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TASMANIAN OCTOPUS ASSESSMENT 2023/24

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This assessment is produced by the Institute for Marine and Antarctic Studies (IMAS) using data downloaded from the Department of Natural Resources and Environment, Tasmania (NRE Tas) Fisheries Integrated Licensing and Management System (FILMS) database. The information presented here includes all logbook returns for the 2023/24 season.

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Contents

1 Executive Summary

1.1 Pale Octopus (*Octopus pallidus*) – Bass Strait

STOCK STATUS	DEPLETING
STOCK	Tasmanian Pale Octopus – Bass Strait
INDICATORS	Catch, effort and CPUE trends; risk assessment of recruitment impairment

1.2 Pale Octopus (*Octopus pallidus*) – Tasmanian Shelf

STOCK STATUS	SUSTAINABLE
STOCK	Tasmanian Pale Octopus – state waters excluding Bass Strait
INDICATORS	Catch and effort

1.3 Gloomy Octopus (*Octopus tetricus*)

STOCK STATUS	SUSTAINABLE
STOCK	Tasmanian Gloomy Octopus
INDICATORS	Catch; risk assessment of recruitment impairment

1.4 Māori Octopus (Macroctopus maorum)

STOCK STATUS	SUSTAINABLE
STOCK	Tasmanian Māori Octopus
INDICATORS	Catch; risk assessment of recruitment impairment

Octopus are caught commercially in Tasmanian waters across multiple fisheries using a variety of gear types. The three recorded species are Pale Octopus (*Octopus pallidus*), Gloomy Octopus (*Octopus tetricus*), and Māori Octopus (*Macroctopus maorum*). Most of the catch comes from a targeted, unbaited trap fishery for Pale Octopus in northern Tasmania, primarily in the Bass Strait, by fishers operating under the fishing licence (octopus). This fishery is referred to as the Tasmanian Octopus Fishery (TOF) in this report and by the Department of Natural Resources and Environment Tasmania (NRE Tas). Holders of the fishing licence (octopus) also retain low quantities of Māori Octopus as by-product and occasionally land Gloomy Octopus in years when the fishery extends towards eastern Bass Strait. The TOF primarily targets Pale Octopus and represents most octopus catches in Tasmania. Developmental permits for targeting Pale Octopus in state waters in the south and east of Tasmania have also been issued largely since 2016, though operators retain harvest in significantly smaller quantities than in the Bass Strait. For the purposes of this assessment, the Pale Octopus stock in Tasmania has been divided into the Bass Strait stock, delineated by the boundaries of the licenced fishery (TOF), and the Tasmanian Shelf stock in the south and east. These stock names are based on those used for similar broad biogeographic regions identified by the Integrated Marine and Coast Regionalisation of Australia framework (Australia 2006).

The Scalefish and Rock Lobster fisheries take octopus as by-product. The Giant Crab fishery operates using similar gear to the Rock Lobster fishery; however, it accounts for only about 2% of the catch volume of the Rock Lobster fishery, and fishing depths are typically much greater. No octopus have been recorded in the returns data from the Giant Crab fishery. Species information has not always been historically recorded for octopus landed within the Scalefish and Rock Lobster fishery; however, the majority is assumed to be Māori Octopus. Based on the low incidence of Gloomy Octopus and Pale Octopus records in fisheries bycatch and byproduct from these fisheries, landings of these two species are considered negligible (León et al. 2019).

Until late 2009, a targeted fishery for Māori Octopus existed in Eaglehawk Bay using hand collection and barrier nets. Catches in this local fishery declined significantly and remained very low after the permit for barrier nets ceased.

Aboriginal cultural catch of octopus species is known to occur, primarily as bycatch from line fishing or diving, but is considered negligible. The most recent recreational survey recorded 'other cephalopods'—excluding Southern Calamari and Gould's squid—as negligible, with most being returned (Tracey and Stark 2024).

1.5 Pale Octopus – TOF

The Scalefish Fishery Management Plan (*Fisheries (Scalefish) Rules 2015*), revised in 2023, provides the legislative framework for the northern Tasmanian commercial unbaited trap fishery targeting Pale Octopus (the TOF). The Pale Octopus stock accessed by this fishery is referred to in this report as the Bass Strait stock. Since its commencement in 1980, the TOF has operated under two licences but as a sole operator fishery, with two vessels fishing in Bass Strait and on the eastern side of Flinders Island. The primary management controls for the fishery include limited access through licensing and gear restrictions.

The Pale Octopus is found in southeastern Australian waters, including Tasmania. Its reproductive biology indicates low resilience to fishing pressure, as females brood small numbers of eggs that develop into large, benthic hatchlings. As a semelparous species, the Pale Octopus reproduces only once before dying, resulting in non-overlapping generations. This means that if recruitment (the survival of new individuals) is disrupted by factors such as overfishing or environmental changes, there is no overlap of generations to compensate, making the population particularly vulnerable to recruitment failure.

The status of the Bass Strait Pale Octopus stock is assessed annually using data on catch, effort, and catch per unit effort (CPUE) from the TOF. Catch and effort data now span the period from 2000/01 to 2023/24. Fishing pressure on Pale Octopus is assessed by using catch as a proxy for absolute mortality, and effort (measured by the number of pot-lifts) as a proxy for the exploitation rate.

The total catch of Pale Octopus in 2023/24 was 111 tonnes, reflecting an increase from 101 t in the previous year. This season marks the sixth consecutive year that total catches have exceeded 100 t a notably high volume for any fishery. A high proportion of the catch came from a relatively small area. Concurrently, total fishing effort rose significantly, with pot-lifts increasing from 314,708 in 2022/23 to 415,637 in 2023/24. In 2023/24, the majority of Pale Octopus catch (80.3%), and effort (74.2%) were concentrated in six fishing blocks located north and northwest of Flinders Island as well as north of Stanley and east of King Island. In recent years, the distribution of Pale Octopus catch and effort has expanded beyond historical patterns (2004–2014), with increased activity around King Island and new areas further north of Flinders Island. While past effort was concentrated near King Island and offshore from Stanley, recent seasons have seen greater spatial expansion, reflecting shifts in fishing effort and potentially changing stock dynamics.

Standardised CPUE for Pale Octopus across the TOF was 0.63 in 2023/24. This marks a continuous decline over the last four years (0.73 in 2022/23, 1.07 in 2021/22 and 1.56 in 2020/21). CPUE derived from the 50-pot sampling programme (data collected in addition to standard logbook data) also showed a decline from previous years, but similar values to the reference year (2004/05).

The utility of total catch and CPUE data for detecting changes in local Pale Octopus abundance in the TOF is limited. Pale Octopus are known to seek refuge in fishing pots for shelter and breeding likely representing multiple local populations. This creates a risk of “hyperstability”, where catch and CPUE figures remain high despite significant population declines. This challenge also affects the reliability of research data derived from the 50-pot sampling programme (outlined in 4.1.1).

To assess potential biomass depletion and estimate maximum sustainable yield (MSY) of Pale Octopus, we utilised a catch-only stock assessment approach (“CMSY”) developed for data-poor fisheries like the TOF. CMSY was run based on regional trends in catch and estimates of stock resilience or natural mortality. The results indicated that Pale Octopus biomass in traditionally fished areas offshore of Stanley and might be depleted below desirable levels (50% of biomass delivering MSY), which is a common target reference point in fisheries management. However, changes in fishing fleet dynamics may also be contributing to the drop in catch from these regions.

Understanding the movement of individual Pale Octopus is crucial for assessing the area impacted by pot fishing. Repeated sampling through the 50-pot sampling program, both in the same location and nearby areas, may help determine whether serial depletion of local populations is occurring and to what extent. However, assessing this requires some level of localized depletion to be observed.

To complement quantitative assessments of catches a risk assessment of recruitment impairment for the TOF was conducted and is included in the 2021/22 assessment (Fraser et al. 2022). The risk assessment approach used procedures established by the Marine Stewardship Council (MSC) based on CSIRO’s “Ecological risk assessment for the effects of fishing” (Hobday et al. 2011). The assessment identified the TOF as a high-risk fishery, failing the meet sustainability criteria in three assessment categories: (1) an energy-intense reproductive strategy (involving active brooding of a relatively few eggs (450 – 800);*Table 3*), (2) the high likelihood of capture, particularly of egg-brooding females seeking refuge in pots, and (3) a high associated risk of recruitment impairment. This assessment is presented in previous reports (Sharples et al. 2024; Fraser et al. 2022) and remain unchanged.

While broad-scale trends in catch and CPUE do not show immediate signs of stock depletion, the ecology of Pale Octopus and its interaction with fishing gear make this a high-risk fishery. The over 100,000-pot increase in the latest year, with only a minimal rise in catch, raises significant concerns about the fishery's status. Additionally, the increased fishing effort farther offshore from Flinders Island, likely driving up time and fuel costs, suggests that once-profitable fishing grounds closer to shore may be diminishing in their productivity.

Catch levels across the fishery have remained high for the past six seasons, with concentrated effort focused on a few small geographic areas. This intense and unrestricted fishing effort could continue, heightening the risk of stock depletion. Thus, the Pale Octopus stock in northern Tasmanian waters is classified as **Depleting**.

1.6 Pale Octopus – developmental fishery

There is a developmental fishery for Pale Octopus (caught under developmental permits) based on the South and East Coast of Tasmania in Tasmanian state waters and referred to as the Tasmanian Shelf stock. In the 2023/24 season, the total catch for this stock was 3.1 tonnes, with 27,837 pots deployed, resulting in an average catch rate of 0.11 kg per pot. This is lower than the TOF's average of 0.26 kg per pot during the same period.

Since the 2019/20 season, both catch and effort for this stock have remained consistently low. Prior to the issuance of developmental fishing permits in 2016/17, there was no commercial fishing for Pale Octopus outside of the TOF. Given the minimal catch and effort in this fishery, the exploitation of the stock remains low, and the Tasmanian Shelf Pale Octopus stock is classified as **Sustainable**.

1.7 Gloomy Octopus – TOF

Catch of Gloomy Octopus within the TOF was 2.0 t in the 2023/24 season. Less than a third that of the previous year (7.2 t). This is likely due to changes in spatial fishing effort. Catches have typically been close to zero unless substantial fishing activity occurs in the eastern Bass Strait around Flinders Island. In the 2022/23 season, 7.2 tonnes of Gloomy Octopus were recorded in TOF data, coinciding with high effort to the northeast of Flinders Island. In contrast, 2.0 tonnes were caught in 2023/24, with the effort shifting to a more northerly and westerly direction and possibly further offshore compared to the previous year. With further catch in this region, it will be interesting to monitor where Gloomy Octopus are being captured.

In the 2023/24 season, landings from the Rock Lobster fishery were identified to the species level for the third time, with 1.0 t of Gloomy Octopus recorded. However, the accuracy of species-level identifications in the Southern Rock Lobster fishery data is uncertain. Gloomy Octopus are found along the eastern Australian coastline, with northeast Tasmania considered to be at the southern end of the species' distribution (Edgar 2008). This species has been reported in TOF catches primarily around Flinders Island, and a small number of sightings have been reported through Redmap near St Helens and Bicheno, with a single sighting near Hobart (2022). In contrast to this known distribution, the Rock Lobster fishery returns data show Gloomy Octopus landings from the east, southeast, southwest, and west coasts, as well as around King Island.

The reproductive biology of Gloomy Octopus – producing relatively large numbers of planktonic larvae are produced from active benthic brooding (~278,500 eggs; *Table 3*) – suggests that this species may be more resilient to fishing pressure than Pale Octopus. This moderate resilience, coupled with minimal catch in recent years and over the duration of the fishery, supports classifying the Tasmanian Gloomy Octopus stock as **Sustainable**.

1.8 Māori Octopus – multiple fisheries

A total of 9.1 t of Māori Octopus was reported by Tasmanian commercial fishers in 2023/24. This comprised 4.9 t of by-product from the Southern Rock Lobster fishery, 1.4 t of by-product from the TOF, 1.5 t was taken by the Scalefish licence holders both as targeted catch at Eaglehawk Neck (1.3 t) and as by-product. This is the third year of recording octopus landings to species level for the Southern Rock Lobster fishery and it is uncertain whether species level identifications in the Southern Rock Lobster fishery returns were accurate. However, observer data suggests that the majority of octopus landed by this fishery are Māori Octopus, therefore this catch total is likely to be a close approximation of actual catch. The formerly productive Eaglehawk Bay fishery targeting Māori Octopus has not been fully operational since the ban of barrier nets in 2009, and thus did not contribute significant catch to recent records.

Rock Lobster and Scalefish fishing licences have a trip limit of 100 kg of retained octopus. In the Rock Lobster fishery, octopus are captured in crustacean traps where they prey on the target species, Southern Rock Lobster (Brock and Ward 2004). Unidentified octopus is a dominant by-product ‘species’ in the Rock Lobster fishery (León et al. 2020), (though identifying to species level has now been implemented) and additional unknown quantities of captured octopus are killed and discarded by rock lobster fishers to prevent future lobster depredation. Data presented here represent the retained, landed by-product only, rather than total fishing mortality.

Uncertainty about discard mortality in the Rock Lobster fishery challenges reliable estimates of total catch and sustainability for Māori Octopus. Unpublished IMAS data from video observation suggests selectivity of rock lobster gear for octopus may be low. Captured octopus will kill lobster in a pot thereby providing a strong incentive for lobster fishers to minimise octopus bycatch. For example, the time of day that pots are hauled is anecdotally considered a critical factor by lobster fishers.

The life-history of Māori Octopus suggests this species may be moderately resilient to fishing pressure, producing relatively high numbers of planktonic larvae from active benthic brooding (< 196,000 eggs; *Table 3*). Māori Octopus are found along the southern Australian coastline, including the whole Tasmanian coast. In a risk-assessment of common bycatch and by-product species in the Southern Rock Lobster fishery, using only productivity/life-history traits of a species and its susceptibility to capture without considering catch or population size, Māori Octopus return a low-risk ranking (León et al. 2020). Based on this evidence, the Tasmanian Māori Octopus stock is classified as **Sustainable**.

2 Introduction

2.1 History of octopus harvesting in Tasmania

2.1.1 Development of commercial octopus harvesting (Māori Octopus)

Pre-colonial seafood harvesting by Tasmanian Aboriginal communities primarily involved hand collection. However, historical reports of octopus catch during the pre-colonial or colonial era are not readily available, despite the likelihood that such catches occurred (Frijlink and Lyle (2013)).

The commercial rock lobster fishery in Tasmania has historically interacted with Māori Octopus populations. In the late 19th century, the expansion of rock lobster fishing led to concerns about sustainability as pots, which were legalised in the north of the state in 1903 and throughout Tasmania in the 1920s, proved more effective than rings. This effectiveness made lobsters in pots vulnerable to predation by Māori Octopus. While octopus were often caught as bycatch during this period, they were generally not retained until changing consumption patterns emerged after World War II, influenced by increased immigration from Mediterranean Europe.

Commercial landings of octopus from the lobster fishery are currently constrained by management regulations that impose a landing limit of 100 kg per trip. Annual recorded landings for the fleet typically fluctuate between 5 and 10 tonnes. Due to this trip limit, fishing mortality of Māori Octopus often exceeds the landed catch, as commercial lobster fishers tend to kill octopus instead of releasing them to mitigate depredation on lobster.

A targeted octopus fishery has operated in Eaglehawk Bay since the 1970s, primarily by one operator using a barrier net to trap octopus moving along the bay's southern side, with some hand collection also taking place. The fishery experienced a substantial decline in catch after the ban of barrier nets under this fishing permit in late 2009. Fisher reports to IMAS indicated that the decline in catch was further attributed to increased seal abundance in the bay, leading to significant assumed predation on octopus.

2.1.2 Development of commercial Pale Octopus harvesting

Targeted fishing for Pale Octopus has occurred since 1980 and operated under permit for many years. The targeted Pale Octopus fishery represents the focus of this report and is referred to officially by NRE Tas as the Tasmanian Octopus Fishery (TOF). Since 1996, under the Offshore Constitutional Settlement (OCS) with the Commonwealth of Australia, Tasmania has assumed management control of the TOF within state waters (up to 200 nm offshore and south of 39°12'S). Since December 2009, a specific octopus licence (fishing licence (octopus)) was required to participate in this fishery, which operates within Bass Strait, including waters to the east of Flinders Island.

The TOF primarily targets Pale Octopus using unbaited moulded plastic pots ('shelter 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*;*Table 2*). Octopus are attracted to these pots as refuges; pots are generally hauled after 3–6 weeks soak time. An abundant food supply in the vicinity of deployed pots may support a large population of octopus. When combined with a shortage of suitable shelters, this results in high catch rates. TOF geographic regions within the Bass Strait, as discussed in this report, can be seen in *Figure 1*.

From 2000/01 to 2005/06 catches of Pale Octopus in the TOF increased substantially and, up until the 2020/21 season, fluctuated around 80 tonnes, ranging from 55 t to 132 t. The 2020/21 season saw a significant increase in Pale Octopus catch, with a total of 154 t, representing the highest catch value in the history of the TOF. Catch from 2021/22 to 2023/24 have returned to just over 100 t.

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 licensed commercial fishing provided necessary research is undertaken. Four permits were issued in 2023/24 for octopus traps targeting Pale Octopus (but permitted to take Gloomy and Maori octopus) in Tasmanian state waters outside the area encompassed by the TOF. Specific areas of permitted use vary among permits but generally encompass waters south of 41° South. The Pale Octopus stock accessed under these permits is identified in this report as the Tasmanian Shelf stock. Each fishing permit is subject to specific limitations on the number and type of gear allowed in designated state waters.

Four developmental Permits were issued from 1 November 2023 – 31 October 2024. Two of the Permit Holders were authorised to use up to 4,000 unbaited shelter pots and fish between Eddystone Point and Whale Head. Two of the Permit Holders with a combined total of 3,000 pots did not fish during this period.

2.1.3 Commercial Gloomy Octopus harvesting

Gloomy Octopus are believed to be uncommon in Tasmania and recorded mainly around the northeast, which is assumed to represent the southern end of their geographic distribution (Edgar 2008), with any range extending sightings being monitored. The most recent and first species level records of octopus catches from the Rock Lobster fishery indicate that Gloomy Octopus might be distributed much more widely, however these species identifications are likely to be inaccurate. Gloomy Octopus are found on both reef and sediment habitat so may be taken by commercial operators in both the Rock Lobster fishery and the TOF. Based on observer observations, catch of Gloomy Octopus taken by the Rock Lobster fishery appears to be negligible. Gloomy Octopus has only been reported from the TOF since 2010/11.

Catches of Gloomy Octopus peaked at 18.6 t in 2017/18, which was unprecedented and thus interpreted as evidence of range expansion (Ramos et al. 2014; Ramos et al. 2015). However, the annual trends in Gloomy Octopus catch can more accurately be attributed to targeted fishing efforts in eastern Bass Strait. Following the westward shift of TOF effort after the 2017/18 season, Gloomy Octopus catches returned to previously low levels. In the 2022/23 season, as effort returned to eastern Bass Strait, Gloomy Octopus catch within the TOF increased to 7.1 t. However, in 2023/24, the Gloomy Octopus catch decreased to 2.2 t, with effort directed more towards the northern and western areas of Flinders Island. In the

2021/22 season, octopus landings from the Rock Lobster fishery were identified to species level for the first time, recording 1.6 t of Gloomy Octopus. This was followed by a report of 1.0 t of Gloomy Octopus from the Rock Lobster fishery in 2023/24.

Table 1: Summary of the management and reporting changes for octopus fishing in Tasmania.

Date	**Management changes**
1903	Legislation banning the use of rock lobster pots overturned, which enabled increased retention of Māori Octopus
1980-90s	Various modifications made to licencing that affected retention of octopus bycatch including access provided to holders of a personal fishing licence, a vessel licence, and a scalefish (or rock lobster) licence. Trip limit of 100 kg applied which limited by-product from lobster pots of Māori Octopus.
2000/01	Commercial fishing for Pale Octopus and other minor species approved under permit using unbaited pots in Bass Strait (TOF).
December 2009-ongoing	Two licences issued for the operation of two vessels (sole operator) using unbaited octopus pots (TOF).
2004/2005	50-pot sampling programme implemented in the TOF Pale Octopus fishery.
2016/2017	Two developmental permits issued (no reportable catches) for east coast Pale Octopus fishery.
2017/2018	Two developmental permits issued (reportable catches) for east coast Pale Octopus fishery.
2019/2020	Two developmental permits issued (reportable catches) for east coast Pale Octopus fishery.
2020/2021	Three developmental permits issued (reportable catches) for east coast Pale Octopus fishery.
2021/2022	Four developmental permits issued (three with reportable catches) for east coast Pale Octopus fishery.
2022/2023	Four developmental permits issued (three with reportable catches) for east coast Pale Octopus fishery.
2023/2024	Four developmental permits issued (two with reportable catches) for east coast Pale Octopus fishery.

Table 2: Summary of the current management systems for octopus fishing in Tasmania.

Fishery characteristics	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).
Octopus licences	Two licences issued for the operation of two vessels.
Management methods	Input control: Fishing licence (octopus) allows the use of 10,000 pots (maximum of 1,000 pots per line) to target Pale Octopus, Gloomy Octopus, and Māori Octopus. Fishing zone restriction for fishing licence (octopus): East and West Bass Strait Octopus zones only.
Main market	Tasmania and mainland Australia
Active vessels	5 targeting octopus with unbaited pots (2 operating the licences and one permit; 3 operating permits only); additional ~ 200 vessels taking small tonnage (<15 tonnes total) of by-product, mainly Māori Octopus.

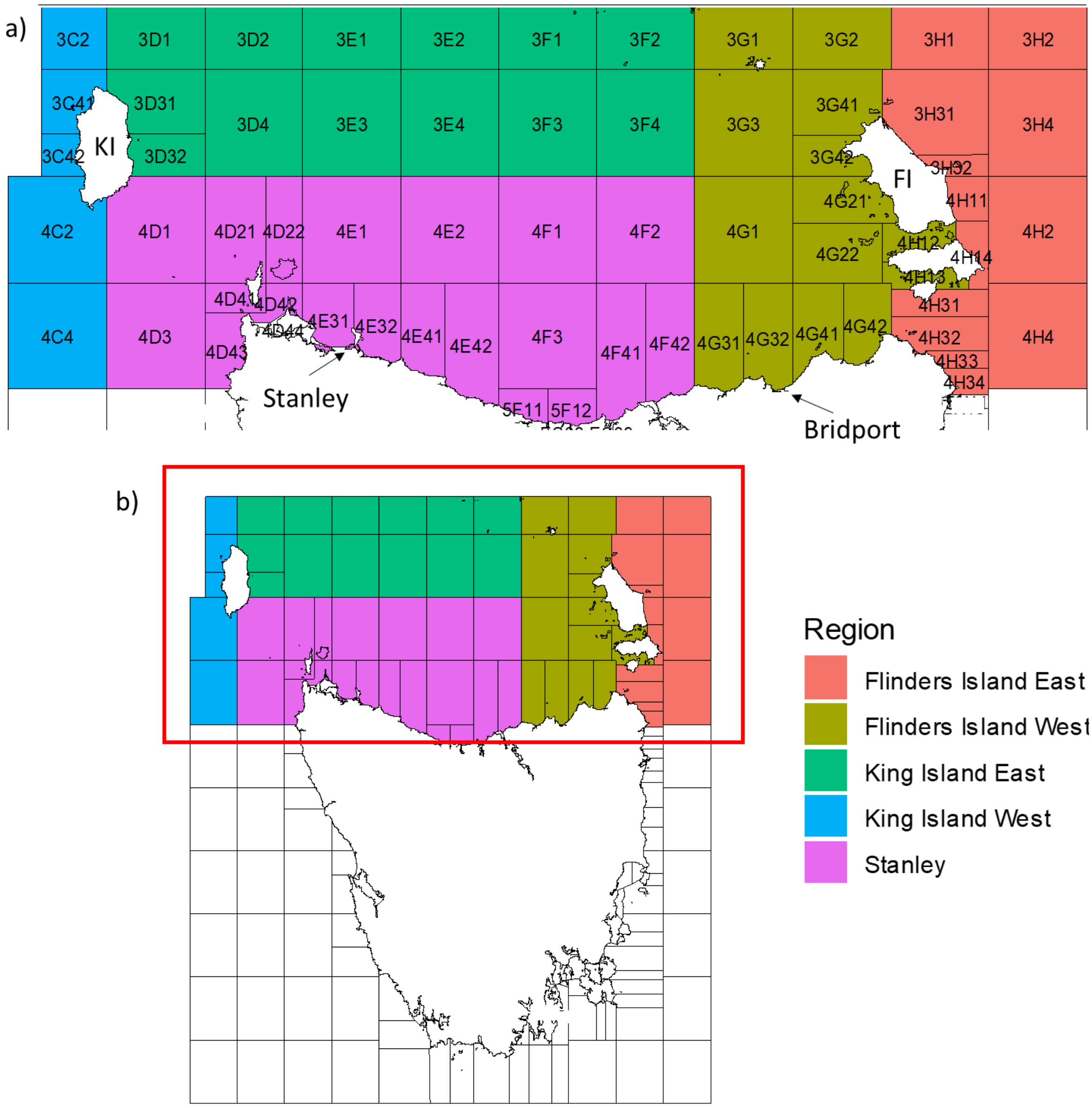

Figure 1: Map of fishing blocks in Tasmania highlighting the Bass Strait target area for Pale Octopus within the TOF, including the 50-pot sampling regions: a) fishing blocks within regions – the TOF reports in latitude and longitude but for the purpose of this report, fishing areas are reported in fishing blocks. Note: no catch or effort data were recorded for the King Island West region during the time series assessed here.

2.2 Species Biology

Table 3: 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	 (Illustration © R.Swainston/anima.fish)	 (Illustration © R.Swainston/anima.fish)	 (Illustration © R.Swainston/anima.fish)	
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 northeast 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: $W = 3.385\left(1 - e^{-0.07642t}\right)^3$ 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. ● Females 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.	

3 Methods

3.1 Data sources

3.1.1 Pale Octopus commercial data from the TOF

Commercial catch and effort data used in the main component of this assessment are based on Pale Octopus landings recorded in TOF Commercial Catch, Effort & Disposal Record logbook returns. TOF fishing records comprise individual demersal unbaited trap longline lifts, with catches per line reported as weight, and effort per line reported as the number of unbaited pots (i.e., 'pot-lifts').

Since November 2004, a 50-pot sampling programme has been conducted within the TOF, 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. Data from the 50-pot sampling programme are separated into geographic regions, as indicated in *Figure 1*.

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).

In the 2023/24 season, commercial data for Pale Octopus also exist for the developmental permits for the east coast of Tasmania. This fishing is outside of the normal TOF operations analysed here; hence it has not been included in the above analysis and has been summarised separately below (**Error! Reference source not found.**).

3.1.2 Māori and Gloomy Octopus commercial data

To assess the status of Māori and Gloomy Octopus we used commercial catch data from the Scalefish and Rock Lobster fishery logbook returns, as well as records of these species in the TOF logbook returns, which include data from the developmental permits. Octopus catch in the Eaglehawk Bay are recorded in the Scalefish logbook returns.

3.2 Data analysis

3.2.1 TOF Pale Octopus Fishery

3.2.2 Catch, Effort, and CPUE

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

(*Figure 1*). For this assessment, catch, effort and CPUE analyses were restricted to commercial catches of Pale Octopus for the period from the start of March 2000 to the end of February 2024.

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

$$\textit{Whole weight} = 1.23 * \textit{Gutted weight}$$

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 (pot-lifts) 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 et al. 2017), where no relationship between soak time and CPUE was apparent. Therefore, soak time was not considered in the resultant catch standardisation process.

The difference in numbers of female and male Pale Octopus in the 50-pot sampling data over the timeseries was assessed using a two-way ANOVA (number of octopus ~ sex + licensing year).

CPUE of Pale Octopus has 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 (Kimura 1981; Kimura 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 are currently two licences issued in the TOF; these permit up to 10,000 pot lifts each. The licences are held by the same family and have two vessels, with the vessels cooperating, with the vessel pulling the gear not necessarily being the same vessel that set it. Consequently, vessel and skipper were not included in the GLM. The depth at which the gear is set is variable; however, the inclusion of the term Depth in the GLM did not significantly explain variation in CPUE ($p > 0.05$), and this term was excluded from the final model. Catch and effort data for many fishing blocks across multiple years were absent or insufficient for testing the interaction between Licensing Year and Fishing Block (i.e., for testing whether CPUE distribution among fishing blocks varied among licensing years), and this interaction term was excluded from the final model. Factors considered in the final GLM were year, month, and block. A lack of spatial block data for multiple trips early in the time series led to 229 t of catch data (11.3% of total catch over the time series) 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. An additional GLM was applied to a subset of CPUE data from the Stanley region (see 50-pot sampling regions in *Figure 1*), and a subset of CPUE data from only the 2023/24 licensing year. Catch and effort data from all other regions within the TOF did not meet the model assumptions of homogenous and normal distribution of residuals, therefore this analysis was not run for other regions.

3.2.3 Catch-only approach

In addition to analysing temporal and spatial trends in catch and effort data, we utilised a "catch-only" approach to estimate the status of the Tasmanian Pale Octopus stock – "CMSY" (Martell and Froese 2013; Froese et al. 2017). CMSY has been consistently applied to data from multiple commercial stocks within Australia (Haddon et al. 2019; Piddocke et al. 2021), including the Tasmanian Pale Octopus stock for the 2020/21 to 2022/23 Tasmanian Octopus Assessment (Fraser et al. 2022; Sharples et al. 2024; Fraser et al. 2022). CMSY can be used to estimate stock depletion and the maximum sustainable yield (MSY) from trends in catch data and was implemented for the TOF using the R package "datalimited2" (Free 2018).

CMSY is a model-assisted stock assessment approach suitable for data-poor conditions. The approach relies on the Schaefer production model, which assumes that the biomass delivering MSY is equal to 50% of the unfished biomass and uses a Monte-Carlo based form of stock reduction analysis to estimate management reference points according to the assumed resilience of the target species and a time series of catch records. In the absence of empirical data on intrinsic population growth rates (r) but considering both a short life span (up to 1.5 years) and reproductive behaviour (active brooding of a relatively small number of eggs (~450 – 800); *Table 3*), the CMSY approach was run by assuming that the resilience of Pale Octopus is likely to be "medium" (r = 0.2 – 0.8). In agreement with the precautionary principle, confidence intervals of CMSY outputs are generally taken into account when making management decisions.

CMSY simulations were run based on regional subsets of the TOF data, which represented those chosen for the 50-pot sampling programme (*Figure 1*). However, some regions could not be meaningfully analysed given that they have not been consistently fished in the past.

3.2.4 Reference Points

During the decade from 2004/05 to 2013/14 (the reference period for the TOF), fishing activity was concentrated in the eastern Bass Strait around Flinders Island and in fishing blocks close to Stanley (*Appendix A*). Total catch for the fishery fluctuated around approximately 75 – 100 t per year (*Figure 6***Error! Reference source not found.**) and effort fluctuated around approximately 250,000 to 350,000 pot-lifts per year (*Figure 6***Error! Reference source not found.**).

Stock assessment methods previously used for the fishery relied on the assumption of 'negligible shifts in the distribution of fishing effort.' However, in the Tasmanian Octopus Fishery (TOF), there has recently been notable and ongoing changes in fishing effort, which may have affected the model's assumptions and, consequently, the representative nature of the results. The stock assessment considers catch, effort, and trends in CPUE and distribution. It is important to note that, due to hyperstability, any observed changes in CPUE are likely to reflect more significant changes in stock abundance than would normally be expected. "Changes in stock" here refers primarily to changes in abundance, as hyperstability can mask the true state of the population.

Following the 2019/20 assessment of the TOF Pale Octopus stock as Depleting, fishery stakeholders initiated a meeting among representatives of the Institute for Marine and Antarctic Studies (IMAS), the Department of Natural Resources and Environment Tasmania (NRE Tas), and the Tasmanian Seafood Industry Council (TSIC). During the meeting, IMAS presented stock assessment outcomes for the 2019/20 season for extended subsequent discussion. The meeting concluded with the aim to establish potential reference points for future management of effort in all different regions currently monitored in the context of the 50-pot sampling programme (*Figure 1*). Reference points for sustainable effort, rather than catch, were considered desirable in terms of both practical implementation as well as fishery impact.

3.2.5 Māori and Gloomy Octopus – multiple fisheries

Landed by-product catch of all octopus species from the Scalefish and Rock Lobster logbook returns were assessed spatially and temporally, across fishing blocks and available time series. For Māori and Gloomy Octopus, these catches also included retained by-product recorded for the TOF. Effort and CPUE data were not included in these assessments because they are unlikely to be informative for by-product species, and because of the high uncertainty about underreported catches and discard mortality of the main species (Māori Octopus). Observer sampling has suggested that octopus catch from the Scalefish, and Rock Lobster fisheries is almost entirely Māori Octopus. In cases where landed octopus were not recorded to species level, we therefore made the simplistic but realistic assumption that these are primarily Māori Octopus. However, for transparency, data with no species name have been assessed and presented here as 'Octopus, unidentified'. Octopus landings from the Rock Lobster fishery were first reported at species level in 2021/2022. It is uncertain whether species identifications were accurate, however data has been presented as reported.

3.3 Assessment of stock status

3.3.1 Stock status definitions

To assess the status of Octopus in a manner consistent with the national approach (and other jurisdictions), we adopted the national stock status categories used in the 2020 Status of Australian Fish Stock (SAFS) report (*Table 4*) (Piddocke et al. 2021). 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. Determination of stock status into the below categories (*Table 4*) was based on temporal and spatial trends in commercial catch, effort and standardised CPUE data from the TOF, as well as catch-only simulations and the MSC risk assessment of recruitment impairment. Fisheries are ideally also managed towards targets that maximise benefits from harvesting, such as economic yield or provision of food. While the SAFS scheme does not attempt to assess the fishery against any target reference points, this report uses catch-only simulation results to assess fishery performance (*i.e.,* predicted biomass depletion) against levels expected to support the maximum sustainable yield (B_{MSY}, which is a common target reference point), thereby supporting future management objectives.

Table 4: 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.

4 Results

4.1 Tasmanian Octopus Fishery (TOF) For Pale Octopus

4.1.1 50-Pot Sampling Programme

The details of the sampling programme require fishers to record the number of pots sampled, number of pots with eggs and the number of females and males sampled. The samples must be taken from:

- at least one line per distinct area fished during each fishing trip;
- at least 50 pots per line — unless operating under the authority of a permit and the number of pots to be sampled specified on the permit is less than 50 pots and
- the first 50 consecutive pots of each line sampled — or the number specified on the permit.

The amount of sampling conducted across the TOF in different years is illustrated in *Figure 2*. In the 2023/24 season, 4,160 pots were sampled representing 1.0% of the 415,637 pots set in the fishery.

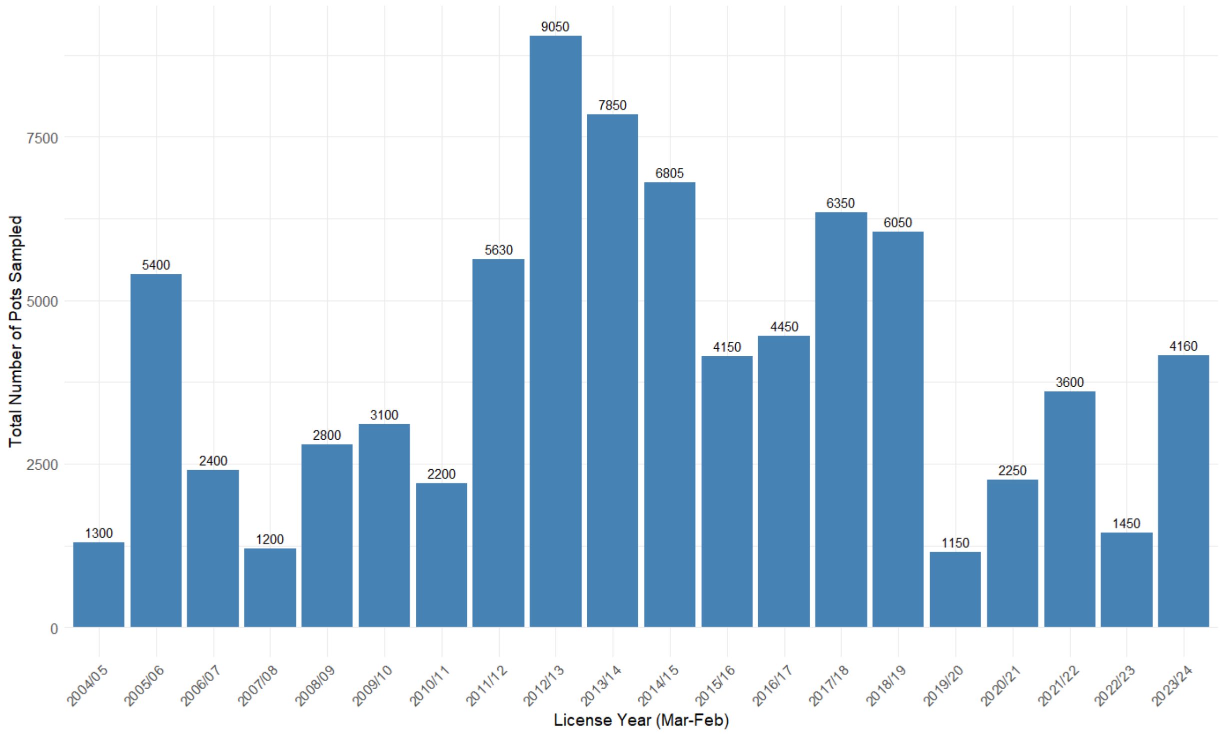

Figure 2: Number of pots sampled per year in the 50-pot sampling programme.

4.1.2 Influence of soak time

As per the 2015/16 report (Emery et al. 2017), an analysis of the 50-pot sample data 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.

4.1.3 Sex ratio

No significant difference in the ratio of female to male Pale Octopus (p > 0.5), based on raw abundance data from the 50-pot sampling programme, was observed on a licensing year basis from the start of the programme (2004/05) to 2023/24. (*Figure 3***Error! Reference source not found.**).

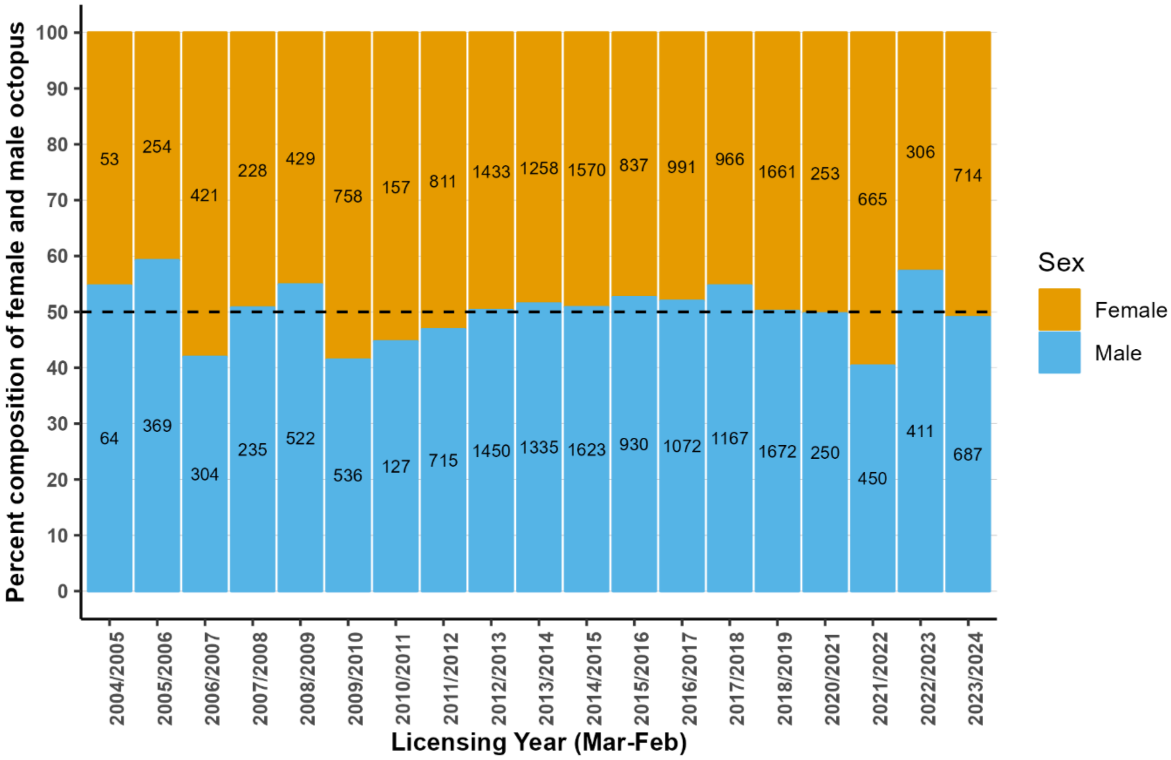

Figure 3: Ratio of female to male octopus from 50-pot samples, represented by percent composition of each sex from total number of 50-pot sample octopus in each licensing year. Printed on each bar is the total number of sampled octopus of each sex for the licensing year. Note that 50-pot sampling data were not provided for 2019/20.

4.1.4 Egg count data

The number of pots containing eggs was recorded in the 50-pot sampling program. Below, we present the annual and seasonal proportions of pots containing females with and without eggs (*Figure 4*,*Figure 5*).

- **Annual Proportions:** The proportion of females brooding eggs from the total number of females sampled fluctuated around 25% across the licensing years, with no significant variation detected (p > 0.5) (*Figure 4*).
- **Seasonal Variations:** Seasonal analysis revealed that the proportion of females brooding eggs shows a marked increase in spring, particularly in October, where it reaches approximately 35%. Conversely, the lowest proportions of brooding females were observed between January and April, remaining below 25% (*Figure 5*).

Further analysis of the data was conducted regionally and with more specific sampling years. However, no significant trends emerged due to low sample sizes and a high degree of variation.

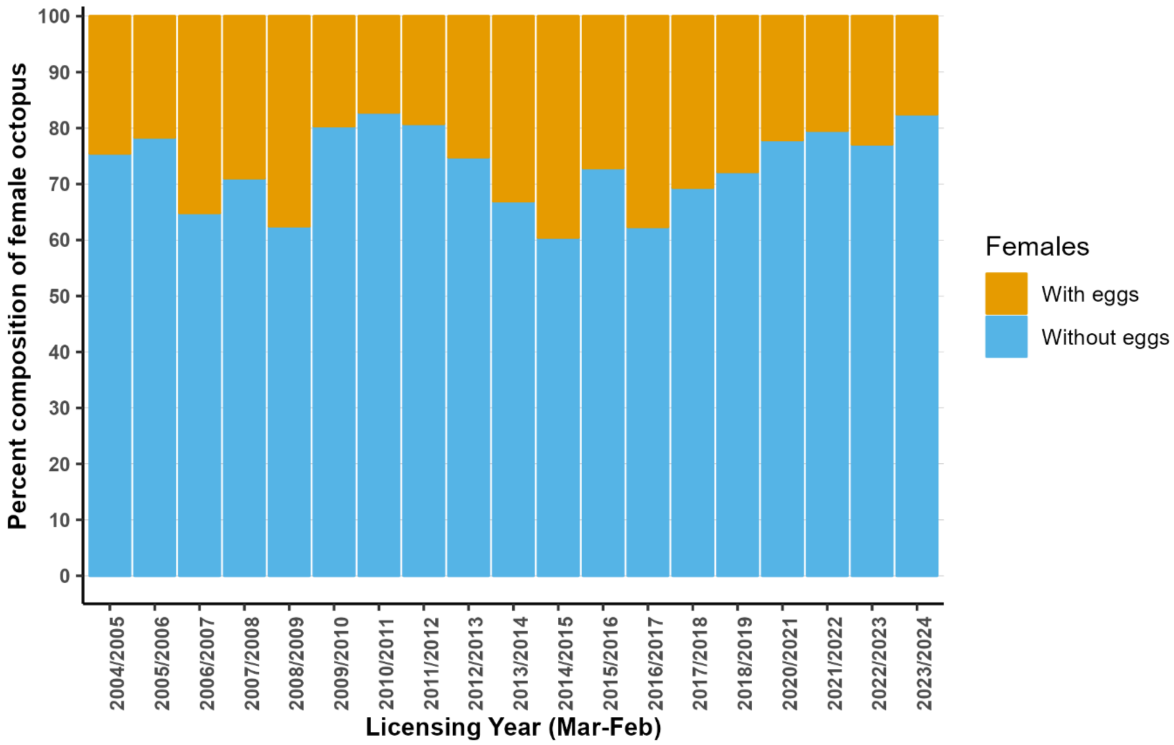

Figure 4: Percent of female octopus from 50-pot sampling with and without eggs sampled in each licensing year. ***Error! Reference source not found.***

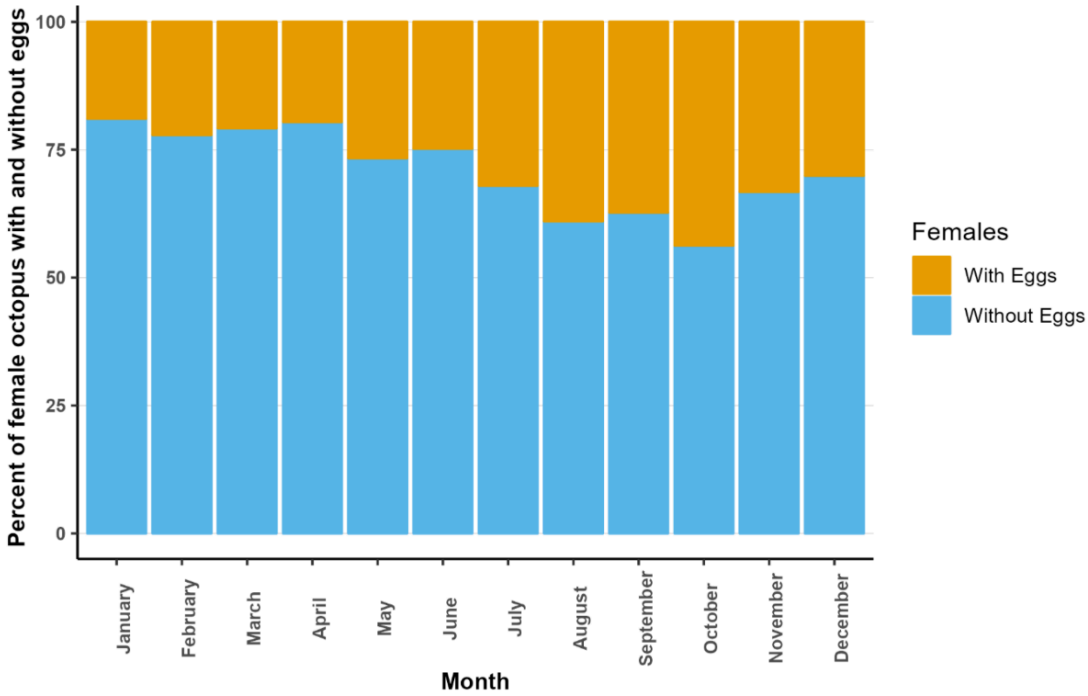

Figure 5: Seasonal ratio of female octopus from 50-pot sampling with and without eggs, represented by percent composition of number with eggs from total number of females sampled in each month across all regions. ***Error! Reference source not found.***

4.1.5 Catch and effort

The total catch of Pale Octopus in the TOF in 2023/24 was 111 t (*Figure 6***Error! Reference source not found.**). This year's catch represents a decline from the historical peak of 154 t in 2020/21. There have now been six consecutive years with TOF catches greater than 100 t. Catches in the fishery have varied between ~60 t and ~130 t since 2003/04.

Catches of Pale Octopus within the TOF exhibit significant seasonal fluctuations (see *Figure 6*). Historically, autumn has been peak season for catches in most years. However, over the last two years peak catches have occurred in winter, accounting for 34.3% of the total catch in the 2023/24 season (*Figure 7*). This was followed by autumn and spring, which contributed 24.2% and 24.1% of the total catch, respectively. In contrast, summer yielded the lowest catch percentage at 16.9%.

Total fishing effort from the TOF in 2023/24 reached 415,637 pot-lifts, reflecting an increase of over 100,000 compared to the 2022/23 total effort of 314,708 pot-lifts (*Figure 6*). Notably, the effort in 2023/24 is higher than in the year when historical catch peaked in 2020/21, although the catch in 2023/24 is significantly lower than that peak year. Seasonal effort is highest in winter (29.1%), followed by summer (26.7%), spring (22.3%), and autumn (21.8%) (*Figure 8*).

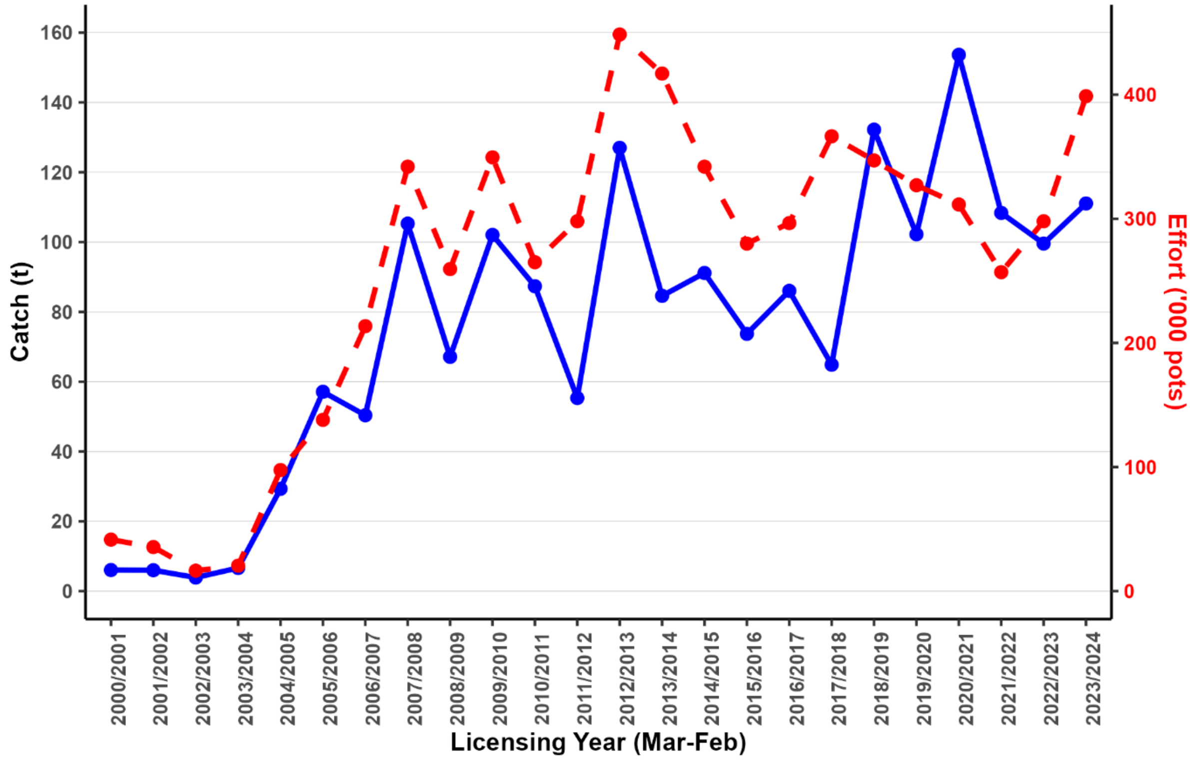

Figure 6: Total catch and effort in the TOF since 2000/01. The blue line represents the total catch weight in tonnes (t) for each licensing year (displayed on the x-axis (right). The red dashed line represents fishing effort, measured in thousands of pots, these values are displayed on the secondary y-axis (right side).

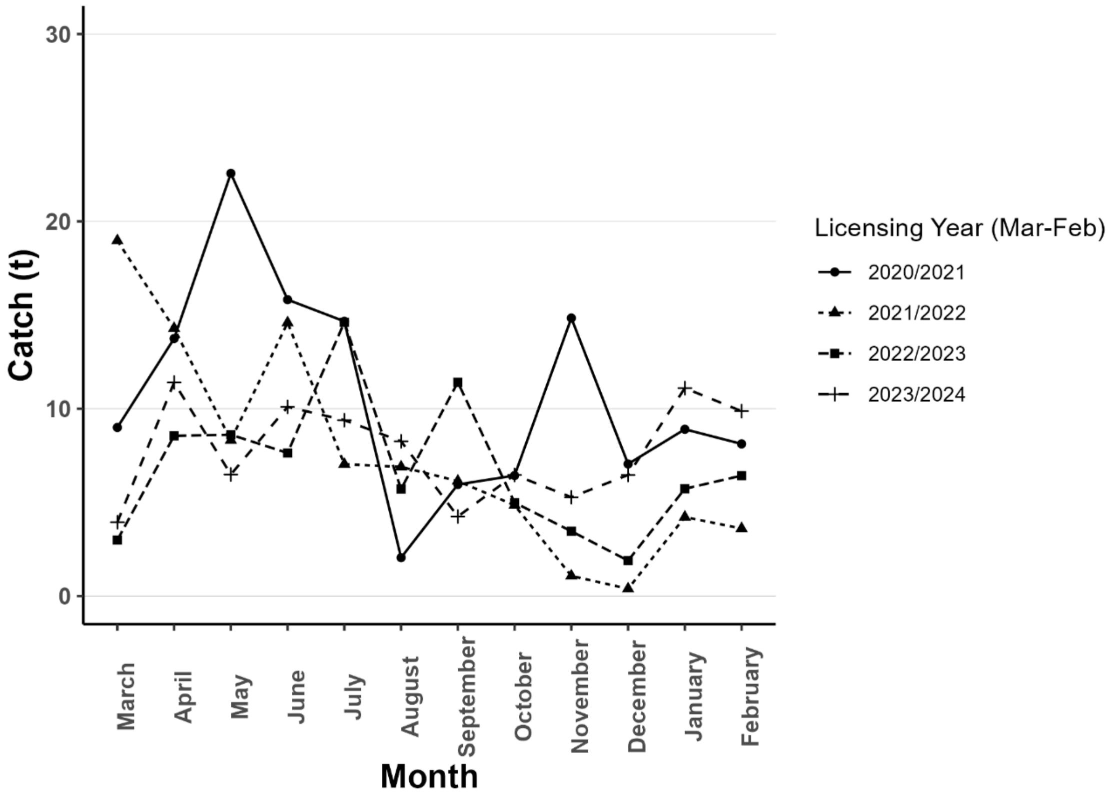

Figure 7: Seasonal catch (tonnes) of Pale Octopus landed in the TOF over the last four licencing years

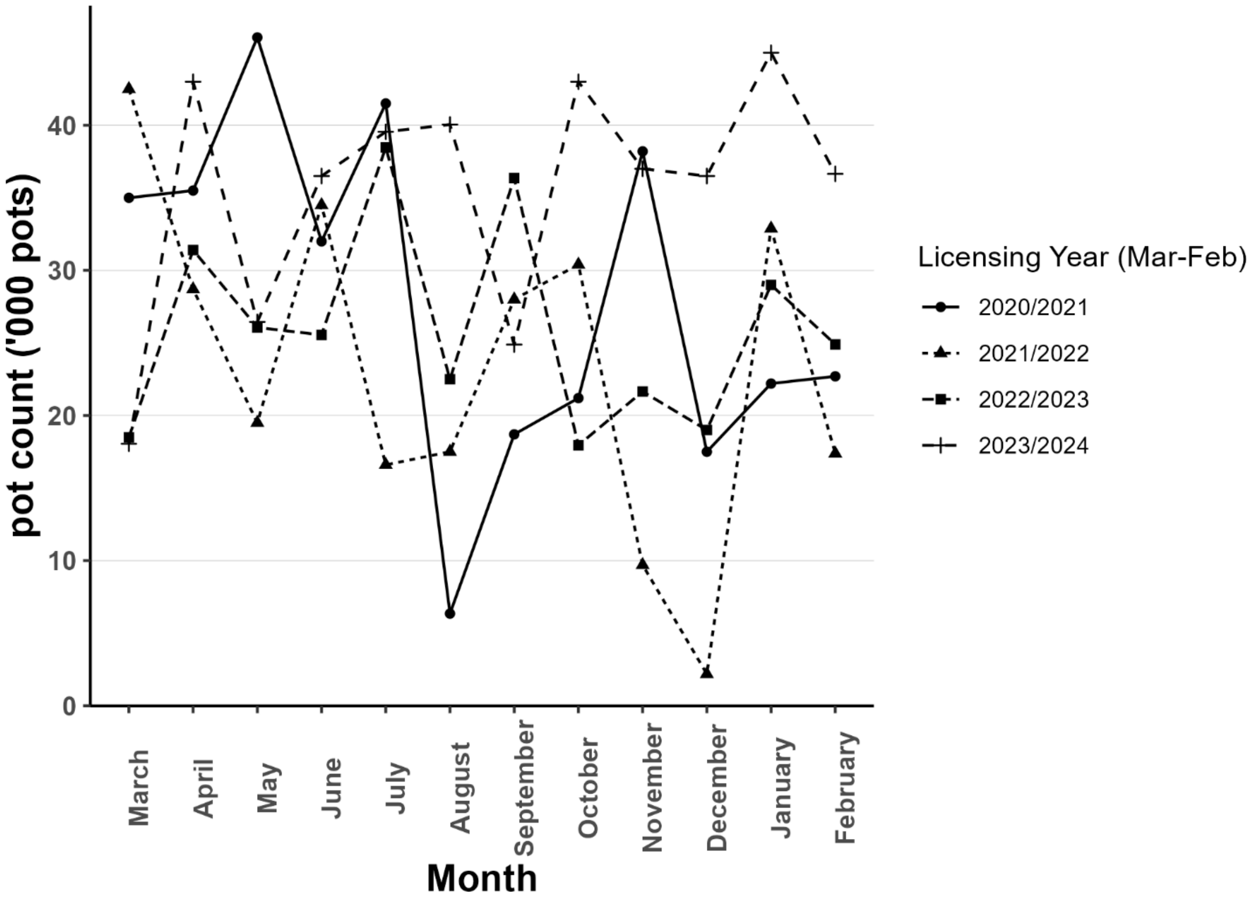

Figure 8: Seasonal Effort of Pale Octopus landed in the TOF over the last four licencing years.

4.1.6 Catch per unit effort (CPUE)

The final Generalised Linear Models (GLM) used to test variation in both commercial catch per unit effort (CPUE) and CPUE from the 50-pot sampling programme included the terms CPUE ~ Licensing Year + Month + Fishing Block. Standardised CPUE varied significantly among licensing years and months, with less significant variation among fishing blocks (see *Appendix B* for model coefficients).

The licensing year 2004/05 was chosen as a reference year for CPUE, in correspondence with the commencement of the 50-pot sampling programme. Historical trends indicate that standardised CPUE for the total commercial catch from logbooks can fluctuate annually, with a higher CPUE year generally followed by a lower CPUE year. From 2011/12 to 2017/18 these fluctuations were minor, with CPUE remaining close to 60% of the reference year. From 2018/19 to 2023/2024, these annual fluctuations continued to occur, however CPUE was generally higher and interannual differences were greater. In 2018/19, a notable increase in CPUE occurred, reaching 92% of the reference year. This was followed by a decline in 2019/20 to 72%, a record peak of 132% in 2020/21, 107% in 2021/22 and a decline to below the reference year in the last two seasons, 2022/23 and 2023/24. Estimates of CPUE from the 50-pot sampling have followed a trend similar to the logbook data, reaching 86% of the reference year in 2023/24.

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 and Boletzky 1996; Rodhouse et al. 2014). Notably, the fishery is removing brooding females, which use fishing pots as shelters to deposit their eggs. As Pale Octopus is a holobenthic species (*i.e.*, they produce egg batches in the hundreds with benthic hatchlings) there is limited dispersal and the stock is presumably highly structured (Doubleday et al. 2008). Genetic studies corroborate this assumption, identifying at least two differentiated sub-populations of Pale Octopus across the northern Tasmanian coast, which suggests limited movements of benthic hatchlings and adults (Higgins et al. 2013) and a high associated potential for localised depletion if fishing effort becomes concentrated. An ongoing FRDC project (2019-031), which focuses primarily on the Victorian fishery but includes Tasmanian samples, aims to further investigate population structure. The outcomes of this study will help determine the appropriate spatial scale for management and provide critical input to mitigate risks associated with localised depletion.

In 2023/24, as with previous assessments, CPUE peaked in autumn (*Figure 10, Figure 11*). While seasonal CPUE estimates from earlier assessment periods indicate a decline in late winter, before stabilising at around 75% of March levels from August to February (*Figure 10)*, the 2023/24 data show an increase in CPUE from March to May, followed by a decline in July and August, and a continued drop through to February. (*Figure 11*). Seasonal trends in CPUE from the 50-pot sampling programme have generally mirrored logbook data across previous assessments (*Figure 10*). However, for 2023/24, 50-pot CPUE is notably lower than overall fishery CPUE, except during November and December (*Figure 11*). This implies that more octopus are being caught at this time, but their total weight is lower, indicating a higher proportion of smaller individuals in the catch.

The ability to use CPUE based on total commercial catch data to detect declines in local abundance is limited by spatial shifts in fishing effort. Given that octopus are known to actively seek pots for breeding and are likely to be targeted most effectively at breeding aggregation sites, there is also a significant risk of "hyperstability" in this fishery. This means CPUE may remain high despite declines in population size. While research pot sampling data provide an important source of information to assess CPUE trends alongside logbook derived CPUE data, the same limitations apply to these data too.

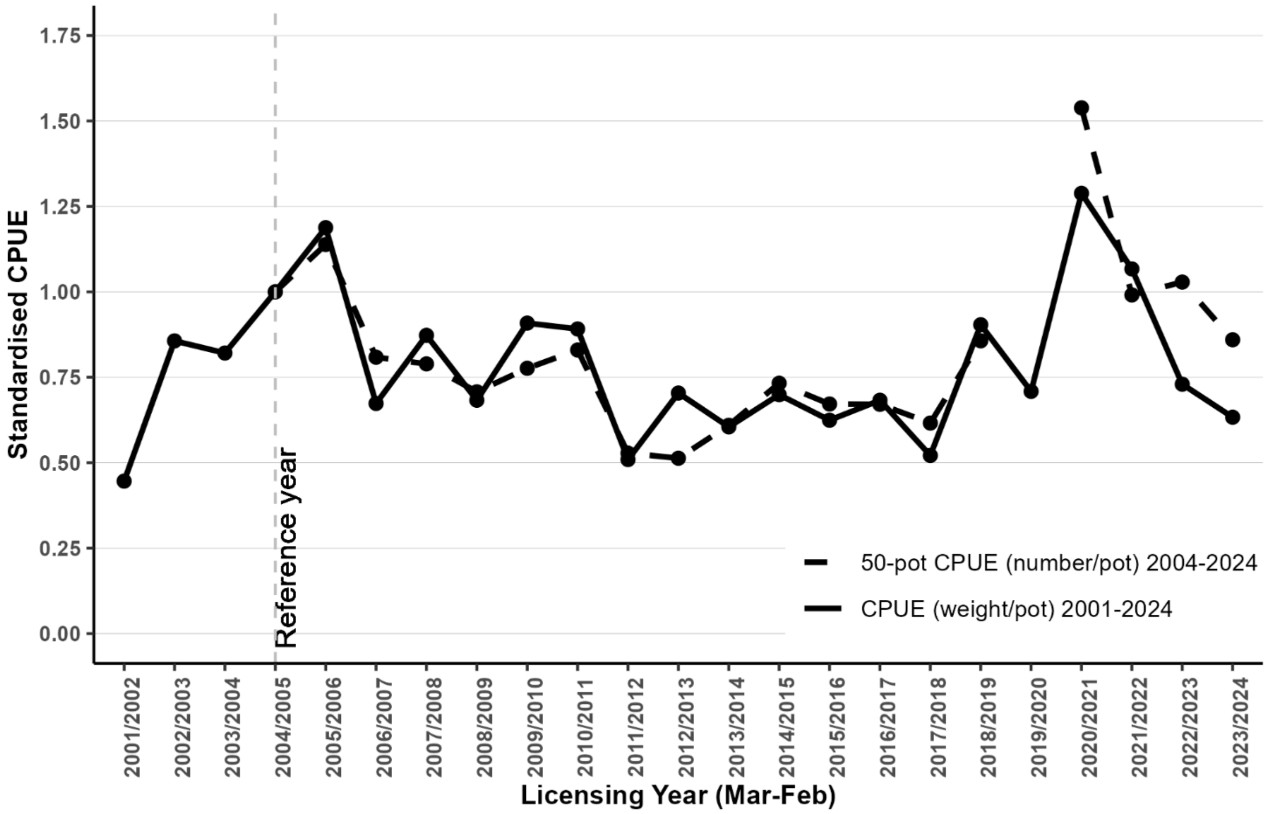

*Figure 9: Pale Octopus standardised annual catch per unit effort (CPUE) for the TOF from 2001/02 to 2023/24. * 2019/20 data were not provided.*

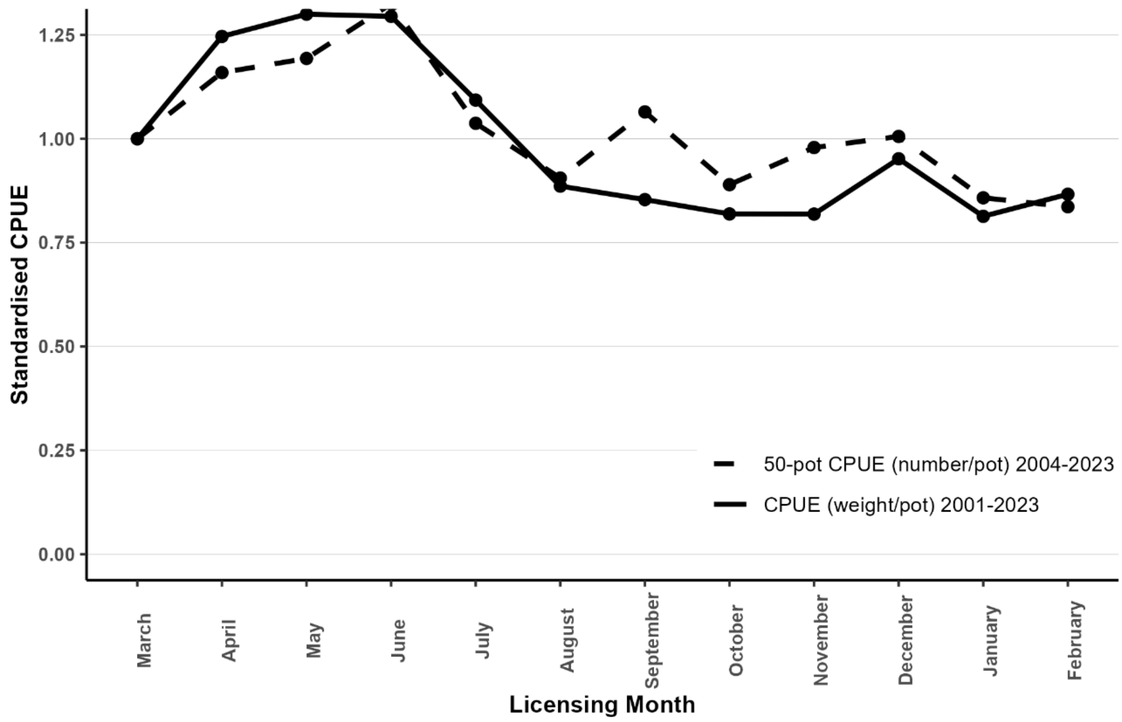

Figure 10: Pale Octopus seasonal trend in standardised catch per unit effort (CPUE) for the TOF relative to March levels in weight per pot (total commercial) and in number per pot (50-pot sampling).

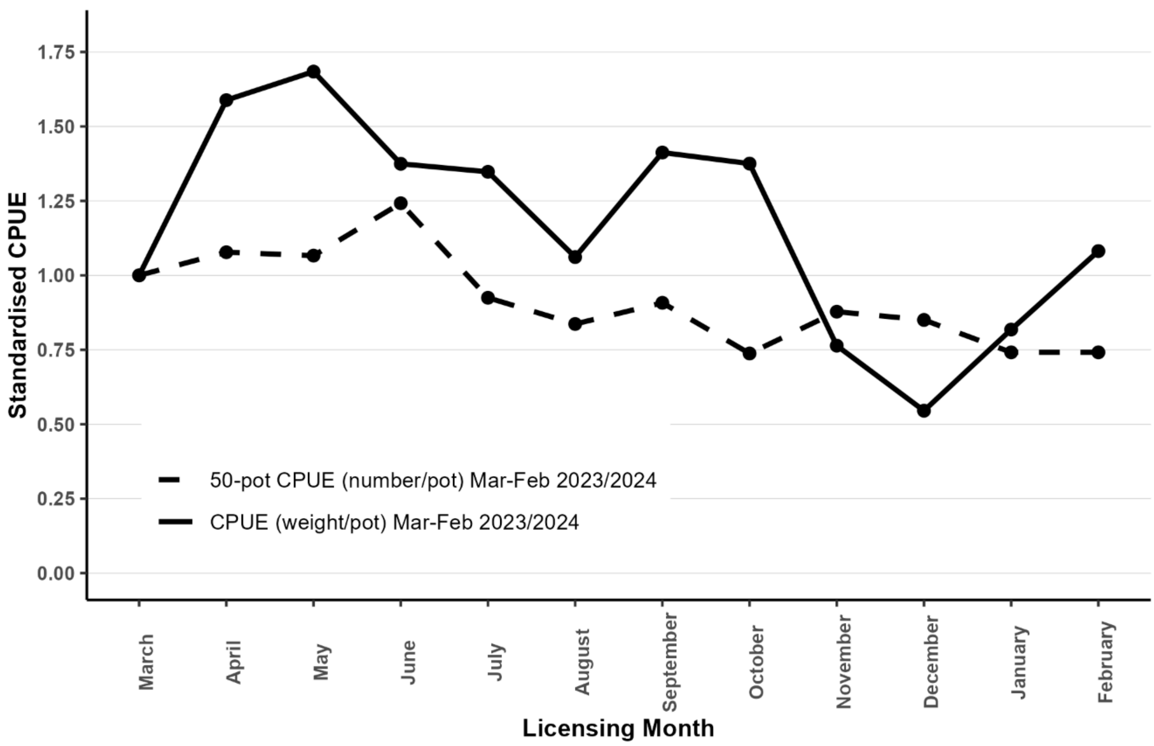

Figure 11: Pale Octopus seasonal trend in standardised catch per unit effort (CPUE) for the TOF relative to March levels in weight per pot (total commercial) and in number per pot (50-pot sampling) for the licencing year 2023/2024.

4.1.7 Local patterns in Pale Octopus catch, effort, and CPUE from the TOF

4.1.8 Spatial distribution over time

The distribution of catch, effort, and CPUE from the TOF in 2023/24 are presented in *Figure 12* alongside the previous four years. Additionally, all fishing years are presented in *Appendix A*. Mapping the fishery over time shows that the concentration of higher catch, effort and CPUE has shifted from the traditionally fished dominant ground in western Bass Straight around King Island to the north and east of Flinders Island. Catch has dropped notably to the east of King Island and offshore of Stanley, while the usage of the area to the north of Flinders Island appears to be a relatively new, particularly the blocks furthest offshore. (blocks 3H1 and 3G2; see *Figure 1* for block numbers).

4.1.9 2023/24 spatial distribution

In the 2023/24 season, the highest fishing effort was concentrated in blocks located to the north, northwest, and east of Flinders Island. Secondary concentrations were observed in one fishing block offshore of Stanley and another east of King Island (block 3D4; see *Figure 1* for block numbers). This pattern of effort and catch north of Flinders Island shares some similarities with the previous year (2022/23), although the focus was more toward the northeast of Flinders Island. In contrast, the previous three licensing years (2019/20, 2020/21, and 2021/22) saw a concentration of effort and catch primarily east of King Island and offshore from Stanley (*Figure 12*).

Such a shift and localized concentration of effort and catch may indicate low productivity in other areas, raising sustainability concerns for the longer term. However, with only two vessels in operation, fleet behaviour is likely influenced by individual decisions that may not be directly related to catch rates.

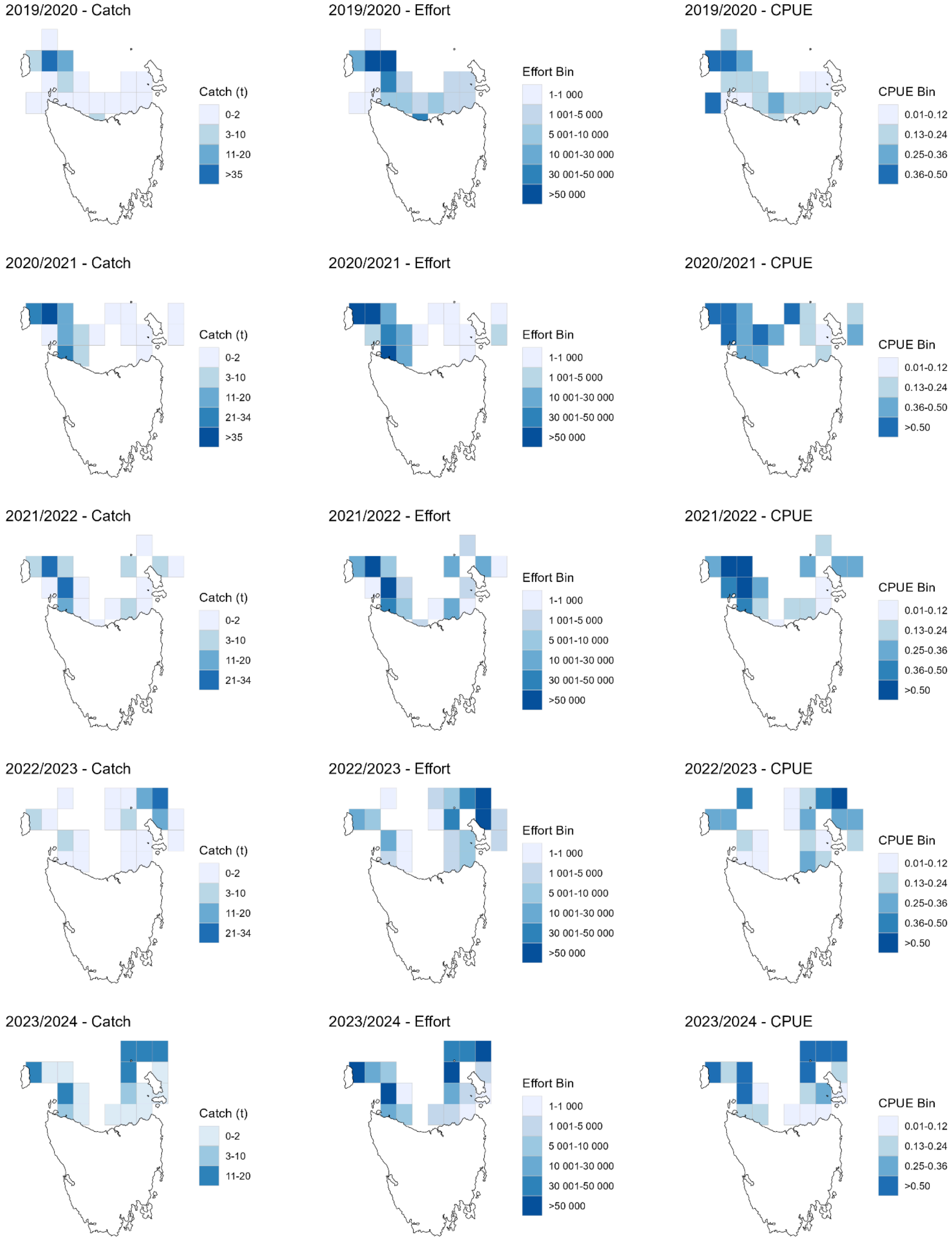

Figure 12: Tasmanian Octopus Fishery catch, effort (pot-lifts), and nominal CPUE presented for the last 5 years. See Appendix A for all years.

4.2 Pale Octopus regional results – TOF

Catch and effort

Each regions catch and effort is presented to illustrate regional trends in the Tasmanian Octopus Fishery (TOF) for each region from the licensing year 2000/01 onward. The blue line represents the total catch weight, measured in tonnes (t), and is plotted against the primary y-axis on the left. The red dashed line shows the fishing effort, which is quantified by the number of pots (in thousands), and is associated with the secondary y-axis on the right side of the figure.

This dual-axis approach allows for a direct comparison between the volume of octopus harvested (catch) and the intensity of fishing activity (effort) over time. The x-axis lists each licensing year, enabling a clear view of how both catch and effort have varied from year to year. The blue and red lines demonstrate how fishing pressure and harvest levels interact, helping to identify trends, such as whether increases in effort result in proportional increases in catch, or if other factors may be affecting the fishery.

CMSY

Figures of estimated B/BMSY show the trend in estimated depletion for the Pale Octopus stock, where depletion is measured as the ratio of biomass to the biomass required to deliver maximum sustainable yield (B/BMSY). The trend includes 95% confidence intervals to reflect the uncertainty around the estimates. The model assumes a "medium" resilience for the species, which affects how quickly the population can recover from depletion.

The green line represents the biomass level needed to achieve MSY, which is 50% of the unfished biomass level. This is considered the target level for sustainable fishing. The red line marks a potential limit reference point, which corresponds to 50% of the biomass required to deliver MSY, or 25% of the unfished biomass level. Falling below this line would be a sign of serious depletion, potentially requiring management intervention to avoid overfishing.

These figures provide insights into how the stock biomass has fluctuated over time relative to sustainable levels, offering a key indicator of stock health to inform fisheries management decisions.

Figures showing MSY are used to depict the trends in catch for the Pale Octopus stock relative to the estimated maximum sustainable yield (MSY). The results again assume "medium" resilience for the species.

The solid red line represents the estimated MSY, which is the estimated maximum catch level that can be sustained over the long term without depleting the stock. This estimate is likely to change as further data points are added to the series. The dotted red lines illustrate the 95% confidence intervals around the MSY estimate, showing the range of uncertainty in the model's predictions.

This figure helps assess whether the fishery's catch is within sustainable limits over time, based on the MSY reference point. If the catch consistently exceeds the solid red line, it could indicate overfishing, while values below the line suggest the stock is not being fully exploited. The confidence intervals highlight the level of uncertainty in these estimates, important for fisheries management decisions.

4.3 Stanley Region - Catch and effort

Catch and effort have fluctuated greatly within the Stanley region (*Figure 13*), with catches ranging from in the order of 10 tonnes up to nearly 75 tonnes in 2018/19 *(Figure 13*). Large catches appear to be followed by steep drops in catch in the subsequent year, however this drop in catch is often mirrored by reductions in the regional effort. Periods of concern for the stock are when the effort level repeatedly falls above the catch level *i.e.* the period between 2011/12 and 2014/15 (*Figure 13*). This has reoccurred in this last season, 2023/24. The number of pots used range from approximately 2000 to over 300,000.

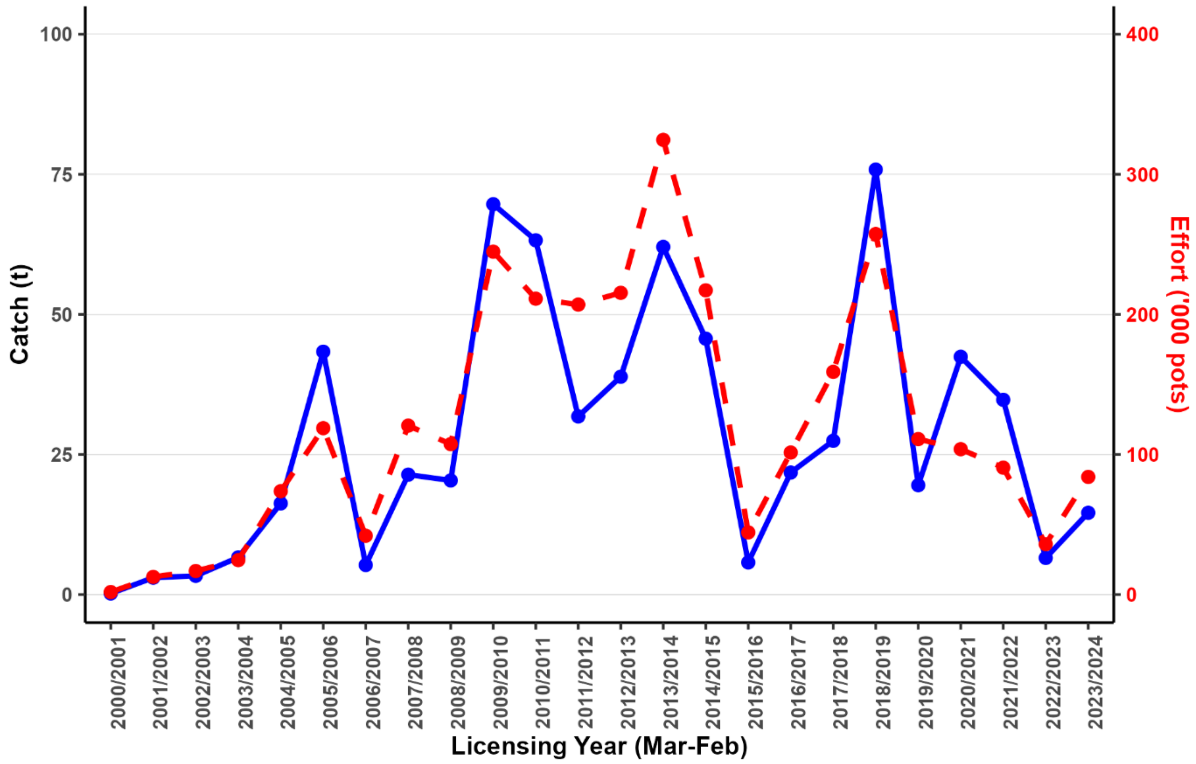

Figure 13: Total catch and effort in the TOF in the Stanley Region since 2000/01. The blue line represents the total catch weight in tonnes (t) for each licensing year (displayed on the x-axis (right). The red dashed line represents fishing effort, measured in thousands of pots, these values are displayed on the secondary y-axis (right side).

4.4 Stanley Region - CMSY

CMSY results suggest that Pale Octopus biomass in the Stanley region has been decreasing steadily over the last 5 years and to below 25% of the unfished biomass over the last 2 years (red line; *Figure 14***Error! Reference source not found.**), which is a commonly suggested limit reference point. This indicates the biomass level in the Stanley region could be overfished and at its lowest since the start of the data series in 2000/01 (*Figure 14*).

CMSY simulations further indicated that the maximum sustainable yield (MSY) of Pale Octopus in the Stanley region is approximately 39.9 t, with a lower 95% confidence interval of approximately 34.5t (*Figure 15*). The catch in this region in 2022/23 was 19.2 t (*Figure 13*).

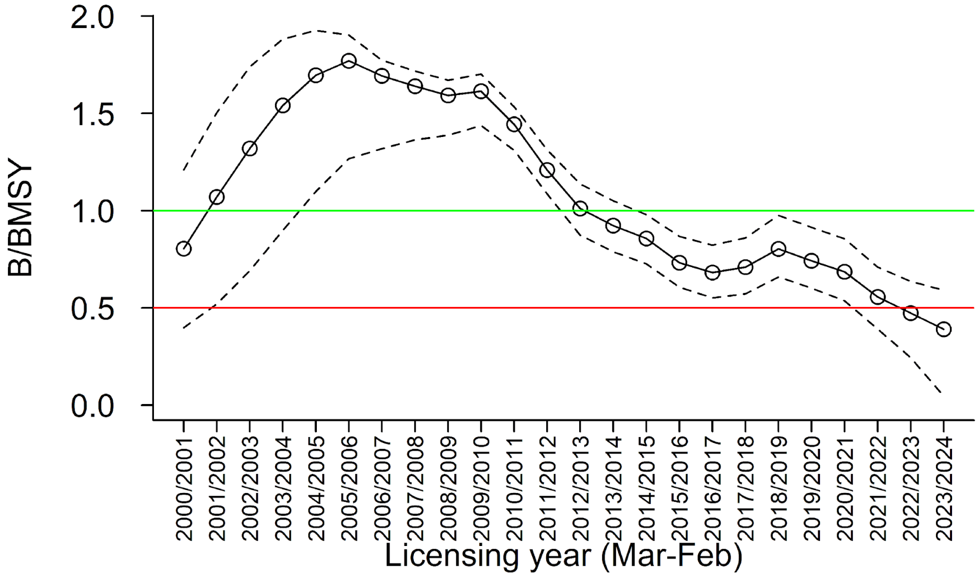

Figure 14: Trend in estimated depletion (biomass divided by biomass at maximum sustainable yield (MSY), including 95% confidence intervals). Results assume "medium" resilience. The green line marks biomass delivering MSY (50% of unfished levels), and the red line marks a possible limit reference point of 50% of the biomass delivering MSY (25% of unfished levels).

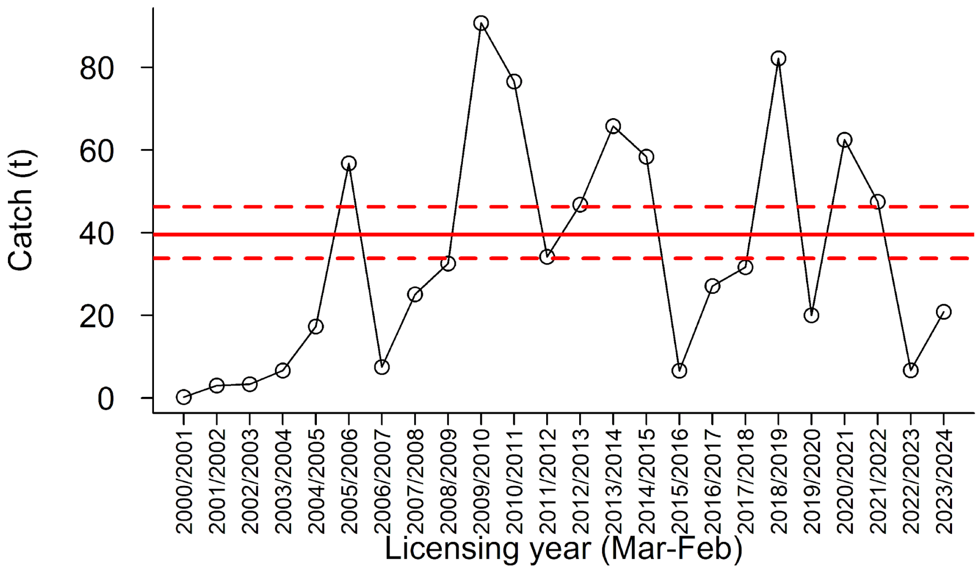

Figure 15: Trends in catch relative to estimated maximum sustainable yield (MSY). Results assume "medium" resilience. The solid red line represents MSY; dotted red lines represent 95% confidence intervals.

4.5 Flinders Island West Region - Catch and effort

Initially, both catch and effort in the region of west of Flinders Island were low, showing minimal fluctuations until 2012/2013, when catches began to increase significantly. Prominent peaks have occurred in 2012/13 (79 tonnes) and again in 2016/17 (56 tonnes) and the last season of 2023/24, with the catch reaching 50.8 tonnes and a corresponding increase in fishing effort (*Figure 16*). Following peaks, there was a notable decline in catches and effort in the subsequent years. 2022/23 and 2023/24 have seen a sharp increase in catch and effort reaching 50.7 tonnes in the last year (214 thousand pot lifts).

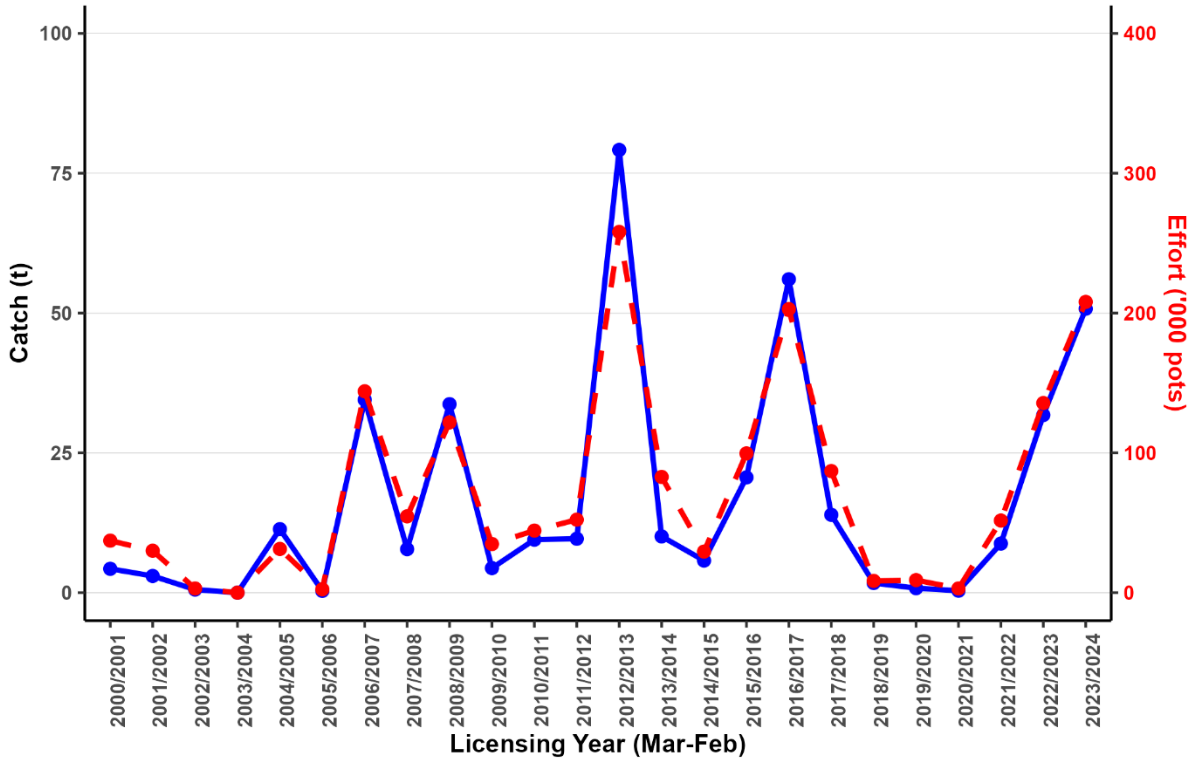

Figure 16: Total catch and effort in the TOF in the Flinders Island West Region since 2000/01. The blue line represents the total catch weight in tonnes (t) for each licensing year (displayed on the x-axis (right). The red dashed line represents fishing effort, measured in thousands of pots, these values are displayed on the secondary y-axis (right side).

4.6 Flinders Island West Region - CMSY

CMSY results suggested that Pale Octopus biomass in the Flinders Island West region may have been depleted below commonly stated target levels (50% of unfished biomass; green line, *Figure 17*) from 2014/15 and notably below the common limit reference point of 0.5 B/BMSY (i.e. 25% of unfished biomass; red line, *Figure 17*) from 2018/19, but show an upward trend in biomass over the last three seasons increasing back up to the biomass delivering MSY of 50% of unfished levels (green line, *Figure 17)* which was last reached in 2014/15.

CMSY simulations further indicated that the maximum sustainable yield (MSY) of Pale Octopus in the Flinders Island West region is approximately 20.0 t, with a lower 95% confidence interval of approximately 16.1 t (*Figure 18).* The catch for this region in 2023/234was well over the estimated MSY at 50.8 t (*Figure 18*), and more than double the last five fishing seasons. We would expect to see a drop in B/BMSY in subsequent years.

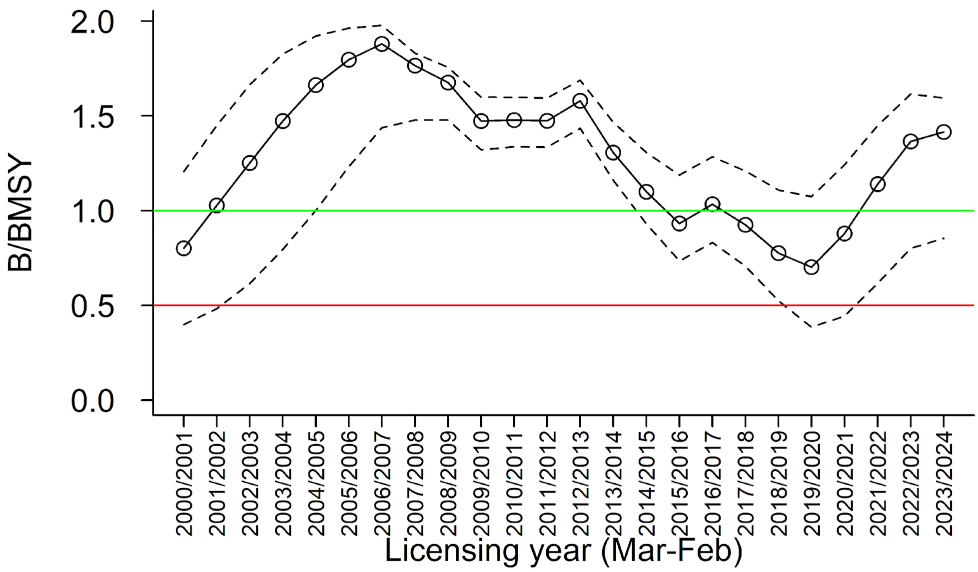

Figure 17: Trend in estimated depletion (biomass divided by biomass at maximum sustainable yield (MSY), including 95% confidence intervals. Results assume "medium" resilience. The green line marks biomass delivering MSY (50% of unfished levels), and the red line marks a limit reference point of 50% of biomass delivering MSY (25% of unfished levels).

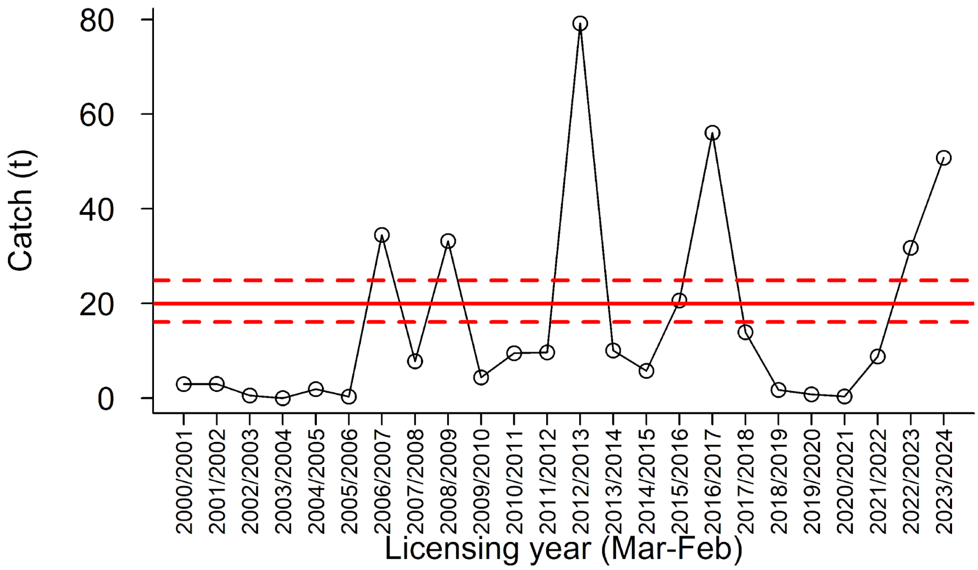

Figure 18: Trends in catch relative to estimated maximum sustainable yield (MSY). Results assume "medium" resilience. The solid red line represents MSY; dotted red lines represent 95% confidence intervals.

4.7 Flinders Island East Region - Catch and effort

The Flinders Island region saw its first peak in catch (nearly 70 tonnes) in 2007/08 (*Figure 19*). Following this peak effort has been higher to return the same catches, particularly in 2017/18. Over the past two years, catches have significantly increased again but not to previous levels, with over 50 tonnes being caught in 2022/23 and approximately 20 tonnes being landed in the region in 2023/24 (*Figure 19*). Future catches will be closely monitored to evaluate ongoing trends and ensure sustainable harvesting practices in this region.

While the catches originated from the same broader area, the specific locations targeted varied subtly between years. For the 2023/24 season, catches were primarily recorded from the western and northern edges of the Flinders Island region. In contrast, the 2022/23 catch, while also overlapping in some areas, was predominantly sourced from locations directly north of Flinders Island.

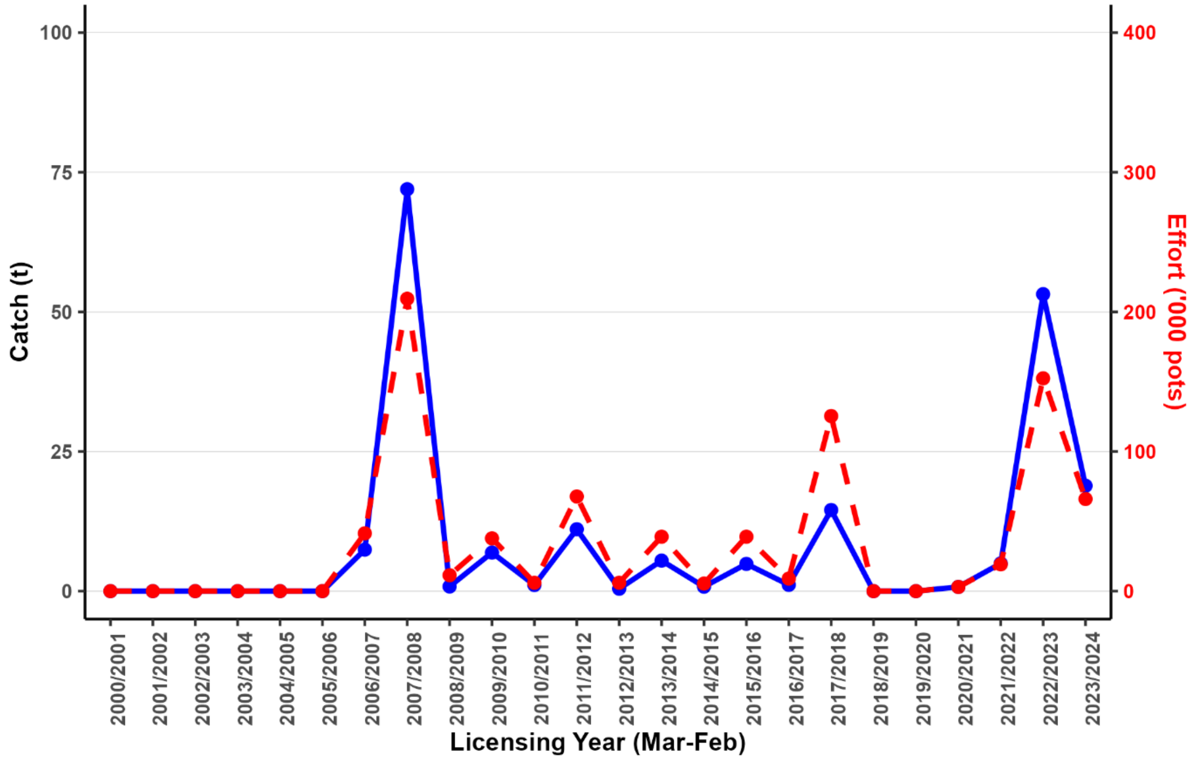

Figure 19: Total catch and effort in the TOF in the Flinders Island East Region since 2000/01. The blue line represents the total catch weight in tonnes (t) for each licensing year (displayed on the x-axis (right). The red dashed line represents fishing effort, measured in thousands of pots, these values are displayed on the secondary y-axis (right side).

4.8 Flinders Island East Region - CMSY

The CMSY results suggest that the Pale Octopus population in the Flinders Island East region may have been depleted below commonly accepted target levels (50% of unfished biomass, represented by the green line in *Figure 20*) from 2009/10 to 2013/14. However, there has been a general upward trend in estimated biomass, now exceeding 50% of the unfished level (green line, *Figure 20*). It is important to note the wide confidence intervals in this model, particularly the lower bounds. Predictions have shifted substantially since a notably high catch in 2022/23, and the recent data points strongly influence these results. These findings should be considered alongside last year's (Sharples et al. 2024) and future predictions.

CMSY simulations further indicated that maximum sustainable yield in the Flinders Island East region is approximately 11.2 t, with a lower 95% confidence interval of 8.0 t (*Figure 21*). The catch for this region in 2023/24 was 18.9 t, a substantial drop from 54.3 t the previous year but still above the MSY estimate (*Figure 21*).

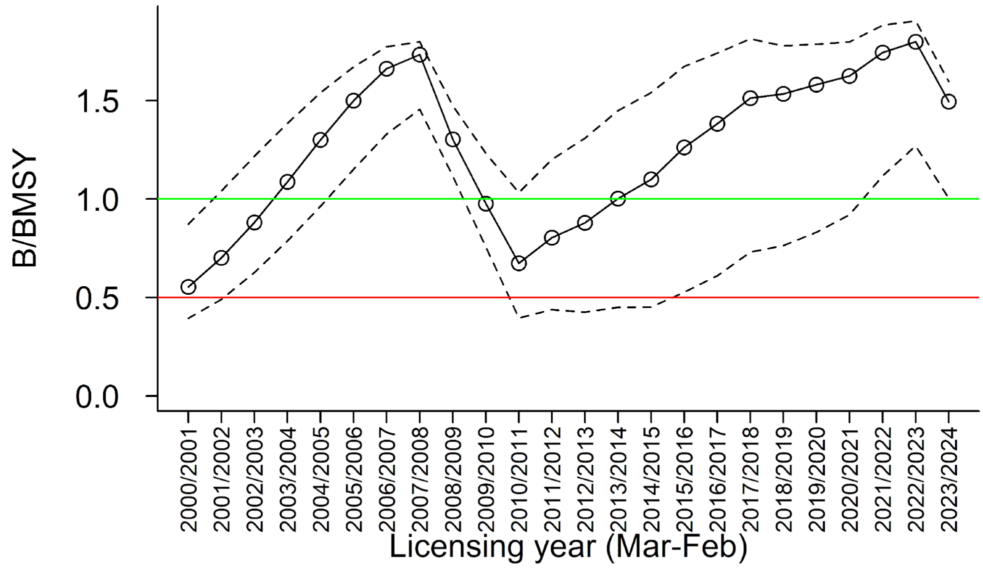

Figure 20: Trend in estimated depletion (biomass divided by biomass at maximum sustainable yield (MSY), including 95% confidence intervals). Results assume "medium" resilience. The green line marks biomass delivering MSY (50% of unfished levels), and the red line marks a limit reference point of 50% of biomass delivering MSY (25% of unfished levels).

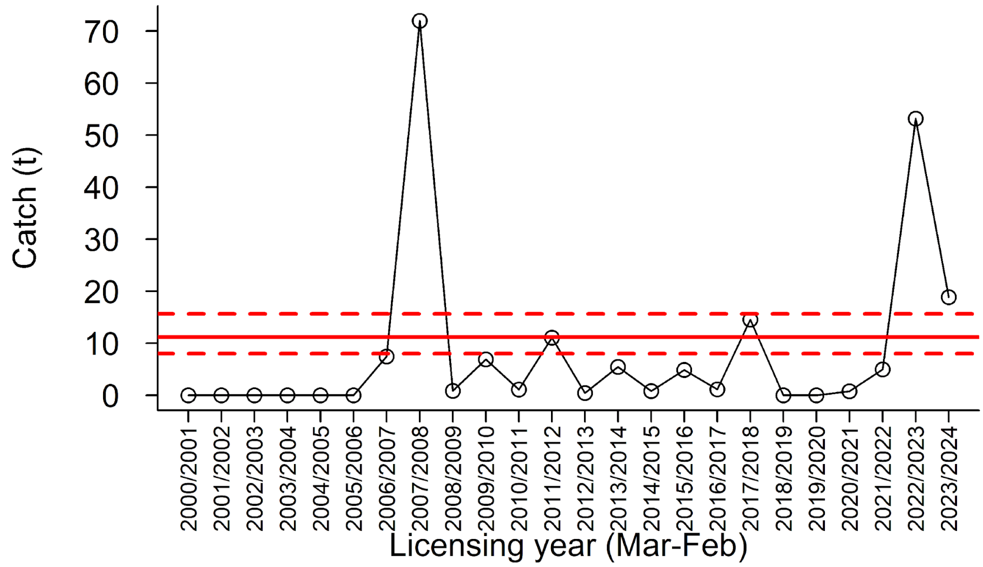

Figure 21: Trends in catch relative to estimated maximum sustainable yield (MSY). Results assume "medium" resilience. The solid red line represents MSY; dotted red lines represent 95% confidence intervals.

4.9 King Island East Region - Catch and effort

The region east of King Island, first saw significant catches in 2013/2014. The region has experienced two notable peaks in both catch and fishing effort. The first peak occurred during the 2014/2015 and 2015/2016 years, with a maximum catch of 41 tonnes (117 thousand pot lifts). A subsequent peak was observed from 2018/2019 to 2021/2022, where the catch reached 75 tonnes. These trends highlight the fluctuations in both catch volume and fishing effort in the region over the years.

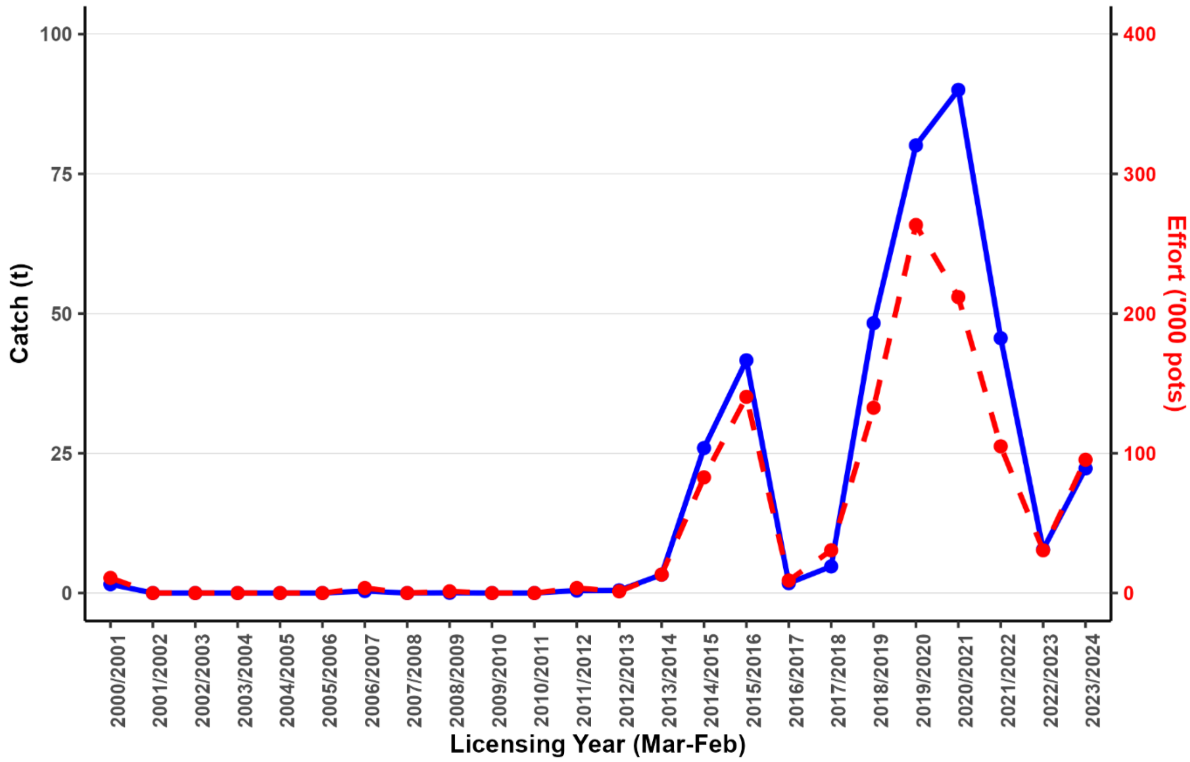

Figure 22: Total catch and effort in the TOF in the King Island East Region since 2000/01. The blue line represents the total catch weight in tonnes (t) for each licensing year (displayed on the x-axis (right). The red dashed line represents fishing effort, measured in thousands of pots, these values are displayed on the secondary y-axis (right side).

4.10 King Island East Region - CMSY

The estimated biomass of Pale Octopus (B/BMSY) shows a steady increase from 2000/01, surpassing the maximum sustainable yield (MSY). However, catch and effort levels in the early years were very low, meaning the stock was likely only minimally impacted. The limited data during this period contributes to significant uncertainty in the predictions. Additionally, the model likely underestimates confidence limits during the interim years, but these estimates have been included due to the increasing catch and associated data in the region.

From 2018/19 onwards, a notable decline in biomass is observed, with the stock falling below the MSY threshold (B/BMSY = 1) by 2021/22. By 2022/23, the biomass approaches the limit reference point (B/BMSY = 0.5), signalling potential overfishing. The 2023/24 season shows the biomass dropping below the limit reference point (red line, *Figure 23*), raising significant concerns about the sustainability of the stock.

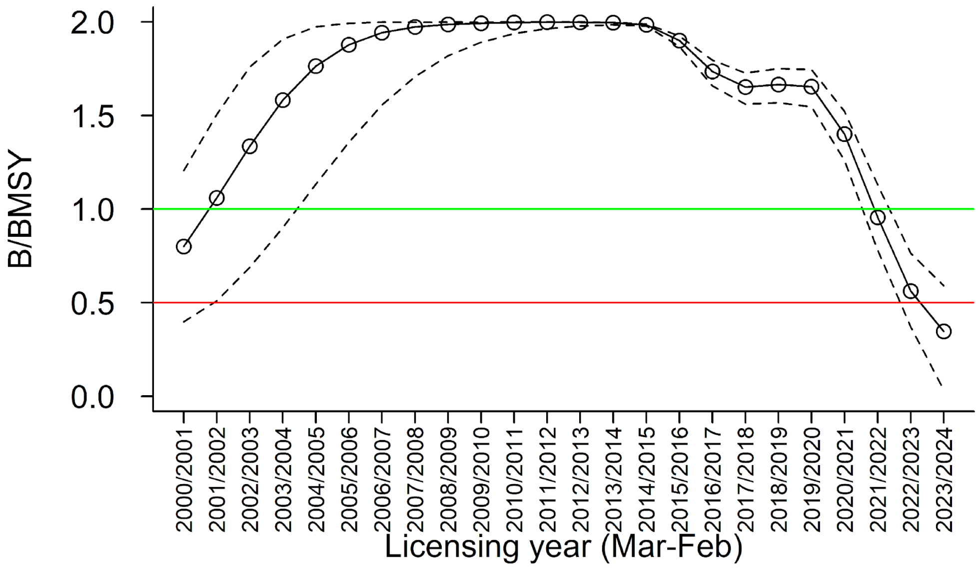

Figure 23: Trend in estimated depletion (biomass divided by biomass at maximum sustainable yield (MSY), including 95% confidence intervals). Results assume "medium" resilience. The green line marks biomass delivering MSY (50% of unfished levels), and the red line marks a limit reference point of 50% of biomass delivering MSY (25% of unfished levels).

Figure 24 illustrates the trend in commercial catches of Pale Octopus in the King Island East region from 2000/01 to 2023/24, with clear reference to maximum sustainable yield (MSY) limits. In the early years, from 2000/01 to 2013/14, catch levels remained extremely low, consistently under 5 tonnes per year. This reflects limited fishing effort in the region (*Figure 24*). During this period, the catches were well below the estimated MSY of 30 tonnes (solid red line), suggesting that the resource was under-utilised.

From 2014/15 onwards, there was a significant rise in catches, peaking at 41.6 tonnes in 2015/16, 30.4 tonnes being the estimated MSY level. This increase in fishing activity continued into 2018/19, where the catch surged to a maximum of 90.0 tonnes, well above the upper MSY limit (42 tonnes, dashed red line), raising concerns about potential overfishing in that year. The following years saw fluctuating catches, with a significant drop to 22.3 tonnes in 2023/24, far below the MSY estimate. These fluctuations in catch suggest instability in the fishery, likely driven by changes in fishing effort, stock dynamics, and/or environmental factors, and highlight the need for close and potential additional monitoring to ensure sustainable harvest levels.

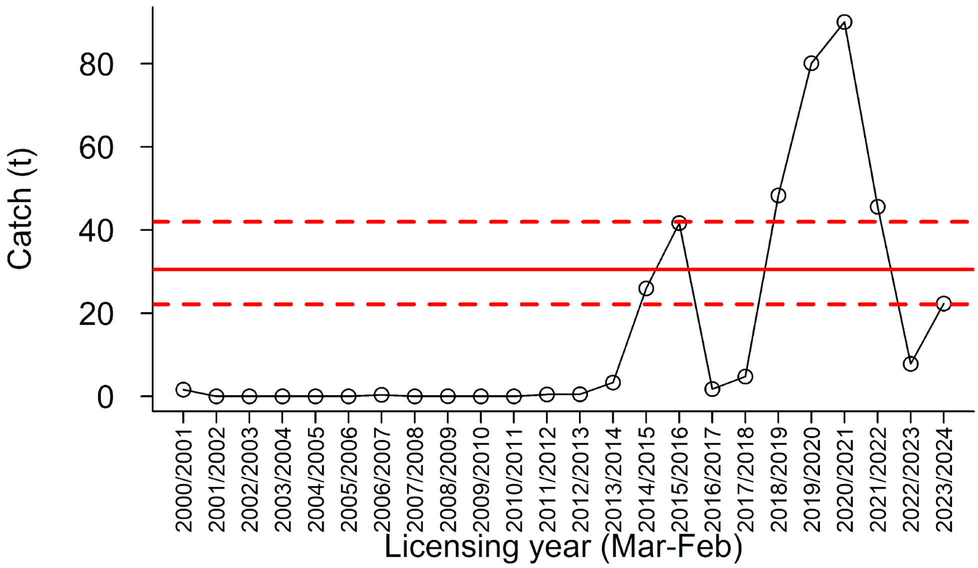

Figure 24: Trends in catch relative to estimated maximum sustainable yield (MSY). Results assume "medium" resilience. The solid red line represents MSY; dotted red lines represent 95% confidence intervals.

4.11 Developmental Pale Octopus Fishery

In the 2023/24 season, four fishing permits were issued, allowing five vessels access to Pale Octopus in Tasmanian state waters south of latitude 41° 0' 00'' (approximately covering all state waters not included in the Tasmanian Octopus Fishery (TOF), subject to exclusion zones). Landings were reported for three of these permits, resulting in a total catch of 3.7 tonnes of Pale Octopus from 27,837 pot-lifts (*Figure 25*).

Over the past three years, the catch has remained low relative to the effort expended; however, this fishery is still in its developmental stages. As a result, catch levels are expected to be modest as fishing methods and locations are still being refined and optimised.

Reported data for landings under permit are available for Pale Octopus from the eastern and southern coasts of Tasmania for 2017/18 to 2023/24 (

Table 5, *Figure 25*). Although a single permit was issued in 2016/17, no data were reported for this licensing year. Prior to the issue of permits, no commercial fishing for Pale Octopus occurred outside of the Bass Strait area covered by the TOF.

Table 5: Pale Octopus fishery data from the developmental octopus fishery in state waters outside of the area encompassed by the TOF. Data include total catch (tonnes), effort (pot-lifts), number of issued permits, and number of vessels for which landings were reported.

Licensing year	Catch (t)	Effort (pot-lifts)	CPUE (Nominal)	Number of permits	Number of vessels with reported landings
2016/17	0	0	-	1	0
2017/18	3.1	24,000	0.13	1	1
2019/20	6.0	31,500	0.19	2	1
2020/21	4.6	22,500	0.20	3	3
2021/22	3.0	21,655	0.14	4	4
2022/23	4.8	32,708	0.15	4	4
2023/24	3.7	27,837	0.13	4	3

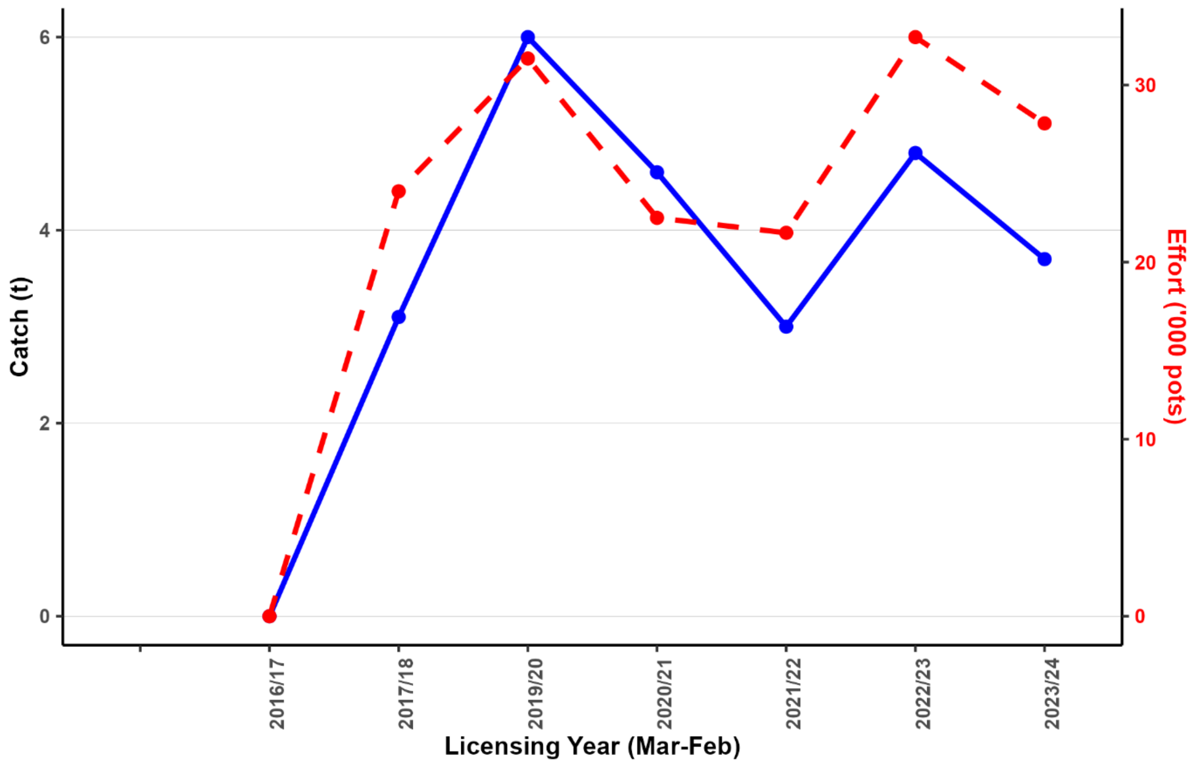

Figure 25: Total catch and effort in the Developmental Octopus Fishery since 2016/17. The blue line represents the total catch weight in tonnes (t) for each licensing year (displayed on the x-axis (right). The red dashed line represents fishing effort, measured in thousands of pots, these values are displayed on the secondary y-axis (right side).

4.11.1 Māori and Gloomy Octopus Fisheries

Total catches of Māori and Gloomy Octopus (mostly Māori Octopus) in Tasmania have fluctuated around 5-25 t since 2002/03 (*Figure 26*). Highest catches in the past can be attributed to the targeted Māori Octopus fishery in Eaglehawk Bay. Two anomalously high catches in the Rock Lobster fishery match 2021/22 when species level reporting began and the first year of required reporting within that fishery (2000/01, see *Figure 26**Error! Reference source not found.***).

In recent years, catches appear to have been dominated by the Rock Lobster fishery, with the exception of 2017/18, when the TOF caught high numbers of Gloomy Octopus near Flinders Island. Total reported commercial catch in 2023/24 of both Māori and Gloomy Octopus combined was 11.1 t, comprising 5.9 t from the Rock Lobster fishery, 2.4 t from the TOF, 1.5 t from the Scalefish fishery and developmental permits for Pale Octopus, and 1.3 t from the Eaglehawk Bay Māori Octopus fishery.

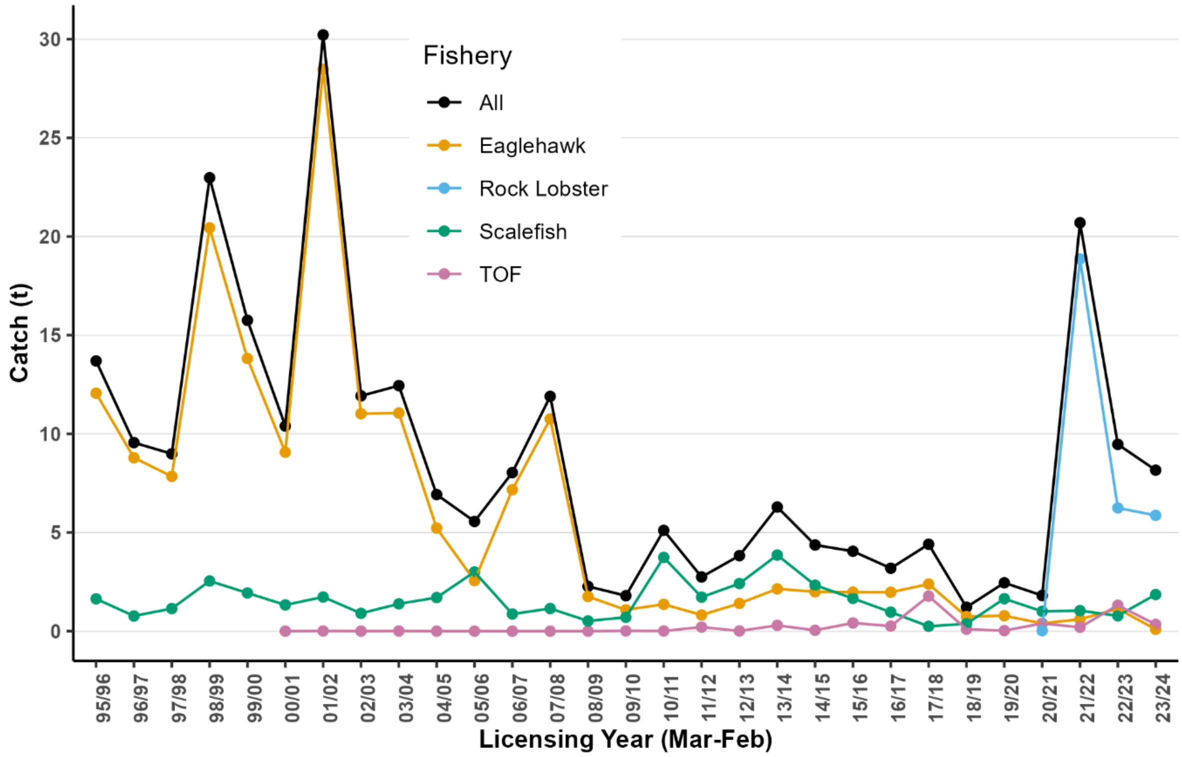

Figure 26: Total catches of octopus across all fisheries since octopus returns were first reported in each fishery. Excludes Pale Octopus catch in the TOF under fishing licence (octopus) and Pale Octopus caught under developmental permits for this species.

4.11.2 Māori and Gloomy Octopus catch from TOF and developmental permits

Total Māori Octopus catch from fisheries targeting Pale Octopus using unbaited traps – the TOF and the developmental fishery – was 3.4 t in 2023/24, comprising 39 kg from the developmental fishery and the remainder from the TOF and rock lobster (*Figure* 27).

Total Gloomy Octopus catch from these fisheries in 2023/24 was 3.0 t, 2.0 t landed by the TOF, (with no landings under developmental permits) and 1.0 t recorded in the Rock Lobster fishery (*Figure 27*). The highest catch from this fishery was 18.6 t in 2017/18, when the TOF fishing effort was concentrated northeast of Flinders Island. In 2022/23 the TOF again concentrated in this area, resulting in notably high catches of Gloomy Octopus (*Figure 27*). In the most recent year with effort based north and west of Flinders Island the catch of Gloomy Octopus was reduced.

Both species were considered to be at negligible risk from unbaited trap fishing in the 2012/13 Ecological Risk Assessment (ERA) due to their low catches and biological traits, including their reproductive biology (Bell et al. 2016). In particular, both species have a strategy of a large number of eggs and planktonic larval dispersal (Gloomy Octopus: ~ 278,500 eggs; Māori Octopus: < 196,000 eggs; *Table 3*), which contrasts with the holobenthic strategy of Pale Octopus.

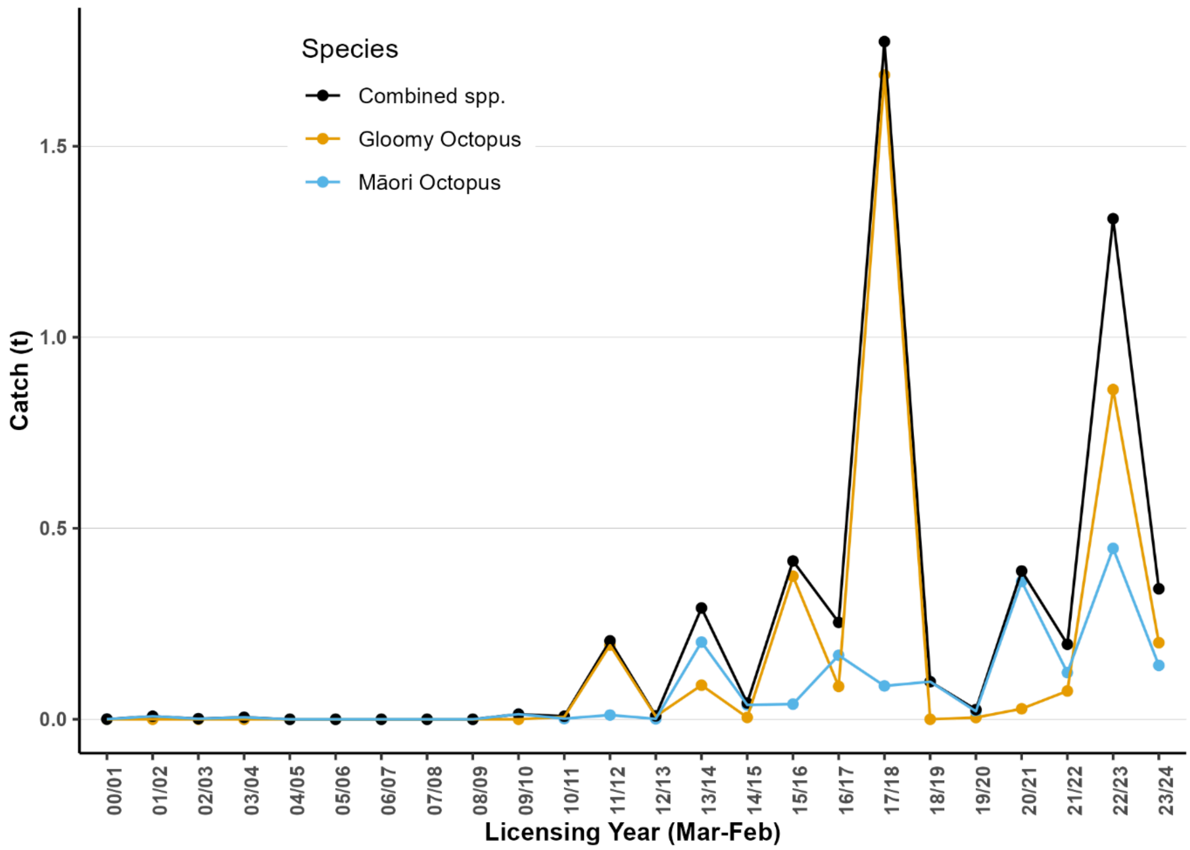

Figure 27: Total catches of Māori Octopus (Macroctopus maorum) and Gloomy Octopus (Octopus tetricus) from unbaited traps in the TOF and east coast developmental fishery for Pale Octopus since 2000/01.

4.11.3 Octopus catch from the Scalefish Fishery

Annual octopus catch within the Scalefish fishery has remained below 3 t since 2001/02 (*Figure 28).* Spear and hand collection are the main gear with which octopus are landed in this fishery, however a diversity of gear types and operations are responsible for octopus landings. In 2023/24, total octopus catch from this fishery was 1.8 tonnes, 30.1 kg Pale Octopus reported, and 1.8 tonnes of Māori Octopus.

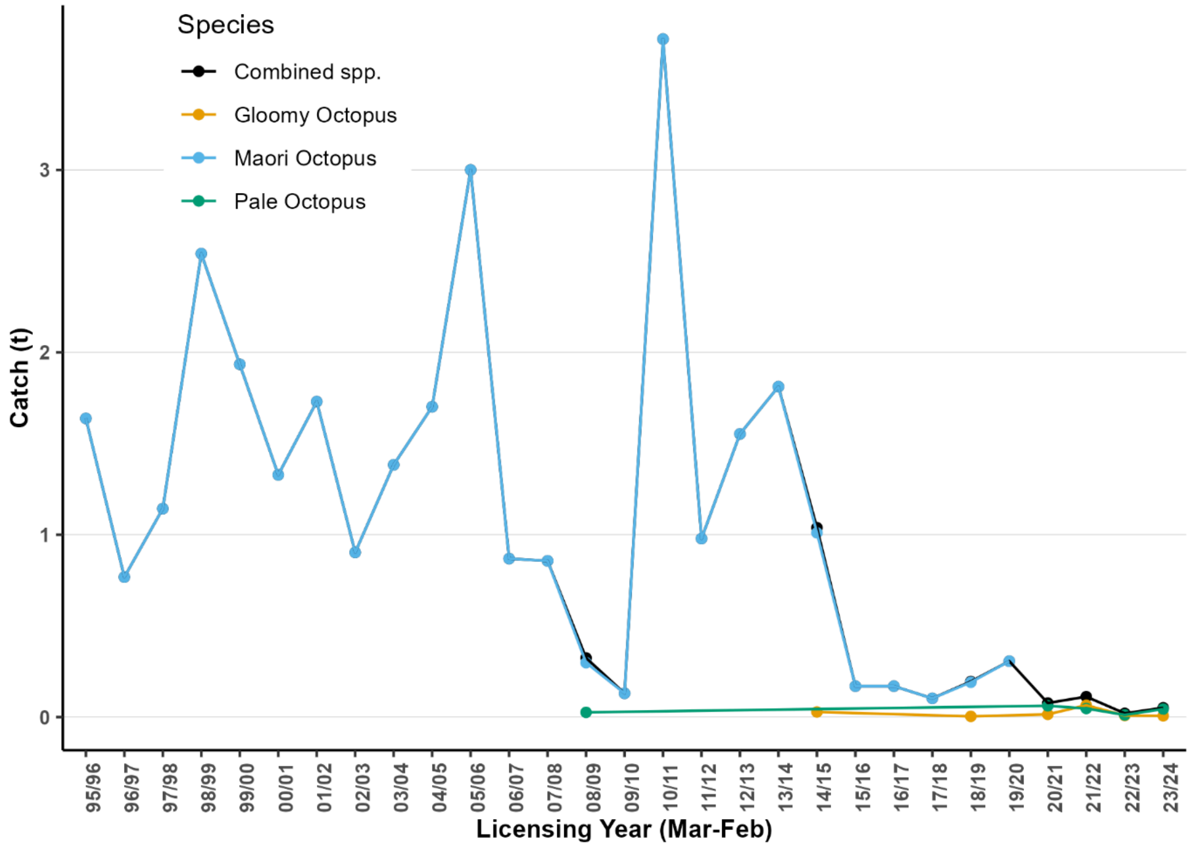

Figure 28:Total catches of octopus from diverse operations within the Scalefish fishery since 2001/02.

4.11.4 Octopus catch from the Rock Lobster Fishery

Octopus catch was not required to be reported by the Rock Lobster fishery before 2000/01. Since then, annual retained, landed octopus catch within this fishery has remained below 10 t (*Figure 29)*. An outstanding exception is the first reporting year, 2000/01, when reported catch was 20.6 t. Since then, reported octopus catch has remained below 10 t, with a return to higher levels in 2021/22. In 2021/22, octopus landings from the Rock Lobster fishery were first identified to species level, however it is uncertain whether these species identifications are entirely accurate. For 2023/24 reported octopus catch in the rock lobster fishery was 7.87 t, comprising 4.59 t Māori Octopus, 2.48 t Gloomy Octopus and 0.80 t Pale Octopus.

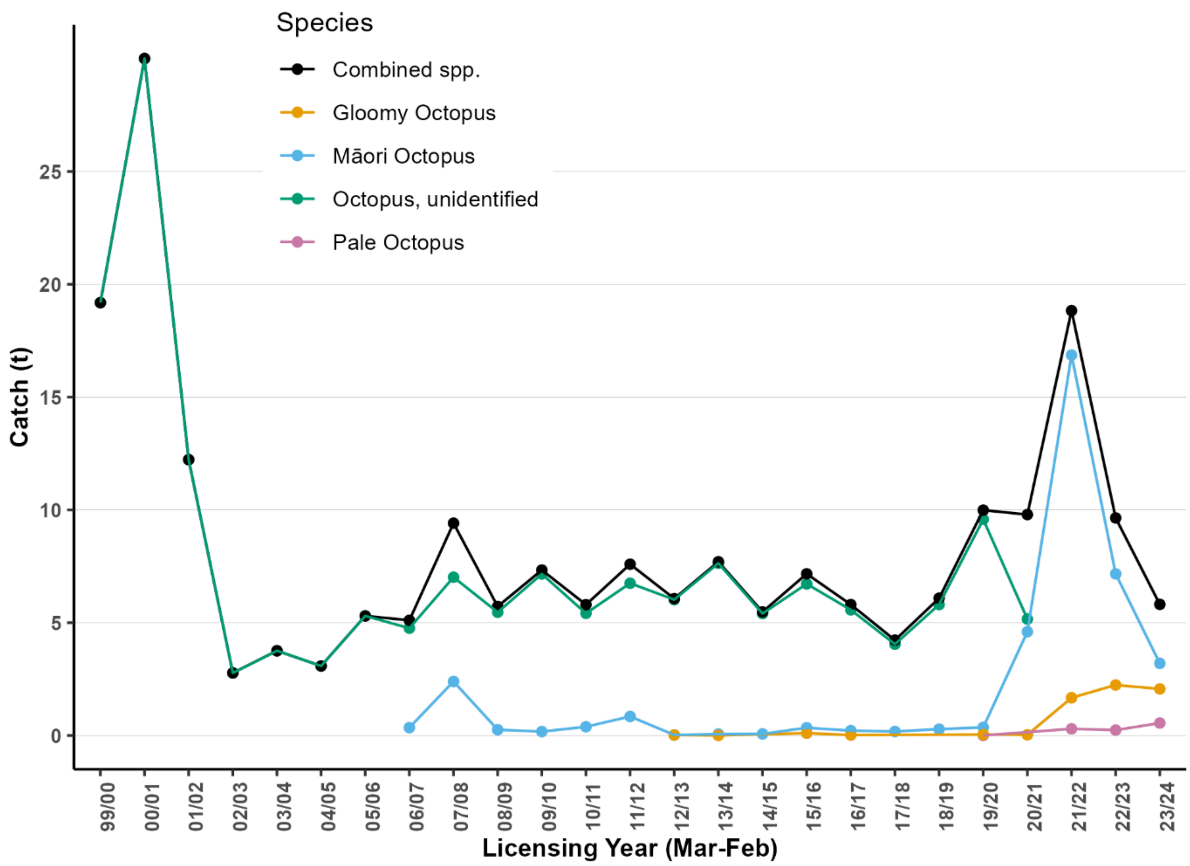

Figure 29: Total catches of octopus from the Rock Lobster fishery since 1999/00. Note that octopus were identified to species level in Rock Lobster fishery returns for the first time in 2021/22, however the accuracy of species identification is uncertain.

4.11.5 Octopus catch from the Eaglehawk Bay Māori Octopus Fishery

Annual octopus catch within the Eaglehawk Bay fishery fluctuated between 0.5-3 t since the 2007/08 season. Catches were dominated by 'Octopus, unidentified' (presumably mostly Māori Octopus) prior to this, and Māori Octopus since then. This is the fourth consecutive year with catches under a tonne.

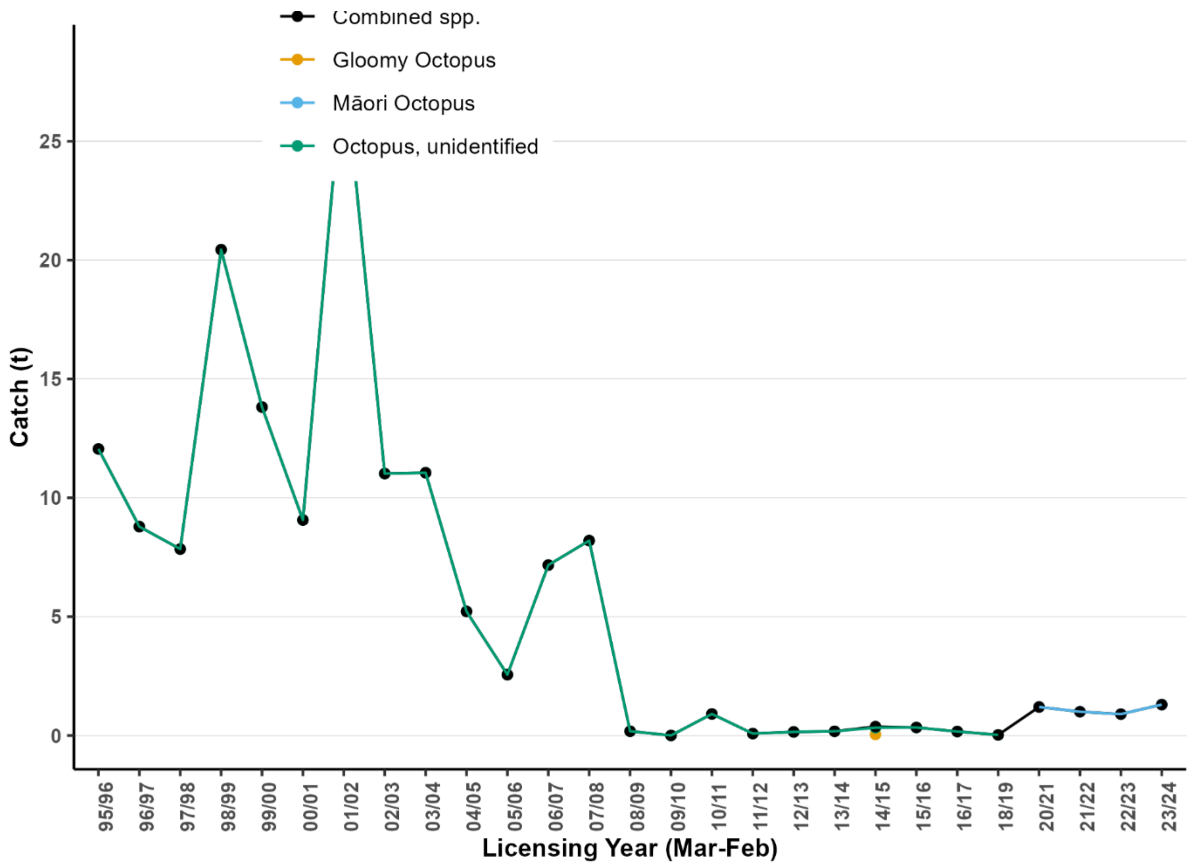

Figure 30: Total catches of octopus from the Eaglehawk Neck fishery since 1995/96. Note that octopus were identified to species level in Eaglehawk Neck fishery returns since 2007/08. Prior to this unidentified species are largely assumed to be Maori Octopus.

4.12 Distribution of all octopus catch in Tasmanian waters

The geographic distribution of annual octopus catch per species was illustrated by averaging catch within fishing blocks over the last five years (2019/20 to 2023/24), including data from– the TOF, the developmental fishery for Pale Octopus, the Scalefish fishery, and the Eaglehawk Bay Māori Octopus fishery *(Figure 31*). Pale Octopus catch was predominantly taken from the Bass Strait, with some catch recorded from south-eastern waters. Gloomy Octopus was mostly taken from the eastern Bass Strait around Flinders Island, Landings identified as Māori Octopus were generally recorded mostly from the western Bass Strait and southeast coast.

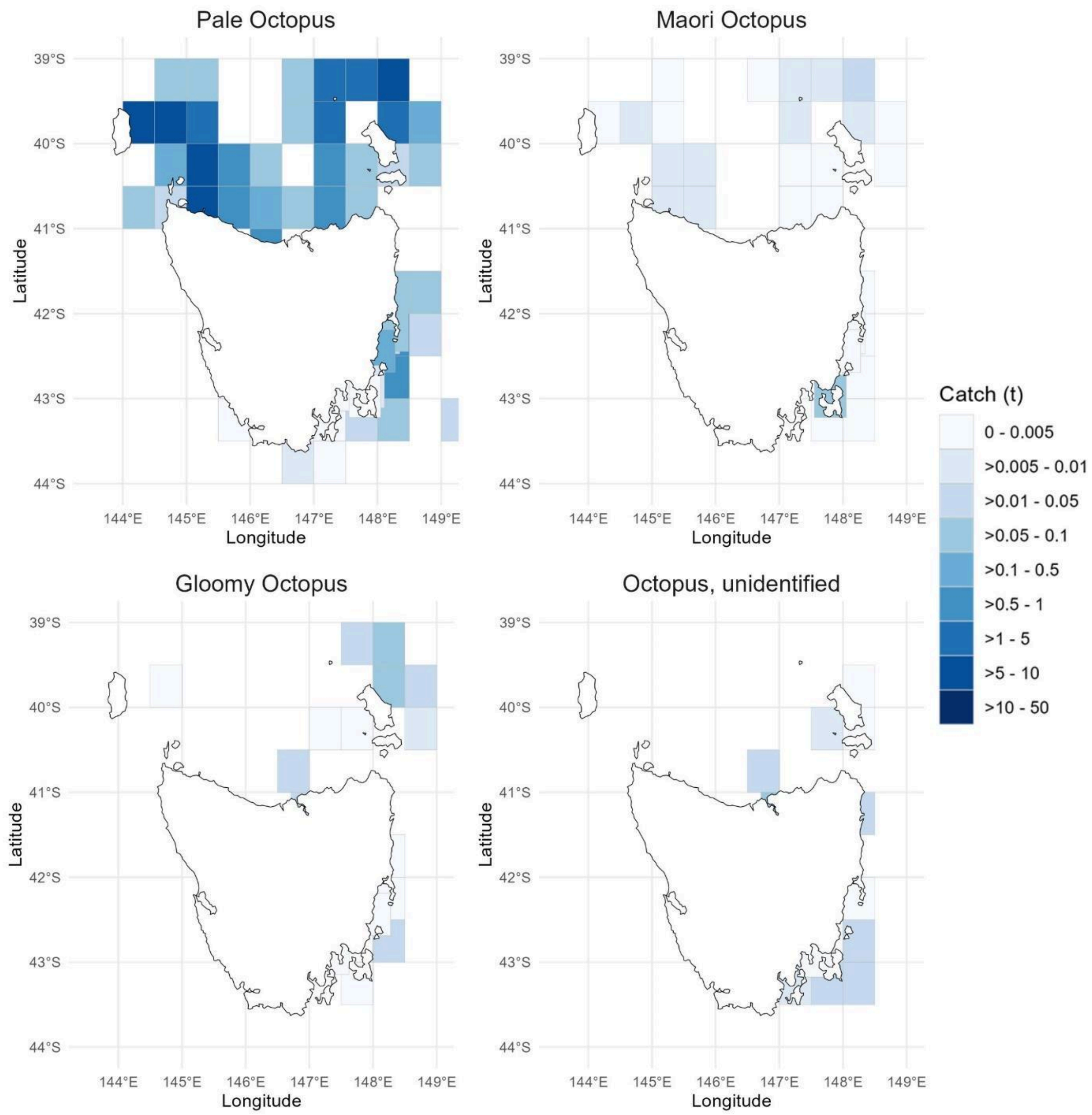

Figure 31:: D*istribution of catch per species by fishing block, averaged over the last five years (2019/20 to 2023/24).*

5 Stock status

5.1 Pale Octopus (*Octopus pallidus*) – Bass Strait Stock

STOCK STATUS	DEPLETING

In 2023/24, the total catch of Pale Octopus in the Tasmanian Octopus Fishery (TOF) although high (111 t), represents a significant decline from the record high of 154 t in 2020/21 despite a similar amount of effort. Effort across the fishery was recorded at 415,637 pot-lifts in 2023/24, a significant increase from the previous year of 314,708 pot-lifts. Standardised CPUE from logbook data and from the 50-pot sampling programme both showed a significant decrease from record high levels in 2020/21.

Combined with a decrease in CPUE across the whole fishery which could indicate stock depletion, regional analyses indicate a shift in effort and catch away from previously productive areas in the western Bass Strait to the east. The ecology of Pale Octopus and the species' interaction with shelter pot gear means that the TOF is a high-risk fishery. Pale Octopus produce small numbers of large benthic larvae from active brooding, and females seek out pots as refuges in which to brood their eggs. Non-brooding adults also actively seek pots as refuges. Catch and CPUE are likely to be "hyper-stable" because of this behaviour, which means there is considerable risk that recruitment may be impaired and sudden declines in biomass might occur without a notable prior change in catches or CPUE.

The increase of over 100,000 pots in the latest year, combined with only a minimal increase in catch, raises significant concerns over the stock status of the fishery. Furthermore, the heightened fishing effort further offshore from Flinders Island, presumably incurring greater time and fuel costs, suggests that closer fishing grounds may not be as profitable as they once were.

Catches across the fishery have remained high for the past six seasons, with particularly high catches and effort concentrated in relatively small geographic areas. Based on this evidence and no evidence of recovery, the Pale Octopus stock in northern Tasmanian waters remains classified as **Depleting**.

5.2 Pale Octopus (*Octopus pallidus*) – Tasmanian Shelf Stock

STOCK STATUS	SUSTAINABLE

Pale Octopus catch from the developmental fishery operating in state waters outside the TOF was 3.7 t in 2023/24. This stock has seen minimal commercial fishing activity. Developmental fishing permits have been issued since 2016/17 (excluding 2018/19) but no catch was recorded prior to 2019/20. Since then, both catch and effort have remained very low. Bycatch and byproduct reports from the rock lobster and scalefish fisheries are also minimal. Given the low levels of exploitation, the Pale Octopus stock in eastern, western, and southern Tasmanian waters is classified as **Sustainable**.

5.3 Gloomy Octopus (*Octopus tetricus*)

STOCK STATUS	SUSTAINABLE

Catch of Gloomy Octopus within the TOF and developmental fishery was 2.0 t in the 2023/24, a quarter of the unusually high catch of 8.4 t in the previous season. Gloomy octopus catch has otherwise remained close to zero since an outlier peak of 18.6 t in 2017/18. Catch reported as by-product from the Rock Lobster fishery was 1.0 t in 2023/24, however the accuracy of species identification in these data is uncertain. Gloomy Octopus catch from other fisheries was negligible.

The reproductive biology of this species suggests that it may be more resilient to fishing pressure than Pale Octopus, but still under moderate risk of recruitment impairment. Gloomy Octopus catches in Tasmania appear to be driven by the distribution of effort in the TOF. Catches have typically been close to zero other than through substantial fishing activity in the eastern Bass Strait around Flinders Island.

For the 2022/23 season, 7.2 tonnes of Gloomy Octopus were recorded in TOF data, coinciding with high effort to the northeast of Flinders Island. In contrast, 2.0 tonnes were caught in 2023/24, with the effort shifting to a more northerly and westerly direction compared to the previous year. Aside from 2023/24 catches around the state reported by the Rock Lobster fishery, this species has been caught primarily in the eastern Bass Strait near Flinders Island. The 2023/24 season saw a return in effort and catch to this region. In the previous five seasons, fishing effort within the TOF was concentrated almost exclusively in western Bass Strait and Gloomy Octopus catch had been negligible. It is unknown whether the biomass of Gloomy Octopus in Tasmanian waters is sufficient for a more substantial fishery. However, given the generally low exploitation of the stock, Gloomy Octopus in Tasmania is classified as **Sustainable**.

5.4 Māori Octopus (*Macroctopus maorum)*

STOCK STATUS	SUSTAINABLE

A total of 9.1 t of Māori Octopus was landed by Tasmanian commercial fishers in 2023/24. Assuming correct species identification, these catches comprise 4.9 t landed by-product from the Rock Lobster fishery, 1.4 t landed by-product from the TOF and developmental Pale Octopus fisheries, 1.5 t landed by-product from the Scalefish fishery, and 1.3 t from the targeted Eaglehawk Bay octopus fishery.

Similarly to Gloomy Octopus, Māori Octopus is likely to be more resilient to fishing pressure than Pale Octopus, albeit under moderate risk of recruitment impairment according to its assessment score. Quantities of Māori Octopus killed and discarded by the Rock Lobster fishery are unknown, which challenges a reliable assessment of both catch and potential biomass depletion. When catch data and trip limits for octopus are compared with the total number of Rock Lobster trips per year, it appears that overall catch and, hence, discard mortality of Māori Octopus in this fishery might be low. Video observations suggest that the gear selectivity for Māori Octopus within the Rock Lobster fishery may also be low. Thus, the Tasmanian Māori Octopus stock is classified as **Sustainable**.

6 Environmental interactions within the TOF

6.1 By-product and by-catch

Aside from Māori and Gloomy Octopus, no significant by-product or bycatch species are captured in the TOF or the east coast developmental fishery for Pale Octopus, apart from small invertebrates and fouling organisms that attach to the gear (which in generally left deployed for 3-6 weeks) and are released back to the sea upon redeployment.

6.2 Protected and threatened species interactions

The nature of the fishery and the gear used make interactions with protected and threatened species unlikely. The boats do not operate at night, which minimises the attraction of seabirds to working lights. Additionally, there are also no bait-discarding issues since the pots are unbaited. The surface gear is minimal, consisting of two buoys and two ropes for each demersal line. Consequently the 2012/13 Environmental Risk Assessment (ERA), concluded that the risks from octopus potting to protected and threatened species were negligible (Bell et al. 2016).

While there have been reports of migrating whales becoming entangled in ropes of pot fisheries in Western Australia (WA Department of Fisheries 2010), the TOF operates in Bass Strait which does form part of the migratory route of southern right whales (TAS Parks and Wildlife Service), no such interactions have been reported. 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 instance, in the Tasmanian Rock Lobster Fishery, a single operator may set up to 60 sets of pots and ropes per day in some areas of the State, resulting in approximately 1.3 million pot-lifts annually. Similarly in the Western Australia Rock Lobster Fishery, there are approximately 2 million pot-lifts each year (De Lestang et al. 2012; Hartmann et al. 2013).

6.3 Ecosystem and habitat interactions

The octopus pots currently utilised in the fishery are lightweight and set in sandy bottom environments, which are the preferred substrate for Pale Octopus. Research has shown the impact of commercial potting on benthic assemblages in minimal (Coleman et al. 2013) and the 2012/13 ERA concluded that octopus potting poses a low risk to both the ecosystem and habitat (Bell et al. 2016).

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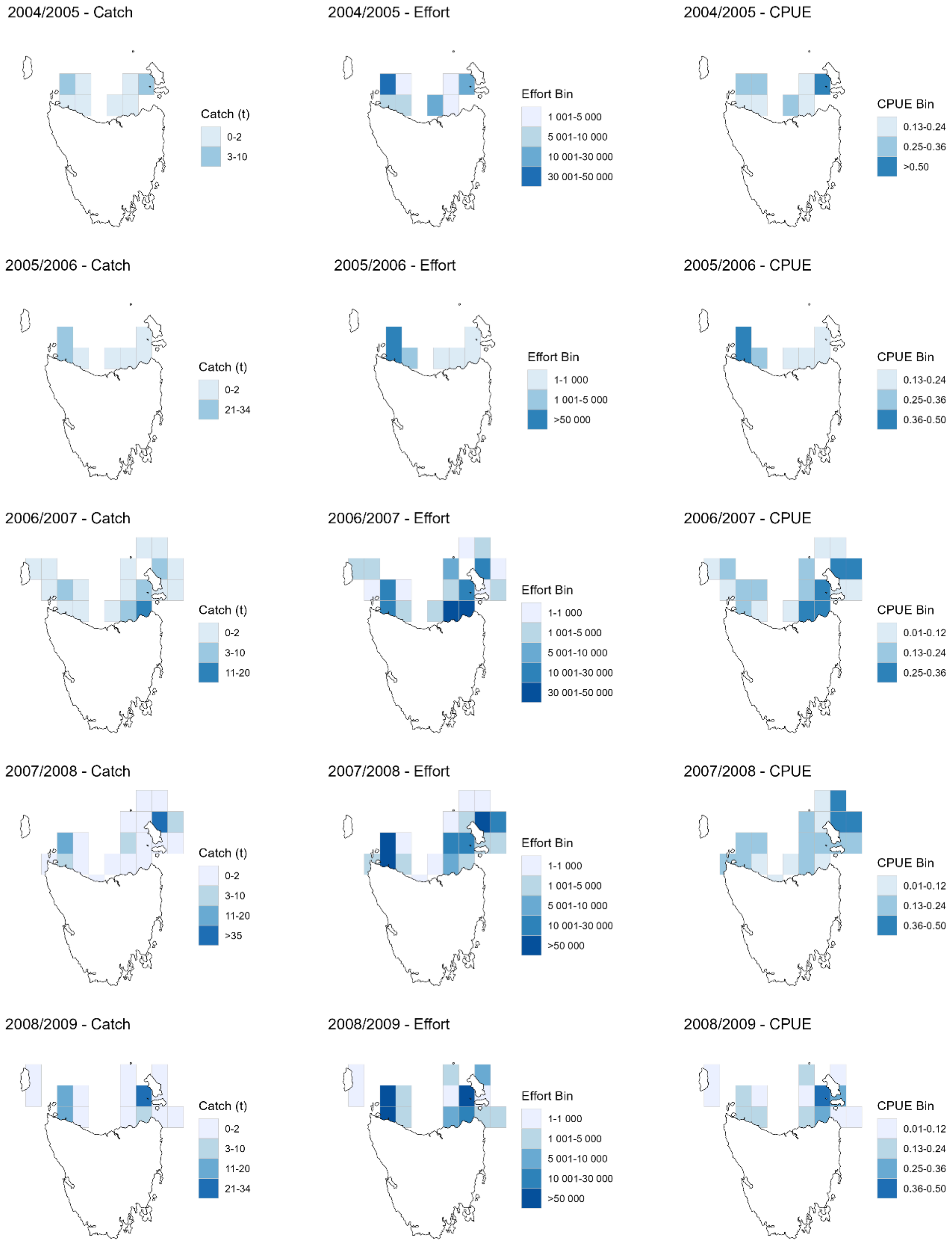
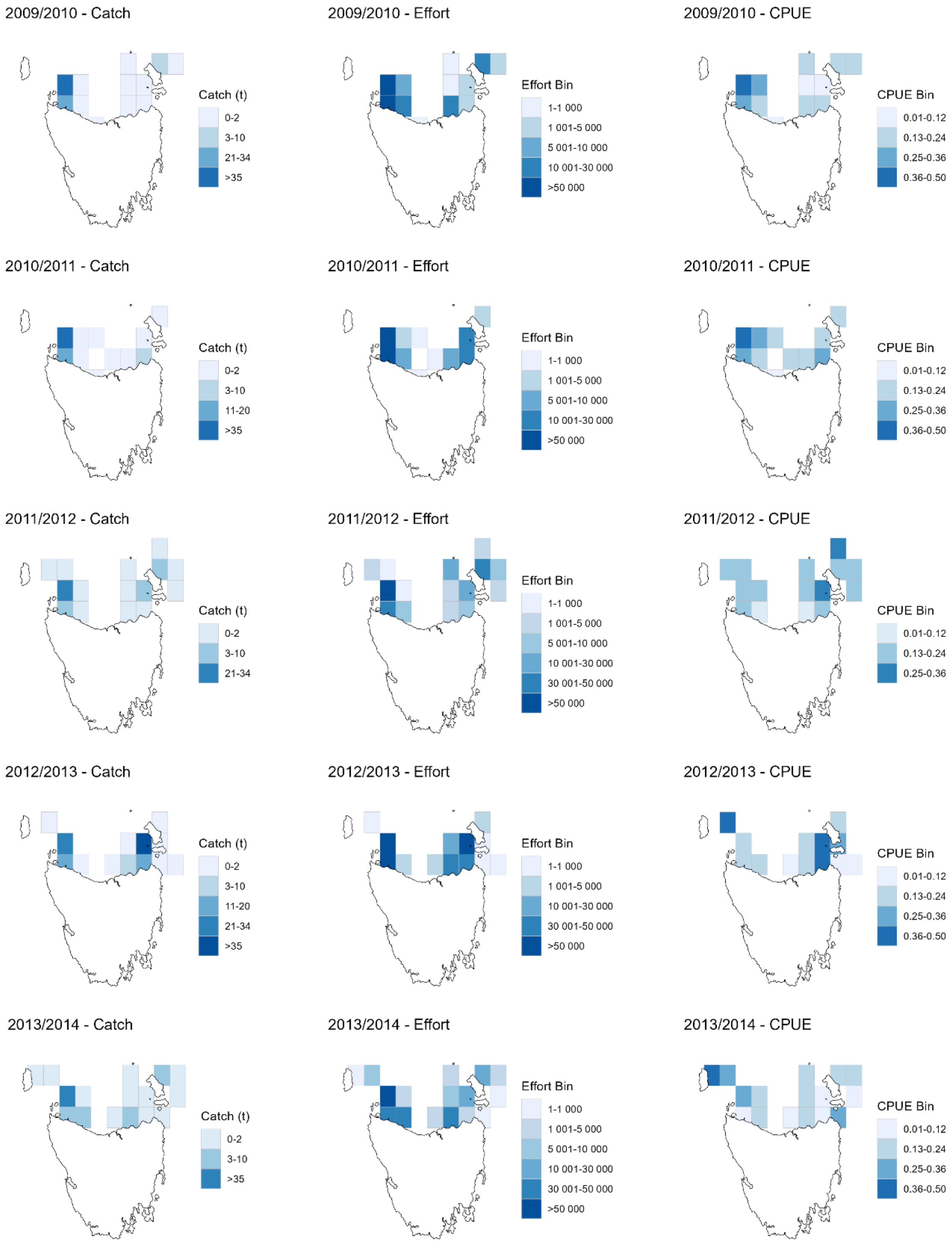
8 Appendix

Appendix A: Annual distribution of catch in the TOF




2009/2010 - Catch
Catch (t)
0-2
3-10
21-34
>35
2009/2010 - Effort
Effort Bin
1-1 000
1 001-5 000
5 001-10 000
10 001-30 000
>50 000
2009/2010 - CPUE
CPUE Bin
0.01-0.12
0.13-0.24
0.25-0.36
0.36-0.50
2010/2011 - Catch
Catch (t)
0-2
3-10
11-20
>35
2010/2011 - Effort
Effort Bin
1-1 000
1 001-5 000
5 001-10 000
10 001-30 000
>50 000
2010/2011 - CPUE
CPUE Bin
0.01-0.12
0.13-0.24
0.25-0.36
0.36-0.50
2011/2012 - Catch
Catch (t)
0-2
3-10
21-34
2011/2012 - Effort
Effort Bin
1-1 000
1 001-5 000
5 001-10 000
10 001-30 000
30 001-50 000
>50 000
2011/2012 - CPUE
CPUE Bin
0.01-0.12
0.13-0.24
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2012/2013 - Catch
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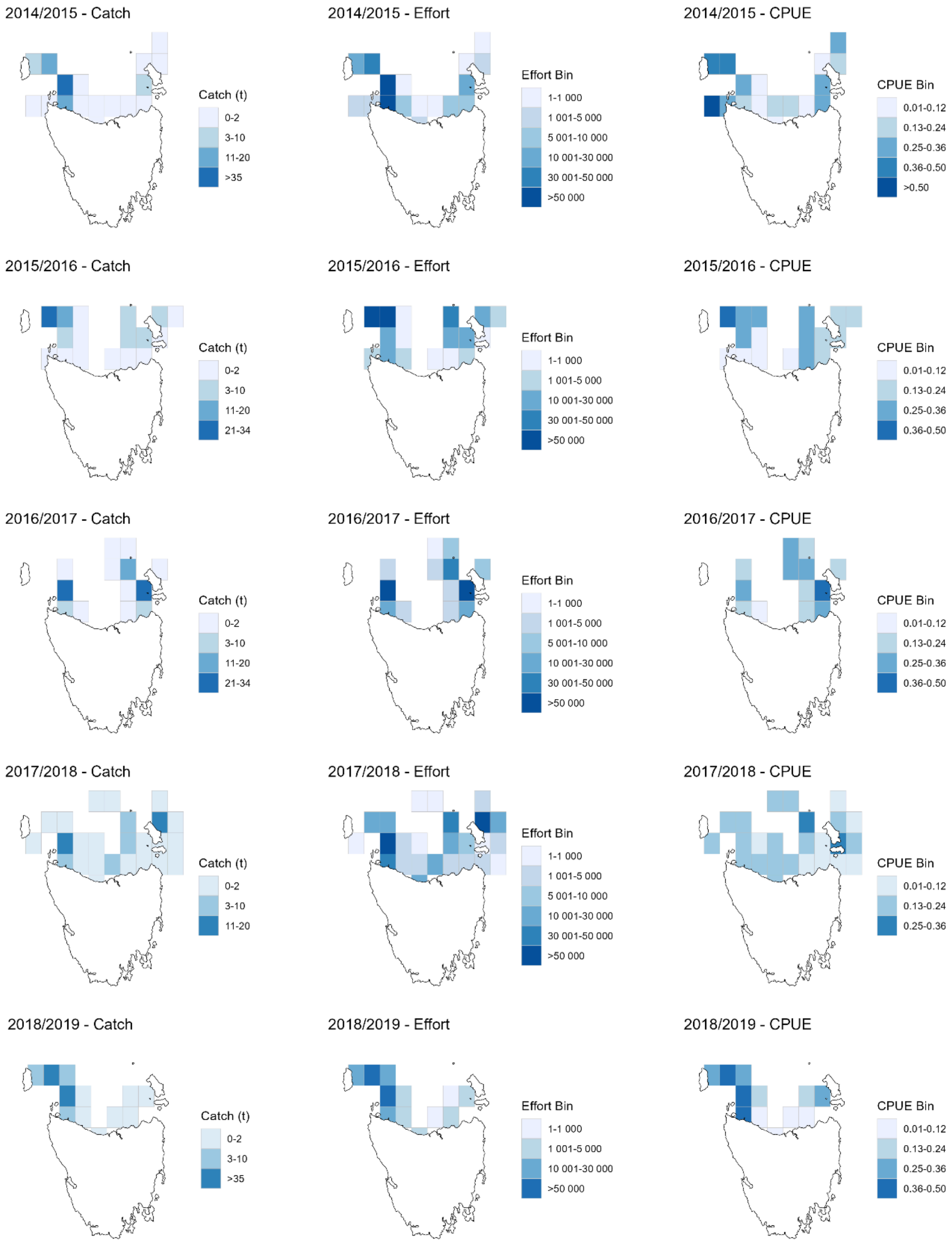
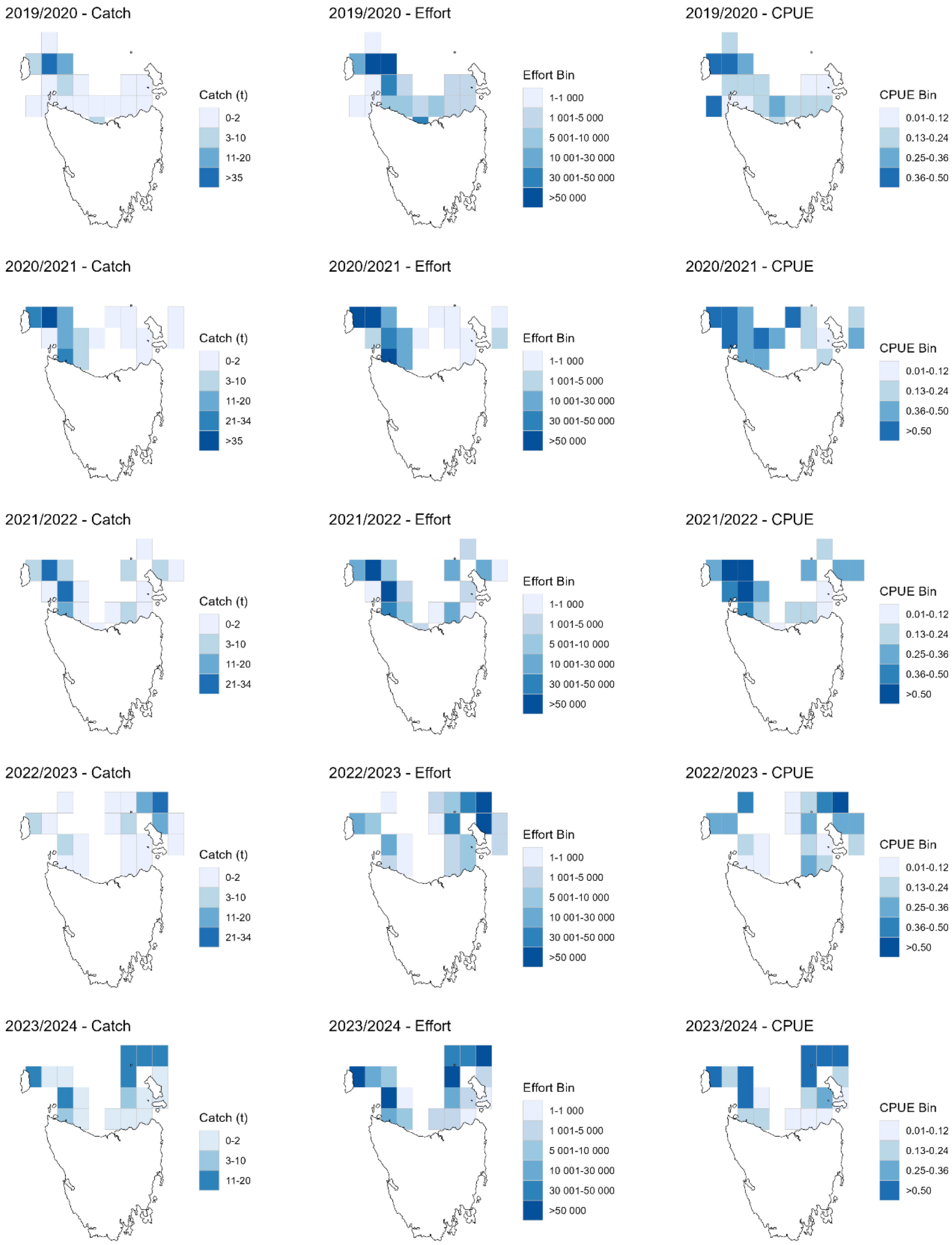
2012/2013 - Effort
Effort Bin
1-1 000
1 001-5 000
10 001-30 000
30 001-50 000
>50 000
2012/2013 - CPUE
CPUE Bin
0.01-0.12
0.13-0.24
0.25-0.36
0.36-0.50
2013/2014 - Catch
Catch (t)
0-2
3-10
>35
2013/2014 - Effort
Effort Bin
1-1 000
1 001-5 000
5 001-10 000
10 001-30 000
30 001-50 000
>50 000
2013/2014 - CPUE
CPUE Bin
0.01-0.12
0.13-0.24
0.25-0.36
0.36-0.50


2014/2015 - Catch
Catch (t)
0-2
3-10
11-20
>35
2014/2015 - Effort
Effort Bin
1-1 000
1 001-5 000
5 001-10 000
10 001-30 000
30 001-50 000
>50 000
2014/2015 - CPUE
CPUE Bin
0.01-0.12
0.13-0.24
0.25-0.36
0.36-0.50
>0.50
2015/2016 - Catch
Catch (t)
0-2
3-10
11-20
21-34
2015/2016 - Effort
Effort Bin
1-1 000
1 001-5 000
10 001-30 000
30 001-50 000
>50 000
2015/2016 - CPUE
CPUE Bin
0.01-0.12
0.13-0.24
0.25-0.36
0.36-0.50
2016/2017 - Catch
Catch (t)
0-2
3-10
11-20
21-34
2016/2017 - Effort
Effort Bin
1-1 000
1 001-5 000
5 001-10 000
10 001-30 000
30 001-50 000
>50 000
2016/2017 - CPUE
CPUE Bin
0.01-0.12
0.13-0.24
0.25-0.36
0.36-0.50
2017/2018 - Catch
Catch (t)
0-2
3-10
11-20
2017/2018 - Effort
Effort Bin
1-1 000
1 001-5 000
5 001-10 000
10 001-30 000
30 001-50 000
>50 000
2017/2018 - CPUE
CPUE Bin
0.01-0.12
0.13-0.24
0.25-0.36
2018/2019 - Catch
Catch (t)
0-2
3-10
>35
2018/2019 - Effort
Effort Bin
1-1 000
1 001-5 000
10 001-30 000
>50 000
2018/2019 - CPUE
CPUE Bin
0.01-0.12
0.13-0.24
0.25-0.36
0.36-0.50


2019/2020 - Catch
Catch (t)
0-2
3-10
11-20
>35
2019/2020 - Effort
Effort Bin
1-1 000
1 001-5 000
5 001-10 000
10 001-30 000
30 001-50 000
>50 000
2019/2020 - CPUE
CPUE Bin
0.01-0.12
0.13-0.24
0.25-0.36
0.36-0.50
2020/2021 - Catch
Catch (t)
0-2
3-10
11-20
21-34
>35
2020/2021 - Effort
Effort Bin
1-1 000
1 001-5 000
10 001-30 000
30 001-50 000
>50 000
2020/2021 - CPUE
CPUE Bin
0.01-0.12
0.13-0.24
0.36-0.50
>0.50
2021/2022 - Catch
Catch (t)
0-2
3-10
11-20
21-34
2021/2022 - Effort
Effort Bin
1-1 000
1 001-5 000
5 001-10 000
10 001-30 000
30 001-50 000
>50 000
2021/2022 - CPUE
CPUE Bin
0.01-0.12
0.13-0.24
0.25-0.36
0.36-0.50
>0.50
2022/2023 - Catch
Catch (t)
0-2
3-10
11-20
21-34
2022/2023 - Effort
Effort Bin
1-1 000
1 001-5 000
5 001-10 000
10 001-30 000
30 001-50 000
>50 000
2022/2023 - CPUE
CPUE Bin
0.01-0.12
0.13-0.24
0.25-0.36
0.36-0.50
>0.50
2023/2024 - Catch
Catch (t)
0-2
3-10
11-20
2023/2024 - Effort
Effort Bin
1-1 000
1 001-5 000
5 001-10 000
10 001-30 000
30 001-50 000
>50 000
2023/2024 - CPUE
CPUE Bin
0.01-0.12
0.13-0.24
0.25-0.36
>0.50

Appendix B: GLM Coefficients

Coefficients of the Generalised Linear Model (GLM) comparing the influence of licensing year, month, and spatial fishing block on standardised commercial CPUE within the TOF. Estimate refers to the difference in CPUE between a year/month/block and the intercept (the first year/month/block in the series). Significance codes: *** < 0.001 < ** < 0.01 < * < 0.05 < **.** < 0.01

	Estimate	Standard Error	t value	Pr(>|t|)	Significance
(Intercept)	-2.5018	0.3922	-6.3787	1.85E-10	***
2001/2002	0.0294	0.1769	0.1664	0.8679	
2002/2003	0.6746	0.2137	3.1576	0.0016	**
2003/2004	0.6363	0.1941	3.2788	0.0010	**
2004/2005	0.8423	0.1421	5.9271	3.17E-09	***
2005/2006	1.0157	0.1326	7.6580	2.03E-14	***
2006/2007	0.4483	0.1311	3.4183	0.0006	***
2007/2008	0.7078	0.1303	5.4311	5.71E-08	***
2008/2009	0.4623	0.1305	3.5436	0.0004	***
2009/2010	0.7479	0.1302	5.7444	9.45E-09	***
2010/2011	0.7288	0.1307	5.5754	2.52E-08	***
2011/2012	0.1690	0.1304	1.2964	0.1949	
2012/2013	0.4927	0.1296	3.8006	0.0001	***
2013/2014	0.3412	0.1299	2.6255	0.0087	**
2014/2015	0.4858	0.1302	3.7325	0.0002	***
2015/2016	0.3727	0.1304	2.8574	0.0043	**
2016/2017	0.4623	0.1301	3.5531	0.0004	***
2017/2018	0.1922	0.1299	1.4791	0.1391	
2018/2019	0.7427	0.1302	5.7040	1.20E-08	***
2019/2020	0.4995	0.1307	3.8210	0.0001	***
2020/2021	1.0971	0.1304	8.4161	4.34E-17	***
2021/2022	0.9087	0.1306	6.9568	3.66E-12	***
2022/2023	0.5287	0.1306	4.0478	5.20E-05	***
2023/2024	0.3868	0.1300	2.9762	0.0029	**

	Estimate	Standard Error	t value	Pr(>|t|)	Significance
May	0.2540	0.0224	11.3502	1.05E-29	***
June	0.2492	0.0230	10.8291	3.36E-27	***
July	0.0874	0.0233	3.7424	0.0002	***
August	-0.1234	0.0242	-5.1060	3.34E-07	***
September	-0.1695	0.0244	-6.9376	4.20E-12	***
October	-0.2268	0.0236	-9.5952	1.00E-21	***
November	-0.2240	0.0240	-9.3478	1.05E-20	***
December	-0.0759	0.0249	-3.0454	0.0023	**
January	-0.2051	0.0231	-8.8972	6.55E-19	***
February	-0.1179	0.0240	-4.9150	9.00E-07	***
Block 3D3	0.5682	0.3710	1.5315	0.1257	
Block 3D4	0.7179	0.3702	1.9392	0.0525	.
Block 3E1	0.8871	0.6401	1.3857	0.1659	
Block 3E3	0.6703	0.3708	1.8074	0.0707	.
Block 3E4	0.8201	0.6404	1.2806	0.2004	
Block 3F1	0.6822	0.6404	1.0652	0.2868	
Block 3F2	0.0310	0.4382	0.0707	0.9437	
Block 3F4	0.4479	0.4030	1.1114	0.2664	
Block 3G1	1.1443	0.3737	3.0617	0.0022	**
Block 3G2	0.9519	0.3728	2.5534	0.0107	*
Block 3G3	0.6643	0.3711	1.7901	0.0735	.
Block 3G4	-0.9949	0.4383	-2.2703	0.0232	*
Block 3H1	0.8438	0.3722	2.2673	0.0234	*
Block 3H3	0.3693	0.3707	0.9962	0.3192	
Block 3H4	0.3077	0.3742	0.8222	0.4110	
Block 3I2	0.6269	0.6407	0.9785	0.3279	

	Estimate	Standard Error	t value	Pr(>|t|)	Significance
Block 4D1	-0.0608	0.4793	-0.1268	0.8991	
Block 4D2	0.6778	0.4047	1.6748	0.0940	.
Block 4D3	1.1579	0.4532	2.5552	0.0106	*
Block 4D4	0.1162	0.3902	0.2977	0.7659	
Block 4E1	0.5265	0.3703	1.4217	0.1551	
Block 4E2	0.3487	0.3737	0.9330	0.3509	
Block 4E3	0.2149	0.3705	0.5801	0.5619	
Block 4E4	-0.0587	0.3715	-0.1581	0.8744	
Block 4F1	0.3841	0.4776	0.8043	0.4212	
Block 4F3	0.2479	0.3956	0.6266	0.5310	
Block 4F4	0.0514	0.3739	0.1376	0.8906	
Block 4G1	0.2901	0.3718	0.7803	0.4352	
Block 4G2	0.6970	0.3708	1.8799	0.0601	.
Block 4G3	0.1593	0.3713	0.4290	0.6679	
Block 4G4	0.5253	0.3715	1.4140	0.1574	
Block 4H1	0.1292	0.4000	0.3230	0.7467	
Block 4H2	-0.2063	0.3837	-0.5376	0.5909	
Block 4H3	-0.4786	0.4057	-1.1796	0.2382	
Block 4H4	-1.3567	0.4200	-3.2304	0.0012	**
Block 5F1	0.1885	0.3732	0.5051	0.6135	