TASMANIAN OCTOPUS FISHERY ASSESSMENT 2014/15

Timothy Emery and Klaas Hartmann

February 2016

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Contents

Executive Summary

STOCK STATUS	TRANSITIONAL-DEPLETING
There has been an ongoing decrease in *Octopus pallidus* CPUE from 2005/06 to the lowest level in 2011/12 where it remained in 2012/13 and 2013/14. This long term trend indicates that the associated level of effort is likely to ultimately result in overfishing. In 2014/15 CPUE increased, however the associated level of effort was at or above that historically linked with depleting the stock. It is possible that this increase is at least partly due to the highly stochastic nature of *Octopus pallidus* and a shift in effort to areas with higher CPUE. *Octopus pallidus* is therefore classified as transitional depleting.	
STOCK	Tasmanian Octopus Fishery
INDICATORS	Catch, effort and CPUE trends

The Tasmanian Octopus Fishery is a multi-species fishery in the Bass Strait primarily targeting *Octopus pallidus* and the less abundant *Octopus tetricus* (Table 1). The Scalefish Fishery Management Plan (revised in 2009) provides the management framework for the fishery. The (commercial) fishery is effectively a sole operator fishery with the same operator since its commencement in 1980. This arrangement is effective in ensuring profitability in the fishery and stewardship of the resource.

In this assessment, the octopus fishery is described in terms of catch, effort and catch rates at the State level. A more detailed analysis of catch, effort and catch rates at the fishing block level is also presented. The commercial catch history for the period 2000/01 to 2014/15 is assessed.

Catches have increased over the last decade and have fluctuated at around 85 tonnes since 2005/06. While fishing effort fluctuated around 300,000 potlifts for almost a decade, it increased to over 400,000 potlifts in 2012/13 and 2013/14 before declining to 342,000 potlifts in 2014/15, which was more consistent with the long-term average. Historically there have been strong seasonal patterns in catch per unit effort (CPUE), with CPUE highest during the brooding peak for the species (autumn). While CPUE was higher in the summer months during 2013/14, the 2014/15 season was more reflective of the norm.

CPUE has declined since the recent peak in the mid-2000s and prior to the latest season had been at similar levels to those experienced in the early 2000s, which corresponded to a lower level of harvest. In the 2014/15 season, both the 50-pot sample and logbook data indicated an increase in CPUE in both number and weight respectively. The stochastic nature of CPUE over the last decade is reflective of the biology of the species, which is inherently linked to environmental conditions making it difficult to assess the state of the stock and impact of fishing mortality.

Relative to the 2013/14 season, catch and effort increased in areas east of King Island (3D3 and 3D4) and within inshore waters off Stanley (4E3) but declined in areas offshore of Stanley (4E1). Fishers continue to respond to changes in CPUE by shifting effort (and therefore catch) from areas with lower CPUE to areas with higher CPUE.

Bycatch of octopus from other commercial fisheries (mainly *Octopus maorum* from the rock lobster fishery) have decreased over time and have been relatively low over the last five years (around 8 tonnes on average). The recreational catch of octopus appears minimal with around a tonne retained per annum. The impact of the fishery on bycatch and protected species is low due to the nature of the gear used (i.e. unbaited pots).

The ongoing decrease in *Octopus pallidus* CPUE since 2005/06 suggests that the associated level of effort is too high and likely to ultimately result in overfishing. While CPUE increased in 2014/15 it remains below the reference year and fishing effort is still at or above that historically linked with depleting the stock. It is possible that the increase in CPUE is at least partly due to the highly stochastic nature of *Octopus pallidus* and a shift in effort to areas with higher CPUE.

Fishing effort remains concentrated in the most productive areas or those close to port, which given the substantial stock structure within *Octopus pallidus* increases the potential for recruitment overfishing. A cap or effective limit on spatial fishing effort could improve the probability that CPUE would increase in the future and ensure that the composition and recruitment potential of *Octopus pallidus* is not impacted by concentrated fishing effort.

1. Introduction

The fishery

The Tasmanian Octopus Fishery has been operating since 1980. Prior to December 2009 the fishery operated under permit. Historically, access to the commercial fishery was provided to holders of a fishing licence (personal), a vessel licence and a scalefish or rock lobster licence via a trip limit of 100 kg. This limit also applies to recreational fishers.

Since December 2009, a specific octopus licence was required to participate in the fishery. Two licenses were issued, belonging to the same operator.

Since 1996, under the Offshore Constitutional Settlement (OCS) with the Commonwealth of Australia, Tasmania has assumed management control of the octopus fishery out to 200 nautical miles.

The Tasmanian Octopus Fishery primarily targets the pale octopus (*Octopus pallidus*), with lesser targeted catches of the Gloomy octopus (*Octopus tetricus*) and the Maori octopus (*Octopus maorum*) also taken, primarily as byproduct. The main fishing method is unbaited moulded plastic pots (volume 3000 ml) attached to a demersal longline 3-4 km long and set on the sea floor at variable depths of 15-85 m (Leporati *et al.*, 2009) Currently, a maximum of 1,000 pots per line is allowed. Octopuses are attracted to these pots as a refuge. Pots are hauled after about 3–6 weeks in the water to achieve optimum catch rates. An abundant food supply may support a large population of octopus and when combined with a shortage of suitable shelters results in high catch rates. Commercial octopus fishing is presently restricted to the East Bass Strait and West Bass Strait fishing zones (Figure 1.1). While no further octopus licences can be issued for the Bass Strait area, the remaining State waters are classified as developmental and could be opened to fishing providing necessary research is undertaken at the cost of the applicant. In 2015, DPIPWE sought developmental fishing permit applications, with expressions of interest received for fishing *Octopus pallidus* off the east coast of Tasmania.

Octopuses are also targeted by recreational fishing, although catch sizes are small. A total of 100kg of octopus in any one day and at any one time is allowed under Tasmanian legislation.

From 2000 to 2005 *Octopus pallidus* catches increased substantially and since then have remained around 85 tonnes, with some strong inter-annual variation (Figure 1.2). The majority of the catch originates from the Octopus Fishery. *Octopus tetricus* has only been reported in the fishery since 2010, mostly from around Flinders Island and a total of 48 kgs was caught in 2014. This is a reduction in catch from the previous season and could be due to reduced fishing effort around Flinders Island. The catch of *Octopus maorum* in the fishery has fluctuated since 2008 but was the highest on record in 2014 at 1,455 kgs.

Main features and statistics for the Tasmanian Octopus Fishery.

Fishing methods	Unbaited octopus pots
Primary landing port	Stanley
Management methods	**Input control:** • Fishing licence (octopus) allows the use of 10,000 pots (and a maximum of 1,000 pots per line) to target *Octopus pallidus*, *O. tetricus* and *O. maorum* • Fishing zone restriction (East Bass Strait and West Bass Strait octopus zones only) **Output control*:*** • Possession limit of 100 kg of octopus per day (all species confounded) for holders of a fishing licence (personal) and a scalefish licence package, and recreational fishery.
Main market	Tasmania and mainland Australia
Fishing licences	2
Active vessels	2

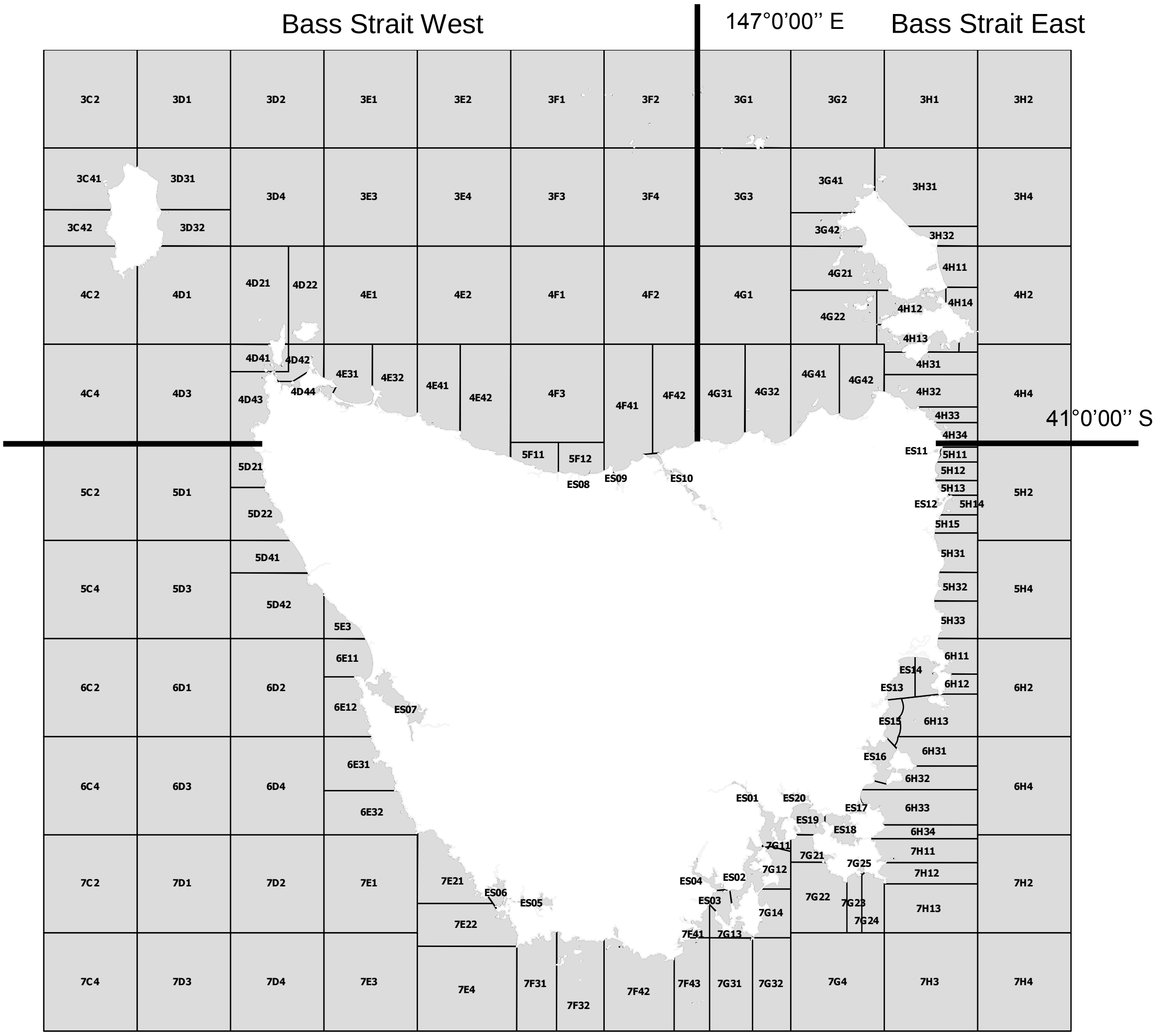


Figure 1.1 East and West Bass Strait octopus fishing zones and blocks. The octopus fishery reports in latitude and longitude but for the purpose of this report, fishing areas will be reported in fishing blocks.

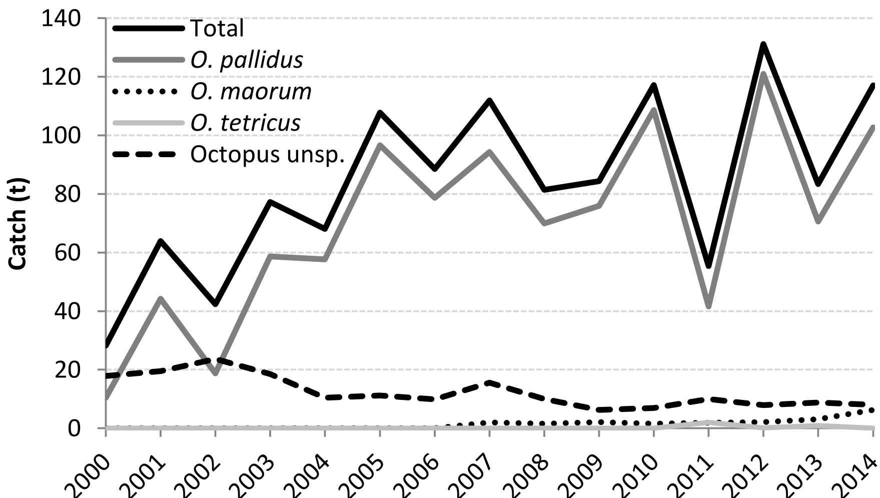


Figure 1.2 State-wide octopus catches since 2000 from all commercial sources.

Assessment of stock status

Stock status definitions

In order to assess the fisheries in a manner consistent with the national approach (and other jurisdictions) we have adopted the national stock status categories (Flood *et al.*, 2012). These categories define the assessed state of the stock in terms of recruitment overfishing, which is often treated as a limit reference point. Recruitment overfished stocks are not collapsed but they do have reduced productivity. Fisheries are ideally also managed towards targets that maximise benefits from the harvesting, such as economic yield or provision of food. The scheme used here does not attempt to assess the fishery against any target outcomes.

Stock status	Description	Potential implications for management of the stock
SUSTAINABLE	Stock for which biomass (or biomass proxy) is at a level sufficient to ensure that, on average, future levels of recruitment are adequate (i.e. not recruitment overfished) and for which fishing pressure is adequately controlled to avoid the stock becoming recruitment overfished	Appropriate management is in place
TRANSITIONAL-RECOVERING ↑	Recovering stock—biomass is recruitment overfished, but management measures are in place to promote stock recovery, and recovery is occurring	Appropriate management is in place, and the stock biomass is recovering
TRANSITIONAL-DEPLETING ↓	Deteriorating stock—biomass is not yet recruitment overfished, but fishing pressure is too high and moving the stock in the direction of becoming recruitment overfished	Management is needed to reduce fishing pressure and ensure that the biomass does not deplete to an overfished state
OVERFISHED	Stock is recruitment overfished, and current management is not adequate to recover the stock; or adequate management measures have been put in place but have not yet resulted in measurable improvements	Management is needed to recover this stock; if adequate management measures are already in place, more time may be required for them to take effect
UNDEFINED	Not enough information exists to determine stock status	Data required to assess stock status are needed

Proposed performance indicators and reference points

The determination of stock status is based on the consideration of the commercial catch and effort data, which are assessed by calculating fishery performance indicators and comparing them with reference points (Table 1.1).

Fishing mortality and biomass are typical performance indicators used to assess stock status in fisheries. Here, total commercial catch and CPUE (numbers per pots from the 50-pot samples) are used instead as proxies as there are insufficient data to calculate fishing mortality or biomass. These are compared to a reference period: 2000/01 to 2009/10 for catch and 2004/05 to 2009/10 for CPUE (2004/05 corresponding to the start of the 50-pot sampling).

Other measures are also taken into consideration in the determination of stock status such as changes in biological characteristics of the stock, indicators of stock stress and significant external factors related to fishing activity.

Table 1.1 Summary of the proposed performance indicators and reference point.

Performance indicators	Reference points
Fishing mortality	• Catch > highest catch value from the reference period (99.57 t) • Catch< lowest catch value from the reference period (17.71 t)
Biomass	• Numbers per pot < lowest value from the reference period (0.40 octopus/pot)
Change in biological characteristics	• Significant change in the size/age composition of commercial catches
Stress	• Significant numbers of fish landed in a diseased or clearly unhealthy condition • Occurrence of a pollution event that may produce risks to fish stocks, the health of fish habitats or to human health • Any other indication of fish stock stress

Data sources and analysis

Commercial data

Commercial catch and effort data are based on the Octopus Fishery and the Scalefish Fishing Record logbook returns. In both cases octopus catches are reported in weight. Since November 2004, a 50-pot sampling program has been conducted, where fishers are required to collect all octopus caught in 50 randomly selected pots from a single line, representing 10% of a standard commercial line. From these 50-pot samples, the numbers of males and females, and the percentage of pots with eggs are recorded. The total and gutted weight of the catch was also recorded from 2004 to 2010. Fishers are only required to sample a single line where multiple lines were located within a 15 km radius.

Weight-at-age is highly variable in octopus due to a high individual variability and a rapid response to environmental factors (Leporati *et al.*, 2008d; André *et al.*, 2009). This introduces stochasticity in catch weight so that it becomes difficult to use when interpreting trends in population size. The 50-pot samples provide numbers of octopus, which is more representative of the state of the stock. Consistent, high level sampling has only been in place since 2011 and a longer time-series will be required to obtain a more accurate understanding of the stock status – particularly at a smaller spatial scale (e.g. block level).

Recreational fishery

Data on the recreational fishery catch of octopus in Tasmania is sparse. Detailed analyses of the Tasmanian recreational fishery are based on the 2000/01 National Survey (Lyle 2005) and the 2007/08 and 2012/13 state-wide fishing surveys (Lyle *et al.,* 2009; Lyle *et al.,* 2014).

Data analysis

For the purpose of this assessment, catch, effort and catch rate analyses were restricted to commercial catches of *Octopus pallidus* for the period March 2000 to February 2015.

A fishing year from 1st March to the last day of February has been adopted for annual reporting, which reflects the licensing year. Catches have been analysed fishery-wide and by fishing blocks (Figure 1.1).

An updated conversion rate has been used since the 2013/14 assessment to provide a more precise measure of octopus whole weight. All gutted weights were converted to whole weight as follows:

Whole weight = 1.233472 * *Gutted weight*

where *Whole weight* and *Gutted weight* are in kilograms. The relationship was estimated from 8,510 individuals recorded in the 50 pot sampling dataset between December 2004 and April 2010.

The number of pots pulled in a given month was used as a measure of effort in this assessment. Catch returns for which effort information was incomplete were flagged and excluded when calculating effort or catch rates. All records were however included for reporting catches.

The impact of soak time (the time during which the fishing gear is actively in the water) was determined by analysing CPUE trends (in catch number per pot) through time for the 50-pot sampling data.

Catch rates of pale octopus have been standardised using a generalised linear model (GLM) to reduce the impact of obscuring effects such as season on the underlying trends (Kimura, 1981, 1988). However, while standardised catch rates are preferred over the simple geometric mean, other factors may remain unaccounted for that obscure the relationship between standardised catch rates and stock size, such as increasing fisher efficiency.

There is currently only one operator in the Tasmanian Octopus Fishery, the depth fished is relatively constant and the two vessels cooperate, with the vessel pulling the gear not necessarily being the same vessel that set it. Consequently depth, vessel and skipper were not included in the GLM, the factors considered were month and block. The generalised linear model was applied to weight per pot for the whole commercial dataset and number per pot for the 50-pot sampling dataset (Table 1.2). This process removes the effect of season and location so that trends in CPUE are more accurately reflective of change in octopus density.

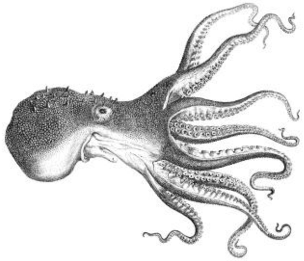
In the 2013/14 assessment the GLM was refined to improve the model fit in comparison with previous years. These refinements consisted of better quality control on the input data, outlier removal and improved spatial modelling.

Given the shifts in seasonal patterns of CPUE both the results from previous year's refined assessment and the current assessment have been included in this report for comparison.

Species biological summaries

All three octopus species harvested in Tasmania are short lived and fast growing. Table 1.3 summarises the biology of each species.

Table 1.3 Life history and biology of *O. pallidus, O. tetricus* and *O. maorum*. In the Source column, [1] refers to *Octopus pallidus,* [2] to *Octopus tetricus and* [3] to *Octopus maorum.*

Species	**Pale octopus** *Octopus pallidus*	**Gloomy octopus** *Octopus tetricus*	**Maori octopus** *Octopus maorum*	**Source**
Illustration	 (William Hoyle)	 (Angustus Gould)	 (Peter Gouldthorpe)	
Habitat	Sand and mud habitats to depth of 600m.	Rocky reefs and sand habitats in shallow waters, up to 30 m depth.	Rocky reefs, beds of seagrass or seaweeds, sand down to 549 m.	Norman (2000)[1,2,3] Edgar (2008)[1,2,3]
Distribution	South-east Australia, including Tasmania.	Subtropical eastern Australia and northern New Zealand, increasingly found in Tasmania.	Temperate and sub-Antarctic waters of New Zealand and southern Australia.	Norman (2000)[1,2] Stranks (1996)[3]
Diet	Crustaceans and shellfish (bivalves).	Crustaceans (crabs, lobster) and shellfish (gastropods, bivalves).	Crustaceans (crabs, lobsters), fish, shellfish (abalone, mussels) and other octopuses.	Norman and Reid (2000)[1,2] Norman (2000)[1,2,3]
Movement and stock structure	Limited movement and dispersal from natal habitat. Eastern and western Bass Strait populations likely to be two discrete sub-populations.	Undefined.	• Several genetically distinct populations. • At least 2 populations in Tasmania: North-east Tasmanian population and South-west Tasmanian populations (which extends to South Australia). • Adults of the species aggregate all year-round in Eaglehawk Bay in the Tasman Peninsula).	Doubleday *et al*. (2008)[1] Doubleday *et al*. (2009)[3]
Natural mortality	High. Undefined.	Undefined.	Undefined.	
Maximum age	Up to 18 months.	Undefined.	Maximum of 7.3 months from ageing study but lifespan potentially up to 3 years.	Leporati *et al*. (2008d)[1] Doubleday *et al*. (2011)[3] Grubert and Wadley (2000)[3]

Growth	• Highly variable, partly dependant on water temperature and hatching season. • Max weight: 1.2 kg • Growth is initially rapid in the post-hatching phase, before slowing down. Growth has been represented by a 2-phase growth model with an initial exponential growth phase followed by a slower (generally power) growth phase. Average growth in the first 114 days was estimated at $W = 0.246e^{0.014t}$ in spring/summer and $W = 0.276e^{0.018t}$ in summer/autumn, where *W* is the weight in g and *t* is the age in days.	• Max weight: up to 2.6 kg • Growth between 49 g to 2.64 kg described by the growth equation: $W = 3.385(1 - e^{-0.07642t})^3$ where *W* is the weight in kg and *t* is the age in days. Growth in the field might however only be about 40% of growth in aquarium.	• Max weight: 15 kg • Growth equation undefined	Leporati *et al*. (2008a)[1] André *et al*. (2008)[1] Joll (1977, 1983)[2] Stranks (1996)[3]
Maturity	Size at 50% maturity for females reached at 473g. Males appear to mature earlier (<250 g).	• Size-at-50% maturity undefined. • Males are mature between 100-150g. Females commence sexual activity at about 500 g and generally spawn between 1-2 kg.	• Size-at-50% maturity undefined. • Female mature between 0.6 to 1 kg. • Weight-specific fecundity range from 6.82 to 27.70 eggs/gram body. • Mating activity is independent of female maturity.	Leporati *et al*. (2008a)[1] Joll (1983)[2] Grubert and Wadley (2000)[3]
Spawning	• Semelparous (i.e. reproduces only once before dying). • Spawns all year round with peaks in late summer/early autumn • Around 450-800 eggs per spawning event. • Egg length: 11-13 mm.	• Semelparous (i.e. reproduces only once before dying). • Spawning season undefined. • Between 125 000 and 700 000 eggs depending on size • Egg length: 2.4 mm.	• Semelparous (i.e. reproduces only once before dying). • Spawning season: spring-summer in New Zealand but appear to mate and lay all year round in Tasmania. • Lay around 7,000 eggs in captivity but up to 196 000 eggs in ovaries of wild caught animals. Egg length: 6.5-7.5 mm.	Leporati *et al*. (2008a)[1] Joll (1983)[2] Anderson (1999)[3] Grubert and Wadley (2000)[3]
Earlylife history	Large benthic hatchlings (0.25g) settling directly in the benthos.	Planktonic hatchlings (2-5mm length) settling at 0.3g (8 mm).	Planktonic hatchlings (5 mm length).	Leporati *et al*. (2007)[1] Joll (1983)[2] Anderson (1999)[3]
Recruitment	Variable.	Variable. No stock-recruitment relationship defined.	Variable. No stock-recruitment relationship defined.	

2. State catch, effort and catch rates

Commercial catch from octopus pots

Influence of soak time

The 50-pot samples indicated that soak time did not appear to affect CPUE by number or weight (*Catch weight per unit effort* = -0.001**Soak time* + 2.89, p>1) (Figure 2.1). This indicated that fishers were choosing a soak time sufficient to obtain maximum catch rates and that the soak time could be disregarded when calculating catch rates. Consequently the number of shots was used as the measure of effort when calculating catch rates.

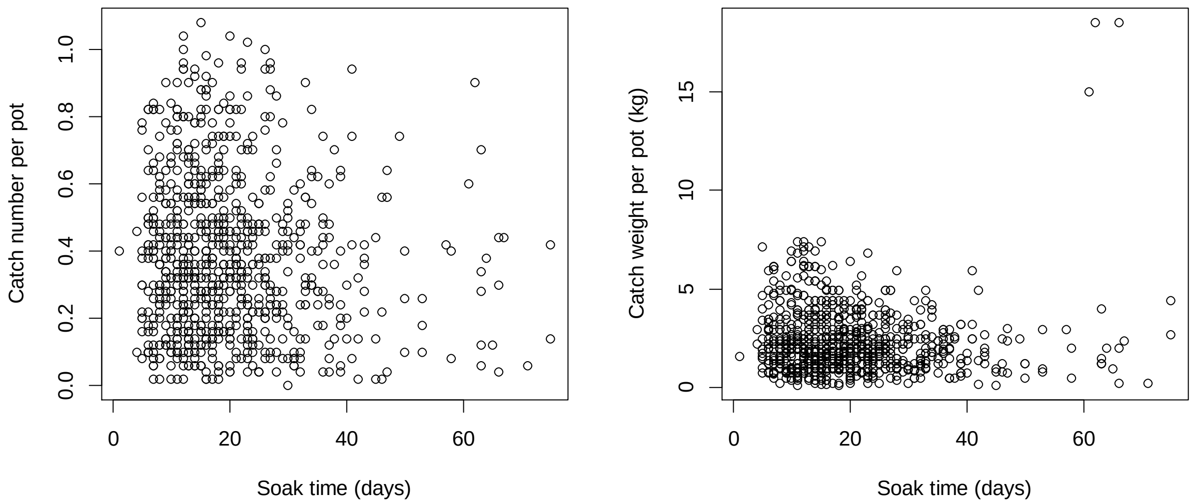


Figure 2.1 CPUE (in catch number and weight per pot) relative to soak time of octopus pots.

Catch and effort

Catch of *O. pallidus* has increased since 2000/01 and over the last nine fishing seasons has fluctuated at around 85 tonnes (Figure 2.2). Catch for the 2014/15 season increased by 8 tonnes from the previous season to 87 tonnes. Current catch levels were about double of what they were prior to 2000 (Leporati *et al.*, 2009). The majority of catch was taken during the autumn and winter seasons (73%) compared to the spring and summer seasons (27%), which was the complete opposite of the previous fishing season where 63% of the catch was taken during the spring and summer seasons (Figure 2.3). Effort has also increased since 2002/03 and while averaging over 400,000 potlifts during the previous two fishing seasons, declined by 70,000 potlifts in 2014/15 to 342,000 potlifts, which was more consistent with the long-term average over the last decade (Figure 2.4).

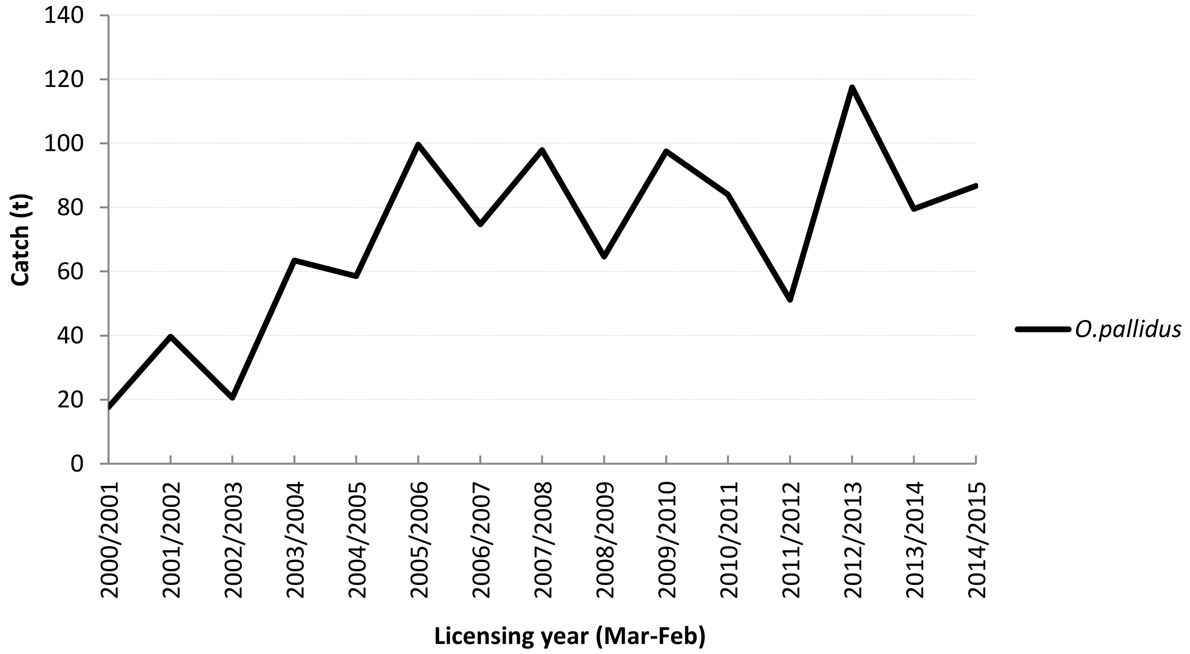


Figure 2.2 Total catches State-wide (tonnes) for *Octopus pallidus* since 2000/01.

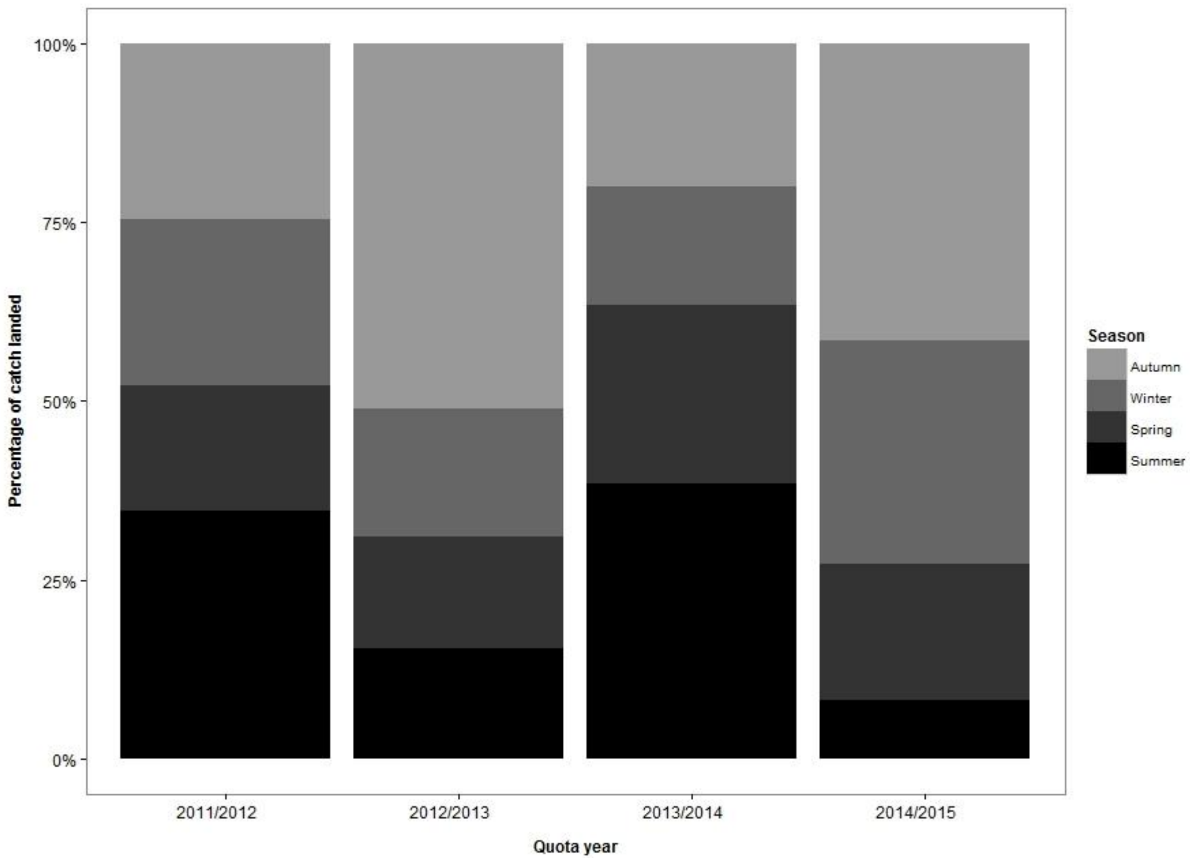


Figure 2.3 Percentage catches of *Octopus pallidus* landed by season for the last four fishing seasons

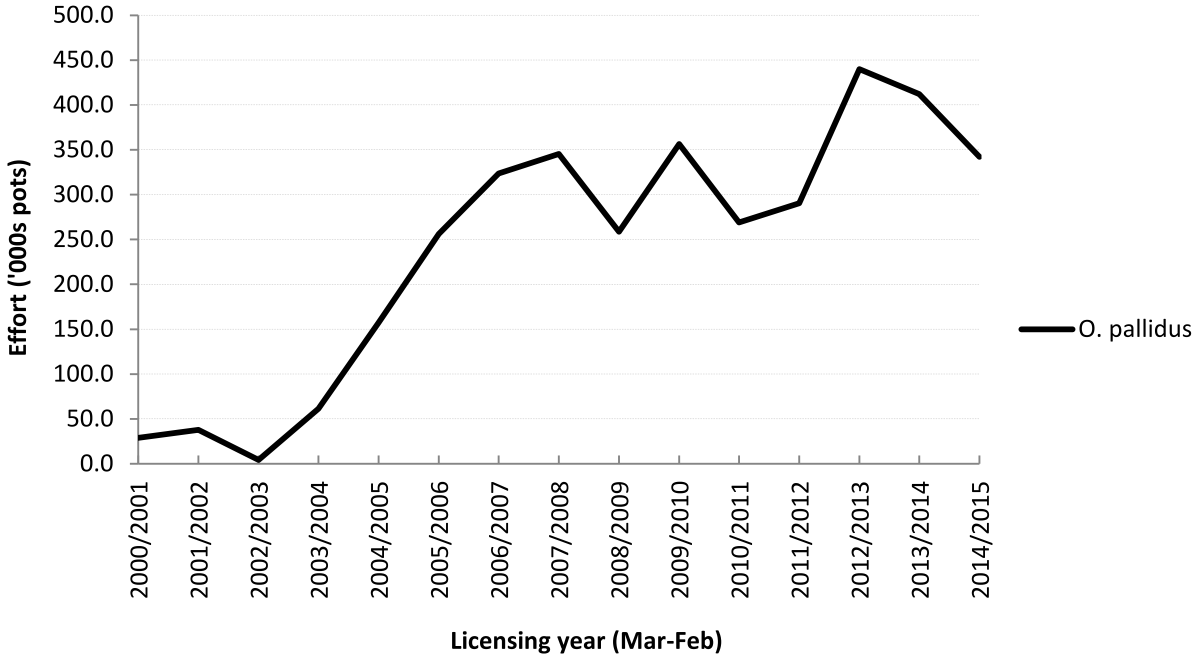


Figure 2.4 State-wide effort (thousands pots) for *Octopus pallidus* since 2000/01.

CPUE

With the exception of 2013/14 fishing season, CPUE based on the 50-pot sampling has followed a similar pattern to the CPUE for the total commercial catch from logbooks, with higher catch rates in autumn/early winter (March-June, Figure 2.5) due to the overlap with the brooding peak for the species (Leporati *et al.*, 2009). Female octopus use the pots as shelters to deposit their eggs and the impact on recruitment of removing brooding females has been questioned previously, especially since *O. pallidus* is a holobenthic species (i.e. produce egg batches in the hundreds and benthic hatchlings) with limited juvenile dispersal.

The licensing year 2004/05 was chosen as a reference year for CPUE as the 50-pot sampling started in that year (Figure 2.7). The catch rate standardisation in previous years has removed the seasonal effect (which was evident in Figures 2.5 and 2.6) but CPUE over the last decade has been highly stochastic through time, albeit at a reduced level relative to the CPUE from the mid-2000s. The variation to some extent is due to the biological characteristics of *Octopus pallidus*, which are inherently linked to environmental conditions, influencing hatching success and timing, larval mortality, recruitment, growth and spawning success. Stocks may be relatively abundant in one year but decline in the succeeding year due to less favourable environmental conditions and/or fishing pressure (Boyle, 1996; Rodhouse *et al.*, 2014).

Prior to 2014/15, the 50-pot sampling CPUE had been around 60% of the reference year for a period of three fishing seasons, with much higher levels of fishing effort. In 2014/15 fishing effort reduced by 70,000 potlifts and CPUE increased to around 85% of the reference year (75% for total commercial catch from logbooks) with spatial shifts in fishing effort. It is possible that this increase in CPUE is at least partly due to the highly stochastic nature of *Octopus pallidus* and a shift in effort to areas with higher CPUE.

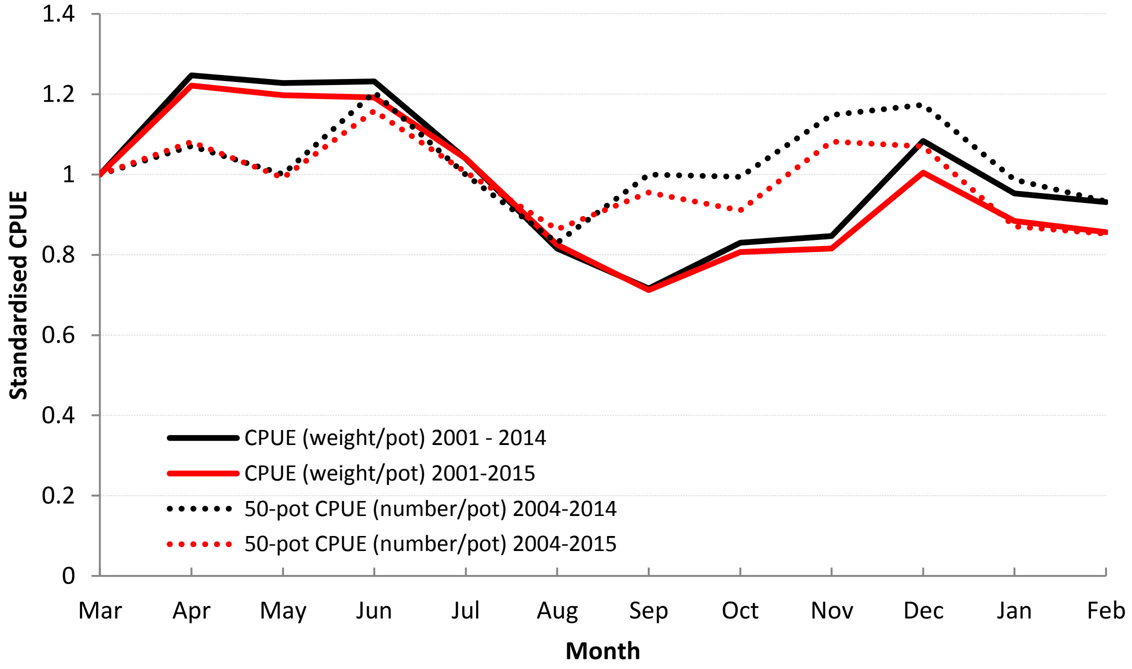


Figure 2.5 *Octopus pallidus* standardised catch per unit effort (CPUE) relative to March levels in weight per pot (total commercial) and in number per pot (50-pot sampling) for the previous and this year's assessments.

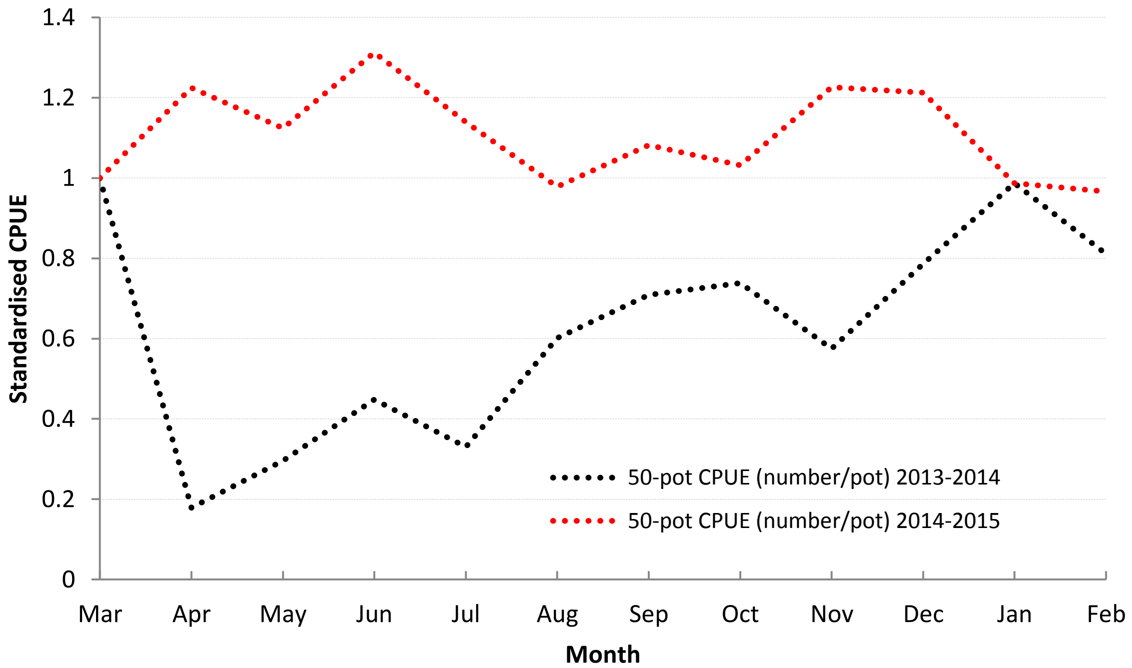


Figure 2.6 *Octopus pallidus* standardised catch per unit effort (CPUE) relative to March levels in number per pot (50-pot sampling) comparing solely the 2013/14 and 2014/15 fishing seasons.

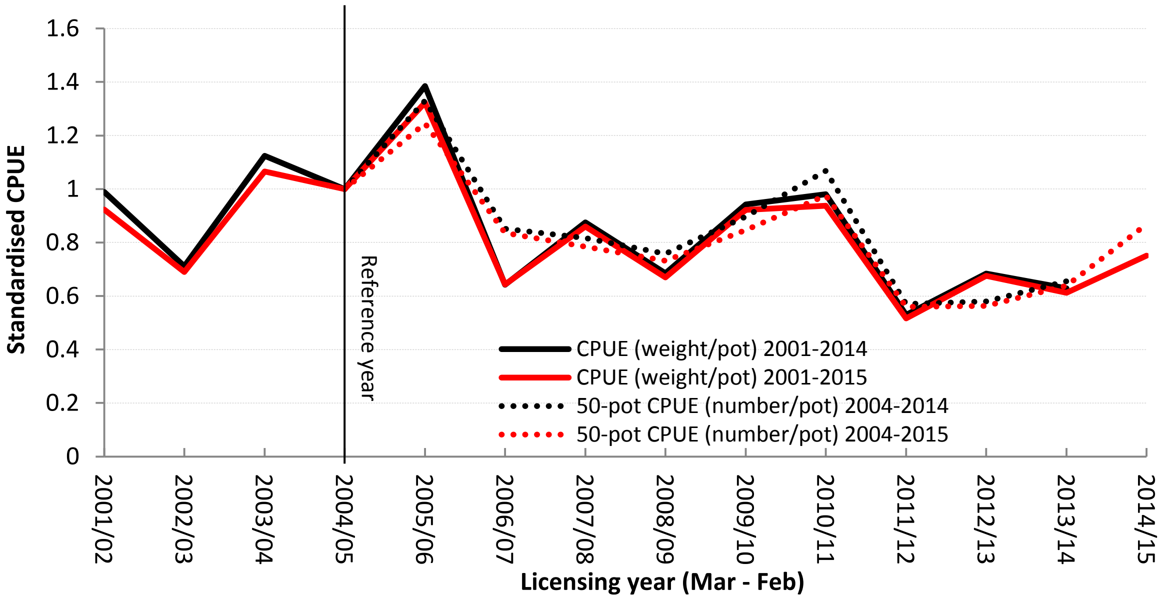


Figure 2.7 *Octopus pallidus* standardised catch per unit effort (CPUE) relative to 2004/05 levels in weight per pot (total commercial) and in number per pot (50-pot sampling) for the previous and this year's assessments.

Commercial catch from other fishing methods

Although historical total octopus bycatch has reached up to 30 tonnes in the early 2000's, recent records of octopus bycatch have dropped, reaching around 12.7 tonnes in 2013/14 (Figure 2.8). Species are seldom recorded and 96% of the bycatch is qualified as unspecified octopus species. It is generally accepted that the rock lobster fishery octopus bycatch is predominantly *Octopus maorum*.

Most of the octopus bycatch in recent years originated from the rock lobster commercial fishery, with an average bycatch of 6.7 tonnes per annum in the last six licensing years (Fig. 2.8). The commercial scalefish fishery provided the other source of octopus bycatch with an average bycatch of 3.6 tonnes per annum in the last six licensing years (not including 2014/15, which is incomplete) (Figure 2.8). Gears that produce the most octopus catch are hand collection and graball nets. Hand collected octopus was once a targeted fishery in Eaglehawk Neck. The current pressure from other commercial fisheries does not appear excessive and does not show any upwards trends. The impact of octopus bycatch on the octopus stocks from these fisheries is therefore considered low at present.

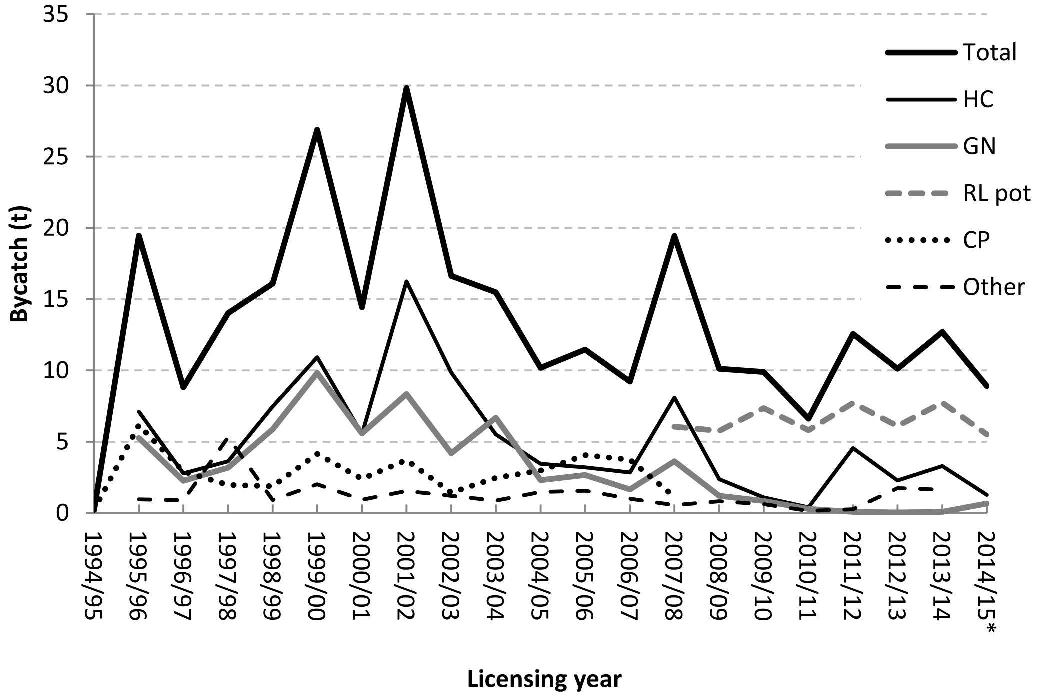


Figure 2.8 Octopus bycatch (tonnes) in other commercial fisheries. HC= hand collection, GN= graball net, RL pot= Rock lobster pots, CP= crab pot. Note that 2014/15* data is incomplete for catch from scalefish fishery.

Recreational catch

Catch and effort information are not routinely available for the recreational fishery. Surveys of the recreational fishery conducted in 2000/01, 2007/08 and 2012/13 provide the only comprehensive snapshots of the Tasmanian recreational fishery (Lyle, 2005; Lyle *et al.*, 2009; Lyle *et al.*, 2014). The recreational fishery surveys did not differentiate between cephalopod species with the exception of southern calamari and Gould's squid. It is, however, understood that the majority of the catch reported as "cephalopods, other" are actually octopus, the remaining portion being cuttlefish.

Octopus species are not the focus of the recreational fishery and appear as bycatch caught predominantly by lines, by gillnets and, to a lesser extent, pots. The impact of the recreational fishery on the octopus stocks is considered minimal.

Table 2.1 Estimated total recreational harvest numbers, number kept and % released for cephalopod taken by Tasmanian residents (refer to Lyle *et al.*, 2009). Note: the survey periods do not correspond with fishing years; 2000/01 represented the period May 2000 to Apr 2001, and 2007/08 represented the period Dec 2007 to Nov 2008.

Cephalopod, other	Number fished	Number kept	% released
2000/01	6,264	<1,000	85.3
2007/08	5,605	1,149	79.5
2012/13	3,773	1,443	61.8

3. Fine-scale catch, effort and catch rates

Catch and catch rates have been analysed at the scale of the fishing block to examine the potential issue of recruitment overfishing. Trends for each block have been calculated as the difference in catch and un-standardised CPUE between the current licensing year and the previous licensing year, as well as between the current licensing year and the average of the five previous licensing years (Figures 3.1 and 3.2).

Areas of high catch and effort have historically been concentrated off Stanley (4E1 and 4E3) and south-west of Flinders Island (4G2) (Figures 3.1A and 3.1B). In the 2014/15 fishing season, catch and effort increased in areas east of King Island (3D3 and 3D4) and areas inshore of Stanley (4E3). Catch and effort reduced in areas offshore of Stanley (4E1) but 4E1 still remained the area with the highest amount of catch and effort (34 tonnes and 134,500 potlifts). Catch also increased slightly in areas south-west of Flinders Island (4G2 and 4G4) with nominal increases in fishing effort.

Overall, CPUE along the south-west coast of Flinders Island remained low relative to the previous five years but slightly increased from the previous fishing season in area 4G4 (Figure 3.2A and 3.2B). CPUE in areas off Stanley (4E1 and 4E3) have remained stable relative to the previous five fishing seasons but slightly increased in area 4E3 relative to the previous fishing season. CPUE was also higher in areas east of King Island relative to the previous five fishing seasons but slightly increased from the previous fishing season in area 3D4.

Significantly, the trends in catch and catch-rate (Figure 3.2) are closely aligned, likely indicating that fishers are responding to changes in CPUE by shifting effort (and therefore catch) from areas with decreasing CPUE to areas with increasing CPUE. For example, higher catch rates in areas inshore of Stanley (4E3) led to increase effort relative to the previous season, while there was reduced effort in offshore areas (4E1) where CPUE was lower.

Fishing effort continues to remain concentrated in the most productive areas or those closer to port, which given the substantial stock structure within *Octopus pallidus* increases the potential for recruitment overfishing. A cap or effective limit on spatial fishing effort could improve the probability that CPUE would increase in the future and ensure that the composition and recruitment potential of *Octopus pallidus* is not impacted by concentrated fishing effort.

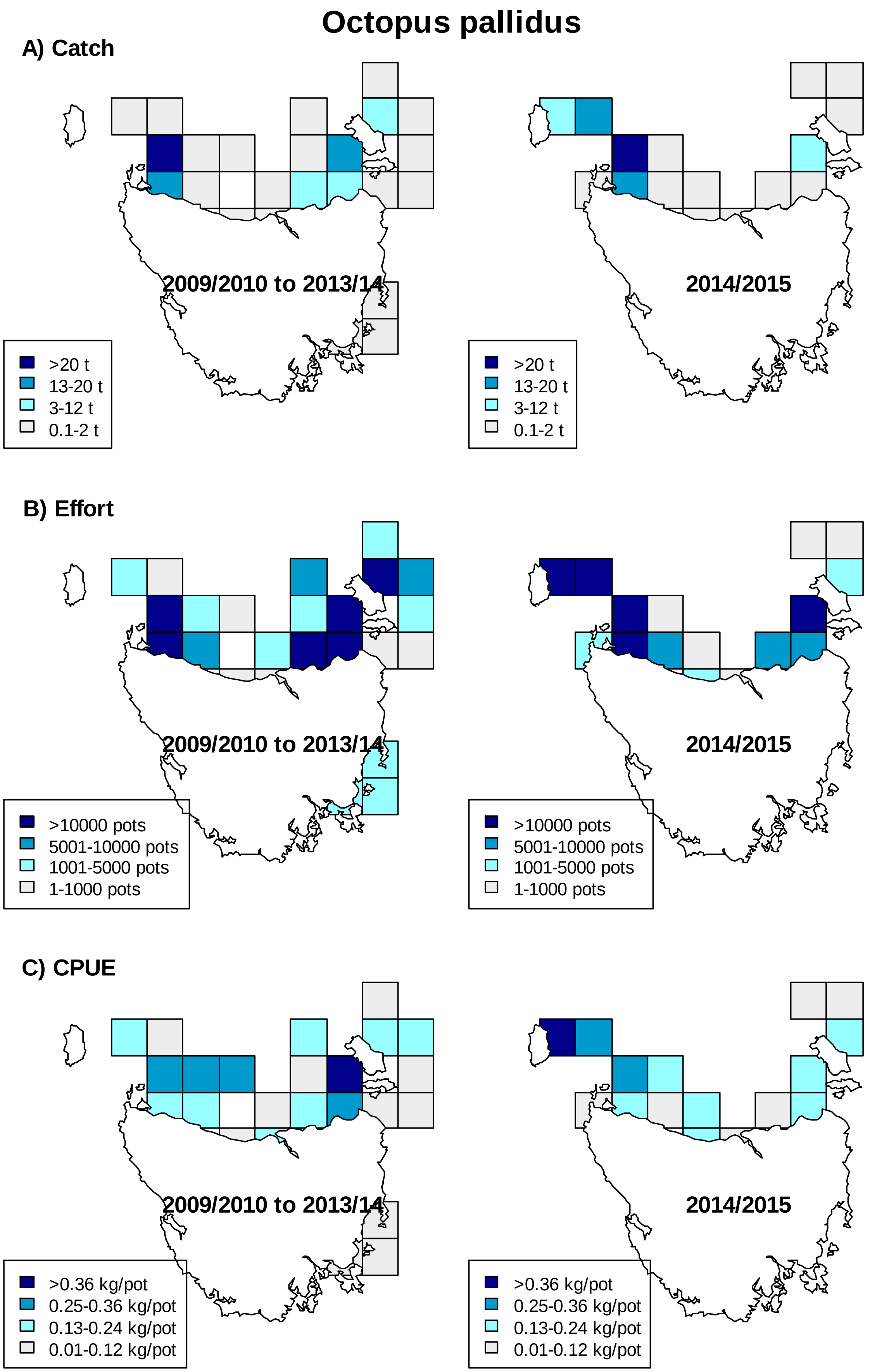


Figure 3.1 (A) Catch, (B) effort and (C) CPUE averaged over the last 5 years and for the licensing year 2014/15.

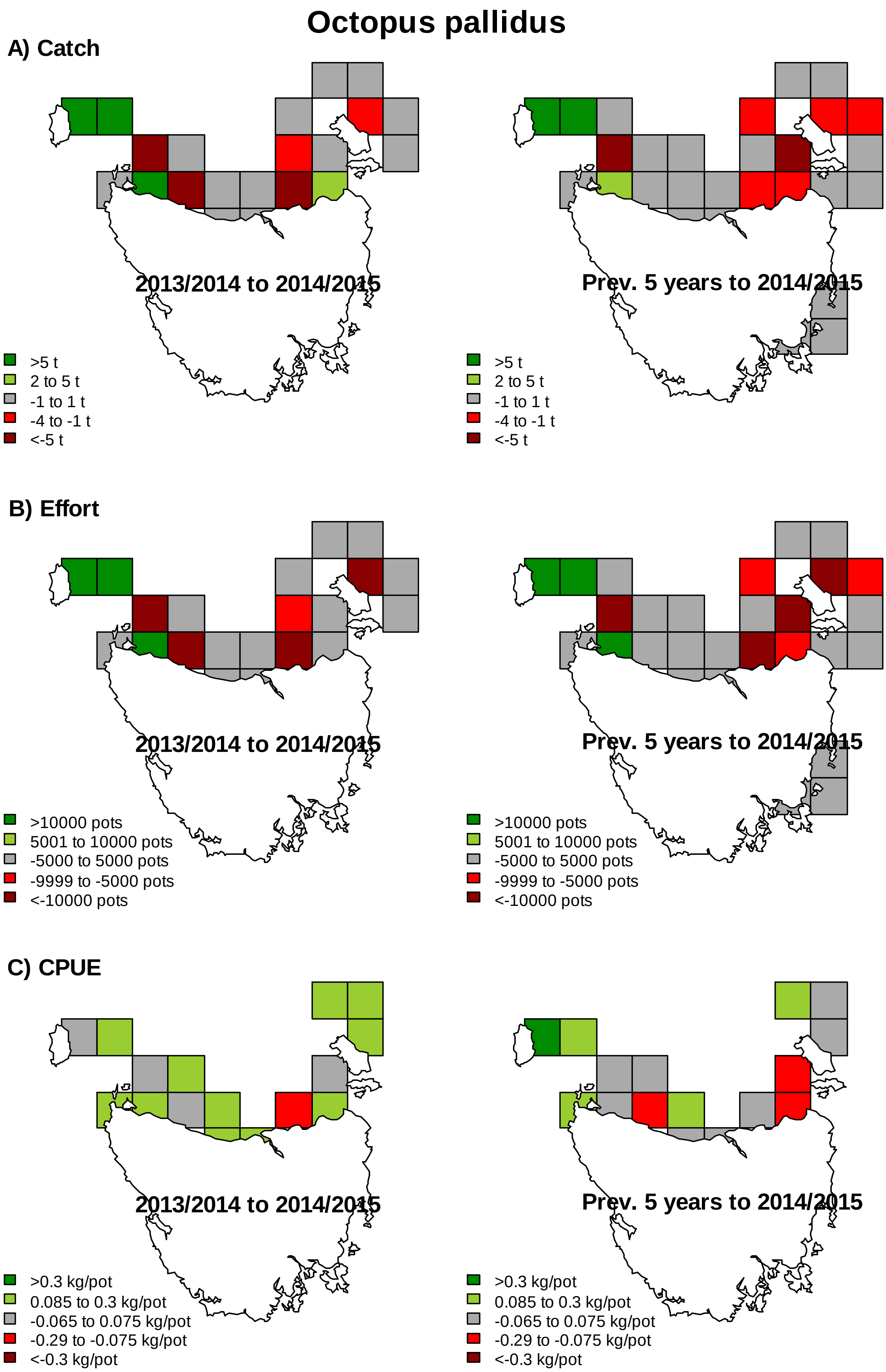


Figure 3.2 Change in (A) catch, (B) effort and (C) CPUE by blocks between the 2014/15 and the previous year, and between the 2014/15 and the previous 5 years (2009/10 to 2013/14).

4. Stock status

No statewide reference points were breached (see below).

Performance indicators	Reference points	Breached ?	By how much?
Biomass	• Catch> highest catch value from the reference period	No	
	• Catch< lowest catch value from the reference period	No	
Fishing mortality	• Numbers per pot < lowest value from the reference period	No	

STOCK STATUS	**TRANSITIONAL-DEPLETING**
There has been an ongoing decrease in *Octopus pallidus* CPUE from 2005/06 to the lowest level in 2011/12 where it remained in 2012/13 and 2013/14. This long term trend indicates that the associated level of effort is likely to ultimately result in overfishing. In 2014/15 CPUE increased, however the associated level of effort was at or above that historically linked with depleting the stock. It is possible that this increase is at least partly due to the highly stochastic nature of *Octopus pallidus* and a shift in effort to areas with higher CPUE. *Octopus pallidus* is therefore classified as transitional depleting.	
STOCK	Tasmanian Octopus Fishery
INDICATORS	Catch, effort and CPUE trends

5. Bycatch and protected species interaction

Bycatch in the octopus pot fishery is low. While *Octopus pallidus* is the main target, pots also attract other octopus species such as *Octopus tetricus* (0.04 tonnes caught in 2014) and *Octopus maorum* (1.4 tonnes caught in same year).

Protected species interactions are also minimal, seals being the only species for which interactions have been recorded. These occurrences are relatively rare (28 interaction records since 2000/01, with no records since 2010/11) and result in losses in catch and gear damage. Most interactions appear to occur in blocks 4E1, 4E2 and 4E3.

The nature of the fishery and the specific gear used make interactions unlikely. Boats do not operate at night; hence birds are not attracted to working lights. There is no bait discarding issues since the pots are unbaited. Surface gear is minimal (two buoys and two ropes for each demersal line).

Entanglement of migrating whales in ropes of pot fisheries have been reported in Western Australia (WA Department of Fisheries, 2010). While the Tasmanian octopus fishery operates in Bass Strait, part of which is in the migratory route of southern right whales (TAS Parks and Wildlife Service), no such interactions have been reported in Tasmania. Furthermore, the limited amount of surface gear, typically 40 buoys in the entire fishery at any one time is negligible in contrast to other pot fisheries. For example in the Tasmanian rock lobster fishery a single operator may set up to 50 sets of pots and ropes and there are approximately 1.3 million potlifts set annually, or in the Western Australia rock lobster fishery where there are approximately 2 million potlifts set annually (De Lestang *et al.*, 2012; Hartmann *et al.*, 2013).

The octopus pots currently used in the fishery are lightweight and set in a sandy bottom environment, which is the preferred substrate for *Octopus pallidus*. The impact of commercial potting has been found to have little impact on benthic assemblages (Coleman *et al.*, 2013) and is therefore considered minor.

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