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FISHERY ASSESSMENT REPORT

TASMANIAN ABALONE FISHERY

2004

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Abalone Fishery Assessment: 2004

Executive summary

The 2004 Abalone Fishery Assessment was based primarily on commercial catch and effort statistics and size-composition data from the Tasmanian fisheries 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 (DPIWE). These data were obtained from catch docketts provided by licensed divers. Catch rates were derived from the catch-effort data and annual variation in catch rate was interpreted as an approximate relative index of abalone abundance. The commercial catch sampling 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 help in the assessment of variation in levels of fishing mortality across years.

Since 2000, the Tasmanian blacklip abalone fishery has been sub-divided into geographical zones which in 2004 included 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 (catch caps). In 2004, the TAC from all parts of the fishery was 2502.5 tonnes.

The reliance upon catch and effort data to monitor trends in abundance has generally been demonstrated to be inappropriate, and its usage has been associated with the collapse of many abalone fisheries. There are several factors that adversely affect the relationship between catch rates and abalone abundance: gregarious behaviour of abalone; serial depletion of local populations constituting the stock; and changes in fishing efficiency. Provided that the effect of these factors on abundance is understood and compensated for, catch rates appear to be a reliable index of abundance. There is a high degree of confidence in the use of catch rates to monitor the fishery, particularly throughout South East Tasmania and other parts of the fishery where effort is consistently applied. Much less confidence pertains where levels of effort are low in proportion to the size of abalone populations and are applied at irregular intervals (e.g. most of the Western Zone). It is considered that catch rates are not reliable in the greenlip fishery, the King Island blacklip fishery and the Bass Strait Zone, hence the assessment is correspondingly less certain in these areas.

The 2004 **Eastern Zone** TAC was 770 t, a reduction of 87.5 t from 857.5 t in 2003. Most of the catch reduction occurred at the Actaeons, where the 2004 catch was down by 71 t. A smaller catch reduction (17 t) occurred at Bruny Island. These reductions were particularly welcome as there was little evidence of widespread stock recovery in either region. In most parts of the Actaeons and along the southern Bruny Island coast, catch rates, whilst stable since 2002, remained below 50 kg/hr. Of greater concern was the fact that the median size of abalone landed in most sub-blocks had declined since the size-limit increase in 2002, and large abalone were now almost entirely absent from catches. The implications of this were that the fishery has become largely dependent

upon recruits and hence vulnerable to inter-annual variation in recruitment, that egg production has declined because of the smaller average size of the abalone, and that more individual abalone needed to be caught per unit of quota. This was strong evidence that exploitation levels had increased and suggests that current levels of fishing are unsustainable. If recovery is to take place, catches need to be limited in the Actaeons and the South Bruny region.

In the remainder of the Eastern Zone, catch rates have generally improved for successive years and there were indications that stock levels were recovering. In Storm Bay the median size of abalone had also trended downward, but considering the increased catch rates, it was thought that this was due to increased levels of recruitment rather than high levels of fishing mortality. On the East Coast, where the 2004 annual catch was the lowest since 1975, divers reported seeing much greater levels of abundance, particularly of emergent abalone smaller than legal size, implying that populations were becoming larger. In conjunction with increased catch rates the increasing median size of market samples from the East Coast was consistent with falling exploitation rates i.e. the abundance of legal-sized abalone had increased faster than they were being removed. However south of Eaglehawk Neck (Block 22) the annual catch and catch rates remained at low levels and it seemed that the rate of recovery here was less than further north.

Principal concerns in this assessment were for **Western Zone** stock levels. Throughout the zone, catch rates have fallen continuously since the later part of the last decade, albeit from high levels. This was interpreted to mean that the large biomass that had built up prior to the introduction of zoning was being steadily reduced. While it is acknowledged that stocks that expanded prior to zoning could not be expected to survive current levels of catch, and that some period of overfishing was acceptable in these circumstances, managers need to determine levels of catch rates where it would be prudent to limit catches. There is a concern over stocks levels in all parts of the Western Zone and how much longer total catches can remain at their current high levels needs to be addressed.

In the South West and the South Coast regions of the Western Zone, abalone grow to sizes larger than optimal for current markets and consequently processors have been refusing to accept abalone greater than 160 mm (live market) or 170 mm (canners). This meant that divers tended to leave large quantities of otherwise legal sized abalone, and fish the remaining stock of abalone (between the legal size limit and the processors' upper limit) at much higher levels. It was reported that sections of coast where abalone commonly grow to unmarketable size were not being fished, and that divers were severely depleting areas with smaller abalone. This greatly affects catch rates, because divers are forced to measure more abalone and selectively fish. It may also lead to divers serially depleting parts of the coast where there are marketable abalone. It also affects the ability to assess abalone stock levels using historical trends in catch and catch rates. The biological consequences of this selective fishing are described as follows: many more abalone are taken per unit of quota; fewer abalone survive until they reach the upper size limit; egg production is greatly reduced; and yield from the larger sized abalone that formerly contributed to the TAC is unavailable. Effectively, the fishable biomass has been reduced in proportion to the weight of legal but un-marketable abalone divided by the weight of the legal-sized biomass, and the

TAC is being taken from the remaining fraction of the biomass. This is clearly unsustainable and requires urgent management consideration.

During the early years of the **Northern Zone**, most fishing was concentrated on the more accessible areas of the North West (Blocks 5, 48 and 49). Despite the recent shift in effort from the region to King Island, reefs close to Woolnorth Point remain depleted. The annual catch from King Island has increased for four consecutive years and is now approximately 130 t, with 85 t being taken from Block 3. While historical catch data from Block 3 must be considered unreliable, only once (in 1977) has the reported annual catch been higher (87 t), so it is unlikely that current levels of catch can be sustained. Stock levels in the remainder of the Zone (North East Tasmania, Furneaux Group) appear to be stable.

Most of the **Bass Strait Zone** blacklip catch was taken from the offshore islands in central Bass Strait. It is unlikely that catches from the Hogan Group can continue at current levels (i.e. > 35 t) without depleting stocks. It is disturbing that effort is not more widespread to areas such as the northern Furneaux Group, which consistently supplied much higher levels of catch during the limited opening fisheries between 1989 and 1995. The central northern coast of the Tasmanian mainland is currently lightly fished in comparison with 1989 when over 80 t was landed.

On King Island, size limits for **greenlip** abalone, which were increased in 1998 to improve sustainability of heavily fished populations, have now proven to be too large for viable fishing in some formerly productive areas. This has meant that effort was concentrated on a reduced number of reefs with adverse effects on their abalone populations. In North East Tasmania, greenlip stocks on most reefs have recently become depleted, and in 2005 the regional cap was reduced from 30 t to 23 t. It remains to be determined whether this level of reduction is adequate, and the fishery in this part of Tasmania will require close monitoring. Stock levels in the remaining parts of the greenlip fishery (North West and the Furneaux Group) appear to be stable.

The number of recreational abalone fishing licenses has increased by an average of 10% annually since the 1995-96 season. It has been estimated that about 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, the recreational catch may seem insignificant, yet because it is taken mostly from the more accessible parts of the coast, and often from areas of the Eastern Zone which are heavily fished by the commercial fishery, it may contribute significantly to localised depletion in those areas.

Abalone are also caught in Tasmanian waters in the following ways: 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.

Recommendations

The inadequacy of CPUE-based assessments in many parts of the Tasmanian fishery is stressed, and it is strongly recommended that a fishery-independent abundance survey program be implemented.

In the most southern parts of the **Eastern Zone**, it is recommended that the catch for sub-blocks 13C, 13D and 13E should be limited to the level of the 2004 catch (220 t), until there are unequivocal indications that stock levels are increasing. The adjacent Block 14 has also been adversely affected by high and constant fishing pressure and managers should curtail any transfer of effort from the Actaeons to South Bruny.

Throughout the **Western Zone**, it is recommended that appropriate levels of catch be set for each block so that catch rates can be sustained at reasonable levels instead of falling continuously. The TAC should then be set at the sum of the catches for all blocks. For example, if the long term geometric mean catch is used for each of the Western Zone blocks (with the top and bottom 3% of catches removed), then the Western Zone TAC should be set at 1004 tonnes, which is 256 tonnes lower than the current TAC.

The selective fishing for smaller abalone in the size range of 140 – 160mm is an impediment to successful management and a significant threat to stocks in the Western Zone. It is recommended that managers either reduce the TAC by the proportion of un-marketable large abalone, or devise ways that the large abalone will become part of the fishable stock once more.

In the **Northern Zone**, King Island is probably now producing blacklip at or beyond maximum capacity. It is recommended that managers request a review of information on size limits and yield for the King Island blacklip fishery and re-assess the ability of the region to provide current levels of catch.

It is strongly recommended that managers review **greenlip** catch and size limits on King Island, and in conjunction with TAFI, explore methods for making slower or smaller growing stocks available to the fishery once more.

There is a concern over the high proportion of **Bass Strait Zone** catch taken in the Hogan Group, and the subsequent rapid decline in catch rates in this area. It is recommended that managers reduce the level of catch in the Hogan Group, and find ways of transferring effort to the relatively unexploited stocks of the central north coast of the Tasmanian mainland. This may require a review of the size limit for the mainland portion of this fishery.

It is recommended that TAFI conduct a review of the performance of the fishery in all areas of concern identified in this report, by September 2005. These areas include Blocks 13, 14, 22 and 30 (Eastern Zone), Blocks 6, 7, 12 and 13 (Western Zone), Blocks 1, 3, 4, 5, 31 and 39 (Northern Zone), Blocks 37 and 53 (Bass Strait Zone) and the King Island and North East greenlip fishery.

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1. Introduction

This document groups the fishery by major regions within zones. Where necessary, reference is made to the blocks or sub-blocks within a region to help understand the performance of each region. However, the fishery in each sub-block is rarely independent of the fishery in other sub-blocks so it is neither valid nor practical to review the performance of every sub-block in the fishery.

Together with each region's catch and catch-rate chart, comparisons of catch-rate distributions for each of the last five years have been included. These charts show the distribution of catch-rates across all divers i.e. the proportion of daily records having catch-rates in categories grouped from low to high. By comparing distributions between the most recent five years, it is possible to see where changes in catch-rate have occurred, and what effect they have had on the mean (average) catch-rate.

As in previous years, geometric means of catch rates have been used instead of arithmetic means. Geometric means are less affected by variable skewness of distributions (for example, where there are a small but variable percentage of high catch-rates) and are more reliable estimators of the mean catch rate across all divers. Only catch rates from catches of 40 kg or more were considered when calculating mean catch rates. This was done in an attempt to reduce the effects of fishing affected by mechanical breakdown or calculating catch rates on the by-catch of fishing for different species.

We have also provided trends of the median size of abalone from diver's catches, by sub-block, month and year. This information is used to help determine the status of stocks (providing sufficient samples have been taken). If the catches are comprised mostly of high percentages of small abalone, or the size of abalone in catches appears to be falling through time, this suggests that fishing pressure is at a high level because all abalone are caught before they can grow to larger sizes.

At the end of this document are a number of appendices. Appendix 1 contains detailed explanations about reading the catch, catch-rate and size-composition charts.

Appendices 2-6 contain tables of annual catches for the blocks in each zone for all years since reliable catch data was first kept. A history of management changes in the fishery and a series of maps of sub-block boundaries have been included to simplify the location of each of the areas under review.

Catch-effort and size-composition figures for each block are grouped by zone. Where catch is greater than 10 tonnes per annum in any of the last five years, or the block is of interest for other reasons, catch-effort information is provided down to sub-block level.

2. Landed Catches, 2004

At the end of 2004, annual landings comprised 2373.6 t of blacklip and 129.4 t of greenlip, from a TAC of 2509.5 t (Table 1).

Table 1. 2004 landings by zone, in tonnes

Zone	2004 TAC	2004 Landings
Greenlip	129.5	129.445
Eastern Blacklip	770.0	768.193
Northern Blacklip	280.0	278.952
Western Blacklip	1260.0	1256.981
Bass Strait	70.0	69.771

Figure 1 shows the location of the zones and statistical blocks from which the 2004 commercial catch information was reported.

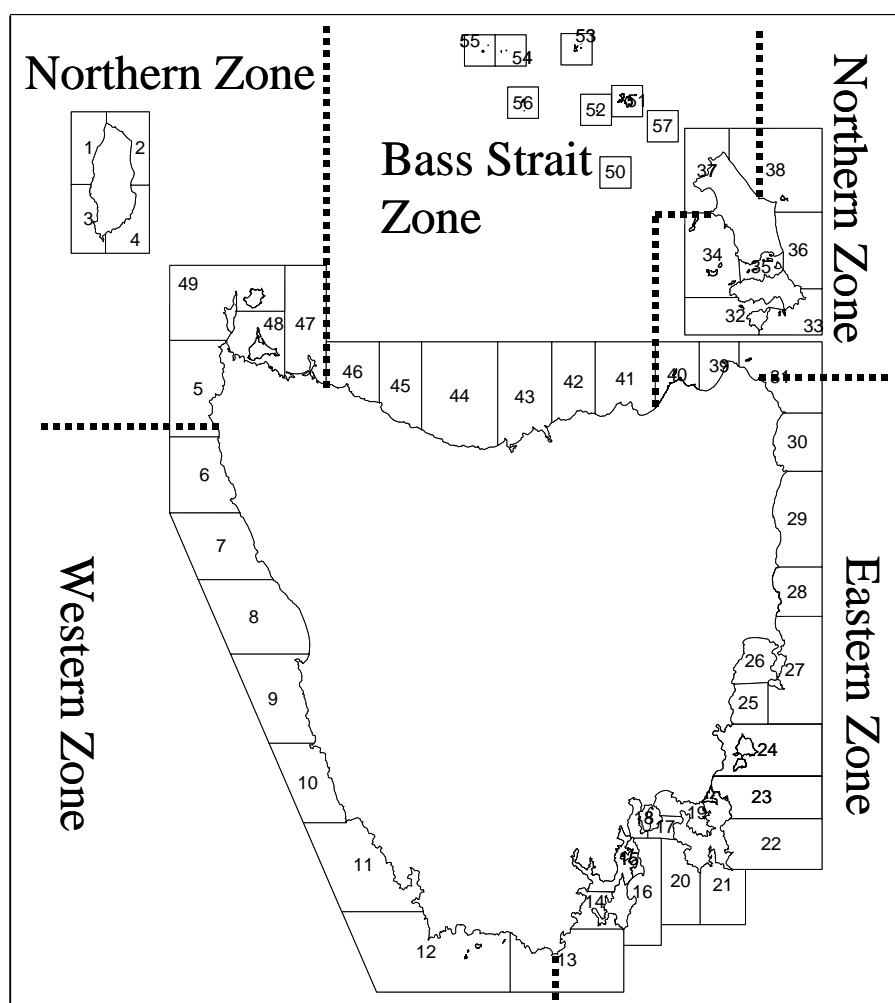


Figure 1. Statistical blocks and zones used in the Tasmanian abalone fishery in 2004. Zones and zone boundaries may change from year to year. Zone boundaries are shown as dotted lines. The Greenlip fishery is not spatially fixed, but mostly takes place on coasts included in the Northern Zone.

3. Interpreting trends in catch and catch rate, and the size composition of the commercial catch.

The use of catch and catch rates 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 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 with some success for many years in the Tasmanian fishery. There are several 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 fishing efficiency. If the effects of the above 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), Rose and Kulka (1999)).

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 reduced (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. This problem would also occur if divers were searching for areas containing abalone within a specified size range, or where divers were swimming over larger abalone within an area while selecting abalone by size.

Where abalone abundance is low, a consequence of aggregating behaviour is that 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, and maintain 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 effort is focused on 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 acceptable 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 would be detected. In Tasmania, the recently introduced sub-block scale of reporting (Appendix 9) is an improvement, but is still 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. Analysis of catch data from a range of reporting blocks has revealed historically low levels of annual catch. Such low catch levels may appear stable in the short term, but have been seen to fall slowly over a period of years, presumably as reefs become less productive (i.e. the period between fishing 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 even rise slowly.

Change in fishing efficiency

The detection and avoidance of difficulties associated with improvement in fishing efficiency, or effort creep is a continuing problem when catch rates are used to assess fisheries. One of the features of commercial 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 per unit time now than in the past. This leads to a rise in reported catch rates without an associated increase in abalone abundance, or alternatively, it can lead to catch rates appearing to be stable while the stock abundance is, in fact, declining. We have noticed two broad categories of causes of change in fishing efficiency in the Tasmanian abalone fishery – technological and behavioural.

Technological causes of change in fishing efficiency are usually easy to detect. For example, early in the history of the Tasmanian abalone fishery, divers anchored their boats, and often worked without a deckhand. Later, 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 (droplines) and they no longer had to surface to the boat every time they filled their nets. This increased efficiency because:

- (a) time spent ascending to the boat, unloading the catch and descending back to the reef was eliminated,
- (b) the diver maintained his position on the productive part of the reef ,
- (c) catch bags could be reduced in size, which meant that divers swam more easily and with less effort.

However, the increase in efficiency caused by droplines is 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 little 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.

Changes in fishing efficiency due to behavioural causes, while not as obvious as technological causes, may have a profound effect upon catch rates. 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, either individually or as a group may learn 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 account for than changes in fishing methods.

Improvements in efficiency stemming from either cause 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 can reliably assume that divers operated with equal efficiency. This assessment reviews catch rate trends primarily over the last five years, but within the context of changes during the last 10 years. By reducing the period over which comparisons are made, we are more likely to avoid changes due to improved 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 improved efficiency are understood and measures are taken to counter their effects, catch rates can reliably reflect abundance. For example, in the NSW blacklip fishery, high visitation and exploitation rates preclude the formation of aggregations of legal-sized abalone, and stocks are uniformly maintained at a low level. A consequence of this is that the recovery-depletion cycle evident in other fisheries is removed. Researchers in NSW have concluded that catch rates had become a reliable index of abundance

(Andrew *et al.*, 1997; Worthington *et al.*, 1998). Similarly, in the more heavily fished parts of Tasmania (e.g. the Actaeons) where it is known that diver visitation rates to reefs are high (i.e. restrict the formation of aggregations), divers are unable to successively deplete reefs (because all reefs support continuous levels of effort). Provided the effects of effort creep are reduced by limiting the review period to years when diving methodology is unchanged, we assume that catch rate trends are indicative of changes in abundance.

It now appears that these conditions of intense fishing pressure 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 relatively low, and abalone are allowed to 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.

Because of recent quota reductions, much of the Eastern Zone, particularly parts of the East Coast, is now fished at low levels of effort. This means that effort is inconsistently applied to populations, allowing the formation of aggregations between fishing events, which may span fishing years. We are also aware that in recent years, catch levels have been dependent upon divers rotating effort and successively depleting reefs on much of the East Coast between Triabunna and Eddystone Point (Blocks 25 – 30). Under these circumstances, the relationship between abalone abundance and catch rates is almost certainly different than under conditions of constant levels of effort, and catch rates trends are used with caution.

Much of Tasmania's greenlip fishery is fished under similar circumstances to the East Coast blacklip, reducing the value of catch rates for assessment purposes. However, there are two more problems to consider with the greenlip fishery. Firstly it is evident that many divers are learning to fish more efficiently, compounding the difficulty faced in interpreting the abundance-catch rate relationship. Secondly, each region's catch is relatively small, with few participating divers. The entry or exit of a diver who catches at different rates from the others can change the region's catch rates (attempts at standardising effort by diver have proved unsuccessful). 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.

Despite these difficulties with interpreting catch rate information, it is proposed that, when catch rates are examined in combination with trends in the catch itself, some interpretations are more likely than others. The strongest indications of abundance change occur in two situations: (i) when catch rates continue to decline despite a decline in the catch; and (ii) when catch rates increase when catches increase.

The first scenario could indicate a recruitment decline: despite a reduction in fishing pressure, catch rates continue to decline because there are increasingly fewer recruits each year to the fishery. An example of this appears to be occurring in Block 6, where between 2001 and 2003, catches and catch rates continuously fell.

The second scenario probably indicates an increase in fishable biomass. Examples include most of the east, south east and west coast blocks in the early and mid 1990's, and more recently, Block 20.

Size composition of the commercial catch

Almost since the inception of the fishery, abalone from divers' catches have been sampled for length measurements to provide information about the condition of stocks. However, because the reporting of catches was at the gross spatial scale of blocks, the samples were of limited value in assessing the impact of fishing on populations. While changes in size structure could be seen, it was never certain whether the changes were due to fishing mortality or because divers re-directed effort between populations with vastly different growth characteristics. In 1998, divers started submitting photographic samples of their catches with details of the location from where the catch was taken, which, given adequate levels of sampling, meant that individual populations could be monitored. Although the photographic program stopped in 2000, in that year the start of catch reporting by sub-blocks increased the value of length-based monitoring for the stock assessment.

Since 2000, diver's catches from around the State have been routinely sampled by TAFI research staff, mostly at fish processing factories, but occasionally at boat ramps and aboard boats. Most of the sampling has been from catches taken in the south east and east coasts, but catches from the north and west coasts have also been measured. The fish processing factories have included both canners and live-market traders. Catches are selected haphazardly, depending upon the availability of both catches and catch-samplers. In recent years, catches have been frequently sampled at Tasmanian Seafoods Pty Ltd (both Margate and Smithton), Coastal Waters Seafoods Pty Ltd, Seafood Traders Pty Ltd, Southern Ocean Seafoods (NSW) Pty Ltd, and less frequently at a number of other factories including Watken Quality Tasmanian Abalone Pty Ltd, Ralph's Tasmanian Seafood Pty Ltd, A.R.Garth Fish Processor Pty Ltd, Krystal Harbour Pty Ltd, and Pacific Shoji Pty Ltd. All of these operators are thanked for their cooperation.

The aim of catch sampling is to provide information about the size-structure of the catch from fished abalone populations, independent of variation caused by a range of confounding effects. For example, divers' catches from the same sub-block on the same

day may comprise abalone of widely varying lengths, caused by fishing populations with different growth characteristics. In the south east, we have observed that the size-structure of catch samples may be influenced by seasonal growth rates, particularly when exploitation rates are low, and consequently samples collected during autumn and winter contain larger abalone than in spring and summer. Market preferences for abalone within a specific size-range will also be reflected in catch samples. There are also other more minor sources of bias relating to measuring errors, both by the diver and the catch sampler.

Sampling involves measuring 100 abalone randomly selected from a diver's catch. Sample design was based upon work done by Andrew and Chen (1997) in the New South Wales abalone fishery. Their strategy was to collect small samples from many catches, rather than large samples from a few catches, increasing the likelihood that the samples better represented the whole catch and hence the populations from which they were taken.

For the purpose of this assessment, samples have been grouped by year and sub-block. Sub-blocks where less than 4% of catches have been sampled during more than 2 years have not been reviewed, because the low level of sampling may be inadequate to reflect size-structure of fished populations. We have been unable to obtain adequate numbers of samples from the Northern Zone, the greenlip fishery, the Bass Strait Zone and much of the Western Zone. Landings from motherships are usually not sampled, because they mostly comprise catches from more than one sub-block and more than one day, and it is not possible to identify the sub-block from where the catch came.

The 4% level was arbitrarily chosen, with consideration given to the methods of Andrew and Chen (1997). However, where the number of annual landings is low, much higher percentages of sampling may still be inadequate. For example, during 2003 in the Western Zone sub-block 8A, there were 41 landings. Of these, four were sampled (~10%). The median and inter-quartile length estimates from the samples were larger than both those from earlier years and 2004. One of the four samples was taken from an unusually large catch caught at high catch rates, and we surmise that, as occasionally happens, unusually calm conditions enabled the diver to fish part of a hitherto unexploited population which contained older and larger abalone than normally encountered.

In the Eastern Zone, particularly the south east, the number of landings is much higher and effort is more evenly distributed across populations, thus reducing the effect of unusual catches. The size-composition charts of the south east blocks consistently show similar trends, even those sampled at less than the 4% level. In particular, the median length of 2002 samples in almost all sub-blocks increased, in conjunction with the 4-mm size-limit increase that was applied in that year, regardless of the level of sampling. The relatively high median size of 1998 and 1999 samples and the fall in length since then is also common across sub-blocks where those years were sampled. This trend is consistent with known decreases in the available stock and confirms that the level of sampling is adequate to detect trends. The level of sampling in 1998-1999 can only be guessed at by applying catch numbers from later years, which suggests sampling was below 4% in many sub-blocks. (The level of sampling of pre-2000 catches could not be determined because although the sampled catch locations were known, all other catches were not reported by sub-block). We conclude that the 4% level of sampling in the

Eastern Zone is adequate, and that trends in median and inter-quartile lengths can reflect changes in the fished population size-structure.

Interpreting annual changes in median and inter-quartile lengths

Our catch samples show that since 1998, throughout much of the south east there is a trend of decreasing median size of abalone in commercial catches. We propose two opposing scenarios that might explain falling median length in the south east.

If abundance levels fall yet catch levels remain constant (i.e. exploitation rates rise), the average period of time between attaining legal size (recruiting) and being caught becomes shorter. Because abalone length is a function of time and growth rate, this means that overall growth is reduced, and the median length falls. Under these circumstances, the 75th percentile length (the length which, down to the legal limit, includes 75% of the available legal stock) could also be expected to fall with the median, but if recruitment levels are unaffected, the 25th percentile length could be expected to remain at similar levels. If exploitation rates further increase, then the 25th percentile length will also fall. We would expect to see a corresponding indication of falling abundance from catch and catch rate trends under this scenario.

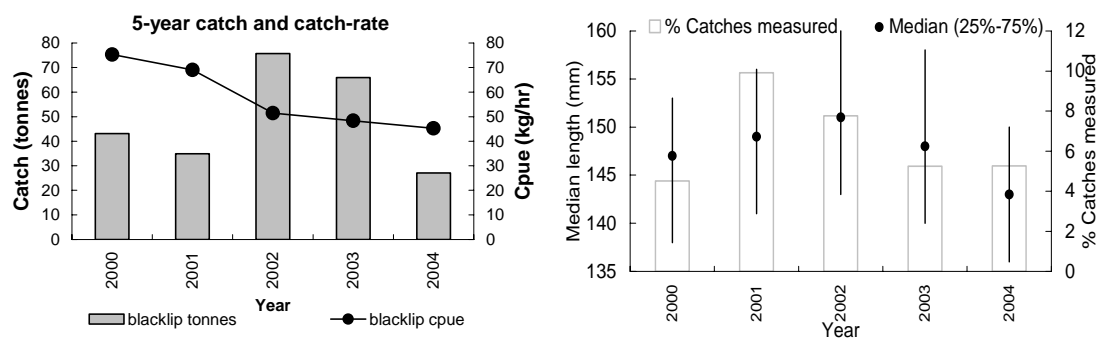


Figure 2. Trends in catch, catch rate and median length (flanked by the 25th and 75th percentile bounds), sub-block 13C.

For example, Figure 2 shows catch, catch rates and size-composition of catches landed from sub-block 13C (Whale Head to Fishers Point, Actaeons region). Between 2002 and 2004, firstly catch rates and then catches fell, suggesting high exploitation rates. The median length of landed abalone increased in 2002, when the size limit was raised 4 mm, but has since fallen, again suggesting high exploitation rates. In 2004, the 75th percentile fell sharply, consistent with a fall in the numbers of large abalone landed. In addition, in 2004, the 25th percentile declined suggesting a decline in recruitment. The catch and catch rate trends indicate that abundance here is low. All three indicators suggest unsustainable levels of fishing.

The second alternative interpretation of the reduced median length is that abundance of small animals has increased due to an extraordinarily large influx of recruits. The median and 25th percentile length could be expected to fall, but, unless the fishery was dominated by recruits, the 75th percentile length would be stable or possible increase as exploitation rates fell. Increased levels of catch and catch rate would confirm that abundance had increased. However, there are no examples of sub-blocks with increasing catch/catch rate indices and falling median length.

Increasing or stable median length, in conjunction with increasing catch and catch rates are strong indicators of rising stock levels. Figure 4 indicates that catch rates and levels of catch in sub-block 24B (Maria Island) have started to recover since 2002. The median length from catches sampled since then is also consistent with stock recovery. The increase in median length associated with the 4-mm increase in size limit in 2002 is again apparent; however, in contrast to sub-block 13C, the size-structure has been maintained, indicating that the levels of fishing pressure currently appear to be sustainable.

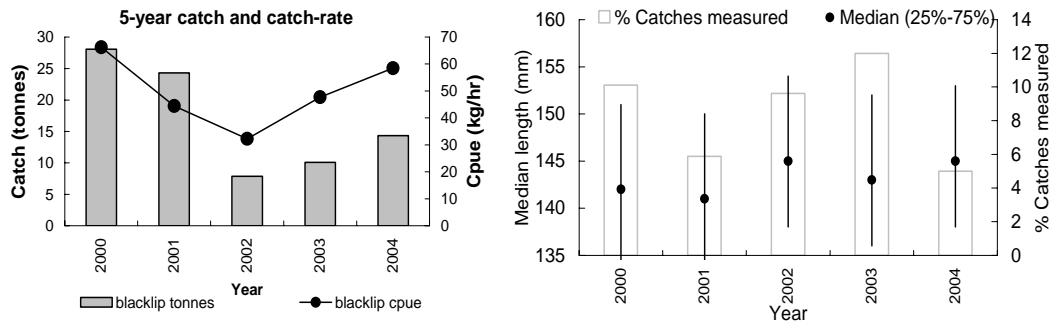


Figure 4. Trends in catch, catch rate and median length (flanked by the 25th and 75th percentile bounds), sub-block 24B.

4. Catch, catch-rate and size-composition figures

Eastern Zone blacklip fishery – major fishing blocks

The 2004 Eastern Zone TAC was 770.0 t, compared with 857.5 t in 2003. Significant increases (>25%) in catch from the previous year occurred only in some of the lower-yielding blocks (Blocks 28, 29). The Block 13 catch was reduced from 291 t to 221 t (Figure 6).

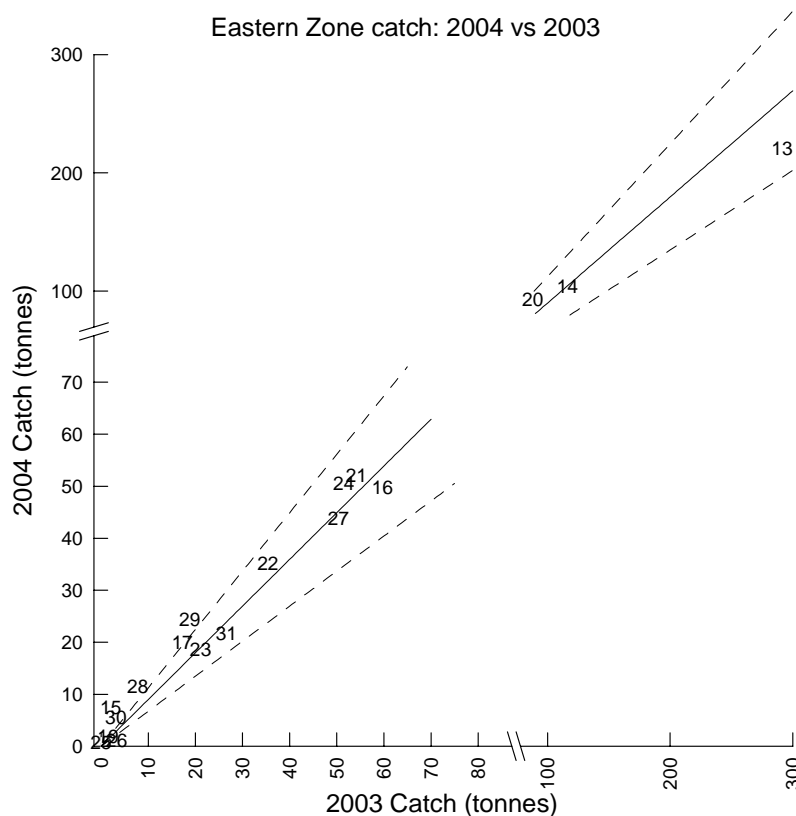
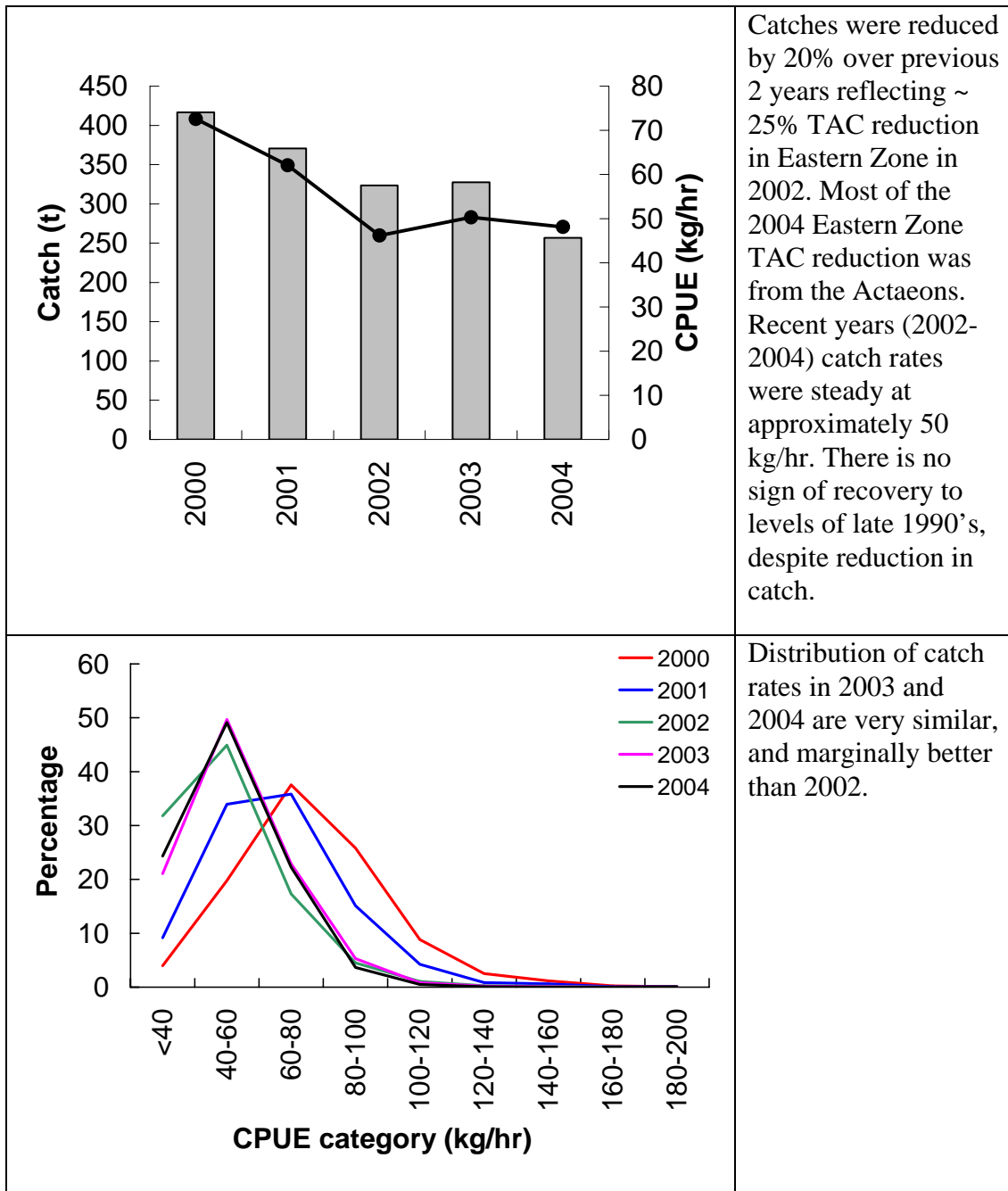
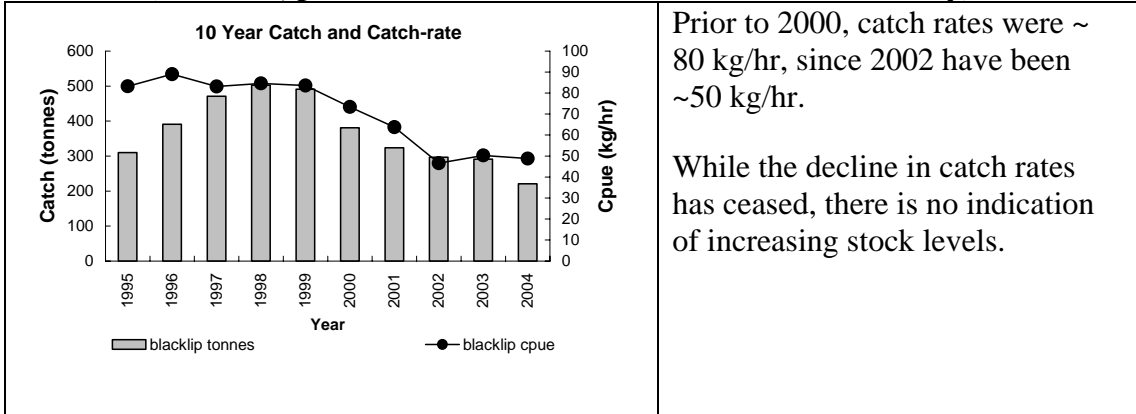


Figure 6. The change in blacklip catch from the Eastern Zone between 2003 and 2004. The solid diagonal lines represent the “no change” position where catches would lie if they were the same in both years but scaled to the 2004 reduction in TAC. The dashed lines represent the 25% deviation from “no change”. Note that the scale changes for three blocks with catches greater than 80 t.

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



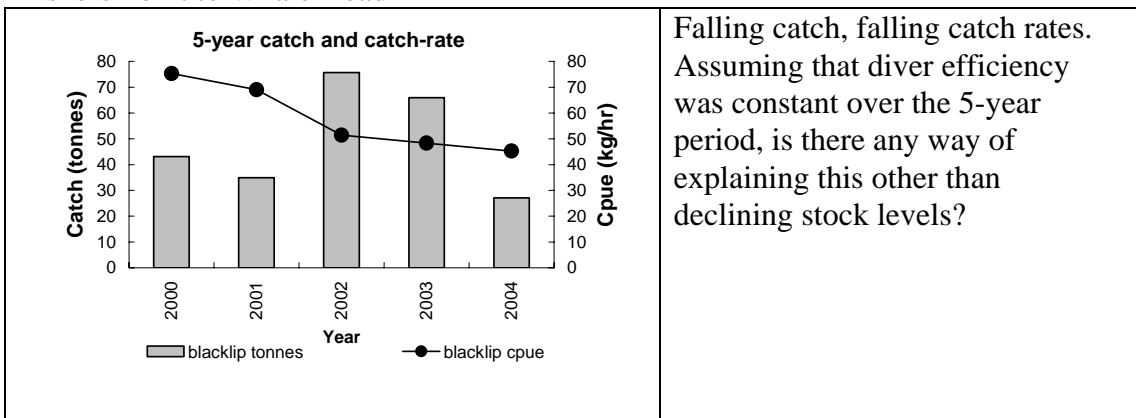
Block 13 (Actaeons, plus South Coast from Whale Head to Prion Bay)



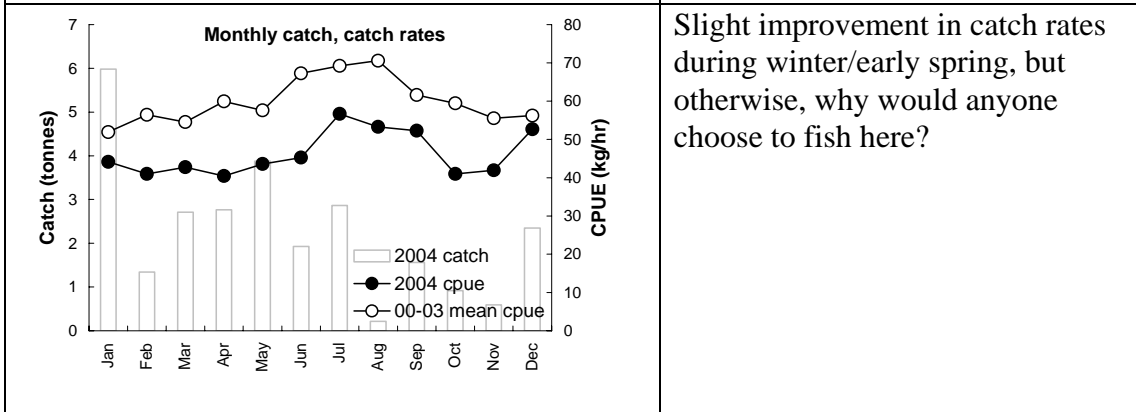
Prior to 2000, catch rates were ~ 80 kg/hr, since 2002 have been ~50 kg/hr.

While the decline in catch rates has ceased, there is no indication of increasing stock levels.

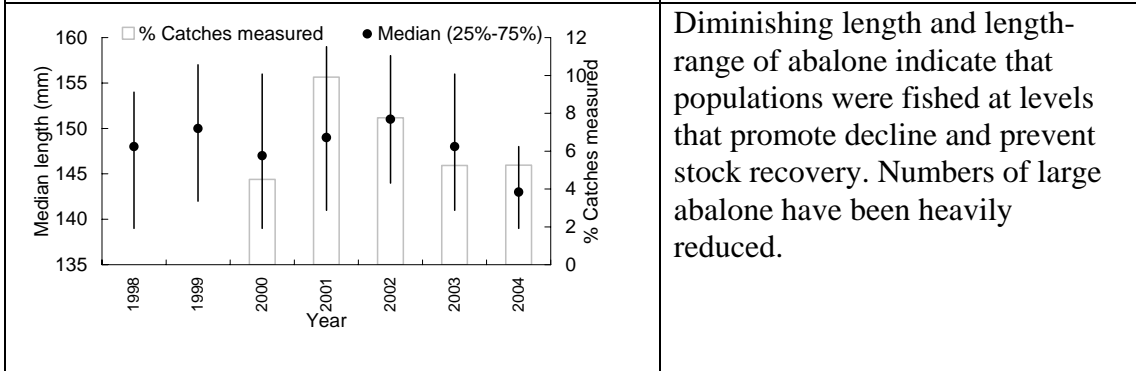
**Sub-block 13C
Fishers Point to Whale Head**



Falling catch, falling catch rates. Assuming that diver efficiency was constant over the 5-year period, is there any way of explaining this other than declining stock levels?



Slight improvement in catch rates during winter/early spring, but otherwise, why would anyone choose to fish here?



Diminishing length and length-range of abalone indicate that populations were fished at levels that promote decline and prevent stock recovery. Numbers of large abalone have been heavily reduced.

Sub-block 13D

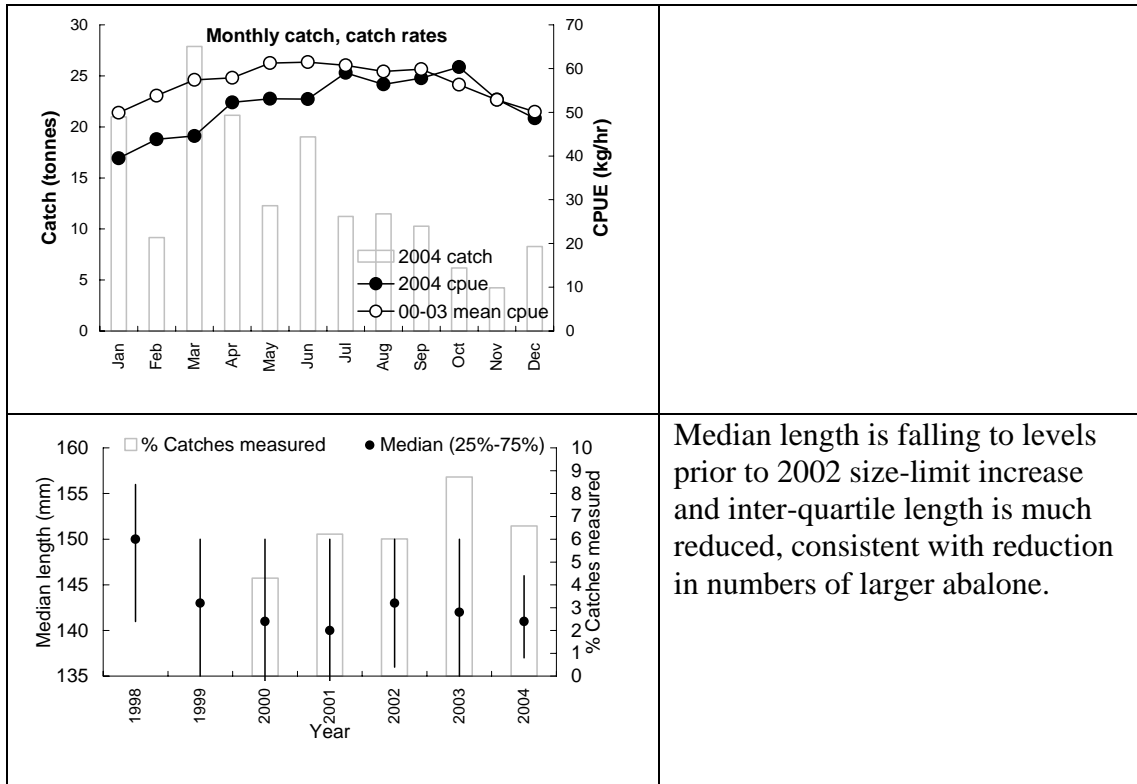
Fishers Point to Southport Lagoon Beach, including Recherche Bay

<p>5-year catch and catch-rate</p> <table border="1"> <thead> <tr> <th>Year</th> <th>blacklip tonnes</th> <th>blacklip cpue (kg/hr)</th> </tr> </thead> <tbody> <tr> <td>2000</td> <td>100</td> <td>75</td> </tr> <tr> <td>2001</td> <td>90</td> <td>70</td> </tr> <tr> <td>2002</td> <td>65</td> <td>55</td> </tr> <tr> <td>2003</td> <td>45</td> <td>80</td> </tr> <tr> <td>2004</td> <td>30</td> <td>75</td> </tr> </tbody> </table>	Year	blacklip tonnes	blacklip cpue (kg/hr)	2000	100	75	2001	90	70	2002	65	55	2003	45	80	2004	30	75	<p>Catch rates stable, catch has fallen. Most divers stopped fishing here after July (see below) despite catch rates approaching 60 kg/hr. The low catch is thus probably not indicative of declining stock levels, but reflects divers choosing to fish elsewhere.</p>																																		
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<p>Monthly catch, catch rates</p> <table border="1"> <thead> <tr> <th>Month</th> <th>2004 catch (tonnes)</th> <th>2004 cpue (kg/hr)</th> <th>00-03 mean cpue (kg/hr)</th> </tr> </thead> <tbody> <tr><td>Jan</td><td>0.5</td><td>45</td><td>65</td></tr> <tr><td>Feb</td><td>1.2</td><td>50</td><td>60</td></tr> <tr><td>Mar</td><td>0.5</td><td>55</td><td>65</td></tr> <tr><td>Apr</td><td>4.5</td><td>60</td><td>70</td></tr> <tr><td>May</td><td>0.5</td><td>55</td><td>65</td></tr> <tr><td>Jun</td><td>4.5</td><td>50</td><td>65</td></tr> <tr><td>Jul</td><td>4.5</td><td>65</td><td>75</td></tr> <tr><td>Aug</td><td>0.5</td><td>60</td><td>70</td></tr> <tr><td>Sep</td><td>2.5</td><td>55</td><td>65</td></tr> <tr><td>Oct</td><td>2.2</td><td>55</td><td>60</td></tr> <tr><td>Nov</td><td>0.5</td><td>45</td><td>55</td></tr> <tr><td>Dec</td><td>0.8</td><td>50</td><td>60</td></tr> </tbody> </table>	Month	2004 catch (tonnes)	2004 cpue (kg/hr)	00-03 mean cpue (kg/hr)	Jan	0.5	45	65	Feb	1.2	50	60	Mar	0.5	55	65	Apr	4.5	60	70	May	0.5	55	65	Jun	4.5	50	65	Jul	4.5	65	75	Aug	0.5	60	70	Sep	2.5	55	65	Oct	2.2	55	60	Nov	0.5	45	55	Dec	0.8	50	60	
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Sub-block 13E

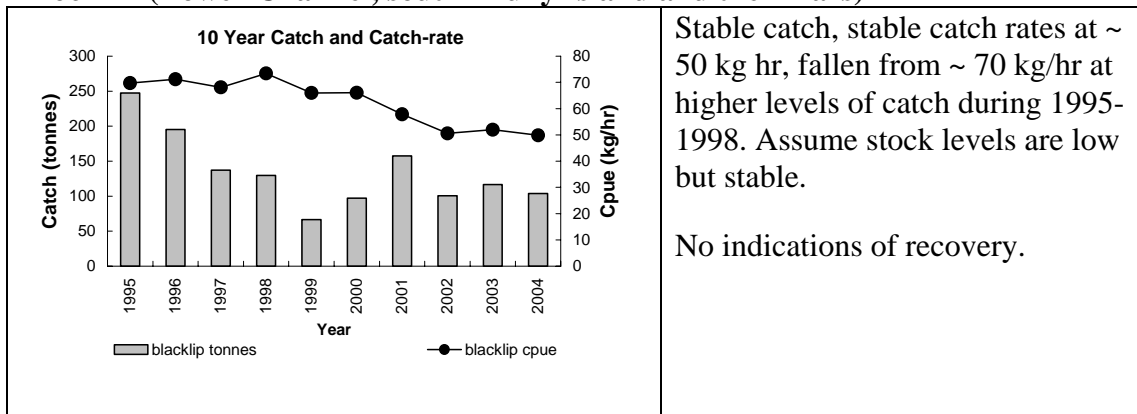
Actaeon and Sterile Islands, and reefs to the south (the Breaks)

<p>5-year catch and catch-rate</p> <table border="1"> <thead> <tr> <th>Year</th> <th>blacklip tonnes</th> <th>blacklip cpue (kg/hr)</th> </tr> </thead> <tbody> <tr> <td>2000</td> <td>240</td> <td>75</td> </tr> <tr> <td>2001</td> <td>200</td> <td>65</td> </tr> <tr> <td>2002</td> <td>160</td> <td>50</td> </tr> <tr> <td>2003</td> <td>180</td> <td>80</td> </tr> <tr> <td>2004</td> <td>160</td> <td>75</td> </tr> </tbody> </table>	Year	blacklip tonnes	blacklip cpue (kg/hr)	2000	240	75	2001	200	65	2002	160	50	2003	180	80	2004	160	75	<p>Catch and catch rates are stable. The level of effort fell sharply from July despite catch rates ~ 60 kg/hr.</p>
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2003	180	80																	
2004	160	75																	



Median length is falling to levels prior to 2002 size-limit increase and inter-quartile length is much reduced, consistent with reduction in numbers of larger abalone.

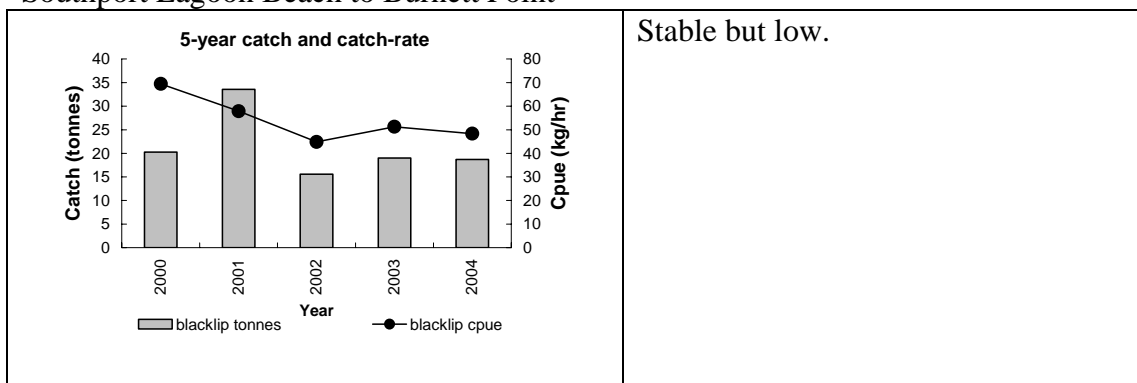
Block 14 (Lower Channel, south Bruny Island and the Friars)



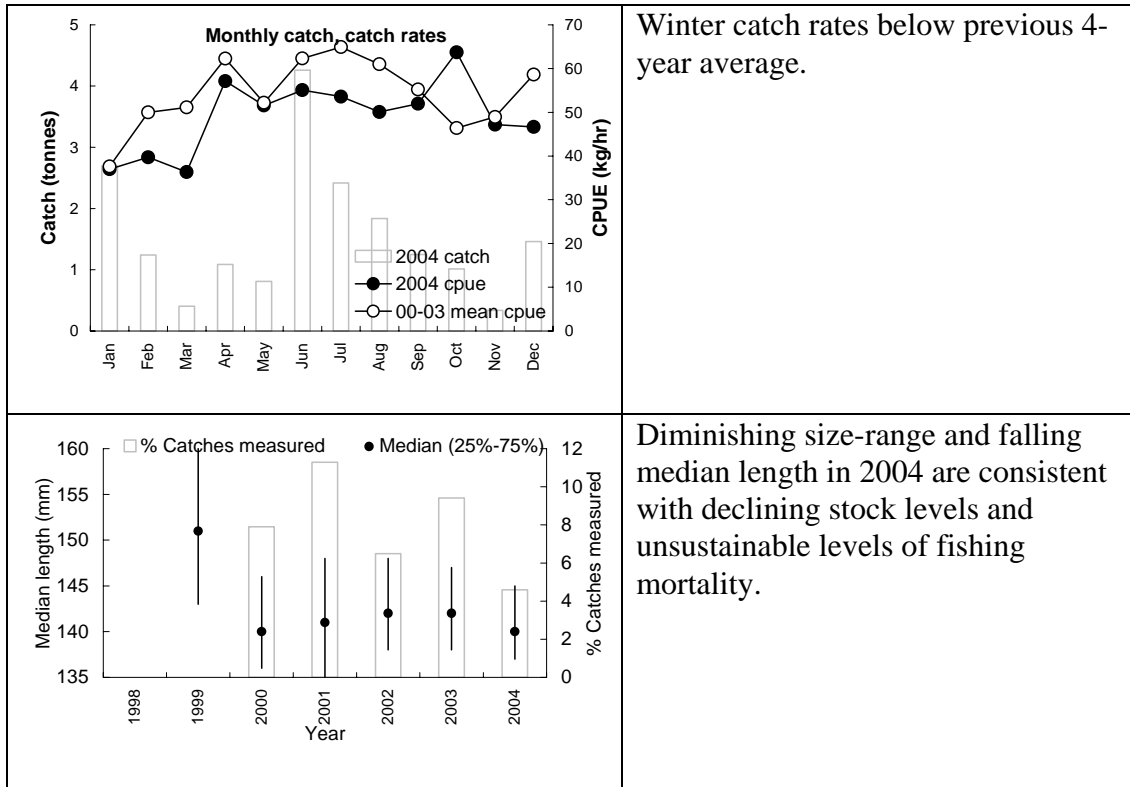
Stable catch, stable catch rates at ~ 50 kg hr, fallen from ~ 70 kg/hr at higher levels of catch during 1995-1998. Assume stock levels are low but stable.

No indications of recovery.

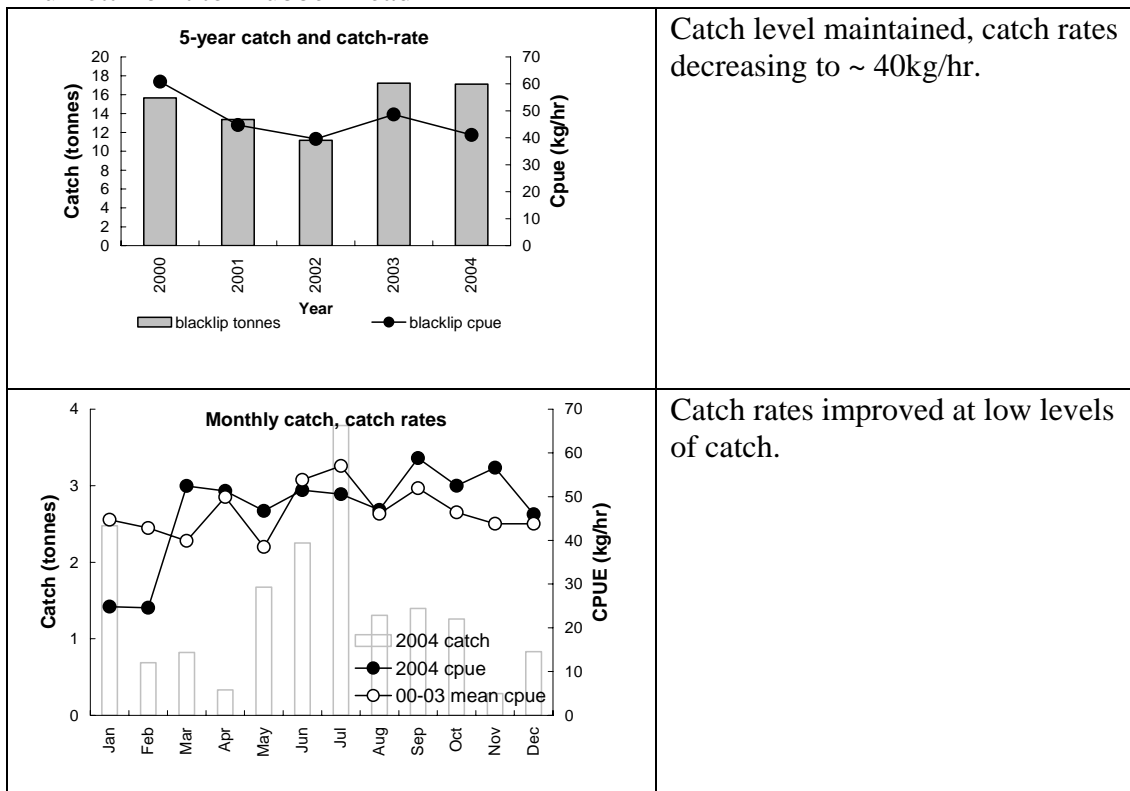
**Sub-block 14A
Southport Lagoon Beach to Burnett Point**



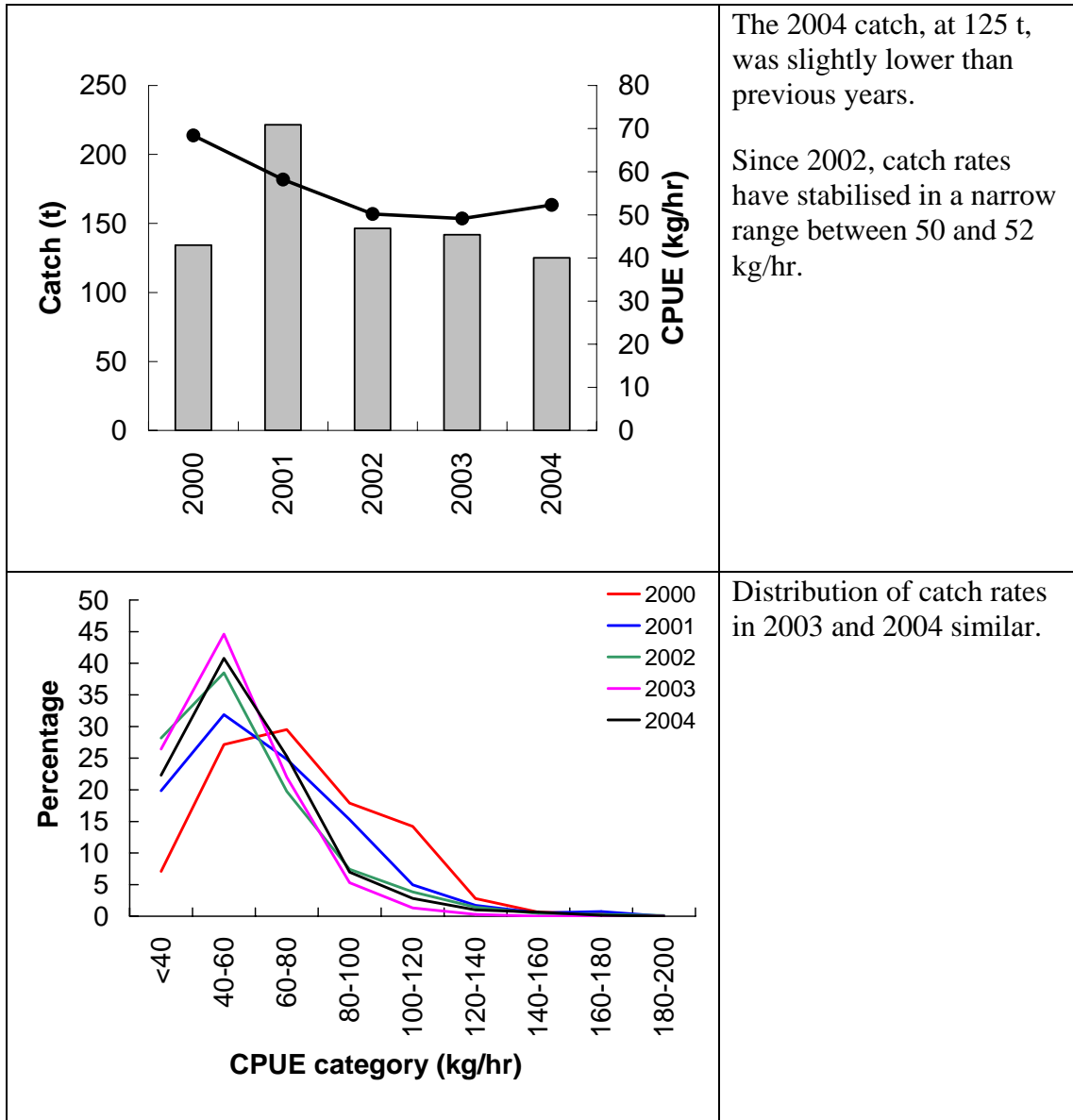
Stable but low.



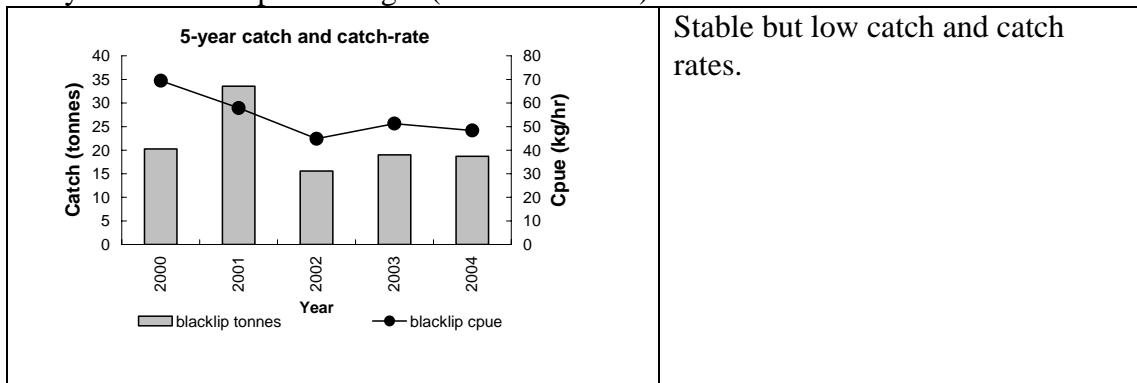
Sub-block 14B
Burnett Point to Blubber Head

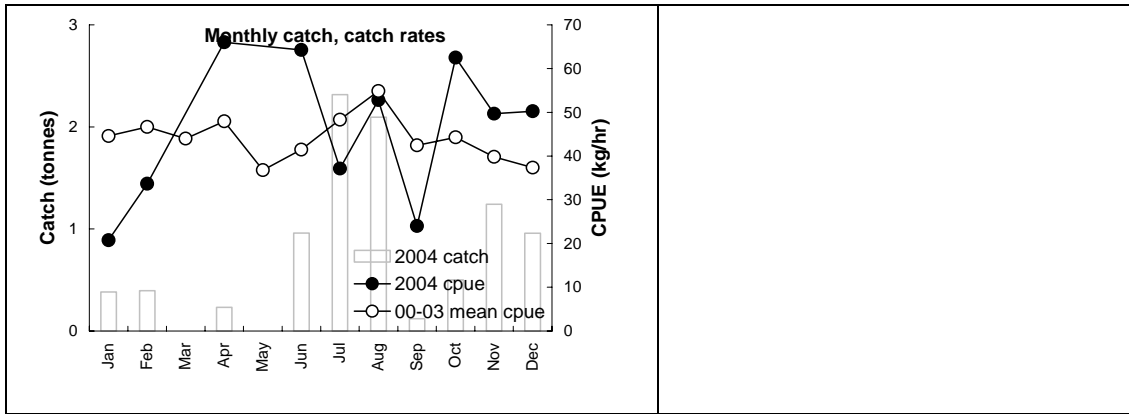


Eastern Zone – Bruny Island (Blocks 14C, 14D, 14E, 15, 16).

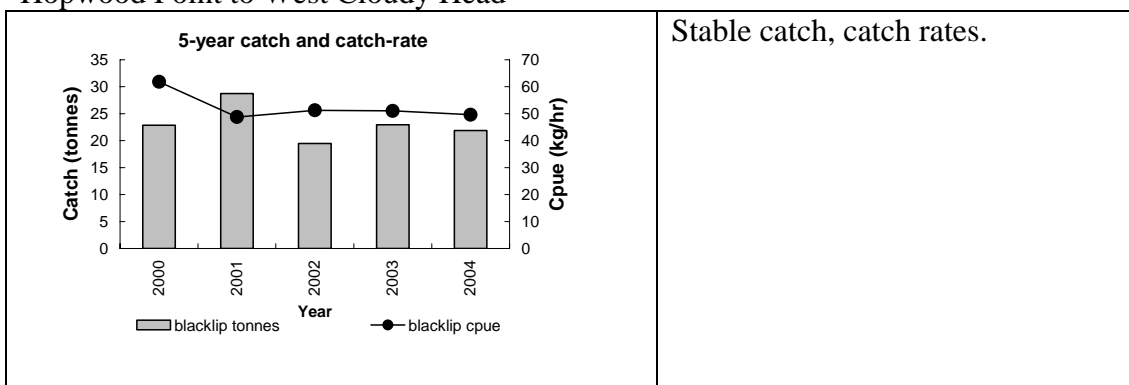


**Sub-block 14C
Mays Creek to Hopwood Light (Lower Channel)**

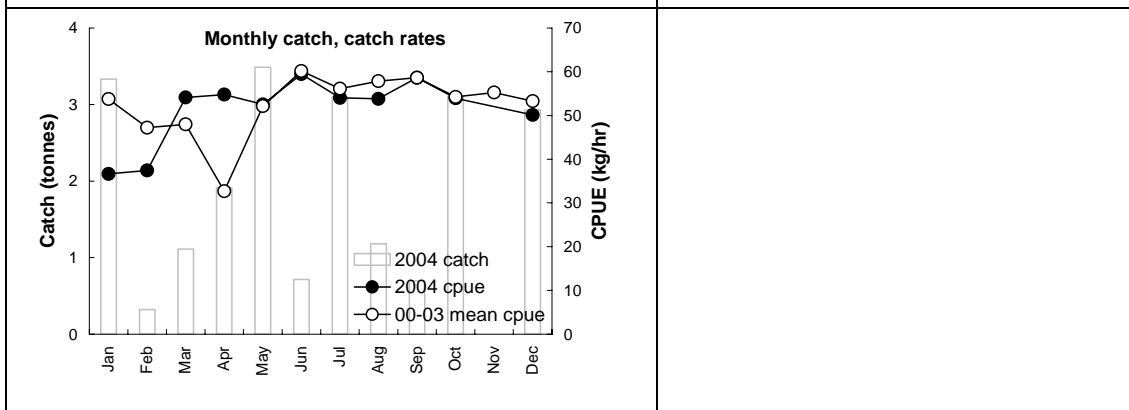




Sub-block 14D
Hopwood Point to West Cloudy Head



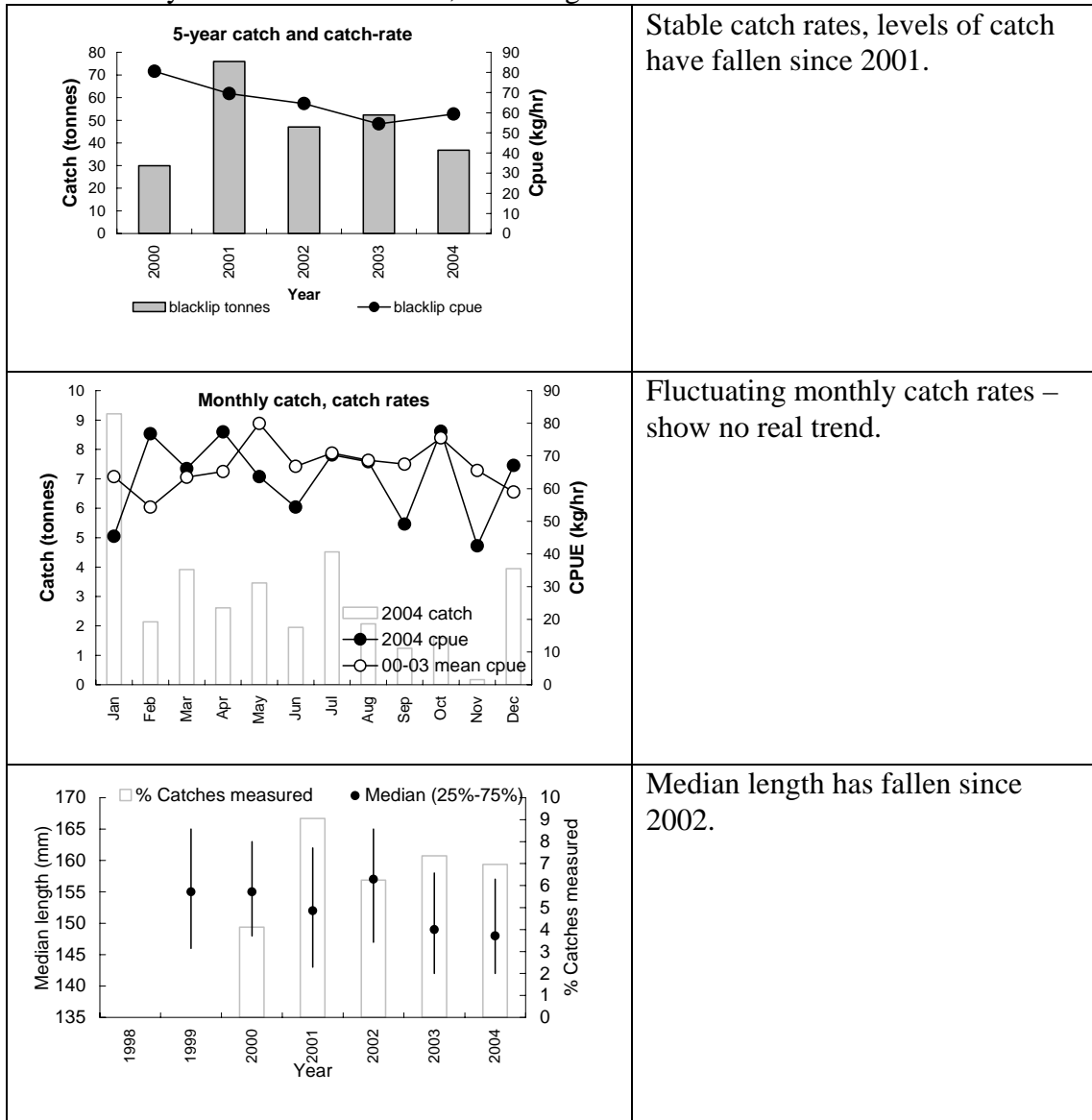
Stable catch, catch rates.



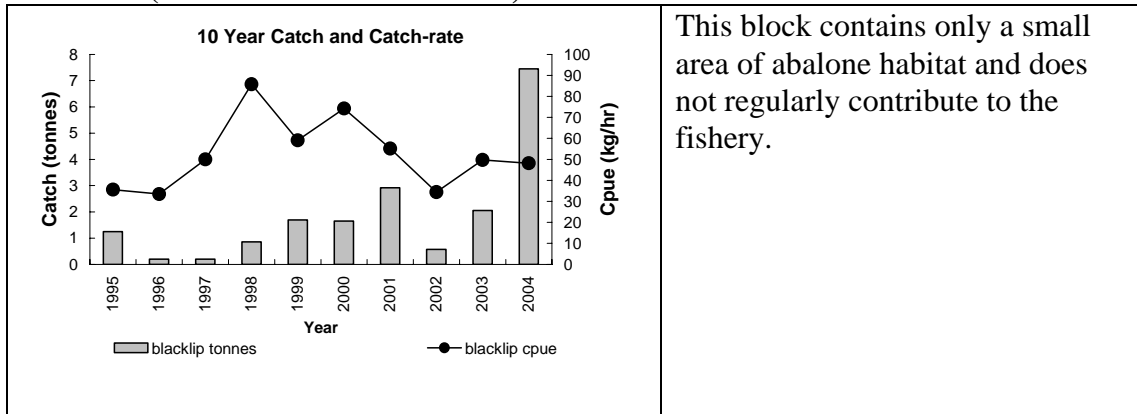
Median size continued to decline, inter-quartile size-range contracted in 2004, implying lower levels of recruitment and fewer numbers of large abalone.

Sub-block 14E

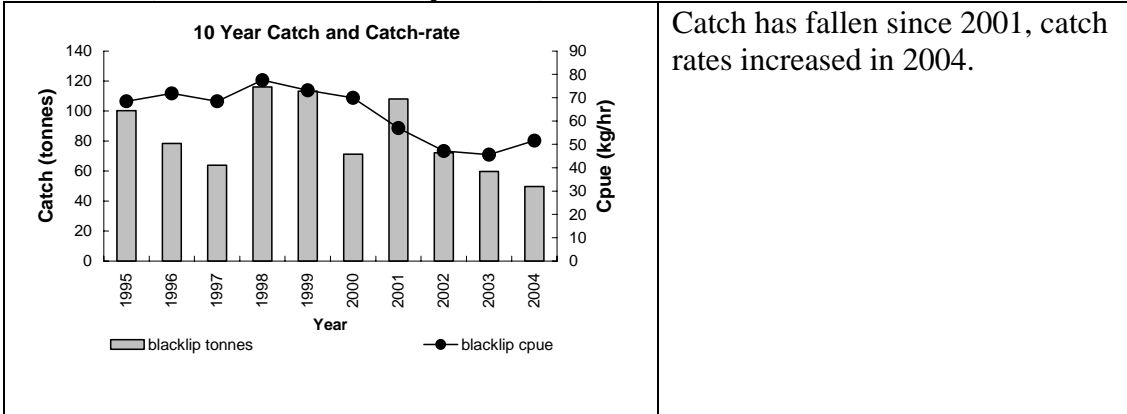
West Cloudy Head to Boreel Head, including the Friars



Block 15 (D'Entrecasteaux Channel)

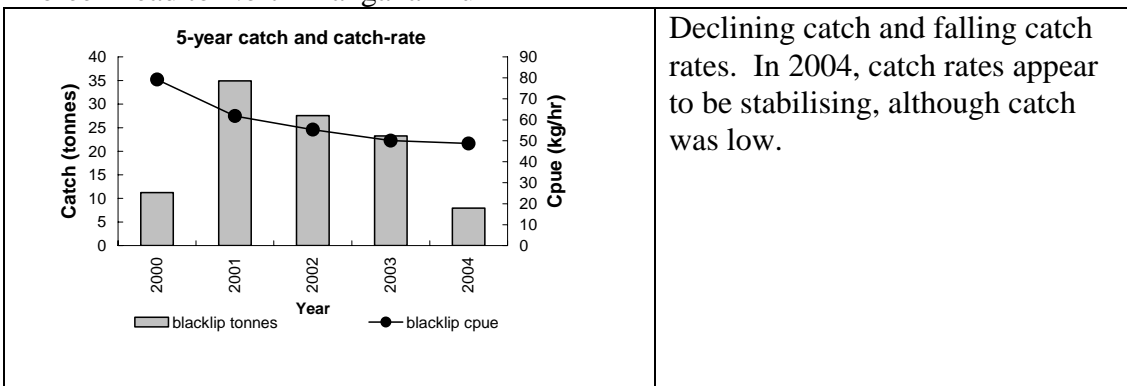


Block 16 (eastern side of Bruny Island)

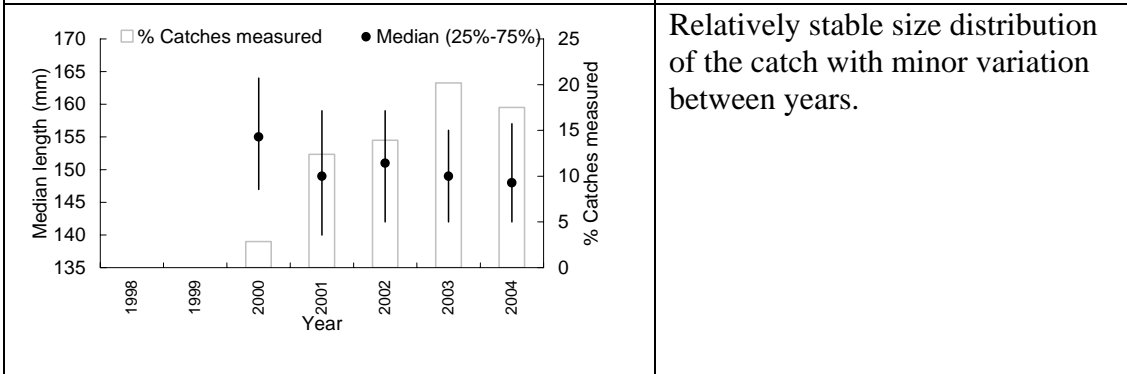
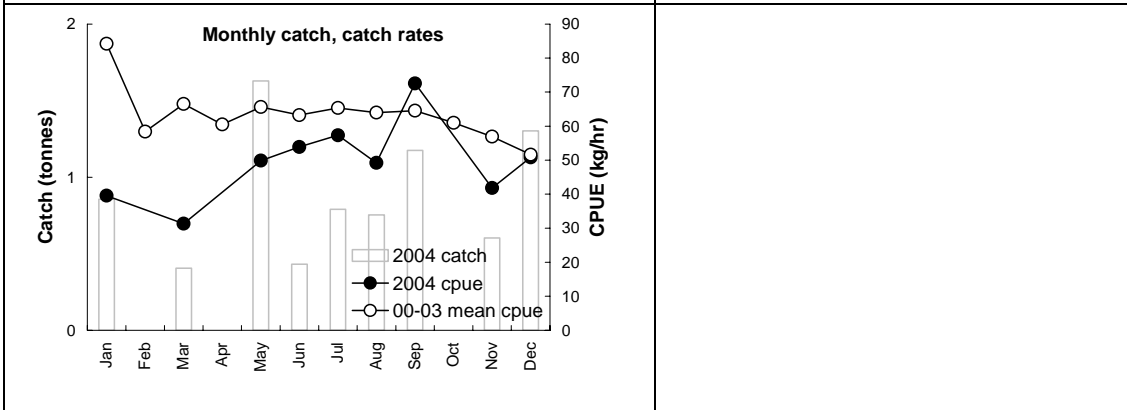


Catch has fallen since 2001, catch rates increased in 2004.

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

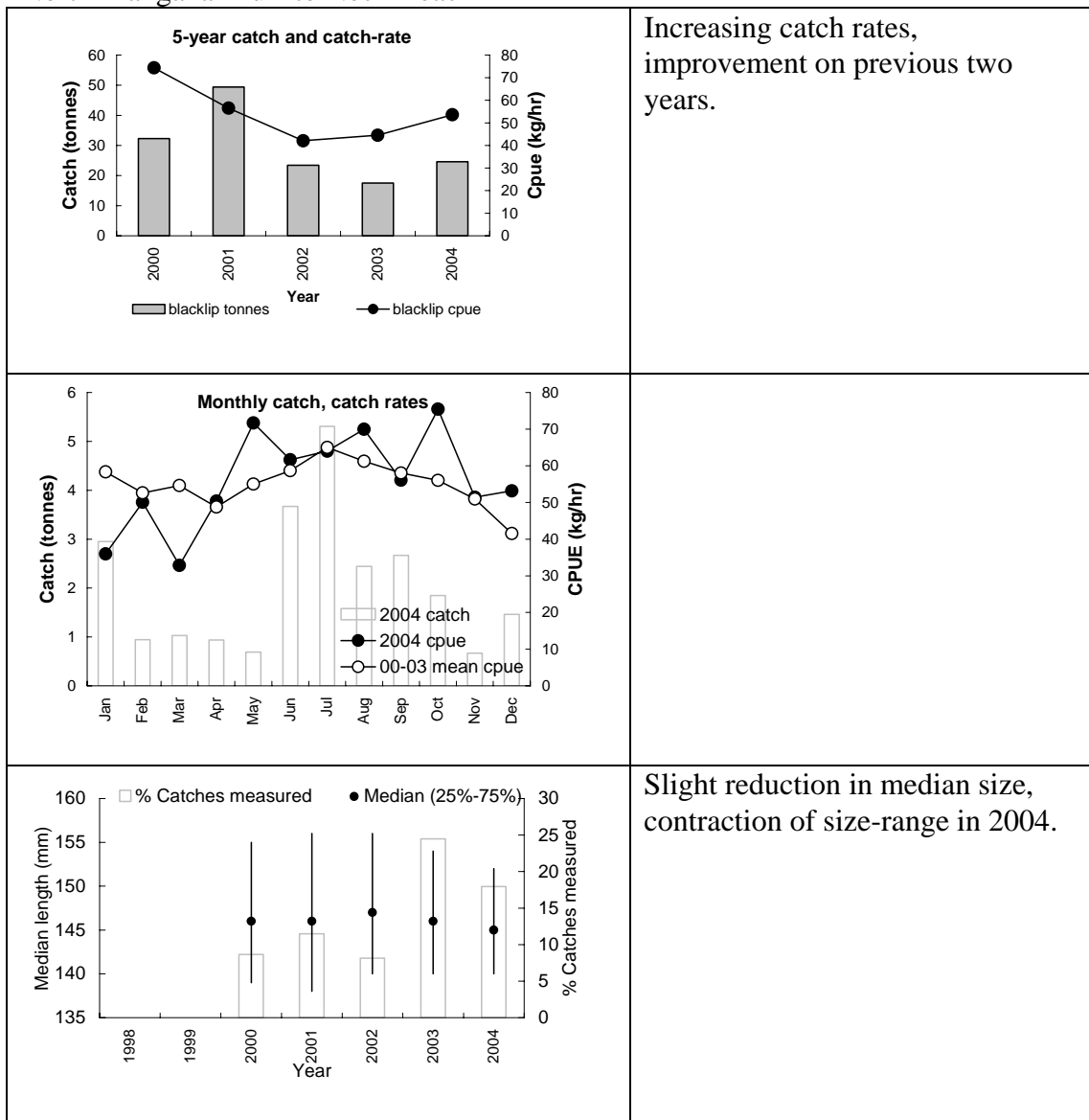


Declining catch and falling catch rates. In 2004, catch rates appear to be stabilising, although catch was low.

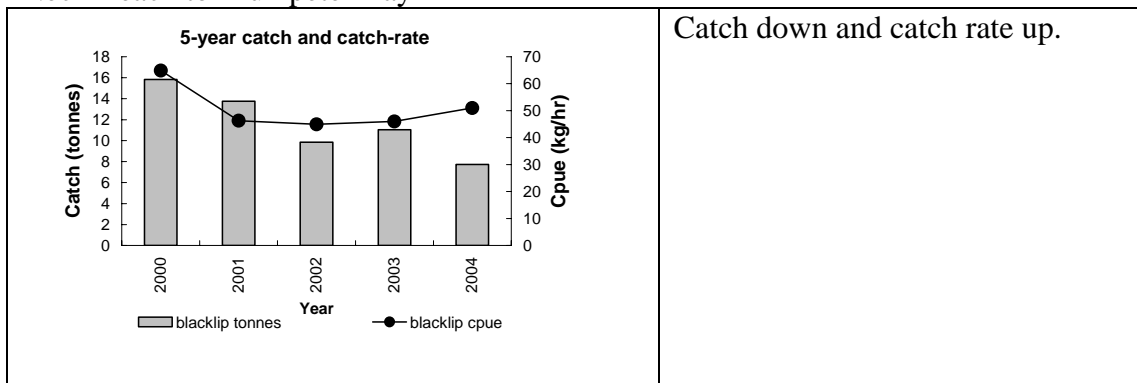


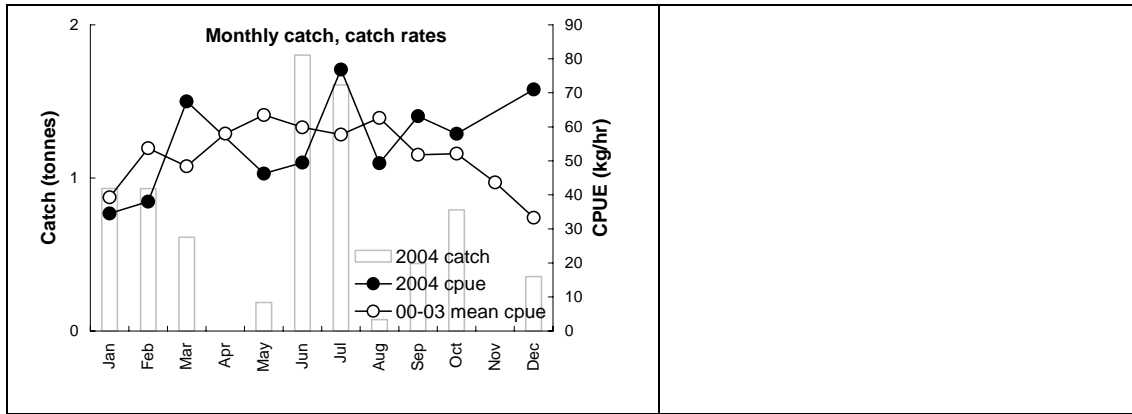
Relatively stable size distribution of the catch with minor variation between years.

Sub-block 16B
North Mangana Bluff to Neck Beach

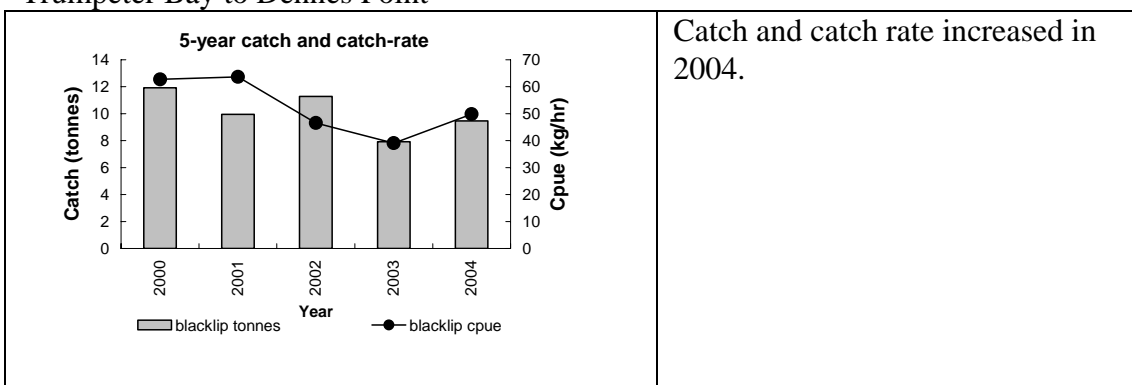


Sub-block 16C
Neck Beach to Trumpeter Bay

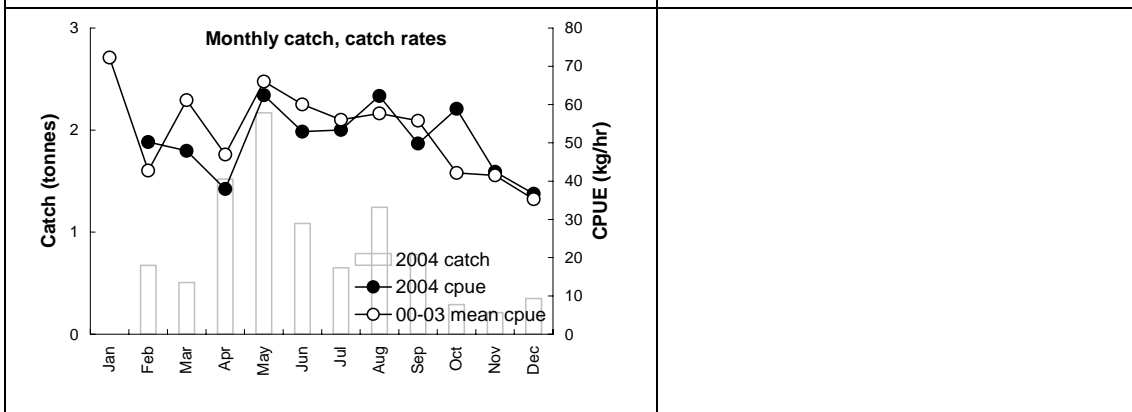




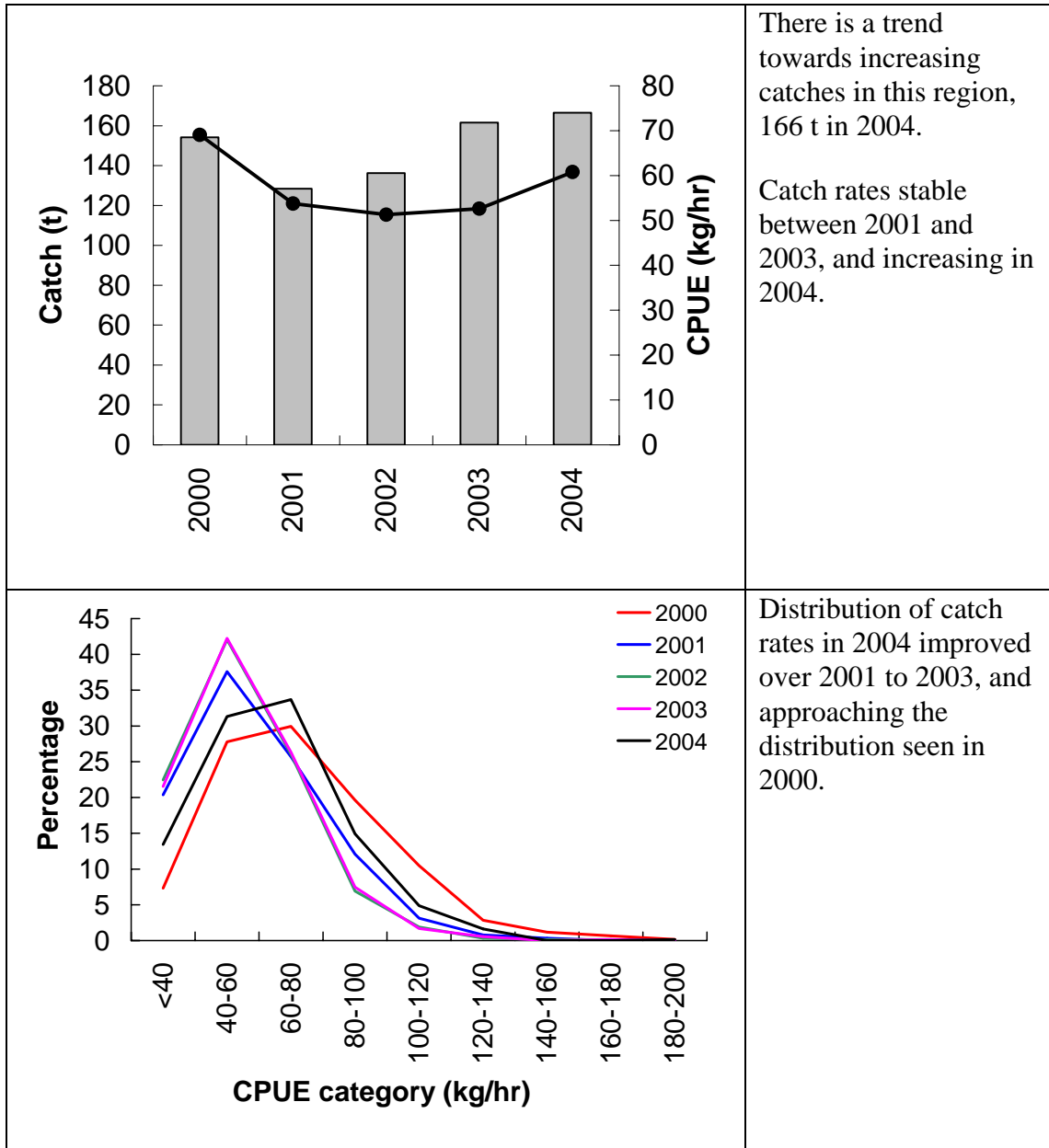
Sub-block 16D
Trumpeter Bay to Dennes Point



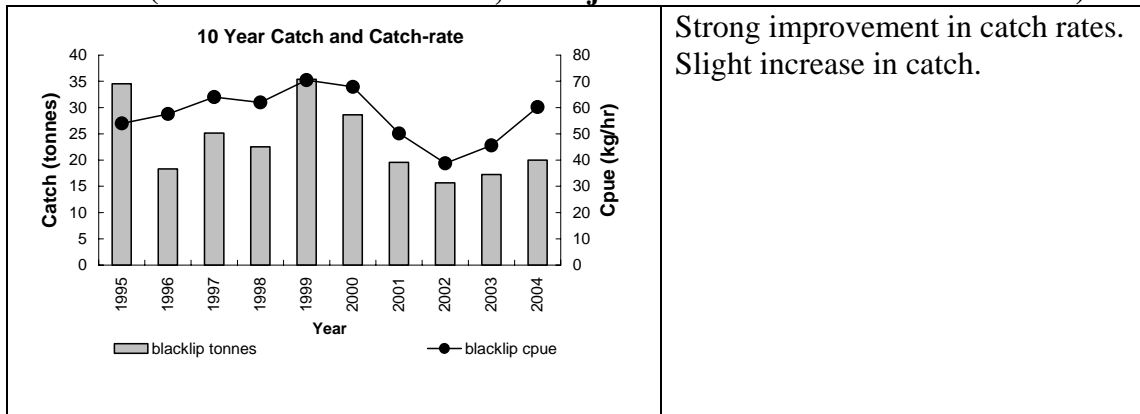
Catch and catch rate increased in 2004.



Eastern Zone - Storm Bay – Betsey Island, Blackjack and Tasman Peninsula east to Tasman Island (Blocks 17-21).

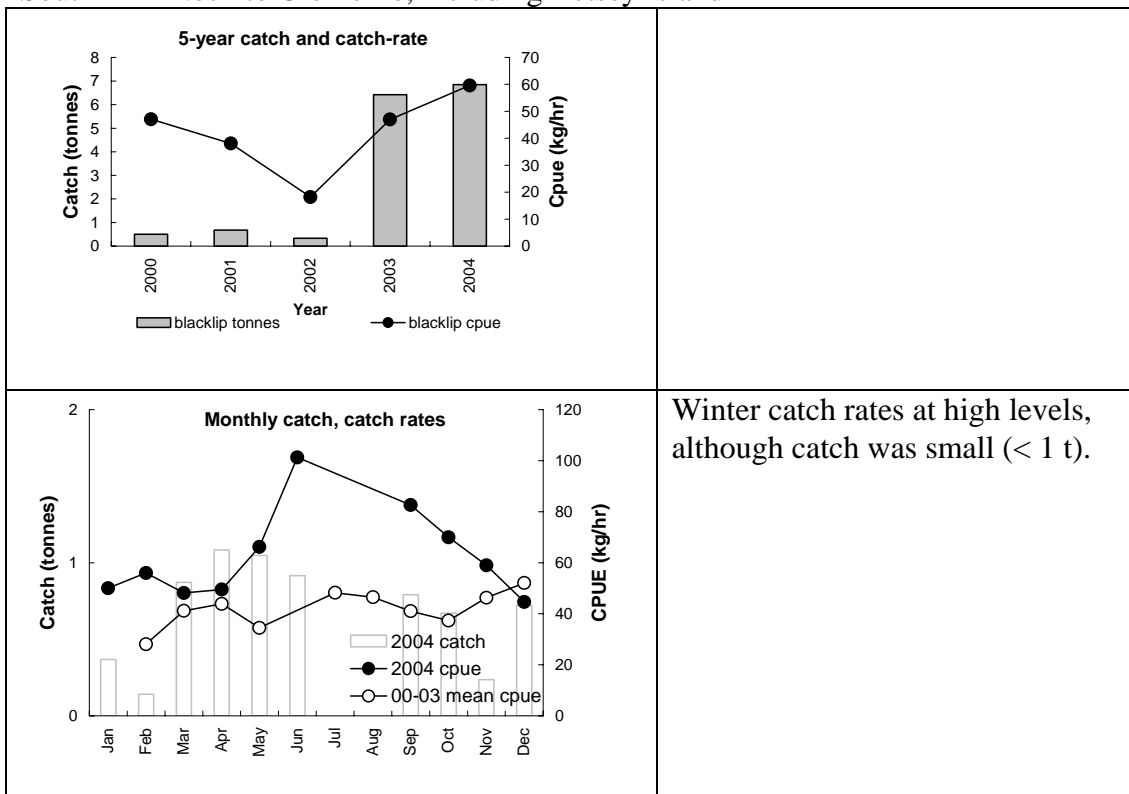


Block 17 (South Arm to Cremorne, Blackjack shoreline to Outer North Head)



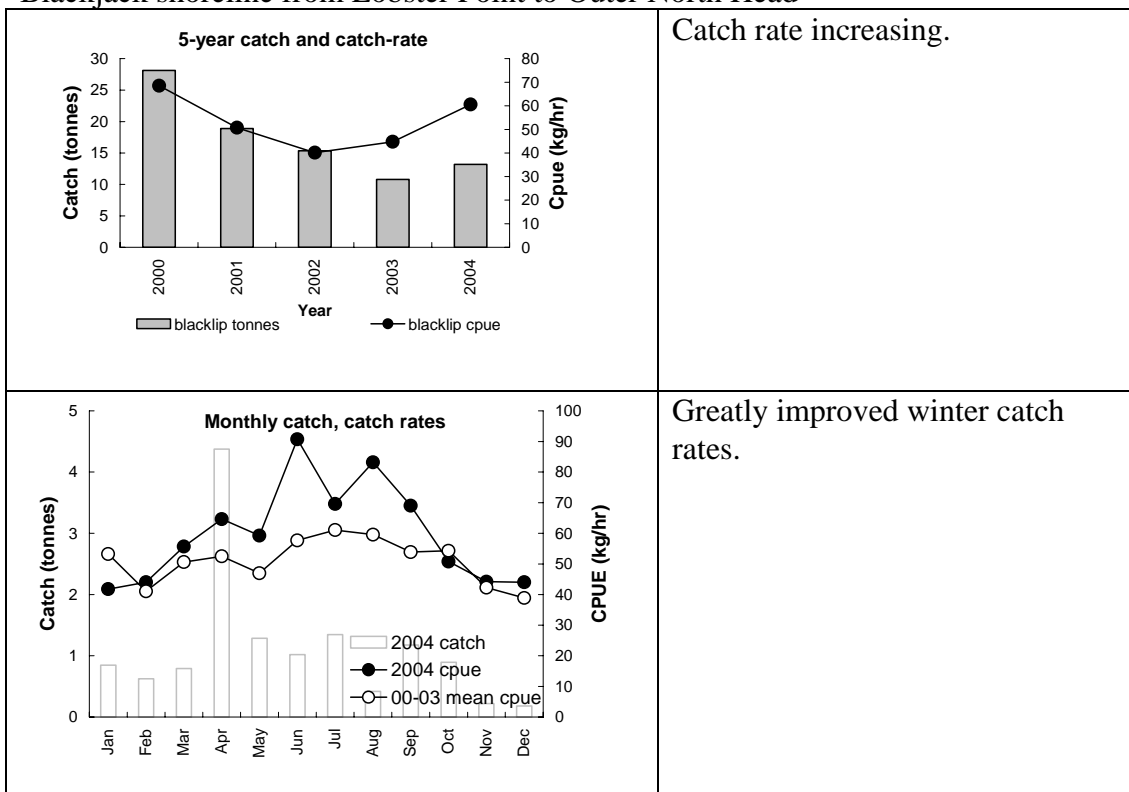
Sub-block 17A

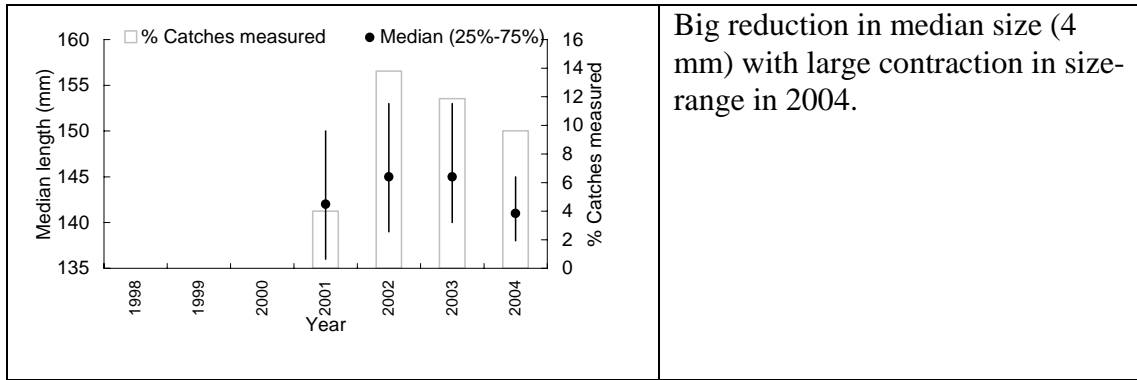
South Arm Neck to Cremorne, including Betsey Island



Sub-block 17B

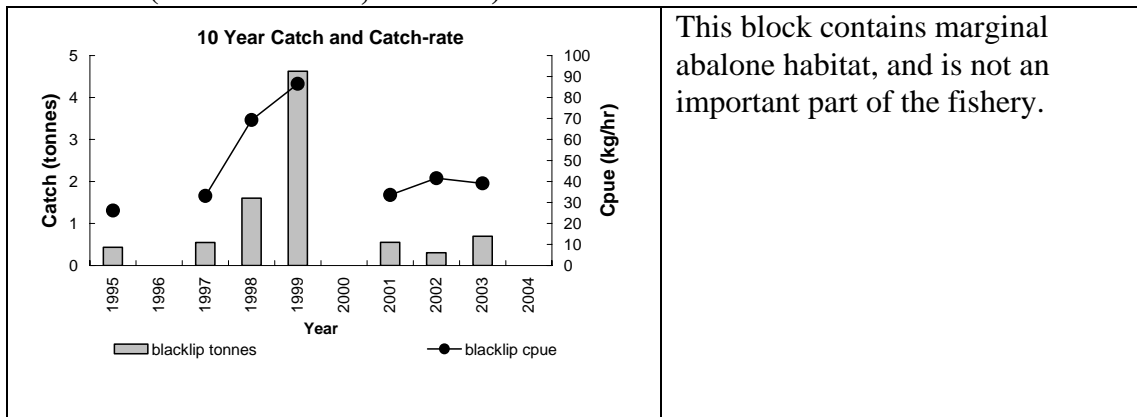
Blackjack shoreline from Lobster Point to Outer North Head





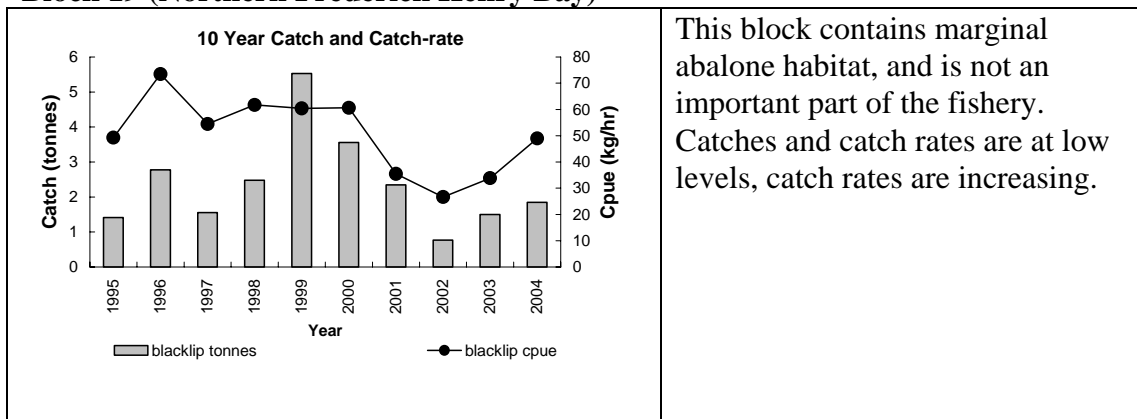
Big reduction in median size (4 mm) with large contraction in size-range in 2004.

Block 18 (Derwent River, Iron Pot)



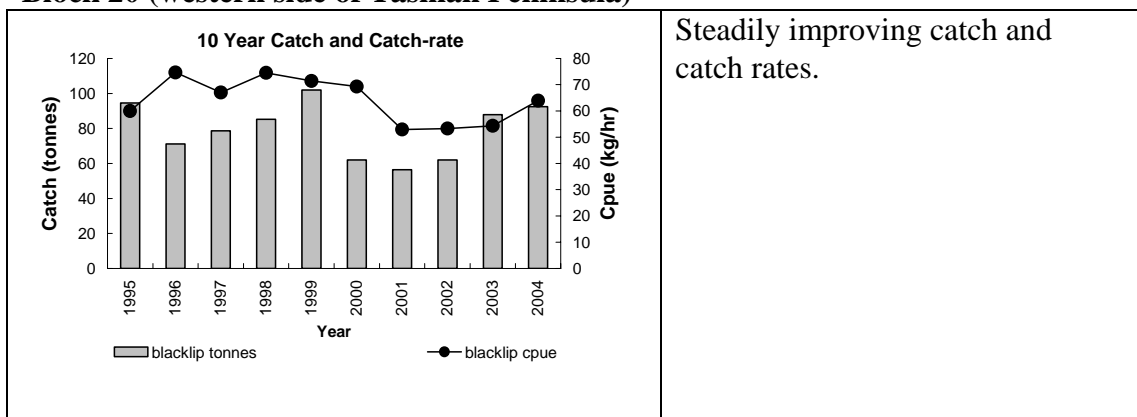
This block contains marginal abalone habitat, and is not an important part of the fishery.

Block 19 (Northern Frederick Henry Bay)



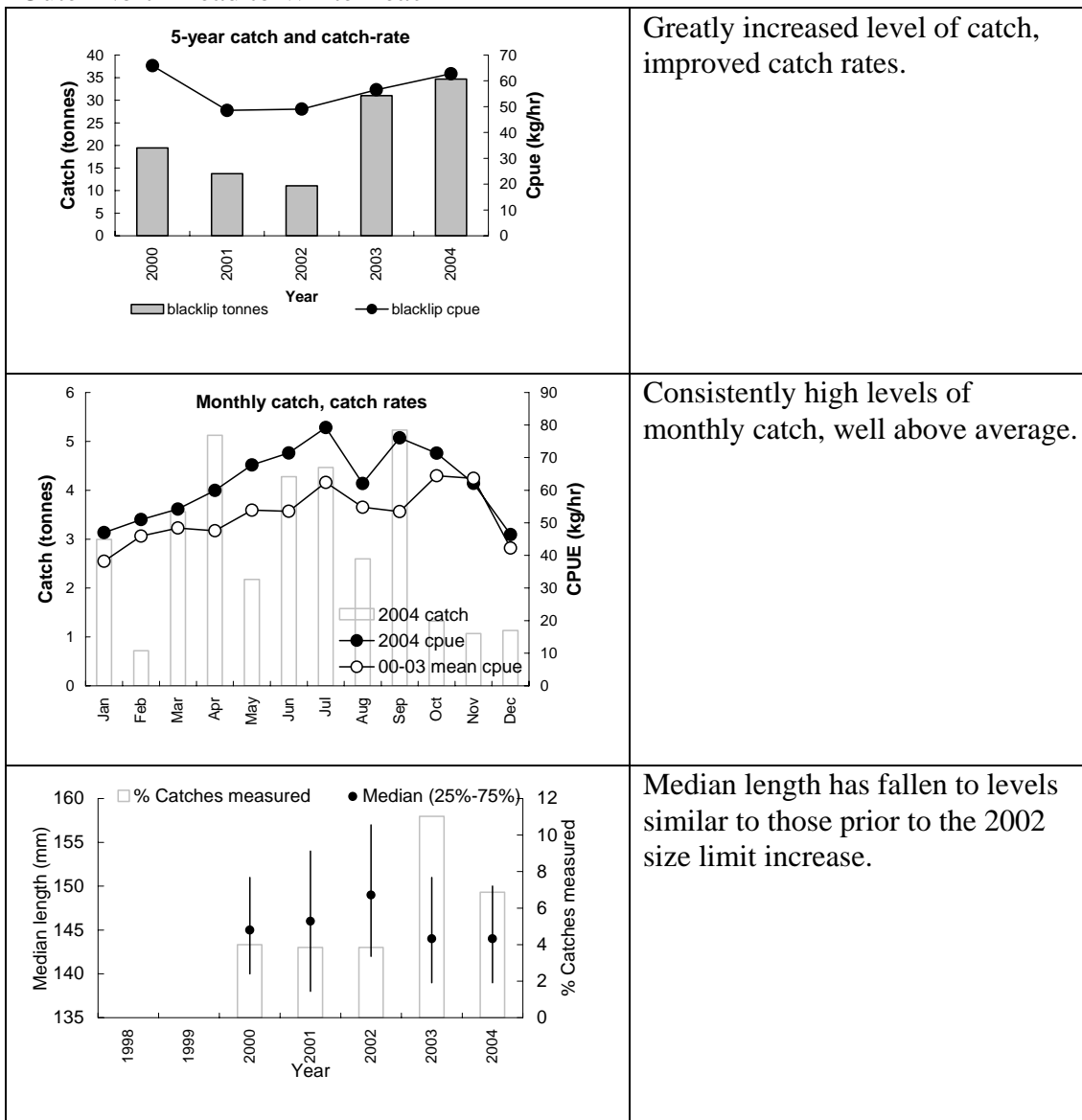
This block contains marginal abalone habitat, and is not an important part of the fishery. Catches and catch rates are at low levels, catch rates are increasing.

Block 20 (western side of Tasman Peninsula)

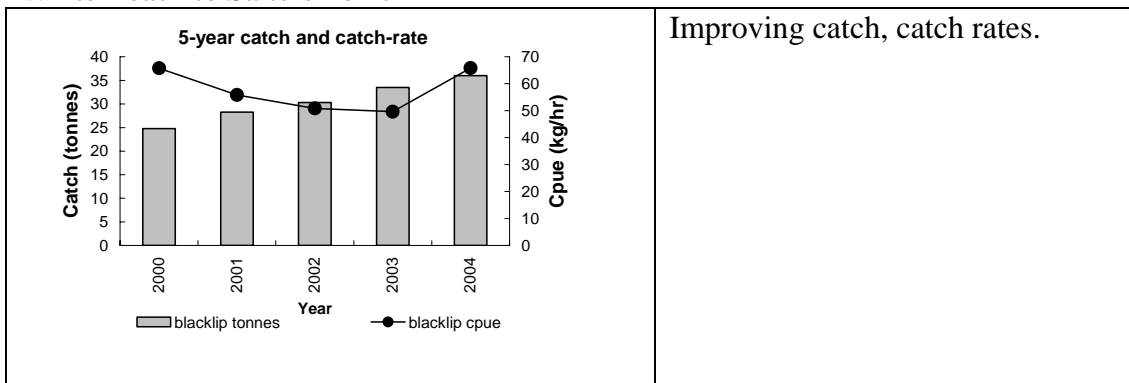


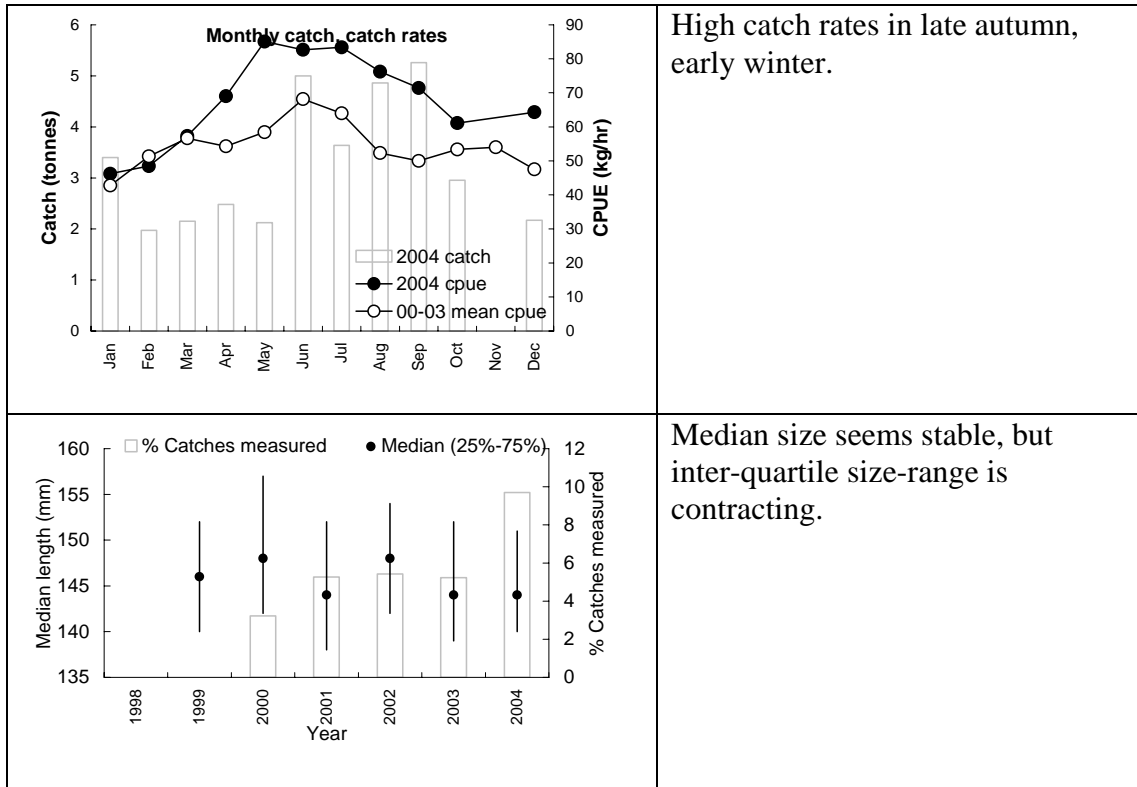
Steadily improving catch and catch rates.

Sub-block 20A
Outer North Head to White Beach



Sub-block 20B
White Beach to Salters Point

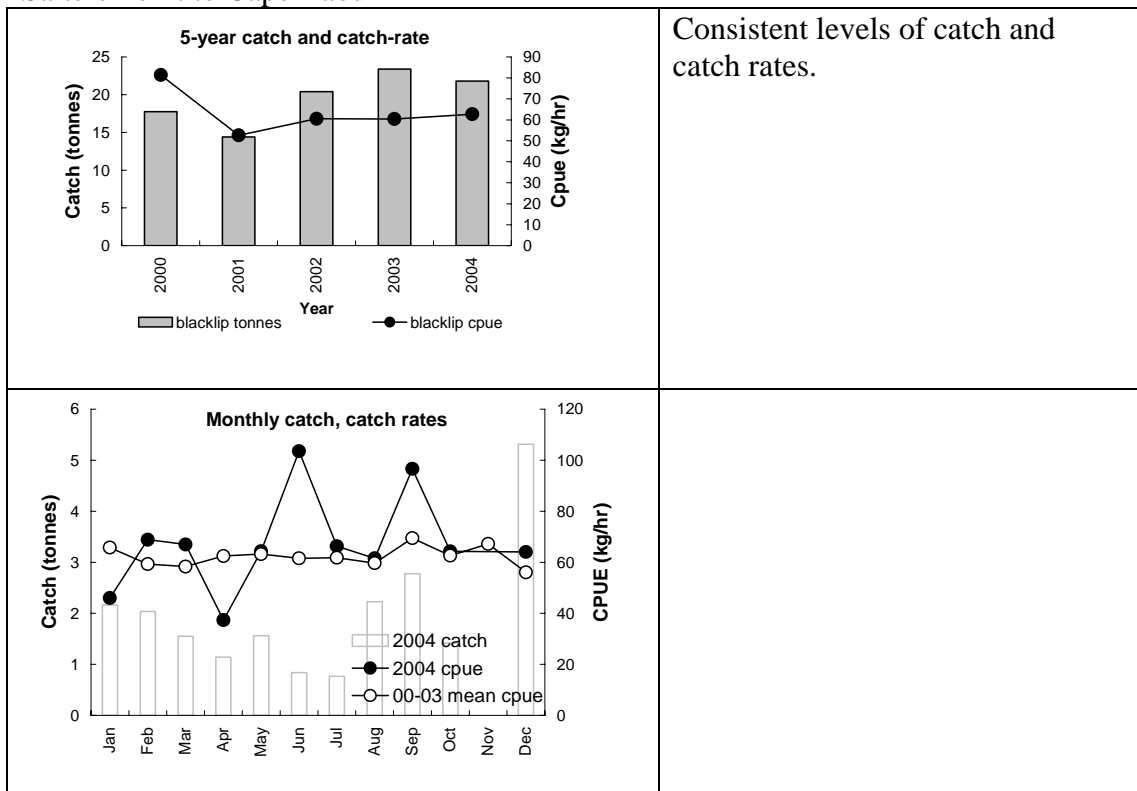




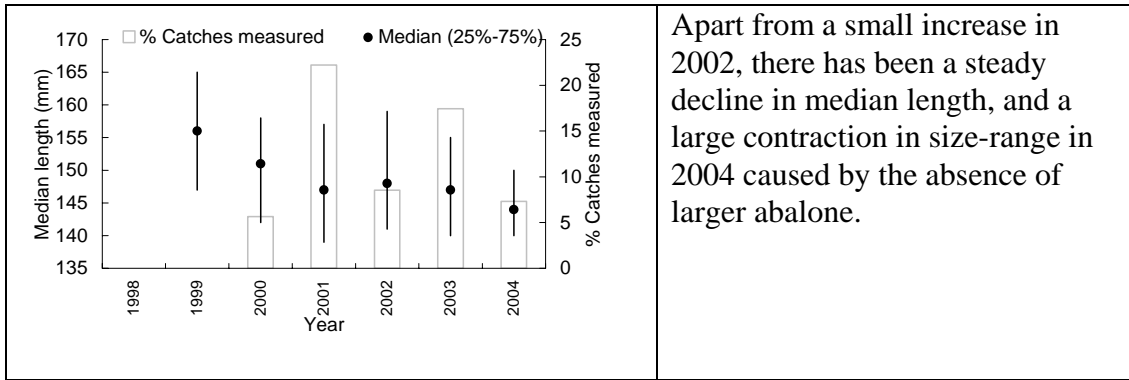
High catch rates in late autumn, early winter.

Median size seems stable, but inter-quartile size-range is contracting.

Sub-block 20C
Salters Point to Cape Raoul

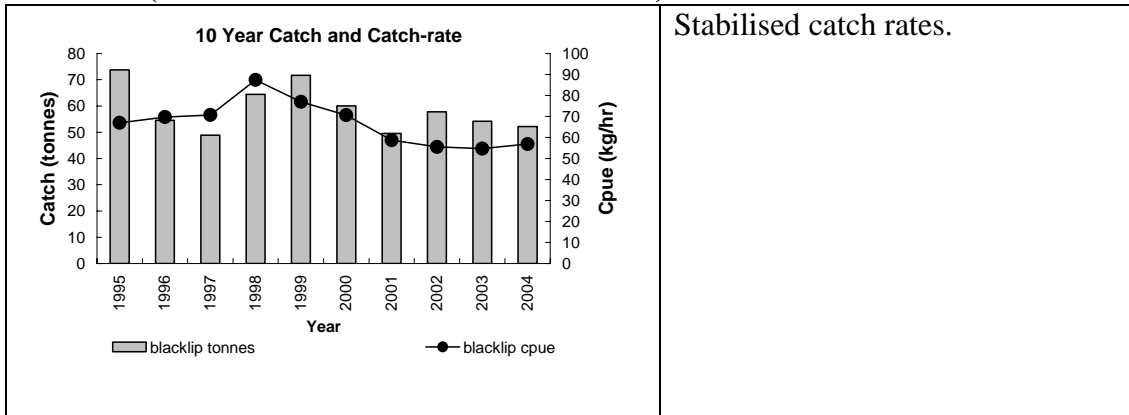


Consistent levels of catch and catch rates.



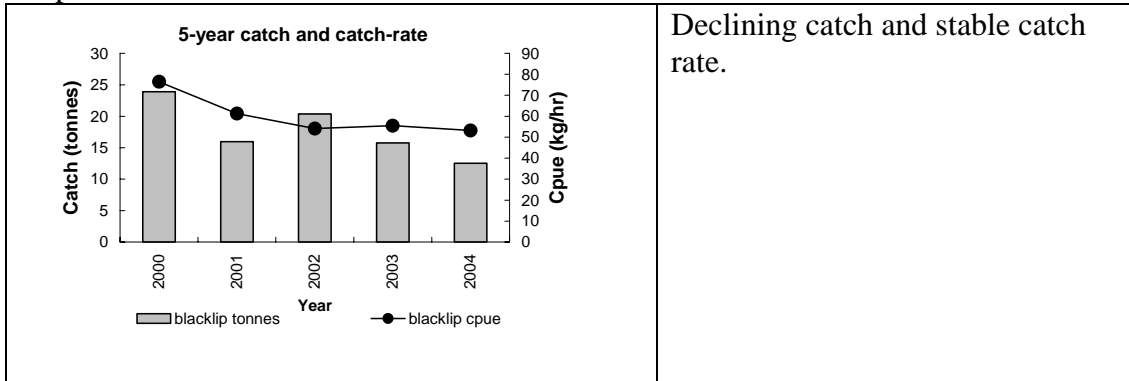
Apart from a small increase in 2002, there has been a steady decline in median length, and a large contraction in size-range in 2004 caused by the absence of larger abalone.

Block 21 (southern shore of Tasman Peninsula)

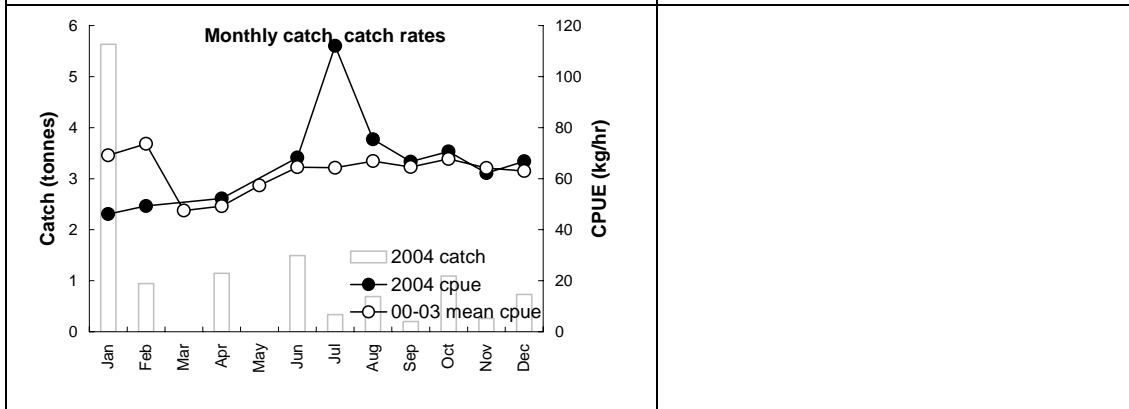


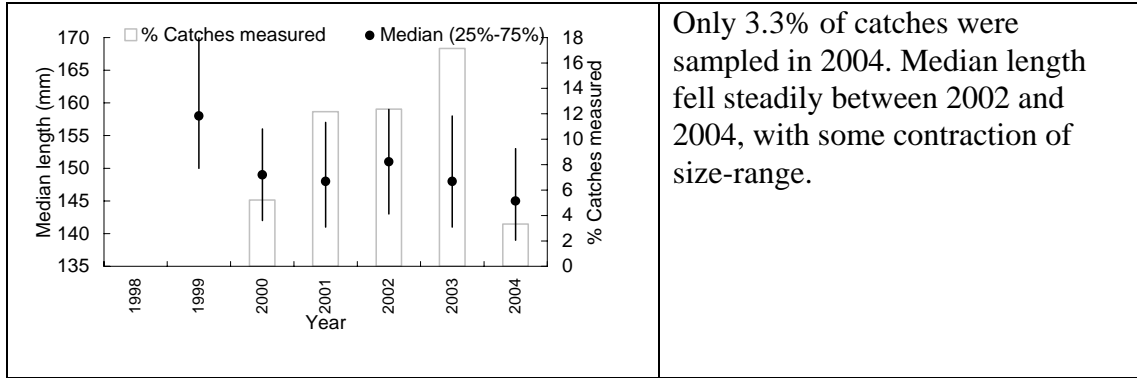
Stabilised catch rates.

**Sub-block 21A
Cape Raoul to Port Arthur**



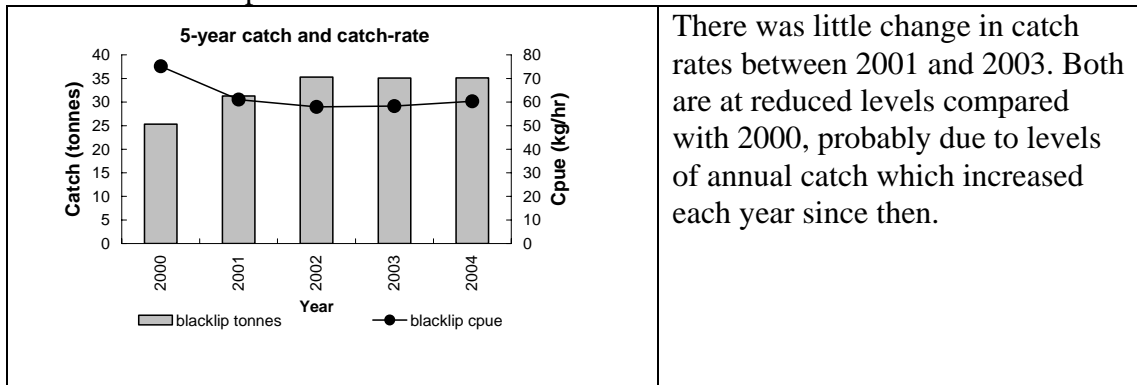
Declining catch and stable catch rate.



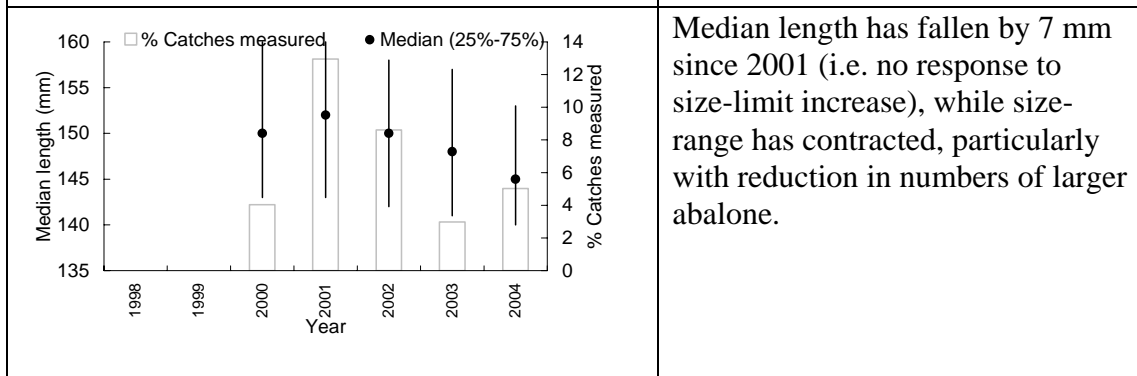
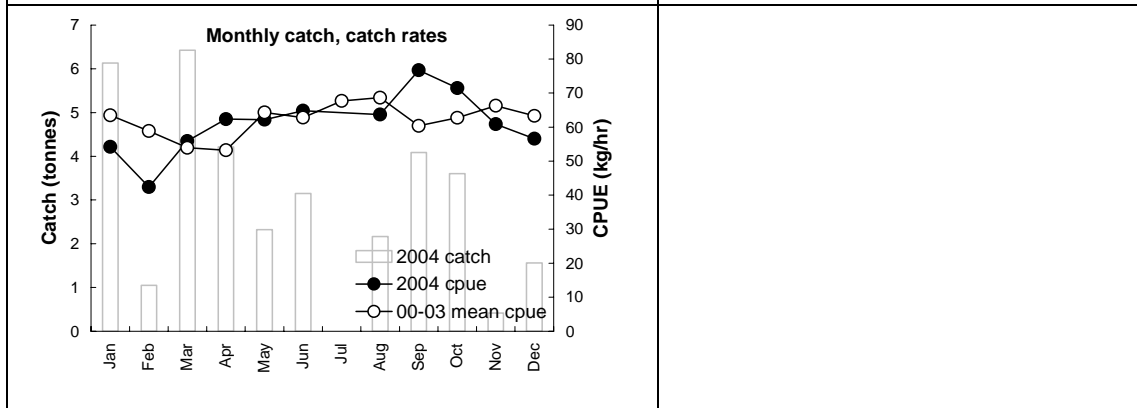


Only 3.3% of catches were sampled in 2004. Median length fell steadily between 2002 and 2004, with some contraction of size-range.

Sub-block 21C
Port Arthur to Cape Pillar

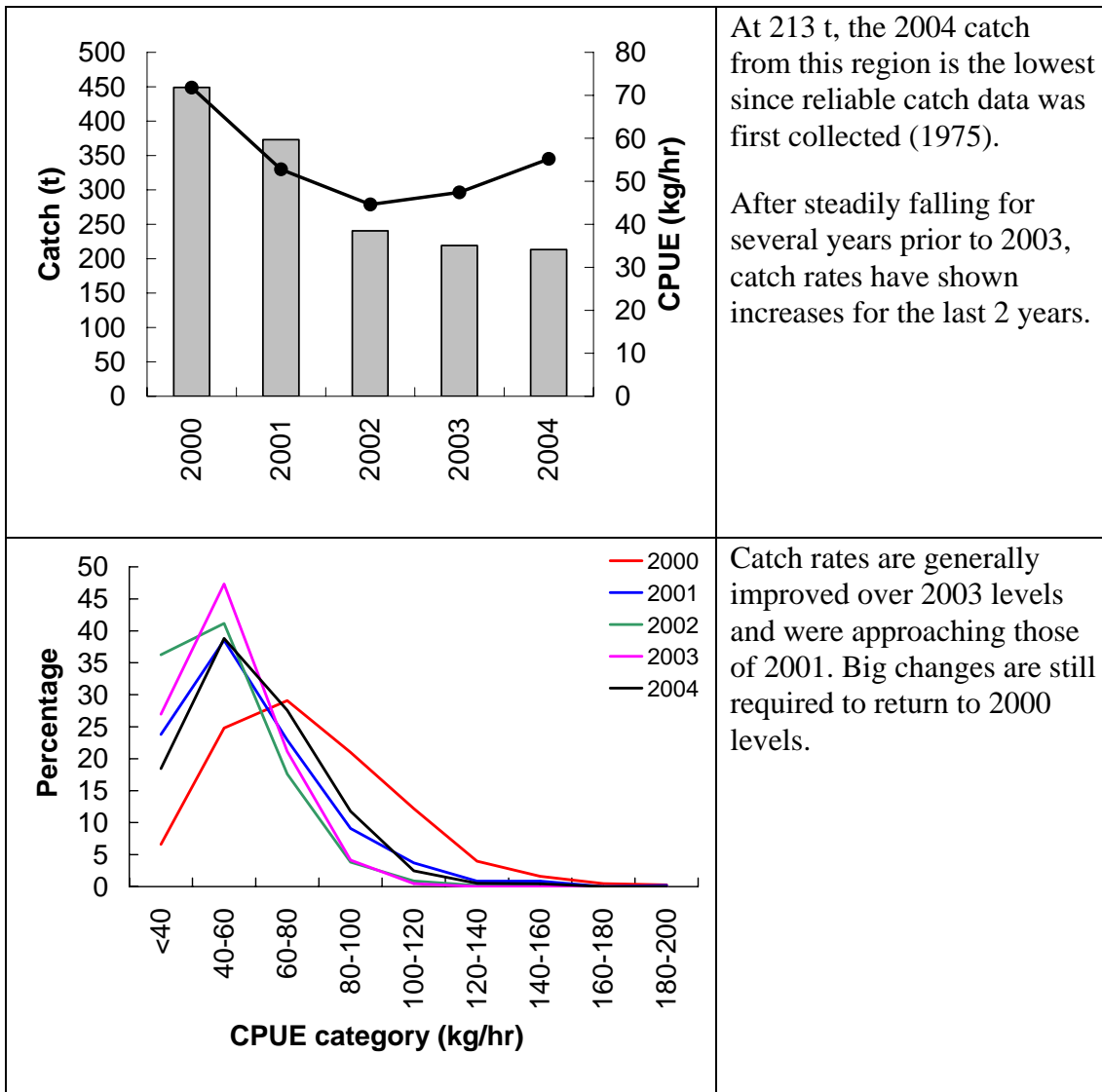


There was little change in catch rates between 2001 and 2003. Both are at reduced levels compared with 2000, probably due to levels of annual catch which increased each year since then.

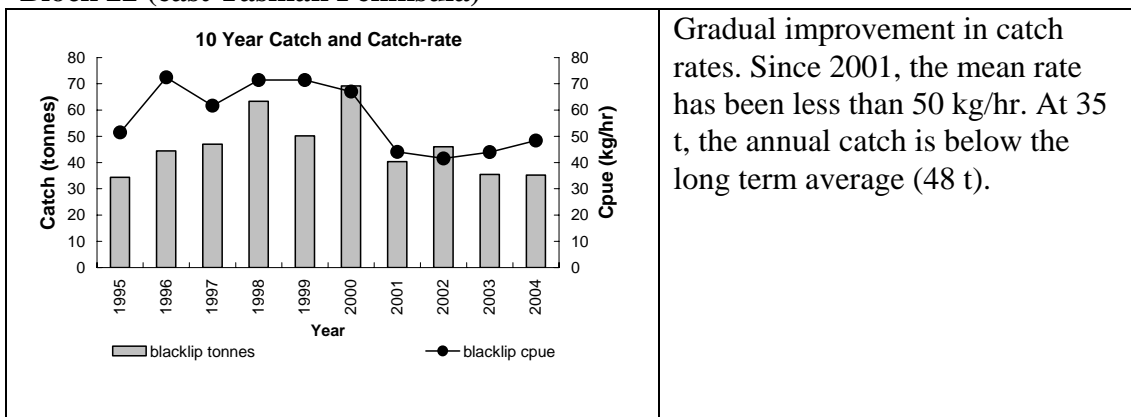


Median length has fallen by 7 mm since 2001 (i.e. no response to size-limit increase), while size-range has contracted, particularly with reduction in numbers of larger abalone.

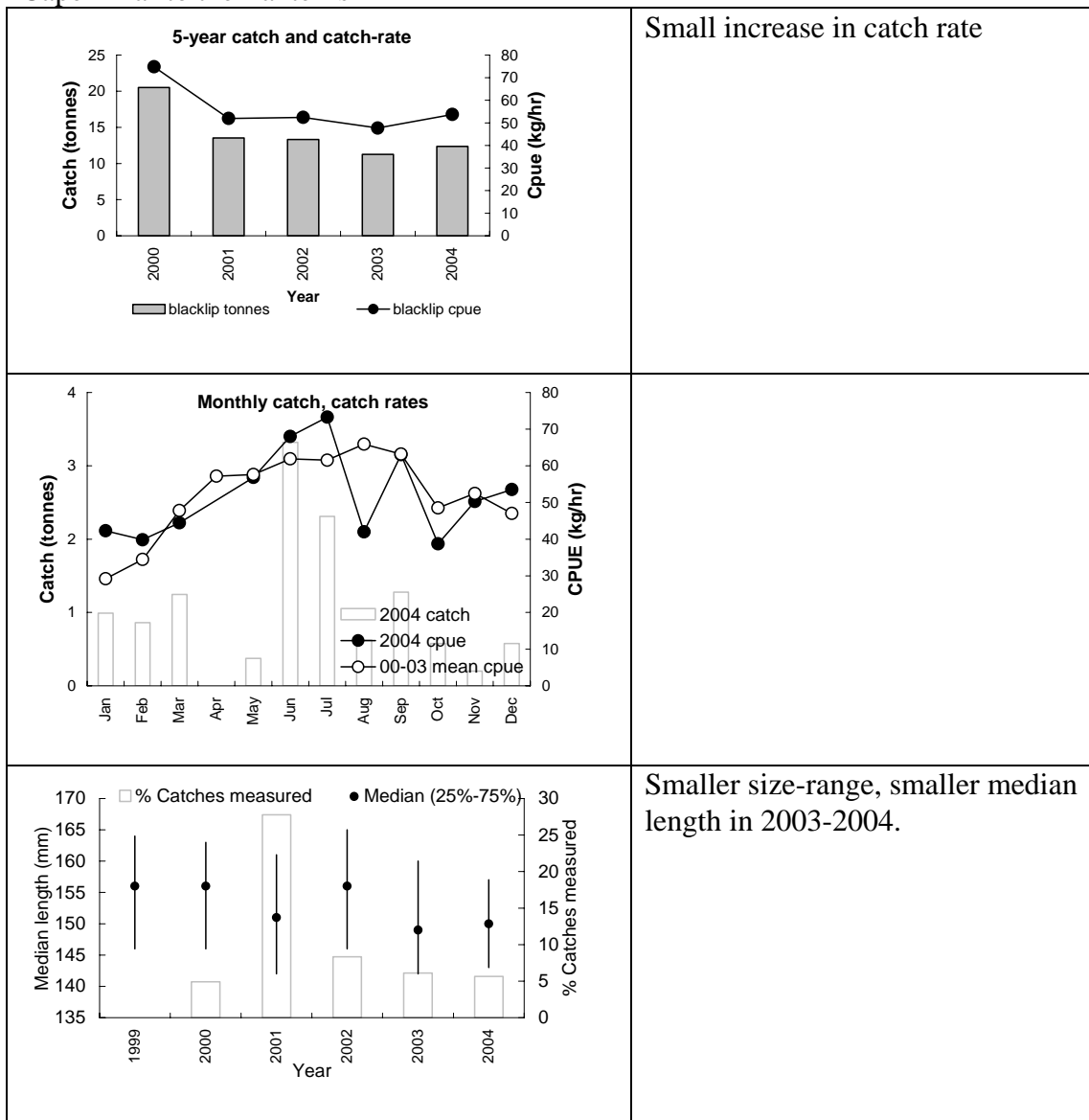
Eastern Zone – East Coast - Tasman Island to Musselroe River (Blocks 22–31B)



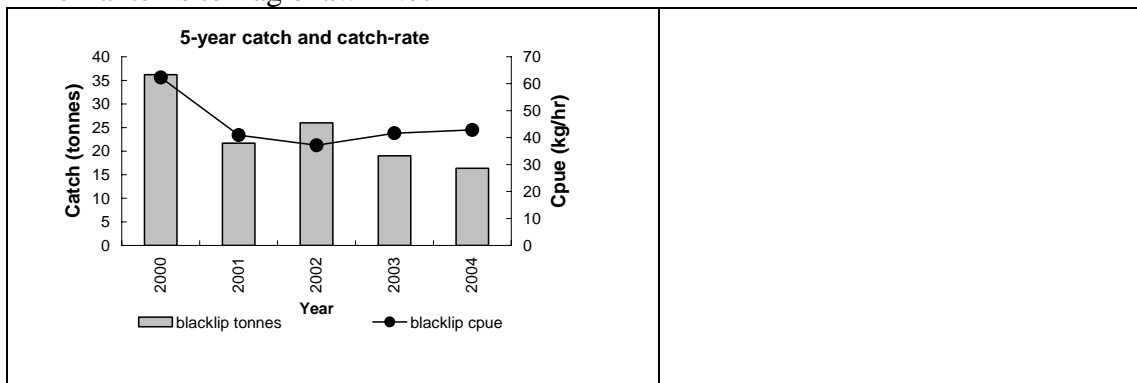
Block 22 (east Tasman Peninsula)

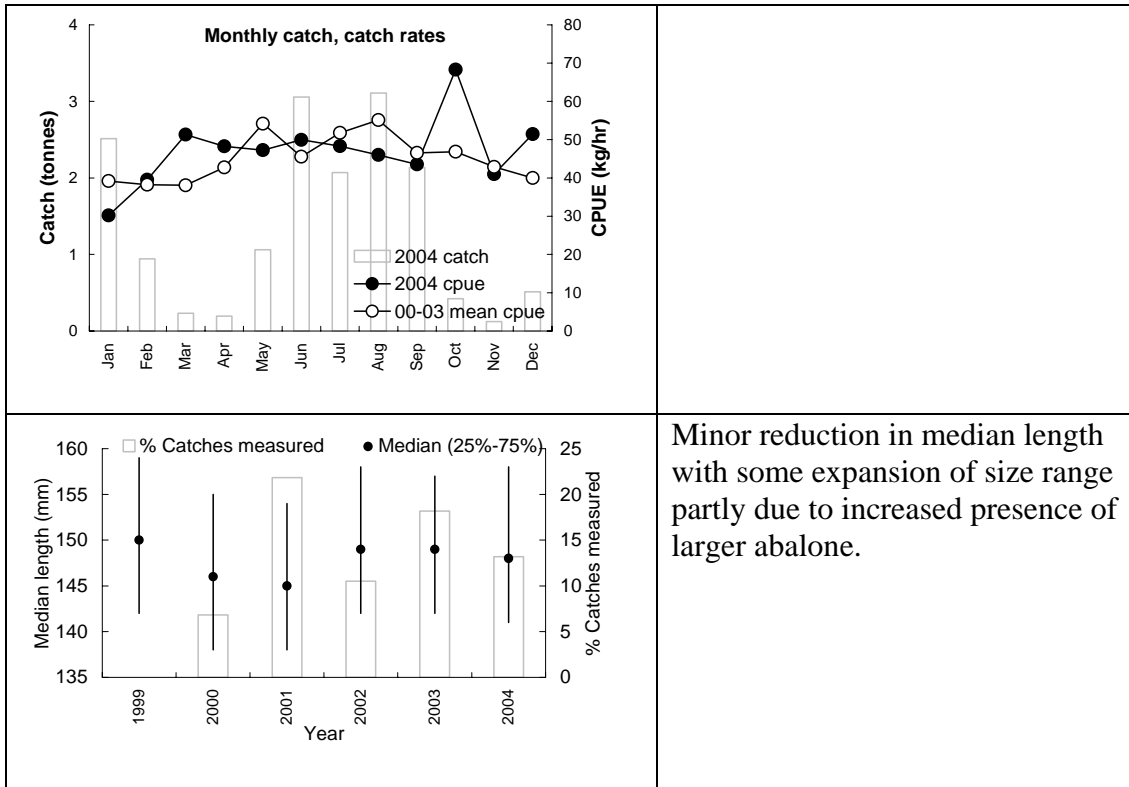


Sub-block 22A
Cape Pillar to the Lanterns



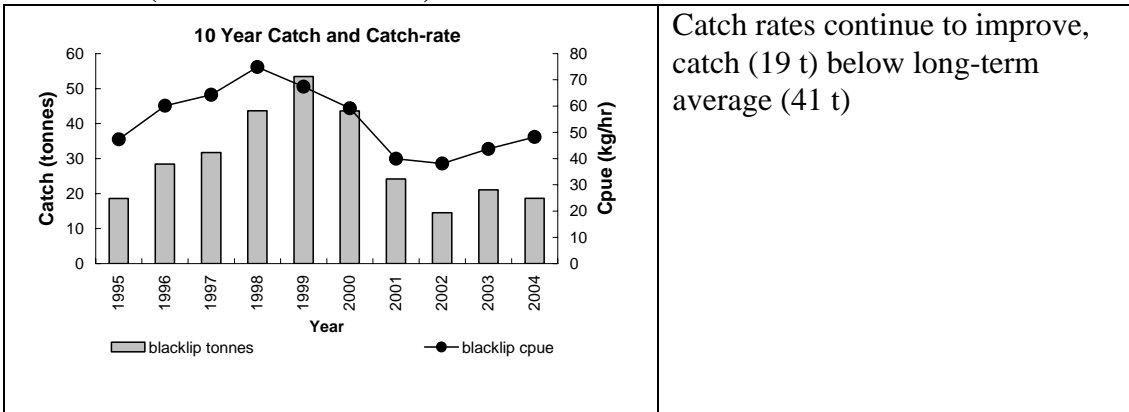
Sub-block 22B
The Lanterns to Eaglehawk Neck





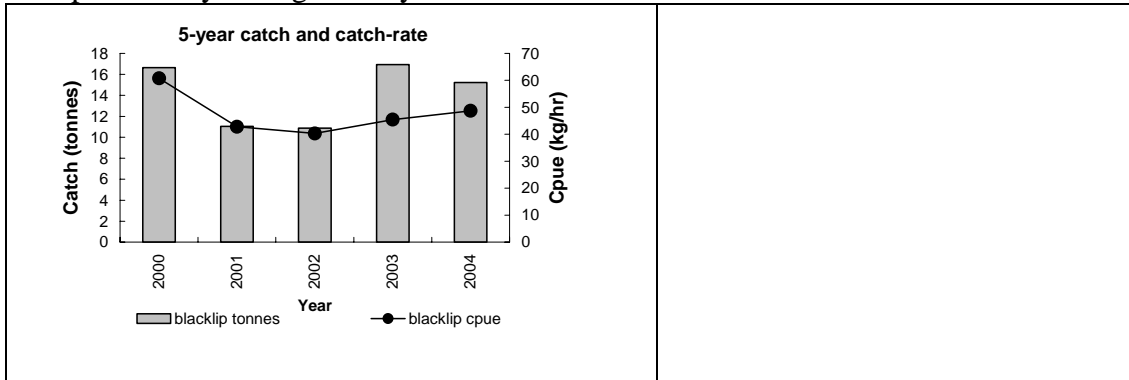
Minor reduction in median length with some expansion of size range partly due to increased presence of larger abalone.

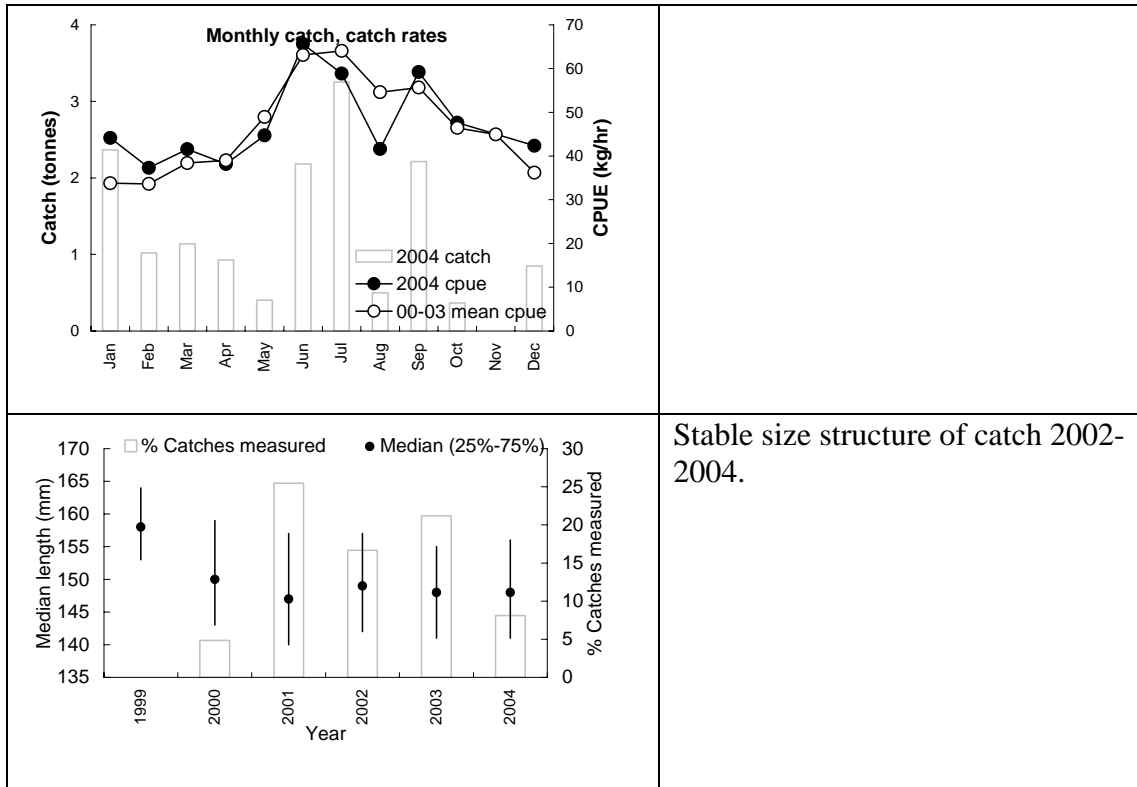
Block 23 (Forestier Peninsula)



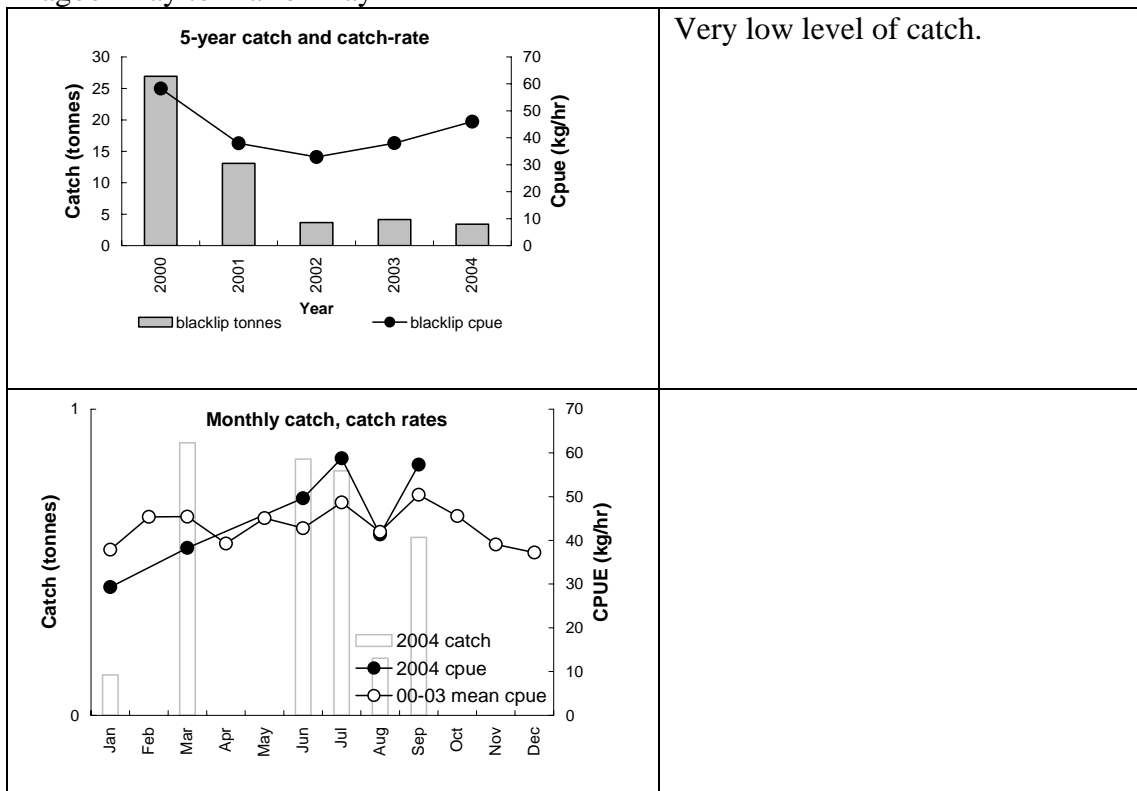
Catch rates continue to improve, catch (19 t) below long-term average (41 t)

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

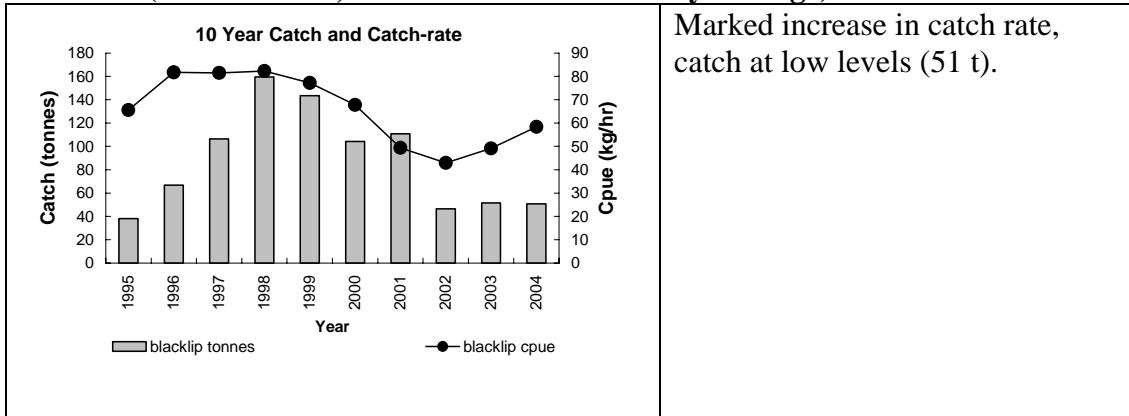




Sub-block 23B
Lagoon Bay to Marion Bay

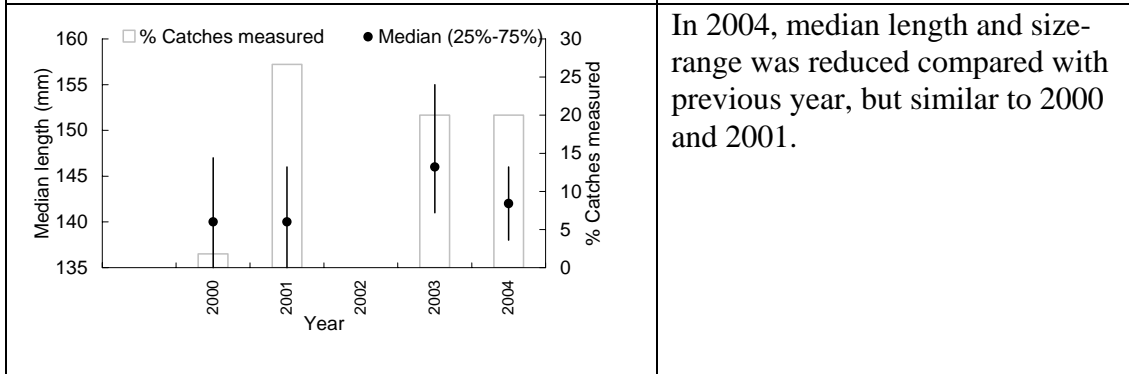
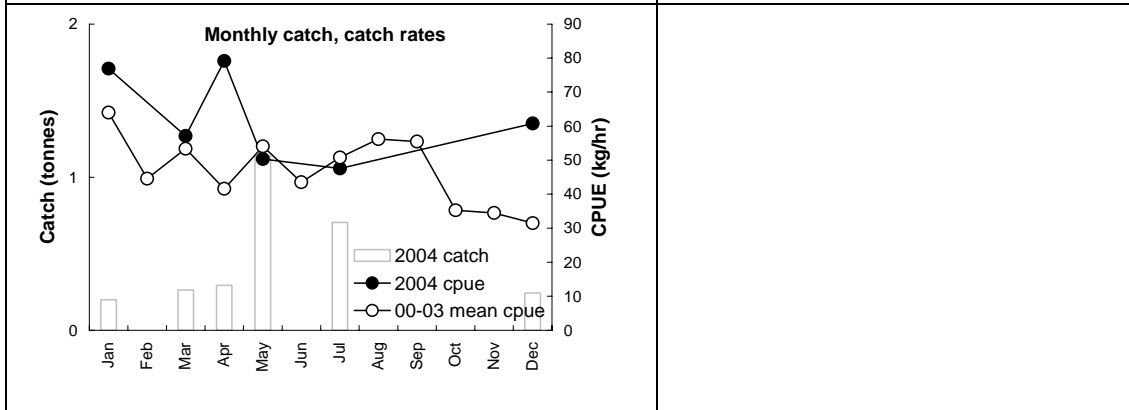
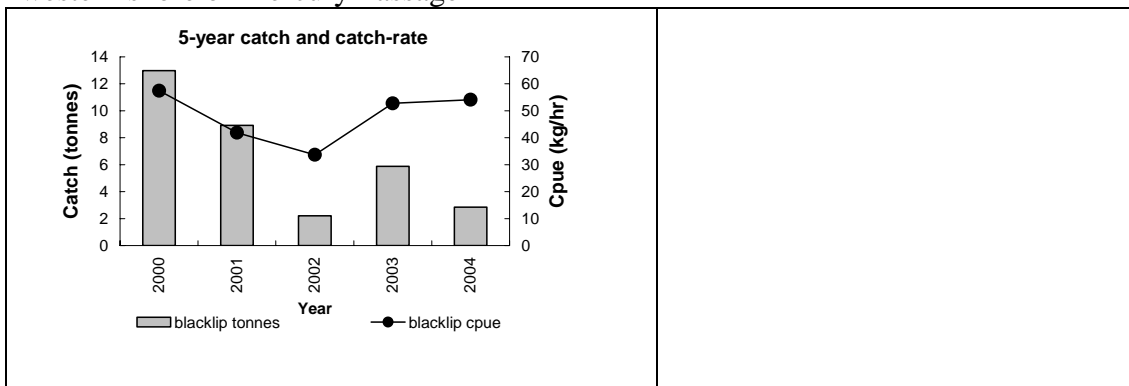


Block 24 (Maria Island, western shore of Mercury Passage)



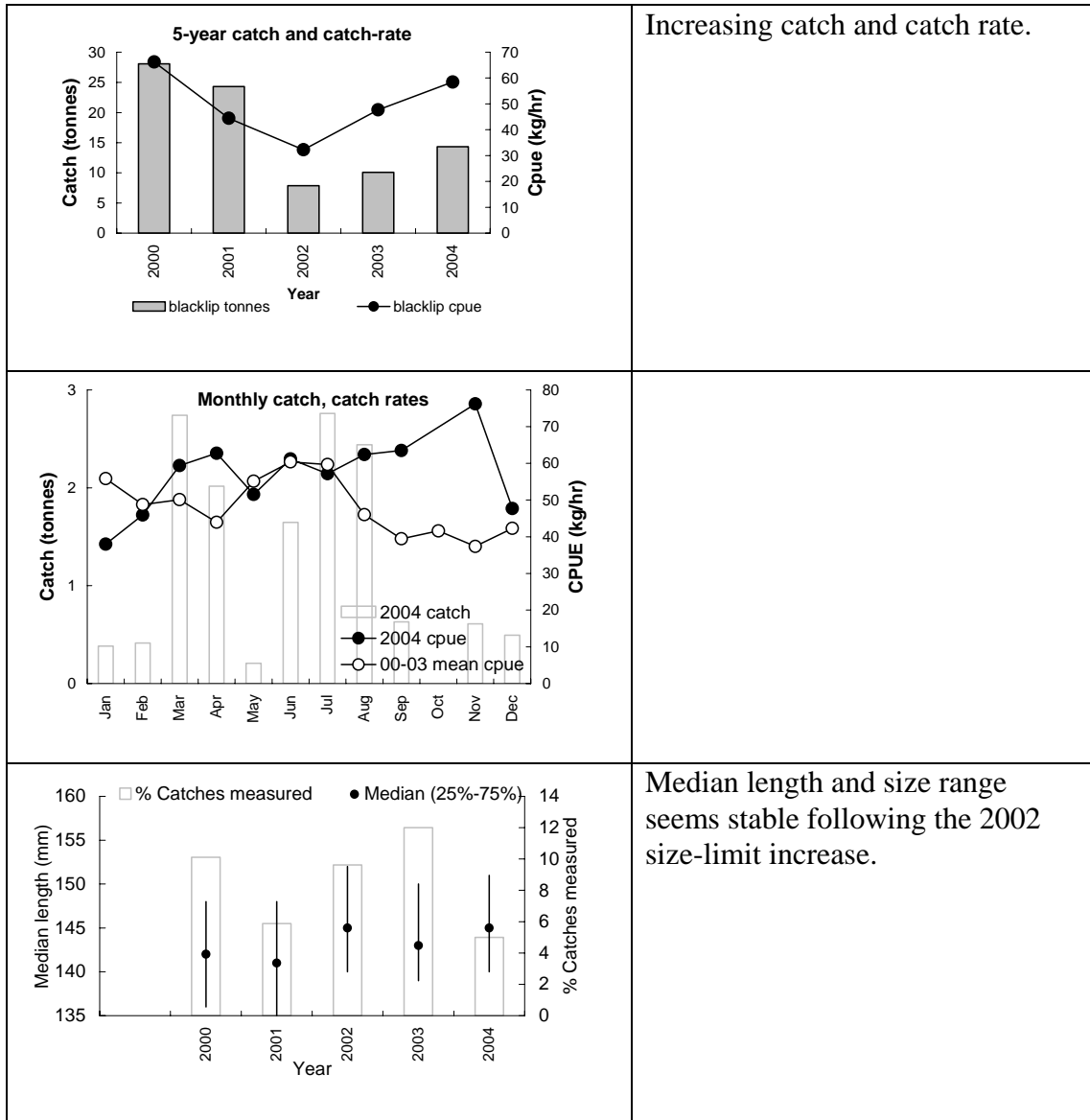
Marked increase in catch rate, catch at low levels (51 t).

Sub-block 24A
western shore of Mercury Passage

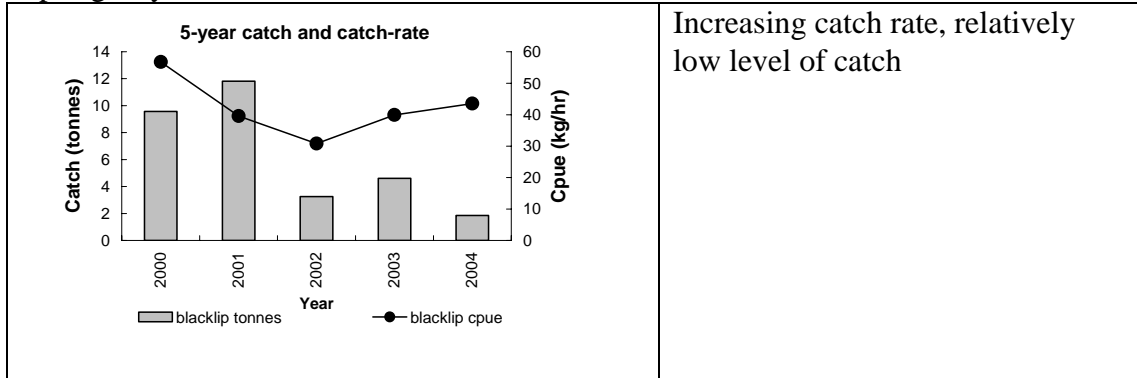


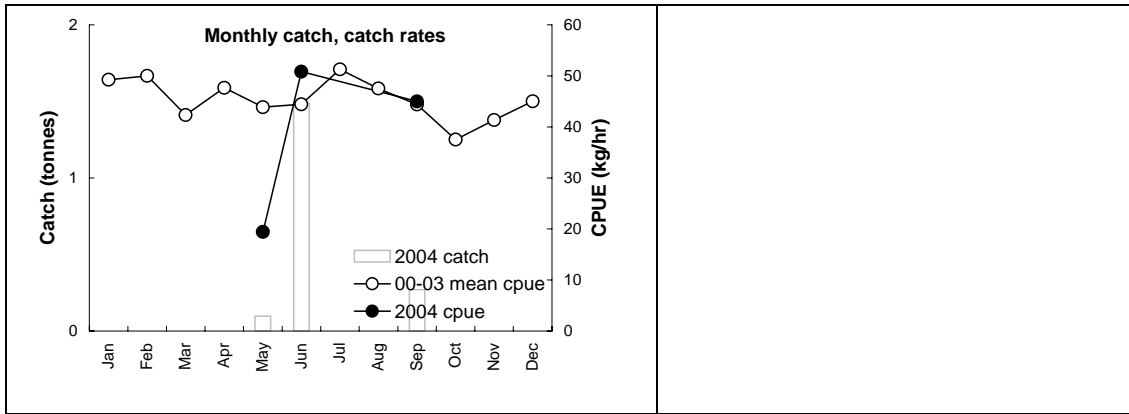
In 2004, median length and size-range was reduced compared with previous year, but similar to 2000 and 2001.

Sub-block 24B
western shore of Maria Island

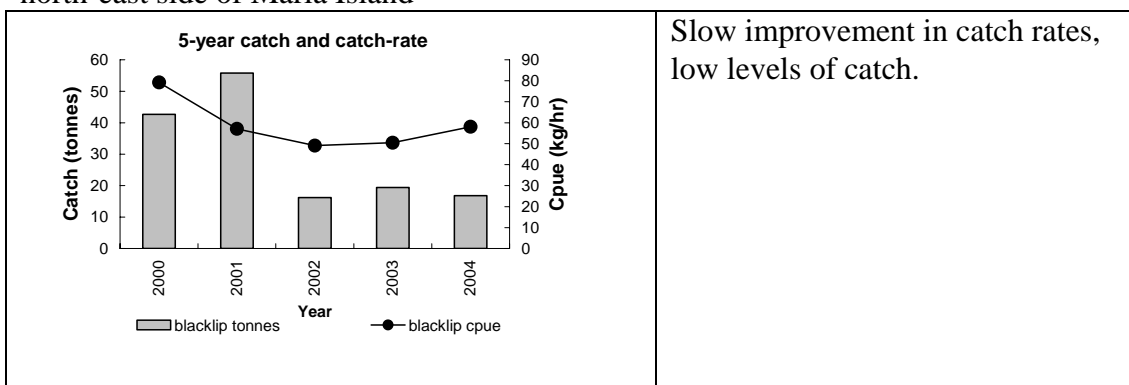


Sub-block 24C
Spring Bay

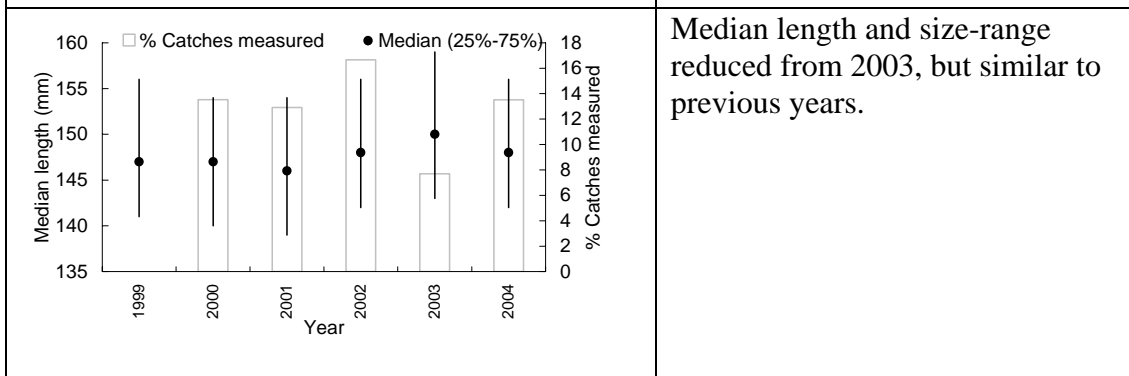
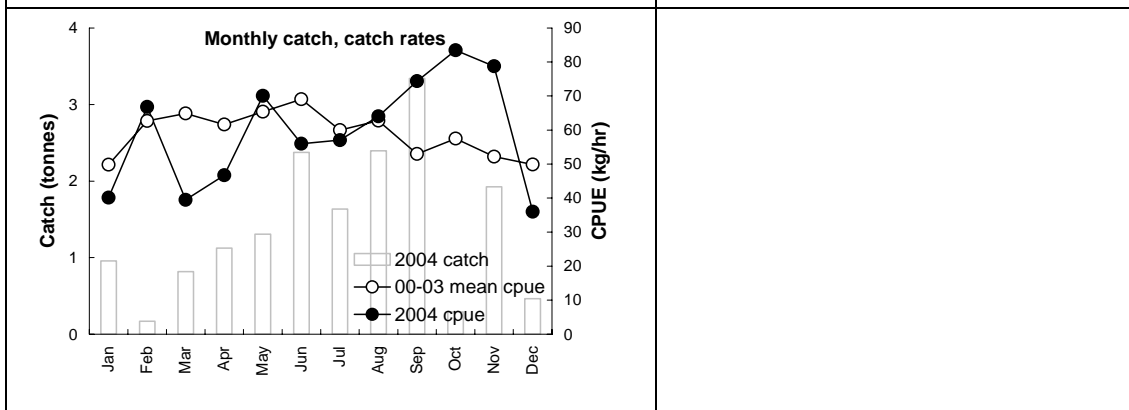




Sub-block 24D
north-east side of Maria Island

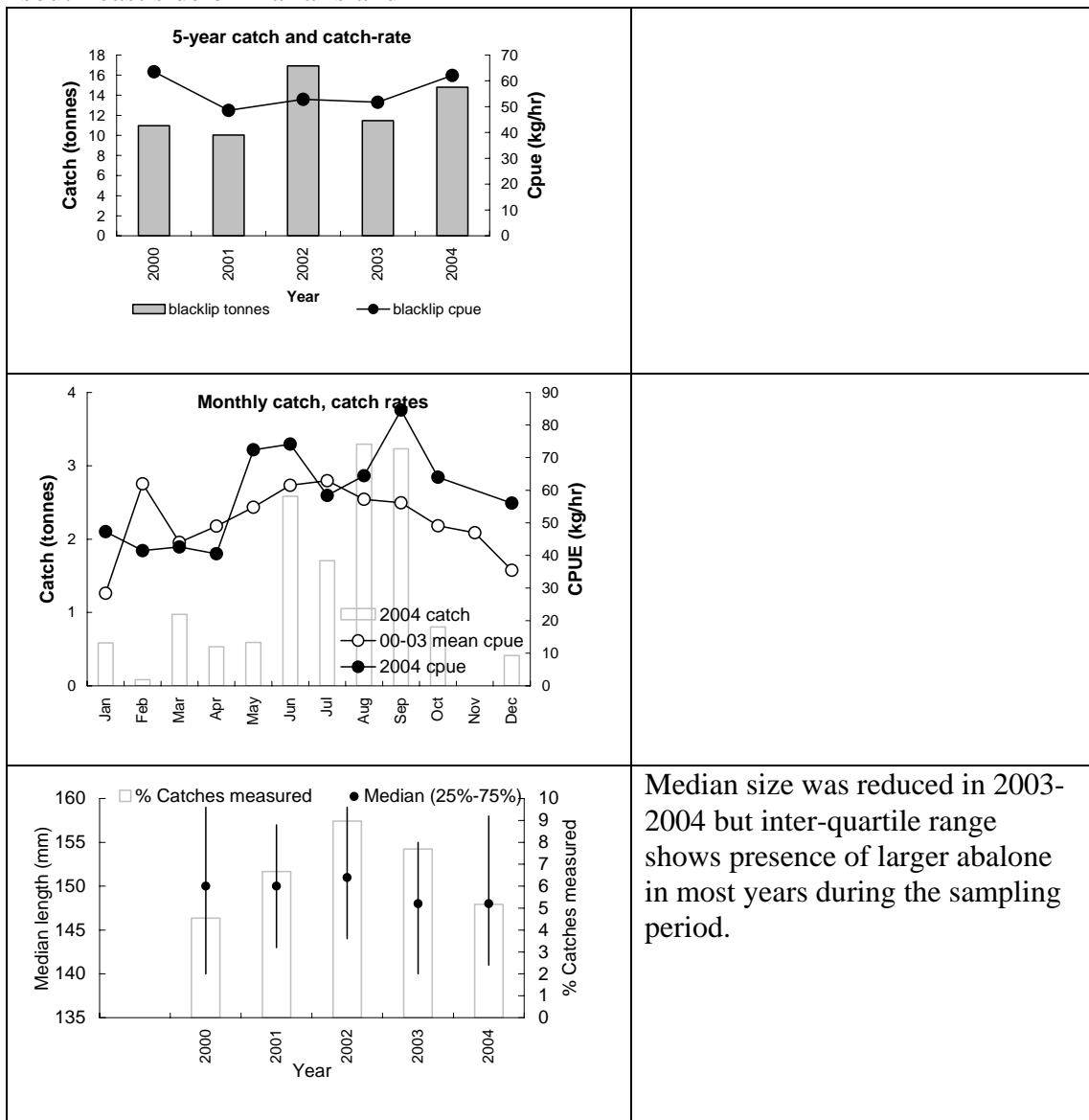


Slow improvement in catch rates, low levels of catch.



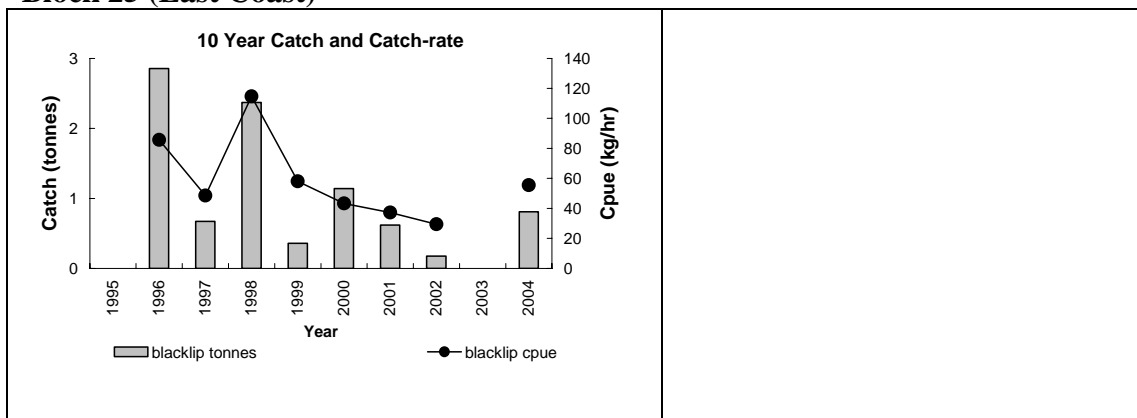
Median length and size-range reduced from 2003, but similar to previous years.

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

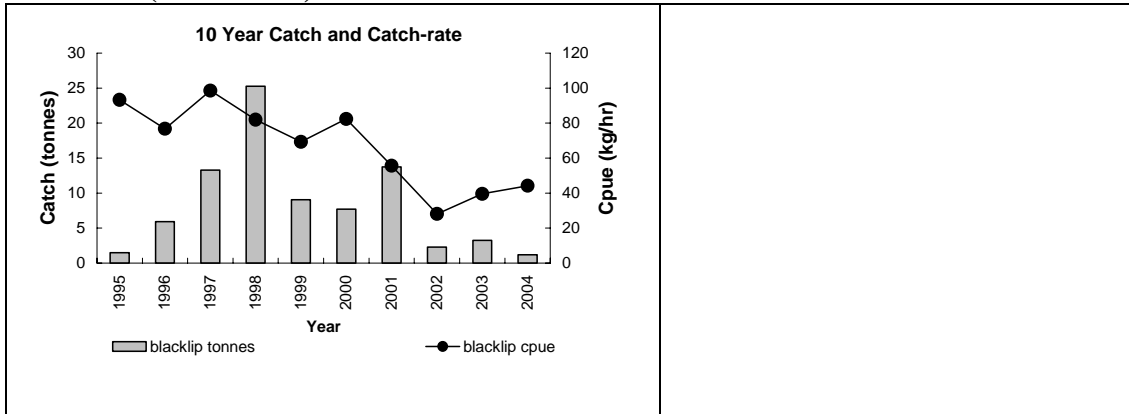


Median size was reduced in 2003-2004 but inter-quartile range shows presence of larger abalone in most years during the sampling period.

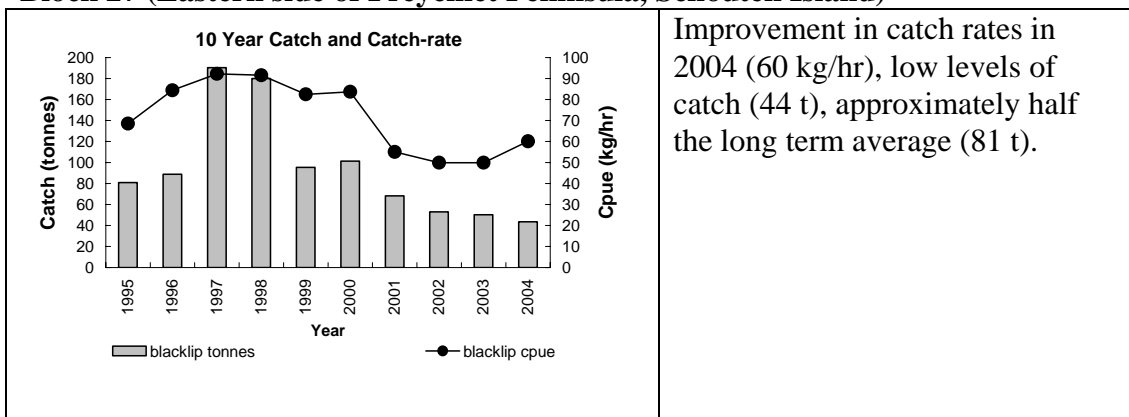
Block 25 (East Coast)



Block 26 (East Coast)



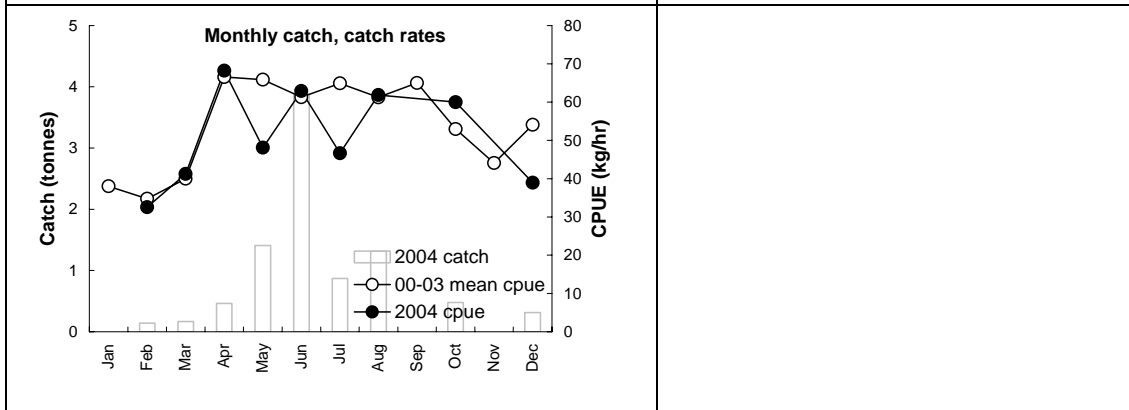
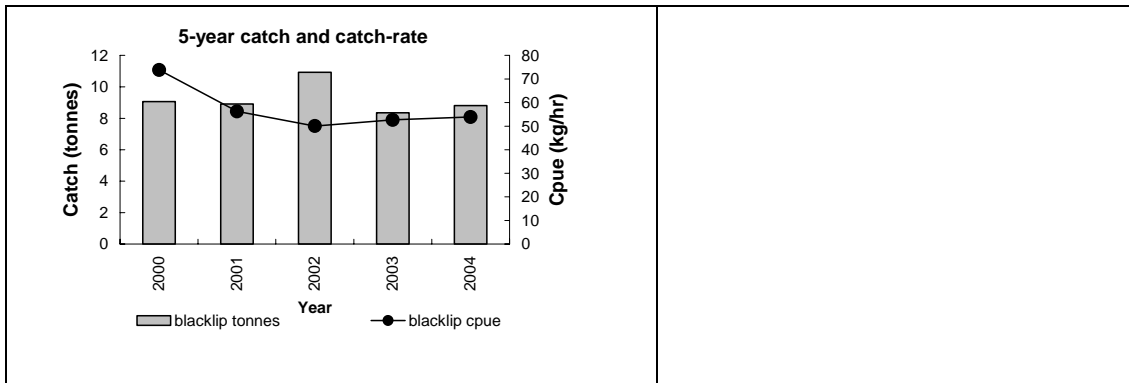
Block 27 (Eastern side of Freycinet Peninsula, Schouten Island)

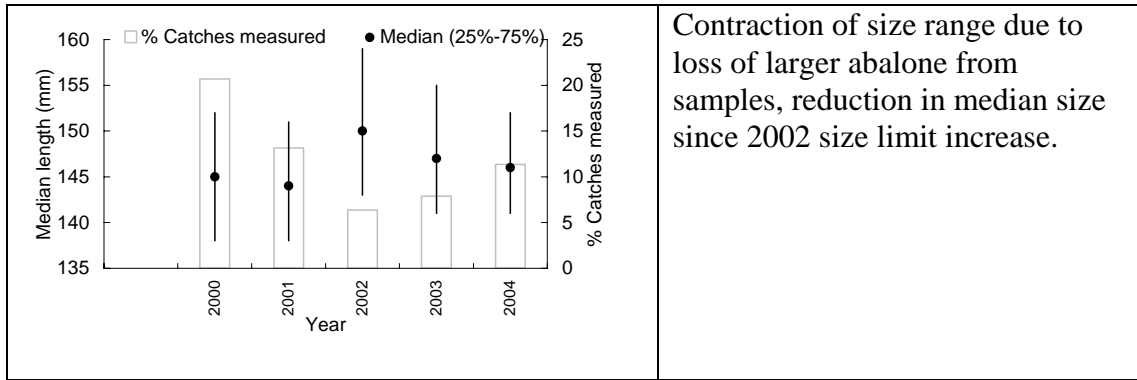


Improvement in catch rates in 2004 (60 kg/hr), low levels of catch (44 t), approximately half the long term average (81 t).

Sub-block 27A

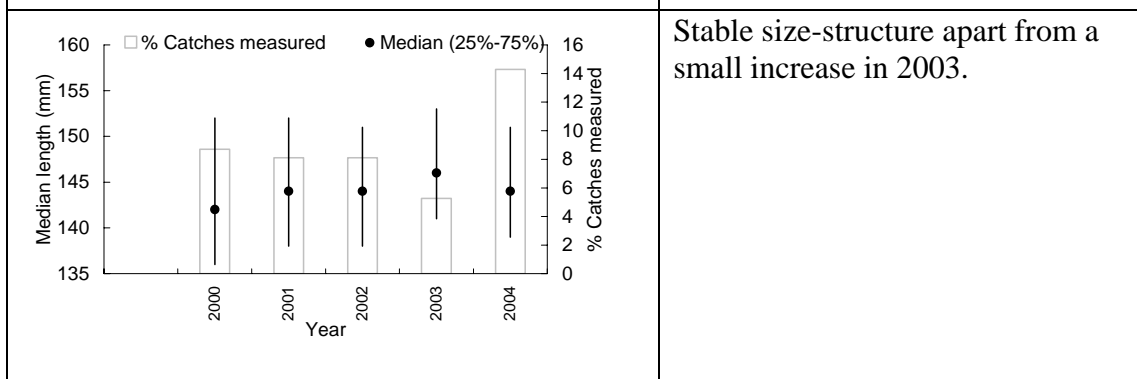
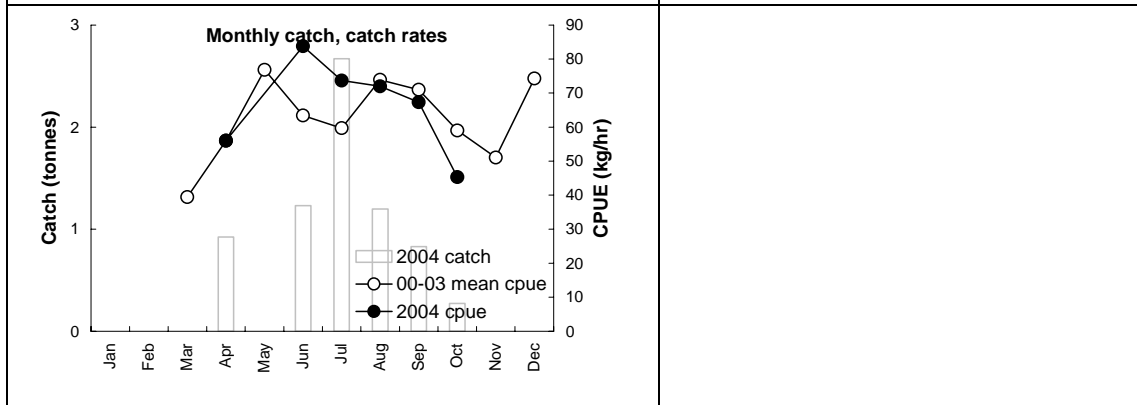
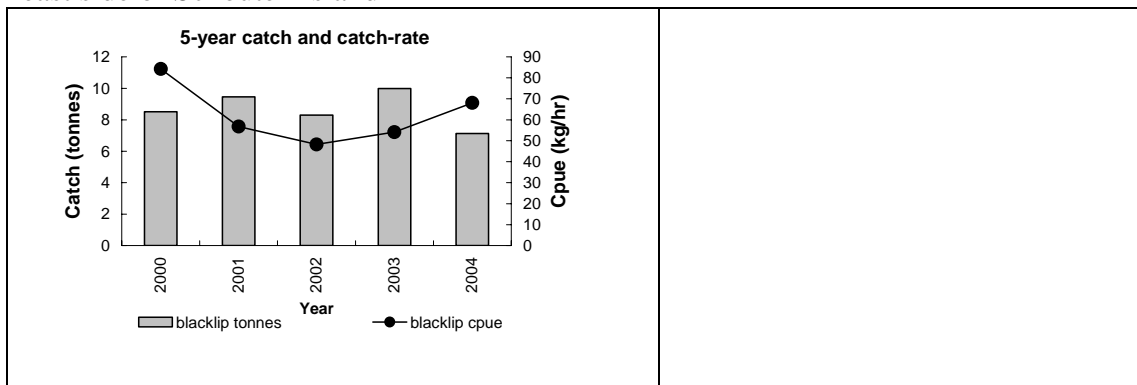
south side of Schouten Island





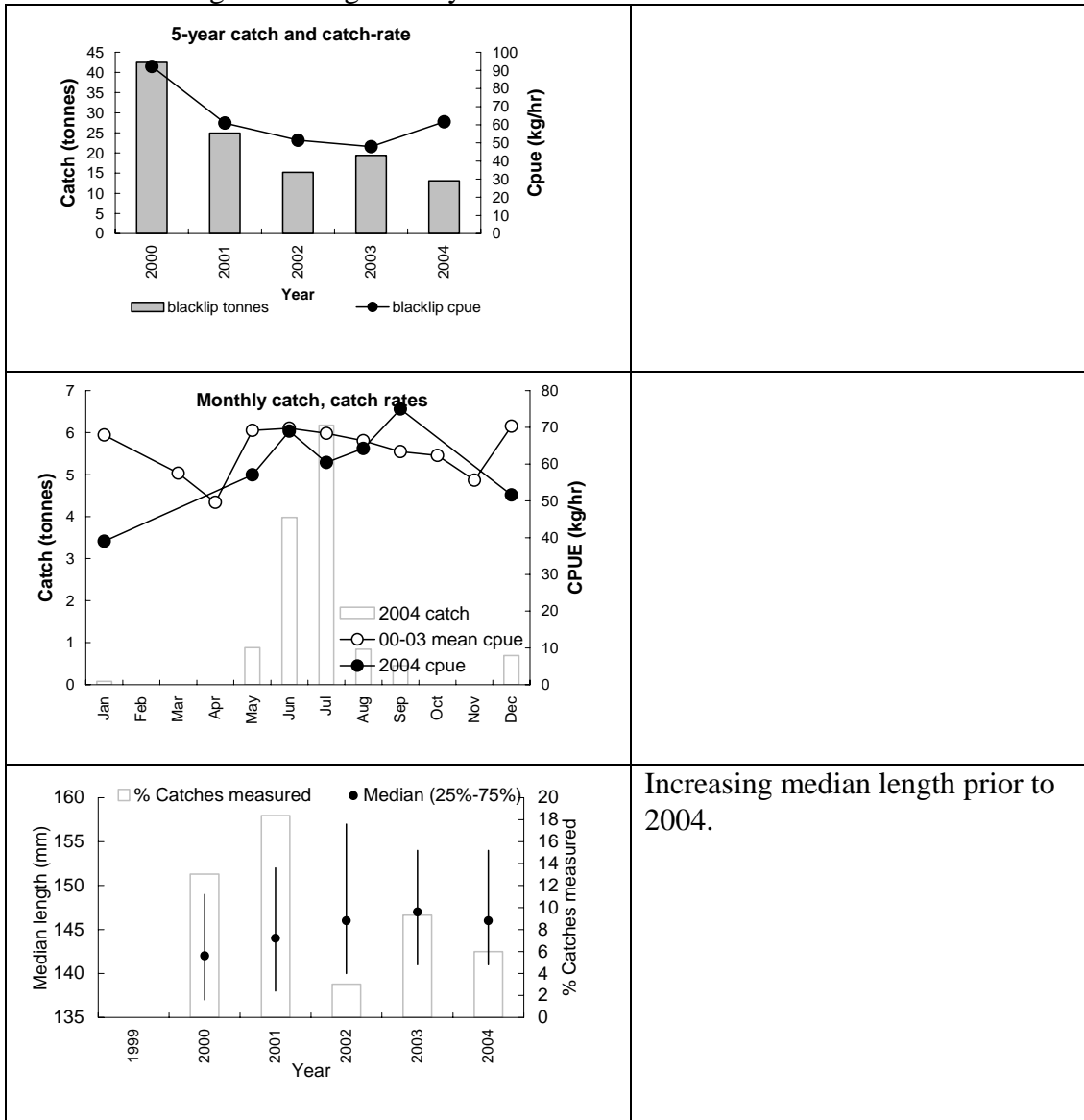
Contraction of size range due to loss of larger abalone from samples, reduction in median size since 2002 size limit increase.

Sub-block 27B
east side of Schouten Island



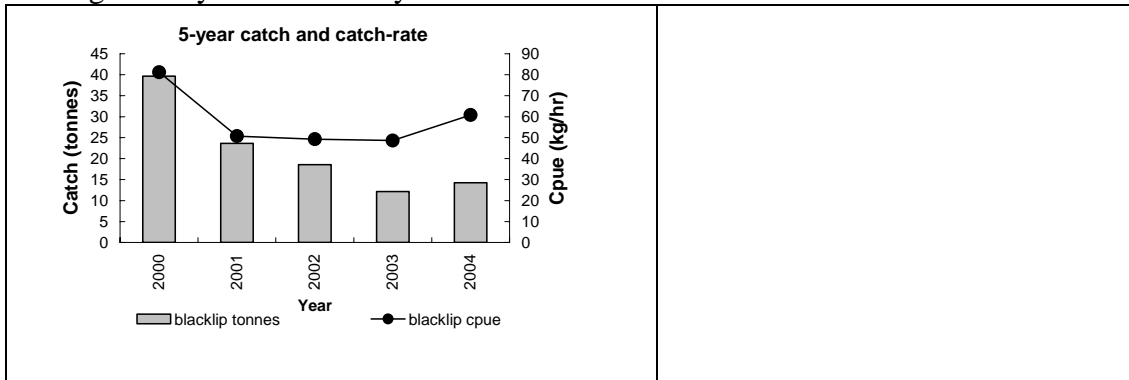
Stable size-structure apart from a small increase in 2003.

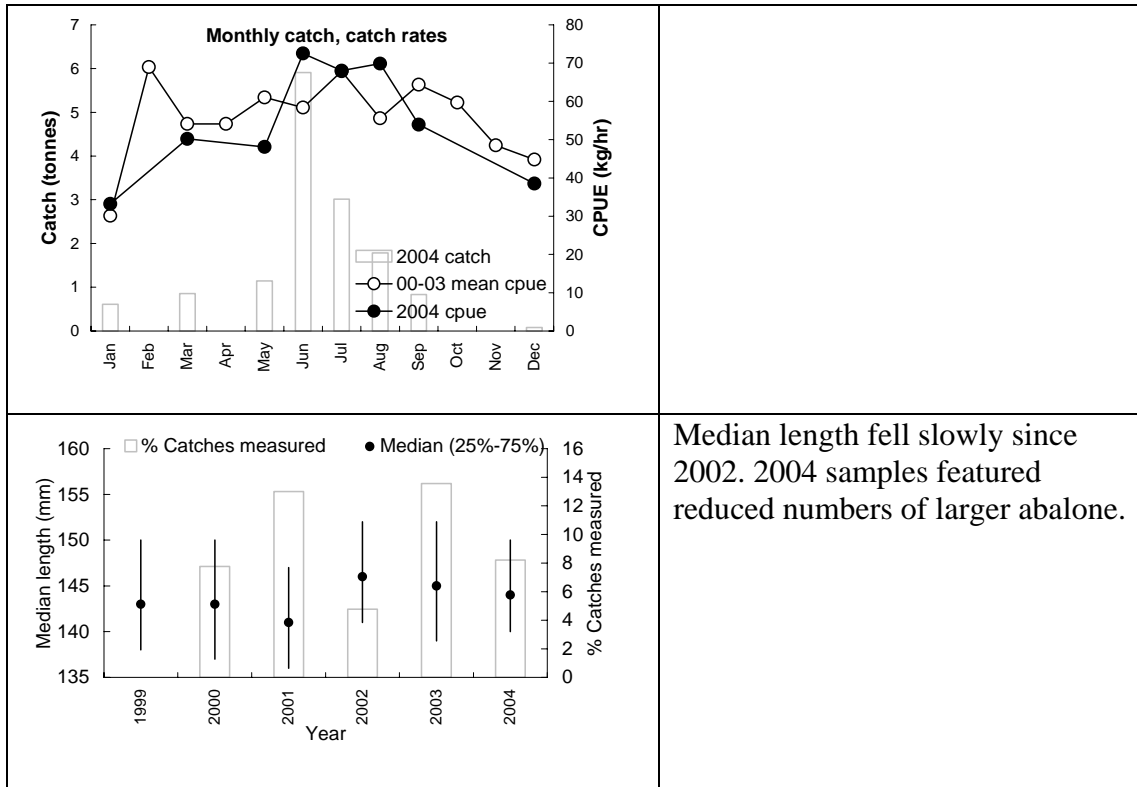
Sub-block 27C
Schouten Passage to Wineglass Bay



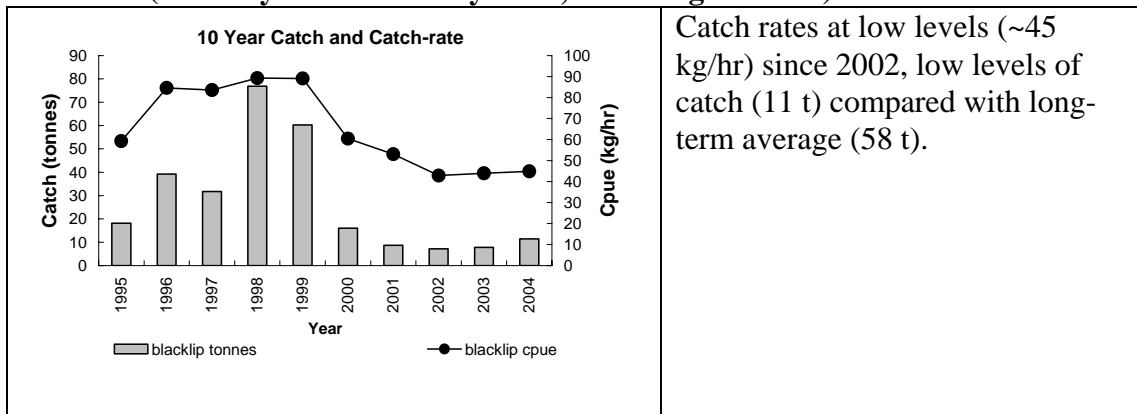
Increasing median length prior to 2004.

Sub-block 27D
Wineglass Bay to the Friendly Beaches

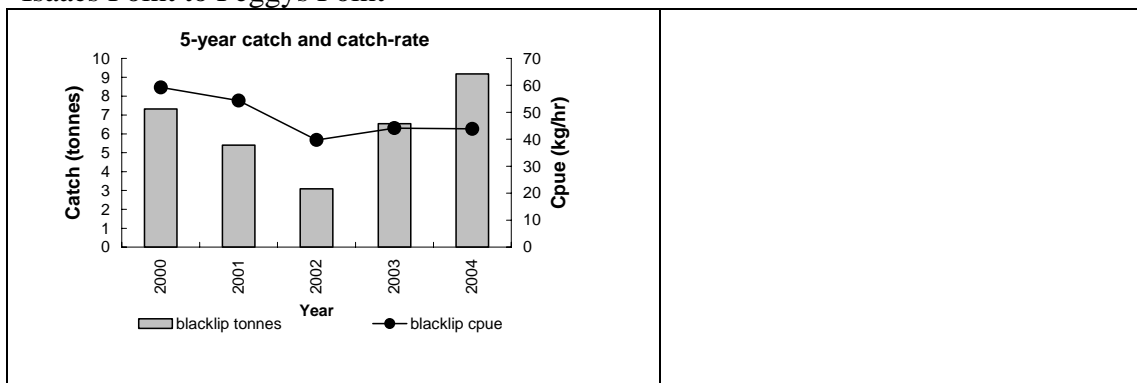


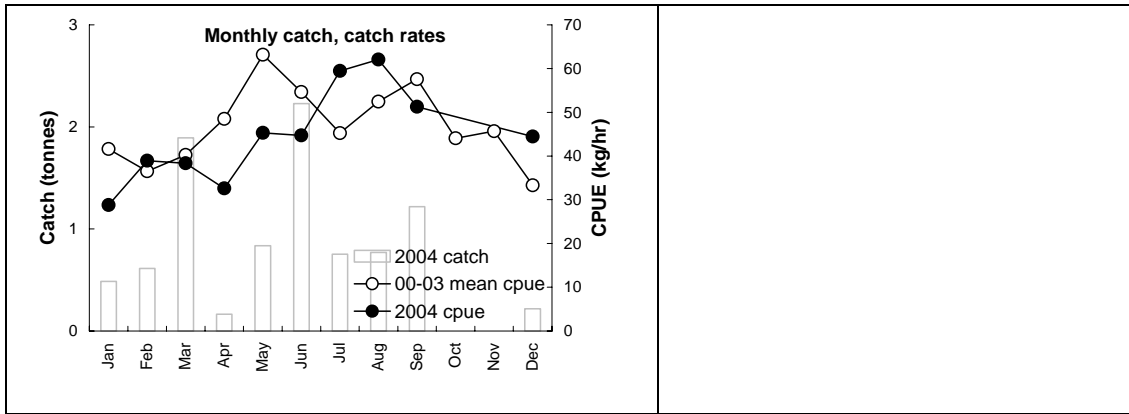


Block 28 (Friendly Beaches to Seymour, including Bicheno)

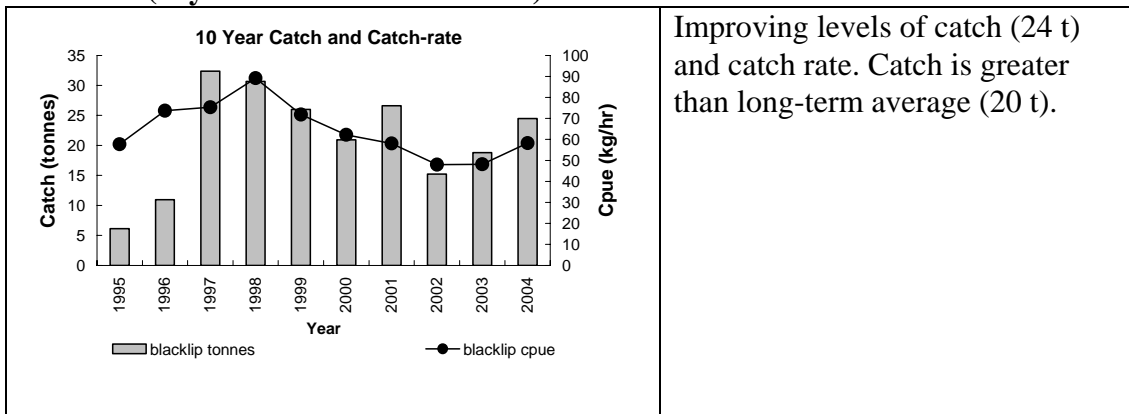


**Sub-block 28A
Isaacs Point to Peggys Point**



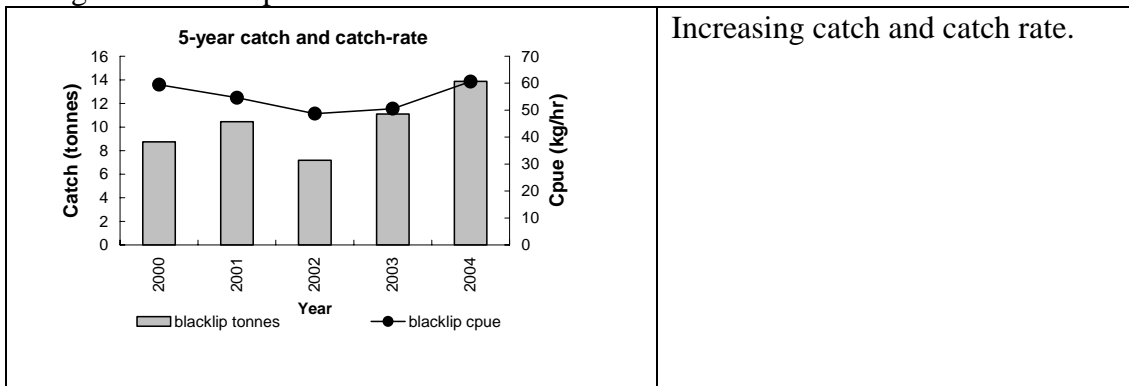


Block 29 (Seymour to St Helens Point)

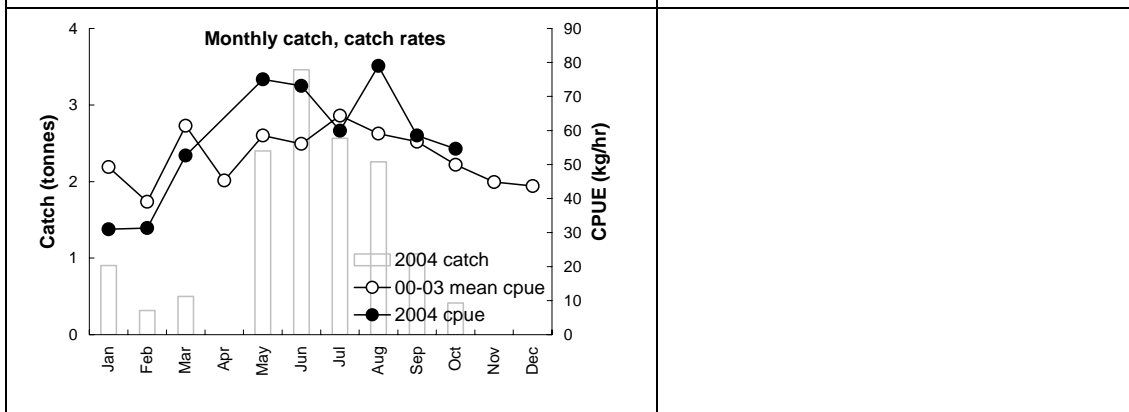


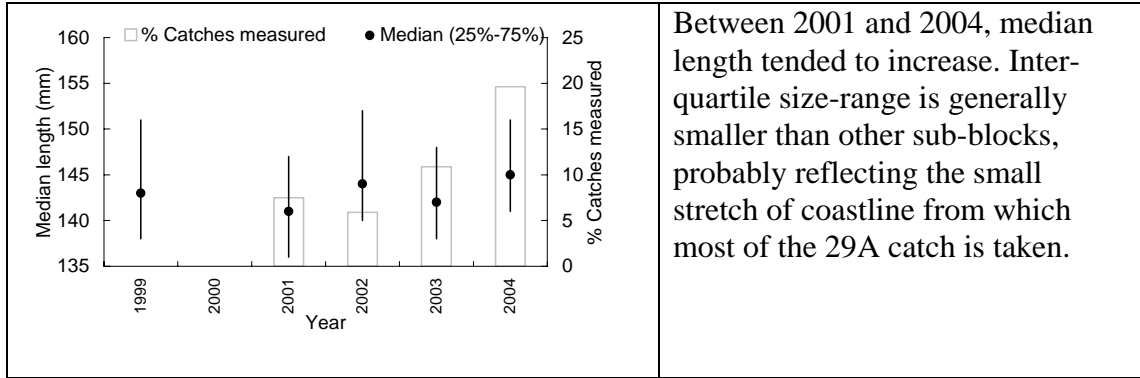
Improving levels of catch (24 t) and catch rate. Catch is greater than long-term average (20 t).

**Sub-block 29A
Long Point to Templestowe Beach**



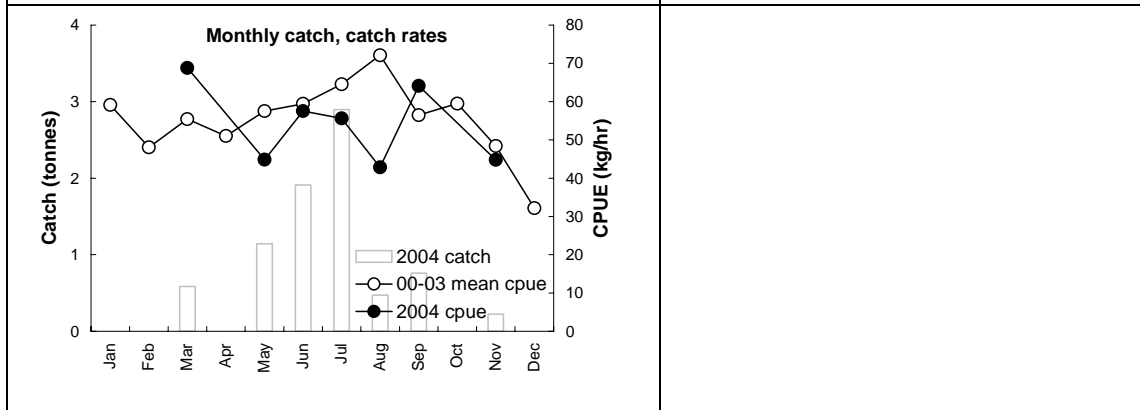
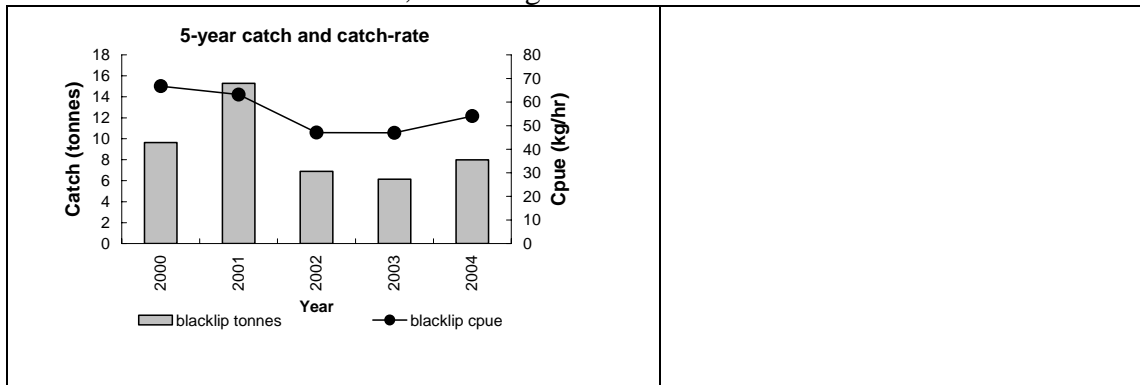
Increasing catch and catch rate.



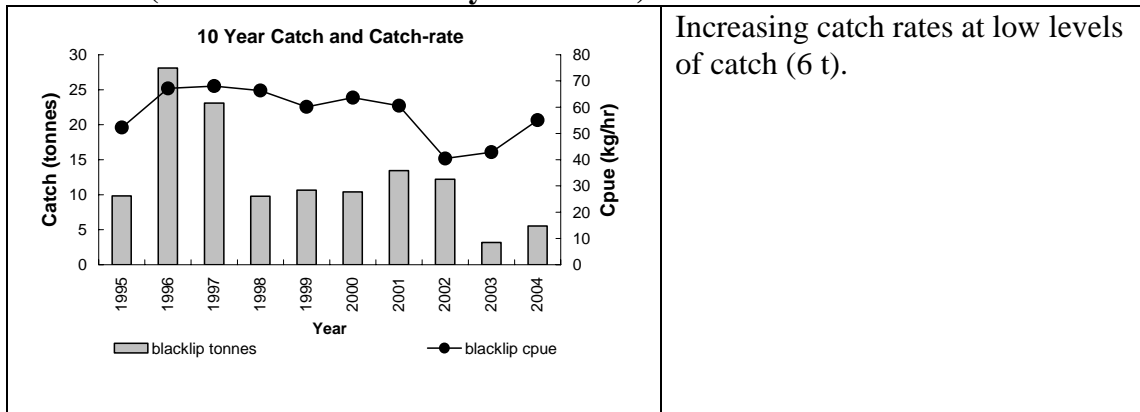


Between 2001 and 2004, median length tended to increase. Inter-quartile size-range is generally smaller than other sub-blocks, probably reflecting the small stretch of coastline from which most of the 29A catch is taken.

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



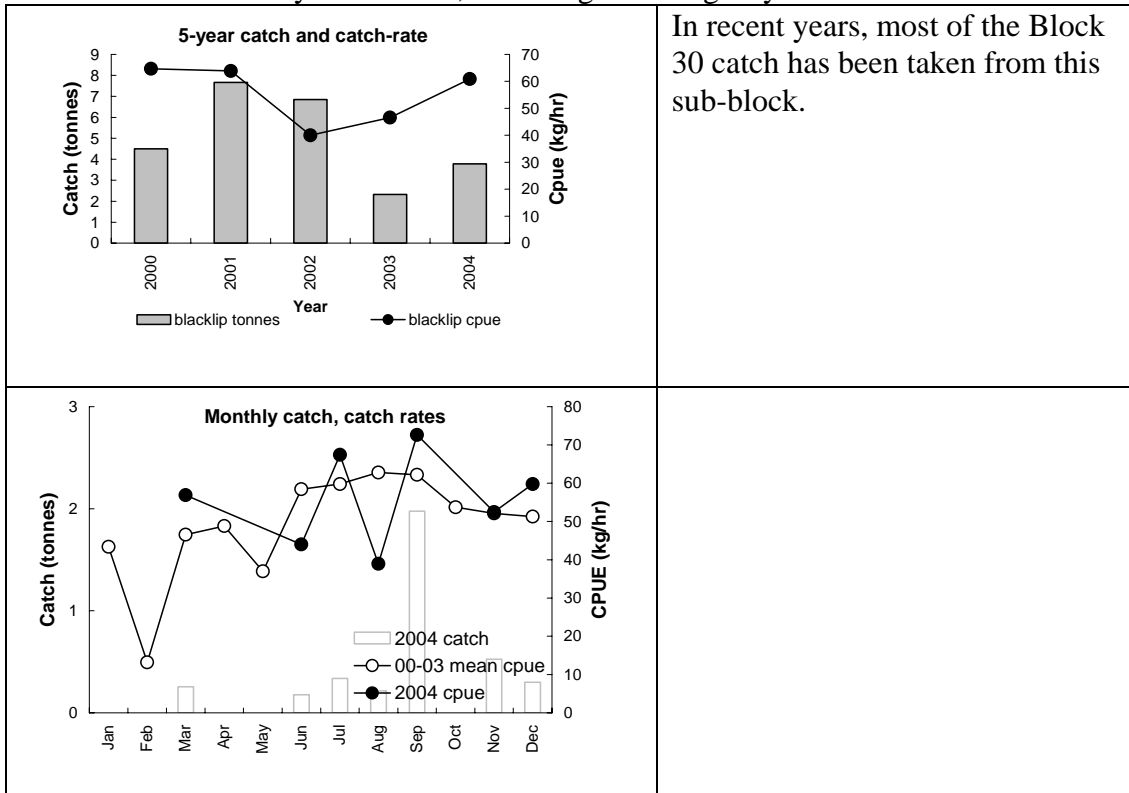
Block 30 (St Helens Point to Eddystone Point)



Increasing catch rates at low levels of catch (6 t).

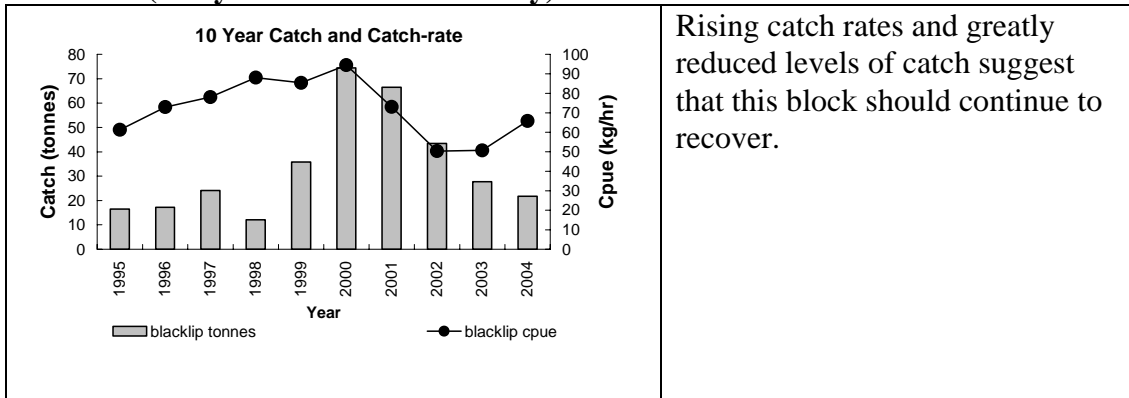
Sub-block 30A

St Helens Point to Taylor's Beach, including Binalong Bay



In recent years, most of the Block 30 catch has been taken from this sub-block.

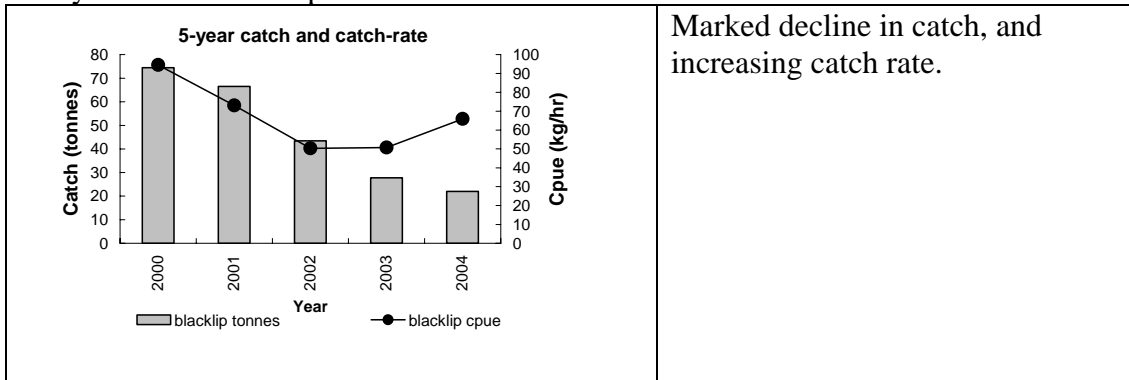
Block 31 (Eddystone to Musselroe Bay)



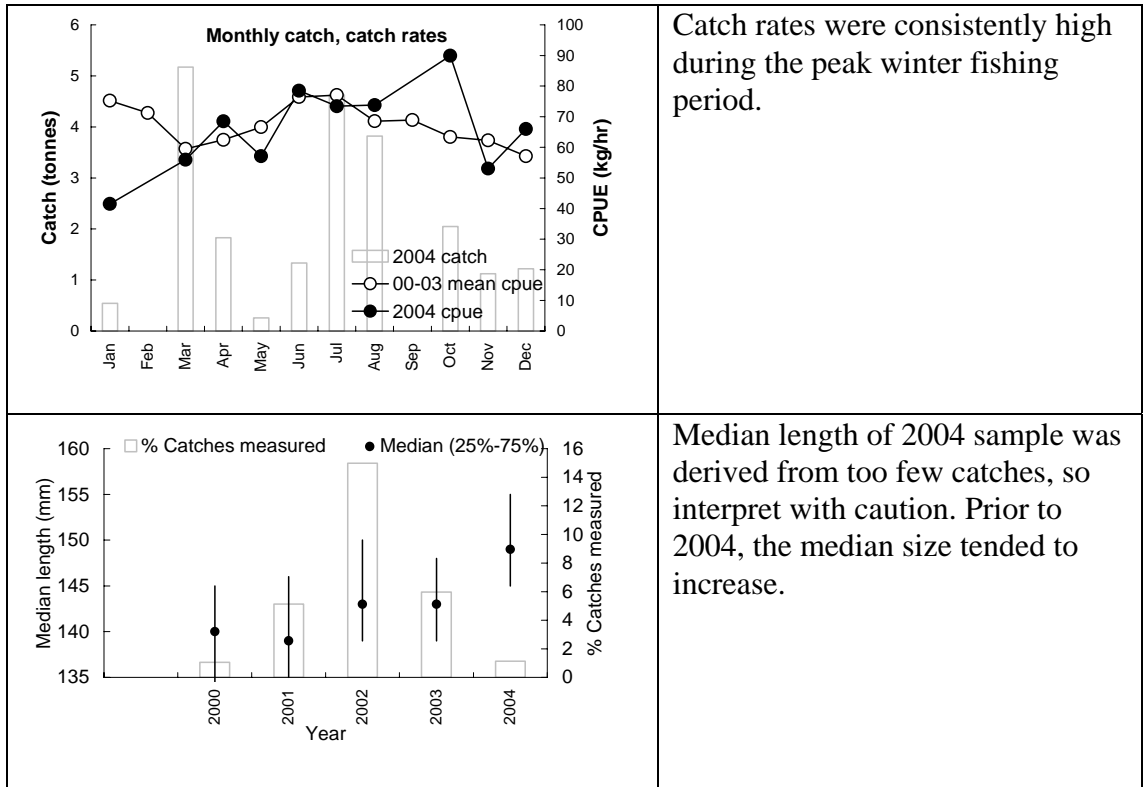
Rising catch rates and greatly reduced levels of catch suggest that this block should continue to recover.

Sub-block 31A

Eddystone Point to Cape Naturaliste



Marked decline in catch, and increasing catch rate.



Western Zone blacklip fishery – major fishing blocks

Catch increased in the WZ section of Block 13, but this was after a large fall in 2003. The Block 10 catch fell, but is still well above the long-term average (see Appendix 2) (Figure 7).

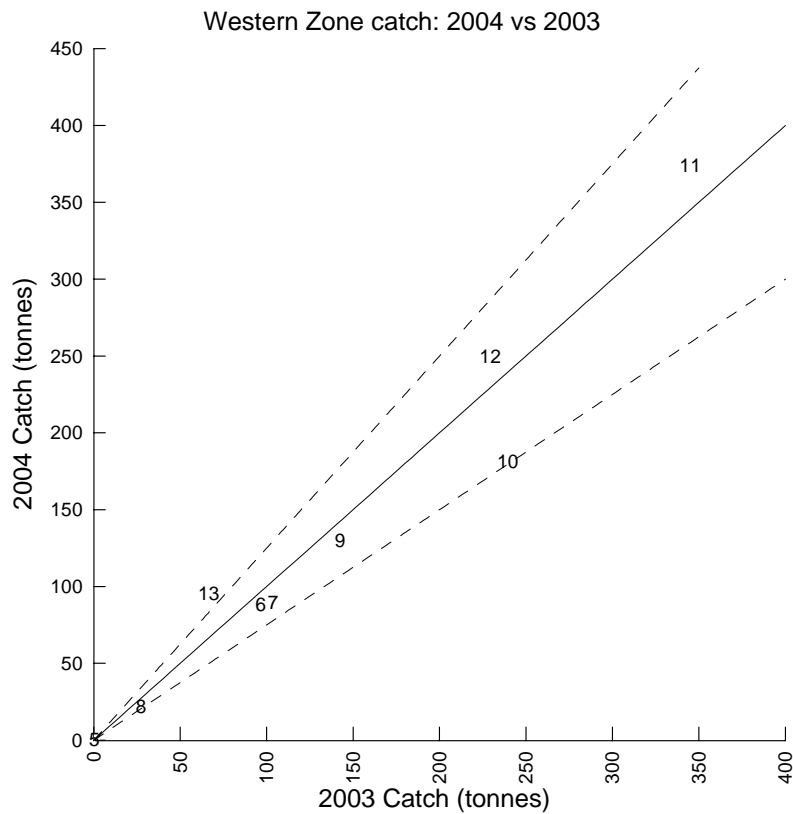
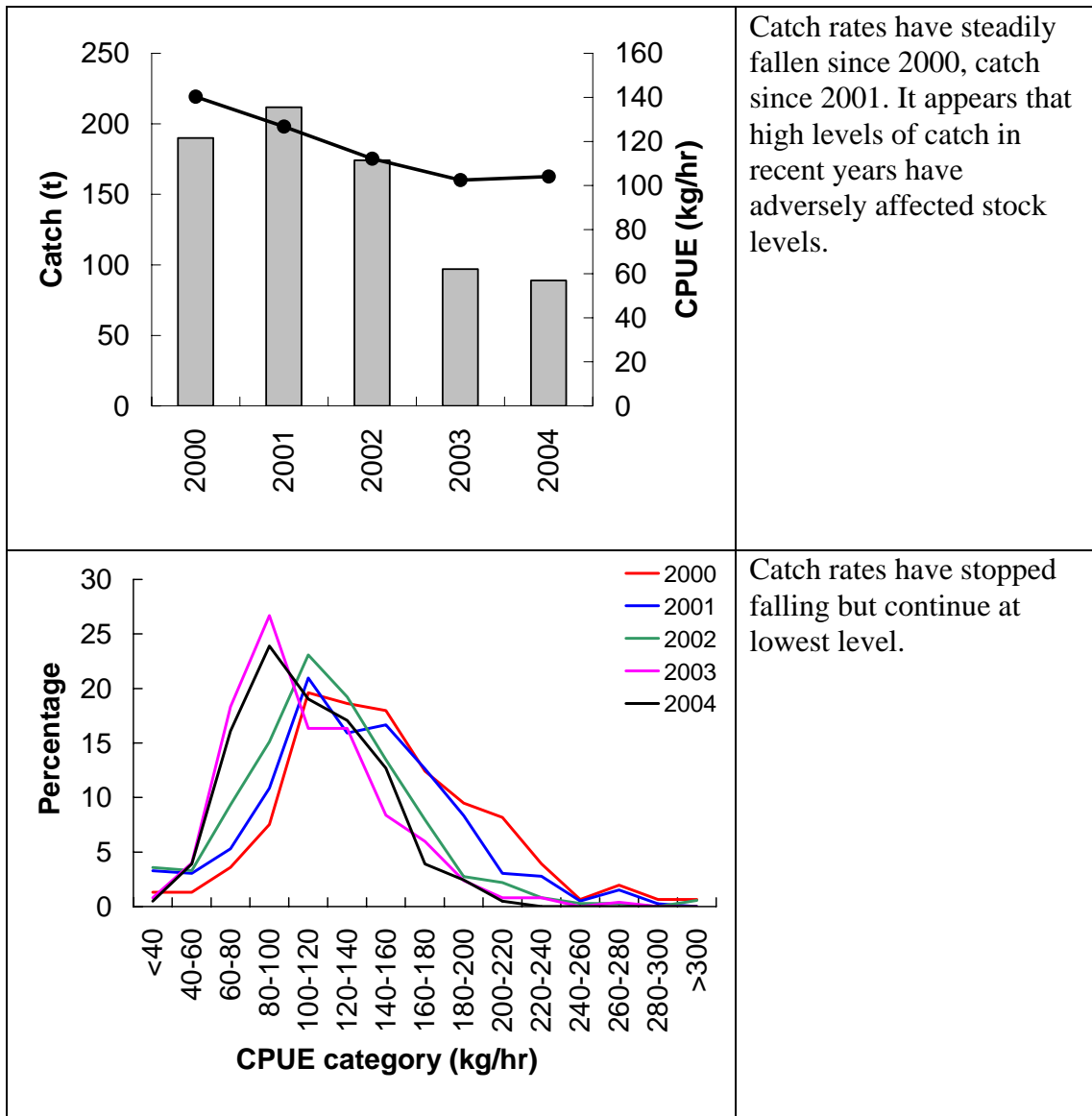


Figure 7. Blacklip catch from the Western Zone (Block 6 to Block 13 (sub-blocks 13 A, B)). In 2004, the Western Zone TAC (1260 tonnes) was unchanged from the previous year. Blocks to the left of the diagonal line reflect increased catches over 2003 levels, blocks to the right reflect falling catches. The dashed lines represent the position 25% greater and less than unchanged levels.

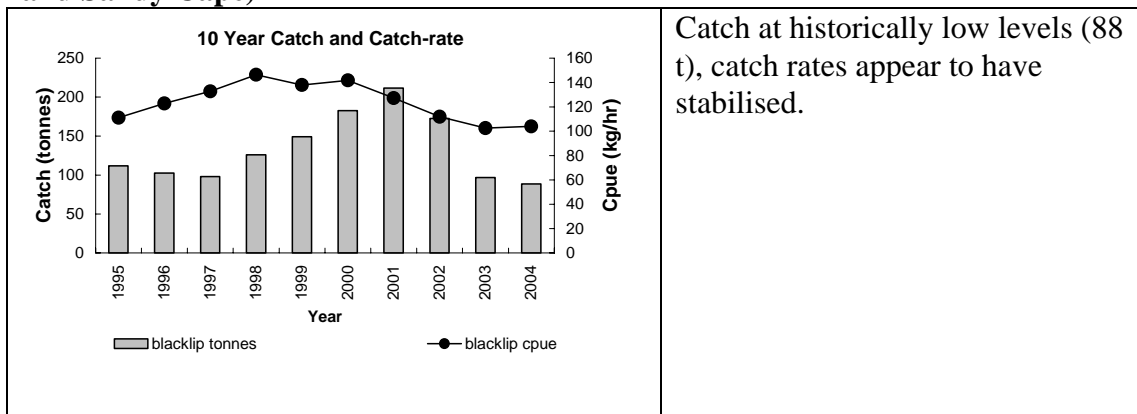
Western Zone - North West (Block 6)



Catch rates have steadily fallen since 2000, catch since 2001. It appears that high levels of catch in recent years have adversely affected stock levels.

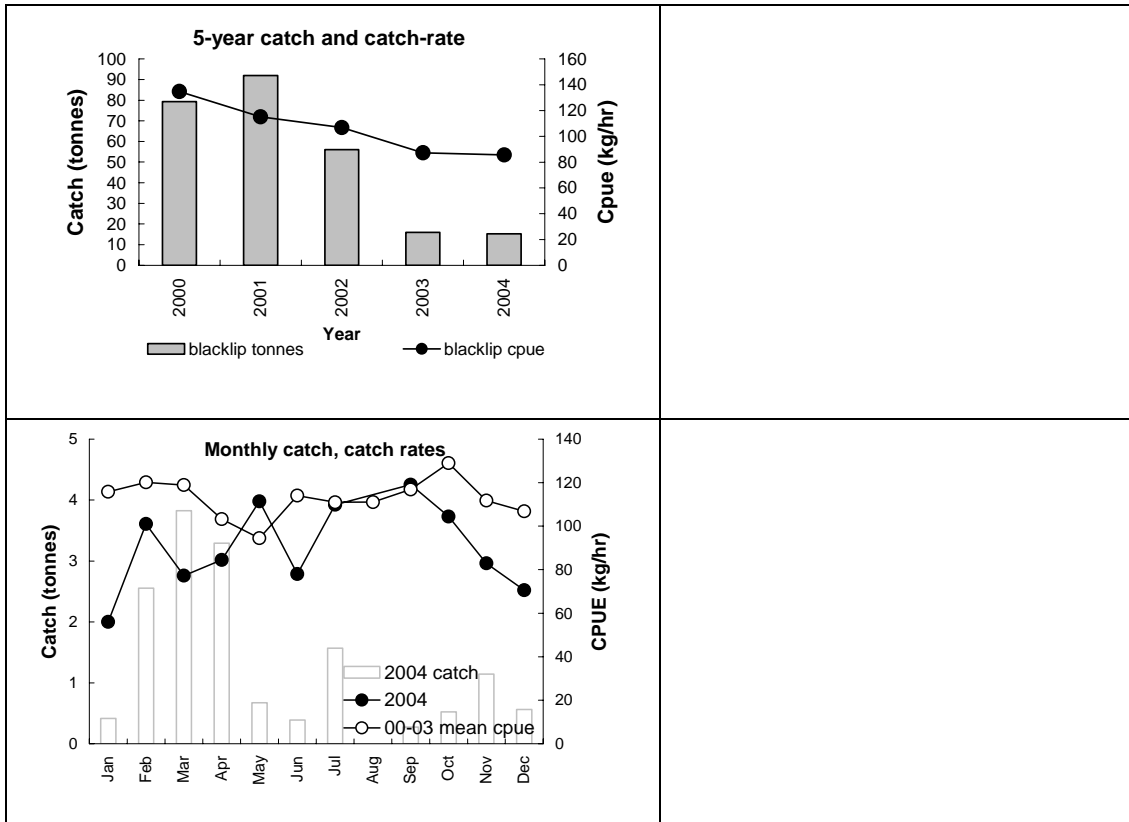
Catch rates have stopped falling but continue at lowest level.

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

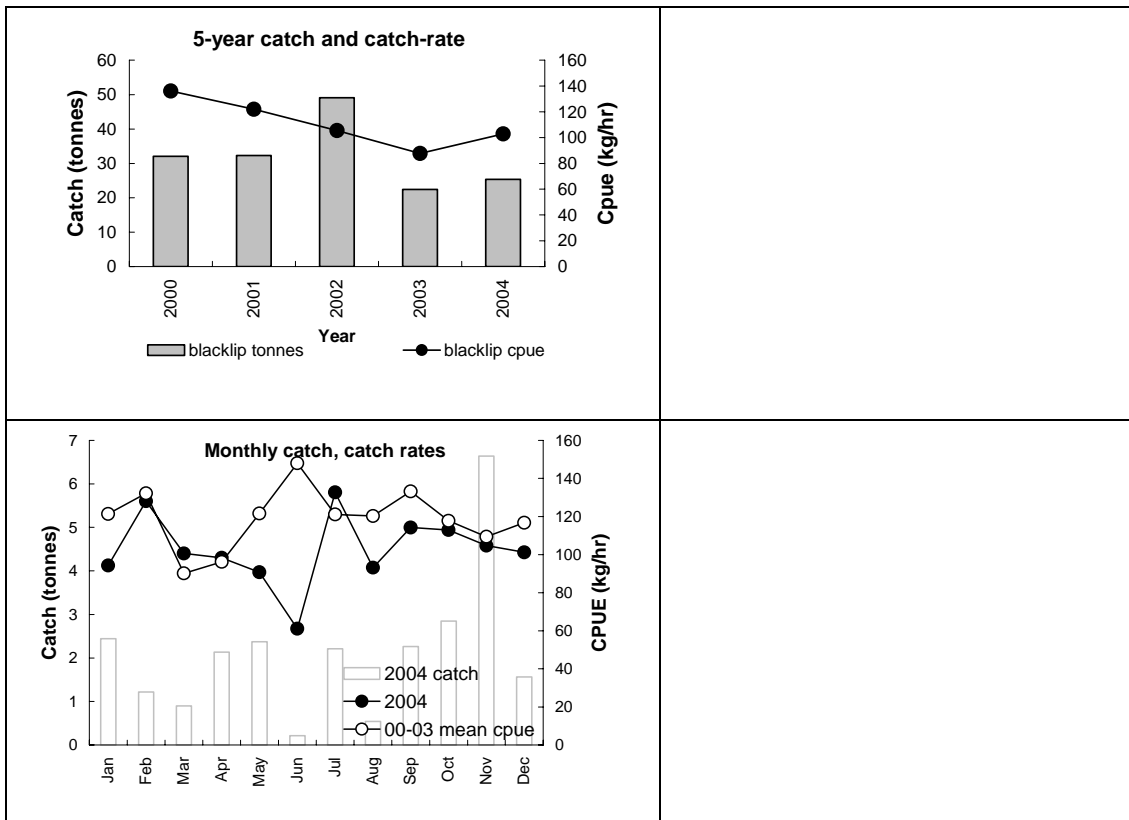


Catch at historically low levels (88 t), catch rates appear to have stabilised.

Sub-block 6A
Sundown to Temma

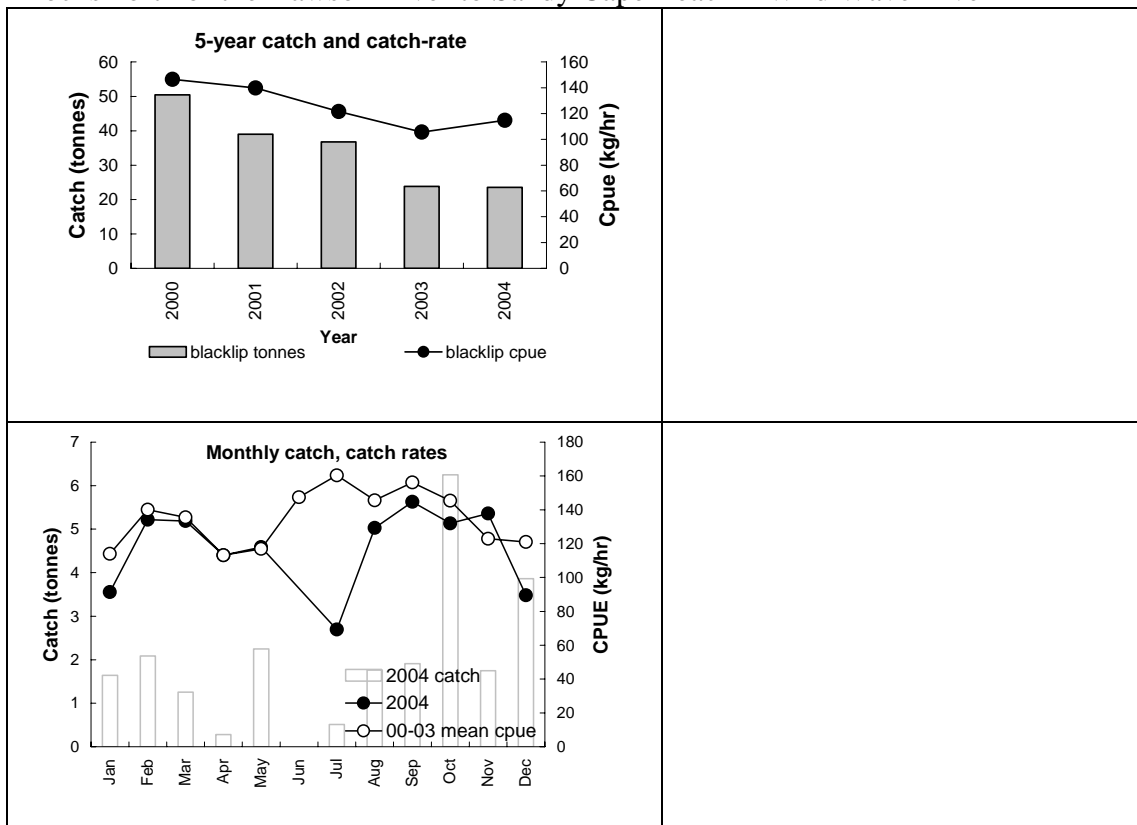


Sub-block 6B
Temma Harbour to rocks north of Dawson River



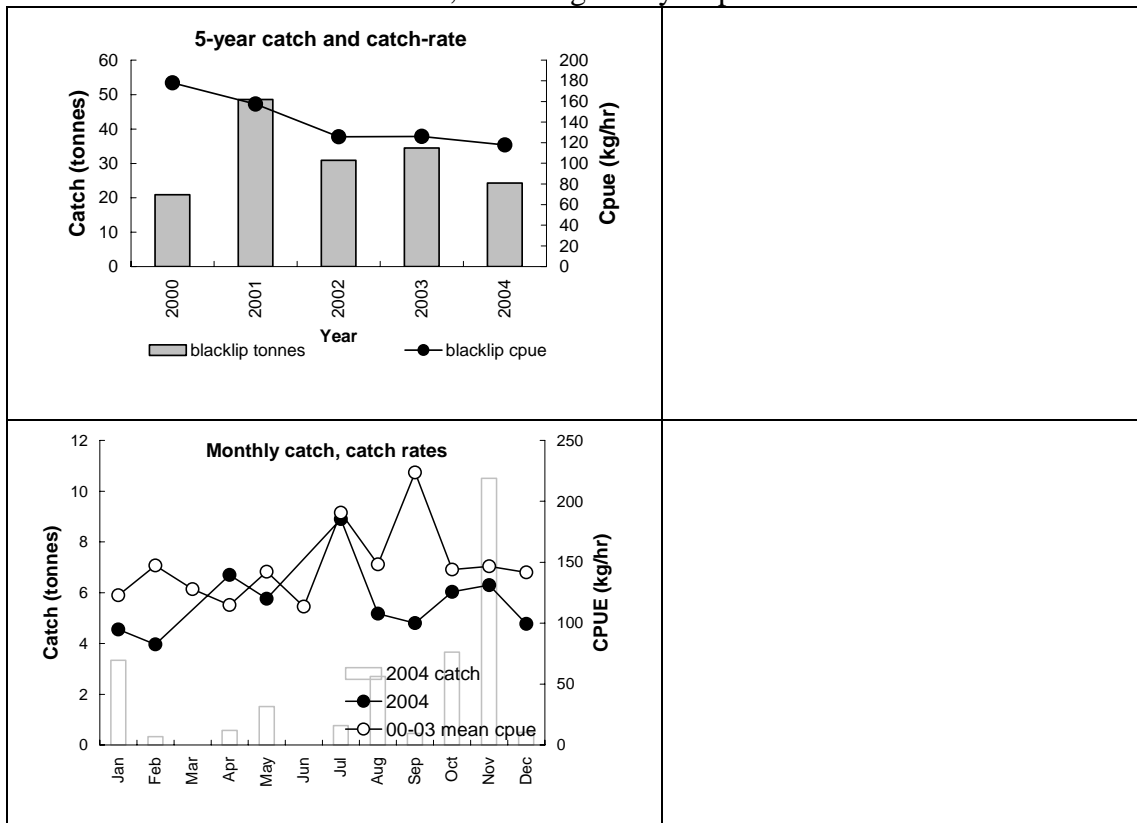
Sub-block 6C

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

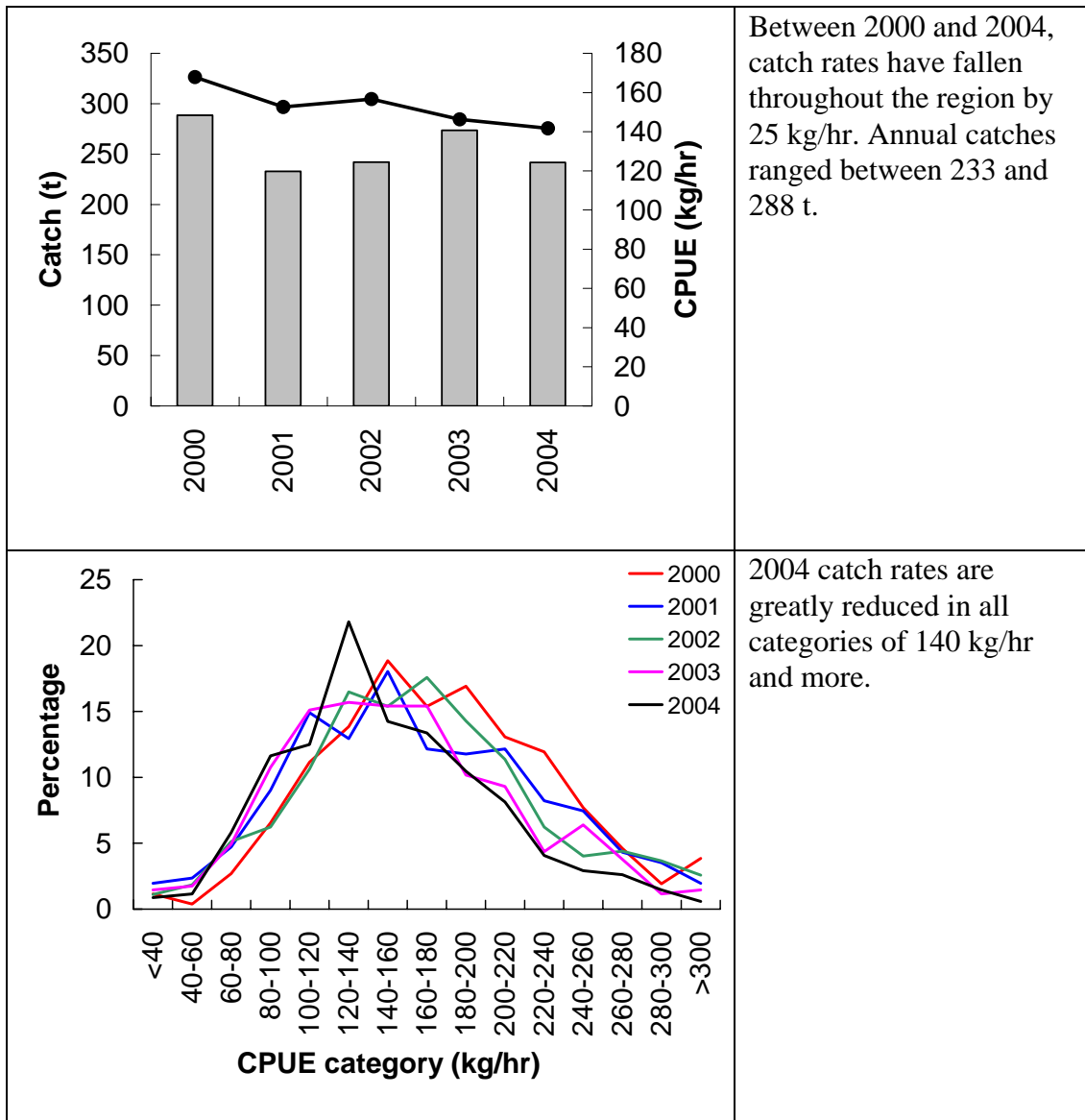


Sub-block 6D

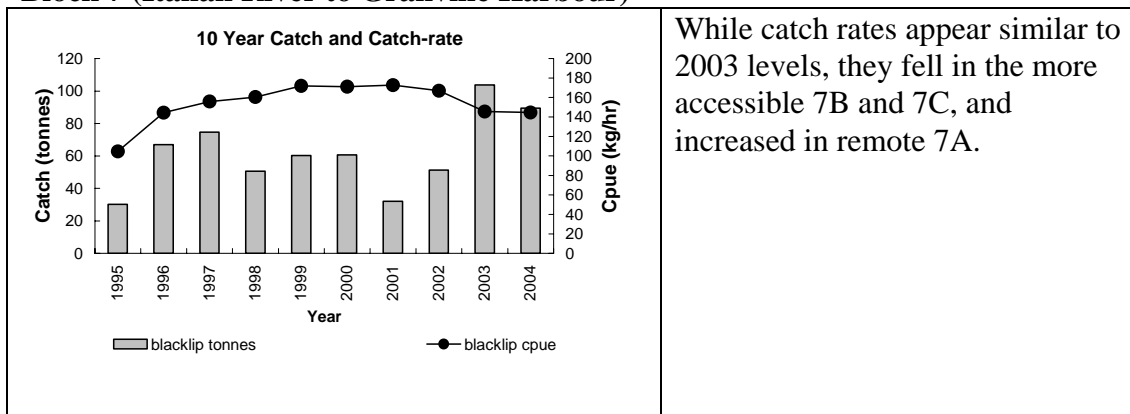
Wild Wave River to Italian River, including Sandy Cape



Western Zone - Central West (Blocks 7-9)

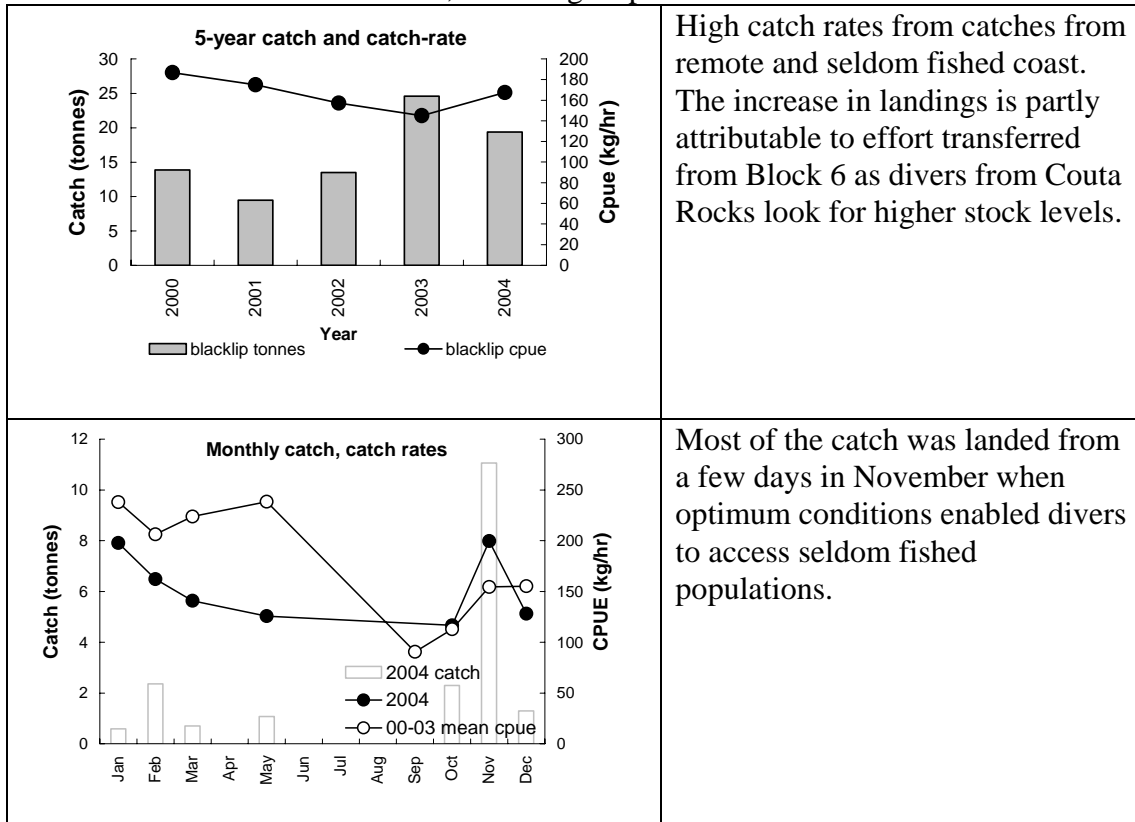


Block 7 (Italian River to Granville Harbour)



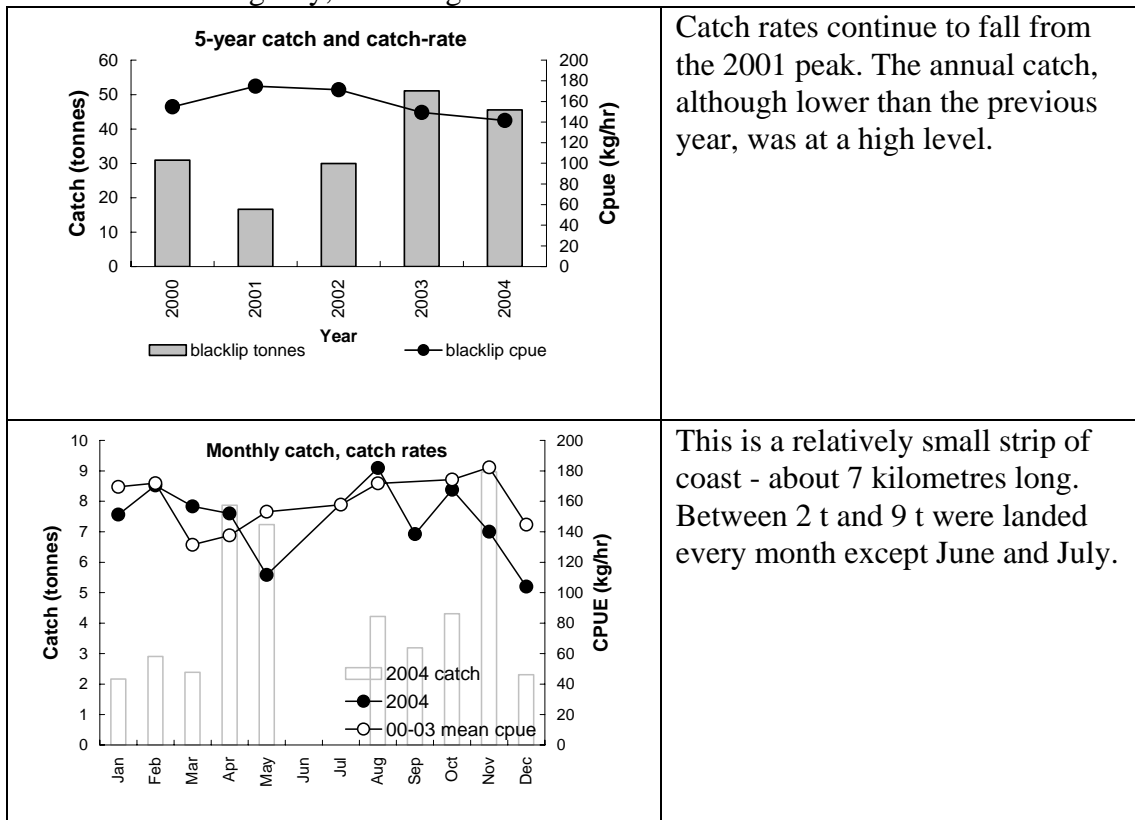
Sub-block 7A

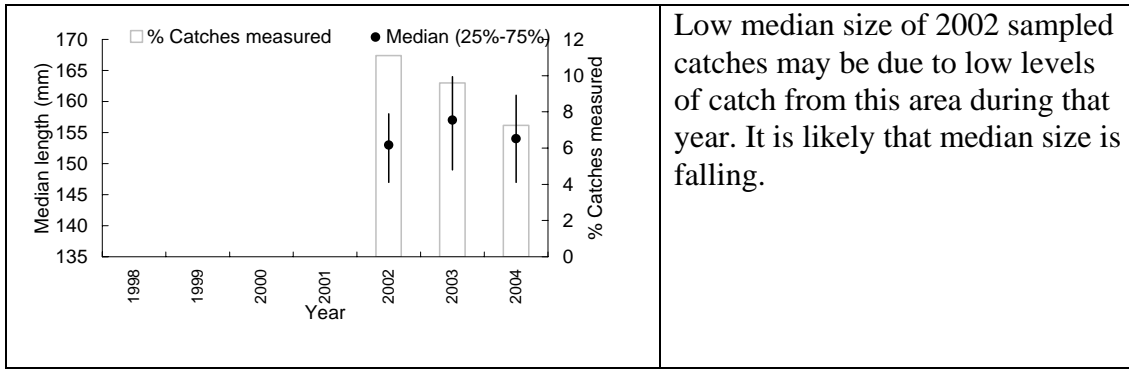
Italian River to the Pieman River, including Rupert Point



Sub-block 7B

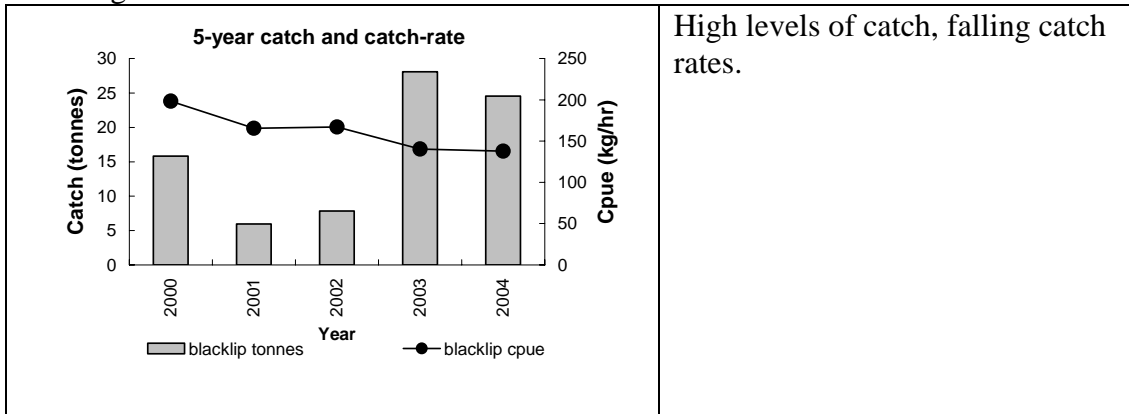
Pieman to Ahrberg Bay, including Conical Rocks



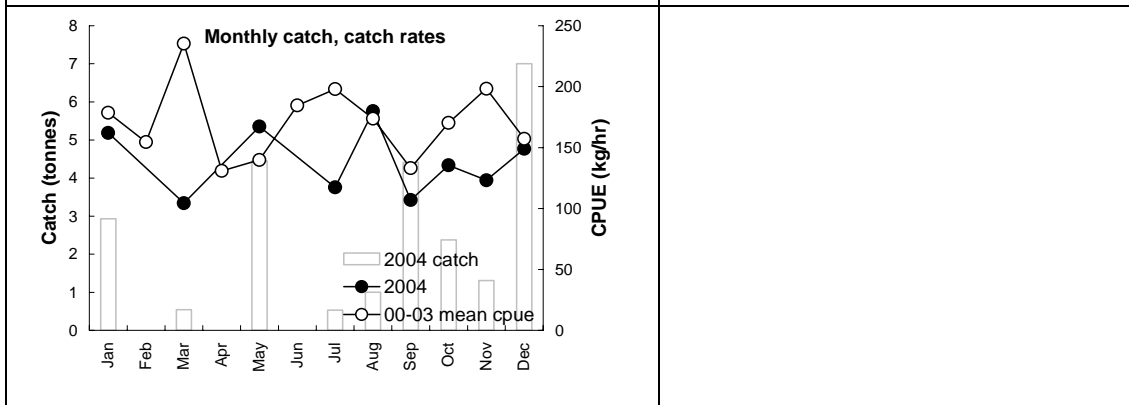


Low median size of 2002 sampled catches may be due to low levels of catch from this area during that year. It is likely that median size is falling.

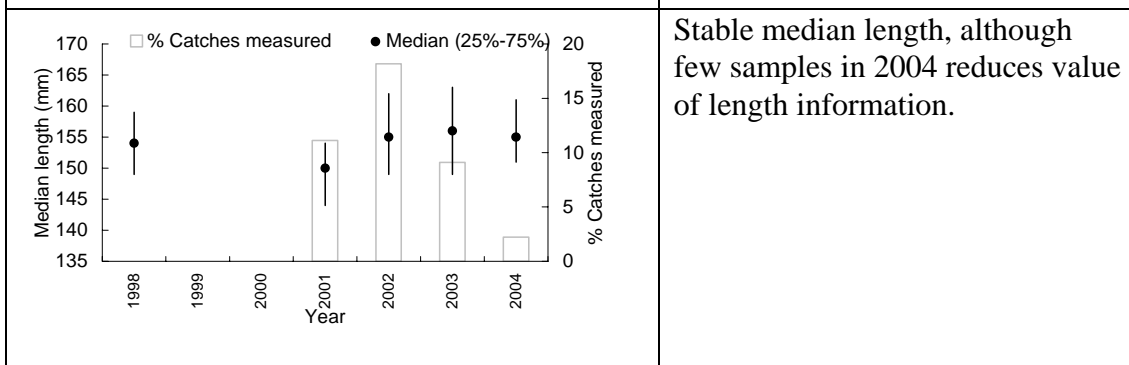
Sub-block 7C
Ahrberg to Granville Harbour



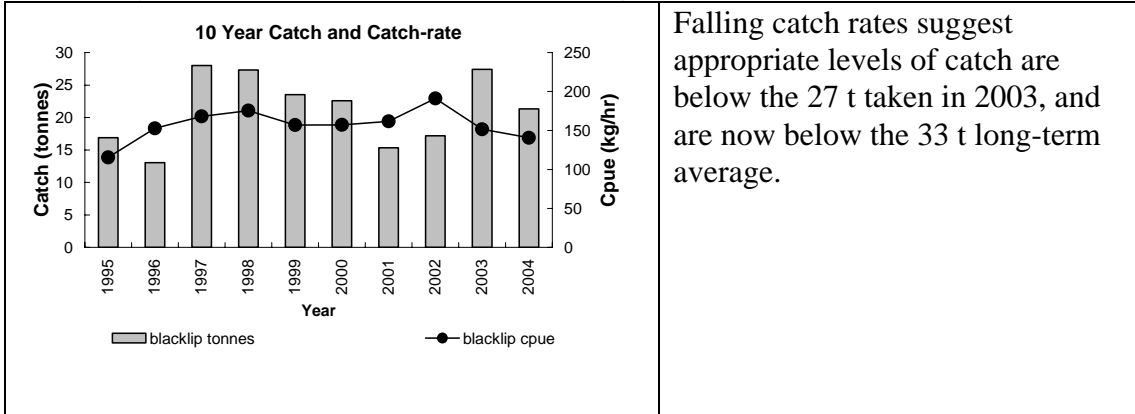
High levels of catch, falling catch rates.



Stable median length, although few samples in 2004 reduces value of length information.

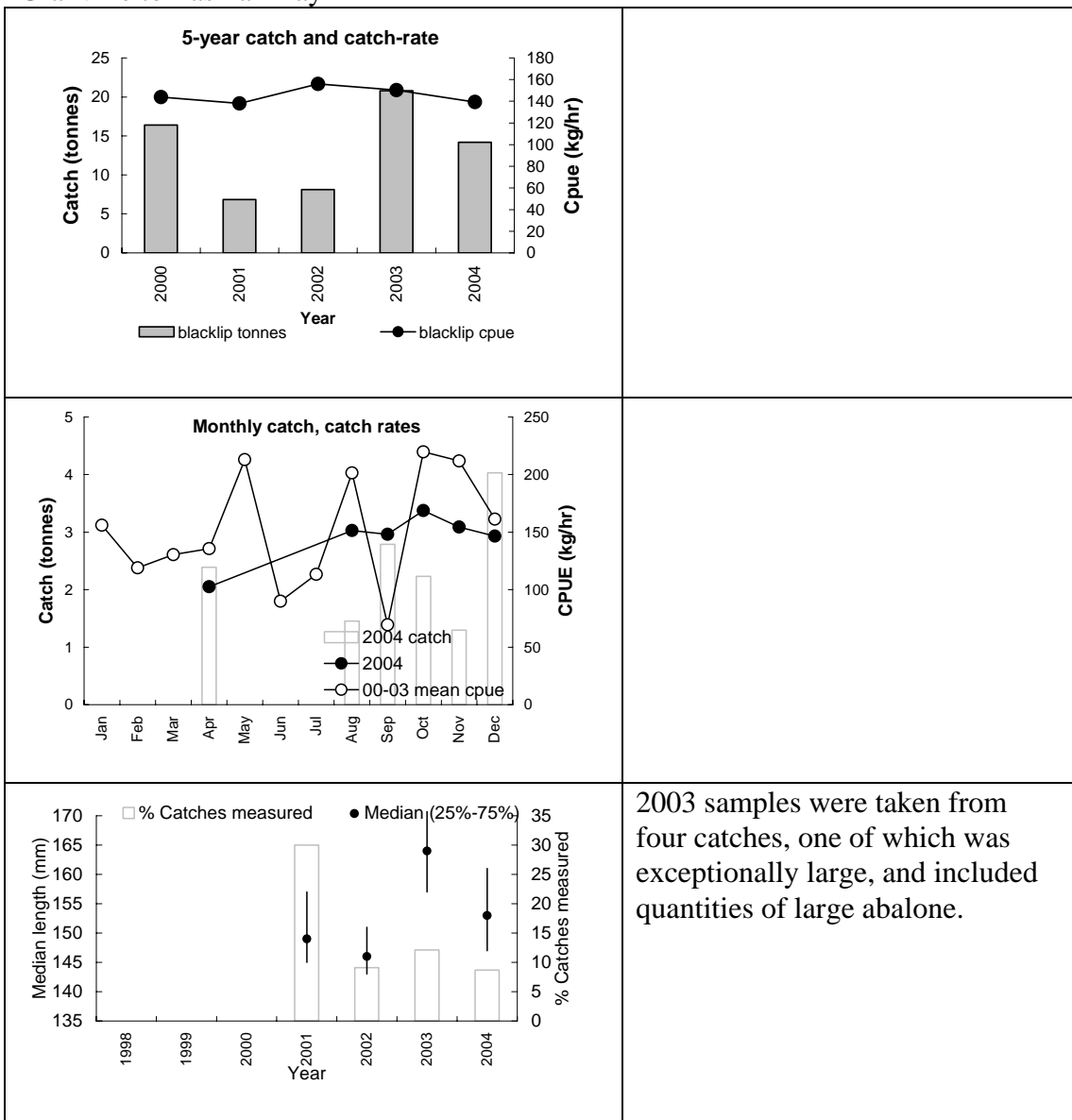


Block 8 (Granville Harbour to Ocean Beach)



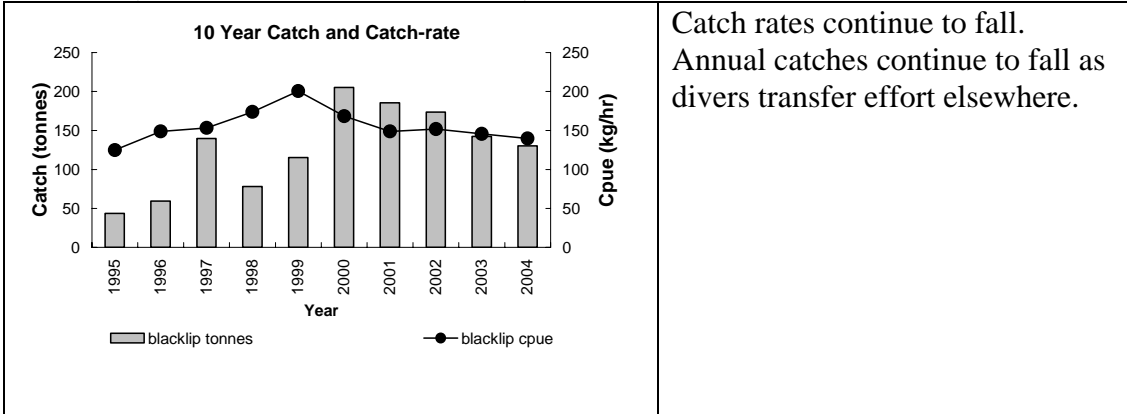
Falling catch rates suggest appropriate levels of catch are below the 27 t taken in 2003, and are now below the 33 t long-term average.

**Sub-block 8A
Granville to Tasman Bay**



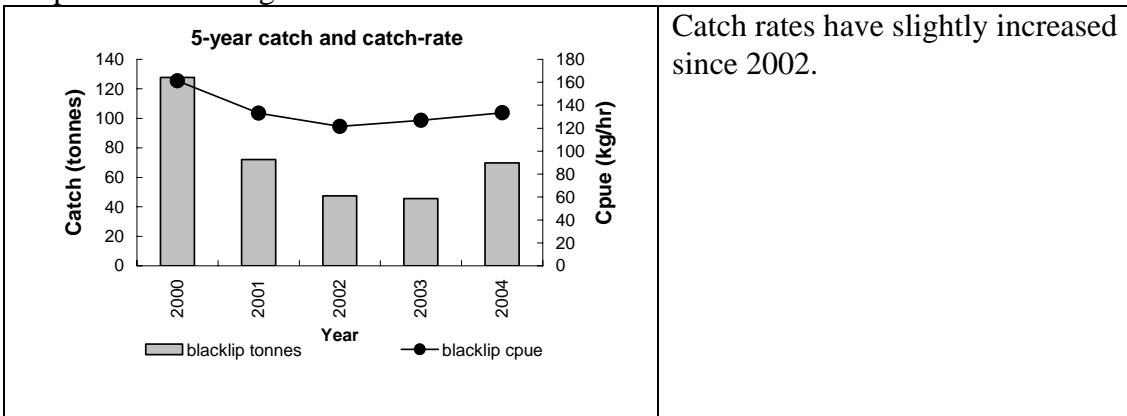
2003 samples were taken from four catches, one of which was exceptionally large, and included quantities of large abalone.

Block 9 (Ocean Beach to Point Hibbs)

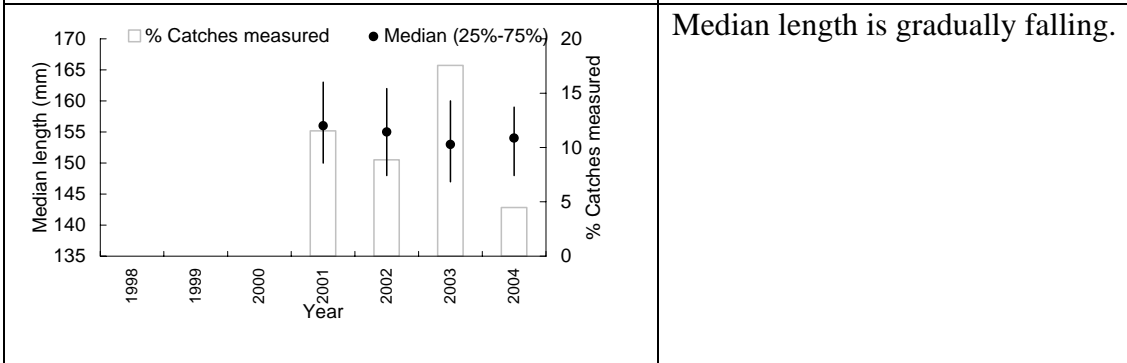
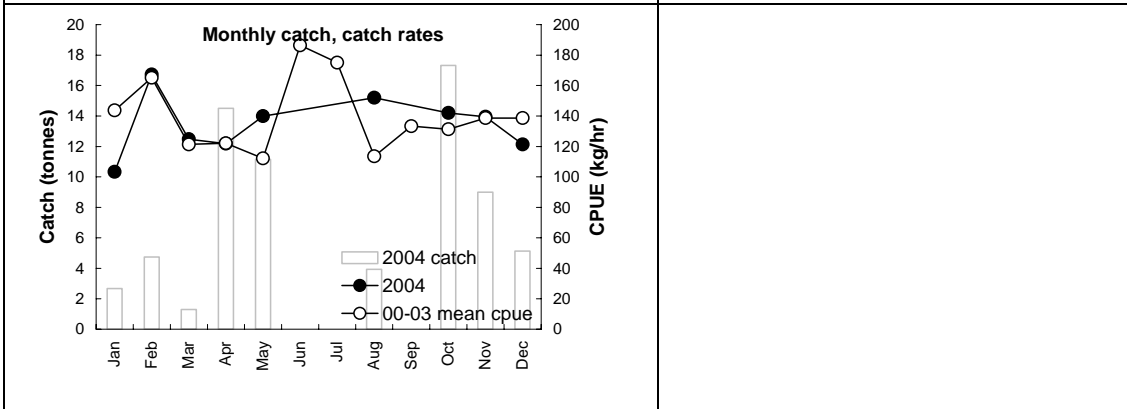


Catch rates continue to fall. Annual catches continue to fall as divers transfer effort elsewhere.

**Sub-block 9B
Cape Sorell to Gorge Point**

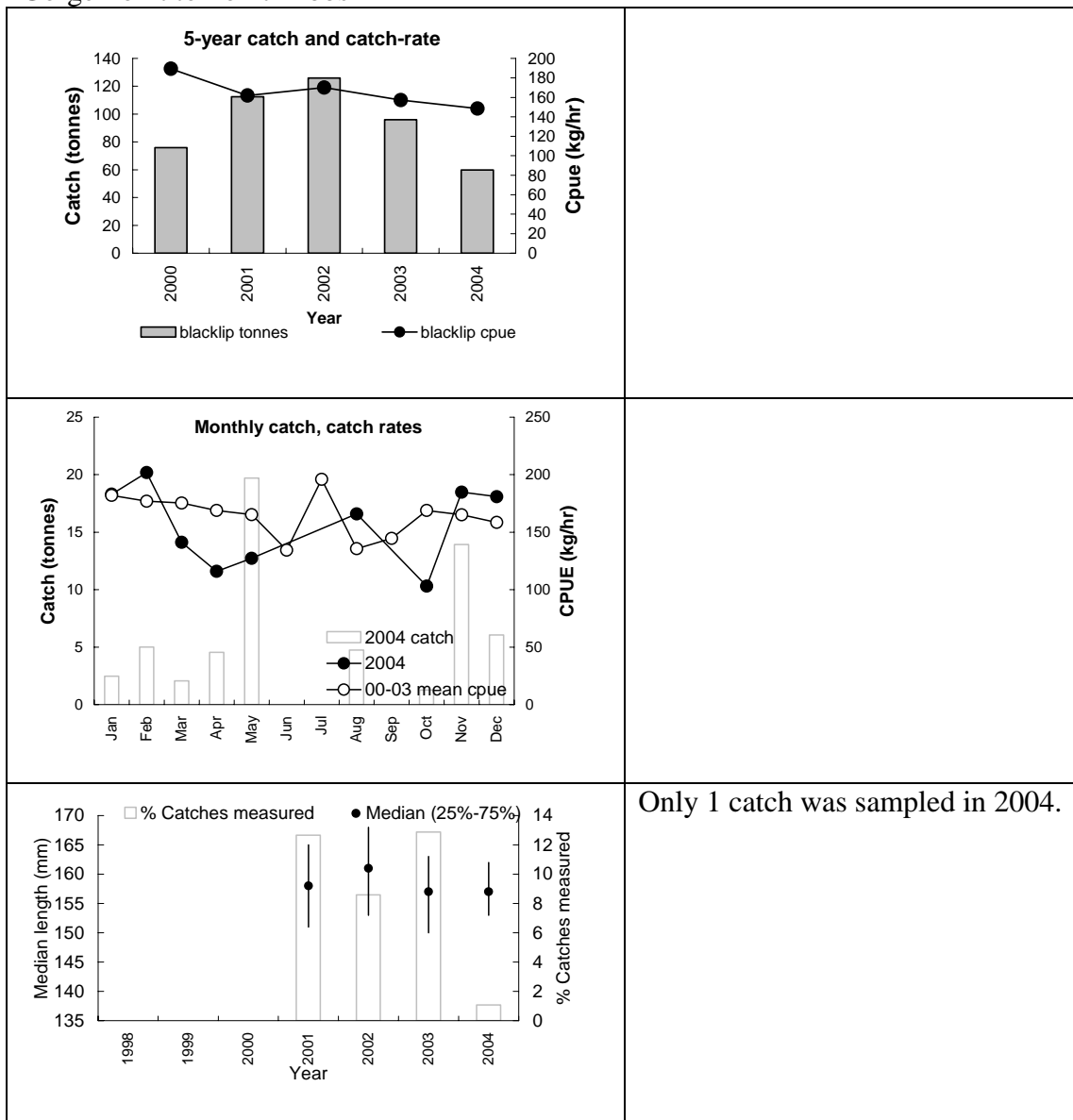


Catch rates have slightly increased since 2002.



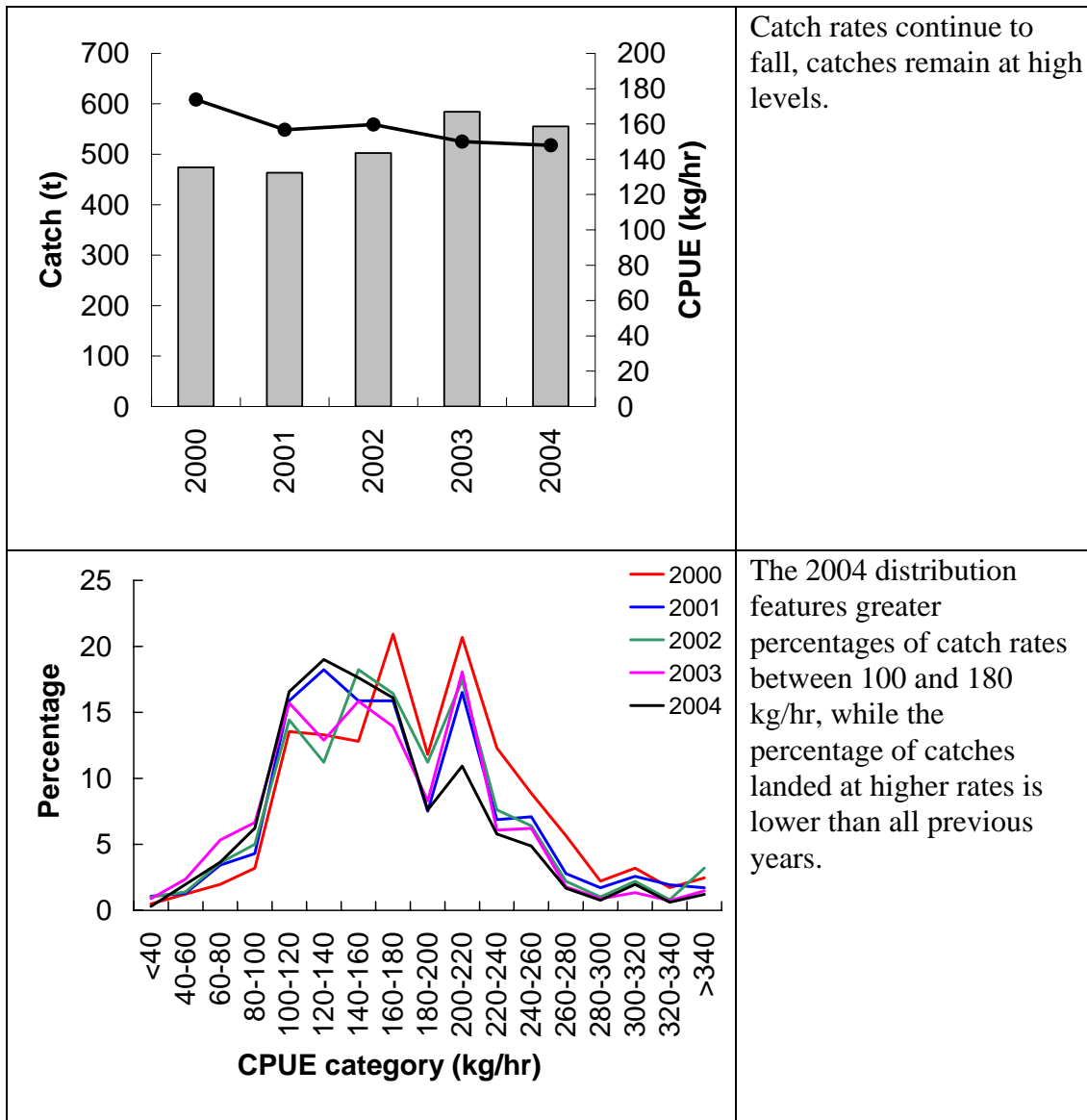
Median length is gradually falling.

Sub-block 9C
Gorge Point to Point Hibbs



Only 1 catch was sampled in 2004.

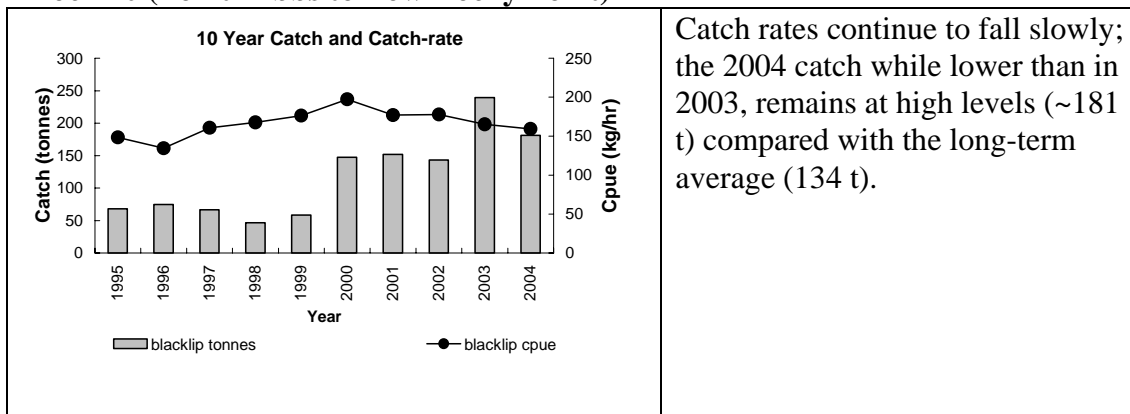
Western Zone - South West (Blocks 10-11)



Catch rates continue to fall, catches remain at high levels.

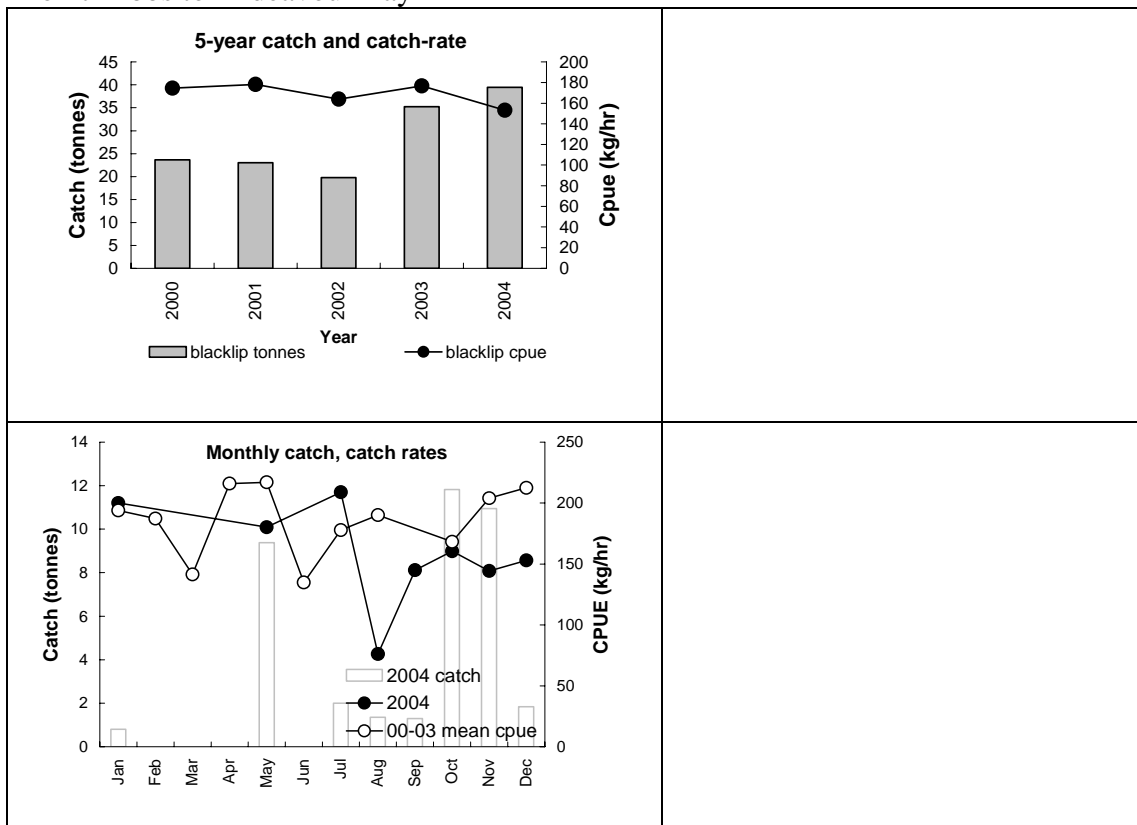
The 2004 distribution features greater percentages of catch rates between 100 and 180 kg/hr, while the percentage of catches landed at higher rates is lower than all previous years.

Block 10 (Point Hibbs to Low Rocky Point)

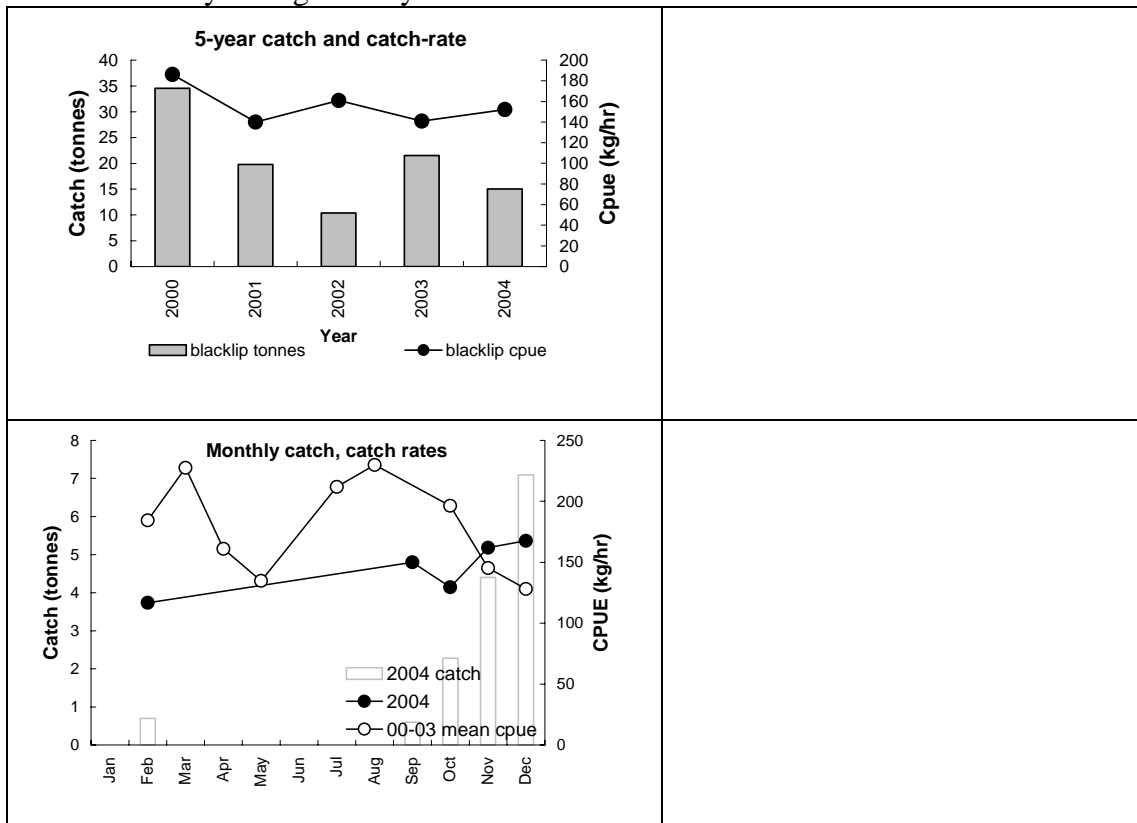


Catch rates continue to fall slowly; the 2004 catch while lower than in 2003, remains at high levels (~181 t) compared with the long-term average (134 t).

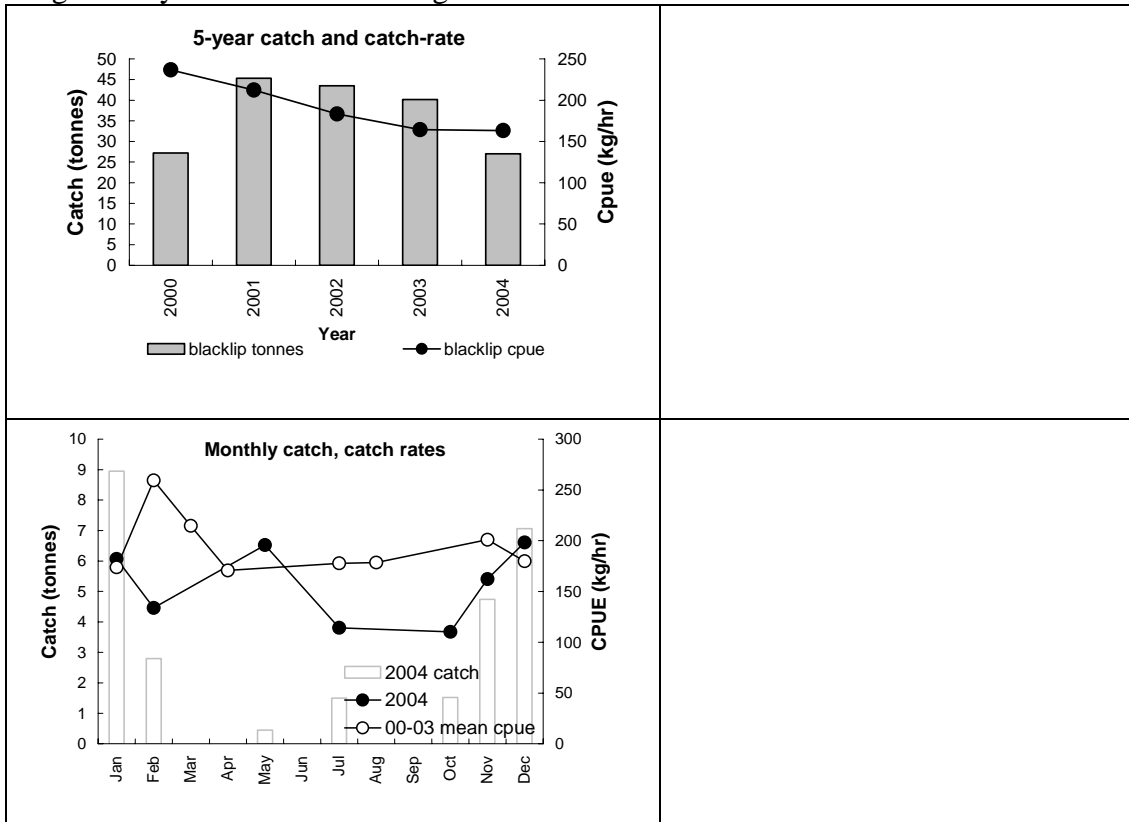
Sub-block 10A
Point Hibbs to Endeavour Bay



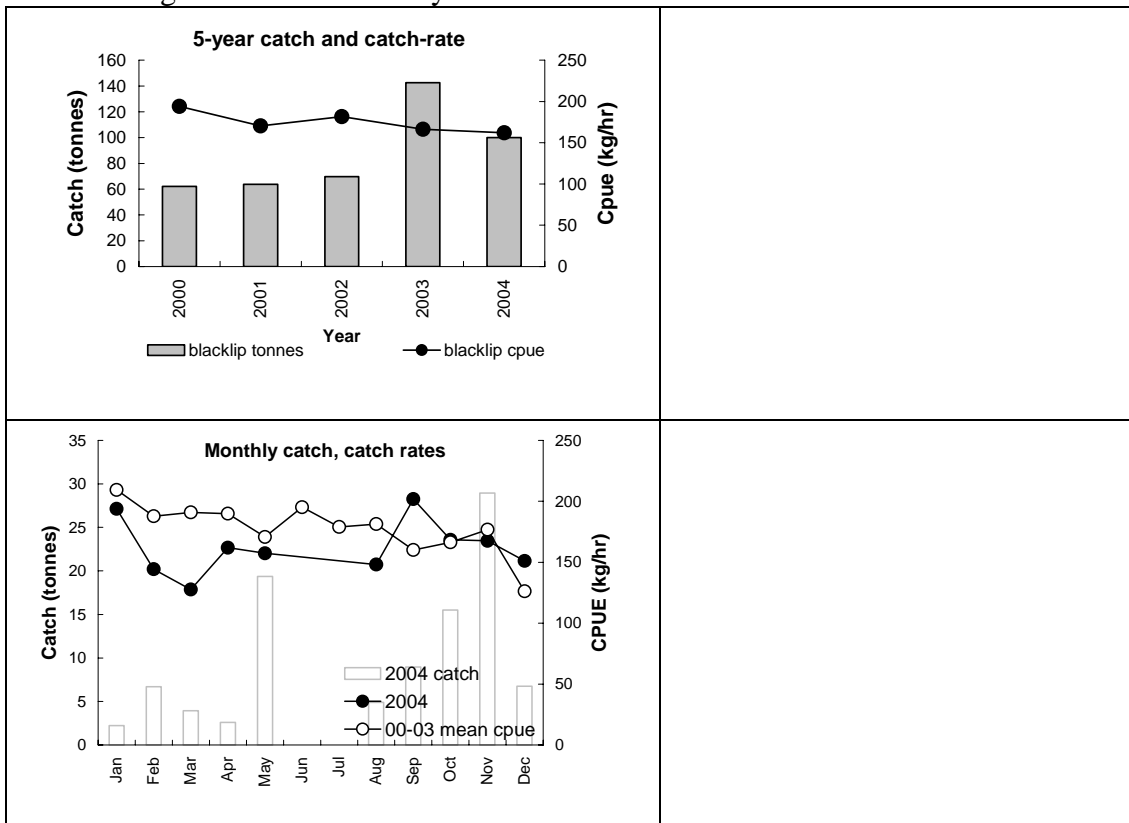
Sub-block 10B
Endeavour Bay to High Rocky Point



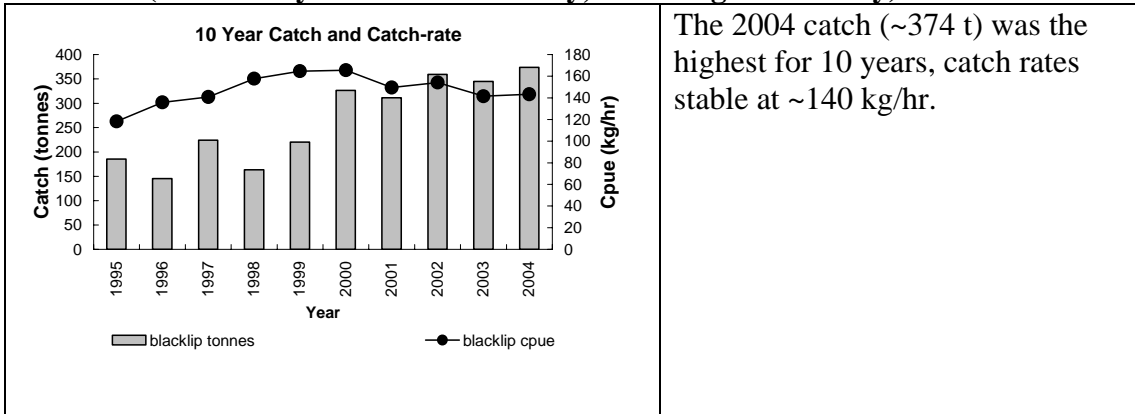
Sub-block 10C
High Rocky Point to Mainwaring River



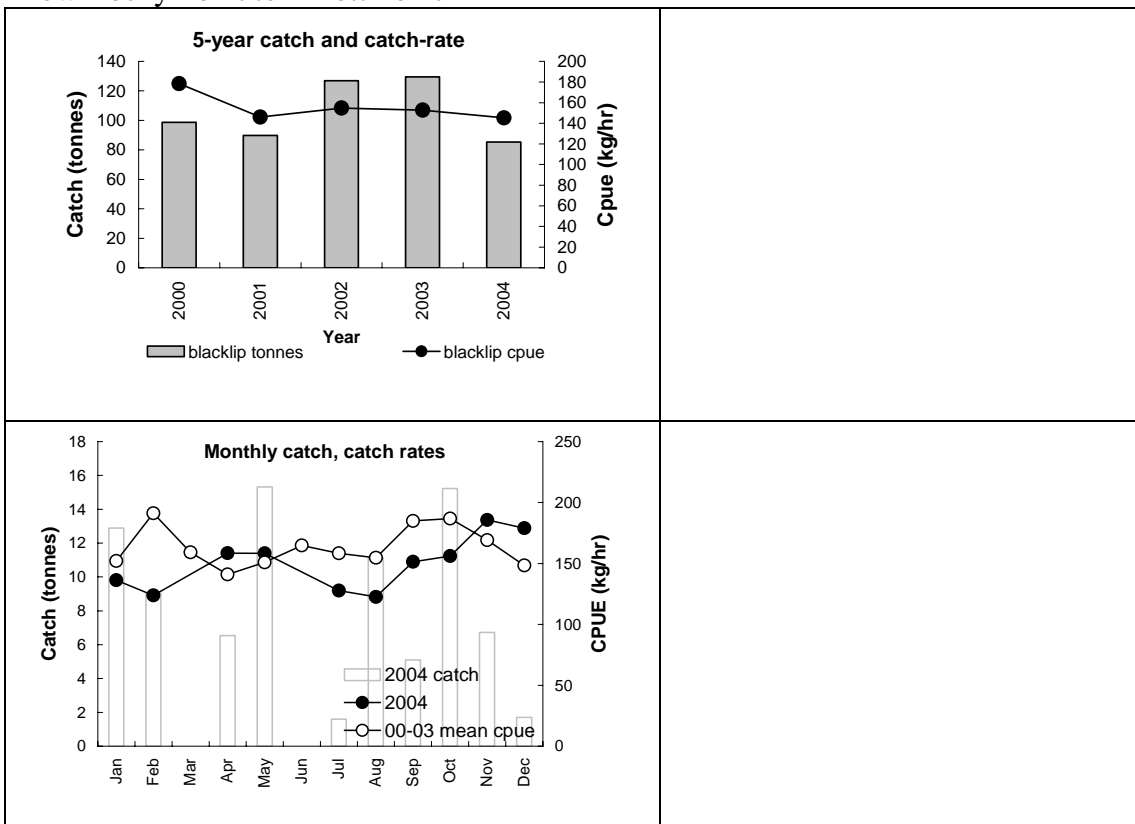
Sub-block 10D
Mainwaring River to Low Rocky Point



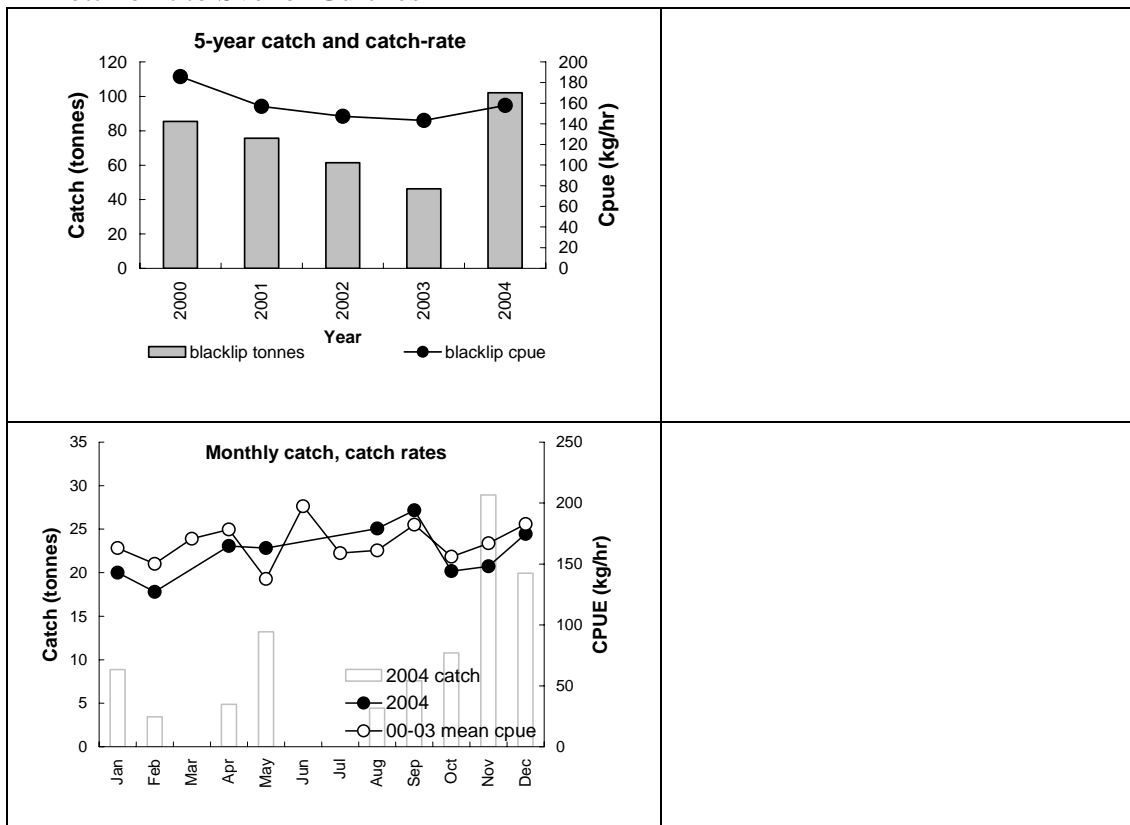
Block 11 (Low Rocky Point to Faults Bay, including Port Davey)



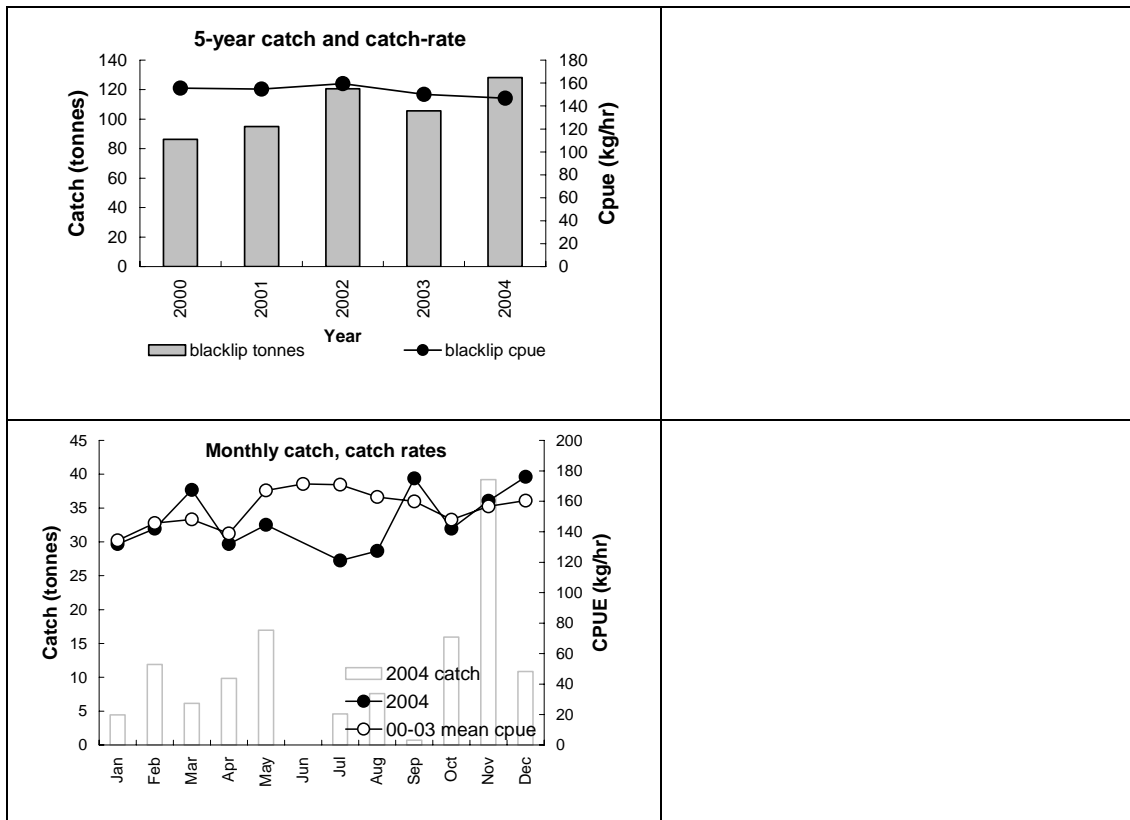
**Sub-block 11A
Low Rocky Point to Elliott Point**



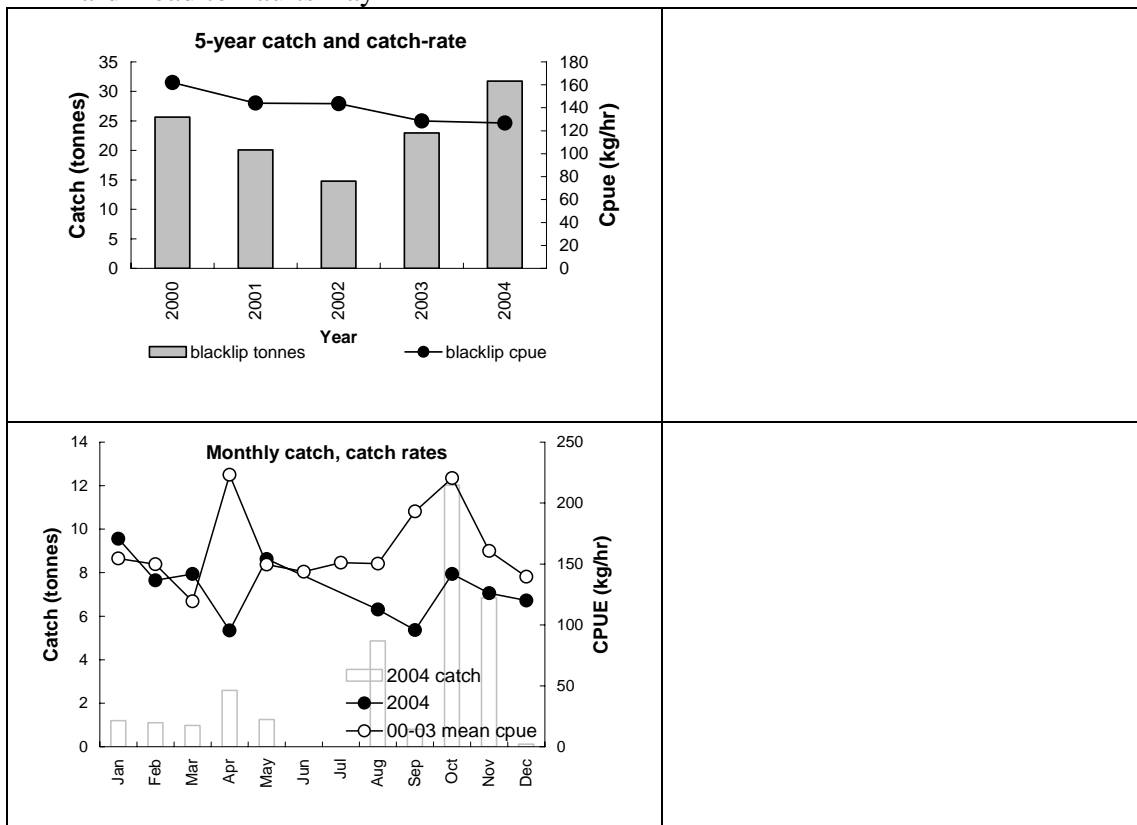
Sub-block 11B
Elliott Point to Svenor Gulches



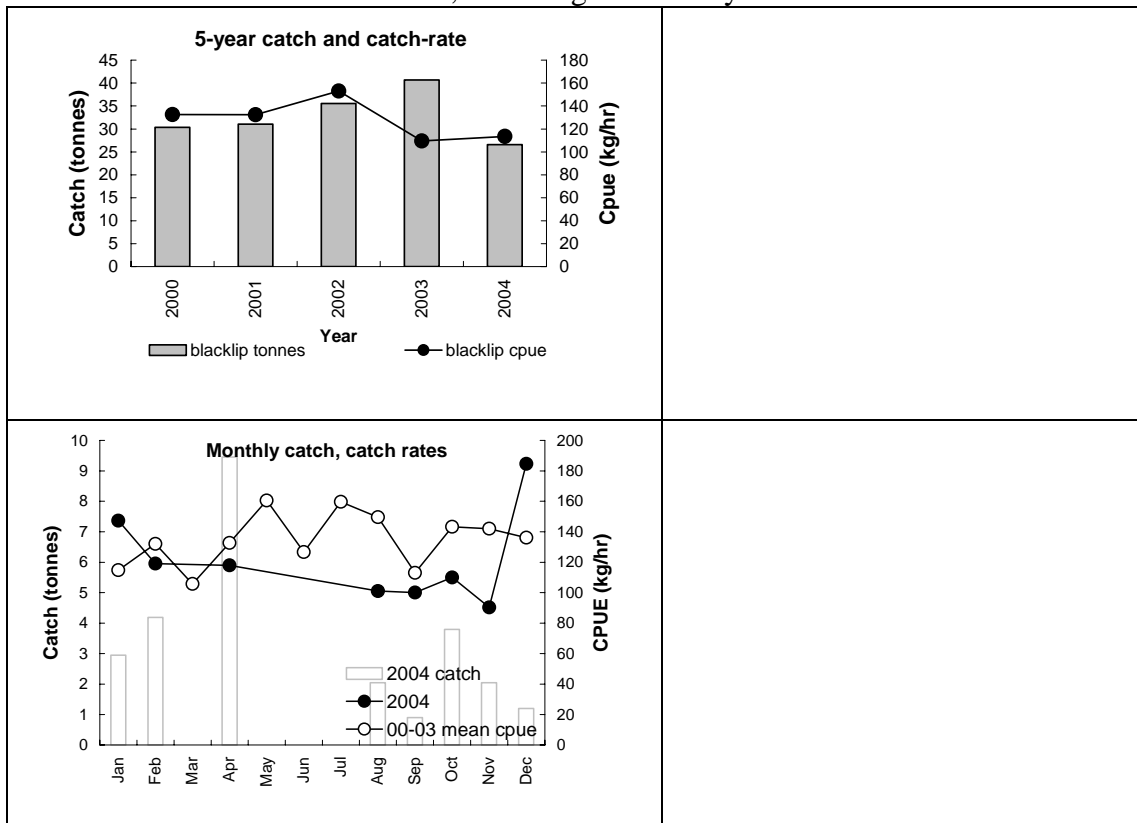
Sub-block 11C
Svenor Gulches to Point St Vincent



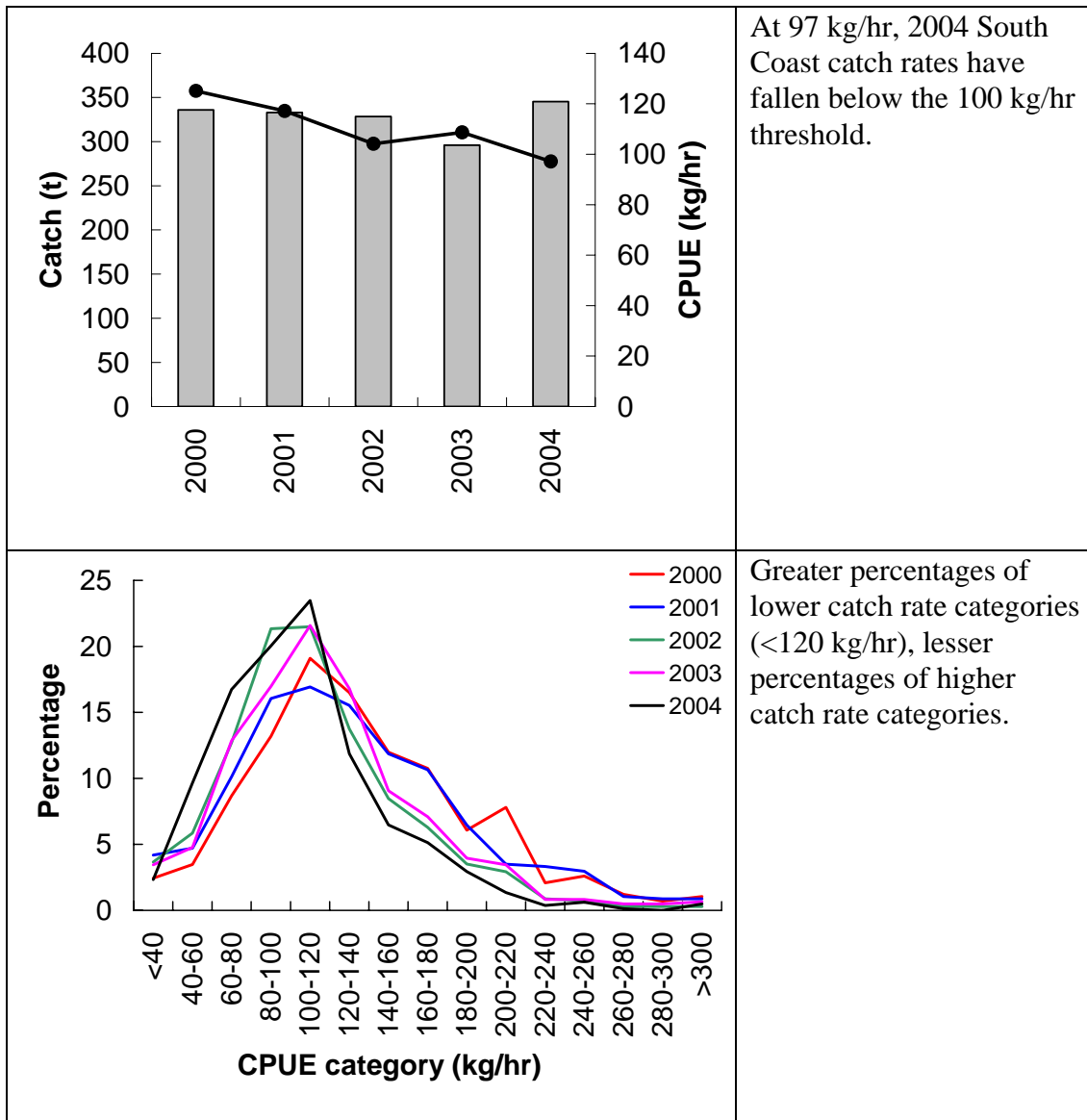
Sub-block 11D
Hilliard Head to Faults Bay



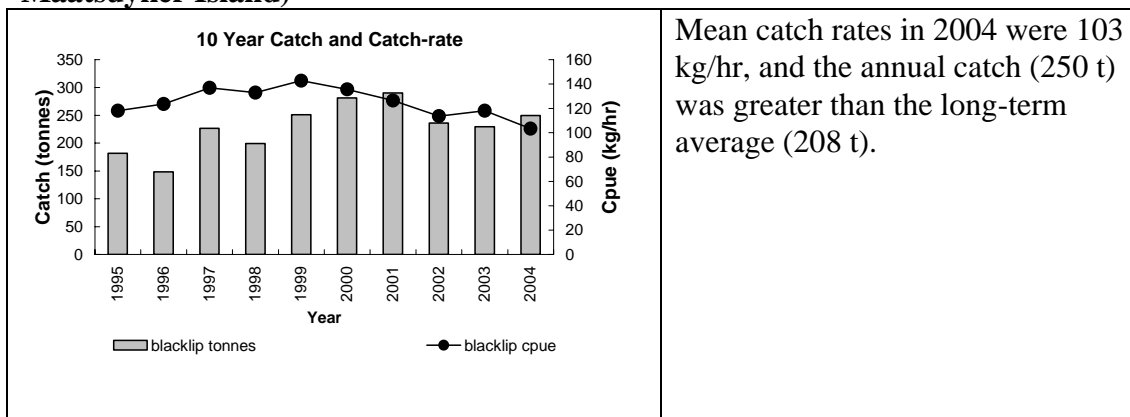
Sub-block 11E
Point St Vincent to Hilliard Head, including Port Davey



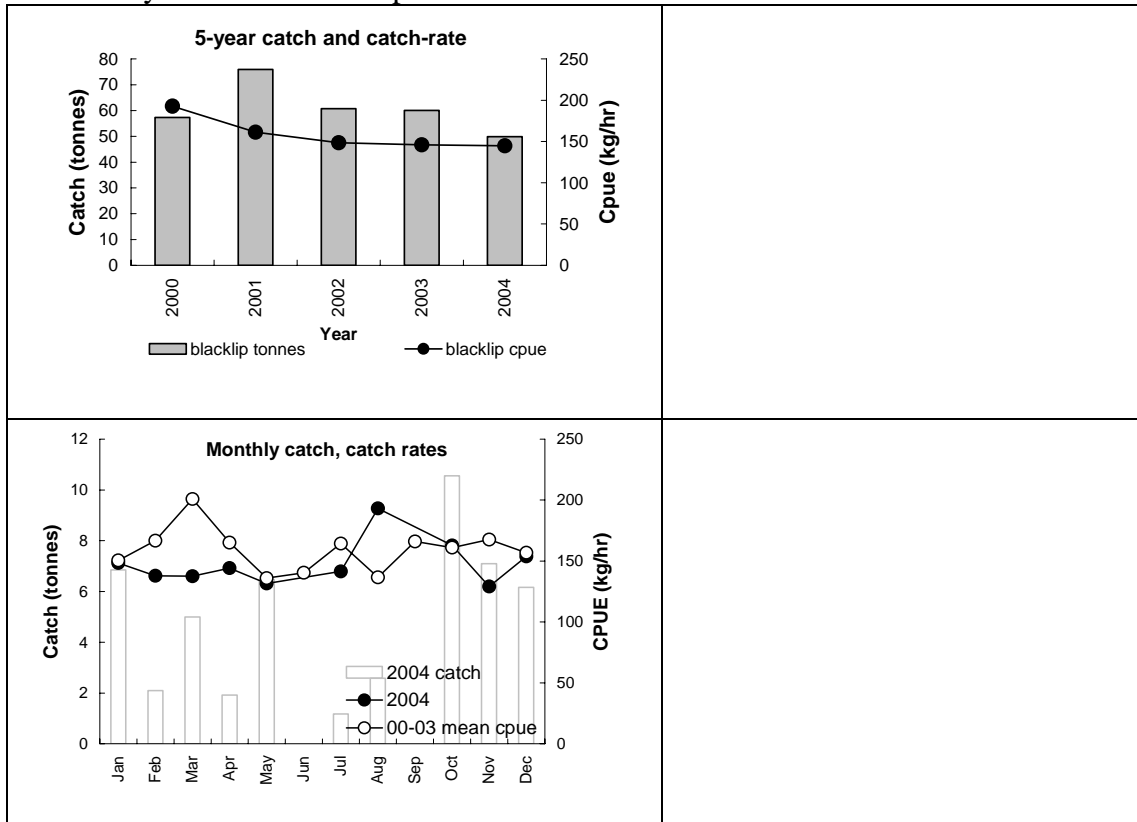
Western Zone - South Coast (Block 12, Sub-blocks 13A, 13B)



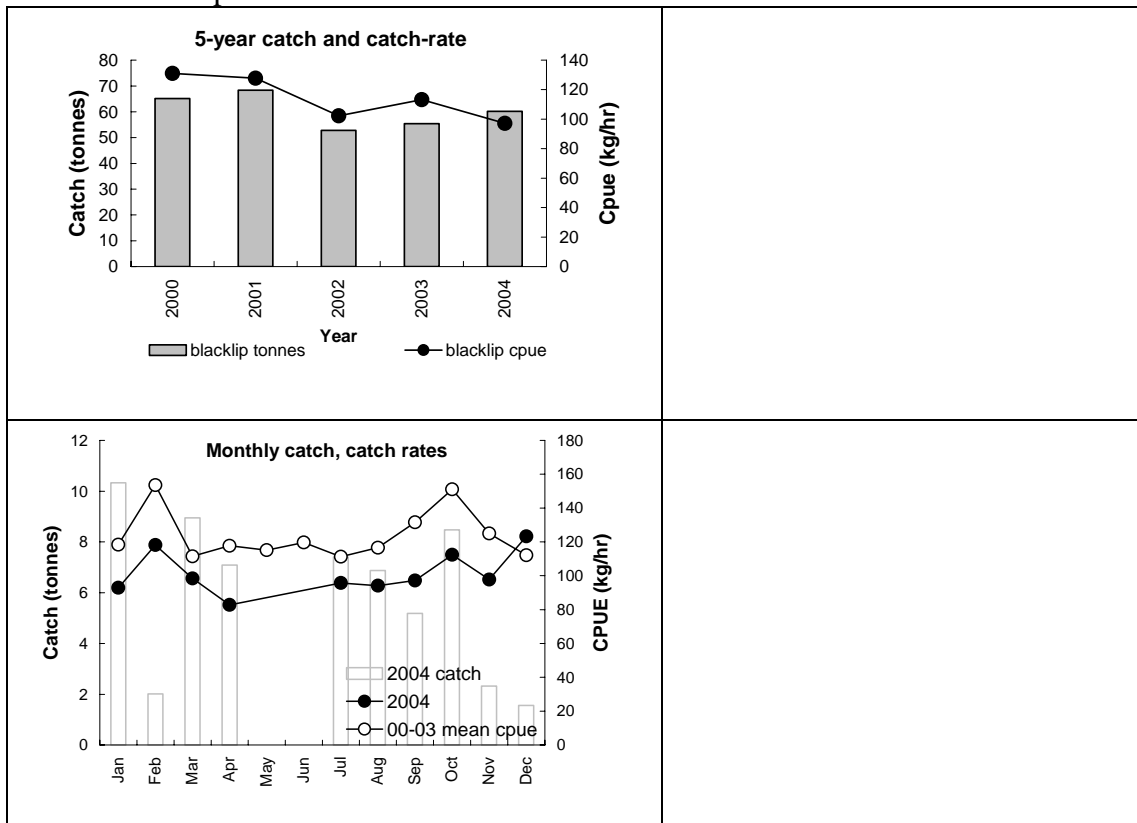
Block 12 (Faults Bay to Prion Beach, including South West Cape, Cox Bight and Maatsuyker Island)



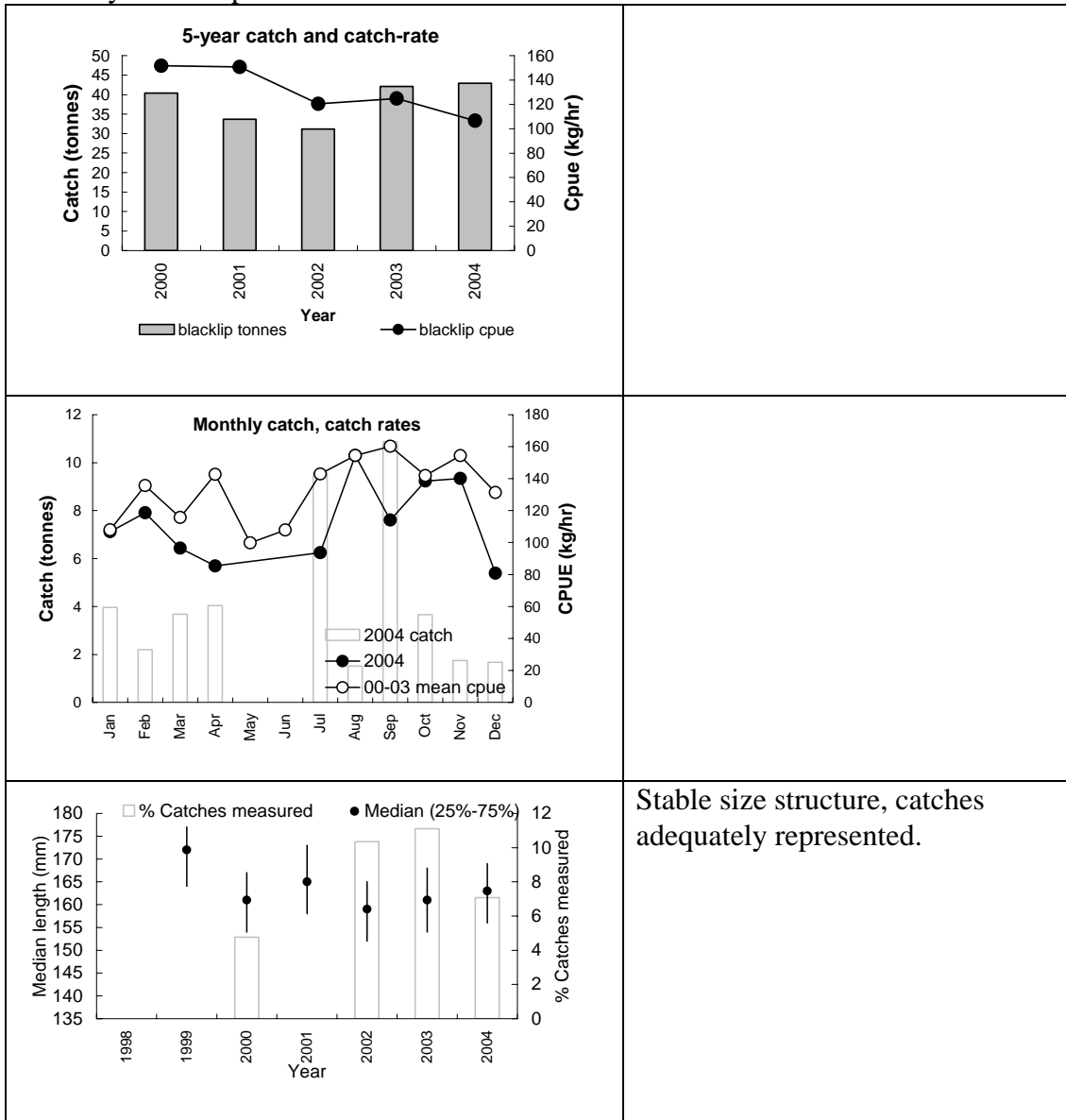
Sub-block 12A
 Faults Bay to South West Cape



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

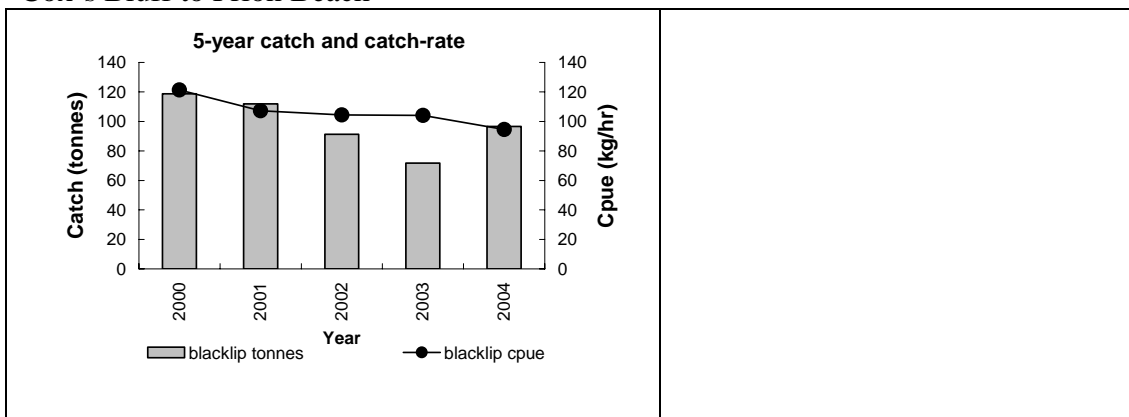


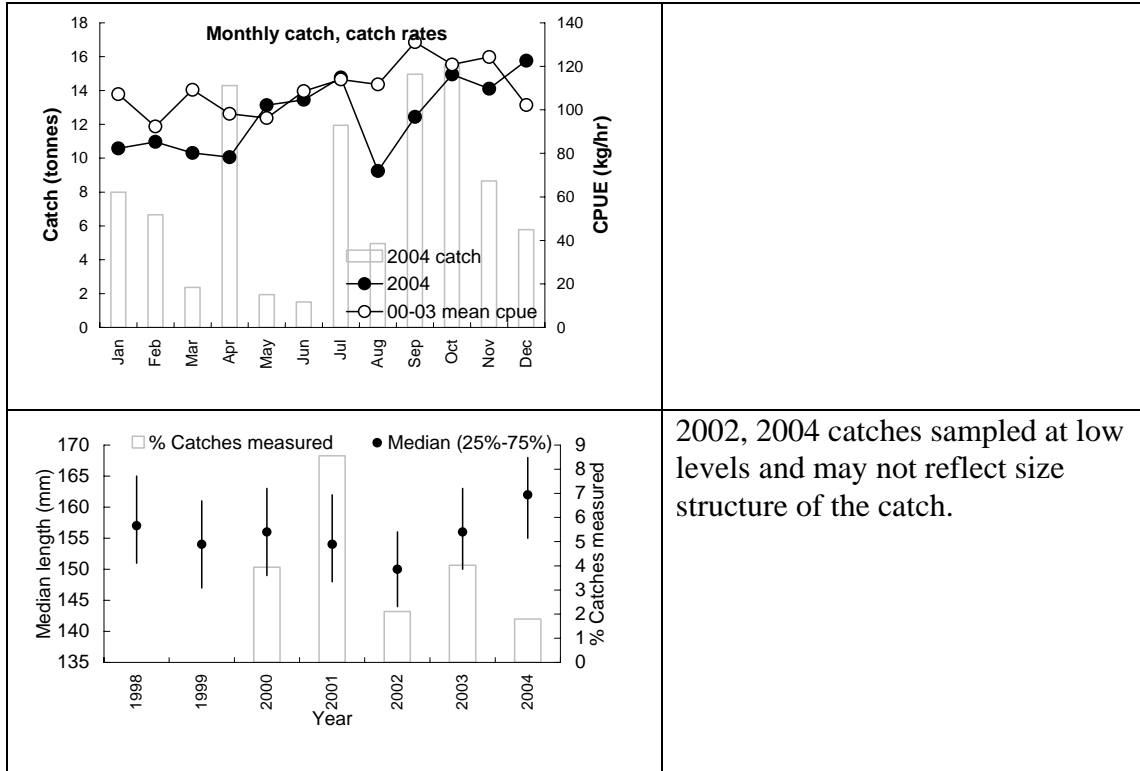
Sub-block 12C
Maatsuyker Group



Stable size structure, catches adequately represented.

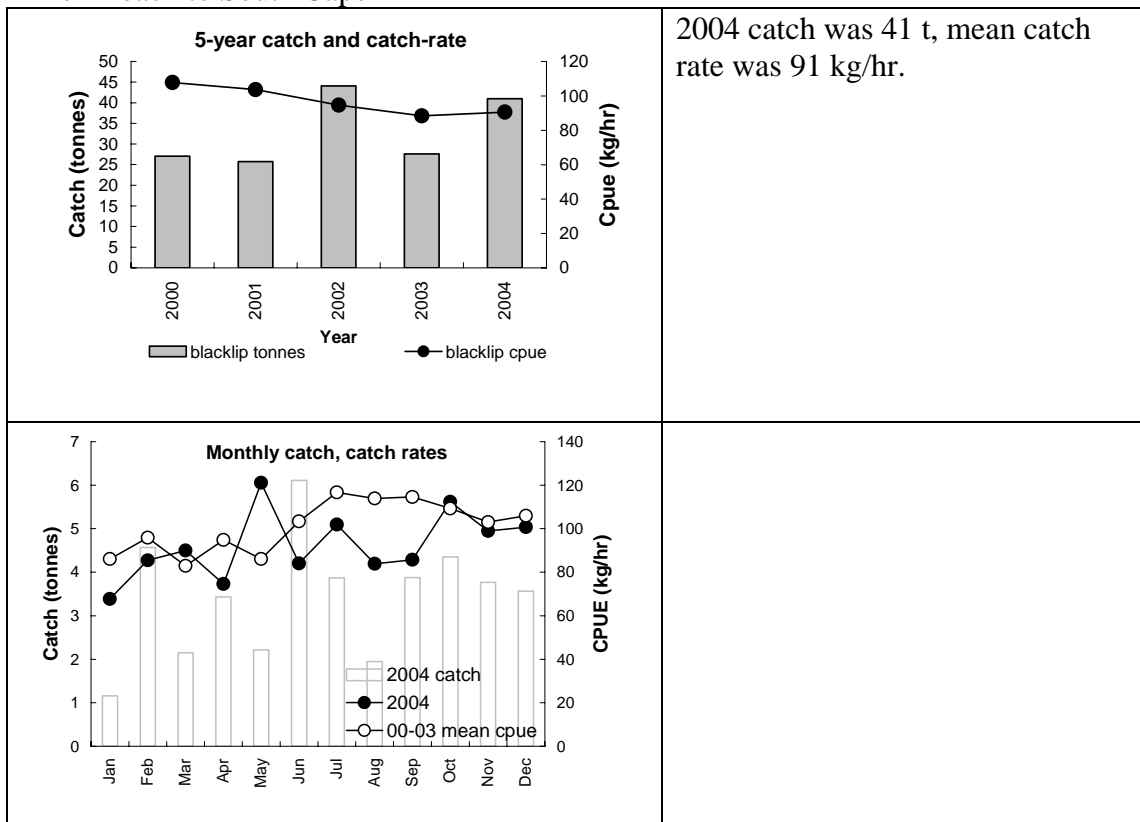
Sub-block 12D
Cox's Bluff to Prion Beach





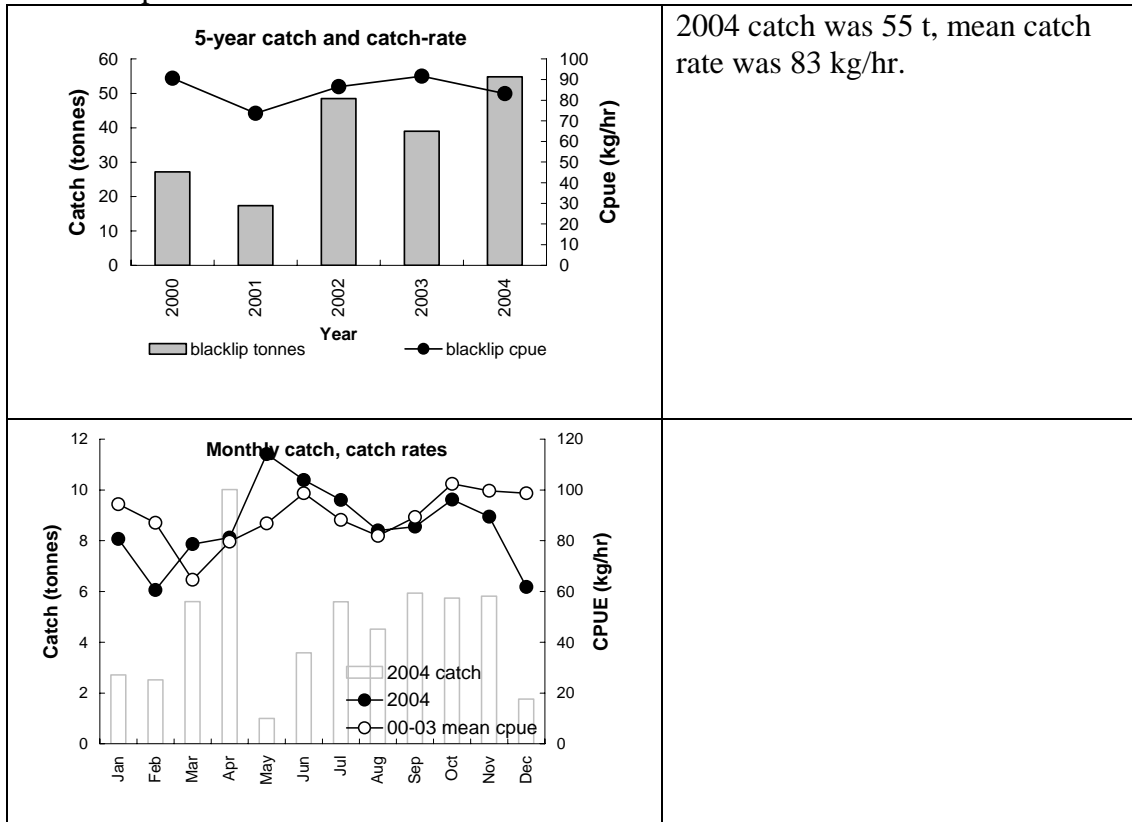
2002, 2004 catches sampled at low levels and may not reflect size structure of the catch.

Block 13 (Prion Beach to Whale Head)
 Sub-block 13A
 Prion Beach to South Cape



2004 catch was 41 t, mean catch rate was 91 kg/hr.

Sub-block 13B
South Cape to Whale Head



Northern Zone blacklip fishery – major fishing blocks

In the Northern Zone, there were considerable variations in catch between 2003 and 2004, particularly in the North West (Blocks 5 and 49) and King Island (Blocks 1, 3 and 4) (Figure 8). In the North East, there was a large increase in catch in Block 31.

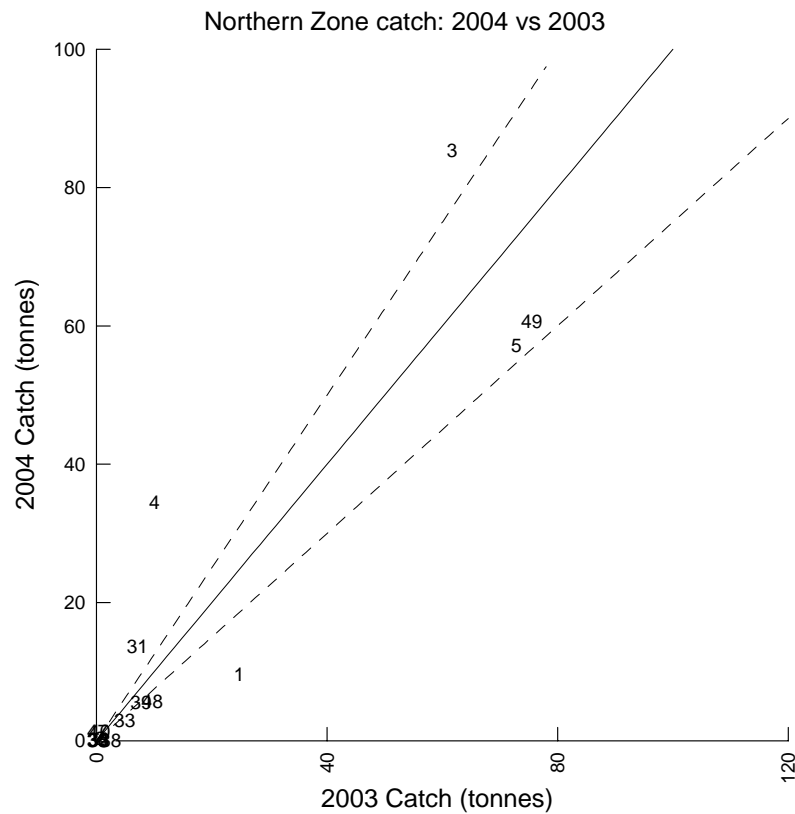
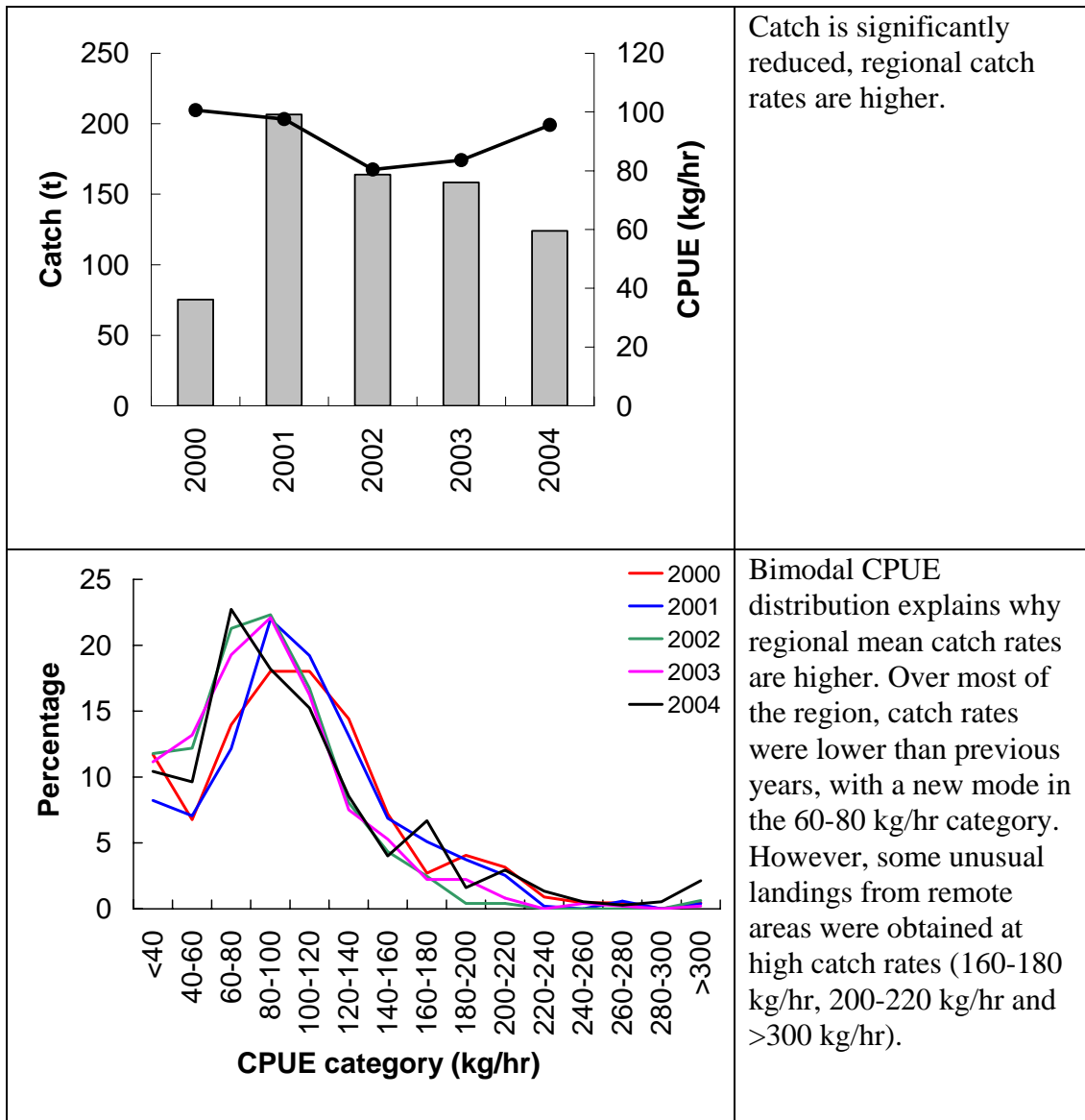
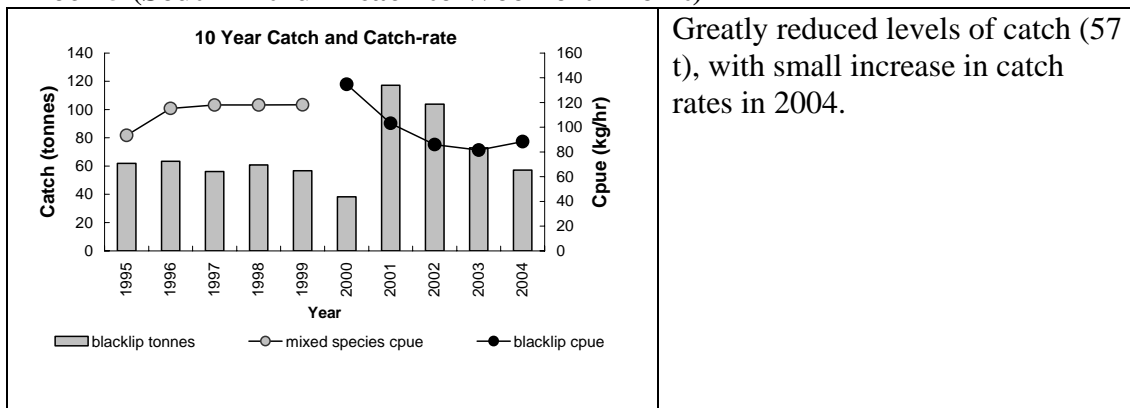


Figure 8. Blacklip catch from the Northern Zone (Blocks 1 to 5, part of sub-block 31B and Blocks 32 to 49). In 2004, the Northern Zone TAC (280 tonnes) was unchanged from the previous year. Blocks to the left of the diagonal line reflect increased catches over 2003 levels, blocks to the right reflect falling catches. Both Blocks 3 and 4 (King Island) show levels of catch increase > 25%, while the catch in the North West Blocks 5 and 49 was reduced.

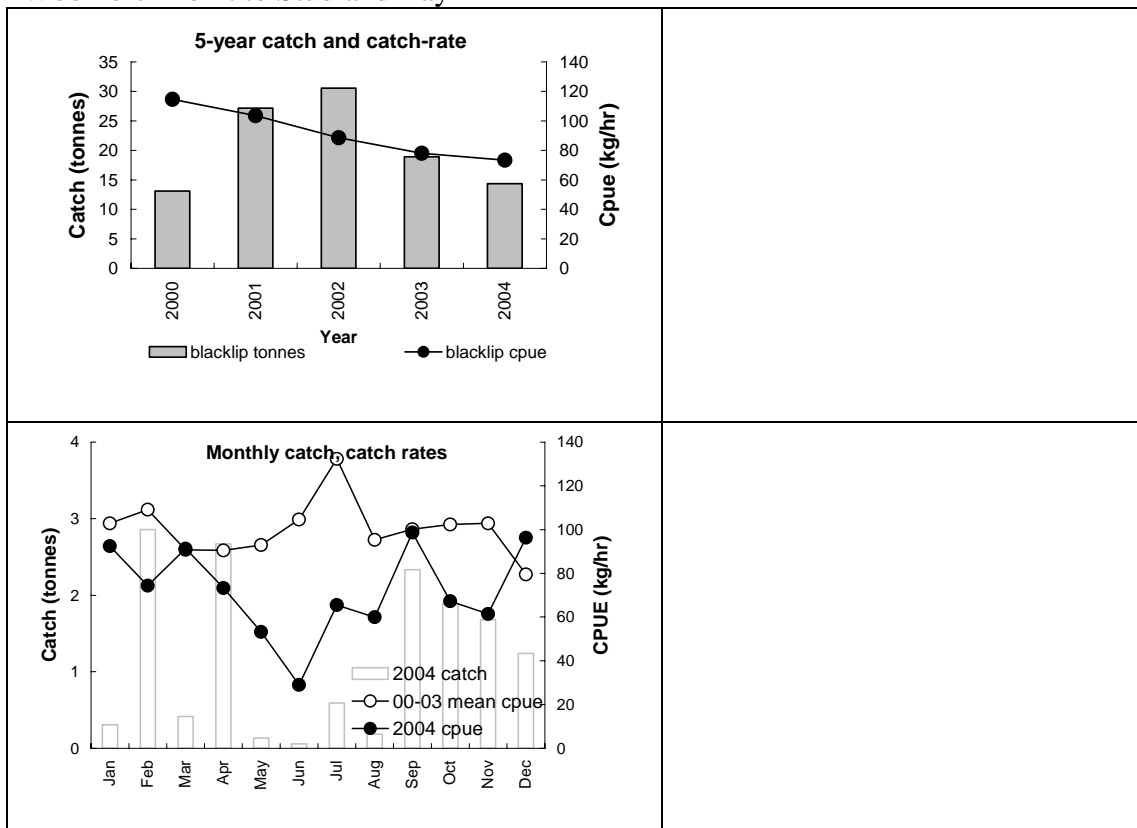
Northern Zone - North West (Blocks 47- 49, 5)



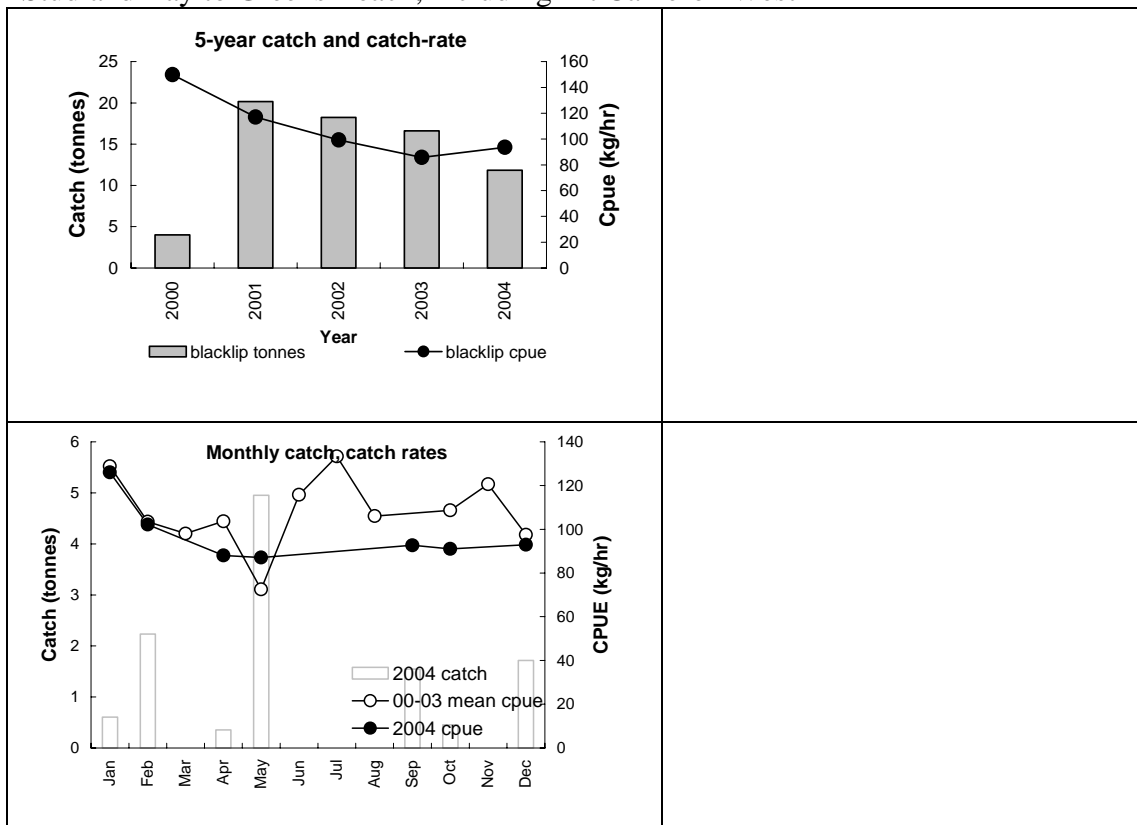
Block 5 (South Arthur Beach to Woolnorth Point)



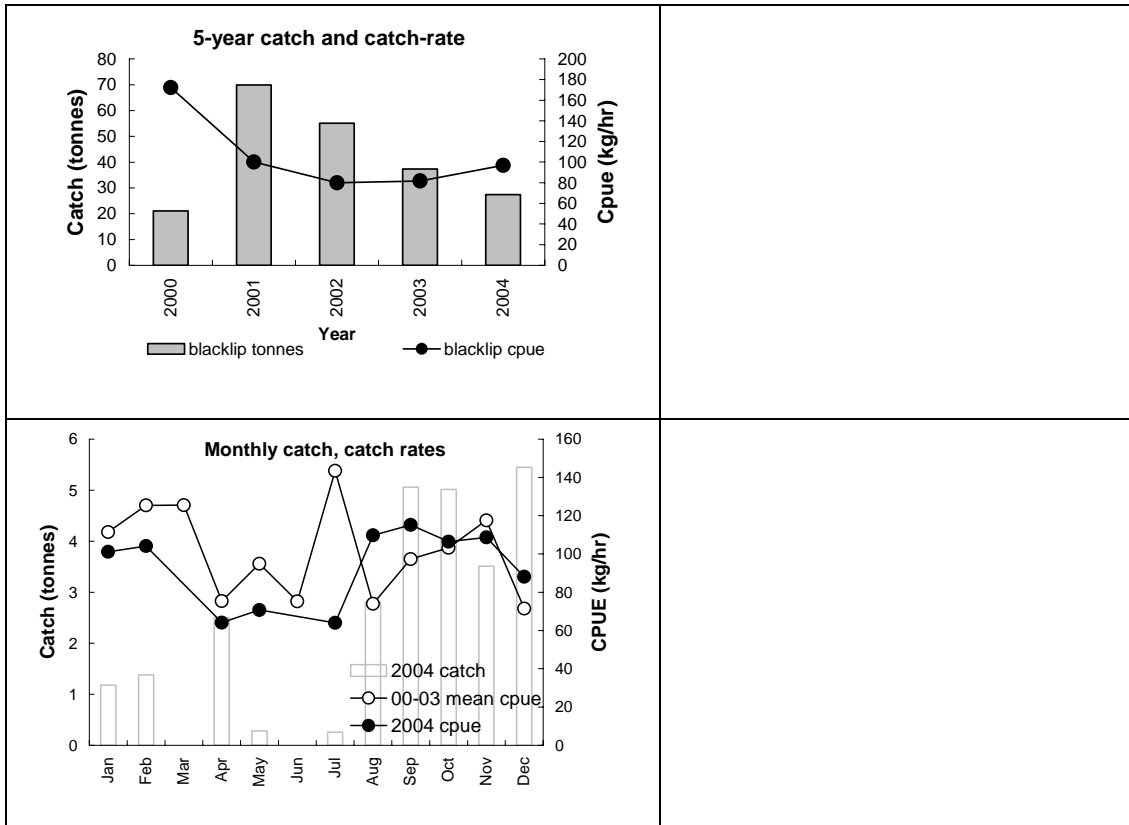
Sub-block 5A
Woolnorth Point to Studland Bay



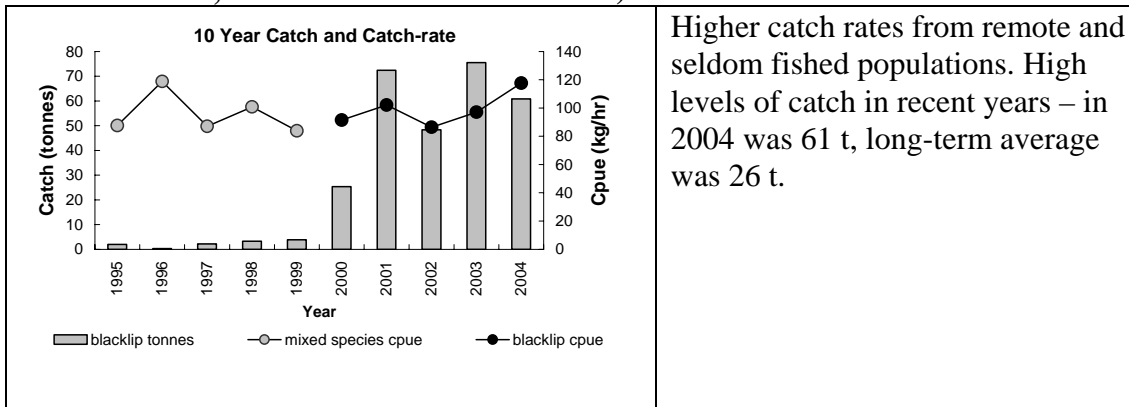
Sub-block 5B
Studland Bay to Greens Beach, including Mt Cameron West



Sub-block 5C
Greens Beach to Arthur River

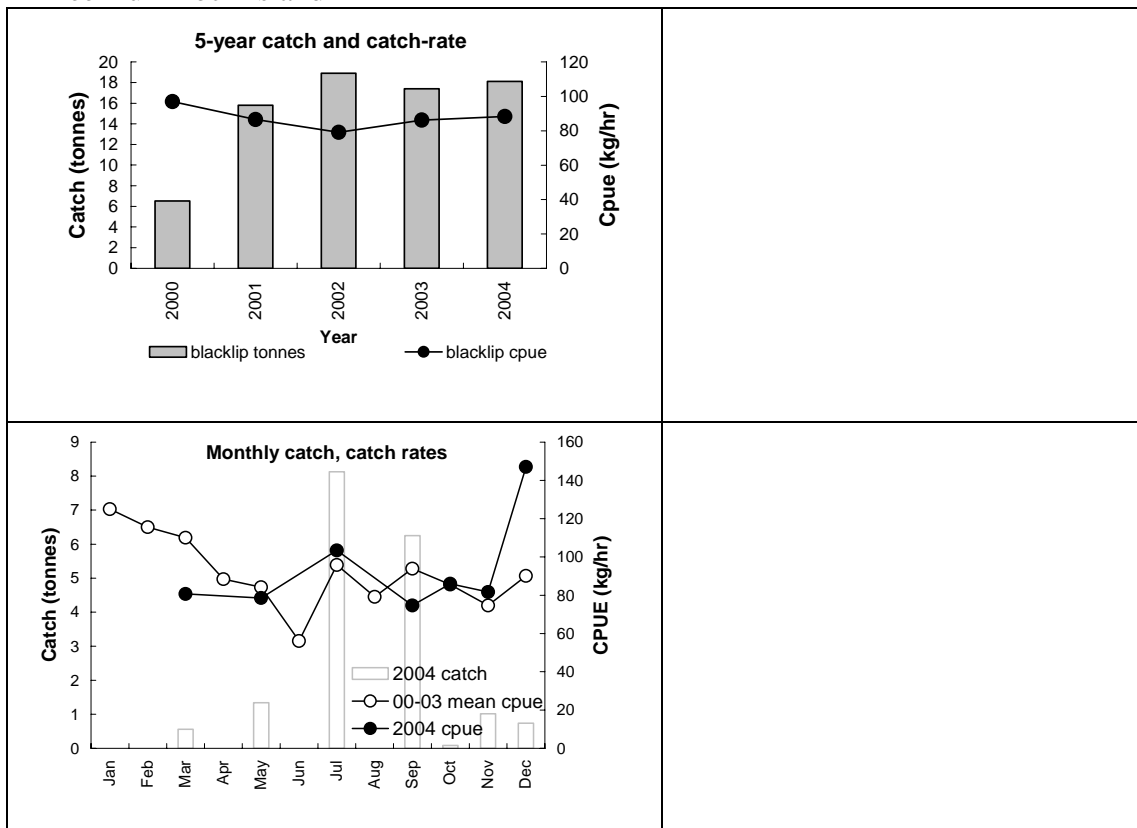


Block 49 (Woolnorth Point to Hunter Island, including western and northern Hunter Island, and Three Hummock Island)

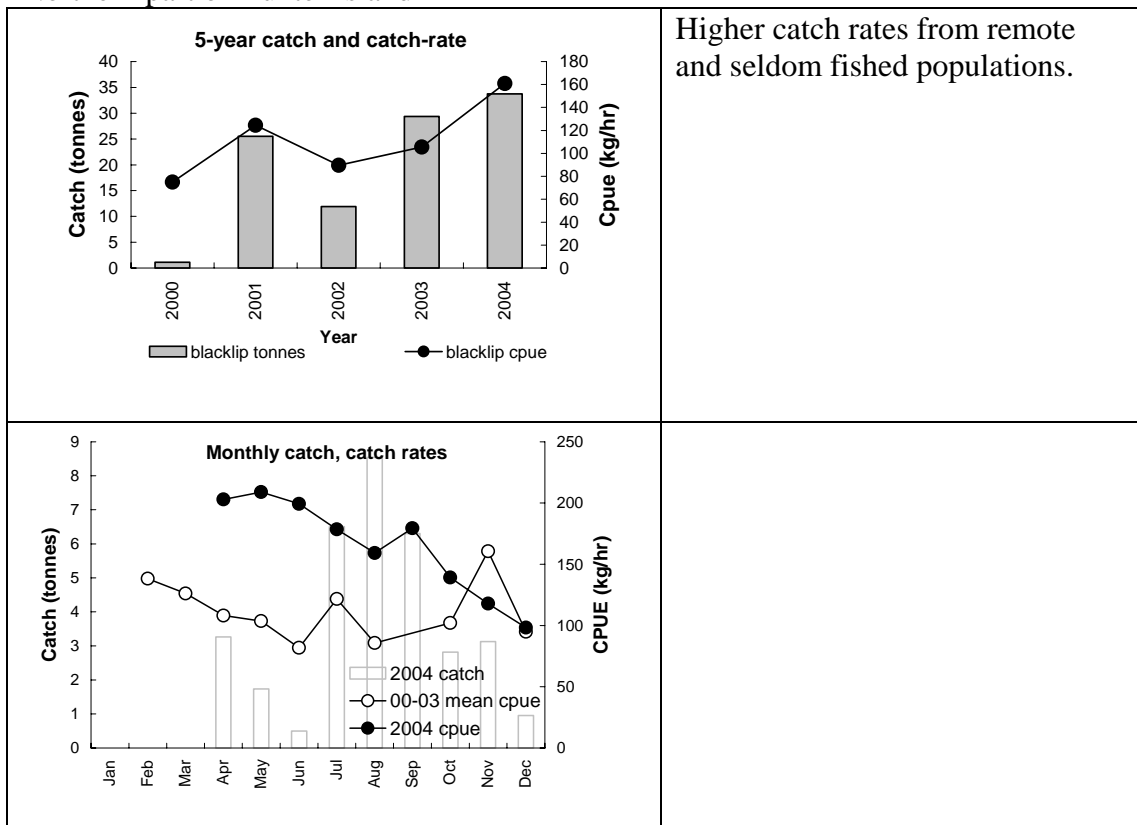


Higher catch rates from remote and seldom fished populations. High levels of catch in recent years – in 2004 was 61 t, long-term average was 26 t.

Sub-block 49A
Three Hummock Island

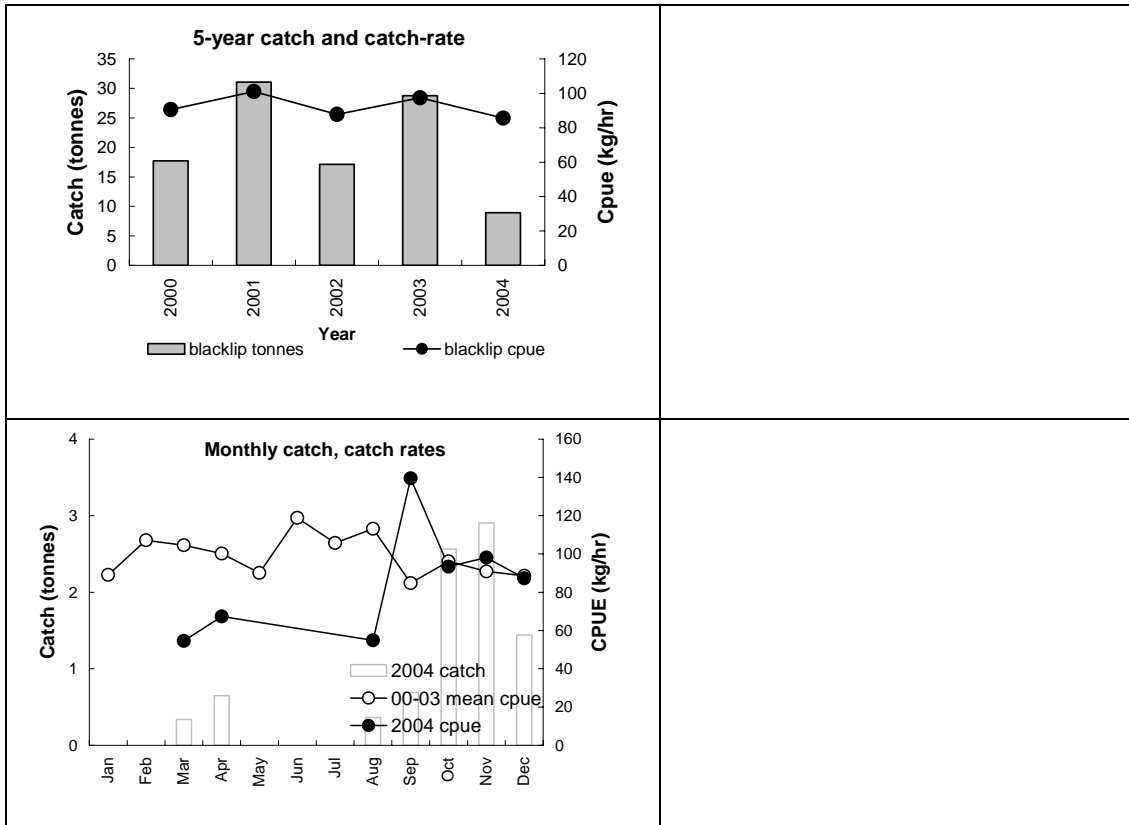


Sub-block 49B
Northern part of Hunter Island

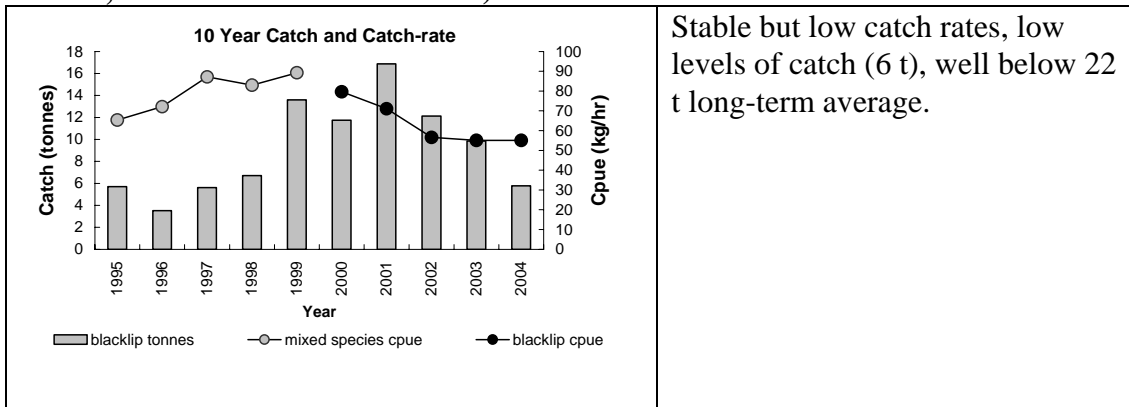


Higher catch rates from remote and seldom fished populations.

Sub-block 49C
South-western Hunter Island

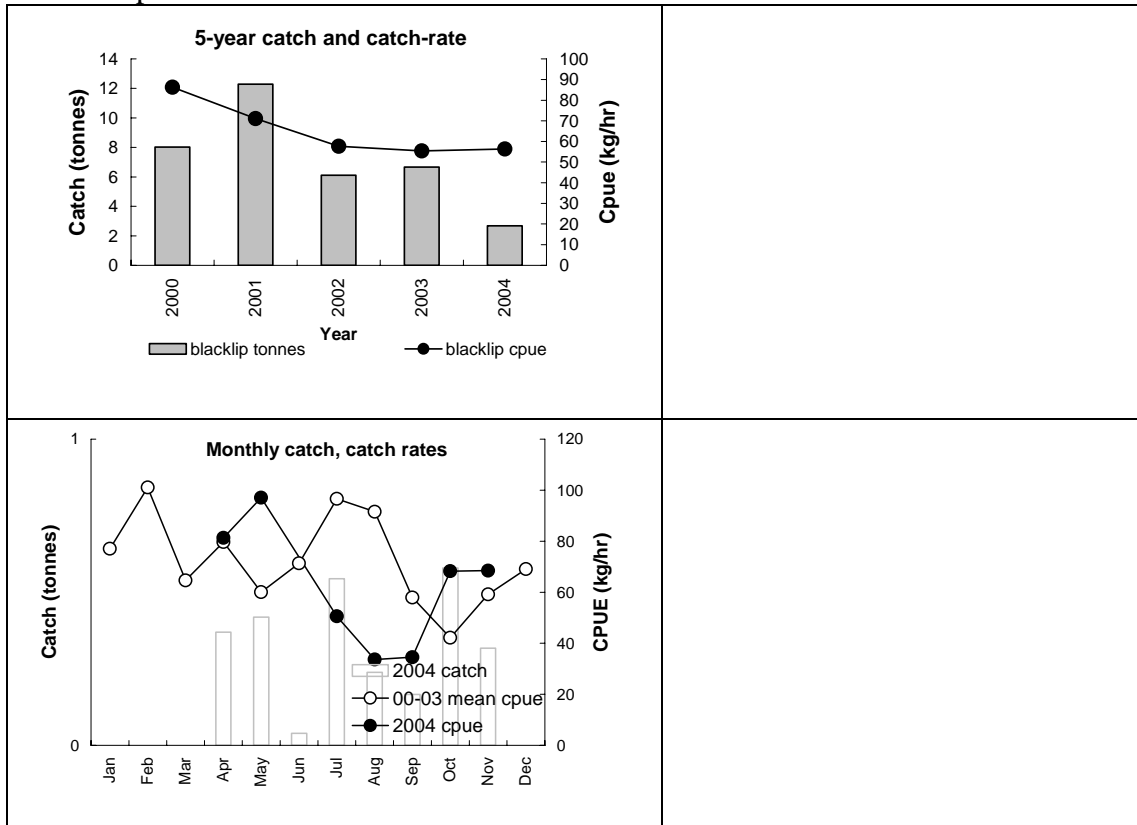


Block 48 (Woolnorth Point to the Duck River, including the eastern side of Hunter Island, the Petrels and Black Reef)

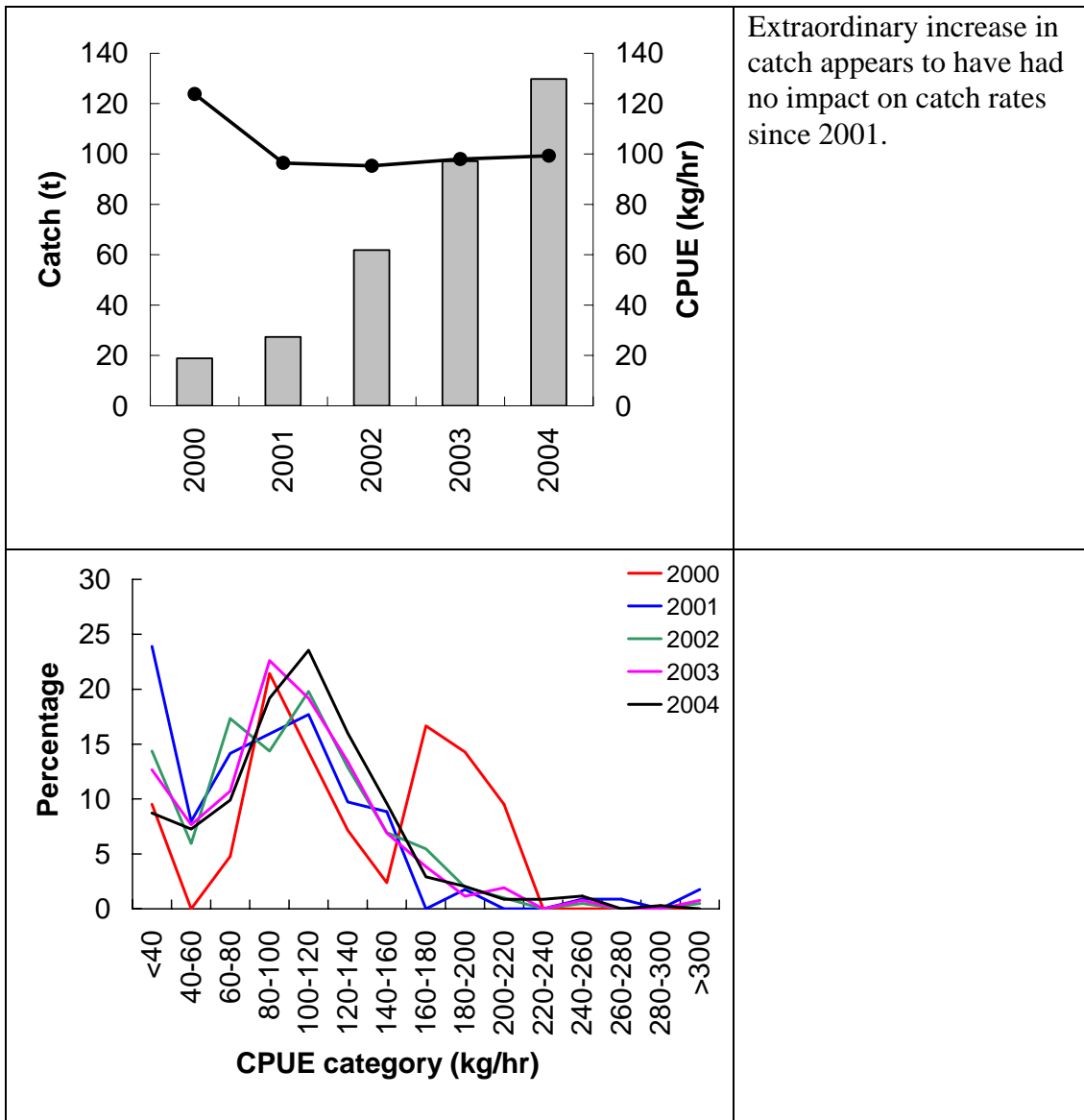


Stable but low catch rates, low levels of catch (6 t), well below 22 t long-term average.

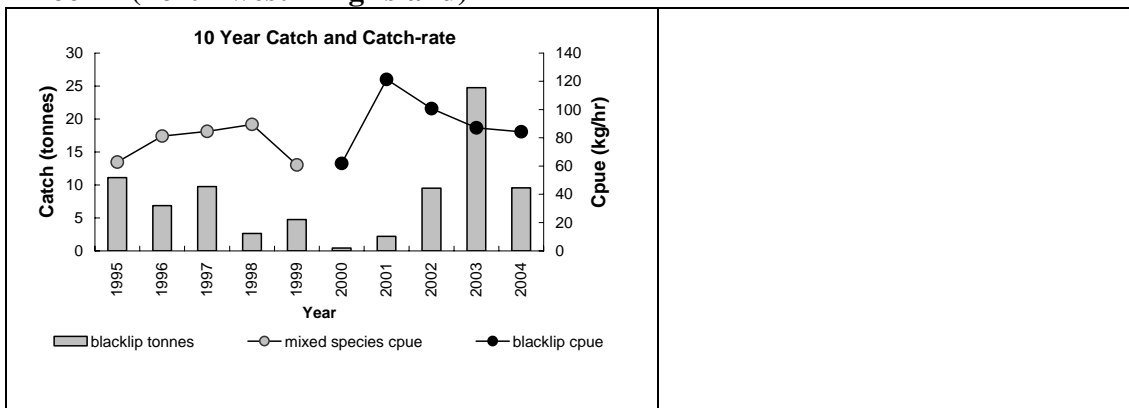
Sub-block 48C
Western part of Block 48



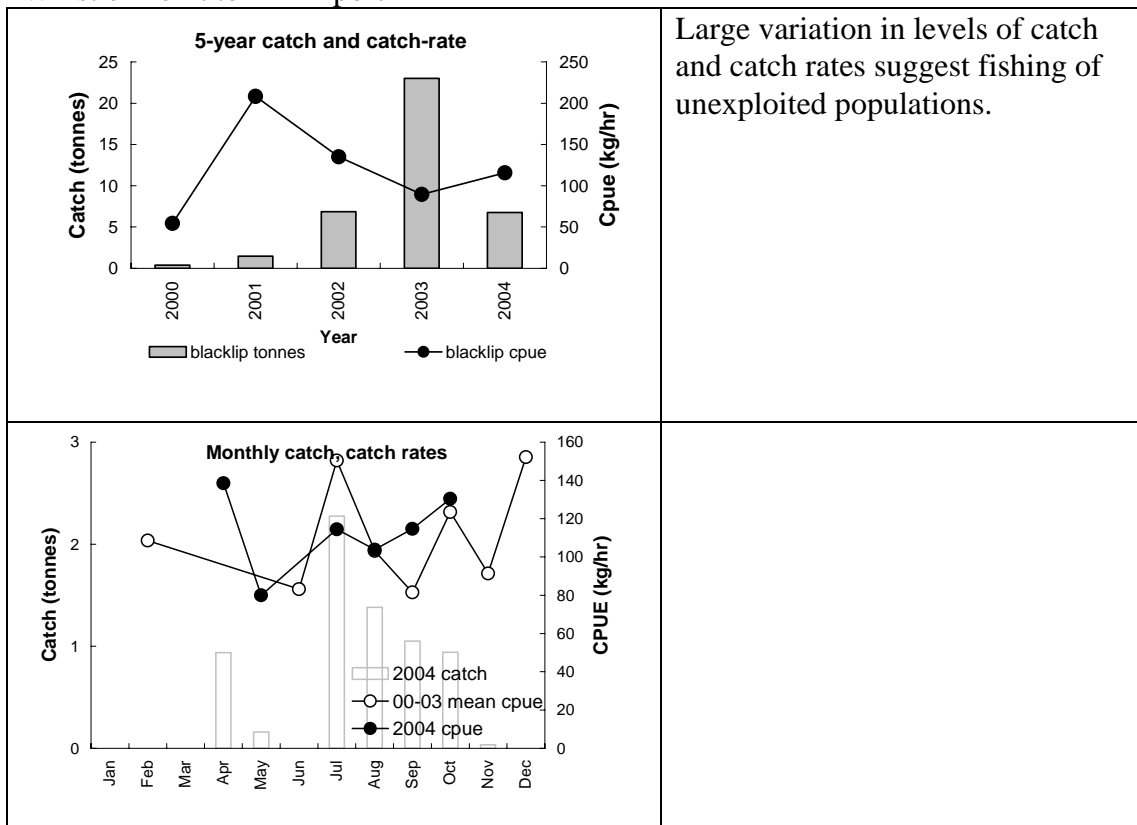
Northern Zone - King Island (Blocks 1-4)



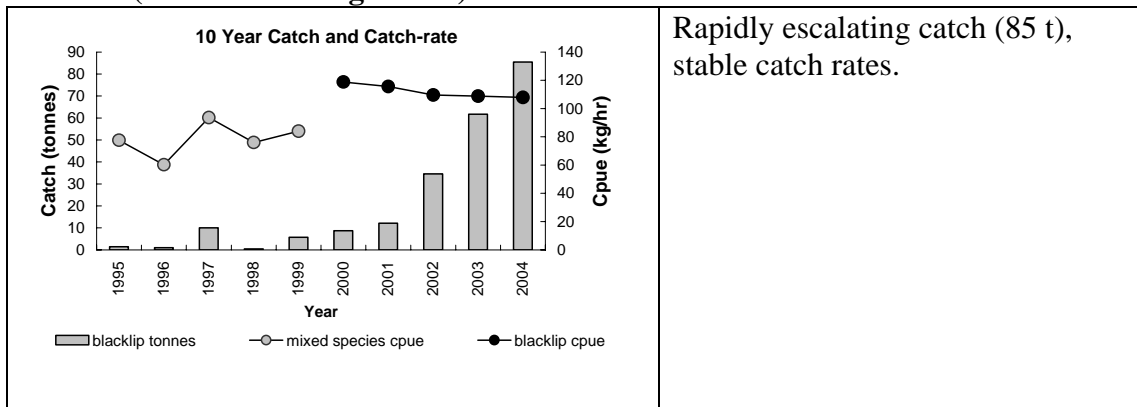
Block 1 (north-west King Island)



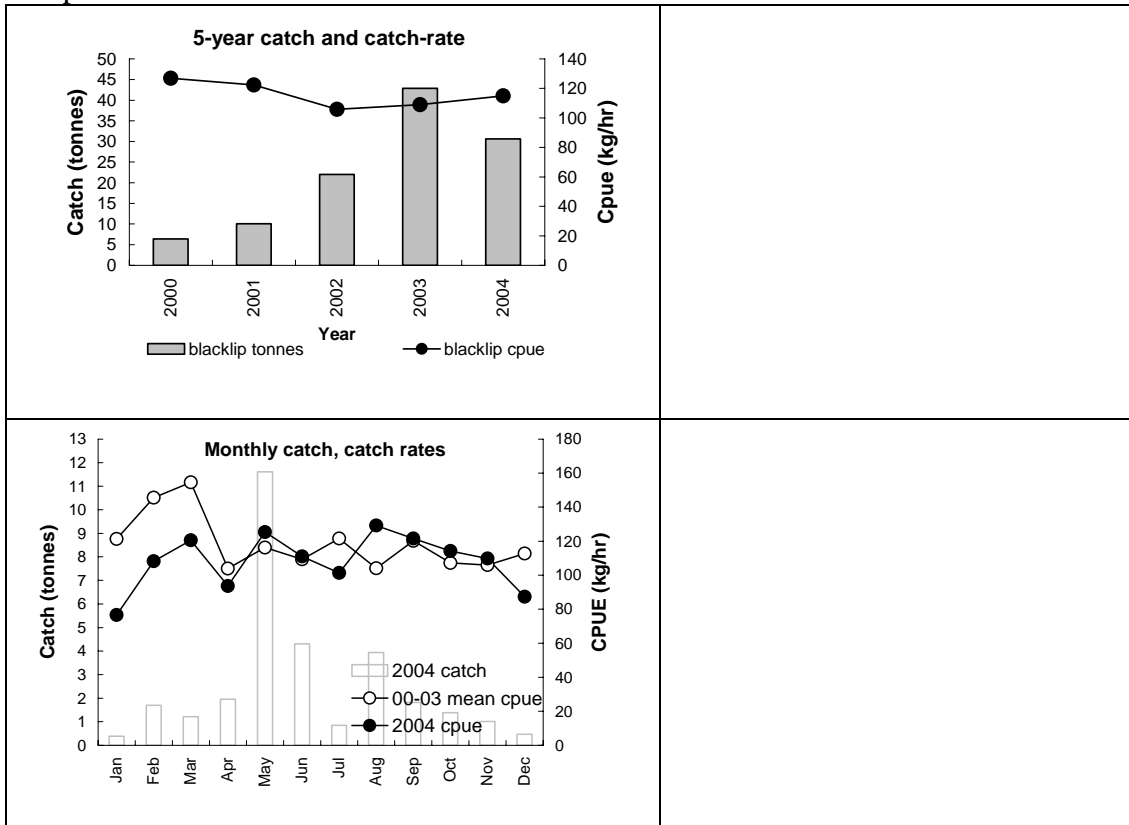
Sub-block 1C
Whistler Point to KI Airport



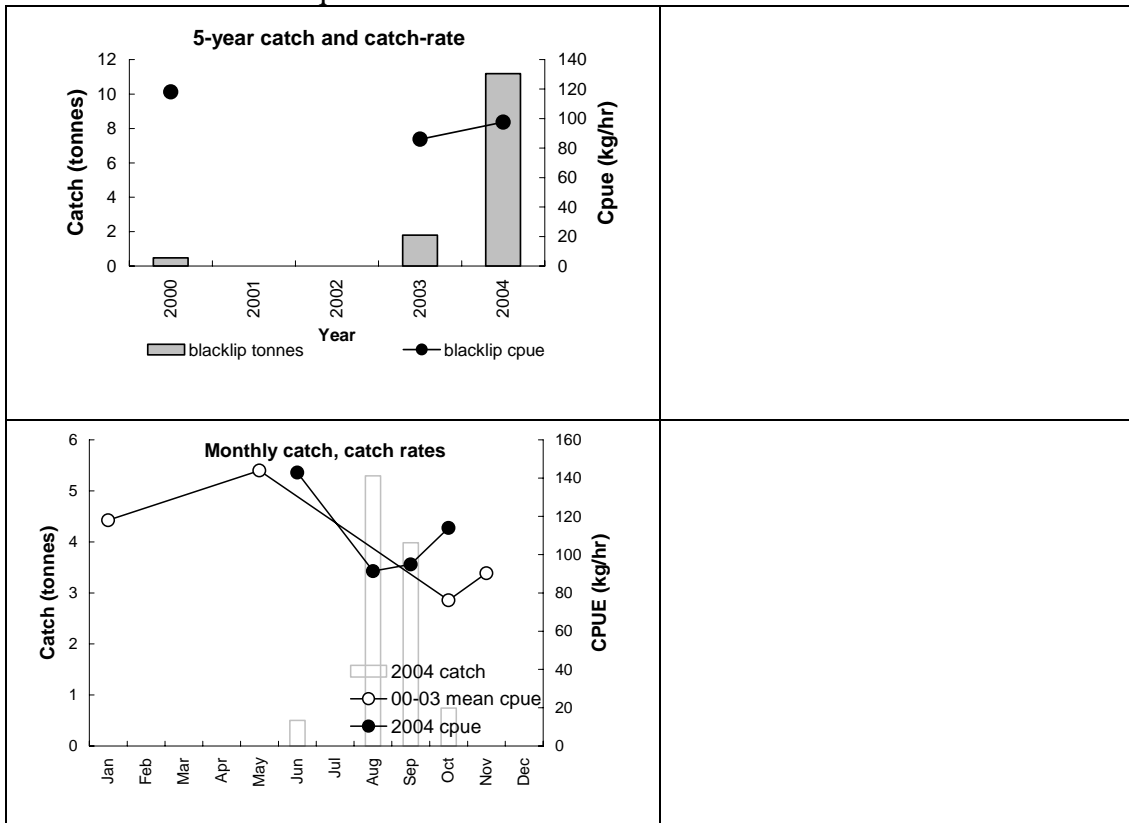
Block 3 (south-west King Island)



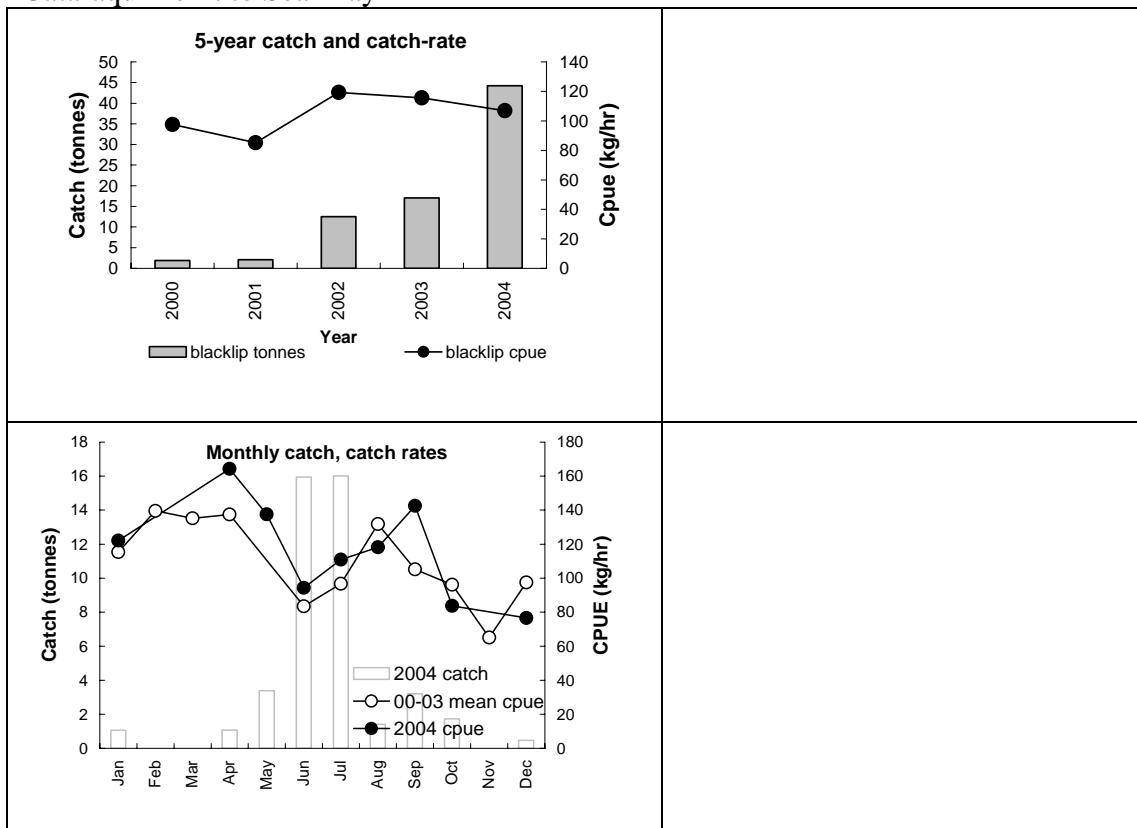
Sub-block 3A
Airport to Ettrick River



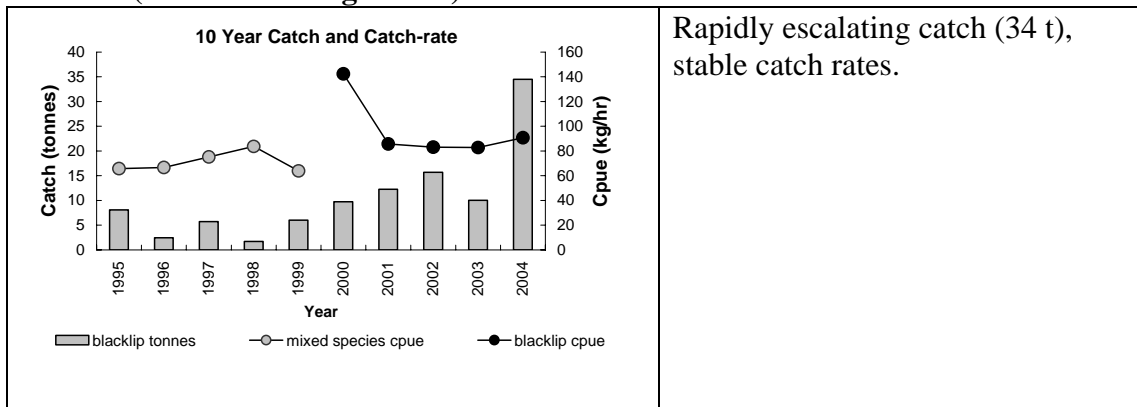
Sub-block 3B
Ettrick River to Catarqui Point



Sub-block 3C
 Cataraqui Point to Seal Bay

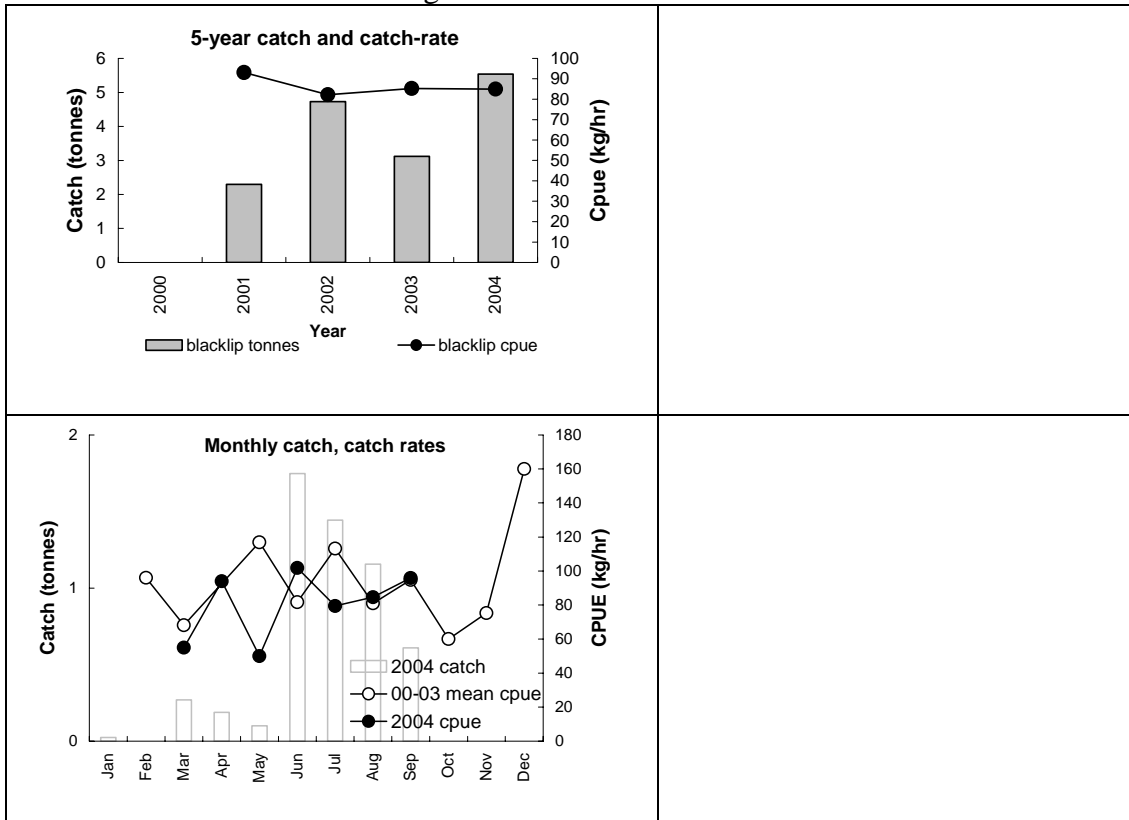


Block 4 (south-east King Island)

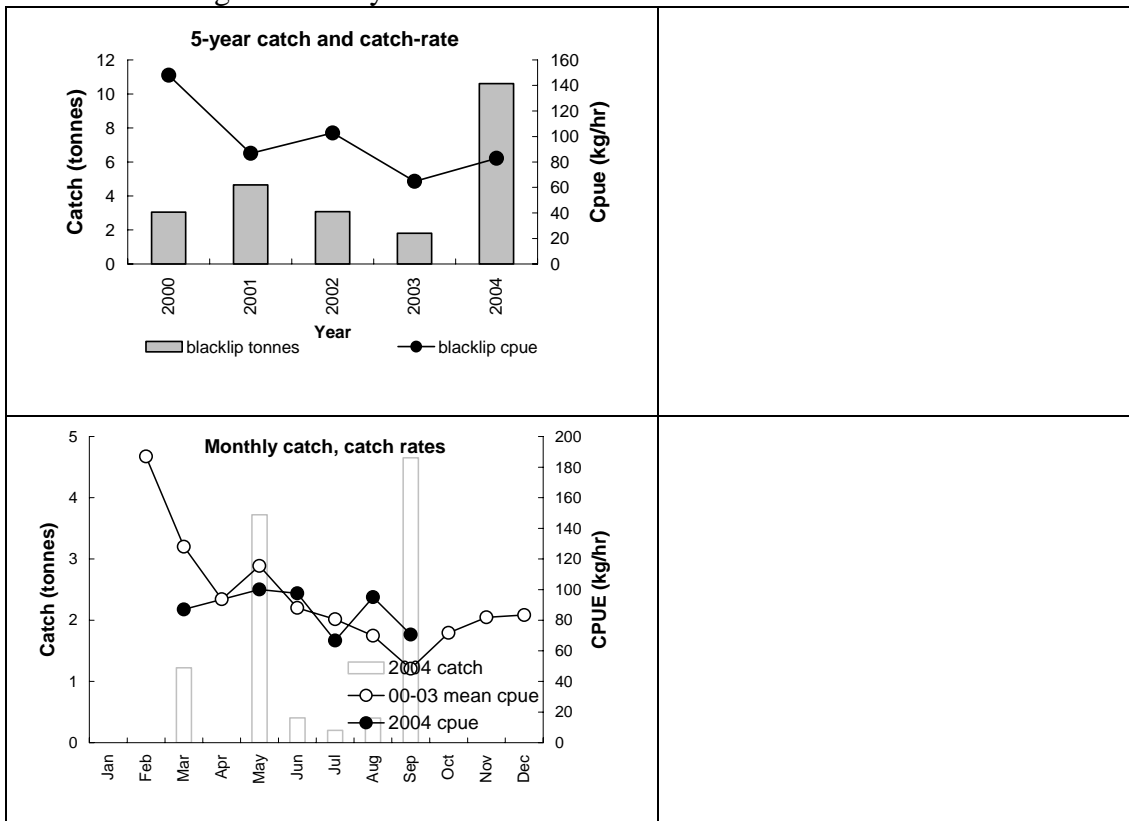


Rapidly escalating catch (34 t),
 stable catch rates.

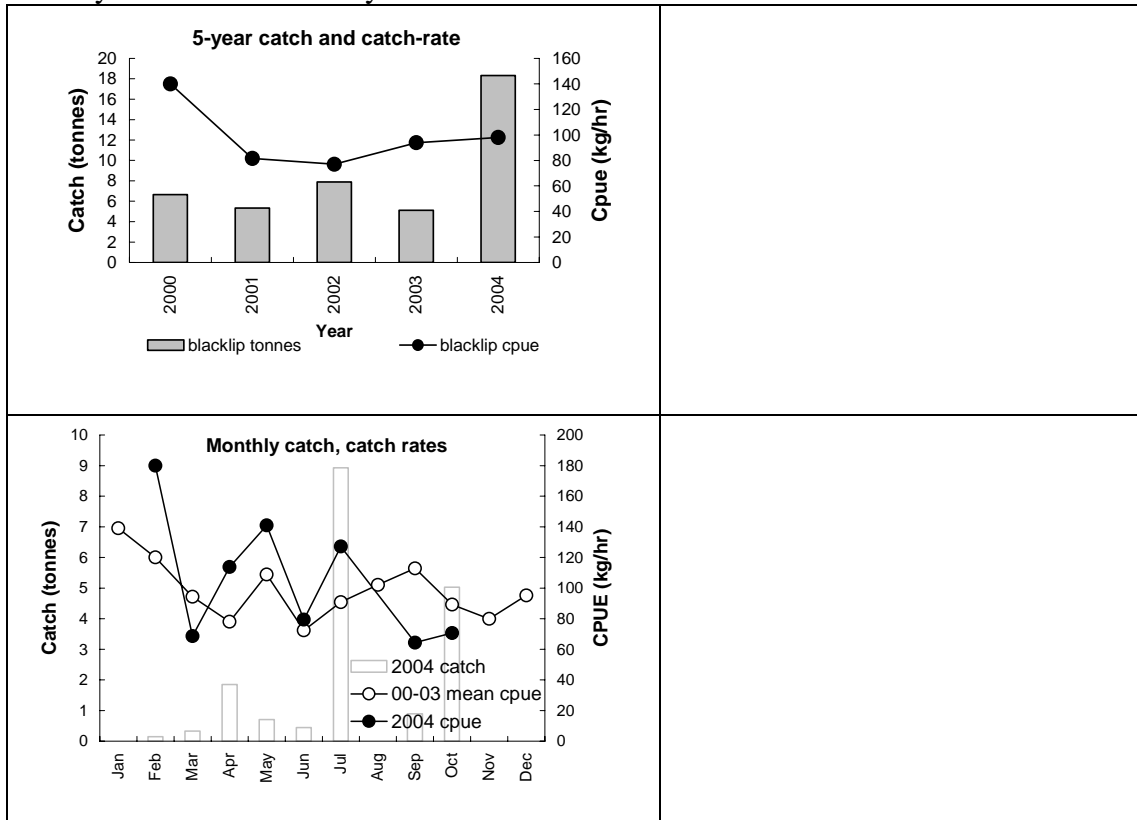
Sub-block 4A
Fraser Beach to Cumberland Light



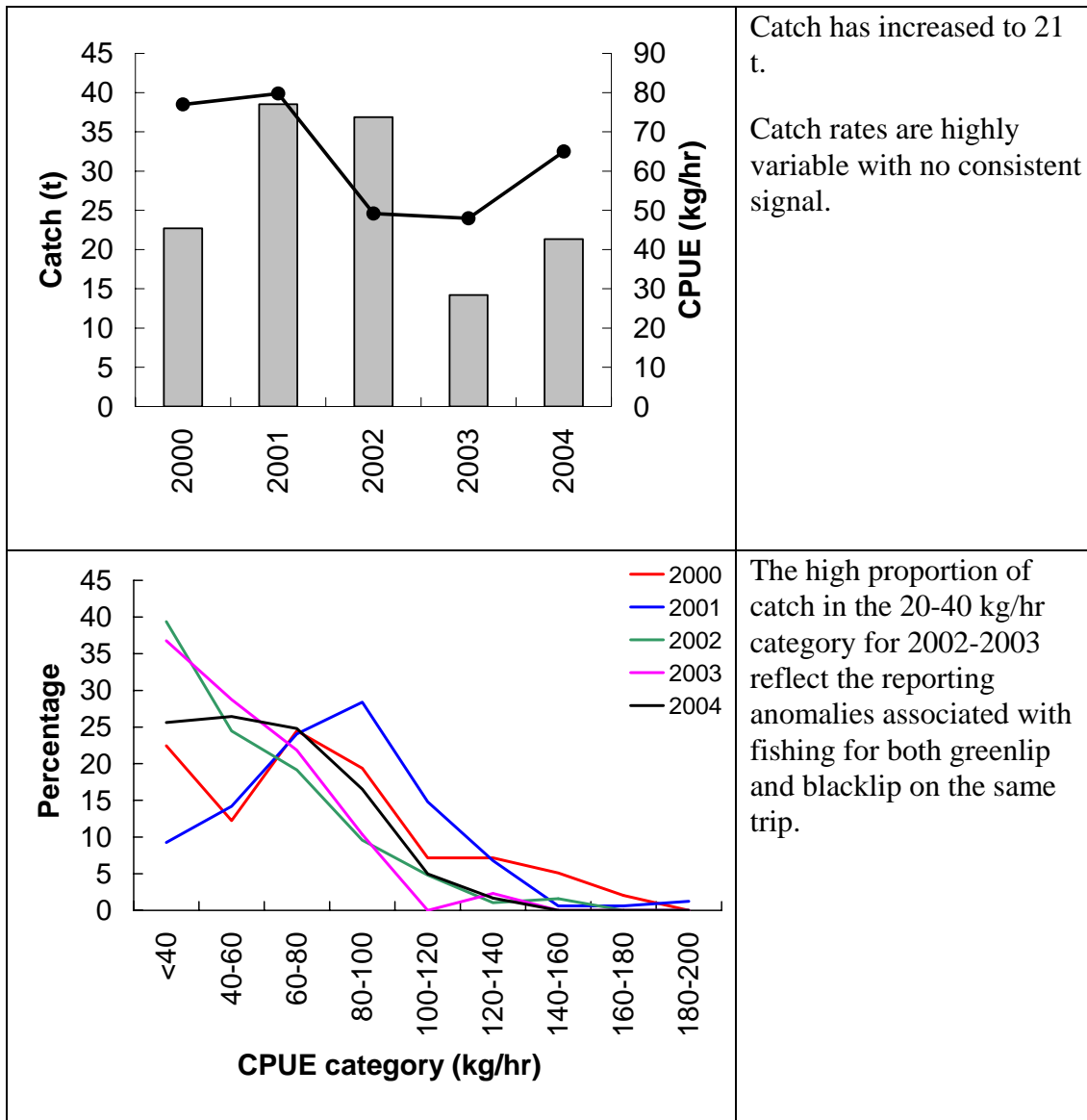
Sub-block 4B
Cumberland Light to Grassy Harbour



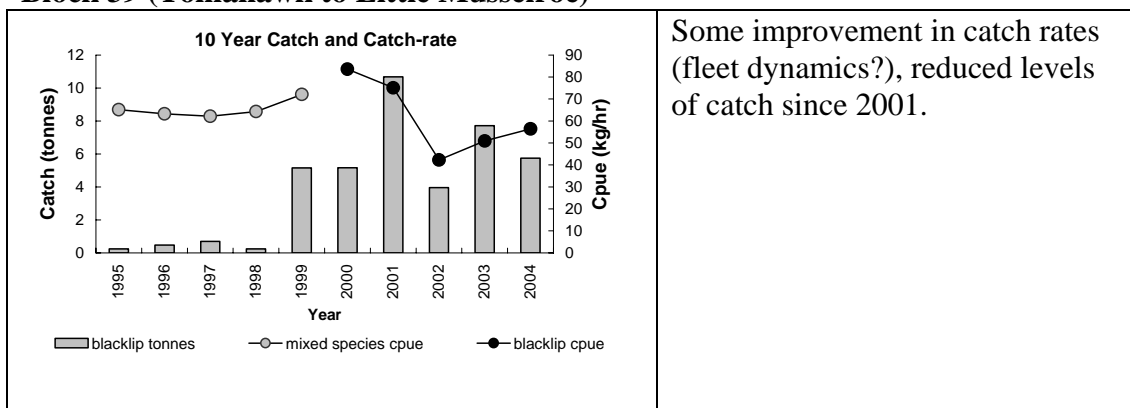
Sub-block 4C
Grassy Harbour to Seal Bay



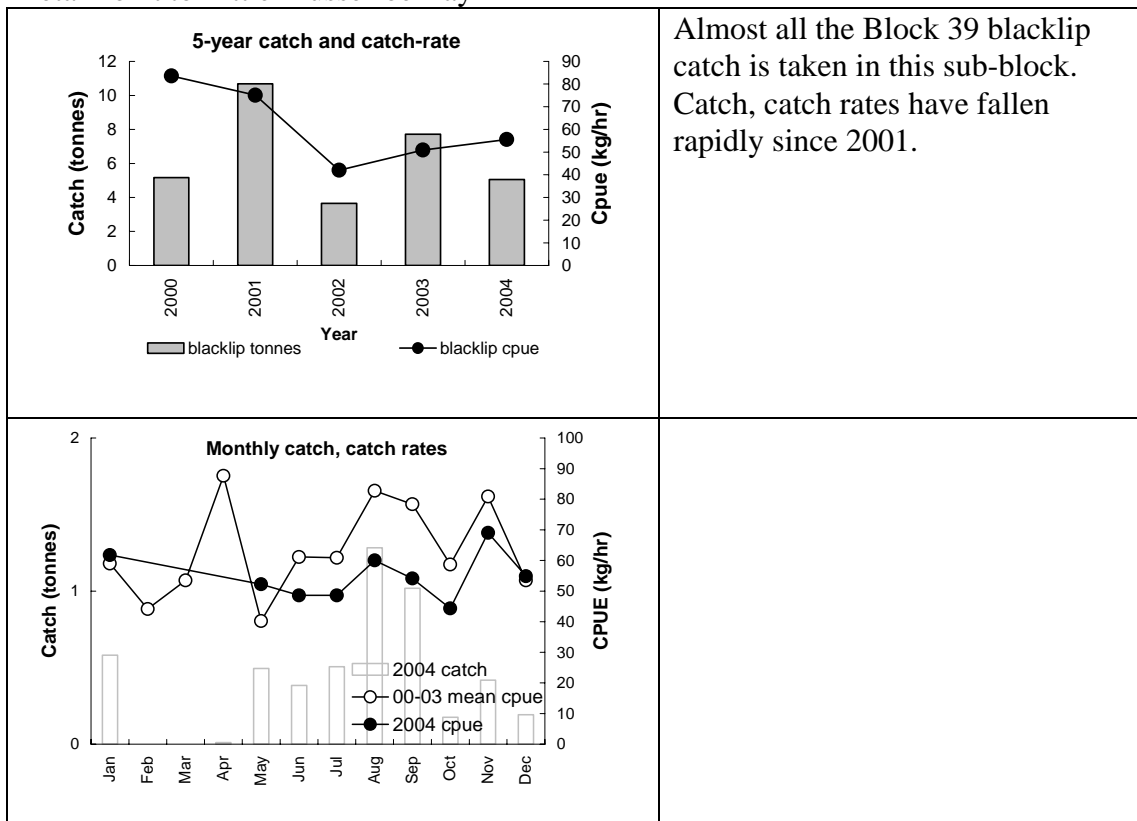
Northern Zone - North East (Sub-block 31B, Blocks 39, 40)



Block 39 (Tomahawk to Little Musselroe)

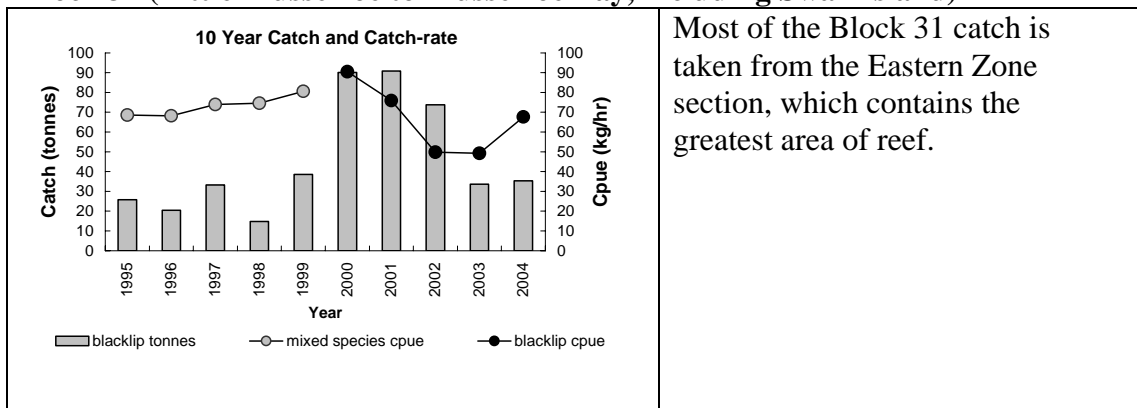


Sub-block 39A
 Petal Point to Little Musselroe Bay



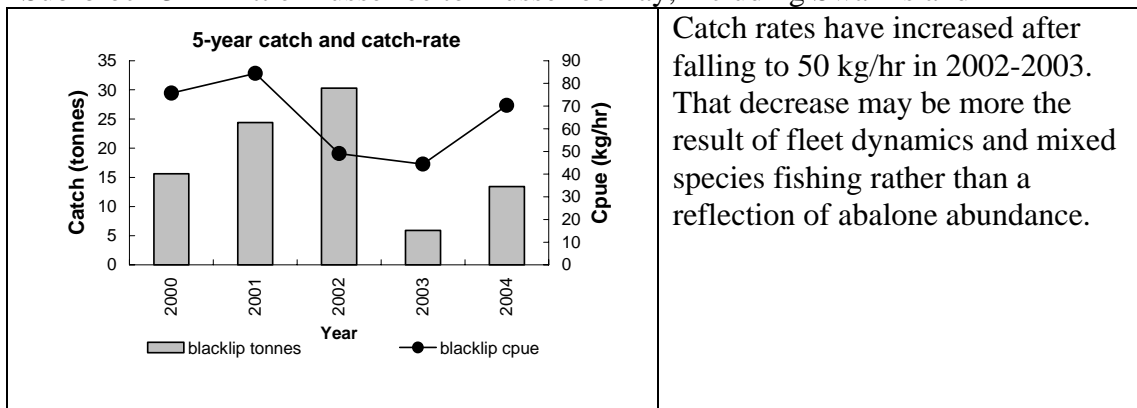
Almost all the Block 39 blacklip catch is taken in this sub-block. Catch, catch rates have fallen rapidly since 2001.

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

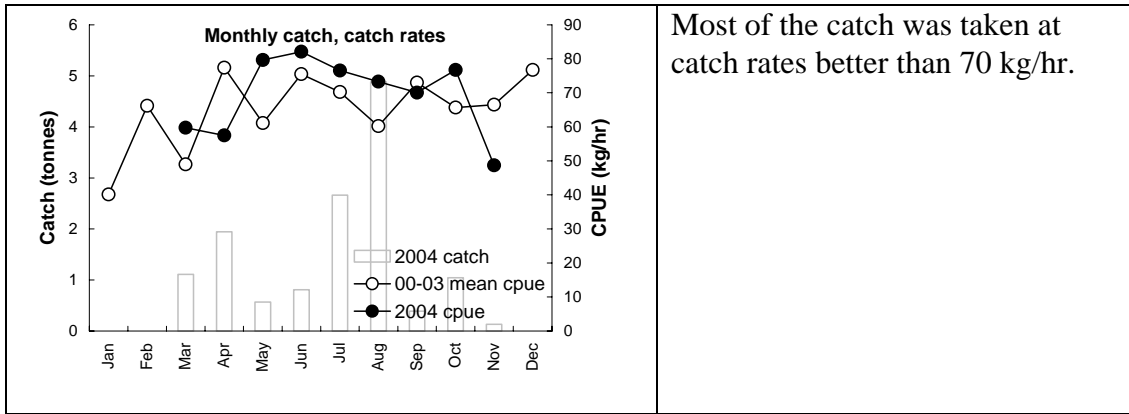


Most of the Block 31 catch is taken from the Eastern Zone section, which contains the greatest area of reef.

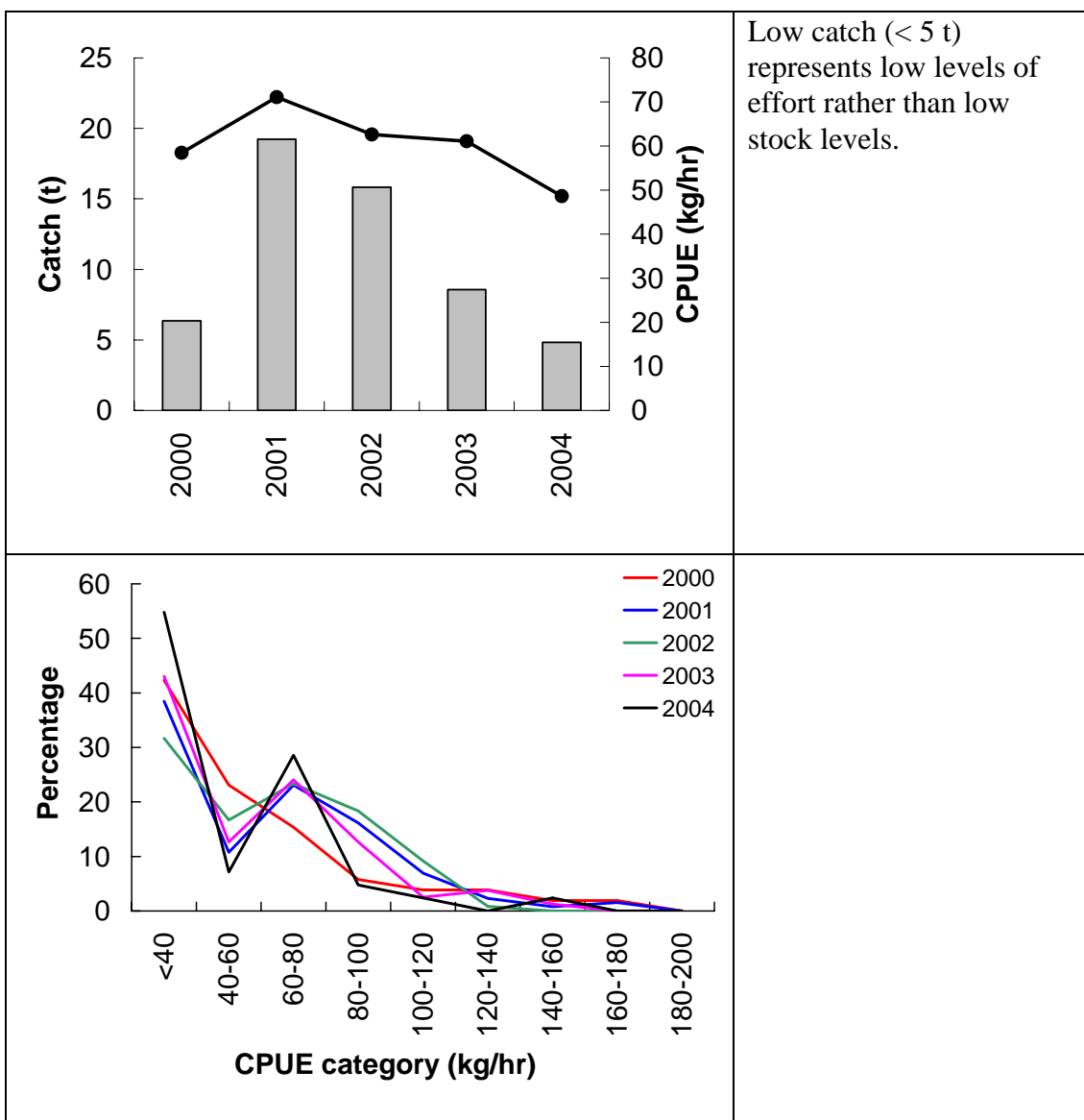
Sub-block 31B Little Musselroe to Musselroe Bay, including Swan Island



Catch rates have increased after falling to 50 kg/hr in 2002-2003. That decrease may be more the result of fleet dynamics and mixed species fishing rather than a reflection of abalone abundance.

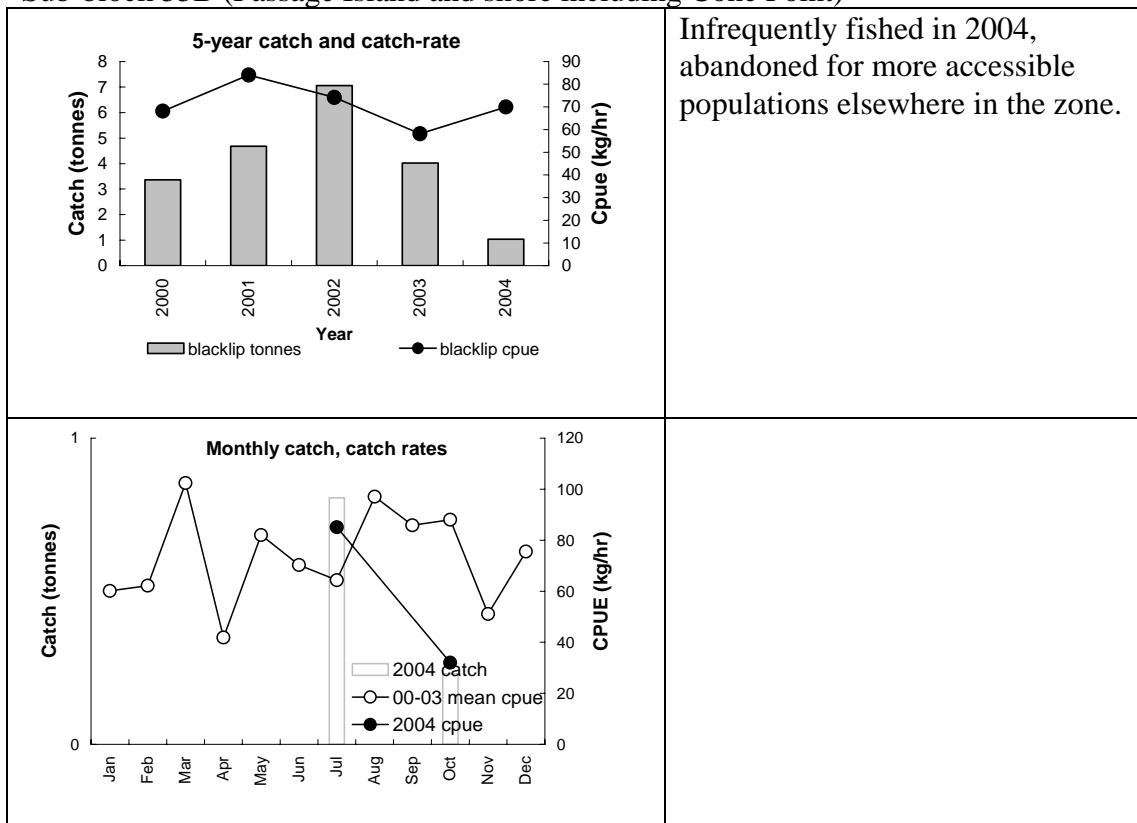


Northern Zone - Furneaux Group (Blocks 32-36, Sub-blocks 38A, 38B)



Block 33 (south-east Cape Barren Island)

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



Bass Strait Zone blacklip fishery – major fishing blocks

In the Bass Strait Zone, there were considerable variations in catch between 2003 and 2004. Notable were Blocks 53 (Hogan Group) and 54 (Moncouer Islands) where catches were increased, while catches fell in the Furneaux Group (Figure 9).

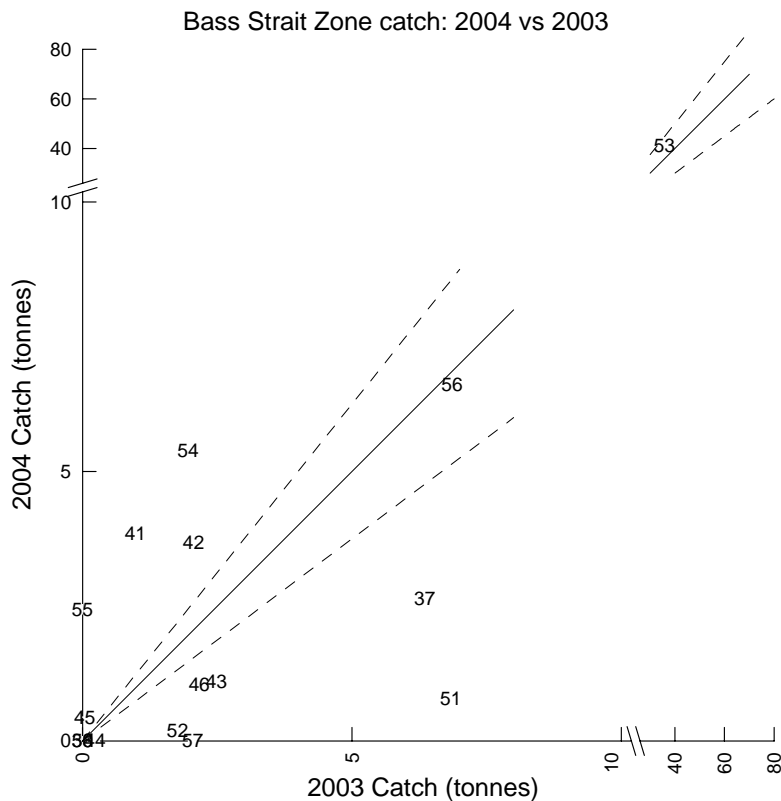
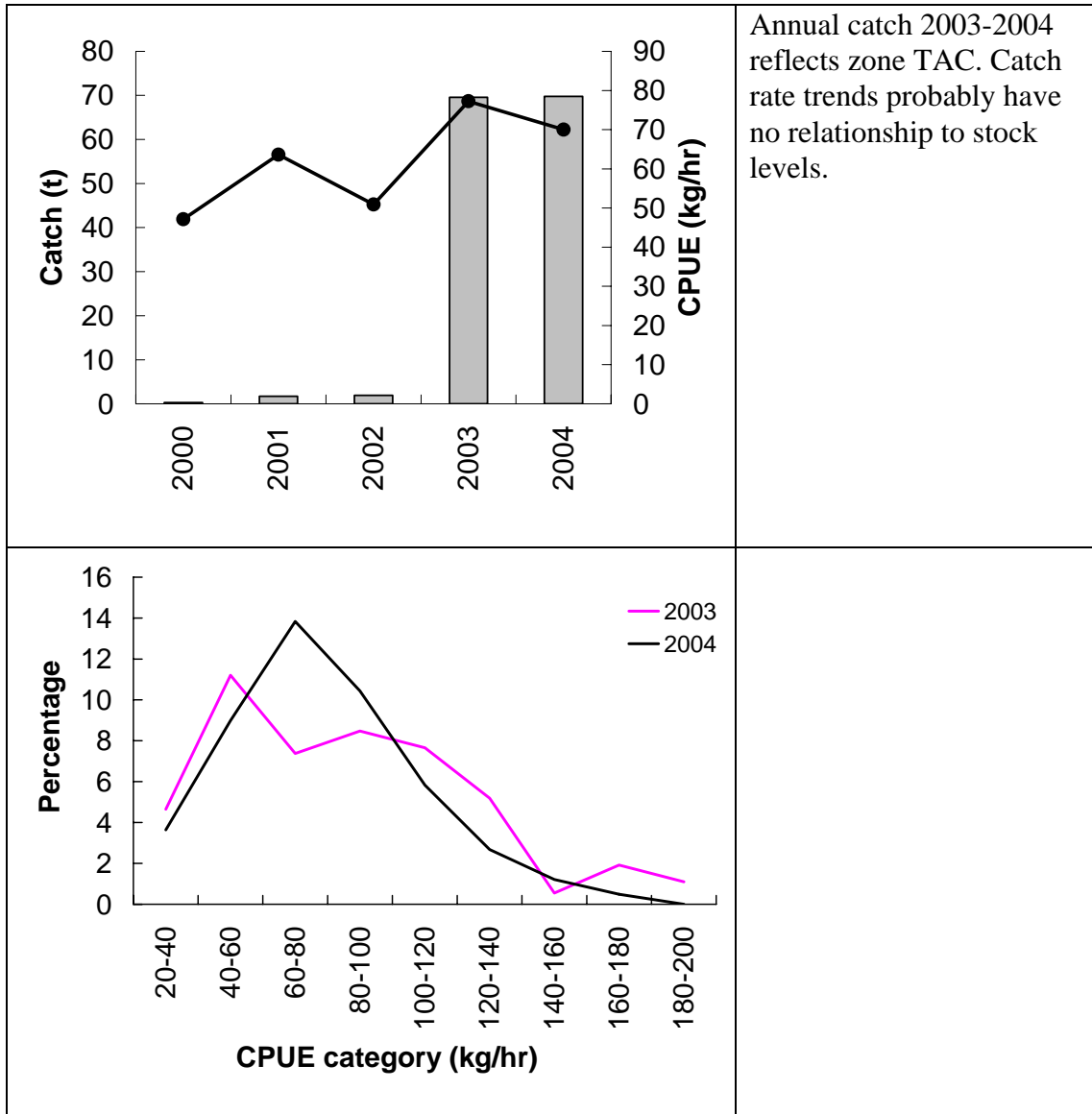
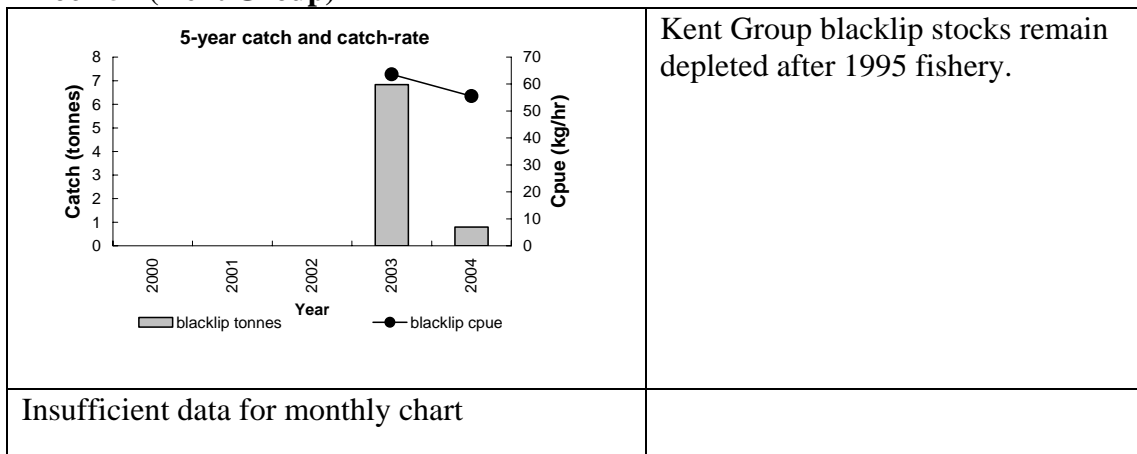


Figure 9. Blacklip catch from the Bass Strait Zone (Block 37, sub-blocks 38B and 38C, Blocks 41 to 46, and Blocks 50 to 57). In 2004, the Northern Zone TAC (70 tonnes) was unchanged from the previous year. Blocks to the left of the diagonal line reflect increased catches over 2003 levels, blocks to the right reflect falling catches. The dashed diagonal lines represent the position of catches 25% more or less than unchanged levels of catch.

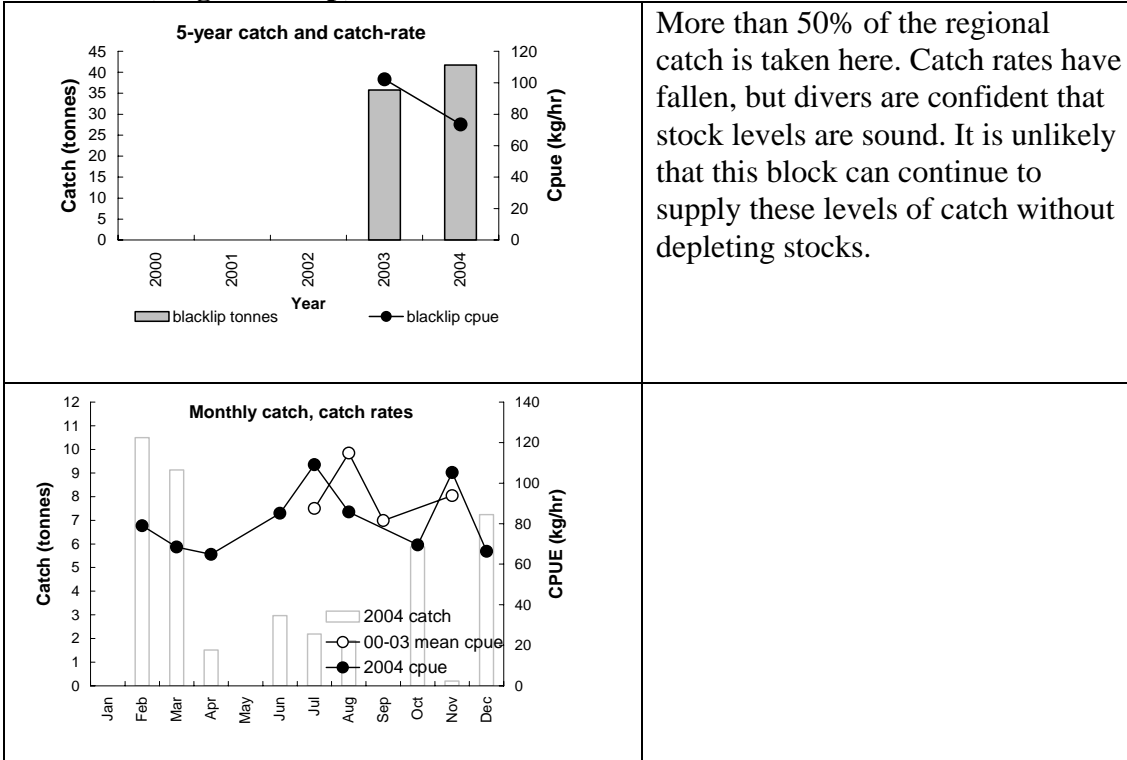
Bass Strait Zone (Sub-block 38C, Blocks 37, 41-46, 50-57)



Block 51 (Kent Group)

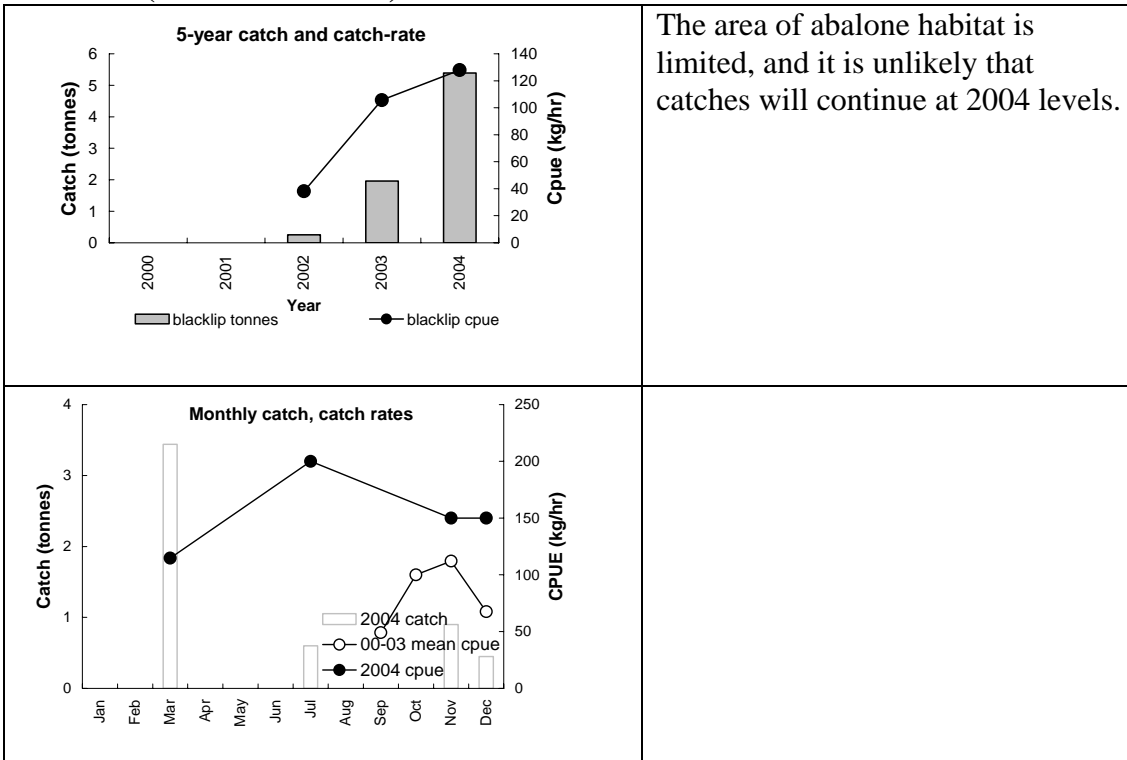


Block 53 (Hogan Group)



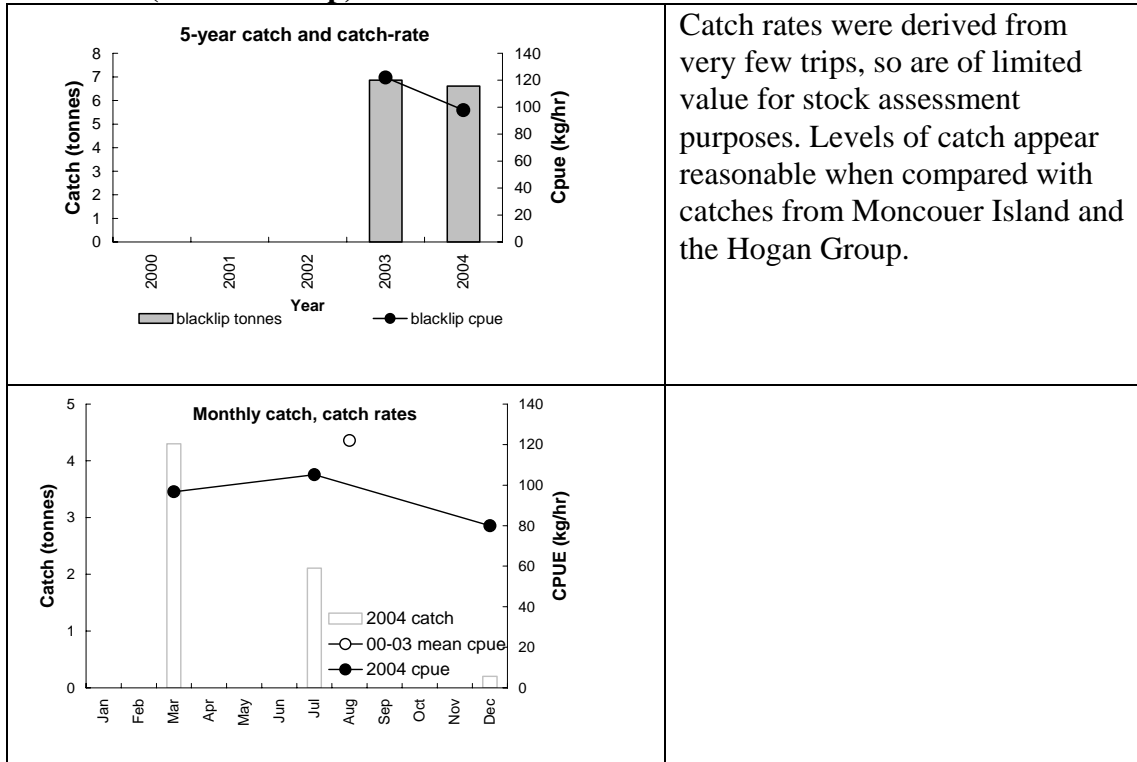
More than 50% of the regional catch is taken here. Catch rates have fallen, but divers are confident that stock levels are sound. It is unlikely that this block can continue to supply these levels of catch without depleting stocks.

Block 54 (Moncouer Island)



The area of abalone habitat is limited, and it is unlikely that catches will continue at 2004 levels.

Block 56 (Curtis Group)



Catch rates were derived from very few trips, so are of limited value for stock assessment purposes. Levels of catch appear reasonable when compared with catches from Moncouer Island and the Hogan Group.

Greenlip fishery – major fishing blocks

The reduced 2004 greenlip catch from Blocks 31, 33, and 49 was compensated by increased catches from Blocks 35, 38, and 39 (Figure 10).

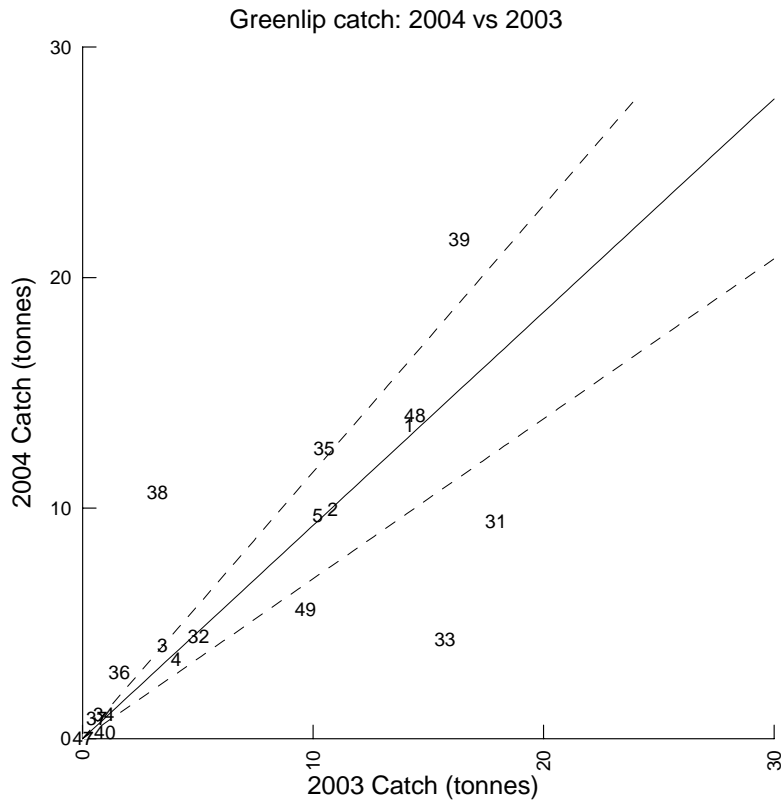
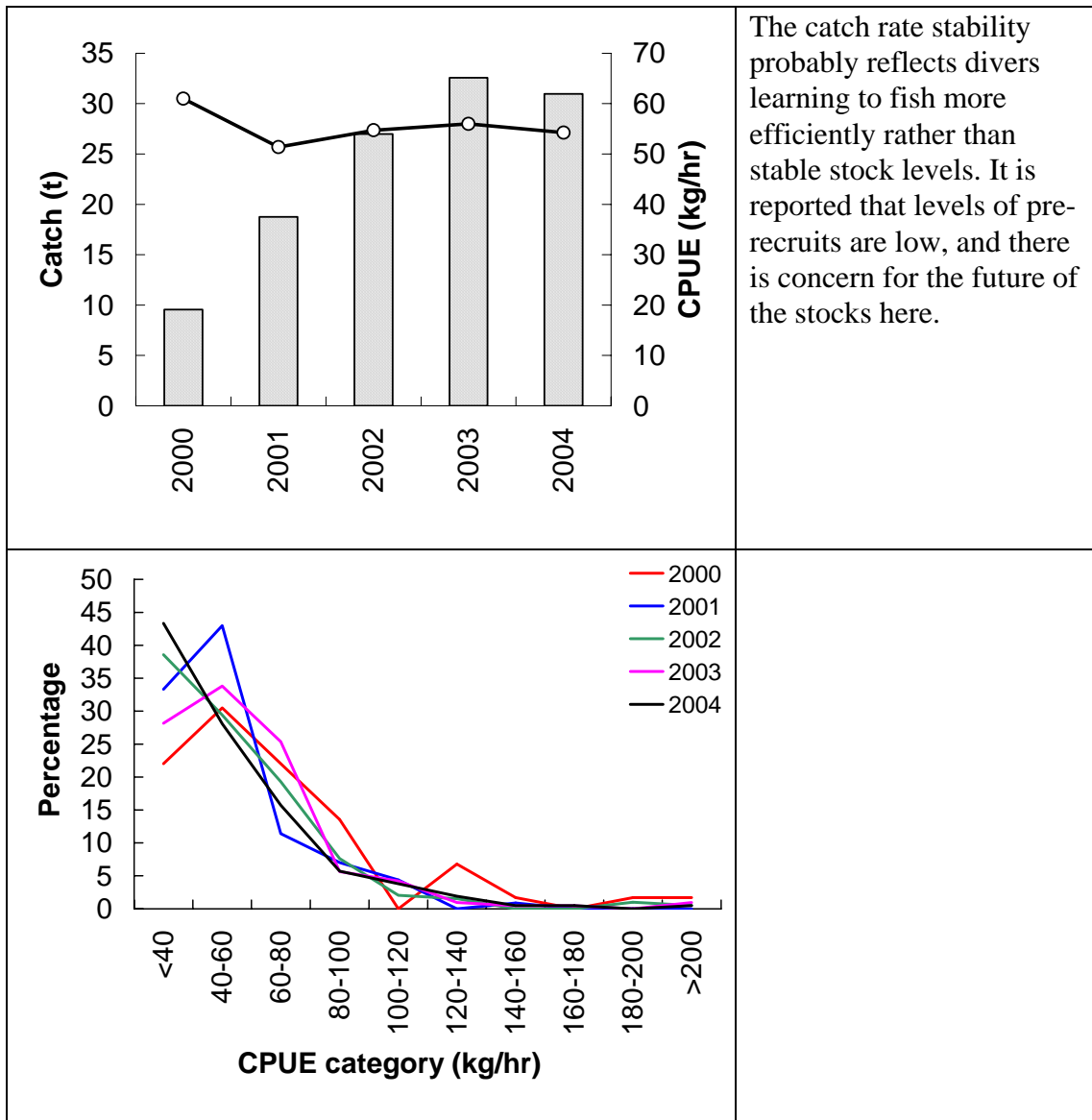


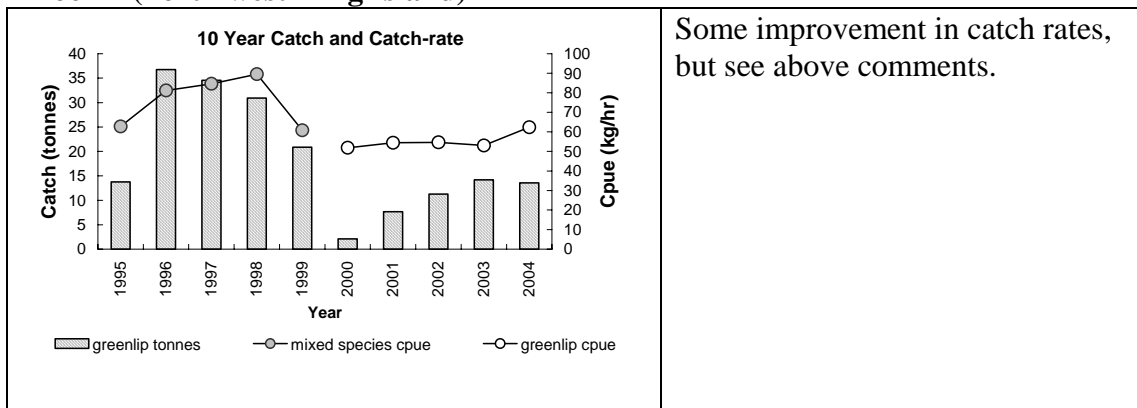
Figure 10. Greenlip catch from Blocks 1 to 49. In 2004, the Greenlip TAC (129.5 t) was reduced from the previous year (140 t). The solid diagonal line represents the position of catches if they were reduced in proportion to the TAC reduction. The dashed lines represent the position of catches 25% more or less than proportional TAC reduction.

Greenlip - King Island (Blocks 1-4)



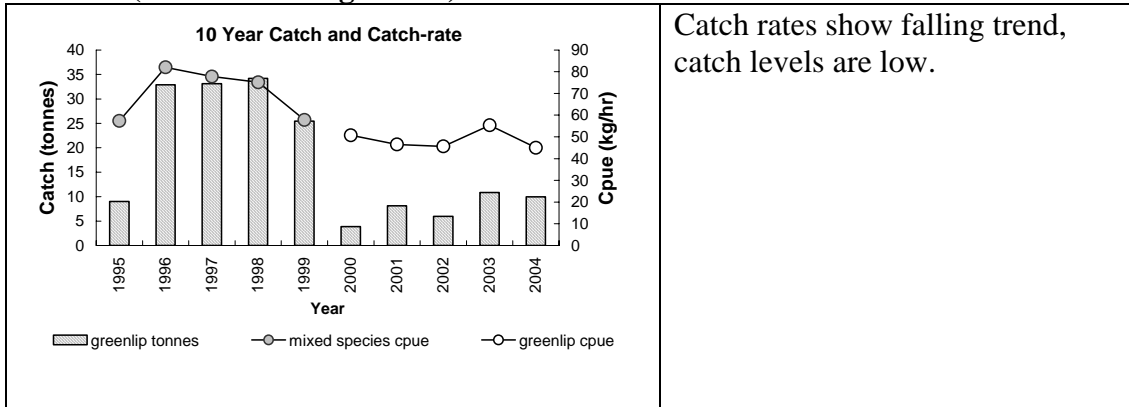
The catch rate stability probably reflects divers learning to fish more efficiently rather than stable stock levels. It is reported that levels of pre-recruits are low, and there is concern for the future of the stocks here.

Block 1 (north west King Island)

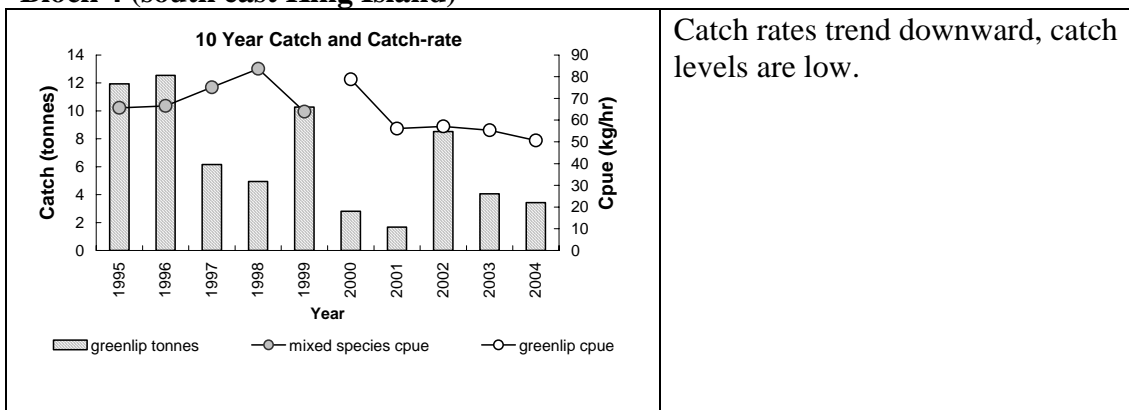


Some improvement in catch rates, but see above comments.

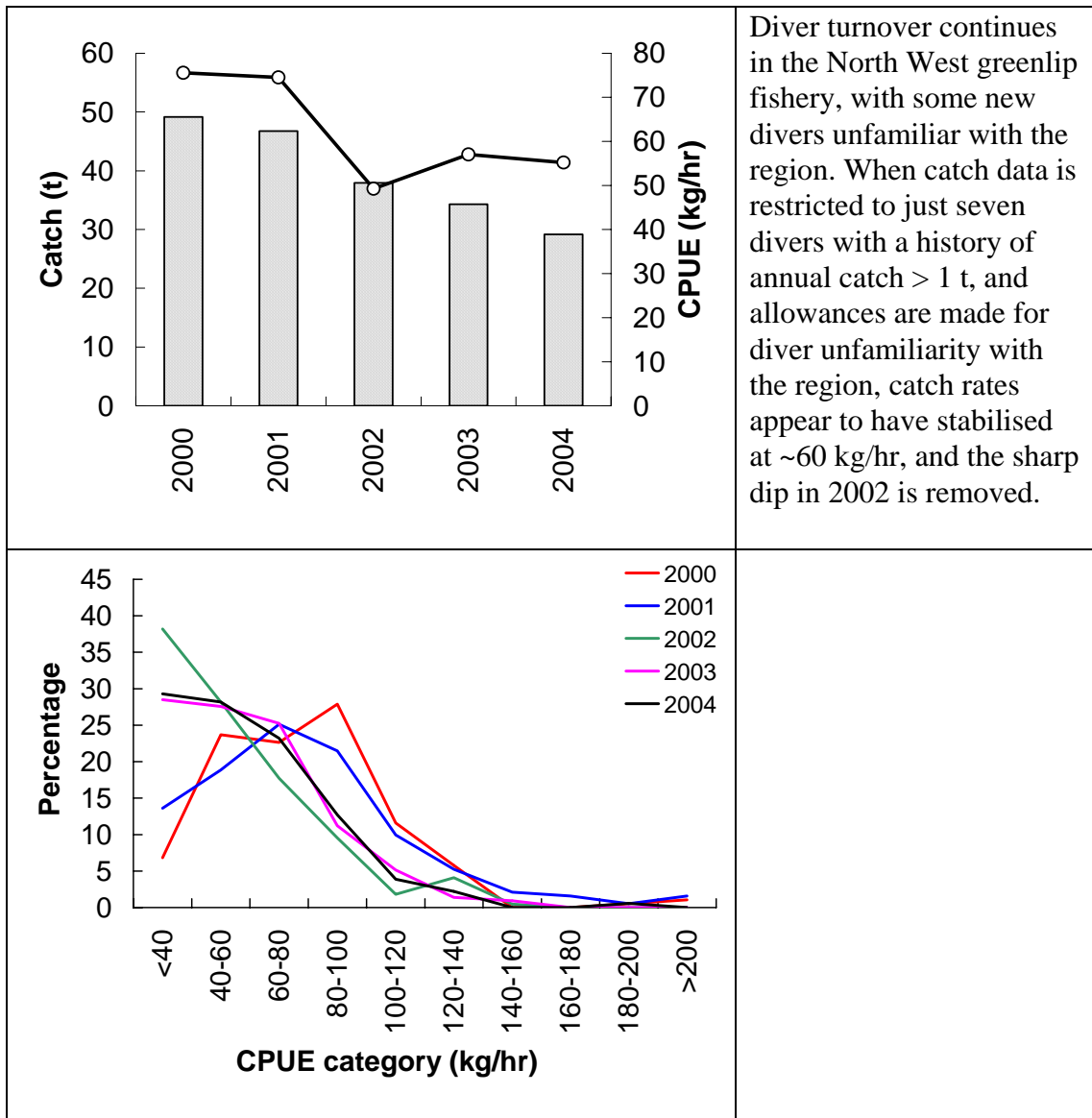
Block 2 (north east King Island)



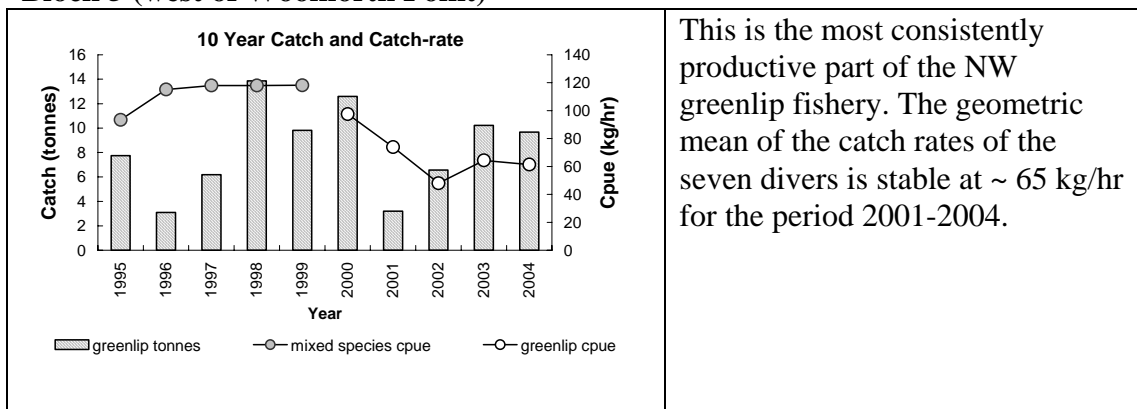
Block 4 (south east King Island)



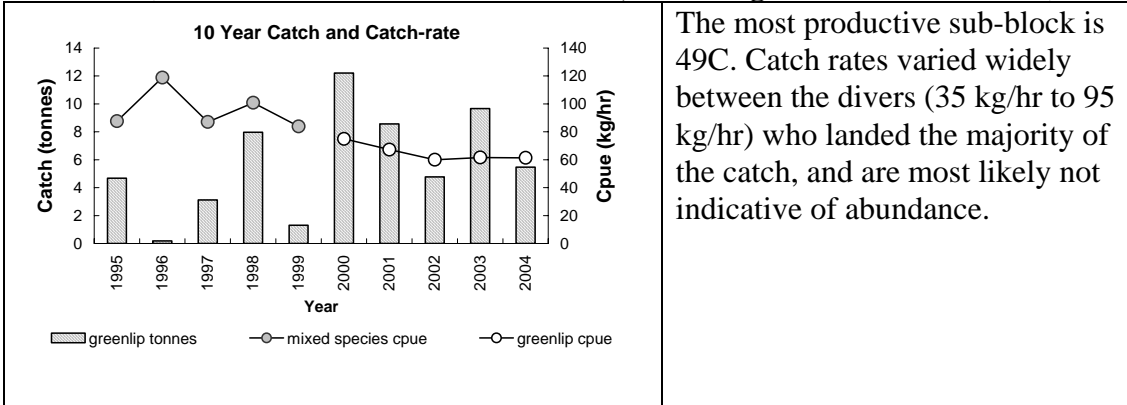
Greenlip - North West (Blocks 5, 47-48)



Block 5 (west of Woolnorth Point)

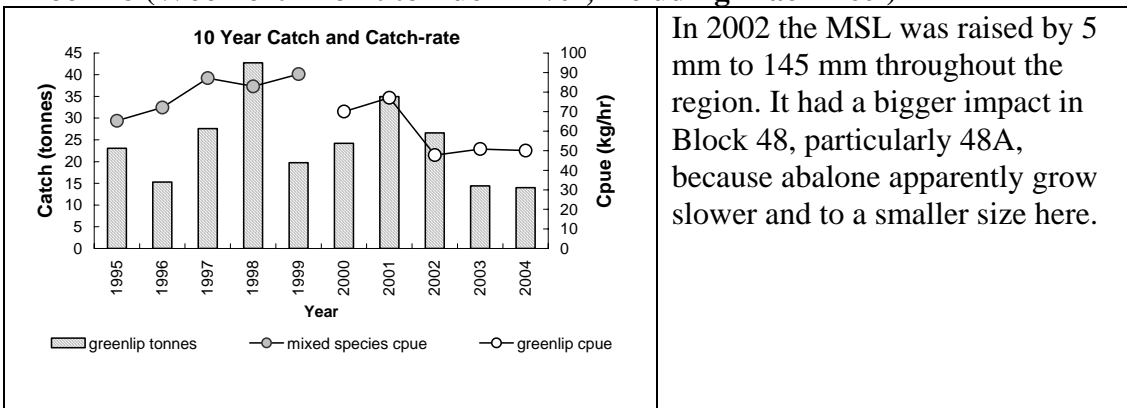


Block 49 (Woolnorth Point to Hunter Island, including Three Hummock Is.)



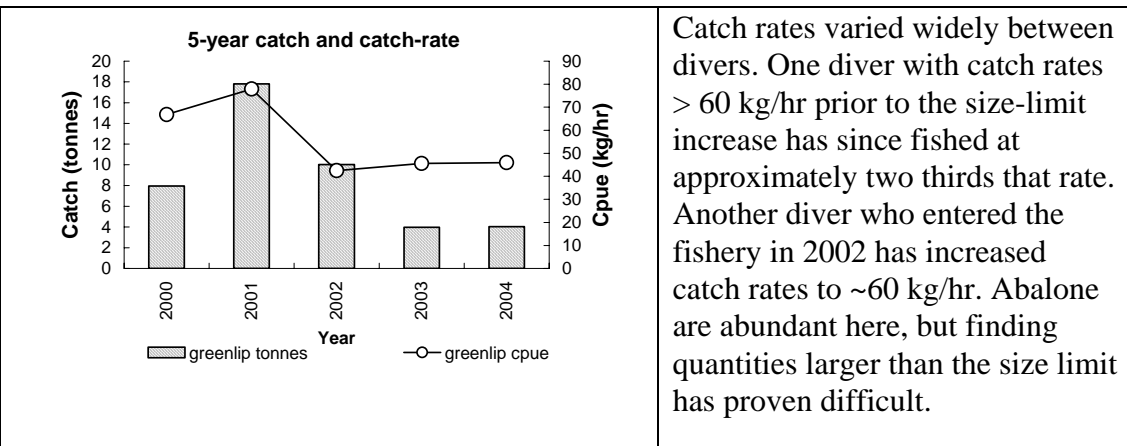
The most productive sub-block is 49C. Catch rates varied widely between the divers (35 kg/hr to 95 kg/hr) who landed the majority of the catch, and are most likely not indicative of abundance.

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



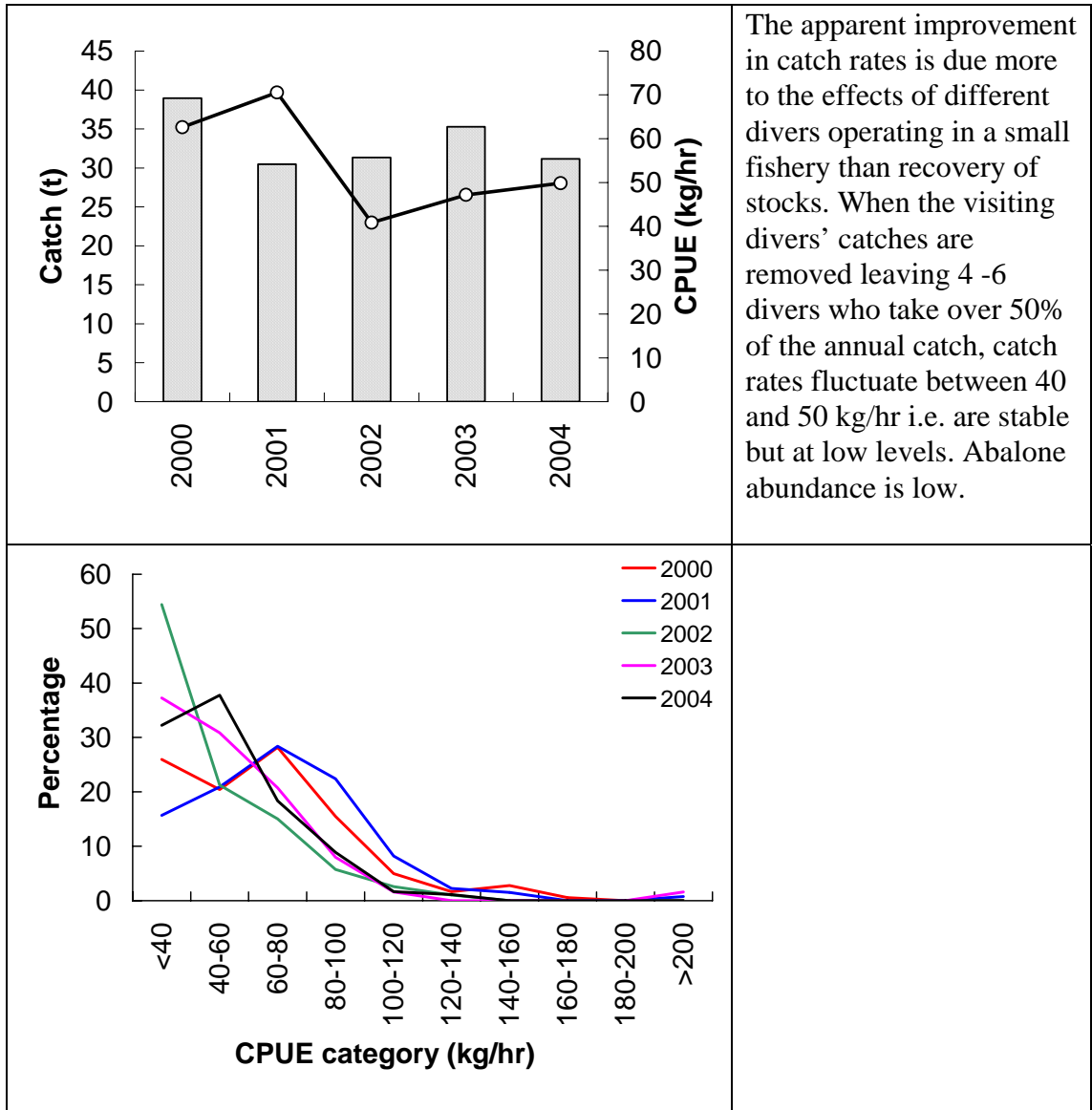
In 2002 the MSL was raised by 5 mm to 145 mm throughout the region. It had a bigger impact in Block 48, particularly 48A, because abalone apparently grow slower and to a smaller size here.

**Sub-block 48A
Black Reef**



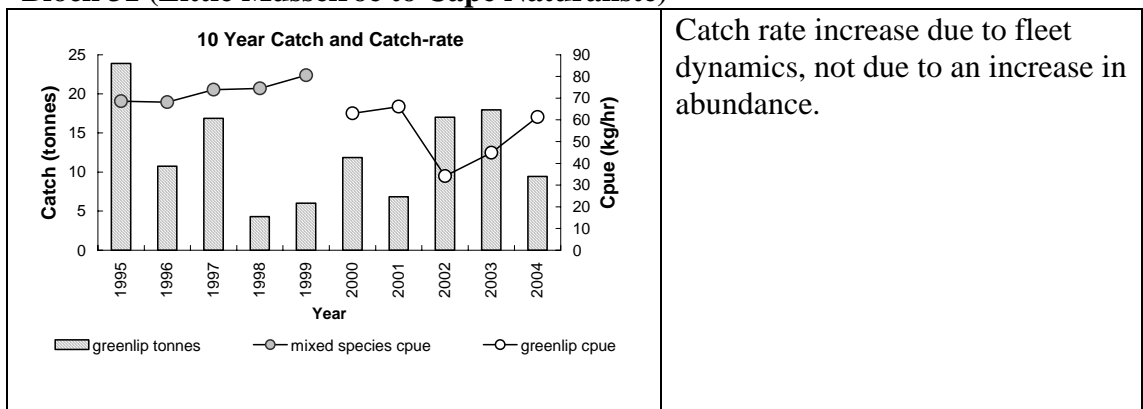
Catch rates varied widely between divers. One diver with catch rates > 60 kg/hr prior to the size-limit increase has since fished at approximately two thirds that rate. Another diver who entered the fishery in 2002 has increased catch rates to ~60 kg/hr. Abalone are abundant here, but finding quantities larger than the size limit has proven difficult.

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



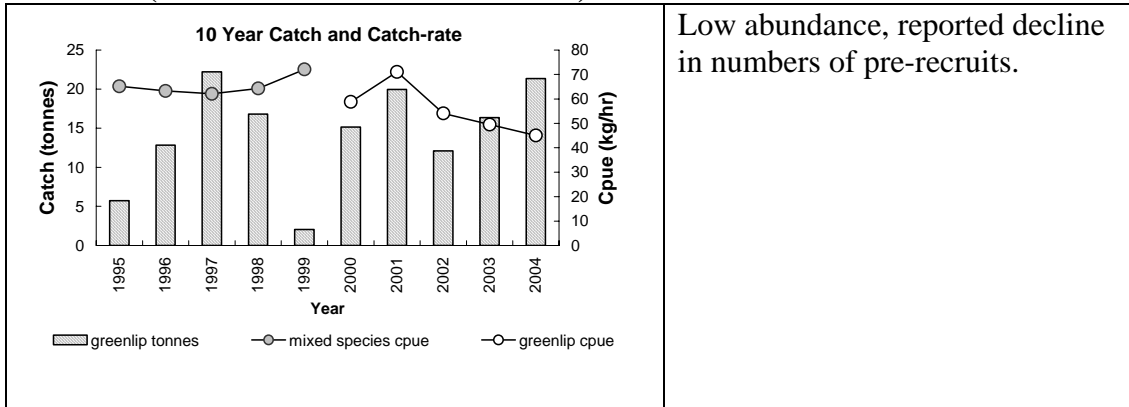
The apparent improvement in catch rates is due more to the effects of different divers operating in a small fishery than recovery of stocks. When the visiting divers' catches are removed leaving 4 -6 divers who take over 50% of the annual catch, catch rates fluctuate between 40 and 50 kg/hr i.e. are stable but at low levels. Abalone abundance is low.

Block 31 (Little Musselroe to Cape Naturaliste)

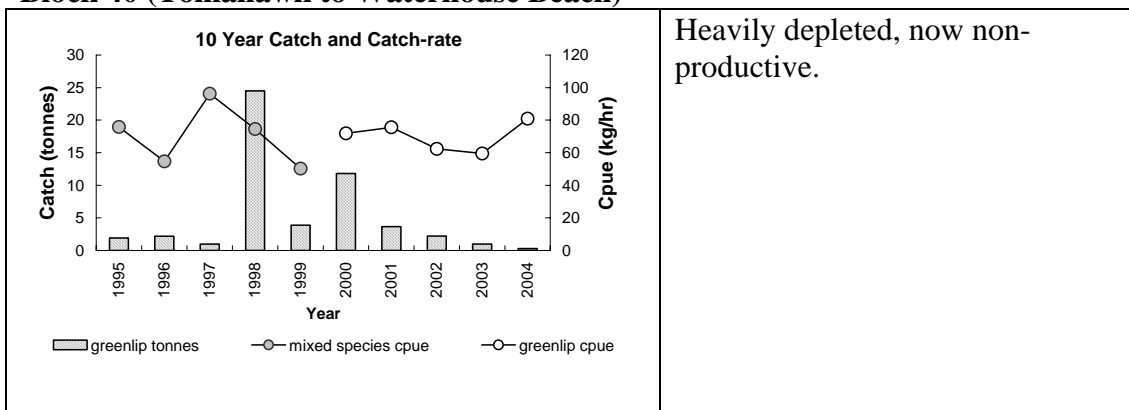


Catch rate increase due to fleet dynamics, not due to an increase in abundance.

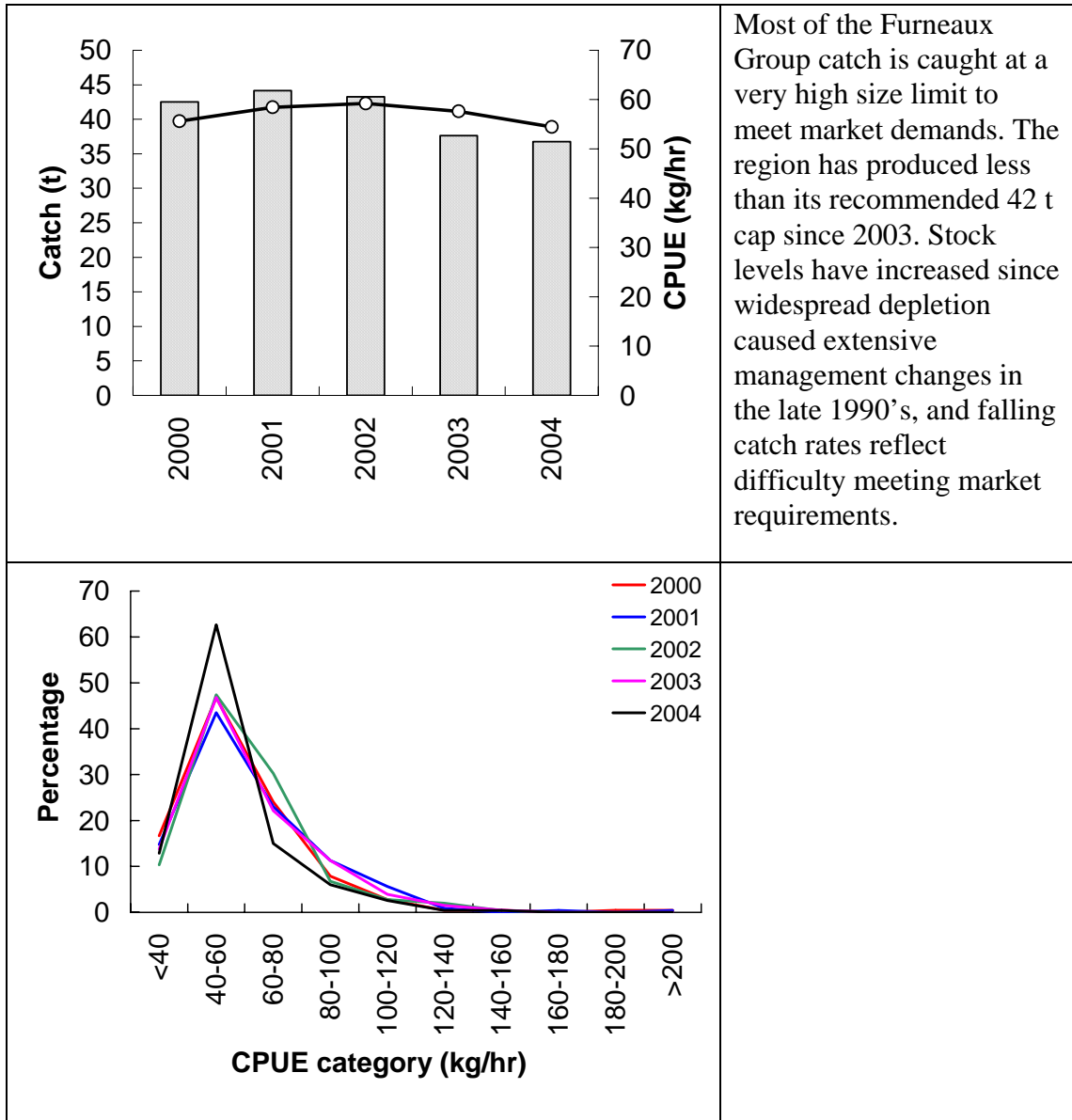
Block 39 (Little Musselroe to Tomahawk)



Block 40 (Tomahawk to Waterhouse Beach)

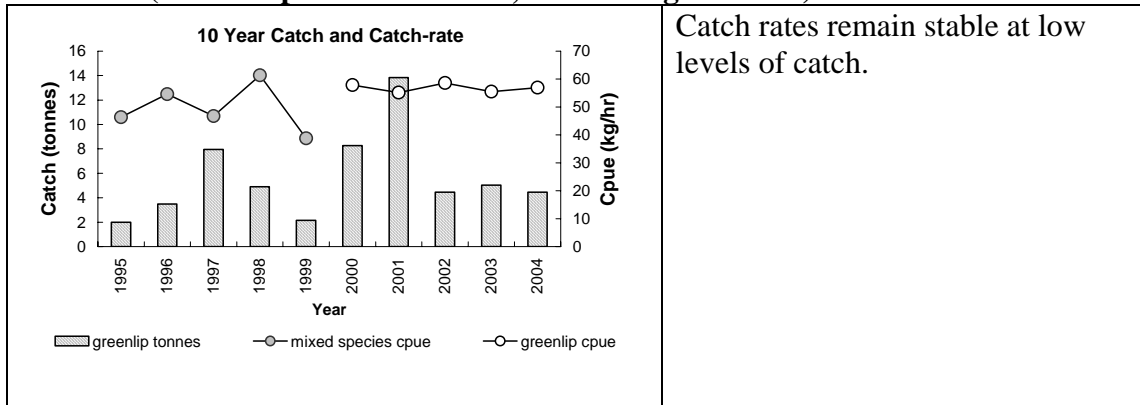


Greenlip - Furneaux Group (Blocks 32-38)



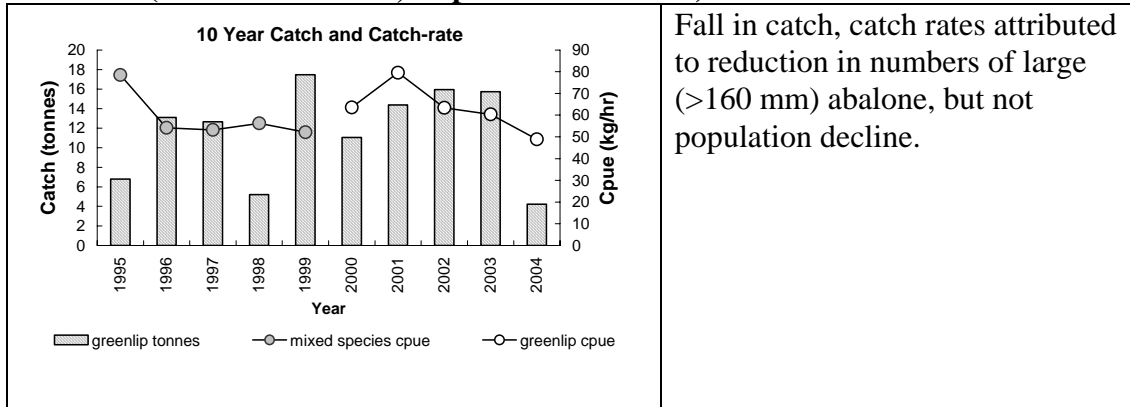
Most of the Furneaux Group catch is caught at a very high size limit to meet market demands. The region has produced less than its recommended 42 t cap since 2003. Stock levels have increased since widespread depletion caused extensive management changes in the late 1990's, and falling catch rates reflect difficulty meeting market requirements.

Block 32 (south Cape Barren Island, Armstrong Channel)

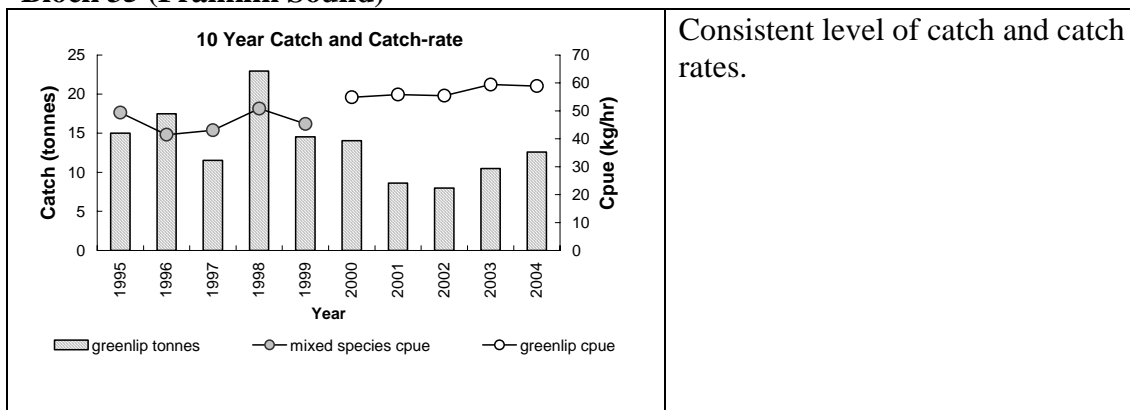


Catch rates remain stable at low levels of catch.

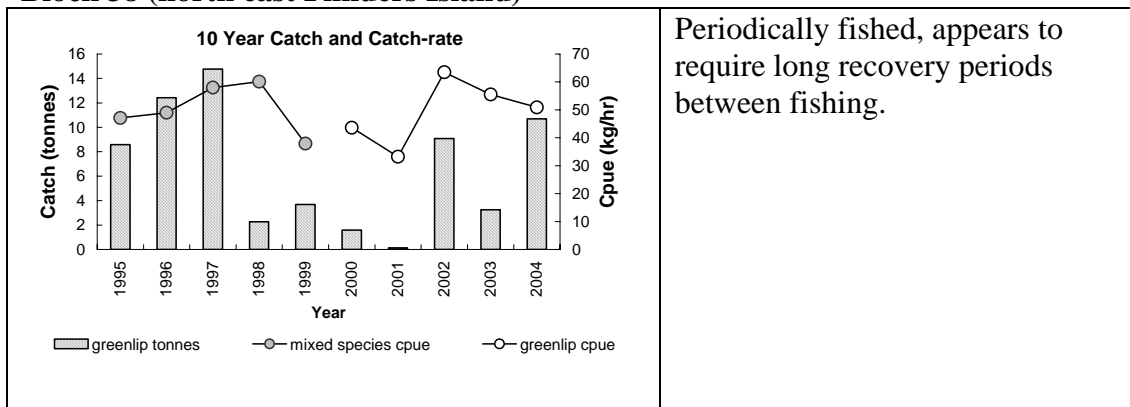
Block 33 (south east Clarke, Cape Barren Islands)



Block 35 (Franklin Sound)



Block 38 (north east Flinders Island)



5. Assessment of the Tasmanian abalone fishery

Eastern Zone

The 2004 Eastern Zone TAC was 770 t, a reduction of 87.5 t from 2003's 857.5 t. Most of the catch reduction occurred at the Actaeons, where the 2004 catch was down by 71 t (Figure 11). A smaller catch reduction (17 t) occurred at Bruny Island. These reductions are particularly welcome as there is little evidence of widespread stock recovery in either region.

Catch rates at the Actaeons, whilst stable since 2002, remain below 50 kg/hr. Of greater concern, abalone are being caught at progressively smaller sizes. The median size of abalone landed in most sub-blocks has trended downwards since the size-limit increase in 2002, and large abalone are almost entirely absent from catches. The implications of this are that the fishery is largely dependent upon recruits and hence vulnerable to inter-annual variation in recruitment, that egg production is reduced because of the small size of the abalone, and that more abalone must be caught per unit of quota. It is strong evidence for increasing levels of exploitation and that current levels of fishing are unsustainable. If recovery is to take place, catches need to be reduced to 2004 levels. This means that the 350 t cap applied to sub-blocks 13C, D and E in 2002 should be reduced to 220 t.

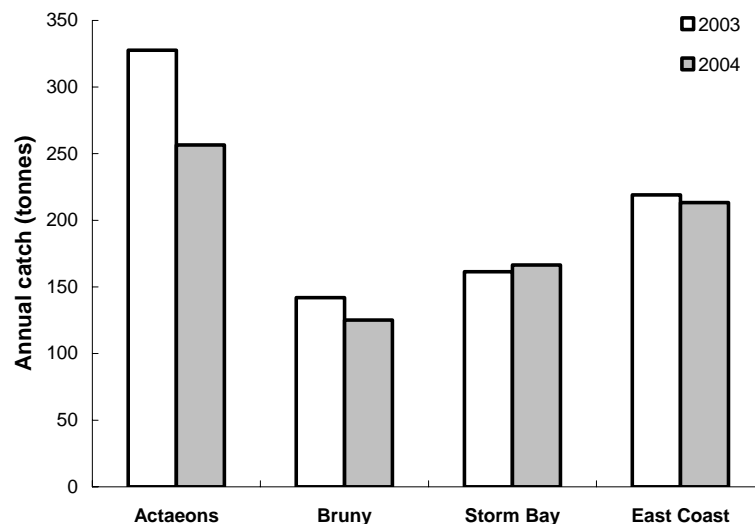


Figure 11. Comparison of the distribution of regional catch (tonnes) between 2003 and 2004.


Fishable stocks on the southern Bruny coast are also depleted. In 2004, catch rates remained at depressed levels (~50 kg/hr) in all areas except 14E, where they were improved. Again, the median size of abalone has trended smaller in recent years, and there is anecdotal information that the typically large south Bruny abalone are now uncommon.

In contrast, catch rates have improved for successive years on parts of Bruny's east coast, and the D'Entrecasteaux Channel (Block 15) produced significant catch for the first time in many years. The size of abalone sampled from the catch in sub-block 16B is trending downward, but considering the increased catch rates, this may be due to increased levels of recruitment rather than high levels of fishing mortality.

In Storm Bay, the stock recovery evident in 2003 continued, with increasing catch and catch rates. Divers reported large quantities of emergent but undersize abalone and said they were harvesting only a small portion of the population. The declining median size of abalone sampled from divers' catches confirms their perceptions, and in conjunction with increasing catch and catch rates may indicate that the fishery here is experiencing a strong influx of recruits. TAFI researchers have found that abalone from the eastern shore of Storm Bay become sexually mature at smaller sizes than other parts of the South East, and thus populations were afforded greater levels of protection after the increase in the size limit by 4 mm in 2002 (TAFI unpublished data). As a likely consequence, levels of egg production here may be relatively higher than other regions, which could account for the apparently greater levels of recruitment and higher abundance.

The 2004 East Coast annual catch was 213 t, the lowest since 1975. Catch rates continued to improve across much of the East Coast, particularly at Maria Island and the Freycinet Peninsula. While this improvement may primarily be due to the low level of catch in recent years, divers report seeing much greater levels of abundance, particularly of emergent abalone smaller than legal size, implying that populations are becoming larger. Market samples support greater stock levels: the increasing median size and 75th percentile of samples from several of the sub-blocks suggests falling exploitation rates i.e. the abundance of legal-sized abalone has increased faster than they were being removed (the harvest rate). In Block 31, the most remote part of the Eastern Zone, the winter 2004 catch rates were relatively high (70 to 90 kg/hr), attributable to both a low level of catch in recent years and population rebuilding. However south of Eaglehawk Neck (Block 22) the annual catch and catch rates remain at low levels and it seems that recovery here is slower than further north.

Western Zone

In the North West (Block 6), catch and catch rates have fallen sharply in recent years. The 2004 catch was 88 t, or approximately half the long-term average, and catch rates are at a 10-year low. Management of stocks in this region is complicated by the relatively large variation in growth rates between its southern and northern parts, and split size limits. Since 2003, when the size limit for the northern stocks was raised by 4 mm (from  mm to 136 mm),^[MH1] the catch in sub-block 6A (Temma to Sundown) has been greatly reduced and catch rates have fallen to between 80 and 100 kg/hr. If the new size limit was appropriate, abalone could be expected to grow the 4-mm difference within six months of its implementation. The present level of catch rates and low catch suggests that only isolated parts of the populations can now be viably fished at the current size limit, and that many divers have abandoned the coast north of Temma for easier fishing elsewhere. Further south in Block 6, catch and catch rates combined with anecdotal information indicate that fishable biomass is relatively low but stable.

Throughout the central part of the West Coast (Blocks 7 to 9), catch rates have fallen gradually in recent years. This is interpreted to mean that the large biomass that built up prior to the introduction of zoning is being steadily reduced, and implies that annual catches should not increase above current levels. In Blocks 7 and 8, recent (2003-2004) levels of catch have been particularly high, partly in response to processor requirements for optimal sized abalone for the live market or high meat yields for canners.

The South West (Blocks 10 and 11) continues to supply much of the Western Zone catch (~550 t in 2004). Like the Central West, catch rates have progressively fallen since 2000, which again is interpreted to mean that the built up biomass is being reduced. Across the South Coast (Blocks 12, 13A and 13B), catch rates have fallen much lower (under 100 kg/hr) and many daily catches are less than 300 kg. In both regions, abalone grow to sizes larger than suitable for current markets and consequently processors refuse to accept abalone greater than 160 mm (live market) or 170 mm (canners). This means that divers must leave large quantities of otherwise legal sized abalone, and fish the remaining stock of abalone between the legal size limit and the processors upper limit at much higher levels. It is reported that sections of coast where abalone commonly grow to unmarketable size are not fished, and that divers are severely depleting areas with smaller abalone. This greatly affects catch rates, because divers are forced to measure more abalone and selectively fish. It causes divers to serially deplete parts of the coast where there are marketable abalone. It also affects our ability to assess abalone stock levels with catch and catch rates.

The biological consequences of this selective fishing are that many more abalone are taken per unit of quota; that fewer abalone will survive until they reach the upper size limit; that egg production is greatly reduced; and that yield from the larger sized abalone that formerly contributed to the TAC has been removed. Effectively, the fishable biomass has been reduced in proportion to the weight of legal but unmarketable abalone divided by the weight of the legal-sized biomass, and the TAC is being taken from the remaining fraction of the biomass. This is plainly unsustainable and if the practice of selective fishing continues then steps will be required to reduce the harvest rate.

Northern Zone

During the early years of the Northern Zone, most fishing was concentrated on the more accessible areas of the North West (Blocks 5, 48 and 49). Despite the recent shift in effort to King Island, the areas close to Woolnorth Point remain depleted. In 2004, good catches were taken from remote islands in Block 49, but the area of productive reef is small and is unlikely to continue supplying abalone at those levels of catch. Further south in Block 5, catch rates have increased following a reduction in annual catch.

The annual catch from King Island has increased for four consecutive years and is now approximately 130 t, with 85 t being taken from Block 3. While historical catch data from Block 3 must be considered unreliable, only once (in 1977) has the reported annual catch been higher (87 t), so it is unlikely that current levels of catch can be sustained. Catch rates, while steady, are probably ineffective as indices of abundance here because effort is sporadic but highly focussed and locally intensive, and low-level

serial depletion is normal. Divers seldom return to the places where they took good catches, preferring to find unfished populations elsewhere.

The North East catch fell to 21 t in 2004. Catch rates increased and there are no indications that the current level of catch is unsustainable. The Furneaux Group provide even less catch (~5 t). These regions are minor contributors to the Northern Zone TAC. Assessment of stocks using catch rates is difficult and unreliable in these regions because few divers participate in these fisheries, and the effort of one or two divers who operate either quickly or slowly can have pronounced effects upon catch rates should they enter or leave the fishery.

Bass Strait Zone

Most of the catch was taken from the offshore islands in central Bass Strait. It is unlikely that catches from the Hogan Group can continue at current levels (i.e. > 35 t) without depleting stocks. It is disturbing that effort is not more widespread to areas such as the northern Furneaux Group, which consistently supplied much higher levels of catch during the limited opening fisheries between 1989 and 1995. The central northern coast of the Tasmanian mainland is lightly fished in comparison with 1989, when over 80 t was landed.

Catch rates were highly variable among island groups, ranging from 55 kg/hr at the Kent Group to 130 kg/hr at Moncouer Island. Better catch rates were achieved at areas with little or no earlier fishing, and in many respects, fishing patterns are similar to those at King Island making assessments that use catch rates unreliable.

Greenlip Fishery

In all four greenlip regions, most of the catch was taken by just a few divers. In these small fisheries, the entry or exit of a diver, or the improvement in fishing ability by learning (e.g. the continuing acquisition of knowledge of productive reef) or serial depletion can affect catch rates. Under these circumstances, catch rates trends may completely misrepresent changes in abundance, and we are forced to rely upon divers' reports about changes in stock levels.

At King Island it was reported that the annual catch (~30 t) is maintained only by fishing areas that have been rested, and that stocks here failed to recover after fishing. Of particular concern are reports from divers who fished King Island from motherships on consecutive years, and found that reefs in Block 1 that had produced quantities of greenlip remained depleted the following year. A separate issue that has affected catches and catch rates is that much of the island's populations do not grow to the bigger size limits set in 1998. The current 150 mm size limit was set following sampling at sites that held larger than average abalone, and therefore is too large for much of the island's stocks. This has increased the level of fishing mortality on the larger growing stocks, with adverse implications.

In the North West, catch rates were highly variable. The trend of mean catch rates of divers with significant levels of annual catch (>1 t) shows that the downward trend of recent years reversed in 2004 (Figure 12). These catch rates are probably more meaningful than the mean of catch rates from all divers, because the selected group of

divers has fished here for longer than the entire group, and thus catch rates are less likely to be affected by learning. It is assumed that the reduced local cap (now 30 t) is sustainable.

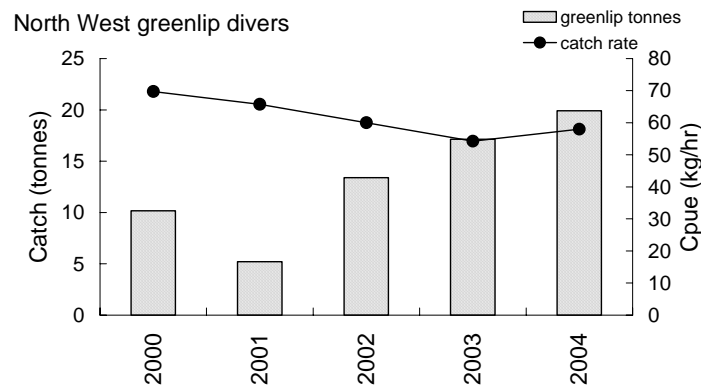


Figure 12. Catch and catch rates of divers with significant levels of greenlip catch (>1 t) in North West Tasmania. The low levels of catch in earlier years is not indicative of total catch for the region, but that the divers' participation was less in those years.

In the North East, it is reported that stock levels are low, and there is concern about lack of pre-recruits. As a precautionary measure, the 30 t regional cap was reduced by 7 t in 2005. In 2004, regional catch rates were affected by fleet dynamics in this small fishery and consequently are unreliable as indicators of abundance. Block 40 populations have not recovered from past fishing, and this block no longer produces significant levels of catch. Whether the 7 t reduction was sufficient is unknown, and we will require feedback from divers to successfully monitor this part of the fishery.

The 2004 Furneaux Group regional catch (37 t) was lower than that of previous years, and did not reach the regional cap (42 t). Catch rates in this fishery are falling and there is concern about the ability to supply markets with abalone of the preferred size range. However, this fishery is unusual, because to satisfy market demand, most abalone are caught at a size limit 15 mm larger than the minimum legal size. While abundance of these large abalone may be declining, smaller abalone are reported to be abundant.

6. Other fisheries

Recreational fishery

Recreational abalone fishing licenses are issued annually, expiring on 31st October each year. New licenses are available from 1st November. Most licenses are issued prior to Christmas, coinciding either with the opening of the rock lobster season in November or with the holiday period over Christmas. The number of recreational abalone licenses has increased by an average of 10% annually since the 1995-96 season (Figure 13). While the number of licenses fell slightly in 2003-04, it increased again for the most recent season, and by 15th April 2005, 9893 licenses had been issued.

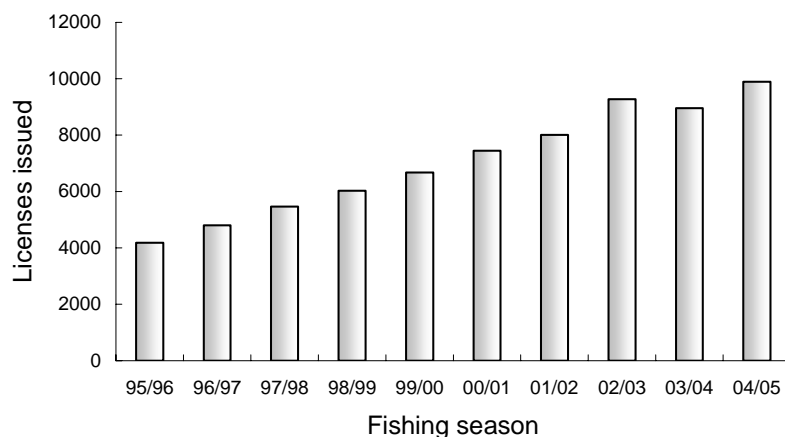


Figure 13. The number of recreational abalone diving licenses issued for the fishing seasons 1995-2004.

The annual recreational catch for the season 2002-03 when 9272 licenses were issued was estimated at 133,711 (95% CI: 112,469-160,451) abalone, or approximately 67 tonnes (Lyle and Morton, 2004). About 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, the recreational catch may seem insignificant, yet because it is taken mostly from the more accessible parts of the coast, and often from areas of the Eastern Zone which are heavily fished by the commercial fishery, it may cause localised depletion 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.

7. Conclusions

Eastern Zone

Actaeons

1. Despite a reduction in catch, and the stabilizing catch rate, the declines in the size distribution of commercial catches indicate that the fishing pressure in the Actaeons region remains too high.
2. Fishable stock levels are yet to recover.
3. In the absence of increased recruitment, further declines are possible.
4. The annual cap of 350 t for sub-blocks 13C, 13D and 13E should be reduced to 220 t.

Bruny Island

1. Stock levels in the southern areas appeared to be either stable at low levels or continuing to fall.
2. Stocks in the east are either recovering slightly or are stable.

Storm Bay

The level of catch and catch rates are increasing, which together are indicative of a continuing recovery. The falling median size of captured abalone may be caused by increasing numbers of recruits in this region.

East Coast

1. There is evidence of some stock recovery in most areas within this region, the exception being Block 22.
2. Current catch levels appear sustainable.

Western Zone

North West

Catches and catch rates suggest that fishable biomass is relatively low but presently stable.

Central West

While falling catch rates are of concern, there is no evidence that current fishing levels are unsustainable in the short term (two-three years).

South West

1. Although catch and catch rates are presently high, the fact that catch rates have generally trended downwards in recent years causes concern.
2. The practise of grading catches (fishing to an upper size limit) reduces the value of CPUE-based assessment on the legal-sized stock. However, catch rate trends clearly indicate that the abundance of stocks within the targeted size-range is falling.
3. Catching the TAC from within a limited size-range exposes the acceptable size-range to greatly increased harvest rates. These appear to be unsustainable and stock levels are expected to decline.

South Coast

1. Catch rates have generally trended downwards in recent years, consistent with a decline in fished stock levels.
2. The practise of grading catches (fishing to an upper size limit) reduces the value of CPUE-based assessment on the legal-sized stock.
3. Catching the TAC from within a limited size-range exposes the acceptable size-range to greatly increased harvest rates. These appear to be unsustainable and stock levels are expected to decline.

Northern Zone

North West

This region is unlikely to support an increased catch.

King Island

1. High catch and catch rate on King Island are sustained by the fish down of accumulated stocks. Catch rates are not reliable indicators of abundance in these circumstances.
2. Continued rapid expansion of catches, and maintenance of current catch and catch rates in the long term is unlikely to be sustainable based on experience elsewhere in the blacklip fishery.

North East

There are no indications that current levels of catch are unsustainable.

Furneaux Group

Although it is recognised that blacklip production in the Northern Zone part of this region has always been quite limited, it could probably support greater levels of catch.

Bass Strait Zone

1. If catches continue to be focused on a small number of areas, the risk of serial depletion and consequent long term damage is high.
2. Catch and catch rates in Block 53 (Hogan Group) require monitoring.

Greenlip Fishery

King Island

Catches should not be increased and size limits should be reviewed.

North West

Current levels of catch (< 30 t) appear sustainable.

North East

Although the 2005 regional cap has been reduced by 7 t, the performance of the fishery in this region will require careful monitoring if long term damage to populations is to be avoided.

Furneaux Group

While catch rates may continue to fall as divers fish to the market size limit, current levels of catch appear sustainable.

8. Recommendations for managers

This assessment is based primarily on commercial catch-effort and size-composition data from the Tasmanian abalone fishery. While size-composition data is used to confirm catch-rate trends, 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 most southern parts of the **Eastern Zone**, stocks continue to be at low levels. For many years, the greatest proportion of the catch has been taken at the Actaeons, where catch rates have remained low, and the median size of abalone is falling. This indicates that despite a large reduction in catch, the fishing pressure on stocks has not been reduced, and it is recommended that the catch for sub-blocks 13C, 13D and 13E should be limited to the level of the 2004 catch (220 t) until there are clear indications that stock levels are increasing. The adjacent Block 14 has also been adversely affected by high and constant fishing pressure and managers should curtail any transfer of effort from the Actaeons to South Bruny. In most of the remaining parts of the Eastern Zone there are strong indications that stocks are continuing to recover, and while catch rates are yet to reach the levels of the previous decade, this part of the fishery appears more robust. However, without more sophisticated stock monitoring and an accepted stock

rebuilding strategy, we would be concerned to see a significant increase in levels of catch taken from these areas.

Throughout the **Western Zone**, catch rates have fallen continuously since the later part of the last decade, albeit from high levels. While it is acknowledged that stocks that expanded prior to zoning could not be expected to survive current levels of catch, and that some level of overfishing is acceptable in these circumstances, managers must determine levels of catch rates where it would be prudent to limit catches. It is frequently said that weather conditions protect stocks on the West Coast, but at current levels of TAC, this protection may be inadequate. We are concerned with stocks levels in Block 6, Block 7, Block 12 and Block 13 and recommend that the performance of the fishery here be reviewed mid-year. Additionally, we recommend that appropriate levels of catch be set for each block so that catch rates can be sustained at reasonable levels instead of falling continuously. The TAC should then be set at the sum of the catches for all blocks. If we use the long term geometric mean catch for each of the Western Zone blocks (with the top and bottom 3% of catches removed), then the Western Zone TAC should be set at 1004 tonnes, which is 256 tonnes lower than the current TAC.

A more significant threat to Western Zone stocks, particularly in the South West and South Coast is selective fishing for smaller abalone in the size range of 140 – 160mm. In these areas, abalone grow to larger sizes than can be easily marketed. Significant quantities of large but otherwise legal abalone are left by divers because processors will not take them. This means that divers must fish the remaining stock of abalone between the legal size limit and the processors' upper limit at much higher levels. Consequently, fewer abalone will survive fishing and stocks will be depleted at far greater rates than caused by the current level of overfishing. It is recommended that managers either reduce the TAC by the proportion of un-marketable large abalone, or devise ways that the large abalone will become part of the fishable stock once more.

In the **Northern Zone**, effort continues to be transferred from the North West to King Island, where, in recent years the fishery has been relatively under-exploited. King Island is probably now producing blacklip at or beyond maximum capacity. Some of the island's stocks have failed to produce worthwhile catches 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.

Also at King Island, it is reported that the recently increased size limit for **Greenlip** abalone is now too high for much of the island's populations, and that stocks that were once heavily fished are no longer able to supply commercially viable levels of catch. It is strongly recommended that managers review catch and size limits on King Island, and in conjunction with researchers, explore methods for making slower or smaller growing stocks available to the fishery once more.

We are concerned with the high proportion of **Bass Strait Zone** catch taken in the Hogan Group, and the subsequent rapid decline in catch rates there. We recommend that managers reduce the level of catch here, and find ways of transferring effort to the

relatively unexploited stocks of the central north coast of the Tasmanian mainland. This may require a review of the size limit for the mainland portion of this fishery.

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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 2005 the Abalone Stock Assessment Group included the following people:

Mr Berkeley Dilworth	Chairman, Diver Sub-Council
Assoc Prof Malcolm Haddon	Wild Fishery Stock Assessment Group, TAFI
Mr Allen Hansen	Tasmanian Abalone Council
Mr John Hayes	Divers' Representative, Tasmanian Abalone Council
Mr John Hoult	Executive Member, Tasmanian Abalone Council
Mr Roger King	Tasmanian Abalone Council
Mr Dean Lisson	President, Tasmanian Abalone Council
Mr Paddy Maguire	Tasmanian Abalone Council
Dr Craig Mundy	Abalone Resource Assessment, TAFI
Mr Andrew Sharman	Principal Fisheries Management Officer, DPIWE
Mr David Tarbath	Abalone Resource Assessment, TAFI
Mr Nigel Wallace	Divers' Representative, Tasmanian Abalone Council
Mr Greg Woodham	Treasurer, Tasmanian Abalone Council
Mr Tony Wurf	Chairman, Quota Holder Sub-Council

We also sought and received specific advice from a number of other people whom we would like to thank for the time and help that they provided to us.

9. Appendices

Appendix 1: Interpreting graphical information

Regional catch and catch rates:

The vertical columns show catch in tonnes, for the period 2000-2004. The black line with balls shows catch rates over the same period (Figure 14).

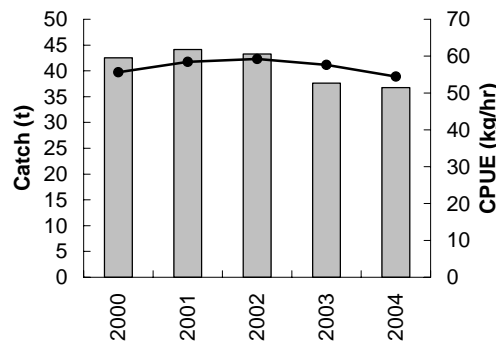


Figure 14. Five year regional total catch (tonnes) and mean catch rates (kilograms per hour), 2000 - 2004.

Regional catch-rate distribution:

The distribution of catch rates provides information about how divers are catching abalone that is not explained by the mean (Figure 15). That the distributions are skewed (not evenly distributed about the category with the highest percentage) implies that fewer divers are achieving high catch rates.

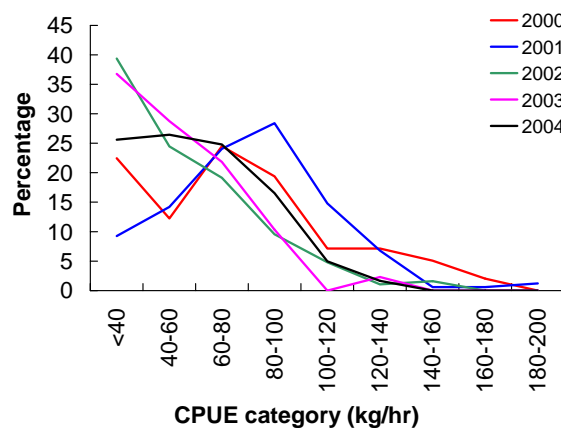


Figure 15. The percentage distribution of catch-rates, 2000 - 2004.

Catch, catch rate by block

The following figures provide catch and catch rate information on a smaller geographical scale.

Figure 16 shows catch (left y-axis) and catch rate (right y-axis) for the last 10 years for a statistical block.

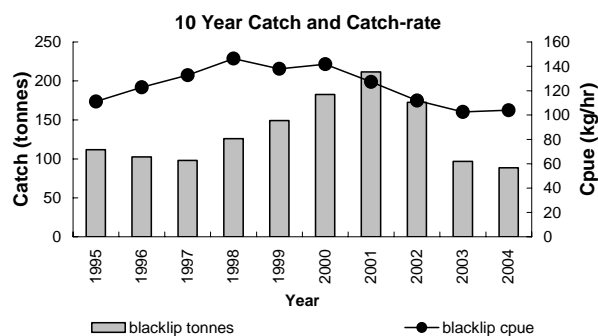


Figure 16. Example ten-year catch and catch rate, by block. Catch rates (geometric means – see below) are shown as a line with balls marking every year. Catch (tonnes) is shown as vertical columns.

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

Figure 17 shows catch and catch rates for the last five 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.

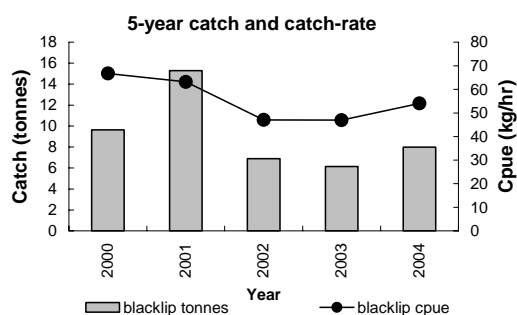


Figure 17. Example catch and catch rate at sub-block level.

Figure 18 shows monthly catch rates for 2004, the average monthly catch rates 2000-2003 (both as lines) and the monthly catch for 2004 (histogram). These are useful to compare catch rates at the time of year when catch rates are highest (e.g. winter in Eastern Zone). They highlight months when only small quantities were landed and consequently catch rates not necessarily reflecting abundance. They help to reduce the diver effect (i.e. when catches are small and infrequent, catch rate changes may reflect the abilities of individual divers rather than abalone abundance), and to allow for months where bad weather affected catches. They may provide supplementary information about changes in annual catch rates.

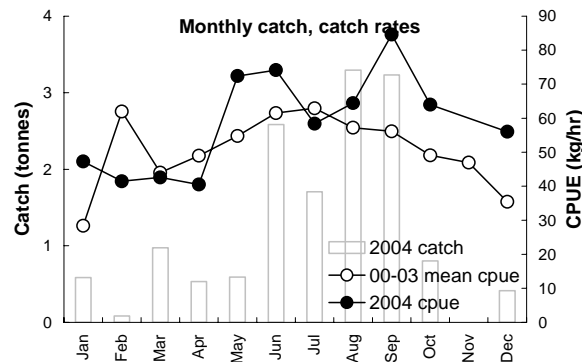


Figure 18. Example of monthly catch rate chart comparing the 2000-2003 average with 2004, at sub-block level. The vertical columns represent 2004 monthly catch.

Size-composition charts.

The size-composition of divers' catches is reviewed at sub-block level (Figure 19). At this spatial scale, there is a greater likelihood that the catches come from populations with similar growth characteristics than at larger scales. Only sub-blocks where levels of sampling averaged 5% or more for the period 2000-2004 are included. We are unable to estimate the percentage of catches sampled prior to 2000 because sub-block reporting was not introduced until then. We are able to attribute some sampled catches to sub-blocks in earlier years, because we know the location from where the catches were taken.

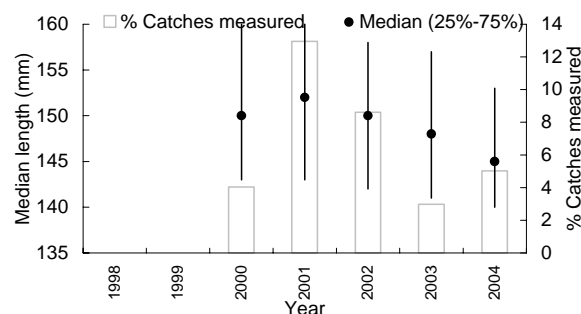


Figure 19. Median length with 25%-75% inter-quartile size range of abalone from commercial catch samples. The vertical columns represent the percentage of catches sampled.

Size-composition charts plot median length (the middle or 50th percentile length if all abalone were sorted from smallest to largest) for the period 1998-2004 (or the period

since catches can be attributed to sub-blocks). They also show the size of abalone at the 25th and 75th percentiles i.e. the size range of 50% of abalone from the sampled catches. A reduction in median size may be due to divers landing more smaller abalone, either because the larger abalone have become depleted or because recruitment has increased and made more small abalone available to catch. If catch rates fell across the review period then the former is likely whereas as if they increased, then reduction in median size may be explained by increased levels of recruitment.

Appendix 2: Annual Catches From The Western Zone 1975 - 2004.

Annual tonnages of blacklip abalone caught within the statistical blocks and sub-blocks comprising the Western Zone in 2004. 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
2004	1	88	89	22	130	181	374	250	96	1231
Mean	1	165	60	33	164	134	288	208	70	1064

Appendix 3: Annual Catches From The Eastern Zone 1975 - 2004.

Annual tonnages of blacklip abalone caught within statistical blocks and sub-blocks comprising the Eastern Zone in 2004. These tonnages are derived from estimated weights, which do not correspond exactly with landed weights. Prior to 2000, the catches for Blocks 13 and 31 include catch from outside the (now) Eastern Zone, which means that the average catch for these particular blocks is not necessarily correct.

Year	13	14	15	16	17	19	20	21	22	23	24	25	26	27	28	29	30	31	Total
1975	247	111	10	48	12	0	16	27	49	74	15	16	5	44	69	16	45	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
2004	221	104	7	50	20	2	92	52	35	19	51	1	1	44	11	24	6	22	761
Mean	285	188	6	98	36	3	59	56	48	41	76	9	8	81	58	20	68	55	1195

Appendix 4: Annual Catches From The Northern Zone 1975 - 2004.

Annual tonnages of blacklip abalone caught within statistical blocks comprising the Northern Zone in 2004. 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. * From 2003, Block 37 tonnage is included in Bass Strait Zone.

Year	31	39	40	32	33	34	35	36	37	38	47	48	49	5	1	2	3	4	Total
1975		3	1	2	9	1	7	7	0	2	1	12	9	39	32	1	27	14	167
1976		5	0	0	6	0	1	1	0	1	1	12	33	46	39	1	51	8	205
1977		5	2	6	11	0	0	2	0	2	0	8	17	50	17	1	87	8	216
1978		8	2	1	5	2	6	5	1	4	3	10	11	65	21	3	56	25	228
1979		6	1	2	9	0	0	1	1	2	0	27	7	85	24	3	10	10	188
1980		3	1	2	6	1	1	2	0	0	0	10	1	92	51	3	33	3	209
1981		7	1	0	7	1	1	0	2	0	2	33	9	120	19	8	33	10	253
1982		5	1	0	5	0	0	2	0	5	1	45	7	121	23	9	27	13	264
1983		7	4	0	4	0	0	5	1	4	9	44	19	227	22	2	32	51	431
1984		5	3	0	7	1	1	2	1	1	4	81	45	311	11	1	34	55	563
1985		5	2	4	6	1	2	0	0	0	4	48	50	319	43	0	26	12	522
1986		10	5	1	9	2	4	3	1	1	15	86	97	267	35	4	24	13	577
1987		6	1	0	7	0	3	1	2	1	18	58	68	197	44	61	24	53	544
1988		2	2	1	11	1	1	1	0	0	18	36	41	168	29	17	22	60	410
1989		1	0	0	4	0	1	0	0	0	14	16	24	88	14	7	10	5	184
1990		0	0	0	1	0	0	0	0	0	6	14	20	82	11	10	9	12	165
1991		1	0	0	2	0	0	0	0	0	8	12	10	97	6	7	13	27	183
1992		3	0	0	2	0	0	0	0	0	2	10	11	76	4	6	14	10	138
1993		0	0	0	3	0	0	1	0	0	1	6	7	66	10	4	8	9	115
1994		0	0	0	3	0	0	0	0	1	0	6	11	49	9	2	4	1	86
1995		0	0	1	1	0	0	0	1	0	0	6	2	62	12	5	2	7	99
1996		0	0	0	0	0	0	0	0	0	0	4	0	63	7	2	1	2	79
1997		1	0	0	0	0	0	0	0	0	0	5	2	56	9	1	10	6	90
1998		0	1	0	2	0	0	0	0	0	0	6	3	61	2	1	1	2	79
1999		4	1	0	2	0	0	0	0	1	0	13	4	45	3	1	4	6	83
2000		5	2	1	5	0	0	0	0	0	0	12	26	45	0	0	10	10	117
2001	12	11	3	5	10	1	0	0	0	3	0	17	72	117	2	1	12	12	279
2002	30	4	3	1	11	1	0	0	0	2	0	12	48	103	10	2	35	16	278
2003	7	8	1	0	5	0	0	0	*	2	0	10	76	73	25	1	62	10	279
2004	14	6	1	0	3	0	0	0		0	1	6	61	57	10	0	85	34	279
Mean	16	4	2	1	5	0	1	1		1	4	22	26	108	18	5	26	17	244

Appendix 5: Annual Catches From The Greenlip Fishery 1975 - 2004.

Annual tonnages of greenlip abalone caught within the statistical blocks comprising the Greenlip fishery in 2004. 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
2004	9	22	0	4	4	1	13	3	1	11	0	14	6	10	14	10	4	3	128
Mean	18	8	3	6	15	7	29	11	5	6	10	25	5	8	7	20	1	8	190

Appendix 6: Annual Catches From The Bass Strait Zone 1975 - 2004.

Annual tonnages of blacklip abalone caught within statistical blocks comprising the Bass Strait Zone in 2004. These tonnages are derived from estimated weights, which do not correspond exactly with landed weights.

Year	37	38	41	42	43	44	45	46	50	51	52	53	54	55	56	57	Tota
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
2004	3	0	4	4	1	0	0	1	0	1	0	42	5	2	7	0	70
Mean	4	0	1	1	2	0	0	1	0	4	0	8	0	0	1	1	23

Appendix 7: History of Management Changes

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

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

	<p>2958.3 tonnes.</p> <p>The minimum legal weight for abalone meats was set at 90 g.</p>
1989	<p>The catch per ITQ was reduced to 600 kg (30% reduction) i.e. TAC was 2076 tonnes.</p> <p>A fishery for 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 caught. 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).</p> <p>The minimum meat weight regulation of 90g was amended to apply only to blacklip abalone.</p>
1990	<p>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.</p> <p>MSL for greenlip in Furneaux Group waters increased to 140 mm.</p> <p>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.</p>
1991	<p>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.</p> <p>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.</p>
1992	<p>Minimum meat weight for greenlip was set at 70 g.</p>
1993	<p>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.</p> <p>Minimum meat weight regulation amended to 90g for all abalone other than greenlip.</p> <p>Penalties reviewed and significantly increased, with the option of prison terms for serious and repeat offenders. Special penalties increased to \$50 per fish.</p>
1994	<p>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.</p> <p>The Deed of Agreement set a fee structure that included both management</p>

	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	<p>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.</p> <p>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.</p>
1996	<p>The <i>Living Marine Resources Management Act 1995</i> was introduced.</p> <p>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.</p>
1997	<p>The TAC was increased to 2520 tonnes (720 kg per quota unit).</p> <p>Differential in beach price between east coast and west coast blacklip first appears – is initially \$2.00.</p>
1998	<p>The first Abalone Fishery Management Plan was introduced. Among changes that it introduced were catch monitoring, which included:</p> <ol style="list-style-type: none"> 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. <p>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:</p> <ul style="list-style-type: none"> • For management purposes, the greenlip fishery was subdivided into two regions: the Furneaux Group and the remainder (North West, North East and King Island) • MSL was raised to 140 mm state-wide (except the North West, which was left at 132 mm), • The annual catch for the Furneaux Group was capped at 42 t based on estimates of sustainable yield. 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.

	<p>Within the Furneaux Group, several other rules were introduced to reduce effort:</p> <ul style="list-style-type: none"> • 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. • 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. • These rules were repealed in 1999. • The greenlip catch from the remainder of the State was to be limited to 106 tonnes. • 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. <p>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.</p> <p>Fixed trigger points were abandoned as an assessment strategy as rising catch and catch rates indiscriminately fired triggers. Assessments have since used catch and catch rate trends to monitor stock levels.</p>
<p>1999</p>	<p>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.</p> <p>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.</p> <p>Within the Furneaux Group, Block 35 was closed to fishing between 1 October and 31 March to protect spawning abalone.</p>
<p>2000</p>	<p>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.</p> <p>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.</p> <p>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</p>

	<p>North East and the Furneaux Group.</p> <p>The Block 35 (Franklin Sound - Furneaux Group) greenlip catch was capped at 20 tonnes.</p> <p>Catch were reported on a smaller spatial scale with the introduction of sub-blocks state-wide.</p> <p>Owners of fishing license (abalone dive) were allowed to hold more than one license and allow others to dive those licenses as supervisors.</p>
2001	<p>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.</p> <p>In association with establishment of Northern Zone, research monitoring areas were set aside at the Inner Sister, Swan Island, Waterwitch Reef, and the Doughboys.</p> <p>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.</p> <p>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.</p>
2002	<p>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.</p> <p>Eastern Zone TAC reduced to 857.5 t (245 kg/unit). Western Zone TAC remained 1260 t (360 kg/unit) Northern Zone TAC remained 280 t (80 kg/unit) Greenlip TAC remained 140 t (40 kg/unit) Production for the whole fishery was set at 2537.5 t (725 kg/unit).</p> <p>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.</p>

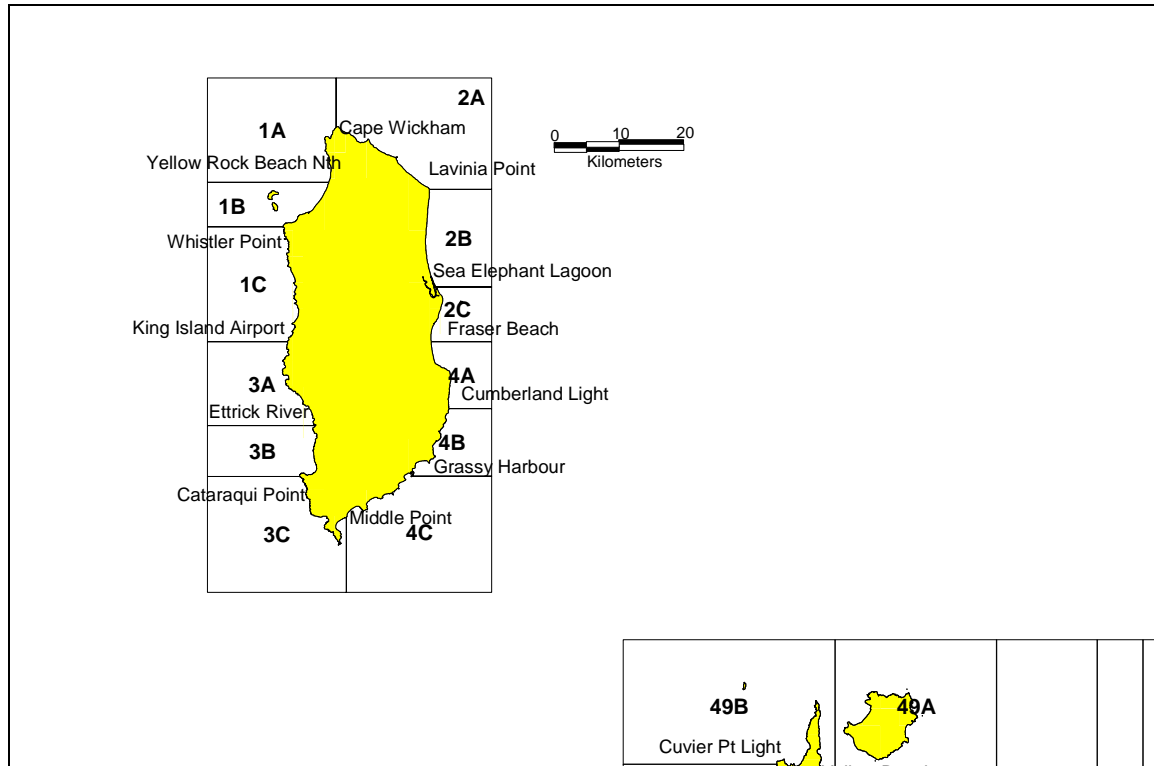
2003	<p>A Bass Strait blacklip zone (TAC 70 tonnes (20 kg/unit), MSL of 114 mm) was superimposed over the Northern Zone in central Bass Strait and part of the Furneaux Group. Its purpose was to enable the catching of abalone smaller than allowed by the Northern Zone size limit. The Bass Strait Boundaries 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.</p> <p>Eastern Zone TAC remained 857.5 t (245 kg/unit). Western Zone TAC remained 1260 t (360 kg/unit) Northern Zone TAC remained 280 t (80 kg/unit) Greenlip TAC remained 140 t (40 kg/unit) Bass Strait Zone TAC set at 70 t (20 kg/unit) Fishery production was set at 2607.5 t (745 kg/unit) state-wide.</p> <p>Blacklip catch from Block 5 (Northern Zone) was capped at 100 t.</p> <p>MSL for Western Zone between the Wild Wave River and Arthur River was increased to 136 mm from 132 mm.</p> <p>Abalone taken from Western Zone subject to upper size limit of 160 mm by canners and live market buyers.</p>
2004	<p>Eastern Zone TAC reduced to 770 t (220 kg/unit) Western Zone TAC remained 1260 t (360 kg/unit) Northern Zone TAC remained 280 t (80 kg/unit) Greenlip TAC reduced to 129.5 t (37 kg/unit) Bass Strait Zone TAC remained 70 t (20 kg/unit) Fishery production was set at 2509.5 t (717 kg/unit) state-wide.</p> <p>The greenlip TAC reduction affected the North West only, where the annual cap was reduced by 10 t to 30 t.</p> <p>October-March closure for Franklin Sound greenlip fishery abolished. Block 35 cap reduced from 20 t to 15 t.</p>
2005	<p>Eastern Zone TAC remained 770 t (220 kg/unit) Western Zone TAC remained 1260 t (360 kg/unit) Northern Zone TAC remained 280 t (80 kg/unit) Greenlip TAC reduced to 122.5 t (35 kg/unit) Bass Strait Zone TAC remained 70 t (20 kg/unit) Fishery production was set at 2502.5 t (715 kg/unit) state-wide. The greenlip TAC reduction affected the North East only, where the annual cap was reduced by 7 t to 23 t.</p> <p>Team diving (sharing catch from one quota unit by two divers) was introduced to legitimise the practise of divers catching abalone for others when they held no quota to which their catch could be assigned.</p>

	<p>Highgrading (discarding large abalone in the catch from the deck) prohibited.</p> <p>Caufing prohibited.</p> <p>Introduction of cancellation reports where a previously reported trip does not occur.</p> <p>Introduction of single (blacklip) zone fishing provisions.</p> <p>Overcatch provisions introduced to cover unintentional underestimation of catch weight.</p>
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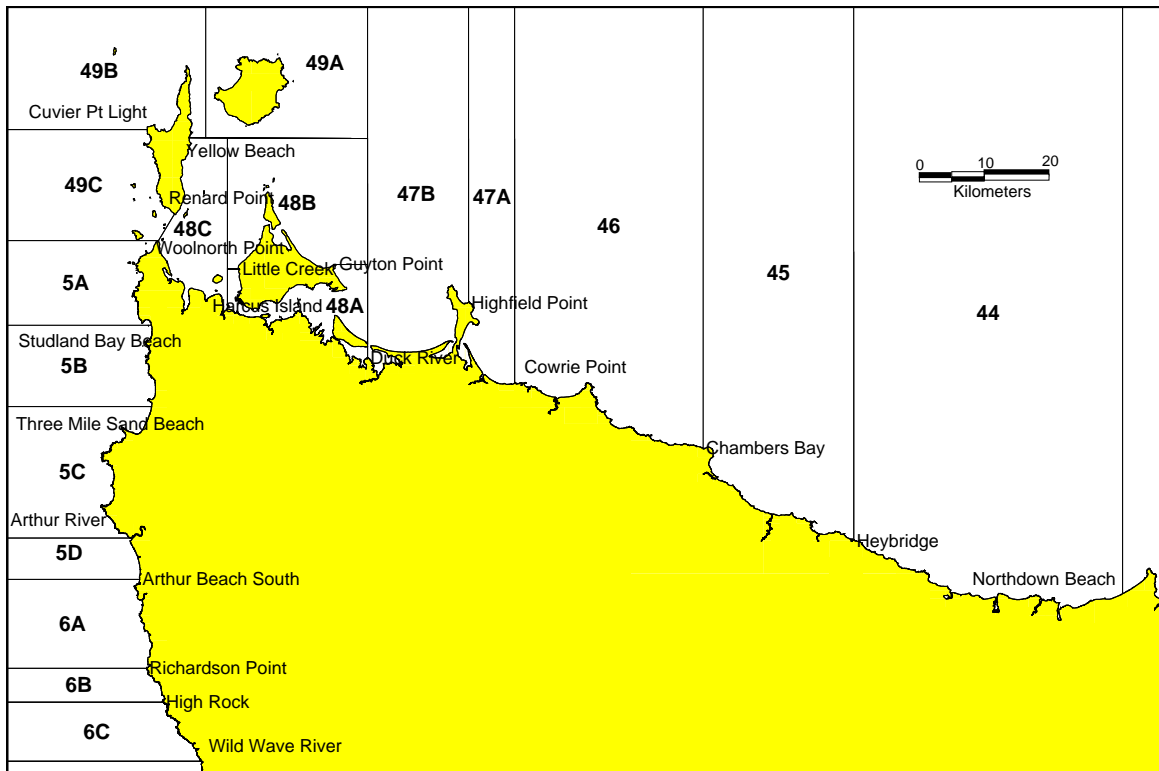
Appendix 8. Maps of blocks, sub-blocks and sub-block boundaries used to report the position from which catch has been taken, for the Tasmanian abalone fishery.

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

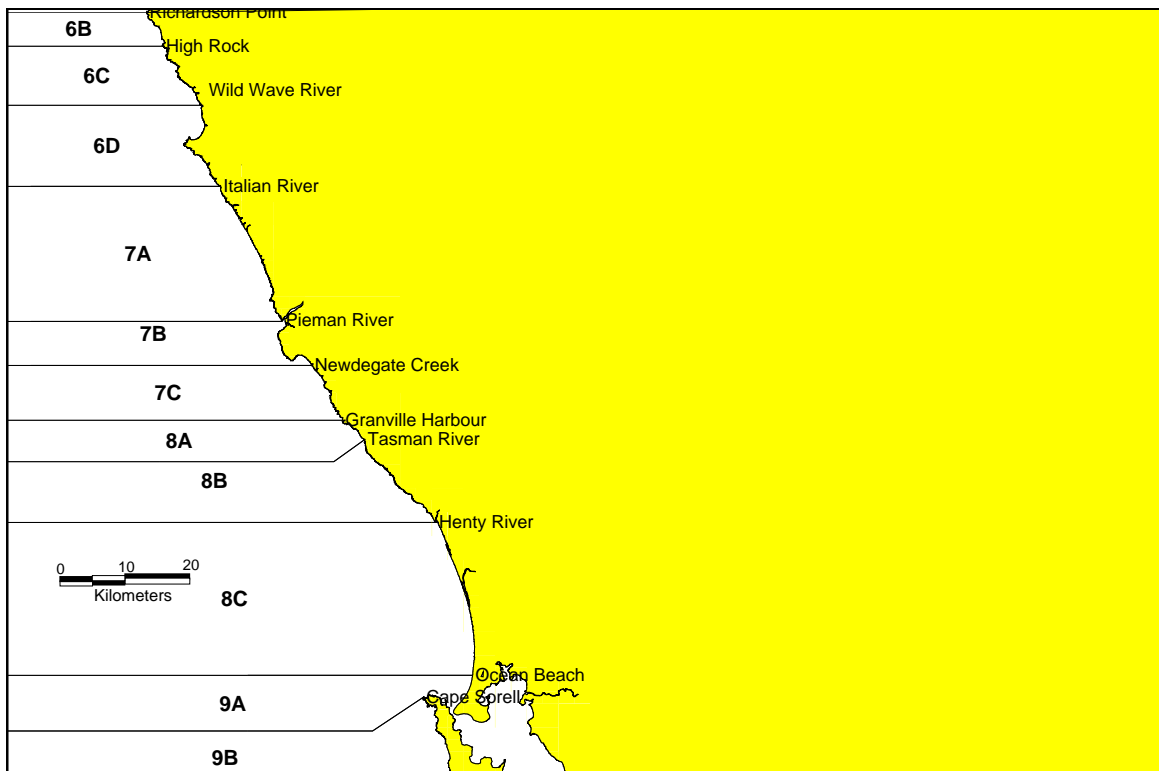
Map1: King Island



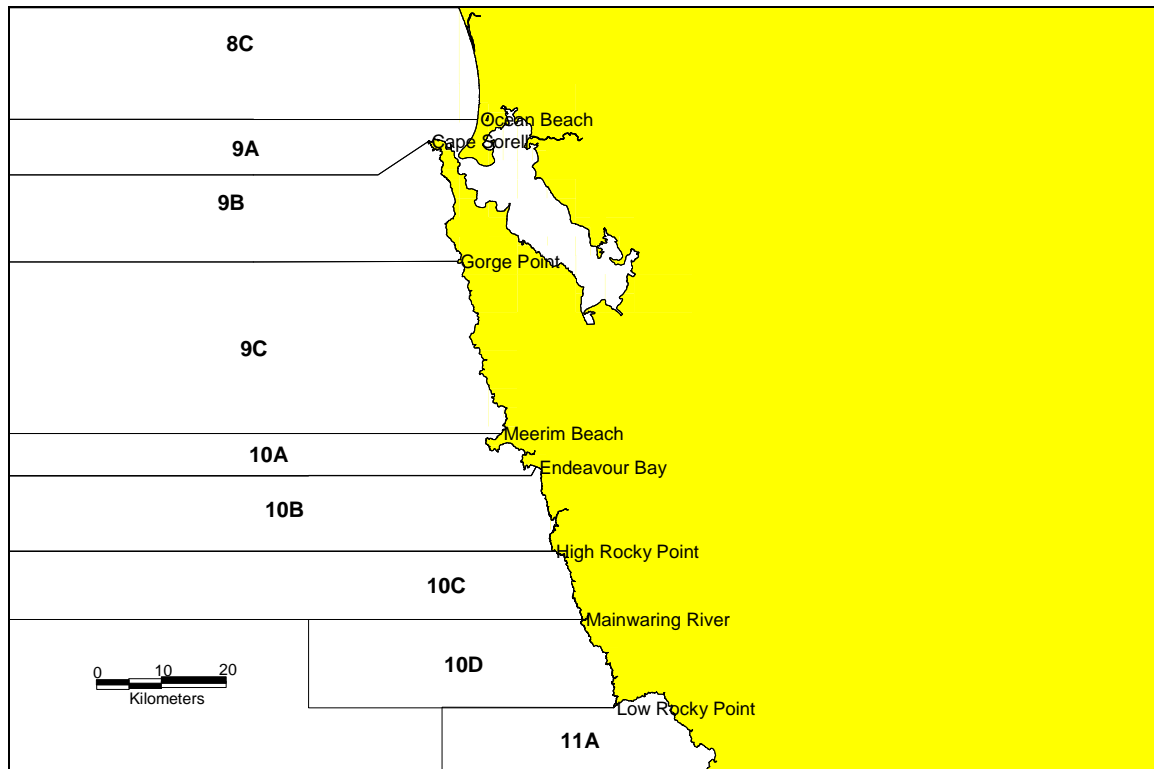
Map 2: North West Tasmania



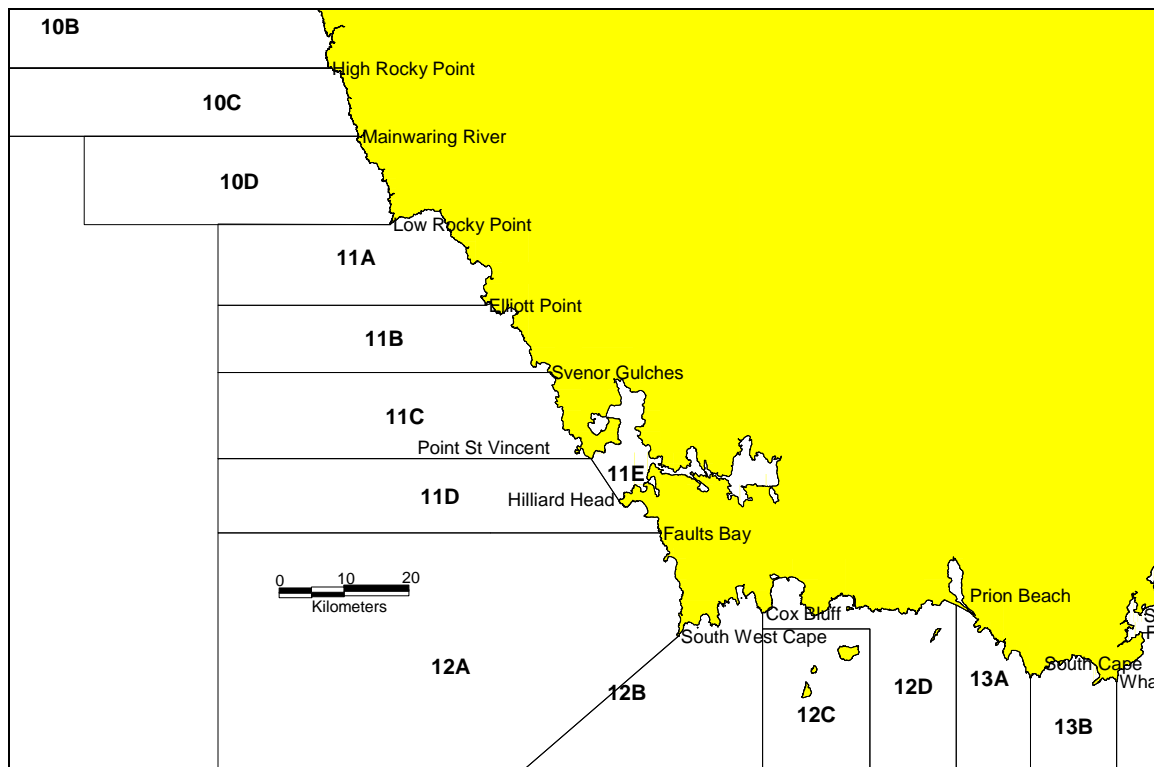
Map 3: Central West Coast (north)



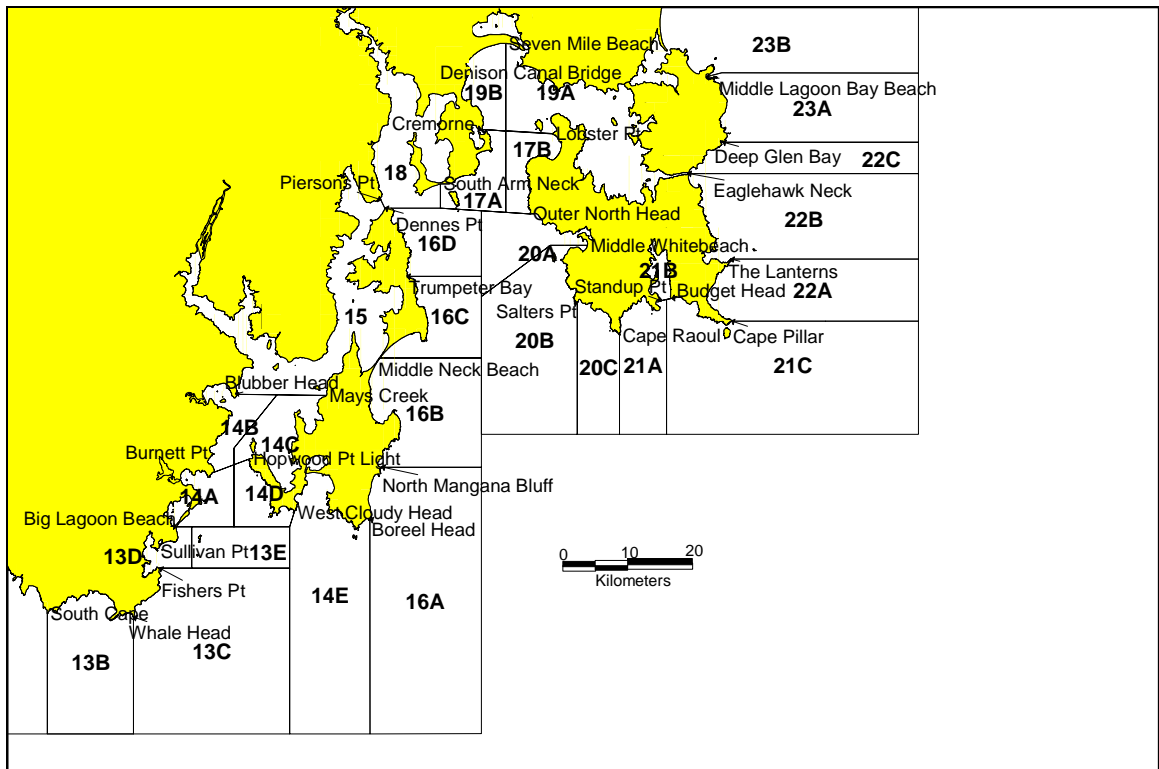
Map 4: Central West Coast (south)



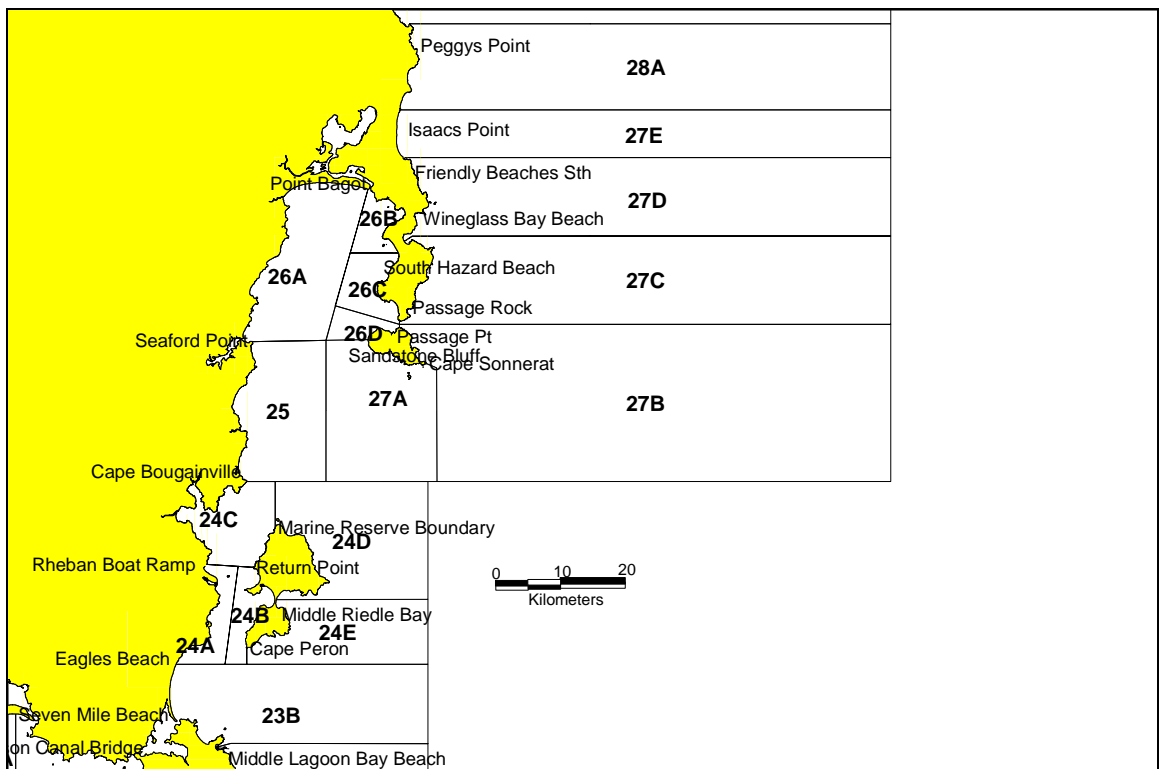
Map 5: South West Tasmania



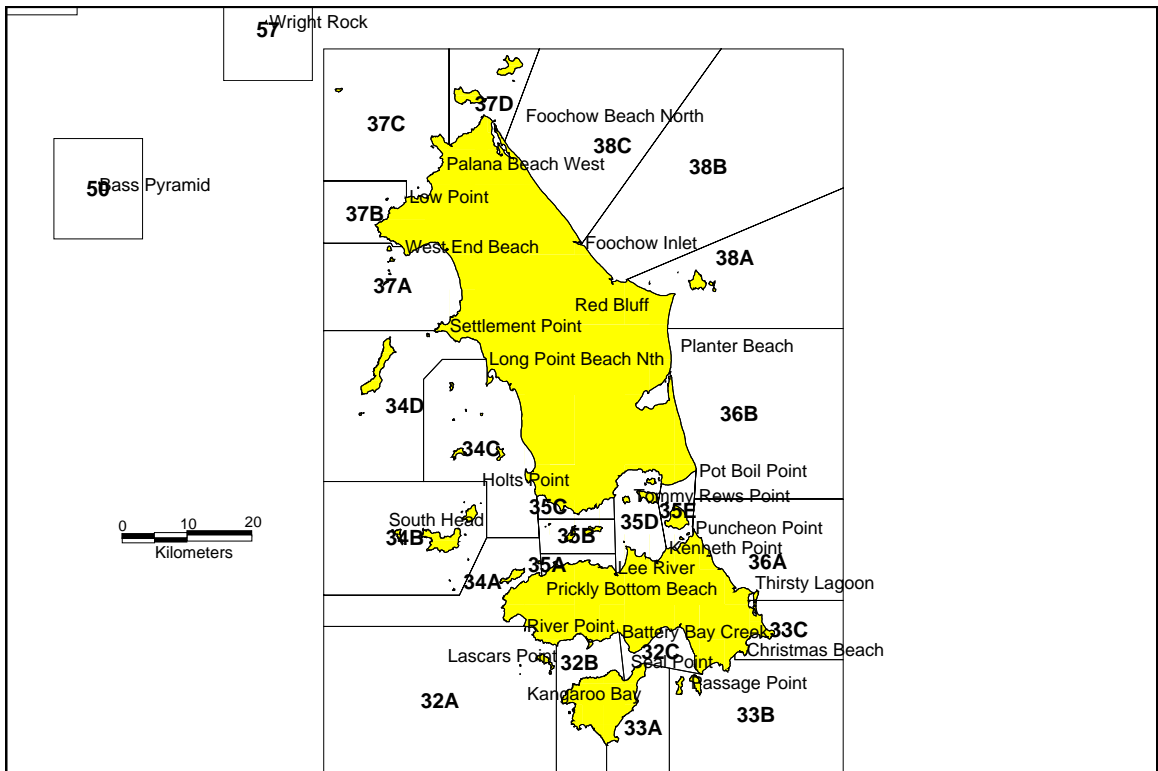
Map 6: South East Tasmania



Map 7: Lower East Coast



Map 10: Furneaux Group



Map 11: Bass Strait Islands

