Fisheries

Status of the Central Zone Abalone Fisheries in 2022

O. Burnell

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Status Report for PIRSA Fisheries and Aquaculture

Government of South Australia
Department of Primary Industries and Regions

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

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ABBREVIATIONS

CPUA	Catch Per Unit Area
CPUE	Catch Per Unit Effort
CZ	Central Zone
FIS	Fishery Independent Survey
GPS	Global Positioning System
HS	Harvest Strategy
KI	Kangaroo Island
NFSRF	National Fishery Status Reporting Framework
PI	Performance Indicator
PIRSA	Department of Primary Industries and Regions
SAAF	South Australian Abalone Fishery
SARDI	South Australian Research and Development Institute
SAU	Spatial Assessment Unit
TACC	Total Allowable Commercial Catch
YP	Yorke Peninsula

EXECUTIVE SUMMARY

This report provides an assessment of stock status for Greenlip Abalone (*Haliotis laevigata*; hereafter referred to as 'greenlip') in the Central Zone (CZ) of the South Australian Abalone Fishery (SAAF) in 2022. The stock status and recommended catch for greenlip was determined using the Harvest Strategy (HS) from the Abalone Management Plan (PIRSA 2021). The HS applies two key indicators, catch-per-unit-effort (CPUE) and abalone legal density from fishery independent surveys (FIS), to generate proxies for biomass and fishing mortality. The HS has been designed to deliver outcomes consistent with the national fishery status reporting framework (NFSRF; Piddock *et al.* 2021). There is no updated assessment for Blacklip Abalone (*Haliotis rubra*; hereafter referred to as 'blacklip') because the fishery is classified as **'depleted'** and was closed to commercial fishing in 2022 with a TACC of zero.

Greenlip

Prior to 2020, catches of greenlip in the CZ fishery were consistent with the total allowable commercial catch (TACC) at approximately 46 t per year. In 2021, catches declined to <30 t for the first time since 1974. Subsequent catches have remained low, with 23.3 t harvested in 2022. The low catch in 2022 was primarily driven by an ongoing reduction in catch at the key fishing ground in the CZ – Tiparra Reef – where 1 t of greenlip was harvested in 2022, which is <5% of the post-TACC average of 25 t. This long-term decline in catch from Tiparra Reef has contributed to higher catches from other SAUs, in particular the West Yorke Peninsula SAU, where average catches have more than doubled over the last decade.

Following record high CPUEs in the early 2000s, over the last two decades catch-rate has declined from 31 kg.hr^{-1} in 2001 to 20 kg.hr^{-1} in 2022. The current CPUE of 20 kg.hr^{-1} is among the lowest levels since the TACC was introduced in 1990, although a small increase was observed between 2021 and 2022. Despite recent low CPUEs, five of the six Spatial Assessment Units (SAUs) had a CPUE score between 3.9 and 5 in 2022, indicating estimates are relatively close to target levels from the HS (PIRSA 2021). Similarly, legal-densities from the FIS at Tiparra Reef and West Yorke Peninsula (scoring 5.0 and 4.6, respectively) were also close to target levels used in the HS.

Application of the HS in 2022 resulted in a **zone score (i.e., biomass proxy) of 4.5 / 10** that, in combination with the **zone trend score (i.e., fishing mortality proxy) of 5.0 / 10** (reflecting a stable trend), defines the stock status for greenlip in the CZ in 2022 as **'sustainable'**. This means biomass is at a level sufficient to ensure that, on average, future levels of recruitment are adequate (i.e., recruitment is not impaired) and for which fishing mortality is adequately controlled to avoid the stock becoming recruitment impaired (Piddocke et al 2021). The fishery is considered 'sustainable' under the HS because, although the biomass proxy is below the target (i.e., a score

of <5), the current level of fishing mortality is adequately controlled (i.e., a score of ≥5). The HS zone score of 4.5 in 2022 translates to a recommended zonal catch of 41.27 t for 2024, which is 14.5% above the current TACC of 36.05 t. If low catches from Tiparra Reef persist, the higher catches obtained from the other SAUs are unlikely to be sustainable even at the lower total catch of around 23 t.

Blacklip

There is no updated assessment for blacklip because the fishery was closed to commercial fishing in 2022. Data available from the most recent assessment (Burnell and Mayfield 2023) are included as an appendix to this report.

Key statistics for the CZ fishery from 2013 to 2022, including total allowable commercial catch (TACC), total commercial catch (TCC), catch per unit effort (CPUE), zone score, zone trend score and stock status from the weight of evidence using the national fishery status reporting framework (NFSRF) or Harvest Strategy. Tmw = tonnes meat weight, $kg.hr^{-1}$ = kilograms per hour. *Indicates years when stock status was determined using the weight of evidence approach from the NFSRF (Piddocke et al. 2021).

Greenlip						
Season	**TACC (t)**	**TCC (t)**	**CPUE ($kg.hr^{-1}$)**	**Zone Score**	**Zone Trend Score**	**Stock Status**
2013	47.7	47.9	23.5	5.8	5.0	Depleting*
2014	47.7	47.5	24.3	6.8	6.0	Depleting*
2015	46.0	45.7	23.4	6.3	5.5	Depleting*
2016	46.0	46.0	23.7	6.1	5.0	Depleting*
2017	46.0	46.1	22.8	5.3	4.1	Sustainable*
2018	46.0	45.7	22.2	5.0	4.3	Sustainable*
2019	46.0	46.0	20.9	4.4	4.0	Depleting
2020	46.0	28.1	19.8	4.4	4.5	Depleting
2021	46.0	24.9	19.2	4.4	4.9	Depleting
2022	36.1	23.3	20.2	4.5	5.0	Sustainable
Blacklip						
2013	8.1	8.4	24.0	3.9	5.0	Depleting*
2014	8.1	7.5	23.7	3.9	5.0	Depleting*
2015	6.4	6.4	24.6	4.4	5.0	Depleting*
2016	6.4	6.2	20.9	1.5	2.7	Depleting*
2017	6.4	5.8	18.3	0.6	0.1	Depleted*
2018	0.0	0.0	NA			Depleted*
2019	6.4	1.0	NA			Depleted*
2020	6.4	1.2	18.9			Depleted*
2021	1.2	1.2	NA			Depleted*
2022	0.0	0.0	NA			Depleted*

Keywords: Greenlip abalone, *Haliotis laevigata*, Blacklip abalone, *Haliotis rubra*, Stock status, Harvest Strategy, South Australia.

1 INTRODUCTION

The most recent stock status of Greenlip and Blacklip Abalone (*Haliotis laevigata and H. rubra*; hereafter referred to as 'greenlip' and 'blacklip' respectively) in the Central Zone (CZ) of the South Australian Abalone Fishery in 2021 was provided in the stock assessment report for the fishery (Burnell and Mayfield 2023). This current report assesses the status of greenlip in the CZ in the 2022 fishing season (calendar year). This report forms part of the South Australian Research and Development Institute's (SARDI Aquatic Sciences) ongoing assessment program for this fishery. In this report, stock status for greenlip was determined using the Harvest Strategy (HS), which has been designed to deliver stock status outcomes consistent with the national fishery status reporting framework (NFSRF; Piddocke *et al.* 2021, Table 1-1). The HS used in this report is included in the Management Plan for the South Australian Commercial Abalone Fisheries (PIRSA 2021). The Management Plan specifies annual application of the HS to determine stock status and review the Total Allowable Commercial Catch (TACC).

There is no updated assessment for blacklip because the fishery is classified as depleted and was closed to commercial fishing in 2022.

Table 1-1. Terminology for the status of key Australian fish stocks (from Piddocke *et al.* 2021).

	Stock status	Description	Potential implications for management of the stock
	Sustainable	Biomass (or biomass proxy) is at a level sufficient to ensure that, on average, future levels of recruitment are adequate (*i.e.,* recruitment is not impaired) and for which fishing mortality (or proxy) is adequately controlled to avoid the stock becoming recruitment impaired	Appropriate management is in place
	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
	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
	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
	Negligible	Catches are so low as to be considered negligible and inadequate information exists to determine stock status	Assessment will not be conducted unless catches and information increase

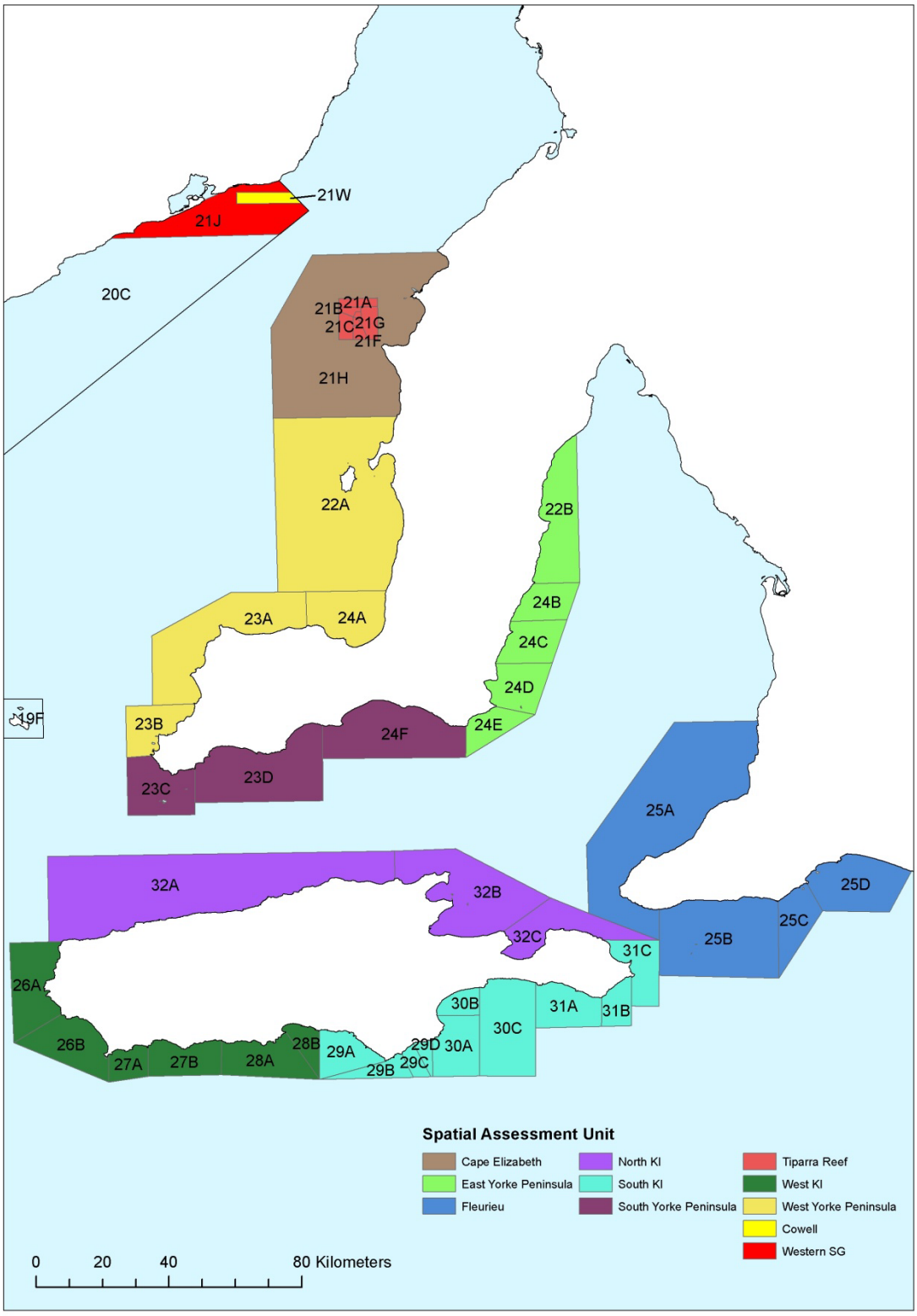

Figure 1-1 Spatial assessment units (SAUs; coloured blocks), fishing areas (numbered areas) and mapcodes (numbered and lettered areas) of the CZ of the South Australian Abalone Fishery.

2 METHODS

Fishery-dependent and fishery-independent methods are described briefly below. A greater level of detail is available in the previous stock assessment report, Burnell and Mayfield (2023). All data in this report are presented at the Spatial Assessment Unit (SAU) scale, except for selected mapcodes in Appendices 1 and 2.

Fishery-dependent data

Commercial catch and effort data have been collected since 1968 by fishers completing a research logbook for each fishing day.

Catch (t, meat weight) was determined from all daily logbook returns.

Catch-per-unit-effort (kg.hr^{-1}, meat weight) was estimated as the mean of daily CPUE weighted by the proportion of the target species in the catch. Due to the mixed nature of catches, effort was split pro-rata based on the proportion of each species in the daily catch. Estimates of CPUE (mean ± se) are not made where <10 fishing events are available at the relevant scale in a given year. Catch rate estimates throughout the report with no standard error shown, represent a running mean CPUE estimated when there are ≥10 fishing events available across three years (with a minimum of 1 fishing event each year), which are required under the HS (PIRSA 2021).

Abalone mean length for each SAU from the commercial shell sampling program is also presented in this report.

Methods and outputs from GPS and depth logger data that were collected in the Central Zone between 2013 to 2021 are included in Appendix 2.

Fishery-independent data

Fishery-independent surveys (FIS) are undertaken biennially in two SAUs in the CZ (i.e., Tiparra Reef and West Yorke Peninsula). The current survey method involves counting and measuring all abalone within a 200 m^2 area at a series of consistent locations, to derive a time-series of mean density of legal (≥135mm) and sub-legal (<135mm) greenlip. No new data were available from FIS in 2022.

No FIS are undertaken for blacklip in the CZ.

Harvest Strategy and Stock Status determination

In the HS, each SAU is designated as surveyed (i.e., FIS undertaken), unsurveyed (i.e., no FIS undertaken) or data-limited (PIRSA 2021). The data-limited SAUs are pooled for estimation of CPUE and scoring in the HS (PIRSA 2021). There are two surveyed SAUs in the CZ, Tiparra Reef and West Yorke Peninsula.

The HS is based on two Performance Indicators (PIs), CPUE and legal-sized abalone density from the FIS. Performance Indicator scores for each SAU range from 0 to 10, based on comparison with a historical reference period. For the CPUE PI the reference period is from 1990 to 2000, except for East Yorke Peninsula (2008 to 2016), due to the absence of fishing between 1990 and 2000 in this SAU. The FIS reference period varies by SAU and is dependent on the number of years surveys have been undertaken. A minimum of four years of surveys are required for a score function to be applied and the reference period requires at least 10 surveys before it becomes fixed (similar to the CPUE reference period). There are two surveyed SAUs for greenlip in the CZ. When FIS scores are available, combined SAU scores reflect equal weighting (i.e., 50:50) of the CPUE and FIS PIs. The upper and lower limit reference points and the target range are indicated on relevant plots for CPUE and legal density (see Results). Scores for each SAU are then weighted based on the last 12 years of catch, and summed to a zone score, which represents the biomass proxy from the NFSRF. The slope from the last four zone scores is used to generate a proxy for fishing mortality (i.e., zone trend score). Stock status is determined based on the the combination of the zone score and the zone trend score, shown in Table 2-1.

Table 2-1. Potential stock status outcomes from the Harvest Strategy

Status	Zone Score	Zone Trend Score
Sustainable	≥5	
Sustainable	<5 & ≥1	≥5
Depleting	<5 & ≥1	<5
Recovering	<1	≥5
Depleted	<1	<5

The zone score (i.e., biomass proxy) translates directly to a recommended zonal catch, via a function which adjusts the target catch level (see PIRSA 2021). The target catch for the CZ greenlip and blacklip fisheries are 46.0 t and 9 t, respectively. For zone scores between 5 and 7, the recommended zonal catch is equal to the target catch (i.e., no adjustment). For zone scores between 7 and 10, there is a optional linear adjustment from 1.0 (i.e., no adjustment) to a maximum of 1.3 (i.e., 30% above the target catch). Consequently, the theoretical maximum recommendable zonal greenlip catch for a score of 10 is 59.8 t (i.e., 46 t x 1.3 = 59.8 t). For a zone score between 5 and 1, the adjustment decreases linearly from 1.0 (i.e., no adjustment) to 0.1 (i.e., 90% below the target catch). Consequently, the recommended zonal greenlip catch for a score of 1 is 4.6 t (i.e., 46.0 t x 0.1 = 4.6 t). For zone scores <1 the recommended catch is zero. The HS is not applied to blacklip.

3 RESULTS

Central Zone

Total greenlip catches were consistent with the TACC from 1994 to 2019 (Figure 3-1a). A small decline in TACC from 47.7 t to 46.0 t occurred in 2015, following the introduction of marine park sanctuary zones. Total annual catch decreased to 28.1 t in 2020, before two further declines in 2021 (24.9 t harvested) and 2022 (23.3 t harvested). The TACC has not been fully harvested since 2019. Catch-per-unit-effort was relatively stable from 1985 to 1999 (average: 21 $kg.hr^{-1}$), before increasing to the highest recorded value of 31 $kg.hr^{-1}$ in 2001. A decreasing trend was then evident for the majority of the next two decades with CPUE falling to 19.2 $kg.hr^{-1}$ by 2021, before increasing to 20.2 $kg.hr^{-1}$ in 2022.

The majority of greenlip catch is traditionally harvested from two SAUs, Tiparra Reef and West Yorke Peninsula (Figure 3-1b). In 2022, however, catches from Tiparra Reef had declined to 1 t, while more than 50% of the catch was taken from West Yorke Peninsula (13 t harvested). Persistently high catches have been harvested from West Yorke Peninsula for over a decade, averaging 15.5 t since 2011, which is more than double the average of 7.2 t from the preceding 30 year period. As is traditionally the case, smaller catches (approximately 0 to 3 t) were harvested from East Yorke Peninsula, West KI, South KI, and the data-limited SAUs.

Tiparra Reef

Following the introduction of the TACC in 1990, catches of greenlip at Tiparra Reef peaked at 45 t in 2001 (Figure 3-2a). Thereafter catches have decreased, and despite some variability, reached a low of 1 t in 2022. A catch-cap was in place at Tiparra Reef from 2005 to 2020 but is no longer used to manage catches. Catch-per-unit-effort at Tiparra Reef has declined from over 30 $kg.hr^{-1}$ in 2014 to 20.8 $kg.hr^{-1}$ in 2022, resulting in a CPUE score of 4.7 in 2022 (Table 3-1). Greenlip legal density from the FIS has generally increased in recent years (Figure 3-2c), from a low of 0.05 ± 0.01 $greenlip.m^{-2}$ in 2011, to reach 0.09 ± 0.02 $greenlip.m^{-2}$ in 2019, before declining again to 0.07 ± 0.02 $greenlip.m^{-2}$ in 2021. The 2021 FIS score of 5.0 for Tiparra Reef was carried forward to 2022, as is required under the HS. The density of sub-legal abalone (0.08 ± 0.02 $greenlip.m^{-2}$) was the lowest on record in 2015 but had increased by 60% by 2021 (0.12 ± 0.03 $greenlip.m^{-2}$), although it remained below most estimates recorded during the 1990s and 2000s (Figure 3-2d). The combination of the CPUE score and the FIS score resulted in a SAU score of 4.8 for Tiparra Reef.

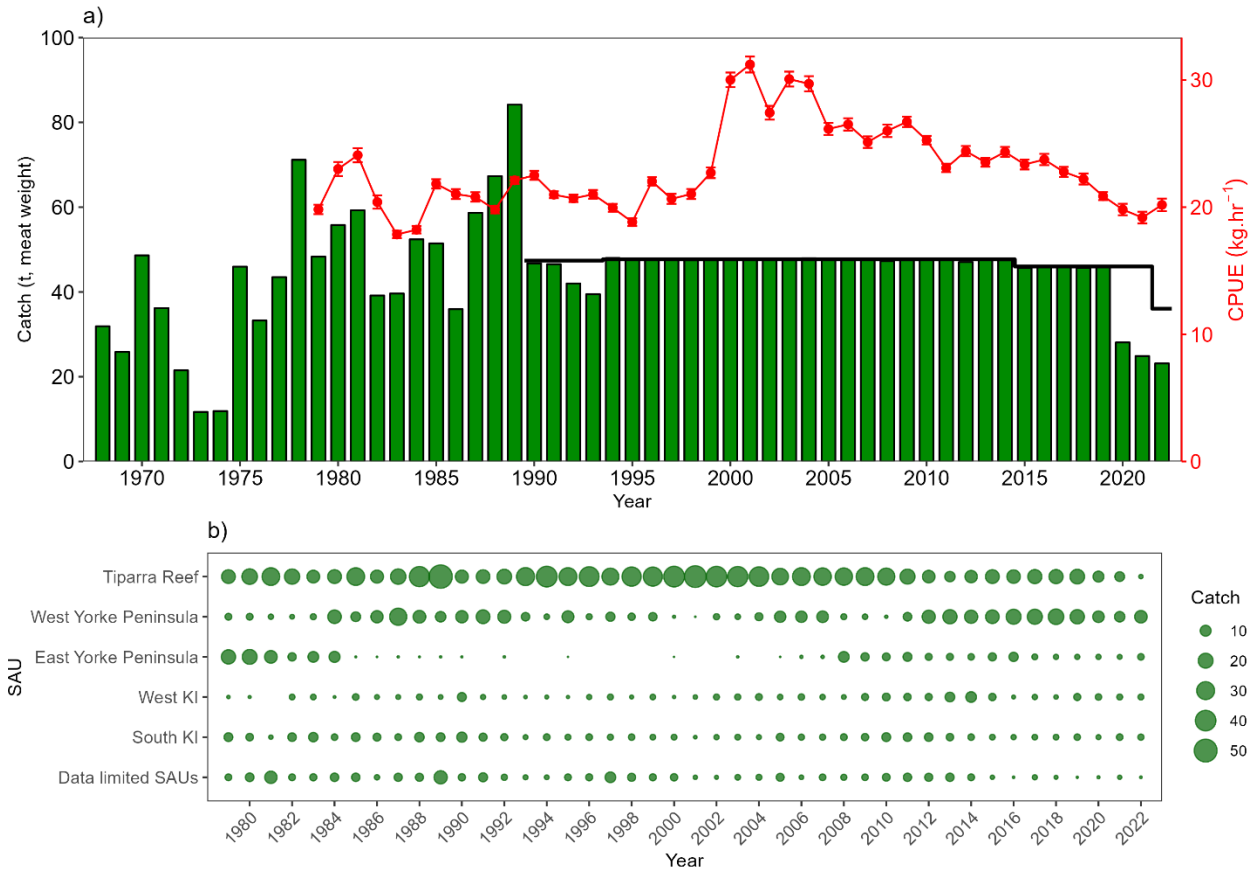

Figure 3-1 Zonal catch, CPUE and the distribution of catch among SAUs available from 1968 to 2022: a) Total catch (green bars, tonnes), CPUE (red line) and TACC (black line) of greenlip in the CZ from 1968-2020. b) Bubble plot showing the spatial distribution of the greenlip catch (t, meat weight; green symbols) among each of the SAUs in the CZ from 1979 to 2022 (data-limited SAUs from the HS are combined).

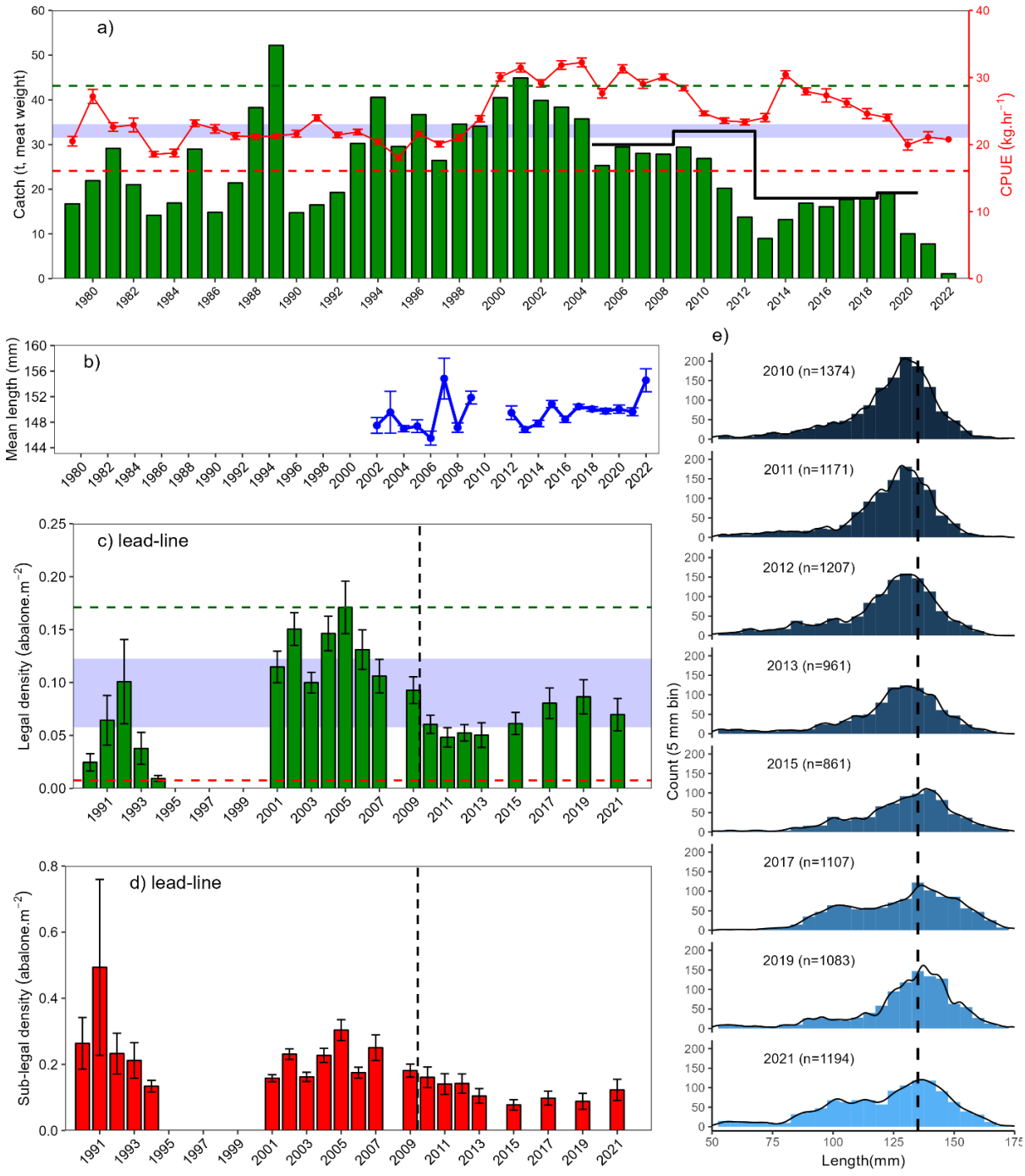

Figure 3-2 Tiparra Reef SAU from 1979 to 2022: a) Catch (green bars, tonnes), CPUE (red solid line, note symbols with no error bar are calculated from a thee year mean – see methods), historic catch-cap (black line), b) mean length from the commercial catch samples (blue line), c) legal density of greenlip (i.e., ≥135 mm green bars) from lead-line surveys, d) sub-legal density of greenlip (i.e., <135 mm SL, red bars) from lead-line surveys, e) Length counts from FIS. Gaps in the time series indicate no data. Scoring from the harvest strategy is shown for panels a) and c): Target Range (score of 5, blue shading), upper limit (score of 10, green dashed line), lower limit (score of 0, red dashed line). Lead-line estimates prior to 2010 onward in panels c) and d) have been scaled from timed-swim data, indicated by the dashed black line.

West Yorke Peninsula

In the West Yorke Peninsula SAU large greenlip catches were harvested between 2012 and 2022, reflecting the longest sustained period of high catches for this SAU (Figure 3-3a). While catches had been lower since 2020, the 13.6 t harvested in 2022 remained 40% above the historical average of 9.4 t. Catch-per-unit-effort was the second highest on record in 2012, before declining to a low of 18.5 kg.hr^{-1} in 2019. Thereafter, CPUE has stabilised and increased reaching 20.0 kg.hr^{-1}, equating to a score of 5.0 in the HS (Table 3-1). Fishery-independent surveys were undertaken at three fishing grounds in the West Yorke Peninsula SAU (see Appendix 1). The density of legal-sized abalone was relatively stable at all three sites from 2019 to 2021 (Appendix 1), equating to a score of 4.6. The combined SAU score for West Yorke Peninsula in 2022 was 4.8.

Within West Yorke Peninsula, there is considerable variation in catch and CPUE among the three primary fishing grounds or 'mapcodes' (see Appendix 1). Both Corny Point and Hardwicke Bay have sustained high levels of catch since 2012, consistent with the elevated catches from the West Yorke Peninsula SAU. Catch-per-unit effort at Hardwicke Bay was among the highest level on record at 24.2 kg.hr^{-1} in 2018 but had declined to 16.9 kg.hr^{-1} by 2022. At Corny Point, CPUE declined by >40% between 2012 and 2019, then stabilised before increasing to 21.8 kg.hr^{-1} in 2022. For Port Victoria, CPUE has been variable among years, with the estimate of 23.6 kg.hr^{-1} in 2022 similar to the historical average.

Unsurveyed SAUs

For West KI, catch and CPUE remained low for three years from 2016 and 2018, following a sustained period of high catches between 2009 and 2015 (Figure 3-4a). From 2019, catches increased and stabilised at approximately 3 t.y^{-1}, while CPUE has generally recovered reaching 21.8 kg.hr^{-1} in 2022. Although CPUE remained below the target range, with a SAU score of 3.9 (Table 3-1).

In the East Yorke Peninsula SAU, fishing recommenced in 2008 after being limited by mortalities related to *Perkinsus olensi* in the mid-1980s. Catches generally declined following a peak of 9.6 t in 2008, although catch increased from 1.5 t in 2021 to 3 t in 2022 (Figure 3-5a). CPUE declined from a peak of 24.1 kg.hr^{-1} in 2010 to reach a contemporary low of ~15.2 kg.hr^{-1} in 2017, before recovering to 23.7 kg.hr^{-1} in 2021. The 2022 CPUE estimate of 19.6 kg.hr^{-1} was within the target range, translating to a SAU score 5 (Table 3-1).

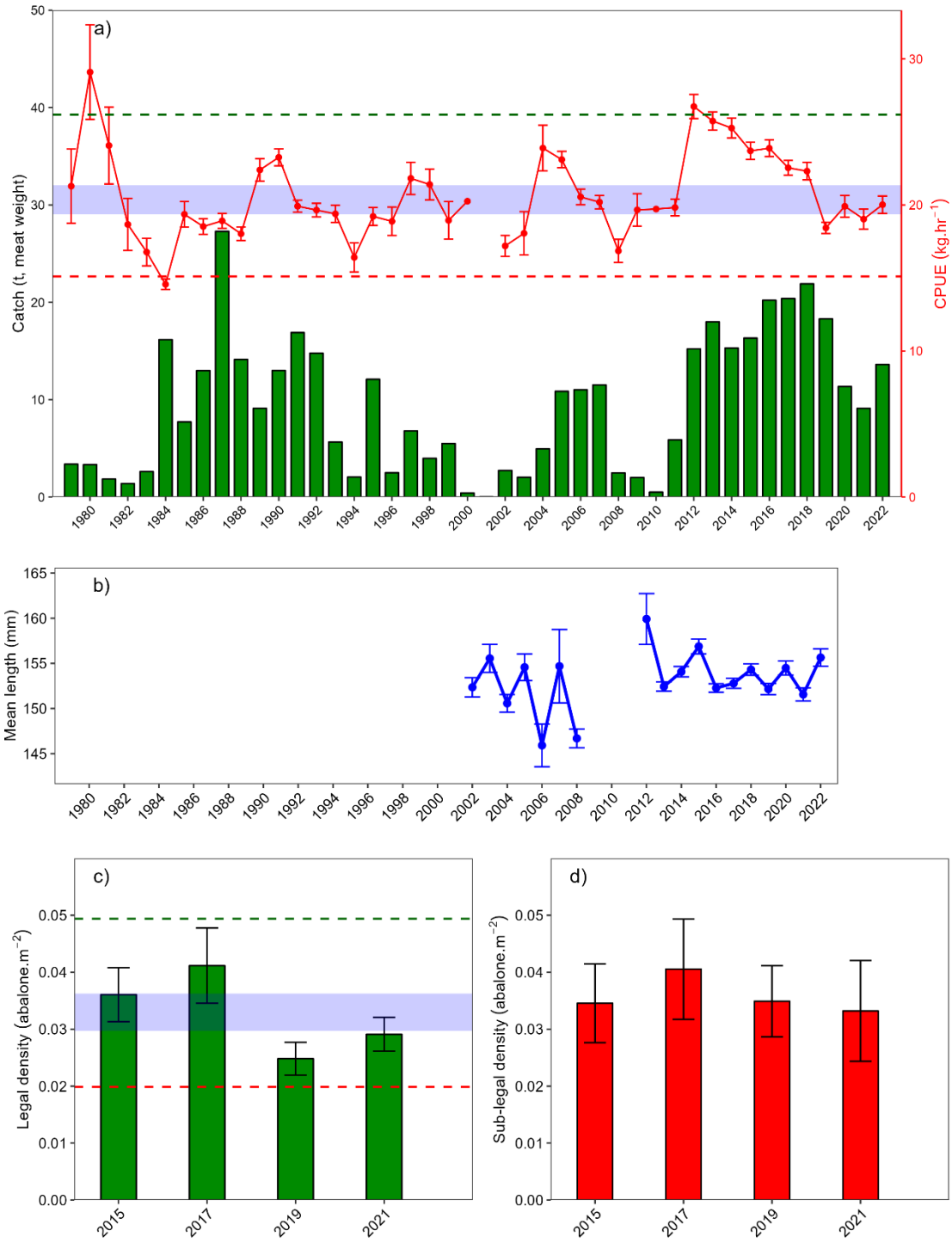

Figure 3-3 West Yorke Peninsula SAU data availble from 1979 to 2022: a) Catch (green bars, tonnes), CPUE (red line, note symbols with no error bar are calculated from a thee year mean – see methods), b) mean length from the commercial catch samples (blue line), c) legal density of greenlip (i.e., ≥135 mm green bars) from lead-line surveys, and d) sub-legal density of greenlip (i.e., <135 mm SL, red bars) from lead-line surveys. Gaps in all time series indicate no data. Scoring from the HS is shown for panels a) and c): Target Range (score of 5, blue shading), upper limit (score of 10, green dashed line), lower limit (score of 0, red dashed line).

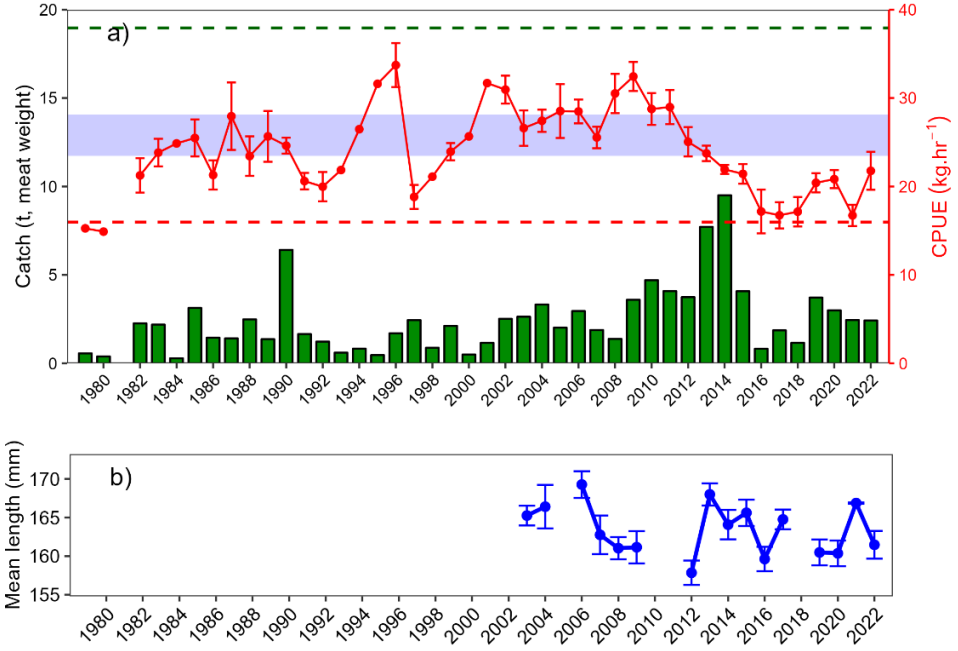

Figure 3-4 West Kangaroo Island SAU from 1979 to 2022: a) Catch (green bars, tonnes), CPUE (red line, note symbols with no error bar are calculated from a thee year mean – see methods), CPUE Target Range (score of 5, blue shading), CPUE upper limit (score of 10, green dashed line), and CPUE lower limit (score of 0, red dashed line), and b) mean length from the commercial catch samples (blue line). Gaps in all time series indicate no data.

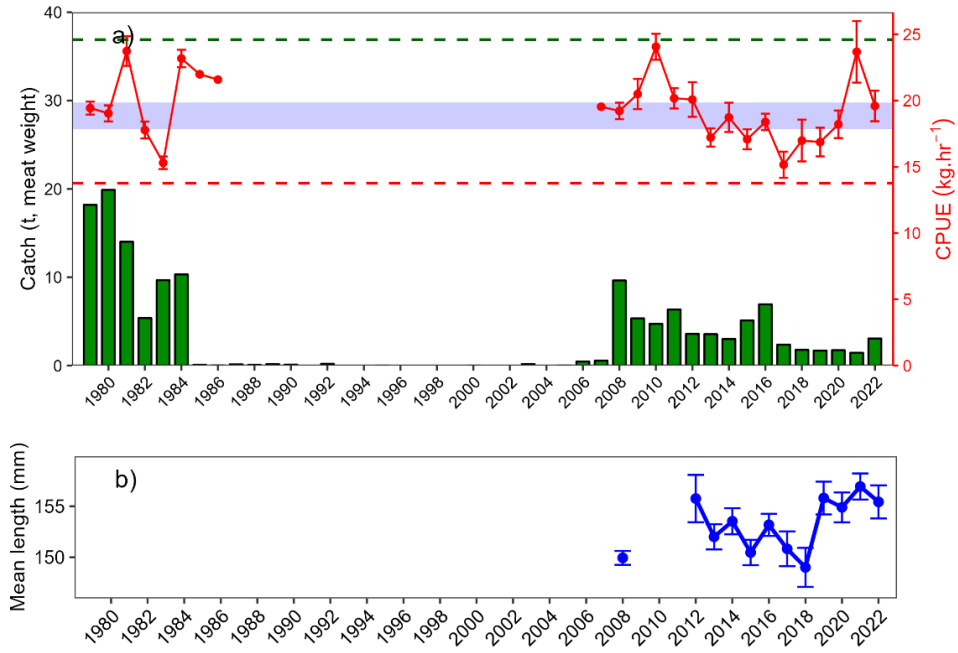

Figure 3-5 East Yorke Peninsula SAU from 1979 to 2022 : a) Catch (green bars, tonnes), CPUE (red line, note symbols with no error bar are calculated from a thee year mean – see methods), CPUE Target Range (score of 5, blue shading), CPUE upper limit (score of 10, green dashed line), and CPUE lower limit (score of 0, red dashed line), and b) mean length from the commercial catch samples (blue line). Gaps in all time series indicate no data.

In South KI, the most recent peak in catches occurred in 2010 when 6.3 t was harvested but thereafter catches generally declined and stablised averaging 2.3 $t.y^{-1}$ since 2015 (Figure 3-6a). Over the last decade CPUE has oscillated between 19 and 25 $kg.hr^{-1}$. In 2022, the CPUE of 20.9 $kg.hr^{-1}$ was just below the target range, equating to a SAU score 4.9 (Table 3-1).

Data-limited SAUs

In 2022, both catch and CPUE from the combined data-limited SAUs were among the lowest levels on record (Figure 7a). The CPUE was below the limit, translating to a SAU score of 0.0 (Table 3-1).

Commercial shell sampling

The mean length of abalone in the commercial catch is shown for each surveyed and unsurveyed SAU. In 2020, the mean length of greenlip was generally toward the upper end of historical values for most SAUs. One exception to this was the West KI SAU.

Harvest Strategy – zone score and stock status

The catch-weighted, zone score (i.e., biomass proxy) for 2022 was **4.5 / 10** (Table 3.1, Figure 3.8). In combination with the zone trend score (i.e., fishing mortality proxy) in 2022 of **5.0 / 10** (reflecting a stable trend), these define the zonal stock status for greenlip in the CZ in 2022 as **'sustainable'** (Figure 3.9).

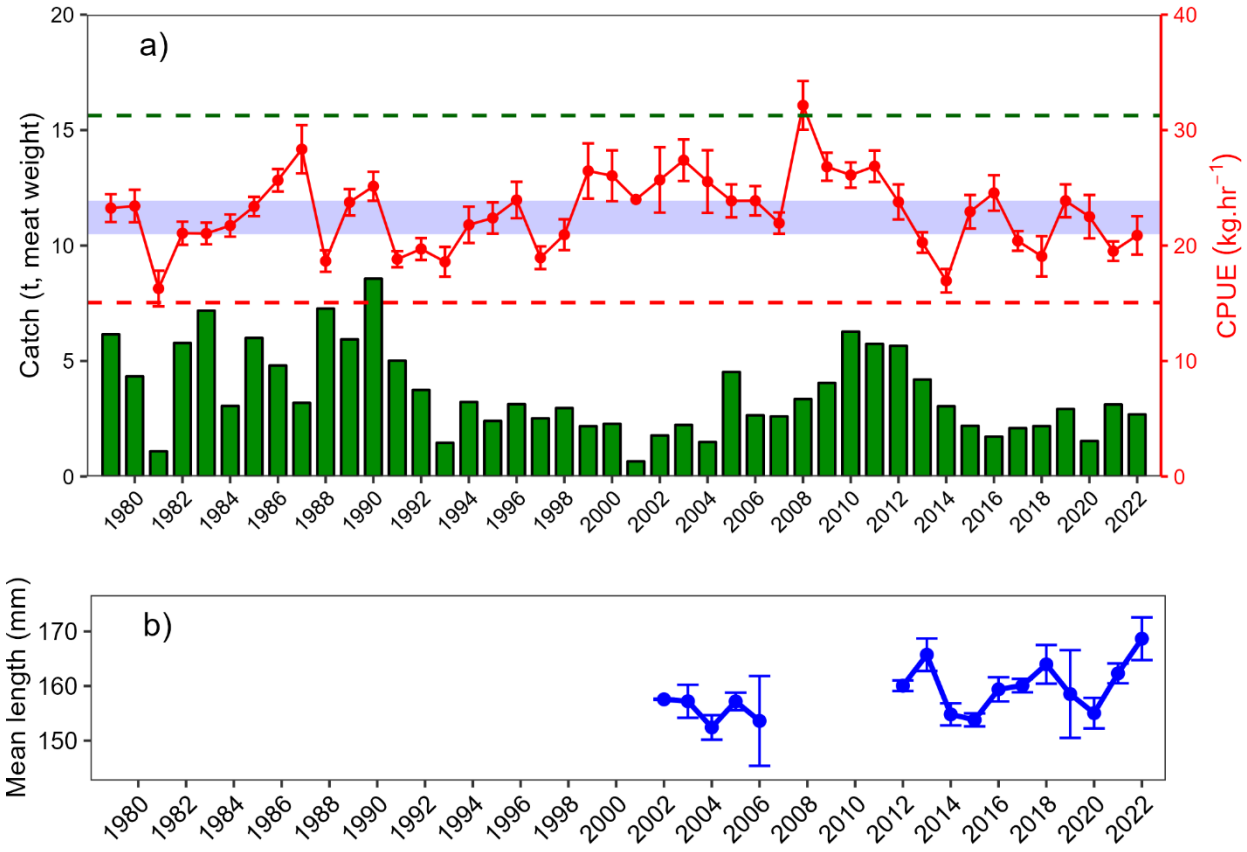

Figure 3-6 South Kangaroo Island SAU from 1979 to 2022: a) Catch (green bars, tonnes), CPUE (red line), CPUE Target Range (score of 5, blue shading), CPUE upper limit (score of 10, green dashed line), and CPUE lower limit (score of 0, red dashed line). b) mean length from the commercial catch samples (blue line). Gaps in all time series indicate no data.

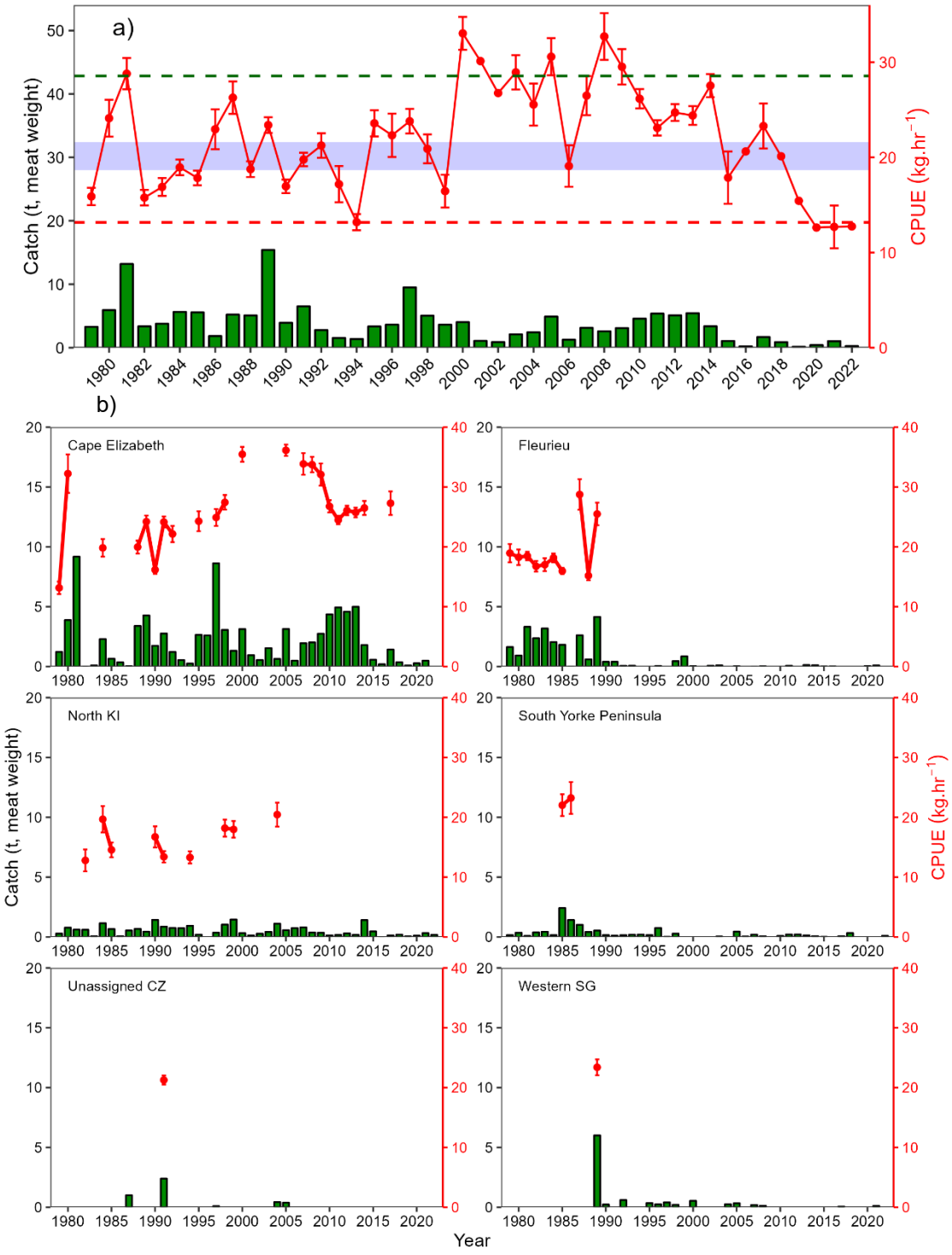

Figure 3-7 Data-limited SAUs from 1979 to 2022. a) Combined data-limited SAUs: Catch (green bars, tonnes), CPUE (red line, note symbols with no error bar are calculated from a thee year mean – see methods), CPUE Target Range (score of 5, blue shading), CPUE upper limit (score of 10, green dashed line), CPUE lower limit (score of 0, red dashed line). b) Individual data-limited SAUs from 1979 to 2022. Catch (green bars, tonnes) and CPUE (red line). Gaps in the time series indicate no data.

Table 3-1. Outcome of application of the Harvest Strategy described in the Management Plan for CZ greenlip in 2022.

SAU	CPUE ($kg.hr^{-1}$)	CPUE score	Legal density ($abs.m^{-2}$)	Legal density score	Combined score	Catch (t)	Catch (proportion)	Weighted SAU score
West Yorke Peninsula	20.0	5.0	0.03	4.6	4.8	13.6	0.38	1.85
Tiparra Reef	20.8	4.7	0.07	5.0	4.9	1.1	0.32	1.55
West KI	21.8	3.9	-	-	3.9	2.4	0.09	0.35
East Yorke Peninsula	19.6	5.0	-	-	5.0	3.1	0.08	0.41
South KI	20.9	4.9	-	-	4.9	2.7	0.08	0.38
Data limited SAUs	12.7	0.0	-	-	0.0	0.3	0.05	0.00
							Zone Score	**4.54**

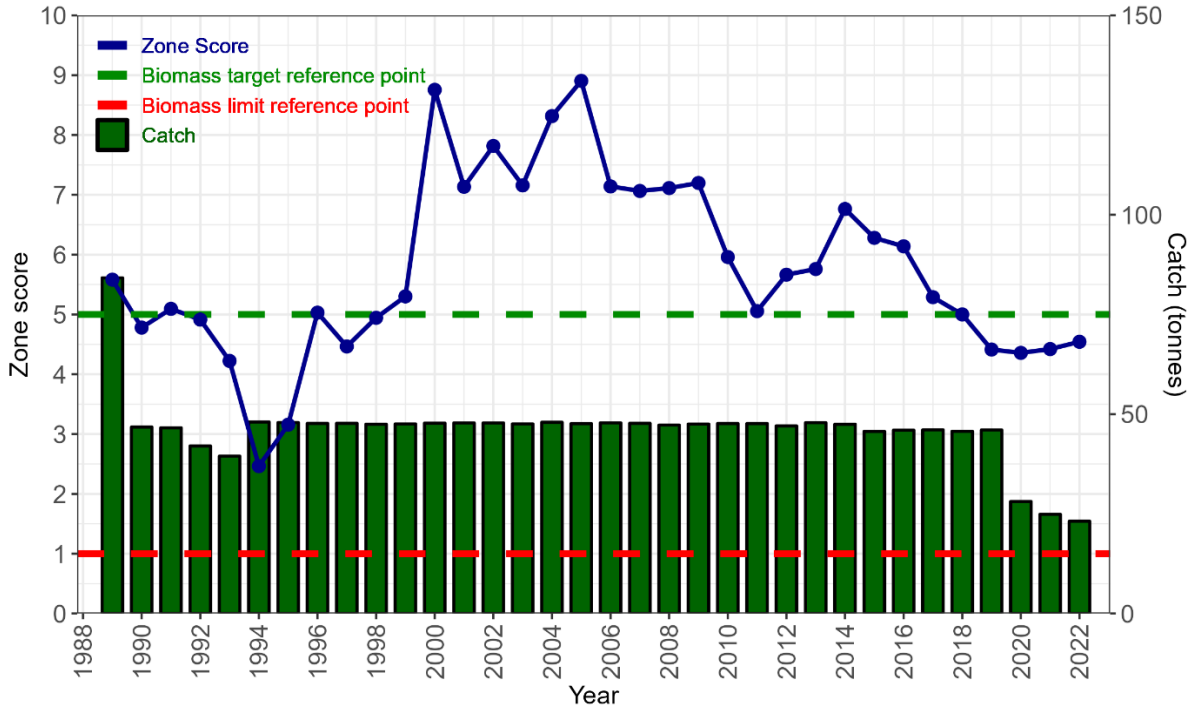

Figure 3-8 Zone score plot for CZ greenlip between 1989 and 2022: Zone score (blue symbols and line), biomass target reference point (green line), biomass limit reference point (red line) and catch (green bars, tonnes).

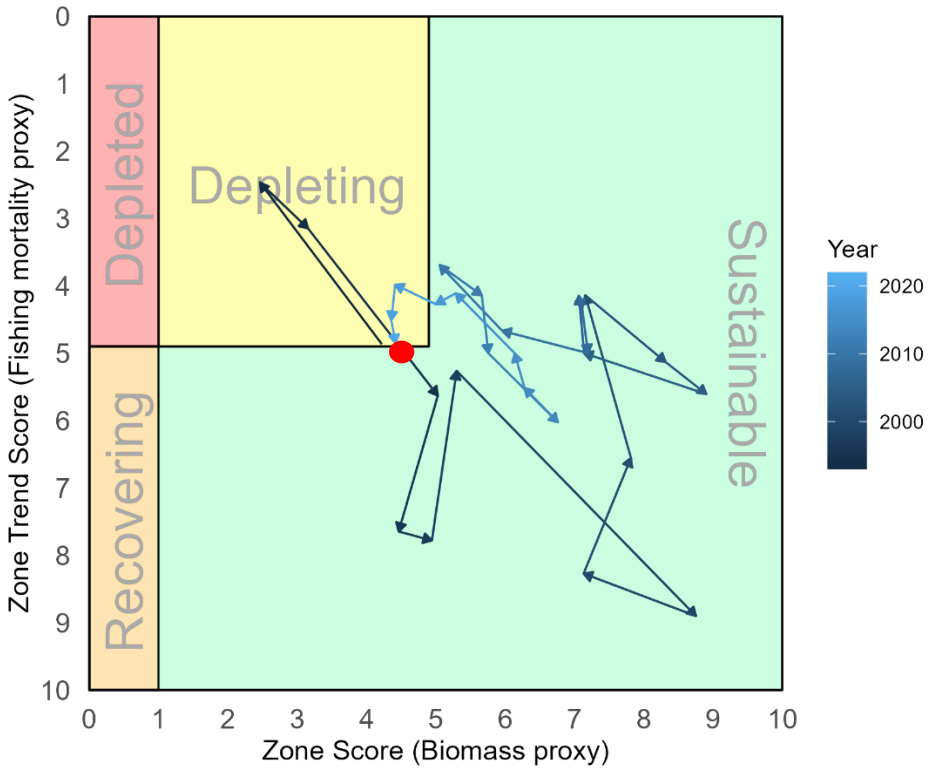

Figure 3-9 Phaseplot indicating changes in Central Zone greenlip stock status between 1993 and 2022. Red symbol indicates 2022 stock status (i.e., sustainable).

4 SUMMARY

There is no updated assessment for blacklip because the fishery is classified as **'depleted'** and was closed to commercial fishing in 2022. The stock status for greenlip was determined using the HS from the Abalone Management Plan (PIRSA 2021). The HS applies two key indicators, CPUE and abalone legal density from FIS, to generate proxies for biomass and fishing mortality.

Prior to 2020, catches of greenlip in the CZ fishery were consistent with the TACC at approximately 46 t per year. In 2021, catches declined to <30 t for the first time since 1974, consistent with an industry decision to under catch the TACC associated with concern for greenlip stocks. Subsequent catches have remained low and below the TACC, with 23.3 t harvested in 2022. This decline in catch is analogous with many other abalone fisheries across southern Australia which are currently characterised by ongoing low productivity and catch (Stobart and Mayfield 2021; Mundy and McAllister 2022; Piddocke *et al.* 2021). The low catch in 2022 was primarily driven by a reduction in catch at the key fishing ground in the CZ – Tiparra Reef – where 1 t of greenlip was harvested in 2022, which is <5% of the post-TACC average of 25 t. If low catches from Tiparra Reef persist, the higher catches obtained from the other SAUs are unlikely to be sustainable even at the lower total catch of around 23 t. This is particularly the case for the West Yorke Peninsula SAU which supported over 50% of the catch (i.e., 13 t) in 2022.

Following record high CPUEs in the early 2000s, over the last two decades catch-rate has declined from 31 $kg.hr^{-1}$ in 2001 to 20 $kg.hr^{-1}$ in 2022. The current CPUE of 20 $kg.hr^{-1}$ is among the lowest levels since the TACC was introduced in 1990, despite a small increase that occurred between 2021 and 2022. Nonetheless, recent low CPUEs are similar to levels observed during most of the 1990s, which constitutes the reference period in the HS for this fishery (PIRSA 2021). Five of the six SAUs in 2022 had a CPUE score between 3.9 and 5. The only exception was the data limited SAU, which had a CPUE score of 0. Similarly, legal-density from the FIS at Tiparra Reef and West Yorke Peninsula (5.0 and 4.6, respectively) were close to target levels used in the HS.

Application of the HS in 2022 resulted in a **zone score (i.e., biomass proxy) of 4.5 / 10** that, in combination with the **zone trend score (i.e., fishing mortality proxy) of 5.0 / 10** (reflecting a stable trend), define the stock status for greenlip in the CZ in 2022 as **'sustainable'**. The fishery is classified as 'sustainable' under the HS because, although the biomass proxy is below the target (i.e., a score of <5), the current level of fishing mortality is adequately controlled (i.e., a score of ≥5). The HS zone score of 4.5 in 2022 translates to a recommended zonal catch of 41.27 t for 2024, which is 15% above the 2023 TACC of 36.05 t and 80% above the expected catch of 23 t by industry in 2023 (i.e., 50% of the target catch).

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APPENDIX 1 - MAPCODES FROM THE WEST YORKE PENINSULA SAU

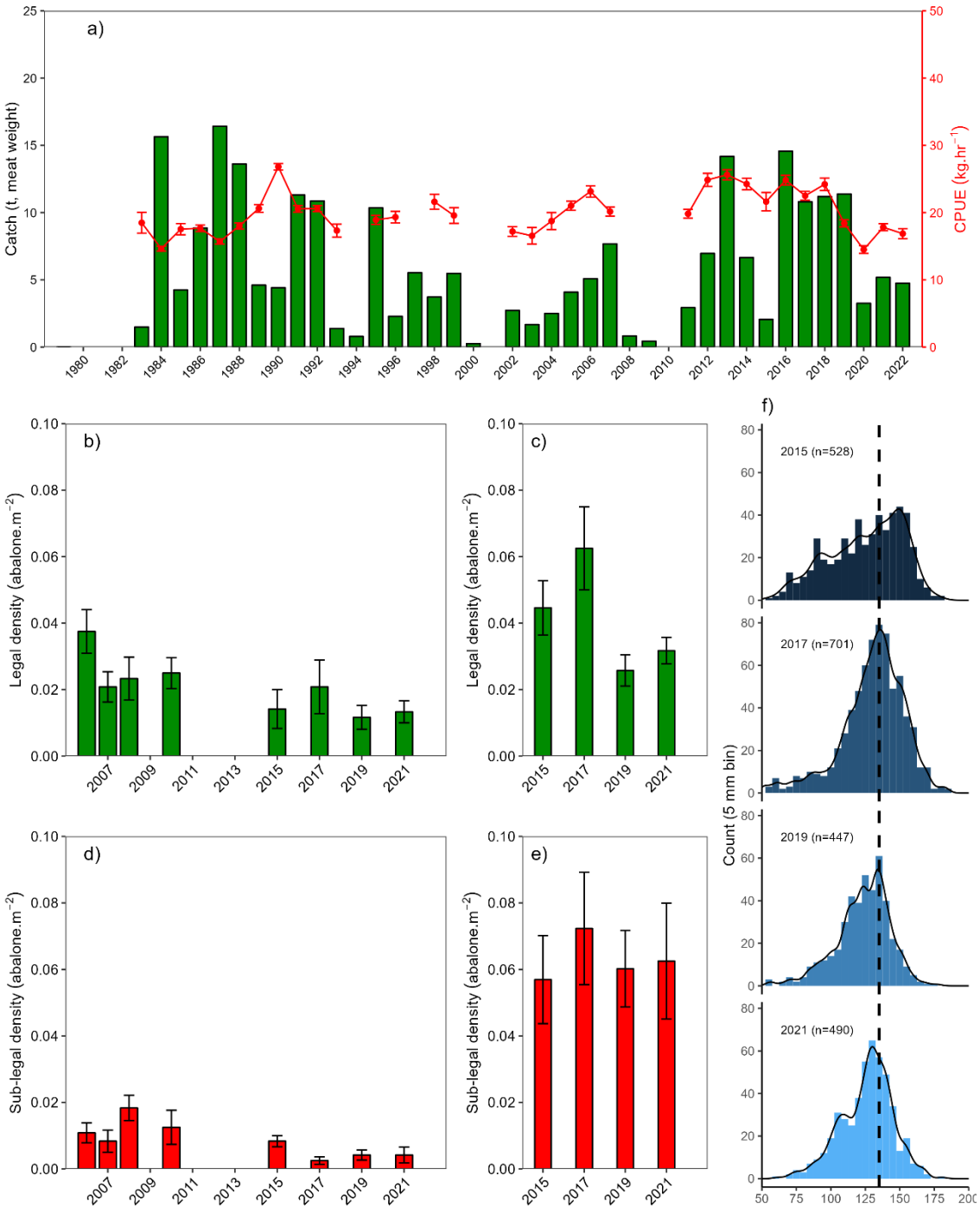

Figure A1-1 Fishery-dependent and fishery-independent data from mapcode 24A (Hardwicke Bay) from 1979 to 2022. a) Catch (green bars, tonnes) and CPUE (red line), b & c) Legal density of greenlip (i.e., ≥135 mm green bars) from historical and expanded survey design, d & e) Sub-legal density (i.e., <135 mm red bars) from historical and expanded survey design, f) Length-count distributions of greenlip from the expanded FIS design. Gaps in all time series indicate no data.

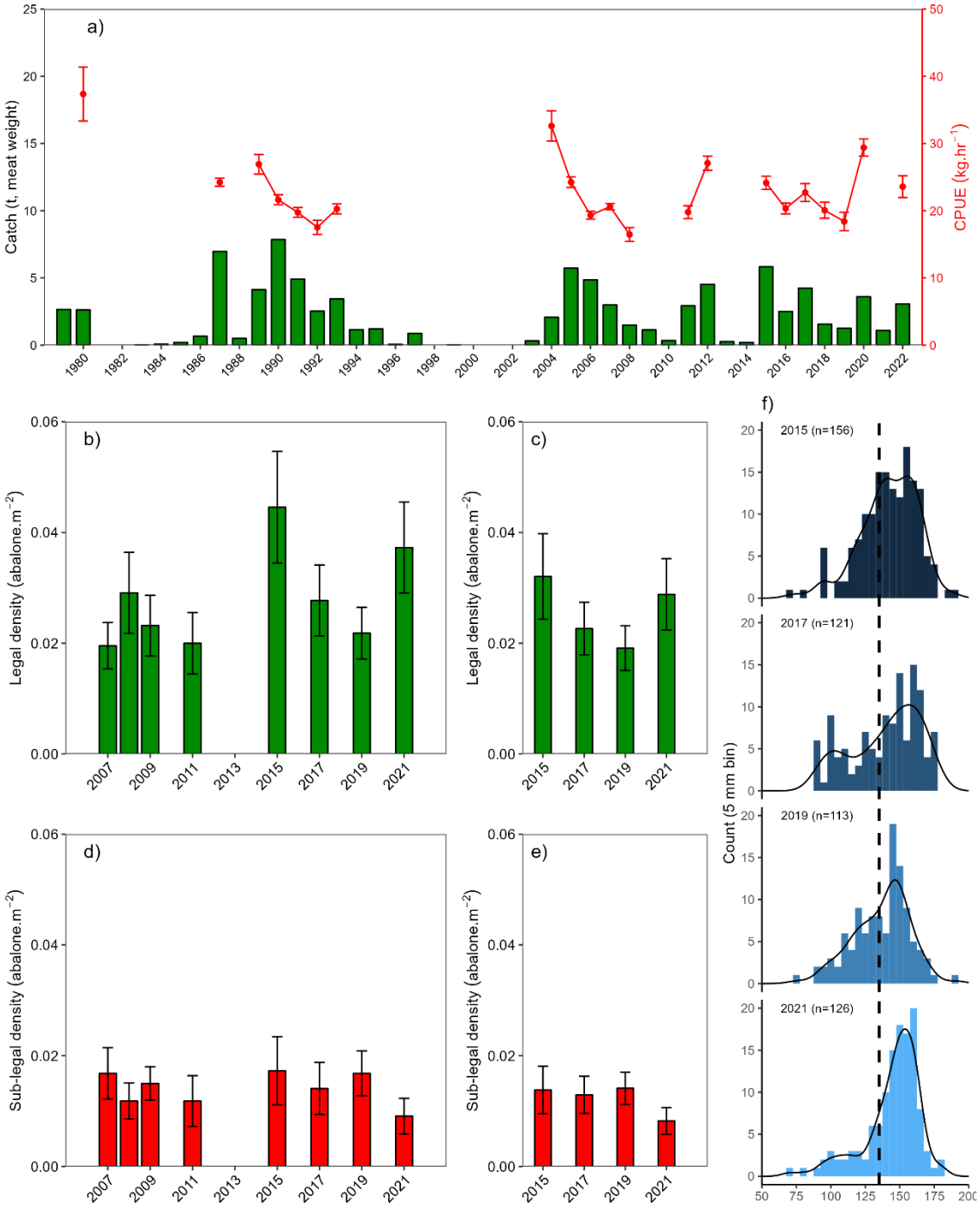

Figure A1-2 Fishery-dependent and fishery-independent data from mapcode 22A (Port Victoria) from 1979 to 2022. a) Catch (green bars, tonnes) and CPUE (red line), b & c) Legal density of greenlip (i.e., ≥135 mm green bars) from historical and expanded survey design, d & e) Sub-legal density (i.e., <135 mm red bars) from historical and expanded FIS design, f) Length-count distributions of greenlip from the expanded FIS design. Gaps in all time series indicate no data.

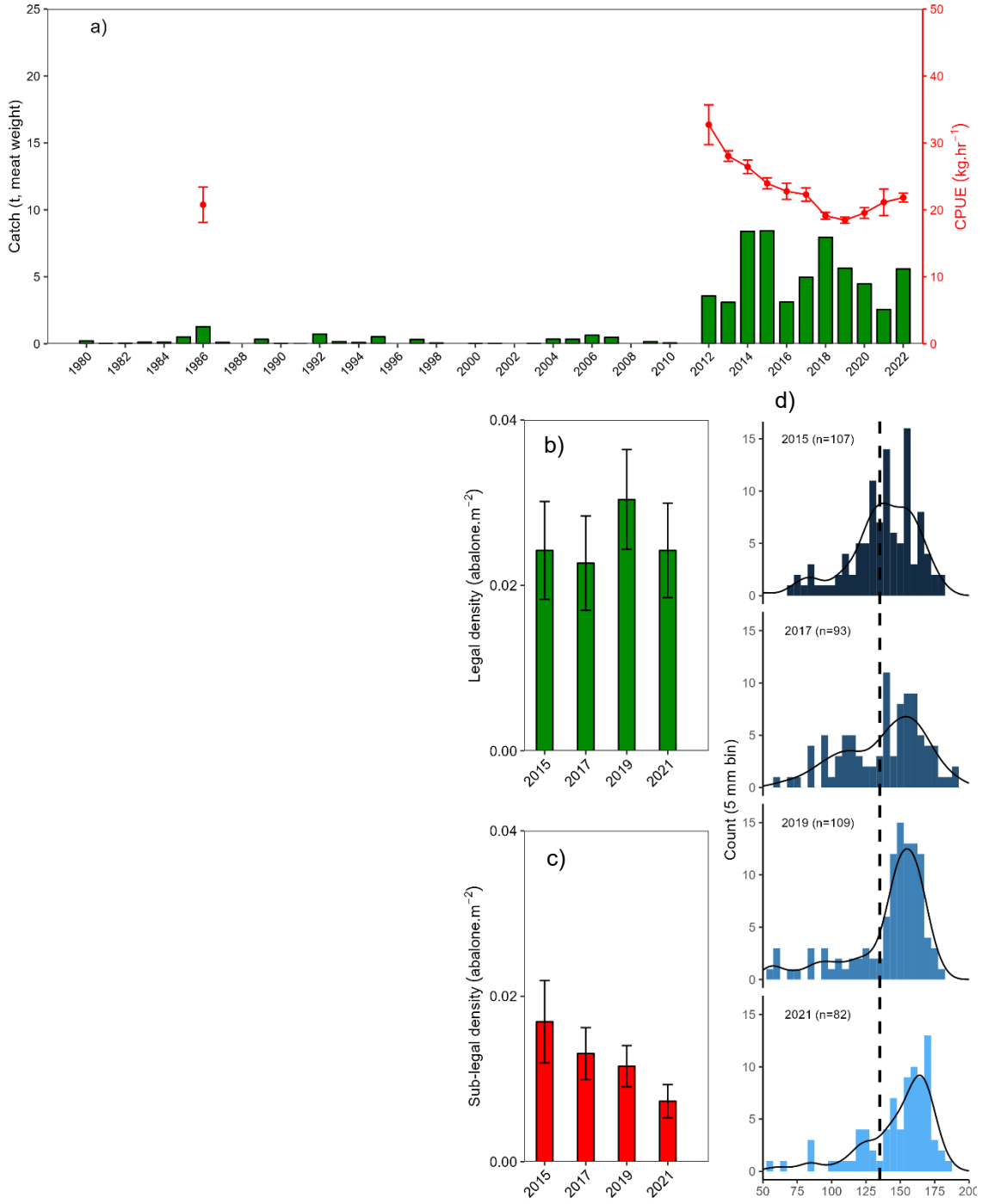

Figure A1-3 Fishery-dependent and fishery-independent data from mapcode 23A (Corny Point) from 1979 to 2022. a) Catch (green bars, tonnes) and CPUE (red line), b) Legal density of greenlip (i.e., ≥135 mm green bars) from the fishery independent surveys, c) Sub-legal density (i.e., <135 mm red bars) from the fishery independent surveys, d) Length-count distributions of greenlip from the expanded FIS design. Gaps in all time series indicate no data.

APPENDIX 2 - GPS AND DEPTH LOGGER DATA

Methods

Between 2013 and 2021, the use of Global Positioning System (GPS) and depth loggers was mandated in the CZ. During fishing operations, the GPS data logger (SciElex) records the position of the dive vessel, while the depth logger (Sensus Ultra, Reefnet), which is attached to the diver (or dive cage), records the duration and depth profile of each dive. Detailed methods for the integration and application of these two data sets are provided in Burnell et al. (2018). A suite of potential performance indicators from the GPS data loggers are presented in previous reports (e.g., Burnell et al. 2018, Burnell and Mayfield 2023), using methods established in Tasmania (Mundy 2012; Mundy and Jones 2017).

In this report the most promising of these PIs (Catch-per-unit-area; CPUA) is compared with CPUE derived from the GPS loggers and logbook at both the SAU scale and for 11 selected mapcodes across the CZ. To aid visual comparison the time series for both CPUE and CPUA have been normalised (i.e., converted to an average of 1) and scaled to align the starting year in the times series (i.e., 2013) at a value of 1. No data is presented if there were fewer than 3 fishing events recorded on the GPS logger in each respective year. Box plots are also used to compare the range in each of the three indices presented (i.e., CPUE logook, CPUE logger and CPUA).

Results and Discussion

At both the SAU and mapcode scale, there is evidence that CPUA from the GPS loggers is likely to provide an index of abundance that is less hyperstable than both CPUE from the GPS loggers and CPUE from the logbook. This is likely to be one of the key findings from FRDC project 2017/026 (“Can spatial fishery-dependent data be used to determine abalone stock status in a spatially structured fishery?”; Dr C Mundy, personal communication). The time-series plots (Figures A2-1, A2-3) demonstrate how an area-based catch rate (i.e., CPUA), compares with a time-based catch rate (i.e., CPUE logger and CPUE logbook). The box plots in Figures A2-2 and A2-4 demonstrate the maximum range in each index (i.e., peak to trough) throughout the nine year time series. The consistently larger change in the area-based indicator (i.e., CPUA > GPS CPUE > logbook CPUE) is consistent with the hyperstable nature of CPUE, highlighting why CPUE, in particular logbook CPUE, may be a poor index of abalone abundance.

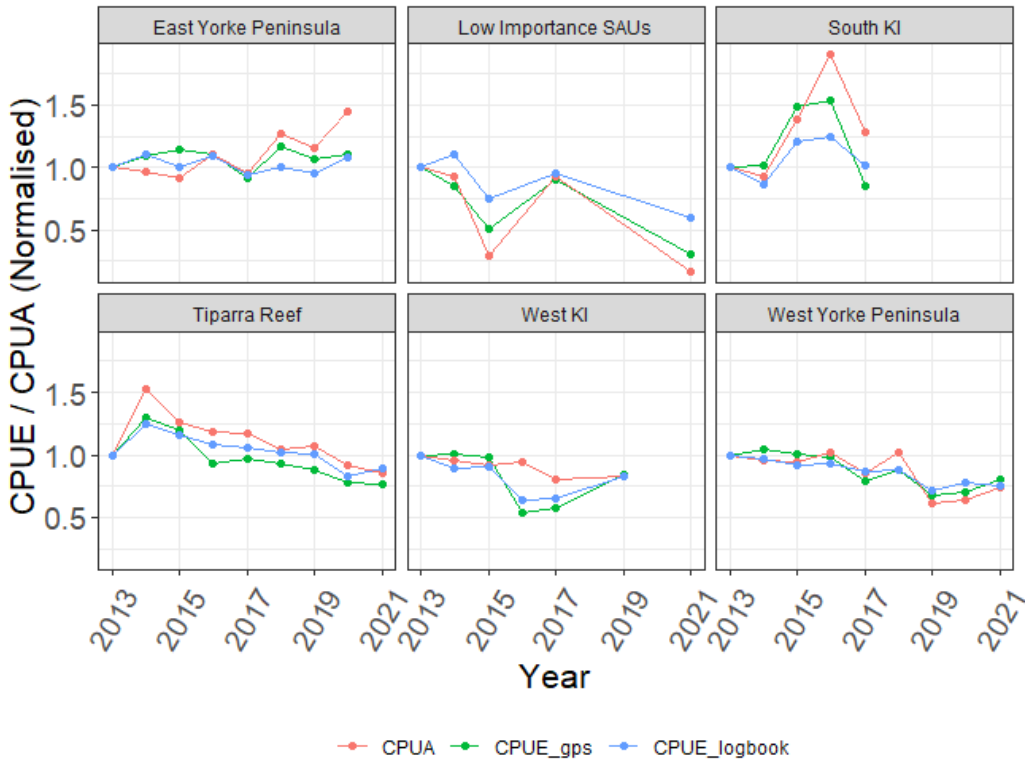

Figure A2-1 Comparison of normalised and scaled mean estimates of catch-per-unit-area (CPUA), GPS catch-per-unit-effort (CPUE_gps) and logbook CPUE (CPUE_logbook) for greenlip in each SAU in the CZ between 2013 and 2021.

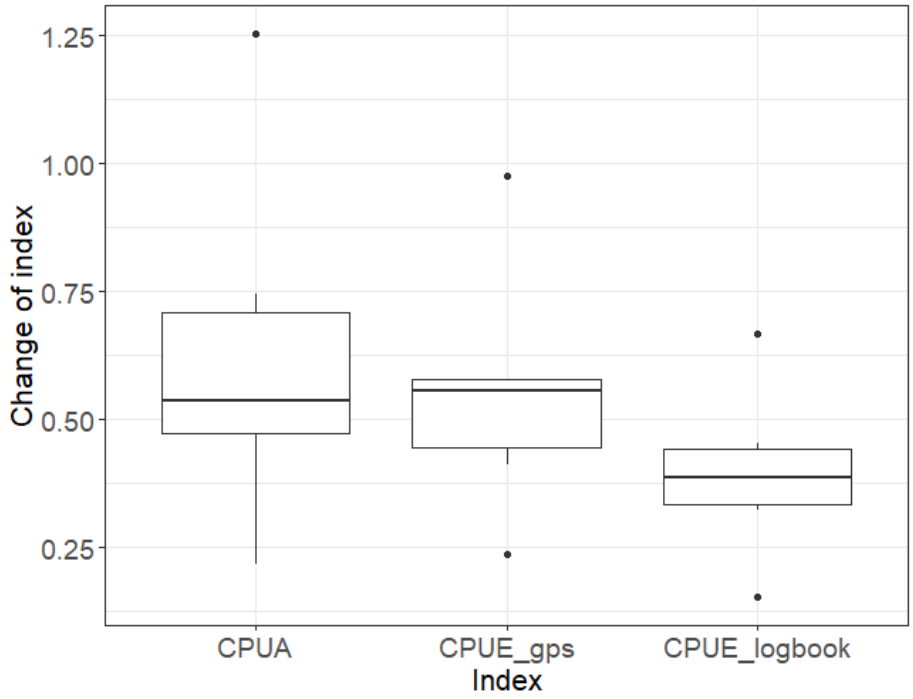

Figure A2-2 Boxplot showing the maximum range in each index (CPUA, CPUE_gps and CPUE_logbook) for greenlip across the six SAUs between 2013 and 2021.

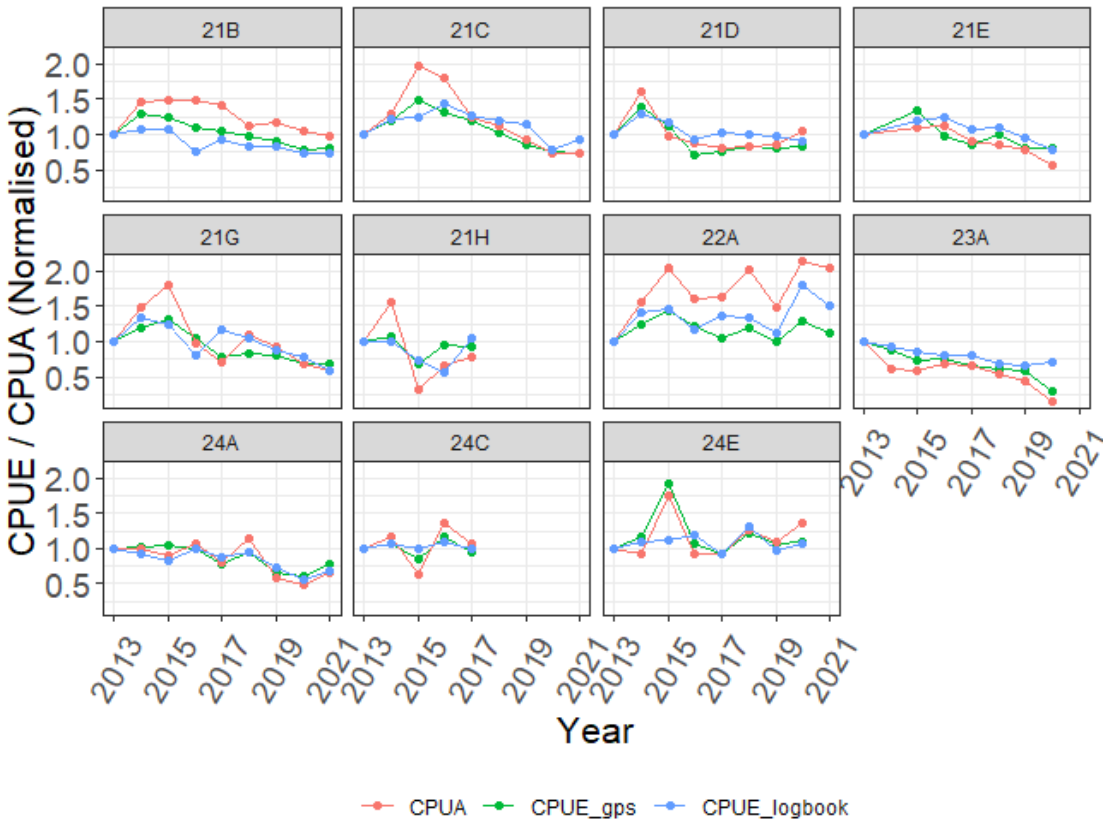

Figure A2-3 Comparison of normalised and scaled mean estimates of catch-per-unit-area (CPUA), catch-per-unit-effort (CPUE_gps) and logbook CPUE (CPUE_logbook) for greenlip in selected mapcodes in the CZ between 2013 and 2021.

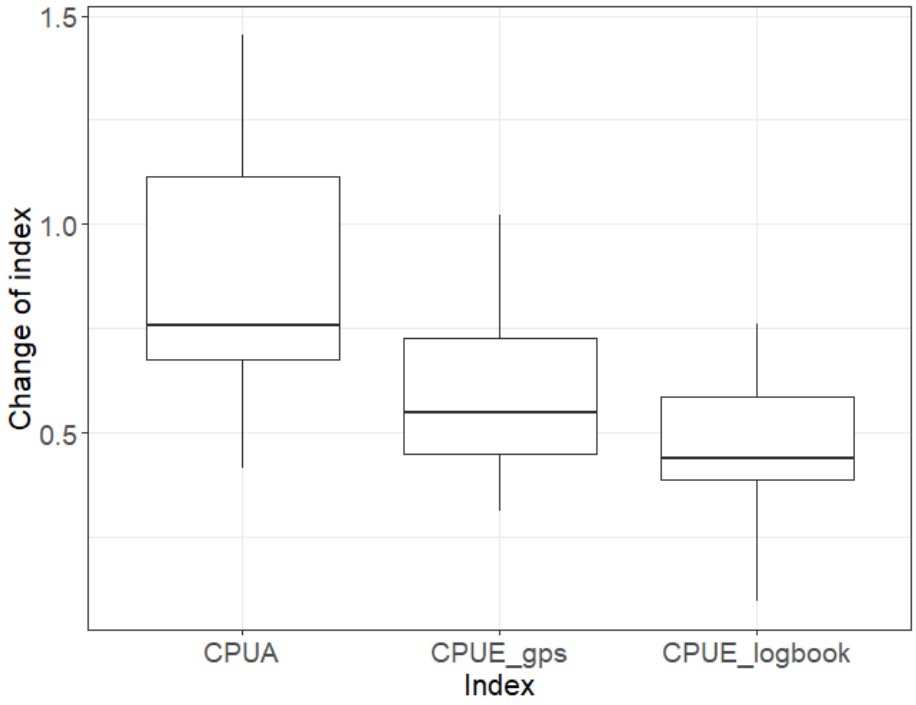

Figure A2-4 Boxplot showing the maximum range in each index (CPUA, CPUE_gps and CPUE_logbook) for greenlip across the 11 selected mapcodes between 2013 and 2021.

APPENDIX 3 - BLACKLIP ABALONE - FIGURES REPRODUCED FROM BURNELL AND MAYFIELD 2023

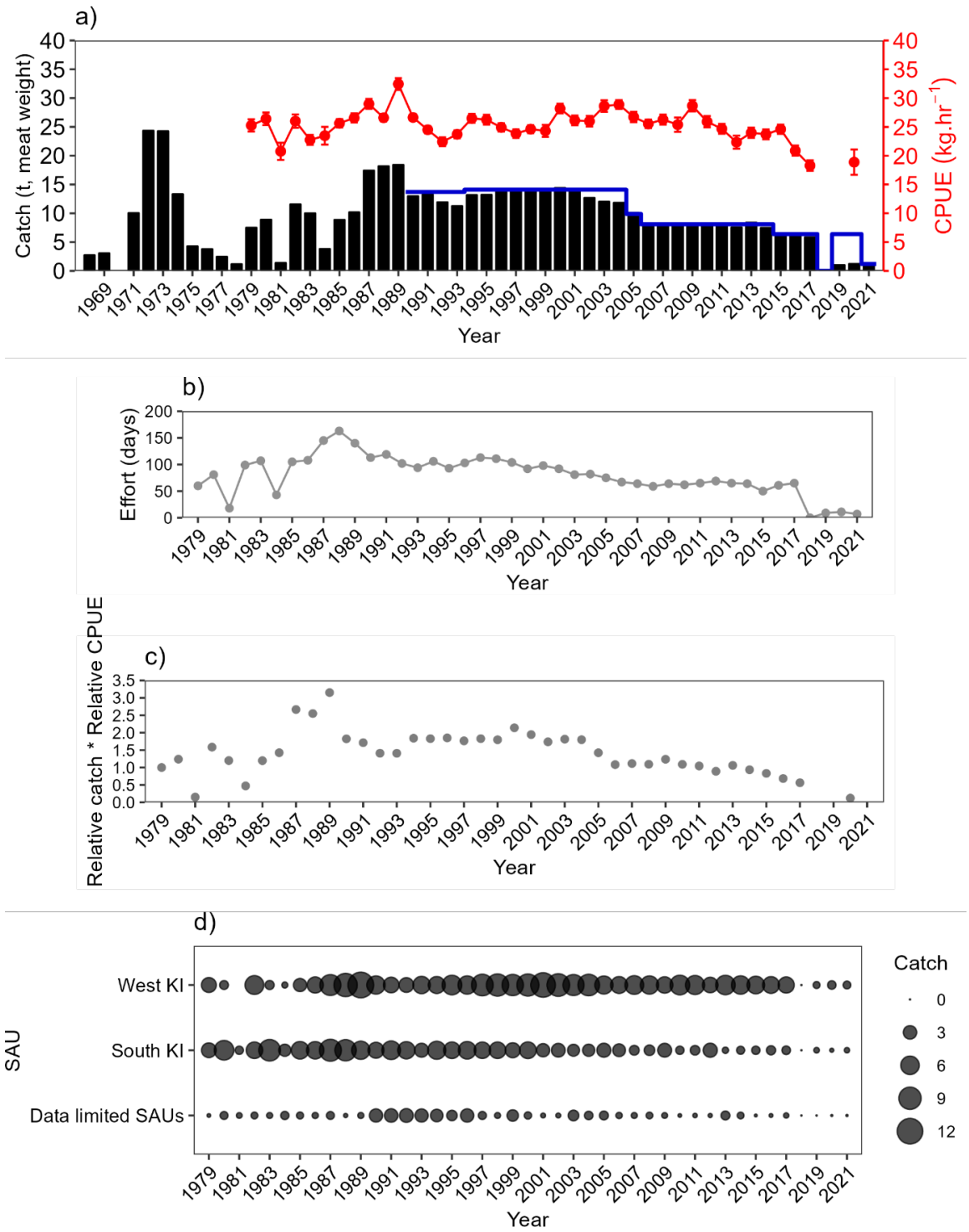

Figure A3-1 Zonal catch, CPUE, Effort, Catch * CPUE and the distribution of catch among SAUs available from 1968 to 2021. a) Total catch (black bars, tonnes), CPUE (red line) and TACC (blue line) of blacklip in the CZ 1968-2021. b) Effort (days) where blacklip are ≥30% of the daily catch in the CZ from 1968-2021 (grey line). c) Combined trend of relative catch and relative CPUE from from 1979 to 2021. d) Bubble plot showing the spatial distribution of the blacklip catch (black symbols) among each of the SAUs in the CZ from 1979 to 2021 (data limited SAUs from the HS are combined).

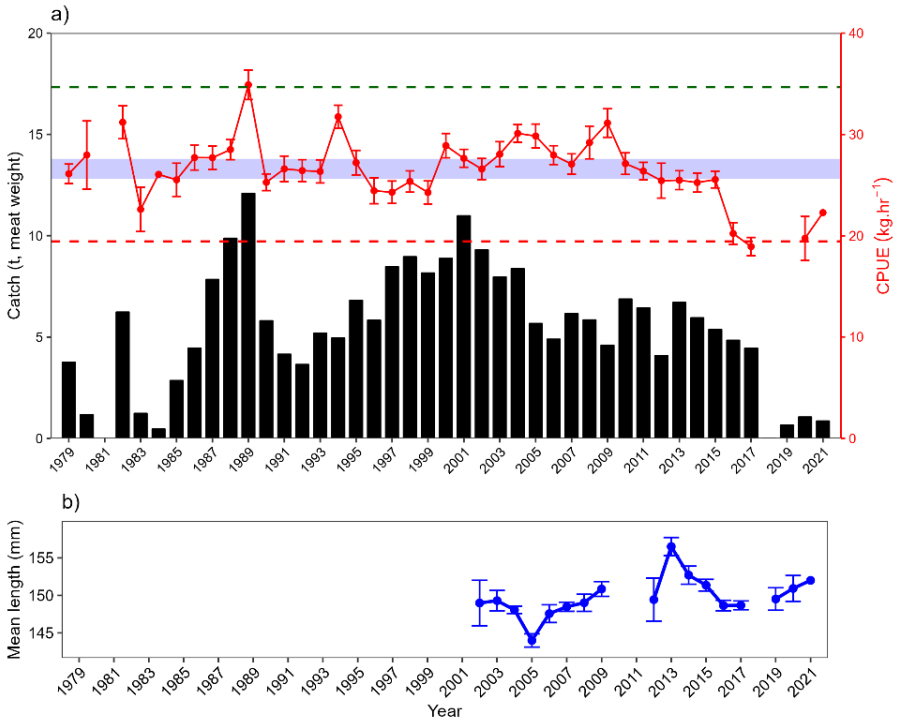

Figure A3-2 West Kangaroo Island SAU data available from 1979 to 2021. a) Catch (black bars, tonnes), CPUE (red line), CPUE Target Range (score of 5, blue shading), CPUE upper limit (score of 10, green dashed line), and CPUE lower limit (score of 0, red dashed line). b) mean length (blue line). Gaps in all time series indicate no data.

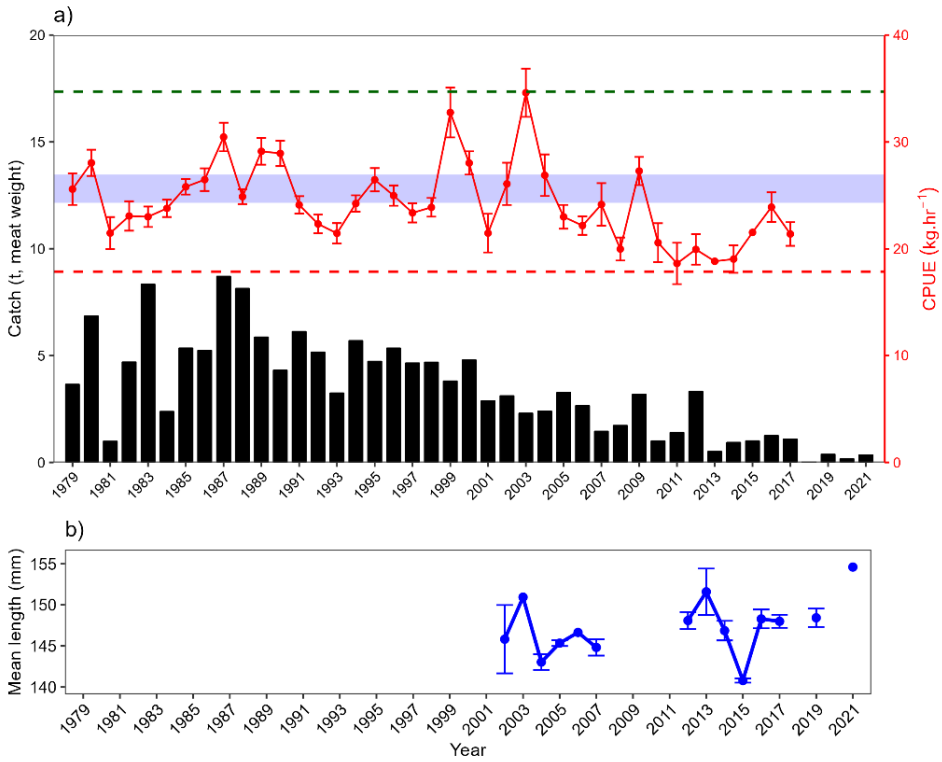

Figure A3-3 South Kangaroo Island SAU data available from 1979 to 2021. a) Catch (black bars, tonnes), CPUE (red line), CPUE Target Range (score of 5, blue shading), CPUE upper limit (score of 10, green dashed line), and CPUE lower limit (score of 0, red dashed line). b) mean length (blue line). Gaps in all time series indicate no data.

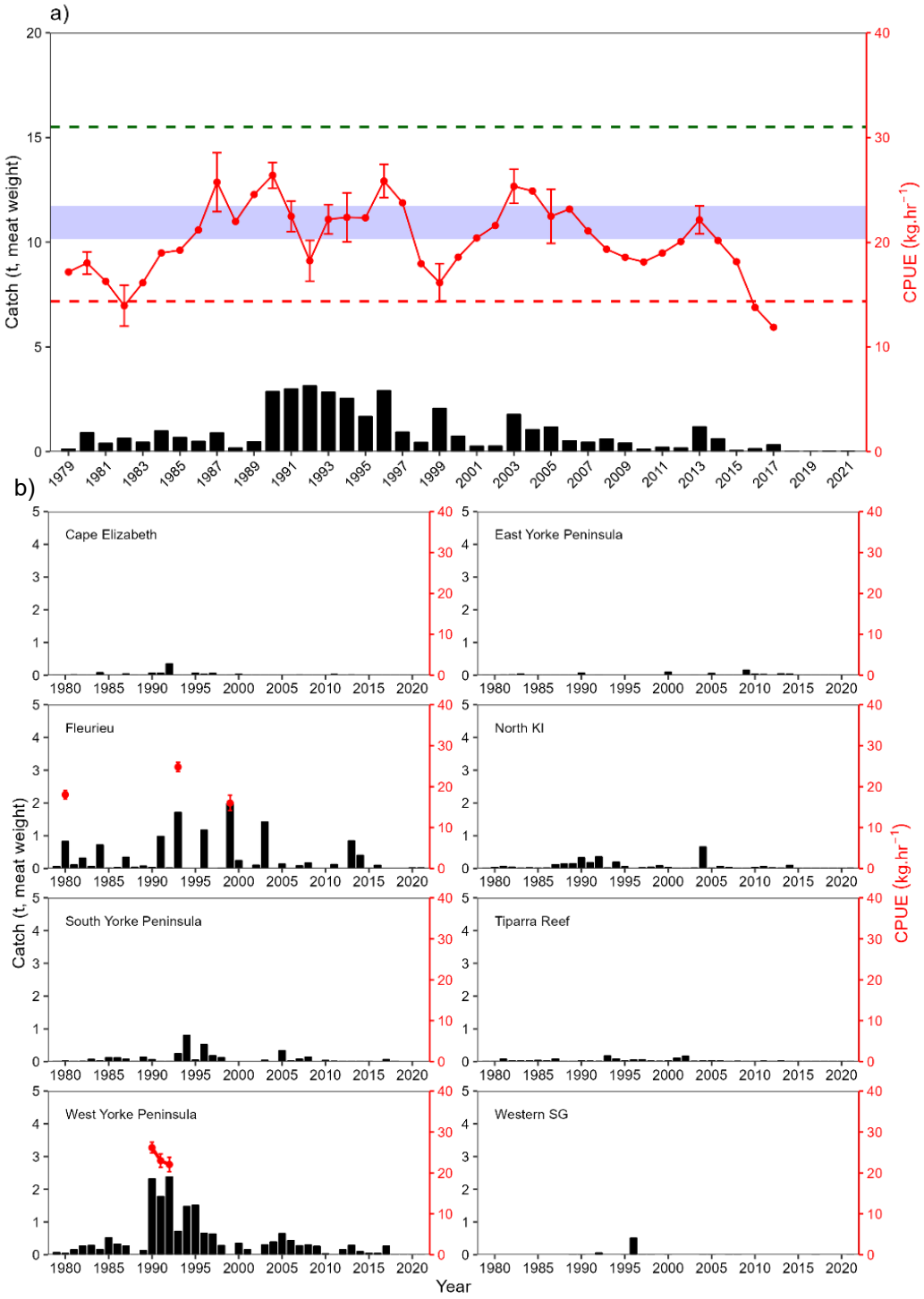

Figure A3-4 Data limited SAUs data available from 1979 to 2021. a) Combined data limited SAUs from 1979 to 2021. CPUE Target Range (score of 5, blue shading), CPUE upper limit (score of 10, green dashed line), CPUE lower limit (score of 0, red dashed line). b) Data limited SAUs from 1979 to 2021. Catch (black bars, tonnes) and CPUE (red line). Gaps in all the time series indicate no data.

APPENDIX 4 - SUMMARY TABLES

Table A4-1. Greenlip and blacklip catch (t MW) from CZ SAUs. Abbreviations for Yorke Peninsula (YP) and Kangaroo Island (KI).

	Greenlip												Blacklip											
SEASON	Cape Elizabeth	East YP	Fleurieu	North KI	South KI	South YP	Tiparra Reef	Unassigned CZ	West KI	West YP	Western SG	Year	Cape Elizabeth	East YP	Fleurieu	North KI	South KI	South YP	Tiparra Reef	Unassigned CZ	West KI	West YP	Western SG
1979	1.22	18.19	1.63	0.28	6.16	0.15	16.75	0.00	0.56	3.38	0.00	1979	0.00	0.00	0.05	0.00	3.64	0.00	0.00	0.00	3.74	0.06	0.00
1980	3.89	19.89	0.92	0.77	4.34	0.35	21.92	0.00	0.39	3.33	0.00	1980	0.00	0.00	0.82	0.03	6.84	0.01	0.00	0.00	1.16	0.04	0.00
1981	9.18	14.01	3.32	0.61	1.09	0.09	29.13	0.00	0.00	1.84	0.00	1981	0.01	0.01	0.10	0.06	0.98	0.00	0.07	0.00	0.00	0.15	0.00
1982	0.00	5.37	2.37	0.60	5.78	0.38	21.03	0.00	2.25	1.37	0.00	1982	0.00	0.01	0.31	0.03	4.69	0.00	0.02	0.00	6.23	0.26	0.00
1983	0.10	9.67	3.18	0.06	7.18	0.44	14.20	0.00	2.19	2.61	0.00	1983	0.00	0.03	0.05	0.00	8.33	0.06	0.01	0.00	1.22	0.28	0.00
1984	2.30	10.31	2.05	1.15	3.05	0.15	16.94	0.00	0.29	16.17	0.00	1984	0.07	0.00	0.71	0.02	2.37	0.01	0.02	0.00	0.45	0.16	0.00
1985	0.66	0.08	1.82	0.66	6.00	2.42	28.98	0.00	3.13	7.71	0.00	1985	0.00	0.00	0.00	0.00	5.34	0.12	0.03	0.00	2.85	0.51	0.00
1986	0.35	0.03	0.00	0.06	4.81	1.41	14.84	0.00	1.45	12.98	0.00	1986	0.00	0.00	0.02	0.01	5.23	0.11	0.02	0.00	4.45	0.32	0.00
1987	0.04	0.14	2.62	0.54	3.19	1.02	21.42	1.01	1.41	27.29	0.00	1987	0.04	0.00	0.34	0.11	8.70	0.07	0.07	0.00	7.83	0.26	0.00
1988	3.39	0.08	0.60	0.67	7.27	0.41	38.29	0.00	2.48	14.13	0.00	1988	0.01	0.00	0.03	0.13	8.13	0.00	0.00	0.00	9.87	0.00	0.00
1989	4.27	0.16	4.15	0.44	5.94	0.53	52.20	0.00	1.36	9.11	6.01	1989	0.01	0.00	0.07	0.14	5.85	0.13	0.00	0.00	12.09	0.13	0.00
1990	1.73	0.10	0.40	1.42	8.57	0.16	14.75	0.00	6.41	13.00	0.23	1990	0.06	0.06	0.03	0.32	4.31	0.06	0.02	0.00	5.80	2.31	0.00
1991	2.76	0.00	0.40	0.86	5.02	0.10	16.50	2.40	1.65	16.89	0.00	1991	0.06	0.00	0.97	0.17	6.11	0.00	0.01	0.00	4.15	1.78	0.00
1992	1.22	0.19	0.06	0.75	3.75	0.15	19.29	0.00	1.23	14.77	0.60	1992	0.34	0.00	0.01	0.35	5.15	0.00	0.00	0.00	3.63	2.38	0.05
1993	0.54	0.00	0.07	0.74	1.46	0.18	30.23	0.00	0.60	5.65	0.00	1993	0.00	0.00	1.71	0.01	3.24	0.24	0.17	0.00	5.18	0.71	0.00
1994	0.26	0.00	0.00	0.93	3.22	0.19	40.56	0.00	0.83	2.05	0.00	1994	0.00	0.00	0.00	0.19	5.69	0.80	0.08	0.00	4.94	1.47	0.00
1995	2.65	0.01	0.00	0.18	2.40	0.16	29.57	0.00	0.47	12.09	0.35	1995	0.06	0.00	0.00	0.04	4.72	0.04	0.02	0.00	6.81	1.51	0.00
1996	2.60	0.00	0.05	0.00	3.13	0.75	36.71	0.00	1.69	2.50	0.24	1996	0.02	0.00	1.17	0.00	5.34	0.52	0.05	0.00	5.82	0.65	0.51
1997	8.62	0.00	0.00	0.36	2.52	0.02	26.45	0.09	2.45	6.78	0.41	1997	0.05	0.00	0.00	0.02	4.64	0.18	0.05	0.00	8.46	0.63	0.00
1998	3.07	0.00	0.46	1.03	2.96	0.27	34.61	0.00	0.88	3.98	0.21	1998	0.00	0.00	0.00	0.03	4.68	0.12	0.01	0.00	8.95	0.28	0.00
1999	1.32	0.00	0.85	1.46	2.17	0.00	34.12	0.00	2.12	5.49	0.00	1999	0.01	0.00	1.98	0.08	3.79	0.00	0.00	0.00	8.15	0.00	0.00
2000	3.13	0.00	0.04	0.32	2.28	0.00	40.52	0.00	0.50	0.41	0.54	2000	0.02	0.09	0.23	0.02	4.78	0.00	0.02	0.00	8.87	0.35	0.00
2001	0.95	0.00	0.00	0.12	0.65	0.00	44.89	0.00	1.15	0.03	0.00	2001	0.00	0.00	0.00	0.00	2.87	0.00	0.10	0.00	10.98	0.15	0.00
2002	0.55	0.00	0.07	0.27	1.77	0.00	39.89	0.00	2.51	2.73	0.00	2002	0.00	0.00	0.09	0.00	3.11	0.00	0.16	0.00	9.30	0.00	0.00
2003	1.55	0.17	0.11	0.42	2.23	0.03	38.38	0.00	2.63	2.03	0.00	2003	0.00	0.00	1.42	0.01	2.29	0.04	0.00	0.00	7.95	0.30	0.00
2004	0.64	0.00	0.00	1.11	1.49	0.00	35.75	0.44	3.33	4.95	0.25	2004	0.00	0.00	0.00	0.65	2.39	0.00	0.01	0.00	8.37	0.39	0.00
2005	3.14	0.02	0.03	0.56	4.53	0.45	25.29	0.38	2.02	10.85	0.34	2005	0.00	0.05	0.13	0.00	3.26	0.33	0.02	0.00	5.66	0.64	0.00
2006	0.49	0.46	0.00	0.74	2.65	0.03	29.47	0.00	2.96	11.01	0.00	2006	0.00	0.00	0.00	0.05	2.64	0.01	0.01	0.00	4.89	0.43	0.00
2007	1.95	0.55	0.00	0.80	2.60	0.19	28.02	0.00	1.88	11.51	0.19	2007	0.01	0.00	0.07	0.02	1.44	0.07	0.00	0.00	6.14	0.27	0.00
2008	2.01	9.63	0.03	0.37	3.35	0.04	27.82	0.00	1.38	2.48	0.13	2008	0.00	0.00	0.16	0.00	1.72	0.14	0.00	0.00	5.84	0.30	0.00
2009	2.74	5.34	0.00	0.35	4.05	0.00	29.43	0.00	3.59	2.00	0.00	2009	0.00	0.15	0.00	0.00	3.17	0.00	0.00	0.00	4.59	0.26	0.00
2010	4.36	4.73	0.00	0.13	6.27	0.09	26.86	0.00	4.70	0.50	0.00	2010	0.00	0.03	0.00	0.03	0.99	0.03	0.00	0.00	6.87	0.03	0.00
2011	4.94	6.35	0.07	0.17	5.74	0.20	20.21	0.00	4.08	5.87	0.00	2011	0.02	0.01	0.12	0.05	1.39	0.00	0.01	0.00	6.43	0.00	0.00
2012	4.59	3.58	0.00	0.30	5.66	0.20	13.77	0.00	3.74	15.20	0.00	2012	0.00	0.00	0.00	0.01	3.31	0.00	0.00	0.00	4.08	0.15	0.00
2013	4.99	3.55	0.13	0.17	4.20	0.13	8.98	0.00	7.71	17.99	0.00	2013	0.01	0.04	0.84	0.00	0.50	0.00	0.01	0.00	6.70	0.29	0.00
2014	1.80	3.00	0.11	1.41	3.04	0.06	13.23	0.00	9.50	15.30	0.00	2014	0.00	0.03	0.40	0.09	0.92	0.00	0.00	0.00	5.94	0.09	0.00
2015	0.57	5.11	0.02	0.46	2.19	0.02	16.90	0.00	4.07	16.33	0.00	2015	0.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	5.37	0.05	0.00
2016	0.19	6.93	0.02	0.00	1.73	0.00	16.09	0.00	0.82	20.21	0.00	2016	0.00	0.00	0.09	0.00	1.25	0.00	0.00	0.00	4.83	0.04	0.00
2017	1.42	2.36	0.00	0.13	2.09	0.06	17.69	0.00	1.86	20.38	0.06	2017	0.00	0.00	0.00	0.00	1.08	0.06	0.00	0.00	4.44	0.26	0.00
2018	0.36	1.77	0.00	0.18	2.18	0.33	17.82	0.00	1.16	21.90	0.00	2018	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2019	0.10	1.70	0.00	0.04	2.92	0.00	19.26	0.00	3.72	18.30	0.00	2019	0.00	0.00	0.00	0.00	0.37	0.00	0.00	0.00	0.64	0.00	0.00
2020	0.27	1.74	0.04	0.10	1.53	0.00	10.06	0.00	3.00	11.34	0.00	2020	0.00	0.00	0.01	0.00	0.16	0.00	0.00	0.00	1.04	0.00	0.00
2021	0.49	1.44	0.10	0.32	3.12	0.00	7.75	0.00	2.45	9.09	0.12	2021	0.00	0.00	0.01	0.00	0.34	0.00	0.00	0.00	0.85	0.00	0.00
2022	0.00	3.07	0.00	0.17	2.69	0.09	1.10	0.00	2.42	13.61	0.00	2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A4-2 Greenlip and blacklip CPUE (kg.hr^{-1}) from CZ SAUs. Abbreviations for Yorke Peninsula (YP) and Kangaroo Island (KI).

	Greenlip											Blacklip										
Year	Cape Elizabeth	East YP	Fleurieu	North KI	South KI	South YP	Tiparra Reef	Unassigned CZ	West KI	West YP	Western SG	Year	Cape Elizabeth	East YP	Fleurieu	North KI	South KI	South YP	Tiparra Reef	Unassigned CZ	West KI	West YP	Western SG
1979	13.15	19.44	18.96		23.25		20.49			21.29		1979					25.58				26.11		
1980	32.24	19.04	18.27		23.43		27.18			29.10		1980			18.02		28.04				27.96		
1981	42.52	23.73	18.47		16.28		22.62			24.07		1981					21.47						
1982		17.78	16.76	12.79	21.07		22.93		21.25	18.66		1982					23.07				31.20		
1983		15.31	17.02		21.05		18.55		23.83	16.77		1983					22.99				22.60		
1984	19.83	23.18	18.17	19.66	21.73		18.73			14.56		1984					23.78						
1985			15.97	14.55	23.38	22.02	23.17		25.48	19.36		1985					25.80				25.52		
1986					25.65	23.22	22.35		21.30	18.52		1986					26.47				27.71		
1987			28.75		28.35		21.28		27.95	18.91		1987					30.46				27.70		
1988	19.98		15.19		18.66		21.18		23.44	18.03		1988					24.88				28.50		
1989	24.22		25.50		23.75		21.27		25.67	22.40	23.39	1989					29.12				34.89		
1990	16.17			16.72	25.13		21.61		24.62	23.26		1990					28.92				25.27	26.19	
1991	24.15			13.39	18.82		23.97	21.27	20.61	19.91		1991					24.10				26.60	23.00	
1992	22.16				19.70		21.44		19.98	19.65		1992					22.32				26.43	22.07	
1993					18.59		21.87			19.39		1993			24.77		21.44				26.34		
1994				13.28	21.80		20.44			16.41		1994					24.24				31.74		
1995	24.29				22.39		18.06			19.22		1995					26.46				27.21		
1996					23.95		21.61		33.73	18.88		1996					24.98				24.43		
1997	24.91				18.95		20.08		18.82	21.82		1997					23.36				24.29		
1998	27.44			18.18	20.94		21.02			21.40		1998					23.88				25.36		
1999				17.97	26.46		23.86		23.93	18.94		1999			15.97		32.75				24.27		
2000	35.47				26.05		30.09					2000					28.03				28.89		
2001							31.48					2001					21.46				27.64		
2002					25.69		29.13		30.96	17.19		2002					26.07				26.58		
2003					27.39		31.86		26.60	18.06		2003					34.60				28.04		
2004				20.44	25.54		32.25		27.43	23.89		2004					26.88				30.10		
2005	36.14				23.87		27.64		28.53	23.11		2005					22.99				29.84		
2006					23.88		31.30		28.49	20.55		2006					22.17				27.95		
2007	33.87				21.95		29.06		25.55	20.19		2007					24.15				27.07		
2008	33.74	19.22			32.14		30.07		30.52	16.85		2008					19.97				29.19		
2009	32.09	20.50			26.83		28.42		32.44	19.66		2009					27.27				31.12		
2010	26.77	24.07			26.11		24.65		28.76			2010					20.57				27.11		
2011	24.49	20.17			26.88		23.56		28.98	19.82		2011					18.62				26.38		
2012	26.09	20.08			23.78		23.35		25.05	26.74		2012					19.94				25.43		
2013	25.75	17.21			20.26		24.02		23.75	25.75		2013									25.48		
2014	26.49	18.73			16.95		30.44		21.93	25.26		2014					19.03				25.25		
2015		17.08			22.93		27.93		21.43	23.71		2015									25.54		
2016		18.39			24.56		27.33		17.17	23.88		2016					23.90				20.22		
2017	27.30	15.16			20.40		26.23		16.74	22.54		2017					21.38				18.92		
2018		16.98			19.07		24.61		17.15	22.31		2018											
2019		16.87			23.88		24.01		20.42	18.43		2019											
2020		18.21			22.50		19.96		20.83	19.91		2020									19.73		
2021		23.68			19.52		21.09		16.73	19.03		2021											
2022		19.60			20.88				21.77	20.02		2022											