TASMANIAN OCTOPUS FISHERY ASSESSMENT 2018/19

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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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The Tasmanian Octopus Fishery (TOF) operates off the north coast of Tasmania and in the Bass Strait, primarily targeting Pale Octopus (*Octopus pallidus*), with Maori Octopus (*Macroctopus maorum*) and Gloomy Octopus (*Octopus tetricus*) landed as by-product. The Scalefish Fishery Management Plan (revised in 2015) provides the management framework for the fishery. The commercial fishery has been a sole operator fishery since its commencement in 1980, with two vessels. The main management controls used to manage this fishery include gear and spatial restrictions and limited access via licensing.

In this assessment, the status of Pale Octopus in the TOF area is assessed using the performance indicators of catch, effort and catch per unit effort (CPUE). A more detailed analysis of catch, effort and CPUE at the fishing block level is also presented, with the commercial catch history for the period 2000/01 to 2018/19.

Fishing mortality for Pale Octopus is represented by the use of catch as a proxy for absolute mortality and effort (number of potlifts) as a proxy for exploitation rate. In 2018/19, the total catch of Pale Octopus was 129 tonnes, the highest recorded catch in this fishery. For secondary species, 1 tonne of Maori Octopus was recorded. In contrast, no catch was recorded for Gloomy Octopus, noting that catch of this species seems to be more sensitive to fishing location.

For Pale Octopus, the 2018/19 catch of 129 tonnes was well above the long-term average for the fishery, with an annual average catch of 85.4 tonnes observed over the last decade. This peak in catch is similar to the peak of 125 tonnes of Pale Octopus recorded in 2012/2013. Effort decreased slightly from last year's total, with 347,000 potlifts recorded in 2018/19. This is near the proposed limit reference point of 350,000 potlifts. Almost all of this effort and resulting catch occurred in the western portion of the fishery surrounding King Island.

Biomass of Pale Octopus is indicated by trends in catch per unit effort (CPUE), which have decreased from 2005/06, albeit with annual fluctuations. In 2018/19, a peak in CPUE was recorded in both the logbook data-derived CPUE (increasing by approximately 30% from 2017/18) and the 50-pot sampling program, which is an initiative to quantify catch rates outside of standard fishing operations. Historically, CPUE declined after a peak in the mid-2000s and has been relatively stable since 2011/12, fluctuating by approximately 60% compared to the reference year (2004/05, corresponding to the start of the 50-pot sampling). In 2018/19, the 50-pot sample and logbook data-derived CPUE was 85% and 89% of the CPUE in the reference year, respectively.

While there is some indication of localised depletion, particularly around the fishing grounds centred off Stanley in the State's north-west and Bridport in the State's north-east, these CPUE data do not indicate that the total biomass of the Pale Octopus stock is in a depleted state. The 2018/19 catch was a record high (129t), which breached the proposed catch limit reference point of 106.3t by 22.9t (21.5%) and if sustained could deplete the stock. However, annual peaks in catch can also be driven partly by high recruitment.

Given the peak in catch and CPUE in 2018/19, it is unlikely that the stock is currently recruitment impaired. Current effort levels are high and will require close monitoring to ensure they are not causing stock depletion. On the weight of evidence from different indicators, Pale Octopus in Tasmania is classified as a sustainable stock.

Acknowledgements

We would like to thank Frances Seaborn and the Hardy family for their valuable contributions to this report.

1. Introduction

The Tasmanian Octopus Fishery

The Tasmanian Octopus Fishery (TOF) 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 licences 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 TOF.

The TOF primarily targets the Pale Octopus (*Octopus pallidus*), but also includes the Gloomy Octopus (*Octopus tetricus*) and the Maori Octopus (*Macroctopus maorum*) albeit taken in much lower numbers as by-product. The main fishing method is unbaited moulded plastic pots (volume 3,000 ml) with no doors, which are attached to a demersal longline that is 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 (Table 1.1; Table 1.2). Octopus are attracted to these pots as a refuge, which are generally hauled after 3–6 weeks soak time. 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 a single permit has been issued restricting the take of Octopus off the east and south coasts of Tasmania using 4,000 unbaited pots (from south of Eddystone Point and East of Whale Head).

From 2000/01 to 2005/06 catches of Pale Octopus in the TOF increased substantially and since then have fluctuated around 80 tonnes, ranging from 58t to 129t. Gloomy Octopus has only been reported in the fishery since 2010/11, with catches concentrated predominantly around Flinders Island. The catch of Maori Octopus in the fishery has continued to fluctuate since 2000/01 with approximately 1 tonne landed in 2018/19.

Table 1.1 Summary the management and reporting changes for the Tasmanian Octopus Fishery.

Date	Management changes
Pre December 2009	Access provided to holders of personal fishing licence, a vessel licence and a scalefish (or rock lobster) licence. Trip limit of 100 kg if not the holder of a fishing licence (octopus) or permit.
December 2009	Two licences issued for the operation of two vessels. Sole Operator.
2004 / 2005	50-pot sampling program implemented
2016 / 2017	Two developmental permits issued (no reportable catches)
2017 / 2018	Single developmental permit issued (reportable catches)

Table 1.2 Summary the management systems for the Tasmanian Octopus Fishery.

Date	Management changes
Fishing methods	Access provided to holders of fishing licence (octopus), a vessel licence and a scalefish (or rock lobster) licence. Trip limit of 100 kg if not the holder of a fishing licence (octopus).
Primary landing port	Two licences issued for the operation of two vessels. Sole Operator.
Management methods	**Input control:** - Fishing licence (octopus) allows the use of 10,000 pots (maximum of 1,000 pots per line) to target *Octopus pallidus*, *O. tetricus* and *O. maorum.* - Fishing zone restriction (East and West Bass Strait Octopus zones only).
Main market	Tasmania and mainland Australia
Octopus licences	2
Active vessels	2

Recreational fishery

Small amounts of Octopus are also targeted by recreational fishing. As of 1 November 2015, recreational fishers have been subject to a bag limit of 5 octopus and a possession limit of 10 octopus (all species combined).

Data on the recreational catch of octopus in Tasmania is sparse. 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. These surveys suggest that 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, rock lobster pots, with the majority being released (Table 1.3).

Table 1.3 Estimated total recreational harvest numbers, number kept and % released for cephalopod taken by Tasmanian residents (Lyle *et al.*, 2009, 2014). 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

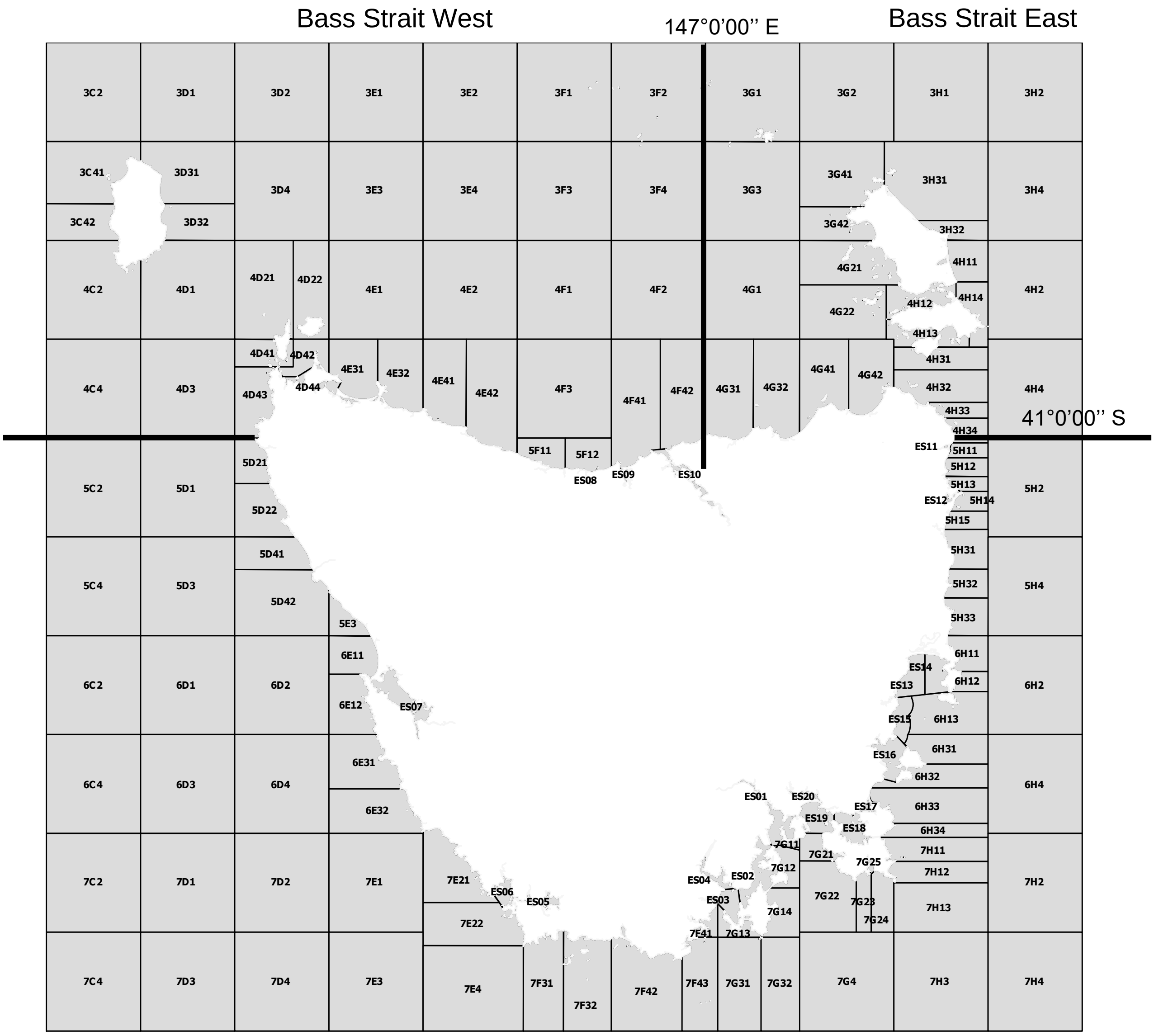
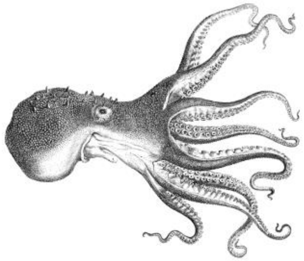


Figure 1.1 East and West Bass Strait octopus fishing zones and blocks. The octopus fishery reports in latitude and longitude but for the purpose of this report, fishing areas will be reported in fishing blocks.

Species Biology

All three octopus species harvested in Tasmania are short lived and fast growing. Table 1.4 summarises the biology of each species.

Table 1.4 Life history and biology of Pale Octopus (*Octopus pallidus*), Gloomy Octopus (*Octopus tetricus*) and Maori Octopus (*Macroctopus maorum*). In the 'Source' column, [1] refers to *O. pallidus,* [2] to *O. tetricus and* [3] to *M. 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	Undefined but potentially high	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 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	• Semelparous (i.e. reproduces only once before dying). • Spawning season undefined but likely all year round.	• 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.	Leporati *et* al. (2008a)[1] Joll (1983)[2] Anderson (1999)[3]

	• Around 450-800 eggs per spawning event. • Egg length: 11-13 mm.	• Average fecundity is 278,448 eggs ± 29,365 se • Average size (maximum length) of ripe eggs is 2.2 mm ± 0.1 se	• 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.	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. Methods

Data sources

Commercial data

Commercial catch and effort data used in this assessment are based on that entered into TOF Commercial Catch, Effort & Disposal Record logbook returns. This information facilitates the determination of catch per unit effort (CPUE). Octopus catches are reported as weight and effort via the number of potlifts. 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 of each species 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 required to sample at least 50 pots per line from at least one line per fishing day, and at least one line per distinct area fished in each day. Areas are distinct when lines are located entirely on different substrates or are separated by more than 10 nautical miles. Additional data of catch from the Rock Lobster and 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. This practice aims to enhance the understanding of the stock status, particularly at a finer spatial scale (i.e. block level). New logbook requirements recently implemented will lead to improved data collection for the 50-pot samples.

In the 2018/19 season commercial data also exists for the developmental permit for the east coast of Tasmania. This data has not been included in the above analysis and has been summarised separately.

Data analysis

Catch, Effort and CPUE

For the purpose of this assessment; catch, effort and CPUE analyses were restricted to commercial catches of Pale Octopus for the period March 2000 to February 2019.

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).

Data on logbook returns include gutted and non-gutted (i.e. whole) weights. All gutted weights were converted to whole weight as follows:

$$\textit{Whole weight} = 1.233472 * \textit{Gutted weight}$$

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

The number of pots pulled (potlifts) 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 the amount of incomplete logbook entries has been negligible to nil. All records were 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. Exploration of this influence was discussed in detail in the 2015/16 stock assessment (Emery & Hartmann, 2016), where no relationship between soak time and CPUE was apparent. Therefore, soak time was not considered in the resultant catch standardisation process below.

CPUE of Pale Octopus have been standardised using a generalised linear model (GLM) to reduce the impact of obscuring effects such as fishing year or season on the underlying trends in biomass (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 TOF, operating from two different vessels. The depth fished is variable 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. Factors considered in the GLM were year, month and block. A lack of spatial block data for a number of trips from 2003/04 to 2007/08 led to 115t of catch data being omitted from the subsequent catch standardisation process. The GLM was applied to weight per pot for the whole commercial dataset and number per pot for the 50-pot sampling dataset. This process removes the effect of season and location so that trends in CPUE are more accurately reflective of change in octopus abundance.

Assessment of stock status

Stock status definitions

To assess the status of Pale Octopus in the TOF in a manner consistent with the national approach (and other jurisdictions), we have adopted the national stock status categories used in the 2018 Status of Australian Fish Stock (SAFS) report (Table 2.1) (Stewardson et al., 2018). These categories define the assessed state of the stock in terms of recruitment overfishing, which is often treated as a limit reference point. If a stock falls below this limit reference point, it is deemed that recruitment is impaired and its productivity reduced. Fisheries are ideally also managed towards targets that maximise benefits from harvesting, such as economic yield or provision of food. The scheme used here does not attempt to assess the fishery against any target outcomes. Determination of stock status into the below categories was based on temporal and spatial trends in commercial catch, effort and standardised CPUE data from the TOF.

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 2.2).

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

Table 2.1 The stock status classifications that were adopted for this assessment.

Stock status	Description	Potential implications for management of the stock
SUSTAINABLE	Biomass (or proxy) is at a level sufficient to ensure that, on average, future levels of recruitment are adequate (recruitment is not impaired) and for which fishing mortality (or proxy) is adequately controlled to avoid the stock becoming recruitment impaired (overfishing is not occurring)	Appropriate management is in place.
RECOVERING ↑	Biomass (or proxy) is depleted and recruitment is impaired, but management measures are in place to promote stock recovery, and recovery is occurring.	Appropriate management is in place, and there is evidence that the biomass is recovering.
DEPLETING ↓	Biomass (or proxy) is not yet depleted and recruitment is not yet impaired, but fishing mortality (or proxy) is too high (overfishing is occurring) and moving the stock in the direction of becoming recruitment impaired.	Management is needed to reduce fishing mortality and ensure that the biomass does not become depleted.
DEPLETED	Biomass (or proxy) has been reduced through catch and/or non-fishing effects, such that recruitment is impaired. 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.

Table 2.2 Summary of the proposed performance indicators and reference point.

Performance indicators	Reference points
Fishing mortality	• Catch > highest catch value from the reference period (106.3 t) • Effort > Approximate effort required to achieve highest catch value from the reference period (106.3 t) assuming average (unstandardised) catch rates across the period 2004/05 to 2009/10 (0.306 kg per pot) (=350,000 pot lifts)
Biomass	• Numbers per pot < lowest value from the reference period (0.40 octopus/pot)

3. Results

Broad scale patterns in catch, effort and catch per unit effort

Catch and effort within the Tasmanian Octopus Fishery

Influence of soak time

As per the 2015/16 report (Emery & Hartmann, 2016), an analysis of the 50 pot samples indicated that soak time had no discernible relationship with CPUE by number or weight and was disregarded when standardising CPUE. The number of pots continues to be used as the measure of effort when calculating catch rates.

Sex ratio

No difference in the ratio of male to female Pale Octopus was observed on a licencing year basis since the start of the 50-pot sampling program (Figure 3.1).

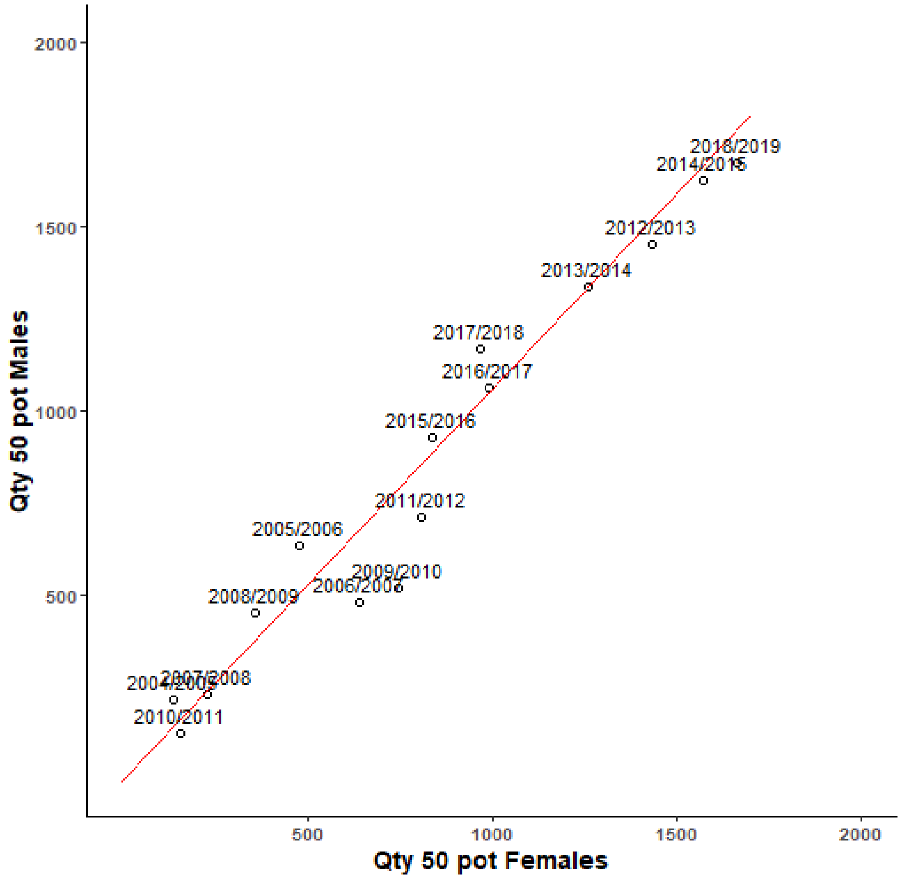


Figure 3.1 Ratio of Male to Female Octopi for 50-pot samples.

Catch and effort

The total catch of Pale Octopus in the TOF in 2018/19 was 129t, a doubling of the previous year's catch of 64.4t and a record high catch for the fishery (Figure 3.2). This pattern of a low catch year followed by an unusually high catch year also occurred in 2011/2012 and 2012/2013. Catches in the fishery have oscillated from ~60t to ~120t since 2003/2004. This record catch occurred despite a small decline in effort, suggesting a strong recruitment for the year, or favourable conditions that led to increased vulnerability to fishing gear.

Catches also vary seasonally within the fishery (Figure 3.3). In 2018/19, catches peaked during winter constituting 37.7% of this year's catch, followed by autumn which constituted 29.2% of catches. The high percentage of catch in winter is atypical to the usual autumn peak in catch recorded in previous years. Spring and summer landings constituted 21.9% and 11.6% of the total annual catch, respectively.

Fishing effort in 2018/19 was 347,000 pot lifts, a slight decrease from 2017/18 effort of 366, 500 pot lifts, and was the fourth highest level of effort recorded for the fishery (Figure 3.4). Effort was concentrated in Autumn and Spring and was largely consistent with the previous three years.

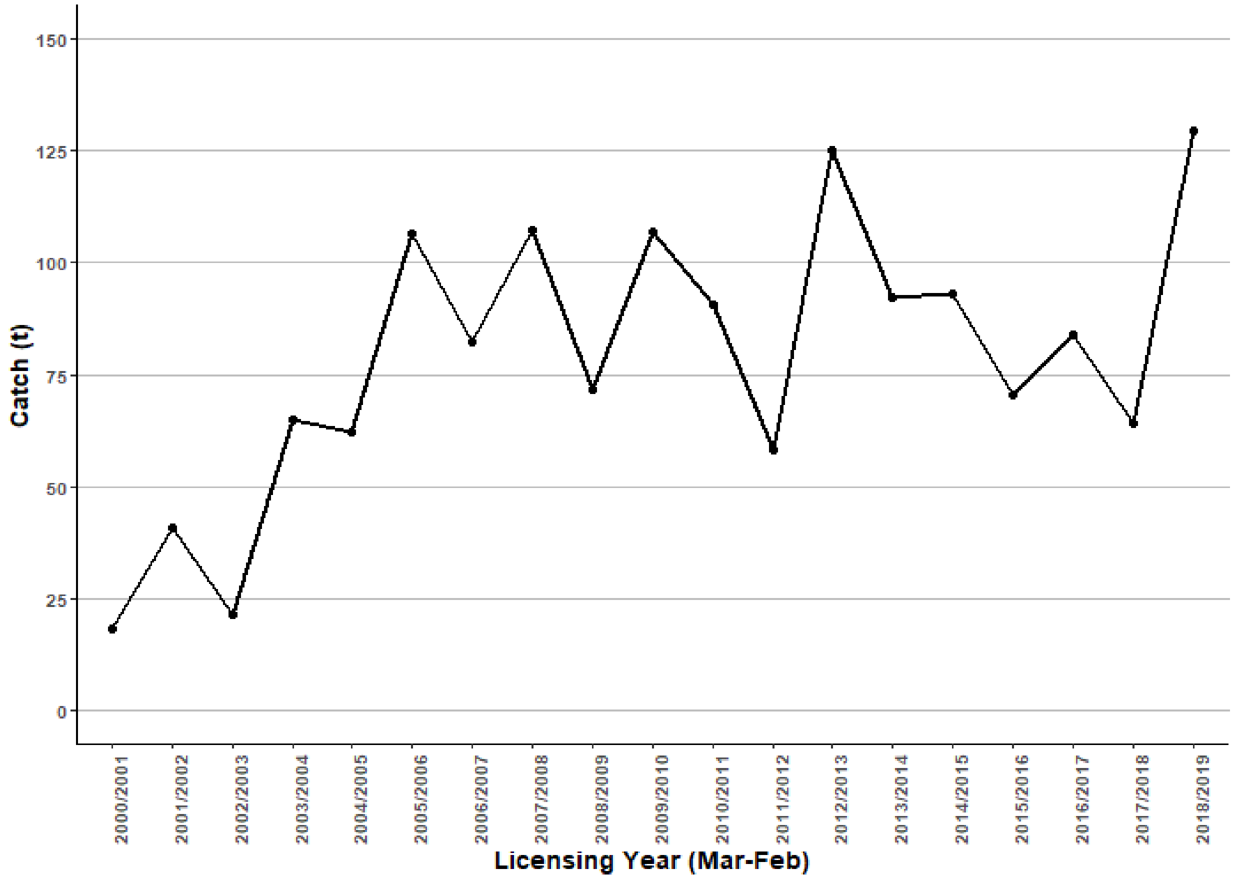


Figure 3.2 Total catches of Pale Octopus in the Tasmanian Octopus Fishery since 2000/01.

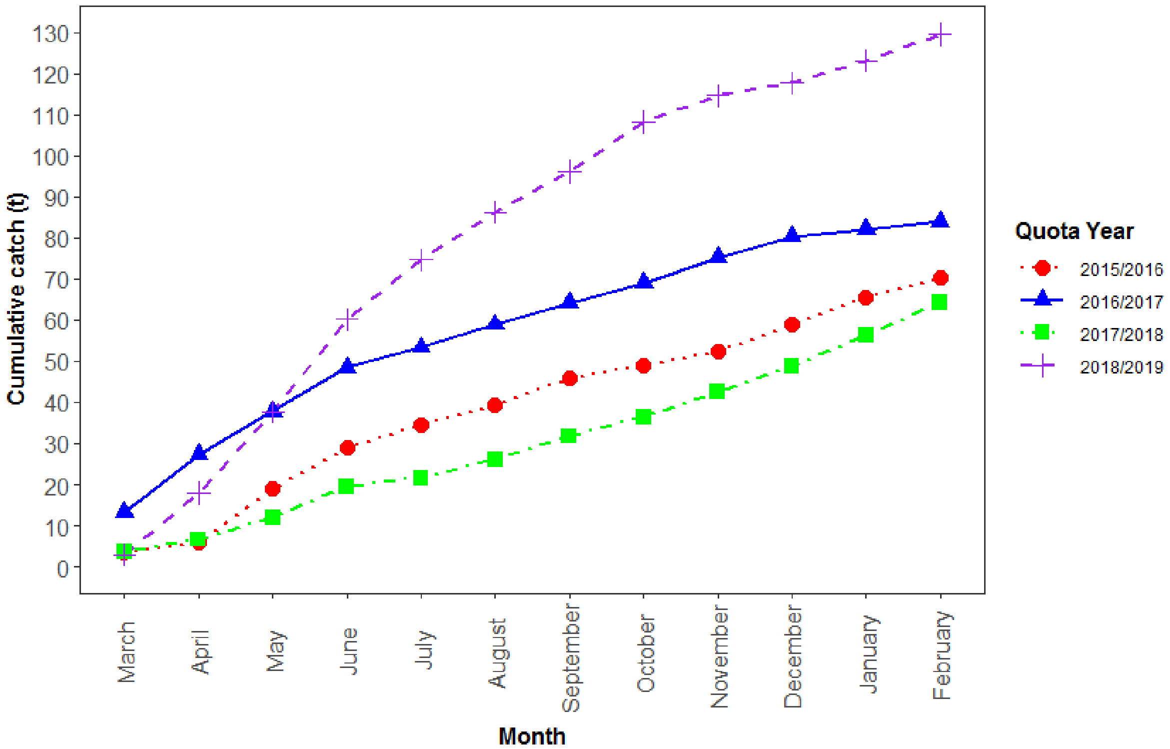


Figure 3.3 Cumulative catches of Pale Octopus landed over the last four licensing years showing seasonal trends.

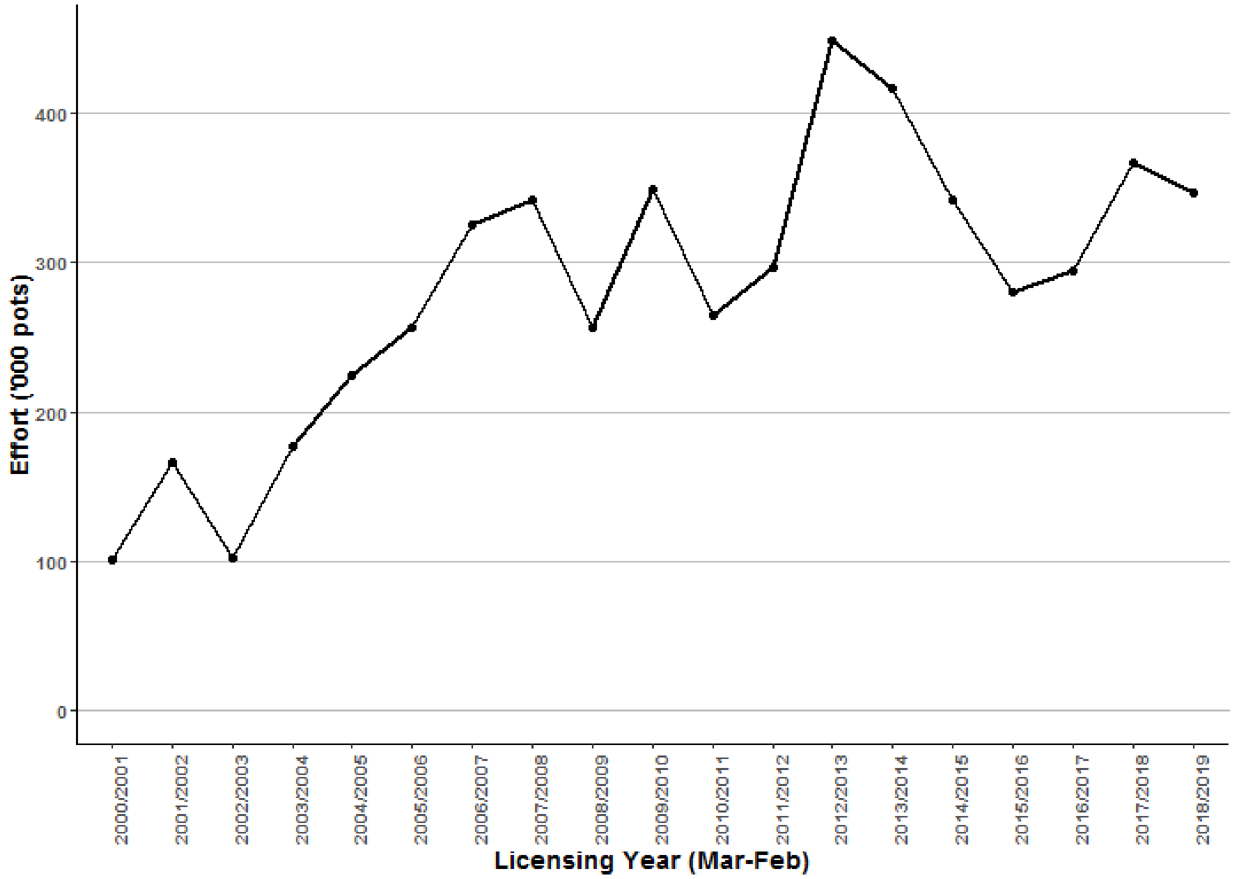


Figure 3.4 Effort (thousands pots) for Pale Octopus in the Tasmanian Octopus Fishery since 2000/01.

Catch per unit effort

In 2018/19, as with previous assessments, CPUE peaked in autumn and winter (March-August, Figure 3.5), coinciding 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 commenced in that year (Figure 3.6). The CPUE standardisation, with removed seasonality (evident in Figure 3.5), shows inter-annual variability in CPUE and a steady decline in CPUE from both the total commercial catch data and 50-pot sampling since 2004/05 to 2010/11 until 2018/19 where a noticeable increase was recorded. The inter-annual variation to some extent is likely due to the biological characteristics of Pale Octopus, 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 following year due to less favourable environmental conditions and/or changes in 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. In consequence, there is a general danger of hyperstability in this fishery, whereby CPUE remains high despite declines in the stock. As Pale Octopus 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 depletion if fishing effort becomes concentrated. The ability of CPUE based on the total commercial catch data to detect declines in localised abundance may be limited by spatial shifts in fishing effort from areas of low to high productivity. In the current year, almost all fishing effort took place in the north-western part of the fishing ground.

Since 2011/12, 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 2018/19, CPUE peaked, increasing from 52% of the reference year in 2017/18 to 86% in 2018/19. Estimates of CPUE from the 50-pot sampling program have largely remained stable since 2011/12, but also showed a similar peak in 2018/19, increasing from 67% of the reference year in 2017/18 to 89% in 2018/19 (Figure 3.6).

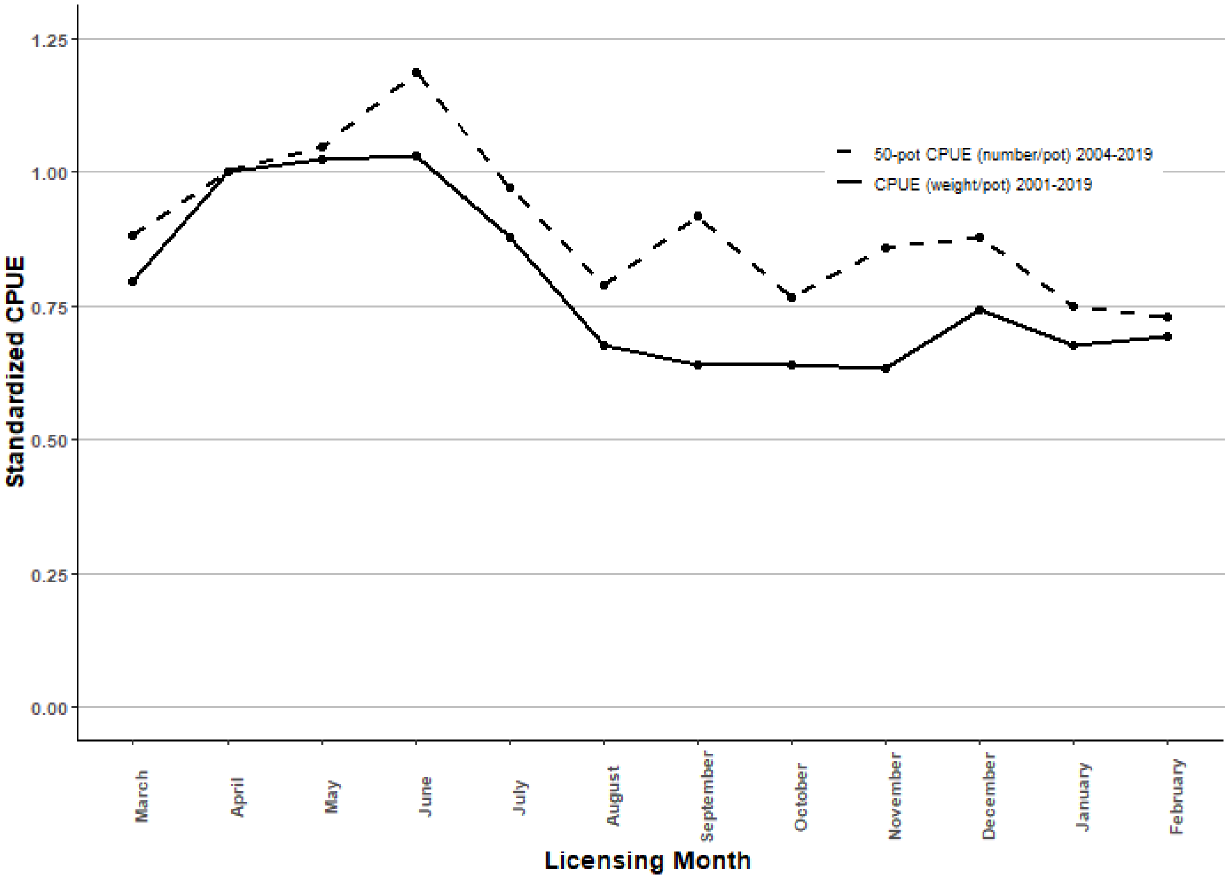


Figure 3.5 Pale Octopus standardised catch per unit effort (CPUE) relative to March levels in weight per pot (total commercial) and in number per pot (50-pot sampling).

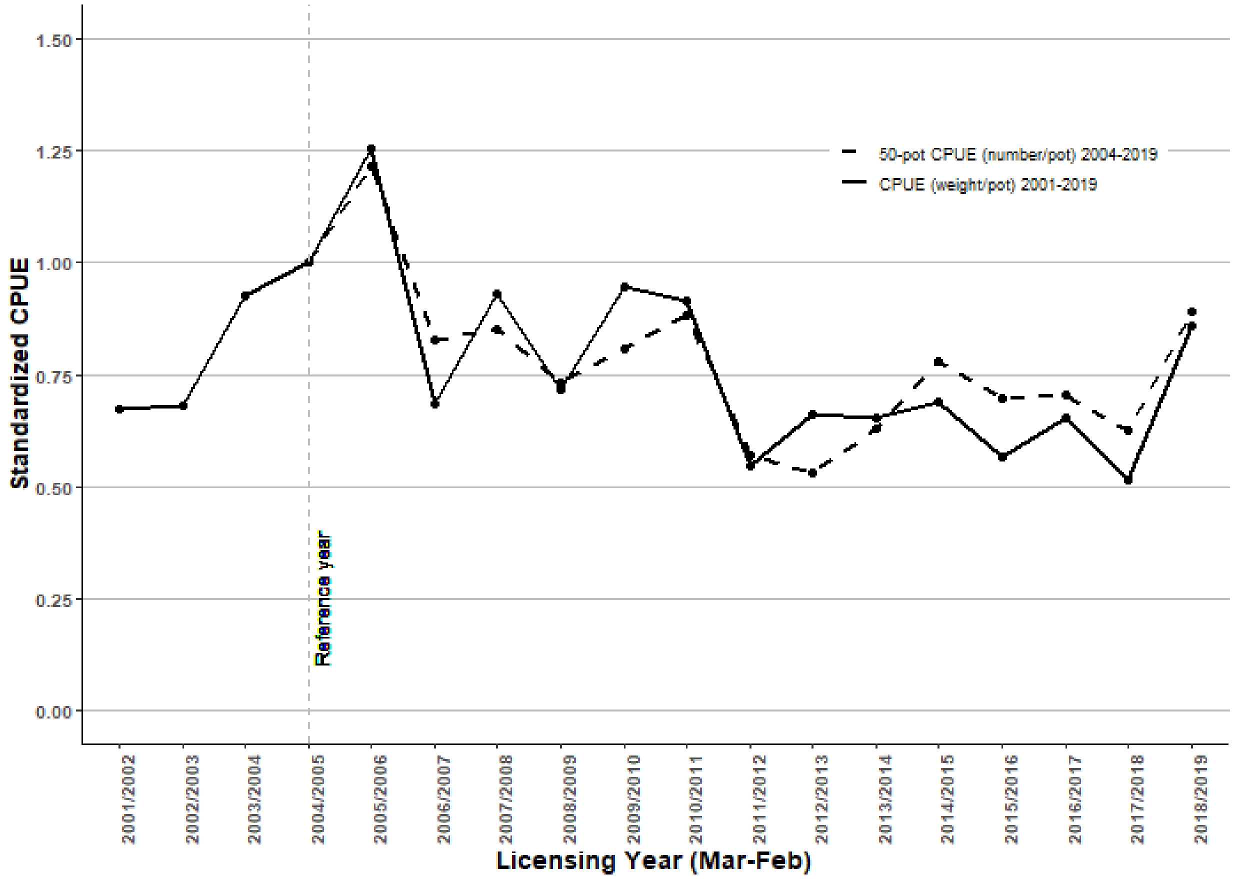


Figure 3.6 Pale Octopus standardised catch per unit effort (CPUE) relative to 2004/05 levels in weight per pot (total commercial) and in number per pot (50-pot sampling).

Commercial catch from developmental fishing permits

The single fishing permit, permitting access along the east coast below latitude 41° 0' 00'' South resulted in a total catch of 4,736.5 kg of Pale Octopus from a total of 33,000 potlifts. The catch of non-targeted species totalled 88 kg for Gloomy Octopus and 192 kg of Maori Octopus, respectively.

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 7.6 tonnes recorded in 2018/19 (Figure 3.7). Individuals are often not identified to the species level, 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 Maori Octopus.

Most of the octopus bycatch in recent years originated from the rock lobster commercial fishery, with an average bycatch (reported as by-product) of 6.2 tonnes per annum over the last ten licensing years (Figure 3.7), which is likely to be a substantial underestimate. In 2018/19 the reported bycatch was 6 tonnes, which is close to the longer-term average. The commercial scalefish fishery represents the other source of octopus bycatch, with an average of 3.3 tonnes per annum reported over the last 10 licensing years. In 2018/19, the catch was 1.6 tonnes. Gears that produce most of the octopus catch are hand collection and gillnets (see Figure 3.7). Hand collected octopus was once a targeted fishery in Eaglehawk Neck but declined after DPIPWE stopped the use of gillnets 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.

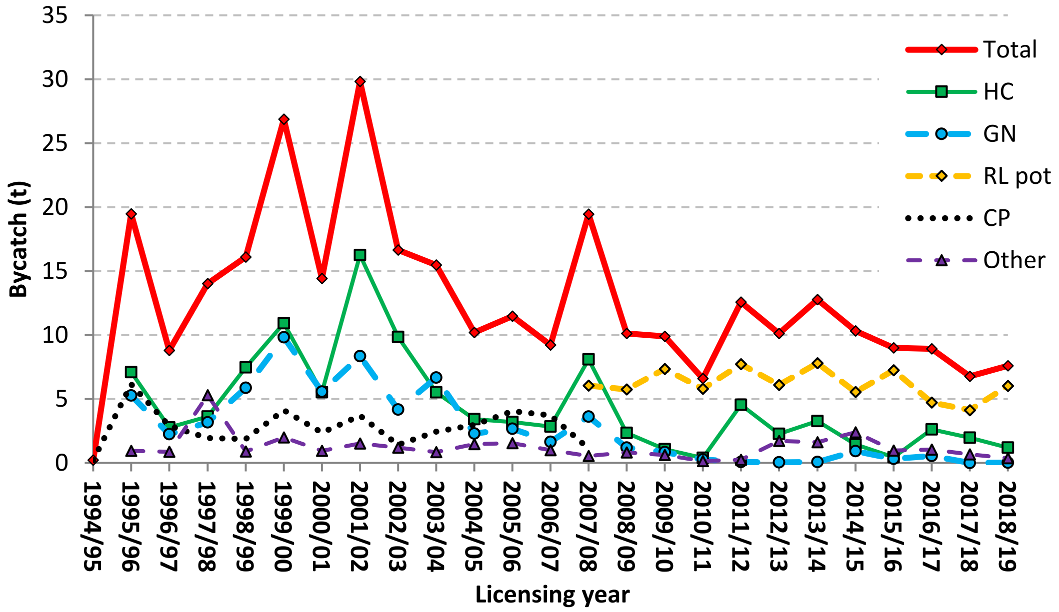


Figure 3.7 Octopus bycatch (tonnes) in other commercial fisheries. HC= hand collection, GN= gillnet, RL pot= Rock lobster pots, CP= crab pot.

Fine-scale patterns in catch, effort and catch per unit effort within the Tasmanian Octopus Fishery

Catch, effort and CPUE from the TOF area have been analysed at the scale of the fishing block to examine the potential issue of localised depletion. Trends for each block have been calculated as the difference in catch and nominal 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 3.8 and 3.9).

Catch and effort values (Figures 3.8 and 3.9, A and B) indicate a shift in spatial distribution for recent years relative to historical fishing. Most notable is a shift in effort, and subsequently catch, from the north-east coast off Bridport, to central, coastal areas of the state, as well as areas north-east of Flinders Island and east of King Island (Figure 3.8; Figure 3.9). Reductions in CPUE have been observed in the inshore waters off Bridport (Figure 3.9 C), suggesting that biomass in this region could be depleted. For the 2018/19 year, a concentration of catch, effort and CPUE were found to occur in the blocks fished east of King Island and North of Stanley in the western portion of the fishery, with effort decreasing in the eastern portion of the fishery.

Areas of high catch and effort have historically been concentrated in inshore waters off Stanley (Blocks 4E1, 4E3 and 4E4, Figure 1.1). In recent years, catch and effort in this region had declined significantly. For Block 4E3 at least, this may be in part due to fishers choosing to avoid interactions with the State Scallop Fishery operating in the area (Semmens et al. 2018). Increased effort was directed to this region in 2017/18 and 2018/19, with a notable increase in CPUE recorded this year (Figure 3.9 C).

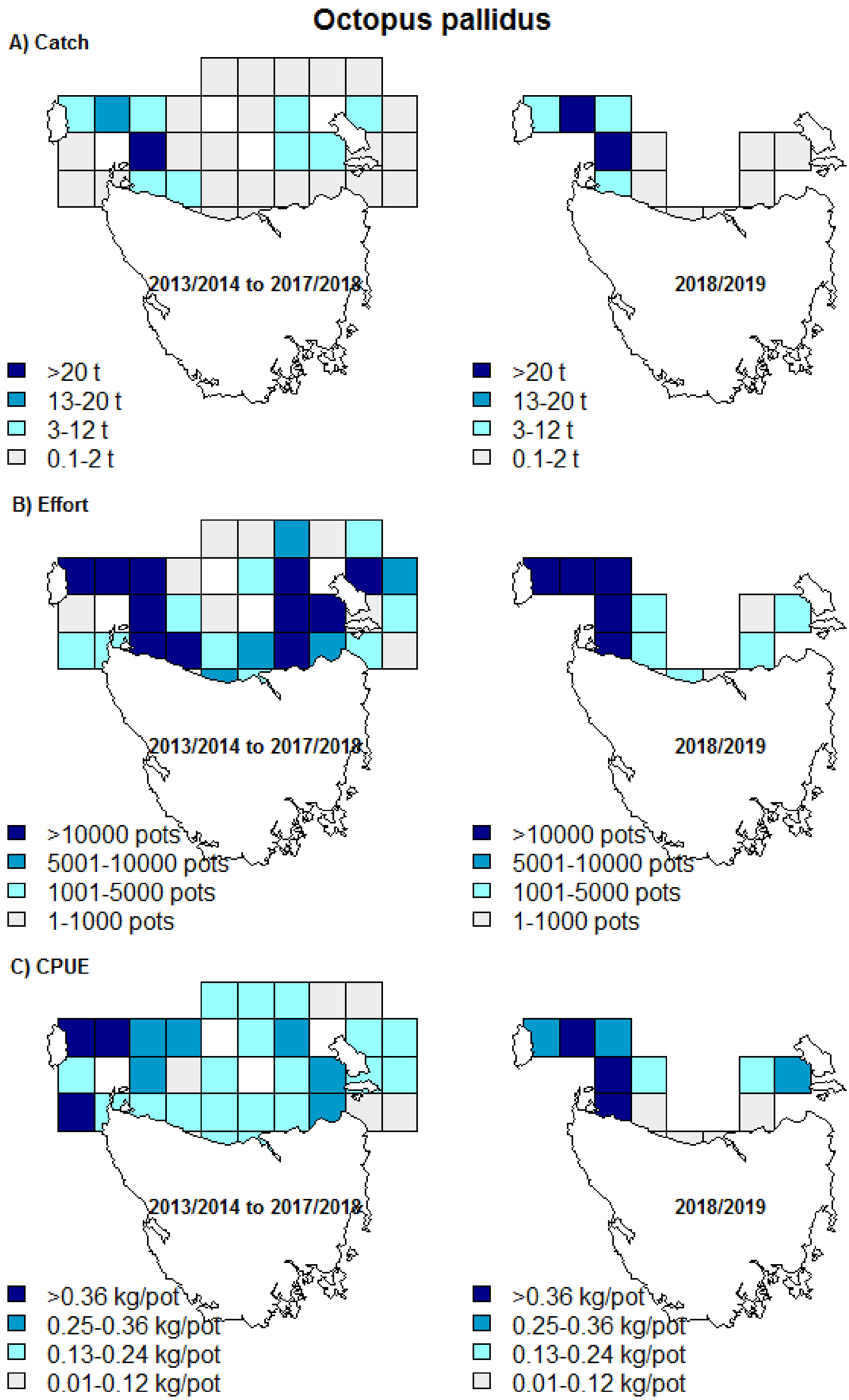


Figure 3.8 (A) Catch, (B) effort and (C) CPUE averaged over the last 5 years and for the current licensing year 2018/19.

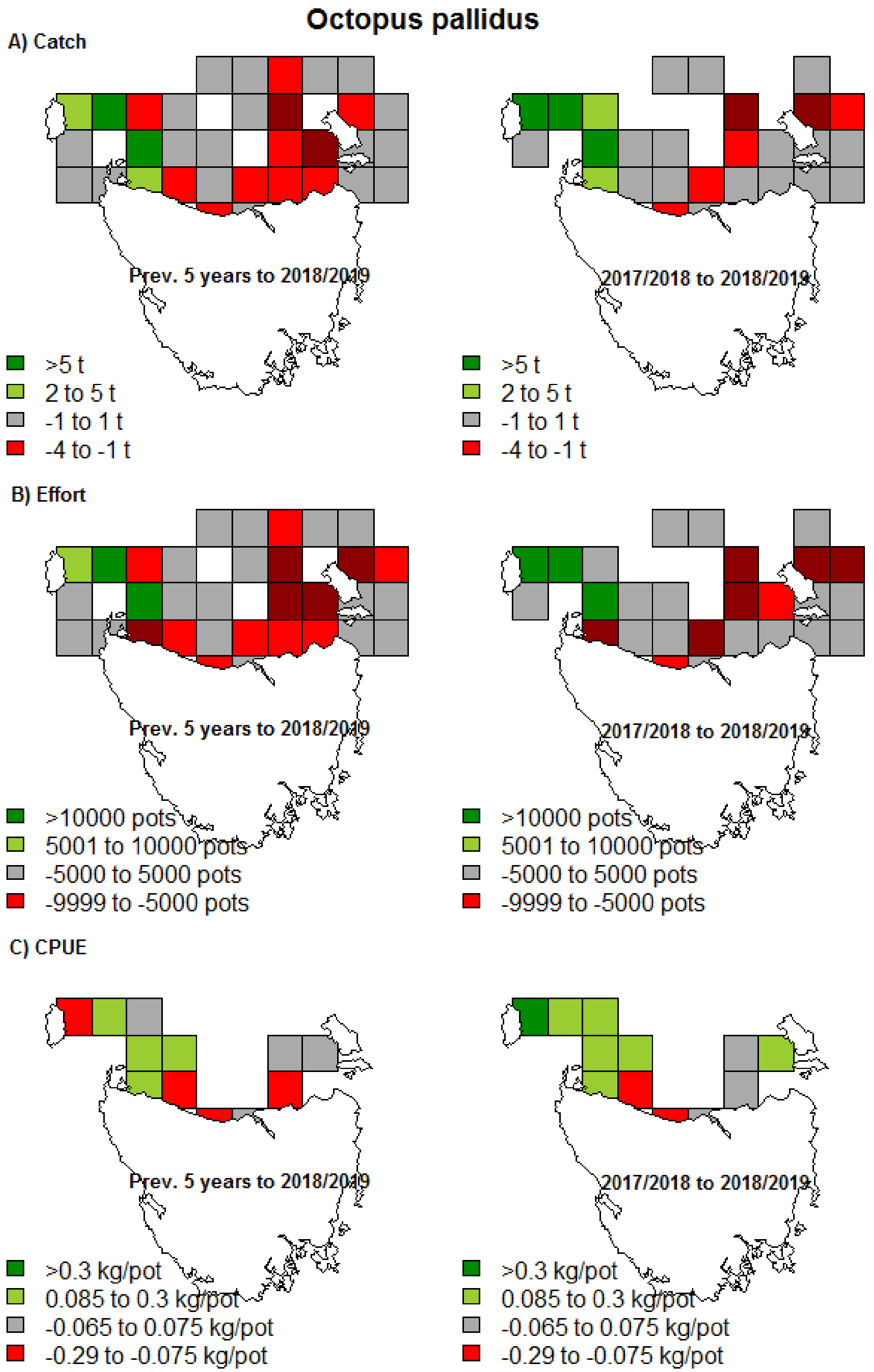


Figure 3.9 Change in (A) catch, (B) effort and (C) CPUE by blocks between 2017/18 and the current year 2018/19 (right), and between 2018/19 and the previous 5 years average (2013/14 to 2017/18) (left).

4. Stock status

STOCK STATUS	SUSTAINABLE

Fishing mortality for Pale Octopus is represented using proxies: catch (tonnes) for absolute mortality, and effort (potlifts) for exploitation rate. In 2018/19, catches of Pale Octopus in the Tasmanian Octopus Fishery increased to a record peak of 129t, a doubling of 2017/18 catch (64.4t). The 2018/19 catch of Pale Octopus represents a peak above the long-term average for the fishery of 85.4 t observed over the last decade. Effort was at its fourth highest level recorded since reporting began, with 347,000 potlifts in 2018/19, which represents a slight decrease from last year and is just below the proposed limit reference point of 350,000 potlifts.

Biomass of Pale Octopus is indicated by trends in catch per unit effort (CPUE) data, which showed a decrease from 2005/06, albeit with annual fluctuations. Historically, CPUE declined after a peak in the mid-2000s, but has been relatively stable since 2011/12, fluctuating at around 60% of the reference year (2004/05, corresponding to the start of the 50-pot sampling). In 2018/19, a peak year was recorded, with the 50-pot sample and logbook data-derived CPUE estimates at 85% and 89% of the reference year, respectively, representing an increase of roughly 30% from 2017/18. Historically, high levels of fishing effort have preceded 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.

Based on the data described above, there are no clear indications that the biomass of Pale Octopus in the Tasmanian Octopus Fishery is in a depleted state. However, levels of fishing mortality experienced in the 2018/19 fishing season were high, which may be driven by increased recruitment, favourable environmental conditions and/or changes in fisher behaviour. On this basis, Pale Octopus in Tasmania is classified as a sustainable stock. However, in several previous years fishing mortality was likely too high and could drive the stock into depletion. Formalising limit and target reference points would serve to reduce fishing pressure and prevent future depletion of the biomass.

5. Bycatch and protected species interactions

Bycatch in the octopus pot fishery is historically low. While Pale Octopus is the main target, pots also attract other octopus species, including Gloomy Octopus and Maori Octopus. Catches of Gloomy Octopus decreased from a peak in 2017/18 of 16.9 t to just 4 kg in 2018/19. In contrast, 2018/19 Maori Octopus catch values of 2 t are more similar to the 2017/18 catch of 1.2 t. 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 in the fishery are minimal, with seals being the only species group for which interactions have been recorded. Occurrences of interactions are relatively rare (28 interaction records since 2000/01, with no records since 2010/11).

The nature of the fishery and the 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. In the Western Australian Rock Lobster Fishery, approximately 2 million potlifts are 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 Pale Octopus. 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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