TASMANIAN OCTOPUS FISHERY ASSESSMENT 2016/17

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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
Fishing Mortality in the *Octopus pallidus* fishery is represented by the use as Catch (tonnes) as a proxy. In the 2016/17 season catch levels increased marginally from the previous year and have remained approximately 80t for the previous four fishing seasons. Biomass in the *Octopus pallidus* fishery is indicated by trends in catch per unit effort (CPUE), which have decreased from 2005/06 to 2011/12. Since 2011/12, CPUE has fluctuated around 60% of the reference year (2004/05 Licencing Year where the time series data for 50-pot sampling records commenced). Historically, high levels of fishing effort have been proceeding declines in fishery-wide CPUE, yet the magnitude of this effect is masked by shifts in spatial fishing effort and the biology of the species. In 2016/17, fishing mortality values were approximately 80 tonnes of catch for 300,000 potlifts, and are comparable to recent (half-decade) values. The stability indicated in the last 5 seasons provides support that the catch and effort, at current levels, are sustainable and future depletion of the biomass appears unlikely, if formal limit or target parameters were to be established. 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 *Macroctopus 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 remains a sole operator fishery with the same operator since commencement in 1980.

In this assessment, the octopus fishery is described state-wide in terms of catch (as a proxy for fishing mortality), effort and catch rates (as a proxy for biomass). 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 2016/17 is assessed.

Catches of *Octopus pallidus* increased in 2016/17 to 84.5 tonnes, which is comparable to that of 2014/15. The fishing effort marginally increased to 292,500 potlifts, which was an increase of 14,000 potlifts from 2015/16, but a reduction of 49,000 to 2014/15. Historically, catch per unit effort (CPUE) declined after a peak in the mid-2000s and now continues (post 2010/11) to fluctuate at around 60% of the reference year (2004/05). The 50-pot sample CPUE is higher than the logbook data-derived CPUE and rests near 80% of the reference value. These fluctuations in CPUE are indicating a steady increase from half-decade stable values of around 60% of the reference year despite large variations in annual fishing effort. In 2016/17 both the 50-pot sample and logbook data-derived CPUE increased from the previous season by 3% and 16% respectively, thereby putting them below the reference year by 11% and 29% respectively (Figure 2.5).

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 each of the vessels. It may also be related to the biology of the species, which is inherently linked to environmental conditions thus making it difficult to assess the 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 2016/17 season.

As in 2015/16 catch has continued to be lower around the historically important Stanley fishing grounds and higher around Bridport and the southwest of Flinders Island. From discussion with fishers this is influenced to a greater extent by the characteristics of the operation than by abundance.

Byproduct species include *Macroctopus maorum* and *Octopus tetricus*. In 2016/17 catches of the former increased from the previous season to 1.7 tonnes, while catches of the latter decreased to 0.9 tonnes.

Bycatch of octopus from other commercial fisheries (mainly *Macroctopus maorum* from the rock lobster fishery) had been relatively stable (10.5 tonnes) over the previous four fishing seasons but declined in 2016/17 to 9 tonnes. The recreational catch of octopus appears minimal with around a tonne retained per annum from historical reference. Further information on recreational catches will be included in the 2018/19 octopus assessment as a 2017/18 survey is currently being conducted. Conversely, the impact of the Octopus fishery on bycatch and protected species is low due to the nature of the gear used (i.e. unbaited octopus 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. This, when coupled with the low dispersal of the species, increases the potential of localised depletion. The risk to the ecosystem and habitats was considered low and the risk to by-product species (*Macroctopus maorum and Octopus tetricus*) and protected species was considered negligible (Bell *et al.*, 2016).

The referencing year utilised herein is based on the 2004/05 Licensing year when the 50-pot time-series sampling of the fishery commenced. A formal limit or target is yet to be defined. 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 (Figures 3.1 and 3.2). Since 2013/14 the inter-annual variation between the statewide CPUE demonstrates less variability. 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, and when combined with recent CPUE stability, indicates a scenario where future depletion of the biomass appears unlikely.

Currently there is no formal 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. Specifically, an Effort limit is deemed feasible for this species. Furthermore, regional controls should be investigated regarding the risk of localised depletion.

1. Introduction

The fishery

The Tasmanian Octopus Fishery has been operating since 1980. Until December 2009, access to the commercial fishery was provided to holders of a fishing licence (personal), a vessel licence and a scalefish or rock lobster licence with 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 (*Macroctopus maorum*) also taken, primarily as byproduct. The main fishing method is unbaited moulded plastic pots (volume 3,000 ml) with no doors, 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 provided necessary research is undertaken. At the time of writing, there are two developmental fishing permits issued for the take of Octopus along the east coast. One is for the use of 100 unbaited pots in state waters from South East Cape to Lemon Rock, and the second for 4000 unbaited pots from Eddystone Point to Whale Head operating in waters 1nm from the coast. Neither permit reported catch for the 2016/17 season.

Small amounts of Octopus are also targeted by recreational fishing. 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. The 2016/17 season reports similar levels of catch to the previous season of approximately 0.9 tonnes, both of which are significantly lower than the 2014/15 peak of 3.7 tonnes. The catch of *Macroctopus maorum* in the fishery has continued to fluctuate since 2000/01, and has increased to near peak levels of 1.7 tonnes in 2016/17.

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

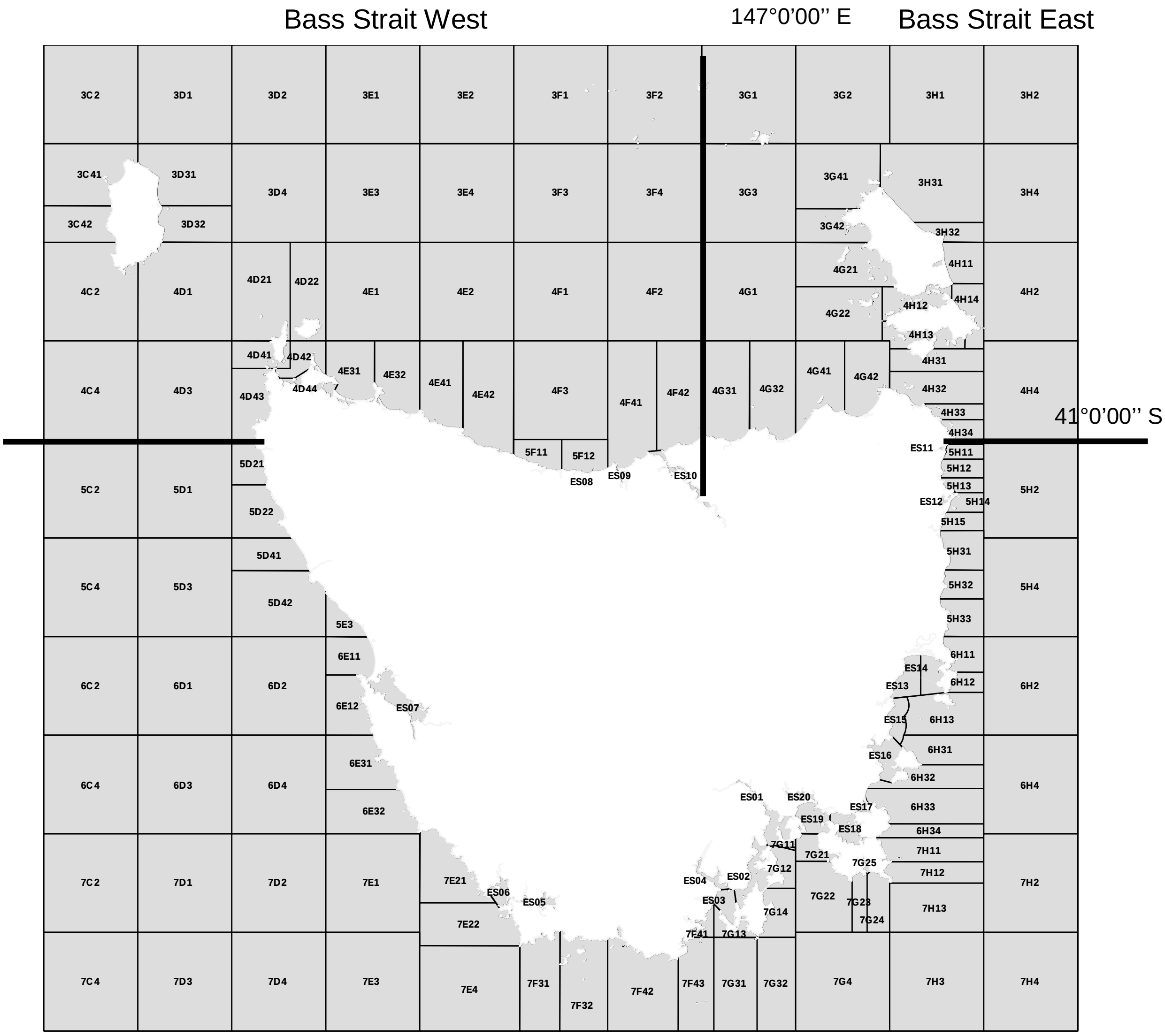


Figure 1.1 East and West Bass Strait octopus fishing zones and blocks. The octopus fishery reports in latitude and longitude but for the purpose of this report, fishing areas will be reported in fishing blocks.

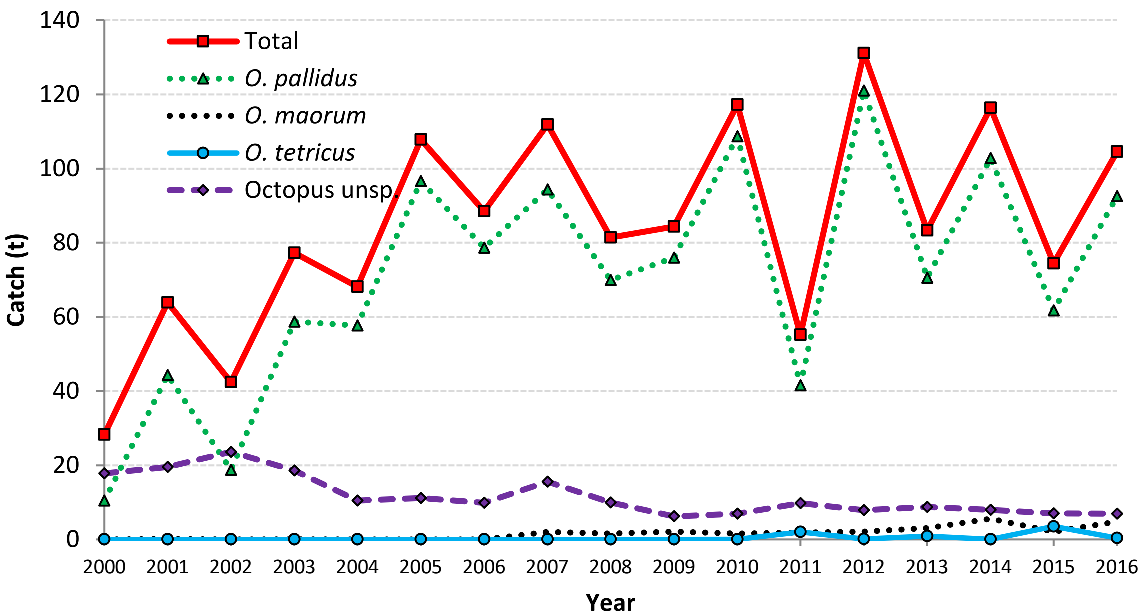


Figure 1.2 State-wide octopus catches since 2000 from all commercial sources.

Assessment of stock status

Stock status definitions

In order to assess the Tasmanian Octopus fishery 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 return. This information facilitates the determination of Catch per Unit Effort. In these 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. Additional data of catch from the Rock Lobster and other Scalefish fisheries is reported as by-catch tonnage and is not included in the CPUE calculations.

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, hence a continued longitudinal study will continually enhance the 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). The 2017/18 statewide fishing survey is currently underway.

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 2017.

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 continues to be 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.

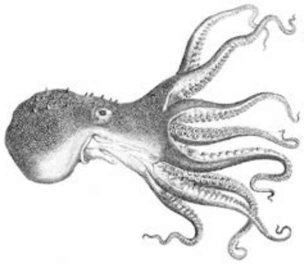
Catch rates of pale octopus have been standardised using a generalised linear model (GLM) to reduce the impact of obscuring effects such as season on the underlying trends (Kimura, 1981, 1988). However, while standardised catch rates are preferred over the simple geometric mean, other factors may remain 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 GLM 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.

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 *Macroctopus maorum.*

Species	**Pale octopus** *Octopus pallidus*	**Gloomy octopus** *Octopus tetricus*	**Maori octopus** *Macroctopus 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 number of pots continues to be used as a measure of effort when calculating catch rates. As per the 2015/16 report, an analysis of the 50 pot samples indicated that soak time did not appear to affect CPUE by number or weight. The results continue to show that current soak time is sufficient to obtain maximum catch rates, hence soak time could be disregarded when calculating catch rates. The number of pots remains the used measure of effort when calculating catch rates.

Catch and effort

Targeted catches of *Octopus pallidus* have increased since 2000/01 and over the last decade have continued to fluctuate around 85 tonnes (Figure 2.1). Catch in 2016/17 increased by 14.5 tonnes from the previous season to 84.5 tonnes, and is indicative of the observed oscillating effect between successive years. Current catch levels are over double of what they were prior to 2000 (Leporati *et al.*, 2009). Catch distribution is less evenly distributed throughout the seasons, and reflects the seasonal trend observed two seasons ago in 2014/15 (Figure 2.2). The majority of the catch (71%) was taken in combined autumn (45%) and winter (26%) months with spring and summer landings constituting 19% and 10% of the total annual catch, respectively.

Fishing effort has marginally increased to 293,500 potlifts in 2016/17. The annual fluctuations in effort are less pronounced than catch fluctuations (Figure 2.3).

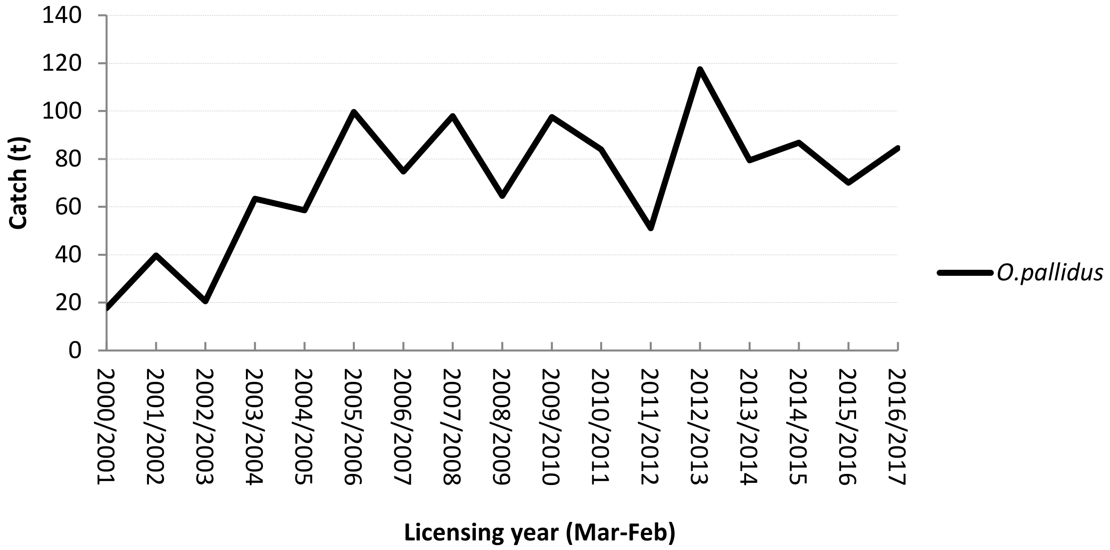


Figure 2.1 Total catches State-wide (tonnes) for *Octopus pallidus* since 2000/01.

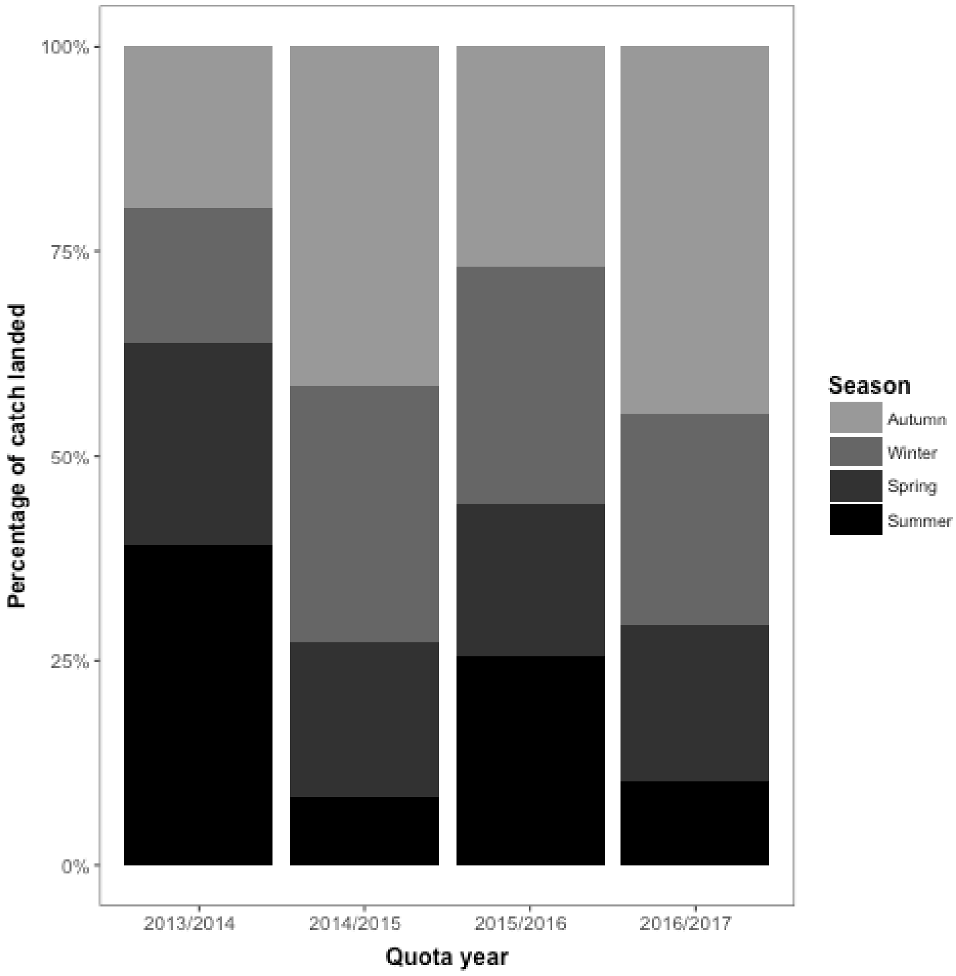


Figure 2.2 Percentage catches of *Octopus pallidus* landed by season for the last four fishing seasons.

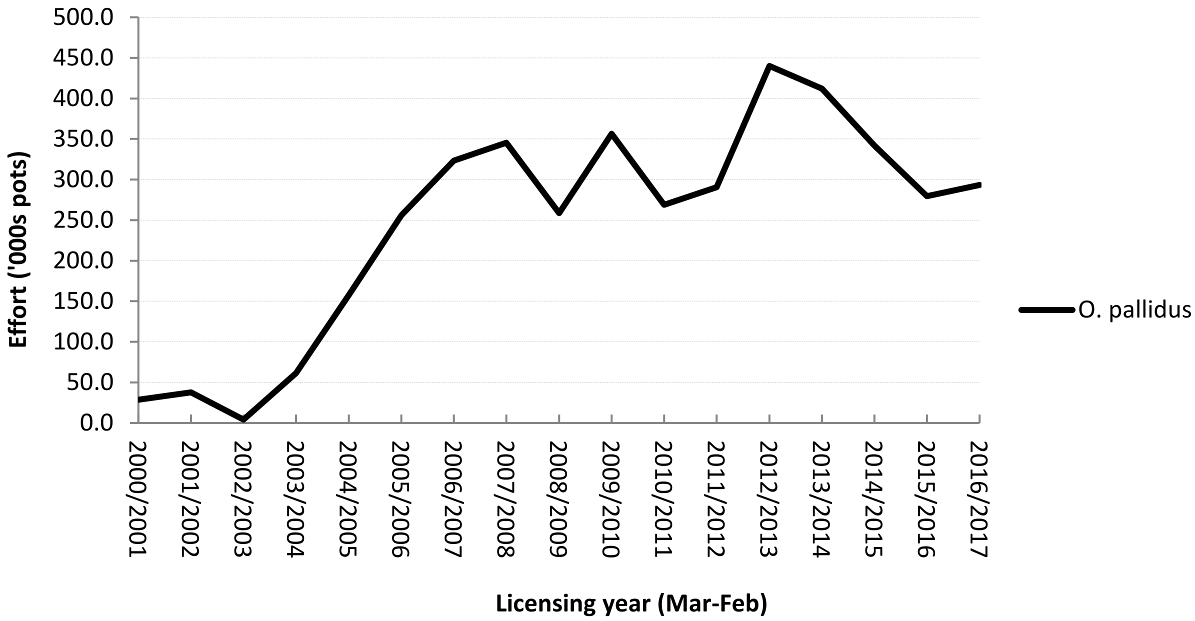


Figure 2.3 State-wide effort (thousands pots) for *Octopus pallidus* since 2000/01.

CPUE

Higher catch rates in are observed from autumn to mid-winter (March-July, Figure 2.4) due to the overlap with the brooding peak for the species (Leporati *et al.*, 2009). With the exception of the 2013/14 fishing seasons, CPUE based on the 50-pot sampling has followed a similar pattern to the CPUE for the total commercial catch from logbooks (Figure 2.5).

The licensing year 2004/05 was chosen as a reference year for CPUE as the 50-pot sampling started in that year (Figure 2.5). The catch rate standardisation in previous years has removed the seasonal effect (which is evident in Figure 2.4) but CPUE over the last decade has remained, albeit at a reducing level, highly stochastic through time. 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 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 2016/17, catch increased by 14.5 tonnes and fishing effort by 14,000 potlifts in comparison to the 2015/16 year. Subsequently the CPUE has increased from 2015/16 levels from 61% to 71% of the reference year. Regarding the 50-pot sample, CPUE has marginally increased to 80% of the reference year, from last season.

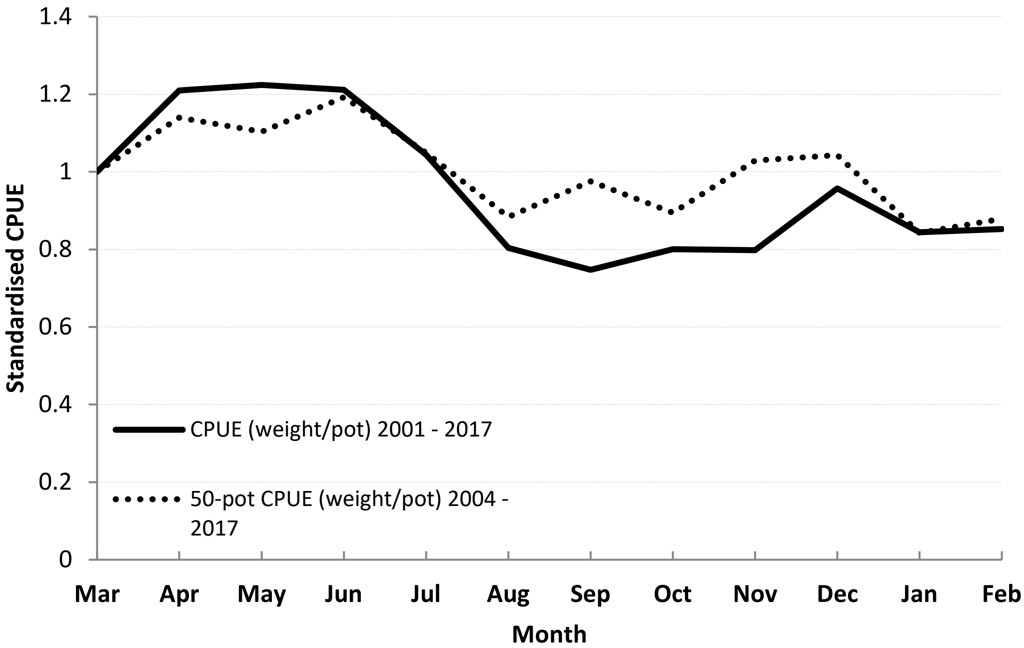


Figure 2.4 *Octopus pallidus* standardised catch per unit effort (CPUE) relative to March levels in weight per pot (total commercial) and in number per pot (50-pot sampling).

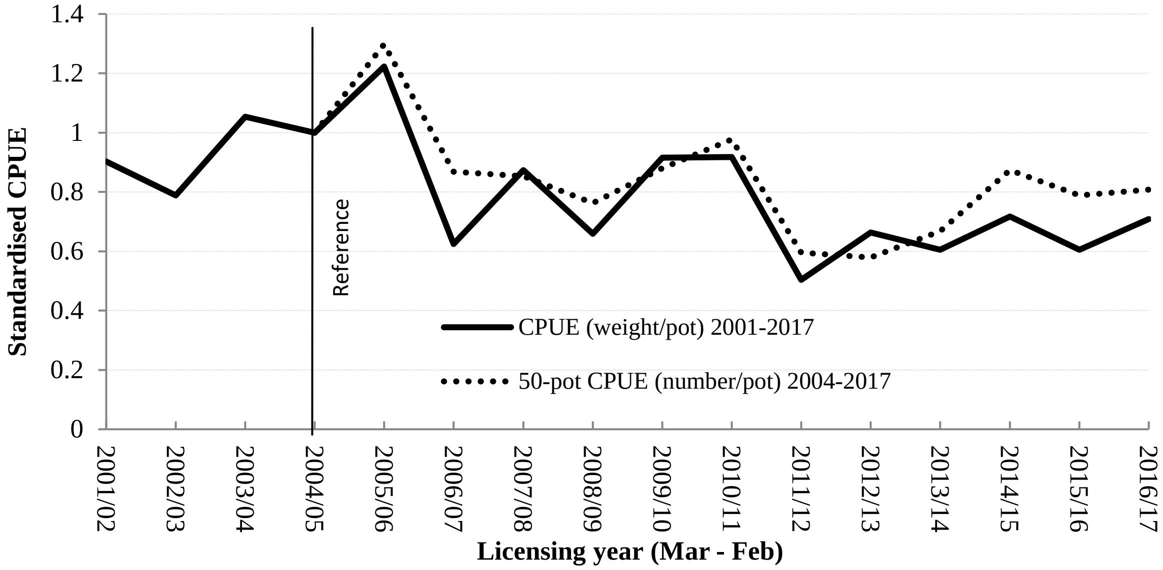


Figure 2.5 *Octopus pallidus* standardised catch per unit effort (CPUE) relative to 2004/05 levels in weight per pot (total commercial) and in number per pot (50-pot sampling).

Commercial catch from other fishing methods

Although historical total octopus bycatch has reached up to 30 tonnes in the early 2000's, recent records are indicating a stable, albeit lower value, with a total of 8.9 tonnes recorded in 2016/17 (Figure 2.6). Species are seldom identified with 65% 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 *Macroctopus maorum*.

Most of the octopus bycatch in recent years originated from the rock lobster commercial fishery, with an average bycatch of 6.5 tonnes per annum over the last six licensing years, which is probably an underestimate (Fig. 2.6). In 2016/17 the reported catch was 4.7 tonnes, which remains the lowest recorded catch in recent history. The commercial scalefish fishery provided the other source of octopus bycatch with an average of 4.1 tonnes per annum over the last six licensing years (Figure 2.6), with the 2016/17 catch totalling 4.2 tonnes. 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 use of graball nets as a barrier in late 2009. The current pressure on the Octopus Fishery from other commercial fisheries does not appear excessive and indicates stability. The impact of bycatch from these fisheries on octopus stocks is therefore considered low.

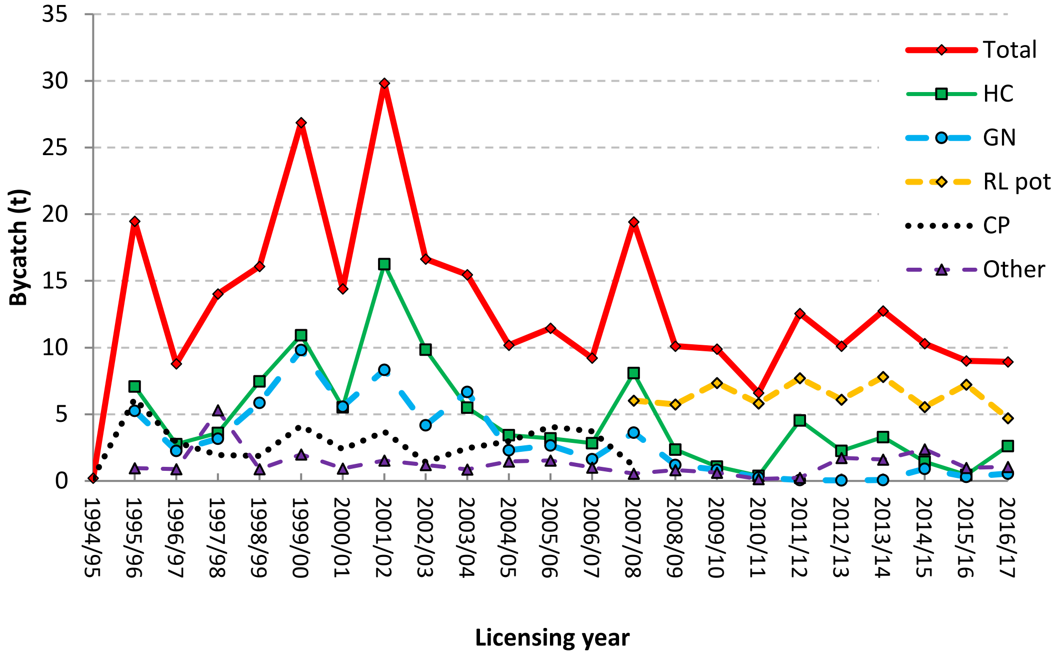


Figure 2.6 Octopus bycatch (tonnes) in other commercial fisheries. HC= hand collection, GN= graball net, RL pot= Rock lobster pots, CP= crab pot.

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). A new survey for 2017/18 is currently being conducted and should be available for inclusion in the 2018/19 octopus assessment. 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).

Catch and effort values (3.1A and 3.1B) indicate that the spatial catch distribution for 2016/17 coarsely aligned with historical fishing, however there has been a shift towards the Eastern fishing blocks (3.2B), specifically West (33.6 tonnes) and North-West (11.4 tonnes) of Flinders Island.

Areas of high catch and effort have historically been concentrated off Stanley. In the previous (2015/16) fishing season, however, catch and effort declined significantly off Stanley, shifting to areas east of King Island and west of Flinders Island. In the 2016/17 season, the previous season's high performing spatial area shows a reduction in CPUE (Figure 3.2C) with only 0.44 tonnes being taken for 2000 potlifts. Conversely, the reduced effort on the historical block in the 2015/16 season has resulted in the second highest catch levels (21.1 tonnes) for 2016/17. This provides opportunity in following the 2017/18 season to review whether the hiatus for the areas east of King Island in the previous season will alter fishing strategy.

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, specifically in areas of previously high yield, could improve the probability that CPUE would maintain annual stability in the future and ensure that the recruitment potential of *Octopus pallidus* is not impacted by concentrated fishing effort.

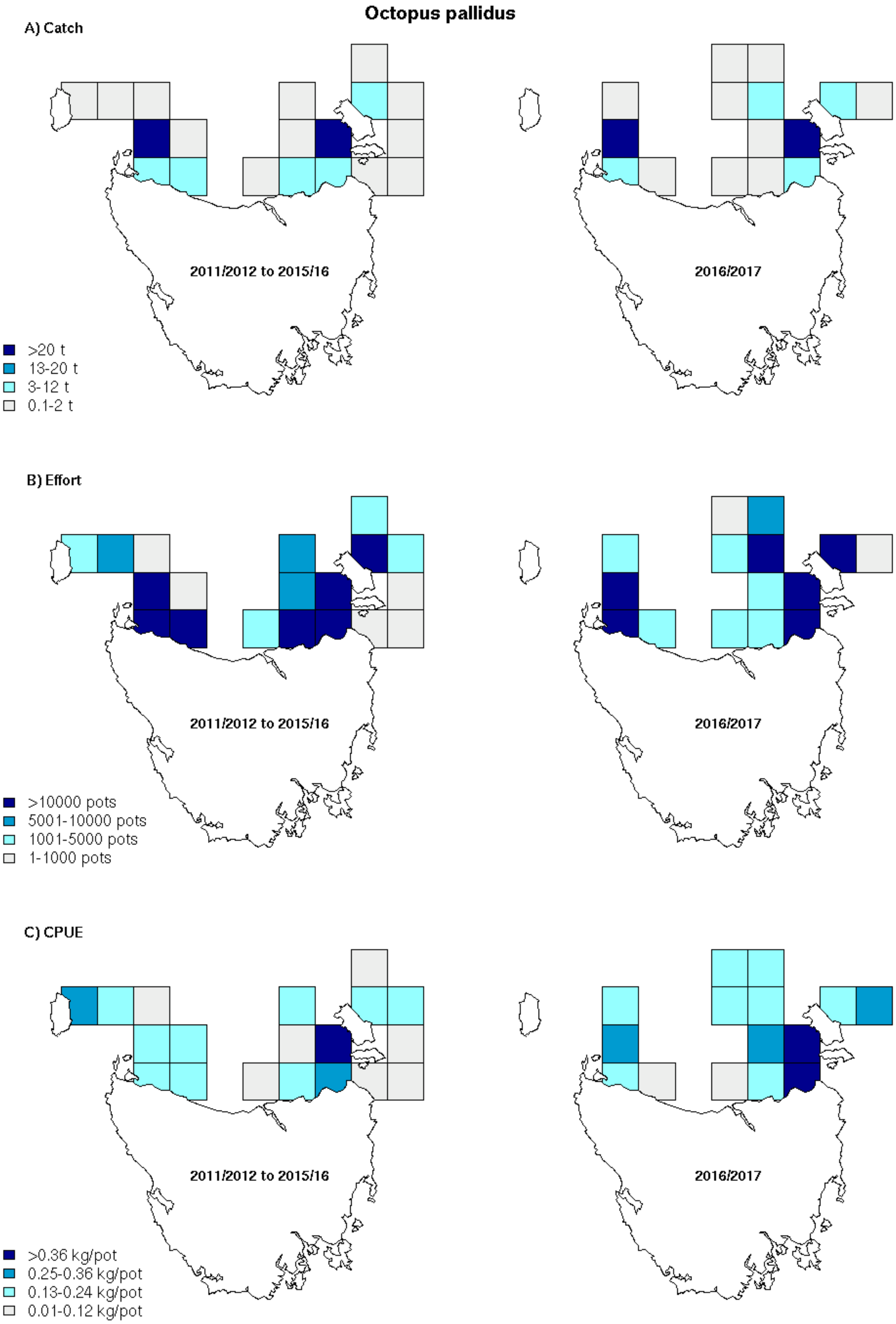


Figure 3.1 (A) Catch, (B) effort and (C) CPUE averaged over the last 5 years and for the licensing year 2016/17.

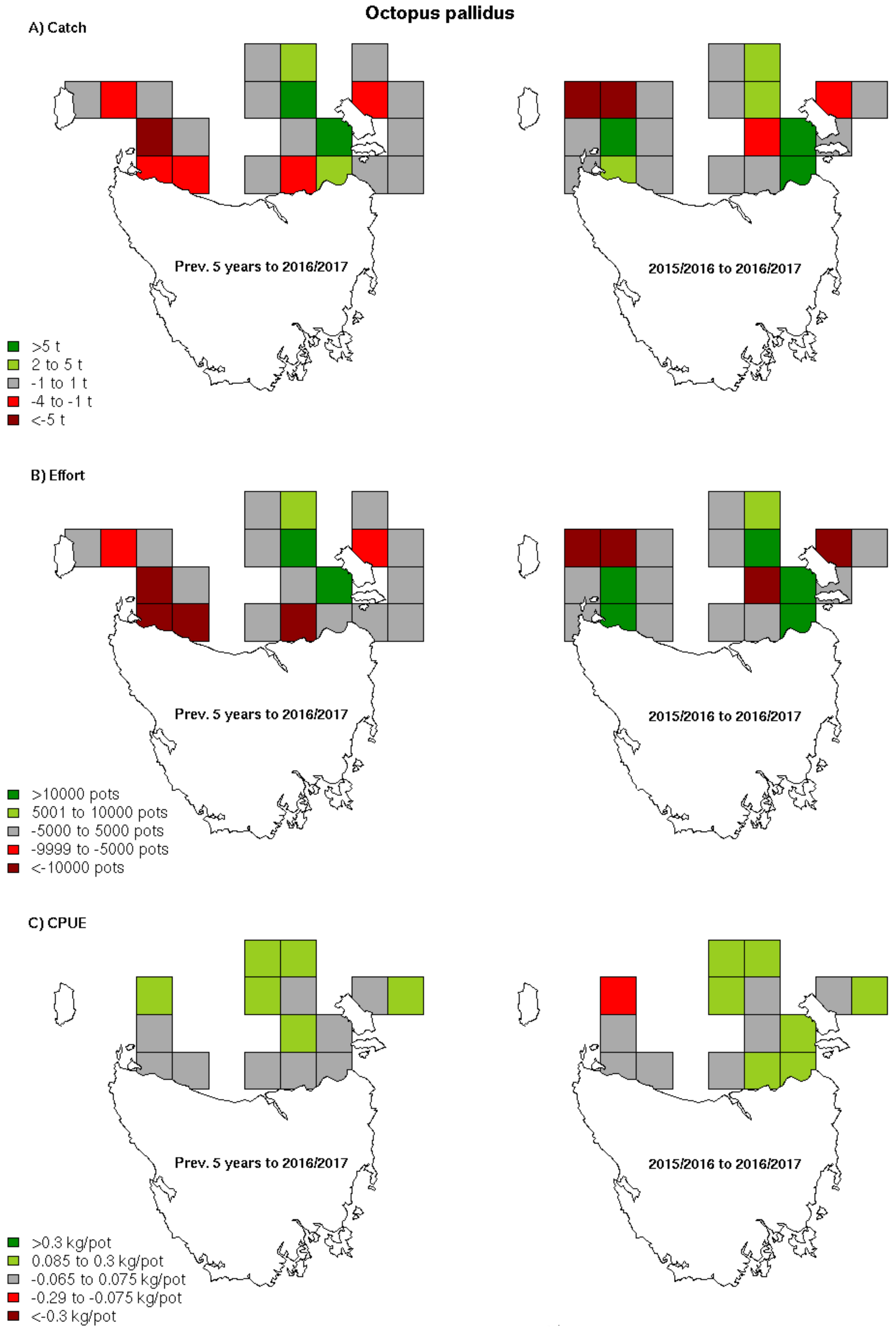


Figure 3.2 Change in (A) catch, (B) effort and (C) CPUE by blocks between the 2016/17 and the previous year (left), and between the 2016/17 and the previous 5 years (2011/12 to 2015/16) (right).

4. Stock status

STOCK STATUS	SUSTAINABLE

Fishing Mortality in the *Octopus pallidus* fishery is represented by the use as Catch (tonnes) as a proxy. In the 2016/17 season catch levels increased marginally from the previous year and have remained approximately 80t for the previous four fishing seasons.

Biomass in the *Octopus pallidus* fishery is indicated by trends in catch per unit effort (CPUE), which have decreased from 2005/06 to 2011/12. Since 2011/12, CPUE has fluctuated around 60% of the reference year (2004/05 Licencing Year where the time series data for 50-pot sampling records commenced).

Historically, high levels of fishing effort have been proceeding declines in fishery-wide CPUE, yet the magnitude of this effect is masked by shifts in spatial fishing effort and the biology of the species.

In 2016/17, fishing mortality values were approximately 80 tonnes of catch for 300,000 potlifts, and are comparable to recent (half-decade) values. The stability indicated in the last 5 seasons provides support that the catch and effort, at current levels, are sustainable and future depletion of the biomass appears unlikely, if formal limit or target parameters were to be established. 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* (0.9 tonnes in 2016/17) and *Macroctopus maorum* (1.7 tonnes in 2016/17) 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 located in the north west.

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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