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FISHERY ASSESSMENT REPORT

TASMANIAN ABALONE FISHERY 2003

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Abalone Fishery Assessment: 2003

Executive summary

The 2003 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 and effort data were supplied by the Tasmanian Department of Primary Industry, Water and Environment. These data were obtained from catch dockets provided by licensed divers. Catch rates were derived from the catch-effort data 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 2003 the Eastern, Western, Northern and Bass Strait 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 separate total allowable catch (TAC), legal minimum size and in some cases, localised annual catch limits (caps). In 2003, the TAC from all parts of the fishery was 2607.5 tonnes.

The 2003 fishery included an increase of 70 tonnes over the previous year's TAC, due to the development of the fishery for smaller abalone in central Bass Strait. This region was previously fished under strict controls that included smaller size limits, limited (less than one month) access and fixed levels of quota. After limited openings in 1989, 1991, 1993 and 1995, stock levels became depleted and between 1995 and 2003 the small size-limit fishery remained closed. In 2003, the region was incorporated into the Tasmanian fishery as a management zone to be fished year-round with a size limit of 114 mm.

Although parts of the Bass Strait Zone have previously supported large catches, it is apparent that high levels of effort directed at small areas have had adverse consequences, e.g. the Kent Group in 1995. In 2003, more than half the Bass Strait TAC was taken at the Hogan Group, which is unlikely to be sustainable in the long term. It is considered that the 70 tonne TAC will only be sustainable if effort is more widely distributed, specifically to Flinders Island and the Tasmanian mainland, rather than focussed on small and isolated sections of coastline.

Previous assessments have documented a concern over declining stock levels in the Eastern Zone. In 2001, declining catch rates and catches led to a substantial reduction in the Eastern Zone TAC from 1120 tonnes to 857.5 tonnes in 2002. In addition to the TAC reduction, the size limit was increased by 4 mm to 136 mm, in order to provide protection of the breeding population in line with the Abalone Management Plan objectives. A cap on catch for the fishery in the Actaeons region was also implemented by managers to limit over-exploitation of specific abalone stocks. Despite these efforts, catch rates continued to decline in 2002. In 2003, catch rates in the Eastern Zone were broadly similar to 2002 with some smaller areas showing marginal increases or

decreases. Thus stock levels (as inferred from catch and catch-effort data) in many parts of the Eastern Zone in 2003 were severely depleted, and remained below the levels in 2001 that had led to the initial Industry driven reduction in TAC. The Interim Assessment of September 2003 found no evidence of widespread stock recovery, and the recommendation from the 2002 Annual Assessment that the TAC be further reduced was implemented for the 2004 fishing year.

This assessment shows that stock levels have remained low in all parts of the Eastern Zone. Of particular concern is the East Coast (Tasman Island to Musselroe Point). The reduced levels of catch, in conjunction with falling catch rates, indicate that whole populations (i.e. not just the fishable biomass) were declining. The reduced level of effort here (and consequently catch) affects the reliability of CPUE trends as an index of abundance as too few records are obtained for any single area. However, on the few areas of the coast where consistent fishing occurred and where accurate assessment was more certain, observed catch rates, although initially high, progressively fell over a short period despite the small catch. Similar patterns were observed of catches taken from Bruny Island, particularly its eastern side (Block 16). There was no certainty that stock levels in these two regions had stabilised, which suggests depletion is continuing.

At the Actaeons and Storm Bay, it was concluded that stock levels are no longer falling. Catch levels were maintained and catch rates had increased slightly in some sub-blocks, which may indicate recovery in these areas. The two regions continue to be fished at high levels, with catch largely unchanged since 2001, despite the reduction in TAC in 2002. Should the TAC reduction in 2004 reduce the catch taken from these regions, further additional evidence of stock recovery may be expected. If unequivocal and widespread signs of recovery are not evident by September 2004, then further reductions in TAC must be considered for 2005, with appropriate management of effort within the Eastern Zone. If stock levels from parts of the East Coast and Bruny Island continue to decline, it is recommended that they be quarantined from the fishing area.

Stock levels appear to be high in many parts of the Western Zone, particularly in the more remote sections between South West Cape and Sandy Cape. In many parts of this Zone, the clumped distribution of abalone combined with low diver visitation rates made CPUE unreliable as an index of abundance. In these areas, there was a reliance on the observations of divers, and on the relatively high absolute value of CPUE compared with other areas with lower CPUE where stock levels are known to be sound.

Effort has been transferred from parts of the Western Zone where stock levels are weaker to the more robust areas, particularly Block 10 in the South West region and Block 7 in the Central West. An unprecedented level of catch was landed from Block 7 which will be of concern should high levels of catch be landed again in 2004. Catch trends in this block will require monitoring. In the North West (Block 6), catches and catch rates have trended downwards for several years. In the more accessible parts of this block, catch rates have fallen to 80 kg/hr, while the annual catch fell to 97 tonnes, from 173 tonnes in 2002. While stocks are obviously depleted here, the reduction in catch appears largely due to divers seeking better catch rates elsewhere. The fishery in this block requires careful monitoring. In the more accessible parts of Block 9, where catch rates had been steadily falling, the annual catch has dropped as divers moved to the South West or Block 7. On the South Coast, catch rates have improved with a reduction in effort and catch to more sustainable levels.

Northern Zone landings from North East Tasmania and the Furneaux Group have fallen to negligible (< 20 tonnes) levels. This was due more to the remoteness of the Furneaux Group, market preferences for abalone from other regions and a shift in effort to King Island than large-scale depletion of stocks, although stock levels in the North East have been reduced. The North West continued to provide most of the Northern Zone catch (160 tonnes). In Block 5, catch rates have stabilised at moderate levels (~ 80 kg/hr), and the local cap of 100 tonnes implemented in 2002 to limit the depleting effects of intensive levels of effort, was not reached. Catch from Block 49 has increased, much of it taken from remote parts of the block, where catch rates were high. The catch from King Island has increased by more than 50% to 98 tonnes since the previous year. Although this catch was only slightly above the long term average taken at the 127-mm size limit (94 tonnes), most of it was taken from the western part of the island. Here catch rates were initially high, but fell quickly, indicating that stocks were being fished in an unsustainable manner. It was reported that abalone from Block 2 were now too small to fish at economical catch rates, and consequently, the sustainable catch from the island may now be less than was estimated during the development of the Northern Zone. The expected catch from King Island may need to be revised downward in the near future, if effort becomes more focused and catch rates decline.

The greenlip fishery comprises four main regions, each (except King Island) with a regional cap. In the two mainland regions (North West and North East), catch rates have fallen, and stocks were almost certainly being depleted. Because of the nature of the fishery (changes in catchability, clustering of abalone along sand edges and serial depletion of reefs) it is considered that catch rates are unreliable indices of abundance, and that abundance is falling at a faster rate than indicated by catch-rate trends.

The North West greenlip fishery has been complicated by the recent size limit increase, which has reportedly made the slow growing stock at Black Reef difficult to fish. This has encouraged divers to fish elsewhere in the region transferring additional effort to the remaining fully exploited stocks. The North West cap was reduced from 40 tonnes to 30 tonnes in 2004. This may be insufficient and inconsequential as the catch did not reach the limit in 2003 and divers preferred to fish in other regions. In contrast the cap in the North East was overrun by 5 tonnes, the total catch being 35 tonnes. Divers reported that this level of catch was too high for the short North East coastline, and that depletion was widespread. The 30 tonne limit was calculated from the average of annual catches since 1975, the larger ones of which were almost certainly unsustainable. A lower catch limit in the North East greenlip fishery should be considered. On King Island, while rising catches and stable catch rates indicate a stable fishery, divers there also reported depletion of reefs, and said that the annual catch was too high. Only in the Furneaux Group did divers consider that the fishery was stable, with stocks apparently recovering after management intervention.

Recommendations from this report

- The increases in TAC that started in 1997 and the subsequent creation of zones have had a significant impact on stock levels. Further adjustments of both TAC and size limits are required in some areas. This assessment has found that the spatial scale of management is still insufficient to prevent localised stock declines. This means that the fishery may need to be managed more

conservatively, perhaps with an increased number of controls and regulations to ensure that adequate stock levels are sustained.

- The reliance upon catch and effort data to monitor trends in abundance has been demonstrated to be inappropriate, and reliance on CPUE has been associated with the collapse of many abalone fisheries elsewhere in the world. The inadequacy of this method in many parts of the Tasmanian fishery is stressed, and it is strongly recommended that a fishery-independent abundance survey program to supplement the CPUE-based fishery assessment is implemented.
- If by September 2004 in the **Eastern Zone** signs of recovery are not seen from either the East Coast between Tasman Island and Musselroe Point, or eastern Bruny Island, or catch rates at the Actaeons or Storm Bay fail to show broad improvement, then additional management responses will be required.
- It is again recommended that Block 30 (St Helens to Eddystone Point) be closed temporarily to abalone fishing. While commercial divers have effectively abandoned the region, recreational fishers continue to deplete the more accessible stocks.
- Given the current state of the Eastern Zone, it is recommended that a rebuilding strategy be developed, identifying catch and catch-rate goals to be achieved within a specific time frame.
- In the **Western Zone** it is recommended that the performance of Blocks 6, 7 and 8 be reviewed in September 2004. CPUE declines need to be monitored to ensure there is not a second year of excessive catch. If indications of depletion become evident, management must respond to limit catches to a more sustainable level.
- In the **Northern Zone**, King Island is probably now producing blacklip at or beyond maximum capacity. It is recommended that a review be undertaken of size limits and yield for the King Island blacklip fishery to assess the ability of the region to provide current levels of catch.
- In the **Greenlip fishery**, it is strongly recommended that management reviews catch and size limits in the North East, North West and King Island. Options for making slower or smaller growing stocks available to the fishery once more should be explored.
- In the **Bass Strait Zone**, although the fishery is in its infancy, a watching brief is required for Hogan Island.
- For the Recreational fishery, it is recommended that management monitor increased levels of recreational catch associated with the rapidly increasing number of recreational licenses.

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1. Introduction

The Tasmanian abalone fishery is assessed using information produced from divers' catch dockets, and length measurements 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 four year period (sub-block level).

In 2003, the abalone fishery was managed as five zones, each with a TAC (total allowable catch). The blacklip fishery was divided into Northern, Eastern, Western and Bass Strait Zones, the greenlip fishery comprising the fifth zone. For the purposes of this assessment, each zone has been divided into regions (Figure 1).

The information used to assess fishery performance in this report is shown as a series of charts, of either catch and catch rates, or the size composition of divers' catches. Within each region, catch and length data have been grouped at sub-block or block levels. At each level, charts have been produced showing variation in catch, catch rates and size composition throughout the review period. These charts were presented to the industry and government representatives of the Abalone Stock Assessment Group (AbSAG). With their specialised knowledge, together with input from a number of other fishers, trends in catch, catch rates and size composition of catches were used to infer changes in abundance. This information was collated by region and detailed assessments of stock levels have been produced for each zone. The report concludes with a list of recommendations to managers based upon these assessments.

This report contains a number of appendices. Appendix 1 contains information about the charts used in this report. Appendices 2 to 6 list historical catches by zone by block. Appendix 7 contains a history of management changes and Appendix 9 contains maps of the block and sub-block boundaries used to report the fishery.

Landed Catches, 2003

At the end of 2003, annual landings comprised 2464.1 tonnes of blacklip and 139.9 tonnes of greenlip (Table 1). In 2002 the Eastern Zone TAC was reduced from 1120 tonnes to 857.5 tonnes. The sum of all TAC's in 2003 was 2607.5 tonnes.

Table 1. 2003 landings by zone, in tonnes

Zone	2003 TAC	2003 Landings
Greenlip	140.0	139.667
Eastern Blacklip	857.5	855.499
Northern Blacklip	280.0	279.183
Western Blacklip	1260.0	1259.951
Bass Strait	70.0	69.505

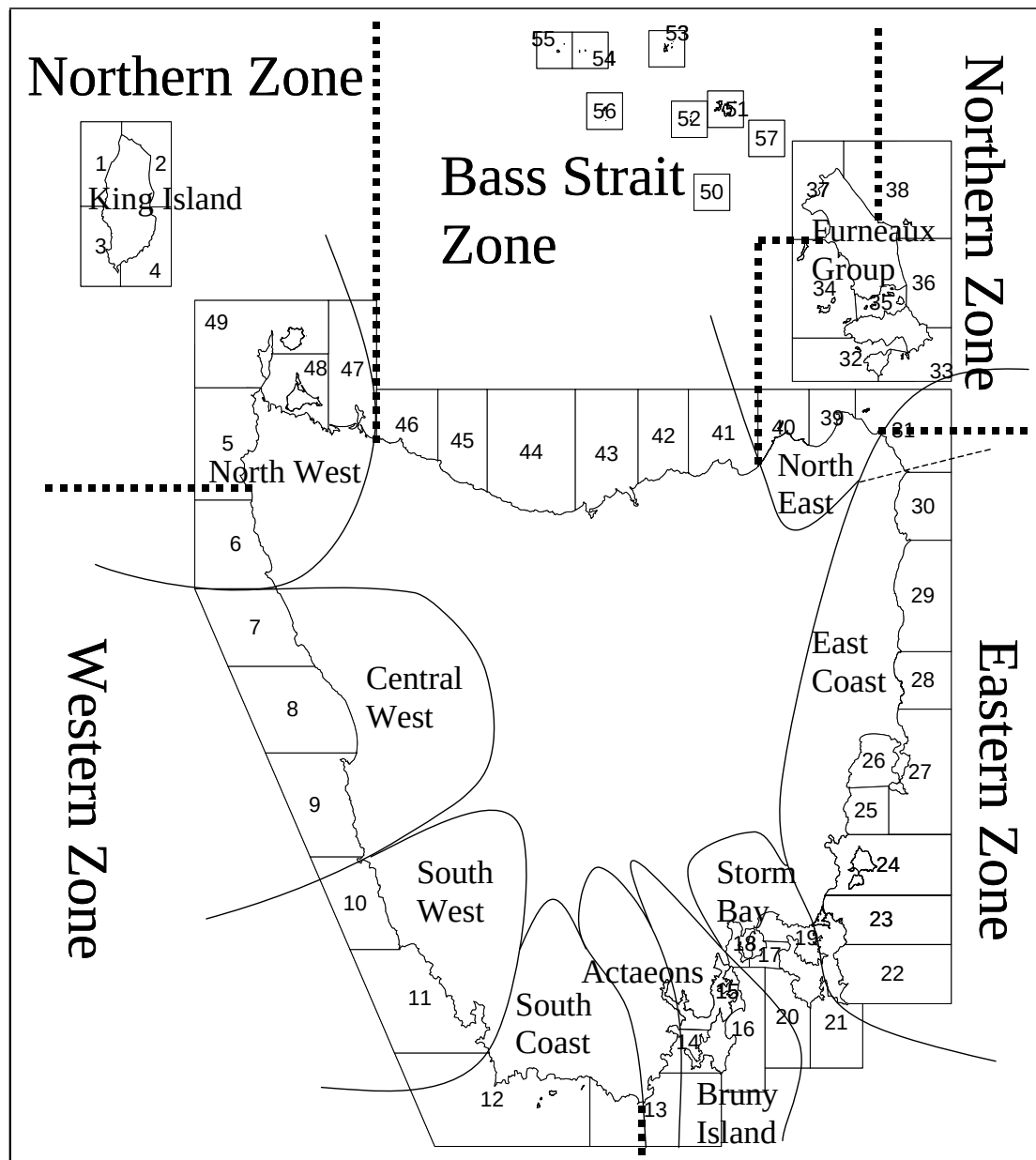


Figure 1. Statistical blocks and zones used for catch reporting in the Tasmanian abalone fishery in 2003. Also shown are the regions used for assessment purposes in this document. Zones and zone boundaries may change from year to year. Zone boundaries are shown as dotted lines. The Greenlip fishery has no geographical boundaries, but mostly takes place on coasts included in the Northern and Bass Strait Zones.

2. 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, both catch distribution and catch rates. It relies upon the assumption that trends in catch-rates accurately reflect changes in abundance of the fishable stock. Despite CPUE being much discredited as an index of abalone abundance (e.g. Breen (1992), Prince (1992), Shepherd *et al.* (2001)) it has been used for many years in the Tasmanian fishery, with some success, as illustrated by the strongly

declining catch rates in the Eastern Zone coinciding with its currently depressed state. There are three factors that adversely affect the relationship between CPUE and abalone abundance: gregarious behaviour of abalone, serial depletion of local populations constituting the stock, and changes in catchability of abalone. If the effects of these factors are understood and can be minimized then the reliability of CPUE as an index of abundance can be improved.

Gregarious behaviour

Abalone tend to aggregate in favourable habitat (gutters, sand-edges, shallow margins), and a large proportion of abalone may be found in only a small area of each reef (Prince, 1992). When these aggregations are fished, the remaining abalone tend to form new aggregations (Officer *et al.*, 2000), and thus reefs may become depleted while catch rates are maintained (McShane, 1995; Officer *et al.*, 2000). Similar problems among other commercially fished marine species are well documented (e.g. Hilborn and Walters (1992), also see Rose and Kulka (1999) for a recent review).

Where abalone abundance is high and abalone are aggregated, catch rates are primarily a function of handling time (the time taken to detach abalone from the reef and transfer them to the boat). As abalone abundance decreases, and aggregations become smaller and further apart, search time increases, and adds significantly to the overall effort required. This makes the relationship between abalone abundance and CPUE non-linear, and by the time catch rates start to decline rapidly abalone abundance will already have been greatly depressed (Prince, 1992).

A related problem occurs when divers search for favourable habitats, and the aggregations in them. Time spent searching for aggregations is only weakly related to the number of individuals landed, and catch rates do not necessarily decline at the same rate as the abundance of aggregations (Breen, 1992). Under these circumstances, catch rates are again unreliable, and extra care is needed when attempting to interpret such information.

Where abalone abundance is low, because of the aggregating behaviour the most favourable habitats can accommodate most of the population and the surrounding areas may be relatively sparsely populated. Provided effort is also low (i.e. diver visitation rates are low), legal-sized abalone move to the favourable habitat (Shepherd and Partington, 1995; Officer *et al.*, 2000) between fishing events. Experienced divers can maintain catch rates by fishing the most favourable areas (Shepherd and Partington, 1995), and the CPUE/abundance relationship is again non-linear.

Serial depletion

Serial depletion of reefs occurs when divers progressively reduce stock abundance on individual reefs while maintaining stable catch rates by moving between reefs (Prince and Shepherd, 1992). Reefs are abandoned when divers find it harder to maintain levels of daily catch, and they move to reefs with higher stock levels. When there are many reefs with low levels of abundance in a reporting block, divers can move between reefs, depleting stocks levels in each, while producing stable but relatively low levels of annual catch at stable catch rates.

If management units are large and catch reporting occurs over large spatial scales, falling catch rates caused by depletion of individual reefs are masked when divers transfer effort to reefs with higher levels of abundance. If catch reporting occurred at the scale of individual reefs, the fall in CPUE that precipitated the divers' movements and the fall in catch indicative of depletion might be detected. In Tasmania, even the recently introduced sub-block scale of reporting (Appendix 9) is much too large to detect such fine scale falls in CPUE.

Regular patterns observed in the spatial distribution of catch from Tasmania's East Coast appear to indicate that provided effort is low enough, stock levels on the reefs first depleted may recover sufficiently to support further fishing, thus developing a cycle of depletion and recovery. Analyses of catch data reveals historically low levels of annual catch, which may appear stable in the short term, but fall slowly over a period of years, presumably as reefs become less productive (i.e. the period between depletion and recovery is greater than the period between fishing events). Examples include Blocks 25, 26, 28, 29 and 30. Catch rates under this scenario typically appear stable, or with improvements in diver efficiency, may rise slowly.

Change in catchability

The detection and avoidance of difficulties associated with changes in catchability, or effort creep is a continuing problem when catch rates are used to assess fisheries. One of the features of modern fisheries is that fishermen find ways to make their operations more efficient, and the abalone fishery has been no exception. Thus, because of improved efficiency, if stock levels are unchanged, more abalone can be collected for any given period of time now than in the past. 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.

Early in the history of the Tasmanian abalone 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. It was estimated that the catching efficiency of divers doubled between the start of the fishery and 1982 (Harrison, 1983).

Possibly the greatest single improvement occurred during the late 1980's when divers widely adopted the practise of attaching their collecting nets to ropes 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. However, the effects of this are not constant across all abalone densities. At low levels of abundance, divers may finish swimming over a reef before their net is full, so the method offers no improvement. At the other extreme, when nets are being filled every few minutes because abalone are particularly abundant, the method offers great savings in time i.e. the method causes catch rates to change non-linearly with abundance.

Catchability may change in less overt ways, unrelated to technological changes. Competition between divers for fish or quota, or inducements offered by processors, or management changes, may all improve the way divers work (Gorfine, 2001). Divers as a group may learn how to fish an area more effectively (Breen, 1992). Daily catches may increase when divers realise they are catching at a high rate, leading to a correlation between high catch rates and larger catches. (Worthington *et al.*, 1998).

These types of changes are more difficult to detect and take into account than changes in fishing methods.

In fact, both forms of change in catchability are extremely difficult to quantify. 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. This assessment reviews catch rate trends primarily over the last 10 years, but with particular attention paid to the last four years. By reducing the period over which comparisons are made, we are more likely to detect or avoid changes to fishing methods or diver behaviour, and are more confident that catch rate trends represent changes in abundance, not changes in fishing power.

Circumstances when catch rates are reliable indices of abalone abundance

When problems caused by abalone aggregations, serial depletion and variable catchability are understood and their effects negated, catch rates can more accurately reflect abundance. For example, in the NSW blacklip fishery, high visitation and exploitation rates preclude both serial depletion and the formation of aggregations of legal sized abalone. Researchers there have concluded that catch rates had become a reliable index of abundance (Andrew *et al.*, 1997; Worthington *et al.*, 1998). Similarly, in parts of Tasmania, as in the Actaeons, where it is known that diver visitation rates to reefs are high (i.e. restrict the formation of aggregations), divers are not able to maintain levels of catch and catch rates by successively depleting reefs (all reefs support continuous levels of effort), and the effect of effort creep is reduced by limiting the review period to years when diving methodology was unchanged, we assume that catch rate trends are indicative of changes in abundance.

It now appears that these conditions are met in parts of the Eastern Zone fishery from where most of the catch is taken, particularly the Actaeons and Storm Bay regions, and the more heavily fished parts of the Northern and Western Zone fisheries in North West Tasmania and the South Coast. However, there are many parts of the Tasmanian fishery where these conditions cannot be met, and assessment of these areas based on catch rates must be viewed with caution. The following cases are discussed:

We assume that abalone abundance remains high in parts of the Western Zone (South West and Central West), the Northern Zone (King Island and the remote part of Block 49) and the Bass Strait Zone given the high catch rates reported from these regions. Because diver visitation rates to these areas are low, and abalone form aggregations, more credence may be placed on absolute values of catch rates. We conclude that stocks levels are high, because catch rates are relatively high compared with other parts of the fishery that we know to be sound. In addition, more reliance has been placed on divers with catch history in those areas to advise us about trends in abundance.

Much of the Eastern Zone fishery, particularly parts of the East Coast, has low levels of abundance, and low levels of effort. We are aware that in recent years, catch levels have been dependent upon divers rotating effort and successively depleting reefs on much of the coast between Triabunna and Eddystone Point (Blocks 25 – 30). Most of Tasmania's greenlip fishery also falls into this category. Throughout southern Australia, fishery managers have a long history of monitoring greenlip fisheries using fishery catch and effort data with a notable lack of success. The Victorian fishery collapsed, and fisheries in South Australia (Shepherd *et al.*, 2001), Western Australia

(Hart *et al.*, 1999), and Tasmania (Officer, 1999) have all wiped out greenlip populations because CPUE trends provided inadequate warning of stock depletion. Consequently we have placed less reliance on a CPUE/catch based assessment in these areas.

3. Catch, Catch-Rate and Size-Composition Figures

Eastern Zone Blacklip Fishery – major fishing blocks

The Eastern Zone TAC was 857.5 tonnes in both 2002 and 2003. Deviations of catch greater than 25% from the levels of the previous year occurred in Blocks 20, 23, 30 and 31 (Figure 2).

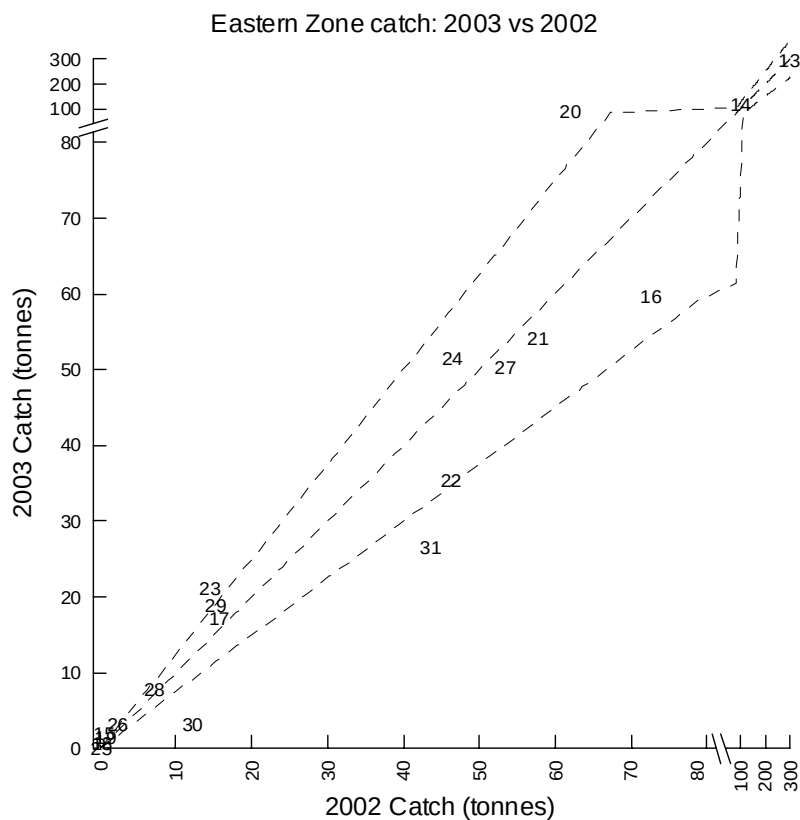
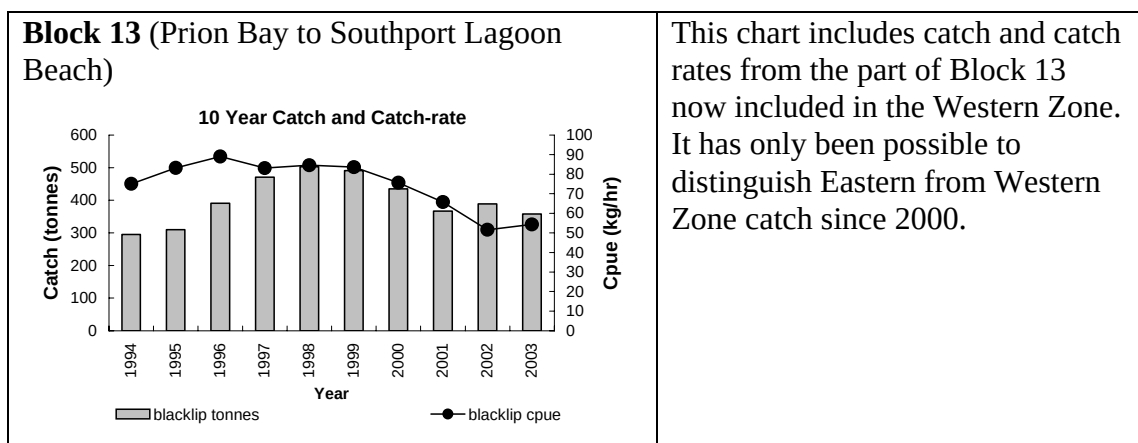
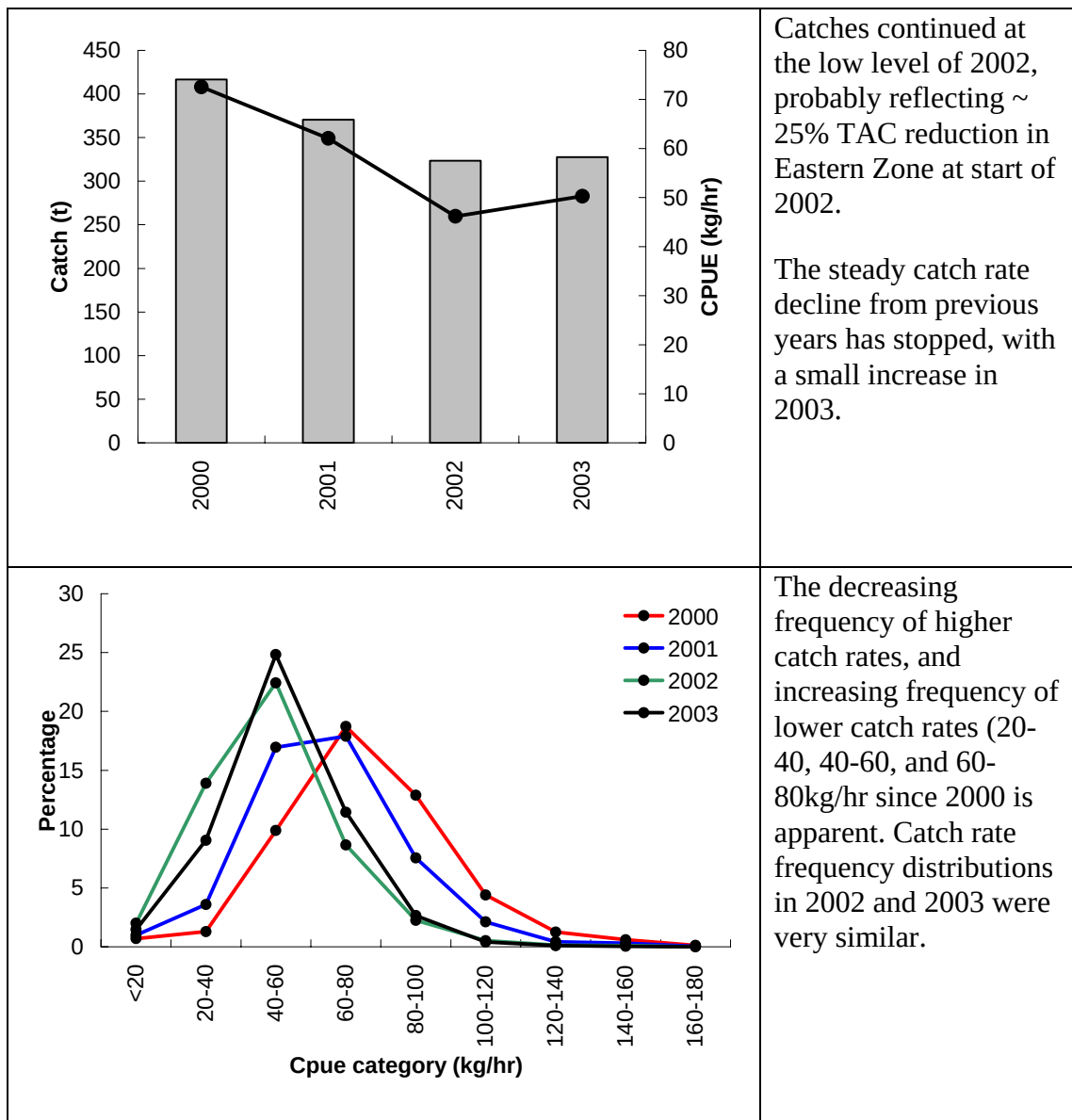
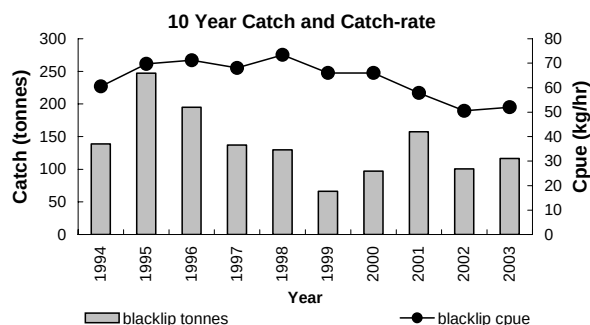


Figure 2. The change in catch between 2002 and 2003 in blacklip catch from the Eastern Zone (Block 13 (sub-blocks 13 C, D, E), Blocks 14 to 30, and Block 31 (sub-block 31 A and part of sub-block 31B)). The diagonal line across the chart represents the “no change” position where catches would lie if they were the same in both years, the other two lines represent the 25% deviation from “no change”. Note that the scale changes between 150 and 200 tonnes to show blocks with smaller catches.

Eastern Zone-Actaeons (Sub-blocks 13C, 13D, 13E, 14A, 14B)



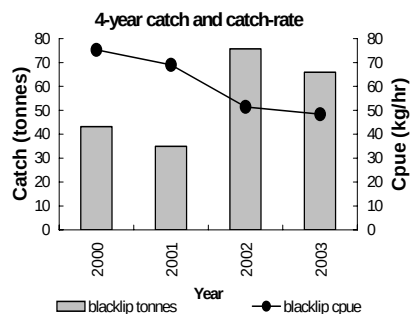
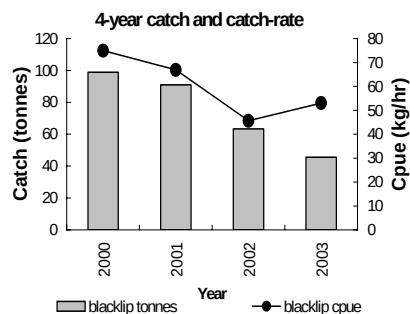
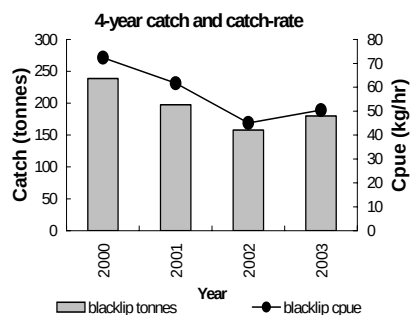
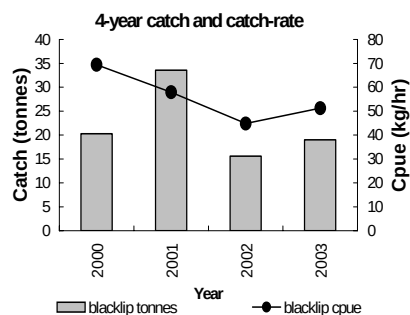
Block 14 (Southport Lagoon Beach to Lower Channel, South Bruny)

From 1995, Block 14 catch rates were stable for some years with minor fluctuations. Since 2000, the catch rate decline has become pronounced.

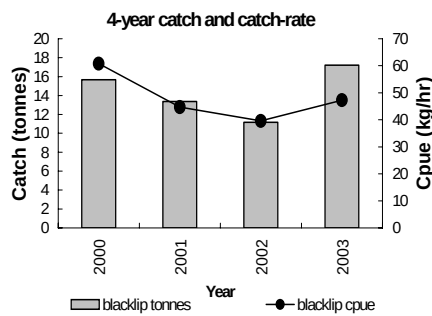
Levels of catch fell sharply after 1995, suggesting that abundance peaked in that year. If this is correct, catch rates failed to indicate falling stock levels. Catch rates were probably buoyed by the reduced levels of catch as divers transferred effort further south to Block 13.

Sub-block catch and catch rates:

Sub-block 13E contributed most (180 t) of the Actaeons catch again this year. Catch fell sharply in 13D, and the reduced effort is almost certainly responsible for the increased catch-rates there. In all other sub-blocks except 13C, the downward trend in catch rates has turned around, with small increases in 2003.

13C (Fishers Point to Whale Head)**13D** (Fishers Point to Southport Lagoon Beach, including Recherche Bay)**13E** (Actaeon and Sterile Islands, reefs to the south)**14A** (Southport Lagoon Beach to Burnett Point)

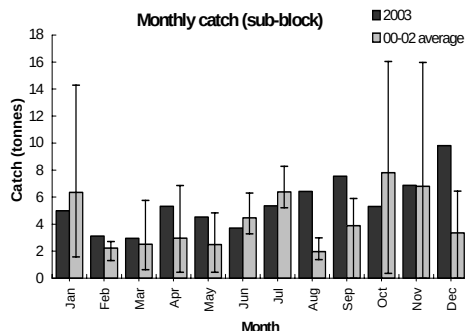
14B (Burnett Point to Blubber Head)



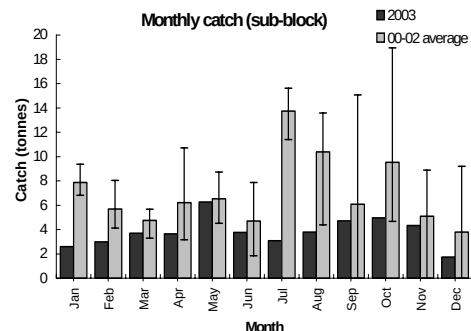
Monthly catch:

This series of charts shows the 2003 catch by month compared with the average for the previous three years. The vertical lines show maximum and minimum values for the earlier catches. Most of the catch was landed during the cooler months (see 13E). The more sheltered 14A and 14B were fished intensively during periods of bad weather in June and September. The December catch from 13C was unusually large.

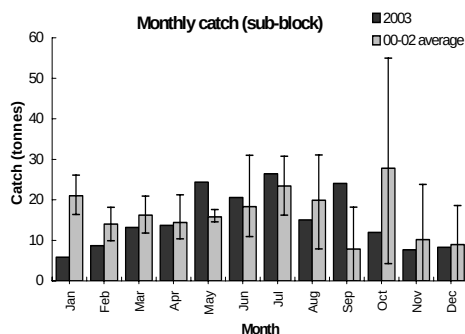
13C (Fishers Point to Whale Head)



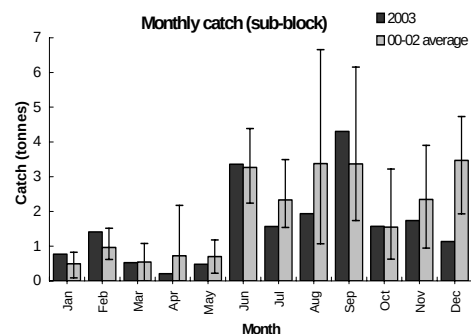
13D (Fishers Point to Southport Lagoon Beach, including Recherche Bay)



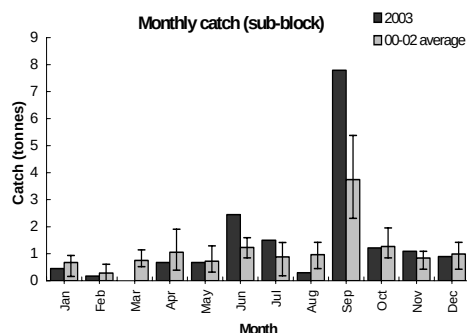
13E (Actaeon and Sterile Islands, reefs to the south)



14A (Southport Lagoon Beach to Burnett Point)



14B (Burnett Point to Blubber Head)

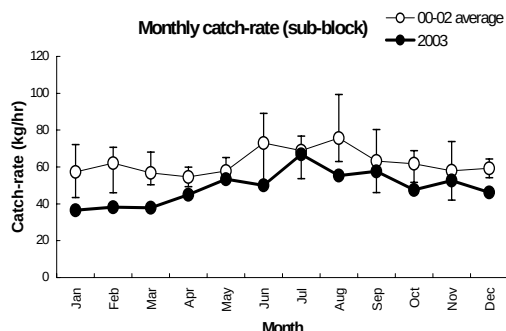


Monthly catch rates:

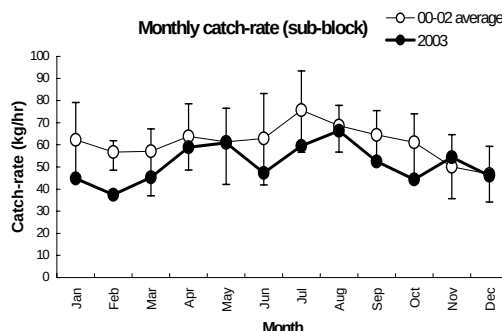
This group of charts compares monthly geometric mean catch-rates (from landings of 40 kg or more) with the average of monthly geometric mean catch rates from the previous three years. It is most useful to compare only months where substantial landings occurred (see monthly catches above).

The 2003 monthly catch rates were mostly below the average of those from 2000-2002. Exceptions occurred in 13D, 14A and 14B, where monthly catch rates were similar to the three year average for months where the greatest volume of catch was landed.

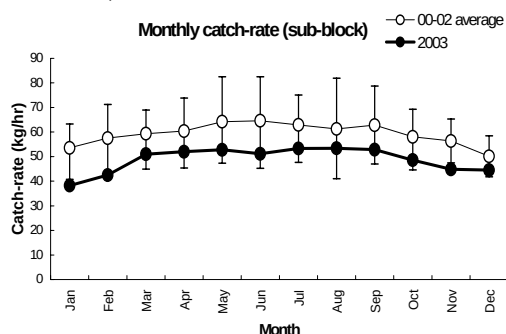
13C (Fishers Point to Whale Head)



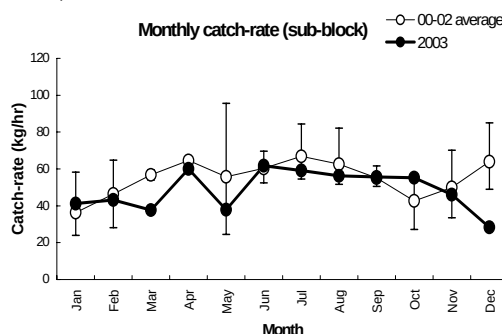
13D (Fishers Point to Southport Lagoon Beach, including Recherche Bay)

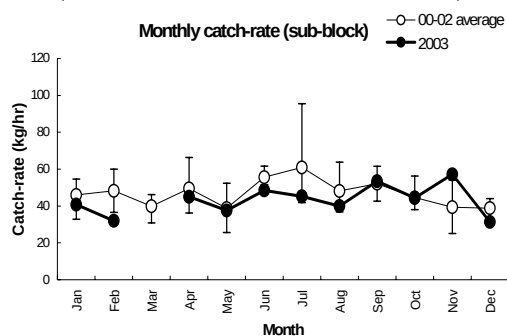


13E (Actaeon and Sterile Islands, reefs to the south)



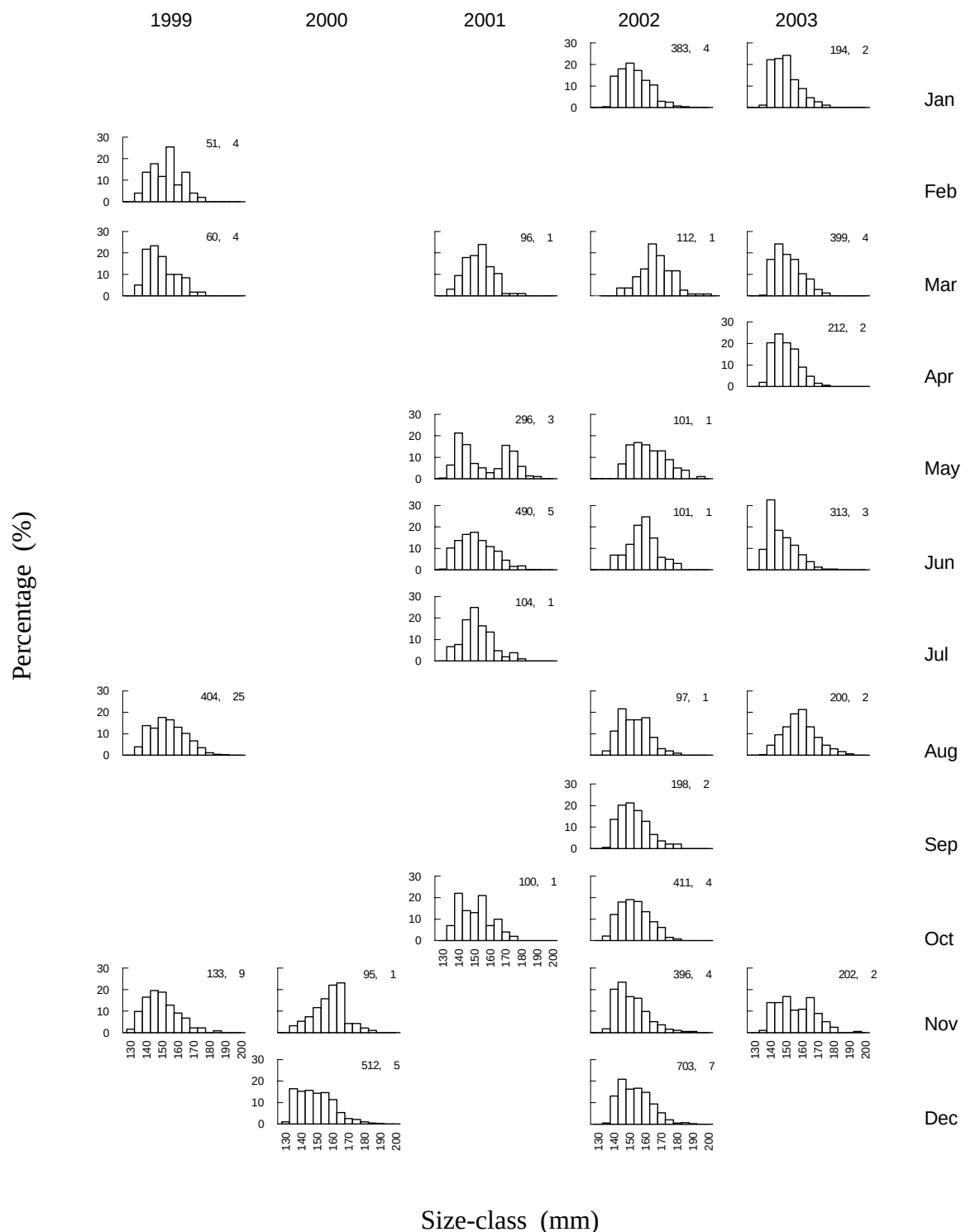
14A (Southport Lagoon Beach to Burnett Point)



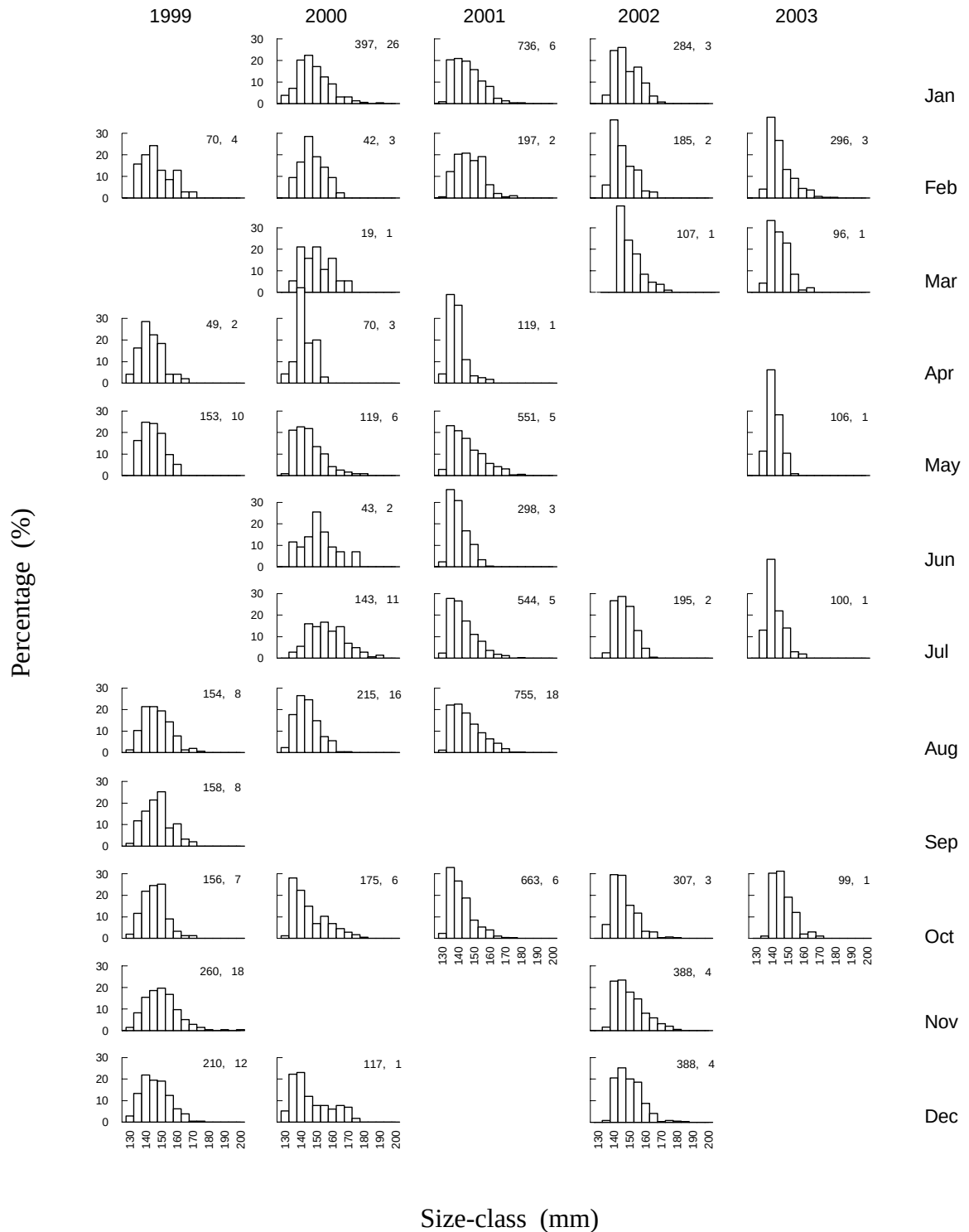
14B (Burnett Point to Blubber Head)**Size-composition of commercial catch:**

Over recent years, catches from sub-blocks 13D and 13E progressively feature greater numbers of smaller abalone. This trend was halted in 2002 when the size limit was increased. While the geometric mean size of abalone from 13E was smaller in 2003 than 2002, the difference was not significant.

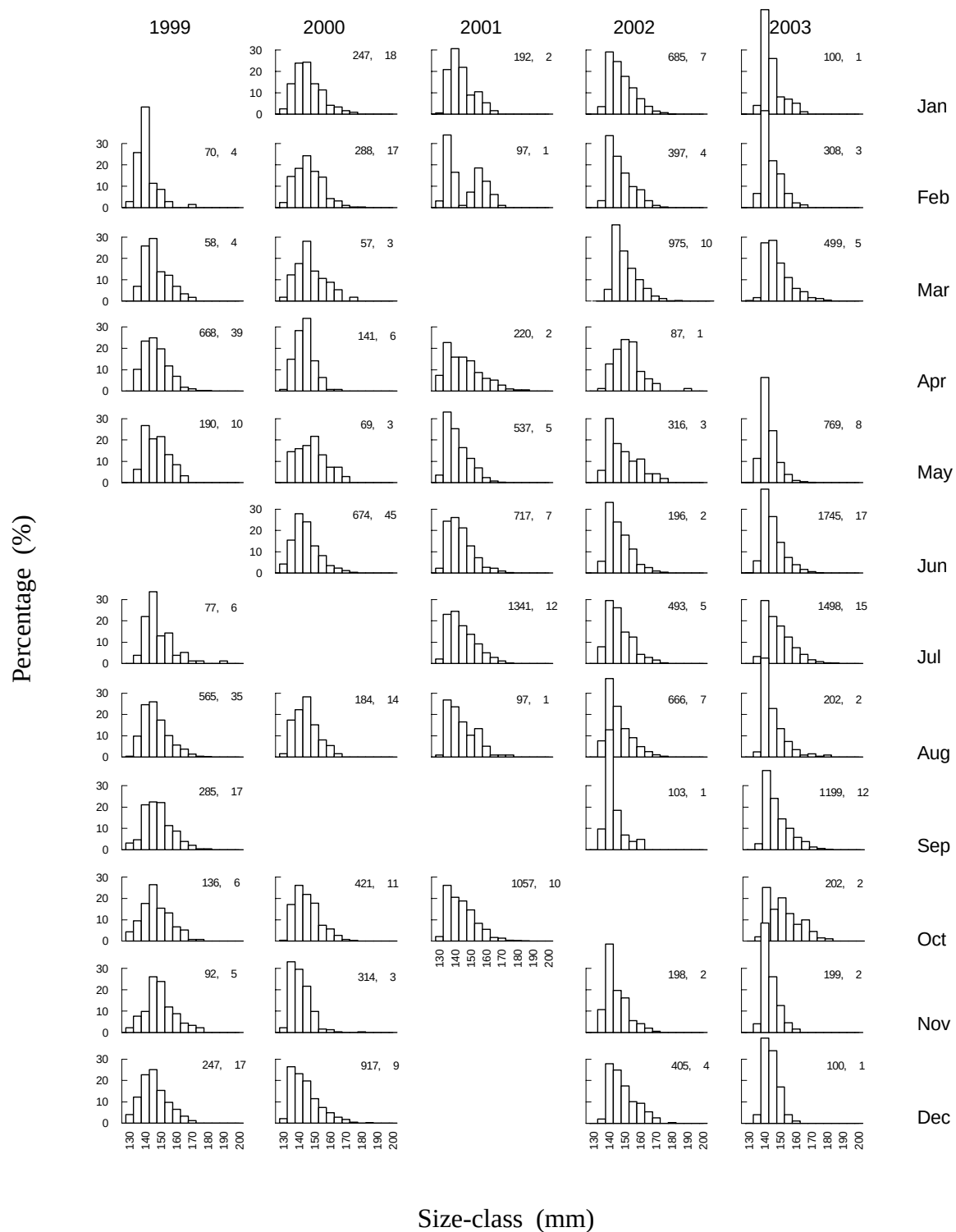
Sub-block 13C (size limit 136 mm)



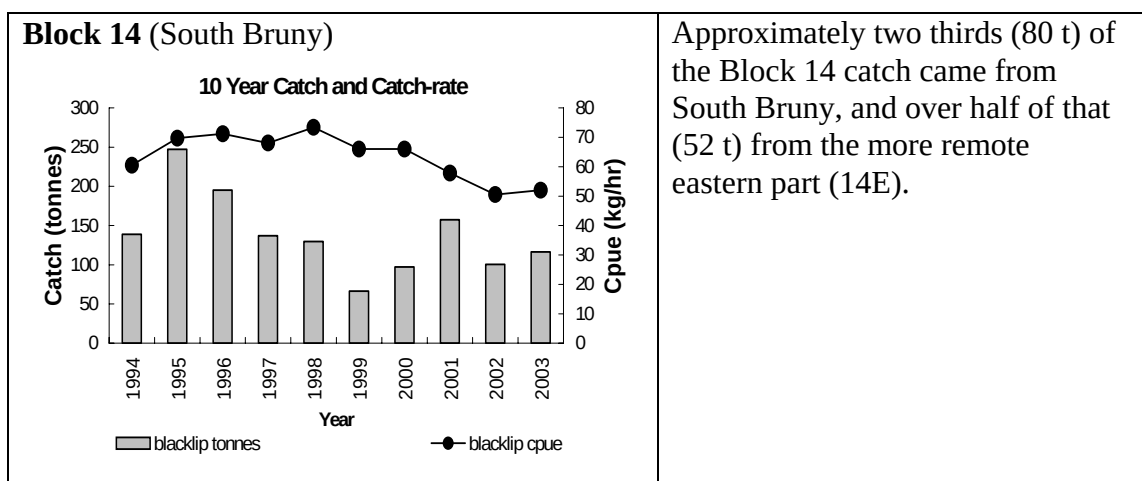
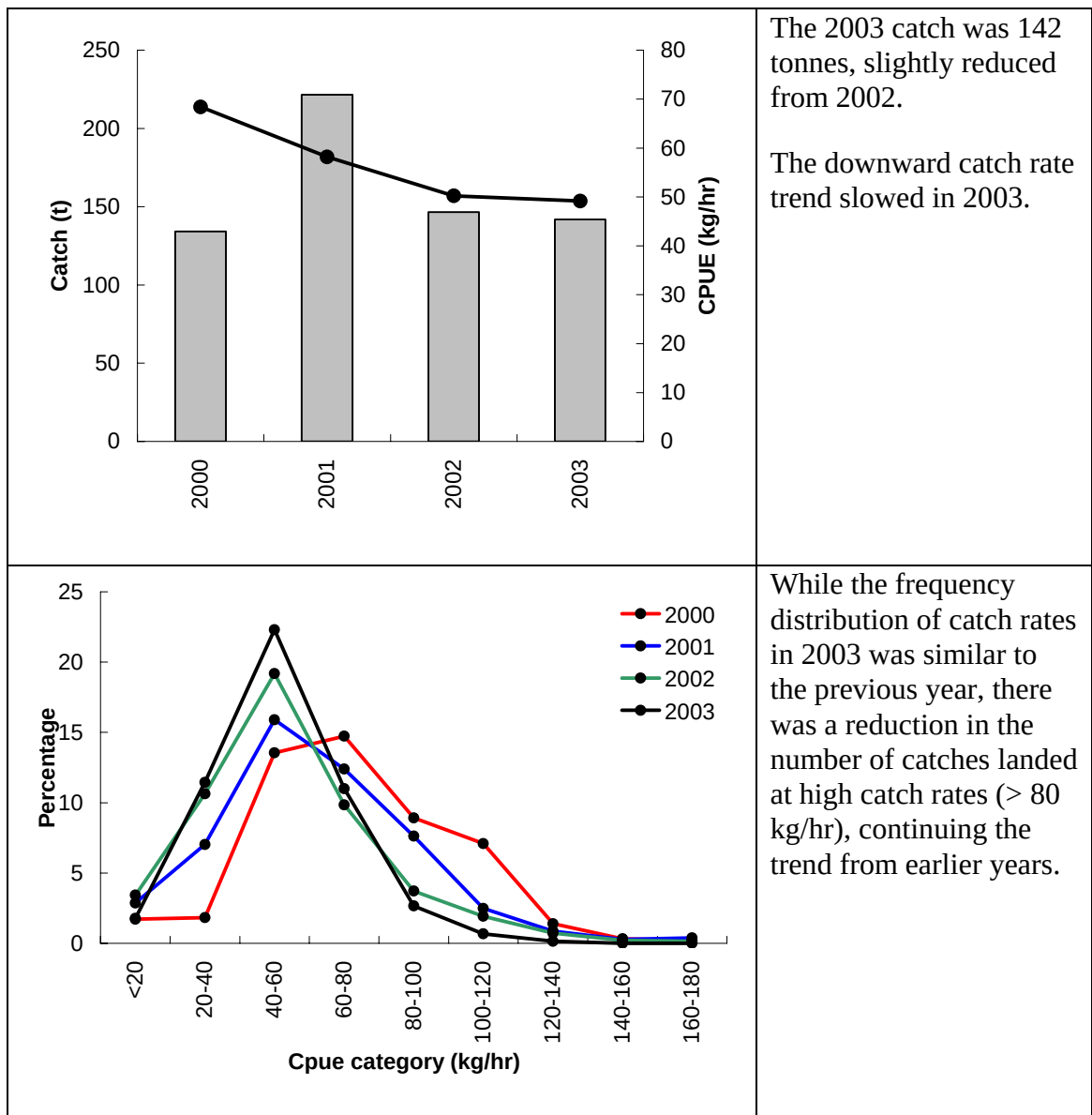
Sub-block 13D (size limit 136 mm)



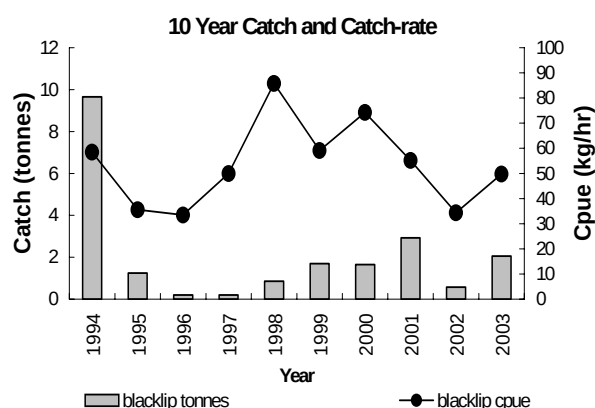
Sub-block 13E (size limit 136 mm)



Eastern Zone-Bruny Island (Blocks 14C, 14D, 14E, 15, 16).

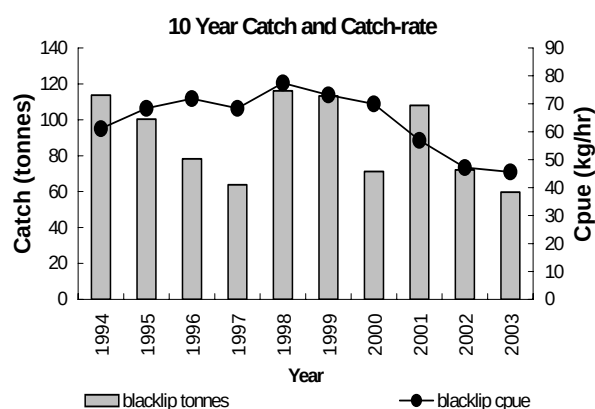


Block 15 (D'Entrecasteaux Channel)



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

Block 16 (East Bruny)

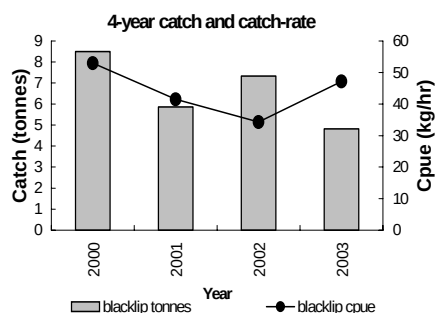


Catch and catch rates have continued to fall in a trend that has been apparent since 1998. Catch trends are erratic, but in conjunction with catch rates, indicate stock levels were at greatest levels between 1994 and 1998.

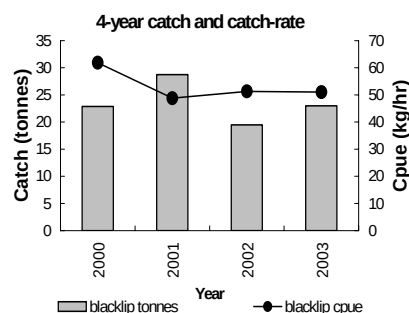
Sub-block catch and catch rates

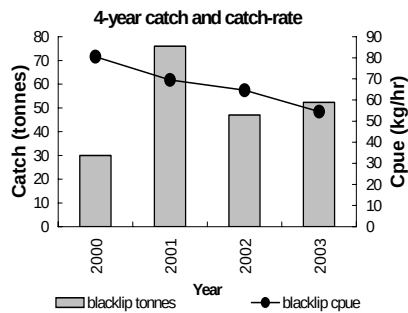
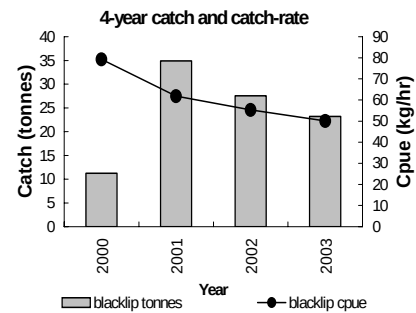
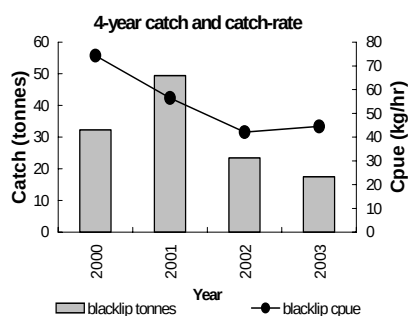
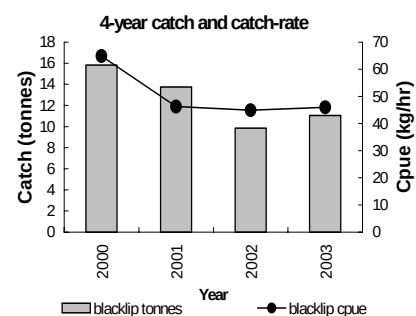
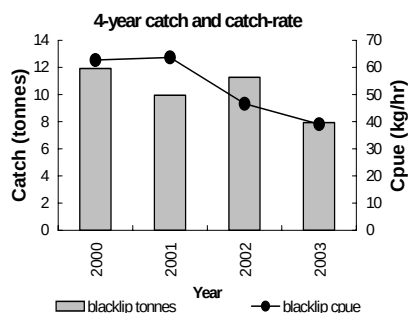
Apart from 14C (which produces insignificant amounts of catch for the purposes of this assessment) and 14D, catch and catch rates were generally lower than previous years. The amount of catch from the Friars (14E) is declining from 2001 levels. Diving at depths greater than 20 m is now less common than it was in 2000-2001, suggesting depletion of the deeper stocks that were then taken at high catch rates.

14C (Partridge Island, Channel side of Bruny north to Lunawanna)



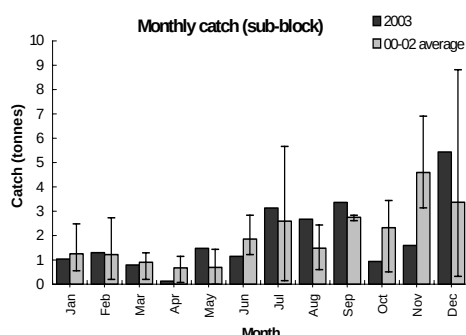
14D (Hopwood Point to West Cloudy Head)



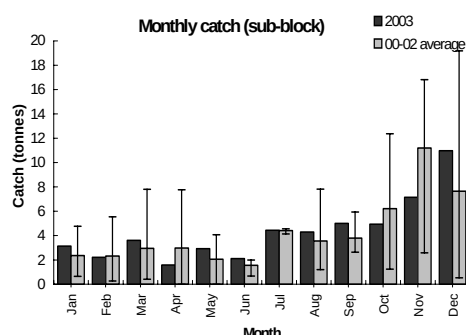
14E (West Cloudy Head to Boreel Head, including the Friars)**16A (Boreel Head to North Mangana Bluff)****16B (North Mangana Bluff to Neck Beach)****16C (Neck Beach to Trumpeter Bay)****16D (Trumpeter Bay to Dennes Point)****Monthly catch**

The distribution of catch by month was generally in accordance with previous years. Like most of the Eastern Zone fishery, the majority of landings from this region occur between May and November. The two South Bruny sub-blocks (14D, 14E) had higher than average catches in December, although not outside the range of previous years.

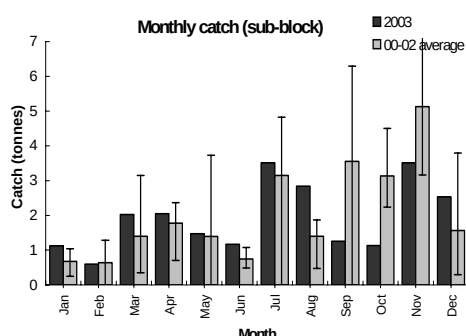
14D (Hopwood Point to West Cloudy Head)



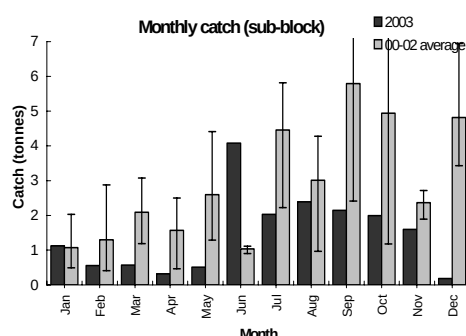
14E (West Cloudy Head to Boreel Head, including the Friars)



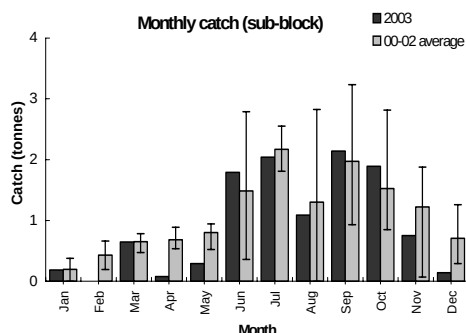
16A (Boreel Head to North Mangana Bluff)



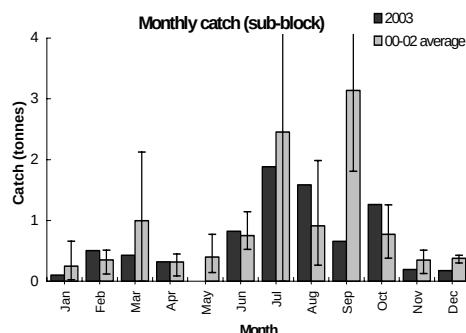
16B (North Mangana Bluff to Neck Beach)



16C (Neck Beach to Trumpeter Bay)



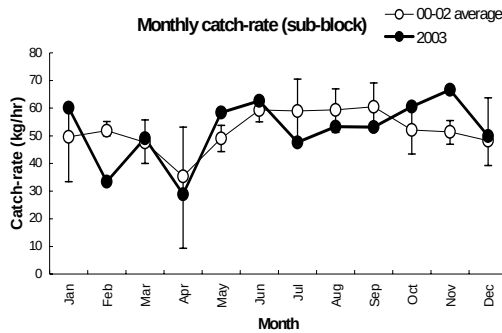
16D (Trumpeter Bay to Dennes Point)



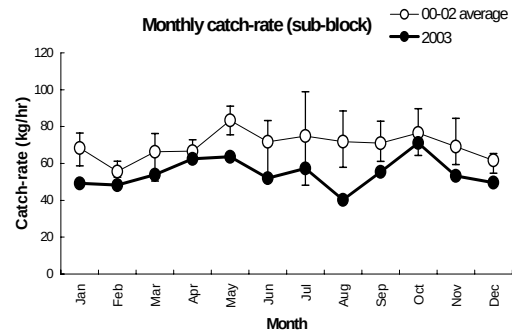
Monthly catch rates

In 14D, the lowest monthly catch rates correspond with the months when the greatest amount of catch was landed. In 14E, catch rates were lower than the previous three years in 4 out of 6 months with significant landings. The Block 16 catch-rates are particularly low.

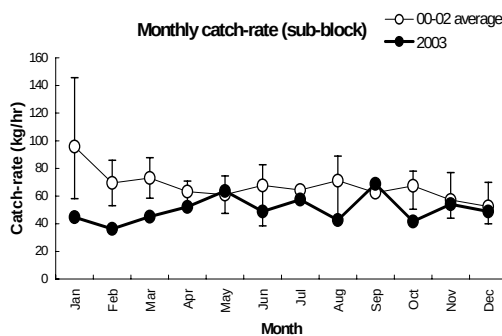
14D (Hopwood Point to West Cloudy Head)



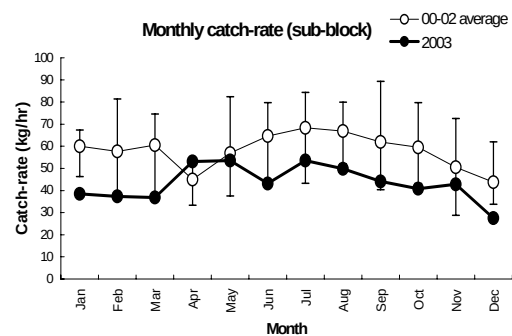
14E (West Cloudy Head to Boreel Head, including the Friars)



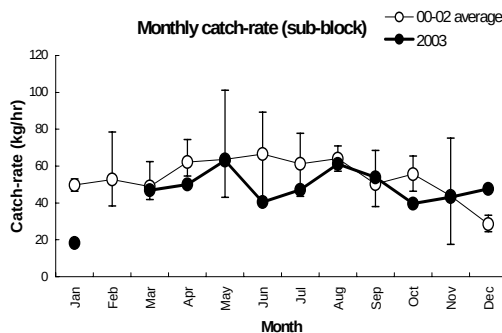
16A (Boreel Head to North Mangana Bluff)



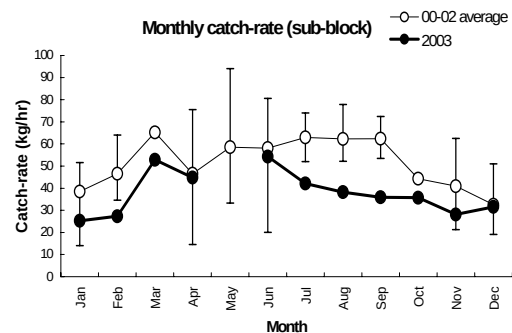
16B (North Mangana Bluff to Neck Beach)



16C (Neck Beach to Trumpeter Bay)



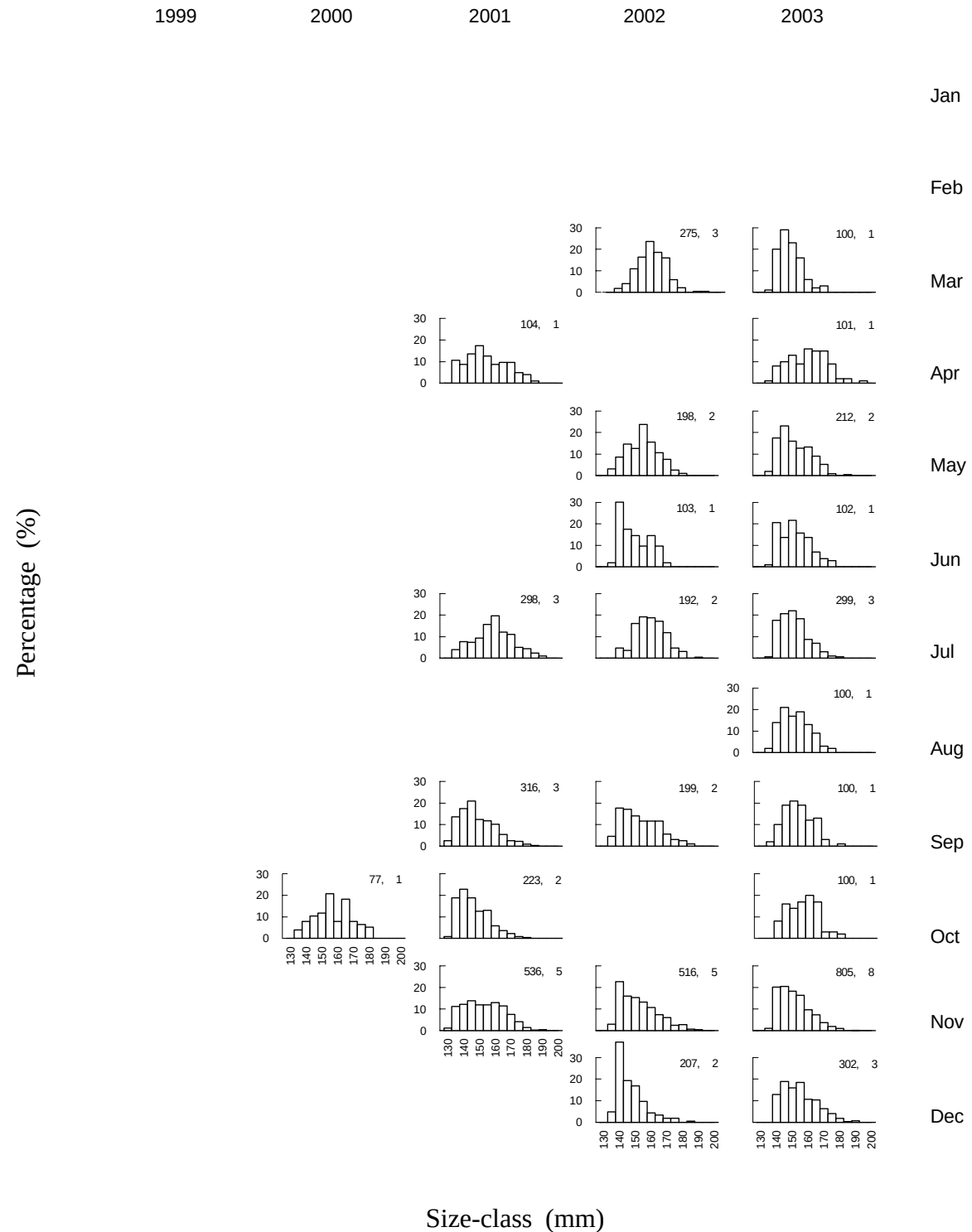
16D (Trumpeter Bay to Dennes Point)



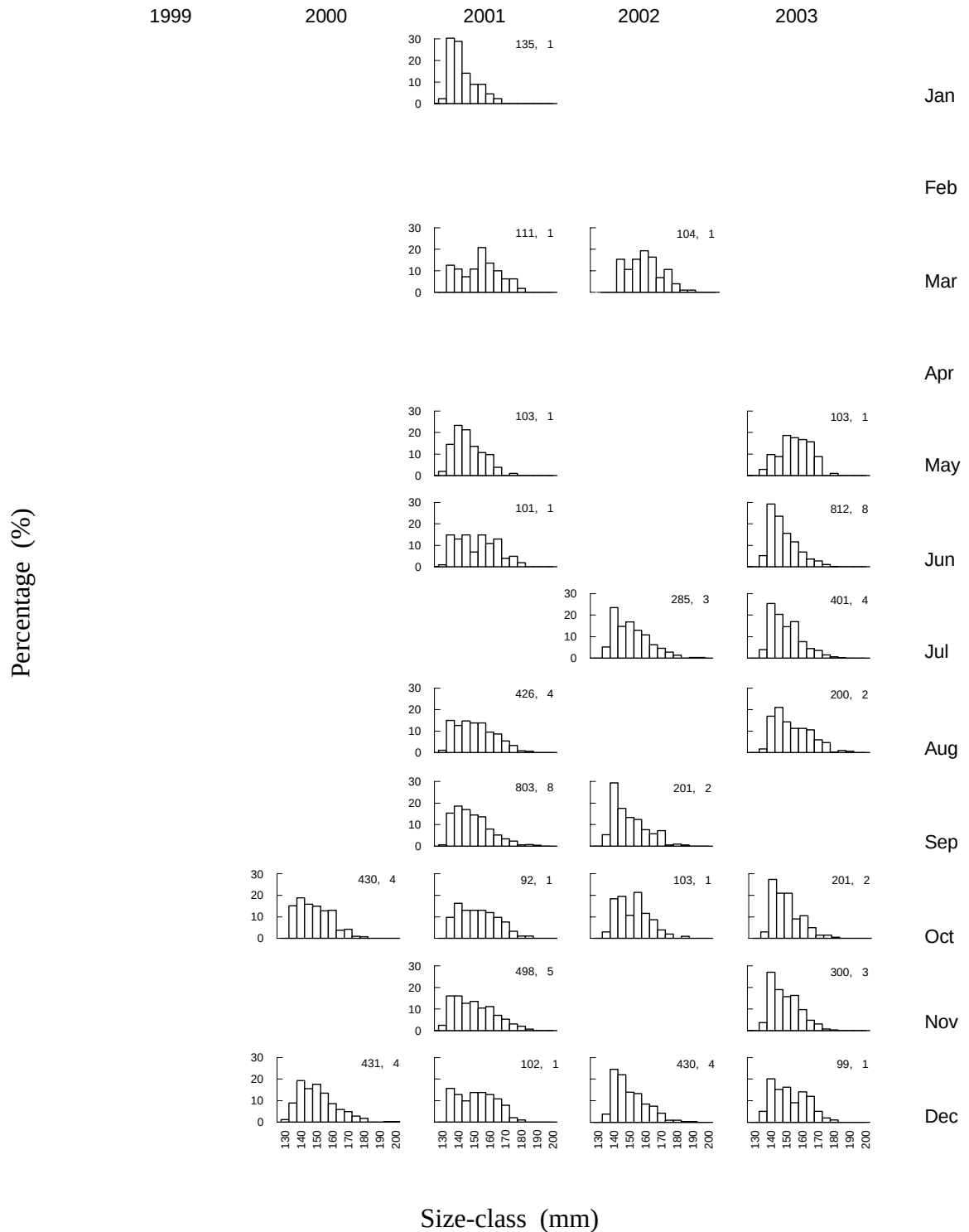
Size composition of the commercial catch:

The size composition from 16A appears stable between years (i.e. the percentage of larger size classes seems to be relatively constant), whereas the catch from 16B, particularly between June and December 2003 has much greater percentages of smaller abalone than in earlier years.

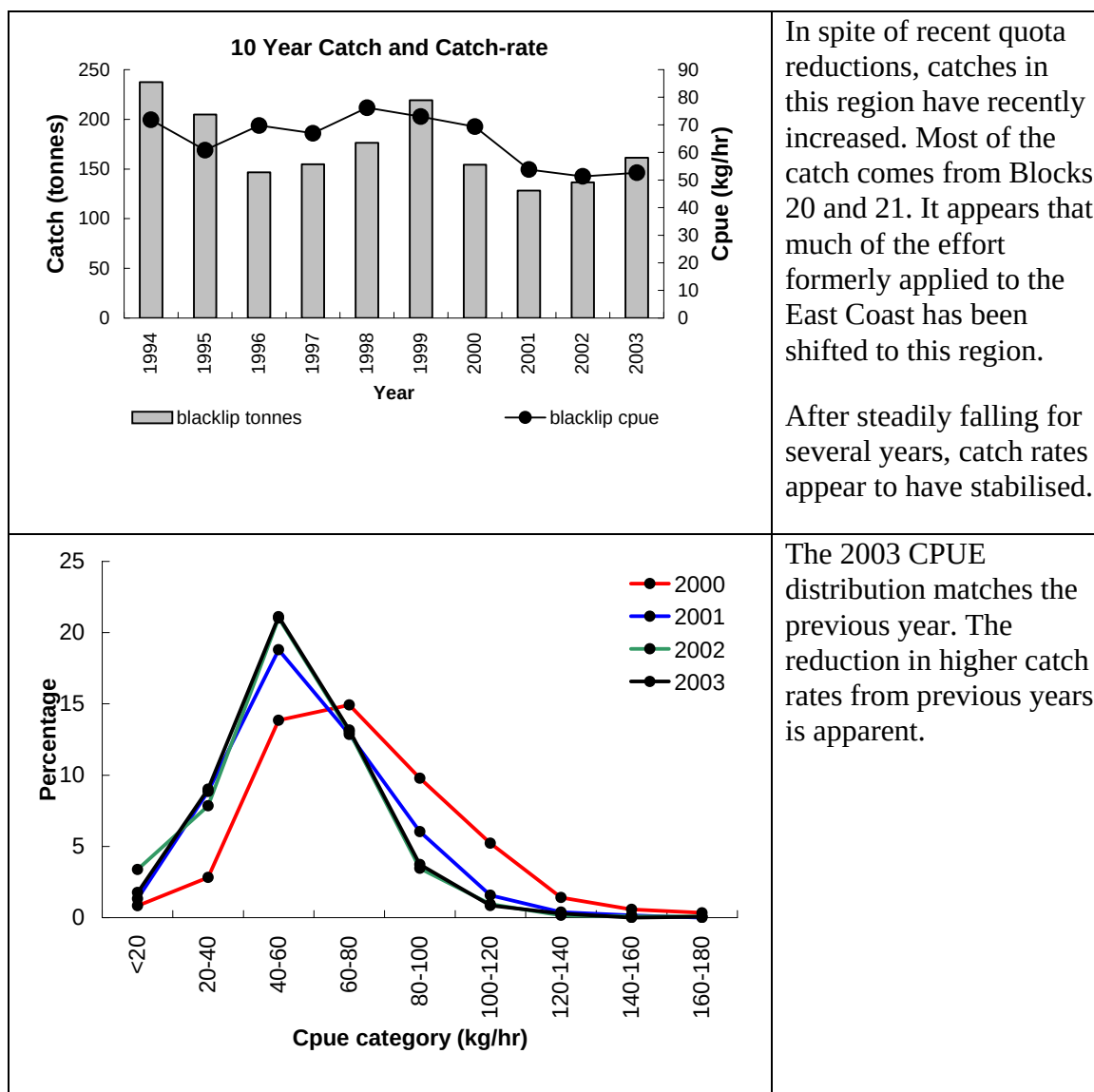
Sub-block 16A (size limit 136 mm)



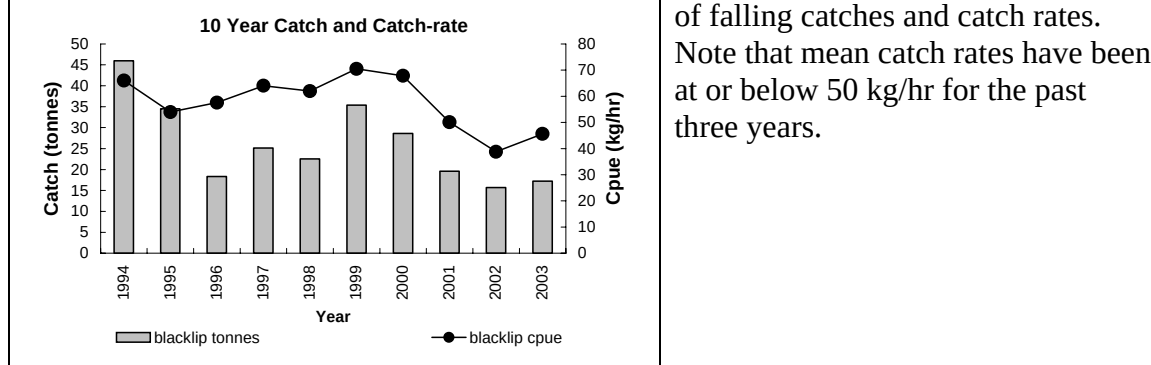
Sub-block 16B (size limit 136 mm)

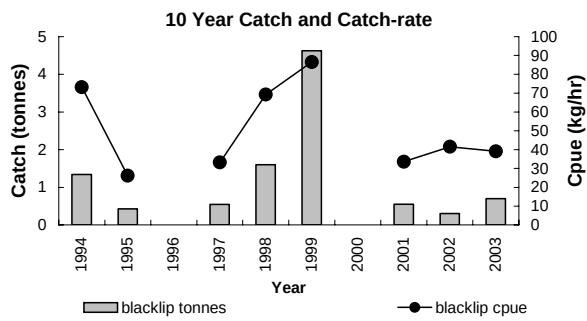


Eastern Zone-Storm Bay (Blocks 17-21).

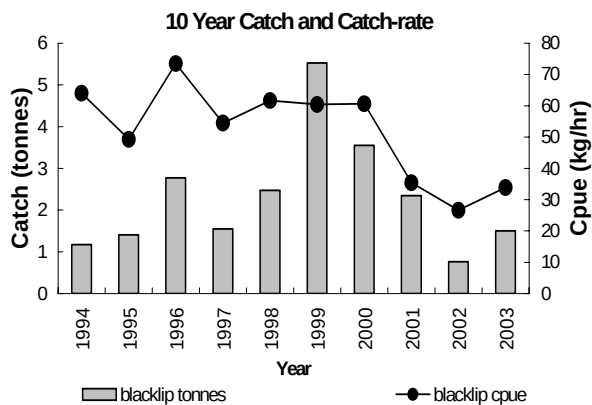


Block 17 (South Arm to Cremorne, Betsey Island, Blackjack shore to Outer North Head)

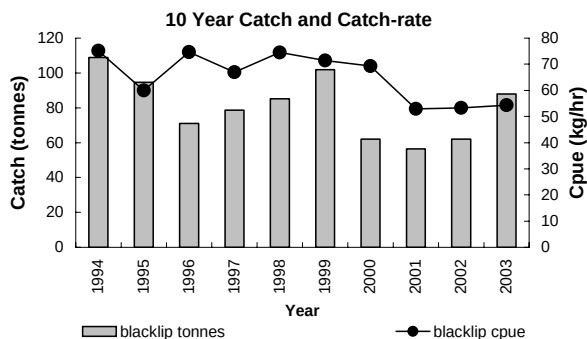


Block 18 (Derwent River, Iron Pot)

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

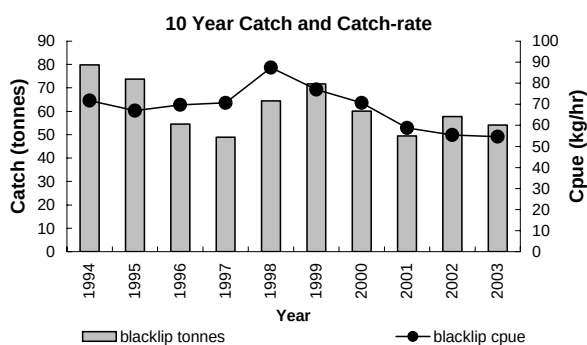
Block 19 (northern Frederick Henry Bay)

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

Block 20 (western shore of Tasman Peninsula)

Stocks in this block seem to be resilient in the face of increasing effort. Like the rest of the Eastern Zone, catch rates fell sharply in 2001. Since then however, catches have increased, with catch rates stable between means of 50 and 60 kg/hr.

Note that the 2003 catch (88 t) is considerably greater than the 1975-2003 average (58 t).

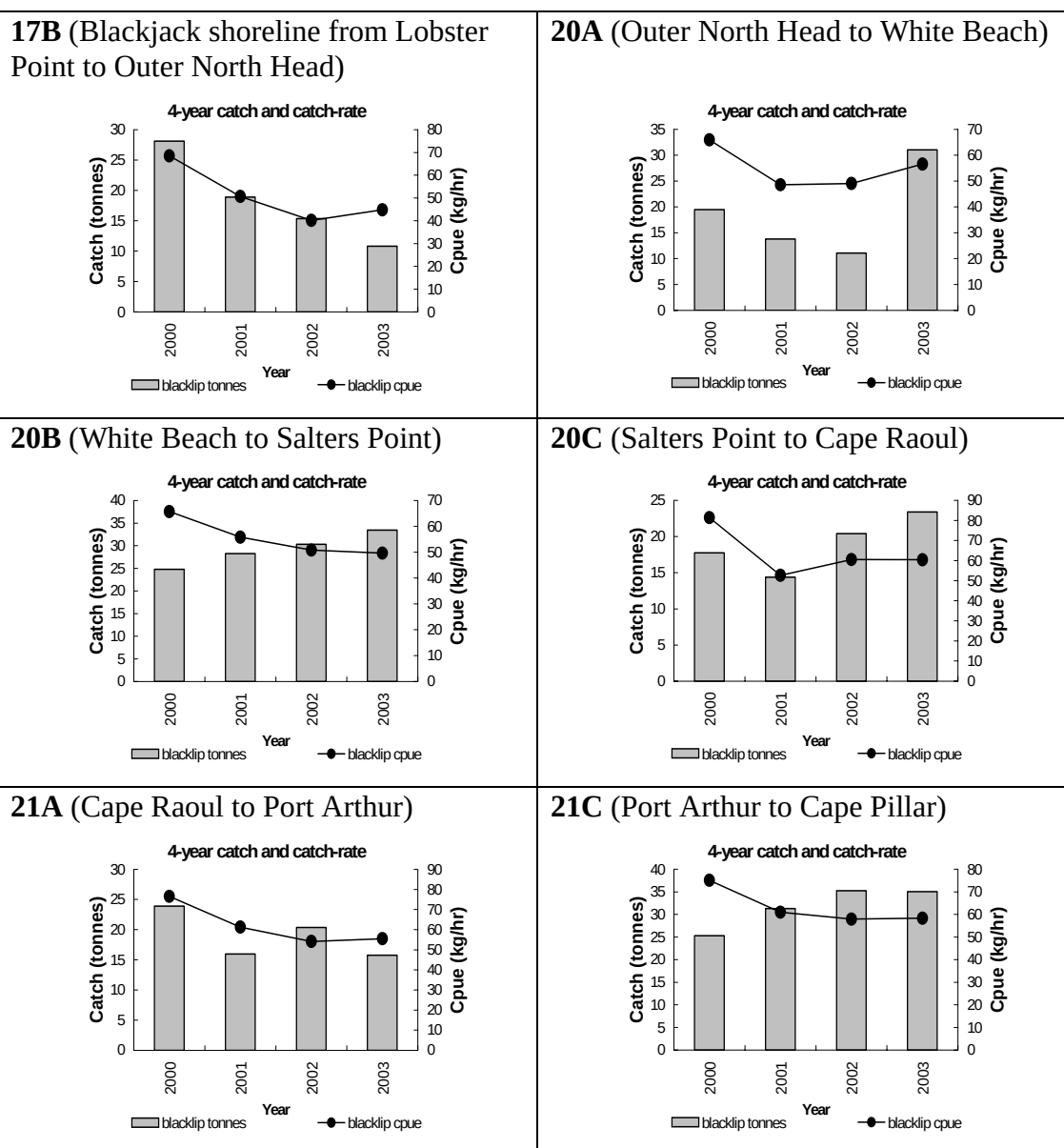
Block 21 (southern shore of Tasman Peninsula)

Recent catches have been hovering around long-term average levels. Catch rates have been steadily declining since 1998, although the rate of decline has been reduced since 2001.

Sub-block catch and catch rates

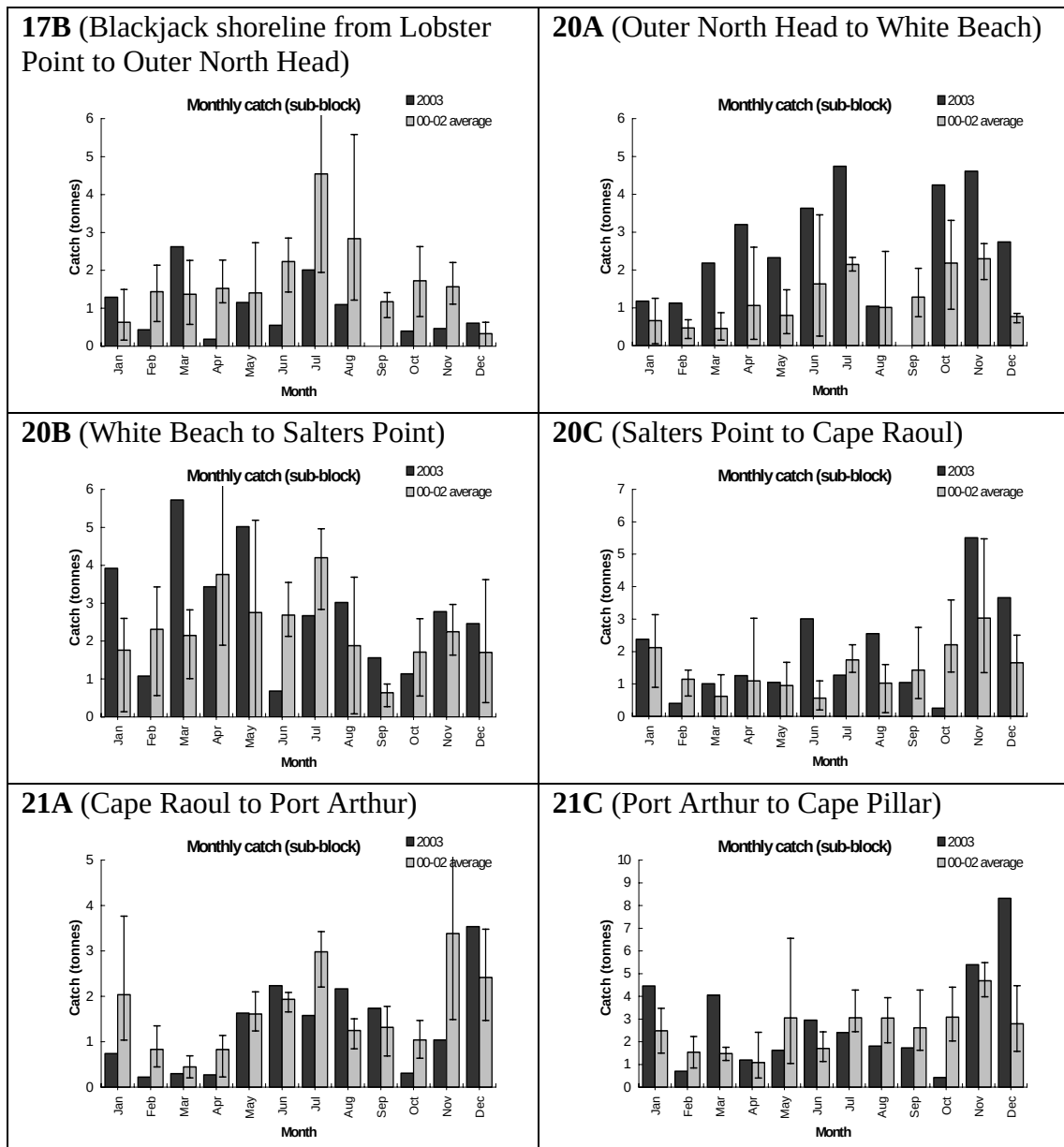
Landings of nearly 7 t were reported from 17A (includes Betsey Island) in 2003 whereas landings reported for the three previous years were less than 1 t. The best performing sub-block was 20A, where the catch increased almost threefold over the previous year, with stable to rising catch rates between 50 and 60 kg/hr. Although sharing similar coastal characteristics, the sub-block immediately to the north of 20A (17B) had much lower levels of catch and catch rates.

Catch and catch rate trends in 20B suggest the level of catch was too high, whereas 20C appeared resilient to increasing levels of catch. The catch rate declines in both 21A and 21B appeared to be slowing.



Monthly catch:

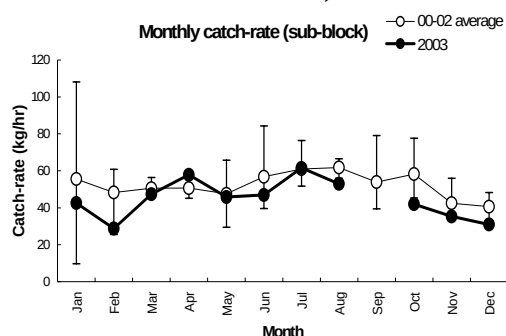
The distribution of catch varied widely between sub-blocks. 21C produced large catches in the warmer months (particularly January, November and December) at better than average catch rates. There was a decline in landings from 20B in the later part of the year as divers moved north to 20A. Block 21 produced an unusually large amount of catch in December.



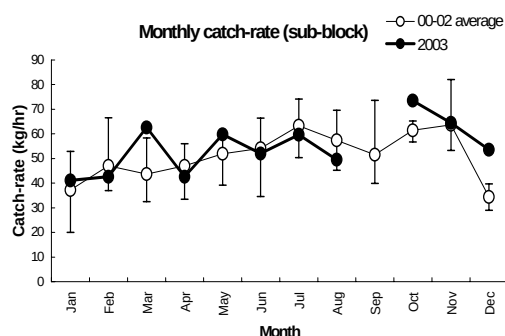
Monthly catch rates:

Generally, catch rates were remarkably stable throughout the year, and except for 17B and 20A, showed few indications of the end-of-year stock decline common to many annual crop fisheries.

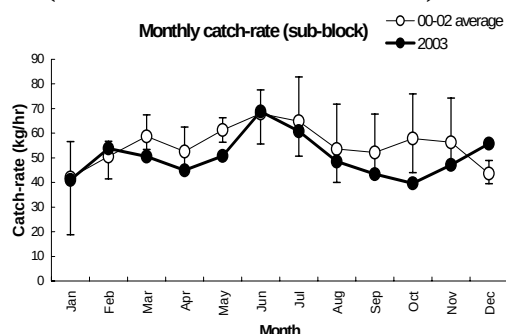
17B (Blackjack shoreline from Lobster Point to Outer North Head)



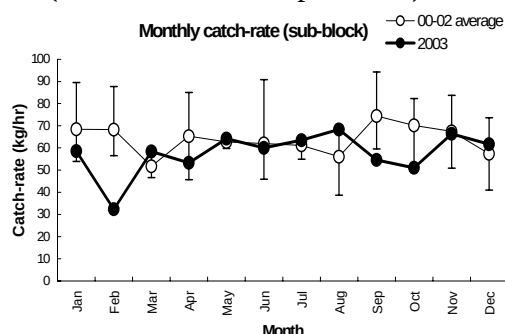
20A (Outer North Head to White Beach)



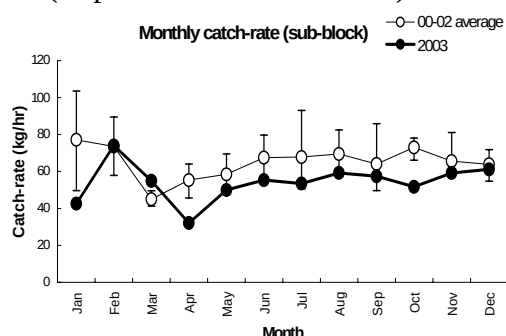
20B (White Beach to Salters Point)



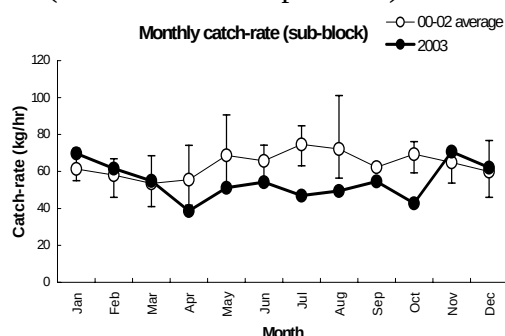
20C (Salters Point to Cape Raoul)



21A (Cape Raoul to Port Arthur)



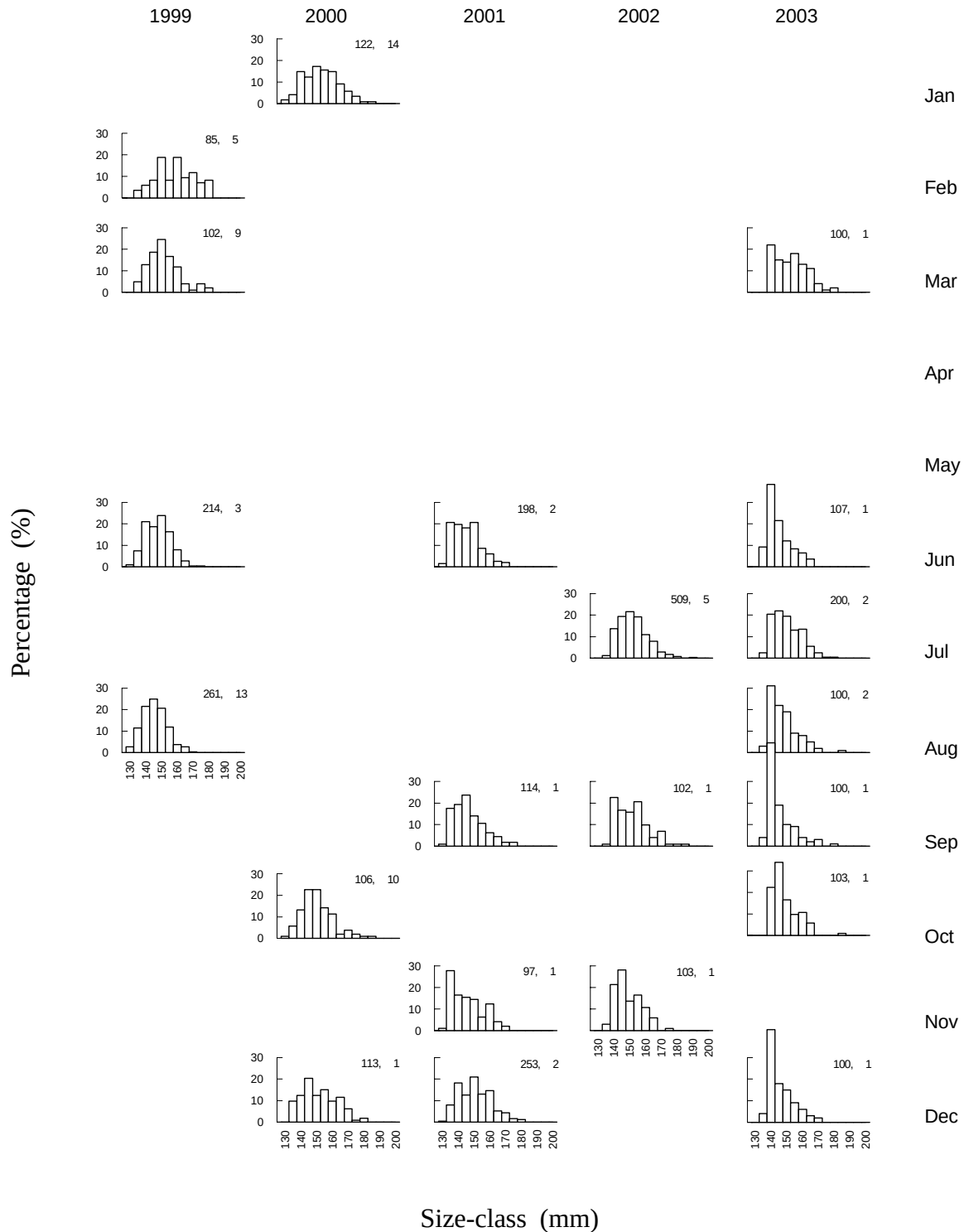
21C (Port Arthur to Cape Pillar)



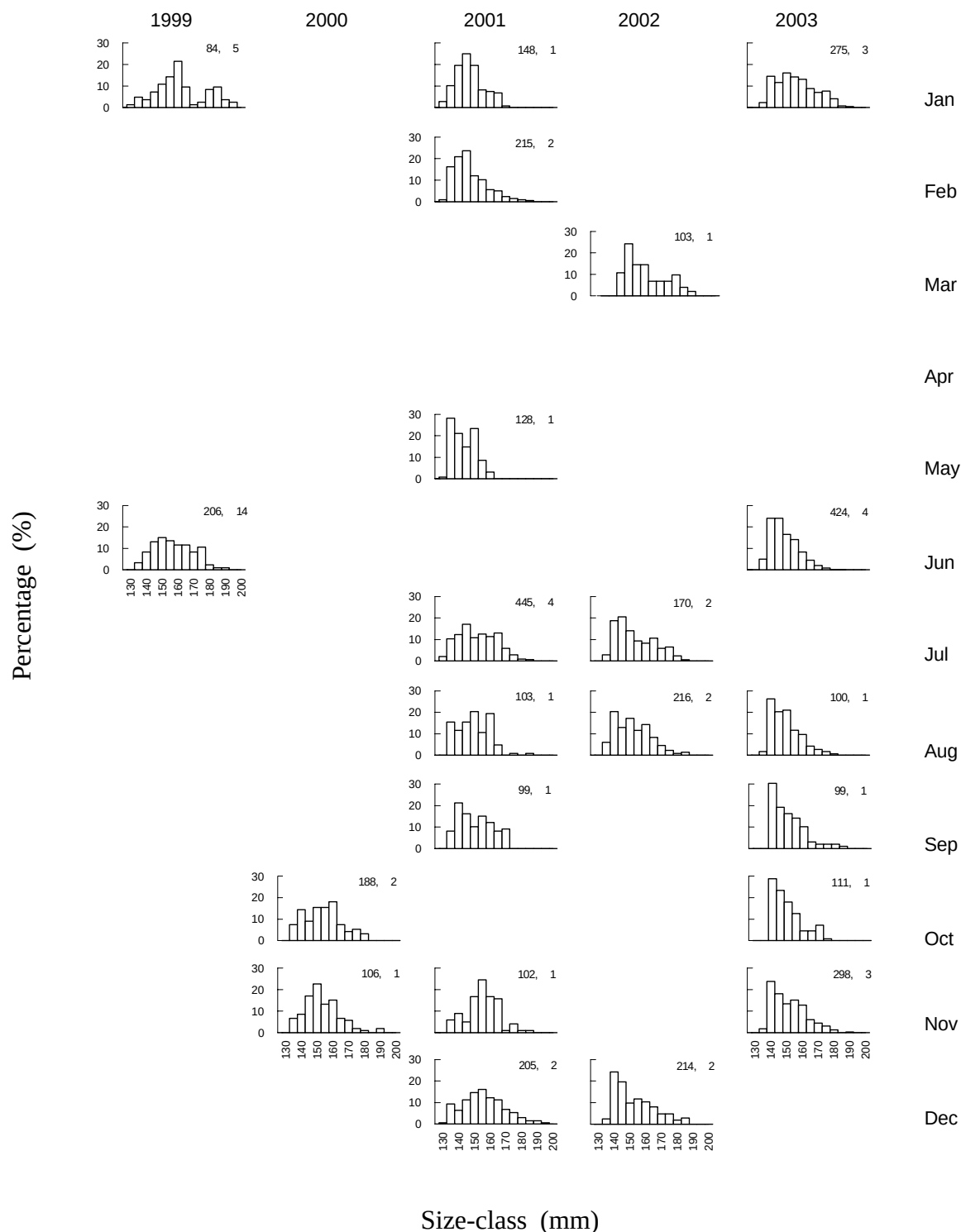
Size composition of the commercial catch:

The number of samples collected from catches in this region is less than we would like, particularly from earlier years. However, the catch samples from most sub-blocks show trends in common with catches from the Actaeons: the catches have greater percentages of smaller size-classes (136-140 mm, 141-145 mm) and less large size-classes (> 160 mm) in 2003 than in previous years. The exceptions were in 21A and 21C, where 2003 samples had similar profiles to earlier samples.

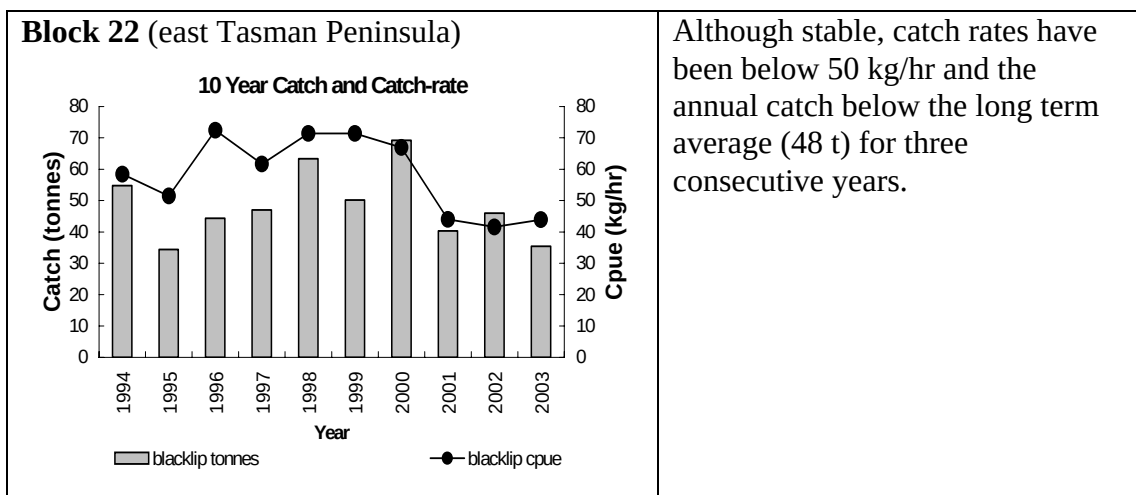
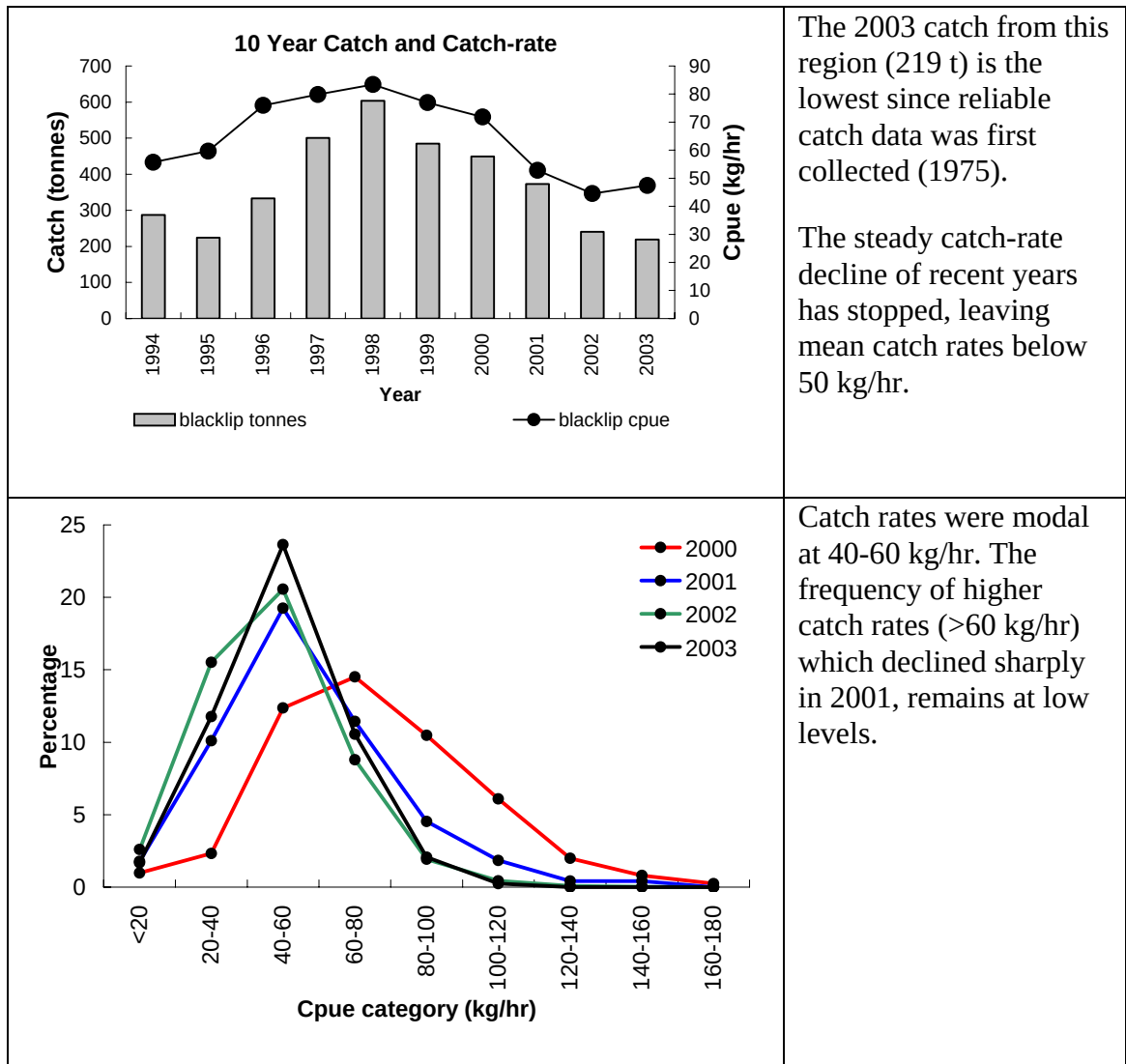
Sub-block 20B (size limit 136 mm)

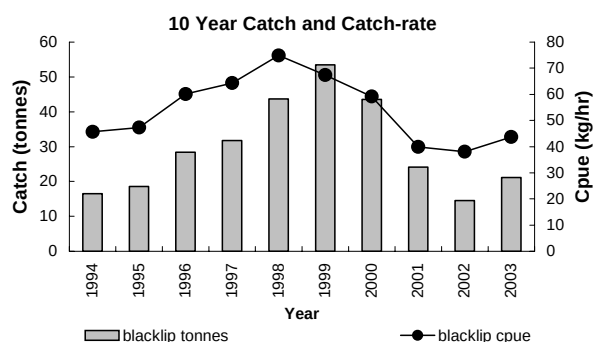


Sub-block 20C (size limit 136 mm)

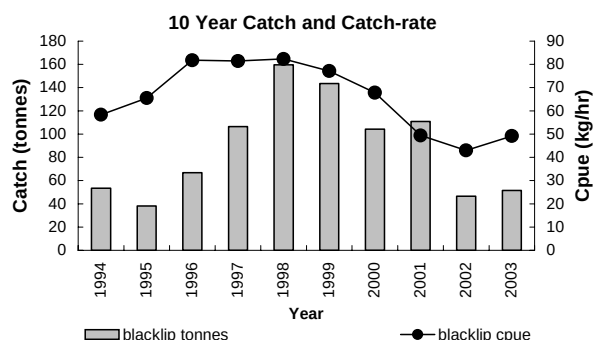


Eastern Zone-East Coast (Blocks 22–31)

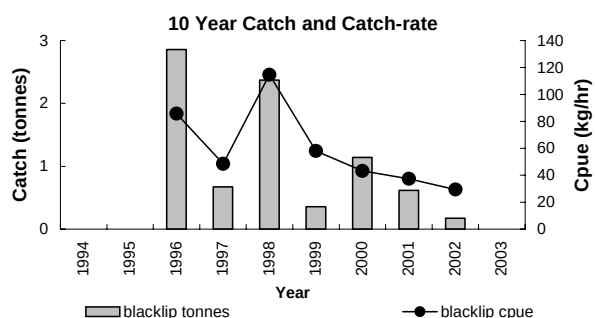


Block 23 (Forestier Peninsula)

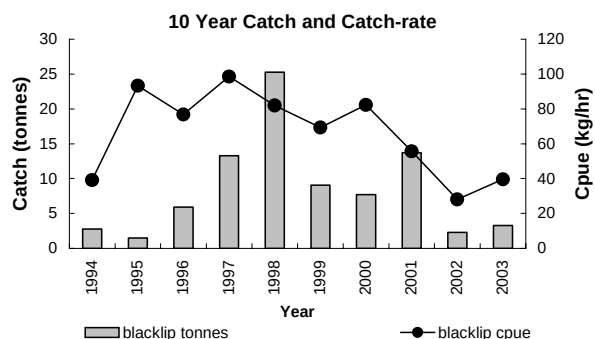
Recent annual catches have been at levels approximately half the long term average (42 t). Since 2000, mean annual catch rates have fluctuated between 38 and 44 kg/hr.

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

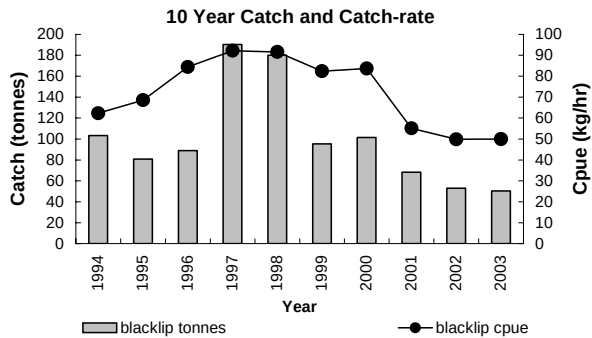
Producing over 100 t for successive years during the late 1990's, the catch from Maria Island and Mercury Passage has dropped to approximately 50 during the last two years. Catch rates have fluctuated at levels below 50 kg/hr.

Block 25 (Triabunna to Little Swanport)

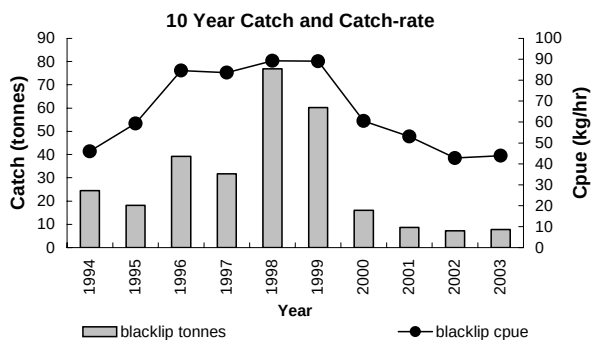
This block has failed to produce significant levels of catch since 1988.

Block 26 (Great Oyster Bay)

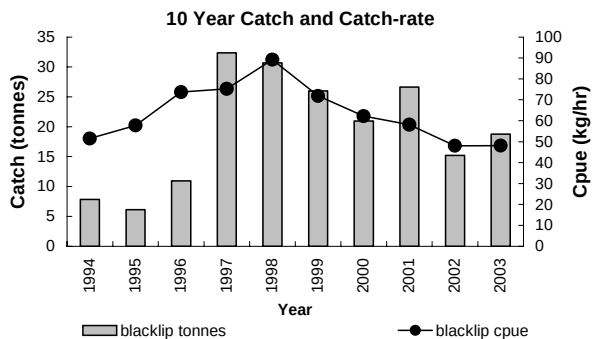
This block produces significant annual catches only at irregular intervals.

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

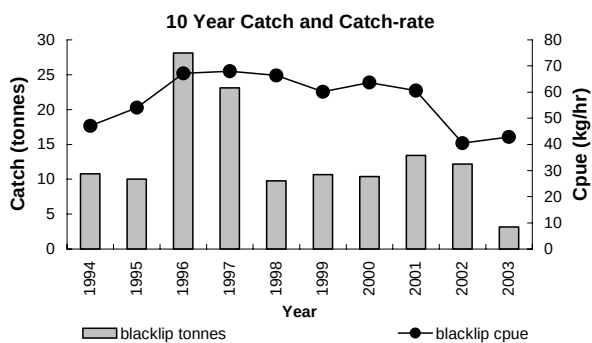
Since 2000, catches have remained below the long-term average (83 t), while catch rates appear to have stabilised but at approximately 50 kg/hr.

Block 28 (Friendly Beaches to Seymour, including Bicheno)

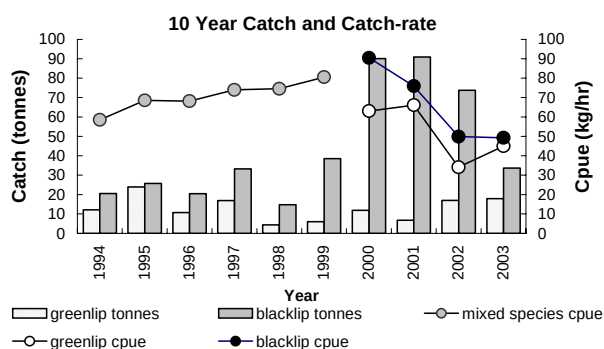
The long-term average for this block is 59 t; catches for the last three years have averaged 8 t at low catch rates

Block 29 (Seymour to St Helens Point)

Most of the catch from this block is taken from the southern end, where the coastline is short but productive. The boundary between Block 28 and Block 29 nominally lies in the centre of the headland at Long Point, but the catch from this area is usually reported as Block 29.

Block 30 (St Helens Point to Eddystone Point)

For many years this block produced over 100 tonnes annually. While it now produces no significant commercial landings, isolated catches can still be taken at reasonable catch rates from remnant populations. Block 30 is an important part of the recreational abalone fishery in North East Tasmania.

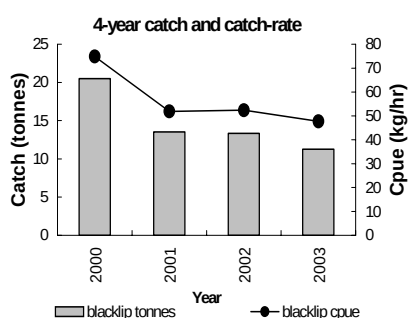
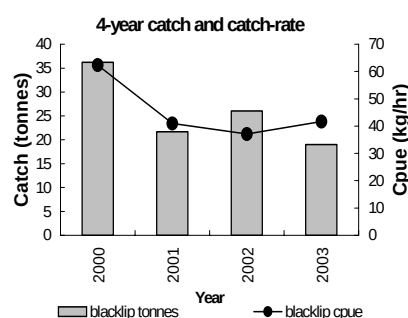
Block 31 (Eddystone to Musselroe Bay)

The 2003 annual catch fell sharply, although the high catches between 2000 and 2002 were well above average (see Appendix 2) and probably at unsustainable levels. Because of the subdivision of this block between zones, it is now difficult to determine what levels of catch to expect from Block 31, and it is possible that the current catch (27 t) is all that can be sustainably produced.

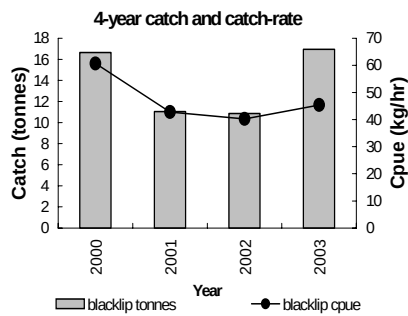
Sub-block catch and catch rates:

Although the trend of falling catch rates from the East Coast appears to have stopped, the indications for recovery are weak and inconclusive. For example, the Spring Bay Mercury Passage region (24A, 24B, 24C) shows a pronounced catch rate increase over 2002, but the catch is so low compared with 2000-2001 that it seems that divers are only able to achieve better catch rates by fishing isolated populations, and that the recovery is therefore limited to small areas and is not widespread. The catch data shows that many divers fished across a range of sub-blocks before settling on one or two areas from which they could take consistent catches.

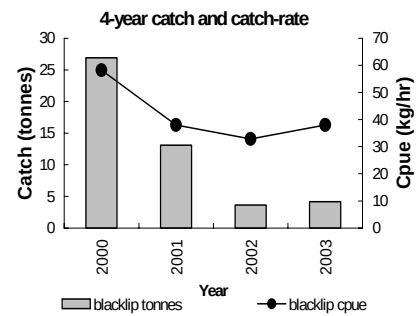
The better sub-blocks (e.g. 23A, 27A, 27B and 29A) were typically the most distant from launching ramps, whilst the sub-blocks showing the greatest reduction in annual catch and lower catch rates are typically more accessible (e.g. sub-blocks 23B, 27C, 27D). This is indicative of serial depletion and unsustainable fishing mortality at current stock levels.

22A (Cape Pillar to the Lanterns)**22B (The Lanterns to Eaglehawk Neck)**

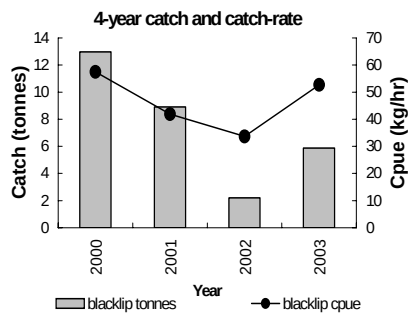
23A (Deep Glen Bay to Lagoon Bay)



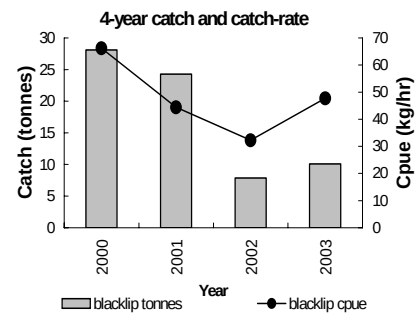
23B (Lagoon Bay to Marion Bay)



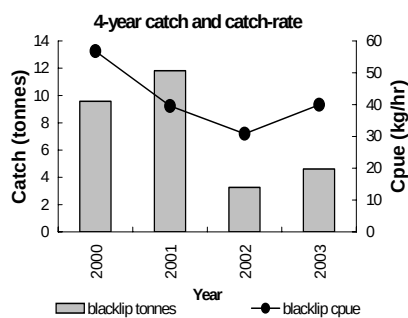
24A (western shore of Mercury Passage)



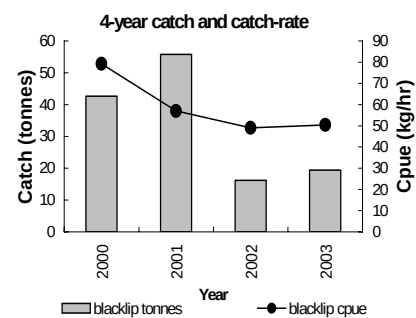
24B (western shore of Maria Island)



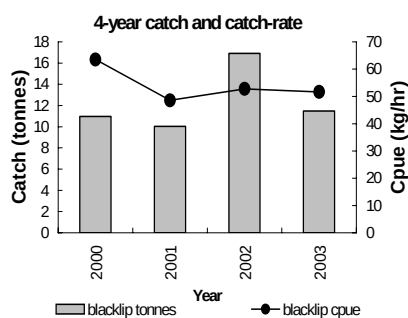
24C (Spring Bay)



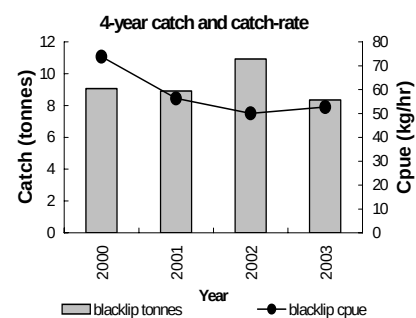
24D (north-east side of Maria Island)



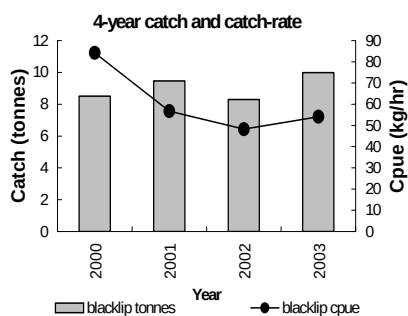
24E (south-east side of Maria Island)



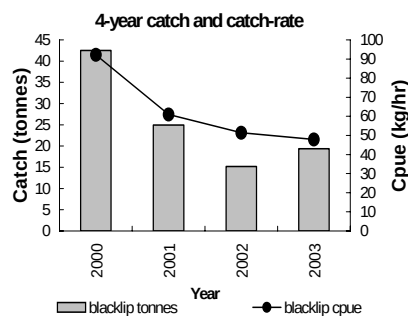
27A (south side of Schouten Island)



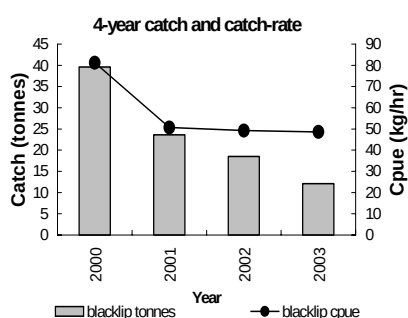
27B (east side of Schouten Island)



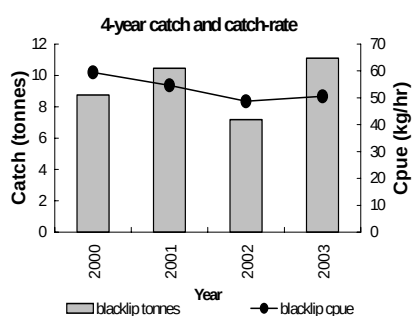
27C (Schouten Passage to Wineglass Bay)



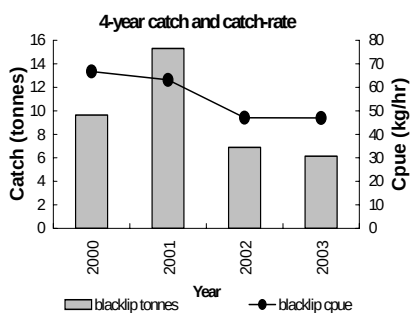
27D (Wineglass Bay to the Friendly Beaches)



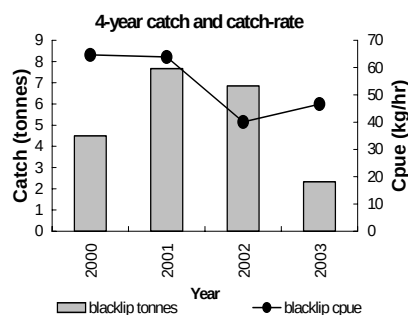
29A (Long Point to mid-Templestowe Beach)



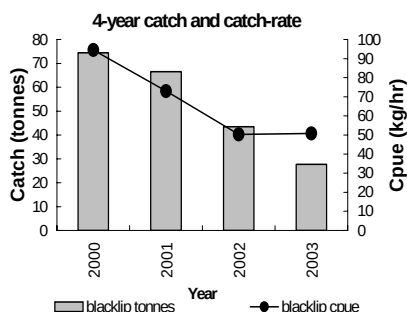
29D (Scamander to St Helens Point, including St Helens Island)



30A (St Helens Point to Taylor's Beach, including Binalong Bay)



31A (Eddystone Point to Cape Naturaliste)



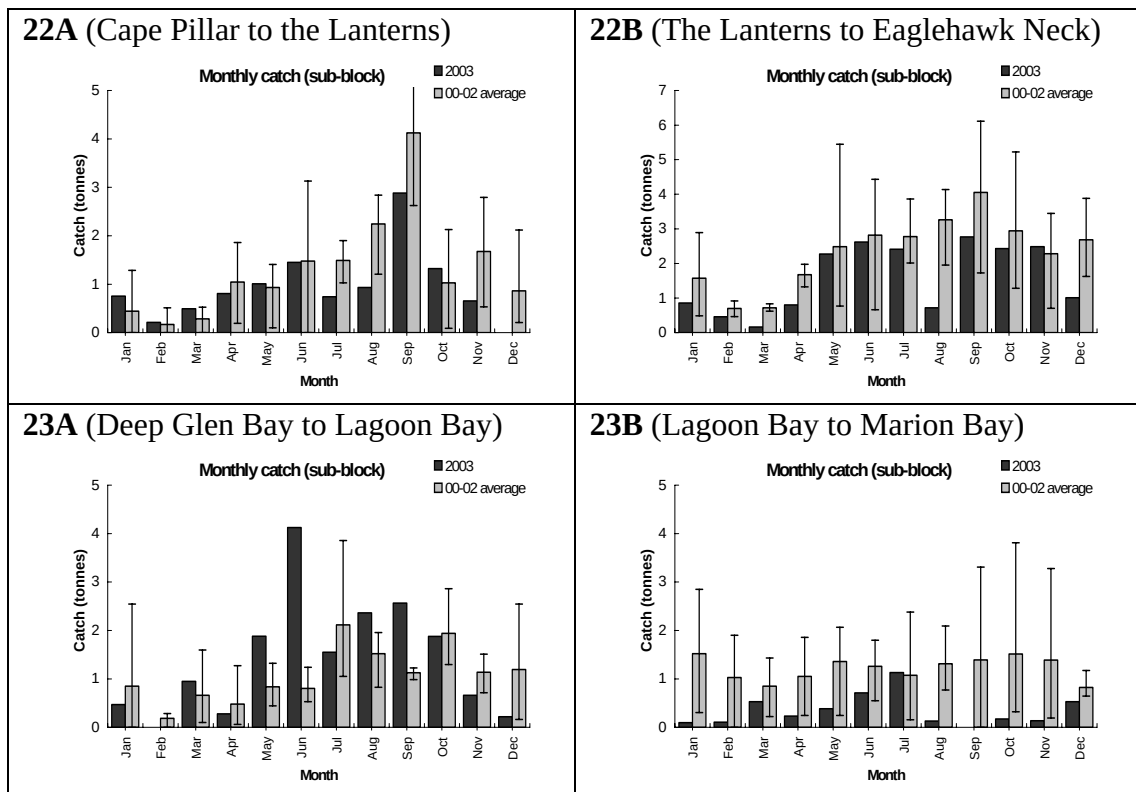
Monthly catch and monthly catch rates:

Only small amounts of catch were taken early in the year, and typically, catch rates were low. Significant levels of catch were not taken until May or June, when catch rates showed some improvement.

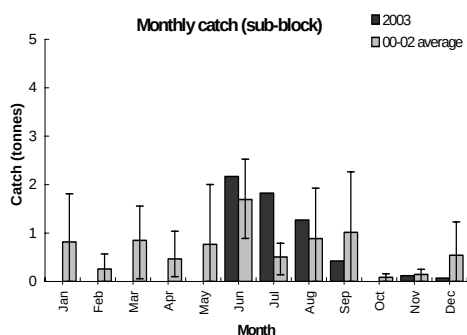
Notwithstanding the low levels of catch taken from the East Coast region in 2003, several catch charts show monthly catches greater than previous catches (e.g. 23A in June, 27B in June and July), or monthly catches consistently greater than the previous year (e.g. 29A). Most of the East Coast catch was taken from fewer sub-blocks than in previous years.

When divers found good stock levels and consistently landed reasonable catches, they tended to re-visit the area until catch rates fell (e.g. 23A), and not move to other areas as they might have done when fishable stocks were more widely dispersed. This could explain why 2003 monthly catches are frequently greater than catches from previous years.

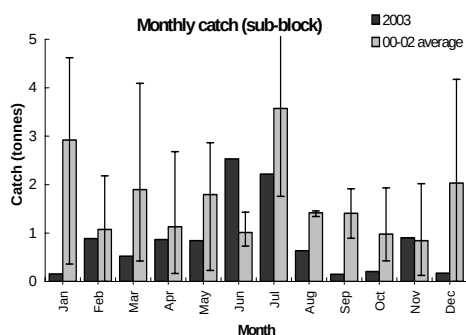
Monthly catch and catch rates charts are supplied for sub-block 30A even though the annual catch is insignificant. Block 30 once supported a large fishery; however it is now evident that even at current levels of catch, only low catch rates can be achieved.



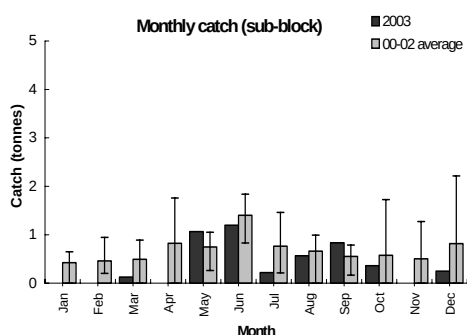
24A (western shore of Mercury Passage)



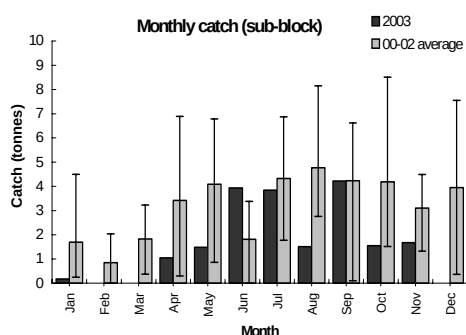
24B (western shore of Maria Island)



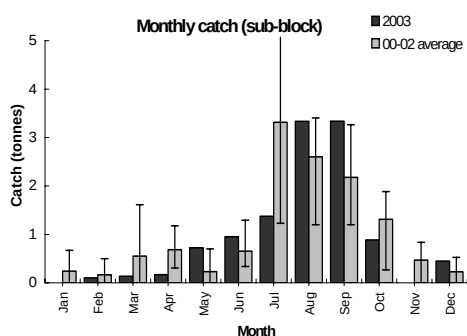
24C (Spring Bay)



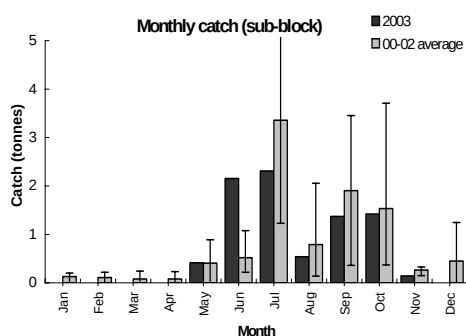
24D (north-east side of Maria Island)



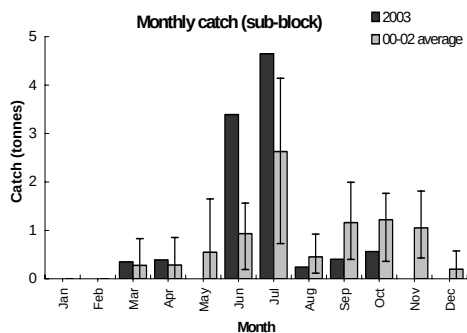
24E (south-east side of Maria Island)



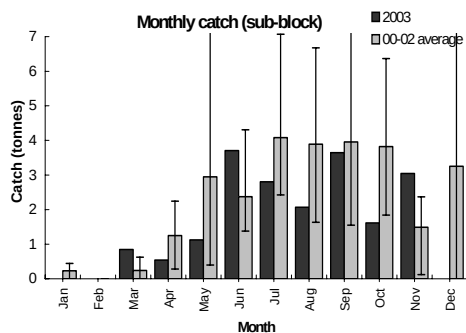
27A (south side of Schouten Island)



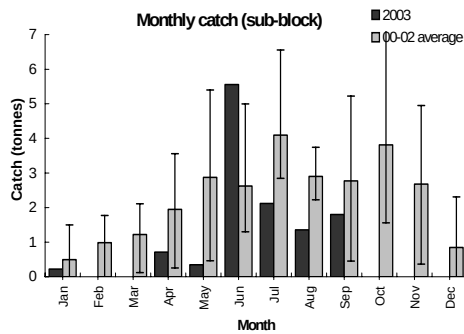
27B (east side of Schouten Island)



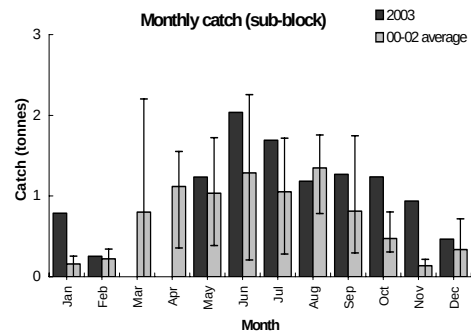
27C (Schouten Passage to Wineglass Bay)



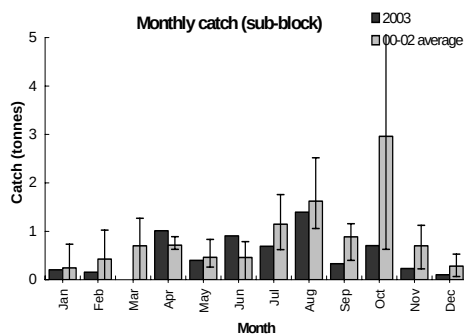
27D (Wineglass Bay to the Friendly Beaches)



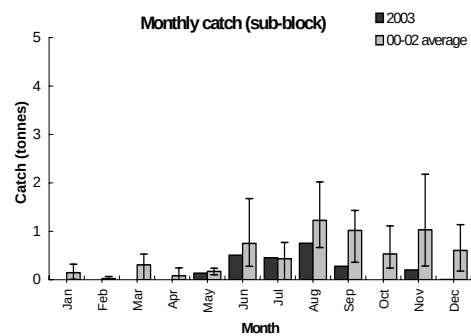
29A (Long Point to mid-Templestowe Beach)



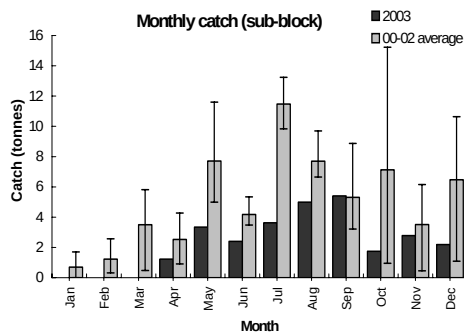
29D (Scamander to St Helens Point, including St Helens Island)



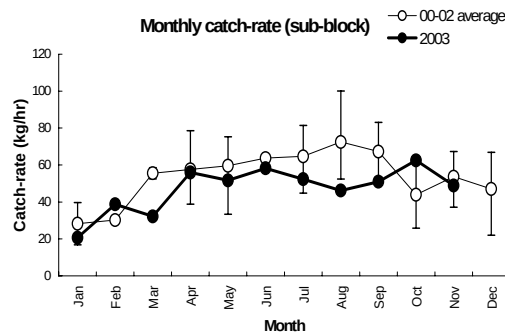
30A (St Helens Point to Taylor's Beach, including Binalong Bay)



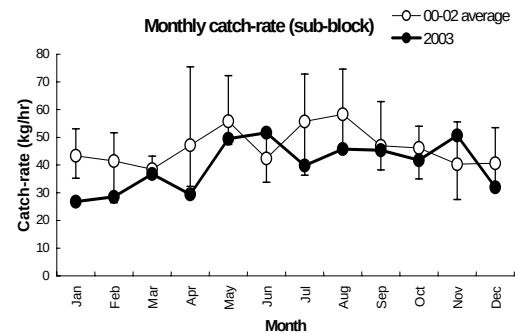
31A (Eddystone Point to Cape Naturaliste)



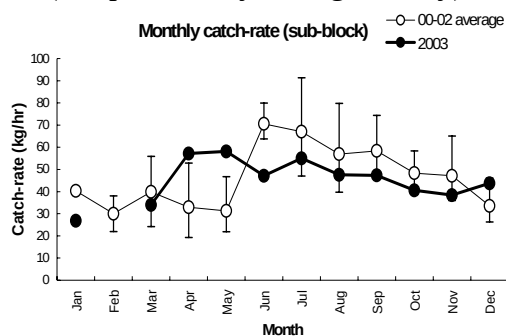
22A (Cape Pillar to the Lanterns)



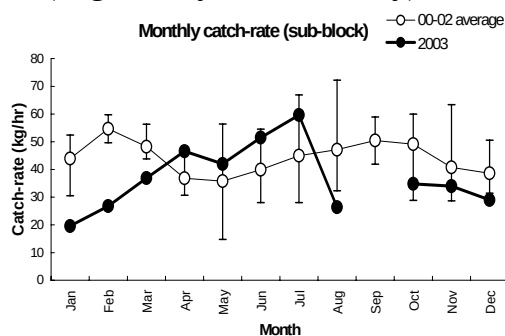
22B (The Lanterns to Eaglehawk Neck)



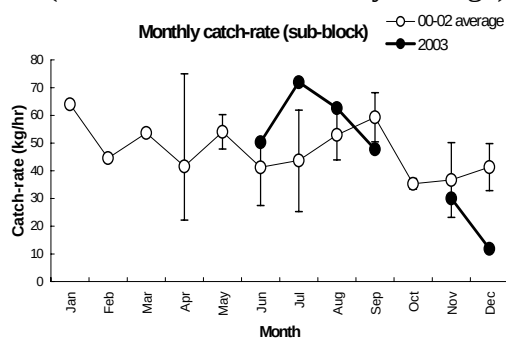
23A (Deep Glen Bay to Lagoon Bay)



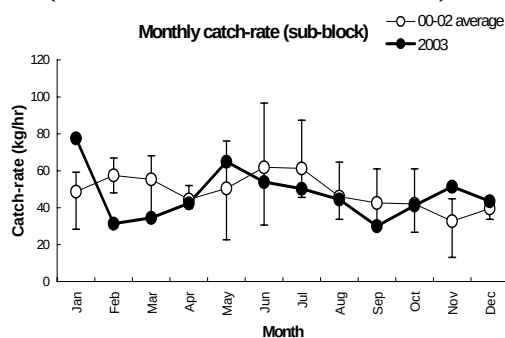
23B (Lagoon Bay to Marion Bay)



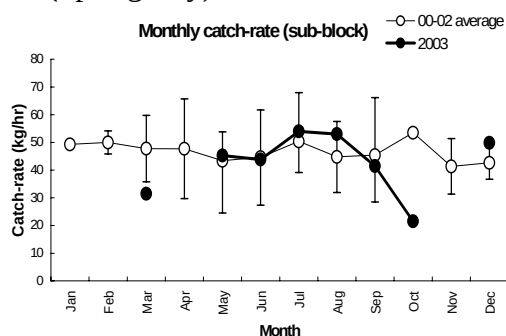
24A (western shore of Mercury Passage)



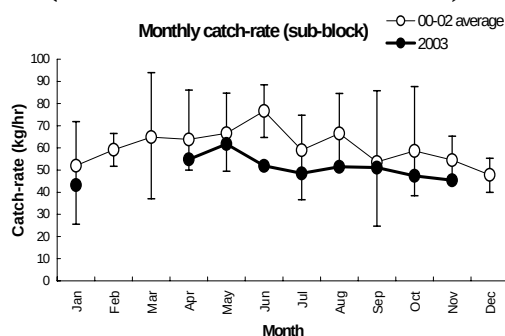
24B (western shore of Maria Island)



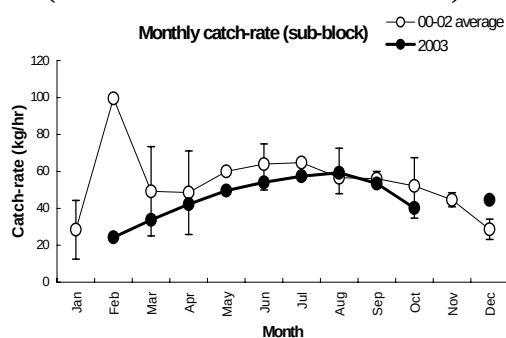
24C (Spring Bay)



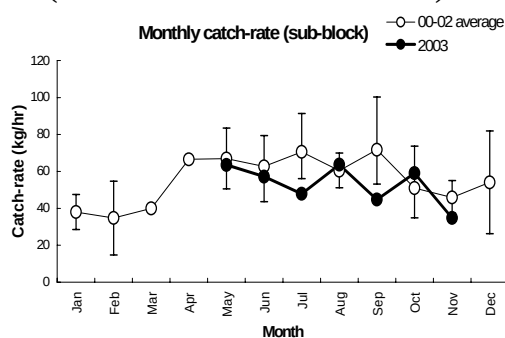
24D (north-east side of Maria Island)



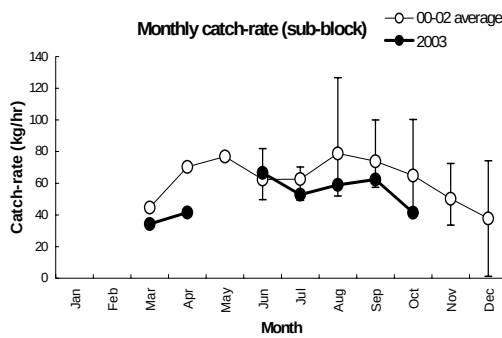
24E (south-east side of Maria Island)



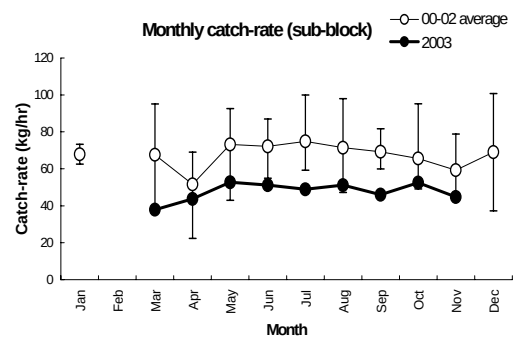
27A (south side of Schouten Island)



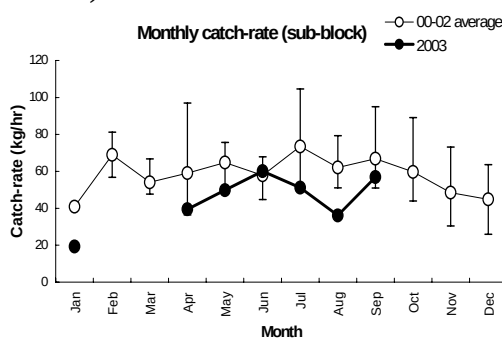
27B (east side of Schouten Island)



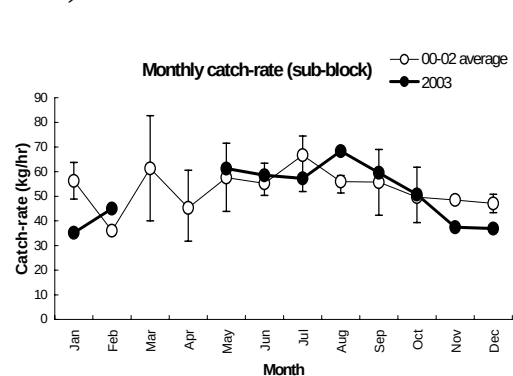
27C (Schouten Passage to Wineglass Bay)



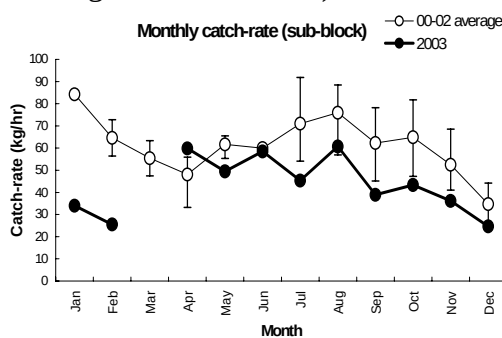
27D (Wineglass Bay to the Friendly Beaches)



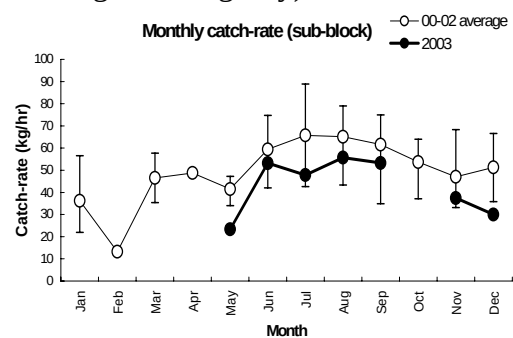
29A (Long Point to mid-Templestowe Beach)



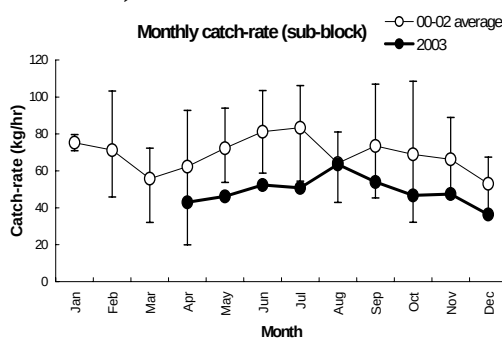
29D (Scamander to St Helens Point, including St Helens Island)



30A (St Helens Point to Taylor's Beach, including Binalong Bay)

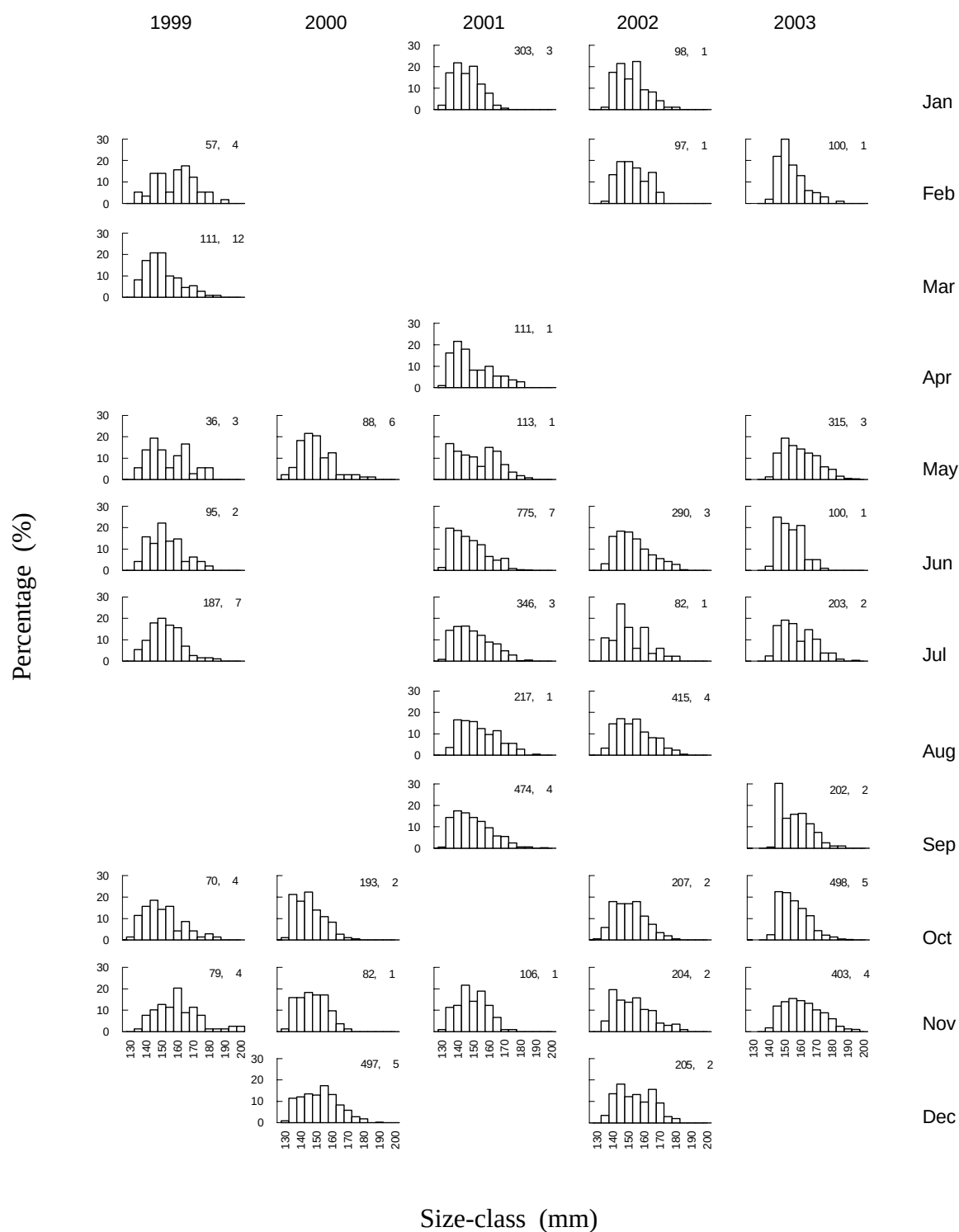


31A (Eddystone Point to Cape Naturaliste)

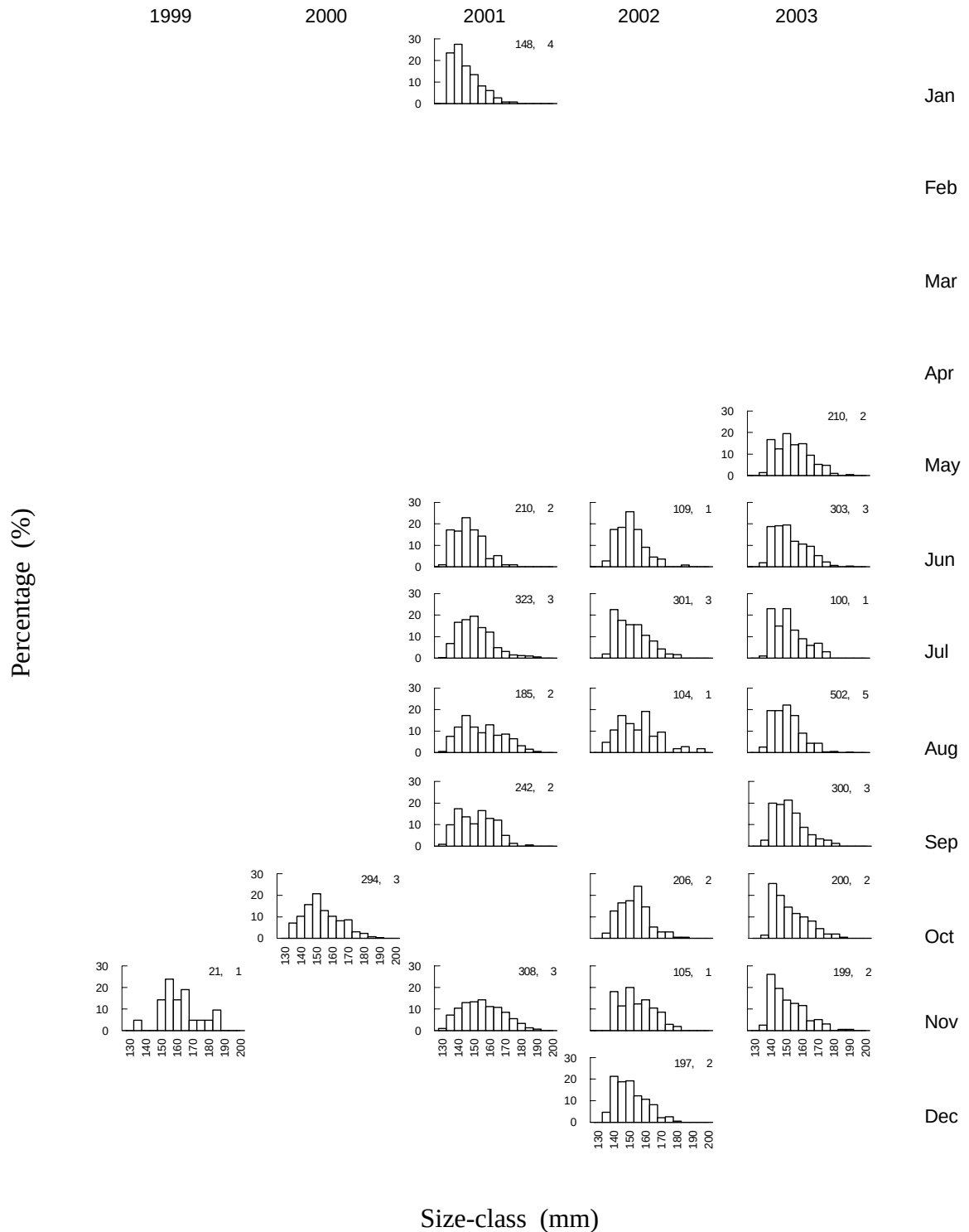


Size composition of the commercial catch: Samples from the northern part of the East Coast are limited to the winter months, because most fishing occurs then. Recent samples from 22B, 23A and 24D show no change in size-composition over previous years, while samples from 27C, 27D and 29A tend to show greater proportions of smaller abalone in the catch.

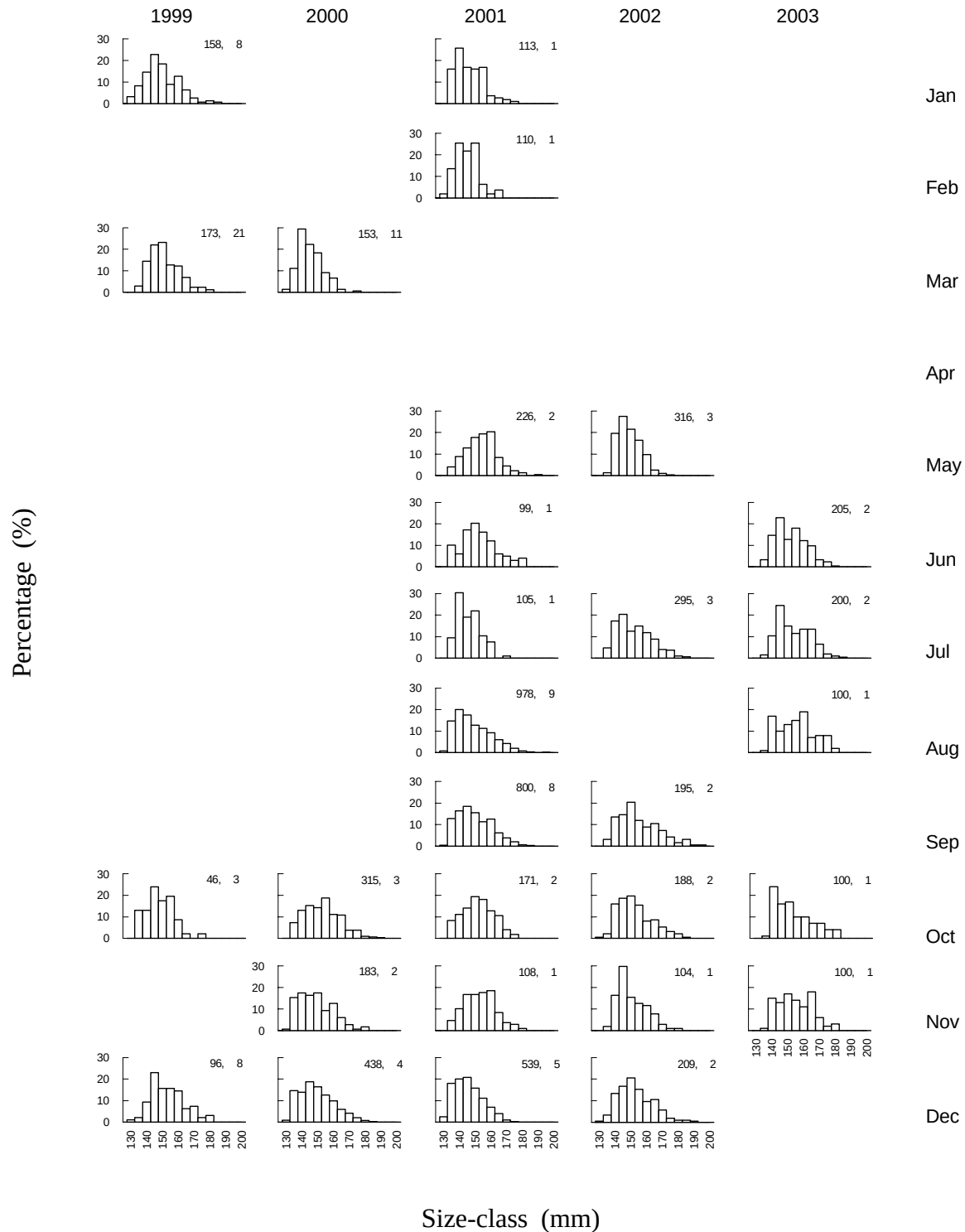
Sub-block 22B (size limit 136 mm)



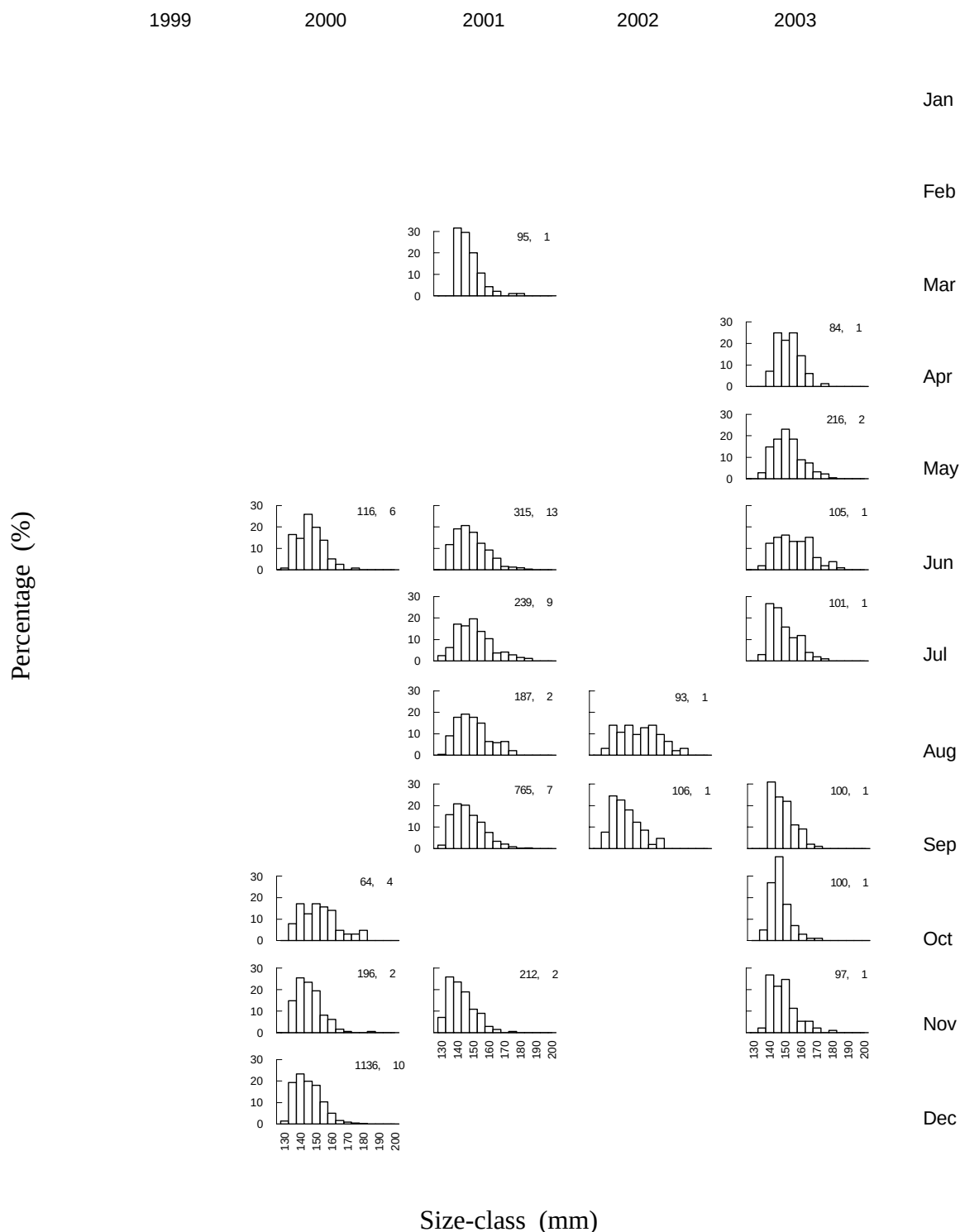
Sub-block 23A (size limit 136 mm)



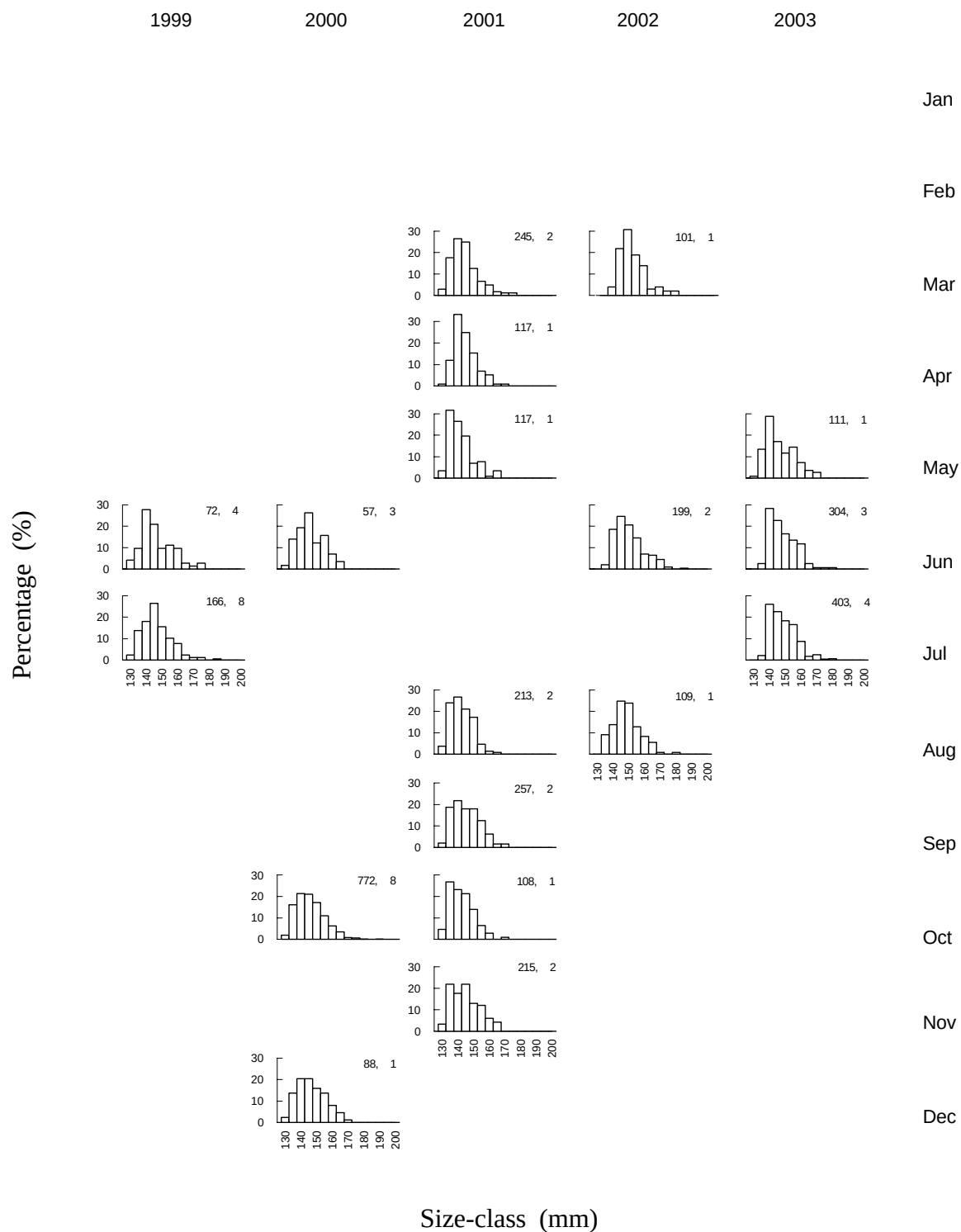
Sub-block 24D (size limit 136 mm)



Sub-block 27C (size limit 136 mm)



Sub-block 27D (size limit 136 mm)



Sub-block 29A (size limit 136 mm)

2003

Dec



Western Zone Blacklip Fishery – major fishing blocks

Catches fell by over 40% in Block 6, and to a lesser extent in Block 9 and 13, but were compensated for by increases in Blocks 7 and 10 (Figure 3).

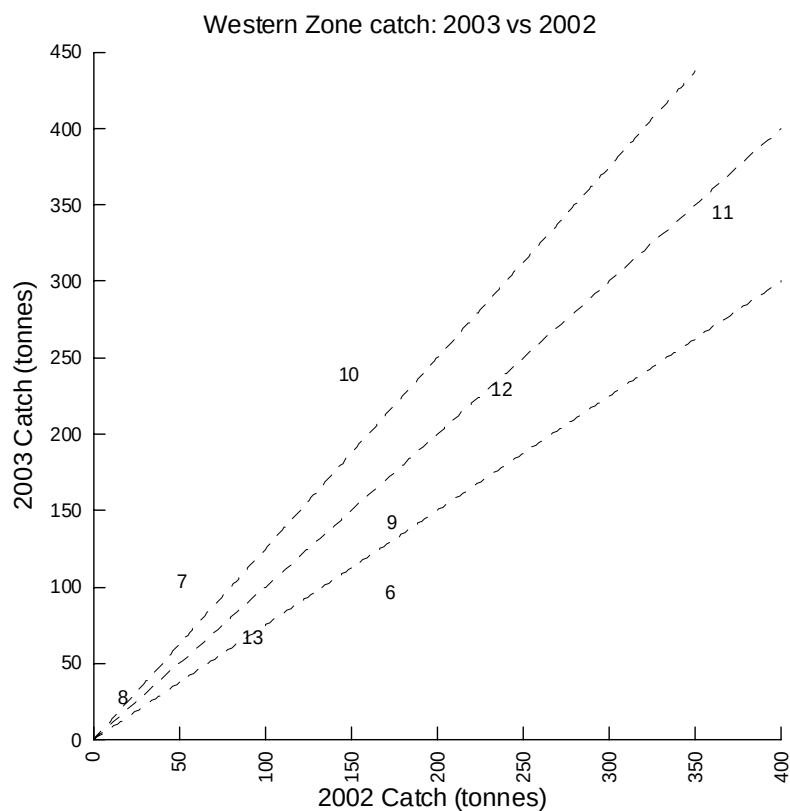
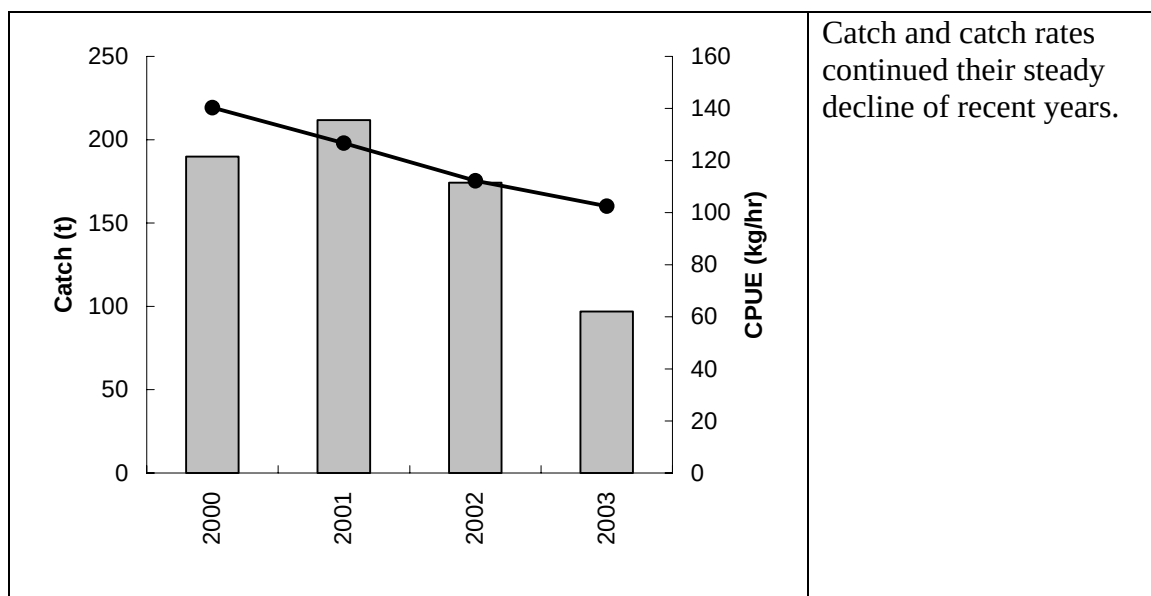
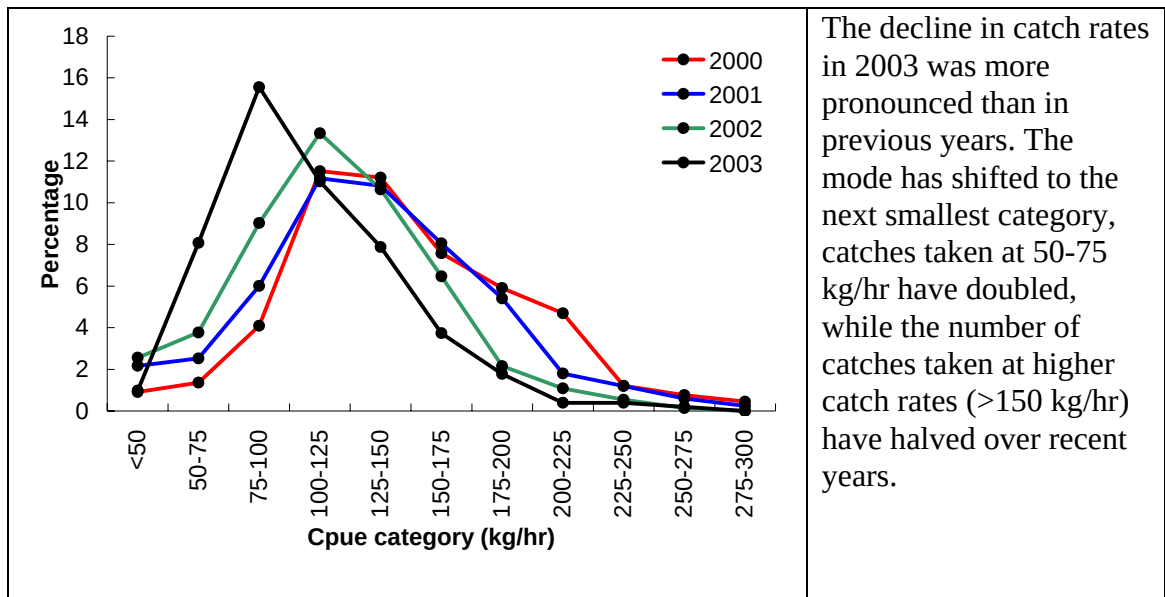


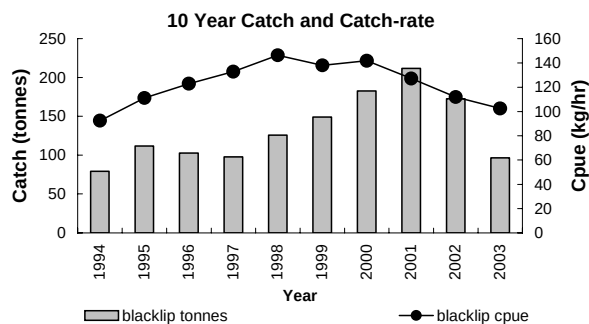
Figure 3. Blacklip catch from the Western Zone (Block 6 to Block 13 (sub-blocks 13A, 13B)). In 2003, the Western Zone TAC (1260 tonnes) was unchanged from the previous year. Blocks to the left of the diagonal line reflect increased catches over 2002 levels, blocks to the right reflect falling catches.

Western Zone-North West (Sub-block 5D, Block 6)





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

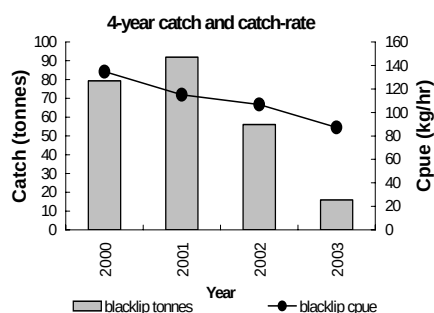


Catch rates have declined steadily since 2000, after catch levels had increased several years previously. Despite a long term average catch of 168 t, it appears that this block can no longer sustain fishing at that level.

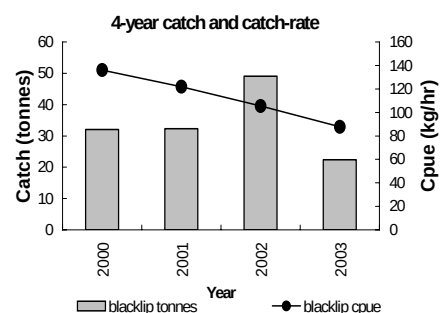
Sub-block catch and catch rates

Catch and catch rates have declined in all parts of Block 6. The biggest decline has been in the more accessible northern parts, but all sub-blocks were severely affected.

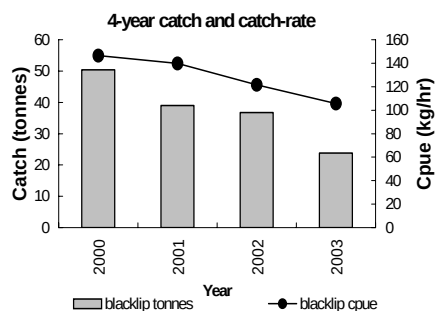
6A (Sundown to Temma)



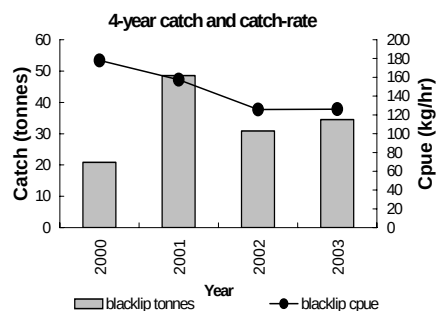
6B (Temma Harbour to rocks north of Dawson River)



6C (Rocks north of the Dawson River to Sandy Cape Beach – Wild Wave River)



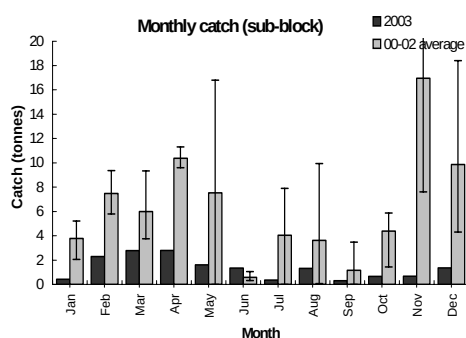
6D (Wild Wave River to Italian River, including Sandy Cape)



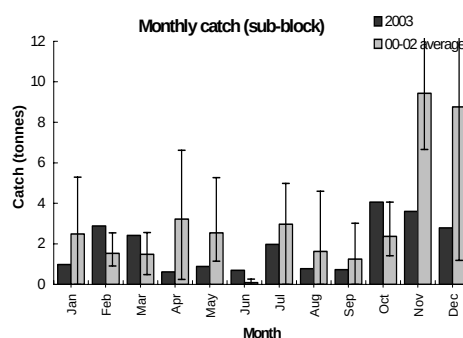
Monthly catch

Much of this block is now fished year round, i.e. abalone stocks do not receive the protection that other parts of this coast receive when bad weather prevents fishing. The close proximity of the Western Zone with other zones in the North West (Northern, greenlip, Bass Strait) means that divers frequent the area year round and are able to fish Block 6 whenever weather and sea conditions permit.

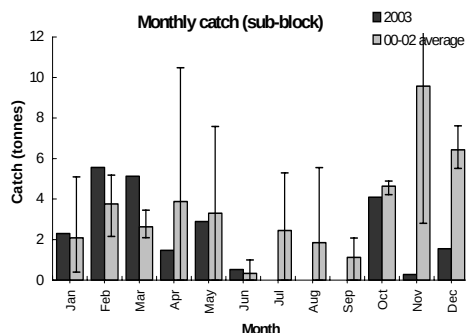
6A (Sundown to Temma)



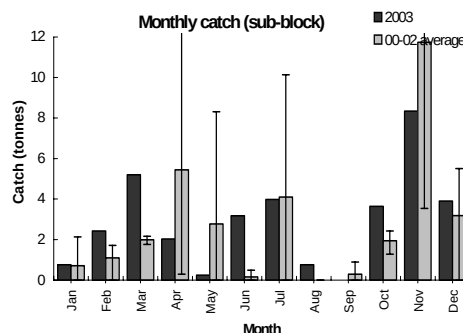
6B (Temma Harbour to rocks north of Dawson River)



6C (Rocks north of the Dawson River to Sandy Cape Beach – Wild Wave River)

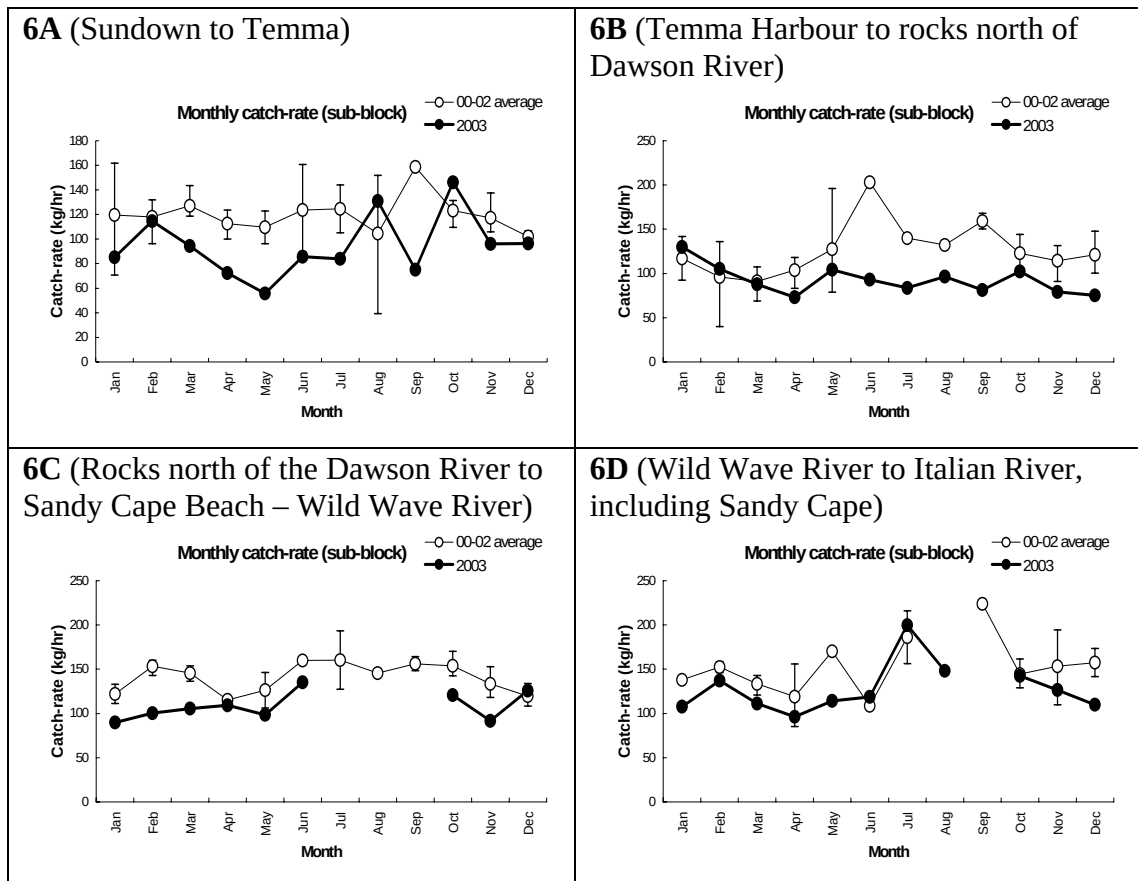


6D (Wild Wave River to Italian River, including Sandy Cape)



Monthly catch rates:

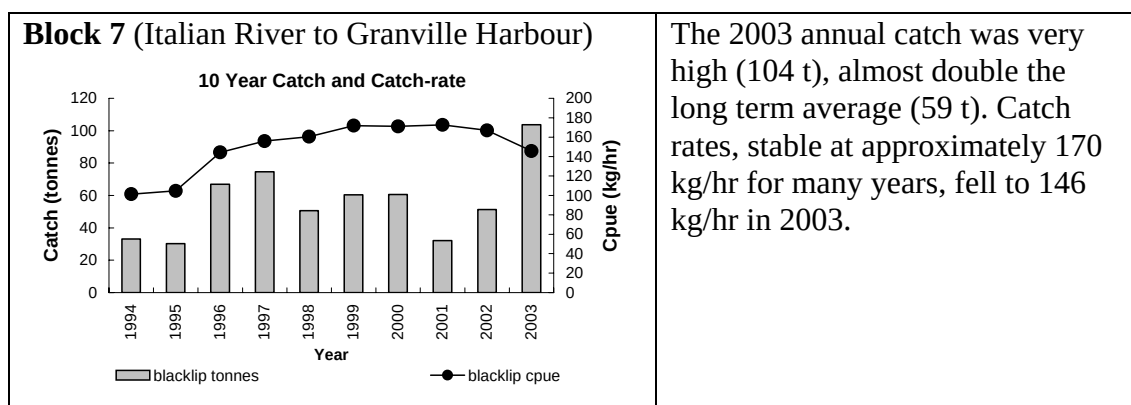
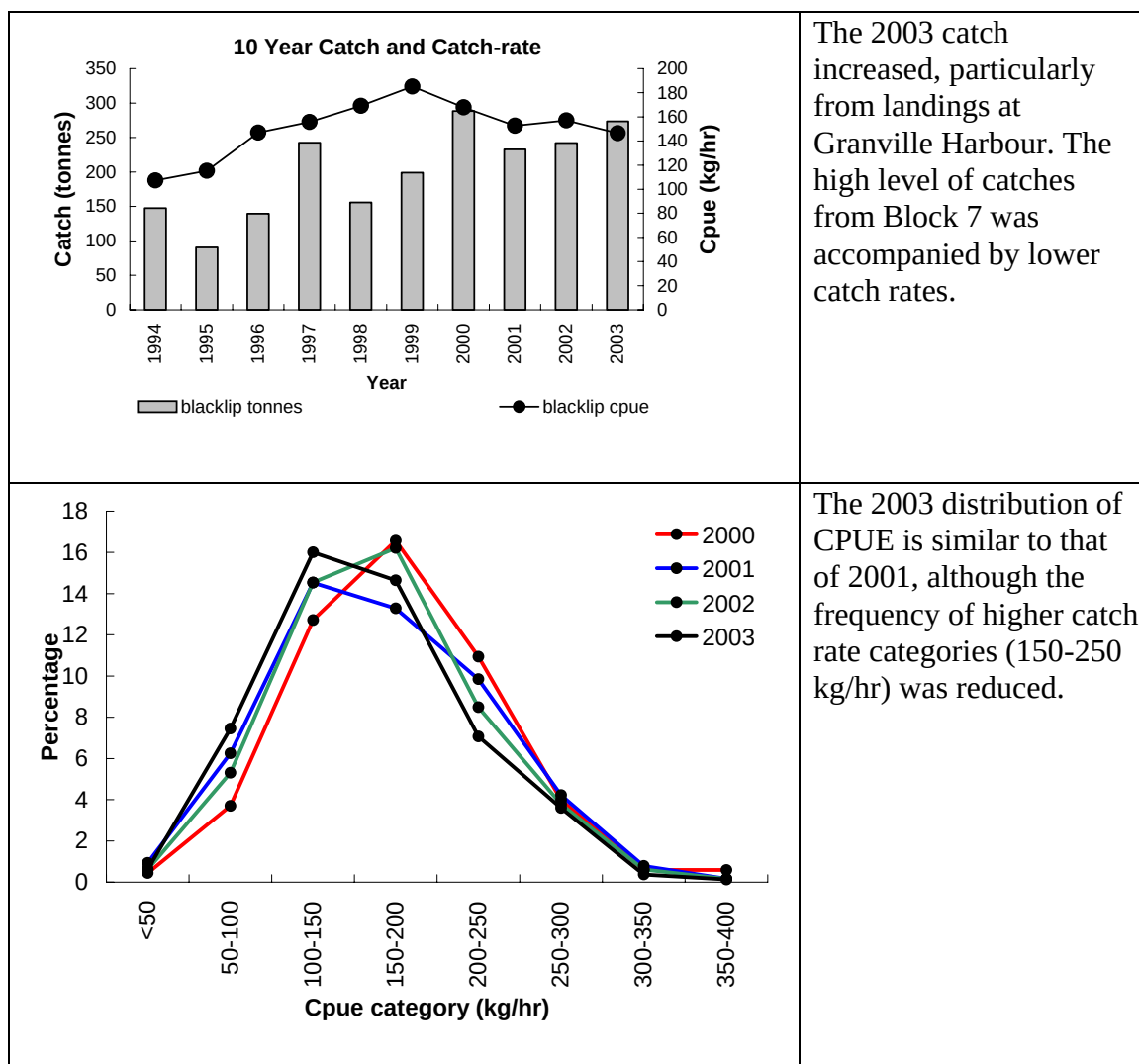
The size limit increase in 2003 from 132 to 136 mm probably reduced catch rates in 6A, 6B and 6C. However catch rates in 6D, where the size limit was unaffected, were mostly as low or lower than previous levels, so the size-limit increase was only partially responsible for lower catch rates in the other blocks in 2003. The lower catch rates appear to be associated with high levels of catch in recent years.



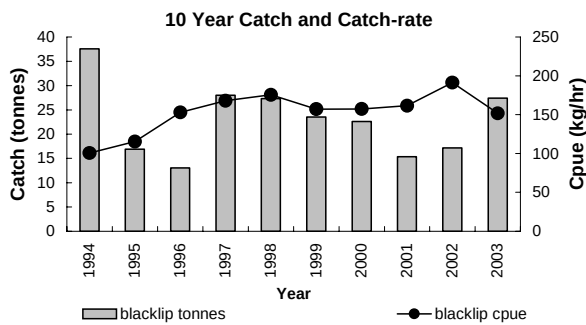
Size composition of the commercial catch:

Sampling frequency was too low to detect changes in the size composition of the catch.

Western Zone-Central West (Blocks 7, 8 and 9)

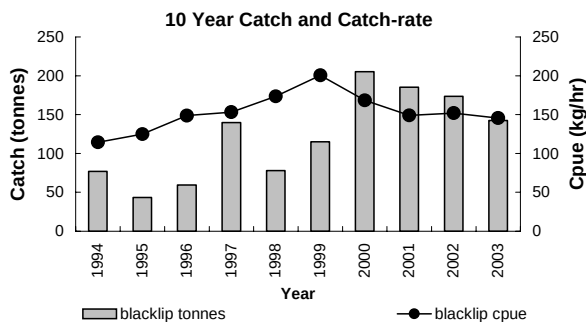


Block 8 (Granville Harbour to Ocean Beach)



Catches increased, partly because more divers fished from Granville Harbour, and partly because processors preferred Western Zone abalone from this region. Catch rates, although greatly reduced from the previous year, remain within the range of earlier years.

Block 9 (Ocean Beach to Point Hibbs)



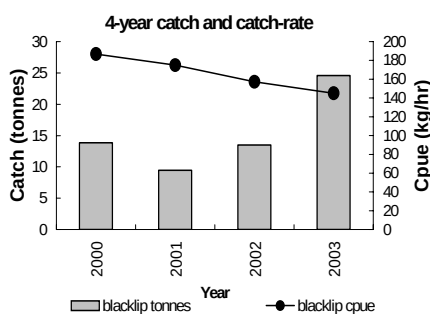
The annual catch fell again in 2003, partly because divers chose to fish north of Strahan, partly because of transfer of effort to motherships in Blocks 10 and 12. Catch rates have tended to stabilise at approximately 150 kg/hr after falling from very high levels in 2000.

Sub-block catch and catch rates:

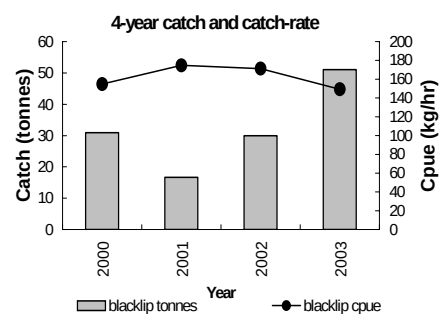
In 7A, the 2003 annual catch doubled to 23 t as greater numbers of divers from Couta Rocks travelled further south in search of higher stock levels. There were more divers operating from Granville Harbour, and the increased fishing pressure forced them to travel to the more remote sub-blocks 7A and 8B. Closer to the ramp, catch from 7B (49 t) almost doubled and from 7C (27 t) increased more than three-fold over the previous year. Catch rates responded to the increased level of catch by falling in all areas except 8A, and are now in the range 140 to 150 kg/hr.

South of Strahan, 9B catches were reduced to one third of 2000 levels, with catch rates stabilising. Catches in the more remote 9C have also fallen, with catch rates fluctuating between 150 and 170 kg/hr during the past three years.

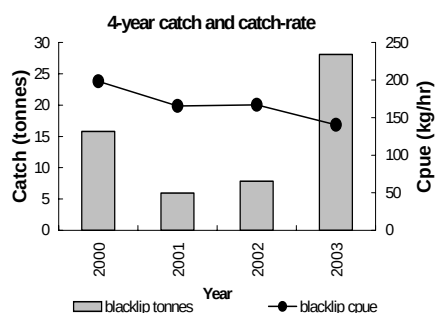
7A (Italian River to the Pieman River, including Rupert Point)



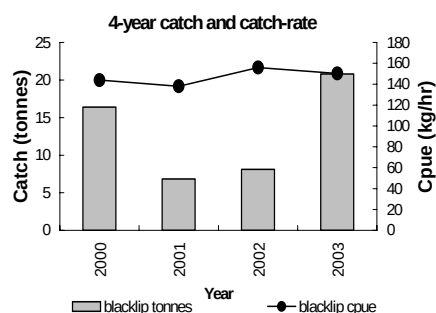
7B (Pieman to Ahrberg Bay, including Conical Rocks)



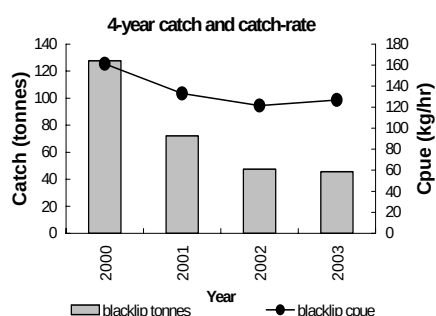
7C (Ahrberg to Granville Harbour)



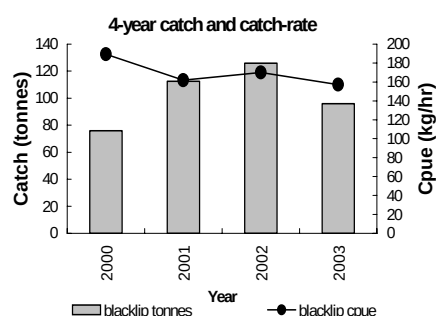
8A (Granville to Tasman Bay)



9B (Cape Sorell to Gorge Point)



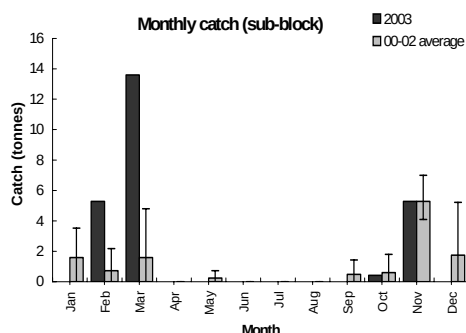
9C (Gorge Point to Point Hibbs)



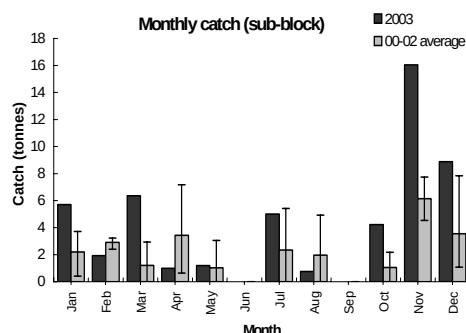
Monthly catch:

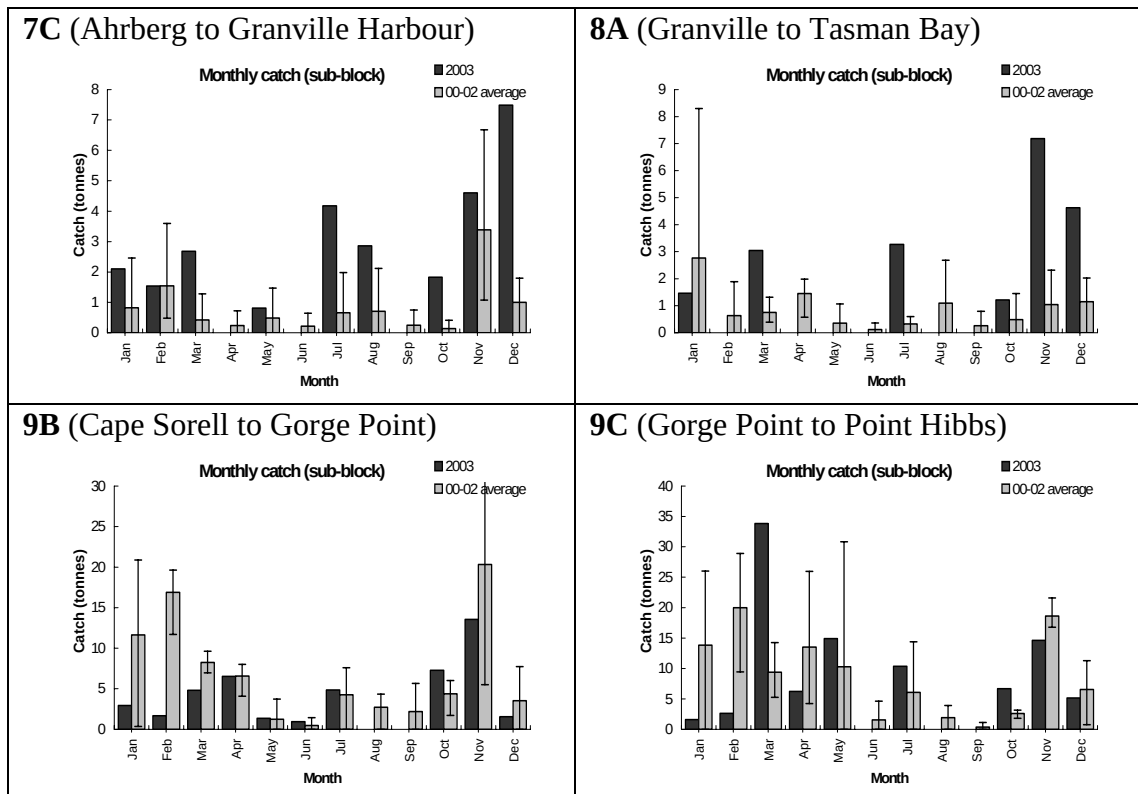
All sub-blocks except 9B show monthly levels of catch outside the range of previous levels. Blocks 7 and 8 are usually fished only in good weather conditions, which occur less frequently in winter. Despite this, divers fished the closer parts at unusually high levels in winter in 2003.

7A (Italian River to the Pieman River, including Rupert Point)



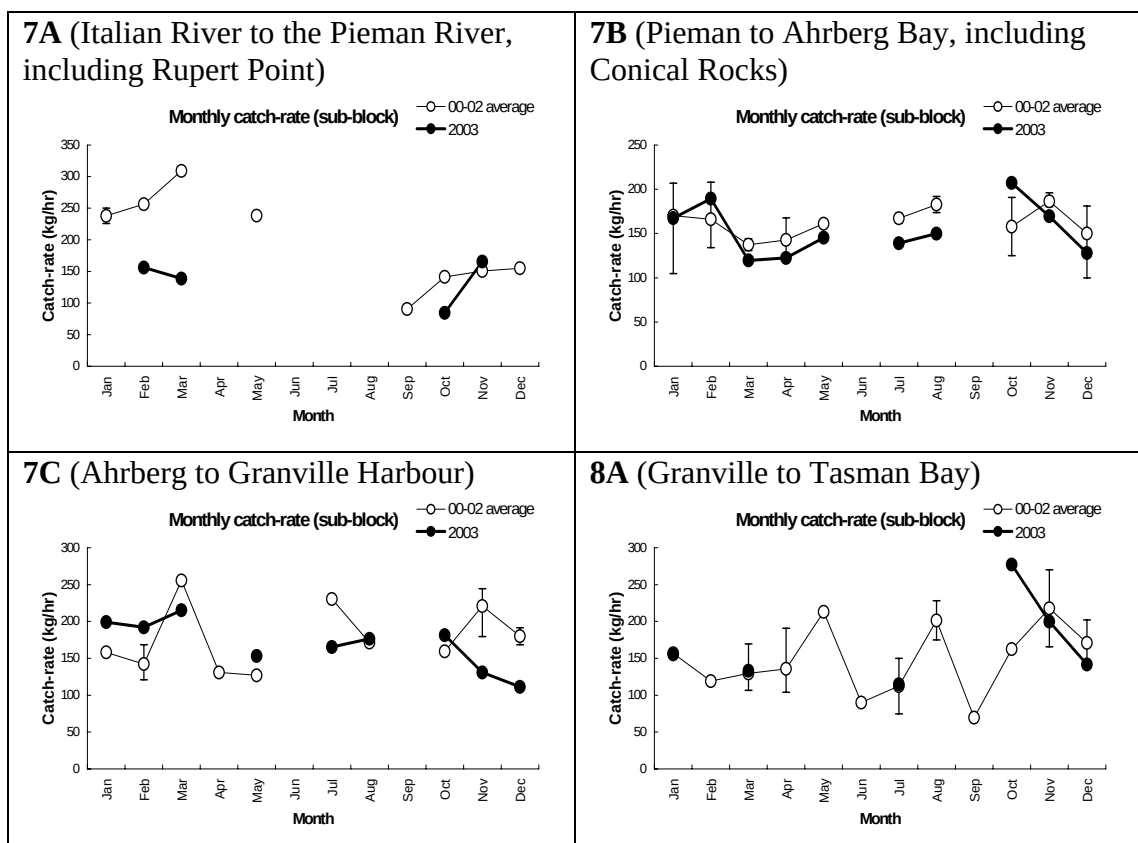
7B (Pieman to Ahrberg Bay, including Conical Rocks)

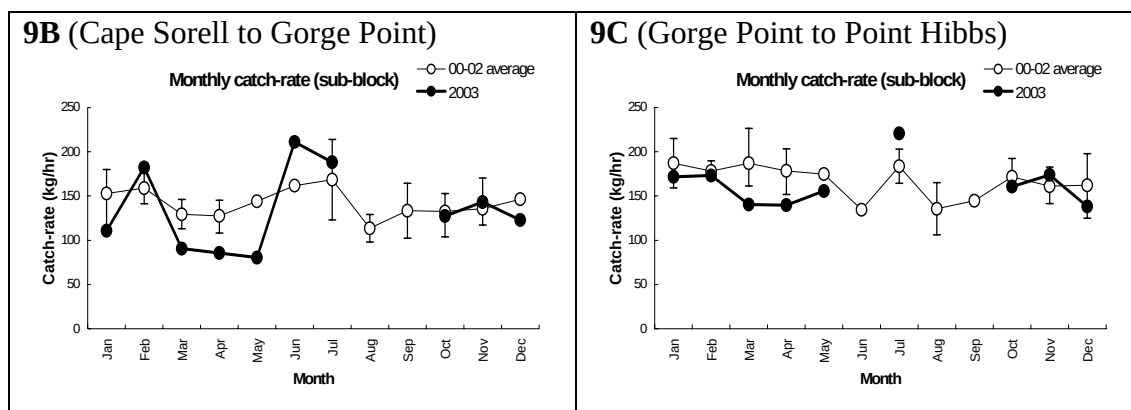




Monthly catch rates:

Monthly catch rates were highly variable. The low catch rates in 9B between March and May are of concern.

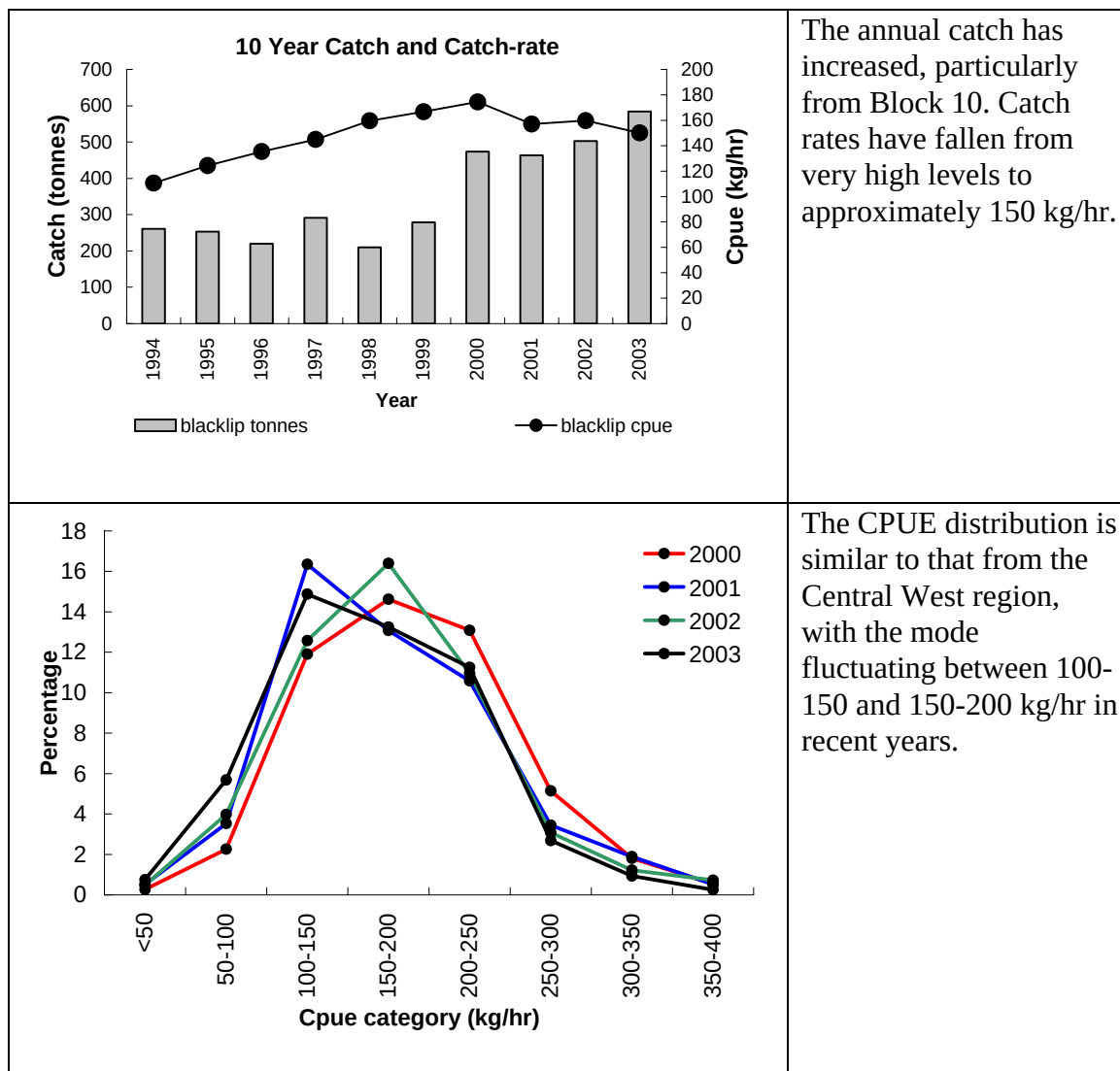




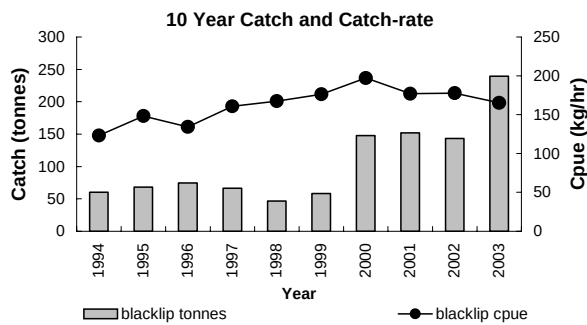
Size composition of the commercial catch:

Sampling frequency was too low to detect changes in the size composition of the catch.

Western Zone-South West (Blocks 10 and 11)

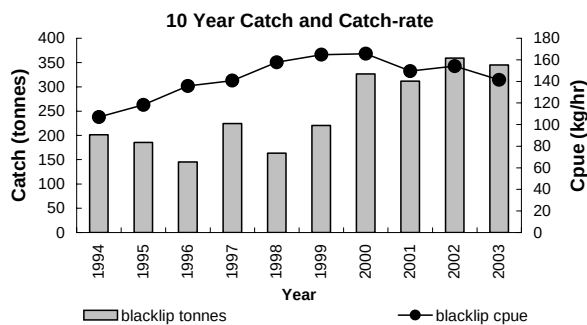


Block 10 (Point Hibbs to Low Rocky Point)



Much greater levels of catch (239 t) were landed in 2003, almost double the long term average. Catch rates fell, though remain at high levels (165 kg/hr).

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

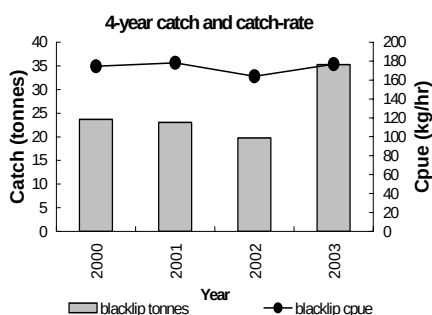


Catch rates have fluctuated during recent years, probably more as a response to fleet dynamics rather than stock depletion.

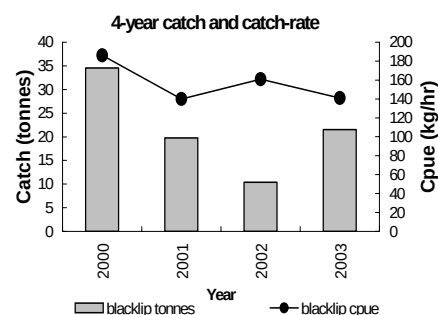
Sub-block catch and catch rates:

The increased level of catch from the region in 2003 came mostly from 10D, where the annual catch doubled to 140 t in 2003. Catch rates fell in 10C, but from very high levels in 2000 (237 kg/hr) and remain above 160 kg/hr. In Block 11, falls in annual catch in 11B and 11C were compensated by rises in the other sub-blocks. Catch rates tend to trend downward when viewed over the past four years, but remain at high levels except in Port Davey and the coast immediately south (11D and 11E). Market preferences for smaller abalone and the refusal of processors to accept large abalone (> 160 mm shell length) must contribute to lower catch rates, and given the prevalence of large abalone in this region, it is remarkable that catch rates did not fall further. Much of Port Davey is now a marine reserve, so the annual catch can be expected to fall in 2004.

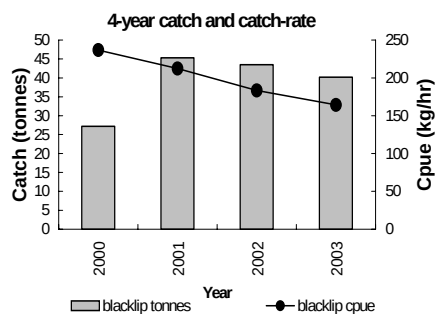
10A (Point Hibbs to Endeavour Bay)



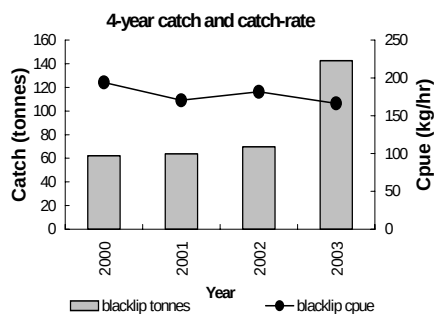
10B (Endeavour Bay to High Rocky Point)



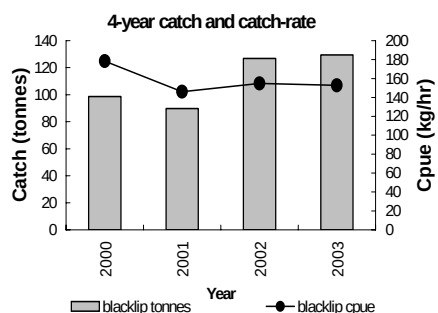
10C (High Rocky Point to Mainwaring River)



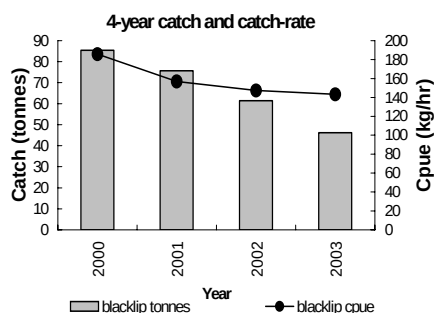
10D (Mainwaring River to Low Rocky Point)



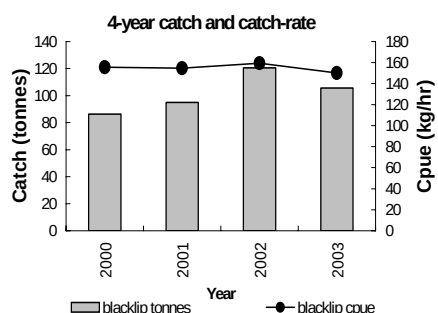
11A (Low Rocky Point to Elliott Point)



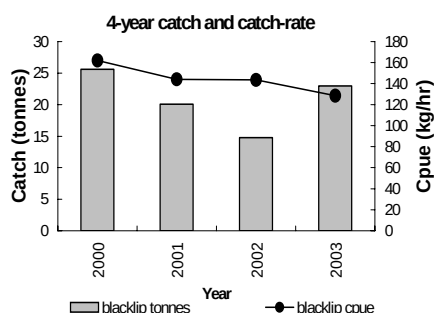
11B (Elliott Point to Svenor Gulches)



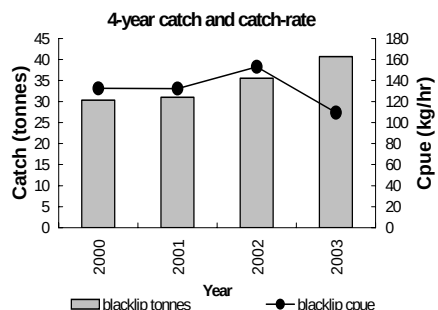
11C (Svenor Gulches to Point St Vincent)



11D (Hilliard Head to Faults Bay)

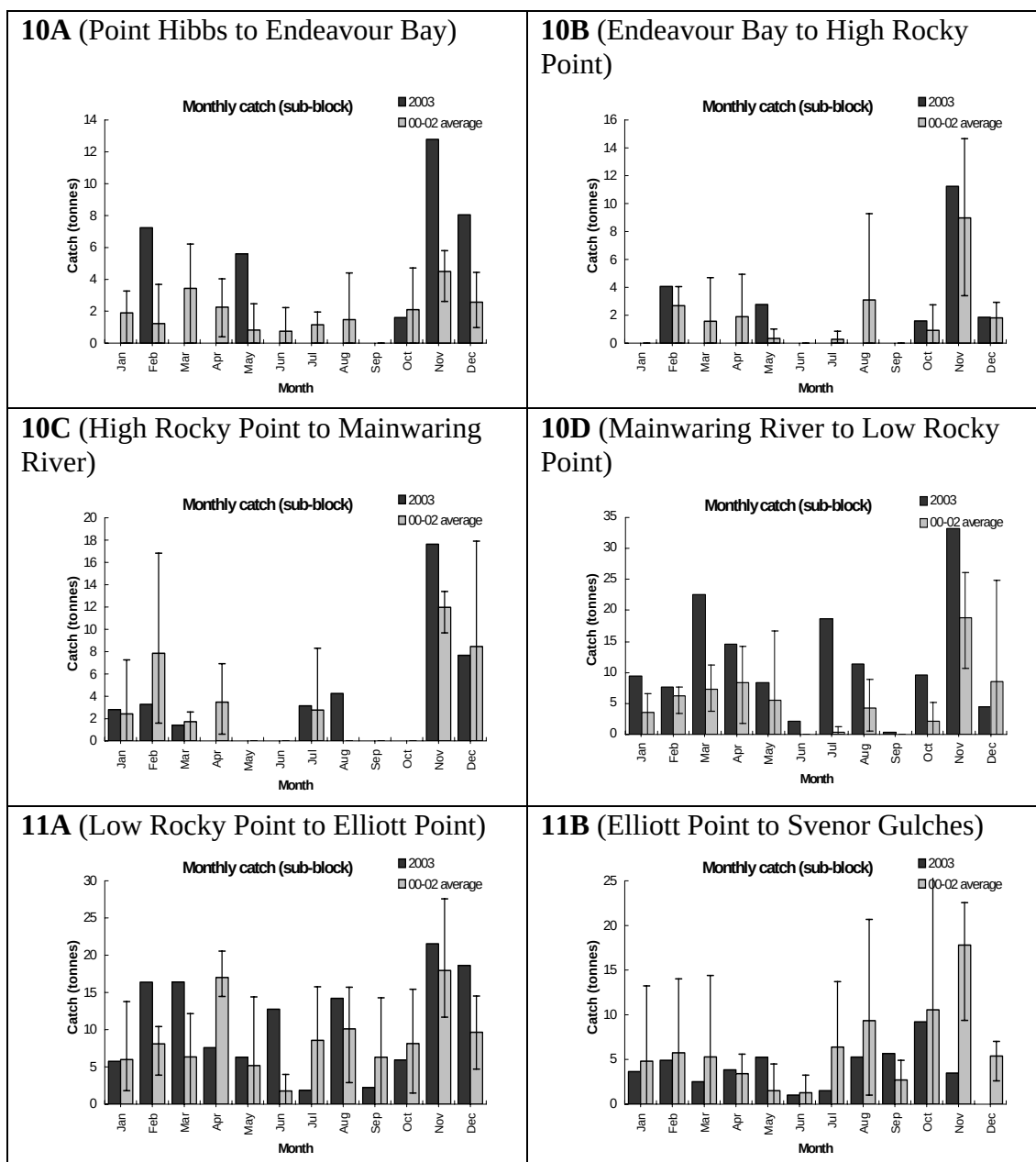


11E (Point St Vincent to Hilliard Head, including Port Davey)

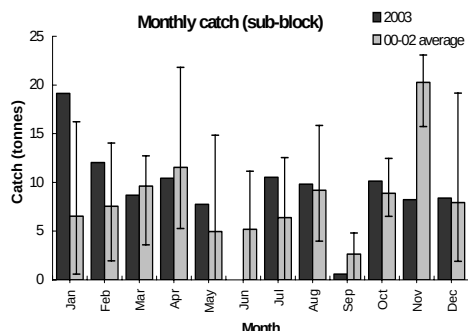


Monthly catch:

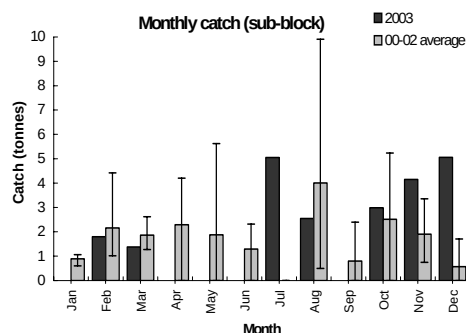
Many areas featured unusually high levels of monthly catch. Catches varied greatly between months; adjacent sub-blocks showed high levels of catch on alternate months (10D, 11A, 11B) as effort appears to be rotated to maintain high catch rates. Most sub-blocks were fished heavily in November.



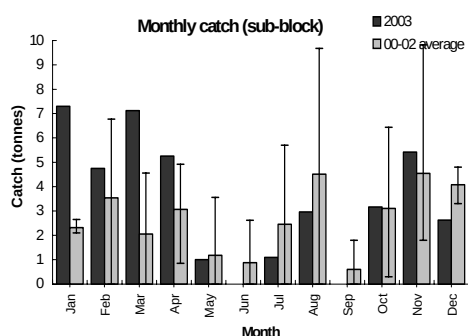
11C (Svenor Gulches to Point St Vincent)



11D (Hilliard Head to Faults Bay)



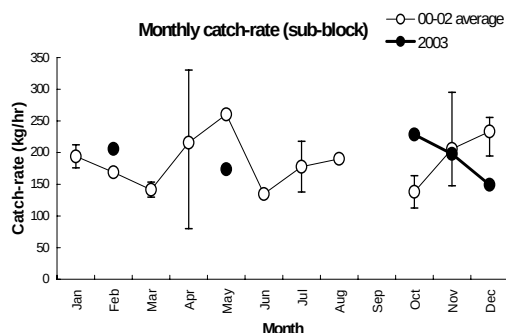
11E (Point St Vincent to Hilliard Head, including Port Davey)



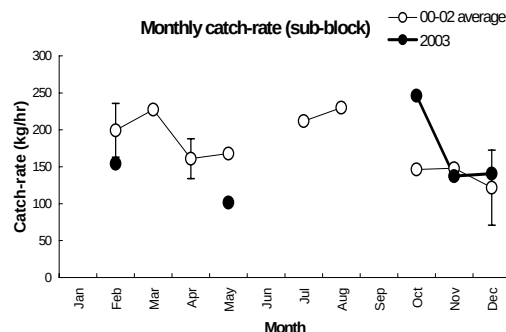
Monthly catch rates:

The low monthly catch rates in parts of Block 11 (e.g. May, June) are usually associated with small levels of monthly catch, assumed to be taken in adverse conditions. However the March catch from 11A was substantial (16 t) and it is assumed that the low catch rates there reflect buyer resistance to large abalone.

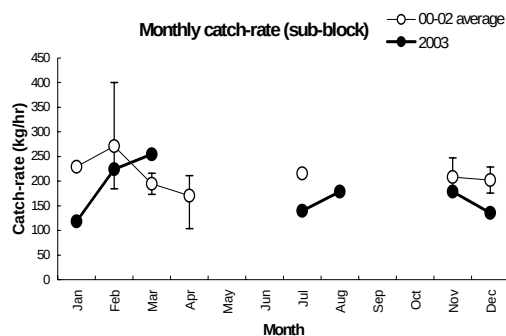
10A (Point Hibbs to Endeavour Bay)



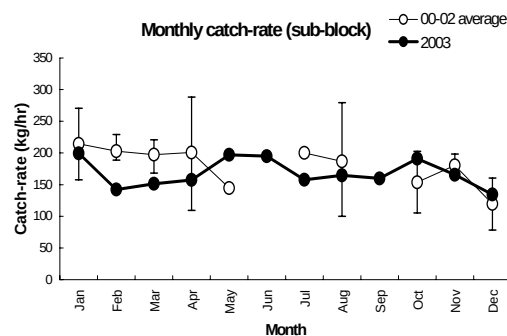
10B (Endeavour Bay to High Rocky Point)



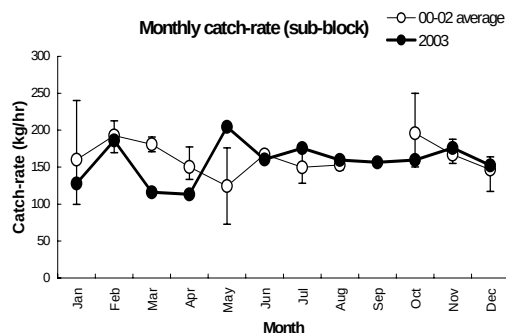
10C (High Rocky Point to Mainwaring River)



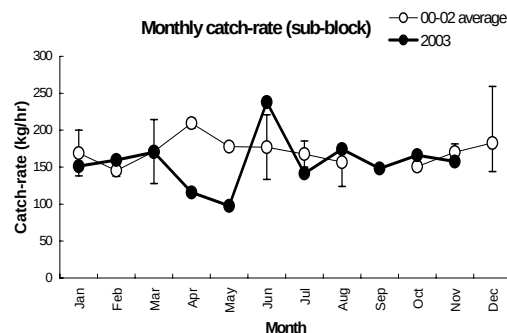
10D (Mainwaring River to Low Rocky Point)



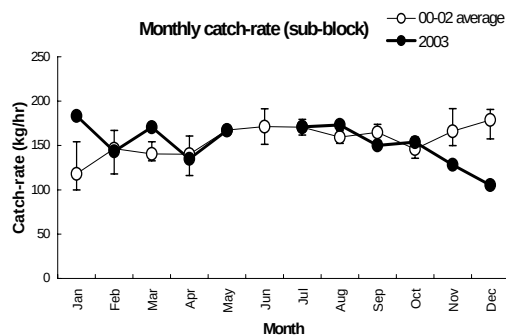
11A (Low Rocky Point to Elliott Point)



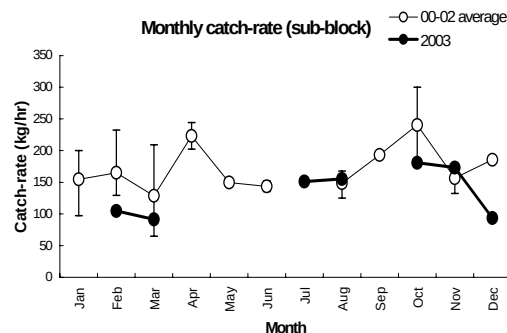
11B (Elliott Point to Svenor Gulches)



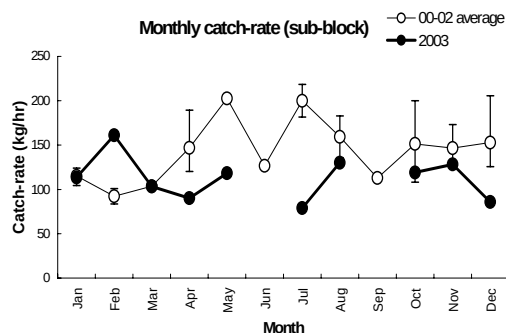
11C (Svenor Gulches to Point St Vincent)



11D (Hilliard Head to Faults Bay)



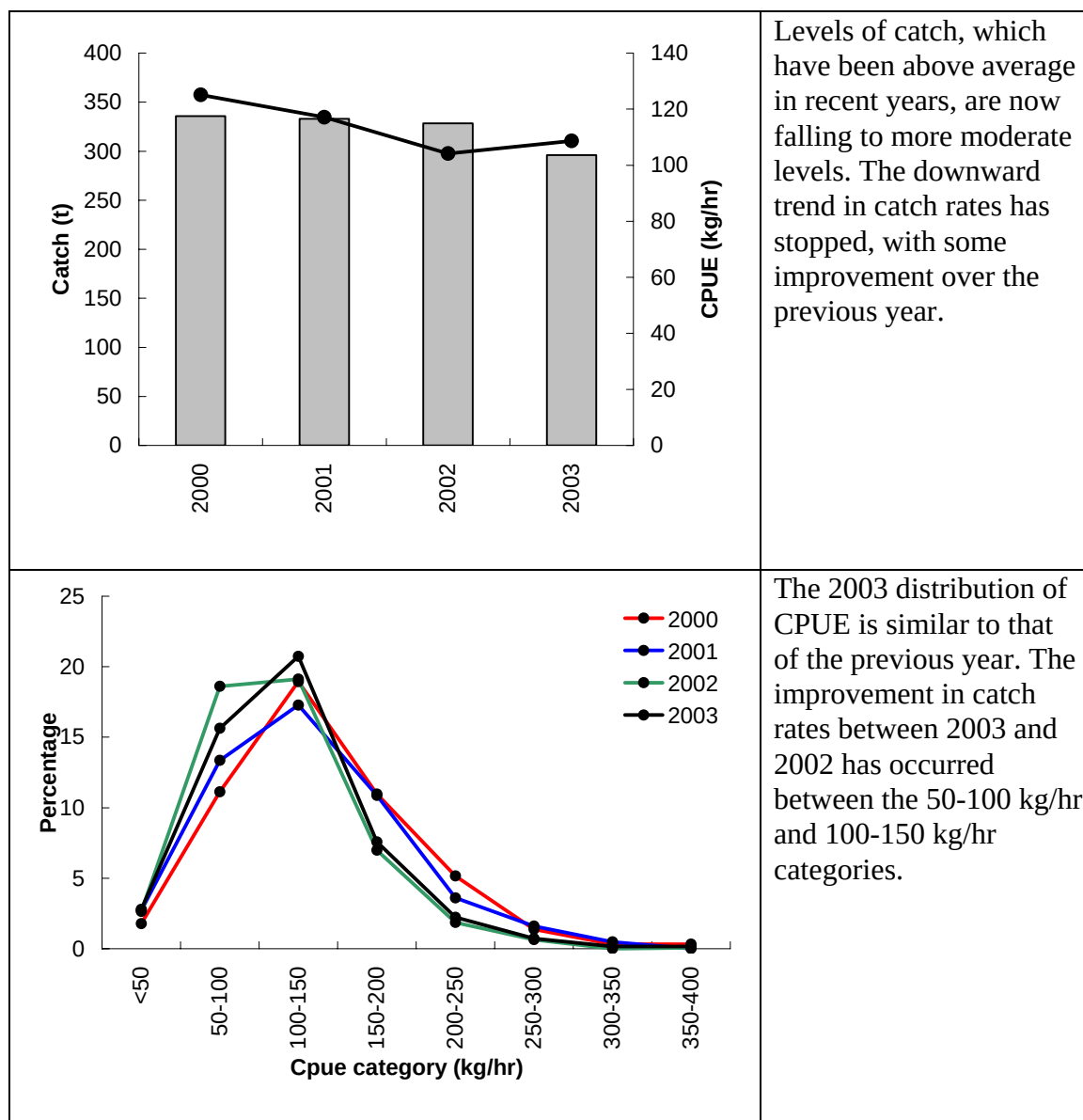
11E (Point St Vincent to Hilliard Head, including Port Davey)



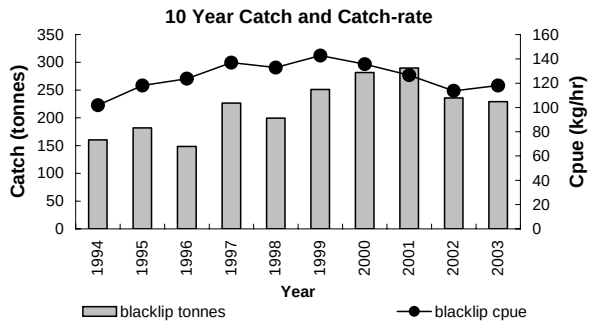
Size composition of the commercial catch:

While significant differences in GMS between samples collected in 2003 and previous years were detected, they appear to be random and followed no obvious pattern. Because most sampling was from catches processed at canneries where abalone larger than 160 mm were accepted, no reduction in GMS due to imposition of an upper size-limit could be detected.

Western Zone-South Coast (Block 12, Sub-blocks 13A, 13B)

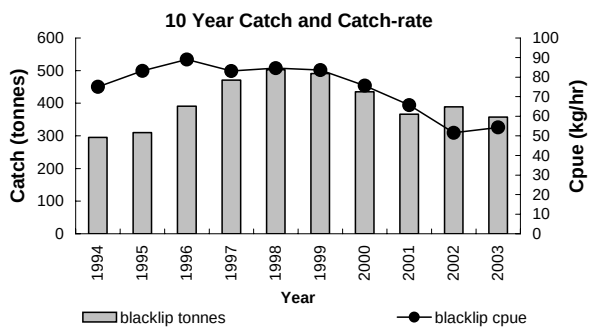


Block 12 (Faults Bay to Prion Beach, including South West Cape, Cox Bight and Maatsuyker Island)



Catch rates have improved, probably as a result of reduced catch levels since 2002. However, the annual catch (229 t) remains at greater than average levels (207 t).

Block 13 (Prion Beach to Whale Head)

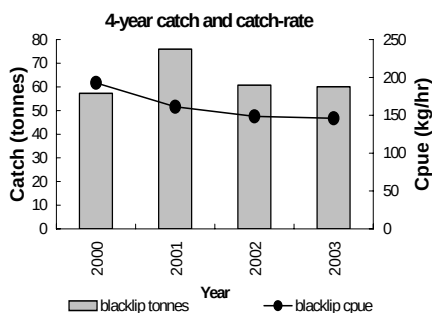


Most catch from this block is from the Eastern Zone, and masks any trends from the Western Zone sub-blocks 13A and 13B. The annual catch reported from these two sub-blocks was almost at the four year average.

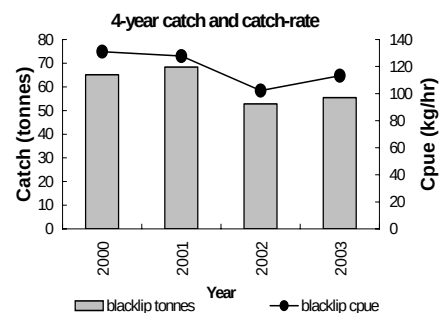
Sub-block catch and catch rates:

Catch and catch rates show no consistent trends. The more remote areas have higher catch rates than 13A and 13B, probably reflecting the more difficult access by small boat from Southport. Previous assessments have been concerned at the level of fishing in the more accessible sub-blocks (13A, 13B). Geometric mean catch rates are approximately 90 kg/hr in these areas but it is difficult to assess whether this indicates stock depletion, divers attempting to catch Western Zone quota in adverse conditions or market preferences for small abalone.

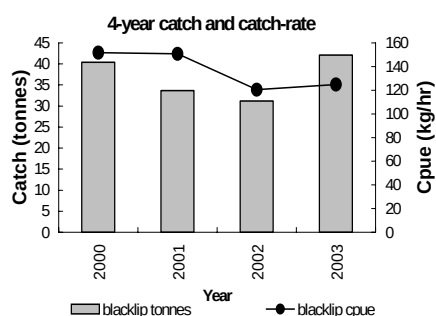
12A (Faults Bay to South West Cape)



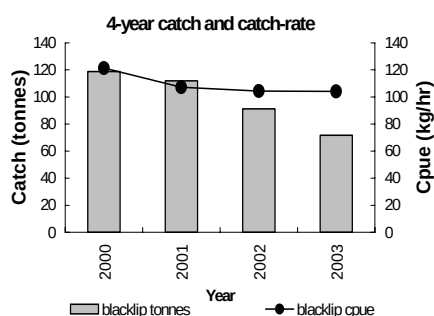
12B (South West Cape to Cox 's Bluff)



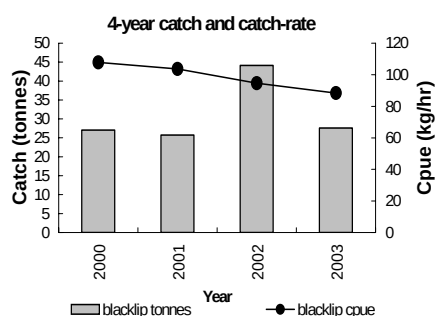
12C (Maatsuyker Group)



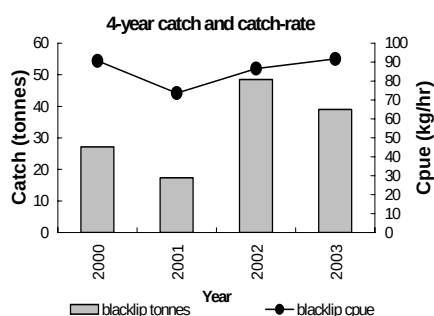
12D (Cox's Bluff to Prion Beach)



13A (Prion Beach to South Cape)



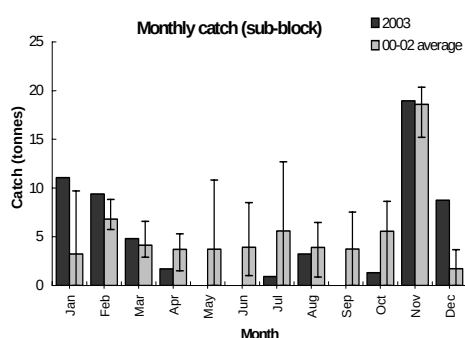
13B (South Cape to Whale Head)



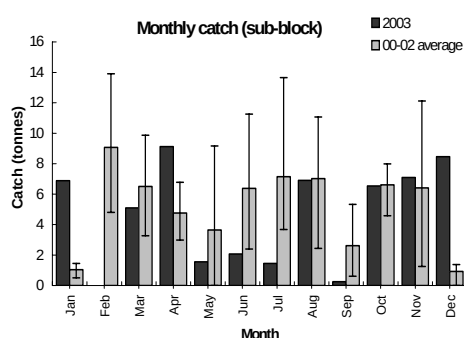
Monthly catch:

In contrast to other parts of the Western Zone, the South Coast was fished consistently throughout the year, increasing the likelihood that catch rate trends reflect levels of abundance and that divers are not maintaining catch rates by serially depleting reefs. Low catches in September coincided with a prolonged spell of bad weather.

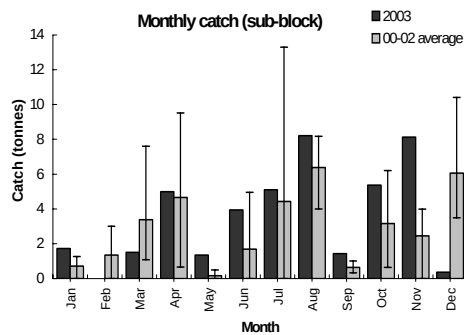
12A (Faults Bay to South West Cape)



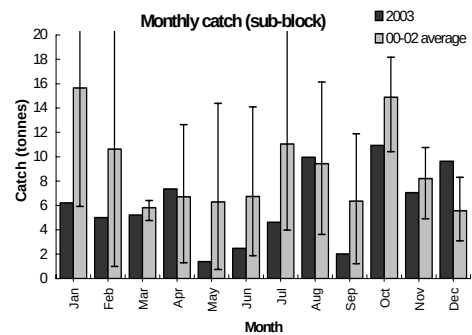
12B (South West Cape to Cox 's Bluff)



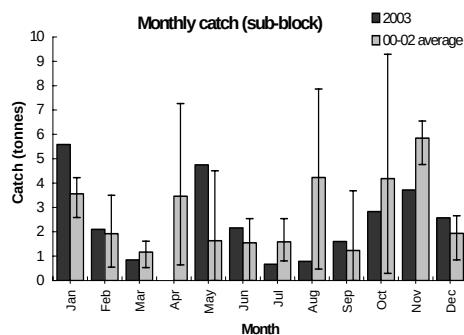
12C (Maatsuyker Group)



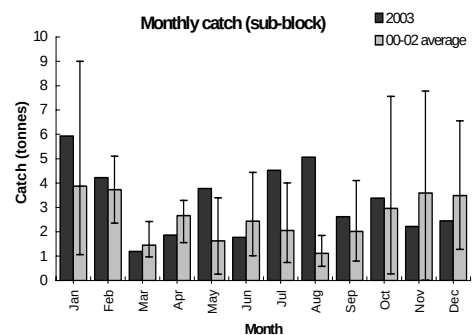
12D (Cox's Bluff to Prion Beach)



13A (Prion Beach to South Cape)



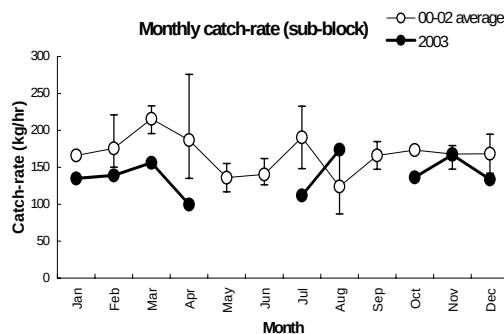
13B (South Cape to Whale Head)



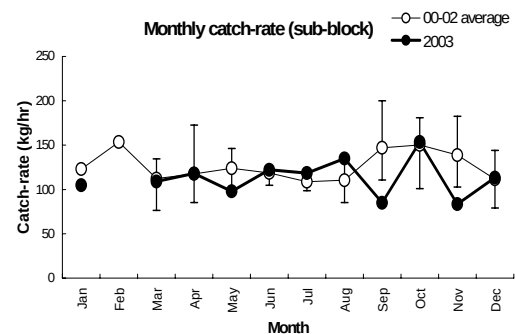
Monthly catch rates:

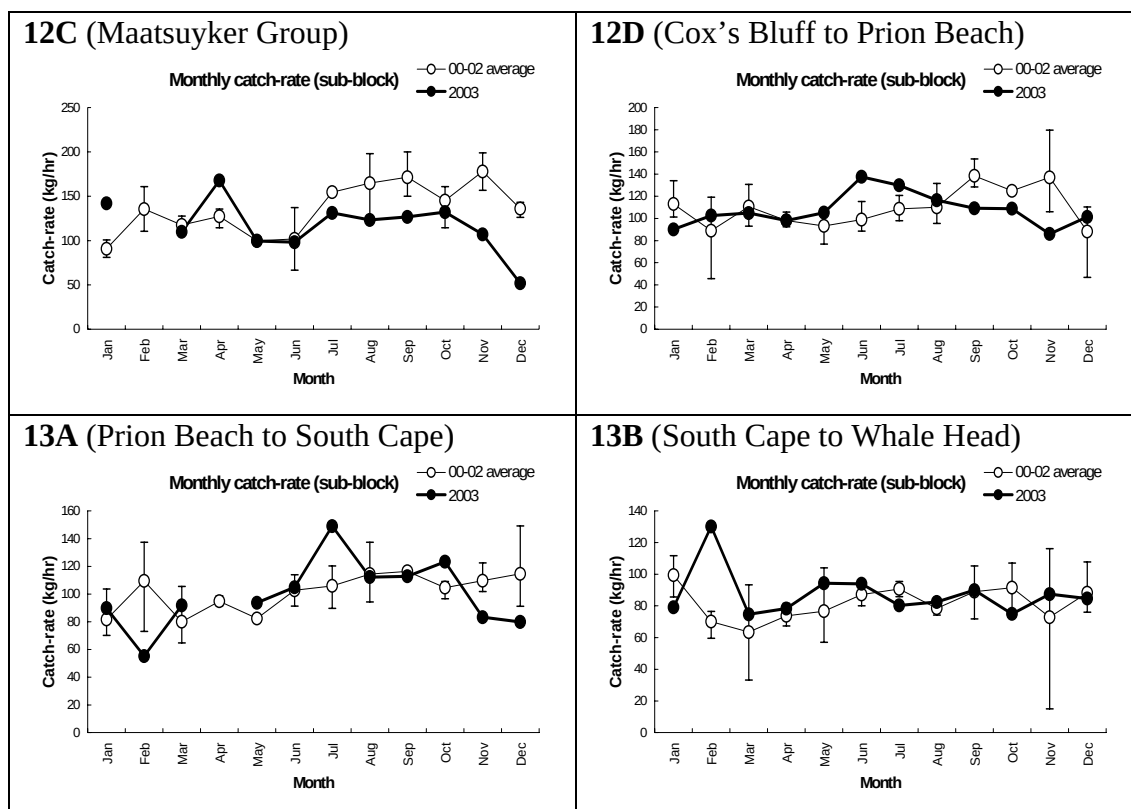
With few exceptions, catch rates were consistent throughout the year. The catch rate variation in February in 13A and 13B, and December in 12C, was due fishing practises of a few individual divers.

12A (Faults Bay to South West Cape)



12B (South West Cape to Cox 's Bluff)





Size composition of the commercial catch:

While significant differences in GMS between samples collected in 2003 and previous years were detected, they appear to be random and followed no obvious pattern. Because most sampling was from catches processed at canneries where abalone larger than 160 mm were accepted, no reduction in GMS due to imposition of an upper size-limit could be detected.

Northern Zone Blacklip Fishery – major fishing blocks

In the Northern Zone, there were considerable variations in catch between 2002 and 2003, particularly in the North West (Blocks 5 and 49) and King Island (Blocks 3 and 1) (Figure 4). In the North East, there was a large fall in catch in Block 31.

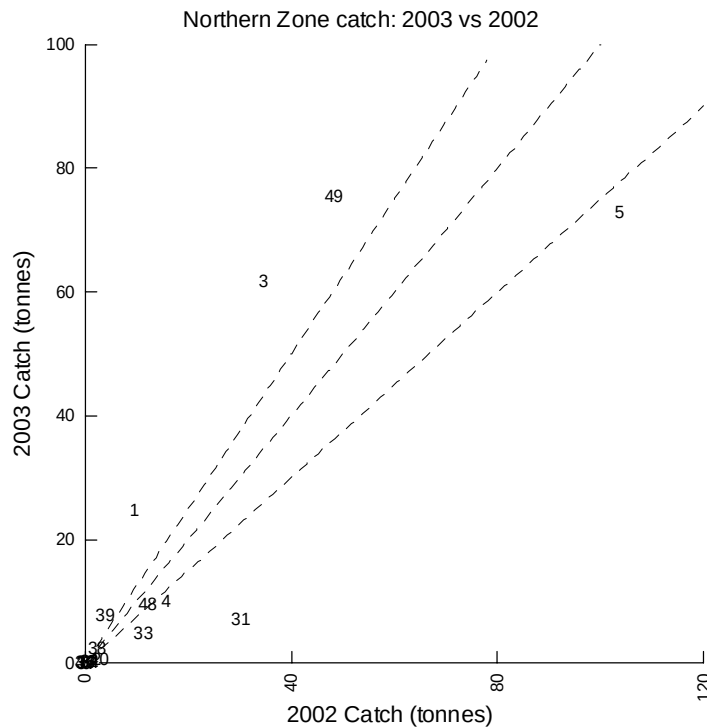
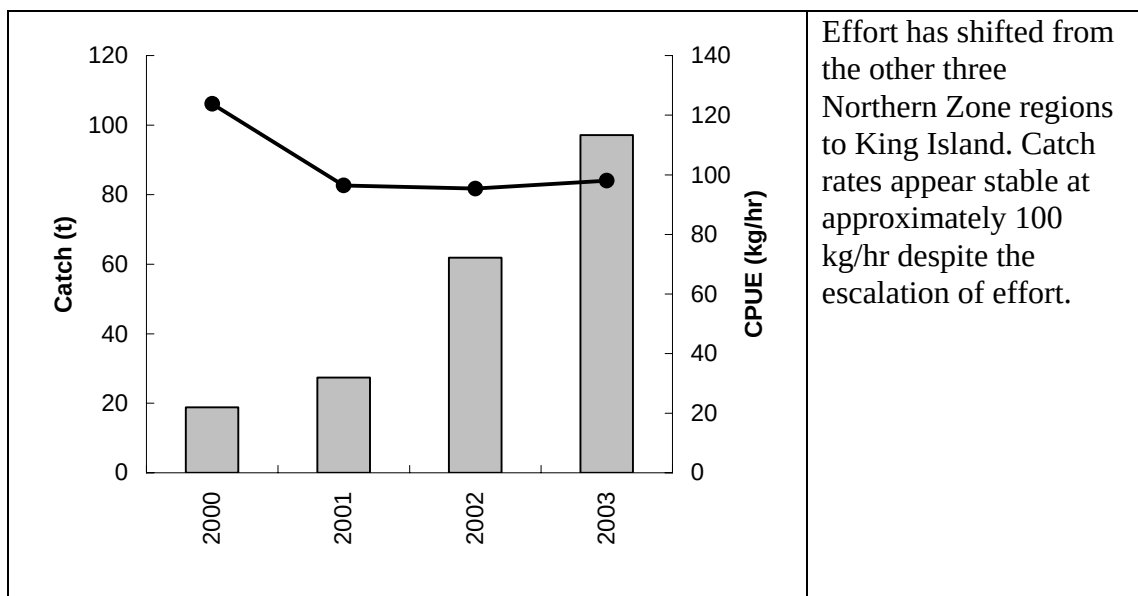
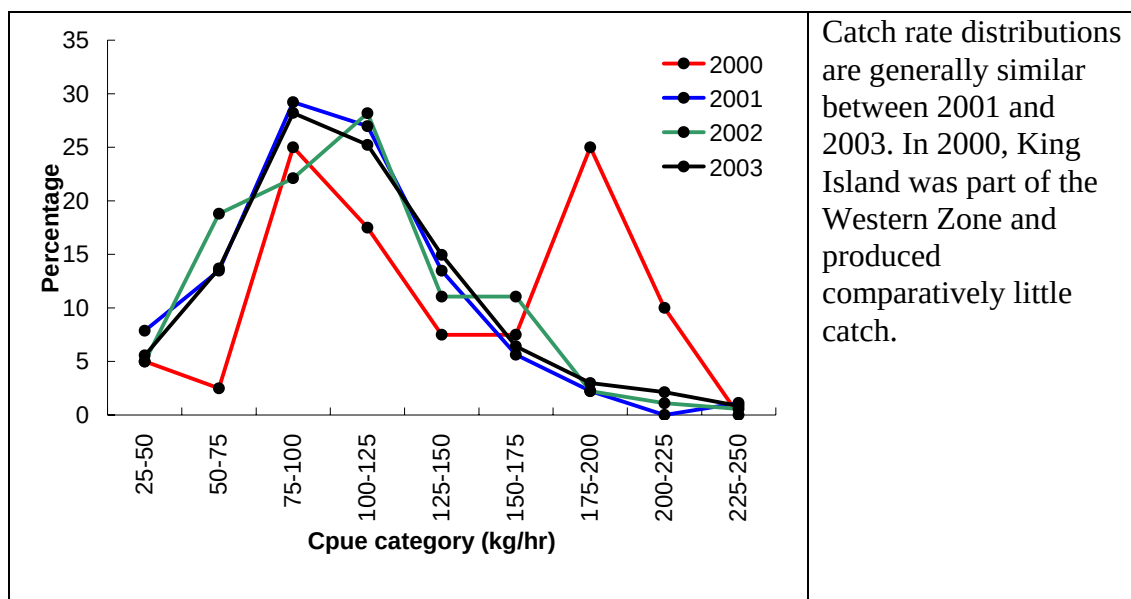


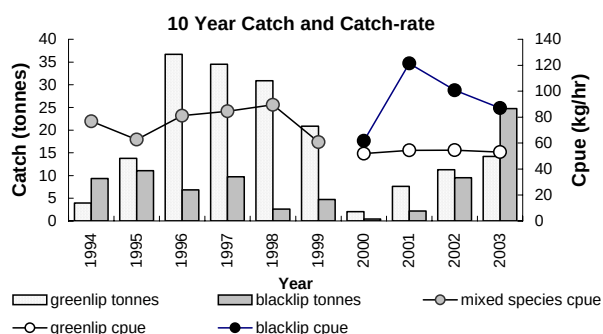
Figure 4. Blacklip catch from the Northern Zone (Blocks 1 to 5, part of sub-block 31B and Blocks 32 to 49). In 2003, the Northern Zone TAC (280 tonnes) was unchanged from the previous year. Blocks to the left of the diagonal line reflect increased catches over 2002 levels, blocks to the right reflect falling catches.

Northern Zone-King Island (Blocks 1-4)



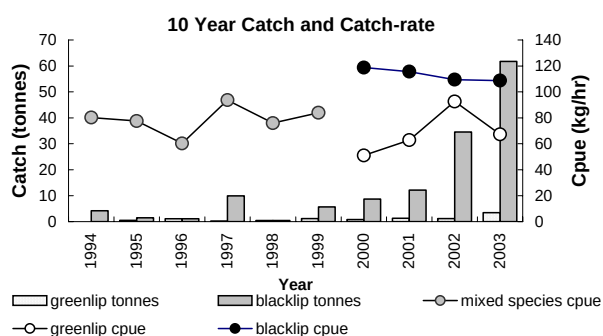


Block 1 (north-west King Island)

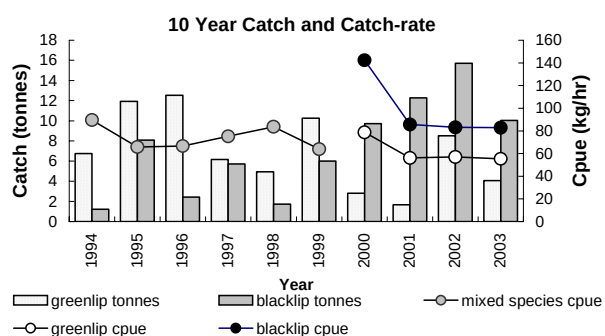


The level of catch taken from this area in 2003 was the highest for many years. It was caught mostly by visiting divers on motherships. Catch rates have not recovered to previous high levels.

Block 3 (south-west King Island)



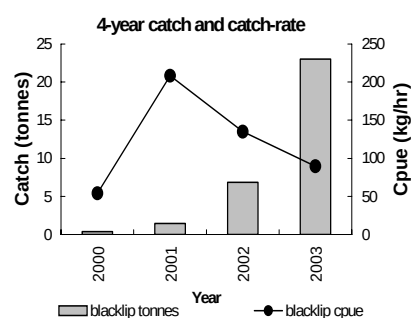
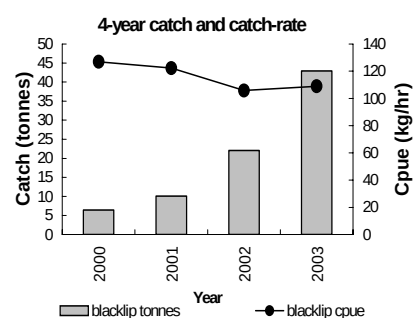
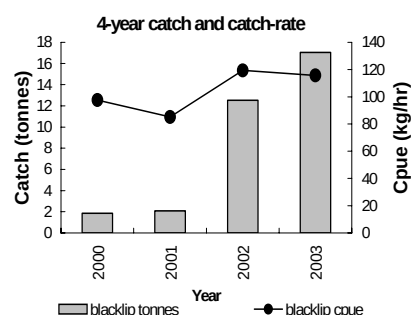
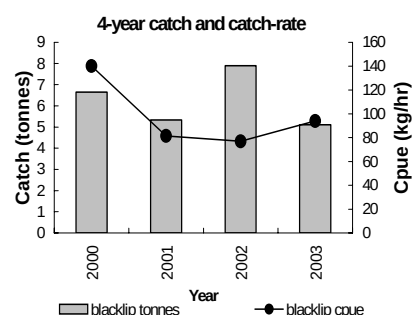
Catch increased rapidly, catch rates declined slowly. This block is the most productive blacklip area on King Island.

Block 4 (south-east King Island)

Despite minor fluctuation in level of catch, catch rates are stable. The block was fished mostly by resident divers.

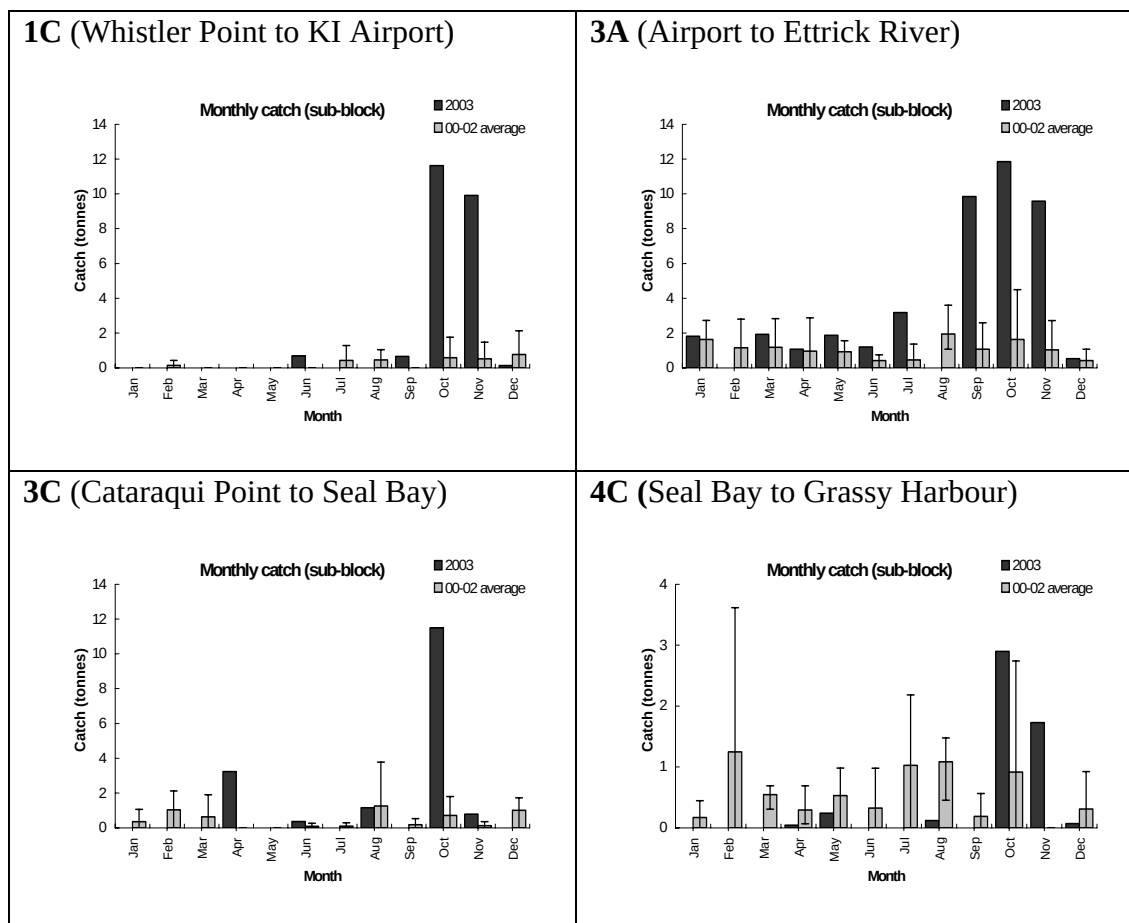
Sub-block catch and catch rates:

Sub-blocks 1C, 3A and 3C show greatly increased levels of catch. 1C was fished mostly by visiting divers in motherships, and catch rates fell after three months of intensive fishing.

1C (Whistler Point to KI Airport)**3A (Airport to Ettrick River)****3C (Cataraqui Point to Seal Bay)****4C (Seal Bay to Grassy Harbour)**

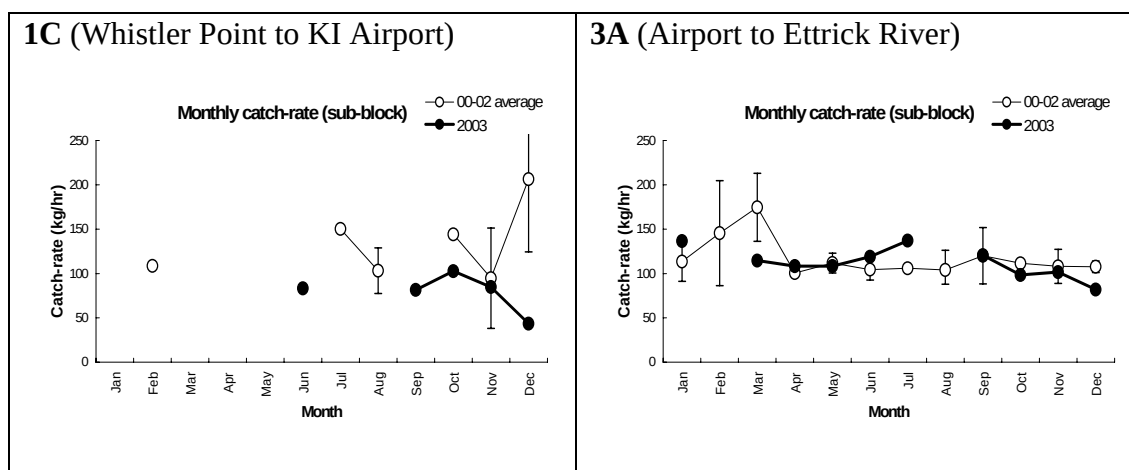
Monthly catch:

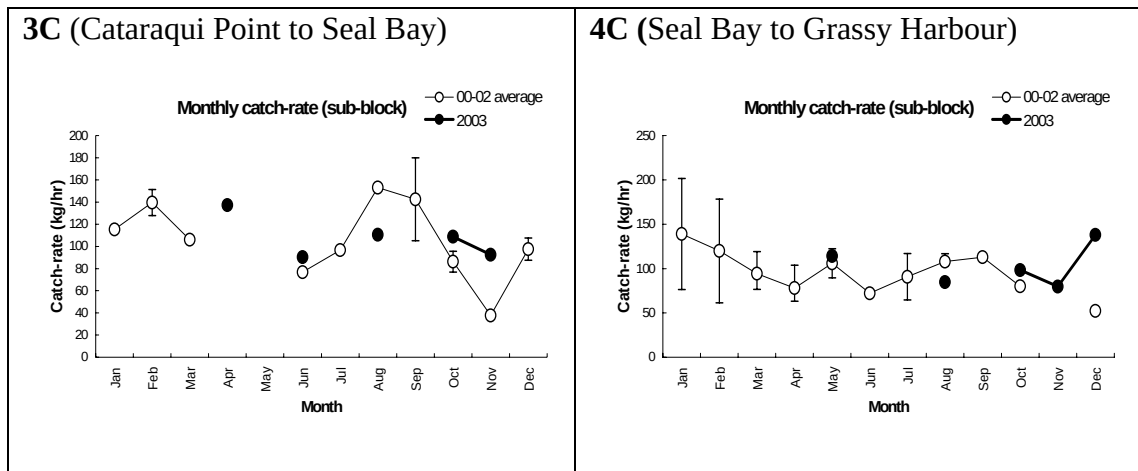
Prior to the end of September, King Island was fished mostly by resident divers, working mostly in 3A and 4C. Motherships visited the island between late September and November.



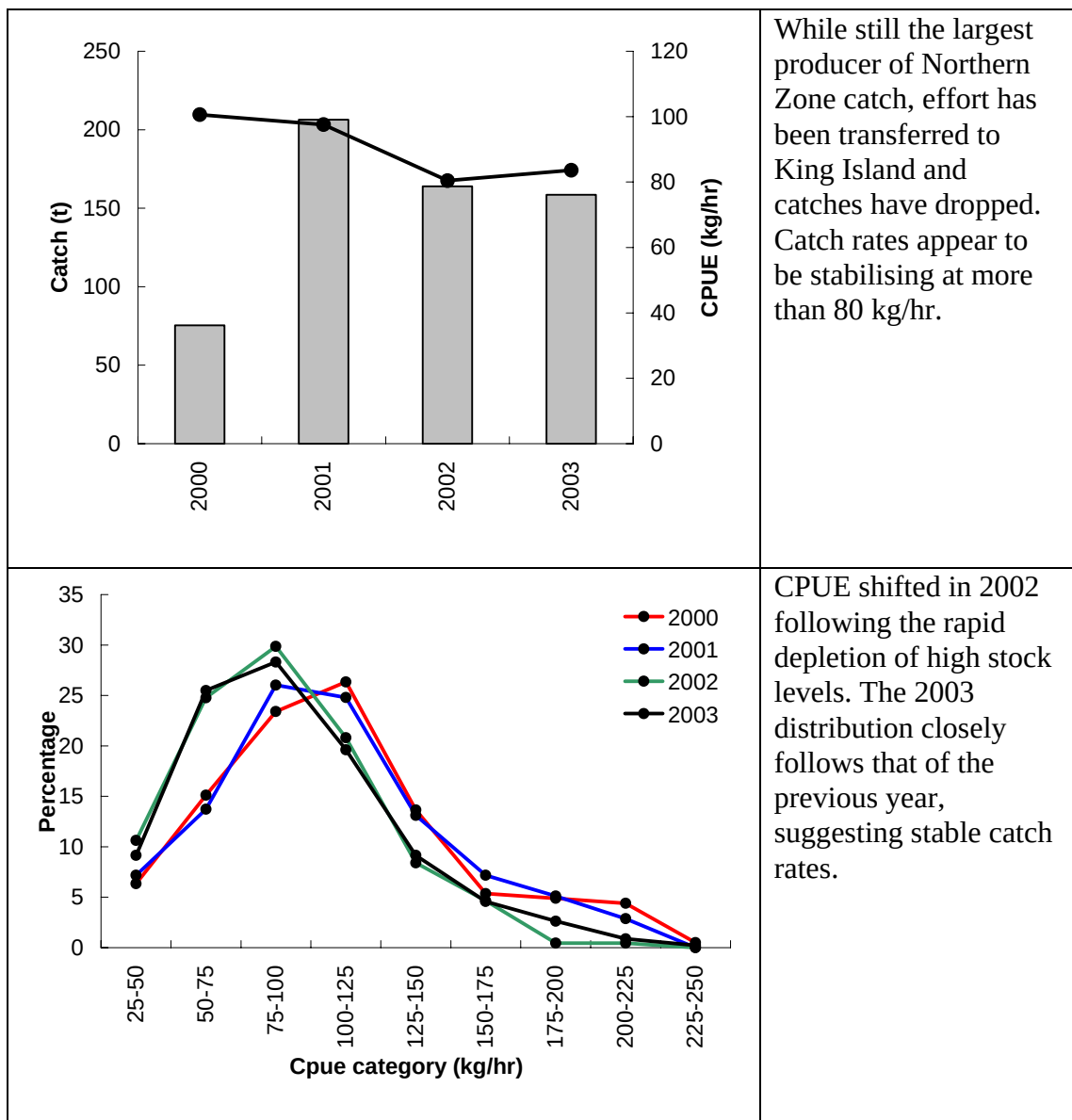
Monthly catch rates:

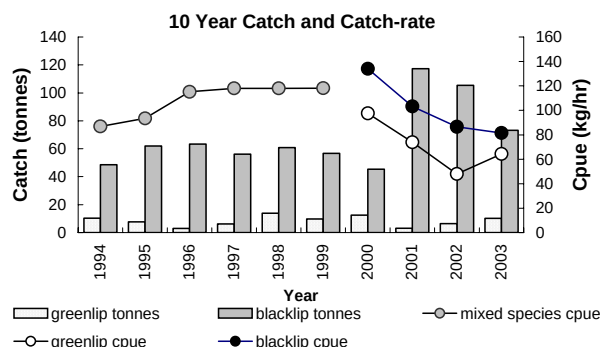
In 1C, catch rates fell quickly and failed to recover after high levels of fishing in October and November. This effect of fishing was less in 3A and 3C. Before September, most of the catch was landed by resident divers.



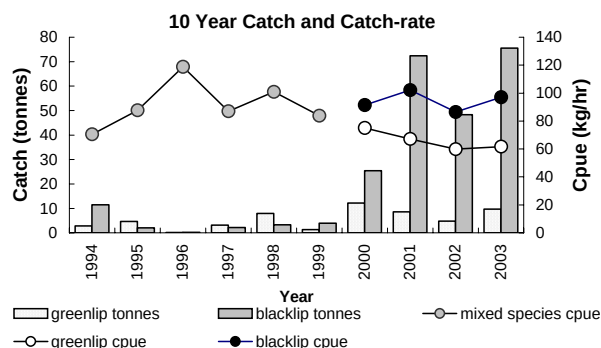


Northern Zone-North West (Blocks 47 – 49, Sub-blocks 5A, 5B, 5C)

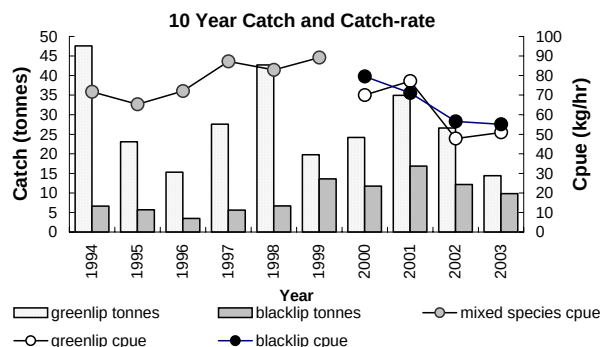


Block 5 (South Arthur Beach to Woolnorth Point)

In 2002, the level of annual blacklip catch in this block was capped at 100 t, but since then, catches have not reached this level. Better catch rates elsewhere have encouraged some divers to leave Block 5.

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

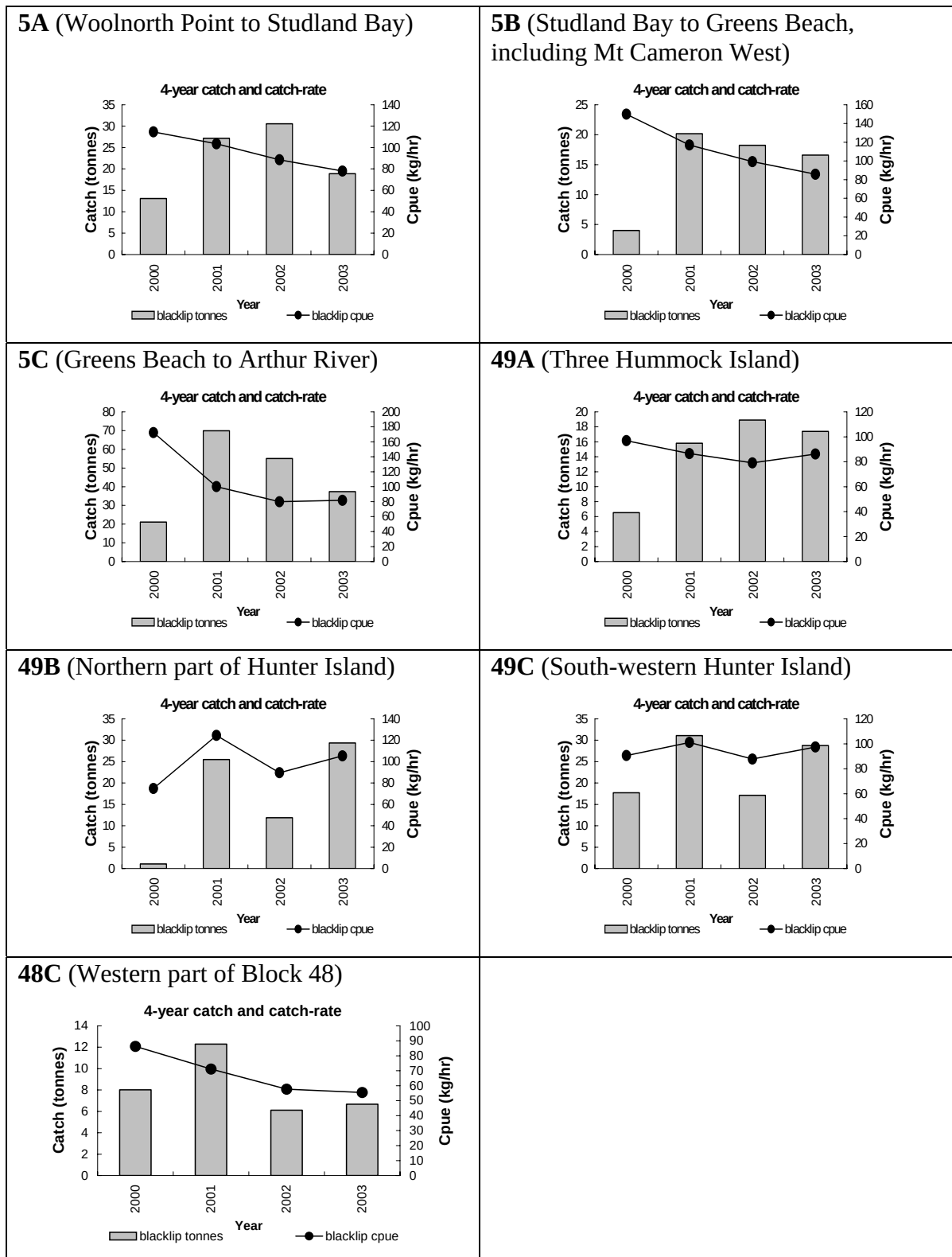
Effort was transferred here from Block 5. The more remote parts are infrequently fished, and divers are able to achieve very high catch rates. The areas closer to Woolnorth Point are now heavily exploited.

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

Much of the blacklip catch here is caught by divers targeting greenlip. The increased minimum legal size for greenlip in the North West has affected catch rates here, and divers have moved elsewhere, thus reducing the blacklip catch.

Sub-block catch and catch rates:

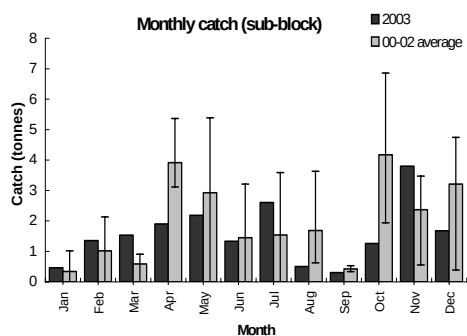
Catch and catch rates in the Block 5 sub-blocks have fallen at a steady rate since the development of the Northern Zone and subsequent rapid transfer of effort there. Catch rates in 5C appear to have stabilised at 80 kg/hr. In 49B, catch and catch rates have increased following diversion of effort to lightly fished areas, although catch and catch rates have also increased in the more heavily exploited 49A and 49C. Catch rates appear to have stabilised at 55 kg/hr in 48C.



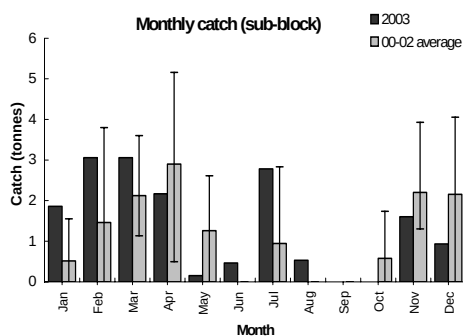
Monthly catch:

The more remote areas (49A, 49B) show infrequent but high monthly catches. These areas are occasionally visited by motherships with groups of divers taking large catches at infrequent intervals. The areas closer to the boat ramps (5A, 49C) were more regularly fished.

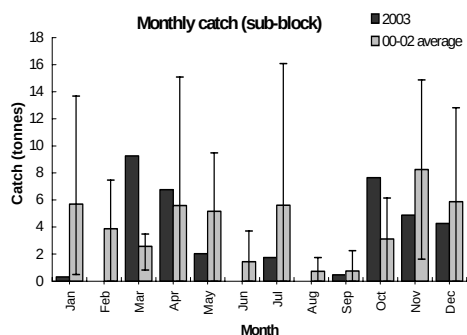
5A (Woolnorth Point to Studland Bay)



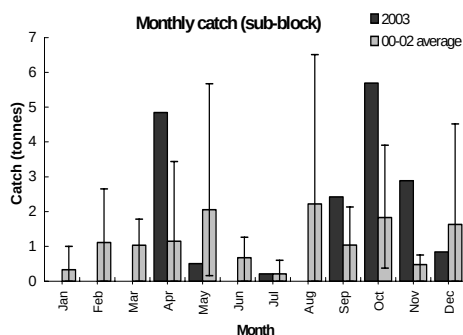
5B (Studland Bay to Greens Beach, including Mt Cameron West)



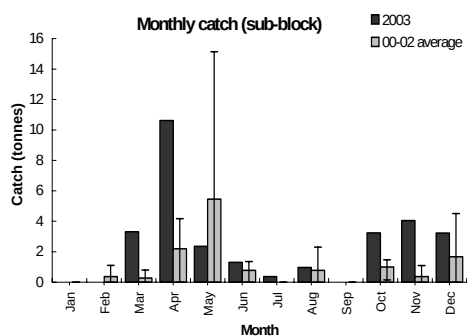
5C (Greens Beach to Arthur River)



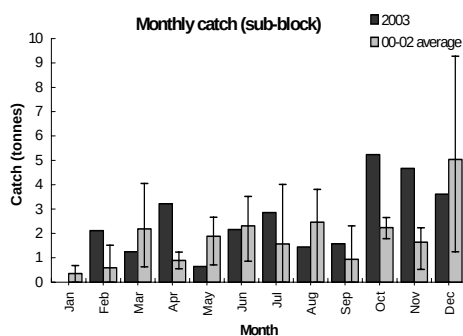
49A (Three Hummock Island)



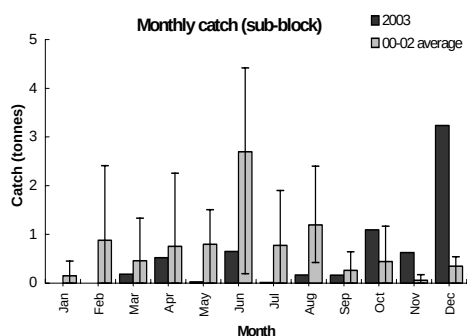
49B (Northern part of Hunter Island)



49C (South-western Hunter Island)

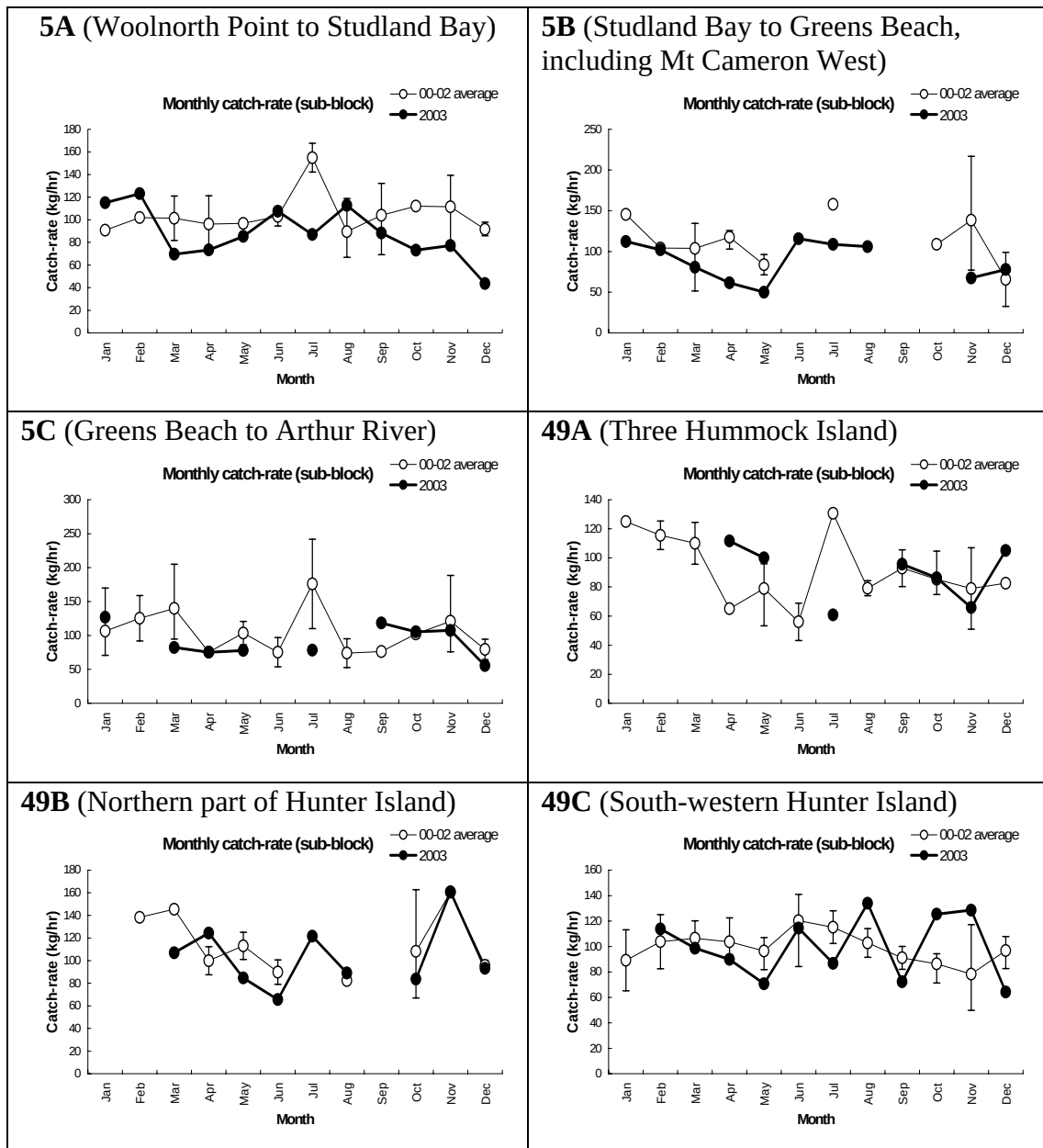


48C (Western part of Block 48)

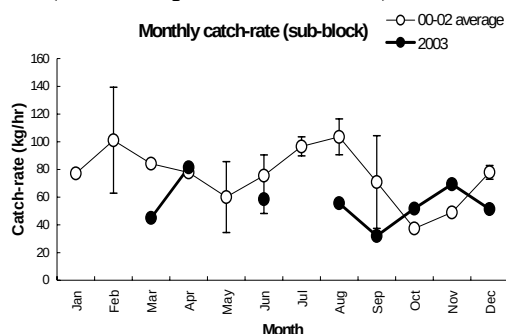


Monthly catch rates:

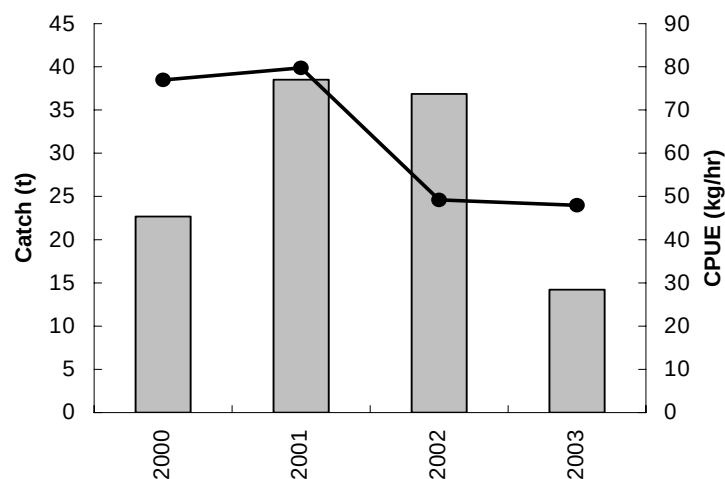
In most areas, between-month variation in catch rates is high, indicating irregular fishing mortality on reefs. This suggests that divers are able to achieve high catch rates when they find reefs that are fished intermittently. Low December catch rates probably reflect the activities of divers finishing off Northern blacklip quota at the end of the year whilst also catching greenlip.



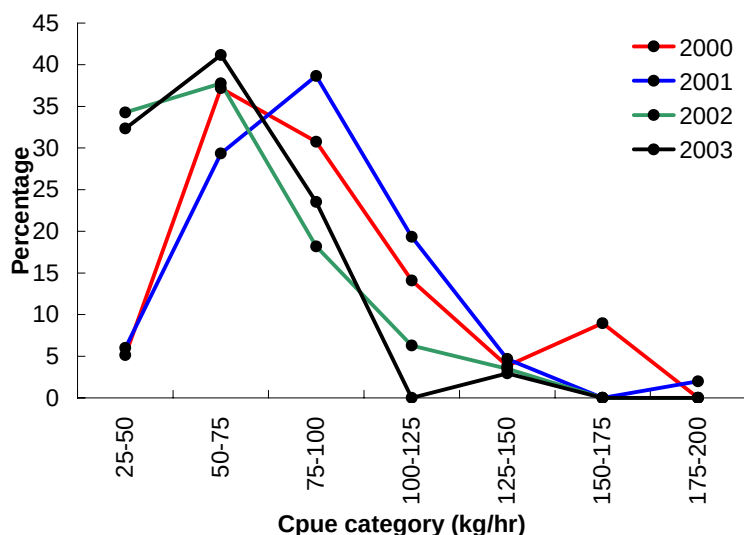
48C (Western part of Block 48)



Northern Zone-North East (Blocks 39, 40, Sub-block 31B)



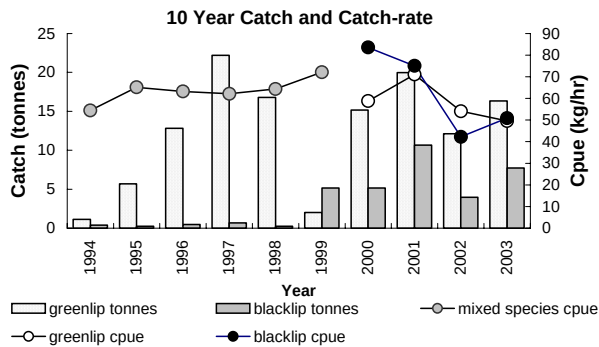
The 2003 catch has now fallen to low levels. Abalone from the North East do not fit the requirements of the live market. This coast does not support the level of catch that it did prior to 1987 when the size limit was 127 mm. Catch rates fell sharply in 2002 and have not recovered.



The high proportion of catch in the 20-40 kg/hr category for 2002-2003 reflects the reporting anomalies associated with fishing for both greenlip and blacklip on the same trip.

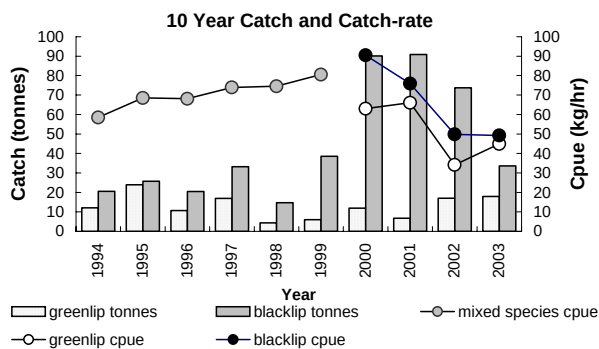
The 2003 CPUE distribution is generally similar to that of the previous year, with some reduction in higher catch rate classes.

Block 39 (Tomahawk to Little Musselroe)



Fishing occurs at irregular intervals and fluctuating annual catch rates probably reflect movement of divers to more productive reefs rather than a resurgence of stock levels.

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

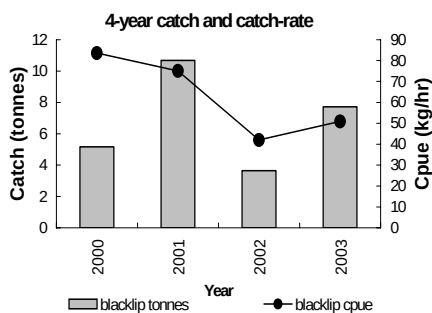


Only 7 t of the 2003 catch from this block was taken in the Northern Zone (the remainder was Eastern Zone).

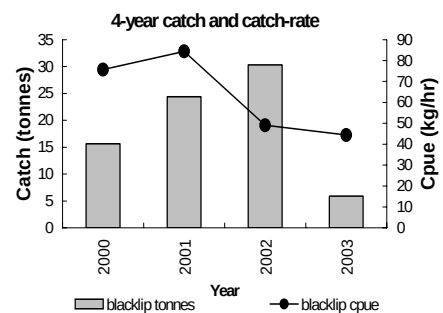
Sub-block catch and catch rates:

Small catch and low, fluctuating catch rates reflect the small amount of productive coast in this area.

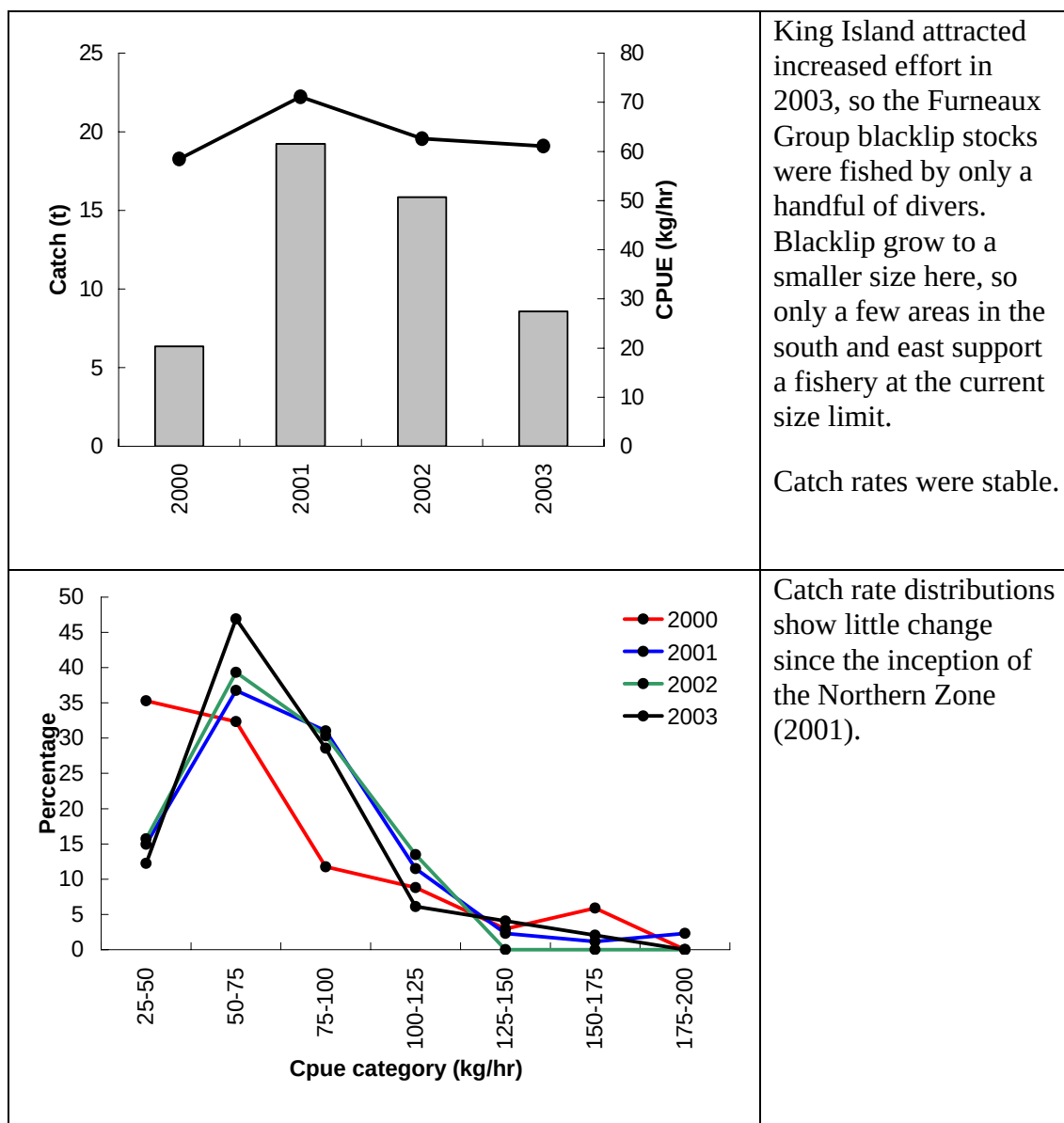
39A (Petal Point to Little Musselroe Bay)



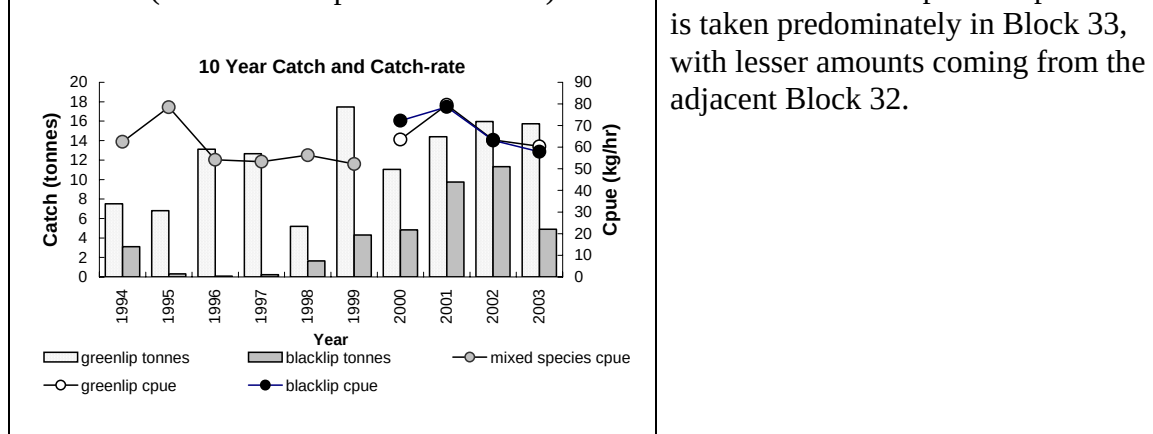
31B (Little Musselroe to Musselroe Bay, including Swan Island)



Northern Zone-Furneaux Group (Blocks 32-38)



Block 33 (south-east Cape Barren Island)



Greenlip Fishery – major fishing blocks

The greenlip catch from Block 48 fell sharply in 2003, which was compensated by increased catches from Blocks 5 and 49. There was a catch overrun in the North East, most of which came from Block 39. The greenlip catch in Blocks 1 and 2 (King Island) increased (Figure 5).

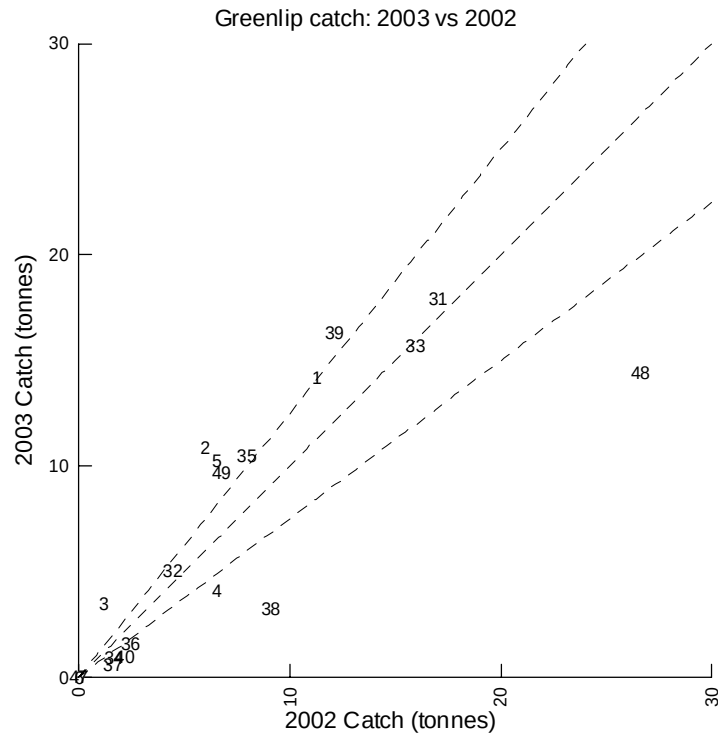
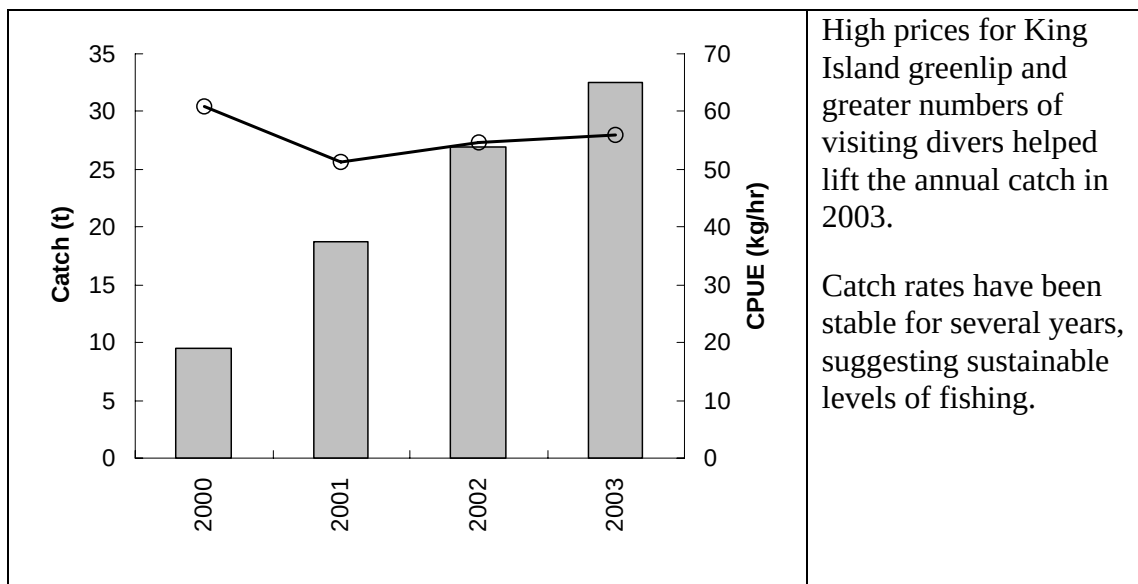
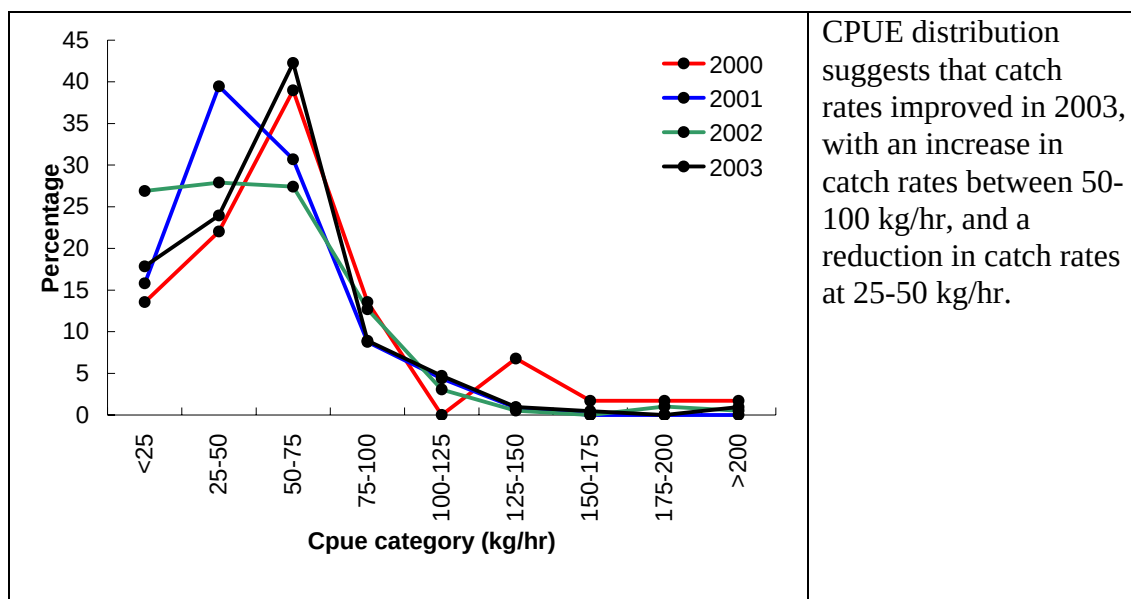


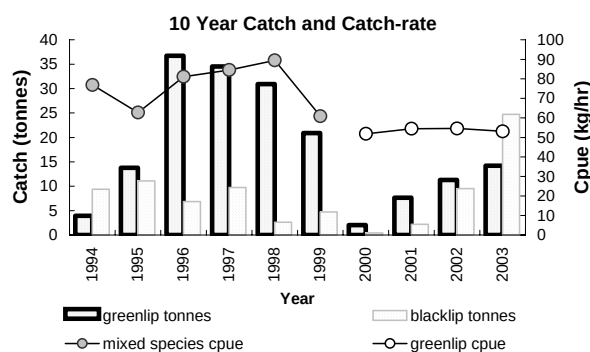
Figure 5. Greenlip catch from Blocks 1 to 49. In 2003, the Greenlip TAC (140 tonnes) was unchanged from the previous year. Blocks to the left of the diagonal line reflect increased catches over 2002 levels, blocks to the right reflect falling catches.

Greenlip-King Island (Blocks 1-4)



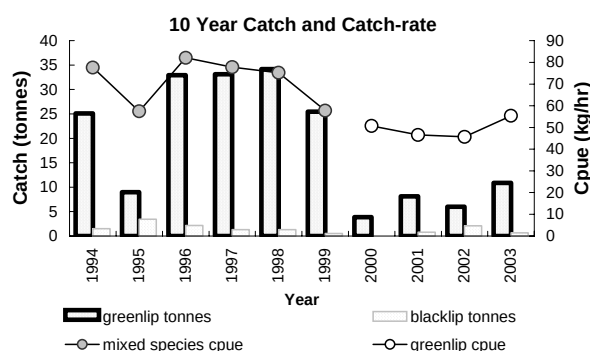


Block 1 (north west King Island)



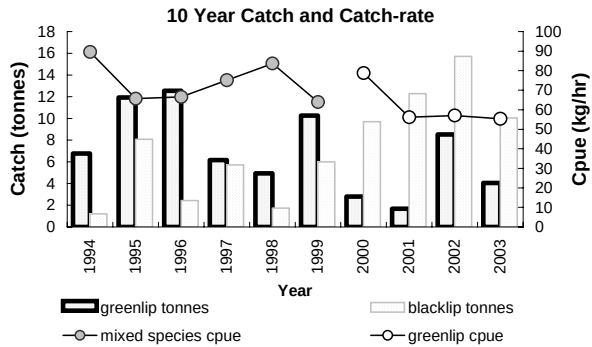
Catch has increased, though is much lower than during late 1990's, when large tonnages were taken at the 132-mm size limit.

Block 2 (north east King Island)



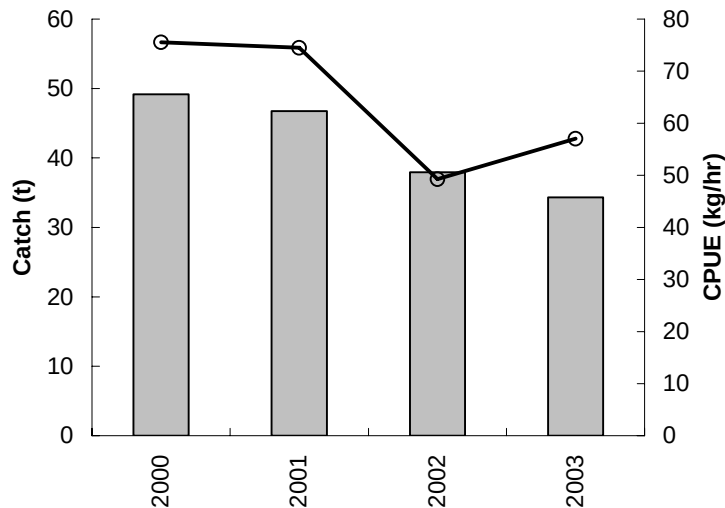
Increased catch, catch rate.

Block 4 (south east King Island)



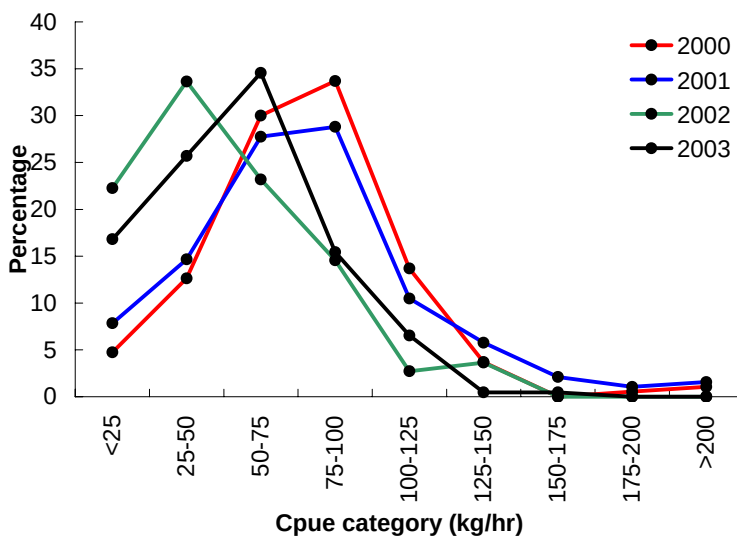
Fluctuating levels of catch, stable but low catch rates.

Greenlip-North West (Blocks 47-49, 5)

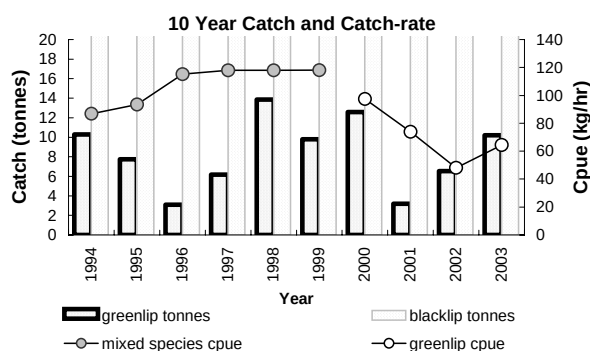


The annual catch was less than the 40-t cap, divers preferring to fish elsewhere.

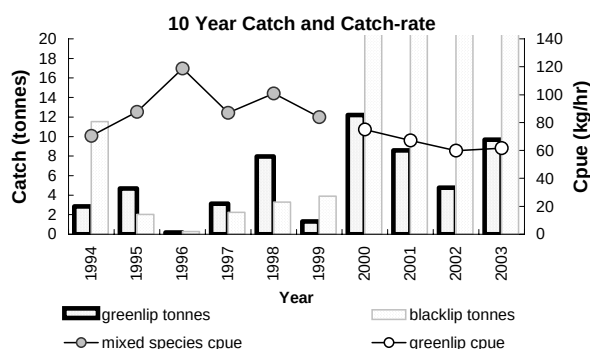
Regional catch rates rose, but probably not due to improved stock levels. Effort was redirected from Black Reef, where catch rates were low, to the western part of the region.



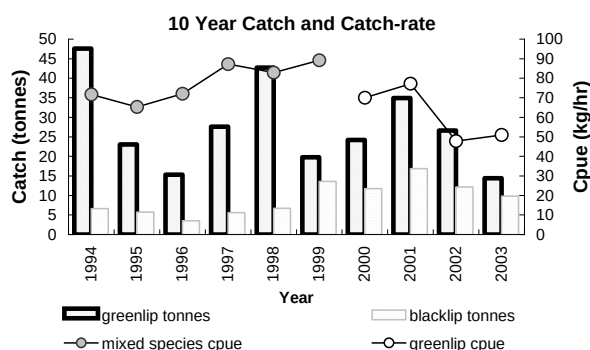
CPUE distribution shows some improvement from 2002, with a reduction in the number of low (<50 kg/hr) catch rates.

Block 5 (west of Woolnorth Point)

Catch and catch rates improved in this area. The 2003 annual catch (10 t) was greater than the long-term average (8 t), despite overall reduced catches from the region.

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

Catch rates appear stable, while the level of catch (10 t) is twice the long term average (5 t), suggesting transfer of effort from Block 48.

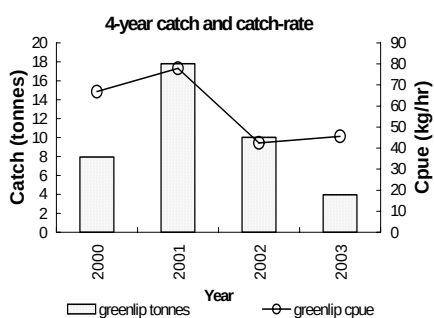
Block 48 (Woolnorth Point to Duck River, including Black Reef)

The 2003 catch (14 t) in this region was about half average levels (25 t). 2003 catch rates (51 kg/hr) were marginally improved over 2002 (48 kg/hr), but both years were much lower than previous levels (65-89 kg/hr).

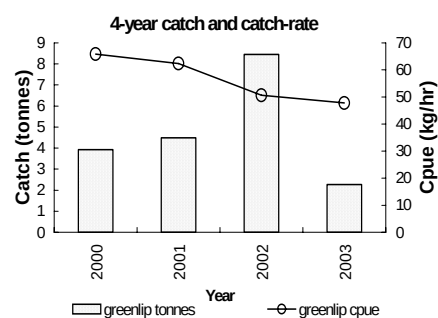
Sub-block catch and catch rate:

The minimum legal size for greenlip in the North West was increased from 140 to 145 mm in 2002. Since then, divers have reported that they are unable to fish 48A (Black Reef), which historically is the area where the majority of the Block 48 catch was taken. They report that most abalone are now too small, and that they do not grow to the new legal size. In 2002, divers moved further north to 48B where there were stocks of larger abalone, but these were rapidly depleted. 48C was fished intensively in 2001, coinciding with the opening of the Northern Zone and the rapid transfer of effort to the North West of the state. Since then, catch rates have fallen sharply suggesting that levels of fishing mortality were too high.

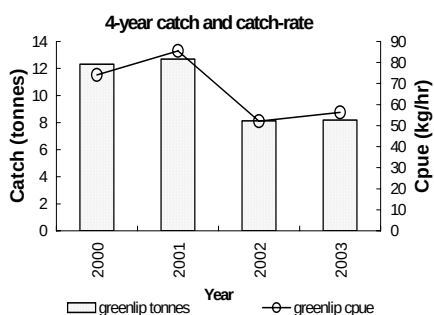
48A (Black Reef)



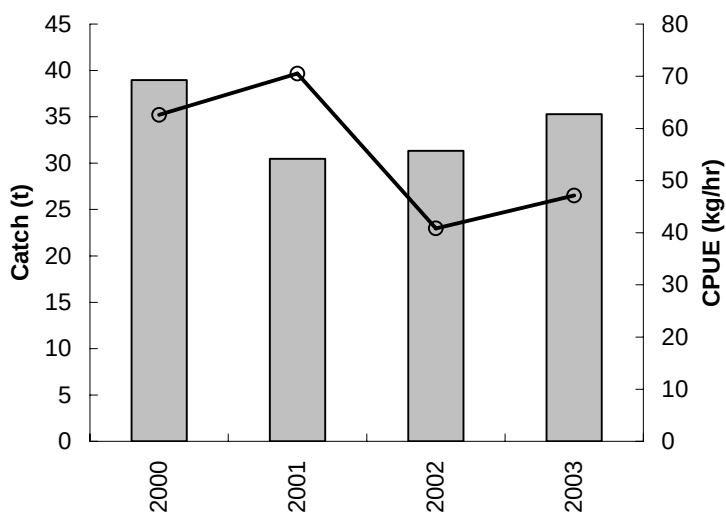
48B (Petrels, Big Stony)



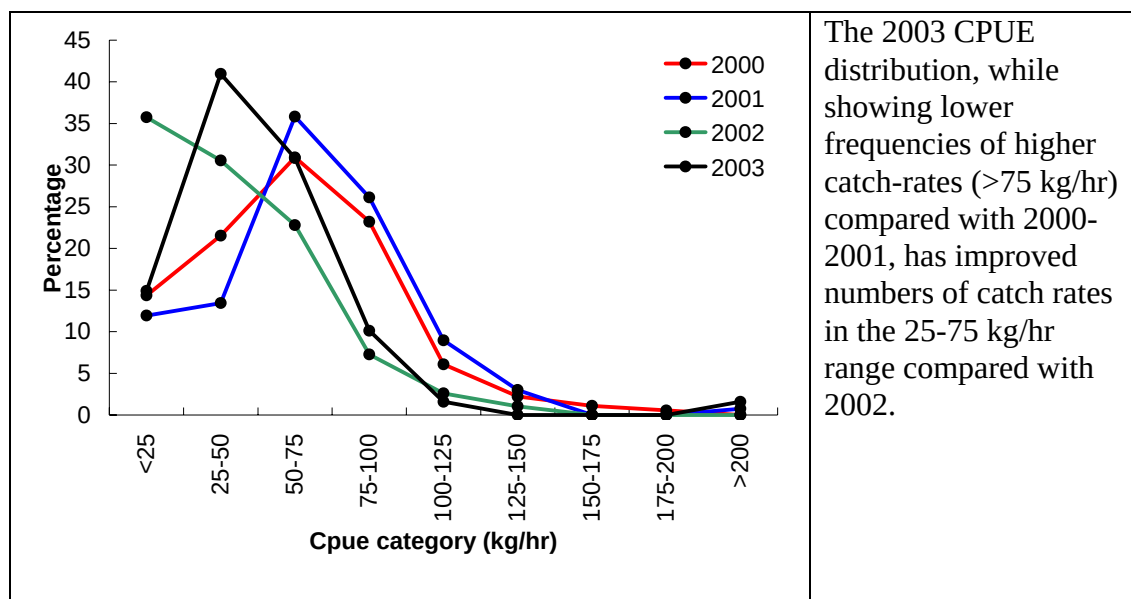
48C (East of Woolnorth Point, east of Hunter Island)



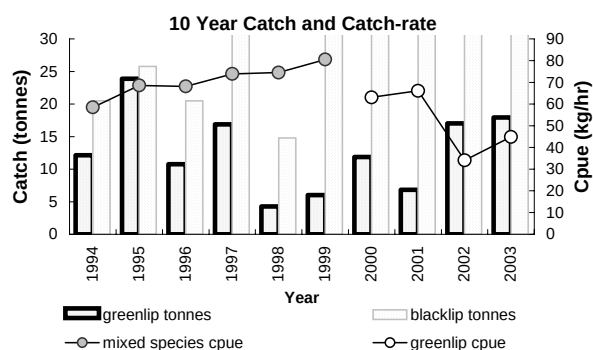
Greenlip-North East (Blocks 31, 39, 40)



The 2003 catch was 5 t greater than the limit imposed by fishery managers. Catch rates, although slightly improved over the previous year, remain low.

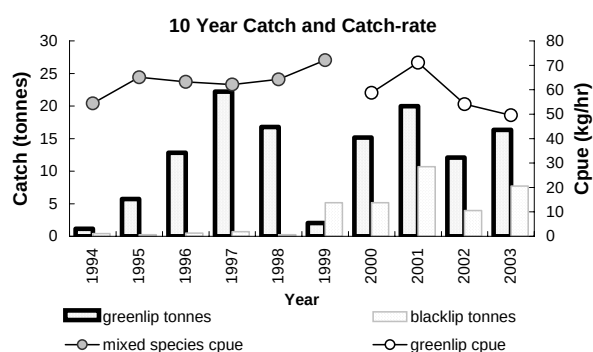


Block 31 (Little Musselroe to Cape Naturaliste)



2003 catch rates, while improved, remained at low levels. Divers reported that greenlip stocks at Swan Island were depleted.

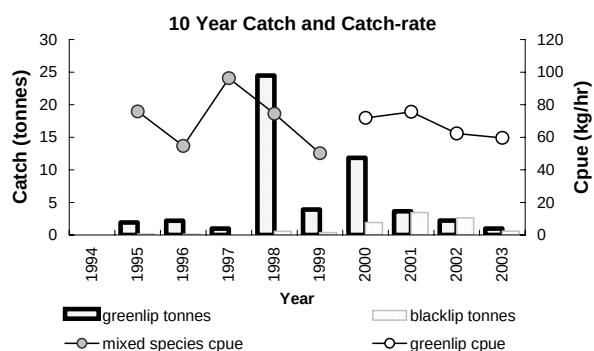
Block 39 (Little Musselroe to Tomahawk)



The annual catch from this block in recent years has been at much greater levels than the long term average (8 t). Catch rates are now falling.

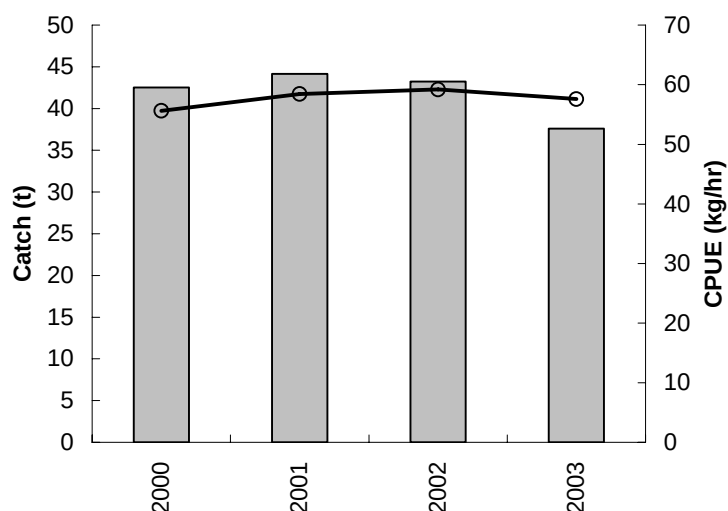
In 2002, divers reported that inshore reefs were depleted, and that they had resorted to fishing offshore in tide affected waters. They now report that these reefs are also depleted.

Block 40 (Tomahawk to Waterhouse Beach)

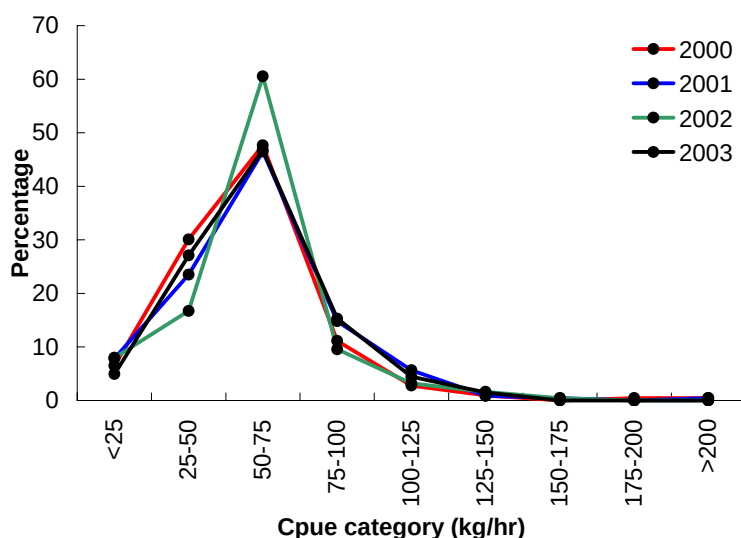


Reefs in this block have failed to produce any significant quantity of greenlip since 2000, despite efforts by local divers who have searched the area.

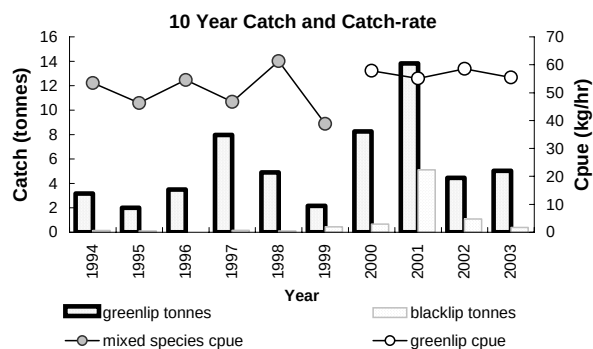
Greenlip-Furieux Group (Blocks 32-38)



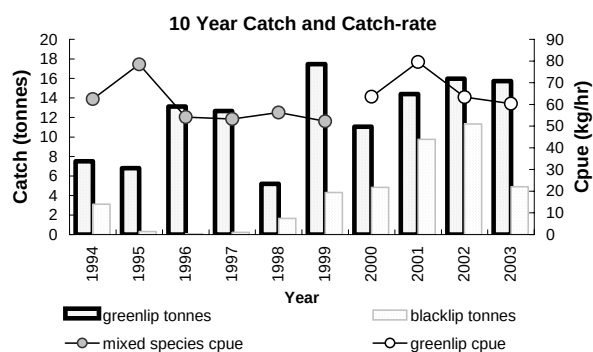
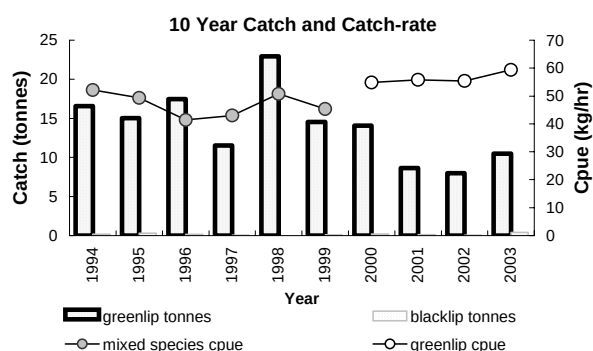
The annual catch failed to reach the regional cap in 2003 as effort shifted to King Island. Catch rates remained stable.



The CPUE distribution remains essentially unchanged from previous years.

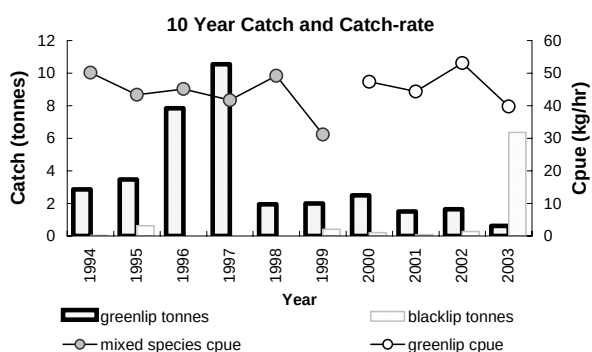
Block 32 (south Cape Barren Island, Armstrong Channel)

The southern part of the Furneaux Group (Blocks 32 and 33) is fished by divers operating from North East Tasmania, as well as resident divers. The level of catch is largely dependent on the amount of quota that these divers are able to obtain, and is not necessarily indicative of falling stock levels.

Block 33 (south east Clarke, Cape Barren Islands)**Block 35 (Franklin Sound)**

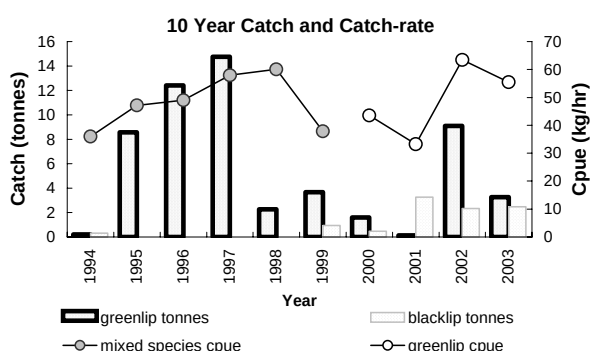
Franklin Sound is fished mostly by resident divers. The annual catch has been capped at 20 t, and the fishing season limited to 6 months between April and September in recent years. The 20 t cap has not been reached since 1998. Catch rates are stable.

Block 37 (north west Flinders Island)



The northern parts of the Furneaux Group (Blocks 37 and 38) are infrequently fished, and then mostly by resident divers. Stocks are sparsely distributed and found mostly in deeper water than in the south of the Furneaux Group.

Block 38 (north east Flinders Island)



4. Assessment of the Tasmanian abalone fishery

Eastern Zone

During 2002 and 2003, the Eastern Zone TAC was 857.5 t, with the majority of the catch coming from the southeast (Actaeons, Bruny and Storm Bay) parts of the Eastern Zone. The distribution of catch at the regional level was remarkably consistent between 2002 and 2003, particularly from the Actaeons and Bruny Island. In 2003, more than one third of the Eastern Zone catch came from the Actaeons. There was some transfer of effort and associated catch from the East Coast to Storm Bay during the period (Figure 6).

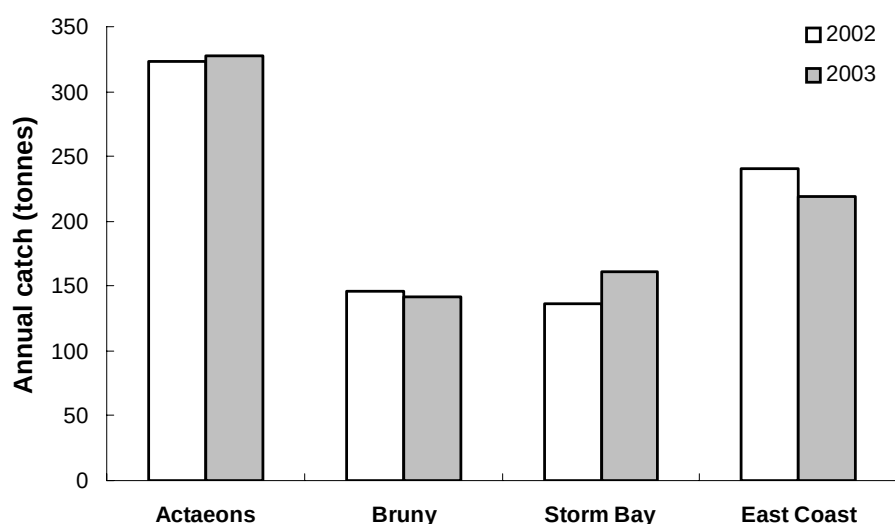


Figure 6. Comparison of the distribution of regional catch (tonnes) between 2002 and 2003.

Most (80 %) of the catch from the Eastern Zone is taken during the cooler months of the year (April-November) when catch rates are highest (Figure 7). Catches taken in summer are usually at relatively low catch rates, which discourages fishing unless there are compensatory factors (e.g. high beach prices immediately prior to the Chinese New Year). The best period to compare catch rates between years is therefore during winter or spring, when the greater levels of catch also help reduce between-diver effects that mask trends indicative of changes in relative abundance.

It has been reported that during December 2003 in particular, divers fished the South Coast (Western Zone) and landed catch as Eastern Zone catch. It has also been suggested that the level of this illicit reporting was sufficiently great that catch rates in Blocks 13 and 14 appeared to increase. While comparison of catch and catch rates between years from the sub-blocks within the Eastern Zone shows that unusually large catches were taken from 13C, 14D, 14E, 21A and 21C in December 2003, catch rates were within the range reported previously. Consequently the degree to which false reporting of catch has affected catch rate trends in the Eastern Zone remains unknown.

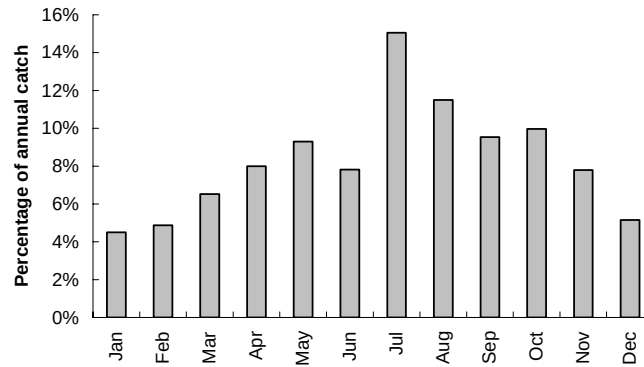


Figure 7. Eastern Zone catch by month, as a percentage of the annual catch, 1994-2003.

Actaeons

Within the Actaeons, 2003 catch and catch rates were generally better than in the previous year and the downward trend in catch rates of recent years has eased, with a small increase (<5 kg/hr) in catch rates to a geometric mean rate of 52 kg/hr. While the frequency distribution of CPUE shows overall that fewer catches have been taken at more than 60 kg/hr since 2000, between 2002 and 2003 there was a small reduction in the proportion of low catch rates (20-40 kg/hr), with a corresponding small increase in the 40-60 and 60-80 kg/hr categories.

In recent years, catches from sub-blocks 13D and 13E have comprised progressively greater numbers of smaller abalone (Figure 8). The geometric mean size (GMS) of samples from the commercial catch fell between 1998 and 2001, but increased in 2002 when the size limit was increased by 4 mm.

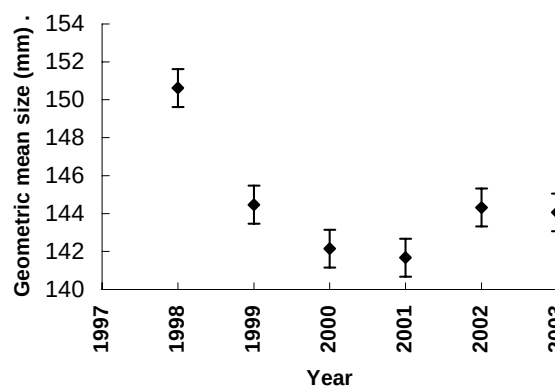


Figure 8. Geometric mean size of abalone from samples of the commercial catch landed from sub-block 13E. Error bars show 95% confidence intervals about the mean.

In conjunction with the catch size-composition data, growth rates derived from tagging studies at the Actaeons suggest that approximately 70% of the catch is taken within one year of attaining legal size (Tarbath, 2003). The larger and older abalone are extensively depleted, and the fishery has become dependent upon an annual crop of recruits. The management rule of setting the legal minimum length so that abalone are able to breed for two years before recruiting to the fishery was developed while the stocks were in a much healthier state, and when each year there was a significant

residual biomass of larger animals remaining on the reefs. The consequences of the reduced residual biomass include:

- reduction of levels of egg-production / larval recruitment,
- reliance upon fewer year classes for egg production, i.e. the consequences of a year class failing to contribute its share of eggs is more profound than if the responsibility for egg-production was spread over many year-classes,
- reduced catch-rates / interruptions to supply when the recruits become depleted,
- greater number of abalone must be caught to achieve the same weight than in previous years.

The same tagging studies also showed that abalone growth rates were affected by seasonal variation in temperature i.e. they grew fastest during periods of highest water temperatures (January - April) with the slowest growth corresponding with the coolest water temperatures (August – October). It appears that pre-recruits to the Actaeons fishery grow rapidly during the warmest part of the year when they reach legal size, and that their subsequent entry to the fishery contributes to the higher winter catch rates (Tarbath, 2003). The numbers of recruits are steadily depleted throughout winter and early spring, when catch rates fall. Catch samples from this period in past years have shown an increase in the frequency of small abalone in late spring/early summer catches, consistent with early recruitment of some of the larger pre-recruits.

In December 2003, some divers reported unusually low catch-rates at the Actaeons (~25kg/hr). This coincided with an unusually prolonged period of low water temperatures, which continued into December. It is likely that increased seasonal growth rates associated with increased water temperatures were delayed by the cooler water, with a consequent shortfall in recruits to sustain the fishery in early summer. It is noted that Actaeons catch rates in March and April 2004 were similar to those of the previous year, which indicates that the smaller abalone eventually recruited. Other parts of the Actaeons (except 13C) show similar trends.

Since 2000 (no catch data for sub-blocks exist prior to this), more than half the Actaeons annual catch has come from sub-block 13E: this year approximately 180 t was landed. Catch fell sharply in 13D, and probably contributed to the increased catch-rates there. In all other sub-blocks except 13C, the downward trend in catch rates has stabilised, with marginally higher (within 5 kg/hr) catch rates in 2003. The more sheltered 14A and 14B were fished intensively in June and September as shown by the unusually large catch from these areas. Divers reported that this was due to bad weather preventing access to less sheltered reefs in other parts of these blocks.

Despite the transfer of effort from the east to the west of the state and recent quota reductions (~ 45% reduction in catch from the area covered by the Eastern Zone since 1998) the combined Block 13 and 14 annual catch (i.e. the area that includes the Actaeons) has remained at high levels, averaging 500 t p.a. since 1994 (Figure 9). This area has received little or no benefit from recent quota reductions, yet displays a degree of resilience not seen in other parts of the fishery.

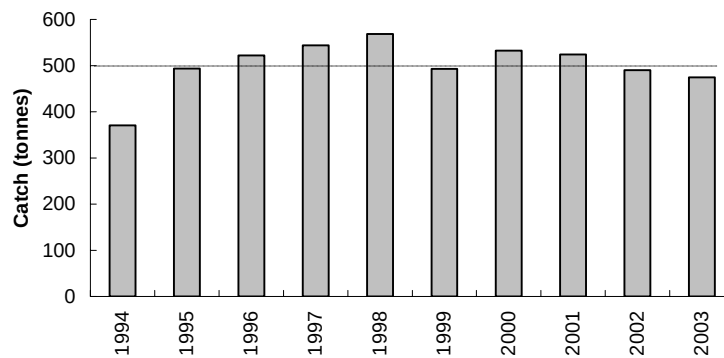


Figure 9. The combined annual catch from the Eastern Zone part of Block 13 and Block 14, 1994-2003. Because the spatial distribution of catches within Block 13 was not reported prior to 2000, the average catch for the period 2000-2003 from the Western Zone part of Block 13 was subtracted from Block 13 catches for earlier years. The 10-year average (501 t) is shown as a horizontal line.

Bruny Island

Like most parts of the Eastern Zone fishery, catch rates from Bruny Island have trended downwards for some years. However while other regions reported small increases in catch rates in 2003, catch rates from Bruny Island continued to fall, albeit at a reduced rate. The frequency distribution of CPUE shows a continual decline in catch rates from the higher categories (80-140 kg/hr) to the 40-60 kg/hr group between 2000 and 2003. At the sub-block level, catch and catch rates were generally lower than previous years, apart from 14C (which produces insignificant amounts of catch for the purposes of this assessment) and 14D, where catch rates had declined to low (< 50 kg/hr) levels in 2001. In this sub-block, while small amounts of catch were taken at better than average catch rates, the lowest monthly catch rates correspond with the months when the greatest amount of catch was landed, suggesting that stock levels are easily depleted. The amount of catch from 14E has fallen to approximately two thirds (52t) of the high 2001 levels. Most importantly, in 14E, catch rates were lower than any of the previous three years in 4 out of 6 months with significant landings. Catch-rates in Block 16 were uniformly low (< 50 kg/hr), with catch rates in only the most remote area (sub-block 16A) above this level.

The size composition of the catch from 16A appears stable between years (i.e. the percentage of larger size classes seems to be relatively constant), whereas the catch from 16B, particularly between June and December 2003 has much greater percentages of smaller abalone than in earlier years, symptomatic of increased levels of depletion.

Storm Bay

Catches from the northern and eastern shores of Storm Bay, and the southern shore of the Tasman Peninsula (Blocks 17-21) have increased since 2001 despite recent quota reductions. Most of this increase occurred in Blocks 20 and 21. It appears that much of the effort formerly applied to the East Coast has been shifted to this region (Figure 6).

Although there was a pronounced decline in frequency of higher catch rates (> 80 kg/hr) in 2001, since then frequency distribution have been remarkably similar,

suggesting consistent fishing patterns. That the annual catch has increased steadily since 2001 suggests stable or increasing stock levels.

Landings of nearly 7 t were reported from 17A (includes Betsey Island) in 2003 whereas landings reported for the three previous years were less than 1 t. The best performing sub-block was 20A, where the catch increased almost threefold over the previous year, with stable to rising catch rates between 50 and 60 kg/hr. Although sharing similar coastal characteristics, the sub-block immediately to the north of 20A (17B) had much lower levels of catch and catch rates. Catch and catch rate trends in 20B suggest the level of catch was too high, whereas 20C appeared resilient to increasing levels of catch. The catch rate declines in both 21A and 21B appear to be slowing or have stopped, with 2003 catch rates similar to those of the previous year.

The monthly distribution of catch varied widely between sub-blocks. 21C produced large catches in the warmer months (particularly January, November and December) at better than average catch rates. There was a decline in landings from 20B in the later part of the year as divers moved north to 20A. Block 21 produced an unusually large amount of catch in December, but overall the 2003 annual catch was less than the previous year and slightly under the long-term average (54 t). Generally, monthly catch rates were remarkably consistent throughout the year, and except for 17B and 20A, showed few indications of the end-of-year stock decline that could be expected from a fishery reliant upon an annual crop.

The number of commercial catch length-frequency samples collected from catches in this region is less than desirable for an accurate appraisal of fishing activity, particularly from earlier years. However, in spite of the low sampling rate, most sub-blocks show trends in common with catches from the Actaeons: there was an increase in Geometric Mean Size (GMS) associated with the size-limit increase in 2002, followed by small but not statistically significant decreases in GMS during 2003. Visual assessment of size composition charts can be deceptive: they show much greater levels of abalone in the smaller size-classes since 2002. This change is to be expected because the size-limit increase effectively transferred abalone from the smallest to the next larger size classes. The size-limit induced change notwithstanding, most sub-blocks showed greater percentages of abalone in smaller size-classes (136-140 mm, 141-145 mm) and fewer abalone in the larger size-classes (> 160 mm) in 2003 compared to previous years. The exceptions were in 21A and 21C, where 2003 samples had similar profiles to earlier samples.

East Coast

The 2003 catch from the East Coast region (Blocks 22-31) at 217 t is the lowest since reliable catch data was first collected (1975), and contrasts with the high levels of catch in the late 1990's, which were two to three times larger. There has been a progressive reduction in catch since 1998, initially because divers found more productive reef elsewhere, then through management induced transfer of effort (zoning), then by reducing the TAC, and most recently, divers again moved from the region because other regions within the Zone were more productive.

The frequency distribution of CPUE shows a pronounced shift from high catch rates (>60 kg/hr) in 2001. In 2002 there was a further but smaller reduction in high catch rates, while the percentage of low (20-40 kg/hr) catch rates increased. Catch rates in

2003 were generally similar to 2002, but there was a shift from 20-40 kg/hr to the 40-60 kg/hr category, i.e. fewer catches were made at low catch rates. While the steady catch-rate decline of recent years has stopped, in some cases reversed, mean catch rates remain below 50 kg/hr and there are few indications that recovery of stocks has commenced, despite a large reduction in catch.

Because effort is low in this region, catch rate trends may be unreliable as an index of abundance. We do not know whether improved catch rates in some parts were due merely to the effort reduction, or improved levels of abalone abundance. For example, the Spring Bay - Mercury Passage region (24A, 24B, 24C) shows a pronounced catch-rate increase compared with 2002. However, the catch (12 t) is less than half the levels of 2000-2001 and consequently catch rates could be expected to improve because effort is at such low levels. This scenario is applicable throughout the East Coast region – because effort is now low, reefs are fished sporadically and catch rates are much less reliable indicators of abundance than they are in the more heavily fished areas.

To supplement our understanding of abundance patterns in the region, there are several other ways of viewing the fishery data that can provide indications about levels of abundance. Firstly, the catch data shows that most sub-blocks contributed some level of catch, even though it may have been low. Divers' catch returns from the East Coast show a consistent pattern: many divers fished across a range of sub-blocks before settling on one or two areas. It appears that divers spent considerable time searching areas where they had in past years taken good catches before finding productive reef. Consequently, the East Coast catch was taken from a smaller range of sub-blocks than in previous years.

Associated with this pattern of fishing activity, the 2003 catch data also show that divers tended to congregate in areas with acceptable levels of catch rates. When divers found good stock levels and consistently landed reasonable catches, they tended to re-visit the area until catch rates fell and not move to other areas as they might have done when fishable stocks were more widely dispersed. Other divers became aware that good catches were being landed, and moved to those places. An example of this behaviour occurred in sub-block 23A. Catches and catch rates were low until April, when catch rates rose sharply. At this stage, just five divers had fished the area. From then until the end of July, the cumulative catch increased from 1.7 to 9.3 tonnes and an additional 11 divers fished the area. Although some divers returned later and occasionally good catches were landed, mean monthly catch rates eventually fell to below 40 kg/hr. This pattern of behaviour is also evident in the unusual patterns of monthly catch in sub-blocks 27A, 27B and 29A.

In these few sub-blocks where effort reaches this level of intensity, and reefs are fished regularly, catch rates may reliably reflect abundance. If so, they indicate that stock levels are easily affected by fishing and suggest that any recovery from 2002 has been negated by fishing in 2003. At best, stock levels in these few productive areas could be considered stable.

It is also noted that the better performing sub-blocks (e.g. 23A, 27A, 27B and 29A) were typically the most distant from launching ramps, whilst the sub-blocks showing the greatest reduction in annual catch and lower catch rates are usually more accessible (e.g. sub-blocks 23B, 27C, 27D). Assuming that divers generally choose to fish closer to the ramp in a cost-effective manner but must move further away to obtain economic

levels of catch indicates that reefs in the closer sub-blocks have been depleted. This pattern of fishing (serial depletion) probably contributed to major declines of abalone populations on reefs since the 1980's in Blocks 28 and 30, both of which are relatively close to population centres.

Sampling of commercial catches has been limited, particularly in earlier years. Samples from the northern part of the East Coast were collected only in the winter months, because fishing mostly takes place at that time. Despite the low frequency of sampling, all showed significant increases ($P < 0.05$) in GMS between 2002 and previous years due to the size limit increase. However, samples collected from the East Coast in 2003 mostly showed reduced GMS compared with 2002 (i.e. abalone were collected at a smaller mean size), though this was not significant ($P < 0.05$) in 22B and 23A. At 24D, GMS increased slightly.

Interpreting these changes in GMS is difficult, particularly because sampling has been infrequent. That the effect of the change in size limit could be detected makes the process credible. While changes in individual blocks may reflect limited sampling, seasonal changes and patterns in site selection by divers, there was a trend in all sub-blocks except one towards a smaller GMS. This means that catches now comprise smaller abalone than previously, which could either be interpreted to mean that recruitment has increased, or that even at the current low levels of catch, stock depletion is continuing.

Western Zone

In 2003, the TAC was unchanged at 1260 tonnes. However, compared with 2002, there was considerable transfer of effort among blocks. This shift in effort arose for several reasons, primarily declining catch rates in some blocks, live market preferences and blocks targeted for higher meat recovery rates by canners. Catches fell by over 40% in Block 6, and to a lesser extent in Block 9 and 13, but were compensated for by increases in Blocks 7 and 10 (Figure 3).

This assessment of the Western Zone fishery depends almost entirely upon analysis of catch and catch-rate trends. Information from catch sampling was too infrequent to detect changes in the size composition of the catch. Most of the sampling of Western Zone catches was done at canneries, which in 2003 were prepared to take abalone larger than the upper 160-mm size limit imposed by live market buyers. Consequently, we were unable to detect changes in GMS caused by the reported Industry imposed upper size limit. There were significant differences in GMS between samples collected in 2003 and previous years, but there were no consistent trends that could be attributed to changes in size caused by variation in levels of fishing mortality.

Advice was sought from divers about the impacts upon catch rates of fishing to an upper size limit. They voiced concerns that by observing the upper size limit imposed by processors, they needed to collect greater numbers of smaller abalone than in previous years to land the same weight. This might have an impact both on catch rates, and place increasing pressure on a smaller size class of abalone. However, despite their concerns, it was difficult to detect any reduction in catch rates, and even more difficult to decide whether those reductions were due to the size limit or to stock depletion.

North West

Almost all the catch from the Western Zone part of the North West is taken from Block 6 (approximately 1 t p.a. is landed in sub-block 5D). Catch rates here have declined steadily since 2000, after catch levels had increased several years previously. The 2003 decline was more pronounced than in previous years. The CPUE distribution shows that the mode has shifted to the next smallest category; catches taken at 50-75 kg/hr have doubled, while the number of catches taken at higher catch rates (>150 kg/hr) have halved over recent years. All parts of Block 6 have been affected, although the most remote part, 6D, less so.

As a means of protecting stock levels, local divers requested the size limit north of 6D be raised from 132 mm to 136 mm (in 6D, the size limit is 140 mm). This measure took effect in 2003, and may have temporarily reduced the fishable biomass in the first part of the year (until the abalone between 132 and 136 mm grew larger than the new size limit). Catch rates and catch fell sharply in the three northern sub-blocks, but it is unclear whether this was in response to the increase in minimum size or to continuing stock depletion. Certainly, the fishery showed no signs of improvement later in the year when the smaller abalone could be considered to have recruited, and by comparison, other parts of the West Coast were then performing well. In 6D, where the size limit was unchanged, catch rates were mostly as low or lower than previous levels. It therefore seems likely that the primary cause of low catch/catch rates in Block 6 is that stocks are too depleted to sustain recent levels of fishing.

The previous stock assessment observed that fishable biomass was probably falling in this region (Tarbath *et al.*, 2003). Catch records show that much of this block is now fished year round, i.e. abalone stocks do not receive the protection that other parts of the West Coast receive when bad weather prevents fishing. The close proximity of Block 6 with the other zones in the North West (Northern, greenlip, Bass Strait) means that some divers frequent the area year round and are able to fish Block 6 whenever weather and sea conditions permit. Despite a long-term average catch of 168 t, it appears that this block can no longer sustain fishing at that level.

The increased size limit has increased the level of protection to abalone populations, and divers reported that there are now much larger numbers of undersize abalone than before. They also believed they were required to measure abalone more frequently, which together with depleted stocks, reduced their catch rates. It was observed that when catch rates fell to between 80 and 100 kg/hr, divers moved to the other regions, particularly the Central West, where catch rates were better. This was the principle reason why the annual catch in Block 6 declined by 40% in 2003.

Central West

The decline in catch from the North West (Block 6) was partially met by increased levels of catch in the Central West, particularly from landings at Granville Harbour (Block 7). Several divers transferred their operations south from Couta Rocks to Granville Harbour because stock levels and consequently catch rates were higher. It is reported that abalone from Blocks 7 and 8 were particularly sought after by canning processors because they produced superior yields compared with abalone from other parts of the Western Zone. Consequently, the 2003 annual catch from Block 7 was very high; almost double the long-term average, and in response to the escalation of effort, catch rates, stable for many years, were generally lower across the region in 2003. The

distribution of CPUE is similar to that of 2001, although the frequency of higher catch rate categories was reduced in 2003.

In remote 7A, the annual catch doubled. Divers from Couta Rocks travelled by boat further south in search of higher stock levels, and the increased number of divers operating from Granville Harbour shifted effort to the more remote parts of the region. Closer to the ramp, catch from 7B almost doubled and from 7C increased more than three-fold over the previous year. In past years, Blocks 7 and 8 have been fished only in good weather conditions, which occur less frequently in winter. Despite this, divers fished the more accessible parts of Block 7 at unusually high levels in winter in 2003. Catch rates responded to the increased level of catch by falling in all areas except 8A, and are now in the range 140 to 150 kg/hr.

Catches from Block 9 were down for the fourth consecutive year. Catch rates continued to decline slowly, although remained at relatively high levels. The reduced catch appears to be a response by divers to better catch rates and more favourable fishing conditions elsewhere. Immediately south of Strahan, 9B catches were reduced to one third of 2000 levels, with catch rates stabilising, although the low catch rates between March and May are of concern. Catches in the more remote 9C have also fallen, with catch rates fluctuating between 150 and 170 kg/hr during the past three years.

South West

Since 2001, the annual catch in the South West has progressively increased by approximately 10% p.a. to 585 t. The most recent increase has come principally from Block 10 (where the 2003 catch was almost double the long term average), and most of that has come from 10D where it is reported the abalone are of smaller size and therefore more acceptable to processors. The annual catch from the other sub-blocks of the region fluctuates between years, with falls in some areas compensated by increases in others.

Catch rates have gradually fallen from very high levels, settling at about 150 kg/hr. Market preferences for smaller abalone and the reported refusal of processors to accept large abalone (> 160 mm shell length) must contribute in part to the lower catch rates in 2003, and given the prevalence of large abalone in this region, it is remarkable that catch rates did not fall further.

The CPUE distribution indicates stable catch rate patterns, with broadly similar frequency distributions when catch rates are grouped at 50 kg/hr, albeit with some loss from the higher catch rate categories since 2000. When grouped in smaller categories (25 kg/hr), the distributions are multi-modal, with peaks and troughs occurring mostly at identical categories (Figure 10). All years share an inflexion at 75-100 kg/hr, a trough at 175-200 kg/hr, another mode at 200-225 kg/hr and inflexions in the larger categories.

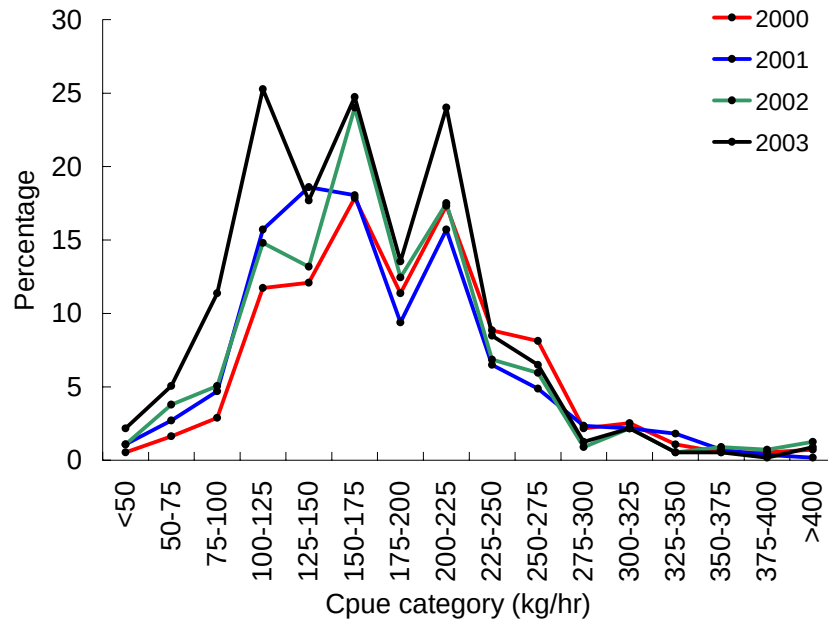


Figure 10. Catch rates from the South West region, grouped at intervals of 25 kg/hr.

The development of multiple modes in the CPUE distribution appears to be influenced by the way divers operate in the South West, where time and motivation, instead of abundance, limit daily catch weights. Figure 11, the distribution of daily catches, is similarly multi-modal, divers working until 1000, 1200 or 2000 kg is landed. The consistency of these patterns is remarkable, and lends support to the divers' views that stock levels in the region are stable.

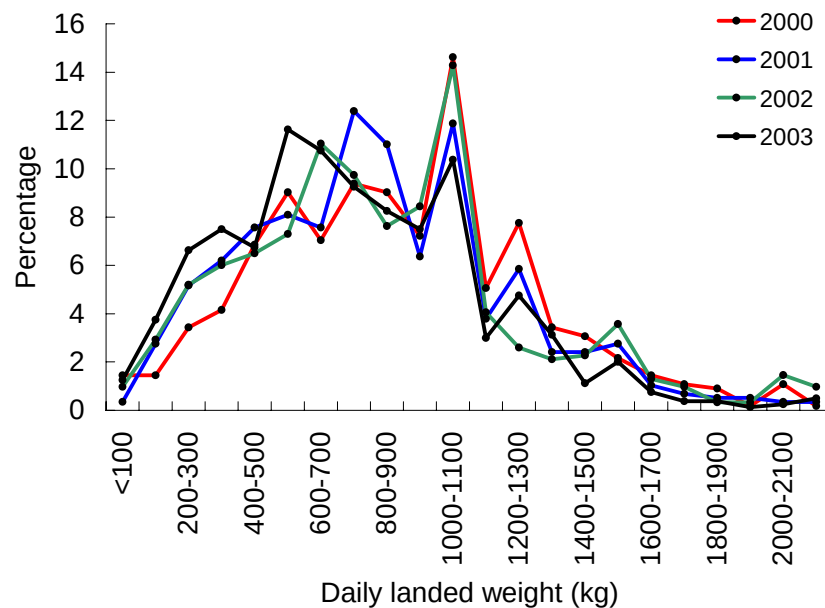


Figure 11. Frequency distribution of daily landed weights from South West Tasmania, 2000 to 2003.

However, there are differences between 2003 daily catches and those from earlier years, specifically an increased proportion of smaller catches, and less larger catches (Figure 11). While this may indicate that high stock levels are being depleted, it must also reflect the requirements of the live market (more careful handling to reduce mortality, fishing to an upper size limit), the catch limits placed upon divers by buyers during the outbreak of SARS in 2003, and the increasing tendency to split daily catches across dockets.

South Coast

The reported 2003 annual catch from this region was reduced by approximately 10% to almost 300 t in 2003. Levels of catch varied between sub-blocks, the annual catch from 12D (Cox's Bight to Prion Bay) declining whereas the catch from offshore islands (12C) increased. Catch from the more accessible 13A and 13B (Prion Bay to Whale Head) also fell relative to 2002.

Catch rates were generally similar to those of previous years, or slightly improved. The more remote areas have higher catch rates than the eastern sub-blocks (12D, 13B and 13A), reflecting greater levels of effort in the east and the comparative ease with which they can be reached by small boat from Southport. Previous assessments expressed concern at the high level of fishing and falling catch rates in these sub-blocks where catch and catch rates trends indicated continuing depletion (Tarbath *et al.*, 2003). In 2003, divers reduced effort in this area, and catch rates improved. They are still low by Western Zone standards - approximately 90 kg/hr in 13A and 13B, but it is difficult to assess whether this indicates stock depletion, divers attempting to catch Western Zone quota in adverse conditions or market preferences for small abalone. The CPUE distribution shows some improvement with lower percentages of catch rates in categories between 50 and 100 kg/hr compared with the previous year.

In contrast to other parts of the Western Zone, the South Coast was fished in all months, although divers reported that bad weather in September limited fishing effort. The regularity of fishing and comparatively high level of exploitation, particularly on the more accessible coast, improves the likelihood that catch rates trends reflect changes in abundance (Andrew *et al.*, 1997). The catch rate variation during February in 13A and 13B, and December in 12C was due to fishing practises of a few individual divers (finishing off quota at the end of the year, accommodating market preferences for abalone of various sizes).

Northern Zone

There were considerable differences in the distribution of effort among blocks between 2003 and 2002. Catches increased by more than 25% in Block 49, into which effort was transferred from Block 5 (North West), and increased catches were also taken from Blocks 1 and 3 (King Island), into which effort was transferred from the other Northern Blacklip regions. The North West continues to be the predominant supplier of Northern Zone blacklip (~60%), with King Island now producing about 35%.

North West

Across the region, catch rates are stabilising at moderate levels (80 kg/hr) following the rapid removal of easily accessible stocks that had built up after a prolonged period of low fishing activity prior to the establishment of the Northern Zone in 2001. The CPUE distribution follows that of the previous year, confirming a pattern of stable catch rates.

In 2002, the annual Block 5 catch was capped at 100 t following concerns at the high level of fishing mortality on stocks and a corresponding rapid drop in catch rates. Since then the annual catch has not reached the cap and the rate of decline of catch rates has slowed in the two northern sub-blocks (5A and 5B), and stabilised in 5C at 80 kg/hr.

There was a corresponding increase in catch in Block 49. The more remote parts (49B) were infrequently fished but were periodically visited by motherships, the divers from which were able to achieve high catch rates. In most areas, between-month variation in catch rates was high, indicating irregular fishing mortality on reefs. This suggests that divers achieved high catch rates by finding intermittently fished reefs. The areas closer to Woolnorth Point must now be considered heavily exploited, and divers who have fished there regularly report that blacklip stocks are depleted. Despite this, catch and catch rates in the sub-block increased, presumably because some parts are still lightly exploited.

Catch rates in 48C were much lower, but stabilised at 55 kg/hr. The catch also fell. Much of the blacklip catch here was caught by divers targeting greenlip. The increased minimum legal size for greenlip in the North West affected catch rates in Block 48, and divers moved elsewhere, thus reducing the blacklip catch.

King Island

The King Island blacklip catch increased by 35 t to 98 t. Catch rates appear to be stable despite the escalation of effort. The distribution of CPUE has been generally similar among years since the implementation of the Northern Zone in 2001. In 2000, King Island was part of the Western Zone and produced comparatively little catch.

For most of 2003 (January to September) King Island was fished by resident divers working predominately in 3A and 4C. From late September, the island was visited by a number of motherships that took large catches, mostly from the western half of the island (1C, 3A, 3C). The level of catch taken from this area in 2003 was the highest for many years. In 1C, catch rates fell quickly and failed to recover after high levels of fishing in October and November. Monthly catch rates declined in 3A and 3C also, but not as quickly as in 1C. These declines are consistent with depletion of fishable biomass.

Estimates of the potential yield from King Island identified during the development of the Northern Zone were based on catches during the early 127-mm size limit period, which were assumed to be sustainable (Tarbath and Officer, 2003). It has been recently reported that Block 2 no longer has commercially viable stocks because abalone, while abundant, fail to grow to legal size in sufficient quantities. The average catch from King Island prior to 1987 (when the 132-mm size limit was introduced) was 85 t, so the

current level, particularly without Block 2 catch, may be excessive. King Island is probably now producing blacklip at or beyond maximum capacity.

North East

The annual catch from the region has now fallen to low levels. This is partially because abalone from the North East do not fit the requirements of the live market and consequently attract a lower beach price. However, low catch rates across the region suggest it can no longer support historical levels of catch and generally reflect the small amount of productive coast in this area. Catch rates fell sharply in 2002 and have not recovered. The 2003 CPUE distribution was generally similar to that of the previous year, but with some reduction in higher catch-rate categories. Divers report that while the fishable biomass was extensively depleted, pre-recruits were abundant. This is consistent with a fishery that receives high levels of protection from the size limit.

Improved annual catch rates in Block 39 reflect movement of divers to more productive reefs within this block, rather than a resurgence of stock levels. In Block 31, catch rates were stable at low levels, but the catch was only 7 t, down from 30 t in 2002.

Furneaux Group

When the Northern Zone opened in 2001, mothership divers visited the Furneaux Group because of the opportunity of fishing both greenlip and Northern blacklip. More recently, most of their effort has been directed to King Island. A few resident divers now mostly fish this region.

Blacklip grow to a smaller size in the Furneaux Group, so only a limited area in the south and east support a fishery at the current size limit (Tarbath and Officer, 2003). The blacklip catch is taken predominately in Block 33, with lesser amounts coming from the adjacent Block 32. Catch rates were stable, and CPUE distributions show little change since the Northern Zone started (2001).

Greenlip fishery

The distribution of catch within the four regions of the greenlip fishery has been set by managers with annual catch limits of 40 t in the North West, 42 t in the Furneaux Group and 30 t in the North East. This left the remainder of the TAC (28 t) to be taken from King Island.

In 2003, the catch from the North West and the Furneaux Group fell to 34 t and 38 t respectively, while in the North East and King Island the catch increased to 35 t and 33 t respectively. There was a catch overrun in the North East, most of which came from Block 39. The greenlip catch in Blocks 1 and 2 (King Island) increased. An insignificant quantity of greenlip catch (~70 kg) was taken in waters bounded by the Bass Strait blacklip zone. The level of sampling of divers' catches undertaken by TAFI was insufficient to indicate changes in the size composition of the annual catch caused by fishing mortality.

North West

The lower greenlip catch in the North West can be mostly attributed to reduced levels of catch from Block 48. Catches in Blocks 5 and 49 increased to levels above long-term averages, but not enough to meet the management target. No catch was taken from Block 47.

Catch rates increased sharply in Block 5, showed no change in Block 49 after a prolonged fall and increased slightly in Block 48. In all areas, mean annual catch rates were above 50 kg/hr. In previous years, catch and catch rates fell in all blocks, and in 2003 it was recommended that the management cap be reduced (Tarbath *et al.*, 2003). The variation in catch rates and reduced level of catch suggest that catch rates reflect fleet dynamics, and not just abundance.

Between 2000 and 2003, more than 70 different divers fished the North West. This contrasts with the other greenlip regions (36 - 43 divers). Many of these divers, while experienced abalone divers, had minimal knowledge or experience of catching greenlip in the North West, and of the 70 divers, only 25 had landed more than one tonne of greenlip from this area in any of the years 2000-2003. The year with the lowest catch rates (2002) coincided with the greatest number of different divers contributing to the catch (51). Many of the divers who fished in 2002 were new to the area, but with the benefit of that experience, managed to increase their catch rates in 2003. We therefore suspect that the increase in catch rates does not necessarily mean that abundance increased, but that catch rates were affected by effort creep due to a group of divers who became more efficient.

To diminish the effect of effort creep or any other fleet dynamics, the catch data from five selected divers were reviewed (Figure 12). These divers were the only ones to continuously land significant levels of greenlip catch (> 1 t) in the North West for the period 2000-2003. Between the five of them, they landed between 27% and 40% of the regional catch in each of the four years. The group did not fish continuously in one sub-block, or even one block during the period, so their catch rates could only be reviewed on a regional basis. Their catch rates were variable, both between years and between divers but progressively declined from an average of 87 kg/hr to 60 kg/hr. We conclude that the declining catch rates, coupled with the reduced annual catch from the region, probably reflect falling abundance.

The size-limit was raised by 5 mm in the North West in 2002. The increased size limit was supported by research which concluded that at high levels of fishing mortality, a size limit of 143 mm or greater was needed to conserve adequate levels of egg production in the region (Officer, 1999). Subsequently, divers reported that at Black Reef (48A) they were no longer able to obtain reasonable catch rates, because fewer abalone grew to the new legal size. Consequently, the 48A annual catch has fallen significantly, while divers reported that undersized abalone were abundant. The 40 t North West catch limit was set using historical catch levels that included high levels of catch from Black Reef at a lower size limit. Should Black Reef fail to provide its share of catch, effort will be transferred elsewhere, probably to populations that are unable to support greater fishing mortality.

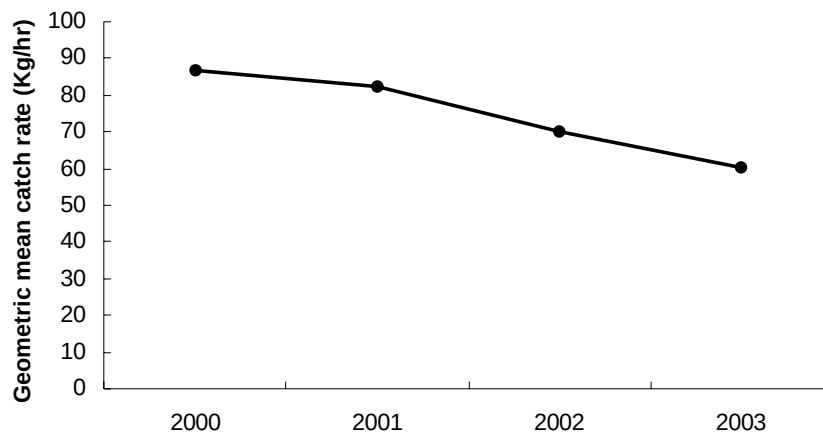


Figure 12. Geometric mean annual catch rates of five divers who landed more than one tonne per annum from the North West greenlip fishery, 2000-2003.

King Island

High prices for King Island greenlip and greater numbers of visiting divers helped lift the annual catch in 2003. CPUE distributions suggest that catch rates have improved since 2002. While the catch has increased, it is currently much lower than during late 1990's, when more than 70 t p.a. were taken at the 132 mm size limit.

However, despite the improved catch and catch rates, which should indicate stable, or increasing abundance, diver reports were to the contrary. Principal among their claims were that the areas that used to support good catches have become depleted, and that the areas that supported large catches at smaller size limits in the past cannot now be fished because the abalone there are too small.

The reports concerning depletion came from several divers, both resident and visiting, who have worked at King Island in recent years. Resident divers accounted for almost two thirds of the 2003 catch. They said that reefs where abalone were formerly abundant and provided good catch rates have not recovered from recent fishing. They were able to maintain levels of catch and catch rates only by moving to new reefs, which subsequently were also depleted.

The current size limit (150 mm) is below that recommended by Officer (1999). He found that to maintain egg production above levels required to sustain the fishery, a minimum size limit of 154 mm was required at moderate levels of fishing mortality ($F=0.6$, or 45% p.a.), rising to 162 mm for isolated populations at higher levels of fishing mortality ($F=1.0$, or 63% p.a.). In 2000, a size limit of 155 mm was introduced at King Island, but was reduced to 150 mm two years later because it prevented fishing much of the island's stocks. The divers argued that fishing effort was disproportionately supported by the larger, faster growing populations at higher levels of fishing mortality than were ever contemplated. Divers became concerned at the levels at which these populations were being depleted, and successfully argued that the size limit be reduced to 150 mm so that effort could be more widely spread.

North East

The North East catch increased from the level of the previous two years (~31 t) to overrun the regional cap by 4 t in 2003. Catches increased from both Blocks 31 and 39, the areas where greenlip are mostly fished. The catch from Block 40 is now negligible after producing 25 t in 1998 and 12 t in 2000. CPUE distribution shows improvement from 2002, but with low catch rates modal at 25-50 kg/hr. Catch rates from Block 31 increased sharply, and fell slightly in Block 39. Catch and catch rate trends suggest that the fishery in 2003 while less productive than earlier years, was stable and that levels of catch were sustainable. This contrasts with the 2002 fishery assessment, which noted that catch rates were falling and that divers had reported depleted inshore reefs. It recommended that the level of catch be reduced (Tarbath *et al.*, 2003).

Approximately 40 different divers fished the North East between 2000 and 2003. However, each year, between one third and one half of the catch was taken by the same two divers. These divers report that contrary to the current catch and catch rate trends, the level of fishing in the North East is not sustainable. Like the King Island divers, they were able to maintain levels of catch and catch rates only by moving to relatively unfished reefs. Several years ago, inshore reefs became depleted, and they then moved offshore into deeper water. These deeper reefs have become progressively depleted, and with scant signs of recovery in the reefs that were first depleted, they doubt that the North East will continue to provide recent levels of catch. They both strongly believe that too much catch has been taken from the North East, and the local cap should be reduced.

These divers have had no difficulty with fishing to the current size limit. They say that most of the abalone that they see are of legal size, and are taken. Officer (1999) found that at moderate levels of fishing mortality ($F=0.6$), minimum recommended levels of egg production could be maintained with a size limit of 144 mm, while at higher levels of fishing mortality ($F=1.0$), more vulnerable populations could achieve sufficient egg production with a 153 mm size limit. The North East size limit was 132 mm prior to 1999, 150 mm in 1999 and 145 mm since 2000.

The 30 t cap and the relatively recent increase in size limit may have failed to protect this fishery. The level of fishing mortality has been higher than expected, the populations more isolated, and the degree of egg production inadequate for stock maintenance. One diver pointed out that while the area of reef and rocky coastline was much smaller than found in the other three greenlip producing regions, the annual catch was similar.

The 30 t cap was estimated from the arithmetic mean of the annual catch 1975-2003 from Blocks 31, 39 and 40. Occasionally, the annual catch for this region was very high and at unsustainable levels: over 60 t during the mid-1980's. The frequency distribution of annual catches is non-normal, instead being skewed towards smaller catches. The geometric mean (26 t) is a more appropriate statistic for skewed distributions. As a consequence of the recent depletion, it is unlikely that a catch limit of 30 t, higher than the long term geometric mean catch, is sustainable.

Furneaux Group

The annual catch, which between 2000 and 2002 was approximately 42 t, was lower in 2003 at 38 t. The fall was not due to low levels of abundance, but to higher prices paid for King Island greenlip, and easier access to stocks in the North East, which combined to divert effort away from the Furneaux Group.

Catch rates were steady at approximately 60 kg/hr over the four-year period. The distribution of CPUE has been remarkably consistent between years. These catch and catch rate trends indicate that abundance levels are stable or increasing, and are unlikely to be decreasing.

Although 36 divers fished the Furneaux Group between 2000 and 2003, over half the catch was taken by just three resident divers. One of these divers has caught between 20% and 50% of the catch in any of the four years. In his opinion, abundance levels are stable in the Furneaux Group. He says that stock levels on reefs recover after fishing, and there are no indications of depletion.

There are two factors which appear to have contributed to the stability of the Flinders Island fishery. Firstly, following a period of high levels of catch, falling catch rates and concerns about declining stocks during the 1990's, the TAC was eventually capped at 42 t. This cap is considerably lower than the geometric mean (70 t) of the annual catches 1975-2003.

Secondly, the size limit (140 mm prior to 1999) was raised, initially to 150 mm, but then reduced to 145 mm. Compared with the other three regions, this was very conservative. At moderate levels of fishing mortality ($F=0.6$), Officer (1999) found that a 132-mm size limit would conserve adequate levels of egg production (40% EPR), while at high levels of fishing mortality ($F=1.0$) in more vulnerable populations, a 142-mm size limit should suffice. In recent years, much of the Furneaux Group catch has been sold to a single processor (Furneaux Aquaculture Pty Ltd), which pays a premium for larger abalone (> 160 mm). Abalone are taken below this size (i.e. between 145 and 160 mm) only if they appear to have stopped growing or are slow growing. Effectively, the size limit across much of the fishery is considerably greater than the recommended minimum, and has clearly been beneficial to the stocks in this region.

Regional summary:

Eastern Zone

- Actaeons - stock levels are stable, and less likely to be decreasing.
- Bruny Island – stock levels are most likely falling, with a lesser probability that stock levels are stable.
- Storm Bay - stock levels are stable, and less likely to be decreasing.
- East Coast - stock levels are most likely falling, with a lesser probability that stock levels are stable.

Northern Zone

- North East - stock levels have been extensively depleted but CPUE is now stable at a low level.
- North West - stock levels have been depleted but are now probably stable, or less likely, decreasing slowly.
- Furneaux Group – stock levels are stable.
- King Island - stock levels are becoming depleted but are still at high levels.

Western Zone

- North West - stock levels have been extensively depleted but are now stable.
- Central West - stock levels are most likely falling, with a lesser probability that stock levels are stable.
- South West – stock levels are stable, but unlikely to support size selective fishing in the longer term.
- South Coast - stock levels have been depleted but are now stable.

Greenlip Fishery

- North East - stock levels have been extensively depleted, with few signs of recovery.
- North West - stock levels in all areas except 48A are probably falling, less likely to be stable. In 48A, divers report large quantities of abalone smaller than the 145 mm size limit.
- Furneaux Group – stock levels are probably increasing.
- King Island - stock levels have been extensively depleted and continue to fall. Parts of the island support considerable stocks of greenlip that are too small to economically fish.

Bass Strait Central Zone

The fishery has been operating for one year. We have insufficient data to make comparisons that indicate changes in stock levels. However, it is considered that the 70 tonne TAC will only be sustainable if effort is more widely distributed, particularly to Flinders Island and to the Tasmanian mainland, rather than focussed on small and isolated sections of coastline.

5. Other fisheries

Recreational fishery

The number of licenses issued for the fishing season 1 November 2002 to 31 October 2003 was 9272, 15% greater than the previous season, and 25% greater than in 2000/2001 (Figure 13). The annual recreational catch for this period was estimated at 133,711 (95% CI: 112,469-160,451) or approximately 67 tonnes (Lyle and Morton, 2004). Approximately half the catch was taken from the southeast (between Marion Bay and Whale Head), with another 25% taken from further north on the East Coast. Compared with the commercial catch (2607.5 t in 2003), the recreational catch is insignificant, yet because it is taken mostly from the more accessible parts of the coast, and often from depleted areas of the Eastern Zone, it may adversely affect stock recovery in those areas.

Indigenous, illegal and permit fisheries

Abalone are caught in Tasmanian waters as part of cultural fishing activities by indigenous people, under exploratory permits for special events, 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.

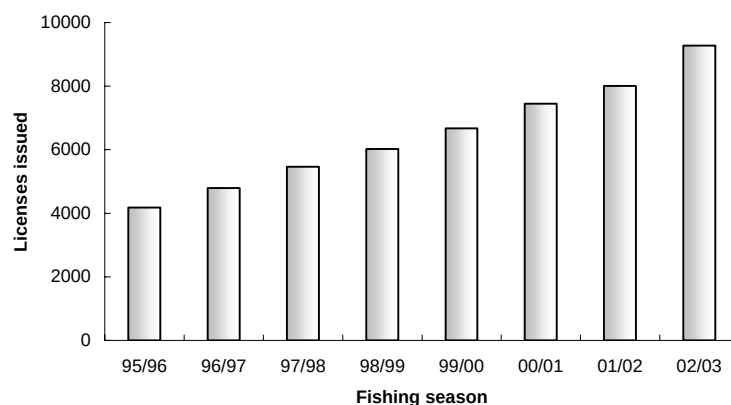


Figure 13. The number of recreational abalone diving licenses issued for the fishing seasons 1995-2003.

6. Recommendations for managers

The increases in TAC that started in 1997 and the subsequent creation of zones more recently 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 may need to manage the fishery more conservatively (perhaps with an increased number of controls and regulations to ensure that adequate stock levels are sustained). In particular, a rebuilding strategy is required in the Eastern Zone.

The reliance upon catch and effort data to monitor trends in abundance has been demonstrated to be inappropriate, and its usage has been associated with the collapse of many abalone fisheries. We continue to stress the inadequacy of this method in many parts of the Tasmanian fishery, and strongly recommend the implementation of a fishery-independent abundance survey program.

In the **Eastern Zone**, stocks continue to be at low levels. Slight increases or stability in catch rates in the Actaeons and Storm Bay may be the precursor of stock recovery, but would need to be observed for more than one year before this indicates a real reversal of the current depletion. Neither Bruny Island nor the East Coast exhibited signs of recovery. Divers have diverted some effort away from the East Coast, and coupled with the recent 70 t reduction in Eastern Zone TAC for 2004, this should aid the recovery of stock levels on the East Coast. It is recommended that the performance of the four regions within the Eastern Zone should be reviewed in September 2004. If signs of recovery are not seen at either the East Coast or Bruny Island, or catch rates at the Actaeons or Storm Bay fail to continue exhibiting an improvement, then the sustainability of current fishing would have to be questioned and management responses would be required.

We continue to recommend that Block 30 (St Helens to Eddystone Point) be closed temporarily to abalone fishing by all fishers. While commercial divers have effectively abandoned the region, recreational fishers continue to deplete the more accessible stocks.

In the 2002 assessment, it was suggested that it would be prudent to place annual catch limits on the catches in **Western Zone** Blocks 6, 12 and 13. While this recommendation was not implemented in 2003 it was the case that divers found better fishing elsewhere in the zone, and the catch was below the suggested limits, particularly in Block 6. There are now indications of recovery in Blocks 12 and 13. The divers transferred much of the effort to Blocks 7 and 8, the former's annual catch being double the long-term average. Abalone from Blocks 7 and 8 are particularly favoured by processors, so it may be assumed that divers will continue to take high levels of catch here while they have the opportunity. This level of fishing mortality is depleting stocks and is clearly unsustainable. We recommend that the performance of Blocks 7 and 8 be reviewed in September 2004, watching for evidence of CPUE declines, and to

ensure there isn't a second year of excessive catch. If indications of depletion are present, then managers must respond to limit catches to more sustainable levels.

Effort in the **Northern Zone** has been transferred out of the most depleted parts of the North West (Block 5) and the North East, to King Island, where, in recent years we have indicated that the fishery was relatively under-exploited. King Island is probably now producing blacklip at or beyond maximum capacity. Some of the island's stocks produce no worthwhile catch at the recently reduced 127-mm size limit, whereas they did prior to 1987. It is recommended that managers request a review be undertaken concerning information about size limits and yield for the King Island blacklip fishery and re-assess the ability of the region to provide current levels of catch.

The **Greenlip fishery**, like other Australian fisheries for this species, is beset with problems of sustainability and local depletion. Catch and catch-rate trends are inadequate indicators of abundance, much more so than in the blacklip fishery. In the North West, the recent minimum legal size increase has caused effort from one of the most productive parts (Black Reef) to be transferred onto fully exploited stocks elsewhere within the region. In the North East and King Island, divers report extensive depletion, with little or no recruitment, and say that recovery of stocks is not possible at current catch levels. On King Island, divers report the presence of stocks that were once heavily fished but that do not grow to the recently introduced larger size limits. It is strongly recommended that managers must review catch- and size-limits in the North East, North West and King Island, and in conjunction with researchers, explore methods for making slower or smaller growing stocks available to the fishery once more.

In the **Recreational** fishery, surveys indicated that approximately three quarters of the estimated 67 tonne annual (November 2002-October 2003) catch comes from the Eastern Zone. Since 1996, recreational effort has escalated, with sales of recreational abalone dive licenses increasing by more than 10% p.a. Recreational effort has the potential to undermine management attempts to halt stock declines, particularly in the more vulnerable parts of the East Coast, and we recommend that managers continue to monitor levels of recreational catch.

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Acknowledgements

A draft copy of this assessment was provided to the Abalone Stock Assessment Group for comment (ABSAG). Specifically, ABSAG members were asked to comment on catch rates and trends (in particular any anomalies) in certain areas of the fishery with which they were most familiar. Information provided by ABSAG members was incorporated into this report. In 2004 the Abalone Stock Assessment Group included the following people:

Grant Pullen	Principal Fisheries Management Officer, DPIWE
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
Roger King	Tasmanian Abalone Council

We also sought specific advice from a number of other people within the industry, including James and Charles Mason, Max Stephenson, Brett Green, Berkeley Dilworth, Murray Young, Neil Batey and Adam Morgan. We would like to thank all the above for the time and help that they provided to us.

Appendix 1: Interpreting graphical information

Catch rates are expressed as geometric mean catch rates rather than arithmetic means because abalone catch rates are not usually normally distributed. 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 14 shows catch (left y-axis) and catch rate (right y-axis) for the last 10 years for a statistical block.

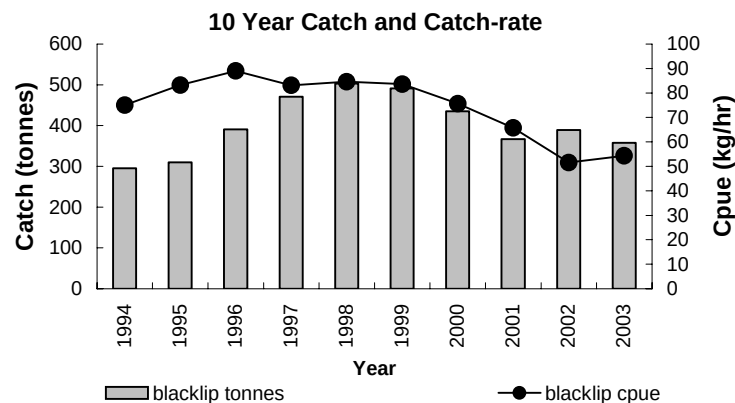


Figure 14. Example ten-year catch and catch rate, by block. Catch rates (geometric means – see below) are shown as a line with blobs marking every year. Catch data (tonnes) is shown as vertical columns.

Figure 15 is similar to Figure 14 (i.e. shows catch and catch rate by block), but it also includes **greenlip** catch (**white** columns) as well as **grey** columns (**blacklip** 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 15:

- 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 2003, the catch rates are shown as two separate lines with **black balls** for **blacklip** and **white balls** for **greenlip**.

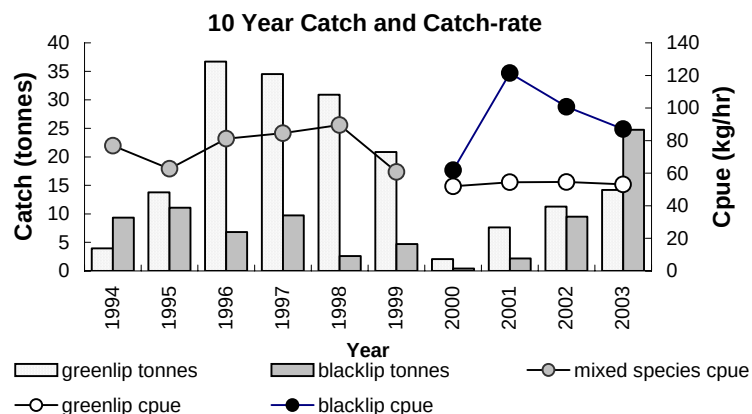


Figure 15. Example ten-year catch and catch rate – blacklip and greenlip.

Figure 16 shows catch and catch rates for the last four 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.

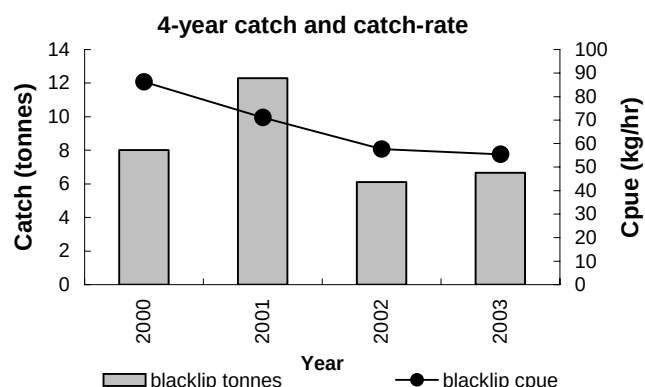


Figure 16. Example catch and catch rate at sub-block level.

Also included are monthly catch rate and catch charts at sub-block level (Figure 17, Figure 18). 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

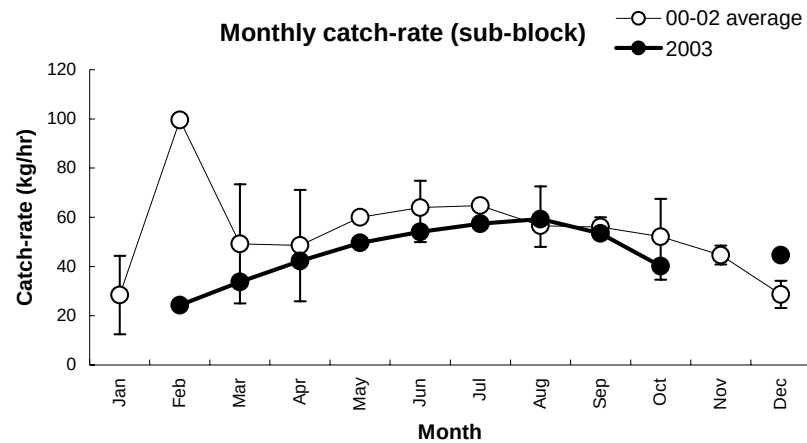


Figure 17. Example of monthly catch rates (kg/hr) at sub-block level. Vertical bars indicate range through the averaged period.

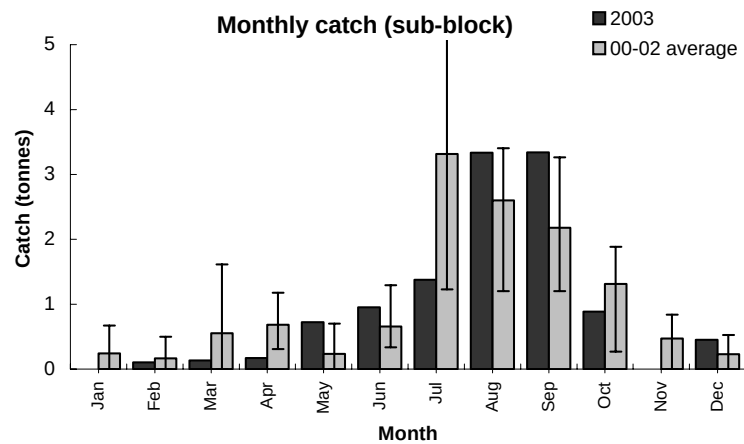


Figure 18. Example of monthly catch (tonnes) at sub-block level. Vertical bars indicate range through the averaged period.

The catch charts (Figure 18) should be used in conjunction with the catch rate (Figure 17) 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 19). 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.

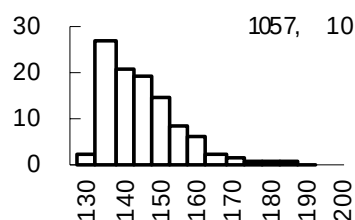


Figure 19. Example size-composition of a sample of abalone taken from a number of divers catches from a 132mm size limit zone.

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 20, 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.

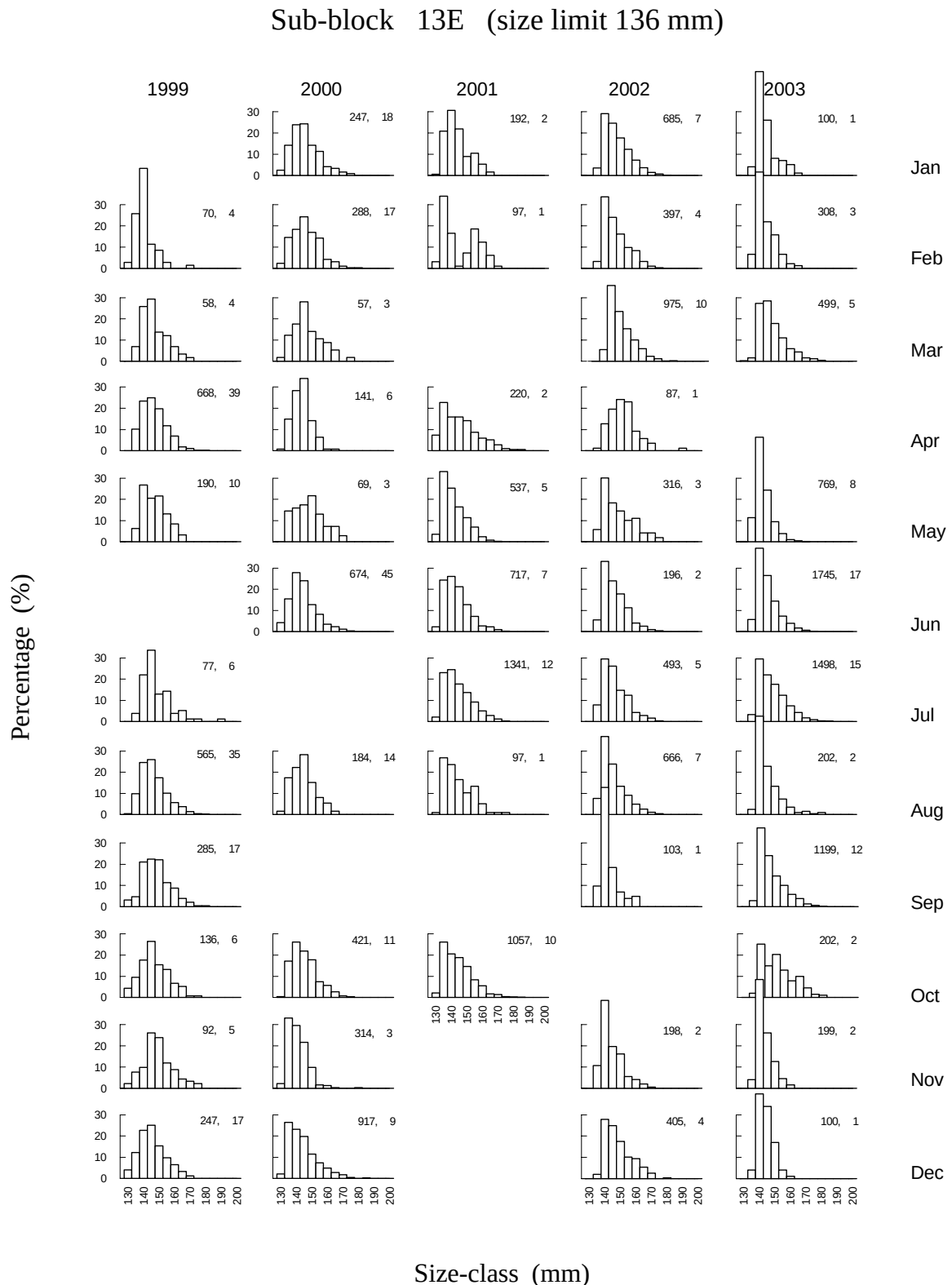


Figure 20. Example size-composition chart of the commercial catch of abalone taken from sub-block 13E, arranged by year and month. The current size limit is indicated at the top of the page. The size limit between 1999 and 2001 inclusive was 132mm.

Appendix 2: Annual Catches From The Western Zone 1975 - 2003.

Annual tonnages of blacklip abalone caught within the statistical blocks and sub-blocks comprising the Western Zone in 2003. 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
2003	0	97	104	27	142	239	345	229	67	1251
Mean	1	168	59	34	165	132	285	207	64	1058

Appendix 3: Annual Catches From The Eastern Zone 1975 - 2003.

Annual tonnages of blacklip abalone caught within statistical blocks and sub-blocks comprising the Eastern Zone in 2003. These tonnages are derived from estimated weights, which do not correspond exactly with landed weights. The catches for Blocks 13 and 31 include catch from outside the (now) Eastern Zone prior to 2000 (Block 13) and 2001 (Block 31), 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	32	836
1976	208	156	0	64	36	1	18	25	45	56	18	12	9	40	72	9	39	50	858
1977	245	232	2	190	13	1	23	35	37	53	11	10	9	55	90	22	122	54	1204
1978	322	218	6	120	24	1	32	65	60	88	22	13	11	93	87	25	137	105	1429
1979	374	251	8	148	25	2	51	52	43	30	10	23	7	80	52	12	107	60	1335
1980	272	255	7	145	30	1	33	30	42	46	158	34	7	108	91	27	148	105	1539
1981	254	299	18	127	48	4	45	69	35	77	137	19	15	68	154	22	146	52	1589
1982	337	218	15	147	24	3	36	62	63	49	97	21	9	89	100	32	171	48	1521
1983	255	300	10	189	28	3	43	63	55	92	99	31	14	100	105	66	298	90	1841
1984	318	297	18	166	35	5	47	70	73	61	109	10	11	106	112	53	149	76	1716
1985	256	262	4	89	83	11	69	80	43	44	120	20	17	86	71	5	91	171	1522
1986	221	262	22	82	93	4	65	67	70	56	88	13	20	50	58	14	126	164	1475
1987	225	229	7	47	80	1	43	44	32	34	66	12	8	77	45	11	68	54	1083
1988	219	258	6	76	57	4	62	44	43	34	79	10	6	65	52	16	96	90	1217
1989	156	172	2	56	43	2	61	42	22	16	34	7		41	31	11	41	27	772
1990	133	193	4	76	29	3	33	51	41	36	61	1	2	61	77	21	54	22	898
1991	127	207	2	60	37	3	53	50	47	31	67	2	9	64	66	12	30	21	888
1992	159	122	4	49	28	3	56	49	56	12	76	1	1	71	56	7	10	13	773
1993	271	121	4	107	47	1	67	79	49	24	75	1	1	87	39	8	15	15	1011
1994	300	148	10	118	65	2	122	85	62	17	57	0	3	104	24	8	11	21	1157
1995	313	256	2	106	35	4	108	78	41	21	43	0	1	81	19	6	11	26	1151
1996	392	195	0	80	18	3	74	55	44	29	69	3	6	90	39	11	28	20	1156
1997	470	137	0	64	25	2	79	49	47	32	106	1	13	190	32	32	23	33	1335
1998	483	109	1	116	23	2	85	64	63	44	160	2	25	182	77	31	10	15	1492
1999	474	66	1	106	34	6	97	61	47	53	139	0	9	94	60	24	10	39	1319
2000	381	98	2	71	29	4	62	60	69	44	104	1	8	101	16	21	10	90	1170
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
2003	291	116	2	60	17	1	88	54	35	21	51	0	3	50	8	19	3	27	848
Mean	287	191	6	100	36	3	58	56	48	42	77	9	9	83	59	20	70	57	1210

Appendix 4: Annual Catches From The Northern Zone 1975 - 2003.

Annual tonnages of blacklip abalone caught within statistical blocks comprising the Northern Zone in 2003. 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. 1989 catches include those from the Bass Strait stunted fishery, taken at a size limit of 110 mm.

Year	31	39	40	32	33	34	35	36	38	47	48	49	5	1	2	3	4	Total
1975		3	1	2	9	1	7	7	2	1	12	9	39	32	1	27	14	167
1976		5	0	0	6	0	1	1	1	1	12	33	46	39	1	51	8	205
1977		5	2	6	11	0	0	2	2	0	8	17	50	17	1	87	8	216
1978		8	2	1	5	2	6	5	4	3	10	11	65	21	3	56	25	227
1979		6	1	2	9	0	0	1	2	0	27	7	85	24	3	10	10	187
1980		3	1	2	6	1	1	2	0	0	10	1	92	51	3	33	3	209
1981		7	1	0	7	1	1	0	0	2	33	9	120	19	8	33	10	250
1982		5	1	0	5	1	0	2	5	1	45	7	121	23	9	27	13	265
1983		7	4	0	4	0	1	5	4	9	44	19	227	22	2	32	51	431
1984		5	3	0	7	0	1	2	1	4	81	45	311	11	1	34	55	562
1985		5	2	4	6	1	2	0	0	4	48	50	319	43	0	26	12	522
1986		10	5	1	9	2	3	3	1	15	86	97	267	35	4	24	13	575
1987		6	1	0	7	0	2	1	1	18	58	68	197	44	61	24	53	542
1988		2	2	1	11	1	1	1	0	18	36	41	168	29	17	22	60	410
1989		1	28	0	4	0	0	0	0	14	16	24	88	14	7	10	5	211
1990		0	0	0	1	0	0	0	0	6	14	20	82	11	10	9	12	165
1991		1	0	0	2	1	1	0	0	8	12	10	97	6	7	13	27	185
1992		3	0	0	2	0	0	0	0	2	10	11	76	4	6	14	10	139
1993		0	0	0	3	1	0	1	0	1	6	7	66	10	4	8	9	116
1994		0	0	0	3	0	0	0	1	0	6	11	49	9	2	4	1	86
1995		0	0	1	1	0	0	0	0	0	6	2	62	12	5	2	7	99
1996		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	5	2	56	9	1	10	6	90
1998		0	1	0	2	0	0	0	0	0	6	3	61	2	1	1	2	79
1999		4	1	0	2	0	0	0	1	0	13	4	45	3	1	4	6	83
2000		5	2	1	5	0	0	0	0	0	12	26	45	0	0	10	10	117
2001	12	11	3	5	10	1	0	0	3	0	17	72	117	2	1	12	12	279
2002	30	4	3	1	11	1	0	0	2	0	12	48	103	10	2	35	16	278
2003	7	8	1	0	5	0	0	0	2	0	10	76	73	25	1	62	10	279
Mean	16	4	2	1	5	0	1	1	1	4	23	25	110	18	6	23	16	243

Appendix 5: Annual Catches From The Greenlip Fishery 1975 - 2003.

Annual tonnages of greenlip abalone caught within the statistical blocks comprising the Greenlip fishery in 2003. 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
2003	18	16	1	5	16	1	10	2	1	3	0	14	10	10	14	11	3	4	140
Mean	18	8	4	6	15	7	29	11	5	5	10	25	5	8	7	20	1	8	192

Appendix 6: Annual Catches From The Bass Strait Zone 1975 - 2003.

Annual tonnages of blacklip abalone caught within statistical blocks comprising the Bass Strait Zone in 2003. These tonnages are derived from estimated weights, which do not correspond exactly with landed weights. The Bass Strait Zone only partially covers Block 38; the remainder is covered by the Northern Zone. Catch for years 1989, 1991, 1993, and 1995 includes that taken for the Bass Strait stunted fisheries at size limits of either 110mm (1989, 1993, 1995) or 118mm (1991).

Year	37	38	41	42	43	44	45	46	50	51	52	53	54	55	56	57	Total
1975	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1976	0		0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
1977	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1978	0		0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
1979	1		0	0	0	0	0	3	0	0	0	0	0	0	0	0	4
1980	1		1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1981	2		0	0	1	0	0	0	0	0	0	0	0	0	0	0	3
1982	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1983	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1984	0		0	0	1	0	0	3	0	0	0	0	0	0	0	0	5
1985	0		2	0	2	0	0	0	0	0	0	0	0	0	0	0	4
1986	1		1	0	4	0	0	1	0	0	0	0	0	0	0	0	8
1987	2		2	0	8	1	0	0	0	0	0	0	0	0	0	0	14
1988	0		0	0	1	1	0	1	0	0	0	0	0	0	0	0	4
1989	8		19	11	34	1	5	14	0	24	0	41	4	0	6	0	167
1990	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1991	17		0	0	0	0	0	0	0	14	5	28	1	0	17	15	96
1992	0		0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
1993	19		0	0	0	0	0	0	0	21	4	37	1	0	6	8	95
1994	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	52		0	0	0	0	0	0	1	46	2	44	0	0	0	5	149
1996	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	0		0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
2002	0		0	0	0	0	0	1	0	0	0	0	0	0	0	0	2
2003	6	0	1	2	2	0	0	2	0	7	2	36	2	0	7	2	70
Mean	4	0	1	0	2	0	0	1	0	4	0	6	0	0	1	1	22

Appendix 7: History of Changes to the Fishery

This history has been compiled from a number of sources, principal among which has been DPIWE's Abalone Management Plans.

Year	Change
1962	Minimum size limit (MSL) of 5 inches (127 mm) minimum shell diameter introduced.
1964	MSL increased to 6 inches (152 mm).
1965	MSL reduced to 5 inches. Introduction of commercial abalone diving licenses. All abalone to be landed live (no processing at sea). Divers required to provide monthly catch statistics as part of their license conditions.
1966	Abalone processing factories required to record the number of persons from whom abalone were bought.
1967	Abalone divers required to carry a measuring device to measure the abalone before taking them. Special penalty introduced for possession of undersized abalone at \$1 per fish. Abalone to be sold in live condition to registered processors only.
1969	License limitation introduced. Rapid expansion of the fishery led to this first attempt to control effort. Only divers fishing the previous year were licensed to fish in 1969. This figure (120 divers) was maintained in subsequent years.
1971	Only licensed divers allowed to dive from a boat engaged in abalone fishing.
1972	License transfer from a retiring diver to his nominee allowable on grounds of health problems. Annual license fees calculated as 1.5% of the mean of the previous three years value of annual production. An additional five licenses were issued to divers living in the Furneaux Group. These divers were restricted to fishing the Furneaux Group, but the other 120 divers were not prevented from fishing there. Penalties for breaches of regulations in relation to abalone fishing increased. Permit to transfer licenses between divers revoked.
1974	License transfer from a retiring diver to his nominee permitted.

- 1979 Penalties for breaches of regulations in relation to abalone fishing increased, with special penalties rising to \$2 per fish.
- Identification cards for divers introduced.
- 1982 Penalties for breaches of regulations in relation to abalone fishing increased, with special penalties rising to \$10 per fish.
- Catch restricted by marketing crisis: processors limit divers to 24 tonnes pa.
- 1983 Penalties for breaches of regulations in relation to abalone fishing increased.
- Easing of market difficulties sees lifting of processor applied catch restrictions.
- 1985 Individual transferable quota (ITQ) and a total allowable catch (TAC) were introduced. Each of the 120 general license divers were allocated 28 units of quota, the Furneaux Group divers 20 units: therefore there were 3460 units. For 1985, the quota unit was set at 1100 kg i.e. the TAC was 3806 tonnes. This amount was derived from an estimate of average catches, with a 10% bonus granted by the Minister to compensate for any financial difficulties caused by the new system.
- License fees were increased to 2.5% of the value of the annual landed catch, for each quota unit held.
- Quota unit transfers between Furneaux divers and non-Furneaux divers were prohibited.
- The 120 Tasmanian mainland divers were prohibited from diving in the Furneaux group.
- Divers were required to own at least 16 units, but could accumulate no more than 80.
- The catch (kg) per quota unit was determined by the Liaison Committee based upon advice from the government researchers.
- 1986 Annual license fees set at 5% of value of annual landed catch.
- The catch per ITQ was reduced to 1000 kg (9% reduction) i.e. TAC was 3460 tonnes.
- 1987 MSL increased to 132 mm from 127 mm.
- The catch per ITQ was reduced to 950 kg (5% reduction) i.e. TAC was 3287 tonnes.
- 1988 The catch per ITQ was reduced to 855 kg (5% reduction) i.e. TAC was 2958.3 tonnes.
- The minimum legal weight for abalone meats was set at 90 g.

- 1989 The catch per ITQ was reduced to 600 kg (30% reduction) i.e. TAC was 2076 tonnes.

To compensate divers for the reduction in TAC, a special fishery for blacklip abalone in Bass Strait was held in April, with a MSL of 110 mm and a maximum size limit of 132 mm. Each diver was limited to 2.4 tonnes, with 198 tonnes landed. The fishery was free of fees, and while only licensed abalone divers could participate, was held to be distinct from the Tasmanian abalone fishery (hence the maximum size limit).

The minimum meat weight regulation of 90g was amended to apply only to blacklip abalone.

- 1990 MSL for blacklip abalone on south and west coasts between the Wild Wave River (north of Sandy Cape) and Whale Head increased to 140 mm.

MSL for greenlip in Furneaux Group waters increased to 140 mm.

Furneaux Group boundary removed. The Furneaux Group divers were issued with an extra 8 units each, which could only be fished by the divers themselves and were not transferable. This increased the number of units in the fishery to 3500, and the TAC to 2100 tonnes.

- 1991 A fishery for abalone in Bass Strait was held in May, with a MSL of 118 mm. The TAC was 110 tonnes, with a fee of \$1.40 per kg of quota.

The license system was restructured: the diving entitlement was uncoupled from the entitlement to hold quota units and the lower and upper limits on the amount of units held was abolished.

- 1992 Minimum meat weight for greenlip was set at 70 g.

- 1993 A fishery for abalone in Bass Strait was held in May and June, with a MSL of 110 mm. The TAC was 100 tonnes, with a fee of \$5.00 per kg of quota.

Minimum meat weight regulation amended to 90g for all abalone other than greenlip.

Penalties reviewed and significantly increased, with the option of prison terms for serious and repeat offenders. Special penalties increased to \$50 per fish.

- 1994 Quota owners were given the choice of continuing with their annual abalone licenses or entering into a Deed of Agreement that applied for 10 years with the right of renewal for perpetuity. 90% of owners chose the Deed of Agreement.

The Deed of Agreement set a fee structure that included both management costs and return to the community, based upon an increasing (but non-linear) proportion of beach price. At \$6/kg, no fees were payable, at \$35/kg fees were 10% at and at \$200/kg fees were 33% of beach price.

- 1995 A fishery for abalone in Bass Strait was held in May and June, with a MSL of 110 mm. Only 12 commercial divers (i.e. non-abalone) participated. While the

TAC was 100 tonnes, only 21 tonnes was taken. The fee was \$10.00 per kg of quota.

Another Bass Strait fishery was held in November, with both abalone and commercial divers participating. The MSL was 100 mm, and the TAC was set at 140 tonnes, with a fee of \$10/kg. Only 106 tonnes was taken before the fishery was closed. It was maintained by divers that a very high proportion of the fishable biomass had been taken, and that continuing the fishery could affect the sustainability of stocks.

1996 The *Living Marine Resources Management Act 1995* was introduced.

Trigger points were introduced by DPIF to initiate a management response if catch and catch rates changed by a pre-determined quantity with respect to those from two earlier reference periods.

1997 The TAC was increased to 2520 tonnes (720 kg per quota unit).

Differential in beach price between east coast and west coast abalone first appears – is initially \$2.00.

1998 The first Abalone Fishery Management Plan was introduced. Among changes that it introduced were catch monitoring, which included:

1. Pre-fishing reporting by divers,
2. Post-fishing reporting of catch by divers and processors,
3. Processors required to maintain a daily balance of stock in, stock out and stock on hand,
4. Processors to report prior to movement of stock out and on receipt of stock,
5. Reports to be made by telephone, where information was immediately available to Compliance Audit Unit and Tasmania Police.

For several years, greenlip abalone had attracted premium beach prices, causing a diversion of effort to that species. To enhance protection, a number of management changes were made:

1. For management purposes, the greenlip fishery was subdivided into two regions: the Furneaux Group and the remainder (North West, North East and King Island)
2. MSL was raised to 140 mm state-wide (except the North West, which was left at 132 mm),
3. The annual catch for the Furneaux Group was capped at 42 t determined from the average of the previous ??? years. This cap was managed monthly, so that where more than one twelfth of the annual cap (3.5 t) was taken in any month, the Minister could close the fishery until the next month.
4. Within the Furneaux Group, several other rules were introduced to reduce effort:
 - a. divers could only work two days per week. Originally, the days were fixed, but because this forced divers to work in often hazardous conditions, divers were allowed to nominate which two days they could work.

- b. A 200 kg/day bag limit was introduced, as was a 200 kg/day landing limit. This effectively meant that catch was not held on motherships overnight.
 - c. These rules were repealed in 1999.
- 5. The greenlip catch from the remainder of the State was to be limited to 106 tonnes.
- 6. Because the Department was unable to monitor catch closely enough, the monthly Furneaux Group catch usually overran its limit, and the fishery there was closed in August when the regional cap was met. The greenlip cap in the rest of the State was also overrun.
- 7. Vessels over 10 m landing abalone at Smithton or Stanley had to make a prior report to the CAU reporting service so that Tasmania Police could inspect their catch.

Fixed trigger points were abandoned as an assessment strategy as rising catch and catch rates indiscriminately fired triggers. Assessments have since primarily used catch and catch rate trends to monitor stock levels.

- 1999 MSL for greenlip raised to 140 mm in North West, and 150 mm for the remainder. This applied to the commercial fishery only, the MSL for recreational fishers remaining at 140 mm.

The greenlip fishery was divided into east (Furneaux Group and North East) and west (King Island and North West) with quarterly caps of 17 tonnes and 20 tonnes respectively. Overrun of caps led to a closure of the greenlip fishery in October.

Within the Furneaux Group, Block 35 (Franklin Sound) was closed to fishing between 1 October and 31 March to protect spawning abalone.

- 2000 The blacklip fishery was divided into two East and West management zones with boundaries at Whale Head and Port Sorell. The greenlip fishery was managed separately. Eastern blacklip units were set at 340 kg (TAC 1190 t), Western units at 400 kg (1400 t) and greenlip units at 40 kg (140t), with a TAC for the whole fishery of 2730 tonnes.

Size limits for blacklip abalone remained unchanged. The zone boundaries meant that the Western Zone had a size limit of 140 mm from Whale Head to the Wild Wave River and 132 mm from there to Port Sorell.

Following egg-per-recruit studies by researchers, the MSL for King Island greenlip was raised to 155 mm, 140 mm for North West and 145 for both the North East and the Furneaux Group.

The Block 35 (Franklin Sound) greenlip catch was capped at 20 tonnes.

Catches were reported on a smaller spatial scale with the introduction of sub-blocks state-wide.

Owners of fishing license (abalone dive) were allowed to hold more than one

license and allow others to dive those licenses as supervisors.

- 2001 The Northern Zone (between Arthur River in the west and Musselroe Point in the east) for blacklip abalone was established, with a MSL of 127 mm except between Woolnorth Point and the Arthur River, where 132 mm prevailed. Catch per unit was 80 kg, with a TAC of 280 t. Because the Northern Zone covered coast that was previously included in the two other blacklip zones, catch for those zones was proportionally reduced, with a further allowance for declining Eastern Zone stocks. The TAC for the West was set at 1260 t (360 kg/unit), and the East at 1120 t (320 kg/unit). The greenlip TAC remained at 140 tonnes, so production from the entire fishery was 2800 t or 800 kg/unit.

Associated with the development of the Northern Zone, four reserves were established to monitor changes in size at maturity and growth rates of abalone populations. The reserves were at the Doughboys (North West), Waterwitch reef (King Island), the Inner Sister (Furneaux Group) and Swan Island (North East).

MSL's for recreational divers were changed to 132 mm for blacklip state-wide, and 145 mm for greenlip in all areas except the North west, which remained at 140 mm.

The regional catch for the greenlip fishery was limited in three of the main regions. The North West catch was capped at 40 t, the North East at 30 t, while the Furneaux Group catch remained fixed at 42 t. Catch from King Island and the Bass Strait islands (Kent, Curtis, Hogan Groups) was not capped.

- 2002 MSL for Eastern Zone was increased to 136 mm.

MSL for greenlip on King Island was reduced to 150 mm.

MSL for greenlip in the North West was increased to 145 mm.

The Eastern Zone TAC was reduced to 857.5 t (245 kg/unit).

The Western Zone and greenlip TAC's remained the same. Production for the whole fishery was set at 2537.5 t (725 kg/unit).

Catch from the Actaeons (sub-blocks 13C, D and E) was capped at 350 t, managed firstly as a half-yearly cap, then quarterly. The fishery there was closed in September and then mid-October when those caps were reached.

- 2003 A Bass Strait blacklip zone (TAC 70 tonnes (20 kg/unit), MSL of 114 mm) was superimposed over the Northern Zone in central Bass Strait and part of the Furneaux Group. Its purpose was to enable the catching of abalone smaller than allowed by the Northern Zone size limit, in areas where no catch had been taken under the Northern Zone because the size limit was too high. The Bass Strait Boundaries were set at Cowrie Point in the west and Anderson Bay in the east. The Flinders Island boundaries were on an unnamed point north of Settlement Point on the western side of the island (40°00'36.32") and Foochow Inlet on the east. While the TAC for the Northern Zone was not decreased,

(remaining at 280 t), the catch from Block 5 was capped at 100 t.

Fishery production was set at 2607.5 t (745 kg/unit) state-wide.

MSL for Western Zone between the Wild Wave River and Arthur River was increased to 136 mm from 132 mm.

Abalone taken from Western Zone subject to upper size limit of 160 mm by canners and live market buyers, although this size limit was not universally applied.

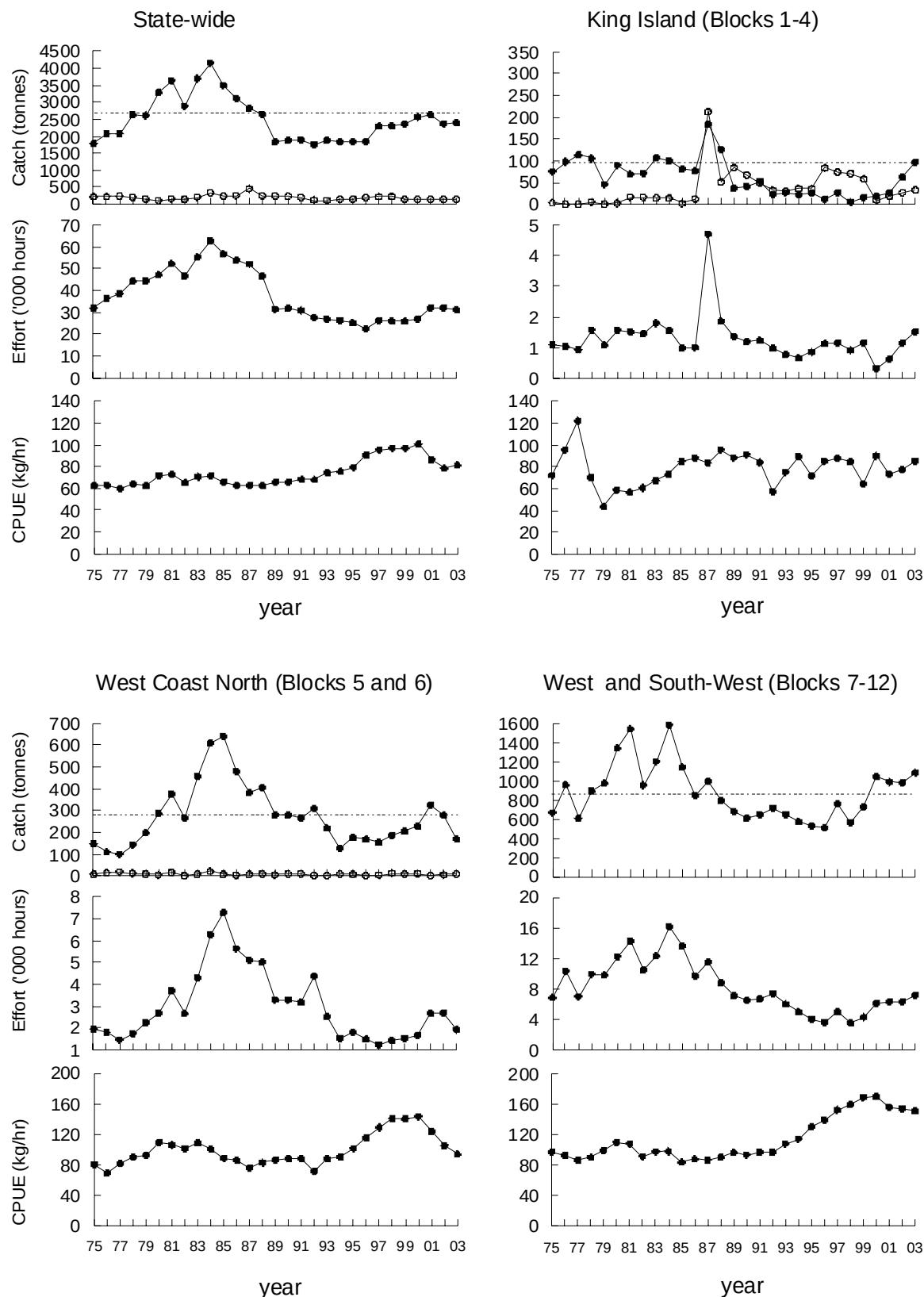
2004 Eastern Zone TAC was reduced to 770 t (220 kg/unit).

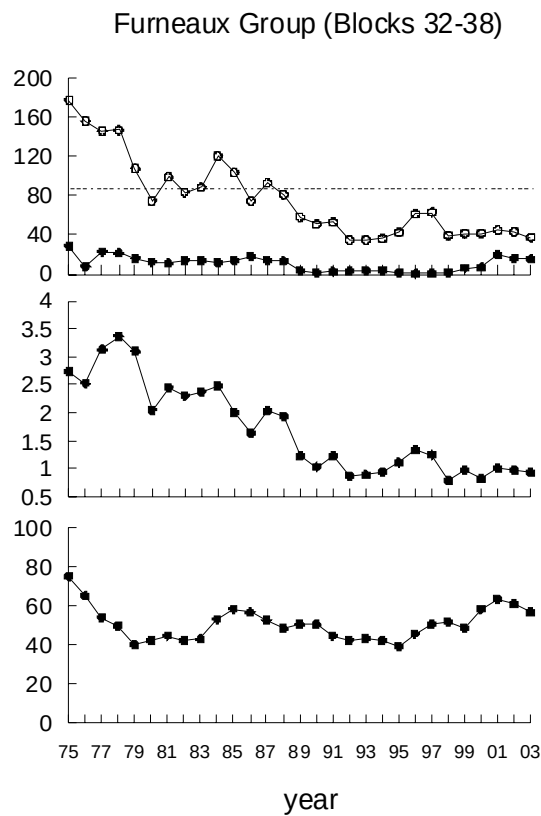
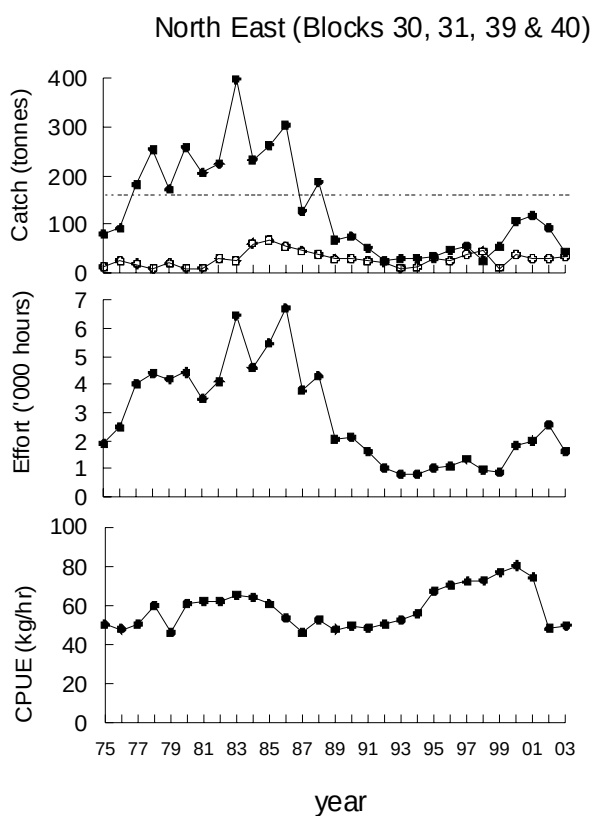
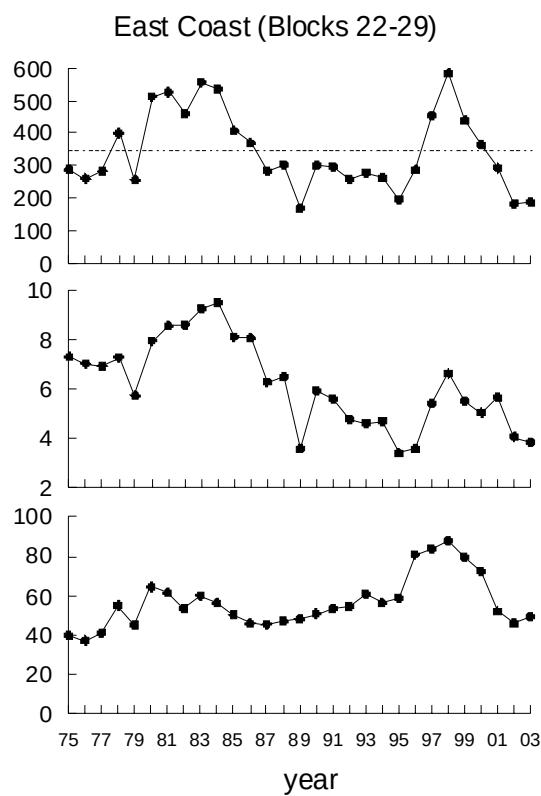
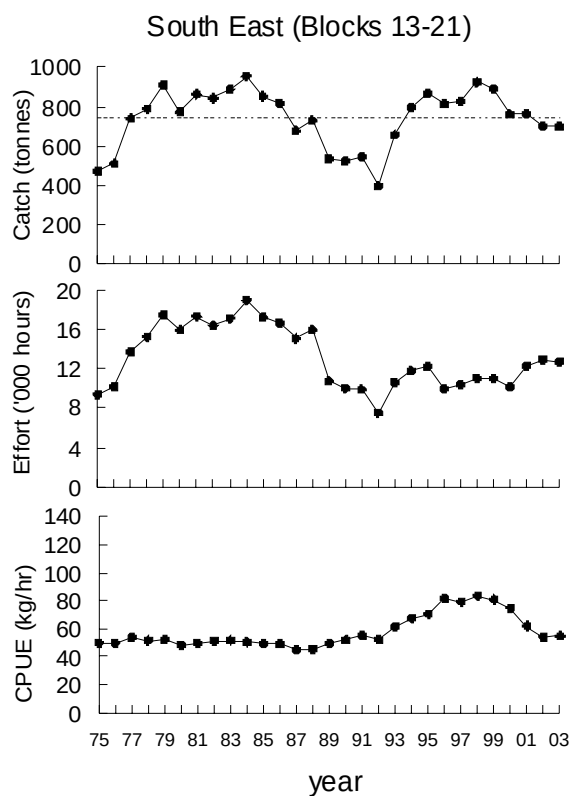
Greenlip TAC was reduced to 129.5 t (37 kg/unit). This affected the North West only, where the annual cap was reduced by 10 t to 30 t.

Production for the fishery was set at 2509.5 t (717 kg/unit)

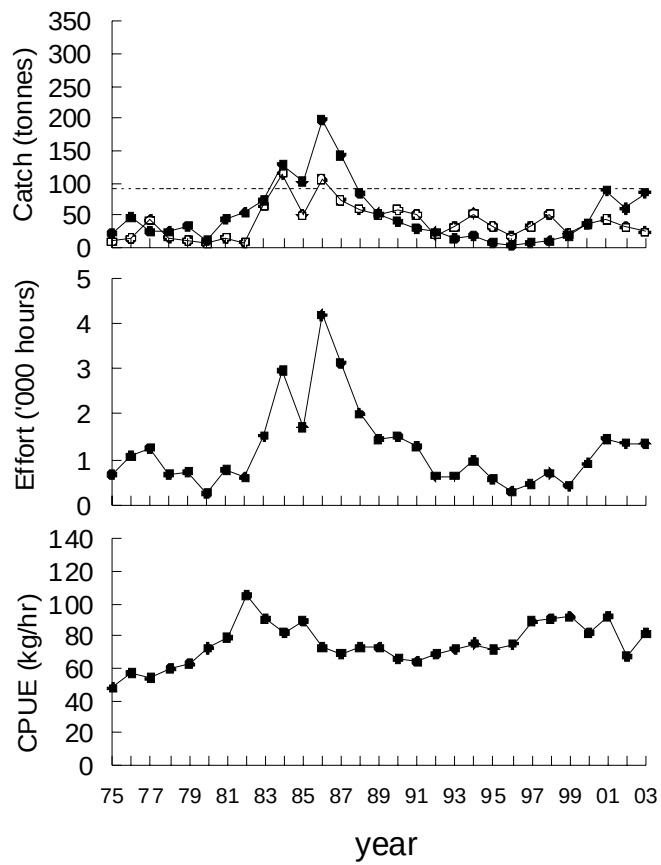
Appendix 8: History of Annual Catch, Effort and Catch Rate.

Catch is shown in tonnes, by species (blacklip - ●, greenlip - ○). CPUE is the annual geometric mean of catch rates, for both species combined. The information from this appendix was not used in the preparation of the 2003 assessment.

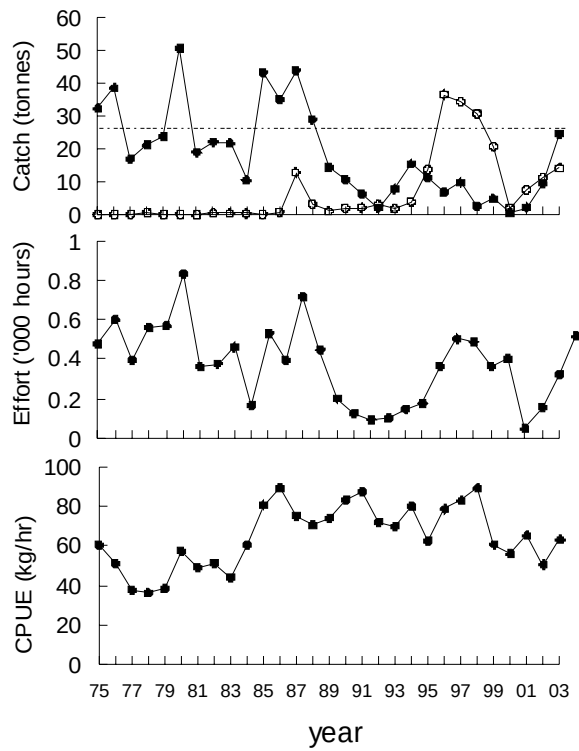




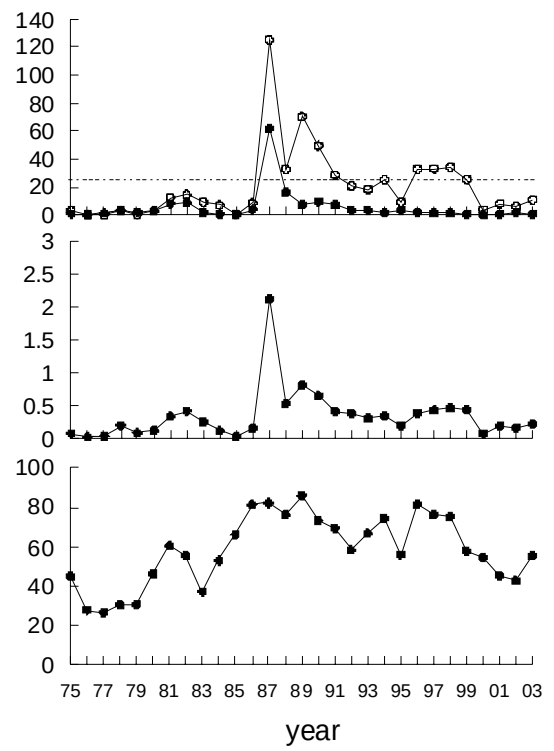
North West (Blocks 47-49)



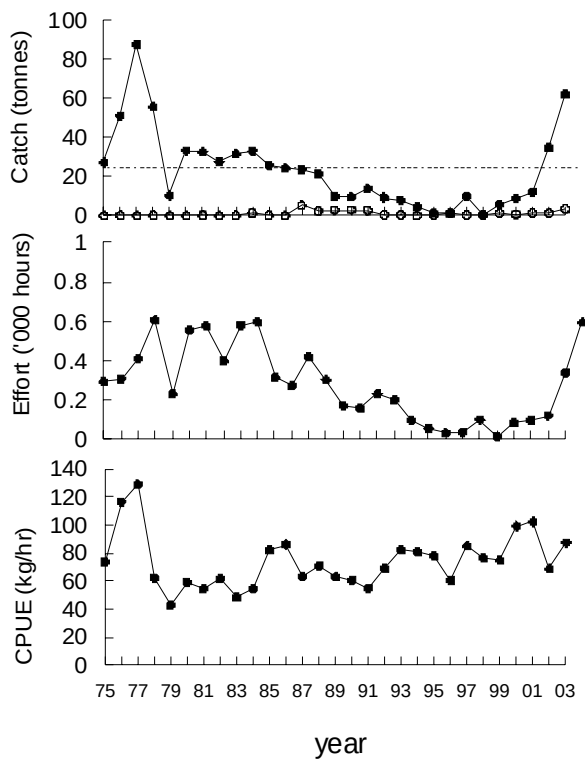
Block 1 (King Island)



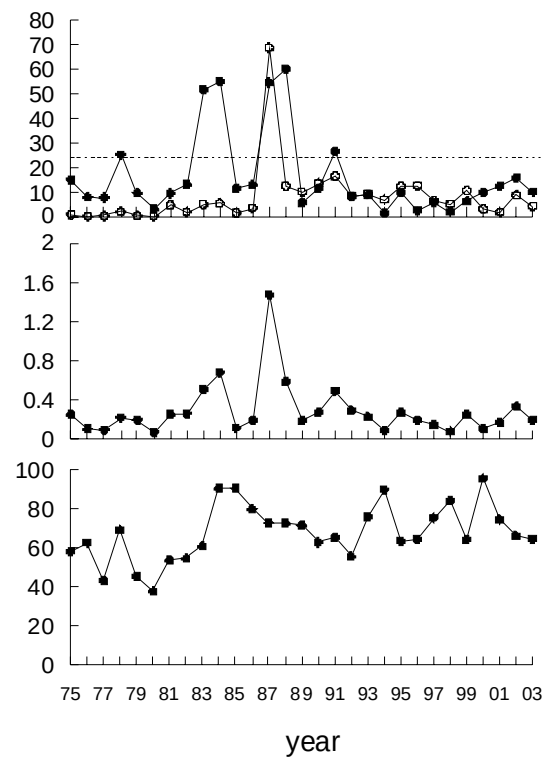
Block 2 (King Island)



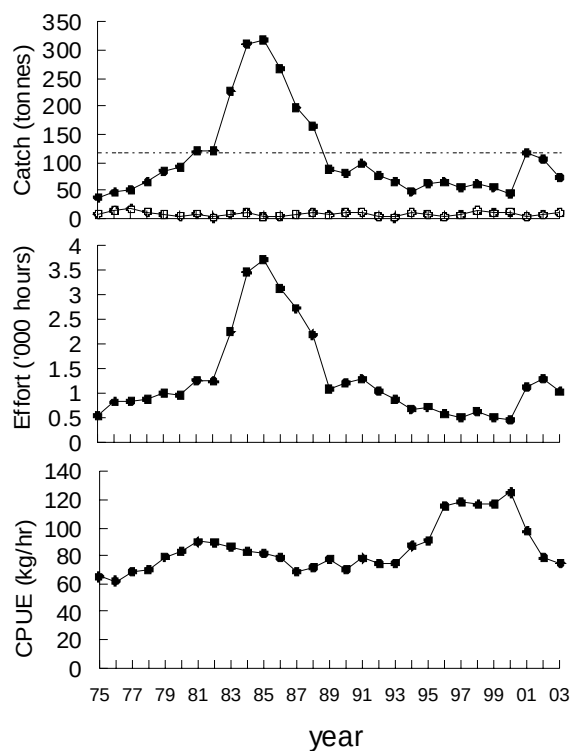
Block 3 (King Island)



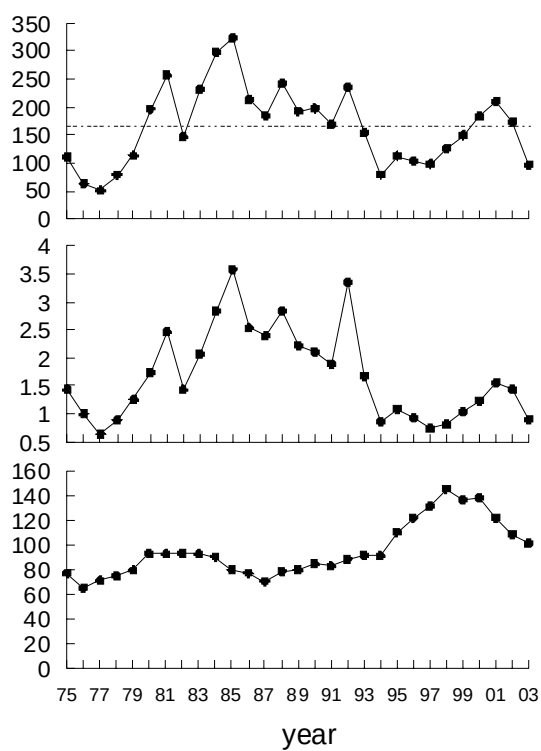
Block 4 (King Island)



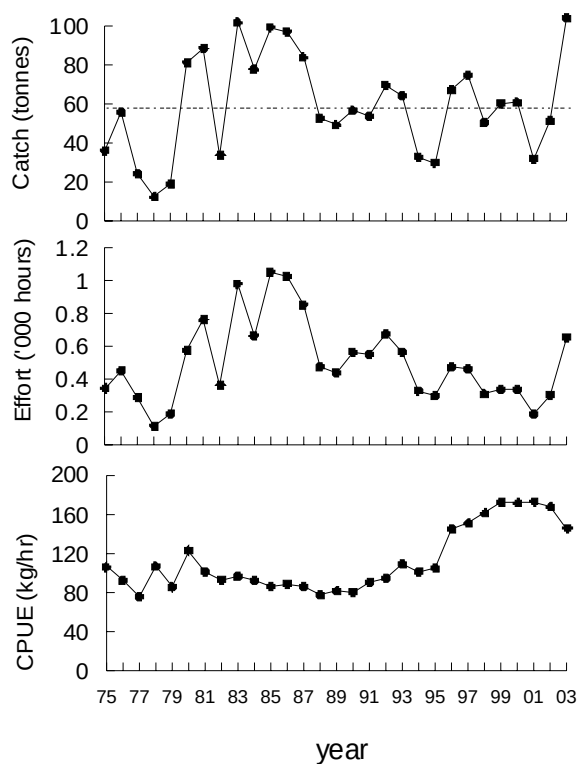
Block 5 (West Coast North)



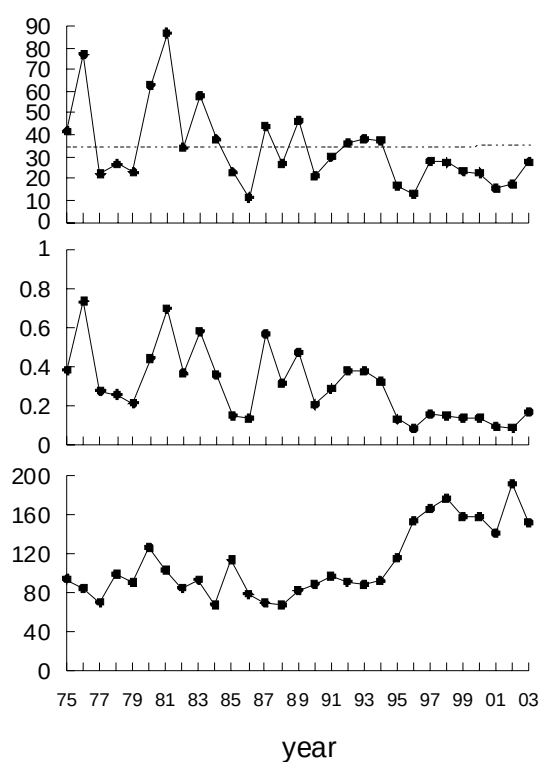
Block 6 (West Coast North)



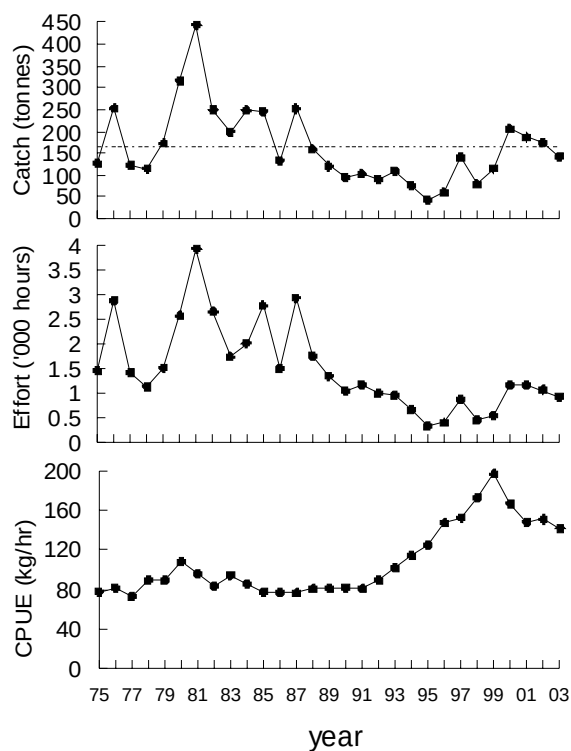
Block 7 (West & South-west)



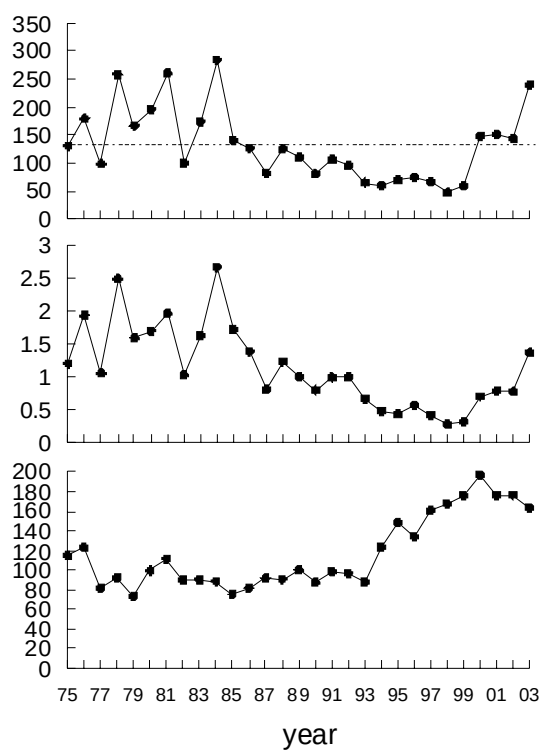
Block 8 (West & South-west)



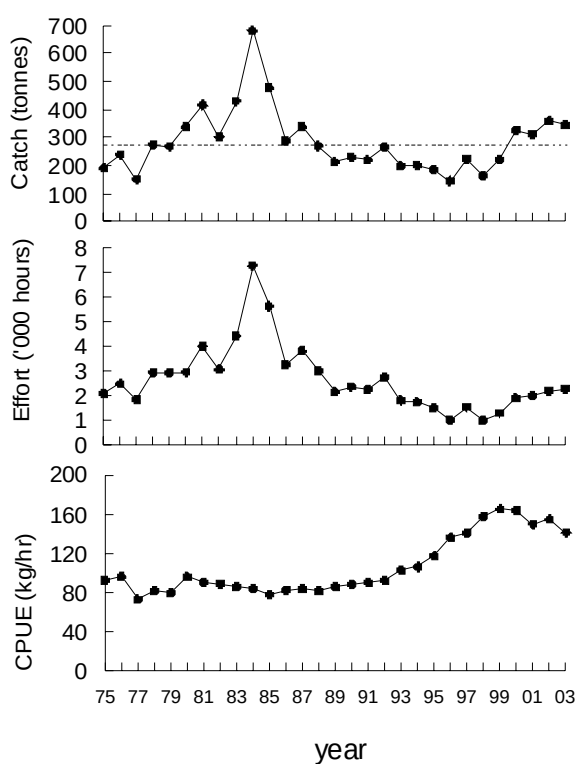
Block 9 (West & South-west)



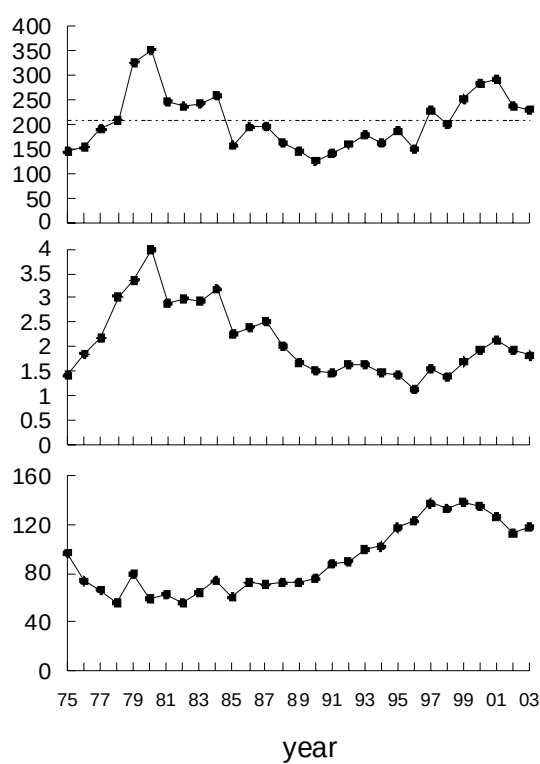
Block 10 (West & South-west)

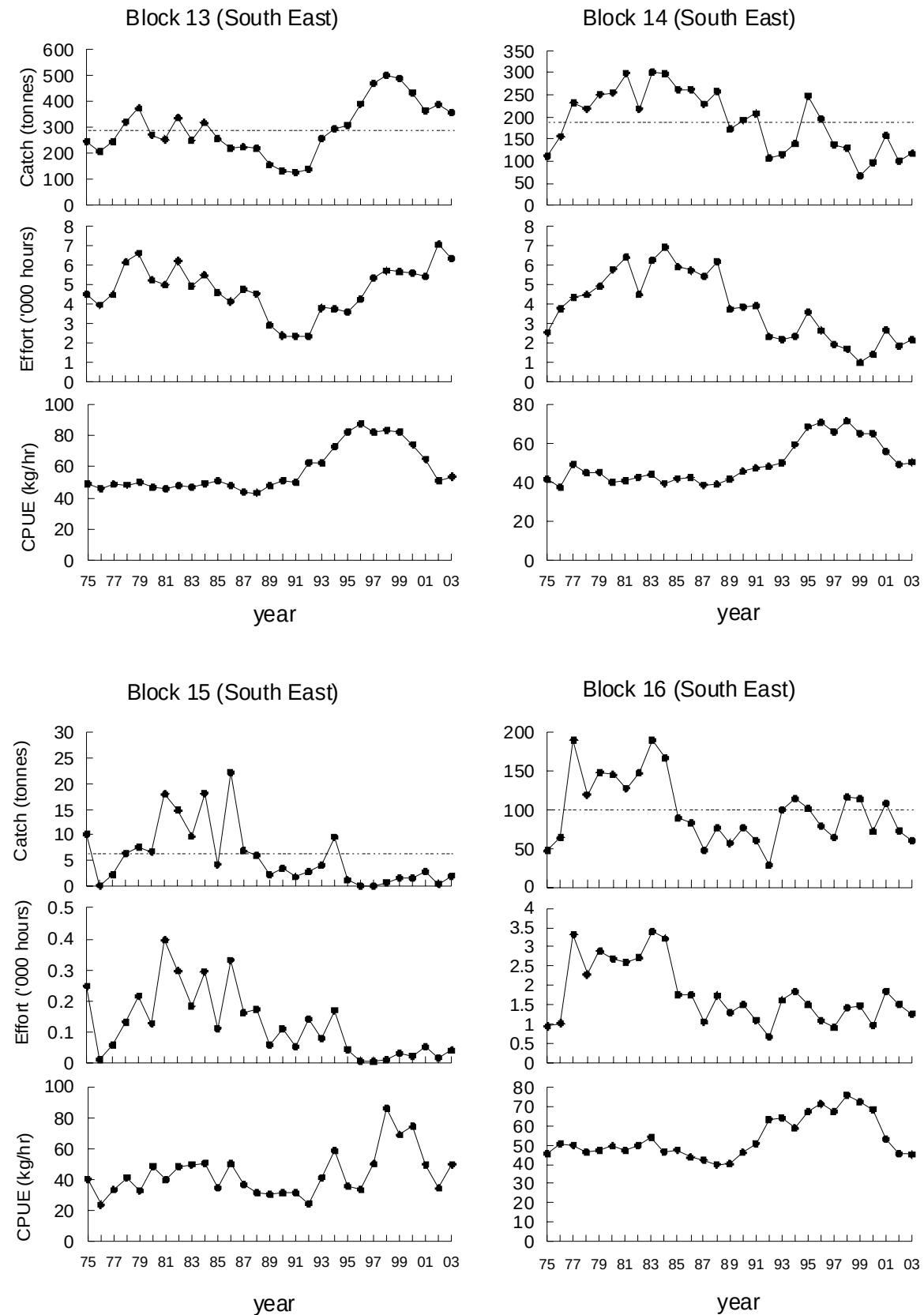


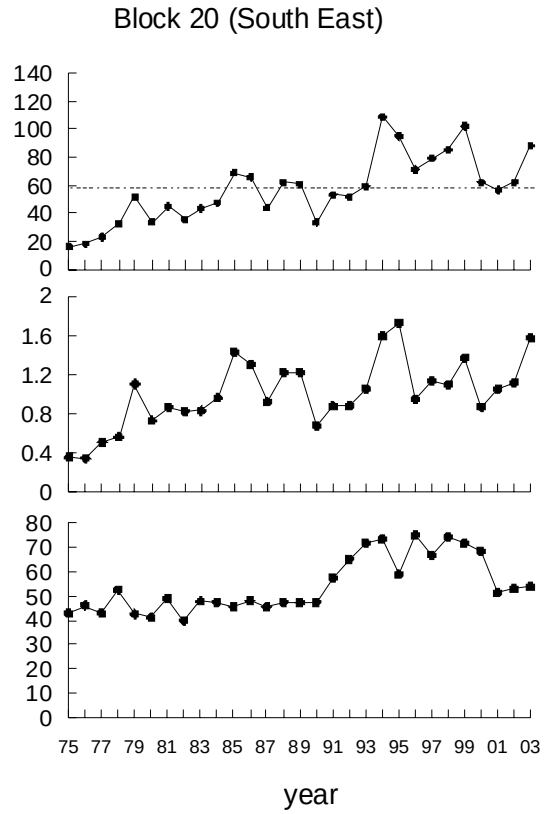
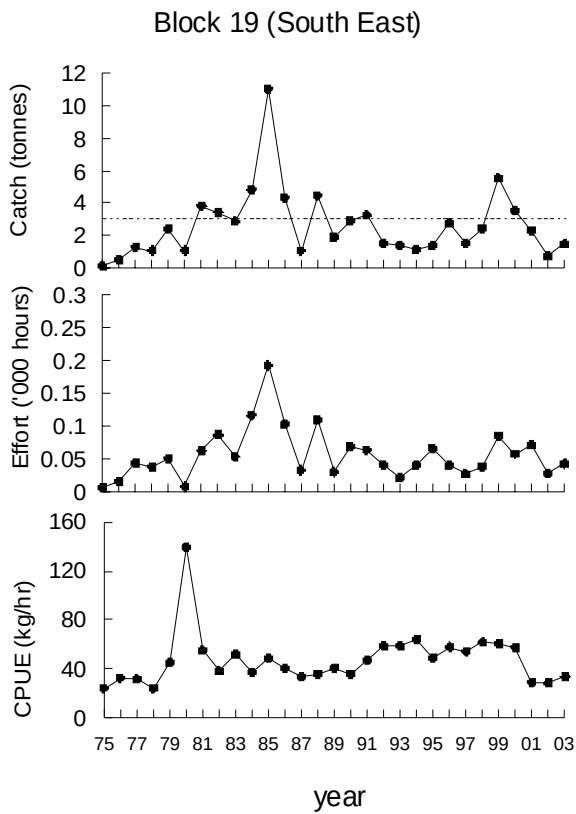
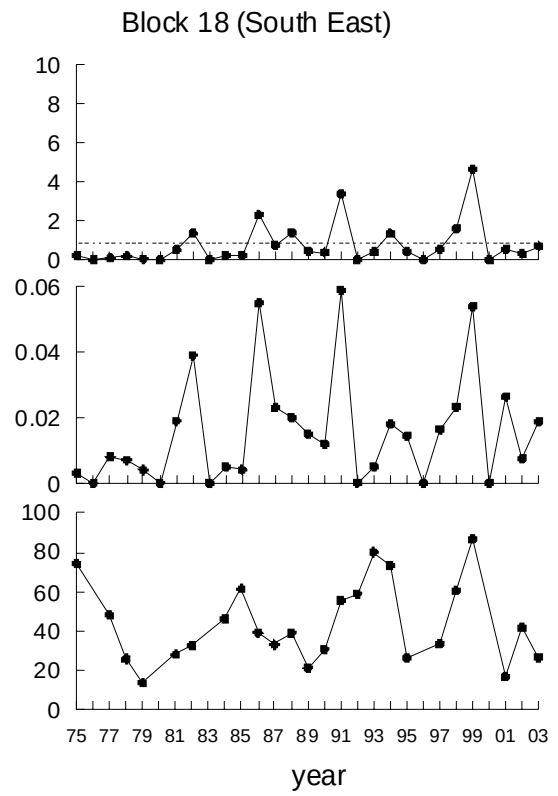
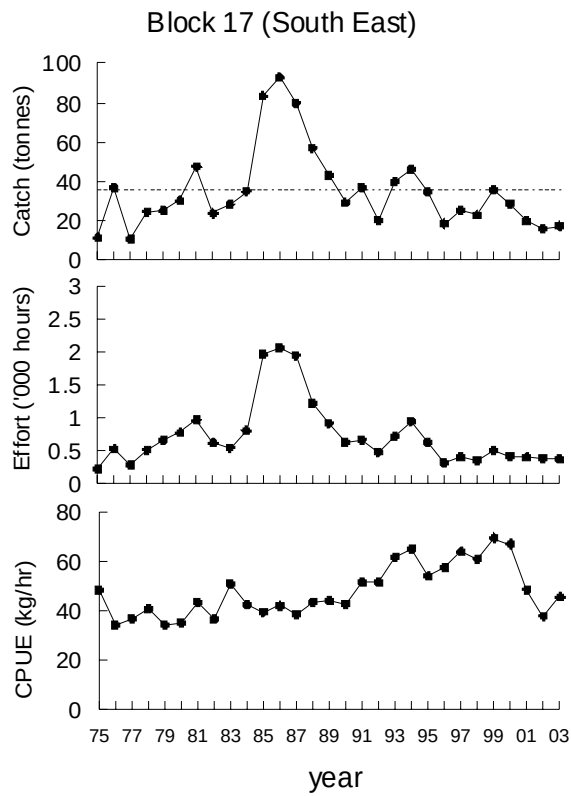
Block 11 (West & South-west)

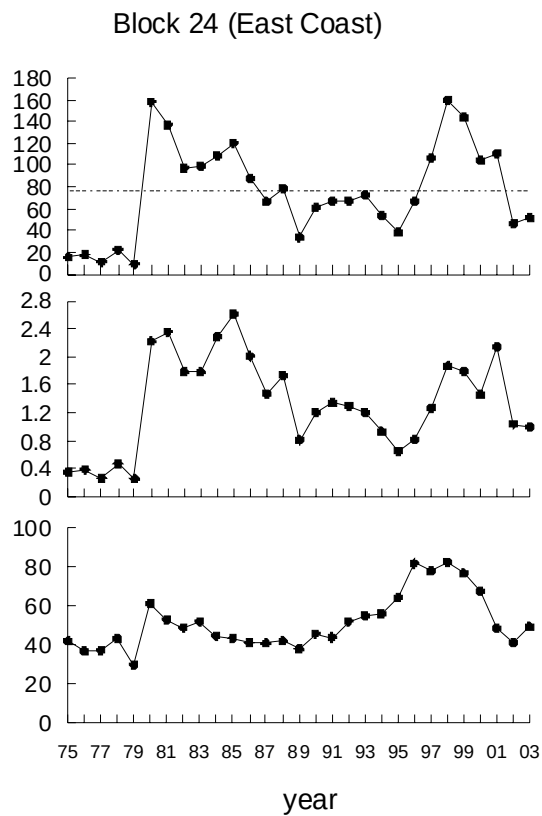
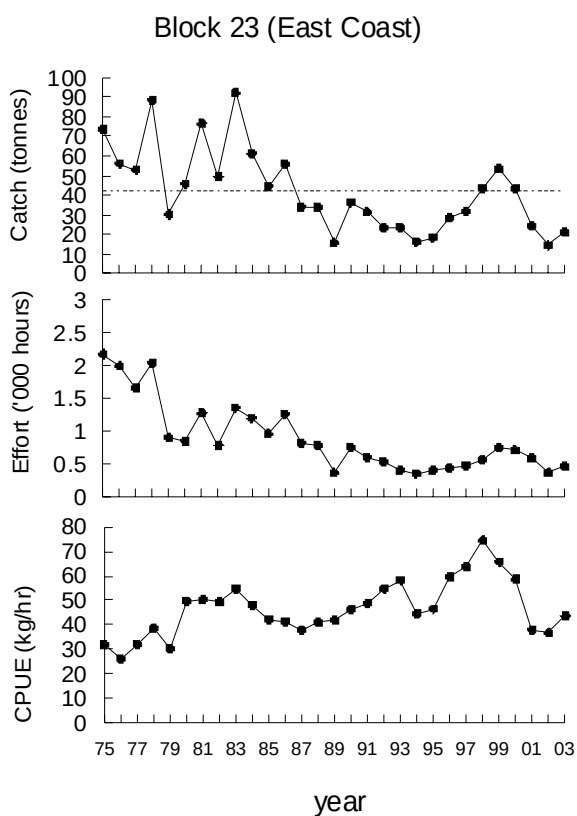
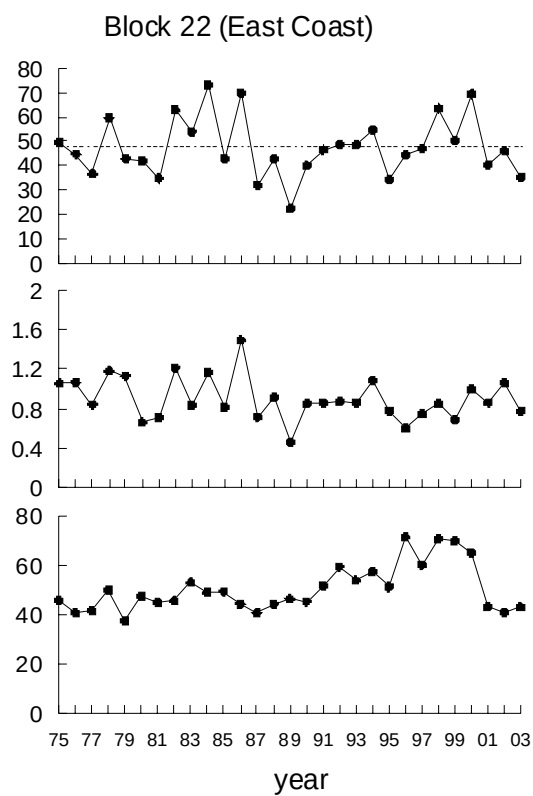
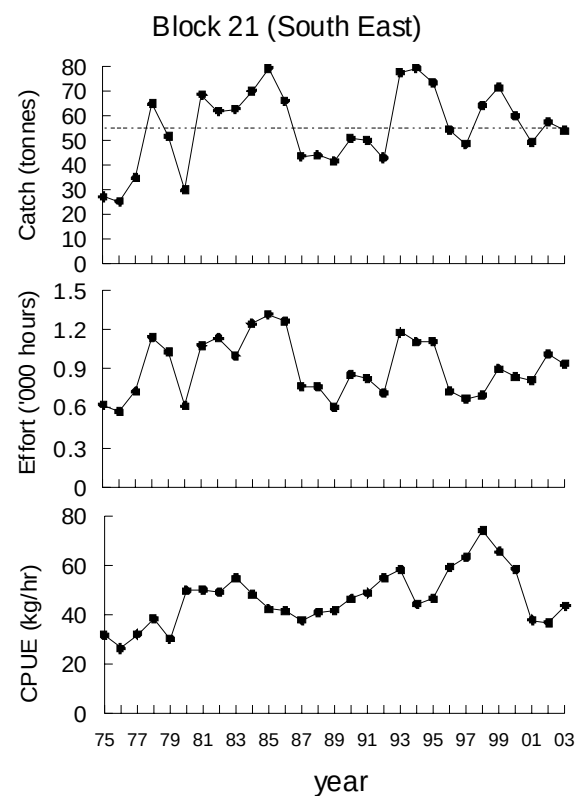


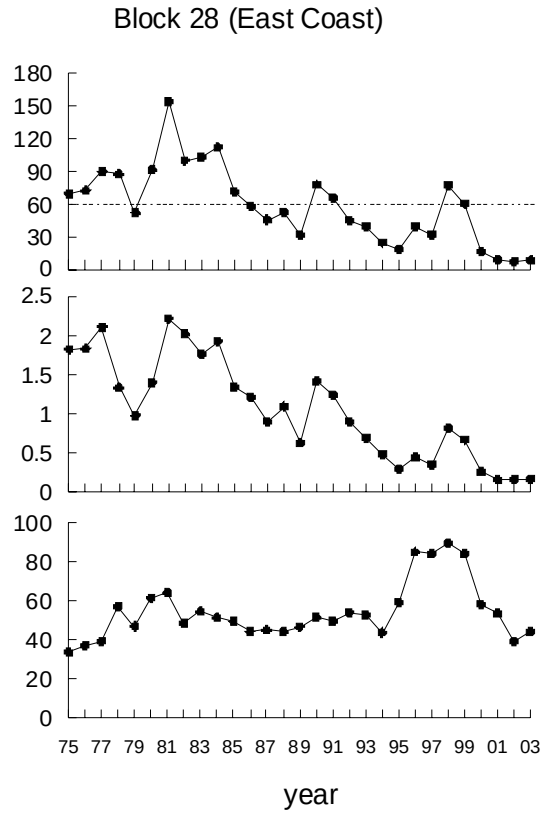
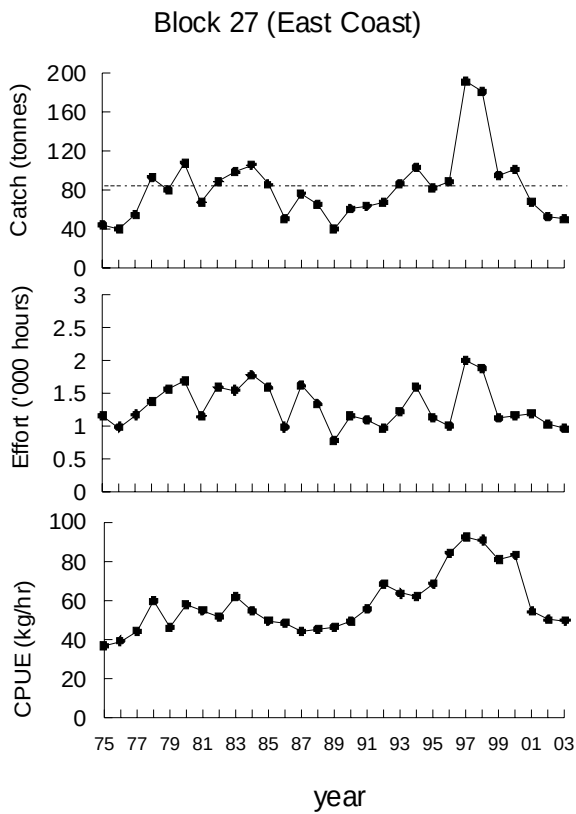
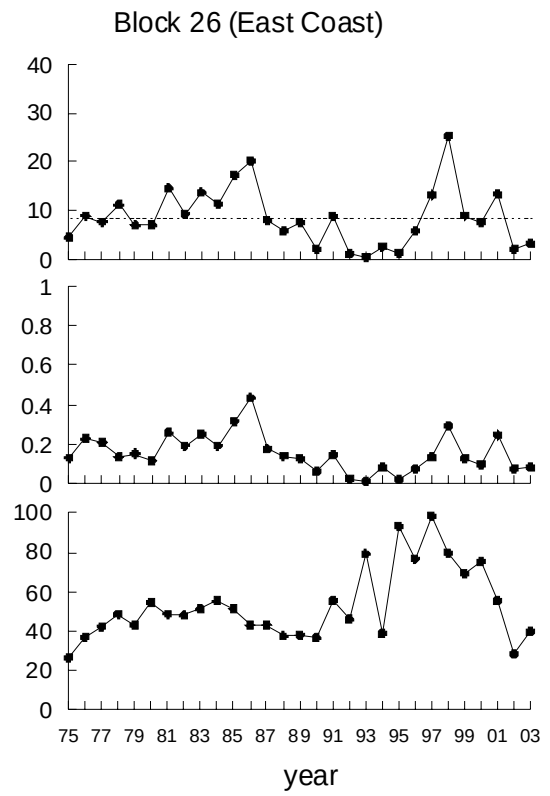
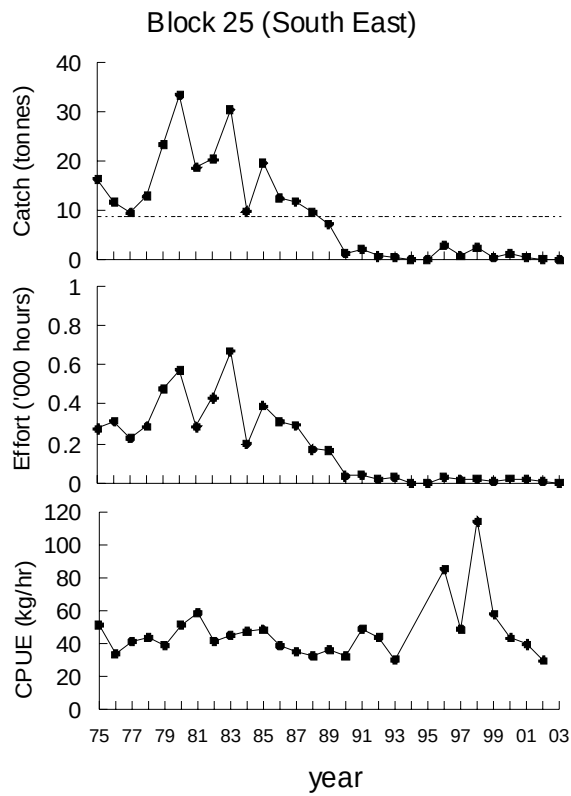
Block 12 (West & South-west)

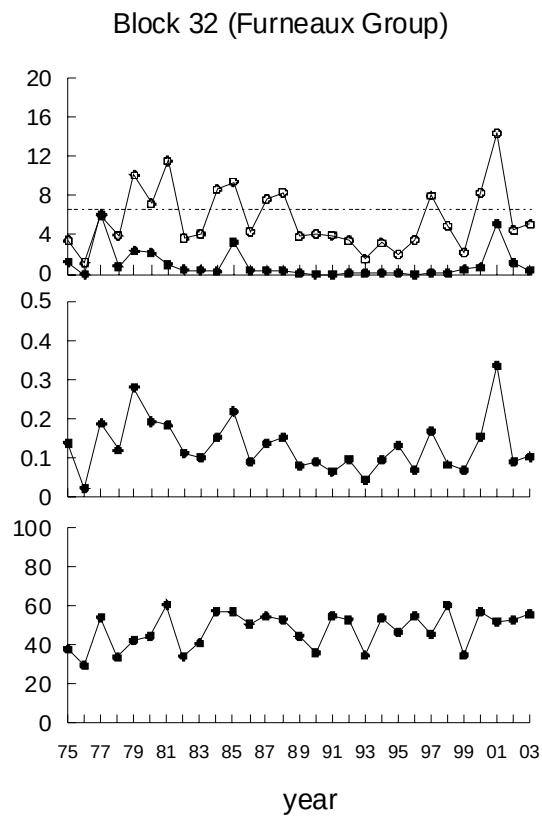
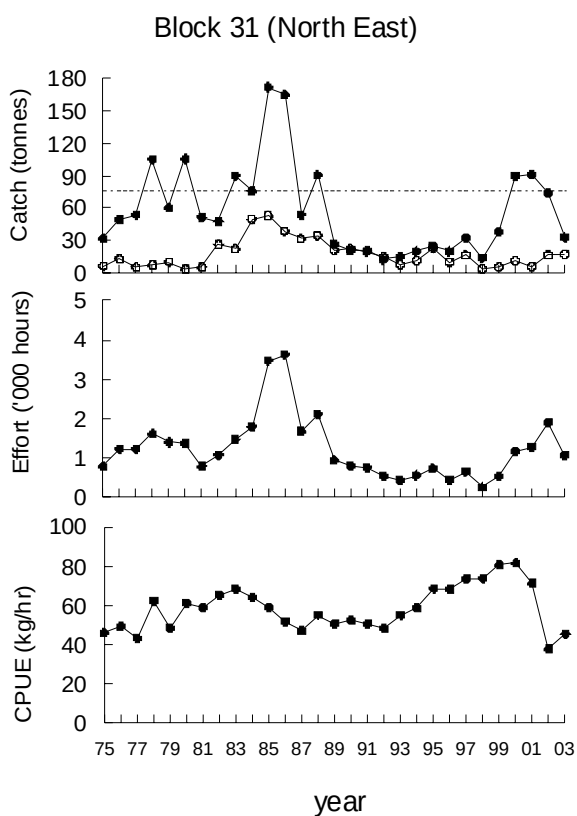
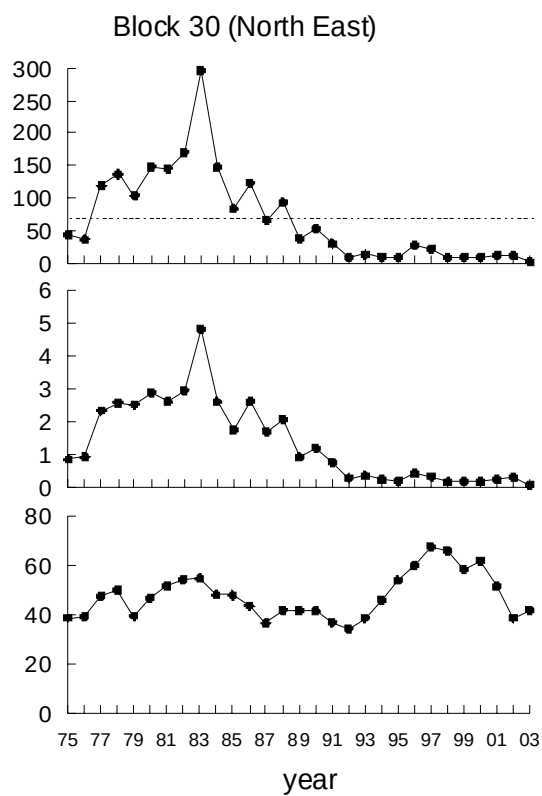
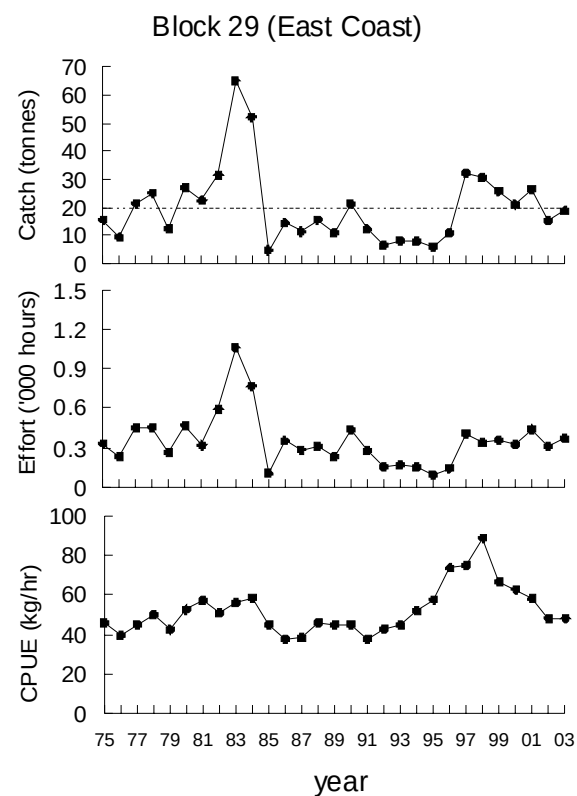




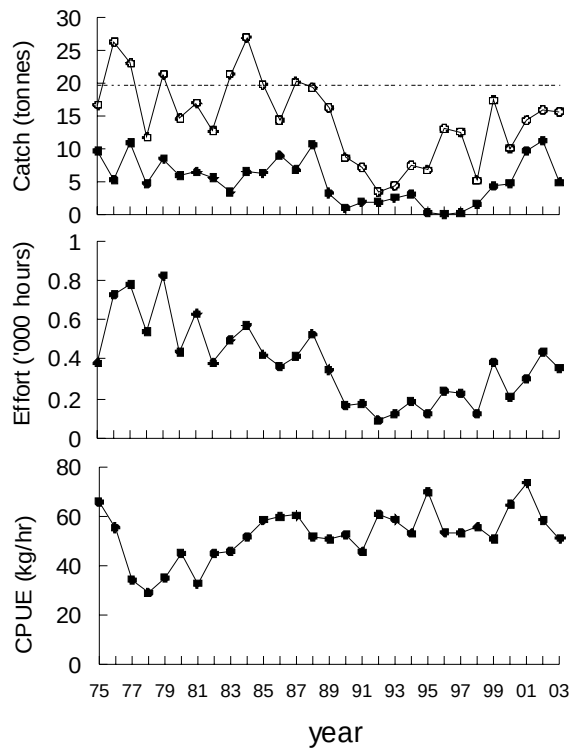




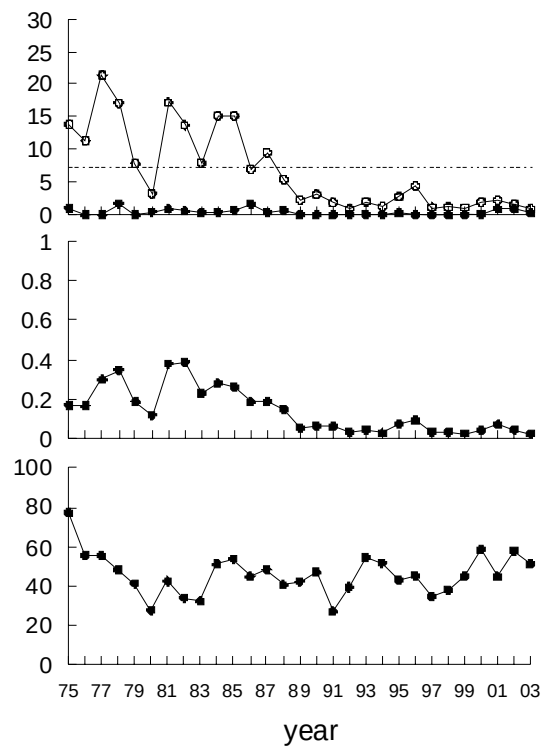




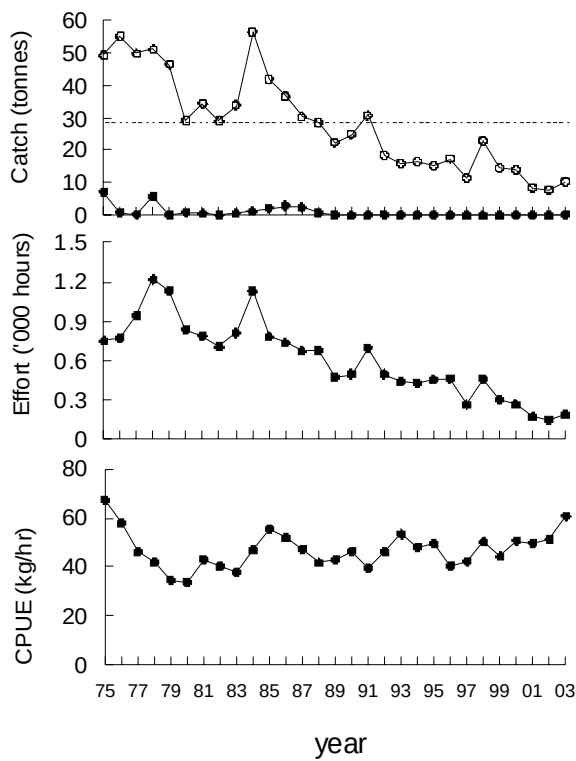
Block 33 (Furneaux Group)



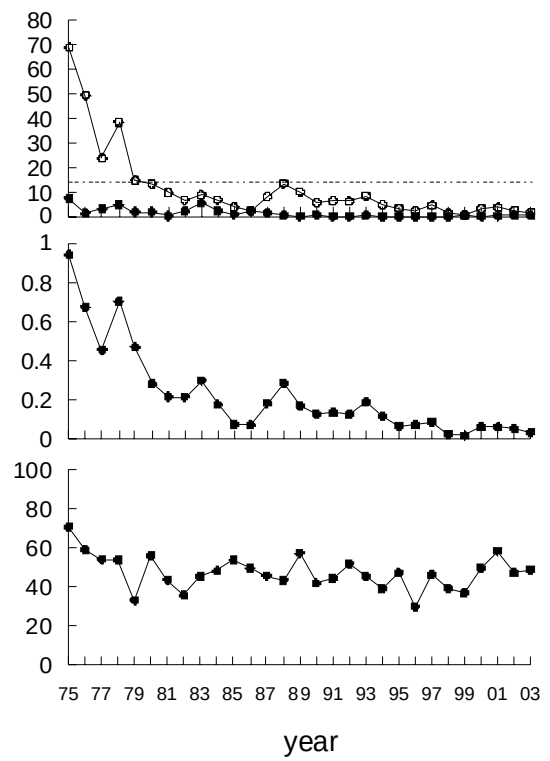
Block 34 (Furneaux Group)

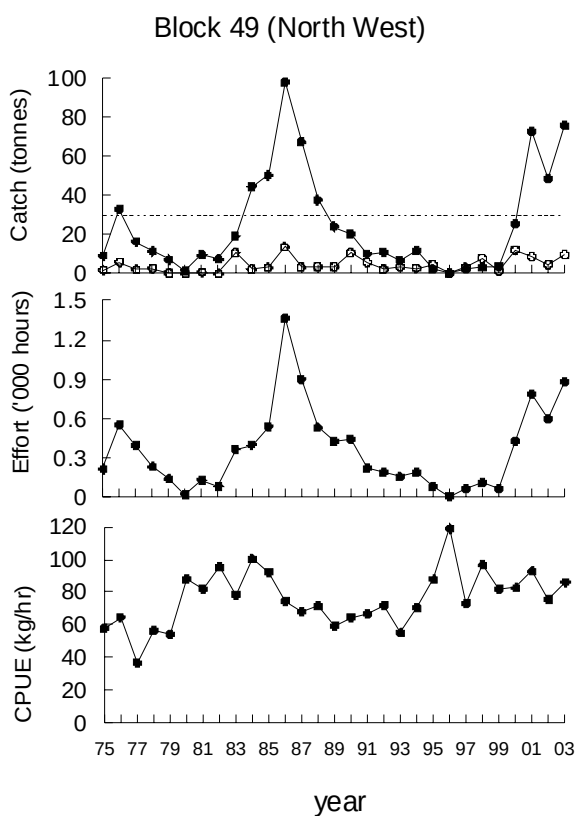
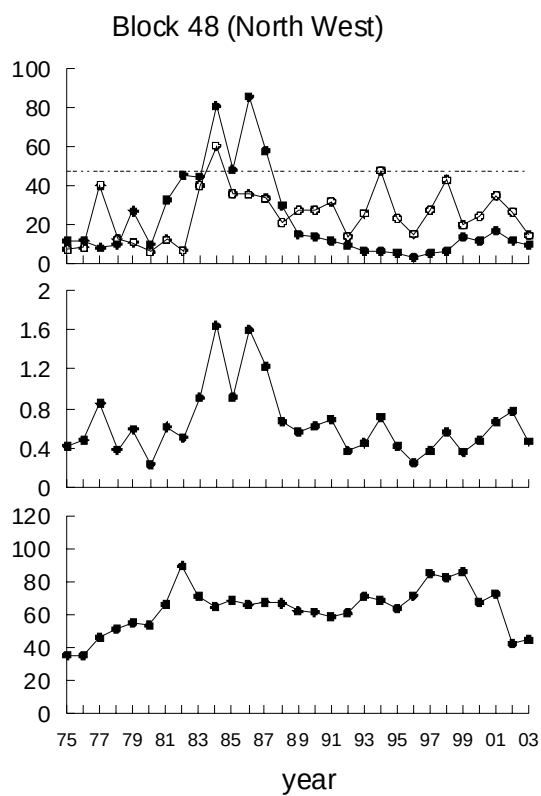
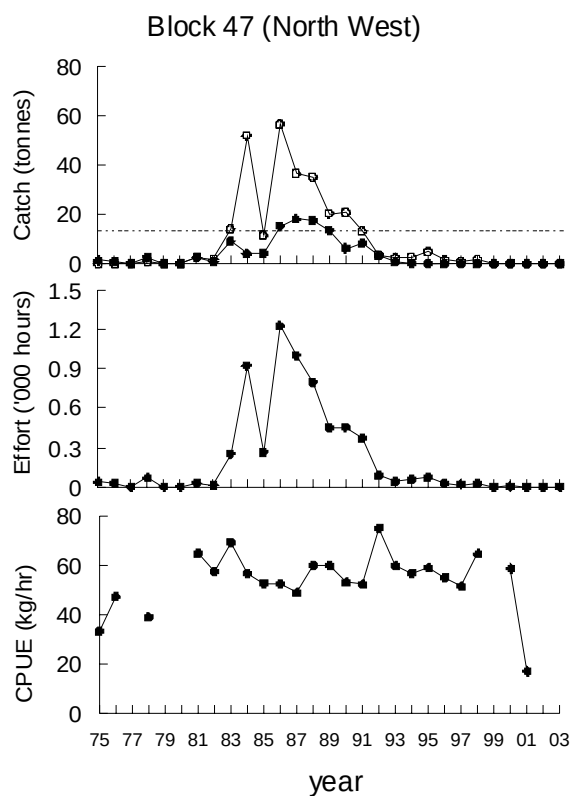


Block 35 (Furneaux Group)



Block 36 (Furneaux Group)



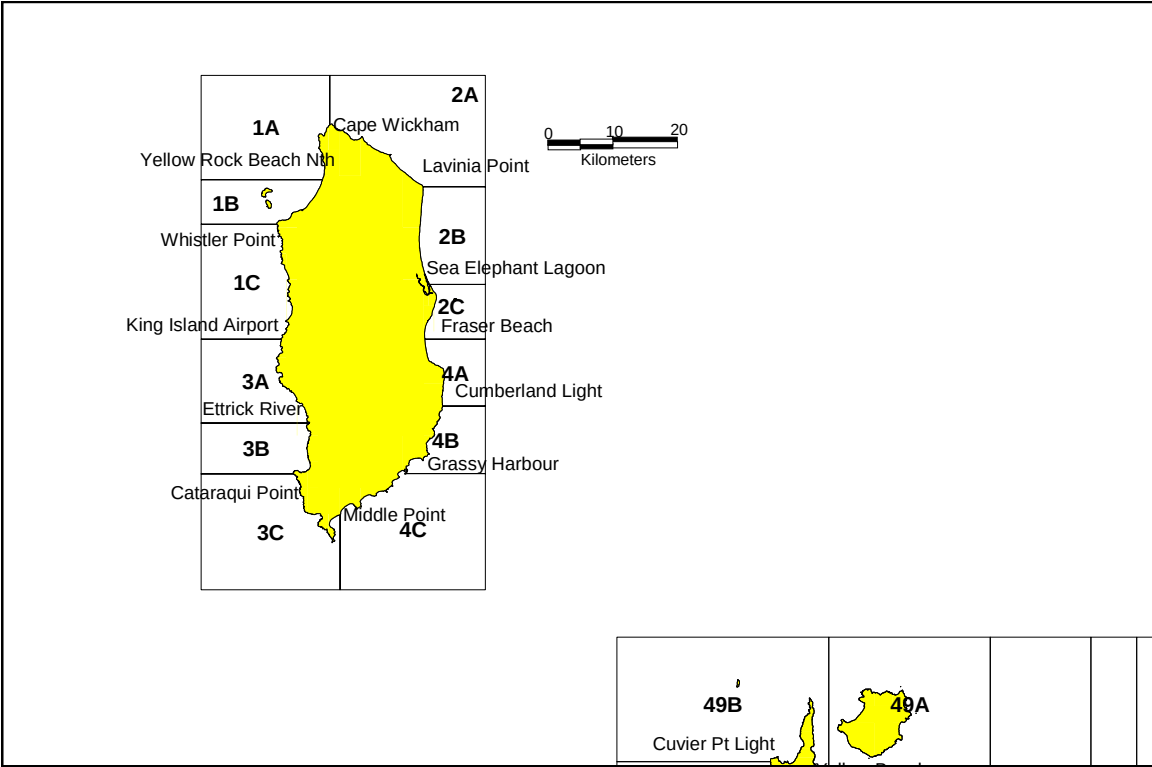


Appendix 9. Maps of blocks and sub-block boundaries.

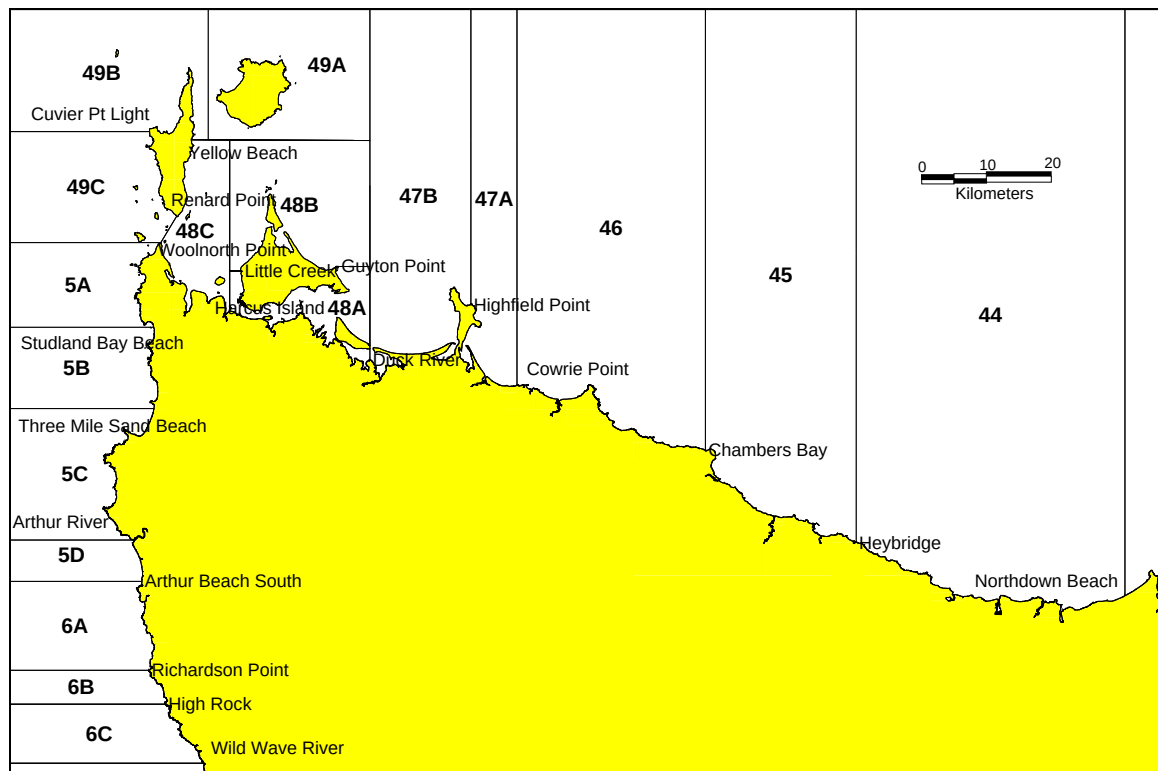
These blocks and sub-blocks are used to report the position from which catch has been taken, for the Tasmanian abalone fishery. Catch has been reported by block since 1974, and by sub-block since 2000.

It is not intended that these maps be used for any purpose other than identifying the position of sub-blocks mentioned in this report.

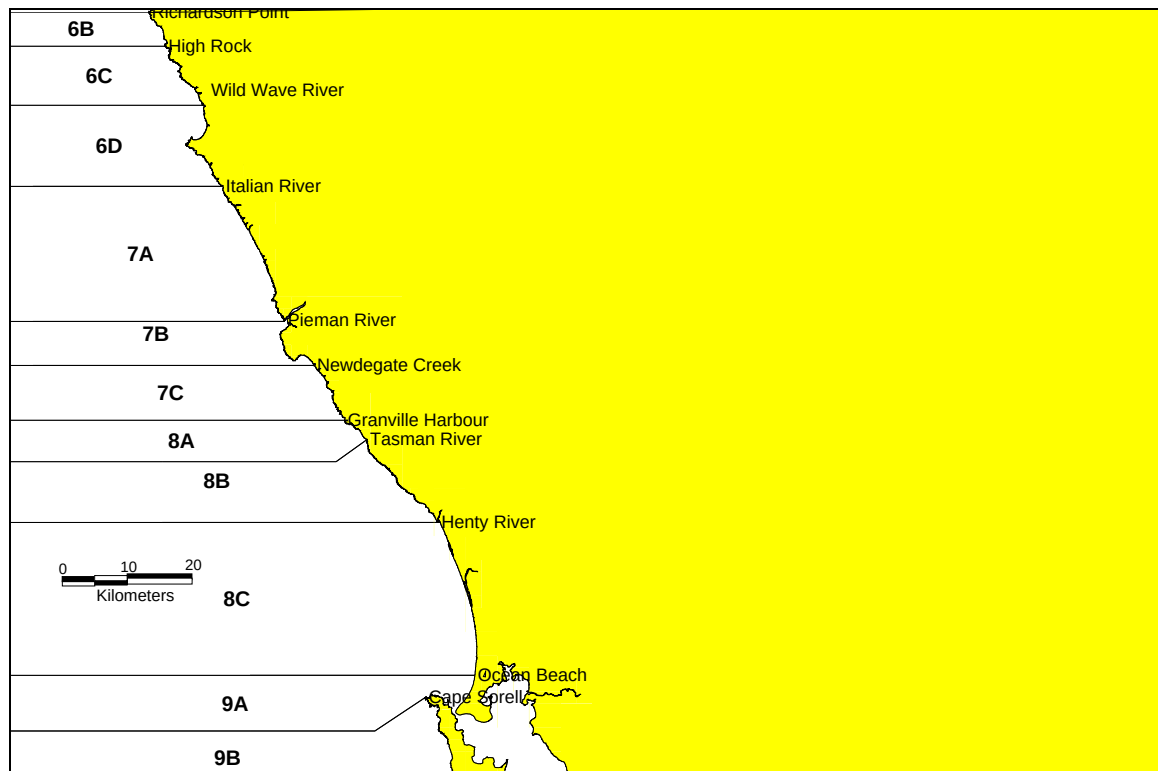
Map1: King Island



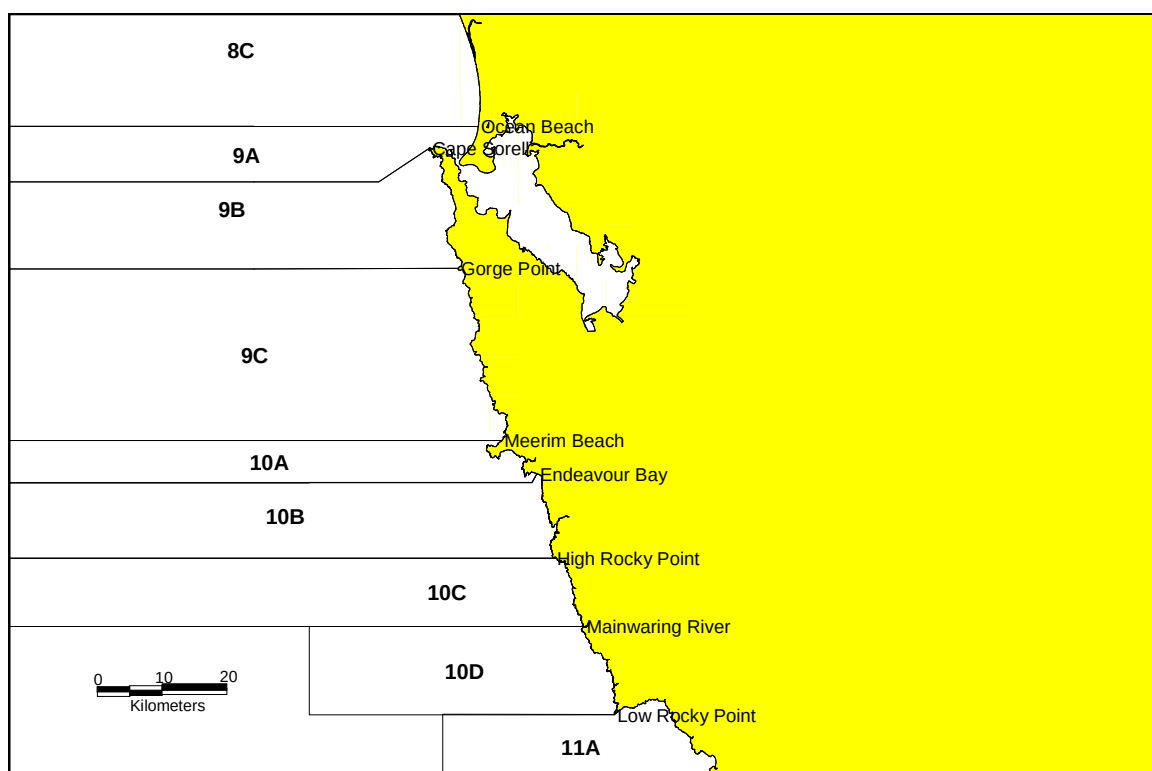
Map 2: North West Tasmania



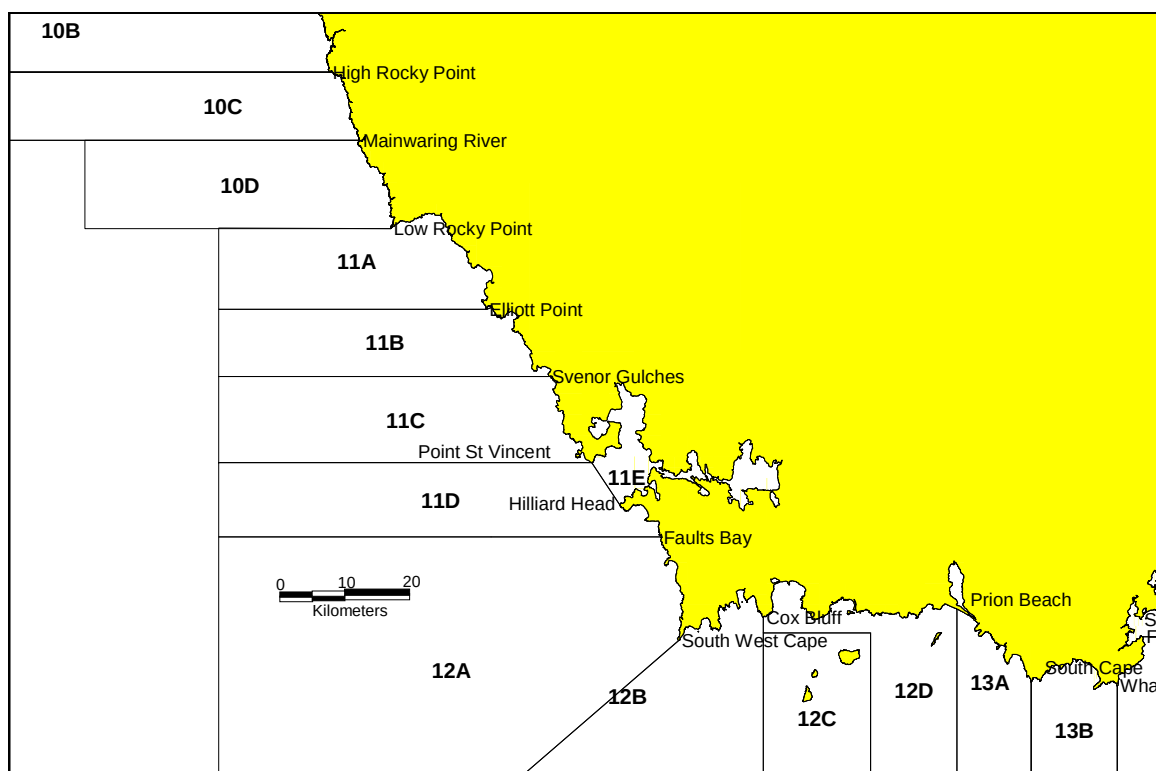
Map 3: Central West Coast (north)



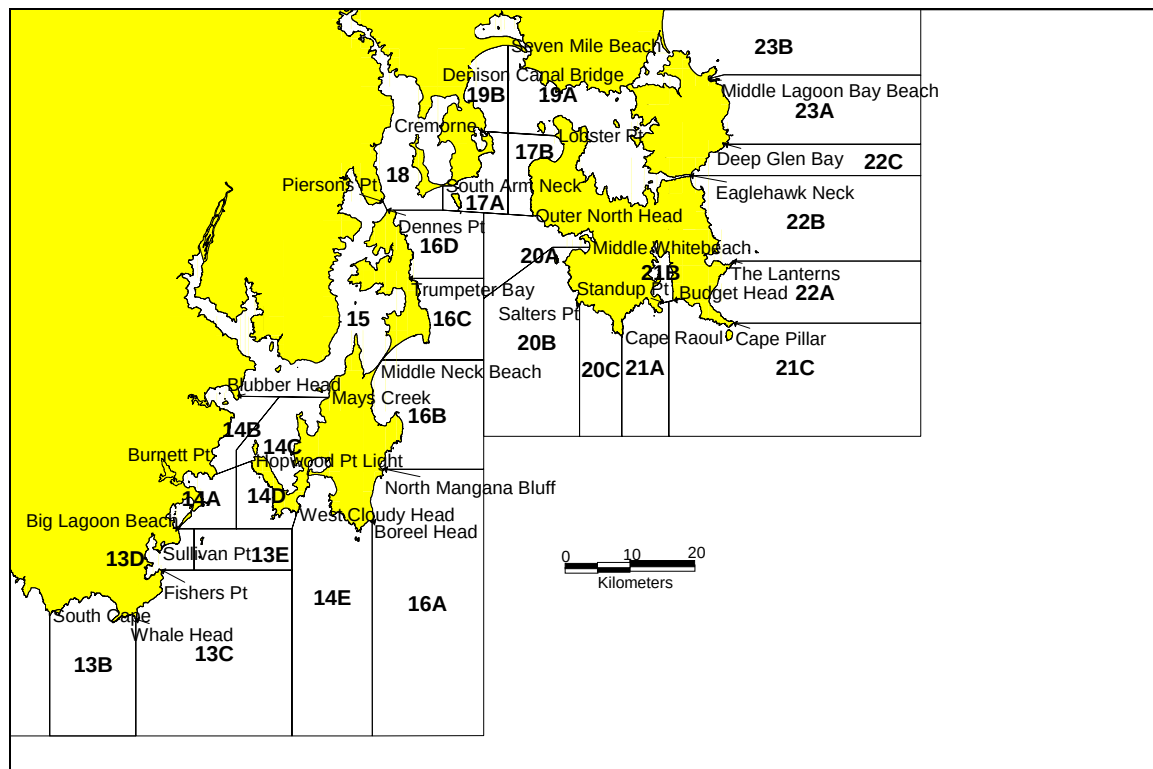
Map 4: Central West Coast (south)



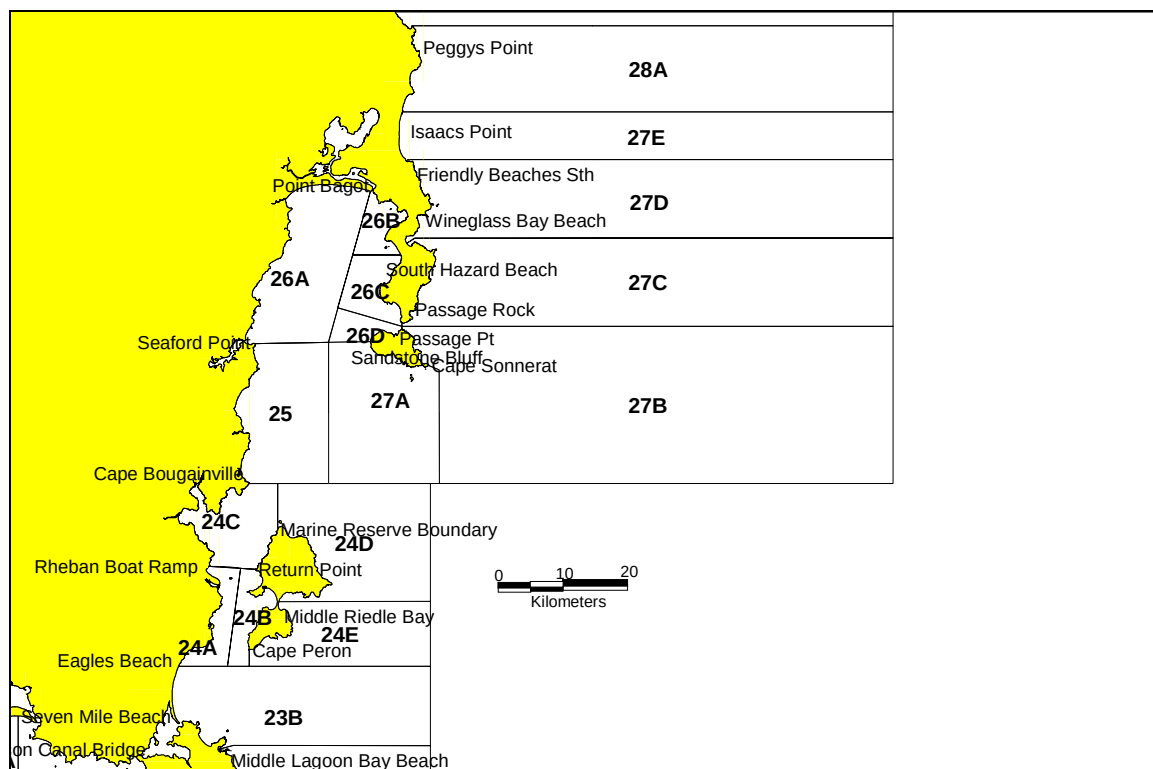
Map 5: South West Tasmania



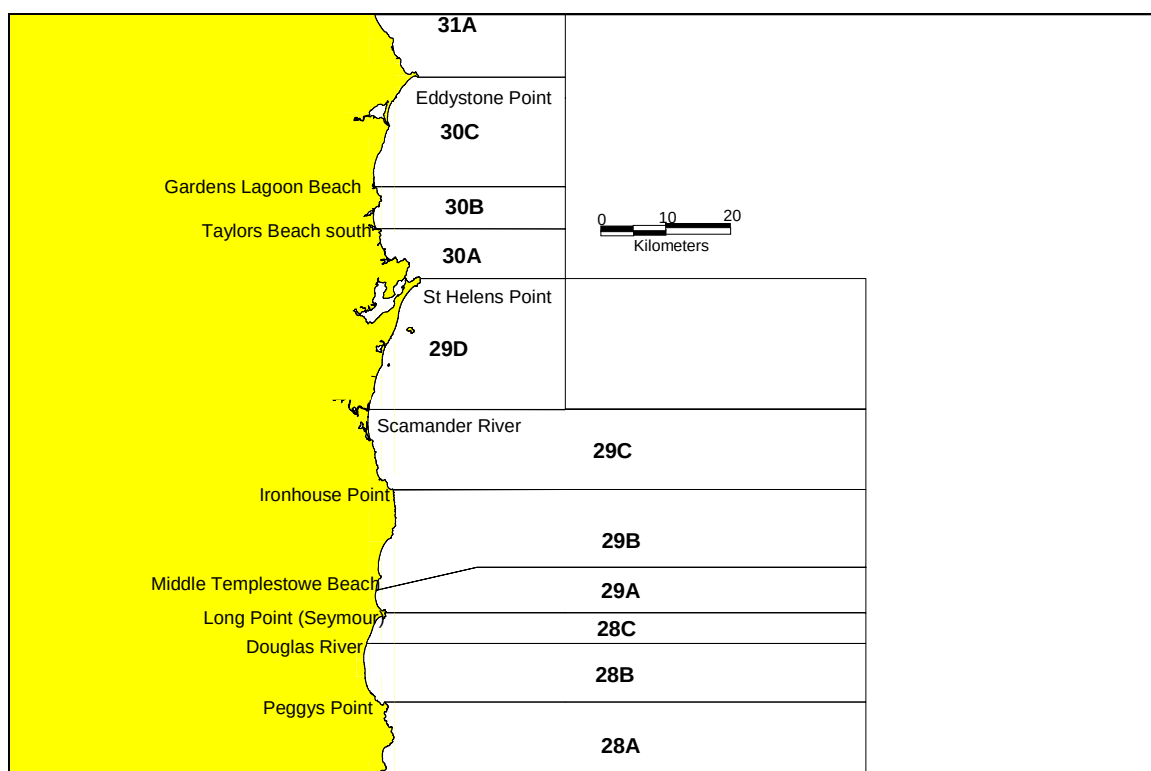
Map 6: South East Tasmania



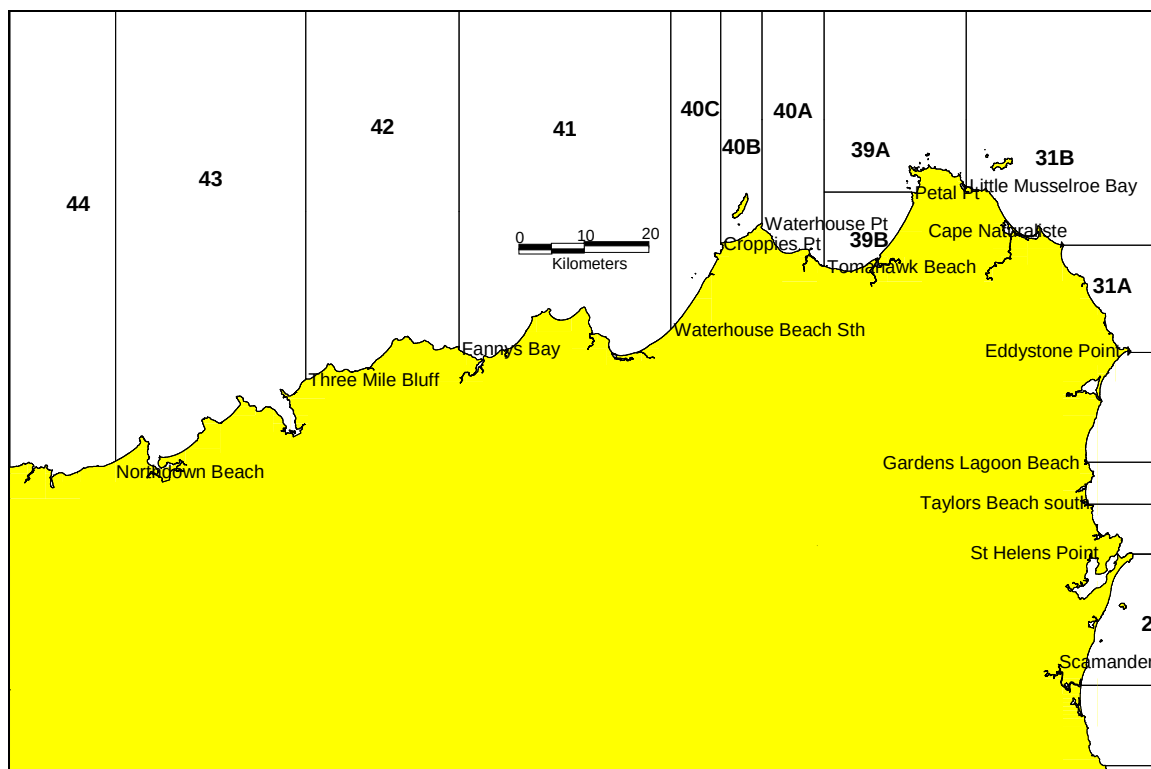
Map 7: Lower East Coast



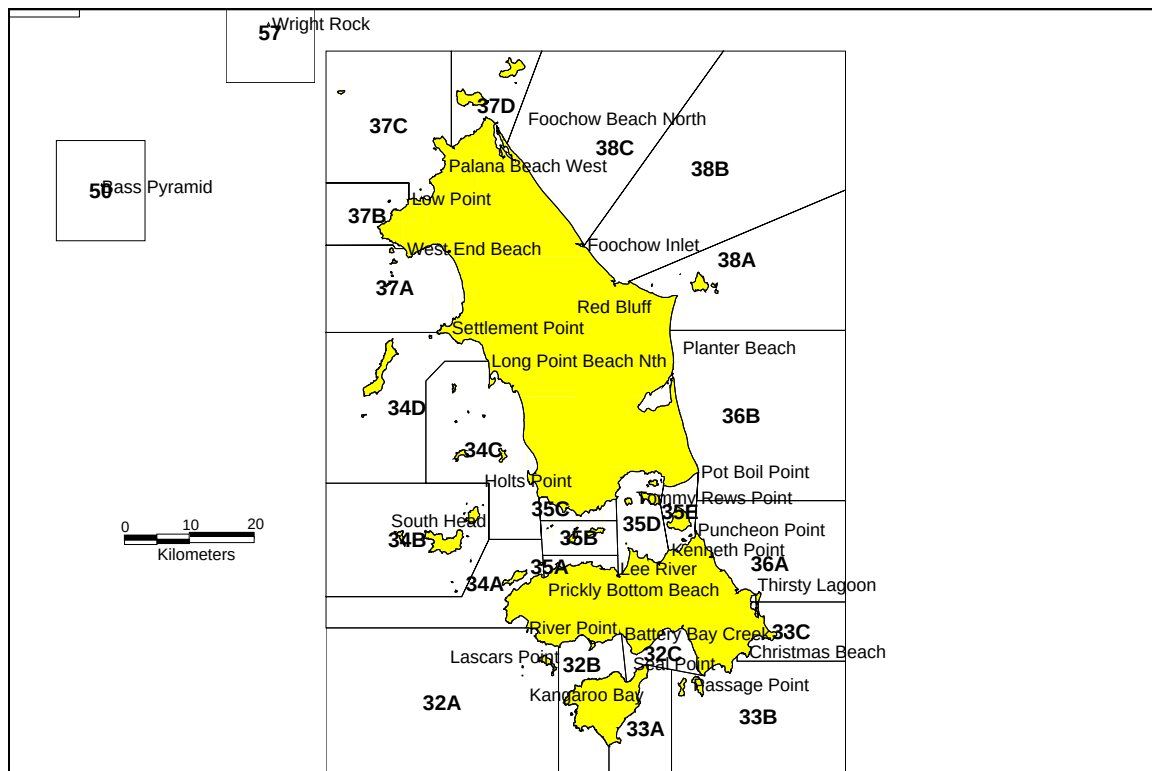
Map 8: Upper East Coast



Map 9: North East Tasmania



Map 10: Furneaux Group



Map 11: Bass Strait Islands

