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FISHERY ASSESSMENT REPORT

TASMANIAN ABALONE FISHERY

2009

Compiled by David Tarbath and Caleb Gardner

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Abalone Fishery Assessment: 2009

Executive summary

Abalone landings to the end of 2009 were 2,485 tonnes (t) of blacklip (*Haliotis rubra*) and 122 tonnes of greenlip (*H. laevigata*), giving a total of 2607 t which was slightly in excess of the Total Allowable Commercial Catch (TACC) of 2604 t (due to catch overruns). Total landings increased by 23.5 t over the previous year due to a 5% increase in Eastern Zone TAC partially offset by a net loss in catch from the creation of a new fishing zone in the west.

In recent years, export prices for processed abalone have fallen due to a weaker market. The beach value of the 2009 catch was \$93 million, \$3 million more than the previous year. Prices for live abalone have also fallen, although the market was stronger in 2009. Royalties collected from quota holders in 2009 totalled \$6.2 million.

The fishery is assessed primarily on catch, effort and size-composition data from the commercial fishery. Annual variation in catch rate was interpreted as a relative index of abalone abundance. Interpretation of catch-rate trends was assisted by changes in median length of commercial catch. In addition, consultation with the abalone industry was undertaken to obtain their observations on the state of the stocks and market drivers affecting the operation of the fishery throughout 2009.

The major findings of this assessment are summarised for each fishing zone.

Eastern Zone

The Actaeons continued to be the most popular region with divers and processors alike, its premium quality blacklip commanding consistently high prices. The annual catch was limited to 340 t, and the region was closed to fishing on 1 November after this amount had been taken. As was the case in 2008, the mean annual catch rate was high compared with earlier years, although the high and constant level of fishing pressure was evident when daily catch rates began to fall as harvests reduced before the closure. Performance indicators (catch, catch-rate and median size) suggest that current harvests are appropriate for the region. Notably the size of abalone from the Actaeons was more concentrated around the size limit than for other Eastern Zone regions, indicating a greater level of dependency upon successful annual recruitment.

The Bruny Island catch was low at approximately half the long-term average. In recent years, the Block 14 catch has been especially low, at approximately one quarter of the amount produced during the 1970's and 1980's, and it appears that there has been a substantial loss of productivity. In the south-east of the island (14E, 16A) catch rates have been falling in recent years rather than rebuilding despite the low catch. In other parts of the island, catch rates improved compared with 2008 which is more in line with expectations from the low level of catch. Catch sampling shows that mean lengths have tended to get larger in recent years, consistent with low recruitment levels. Consequently, stock trends in this region are of concern.

Catch along Storm Bay's eastern shore and further east to Tasman Island had a similar trend to Bruny Island (below average), but in contrast catch rates were generally high. The combination of increasing size of fish, high catch rates, low catch and divers' reports indicated that stock levels were moderate to high in this region.

On the East Coast from Tasman Island north to Musselroe Bay, catch rates indicated that there was an improvement in stock levels in 2009. There was considerable uncertainty as to whether this represented a sustained trend because abalone stock levels on the East Coast appear to be especially variable. This is due to changing patterns in harvest (driven by processors) and apparently more variable recruitment. This region is also vulnerable to ecological changes as a result of climate change. One climate change effect that was emphasised by divers was their observations of the expansion of non-productive 'barrens habitat' caused through over-grazing by the long spined sea urchin (*Centrostephanus rodgersii*), a species that has expanded its range from NSW over the past two decades.

Central Western Zone

Data from Couta Rocks (Block 6) indicated that stock levels remained moderate to high, particularly in the north, although there were signs that the prime area around Sandy Cape had been depleted. The average size of abalone increased, which implied that divers did not take full advantage of the reduced size limit, but adjusted their harvesting to meet processors' preferences.

Further south at Granville Harbour and elsewhere in Blocks 7 and 8, much larger catches than anticipated were taken, and the management cap of 108 t was substantially overrun (by 50 t) before this section of coast was closed on 13 July. The creation of the Central Western Zone has increased levels of effort in the region not seen since the 1980's. The high hourly catch rates in conjunction with the rapid fishing down of the cap and the evident success of divers unfamiliar with the region indicate that stocks were perhaps larger and more widespread than initially considered. There is uncertainty that a similarly high level of harvest is appropriate for 2010.

Western Zone

Increased catch rates and moderate levels of catch south of Strahan in Block 9 indicated that stock levels in this region were stable. However, divers reported that improvements in weather forecasting had contributed to improvements in their ability to fish this area, which in turn was thought to improve catch rates independently of stock abundance.

In the South West (Blocks 10, 11, 12A), stocks have been considerably reduced by years of high fishing effort. It is unclear at this point whether a recent reduction in the TAC and the current catch cap are sufficient to stabilise catch rates and enable stock rebuilding, or whether additional management actions are required.

Stocks along the South Coast (Sub-blocks 12B-13B) appear to have high exploitation rates based on the combination of low stable catch rate and decline in the size of abalone. Catch in this area has also been very high and catch rates may be biased by improvements in weather forecasting as per Block 9. The increasing proportion of recruits in the catch increased the dependency on a reduced range of year classes to supply catch. This in turn increased the level of risk. Stock levels were assessed to be at best stable, but probably falling.

Northern Zone

Data from King Island suggested that harvests were stable and sustainable. Stock levels in shallow water appeared to be rebuilding following high fishing effort between 2003 and 2005.

In the North West, catch rates remained high despite the large catch. It was evident that the high catch rates were being maintained through the divers' ability to rotate effort between key areas which were being successively depleted. This strategy carries an inherent risk of serial depletion if the rate of depletion exceeds the rate of recovery in each area. The live market depended upon only a relatively small part of the fishery to supply fish. This pattern would have lower risk if acceptable quality fish could be found in other areas, such as Woolnorth or Three Hummock Island.

In North East Tasmania, blacklip stocks have been substantially reduced following the high level of catch in 2007. There was insufficient information to determine whether stocks were stable but at a reduced level, or whether they continued to fall. In the Furneaux Group, blacklip stocks were assumed to be stable due to the low level of catch.

Bass Strait Zone

The Central North Coast (Blocks 41-46) fished well in 2009, but stocks were still classed as depleted due to low rates of recovery. Effort focussed on the Central North Coast is expected to be diverted to the southern part of the Furneaux Group due to a change in the Bass Strait/Northern Zone boundary and consequent size-limit reduction. Catch rates in Block 37 (Flinders Island) and the remote Bass Strait islands (Blocks 50-57) have declined slightly, but remain at acceptably high levels for most divers.

Greenlip

Greenlip stocks appear to be stable across the wider fishery, although the large catch in the North East has reduced abundance, and it may take some time for catch rates to recover. Because of the low catch in the North West outside the Perkins Bay area, potentially greater amounts of catch than the 10 t allowed could possibly be taken without causing a long-term reduction in stock levels.

Recreational and other fisheries

The most recent survey of recreational divers estimated that 39 t was taken in 2009. This was about 1.5% of the total abalone catch in Tasmania, over half which was taken in the east and south east. This figure does not include abalone taken as part of cultural fishing activities by indigenous people, or under permit for special events and research purposes, or through illegal fishing. There is no estimate for either the illegal catch or the cultural fishing activities; however, abalone taken under permits was less than two tonnes.

Summary of Recommendations:

Eastern Zone:

The TAC for 2009 was increased by 42 t in consideration of high catch rates in key areas of the fishery. This assessment of the four regions shows:

- the Actaeons appeared to be fully exploited,
- Bruny Island and the southern parts of the East Coast appeared to be fully or over-exploited, and
- Storm Bay and the north-east part of the East Coast appeared to be under-exploited.

These criteria are in terms of potential catch, not ecological or economic targets. Stock levels in Block 14 do not appear to be re-building despite low catch. The key to

successful management of stock levels in this zone during 2010 appears to lie through spreading effort to the two areas that can sustain greater levels of catch. The expansion of long-spined sea urchin barrens into abalone habitat and the effect of increased water temperatures on abalone population dynamics require careful monitoring.

Western Zone:

A reduction in catch from the South West appeared to have resulted in improvement in catch rates. Catches from the region will require careful monitoring to ensure that the level of catch reduction is sufficient to enable rebuilding of stocks as planned. It is evident that size limits have failed to maintain reproductive capacity sufficient for the level of catch, and managers may wish to investigate whether the larger growing populations in this region are adequately protected to enable sustainable fishing. For the past two years, South Coast annual catches have been among the largest on record. There is concern whether the South Coast can continue supplying catches of this magnitude without affecting catch rates or reproductive capacity.

General:

Management and administration of the spatial distribution of catch remains a problem. Caps in some areas were overrun by excessive catch (e.g. the Blocks 7 and 8 blacklip cap and the North East greenlip cap), while other areas produced negligible catch (e.g. Block 31). Effective management of catch caps for individual blocks requires the ability to respond to catch triggers and close parts of the fishery in sufficient time to prevent catch overruns. This process is logistically difficult and has been only partially effective in 2009. A review of this system may be required if block caps are to be an effective tool for distributing catch within zones.

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Introduction

This assessment relies on fishery-dependent data. Principally, changes in catch and catch rate have been used to make inferences about changes in abalone abundance. In addition, information is presented on changes in the median length of abalone sampled from the commercial catch across relatively fine spatial scales. Combined with changes in median length, trends in catch rates can be useful indicators of changes in abalone populations in Tasmania.

The use of catch and catch rates to monitor changes in abalone abundance has often been criticised as unreliable and elsewhere is infrequently used. In theory, the fishing of abalone aggregations, serial depletion and changes in fishing efficiency reduce the link between catch rates and abundance. These factors are more problematic in areas where effort and catch data are sparse and compounded by the use of arithmetic means which are sensitive to skewed data.

However, when abalone populations are intensively fished, as occurs throughout much of the Tasmanian fishery, catch and catch rate trends appear to be reliable indicators of changes in abundance. When fishing pressure is sufficient, aggregations are unable to develop, and high visitation rates prevent stock build up and subsequent serial depletion. The confounding effects of effort creep may be reduced by using short-term (10 years or less) catch and catch-rate trends to assess changes in stock levels. Under these circumstances, catch and catch-rate trends appear to reflect changes in abundance.

This document makes use of fisheries data collated over progressively diminishing spatial scales. The top level scale is the zone. The use of zones was first introduced into the Tasmanian fishery in 2000, to control falling stock levels by managing the spatial distribution of catch. Since 2003, the Tasmanian blacklip fishery has been divided into four zones: Eastern, Western, Northern and Bass Strait. A fifth zone (Central West) was introduced in 2009. The greenlip abalone fishery is managed separately from the blacklip fishery. The greenlip fishery is restricted to the north of the state, and the spatial distribution of its catch is managed by regions.

Whilst zones are now the established method of managing the fishery, they mask details important for fishery assessment. Zones are too large and include too many physical differences (e.g. water temperature regimes, geology, accessibility), and may include divergent recruitment patterns, and different levels of abundance and fishing methods. There is a risk that patterns in sub-sets of a zone may be very different to that for data pooled across the wider region. In this assessment, understanding of stock abundance is improved by looking at fishing patterns across smaller regions which have a greater likelihood of sharing common fishing practises and stock levels.

The regions and region boundaries used in this assessment have been set arbitrarily, but are generally based upon commonly used Tasmanian regions, about which boundaries have been placed aligned with the abalone fishery reporting blocks. Where necessary, reference is made to the component blocks or sub-blocks within a region to help understand the performance of its fishery, with a proviso that the annual catch was 10 t or more in any one of the years since 2000.

The zones, regions and statistical blocks from which the 2009 commercial catch was reported or which are referred to in this document are shown below (Figure 1; for sub-blocks see Appendix 11). Note that there were changes to the Western Zone boundaries in 2009.

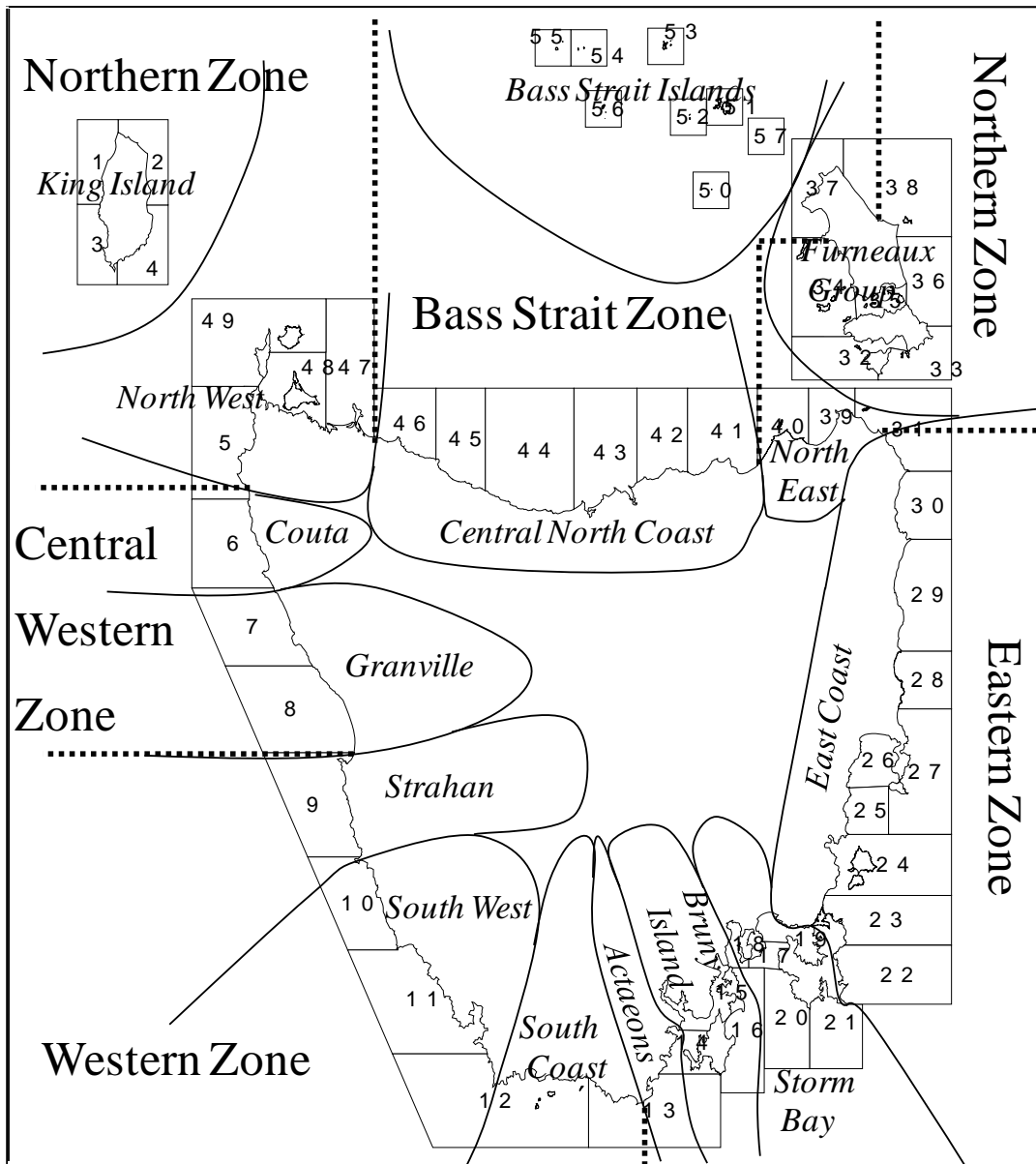


Figure 1. Zones and statistical blocks used in the Tasmanian abalone fishery in 2009. Also shown are the regions used for assessment purposes in this document. Zone boundaries are shown as dotted lines. The greenlip fishery has no geographical boundaries, but mostly takes place on coasts included in the Northern and Bass Strait Zones. The boundaries of the Bass Strait and Northern Zones around the Furneaux Group will be changed for the 2010 fishing year. More detailed maps of catch reporting areas are shown in Appendix 11.

The zone boundaries and their reporting blocks for the 2009 fishing year are as follows:

Zones (blacklip fishery)

Eastern Zone:

Whale Head to Great Musselroe River, Sub-blocks 13C, 13E, 13E, Blocks 14 to 30, Sub-blocks 31A, part of 31B.

Northern Zone:

Great Musselroe River to Anderson Bay, Cowrie Point to Arthur River including King Island, part of 31B, Blocks 39 to 40, Blocks 47 to 49, Sub-blocks 5A, 5B, 5C. In the Furneaux Group, Blocks 32 to 36, Sub-block 38A.

Bass Strait Zone:

Cowrie Point to Anderson Bay, Blocks 41 to 46, 50 to 57. In the Furneaux Group, Block 37, Sub-blocks 38B, 38C.

Central Western Zone:

Arthur River to Ocean Beach, Sub-block 5D, Blocks 6 to 8.

Western Zone:

Ocean Beach to Whale Head, Blocks 9 to 12, Sub-blocks 13A, 13B.

The greenlip fishery has no spatial boundaries.

Regions

The regions used for blacklip assessment purposes in this document comprise the following reporting blocks:

Actaeons (and lower Channel):

Sub-blocks 13C, 13D, 13E, 14A, 14B

Bruny Island:

Sub-blocks 14C, 14D, 14E, Blocks 15 and 16

Storm Bay:

Blocks 17 to 21

East Coast:

Blocks 22 to 30, Sub-blocks 31A, part of 31B (south of Great Musselroe River)

North East:

Part of 31B (north of Great Musselroe River), Blocks 39 and 40

Furneaux Group (Northern Zone):

Blocks 32 to 36, 38A

Furneaux Group (Bass Strait Zone):

Block 37, 38B, 38C

Bass Strait Islands: Blocks 50 to 56

Central North Coast:

Blocks 41 to 46

King Island:

Blocks 1 to 4

North West:

Blocks 47 to 49, Sub-blocks 5A, 5B, 5C

Couta:

Sub-block 5D, Block 6

Granville:

Blocks 7 to 8

Strahan:

Block 9

South West: Blocks 10 to 11, Sub-block 12A

South Coast: Sub-blocks 12B, 12C, 12D, 13A, 13B

The greenlip fishery is reported from the *North West* (Blocks 5, 47 to 49), *King Island* (Blocks 1 to 4), the *Furneaux Group* (Blocks 32 to 38) and the *North East* (Blocks 31, 39 and 40). Small catches are occasionally reported from the *Central North Coast* (Blocks 41 to 46) and the remote *Bass Strait islands* (Blocks 50 to 57).

This document contains charts of annual total catch and geometric mean catch rates, catch-rate distributions and annual median length. Important details about the use of these charts and the data from which they were produced are summarised here (a more detailed explanation may be found in Appendix 1):

- The catches from all reported catches between 1975 and 2009 (inclusive) were used to estimate annual total catches i.e. no catches were omitted. The catch and effort database is known to contain duplicate, incorrect and incomplete records. These records are difficult to detect, but are corrected when they are encountered. Consequently, there may be minor variations in annual catch reported in these documents from year to year. (See Appendix 9 for details of recent corrections.)
- Between 1975 and 1984, abalone catches were usually reported as *estimated* weights, on a monthly basis, by the skipper of the fishing vessel. Between 1985 and 1992, catches were recorded as *landed* weights, by the diver, per landing. Estimated weights, by block, are unavailable for this period, which means that catches taken from several blocks in one trip may be reported as caught from one of those blocks. Since 1992, *estimated* weights by block have been used, to enable the best spatial resolution of catch. The sum of estimated weights by zone is usually within 2-3% of the sum of landed weights by zone, but between 1992 and 1995 was up to 10% less.
- Annual catch rates were derived from the geometric mean of individual catch rates and not arithmetic means (averages), and all mean catch rates referred to in this document are geometric means. Geometric means are a more reliable estimator of the mean catch rate across all divers, because they are more consistent and less affected by variable skewness of distributions (e.g. where there are small but variable percentages of high catch rates), and the standard error of the geometric mean is smaller than that of the arithmetic mean. Only catch rates from catches of 40kg or more were considered when calculating catch-rate means (to reduce the effects of fishing events that were adversely affected by mechanical breakdown or calculating catch rates on the by-catch of fishing for different species).
- Catch-rate distribution 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 the distribution of catch rates between recent years, it is possible to see where changes in catch rate have occurred, and the effect that they have had on the mean catch rate.
- The annual median length of abalone, when viewed as a time series of data, is used to show changes in the length of abalone which may reflect changes in fishing pressure or levels of recruitment. Between 1998 and 2000, median length was derived from length measurements obtained from photographs of 25 abalone taken from divers' catches, photographed aboard divers' boats. Since 2000, median lengths were derived from samples of 100 measured abalone randomly selected from individual catches, and in most cases, sampling has been undertaken at factories. Since 2008, sampling has been undertaken by the larger processors on behalf of TAFI. As a rule of thumb, median lengths are deemed useful when more than 4% of catches in a reporting area have been

sampled, although in the less productive blocks where relatively few catches are landed, a much higher proportion of sampled catches is required to produce reliable information.

Assessment of the Tasmanian abalone fishery

The boundaries of zones, regions, blocks and sub-blocks used in this report are described in Section 0 (Introduction) and Appendix 11. For information about catch, catch rates and median length, see Appendix 1: Catch, catch-rates and size-composition.

Landed catches and revenue - 2009

At the end of 2009, annual totals of reported landings comprised 2484.6 t of blacklip and 122.4 t of greenlip, a total of 2606.9 t from a TAC of 2604.0 t (Table 1). These landings represent an increase of 23.5 t over the previous year, attributable to a TAC increase of 42 t in the Eastern Zone, and a Western Zone TAC reduction of 31.5 t following the redistribution of catch from the Western Zone to the new Central Western Zone.

Processor returns show that the 2009 catch had a gross landed value of \$92.0 million, up by \$2.1 million from the previous year. Royalties collected by the Tasmanian government amounted to \$6.2 million.

Table 1. 2009 landings by zone, in tonnes

Zone	2009 TAC	2009 Landings (tonnes)
Greenlip	122.5	122.4
Eastern Blacklip	850.5	850.5
Northern Blacklip	332.5	332.2
Western Blacklip	924.0	928.0
Central Western Blacklip	304.5	304.2
Bass Strait Blacklip	70.0	69.6

Eastern Zone

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

Fishery-dependent data

The 2009 catch from the southern part of this region (13C, 13D, and 13E) was capped at 340 t to manage the spatial distribution of catch across the broader zone. These sub-blocks were closed on 1 November, with the estimated weight of catch at 340.7 t. The same amount of catch was taken in 2008. The estimated long-term average for these three sub-blocks is 244 t.

In the Lower Channel, another 20 t was taken. This level of catch is low compared with the period 2000-2006, when the annual catch was as much as twice this amount, and is less than half the long-term average (45 t).

The long-term average catch for the Actaeons plus Lower Channel was 286 t. Long-term averages were calculated by applying the proportion of recent catches from sub-blocks to annual block totals prior to 2000 (when sub-block reporting of catch

commenced). For the Actaeons and Lower Channel region, 80% of Block 13 catches and 30% of Block 14 catches between 1985 and 1999 were used, then 13C to 14B catches between 2000 and 2008.

Most of the Actaeons (13C, 13D, 13E) catch comes from the reefs surrounding the two islands and the extensive reef system to their south in sub-block 13E. The 2009 catch from this sub-block (257 t) was 30 t lower than the previous year's catch, but still historically high. Levels of catch taken from sub-blocks 13C (48 t) and 13D (35 t) were more moderate, and within the range of recent years. Much smaller amounts of catch came from the Lower Channel sub-blocks 14A (15 t) and 14B (4 t).

Catch rates in sub-block 13E (86 kg/hr) and 13D (84 kg/hr) have remained stable over the last three years and are relatively high compared with other blocks in the Eastern Zone. In 13C, catch rates have fallen sharply from 101 kg/hr in 2007 to 75 kg/hr in 2009. In the Lower Channel sub-blocks, catch rates have continued to increase in 14A (75 kg/hr) and increased by 6 kg/hr in 14B to 59 kg/hr. In both sub-blocks catch rates have maintained an upwards trend from a low point (40-45 kg/hr) in 2002.

Generally there was a fall in the median size of abalone from the region, to 144 mm in 13E, 13D, and 14A. In 13C, the median size fell by 2 mm to 148 mm. This fall in size is a reversal to the trend of increasingly larger fish seen in 13C and 13E over the previous few years.

Diver perceptions

As with previous years, divers reported good fishing at the Actaeons. Most were disappointed when the 340 t cap was announced, questioning why the Actaeons was closed when it was the best part of the Eastern Zone fishery. However, by October many found the fishing more difficult and they said that it appeared that fish stocks were running low. Consequently there was greater acceptance of the cap and the outcome of catch shifted elsewhere. They remained impressed with the quantity of small fish (i.e. pre-recruits) visible on the reef, particularly at places such as the Breaks, where small fish were once rarely seen, but also the Western Reef and the Middle Ground. This gave them confidence that the region could support current levels of fishing. They noted that legal-sized fish seemed to be getting smaller at the Actaeons, and that the smaller size was not caused by selectively fishing for smaller fish (which is rarely if ever practiced in the Eastern Zone).

Divers explained that the reduced catch rates in 13C could be attributed to fluctuations in weather. The coastline between Fishers Point and Whale Head requires low sea conditions for high catch rates, and they said that much of the catch was taken in unfavourable conditions, compared with previous years (although reasons for this pattern in effort were not clear).

14B had low catch and divers said that patches of good fish were scarce and mostly limited to the shore near Stringers Creek and parts of Hope Island. Concern was expressed that "ghost" weed was becoming common in this area and also in Great Taylors Bay (14C). The reduced catch in 14A and 14B was also caused by divers' preferences to fish elsewhere in winter, such as the East Coast.

Qualitative assessment

Region-wide, catch rates were high and stable. Some of the less productive sub-blocks

had reduced catch rates. The small-sized fish and high growth rates in most parts of this region indicate a recruit based fishery. The reduction in catch rates prior to the Actaeon's closure on 1 November confirms just how dependent this part of the fishery is upon successful recruitment, and that fluctuations in recruit abundance will have an immediate impact on catch rates. While it appears that the current catch cap (340 t) is sustainable, this is contingent on recruitment continuing at recent historical levels.

Bruny Island (Sub-blocks 14C, 14D, 14E, Blocks 15 and 16):

Fishery-dependent data

The Bruny regional catch (97 t) remained low in 2009 at approximately half the long-term average of 182 t (calculated using 70% of Block 14 catch up to 2000, plus catch from Blocks 15 and 16, then catch from 14C, 14D and 14E, plus Blocks 15 and 16 between 2000 and 2008).

Catches fell in almost every sub-block except south Bruny, where in 14D they increased to twice the previous year's catch at 19 t, and in 14C, where reported catches increased to 12 t. Incorrect reporting of estimated weights was identified in catch records from Blocks 15, 14C and 14D, and actual catches were substantially lower than our records show. This part of Bruny Island (14C, 14D) re-opened to fishing on 13 March 2009, after being closed for approximately 18 months as a precaution to prevent the spread of AVG.

Regional catch rates reversed their downward trend, rising sharply to their highest level (77 kg/hr) for many years. This trend was seen across most sub-blocks with the greatest increases in Blocks 15, 14C and 14D (although at least some of these increases were due to misreporting of catch). Declines in catch rates were observed in the south-east corner of Bruny Island, to 76 kg/hr (16A) and 67 kg/hr (14E). This fall in 14E comes off a 90 kg/hr peak reached in 2006.

Median sizes of abalone from Bruny Island tended to be large, typically 150 mm or more. Most sub-blocks (not 14D) show increasing median and 75th percentile lengths since 2004. This increase when viewed in combination with falling catch rates indicates a trend of reduced recruitment. Given the large median size of fish in this area, catch rates below 70 kg/hr represent low levels of abundance.

Diver perceptions

Observations from 14D and 14C were mixed with a few catch rates > 200 kg/hr while other divers found stock levels were unexceptional. Further east, around the Friars and north along the Strip (14E, 16A), fishing conditions were disappointing, and some experienced divers have expressed strong concerns about stock levels in this part of the region. The divers who chose to fish Bruny after the Actaeons closure (1 November 2010) found the fishing difficult. Most of these divers fished in 14E and 16A, where they found a sharp drop in catch rates to between 50 and 60 kg/hr. Some divers expressed the view that there was a cyclical process of good and bad fishing years at south Bruny, operating independently of levels of fishing pressure. Others said that the low catch rates were at least partly attributable to current divers preferences to work in shallower water, and that much of the better catches in earlier years were taken in relatively deep water.

Better fishing was experienced in Adventure Bay (16B), and north Bruny (16C, 16D), although divers thought that stock levels were reduced. They said that catch rates at north Bruny in winter were better than they had expected, and they attributed this to reduced levels of fishing effort.

Qualitative assessment

Stocks appeared stable at low to moderate levels, and unlikely to be increasing. Any improvements in catch rates appear to be due to lower catch rather than improvement in production. In the south-east part of Bruny Island (14E, 16A), stock levels have continually fallen in recent years, and there are no indications that they have stabilised.

Block 14 is of particular concern. In recent years, the annual catch has dropped sharply, and in 2009 was less than half the long term average, and one quarter of the levels seen during the early part of the fishery when catch was widely under-reported. This is concerning because the lower catch has not resulted in improvement in catch rates. Thus it appears that Block 14 has lost the capacity to produce between 100 t-200 t per annum as it did historically.

Storm Bay (Blocks 17-21):

Fishery-dependent data

Catch rates remained high (region: 89 kg/hr) and stable. Only one sub-block (20C) had catch rates below 80 kg/hr (78 kg/hr), and several (21A, 21C, 17B) were better than 90 kg/hr.

The annual catch increased slightly (by 4 t) to 124 t in 2009, still well down on peak catches earlier in the decade at 200 t in 2005. In contrast to the previous year, more catch came from the western side of Cape Raoul (Blocks 20, 17), than in Maingon Bay (Block 21), and there was a substantial increase in activity along the Blackjack Shore (17B).

All sub-blocks have shown a trend towards increasing median size and 75th percentile length since 2004, although in the northern part of the region (17B, 20A) abalone were smaller than in 2008. The level of sampling was again high, with between 10% and 30% of catches sampled.

Diver perceptions

The westerly weather patterns that prevailed throughout most of the year made fishing on the eastern shores of Storm Bay (Blocks 17 and 20) difficult, and under these conditions it was usually easier to fish the East Coast at Eaglehawk Neck. In addition, the water in Blocks 17 and 20 was frequently made turbid by freshwater from the Derwent River for months after exceptionally prolonged high rainfall. However, when conditions were suitable, divers landed good catches, and expressed no concerns that stocks were being depleted.

Qualitative assessment

The increasing size of fish, high catch rates, low visitation rates, low catch and divers' reports all indicate that stock levels were moderate to high in this region.

East Coast (Blocks 22 to 30, Sub-blocks 31A, part of 31B):

Fishery-dependent data

Prior to 2009, nearly all productive sub-blocks (i.e. those that produce > 10 t) had been experiencing catch-rate declines, some for periods of several years. In sharp contrast, in 2009 catch rates improved almost throughout the region. Most sub-blocks have catch rates of 80 kg/hr or more, with some (24D, 27A, 27B, 27C and 29D) approaching 100 kg/hr. In Block 31A, catch rates were 116 kg/hr. In 29A and 24E, catch rates remained similar to previous years, at 74 kg/hr and 86 kg/hr respectively.

The CPUE distribution shows an upward shift in the mode to the 75-100 kg/hr category, a reduction in catches taken at lower catch rates, and an increase in the proportion of catches taken between 100 kg/hr and 175 kg/hr.

The regional catch was 271 t, approximately 20% greater than in recent years, but well below the long-term average (355 t). The increased catch was almost entirely attributable to increased fishing in Block 22, where the 91 t annual catch was more than double its long-term average. In the remainder of the region, catch levels were relatively low, and similar to recent years.

The size distributions show no clear inter-annual trends. It might be expected that a sharp increase in CPUE would be accompanied by an increase in the number of small fish being landed, i.e. a reduction in 25th percentiles and median lengths; but in 2009, this was not the case. In 2008, however, smaller median lengths and 25th percentiles were common features of catches collected throughout the region (23A, 24D, 24E, 27D), and it is possible that the catch rate improvement in 2009 was preceded by a small boost to the numbers of recruits first evident in 2008. The lack of smaller fish in 2009, particularly in the more southern part of the East Coast (22A, 22B) suggests that the catch rate improvement may be short-lived.

Diver perceptions

Divers attributed the high level of catch in Block 22 to both high catch rates and to processors' preferences that divers land catch at Eaglehawk Neck (increasing transport efficiency by loading several catches into one truck). Divers saw no reason to fish elsewhere because the fishing was consistently good.

Divers also enjoyed good fishing further north at Maria Island (Block 24) and the Freycinet Peninsula (Block 27). They reported that most processors were not interested in picking up catches too far from their factories, the limit usually being Bicheno, and consequently few divers were able to fish much further north than Seymour (29A). However, those who fished near St Helens or Eddystone Point said that stock levels were high, and that the fish were mostly of good quality.

Divers were concerned about the grazing effects of the long-spined sea urchin *Centrostephanus* on abalone habitat, and its consequences for stock levels and the future of the East Coast. They expressed doubt about the viability of controlling *Centrostephanus* by maintaining populations of large rock lobsters because there were so few in shallow water. They said that they were interested in participating in the *Centrostephanus* destruction project, but that they usually only fished the project's reef areas during winter when the destructions of urchins increased risk of artificially induced spawning.

Divers were also concerned about the increased warming of East Coast waters and its effects on abalone growth, size at maturity and egg production. They were particularly cautious of increasing catch levels if, as evidence suggests, fecundity of populations is likely to be reduced. One diver reported that there were many small fish north of Paddys Head (Block 29), which could not be taken because they were below legal size.

Qualitative assessment

Catch rates indicated that there was an improvement in stock levels in 2009. There was no evidence for continuing increased recruitment so it appears that the current high catch rates may not be sustained in future years. Lower catch in the south (Block 22) and the aversion by processors to taking fish from the north-east will intensify pressure on stocks in the rest of the region. This area is likely to be most affected by climate change and there is concern about increasing *Centrostephanus* impacts on abalone habitat. Abalone stock levels on the East Coast appeared to be more dynamic than in other regions.

Central West Zone

Couta Rocks Region (Sub-block 5D and Block 6):

Fishery-dependent data

Catch rates increased slightly in 6A to 136 kg/hr, but fell substantially in the other three sub-blocks, although they remained above 120 kg/hr.

In Block 6, 143 t was taken, which was approximately one third more than recent annual totals. Of the sub-blocks where the size-limit was reduced from 136 mm to 132 mm in 2008, in 6A (north of Temma), and 6B (immediately south of Temma), the annual catch was approximately double the 2008 catch, at 50 t and 22 t respectively, while the catch almost halved in 6C to 23 t. In 6D (Sandy Cape), where the size limit has remained unchanged at 140 mm, the annual catch increased by 12 t to 47 t. No catch was reported from sub-block 5D.

The size of fish sampled from catches increased everywhere, with higher 25th, 50th (median) and 75th percentiles. The percentage of catches sampled ranged from 7 - 16%, with more catches sampled from the south. It is clear that divers were not fishing patches of small fish, and were attempting to meet processor requests for higher quality fish suited to live markets.

Diver perceptions

Divers reported that processors had different opinions about the areas that could supply fish of suitable quality for the live market, and this controlled the distribution of effort in Block 6, particularly after Blocks 7 and 8, the source of most of the live market Central West fish closed in July.

Some processors would only take fish from Sandy Cape and this area was heavily fished. Others were apparently more willing to take fish from anywhere in Block 6, provided the fish were of sufficient quality. In the north of Block 6, (6A and 6B) visiting divers (as distinct from divers from the north-west) landed most of the catch. They had no concerns with stock levels and catch rates, although some said it was difficult to find fish of the quality requested by processors.

Divers believed that the size limit from Couta Rocks south to the Wild Wave River (effectively 6B and 6C) is now too small. The reduction of the size limit from 136 mm to 132 mm enabled a short-term increase in catch rates in 2008, but most of these smaller fish have been removed with no apparent long-term benefit. Many areas that provided good quality fish at the 136-mm size limit, such as Possum Banks, Jack Smiths, the Gannet, Dawsons Bay and Ordnance Point were heavily fished in 2009, and there is uncertainty about their ability to produce similar amounts of fish in 2010.

Qualitative assessment

Stock levels in most areas, particularly the north, remain moderate to high, although there are signs that the prime area around Sandy Cape has been depleted. The increased size of fish means that divers are not taking full advantage of the reduced size limit, but are instead finding areas of better quality fish to meet processors' requests.

Granville Harbour Region (Blocks 7 to 8):

Fishery-dependent data

At the start of 2009, catch rates were initially high to very high (>200 kg/hr) in both blocks, but fell back to lower levels (<150 kg/hr) prior to the closure in July.

The cap (catch limit) for this region was set at 108 t. The cap was reached in early July, and by the time the fishery closure was affected, 155 t had been taken. Of this, 104 t was taken from Block 7, and a further 51 t from Block 8 (a further 3.3 t is logged from Block 7 in November, but this is a data error).

Similar quantities of catch have been taken from Block 7 in recent years, but it is not since the 1980's that Block 8 has produced this much catch. The presence of motherships in the zone meant that effort was more widely distributed, accounting for part of the increased Block 8 catch.

The level of length data sampling was insufficient to detect any clear trend in the size of fish compared with previous years. In common with other parts of the west coast, median lengths were approximately 155 mm, and 75th percentiles between 160 mm and 165 mm, i.e. the fish were of large size.

Diver perceptions

Generally, divers were pleased with stock levels in the region. Many divers fished there for the first time, and fished in places usually bypassed by more experienced divers. Despite this, they were mostly successful. They had no trouble finding fish in Blocks 7 and 8, and when the weather was suitable, divers converged on the region in dinghies, runabouts and motherships (for the first time in many years, there was an increased presence of motherships in the region).

Processors and quota owners were aware of the limited catch available from the region (108 t), and preferring to have their Central West quota caught here rather than Couta Rocks, directed divers to the region. This meant that whenever a suitable weather window appeared, large portions of the Block 7/8 cap were landed and the cap eventually exceeded.

While the Granville fish were reputed to be have been of better quality than the fish landed at Couta Rocks, this was not reflected in the beach price. Up until the end of

July, the average price for fish landed at Couta Rocks was \$31.02, compared with \$30.82 at Granville Harbour and \$30.97 at Strahan. In contrast, fish landed from motherships in southern ports (almost all taken from Blocks 7 and 8) received an average of \$32.74.

Qualitative assessment

The creation of the Central West Zone has increased levels of effort in the region not seen since the 1980's. The high hourly catch rates in conjunction with the rapid fishing down of the cap and the success of some divers unfamiliar with the region, all indicate that stocks were perhaps larger and more widespread than anticipated. While catch rates have certainly declined, they fell slowly over the fishing period, and only to moderate levels. There is uncertainty that the same level of catch could be taken in 2010.

Western Zone

Strahan Region (Block 9):

Fishery-dependent data

Catch rates increased to levels not seen since 2000, at 179 kg/hr in 9C, and 165 kg/hr in 9B.

2009 was the first year in which Block 9 catches have been capped. The total catch for Block 9 was 155 t, and consequently the 166 t cap was not reached. This level of catch is approximately equal to the recent 10-year average of catches from this block (156 t). The catch was mostly taken from 9B (90 t) and 9C (63 t), with under 2 t taken from the short strip of coast between Macquarie Heads and Cape Sorell (9A).

There were no clear trends in size of fish, but they remained large, with median lengths of 155 mm or more. The level of sampling from 9C was low (6% of catches), and needs to be increased in order that it can provide useful information.

Diver perceptions

Almost all the Block 9 catch was taken from dinghies or runabouts operating from Macquarie Heads or Strahan. The reduced catch compared with recent years can be attributed partly to the creation of the Central West Zone and the diversion of effort there, and the continuing preferences of processors for Western Zone catch landed from motherships in southern ports rather than freighted by road from Strahan.

Divers reported that fishing was good, with the best fishing in shallow water. Fishing in deeper water (>10m depth) was much less productive. They said that much of the improvement in catch rates could be attributed to better weather forecasting and more widespread usage of internet and phone weather reports, particularly Buoyweather and Weatherzone. While divers have used these services for many years, they report that recently forecasting has become consistently more reliable, and that they are able to plan diving around low swell windows much more successfully. This enabled them to fish shallow inshore abalone populations that they could not reach when sea heights were up. They said that the weather forecasting reduced the need for them to work in adverse conditions that made catching abalone difficult and reduced catch rates, making their diving operations easier, safer and more productive.

Qualitative assessment

The increased catch rates and moderate level of catch indicate that stock levels were stable. However, it is difficult to determine how much of the catch-rate increase was due to improvements in forecasting and how much to improvements in stock levels.

South West (Blocks 10 to 11, Sub-block 12A):

Fishery-dependent data

Catch rates have been falling in this area for many years but appeared to stabilise in 2009. The combined regional catch rate was 122 kg/hr, but this varied widely between sub-blocks. Catch rates in northern sub-blocks with comparatively little catch were just short of 150 kg/hr (10B, 10C), while in the more heavily fished south catch rates were usually less than 120 kg/hr i.e. sub-blocks with the greatest reduction in catch generally had the best catch rates.

Following the creation of the Central West Zone and the imposition of a cap (458 t), the annual catch from the South West has been reduced by approximately one third of recent levels to 437 t. There were substantial reductions in catch in most sub-blocks, but particularly so on the coast from 10A to 10C (Point Hibbs to the Mainwaring River), and 11A to 11C (Low Rocky to Port Davey). The catch increased in 12A. Most of the 2009 catch came from between Port Davey north to the Mainwaring River (11C, 11B, 11A and 10D), and south of Port Davey in 12A.

Catch sampling from this region is made difficult because most fishing is done from motherships, and usually landings comprise catches mixed from several sub-blocks. Consequently, changes in the size of fish measured from samples are almost invariably confounded by spatial factors. The fish from this region are usually large, with median lengths of 155 mm or more.

Diver perceptions

Most divers reported low stock levels, particularly in the vicinity of Port Davey and near popular anchorages elsewhere. In these areas, some reefs which were formerly productive abalone habitat have become devoid of abalone and divers questioned the adequacy of the 140-mm size limit and its role in protecting stocks. In areas still fished, patches of abalone have become uncommon and patch-sizes have become smaller. Fishing improved following spells of prolonged bad weather which allowed some recovery. Divers who fished further north in Block 10 achieved reasonable catch rates.

Divers spoke of the benefits to their operations in this area from improved weather forecasting. Some mothership operators said that they now generally left port one day later each weather window. This meant that they avoided reaching the fishing grounds too early and having to work in the last day of a falling swell, which improved the overall efficiency of their fishing operations, including catch rates.

Qualitative assessment

Stocks have been considerably reduced throughout this region by years of overfishing. The size limit may have failed to protect some populations resulting in enduring depletion. It remains to be seen whether the TAC reduction and cap are sufficient to stabilise catch rates and enable some stock rebuilding, or whether further reductions are required.

South Coast (Sub-blocks 12B, 12C, 12D, 13A, 13B):*Fishery-dependent data*

Catch rates in this region have remained surprisingly stable considering the high levels of catch in the recent past, fluctuating between 93 kg/hr and 104 kg/hr. In 2009, the regional catch rate was 99 kg/hr. Catch rates in individual sub-blocks varied according to the distance from boat ramps in the south east, with the most distant having the highest rates (12C – 117 kg/hr), and the closest the lowest catch rates (13A – 83 kg/hr).

The South Coast catch was 321 t, overrunning the 300 t cap before it was closed on 1 November. Much of the increased catch came from 12D (143 t), where landings were almost 50% greater than the recent (2000-2008) average (97 t). Catches from the other sub-blocks were approximately average (12B – 61 t, 12C – 39 t, 13A – 36 t, 13B – 41 t).

Length data from the South Coast are of high quality, mostly because catches are landed daily and it is possible to match catches to individual sub-blocks. Across each of the five sub-blocks, the size of fish in 2008 and 2009 has decreased compared with earlier years, and in all except 12C, median lengths have fallen to 150 mm, and 75th percentiles to less than 160 mm i.e. they are of similar size to fish from most parts of the south of the Eastern Zone, and smaller than fish from some sub-blocks (22A, 21C, 16A). The 25th percentile has fallen to 145 mm, indicating the proportion of recruits in the catch is increasing. In 12C (Maatsuyker Group), the fish were slightly larger.

The increase in the proportion of recruits is unlikely to be associated with an unusually large recruitment event. If this was the case, then catch rates would almost certainly increase. In the context of current catch rates, the high proportion of recruits probably represents high exploitation rates.

Diver perceptions

Most divers believed that South Coast stocks have been extensively depleted. There were many trips back to the ramp with less than 300kg on board, and divers were concerned about the economic viability of fishing this part of the coast. Nearly all divers stated that stock levels were under pressure, and unless they were familiar with the region and knew where to avoid recent fishing, found it difficult to achieve satisfactory catch rates. They agreed that stock levels were at best stable, and probably falling.

The increased effort on the South Coast has been market-driven, with processors preferring fish from this region. In addition, parts of the South Coast can be fished in conditions that would make fishing impractical west of South West Cape, and processors rely on this part of the coast to be able to fill orders for Western Zone fish.

Some divers believe that the South Coast fishery is more resilient to intensive fishing than other areas, including the South West. They say that this is because South Coast abalone habitat is more cryptic (more boulders, less slabs) and enables part of the population to remain hidden and evade capture. Consequently, although catch rates are generally lower, the widespread depletion seen in the South West is less evident on the South Coast.

Qualitative assessment

Catch rates, while appearing stable were at a relatively low level. The effect of improved weather forecasting on catch rates cannot be quantified, but is likely to cause catch rates to rise relative to stock size, or to be stable when stocks are falling.

The catch history shows many cases where there have been large falls in annual catch following years of high catch. The 2008 and 2009 South Coast catches were very high compared with recent past catches. For example, the post-zoning 2000-2008 average is 278 t, whilst the 1985-2008 (estimated) average is lower still at 224 t.

Stable catch rates (despite improvements in weather forecasting) combined with declining size of fish indicates that exploitation rates were high. The increasing proportion of recruits in the catch increases dependency on a reduced range of year classes to supply fish, which increases risk (through greater exposure to lower recruitment).

In conclusion, stock levels were at best stable, and probably falling. The current level of catch increases risk of fishery impacts from below average recruitment.

Northern Zone

King Island (Blocks 1 to 4):

Fishery-dependent data

Catch rates were lower in 2009 compared with the previous year, falling from 122 kg/hr to 106 kg/hr. There was an accompanying shift in effort from deep water to shallower water stocks.

The 2009 catch remained low (42 t) although it was slightly higher than the previous year. In comparison, almost 130 t was taken each year in 2004 and 2005. Most of the blacklip catch was taken from Block 3 (27 t). Like 2008, most of the catch was taken by the resident divers, although in 2009 several motherships made brief visits to the island.

There is no information about changes in median length (no catch sampling was done on the island).

Diver perceptions

In 2008 most of the catch was taken from deep-water stocks that had not been fished for many years and consequently abalone were abundant and catch rates high (frequently >150 kg/hr). However, markets preferred the higher quality fish from shallower water where the fishing was more difficult, and although stocks levels still appear satisfactory, catch rates have fallen.

Following changes to the landing requirements for catch from motherships in Tasmanian (mainland) waters, several motherships have visited King Island. They said that abalone were abundant. The major impediments to fishing King Island were seen to be the requirements of the AVG risk reduction strategy (i.e. landing restrictions) and the difficulty in finding fish that met market requirements.

Qualitative assessment

Levels of fishing appeared sustainable. Stocks in shallow water appeared to be high and rebuilding.

North West (Blocks 47 to 49, Sub-blocks 5A, 5B, 5C):*Fishery-dependent data*

Catch rates remained high across this region at 100 kg/hr. This high level was due to the large amount of catch taken from Albatross Island and the Bluff. Catch rates from 49B (Albatross Island) were 117 kg/hr, and from 5C (the Bluff) were 107 kg/hr. Catch rates at one of the key areas in 2008 (the flats south of Trefoil Island) fell slightly to 93 kg/hr, presumably in response to the unusually large 2008 catch. It appears that the high regional catch rates were a consequence of divers ability to rotate effort between key areas which were being successively depleted.

Monthly catch rates in 5C fell through the year in response to removals through the season (Figure 2). The large (38 t) November catch was taken at an overall average of 106 kg/hr, down from 130 kg/hr in January. During the last half of November, almost 25% of catches were taken at rates between 50 kg/hr and 70 kg/hr.

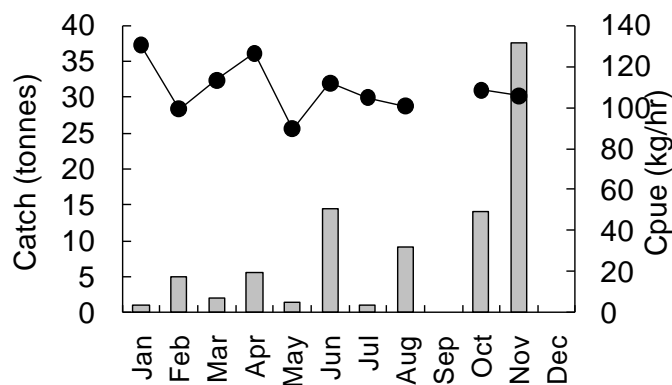


Figure 2. Catch rates and catch totals in sub-block 5C, 2009, showing the distribution of catch by month, and the decline in catch rates during the year.

The regional catch was 250 t similar to that of the previous year. Most of the catch (almost 70%) was taken in Block 5. The Block 5 cap was overrun by 19 t, and the fishery was closed on 1 December with the total at 171 t. The main fishing grounds in Block 5 included the area west of Woolnorth (5A) and the area around Bluff Hill Point (5C). In 2009, the 5A catch was sharply reduced from 71 t (2008) to 45 t. There was a corresponding increase in catch in 5C, from 57 t (2008) to 92 t. The catch in 5B remained high (35 t). Much of the increased catch was taken in November, when there was an unusually long period of good weather.

Further north in Block 48, the catch was 75 t. Although the recent average has been 59 t, the Block 49 catch was not unusually high, having been at that level several times in the post-zoning period. Over half (40 t) the Block 49 catch came from 49B, where most was reported taken from Albatross Island.

Only 4 t was taken from Block 48. No catch was taken from Block 47.

The level of catch sampling from Block 5 catches was adequate with coverage of between 7% and 14% for each sub-block. Trends in Block 49 could not be assessed because sufficient coverage has not been achieved until recently. All three Block 5 sub-blocks show larger median sizes and 75th percentile lengths than in 2008.

Diver perceptions

Processors preferred live market fish from two key areas of the North West: Albatross Island in 49B, and Bluff Hill Point in 5C. Despite uncertainty about fish stocks at Albatross Island in 2008, divers found that it fished well in 2009. Most divers also reported good fishing at the Bluff, but believed that stock levels were heavily impacted by intensive fishing towards the end of 2009, and doubted that it could continue to supply the same level of fish in 2010. They said that they preferred to catch the Bluff fish early in the year before catch rates fell.

The Trefoil flats in 5A were heavily fished in 2008 and divers reported that these remained depleted in 2009. Three Hummock Island continued to fish well, although most processors found the fish unacceptable for the live market.

Most divers were not fishing patches of small fish following the decrease in size-limit in Block 5, but were able to take more (smaller) fish from the areas that they had formerly fished at 132 mm. Change in quality of fish was hard to gauge over such a short time period but divers said new recruits also were crusty-shelled fish i.e. they could see no improvement in fish quality.

Divers were concerned with the size of the Block 5 cap, believing that it was too high and unsustainable.

Qualitative assessment

Catch rates remained high in the North West, despite the large catch. It appears that this stability in catch rates was caused by divers moving between areas which have been depleted. This strategy will be successful until the rate of fishing exceeds the rate of recovery in each area. The live market depended upon only a relatively small part of the fishery (Albatross Island and the Bluff). The large catch would be more sustainable if acceptable quality fish could be found in other places, such as Woolnorth or Three Hummock Island.

North East (Northern part of 31B, Blocks 39 and 40), **Furieux Group** (Blocks 32 to 36, 38A):

Fishery-dependent data

Catch rates in the North East fell marginally to 56 kg/hr, rising slightly in 31B to 63 kg/hr and falling quite steeply to 43 kg/hr in 39A. Catch rates in the Furieux Group fell to 47 kg/hr. In this region particularly Block 33, catch rates varied greatly between years, and almost certainly reflected the ability of visiting divers to find isolated pockets of abalone rather than genuine variation in abundance. In both 39A in the North East and in many parts of the Furieux Group, much of the total blacklip catch was taken as by-catch of greenlip fishing, and low catch rates frequently arose when divers did not apportion effort between the two species.

The North East catch was 29 t, compared with 34 t in 2008, and 66 t the previous year. Of the 29 t, 20 t was taken from around Swan Island (31B) and the remainder from

Cape Portland (39A). In the Furneaux Group, just 8 t was landed, of which 4 t came from the south-east of Cape Barren Island (Block 33) and 1.4 t from Babel Island (sub-block 38A).

No measurements of abalone were obtained from catch sampling.

Diver perceptions

As in 2008, divers reported that blacklip fishing was poor at Swan Island, and that populations were yet to recover from 2007, when an unusually high catch was taken. Many divers who formerly worked in the region have moved elsewhere.

Qualitative assessment

Blacklip stocks were substantially reduced in the North East following the high level of catch in 2007. There was insufficient information to determine whether stocks were stable but at a reduced level, or whether they have continued to decline. Blacklip stocks were assumed to be stable in the Furneaux Group due to the low level of catch.

Bass Strait Zone

There are three main regions in the Bass Strait zone: the Central North Coast of the Tasmanian mainland (Blocks 41-46), the Furneaux Group (Block 37) and the remote Bass Strait islands, including the Hogan, Kent and Curtis Groups (Blocks 50-57). Of the 70 t TAC, almost half (36 t) was caught in the remote island region and of this, 24 t was taken from the Hogan Group. In the Furneaux Group, 10 t was caught from Block 37, most (7 t) of which came from the Sisters or northern tip of Flinders Island (37D). The remaining 24 t of the TAC was caught across the Central North Coast, one of the highest levels of catch since the size-limit was reduced in 1989.

Catch rates improved in the Central North from 41 kg/hr to 52 kg/hr. Elsewhere they fell slightly: in the Furneaux Group to 49 kg/hr and in the Bass Strait islands to 66 kg/hr.

Insufficient catches were sampled to provide information about the size of abalone.

Diver perceptions

Most of the catch from the central North Coast was taken between Port Sorell and Bridport, with effort focused around the mouth of the Tamar. The increased effort in this region was partially due to the reduced availability of motherships for work further offshore.

The divers who travelled to Hogan Island reported reasonable fishing. Elsewhere in the remote islands, fishing conditions were fine unless another diver had fished there recently, and then it became evident how slowly Bass Strait populations recovered from fishing compared with other parts of the state.

Qualitative assessment

The Central North Coast fished well in 2009 but exhibited a low rate of recovery. Much of the attention focussed on the Central North Coast is expected to be diverted to the southern part of the Furneaux Group in 2010 where the Bass Strait/Northern Zone boundary change and size-limit reduction will increase the availability of fish. Catch

rates in Block 37 (Flinders Island) and the remote Bass Strait islands declined slightly, but remained acceptable for most divers.

Greenlip fishery

Fishery derived performance measures such as changes in catch rates and catch are difficult to interpret for the greenlip fishery for the following reasons:

- The greenlip TAC is relatively small, and each region's catch is capped, effectively masking changes in catch that might indicate changed stock levels.
- Consistent catch rates are dependent on current knowledge of a regions' stocks. Most of the greenlip catch from the offshore islands is taken by a few resident divers, and under these circumstances, catch rates may be better indicators of abundance than on Tasmania's mainland, where divers with a range of levels of knowledge operate.
- Where divers catch both greenlip and blacklip in a single fishing trip effort may be reported in two ways. Some divers estimate the proportion of time taken to catch each species, while others report the total amount of fishing time twice, once for each species. Reliability of the first method depends upon the divers' ability to accurately gauge how much time was devoted to catching each species. The second method is likely to be more accurate, but catch rates will be lower (for both species). The effect of the second method is noticeable in CPUE distributions from these regions where up to 20% of catches were reported with catch rates of less than 25 kg/hr. It is also noticeable in CPUE time series, where varying proportions of the usage of both methods masks the abundance signal. In 2009, DPIPWE wrote to all divers requesting that they report effort for each species as a proportion of the trip's total effort.
- Markets often preferred large greenlip to smaller greenlip. A diver selecting only large greenlip will usually catch fish at lower catch rates than a diver who takes fish of all legal sizes.

The King Island catch was 25 t. The King Island catch has been capped at 30 t, but has not reached that level since 2004, because for a variety of reasons most divers find it difficult to work there. The island produces high quality greenlip that command premium prices on the domestic live market. However, because of its remoteness, it is costly for non-resident divers to operate there. The catch from local divers is limited by market demand. In 2009, local divers took two thirds of the greenlip catch, the balance being caught by visitors working from motherships. Catch rates were variable between sub-blocks in a range between 55 kg/hr and 65 kg/hr. There is no evidence that stock levels were changing rapidly, and divers reported that fishing conditions had not changed significantly.

In the North West, 33 t was landed. The North West greenlip cap was 30 t. Of the 2009 catch, 20 t came from the reduced size-limit area at Black Reef in Perkins Bay (48A and Block 47), 11 t from Woolnorth (5A, 48C, 49C) and 2 t from the Petrels (48B). Woolnorth once supplied greater levels of catch, but because of the Perkins Bay fishery, only 10 t is available in the remainder of the North West. Most divers landed reasonable catches at Woolnorth, and reported good fishing conditions. The fishing was slower at the Petrels. At Black Reef, the fishing was again very good, with mean catch rates of 111 kg/hr, and some individual catch rates of 200 kg/hr. There were no reports that stock levels were being depleted, and some divers said that the quality of fish was

improving with the high rate of fishing pressure as presumably the old fish were being replaced with fast-growing recruits.

The North East cap of 23 t was overrun by 12 t, i.e. 35 t was landed. The region was closed to greenlip fishing on 19 October. Of the 35 t, 20 t was taken from the short stretch of coast around Cape Portland and the Foster Islands (39A), 9.5 t from 31B (mostly from a similarly small length of coastline around Swan Island), and 1 t from the Waterhouse region (40B). Interestingly, 3.7 t was reported from 31A, which has never previously produced greenlip since reporting at sub-block level began. Not surprisingly, divers reported that fishing was good in the North East, and some of the largest catches in the state were taken here. However, the high level of fishing mortality was evident by late winter, and stocks were reported extensively depleted when the fishery closed.

In the Furneaux Group, the total catch has dropped to 27 t, from a capped total of 42 t. The most heavily fished areas were Franklin Sound (Block 35 – 12.5 t) and the south-east of Cape Barren Island and Clarke Island (Blocks 32 and 33 – 7 t).

Qualitative assessment

Greenlip stocks appear to be stable across the wider fishery, although the large catch in the North East has reduced stock levels there, and it may take some time for catch rates to recover to former levels. Because of the low catch in the North West outside the Perkins Bay area, potentially greater amounts of catch than the 10 t allowed could probably be taken without causing a long-term reduction in stock levels.

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 dive licenses has trended strongly upwards since 1996 but has remained stable since 2007 (Figure 3). Between 12,500 and 13,500 licenses have been issued during each of the last four seasons. For the fishing season 2009/2010, 13,068 licenses were issued.

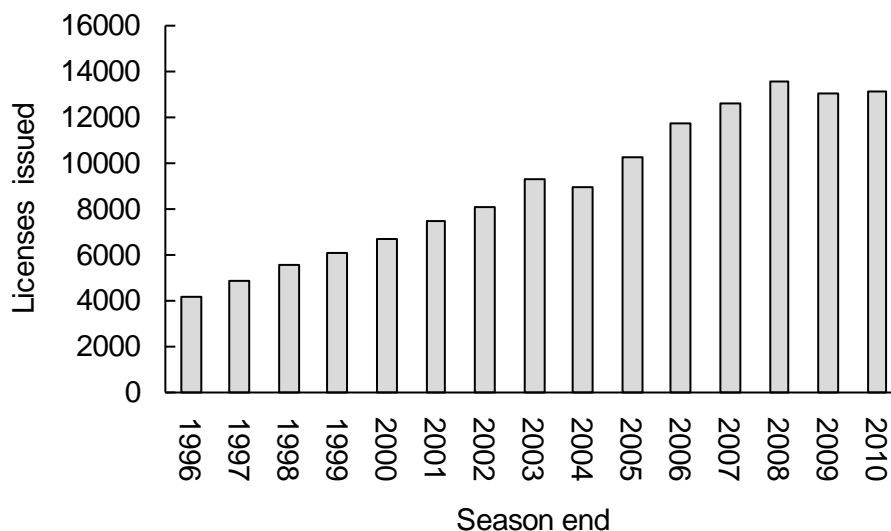


Figure 3. The number of recreational abalone diving licenses issued for the fishing seasons 1996-2010.

The most recent survey of recreational divers was undertaken for the 2008/2009 season (Lyle and Tracey, 2010). Its results showed that 81,500 abalone (approximately 39 t) were taken by the recreational fishery, i.e. about 1.5% of the total Tasmanian abalone catch. Almost 60% of the recreational catch was taken in the east and south-east between Southport and Eddystone Point, or the area covered by Blocks 14 to 30. Another 20% was taken on the coast north of latitude 41° (which passes near Eddystone Point in the east, and Bluff Hill Point in the west, and includes the Bass Strait islands), and the remainder was caught on the west and south coasts east to longitude 147° (near Southport).

Indigenous, illegal and permit fisheries

Abalone were caught in Tasmanian waters as part of cultural fishing activities by indigenous people, under permits for special events and research purposes, and as part of illegal fishing operations. There were no estimates available for either the illegal catch or for the total catch from cultural fishing activities. The quantity of abalone taken under permits for special events and research purposes was less than two tonnes.

Assessment Summary

Eastern Zone

Actaeons: Stock levels appeared stable or possibly decreasing slightly. This area has an especially high level of dependency upon successful annual recruitment.

Bruny Island: In the south-east of the island stock levels were reduced and probably decreasing. Elsewhere, stocks were at best stable.

Storm Bay: Stock levels appeared stable or possibly increasing, unlikely to be decreasing.

East Coast: Stock levels increased from 2008 to 2009, as did the catch. Stock levels appeared stable but tend to be volatile in this region.

Central Western Zone

Couta Rocks: Stock levels were moderate.

Granville Harbour: Stock levels were moderate to high but appeared to be decreasing.

Western Zone

Strahan south: Stock levels were moderate and appeared stable.

South West: Stocks have been in sustained decline although there were indications that this decline has stabilised.

South Coast: Stocks have been reduced to relatively low levels and appeared to be stable or in decline.

Northern Zone

North West: Stock levels were moderate to high, but were probably falling under the sustained high catch.

King Island: The level of catch was low. There were no indications that levels of fishing were unsustainable. Stock levels in shallow water appeared to be stable

North East, Furneaux Group: North East blacklip stocks have been considerably reduced. There has been insufficient fishing of blacklip in the Furneaux Group to provide information about stock levels, and it is assumed that they were stable.

Bass Strait Zone:

Remote Bass Strait islands: Stock levels were possibly stable but more probably decreasing slowly.

Furneaux Group: In Block 37 stock levels were possibly stable but more probably decreasing slowly. There will be increased catch in the remainder of the Furneaux Group following the zone boundary change and size-limit reduction there.

Central North Coast: Fishing of forgotten or long-rested reefs produced larger than expected catches but because of slow recovery, stocks were assumed considerably reduced.

Greenlip:

King Island: Stock levels appeared low to moderate.

North West except Perkins Bay: Stock levels appeared moderate.

Perkins Bay (including Black Reef): Stock levels remained high.

North East: Stock levels were moderate at the start of the season but became depleted.

Furneaux Group: Stocks continued to rebuild and are at moderate levels.

Management recommendations

Eastern Zone: The TAC for 2009 was increased by 42 t in consideration of high catch rates in key areas of the fishery. This end-of-year assessment shows that of the four

regions, the Actaeons were fully exploited, Bruny Island and the southern parts of the East Coast were fully or over-exploited, and that Storm Bay and the north-east part of the East Coast were probably under-exploited. The key to successful management of stock levels in this zone during 2010 lies through the diversion of effort to the two areas that can sustain greater levels of catch. Non-fishing impacts of the expansion of long-spined sea urchin barrens and the effect of increased water temperatures on abalone population dynamics require monitoring.

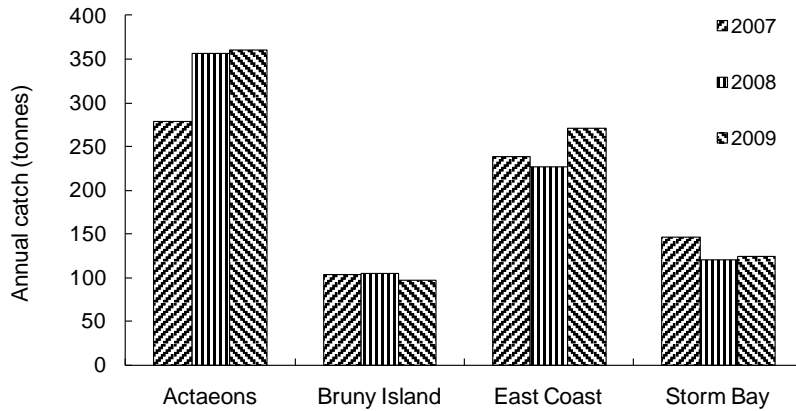
Western Zone: Following the reduction in catch from the South West, catch rates appear to have responded. Catches from the region will require ongoing management to ensure that the level of catch reduction is sufficient to enable rebuilding of stocks as planned. It is evident that size limits have failed to maintain reproductive capacity sufficient for the level of catch, and managers may wish to investigate whether the larger growing population in this region are adequately protected to enable sustainable fishing. For the past two years, South Coast annual catches have been among the largest on record. It is uncertain that the South Coast can continue supplying catches of this magnitude without affecting catch rates or reproductive capacity.

In general: Management and administration of the spatial distribution of catch was a problem in 2009. Caps in some areas were overrun by excessive catch (e.g. the Blocks 7 and 8 blacklip cap and the North East greenlip cap), while other areas produced negligible catch (e.g. Block 31). Thus there appears to be a need to either modify the system of responding to caps or develop alternative spatial controls.

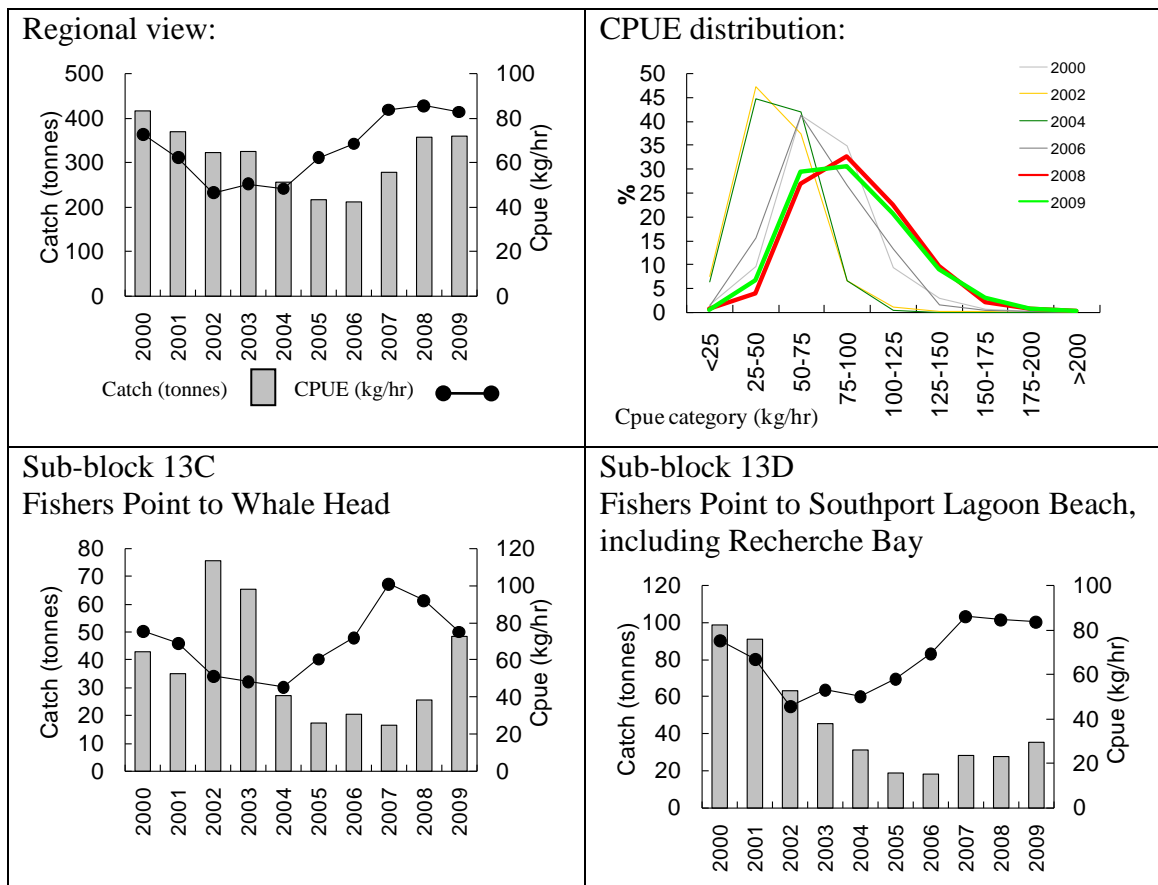
Appendix 1: Catch, catch-rates and size-composition

Eastern Zone blacklip fishery

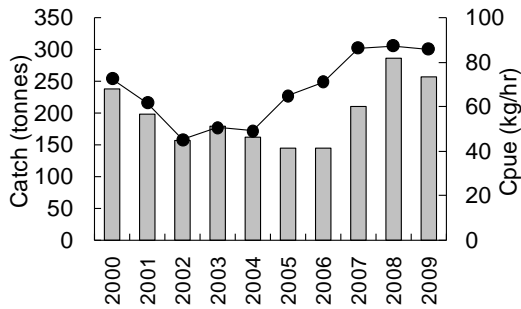
Distribution of catch between the four main regions of the fishery:



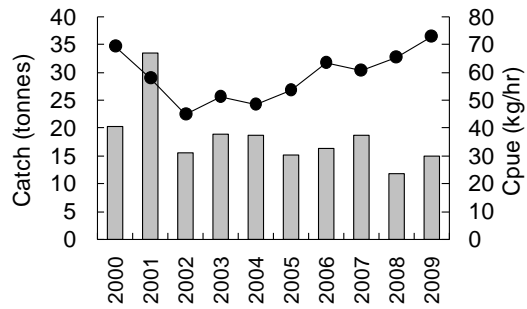
Eastern Zone - Actaeons, Lower Channel (Sub-blocks 13C, 13D, 13E, 14A, 14B)



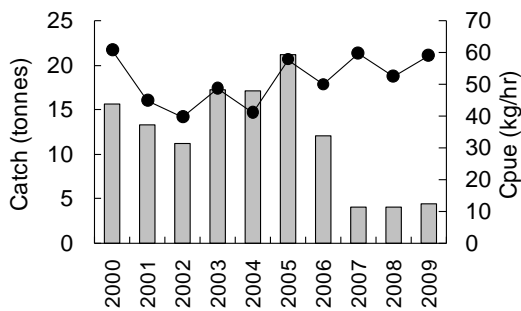
Sub-block 13E
Actaeon and Sterile Islands, and reefs to the south (the Breaks)



Sub-block 14A
Southport Lagoon Beach to Burnett Point

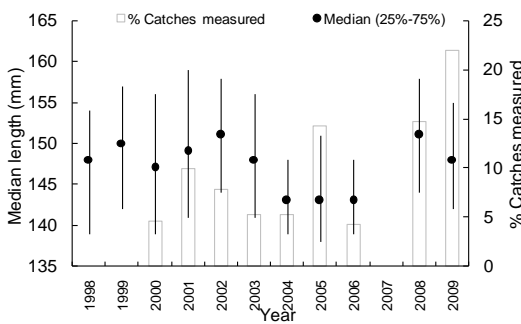


Sub-block 14B
Burnett Point to Blubber Head

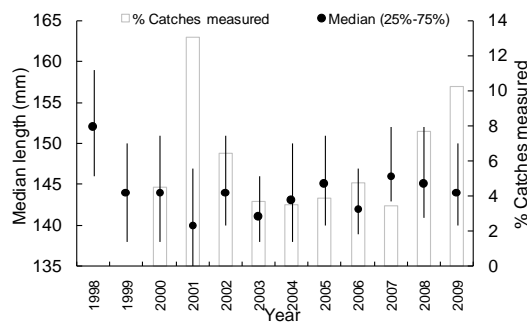


Actaeons, Lower Channel (Sub-blocks 13C, 13D, 13E, 14A, 14B)
Median length of catch

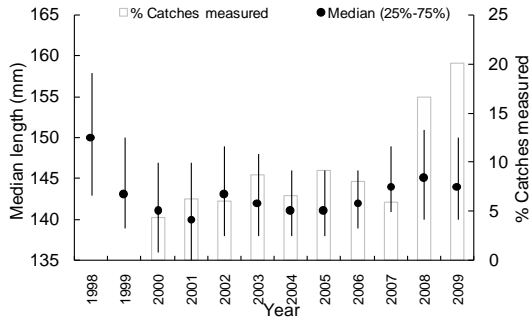
Sub-block 13C
Whale Head to Fishers Point



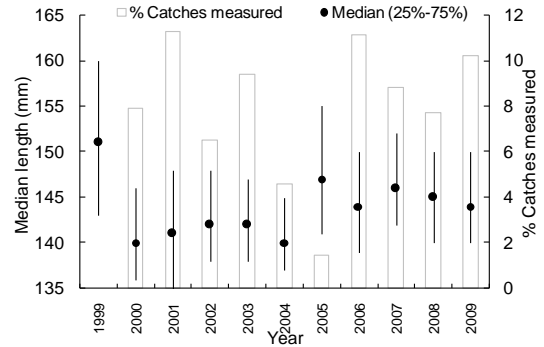
Sub-block 13D
Fishers Point to Southport Lagoon Beach, including Recherche Bay



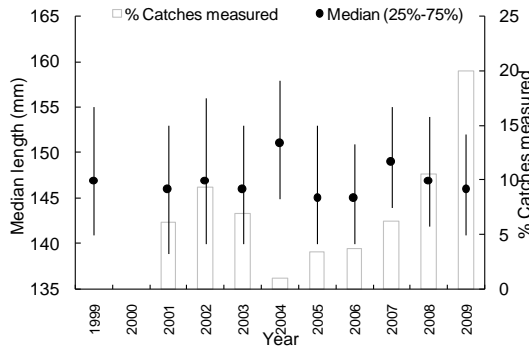
Sub-block 13E
Actaeon and Sterile Islands, and reefs to the south (the Breaks)



Sub-block 14A
Southport Lagoon Beach to Burnett Point

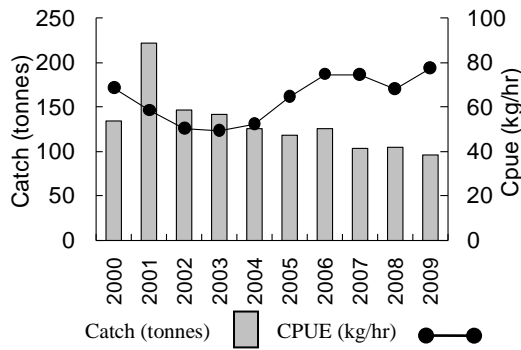


Sub-block 14B
Burnett Point to Blubber Head

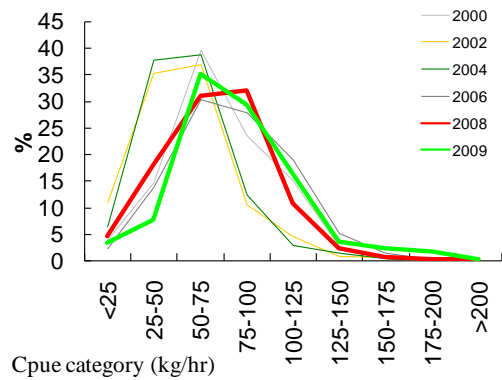


Eastern Zone – Bruny Island (Blocks 14C, 14D, 14E, 15, 16).

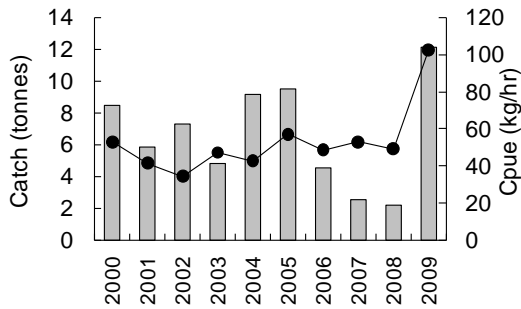
Regional view:



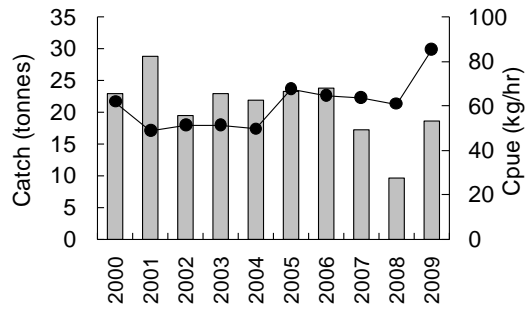
CPUE distribution:



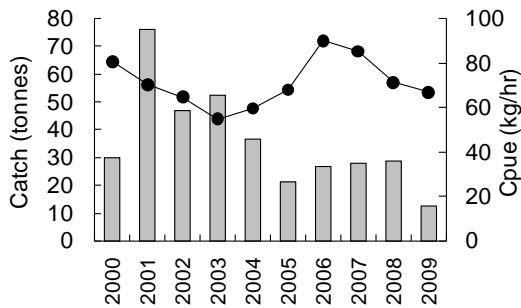
Sub-block 14C
Mays Creek to Hopwood Light (Lower Channel)



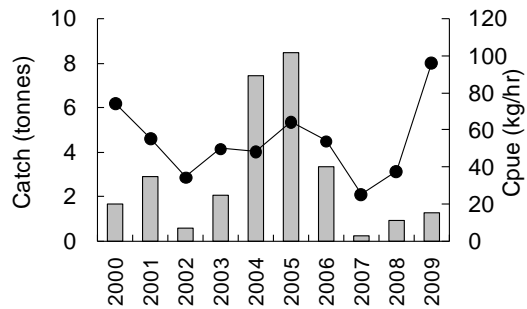
Sub-block 14D
Hopwood Point to West Cloudy Head



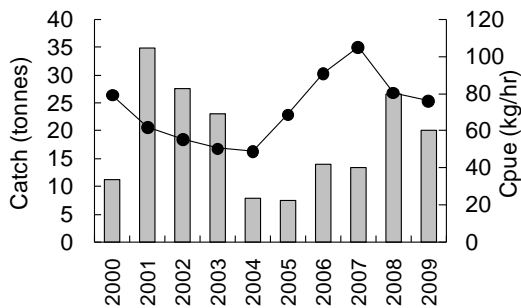
Sub-block 14E
West Cloudy Head to Boreel Head, including the Friars



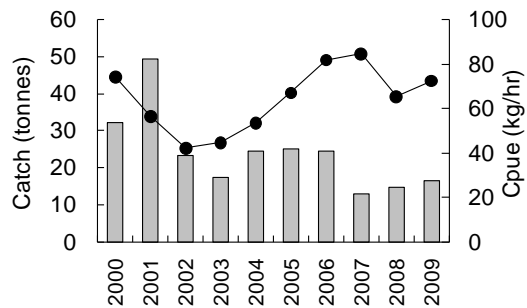
Block 15
D'Entrecasteaux Channel, Huon Estuary



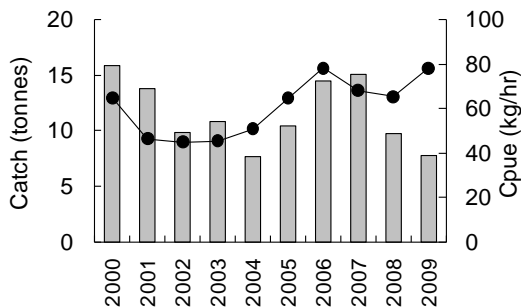
Sub-block 16A
Boreel Head to North Mangana Bluff



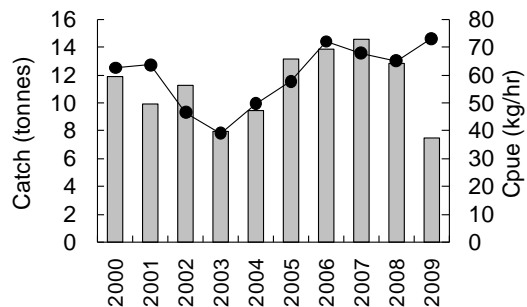
Sub-block 16B
North Mangana Bluff to Neck Beach



Sub-block 16C
Neck Beach to Trumpeter Bay

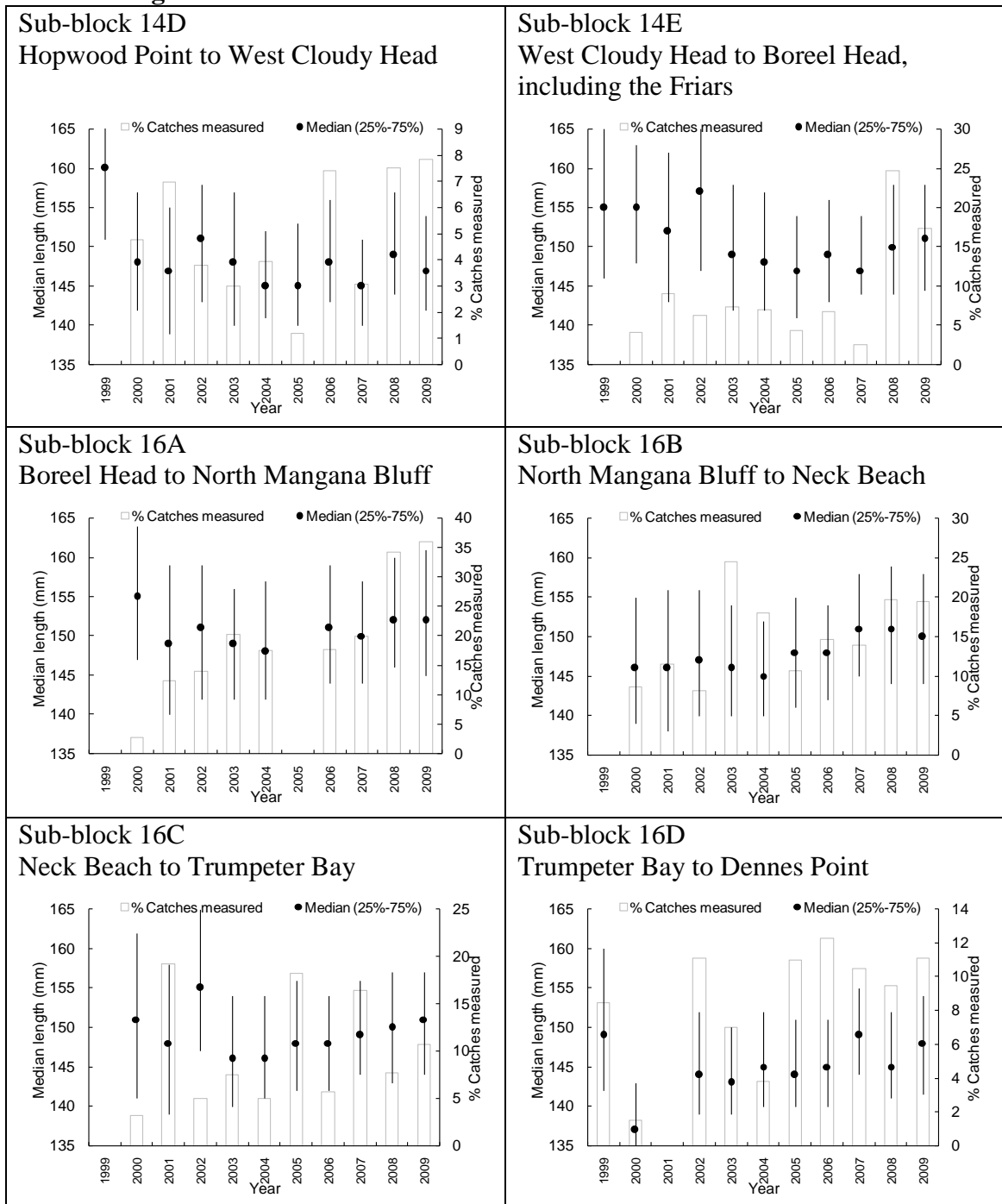


Sub-block 16D
Trumpeter Bay to Dennes Point

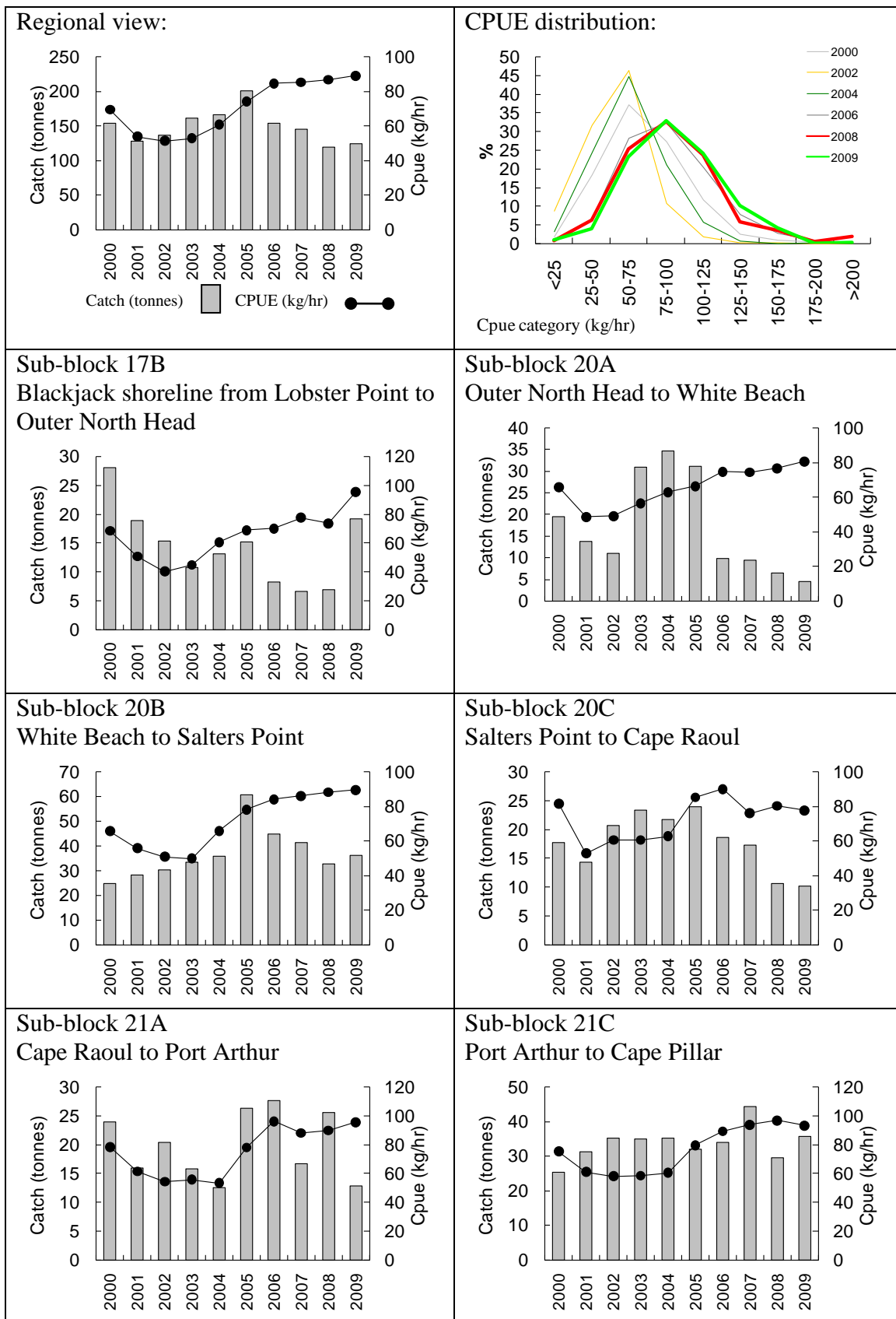


Eastern Zone – Bruny Island (Blocks 14C, 14D, 14E, 15, 16).

Median length of catch

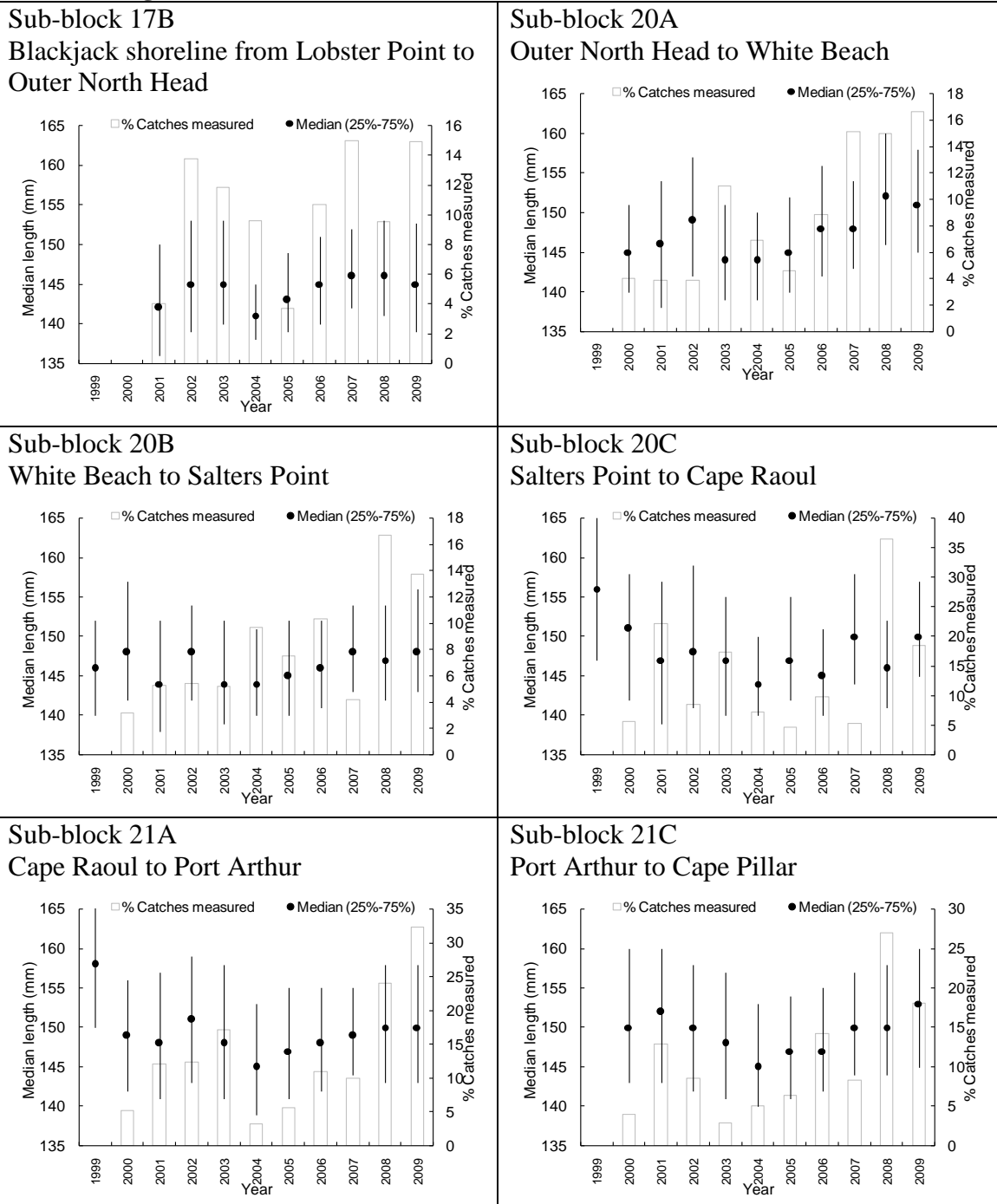


Eastern Zone - Storm Bay (Blocks 17-21)

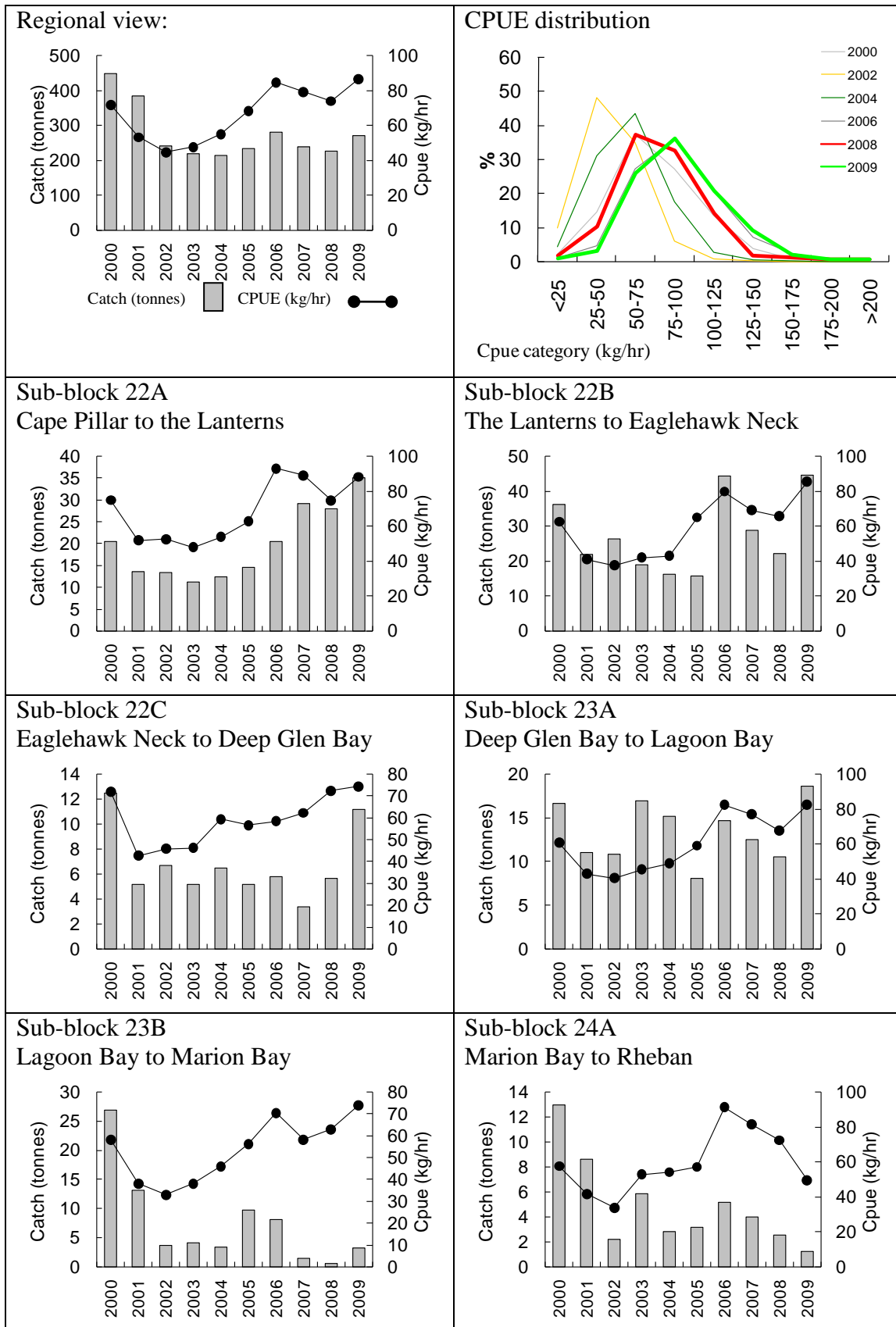


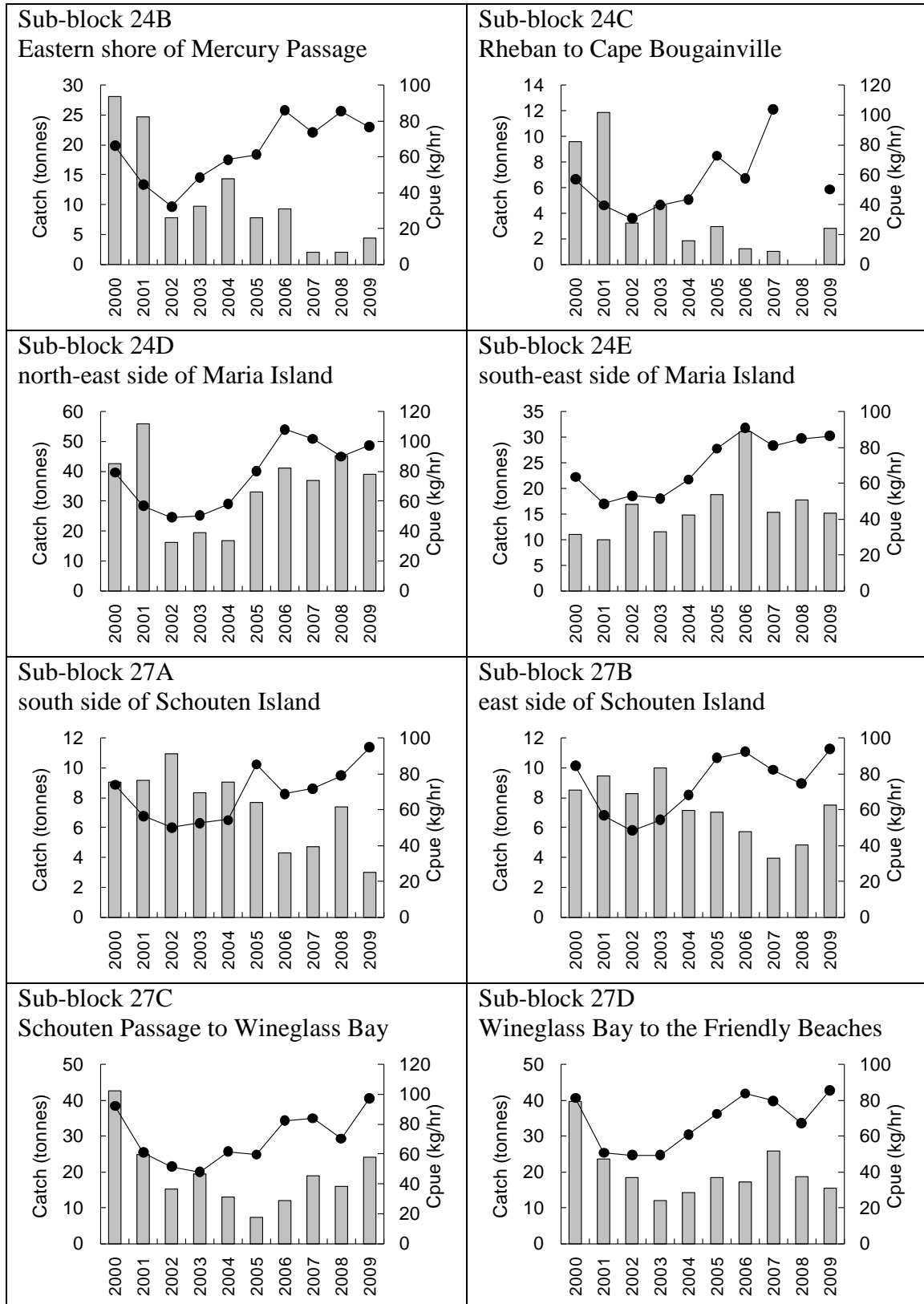
Eastern Zone - Storm Bay (Blocks 17-21)

Median length of catch

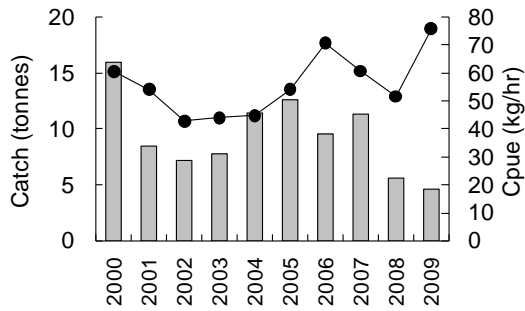


Eastern Zone – East Coast (Blocks 22-31)

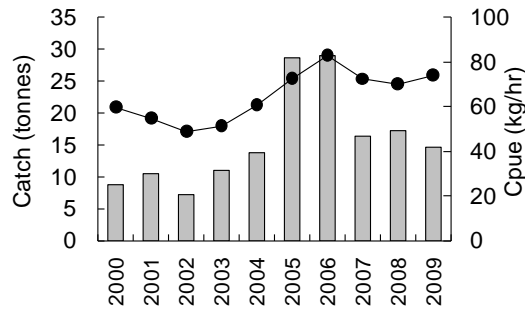




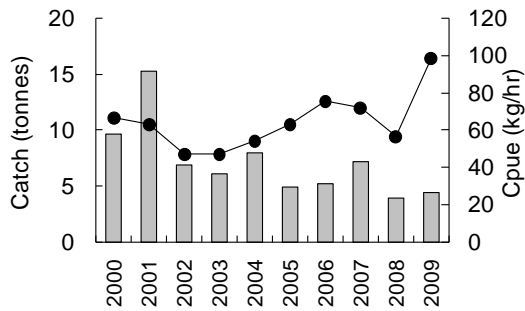
Block 28
Friendly Beaches to Long Point



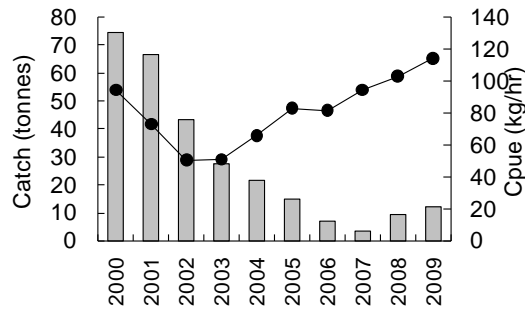
Sub-block 29A
Long Point to Templestowe Beach



Sub-block 29D

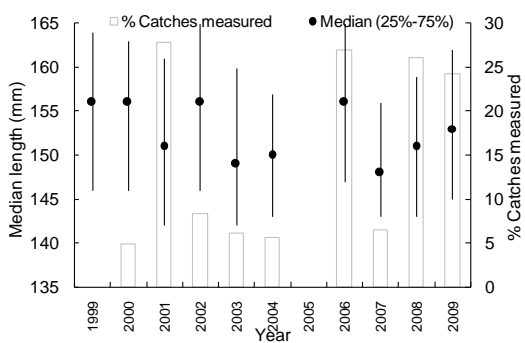


Sub-block 31A
Eddystone Point to Cape Naturaliste

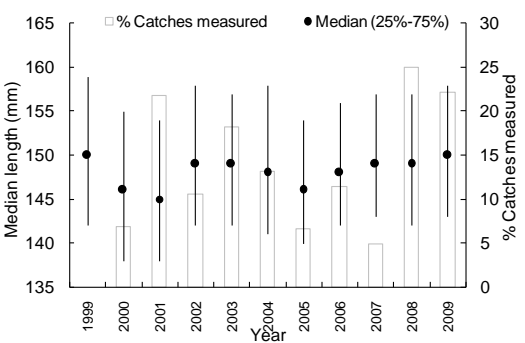


Eastern Zone – East Coast (Blocks 22-31)
Median length of catch

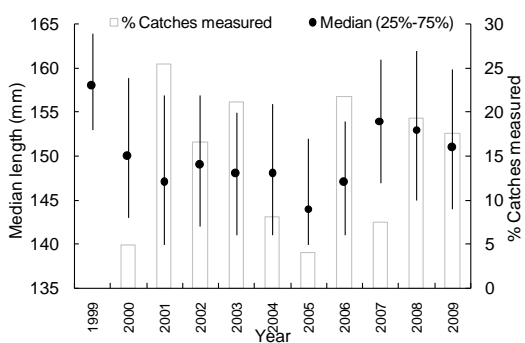
Sub-block 22A
Cape Pillar to the Lanterns



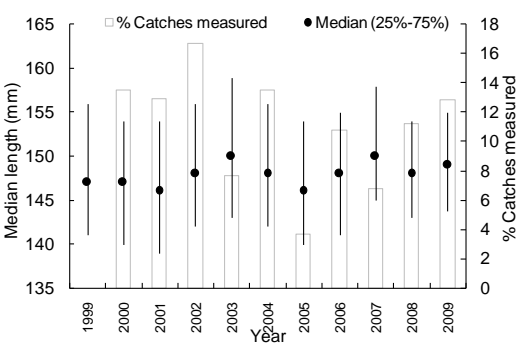
Sub-block 22B
The Lanterns to Eaglehawk Neck

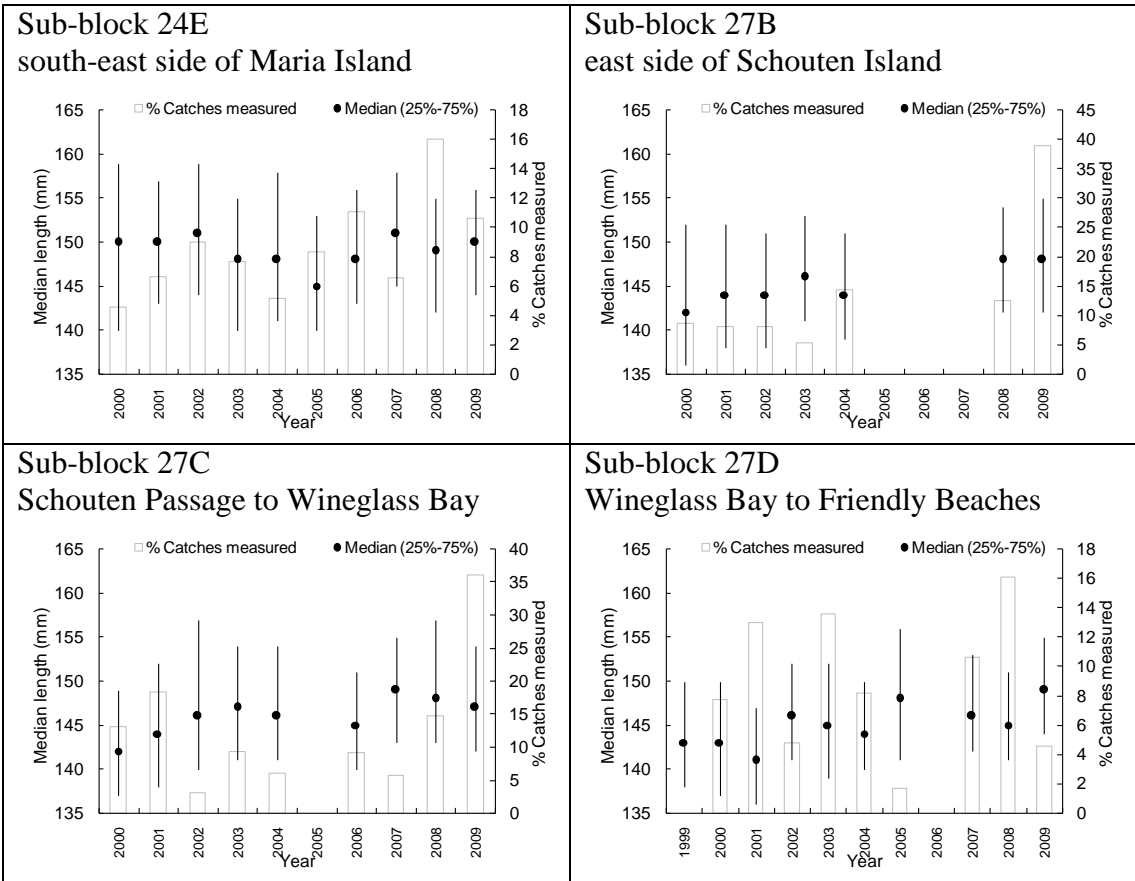


Sub-block 23A
Deep Glen Bay to Lagoon Bay



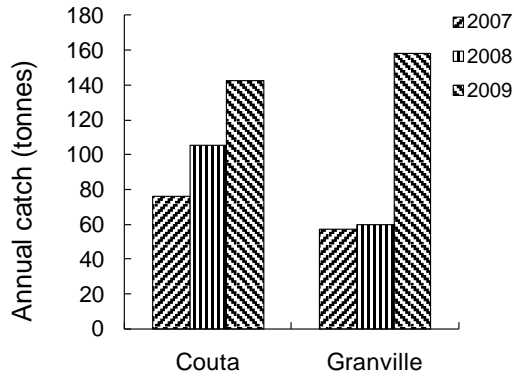
Sub-block 24D
north-east side of Maria Island



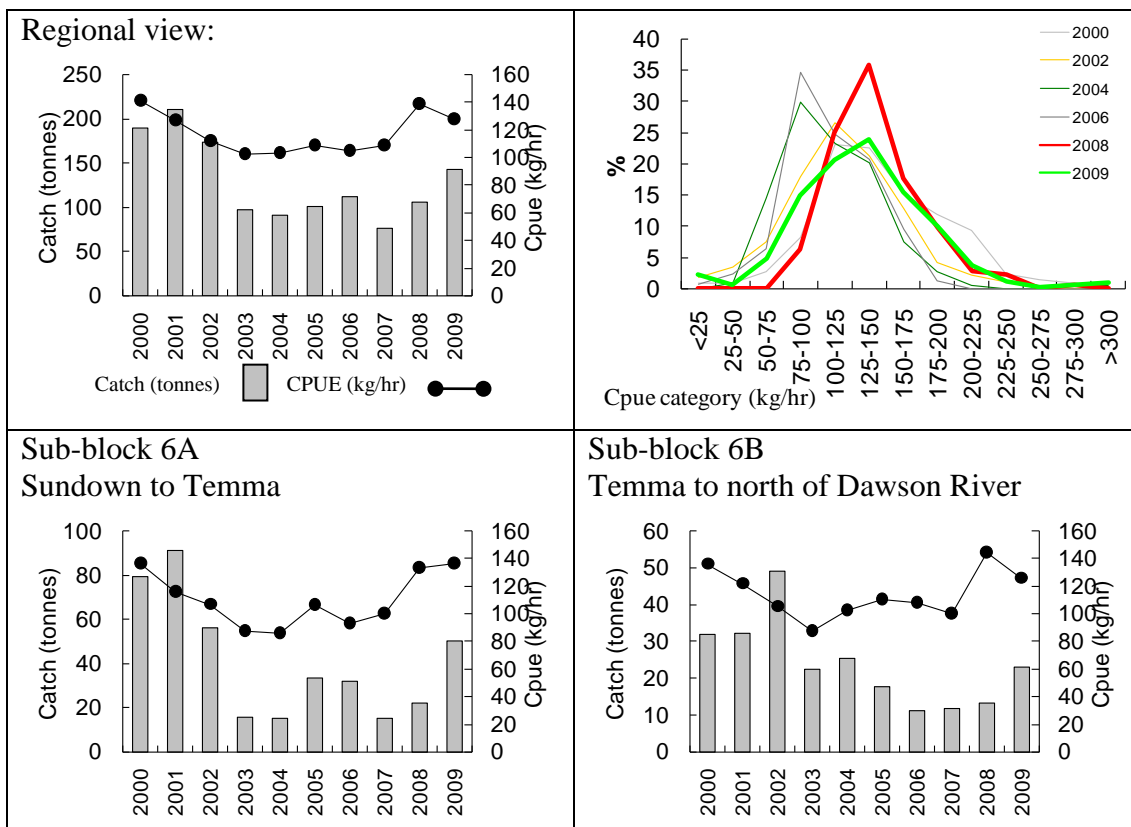


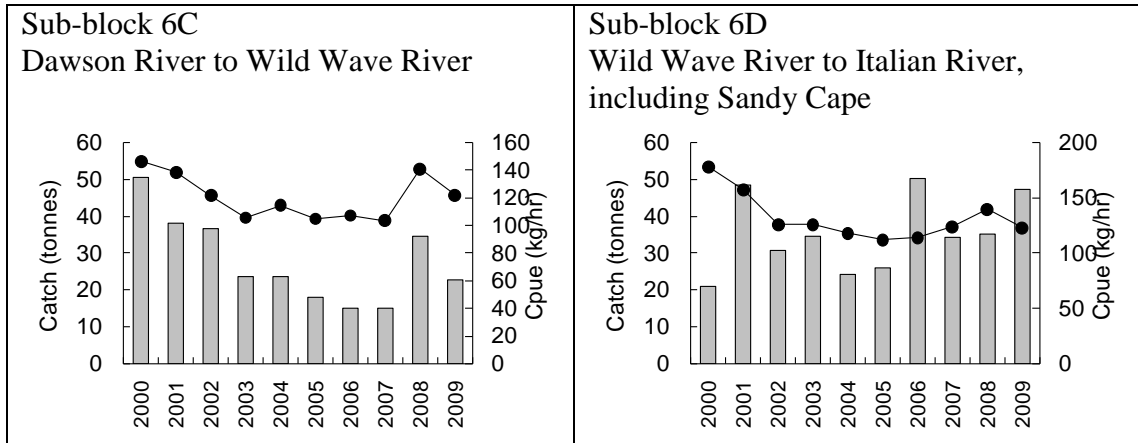
Central Western Zone blacklip fishery

Distribution of catch between the Couta Rocks region (Block 6) and the Granville Harbour region (Blocks 7 and 8):

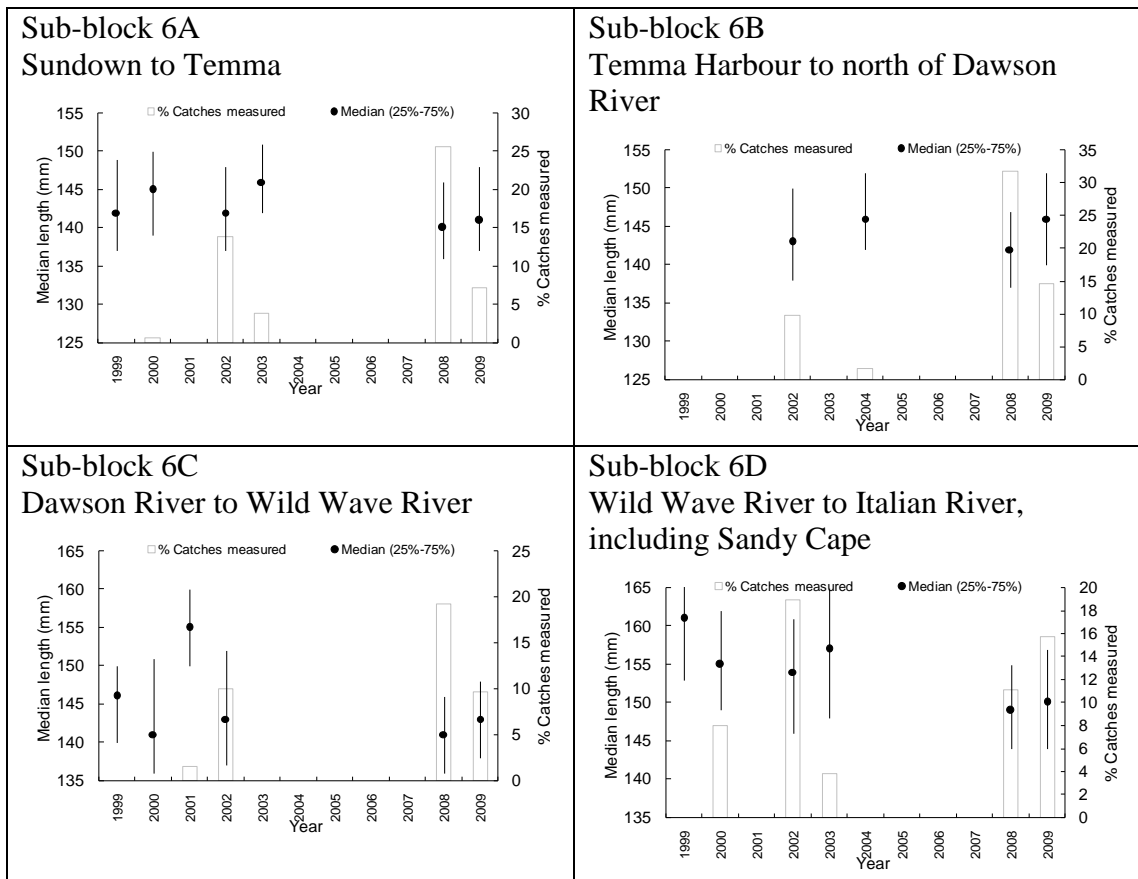


Central Western Zone – Couta Rocks (Block 6)

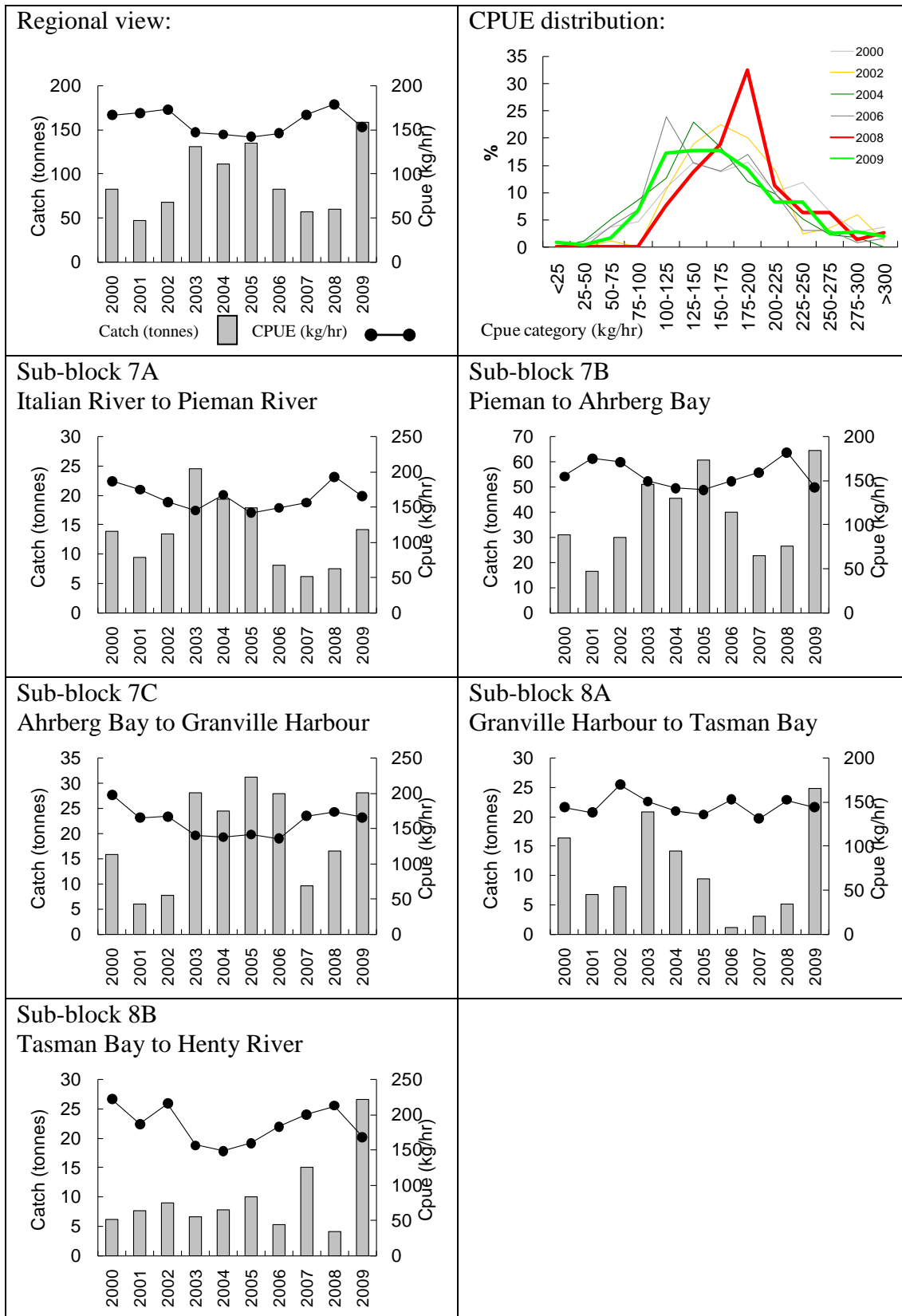




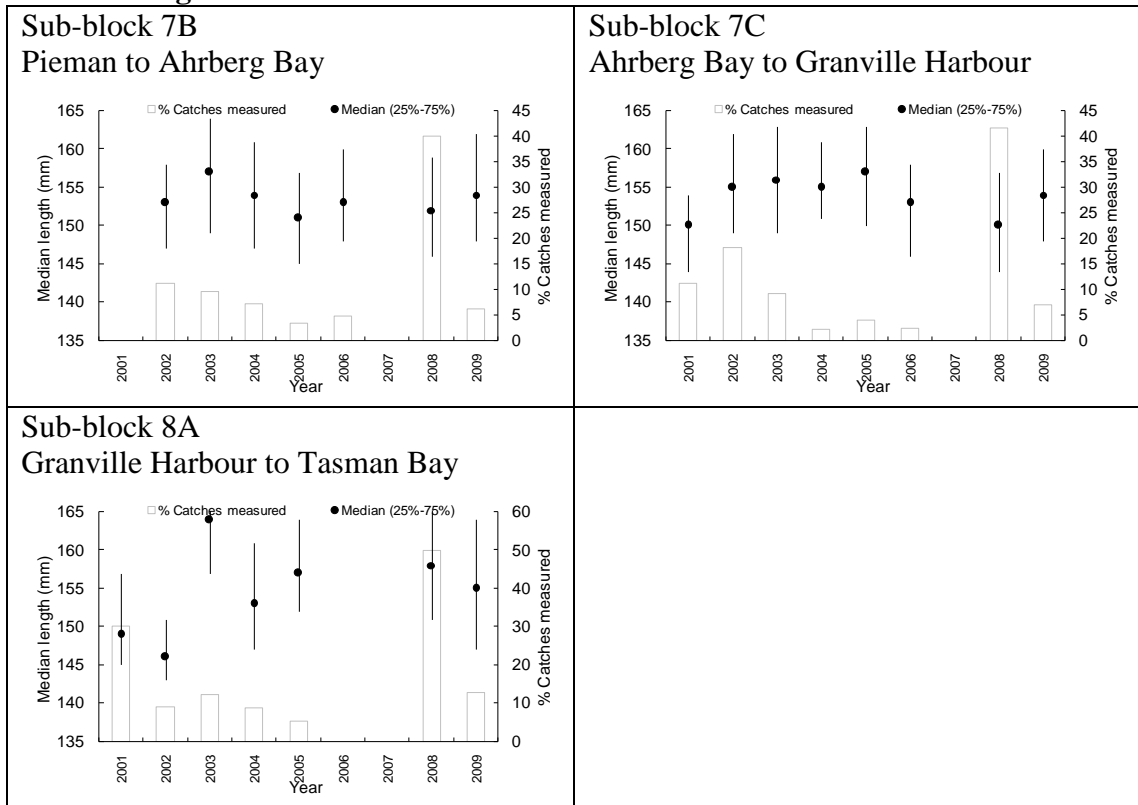
**Central Western Zone – Couta Rocks (Block 6)
Median length of catch**



Central Western Zone – Granville Harbour (Blocks 7 and 8)

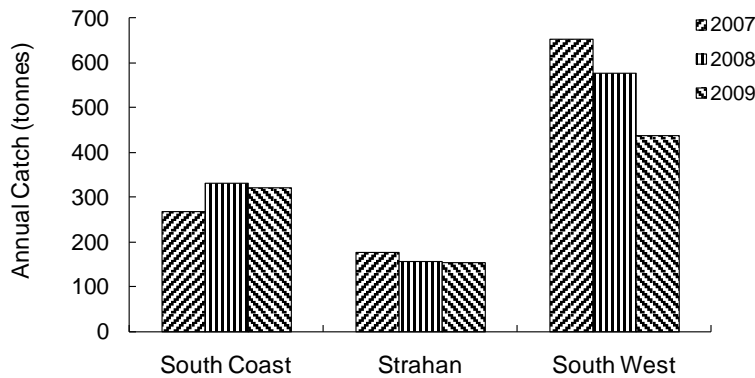


Central Western Zone – Granville Harbour (Blocks 7 and 8)
Median length of catch

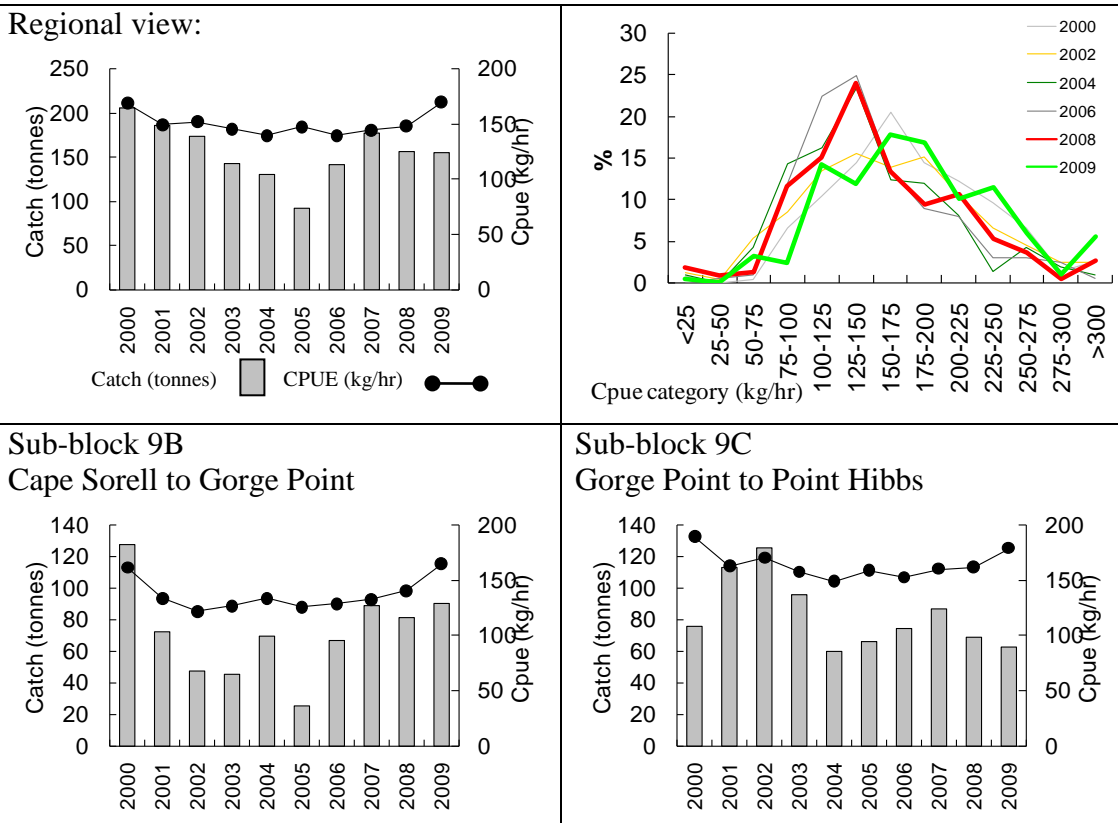


Western Zone blacklip fishery

Distribution of catch in the Western Zone:

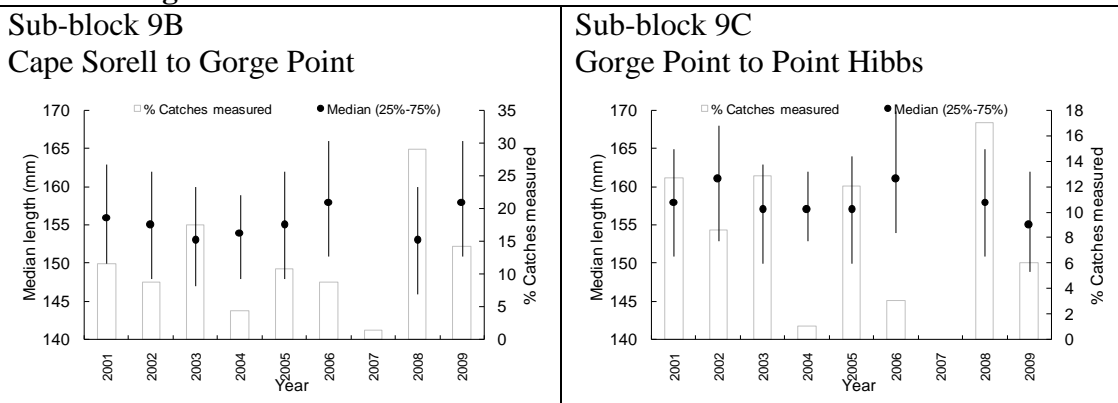


Western Zone – Strahan (Block 9)

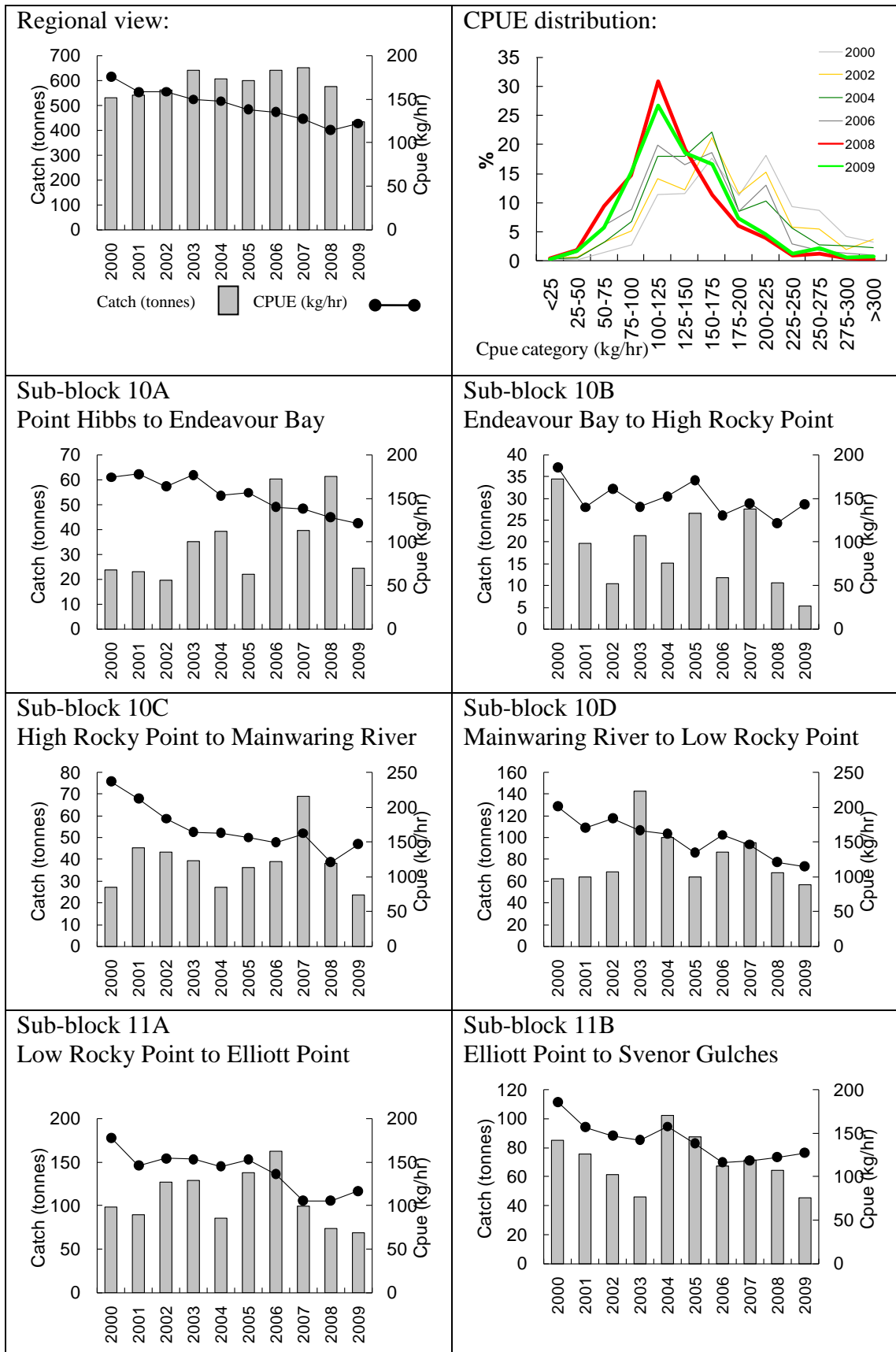


Western Zone – Strahan (Block 9)

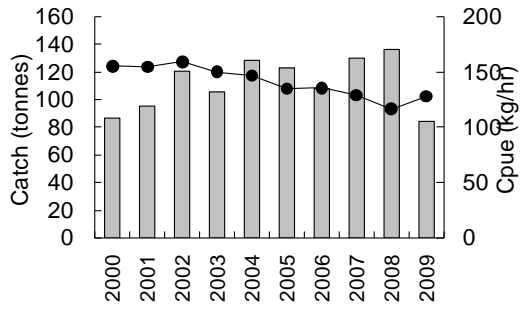
Median length of catch



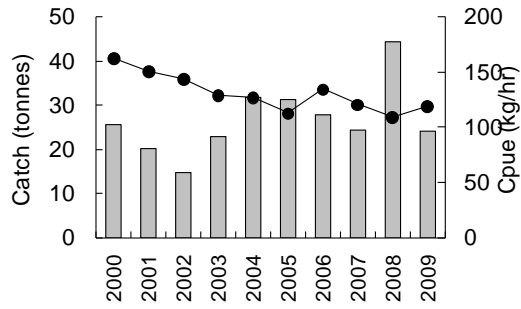
Western Zone - South West (Blocks 10-11, Sub-block 12A)



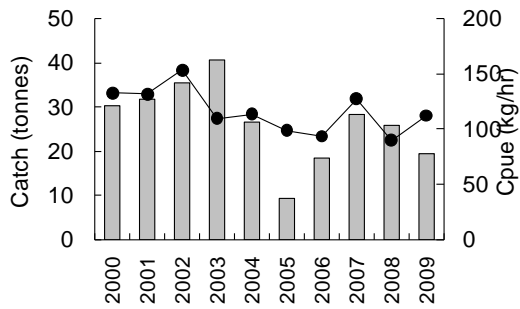
Sub-block 11C
Svenor Gulches to Point St Vincent



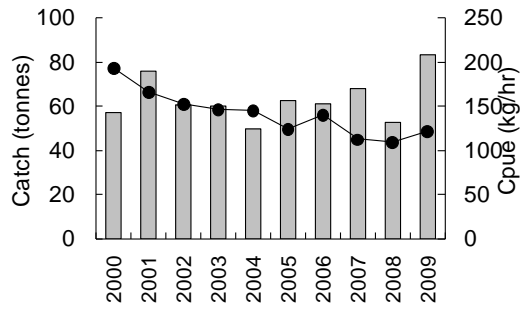
Sub-block 11D
Hilliard Head to Faults Bay



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

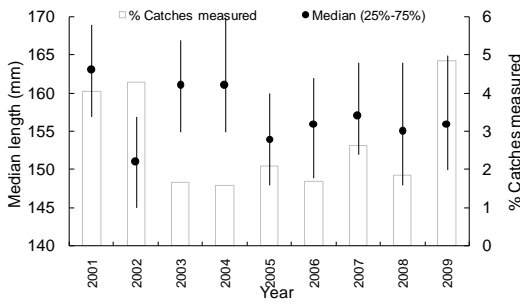


Sub-block 12A
Faults Bay to South West Cape

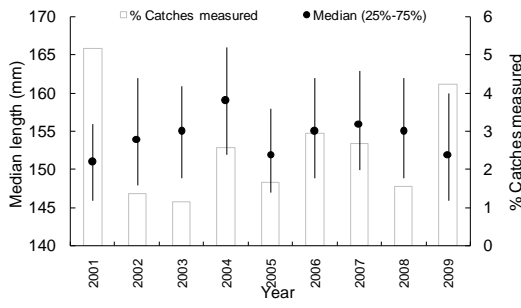


Western Zone - South West (Blocks 10-11, Sub-block 12A)
Median length of catch

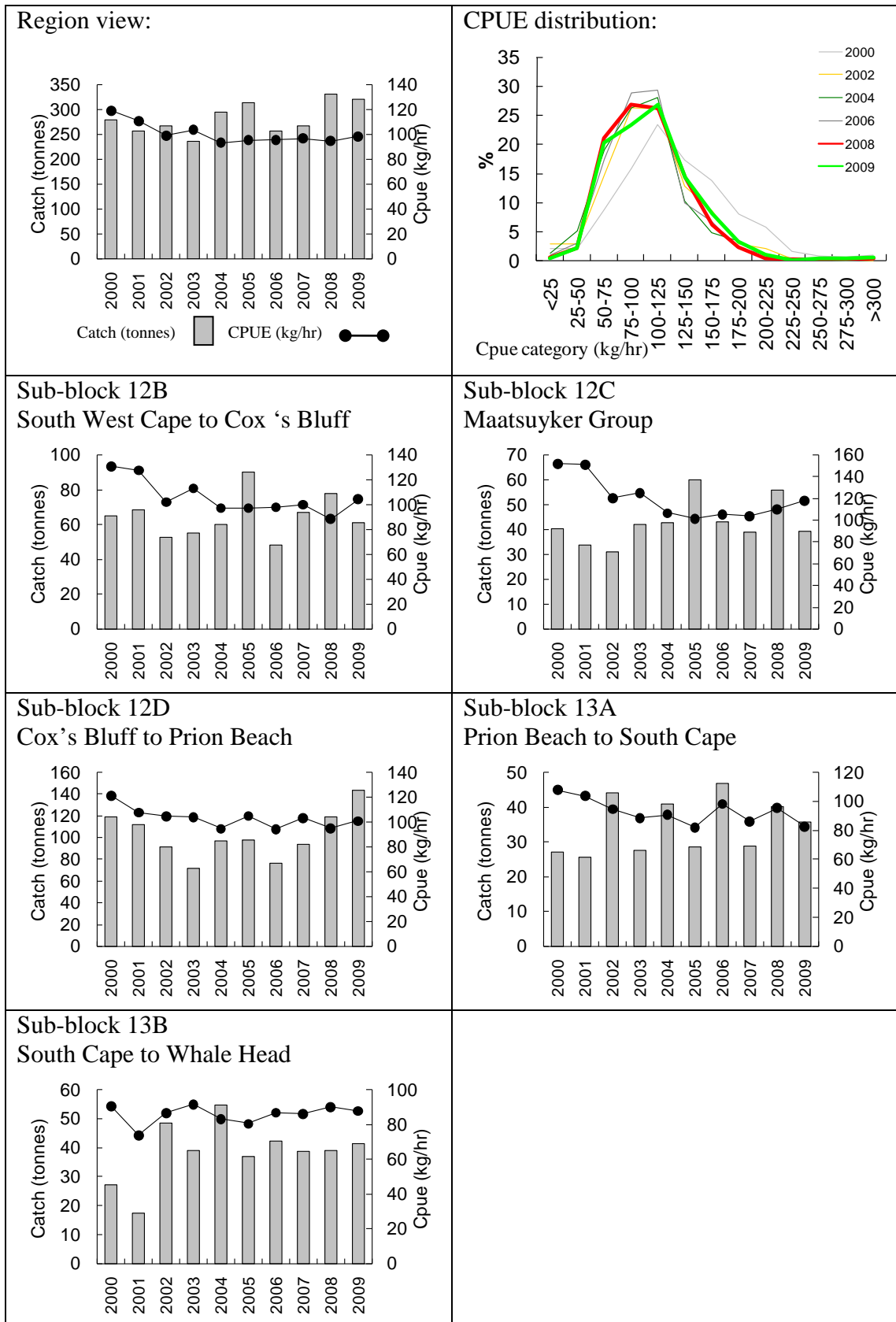
Sub-block 10D
Mainwaring River to Low Rocky Point



Sub-block 11A
Low Rocky Point to Elliott Point

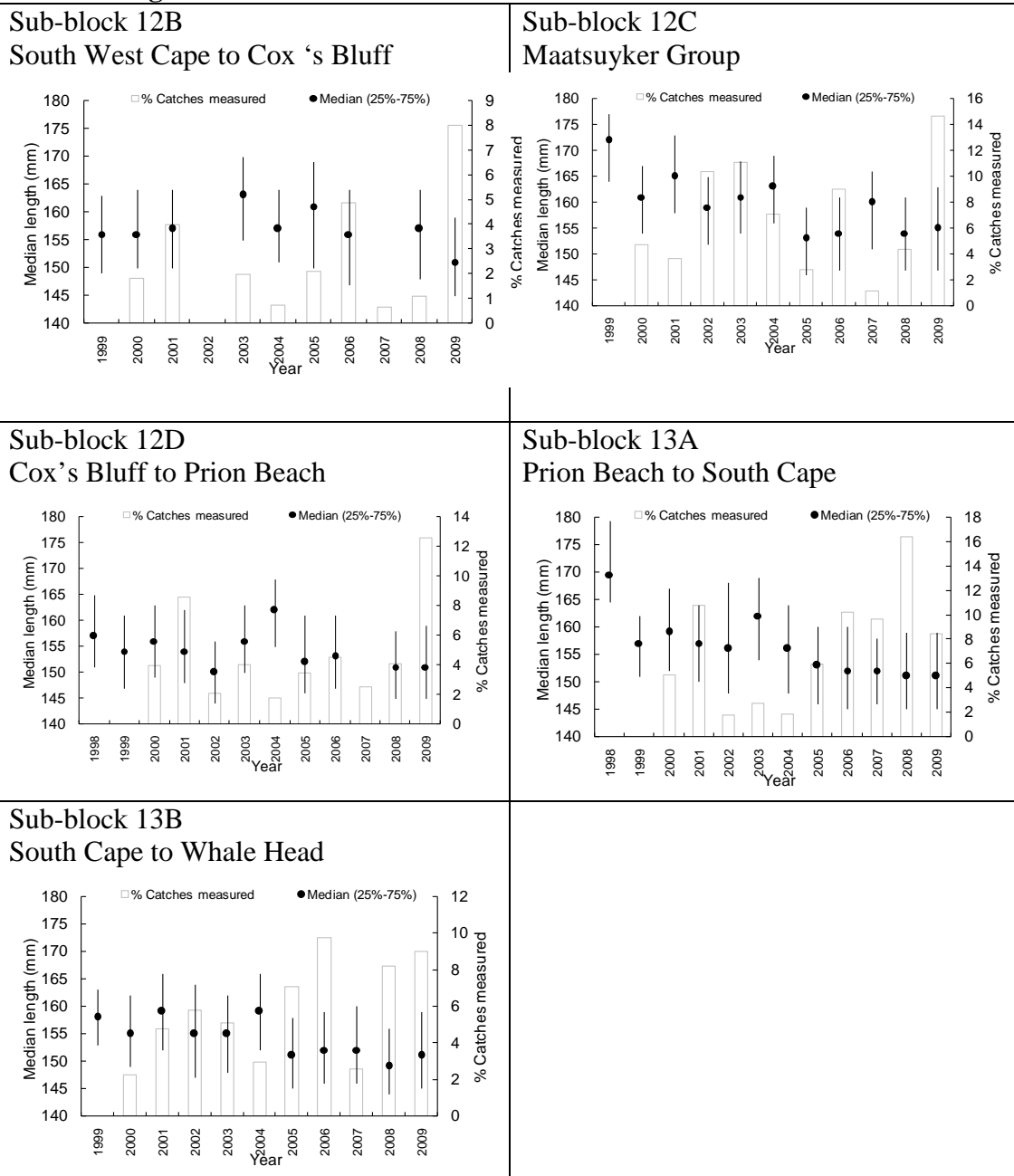


Western Zone - South Coast (Sub-blocks 12B, 12C, 12D, 13A, 13B)



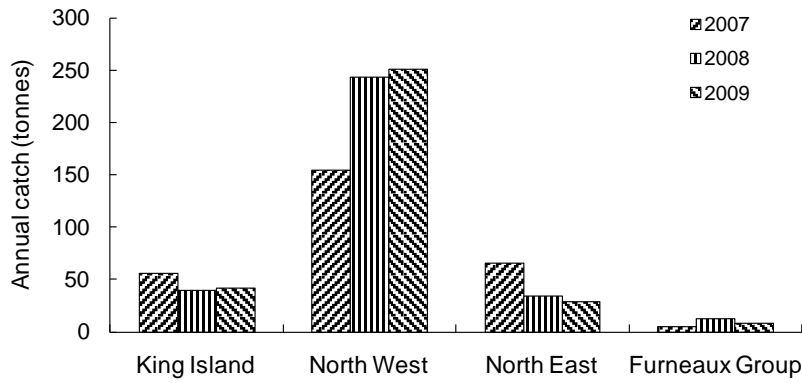
Western Zone - South Coast (Block 12, Sub-blocks 13A, 13B)

Median length of catch

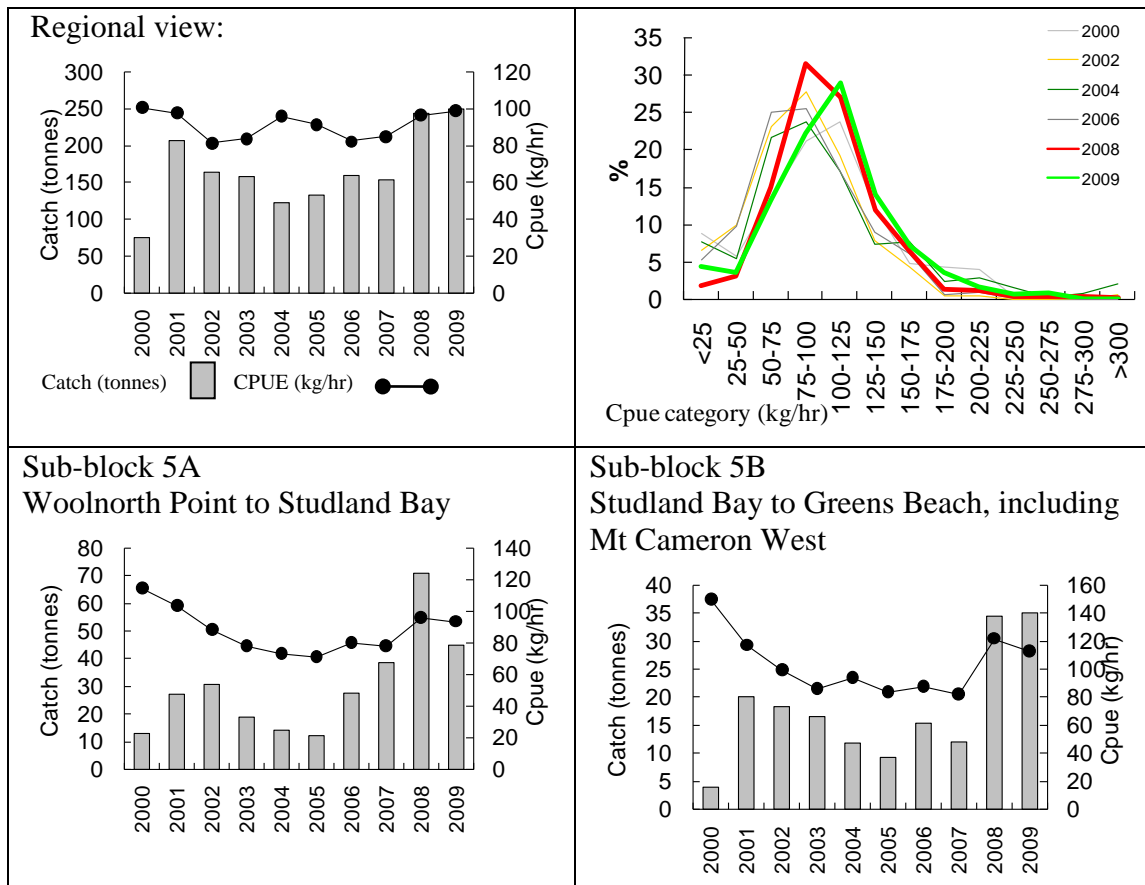


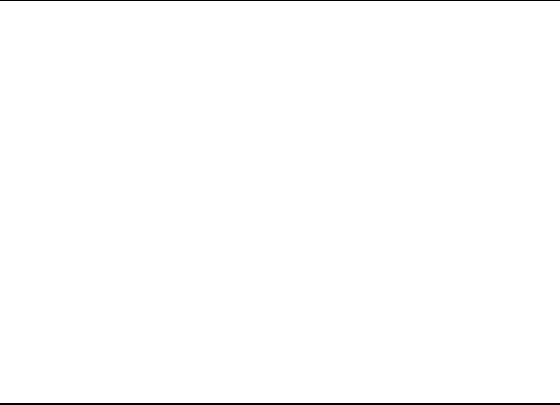
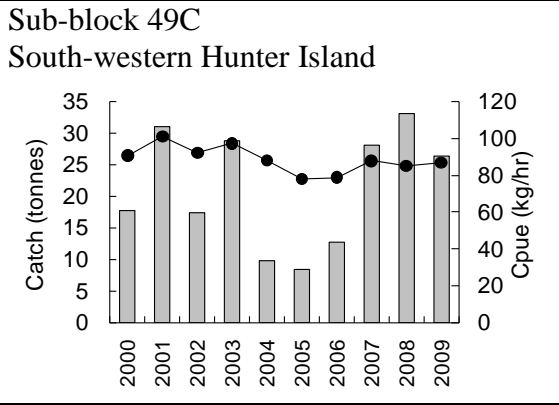
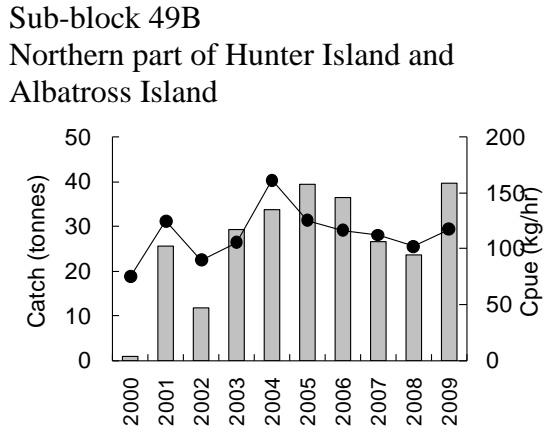
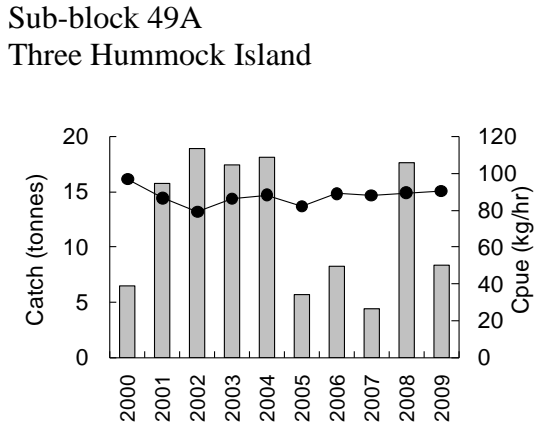
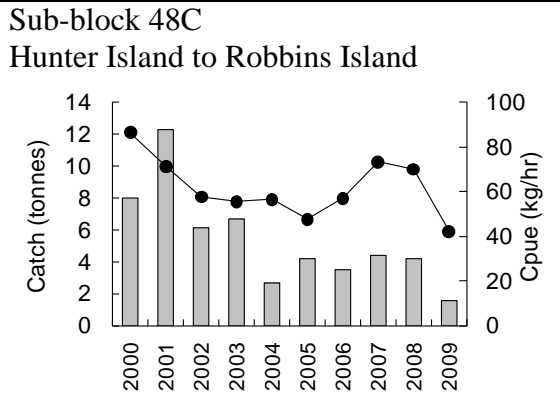
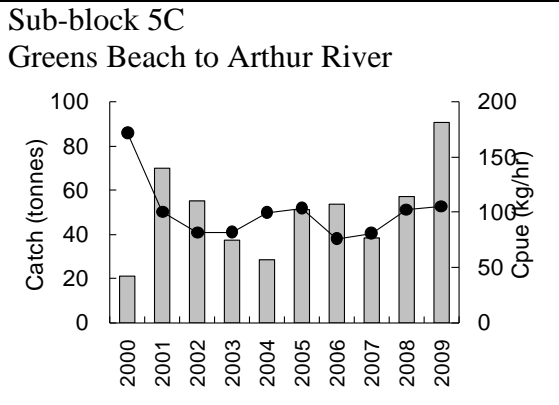
Northern Zone blacklip fishery

Distribution of catch between Northern Zone regions:



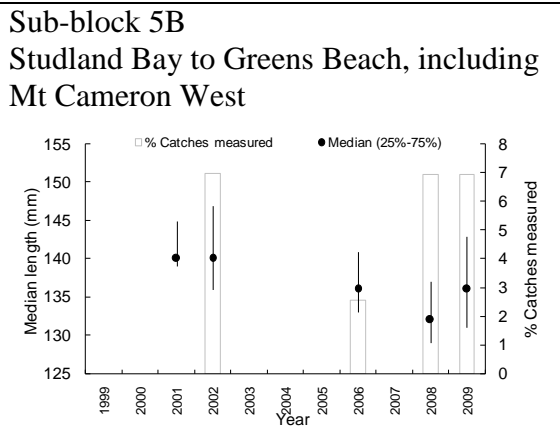
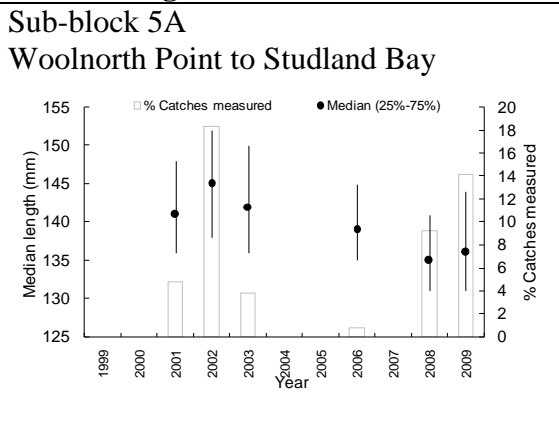
Northern Zone - North West (Blocks 5, 47- 49)

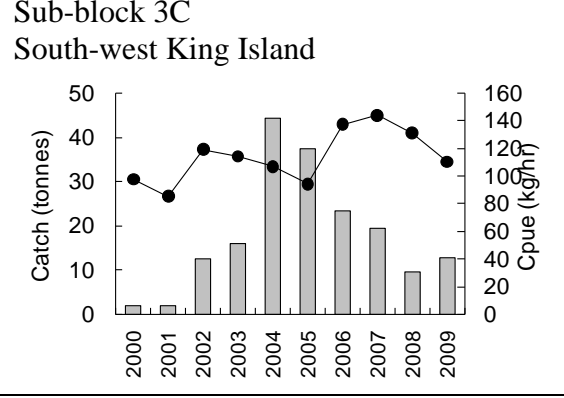
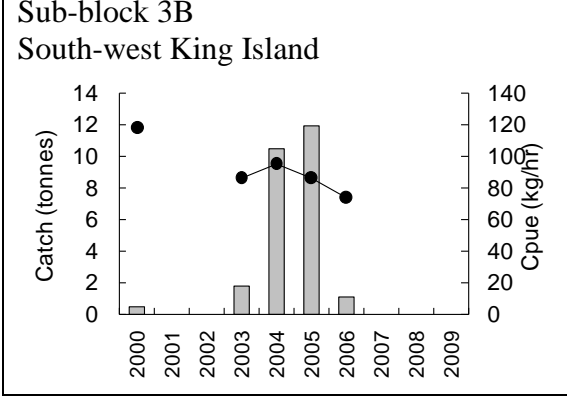
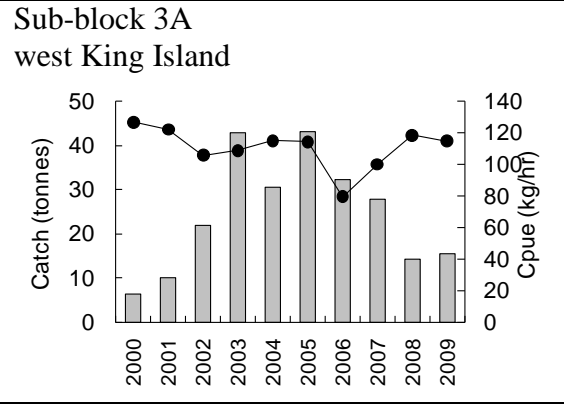
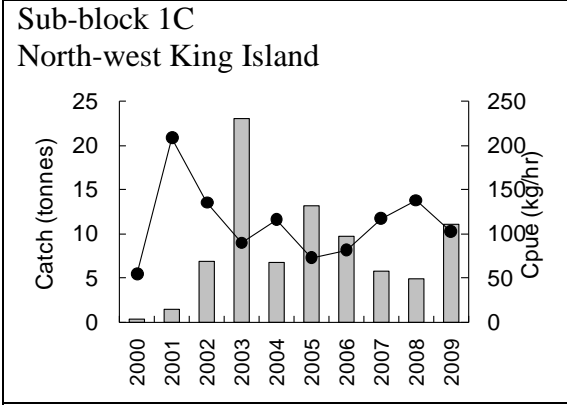
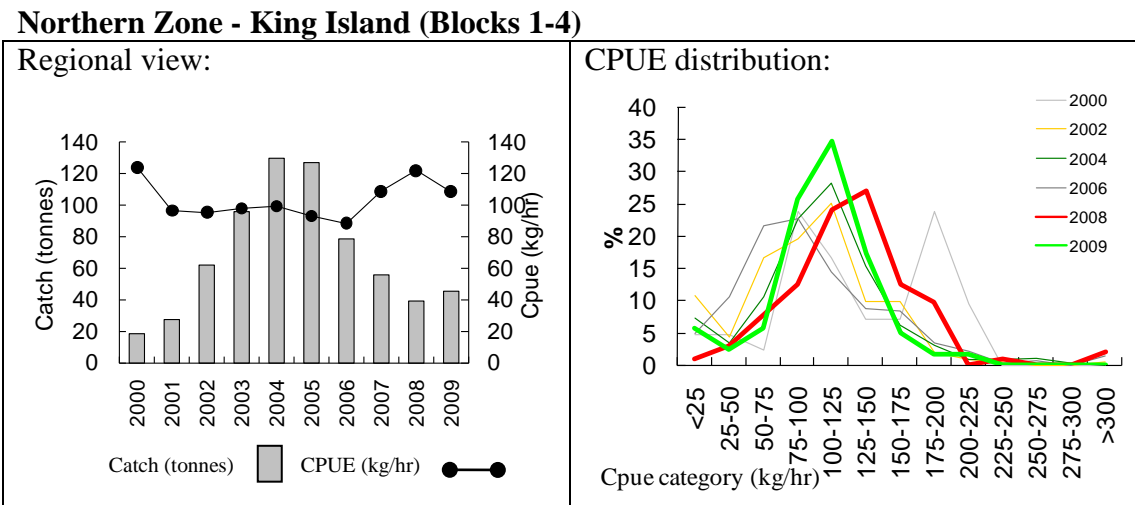
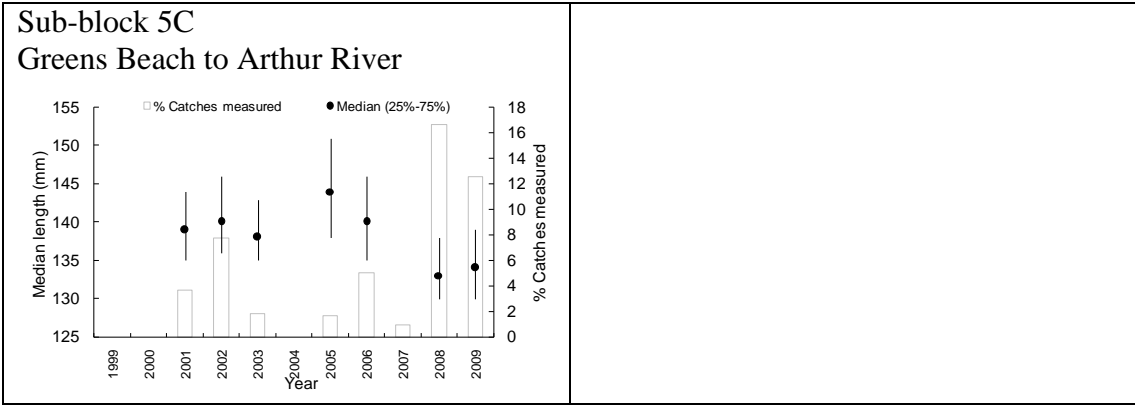




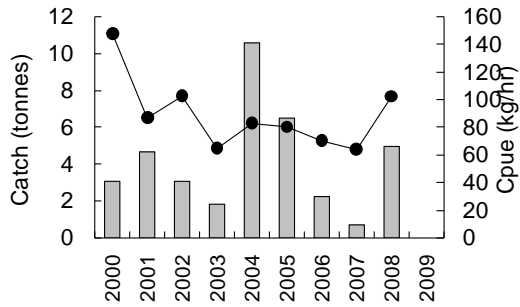
Northern Zone – North West (Blocks 5, 47- 49)

Median length of catch

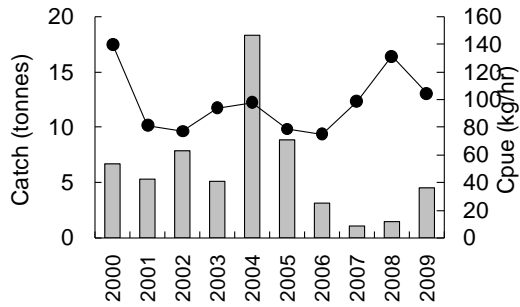




Sub-block 4B
South-east King Island

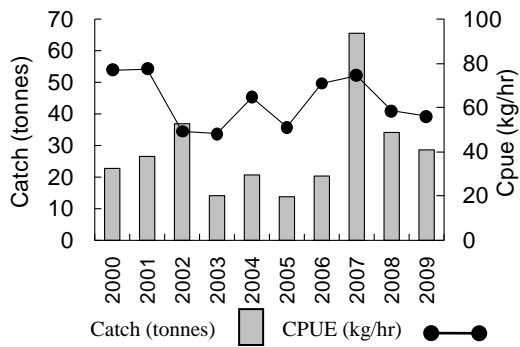


Sub-block 4C
South-east King Island

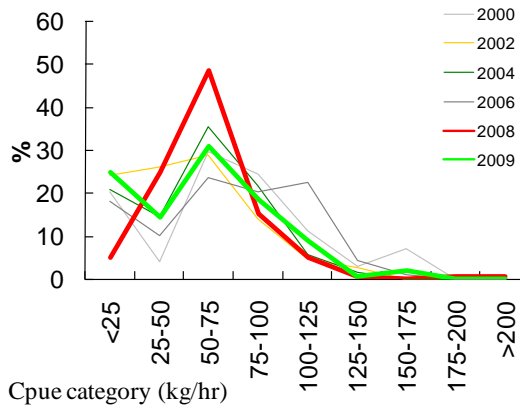


Northern Zone - North East (Sub-block 31B, Blocks 39, 40)

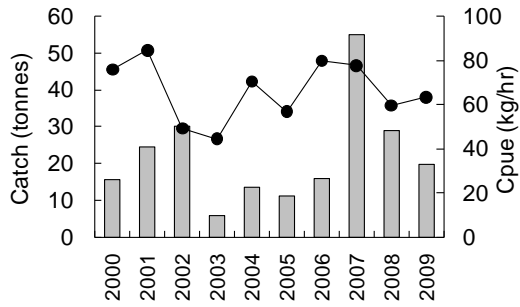
Regional view:



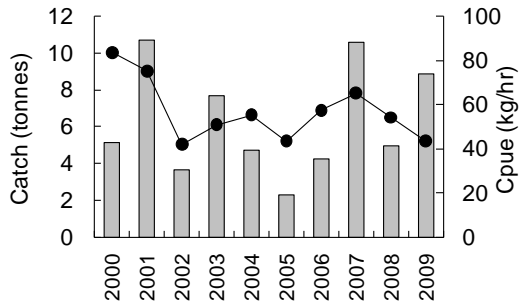
CPUE distribution:



Sub-block 31B
Cape Naturaliste to Little Musselroe Bay

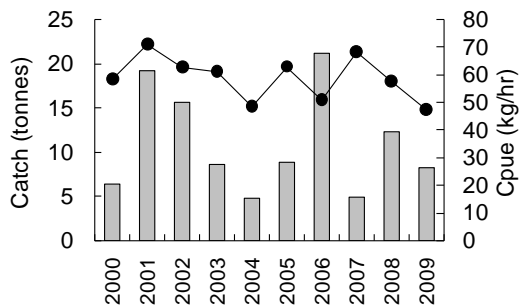


Sub-block 39A
Little Musselroe Bay to Petal Point



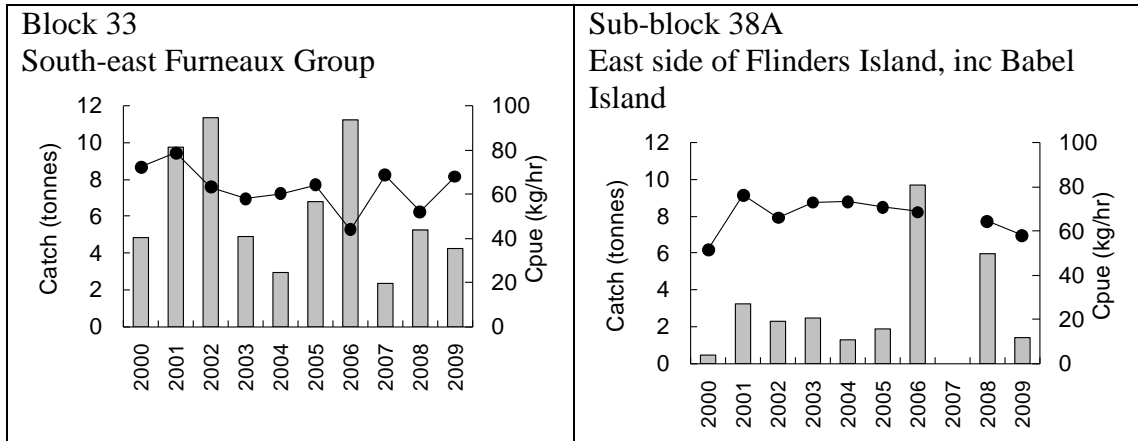
Northern Zone - Furneaux Group (Blocks 32-36, Sub-blocks 38A, 38B)

Regional view:

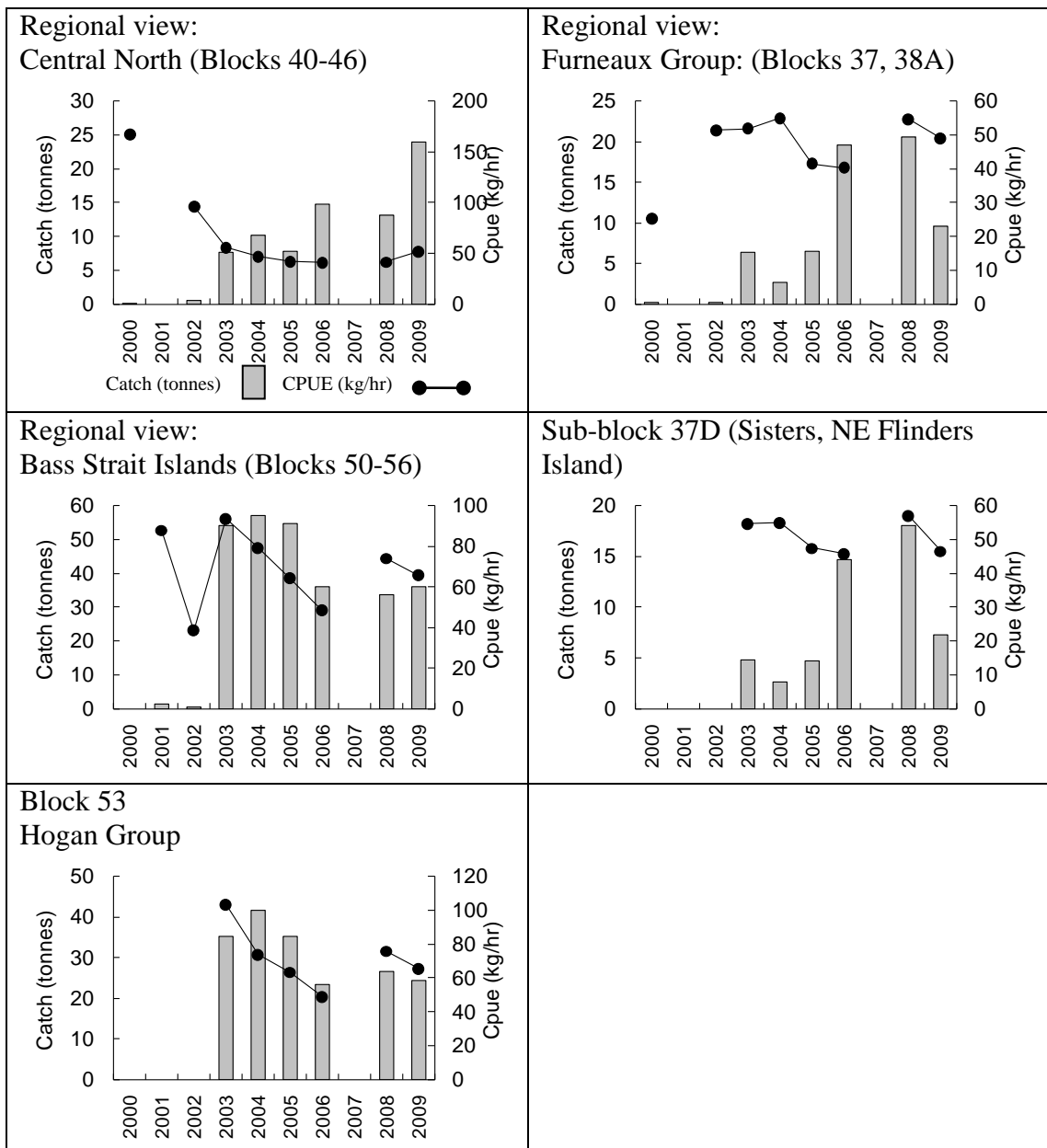


CPUE distribution:

Insufficient catch to display



Bass Strait Zone blacklip fishery



Greenlip fishery

Distribution of the 2009 catch (caps) between the four regions was fixed at the following levels:

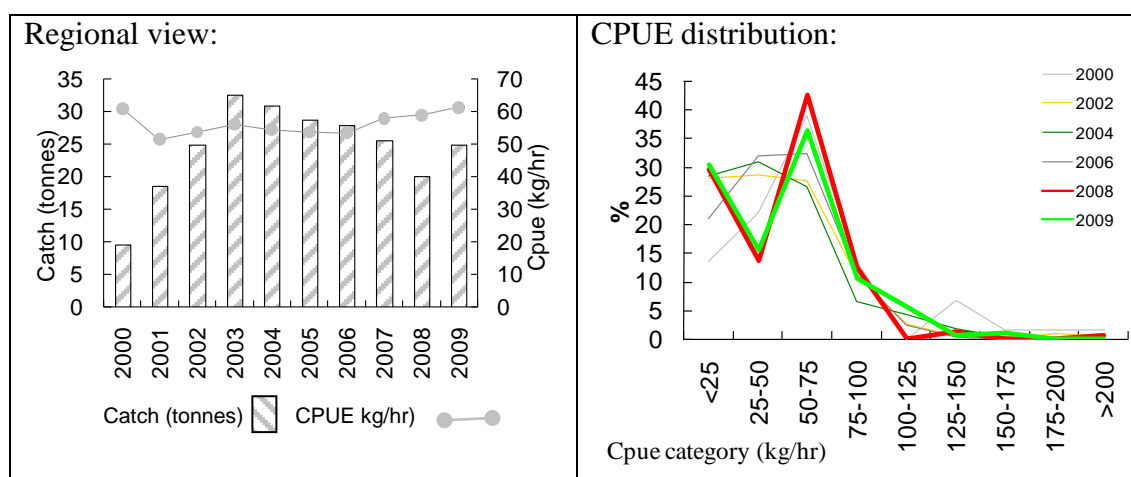
- King Island – 30t
- North West – 30t
- North East – 23t
- Furneaux Group – 42t

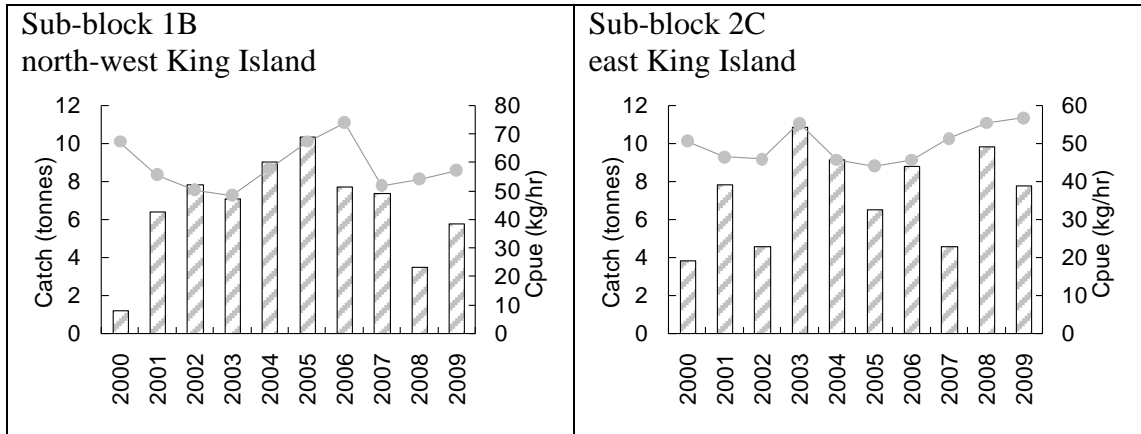
Annual catches:

Year	King Island	North West	North East	Furneaux Group
2000	9.6	49.1	38.9	42.5
2001	18.6	46.8	30.4	44.2
2002	25.0	39.9	31.3	43.3
2003	32.6	34.3	35.3	37.6
2004	31.0	29.3	31.4	36.8
2005	28.8	32.4	19.4	42.4
2006	27.9	39.1	16.2	39.6
2007	25.6	33.3	33.5	31.1
2008	20.0	41.1	24.4	34.9
2009	25.3	33.9	35.0	27.3

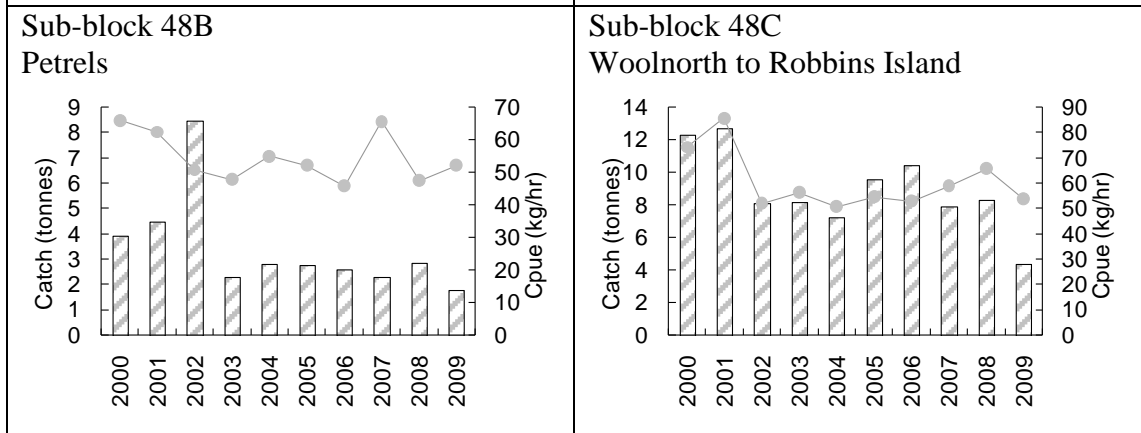
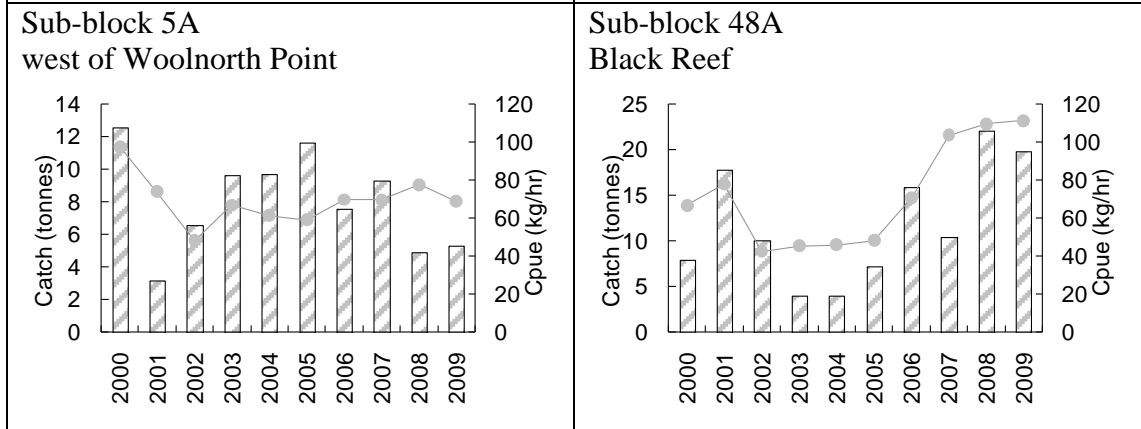
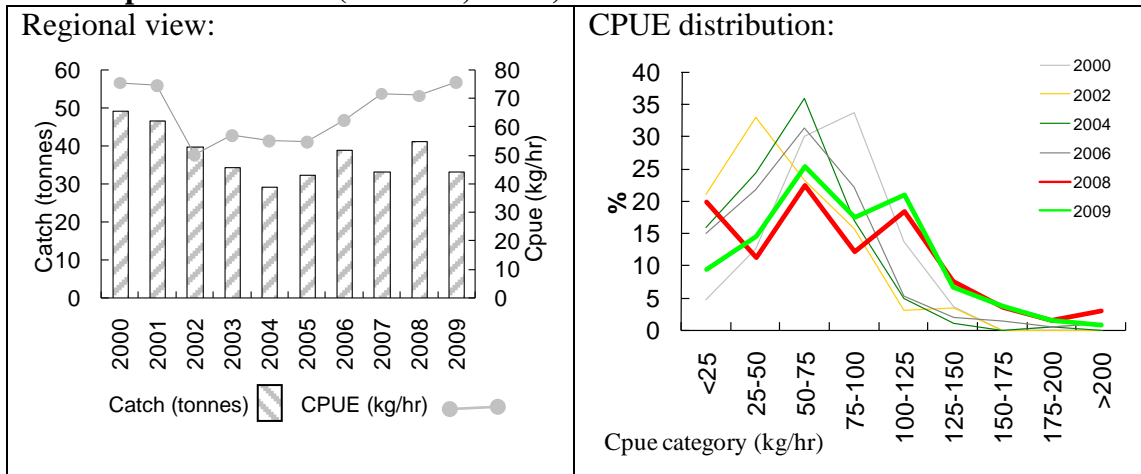
Within the North West, the catch from Perkins Bay including Black Reef was capped at 20 t. In 2009, 20.1 t was taken from Black Reef (Sub-block 48A), which means that the remainder of the North West capped region produced 11.1 t.

Greenlip - King Island (Blocks 1-4)

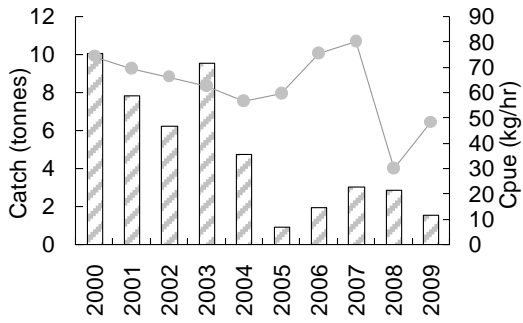




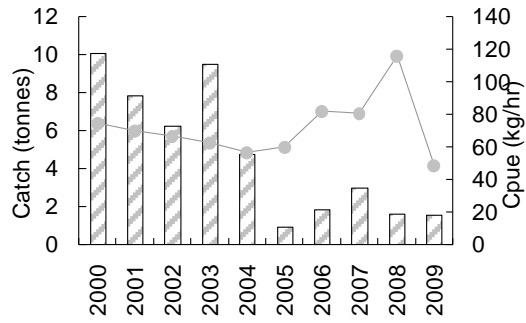
Greenlip - North West (Blocks 5, 47-48)



Sub-block 49C
west of Hunter island

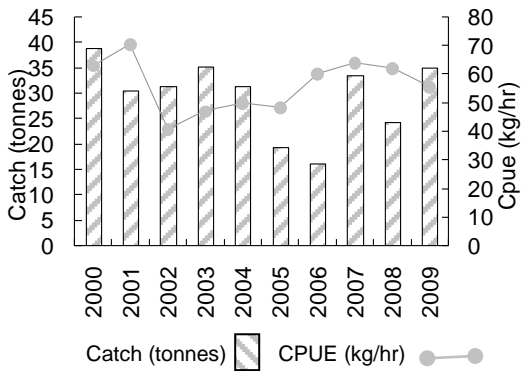


Sub-block 49C
(multiple dive times removed)

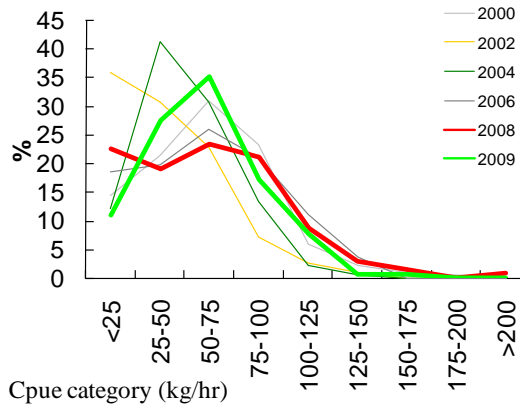


Greenlip - North East (Blocks 31, 39, 40)

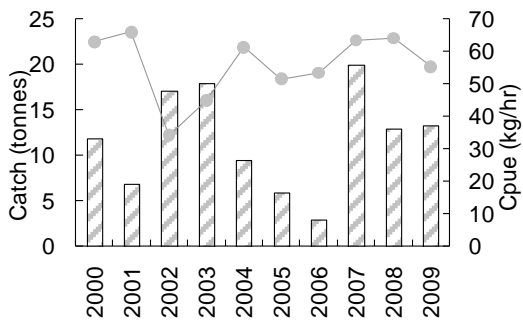
Regional view:



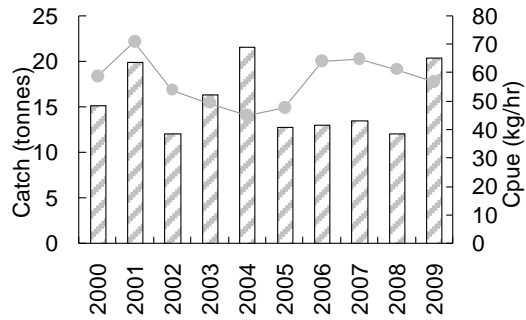
CPUE distribution:

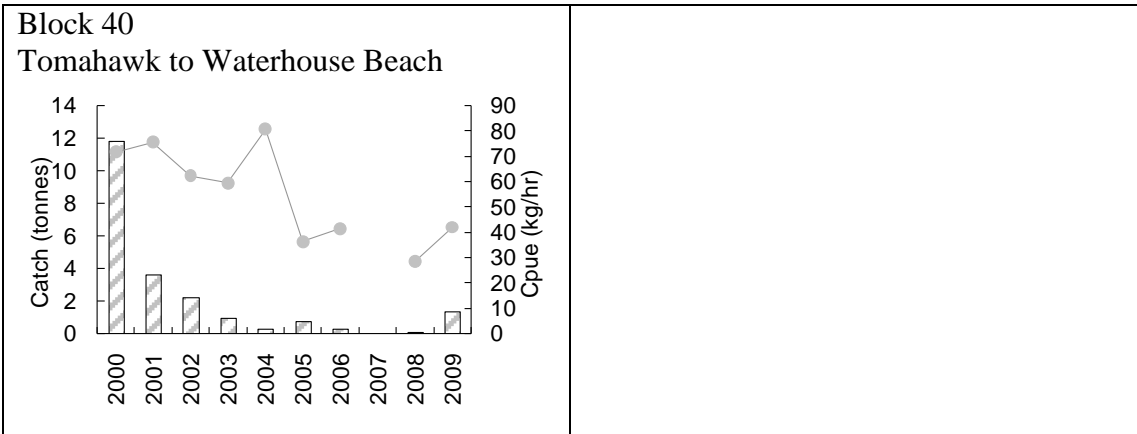


Block 31
Eddystone Point to Little Musselroe,
Swan Is.

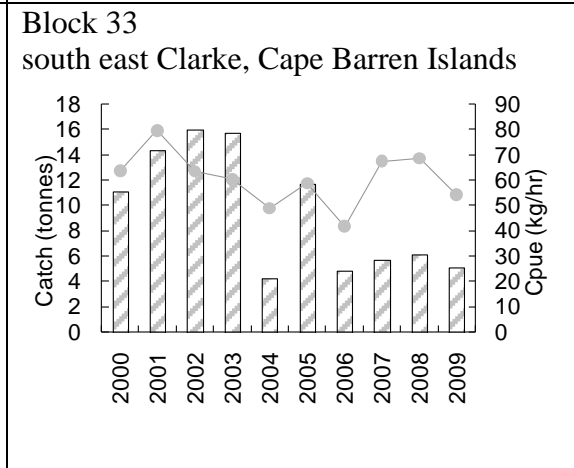
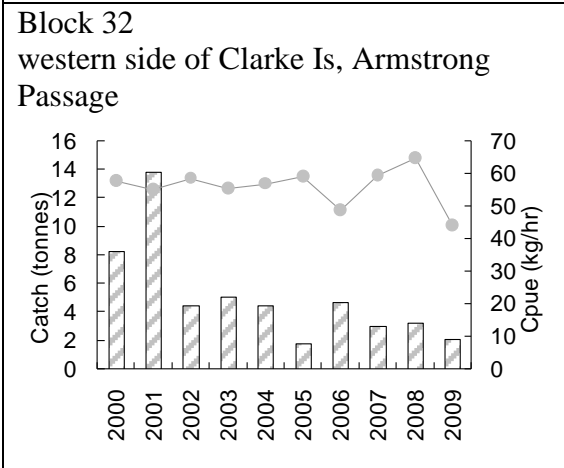
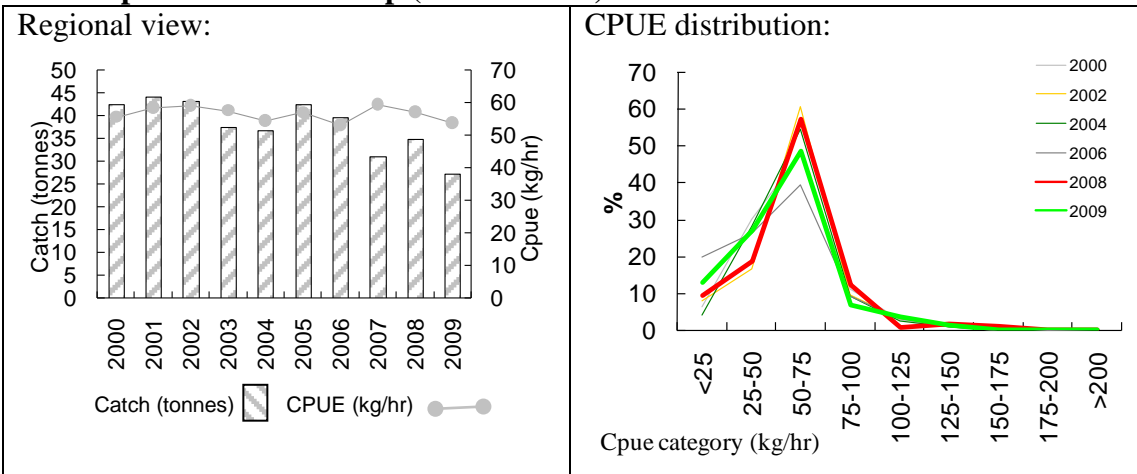


Block 39
Tomahawk to Little Musselroe

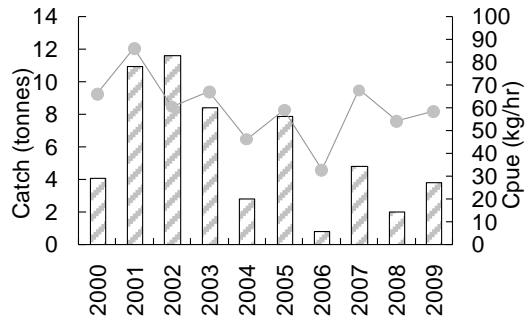




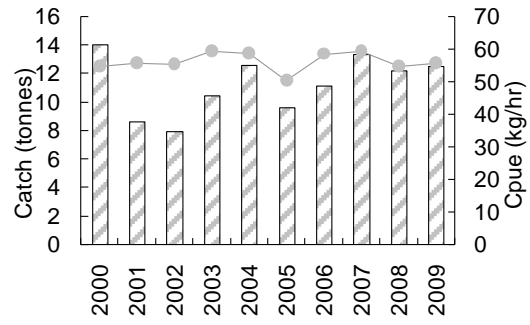
Greenlip – Furneaux Group (Blocks 32-38)



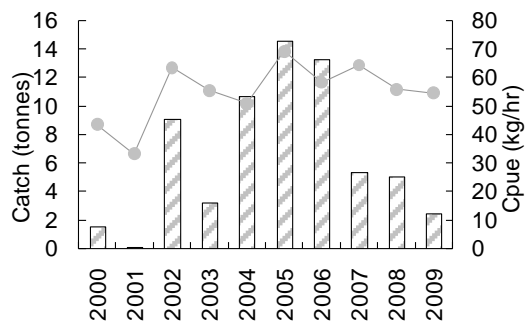
Sub-block 33A
east Clarke Island



Block 35
Franklin Sound



Block 38
north-east Flinders Island



Appendix 2: Interpreting graphical information

Catch and catch rate by region, block and sub-block.

Catch and catch rate information is shown across a range of geographical scales ranging from large (regional) to small (sub-block) where relevant (*i.e.* catches consistently larger than 10 t pa, or six or more divers contributed to the catch). Figure 4 shows catch and catch rates for the last eight years for sub-blocks. The vertical columns show catch in tonnes, for the period 2000-2007. The black line with balls shows catch rates (CPUE) over the same period. Greenlip charts show catch as hatched columns, and catch rates as grey balls joined with a grey line.

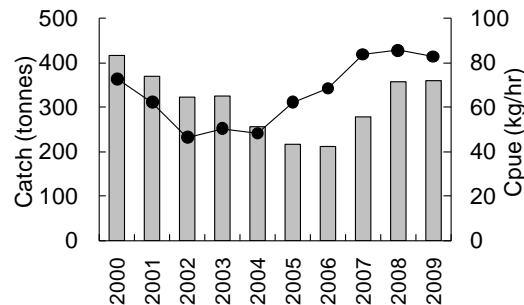


Figure 4. Annual catch (tonnes) and geometric mean catch rates (kg/hour), 2000 - 2009.

Catch and effort were not reported by sub-block and zone prior to 2000, and consequently are shown only from that year onwards. Additionally, catch rates trends over short periods (compared with longer periods) are more likely to reflect changes in abundance of abalone and not changes in fishing methods, and catch rates earlier than 2000 are not used in this assessment.

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 5). That the distributions are skewed (not evenly distributed about the category with the highest percentage) implies that fewer divers are achieving high catch rates. Skewness tends to be greatest when abalone abundance is low or has been recently reduced, making high catch rates less common.

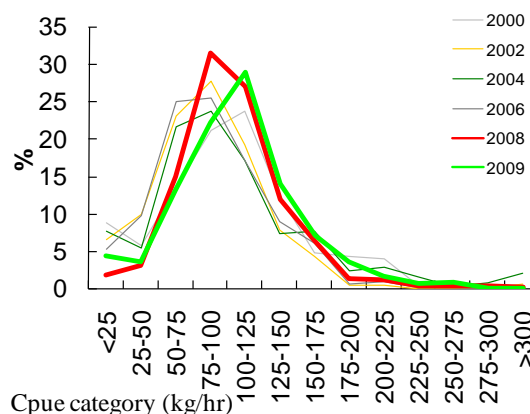


Figure 5. The percentage distribution of catch-rates, 2000 - 2009.

Size-composition charts.

The size-composition of divers' catches is reviewed at sub-block level (

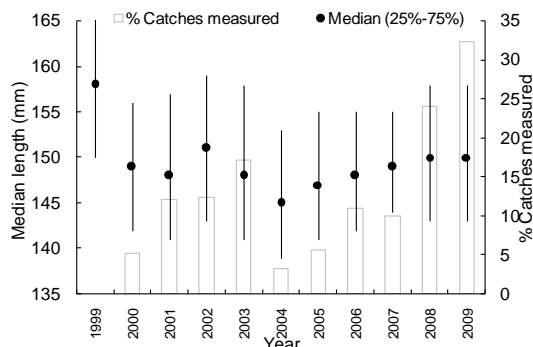


Figure 6). At this spatial scale, there is a greater likelihood that the catches come from populations with similar growth characteristics than at larger scales. We are unable to estimate the percentage of catches sampled prior to 2000 because sub-block reporting was not introduced until then. We are able to attribute some sampled catches to sub-blocks in earlier years, because we know the location from where the catches were taken.

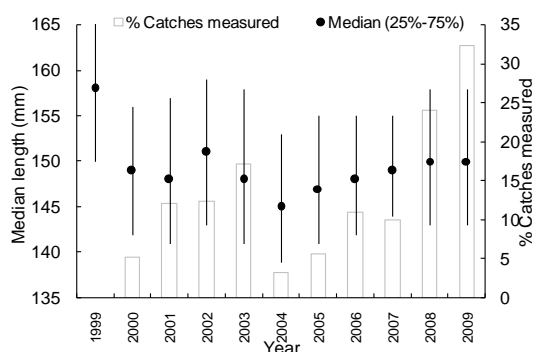


Figure 6. Median length with 25%-75% inter-quartile size range of abalone from commercial catch samples. The vertical columns represent the percentage of catches sampled.

Size-composition charts plot median length (the middle or 50th percentile length if all abalone were sorted from smallest to largest) for the period 1998-2008 (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 the middle 50% of abalone from the sampled catches.

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

a) 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 (*e.g.* 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 (hyperstable – CPUE remains high even when stock size reduces), 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 within 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 if selecting a particular size range of abalone.

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 (Officer *et al.*, 2000; Shepherd and Partington, 1995) 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 and hyperstable.

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 stock 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 11) is an improvement, but is still too large to detect such fine scale declines 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 as an index of stock biomass or abundance when assessing fisheries. Catch rates (CPUE) and the stock biomass are assumed to be related: $CPUE = qB$, where q is the catchability coefficient and B is the exploitable biomass. If q increases through time in an unknown manner, through diving operations becoming more efficient, then the relationship between CPUE and biomass becomes altered to an unknown degree and the interpretation of CPUE as a measure of biomass becomes biased high.

One of the features of commercial fisheries is that fishermen almost always 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 *i.e.* catchability increases. 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. Two broad categories of causes of change in fishing efficiency have been identified 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 in the 1960's 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 could swim 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.

More recent technological changes to fishing operations include the increased use of GPS navigation systems, Nitrox breathing gases and diver propulsion vehicles (DPV). The extent of the usage of GPS navigators and associated plotting equipment by abalone divers is unknown, but it apparently has become much more widespread over the last five years. Nitrox gas mixing plants are currently used by only a few divers, but these divers are responsible for landing a large proportion of the catch in the regions where they work. DPVs are also not yet in common usage, but help divers move more quickly between concentrations of abalone, particularly in deeper water.

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, or at least alter, 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.

In Tasmania, the practise of team diving (where two divers share a boat and catch fish on the same quota unit) was legitimised in 2005. Team diving potentially has the effect of reducing diver efficiency, but increasing profitability because of cost-sharing between the divers. Prior to 2005 team diving was illegal and unreported but allegedly quite common. There is no information to show that the incidence of team diving post-legalisation is different to the former level, but it is potentially a cause of changes to diver efficiency.

Since 2007, divers have reported that the availability of improved forecasting of sea conditions was responsible for effort creep through improved catch rates, because they could choose to fish the West Coast when conditions were optimal. Previously they had travelled to the west when they hoped conditions were favourable, but often were not, and faced with the prospect of returning home with no catch, were obliged to fish in less favourable conditions with a greater likelihood of reduced catch rates.

The most recent Tasmanian study into the effects of effort creep on abalone catch rates was made using catch-effort data collected between 1975 and 2000, from Blocks 13 and 14. Using documented estimates of effort creep as guidelines (Buckworth, 1987; Haddon and Hodgson, 2000; Harrison, 1983), a series of plausible effort creep scenarios was constructed. Extrapolation of Harrison's (1983) estimate of effort creep (approximately 5% p.a.) caused an overall reduction in relative CPUE over the study period *i.e.* by removing the confounding effect caused by improvements in diver efficiency, catch rates were higher in 1975 than they were in 2000 (Tarbath et al., 2001). However, the overall relative trends in catch rate were only slightly altered when using the standardization (Figure 7).

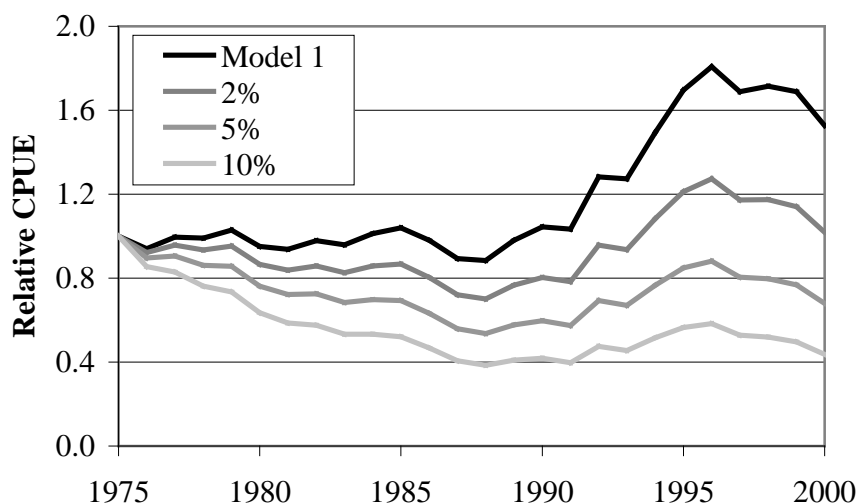


Figure 7. Relative CPUE indices for Block 13, 1975-2000. Model 1 is the raw geometric mean of CPUE. The three effort creep scenarios considered are: (i) 2% per annum; (ii) 5% per annum; and (iii) 10% per annum. All values of CPUE are relative to 1975 (Tarbath et al., 2001).

Improvements in efficiency are extremely difficult to quantify accurately. Without the resources to make an intensive study into historical diving techniques and behaviour (which anyway would have to rely on divers' memories) or alternatively make guesses about how much more efficient current divers have become, we have chosen to limit the comparison of catch rates over a short period during which we assume that divers operated with equal efficiency. This assessment reviews catch-rate trends over the last seven years. (The introduction of sub-blocks and consequent finer scale reporting in 2000 means that most comparisons at a finer geographical scale are currently limited to a seven-year period.) By reducing the period over which comparisons are made, it is assumed to be more likely that changes due to improved fishing methods or diver behaviour are avoided, and there is more confidence 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 with the lowered stock abundance 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 can assume that catch-rate trends are indicative of changes in abundance.

These conditions of intense fishing pressure are probably common 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:

Earlier assessments assumed that abalone abundance was high on Tasmania's west coast because catch rates were relatively high compared with the east coast. It now appears that along much of the coast line, the population remnants contracted to either deep water or the wash zone, where they could still be caught at high catch rates. Earlier assessments also failed to account for the larger size of west coast fish, which accounted for much of the difference in catch rates. The reported decline of stocks and widespread concern among divers who fish in the South West highlights the dangers of relying upon absolute values of catch rates to gauge abundance levels.

Because of past quota reductions, much of the Eastern Zone, particularly the northern part of the East Coast, has been fished at low levels of effort. This means that effort has not been consistently applied to populations, allowing the formation of aggregations between fishing events, which may span fishing years. In addition, 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 rate trends should be 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 further problems to consider with the greenlip fishery. Firstly, it is evident that many divers are learning to fish greenlip abalone more efficiently, compounding the difficulty faced in interpreting the abundance/catch-rate relationship. Secondly, each region's greenlip 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 the difficulties with interpreting catch-rate information, it is proposed that, when catch rates are examined in combination with trends in the catch itself, along with the median size of captured abalone, 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.

Declining catches combined with continuing declines in catch rates 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. This is expected to be associated with a decline in the median size of abalone because fishing mortality increases and fewer animals are left to grow to larger sizes.

Catch rates increasing with increasing catches are likely to indicate 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, the Actaeons. It is expected that the median size will eventually increase, though a decrease is possible if the increased catch is due to large numbers of new recruits entering the fishery.

b) 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.

Between 2000 and 2008, diver's catches from around the State were routinely sampled by TAFI research staff at fish processing factories. 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.

Since 2008, market measuring has been undertaken by four abalone processors (Ralphs Tasmanian Seafoods Pty Ltd, Tasmanian Seafoods (Margate) Pty Ltd, Tasmanian

Seafoods (Smithton) Pty Ltd and Abalone Tasmania Pty Ltd) who together process over 40% of the catch. Processor staff measure samples of 100 abalone from catches using electronic measuring boards.

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, 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, stemming from both the diver and the catch sampler.

Sampling involves measuring 100 abalone randomly selected from a diver's catch. Sample design was loosely 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 commercial 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 two years have usually not been reviewed, because the level of sampling is probably inadequate to reflect size-structure of fished populations. Across much of the fishery, the level of sampling has been inadequate. Landings from motherships usually comprise catches from more than one sub-block and more than one day, and because it is not possible to identify the sub-block from where the catch came, size-compositions from areas fished predominately by motherships are not available.

The 4% level was chosen arbitrarily, 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 it is surmised that, as occasionally happens on the west coast, 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

Catch samples show that since 1998, throughout much of the south east there has been a trend of decreasing median size of abalone in commercial catches. Two opposing scenarios are proposed 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 of the catch will fall. 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. As long as recruitment levels are unaffected, the 25th percentile length would be expected to remain at similar levels to those seen in previous years. If exploitation rates further increase, then the 25th percentile length would eventually fall. As a further indication of falling abundance a corresponding reduction in catch and catch rate trends would be expected.

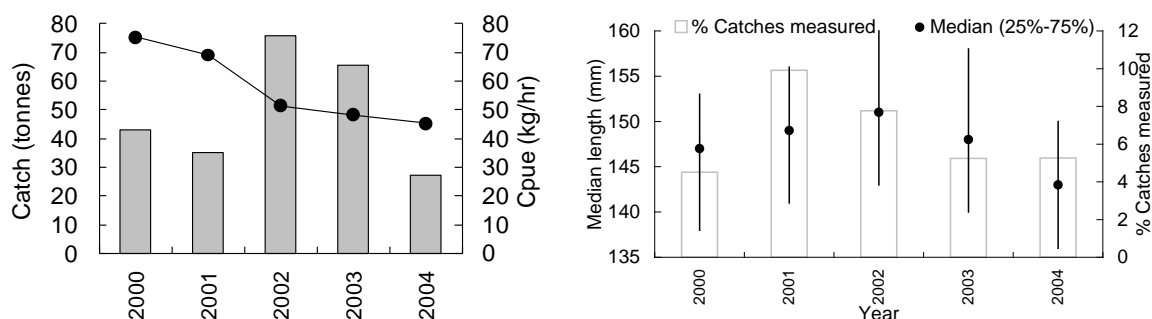


Figure 8. Trends in catch, catch rate and median length (flanked by the 25th and 75th percentile bounds), sub-block 13C, 2000-2004.

For example, in 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 (Figure 8). 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 suggested unsustainable levels of fishing in 2004 (Figure 8).

The second alternative interpretation of the reduced median length is that abundance of small abalone 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. An example of this has occurred in sub-block 20B (Figure 9).

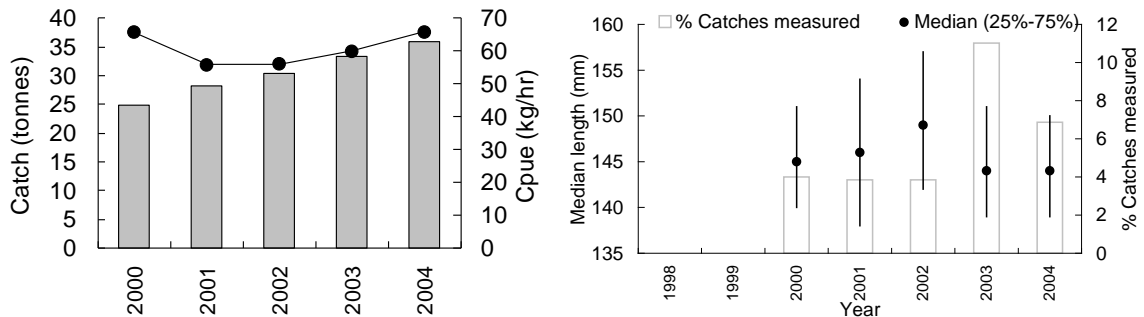


Figure 9. Trends in catch, catch rate and median length (flanked by the 25th and 75th percentile bounds), sub-block 20B, 2000-2004.

Increasing or stable median length, in conjunction with increasing catch and catch rates are strong indicators of rising stock levels. Catch rates and levels of catch in sub-block 24B (Maria Island) have started to recover since 2002 (Figure 10). 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 (Figure 8), the size-structure has been maintained, indicating that the levels of fishing pressure currently appear to be sustainable.

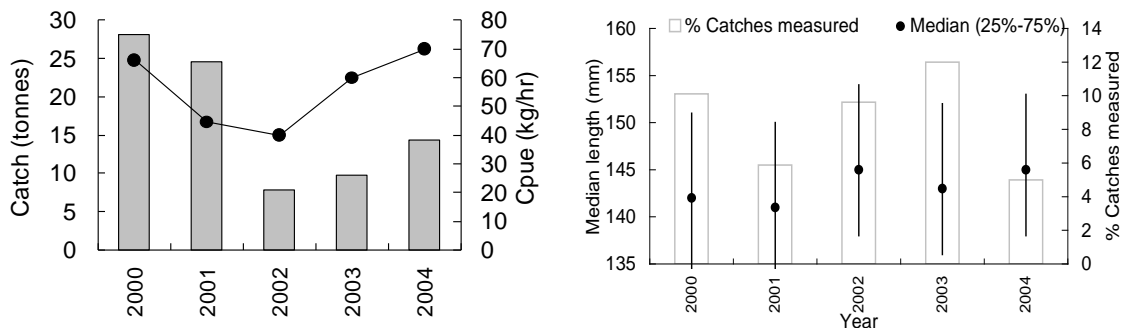


Figure 10. Trends in catch, catch rate and median length (flanked by the 25th and 75th percentile bounds), sub-block 24B, 2000-2004.

Appendix 4: Annual Catches by Zone – 1975-2009

Eastern Zone

The Eastern Zone comprises Sub-blocks 13C, 13D, 13E, Blocks 14 to 30, Sub-block 31A, part of Sub-block 31B). Because the Western and Eastern Zones were not established until 2000, and the Northern Zone until 2001, prior to those years catches cannot be accurately assigned to zones in blocks where zone boundaries occur (Blocks 13 and 31). Catches in these blocks are reported as Eastern Zone because the majority of later catches occurred there, and consequently the average catch for these two blocks may be overestimated.

	Year	13	14	15	16	17	19	20	21
Estimated weights	1975	247	111	10	47	11	0	16	27
	1976	208	156	0	64	36	1	18	25
	1977	245	232	2	190	11	1	23	35
	1978	322	218	6	119	24	1	32	65
	1979	374	251	8	148	25	2	51	52
	1980	272	255	7	145	30	1	33	30
	1981	254	299	18	127	48	4	45	69
	1982	337	218	15	147	24	3	36	62
	1983	250	300	10	189	28	3	43	63
	1984	318	297	18	166	35	5	47	70
Landed weights	1985	256	262	4	89	83	11	68	80
	1986	220	262	22	82	93	4	65	66
	1987	224	229	7	47	80	1	43	44
	1988	219	258	6	76	57	4	62	44
	1989	156	172	2	56	43	2	61	42
	1990	132	193	4	76	29	3	33	51
	1991	127	207	2	60	37	3	53	50
Estimated weights	1992	140	106	3	28	20	2	51	43
	1993	257	116	4	100	40	1	59	78
	1994	295	139	10	114	46	1	109	80
	1995	310	247	1	100	35	1	95	74
	1996	391	195	0	78	18	3	71	55
	1997	471	137	0	64	25	2	79	49
	1998	470	108	1	116	23	2	85	64
	1999	491	66	2	113	35	6	102	72
	2000	381	98	2	71	29	4	62	60
	2001	324	157	3	108	20	2	56	50
	2002	296	101	1	72	16	1	62	58
	2003	291	116	2	60	17	1	88	54
	2004	221	104	7	50	20	2	92	52
	2005	181	90	8	56	20	3	116	62
	2006	184	84	3	67	13	2	73	66
	2007	255	70	0	56	8	6	68	63
	2008	340	56	1	64	8	0	50	61
2009	341	63	1	52	20	1	51	52	
Average 75-09	280	171	5	91	32	3	60	56	
Average 85-09	279	145	4	74	33	3	70	59	
Average 00-09	282	94	3	66	17	2	72	58	

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Eastern Zone (continued).

	Year	22	23	24	25	26	27	28	29	30	31	Total
Estimated weights	1975	49	74	15	16	5	44	69	16	44	32	835
	1976	45	56	18	12	9	40	72	9	37	50	857
	1977	37	53	11	10	8	55	90	22	119	54	1196
	1978	60	88	22	13	11	93	87	25	137	105	1431
	1979	43	30	9	23	7	80	52	12	105	60	1332
	1980	42	46	158	34	7	108	91	27	148	105	1538
	1981	35	77	137	19	15	68	154	22	146	52	1586
	1982	63	49	97	20	9	89	100	32	170	48	1519
	1983	54	92	99	31	14	99	103	65	296	90	1828
1984	73	61	109	10	11	106	112	52	148	76	1714	
Landed weights	1985	43	44	120	20	17	86	71	5	84	171	1515
	1986	70	56	88	12	20	50	58	14	124	164	1472
	1987	32	34	66	12	8	76	45	11	67	54	1082
	1988	43	34	79	10	6	65	52	16	93	90	1214
	1989	22	16	34	7	8	41	31	11	39	27	770
	1990	40	36	61	1	2	61	77	21	54	22	897
	1991	47	31	67	2	9	64	66	12	30	21	890
Estimated weights	1992	49	23	67	1	1	67	45	7	10	13	676
	1993	48	24	73	1	1	86	39	8	15	15	964
	1994	55	16	53	0	3	103	24	8	11	21	1088
	1995	34	19	38	0	1	81	18	6	10	26	1097
	1996	44	28	67	3	6	89	39	11	28	20	1147
	1997	47	32	106	1	13	190	32	32	23	33	1336
	1998	63	44	160	2	25	180	77	31	10	15	1476
	1999	50	53	143	0	9	95	60	26	11	39	1374
	2000	69	44	104	1	8	101	16	21	10	90	1171
	2001	40	24	111	1	14	68	9	27	13	78	1104
	2002	46	15	46	0	2	53	7	15	12	44	847
	2003	35	21	51	0	3	50	8	19	3	27	848
	2004	35	19	51	1	1	44	11	24	6	22	761
	2005	36	18	66	0	0	43	13	36	7	15	770
	2006	71	23	88	1	1	40	10	41	0	7	773
2007	61	14	59	0	1	55	11	32	0	4	766	
2008	56	11	68	0	1	48	6	28	0	10	807	
2009	91	22	63	0	0	50	5	26	2	12	852	
Average 75-09	49	38	74	7	7	76	50	22	58	49	1130	
Average 85-09	49	28	77	3	6	76	33	20	27	42	1028	
Average 00-09	54	21	71	0	3	55	10	27	5	31	870	

Central Western Zone

Annual tonnages of blacklip abalone caught within the statistical blocks and sub-blocks comprising the Central Western Zone (Sub-block 5D, Blocks 6, 7 and 8). Catches from Block 5 prior to 2001 are reported in the Northern Zone.

	Year	5	6	7	8	Total
Estimated weights	1975		110	36	42	188
	1976		63	56	77	196
	1977		50	24	22	96
	1978		79	13	27	118
	1979		112	19	23	154
	1980		196	81	63	340
	1981		257	88	87	432
	1982		147	34	34	215
	1983		231	102	58	390
	1984		298	78	38	413
Landed weights	1985		322	99	23	444
	1986		213	97	11	321
	1987		185	84	44	313
	1988		241	53	27	320
	1989		192	49	46	287
	1990		197	56	21	275
	1991		169	54	30	253
Estimated weights	1992		235	70	36	341
	1993		154	64	38	256
	1994		79	33	38	150
	1995		112	30	17	159
	1996		103	67	13	183
	1997		98	75	28	201
	1998		126	51	27	204
	1999		149	60	24	233
	2000		183	61	23	266
	2001	0	210	32	15	257
	2002	2	173	51	17	243
	2003	0	97	104	27	229
	2004	3	88	89	22	203
	2005	6	95	110	26	236
	2006	4	109	76	6	196
	2007	0	76	39	18	133
	2008	0	105	51	9	166
2009	0	143	107	51	301	
Average 75-09	2	154	63	32	249	
Average 85-09	2	154	66	26	247	
Average 00-09	2	128	72	22	223	

Western Zone

Annual tonnages of blacklip abalone caught within the statistical blocks and sub-blocks comprising the Western Zone in 2009 (Blocks 9 to 12, Sub-blocks 13A, 13B). Pre-zoning (1975-1999) catches from Block 13 are reported in the Eastern Zone.

	Year	9	10	11	12	13	Total
Estimated weights	1975	126	130	191	143		590
	1976	252	179	240	153		824
	1977	123	98	153	189		562
	1978	115	258	275	208		855
	1979	172	166	269	325		933
	1980	316	195	338	351		1200
	1981	444	260	417	246		1366
	1982	249	100	303	235		887
	1983	199	174	430	242		1045
	1984	248	284	681	258		1471
Landed weights	1985	246	140	478	155		1019
	1986	133	127	289	193		742
	1987	252	82	339	195		868
	1988	159	124	270	162		715
	1989	120	109	212	144		586
	1990	95	80	232	125		532
	1991	102	106	219	140		567
Estimated weights	1992	91	95	266	159		611
	1993	110	65	197	177		548
	1994	77	60	202	160		499
	1995	44	68	186	182		479
	1996	59	75	145	148		428
	1997	140	66	224	227		657
	1998	78	47	163	192		480
	1999	115	58	220	251		645
	2000	205	148	326	282	54	1015
	2001	186	152	312	290	43	983
	2002	174	143	360	236	93	1005
	2003	142	239	345	229	67	1023
	2004	130	181	374	250	96	1031
	2005	92	149	389	311	65	1006
2006	142	198	384	228	89	1041	
2007	178	231	354	267	68	1097	
2008	156	178	345	305	79	1064	
2009	155	110	244	327	77	913	
Average 75-09		161	139	296	220	73	849
Average 85-09		135	121	283	213	73	799
Average 00-09		156	173	343	272	73	1060

Northern Zone

The Northern Zone comprises Blocks 1 to 4, Sub-blocks 5A, 5B and 5C, part of Sub-block 31B, Blocks 32 to 40 and Blocks 47 to 49. There are no records for the Northern Zone part of Block 31 prior to the creation of the zone in 2001.

	Year	31	39	40	32	33	34	35	36	38
Estimated weights	1975		2	1	1	10	1	7	7	2
	1976		5	0	0	5	0	1	1	0
	1977		6	2	6	11	0	0	3	2
	1978		8	2	1	5	2	6	5	4
	1979		6	1	2	9	0	0	2	2
	1980		3	1	2	6	1	1	2	0
	1981		6	2	1	6	1	1	0	0
	1982		5	2	0	6	1	0	2	4
	1983		7	4	0	3	0	1	5	3
	1984		6	3	0	7	0	1	2	1
Landed weights	1985		5	1	3	6	1	2	1	0
	1986		10	5	0	9	2	3	2	1
	1987		6	1	0	7	0	2	1	1
	1988		3	1	0	11	1	1	0	0
	1989		1	28	0	3	0	0	0	0
	1990		0	0	0	1	0	0	1	0
	1991		1	0	0	2	0	0	0	0
Estimated weights	1992		4	0	0	2	0	0	0	0
	1993		0	0	0	3	0	0	0	0
	1994		0	0	0	3	0	0	0	0
	1995		0	0	0	0	0	0	0	0
	1996		0	0	0	0	0	0	0	0
	1997		1	0	0	0	0	0	0	0
	1998		0	1	0	2	0	0	0	0
	1999		5	0	0	4	0	0	0	1
	2000		5	2	1	5	0	0	0	0
	2001	12	11	3	5	10	1	0	0	3
	2002	30	4	3	1	11	1	0	0	2
	2003	7	8	1	0	5	0	0	0	2
	2004	14	6	1	0	3	0	0	0	1
	2005	11	2	0	0	7	0	0	0	2
	2006	16	4	0	0	11	0	0	0	10
	2007	55	11	0	0	2	0	3	0	0
	2008	29	5	0	1	5	0	0	0	6
	2009	20	9	0	2	4	0	1	0	1
	Average 75-09		22	4	2	1	5	0	1	1
Average 85-09		22	4	2	1	5	0	1	0	1
Average 00-09		22	6	1	1	6	0	0	0	3

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Northern Zone (continued)

	Year	47	48	49	5	1	2	3	4	Total
Estimated weights	1975	1	12	9	38	32	1	27	15	167
	1976	1	12	33	46	39	0	51	8	203
	1977	0	8	17	51	17	1	87	8	218
	1978	3	10	11	65	21	3	55	25	225
	1979	0	27	7	85	24	2	10	9	187
	1980	0	10	1	92	51	3	33	3	209
	1981	3	33	10	120	19	8	32	9	251
	1982	1	45	7	121	22	9	27	13	266
	1983	9	45	19	228	22	2	31	52	431
	1984	4	80	44	312	10	1	33	55	560
Landed weights	1985	4	48	50	319	43	0	26	11	522
	1986	15	85	97	267	35	4	24	13	573
	1987	18	58	67	198	44	62	24	54	543
	1988	18	30	38	165	29	16	21	60	393
	1989	14	15	24	88	14	7	10	5	210
	1990	6	14	20	82	11	10	9	11	166
	1991	8	12	10	97	6	7	14	26	185
Estimated weights	1992	3	10	11	76	2	3	9	8	129
	1993	1	7	7	65	8	3	8	9	111
	1994	0	7	12	49	15	2	4	1	94
	1995	0	6	2	62	11	3	1	8	95
	1996	0	4	0	63	7	2	1	2	80
	1997	0	6	2	56	10	1	10	6	92
	1998	0	7	3	61	3	1	0	2	79
	1999	0	14	4	57	5	1	6	6	103
	2000	0	12	25	45	0	0	9	10	114
	2001	0	17	72	117	2	1	12	12	279
	2002	0	12	48	103	10	2	35	16	277
	2003	0	10	76	73	25	1	61	10	279
	2004	0	6	62	55	10	0	85	34	277
	2005	0	6	54	73	15	2	92	18	282
	2006	0	5	57	96	11	3	57	8	279
	2007	0	6	59	89	6	0	47	3	280
	2008	0	7	74	163	5	0	24	10	329
	2009	0	4	75	172	10	0	27	5	330
Average 75-09	3	20	32	110	17	5	29	16	252	
Average 85-09	4	16	38	108	14	5	25	14	244	
Average 00-09	0	8	60	99	9	1	45	13	273	

Bass Strait Zone

Annual tonnages of blacklip abalone caught within statistical blocks comprising the Bass Strait Zone. The fishery was closed in 2007.

	Year	37	41	42	43	44	45	46	50	51	52	53	54	55	56	57	Total
Estimated weights	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
Landed weights	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	1	24	0	41	4	0	6	0	168
	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
Estimated weights	1992	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	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	0	2
	2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	2003	6	1	2	2	0	0	2	0	7	2	36	2	0	7	2	70
	2004	3	4	4	1	0	0	1	0	1	0	42	5	2	7	0	70
	2005	6	4	1	2	0	0	0	0	8	0	35	5	3	3	0	69
	2006	20	1	4	5	0	0	5	0	3	0	24	5	2	1	1	70
2007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2008	21	1	2	5	1	1	3	0	1	0	27	0	0	6	0	67	
2009	10	5	2	8	6	1	1	0	5	0	24	1	0	4	2	69	
Average 75-09	5	1	1	2	0	0	1	0	4	0	10	1	0	2	1	28	
Average 85-09	7	2	1	3	0	0	1	0	5	0	13	1	0	2	1	38	
Average 00-09	7	2	1	2	1	0	1	0	2	0	19	2	1	3	1	42	

Greenlip Fishery

Annual tonnages of greenlip abalone caught from the Greenlip fishery. Greenlip are taken from northern Tasmanian waters, and the fishery is managed by species. Occasionally, small amounts of catch (< 1 t) is taken from northern blocks not listed here. In 2009, 1.1 t was taken from 4 blocks across the central north coast.

	Year	31	39	40	32	33	34	35	36	37	38
Estimated weights	1975	7	3	4	3	17	14	49	69	14	11
	1976	14	2	9	1	26	11	55	49	2	10
	1977	6	8	4	6	23	21	50	24	1	22
	1978	8	1	2	4	12	17	51	38	7	17
	1979	11	6	2	10	21	8	46	15	4	4
	1980	4	3	5	7	15	3	29	13	4	4
	1981	6	4	2	12	17	17	34	10	9	0
	1982	27	1	3	4	13	14	29	7	9	9
	1983	23	2	0	4	21	8	34	9	4	8
	1984	50	8	4	9	27	15	56	7	6	0
Landed weights	1985	53	5	4	9	20	15	42	4	7	7
	1986	39	8	7	4	14	7	36	2	10	0
	1987	32	12	1	8	20	10	30	8	10	7
	1988	35	2	1	8	19	5	28	13	6	0
	1989	22	5	2	4	16	2	22	10	3	0
	1990	23	7	0	4	9	3	25	6	1	3
	1991	20	6	0	4	7	2	31	6	3	0
Estimated weights	1992	15	9	0	3	4	1	18	6	2	0
	1993	9	2	0	1	4	2	16	8	3	0
	1994	12	1	0	3	8	1	17	5	3	0
	1995	24	6	2	2	7	3	15	3	3	9
	1996	11	13	2	3	13	4	17	2	8	12
	1997	17	22	1	8	13	1	12	4	11	15
	1998	4	17	24	5	5	1	23	1	2	2
	1999	6	2	4	2	17	1	15	1	2	4
	2000	12	15	12	8	11	2	14	3	2	2
	2001	7	20	4	14	14	2	9	3	1	0
	2002	17	12	2	4	16	2	8	2	2	9
	2003	18	16	1	5	16	1	10	2	1	3
	2004	9	22	0	4	4	1	13	3	1	11
	2005	6	13	1	2	12	1	10	3	1	15
	2006	3	13	0	5	5	1	11	1	4	13
	2007	20	14	0	3	6	1	13	2	0	5
	2008	13	12	0	3	6	1	12	4	3	5
2009	13	20	1	2	5	1	13	2	2	2	
Average 75-09	17	9	3	5	13	6	26	10	4	6	
Average 85-09	18	11	3	5	11	3	18	4	4	5	
Average 00-09	12	16	2	5	9	1	11	3	2	7	

Continued next page

Greenlip Fishery(continued)

Year	47	48	49	5	1	2	3	4	Total	
Estimated weights	1975	0	7	2	8	0	3	0	1	213
	1976	0	8	6	14	0	0	0	0	210
	1977	0	40	2	17	0	0	0	0	223
	1978	1	13	3	12	1	3	0	2	191
	1979	0	11	0	8	0	0	0	0	146
	1980	0	6	0	5	0	3	0	0	100
	1981	3	12	1	9	0	12	0	4	153
	1982	2	7	0	2	0	14	0	2	141
	1983	14	40	11	9	0	9	0	5	201
1984	52	60	2	11	0	7	1	5	320	
Landed weights	1985	12	36	3	3	0	1	0	1	222
	1986	57	35	14	5	1	8	0	3	251
	1987	37	33	3	8	13	125	5	69	431
	1988	35	21	4	10	3	33	2	12	240
	1989	20	27	4	6	1	70	3	10	227
	1990	21	27	11	11	2	49	3	13	218
	1991	13	32	6	12	2	29	3	16	191
Estimated weights	1992	4	14	2	4	3	21	0	8	115
	1993	2	26	4	2	2	18	0	9	110
	1994	3	48	3	10	4	25	0	7	149
	1995	5	23	5	8	14	9	0	12	149
	1996	1	15	0	3	37	33	1	13	190
	1997	1	28	3	6	35	33	0	6	215
	1998	2	43	8	14	31	34	0	5	222
	1999	0	20	1	10	21	25	1	10	142
	2000	0	24	12	13	2	4	1	3	140
	2001	0	35	9	3	8	8	1	2	140
	2002	0	27	7	7	11	6	1	7	140
	2003	0	14	10	10	14	11	3	4	140
	2004	0	14	6	10	14	10	4	3	128
	2005	0	19	1	12	16	7	4	3	123
	2006	0	29	2	8	11	10	2	5	123
	2007	0	21	3	9	10	7	3	6	124
2008	0	33	3	5	4	10	1	5	121	
2009	0	26	2	5	8	8	3	6	121	
Average 75-09	8	25	4	8	8	18	1	7	179	
Average 85-09	9	27	5	8	11	24	2	10	175	
Average 00-09	0	24	5	8	10	8	2	4	130	

Appendix 5: Catch/effort data extract query.

Catch/effort data from divers' catch docket were provided by DPIPWE, with tables updated weekly and stored in an Oracle database at the University of Tasmania. The following SQL query was used to extract catch records from the Oracle database:

```

SELECT DISTINCT
    d.docket_number docket
  ,   f.fishing_date day
  ,   EXTRACT(month FROM f.fishing_date) month
  ,   EXTRACT(year FROM f.fishing_date) year
  ,   UPPER(n3.last_name)||','||REPLACE(TRANSLATE(INITCAP(n3.first_names),
'abcdefghijklmnopqrstuvwxyz','#####'), '#','') diver_name
  ,   SUBSTR(d.zone_fishery_code, 3, 2) zone
  ,   CASE
        WHEN f.block_code BETWEEN 'AB13C' AND 'AB14B' THEN 'ACT'
        WHEN f.block_code BETWEEN 'AB14C' AND 'AB16D' THEN 'BRUNY'
        WHEN f.block_code BETWEEN 'AB17A' AND 'AB21C' THEN 'STMBY'
        WHEN f.block_code BETWEEN 'AB22A' AND 'AB31A' THEN 'EC'
        WHEN f.block_code BETWEEN 'AB32A' AND 'AB38C' THEN 'FG'
        WHEN f.block_code BETWEEN 'AB39A' AND 'AB40C' THEN 'NE'
        WHEN f.block_code BETWEEN 'AB41' AND 'AB46' THEN 'CN'
        WHEN f.block_code BETWEEN 'AB47A' AND 'AB49C' THEN 'NW'
        WHEN f.block_code BETWEEN 'AB01A' AND 'AB04C' THEN 'KI'
        WHEN f.block_code BETWEEN 'AB05A' AND 'AB05C' THEN 'NW'
        WHEN f.block_code BETWEEN 'AB05D' AND 'AB06D' THEN 'COUTA'
        WHEN f.block_code BETWEEN 'AB07A' AND 'AB08C' THEN 'GRANVILLE'
        WHEN f.block_code BETWEEN 'AB09A' AND 'AB09C' THEN 'STRAHAN'
        WHEN f.block_code BETWEEN 'AB10A' AND 'AB12A' THEN 'SW'
        WHEN f.block_code BETWEEN 'AB12B' AND 'AB13B' THEN 'SC'
        WHEN f.block_code BETWEEN 'AB50' AND 'AB57' THEN 'ISLAND'
        WHEN (f.block_code = 'AB31B' AND d.zone_fishery_code = 'AQE') THEN 'EC'
        ELSE 'NE'
    END region
  ,   SUBSTR(f.block_code,1,4) blok
  ,   f.block_code sub_block
  ,   ROUND(f.blacklip_estimated_weight,0) blips,
ROUND(f.greenlip_estimated_weight,0) glips,    NVL(dive_time_1,0) + NVL(dive_time_2,0) +
NVL(dive_time_3,0) total_time
FROM qms.abalone_fishing_details f
  ,   qms.quota_dockets d
  ,   lmm.clients n3
WHERE EXTRACT(year FROM f.fishing_date)= 2009
      AND d.qudo_id = f.qudo_id
      AND n3.client_id = d.docket_signatory_id
ORDER BY
f.fishing_date asc

```

Appendix 6: Treatment of errors in catch data in 2009.

While it is known that a number of errors exist in the historical catch data, no amendments were made to catch totals from earlier years presented in this report. These errors may be corrected as time allows, and any corrections will be reported in subsequent assessment reports.

Appendix 7: History of Management Changes

This history has been compiled from a number of sources, principal among which has been DPIW'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). Skippers of boats engaged in abalone fishing required to lodge monthly fish returns 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.
1968	Abalone catch returns were introduced. These recorded daily catches and effort by reporting block, and were lodged monthly by the skipper (not necessarily a diver) of an abalone fishing vessel. More than one diver's catch could be reported on a return. These returns replaced the general fish return on which earlier catches were reported.
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. Computerised catch records started from July 1974.
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>i.e.</i> 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. Catch dockets recording the catch weight landed by individual divers were introduced.
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>i.e.</i> 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>i.e.</i> TAC was 3287 tonnes.
1988	The catch per ITQ was reduced to 855 kg (5% reduction) <i>i.e.</i> TAC was 2958.3 tonnes. The minimum legal weight for abalone meats was set at 90 g.
1989	The catch per ITQ was reduced to 600 kg (30% reduction) <i>i.e.</i> TAC was 2076 tonnes. 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

	<p>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> <p>Compliance catch database (SEALSPROD) that enabled auditing of catch from vessel to factory introduced by DPIF.</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 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.</p>
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>i.e.</i> 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>Difference 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>A new compliance catch database (LMM/QMS) introduced by DPIWE</p>
1999	<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>
2000	<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 (140 t), 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, MSL for King Island greenlip was raised to 155 mm, 140 mm for North West and 145 for both the North East and the Furneaux Group.</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 (360kg/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</p>

	<p>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.</p> <p>MSL for greenlip on King Island was reduced to 150 mm.</p> <p>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).</p> <p>Western Zone TAC remained 1260 t (360 kg/unit)</p> <p>Northern Zone TAC remained 280 t (80 kg/unit)</p> <p>Greenlip TAC remained 140 t (40 kg/unit)</p> <p>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 (20kg/unit), MSL of 114 mm) was created within 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).</p> <p>Western Zone TAC remained 1260 t (360 kg/unit)</p> <p>Northern Zone TAC remained 280 t (80 kg/unit)</p> <p>Greenlip TAC remained 140 t (40 kg/unit)</p> <p>Bass Strait Zone TAC set at 70 t (20 kg/unit)</p> <p>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. Note that this was not rigidly enforced and market sampling showed most samples contained many abalone over this</p>

	size.
2004	<p>Eastern Zone TAC reduced to 770 t (220 kg/unit)</p> <p>Western Zone TAC remained 1260 t (360 kg/unit)</p> <p>Northern Zone TAC remained 280 t (80 kg/unit)</p> <p>Greenlip TAC reduced to 129.5 t (37 kg/unit)</p> <p>Bass Strait Zone TAC remained 70 t (20 kg/unit)</p> <p>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)</p> <p>Western Zone TAC remained 1260 t (360 kg/unit)</p> <p>Northern Zone TAC remained 280 t (80 kg/unit)</p> <p>Greenlip TAC reduced to 122.5 t (35 kg/unit)</p> <p>Bass Strait Zone TAC remained 70 t (20 kg/unit)</p> <p>Fishery production was set at 2502.5 t (715 kg/unit) state-wide.</p> <p>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. Team dive docketts were submitted by teams, but not computerised.</p> <p>High grading (discarding large abalone in the catch from the deck) prohibited.</p> <p>Caufing prohibited.</p> <p>Introduction of cancellation reports where a prior reported trip is cancelled.</p> <p>Introduction of single (blacklip) zone fishing provisions.</p> <p>Overcatch provisions introduced to cover unintentional underestimation of catch weight.</p> <p>In Victoria in December, ganglioneuritis detected on two land-based (Portland and Port Fairy) and two offshore (Westernport) aquaculture sites.</p>
2006	<p>Eastern Zone TAC remained 770 t (220 kg/unit)</p> <p>Western Zone TAC remained 1260 t (360 kg/unit)</p> <p>Northern Zone TAC remained 280 t (80 kg/unit)</p> <p>Greenlip TAC remained 122.5 t (35 kg/unit)</p> <p>Bass Strait Zone TAC remained 70 t (20 kg/unit)</p>

	<p>Fishery production was set at 2502.5 t (715 kg/unit) state-wide.</p> <p>On 1 January 2006, interim reduction in MSL for Perkins Bay greenlip area (Blocks 47, 48A), from 145 mm to 140 mm.</p> <p>On 20 September 2006, MSL for Bass Strait Zone in Blocks 41-46 (North Coast) reduced from 114 mm to 110 mm.</p> <p>On 1 November 2006, MSL for Eastern Zone was increased to 138 mm from 136 mm. MSL for greenlip abalone in Perkins Bay was reduced to 132 mm from 140 mm.</p> <p>As a temporary measure to facilitate research, Block 30 was entirely closed to commercial abalone fishing and partially closed (except sub-block 30A) to recreational abalone fishing. The bag limit for recreational fishers in sub-block 30A reduced to 5 abalone per day.</p> <p>May 2006: Victorian ganglioneuritis (AVG) outbreaks reported from wild stocks adjacent to land-based aquaculture site at Port Fairey. As a precautionary measure, the Tasmanian wild fishery in Bass Strait closest to the Victorian coast was closed to abalone fishing, from 16 August 2006, initially for three months but then extended to 28 February 2007. The closure was for waters within latitudes 39° 12' S and 39 ° 33' S, and longitudes 146 ° to 147 ° 35' (Blocks 51 to 56, and part of Block 57, including Wright Rock and Endeavour Reef). The taking of abalone in Tasmanian waters from vessels used in the Victorian fishery was prohibited, and the transfer by sea of abalone from King Island to the Tasmanian mainland was prohibited.</p>
2007	<p>Eastern Zone TAC remained 770 t (220 kg/unit)</p> <p>Western Zone TAC remained 1260 t (360 kg/unit)</p> <p>Northern Zone TAC remained 280 t (80 kg/unit)</p> <p>Greenlip TAC remained 122.5 t (35 kg/unit)</p> <p>Bass Strait Zone TAC remained 70 t (20 kg/unit)</p> <p>Fishery production was set at 2502.5 t (715 kg/unit) state-wide. However, it was agreed that the Bass Strait component (70 t) would not be caught due to concerns about disease outbreaks (AVG) in abalone stocks in adjacent Victorian waters.</p> <p>In October 2007, it was agreed that the cap for the southern part of the Actaeons (Sub-blocks 13C, 13D and 13E) would be reduced from 350 t to 266 t, and that a cap of 245 t be implemented for the South Coast (Sub-blocks 12B, 12C, 12D, 13A and 13B).</p>
2008	<p>Eastern Zone TAC increased to 808.5 t (231 kg/unit)</p> <p>Western Zone TAC remained 1260 t (360 kg/unit)</p> <p>Northern Zone TAC increased to 332.5 t (95 kg/unit)</p> <p>Greenlip TAC remained 122.5 t (35 kg/unit)</p> <p>Bass Strait Zone TAC remained 70 t (20 kg/unit)</p>

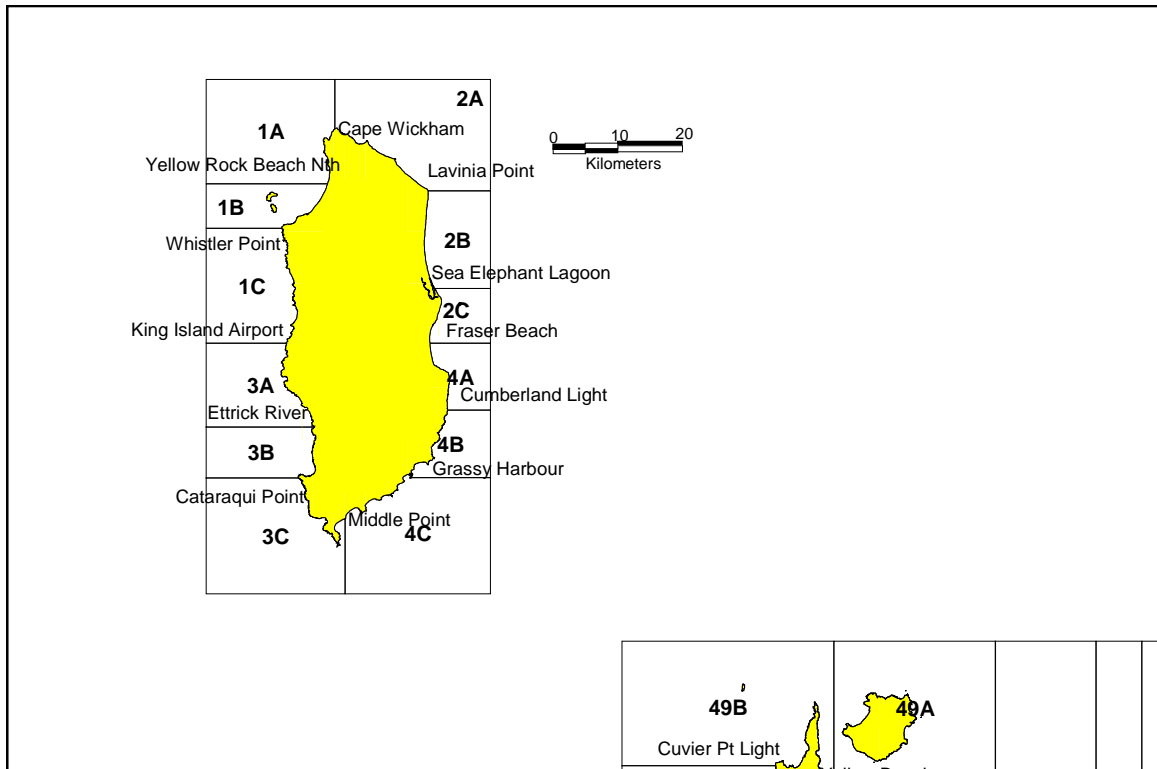
	<p>The total catch state-wide was set at 2,593.5 t, or 741 kg/unit.</p> <p>As part of a controlled trial in the North West, size limits in Block 5 and part of Block 6 were reduced for divers meeting defined operating requirements on the basis that there were large stocks of fish too small to catch at the larger size limit, and that removing these smaller fish would promote growth among the remaining fish. The MSL in the Northern Zone part of Block 5 (5A, 5B and 5C) was reduced from 132 mm to 127 mm, and in sub-blocks 5D, 6A, 6B and 6C, from 136 mm to 132 mm. To promote fishing in the Northern Zone part of Block 5, the cap was increased from 100 t to 152.5 t and the Northern Zone TAC increased to 332.5 t. The remainder of the Northern Zone was capped at 180 t.</p> <p>In Bass Strait, south of 39° 33', the Bass Strait Zone was reopened to fishing on 1 January 2008. North of this line, all islands in the Bass Strait Zone remained closed to fishing as part of measures to reduce the spread of AVG from Victoria. The closed area included the Kent, Hogan and Curtis Groups. It was reopened to fishing on 6 July 2008.</p> <p>Fears of an outbreak of AVG resulted in the closure of the Lower Channel (sub-blocks 14A, 14B, 14C and 14D) to abalone fishing between 16 September 2008 and 12 March 2009. The area was reopened after extensive sampling and testing failed to find diseased abalone.</p> <p>Actaeons (Blocks 13C, 13D, 13E) closed to fishing for the remainder of the year from 21 October because the 266 t catch limit had been reached (340 t).</p> <p>South Coast closed to fishing on 29 October because the 245 t catch limit had been reached (332 t).</p>
2009	<p>Eastern Zone TAC increased to 850.5 t (243 kg/unit)</p> <p>Western Zone TAC reduced to 924 t (264 kg/unit)</p> <p>Central Western Zone established at 304.5 t (87 kg/unit)</p> <p>Northern Zone TAC remained 332.5 t (95 kg/unit)</p> <p>Greenlip TAC remained 122.5 t (35 kg/unit)</p> <p>Bass Strait Zone TAC remained 70 t (20 kg/unit)</p> <p>The total catch state-wide was set at 2,604 t, or 744 kg/unit.</p> <p>A new zone was created on the west coast to transfer catch from the South West further north. The Central Western Zone covers Blocks 6, 7 and 8. The Western Zone was correspondingly reduced to Blocks 9, 10, 11, 12, 13A and 13B.</p> <p>Blocks 7 and 8 were closed to fishing on 13 July because the 108 t cap had been reached (155 t).</p> <p>The North West greenlip region (cap 30 t) was closed to fishing on 1 August after the 20 t Perkins Bay cap was reached (20.1 t). The region's catch was 33.9 t.</p> <p>The North East greenlip region was closed to fishing on 19 October because the 23 t cap had been reached (35 t).</p> <p>The Actaeons were closed to fishing on 1 November, because the 340 t cap</p>

	<p>had been reached (341 t).</p> <p>The South Coast (cap 300 t) was closed to fishing on 1 November with the catch at 321 t.</p> <p>The Block 5 (cap 152 t) was closed to fishing on 5 December with the catch at 172 t.</p>
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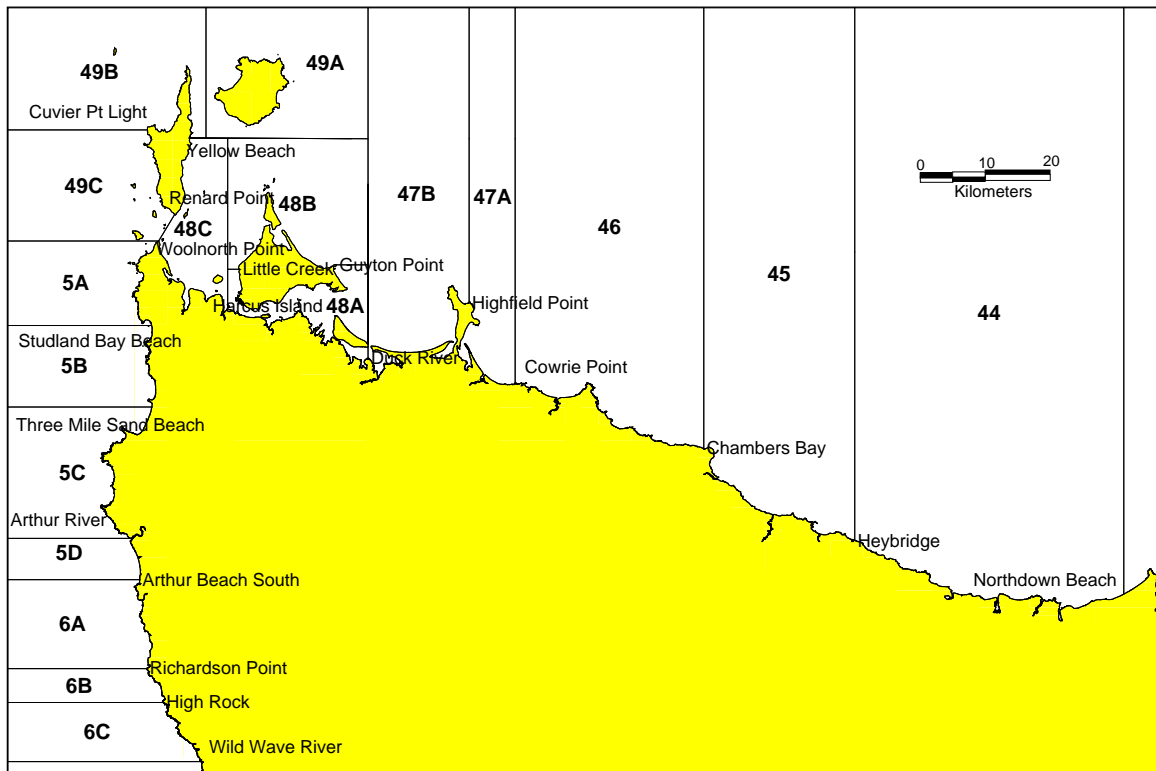
Appendix 8. Maps of catch-reporting blocks and sub-blocks.

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

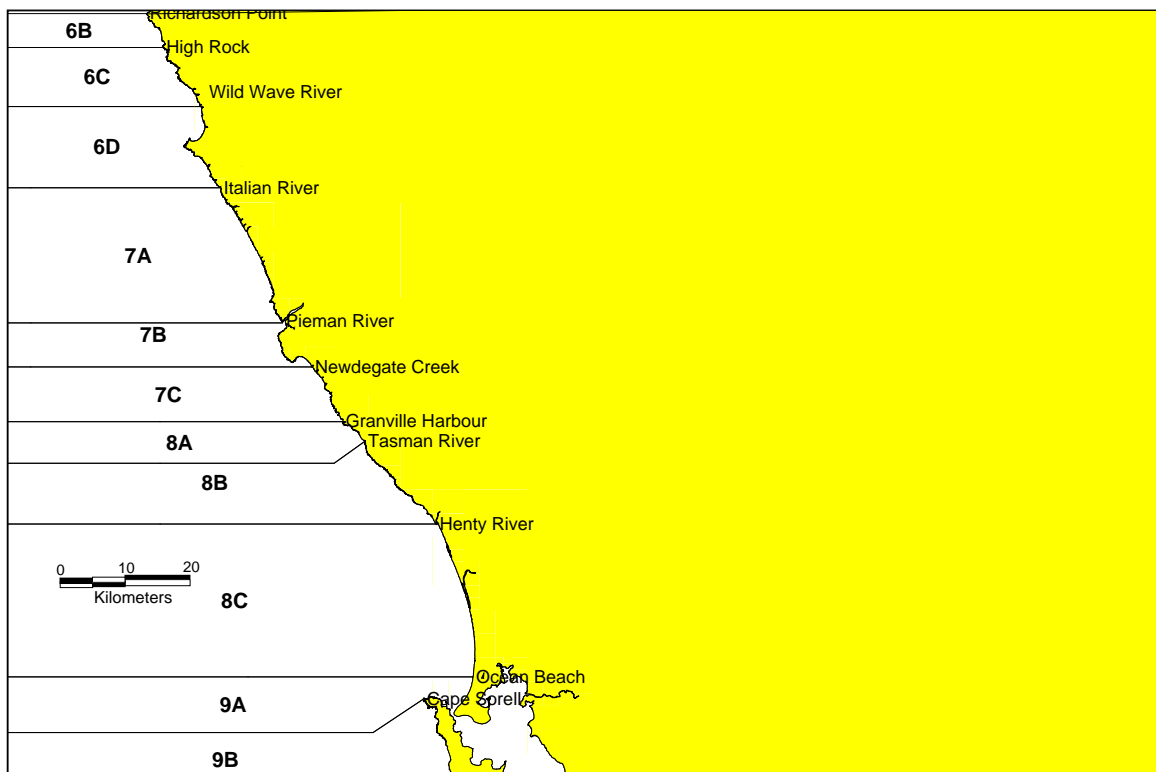
Map1: King Island



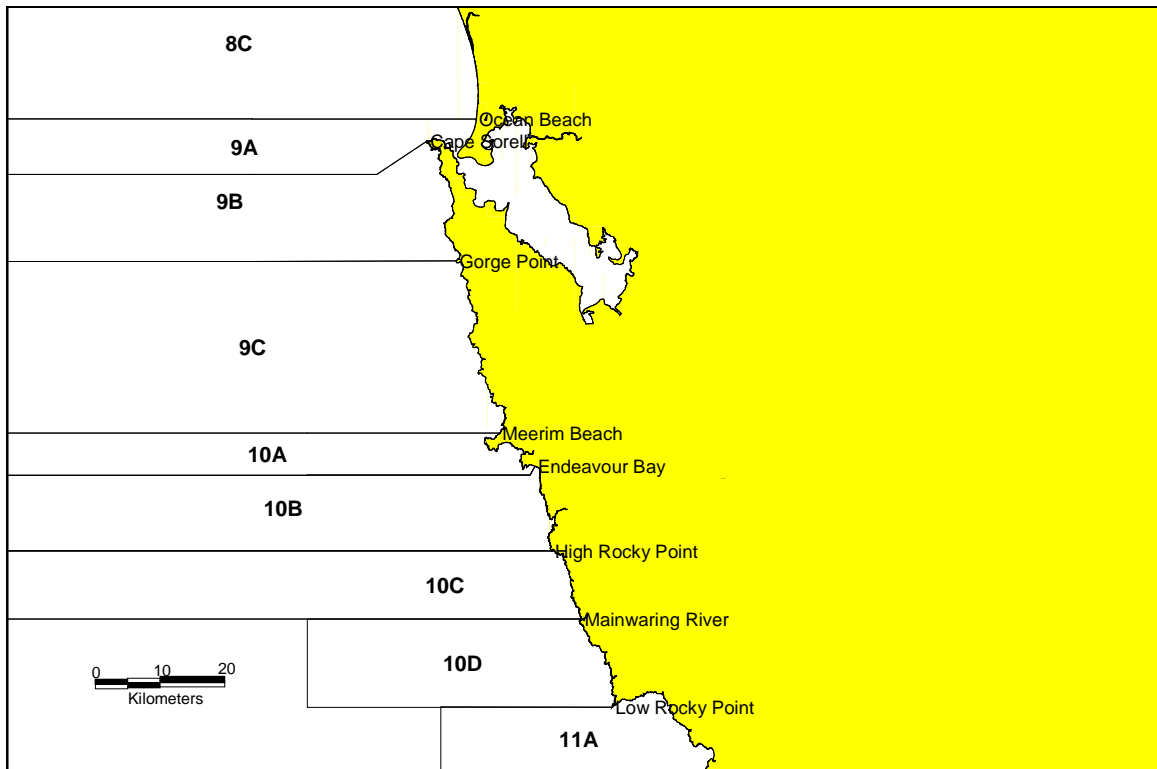
Map 2: North West Tasmania



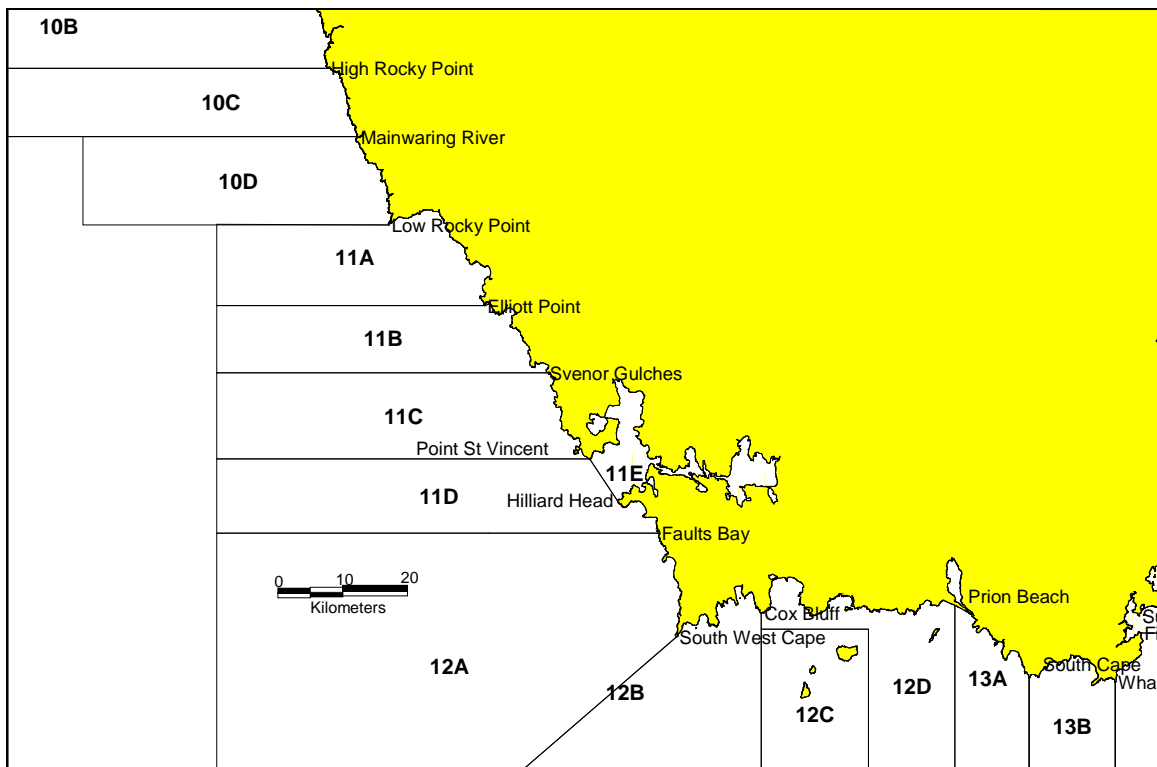
Map 3: Central West Coast (north)



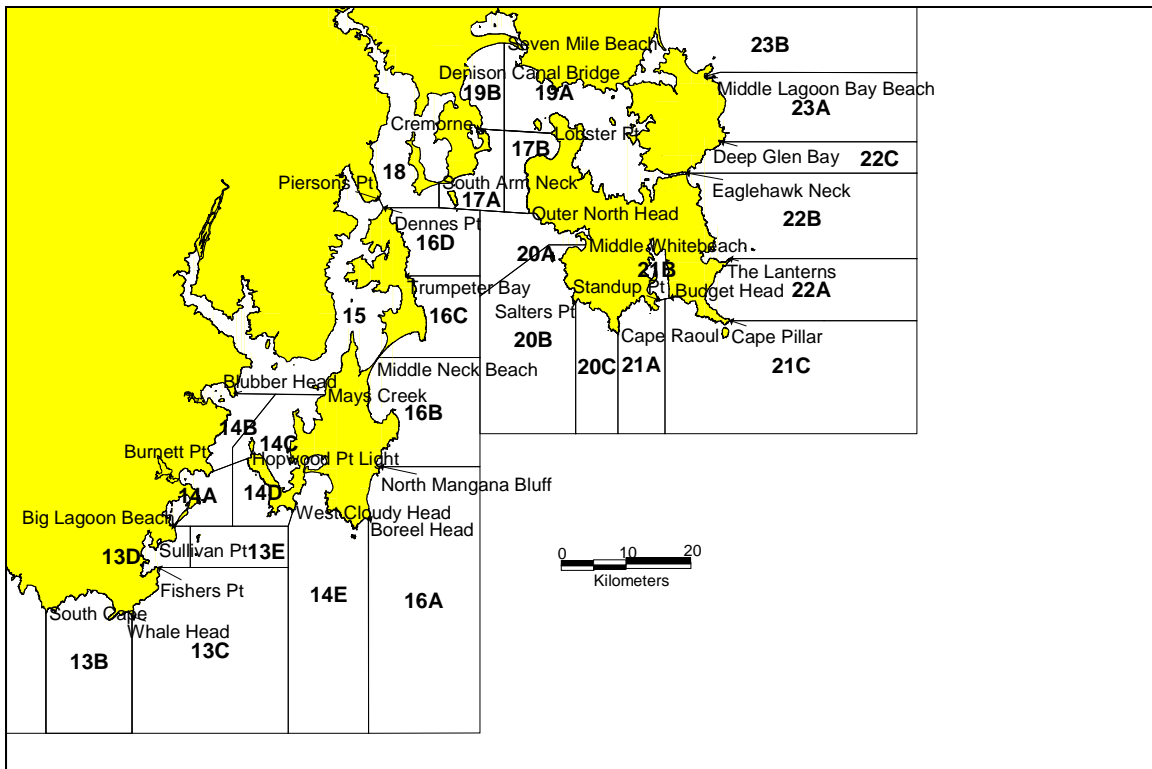
Map 4: Central West Coast (south)



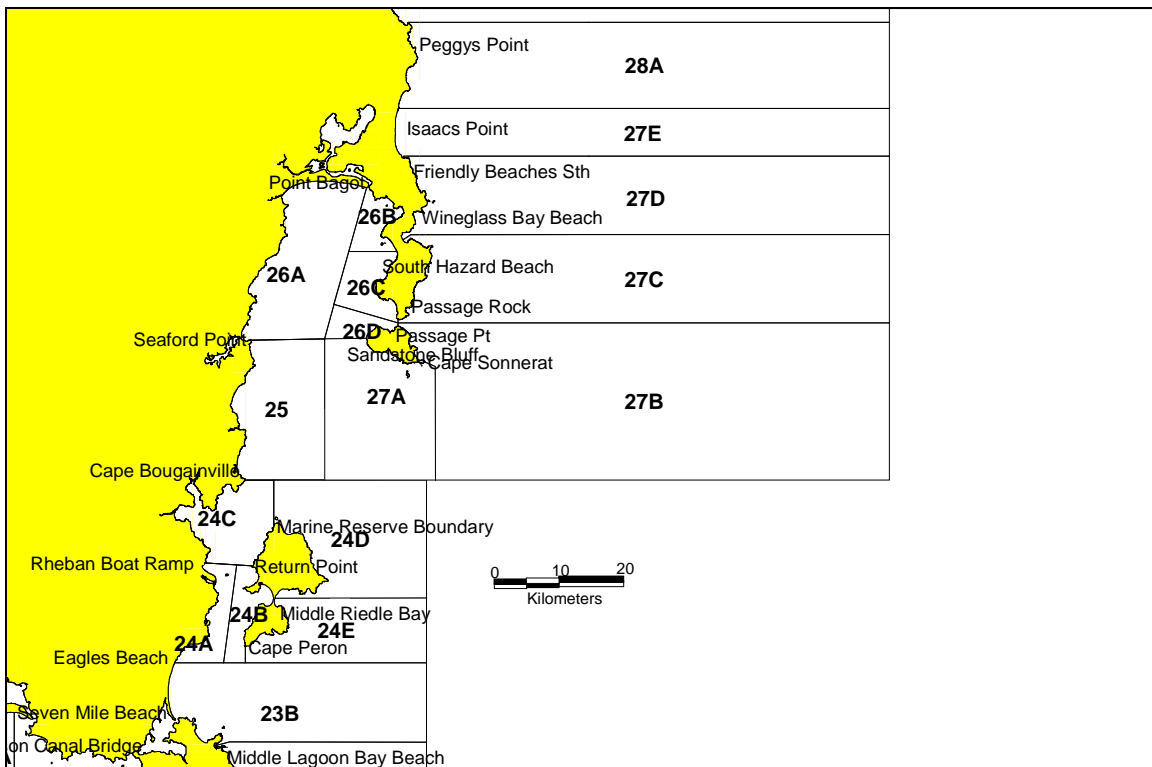
Map 5: South West Tasmania



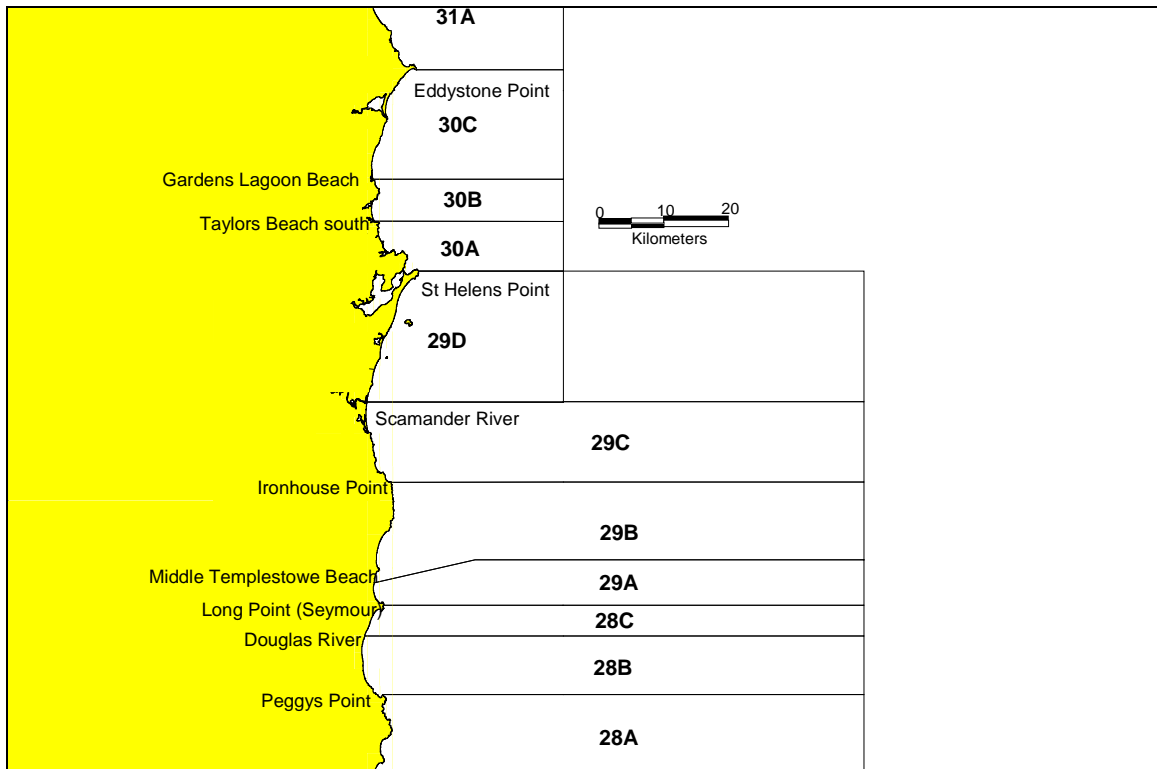
Map 6: South East Tasmania



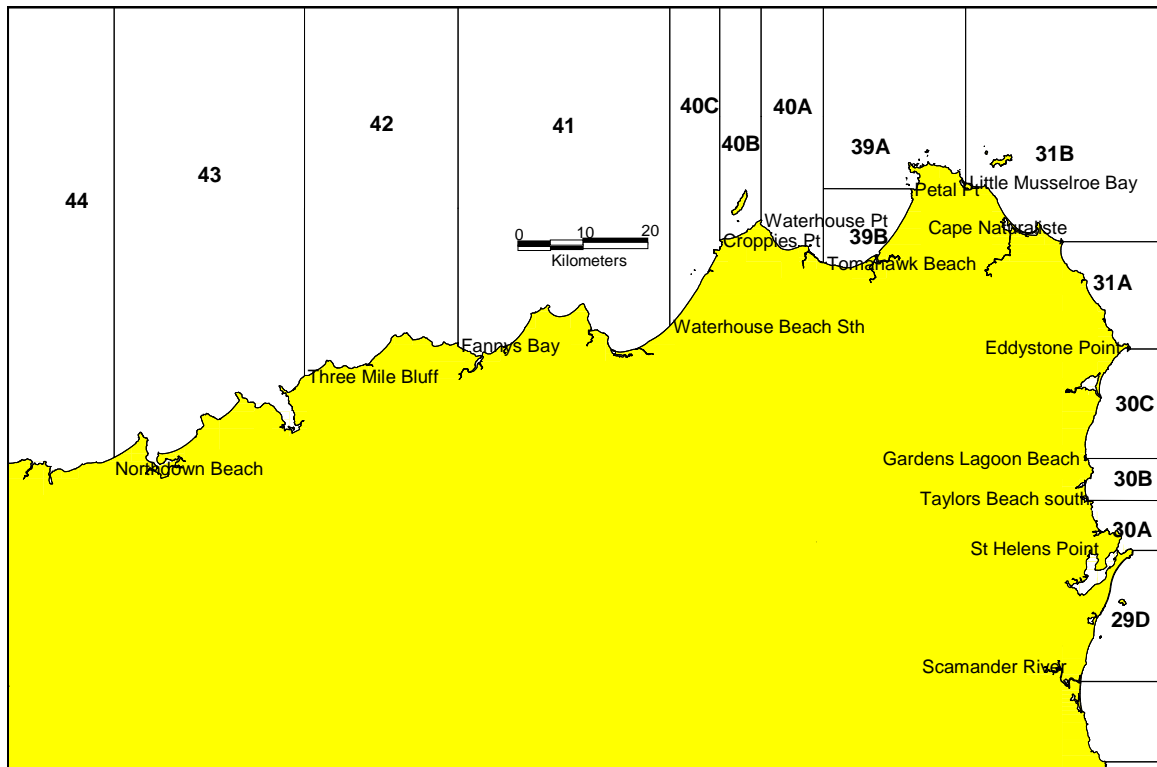
Map 7: Lower East Coast



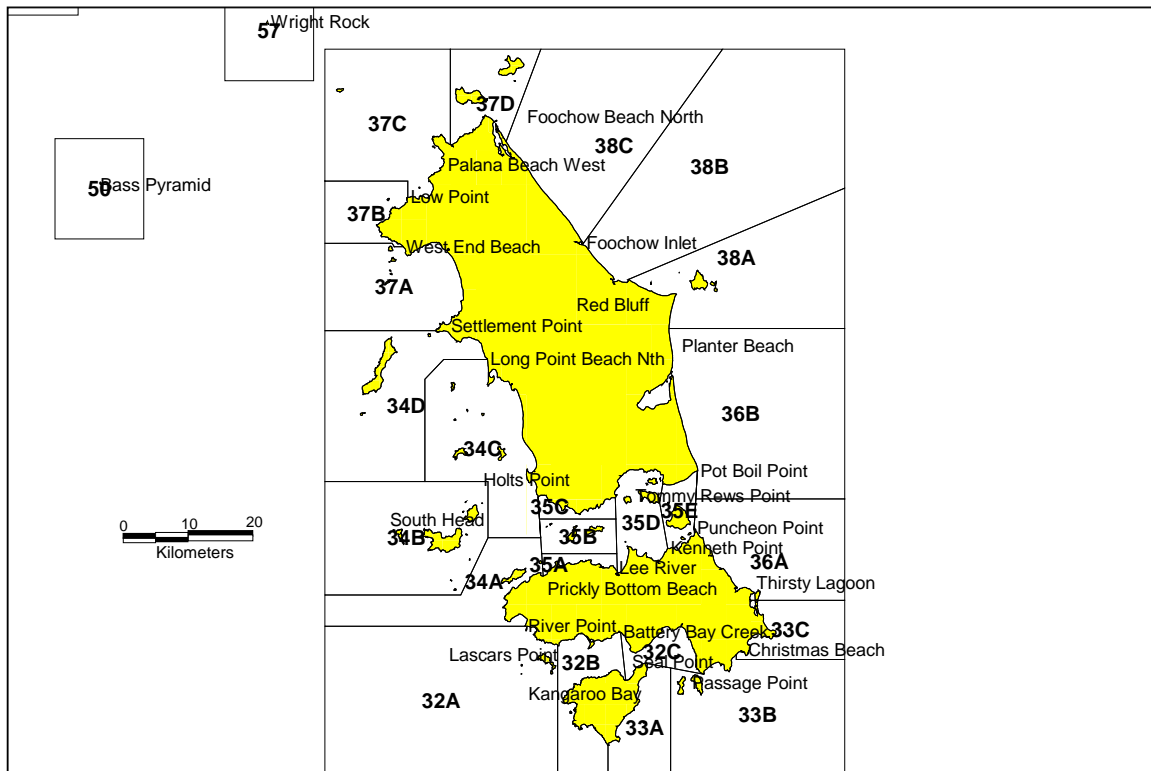
Map 8: Upper East Coast



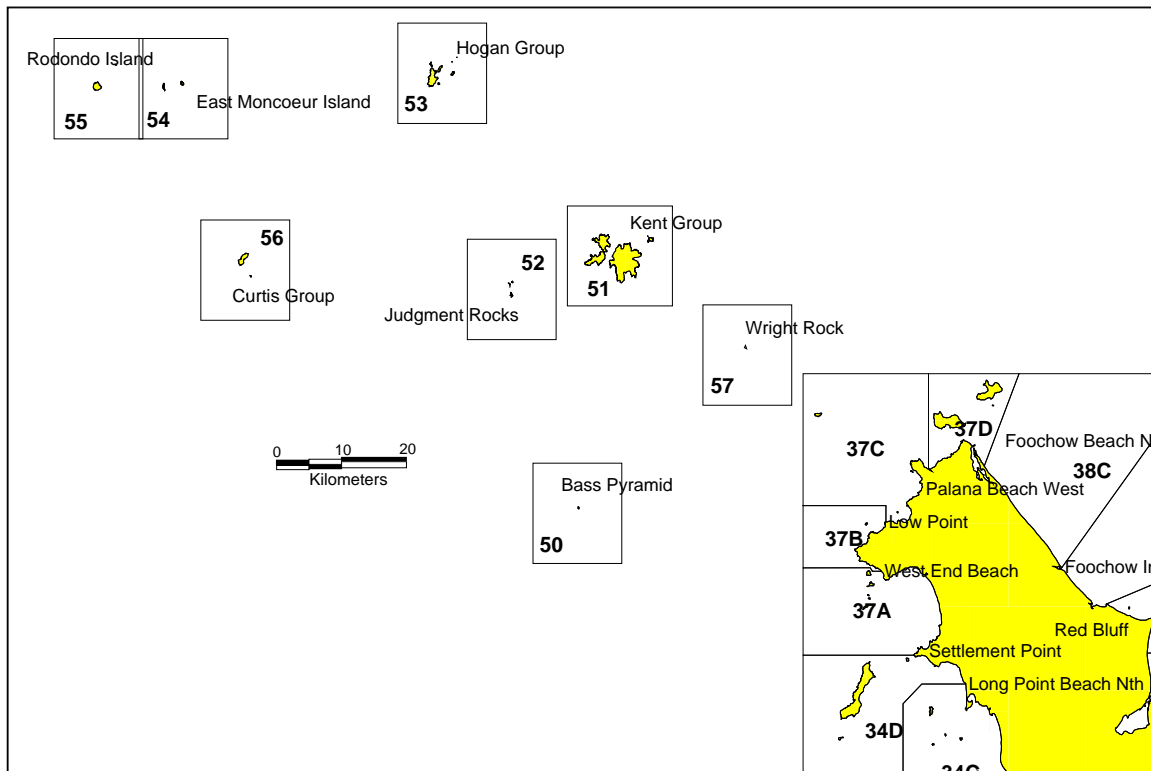
Map 9: North East Tasmania



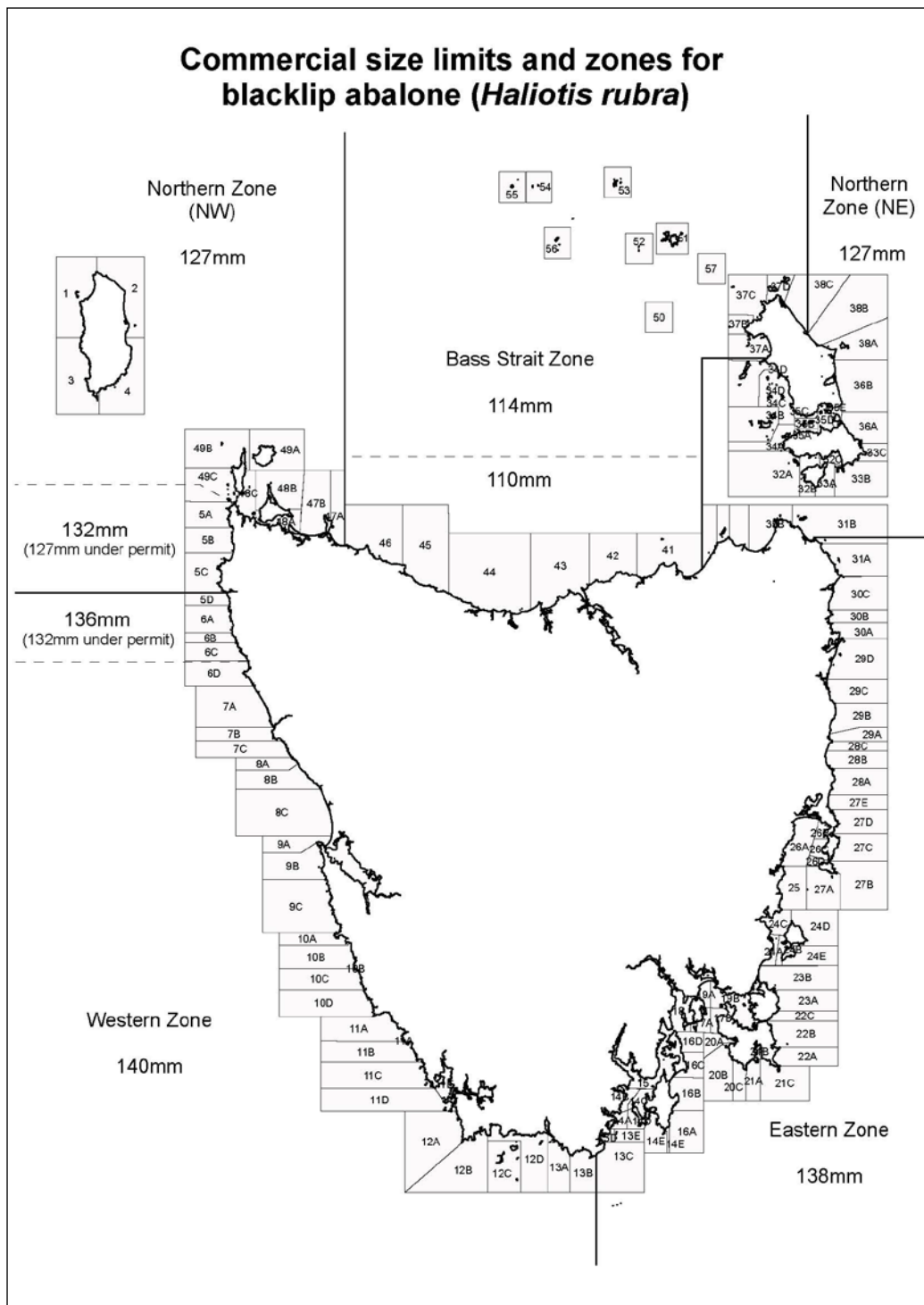
Map 10: Furneaux Group



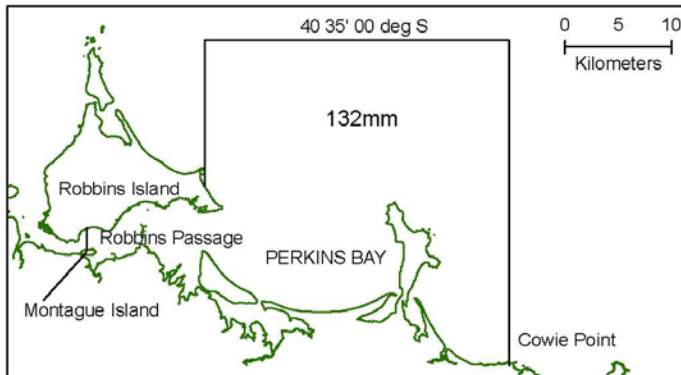
Map 11: Bass Strait Islands



Appendix 9. Commercial Size Limits for blacklip and greenlip abalone, 2009



Commerical size limits for greenlip abalone (*Haliotis laevisgata*)



King Island

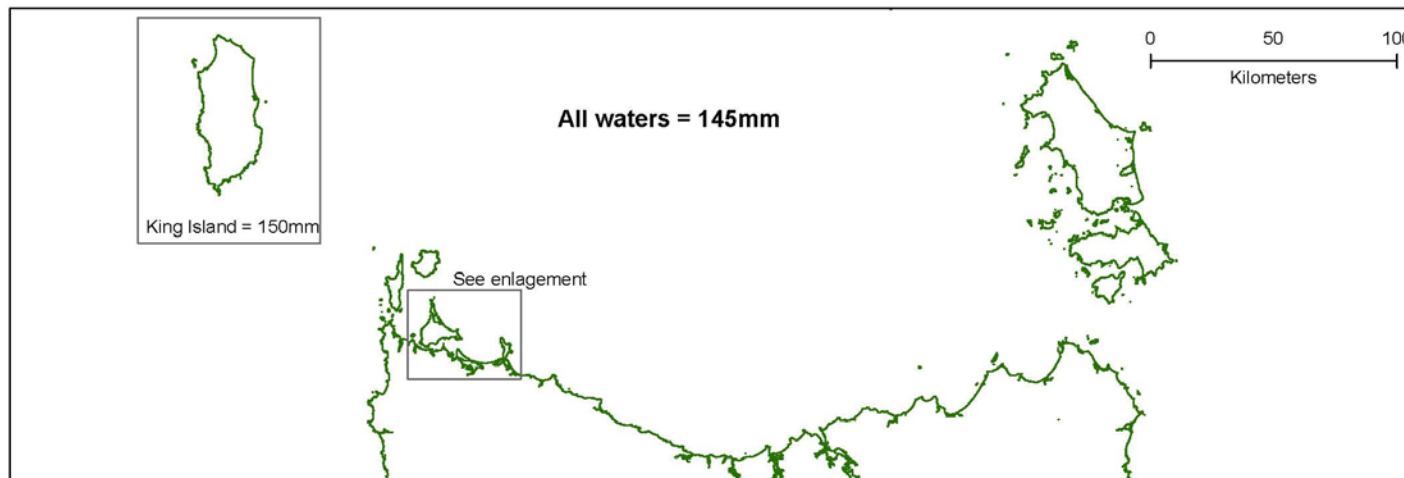
- All fish taken from King Island waters 150mm or greater.

Perkins Bay

- A 132mm size limit applies in Perkins Bay which is defined by waters which are enclosed with the following boundaries:
- N/S of Montagu Island in Robbins passage to Cowrie Pt. and to a northward extent of 40 35' 00 deg S. to a western extent of 145 02' 52 E.

All other waters

- A 145 mm size limit exists for all other state waters for the take of greenlip abalone.



References:

Andrew, N. L. and Chen, Y. (1997). Optimal sampling for estimating the size structure and mean size of abalone caught in a New South Wales fishery. *Fisheries Bulletin* **95**, 403-413.

Andrew, N. L., Worthington, D. G. and Brett, P. A. (1997). Size-structure and growth of individuals suggest high exploitation rates in the fishery for blacklip abalone, *Haliotis rubra*, in New South Wales, Australia. *Molluscan Research* **18**, 275-287.

Breen, P. A. (1992). A review of models used for stock assessment in abalone fisheries. In *Abalone of the world: biology, fisheries and culture*, eds. S. A. Shepherd M. J. Tegner and S. A. Guzmán del Prío, pp. 253-275. Oxford: Blackwell.

Buckworth, R. (1987). Changes in fishing effort and catching power in the DMZ tiger prawn fishery. In *Northern Prawn Fishery Information Notes*, vol. February 1987. Cleveland: CSIRO Division of Fisheries.

Gorfine, H. K. (2001). Diver behaviour and its influence on assessments of a quota-managed abalone fishery. *Journal of Shellfish Research* **20**, 787-794.

Haddon, M. and Hodgson, K. (2000). Spatial and seasonal stock dynamics of Northern Tiger prawns using fine-scale commercial catch-effort data. In *FRDC Final Report*, (ed. FRDC): FRDC.

Harrison, A. J. (1983). The Tasmanian abalone fishery. In *Tasmanian Fisheries Research*, vol. 26, pp. 1-42. Hobart: Tasmanian Fisheries Development Authority.

Hart, A. M., Hall, N. and Syers, C. (1999). Stock assessment and modelling for management of the WA greenlip abalone fishery. Perth: Fisheries Western Australia.

Hilborn, R. and Walters, C. J. (1992). Quantitative fisheries stock assessment: choice, dynamics and uncertainty. London: Chapman and Hall.

Lyle, J. M. and Tracey, S. R. (2010). Tasmanian recreational rock lobster and abalone fisheries: 2008-09 fishing season. In *TAFI Reports*. Hobart: University of Tasmania.

McShane, P. E. (1995). Estimating the abundance of abalone: the importance of patch size. *Marine and Freshwater Research* **46**, 657-662.

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

Officer, R. A., Gorfine, H. K. and Dixon, C. D. (2000). Movement and re-aggregation of the blacklip abalone, *Haliotis rubra*, after fishing. *Journal of Shellfish Research* **20**, 771-779.

Prince, J. D. (1992). Using a spatial model to explore the dynamics of an exploited stock of the abalone *Haliotis rubra*. In *Abalone of the world: biology, fisheries and culture*, eds. S. A. Shepherd M. J. Tegner and S. A. Guzmán del Prío, pp. 305-317. Oxford: Blackwell.

Prince, J. D. and Shepherd, S. A. (1992). Australian abalone fisheries and their management. In *Abalone of the world: biology, fisheries and culture*, eds. S. A. Shepherd M. J. Tegner and S. A. Guzmán del Prío. Oxford: Blackwell.

Rose, G. A. and Kulka, D. W. (1999). Hyperaggregation of fish and fisheries: how catch-per-unit-effort increased as the northern cod (*Gadus morhua*) declined. *Canadian Journal of Fishery and Aquatic Sciences* **56**, 118-127.

Shepherd, S. A. and Partington, D. (1995). Studies on southern Australian abalone (genus *Haliotis*) XVI. Recruitment, habitat and stock relations. *Marine and Freshwater Research* **46**, 669-680.

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

Tarbath, D. B., Hodgson, K., Karlov, T. and Haddon, M. (2001). Tasmanian abalone fishery 2000, pp. 103. Hobart: Tasmanian Aquaculture and Fisheries Institute.

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

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