Australian Government

Australian Fisheries Management Authority

Bass Strait Central Zone Scallop Fishery — 2025 Survey

AFMA Project 24/0807

July 2025

Matt Koopman and Ian Knuckey

fishwell

Contents

About this document

ISBN 978-1-7642107-0-6

Title: Bass Strait and Central Zone Scallop Fishery - 2025 Survey

AFMA Project 24/0807

2025

Ownership of Intellectual Property Rights

This publication (and any information sourced from it) should be attributed to:

Koopman, M., and Knuckey, I. (2025). Bass Strait and Central Zone Scallop Fishery - 2025 Survey. AFMA Project 24/0807. Fishwell Pty Ltd. 54 pp.

Creative Commons Licence

Cover photo: Jess Kube

Disclaimer

Researcher Contact Details

Name:	Ian Knuckey
Address:	Fishwell Pty Ltd
	Queenscliff, VIC 3225
Phone:	+61 3 5258 4399
Web:	www.fishwell.com.au

Executive Summary

At the start of each Bass Strait and Central Zone Scallop Fishery (BSCZSF) fishing season, the Australian Fisheries Management Authority (AFMA) provides a 150 t research catch allowance to enable fishers to search for commercially-viable scallop (*Pecten fumatus*) beds. Industry members must then undertake research surveys to determine if the fishery can remain open under a Tier 1 (catches ≤ 2,000 t) or Tier 2 (catches > 2,000 t) management arrangement. Research surveys must carry an independent observer or apply electronic monitoring that is able to verify catch quantity, shell size, bycatch and any other scientific data required to determine biomass estimates. This report provides the results of the 2025 research surveys.

Five commercial fishing vessels were selected by an independent panel to conduct the 2025 scallop surveys: the *Shandara*, *Northern Star*, *Karumba Gulf*, *Odette C* and the *Dell Richey II*. During May/June 2025, stratified random surveys were conducted using these vessels on three beds in the Flinders Island (FI) region (including a new bed FI – 5); seven beds in the King Island (KI) region including two new beds (KI – 11 and KI - 12), and one bed in the Apollo Bay (AB) region. Choice and prioritisation of these beds was based on previous surveys, commercial catches from 2024, and input from the Scallop Resource Assessment Group (ScallopRAG) and the Industry Co-Management Committee. Biomass estimates of scallops were calculated for each bed using area swept calculated from the straight-line distance between the start and end tow points and the measured internal width of dredges. Based on previous experimental work, an assumption of 33% dredge efficiency was used for the biomass estimates.

Biomass of commercial scallops greater than 85 mm (shell length) was estimated to be 27 t at the AB – The Hill bed, 26,389 t across the seven KI beds and 4,021 t across the three FI beds. Total biomass of scallops greater than 85 mm at all sites combined was 30,437 t. The percent of commercial scallops greater than 85 mm in length was less than 80% at three of the eleven beds, with the lowest proportion of 66.7% at AB – The Hill, and the highest of 97.2% at KI – Lavinia North and at KI – Lavinia East. Densities of scallops > 85 mm in individuals per m^2, ranged from 0.01 at AB – The Hill to 2.61 at KI – 3 Hummocks SE.

Catch composition varied greatly among beds surveyed. Overall, live Commercial Scallops comprised 18% of the catch, whereas old single shell (21%), broken shell (15%), new single shell (13%) and sponge (11%) comprised the largest other components of the catch by weight. For FI – NB, nearly half the catch by weight was sponge and oysters. Similarly, relatively high catches of sponge were recorded at KI – Lavinia East (30%), AB – the Hill (20%), and KI -BDE (18%). Relatively large catches of Doughboy Scallops were recorded at KI – 12 (14%) and KI – BDE (12%). Although 60 species/groups were identified in bycatch, most species were caught in relatively low numbers. Notably, Eleven Armed Seastars (*Coscinasterias calamaria*), a major predator of scallops comprised 26%, 14%, 5% and 3% of the catch by weight at KI – 12, KI – 11, KI – Lavinia North and KI – 3 Hummocks SE respectively. Two high-risk species were caught during the survey: Southern Blue-Ringed Octopuses were recorded at FI-1 (6.3 kg) and FI-5 (0.2 kg); Black and White Seastars were recorded from AB – the Hill (14.7 kg), FI – 5 (0.5 kg), FI – NB (0.6 kg), KI – BDE (8.9 kg), KI – Lavinia East (9.2) and, particularly, KI – Lavinia North (70.0 kg).

These results were presented at the ScallopRAG meeting on 19 June 2025 and at the Scallop Management Advisory Committee (ScallopMAC) meeting on 20 June 2025.

List of Tables

List of Figures

Acknowledgements

We would like to thank Glen Wisby and the crew of the Odette C, John and Johno Hammond and crew of the Shandara, John and Graham Cull and crew of the Karumba Gulf, Andy and Jake Watts and the crew of the Northern Star, John and Stuart Richey and the crew of the Dell-Richey II for all of their assistance and hard work in undertaking the 2025 survey. Johno Hammond, John Richey and Jake Watts provided valuable information used to define new beds. The observers Bryce Nurnaitis and Tamsin Jones worked very hard to collect all data required to a high-quality standard.

Andrew Powell (AFMA), provided the logbook data used to guide the survey design.

1 Introduction

The main target species in the Bass Strait Central Zone Scallop Fishery (BSCZSF) is the Commercial Scallop, *Pecten fumatus*. Commercial Scallops are short-lived species (up to nine years of age) (Gwyther and McShane 1988), but have been observed to die-off rapidly after only three to five years in some situations (Haddon *et al.,* 2006, Penney *et al*. 2025). Scallops are generally subject to high spatial and temporal variability in recruitment and abundance (Penney *et al*. 2025). They show variable growth and mortality, and rapidly changing meat yield and reproductive condition (Gwyther and McShane 1988, Penney *et al.* 2025). This variability means that management of Commercial Scallops must adapt to short-term changes in distribution and abundance, yet still ensure conservation of the resource consistent with the *Commonwealth Fisheries Harvest Strategy Policy 2018* (HSP).

Under the original HSP, the initial harvest strategy for the BSCZSF was developed during 2007. The harvest strategy was revised during the 2012 season. Furthermore, in response to industry concerns about the cost-effectiveness and flexibility of management, the HSP was further revised during 2014. The current BSCZSF Harvest Strategy (the Harvest Strategy) has two primary objectives. To:

1. keep stocks within the BSCZSF at ecologically sustainable levels and, within that context, maximise the economic returns to the Australian community; and,

2. pursue efficient and cost-effective management in attaining (1) above.

The HSP uses a tiered approach designed to apply different levels of management and research input depending on the state of the resource. Underpinning the tiered approach is the need to balance the risk of over exploitation whilst obtaining knowledge on the status of the stock at the commencement of the season through pre-season surveys.

At the start of each fishing season, the Australian Fisheries Management Authority (AFMA) provides a 150 t research catch allowance to enable fishers to search for commercially-viable scallop beds, defined as "…*an area or scallop bed containing no greater than 20 per cent of scallops of a size less than 85 mm"*. To increase the catch allowance above 150 t, industry members must undertake research surveys to determine if the fishery can remain open under Tier 1 or Tier 2 level management arrangements (as defined below).

- **Tier 1 management arrangements** require initial closure of an area/s (not more than 2 scallop beds) that contain a total biomass of ≥1,500 tonnes of high-density scallops of a minimum size of 85 mm. The season begins with a 1,000 t total allowable catch (TAC) that can be increased to 2,000 t if good catches are achieved.

- **Tier 2 management arrangements** require initial closure of an area/s (not more than 2 scallop beds) that contain a total biomass of ≥3,000 tonnes of high-density scallops of a minimum size limit of 85 mm. The season begins with a 2,000 t TAC that can be increased if good catches are achieved.

Research surveys must carry an independent observer or apply electronic monitoring that is able to verify catch quantity, shell size and any other scientific data required to determine biomass estimates. This report provides the results of the 2025 stratified random surveys.

1.1 Objectives

1. Estimate the scallop biomass and potential commercial catch rates in three different areas of the BSCZSF.
2. Measure the size frequency distribution of scallops in each area to calculate discard rates.
3. Report results to AFMA, the Scallop Resource Assessment Group (ScallopRAG) and the Scallop Management Advisory Committee (ScallopMAC).

2 Methods

2.1 Survey History

The 2015 survey covered three beds in the King Island (KI) region and one bed in the Flinders Island (FI) region (Figure 1, Figure 2, Figure 3, Table 1). To provide greater flexibility in management arrangements regarding closures, the pre-season survey was expanded in 2016 with the addition of an extra four beds in the KI region and another bed in the FI region. In addition to the extra sites, the boundaries of some of the 2015 beds were modified. For example, northern and southern boundaries of the bed known as KI-Main in Knuckey *et al.* (2015) were contracted slightly, and the eastern and western boundaries moved east slightly to form a bed titled KI-2 in Knuckey *et al.* (2016).

The beds surveyed during 2017 were based on advice from the Scallop Research Workshop and input from ScallopRAG and the BSCZSF Co-Management Committee. They comprised previously surveyed beds, modified beds and new exploratory beds. In 2018 two beds were added off King Island, whereas Apollo Bay (AB) – 3, AB – 4, FI – 3 and FI – 4 were not surveyed. In 2019, together with the FI bed, AB 1 and 2 were surveyed, and two new beds (one stretching south-east of KI Bluedot Extended (BDE) and another called the KI – JH bed comprising high density of juvenile scallops) were added. To protect the juvenile scallops at KI – JH, sampling intensity was reduced, and a fine mesh cover was placed over half of the dredge to improve sampling of small scallops. No survey was undertaken in 2020 because of concerns regarding the COVID-19 outbreak. Twelve beds were surveyed in 2021 when the FI – North - The Sisters and FI – North of Babel (NB) beds were added in the FI region, the KI – JH site was extended to the southeast, AB – 2 was extended to the north and AB – The Hill and AB – Five Hours sites were added in the AB region.

Significant catches were taken from an area to the north-west of the FI South – North of Babel site during 2021. Accordingly, reflecting these catches, new beds were surveyed in 2022 (FI – Wreck A together with FI – The Wreck B).

New beds introduced in 2023 included: KI – Three Hummocks East, KI – Three Hummocks West and FI – The Sisters East. The Three Hummocks beds were based on results of an FRDC-funded industry survey in December 2021 that showed high densities of undersized scallops. The Three Hummocks beds showed decreasing size of scallops with depth. These two beds were subsequently split at approximately the 52 m line, with the two new beds called KI – Three Hummocks Shallow and KI – Three Hummocks Deep. KI – Three Hummocks Deep was one of the beds closed during the 2023 season. Similarly, VMS data showed high fishing effort in a new bed east of the Sisters and so a new bed (FI North – The Sisters East) was surveyed there in 2023. Other beds surveyed in 2023 were: KI – 9, KI – 10, KI – BDSE, AB – The Hill North, FI, FI North – The Sisters, FI South – North of Babel, FI – The Wreck A and FI – The Wreck B.

For the 2024 survey, the following new beds were surveyed: FI – Babel North East, KI– Lavinia North, KI– Lavinia East, KI– Three Hummocks South and KI – Three Hummocks South East.

New beds introduced in 2025 included: KI – 11, KI – 12 and FI – 5. These beds were based on previous surveys; analysis of 2024 catch and effort data and advice from the ScallopRAG and the BSCZSF Co-Management Committee.

Changes to the beds surveyed since 2015 are outlined in Table 1.

For the 2025 survey, ScallopRAG recommended including the following beds:

1. King Island 10
2. King Island 11
3. King Island 12
4. King Island Blue Dot Extended
5. King Island Three Hummock South East
6. King Island Lavinia North
7. King Island Lavinia East
8. Apollo Bay – The Hill North
9. Flinders Island 1
10. Flinders Island 5
11. Flinders Island South – North of Babel

With the exception of new beds King Island 11, 12, Blue Dot extended; and Flinders Island 5, these beds were surveyed in 2024. King Island Blue Dot Extended has been previously surveyed. New beds are highlighted in Table 1 and shown in Figure 4 and Figure 5. Surveyed beds and their size are shown in Table 2.

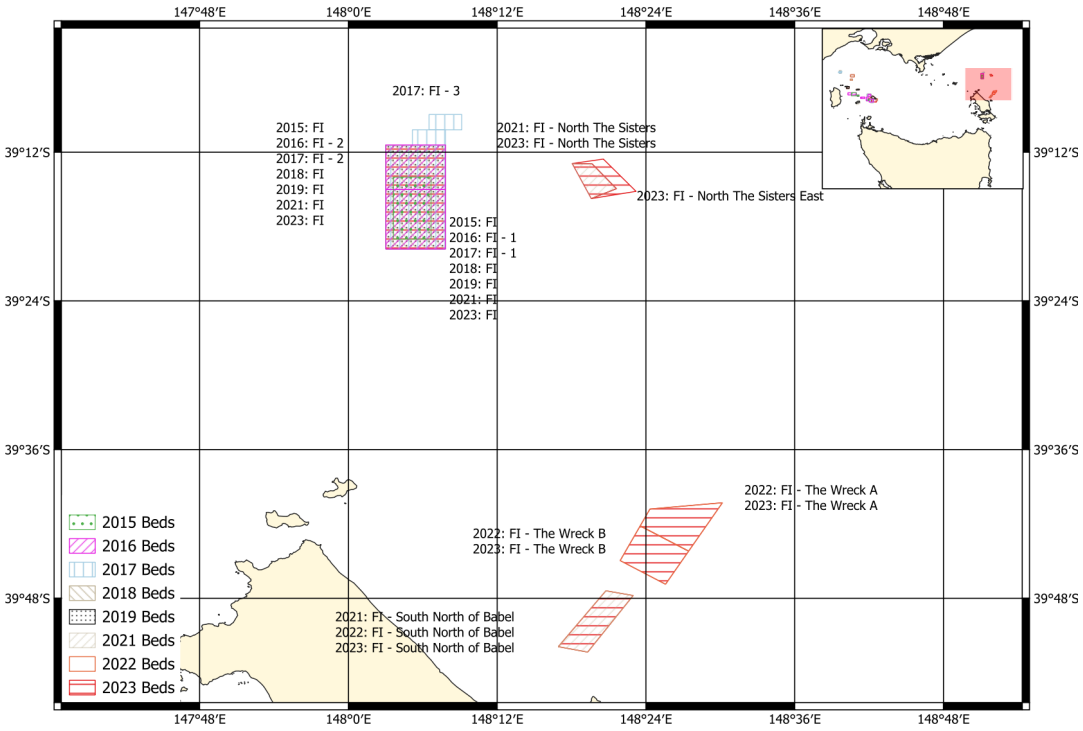


Figure 1. History of beds surveyed off Flinders Island from 2015 to 2023.

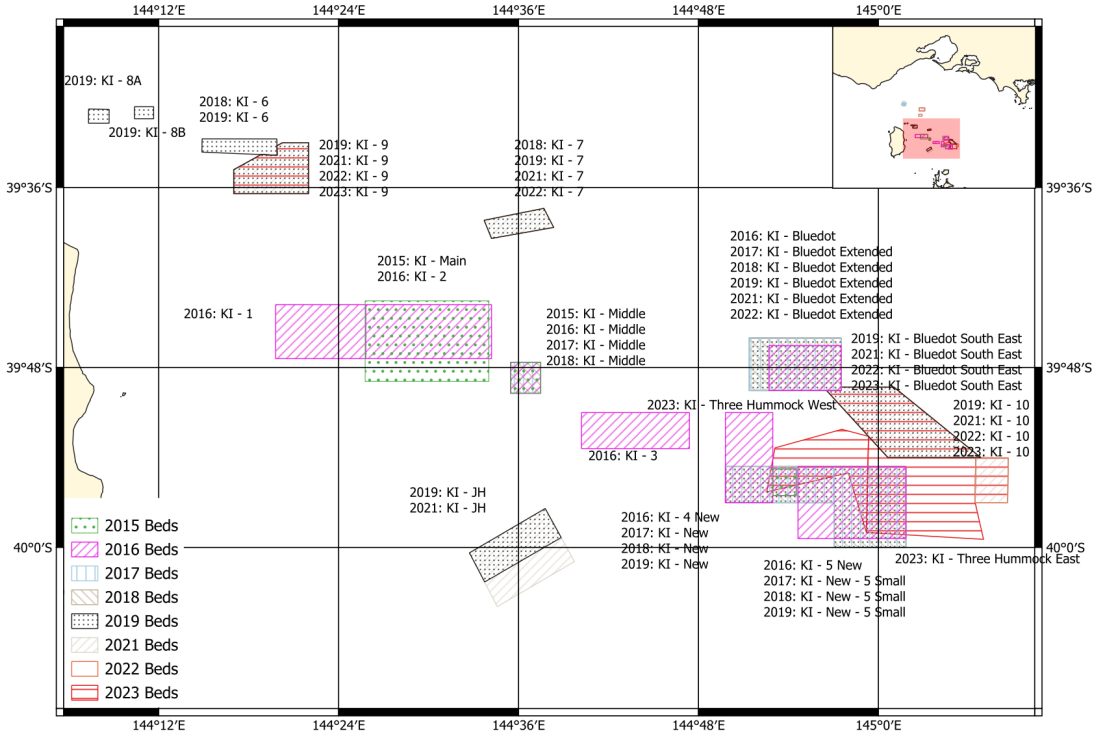


Figure 2. History of beds surveyed off King Island from 2015 to 2023.

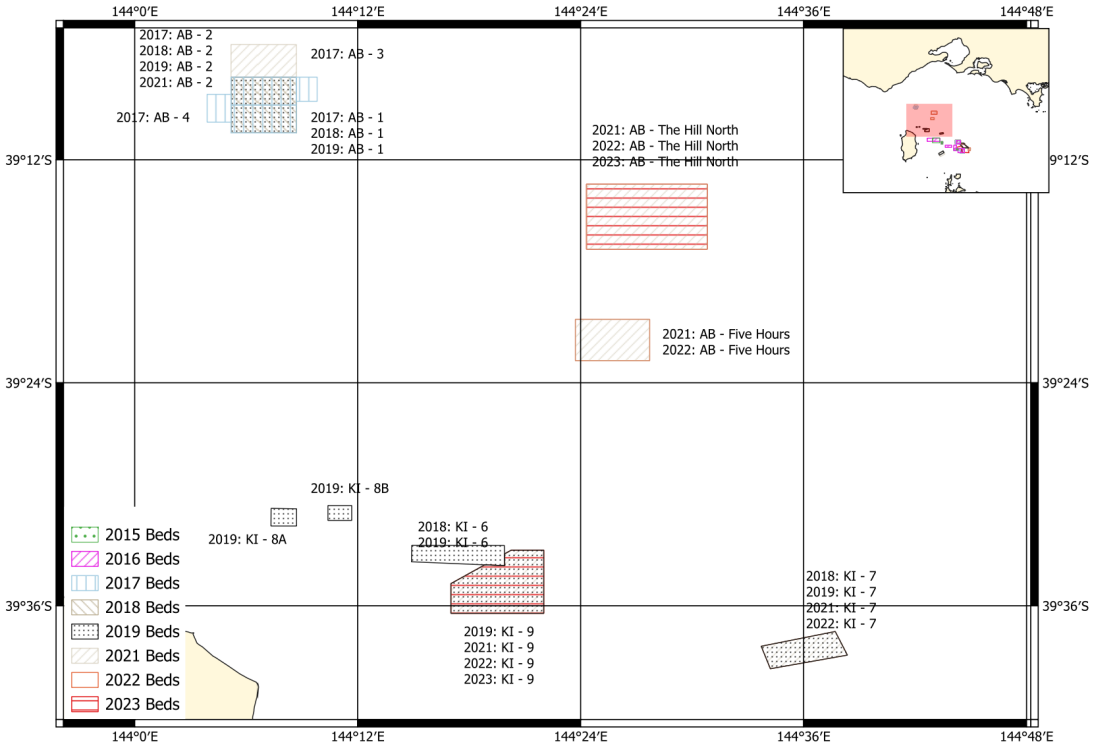


Figure 3. History of beds surveyed off Apollo Bay and King Island from 2015 to 2023.

Table 1. Description of beds surveyed since 2015 and beds new to 2025. See Figure 1, Figure 2 and Figure 3 for maps of beds.

Name	Description
KI – 5S	Originally a larger area that was surveyed in 2016, KI – 5S was formed by extending the eastern boundary of KI-New south to -40˚S, and including the area of KI – 5 to the east of that. This bed remained unchanged from the 2017 to 2019 when it was last surveyed.
KI – New	KI-New was a bed that was defined for management proposes (it formed the initial closure) after the 2016 survey, covering at least parts of three different beds surveyed in 2016. It comprised parts of a bed called KI – East which was surveyed during 2015, and again in 2016, along with two new adjacent beds, KI – 4 and KI – 5. KI – New remained unchanged from the 2017 to 2019 when it was last surveyed.
KI – BDE	During the TAC setting by the MAC for the 2016 season, industry provided information regarding a dense bed of small scallops that would be more suitable for closure than the KI – New bed. This bed titled King Island Blue Dot was mapped out and then surveyed during August of 2016. The area was expanded north and west to form an area closure that replaced the closure of KI – New. The boundaries of this expanded area are shown in Figure 2. This bed remained unchanged from the 2017 to 2022 surveys.
AB – 1 and AB – 2	Seven exploratory marks in the KI region were provided by industry in 2017 to be explored and considered for additional survey beds. Only one of those showed sufficient density to survey, and the skippers mapped out the area, splitting it into two beds. Two additional smaller beds were added to each of the western and eastern boundaries. However, these beds contained low densities of scallops and were omitted from the 2018 and future surveys. The AB-1 and AB – 2 bed boundaries remained unchanged during the 2018 and 2019 surveys. For the 2021 survey, only AB – 2 was surveyed, and the northern boundary was moved north to cover relatively high levels of commercial effort in that area. Neither beds were surveyed in 2022.
KI – 6	Examination of 2018 commercial catch and effort data revealed significant catches in a large area at approximately longitude 144˚ 17', latitude 39˚ 32'. The vessels mapped out this area to provide a smaller area with high density scallops within the boundaries shown in Figure 2. The bed boundaries remained unchanged from the 2018 survey, was resurveyed in 2019, but omitted for the 2021 survey.
KI – 7	Examination of 2018 commercial catch and effort data revealed significant catches in a large area at approximately longitude 144˚ 36', latitude 39˚ 38'. The vessels mapped out this area to provide a smaller area with high density scallops within the boundaries shown in Figure 2. The bed boundaries remained unchanged from the 2018 survey, was resurveyed in 2019 and was surveyed in 2021 as a replacement for KI – Mid (in accordance with ScallopRAG recommendations).
FI	FI-1 was called the "Flinders Island" bed during the 2015 survey. For the 2016 and 2017 surveys, the area was expanded and spilt into the two beds (FI – 1 and FI – 2). Two additional smaller beds were added to the northern boundary of FI-2 in 2017. However, because of low scallop densities, these beds were omitted for the 2018 survey. For the 2018 survey, FI – 1 and FI – 2 were combined into a single large bed (Figure 1). The bed boundaries remained unchanged from the 2018 survey and the bed was resurveyed in 2019, 2021 and 2023, but not in 2022.
KI – 8a and KI – 8b	Examination of 2019 commercial catch and effort data revealed significant catches in a large area at approximately longitude 144˚ 10', latitude 39˚ 31'. Within the general area worked, there were three main patches of densely populated scallop beds separated by areas of low density and an underwater cable. The two largest of these small areas were selected to survey in that year. They were not surveyed in 2021 or 2022.

Name	Description
KI – 9	Examination of 2019 commercial catch and effort data revealed significant catches within a large area at approximately longitude 144˚ 21', latitude 39˚ 35'. The final boundaries were set based on a combination of fishing effort by the survey vessel in the previous year and exploratory fishing. This bed was resurveyed in 2021, 2022 and 2023.
KI – JH	An industry member provided two marks defining a line of exploratory tows that contained relatively high densities of juvenile scallops (~50 mm). Being the most recent sign of significant recruitment there was interest in tracking the growth of scallops within this bed. However, there was concern of potential disturbance to the bed by surveying it. As a compromise, a relatively small survey area was established with only 20 sampling sites. Based on advice from industry, the bed was extended to the south-east for the 2021 survey. This bed was not surveyed in 2022.
KI – BDSE	Examination of 2019 commercial catch and effort data revealed significant catches in a large area at approximately longitude 145˚ 00, latitude 39˚ 49. The final boundaries were set based on a combination of fishing effort by the survey vessel in the previous year and exploratory fishing. This bed was resurveyed in 2021, 2022 and 2023.
KI – Mid	This bed remained unchanged from 2015, 2016, 2017 and 2018. In accordance with RAG recommendations, five exploratory tows were conducted at this bed during 2021 revealing low densities (no scallops were caught). Accordingly, KI – 7 was surveyed instead. This bed was not surveyed in 2022.
KI – 10	Significant catches were taken from an area to the south-east of the KI-BDSE site during 2020. KI – 10 was subsequently established and was surveyed in 2021, 2022 and 2023.
AB – The Hill North	Industry members provided marks about 17 nm to the south-east of Apollo 2 where significant amounts of scallops were caught in 2020. Based on commercial effort reported from the area, and notes made on a fishing vessel's plotter, a bed was defined and surveyed in 2021 and 2022.
AB – Five hours	Industry members provided marks about 19 nm to the south-east of AB – Apollo 2 where significant amounts of scallops were caught in 2020. Based on commercial effort reported from the area, and notes made on a fishing vessel's plotter, a bed was defined and surveyed in 2021 and 2022.
FI – North - The Sisters	Significant catches were taken from an area about 11 nm to the east of the FI site. Based on commercial effort reported from the area, and notes made on a fishing vessel's plotter, a bed was defined. This bed was surveyed in 2021 and 2023, but not in 2022.
FI – South – North of Babel	Significant catches were taken from an area about 31 nm to the south-south-east of the FI site. Based on commercial effort reported from the area, and notes made on a fishing vessel's plotter, a bed was defined and surveyed in 2021, 2022 and 2023.
FI – The Wreck A	Significant catches were taken from an area to the north-west of the FI South – North of Babel site during 2021. FI – The Wreck A was a new bed in 2022 that together with FI – The Wreck B, surrounds that catch. It was also surveyed in 2023.
FI – The Wreck B	Significant catches were taken from an area to the north-west of the FI South – North of Babel site during 2021. FI – The Wreck B was a new bed in 2022 that together with FI – The Wreck A, surrounds that catch. It was also surveyed in 2023.
KI – Three Hummocks West	An industry-led survey in December 2021 (as part of a FRDC project) revealed high densities of undersized scallops. The bed was not surveyed in 2022 as many scallops remained undersized. It was surveyed in 2023, and together with KI – Three Hummocks East and, on request of the RAG, the boundaries were re-defined based on bathymetry which appeared to delineate densities and size of scallops.

Name	Description
KI – Three Hummocks East	An industry -led survey in December 2021 (as part of a FRDC project) revealed high densities of undersized scallops. The bed was not surveyed in 2022 as many scallops remained undersized. It was surveyed in 2023, and, on request of the RAG, the boundaries were re-defined based on bathymetry which appeared to delineate densities and scallop size.
FI – The Sisters East	For the 2023 survey, the previously agreed FI – North bed was replaced with an eastern extension to FI – North - The Sisters. This new bed is based on VMS data and commercial fisher input (Figure 5).
FI – Babel North East	An exploratory area was foreshadowed between FI and FI – South North of Babel. This area revealed few scallops, but it was discovered that the FI – South North of Babel extends to the north-east. This area was mapped out and surveyed in 2024.
KI – Lavinia North	Industry noted that there was a very large bed of scallops to the west and south of KI – 9. The boundaries of this very large bed were set in consultation with Industry, and divided into two areas at approximately the halfway point. KI – Lavinia North is the north-western half of this bed.
KI – Lavinia East	Industry noted that there was a very large bed of scallops to the west and south of KI – 9. The boundaries of this very large bed were set in consultation with Industry, and divided into two areas at approximately the halfway point. KI – Lavinia East is the south-eastern half of this bed.
KI – Three Hummocks South	Based on the 2023 KI – Three Hummocks East and KI – Three Hummocks West beds and information from Industry, a new bed along the southern boundary of KI – Three Hummocks East and extending north-west to just below KI – Three Hummocks West was established and surveyed.
KI – Three Hummocks south-east	Industry observed that the KI – Three Hummocks East bed extended to the south-east. Based on this information, KI – Three Hummocks South East was established and surveyed.
KI – 11	Industry members provided information that the KI – Three Hummocks south-east bed continued to the north-west and south-east. KI – 11 was mapped out by one of the survey vessels to the north-west of KI – Three Hummocks south-east, and partially overlaps with the 2024 KI – Three Hummocks South bed and the 2023 KI – Three Hummocks East site.
KI –12	Industry members provided information that the KI – Three Hummocks south-east bed continued to the north-west and south-east. KI – 1 was mapped out by one of the survey vessels to the south-east of KI – Three Hummocks south-east, and partially overlaps with the 2024 KI – Three Hummocks South bed.
FI – 5	Industry suspected that there were unknown scallop beds off Flinders Island and two vessels conducted a search. Only one viable bed was discovered and mapped. KI – 5 partially overlaps with the 2001, 2023 and 2024 FI – North – The Sisters and the 2023 FI – The Sisters East bed.

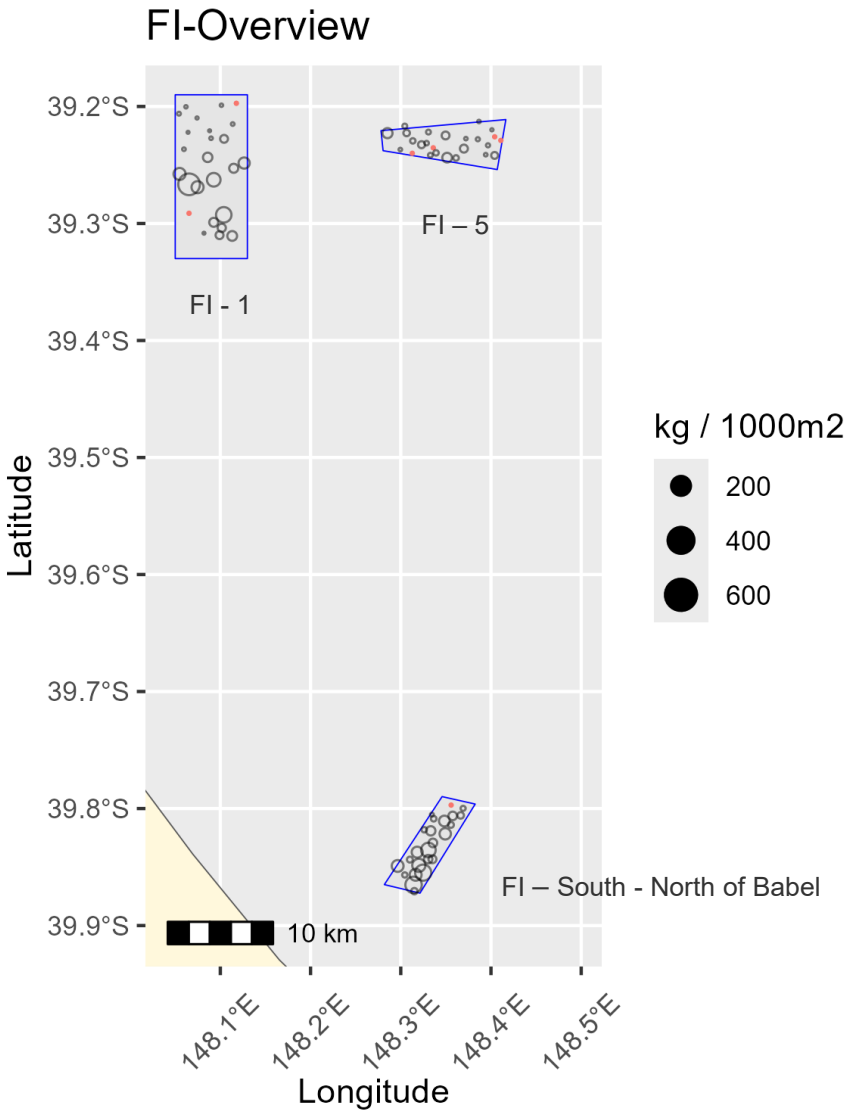


Figure 4. Beds surveyed in 2025 off Flinders Island.

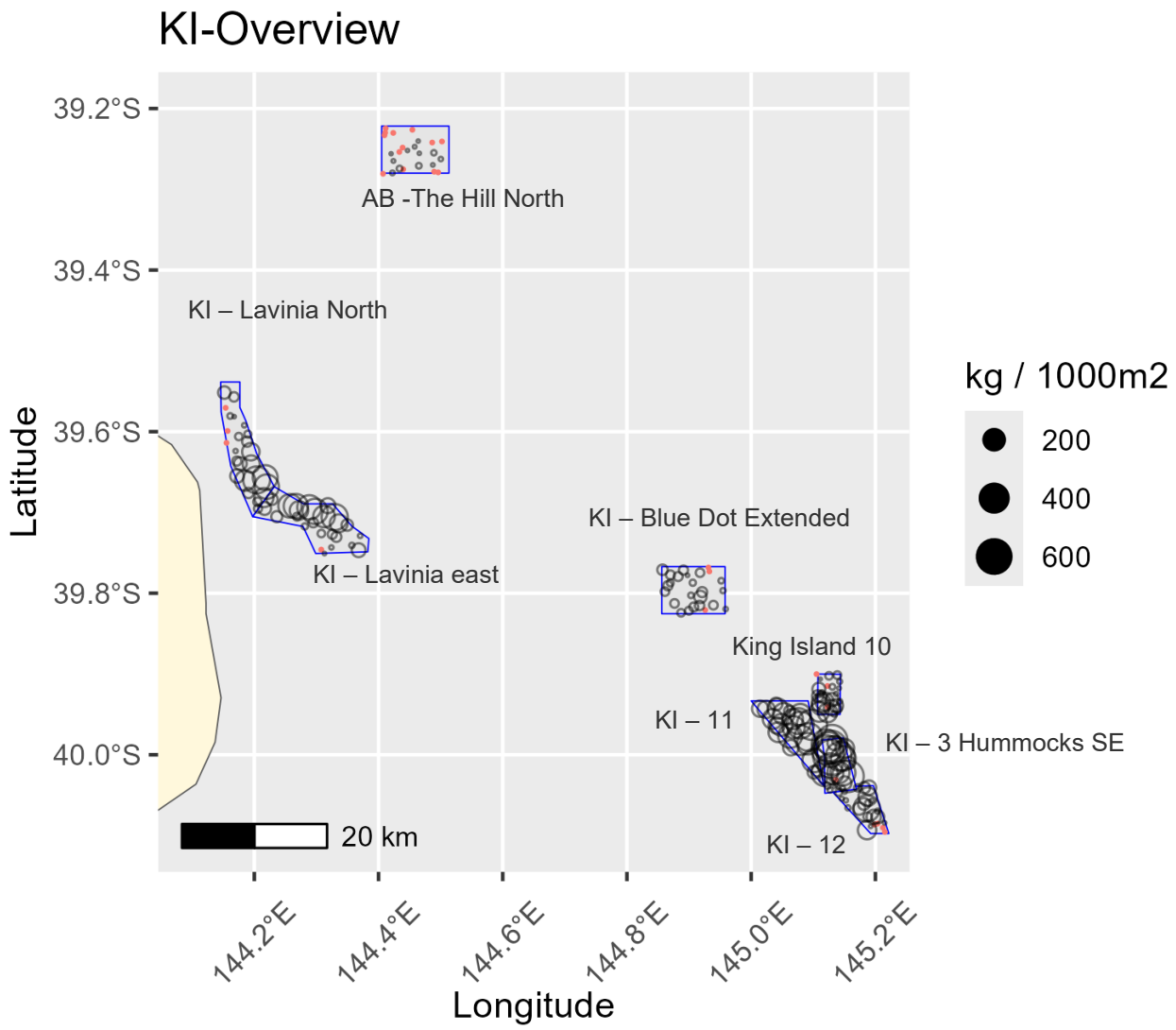


Figure 5. Beds surveyed in 2025 off King Island.

2.2 Survey Design

Survey methods follow those of Knuckey *et al.* (2015, 2016, 2017, 2018) and Koopman *et al.* (2019, 2021, 2022, 2023, 2024), modified from those described in Harrington *et al.* (2008). Five vessels were selected to undertake the survey. A procedures manual (Fishwell 2024) guided vessel-based conduct of the survey. This manual was updated for the 2025 survey by including a more detailed species identification guide.

The number of survey points allocated to each bed was largely guided by sampling effort during past surveys, with consideration given to the maximum number of tows that can be achieved in a 12-hour sampling block[1]. Primary sampling sites within each bed were randomly allocated using the QGIS Random Points in Polygons Tool. Additional random survey points were allocated to each bed as "backup sites", to be used where "primary sites" were unfishable.

[1] For OHS reasons, observers are restricted to a maximum of 12 hours of sampling in a 24-hour period.

During 2025, surveys were conducted onboard the fishing vessels *Karumba Gulf* (Scientific Permit# 1006257), *Shandara* (Scientific Permit# 1006258), *Odette C* (Scientific Permit# 1006259), *Dell Richey II* (Scientific Permit# 1006256) and the *Northern Star* (Scientific Permit# 1006255), which were selected by an independent panel. To be considered a valid tow, the vessel must dredge within 100 m of the tow location provided.

2.2.1 Sampling methods

For each tow, estimates were made of weight of: total live scallop catch, dead shell and all bycatch by species / species group. Dead Commercial Scallop shell was separated into:

- Clappers (both valves still connected at the hinge)
- Old single shell (single valve – inside appears old and overgrown with epiphytes / epifauna)
- New single shell (single valve – inside appears new without any epiphytes / epifauna)

A random sample of at least 35 scallops (where available) was collected from each tow before sorting. The observer measured the length of those scallops using an electronic measuring board. Either the first or last (or both) scallop from each tow measured using the measuring board was also measured by hand using digital callipers or a metal ruler. This was done to ensure accuracy and consistency of the measuring board throughout the survey. The sample weight of scallops measured was also recorded.

From every fifth tow, an additional 10 random scallops were taken to collect biological information. First, the whole scallop was weighed, then split and the gonad condition staged according to the scale based on Semmens, *et al*. (2018) (Table 9). Adductor meat and gonad were removed from the shell and weighed together to calculate number of meats per kg. Shell height and width were also measured for morphometric analyses (Fishwell 2024).

2.2.2 Data analysis

All data processing and analysis was undertaken in R (R Core Team 2025). Estimates of biomass followed the methods of Semmens and Jones (2014).

2.2.3 Biomass estimates

The internal widths of the dredges used during the survey were measured in accordance with Semmens and Jones (2014). Dredge widths used by the *Shandara*, *Odette C*, *Northern Star*, *Del-Richey II* and *Kurumba Gulf* were 4.87 m, 3.905 m, 3.583 m, 3.930 m and 4.28 m. A dredge efficiency of 33% was assumed.

Swept area (S) of each tow was calculated as follows:

$S = L \times W$

Where L is the tow distance (m) and W is the width of the dredge (m). Tow distance was calculated from the straight-line distance between start and end tow positions.

Scallop catch in each tow ($C^{standardised}$ in kg/1000 m^2) was calculated as follows:

$C^{standardised} = (C/S)x1000$

Where C is the estimated catch in a tow (kg).

Assuming a 33% dredge efficiency, biomass (B) in tonnes and 95% confidence interval (CI) were estimated for each stratum (bed) as follows:

$B = \text{mean}D * A * 3.03 / 1000$

Upper 95% CI= ((mean*D* + (tn-1 x SE_{meanD})) x *A*)*3.03 / 1000

Lower 95% CI= ((mean*D* - (tn-1 x SE_{meanD})) x *A*)*3.03 / 1000

Were mean*D* is the mean density (kg) of scallops per m^2 swept, t_{n-1} is the t –value for the number of tows (n) -1, SE_{meanD} is the standard error of mean*D* and *A* is the total stratum area (m^2). The area of each bed was calculated using the R package "Simple Features" (Pebesma 2018).

Biomass and upper and lower 95% confidence intervals (CI) of scallops greater than 85 mm (shell length) were calculated as follows:

B>85 mm = *B* * (1-discard rate)

Upper 95% CI >85 mm = Upper 95% CI * (1-discard rate)

Lower 95% CI >85 mm = Lower 95% CI * (1-discard rate)

where the discard rate was calculated using catch weighted length frequencies converted to weight.

An estimate of density in individuals per square metre (I) was obtained as follows

$$I = \sum_{len} WLf/S$$

Were *W*Lf is the weighted length frequency for each length class *len*, and *S* is the swept area (m^2).

All densities (kg / m^2 and individuals per m^2) reported have been adjusted for the 33% assumed dredge efficiency (see Harrington *et al*. (2008) for origin of the 33%).

2.2.4 Biologicals

The length-weight relationship was calculated for each area separately, and the parameters of the relationship are provided in the results. The length-weight relationship was applied to catch-weighted size frequencies to calculate the discard rate at 85 mm. The discard rate was used in calculations of biomass of scallops greater than 85 mm shell length. Number of meats per kg was calculated separately for each bed by dividing 1,000 by the mean meat and gonad weight in grams.

2.2.5 Bycatch

The bycatch from each tow was sorted, identified to the lowest taxonomic level and recorded. A subsample was weighed and scaled up to total catch for each bed. Given concerns that high risk species such as Black and White Seastars and King Island Thickshell Clams may be misidentified, observers were provided with an identification guide and paid particular attention to these species together with other at-risk species such as Southern Blue-Ringed Octopus.

2.2.6 Quality Assurance

The survey was undertaken following Standard Operating Procedures (Fishwell, 2024). All tow and scallop catch data were recorded in OLRAC Dynamic Data Logger (DDL), which contains quality assurance protocols including automatic data capture (time, date and position), field restrictions, range checks, mandatory fields and lookup tables. These data are maintained in the OLRAC Dynamic Data Manager (DDM) database on a cloud-based server from which data are extracted for analyses. Data were manually error checked against data sheets. Analyses were undertaken using R (R Core Team, 2025), and a subset of outputs were reproduced and compared using an alternative software package. Scallops were measured using electronic measuring boards, or callipers in the event of measuring board failure. The first or last (or both) scallop

from each tow was measured by both the measuring board and by hand using either digital callipers or a metal ruler. This was done to ensure accuracy and consistency of the measuring board throughout the survey.

Results and their interpretations and conclusions were discussed amongst the research team, and draft reports were reviewed by co-authors and AFMA managers. Where required, comments were addressed in preparation of the final report.

3 Results

3.1 Survey order

The 2025 BSCZSF survey was undertaken during May and June of 2025. Commencing May 10, the *Shandara* surveyed the KI – 12, KI – 11 and KI – 3 Hummock South East beds off King Island. Commencing May 13, the *Kurumba Gulf* surveyed KI – Lavinia East, KI – Lavinia North and AB – the Hill North beds. Commencing May 18, the *Odete C* surveyed KI – 3 Hummock South East, KI – 10 and KI – BDE. Commencing May 31, the Northern Star surveyed FI – 1 and FI – 5 beds off Flinders Island. Commencing May 31, the *Dell Richey II* surveyed the FI - NB bed off Flinders Island.

3.2 Biomass, size and potential commercial catch rates

The mean biomass estimate for AB – The Hill was 41.2 t (95%CI 6.8 t – 75.5 t) (Table 4) a substantial decrease in estimated biomass of scallops in 2024 (3,304 t). The percentage of scallops >85mm at each of that bed was 66.7% (Table 5), and consequently the mean biomass of scallops > 85 mm was 27 t (Table 5) compared with 1,742 t in 2024.

Similarly, for beds previously surveyed off King Island, mean biomass estimates for KI – 10, KI – Three Hummock SE, KI – Lavinia East and KI – Lavinia North were 794t (95%CI 381 – 1,208 t); 6,462t (95%CI 4,214 – 8,710t) ; 6,335 (95%CI 3,289 – 9,381 t) and 4,473 (95%CI 1,935 – 7,012 t) respectively (Table 4). The biomass of scallops from KI-BDE was 845t (95%CI 549 – 1,142 t), KI-11 8,810 t (95%CI 6,514 – 11,105) and KI-12 1,085 (95%CI 278 – 1,891) (Table 4). The percentage of scallops >85mm was more than 97% at KI – Lavinia East and KI – Lavinia North and was lowest at KI – BDE (63.2%), (Table 5), and consequently mean biomasses of scallops > 85 mm were proportionally lower than total biomass estimates (Table 5).

The percentages of scallops >85 mm surveyed off Flinders Island ranged from 75.6% at FI – 5 to 87.9% at FI – 1 (Table 5) resulting in mean biomasses of scallops > 85 mm of 190 t, 908 t and 2,923 t for FI – 5, FI – NB and FI -1 respectively (Table 5).

Consistent with biomass estimates, densities of scallops were generally lower than those from the 2024 survey particularly for AB – the Hill (Table 4, Figure 6). Densities off King Island were higher than at AB – the Hill (Figure 7, Figure 8), but lower than those estimated from locations surveyed in 2024; although KI – Lavinia East and KI – Lavinia West maintained relatively high densities of scallops (Figure 8). Similarly, locations surveyed off Flinders Island had relatively low densities of scallops including the at new bed FI - 5 (Figure 9).

Estimated densities in numbers of commercial scallops >85 mm ranged from 0.01 individuals per m^2 at AB – the Hill to 2.61 individuals per m^2 at KI – 3 Hummocks SE (Table 4).

Comparisons of biomass estimates, percent catch composition and size distributions of beds that have been repeatedly surveyed and surveyed in 2025 are shown in Appendix 2. Although the sampling methods have

been consistent, the areas of some beds have changed. Care should be taken when interpreting those results, and consideration of changes in bed areas over time should be made.

3.3 Biologicals

Mean length of scallops measured ranged from 83 mm at FI – NB to 98 mm KI – Lavinia East (Table 6). The mean lengths were greater for beds surveyed in 2025 compared with 2024, reflects fewer smaller scallops and growth of larger scallops (Figure 11). Recruitment was generally sparse with notable exceptions at FI – NB and KI – BDE (Figure 11). Consistent with the 2024 survey, scallop meats were much smaller at the KI and AB beds compared with beds surveyed off Flinders Island (Table 6). Scallop meats per kg ranged from 72 at FI – 5 to 117 at KI – 11. Maturity states varied greatly across beds (Figure 12, Table 9). More than 80% of scallops examined had stage one gonads at AB – the Hill. The highest percentage of stage two gonads were recorded from FI – 5 and FI – NB (Figure 12). For KI – Three Hummocks SE 25% of scallops were recorded as stage three (Figure 12).

Comparison of length-weight regressions revealed no strong evidence for a difference between sites at Flinders Island significant ($p = or > 0.05$). Data were combined to calculate coefficients. For the King Island beds, only KI – 12 had statistically a significantly different slope and intercept ($p<0.05$), however given the proximity to other King Island beds, data were combined to calculate coefficients.

Separate length-weight relationships were calculated for area (Table 7). Scatterplots of each combination of size measurements (including total weight) are shown in Figure 10.

3.4 Bycatch

A total of 60 different species / groups were identified during the survey (Table 8), and catch composition varied greatly among beds (Figure 13 and Figure 14). Notably, Eleven Arm Seastars (*Coscinasterias calamaria*), a major predator of scallops comprised 26%, 14%, 5% and 3% of the catch by weight at KI – 12, KI – 11, KI – Lavinia North and KI – 3 Hummocks SE respectively. Compared with previous surveys, the abundance of Eleven Arm Seastars has increased considerably in 2025 (Figure 15). Overall, live commercial scallops comprised 18% of the catch, whereas broken shell (15%), old single shell (21%), new single shell (13%) and sponge (11%) comprised the largest other components of the catch by weight. Most of the catch by weight (67%) was scallops (including dead shell). However, bycatch composition varied among survey locations. For FI – NB, nearly half the catch by weight was sponge and oysters. Similarly, relatively high catches of sponge were recorded at KI – Lavinia East (30%), AB – the Hill (20%), and KI -BDE (18%). Relatively large catches of Doughboy Scallops were recorded at KI – 12 (14%) and KI – BDE (12%).

Some high-risk species were caught during the survey: Southern Blue-ringed Octopuses were recorded at FI – 1 (6.3 kg) and FI – 5 (0.2 kg); Black and White Seastars were recorded from AB – the Hill (14.7 kg), FI – 5 (0.5 kg), FI – NB (0.6 kg), KI – BDE (8.9 kg), KI – Lavinia East (9.2) and, particularly, KI – Lavinia North (70.0 kg). The abundance of Black and White Seastars has increased in some beds compared with previous surveys (Appendix 3). King Island Thickshell Clams were only recorded in relatively low numbers from 3 beds: KI – 10 (14kg), KI – 12 (0.1kg) and KI – BDE (1.3kg)

Considering only the four different scallop “groups” (Commercial Scallops, old single, new single, and clappers), FI – 1, FI – 5, AB – The Hill and KI – BDE had a much higher percentage of old single shell (more than 70%) than other beds (Figure 16). Only KI – Three Hummock SE, had a relatively high proportion of live commercial scallop (>50%). Clappers were reported from most beds, but only in small percentages (Figure 16).

Time series of other bycatch species are shown in figures 25 to 31.

Table 2. Names, nicknames (used in this report) surveyed in 2025 and area of polygons (km2).

Bed	Nickname	Total Area (km^2)
Flinders Island – Flinders Island 1	FI – 1	107
Flinders Island South – North of Babel	FI – NB	31
Flinders Island – Flinders Island 5	FI – 5	38
Apollo Bay – The Hill North	AB – The Hill	61
King Island – 10	KI – 10	17
King Island – Blue Dot Extended	KI – BDE	57
King Island – 11	KI – 11	46
King Island – Three Hummock South East	KI – 3 Hummocks SE	26
King Island – 12	KI – 12	26
King Island – Lavinia East	KI – Lavinia East	67
King Island – Lavinia North	KI – Lavinia North	60

Table 3. Total commercial catch (t) and the number of vessels that fished within each 2024 survey bed during the 2024 fishing season based on logbook data.

Bed	Number of Vessels	Catch (t)
AB – The Hill		
KI-10	<5	Confidential
KI-3 Hummock S	<5	Confidential
KI-3 Hummock SE		
KI-6		
KI-9		
KI-Lavinia East	6	250.36
KI-Lavinia North	5	219.90
FI-FI1		
FI – The Wreck B		
FI-NB		
FI-NBNE		
FI-TS		
Outside of beds	7	287.09
Total		**766.4 t (0 t east, 766.4 t west)**

Table 4. Biomass estimates, 95% confidence intervals and number of tows included in analyses. Note that both densities have been adjusted for a 33% assumed dredge efficiency.

Area	Bed	Number of tows	Mean density (kg/1000 m^2)	Standard deviation (kg/1000 m^2)	Lower 95% CI (t)	Estimated biomass (t)	Upper 95% CI (t)	Density (ind/m^2 >85mm)
Apollo	AB–The Hill	25	0.7	1.3	6.8	41.2	75.5	0.01
Sub-total		**25**				**41**		
King	KI-10	25	46.4	58.5	380.9	794.3	1,207.6	0.68
	KI-11	25	193.1	121.9	6,514.2	8,809.6	11,105.0	1.90
	KI-12	25	41.2	74.2	277.8	1,084.6	1,891.4	0.51
	KI-3 Hummocks SE	25	250.2	210.8	4,214.2	6,461.9	8,709.6	2.61
	KI-BDE	25	15.0	12.7	548.5	845.3	1,142.0	0.14
	KI-Lavinia East	25	94.5	110.1	3,288.6	6,334.9	9,381.1	0.93
	KI-Lavinia North	25	73.8	101.4	1,935.3	4,473.4	7,011.6	0.79
Sub-total		**175**				**28,804**		
Flinders	FI-1	25	31.0	53.6	952.8	3,326.5	5,700.2	0.42
	FI-5	25	6.6	9.9	96.0	251.1	406.3	0.07
	FI-NB	24	34.9	37.9	593.2	1,095.9	1,598.7	0.32
Sub-total		**74**				**4,674**		
Total		**274**				**33,519**		

Table 5. Percent weight of scallops > 85 mm (catch-weighted by weight), and biomass estimates 95% confidence intervals for scallops greater than 85 mm.

Area	Bed	% weight > 85 mm	Lower 95% CI (t)	Estimated Biomass > 85 mm (t)	Upper 95% CI (t)
Apollo Bay	AB–The Hill	66.7	5	27	50
Sub-total			**5**	**27**	**50**
King Island	KI-10	83.0	316	659	1,002
	KI-BDE	63.2	496	534	1,032
	KI-11	87.6	4,117	7,717	7,018
	KI-3 Hummocks SE	92.7	3,907	5,992	8,074
	KI-12	90.4	243	981	1,657
	KI-Lavinia East	97.2	3,197	6,159	9,118
	KI-Lavinia North	97.2	1,881	4,347	6,815
Sub-total				**26,389**	
Flinders Island	FI-NB	82.8	521	908	1,405
	FI-5	75.6	73	190	307
	FI-1	87.9	789	2,923	4,720
Sub-total				**4,021**	
Total				**30,437**	

Table 6. Number of length measurements (N), median, mean and standard error (SE) of scallops measured, and % of scallops measured (catch weighted by weight) less than and greater than 85 mm and mean number of meats per kg of scallops greater than 85 mm from each bed.

		Length (mm)			85 mm		Meats / kg
Bed	N	Median	Mean	SE	%<	%>	Mean
AB-The Hill	75	87	88	0.8	33.3	66.7	104
KI-10	583	88	88	0.3	17.0	83.0	117
KI-11	1,136	91	92	0.2	12.4	87.6	112
KI-12	672	95	90	0.3	9.6	90.4	102
KI-3 Hummocks SE	1,144	93	93	0.2	7.3	92.7	86
KI-BDE	312	86	85	0.5	36.8	63.2	94
KI-Lavinia East	1,097	98	98	0.2	2.8	97.2	85
KI-Lavinia North	864	97	97	0.3	2.8	97.2	90
FI-1	546	93	92	0.4	12.1	87.9	76
FI-5	577	88	89	0.3	14.4	75.6	72
FI-NB	932	88	83	0.6	17.2	82.8	77

Table 7. Number of scallops retained for biological sampling, and parameter estimates for length-weight relationships.

Sub Area	N	a	bb	Adjusted R^2
FI	149	-7.3471	2.5784	0.830
KI	350	-7.7212	2.6727	0.878
AB	28	-7.1617	2.5488	0.578

Table 8. Catch (kgs) of each species in each bed. (u) refers to undifferentiated species recorded at a higher taxonomic level.

SPECIES	AB-THE HILL	FI-1	FI-5	FI-NB	KI-10	KI-11	KI-12	KI-3 HUMMOCK SE	KI-BDE	KI-LAVINIA EAST	KI-LAVINIA NORTH
Commercial Scallop	9	453	93	520	983	4,127	905	5079	302	1,252	966
Clappers	1.5	20.8	0.1	2.1	37.1	217.9	295.7	44.6	10.5	104.1	264.8
New Single	149.5	36.7	30.3	99.9	1,343.5	4,682.2	2,022.7	1,533.1	354.4	130.4	186.8
Old Single	967	2,120	845	1,000	2,423	1,792	616	643	2,403	1,745	2,624
Algae - *Phyllospora*				2.0							0.5
Banded Stingaree	0.3	0.1	1.5						9.1	11.4	0.5
Beaked Salmon				1.0							
Black And White Seastar	14.7		0.5	0.6		1.0			8.9	70.0	9.2
Brittlestars (U)		1.55				0.70	0.37	0.01			0.02
Bulldog Stargazer	2.5		18.0								
Butterfly Gurnard					8.1	4.7	2.6	19.2	6.9	0.1	
Cassidae (U)							0.1	2.8			
Cockle (U)		58.5	0.2								
Cocky Gurnard	1.0									0.1	
Common Gurnard Perch	0.4							1.2		0.2	
Common Stargazer	1.3		3.0								
Common Stinkfish				5.5							
Cowrie (U)		0.5					0.8			0.2	2.1
Crested Flounder							0.2				
Doughboy Scallop		136.6		129.9	632.6	61.9	998.0	370.3	1,119.1	99.6	
Draughtboard Shark										1.0	
Eastern Balmain Bug							0.3				
Echinoderm (U)							0.1		0.3		
Eleven-Armed Seastar	64.5	112.6	68.9	1,102.9	446.8	1,892.6	1840.4	267.7	450.5	74.6	323.9
False Bailer Shell		3.4	2.5			1.3		4.5	19.8		
Flounder (U)						0.7					
Hard Coral	8.9										
Hermit Crab (U)		41.4	33.0	22.7	0.3	1.0	3.7	0.2	3.0	0.1	5.4
Holothurian (U)	56.5				2.3		0.8	4.7	5.8	36.0	
King Island Thickshell-Clam					14.0		0.1		1.3		
Latchet	1.8									0.8	0.1
Lefteye Flounder (U)			0.01								
Maori Octopus		1.7									

Mollusc (U)		4.9	1								
Moreton Bay Bug (U)									3.6		
Octopus (U)										0.8	0.1
Oysters		4.3		1,729.1	861.6	274.2	131.4	122.3	1,497.7		
Pale Octopus	0.1	13.0	8.4	1.4	0.8	0.3	1.2	1.1	0.7	4.0	0.5
Pen Shell				7.6	4.2	0.1	2.3	6.4			
Polychaete Worm (U)										0.01	0.01
Razorfish (U)	1.3	20.2	19.4			3.5	5.1	1.4		0.5	
Reef ocean perch		0.1									
Roundsnout Gurnard										0.3	
Sand crab						0.3			0.7		
Sea grasses	36.1										
Sea Urchin (U)		57.3		0.3				0.1			
Seapen (U)		13.8			0.6	0.6	13.4	25.6	0.5		
Seastar (U)	0.6	1.5	4.7	1.7		0.5	1.7	0.3	5.5		0.1
Shark Egg (U)								1.9			
Soft Coral (U)	19.3									4.2	
Southern Blue-Ringed Octopus		6.3	0.2								
Sparsely-Spotted Stingaree	0.3			1.7		3.1		9.8		0.9	
Spider Crab (U)	0.3	2.9		45.6	6.5		6.7	10.2	45.9	3.9	9.3
Sponge	498.3	5.9	2.9	1,902.6	1223.5	256.7	49.0	236.6	1.706.1	2,130.8	966.7
Starfish	0.94		2.48						2.55		
Substrate - Broken Shell	100.2	3,933.9	1,384.3	835.7	2,590.2		141.8		1,101.6	1,340.6	785.7
Substrate - Rock	494.8		3.1	41.0						2.2	7.7
Tasmanian numbfish			0.3	10.8			5.5	8.2	8.6		0.5
Tiger Flathead	0.6										
Triggerfish & Leatherjacket (U)		0.1									
Velvet leatherjacket							0.3				
Volute (U)	23.0	0.5		1.7			2.1	0.4	5.7	0.5	2.3
Whelk	6.3	66.4	1.5	74.7	104.8	56.0	15.9	58.8	182.9	32.3	128.6

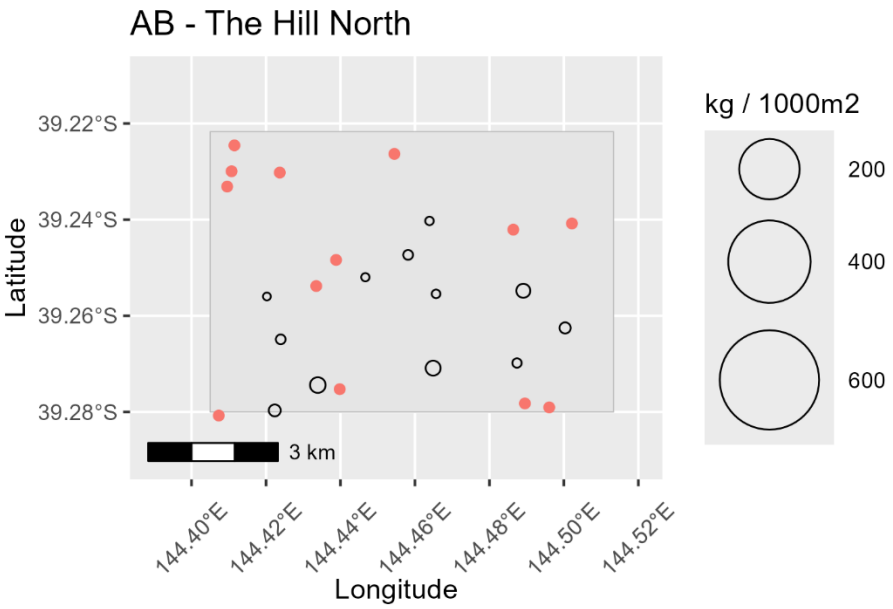


Figure 6. Scallop density (kg / 1,000 m^2) within the AB – The Hill North. The top right scale bubbles reflect the estimated scallop density of each tow assuming a dredge efficiency of 33%. Red circles denote zero catches.

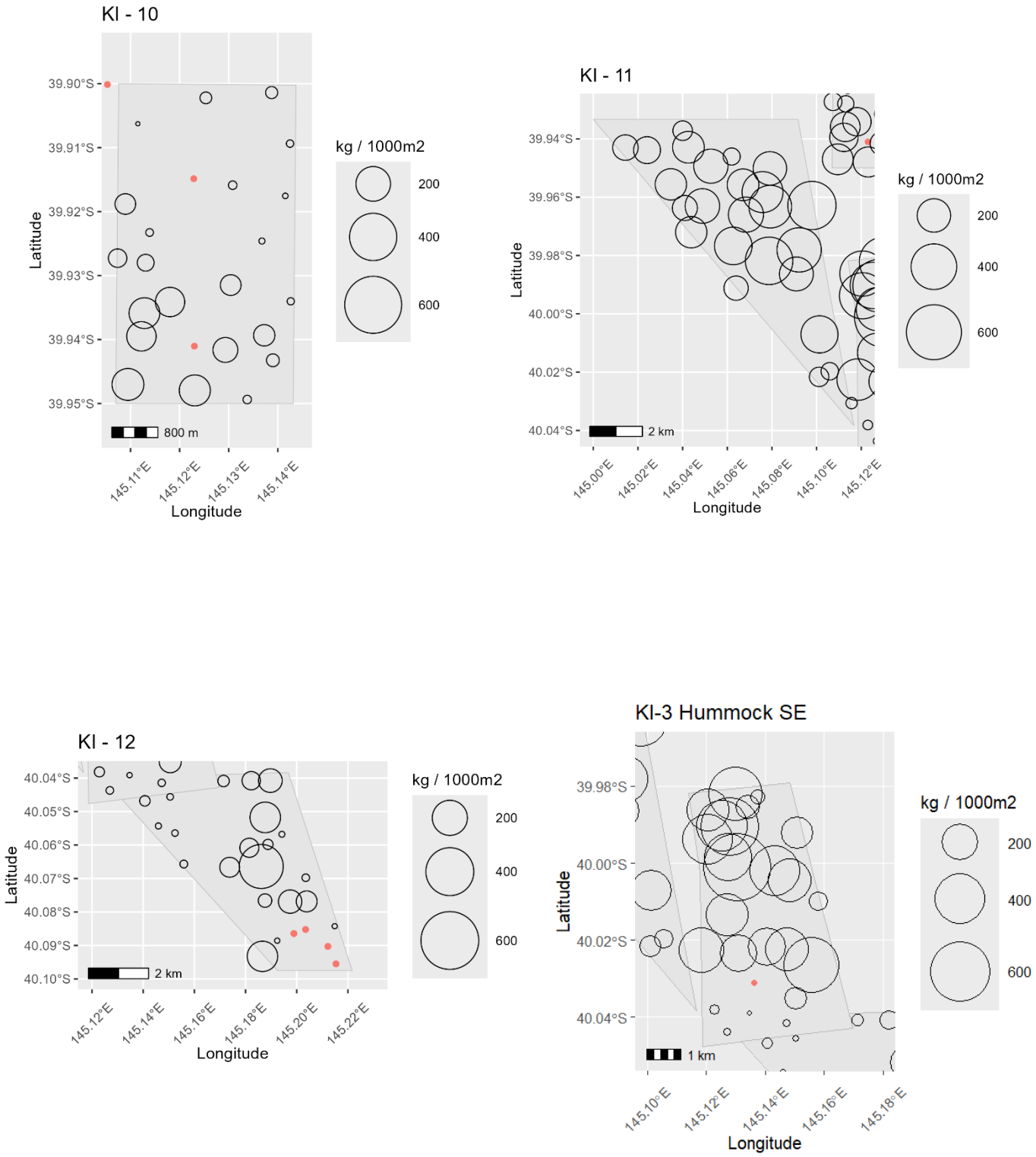


Figure 7. Scallop density (kg / 1,000 m^2) within KI–10, KI–11, KI–12 and KI-3 Hummocks SE. The scale bubbles on the right reflect the estimated scallop density of each tow assuming a dredge efficiency of 33%. Red circles denote zero catches.

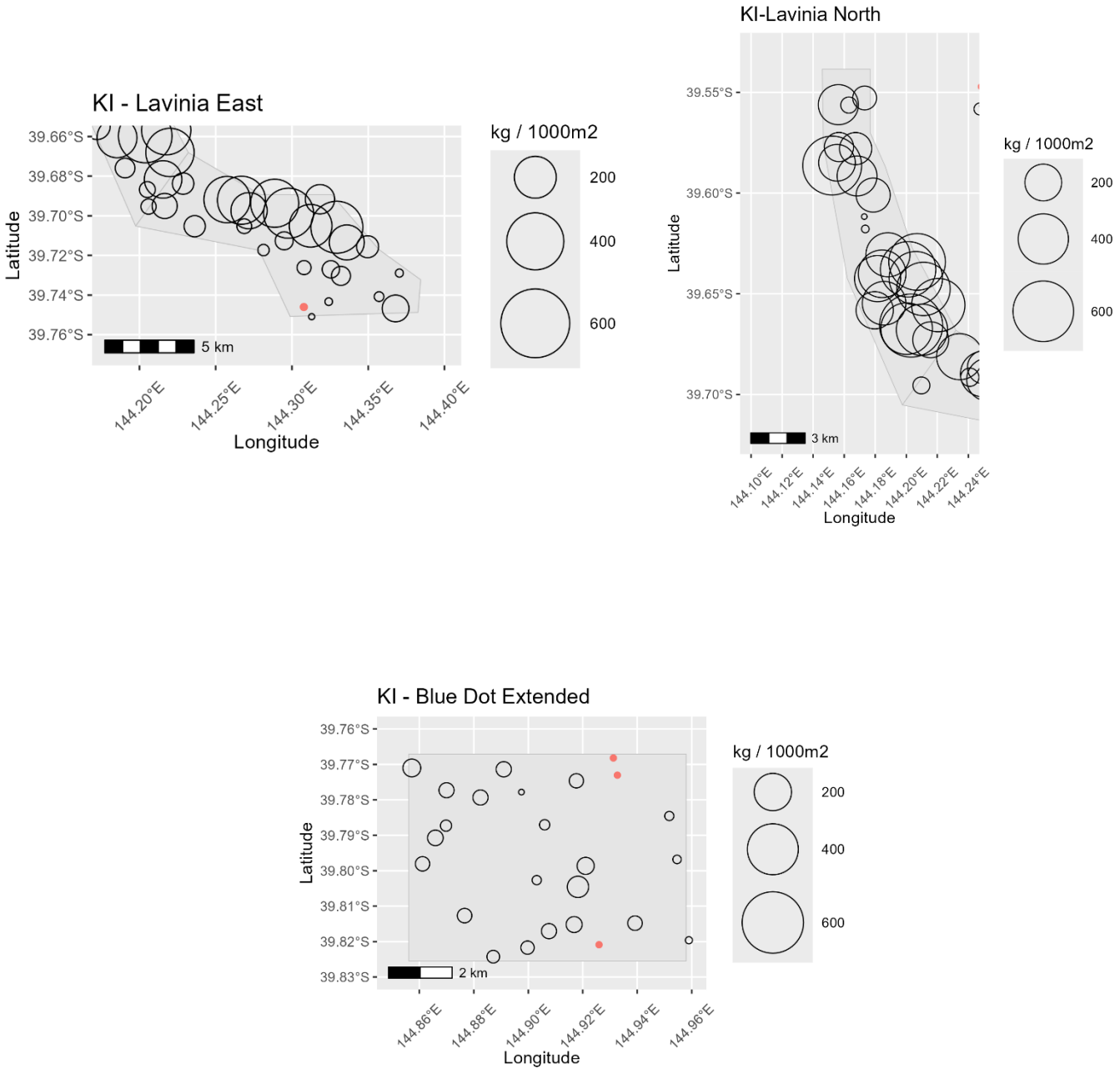


Figure 8. Scallop density (kg / 1,000 m^2) within KI–Lavinia North, KI–Lavinia East and KI-Blue Dot Extended. The scale bubbles on the right reflect the estimated scallop density of each tow assuming a dredge efficiency of 33%. Red circles denote zero catches.

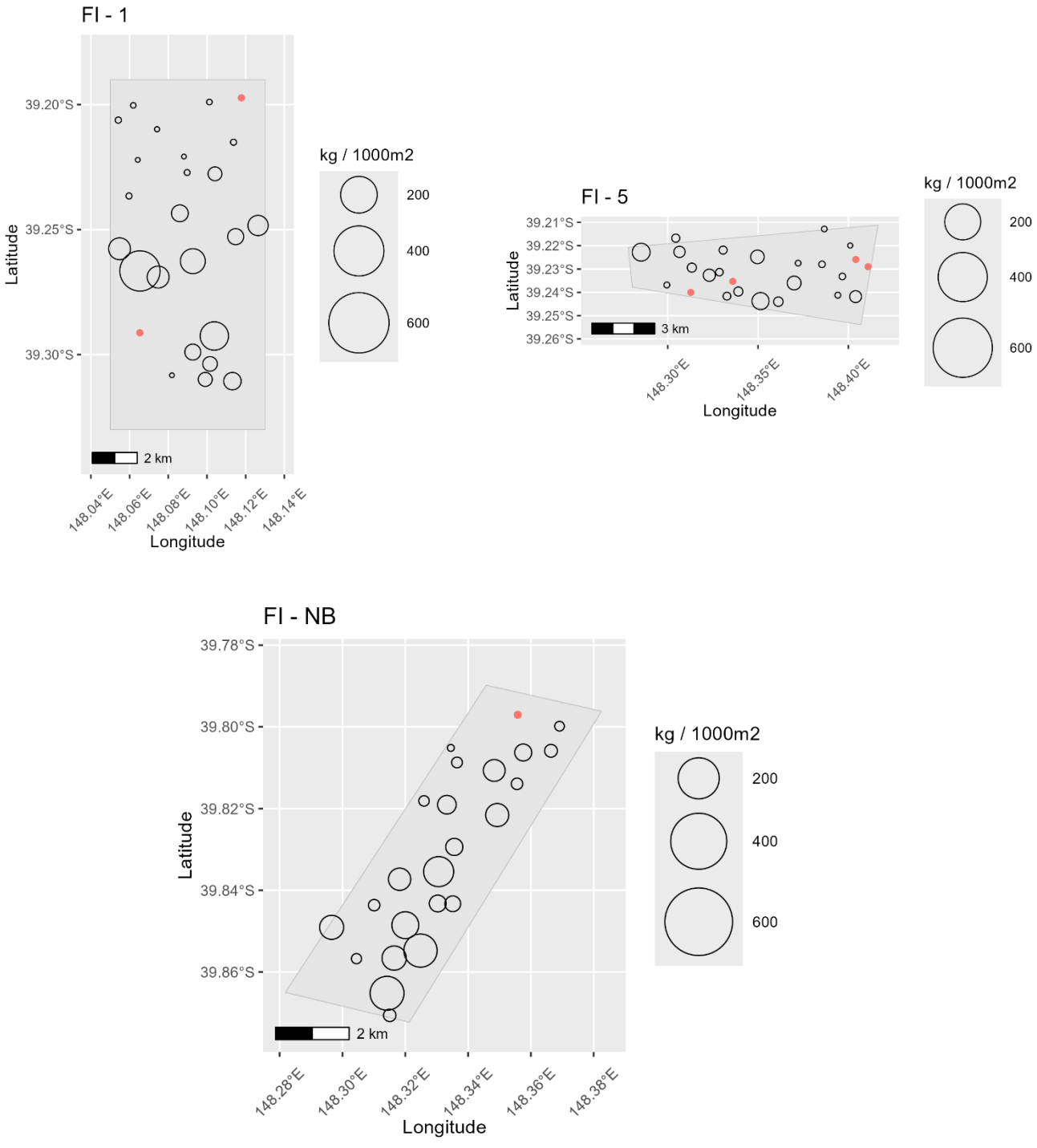


Figure 9. Scallop density (kg / 1,000 m^2) within the FI – 1, FI – 5, and FI-NB beds near Flinders Island. The scale bubbles on the right reflect the estimated scallop density of each tow assuming a dredge efficiency of 33%. Red circles denote zero catches.

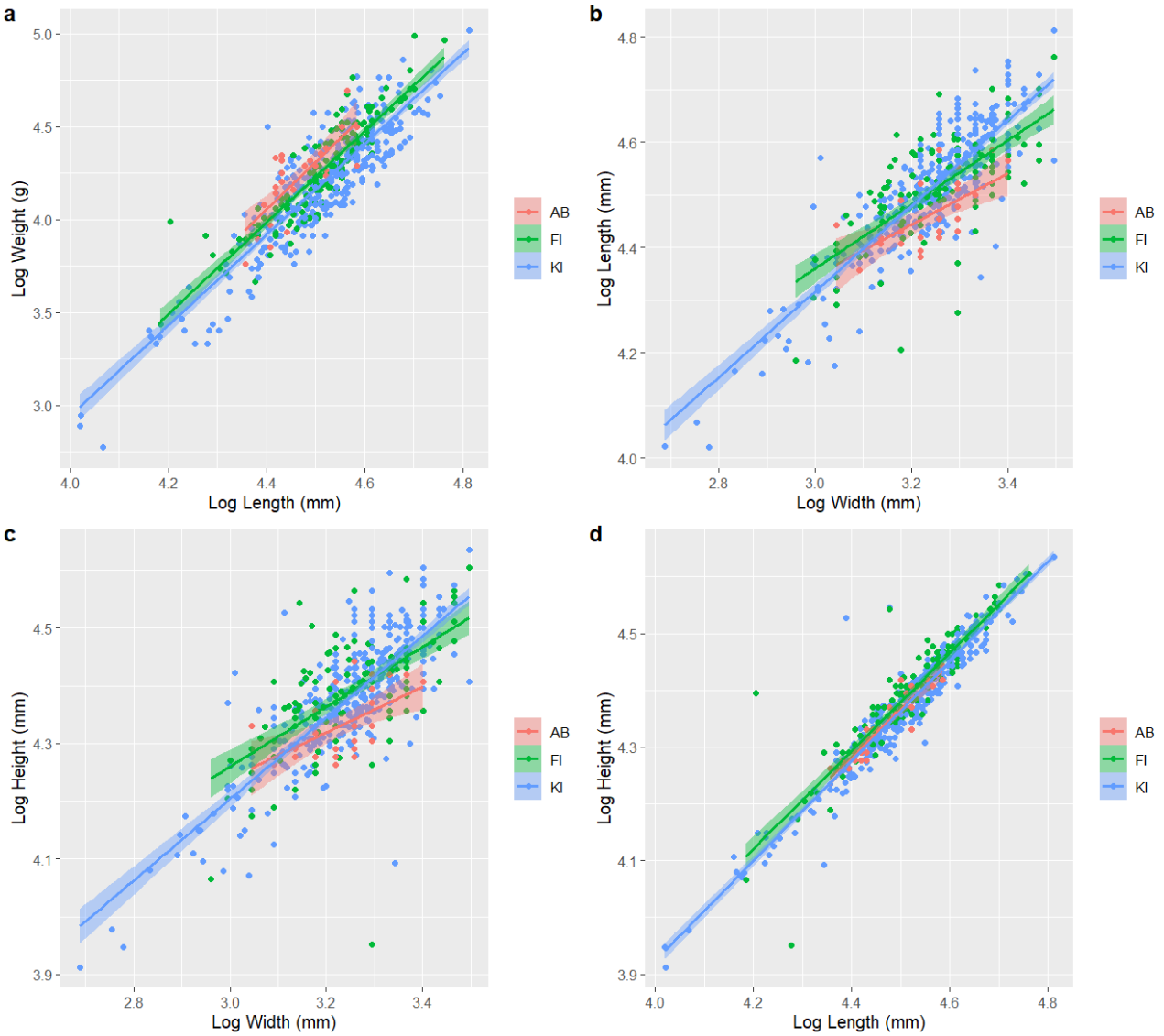


Figure 10. Log transformed A) length and weight, B) length and width, C) height and width and D) height and length from each area bed.

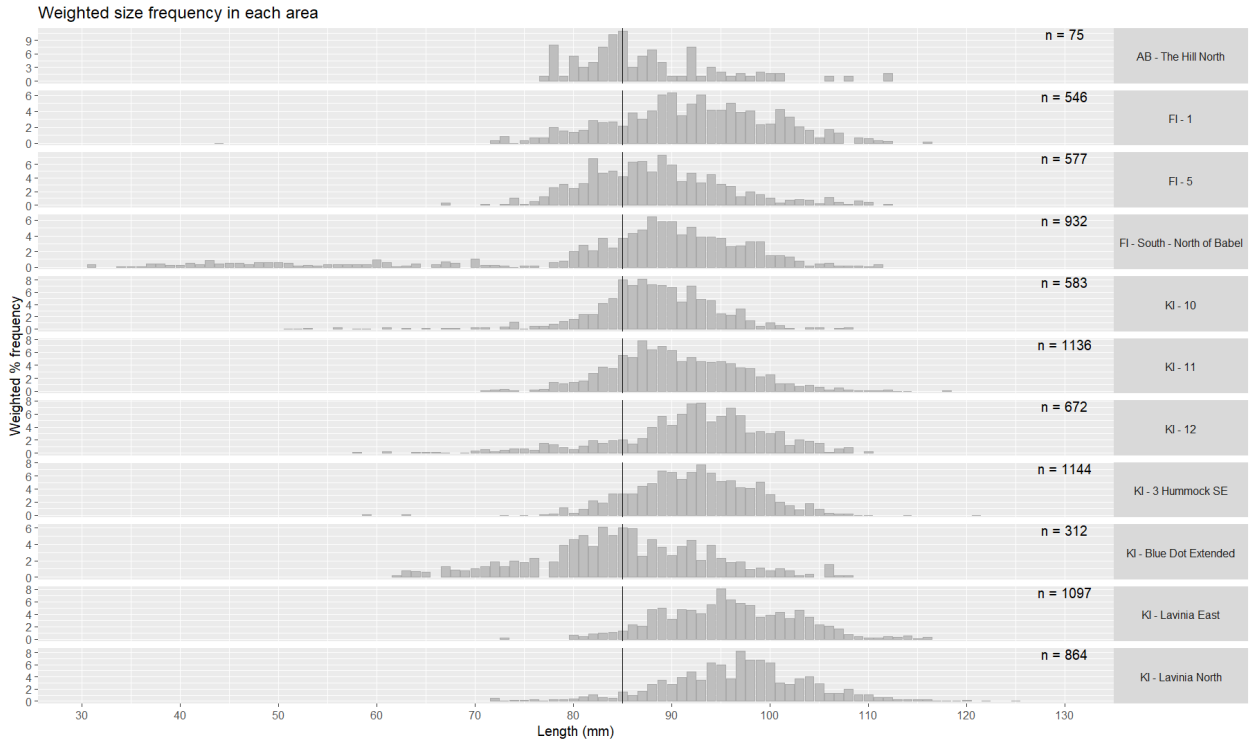


Figure 11. Catch-weighted length frequency of beds surveyed during 2025. Vertical black line indicates 85mm.

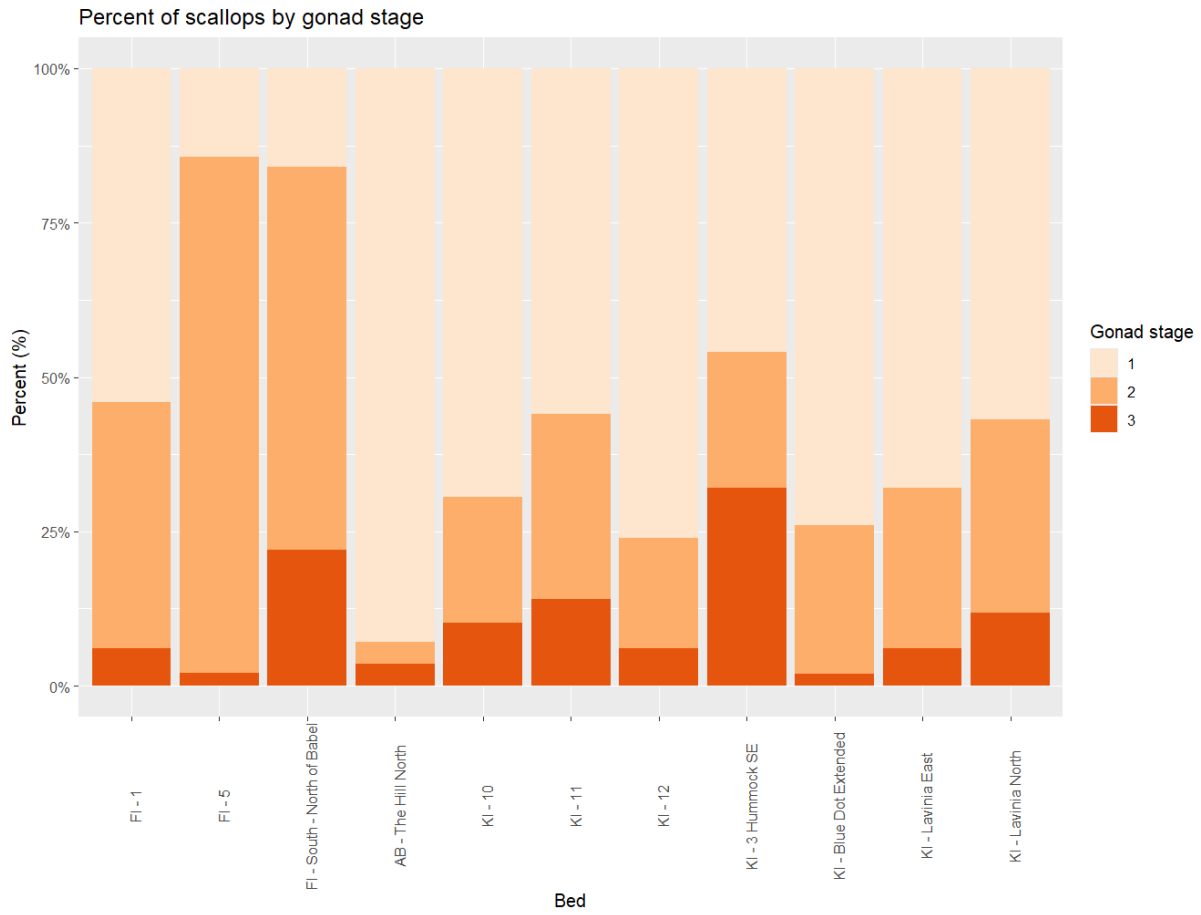


Figure 12. Percent of scallops at each stage from each bed based on macroscopic staging criteria shown in Table 9.

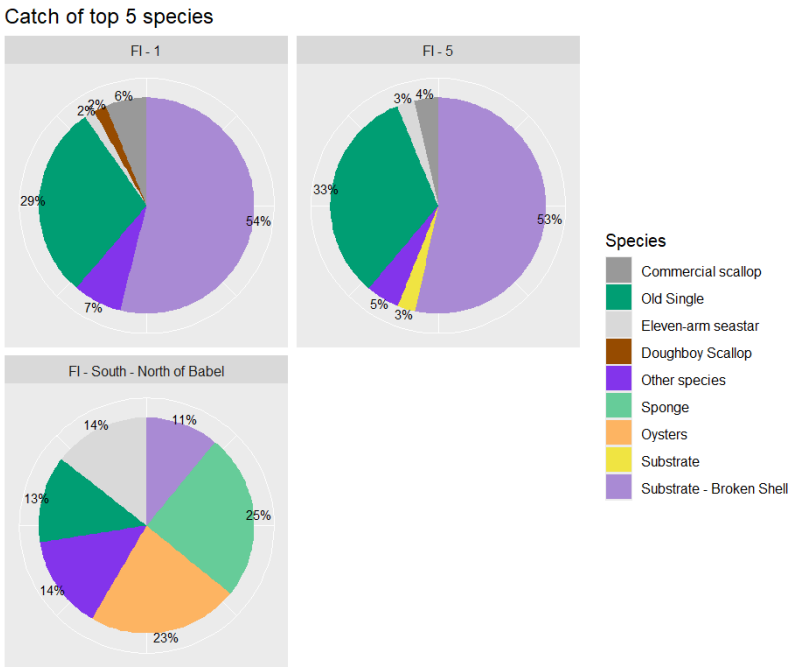


Figure 13. Percent catch composition by weight from beds near Flinders Island.

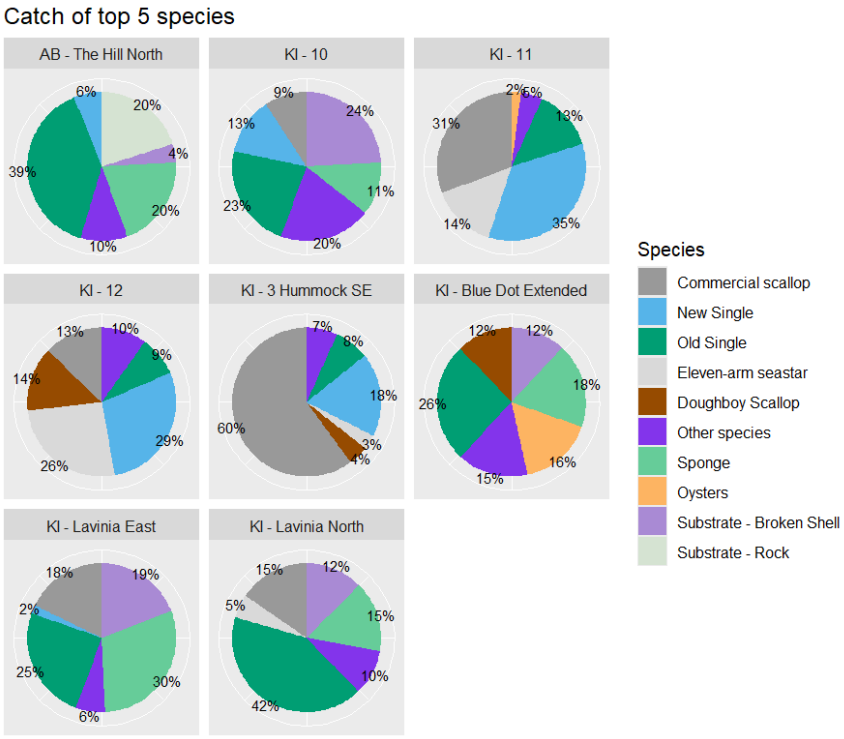


Figure 14. Percent catch composition by weight from beds near King Island.

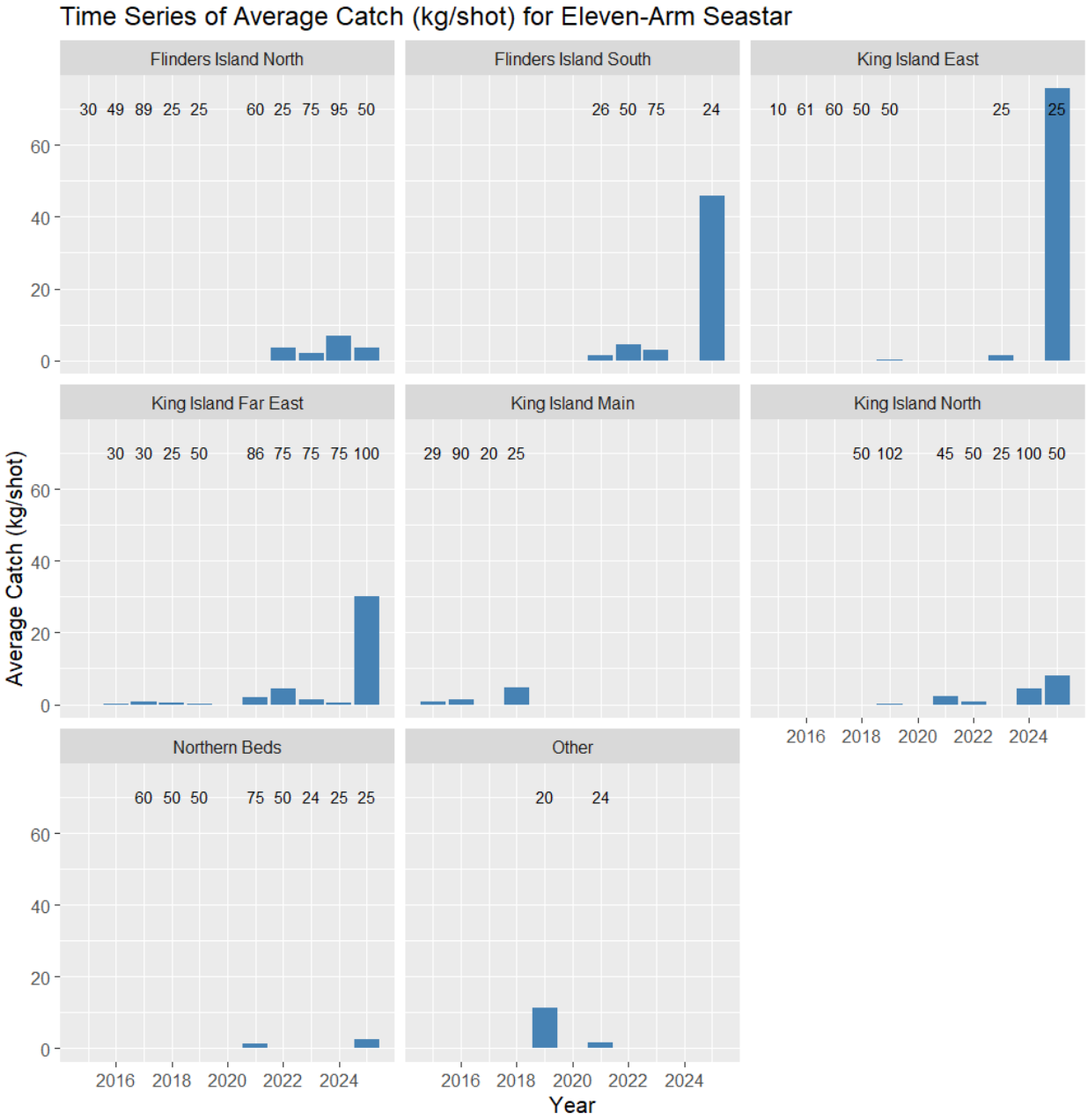


Figure 15. Interannual variation in the abundance of the Eleven-Armed Seastar in beds grouped in regions by Penney *et al*. (2025). Data are mean weight (kg/shot). Numbered annotations are number of shots.

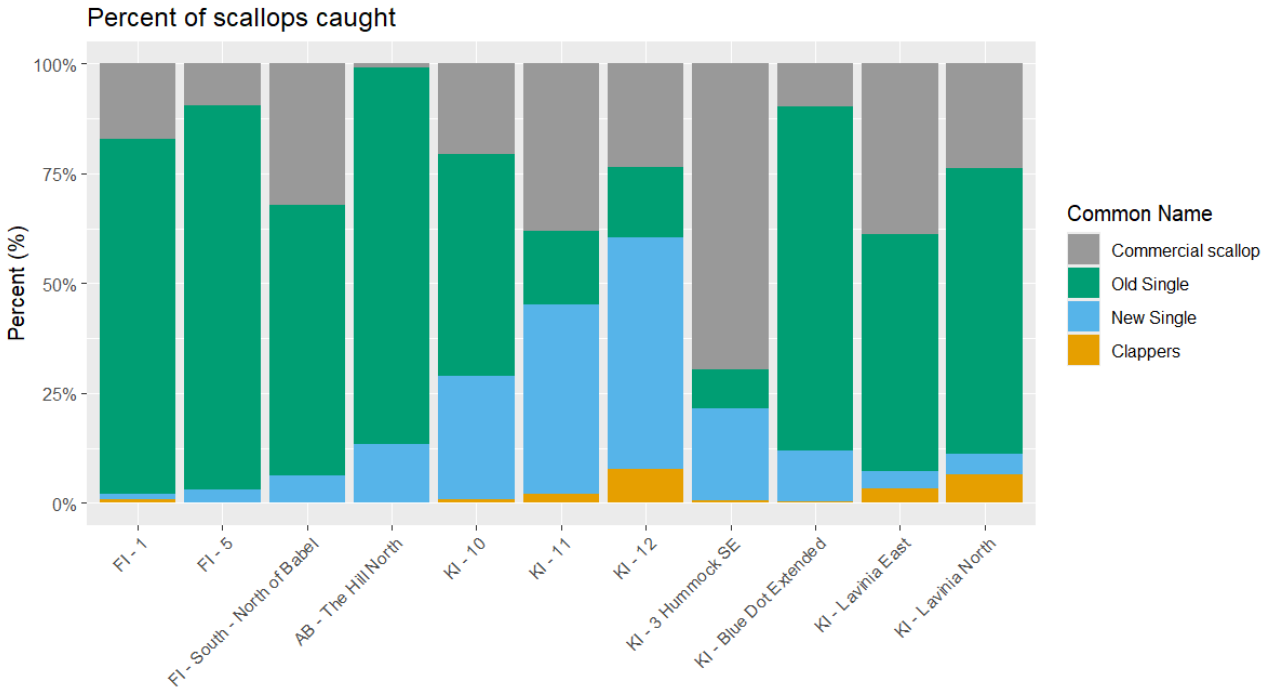


Figure 16. Percent composition of clappers, live scallop, new single and old single shell from each bed.

4 Discussion

Random stratified surveys were successfully undertaken on a total of eleven scallop beds off Flinders Island, King Island and Apollo Bay. Biomass of scallops varied considerably among beds. The bed surveyed off Apollo Bay had a considerably reduced biomass of scallops (41 t) compared with 2024 (3,304 t). However, biomasses > 3,000 tonnes of scallops of commercial size (i.e. > 85 mm) were estimated from KI – 11, KI – 3 Hummocks SE, KI – Lavinia East and KI – Lavinia North beds. Off Flinders Island, the biomass of scallops > 85 mm at FI – 1 was estimated to be 2,923 t whereas the other beds surveyed yielded estimates < 1,000 t.

Although 60 taxa were recorded as bycatch during the survey, most species/groups were caught in low numbers/weights. The bycatch recorded was dominated in most beds surveyed by substrata particularly dead scallop shells. Notable live bycatch was sponge (unclassified) particularly off Flinders Island (FI – NB), Apollo Bay, King Island (KI – Lavinia east, KI – Lavinia north, and KI – BDE). Doughboy Scallops were generally absent from tows with small amounts recorded at FI – 1 and KI – 3 Hummocks SE and substantial (> 10% by total weight of catch) at KI – 12 and KI – BDE. Similarly, Native Oysters (*Ostrea angasi*) were recorded as bycatch at FI – NB (23% by weight), KI – BDE (16% by weight), KI – 11 (2% by weight) but were generally absent from other beds surveyed.

High risk species recorded including Black and White Seastars were recorded from some beds particularly north of King Island. However, overall, about 100 kg of these seastars were caught. Southern Blue-Ringed Octopus and King Island Thickshell Clam were caught in some beds but in very low numbers (total of 6.5 kg and 15.7 kg respectively).

The Eleven-Armed Seastar (*Coscinasterias calamaria*) had been recorded in relatively low numbers in previous surveys but several beds in the current survey revealed high abundance (> 1 t/ bed) particularly FI – NB, KI – 11 (both 14% by weight) and KI – 12 (26% by total weight of catch). The emergence of this seastar on several beds is associated with relatively high abundance of dead shell including clappers. As a predator of scallops, Eleven-Armed Seastar can cause considerable mortality (Pitcher and Butler 1987) and as such may be a factor in decreased biomass estimates of beds surveyed in 2025 compared with 2024.

This, and relatively low recruitment levels (as indicated by the relative abundance of scallops < 85 mm) may affect future stock levels. In any case, recruitment of scallops is patchy with considerable interannual variability independent of stock size (Penney *et al*. 2025). Tidal currents are influential in dispersal and recruitment of scallops in Bass Strait, and this can influence the relative abundance of scallops in beds (Penney *et al*. 2025).

The current surveys reveal commercial quantities of scallops consistent with healthy populations within selected beds. The results provide greater certainty in targeting scallops without compromising future recruitment by fishing in beds dominated by undersized scallops. For a fast-growing, short-lived species, spatial surveys allow for optimal harvesting consistent with sustainable management of the fishery.

These results were presented at the ScallopRAG meeting on 19 June 2025 and at the Scallop Management Advisory Committee (ScallopMAC) meeting on 20 June 2025.

5 References

Fishwell. (2024). 2024 BSCZSF Survey. Operation and Procedures Manual. Fishwell Consulting 28 pp.

Gwyther, D. and McShane, P.E. (1988). Growth rate and mortality of the scallop *Pecten alba* Tate in Port Phillip Bay, Australia, and evidence for changes in growth rate after a 20-year period. *Fisheries Research* 6, 347-361.

Haddon, M., Harrington, J.J. and Semmens, J.M. (2006). Juvenile Scallop Discard Rates and Bed Dynamics: Testing the Management Rules for Scallops in Bass Strait. Tasmanian Aquaculture and Fisheries Institute, Taroona, Tasmania.

Harrington, J., Semmens, J. and Haddon, M. (2008). 2008 Commonwealth Bass Strait Central Zone Scallop Fishery Survey. Survey Final Report. Tasmanian Aquaculture and Fisheries Institute. University of Tasmania.

Knuckey, I., Koopman, M., and Davis, M. (2015). Bass Strait and Central Zone Scallop Fishery - 2015 Survey. AFMA Project 2015/001291. Fishwell Consulting 22pp.

Knuckey, I., Koopman, M., and Davis, M. (2016). Bass Strait and Central Zone Scallop Fishery - 2016 Survey. AFMA Project 2016/0804. Fishwell Consulting. 30pp

Knuckey, I., Koopman, M., Hudson, R., Davis, M., and A. Sullivan (2017). Bass Strait and Central Zone Scallop Fishery - 2017 Survey. AFMA Project 2016/0806. Fishwell Consulting. 42pp.

Knuckey, I., Koopman, M. and, Hudson, R., (2018). Bass Strait and Central Zone Scallop Fishery - 2018 Survey. AFMA Project 2017/0822. Fishwell Consulting. 44pp.

Koopman, M., Knuckey, I., Sih, T. and Kube, J. (2019). Bass Strait and Central Zone Scallop Fishery - 2019 Survey. AFMA Project 2019-0812. Fishwell Consulting. 39 pp.

Koopman, M., Knuckey, I., Kube, J., Davis, A. and Sullivan, A. (2021). Bass Strait and Central Zone Scallop Fishery - 2021 Survey. AFMA Project 2019-0812. Fishwell Consulting. 39 pp.

Koopman, M., and Knuckey, I. (2022). Bass Strait and Central Zone Scallop Fishery - 2022 Survey. AFMA Project 2019-0807. Fishwell Consulting. 39 pp.

Koopman, M., and Knuckey, I. (2023). Bass Strait and Central Zone Scallop Fishery - 2023 Survey. AFMA Project 2021-0802. Fishwell Consulting. 39 pp.

Koopman, M., and Knuckey, I. (2024). Bass Strait and Central Zone Scallop Fishery - 2024 Survey. AFMA Project 2022-0808. Fishwell Consulting. 44 pp.

Pebesma, E. (2018). Simple Features for R: Standardized Support for Spatial Vector Data. The R Journal 10 (1), 439-446, https://doi.org/10.32614/RJ-2018-009

Penney, A. Koopman, M., and Knuckey, I. (2025). Bass Strait and Central Zone Scallop Fishery – Population Dynamics. AFMA Project 2022-0809. Fishwell Consulting. 148 pp.

Pitcher, C.R. and Butler, A.J. (1987). Predation by asteroids, escape response, and morphometrics of scallops with epizoic sponges. *Journal of Experimental Marine Biology and Ecology* 112, 233-249.

R Core Team (2025). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

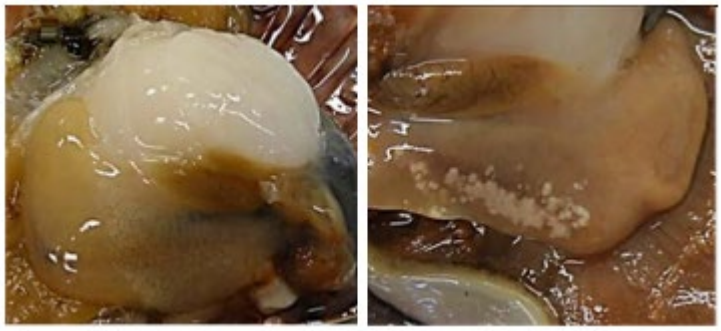
Semmens, J.M., Mendo, T., Jones, N., Keane, J., Leon, R., Ewing, G. and Hartmann, K. (2018). Determining when and where to fish: Linking scallop spawning, settlement, size and condition to collaborative spatial harvest and industry in-season management strategies, Institute for Marine and Antarctic Studies and University of Tasmania, Hobart, June. CC BY 3.0

Semmens, J. and Jones, N. (2014). Draft 2014 BSCZSF survey report. Institute for Marine and Arctic Studies. July 2014.

6 Appendix 1 – Methods

6.1 Gonad Staging

Table 9. Gonad maturation scheme for macroscopic field staging of scallops (modified from Semmens *et al*., 2019).[2]

Stages	Description
1 Developing or spent	Gonad is small, thin, translucent, brownish colour. Intestinal loop usually visible. Ovarian and testicular tissues difficult to differentiate. 
2 Maturing or atretic (reabsorbing eggs as spawning is delayed)	Separate acini clearly visible, male (white) and female (orange) part of gonad distinguishable. Gonad increases in turgor (rigidity) and becomes less granular in appearance as acini begin to fill until ovarian tissue appears uniform in colour. 
3 Partially spawned	Gonad reduced in size compared to previous stage. Ovary appears mottled, presumably due to some acini being voided. Intestinal loop usually visible, ovarian tissue uniform in colour, but interspersed with isolated specs of translucent (void) acini. Testicular tissues turn paler in colour. 

[2] Semmens, J.M., Mendo, Jones, Keane, Leon, Ewing, Hartmann., Institute for Marine and Antarctic Studies, 2019, Determining when and where to fish: Linking scallop spawning, settlement, size and condition to collaborative spatial harvest and industry in-season management strategies, University of Tasmania, Hobart, June. CC BY 3.0

6.2 Shell measurements

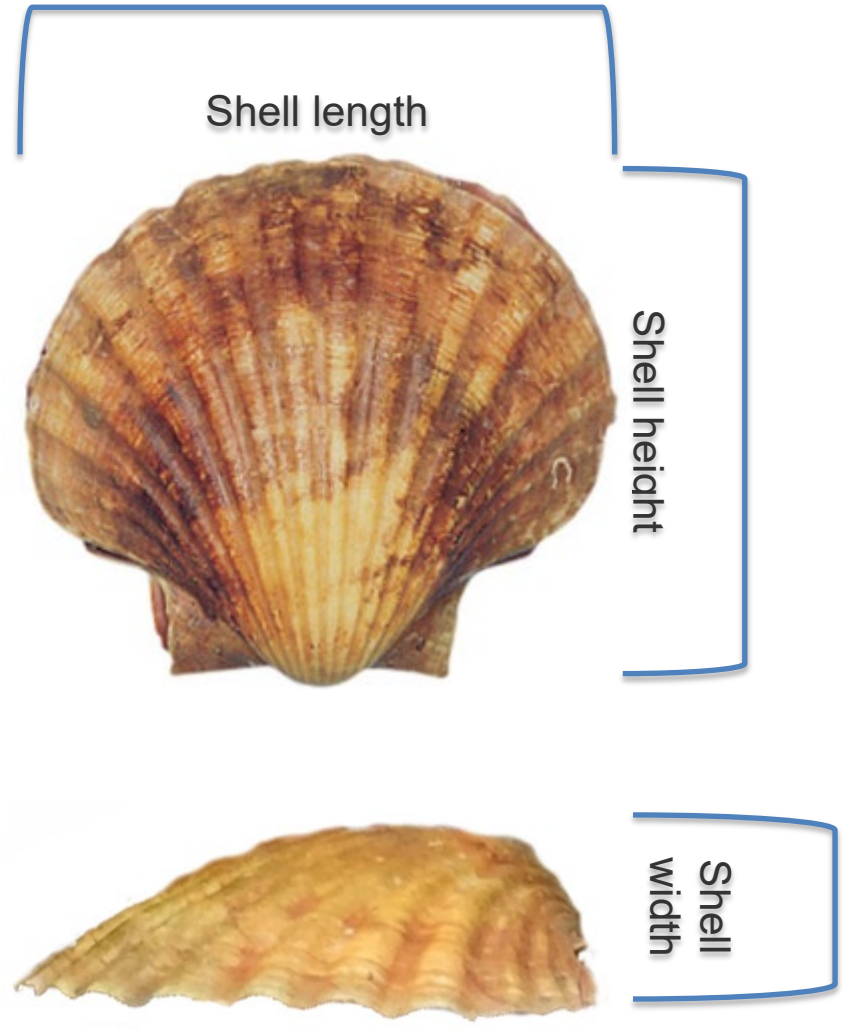


Figure 17. Scallop width, length and height to be measured.

7 Appendix 2 - Time-series data

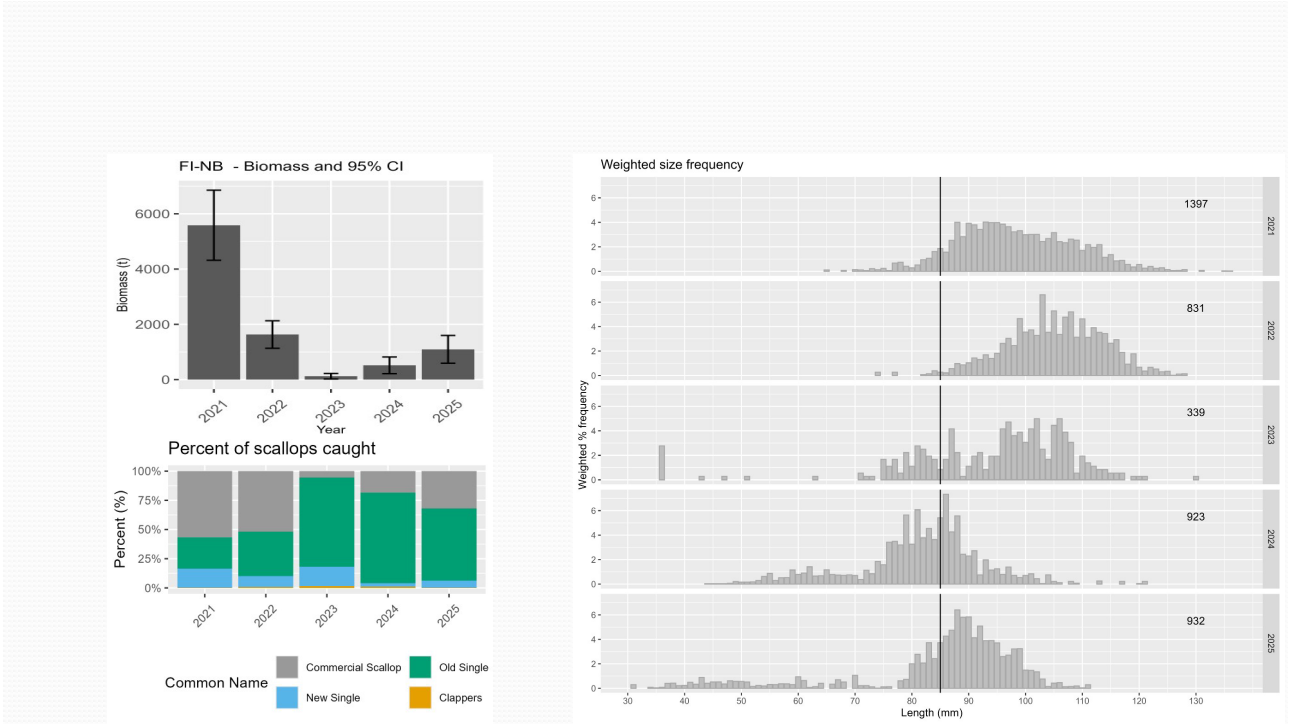


Figure 18. Time-series of biomass estimate, size frequency and percent of scallop (live/shell type) at the FI South – North of Babel.

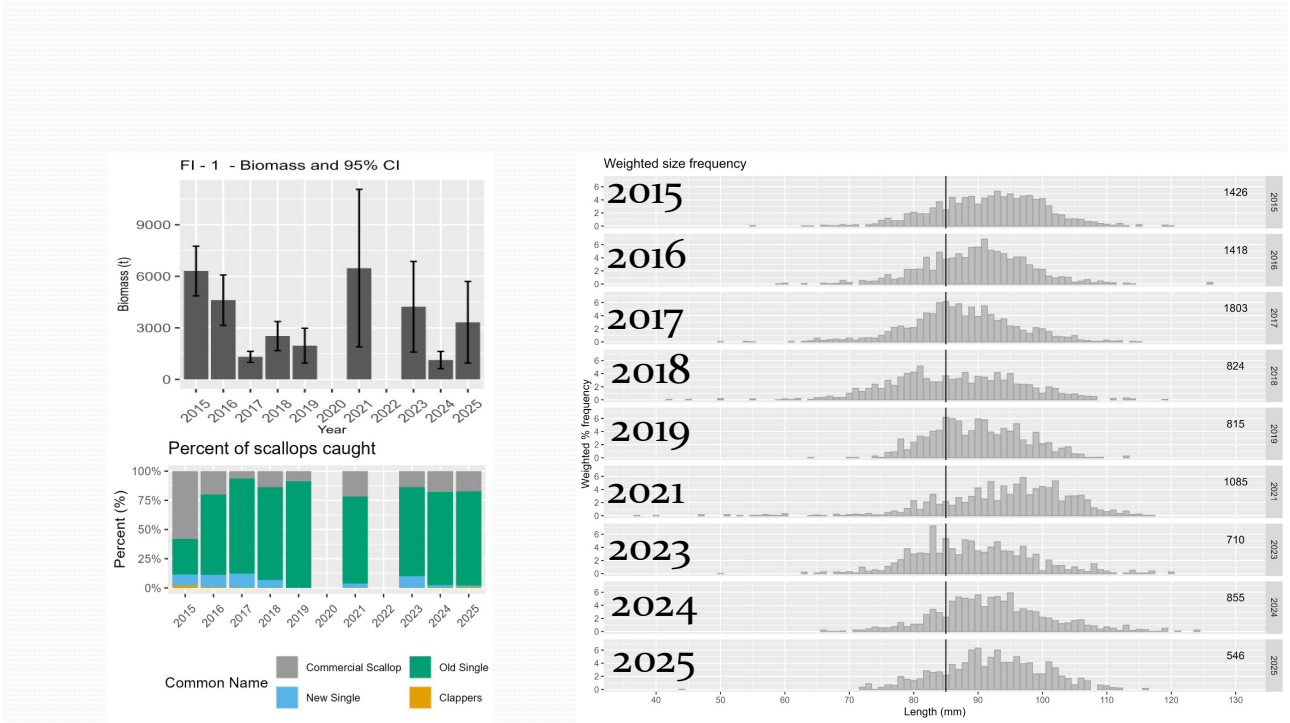


Figure 19. Time-series of biomass estimate, size frequency and percent of scallop (live/shell type) at the FI -1 bed.

Figure 20. Time-series of biomass estimate, size frequency and percent of scallop (live/shell type) at the KI-10 bed.

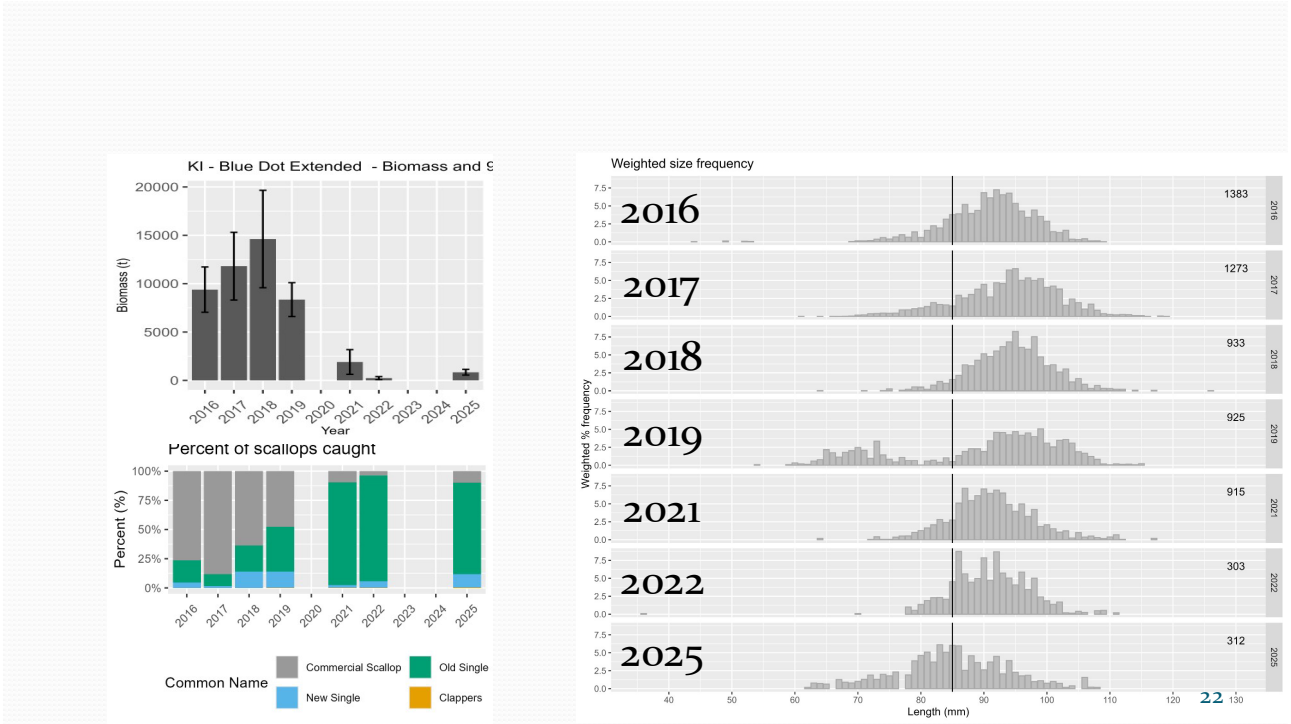


Figure 21. Time-series of biomass estimate, size frequency and percent of scallop (live/shell type) at the KI – BDE bed.

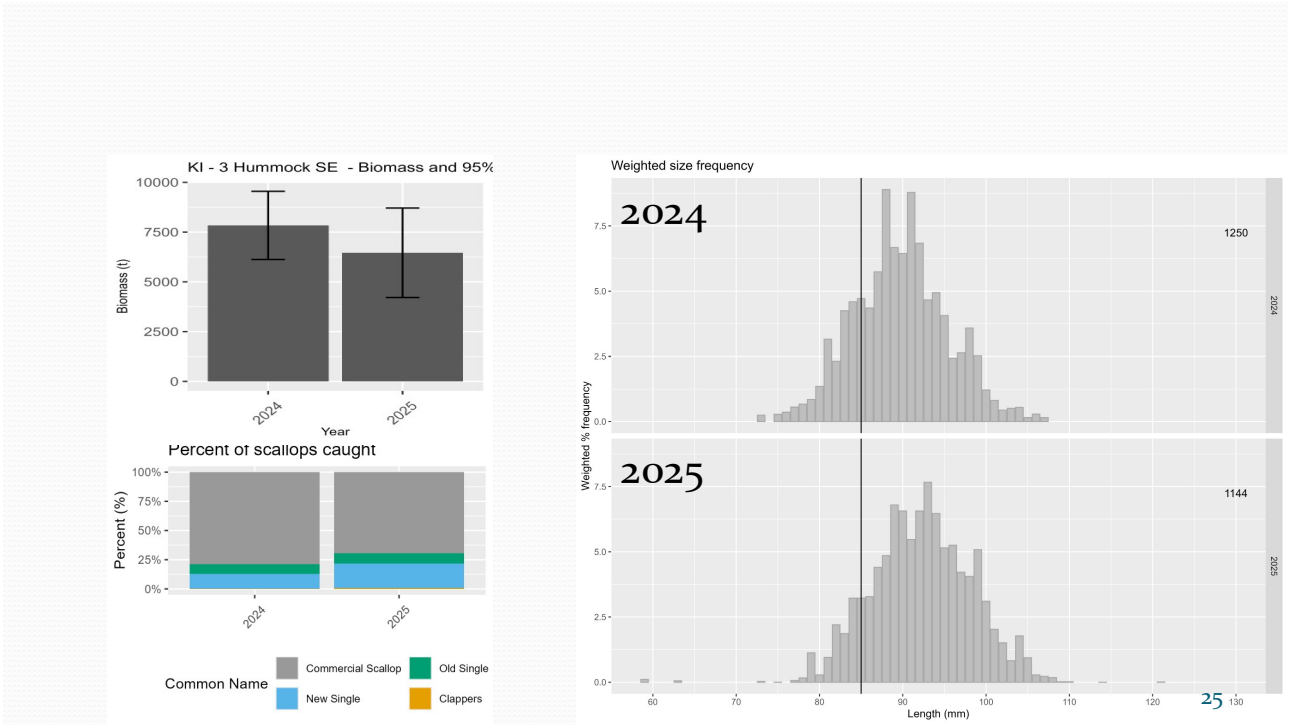


Figure 22. Time-series of biomass estimate, size frequency and percent of scallop (live/shell type) at the KI – 3 Hummocks SE bed.

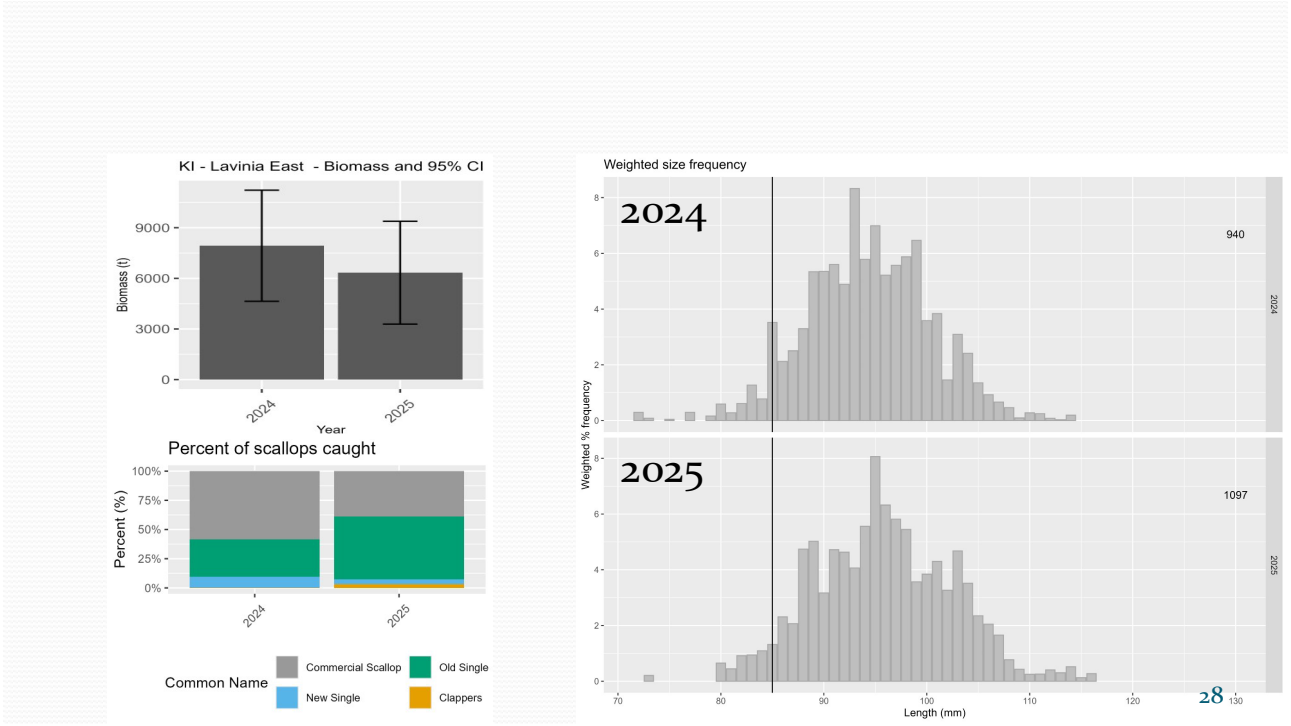


Figure 23. Time-series of biomass estimate, size frequency and percent of scallop (live/shell type) at the KI – Lavinia east bed.

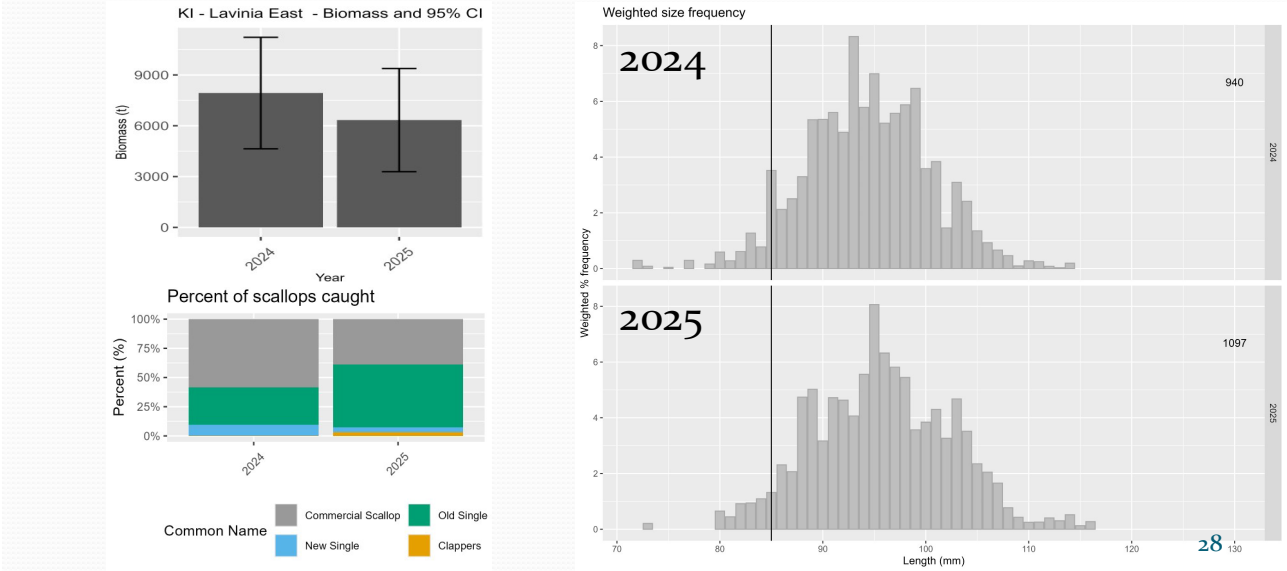


Figure 24. Time-series of biomass estimate, size frequency and percent of scallop (live/shell type) at the KI – Lavinia north bed.

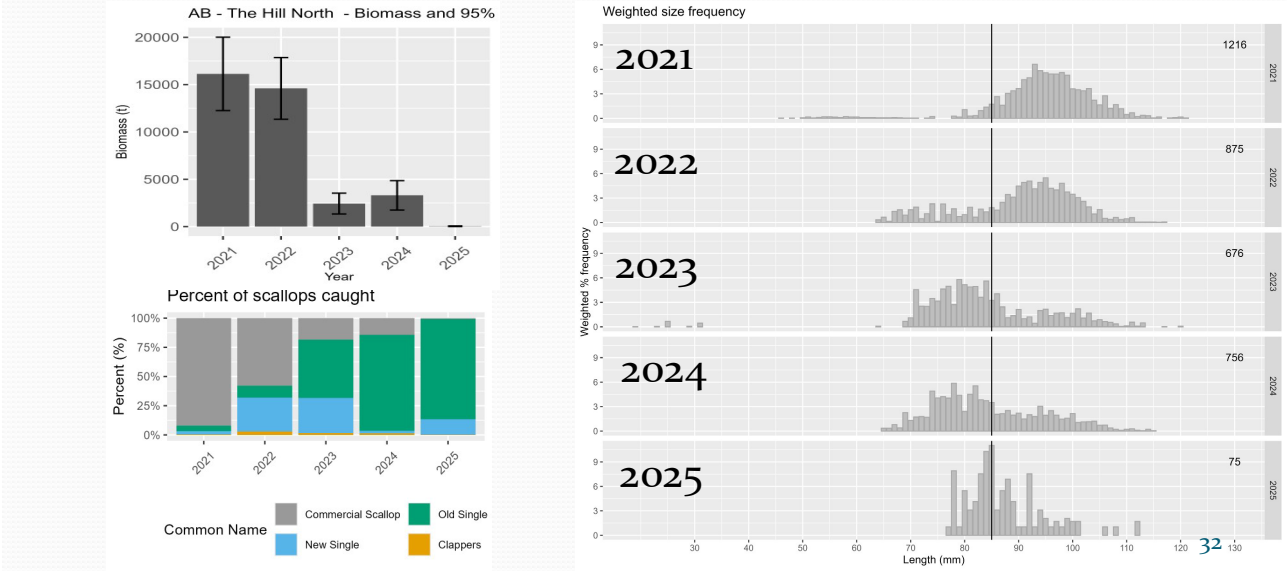


Figure 25. Time-series of biomass estimate, size frequency and percent of scallop (live/shell type) at the AB – The Hill North bed.

8 Appendix 3 – By catch

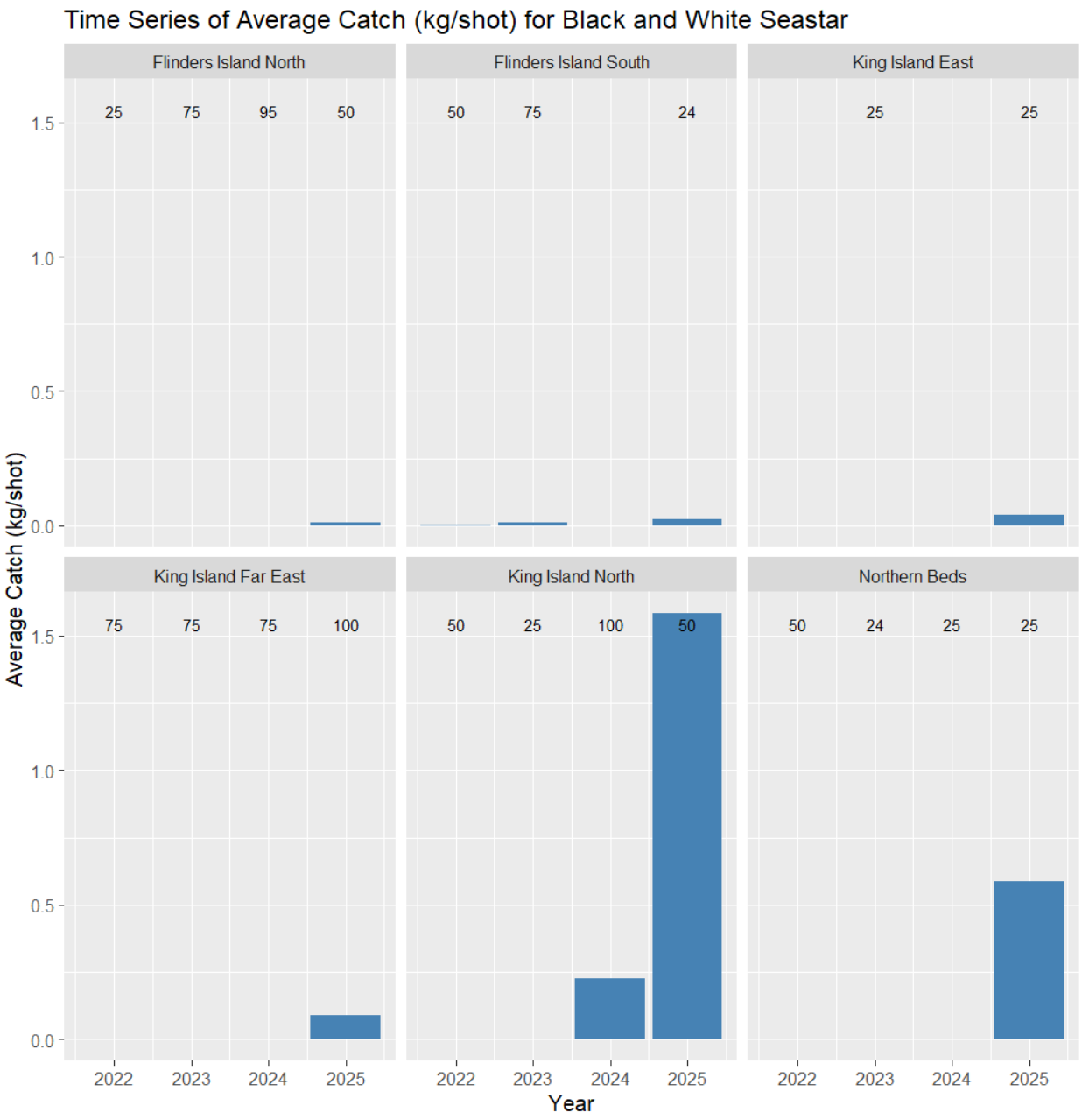


Figure 26. Average catch rates (kg/shot) of Black and White Seastars grouped in regions identified by Penney *et al.* (2025). Data are mean weight (kg/shot). Numbered annotations are number of shots.

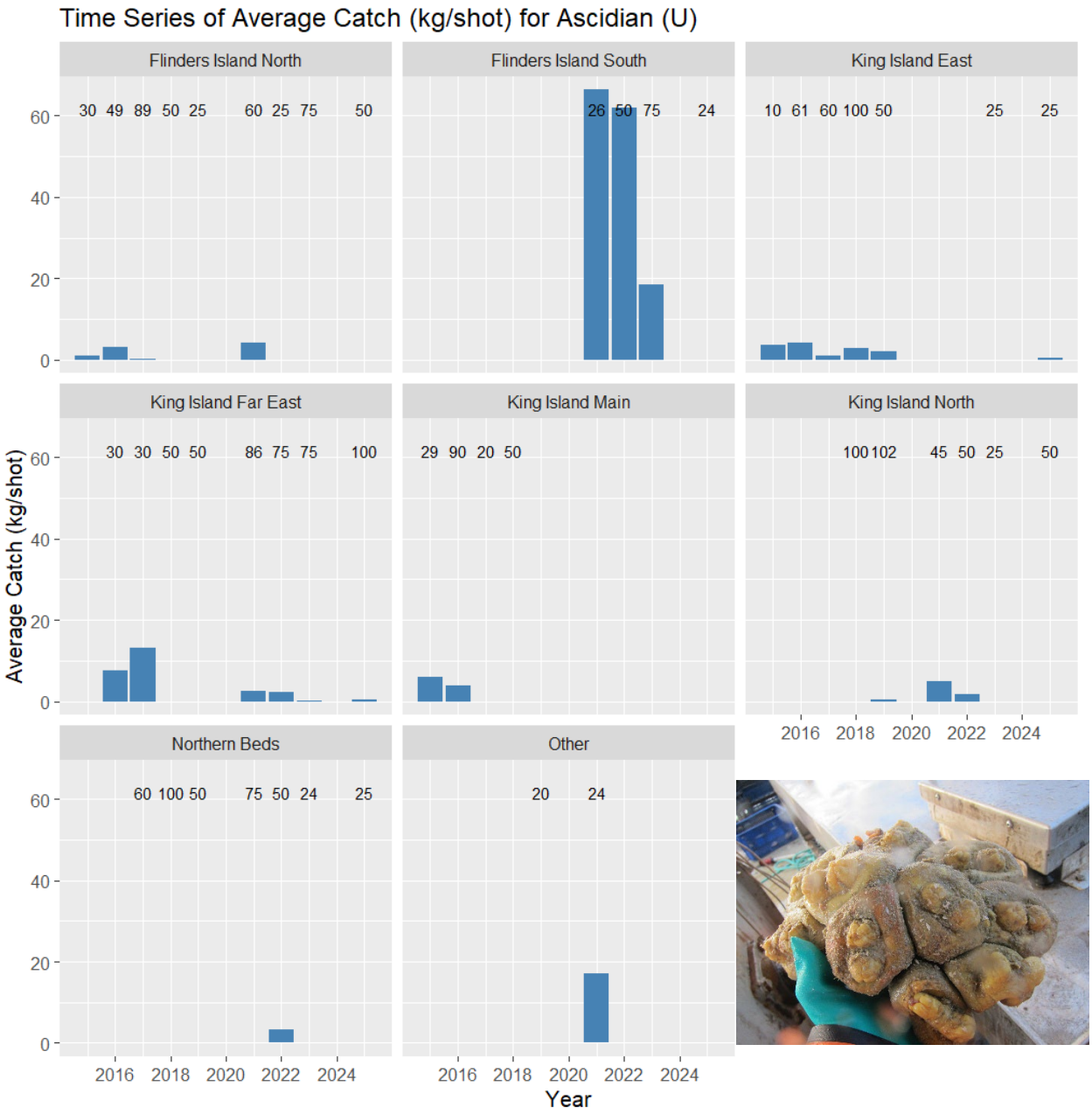


Figure 27. Average catch rates (kg/shot) of ascidians grouped in regions identified by Penney *et al.* (2025). Data are mean weight (kg/shot). Numbered annotations are number of shots.

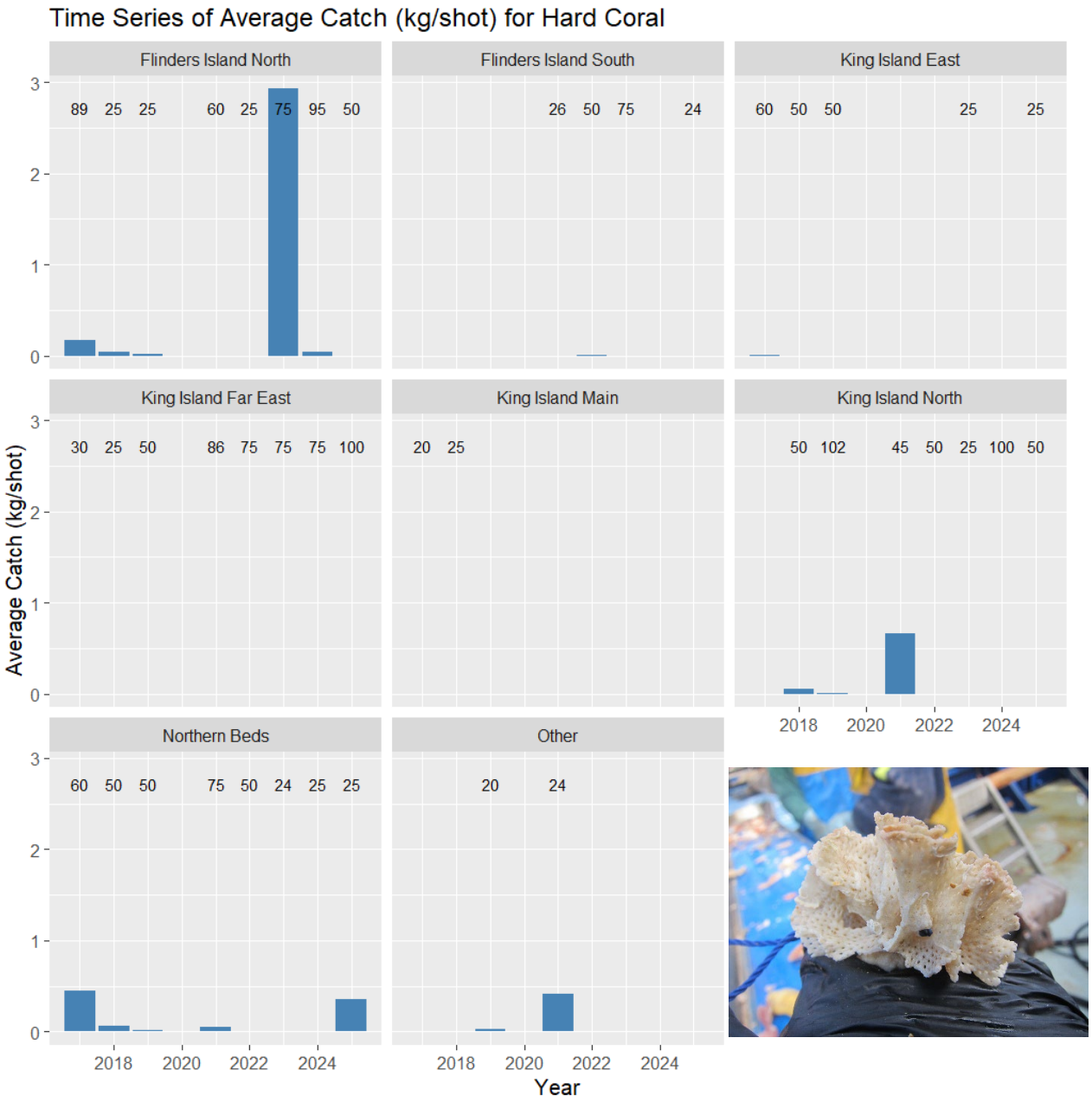


Figure 28. Average catch rates (kg/shot) of hard coral grouped in regions identified by Penney *et al.* (2025). Data are mean weight (kg/shot). Numbered annotations are number of shots.

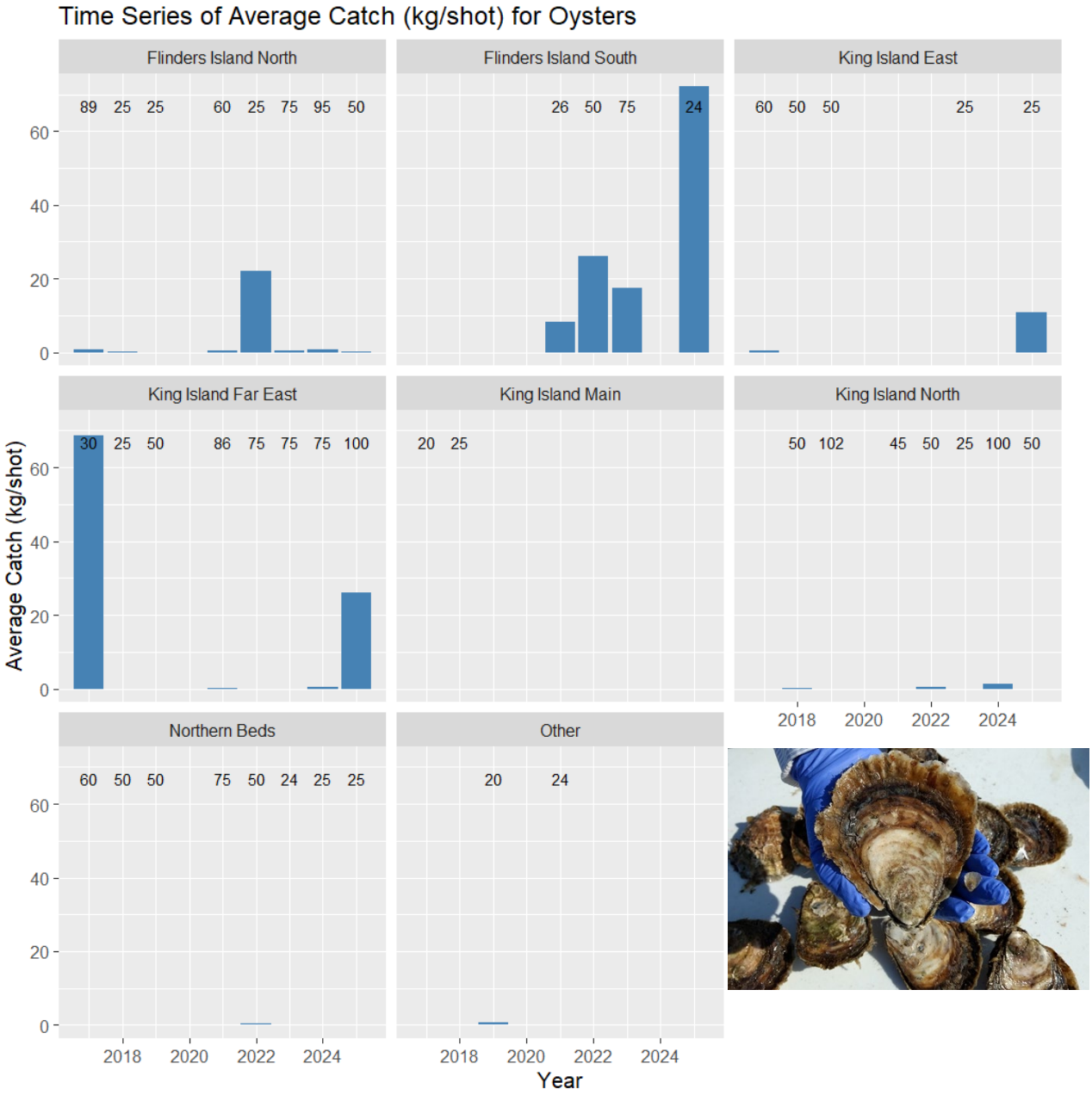


Figure 29. Average catch rates (kg/shot) of hard coral grouped in regions identified by Penney *et al.* (2025). Data are mean weight (kg/shot). Numbered annotations are number of shots.

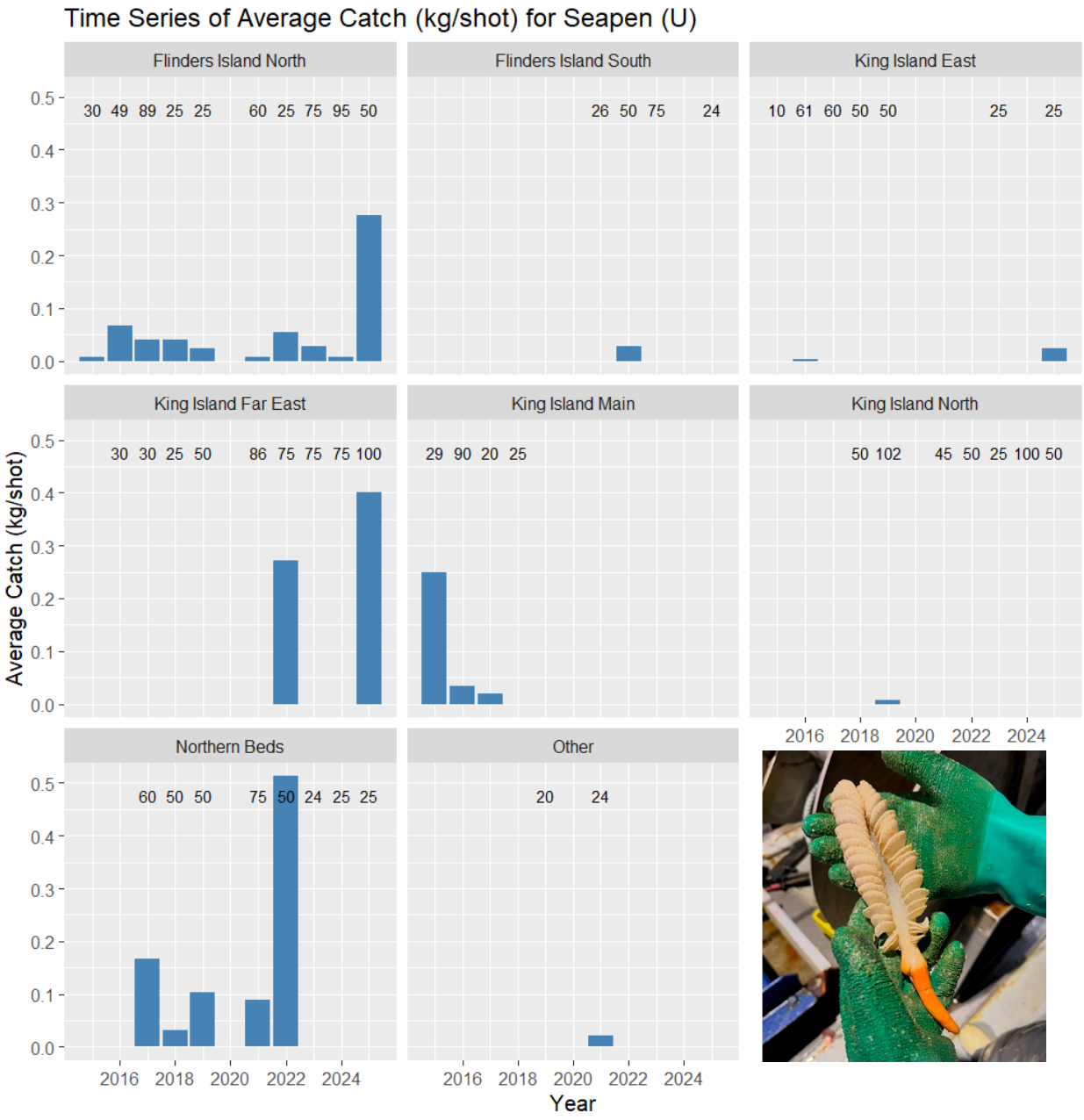


Figure 30. Average catch rates (kg/shot) of sea pens grouped in regions identified by Penney *et al.* (2025). Data are mean weight (kg/shot). Numbered annotations are number of shots.

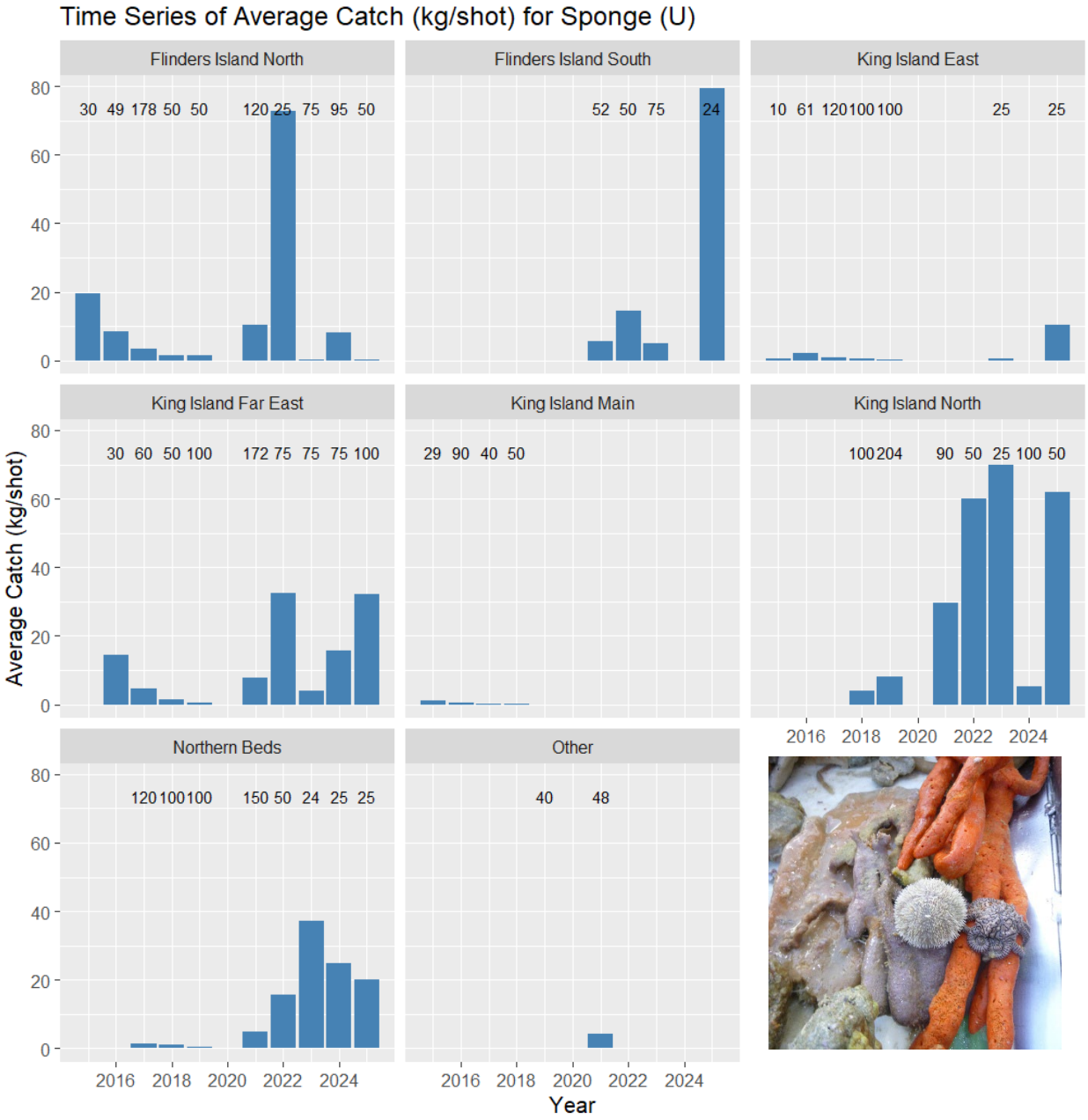


Figure 31. Average catch rates (kg/shot) of sponge grouped in regions identified by Penney *et al.* (2025). Data are mean weight (kg/shot). Numbered annotations are number of shots.

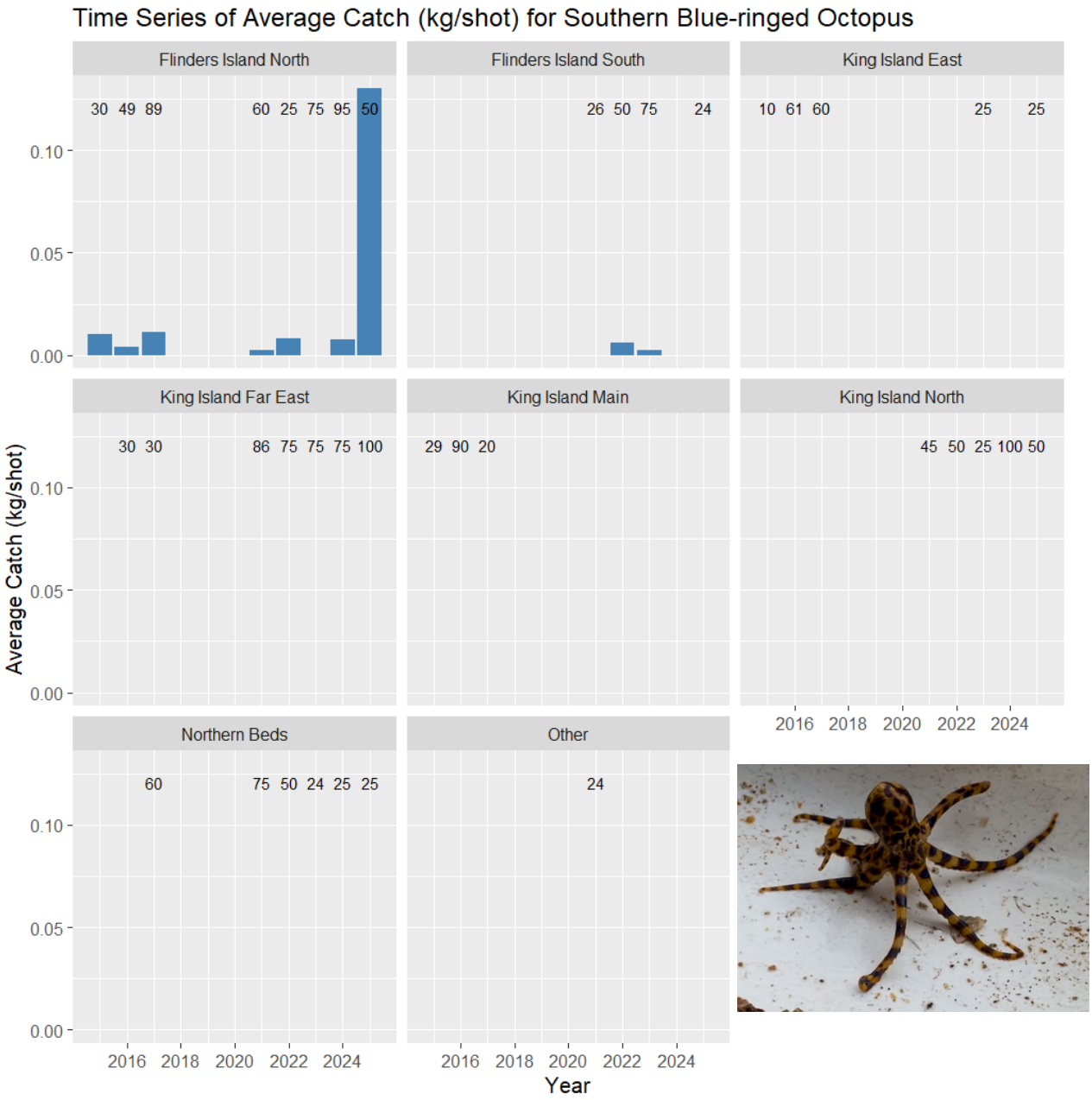


Figure 32. Average catch rates (kg/shot) of Blue-ringed Octopus grouped in regions identified by Penney *et al.* (2025). Data are mean weight (kg/shot). Numbered annotations are number of shots.

Table 10. *Vertices of Surveyed Scallop Beds 2025

Bed	Vertex_index	Longitude	Latitude
FI - South - North of Babel	0	148.3458	-39.7898
FI - South - North of Babel	1	148.3825	-39.79617
FI - South - North of Babel	2	148.3213	-39.8723
FI - South - North of Babel	3	148.2818	-39.865
FI - South - North of Babel	4	148.3458	-39.7898
AB - The Hill North	0	144.5133333	-39.2217
AB - The Hill North	1	144.5133333	-39.28
AB - The Hill North	2	144.405	-39.28
AB - The Hill North	3	144.405	-39.2217
AB - The Hill North	4	144.5133333	-39.2217
KI - 10	0	145.1075685	-39.8999981
KI - 10	1	145.1437184	-39.90022291
KI - 10	2	145.1431344	-39.95002409
KI - 10	3	145.1069616	-39.94999994
KI - 10	4	145.1075685	-39.8999981
KI - Lavinia North	0	144.232055	-39.66814062
KI - Lavinia North	1	144.1974672	-39.70519294
KI - Lavinia North	2	144.1974618	-39.70519212
KI - Lavinia North	3	144.1721183	-39.66033207
KI - Lavinia North	4	144.1620468	-39.64250469
KI - Lavinia North	5	144.1465775	-39.57574639
KI - Lavinia North	6	144.1458831	-39.53848544
KI - Lavinia North	7	144.1766846	-39.53848311
KI - Lavinia North	8	144.1766994	-39.57004716
KI - Lavinia North	9	144.1864848	-39.58685371
KI - Lavinia North	10	144.2038234	-39.62720419
KI - Lavinia North	11	144.2123765	-39.63960634
KI - Lavinia North	12	144.232055	-39.66814062
KI - Lavinia East	0	144.1974672	-39.70519294
KI - Lavinia East	1	144.232055	-39.66814062
KI - Lavinia East	2	144.2320607	-39.66814892
KI - Lavinia East	3	144.2792795	-39.68931571
KI - Lavinia East	4	144.2792795	-39.68931571
KI - Lavinia East	5	144.3260908	-39.68931518
KI - Lavinia East	6	144.3570487	-39.7170416
KI - Lavinia East	7	144.3844459	-39.73228503
KI - Lavinia East	8	144.3826726	-39.74874586
KI - Lavinia East	9	144.2988193	-39.75078213
KI - Lavinia East	10	144.2784659	-39.71740316
KI - Lavinia East	11	144.2784659	-39.71740312
KI - Lavinia East	12	144.1974672	-39.70519294
KI - 3 Hummock SE	0	145.1180023	-40.00243773
KI - 3 Hummock SE	1	145.1141019	-39.98184615
KI - 3 Hummock SE	2	145.148275	-39.97903659
KI - 3 Hummock SE	3	145.1697128	-40.04280219
KI - 3 Hummock SE	4	145.1186577	-40.04760293
KI - 3 Hummock SE	5	145.1180023	-40.00243773
FI - 1	0	148.13	-39.25
FI - 1	1	148.13	-39.33
FI - 1	2	148.05	-39.33
FI - 1	3	148.05	-39.25
FI - 1	4	148.05	-39.19
FI - 1	5	148.13	-39.19
FI - 1	6	148.13	-39.25
KI - Blue Dot Extended	0	144.8561	-39.82548333
KI - Blue Dot Extended	1	144.8561	-39.76711667
KI - Blue Dot Extended	2	144.95795	-39.76711667
KI - Blue Dot Extended	3	144.95795	-39.82548333
KI - Blue Dot Extended	4	144.8561	-39.82548333
KI - 12	0	145.2216667	-40.0975
KI - 12	1	145.1925	-40.0975
KI - 12	2	145.1317401	-40.04637278
KI - 12	3	145.1697128	-40.04280219
KI - 12	4	145.1684287	-40.03898248
KI - 12	5	145.1966667	-40.03833333
KI - 12	6	145.2216667	-40.0975
KI - 11	0	145.0916667	-39.93333333
KI - 11	1	145.1166667	-40.03833333
KI - 11	2	145	-39.93333333
KI - 11	3	145.0916667	-39.93333333
FI - 5	0	148.2804167	-39.2378
FI - 5	1	148.2780833	-39.22066667
FI - 5	2	148.4164667	-39.21118333
FI - 5	3	148.40695	-39.2539
FI - 5	4	148.2804167	-39.2378

*Note:- When comparing vertices with the description of area closures, there are vertices in table 10. that are not in the closure description. The software used adds additional vertices aong a straight line which are omitted when describing the closures for simplicity.