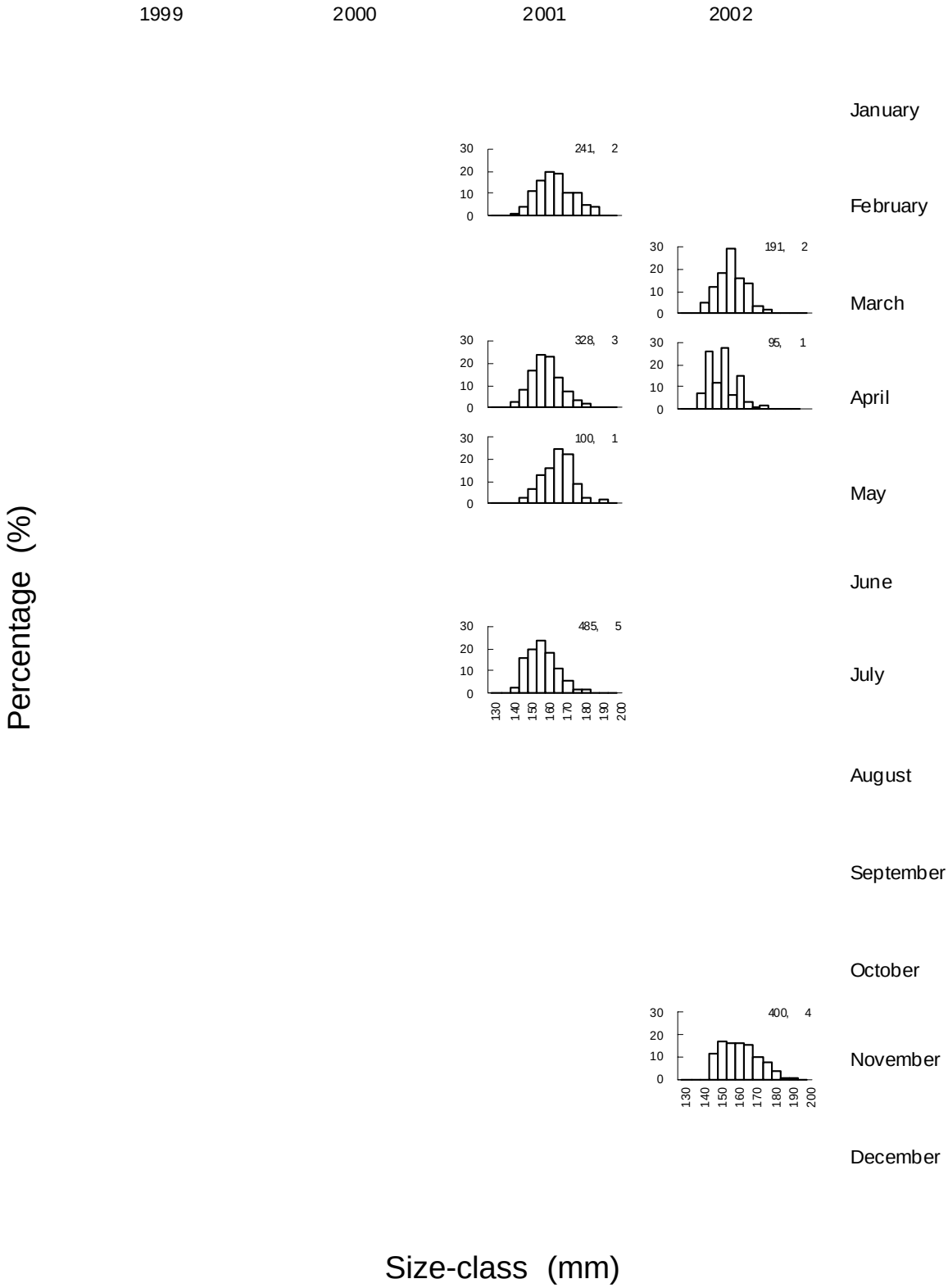
Sub-block 6C (size limit 132 mm)



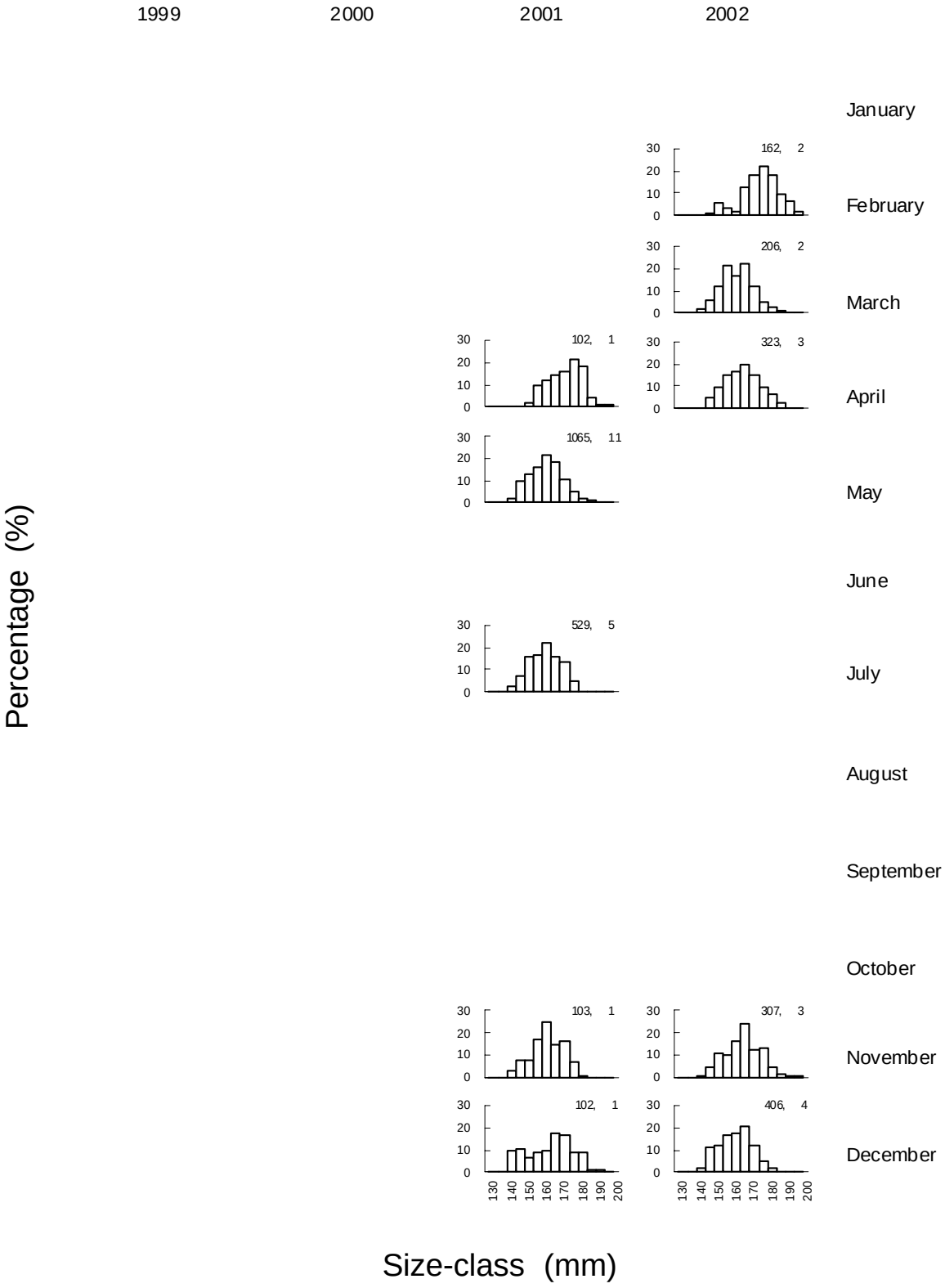
Sub-block 6D (size limit 140 mm)



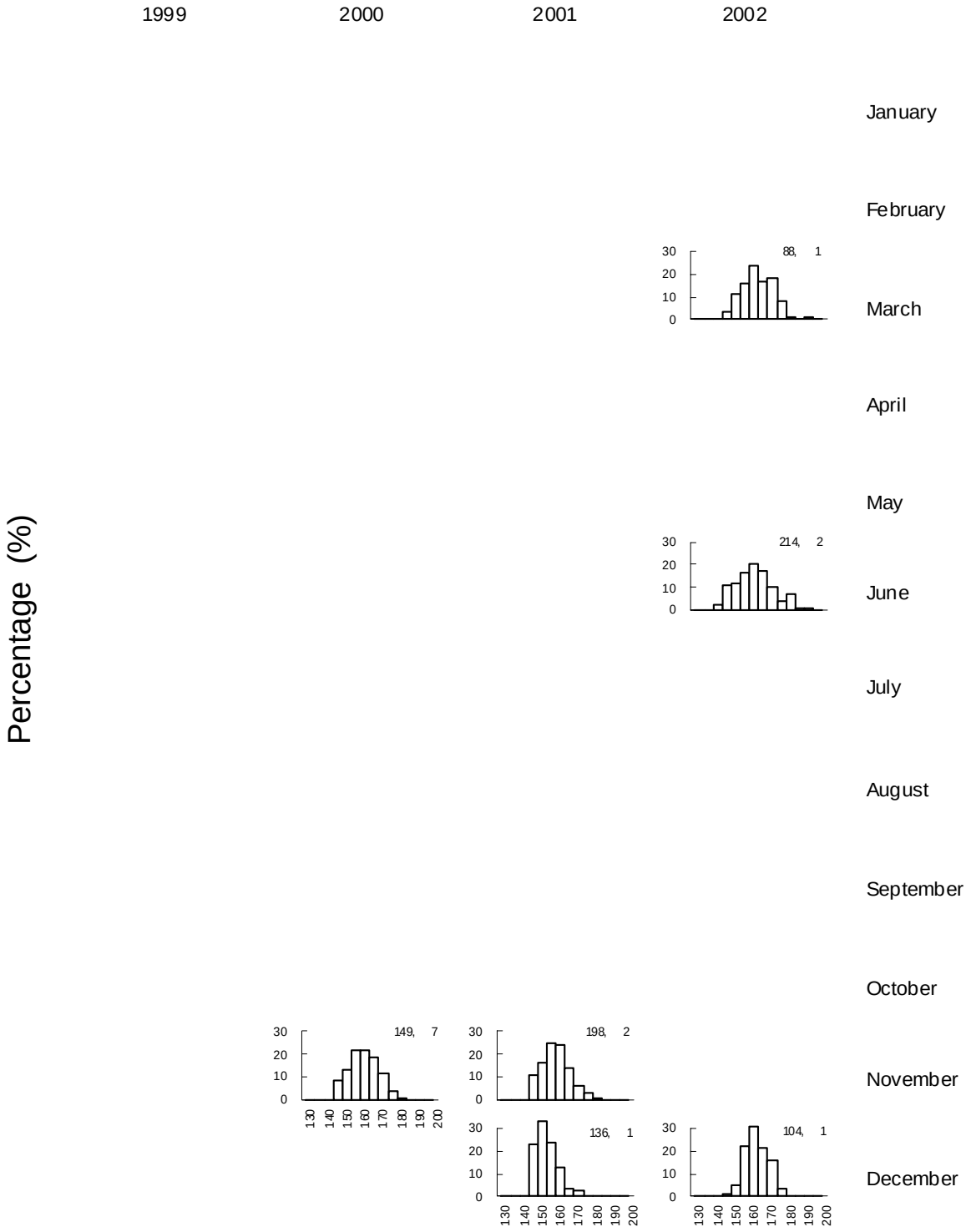
Sub-block 9B (size limit 140 mm)



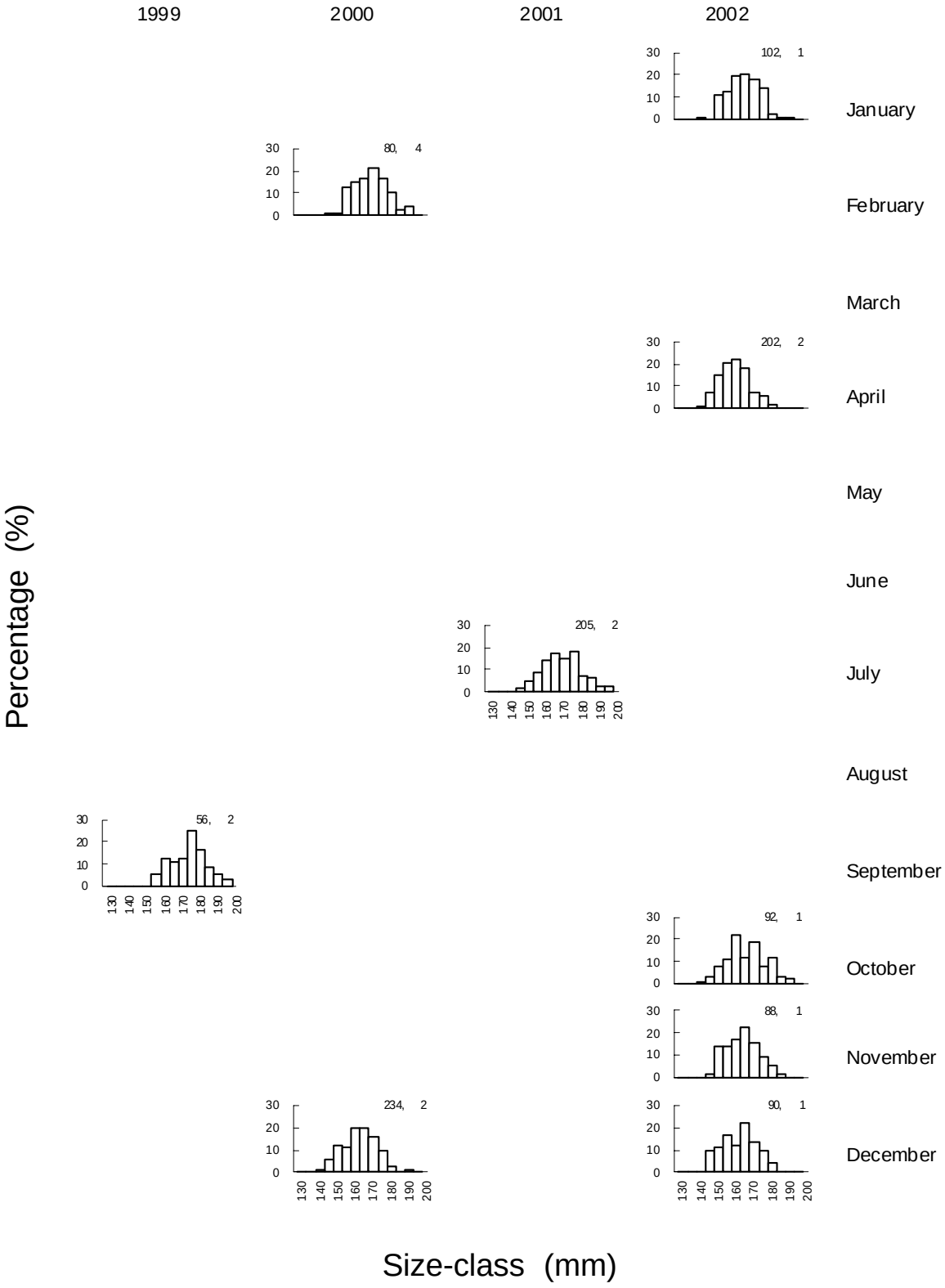
Sub-block 9C (size limit 140 mm)

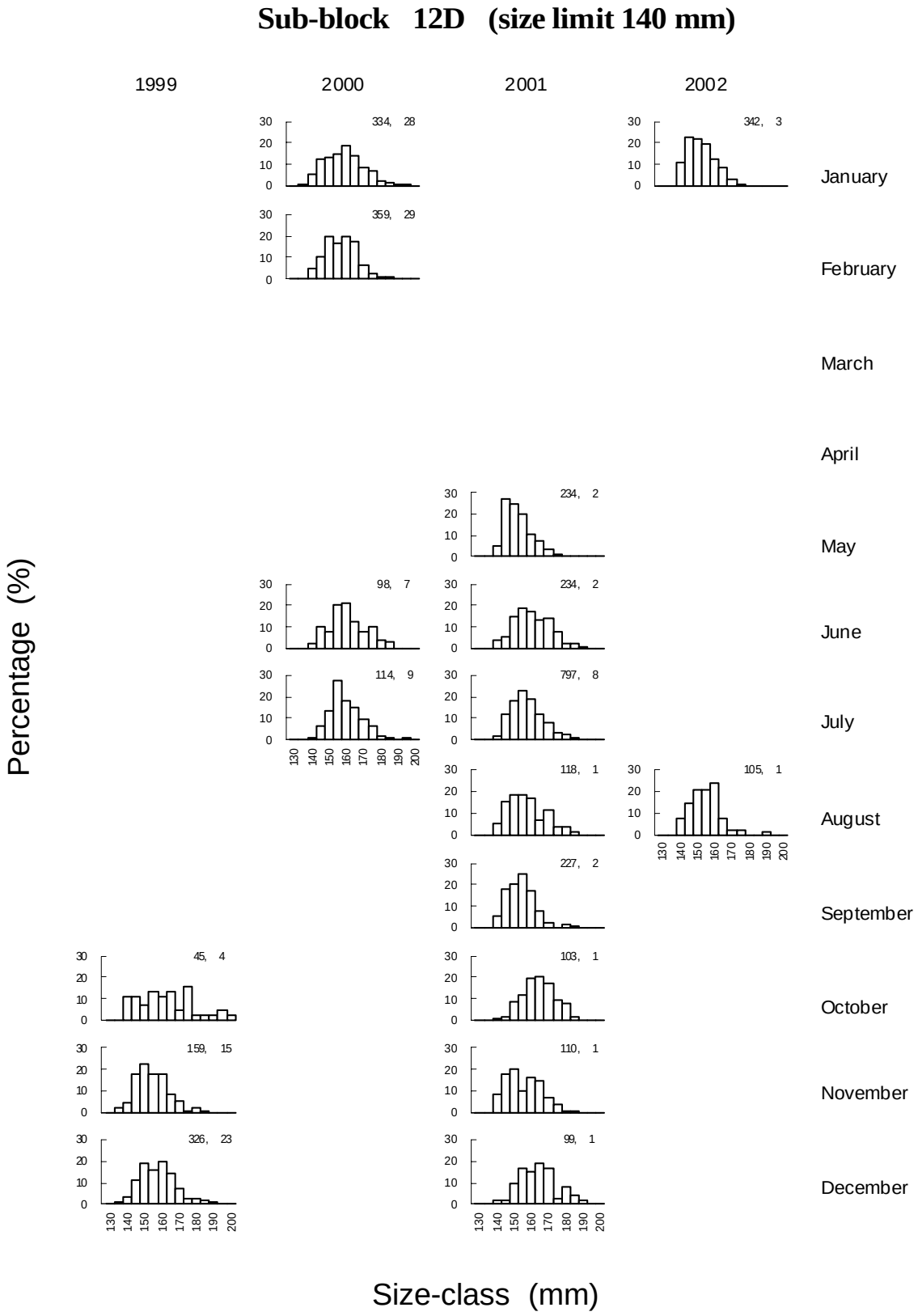


Sub-block 12A (size limit 140 mm)



Sub-block 12C (size limit 140 mm)




Sub-block 12D (size limit 140 mm)
1999
2000
2001
2002
January
February
March
April
May
June
July
August
September
October
November
December
Percentage (%)
Size-class (mm)
334, 28
359, 29
342, 3
234, 2
98, 7
234, 2
114, 9
797, 8
118, 1
105, 1
227, 2
45, 4
103, 1
159, 15
110, 1
326, 23
99, 1

4.10 Western Zone Summary

- The more remote southwest part of the Western Zone (Blocks 9, 10 and 11 – Strahan to Port Davey) produced 55% of the TAC. Another 25% was taken from the South Coast between Whale Head and Port Davey (Blocks 12 and 13). With the exception of abalone from Block 6, Western Zone abalone are generally larger than abalone from elsewhere in the State. Little fishing is done in winter and early spring because poor weather conditions usually prevent divers from entering the water.

- Catches and catch rates from the remote south west of the State between Gorge Point and South West Cape (Sub-block 9C, Blocks 10 and 11, Sub-block 12A) were generally stable. There were small increases in catch and catch rates in some sub-blocks (eg 10D, 11A), which compensated for adjacent sub-blocks (e.g.10C, 11B) where catches and catch rates fell. Because of the difficulty of sourcing mothership catches to statistical fishing blocks, few size-frequency samples were obtained from catches taken from this region. The only area that was sampled consistently in 2001 and 2002 was Sub-block 9C, which showed that the population structure of the catch was consistent between months with a modal size class that, although occasionally larger, was mostly between 160 and 170 mm. Divers who fished this region usually expressed the opinion that while they believed that stocks were healthy here, they would not like to see an increase in the level of catch that might cause catch rates to fall. Fishing this region is more costly due to its comparative remoteness, and to make fishing here financially viable, abalone needed to be caught at high catch rates. Fishing would become less viable at higher yields and lower catch rates.

- Fishable stocks along the coast between Cape Sorell and Gorge Point (Sub-blocks 9A and 9B) have continued the decline described in previous assessments. This is the closest part of the coast to launching facilities for small craft in Macquarie Harbour and has been heavily fished. Despite low catch rates, it continues to be fished by divers with vessels too small to travel to more productive coast further south or north. While prevailing adverse sea conditions offer some respite to stocks, this coast will continue to be fished by divers who operate on a low budget through economic necessity.

- Catches from between Strahan and Italian River (near Sandy Cape) increased slightly in 2002, probably due to transferred effort from the less productive Block 9 stocks mentioned above, or from divers travelling south from Couta Rocks. Catch rates are consistently high and reflect strong stock levels.

- Catch rates in the northern part of the Western Zone (Block 6) continued to fall in 2002, the catch falling from 2001's ten year high by 15%. This block must be considered heavily exploited. Abalone populations here are relatively accessible to small boats by West Coast standards. It is also close to the Northern Zone and to the Greenlip fishery, with supporting infrastructure (good launching facilities, processors and accommodation) nearby. In addition, the varied coastline of the North West region offers divers the benefits of working throughout most weather conditions. Also affecting Block 6 is the size of its abalone, which throughout most of the block are substantially smaller than abalone south of Sandy Cape, and in most of the block are fished at a smaller legal minimum size (132 mm in 2002). The

smaller size means that Block 6 abalone may be preferred over abalone from further south for sale to the live fish market. This potentially makes Block 6 more attractive to divers and quota owners looking for higher beach prices. However, despite the difference in size of abalone, catches and catch rates have deteriorated to the point where divers working from Temma Harbour and Couta Rocks are finding it increasingly advantageous to bypass Block 6 and work further south in Block 7 at higher catch rates.

- The South Coast fishery (South West Cape to Whale Head - Sub-blocks 12B, 12C, 12D, 13A, 13B) appears to be declining slowly. In 2002, catch rates in all sub-blocks apart from Sub-block 13B fell below 120 kg/hr. In Sub-block 13B catch rates were below 100 kg/hr. Like the coast further west, the South Coast abalone are fast growing, and reach larger sizes than abalone in the East and North. Catch samples show that catches generally comprised large abalone with modal size classes between 150 and 170 mm. While the catch rates on the South Coast might be considered satisfactory, the large individual average size of abalone means that the number of abalone caught per hour is lower than areas sharing similar catch rates but with smaller abalone, such as Block 6 in the North West.

- In common with other parts of the Western Zone with falling catch rates, the South Coast is accessible to trailer-borne craft launched from Southport, Dover or Catamaran. Catch rates become progressively lower in sub-blocks closer to the launching facilities, so while catch rates are relatively high around the Maatsuyker Group (Sub-block 12C), they become lower from Cox's Bight (Sub-block 12D) eastwards to South Cape Bay and Whale Head (Sub-block 13B).

- The 2002 catch from Sub-blocks 13A and 13B was more than double that of 2001. In Sub-block 13B, good catches were taken at high catch rates in January, but for the rest of the year monthly catch rates were much lower.

5. Northern Zone Blacklip

5.1 Northern Zone blacklip fishery – major fishing blocks

In the North West, catches from Blocks 49 and 48 declined sharply; Block 5 also declined but to a lesser extent (Figure 11). In the North East, catches declined in Block 39, but were much higher in neighbouring Block 31. King Island reported greatly increased catches (Blocks 3 and 4)

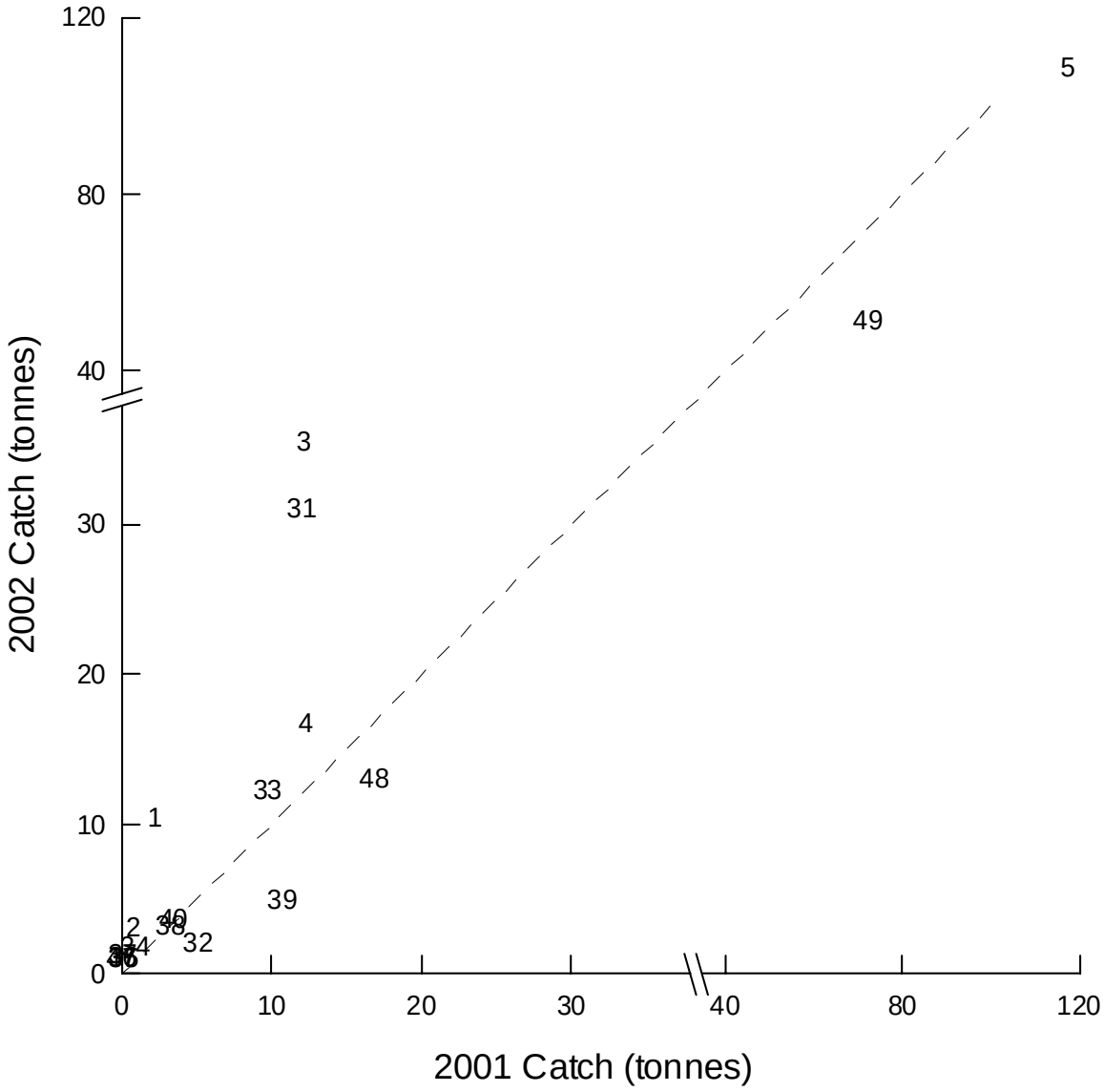
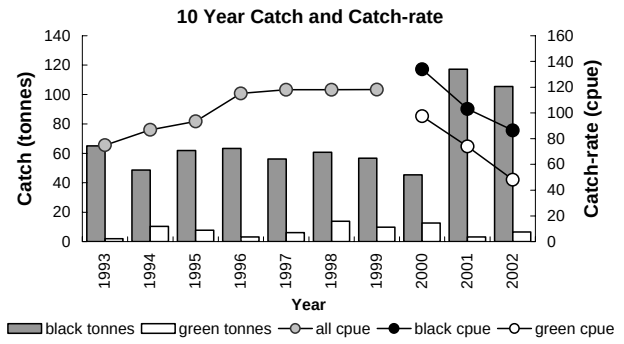


Figure 11. Blacklip catch from the Northern Zone (Blocks 1 to 5, part of sub-block 31B and Blocks 32 to 49). In 2002, the Northern Zone TAC (280 tonnes) was unchanged from the previous year. Blocks to the left of the diagonal line reflect increased catches over 2001 levels, blocks to the right reflect falling catches.

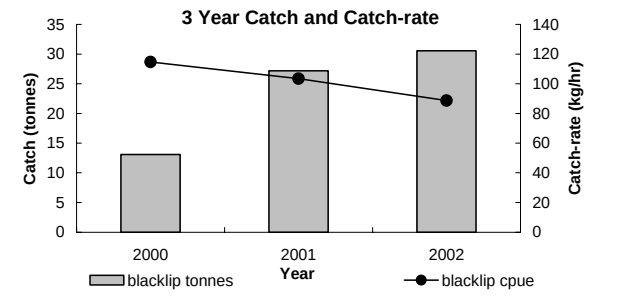
5.2 Block 5 (South Arthur Beach to Woolnorth Point)



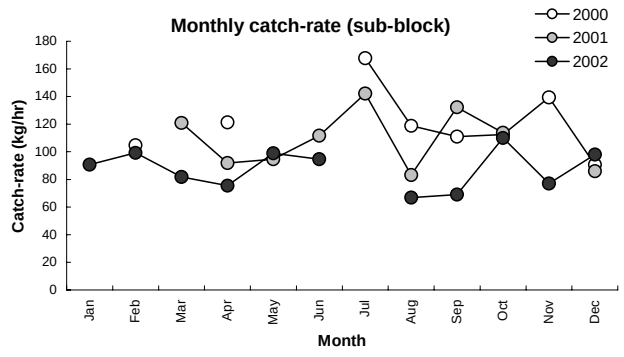
Catches and catch rates have fallen following high levels of effort after the development of the Northern Zone.

The catch from this block has been capped at 100 tonnes in 2003.

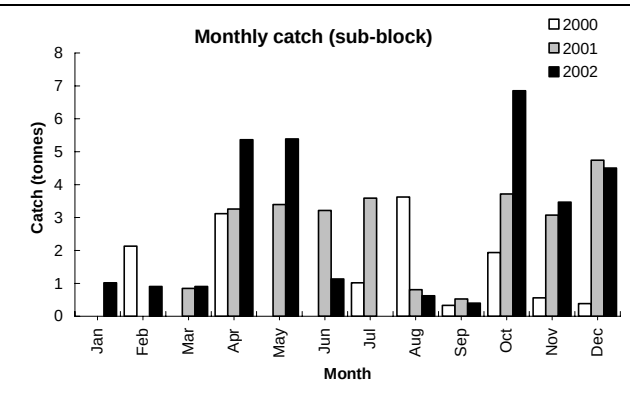
5.2.1 Sub-block 5A
Woolnorth Point to Studland Bay



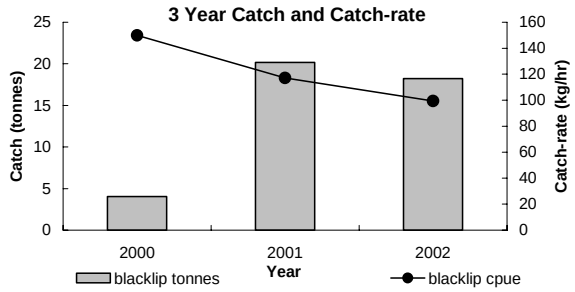
Catch has increased substantially since 2000.



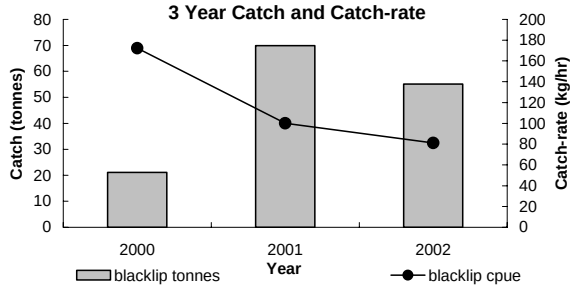
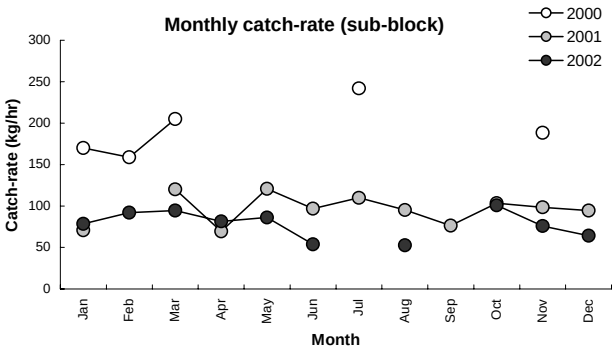
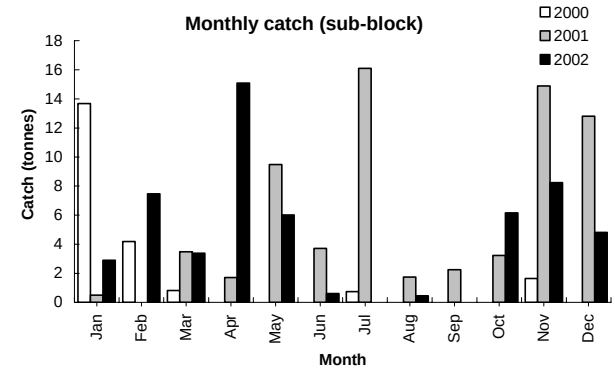
Monthly catch rates during the most productive months (i.e. where sampling is greatest) are generally similar across years.



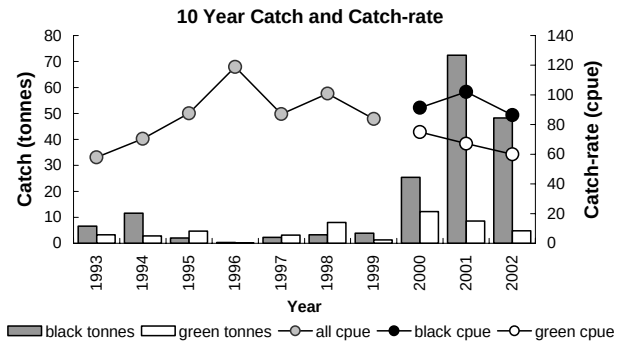
5.2.2 Sub-block 5B
Studland Bay to Greens Beach, including Mt Cameron West

	This is the most inaccessible part of Block 5.Catch rates are falling from high levels.

5.2.3 Sub-block 5C
Greens Beach to Arthur River

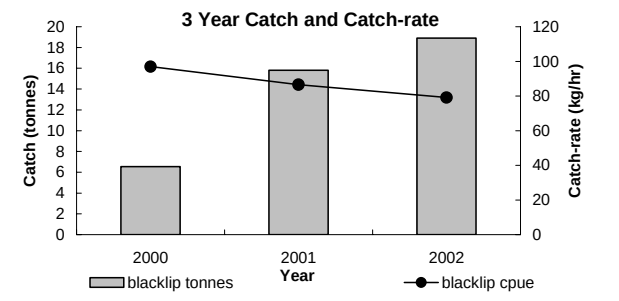
	Following a large increase in catch in 2001, catch rates have fallen to more moderate levels.
	Monthly catch rates are generally lower than in 2001.
	

5.3 Block 49 (Woolnorth Point to Hunter Island, including western and northern Hunter Island, and Three Hummock Island)

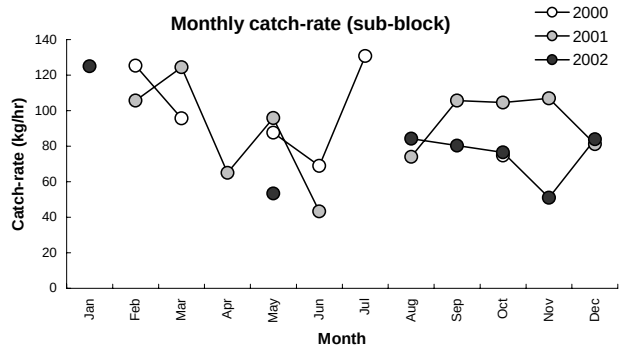


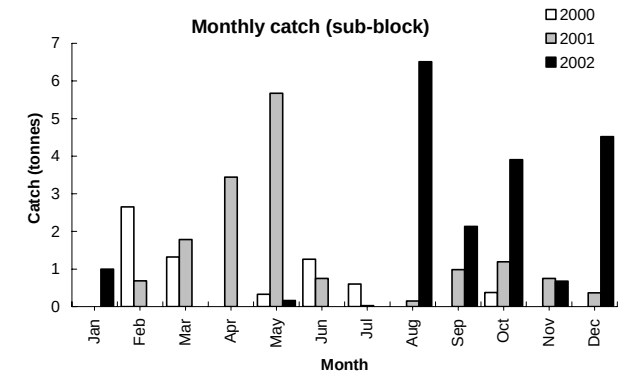
Fluctuating catches and catch rates present no clear picture. It is reported that abalone abundance is still at high levels in the more remote parts of the block, while nears shore stocks are becoming depleted.

5.3.1 Sub-block 49A
Three Hummock Island



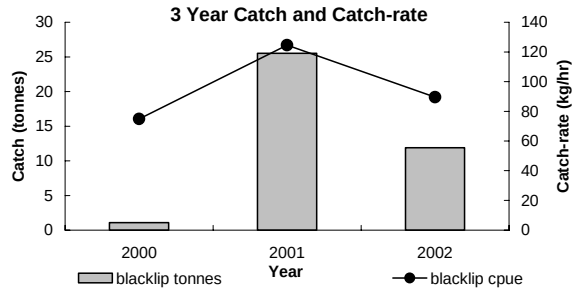
The 2002 catch is larger than previous years, and might explain the falling catch rates.





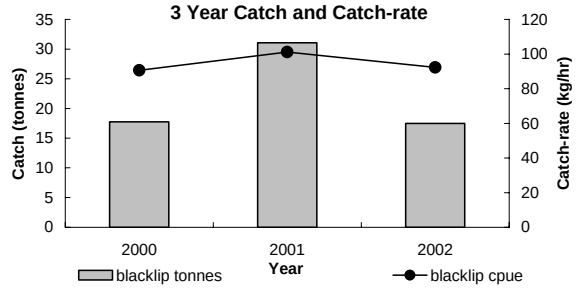
Most of the 2001 catch was taken in autumn, the 2002 catch in spring, reflecting opportunistic fishing.

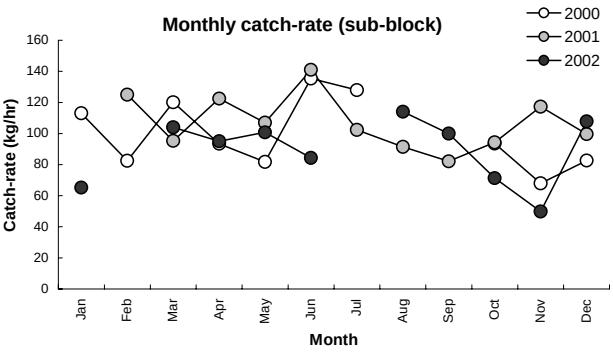
5.3.2 Sub-block 49B
Northern part of Hunter Island

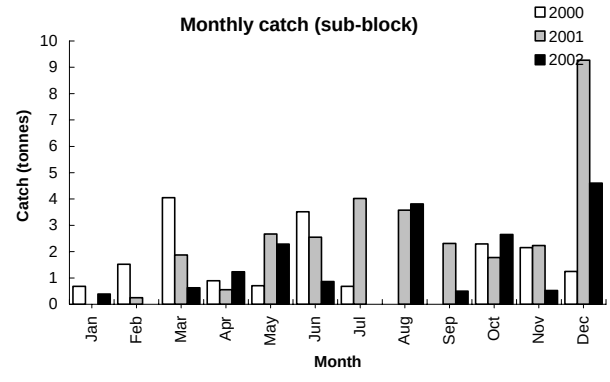


Was fished heavily by one group of divers in 2001 who took large catches at high catch rates. These divers did not return in 2002.

5.3.3 Sub-block 49C
South-western Hunter Island

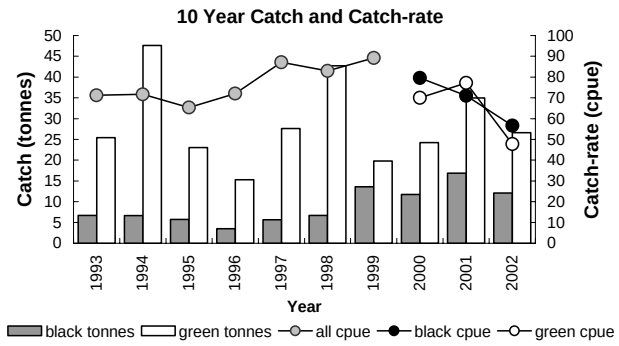






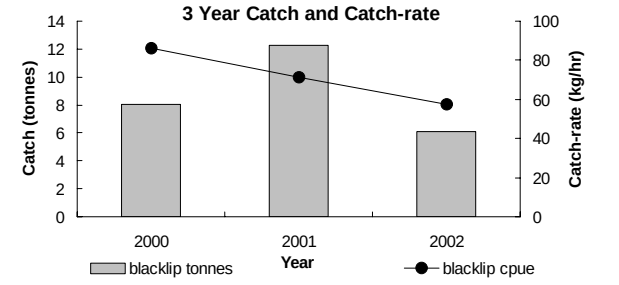
Apart from large catches in December 2001, 2002 seems to be unchanged from the previous year.

5.4 Block 48 (Woolnorth Point to the Duck River, including the eastern side of Hunter Island, the Petrels and Black Reef)



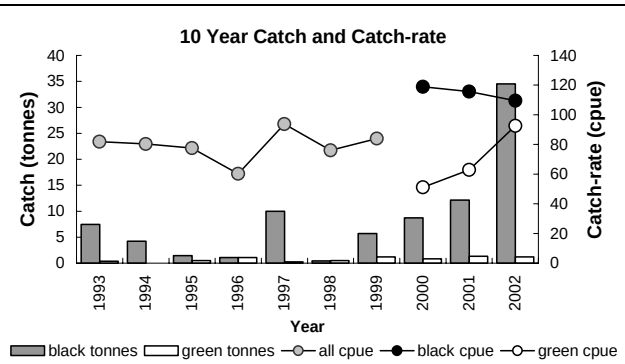
This is predominately a greenlip producing area, although good mixed catches are taken.

5.4.1 Sub-block 48C
Western part of Block 48



Catch rates are falling following a high level of catch in 2001. There is insufficient monthly data to provide a between-year comparison.

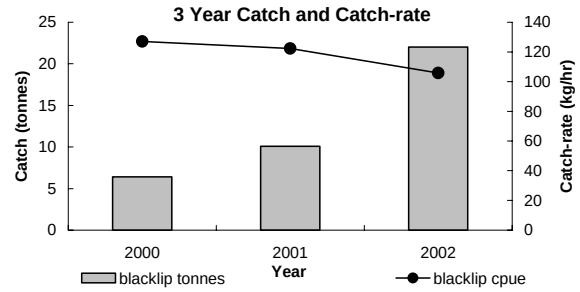
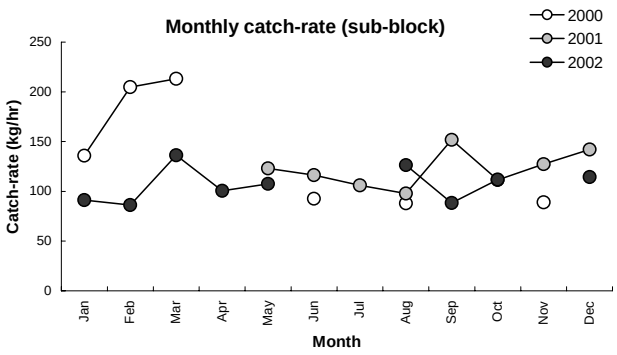
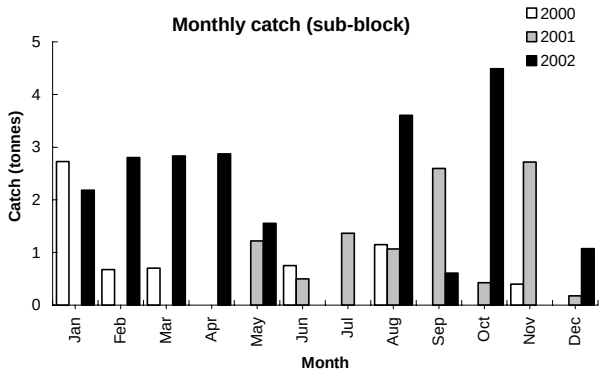
5.5 Block 3 (south-west King Island)



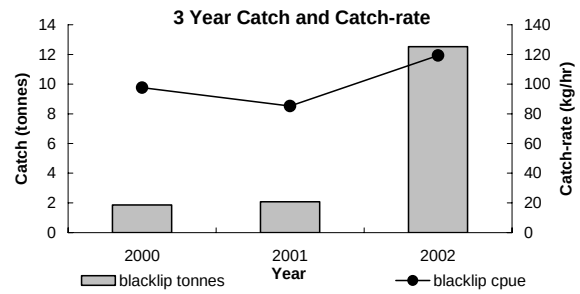
Catch rates falling slightly, huge increase in catch as two divers work long unexploited stocks.

The moderate catch rates prior to 2000 are due to the influence of greenlip effort on catches.

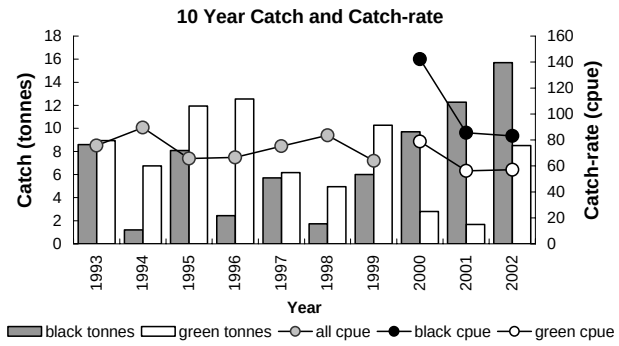
5.5.1 Sub-block 3A
Airport to Ettrick River

	The catch has risen substantially. The catch rate decline is probably more a response to weather/sea conditions or divers than to abalone abundance
	Between year comparison of catch rates are similar at comparable levels of catch.
	

5.5.2 Sub-block 3C
Cataraqui Point to Seal Bay

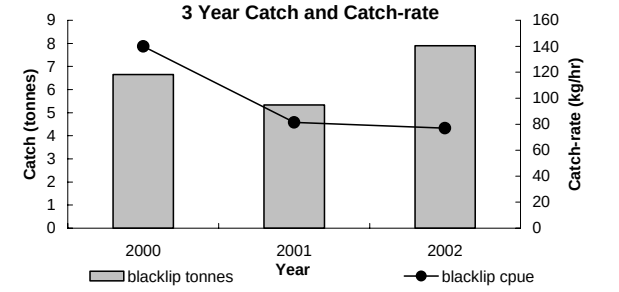
	This area is providing substantial catches for the first time in many years.

5.6 Block 4 (south-east King Island)

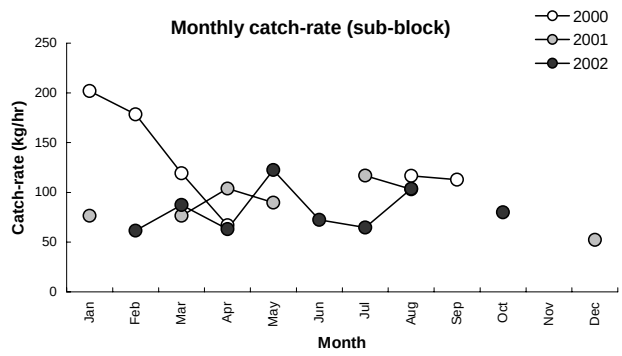


Catch rates are lower than Block 3, possibly because divers are taking greenlip as well as blacklip. This block was visited by divers on motherships whose catch rates were lower than those of the residents. Visiting divers may be less familiar with the coast, or work in less than optimal conditions than resident divers.

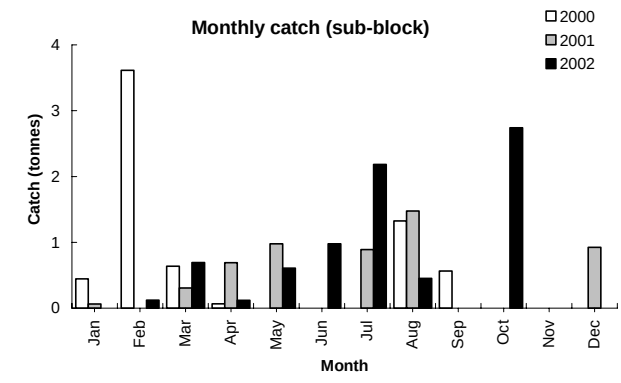
5.6.1 Sub-block 4C
Seal Bay to Grassy Harbour



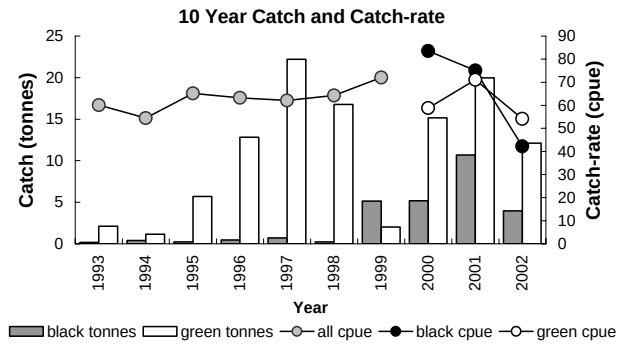
Catch fluctuates; catch rates are stable or falling slightly.



Catch rates for months where the larger tonnages were landed (July, October) are not particularly high.

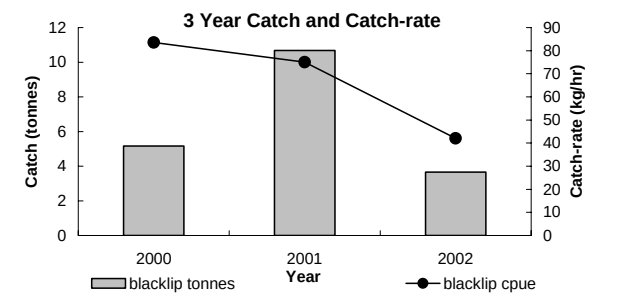


5.7 Block 39 (Tomahawk to Little Musselroe)

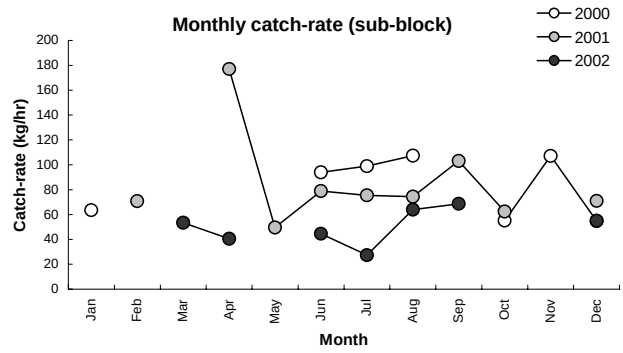


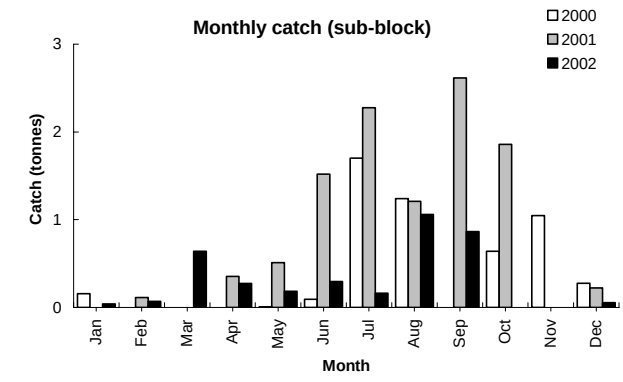
Catch and catch rates have fallen sharply. After rapidly depleting high stock levels in 2001, divers found it much more difficult to make worthwhile landings and the annual catch has reverted to insignificant levels.

5.7.1 Sub-block 39A
Petal Point to Little Musselroe Bay

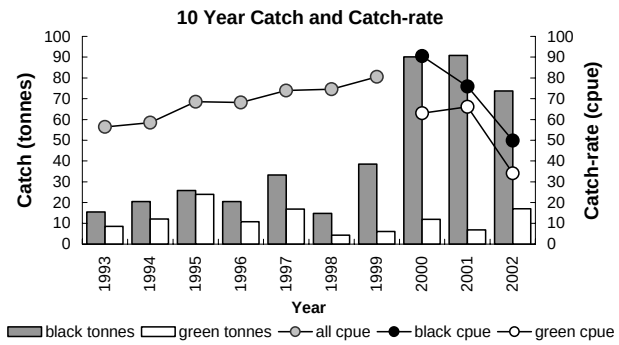


Almost all the blacklip catch is taken in this sub-block. Catch, catch rates have fallen rapidly.





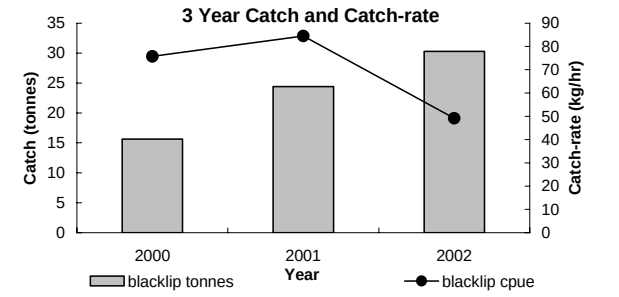
5.8 Block 31 (Little Musselroe to Musselroe Bay, including Swan Island)



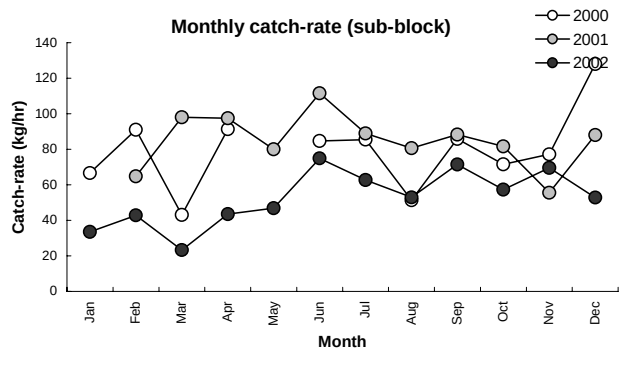
This block is part Northern Zone, part Eastern Zone. The zone boundary passes through the northern part of Sub-block 31A (which supplied 730 kg of Northern Zone catch in 2002). Effort is increasing in this block, while catch rates are falling sharply.

5.8.1 Sub-block 31B

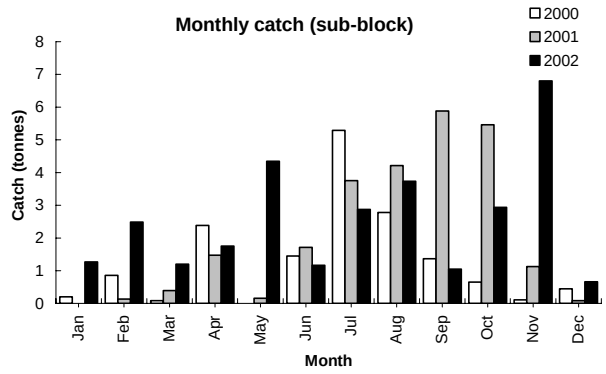
Little Musselroe to Musselroe Bay, including Swan Island



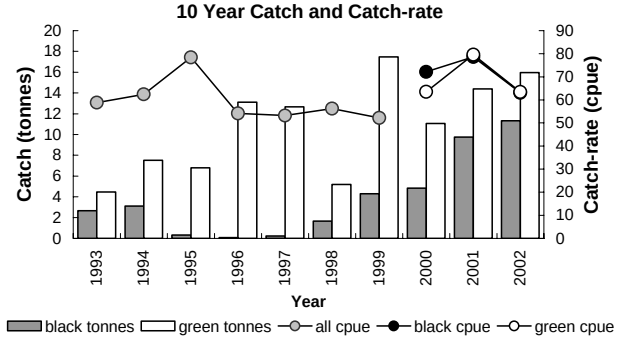
This sub-block has a very similar pattern of catch rates to sub-block 31A (i.e. low catch rates in the early part of the season), but was unaffected by the Eastern Zone size limit increase. Low catch rates in the region might be a response to seasonal conditions (thick weed growth?), and not just low stock levels.



Catches (and effort) have increased substantially since 2000.

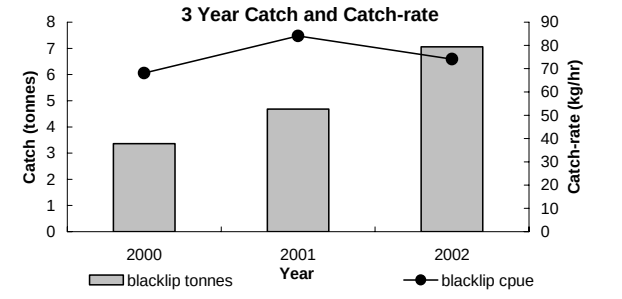


5.9 Block 33 (south-east Cape Barren Island)



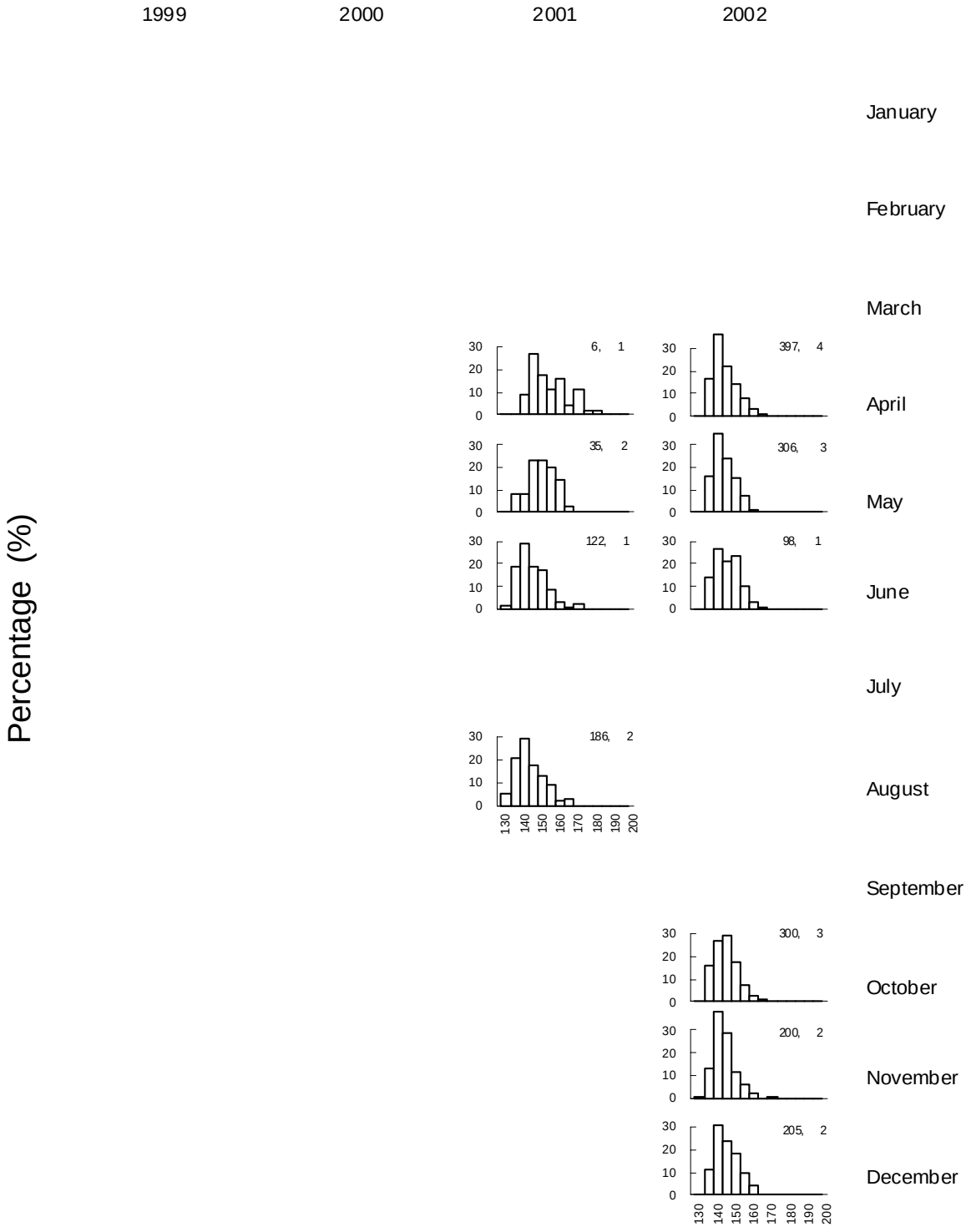
The Furneaux Group is a minor producer of blacklip, the abalone generally being too small and slow growing for the 127 –mm size limit. The larger abalone are to be found on the east and southeast parts of the Furneaux Group. Much of the catch from this block is taken by divers visiting the area to catch greenlip.

5.9.1 Sub-block 33B (Passage Island and shore including Cone Point)

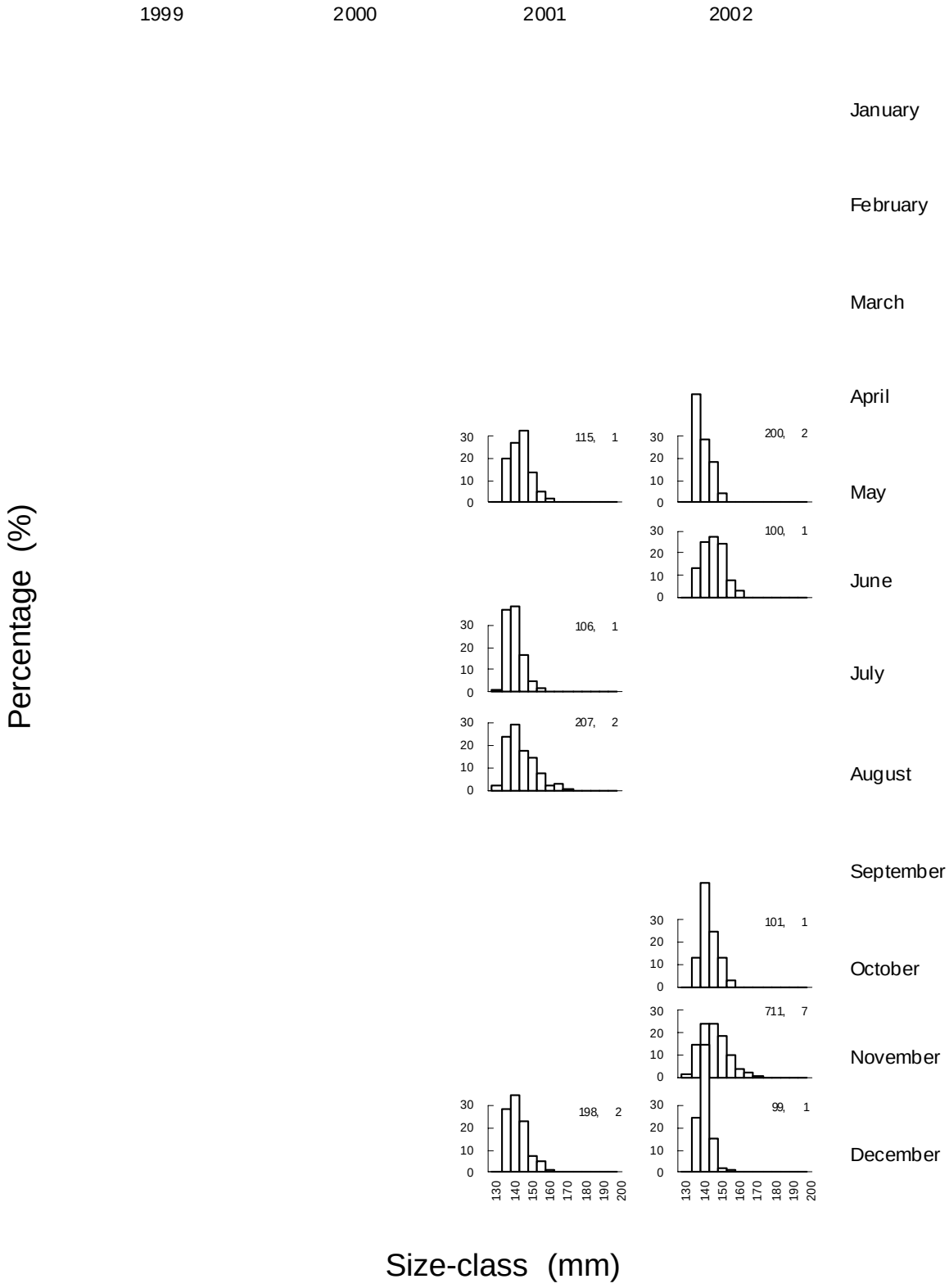


This sub-block and the one immediately to the east (33C) provide most of the blacklip catch from the Furneaux Group. The abalone habitat here is not extensive, being mostly fringing reef, and so catches are unlikely to increase beyond current levels.

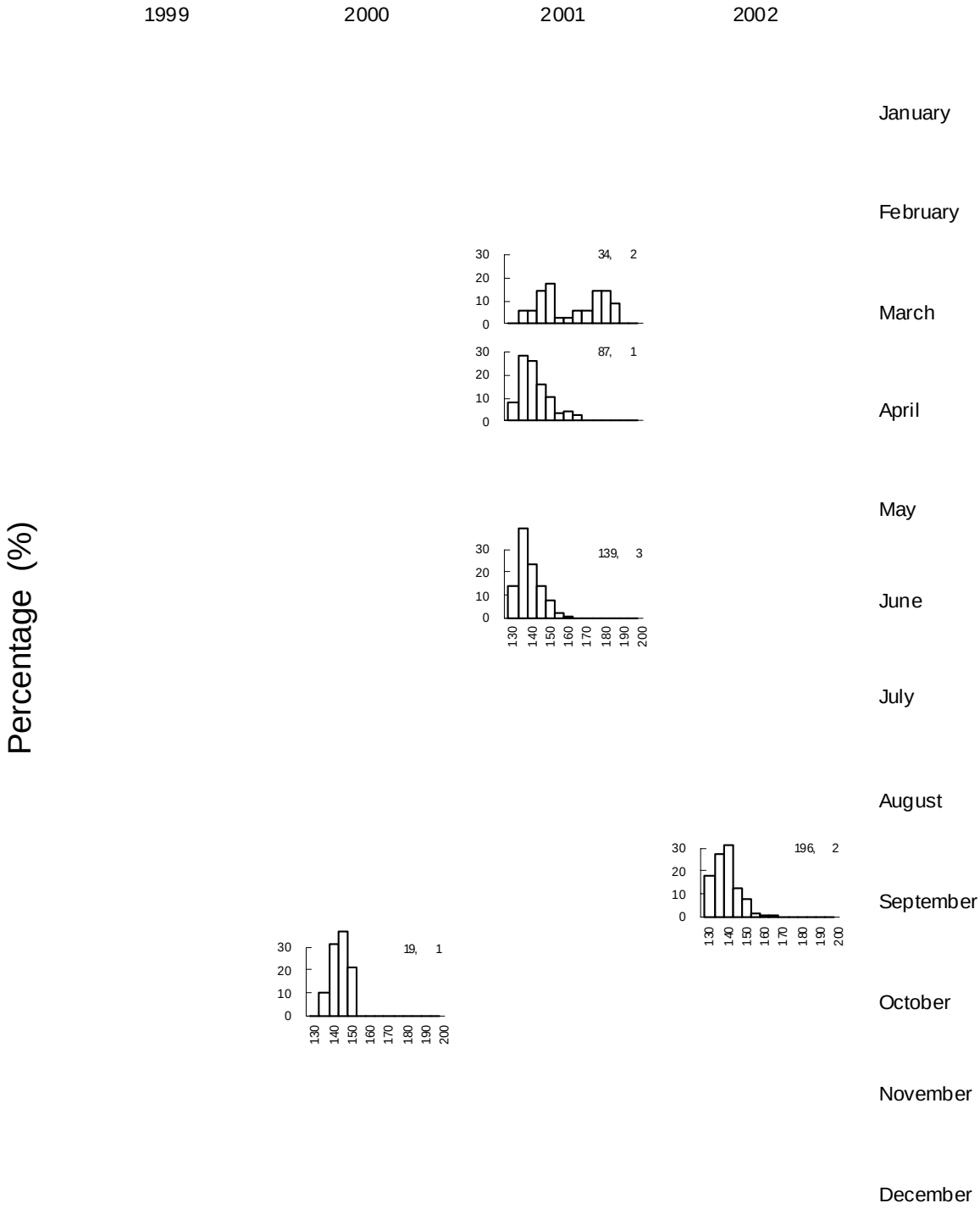
Sub-block 5A (size limit 132 mm)



Sub-block 5C (size limit 132 mm)

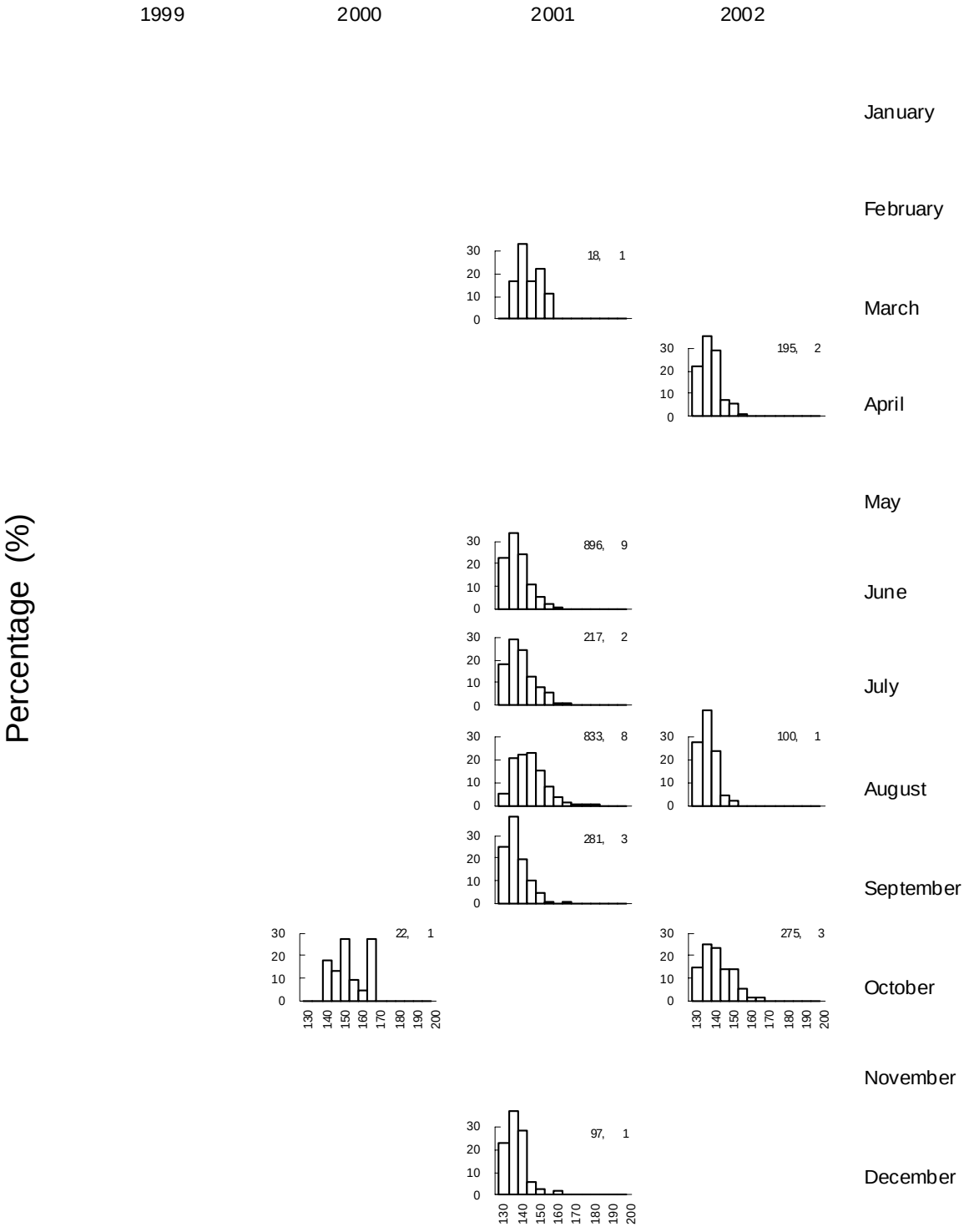


Sub-block 49A (size limit 127 mm)



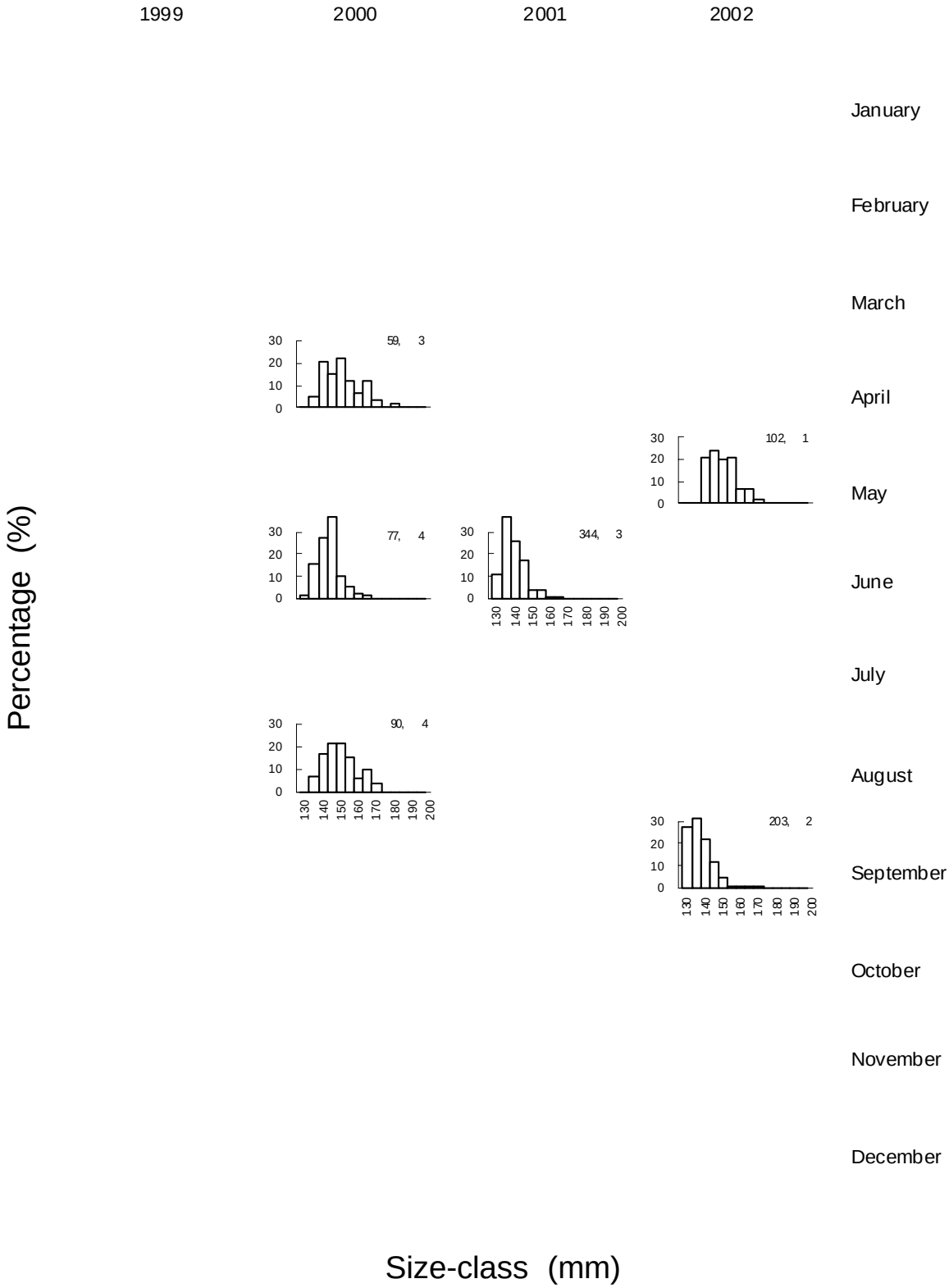
Samples from divers catches confirm that abalone from this part of the coast are much smaller than further south.

Sub-block 49C (size limit 127/132 mm)



Samples from divers catches confirm that abalone from this part of the coast are much smaller than further south.

Sub-block 31B (size limit 127 mm)



5.10 Northern Zone Summary

- The North West (Blocks 5, 48 and 49) produced about 60% of the Northern Zone catch in 2002 (compared with 74% in 2001), while King Island (Blocks 1 to 4) produced 22% of the catch.

- Since the Northern Zone fishery was created in 2001, there has been a rapid reduction of stocks that had built up following years of low levels of fishing mortality. Almost certainly, divers are depleting near-shore stocks before moving further offshore (localized serial depletion). Much of the catch is taken from aggregations rather than sparsely distributed individual abalone, consequently divers are able to maintain stable catch rates. Under these conditions, catch rate trends are not reliable indicators of abundance, and fishable biomass is probably being reduced much faster than any fall in catch rates would indicate.

- Blacklip catches from King Island (Blocks 1 to 4) continued to increase in 2002. While catch rates fell in Block 4, in the more productive Block 3 catch rates fluctuated at relatively high levels, implying that fishable stocks were at high levels. The King Island catch more than doubled, compensating for lower catches in the North West. Most of the King Island catch was taken by two resident divers. While greater amounts of catch could probably be taken from the island (potentially transferring more effort from the heavily fished North West), visiting divers find that it is difficult to coordinate their visits with suitable weather conditions, and that it is more costly to work so far from their established fishing areas. As a result, it is unlikely that more effort will be transferred to the island, and that most of the blacklip catch will continue to be caught by resident divers.

- In the North West (Blocks 5, 49 and 48), blacklip catches fell from 2001 levels. Generally, catch rates fell also. The creation of the Northern Zone in 2001 created opportunities to fish stocks that had been visited infrequently since the implementation of a quota based fishery in the mid 1980's. Catch rates were initially high as divers fished built up stocks, but as fishing mortality impacted on the more accessible populations, catch rates started to fall.

- Under the current zoning system, the North West region will continue to be heavily fished. It now offers the possibility of working in three zones plus the greenlip fishery, with good supporting infrastructure.

- Much (37%) of the 2002 catch came from Block 5. The improvement of the road and development of a boat ramp at Bluff Hill Point made it easier to operate here in 2002, and it rapidly became a popular place to work from. The ramp is in the southern part of Sub-block 5C, and catch rates and catches in that sub-block have dropped, causing divers to transfer effort to the more northern (and distant) Sub-block 5B, where catch rates, although higher than Sub-block 5C also fell. There was a slight increase in catch from Sub-block 5A.

- The size composition of samples from Block 5 catches show that while abalone are usually small (modal between 136-140 mm), there is no evidence of structural change consistent with high levels of fishing mortality. Catch rates for

Block 5 in 2002 were generally between 80 and 100 kg/hr, which, considering the small size of the abalone must be considered acceptable. However, a further decline of catch rates or a downward shift in size of sampled abalone would indicate that fishing mortality was too high for sustainable stock levels.

- Catch rates from north of Woolnorth Point (Hunter and Three Hummock Island -Block 49) fell slightly in 2002. Catch samples indicate that the size structure of the catch is stable. The more remote parts of this block, particularly the northern end of Hunter Island and remote offshore islands, are fished infrequently. Catch data indicate that there are isolated but dense populations of abalone here that are occasionally taken at high catch rates. In nearby Block 48, where blacklip catch rates also fell, most of the catch appeared to be taken as part of combined blacklip/greenlip fishing operations.

- The North East and Furneaux Group were fished by many divers in 2002 who visited the area to catch both greenlip and blacklip abalone, from both runabouts and motherships. In Sub-block 31B, the 2002 catch increased by 25% over the previous year, while catch rates fell sharply. Perhaps visiting divers unfamiliarity with the area caused some of the catch-rate fall: some resident divers maintained consistently high catch rates. Approximately one third of the catch was taken before winter when diving would have been hampered by thick weed growth. Significant catches also came from the southern part of the Furneaux Group, particularly the south east side of Cape Barren Island (Sub-blocks 33B, 33C). Babel Island (Sub-block 38A) and parts of Block 40, particularly Waterhouse Island contributed small catches.

6. Greenlip Fishery

6.1 Greenlip fishery – major fishing blocks

Catches from the North West (Blocks 49 and 48) fell sharply, but were compensated by strong increases from Blocks 3 and 31. There were significant landings from Block 38 in 2002, while catches from Blocks 39 (North East) and 32 (Furneaux Group) fell.

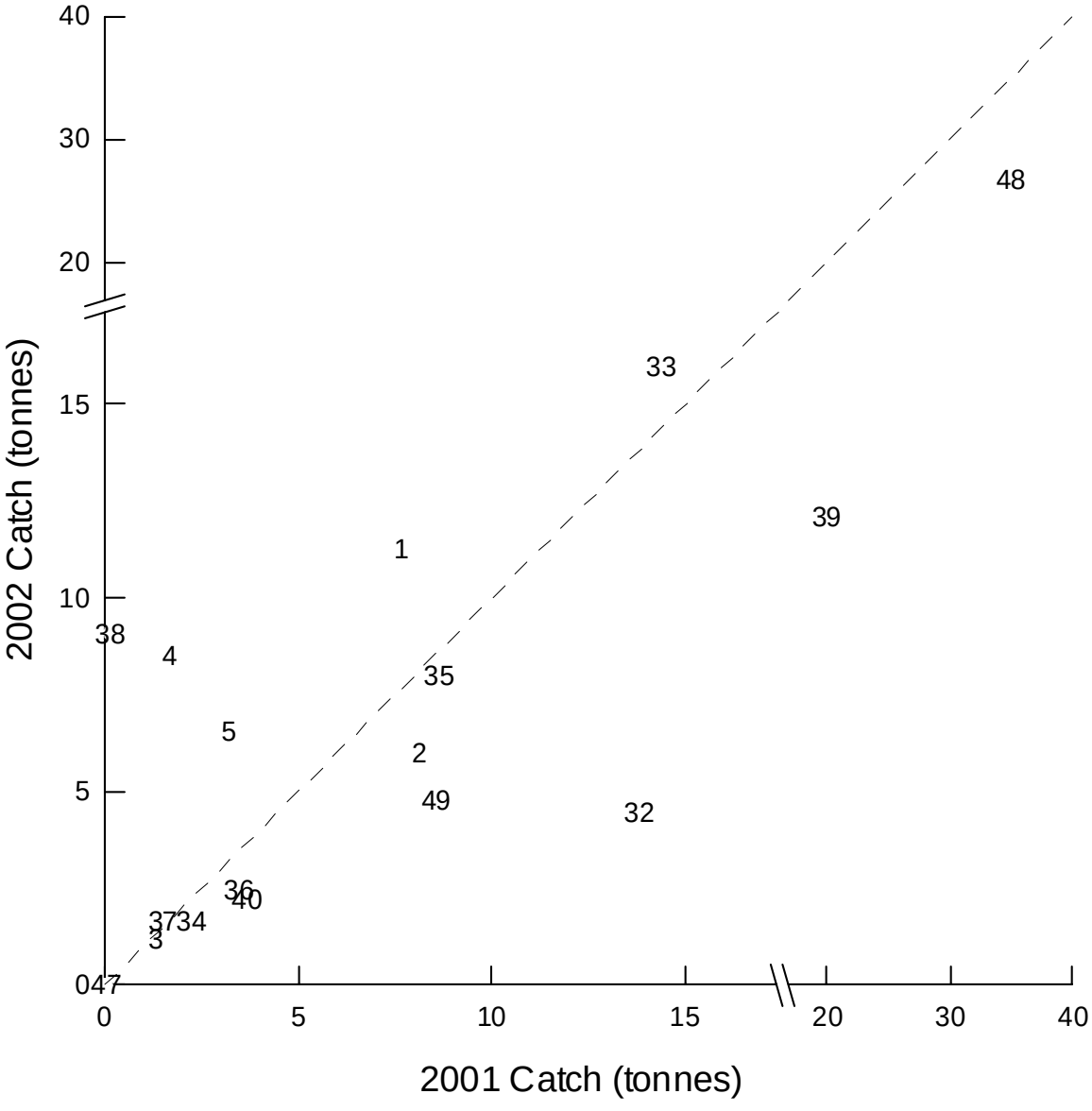
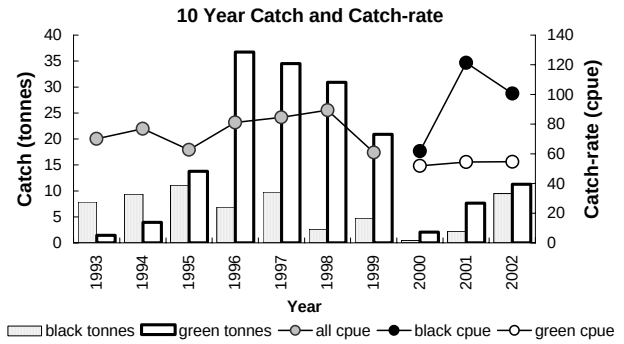
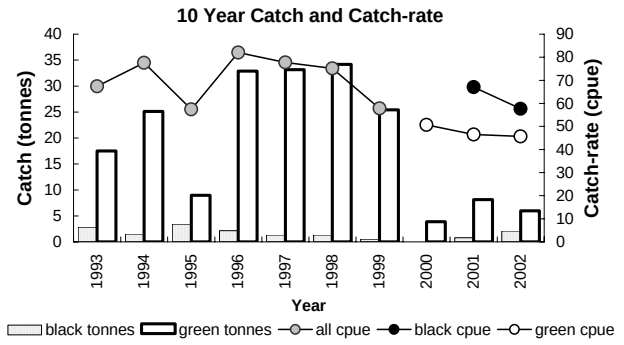


Figure 12. Greenlip catch from Blocks 1 to 49). In 2002, the Northern Zone TAC (280 tonnes) was unchanged from the previous year. Blocks to the left of the diagonal line reflect increased catches over 2001 levels, blocks to the right reflect falling catches.

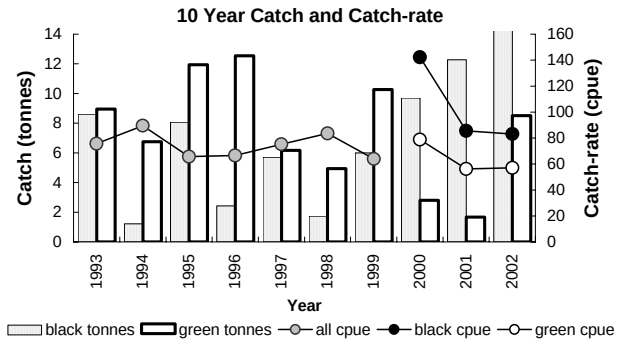
6.2 Block 1 (north west King Island)

	Low level of catch, stable catch rates. This block is recovering from the mid 1990's when large catches were taken at a much smaller size limit.

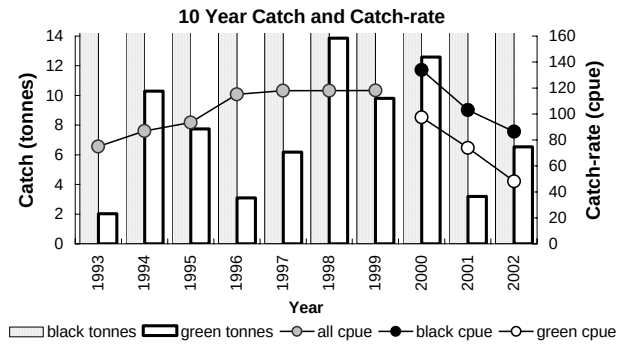
6.3 Block 2 (north east King Island)

	Low level of catch, slowly falling catch rates. As with Block 1, stocks levels were affected by heavy fishing pressure in the mid 1990's.

6.4 Block 4 (south east King Island)

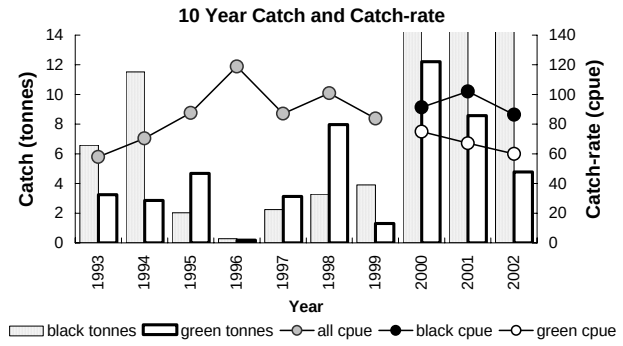
	Moderate levels of catch, moderate catch rates.

6.5 Block 5 (west of Woolnorth Point)



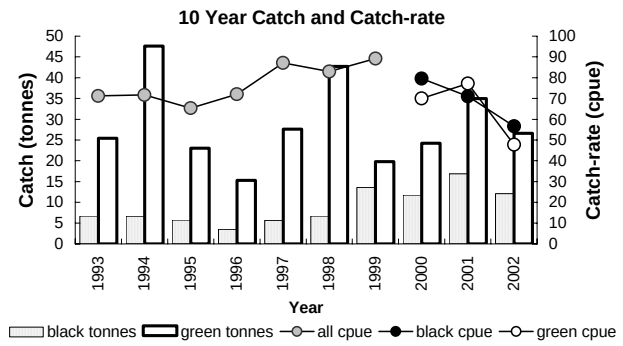
There was a slight rise in catch in 2002, but levels are below those of earlier years. Some isolated good catches were taken at reasonable catch rates, often in conjunction with blacklip catches, but otherwise levels of effort were high for average sized catches.

6.6 Block 49 (Woolnorth Point to Hunter Island, including Three Hummock Is.)



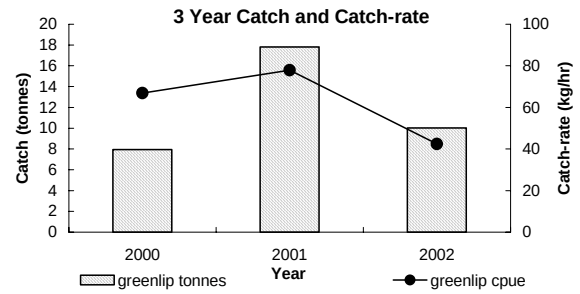
Greenlip catches and catch rates are falling here in response to high levels of effort. Occasionally good catches are landed from the more remote parts of the block.

6.7 Block 48 (Woolnorth Point to Duck River, including Black Reef)



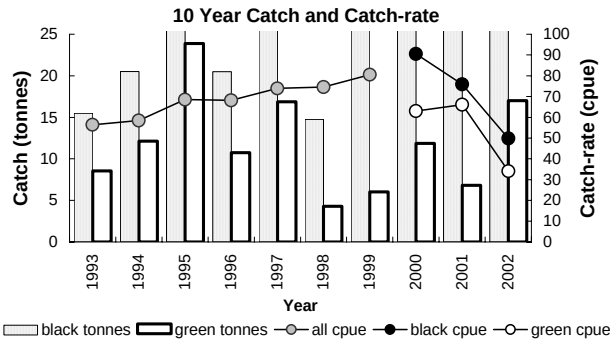
Traditionally, this block has been a consistent producer of greenlip abalone. The lower catches and catch rates could be a response to increased size limit. Market samples show a preponderance of smaller abalone from this block

6.7.1 Sub-block 48A
Black Reef



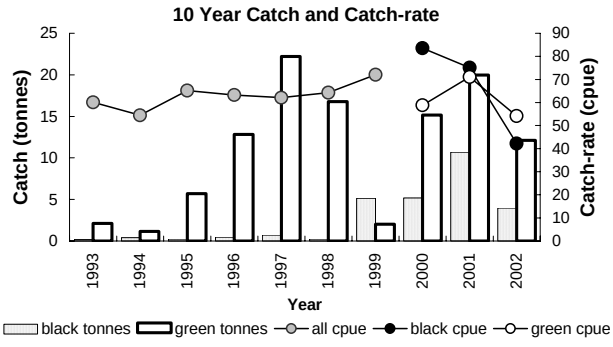
Black Reef reportedly has smaller abalone than in other parts of the block. The lower catches and catch rates may reflect the affects of the increased size limit more than falling abundance. Divers transferred effort to the other sub-blocks, where catch rates also fell.

6.8 Block 31 (Little Musselroe to Cape Naturaliste)



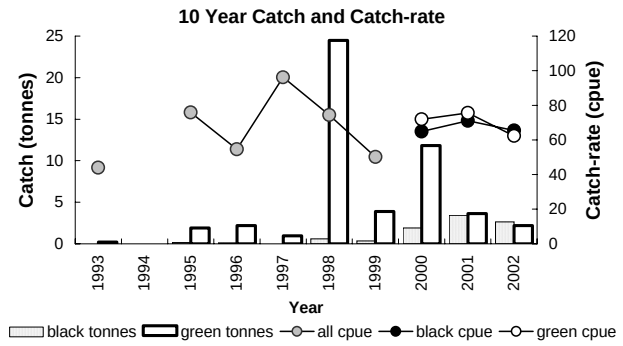
Moderate levels of catch, recent sharp fall in catch rates. Some of the catch attributed to this block is reported to have come from the Furneaux Group, so the increased catch in 2002 may be incorrect.

6.9 Block 39 (Little Musselroe to Tomahawk)



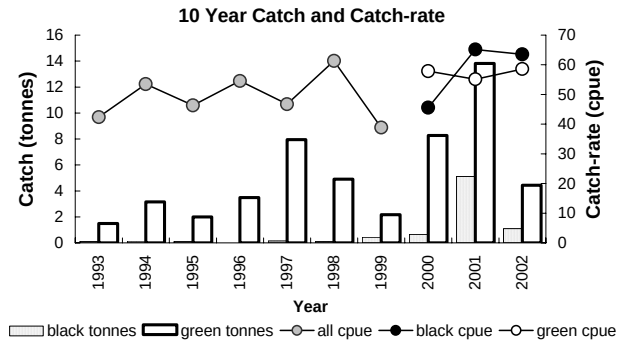
Inshore greenlip stocks here are depleted, and the best catches come from offshore reefs exposed to strong tidal movements. These reefs have also been heavily fished in recent years, and their ability to continue supplying consistently high levels of catch must be questioned.

6.10 Block 40 (Tomahawk to Waterhouse Beach)



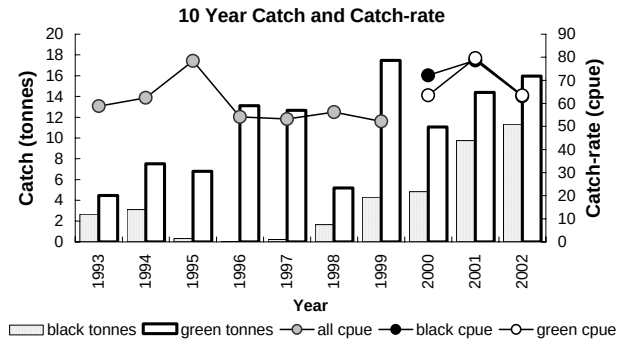
Although occasionally yielding large annual catches, this area takes many years to recover, and cannot be relied upon to consistently produce significant tonnages.

6.11 Block 32 (south Cape Barren Island, Armstrong Channel)



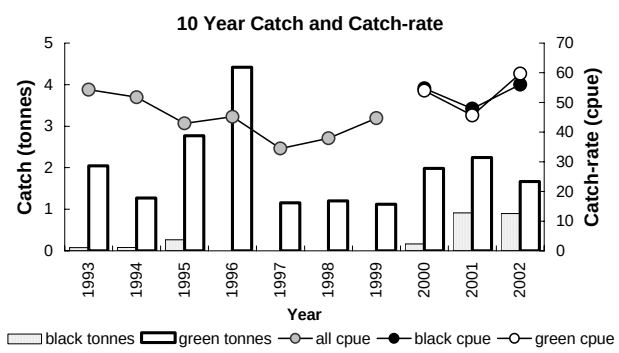
Catches in this block were lower mostly because effort was directed to the adjacent Block 33. Catch rates are stable. It was reported by one processor that the large premium abalone from here are scarcer.

6.12 Block 33 (south east Clarke, Cape Barren Islands)



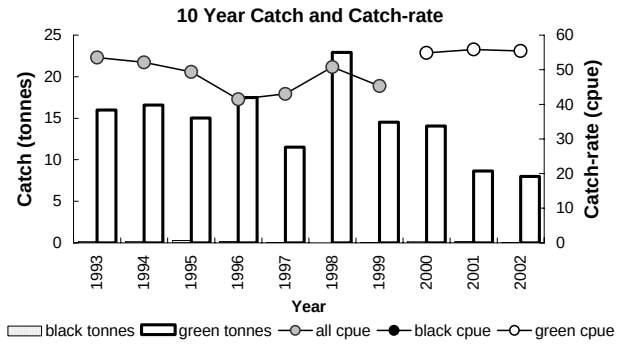
This block continues to produce consistent yields of both greenlip and blacklip abalone for both resident and visiting divers. It is accessible to runabouts from the Tasmanian mainland, and together with Block 32, some of the catch from here has been attributed to Block 31.

6.13 Block 34 (west coast Flinders, Cape Barren Islands)



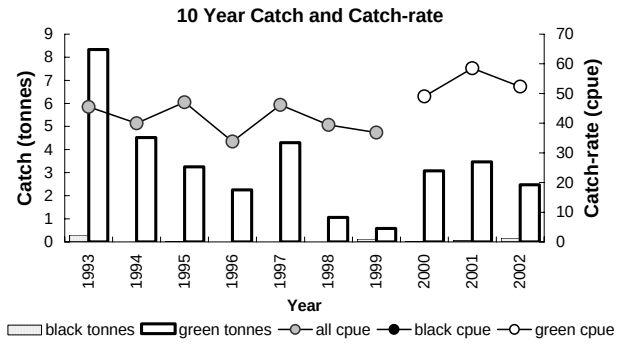
This block is infrequently visited, and then, only by resident divers, producing low levels of catch with fluctuating catch rates.

6.14 Block 35 (Franklin Sound)



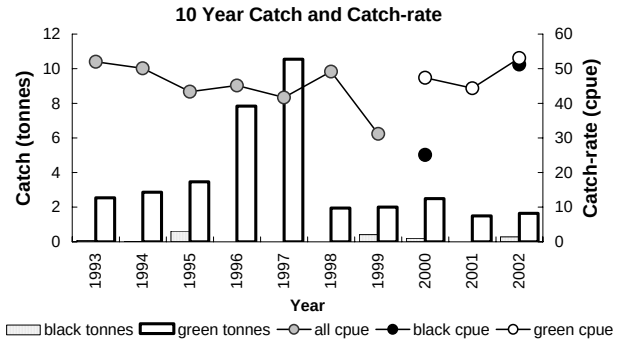
Catches from the Franklin Sound fishery have fallen from the levels of earlier years, not because of reduced stock levels, but because of lower levels of total effort by resident divers.

6.15 Block 36 (east coast Flinders, Cape Barren Islands)



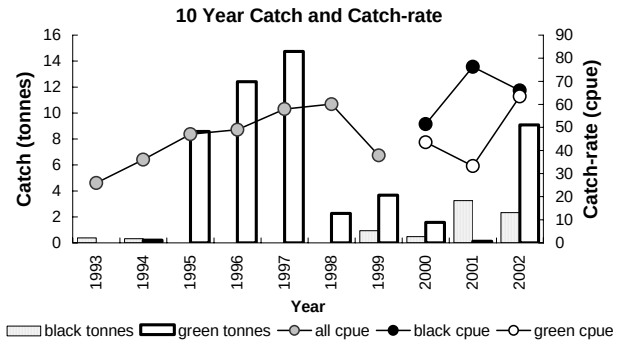
This block is infrequently visited, and then, only by resident divers, producing low levels of catch with fluctuating catch rates.

6.16 Block 37 (north west Flinders Island)



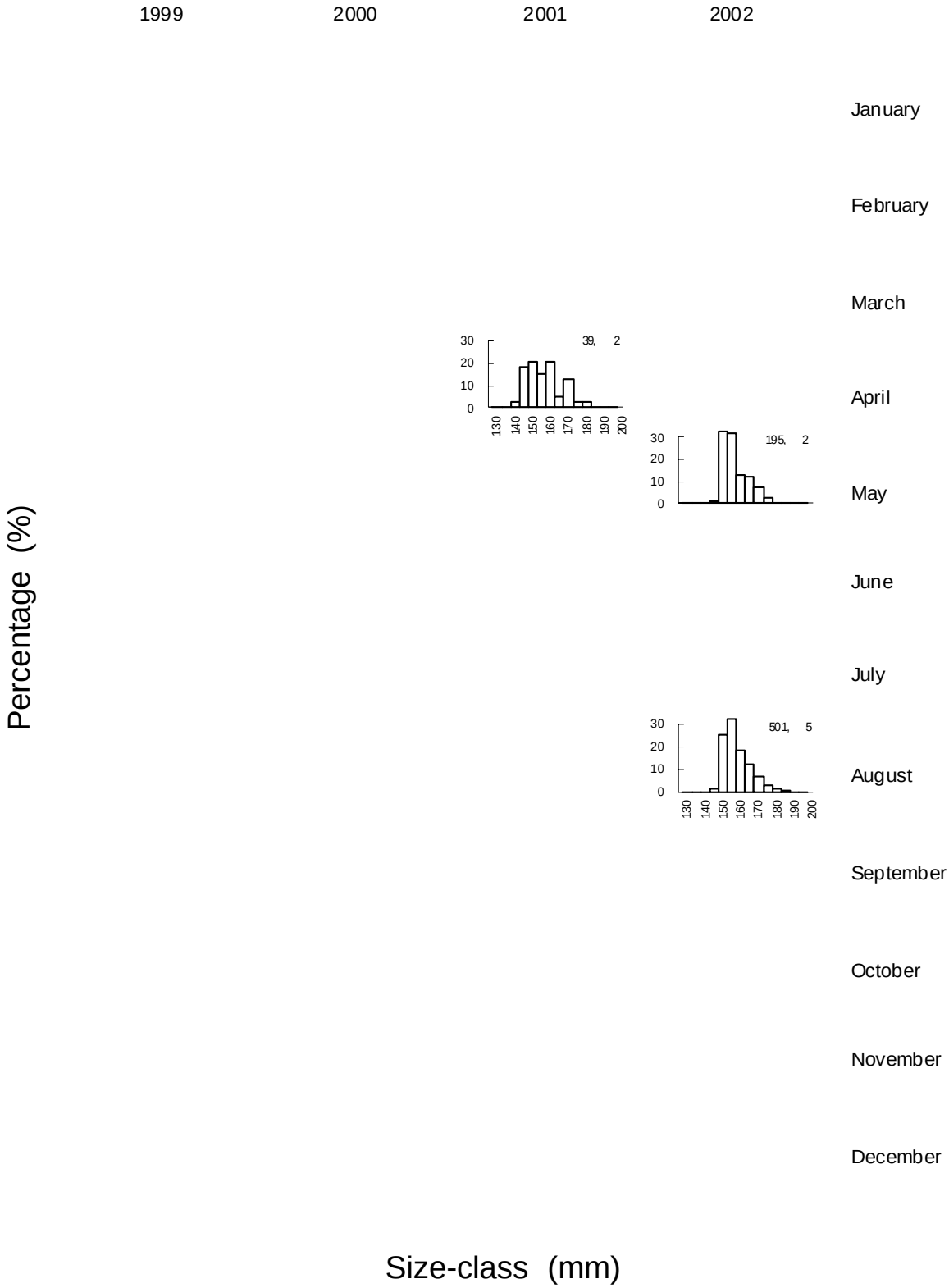
This block is infrequently visited, and then, only by resident divers, producing low levels of catch with fluctuating catch rates.

6.17 Block 38 (north east Flinders Island)

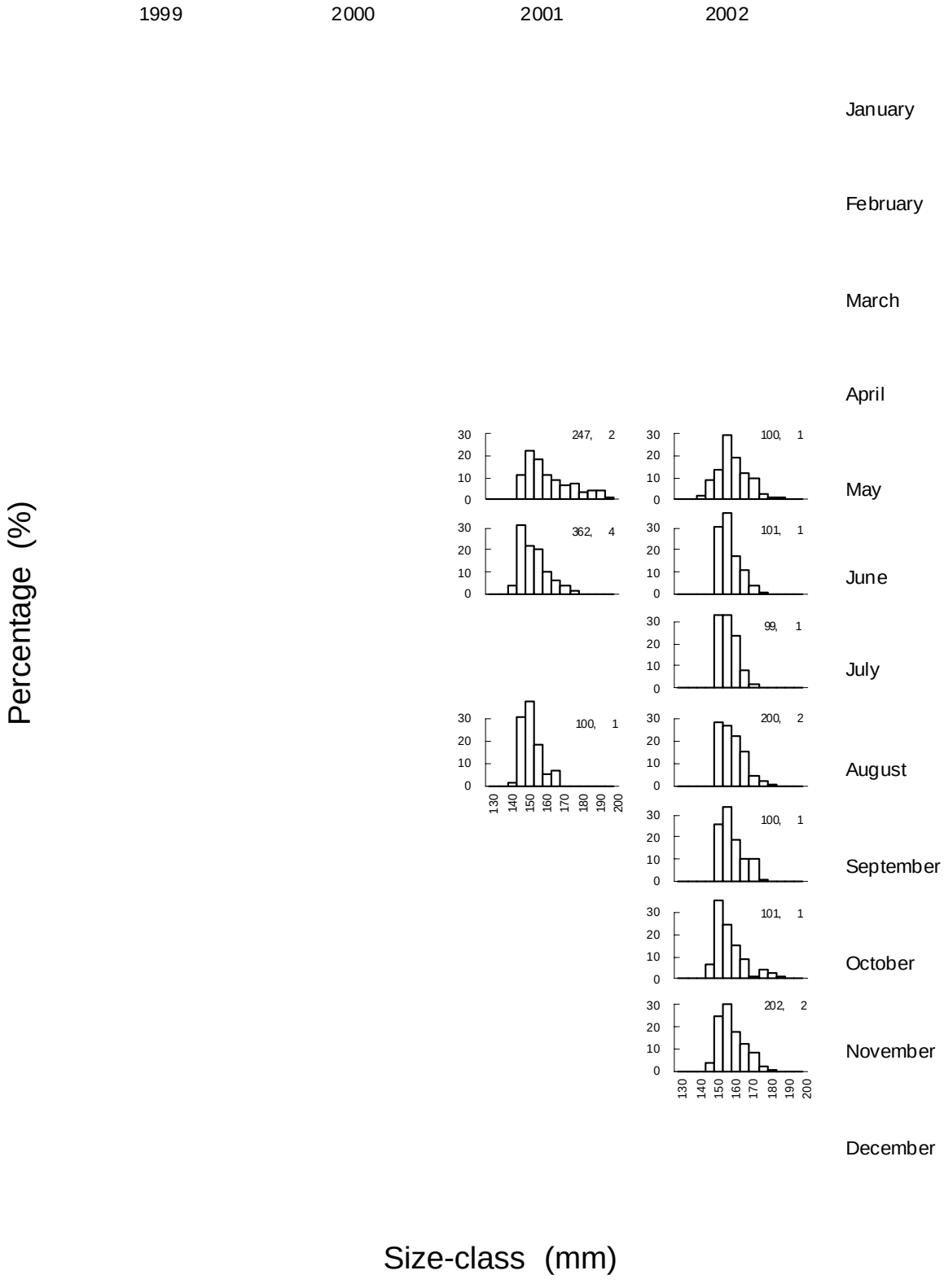


Resident divers who have a good knowledge of the distribution of fishable stocks fish this block sporadically.

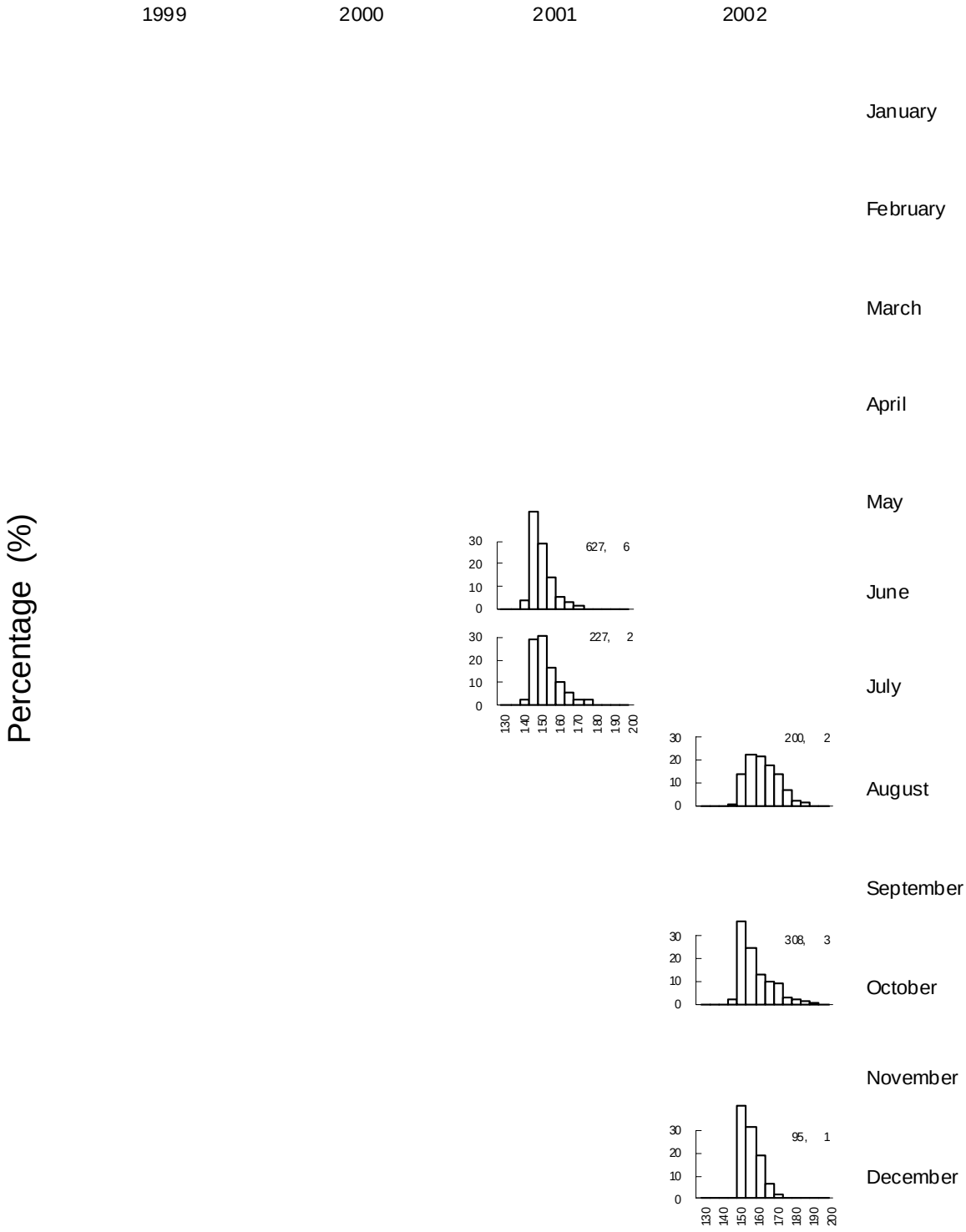
Sub-block 5A (size limit 145 mm)



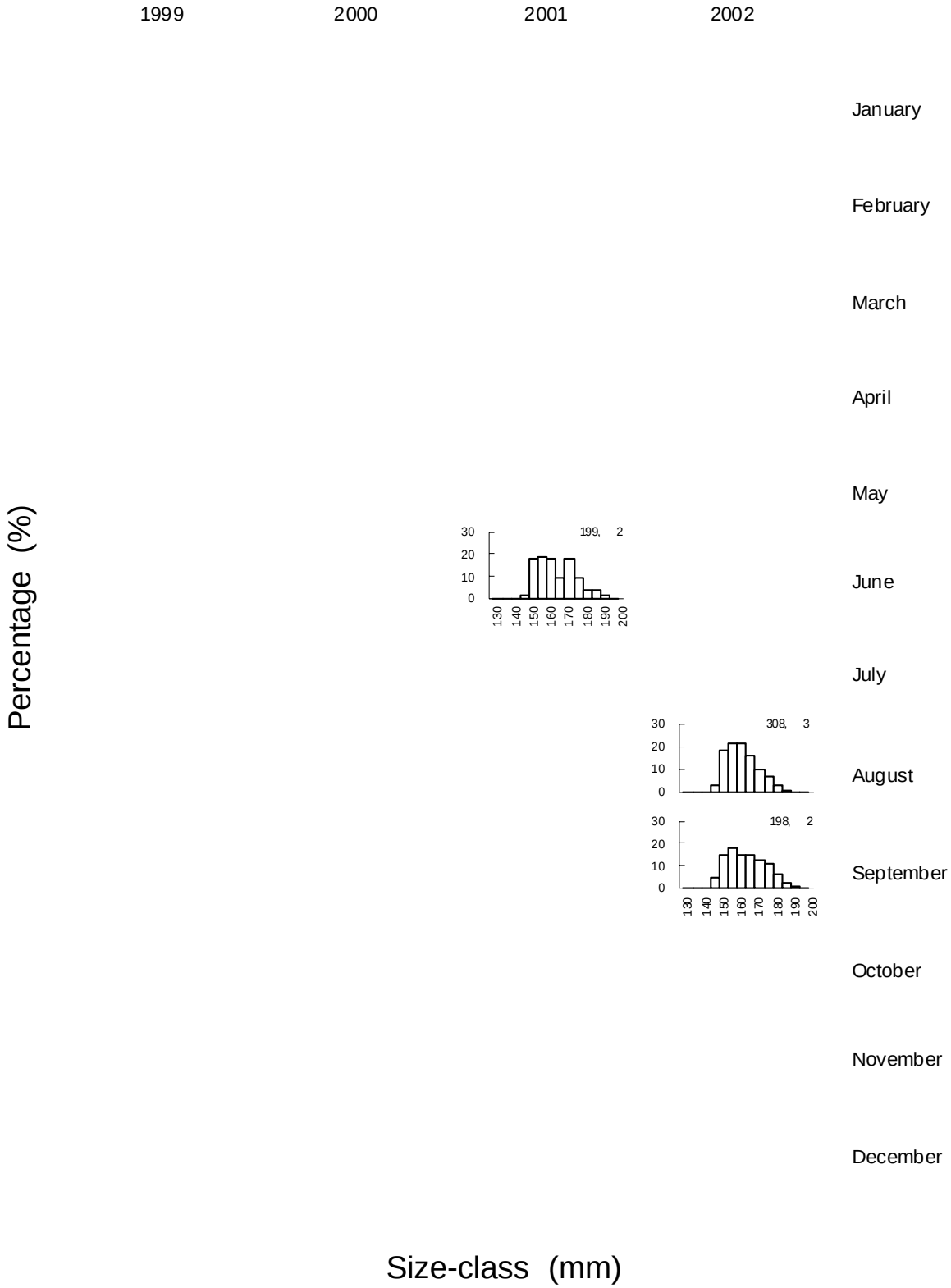
Sub-block 48A (size limit 145 mm)



Sub-block 48C (size limit 145 mm)



Sub-block 31B (size limit 145 mm)



6.18 Greenlip Fishery Summary

- Catches from three of the four greenlip producing regions were capped in 2002. The North East was capped at 30 tonnes, the Furneaux Group at 42 tonnes and the North West at 40 tonnes, leaving 28 tonnes to be taken from King Island. It is understood that some of the catch attributed to the North East was caught from the Furneaux Group.

- While the two resident divers took most of the King Island catch, several motherships visited King Island in 2002. Catch rates over recent years have mostly been stable at levels between 50 and 60 kg/hr. Since recent size limit increases, the King Island greenlip fishery has relied heavily on populations of larger growing abalone from Sub-block 1B (New Year and Christmas Islands), and in the south east (Block 4), while areas that hold smaller abalone go unfished. Should effort be further diverted from the other greenlip regions, this fishery could be jeopardised.

- In the North West (Blocks 5, 49, 48 and 47), catch rates fell. Some divers who found isolated concentrations reported catches over 500 kg, but for the most part daily catches were closer to 200 kg. Catch rates at Black Reef (Sub-block 48A) are reportedly adversely affected by the recently increased size limit. It is believe that in this particular part of the block abalone grow to smaller sizes than further west. The size composition of samples from the catch confirms that most abalone are caught within 10 mm of reaching legal size, but whether this is caused by restricted growth or high levels of fishing mortality or a combination of both is not clear. Many divers who fish here believe that too much catch is taken from the North West, that catch rates are too low for them to travel there from other parts of the state, and that the fishery will decline further unless the level of catch is reduced.

- Catch rates also fell across the North East. In 2001, good catches at relatively high catch rates were reported from Block 39. However, in 2002 there was a strong downturn from this part of the fishery, which saw a shift in effort from west of Little Musselroe (Block 39) to the east (Block 31). Prior to winter in Block 31, in common with Northern Zone blacklip catches here, greenlip catch rates were particularly low. It is reported that fishable populations of greenlip abalone in inshore areas have become depleted, while offshore concentrations of greenlip have become harder to find. In contrast to catches from the North West, samples of North East abalone contain larger abalone.

- The Furneaux Group greenlip fishery appears to be relatively healthy compared with the mainland Tasmanian fishery. While catch rates are stable, the level of catch changes between blocks over time. For example, Block 38 (north-east Flinders Island) has produced little catch in recent years, but in 2002 produced 9 tonnes. Catches taken from the northern part of the Furneaux Group usually come from isolated patches in deep water, and successful fishing relies heavily on local knowledge. Much of the fishery around these islands depends upon periodic breaks from fishing to recover, and sustained levels of fishing could severely impact upon stock levels. While catch data from the south around Clarke Island and Cape Barren Island (Blocks 32, 33) continue to indicate a robust fishery, this area has declined previously in the face of heavy fishing pressure. It has been reported by a processor that larger premium sized abalone from here have become more scarce, which

indicates that fishable stock depletion is occurring. The Franklin Sound fishery continues to produce moderate tonnages at moderate catch rates.

7. Recreational fishery

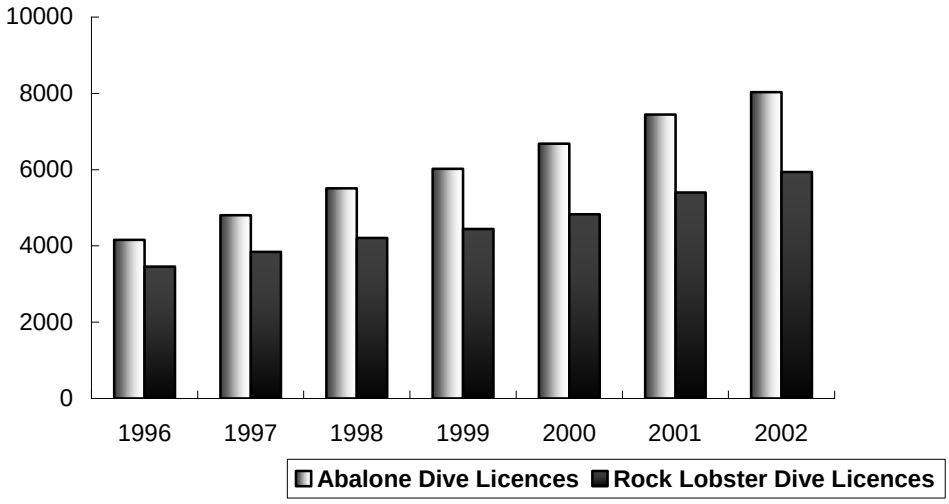


Figure 13. The number of licenses issued by DPIWE to recreational divers for abalone and rock lobster, for the fishing seasons 1995-96 to 2001-02 (from data supplied by Licensing and Administration Section, Marine Resources, DPIWE).

The number of recreational licenses continues to increase at about 10% per annum (the number of recreational licences reported in the 2001 Abalone Fishery Assessment was incorrect). DPIWE have no information to explain why the number of licences should increase at this rate, and considering that the Tasmanian population is stable and ageing, who is contributing to the increase. From data collected by TAFI researchers into the recreational fishery, it appears likely that the estimated catch at the end of the 2001 season was about 140,000 abalone, or approximately 70 tonnes. About half of this was taken in the southeast, between Marion Bay and Whale Head, and another 25% was taken from further north on the East Coast.

In addition to the recreational catch, abalone are caught in Tasmanian waters as part of cultural fishing activities by indigenous people, under exploratory permits for special events (e.g. Binalong Bay Abalone Festival) and for research purposes (e.g. TAFI sponsored abalone research), and as part of illegal fishing operations. There are no estimates available for either the illegal catch or for the total catch from cultural fishing activities. The quantity of abalone taken under exploratory permits was less than five tonnes.

8. Discussion

8.1 The use of fishery data to infer changes in abundance

This assessment is primarily based upon the interpretation of information produced from fishery catch data. One of the problems with working only with information produced from the fishery is that inferences must be made about the state of the whole population from changes in the fishable stock. It relies upon the assumption that catch-rate changes accurately reflecting changes in abundance of the fishable stock. This was discussed in the 2001 abalone stock assessment (Tarbath *et al.*, 2002), where it was concluded that at the low stock levels currently found in the Eastern Zone, catch rates are probably reliable indicators of abundance. Researchers of the New South Wales abalone fishery had earlier arrived at a similar conclusion (Worthington *et al.*, 1998). However, where abalone abundance is comparatively high, and they are grouped in large clusters, the rate of change in abundance may occur much faster than the rate of change in catch rates. In parts of the fishery where catch rates are high, such as south west Tasmania or parts of the Northern Zone, abalone abundance may potentially fall at much faster rates that indicated by catch rates. Under these circumstances, catch rates are not reliable indicators of abundance and extra care is needed when attempting to interpret such information.

This assessment is restricted to catch data from the past 10 years of the fishery. One of the features of modern fisheries is that fishermen find ways and utilise new technologies to make their operations more efficient, and the abalone fishery has been no exception. Thus more abalone can be collected in a given period of time now than in the past, even if stock levels were unchanged. This causes catch rates to rise without abalone abundance changing, or conversely for catch rates to appear stable when in fact the stocks are declining. For example, early in the fishery, divers anchored their boats, and often worked without a deckhand. During the 1970's, the boats carried a deckhand who drove the boat and followed the diver, thus eliminating time spent swimming the catch from the reef to the anchored boat. However, anchored boats and long hoses were still used well into the 1980's. It was estimated that the catching efficiency of divers doubled between the start of the fishery and 1982 (Harrison, 1983). During the late 1980's, divers widely adopted the practise of attaching their collecting nets to ropes, which were then lowered to them by their deckhands. This meant that they no longer had to surface to the boat every time they filled their nets, greatly increasing their productivity. This increase in efficiency ("effort creep") is extremely difficult to quantify, so rather than make guesses about how much more efficient current divers have become, we have limited our comparison of catch rates to a period during which we think that divers operated with equal efficiency i.e. the last 10 years. We can therefore be reasonably sure that catch rate trends represent changes in abundance, not changes in fishing power.

Much of the Tasmanian fishery experienced falling catch rates in 2001 and this has continued through 2002. This naturally produces a rather disturbing view of the fishery, and the obvious response is to reduce the TAC's in affected areas. However, the Eastern Zone TAC was reduced by 23 percent at the start of 2002, and yet generally, catches and catch rates are still falling.

8.2 Significance of catch-rate falls

The recent catch-rate declines need to be reviewed within the context of each particular fishery i.e. the level of catch where the catch rates changes occurred, and any other changes to the fishery such as size limit increases or market induced pressure to catch only small abalone.

8.2.1 The effect of changes in size limits and market preferences on catch rates

The size limit was increased throughout the Eastern Zone on 1st January 2002, from 132 mm to 136 mm. This immediately reduced the amount of fishable stock, thus reducing catch rates. From biological studies of abalone growth in the Eastern Zone, we can determine the period that it would have taken for abalone to grow to the new size limit. In particular, from tagging studies of two populations at the Actaeons, it was found that on average, at one site 132-mm abalone grew nearly 11 mm (standard deviation 4.8 mm) in one year, while at the other site, 132-mm abalone grew 6.9 mm (standard deviation 2.8 mm). Because abalone growth is seasonal, and is faster in the months of warmer water temperatures (typically the peak occurs in March), those 132-mm abalone from the faster growing population that would previously have been part of the fishable stock, would on average have reached the new legal size within several months of 1st January. At the slower growing site, recruitment effectively would have been complete by winter. This means (assuming natural mortality was negligible during the period it took to grow from 132 to 136 mm), that any reduction in catch rates due to lesser numbers of abalone caused by the size-limit increase would be increasingly difficult to detect approaching winter, and from then would have no effect.

While the numbers of available abalone were initially reduced by the size-limit increase, the increase in average size meant that the average weight of catches would be higher. This would help mitigate the fall in catch rates associated with the size increase. Between 2001 and 2002, at Sub-block 13E in the Actaeons, there was a significant ($P<0.0001$) increase in average size of abalone that were measured in samples of diver's catches. Using a length/weight relationship for abalone from that region, the size increase translates to a six percent increase in average weight. This, for example, means that a typical 200 kg catch in 2001 that comprised on average 424 abalone would weigh 212kg in 2002. Conversely, it would only take 400 abalone to obtain the same 200 kg catch.

If fishable stock levels at the Actaeons were static in 2002, assuming that the growth study represents the range of growth rates among the Actaeons populations and that all the 132-mm abalone became fully recruited, there should have been a slight increase in catch rates during the latter half of the year as the 132 - 136mm animals grew above the size limit. Comparison of catch rates between the same months in 2002 and 2001 for Sub-blocks 13C, 13D, and 13E is made difficult because the fishery was closed at the Actaeons in 2001 for several months in the last part of that year. However, the comparison shows that catch rates in Sub-block 13C fluctuate erratically, fall in Sub-block 13D, and are static in Sub-block 13E. There are no signs of improvement among catch rates in 2002, which are at lower levels than in 2001. Clearly, the fall in catch rates in Block 13 since 2001 was not caused by the increase in size limits, and must therefore reflect falling levels of the fishable stock.

From our limited knowledge of spatial variation in abalone growth throughout the Eastern Zone, it appears reasonable to assume that in most other blocks catch-rate falls similarly reflect a fall in fishable stock levels rather than the influence of increased size limits. There may be exceptions in the two blocks north of St Helens (Blocks 30 and 31) where abalone growth rates are lower than elsewhere in the Eastern Zone. However, because of the previously high levels of catch from Block 31 and the poor state of stocks in Block 30, we conclude that falling catches and catch rates are primarily due to falling stock levels rather than the increase in size limit.

Market preferences for small abalone have the potential to reduce catch rates in areas where there are significant numbers of large abalone. In 2003, there have been many reports of divers working in south west Tasmania taking only small abalone and leaving large abalone on the reef because the large abalone were unacceptable to the live-market processors. This has had an immediate effect upon catch rates, causing them to fall independently of stock levels. However, in 2002, there were no similar reports of divers selectively fishing for small abalone, particularly in the areas where catch-rate declines occurred, so it is assumed that changes in catch rate were not caused by market preferences.

8.2.2 The effect of changing levels of catch on catch rates.

Catch is described in spatial terms i.e. the amount of tonnes from an area of the fishery such as blocks and sub-blocks. When assessing appropriate levels of catch for an area, and assuming that stock levels are stable, we expect reefs within an area to supply abalone at the same rate from year to year. However, when the catch history of the fishery is examined, we find that this is an unrealistic expectation, and that levels of catch from blocks may rise, as they did a few years ago, or stop producing altogether. The tonnage caught from a block early in the history of the fishery will not necessarily be the same today. The level of catch may itself be used to infer abundance, but its utility is confounded by a number of other factors such as regional TAC's, market preferences, contraction of abalone producing reef and the economic cost of fishing. For this reason, we combine the use of catch and catch rates to infer abundance. Table 2 summarises the way in which changes in catch and catch rate are interpreted, and classifies each block in accordance with its particular trend in catch and catch-rate.

Some of the interpretations of changes in catch and catch rate are self-evident. For example, when the catch is stable, but catch rates fall over a period of years, it is most likely that abalone are harder to catch (i.e. catch rates are lower) because they are less abundant. There could be other reasons, such as diving on the East Coast in summer when the weed growth is thicker and higher, or the catches are mostly from inexperienced divers, or changes in the market preference for smaller abalone. However, using the East Coast example, if the comparison is limited to the winter months with substantial quantities of catch, and catch rates are still lower, the only logical conclusion is that the fishable biomass has become less abundant. Similarly, if the catch and catch rates both increase, then it is most probable that there are more abalone available to catch because the fishable biomass is larger.

Lower catches, but stable catch rates could indicate a stable biomass, with divers choosing to fish elsewhere. However, if divers transfer effort elsewhere (i.e. catch less), catch rates should increase because the remaining abalone have more time to regroup

between visits from divers, and because of continued recruitment from the sub-legal part of the population. This scenario could therefore also be interpreted as a falling biomass and with perhaps a falling sub-legal population.

Table 2. The interpretation of trends in changes in annual catch and catch rate and the classification of statistical blocks

These trends in combinations of catch and catch rate were observed over a 10 year period, although are mostly affected by events in recent years. The combinations are ordered, with the best at the top of the table and the worst towards the bottom. Erratic catches combined with erratic catch rates were not interpreted. Statistical blocks grouped by zone have been assigned to relevant combinations.

Catch	Catch rate	Interpretation	Eastern	Western	Northern	Greenlip
↑	↑	Best scenario. Difficult to interpret other than as increasing fishable biomass unless fishing power has increased dramatically and/or fishing is occurring in new areas.				
Stable	↑	Fishable biomass stable or increasing, less likely to be decreasing.				
↑	Stable	Fishable biomass stable or increasing, less likely to be decreasing.		10, 11	49, 3, 33	33
↓	↑	Fishable biomass stable or increasing, could be decreasing.		8		
Erratic	Stable	Fluctuating catches, stable catch rates indicate low levels of exploitation with stable abundance				32, 34, 36, 37, 38
Stable	Stable	Fishable biomass stable or decreasing, less likely to be increasing.	20	7		4
↑	↓	Fishable biomass stable or decreasing.	22	12	4, 5, 48	
↓	Stable	Fishable biomass falling, or at best, stable. However, if biomass was stable, catch rates should increase because catchability increases when the abalone are given more time to aggregate.		9		1, 2, 35
Erratic	↓	Fishable biomass decreasing.	14, 21	6	39	31
Stable	↓	Fishable biomass decreasing.				39
↓	↓	Worst scenario. Continued decline in catch rates despite displacement of catch may indicate a recruitment decline.	13, 15, 16, 17, 18, 19, 23, 24, 25, 26, 27, 28, 29, 30, 31			5, 49
Erratic	Erratic	No clear trends in catch & catch rate, difficult to interpret the probable change in abundance.		13	31	48, 40

Falling catch rates combined with falling catches constitute the worst scenario. It can only occur when fishable stock levels fall because the sub-legal part of the population cannot maintain the supply of recruits. If catches are reduced, and catch rates continue to indicate a shortfall in recruits, the only conclusion to be drawn is that the sub-legal population has become smaller. This has implications beyond maintaining catch rates and matching the TAC to the fishable biomass, such as reducing the amount of eggs produced from the fishery, and potentially, degradation of abalone habitat and the loss of reef area to the fishery.

8.3 Alternative sources of abundance information

The only other insight currently available into abalone abundance relies on analysis of samples of the commercial catch from a population throughout the year. Changes in the size structure of the catch (i.e. the proportion of small to large abalone) may provide information about the population from which it is taken. For example, the disappearance of large abalone from catches might indicate increasing levels of fishing mortality, because the abalone now get caught before they can grow to a large size.

Recent research in southeast Tasmania showed that blacklip abalone growth rates varied seasonally, being lowest in early spring and highest in early autumn. Between August and December, the growing edge of the shells of smaller abalone is usually newly formed and sharp edged, reflecting an increase in growth rates. Because they are growing quickly, the undersized abalone are more likely to grow to legal size and be seen in the commercial catch at this time of year than any other. If samples from the commercial catch fail to contain small abalone, then one explanation for this is that the undersized part of the population has declined. For example, catch samples show high levels of recruits in Sub-block 13E, whereas in Sub-block 24D the proportion of small abalone is low in spring and early summer.

Note that this technique is dependent on adequate sampling from similar populations in small areas (e.g. Sub-blocks 13E, 24D). It is not valid on the west coast where abalone populations are cryptic at much larger sizes than elsewhere, or where the time series of sampling is discontinuous, or where the sampling area is large and contains populations of greatly different average sizes.

8.4 Fishery performance by zone

Most of the **Eastern Zone** fits into the worst category of Table 2 with catch rates continuing to decline despite catches being significantly reduced. Even optimistically, this means that the fishable biomass has been reduced and is still falling. The worst outlook is that populations have declined, and even with further quota reductions, it may be many years before stocks rebuild. The most risk averse strategy now would be to decrease the TAC further.

Samples from the commercial catch provide evidence that in at least one sub-block (24D), the pre-recruit population has declined. Because of low numbers of samples, large spatial scales and an inadequate time series of data, it is not possible to confirm whether populations in other sub-blocks have declined. However, there is evidence that the stock decline at the Actaeons (Sub-blocks 13C, D and E) has affected only the fishable biomass, and that recruitment appears to be unaffected.

The blocks around the Tasman Peninsula appear to be affected to a lesser extent than elsewhere in the Eastern Zone, with the most stable levels of catch and catch rate. Unfortunately, these blocks provided less than 20 percent of the annual TAC.

In the **Western Zone**, Blocks 6, 9A, 9B, and 12 are performing at levels where the fishable biomass is probably falling. The status of Block 13 (A and B) is unclear, but fishable stocks here are probably falling. The level of catch should be reduced in these blocks. The remaining blocks, which account for almost 50 percent of the catch appear to be stable.

Because of the recent creation of the **Northern Zone**, the time period over which trends are reviewed is short and they may therefore be unreliable.

In the North East, the status of Block 31 is unclear, but the rapid increase in catch and 2002's lower catch rate indicates that this level of catch is probably unsustainable. In the adjacent Block 39, fishable stock levels are decreasing. The level of catch should be reduced in these blocks.

In the North West, fishable biomass in Blocks 5 and 48 is at best stable, but is probably decreasing. In Block 49, stock levels appear stable, but near shore stocks may be heavily exploited. On King Island, Block 3 appears to be providing stable levels of catch, while stock levels are falling in Block 4. In the Furneaux Group, the only significant producer of blacklip is Block 33, where stocks appear stable.

In the **Greenlip** fishery, Furneaux Group stocks appear to be stable, with Block 35 at a better level than it has been rated in Table 2 (its declining catches are not due to abundance levels but associated more with its remoteness). On King Island, stock levels seem to be stable, although indications from the north of the island (Blocks 1 and 2) are less certain.

In the North West, Blocks 5 and 49 are in the worst category with falling catches and catch rates. In the North East, fishable biomass is decreasing in Blocks 31 and 39. Catches are too erratic in Block 40 to classify. The level of catch should be reduced in these blocks. It is not possible to classify Block 48, where a recent size limit change may have affected catch rates.

8.5 Options available to managers

There are several options available to managers to deal with the current stock decline and each of these is discussed in detail below:

1. Reduce the TAC

   Previously, managers have responded to falling stock levels by reducing the TAC. During the 1980's, managers cut catch levels by at first small amounts, and then in 1989, by 30 percent. Although catch rates eventually rose some years later, there was no immediate response to these cuts from catch rates, even after the large reduction, and so it appears as though improving catch rates lag behind catch reductions. However, this is not necessarily so.

   A relatively large TAC reduction is will leave significant amounts of uncaught abalone on the reef, and then the uncaught stocks should be available the following year and thus provide an immediate boost to catch rates. If a reduction in TAC is too small, catch rates will fail to respond, which clearly indicates that catch levels remain too high for the amount of fishable biomass. Although catches may be sustainable at low catch rates, there will be no opportunity for the build-up of biomass and the recovery of the fishery, and the stocks may be maintained at a low level or decline further. At low stock levels, populations (and not just fishable stocks) become depleted, with an increasing risk that areas of reef will change and stop producing abalone.

The course of action available to managers then is to reduce the TAC by amounts that produce an increase in catch rates, indicative of stock rebuilding. This sounds simple, yet it is difficult to quantify an appropriate level of TAC reduction. The recent Eastern Zone reduction was slightly less than 24 percent, and it had no appreciable immediate effect on halting the catch-rate decline. How much further to reduce the TAC is not immediately obvious but from the arguments above a precautionary reduction would be the safest option.

If a TAC reduction was selected that was bigger than absolutely necessary, this would imply lost economic opportunity costs but would lead to a more rapid recovery. If too small a TAC reduction was applied, however, this could risk further, possibly catastrophic declines to previously unexperienced levels. These outcomes are a natural consequence when there is a mis-match of TAC with exploitable biomass.

The danger with reducing the TAC is that any upturn in abundance is missed, and the TAC is cut needlessly. However, by comparing monthly catch rates between years in the highest yielding sub-blocks it should be possible to detect small changes in abundance, although it is less certain how this translates to stock recovery. It should be noted that at the time of writing (end of April, 2003), severe marketing problems have greatly reduced fishing effort and consequently the Eastern Zone catch is approximately two thirds of that from the same period in 2002. In the south of the Eastern Zone, from where most of the catch has been taken, this has had a positive effect on catch rates, which have now stabilised.

2. Increase the size limit

The Eastern Zone size limit was increased by 4 mm in 2002 to levels that will offer more protection to populations under the terms of the two-year rule (the two year rule specifies that abalone must be allowed to breed for at least two years prior to entering the fishery). While we can see evidence of some beneficial effects of the size increase (e.g. increases in average size and weight of landed abalone, and divers reporting seeing more under-sized abalone), it is also understood that some areas that contain small abalone are reportedly producing less catch, while effort has been increased in areas with larger abalone with consequent adverse effects. TAFI researchers are currently studying spatial variation in size at maturity in southeast Tasmania, and should have improved knowledge of the effects of any further size-limit increase by the end of 2003. Until then, it is not known if further increases in size limit will benefit the fishery, either resulting in a more rapid recovery, or recovery to greater production levels than if size limit remained at the current level.

3. Local caps on catch

Limiting the annual catch by regions within zones has been used successfully in the greenlip fishery in recent years. However, the method does have limitations: the zonal TAC initially has to be set at an appropriate level, otherwise effort is merely transferred from a region with low stock levels to other regions with perhaps marginally greater stock levels, which in turn become depleted. It also relies upon the honesty of divers to report the source of their catches. There is anecdotal information that in 2002, some divers landed greenlip catches from one area but

reported the catch as coming from a different another distant area. If the managers' intent is to protect particular stocks, then clearly local caps will not work with misreported catches.

4. Seasonal closures

One of the reasons given for low catch rates in the Eastern Zone is that divers are compelled by both market demands and the distribution of quota to catch abalone in summer. Periodically, seasonal closures have been touted as a means of remedying some of the problems that exist in the Eastern Zone fishery, such as low summer catch rates. A seasonal closure has successfully operated in the greenlip fishery in Franklin Sound (Block 35) for a number of years.

In the Eastern Zone, a similar closure between October and April would probably increase average catch rates because divers would be less affected by heavy weed growth in the warmer months. However, the benefits of a seasonal closure for biological reasons are uncertain. Current evidence indicates that blacklip abalone spawn mostly between August and October, so a summer closure would be of little benefit in increasing egg production. Offsetting this, the condition of abalone would be enhanced because by April, recruits would weigh more, and the spawned abalone would have recovered. There are also, however, economic problems with closures: the demand for abalone for the Chinese New Year usually means high beach prices for smaller Eastern Zone abalone in January, which offsets the lower catch rates and poor recovery of the summer fishery. The recently dominant live-fish market is also dependent upon a constant supply of smaller abalone, and it is not known how it would be affected if forced to source blacklip solely from the Western Zone during summer.

Generally, a closed season that does not include the spawning season is unlikely to have any appreciable affect on fishable stock levels, and from a biological point of view, is not an option to halt falling stock levels. Closed seasons that include the spawning season will only have long-term benefits that should manifest over 6 to 8 year time scales.

5. Area closures

The option of closing areas off to the fishery is available to managers if they suspect that populations (as opposed to fishable stocks) are declining, and they cannot stop the decline by reducing the TAC. Unless stock levels in the surrounding region were buoyant, it would also require a TAC reduction by the amount that the closed area produced. The closure would be in effect for the period that it took fishable stock levels to increase to levels that managers deemed appropriate (note that this would be difficult to measure and quantify). Fishery closures presume that stocks will increase following cessation of fishing. Although this may be generally assumed, it does not necessarily follow. In other parts of the world, abalone populations have not recovered more than 10 years after legal fishing had ceased (Campbell, 1997).

6. Status quo (do nothing)

This is probably the riskiest option, for two reasons.

Firstly, there is much evidence that fishing stocks to low levels eventually causes declines in the rest of the population, from which recovery is uncertain e.g. Shepherd *et al.* (2001). The 2001 Tasmanian stock assessment (Tarbath *et al.*, 2002) discussed the problem of the reduction of the area of abalone producing reef. In the 1980's, catch rates and catches in parts of the East Coast with hitherto consistent yields slowly fell, and although during later years occasionally annual catches approached former levels, usually they were a fraction of that formerly produced. This phenomenon is particularly noticeable on the East Coast north of St Helens (Block 30), but also applies to the coast north of Bicheno (Block 28) and the western shore of Great Oyster Bay (Blocks 25 and 26). We believe that this coast has been lost to the fishery because fishery managers then were unaware of the extent of stock declines. When they became aware, and took action (i.e. introduction of quota based fishery in 1985), it was too late.

There are problems identifying localised population collapses as opposed to declines in fishable stock levels. Commercial divers tend to stop fishing in areas when catch rates fall too low. Subsequent population declines then go unnoticed because those divers concentrate on areas that hold abalone and avoid areas that do not. The current spatial scale of reporting of fishing activities (e.g. sub-block) is too large to identify changes at the site, reef or population level. Hence, it is only when annual catches are reviewed over a period of many years, and anecdotal information from fishers collated that losses to the fishery become apparent.

Secondly, because the problem of falling stock levels has been identified in this assessment, under the conditions that Environment Australia issues export permits for the industry, managers are bound to take action that will ensure that fishing mortality returns to sustainable levels (Kemp, 2002).

For both these reasons, doing nothing, or maintaining the status quo, is not an option that managers can consider when faced with good evidence of falling stock levels.

9. Recommendations for managers

In the **Eastern Zone**, a population decline is the only plausible explanation for falling catch rates in the presence of a significantly reduced TAC. A further reduction in the TAC would improve the chances of stock recovery.

A management strategy is required to trigger responses under circumstances of declining fishable biomass. A modelling framework is being developed to provide more precise management advice. Until that is completed the relationship between any specific TAC reduction and consequent stock recovery rate remains unknown and we can only rely on previous experience to manage the stock. The available evidence indicates that the Eastern Zone stock may be at levels lower than previously encountered. It would therefore be prudent to respond to these present circumstances.

The response of local stocks to effective collapse following overfishing has yet to be determined. We are ignorant about the ability of local stocks to recover once their

numbers are taken down to very low levels: Are they lost forever or can they recover? We therefore recommend that Block 30 (St Helens to Eddystone Point) be closed temporarily to both commercial and recreational fishing to determine whether abalone populations there will recover and spread to the reefs from where they were formerly abundant. The amount of catch lost to the fishery would be slight (13 tonnes in 2001, 12 tonnes in 2002) but nevertheless, the TAC should be reduced by that amount to prevent that catch being taken elsewhere in the fishery. We have similar concerns about Blocks 24 (Maria Island) and 28 (North of Bicheno), but at present lack sufficient evidence to support their closure, and consequently suggest that a wait and see approach is appropriate here.

In the **Western Zone**, falling catch rates and catches suggest that it would be prudent to place annual catch limits (caps) on the catches in Blocks 6, 12 and 13. It is suggested that caps initially be set approximately equal to the 10 year average of catches for those blocks, or in the case of the Block 13 sub-blocks, to the three year average (this implies, Block 6: 140 tonnes, Block 12: 215 tonnes and Block 13: 60 tonnes). We anticipate that these levels would be reviewed in future assessments. The re-distributed catch (approximately 85 tonnes using 2002 catch levels) could be transferred from the capped blocks to the remaining part of the Western Zone where stock levels are higher. However, if a mechanism cannot be developed to prevent the displaced catch being taken from 9A and 9B (which would lead to serious depletion in these sub-blocks), then consideration should be given to reducing the Western Zone TAC by the required amount.

In the **Northern Zone** caps are also indicated for the North East (Blocks 31 and 39), and a review of caps in the North West. The North East cap should initially be set at levels below the 2002 catch, and the Block 5 catch in the North West maintained at 100 tonnes. While the current Block 5 cap seems reasonable, unless the remaining blocks are also capped, there is potential for unregulated amounts of catch to be taken from those blocks to the detriment of abalone populations present. If catch cannot be transferred offshore to King Island and the Furneaux Group, and this has not happened to sufficient extent since the advent of the Northern Zone, then the Northern Zone TAC should be reduced accordingly.

In the **Greenlip** fishery the level of catch needs to be reduced in the North West (Blocks 5, 48 and 49) and North East (Blocks 31, 39 and 40), but maintained at King Island and the Furneaux Group. The North West cap is currently 40 tonnes (which is less than the 10 year average), so if a relatively small reduction, for example 10 tonnes, is made, then catch and catch rates should be monitored to determine whether recovery occurs.

Divers are now reporting greater difficulty in achieving their expected catch rates in Sub-block 48A (Black Reef) and have suggested that the recently increased size limit is now too high. However, considering the level of fishing mortality there, this conflicts with the results of work by Officer (1999), which suggested that a minimum legal size limit of 143mm was necessary to ensure sufficient levels of egg production.

Similar patterns of decline are apparent in the North East and the cap (now 30 tonnes) should also be revised, as per the North West. Because there is no potential for the transfer of catch to other areas in the Greenlip fishery, the Northern Zone TAC would

need to be reduced by the amount that the North West and North East catches are reduced.

In the **Recreational** fishery, surveys indicate approximately three quarters of the estimated 70 tonne annual catch comes from the Eastern Zone. The sale of licenses reportedly continues to increase unabated at approximately 10 percent per annum. Recreational effort has the potential to undermine management attempts to halt stock declines, particularly in the more vulnerable parts of the East Coast. We recommend that managers investigate whether there are corresponding increased levels of recreational catch associated with the increasing number of recreational licenses.

The increases in TAC that started in1997 and the creation of zones in 2000 and 2001 have had a significant impact on stock levels. Not only are the more accessible stocks now more intensively fished, but also the likelihood that even the most remote stocks are fully exploited has increased. While managers have attempted to protect stocks from overfishing, this assessment has found that the spatial scale of management is still insufficient to prevent localised stock declines. This means that fishery managers need to manage the fishery more intensively, with an increased number of controls and regulations to ensure that adequate stock levels are sustained.

References

Campbell, A. (1997). Possible criteria for reopening the northern abalone (*Haliotis kamtschatkana*) fishery in British Columbia, Canadian Stock Assessment Secretariat, pp. 1-47. Nanaimo: Fisheries and Oceans Canada.

Harrison, A. J. (1983). The Tasmanian abalone fishery. *Tasmanian Fisheries Research* **26**, 1-42.

Kemp, D. M. (2002). Ministerial decision on the Tasmanian abalone fishery, Environment Australia. 5 February 2002, http://ea.gov.au/coasts/fisheries/assessment/tas/abalone/pubs/ea-letter.pdf, (20 May 2003).

Nash, W. J. (1995). The development of new techniques for assessing and managing the Australian abalone fisheries, Final Report to the Fisheries Research and Development Corporation FRDC Grant 88/94. Hobart: Department of Primary Industry and Fisheries, Tasmania.

Officer, R. A. (1999). Size limits for greenlip abalone in Tasmania, Technical Report 5. Hobart: Tasmanian Aquaculture and Fisheries Institute.

Shepherd, S. A., Rodda, K. R. and Vargas, K. M. (2001). A chronicle of collapse in two abalone stocks with proposals for precautionary management. *Journal of Shellfish Research* **20** (2), 843-856.

Tarbath, D. B., Hodgson, K., Mundy, C. and Haddon, M. (2002). Tasmanian abalone fishery 2001, Fishery assessment report, pp. 137. Hobart: Tasmanian Aquaculture and Fisheries Institute.

Worthington, D. G., Andrew, N. L. and Bentley, N. (1998). Improved indices of a catch rate in the fishery for blacklip abalone, *Haliotis rubra*, in New South Wales, Australia. *Fisheries Research* **36**, 87-97.

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Grant Pullen	Principal Fisheries Management Officer, DPIWE
Dean Lisson	President, Tasmanian Abalone Council
John Hoult	Executive Member, Tasmanian Abalone Council
Robert Royle	Chairman, Quota Holder Sub-Council
Allen Hansen	Tasmanian Abalone Council
Steven Gasparinatos	Chairman, Diver Sub-Council

Greg Woodham	Treasurer, Tasmanian Abalone Council
Nigel Wallace	Secretary, Tasmanian Abalone Council
John Hayes	Divers' Representative, Tasmanian Abalone Council
Paddy Maguire	Tasmanian Abalone Council

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Appendix 1: Annual Catches From The Western Zone 1975 - 2002.

Annual tonnages of blacklip abalone caught within the statistical blocks and sub-blocks comprising the Western Zone in 2002. These tonnages are derived from estimated weights, which do not correspond exactly with landed weights.

Year	5	6	7	8	9	10	11	12	13	Total
1975		111	36	42	126	130	191	143		779
1976		64	56	77	255	179	240	154		1025
1977		53	24	23	123	98	153	189		663
1978		81	13	27	115	258	277	209		980
1979		115	19	23	172	166	269	325		1089
1980		197	81	63	316	195	338	351		1541
1981		264	89	87	444	260	417	246		1807
1982		147	34	34	249	100	303	235		1102
1983		231	102	58	199	175	431	242		1438
1984		309	78	40	248	284	682	258		1899
1985		327	99	23	246	140	479	155		1469
1986		213	97	11	134	127	289	194		1065
1987		185	84	44	251	82	339	195		1180
1988		244	53	27	160	126	276	162		1048
1989		193	49	46	120	110	212	145		875
1990		197	56	21	95	80	235	125		809
1991		169	54	30	102	106	219	140		820
1992		266	69	40	100	102	269	159		1005
1993		160	66	38	110	66	197	177		814
1994		82	37	38	78	60	200	160		655
1995		123	32	17	44	68	185	182		651
1996		113	68	13	59	81	145	148		627
1997		98	75	28	140	66	224	227		858
1998		129	51	27	78	44	165	202		696
1999		131	51	18	107	42	192	229		770
2000		183	61	23	205	148	333	286	54	1291
2001	0	212	32	15	185	152	311	290	43	1241
2002	2	173	51	17	174	143	359	236	93	1248
Average	1	170	58	34	166	128	283	206	63	1052

Appendix 2: Annual Catches From The Eastern Zone 1975 - 2002.

Annual tonnages of blacklip abalone caught within statistical blocks and sub-blocks comprising the Eastern Zone in 2002. These tonnages are derived from estimated weights, which do not correspond exactly with landed weights. Prior to 2000, the catches for Blocks 13 and 31 include catch from outside the (now) Eastern Zone, which means that the average catch for these particular blocks is not necessarily correct.

Year	13	14	15	16	17	19	20	21	22	23	24	25	26	27	28	29	30	31	Total
1975	247	111	10	48	12	0	16	27	49	74	15	16	5	44	69	16	45	39	843
1976	208	156	0	64	36	1	18	25	45	56	18	12	9	40	72	9	39	63	871
1977	245	232	2	190	13	1	23	35	37	53	11	10	9	55	90	22	122	60	1210
1978	322	218	6	120	24	1	32	65	60	88	22	13	11	93	87	25	137	113	1437
1979	374	251	8	148	25	2	51	52	43	30	10	23	7	80	52	12	107	71	1346
1980	272	255	7	145	30	1	33	30	42	46	158	34	7	108	91	27	148	109	1543
1981	254	299	18	127	48	4	45	69	35	77	137	19	15	68	154	22	146	58	1595
1982	337	218	15	147	24	3	36	62	63	49	97	21	9	89	100	32	171	75	1548
1983	255	300	10	189	28	3	43	63	55	92	99	31	14	100	105	66	298	113	1864
1984	318	297	18	166	35	5	47	70	73	61	109	10	11	106	112	53	149	126	1766
1985	256	262	4	89	83	11	69	80	43	44	120	20	17	86	71	5	91	225	1576
1986	221	262	22	82	93	4	65	67	70	56	88	13	20	50	58	14	126	203	1514
1987	225	229	7	47	80	1	43	44	32	34	66	12	8	77	45	11	68	86	1115
1988	219	258	6	76	57	4	62	44	43	34	79	10	6	65	52	16	96	132	1259
1989	156	172	2	56	43	2	61	42	22	16	34	7	8	41	31	11	41	49	794
1990	133	193	4	76	29	3	33	51	41	36	61	1	2	61	77	21	54	44	920
1991	127	207	2	60	37	3	53	50	47	31	67	2	9	64	66	12	30	42	909
1992	159	122	4	49	28	3	56	49	56	12	76	1	1	71	56	7	10	29	789
1993	271	121	4	107	47	1	67	79	49	24	75	1	1	87	39	8	15	24	1020
1994	300	148	10	118	65	2	122	85	62	17	57	0	3	104	24	8	11	34	1170
1995	313	256	2	106	35	4	108	78	41	21	43	0	1	81	19	6	11	50	1175
1996	392	195	0	80	18	3	74	55	44	29	69	3	6	90	39	11	28	31	1167
1997	470	137	0	64	25	2	79	49	47	32	106	1	13	190	32	32	23	50	1352
1998	483	109	1	116	23	2	85	64	63	44	160	2	25	182	77	31	10	19	1496
1999	474	66	1	106	34	6	97	61	47	53	139	0	9	94	60	24	10	43	1324
2000	381	98	2	71	29	4	62	60	69	44	104	1	8	101	16	21	10	102	1182
2001	324	157	3	108	20	2	56	50	40	24	111	1	14	68	9	27	13	79	1105
2002	296	101	1	72	16	1	62	58	46	15	46	0	2	53	7	15	12	44	847
Average	287	194	6	101	37	3	57	56	49	43	78	9	9	84	61	20	72	75	1241

Appendix 3: Annual Catches From The Northern Zone 1975 - 2002.

Annual tonnages of blacklip abalone caught within statistical blocks comprising the Northern Zone in 2002. These tonnages are derived from estimated weights, which do not correspond exactly with landed weights. There are no records for the Northern Zone part of Block 31 prior to the establishment of that zone in 2001.

Year	31	39	40	32	33	34	35	36	37	38	47	48	49	5	1	2	3	4	Total
1975		3	1	2	9	1	7	7	0	2	1	12	9	39	32	1	27	14	167
1976		5	0	0	6	0	1	1	0	1	1	12	33	46	39	1	51	8	205
1977		5	2	6	11	0	0	2	0	2	0	8	17	50	17	1	87	8	216
1978		8	2	1	5	2	6	5	1	4	3	10	11	65	21	3	56	25	228
1979		6	1	2	9	0	0	1	1	2	0	27	7	85	24	3	10	10	188
1980		3	1	2	6	1	1	2	0	0	0	10	1	92	51	3	33	3	209
1981		7	1	0	7	1	1	0	2	0	2	33	9	120	19	8	33	10	253
1982		5	1	0	5	0	0	2	0	5	1	45	7	121	23	9	27	13	264
1983		7	4	0	4	0	0	5	1	4	9	44	19	227	22	2	32	51	431
1984		5	3	0	7	1	1	2	1	1	4	81	45	311	11	1	34	55	563
1985		5	2	4	6	1	2	0	0	0	4	48	50	319	43	0	26	12	522
1986		10	5	1	9	2	4	3	1	1	15	86	97	267	35	4	24	13	577
1987		6	1	0	7	0	3	1	2	1	18	58	68	197	44	61	24	53	544
1988		2	2	1	11	1	1	1	0	0	18	36	41	168	29	17	22	60	410
1989		1	0	0	4	0	1	0	0	0	14	16	24	88	14	7	10	5	184
1990		0	0	0	1	0	0	0	0	0	6	14	20	82	11	10	9	12	165
1991		1	0	0	2	0	0	0	0	0	8	12	10	97	6	7	13	27	183
1992		3	0	0	2	0	0	0	0	0	2	10	11	76	4	6	14	10	138
1993		0	0	0	3	0	0	1	0	0	1	6	7	66	10	4	8	9	115
1994		0	0	0	3	0	0	0	0	1	0	6	11	49	9	2	4	1	86
1995		0	0	1	1	0	0	0	1	0	0	6	2	62	12	5	2	7	99
1996		0	0	0	0	0	0	0	0	0	0	4	0	63	7	2	1	2	79
1997		1	0	0	0	0	0	0	0	0	0	5	2	56	9	1	10	6	90
1998		0	1	0	2	0	0	0	0	0	0	6	3	61	2	1	1	2	79
1999		4	1	0	2	0	0	0	0	1	0	13	4	45	3	1	4	6	83
2000		5	2	1	5	0	0	0	0	0	0	12	26	45	0	0	10	10	117
2001	12	11	3	5	10	1	0	0	0	3	0	17	72	117	2	1	12	12	279
2002	30	4	3	1	11	1	0	0	0	2	0	12	48	103	10	2	35	16	278
Average	21	4	1	1	5	0	1	1	0	1	4	23	23	111	18	6	22	16	241

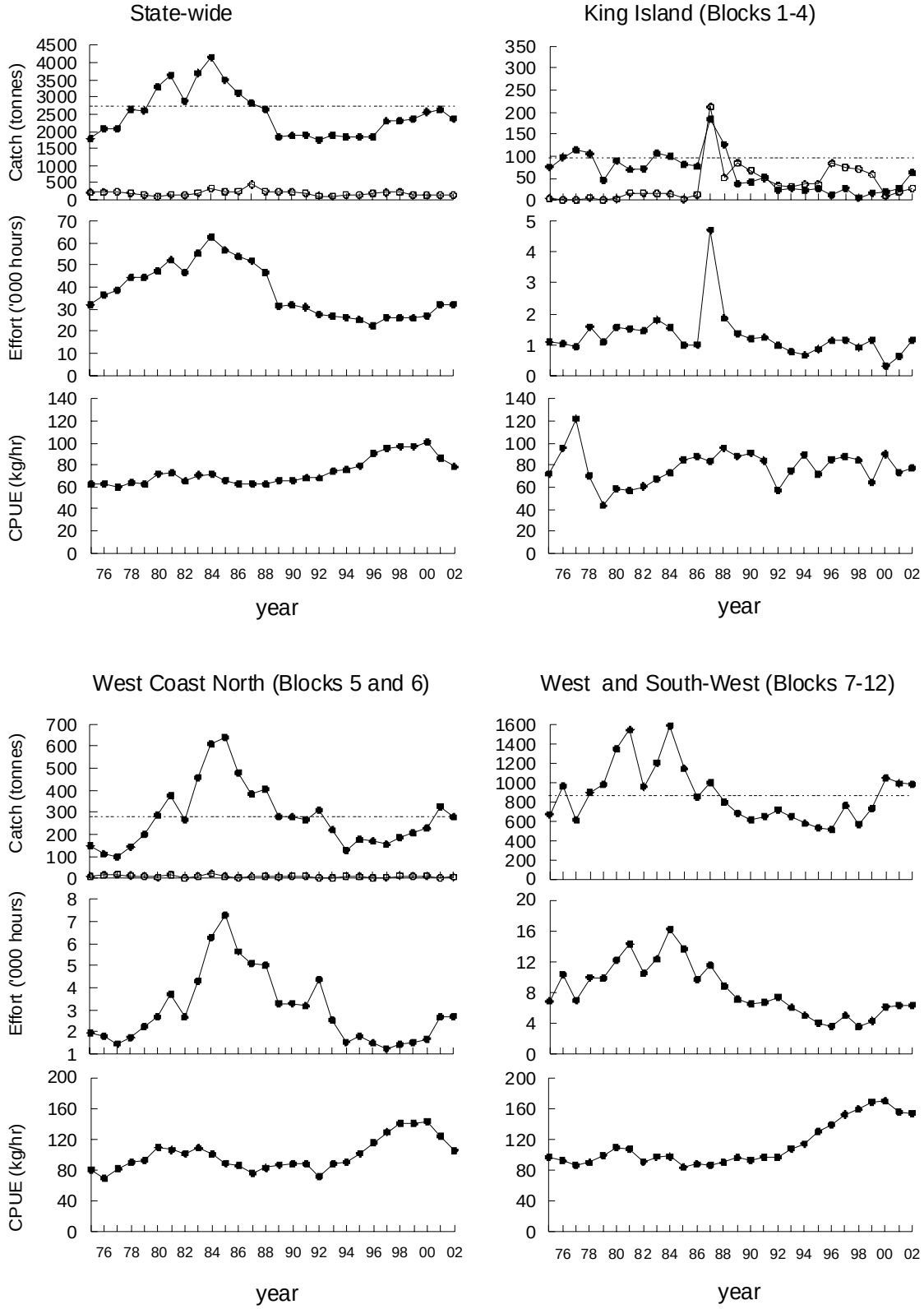
Appendix 4: Annual Catches From The Greenlip Fishery 1975 - 2002.

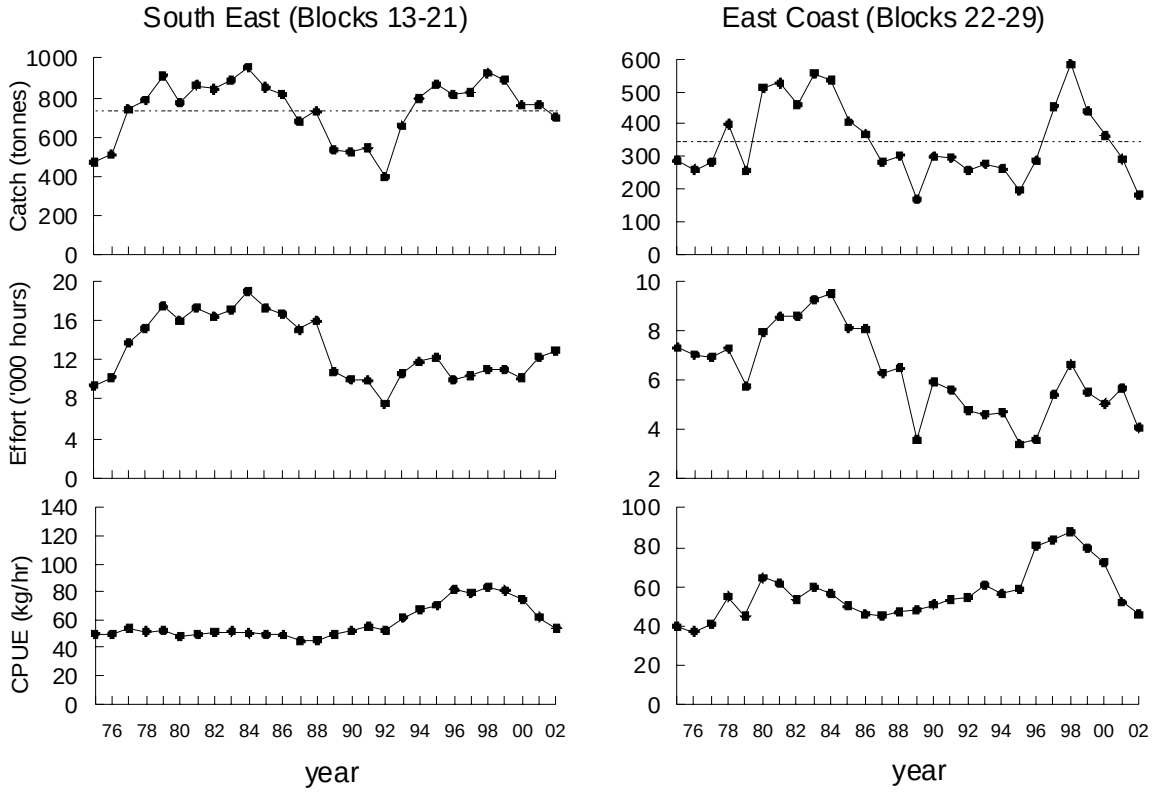
Annual tonnages of greenlip abalone caught within the statistical blocks comprising the Greenlip fishery in 2002. These tonnages are derived from estimated weights, which do not correspond exactly with landed weights.

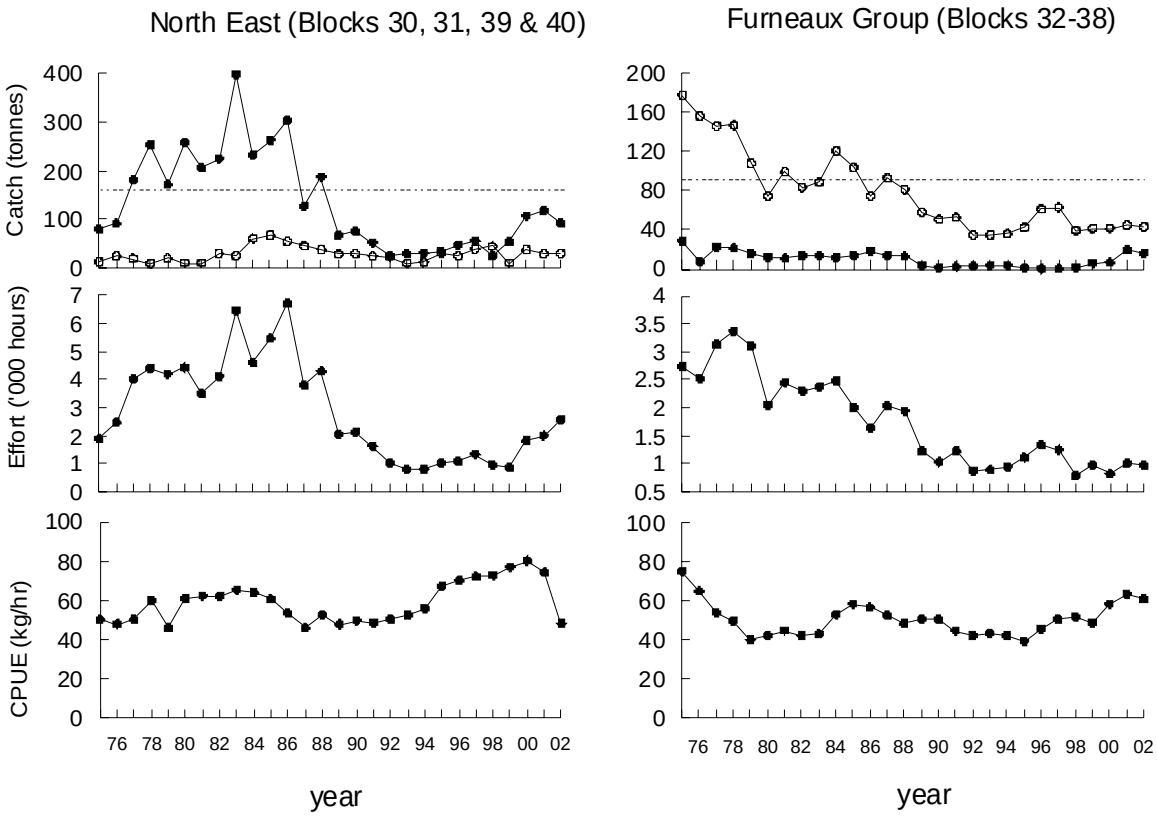
Year	31	39	40	32	33	34	35	36	37	38	47	48	49	5	1	2	3	4	Total
1975	7	3	4	3	17	14	49	69	14	11	0	7	2	8	0	3	0	1	212
1976	14	2	9	1	26	11	55	49	2	10	0	8	6	14	0	0	0	0	207
1977	6	8	4	6	23	21	50	24	1	22	0	40	2	17	0	0	0	0	224
1978	8	1	2	4	12	17	51	38	7	17	1	13	3	12	1	3	0	2	192
1979	11	6	2	10	21	8	46	15	4	4	0	11	0	8	0	0	0	0	146
1980	4	3	5	7	15	3	29	13	4	4	0	6	0	5	0	3	0	0	101
1981	6	4	2	12	17	17	34	10	9	0	3	12	1	9	0	12	0	4	152
1982	27	1	3	4	13	14	29	7	9	9	2	7	0	2	0	14	0	2	143
1983	23	2	0	4	21	8	34	9	4	8	14	40	11	9	0	9	0	5	201
1984	50	8	4	9	27	15	56	7	6	0	52	60	2	11	0	7	1	5	320
1985	53	5	4	9	20	15	42	4	7	7	12	36	3	3	0	1	0	1	222
1986	39	8	7	4	14	7	36	2	10	0	57	35	14	5	1	8	0	3	250
1987	32	12	1	8	20	10	30	8	10	7	37	33	3	8	13	125	5	69	431
1988	35	2	1	8	23	5	28	13	6	0	35	28	5	10	3	33	2	12	249
1989	22	5	2	4	16	2	22	10	3	0	20	27	4	6	1	70	3	10	227
1990	23	7	0	4	9	3	25	6	1	3	21	27	11	11	2	49	3	13	218
1991	20	6	0	4	7	2	31	6	3	0	13	32	6	12	2	29	3	16	192
1992	16	10	0	5	4	2	24	7	2	0	4	14	2	4	3	18	1	8	124
1993	9	2	0	2	5	2	22	8	3	0	2	26	3	2	1	17	0	9	113
1994	12	2	0	6	8	1	22	5	5	0	3	48	3	10	4	25	0	7	161
1995	25	6	2	5	9	3	21	3	3	9	5	23	5	8	14	10	0	13	164
1996	11	13	2	4	14	4	20	2	8	12	1	15	0	3	36	33	1	12	191
1997	17	22	1	8	13	1	12	4	11	15	1	28	3	6	35	33	0	6	216
1998	4	17	25	5	6	1	23	1	2	2	2	43	8	14	33	34	0	5	225
1999	6	2	4	2	17	1	15	1	2	4	0	18	1	10	21	25	1	10	141
2000	12	15	12	8	11	2	14	3	2	2	0	24	12	13	2	4	1	3	140
2001	7	20	4	14	14	2	9	3	1	0	0	35	9	3	8	8	1	2	140
2002	17	12	2	4	16	2	8	2	2	9	0	27	5	7	11	6	1	9	139
Average	18	7	4	6	15	7	30	12	5	6	10	26	4	8	7	21	1	8	194

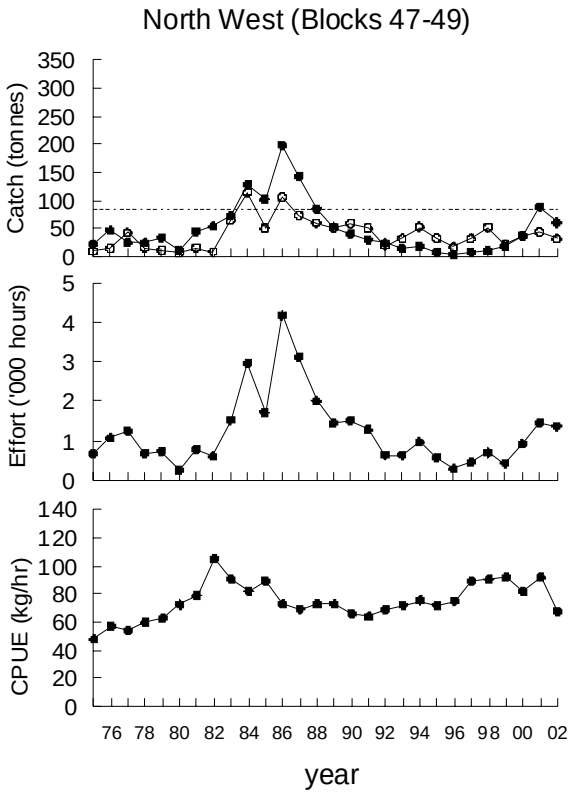
Appendix 5: Annual Total Catch, Effort and Mean Catch Rate, by State, Region, Block and Year.

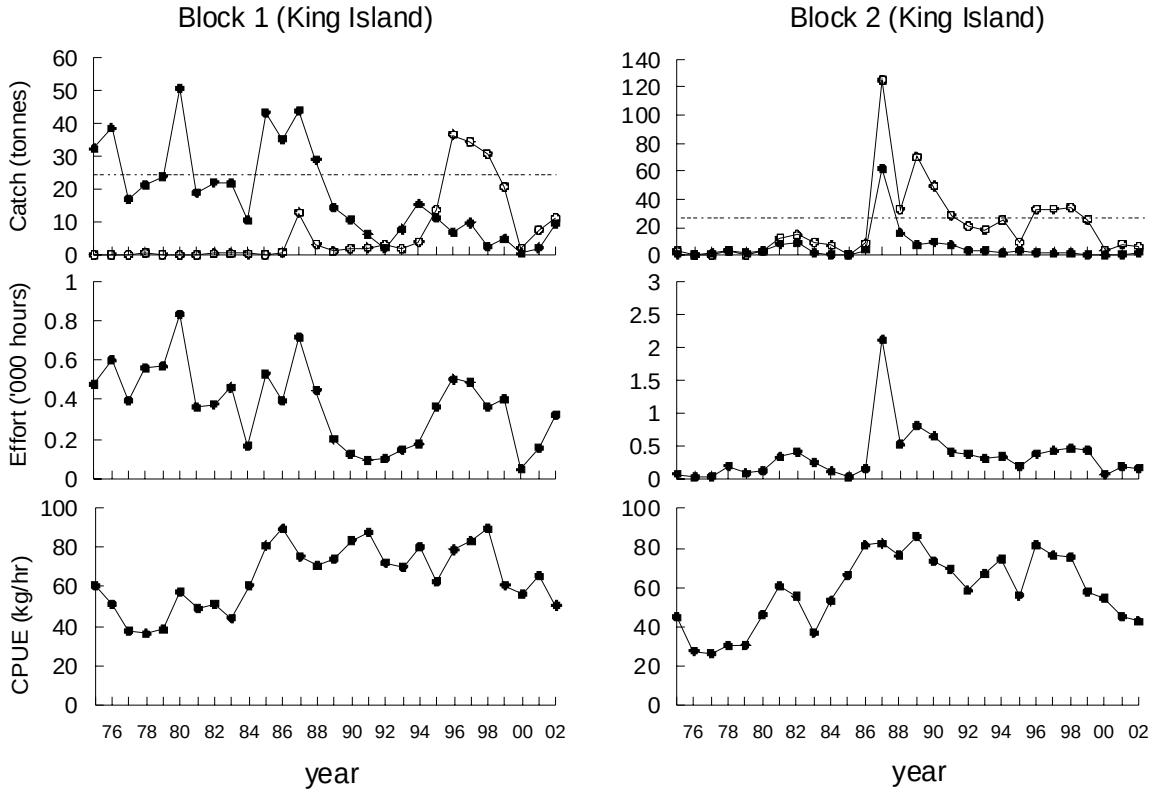
Catch is shown in tonnes, by species. CPUE is the annual geometric mean of catch rates, for both species combined.



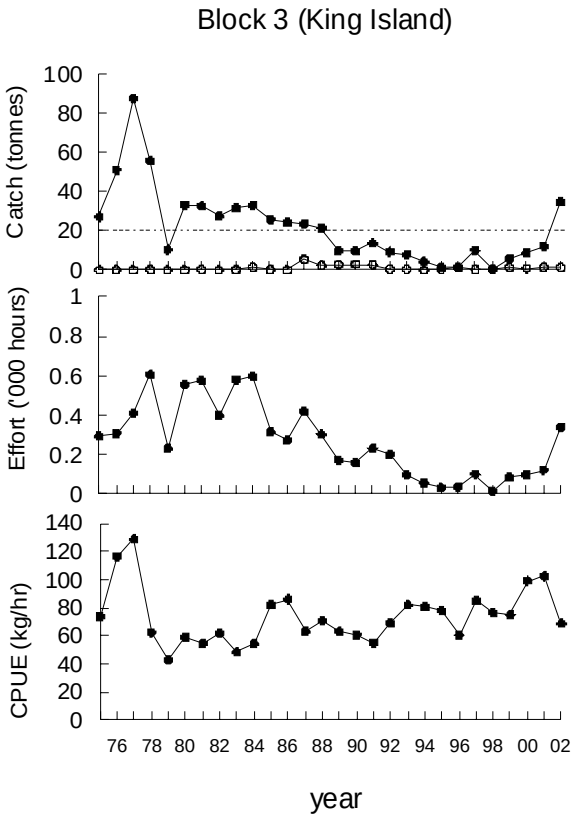

South East (Blocks 13-21)
East Coast (Blocks 22-29)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year

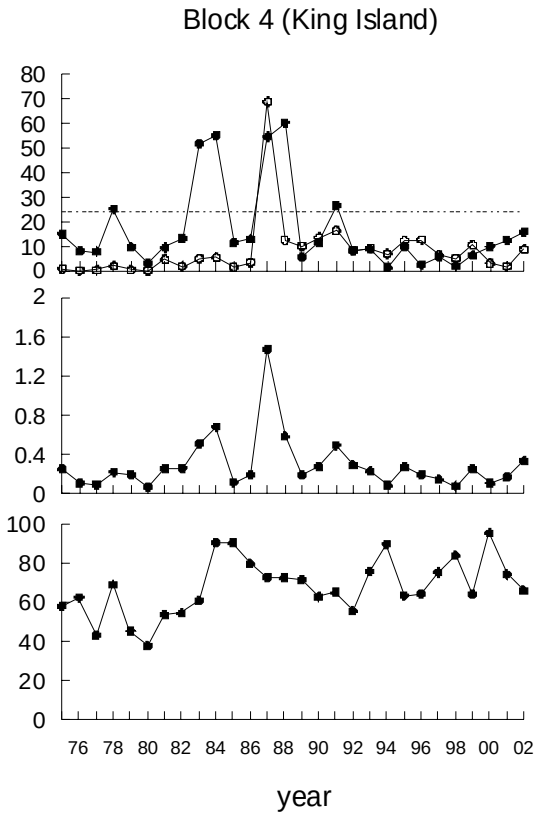

North East (Blocks 30, 31, 39 & 40)
Furneaux Group (Blocks 32-38)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year

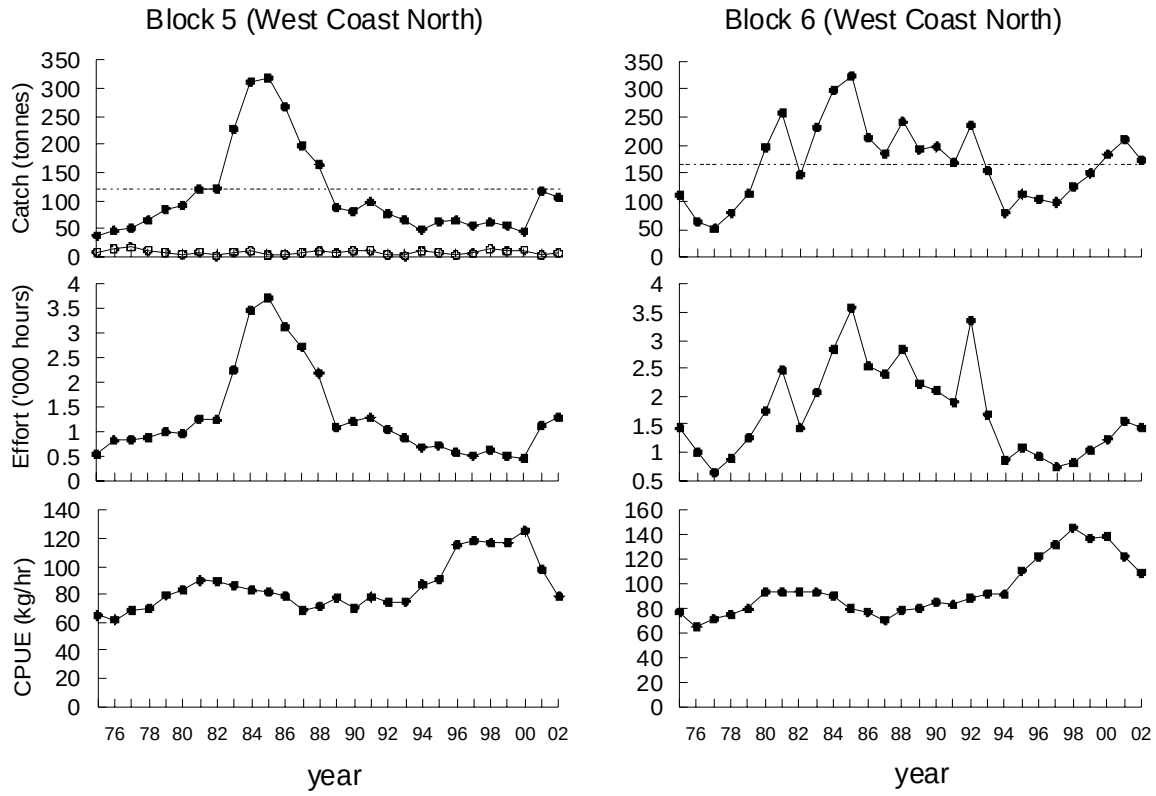

North West (Blocks 47-49)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
year
76 78 80 82 84 86 88 90 92 94 96 98 00 02

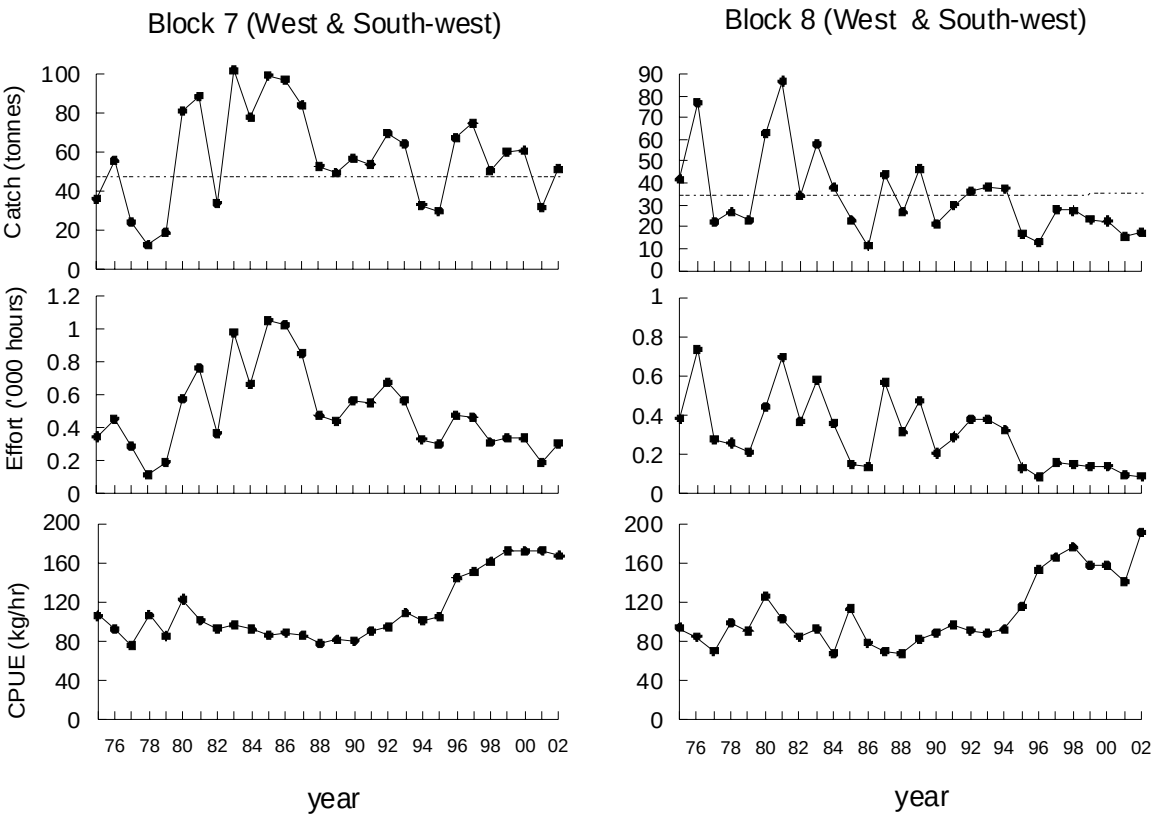

Block 1 (King Island)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year

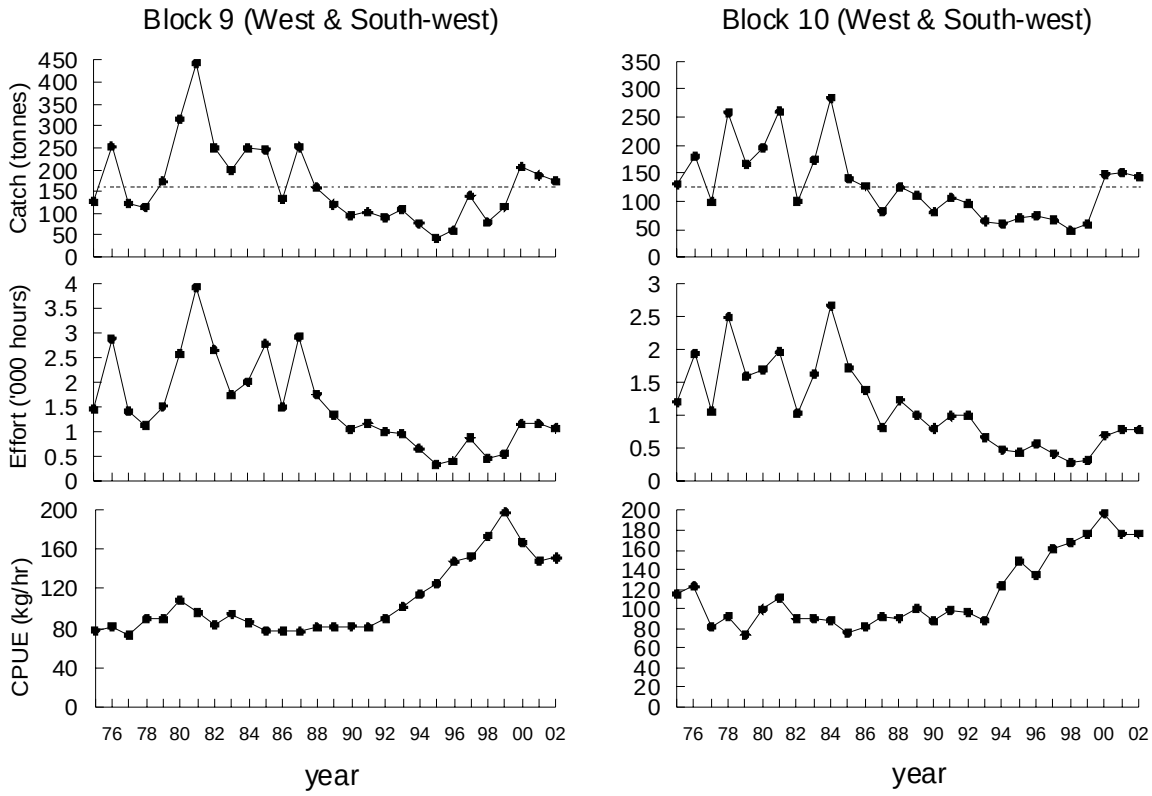
Block 2 (King Island)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year

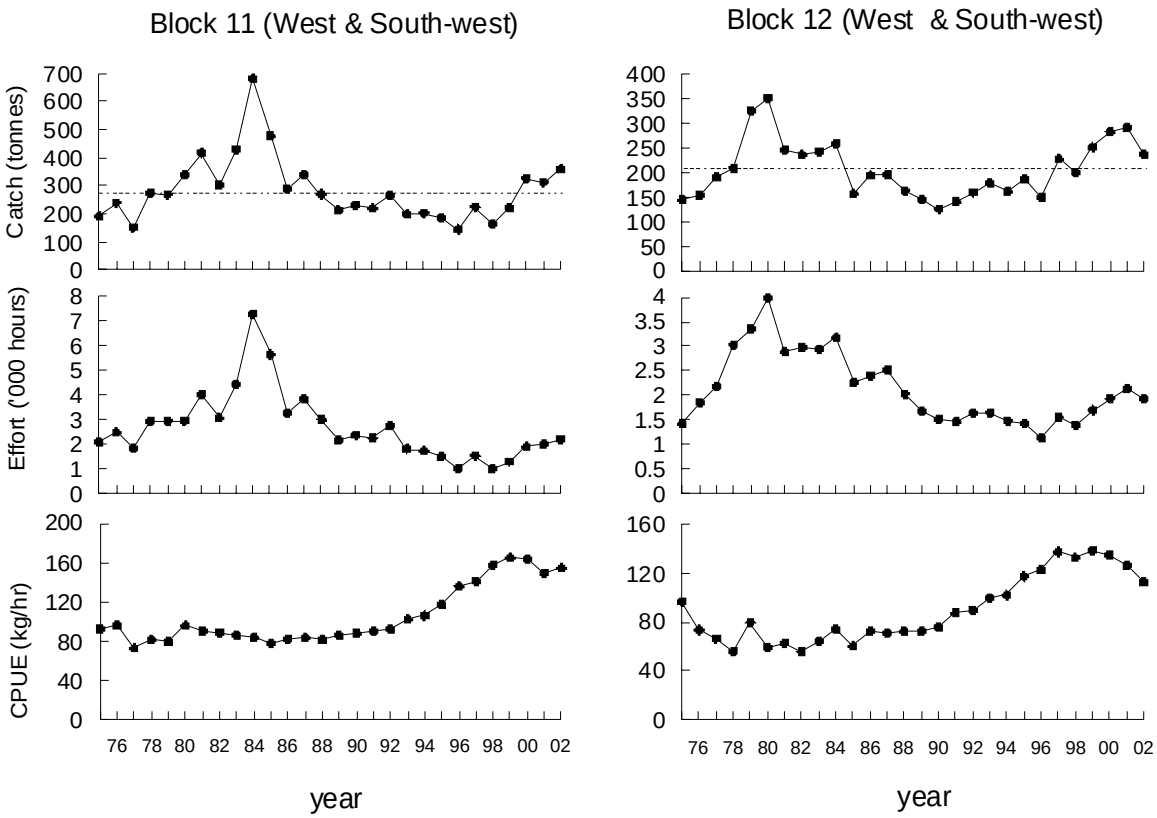

Block 3 (King Island)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year

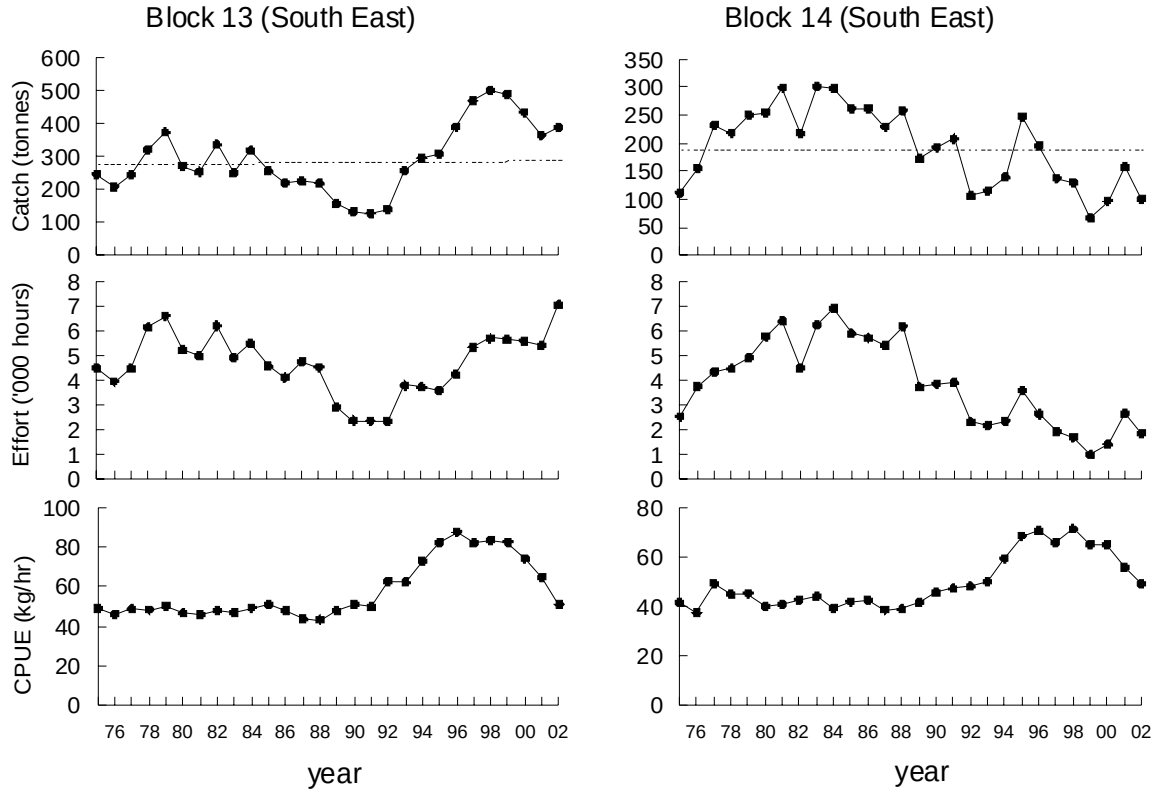

Block 4 (King Island)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year

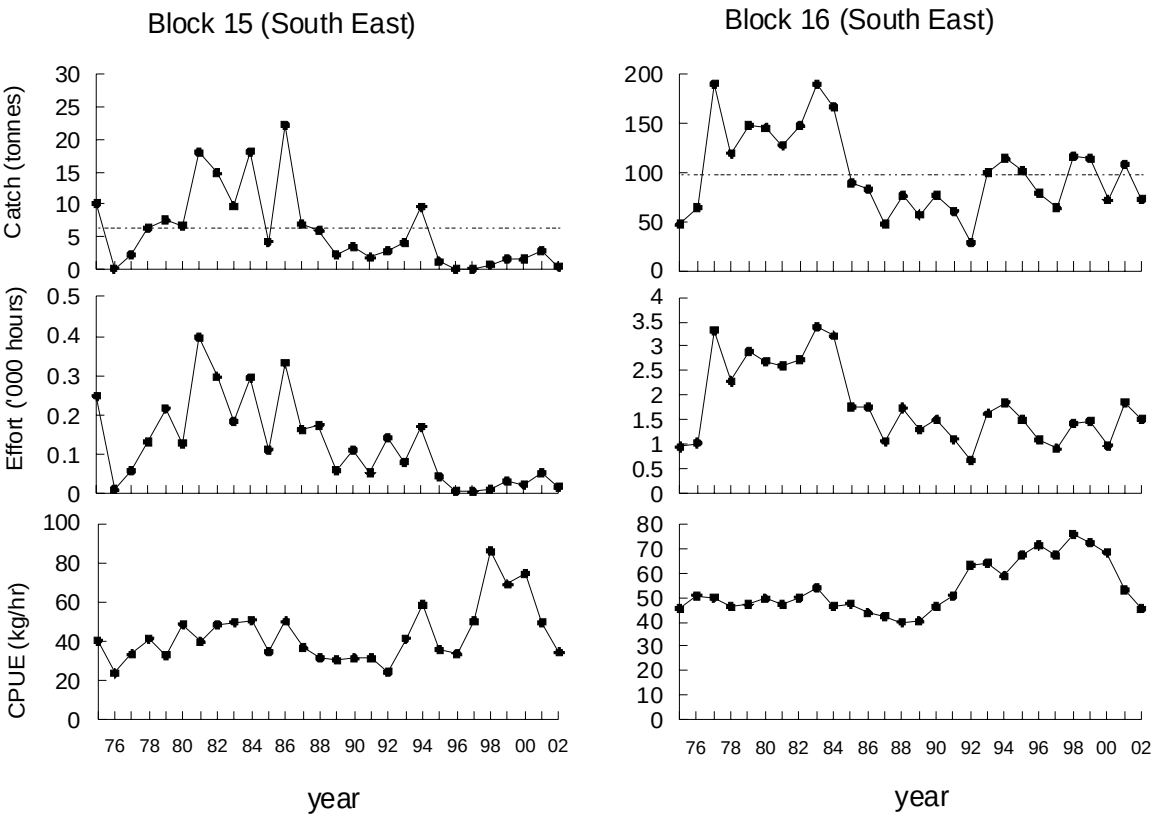

Block 5 (West Coast North)
Block 6 (West Coast North)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
year

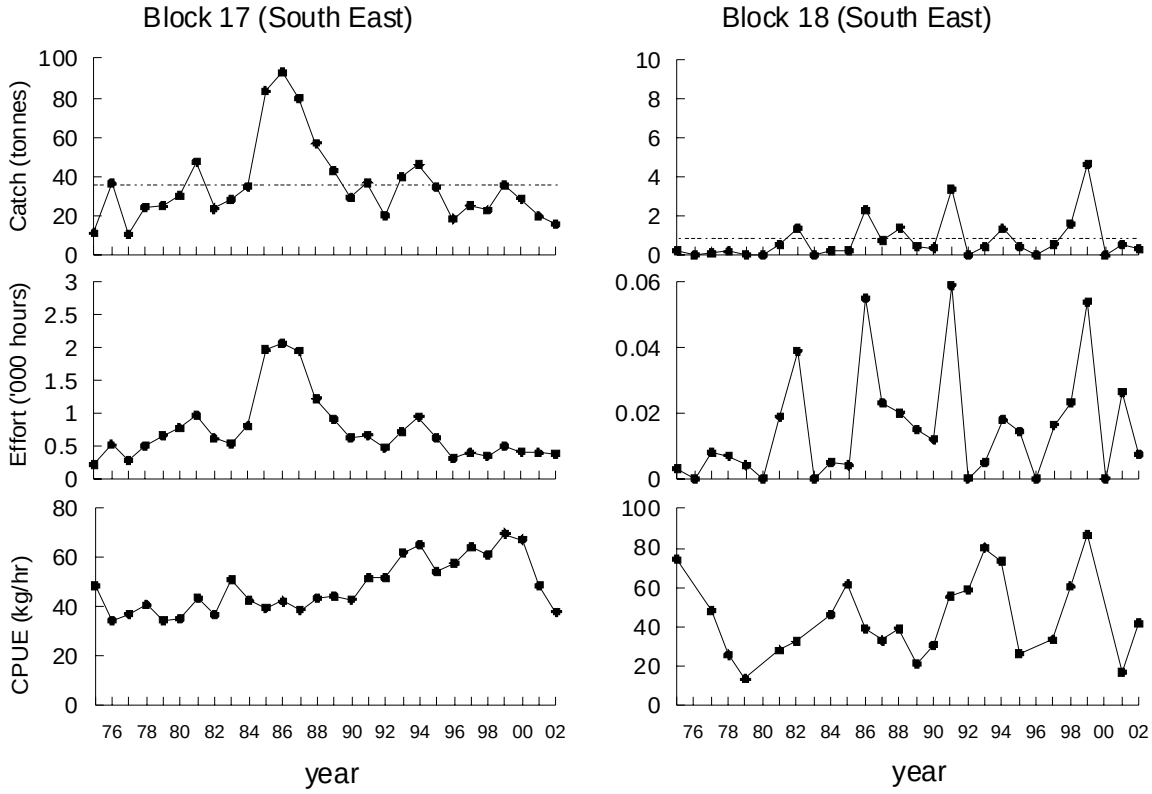

Block 7 (West & South-west)
Block 8 (West & South-west)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
year


Block 9 (West & South-west)
Block 10 (West & South-west)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year

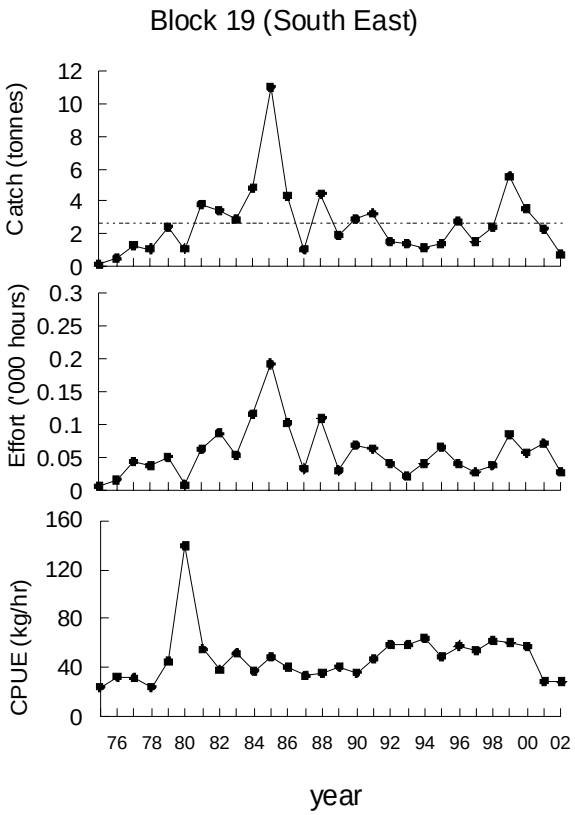

Block 11 (West & South-west)
Block 12 (West & South-west)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year

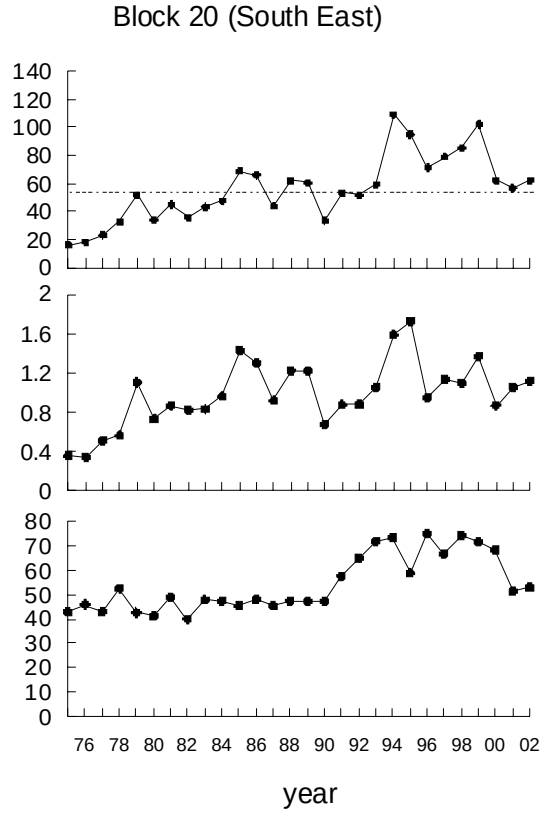

Block 13 (South East)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
year
Block 14 (South East)
year

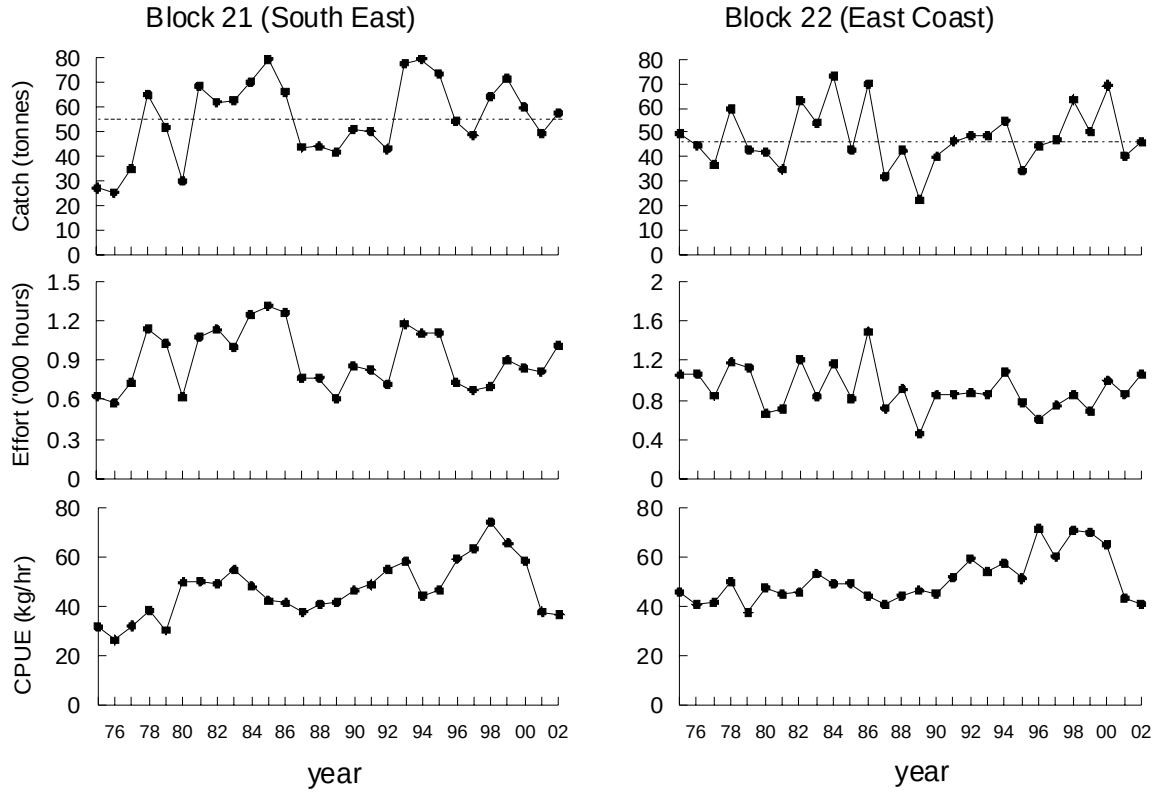

Block 15 (South East)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
year
Block 16 (South East)
year

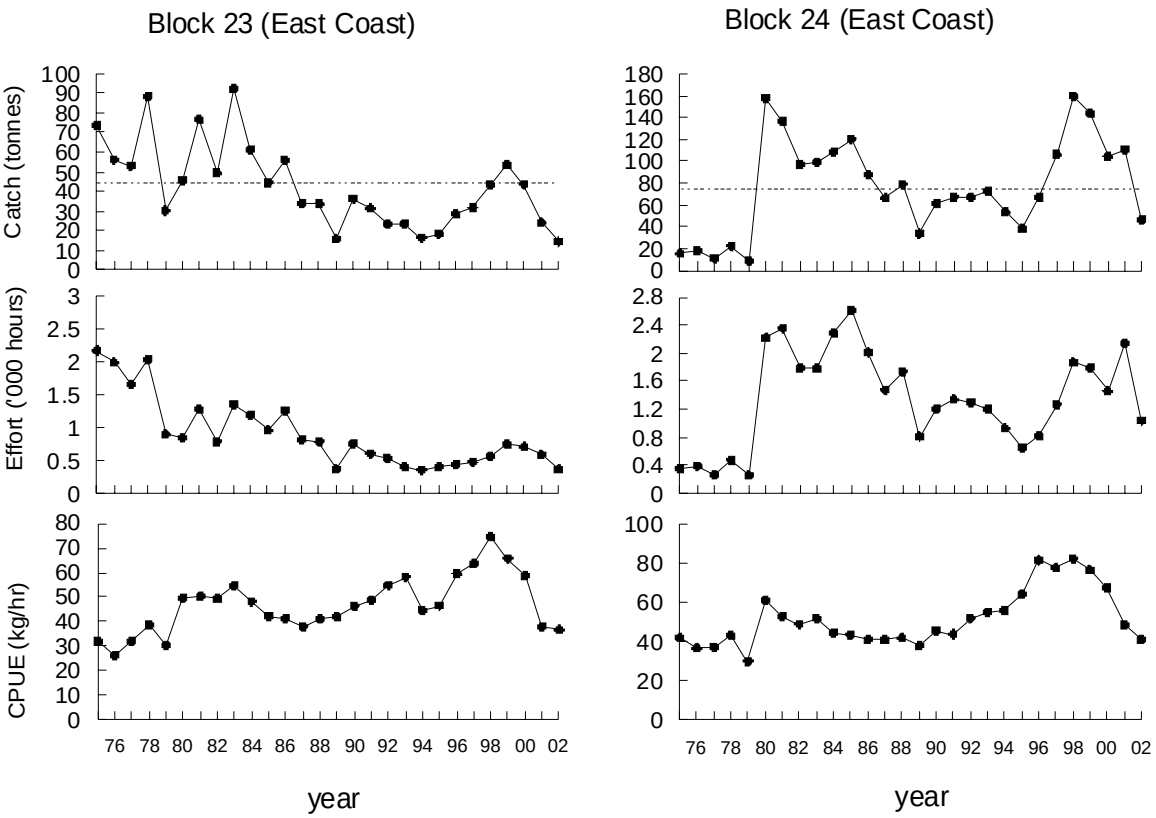

Block 17 (South East)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year

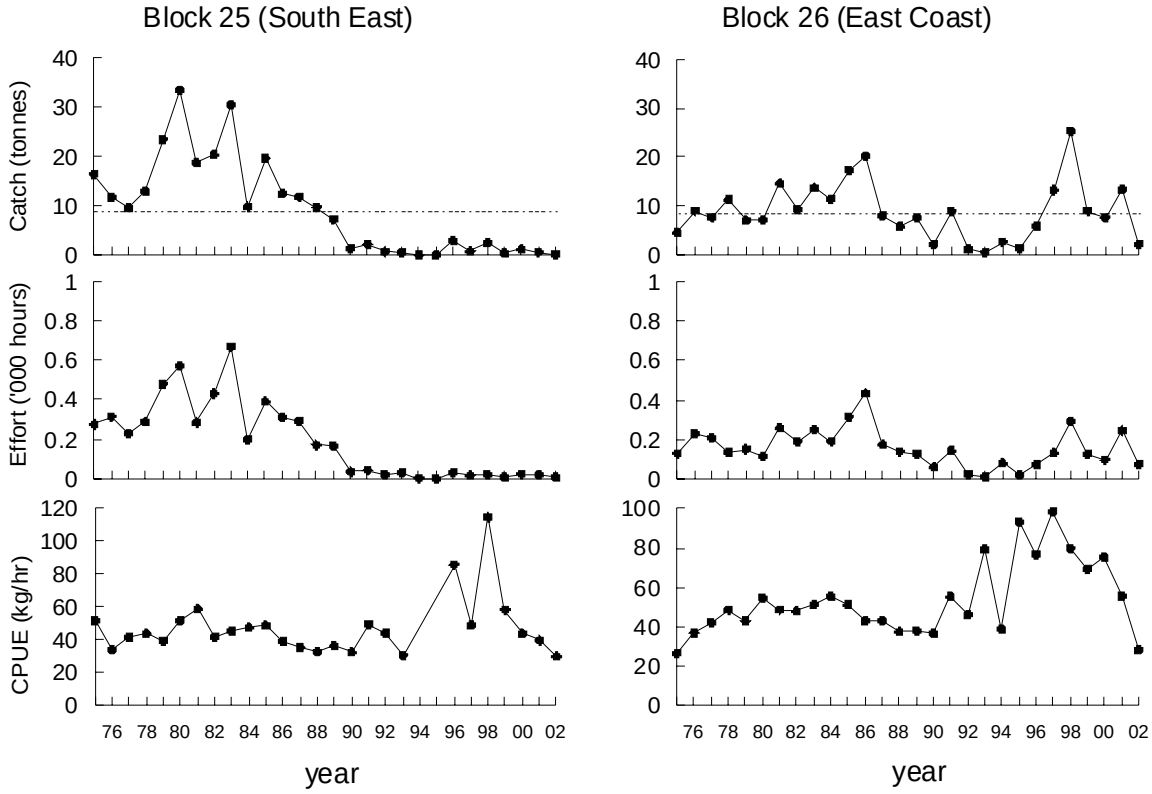
Block 18 (South East)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year

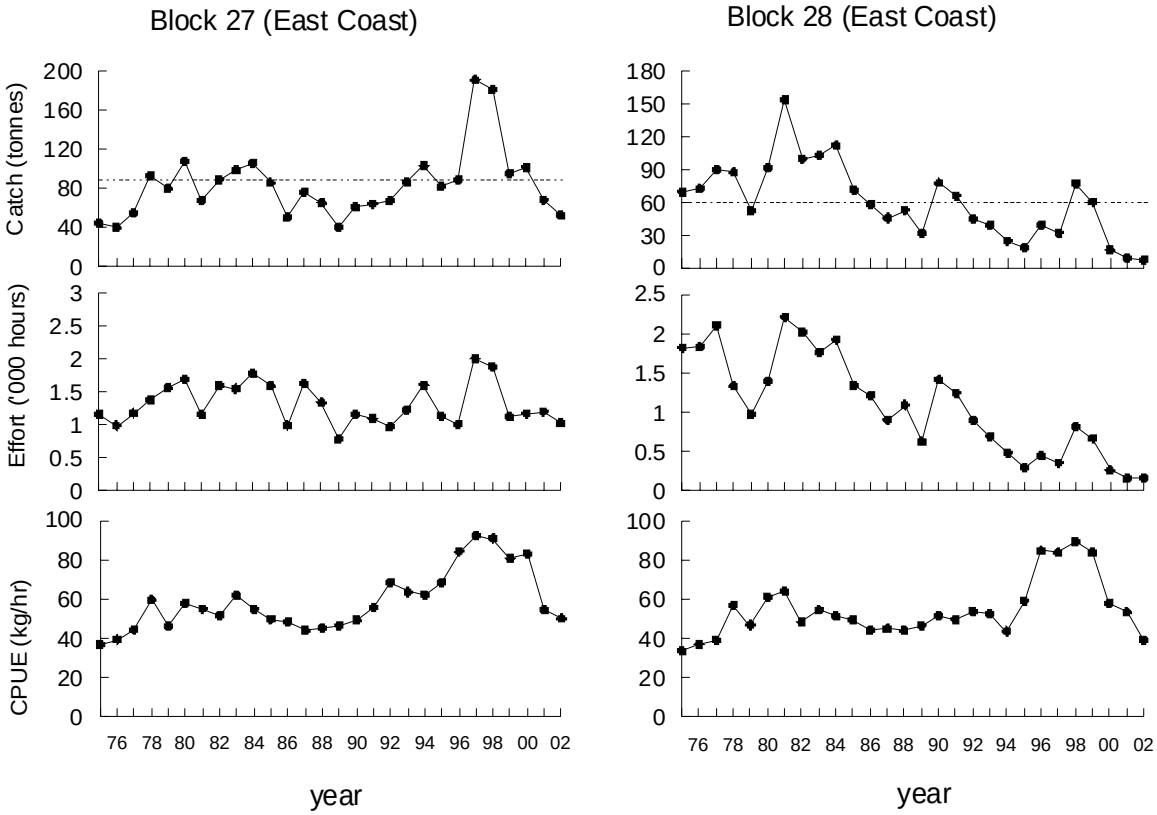

Block 19 (South East)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year

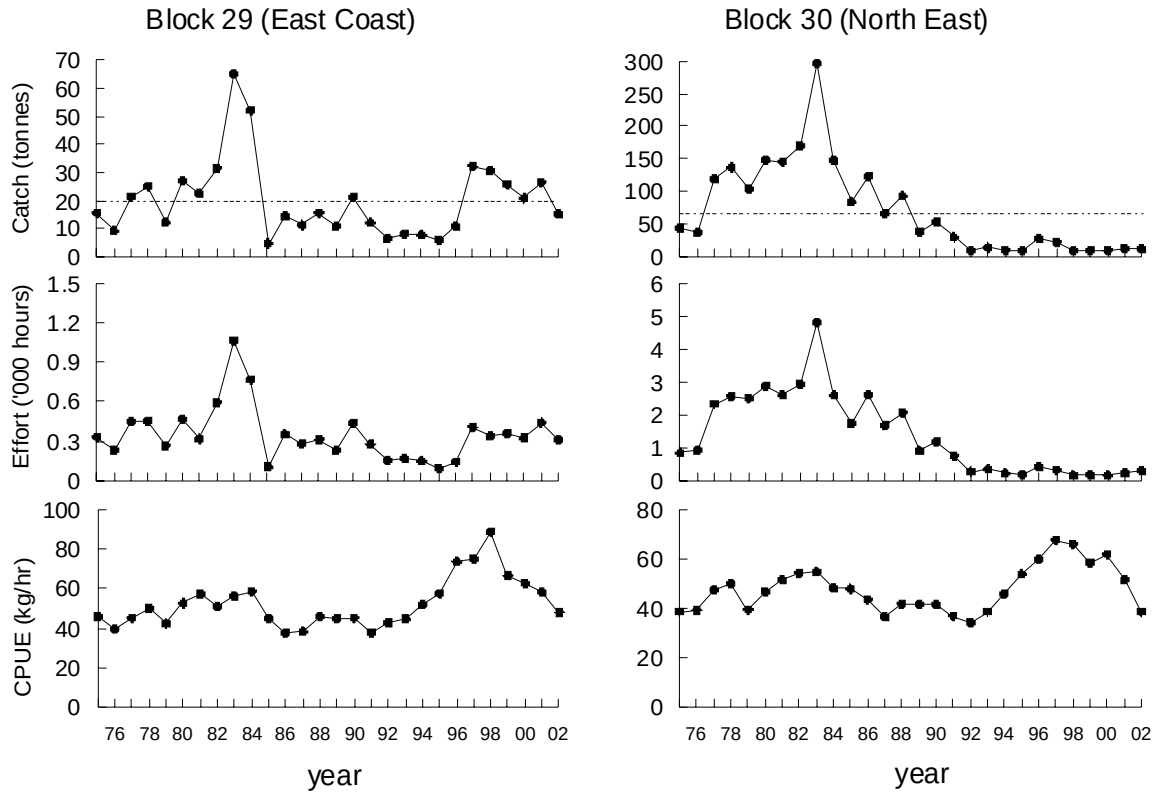

Block 20 (South East)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year

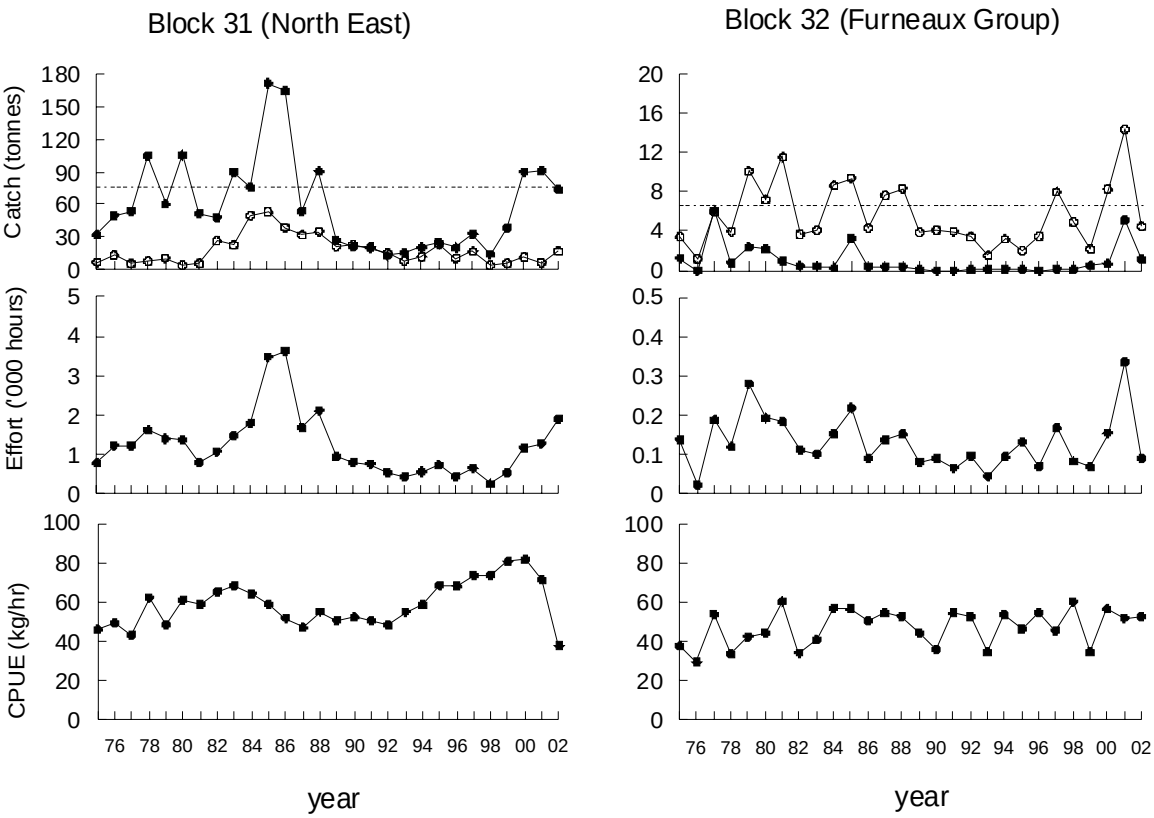

Block 21 (South East)
Block 22 (East Coast)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year

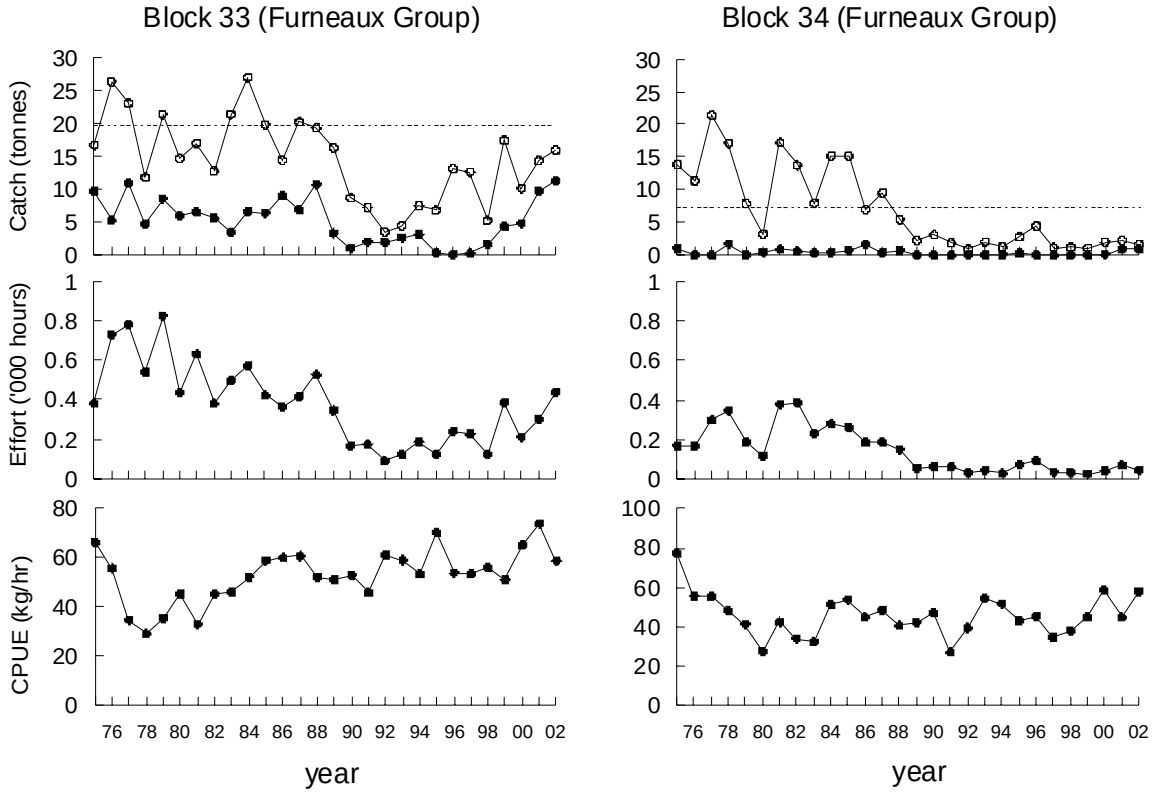

Block 23 (East Coast)
Block 24 (East Coast)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year

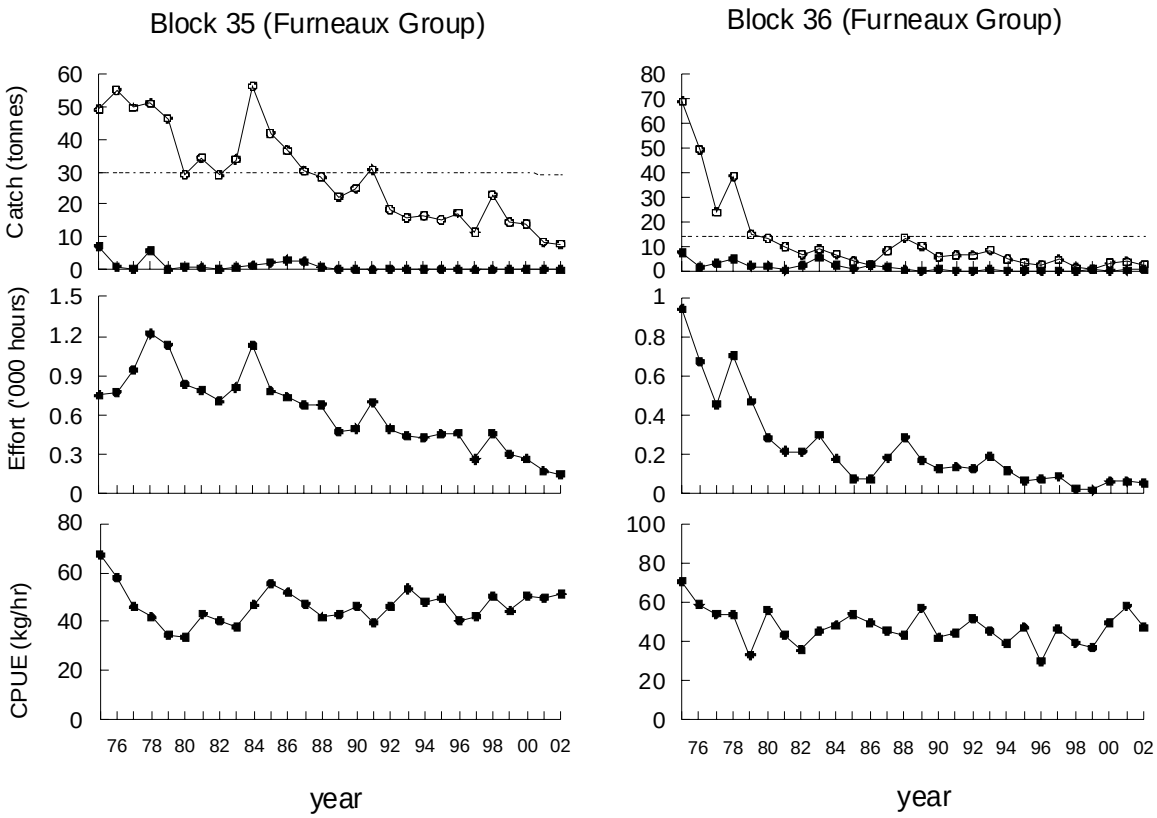

Block 25 (South East)
Block 26 (East Coast)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year

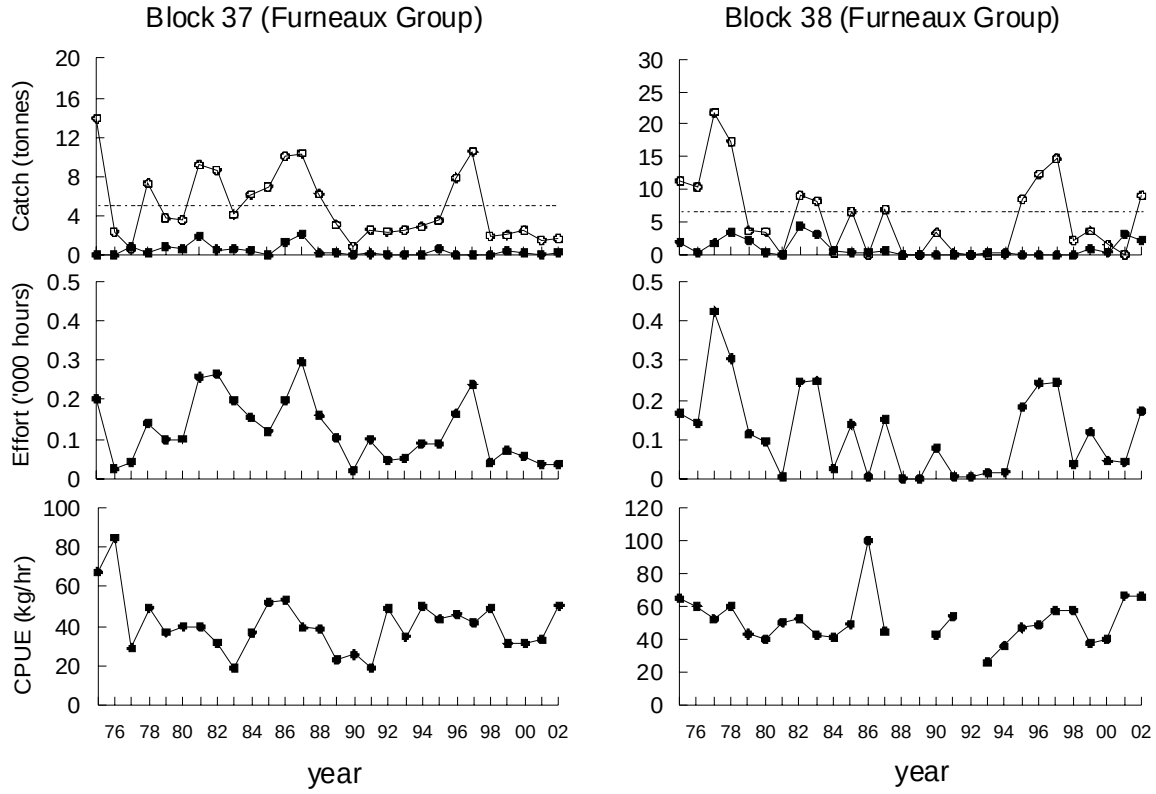

Block 27 (East Coast)
Block 28 (East Coast)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year


Block 29 (East Coast)
Block 30 (North East)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year

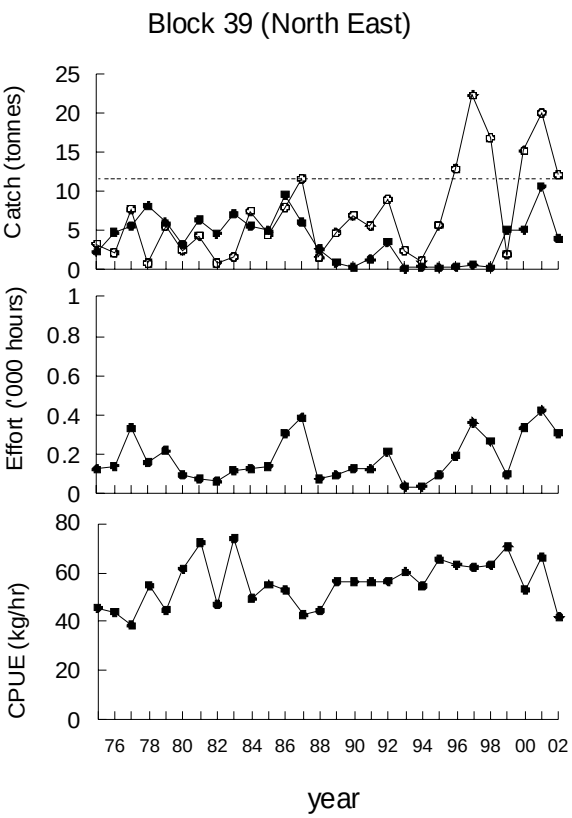

Block 31 (North East)
Block 32 (Furneaux Group)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year

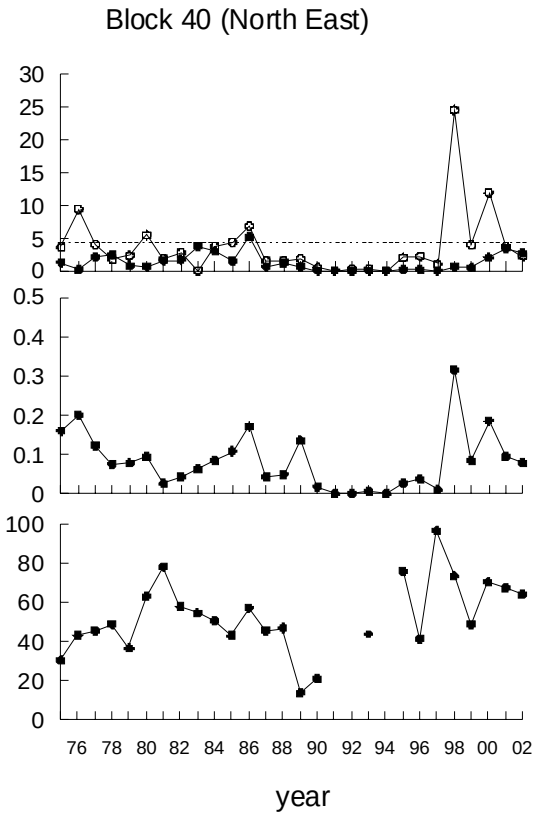

Block 33 (Furneaux Group)
Block 34 (Furneaux Group)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
year

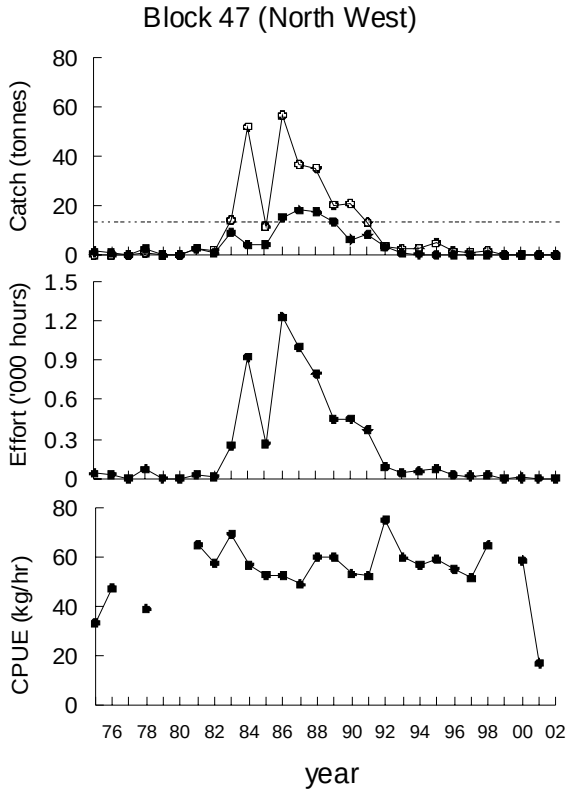

Block 35 (Furneaux Group)
Block 36 (Furneaux Group)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
year

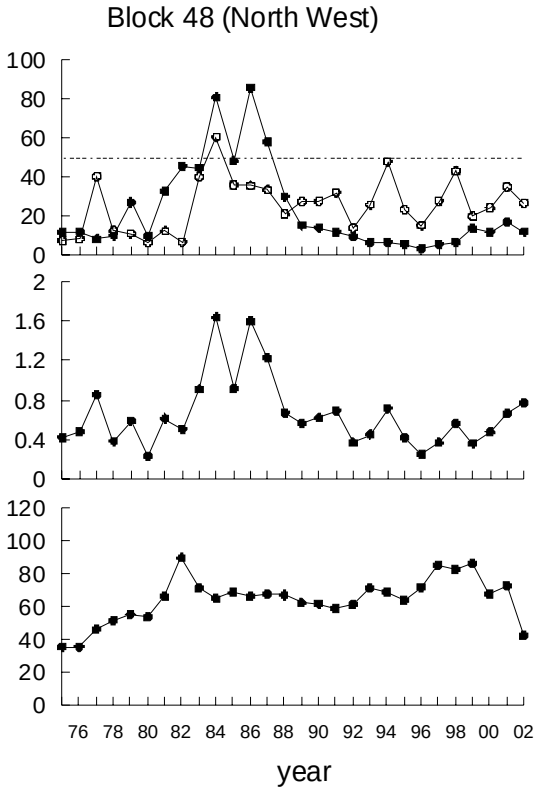

Block 37 (Furneaux Group)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year

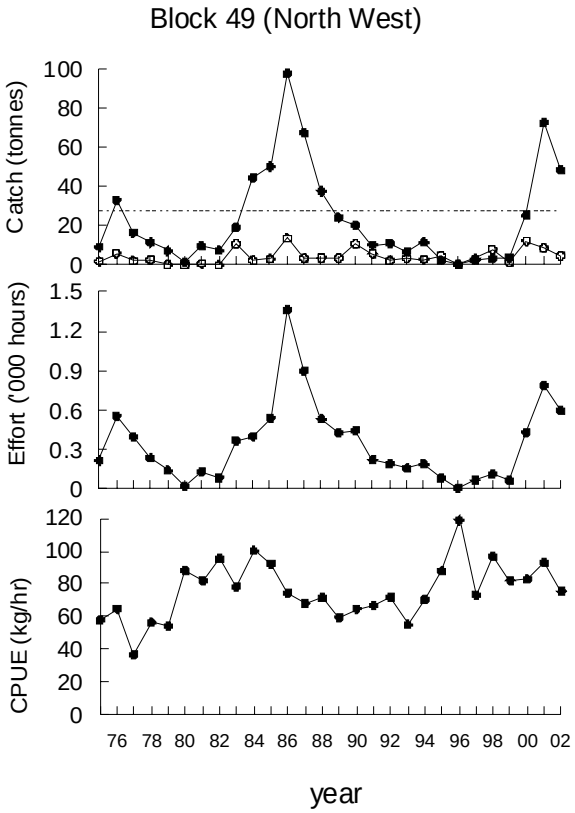
Block 38 (Furneaux Group)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year


Block 39 (North East)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year


Block 40 (North East)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year


Block 47 (North West)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year


Block 48 (North West)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year


Block 49 (North West)
Catch (tonnes)
Effort ('000 hours)
CPUE (kg/hr)
76 78 80 82 84 86 88 90 92 94 96 98 00 02
year