

TASMANIAN ABALONE FISHERY ASSESSMENT 2014

David Tarbath and Craig Mundy
July 2015

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This assessment of the Tasmanian Abalone Fishery is produced by the Institute for Marine and Antarctic Studies (IMAS) and uses input from the Abalone Fishery Resource Advisory Group (AbFRAG). AbFRAG meets four times annually to consider trends in fishery dependent data and provide input into the assessments.

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Enquires should be directed to:

Dr Craig Mundy
IMAS Fisheries and Aquaculture Centre
University of Tasmania
Private Bag 49
Hobart TAS 7001
Australia

Email: Craig.Mundy@utas.edu.au
Ph: 03 6227 7232, +61 3 6227 7232 (international)
Fax: 03 6227 8035

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Abalone Fishery Assessment: 2014

Executive summary

Total landings for the 2014 Tasmanian abalone fishery were 1,927.7 t, comprising 1,787.5 t of blacklip and 140.2 t of greenlip, from a total allowable commercial catch (TACC) of 1,932 t. This is a reduction of 217 t on the 2013 fishing year, principally from the Western Zone (161 t), and with minor reductions in the Northern and Central Western Zones (28 t in each). There has been a progressive reduction in TACC from 2,660 t in 2010 to 1,932 t in 2014, to address falling stock levels.

The gross landed value (GLV) of the 2014 catch fell by \$4.6 million from 2013, to \$69 million, comprising \$64.5 million blacklip and \$4.5 million greenlip. Royalties collected by the Tasmanian Government in 2014 totalled \$4.97 million, reduced by \$0.45 million from the previous year. Beach prices for live market product (mostly sourced from Eastern, Western and part of the Central Western Zones) and greenlip rose steadily throughout the year reaching up to \$45.00/kg in December, while processing grade blacklip (mostly Northern, Bass Strait and some Central West Zone product) remained flat at approximately \$25.00/kg. Both GLV and royalties have fallen in recent years, due to reduced catch and lower beach prices.

The status of the fishery was assessed using two empirical performance measures (catch and catch rates) from diver returns, and supplemented by length-frequency samples from commercial catches. The abalone industry also provided comment on relative stock status, particularly where local knowledge or market preference assists with interpretation of trends.

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

Eastern Zone

The 2014 Eastern Zone TACC was 528.5 t. The TACC has been below 550 t from 2012 as a part of a management response to falling stock levels. Annual catches of this size are the lowest recorded for this part of the fishery.

At the Actaeons (Block 13), stock levels remained low. Catch rates in the most important sub-block (13E) continued to fall, despite a reduction in catch as fishers shifted to better fishing grounds further north. The combination of declining catch and catch rates and increasing median length suggests that stock levels in the Actaeons were falling and that action will be required to reverse this negative trend.

Export of abalone from much of the Lower Channel (14A, 14B, 14C and Block 15) has been restricted or prohibited for several years following prolonged blooms of toxic micro-algae, effectively closing Blocks 14B, 14C and 15 to fishing. Restrictions were lifted from 14B and 14C in November 2014 allowing a small amount of fishing late in the season. Importantly, low catch rates experienced for the small amount of catch there provided no evidence of stock rebuilding during the closed period.

Stock levels at Bruny Island (sub-blocks 14D, 14E and Block 16) remained low, as evidenced by low but stable catch rates. In conjunction with the stable catch rates, the small but regular increases in annual catch since 2012 suggest stock levels were no longer declining. Similarly, on the eastern side of Storm Bay (Blocks 17-21),

increasing levels of annual catch between 2012 and 2014 combined with stable catch rates suggest stock levels there were stable, but at a low level.

On the Tasman Peninsular, stock levels in Block 22 show signs of severe depletion following many years of above-average annual catches. It is recommended that management action be taken to divert excessive levels of catch away from this block. Further north, in Blocks 23 and 24 catch rates have been variable, from a low in 2012, a minor improvement in 2013, then falling away again in 2014 in response to small increases in catch. This decline indicates that stock levels here were low, with little evidence of stock rebuilding under the current TACC.

Between 2007 and 2012, the annual catch in the Bicheno-Freycinet region (Blocks 26-28, 29A) has greatly reduced in response to falling stock levels. Catch rates were also much reduced, although with a sharp increase in 2013. This increase was not sustained through 2014. Stock levels were assessed low.

In 2013, the North East (29B, 29C, 29D, Block 30) produced a relatively large catch at moderate catch rates, and stock levels were noticeably higher than further south in the Eastern Zone. This high catch continued in 2014 with a minor decline in catch rate. It should be noted that successive years of unusually large catches in Eastern Zone regions are commonly followed by rapid declines in catch rates. The large catch appears due to renewed processor interest in the region and the closure to fishing of the coast south of Bicheno. Should catch rates from this region continue to fall in 2015, catch will need to be reduced from this part of the Eastern Zone. Stocks were assessed moderate, but there were indications of depletion.

Within Block 31A, divers reported high stock levels throughout most of the region, although catch rates declined again in 2014. It appears that abalone there, particularly north of George Rocks, were unacceptable to processors. Where abalone were of higher quality, fishing has impacted stock levels, with appropriately low catch rates. Generally, stock levels were assessed high, although it is recognised that much of the stock was sub-standard for Eastern Zone product, and hence unavailable to divers.

Central Western Zone

The Central Western Zone 2014 TACC was 73.5 t, reduced by 28 t from 2013. This zone has been reduced to a small area in Block 6, between (but not including) the Arthur River and Sandy Cape. There was ongoing decline in catch and catch rates in this region, which indicates that stock levels continued to fall despite reductions in TACC, and should now be considered low. A catch reduction is required in this zone to prevent further declines and to allow rebuilding to occur.

Western Zone

The Western Zone TACC was 840 t, reduced by 161 t from 2013. This reduction was part of a management response in 2014 to address ongoing stock declines throughout the zone. The reduction in catch is most apparent in Block 9 and the South West.

In the north from Sandy Cape (Blocks 6D, 7 and 8) south to Strahan, it is evident that there has been a substantial reduction in fishing activity following the region's return to the Western Zone, with greatly reduced catch and irregular application of fishing effort. While under the Central Western Zone, annual catches in the region were excessive, but were accepted because of previously low annual catches, and a consequent build-up of

stocks to high levels. Now, like other parts of the west coast fishery, catch rates have been reduced to below 100 kg/hr, and catch levels need to be maintained appropriately low until stocks recover.

South of Strahan in Block 9, catch rates declined rapidly during the last three years following a period of many years where they were consistently high and stable. It was reported that technological improvements in weather forecasting enabled divers to fish at high catch rates while stock levels were falling. More recently, the extent of the depletion became apparent, with the 2014 catch reduced to approximately two-thirds of the 2013 catch, but at a catch rate nearly 20 kg/hr lower than in 2013. The regional catch has been reduced, but it is not known whether it has been reduced sufficiently to prevent further depletion.

In the South West (Blocks 10, 11 and 12A) catch rates continued to fall despite a reduction in catch. Catch rates in 2014 were almost 100 kg/hr lower than catch rates in 2000. It is evident that depletion of stocks was widespread along most of the coast.

Across the South Coast (Blocks 12B, 12C, 12D, 13A and 13B) stock levels have fallen in recent years, and many areas which were once highly productive now have low levels of stock. Stock levels in deeper reefs around the offshore islands appeared much higher, but it is unknown how large these stocks are, or how long they can sustain current high rates of fishing.

Northern Zone

The Northern Zone TACC was 280 t, reduced by 28 t from 2013. At King Island, stock levels have fallen, as evidenced by catch-rate declines experienced by all divers. In the parts of its west coast where most of the fishing has occurred, and where stocks were formerly at high levels, catch rates indicate that stock levels have been reduced to moderate levels.

In Block 5, catch rates have declined in every year since 2009 following a 50% increase in annual catch and a reduction in LML from 132 mm to 127 mm, and indicated widespread stock depletion. Catch rates continued falling in 2014, particularly in the north in 5A, but appeared to be stabilising further south in 5B and 5C. Abalone in this region grow comparatively slowly, with half the catch taken within a few mm of the LML, so a quick recovery of stocks to former levels is unlikely.

In the remainder of the North West (Blocks 47, 48 and 49), following a 5-mm size-limit reduction in 2012 and a consequent increase in the fishable stock, the annual catch doubled in size. It is apparent that the catch has been excessive, because catch rates have now fallen below levels prior to the size-limit reduction. To arrest the decline in stock levels, reductions in catch will be required in the short term.

In the North East (Blocks 31B, 39 and 40) catch rates, while stable for the last three years at approx. 60 kg/hr, have declined from previously higher levels. In 2014, the regional catch exceeded the management cap by almost 50%. Stock levels were considered stable in this region, but because of its small size and difficulty in limiting excessive catch, its stocks are considered vulnerable to depletion.

Bass Strait Zone

The Bass Strait Zone fishery has been managed with a 70 t TACC since its development in 2003. Generally, stock levels were considered stable across the region, with an appropriate level of catch. In the remote islands (Blocks 50-57) the catch was lower than recent years, and instead, greater amounts were taken from the Furneaux Group, much of which was caught while fishing for greenlip. The eastern side of the Furneaux Group (Blocks 33, 36 and 38) continued to support high catch rates, and given the small size of blacklip there, stock levels were considered high. Across the North Coast (Blocks 41-46), catch and catch rates were much lower, but were in line with previous years, indicating stable stock levels.

Greenlip

The greenlip fishery operates in northern Tasmanian waters. The fishery is managed by regional catch caps and size limits. In 2014, the 140 t TACC was distributed between six regions (King Island, Far North West, Perkins Bay, Central North Coast, North East and the Furneaux Group). Unusually, in 2014 a large amount of the TACC (~ 40%) was caught between January and March. There is evidence that greenlip are in spawning or post-spawning condition at this time of year and individually weigh less by up to 13%, meaning that a larger number need to be caught per unit of quota.

At King Island, greenlip stocks continued to be under pressure and the region appeared to be producing at or beyond its maximum capacity. It is recommended that the annual catch there be reduced, and the greenlip TACC be reduced accordingly.

In the far North West (Blocks 5, 49, 48B and 48C), catch rates have fluctuated in recent years, thought to be due to the involvement of different divers and differences in their allocation of blacklip and greenlip quota. Catch rates were relatively higher in this region than other parts of the greenlip fishery, which provides confidence that stock levels were stable and that fishing was at sustainable levels.

Further east, Perkins Bay (48A) produced barely half its management cap. Catch rates have been falling there for several years and while still relatively high (~90 kg/hr), the reduced catch was probably beneficial to the region. However, it also meant that the remaining catch allocated there was caught elsewhere. Similarly, almost no catch was taken from the Central North Coast (Blocks 41-47), and its allocated 10-t catch was caught elsewhere. The uncaught catch contributed to a substantial catch overrun in the Furneaux Group, and increased pressure at King Island and the far North West. It is recommended that the amount of catch allocated to the Central North Coast be removed from the TACC.

In the North East (Blocks 31, 39 and 40), while the size of the annual catch has been within management expectations, catch rates have fallen, indicative of stock decline. In 2014, all of the catch from this greenlip region was taken in the first quarter, which is a major departure in fishing pattern, driven by processor requirements. Whether over-fishing or poor recruitment has contributed to the falling stock levels is unknown, but it is recommended that catch in the region be reduced to allow stock rebuilding to occur.

In the Furneaux Group (Blocks 32 to 38), catch has climbed steadily since 2009 and is now at a 15-year high. These high catch levels have been excessive and appear to be causing a decline in catch rates. It is evident that stocks across much of the region have

become depleted. It is recommended that the catch in this region be reduced, and the TACC be reduced accordingly.

Recreational and other fisheries

The number of recreational abalone diving licenses issued by DPIPWE for the year ended 2014 was 11,485. The most recent survey of recreational abalone fishing catch was undertaken for the 2012/2013 season and estimated that 32 t of blacklip and greenlip abalone, or 1.5% of the total Tasmanian abalone catch, was taken by recreational fishers. This catch is slightly more (3 t) than reported from the previous survey (2010/2011), but is less than 50% of the peak catch reported in 2002-2003.

Abalone are caught in Tasmanian waters as part of cultural fishing activities by indigenous people. This catch is not quantified but is believed to be negligible. Catch is also taken under permits for special events and research purposes. In 2014, the catch under permit totalled less than 5 t.

Illegal fishing is known to occur but no estimates of this catch are available.

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1. Introduction

This assessment relies on fishery-dependent data, principally, catch and catch rate data, which have been used to infer changes in abalone abundance. In addition, information is presented on changes in the median length of abalone sampled from the commercial catch across fine spatial scales. This provides additional information on changes in abundance, especially in interpreting trends in recruitment and fishing mortality.

The use of catch and catch rates to monitor changes in abalone abundance has often been criticised as unreliable (Prince, 1992). In theory, the fishing of abalone aggregations, serial depletion and changes in fishing efficiency reduce the strength of 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 that are sensitive to skewed data.

However, when abalone populations are intensively fished, catch and catch-rate trends are more reliable indicators of changes in abundance. When fishing pressure is sufficient, large 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. Zones were first introduced into the Tasmanian fishery in 2000 to manage 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, types of habitat, accessibility for divers), and may include divergent recruitment patterns, and different levels of abundance and fishing methods. There is a risk that recruitment in particular parts of a zone may be very different to that of the wider region. In this assessment, understanding of stock abundance is improved by looking at fishing patterns across smaller regions within each zone which have a greater likelihood of sharing common fishing approaches and stock levels.

The regions and region boundaries used in this assessment are used by managers to control discrete areas within each zone. The boundaries have been 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, provided the annual catch was 10 t or more in any one of the previous nine years.

The zones, regions and statistical blocks from which the 2014 commercial catch was reported or which are referred to in this document are shown below (Figure 1; for sub-blocks see Appendix 11: Maps of catch-reporting blocks and sub-blocks). For information about charts of catch, catch rates and median length, see Appendix 1: Catch, catch rates and size-composition, and Appendix 3: Interpreting graphical information.

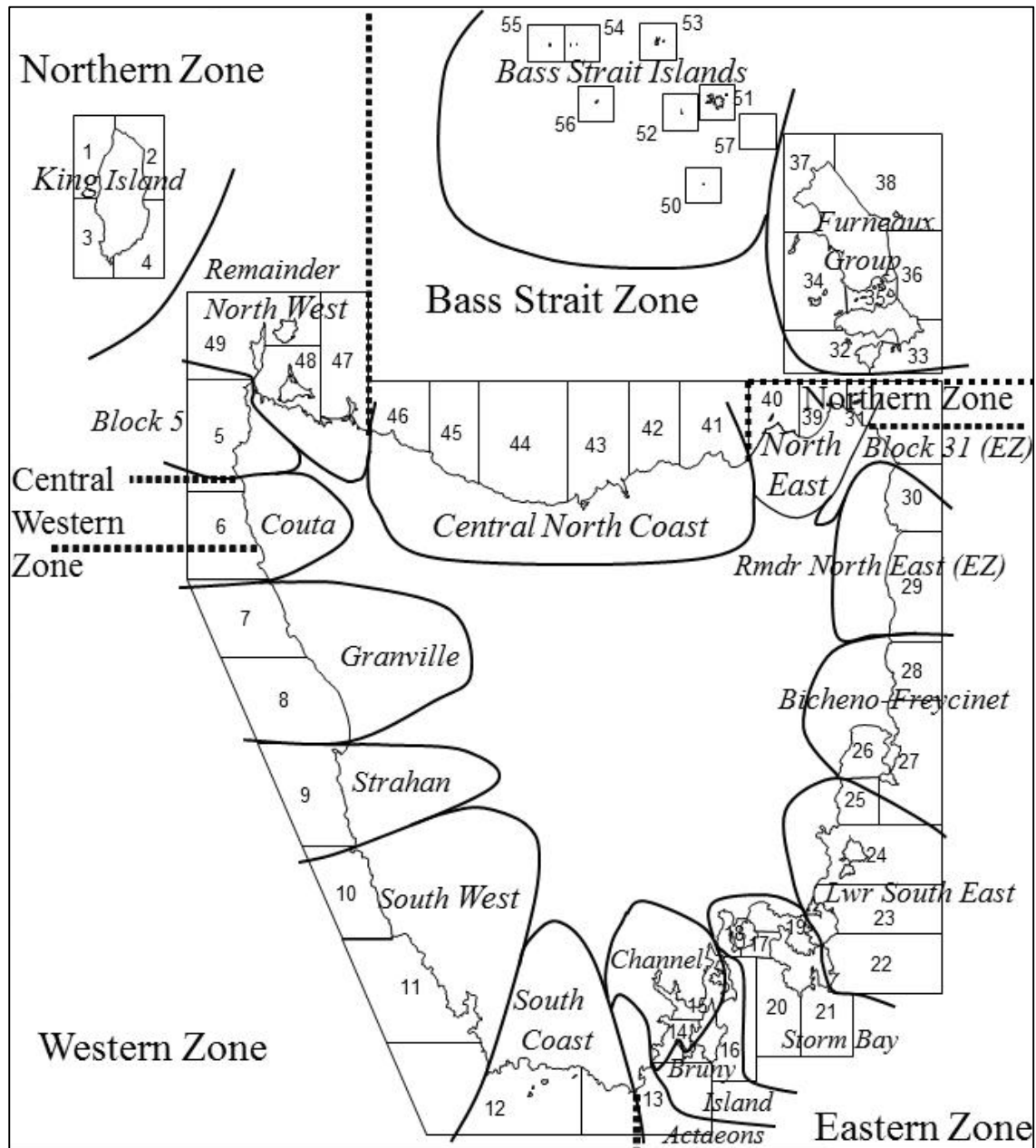


Figure 1. Zones and statistical blocks used in the Tasmanian abalone fishery in 2014. Also shown are the regions used for assessment purposes in this document. Zone boundaries are shown as dotted lines. The greenlip fishery has no geographical boundaries, but mostly takes place on coasts included in the Northern and Bass Strait Zones. More detailed maps of catch reporting areas can be found in Appendix 11: Maps of catch-reporting blocks and sub-blocks.

The zone boundaries and their reporting blocks for the 2014 fishing year were as follows:

Zones (blacklip fishery)

Eastern Zone:

Whale Head to Musselroe River. Sub-blocks 13C, 13E, 13E, Blocks 14 to 30, Sub-block 31A.

Northern Zone:

Musselroe River to Anderson Bay, then Cowrie Point to Arthur River including King Island. Blocks 1 to 4, Sub-blocks 5A, 5B, 5C, Sub-block 31B, Blocks 39 to 40, Blocks 47 to 49.

Bass Strait Zone:

Central North Coast: Cowrie Point to Anderson Bay. Blocks 41 to 46. Remote Bass Strait Islands: Blocks 50 to 57. Furneaux Group: Blocks 32 to 38.

Central Western Zone:

Arthur River to Wild Wave River. Sub-blocks 5D, 6A, 6B, 6C

Western Zone:

Wild Wave River to Whale Head. Sub-block 6D, Blocks 7 to 12, Sub-blocks 13A, 13B.

The greenlip fishery has no spatial boundaries but is restricted by the natural distribution of greenlip to waters north of the Musselroe River in the east and Cape Grim in the west.

Regions

The regions used for blacklip assessment purposes in this document comprise the following reporting blocks and sub-blocks (note changes were made to Lower Channel, Bruny and East Coast regions in 2014):

Actaeons: Sub-blocks 13C, 13D, 13E

Lower Channel: Sub-blocks 14A, 14B, 14C, Block 15

Bruny Island: Sub-blocks 14D, 14E, Block 16

Storm Bay: Blocks 17 to 21

Lower South East: Blocks 22 to 25

Bicheno-Freycinet: Blocks 26, 27, 28, sub-block 29A

Remainder North East – EZ: sub-blocks 29B, 29C, 29D, Block 30

Block 31 – EZ: sub-block 31A

North East-NZ: Sub-block 31B, Blocks 39 and 40

Furneaux Group: Blocks 32 to 38

Bass Strait Islands: Blocks 50 to 57

Central North Coast: Blocks 41 to 46

King Island: Blocks 1 to 4

Block 5: Sub-block 5A, 5B, 5C

Remainder North West: Blocks 47 to 49

Couta: Sub-blocks 5D, 6A, 6B, 6C, 6D

North of Strahan: Blocks 7 and 8

South of 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 *North West* (Blocks 5, 48B, 48C & 49), *King Island* (Blocks 1 - 4), *Furneaux Group* (Blocks 32 - 38), *North East* (Blocks 31, 39 & 40), *Perkins Bay* (sub-block 48A) and *Central North Coast* (Blocks 41 - 47). Catches are occasionally reported from the remote *Bass Strait Islands* (Blocks 50 - 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 below (a more detailed explanation may be found in Appendix 3: Interpreting graphical information).

The weights from all reported catches between 1975 and 2014 (inclusive) were used to estimate annual total tonnages 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, and consequently there may be minor variations in annual catch reported in these documents from year to year.

Sales of abalone commenced during the late 1950's but catch return data is available only from 1975. Between 1975 and 1984 abalone catches were reported by the skipper of the fishing vessel as *estimated* weights, on a monthly basis. Between 1985 and 1992, catches were reported 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 all mean catch rates referred to in this document are geometric means. Geometric means are more reliable estimators of the mean catch rate across all divers than arithmetic means (averages), because they are 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 40 kg or more were considered when calculating catch-rate means (to reduce the effects of atypical fishing events such as those affected by mechanical breakdown or where greenlip / blacklip abalone were taken as by-catch of fishing for the other species). Where fishers landed both greenlip and blacklip catches on the same day, effort used in the calculation of catch rates for each species was based on a pro-rata allocation of effort based on the single species proportion of the total daily catch (Burch et al., 2011).

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 that 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, the larger processors have conducted this sampling. As a rule of thumb, median lengths are

deemed useful when more than 4% of catches in a reporting area have been sampled (Andrew and Chen, 1997), although in practise, in the less productive blocks where relatively few catches are landed, a much higher proportion of sampled catches is required to produce reliable information.

The performance measures (catch, catch rates and median length) for each region of the fishery were assigned a status (stable, rising, falling and erratic or no data), and an initial assessment made (Appendix 2: Preliminary assessment of the fishery). The regional assessments were combined and presented as a draft fishery assessment to divers and other industry participants at a meeting of the Fisheries Resource Advisory Group (FRAG) in Hobart, April 2015. The initial assessments were subsequently modified where it was apparent that the performance measures reflected changes caused by factors other than changes in stock levels, and a final assessment was developed.

2. Total landings and gross revenue

At the end of 2014 total landings were 1,927.7 t, comprising 1,787.5 t of blacklip and 140.2 t of greenlip, from a total allowable commercial catch (TACC) of 1,932 t. Compared with the previous year, the 2014 TACC was reduced by 217 t, which occurred principally in the Western Zone (161 t), and also in the Northern and Central Western Zones, which were both reduced by 28 t. There has been a progressive reduction in TACC from 2,660 t in 2010, to accommodate falling stock levels.

Table 1. 2014 landings by zone, in tonnes

Zone	2014 TACC	2014 Landings (tonnes)
Greenlip	140.0	140.2
Eastern Blacklip	528.5	528.7
Northern Blacklip	280.0	276.6
Western Blacklip	840.0	839.2
Bass Strait Blacklip	73.5	73.4
Central Western Blacklip	70.0	69.6
	1,932.0	1,927.7

The gross landed value (GLV) of the 2014 catch fell by \$4.6 million from the previous year, to \$69 million, comprising \$64.5 million blacklip and \$4.5 million greenlip. Royalties collected by the Tasmanian Government in 2014 totalled \$4.97 million, approximately \$450,000 less than the previous year. In comparison, the 2010 catch was worth \$104 million, with royalties of \$7.2 million. Both GLV and royalties have been affected in recent years by reductions in catch and beach prices.

In 2014, beach prices for live market product (mostly sourced from Eastern, Western and part of the Central Western Zones) rose steadily throughout the year reaching up to \$45.00/kg in December, while processing grade blacklip (mostly Northern, Bass Strait and some Central West Zone product) remained flat at approximately \$25.00/kg (Figure 2).

Australian beach prices are affected by a complex array of factors, including competition from Asian aquaculture product, exchange rates, politically determined austerity measures in China, tariffs and import restrictions in China, and structural changes in the market. Within Australia, beach prices are affected by seasonal quality factors and pulses in local supply.

Falling prices in the live blacklip market in 2013 may have been in response to growth in supply when landings totalled 200-350 tonnes per month during the last four months of the year. Likewise, higher prices in 2014 may have been from reduced supply from the Western Zone TACC. Beach prices were also bolstered by the Australian dollar exchange rates, particularly in the last four months of 2014. Future implementation of the Free Trade Agreement with China is expected to be positive for beach prices for live blacklip product.

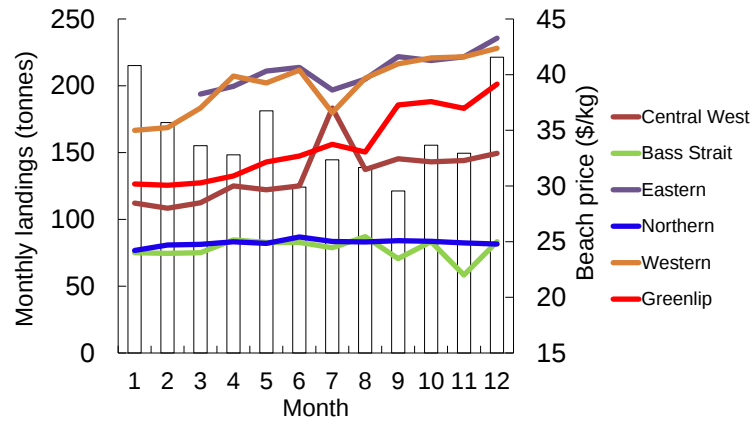


Figure 2. Total monthly landings (vertical columns) and monthly trends in average beach price for abalone in 2014, by zone. Bass Strait and Northern Zone abalone were predominantly used for canning; Eastern, Western and Central West Zone abalone were mostly sold to the live market. Greenlip beach-price data were incomplete.

3. Assessment of the Tasmanian abalone fishery

3.1 Eastern Zone.

The Eastern Zone covers the coast between Whale Head in the south to the Musselroe River in the north-east (Blocks 13 to 31) and includes some of the most productive parts of the Tasmanian fishery. In 2014, the TACC was 528.5 t. The TACC has been below 550 t from 2012 as a part of a management response to falling stock levels. This is the lowest TACC for the area currently covered by the Eastern Zone since the introduction of the Quota Management System (QMS) in 1985, and is lower than any previously recorded catch total. Of the four Eastern Zone regions, most catch was taken from the Actaeons and the East Coast, with smaller amounts from Bruny Island and Storm Bay (Figure 3).

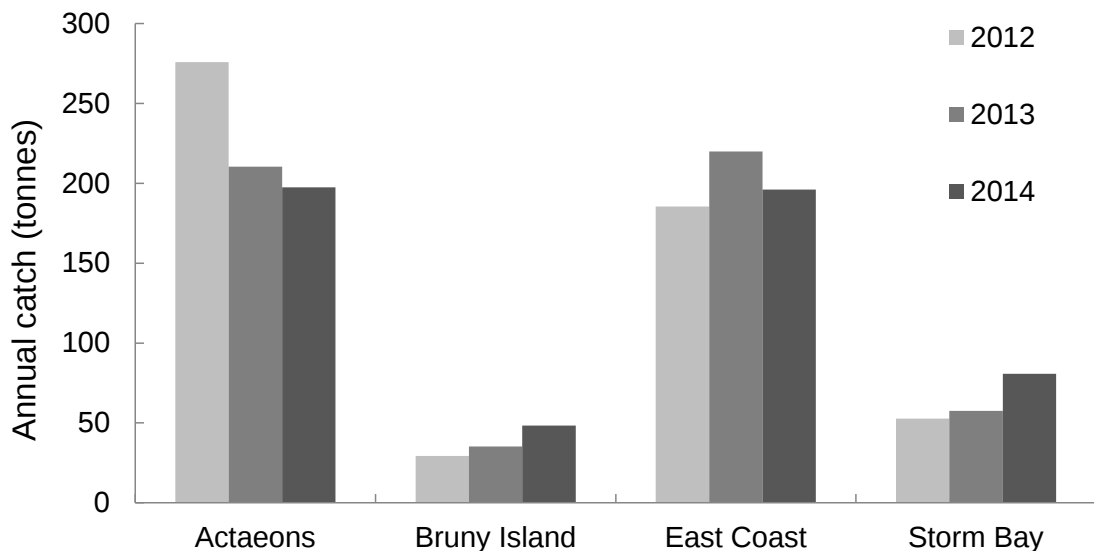


Figure 3. Distribution of catch, Eastern Zone, 2012-2014.

3.1.1 Actaeons (Sub-blocks 13C, 13D, 13E)

Fishery-dependent data

The annual catch in this region has been reduced by 150 t in recent years, from a five-year (2007-2011) average of ~ 350 t to the current level of approximately 200 t (Figure 3). This reduction is due to lower overall TACs in the Eastern Zone in recent years. In 13C, just 8 t was landed, with 34 t from 13D and the remainder (138 t) from 13E. All these annual catches were substantially below post-zoning (2000-2013) averages.

From 2012, throughout most of the region catch rates have been low but stable, at approximately 50 kg/hr. In the south, catch rates varied between 52 kg/hr (13C) and 48 kg/hr (13E). The 2014 distribution of raw catch rates is skewed slightly lower than in 2012 and 2013, and tracks a similar path to the 2002 distribution, when the previous slump in stock levels occurred.

Throughout 2014 catch rates were stable at approximately 50 kg/hr until the last two months when they fell to a low of 43 kg/hr in December (Figure 4). This end-of-year decline has been a feature of the Actaeons fishery for many years and is common throughout the Eastern Zone fishery. It is variously attributed to a number of seasonal responses, including increased algal growth, abalone movement into cryptic habitat and a reduced supply of recruits following slower growth rates in winter and spring. Monthly catch rates peaked in August, and showed an overall trend of decreasing catch rates to December.

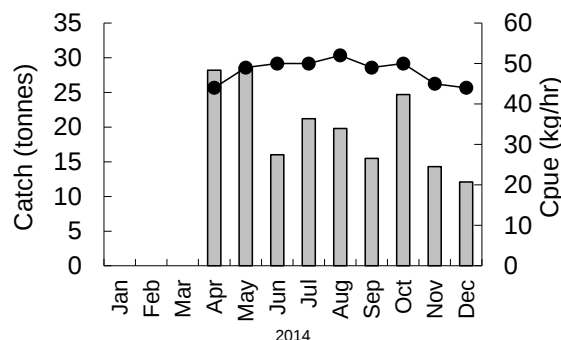


Figure 4. Monthly catch totals and mean catch rates, Actaeons, 2014. Grey bars indicate catch in tonnes and black dotted line indicates catch per unit effort (Kg/Hr).

The median length of abalone continued to increase throughout the region, to 150 mm in 13D and 13E, and 153 mm in 13C. Levels of catch sampling were high, between 16% (13C) and 25% (13E). In conjunction with the low catch rates, the increase in length is attributed to reduced numbers of recruits, and an increased reliance on older year classes.

Diver observations

Divers observed large quantities of sub-legal abalone. They reported that the size of abalone in their catches appeared small, and that they were catching fewer large abalone.

Qualitative assessment

At the Actaeons (Block 13), stock levels remained low. Catch rates in the most important sub-block (13E) have continued to fall, despite a reduction in catch as fishers

shifted to better fishing grounds elsewhere in the zone. The combination of declining catch, declining catch rates and increasing median length suggests stocks in the Actaeons are declining and action will be required to reverse this negative trend.

3.1.2 Lower Channel (14A, 14B, 14C, Block 15)

Fishery-dependent data

This region was highly productive during the early years of the fishery, but there have been major declines in catch from this region. The scale of catch reporting prevents accurate estimates of catch until 2000, but estimates from divers based upon their personal records indicated that annual production was greater than 100 t until the late 1980's (Frusher et al., 2009). Between 2000 and 2005, the regional catch averaged 48 t pa, but since then, has reached 30 ton only three occasions.

Export of abalone from much of the Lower Channel has been restricted or prohibited for several years following prolonged blooms of toxic micro-algae, effectively closing 14B, 14C and Block 15 to fishing. Restrictions were lifted from sub-blocks 14B and 14C (but not Block 15) in November 2014 causing renewed interest in the region with a corresponding increase in catch (Figure 5). The 2014 catch was 20 t, most of which (12 t) was caught in 14A, with 5 t landed from 14B and 3 t from 14C.

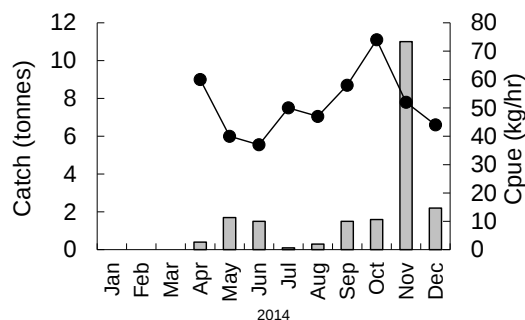


Figure 5. Monthly catch totals and mean catch rates, Lower Channel, 2014. Grey bars indicate catch in tonnes and black dotted line indicates catch per unit effort (Kg/Hr)

Catch rates are generally lower in this region than elsewhere, and since 2000, have seldom risen above 60 kg/hr. Divers reported that abalone were distributed mostly within two to three metres of the surface where algal growth was most dense, and this hindered fishing resulting in lower catch rates. They said that this was a normal feature of the region (Frusher et al., 2009). In 14A catch rates were 52 kg/hr, 45 kg/hr in 14B and 47 kg/hr in 14C.

Like the Actaeons further south, the median length of abalone in this region has increased. In 14A, the median length was 151 mm, in 14B 154 mm. Sampling levels were high in 2014, at between 24%-26% of catches. In conjunction with the low catch rates, this increase in length was attributed to low levels of recruitment in the region.

Qualitative assessment

The low catch rates experienced for the small amount of catch provided no evidence of stock rebuilding during the closed period, and stock levels were assessed low.

3.1.3 Bruny Island (Sub-blocks 14D, 14E, Block 16)

Fishery-dependent data

The Bruny Island catch continued to increase from a low of 29 t in 2012 to 45t in 2014. Until 10 years ago, annual catches were consistently between three and four times recent levels, so the recent low levels of catch represent a serious decline. Small amounts were taken in the south in 14E (11 t) and 14D (7 t). On the south-east side of the island, 6 t was taken from 16A and 9 t from 16B. Further north, 8 t was caught in 16C and 4 t in 16D.

Across the region, catch rates averaged 50 kg/hr. Catch rates have been low but stable, ranging between 44-50 kg/hr since 2009. The 2014 CPUE distribution was improved over previous years, with a shift in modal catch rates from 40-49 kg/hr to 50-59 kg/hr.

In contrast to previous years, catch rates were higher in Adventure Bay and further south (16B – 56 kg/hr, 16A – 55 kg/hr). Along the southern shore from the Friars to Partridge Island, catch rates were lower (14E – 50 kg/hr, 14D and 14C both 47 kg/hr) i.e. unchanged from previous years. North of Adventure Bay catch rates varied between 44 kg/hr (16C) and 54 kg/hr (16D).

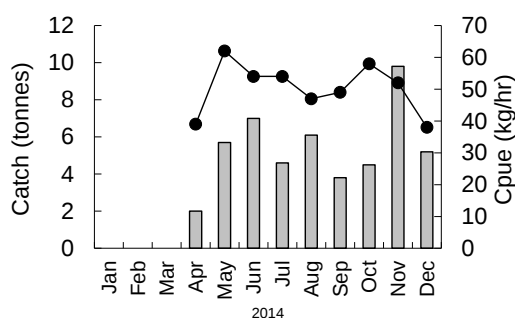


Figure 6. Monthly catch totals and mean catch rates, Bruny Island, 2014.

During the year, monthly catch totals varied between 2-7 t until November, when 10 t was landed (Figure 6). The increased level of catch at Bruny Island in November has been a consistent feature for many years, dating back at least to 2002 when the Actaeons was capped and closed to fishing later in the year. Between months, catch rates varied widely, from less than 40 kg/hr in April to a high of 65 kg/hr the following month, reflecting small quantities of catch and the presence of different groups of divers. In December catch rates dropped to 38 kg/hr, with the average daily catch almost halving in size. This is attributed to divers finishing the remainder of quota units at the end of the quota year, with Bruny Island considered a cost-effective destination for Hobart-based divers with orders for small quantities of catch.

The level of length sampling from catches from Bruny was relatively high between 2012-2014, generally between 15% and 30% for each sub-block. In the south, in 14D and 14E and in the north, in 16D, the median length of abalone has been higher during this period than at any time since the previous size-limit increase in 2007. Elsewhere there was no clear trend. In conjunction with low catch rates, this larger size was attributed to low levels of recruitment. In 2014, median sizes were relatively large, ranging between 151 mm (14D) and 155 mm (14E) in the south, and 152 mm (16A, 16B, 16D) and 156 mm (16C) in the east.

Diver observations

Divers with a history of fishing at Bruny Island said that stock levels had been greatly reduced, and that once densely populated reefs now held few abalone.

Qualitative assessment

Stock levels at Bruny Island remained low, as evidenced by low but stable catch rates. In conjunction with the stable catch rates, the small but regular increases in annual catch since 2012 provided evidence that stocks levels were probably stable and no longer declining.

3.1.4 Storm Bay (Blocks 17-21)

This region includes the coast from the Derwent Estuary (Block 18) to Cape Pillar (Block 21). The total catch has increased from 2012, from 52 t to 81 t in 2014, despite a stable TACC. Catches during the period 2012-2014 were relatively low compared with the average annual catch of 143 t for the post-zoning period prior to 2012.

Within the region, no catch was reported from Block 18, 2 t from each of Block 19 (eastern shore of Fredrick Henry Bay) and sub-block 17A (Betsey Island) and 3 t from 21B (Port Arthur). On the Blackjack shore of Storm Bay (17B) 8 t was caught, while further south in 20A, 11 t was caught. Between White Beach and Salters Point (20B) 20 t was caught, and between Salters Point and Cape Raoul (20C), 8 t was taken. In the western part of Maingon Bay (21A), 11 t was taken, while further east in 21C, 17 t was caught. All the above catches are relatively small compared with those prior to 2011.

The 2014 catch-rate distribution was similar to that of 2013, and improved on 2012. Generally however, regional catch rates appeared stable at 55 kg/hr, having fluctuated in the range 52-58 kg/hr since 2011. This contrasts with the period several years prior to 2011 when catch rates were among the highest recorded for the zone at > 80 kg/hr with levels of catch 50% greater, so recent-year catch rates represent a considerable reduction. Across the region, catch rates varied widely, from 44 kg/hr in 17B, to 67 kg/hr in 21A.

Between months, catch rates were generally stable in the range 55-62 kg/hr, until November when they fell to 45 kg/hr (Figure 7). Examination of catch records shows an unusually large variation in catch rates, with some divers reporting > 100 kg/hr while others reported < 30 kg/hr.

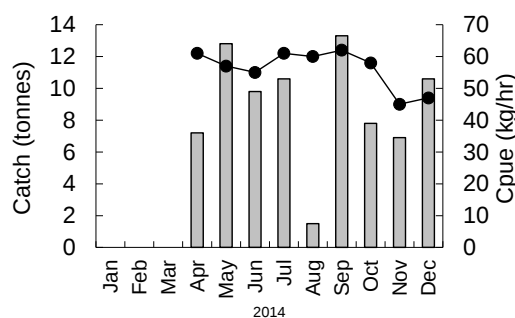


Figure 7. Monthly catch totals and mean catch rates, Storm Bay, 2014.

In past assessments we have reported that catch rates in this region have been maintained or improved by divers increasingly choosing to work at greater depths,

particularly towards the end of the year. There is no longer evidence that this trend is continuing. In 2014, depth/effort profiles in the region were similar to those from previous years, implying that all stocks were fully exploited and that there are no further opportunities for expansion of effort into deeper water to alleviate pressure on the shallower stocks (Figure 8).

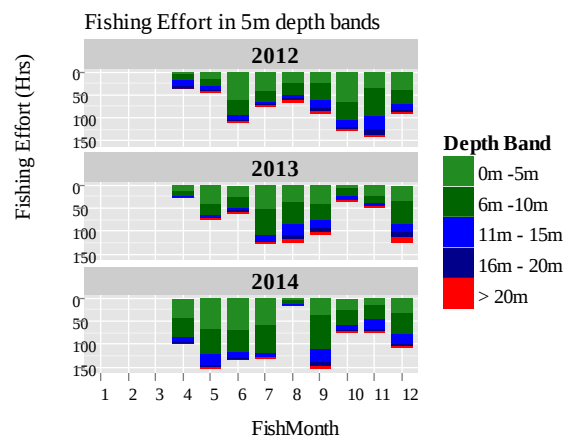


Figure 8. Monthly fishing effort by 5m depth bands for Storm Bay, 2012-2014.

In the northern part of Frederick Henry Bay (17B), abalone were smaller (median length 149 mm), and increased in size southward, reaching 157 mm in 20C. In Maingon Bay, median lengths were 154 mm (21A) and 153 mm (21C). Levels of sampling were high between 2013 and 2014, with between 15% and 30% of catches sampled. Since 2007, median lengths have increased throughout most of the region. Whereas when catch rates were much higher (between 2007 and 2009), increasing size was interpreted to mean that rates of fishing mortality were relatively low, enabling abalone to grow larger before capture. In the current low catch-rate environment, the larger size is attributed to reduced numbers of small abalone in the catch i.e. reduced recruitment. Throughout much of the region, median lengths tended to be as large as or larger than previous years, which was attributed to reduced low levels of recruitment.

Qualitative assessment

Stock levels in Storm Bay were assessed low, with low levels of recruitment. However, increasing levels of annual catch and stable catch rates suggest that stocks were stable.

3.1.5 Lower South East (Blocks 22 to 25)

This region includes coast from Cape Pillar and the eastern side of the Tasman and Forestier Peninsulas, Maria Island and Mercury Passage, and the western shore of Great Oyster Bay northward to Little Swanport. The 2014 annual catch was 104 t, which is approximately 20% of the Eastern Zone TACC

Block 22 extends from Cape Pillar to Deep Glen Bay, including Eaglehawk Neck. The Block 22 catch was 43 t, which is a 25% reduction over the previous year and is the first time for many years that the catch has been below the long-term average (1975-2013) of 51 t. Since 2006, the amount of catch taken from Block 22 has been unusually large. It is one of only two regions (the other being the Actaeons) where the post-zoning average catch (2000-2013) has been greater than the long-term average catch.

During the eight years between 2006 and 2013 the average catch increased to 65 t, with individual years producing up to 91 t. In line with TACC adjustments, the catch has dropped recently, but it is apparent that Block 22 has shown an unusual capacity to produce disproportionately large quantities of catch.

The 2014 distribution of catch rates was improved over 2012, but was skewed lower than in 2013, as the recovery in catch rates stalled. Catch rates were sustained at over 70 kg/hr between 2006 and 2009, but fell from then onwards to 46 kg/hr in 2012, and were at this level in 2014. Catch rates were best furthest south in 22A (50 kg/hr), and on the coast closer to Eaglehawk Neck in 22B, reached only 43 kg/hr. Monthly catch rates fell below 40 kg/hr in November, and while CPUE declines are to be expected at this time of year as increasing kelp growth slows abalone fishing, catch rate falls of this magnitude are usually consistent with extensive stock depletion (Figure 9).

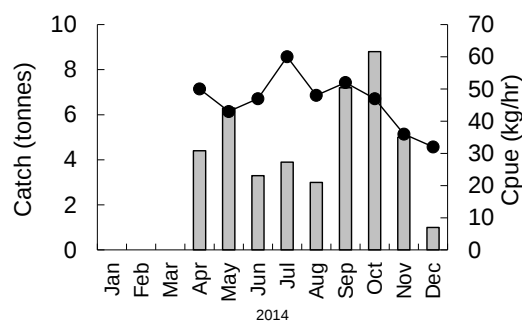


Figure 9. Monthly catch totals and mean catch rates, Block 22, 2014.

Blocks 23, 24 and 25 include the coast from Deep Glen Bay on the Forestier Peninsula north to Little Swanport, including Maria Island. In 2014, the region produced 61 t, approximately three-quarters of its post-zoning average of 84 t. Most of the catch came from the more exposed shores of the Forestier Peninsula (23A) and Maria Island (24E and 24D) which in 2014 produced 15 t, 11 t and 14 t respectively. Smaller amounts of catch came from 23B (8 t) on the northern end of the Forestier Peninsula, and in the lower part of Mercury Passage (24A – 7 t and 24B – 6 t). The coast between Rheban and Little Swanport (24C, Block 25) produced abalone until the late 1980s, but since then has produced negligible catch.

Throughout the region, catch and catch rates increased substantially in 2013, but fell again in 2014. The 2014 regional catch rate was 50 kg/hr, ranging from 48 kg/hr to 50 kg/hr between sub-blocks. During the year, catch rates peaked early in the year, and after September fell below 50 kg/hr until December, when 1.6 t was taken at 40 kg/hr (Figure 10).

The abalone in Block 22 were comparatively large, with median lengths of 152 mm (22B) and 153 mm (22A) and 75th percentiles 7 mm larger. In 22B, the size of abalone has tended to increase since the last size limit increase in 2007, whereas in 22A there was no discernible trend. Mark-recapture studies conducted by IMAS show that abalone in this block have relatively high growth rates, which explains their larger median length. Elsewhere in the region, median lengths were generally smaller (23A – 150 mm, 24D and 24E – 151 mm). Levels of sampling were high, between 16% and 35% in all sub-blocks reported except 24D (9%).

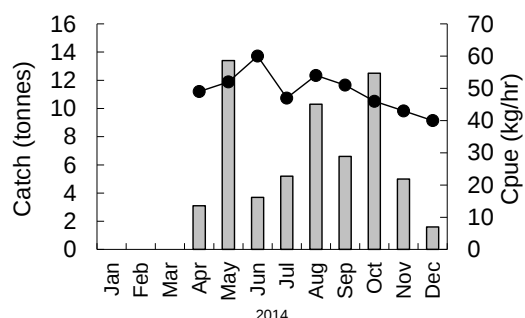


Figure 10. Monthly catch totals and mean catch rates, Blocks 23, 24, 25, 2014.

Diver Observations

Regarding the low end-of-year catch rates in Block 22 (Figure 9), there was no consensus among divers that stock depletion was ongoing. They said that that stock levels there were lower than they would like, but were unconvinced that rates of depletion were increasing. They attributed the rapid end-of-year catch-rate decline to fleet and processor dynamics in conjunction with increasing water temperatures and daylight hours which increased both kelp cover and cryptic behaviour among abalone, all of which combined to manifest as reduced catch rates. There were no reports of unusually low (or high) numbers of pre-recruits.

Qualitative assessment

Most recently, stock levels in Block 22 have shown signs of severe depletion following many years of above-average annual catches. Stock levels are considered to have been reduced, and should now be considered low. It is recommended that management action be taken to divert excessive levels of catch away from this block. Further north, in Blocks 23 and 24, catch rates have been variable, from a low in 2012, a rapid improvement in 2013, then falling back to intermediate levels in 2014. This decline indicates that stock levels are lower than thought previously, and accordingly our assessment of them is revised to low.

3.1.6 Bicheno-Freycinet (Blocks 26 to 28, sub-block 29A)

The Bicheno-Freycinet region includes coastline normally accessed from Coles Bay and Bicheno and incorporates Blocks 26, 27, 28 and 29A i.e. Little Swanport to Templestowe Beach north of Long Point, including the Freycinet Peninsula and Schouten Island. Part of the region (sub-blocks 26B, 26C, 26D, Block 27 and sub-blocks 28A and 28B) was identified as extraordinarily vulnerable to overfishing and at risk of stock collapse in 2011. Since then it has been fished under special management provisions including a catch cap and larger legal minimum length (145 mm).

The region's catch fell to a historical low of 23 t in 2012, and has slowly increased since then. In 2014 the region produced 34 t, which is less than half the post-zoning average (71 t) and approximately one third of the long-term average for Blocks 27 and 28 combined. No catch was reported from Block 26. The capped area produced 20 t.

Catch rates from the region dipped to 54 kg/hr, after rising sharply to over 60 kg/hr the previous year. In the capped area catch rates were lower (49 kg/hr), also reduced from 2013. Catch rates were lowest (<45 kg/hr) at Schouten Island (27A, 27B) and in Block 28, where they were less than 45 kg/hr. Compared with previous years, catch was

greatly reduced in these sub-blocks (< 1500 kg). Highest catch rates were in 29A (Long Point), where 14 t was caught at 63 kg/hr. From Schouten Passage north to the Friendly Beaches, including Wineglass Bay (27C, 27D), 17 t was caught at 52 kg/hr.

Catch rates are traditionally best during the winter months in this region, but because of a low initial catch cap (10 t) and interim closure between 4 June and 24 September (sub-block 29A remained open), most of the catch was taken at other times of the year (Figure 11). This may have caused average catch rates to be lower.

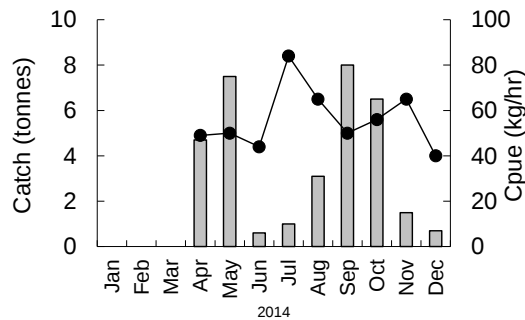


Figure 11. Monthly catch totals and mean catch rates, Freycinet-Bicheno region (Blocks 26, 27, 28, 29A).

Probably as a direct result of the 7-mm increase in LML within the capped area in 2013, the median length of abalone in catches sampled from the Freycinet Peninsula increased from the 2007-2012 range of 145-149 mm, to 154 mm (27D) and 157 mm (27C). Further north in 29A (Long Point), where the size limit was unchanged, the median length was 150 mm which is within the range of lengths observed since 2007. The sampling level of catches was high (32%-40%) in all three sub-blocks.

Diver observations

Although nowhere near former levels, stock levels in this region were viewed acceptable, particularly when compared with other regions of the East Coast.

Qualitative assessment

The regional catch has been greatly reduced from former levels in response to falling stock levels. Catch rates were also much reduced, although with a sharp increase in 2013. This increase was not sustained through 2014. Stock levels were assessed low.

3.1.7 Remainder North East (sub-blocks 29B, 29C, 29D, Block 30)

For the second successive year, the coast north of Long Point up to Eddystone Point (29B, 29C, 29D and Block 30) again produced a large catch (37 t), more than double the post-zoning average (17 t) and well above the 10-15 t usually produced. The increase has been driven partly because of the capping of catch and closure to fishing of the Bicheno-Freycinet region, and partly because some of the larger processors resumed accepting abalone from the region and collected catch from the ramps near St Helens.

Catch rates were 61 kg/hr, down on the previous year (67 kg/hr), but within a narrow four-year range of 56-67 kg/hr. In a sign that stocks were becoming depleted, catch rates were best in the most remote/least fished area (29C) at 72 kg/hr, whilst elsewhere were between 58-62 kg/hr.

Monthly catch rates were generally stable between 60-70 kg/hr until September, after which they dropped to below 50 kg/hr in November in the manner typical of the Eastern Zone fishery (Figure 12). They rose again in December when divers fished the more remote parts of the region.

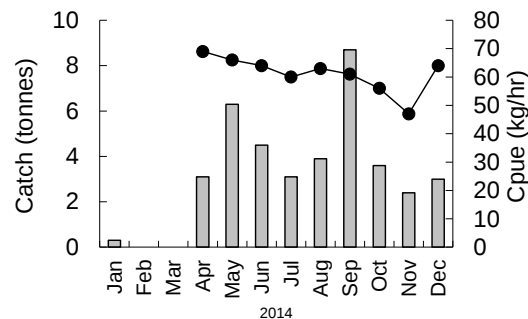


Figure 12. Monthly catch totals and mean catch rates, North East Eastern Zone (sub-blocks 29B, 29C, 29D, 30A).

Qualitative assessment

In 2013, the North East (29B, 29C, 29D, Block 30) produced a relatively large catch at moderate catch rates, and stock levels were noticeably higher than further south in the Eastern Zone. This high catch continued in 2014 with a minor decline in catch rate. It should be noted that successive years of unusually large catches in Eastern Zone regions are commonly followed by rapid declines in catch rates. The large catch appears due to renewed processor interest in the region and the closure to fishing of the coast south of Bicheno. Should catch rates from this region continue to fall in 2015, catch will need to be reduced from this part of the Eastern Zone. Stocks were assessed moderate, but there were indications that stocks were reduced lower in some areas.

3.1.8 Block 31 – Eastern Zone

Block 31 was fished sporadically throughout the year. Unlike the rest of the Eastern Zone, the region is open to fishing in the first three months. The quality of abalone in the block is highly variable, with much of it unacceptable to the live market, and hence the region is now infrequently fished.

The 2014 catch was 19 t, below the post-zoning average (33 t) and at the low end of the range of catches since 2000 (4 t-74 t). The drop in catch is in part due to low processor interest in the region. Catch rates have declined significantly since a recent peak in 2009 to 67 kg/hr, and have been in the range 67- 71 kg/hr since 2012. Most of the fishing is undertaken in a few small areas, with much effort spent on finding acceptable quality abalone. Catch rates vary according to knowledge of stocks and the standard of quality expected by the processors, and hence catch-rates depend more upon individual divers than elsewhere in the zone. This is illustrated by the high degree of between-month variability in catch and catch rates as different divers moved in and out of the region (Figure 13).

The median length of abalone increased to 150 mm, from the post-2007 range 140-147 mm. (This range is wide because it includes catches from 2009-2010 when divers were permitted to fish at LML less than 138 in Block 31.) The increase is consistent with divers fishing better quality populations and selecting larger and higher grade abalone.

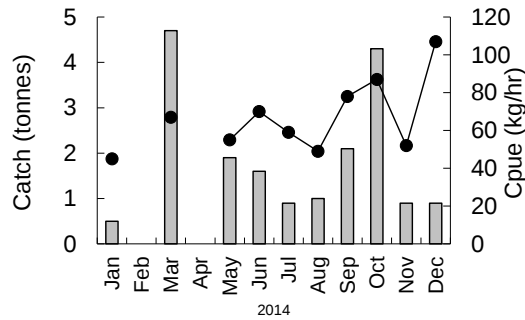


Figure 13. Monthly catch totals and mean catch rates, North East Eastern Zone (sub-block 31A).

Divers reported high stock levels throughout most of the region, but say that most of it, particularly north of George Rocks, is unacceptable to processors. Where abalone were of higher quality, fishing has impacted stock levels, with appropriately low catch rates. Generally, stock levels were assessed high, although it is recognised that much of it was sub-standard for Eastern Zone product, and hence unavailable to divers.

3.2 Central West Zone (Sub-blocks 5D, 6A, 6B and 6C)

Fishery-dependent data

The zone was reduced in size in 2013 when sub-blocks 6D and Blocks 7 and 8 were transferred back to the Western Zone. The TACC for the zone was further reduced to 73.5 t. The annual catch has been reduced to almost half that of the period 2010-2012 when the catch for the (reduced) area was between 128-136 t. The catch was distributed between 6A (33 t), 6B (13 t) and 6C (27 t). No catch was reported from 5D.

The 2014 catch-rate distribution was skewed to its lowest point since zoning started (2000), as catch rates fell to their lowest levels. Across the zone they averaged 67 kg/hr, ranging between 72 kg/hr in the north (6A) to 64 kg/hr in the south (6C).

Abalone from this region are less preferred by many processors, who, when weather conditions are suitable, prefer fish from the Western Zone over those from the Central West. This meant that catches were low in January and February but caused a large spike in catch in December, at the end of the quota year (Figure 14).

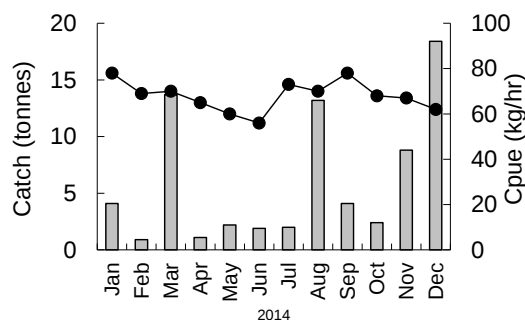


Figure 14. Monthly catch totals and mean catch rates, Central Western Zone (sub-blocks 6A, 6B, 6C).

No catch sampling for abalone lengths was done in 2014. In 2013, median lengths fell in both 6A and 6B to 137 mm, with the 25th percentile length at or just above the 132-mm LML. In 6C, abalone were larger, with median length of 143 mm, and 25th

percentile length of 137 mm. Rates of sampling were between 7%-12%, down from previous years when between 15%-25% of catches were measured.

Qualitative assessment.

The ongoing decline in catch and catch rates in this region indicates that stock levels have continued to fall despite reductions in TACC. Stocks that were previously assessed as moderate should now be regarded as low. A catch reduction is required in this zone to prevent further declines and to allow rebuilding to occur.

3.3 Western Zone

The Western Zone TACC was 840 t. This represents a reduction of 161 t from previous levels, and is part of a management response to stop ongoing stock declines throughout the zone. The reduction in catch is apparent in Block 9 and the South West (Figure 15). In 2012, Blocks 6D, 7 and 8 were part of the Central Western Zone.

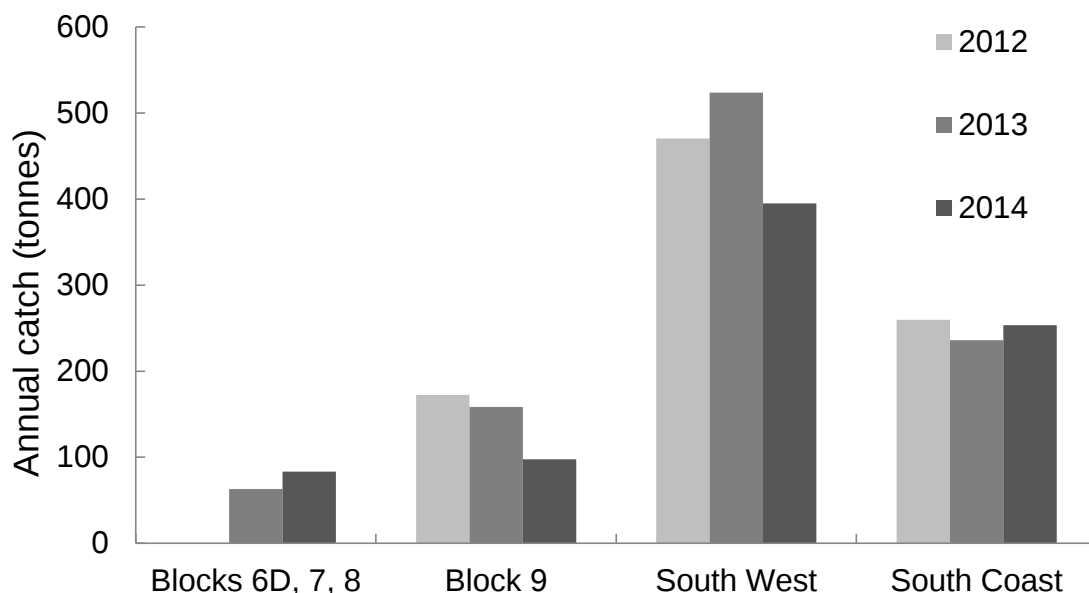


Figure 15. Distribution of regional catch, Western Zone, 2012-2014. In 2012, Blocks 6D, 7 and 8 were part of the Central Western Zone,

3.3.1 North of Strahan (Sub-block 6D, Blocks 7 and 8)

The regional catch in 2014 was 83 t. Although higher than in 2013 (63 t), the 2014 catch represents a significant reduction from the annual harvest of around 150 t during the period 2009-2012.

Most of the catch was caught at Sandy Cape (6D – 34 t) and Conical Rocks (7B – 33 t). The two sub-blocks close to Granville Harbour (7C, 8A) which have previously produced the bulk of the catch were only lightly fished, producing 8 t and 1 t respectively. Catch records show increased mothership fishing compared with runabout fishing in the region, and the reduction of catch close to Granville Harbour appears to be associated more with the preference to fish closer to the mothership anchorages at Sandy Cape and Ahrberg Bay, compared with earlier years when the region was predominately fished from runabouts.

The distribution of monthly catches reveals low but persistent levels of effort throughout the year until December when a small number of divers visited the region to finish their allocation of Western Zone quota (Figure 16). Visitation by divers was irregular, with most visiting the region just once. Catch rates varied greatly throughout the year, dependent on divers and where they fished.

Regionally, catch rates have been reduced further, to 90 kg/hr, and the 2014 distribution of catch rates was skewed lowest. In 6D and 7B catch rates were 86 and 91 kg/hr, respectively. Near Granville Harbour catch rates were also low (7C – 98 kg/hr, 8A-72 kg/hr). In the more remote areas, such as Rupert Point (7A) and Trial Harbour (8C) catch rates were higher at 125 kg/hr and 163 kg/hr respectively, but the combined annual catch from these areas was less than 7 t.

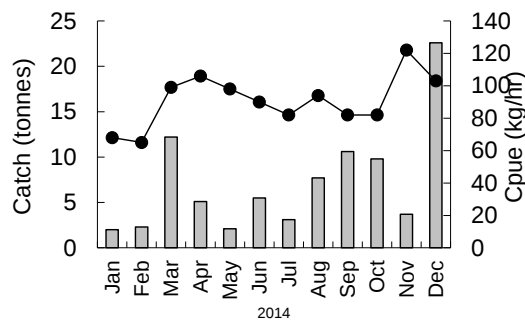


Figure 16. Monthly catch totals and mean catch rates, Western Zone north of Strahan (sub-blocks 6D, Block 7 and 8). Grey bars indicate catch in tonnes and black dotted line indicates catch per unit effort (Kg/Hr)

Levels of catch sampling have been low in most years since 2000, and comparing changes in size of abalone throughout this period is consequently unreliable. In 2014, around 14% of catches were sampled. Median lengths were 157 mm in both 7B and 7C, which is as large as or larger than any year in the review period.

Diver observations

Reduced weather opportunities prevented greater amounts of catch being taken from Rupert Point and Trial Harbour. Fleet dynamics played a large part in determining catch rates e.g. extreme fluctuations in catch rates in 8B.

Qualitative assessment.

It is evident that there has been a substantial reduction in fishing activity in the region following the region's return to the Western Zone, with greatly reduced catch and irregular application of effort. While under the Central Western Zone, annual catches in the region were excessive, but were accepted because of previously low annual catches, and a consequent build-up of stocks to high levels. Now, like other parts of the west coast fishery, catch rates have been reduced to below 100 kg/hr, and catch levels need to be maintained appropriately low until stocks recover.

3.3.2 South of Strahan (Block 9)

Block 9 covers coast from Macquarie Heads to the beach north of Point Hibbs. Like the coast north of Strahan, it has traditionally been a runabout fishery, but has been increasingly fished from motherships, particularly in 2014 when the South West was closed to fishing for part of the year.

The 2014 catch was 98 t, reduced by 60 t from the previous year, and approx. two-thirds of the post-zoning average catch of 159 t. The catch was split between sub-blocks 9B (37 t) and 9C (61 t) with less than 1 t from 9A. These catches are as low as or lower than any previous catches in the post-zoning era.

During the period 2001-2011, the median catch rate was around 150 kg/hr, reaching a peak in 2009. Since 2011, the catch rate in this region has continued to fall, and at 98 kg/hr in 2014 is the lowest catch rate recorded in this region since 1991. Catch rates were slightly higher in the more remote 9C (99 kg/h) than in 9B (96 kg/hr). While the modal 2014 catch-rate is comparable with 2013, catch rates greater than 125 kg/hr are heavily reduced. The fall in catch rates at the end of summer (March) and late in the year is consistent with heavy fishing pressure (Figure 17).

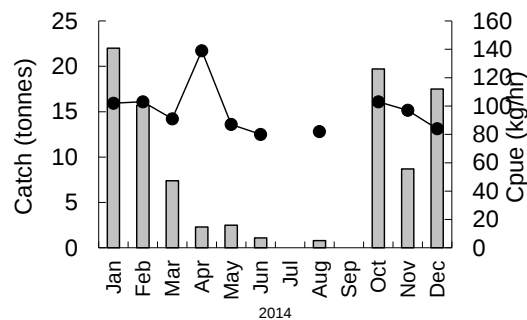


Figure 17. Monthly catch totals and mean catch rates, Western Zone south of Strahan (Block 9).

Diver observations

In recent years divers have reported that despite high catch rates, stock levels in Block 9 were being steadily depleted. They warned that the former high catch rates could not be sustained and that they were becoming possible only when sea conditions were flat enough to enable them to fish shallow water inshore. Recent improvements in weather forecasting helped them pick the best weather to fish the region, and this maintained high catch rates while stock levels were being eroded.

Increased doubled-up dinghy fishing in the area has caused catch rates to fall because of the inherent inefficiencies of this type of fishing compared with single-diver runabout fishing. Doubled-up dinghy fishing from motherships has become more prevalent because it offers lower cost fishing and processors prefer mothership product from the region over runabout product shipped by truck from Strahan.

Median lengths of abalone from 9B and 9C were 153 mm and 155 mm respectively, and within the range observed in previous years. Sampling rates were 9% and 11% respectively.

Qualitative assessment.

After many years of high and stable catch rates, there has been a rapid decline during the last three years. It was reported that technological improvements in weather forecasting enabled divers to fish at high catch rates while stock levels were falling. More recently, the extent of the depletion became apparent, with the 2014 catch reduced to approximately two-thirds of the 2013 catch, but at a catch rate nearly 20 kg/hr lower than in 2013. The regional catch has been reduced, but it is not known whether it has been reduced sufficiently to prevent further depletion.

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

This region covers coast between Point Hibbs and South West Cape. Its remoteness means that almost all the catch is taken by divers operating from motherships. In a bid to prevent overfishing in 2014, the region was closed to fishing on 28 April 2014 after 287 t had been taken. This follows intensive fishing late in 2013 which caused the 405 t management catch cap to overrun by 121 t. The region was reopened to fishing on 26 November 2014 to enable effort to be spread more equitably across the zone, and a further 108 t was caught, 45 tonnes over the catch cap set for this region.

Fishery-dependent data

The regional catch was 395 t, which, compared with other catches since the inception of zoning, is low. The average annual catch during this period was 554 t, and catches have ranged between 659 t in 2003 and 434 t in 2010. Catches were greatly reduced in 10A (24 t), 10B (6 t), 10C (34 t), 11A (45 t), 11B (48 t), 11E (17 t) and 12A (32 t). Catches were approximately the same as the previous year in 11C (77 t) and 11D (32 t) and increased in 10 D (78 t).

Regional catch rates again fell in 2014, reaching 87 kg/hr, which is the lowest point of an almost continuous decline in catch rates since zoning started in 2000. Sub-block catch rates ranged between 77-97 kg/hr, with the highest in 10D and 11A, and the lowest in 10A, 11D and 11E. The 2014 CPUE distribution is heavily skewed towards lower catch rates, with catch rates > 150 kg/hr minimally represented.

Usually most of the South West catch is taken between November and the following April because it is too difficult to fish there during winter and spring, and it is more cost-effective to fish elsewhere in the Western Zone at that time. Note that the 2014 fishing season was closed at the end of April, and in the previous year, early December (Figure 18). Catch rates fell throughout the 2013/2014 summer season until the April closure. Effective management of this region is made difficult because the November-April fishing season straddles quota years and catch and catch rates derived from calendar years make comparisons between fishing seasons more difficult to interpret. Limiting excessive catch by management caps is difficult, because the industry has capacity to catch 100 t or more in a week and during much of the fishing season there is strong demand for live product for the Chinese New Year when the other source of live abalone (the Eastern Zone) is closed. This means that caps can be overrun before managers are able to close the fishery.

Catches from reporting blocks in the South West may contain abalone from a mixture of blocks within the Western Zone, and consequently, length measurements from Blocks 10 and 11 may include abalone from elsewhere. Median lengths for abalone from Blocks 10 and 11 were 157 mm and 155 mm, with levels of sampling at 11% and 10% respectively.

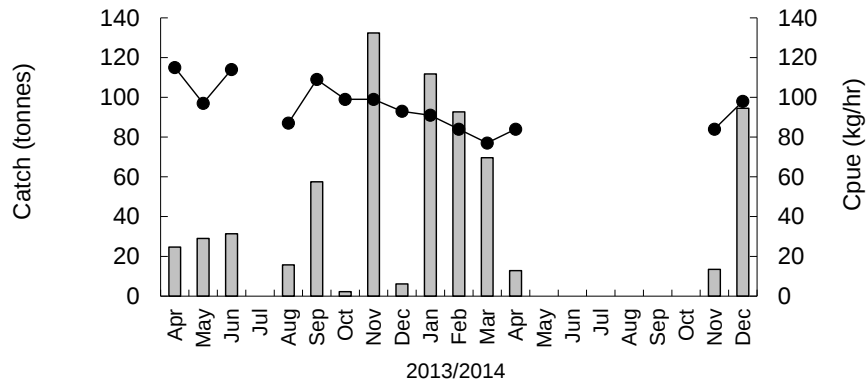


Figure 18. Monthly catch totals and mean catch rates, South West (Blocks 10 and 11, sub-block 12A, April 2013-December 2014).

Qualitative assessment.

Despite a smaller catch, catch rates have continued to fall and in 2014 reached their lowest levels post-zoning. Catch rates in 2014 were almost 100 kg/hr lower than catch rates in 2000. It is evident that depletion of stocks was widespread along most of the coast.

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

Fishery-dependent data

The South Coast catch in 2014 was 254 t, similar to the previous three years, and lower than during the period 2008-2010 when catches were over 300 t. Within this region, an increasing level of catch has been taken from sub-block 12C, (Maatsuyker Group) with an unprecedented high level of catch (126 t) reported in 2014. Catches were reduced in 12B (28 t) and in 12D (62 t), while catch in 13A (22 t) and 13B (15 t) was maintained at levels similar to 2012 and 2013.

The regional average catch rate was higher in 2014 (88 kg/h), compared to 2013 (80 kg/hr), and almost within the stable 90-100 kg/hr range typical of the preceding 10 years. The improvement however, is due to a sharp rise in catch and catch rates at the Maatsuyker Group (12C), where catch rates have increased to 129 kg/hr. Catch rates elsewhere along the South Coast have declined.

The catch-rate improvement in 12C is not necessarily due to improved stocks there, but to a recent shift in effort to deeper water stocks which have been relatively unfished since the 1980's (Figure 19). In all other sub-blocks in the region catch rates have fallen below 75 kg/hr.

The South Coast provided catch throughout the year, but like the rest of the Western Zone, the largest amounts were taken between late spring and autumn when weather conditions became more favourable for diving (Figure 20).

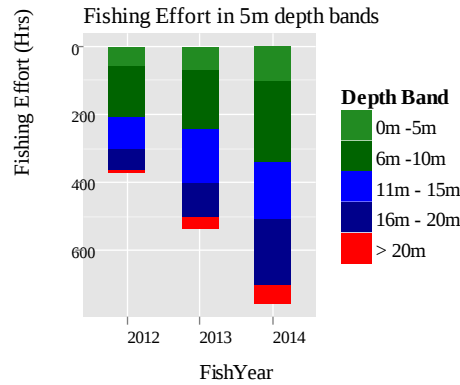


Figure 19. Effort by depth, sub-block 12C (Maatsuyker Group), 2012-2014.

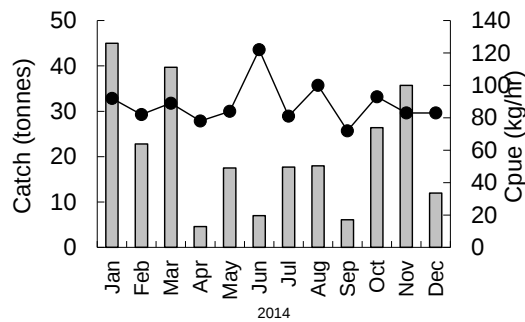


Figure 20. Monthly catch totals and mean catch rates, South Coast (sub-blocks 12B, 12C, 12D, 13A, 13B).

With the exception of 12C, the size of abalone from the region has tended to increase during the past five years. Median lengths increased from east to west, from 155 mm in 13B to 160 mm in 12B, with a corresponding increase in 25th percentile lengths. In conjunction with falling catch rates, this is interpreted to mean that levels of recruitment have not kept pace with fishing mortality on the mainland shore. At the offshore islands (12C) abalone size (median length = 159 mm) has been comparatively stable during the past three years of increasing annual catches. Rates of sampling were moderate throughout the region, from between 9%-21%.

Diver observations

The high catch rates in 12C were not due to improvement in stocks there, but due to a shift in effort to deeper water stocks which have not been fished for many years.

Qualitative assessment.

Stock levels across most of the South Coast have fallen in recent years, and many areas which were once highly productive now have low levels of stock. Offshore island stock levels appear much higher, but it is unknown how extensive these stocks are, or how long they can sustain current high rates of fishing.

3.4 Northern Zone

The Northern Zone TACC was 280 t in 2014. There has been a progressive reduction in the Northern Zone TACC since 2011 when it was 402.5 t. These reductions have been made in response to falling stock levels. Most of the reduction has occurred in the North West and Block 5 management regions (Figure 21).

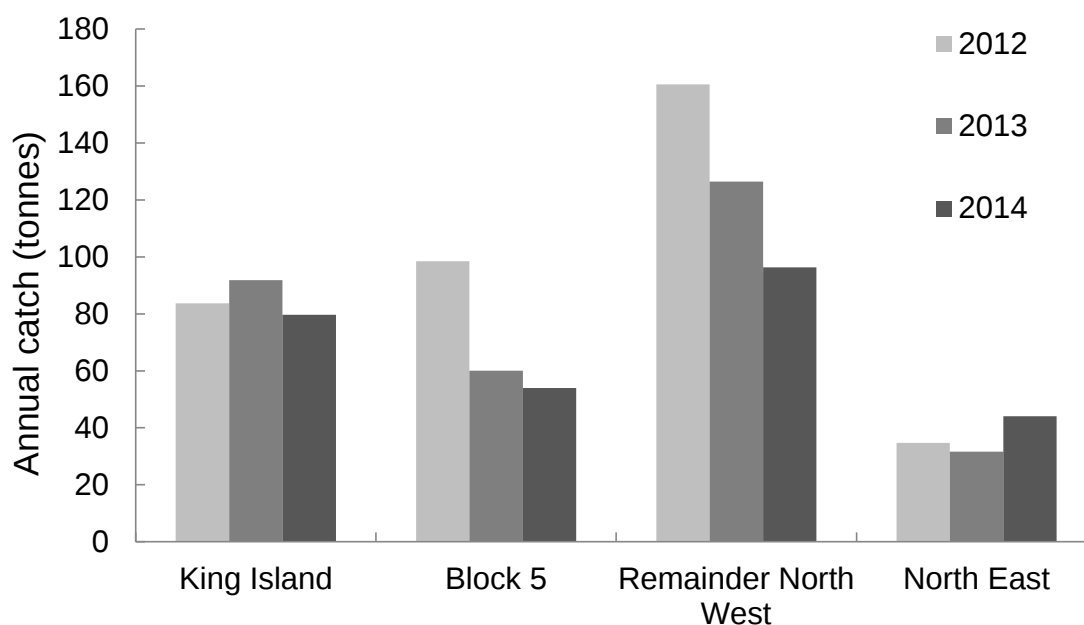


Figure 21. Distribution of regional catch, Northern Zone, 2012-2014.

3.4.1 King Island (Blocks 1 to 4)

The King Island catch was 80 t in 2014, slightly higher than the post-zoning average (74 t), and 12 t lower than in 2013. The catch was almost entirely from the western side of the island with most coming from the vicinity of Currie in 3A (37 t) and north to Whistler Point in 1C (13 t), or further south in 3C (23 t). Less than 5 t was reported from Blocks 2 and 4, almost all of which was taken in conjunction with greenlip fishing. Almost all the catch was taken after April (Figure 22).

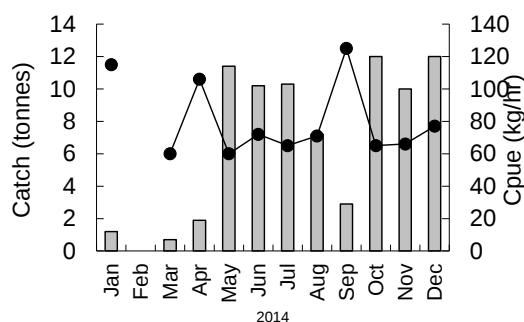


Figure 22. Monthly catch totals and mean catch rates, King Island (Blocks 1-4). Grey bars indicate catch in tonnes and black dotted line indicates catch per unit effort (Kg/Hr)

The mean catch rate at King Island dropped again in 2014, declining to 69 kg/hr. The calculation of catch rate for King Island blacklip includes some greenlip effort. The degree to which greenlip are caught while blacklip fishing on King Island varies greatly between years, but the amounts of greenlip are usually small, and average annual catch rates from blacklip-only catches are normally marginally higher than catch rates that include mixed species catches. Importantly, the differences between catch rates does not obscure inter-annual catch-rate trends. In 2014, the catch rate from blacklip-only catches was 72 kg/hr.

The 2014 CPUE distribution is unusual. It is distinctly bi-modal, with a large mode at 50-59 kg/hr, and a smaller mode at 100-109 kg/hr i.e. a diminished frequency of higher catch rates and a corresponding increase in low catch rates (Figure 23). There are several factors which contribute to this change:

- a) Divers reported spending more time 'scratching' or fishing at low catch rates. However, when they found patches of abalone, high catch rates were attainable. This implies that the frequency and extent of patches have become reduced. Divers who work on King Island fall into two broad categories: local divers and visiting divers.
- b) The local divers routinely have higher catch rates than visiting divers and are responsible for much of the higher mode catch rates. The proportion of catch taken by visiting divers has increased in recent years, causing a shift to the left in the CPUE distribution and overall lower catch rates.

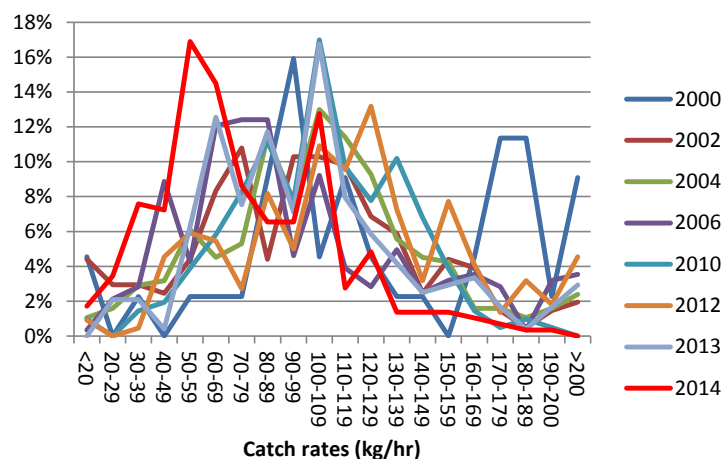


Figure 23. Distribution of raw catch rates, King Island Northern Zone, 2000-2014. Catch rates include small and variable amounts of greenlip effort, apparent here in the lowest catch-rate categories.

Across much of the Tasmanian abalone fishery, profound differences in catch rates exist between local and visiting divers, with local divers usually catching at faster rates. For example, differences in catch rates between the two groups at King Island are apparent in Figure 22, where catch rates were up to 50 kg/hr higher during months when visitors were absent. It is assumed that local divers were better informed of abalone stocks in the region, and used this knowledge to locate patches of abalone and were better able to maintain high catch rates. In contrast, the visiting divers were unaware of where previous fishing had occurred and took longer to locate patches. This difference means that changes in distribution of catch between the two groups could affect average catch rates independently of abalone abundance. However, at King Island, both groups of divers have experienced reducing catch rates in recent years, but the reduction for visiting divers was much greater (from 87 kg/hr to 62 kg/hr in 2014) than for local divers.

Rates of length sampling are too inconsistent between years to provide information about trends in abalone size. In 2014, approximately 5% of catches from 3A were sampled, with median length of 142 mm, and 25th and 75th percentiles at 134 mm and 153 mm.

Qualitative assessment.

Stock levels at King Island have fallen, as evidenced by catch-rate declines experienced by all divers. In the parts of its west coast where most of the fishing has occurred, and where stocks were formerly at high levels, catch rates indicate that stock levels have been reduced to moderate levels.

3.4.2 Block 5

The catch in Block 5 was 54 t, down from 60 t in 2013, and is a reduction to one third of the levels of the four-year period 2008-2011, when it ranged between 134 t-172 t. The catch was distributed between 5A in the north (20 t), 5B (10 t) and 5C (24 t).

Block-wide, catch rates averaged 59 kg/hr. The method of reporting effort while fishing for both greenlip and blacklip may affect catch rates in this block. In 5A in 2014, 74%

of the blacklip catch was taken while fishing blacklip only and the proportion of blacklip-only fishing has varied between 39%-83% since 2000. In this period, catch rates that included effort from greenlip fishing were up to 8 kg/hr lower than for blacklip fishing alone. In 2014, the blacklip-only catch rate was 52 kg/hr, down from 60 kg/hr in 2013. The catch-rate decline in 5A has been continuous from 97 kg/hr since 2008 when the exploitable stock size expanded overnight following the reduction of the LML from 132 mm to 127 mm, and the region's harvest level increased from less than 100 t to over 150 t.

Further south in 5B and 5C, mixed-species effort becomes less problematic because greenlip are found only in 5A (although divers reported small amounts of greenlip catch from both sub-blocks 5B and 5C). Catch rates in 5B were 66 kg/hr, down slightly from 2013 (72 kg/hr) and 2012 (74 kg/hr), but significantly reduced from much higher levels in 2008 (126 kg/hr). In 5C, catch rates increased over the previous year by 3 kg/hr to 72 kg/hr, but have also been considerably reduced, from 106 kg/hr in 2008. The Block 5 blacklip fishery was closed on 12 November after its 50 t management cap was reached (Figure 24).

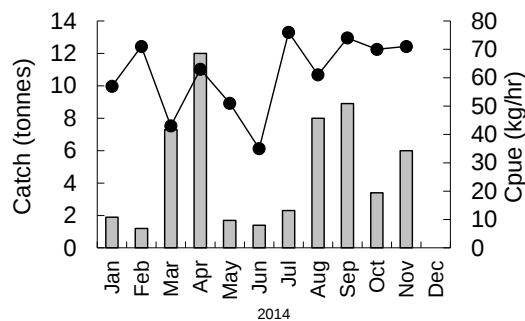


Figure 24. Monthly catch totals and mean catch rates, Block 5.

Negligible length sampling was undertaken from this region in 2014. In 5A, less than 4% of catches were sampled, and none were obtained from further south in 5B and 5C. In 2013 we found that 25th percentiles were at the 127-mm LML in both 5A and 5B, and just 1 mm larger in 5C, with median lengths at 130 mm in all three sub-blocks. This small size indicates that fishing pressure is intensive. Estimates of growth rates from a tagging program conducted by IMAS at West Point in sub-block 5C showed that at the 127-mm LML, abalone grew at approximately 1 mm pa. While these abalone were slow growing, we remain uncertain about how representative these growth rates were of the Block 5 stock in general.

Diver observations

Divers reported that the Woolnorth area (5A) was extensively depleted. Divers fished there because blacklip could be caught when weather conditions prevented fishing further south. They also had the opportunity to catch greenlip. Elsewhere, divers reported that there were substantial quantities of abalone below the LML. Catch rates were reduced, the abalone were mostly small relative to the LML, and divers need to measure a high percentage of the catch.

Qualitative assessment.

In Block 5, catch rates have declined in every year since 2009 following a 50% increase in annual catch and a reduction in LML from 132 mm to 127 mm, and indicated widespread stock depletion. Catch rates continued falling in 2014, particularly in the

north in 5A, but appear to have stabilised further south. Abalone in this block grow comparatively slowly, with half the catch taken within a few mm of the LML, so a quick recovery of stocks to former levels is unlikely.

3.4.3 Remainder North West (Blocks 47 to 49)

In 2012, the LML in the region between Stanley and Woolnorth Point (Blocks 47, 48 and 49) was reduced from 125 mm to 120 mm, thereby increasing the size of the stock and enabling the catch to be doubled to 161 t. Since then, the annual catch has reduced by approx. 30 t/pa, with 96 t caught in 2014.

Most of the catch (89 t) came from Block 49, in the vicinity of Hunter, Albatross and Three Hummock Islands. In 49A (Three Hummock Island) 28 t was taken, and 27 t was caught from 49B (north Hunter Island and Albatross Island). In 49C (south Hunter Island and islands to the west), 34 t was caught, much of it while also fishing for greenlip. In Block 48, almost 8 t was taken, mostly from 48C (4 t) i.e. east from Woolnorth Point to Robbins Island, with <2 t each from 48B (Petrels) and 48A (Black Reef). No catch was reported from Block 47.

Regional catch rates were 61 kg/hr. In 49A (Three Hummock Island) catch rates were stable between 85 kg/hr-95 kg/hr for many years until falling to 72 kg/hr in 2013, and then 62 kg/hr in 2014. This fall in catch rates follows the large amount of catch taken after the 2012 size-limit reduction, which was three times the size of earlier catches. Further west, in 49B, catch rates fell sharply in 2014 to 73 kg/hr, lower than the 90 kg/hr -120 kg/hr range from the previous five years.

The distribution of raw catch rates shows the most extreme leftward skewing since 2000 and an almost entire absence of catch rates > 139 kg/hr, and illustrates the rapid decline of this part of the fishery (Figure 25). The small percentage of low catch-rate categories (< 40 kg/hr) stems mostly from the reporting of small amounts of catch while fishing for both greenlip and blacklip on a single trip.

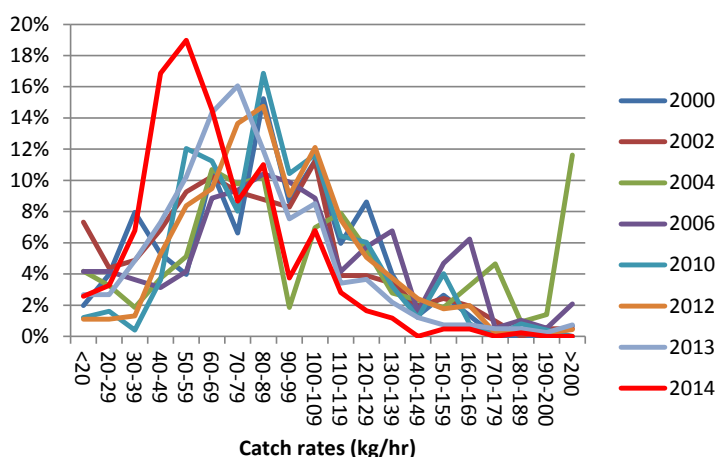


Figure 25. Distribution of raw catch rates, Blocks 47-49 Northern Zone, 2000-2014, including Hunter, Three Hummock and Albatross Islands. Catch rates include small and variable amounts of greenlip effort, apparent here in the lowest catch-rate categories.

In other parts of the region, greenlip are frequently caught while blacklip fishing, and catch rates are often affected by the way in which greenlip effort is reported. In 49C

during the past 5 years, blacklip-only fishing comprised between 64%-81% of trips. Blacklip-only catch rates have fallen sharply from a relatively stable range between 80 kg/hr – 90 kg/hr to 56 kg/hr. Further east, in 48C where blacklip-only fishing comprised only 27%-44% of trips, mean catch rates were 62 kg/hr, having been relatively stable at between 60-70 kg/hr in recent years. In 48B and 48A, the variable level of blacklip only fishing, the low number of trips and the small amount of catch (< 2 t) causes between-year catch rates to become highly variable and not useful for assessment purposes.

In 2014 only seven catches were sampled from the region, and this low level of sampling produced no useful information. In 2013 where approximately 20% of catches were sampled, median lengths were 128 mm in 49A and 49C. In contrast with Block 5 where 25th percentiles were on or just above the LML, in these two sub-blocks the 25th percentiles were 4 mm and 3 mm respectively above the 120-mm LML, indicating less fishing pressure. Like Block 5, growth studies conducted by IMAS indicate that recruits grow at approximately 1 mm pa i.e. they grow very slowly at the LML. Length samples from 49B were not considered useful because 49B includes both north Hunter Island and Albatross Island where there are large differences in the size of abalone, and it has not been possible to distinguish catches from the two areas.

Qualitative assessment.

Following a 5-mm size limit reduction in 2012 and a consequent increase in the fishable stock, the catch from this region has doubled in size. It is apparent that the catch has been excessive, because catch rates have now fallen below levels prior to the size-limit reduction. To arrest the decline in stock levels, reductions in catch will be required in the short term.

3.4.4 North East (Sub-block 31B, Blocks 39 and 40)

The North East region includes the coastline in north-east Tasmania between the Eastern Zone boundary at the Musselroe River and the Bass Strait Zone east of Bridport. Much of the Northern Zone catch is usually taken while greenlip fishing, but in 2014 the greenlip fishery was closed early in the year (20 March 2014). In 2014 the region was managed under a Northern Zone cap of 30 t, which was over-caught by 14 t and closed on 23 July. Most blacklip catch usually comes from 31B around Swan Island, which produced 40t in 2014, with small amounts (4t) from Cape Portland (39A).

Blacklip catch rates in the region are usually affected by greenlip effort. In recent years, the percentage of blacklip-only trips has ranged between 19% and 63%, the highest being in 2014, probably due to the early greenlip closure. In 31B, blacklip-only catch rates were 57 kg/hr, slightly lower than the previous three years, but lower than in 2009-2010 when catch rates were over 70 kg/hr. In 39A, only 7%-13% of trips were blacklip-only during the recent five-year period, but in 2014 38% were blacklip only. The small number of trips, fluctuating level of blacklip-only fishing and the reduced level of catch causes variability in catch rates not associated with abalone abundance, and makes catch rates unreliable for assessment purposes. In 2014, blacklip-only catch rates were 59 kg/hr.

Like the other regions of the Northern Zone, IMAS has been unable to consistently obtain sufficient length measurements to provide information about trends in the size of abalone. In 31B, where approximately 8% of the catch was measured in 2008 and 2010,

median lengths were 136 mm, with 25th percentiles 3-4 mm above the 127- mm LML. To the west in 39A where respective rates of sampling in 2011 and 2013 were 8% and 11%, the median length fell from 134 mm to 132 mm, and the 25th percentile also fell, from 130 mm to 128.75 mm. Because of the paucity of samples, we are unable to determine whether the reduced size is due to increased fishing pressure or is just part of the normal variability in size associated with sampling abalone from different parts of a sub-block. A growth study conducted by TAFI at the eastern side of Swan Island in 2000 indicated that abalone grew at almost 4 mm pa at the 127-mm LML. As with other isolated growth studies, we are unsure how representative growth rates from this population were of growth rates generally throughout the region.

Qualitative assessment.

Catch rates, while stable for the last three years at approx. 60 kg/hr, have declined from previously higher levels. In 2014, the regional catch exceeded the management cap by almost 50%. Stock levels were considered stable in this region, but because of its small size and difficulty in limiting excessive catch, its stocks are considered vulnerable to depletion.

3.5 Bass Strait Zone

Blacklip are caught from three principle regions in this fishery: the remote Bass Strait Islands (Blocks 50-57), the Furneaux Group (Blocks 32-38) and the Central North Coast (Blocks 41-46). In parts of the Furneaux Group, blacklip are caught in conjunction with greenlip, which affects catch rates. There is negligible greenlip fishing in the other two regions.

The Bass Strait Island catch (16 t) was one of the lowest recorded since the inception of the zone in 2003, and approximately two thirds (26 t) of its average catch. As usual, most catch (11 t) was taken from the Hogan Group, with smaller amounts from the Kent Group (3 t) and the Moncoeur Islands (2 t). No catch was reported from the Curtis Group (Block 56) or Redondo Island (Block 55) in 2014.

Since the advent of the Bass Strait Zone, catch rates have been variable from year to year, apparently influenced by diver participation and weather. For example, catch rates are usually higher during years when greater amounts of catch are taken from exposed western shores or islands such as Curtis Island or the Moncoeur Islands. The regional mean catch rate was 62 kg/hr, slightly improved from the previous year (59 kg/hr), but reduced by 21 kg/hr from 2012. At the Hogan Group mean catch rate was the same as in 2013 (58 kg/hr), marginally higher at the Kent Group (60 kg/hr) and lower at the Moncoeur Islands (111 kg/hr).

At the Furneaux Group, the blacklip fishery is effectively divided into two parts: a capped area where the annual total catch is limited, and the remainder of the fishery. The capped area covers the eastern side of the Furneaux Group (sub-blocks 33A, 33B, 33C, 36A, 36B, 38A, 38B, 38C), although in previous years, 33A was omitted. The LML in this area was reduced from 127 mm to 114 mm in 2010, and there were corresponding increases in catch to take advantage of the increased stock (e.g. 46 t in 2010). As a management measure to limit depletion, from 2012 annual catch caps have been set at 30 t.

In 2014, the catch from the capped area was 37 t, with a further 6 t reported from the remainder of the region. The capped area was closed to fishing on 30 June. The remainder of the Furneaux Group was also closed to fishing on 8 August to encourage more fishing in the remote islands,. In Block 38, all the catch (16 t) was taken at or near Babel Island (38A). At south-east Cape Barren Island, 8 t was taken from 33B and 5 t from 33C. Small amounts of catch were taken elsewhere, mostly in conjunction with greenlip fishing.

Catch rates from the capped area were mostly higher than recent years. Across the region, blacklip-only catch rates (53% of trips in 2014) continued to improve to 87 kg/hr. In Block 33B and 33C, blacklip-only catch rates were over 100 kg/hr; however less than 25% of trips were blacklip-only fishing in 2014, reducing the reliability of this measure of abundance. In contrast, in Block 38 most trips (88%) caught only blacklip. Catch rates here were 84 kg/hr, similar to 2013 (80 kg/hr).

Outside the Furneaux capped area, 6 t was taken from 33A, while small amounts of 1 t or less were taken from other sub-blocks including 37D (the Sisters). Almost all the catch was taken on mixed-species fishing trips, and catch rates were affected by greenlip effort to varying degrees, and consequently are not useful as an indicator of relative stock levels.

Across the Central North Coast 7 t was caught, comprising 5 t from the mouth of the Tamar (Block 43) and small amounts from Blocks 41 and Blocks 44-46. Since 2010, annual catches have all been less than 10 t. Catch rates in Block 43 were 49 kg/hr, down slightly from the previous year (51 kg/hr) but as good as or better than other years since the fishery has been managed under the Bass Strait Zone (2003).

Qualitative assessment.

The Bass Strait Zone fishery has been managed with a 70 t TACC since its development in 2003. Stocks in the Bass Strait Zone blacklip fishery appeared stable. In the remote islands (Blocks 50-57) the catch was lower than recent years, and instead, greater amounts were taken from the Furneaux Group, much of which was caught while fishing for greenlip. The capped area of the Furneaux Group continued to support high catch rates, and considering the small size of blacklip there, stock levels were considered high. Across the North Coast, catch and catch rates were much lower, but were in line with previous years, indicating stable stock levels.

3.6 Greenlip fishery

The greenlip fishery operates in northern Tasmanian waters. The fishery is managed by regional catch caps and size limits. In 2014, the 140 t TACC was distributed between six regions by management catch caps (note sum of region caps is 148.5 t):

King Island – 20 t
North West – 21 t
Perkins Bay- 25 t
Central North-10 t
North East – 25.5 t
Furneaux Group – 47 t

Assessment of this fishery remains challenging, made so by peculiarities of the fishery that conflict with assumptions preliminary to accept that CPUE is proportional to stock biomass. These include (a) size-selective fishing, (b) mixed-species effort, (c) low and infrequent visitation rates and (d) specialisation in greenlip fishing within a region among a handful of divers, and (e) variation among divers in estimates of effort entered on catch returns. Some of these features are no longer relevant, or can be circumvented by data processing techniques (e.g. Burch et al., 2011). Size-selective fishing for the domestic live market was important until November 2011, when AGV was found in a consignment of greenlip, and the key market (NSW) stopped further imports, effectively reducing the demand for large greenlip. Assessments can be made using single-species fishing trips, thereby avoiding the variable effects on CPUE caused by mixed-species effort. Increased participation by motherships and an influx of divers from the south has seen most parts receiving regular fishing. Similarly, diver effect has been reduced, because whereas the fishery was once dominated by a few local divers, participation has become more diversified, with more than 20 divers now catching 50% of the TACC. Reducing the effects of these features on catch rates has reduced their between-year variability, and increased confidence that the assessment is robust.

The 2014 greenlip fishery started unusually because of strong processor demand for product in January, and over one third of the TACC was caught by the end of March (Figure 26). Fishery managers were concerned, because anecdotally, early in the year much of the stock is in poor (post-spawning) condition, weigh less for a given size and hence more individuals are taken per unit of quota. Among South Australian greenlip, a 13% reduction in the number of greenlip per unit weight harvested later in autumn was reported, compared with those caught in summer (Stobart et al., 2013). Consequently, early-season catch rates may be affected because of the reduced weight/length ratio.

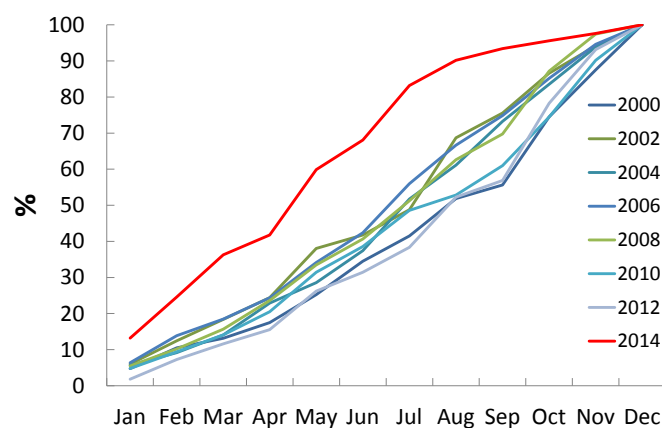


Figure 26. Percent cumulative greenlip catch by month 2000-2014. For the sake of clarity, odd year catches were omitted. The 2014 (red line) greenlip catch was unusual because so much of it was caught early in the year.

King Island

The greenlip catch at King Island was 22 t. The catch cap was 20 t. Greenlip are present on most parts of the King Island coast, but in recent years greenlip-only fishing has been restricted mostly to the eastern side of King Island because of a rapid stock decline around the formerly productive islands in the North West. Most of this catch was taken in Block 2, where almost 14 t was caught, and Block 4 (4 t).

Small quantities of greenlip are often collected while fishing for blacklip on the western side of the island, and a further 2 t was caught in each of Blocks 1 and 3. Block 1 has produced as much as 16 t of greenlip as recently as 10 years ago, but stocks now appear to have collapsed around the two islands where most of the catch was taken. This stock decline at King Island has been highlighted in recent assessments.

Since 2009, regional greenlip-only catch rates have fallen from 59 kg/hr to 44 kg/hr. Catch rates were highest in Block 2 (50 kg/hr).

Very limited catch sampling has been undertaken from the region, but in 2014 greenlip from four of the 50 catches reported from 2C were measured. The median length was 170 mm, or 20 mm greater than the 150 mm LML (25th, 75th percentiles: 161 mm, 178 mm). The large size and rapid growth rates of greenlip from this sub-block have been previously reported and for this reason the LML was initially set at 155 mm following the state-wide TAFI review of greenlip size limits (Officer, 1999).

Divers have reported that stocks are becoming depleted, and catch rate trends support this. They say that the area from which most of the catch is taken is too small to sustain current levels of catch.

Greenlip stocks were under pressure at King Island and appeared to be producing at or beyond maximum capacity. It is recommended that the annual catch be reduced, and the greenlip TACC be reduced accordingly.

North West Tasmania

In North West Tasmania (i.e. west and north of sub-block 48A) the 2014 greenlip catch was 23 t, from a cap of 21 t. This part of the fishery was closed on 1 June 2014, following unusually intensive fishing earlier in the year.

Most of the catch was taken in the vicinity of Woolnorth Point, from 5A (7 t), 48C (9 t) and 49C (6 t). Further east, 1.4 t was taken from the Petrels (48B), and small amounts were reported from other sub-blocks in the region. These levels of catch are normal when viewed within the context of post-zoning fishing.

Regional greenlip-only catch rates were 75 kg/hr. Greenlip fishing in the region is usually done in conjunction with Northern Zone blacklip fishing, and in 2014, only 28% of trips during which 8 t was caught were greenlip-only. This introduces risk that the small proportion of trips fails to adequately represent greenlip fishing across the region. Since 2009, catch rates have fluctuated greatly from year to year, between 58 kg/hr (2013) and 84 kg/hr (2012), and it is apparent that these rapid changes reflect factors apart from abundance. Greenlip catch rates were relatively high across the region, between 66 kg/hr (48C) and 82 kg/hr (48B).

Limited catch sampling has been undertaken in the region. In 49C in 2011 - 2012, median lengths were 150 mm, with 25th percentiles at 146 mm, just 1 mm larger than the 145-mm LML. In 48C in 2013, the median length was 148 mm (25th percentile 145 mm) and in 5A, 150 mm (25th percentile 146 mm). Clearly fishing pressure is very high among greenlip stocks in this region, and growth rates are slower than elsewhere.

Divers continued to report satisfaction with stock levels in the region. This, and the relatively high catch rate indicates that current levels of catch are appropriate for the region.

Perkins Bay

For the second successive year, this region produced less than its 25 t management cap, at just 13.4 t. This contrasts with previous years, when catches have been as high as 26 t. Markets have preferred larger abalone than those generally found in this region and the Central North region to the east. This has meant that catch allocated to Perkins Bay was taken elsewhere, causing catch caps there to overrun.

Between 2008 and 2012, catch sampling rates were high (30%-47% of catches). The LML was reduced from 145 mm to 132 mm in 2008. Following this, the median length fell from 149 mm to 139 mm, and the 25th percentile from 142 mm to 135 mm. This reduction in size is consistent with high levels of fishing mortality.

Almost all fishing trips were greenlip-only, and were undertaken at Black Reef. Catch rates have fallen from a high of 140 kg/hr (2011) to 85 kg/hr in 2014. While catch rates of this latter magnitude are still relatively high, it is apparent from the extent of the catch-rate decline and the reduction in size that the once high stock levels are becoming substantially depleted, and that the management target of 20 t pa cannot be sustained indefinitely.

Central North Coast

Whilst determining the greenlip TACC in recent years, managers have allocated 10 t of greenlip for the region, which includes coast between the mouth of the Duck River near Smithton in the north-west eastwards to the beach at Anderson Bay near Bridport in the north-east (Blocks 41-47). During the past ten years, the maximum annual catch was 1.6 t, caught in 2011. In 2014, just 276 kg of greenlip was landed. Given that markets pay lower prices for the smaller-sized greenlip found in this region, it is unlikely that it will ever produce 10 t in the foreseeable future, and that its allocated catch will continue to contribute to catch overruns elsewhere.

North East

This region covers the coast between Eddystone Point and the beach at Anderson Bay near Bridport, including Swan Island, Cape Portland and Waterhouse Island (Blocks 31, 39 and 40). The regional catch was 21 t, 4.5 t short of its management target. The fishery was closed on 20 March following concerns that the cap would be overrun after unprecedented levels of greenlip fishing in the region.

Most of the catch (14 t) was taken from 31B, the remainder (7 t) from 39A. Greenlip-only catch rates averaged 56 kg/hr across the region, and at sub-block level were 54 kg/hr in 31B and 57 kg/hr in 39A. Regionally, catch rates have fallen from a high of 75 kg/hr in 2010. In this region, blacklip and greenlip are usually caught on the same trip. Only 16% of trips in the region involved greenlip-only fishing in 2014, increasing risk that catch rates from this small proportion of trips fail to adequately represent abundance. However, mixed species trips show a similar pattern of catch-rate decline, reducing the likelihood that the fall is attributable solely to low sampling numbers, and more likely that it represents reducing stock levels.

The most recent year that significant quantities of catches were measured was in 2013, when 16% of catches were measured from 31B, and 9% were measured from 39A. Respective median lengths were 155 mm and 154 mm, with 25th percentiles 5 mm and 4 mm larger than the 145-mm LML. Compared with greenlip from the North West, the relatively larger size of abalone here implies higher growth rates. Growth rates from tagging studies done by TAFI in 1999 also found that greenlip from the north-east were relatively fast growing (Officer, 1999). In addition, divers frequently report that abalone from this region appear to grow rapidly, even at the 145-mm LML, and a number of divers have suggested that the LML be raised here.

While recent catches have been within management expectations, during the past five years catch rates have fallen, indicating reducing stock levels. It is recommended that catch here be reduced until there is evidence that stocks levels are being sustained.

Furneaux Group

The region includes the larger Flinders and Cape Barren Islands, plus a number of smaller islands, such as Clarke, Preservation and Prime Seal Islands (Blocks 32-38). The annual catch from the region increased in 2014 to 59 t, overrunning the catch cap by 12t. Catch from the region has steadily increased from a low of 27 t in 2009. Most of the catch came from Franklin Sound (Block 35 – 20 t) and the south and east of Cape Barren Island (Blocks 32 – 10 t and 33 – 18 t), with smaller amounts from the remaining sub-blocks. Generally, these levels of catch are among the highest since catch management was introduced to the greenlip fishery in 1998.

In 2014, greenlip-only catch rates fell to among the lowest levels in the post-zoning period, at 53 kg/hr. In 2014, 53% of trips were greenlip-only fishing. The proportion of greenlip-only trips is relatively high at the Furneaux Group, ranging between 51% and 90% since 2000. This catch rate decline corresponds with the increasingly larger annual catch since 2009. The areas where catch rates have been most affected include Block 33 where catch rates have fallen by almost 30 kg/hr in 2010 to 55 kg/hr, and Block 35, where catch rates reached 47 kg/hr. Catch rates were higher in Block 32 (65 kg/hr) and Block 38 (62 kg/hr).

Recent high levels of annual catch in this region are excessive, and are causing a decline in catch rates. It is evident that stocks have become depleted. It is recommended that the catch in this region be reduced, and the TACC be reduced accordingly.

3.7 Recreational fishery

Recreational fishing licenses are issued annually, expiring on 31 October each year. New licenses are available from 1 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 diving licenses issued by DPIWE has fallen from a peak of 13,538 issued in 2008, to 11,485 in the year ended 2014, although numbers have been relatively stable since 2011 (Figure 27).

The most recent survey of recreational abalone fishing catch was undertaken for the 2012/2013 season (Lyle and Tracey, 2014). The survey estimated that 32 t of blacklip and greenlip abalone, or 1.5% of the total Tasmanian abalone catch, was taken by

recreational fishers. This catch is slightly more (3 t) than reported from the previous survey (2010/2011), but is less than 50% of the peak catch reported in 2002-2003.

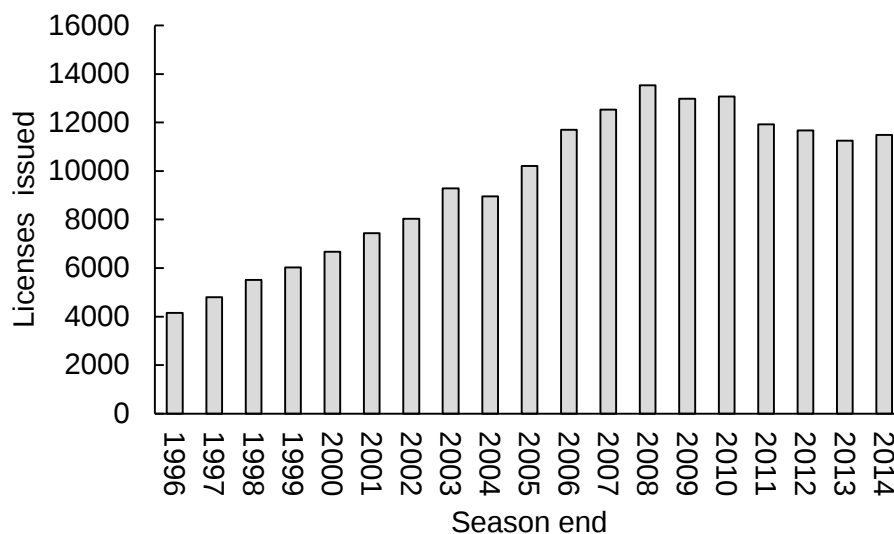


Figure 27. The number of recreational abalone diving licenses issued for the fishing seasons 1996-2014.

3.8 Indigenous and permit fisheries, and illegal catch

Abalone are caught in Tasmanian waters as part of cultural fishing activities by indigenous people. This catch is not quantified but is believed to be negligible. Catch is also taken under permits for special events and research purposes. In 2014, the catch under permit totalled less than 5 t. Illegal fishing is known to occur but no estimates of its total catch are available.

4. Recommendations to the final FRAG meeting and their implementation.

A review of fishery performance is undertaken quarterly by the Fisheries Resource Advisory Group (FRAG) using all available information, and with invited input from experienced fishers in key parts of the fishery. The FRAG is an industry run forum, in workshop format with the core members comprising the Tasmanian Abalone Council board, research staff (IMAS, CSIRO) and DPIPWE managers. The FRAG provides TACC determinations and recommendations to the Fishery Advisory Committee (FAC), and to the Tasmanian Abalone Council (TAC) AGM for the following year. In most cases, the FAC and the TAC AGM endorse the FRAG recommendations, which in turn are usually adopted by the Minister for Primary Industries. The Tasmanian abalone fishery operates on a calendar fishing year, with the final FRAG meeting taking place in late September/October. Under this arrangement, the FRAG utilises fishery dependent performance measures based on the past ten years, including partial year (year-to-date) data.

Recommendations of revised TACCs for specific blocks or region are made using graphical interpretation of trends in performance measures (Catch, CPUE, and Commercial Length Frequency) provided by IMAS with additional input from other research staff. The FRAG recommendation is determined by FRAG member consideration of the IMAS view (Table 2) along with additional narrative information from FRAG members and fishery observers present at the workshop. The FRAG recommendation is not necessarily the same as the recommendation by IMAS.

In 2014 the performance of the fishery in the Bass Strait was considered satisfactory and the current TACC for this zone were considered acceptable. While there were signals of decline stock levels in some areas of the greenlip fishery, uncertainty in the accuracy of these trends driven by fishery-dependent data reporting complications, diminished IMAS's capacity to make firm recommendations. Substantial quota reductions have been made in recent years in the Eastern Zone, and signs of rebuilding in component areas of this zone were clearly evident. However, the south east had not shown the same level of improvement and IMAS recommended an unchanged TACC, identifying that this would be the final year of stable TACC in this zone if unequivocal signs of improvement were not seen in 2015. A range of recommended TACC reductions were made for regions within the Northern, Central Western and Western Zones. IMAS recommendations for the Northern and Central Western Zones were largely also recommended by the FRAG, whereas the FRAG recommended no change be made to the Western Zone TACC for the 2015 fishing year. For the Western Zone, the Industry FRAG members said that a substantial reduction had been made to the TACC for the 2014 fishing year, and that it was too soon to see the effects of that reduction.

The implementation lag effect received considerable discussion during 2014, and IMAS agreed that response to TACC reductions may not be evidenced in the following calendar year. However IMAS strongly recommends that an objective and consistent time frame needs to be established a-priori over which positive effects of previous TACC adjustments should be seen in the fishery dependent data.

Table 2. IMAS recommendations on changes to existing TACs (tonnes) for specific blocks/regions to FRAG Meeting 4, 2014

Target species	Zone	Block	Capped Areas	2014 Area Cap (t)	IMAS Recommendation (t)	FRAG Recommendation (t)	Approved catch (t)
Blacklip	Eastern					Status quo	528.5 t
	Bass Strait					Status quo	70 t
	Central Western	6A-C	Couta Rocks	75	50-65	52.5	
		TOTAL		75	50-65	52.5	52.5 t
	Western	6D	Granville Harbour, Sandy Cape	100	20-25	25	
		7			30-40	60	
		8			10-15	15	

Target species	Zone	Block	Capped Areas	2014 Area Cap (t)	IMAS Recommendation (t)	FRAG Recommendation (t)	Approved catch (t)
		TOTAL		100	60 to 80	100	100 t
		9	Strahan	125	85-90	125	
		TOTAL		125	85-90	125	125 t
		10	South West	350	75-90	100	
		11			180-195	200	
		12A			35-40	50	
		TOTAL		350	290-325	350	350 t
		12B-D	South Coast	265	190-210	230	
		13			30-35	35	
		TOTAL		265	220-245	265	265 t
	Northern	1	King Island	100	10-15	15	
		3			40-50	50	
		4			5-8	5	
		TOTAL		100	55 to 73	70	70 t
		5	Block 5	50	50	50	
		TOTAL		50	50	50	50 t
		47	North West	100	-	-	
		48			10	10	
		49			75-85	75	
		TOTAL		100	75-85	85	85 t
		31B	North East	30	25	25	
		39			5	5	
		40			-	-	
		TOTAL		30	30	30	30 t
Greenlip						Status quo	140 t

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Acknowledgements

In recent years, abalone divers' catches have been sampled at Tasmanian Seafoods Pty Ltd (both Margate and Smithton), Ralph's Tasmanian Seafood Pty Ltd and Adelaide Bay Seafoods Pty Ltd. These processors are thanked for their cooperation.

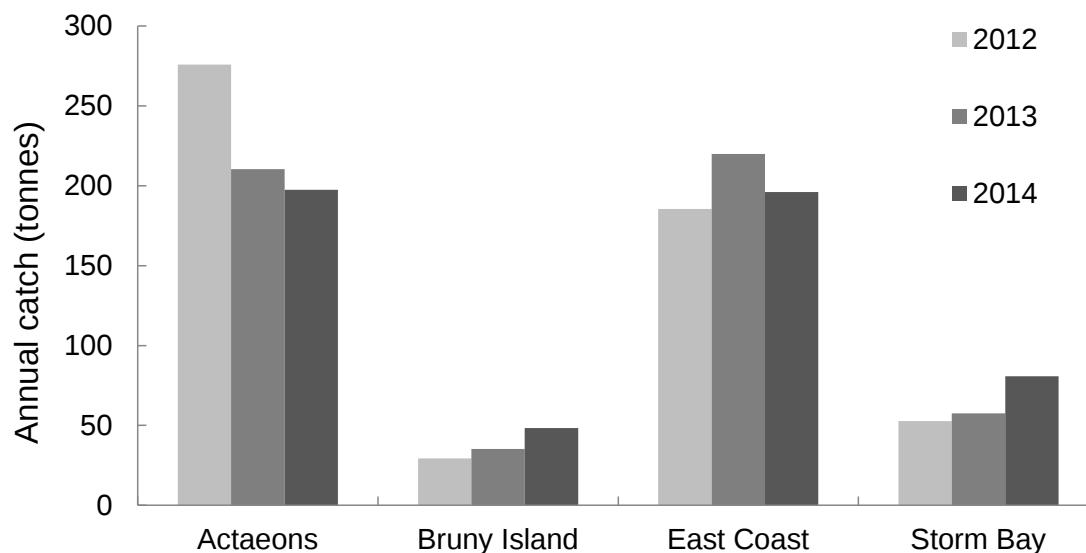
The committee of the FRAG and divers who attended its meetings are thanked for their input into this assessment.

A number of individual divers were approached directly for information about fishery performance. These divers are also thanked.

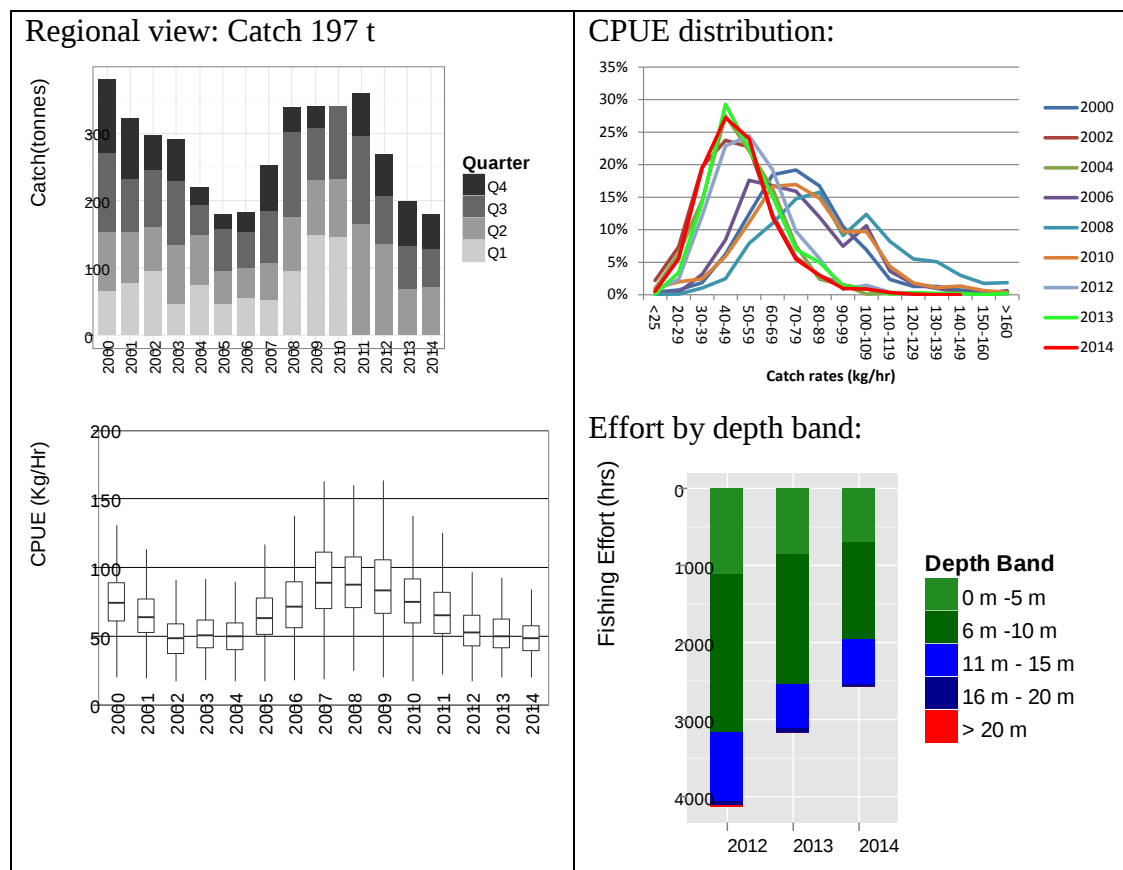
Appendix 1: Catch, catch-rates and size-composition

Eastern Zone blacklip fishery

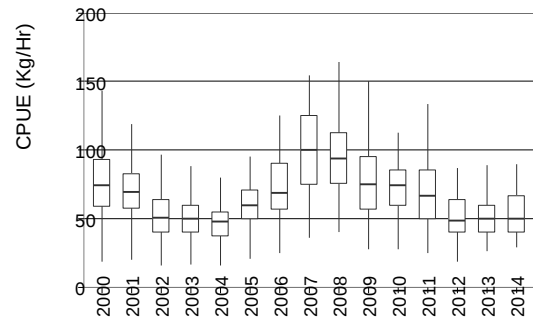
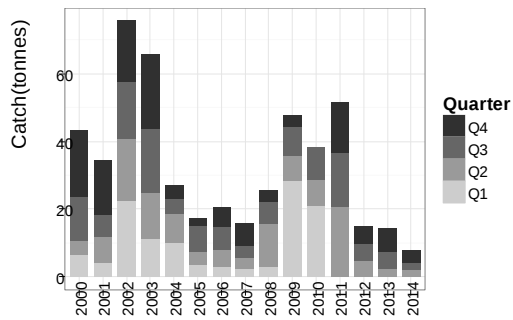
The TACC in 2013 and 2014 was 528.5 t, reduced from 547.5 t in 2012. The catch was distributed between the four main regions of the fishery as follows:



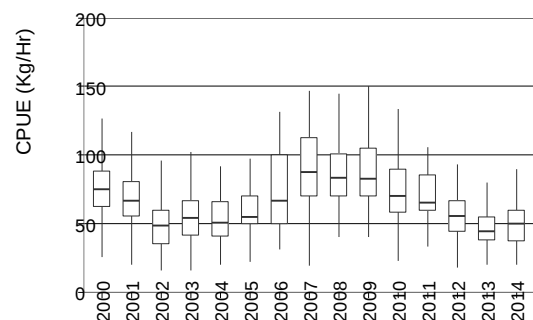
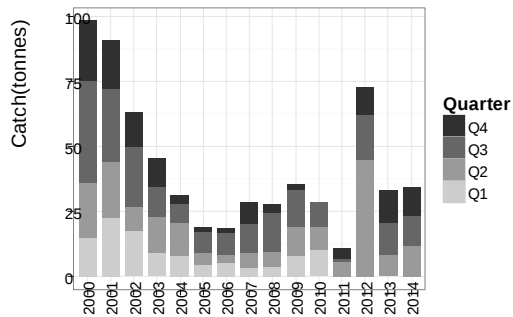
Eastern Zone – Actaeons (Sub-blocks 13C, 13D, 13E)



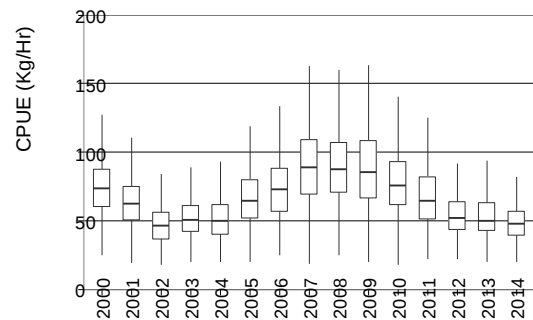
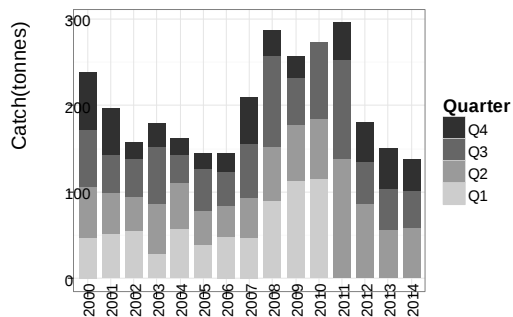
Sub-block 13C
Fishers Point to Whale Head



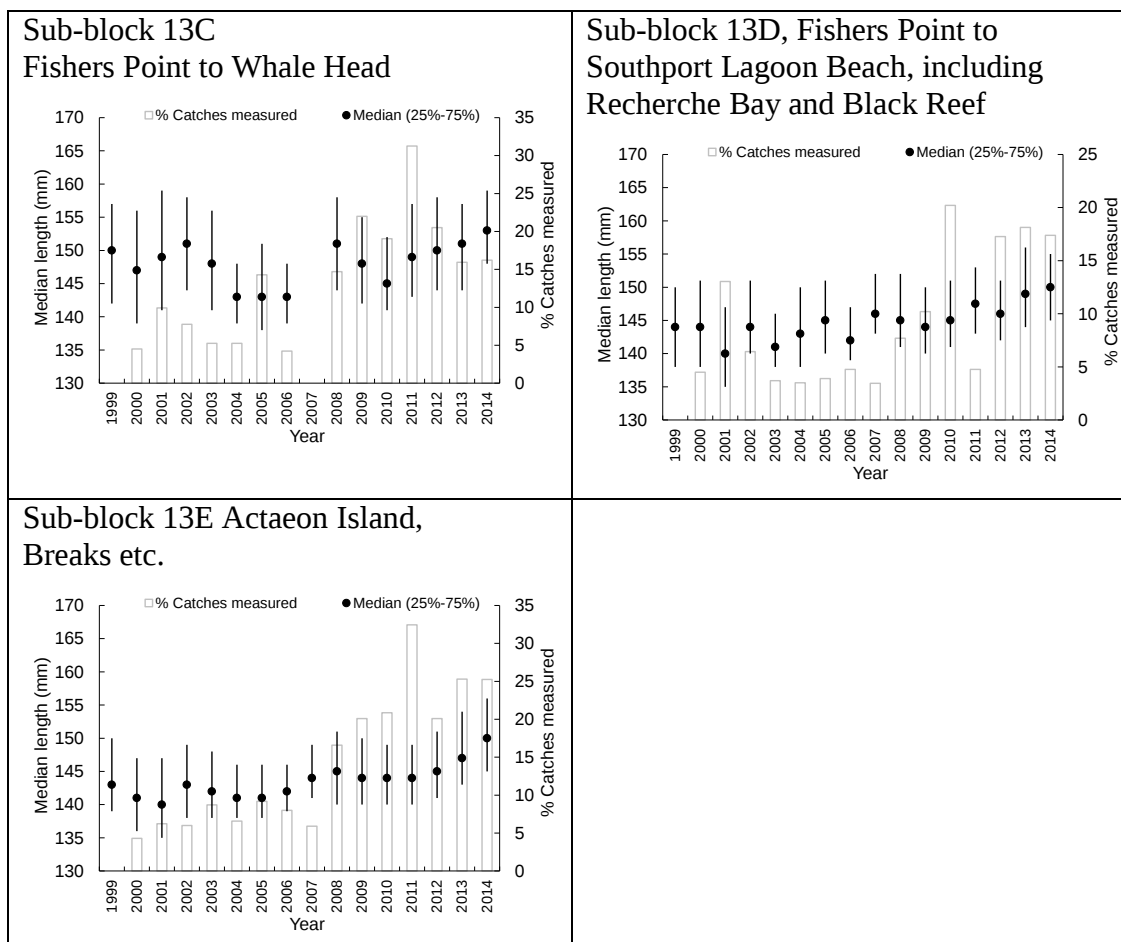
Sub-block 13D
Fishers Point to Southport Lagoon
Beach, including Recherche Bay and
Black Reef



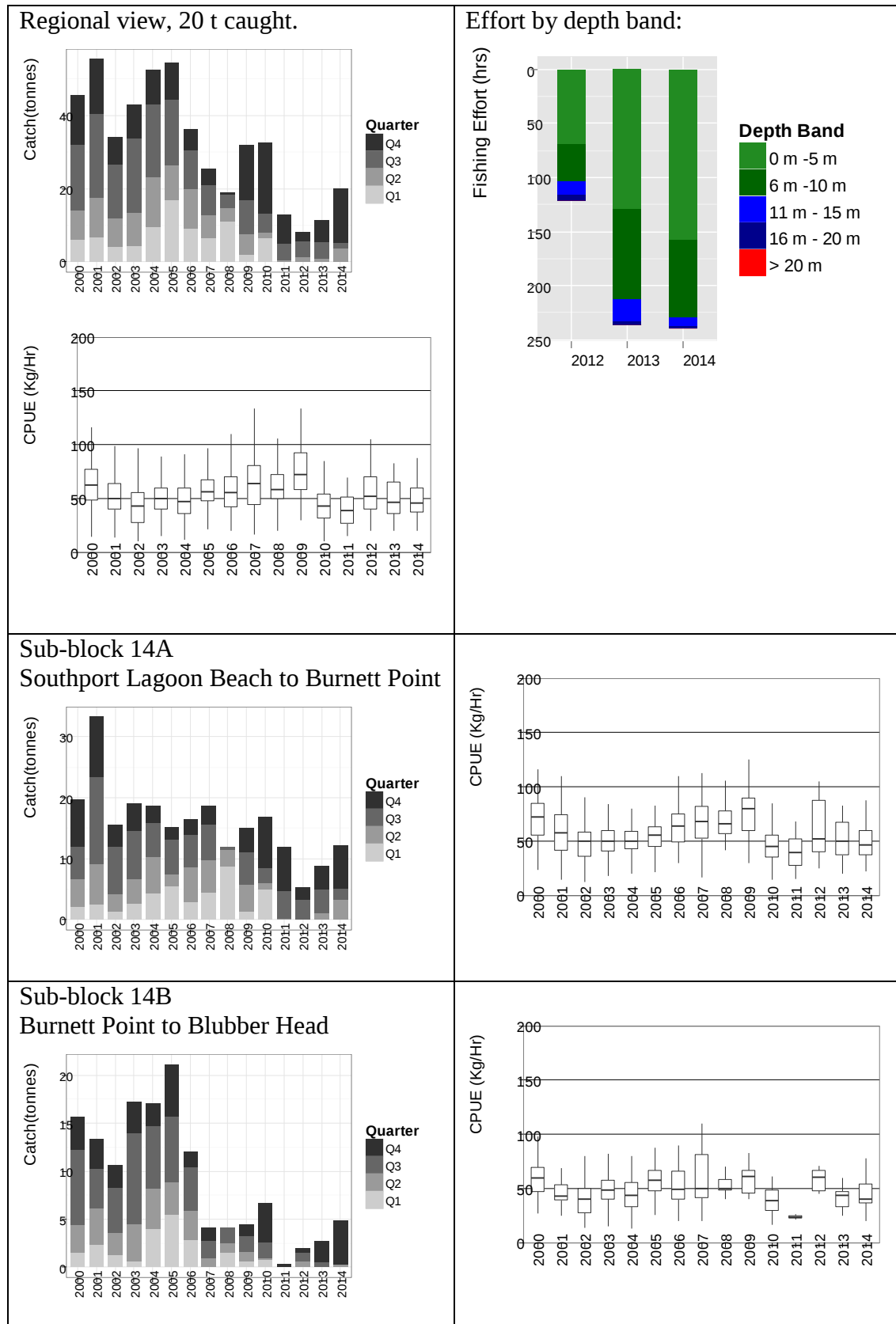
Sub-block 13E
Actaeon and Sterile Islands, and reefs to
the south (the Breaks)



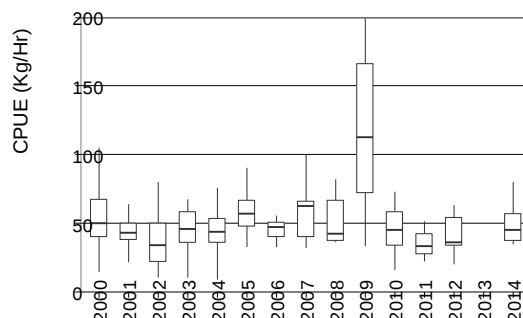
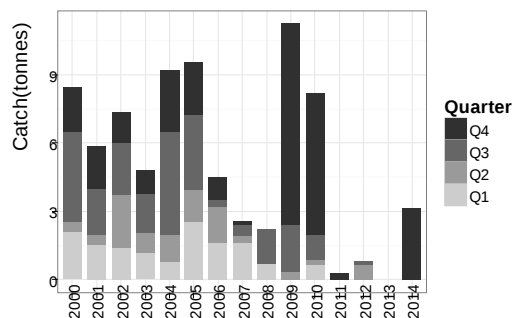
Actaeons (Sub-blocks 13C, 13D, 13E) Median length of catch



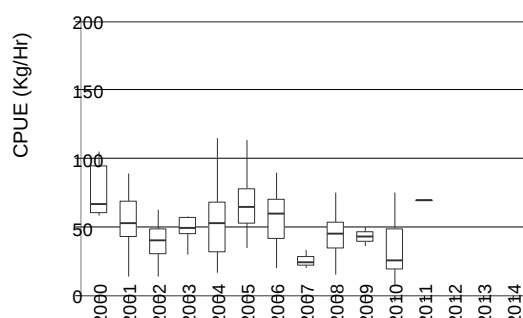
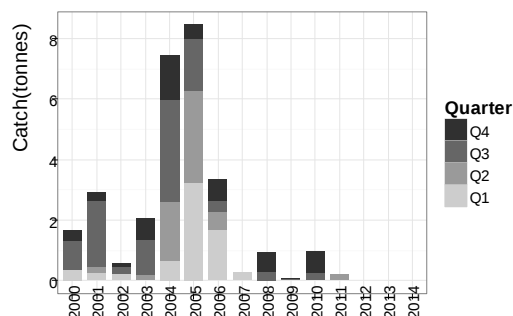
Eastern Zone – Lower Channel (Sub-blocks 14A, 14B, 14C, Block 15)



Sub-block 14C Mays Creek to Hopwood Light (Lower Channel) – significant catch reporting errors in 2009.

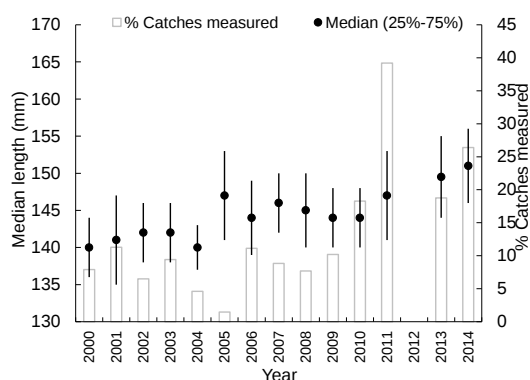


Block 15 D'Entrecasteaux Channel, Huon Estuary- significant catch reporting errors in 2009

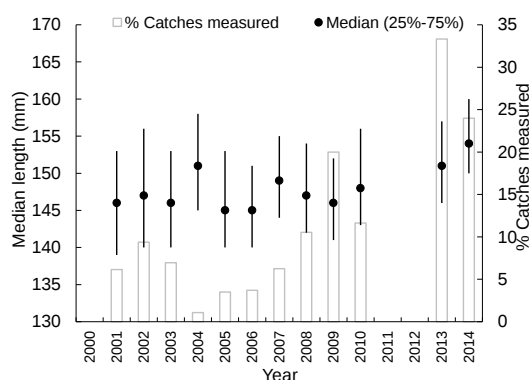


Lower Channel (Sub-blocks 14A, 14B, 14C, Block 15) Median length of catch

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

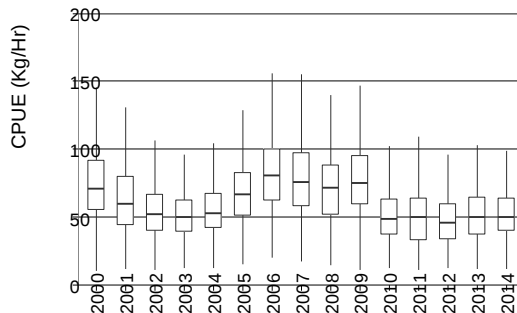
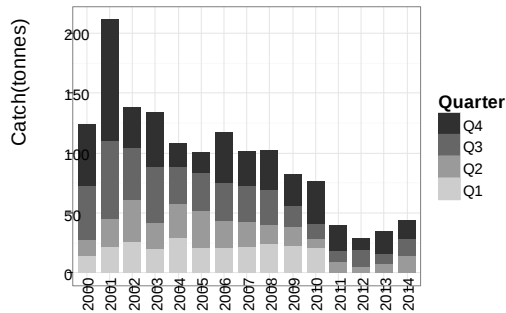


Sub-block 14B Burnett Point to Blubber Head.

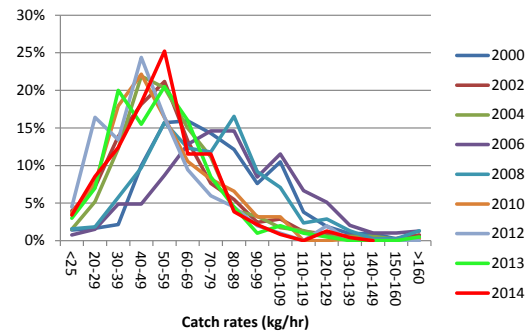


Eastern Zone – Bruny Island (Blocks 14D, 14E, 16).

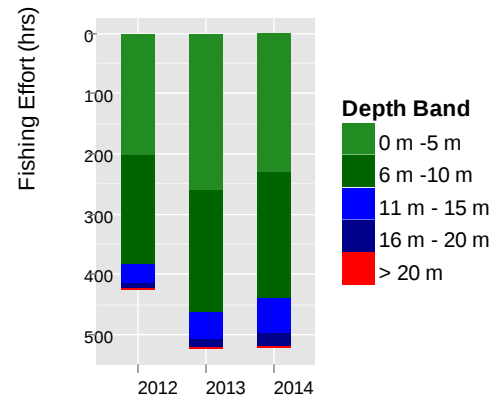
Regional view, catch not capped in 2014, 48 t caught.



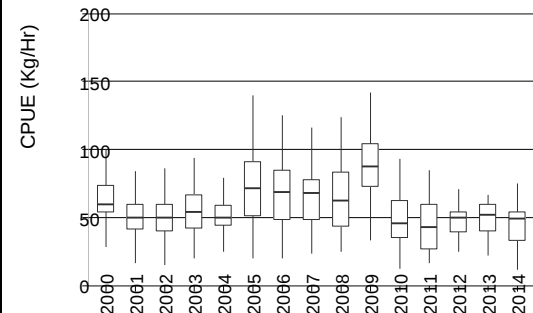
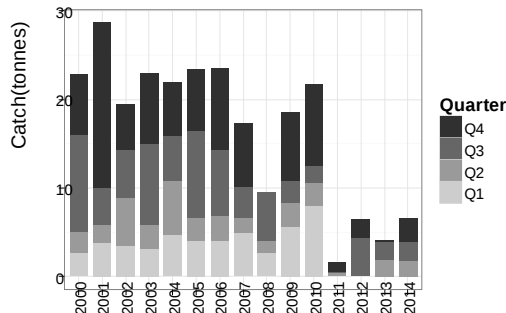
CPUE distribution:



Effort by depth band:

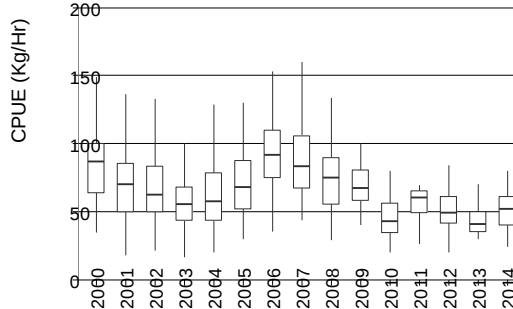
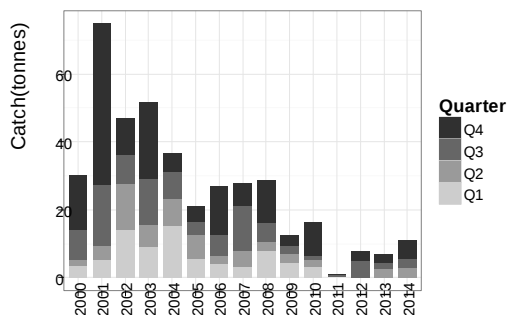


Sub-block 14D Hopwood Point to West Cloudy Head - significant catch reporting errors in 2009



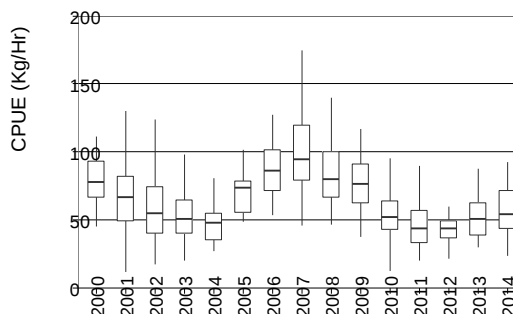
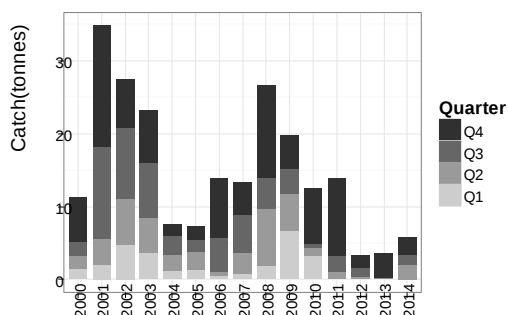
Sub-block 14E

West Cloudy Head to Boreel Head,
including the Friars.



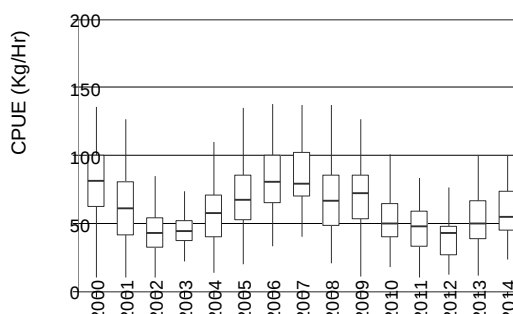
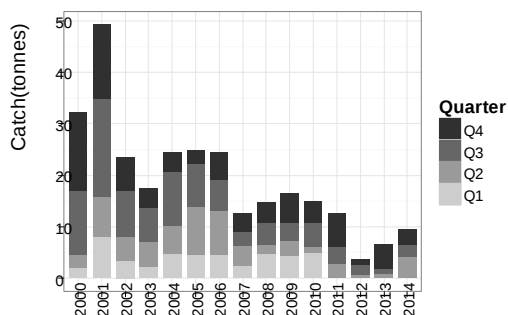
Sub-block 16A

Boreel Head to North Mangana Bluff.



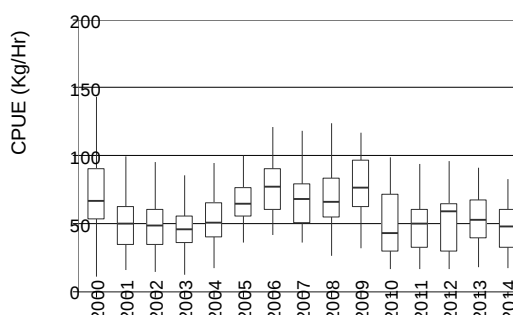
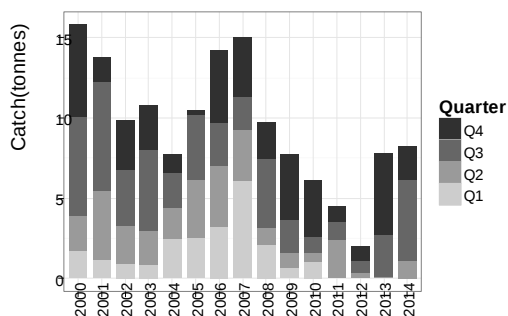
Sub-block 16B

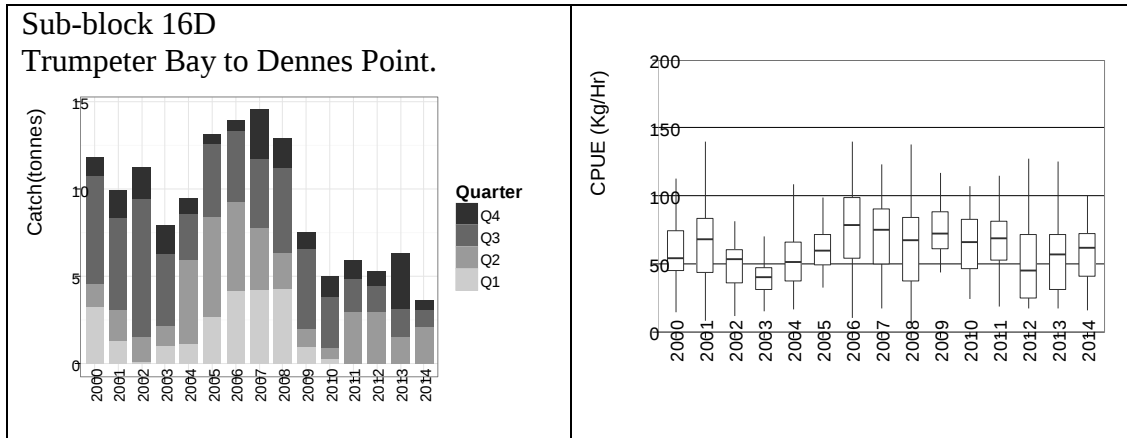
North Mangana Bluff to Neck Beach.



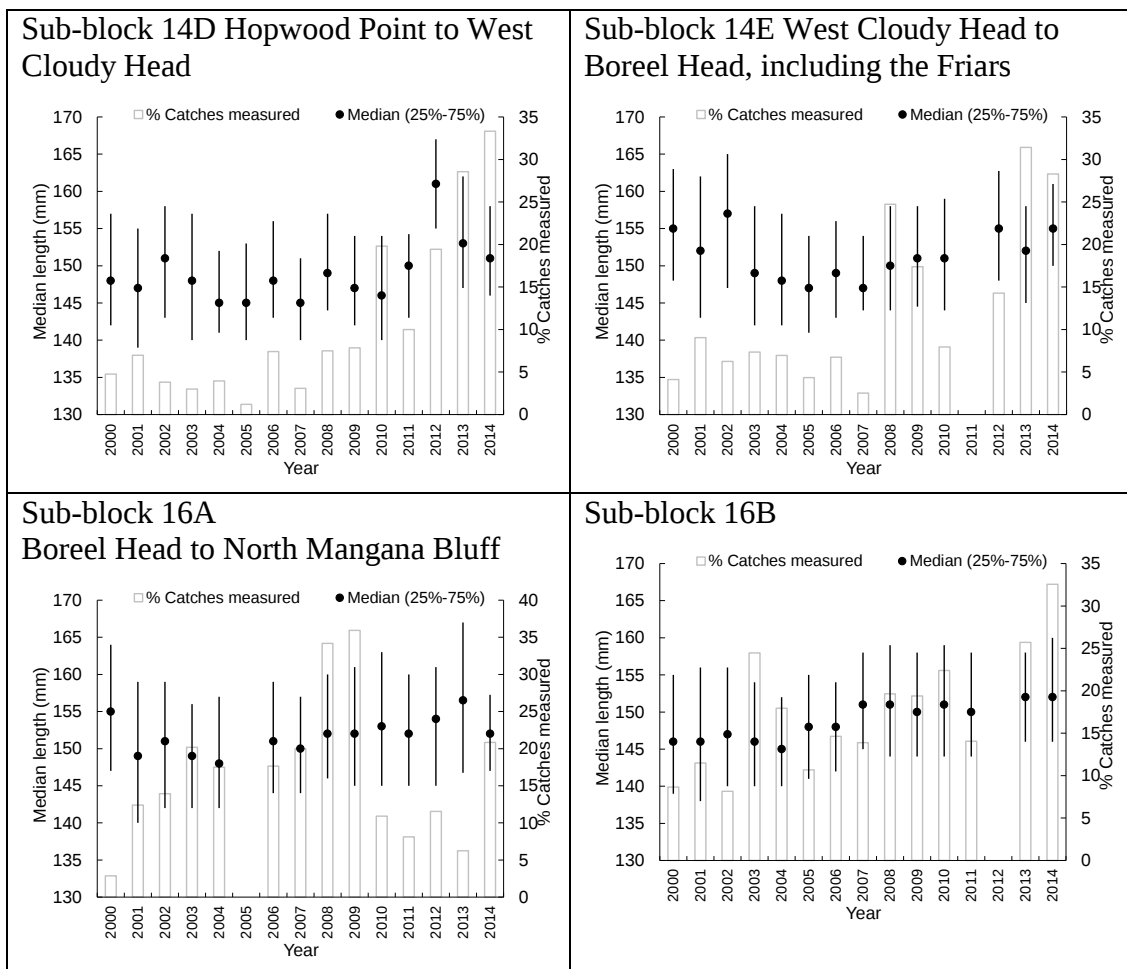
Sub-block 16C

Neck Beach to Trumpeter Bay.

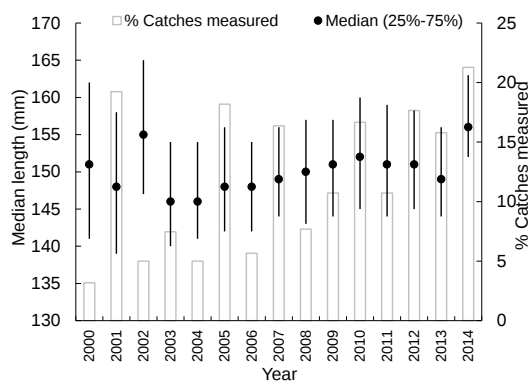




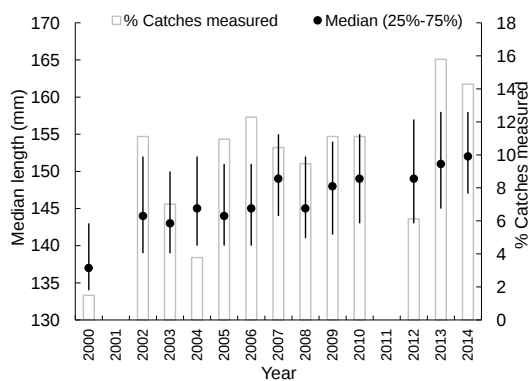
Eastern Zone – Bruny Island (14D, 14E, Block 16) Median length of catch



Sub-block 16C Neck Beach to Trumpeter Bay

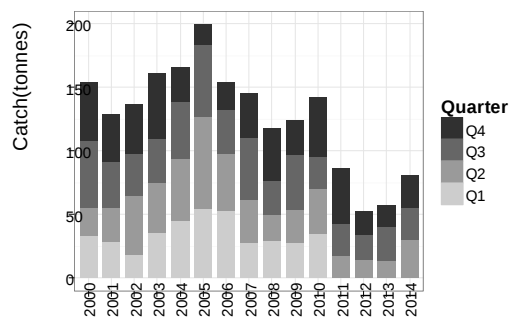


Sub-block 16D Trumpeter Bay to Dennes Point

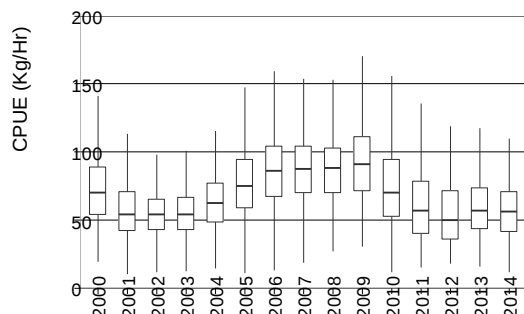
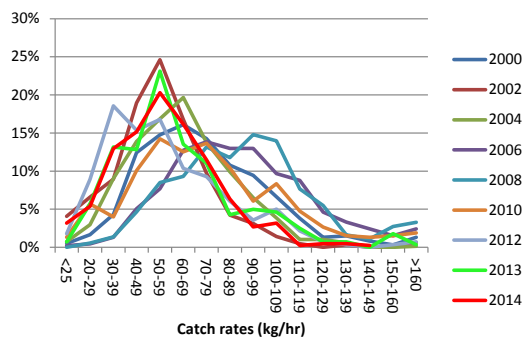


Eastern Zone - Storm Bay (Blocks 17-21)

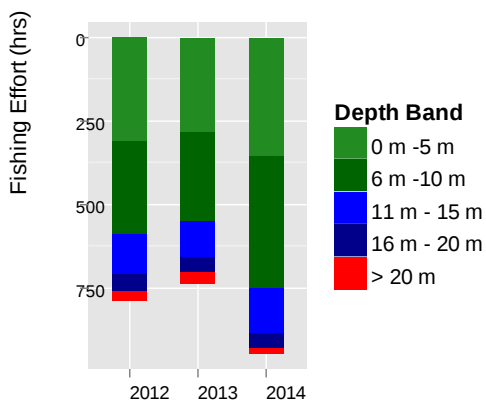
Regional view, 81 t caught.



CPUE distribution:

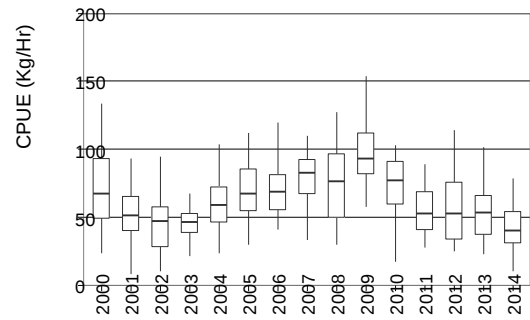
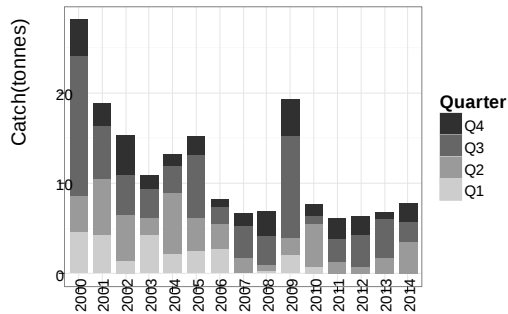


Effort by depth band:



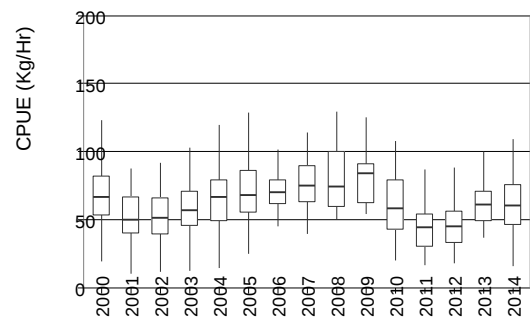
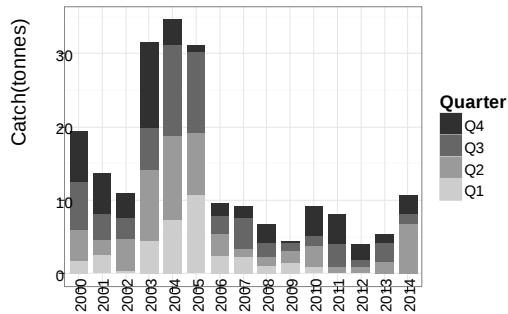
Sub-block 17B

Blackjack shoreline from Lobster Point to Outer North Head



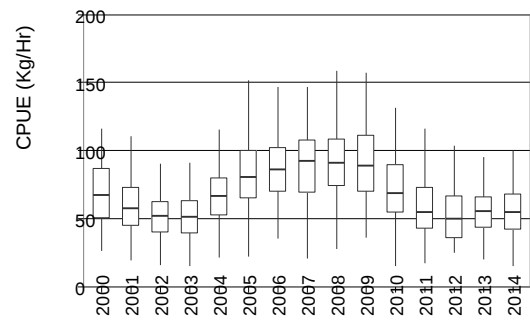
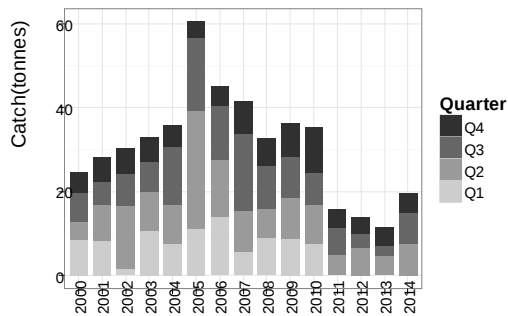
Sub-block 20A

Outer North Head to White Beach



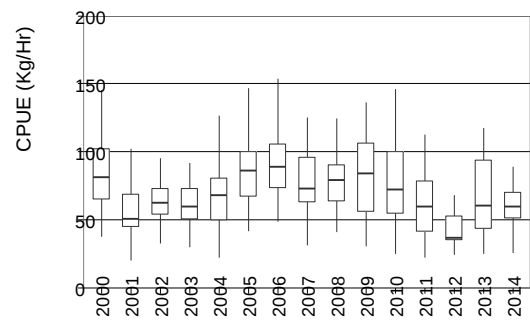
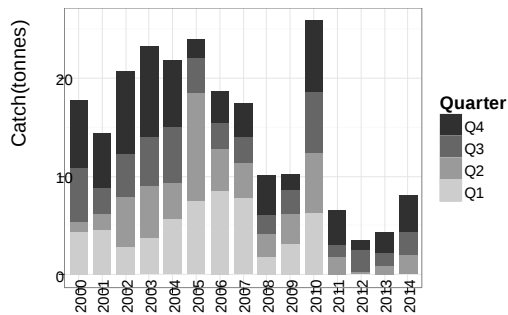
Sub-block 20B

White Beach to Salters Point

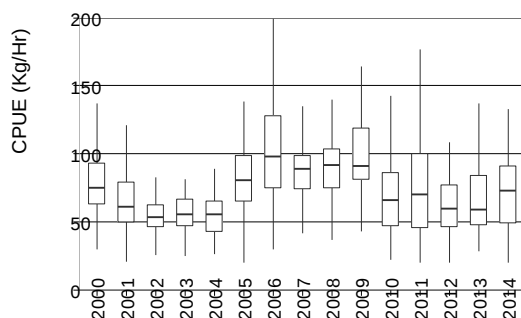
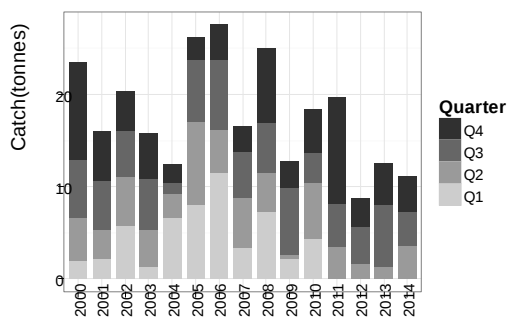


Sub-block 20C

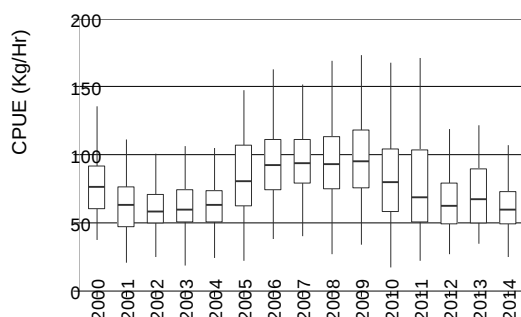
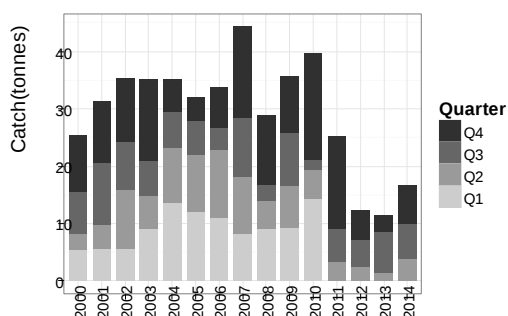
Salters Point to Cape Raoul



Sub-block 21A Cape Raoul to Port Arthur

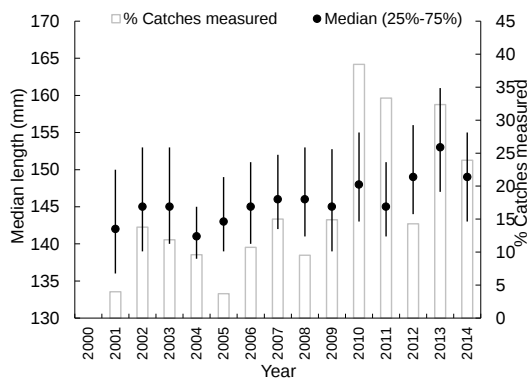


Sub-block 21C Port Arthur to Cape Pillar

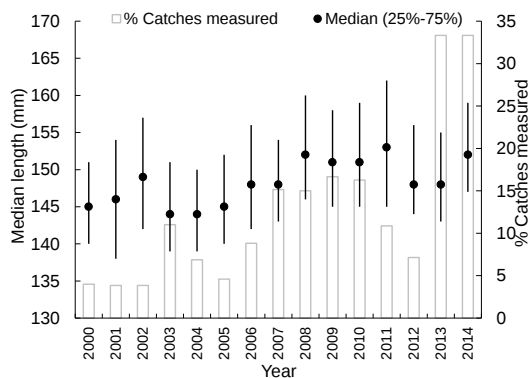


Eastern Zone - Storm Bay (Blocks 17-21) Median length of catch

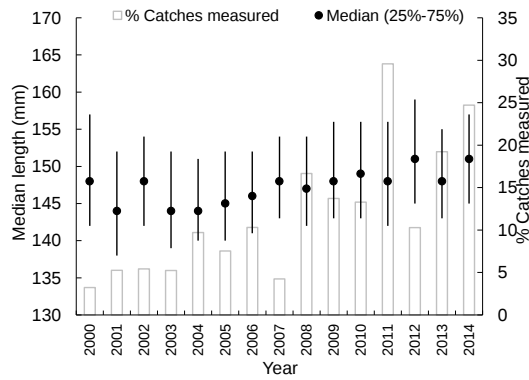
Sub-block 17B Blackjack shoreline from Lobster Point to Outer North Head



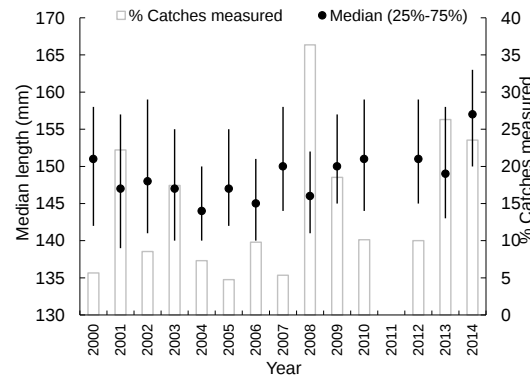
Sub-block 20A Outer North Head to White Beach



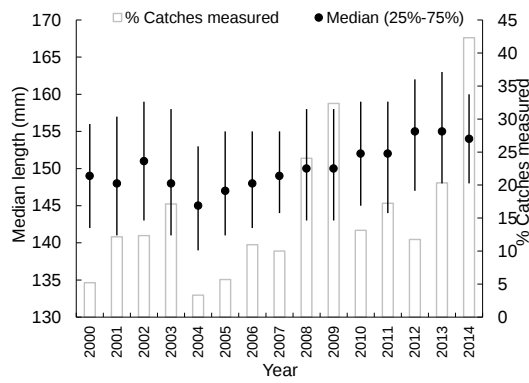
Sub-block 20B White Beach - Salters Point



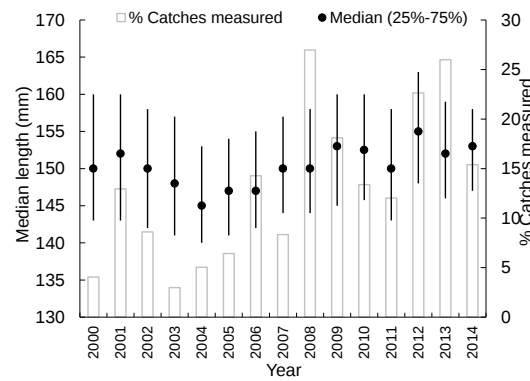
Sub-block 20C Salters Point to Cape Raoul



Sub-block 21A Cape Raoul to Port Arthur

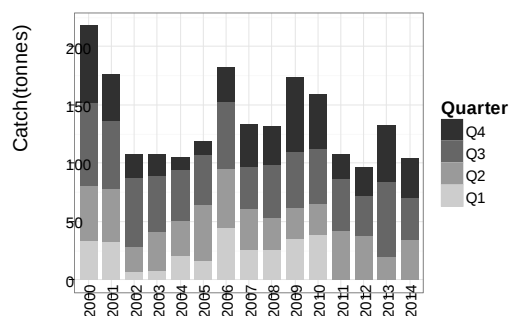


Sub-block 21C Port Arthur to Cape Pillar

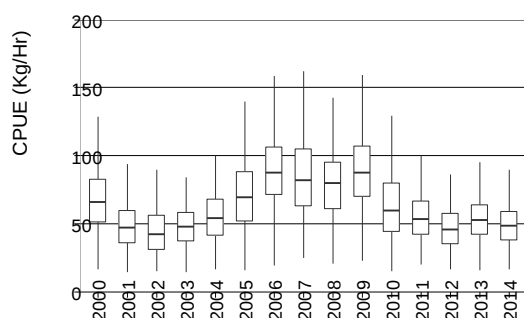
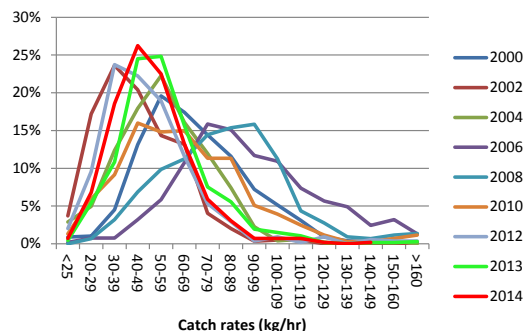


Eastern Zone – Lower South East (Blocks 22-25)

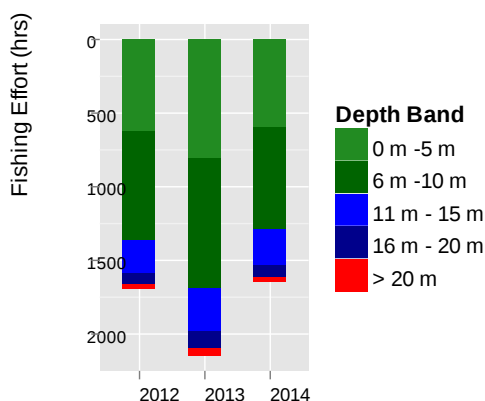
Regional view: 196 t caught in 2014



CPUE distribution:

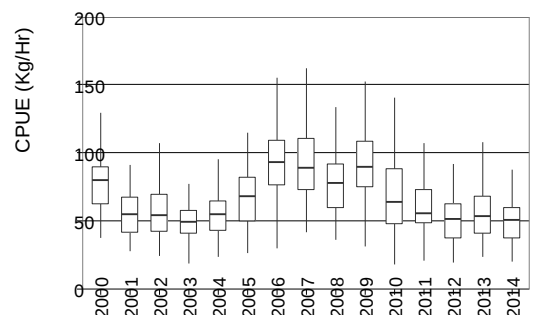
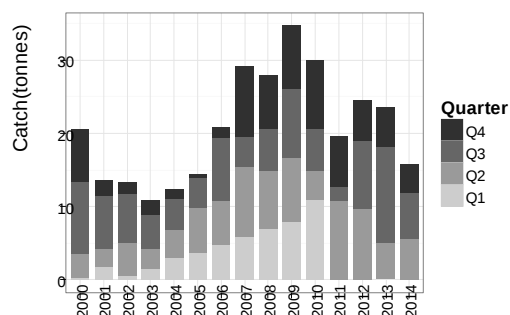


Effort by depth band:



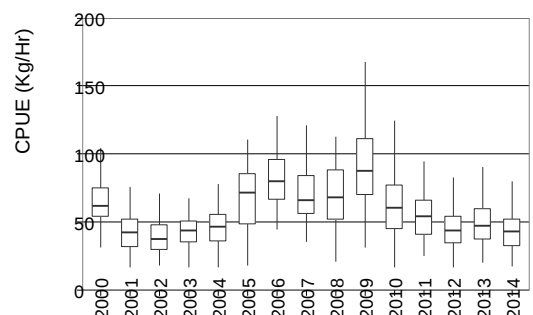
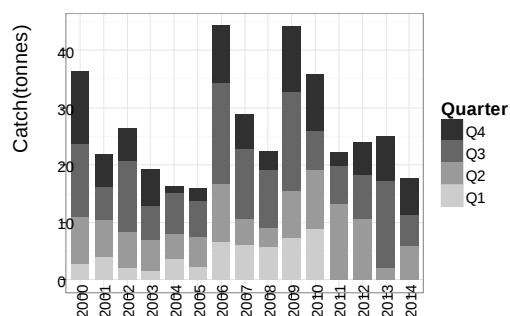
Sub-block 22A

Cape Pillar to the Lanterns

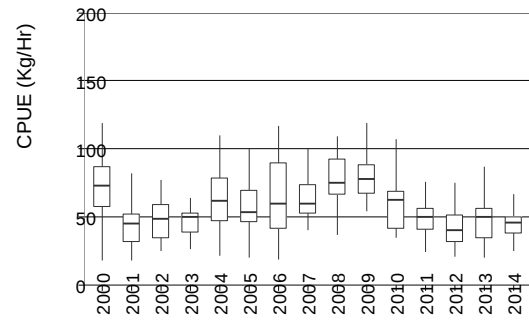
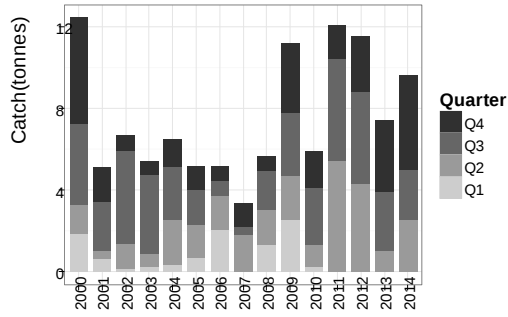


Sub-block 22B

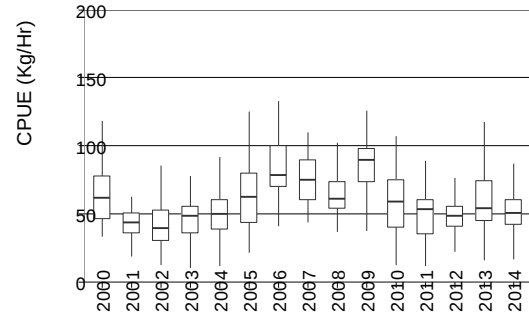
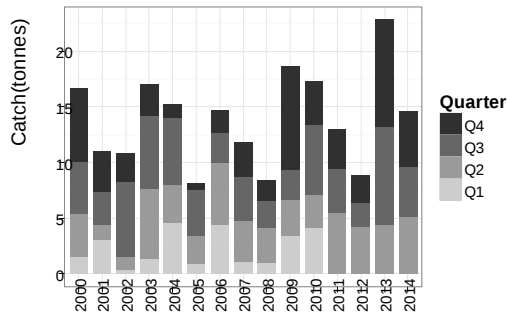
The Lanterns to Eaglehawk Neck



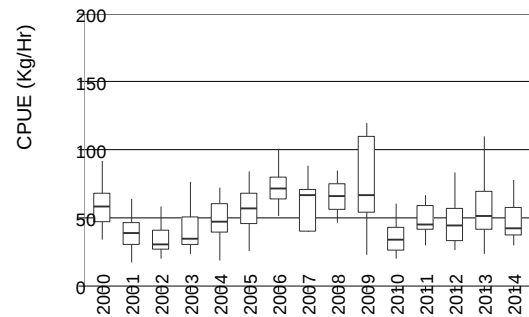
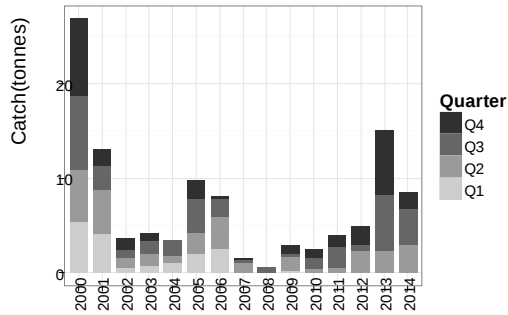
Sub-block 22C
Eaglehawk Neck to Deep Glen Bay



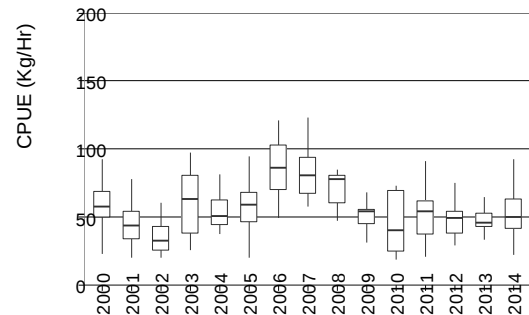
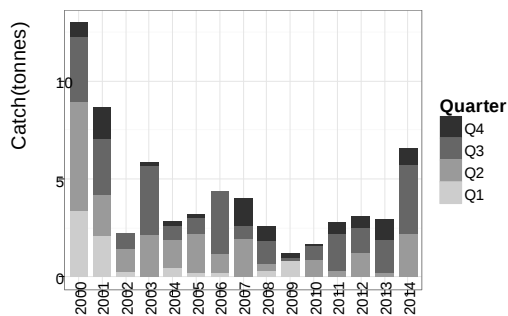
Sub-block 23A
Deep Glen Bay to Lagoon Bay



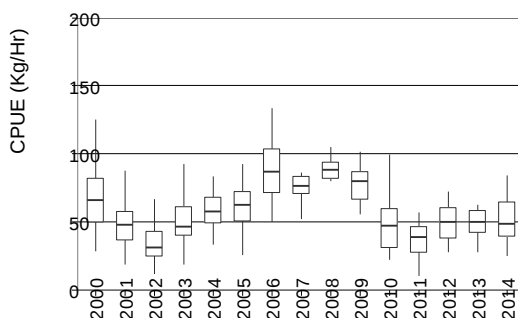
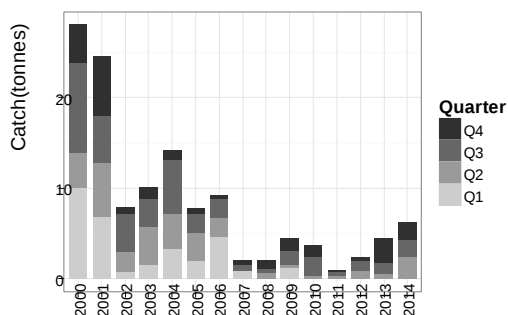
Sub-block 23B
Lagoon Bay to Marion Bay



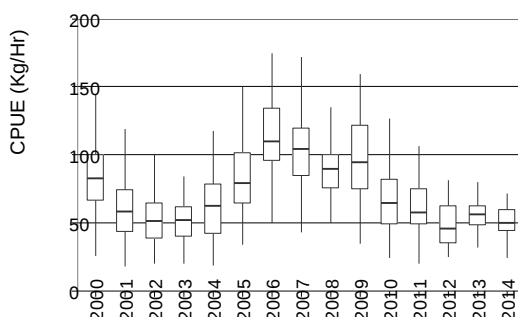
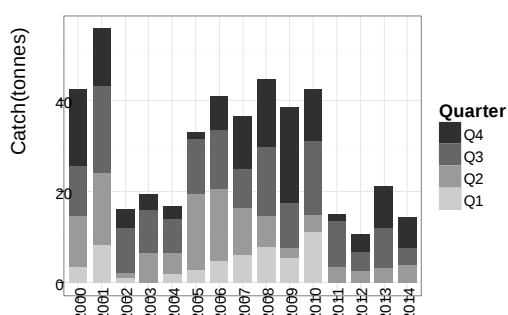
Sub-block 24A
Marion Bay to Rheban



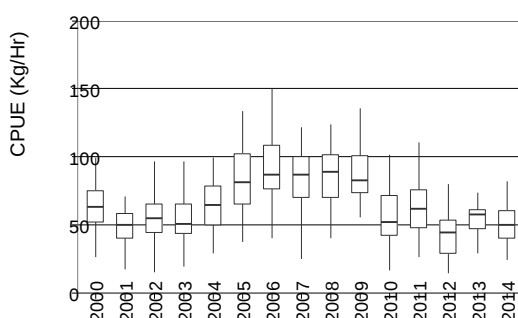
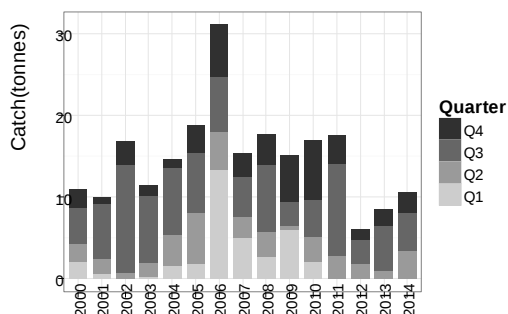
Sub-block 24B
Eastern shore of Mercury Passage



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

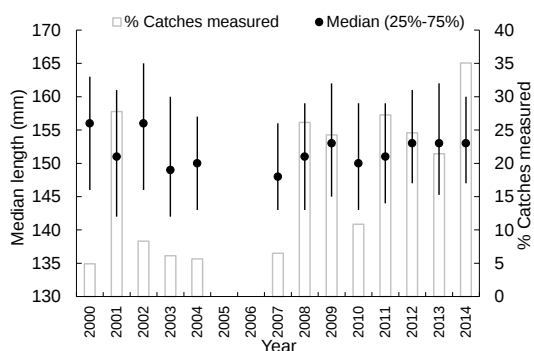


Sub-block 24E
south-east side of Maria Island

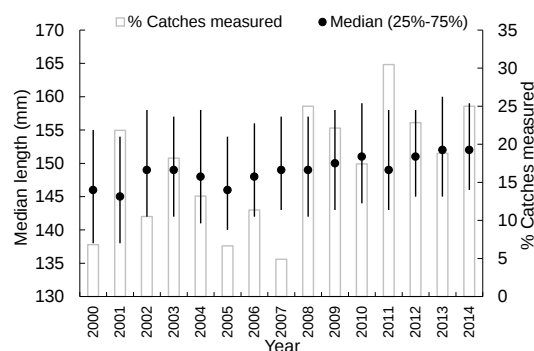


Eastern Zone – Lower South East Coast (Blocks 22-25) Median length of catch

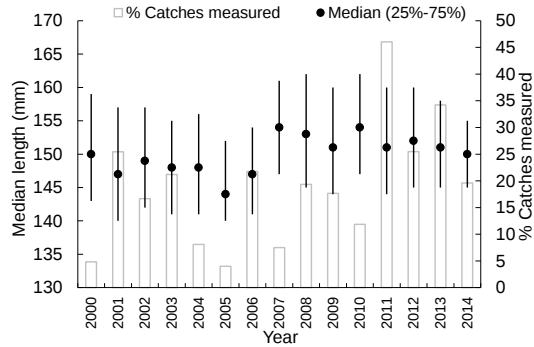
Sub-block 22A Cape Pillar to the Lanterns



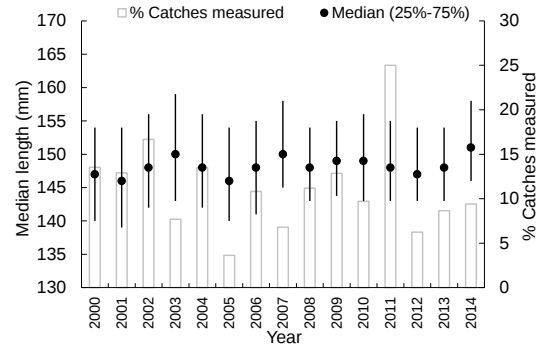
Sub-block 22B The Lanterns to Eaglehawk Neck



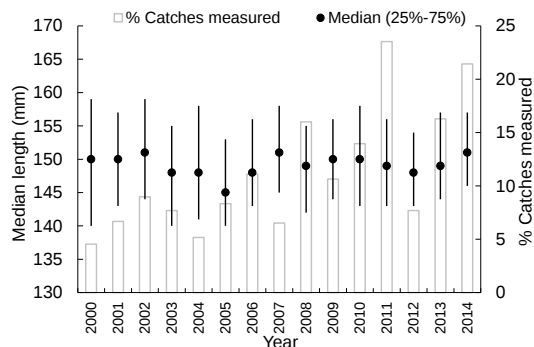
Sub-block 23A Deep Glen Bay to Lagoon Bay



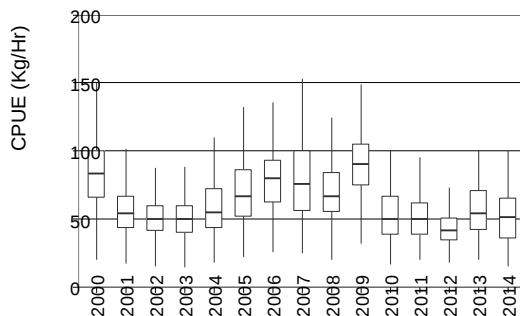
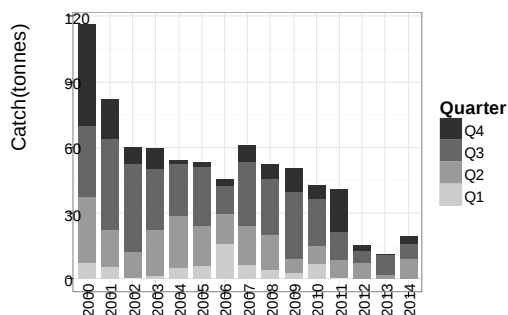
Sub-block 24D north-east side of Maria Island



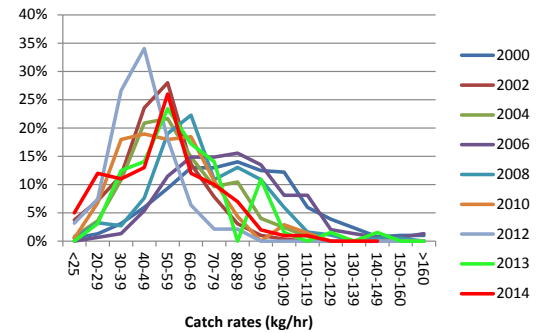
Sub-block 24E south-east side of Maria Island



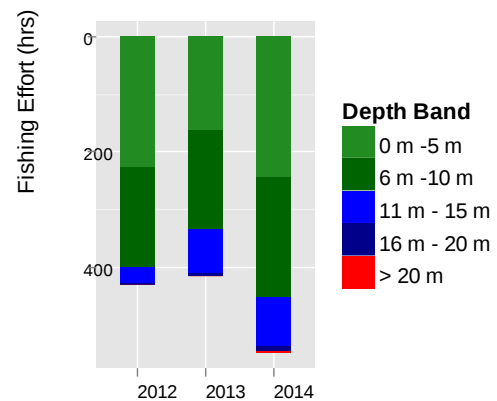
Freycinet-Bicheno capped area (sub-blocks 26B, 26C, Block 27, sub-blocks 28A, 28B, cap 11 t, 20 t caught)



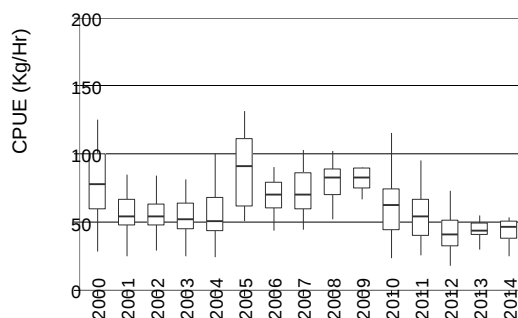
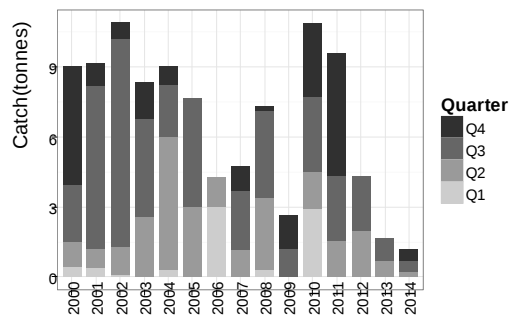
CPUE distribution:



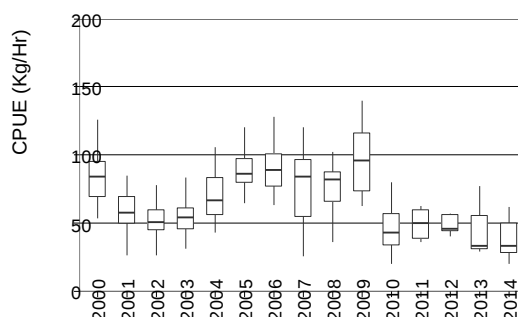
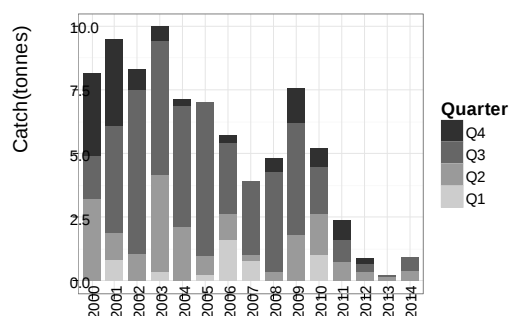
Effort by depth band:



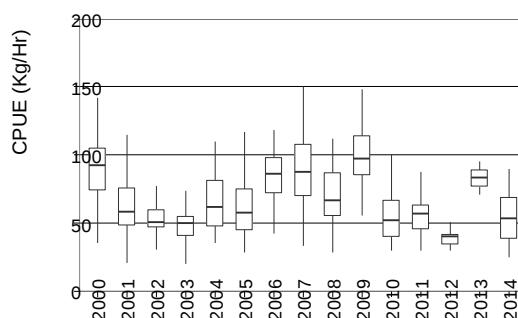
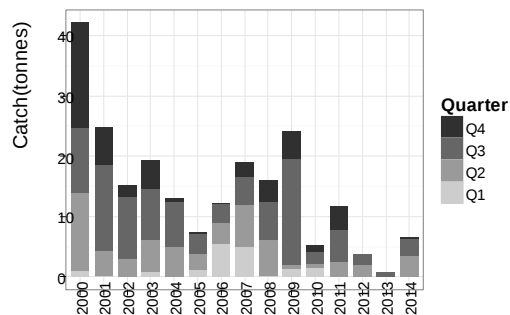
Sub-block 27A
south side of Schouten Island



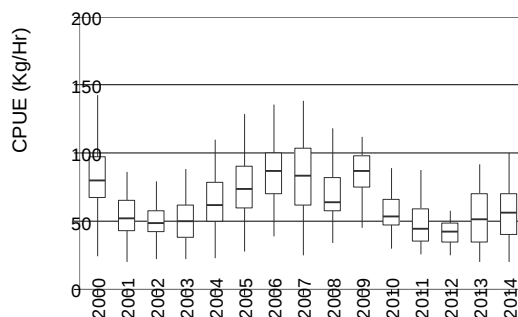
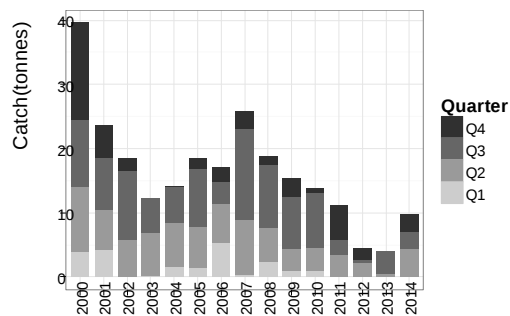
Sub-block 27B
east side of Schouten Island

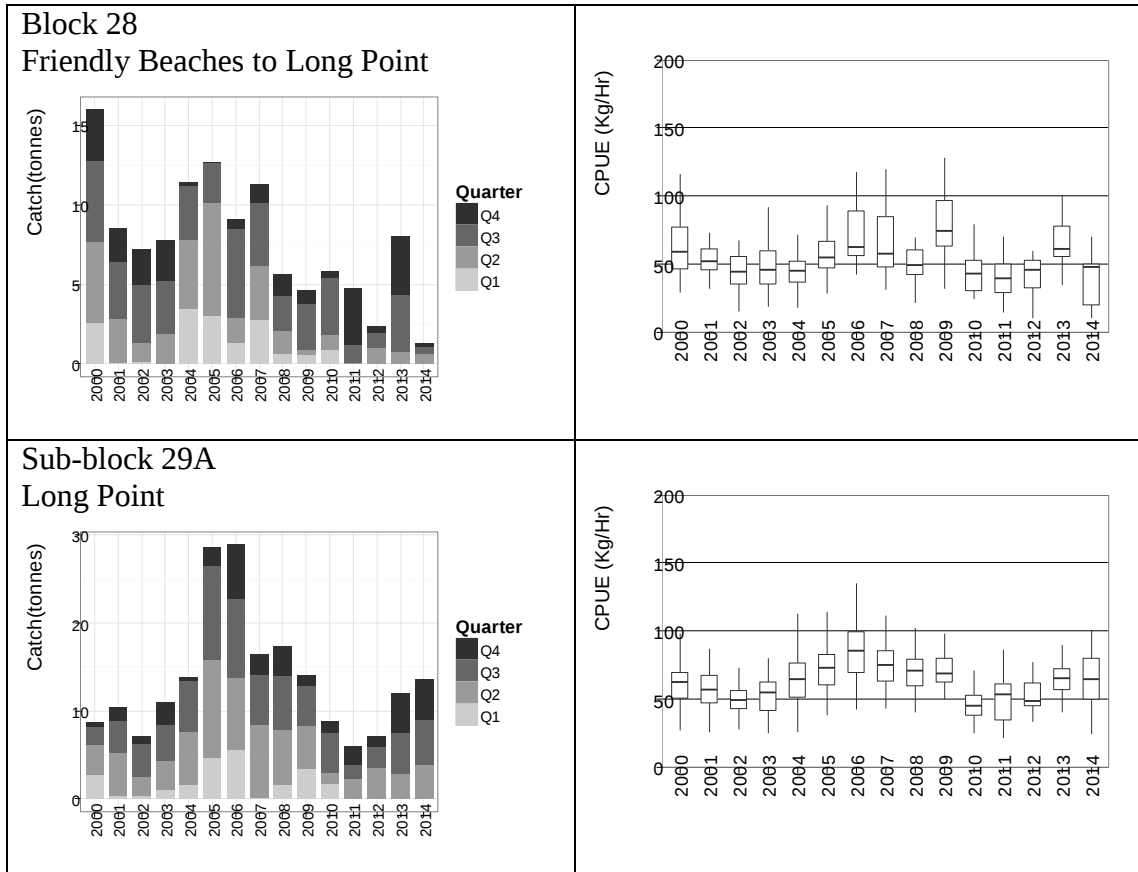


Sub-block 27C
Schouten Passage to Wineglass Bay

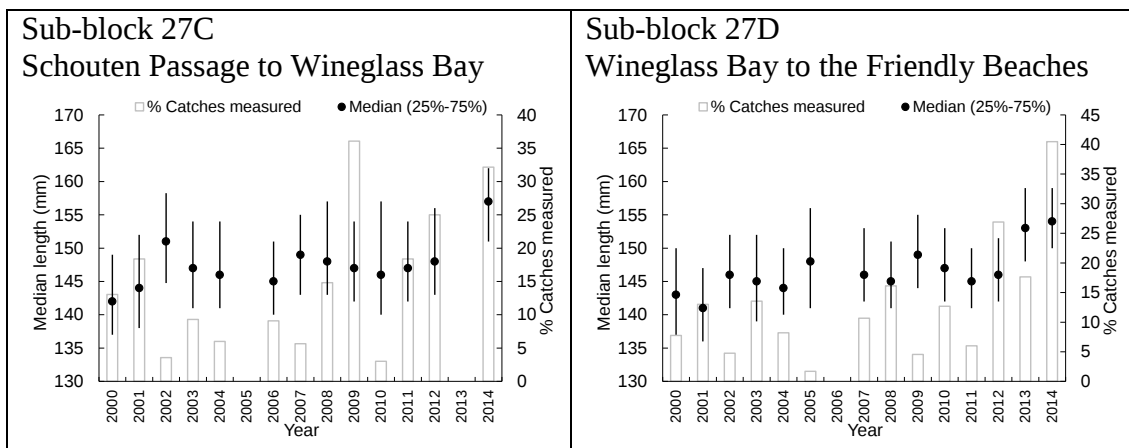


Sub-block 27D
Wineglass Bay to the Friendly Beaches

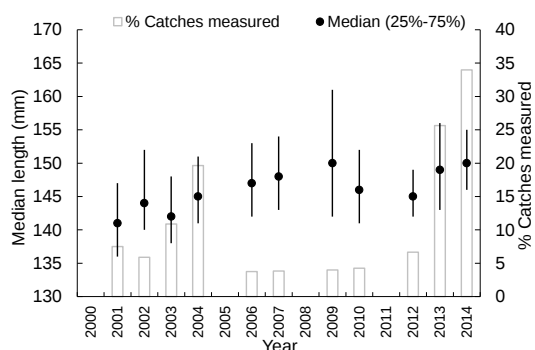




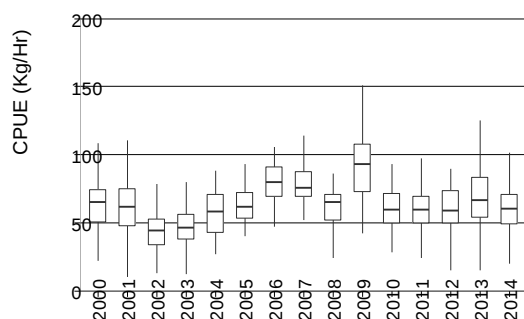
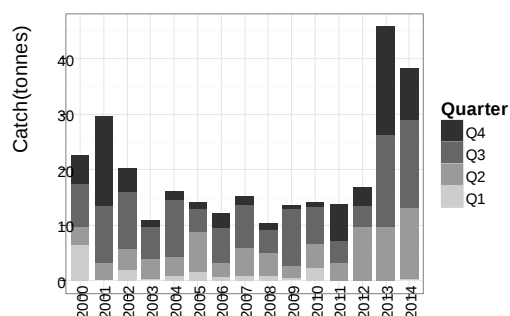
Eastern Zone – Freycinet-Bicheno (Blocks 26, 27, 28, sub-block 29A) Median length of catch



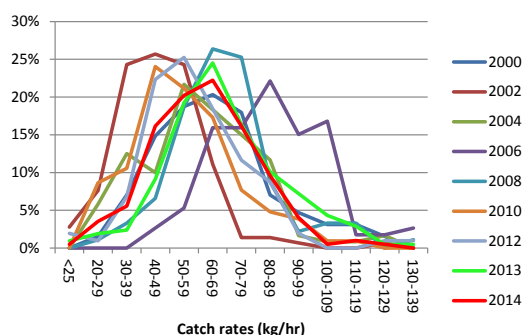
Sub-block 29A Long Point to Templestowe Beach



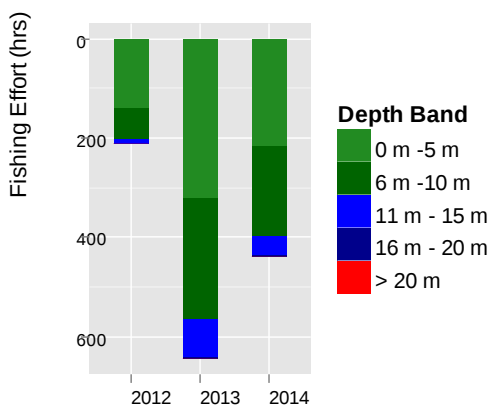
St Helens: Sub-blocks 29B, 29C, 29D, Block 30, Templestowe Beach to Eddystone Point, 37 t caught in 2014



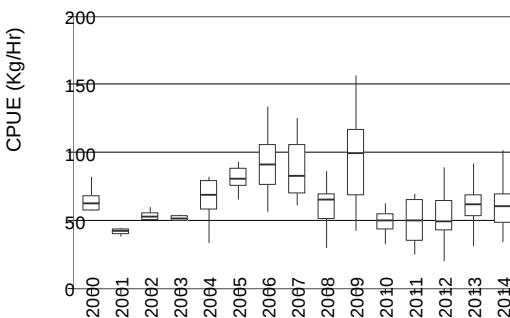
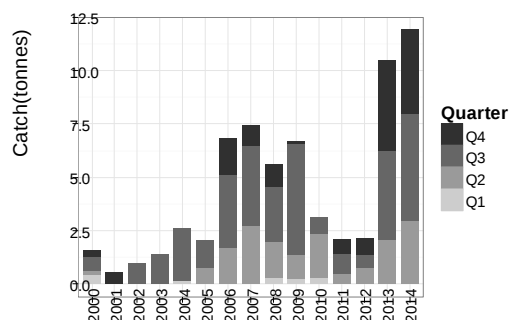
CPUE distribution:



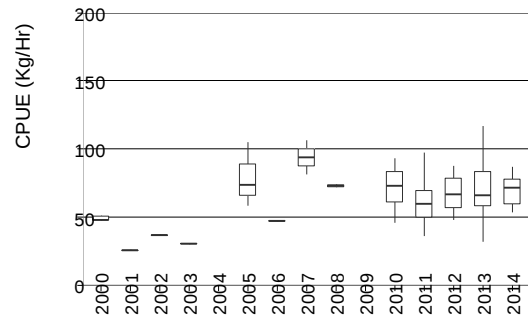
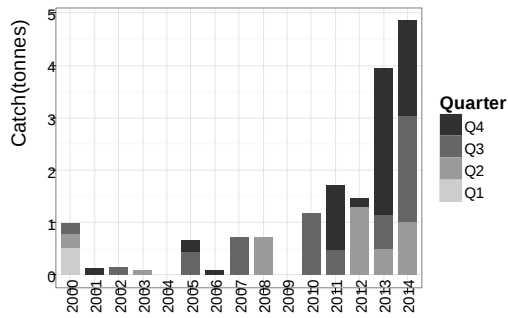
Effort by depth band:



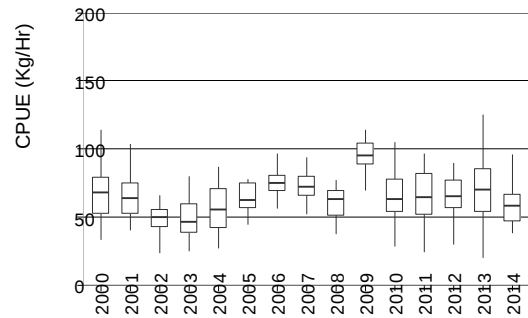
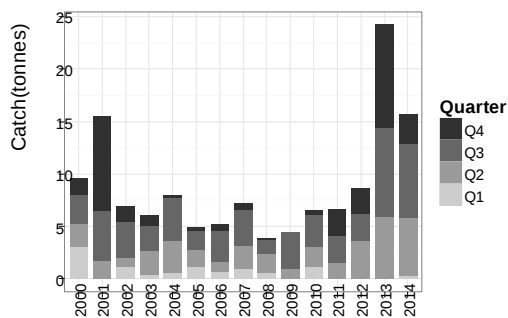
Sub-block 29B Templestowe Beach to Ironhouse Point



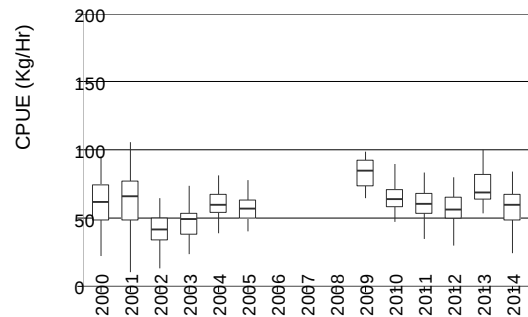
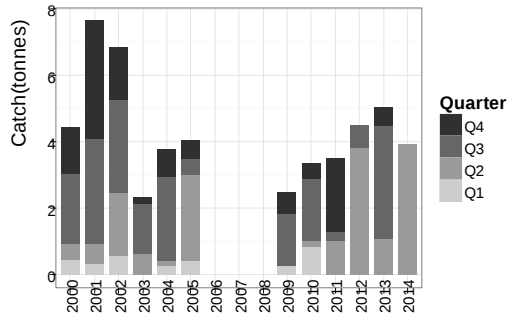
Sub-block 29C
Ironhouse Point to Scamander River



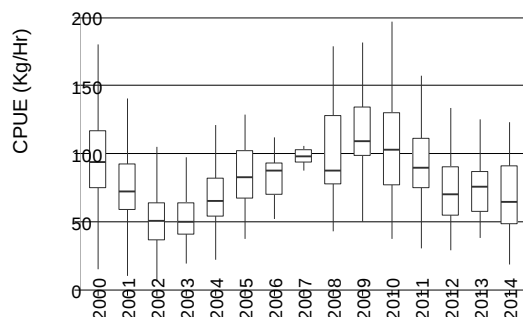
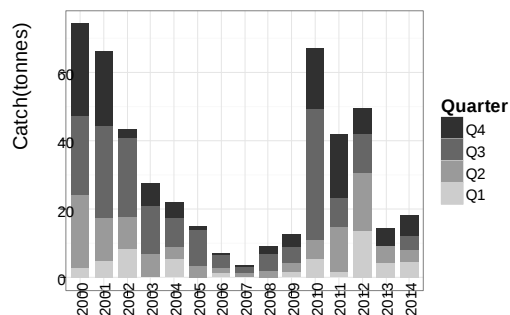
Sub-block 29D
Scamander River to St Helens Point



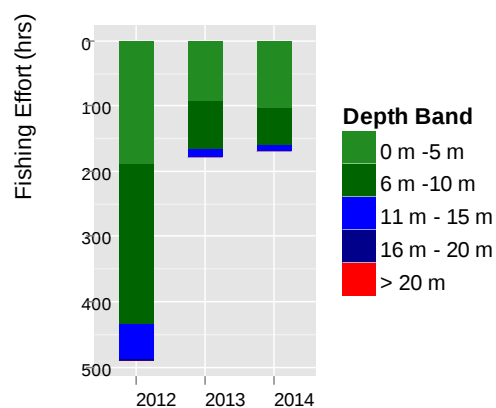
Sub-block 30A
St Helens Point to Taylors Beach



Sub-block 31A (also includes old E zone part of 31B), Eddystone Point to Musselroe: 19 t caught in 2014.



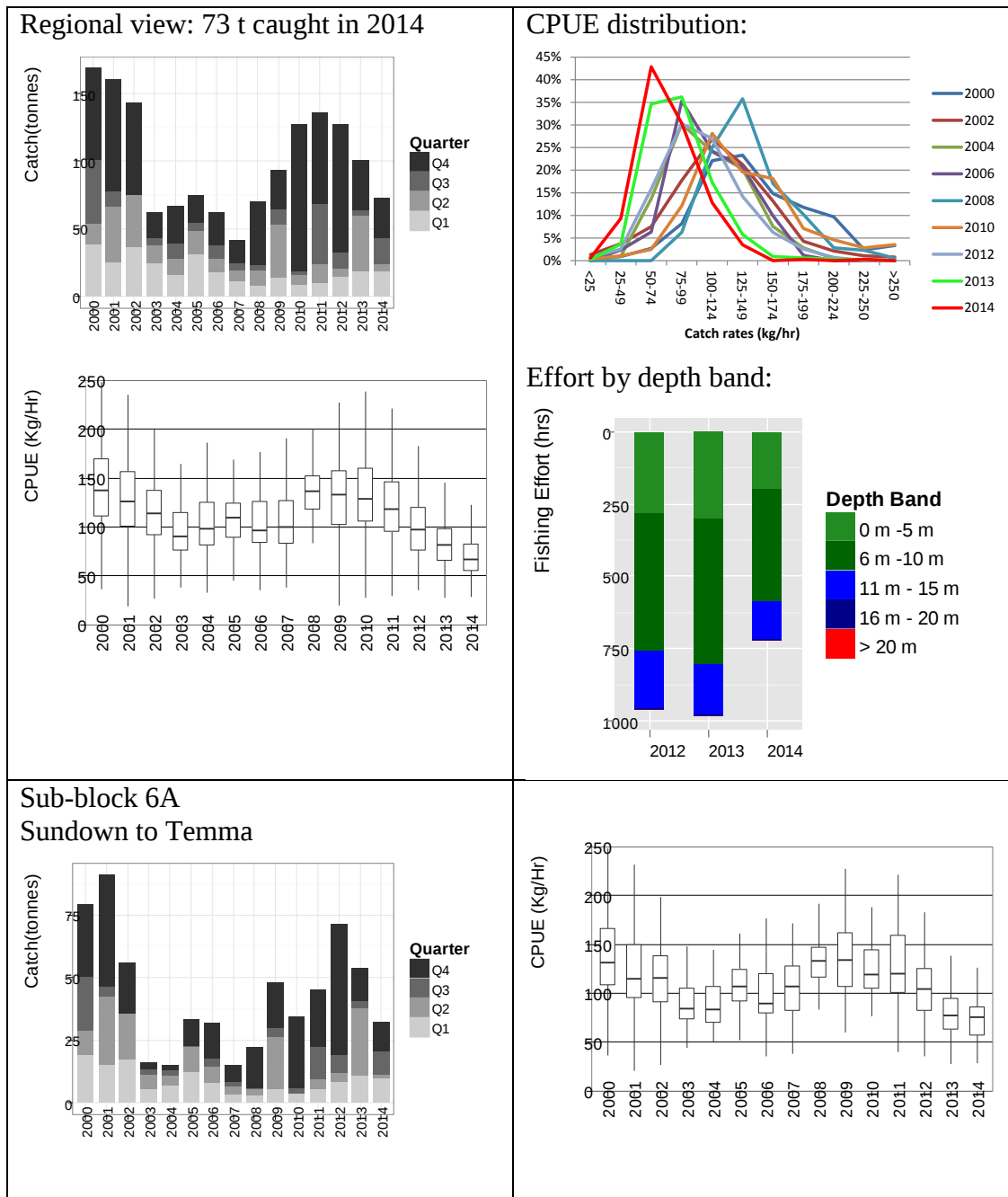
Effort by depth band:



Central Western Zone blacklip fishery

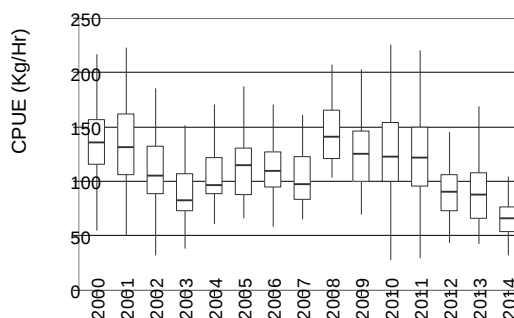
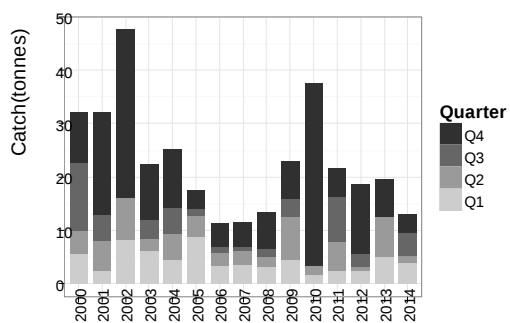
In 2013, the Central Western Zone was reduced in size to cover sub-blocks 5D, 6A, 6B and 6C. Sub-block 6D, and Blocks 7 and 8 were transferred to the Western Zone. Negligible catch was taken from sub-block 5D. In 2014, the TACC was set at 73.5 t.

Central Western Zone – Couta Rocks (Sub-blocks 5D, 6A, 6B and 6C)



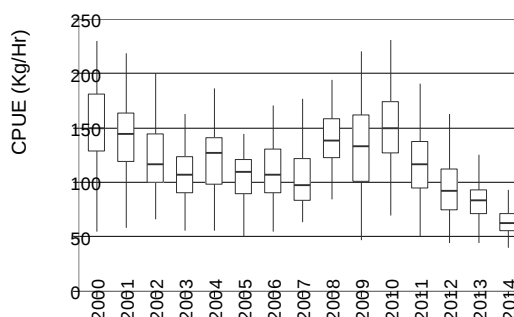
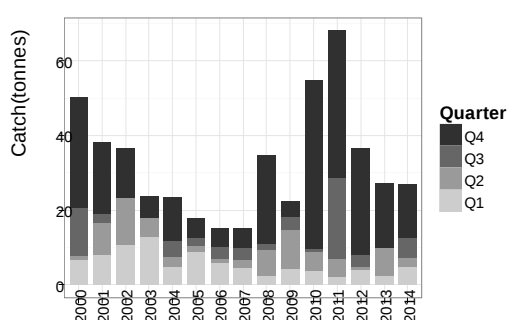
Sub-block 6B

Temma to north of Dawson River



Sub-block 6C

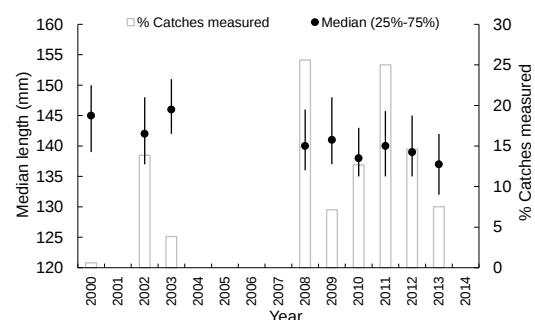
Dawson River to Wild Wave River



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

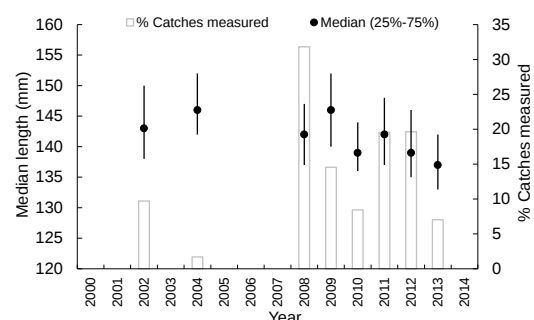
Sub-block 6A

Sundown to Temma



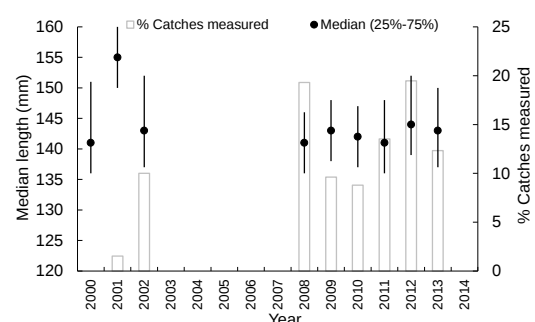
Sub-block 6B

Temma to north of Dawson River



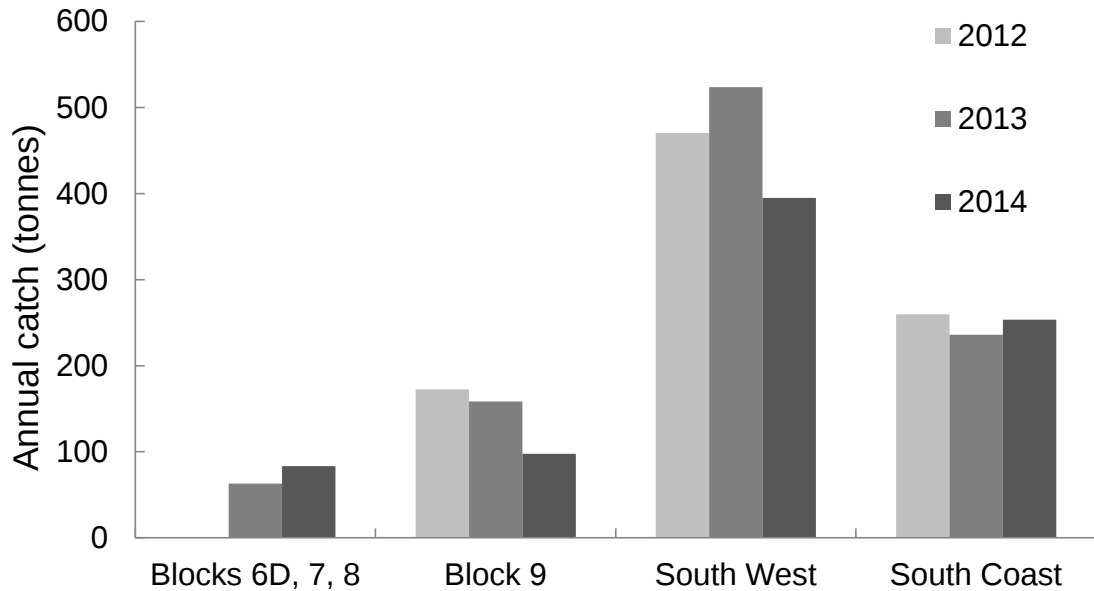
Sub-block 6C

Dawson River to Wild Wave River

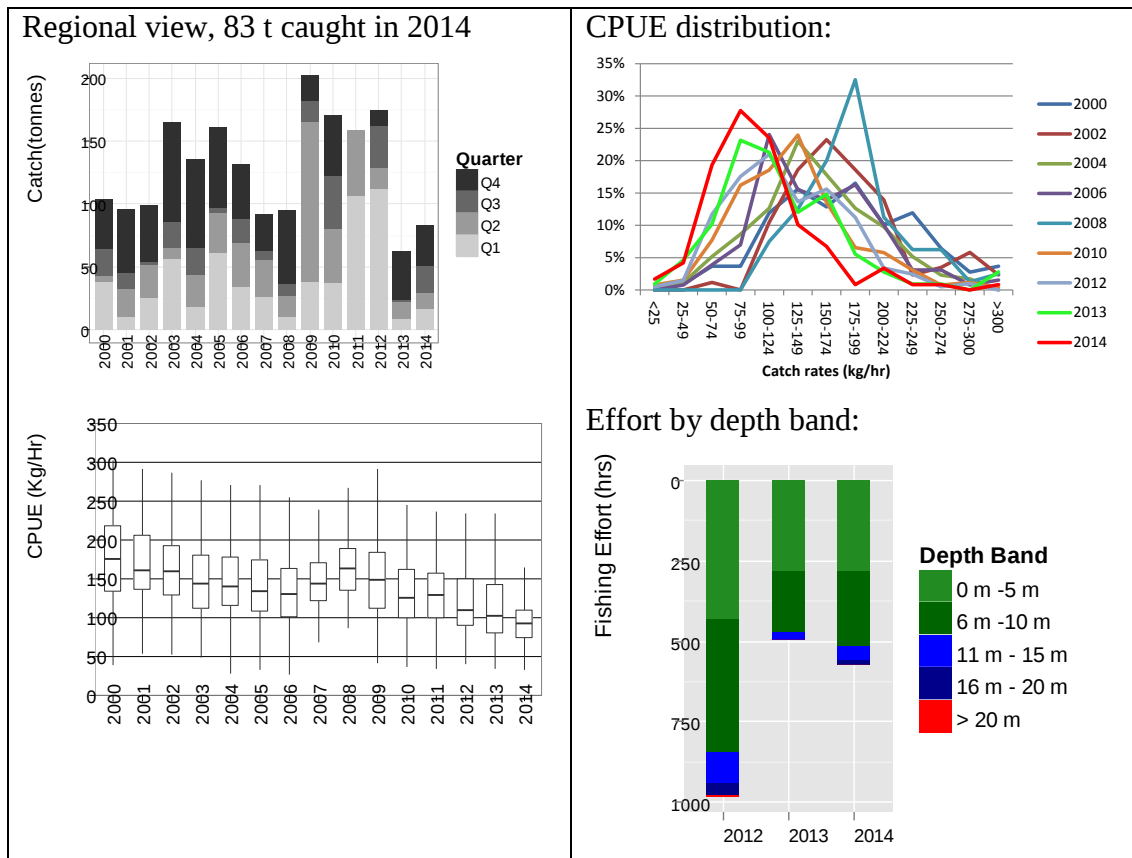


Western Zone blacklip fishery

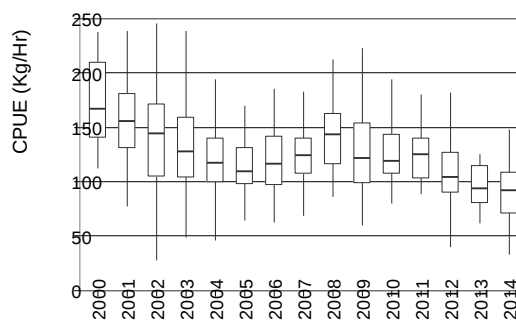
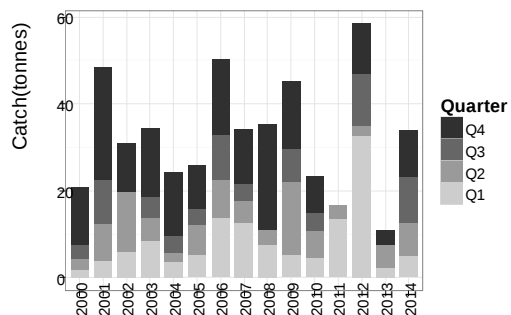
The Western Zone TACC was 840 t in 2014, reduced from 1001 t in 2013. In 2012 Blocks 6D, 7 and 8 were part of the Central Western Zone. The 2012-2014 catch was distributed between management regions as follows:



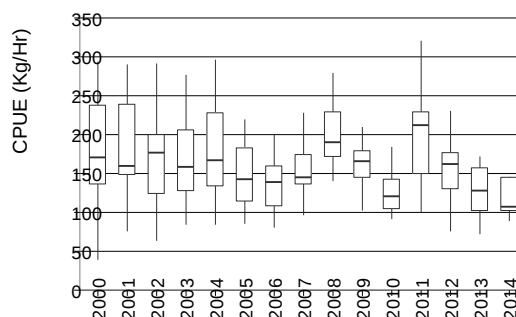
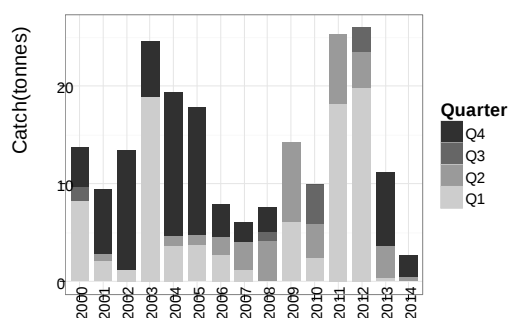
Western Zone – Sandy Cape, Granville and Trial Harbours (Sub-block 6D, Blocks 7 and 8)



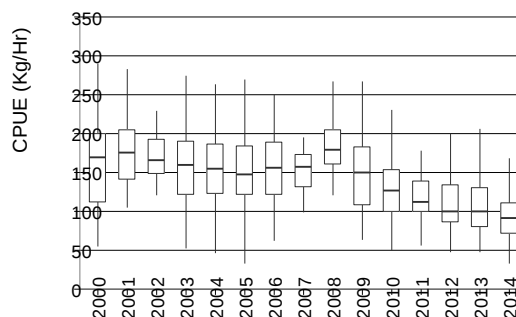
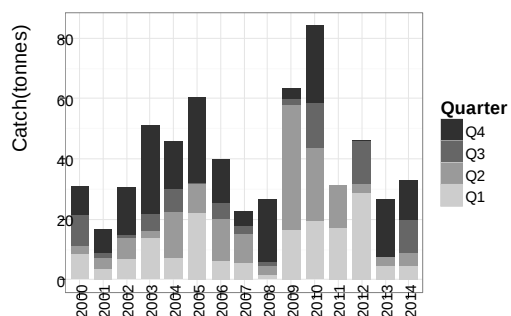
**Sub-block 6D - capped area see below
Wild Wave River to Italian River,
including Sandy Cape**



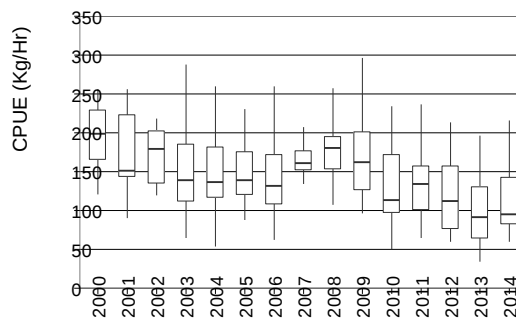
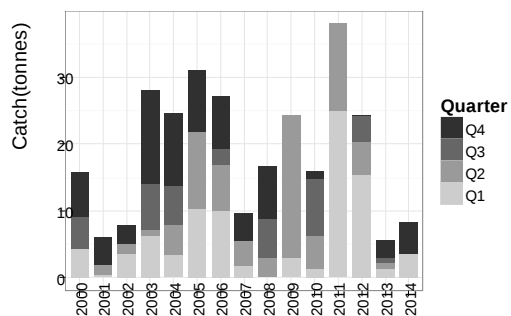
**Sub-block 7A
Italian River to Pieman River**

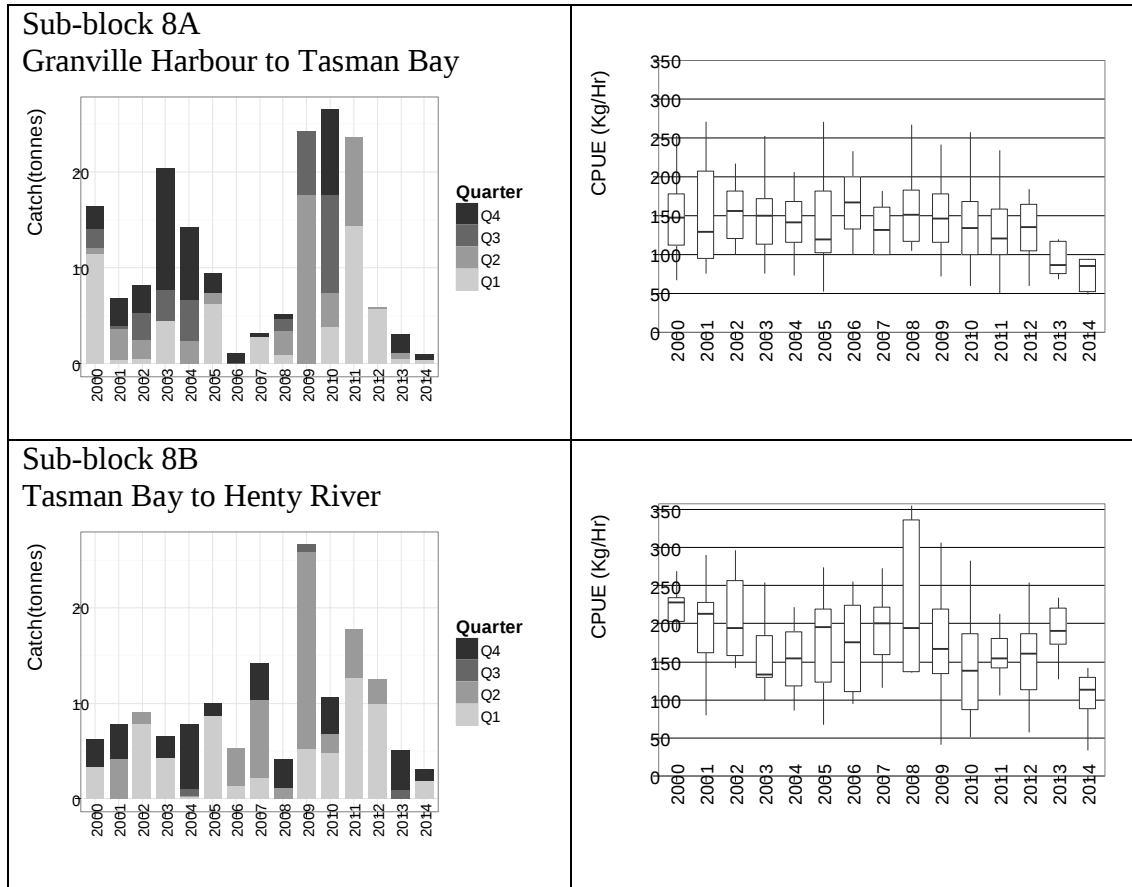


**Sub-block 7B
Pieman to Ahrberg Bay**

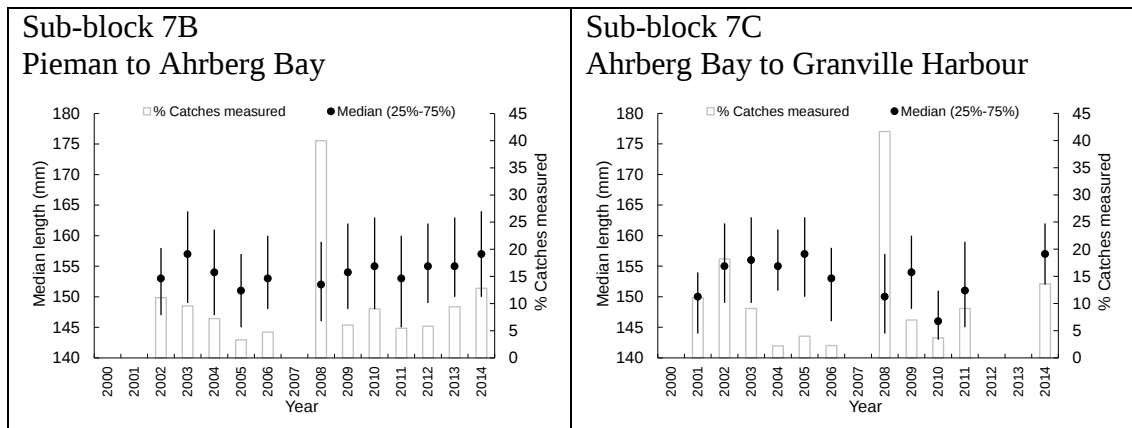


**Sub-block 7C
Ahrberg Bay to Granville Harbour**



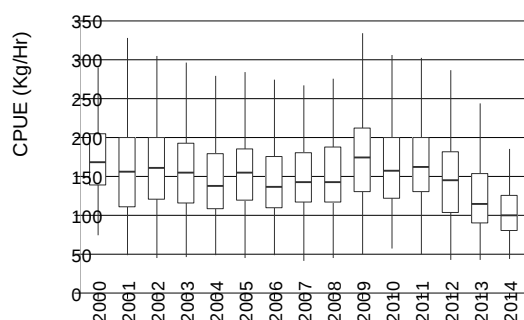
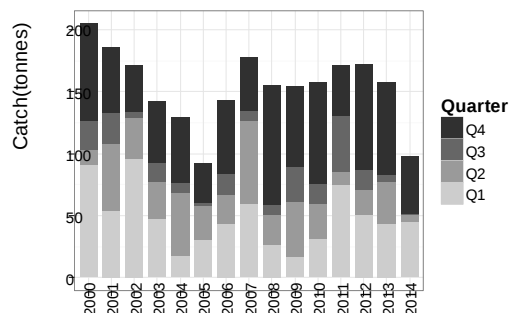


Western Zone – Sandy Cape, Granville and Trial Harbours (Sub-block 6D, Blocks 7 and 8) - Median length of catch

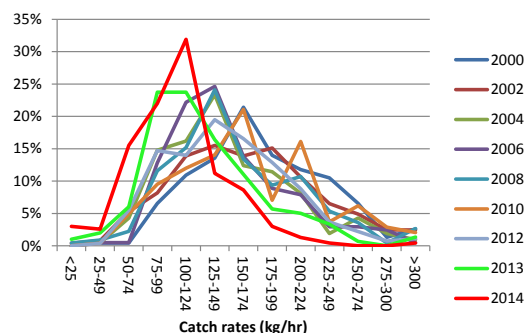


Western Zone – Strahan (Block 9)

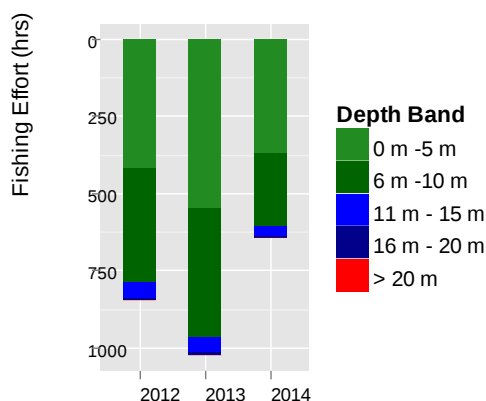
Regional view, cap set at 125 t, 98 t caught in 2014



CPUE distribution:

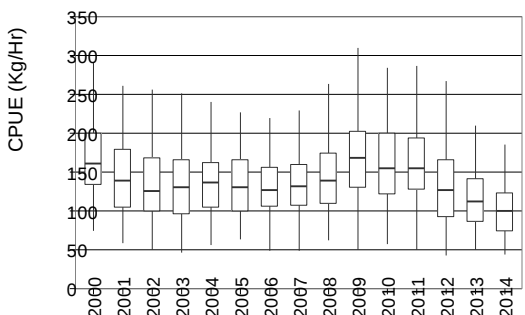
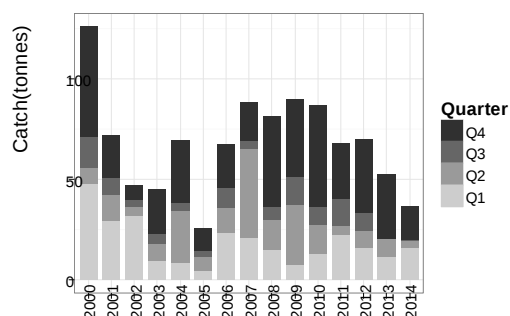


Effort by depth band:



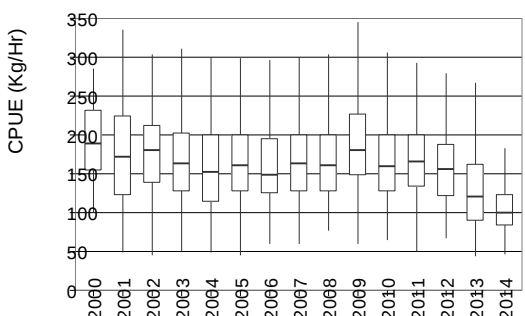
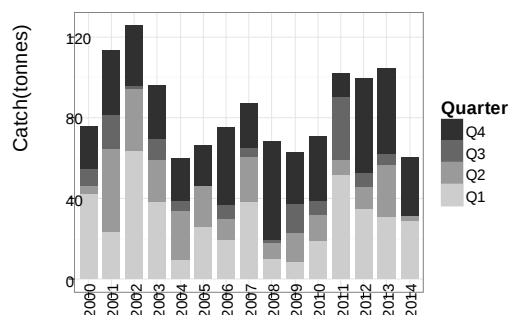
Sub-block 9B

Cape Sorell to Gorge Point

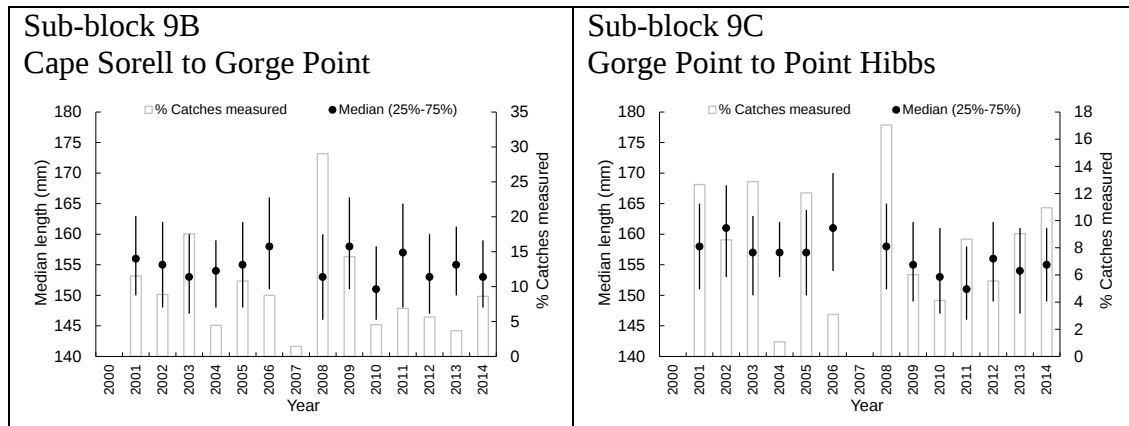


Sub-block 9C

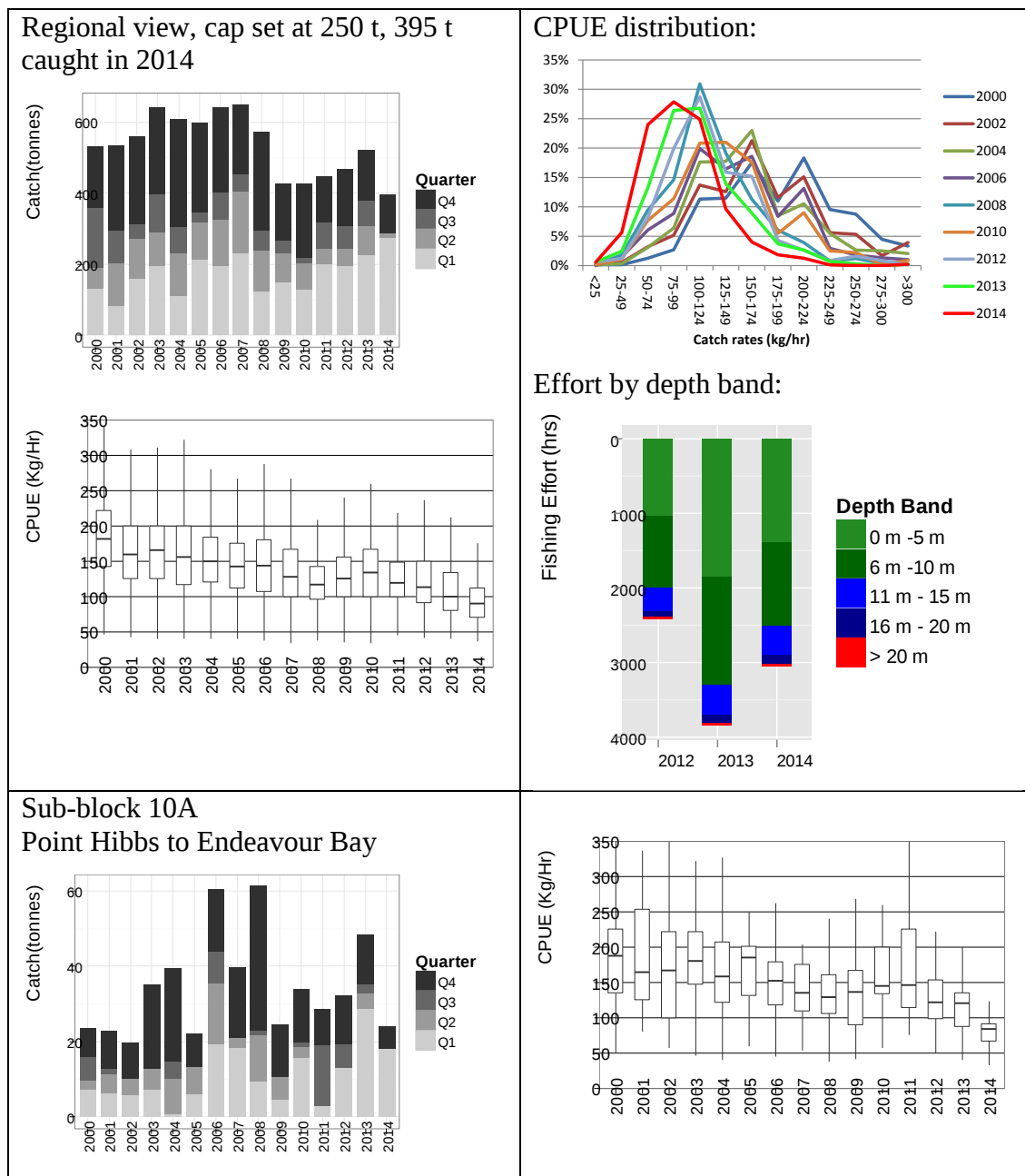
Gorge Point to Point Hibbs



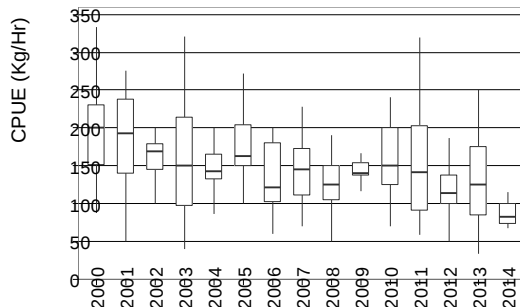
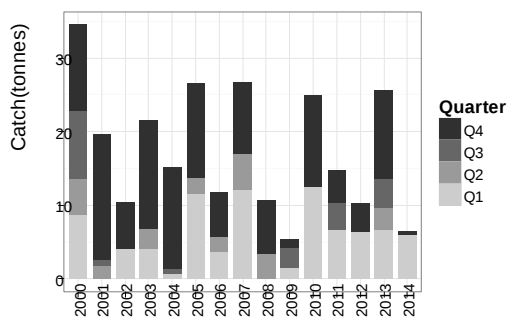
Western Zone – Strahan (Block 9) Median length of catch



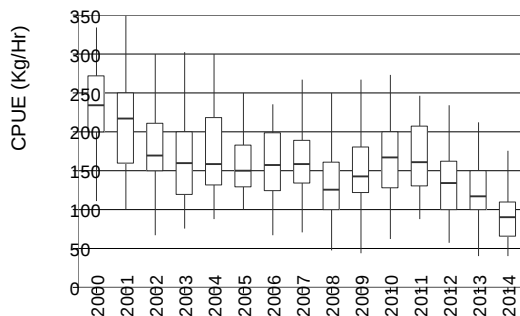
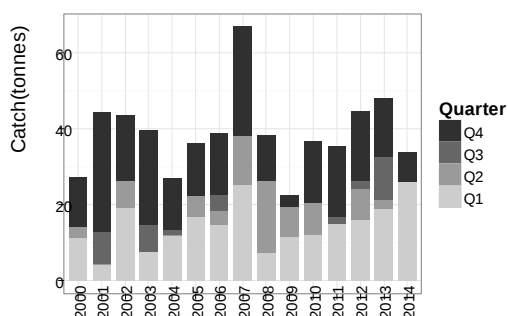
Western Zone - South West (Blocks 10-11, Sub-block 12A)



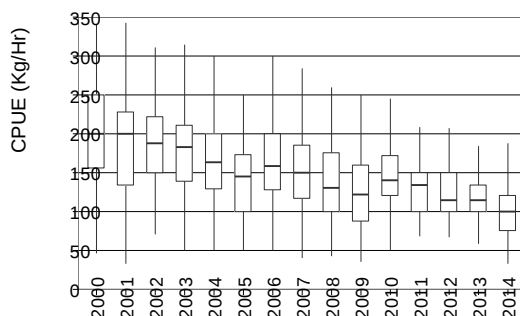
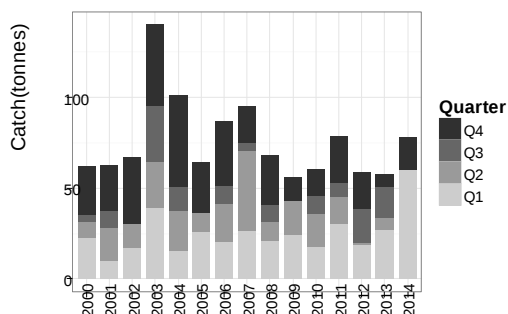
Sub-block 10B Endeavour Bay to High Rocky Point



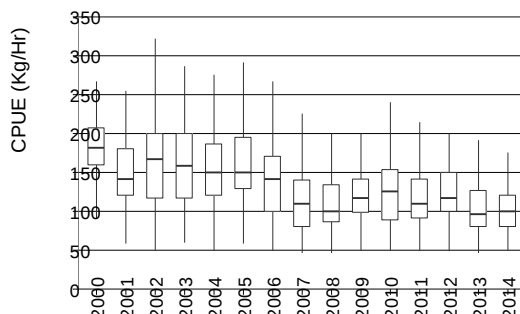
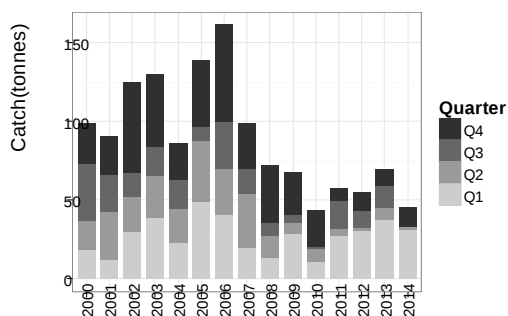
Sub-block 10C High Rocky Point to Mainwaring River



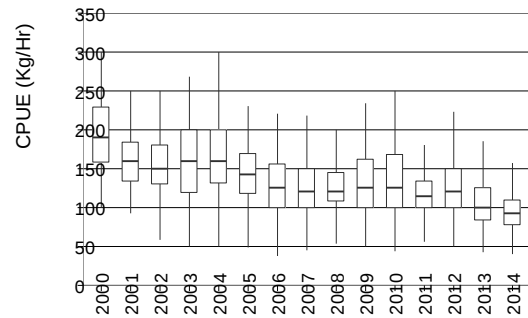
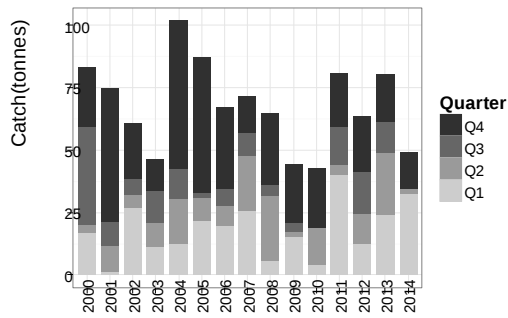
Sub-block 10D Mainwaring River to Low Rocky Point



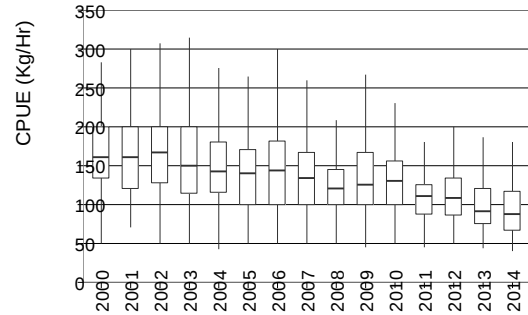
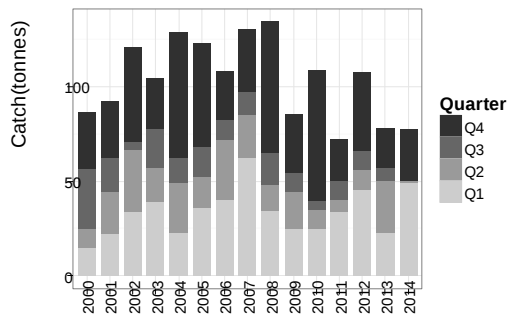
Sub-block 11A Low Rocky Point to Elliott Point



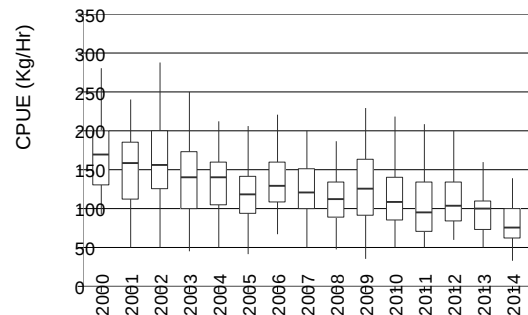
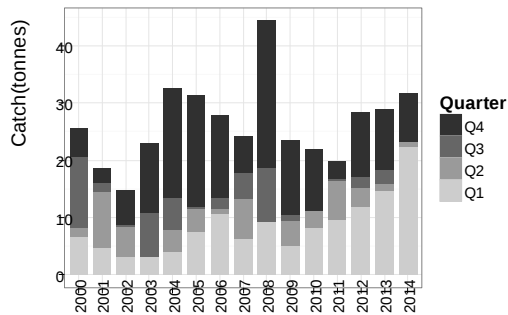
Sub-block 11B
Elliott Point to Svenor Gulches



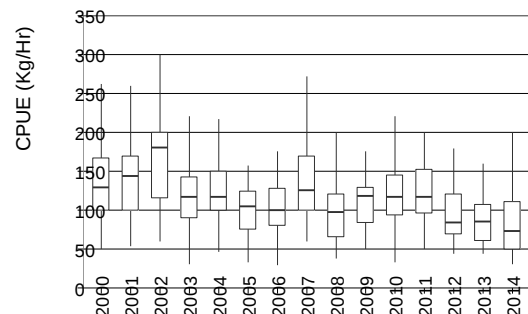
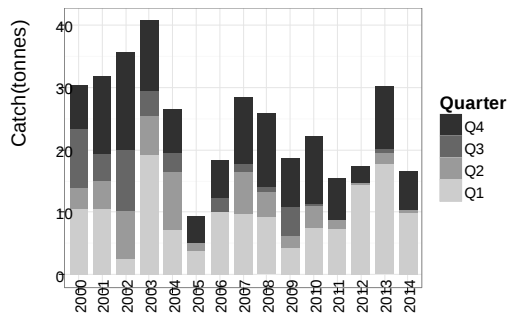
Sub-block 11C
Svenor Gulches to Point St Vincent



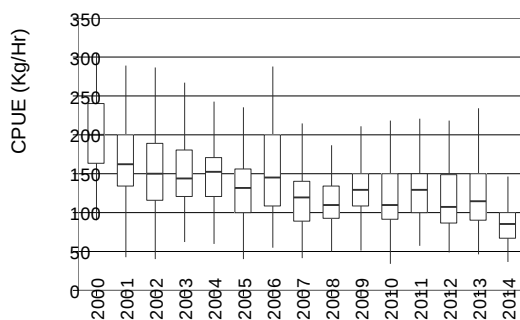
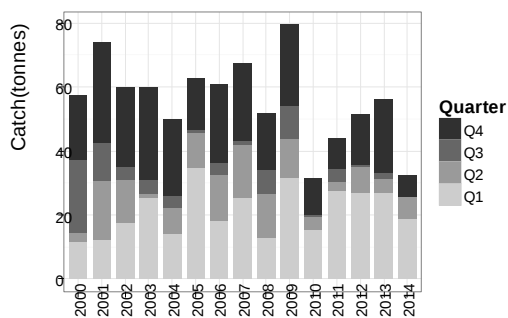
Sub-block 11D
Hilliard Head to Faults Bay



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

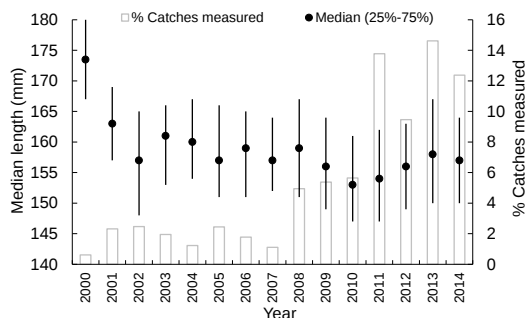


Sub-block 12A Faults Bay to South West Cape

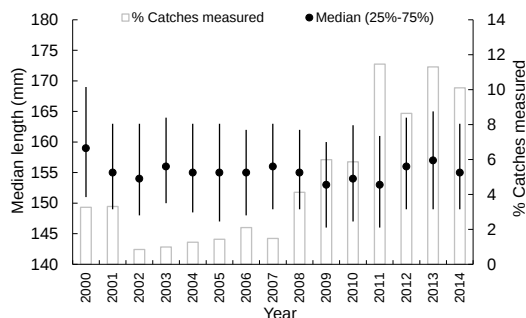


Western Zone - South West (Blocks 10-11, Sub-block 12A) Median length of catch

Block 10 (aggregated)
Point Hibbs to Low Rocky Point
Note sampling rate below 4% prior to 2008

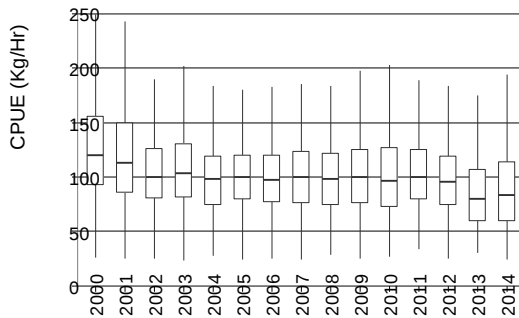
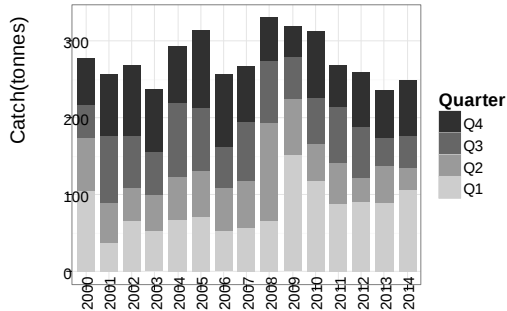


Block 11 (aggregated)
Low Rocky Point to Faults Bay
Note sampling rate below 4% prior to 2008

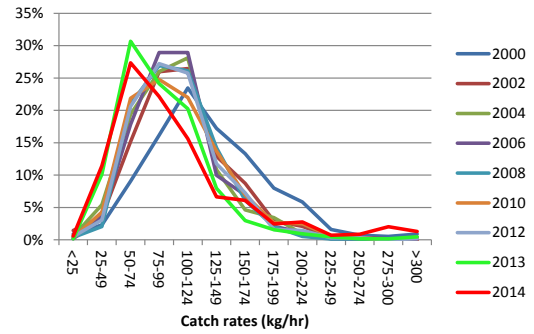


Western Zone - South Coast (Sub-blocks 12B, 12C, 12D, 13A, 13B)

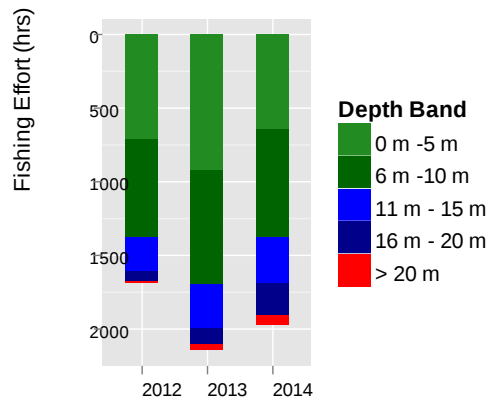
Region view, cap set at 265 t, 254 t caught in 2014



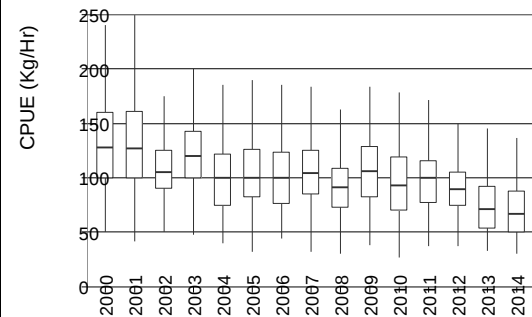
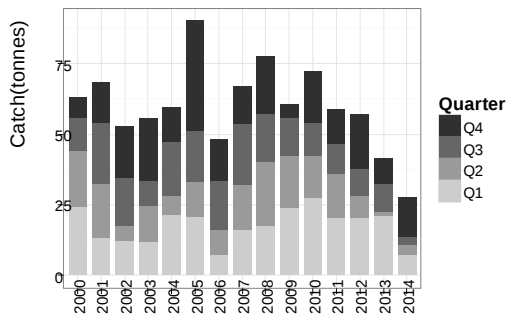
CPUE distribution:



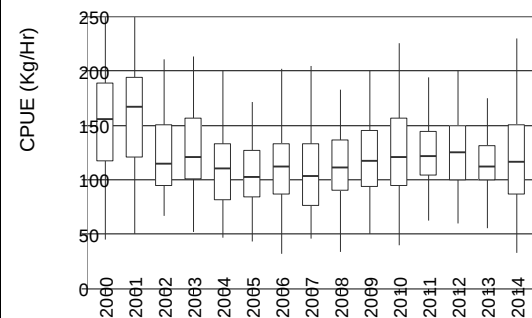
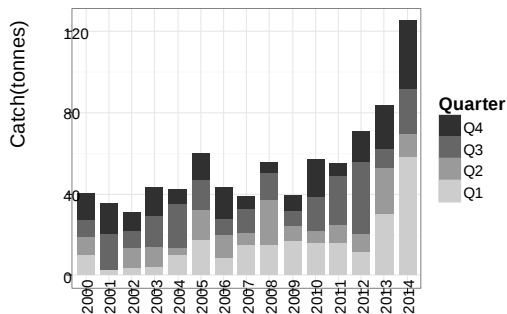
Effort by depth band:

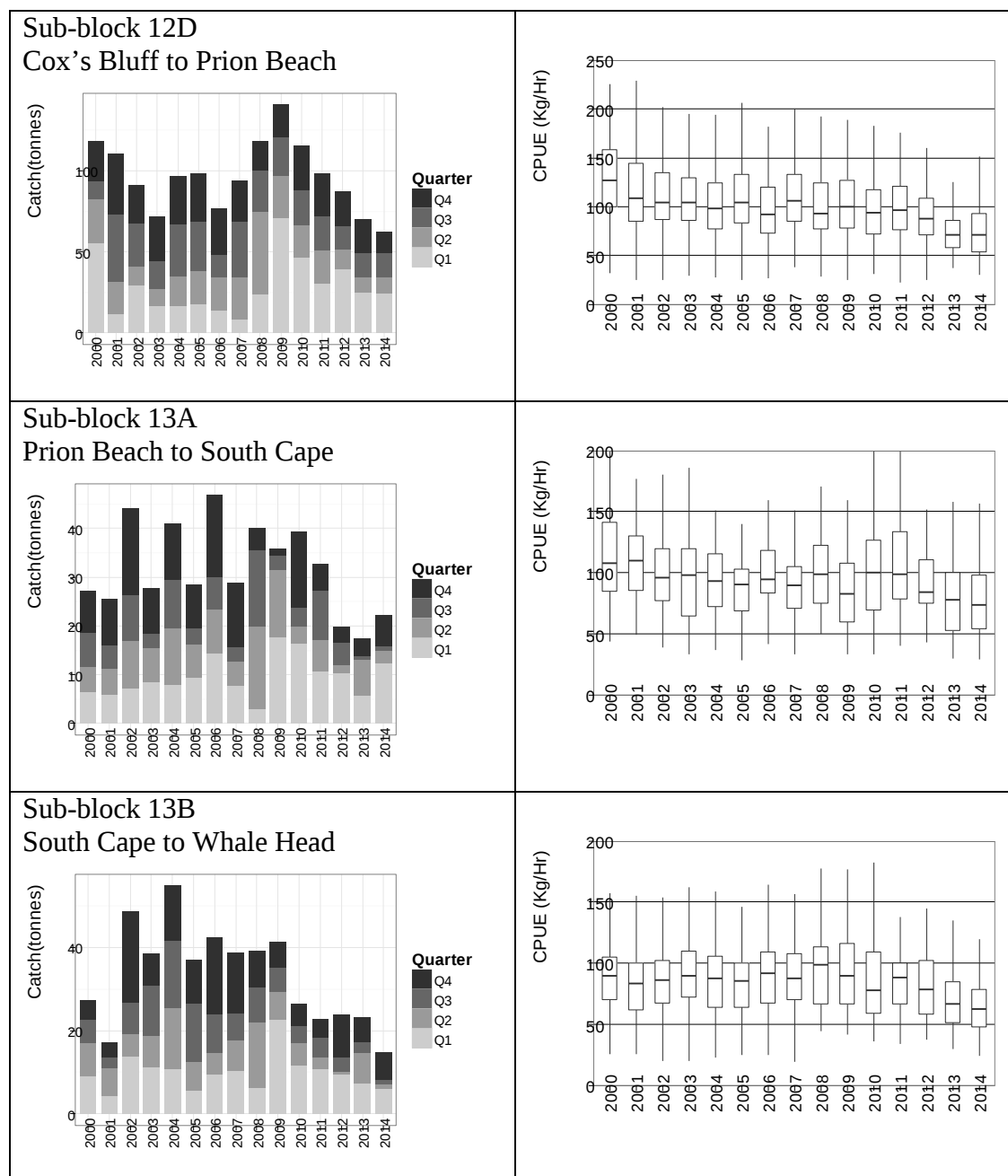


Sub-block 12B
South West Cape to Cox's Bluff

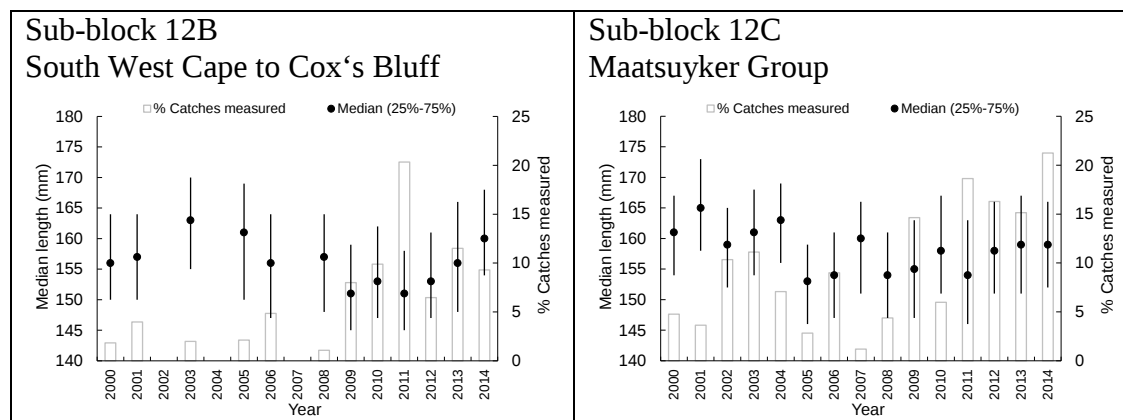


Sub-block 12C
Maatsuyker Group

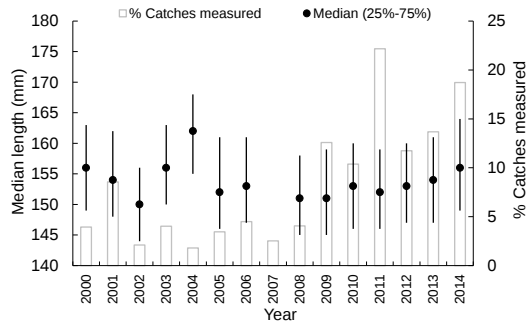




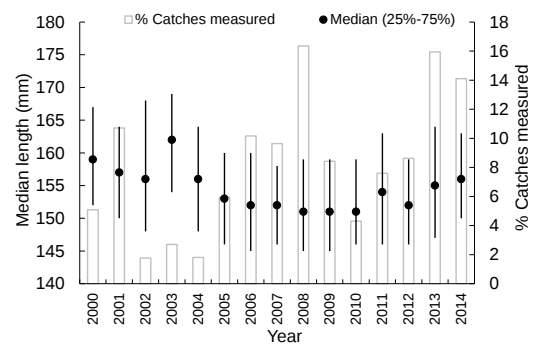
Western Zone - South Coast (Block 12, Sub-blocks 13A, 13B) Median length of catch



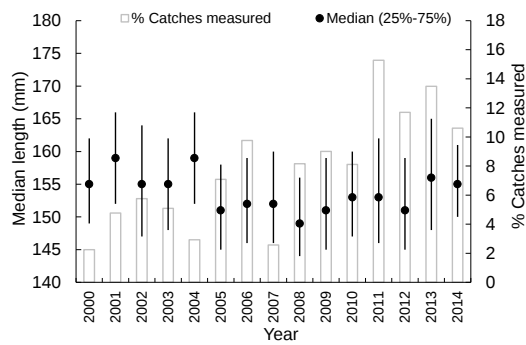
Sub-block 12D Cox's Bluff to Prion Beach



Sub-block 13A Prion Beach to South Cape

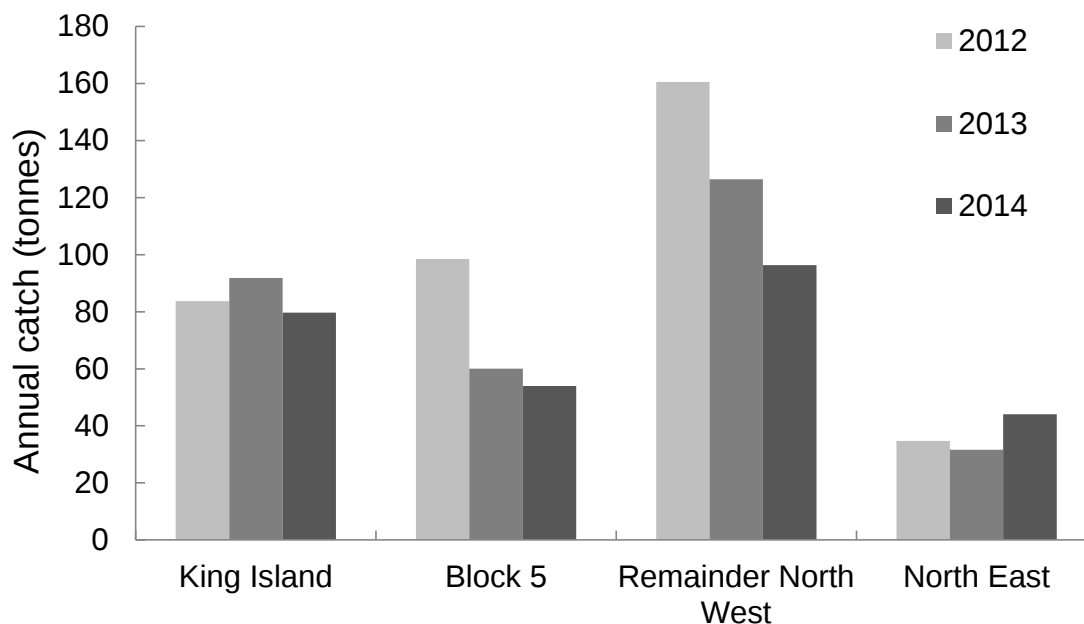


Sub-block 13B South Cape to Whale Head



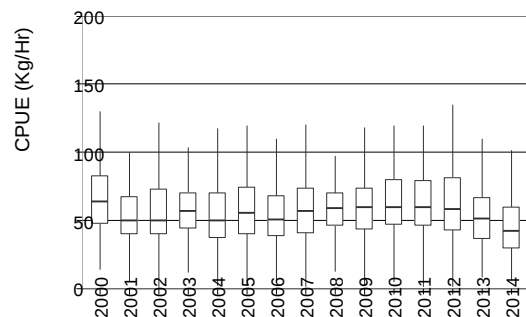
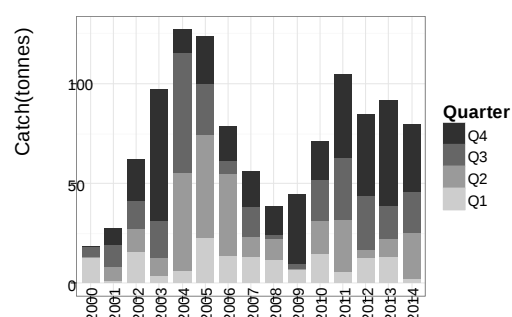
Northern Zone blacklip fishery

The Northern Zone TACC was 280 t in 2014, reduced from 308 t in 2013 and 378 t in 2012. The 2012-2014 catch was distributed between management regions as follows:

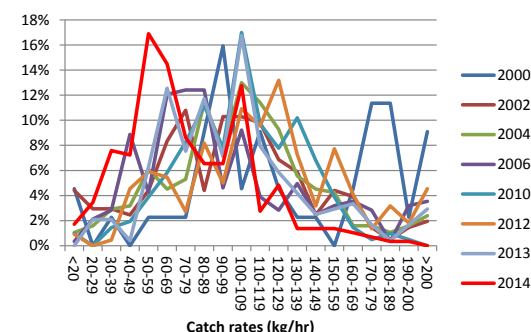


Northern Zone - King Island (Blocks 1-4)

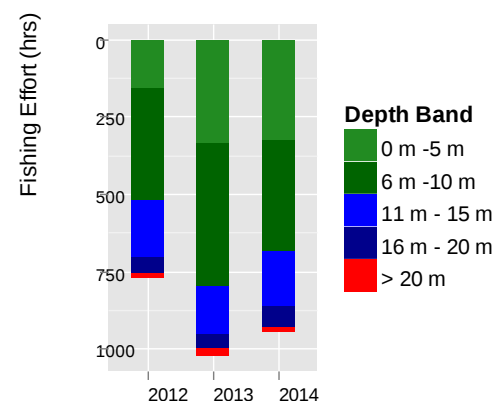
Regional view: 80 t caught in 2014.

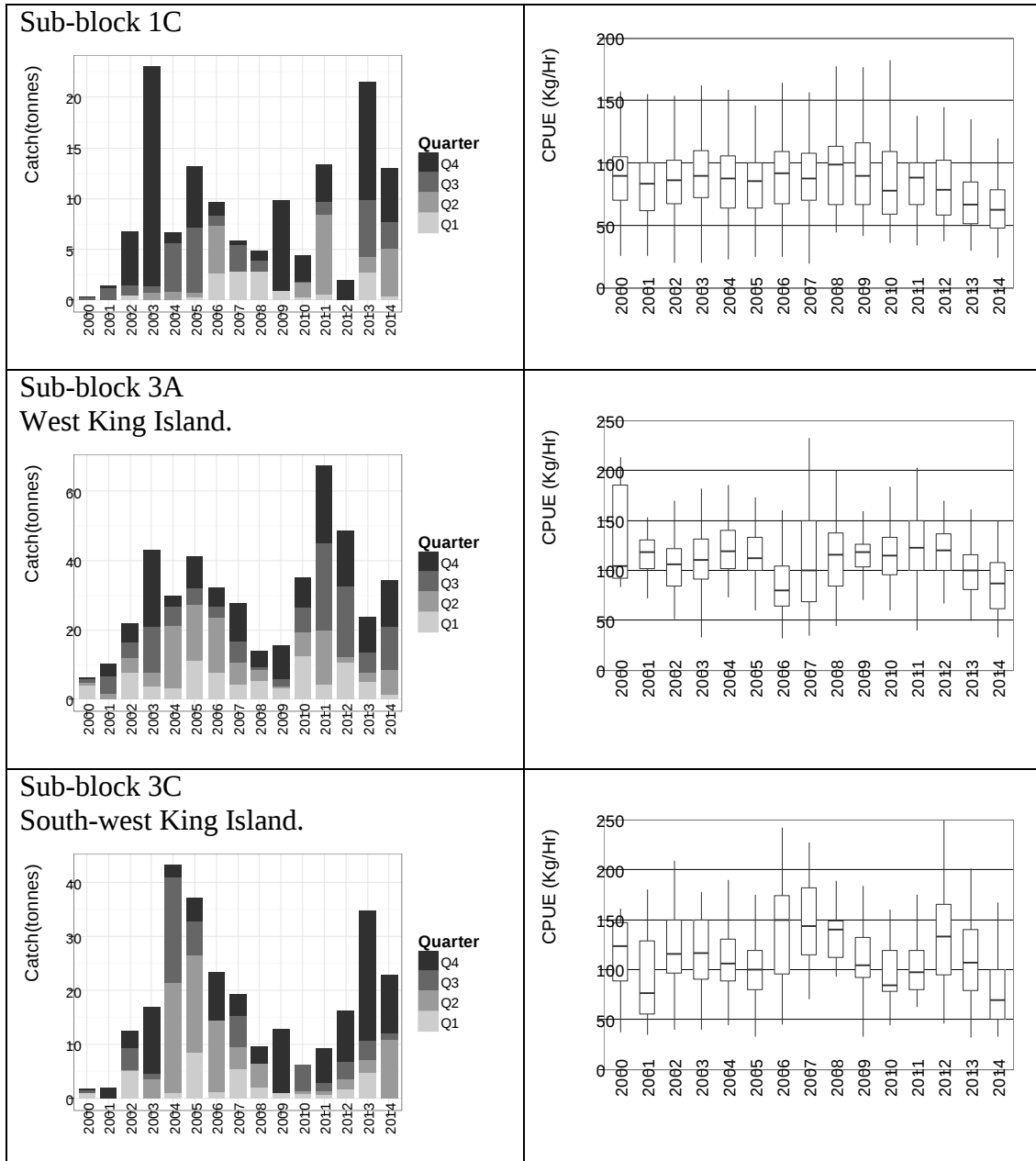


CPUE distribution:



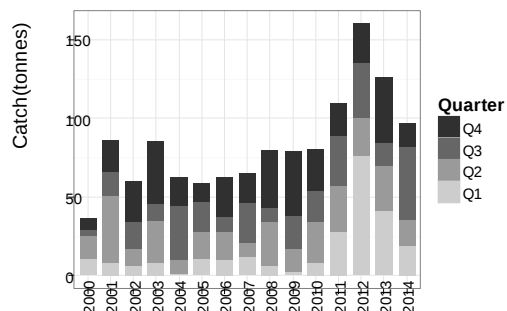
Effort by depth band:



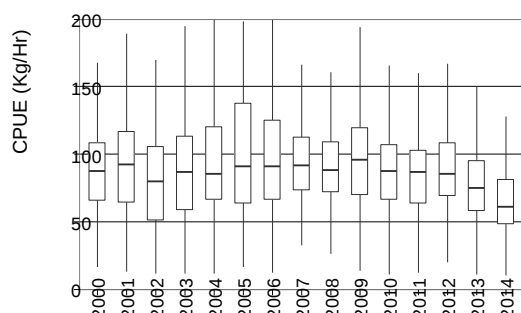
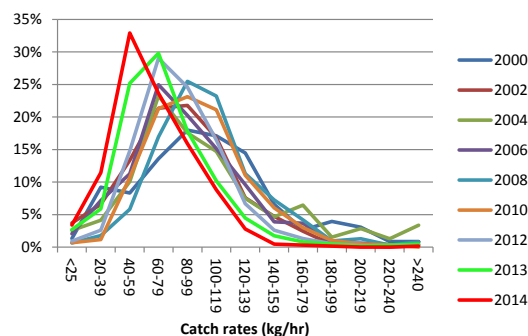


Northern Zone – North West (Blocks 5, 47, 48, 49)

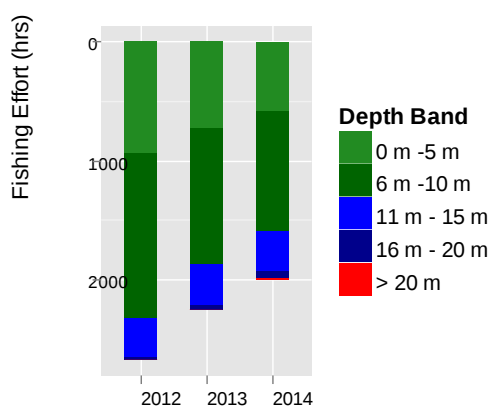
Blocks 47-49: cap 100 t, 96 t caught in 2014



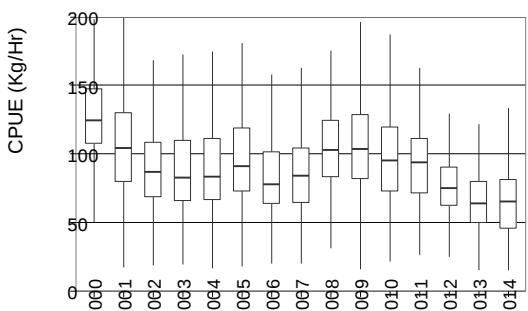
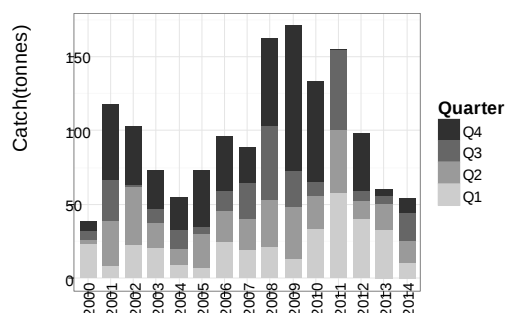
CPUE distribution:



Effort by depth band:

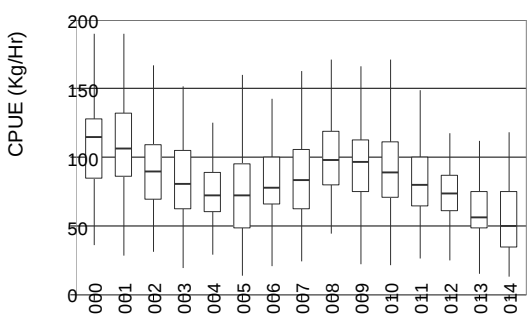
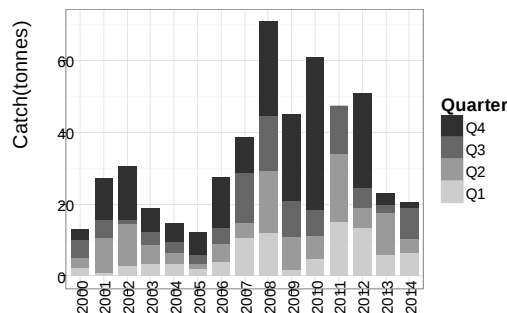


Block 5: cap 50 t, 54 t caught in 2014

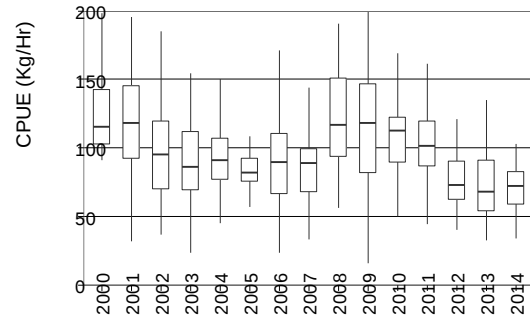
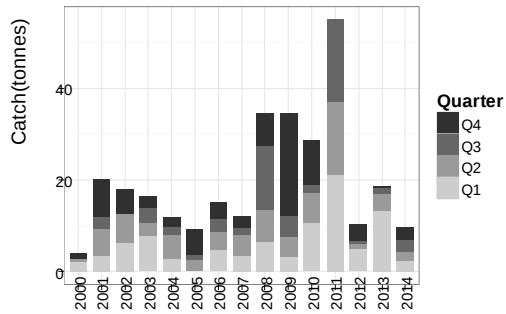


Sub-block 5A

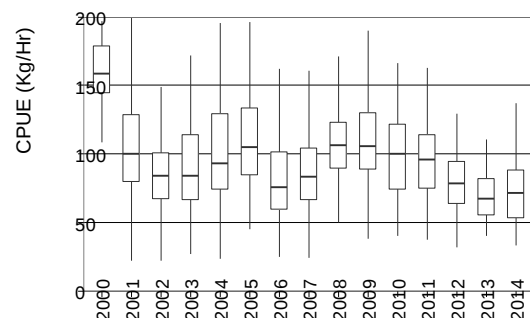
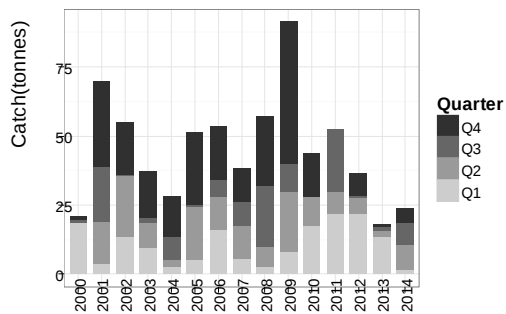
Woolnorth Point to Studland Bay.



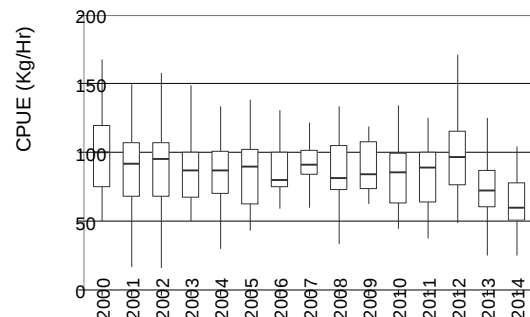
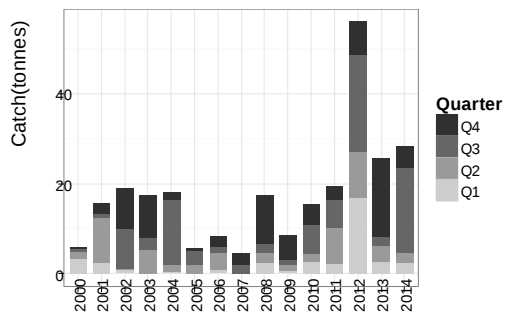
Sub-block 5B
Studland Bay to Greens Beach, including
Mt Cameron West.



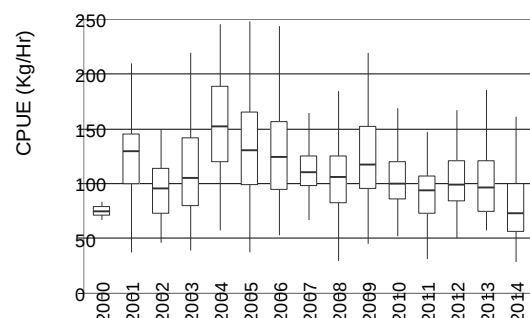
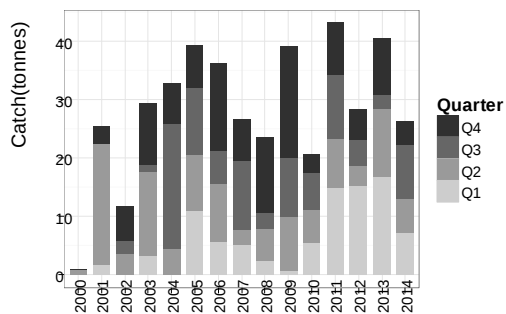
Sub-block 5C
Greens Beach to Arthur River.



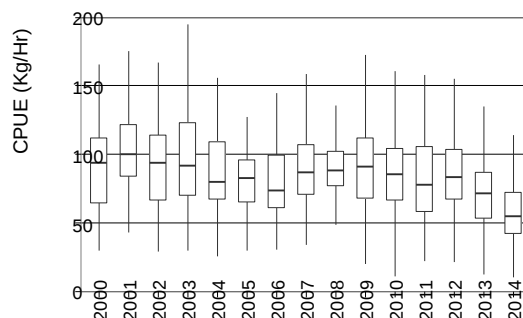
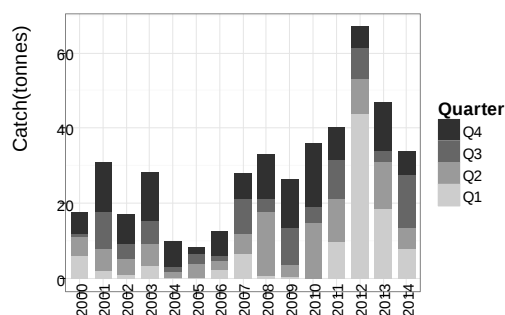
Sub-block 49A
Three Hummock Island



Sub-block 49B
Northern part of Hunter Island and
Albatross Island

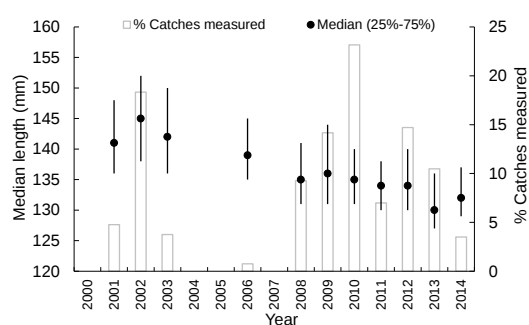


Sub-block 49C
South-western Hunter Island.

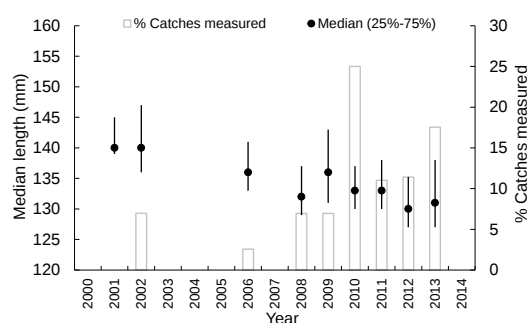


Northern Zone – North West Median length of catch

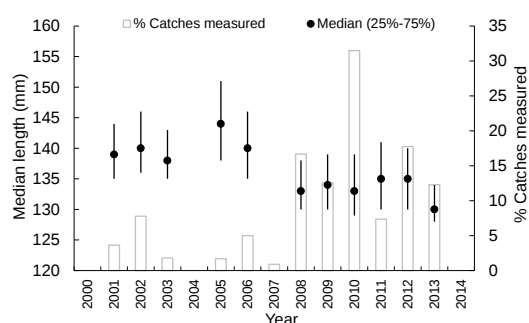
Sub-block 5A
Woolnorth Point to Studland Bay



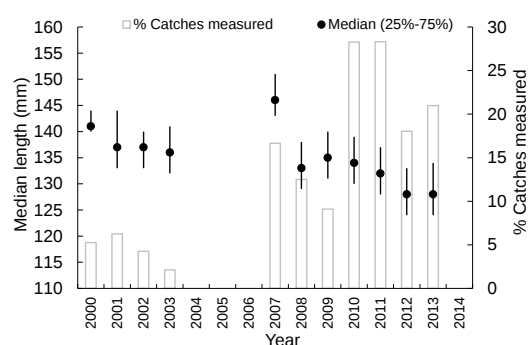
Sub-block 5B
Studland Bay to Greens Beach, including Mt Cameron West



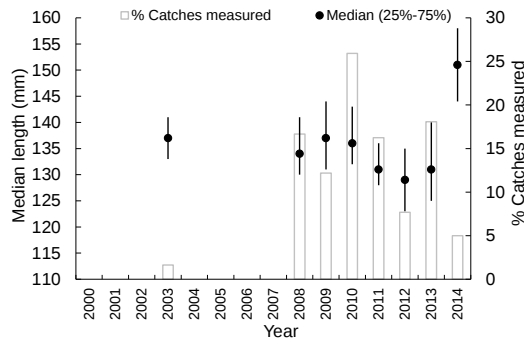
Sub-block 5C
Greens Beach to Arthur River



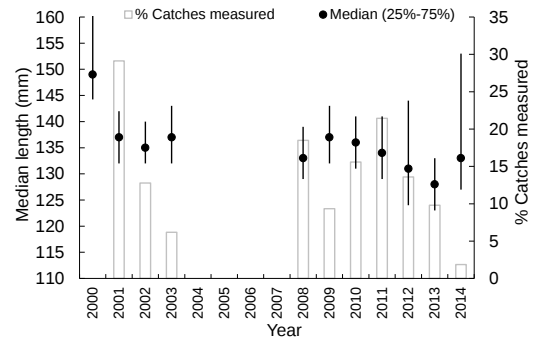
Sub-block 49A
Three Hummock Island



Sub-block 49B
Northern part of Hunter Island and Albatross Island

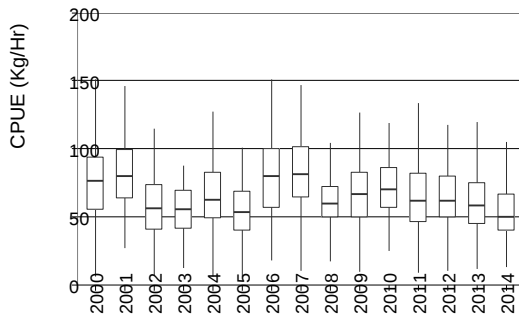
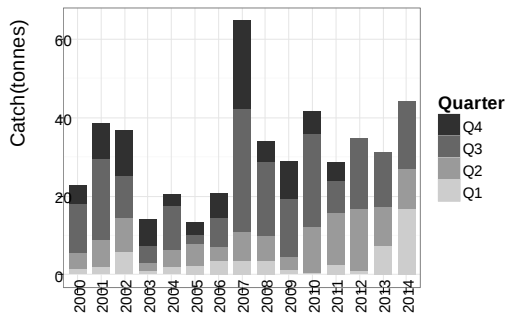


Sub-block 49C
South-western Hunter Island.

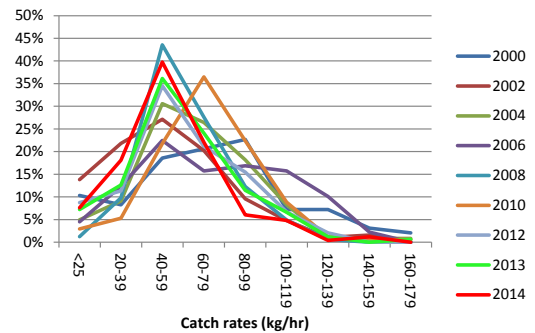


Northern Zone - North East (Sub-block 31B, Blocks 39, 40)

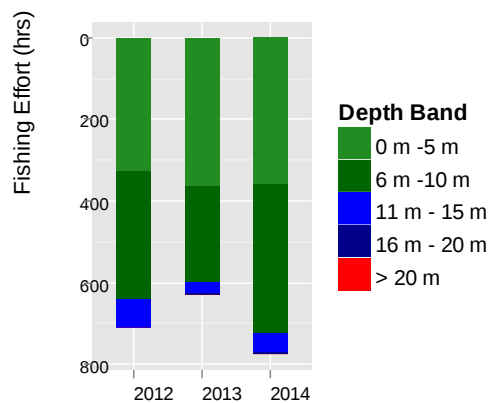
Regional view: Area cap 30 t in 2014, 44 t caught.



CPUE distribution:

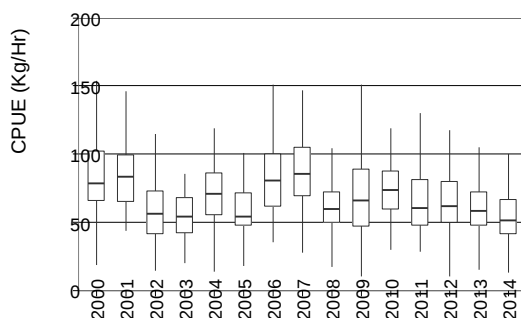
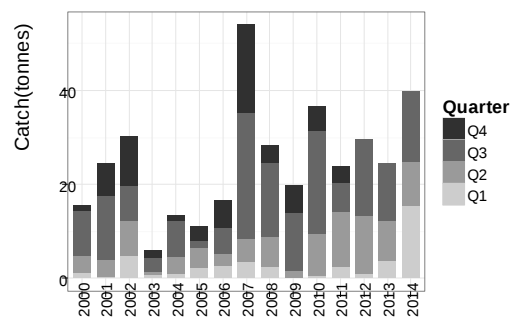


Effort by depth band



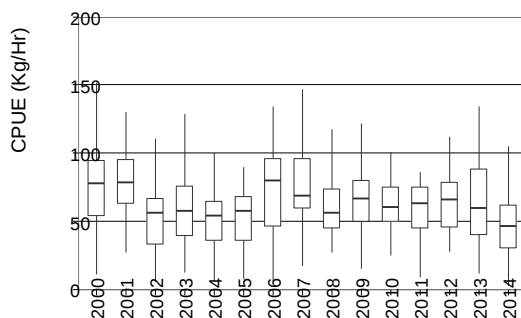
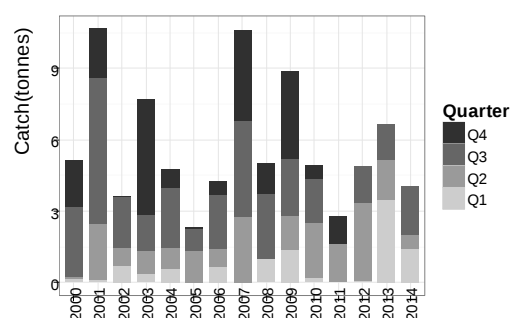
Sub-block 31B

Cape Naturaliste to Little Musselroe Bay.



Sub-block 39A

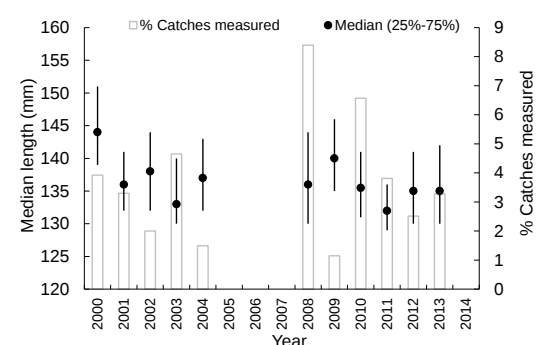
Little Musselroe Bay to Petal Point



Northern Zone – North East Median length of catch

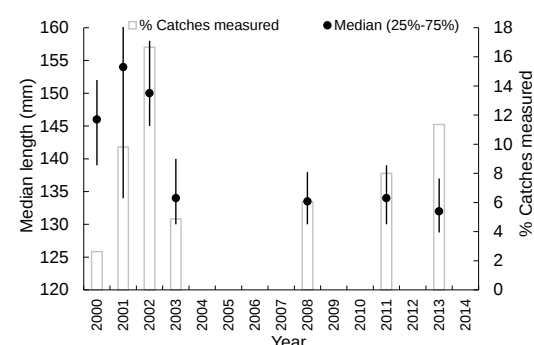
Sub-block 31B

Cape Naturaliste to Little Musselroe Bay.



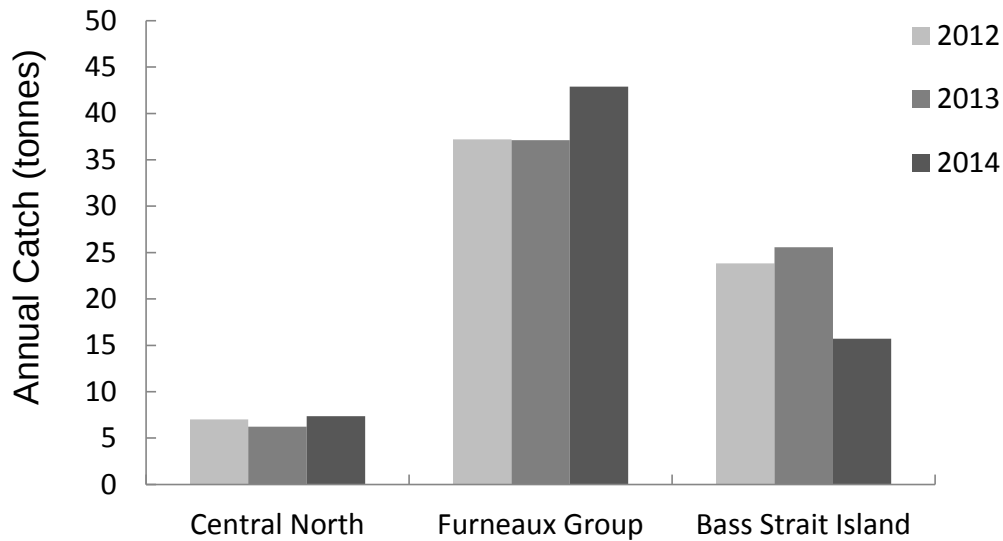
Sub-block 39A

Little Musselroe Bay to Petal Point



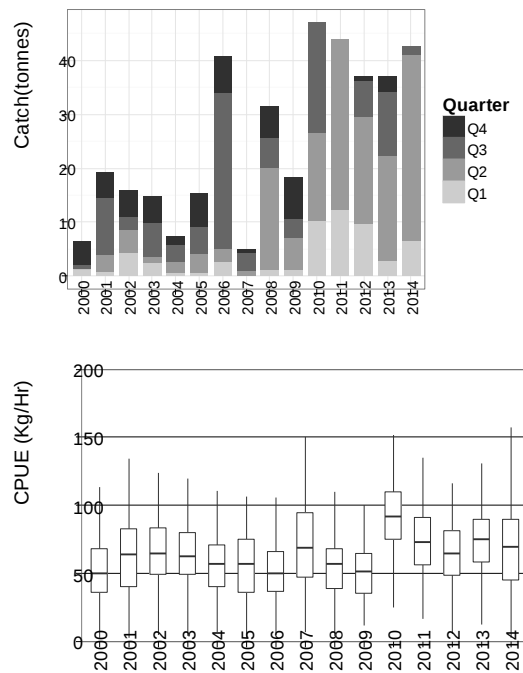
Bass Strait Zone blacklip fishery

The TACC for each year 2012-2014 was set at 70 t pa. The catch was distributed as follows:

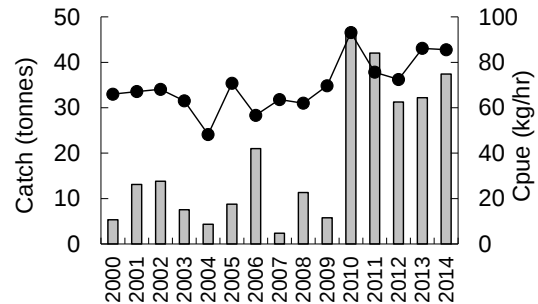


Bass Strait Zone - Furneaux Group (Blocks 32-38)

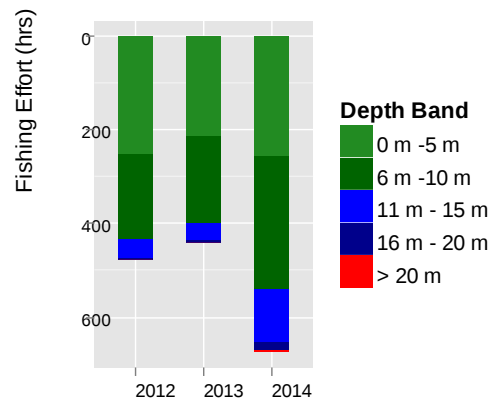
Furneaux Group: (Blocks 32-38)
43 t caught in 2014.



Eastern Furneaux Group: capped area (33A, 33B, 33C, 36A, 36B, 38A, 38B, 38C), area cap 30 t, 31 t taken in 2014. Mixed catch CPUE removed, 44% of catch was taken blacklip-only fishing in 2014.

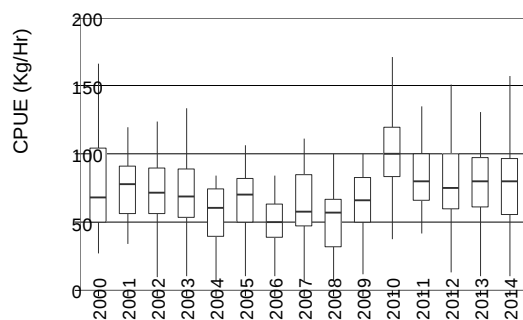
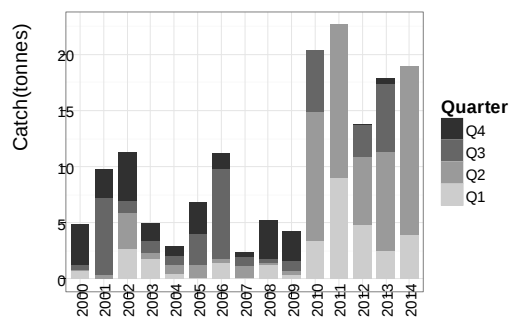


Effort by depth band:



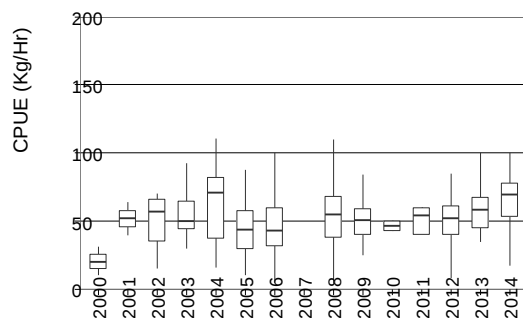
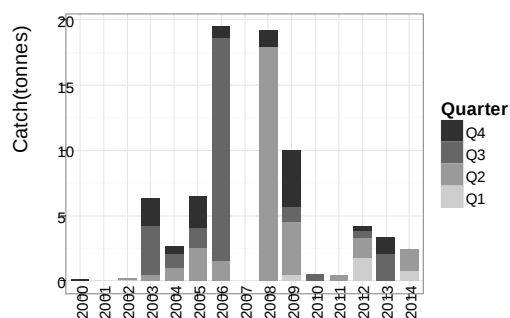
Block 33

South-east Furneaux Group



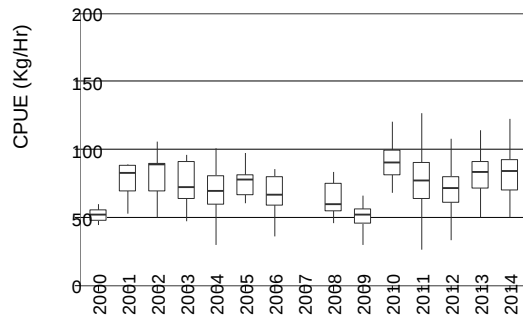
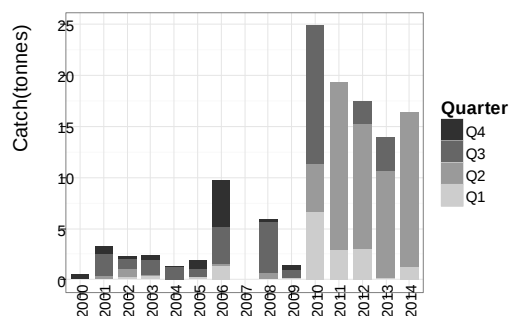
Block 37

North Flinders Island, inc. Sisters Islands

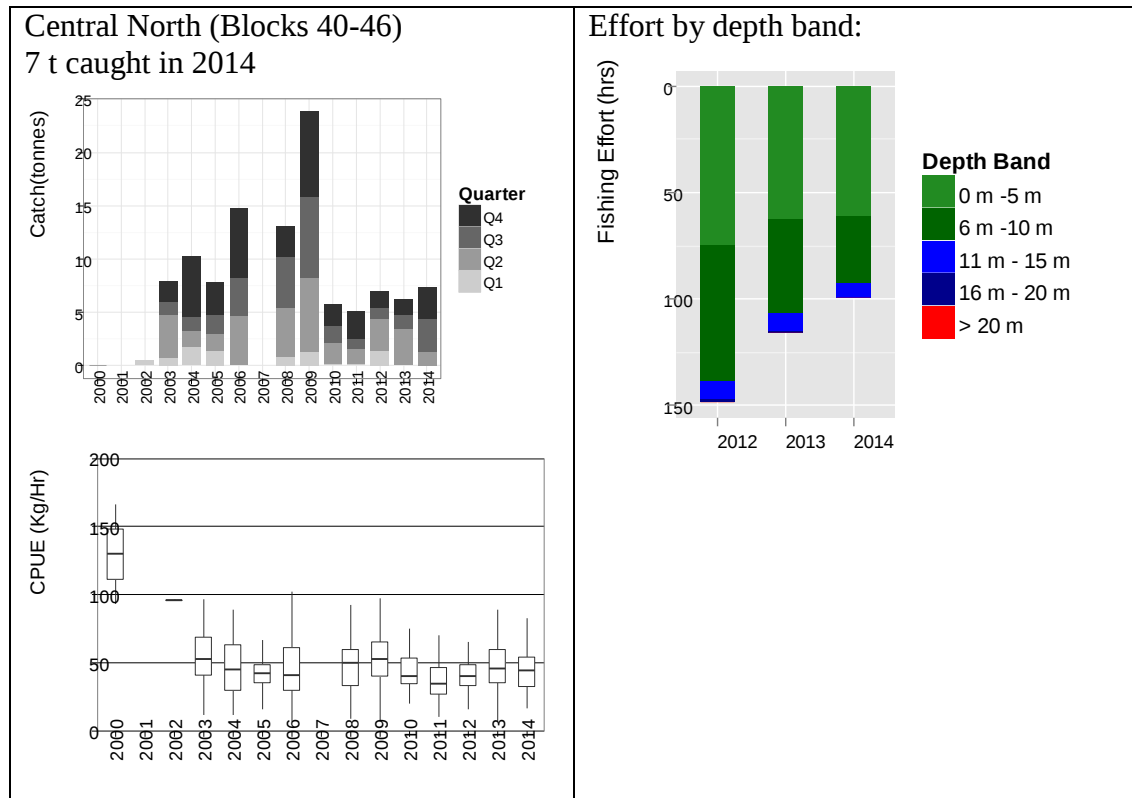


Block 38

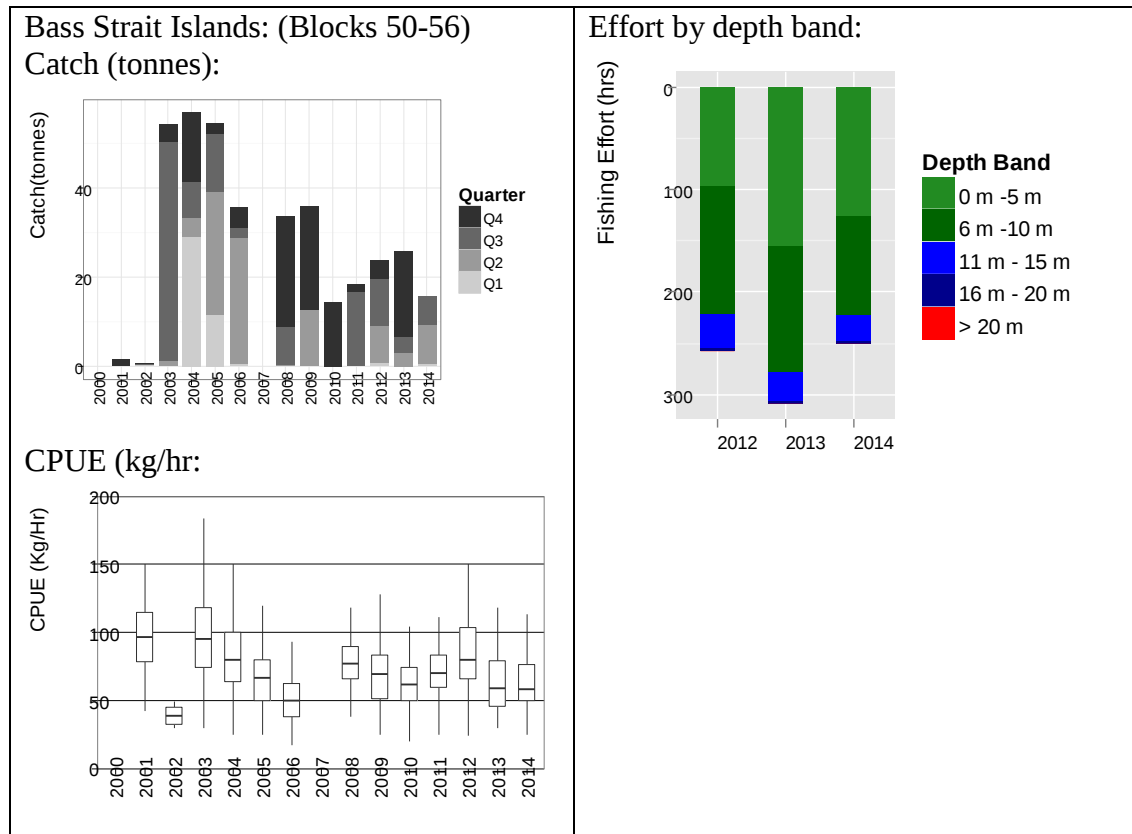
East side of Flinders Island, inc. Babel Island.



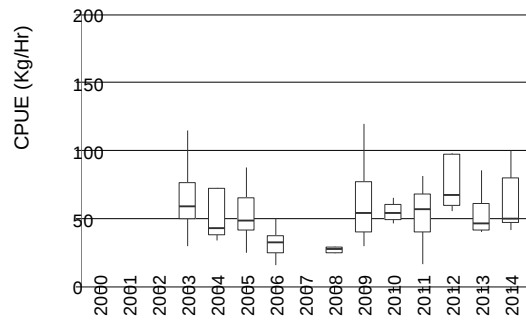
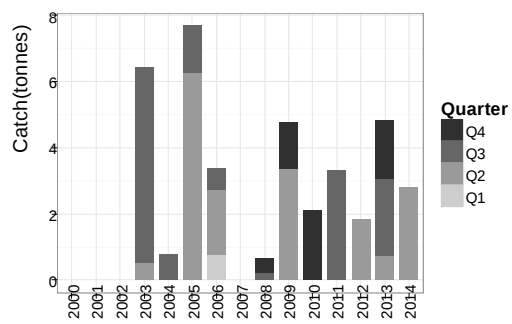
Bass Strait Zone – Central North Coast (Blocks 40-46)



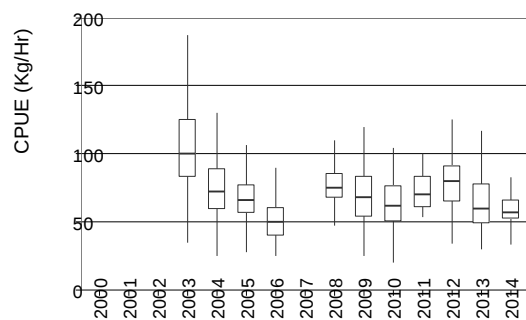
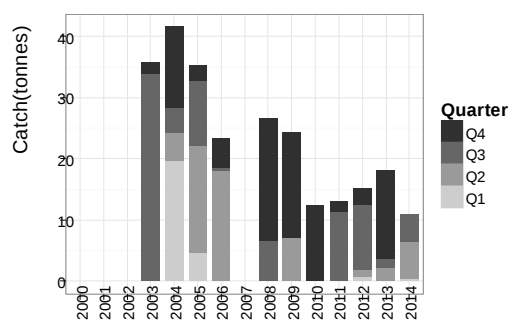
Bass Strait Zone – Remote Islands (Blocks 50-57)



Block 51: Kent Group



Block 53: Hogan Group



Greenlip fishery

The 2014 greenlip TACC was 140 t. It was distributed between six regions (note sum of region caps is 148.5 t):

King Island – 20 t
 North West – 21 t
 Perkins Bay- 25 t
 Central North-10 t
 North East – 25.5 t
 Furneaux Group – 47 t

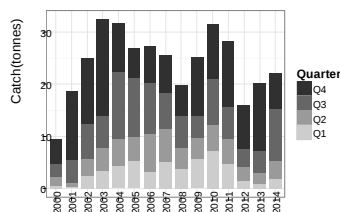
Annual catches:

Year	King Island	North West	North East	Furneaux Group	Perkins Bay	Central North	Total
2000	9.6	41.0	38.9	42.5	8.1	0.1	140.2
2001	18.6	28.9	30.4	44.2	17.8	0	139.9
2002	25.0	29.9	31.3	43.3	10.0		139.5
2003	32.6	30.3	35.3	37.6	4.0	0	139.8
2004	31.0	25.3	31.4	36.8	4.0	0.1	128.6
2005	28.8	25.2	19.4	42.4	7.2	0.1	123.1
2006	27.9	22.9	16.2	39.6	16.1	0.4	123.1
2007	25.6	22.9	33.5	31.1	10.5		123.6
2008	20.0	19.1	24.4	34.9	22.1	0.2	120.7
2009	25.3	13.7	35.0	27.3	20.2	1.1	122.6
2010	33.1	22.4	24.6	33.6	20.1		133.8
2011	28.3	21.1	23.7	44.3	21.0	1.6	140.0
2012	16.1	18.5	32.7	45.4	26.2	0.2	139.1
2013	20.1	22.6	24.5	55.1	17.1	0.3	140.4
2014	22.1	24.1	21.0	59.4	13.4	0.2	140.2

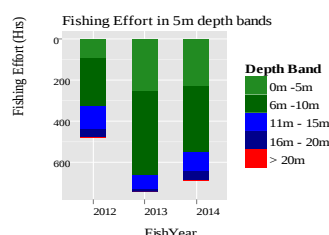
Small quantities (<1.0t pa) have been taken in recent years from Blocks 50 to 57.

Greenlip - King Island (Blocks 1-4)

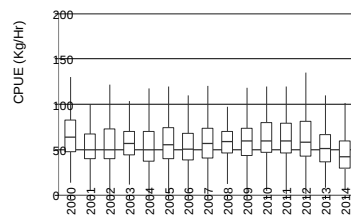
Regional view: Area cap
20 t in 2014, 22 t caught.
Catch (tonnes):



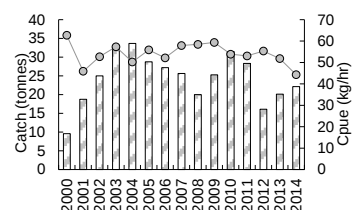
Effort by depth band:



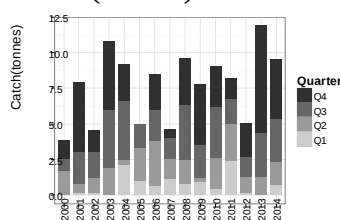
Median CPUE (kg/hr):



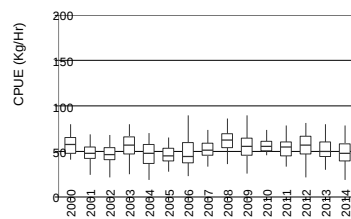
Catch and mean CPUE:
Mixed catch CPUE
removed, 48% of catch
was taken while single
species fishing in 2014.



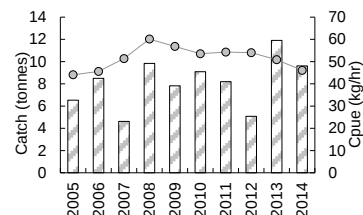
Sub-block 2C: East King
Island
Catch (tonnes):



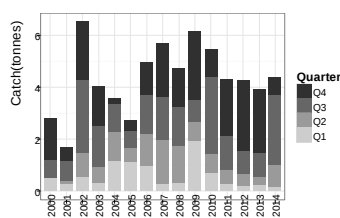
Median CPUE (kg/hr):



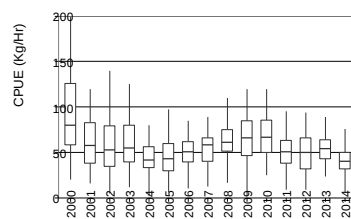
Catch and mean CPUE:
Mixed catch CPUE
removed, 85% of catch
was taken while single
species fishing in 2014.



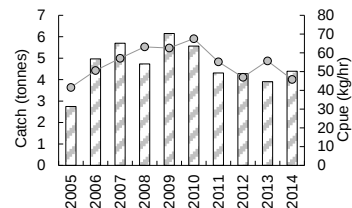
Block 4: South-east King
Island
Catch (tonnes):



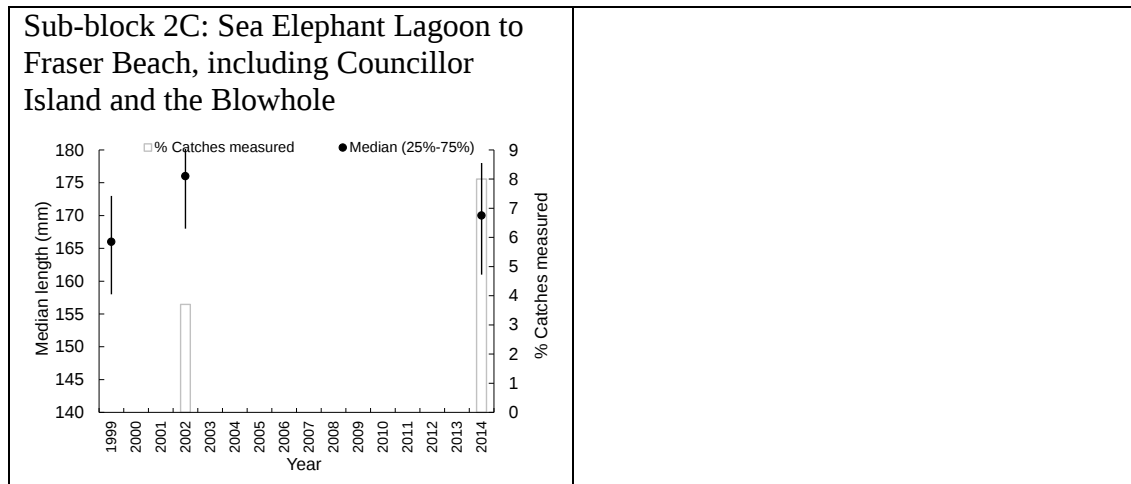
Median CPUE (kg/hr):



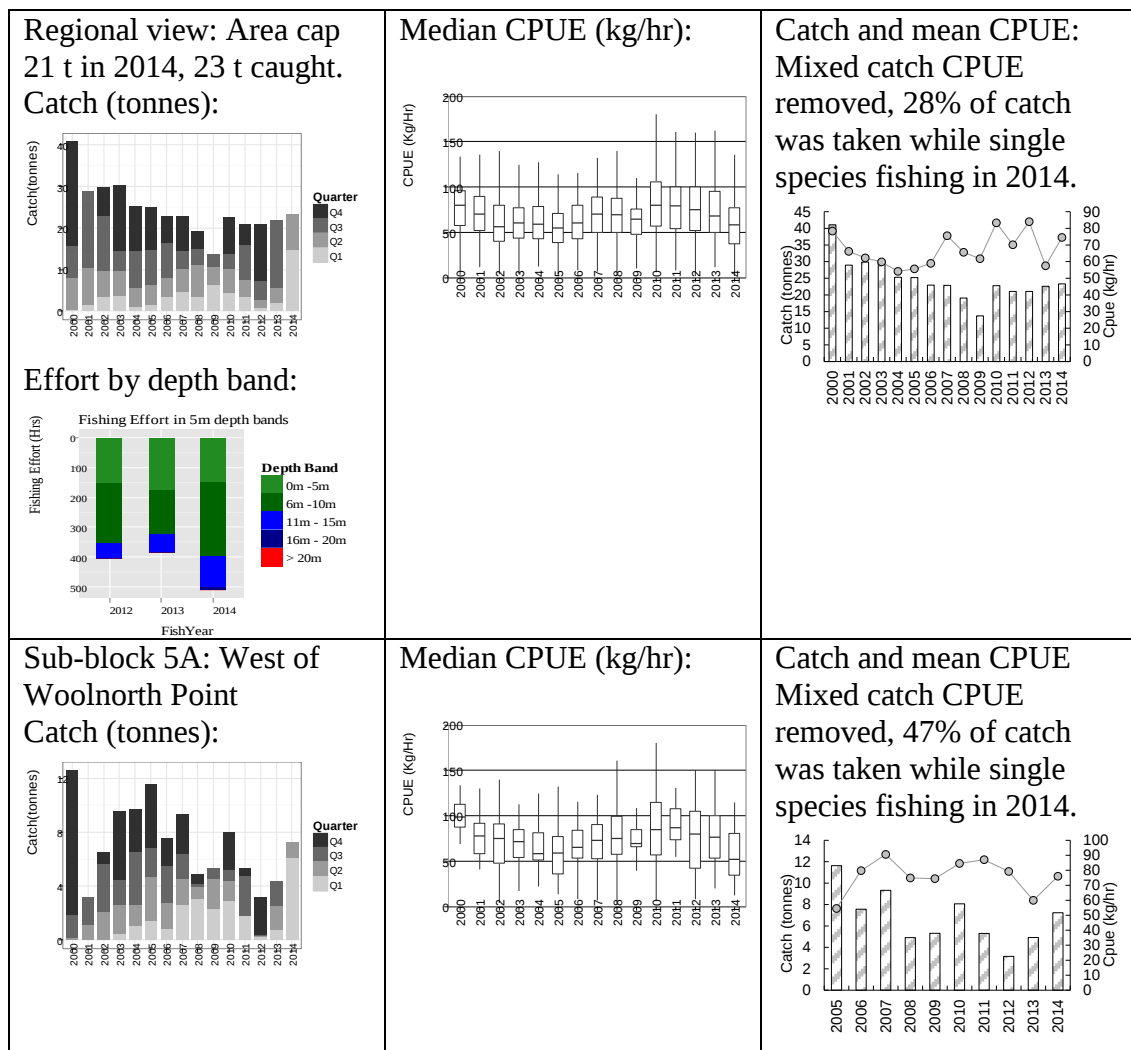
Catch and mean CPUE:
Mixed catch CPUE
removed, 19% of catch
(from 5 trips out of 27)
was taken while single
species fishing in 2014.

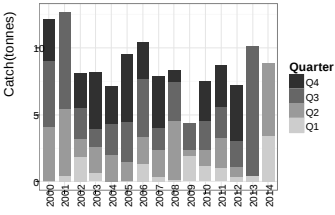
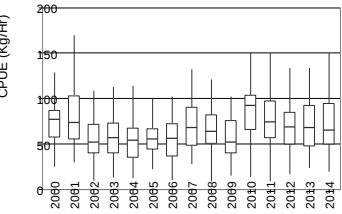
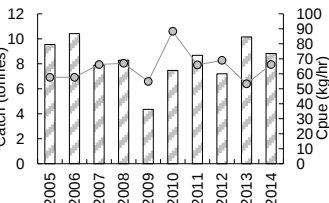
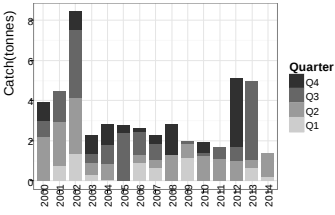
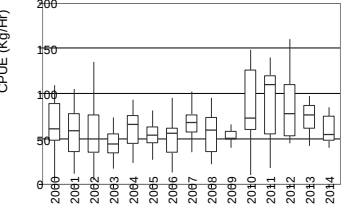
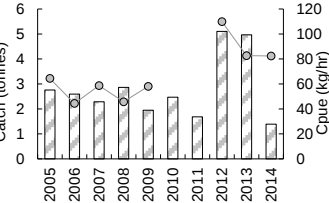
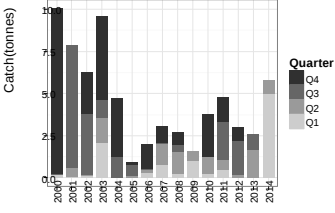
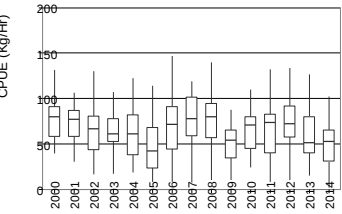
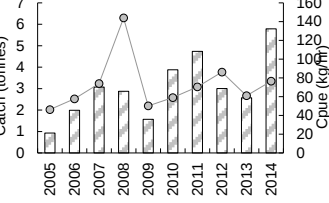


Greenlip – King Island Median length of catch

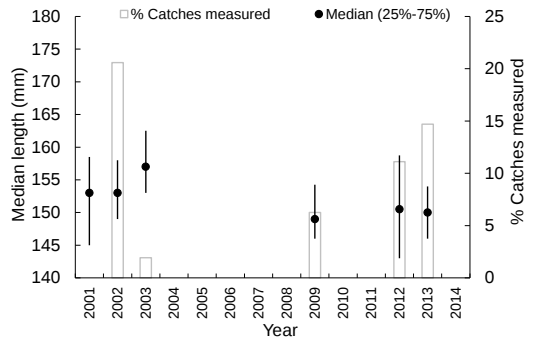
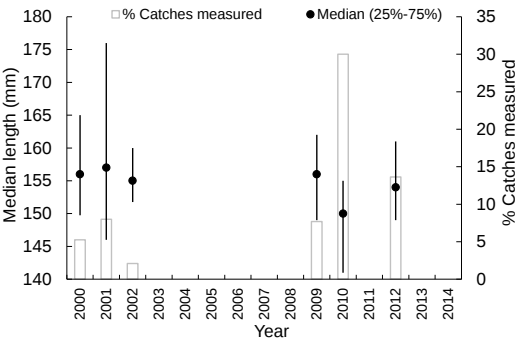


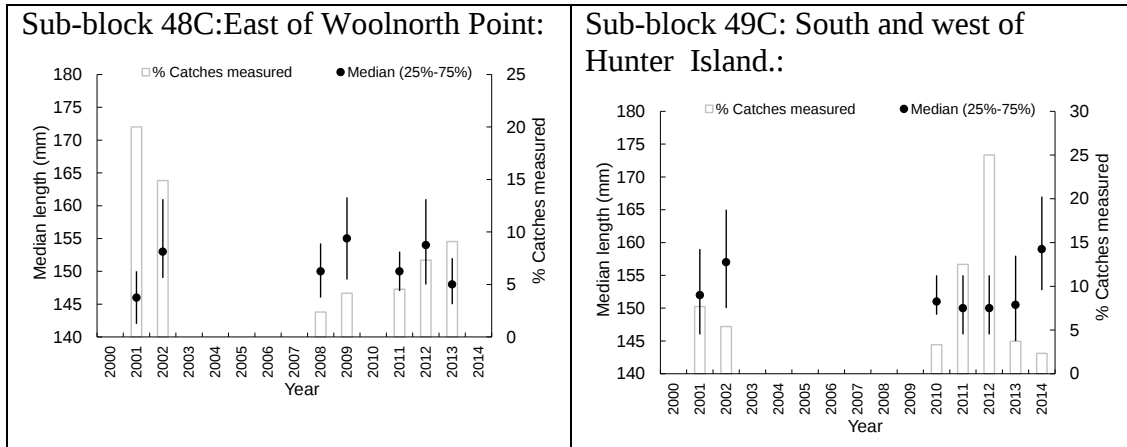
Greenlip - North West (Blocks 5, 48B, 48C, 49)



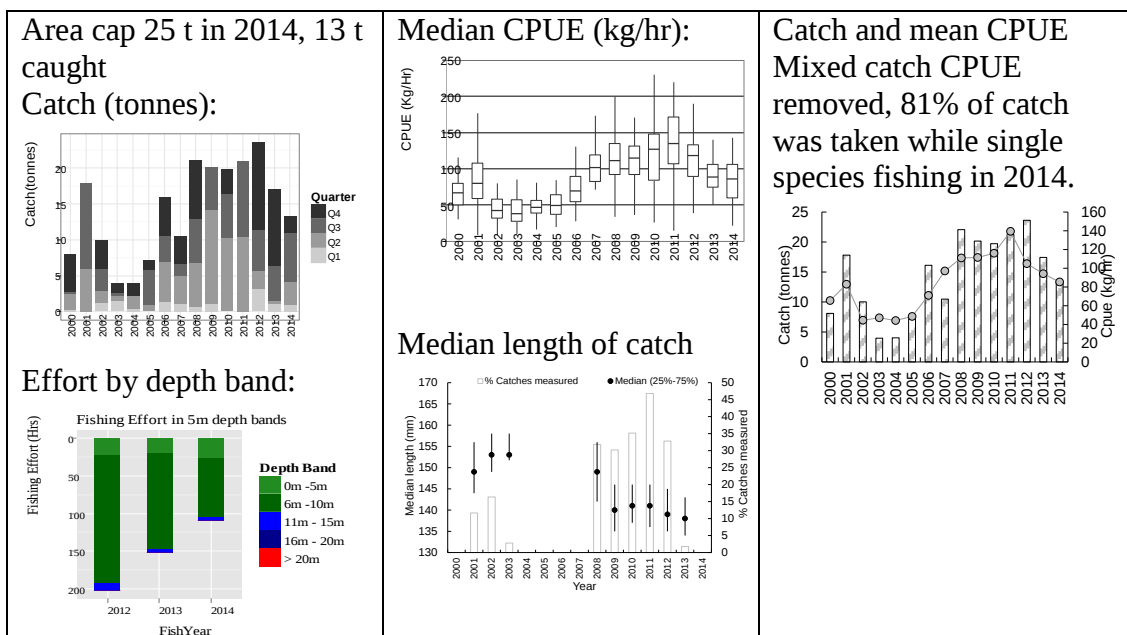
Sub-block 48C: Woolnorth to Robbins Island. Catch (tonnes): 	Median CPUE (kg/hr): 	Catch and mean CPUE Mixed catch CPUE removed, 14% of catch (from 6 trips out of 42) was taken while single species fishing in 2014. 
Sub-block 48B: Petrels Catch (tonnes): 	Median CPUE (kg/hr): 	Catch and mean CPUE Mixed catch CPUE removed, 33% of catch (from 2 trips out of 6) was taken while single species fishing in 2014. 
Sub-block 49C: South and west of Hunter Island Catch (tonnes): 	Median CPUE (kg/hr): 	Catch and mean CPUE Mixed catch CPUE removed, 22% of catch (from 7 trips out of 32) was taken while single species fishing in 2014. 

Greenlip – North West: median length of catch

Sub-block 5A: West of Woolnorth Point. 	Sub-block 48B: Petrels. 
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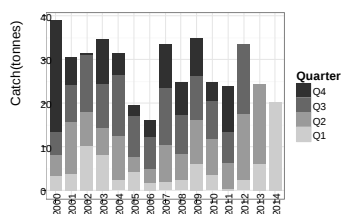


Greenlip – Perkins Bay (Sub-block 48A)

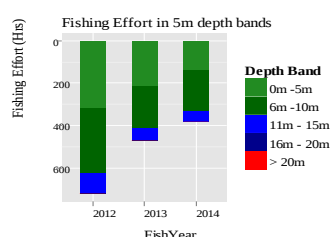


Greenlip - North East (Blocks 31, 39, 40)

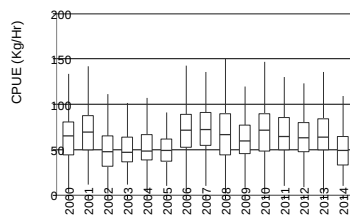
Regional view: Area cap
23 t in 2014, 21 t caught.
Catch (tonnes):



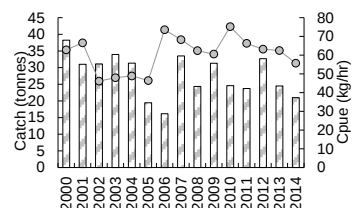
Effort by depth band:



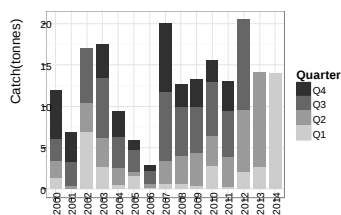
Median CPUE (kg/hr):



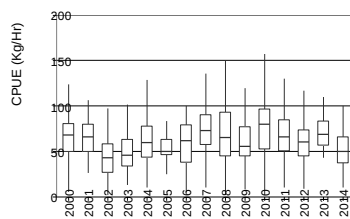
Catch and mean CPUE:
Mixed catch CPUE
removed, 16% of catch
(21 trips out of 126) was
taken while single species
fishing in 2014.



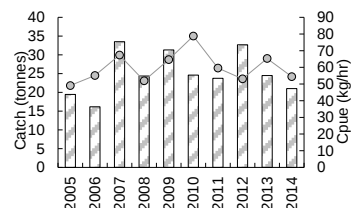
Block 31
Eddystone to Little
Musselroe, Swan Is.
Catch (tonnes):



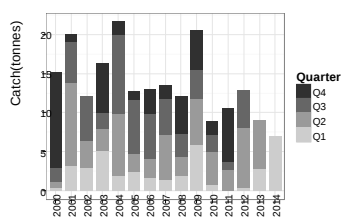
Median CPUE (kg/hr):



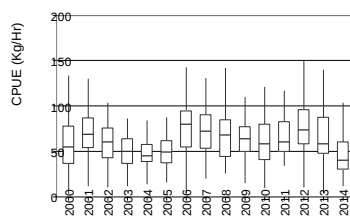
Catch and mean CPUE:
Mixed catch CPUE
removed, 15% of catch
(12 trips out of 82) was
taken while single species
fishing in 2014.



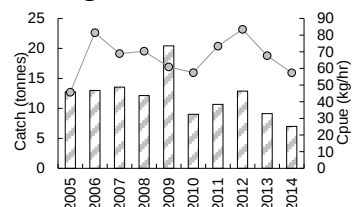
Block 39
Tomahawk to Little
Musselroe.
Catch (tonnes):



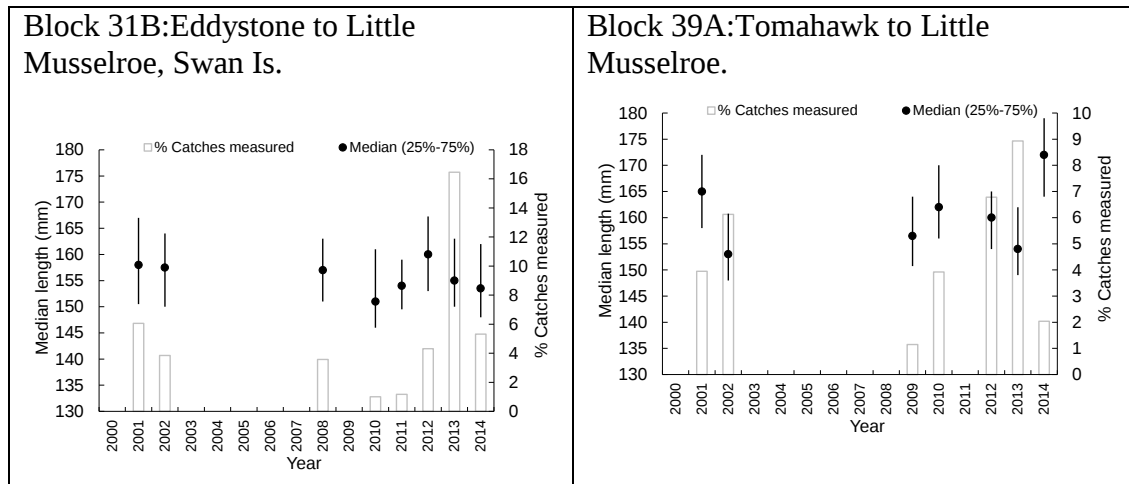
Median CPUE (kg/hr):



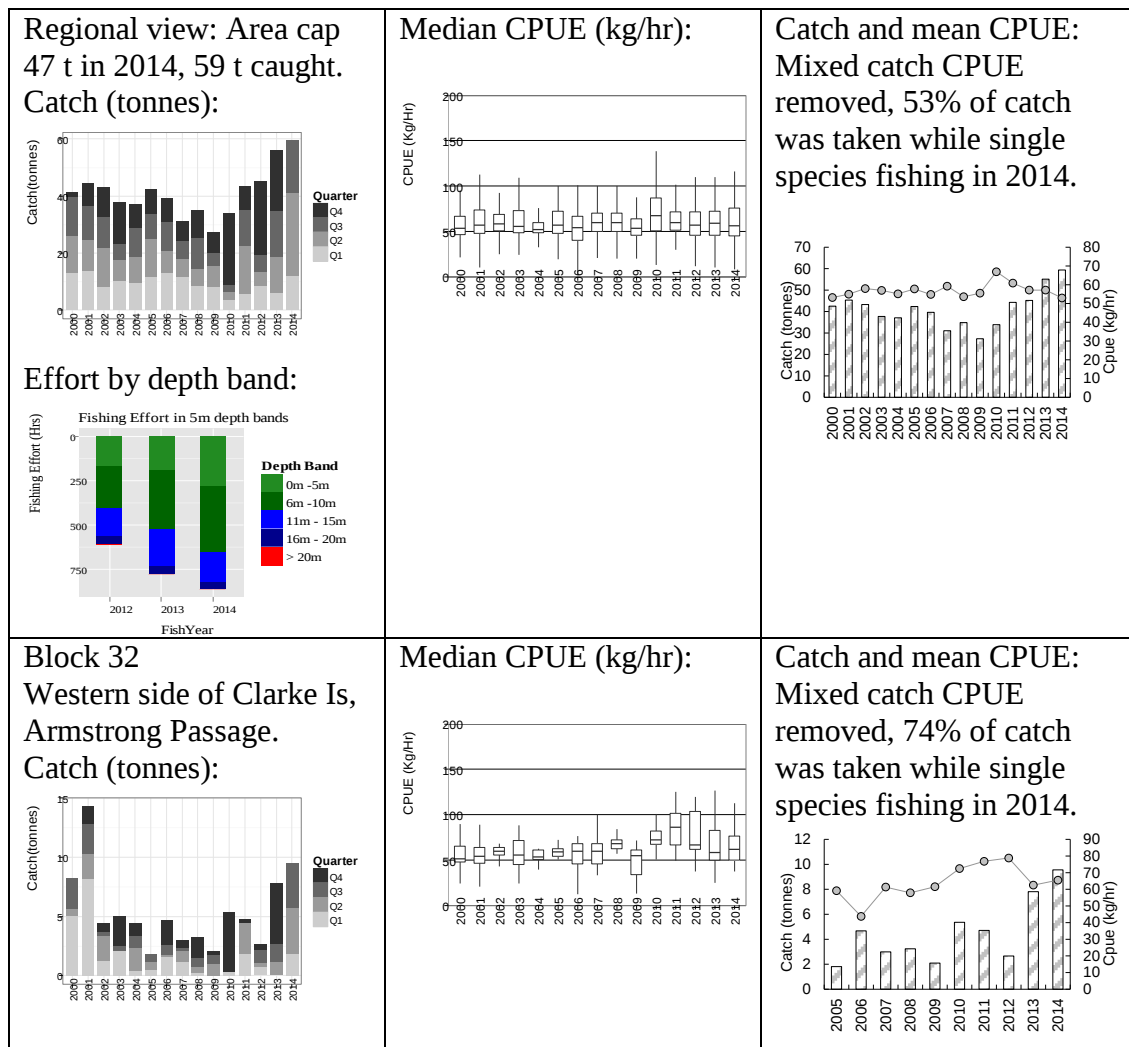
Catch and mean CPUE:
Mixed catch CPUE
removed, 27% of catch
(12 trips out of 44) was
taken while single species
fishing in 2014.

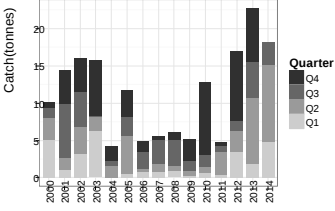
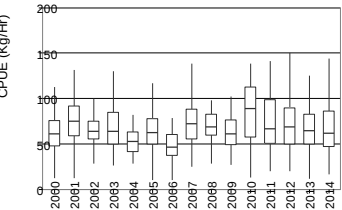
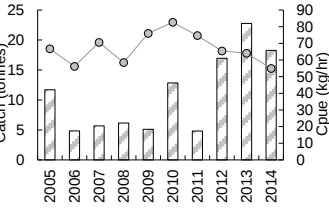
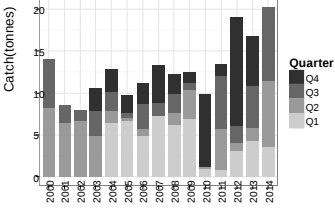
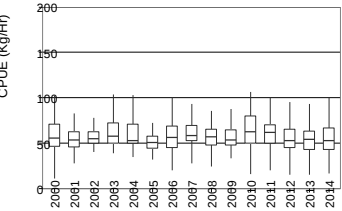
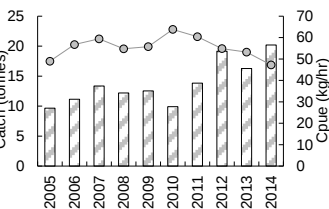
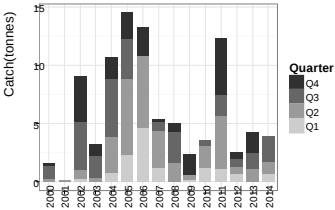
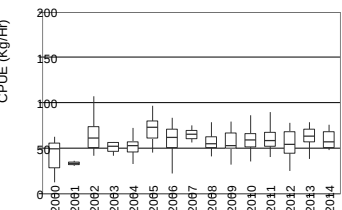
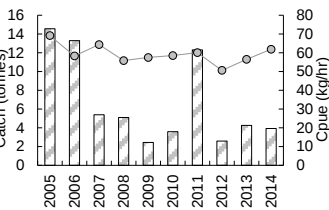


Greenlip – North East Median length of catch



Greenlip – Furneaux Group (Blocks 32-38)



Block 33 south east Clarke, Cape Barren Islands Catch (tonnes): 	Median CPUE (kg/hr): 	Catch and mean CPUE: Mixed catch CPUE removed, 41% of catch was taken while single species fishing in 2014. 
Block 35 Franklin Sound Catch (tonnes): 	Median CPUE (kg/hr): 	Catch and mean CPUE: Mixed catch CPUE removed, 56% of catch was taken while single- species fishing in 2014. 
Block 38 north-east Flinders Island Catch (tonnes): 	Median CPUE (kg/hr): 	Catch and mean CPUE: Mixed catch CPUE removed, 88% of catch was taken while single- species fishing in 2014. 

Appendix 2: Assessment of stock status

Table 3. Summary of changes in catch, catch rate (CPUE) and median length, by region, and interpretation for fishery status.

Region	Catch	CPUE	Length	Interpretation
Furneaux Group capped area (BSZ)	stable	rising	no data or erratic	Stable or increasing abundance
South Coast (WZ)	stable	falling	rising	Stock levels almost certainly falling, absence of recruits causes median length to rise, indicates weak recruitment
King Island (NZ), North West (G)	stable	falling	no data or erratic	Stock levels almost certainly falling
Central North (BSZ)	stable	stable	no data or erratic	Abundance stable or falling
Actaeons (EZ)	falling	falling	rising	Stock levels almost certainly falling, absence of recruits causes median length to rise, indicates weak recruitment
North East (G), Block 9 (WZ), South West (WZ), North West (NZ), Perkins Bay (G), Block 6 (CWZ)	falling	falling	no data or erratic	Stock levels almost certainly falling
Block 5 (NZ)	falling	erratic	no data or erratic	Stock levels stable or decreasing, less likely to be increasing.
Lower Channel (EZ)	rising	rising	rising	Increasing abundance
King Island (G)	rising	falling	no data or erratic	Stock levels falling
Bruny Island (EZ), Storm Bay (EZ), Furneaux (G),	rising	stable	no data or erratic	Stock levels stable or increasing, less likely to be decreasing
St Helens (EZ)	rising	erratic	no data or erratic	No clear signal
North of Strahan (WZ), North East (NZ)	erratic	falling	no data or erratic	No clear signal

Lower South East, Freycinet-Bicheno, Furneaux Group (BSZ) uncapped area, remote Bass Straight Islands (BSZ)	erratic erratic no data or erratic	No clear signal
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Appendix 3: Interpreting graphical information

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).

Catch by region, block and sub-block.

Figure 28 shows catch in tonnes for the last fifteen years by quarter.

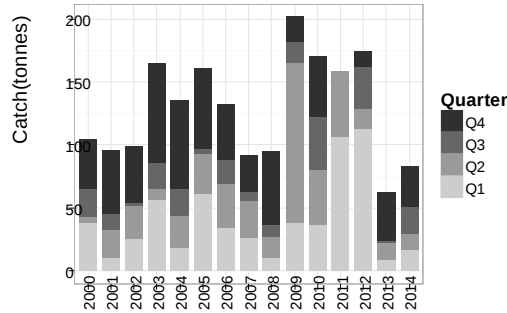


Figure 28. Annual catch (tonnes) by quarter, 2000-2014.

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.

Catch rate by region, block and sub-block.

Median catch rates are shown as a horizontal bar across the box, the top and bottom of which represent 25th and 75th percentile (i.e. the range of the middle half) catch rates (Figure 29). The vertical lines extending above and below the box show the range of 95% of catch rates. In areas where blacklip and greenlip may be caught on the same trip, catch rates are calculated from effort from both species.

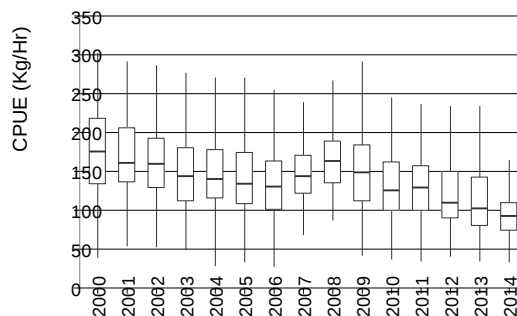


Figure 29. Box plot of annual catch rates (kg/hr), 2000-2014. Central line within box indicates median, box boundaries indicates 25th and 75th percentiles, and whiskers show 2.5 and 97.5 percentiles. N.b. Blacklip and greenlip effort is not separated.

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

Catch is shown by a series of vertical columns, while geometric mean catch rates are shown by connected balls. The columns and balls are shaded grey for greenlip, and

black for blacklip. In this assessment report, these charts are used to show mean catch rates in parts of the fishery where both greenlip and blacklip are fished, and where catches of both species made on the same trip have been removed. This prevents effort from one species influencing catch rates of the other species. The percentage of trips involving single-species fishing is specified for the most recent year.

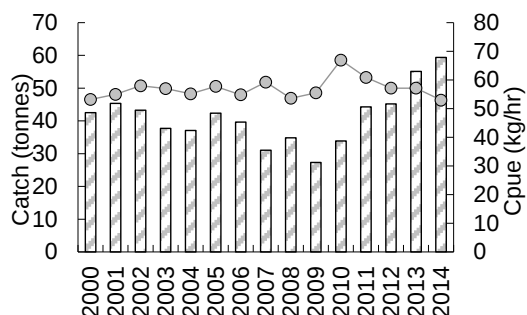


Figure 30. Annual catch and geometric mean catch rates for a single species (grey shading= greenlip, black shading = blacklip) from areas where both species may be caught on the same fishing trip.

Regional CPUE distribution:

The CPUE distribution provides further information about catch rates (Figure 31). The position of the mode (highest percentage catch rate category) indicates the rate at which the bulk of catch is caught. Skewness, or uneven distribution of the mode either side of the mid-range categories implying abnormal distribution of effort typically occurs when a small percentage of catches are made at high catch rates, but the bulk of catches are taken at low catch rates. We have not seen CPUE distributions skewed upward (i.e. to the right of centre). Skewness tends to be greatest when abalone abundance is low or has been recently reduced, making high catch rates less common.

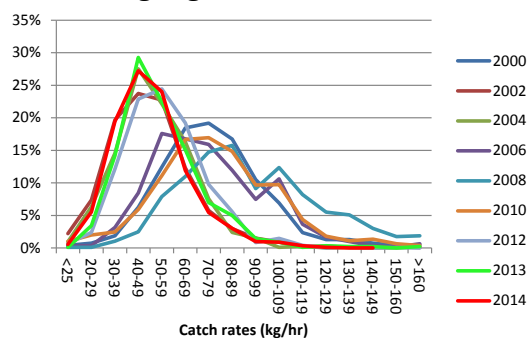


Figure 31. The percentage distribution of catch-rates, 2000 - 2014. Odd numbered years have been removed for clarity, except for 2013 which was retained to provide contrast.

Monthly catch and catch rates,

These charts are provided regionally, and show monthly totals of catch and geometric mean catch rates (Figure 32). The vertical columns show total catch in tonnes, for the period January-December. The black line with balls shows mean catch rates (CPUE) over the same period.

The charts provide information about temporal changes in fishing patterns throughout the year, such as the end-of-year drop in catch rates in the Eastern Zone, or the reduction of catch from the Western Zone during winter and spring. Deviation from

these established patterns would warn of changes to fishing behaviour that might invalidate the use of catch rates to monitor abundance.

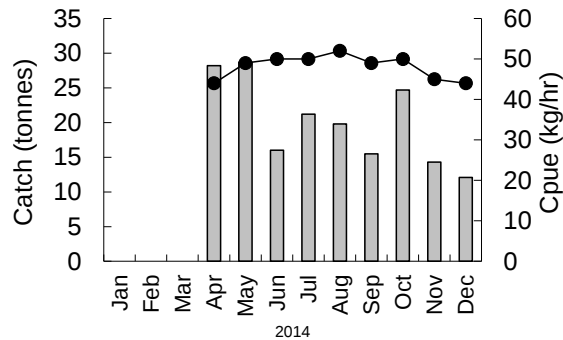


Figure 32. Monthly catch totals and mean catch rates, 2014

Size-composition charts.

The size-composition of divers' catches is reviewed at sub-block level (Figure 33). 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 the catches were reported from specific locations.

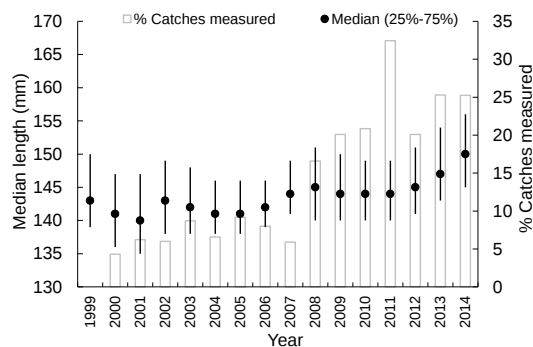


Figure 33. Median length with 25%-75% inter-quartile size range of abalone from commercial catch samples, 1999-2014. The vertical columns represent the percentage of catches sampled.

Size-composition charts plot median length (the middle or 50th percentile length if all abalone were sorted from smallest to largest). The vertical bars 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. The percentage of catches sampled is shown on the right hand side of the chart. The higher the percentage of catches sampled, the more likely that the size distribution reflects the populations within the reporting area, provided that sufficient fishing has occurred. In years where low levels of fishing have occurred, even very high percentages of catch sampling may fail to provide adequate data to be informative of changes in abalone length within the fished area. Generally, sampling rates of 10% or more are preferred, although where fishing is intensive, rates as low as 4% may be acceptable (Andrew and Chen, 1997).

Effort by depth band.

Since 1 January, 2012, divers have been required to wear loggers that monitor depth and effort. Changes in the distribution of effort by depth may indicate changes in

fishing behaviour that invalidate the assumption that catch rates reflect abalone abundance. The charts show total effort (hours) pa, at five-metre depth intervals ranging from the surface to >20 m (Figure 34).

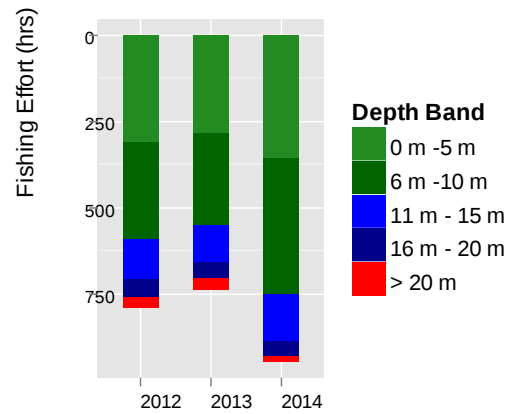


Figure 34. Fishing effort (hours) by five-metre depth band, 2012-2014.

Appendix 4: Interpreting trends in catch and catch rate, and the size composition of the commercial catch

The use of catch and catch rates to infer changes in abundance

This assessment is primarily based upon the interpretation of information produced from fishery catch data; both catch distribution and catch rates. It relies upon the assumption that trends in catch-rates reflect changes in abundance of the fishable stock. Despite CPUE being much discredited as an index of abalone abundance (e.g. Breen, 1992; Prince, 1992; Shepherd *et al.*, 2001) it has been used with some success for many years in the Tasmanian fishery. There are several factors that adversely affect the relationship between CPUE and abalone abundance: gregarious behaviour of abalone, serial depletion of local populations constituting the stock, and changes in fishing efficiency. If the effects of the above factors are understood and can be minimized then the reliability of CPUE as an index of abundance can be improved.

Gregarious behaviour

Abalone tend to aggregate in favourable habitat (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 sub-block scale of reporting (Appendix 11) is 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.

The increase in efficiency caused by droplines is not constant across all abalone densities however. 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 abalone 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.

Team diving has the effect of reducing diver efficiency, but increasing profitability because of cost-sharing between the divers. Economic returns to divers have fallen since 2000 (Felmingham and Van Putten, 2009). Many divers reduce operating costs by teaming up with other divers and work from the same vessel, particularly when quota availability becomes reduced and they have comparatively small orders to fill e.g. following a TACC reduction. This introduces inefficiencies to the fishing operation, and team dive catch rates are generally lower than single diver catch rates. In the

example below (Figure 35), the average difference between annual mean catch rates from team divers compared with single divers during the period 2000-2014 was 9 kg/hr (range 3-16 kg/hr). During this period, the percentage of team dives increased, from 15% in 2000, to a maximum of 42% in 2011, so the net effect of team diving over this period caused a reduction in the mean catch rate.

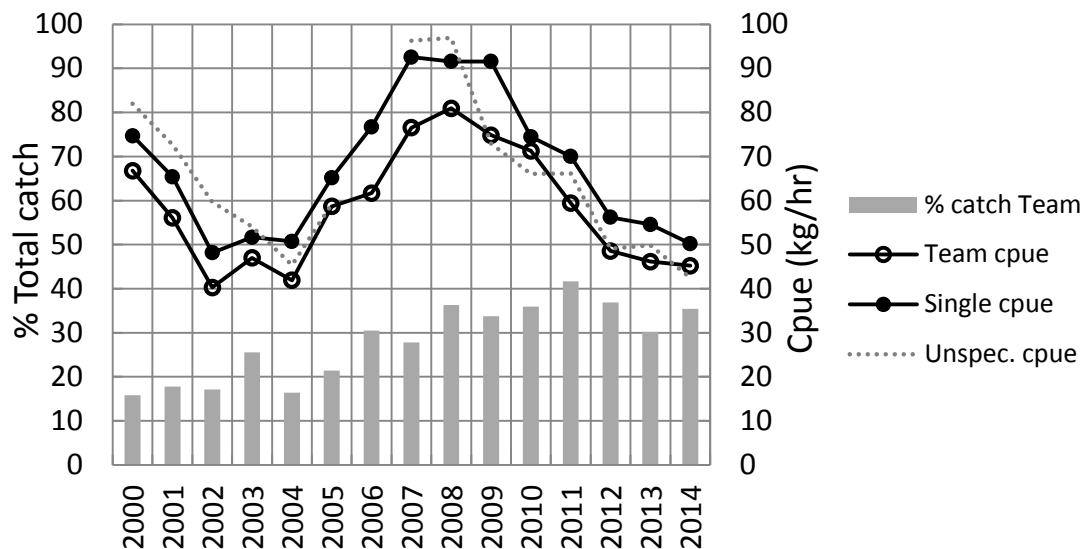


Figure 35. Comparison between catch rates derived from catches by dive teams (“Team cpue”) and by single divers (“Single cpue”), showing the percentage of the total catch taken by dive teams, from Block 13 (Eastern Zone), between 2000 and 2014. “Unspec.cpue” refers to catch rates where the number of divers could not be determined, which ranged 0-6% pa during the period.

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 36).

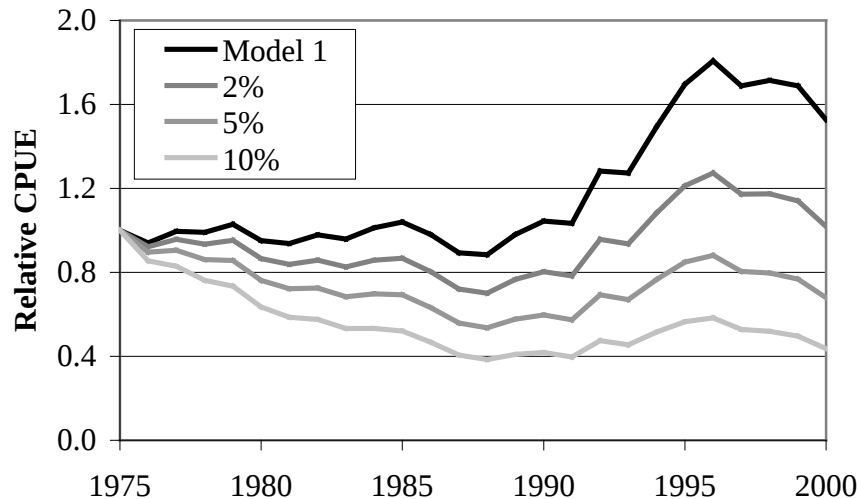


Figure 36. Relative CPUE indices for Block 13, 1975-2000. Model 1 is the raw geometric mean of CPUE. The three effort creep scenarios considered are: (i) 2% per annum; (ii) 5% per annum; and (iii) 10% per annum. All values of CPUE are relative to 1975 (Tarbath et al., 2001).

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 ten years during which we assume that divers operated with equal efficiency. 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 in fished populations. For example, in the NSW blacklip fishery, high visitation and exploitation rates limit 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 and fishing behaviour is unchanged, we 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 coastline, the population remnants contracted to either deep water or the wash zone, where they can still be caught at high catch rates. Earlier assessments also failed to account for the larger size of west coast fish, which causes high catch rates relative to other parts of the fishery. 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.

We assume that a change in annual catch (e.g. TACC reduction) will cause effort to be proportionally reduced throughout a zone, but this is not usually the case. Effort is maintained on favoured areas, while less favoured areas may go unfished, which means that effort is not applied consistently to populations. This can increase the time between fishing events and allow aggregations to form where previously there were none, or worse, reduce effort on populations to superficial levels. Both can produce high catch rates and the illusion of high stock levels. Under these circumstances, the relationship between abalone abundance and catch rates is different than when under conditions of constant levels of effort, and catch rate trends should be used with caution.

Much of Tasmania's greenlip fishery is fished at low levels of effort, 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 should indicate falling recruitment: despite a reduction in fishing pressure, catch rates continue to decline because there are increasingly fewer recruits each year to the fishery. Conversely, catch rates increasing with increasing catches are likely to indicate an increase in fishable biomass.

Size composition of the commercial catch

Almost since the start 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 IMAS 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 several of the major processors who together process over 40% of the catch. Processor staff measure samples of 100 abalone from catches using electronic measuring boards. The length measurements and catch docket numbers are returned to IMAS, where the length data is collated by sub-block.

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. This variation may stem from several causes: e.g. 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. The size-structure of catch samples may also 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.

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 generally not used in this assessment.

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 likelihood 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. For example (a) the median length of samples in almost all sub-blocks has increased with increases in size limit, and (b) the relatively high median length of 1998 and 1999 samples and the fall in length up to 2002 is also common across sub-blocks where those years were sampled. These trends are consistent with known decreases in the available stock and confirm that the 4% level of sampling is adequate to detect changes in length caused by fishing in the Eastern Zone.

Interpreting annual changes in median and inter-quartile lengths

Catch samples show that throughout much of south east since 1998, 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 below which 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.

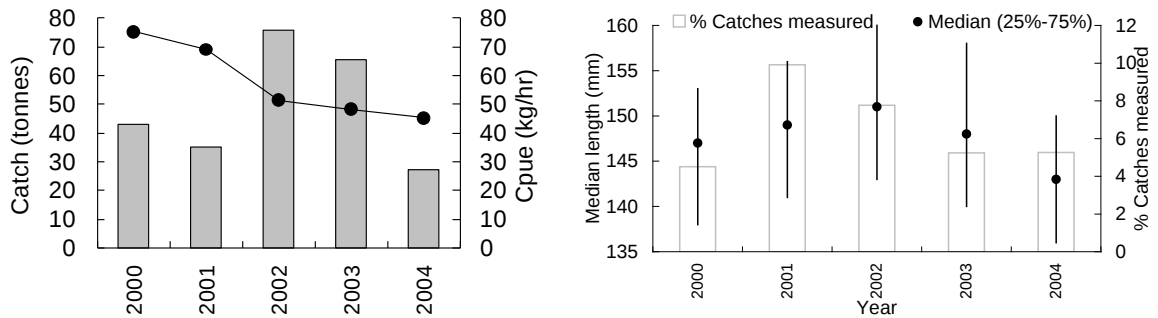


Figure 37. Trends in catch, catch rate and median length (flanked by the 25th and 75th percentile bounds), sub-block 13C, 2000-2004.

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 37). The median length of landed abalone increased in 2002, when the LML 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 37).

An 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 38).

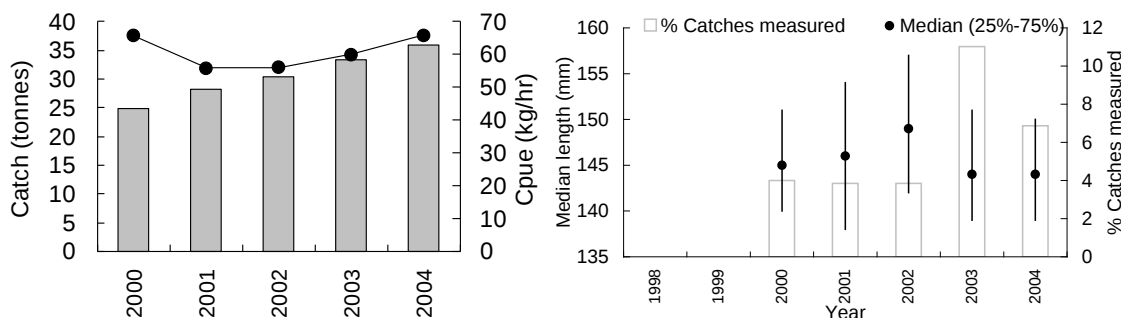


Figure 38. Trends in catch, catch rate and median length (flanked by the 25th and 75th percentile bounds), sub-block 20B, 2000-2004.

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) started to recover after 2002 (Figure 39). 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 37), the size-structure has been maintained, indicating that the levels of fishing pressure appeared sustainable.

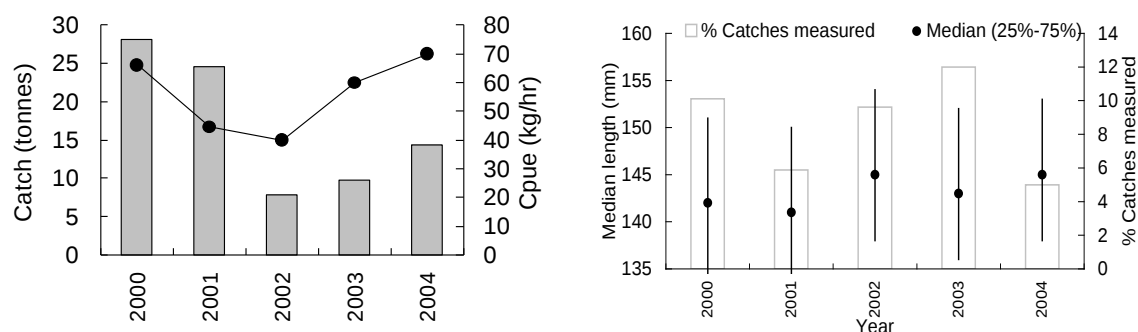


Figure 39. Trends in catch, catch rate and median length (flanked by the 25th and 75th percentile bounds), sub-block 24B, 2000-2004.

Increasing median length and 25th percentile length with falling catch rates may indicate stock decline, particularly after several years of reducing catch rates (Figure 40). In this scenario, divers have abandoned the formerly popular reefs because of low catch rates, and are searching low yield reefs where catch rates were previously too low to tolerate. Here they encounter small numbers of older (and larger) abalone. The 25th percentile tends to increase because of low recruitment, while the 75th percentile may be less affected because growth rates on these unproductive reefs are generally low.

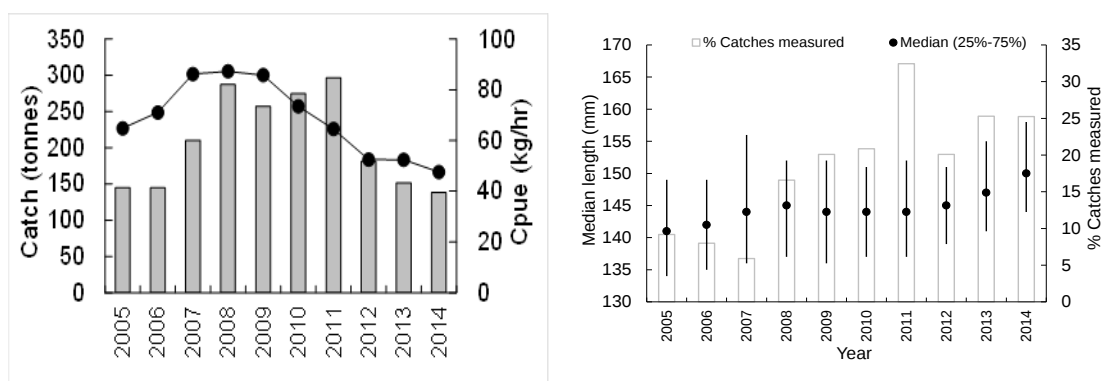


Figure 40. Trends in catch, catch rate and median length (flanked by the 25th and 75th percentile bounds), sub-block 13E, 2005-2014.

Appendix 5: Early abalone production 1960-1981

Annual tonnages of abalone production from Tasmania are shown below. The first two series - divers' catches^a and Tasmanian processors' receipts^b have been reproduced from "Summary of Statistics – Tasmania", Abalone Situation Report 10, Demersal Mollusc Research Group, published by CSIRO, 1982. Tasmanian Year Book^c totals were published each year from 1967 by the Commonwealth Bureau of Census and Statistics (annual totals from 1964 were reported in the 1967 edition).

All three totals were reported by financial year. Abalone catch prior to 1968 was reported by divers in general fish returns as miscellaneous catch, and annual totals are incomplete. Catches are believed to have been substantially under-reported between 1960 and 1981 i.e. catch totals were higher than shown here. Processor receipts were from Tasmanian processors only: much of the early catch was freighted to interstate processors and is not included amongst these processor receipts. Little or no processing was done in Tasmania prior to 1964. The source of the Tasmanian Year Book totals was not reported.

Year	Diver ^a returns	Processor ^b returns	Tasmanian Year Book ^c
1960	*	*	**
1961	*	*	**
1962	*	*	**
1963	*	*	**
1964	*	49	33
1965	*	225	225
1966	412	753	727
1967	1,050	1,722	2,003
1968	1,966	2,354	2,792
1969	1,894	2,139	2,113
1970	2,297	2,613	2,613
1971	2,504	3,488	3,495
1972	2,287	2,971	2,977
1973	1,703	2,174	2,172
1974	1,883	2,106	2,060
1975	1,919	2,108	2,108
1976	2,289	2,429	2,429
1977	2,263	2,368	2,368
1978	2,823	2,524	2,525
1979	2,762	3,100	3,100
1980	3,391	3,204	3,214
1981	3,800	3,621	3,743

* Records unavailable.

** Records not published.

Appendix 6: Annual Catches by Zone – 1975-2014

Eastern Zone

Annual tonnages of blacklip abalone caught within the statistical blocks and sub-blocks comprising the Eastern Zone in 2014 (sub-blocks 13C, 13D, 13E, Blocks 14 to 30 and sub-block 31A). Pre-zoning catches cannot be accurately assigned to zones in blocks where zone boundaries occur (Blocks 13 and 31). Catches in those blocks are reported as Eastern Zone because the majority of later catches occurred there. Any discrepancies between totals and sums of component blocks are due to rounding.

	Year	13	14	15	16	17	19	20	21	22
Estimated weights	1975	247	111	10	47	11	0	16	27	49
	1976	208	156	0	64	36	1	18	25	45
	1977	245	232	2	190	11	1	23	35	37
	1978	322	218	6	119	24	1	32	65	60
	1979	374	251	8	148	25	2	51	52	43
	1980	272	255	7	145	30	1	33	30	42
	1981	254	299	18	127	48	4	45	69	35
	1982	337	218	15	147	24	3	36	62	63
	1983	250	300	10	189	28	3	43	63	54
	1984	318	297	18	166	35	5	47	70	73
Landed weights	1985	256	262	4	89	83	11	68	80	43
	1986	220	262	22	82	93	4	65	66	70
	1987	224	229	7	47	80	1	43	44	32
	1988	219	258	6	76	57	4	62	44	43
	1989	156	172	2	56	43	2	61	42	22
	1990	132	193	4	76	29	3	33	51	40
	1991	127	207	2	60	37	3	53	50	47
Estimated weights	1992	140	106	3	28	20	2	51	43	49
	1993	257	116	4	100	40	1	59	78	48
	1994	295	139	10	114	46	1	109	80	55
	1995	310	247	1	100	35	1	95	74	34
	1996	391	195	0	78	18	3	71	55	44
	1997	471	137	0	64	25	2	79	49	47
	1998	470	108	1	116	23	2	85	64	63
	1999	491	66	2	113	35	6	102	72	50
	2000	381	98	2	71	29	4	62	60	69
	2001	324	157	3	108	20	2	56	50	40
	2002	296	101	1	72	16	1	62	58	46
	2003	291	116	2	60	17	1	88	54	35
	2004	221	104	7	50	20	2	92	52	35
	2005	181	90	8	56	20	3	116	62	36
	2006	184	84	3	67	13	2	73	66	71
	2007	255	70	0	56	8	6	68	63	61
	2008	340	56	1	64	8	0	50	61	56
	2009	341	63	1	52	20	1	51	52	91
	2010	342	70	1	39	10	2	71	59	73
	2011	359	15	0	37	8	1	30	47	54
	2012	268	22	0	15	8	1	21	23	60
	2013	199	22	0	24	9	1	21	27	56
	2014	180	38	0	27	10	2	38	30	43
	Average 75-14	279	154	5	84	29	2	57	54	50
	Average 85-14	277	127	3	67	29	3	65	55	50
	Average 00-14	278	74	2	53	14	2	60	51	55

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Eastern Zone (continued)

	Year	23	24	25	26	27	28	29	30	31	Total
Estimated weights	1975	74	15	16	5	44	69	16	44	32	835
	1976	56	18	12	9	40	72	9	37	50	857
	1977	53	11	10	8	55	90	22	119	54	1196
	1978	88	22	13	11	93	87	25	137	105	1431
	1979	30	9	23	7	80	52	12	105	60	1332
	1980	46	158	34	7	108	91	27	148	105	1538
	1981	77	137	19	15	68	154	22	146	52	1586
	1982	49	97	20	9	89	100	32	170	48	1519
	1983	92	99	31	14	99	103	65	296	90	1828
	1984	61	109	10	11	106	112	52	148	76	1714
Landed weights	1985	44	120	20	17	86	71	5	84	171	1515
	1986	56	88	12	20	50	58	14	124	164	1472
	1987	34	66	12	8	76	45	11	67	54	1082
	1988	34	79	10	6	65	52	16	93	90	1214
	1989	16	34	7	8	41	31	11	39	27	770
	1990	36	61	1	2	61	77	21	54	22	897
	1991	31	67	2	9	64	66	12	30	21	890
Estimated weights	1992	23	67	1	1	67	45	7	10	13	676
	1993	24	73	1	1	86	39	8	15	15	964
	1994	16	53	0	3	103	24	8	11	21	1088
	1995	19	38	0	1	81	18	6	10	26	1097
	1996	28	67	3	6	89	39	11	28	20	1147
	1997	32	106	1	13	190	32	32	23	33	1336
	1998	44	160	2	25	180	77	31	10	15	1476
	1999	53	143	0	9	95	60	26	11	39	1374
	2000	44	104	1	8	101	16	21	10	90	1171
	2001	24	111	1	14	68	9	27	13	78	1104
	2002	15	46	0	2	53	7	15	12	44	847
	2003	21	51	0	3	50	8	19	3	27	848
	2004	19	51	1	1	44	11	24	6	22	761
	2005	18	66	0	0	43	13	36	7	15	770
	2006	23	88	1	1	40	10	41	0	7	773
	2007	14	59	0	1	55	11	32	0	4	766
	2008	11	68	0	1	48	6	28	0	10	807
	2009	22	63	0	0	50	5	26	2	12	852
	2010	20	67	0	0	38	6	20	3	67	888
	2011	17	37	0	1	35	5	16	4	42	710
	2012	14	22	0	0	14	2	19	5	49	543
	2013	38	39	0	0	7	8	51	7	15	523
	2014	23	38	0	0	19	1	47	6	19	523
Average 75-14		36	70	7	6	70	44	23	51	48	1068
Average 85-14		27	71	3	5	67	28	21	23	41	963
Average 00-14		21	61	0	2	44	8	28	5	33	792

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Central Western Zone

Annual tonnages of blacklip abalone caught within the statistical blocks and sub-blocks comprising the Central Western Zone (Sub-block 5D, 6A, 6B, 6C) in 2014. Catches from Block 5 prior to 2001 are reported in the Northern Zone, catches from sub-block 6D from 2000 are reported in the Western Zone. Any discrepancies between totals and sums of components are due to rounding.

	Year	5D	6A, 6B, 6C (all block 6 prior to 2000)	Total
Estimated weights	1975		110	110
	1976		63	63
	1977		50	50
	1978		79	79
	1979		112	112
	1980		196	196
	1981		257	257
	1982		147	147
	1983		231	231
	1984		298	298
Landed weights	1985		322	322
	1986		213	213
	1987		185	185
	1988		241	241
	1989		192	192
	1990		197	197
	1991		169	169
Estimated weights	1992		235	235
	1993		154	154
	1994		79	79
	1995		112	112
	1996		103	103
	1997		98	98
	1998		126	126
	1999		149	149
	2000		162	162
	2001	0	162	162
	2002	2	142	144
	2003	0	62	62
	2004	3	64	67
	2005	6	69	75
	2006	4	58	62
	2007	0	42	42
	2008	0	70	70
	2009	0	95	95
	2010	0	127	127
	2011	1	135	136
	2012	1	127	128
	2013	0	101	101
	2014	0	73	73
Average 75-14		1	140	141
Average 85-14		1	135	136
Average 00-14		1	99	100

Western Zone

Annual tonnages of blacklip abalone caught within the statistical blocks and sub-blocks comprising the Western Zone in 2014 (Blocks 9 to 12, Sub-blocks 13A, 13B). Pre-zoning (1975-1999) catches from Block 13 are reported in the Eastern Zone. Any discrepancies between totals and sums of components are due to rounding.

	Year	6D	7	8	9	10	11	12	13	Total
Estimated weights	1975		36	42	126	130	191	143		668
	1976		56	77	252	179	240	153		957
	1977		24	22	123	98	153	189		608
	1978		13	27	115	258	275	208		894
	1979		19	23	172	166	269	325		974
	1980		81	63	316	195	338	351		1343
	1981		88	87	444	260	417	246		1541
	1982		34	34	249	100	303	235		955
	1983		102	58	199	174	430	242		1204
Landed weights	1984		78	38	248	284	681	258		1586
	1985		99	23	246	140	478	155		1141
	1986		97	11	133	127	289	193		851
	1987		84	44	252	82	339	195		996
	1988		53	27	159	124	270	162		795
	1989		49	46	120	109	212	144		681
	1990		56	21	95	80	232	125		610
	1991		54	30	102	106	219	140		650
Estimated weights	1992		70	36	91	95	266	159		717
	1993		64	38	110	65	197	177		651
	1994		33	38	77	60	202	160		570
	1995		30	17	44	68	186	182		526
	1996		67	13	59	75	145	148		508
	1997		75	28	140	66	224	227		760
	1998		51	27	78	47	163	192		558
	1999		60	24	115	58	220	251		729
	2000	21	61	23	205	148	326	282	54	1119
	2001	49	32	15	186	152	312	290	43	1079
	2002	31	51	17	174	143	360	236	93	1104
	2003	34	104	27	142	239	345	229	67	1189
	2004	24	89	22	130	181	374	250	96	1167
	2005	26	110	26	92	149	389	311	65	1167
	2006	50	76	6	142	198	384	228	89	1174
	2007	34	39	18	178	231	354	267	68	1189
	2008	35	51	9	156	178	345	305	79	1159
	2009	47	107	51	155	110	244	327	77	1118
	2010	23	110	37	159	158	245	277	68	1077
	2011	17	95	48	171	159	247	256	56	1048
	2012	59	97	19	172	146	273	267	44	1076
	2013	11	44	8	158	180	287	251	41	981
	2014	34	44	5	98	142	220	249	37	829
Average 75-14		33	65	31	160	142	291	225	65	949
Average 85-14		33	68	25	138	127	278	221	65	907
Average 00-14		33	74	22	155	168	314	268	65	1098

Northern Zone

Annual tonnages of blacklip abalone caught within the statistical blocks and sub-blocks comprising the Northern Zone in 2014 (Blocks 1 to 4, Sub-blocks 5A, 5B, 5C, 31B, Blocks 39 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. Any discrepancies between totals and sums of components are due to rounding.

	Year	31	39	40	47	48	49	5	1	2	3	4	Total
Estimated weights	1975		2	1	1	12	9	38	32	1	27	15	139
	1976		5	0	1	12	33	46	39	0	51	8	195
	1977		6	2	0	8	17	51	17	1	87	8	196
	1978		8	2	3	10	11	65	21	3	55	25	204
	1979		6	1	0	27	7	85	24	2	10	9	172
	1980		3	1	0	10	1	92	51	3	33	3	197
	1981		6	2	3	33	10	120	19	8	32	9	242
	1982		5	2	1	45	7	121	22	9	27	13	253
	1983		7	4	9	45	19	228	22	2	31	52	418
	1984		6	3	4	80	44	312	10	1	33	55	548
Landed weights	1985		5	1	4	48	50	319	43	0	26	11	508
	1986		10	5	15	85	97	267	35	4	24	13	556
	1987		6	1	18	58	67	198	44	62	24	54	531
	1988		3	1	18	30	38	165	29	16	21	60	380
	1989		1	28	14	15	24	88	14	7	10	5	206
	1990		0	0	6	14	20	82	11	10	9	11	164
	1991		1	0	8	12	10	97	6	7	14	26	182
Estimated weights	1992		4	0	3	10	11	76	2	3	9	8	126
	1993		0	0	1	7	7	65	8	3	8	9	107
	1994		0	0	0	7	12	49	15	2	4	1	90
	1995		0	0	0	6	2	62	11	3	1	8	94
	1996		0	0	0	4	0	63	7	2	1	2	80
	1997		1	0	0	6	2	56	10	1	10	6	91
	1998		0	1	0	7	3	61	3	1	0	2	78
	1999		5	0	0	14	4	57	5	1	6	6	97
	2000		5	2	0	12	25	45	0	0	9	10	108
	2001	12	11	3	0	17	72	117	2	1	12	12	260
	2002	30	4	3	0	12	48	103	10	2	35	16	262
	2003	7	8	1	0	10	76	73	25	1	61	10	270
	2004	14	6	1	0	6	62	55	10	0	85	34	273
	2005	11	2	0	0	6	54	73	15	2	92	18	273
	2006	16	4	0	0	5	57	96	11	3	57	8	258
	2007	55	11	0	0	6	59	89	6	0	47	3	276
	2008	29	5	0	0	7	74	163	5	0	24	10	317
	2009	20	9	0	0	4	75	172	10	0	27	5	322
	2010	36	5	0	0	8	72	132	5	1	41	24	324
	2011	24	5	0	0	8	103	155	17	1	82	6	400
	2012	30	5	0	0	9	151	99	2	0	74	9	379
	2013	25	7	0	0	14	112	60	22	0	68	2	310
	2014	40	4	0	0	8	89	54	17	1	59	3	274
Average 75-14		25	5	2	3	18	41	109	16	4	33	15	254
Average 85-14		25	4	2	3	15	49	106	13	4	31	13	253
Average 00-14		25	6	1	0	9	75	99	10	1	52	11	287

Bass Strait Zone

Annual tonnages of blacklip abalone caught within statistical blocks comprising the Bass Strait Zone in 2014 (Blocks 32-38, 41-46, 50-57). The fishery was temporarily closed in 2007. Any discrepancies between totals and sums of components are due to rounding.

	Year	32	33	34	35	36	37	38	41	42	43	44
Estimated weights	1975	1	10	1	7	7	0	2	0	0	0	0
	1976	0	5	0	1	1	0	0	0	0	1	0
	1977	6	11	0	0	3	1	2	0	0	0	0
	1978	1	5	2	6	5	0	4	0	0	1	0
	1979	2	9	0	0	2	1	2	0	0	0	0
	1980	2	6	1	1	2	1	0	1	0	0	0
	1981	1	6	1	1	0	2	0	0	0	1	0
	1982	0	6	1	0	2	1	4	0	0	0	0
Landed weights	1984	0	7	0	1	2	0	1	0	0	1	0
	1985	3	6	1	2	1	0	0	2	0	2	0
	1986	0	9	2	3	2	1	1	1	0	4	0
	1987	0	7	0	2	1	2	1	2	0	8	1
	1988	0	11	1	1	0	0	0	0	0	1	1
	1989	0	3	0	0	0	8	0	19	11	34	1
	1990	0	1	0	0	1	0	0	0	0	0	0
	1991	0	2	0	0	0	17	0	0	0	0	0
Estimated weights	1992	0	2	0	0	0	0	0	0	0	0	0
	1993	0	3	0	0	0	19	0	0	0	0	0
	1994	0	3	0	0	0	0	0	0	0	0	0
	1995	0	0	0	0	0	52	0	0	0	0	0
	1996	0	0	0	0	0	0	0	0	0	0	0
	1997	0	0	0	0	0	0	0	0	0	0	0
	1998	0	2	0	0	0	0	0	0	0	0	0
	1999	0	4	0	0	0	0	1	0	0	0	0
	2000	1	5	0	0	0	0	0	0	0	0	0
	2001	5	10	1	0	0	0	3	0	0	0	0
	2002	1	11	1	0	0	0	2	0	0	0	0
	2003	0	5	0	0	0	6	2	1	2	2	0
	2004	0	3	0	0	0	3	1	4	4	1	0
	2005	0	7	0	0	0	6	2	4	1	2	0
	2006	0	11	0	0	0	20	10	1	4	5	0
	2007	0	2	0	3	0	0	0	0	0	0	0
	2008	1	5	0	0	0	21	6	1	2	5	1
	2009	2	4	0	1	0	10	1	5	2	8	6
	2010	0	20	0	0	0	1	26	1	0	3	0
	2011	0	23	0	1	0	0	19	1	0	2	0
	2012	1	14	0	0	0	4	17	0	0	3	1
	2013	0	18	1	0	0	4	14	0	0	5	1
	2014	1	19	1	1	2	2	16	0	0	5	1
Average 75-14		1	7	0	1	1	5	4	1	1	2	0
Average 85-14		1	7	0	1	0	6	4	1	1	3	0
Average 00-14		1	10	0	0	0	5	8	1	1	3	1

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Bass Strait Zone (continued)

	Year	45	46	50	51	52	53	54	55	56	57	Total
Estimated weights	1975	0	0	0	0	0	0	0	0	0	0	29
	1976	0	0	0	0	0	0	0	0	0	0	9
	1977	0	0	0	0	0	0	0	0	0	0	23
	1978	0	0	0	0	0	0	0	0	0	0	22
	1979	0	3	0	0	0	0	0	0	0	0	20
	1980	0	0	0	0	0	0	0	0	0	0	13
	1981	0	0	0	0	0	0	0	0	0	0	12
	1982	0	0	0	0	0	0	0	0	0	0	14
	1983	0	0	0	0	0	0	0	0	0	0	14
	1984	0	3	0	0	0	0	0	0	0	0	16
Landed weights	1985	0	0	0	0	0	0	0	0	0	0	18
	1986	0	1	0	0	0	0	0	0	0	0	25
	1987	0	0	0	0	0	0	0	0	0	0	26
	1988	0	1	0	0	0	0	0	0	0	0	16
	1989	5	14	1	24	0	41	4	0	6	0	172
	1990	0	0	0	0	0	0	0	0	0	0	2
	1991	0	0	0	14	5	28	1	0	17	15	98
Estimated weights	1992	0	0	0	0	0	0	0	0	0	0	3
	1993	0	0	0	21	4	37	1	0	6	8	99
	1994	0	0	0	0	0	0	0	0	0	0	4
	1995	0	0	1	46	2	44	0	0	0	5	150
	1996	0	0	0	0	0	0	0	0	0	0	0
	1997	0	0	0	0	0	0	0	0	0	0	0
	1998	0	0	0	0	0	0	0	0	0	0	2
	1999	0	0	0	0	0	0	0	0	0	0	6
	2000	0	0	0	0	0	0	0	0	0	0	7
	2001	0	0	0	0	0	0	0	0	0	2	21
	2002	0	0	0	0	0	0	0	0	0	0	17
	2003	0	2	0	7	2	36	2	0	7	2	78
	2004	0	1	0	1	0	42	5	2	7	0	75
	2005	0	0	0	8	0	35	5	3	3	0	78
	2006	0	5	0	3	0	24	5	2	1	1	91
	2007	0	0	0	0	0	0	0	0	0	0	5
	2008	1	3	0	1	0	27	0	0	6	0	80
	2009	1	1	0	5	0	24	1	0	4	2	78
	2010	1	1	0	2	0	13	0	0	0	0	68
	2011	1	1	0	3	0	13	0	0	2	0	68
	2012	1	1	0	2	0	15	2	0	5	0	68
	2013	1	0	0	5	0	18	3	0	0	0	69
	2014	1	0	0	3	0	11	2	0	0	0	66
Average 75-14		0	1	0	4	0	10	1	0	2	1	41
Average 85-14		0	1	0	5	0	14	1	0	2	1	50
Average 00-14		1	1	0	3	0	17	2	0	2	0	58

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) are taken from Blocks 50-57. Any discrepancies between totals and sums of components are due to rounding.

	Year	32	33	34	35	36	37	38	31	39	40	41	42	43	44
Estimated weights	1975	3	17	14	49	69	14	11	7	3	4	2	0	0	0
	1976	1	26	11	55	49	2	10	14	2	9	2	0	0	0
	1977	6	23	21	50	24	1	22	6	8	4	1	0	1	0
	1978	4	12	17	51	38	7	17	8	1	2	0	0	1	0
	1979	10	21	8	46	15	4	4	11	6	2	1	0	0	0
	1980	7	15	3	29	13	4	4	4	3	5	0	0	0	0
	1981	12	17	17	34	10	9	0	6	4	2	0	0	2	0
	1982	4	13	14	29	7	9	9	27	1	3	0	0	0	0
	1983	4	21	8	34	9	4	8	23	2	0	0	0	0	0
	1984	9	27	15	56	7	6	0	50	8	4	0	0	1	0
Landed weights	1985	9	20	15	42	4	7	7	53	5	4	1	0	1	0
	1986	4	14	7	36	2	10	0	39	8	7	0	0	2	0
	1987	8	20	10	30	8	10	7	32	12	1	1	0	9	5
	1988	8	19	5	28	13	6	0	35	2	1	1	0	2	0
	1989	4	16	2	22	10	3	0	22	5	2	5	1	2	0
	1990	4	9	3	25	6	1	3	23	7	0	2	0	0	0
	1991	4	7	2	31	6	3	0	20	6	0	1	0	0	0
Estimated weights	1992	3	4	1	18	6	2	0	15	9	0	0	1	0	0
	1993	1	4	2	16	8	3	0	9	2	0	0	0	0	0
	1994	3	8	1	17	5	3	0	12	1	0	0	0	0	0
	1995	2	7	3	15	3	3	9	24	6	2	1	0	0	0
	1996	3	13	4	17	2	8	12	11	13	2	0	0	0	0
	1997	8	13	1	12	4	11	15	17	22	1	0	0	0	0
	1998	5	5	1	23	1	2	2	4	17	24	0	0	1	0
	1999	2	17	1	15	1	2	4	6	2	4	0	0	0	0
	2000	8	11	2	14	3	2	2	12	15	12	0	0	0	0
	2001	14	14	2	9	3	1	0	7	20	4	0	0	0	0
	2002	4	16	2	8	2	2	9	17	12	2	0	0	0	0
	2003	5	16	1	10	2	1	3	18	16	1	0	0	0	0
	2004	4	4	1	13	3	1	11	9	22	0	0	0	0	0
	2005	2	12	1	10	3	1	15	6	13	1	0	0	0	0
	2006	5	5	1	11	1	4	13	3	13	0	0	0	0	0
	2007	3	6	1	13	2	0	5	20	14	0	0	0	0	0
	2008	3	6	1	12	4	3	5	13	12	0	0	0	0	0
	2009	2	5	1	13	2	2	2	13	20	1	0	0	0	0
	2010	5	13	2	10	0	0	3	16	9	0	0	0	0	0
	2011	5	5	3	14	4	2	12	13	11	0	1	0	0	0
	2012	3	17	3	19	1	1	3	20	13	0	0	0	0	0
	2013	8	23	2	16	2	1	4	14	9	1	0	0	0	0
	2014	10	18	2	20	3	3	4	14	7	0	0	0	0	0
Average 75-14		5	14	5	24	9	4	6	17	9	3	1	0	1	0
Average 85-14		5	12	3	18	4	3	5	17	11	2	0	0	1	0
Average 00-14		5	11	2	13	2	2	6	13	14	2	0	0	0	0

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Greenlip Fishery (continued)

	Year	45	46	47	48	49	5	1	2	3	4	Total
Estimated weights	1975	0	0	0	7	2	8	0	3	0	1	214
	1976	0	0	0	8	6	14	0	0	0	0	212
	1977	0	0	0	40	2	17	0	0	0	0	225
	1978	0	0	1	13	3	12	1	3	0	2	192
	1979	0	0	0	11	0	8	0	0	0	0	147
	1980	0	0	0	6	0	5	0	3	0	0	101
	1981	0	0	3	12	1	9	0	12	0	4	155
	1982	0	0	2	7	0	2	0	14	0	2	141
	1983	0	0	14	40	11	9	0	9	0	5	201
	1984	0	2	52	60	2	11	0	7	1	5	323
Landed weights	1985	0	1	12	36	3	3	0	1	0	1	225
	1986	0	1	57	35	14	5	1	8	0	3	255
	1987	0	1	37	33	3	8	13	125	5	69	446
	1988	0	7	35	21	4	10	3	33	2	12	251
	1989	0	6	20	27	4	6	1	70	3	10	241
	1990	0	4	21	27	11	11	2	49	3	13	224
	1991	0	8	13	32	6	12	2	29	3	16	200
Estimated weights	1992	0	3	4	14	2	4	3	21	0	8	119
	1993	1	3	2	26	4	2	2	18	0	9	113
	1994	0	0	3	48	3	10	4	25	0	7	149
	1995	0	0	5	23	5	8	14	9	0	12	150
	1996	0	1	1	15	0	3	37	33	1	13	191
	1997	0	0	1	28	3	6	35	33	0	6	215
	1998	0	0	2	43	8	14	31	34	0	5	223
	1999	0	0	0	20	1	10	21	25	1	10	142
	2000	0	0	0	24	12	13	2	4	1	3	140
	2001	0	0	0	35	9	3	8	8	1	2	140
	2002	0	0	0	27	7	7	11	6	1	7	140
	2003	0	0	0	14	10	10	14	11	3	4	140
	2004	0	0	0	14	6	10	14	10	4	3	129
	2005	0	0	0	19	1	12	16	7	4	3	123
	2006	0	0	0	29	2	8	11	10	2	5	123
	2007	0	0	0	21	3	9	10	7	3	6	124
	2008	0	0	0	33	3	5	4	10	1	5	121
	2009	0	0	0	26	2	5	8	8	3	6	123
	2010	0	0	0	30	5	8	11	13	4	5	134
	2011	0	0	0	31	5	6	6	9	9	4	140
	2012	0	0	0	35	6	3	2	6	3	4	140
	2013	0	0	0	32	3	5	2	12	2	4	140
	2014	0	0	0	24	6	7	2	14	2	4	140
Average 75-14		0	1	7	26	4	8	7	17	2	7	176
Average 85-14		0	1	7	27	5	7	10	22	2	9	171
Average 00-14		0	0	0	26	5	7	8	9	3	4	133

Appendix 7: Catch/effort data extract query

Catch/effort data from divers' catch dockets 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 'AB13E' THEN 'ACT'
      WHEN f.block_code BETWEEN 'AB14A' AND 'AB14C' or f.block_code = 'AB15' THEN 'LWR_CHANNEL'
      WHEN f.block_code BETWEEN 'AB14D' AND 'AB14E' or f.block_code = 'AB16' THEN 'BRUNY'
      WHEN f.block_code BETWEEN 'AB17A' AND 'AB21C' THEN 'STMBY'
      WHEN f.block_code BETWEEN 'AB22A' AND 'AB25' THEN 'LWR_SE'
      WHEN f.block_code BETWEEN 'AB26A' AND 'AB29A' THEN 'BICH_FREY'
      WHEN f.block_code BETWEEN 'AB29B' AND 'AB30C' THEN 'RMDR_NE_EZ'
      WHEN f.block_code = 'AB31A' THEN 'BLOCK_31_EZ'
      WHEN f.block_code = 'AB31B' THEN 'NE_NZ'
      WHEN f.block_code BETWEEN 'AB32A' AND 'AB38C' THEN 'FG'
      WHEN f.block_code BETWEEN 'AB39A' AND 'AB40C' THEN 'NE_NZ'
      WHEN f.block_code BETWEEN 'AB41' AND 'AB46' THEN 'CN'
      WHEN f.block_code BETWEEN 'AB47A' AND 'AB49C' THEN 'RMDR_NW'
      WHEN f.block_code BETWEEN 'AB01A' AND 'AB04C' THEN 'KI'
      WHEN f.block_code BETWEEN 'AB05A' AND 'AB05C' THEN 'BLOCK 5'
      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'
    END REGION
  , SUBSTR(f.block_code,1,4) blok
  , f.block_code sub_block
  , CASE WHEN f.blacklip_estimated_weight>0 THEN ROUND(f.blacklip_estimated_weight,0)
    ELSE 0
  END blips
  , CASE WHEN f.greenlip_estimated_weight>0 THEN ROUND(f.greenlip_estimated_weight,0)
    ELSE 0
  END glips
  , NVL(dive_time_1,0) + NVL(dive_time_2,0) + NVL(dive_time_3,0)+ NVL(f.block_dive_time,0) total_time
  , CASE WHEN (NVL(dive_time_1,0) + NVL(dive_time_2,0) + NVL(dive_time_3,0)+ NVL(f.block_dive_time,0)>0) AND
    ((NVL(f.blacklip_estimated_weight,0)>39 or NVL(f.greenlip_estimated_weight,0)>39))
    THEN LN((NVL(f.blacklip_estimated_weight,0)+ NVL(f.greenlip_estimated_weight,0))/(NVL(dive_time_1,0) +
    NVL(dive_time_2,0) + NVL(dive_time_3,0)+ NVL(f.block_dive_time,0)))
  END lncpue
  , CASE WHEN (NVL(dive_time_1,0) + NVL(dive_time_2,0) + NVL(dive_time_3,0)+ NVL(f.block_dive_time,0)>0) AND
    NVL(f.blacklip_estimated_weight,0)>39
    THEN LN((NVL(f.blacklip_estimated_weight,0))/(NVL(dive_time_1,0) + NVL(dive_time_2,0) + NVL(dive_time_3,0)+
    NVL(f.block_dive_time,0)))
  END blncpue
  , CASE WHEN (NVL(dive_time_1,0) + NVL(dive_time_2,0) + NVL(dive_time_3,0)+ NVL(f.block_dive_time,0)>0) AND
    NVL(f.greenlip_estimated_weight,0)>39
    THEN LN((NVL(f.greenlip_estimated_weight,0))/(NVL(dive_time_1,0) + NVL(dive_time_2,0) + NVL(dive_time_3,0)+
    NVL(f.block_dive_time,0)))
  END glncpue
  , CASE WHEN (f.blacklip_estimated_weight>0 AND f.greenlip_estimated_weight>0) THEN 'DATA ERROR'
    WHEN f.blacklip_estimated_weight>0 THEN 'B'
    WHEN f.greenlip_estimated_weight>0 THEN 'G'
    ELSE ' '
  END effort_type
  , CASE WHEN (NVL(dive_time_1,0) + NVL(dive_time_2,0) + NVL(dive_time_3,0)+ NVL(f.block_dive_time,0)>0) AND
    ((NVL(f.blacklip_estimated_weight,0)>0 or NVL(f.greenlip_estimated_weight,0)>0))
    THEN ROUND((NVL(f.blacklip_estimated_weight,0)+ NVL(f.greenlip_estimated_weight,0))/(NVL(dive_time_1,0) +
    NVL(dive_time_2,0) + NVL(dive_time_3,0)+ NVL(f.block_dive_time,0)),0)
  END raw_catch_rate
  , CASE WHEN v.overall_length <9 then v.vessel_name
    WHEN v2.overall_length <9 then v2.vessel_name
    ELSE NULL
  END boat_name
  , CASE WHEN v.overall_length <9 then v.overall_length
    WHEN v2.overall_length <9 then v2.overall_length
    ELSE NULL
  END boat_length
FROM qms.abalone_fishing_details f
  , qms.quota_dockets d
  , lmm.clients n3
  , lmm.vessels v
  , lmm.vessels v2
WHERE EXTRACT (YEAR FROM f.fishing_date)= 2014
  AND d.qudo_id = f.qudo_id
-- diver name
  AND n3.client_id = d.docket_signatory_id
-- get boat id
  AND v.vessel_id (+) = d.primary_vessel_id
-- get seconary boat id (if there is any)
  AND v2.vessel_id (+) = d.secondary_vessel_id
ORDER BY f.fishing_date ASC

```

Appendix 8: Treatment of errors in catch data in 2014

No amendments were made to catch totals from earlier years presented in this report. Where errors are identified they will be corrected, and any corrections will be reported in subsequent assessment reports. Several errors have been found and corrected in previous years. Although this process is important for rigor of the assessment, the magnitude of any errors identified to date has been small and had no effect on interpretation of stock trends and thus management decisions. This is because errors identified to date typically involve key stroke errors on individual catch records rather than systematic errors affecting a large portion of the catch.

Appendix 9: Ecological effects of abalone fishing

Abalone fishing is typically regarded as having low ecological impact because there is no bycatch (other than sessile organisms on the shells), the conservation status of the target species is secure, and the high energy coastal environments where the fishery operates are typically subject to large environmental variation which creates resilience. For this reason there is little concern regarding the ecological effects of abalone fishing and thus there has been little research initiated on the issue. Nonetheless, consideration of the issue is important for EBFM. Information from recent research at IMAS is presented here.

This summary is an extract from Chapter 2, *Towards integrated multi-species management of Australia's SE reef fisheries: A Tasmanian example*. Report to Fisheries Research and Development Corporation. No. 2004/013. Tasmanian Aquaculture and Fisheries Institute, University of Tasmania. Frusher S, Buxton C, Barrett N, Tarbath D, Redd K, Semmens J, Pederson H, Valentine J & Guest M (2009).

At a global level, overfishing and subsequent depletion leading to the collapse of abalone populations on individual reefs and parts of the coast are common problems (Dugan and Davis, 1993; Karpov et al., 2000; Shepherd and Baker, 1998). While overall the Tasmanian blacklip abalone fishery has been relatively robust, depletion and consequent loss of production are evident in parts of the fishery. For example, following years of fishing at apparently sustainable levels, some reporting areas ('blocks') of the abalone fishery in east and north-east Tasmania experienced rapid declines in annual catch to less than 10% of their former levels (Tarbath et al., 2007).

These reporting blocks are large (tens of kilometres), and consequently the history of abalone production at the scale of individual reefs within them is unknown. Divers who once worked extensively along the coastline have reported that many of the reefs had become too depleted to warrant fishing at economic levels, and fishing activity was concentrated on the remaining productive reefs. Similar patterns had also been reported by divers in other previously productive parts of the Tasmanian fishery.

Information was sought about the history of productive abalone reefs from commercial abalone divers. Thirty three divers were interviewed: 16 early divers from pre-1972, 7 mid-era divers from between 1972 and 1992 and 10 current divers. By using a combination of maps, logbooks and diaries, reefs and coastline in use by the fishery were identified in five key areas (Blocks 13, 14, 23, 28, and 30) in the east and south-east, throughout the course of its history.

Perceptions of productivity varied greatly and were affected by economic factors (beach price, costs) as well as abundance. However, by comparing usage of reefs over time, it was possible to identify continuously productive reefs and reefs where production had fallen, and subsequently produce approximate estimates of the extent of reef decline in each of the five key areas. Fished areas were relatively unchanged in Block 13 (10% decline – mostly Recherche Bay), while areas lost to fishing in the east and north-east (Block 28, Block 30) were as high as 90%. Reefs in the northern part of Block 23 were no longer productive, but the remaining 90% of reefs elsewhere in the block were still fished, while in Block 14, mostly in the vicinity of the southern D'Entrecasteaux Channel, productive reef area had declined by 50%.

To assuage doubts about the validity of these estimates, we compared levels of fishing effort through time in each block (current compared with peak years). We found comparable declines in effort in Blocks 13, 28 and 30, but greater declines in Block 14, and Block 23. It was considered likely that losses of productive reef in the last two blocks were underestimated because current divers could fish these areas at low cost and had heightened perceptions of recent productivity.

Associated with depletion, there have been persistent reports from divers concerning changes to reef habitat. These changes appeared to follow extensive depletion of abalone populations by fishing, suggesting a level of interdependency between abalone and habitat. They included the reduction in coverage of crustose coralline algae and its subsequent replacement by sediment, other encrusting organisms and algae. Globally, over-harvesting of herbivores is recognised as one of the main factors contributing to changes in marine systems (Burkepile and Hay, 2006). In abalone fisheries, these changes implied a reduction of habitat type associated with juvenile abalone recruitment (McShane and Smith, 1988; Shepherd and Turner, 1985).

Field surveys were conducted at reefs with a history of abalone production in each region. A quantitative survey of benthic organisms on reefs with contrasting levels of abalone abundance was conducted, and a correlative approach was used to investigate interactions between benthic organisms and abalone to detect effects of fishing on reef communities.

In all regions there were positive correlations between abalone abundance and crustose coralline algae, while understory algae and abundance were negatively correlated. However, these associations were only weakly significant ($\alpha=0.05$, $r^2=0.02-0.30$), implying that abalone abundance explained only a small proportion of the variability in their distribution and abundance. In addition, there were isolated and inconsistent associations between abalone abundance and other understory groups (sessile invertebrates, canopy-forming algae recruits). Typically, regional differences in community structure were more strongly correlated than abalone density. While not experimentally tested it was apparent that physical characteristics (exposure, reef structure, orientation) played a much greater role in determining community structure than the activities of abalone.

In summary, abalone played a relatively minor role in structuring habitat on reefs fished by abalone divers. As a consequence, it is unlikely that the observed reef-scale changes to habitat on reefs have occurred as a consequence of depletion of abalone stocks. It also means that loss of juvenile abalone habitat (crustose coralline algae habitat) does not necessarily occur following over-fishing.

Appendix 10: History of Management Changes

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

1962	Legal minimum length (LML) of 5 inches (127 mm) minimum shell diameter introduced.
1964	LML increased to 6 inches (152 mm).
1965	LML 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. Unusually prolonged calm sea conditions and warm water were associated with a widespread die-off of abalone and rock lobster between the Arthur River and Granville Harbour. Substantial quantities of both species were reported killed.
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 (TACC) were introduced. Each of the 120 general license divers were allocated 28 units of quota, the Furneaux Group divers 20 units: therefore there were 3460 units. For 1985, the quota unit was set at 1100 kg i.e. the TACC 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.e. TACC was 3460 tonnes.
1987	LML increased to 132 mm from 127 mm. The catch per ITQ was reduced to 950 kg (5% reduction) i.e. TACC was 3287 tonnes.
1988	The catch per ITQ was reduced to 855 kg (5% reduction) i.e. TACC was 2958.3 tonnes. The minimum legal weight for abalone meats was set at 90 g.

1989	The catch per ITQ was reduced to 600 kg (30% reduction) i.e. TACC was 2076 tonnes. A fishery for abalone in Bass Strait was held in April, with a LML of 110 mm and a maximum size limit of 132 mm. Each diver was limited to 2.4 tonnes, with 198 tonnes caught. The fishery was free of fees, and while only licensed abalone divers could participate, was held to be distinct from the Tasmanian abalone fishery (hence the maximum size limit). The minimum meat weight regulation of 90g was amended to apply only to blacklip abalone.
1990	LML for blacklip abalone on south and west coasts between the Wild Wave River (north of Sandy Cape) and Whale Head increased to 140 mm. LML for greenlip in Furneaux Group waters increased to 140 mm. Furneaux Group boundary removed. The Furneaux Group divers were issued with an extra 8 units each, which could only be fished by the divers themselves and were not transferable. This increased the number of units in the fishery to 3500, and the TACC to 2100 tonnes.
1991	A fishery for abalone in Bass Strait was held in May, with a LML of 118 mm. The TACC was 110 tonnes, with a fee of \$1.40 per kg of quota. The license system was restructured: the diving entitlement was uncoupled from the entitlement to hold quota units and the lower and upper limits on the amount of units held was abolished.
1992	Minimum meat weight for greenlip was set at 70 g. Development of DPIF's compliance catch database (SEALSPROD) that enabled auditing of catch from vessel to factory.
1993	A fishery for abalone in Bass Strait was held in May and June, with a LML of 110 mm. The TACC was 100 tonnes, with a fee of \$5.00 per kg of quota. Minimum meat weight regulation amended to 90g for all abalone other than greenlip. Penalties reviewed and significantly increased, with the option of prison terms for serious and repeat offenders. Special penalties increased to \$50 per fish.
1994	Quota owners were given the choice of continuing with their annual abalone licenses or entering into a Deed of Agreement that applied for 10 years with the right of renewal for perpetuity. 90% of owners chose the Deed of Agreement. The Deed of Agreement set a fee structure that included both management costs and return to the community, based upon an increasing (but non-linear) proportion of beach price. At \$6/kg, no fees were payable, at \$35/kg fees were 10% at and at \$200/kg, fees were 33% of beach price.
1995	A fishery for abalone in Bass Strait was held in May and June, with a LML of 110 mm. Only 12 commercial divers (i.e. non-abalone) participated. While the TACC was 100 tonnes, only 21 tonnes was taken. The fee was \$10.00 per kg of quota.

	Another Bass Strait fishery was held in November, with both abalone and commercial divers participating. The LML was 100 mm, and the TACC was set at 140 tonnes, with a fee of \$10/kg. Only 106 tonnes was taken before the fishery was closed. It was maintained by divers that a very high proportion of the fishable biomass had been taken, and that continuing the fishery could affect the sustainability of stocks.
1996	The <i>Living Marine Resources Management Act 1995</i> was introduced. Trigger points were introduced by DPIF to initiate a management response if catch and catch rates changed by a pre-determined quantity with respect to those from two earlier reference periods.
1997	The TACC was increased to 2520 tonnes (720 kg per quota unit). Difference in beach price between east coast and west coast blacklip first appears – is initially \$2.00.
1998	The first abalone Fishery Management Plan was introduced. Among changes that it introduced were catch monitoring, which included: 1. Pre-fishing reporting by divers, 2. Post-fishing reporting of catch by divers and processors, 3. Processors required to maintain a daily balance of stock in, stock out and stock on hand, 4. Processors to report prior to movement of stock out and on receipt of stock, 5. Reports to be made by telephone, where information was immediately available to Compliance Audit Unit and Tasmania Police. For several years, greenlip abalone had attracted premium beach prices, causing a diversion of effort to that species. To enhance protection, a number of management changes were made: • For management purposes, the greenlip fishery was subdivided into two regions: the Furneaux Group and the remainder (North West, North East and King Island) • LML 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. Within the Furneaux Group, several other rules were introduced to reduce effort: • 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. Vessels over 10 m landing abalone at Smithton or Stanley had to make a prior report to the CAU reporting service so that Tasmania Police could inspect their catch. Fixed trigger points were abandoned as an assessment strategy as rising catch and catch rates indiscriminately fired triggers. Assessments have since used catch and catch rate trends to monitor stock levels. A new compliance catch database (LMM/QMS) introduced by DPIWE
1999	LML for greenlip raised to 140 mm in North West, and 150 mm for the remainder. This applied to the commercial fishery only, the LML for recreational fishers remaining at 140 mm. The greenlip fishery was divided into east (Furneaux Group and North East) and west (King Island and North West) with quarterly caps of 17 tonnes and 20 tonnes respectively. Overrun of caps led to a closure of the greenlip fishery in October. Within the Furneaux Group, Block 35 was closed to fishing between 1 October and 31 March to protect spawning abalone.
2000	The blacklip fishery was divided into two East and West management zones with boundaries at Whale Head and Port Sorell. The greenlip fishery was managed separately. Eastern blacklip units were set at 340 kg (TACC 1190 t), Western units at 400 kg (1400 t) and greenlip units at 40 kg (140 t), with a TACC for the whole fishery of 2730 tonnes. Size limits for blacklip abalone remained unchanged. The zone boundaries meant that the Western Zone had a size limit of 140 mm from Whale Head to the Wild Wave River and 132 mm from there to Port Sorell. Following egg-per-recruit studies by researchers, LML for King Island greenlip was raised to 155 mm, 140 mm for North West and 145 for both the North East and the Furneaux Group. The Block 35 (Franklin Sound - Furneaux Group) greenlip catch was capped at 20 tonnes. Catch were reported on a smaller spatial scale with the introduction of sub-blocks state-wide. Owners of fishing license (abalone dive) were allowed to hold more than one license and allow others to dive those licenses as supervisors.

2001	The Northern Zone (between Arthur River in the west and Musselroe Point in the east) for blacklip abalone was established, with a LML of 127 mm except between Woolnorth Point and the Arthur River, where 132 mm prevailed. Catch per unit was 80 kg, with a TACC 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 TACC for the West was set at 1260 t (360kg/unit), and the East at 1120 t (320 kg/unit). The greenlip TACC remained at 140 tonnes, so production from the entire fishery was 2800 t, or 800 kg/unit. In association with establishment of Northern Zone, research monitoring areas were set aside at the Inner Sister, Swan Island, Waterwitch Reef, and the Doughboys. LML's for recreational divers were changed to 132 mm for blacklip state-wide, and 145 mm for greenlip in all areas except the North West, which remained at 140 mm. The regional catch for the greenlip fishery was limited in three of the main regions. The North West catch was capped at 40 t, the North East at 30 t, while the Furneaux Group catch remained fixed at 42 t. Catch from King Island and the Bass Strait islands (Kent, Curtis, Hogan Groups) was not capped.
2002	Production for the whole fishery was set at 2537.5 t (725 kg/unit). LML for Eastern Zone was increased to 136 mm. LML for greenlip on King Island was reduced to 150 mm. LML for greenlip in the North West was increased to 145 mm. Eastern Zone TACC reduced to 857.5 t (245 kg/unit). Western Zone TACC remained 1260 t (360 kg/unit). Northern Zone TACC remained 280 t (80 kg/unit). Greenlip TACC remained 140 t (40 kg/unit). Catch from the Actaeons (sub-blocks 13C, D and E) was capped at 350 t, managed firstly as a half-yearly cap, then quarterly. The fishery there was closed in September and then mid-October when those caps were reached.
2003	Fishery production was set at 2607.5 t (745 kg/unit) state-wide. Eastern Zone TACC remained 857.5 t (245 kg/unit). Western Zone TACC remained 1260 t (360 kg/unit). Northern Zone TACC remained 280 t (80 kg/unit). Greenlip TACC remained 140 t (40 kg/unit). Bass Strait Zone TACC set at 70 t (20 kg/unit).

	A Bass Strait blacklip zone (TACC 70 tonnes (20kg/unit), LML 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. Blacklip catch from Block 5 (Northern Zone) was capped at 100 t. LML for Western Zone between the Wild Wave River and Arthur River was increased to 136 mm from 132 mm. Abalone taken from Western Zone subject to upper size limit of 160 mm by canners and live market buyers. Note that this was not rigidly enforced and market sampling showed most samples contained many abalone over this size.
2004	Fishery production was set at 2509.5 t (717 kg/unit) state-wide. Eastern Zone TACC reduced to 770 t (220 kg/unit). Western Zone TACC remained 1260 t (360 kg/unit). Northern Zone TACC remained 280 t (80 kg/unit). Greenlip TACC reduced to 129.5 t (37 kg/unit). Bass Strait Zone TACC remained 70 t (20 kg/unit). The greenlip TACC reduction affected the North West only, where the annual cap was reduced by 10 t to 30 t. October-March closure for Franklin Sound greenlip fishery abolished. Block 35 cap reduced from 20 t to 15 t.
2005	Fishery production was set at 2502.5 t (715 kg/unit) state-wide. Eastern Zone TACC remained 770 t (220 kg/unit). Western Zone TACC remained 1260 t (360 kg/unit). Northern Zone TACC remained 280 t (80 kg/unit). Greenlip TACC reduced to 122.5 t (35 kg/unit). Bass Strait Zone TACC remained 70 t (20 kg/unit). The greenlip TACC reduction affected the North East only, where the annual cap was reduced by 7 t to 23 t. 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. High grading (discarding large abalone in the catch from the deck) prohibited.

	Caufing of abalone (holding abalone in cages at sea) was prohibited. Introduction of cancellation reports where a prior reported trip is cancelled. Introduction of single (blacklip) zone fishing provisions. Overcatch provisions introduced to cover unintentional underestimation of catch weight. In Victoria in December, ganglioneuritis detected on two land-based (Portland and Port Fairy) and two offshore (Westernport) aquaculture sites.
2006	Fishery production was set at 2502.5 t (715 kg/unit) state-wide. Eastern Zone TACC remained 770 t (220 kg/unit) Western Zone TACC remained 1260 t (360 kg/unit) Northern Zone TACC remained 280 t (80 kg/unit) Greenlip TACC remained 122.5 t (35 kg/unit) Bass Strait Zone TACC remained 70 t (20 kg/unit) On 1 January 2006, interim reduction in LML for Perkins Bay greenlip area (Blocks 47, 48A), from 145 mm to 140 mm. On 20 September 2006, LML for Bass Strait Zone in Blocks 41-46 (North Coast) reduced from 114 mm to 110 mm. On 1 November 2006, LML for Eastern Zone was increased to 138 mm from 136 mm. LML for greenlip abalone in Perkins Bay was reduced to 132 mm from 140 mm. 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. 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.
2007	Fishery production was set at 2502.5 t (715 kg/unit) state-wide. Eastern Zone TACC remained 770 t (220 kg/unit) Western Zone TACC remained 1260 t (360 kg/unit) Northern Zone TACC remained 280 t (80 kg/unit) Greenlip TACC remained 122.5 t (35 kg/unit)

	Bass Strait Zone TACC remained 70 t (20 kg/unit) N.B. 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. 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).
2008	The total catch state-wide was set at 2,593.5 t, or 741 kg/unit. Eastern Zone TACC increased to 808.5 t (231 kg/unit) Western Zone TACC remained 1260 t (360 kg/unit) Northern Zone TACC increased to 332.5 t (95 kg/unit) Greenlip TACC remained 122.5 t (35 kg/unit) Bass Strait Zone TACC remained 70 t (20 kg/unit) 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 abalone too small to catch at the larger size limit, and that removing these smaller abalone would promote growth among the remaining fish. The LML 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 TACC increased to 332.5 t. The remainder of the Northern Zone was capped at 180 t. 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. 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. 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). South Coast closed to fishing on 29 October because the 245 t catch limit had been reached (332 t).
2009	The total catch state-wide was set at 2,604 t, or 744 kg/unit. Eastern Zone TACC increased to 850.5 t (243 kg/unit) Western Zone TACC reduced to 924 t (264 kg/unit) Central Western Zone TACC established at 304.5 t (87 kg/unit)

	Northern Zone TACC remained 332.5 t (95 kg/unit) Greenlip TACC remained 122.5 t (35 kg/unit) Bass Strait Zone TACC remained 70 t (20 kg/unit) 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. Blocks 7 and 8 were closed to fishing on 13 July because the 108 t cap had been reached (155 t). 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. The North East greenlip region was closed to fishing on 19 October because the 23 t cap had been reached (35 t). The Actaeons were closed to fishing on 1 November, because the 340 t cap had been reached (341 t). The South Coast (cap 300 t) was closed to fishing on 1 November with the catch at 321 t. The Block 5 (cap 152 t) was closed to fishing on 5 December with the catch at 172 t. Experimental fishing project with reduced size limits started in Blocks 5 and 6, where the LML was reduced from 132 mm to 127 mm (Block 5) and 136 mm to 132 mm (Block 6), provided GPS data loggers were used.
2010	The total catch state-wide was set at 2,660 t, or 760 kg/unit. Eastern Zone TACC increased to 896 t (256 kg/unit). Western Zone TACC remained 924 t (264 kg/unit). Central Western Zone TACC remained 304.5 t (87 kg/unit). Northern Zone TACC remained 332.5 t (95 kg/unit). Greenlip TACC increased to 133 t (38 kg/unit). Bass Strait Zone TACC remained 70 t (20 kg/unit). In September 2010, the size limit for greenlip caught between Andersons Bay (Block 41) and Cowrie Point (Block 46) was reduced from 145 mm to 132 mm, in line with Blocks 47 and 48A (Perkins Bay/Black Reef) . The size limit for Eastern Zone blacklip caught in Block 31A north of Cod Bay and Georges Rocks (latitude 40°54'53"S) was reduced from 138 mm to 132 mm while fishing under permit. This was a temporary measure between July and October to encourage fishing there. Block 31A was closed to fishing on 4 October after 50 t of abalone had been caught, but was subsequently reopened in December 2010 (at 138 mm) to ease pressure across the remainder of the fishery. Furneaux Group blacklip closed 9 August, capped at 35 t (49 t caught).

	The Actaeons closed 13 September capped at 340 t cap (342 t). Block 22 closed 13 October when the 60 t cap was almost reached (55 t). It was reopened in December to ease pressure on the remainder of the fishery. Blocks 7, 8 and 6D closed 20 October capped at 150 t (171 t). North East greenlip closed 1 November, capped at 23 t (25 t). North West greenlip closed 13 November, capped at 18 t (23t). Perkins Bay greenlip closed 13 November, capped at 20 t (20t). All the Northern Zone except Block 5 closed 22 November capped at 180 t (191 t caught). South Coast closed 13 December capped at 300 t (311 t). King Island greenlip closed on 13 December, cap 30 t (32 t).
2011	The total catch state-wide was set at 2,565.5 t, or 733 kg/unit. Eastern Zone TACC decreased to 721 t (206 kg/unit). Western Zone TACC remained 924 t (264 kg/unit). Central Western Zone TACC remained 304.5 t (87 kg/unit). Northern Zone TACC increased to 402.5 t (115 kg/unit). Greenlip TACC increased to 143.5 t (41 kg/unit). Bass Strait Zone TACC remained 70 t (20 kg/unit). The remainder of the 40 units issued to the five Furneaux Group divers in 1990 were transferred back to the Government. The Eastern Zone was closed to fishing in all parts except Block 31 between 1 January and 31 March. Actaeons (Sub-blocks 13C, 13D and 13E) closed 29 October capped at 341 t (359 t caught). Lower Channel (sub-blocks 14A, 14B) closed 5 December cap 10 t (12.5 t caught). Block 22 closed 12 September, reopened 18 December cap 40 t (54 t caught). Blocks 23, 24 closed 12 November cap 50 t (54 t caught). Freycinet/Bicheno (Blocks 25-28, 29A) closed 5 December cap 40 t (47.5 t caught). Block 5 Northern Zone closed 29 August cap 142.5 t (155 t caught). Remainder NW Northern Zone (Blocks 47, 48, 49) closed 29 October cap 100 t (112 t caught). North East Northern Zone (Block 39, 40, 31B) closed 5 December cap 30 t (29 t caught). Granville Harbour/Sandy Cape (Blocks 7, 8, 6D) closed 23 May cap 160 t (159.5 t caught). Furneaux Group Bass Strait Zone closed 20 June cap 35 t (44 t caught).

	North West greenlip closed 29 October cap 18 t (21 t caught). Perkins Bay greenlip closed 1 October cap 20 t (21 t caught). North East greenlip closed 5 December cap 23 t (23.5 t caught). Furneaux Group greenlip closed 28 November cap 42 t (44.5 t caught). Telephone reporting requirements were suspended on 16 November when the company operating the call centre unexpectedly ceased trading. Following the discovery of AVG-affected greenlip in NSW in November 2011, all imports of live abalone into that state from Tasmania and Victoria have been subject to restrictions. This measure has since greatly reduced the size of the domestic live greenlip market causing a collapse in high-grade greenlip beach prices. LML in the Northern blacklip fishery in Blocks 47, 48 and 49 reduced from 127 mm to 125 mm, provided GPS loggers used.
2012	The total catch state-wide was set at 2,366 t, or 676 kg/unit. Eastern Zone TACC decreased to 549.5 t (157 kg/unit). Western Zone TACC remained 924 t (264 kg/unit). Central Western Zone TACC remained 304.5 t (87 kg/unit). Northern Zone TACC decreased to 378 t (108 kg/unit). Greenlip TACC decreased to 140 t (40 kg/unit). Bass Strait Zone TACC remained 70 t (20 kg/unit). No caps were implemented in the Eastern Zone. The Eastern Zone was closed to fishing in all parts except Block 31 between 1 January and 31 March. East Furneaux Bass Strait Zone (sub-blocks 33B, 33C, Blocks 36, 38) closed 13 August, cap 35 t (36.4 t caught). Eastern Zone sub-block 30A closed 13 August, cap 4 t (4.5 t caught). North East greenlip closed 27 August cap 23 t (32.7 t caught). North East Northern Zone closed 27 August cap 30 t (35 t caught). Granville Harbour/Sandy Cape (Blocks 7, 8, 6D) closed 15 October cap 154.5 t (174 t caught). Blocks 47, 48, 49 Northern Zone (Hunter & Three Hummock Islands) closed 15 October, cap 130 t (156 t caught). Sub-block 48A, Block 47 (Black Reef greenlip) closed 12 November cap 20 t (26 t caught). Remainder North West greenlip closed 19 November, cap 18 t (18.5 t caught). Telephone reporting requirements reinstated with a new operator on 27 February.

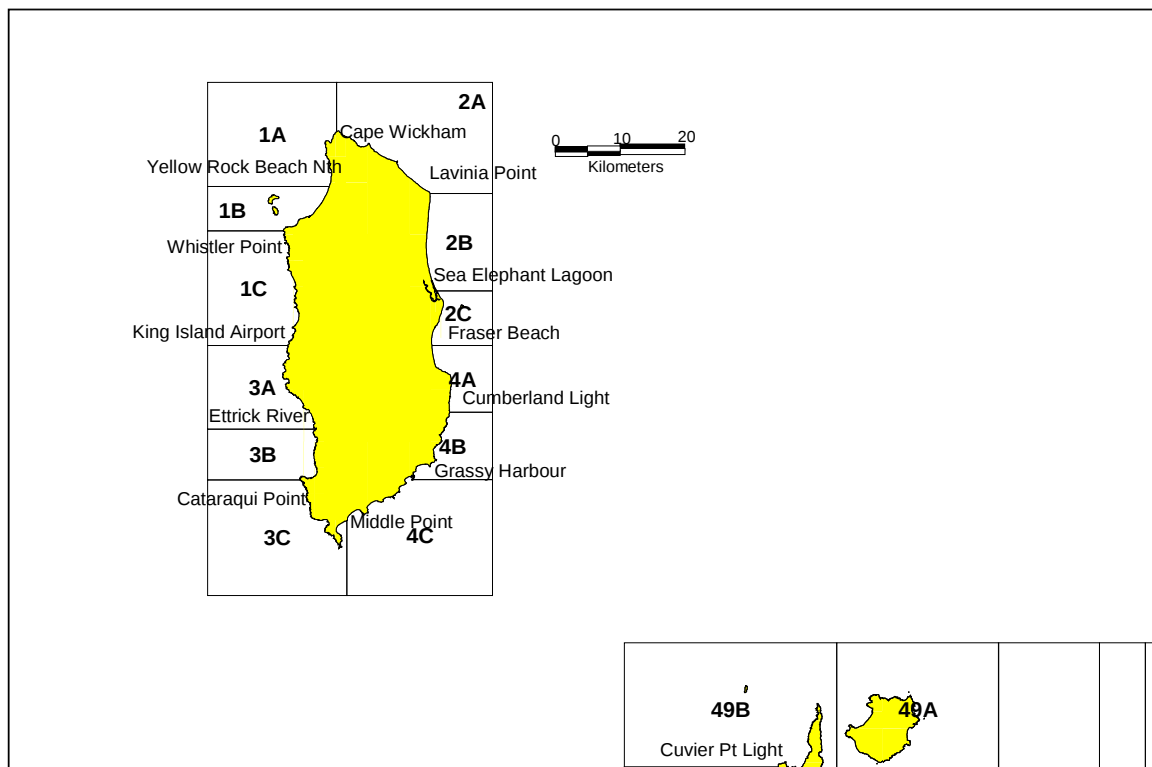
	GPS and depth loggers made mandatory throughout the fishery from 1 January 2012. LML at Block 49 (Hunter Island & Three Hummock Island but not Albatross Island) was reduced from 125 mm to 120 mm. The LML at Albatross Is. was increased to 127 mm from 125 mm.
2013	The total catch state-wide was set at 2,149 t, or 614 kg/unit. Eastern Zone TACC decreased to 528.5 t (151 kg/unit). Western Zone TACC increased to 1001 t (286 kg/unit). Central Western Zone TACC decreased to 101.5 t (29 kg/unit). Northern Zone TACC decreased to 308 t (88 kg/unit). Greenlip TACC remained 140 t (40 kg/unit). Bass Strait Zone TACC remained 70 t (20 kg/unit). The Central Western Zone/Western Zone boundary was moved north to the Wild Wave River between 6D and 6C, meaning that Blocks 7 and 8, and sub-block 6D reverted to the Western Zone, and that the Central Western Zone comprised 5D, 6A, 6B and 6C. The Eastern Zone was closed to fishing in all parts except Block 31 between 1 January and 31 March. North East greenlip closed 3 June, cap 23 t (24 t caught). Bass Strait Zone east coast Furneaux Group closed 19 August, cap 30 t (27 t caught). Annual catch from waters around the Freycinet Peninsula and northward, (including sub-blocks 26B, 26C, 26D, 27A, 27B, 27C, 27D, 27E, 28A & 28B) was capped at 5 t, and the LML increased to 145 mm, these measures to restore populations in the area. It was closed 26 August, 11 t caught. North West greenlip closed 23 September, cap 18.5 t (23 t caught). Block 30A blacklip closed 23 September, cap 4 t (4.5 t caught). North East blacklip closed 7 October, cap 30 t (32 t caught). Blocks 47, 48, 49 Northern Zone (Hunter & Three Hummock Islands) closed 15 October, cap 100 t (126 t caught). Blocks 5 closed 11 November, cap 60 t (60 t caught). Furneaux Group greenlip closed 25 November, cap 47 t (55 t caught). South West Western Zone closed 2 December, cap 405 t (528 t caught).
2014	The total catch state-wide was set at 1,932 t, or 552 kg/unit. Eastern Zone TACC remained 528.5 t (151 kg/unit). Western Zone TACC decreased to 840 t (240 kg/unit). Central Western Zone TACC decreased to 73.5 t (21 kg/unit). Northern Zone TACC decreased to 280 t (80 kg/unit).

	Greenlip TACC remained 140 t (40 kg/unit). Bass Strait Zone TACC remained 70 t (20 kg/unit). Number of Fishing Licenses (Abalone Dive) or FLAD, changed from 125 to 121. Catch from part of the Freycinet-Bicheno region (26B-28B) was capped at 10 t at LML 145 mm and closed to fishing on 4 June 2014. It was reopened again at 145 LML on 24 September to spread fishing effort, with a further 10 t cap. South West Western Zone closed 28 April, cap 350 t (287 t caught). South West Western Zone re-opened 26 November (108 t caught). North East greenlip closed 20 March, cap 25.5 t (21 t caught). North West greenlip closed 1 June 2014, cap 21 t (23 t caught). Sub-block 30A closed 1 June 2014, cap 4 t (4 t caught). East Furneaux Bass Strait Zone closed 30 June 2014, cap 30 t (37 t caught). Furneaux Group greenlip closed 23 July, cap 47 t (59 t caught). North East Northern Zone closed 23 July, cap 30 t (44 t caught). Remainder Furneaux Bass Strait Zone closed 8 August, no cap (6 t caught). Block 5 Northern Zone closed 12 November, cap 50 t (54 t caught).
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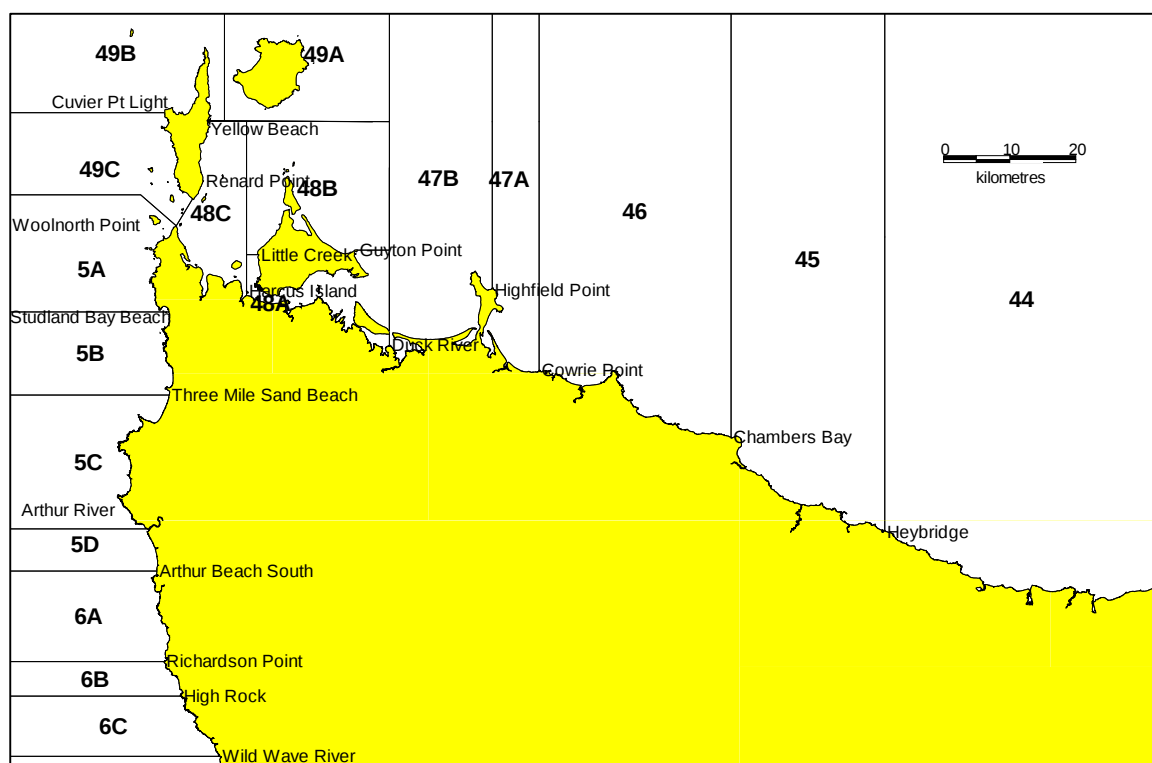
Appendix 11: Maps of catch-reporting blocks and sub-blocks, 2014

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

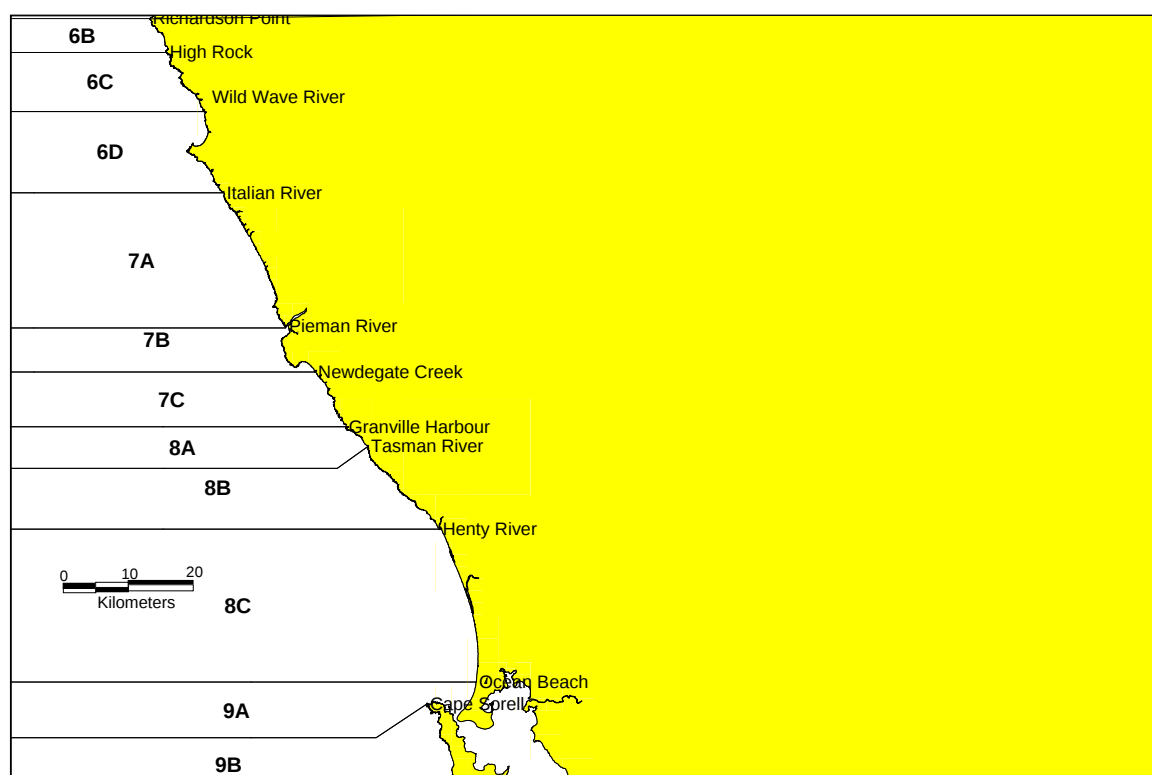
Map1: King Island



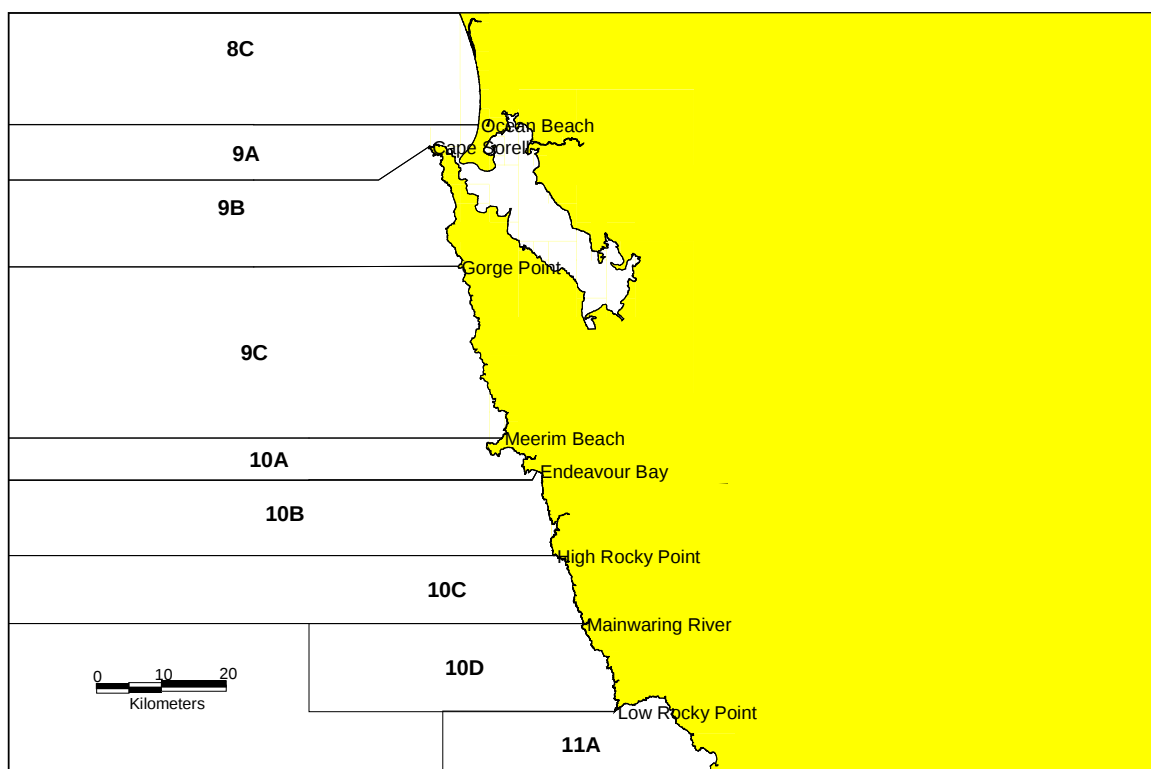
Map 2: North West Tasmania



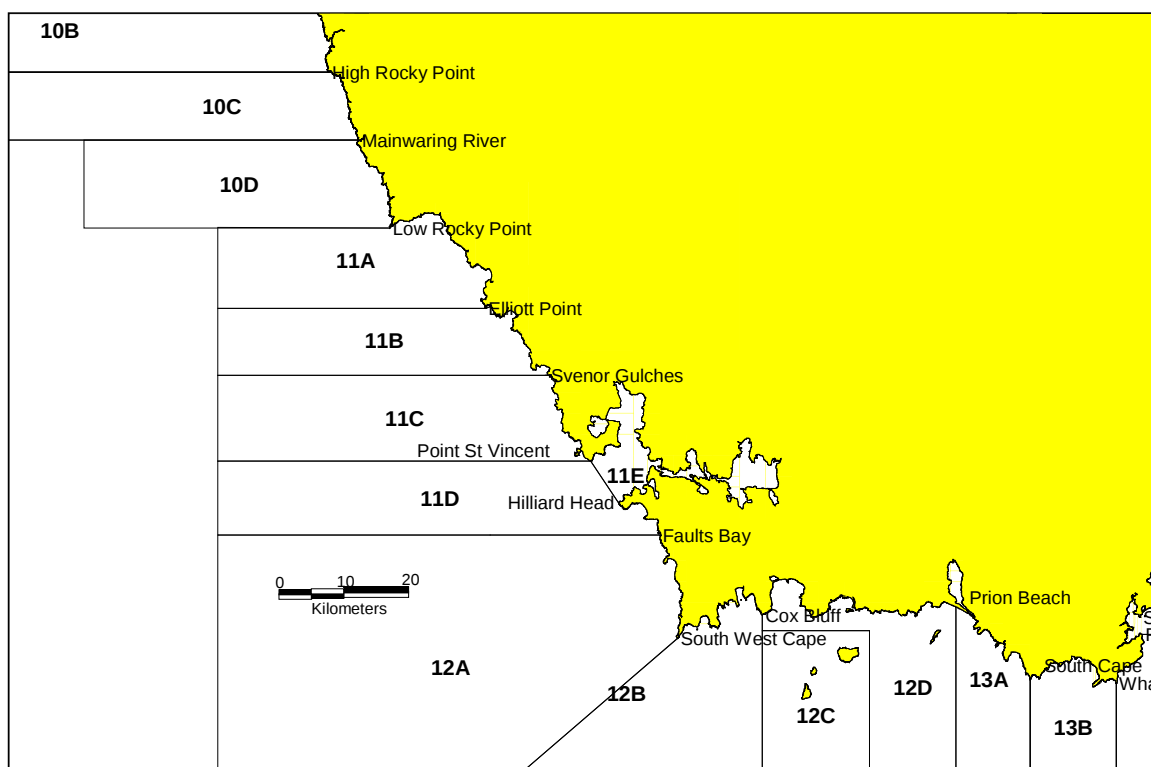
Map 3: Central West Coast (north)



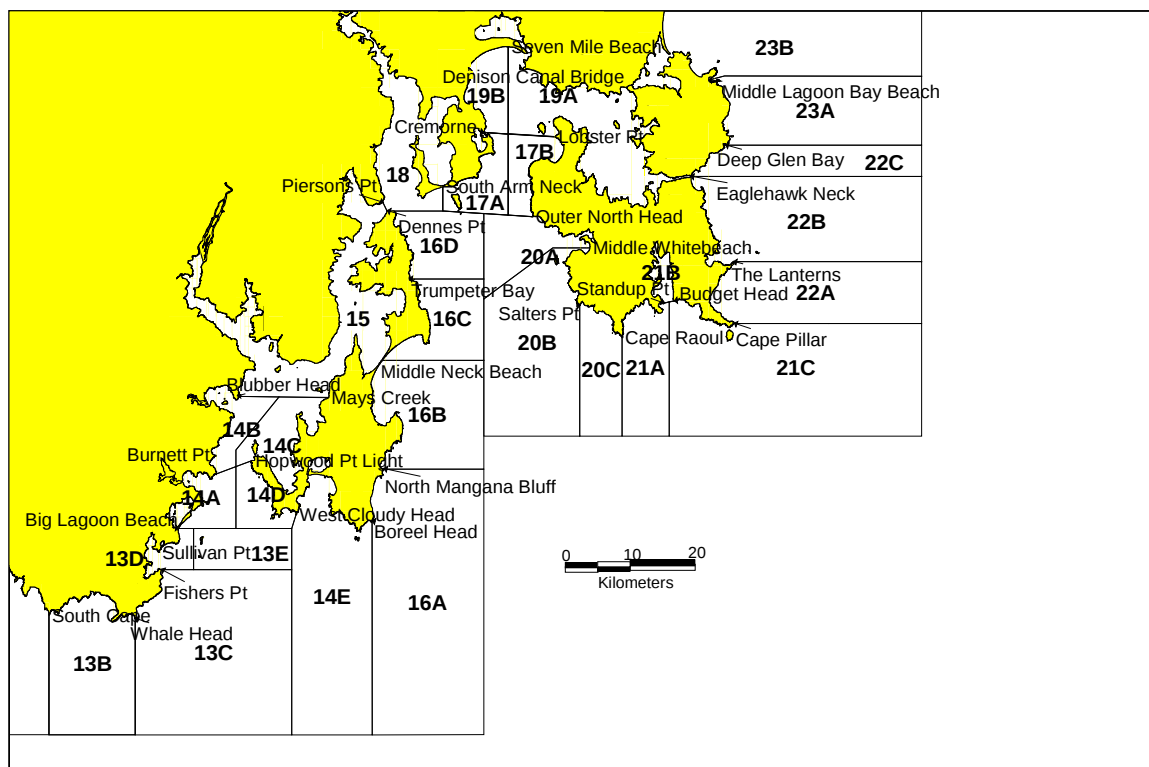
Map 4: Central West Coast (south)



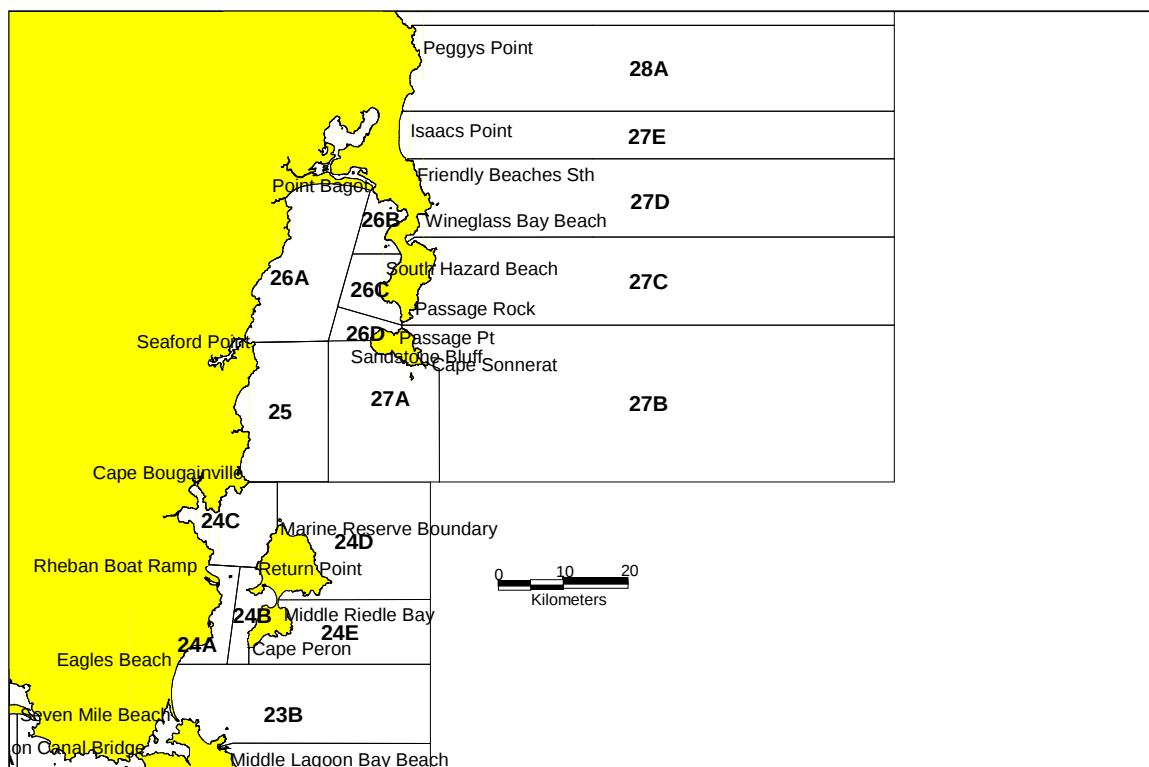
Map 5: South West Tasmania



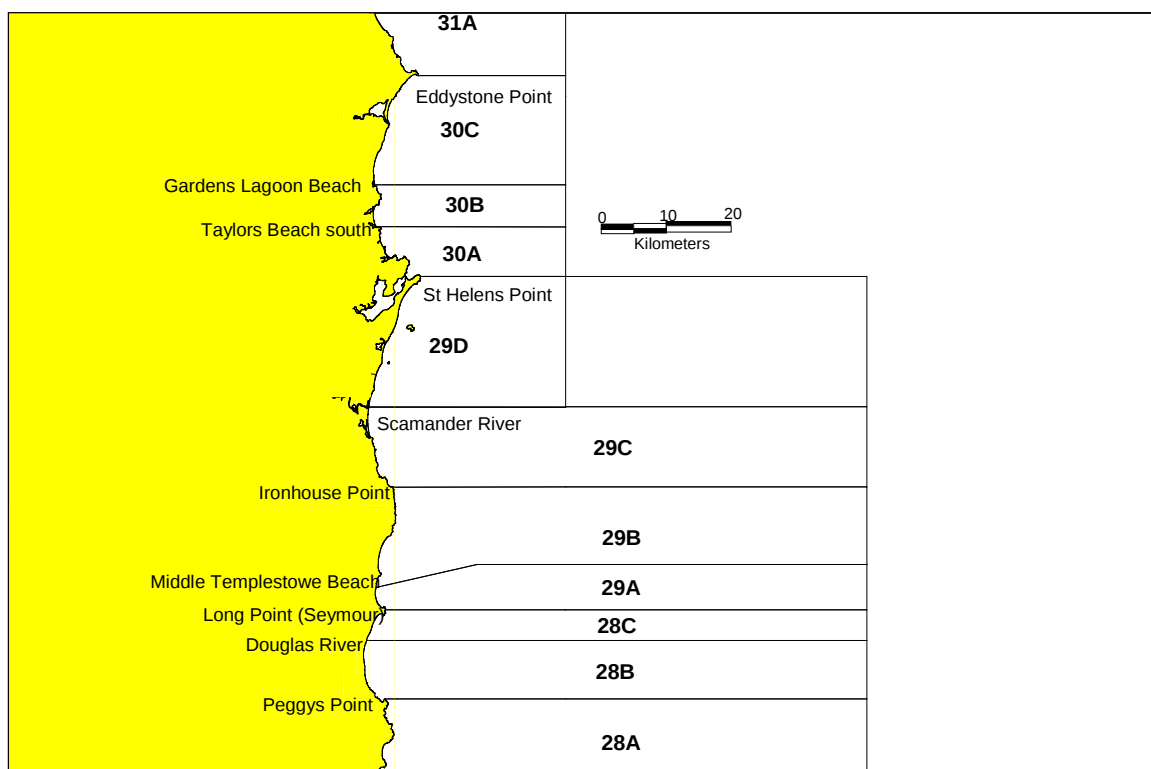
Map 6: South East Tasmania



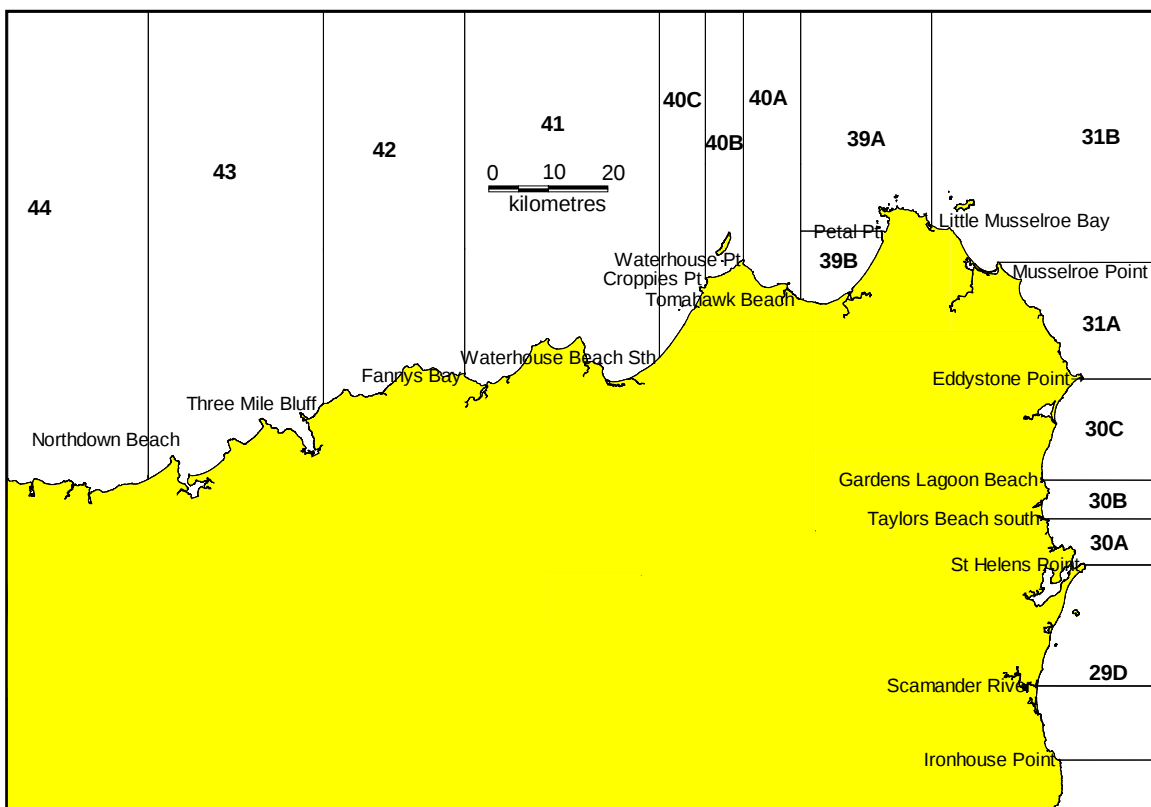
Map 7: Lower East Coast



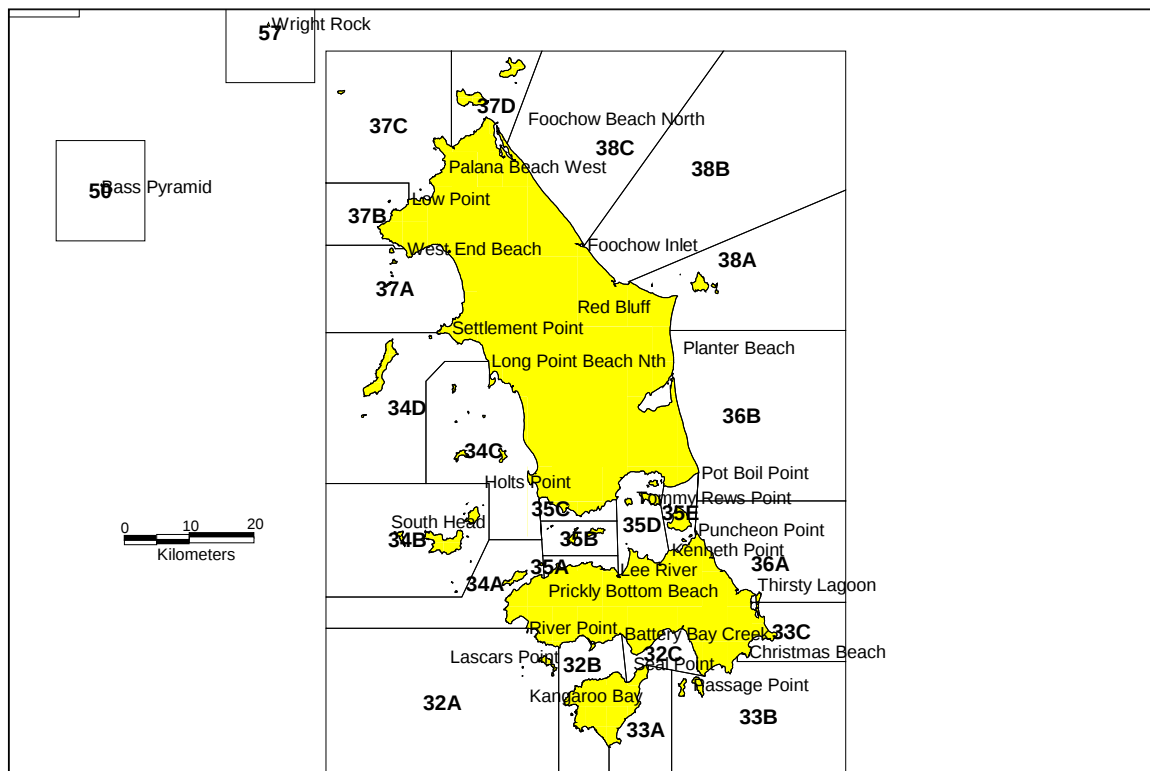
Map 8: Upper East Coast



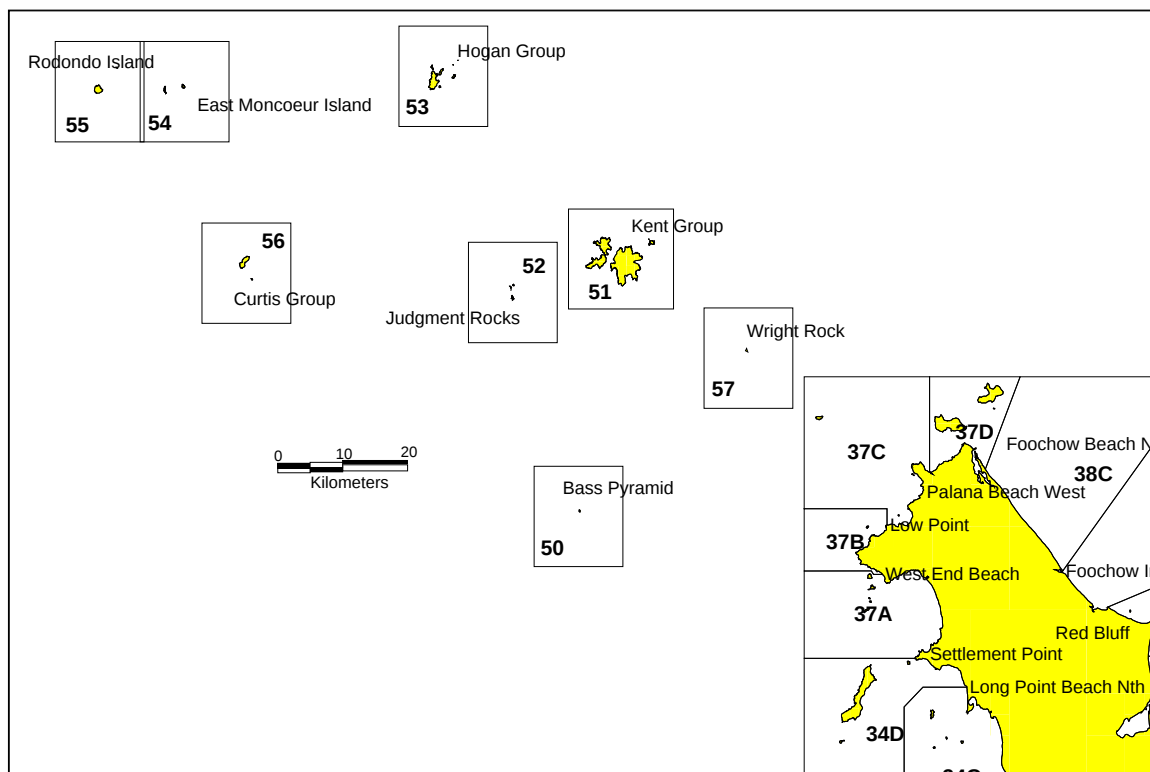
Map 9: North East Tasmania



Map 10: Furneaux Group

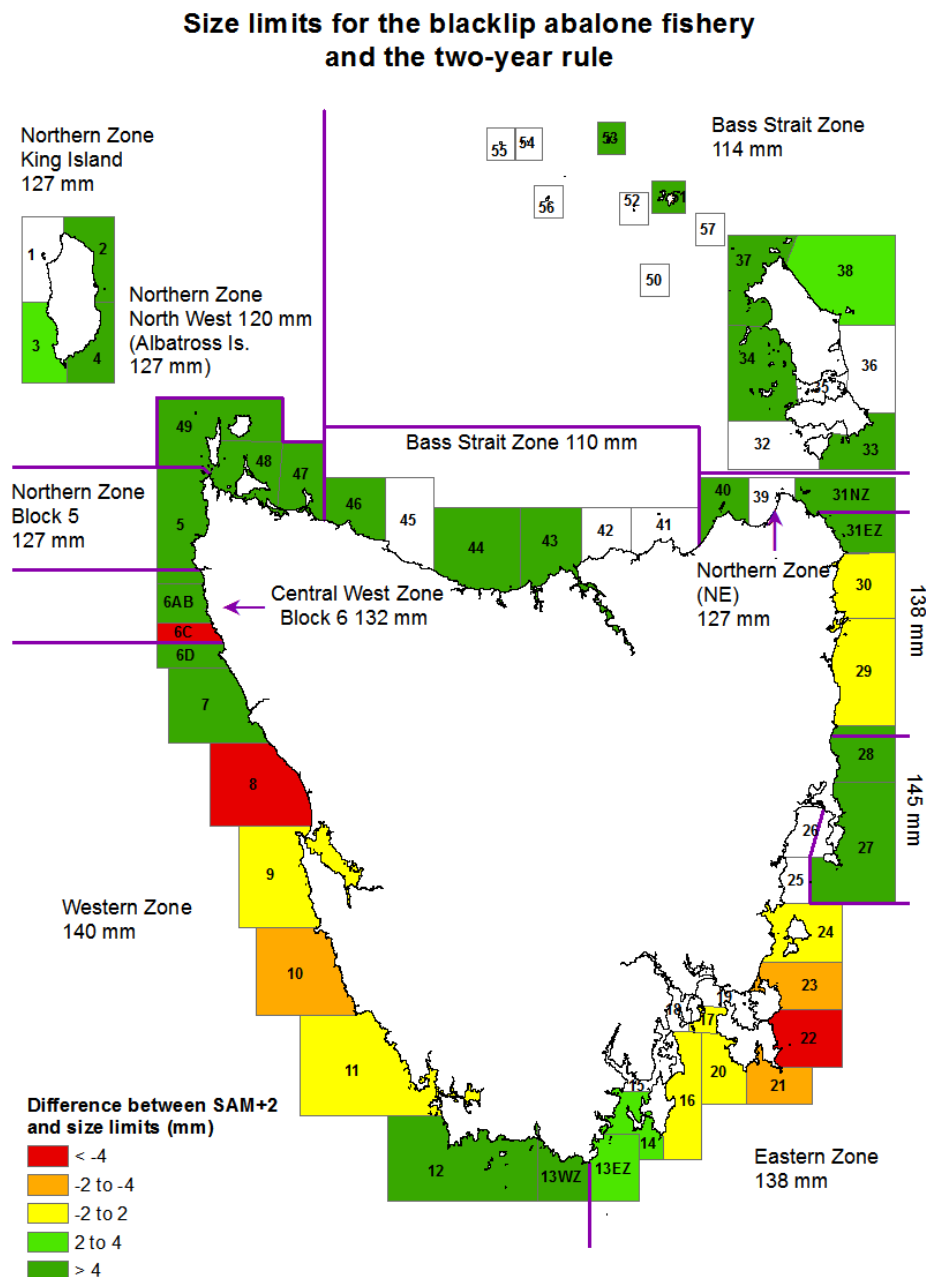


Map 11: Bass Strait Islands



Appendix 12: Application of the “two-year rule” to the blacklip abalone fishery, 2014

In the blacklip fishery, management policy specifies that size-limits allow abalone to have had at least two breeding seasons before they reach legal size. This policy is known as the “two-year rule”. Biological information from field studies is used to determine the average size to which abalone grow in the two years following maturation. The map below shows how well size limits match the application of the policy to blacklip populations, grouped by reporting block. The map may change from year to year as new biological information becomes available, or size limits change.



Colours between orange and red show that the estimated size at maturity plus two years growth (SAM+2) is greater than the 2014 size limit operating in a particular block, and by how much (in millimetres). Blocks shaded orange to red means that the size limit is too low to meet the policy. In blocks shaded yellow, SAM+2 is within 2 mm (+/-) of the size limit and the size-limit policy is approximately met. Blocks shaded green show where SAM+2 is less than the size limit, Blocks with no colour indicate no information is available.

Growth rates, maximum size and median size at maturity are highly variable among abalone populations around Tasmania's coast. Generally, abalone in the north grow slower and to a smaller maximum size, and become sexually mature at a smaller size than abalone in the south. There are exceptions, and in the south there are places with significant populations of smaller abalone, while in the north there are places where abalone grow larger and faster than those around them.

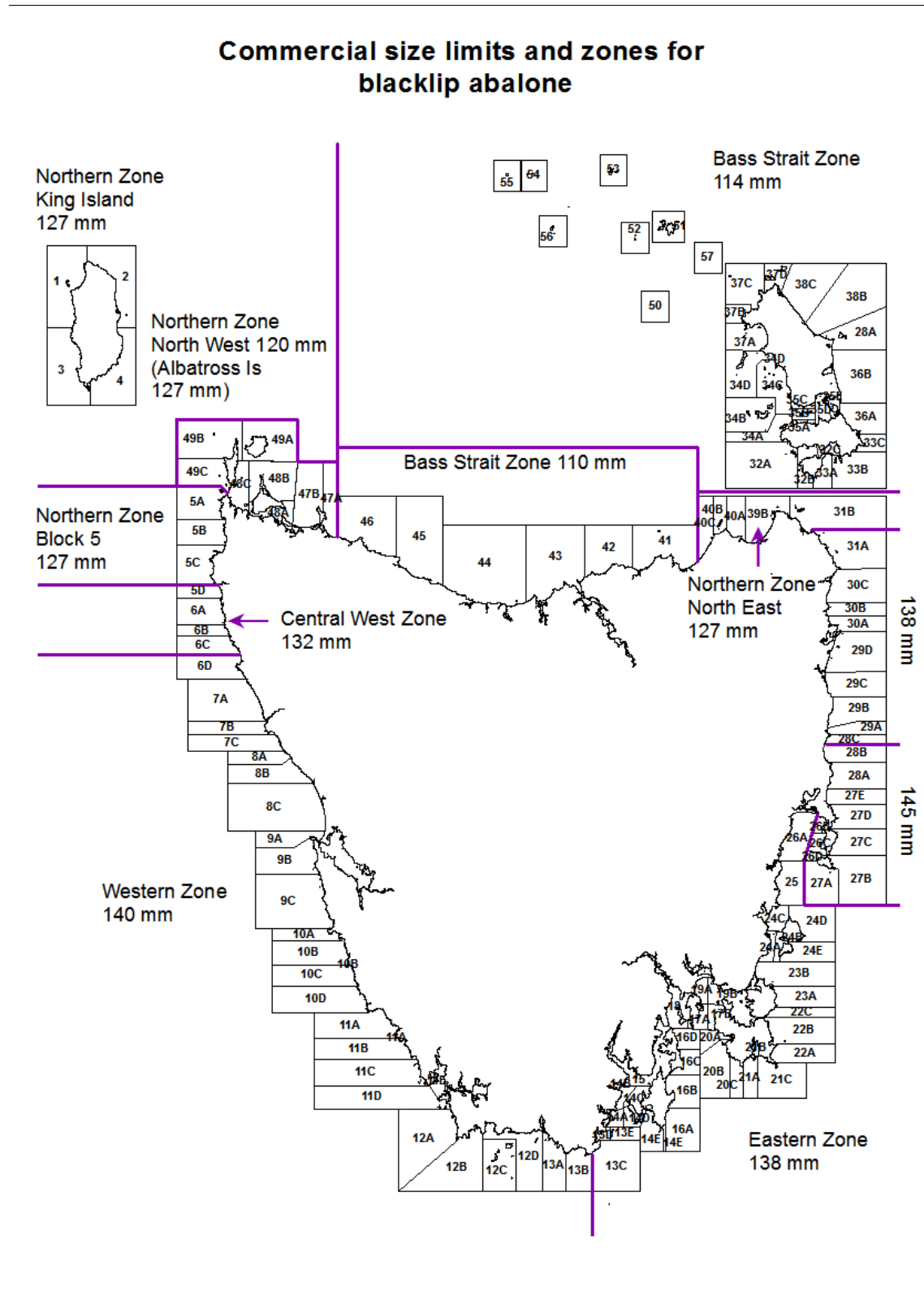
On a smaller scale, within each region, there is also variation in growth and maturity between populations. This occurs particularly in the North East in Block 31 and in the North West, in Block 6, where there are large differences in growth over small distances. In other areas, Block 22 (Tasman Peninsula) and the Western Zone part of Block 13 exhibit greater variation than surrounding blocks. It is impractical to develop size limits that accommodate all the combinations of growth and size at maturity exhibited by populations within a region, so managers aim to achieve the best fit, where the average of SAM+2 meets the management policy.

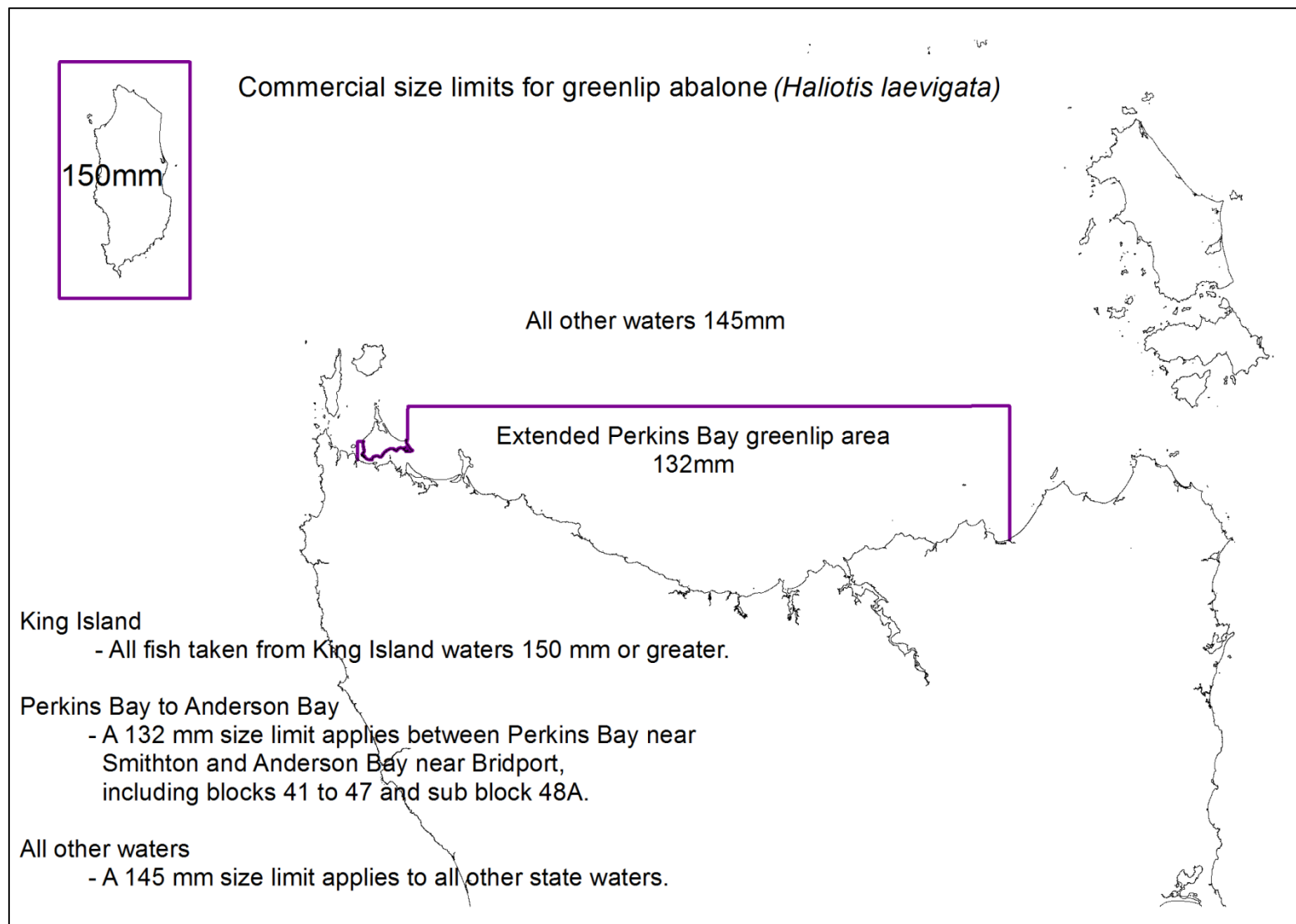
Abalone populations around the coast are regularly sampled by IMAS for the purpose of estimating their median size at maturity. In addition, abalone growth is measured through tagging programs at key parts of the fishery. These maturity and growth studies are ongoing, have been in place since the late 1980's, and useful information from approximately 500 maturity samples and over 40 growth studies is available.

Acquiring biological information is difficult and costly, and while there is substantial knowledge of abalone populations in some regions, others have less than adequate or no information. Where biological information is sparse, there are limitations with the application of SAM+2 across populations within an area, and the map needs to be viewed accordingly. Many of the SAM+2 estimates for the North West, North Coast and Central West blocks were derived from just a few samples, or the samples were collected many years ago, and consequently there is less confidence about these estimates. These include estimates for parts of the coast between the Arthur River and Cape Sorell (Blocks 6-8) and the South Coast (Block 12, WZ Block 13).

Most sites where maturity sampling has occurred lack population-specific growth information, so assumptions about population growth characteristics are made, and growth parameters from regionally similar populations are applied. This means that SAM+2 estimates are only as valid as the assumptions made about regional population growth, and while the best available knowledge is used when developing these assumptions, it is possible that there are some regions where these assumptions are not met.

Appendix 13: Commercial size limits for blacklip and greenlip abalone, 2014







The Institute for Marine and Antarctic Studies (IMAS), established in 2010, comprises the University of Tasmania's internationally recognised expertise across the full spectrum of temperate marine, Southern Ocean and Antarctic research and education.

IMAS – Hobart

20 Castray Esplanade
Battery Point TAS 7004
Telephone: +61 3 6226 6379

Postal address:

Private Bag 129, Hobart TAS 7001

IMAS – Taroona

Nubeena Crescent
Taroona Tasmania Australia
Telephone: +61 3 6227 7277

Postal address:

Private Bag 49, Hobart TAS 7001

IMAS – Launceston

Old School Road
Newnham Tasmania Australia
Telephone: +61 3 6324 3801

Postal address:

Private Bag 1370, Launceston TAS 7250

www.imas.utas.edu.au