TASMANIAN OCTOPUS FISHERY ASSESSMENT 2015/16

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This assessment of the Tasmanian Octopus Fishery is produced by the Institute for Marine and Antarctic Studies (IMAS).

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Executive Summary

STOCK STATUS	SUSTAINABLE
Biomass in the *Octopus pallidus* fishery is indicated by trends in catch per unit effort (CPUE), which decreased from 2005/06 to 2011/12. Since 2011/12, CPUE has fluctuated around 60% of the reference year. Catch is used as a proxy for fishing mortality and in 2015/16 decreased to its lowest level since 2011/12, with similar declines in fishing effort. Historical high levels of fishing effort are likely associated with declines in fishery-wide CPUE but the magnitude of this effect is masked by shifts in spatial fishing effort and the biology of the species. In 2015/16, fishing mortality reduced to within historically sustainable levels where future depletion of the biomass appears unlikely. On this basis *Octopus pallidus* in Tasmania is classified as a sustainable stock.	
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*, with *Octopus maorum* and *Octopus tetricus* landed as byproduct (Table 1). The Scalefish Fishery Management Plan (revised in 2015) 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.

In this assessment, the octopus fishery is described in terms of catch (as a proxy for fishing mortality), effort and catch rates (as a proxy for biomass) 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 2015/16 is assessed.

Catches of *Octopus pallidus* fell in 2015/16 to 70 tonnes, which was the lowest since 2011/12. Likewise, fishing effort declined to 279,500 potlifts, which was a reduction of 62,500 potlifts from 2014/15. Catch per unit effort (CPUE) has declined after a peak in the mid-2000s and since 2010/11 has fluctuated at around 60% of the reference year (2004/05), despite large variations in annual fishing effort. In the 2015/16 season, both the 50-pot sample and logbook data-derived CPUE declined in both number (by 12%) and weight (by 11%) respectively. The stochastic nature of CPUE over the last decade may be affected by spatial shifts in fishing effort from areas of high productivity to areas of low productivity, as well as reductions in effort from one or more vessels. It may also be related to the biology of the species, which is inherently linked to environmental conditions making it difficult to assess the stock biomass and impact of fishing mortality. Historically there have been strong seasonal patterns in CPUE, with CPUE highest during the brooding peak for the species (autumn). This was again the case in the 2015/16 season.

Relative to the 2014/15 season, catch and effort decreased significantly in areas off Stanley (4E1 and 4E3), which have been the main fishing grounds historically. Conversely, catch and effort increased in previously unfished areas east of King Island (3D4 and 3E3). In 2015/16, area 3D4 had the highest level of catch (24 tonnes) and effort (63,000 potlifts). This shift in catch and effort was due to one vessel reducing their fishing effort and may have also been due to changes in CPUE, with fishers shifting effort (and therefore catch) from areas with lower CPUE to areas with higher CPUE.

Byproduct species include *Octopus maorum* and *Octopus tetricus*. In 2015 catches of the former declined from the previous season to 0.3 tonnes, while catches of the latter increased to 3.5 tonnes, which was the highest reported catch on record.

Bycatch of octopus from other commercial fisheries (mainly *Octopus maorum* from the rock lobster fishery) had been relatively stable (11 tonnes) over the previous four fishing seasons but declined in 2015/16 to 7 tonnes. 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).

In the 2012/13 ecological risk assessment (ERA) of the Tasmanian scalefish fishery, octopus potting was classified as a medium risk to *Octopus pallidus* populations as the fishery was removing a significant quantity of octopus over a relatively small geographical area. The risk to the ecosystem and habitats was considered low and the risk to by-product species (*Octopus maorum and Octopus tetricus*) and protected species was considered negligible (Bell *et al.*, 2016).

Statewide CPUE has fluctuated at around 60% of the reference year since 2010/11, with fishers continuing to shift effort in response to declining CPUE. Given the substantial stock structure within *Octopus pallidus* due to its holobenthic life history strategy, which has led to discrete subpopulations (sometimes < 100 km apart), concentrated fishing effort has the potential to lead to localised recruitment overfishing. Current fishing mortality however, has reduced to within historically sustainable levels where future depletion of the biomass appears unlikely. Nevertheless, there is currently no management measure in place to prevent future increases in fishing mortality. 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 excessive or concentrated fishing pressure.

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.

Since December 2009, a specific octopus licence was required to participate in the Bass Strait 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 3,000 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. Octopus 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. In 2015, DPIPWE sought developmental fishing permit applications, with three expressions of interest received (to date) to engage in octopus fishing operations off the east coast of Tasmania. In 2016, a one permit for the use of 100 unbaited pots was issued for the area from South East Cape to Lemon Rock, including Great Oyster Bay, to catch ten tonnes of octopus per annum with an associated trip limit of 100 kg.

Octopus are also targeted by recreational fishing, although catch sizes are small. Recreational fishers have a bag limit of 5 octopus and a possession limit of 10 octopus.

From 2000/01 to 2005/06 *Octopus pallidus* catches increased substantially and since then have remained around 80 tonnes, with some strong inter-annual variation (Figure 1.2). *Octopus tetricus* has only been reported in the fishery since 2010/11, mostly around Flinders Island and a total of 3.7 tonnes was caught in 2015/16, which was the highest reported seasonal catch. The catch of *Octopus maorum* in the fishery has fluctuated since 2000/01, peaking at 1.9 tonnes in 2013/14 before declining to just 0.4 tonnes in 2015/16.

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. • Bag limit of 5 and possession limit of 10 octopus (all species combined) for recreational fishers.
Main market	Tasmania and mainland Australia
Fishing licences	2
Active vessels	2

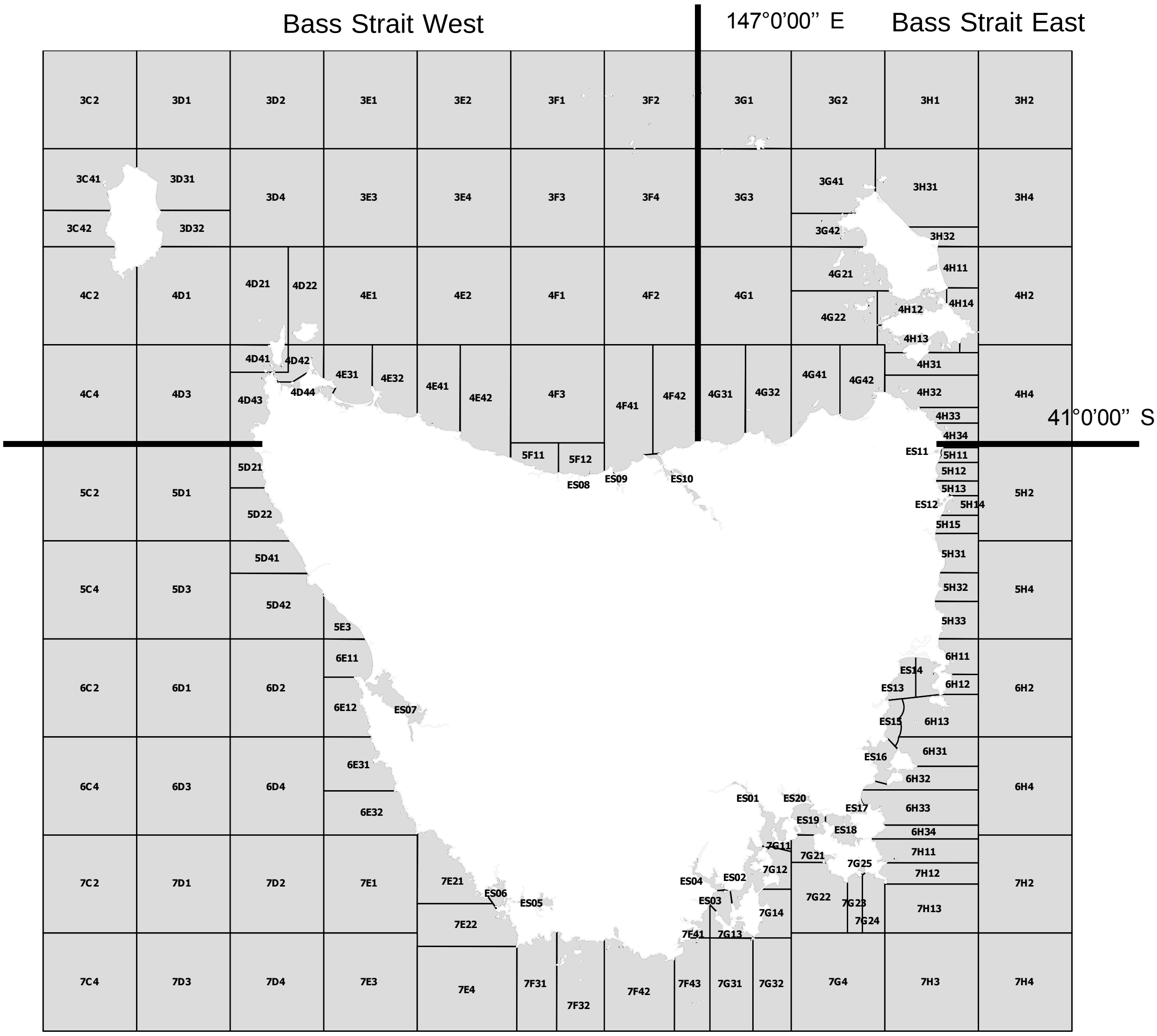


Figure 1.1 East and West Bass Strait octopus fishing zones and blocks. The octopus fishery reports in latitude and longitude but for the purpose of this report, fishing areas will be reported in fishing blocks.

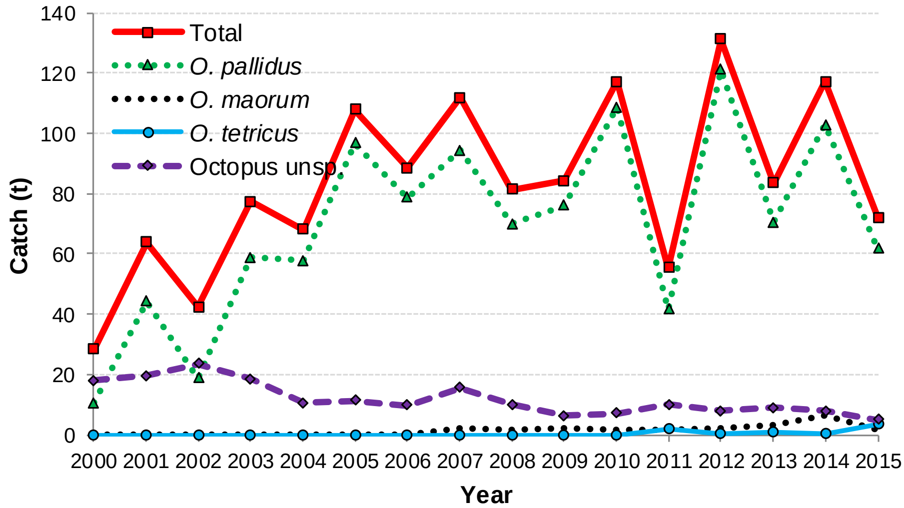


Figure 1.2 State-wide octopus catches since 2000 from all commercial sources.

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 Commercial Catch, Effort & Disposal 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*., 2008b; 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 2016.

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, however in recent years this has been negligible to nil. 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 or spatial shifts in fishing effort from areas of low to higher catch rates.

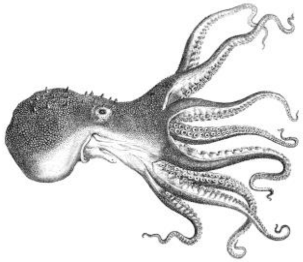
There is currently only one operator in the Tasmanian Octopus Fishery, the depth fished is relatively constant and the two vessels cooperate, with the vessel pulling the gear not necessarily being the same vessel that set it. Consequently, depth, vessel and skipper were not included in the GLM, the factors 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.

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.	Maximum of 11 months	Maximum of 7.3 months from ageing study but lifespan potentially up to 3 years.	Leporati *et al*. (2008b)[1] Doubleday *et al*. (2011)[3] Grubert and Wadley (2000)[3] Ramos *et al* (2014)[2]

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 was 132g for females and 92g for males • Age at 50% maturity 224 days for females and 188 days for males	• 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] Grubert and Wadley (2000)[3] Ramos *et al* (2015)[2]
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 but likely all year round. • Average fecundity is 278,448 eggs ± 29,365 se • Average size (maximum length) of ripe eggs is 2.2 mm ± 0.1 se	• 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] Ramos *et al* (2015)[2]
Early life 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 pots was used as the measure of effort when calculating catch rates.

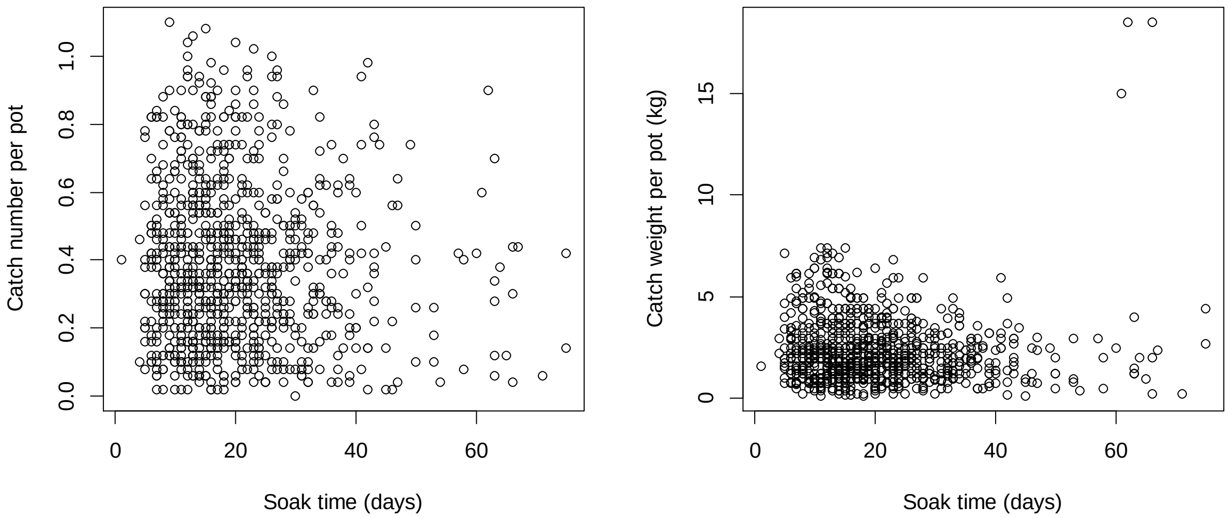


Figure 2.1 CPUE (in catch number and weight per pot) relative to soak time of octopus pots.

Catch and effort

Catch of *Octopus pallidus* has increased since 2000/01 and over the last ten fishing seasons has fluctuated around 85 tonnes (Figure 2.2). Catch in 2015/16 decreased 17 tonnes from the previous season to 70 tonnes, which was the lowest recorded catch since 2011/12. Current catch levels are over double of what they were prior to 2000 (Leporati *et al.*, 2009). Catch was fairly evenly distributed throughout the seasons, with 27% and 29% landed in the autumn and winter months respectively and 19% and 25% landed in the spring and summer months respectively. Last season the majority (73%) of the catch was taken in combined autumn and winter months (Figure 2.3).

Fishing effort has also increased since 2002/03 and while averaging over 400,000 potlifts during 2012/13 and 2013/14, declined to 280,000 potlifts in 2015/16. This level of fishing effort was below the long-term average over the last decade and the lowest since 2010/11 (Figure 2.4).

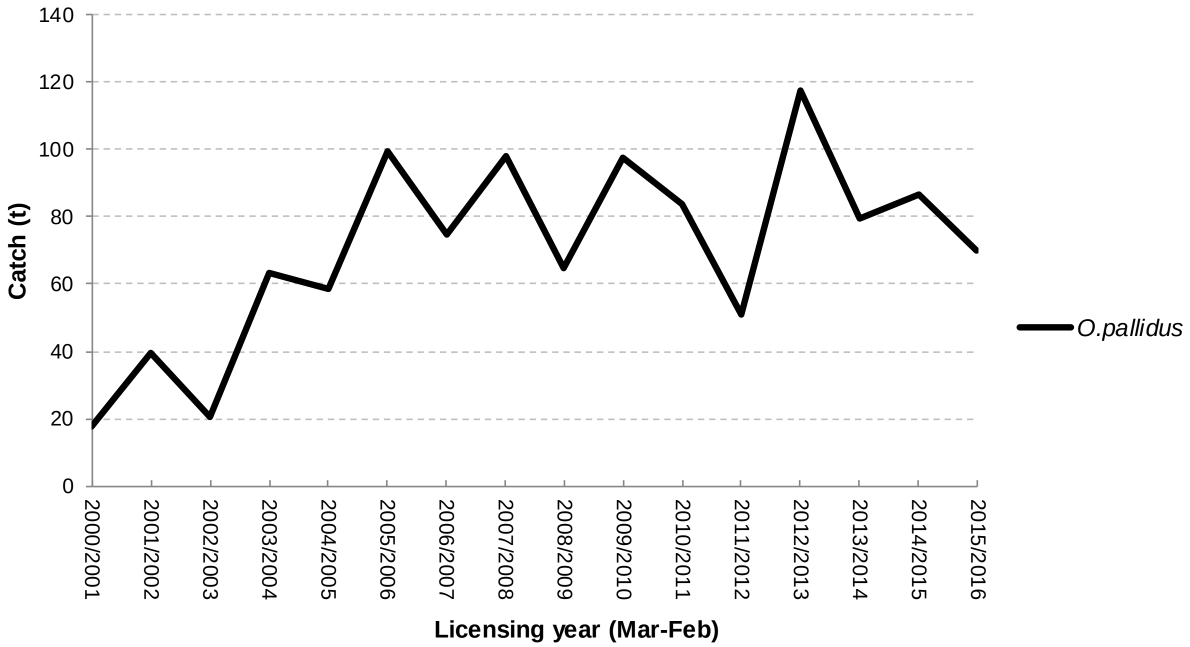


Figure 2.2 Total catches State-wide (tonnes) for *Octopus pallidus* since 2000/01.

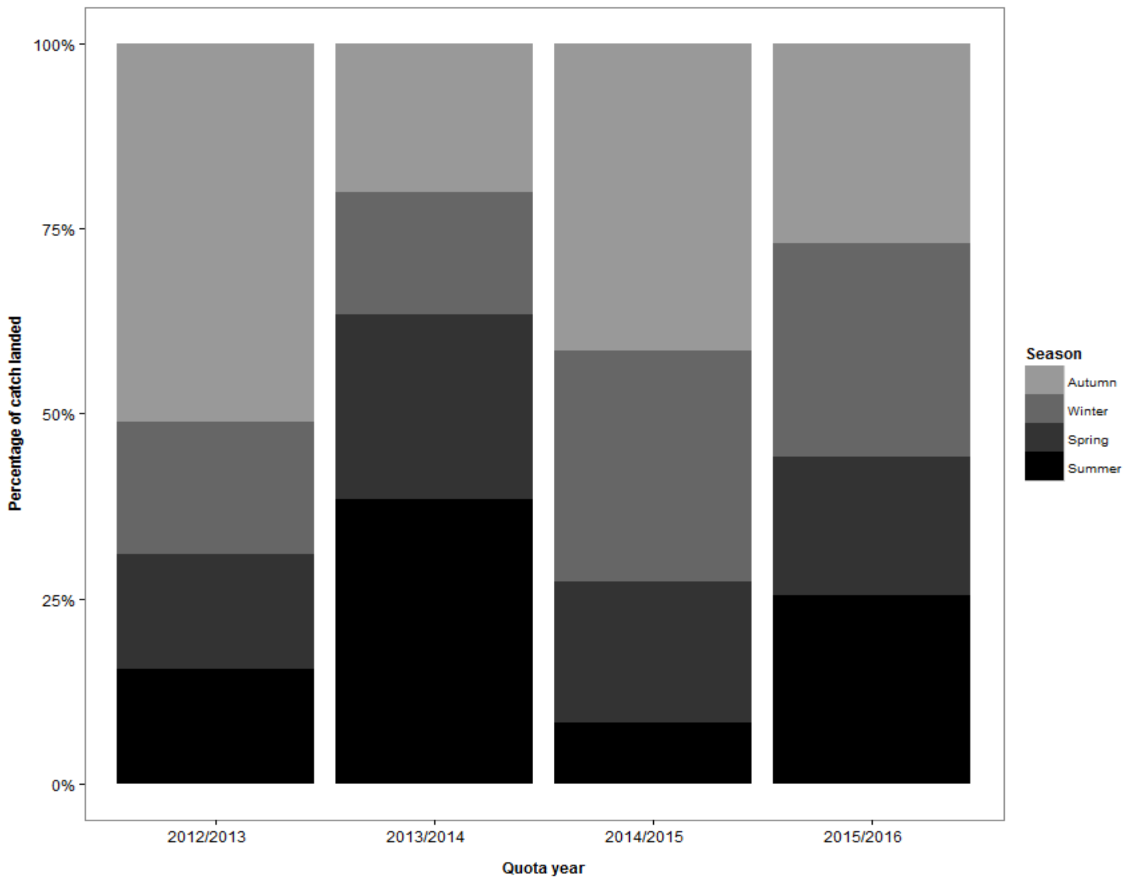


Figure 2.3 Percentage catches of *Octopus pallidus* landed by season for the last four fishing seasons

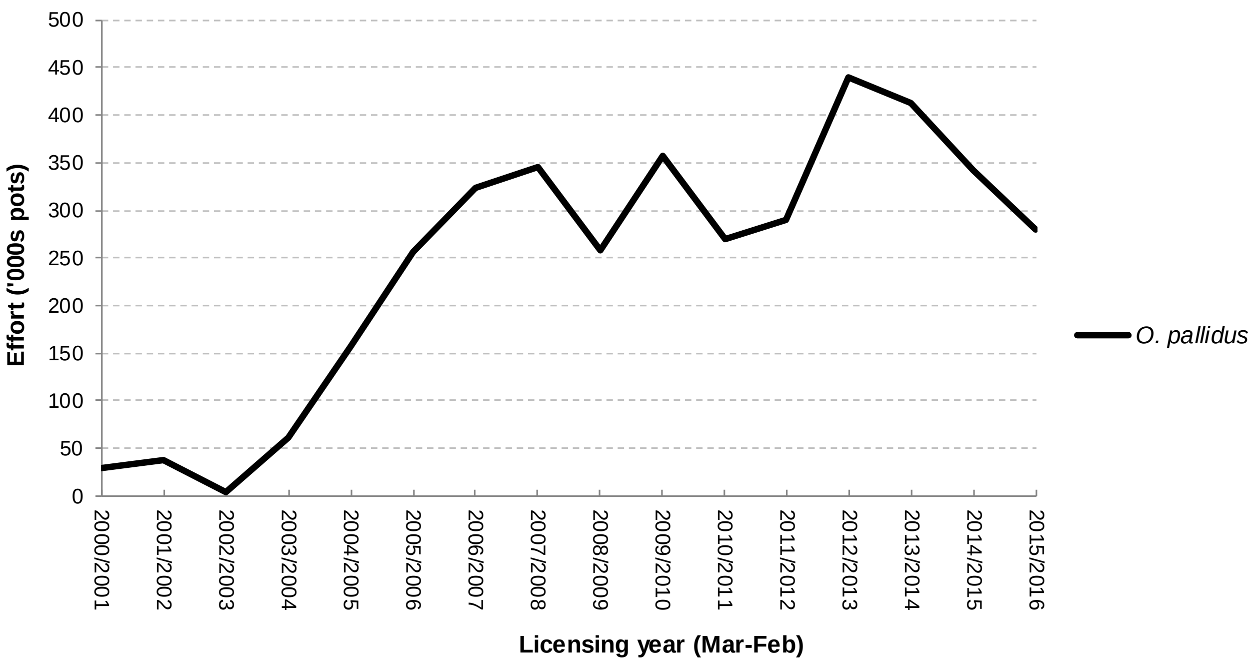


Figure 2.4 State-wide effort (thousands pots) for *Octopus pallidus* since 2000/01.

CPUE

With the exception of the 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).

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). The fishery is also removing brooding females, which use fishing pots as shelters to deposit their eggs. As *Octopus pallidus* is a holobenthic species (i.e. produce egg batches in the hundreds with benthic hatchlings) there is limited dispersal and the stock is highly structured (Doubleday *et al.*, 2008), increasing the potential for localised recruitment failure if fishing effort becomes concentrated. The ability for the State-wide CPUE to detect declines in localised production however, may be masked by shifts in spatial fishing effort from areas of low to high catches.

Since 2010/11 the standardised catch rate for the total commercial catch from logbooks has fluctuated at around 60% of the reference year, with large variations in annual fishing effort. In 2015/16, catch declined by 17 tonnes and fishing effort reduced by 62,500 potlifts, with a comparative decline in CPUE to 61% (11% reduction from 2014/15) of the reference year. A similar trend in the CPUE was evident for the 50-pot sampling with a decline to 77% (12% reduction from 2014/15) of the reference year.

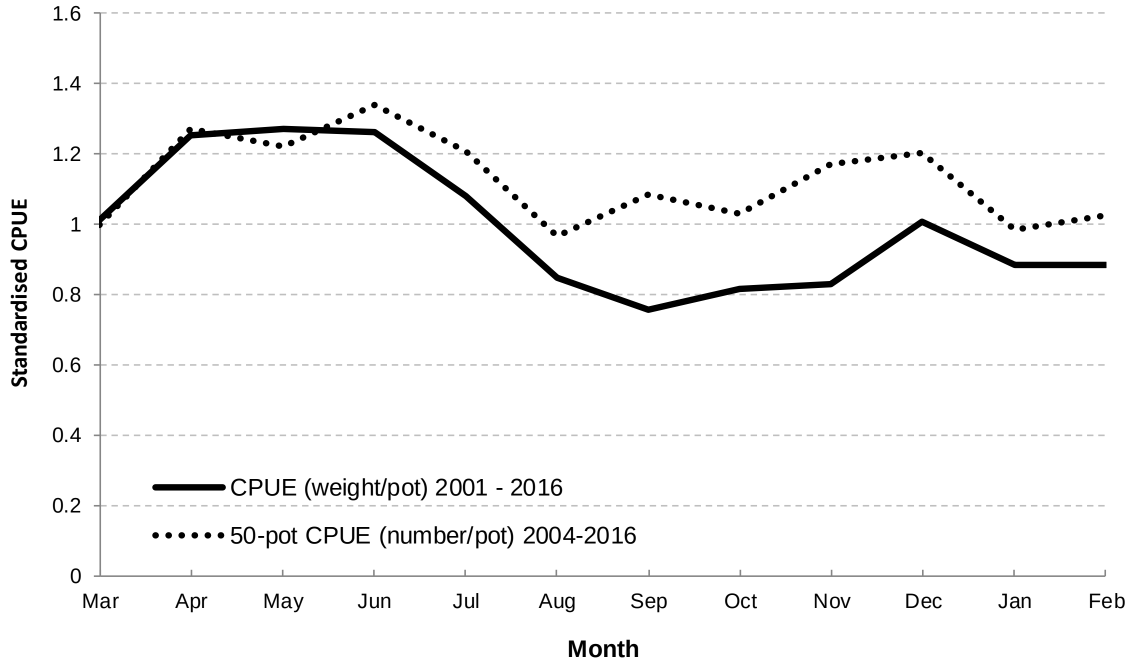


Figure 2.5 *Octopus pallidus* standardised catch per unit effort (CPUE) relative to March levels in weight per pot (total commercial) and in number per pot (50-pot sampling).

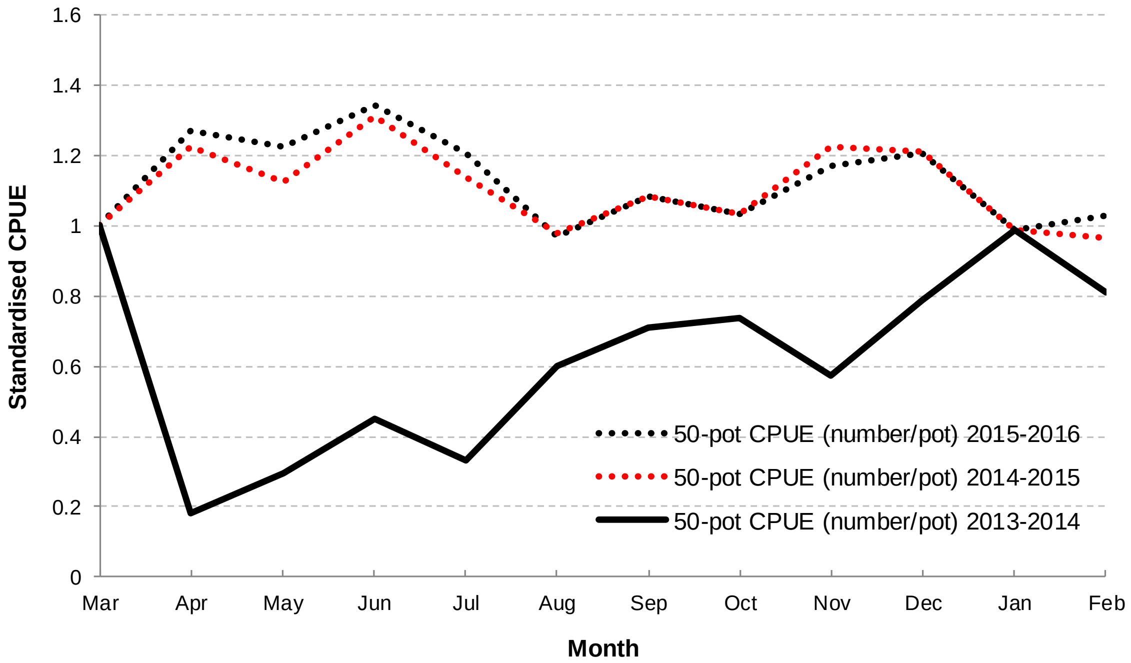


Figure 2.6 *Octopus pallidus* standardised catch per unit effort (CPUE) relative to March levels in number per pot (50-pot sampling) comparing the 2013/14, 2014/15 and 2015/16 fishing seasons.

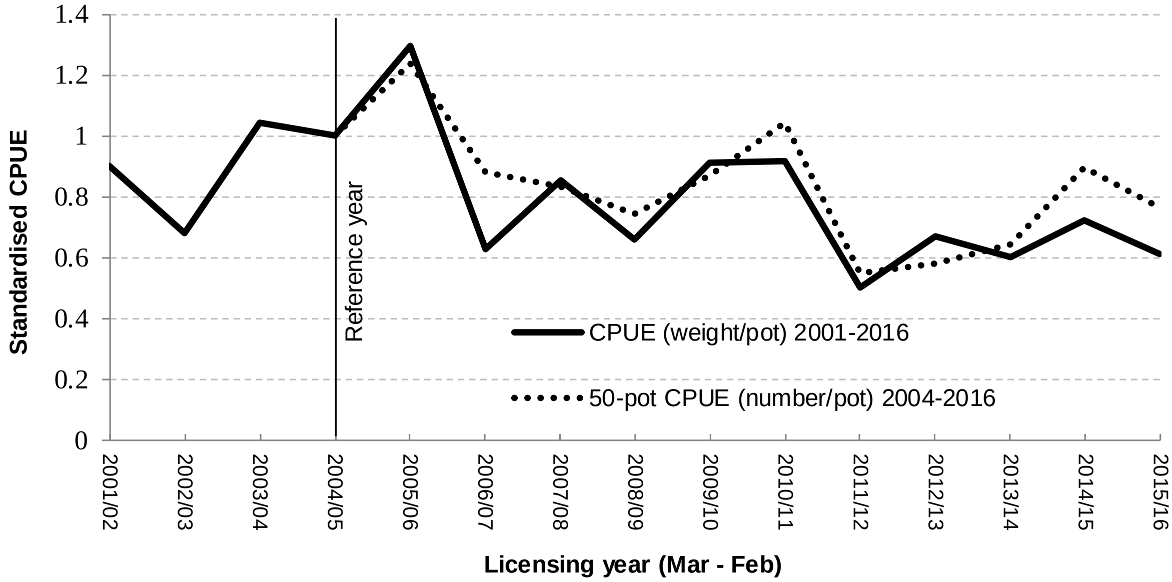


Figure 2.7 *Octopus pallidus* standardised catch per unit effort (CPUE) relative to 2004/05 levels in weight per pot (total commercial) and in number per pot (50-pot sampling).

Commercial catch from other fishing methods

Although historical total octopus bycatch has reached up to 30 tonnes in the early 2000's, recent records have indicated a decline, with a total of 6.9 tonnes recorded in 2015/16 (Figure 2.8). Species are seldom identified with 82% of the bycatch from the rock lobster and scalefish fisheries detailed 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 6.3 tonnes per annum over the last six licensing years, which is probably an underestimate (Fig. 2.8). In 2015/16 the reported catch was 5.1 tonnes, which is the lowest recorded catch in recent history. The commercial scalefish fishery provided the other source of octopus bycatch with an average of 3.5 tonnes per annum over the last six licensing years (Figure 2.8). In 2015/16 the catch was 1.7 tonnes, which was a significant decline from the previous four years, where an average 4.6 tonnes was recorded. Gears that produce most of the octopus catch are hand collection and graball nets. Hand collected octopus was once a targeted fishery in Eaglehawk Neck but declined after DPIPWE stopped the permit using graball nets as a barrier in late 2009. The current pressure from other commercial fisheries does not appear excessive and is declining. The impact of bycatch from these fisheries on octopus stocks is therefore considered low.

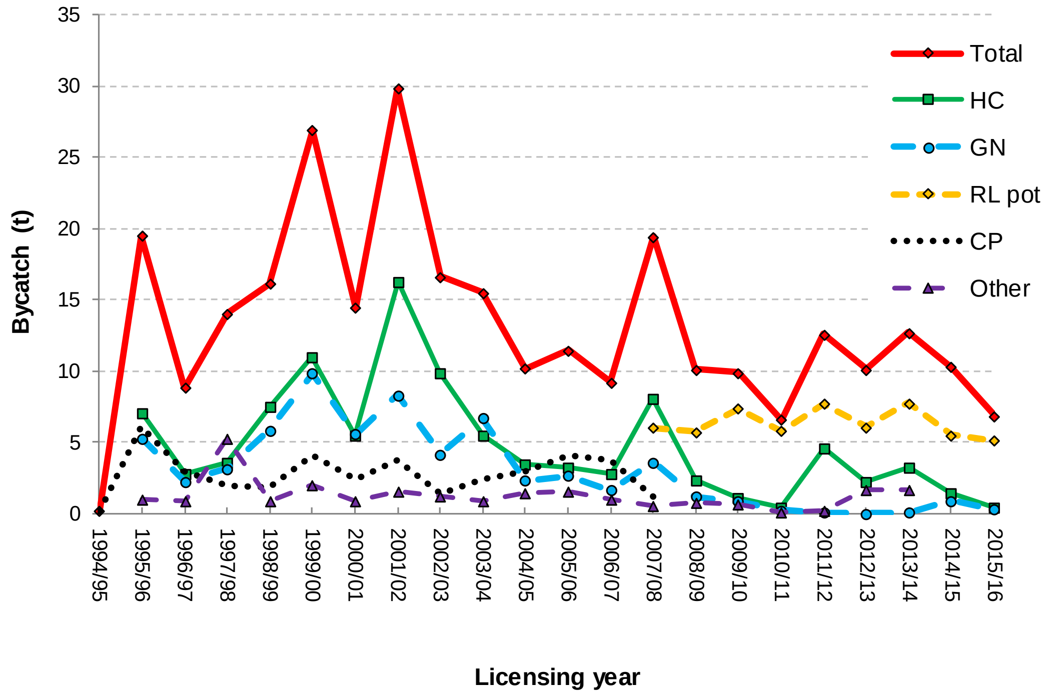


Figure 2.8 Octopus bycatch (tonnes) in other commercial fisheries. HC= hand collection, GN= graball net, RL pot= Rock lobster pots, CP= crab pot.

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 octopus, the remaining portion being cuttlefish.

Octopus species are not a key target for the recreational fishery and appear as a bycatch caught predominantly by line fishing, 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 localised 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) (Figures 3.1, 3.2A and 3.3B). In the 2015/16 fishing season, however, catch and effort declined significantly off Stanley (4E1 and 4E3), shifting to areas east of King Island (3E3 and 3D4) and west of Flinders Island (3G3 and 4G2). In 2015/16, area 3D4 had the highest levels of catch (24 tonnes) and effort (63,000 potlifts) (Figures 3.2A and 3.3B).

This shift in catch and effort was due to one vessel significantly reducing their fishing effort in the latter half of the season. It could also have been due to declining CPUE in previously fished areas. For example, in 2015/16, CPUE was highest in areas east of King Island (3E3 and 3D4), which had remained unfished in 2014/15 (Figure 3.2C). In contrast, CPUE in all 4E blocks in 2015/16 was lower than the previous fishing season. CPUE was also higher in the areas east of King Island (3E3 and 3D4) and lower in the areas close to Stanley (4E1, 4E2, 4E3, and 4E4) relative to the previous five fishing seasons (Figure 3.3C).

Fishing effort continues to remain concentrated in the most productive areas, which given the substantial stock structure within *Octopus pallidus* increases the potential for localised 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 recruitment potential of *Octopus pallidus* is not impacted by concentrated fishing effort.

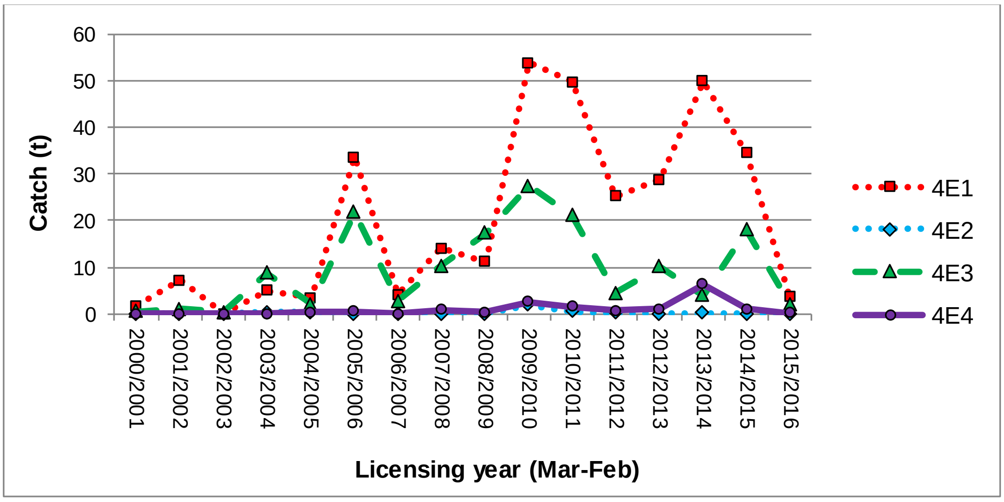


Figure 3.1 Catches of *Octopus pallidus* through time in block 4E, which was the main historical fishing ground.

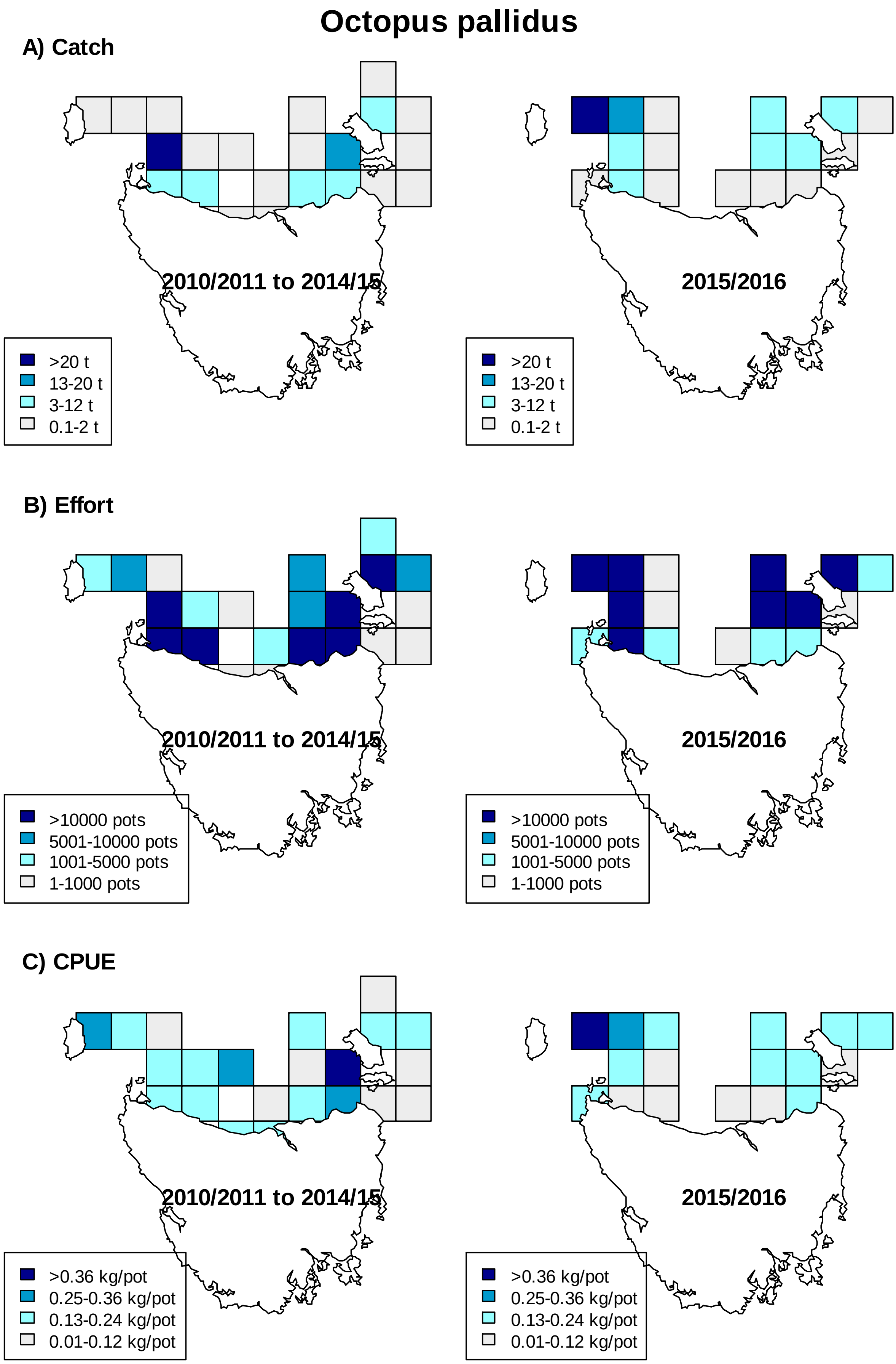


Figure 3.2 (A) Catch, (B) effort and (C) CPUE averaged over the last 5 years and for the licensing year 2015/16.

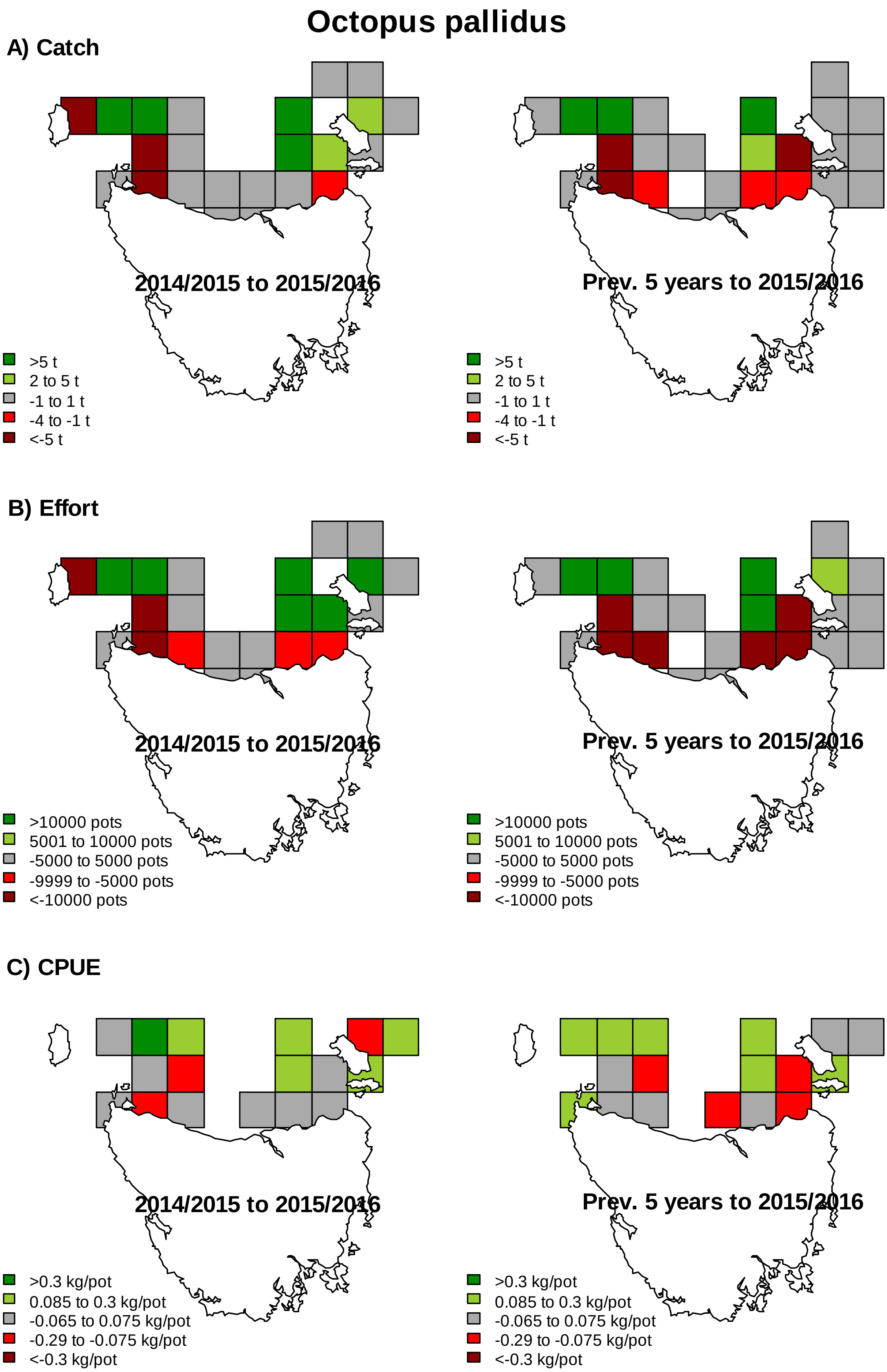


Figure 3.3 Change in (A) catch, (B) effort and (C) CPUE by blocks between the 2015/16 and the previous year, and between the 2015/16 and the previous 5 years (2010/11 to 2014/15).

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	**SUSTAINABLE**
Biomass in the *Octopus pallidus* fishery is indicated by trends in catch per unit effort (CPUE), which decreased from 2005/06 to 2011/12. Since 2011/12, CPUE has fluctuated around 60% of the reference year. Catch is used as a proxy for fishing mortality and in 2015/16 decreased to its lowest level since 2011/12, with similar declines in fishing effort. Historical high levels of fishing effort are likely associated with declines in fishery-wide CPUE but the magnitude of this effect is masked by shifts in spatial fishing effort and the biology of the species. In 2015/16, fishing mortality reduced to within historically sustainable levels where future depletion of the biomass appears unlikely. On this basis *Octopus pallidus* in Tasmania is classified as a sustainable stock.	
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* (3.4 tonnes caught in 2015) and *Octopus maorum* (0.3 tonnes caught in same year) These by-product species were considered to be at negligible risk from octopus potting in the 2012/13 Ecological risk assessment (ERA) of the Tasmanian scalefish fishery due to their low historical catches (Bell *et al.*, 2016).

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 with bycatch or protected species unlikely. Boats do not operate at night; hence seabirds 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). The 2012/13 ERA considered that risks from octopus potting to protected species were negligible (Bell *et al.*, 2016).

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 the 2012/13 ERA considered that octopus potting was of low risk to both the ecosystem and habitat (Bell *et al.*, 2016).

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