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Western Zone Greenlip Abalone (*Haliotis laevigata*) and Blacklip Abalone (*H. rubra*) Fisheries in 2019/20

B. Stobart, S. Mayfield and K. Heldt

SARDI Publication No. F2017/000331-4
SARDI Research Report Series No. 1079

SARDI Aquatics Sciences
PO Box 120 Henley Beach SA 5022

November 2020

Report to PIRSA Fisheries and Aquaculture

SOUTH AUSTRALIA

Government of South Australia
Department of Primary Industries and Regions

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This publication may be cited as:
Stobart, B., Mayfield, S. and Heldt, K. (2020). Western Zone Greenlip Abalone (*Haliotis laevigata*) and Blacklip Abalone (*H. rubra*) Fisheries in 2019/20. Report to PIRSA Fisheries and Aquaculture. South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. F2017/000331-4. SARDI Research Report Series No. 1079. 73pp.

Cover photograph: Greenlip abalone aggregation, B. Stobart

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Date:	20 November 2020
Distribution:	PIRSA Fisheries and Aquaculture, SARDI Aquatic Sciences, Parliamentary Library, State Library and National Library
Circulation:	Public Domain

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ABBREVIATIONS

AVG	Abalone Viral Ganglioneuritis
CPUE	Catch Per Unit Effort
FD	Fishery Dependent
FI`	Fishery Independent
FY	Financial Year
HS	Harvest Strategy
MDS	Multi-Dimensional Scaling
MLL	Minimum Legal Length
NFSRF	National Fishery Status Reporting Framework
PIRSA	Department of Primary Industries and Regions
PropG1	Proportion of Grade 1
SAAF	South Australian Abalone Fishery
SAU	Spatial Assessment Unit
TACC	Total Allowable Commercial Catch
WZ	Western Zone
WZAF	Western Zone Abalone Fishery

ACKNOWLEDGEMENTS

Funds for this research were provided by PIRSA Fisheries and Aquaculture and obtained through licence fees. SARDI Aquatic Sciences provided substantial in-kind support. We thank the Western Zone licence holders, fishers and shellers for their contribution to our understanding of information presented in this report. We are grateful to David Delaine, Doug Graske, Dr Owen Burnell, Bruce Miller-Smith, Dr Rowan Chick, Brian Foureur, Damian Matthews, Andrew Hogg, Jay Dent, Toby Fox and other SARDI past and present divers for assistance with diving and the collection and management of data. We thank Dr Johnathan Smart for statistical support and programming. This report was formally reviewed by Drs Richard McGarvey and Owen Burnell (SARDI Aquatic Sciences) and Dr Annabel Jones (PIRSA Fisheries and Aquaculture). It was formally approved for release by Associate Professor Tim Ward, Science Leader, Marine Ecosystems, SARDI Aquatic Sciences.

EXECUTIVE SUMMARY

This report assesses the status of *Haliotis laevigata* and *H. rubra* stocks (hereafter referred to as greenlip and blacklip, respectively) in the Western Zone (WZ) of the South Australian Abalone Fishery (SAAF) in the 2019/20 financial year. The assessment includes application of the proposed harvest strategy (HS) included in the Draft Management Plan for the South Australian Commercial Abalone Fishery (PIRSA in prep) to determine stock status. The stock status from the proposed HS is aligned with the National Fishery Status Reporting Framework (NFSRF; Stewardson et al. 2018).

The proposed HS uses financial year (FY), which is different to the quota year (calendar year; CY) for the fishery.

Greenlip

During the 2019 CY, greenlip comprised 56% (66 t) of the combined abalone catch in the WZ, with the total catch of greenlip having decreased 21% from 2008 (83 t). This 17 t reduction reflects reductions to the total allowable commercial catch (TACC), the removal of one licence during the implementation of marine park sanctuary zones and a voluntary under-catch of 9% in 2019.

Greenlip were classified as ‘depleting’ in 2017 and 2018. The change in classification from ‘sustainable’ in 2016 followed widespread decreases in catch rate and legal density.

Application of the proposed HS to the 2019/20 FY resulted in a zone score of 3.33 that, in combination with the zone trend score of 3.83 (reflecting a decreasing trend), define the stock status for greenlip in the WZ as **‘depleting’.** A zone score of 3.33 translates to a recommended zonal catch of 49 t for 2021, which is 4% below the 2020 TACC of 51 t.

Most of the CY evidence available shows that the harvestable biomass declined further in 2019. This includes (1) continuing decline in the zonal catch per unit effort (CPUE) to the fourth lowest value on record; (2) CPUE was low and/or declining in most fishing grounds, including the three key SAUs (Anxious Bay, The Gap and Avoid Bay); (3) low legal and sub-legal densities from fishery independent surveys; and (4) declining proportion of the large (Grade 1) greenlip in the catch, despite their higher value. Thus, the reductions in fishing mortality (i.e. lower catches and changed fishing season) over the last five years have not been adequate to match the current productivity of the stock.

Thus, these data support the ‘depleting’ stock status from the harvest strategy. The stock is not yet depleted, and recruitment is not yet impaired, but fishing mortality is too high and moving the stock in the direction of becoming recruitment impaired.

Blacklip

During the 2019 CY, blacklip comprised 44% (51 t) of the combined abalone catch in the WZ, with the total blacklip catch having decreased 50% from 2009 (102 t). This 51 t reduction reflects lower TACCs, the removal of one licence from the WZ in 2014 and a voluntary under-catch of 9.6% in 2019.

Application of the proposed HS to the 2019/20 FY resulted in a zone score of 3.34 that, in combination with the zone trend score of 5.04 (reflecting an increasing trend), define the stock status for blacklip in the WZ as **'sustainable'**. This was a change in stock status from 'depleting' in 2018. A zone score of 3.34 translates to a recommended zonal catch of 48 t for 2021, which is 12% above the 2020 TACC of 43 t.

Evidence available from CPUE and FIS density estimates suggest that the decline in harvestable biomass, evident since 2009, has abated because (1) there were clear increases in CPUE for a high proportion (79%) of SAUs between 2018/19 and 2019/20; and (2) FIS estimates of legal density were high in 2019.

These data support the change in stock status from the proposed HS strategy, indicating that catch may have been adequately reduced to match current stock productivity. Nonetheless, the harvestable biomass remains low, so additional years of CPUE and FIS data are required to confirm the recent change in harvestable biomass trajectory. Thus, blacklip will require careful monitoring in coming years.

Key WZ blacklip and greenlip statistics from 2019 are summarised in the table below that shows number of licences (No. licences); total allowable commercial catch (TACC); voluntary catch limit (VCL) and total commercial catch (TCC) by calendar year. Stock status from the proposed harvest strategy (HS) is estimated from financial year data. tmw = tonnes meat weight, VCL -= Voluntary Catch Limit, TCC = Total Commercial Catch.

Season	No licences	TACC (tmw)	VCL (tmw)	TCC (tmw)	HS Stock Status (2019/20 FY)
BLACKLIP					
2019	22	58.6	53.0	51.08	Sustainable
GREENLIP					
2019	22	73.01	66.4	66.05	Depleting

Keywords: Greenlip abalone (*Haliotis laevigata*), Blacklip abalone (*Haliotis rubra*), Stock assessment, Harvest strategy, Stock status, South Australia.

1 GENERAL INTRODUCTION

1.1 Background

This report provides a fishery assessment for Greenlip Abalone (*Haliotis laevigata*, hereafter referred to as greenlip) and a stock status for Blacklip Abalone (*Haliotis rubra*; hereafter referred to as blacklip) in the Western Zone (WZ) of the South Australian Abalone Fishery (SAAF; Figure 1.1) in the 2019/20 FY. The level of reporting for the two species differs because species-specific

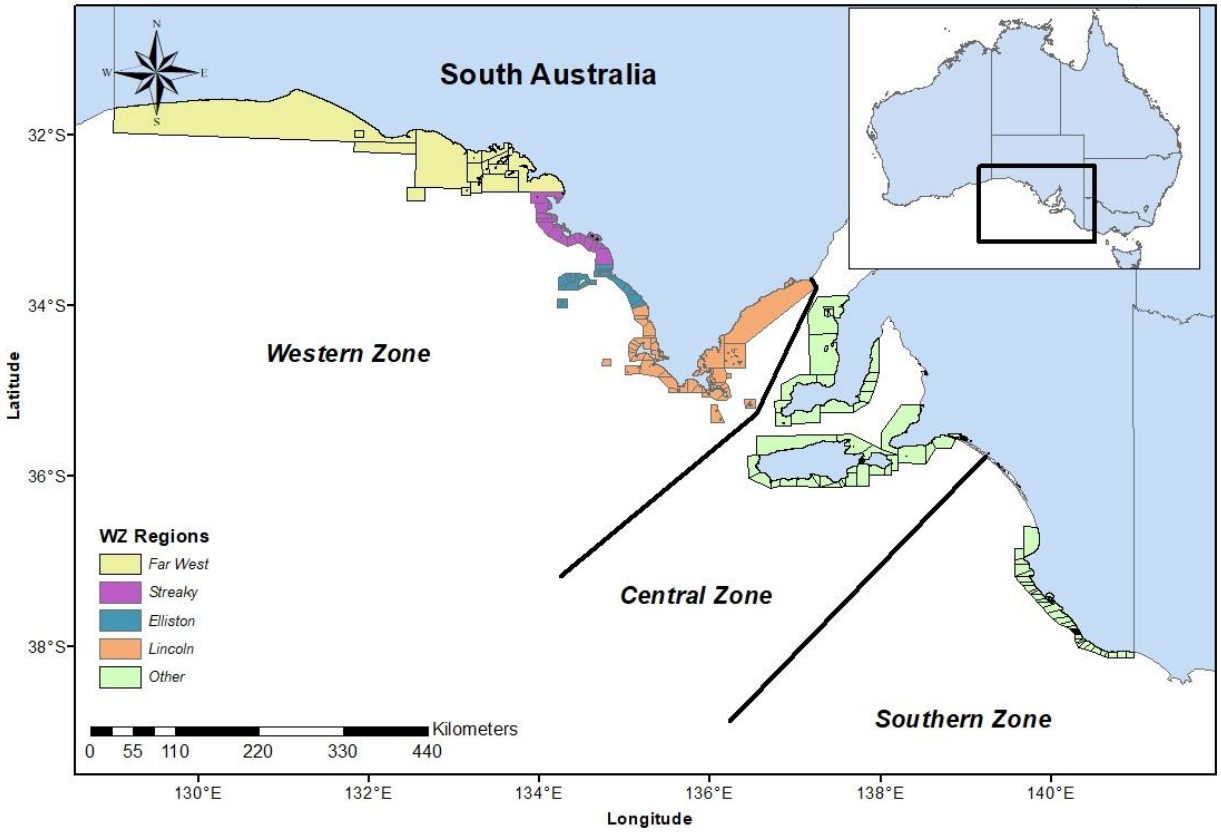

Figure 1.1. Fishing zones and mapcodes of the South Australian Abalone Fishery and regions of the WZ.

assessments are undertaken biennially as part of an overall rationalisation of the research program. These form part of the South Australian Research and Development Institute's (SARDI – Aquatic Sciences) ongoing assessment program for greenlip and blacklip fisheries and update previous fishery assessment and status reports (see Stobart et al. 2019). This report (1) assesses the status of the resource; (2) identifies the uncertainty associated with the assessment; and (3) documents future research needs for both species.

Data are presented for two time periods (calendar and financial) and for three spatial scales (Zone, Spatial assessment units, and Regions). The two time periods are used because calendar year equates to quota year and financial year is the time step specified by the proposed harvest strategy (HS) described in the draft Management Plan for the fishery (PIRSA in prep). This proposed HS has been developed by the Abalone HS Working Group, which consists of representatives from PIRSA Fisheries and Aquaculture, SARDI and industry. The proposed HS includes assignment of stock status consistent with the NFSRF (Table 1.1; Stewardson et al. 2018) that has been adopted by PIRSA Fisheries and Aquaculture for classifying fish stocks (PIRSA 2015).

Table 1.1. Terminology for the status of key Australian fish stocks reports (Stewardson et al. 2018).

	Stock status	**Description**	**Potential implications for management of the stock**
	Sustainable	Stock for which biomass (or biomass proxy) is at a level sufficient to ensure that, on average, future levels of recruitment are adequate (i.e. 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 pressure 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 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

History and description of the fishery

1.1.1 Commercial fishery

A review of the management history of the SAAF since its inception in 1964 is provided by Mayfield et al. (2012). Major management milestones are listed in Table 1.2.

Entrants to the fishery increased in the late 1960s and exceeded 100 operators by 1970. In 1971, the SAAF was divided into three zones (Western (WZ), Central and Southern; Figure 1.1). During the same year, licences were made non-transferable to reduce the number of operators in the fishery and by 1976 had fallen to 35. These 35 licences remained until 2013. From 1 January

2014, removal of one licence from the WZ, as part of the marine park buy-back scheme, reduced the total number of licences in the SAAF to 34.

The WZ of the SAAF includes coastal waters of South Australia between the Western Australia/South Australia border and eastern Eyre Peninsula (Figure 1.1). This zone was subdivided into Region A and Region B in 1985. In Region A, annual Total Allowable Commercial Catches (TACCs) were introduced for blacklip and greenlip in 1985 and amended to the calendar year fishing season from 1989 (Table 1.3; Nobes et al. 2004). For Region B, both species were included under a single annual TACC that was introduced in 1991. Regions A and B were recombined in 2014. There are currently 22 licences operating in the WZ, and the fishing season extends from 1 January to 31 December each year. However, in order to take advantage of the benefits of seasonal differences in greenlip meat weight and recovery (Stobart et al. 2013), during 2020 fishing was restricted under section 79 of the Act preventing harvesting greenlip and blacklip East of Cape Carnot (Figure 1.2) from 1 January to 31 March, and throughout the WZAF from 1 October to 31 December.

A catch and effort logbook must be completed for each fishing day and submitted to SARDI Aquatic Sciences at the end of each month. Commercial catch and effort data on this fishery have been collected since 1968 and are used in stock assessment and status reports for each zone.

Since 1997, the WZ fishery has operated under the control of formal management plans (Zacharin 1997, Nobes et al. 2004, PIRSA 2012). These plans guide management through a regime of input (e.g. limited entry) and output (e.g. minimum legal lengths (MLLs) and quotas) controls. Some of the current management arrangements in the WZ are summarised in Tables 1.2 and 1.3.

Table 1.2. Management milestones: Western Zone of the South Australian Abalone Fishery.

Date	Milestone
1964	Fishery started
1970	In excess of 100 operators
1971	Licences made non-transferable
	Fishery divided into three zones (Western, Central and Southern)
	Minimum legal length (MLL) set at 130 mm shell length (SL) for both species
1976	30 licences remained; 5 additional licences issued
1978	Sub-zones and fishing blocks replaced by map numbers and codes
1980	Licences became transferable
1984	Greenlip minimum legal length amended to 145 mm SL
1985	Western Zone divided into regions A and B
	Quota introduced to Region A (97.75 t blacklip; 97.75 t greenlip)
1989	Total allowable commercial catch (TACC) in Region A greenlip fishery reduced to 69 t
1991	Quota introduced to Region B (9.2 t both species)
1993	Abolition of owner-operator regulation
	TACC in Region B increased to 11.5 t
1994	TACC in Region B increased to 13.8 t
1996	TACC in Region A blacklip fishery decreased to 86 t
1997	Management Plan implemented (Zacharin 1997)
	TACC in Region A blacklip fishery increased to 97.8 t
2004	Management Plan reviewed (Nobes et al. 2004)
2006	TACC in Region A greenlip fishery increased to 75.9 t
2010	TACC in Region A blacklip fishery decreased to 92 t
	TACC in Region A greenlip fishery decreased to 69 t
2011	TACC in Region B fishery decreased to 9.2 t
2012	New Management Plan including harvest strategy (PIRSA 2012)
	TACC in Region B fishery decreased to 6.9 t
2013	TACC in Region A blacklip fishery decreased to 87.4 t
2014	Regions A and B amalgamated; Number of licences reduced to 22.
	TACC for greenlip increased to 73 t; TACC for blacklip decreased to 84.1 t
	Ministerial exemption to harvest *Haliotis roei* in with a TACC of 11 t granted from February 2014
2015	Harvest strategy review commenced
2016	TACC in blacklip fishery decreased to 74.6 t; voluntary agreement to limit catch to 66.4 t
2018	TACC in blacklip fishery decreased to 66.6 t; voluntary agreement to limit catch to 58.6 t
	Minor adjustment made to mapcodes constituting Searcy Bay, Baird Bay, Venus Bay and Anxious Bay (see Figure 1.2).
2019	TACC in blacklip fishery decreased to 58.6 t; voluntary agreement to limit catch to 53.0 t t
	TACC in greenlip fishery remained at 73.0 t; voluntary agreement to limit catch to 66.4 t
2020	TACC in blacklip fishery decreased to 43 t. Under a Section 79 notice, catch from Drummond capped at 11 t, WZAF closed to fishing from 1 October to 31 December and area East of Cape Carnot closed to fishing from 1 January to 31 March
	TACC in greenlip fishery decreased to 51 t. Under a Section 79 notice, WZAF closed to fishing from 1 October to 31 December and area East of Cape Carnot closed to fishing from 1 January to 31 March

Table 1.3. Western Zone commercial abalone fishery management arrangement summary.

Management strategy	Western Zone management arrangements in 2020
Licence holders	22
Target species	*Haliotis rubra* (blacklip), *H. laevigata* (greenlip), *H. roei* (roei)
Minimum legal length	Blacklip 130 mm shell length (SL), Greenlip 145 mm SL, Roei 75 mm SL
Quota year	1 January to 31 December (note section 79 restrictions in Table 1.2 above)
Quota transferability	Yes
Other species permitted	*H. scalaris*, *H. cyclobates* when SL ≥130 mm
Method of capture	By hand – dive fishery
By-catch	Negligible

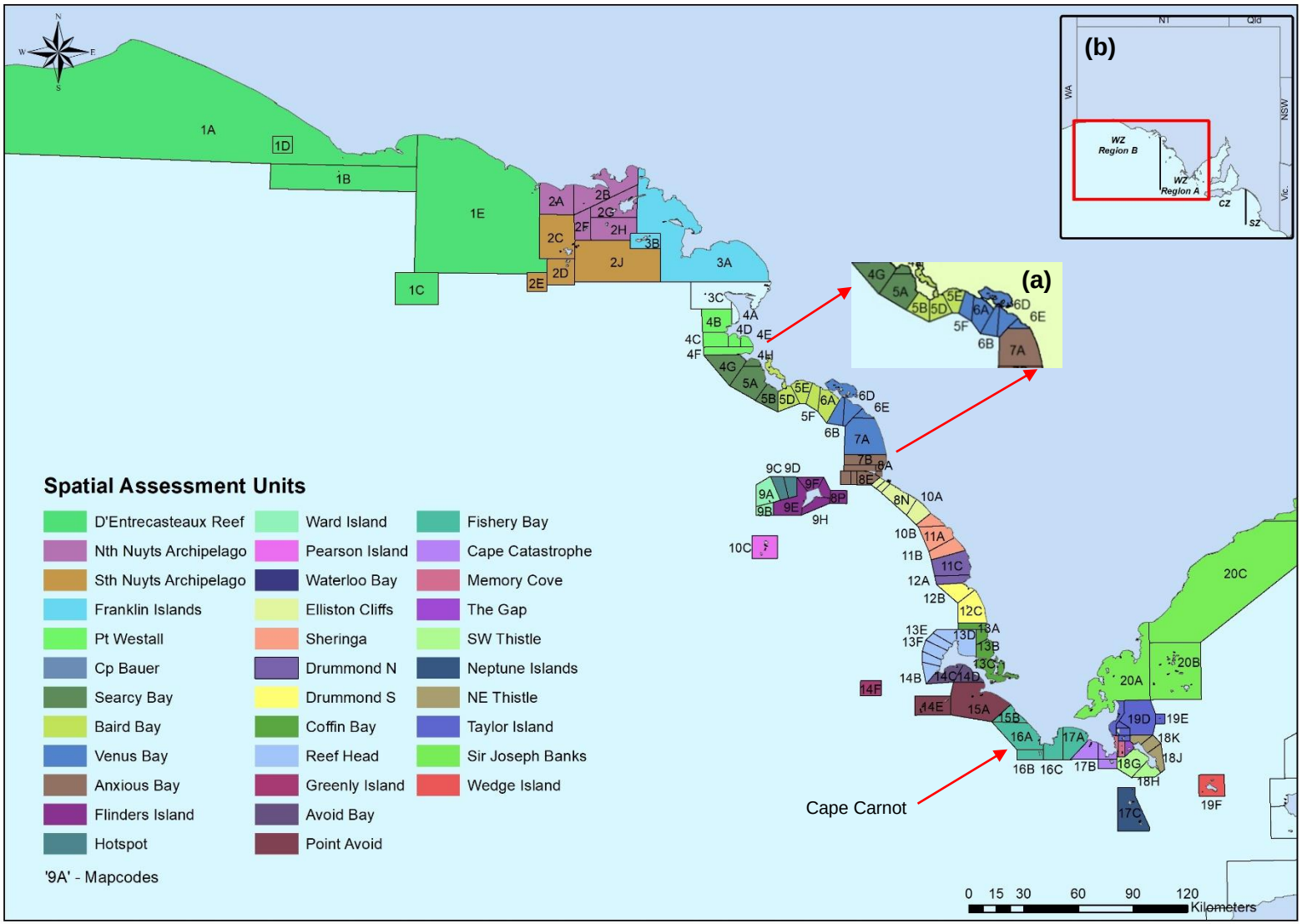

Figure 1.2. Spatial assessment units (SAUs) and map codes of the Western Zone South Australian Abalone Fishery. Inlay (a) shows old mapcode groupings for SAUs Searcy, Baird, Venus and Anxious Bays; inlay (b) shows old WZ region split.

1.1.2 Recreational fishery

The most recent recreational abalone catch estimate for South Australia was for the 2013/14 financial year and was 282 blacklip and 4,651 greenlip individuals (Giri and Hall 2015). This equates to 2.04 t meat weight, a 13% decrease since the previous survey from late 2007 to 2008 (Jones 2009). Recreational fishing effort was estimated at 16% for the West Coast (Memory cove to Western Australian border) during 2013/14 (Giri and Hall 2015), equating to 789 abalone.

1.2 Management Plan

The third management plan for the SAAF (PIRSA 2012) was reviewed from 2015/16 to 2019/20 and a draft management plan is currently in development (PIRSA 2020 in prep). This draft management plan describes the management goals and objectives for the fishery that reflect current policy drivers including Section 7 of the *Fisheries Management Act 2007*, and Ecologically Sustainable Development as described in the *Environmental Protection and Biodiversity Conservation Act 1999*.

The four goals of the draft Management Plan are to ensure (1) the abalone resource is sustainably harvested; (2) optimum economic use and equitable distribution of the resource; (3) impacts on the ecosystem are minimised; and (4) Provisioning of cost-effective and participative management of the fishery. This report is directly relevant to the first goal, for which the objectives are to maintain the stocks above ecologically sustainable levels and to ensure enough data and information are available to undertake the HS which underpins the management decisions. The proposed HS is described in the draft Management Plan and is intended to be the primary tool used to achieve the goal of sustainably harvesting the abalone resource and allocating stock status in accordance with the NSRF (PIRSA 2020 in prep). The proposed HS is consistent with the *National Guidelines to Develop Harvest Strategies* (Sloan et al. 2014) and the *South Australian HS Policy* (PIRSA 2015).

The proposed HS provides a structured, species-specific and spatially explicit framework for decision making and includes assignment of stock status consistent with the NSRF. It has three main phases: (1) a monitoring phase in which information is collected for the two performance indicators, CPUE and legal density of abalone from FIS, along with other relevant fishery information; (2) the stock assessment phase where the performance of each SAU is scored based on a CPUE score and, for some key SAUs, a legal density score. This scoring is based on limit and target reference points. Aggregated scores for the SAUs provide an overall stock status based on trigger reference points for biomass (zone score used as a proxy) and fishing mortality

(zone score trend used as a proxy); and (3) the final step where zone score is translated to a recommended zonal catch. During this step a workshop is held with Industry to share relevant information, and zonal catch can be adjusted within a 10% range based on the information through harvest decision rules. The adjusted zonal catch helps to inform a TACC for the following season.

1.3 Abalone biology

The biology of blacklip and greenlip in the WZ is described in previous stock assessment reports (e.g. Stobart et al. 2015, Stobart and Mayfield 2016a). Additional information on the biology of both species is also provided in Appendix 5.1. Greenlip and blacklip are present throughout southern Australia but have differing overall distributions. Blacklip range from Coffs Harbour (New South Wales) to Rottnest Island (Western Australia), while greenlip range from Flinders Island (Tasmania) to Cape Naturaliste (Western Australia). Typically, these two species occupy different habitats, with blacklip mostly inhabiting crevices and caves or the bottom of steep rock faces of topographically complex rocky reefs (1 to 30 m depth) and greenlip tending to inhabit the edge of reefs and boulders near sand or seagrass (5 to >50 m depth).

Blacklip populations can show significant genetic differentiation between sites less than 15 km apart (Shepherd and Brown 1993, Temby et al. 2007, Miller et al. 2009), suggesting limited dispersal among ‘metapopulations’ (Fleming 1997, Miller et al. 2009). In contrast, greenlip dispersal appears to be more widespread as reflected in population genetics that suggest ‘metapopulations’ cover spatial scales of up to 135 km (Miller et al. 2014). The limited dispersal of abalone has implications for depleted stock recovery, contrasting with many other marine organisms, whose widespread dispersal makes them more resilient to localised depletion.

Abalone are prone to several diseases that can cause significant mortality and/or affect the quality of meat for sale. The two primary diseases affecting Australian stocks are abalone viral ganglioneuritis (AVG; Mayfield et al. 2012) and the protozoan parasite *Perkinsus olensi* (Goggin and Lester 1995). AVG has not been recorded in South Australia but *Perkinsus* is established and negatively impacts three commercially harvested abalone species (Goggin and Lester 1995, Lester and Heyward 2005). Chronically infected animals often exhibit extensive macroscopic lesions rendering the product unsaleable. Avoidance of fishing areas in the WZ of the SAAF that have a high prevalence of *Perkinsus*-related lesions has displaced ~10% (11 $t.yr^{-1}$) of blacklip catch to alternative fishing grounds, exacerbated the need for quota reductions and likely cost the fishery in excess of $10 million over the past ten years. The disease is currently visibly expressed in fishing grounds near Port Lincoln and in the Baird Bay SAU (SARDI unpublished data).

2 METHODS

2.1 Greenlip assessment

2.1.1 Data used and spatial scales of analyses

This assessment uses fishery dependent (FD) and fishery independent (FI) data. The FD data consist of catch and effort and the proportion of greenlip in the differing weight grades (Mayfield 2009) from 1 January 1968 to 30 June 2020. The FI data consist of density estimates and length frequency distributions from timed swim and lead-line (McGarvey et al. 2007) surveys conducted periodically at selected SAUs.

Data were analysed at three spatial scales: (1) the WZ overall; (2) four regions of the WZ (termed Port Lincoln, Elliston, Streaky Bay and Far West); and (3) the SAUs defined in the proposed HS (see Figure 1.2). The regions of Port Lincoln, Elliston, Streaky Bay and Far West are comprised of SAUs typically accessed from each respective regional centre (see Figure 1.1). Data are presented for calendar year, expect for HS zone score tables and associated phase plots, which were presented for FY.

2.1.2 Fishery-dependent data

Commercial catch and effort data have been collected since 1968 in the form of daily entries to commercial logbooks submitted to SARDI, allowing spatial and temporal analyses of catch (t, meat weight), fishing effort by depth category (hours) and mean CPUE ± standard error (se). Multi-dimensional scaling (MDS) was used to evaluate temporal changes in the distribution of the proportion of catch among SAUs; closer proximity among years indicates greater similarity. MDS results were further interpreted with similarity percentage (SIMPER) analysis and hierarchical cluster analysis (CLUSTER) using complete linkage. SIMPER indicates which SAUs are contributing most to the differences between years and CLUSTER identifies “natural groupings” of years where years within a group are more like each other than years outside of the group and years in other groups.

Spatial and temporal analyses of annual CPUE were compared across years and seasons, and proportion of Grade 1 greenlip (PropG1; the largest grade category) was compared across years. CPUE is estimated as the catch-weighted mean of daily CPUE where 1) the percentage of the target species in the catch for each daily record is used as a weighting factor in calculating the arithmetic mean of daily CPUE records; and 2) effort is split based on the species proportion in the daily catch, assuming equal catch rate for each species (Appendix 5.2, Table 6.12). In all instances, prior to calculation of CPUE, daily data were filtered to remove records where effort

was <3 and >8 hours and the ratio of total catch over total hours was >66.7 kg.hr^{-1}. Daily records with <30% of the target species were also excluded from data used to estimate CPUE. For weight grade data, records where the total catch was >1% different from the sum of all three weight-grade categories were excluded, as were all records with zero catch. The minimum sample size used to calculate both CPUE and PropG1 was 10 fishing records; therefore, the absence of data for either of these measures in any one year indicates fewer records were available. The combined trend of CPUE and catch is also displayed as a time series of relative catch multiplied by relative CPUE, where the metric for each year is divided by that in 1979 prior to multiplication, as an approximation to a Kobe plot (Kell 2012).

Ranking and percent of total catch in SAU titles refer to the current catch rank the SAU represents relative to all SAUs, and the percentage of the total 2019 catch taken within the SAU.

2.1.3 Fishery-independent data

Greenlip abundance and size structure were obtained from SARDI FI surveys which are currently undertaken biennially. The FI output statistics include length-frequency distributions and mean density (± se) of legal and sub-legal-sized greenlip. In 2020, FI data were obtained for three SAUs – Anxious Bay, The Gap and Avoid Bay – and were estimated from lead line surveys (Mayfield et al. 2008). Historically, FI surveys were also conducted in other SAUs (Hotspot, Flinders Island, Ward Island and Point Avoid; see Stobart et al. 2017), and density was estimated using timed swims (Shepherd 1985), lead lines (Mayfield et al. 2008), or a combination of these.

Greenlip density estimates from timed swims at The Gap from 2016 were required for application of the proposed HS and were obtained by applying the percentage change in density from lead lines in successive surveys to the 2013 timed swim value. In order to aid the interpretation of the length-frequency distributions, the percentage of large greenlip (LARGE) from FI survey length-frequency distributions was defined as the ratio of ‘large’ greenlip (≥165 mm SL) to all legal-sized (*i.e.* ≥145 mm SL) measurements. The percentage of small greenlip (SMALL) was defined as the ratio of ‘small’ greenlip (<110 mm SL) to all sub-legal-sized greenlip (*i.e.* ≥110 mm to <144 mm SL).

2.2 Blacklip status

Data sources and methods used for blacklip are described in Stobart et al. (2019) and generally mirror those described above for greenlip. One difference between greenlip and blacklip was the use of two SAUs (Drummond South and Drummond North) for blacklip at Drummond in the assessment, whereas for greenlip Drummond remained the single, assessed SAU.

2.3 Application of the Harvest Strategy – Greenlip and Blacklip

Application of the proposed HS is described in the draft Management Plan for the South Australian Commercial Abalone Fishery in development (PIRSA in prep). Briefly, the proposed HS uses financial year (FY; rather than the use of calendar year data as described above) FD and FI data. The FD data are used to estimate FY CPUE, and the FI data are used to estimate density of legal-sized abalone. SAU-specific limit and target reference points, determined from pre-identified reference periods, are used to score CPUE and legal-density for each SAU. Scores of these two performance indicators (PIs) are combined to achieve a final SAU score which is a measure of overall stock performance for the SAU. If both PIs are available, they are calculated using a 50:50 weighting, otherwise the available PI equals the final score. For detail of scoring where there are missing years see PIRSA (in prep).

Annual zone score is an aggregate of the SAU scores that are first adjusted relative to their importance to the fishery (i.e. proportion of catch from previous 12 years) and is used to set the recommended catch.

Stock status under the NSRF is based on the interplay of two factors, biomass and fishing mortality (Stewardson et al. 2018). In the proposed HS these are represented by two proxies, the annual zone score for biomass and the trend in zone score (slope) for fishing mortality. The trend slope is derived from the change in zone score over the last four years.

2.4 Quality Assurance

Quality assurance systems form an integral part of stock assessments undertaken by SARDI. These systems are designed to ensure high quality project planning, data collection and storage, analyses, interpretation of results and report writing. Details of the five individual components are provided in Appendix 5.3.

3 RESULTS

3.1 GREENLIP

3.1.1 Western Zone annual patterns in catch, CPUE and fishing depth

Total catches were relatively stable between 1989 and 2019, with catch ranging from a high of 83.6 t in 2006 to a low of 66.1 t in 2019 (Figure 3.1a). Within this period, fluctuations in catch were attributable to: (1) the introduction of quota to Region B in 1991 (TACC of 9.2 t); (2) increases to the Region B TACC in 1993 (11.5 t) and 1994 (13.8 t); (3) variation in the proportion of greenlip caught in Region B; (4) an increase to the Region A TACC from 2006 to 2009 (75.7 t); and (5) catch reductions between 2009 (82.6 t) and 2015 (68.9 t) after reductions to the Region A TACC in 2010 (69 t), Region B in 2011 (9.2 t) and 2012 (6.9 t), the removal of a licence during the implementation of marine park sanctuary zones in 2014 and voluntary under-catches of the TACC in 2015 (5%), 2016 (5%) and 2019 (9.1%).

CPUE fluctuated between 1979 and 1998 (mean 21.4 $kg.hr^{-1}$), whereafter it increased to a peak of 29.6 $kg.hr^{-1}$ in 2006 (Figure 3.1a), and then decreased 32% from 2006 to 2014 when it was among the lowest values on record (20.2 $kg.hr^{-1}$). Between 2014 and 2015, CPUE increased 13%, but then continued to decline to 2019 when it was the fourth lowest value on record (19.7 $kg.hr^{-1}$; Figure 3.1b). The proportion of Grade 1 greenlip in the commercial catch was the highest on record in 2017 and, although it has since decreased for two consecutive years, it remained relatively high in 2019. The 2019 value for the combined trend of relative catch and CPUE was the lowest value on record (Figure 3.1c). Fishing effort across depth ranges has remained relatively stable for the last 10 years, although there was evidence that fishing effort at a depth greater than 20 m was higher from 2016 – 2019 than from 1994 - 2018 (Figure 3.1d). There was no evidence that the increase in live catch from 2012 onwards influenced recent zonal CPUE values (Appendix 5.7).

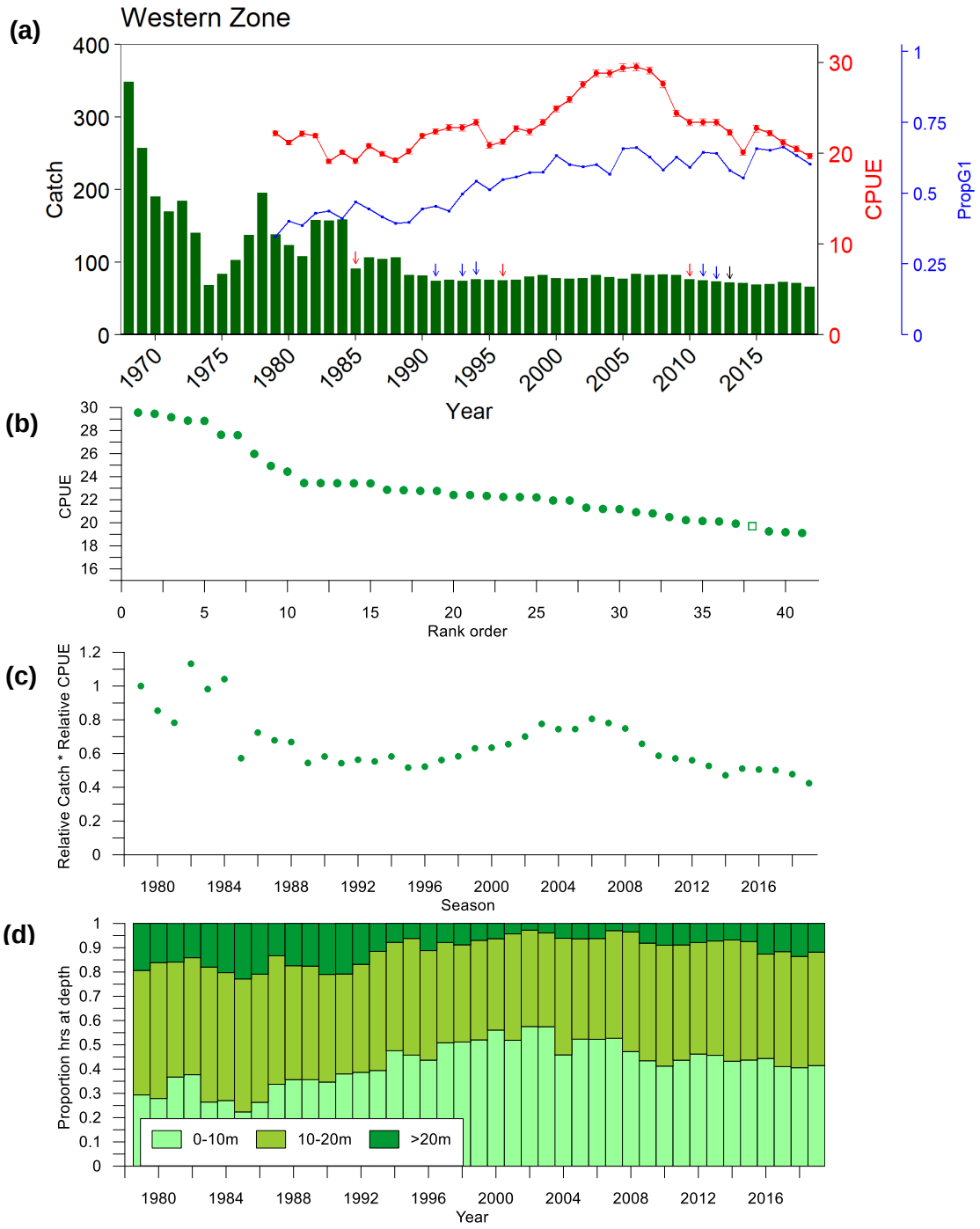

Figure 3.1. Calendar year greenlip **(a)** Catch (t, meat weight; green bars) from the Western Zone from 1968 to 2019. CPUE ± se (kg.hr^{-1}) and PropG1 are shown as solid red and blue line lines, respectively. Red arrows indicate implementation (1985) and amendment (1996, 2006 and 2010) of the greenlip TACC in Region A. Blue arrows indicate implementation (1991) and amendment (1993, 1994, 2011 and 2012) of the TACC in Region B. Black arrow indicates amendment to the WZ TACC (2014). **(b)** Rank order of Western Zone greenlip CPUE. Open square symbol is 2019 data point. **(c)** Combined trend of relative catch and relative CPUE from the Western Zone from 1979 to 2019. **(d)** Proportion of hours fished in the Western Zone at three depth ranges (see legend) using fishing records where greenlip constituted 75% or more of the catch.

3.1.2 **Regions of the WZ and within-season catch and CPUE**

The percent of catch from the four regions was variable from 1978 to 1996, with Port Lincoln catch consistently higher than the other regions (Figure 3.2a). Subsequently, catch from Elliston increased, remaining at a level similar to Port Lincoln between 1996 and 2006, with all regions having very stable catch during this eleven-year period, whereafter catches from Elliston declined while those from Port Lincoln increased to the third highest on record in 2016 and then decreased 10.5% by 2019. The proportion of catch from the Streaky region increased from 2013, while that from the Far West decreased coincident with the merging of Regions A and B.

CPUE for all regions was relatively stable during the HS reference period (1990-2000) with average values for Port Lincoln and Elliston higher (~ 21 $kg.hr^{-1}$) than those for the Streaky and the Far West regions (~16 $kg.hr^{-1}$; Figure 3.2 b-e). The CPUE from Port Lincoln, Elliston and Streaky then increased to high values in the mid-2000s. From the mid-late 2000s CPUE in Port Lincoln and Elliston decreased and, in 2019, were relatively low. Streaky Bay CPUE remained high after the mid-2000s and remained relatively high in 2019. CPUE in the Far West has generally varied around 16 $kg.hr^{-1}$. However, CPUE in this region decreased from 2017 and, in 2019, was the lowest value on record (12 $kg.hr^{-1}$).

With the exception of 1981 and 1982, more than 50% of the catch has been harvested in summer or autumn, with the percentage increasing to over 70% from 1990 onwards (Figure 3.3a). From 1987 to 2004, the percentage of the catch caught in summer increased substantially, with a peak of 64% in 2004. The percentage of catch in summer has subsequently decreased and, in 2019, was 23% of the WZ greenlip catch (Figure 3.3a). Autumn catch has increased from a historic low in 2005 (18%) to 2019 (59%), the highest value on record.

Annual estimates of summer CPUE were generally lower than the estimates of autumn CPUE, with the difference being greatest between 2014 and 2018 (summer >3$kg.hr^{-1}$ lower than autumn; Figure 3.3b). Summer and autumn CPUE values in 2019 were both the sixth lowest on record. For the Port Lincoln region CPUE was mostly higher in autumn (Figure 3.3c). Historically, this difference was not as clear for Elliston and Streaky Bay, but higher autumn CPUE was apparent from 2015, coinciding with an increase in the percent of catch in autumn (Figure 3.3 d-e). There was no clear difference between seasons for the Far West where fishing occurs primarily in autumn (Figure 3.3 f). In the Regions, he 2019 CPUE values for both seasons were among the lowest values on record, the only exceptions were autumn CPUE for Elliston (11th from lowest) and Streaky Bay (7th from highest).

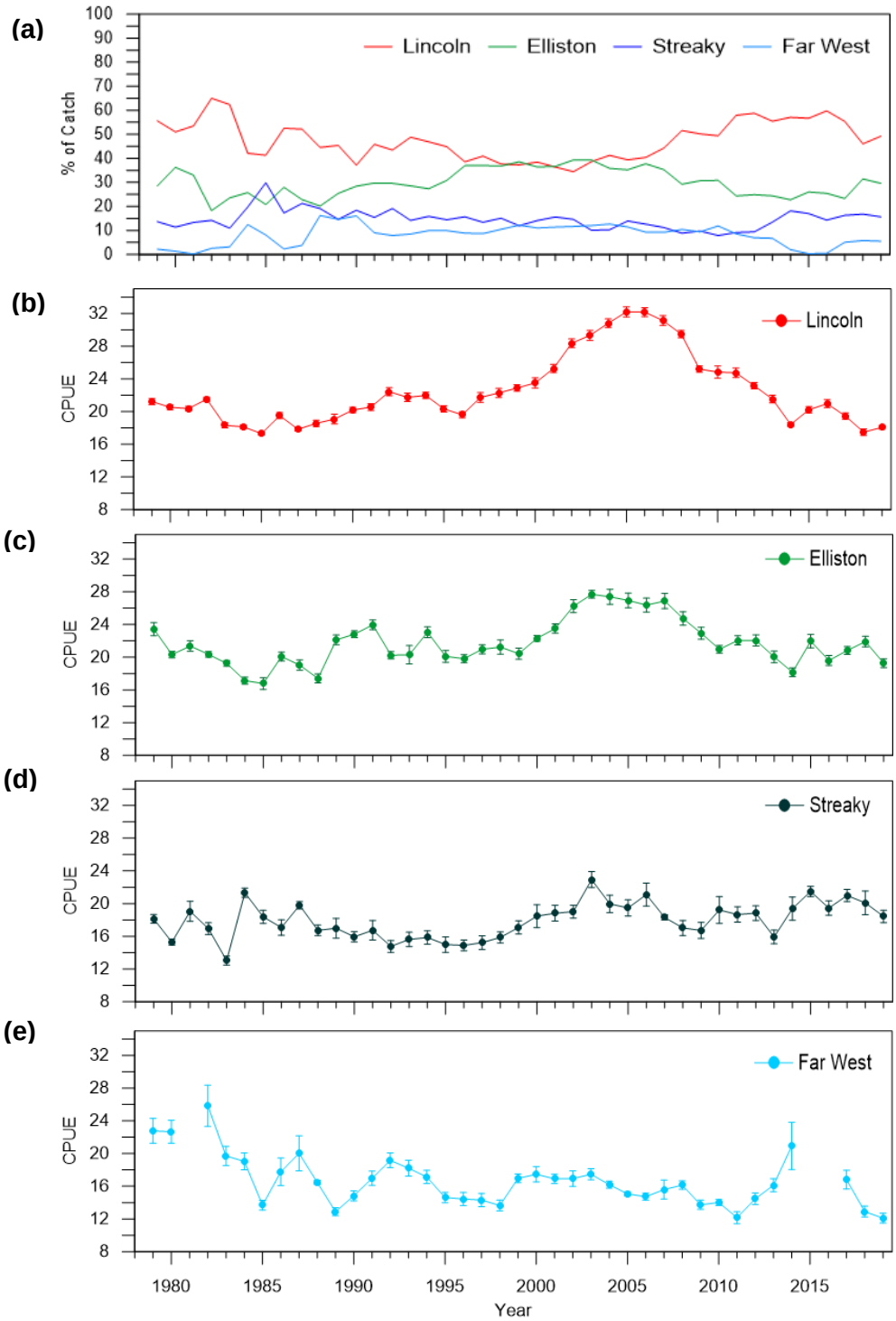

Figure 3.2. **(a)** Comparison between percent greenlip catch and **(b-e)** CPUE ±se (kg.hr^{-1}) at Western Zone regions (see legend) from 1968 to 2019 calendar year.

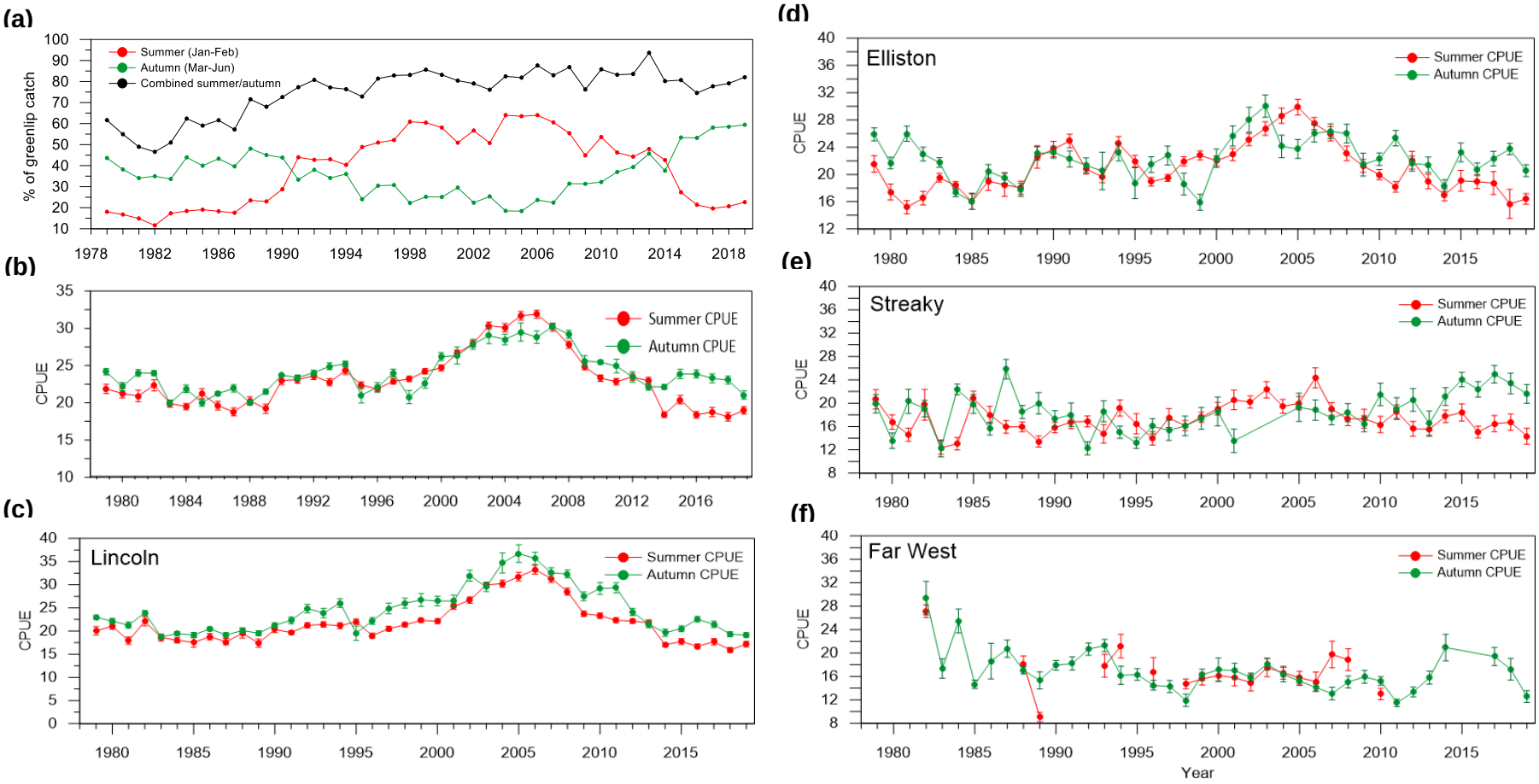

Figure 3.3. Calendar year greenlip **(a)** Within season summer and autumn distribution of catch (% of catch between January and June) from the Western Zone from 1979 to 2019 where Summer = Jan-Feb and Autumn = Mar-Jun. **(b)** Seasonal CPUE ± se (kg.hr^{-1}) difference from 1979 to 2019 for the WZ. **(c-f)** Seasonal CPUE ± se (kg.hr^{-1}) difference from 1979 to 2019 by region.

3.1.3 Distribution of catch among spatial assessment units

In 2019, the eight SAUs from which more than 5% of the total greenlip catch for the WZ was harvested were Point Avoid (11.3%), Anxious Bay (8.9%), Hotspot (8%), Avoid Bay (7.5%), Baird Bay (6.4%), The Gap (6.3%), Flinders Island (6%) and Drummond (5.8%). Cumulatively, 60% of the catch was harvested from these SAUs. These are different to the eight SAUs that exceeded 5% of the total greenlip catch and cumulatively represented 54% of the catch in the last assessment for this species in 2017 (Stobart et al. 2018). The changes that contributed to this difference included increases in catch at Point Avoid (4.5 t; 6.2% to 7.4 t; 11.3%), Hotspot (4.1 t; 5.6% to 5.3 t; 8.0%), Avoid Bay (4.9 t; 6.7% to 5.0 t; 7.5%), Flinders Island (3.9 t; 5.4% to 4.0 t; 6.0%), Anxious Bay (5.3 t; 7.3% to 5.9 t; 8.9%) and, amongst others, decreases in catch at The Gap (7.7 t; 10.7% to 4.2 t; 6.3%) and Baird Bay (4.5 t; 6.2% to 4.2 t; 6.4%).

The MDS plot shows two groupings of years where the distribution of catch in WZ SAUs within each group was similar (75% similarity; Figure 3.4). The more recent distribution of catch, from 2010 to 2019, is most similar to that obtained in the mid to late 1980s, with the spatial distribution of catch in 2019 most similar to that from 2012 (green Cluster; Figure 3.4). The current catch distribution remains more evenly distributed throughout the WZ greenlip SAUs than was the case between 1990 and 2009 (Figure 3.5). The difference between 2018 and 2019, identified using the SIMPER analysis, was primarily attributed to increased catch from Point Avoid, Cape Bauer, Drummond and SW Thistle SAUs and decreased catch from the Ward Island and Neptune Island SAUs.

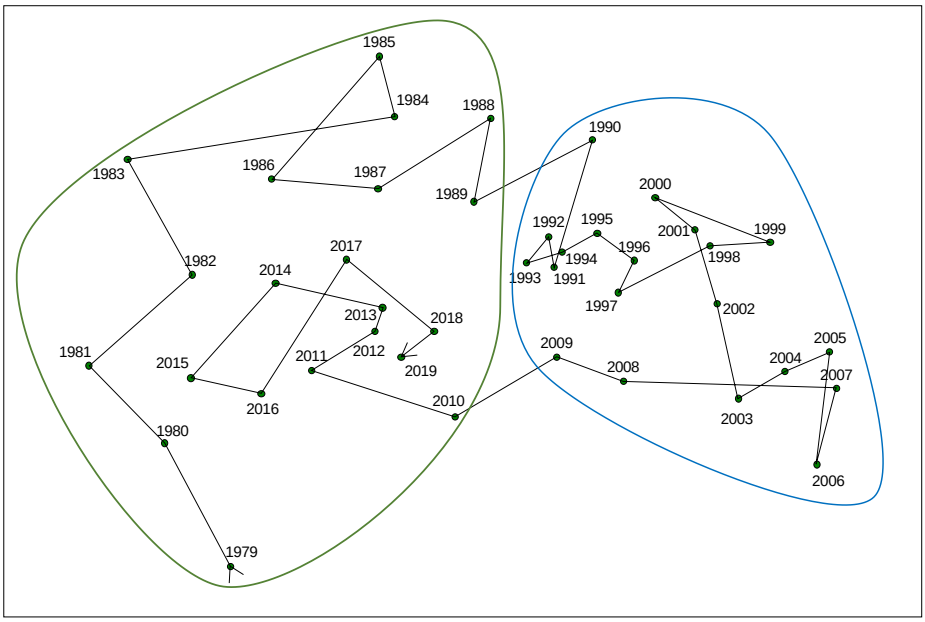

Figure 3.4. Multi-dimensional scaling (MDS) plot for SAUs showing similarity among years based on greenlip catch from the Western Zone from 1979 to 2019 calendar year. 2D stress = 0.14. Green and blue lines indicate numbered clusters with 75% similarity.

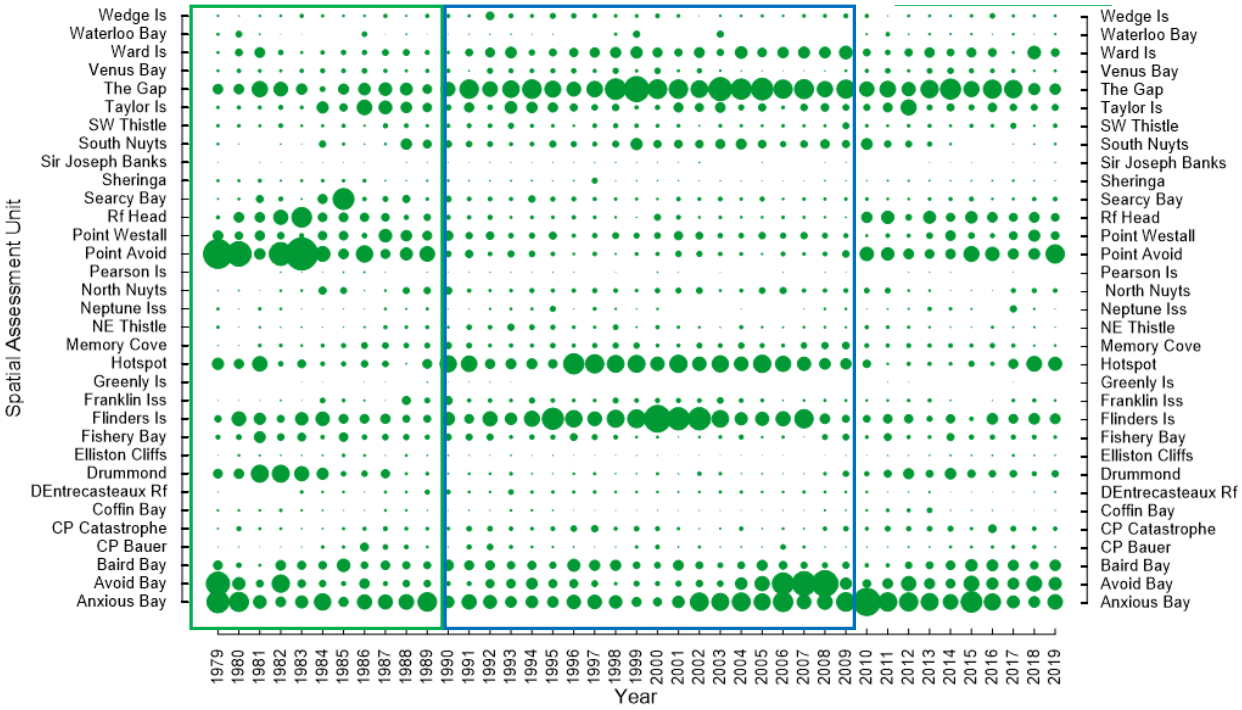

Figure 3.5. Bubble plot showing the spatial distribution of the greenlip catch (% of total catch) among the SAUs in the WZ from 1979 to 2019 calendar year. Coloured boxes are clusters 1 (green) and 2 (blue) from the MDS in Figure 3.4. Note abbreviations for Cape (Cp), Island (Is), Reef (Rf), North East (NE) and South West (SW).

3.1.4 **Distribution of harvest strategy scores among spatial assessment units**

Ten of the 15 SAUs scored for CPUE had values below 5, as did three of the four amalgamated low SAUs and the three SAUs scored for legal density (Figure 3.6). These SAUs contributed 77% of the 2019 FY greenlip catch. Anxious Bay, The Gap and Avoid Bay, the three most important SAU contributors to greenlip catch, had low CPUE and legal density scores. Point Westall and Baird Bay were the only SAUs with scores above a 5.

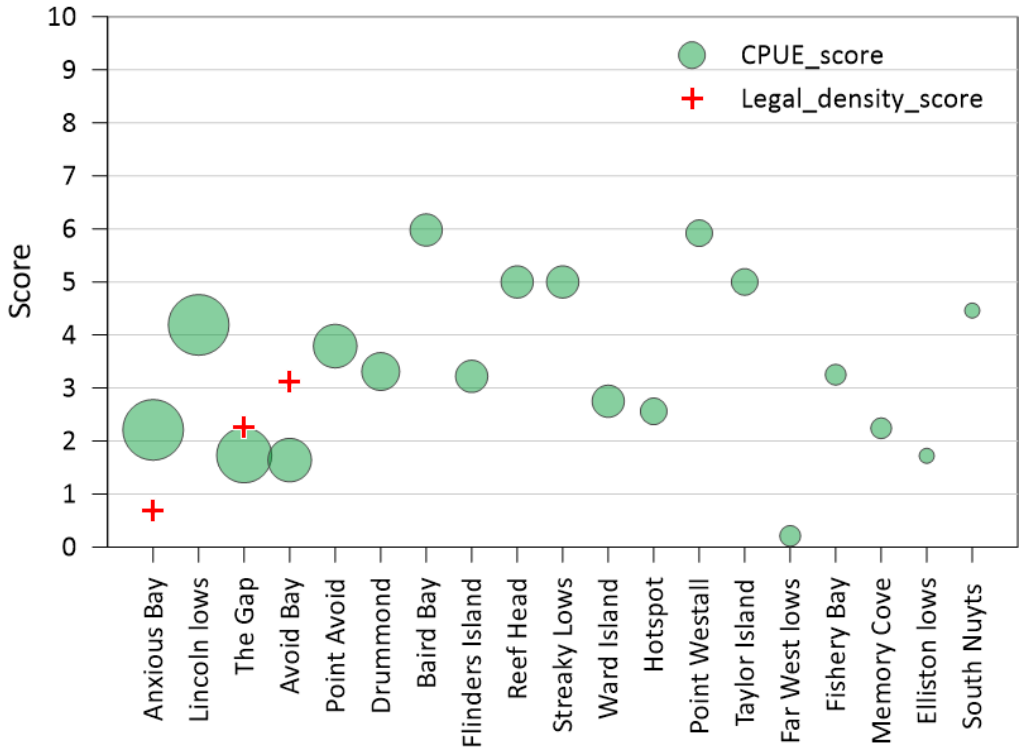

Figure 3.6. Greenlip SAU CPUE and legal density scores for the 2019/20 financial year (see legend). Bubble size for CPUE indicates % of WZ catch in 2019/20.

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3.1.5 Temporal patterns in spatial assessment units (CY)

Anxious Bay (2; 8.9%)

The Anxious Bay SAU had the highest average catch of WZ SAUs over the last ten years, and the second largest in 2019 (5.9 t). Catch has generally been stable, ranging from 5 to 10 t.yr^{-1}, with exceptions in 1979 (20 t), 1979 (19 t), 1984 (16 t) and 2010 (13 t; Figure 3.7 a). CPUE generally increased from 1983 with maxima in 2004 and 2007 (~36 kg.hr^{-1}). However, CPUE decreased after 2007 and, in 2019, was 21 kg.hr^{-1}. PropG1 has been relatively high since 2005 and, in 2019, was the second highest value on record. Thus, in 2019, catch and CPUE were relatively low compared to years since 1979, while PropG1 was high (Figure 3.7 b).

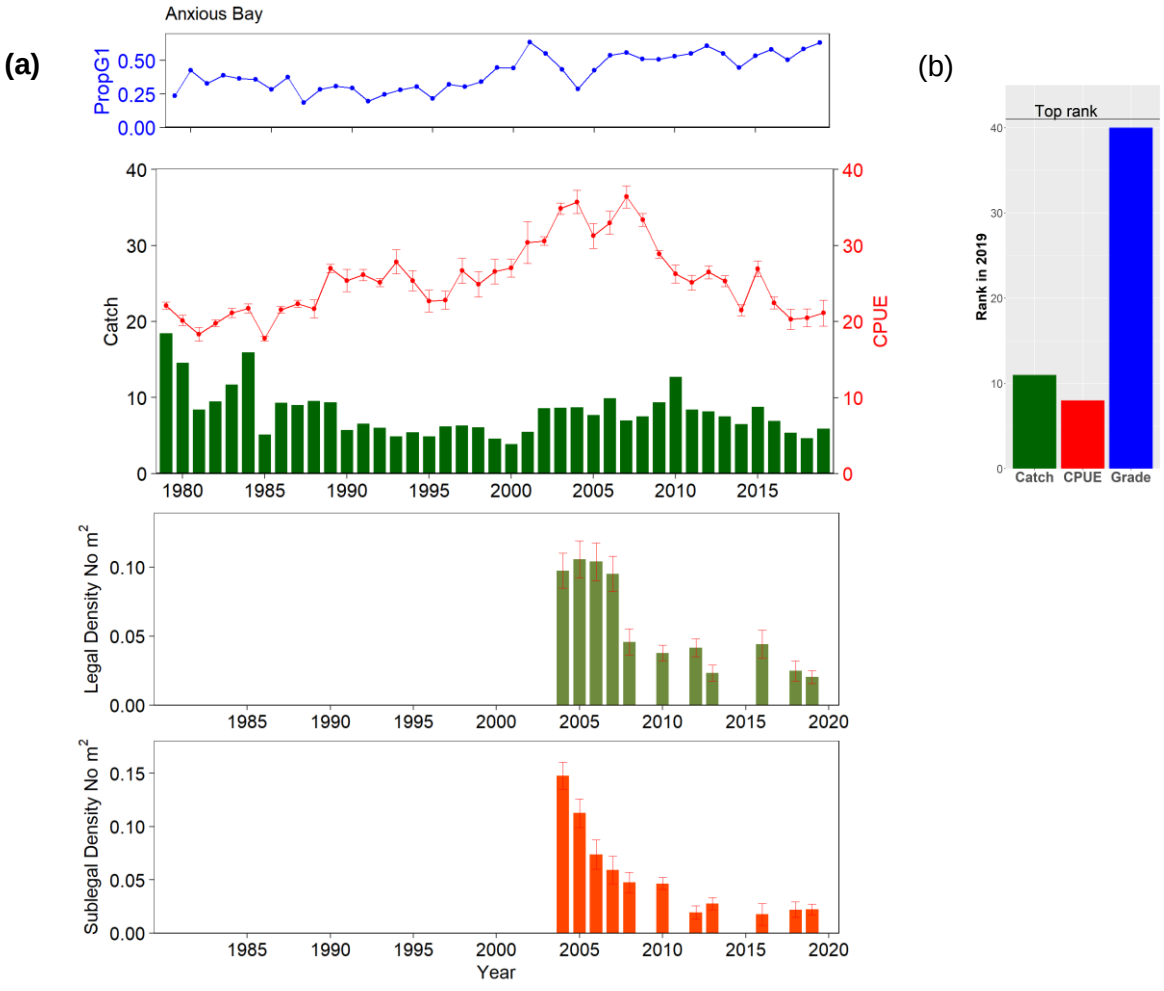

Figure 3.7. Calendar year Anxious Bay greenlip **(a)** PropG1 (blue), Catch (t meat weight, green), CPUE ± se (kg.hr^{-1}, red), legal-sized mean density ± se (abalone.m^{-2}; olive green) and sublegal-sized mean density ± se (abalone.m^{-2}; orange red) from 1979 to 2019. Densities are from LL fishery-independent surveys from 2004 to 2019 in mapcode 8A. **(b)** Rank of Catch, CPUE and PropG1 in 2019 relative to historic.

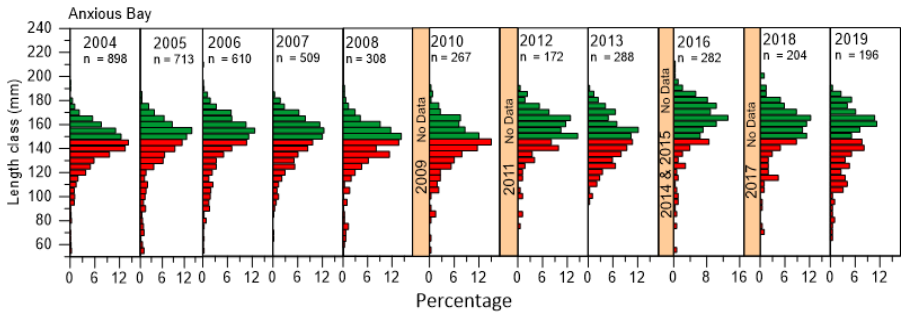

Figure 3.8. Legal (green bars) and sub-legal-sized (red bars) length-frequency distributions observed on fishery-independent surveys from 2004 to 2019 calendar years in mapcode 8A. Length classes represent the upper length of each 5 mm bin. n = number measured. Bin classes < 50 mm SL pooled.

From FI surveys, the density of legal-sized greenlip halved between 2007 and 2008 and remained low in all subsequent survey years, including 2019, which was the lowest legal density on record (Figure 3.7 a). The density of sub-legal sized greenlip decreased consistently between 2004 and 2012, remaining at similarly low levels in all subsequent survey years. The percentage of LARGE greenlip varied among years (range: 24-68%), but has generally increased from 2004 (24%) to 2016, 2018 and 2019 when it was 68% and 52% and 55%, respectively (Figure 3.8). The percentage of SMALL greenlip was relatively low throughout the survey period (range 8-26%).

The Gap (6; 6.3%)

With few exceptions, annual catches from The Gap have been relatively stable, ranging between approximately 6 and 10 t.yr^{-1} (Figure 3.9 a). Catch almost halved between 2017 (7.7 t) and 2019 to 4.2 t, the lowest value on record. CPUE decreased between 1980 and 1989, to the second lowest value on record (16.1 kg.hr^{-1}), whereafter it generally increased to a peak of 31.8 kg.hr^{-1} in 2005. Between 2005 and 2018, CPUE declined 53% to 14.9 kg.hr^{-1}, the lowest value on record, and remained low in 2019 (16.4 kg.hr^{-1}). PropG1 decreased substantially between 2017 and 2018 and, in 2019 was equivalent to values in the mid-1980's to mid-1990's (Figure 3.9 a). In 2019, catch, CPUE and PropG1 were low relative to historic values (Figure 3.9 b).

FI surveys at The Gap indicate that the densities of legal-sized greenlip from timed swims were lowest in the early 1990s, increased to the highest value on record in 2004 and subsequently declined to an intermediate value by 2009 (Figure 3.9 a). Density then remained stable in 2011 and 2013. Density data from lead lines, available from 2009, also show stable legal-sized density in 2009, 2011 and 2013 followed by small decreases from 2016 to 2020. Conversion of the lead line densities to an equivalent timed swim density suggests that the legal-sized density decreased 12% between 2018 and 2020 and, in 2020, was the third lowest on record. The density of sub-legal-sized greenlip from timed swims had high but variable values between 1989 and 2007 and

subsequently has been relatively low during surveys from 2009, 2011 and 2013. The densities of sub-legal greenlip obtained using leaded lines were stable between surveys in 2009, 2011 and 2013, but have declined to a lower level from 2016 to 2020. Conversion of the lead line densities to an equivalent timed swim density suggests that, in 2018, sub-legal greenlip density at The Gap was the lowest on record. The percentage of LARGE greenlip has been stable among years (range: 33-50%; Figure 3.10), with the highest percentage recorded in 2019. The percentage of SMALL greenlip has ranged from the lowest recorded in 2003 (15%) to the highest value in 2019 (34%).

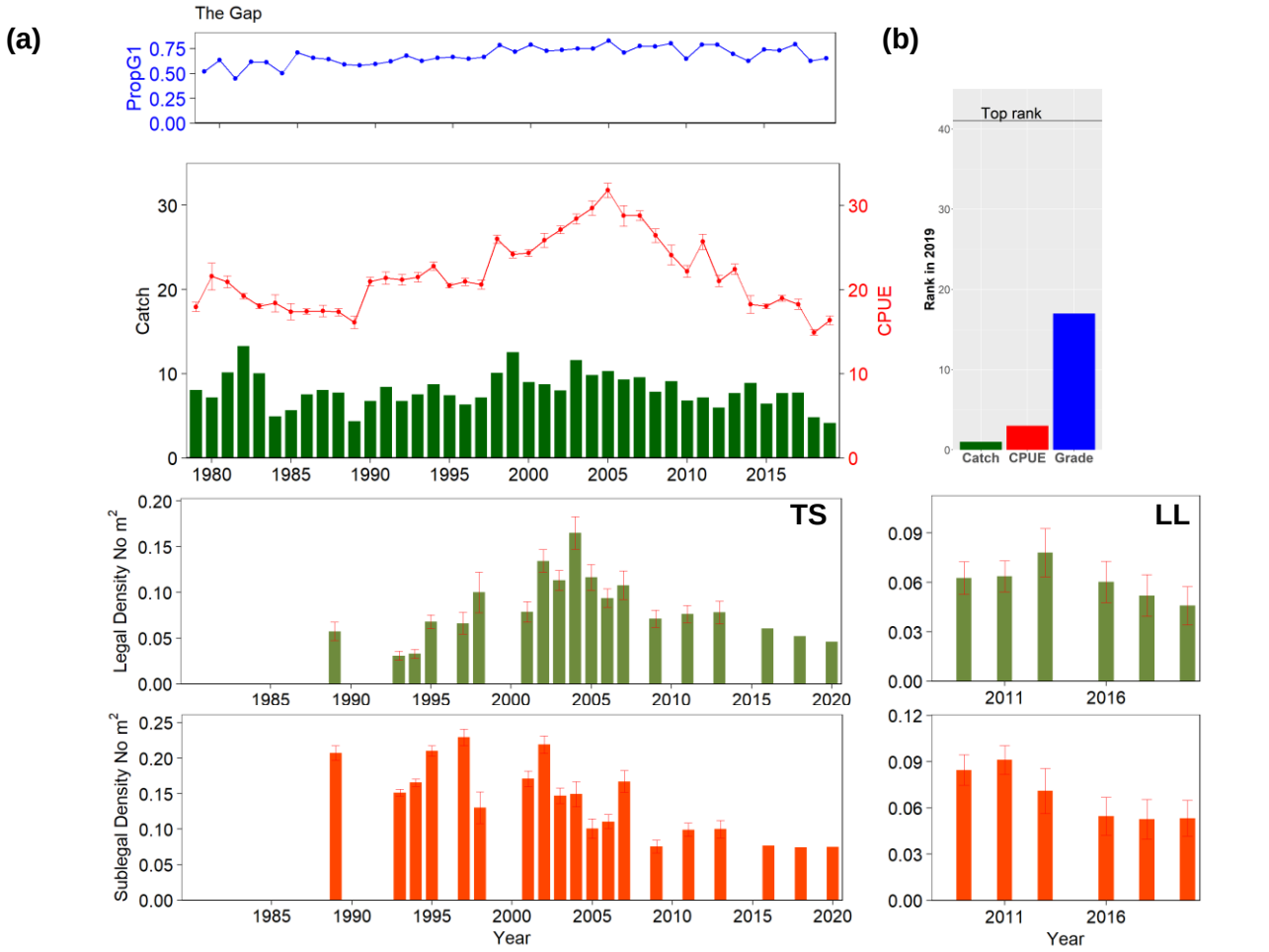

Figure 3.9. Calendar year The Gap greenlip **(a)** PropG1 (blue), Catch (t meat weight, green), CPUE ± se (kg.hr^{-1}, red), legal-sized mean density ± se (abalone.m^{-2}; olive green) and sublegal-sized mean density ± se (abalone.m^{-2}; orange red) from 1979 to 2019. Densities are from fishery-independent surveys from 2004 to 2020 in mapcode 18F. TS = timed swim, LL = Lead line **(b)** Rank of Catch, CPUE and PropG1 in 2019 relative to historic.

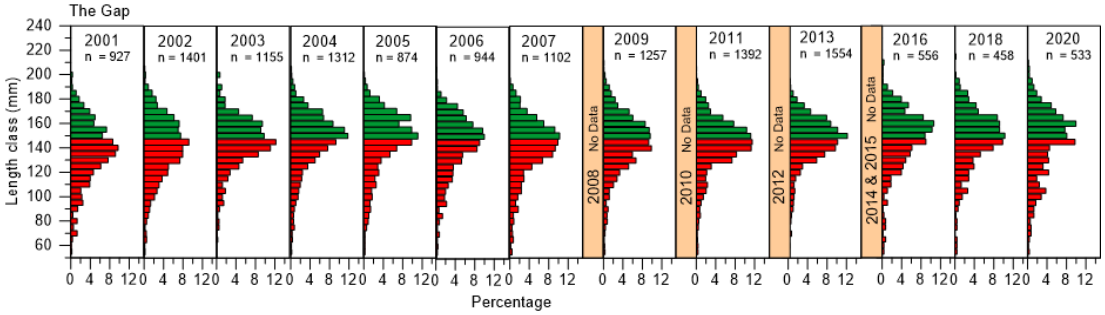

Figure 3.10. Legal (green bars) and sub-legal-sized (red bars) length-frequency distributions observed on fishery-independent surveys from 2004 to 2020 calendar years in mapcode 18F. Length classes represent the upper length of each 5 mm bin. n = number measured. Bin classes < 50 mm SL pooled.

Avoid Bay (4; 7.5%)

Catch from Avoid Bay has generally ranged from 1 to 9 t.yr^{-1} with the exception of 1979, 1982 and 2006-2008 when catch ranged from 11t in 2006 to 20t in 1979 (Figure 3.11 a). In 2019, catch was 5 t. CPUE has varied among years, declining from a peak in 2006 (40.3 kg.hr^{-1}). In 2019 (19.8 kg.hr^{-1}), CPUE was the lowest value since 1987 and the fifth lowest value on record. PropG1 in the commercial catch increased substantially between 1996 and 2000 and has remained relatively high thereafter (Figure 3.11 a). In 2019, CPUE was ranked relatively low while catch and PropG1 were relatively high (Figure 3.11 b).

The abundance of legal-sized greenlip almost halved between 2008 and 2010, remained at a similar low level between 2010 and 2014, and then increased to the second highest level in 2016, subsequently decreasing to the third lowest value on record in 2020 (Figure 3.11 a). The density of sublegal-sized greenlip declined from 2008 to 2010, whereafter, except for a lower value in 2016, it remained relatively stable. The percentage of LARGE greenlip remained relatively stable from 2008 to 2014 (range 30-39%), whereafter it increased (range 41-51%; Figure 3.12). The percentage of SMALL greenlip decreased consistently from 38% in 2008 to 12% in 2016 but increased to 39% in 2020.

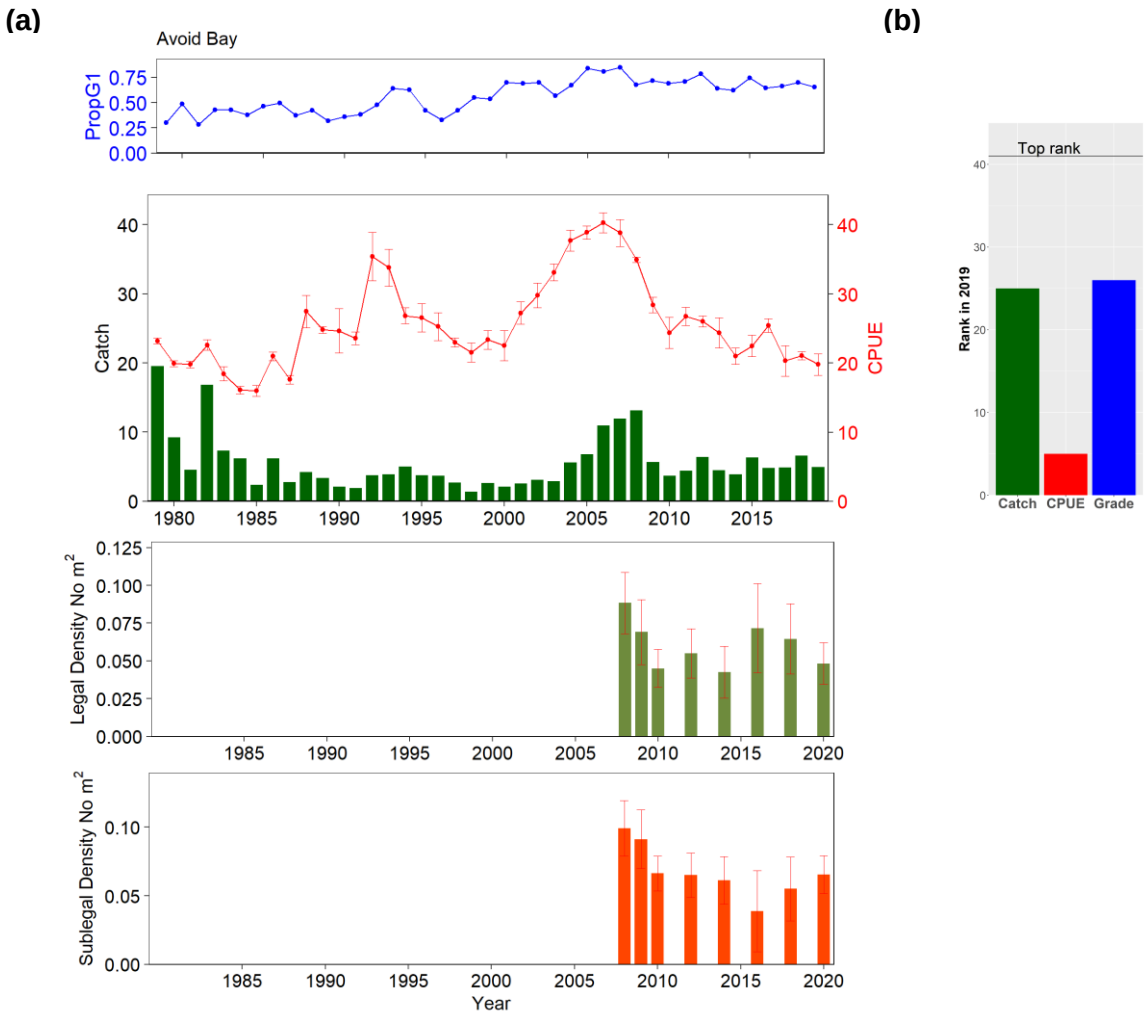

Figure 3.11. Calendar year Avoid Bay greenlip **(a)** PropG1 (blue), Catch (t meat weight, green), CPUE ± se (kg.hr^{-1}, red), legal-sized mean density ± se (abalone.m^{-2}; olive green) and sublegal-sized mean density ± se (abalone.m^{-2}; orange red) from 1979 to 2019. Densities are from LL fishery-independent surveys from 2008 to 2020 in mapcode 14D. **(b)** Rank of Catch, CPUE and PropG1 in 2019 relative to historic.

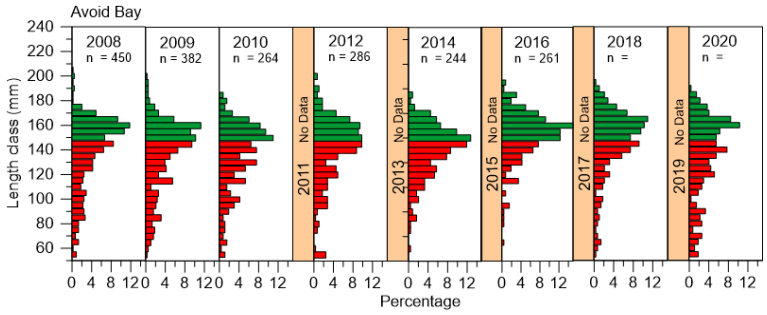

Figure 3.12. Legal (green bars) and sub-legal-sized (red bars) length-frequency distributions observed on fishery-independent surveys from 2008 to 2020 calendar years in mapcode 14D. Length classes represent the upper length of each 5 mm bin. n = number measured. Bin classes < 50 mm SL pooled.

Point Avoid (1; 11.3%)

Catches from Point Avoid were relatively high in the 1980's and stable at a low value from 1990 to 2009 (~2 $t.yr^{-1}$). In 2010, catch increased to 6.4 t, whereafter it has remained relatively stable and, in 2019, was the highest value since 1989 (7.4 t; Figure 3.13 a). CPUE has fluctuated among years, with a historic high in 2003 (33.6 $kg.hr^{-1}$). In 2019, CPUE was 20.3 $kg.hr^{-1}$ (Figure 3.13 a). PropG1 has been relatively high from 1997 to 2019. CPUE was ranked low, while catch and grade were ranked high (3.13 b).

Drummond (8; 5.8%)

Catch from Drummond was relatively high from 1979 to 1987, low from 1988 to 2007 (~1 $t.yr^{-1}$), and then increased and remained relatively high from 2009 to 2019 (~ 4.2 $t.yr^{-1}$; Figure 3.13). CPUE was relatively low between 1979 and 1989 (~20 $kg.hr^{-1}$), whereafter, for those years where it was estimable, it increased to a maximum of 42 $kg.hr^{-1}$ in 2002. CPUE has subsequently declined and, in 2019, was the lowest since 1996 (19.2 $kg.hr^{-1}$). PropG1 has declined consistently from 2015 and, in 2019, was close to the mid-point of ranked values (Figure 3.13 b). In contrast, catch was ranked high and CPUE was ranked low (3.13 b).

Reef Head (11; 4.7%)

Following relatively high catches from Reef Head throughout the 1980s, including very high catches in 1982 (14 t) and 1983 (19 t), catch was stable at less than 1.5 $t.yr^{-1}$ between 1990 and 2009 (Figure 3.13). Catch increased eight-fold in 2010 and, since then, has remained high ranging from 2.6 t in 2012 to 5.6 t in 2011 and, in 2019, was above the mid-point of ranked values (3.13 b). CPUE was relatively stable from 1979 to 1998, whereafter for those years where it was estimable, CPUE increased, with a maximum of 34 $kg.hr^{-1}$ in 2006. CPUE decreased from 2006 to 2019 and, in 2019, was among the lowest values recorded and ranked low (3.13 b). PropG1 was relatively low between 1979 and 1993, whereafter it increased to a historic high in 2007. PropG1 decreased from 2007 to 2017 whereafter it has increased and, in 2019 was relatively high and above the mid-point of ranked values (Figure 3.13 b).

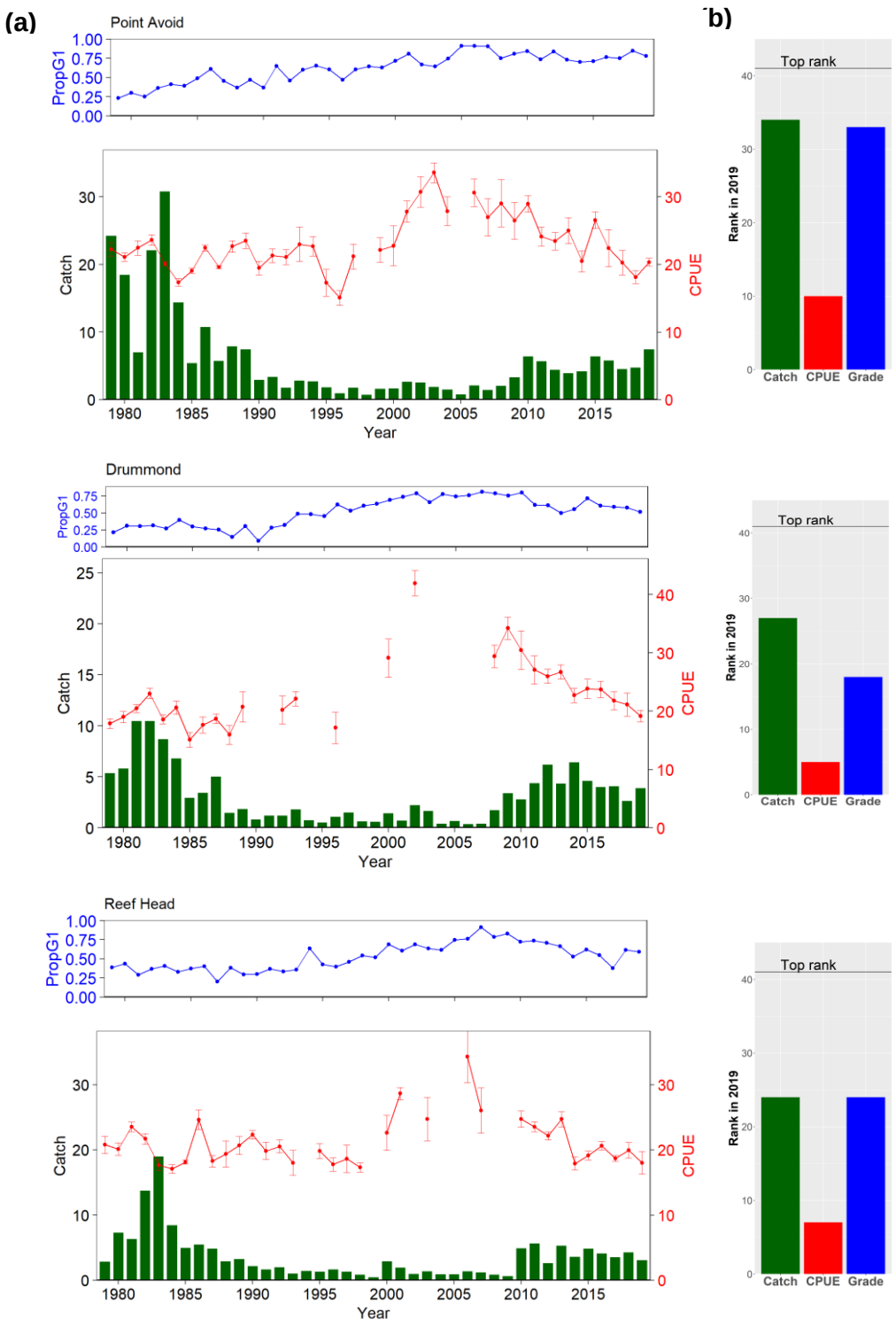

Figure 3.13. Calendar year Point Avoid, Drummond and Reef Head greenlip **(a)** PropG1 (blue), Catch (t meat weight, green) and CPUE ± se (kg.hr^{-1}, red) from 1979 to 2019. **(b)** Rank of Catch, CPUE and PropG1 in 2019 relative to historic.

Flinders Island (7; 6.0%)

Catch from Flinders Island has been variable, with the highest catches recorded in the early 1980s and 2000s (Figure 3.14 a). Catch generally declined from the second highest value in 2000 (12.7 t) to 2009 (3.6 t), whereafter it has remained relatively stable at a lower level (~3.6 t). CPUE declined in the early 1980s to the lowest value on record in 1988 (17.9 $kg.hr^{-1}$), whereafter it increased to the highest on record in 2002 (32 $kg.hr^{-1}$). From 2002, CPUE generally decreased to the second lowest on record in 2015 but increased thereafter and, in 2019, was 20.8 $kg.hr^{-1}$. Both catch and CPUE were relatively low in rank (Figure 3.14 b). PropG1 was the highest value on record in 2017 and, while declining in 2018 and 2019, it remains relatively high in value and rank (Figure 3.14 a, b).

Baird Bay (5; 6.4%)

For the past 41 years, annual catches from Baird Bay have been relatively stable at approximately 3.6 $t.yr^{-1}$ (Figure 3.14 a). Catch was 4.2 t in 2019 and was ranked around the mid-point of values (Figure 3.14 a, b). CPUE was variable among years, with three peaks that were greater than 30 $kg.hr^{-1}$ occurring in 1991, 2005 and 2016. CPUE decreased between 2016 and 2018 (24.18 $kg.hr^{-1}$), remaining at a similar value in 2019. CPUE in 2019 ranked low (Figure 3.14 b). PropG1 has fluctuated among years but progressively increased from 1989 and, in 2019, was among the highest values on record (Figure 3.14 a, b).

Taylor Island (12; 3.7%)

With the exception of a period of high catches in the mid to late 1980s and in 2012 (6.8 t), annual catch from Taylor Island has remained relatively stable at about 3.5 $t.yr^{-1}$ (Figure 3.14 a). CPUE was relatively stable between 1979 and 1999, whereafter it increased to a historic high in 2005 (27 $kg.hr^{-1}$) and remained relatively high until 2012. In 2013, CPUE decreased by 34% to 15.6 $kg.hr^{-1}$ and has since fluctuated at a similarly low level. With few exceptions, PropG1 has been relatively high from 1985 to 2017, but has since decreased and, in 2019 was amongst the lowest values on record. Catch, CPUE and PropG1 all ranked low in 2019 (Figure 3.14 b).

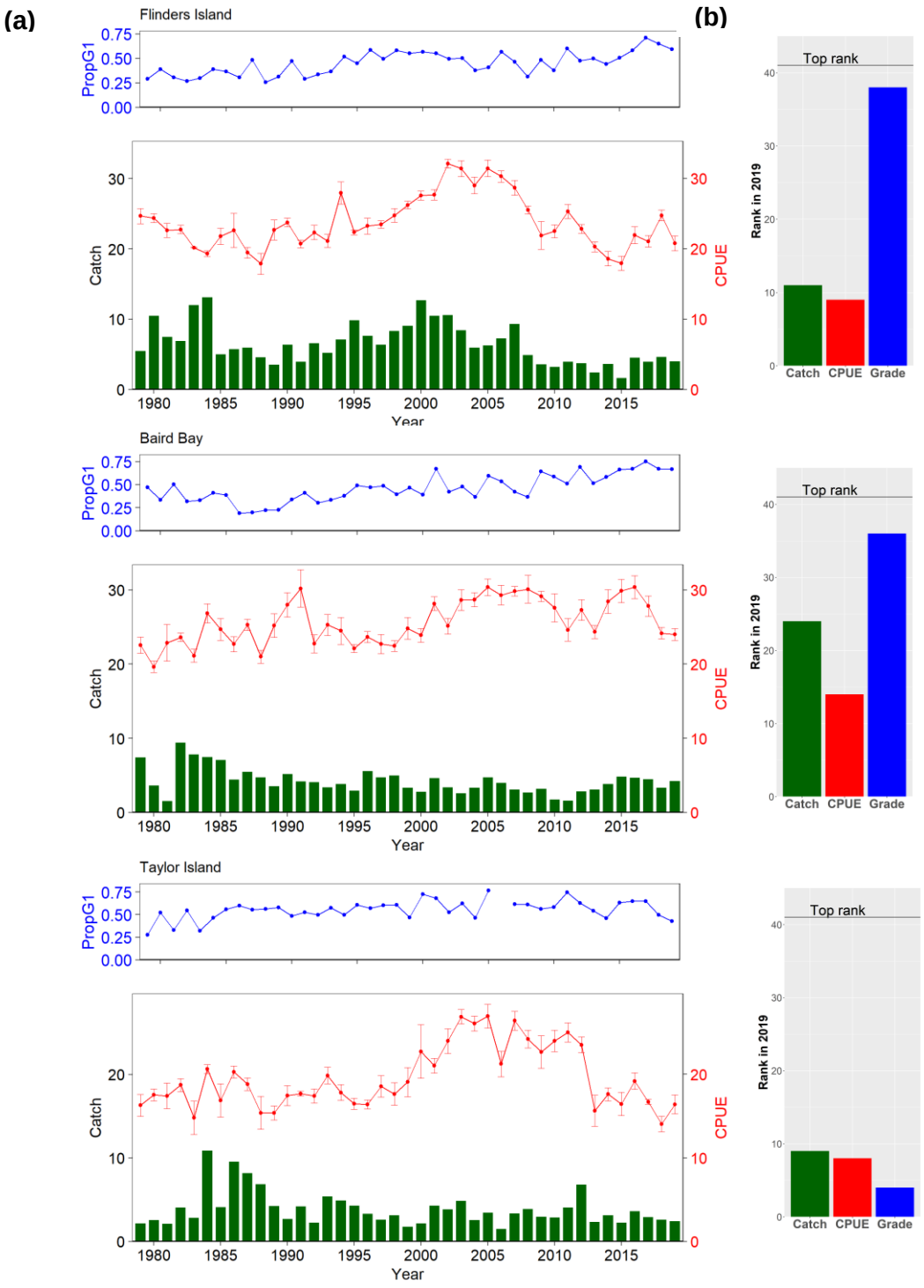

Figure 3.14. Calendar year Flinders Island, Baird Bay and Taylor Island greenlip **(a)** PropG1 (blue), Catch (t meat weight, green) and CPUE ± se (kg.hr^{-1}, red) from 1979 to 2019. **(b)** Rank of Catch, CPUE and PropG1 in 2019 relative to historic.

Ward Island (10; 4.7%)

The annual catch from Ward Island has oscillated on a 5-6 year scale from approximately 1 t.yr^{-1} to 6 t.yr^{-1} (Figure 3.15 a). In 2019, catch was 3.1. CPUE has fluctuated among years but generally increased from the lowest value on record in 1984 (22.5 kg.hr^{-1}) to a historic peak in 2004 (40.6 kg.hr^{-1}). CPUE decreased consistently from 2004 to 2010, whereafter it has varied among years. In 2019, CPUE was 28 kg.hr^{-1} and similar to mean CPUE for this SAU but low in ranking. PropG1 increased substantially from 2014 to 2015 (a 75% increase), whereafter it has remained high and has ranked high in 2019.

Hotspot (3; 8.0%)

The catch at Hotspot varied among years between 1979 and 1995, was generally higher and more stable between 1996 to 2006, whereafter it decreased consistently from 7.8 t in 2006 to the second lowest (0.8 t) in 2011 (Figure 3.15 a). Catch remained low between 2012 and 2016 (~1.7 t) but increased to 6.5 t in 2018 and remained relatively high in 2019 (5.3 t CPUE was variable between 1979 and 1995 following which it increased to a peak in 2003 (35.2 kg.hr^{-1}). CPUE then generally declined from 2003 to 2014, whereafter it increased steadily to 2017 (31.5 kg.hr^{-1}). However, CPUE has subsequently declined and, in 2019, was 23.3 kg.hr^{-1}, the fourth lowest value on record, and ranked low. PropG1 increased 268% from the second lowest value on record in 2014 to the highest value on record in 2018. PropG1 then decreased substantially in 2019 but was among the mid-range of historic values (Figure 3.15 a, b).

Point Westall (9; 4.8%)

Annual catches at Point Westall were initially high, but more than halved between 1987 and 1991, whereafter they remained relatively stable at about 2.6 t.yr^{-1} for 28 years (range 1.0 t in 2010 and 4.8 t in 2018; Figure 3.15 a). CPUE was variable in the 1980s, followed by a period of relative stability in the early to mid-1990s. From 1997, CPUE increased to a maximum of 27.9 kg.hr^{-1} in 2007, whereafter it has oscillated at a relatively high value, and, in 2019, CPUE was relatively high (24.8 kg.hr^{-1}). PropG1 has remained relatively high from 2009 to 2019. Catch, CPUE, and grade scored above mid-point ranking in 2019 (Figure 3.15 b).

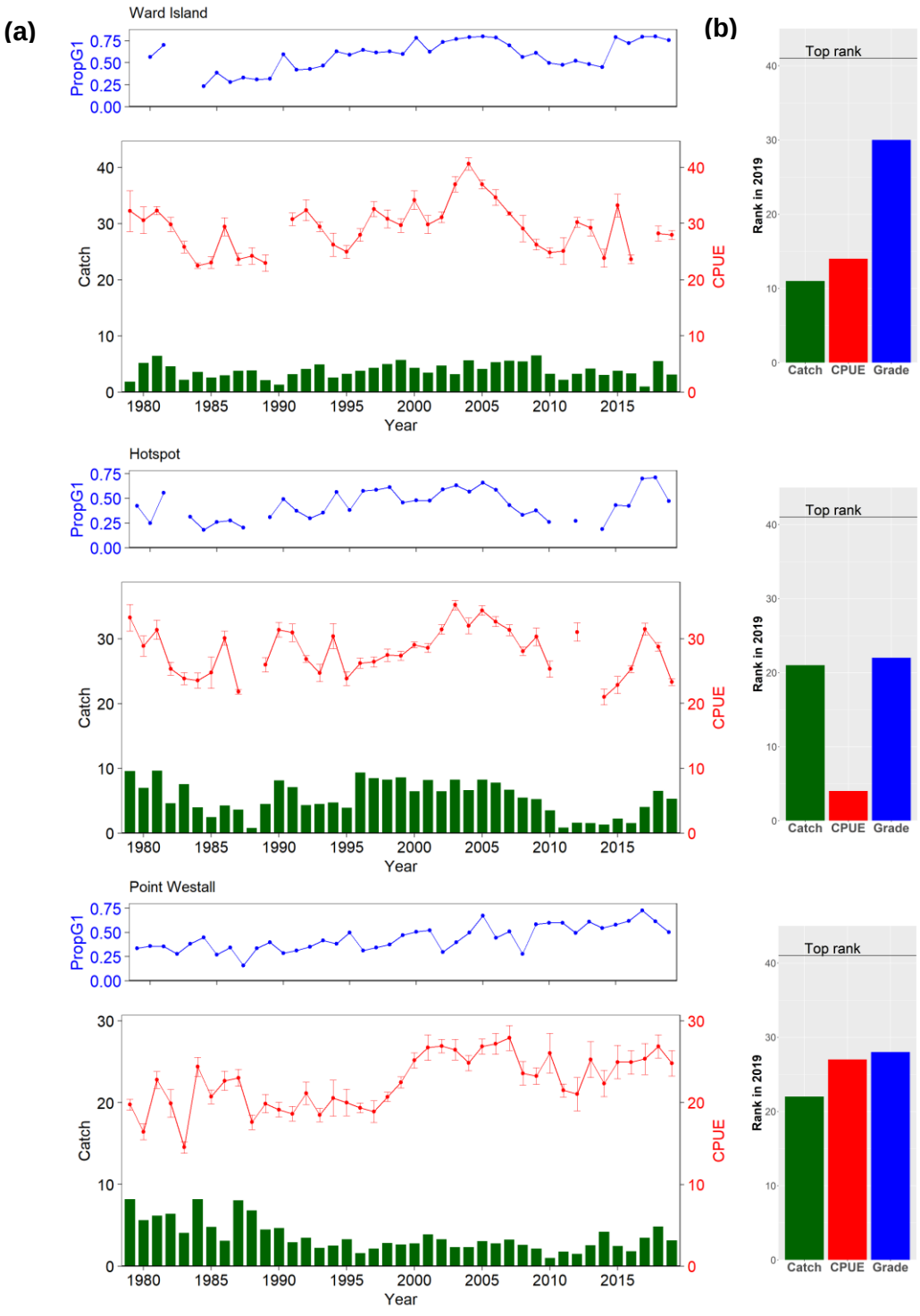

Figure 3.15. Calendar year Ward Island, Hotspopt and Point Westall greenlip **(a)** PropG1 (blue), Catch (t meat weight, green) and CPUE ± se (kg.hr^{-1}, red) from 1979 to 2019. **(b)** Rank of Catch, CPUE and PropG1 in 2019 relative to historic.

Fishery Bay (17; 1.8%)

Catch ranged between 0.8 t in 2005 and 3.1 t in 2014 with the exception of relatively high catches from Fishery Bay between 1981 to 1983, and low catches in 2001 and 2007(Figure 3.16 a). CPUE has varied among years with a low of 13.7 kg.hr^{-1} in 1987 and a high of 45 kg.hr^{-1} in 2004. In 2019, CPUE was relatively low (16.8 kg.hr^{-1}). PropG1 could not be estimated in 2018 and 2019 (Figure 3.16 a). Both catch and CPUE ranked low relative to historic values (Figure 3.16 b).

South Nuyts Archipelago (20; 1.2%)

Catch has been variable from the South Nuyts Archipelago and, with few exceptions, has been below 5 t.yr^{-1} (Figure 3.16 a). Catch decreased steadily from a high in 2010 to zero catch in 2015 subsequently increasing to 0.8 t in 2019. The low catches after 2014 reflect the implementation of a sanctuary zone that now prevents fishing in most of this SAU. CPUE has varied among years and, in 2019, was mid-range (17.0 kg.hr^{-1}). PropG1 was not estimable from 2015 to 2019. Both catch and CPUE ranked low relative to historic values (Figure 3.16 b).

Memory Cove (22; 1.1%)

With few exceptions, catch from Memory Cove has ranged between 1.5 and 2.5t (Figure 3.16 a), but has recently halved from 1.5 t in 2017 to 0.7 t in 2018 and 2018. CPUE was relatively stable between 1979 and 1996, whereafter it increased to a historic high in 2005 (30.2 kg.hr^{-1}) and remained relatively high until 2007. CPUE has subsequently decreased to 15.2 kg.hr^{-1} in 2019. PropG1 was not estimable from 2018 to 2019. Both catch and CPUE ranked low relative to historic values (Figure 3.16 b).

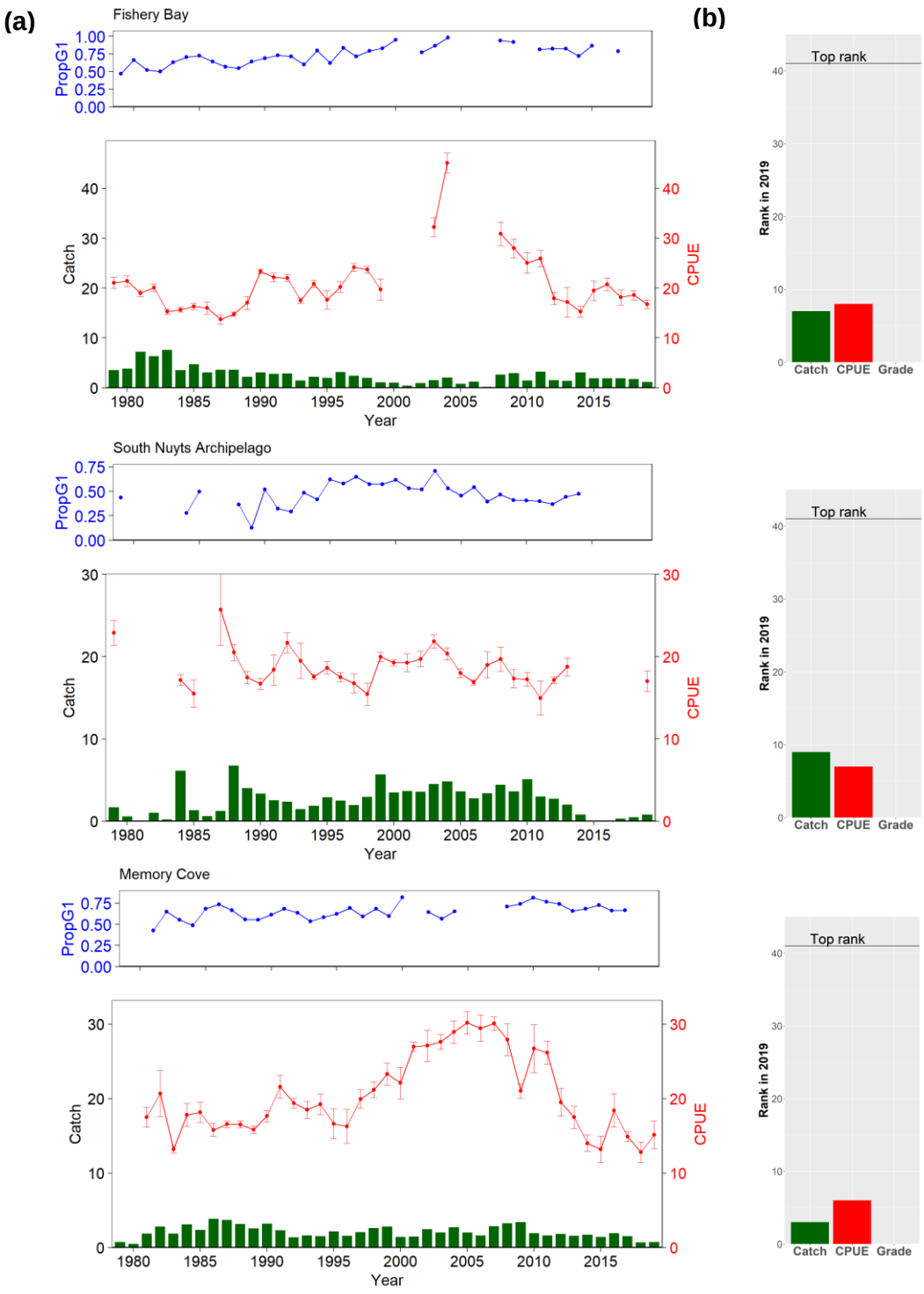

Figure 3.16. Calendar year Fishery Bay, South Nuyts Archipelago and Memory Cove greenlip **(a)** PropG1 (blue), Catch (t meat weight, green) and CPUE ± se (kg.hr^{-1}, red) from 1979 to 2019. **(b)** Rank of Catch, CPUE and PropG1 in 2019 relative to historic.

Temporal patterns in pooled low catch spatial assessment units

Annual catch, CPUE and PropG1 for the individual low-catch SAUs is provided in Appendix 5.4, while the data pooled by regions is summarised and provided below.

Lincoln low SAUs

Catch has varied among years, ranging from 13.4 t in 1982 to 2.9t in 2002 (Figure 3.17). In 2019 catch was relatively low (4.7 t). CPUE was relatively stable from 1979 to 2000 (~20 kg.hr^{-1}), then increased rapidly to a peak of 32 kg.hr^{-1} in 2003. Subsequently CPUE decreased to the lowest value on record in 2018 (16.1 kg.hr^{-1}), remaining at a similarly low value in 2019. PropG1 has been relatively stable from 1996 to 2017, whereafter it decreased and, in 2019, was the seventh lowest value on record.

Elliston low SAUs

From 1979 to 1986 catch was ~ 5t.yr^{-1}, whereafter it has varied among years at a low value (average 1.5t.yr^{-1}; Figure 3.17). CPUE was frequently unable to be estimated, including 2019. PropG1 was relatively high from 2000 to 2015, whereafter it decreased to a relatively low value in 2018 and 2019.

Streaky low SAUs

With the exception of high values from 1984 to 1988, average catch was 4.1 t (Figure 3.17). CPUE was relatively stable from 1979 to 2001, whereafter it increased to a peak in 2003 (31.3 kg.hr^{-1}). Subsequently, CPUE has generally decreased and in 2019 was 20.6 kg.hr^{-1} and among the lowest values on record. PropG1 was relatively high in 2019.

Far West low SAUs

Catch was high in 1984 (13.6 t) and 1988 to 1990 (range 8 t to 10.5 t; Figure 3.17). In recent years, coincident with the merging of regions A and B, catch dropped to less than 1 t from 2014 to 2016 but has since increased and, in 2019, was 2.8 t. CPUE varied among years but has generally declined from the highest value in 1982 (26.9 kg.hr-1) to 2019 (13.7 kg.hr-1), the lowest value on record. PropG1 was stable from 1992 to 2013, whereafter it increased and has remained relatively high.

Figure 3.17. Calendar year Lincoln, Elliston, Streaky and Far West Low SAUs PropG1 (blue), Catch (t meat weight, green) and CPUE ± se (kg.hr^{-1}, red) from 1979 to 2019.

3.1.6 **Proposed Harvest strategy – zone score and stock status (FY)**

The catch weighted zonal score for the 2019/20 FY was 3.3 (Table 3.1). In combination with the zone trend score of 3.83 (Appendix 5.7; reflecting a decreasing trend), these define the stock status for greenlip in the WZ in the 2019/20 FY as **'depleting'** (Figure 3.18).

Table 3.1. Outcome of application of the proposed harvest strategy described in the draft Management Plan for the South Australian Abalone Fishery to greenlip in the 2019/20 financial year. Combined score is half the sum of the CPUE and legal density scores. See Appendix 5.5. for FY CPUE.

SAU	CPUE	CPUE score	Legal Density	Legal density score	Combined score	Catch Proportion	Weighted SAU score
Anxious Bay	21.54	2.21	0.02	0.68	1.44	0.10	0.15
Lincoln low SAUs	20.16	4.19			4.19	0.10	0.41
The Gap	18.3	1.73	0.05	2.27	2.00	0.09	0.19
Avoid Bay	20.56	1.64	0.05	3.12	2.38	0.07	0.17
Point Avoid	18.29	3.79			3.79	0.07	0.28
Drummond	18.96	3.31			3.31	0.06	0.19
Baird Bay	27.37	5.98			5.98	0.05	0.28
Flinders Island	20.59	3.22			3.22	0.05	0.16
Reef Head	20.25	5.00			5.00	0.05	0.26
Streaky Low SAUs	22.38	5.00			5.00	0.05	0.25
Ward Island	24.91	2.75			2.75	0.05	0.14
Hotspot	23.33	2.56			2.56	0.04	0.11
Point Westall	24.07	5.92			5.92	0.04	0.23
Taylor Island	18.61	5.00			5.00	0.04	0.22
Far West low SAUs	13.79	0.21			0.21	0.03	0.01
Fishery Bay	18.1	3.25			3.25	0.03	0.09
Memory Cove	16.3	2.24			2.24	0.03	0.06
Elliston low SAUs	15.81	1.72			1.72	0.02	0.04
South Nuyts	16.83	4.46			4.46	0.02	0.10
					Total Zone Score		**3.34**

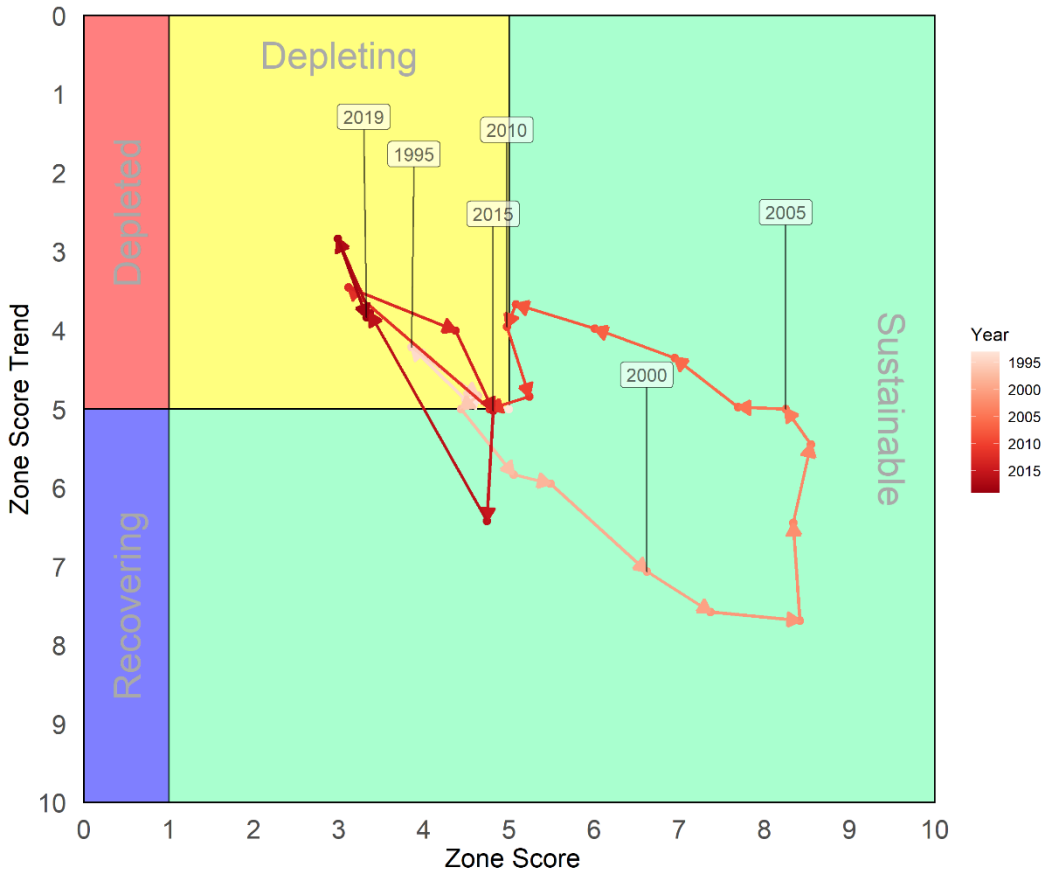

Figure 3.18. Phase plot showing the WZ changes in greenlip stock status from 1979 to 2019

3.2 **Blacklip**

3.2.1 **Western Zone (CY)**

Total catches were relatively high and mostly stable from the introduction of Region A quota in 1985 (98 t) to 2009 (Figure 3.19 a). From 2009 to 2019 there has been a 50 % reduction to the blacklip TACC. This was due to the reductions to the Region A TACC in 2010 (92 t) and 2013 (87.4 t), decreases in TACC for Region B in 2011 (9.2 t) and 2012 (6.9 t), the removal of one licence from the WZ in 2014 and reductions to the WZ TACC in 2016 (74.6 t), 2018 (66.6 t) and 2019 (58.6 t; see Table 1.2).

Catch per unit effort (CPUE) was generally stable from 1979 to 1988 (mean 24 $kg.hr^{-1}$) and 1990 to 2000 (mean 26 $kg.hr^{-1}$) and then increased to a historic high in 2006 (31.2 $kg.hr^{-1}$). CPUE has then decreased consistently and, from 2016 onwards, has been the lowest value on record each subsequent year reaching 20.6 $kg.hr^{-1}$ in 2019 (Figure 3.19 a, b). The 2019 value from the combined trend of relative catch and relative CPUE was the second lowest value on record and the lowest since 1979 (Figure 3.19 c). Fishing effort across depth ranges has remained relatively stable over the last ten years (Figure 3.19 d).

3.2.2 **Regions and spatial assessment units (CY)**

The 2019 CPUE estimates for Port Lincoln and Elliston were the second lowest on record, while those for Streaky Bay and Far West were both the 6th lowest on record (Figure 3.20).

There were small changes to the distribution of catch among SAUs between 2018 and 2019. These included increases in catch from Drummond North and South, Elliston Cliffs and Cape Bauer and a decreases at Sheringa and Venus Bay (Figure 3.21). Nine of the 13 SAUs scored for CPUE had values below 5, as did the four amalgamated low SAUs and one of the four SAUs scored for legal density (Figure 3.22). In contrast, three of the four SAUs scored for legal density had scores of 5 or higher, with Point Westall scoring 10.

There was no evidence that the increase in live catch from 2012 onwards influenced recent CPUE values (Appendix 5.8).

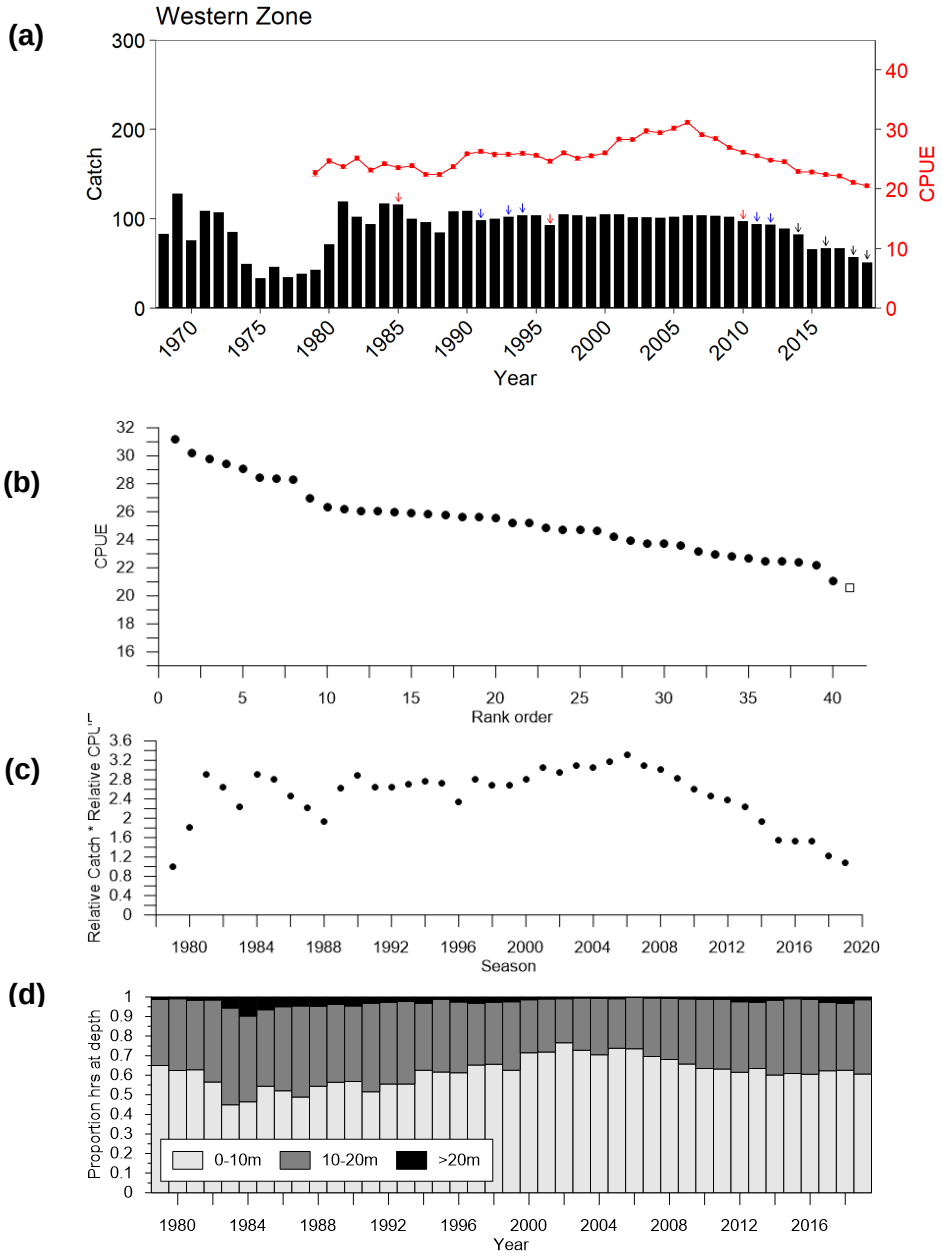

Figure 3.19. Calendar year blacklip - **(a)** Catch (t, meat weight; black bars) and CPUE ± se (kg.hr^{-1}; solid red line) of blacklip from the Western Zone from 1968 to 2019. Red arrows indicate implementation (1985) and amendment (1996, 2010 and 2013) of the blacklip TACC in Region A. Blue arrows indicate implementation (1991) and amendment (1993, 1994, 2011 and 2012) of the TACC in Region B. Black arrow indicates amendment to the WZ TACC (2014, 2016, 2018 and 2019). **(b)** Rank order of Western Zone CPUE (kg.hr^{-1}) from 1979 to 2019. Open square symbol is 2019 data point **(c)** Combined trend of relative catch and relative CPUE from the Western Zone from 1979 to 2019. **(d)** Proportion of hours fished in the Western Zone at three depth ranges (see legend) using fishing records where blacklip constituted 75% or more of the catch.

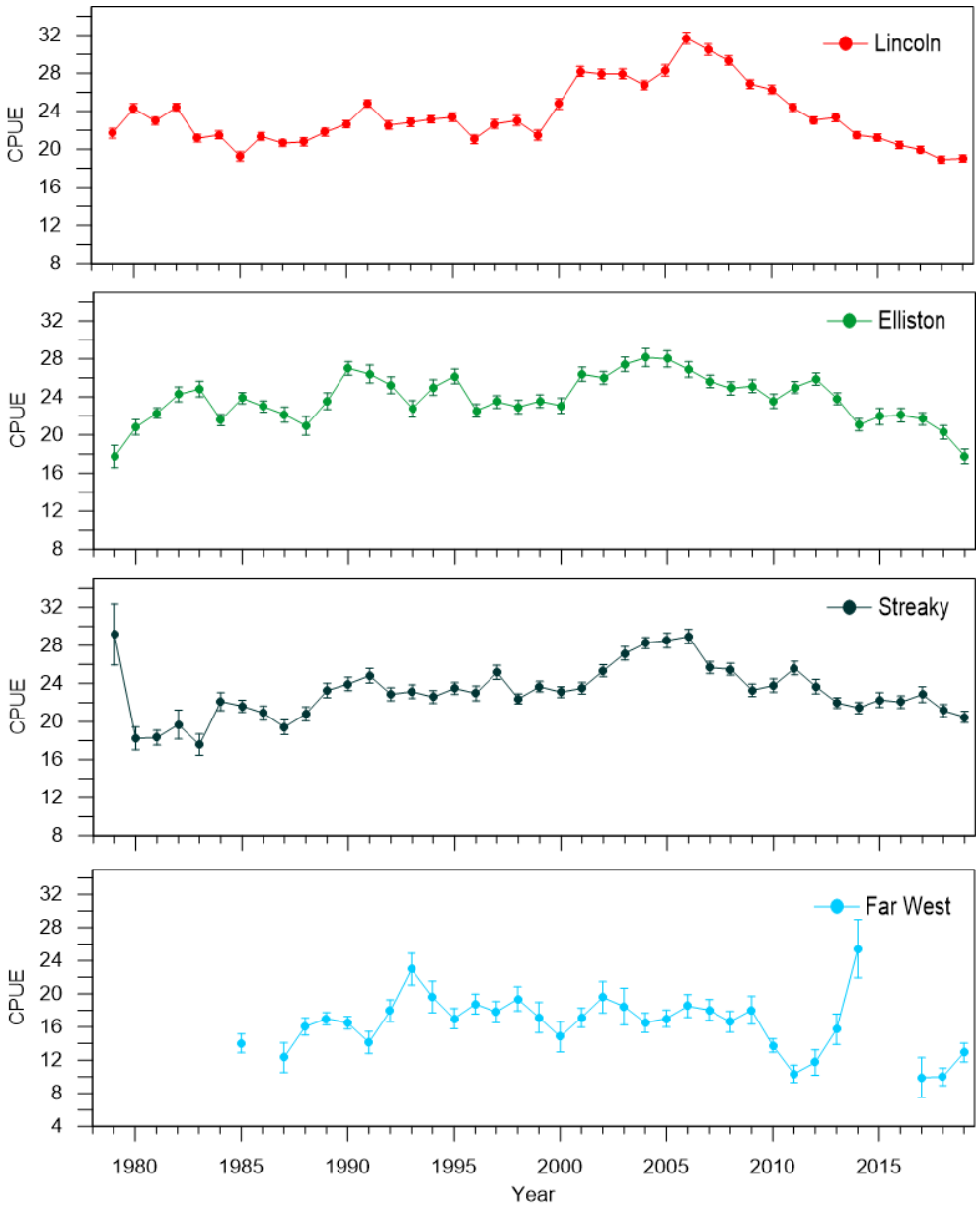

Figure 3.20. Comparison between CPUE ± se (kg.hr^{-1}) of blacklip by calendar year at SAUs located near Port Lincoln, Elliston, Streaky Bay and Far West (see legend) from the Western Zone from 1979 to 2019.

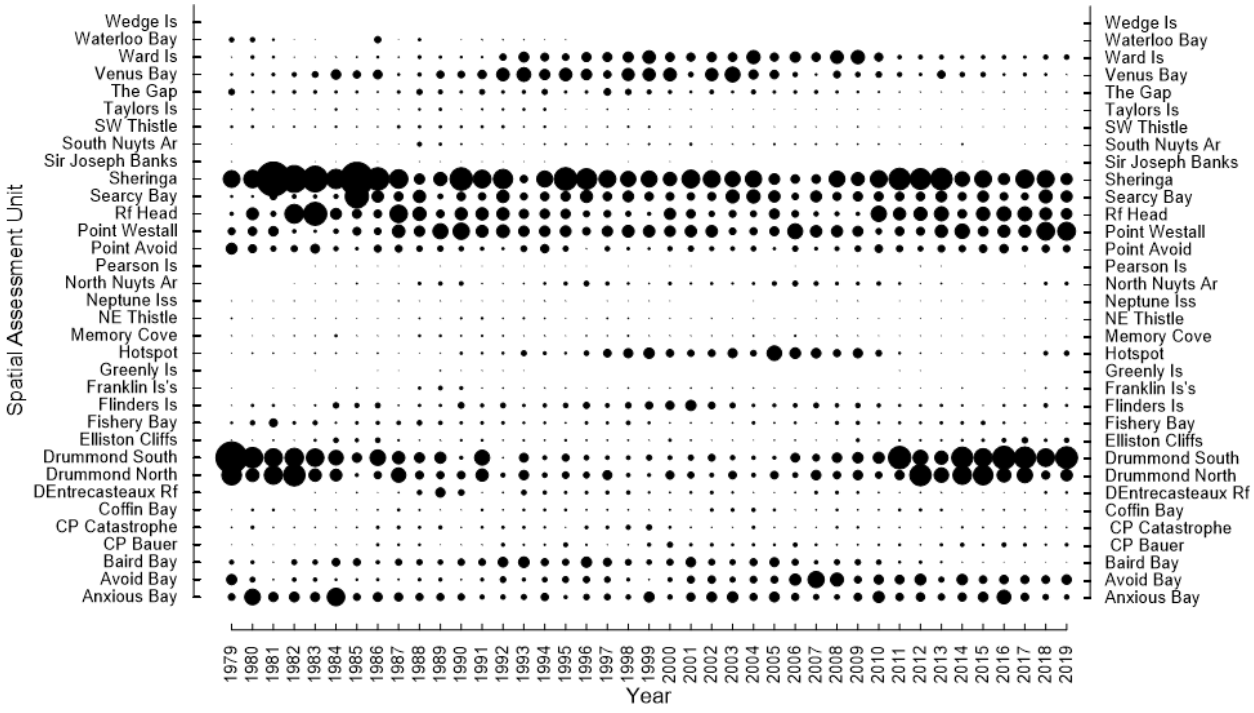

Figure 3.22. Bubble plot showing the spatial distribution of blacklip catch (% of total catch) among the SAUs in the WZ from 1979 to 2019 by calendar year. Note abbreviation for Cape (Cp), Island (Is), Reef (Rf), North East (NE), South West (SW) and Archipelago (Ar).

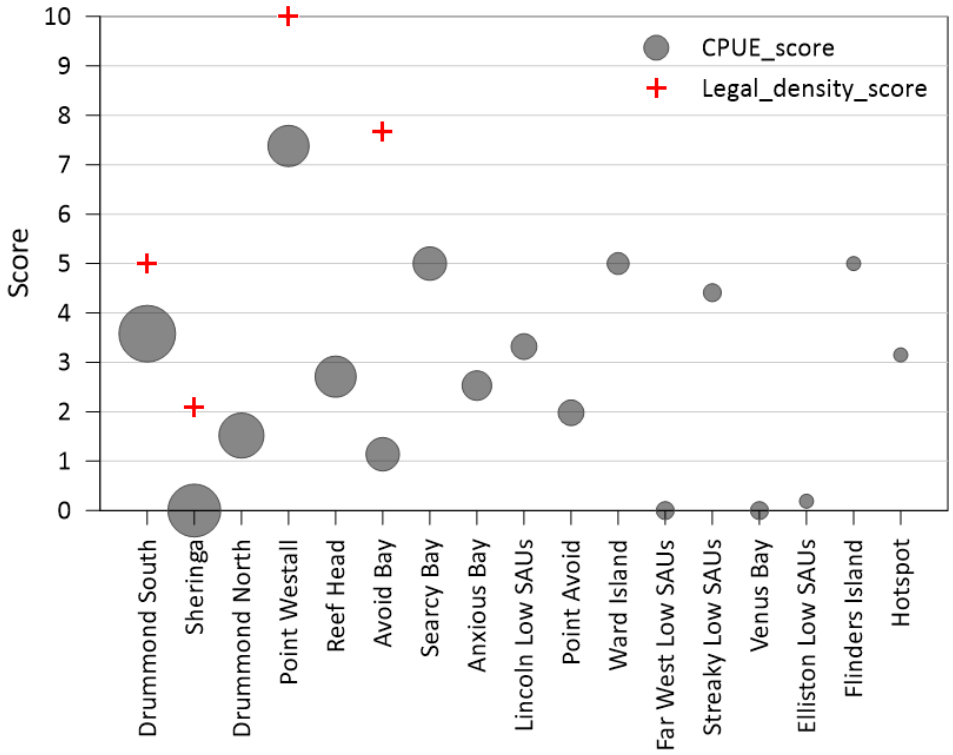

Figure 3.21.Blacklip SAU CPUE and legal density scores for the 2019/20 financial year (see legend). Bubble size for CPUE indicates % of WZ catch in 2019/20.

3.2.3 **Harvest strategy – zone score, trend in zone score and stock status (FY)**

The catch weighted zonal score for 2019/20 FY was 3.33 (Table 3.2). In combination with the zone trend score of 5.04 (Appendix 5.7; reflecting an increasing trend), these define the zonal stock status for blacklip in the WZ in the 2019/20 FY as **'sustainable' (**Figure 3.23**).**

Table 3.2. Outcome of application of the harvest strategy described in the Management Plan for the South Australian Abalone Fishery against the blacklip fishery in the 2019/20 FY. Combined score is half the sum of the CPUE and legal density scores. See Appendix 5.6 for FY CPUE.

SAU	CPUE	CPUE score	Legal Density	Legal density score	Combined score	Catch Proportion	Weighted SAU score
Drummond South	21.48	3.58	0.25	5.00	4.29	0.13	0.54
Sheringa	21.73	0.00	0.12	2.09	1.05	0.12	0.13
Drummond North	20.88	1.52			1.52	0.10	0.15
Point Westall	27.75	7.38	0.52	10.00	8.69	0.09	0.78
Reef Head	18.83	2.71			2.71	0.09	0.23
Avoid Bay	18.92	1.14	0.21	7.67	4.40	0.07	0.29
Searcy Bay	25.95	5.00			5.00	0.07	0.34
Anxious Bay	20.29	2.53			2.53	0.06	0.15
Lincoln Low SAUs	18.73	3.32			3.32	0.05	0.15
Point Avoid	19.09	1.98			1.98	0.05	0.10
Ward Island	27.68	5.00			5.00	0.04	0.18
Far West Low SAUs	14.72	0.00			0.00	0.03	0.00
Streaky Low SAUs	24.71	4.41			4.41	0.03	0.14
Venus Bay	17.64	0.00			0.00	0.03	0.00
Elliston Low SAUs	19.68	0.19			0.19	0.02	0.00
Flinders Island	23.96	5.00			5.00	0.02	0.09
Hotspot	25.5	3.15			3.15	0.02	0.06
					Total Zone Score		**3.33**

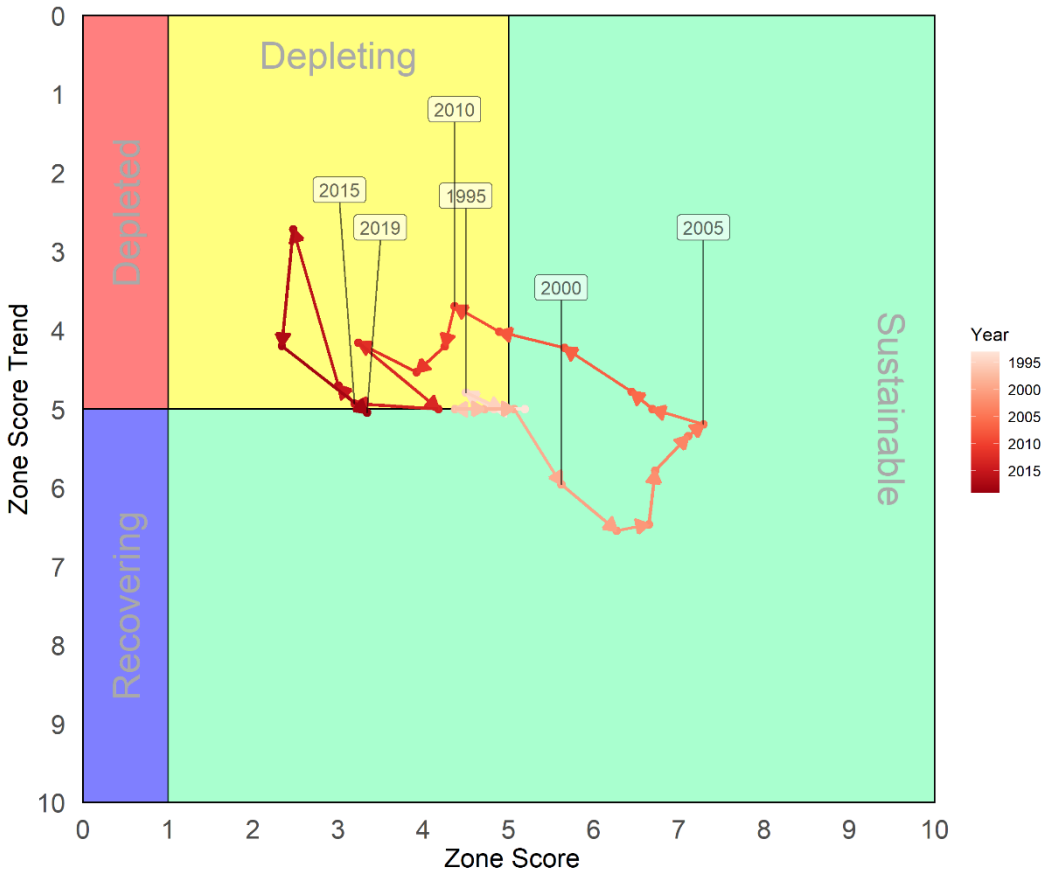

Figure 3.23. Phase plot showing the WZ blacklip stock status from 1979 to 2019

4 DISCUSSION

4.1 Current status of greenlip and blacklip in the WZ

The proposed HS for the South Australian Abalone Fishery (PIRSA 2020 in prep) followed an extensive review process. Stock status from the proposed HS uses the same terminology and approach to stock status under the NFSRF. As this report is the first application of the proposed HS to the WZAF, the validity of stock status outcome from the proposed HS is evaluated using the traditional 'weight-of-evidence' approach (Stobart et al. 2019). Notably, the proposed HS uses FY, which is different to the quota year (CY) for the fishery

There were three key limitations to this assessment. First, CPUE is used as a key index of legal-sized abalone abundance, based on the assumption that it relates to changes in the relative abundance of the fishable stock (Tarbath et al. 2005). Yet, CPUE can be influenced by numerous factors unrelated to abalone abundance (Stobart et al. 2017), and this measure is often viewed as a biased index of relative abundance (Harrison 1983, Breen 1992, Prince and Shepherd 1992, Gorfine et al. 2002, Stobart et al. 2017). For example, the continued focus on harvesting large greenlip because of their premium beach price may be depressing the CPUE on greenlip in recent years. Second, there have been substantial changes in the distribution of catch among SAUs since 2011 that are difficult to interpret (Stobart et al. 2017). Third, the FIS are (1) except for greenlip at The Gap, available for a relatively short time period and cover spatially discreet areas (Stobart et al. 2017).

4.1.1 Greenlip

For the CY ending 31 December 2019, greenlip comprised 56% (66 t) of the combined abalone catch in the WZ, having decreased 21% from 2008 (83 t). This 17 t reduction reflects lower TACCs, the removal of one licence during the implementation of marine park sanctuary zones and a voluntary under-catch of 9% in 2019.

Greenlip was classified as 'depleting' in 2017 and 2018. The change in the classification of this stock from 'sustainable' in 2016 reflected rapid and widespread deterioration in stock abundance and harvestable biomass observed since 2015. Evidence of the deterioration included CPUE in the WZ and most SAUs being relatively low and declining, CPUE values in the three high-importance SAUs (as defined in the current HS, PIRSA 2012) amongst the lowest on record and low fishery-independent survey densities in two of the three high-importance SAUs (The Gap and Anxious Bay). These patterns demonstrated that fishing mortality is too high and moving the stock in the direction of becoming recruitment impaired (Stobart et al. 2018, Stobart et al. 2019).

Application of the proposed HS resulted in a zone score of 3.34 that, in combination with the zone trend score of 3.83 (reflecting a decreasing trend), define the stock status for greenlip in the WZ in the 2019/20 FY as **'depleting'**. This means that biomass is declining and that the current level of fishing mortality (i.e. catch) is likely to cause the stocks to become recruitment impaired (see table 1.1). The zone score of 3.34 in the proposed HS translates to a recommended zonal catch of 49 t for 2021, which is 4% below the TACC of 51 t in 2020.

Most of the CY available evidence –CPUE, PropG1 and density estimates from FIS – demonstrates that the decline in harvestable biomass continued between 2018 and 2019, which is consistent with the stock status outcome from the proposed HS, and shows that catches have not been adequately reduced to match the current productivity of the stock.

There was a further decrease in zonal CPUE in 2019 to the fourth lowest value on record, that is the cumulative result of CPUE continuing to decline and/or remaining relatively low in most fishing grounds. The declines in CPUE from most SAUs from 2015 to 2019 occurred despite the recent change from fishing primarily in summer, when abalone of a given shell length weigh less, to autumn when abalone of equivalent shell length weigh more (Stobart et al. 2013). The observed CPUE reductions have occurred despite CPUE being prone to hyperstability (Shepherd et al. 2001, Dowling et al. 2004, Stobart et al. 2012). In addition, reductions in CPUE have also likely been moderated by changes in effective fishing effort (e.g. differences in skipper skill or technological differences; McClouskey and Lewison 2008). Neither hyperstablity, nor changes in effective fishing effort, have been quantified or accounted for in this assessment. Consequently, the harvestable biomass in 2019 may be lower than indicated by the commercial CPUE data. There is also no evidence that the continued decrease in CPUE is being driven by the recent increase in live fishing from zero to about 12% of the catch, because the decrease remains similar when live fishing is removed from the estimates, indicating that the putative additional diving time needed to effectively harvest live animals has not resulted in CPUE declining faster than abundance (Appendix 5.5). The single piece of contradictory data are the small, but widespread, increases in SAU CPUE evident for the 2019/20 FY (Appendix 5.5), primarily driven by slightly higher catch rates between January and June 2020, when compared with the same time period in 2019. Despite these increases evident for the 2019/20 FY being accounted for in the HS, the SAU scores remain low.

The proportion of Grade 1 greenlip remained relatively high in most SAUs. However, there is also evidence that PropG1 has decreased recently in in the WZ, in particular at The Gap, Drummond, Taylor Island, Hotspot, Point Westall, Cape Catastrophe and Venus Bay. These decreases have

occurred even though there is a preference for the targeting of large greenlip due to their considerably higher value.

Fishery-independent surveys at Anxious Bay, The Gap and Avoid Bay indicate a low density of legal-sized greenlip at these locations in 2020, with Anxious Bay having the lowest density recorded. Similarly, sub-legal-sized greenlip density was the lowest on record at The Gap and relatively low at Anxious Bay. Collectively, 23% of the greenlip catch was obtained from these three SAUs in 2019.

Overall, the 2019 management arrangements, catch reductions and the shift in timing of harvest from summer to autumn neither arrested the deterioration in stock abundance in this fishery nor prevented continued overfishing. The greenlip stocks will require careful monitoring to determine whether the CPUE trend reversals observed in some SAUs continue and the decreasing CPUE trend in the remaining SAUs is reversed, indicative of increasing harvestable biomass.

4.1.2 **Blacklip**

During the 2019 calendar year, blacklip comprised 44% (51 t) of the combined abalone catch in the WZ, having decreased 50% from 2009 (102 t). This 51 t reduction reflects numerous changes including lower TACCs and voluntary under-catch of 9.6% in 2019. Blacklip has been classified as ‘depleting’ since 2013.

The outcome of the proposed HS for the 2018/19 financial year, was ‘depleting’. For 2019/20, the outcome was ‘**sustainable**’. This means that fishing mortality is likely to be adequately controlled to avoid the stock becoming recruitment impaired.

The change in classification between 2018/19 and 2019/20 is the result of the zone score increasing from 2.3 to 3.33, and the consequent increase in the zone score trend from 4.2 to 5.04. The value of the trend in zone score in 2019/20, 5.04, is just above the threshold that would have maintained the classification of ‘depleting’. The zone score of 3.33 translates to a recommended zonal catch of 48 for 2021, which is 12 % above the TACC of 43 t in 2020.

Evidence available from CPUE and FIS density estimates suggest that the decline in harvestable biomass, evident since 2009, has abated. Notably, (1) there were clear increases in CPUE for a high proportion (79%) of SAUs between 2018/19 and 2019/20 (Appendix 5.6), reflecting higher catch rates between January and June 2020, when compared with the same time period in 2019; and (2) FIS estimates of legal density were high and/or increasing when surveys were last undertaken in 2019. These data support the change in stock status from the proposed HS and provide the first evidence that catches may have been adequately reduced to match the current

productivity of the stock. Nonetheless, the harvestable biomass remains low (zone score = 3.33), and additional years of CPUE and FIS data are required to confirm the apparent recent change in harvestable biomass trajectory. Thus, blacklip will require careful monitoring in coming years.

4.2 Future research needs

There are four high priority research needs for the WZ Abalone Fishery. The first high priority research need is to develop and validate a method for stock enhancement to aid the recovery and rebuilding of the high value greenlip fishery. This is a high research priority given wild catches of abalone have decreased 40% in South Australia over the past 40 years, and 50% nationally. Abalone is a high-value product so small increases in volume aimed at recovering depleted and depleting stocks can also translate to large increases in GVP. A project to support production and release of hatchery-reared abalone for enhancement/aquaculture is therefore a high priority for the WZ abalone fishery. The research should initially include: (1) undertaking an expert-based, risk-assessment workshop to address a key barrier already identified - genetic risks to wild stocks from hatchery produced and out planted abalone; (2) identification of linkages between environmental and genetic variation in SA to map the expected geographic distribution of regionally-adapted greenlip abalone clusters (after Miller et al. (2014) & Sandoval-Castillo et al. (2017)); and (3) if required/funded, collection of greenlip tissue samples from systematically-distributed locations between Streaky Bay and Edithburgh, to refine the cluster distribution map using SNPs, that would be expected to provide a higher level of genetic resolution than the existing microsatellite data.

The second research priority is to investigate the impact and factors leading to the proliferation and spread of *Perkinsus olensi*, a project for which a FRDC research proposal has been approved (Project No 2020-004). *Perkinsus* is a protozoan parasite that has negative effects on three commercially harvested abalone species in Australia (blacklip, greenlip and roei). This is a priority because disease manifestation ranges from high mortality (e.g. New South Wales; Liggins and Upston 2010) to chronic clinical infection. Chronically infected animals often exhibit extensive macroscopic lesions rendering the product unsaleable. Avoidance of fishing areas in the WZ abalone fishery with high prevalence of *Perkinsus*-related lesions is estimated to have displaced ~10% (11t.yr^{-1}) of blacklip catch to alternative fishing grounds (SARDI unpublished), exacerbated quota reductions and likely cost the fishery in excess of AUD $10 m over the past ten years. As the impact of *Perkinsus* on abalone fisheries has not been quantified, and the factors driving prevalence and disease expression are unknown, there is a need to obtain relevant information on this disease that is fundamental to its effective management.

The third high-priority research need is to identify and test a process to objectively obtain industry diver information that can be interpreted and used in the application of the proposed HS harvest decision rules for determining TACCs. This is required because: (1) changes in the value of PIs through time may not be directly related to stock status and their interpretation can be informed by credible, structured information (e.g. market demand, weather patterns, changing diver demography); and (2) abalone divers directly observe abalone stocks through their harvesting process. The latter is different to nearly all other fisheries where fishers typically use fishing methods (e.g. traps, nets, lines) that do not readily facilitate direct observations on the distribution, abundance and population structure of the target species.

The fourth high-priority research need is to collect data and then develop, validate and, if appropriate, integrate PIs from GPS and diver-based depth logger data – potentially including biomass – into the assessment program for the fishery. GPS and depth logger data have the potential to transform abalone stock assessments because the data are collected at finer spatial scales than the current FD catch and effort data (Mundy 2012; see FRDC project 2011/201) and the use of these data can ease the burden of heavy reliance on traditional FD data (principally catch and CPUE) for assessing these stocks. However, for these data to be used, their suitability will need to be validated following several years of data collection. This has occurred in the Central Zone, where these GPS and depth logger data are now a component of the assessment program (see Burnell et al. 2018).

The fifth high-priority research need is to establish and validate an index of recruitment for use as a leading indicator (e.g. FRDC project 2014/010). This is because the development of an index of recruitment for use as a leading indicator of harvestable biomass is essential to be able to predict suitability of future catch levels. A juvenile abalone monitoring method has recently been developed by the Institute of Marine and Antarctic Studies in Tasmania (FRDC project 2014/010) and its' efficacy for South Australia is currently being assessed by SARDI.

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6 APPENDIX

6.1 Blacklip and Greenlip biology

Table 6.1. Size at L_{50} (mm, shell length) for blacklip at different sites in the Western Zone. a is the maximum proportion of mature blacklip (the asymptote) and b is the slope of the logistic ogive. The equation is of the form (f(x) = a/(1+exp(-((x-L_{50})/b)). N = total number sampled, *n* = number of abalone sampled within length range of maturity transition.

Site	Year	Month	a	b	L_{50}	*N*	n	Reference
Anxious Bay	2013	5	0.9947	4.670	88.1	150	60	SARDI unpublished
Avoid Bay	2012	7	0.9867	0.892	92.0	108	16	SARDI unpublished
Hotspot	2004	5	1.0042	7.495	82.3	124	31	SARDI unpublished
Hotspot	2005	5	1.0094	5.359	94.3	192	32	SARDI unpublished
Reef Head	2001	5	0.9979	6.784	87.7	189	126	SARDI unpublished
Pt Drummond	2011	6	0.9923	6.253	99.3	222	102	SARDI unpublished
Searcy Bay	2014	5	0.9720	0.102	79.9	84	26	SARDI unpublished
Sheringa	2004	5	1.0022	5.369	97.3	130	46	SARDI unpublished
Tungketta	2004	5	0.9942	8.135	103.0	88	37	SARDI unpublished
Ward Island	2001	5	1.0353	10.72	92.0	65	36	SARDI unpublished
Ward Island	2005	5	1.0000	0.333	91.8	145	7	SARDI unpublished
West Bay	2001	6	0.9917	7.040	96.1	222	185	SARDI unpublished

Table 6.2. Relationships between shell length (SL, mm) and fecundity (F, millions of eggs) for legal sized (130 mm) blacklip at different sites in the Western Zone. The equation is of the form $F = aSL^b$. * indicates calculations based on anterior counts only.

Site	Year	a	b	r	n	SL	F	Reference
Avoid Bay	2010	1.01E+01	2.46	0.49	15	130	1.60E+06	SARDI unpublished
Hotspot*	2005	2.00E-04	4.58	0.83	22	130	9.47E+05	SARDI unpublished
Point Drummond	2011	2.07E-02	3.59	0.70	20	130	8.07E+05	SARDI unpublished
Ward Island*	2005	1.87E-01	3.29	0.70	27	130	1.68E+06	SARDI unpublished

Table 6.3. Relationships between shell length (SL, mm) and total weight (TW, g) blacklip abalone at various sites in the Western Zone. TW is calculated total weight for 130 mm legal-sized blacklip. The equation is of the form $TW = aSL^b$.

Site	Year	a	b	TW	r	n	Reference
Avoid Bay	2012	3.0E-04	2.90	405	0.95	204	SARDI unpublished
Flinders Island	1998	6.7E-05	3.16	321	0.95	85	SARDI unpublished
Hotspot	2004	7.1E-05	3.19	391	0.98	124	SARDI unpublished
Hotspot	2005	3.0E-04	2.90	399	0.98	192	SARDI unpublished
Kiana	1999	3.2E-02	1.93	378	0.73	46	SARDI unpublished
Drummond Point	1998	6.2E-05	3.21	370	0.94	54	SARDI unpublished
Drummond Point	2011	6.4E-05	3.20	377	0.98	222	SARDI unpublished
Point Labatt	1999	1.4E-03	2.58	396	0.85	102	SARDI unpublished
Point Whidbey	1998	4.9E-05	3.26	387	0.97	49	SARDI unpublished
Price Island	1999	5.3E-04	2.75	345	0.83	50	SARDI unpublished
Reef Head	1999	1.1E-02	2.16	411	0.79	44	SARDI unpublished
Reef Head	2004	6.0E-04	2.72	345	0.94	63	SARDI unpublished
Sheringa	2004	2.0E-05	3.44	379	0.98	130	SARDI unpublished
Smoothpool	1999	6.0E-04	2.72	340	0.92	127	SARDI unpublished
Tungketta	2004	9.8E-05	3.12	395	0.98	88	SARDI unpublished
Waldegrave Island	1998	1.0E-04	3.05	274	0.94	100	SARDI unpublished
Waldegrave Island	2005	1.0E-04	3.06	294	0.98	94	SARDI unpublished
Waterloo Bay	2005	5.0E-04	2.77	362	0.94	162	SARDI unpublished
Ward Island	1998	3.0E-04	2.90	399	0.92	100	SARDI unpublished
Ward Island	2005	3.0E-04	2.86	329	0.98	145	SARDI unpublished
West Bay	1998	2.0E-04	2.94	331	0.95	99	SARDI unpublished
West Bay	1999	7.0E-04	2.72	386	0.89	99	SARDI unpublished

Table 6.4. Growth rate, k ($yr.^{-1}$) and L_∞ (mm SL) for blacklip tagged and recaptured at different sites in the Western Zone. Size ranges are shell length at time of tagging for recaptured abalone (mm). n is the number of recaptures. For 'year tagged' * indicates uncertainty over aspects of the data including the year of tagging, time period at liberty may not adhere to criteria used for SARDI data (Geibel *et al.* 2010) while for 'size range'*indicates size ranges estimated from published graphs.

Site (Year recovered)	Year tagged	r^2	k	L_∞	Size range	n	Reference
Avoid Bay (2013)	2012	0.462	0.236	156.3	56-170	113	SARDI unpublished
Reef Head (2002)	2001	0.176	0.102	153.6	52-116	29	SARDI unpublished
Reef Head (2003)	2002	0.404	0.177	132.8	66-133	58	SARDI unpublished
Sheringa (2004)	2002	0.571	0.190	152.4	54-135	20	SARDI unpublished
Venus Bay (2002)	2001	0.448	0.295	152.7	66-124	54	SARDI unpublished
Venus Bay (2003)	2001	0.369	0.155	167.9	62-117	34	SARDI unpublished
Ward Is. (2001)	2000	0.053	0.086	217.4	57-135	27	SARDI unpublished
Ward Is. (2002)	2000	0.182	0.139	150.2	67-129	18	SARDI unpublished
Ward Is. (2002)	2001	0.244	0.180	152.5	58-117	24	SARDI unpublished
Ward Is. (2005)	2004	0.363	0.172	167.4	40-153	24	SARDI unpublished
Waterloo Bay*	1969	0.911	0.406	144.0	57-150	52	(Shepherd and Hearn 1983)
West Bay (2001)	2000	0.078	0.078	244.0	59-127	53	SARDI unpublished

Table 6.5. Size at L_{50} (mm, shell length) for greenlip at different sites in the Western Zone. a is the maximum proportion of mature greenlip (the asymptote) and b is the slope of the logistic ogive. The equation is of the form (f(x) = a/(1+exp(-((x-L50)/b)). N = total number sampled, *n* = number of abalone sampled within period of maturity transition.

Site	Year	Month	a	b	L_{50}	*N*	n	Reference
Anxious Bay	2005	11	0.983	7.312	76.6	119	32	SARDI unpublished
Hotspot	2006	11	1.005	3.637	111.6	109	36	SARDI unpublished
Hotspot	2010	8	1.011	6.812	120.8	144	52	SARDI unpublished
The Gap	2003	9	1.018	4.441	94.0	96	54	SARDI unpublished
The Gap	2004	9	0.984	1.952	93.8	124	62	SARDI unpublished
The Gap	2010	9	1.010	4.170	100.6	160	18	SARDI unpublished
Waterloo Bay	1974	-	-	-	102.0	-	34	(Shepherd & Laws 1974)
Ward Island	2006	11	1.033	11.548	127.7	90	62	SARDI unpublished

Table 6.6. Relationships between shell length (SL, mm) and fecundity (F, millions of eggs) for legal sized (145 mm) greenlip at different sites in the Western Zone. The equation is of the form $F = aSL^b$.

Site	Year	a	b	r	n	SL	F	Reference
Anxious Bay	1987	2.94E-02	3.70	0.74	15	145	2.9E+06	(Shepherd et al. 1992b)
Flinders Bay	2010	2.50E-03	4.07	0.46	10	145	1.6E+06	SARDI unpublished
Hotspot	2010	3.90E-08	6.33	0.85	17	145	1.9E+06	SARDI unpublished
Maclaren Point	1987	1.93E-06	5.61	0.97	14	145	2.6E+06	(Shepherd et al. 1992b)
Sceale Bay	1987	6.19E-10	7.24	0.90	17	145	2.8E+06	(Shepherd et al. 1992b)
Taylor Island	1987	7.55E-06	5.33	0.94	15	145	2.5E+06	(Shepherd et al. 1992b)
The Gap	2011	8.20E-03	4.18	0.75	26	145	8.9E+06	SARDI unpublished
Waterloo Bay	1987	6.40E-03	3.85	0.76	15	145	1.3E+06	(Shepherd et al. 1992b)
Yanerbie	1987	1.11E-02	3.87	0.87	14	145	2.6E+06	(Shepherd et al. 1992b)

Table 6.7. Relationships between fecundity (F, millions of eggs) and whole weight (W, g) for greenlip at different sites in the Western Zone. The equation is of the form F = c + dW.

Site	c	d	Reference
Sceale Bay	-1.13	0.011	(Shepherd & Baker 1998)
Thorny Passage	-1.57	0.014	(Shepherd & Baker 1998)
Waterloo Bay	-0.36	0.004	(Shepherd & Baker 1998)
Ward Island	-1.87	0.008	(Shepherd & Baker 1998)

Table 6.8. Relationships between shell length (SL, mm) and total weight (TW, g) greenlip abalone at various sites in the Western Zone. TW is calculated total weight for 145 mm legal-sized greenlip. The equation is of the form $TW = aSL^b$.

Site	Year	a	b	TW	r	n	Reference
Anxious Bay	1987	1.0E-04	3.07	432	0.99	46	(Shepherd et al. 1992b)
Anxious Bay	2004	4.0E-04	2.79	422	0.97	52	SARDI unpublished
Anxious Bay	2005	2.9E-05	3.30	407	0.99	110	SARDI unpublished
Flinders Island	1998	3.0E-04	2.90	551	0.94	69	SARDI unpublished
Flinders Island	1999	7.2E-04	2.69	469	0.68	47	SARDI unpublished
Flinders Bay	2004	2.4E-05	3.34	404	0.98	53	SARDI unpublished
Hotspot	1998	2.8E-05	3.33	439	0.94	80	SARDI unpublished
Hotspot	1999	3.5E-05	3.29	441	0.90	35	SARDI unpublished
Hotspot	2004	4.0E-04	2.81	479	0.93	53	SARDI unpublished
Hotspot	2006	6.1E-05	3.18	453	0.98	109	SARDI unpublished
Hotspot	2010	1.8E-05	3.41	404	0.98	144	SARDI unpublished
Maclaren Point	1987	5.8E-05	3.12	321	0.99	47	(Shepherd et al. 1992b)
Price Island	1997	5.0E-05	3.20	417	0.97	47	SARDI unpublished
Price Island	1999	2.0E-04	2.89	361	0.90	43	SARDI unpublished
Rowly Bay	1991	1.0E-04	3.04	363	0.93	65	SARDI unpublished
Searcy Bay	1999	7.0E-04	2.68	437	0.94	127	SARDI unpublished
Taylor Island	1987	4.7E-05	3.16	318	0.99	45	(Shepherd et al. 1992b)
The Gap	1998	2.0E-04	2.99	578	0.96	88	SARDI unpublished
The Gap	2000	1.5E-03	2.51	390	0.77	43	SARDI unpublished
The Gap	2003	4.8E-05	3.22	442	0.98	27	SARDI unpublished
The Gap	2004	6.1E-05	3.15	392	0.95	87	SARDI unpublished
The Gap	2010	4.7E-05	3.20	394	0.98	160	SARDI unpublished
Ward Island	1998	6.7E-05	3.15	425	0.94	75	SARDI unpublished
Ward Island	2004	1.0E-04	3.05	396	0.97	72	SARDI unpublished
Waterloo Bay	1987	2.0E-04	2.92	409	0.99	57	(Shepherd et al. 1992b)
Waterloo Bay	1999	6.0E-04	2.72	445	0.74	152	SARDI unpublished
Waterloo Bay	2005	2.8E-05	3.33	428	0.97	150	SARDI unpublished
Yanerbie	1987	4.6E-05	3.20	379	0.98	53	(Shepherd et al. 1992b)

Table 6.9. Growth rate (mm yr^{-1}) (± se) of sublegal greenlip at different sites in the Western Zone.

Site	Size range (mm)	Growth rate ($mm.yr^{-1}$ ± S.E.)	Reference
Anxious Bay	25-95	20.4 ± 1.5	(Shepherd & Breen 1992)
Avoid Bay	45-115	19.7 ± 2.4	(Shepherd & Triantafillos 1997)
Maclaren Point	20-140	20.3 ± 0.4	(Shepherd et al. 1992a)
Sceale Bay	45-110	20.4 ± 1.8	(Shepherd et al. 1992a)
Taylor Island	15-145	39.6 ± 0.9	(Shepherd et al. 1992a)
Ward Island	60-125	25.7 ± 1.5	(Shepherd et al. 1992a)
Yanerbie	15-110	15.3 ± 0.9	(Shepherd et al. 1992a)

Table 6.10. Growth rate, k ($yr.^{-1}$) and L_∞ (mm SL) for greenlip tagged and recaptured at different sites in the Western Zone. Errors are standard errors. Size ranges are shell length at time of tagging for recaptured abalone (mm). n is the number of recaptures. For 'tag period' * indicates uncertainty over aspects of the data including the year of tagging, time period at liberty may not adhere to criteria used for SARDI data (Geibel *et al.* 2010) while for 'size range' * indicates size ranges were estimated from published graphs.

Site	Tag period	r^2	k (± se)	L_∞ (± se) (mm)	Size range	n	Reference
Anxious Bay	1988*	0.744	0.385(0.07)	119.5(5.3)	43-102*	26	(Shepherd et al. 1992a)
Anxious Bay	1999-2000	0.302	0.343	157.0	110-156	40	SARDI unpublished
Flinders Is	2004-2005	0.692	0.365	162.8	64-177	153	SARDI unpublished
Hotspot	2002-2003	0.477	0.256	213.5	63-158	120	SARDI unpublished
Hotspot	2002-2004	0.659	0.306	181.7	63-131	53	SARDI unpublished
Maclaren Pt.	1988*	0.534	0.368(0.10)	178.3(7.7)	31-163*	35	(Shepherd et al. 1992a)
Sceale Bay	1988*	0.856	0.186(0.04)	186.3(28.2)	79-148*	9	(Shepherd et al. 1992a)
Taylor Island	1988*	0.713	0.552(0.08)	180.4 (10.3)	32-158*	41	(Shepherd et al. 1992a)
Taylor Island	1996	0.658	0.271	195.0	68-115	23	SARDI unpublished
The Gap	2002-2003	0.658	0.278	152.8	45-159	77	SARDI unpublished
The Gap	2002-2004	0.731	0.263	155.0	44-165	108	SARDI unpublished
The Gap	2009-2010	0.686	0.344	139.3	42-167	82	SARDI unpublished
Ward Island	1988*	0.81	0.413(0.053)	167.2(5.2)	76-167*	36	(Shepherd et al. 1992a)
Waterloo Bay	1969*	0.921	0.595(0.036)	147.8(1.8)	52-169	126	(Shepherd & Hearn 1983)
Yanerbie	1988*	0.642	0.268(0.076)	140.4(8.6)	62-135*	19	(Shepherd et al. 1992a)

Table 6.11. Natural mortality rates (yr^{-1}) for adult (emergent) greenlip at different sites in the Western Zone.

Site	M (yr^{-1})	Reference
Sceale Bay	0.25	(Shepherd & Baker 1998)
Thorny Passage	0.25	(Shepherd & Baker 1998)
Waterloo Bay	0.40	(Shepherd & Baker 1998)
Ward Island	0.13	(Shepherd & Baker 1998)

6.2 **Performance indicators and other metrics**

Table 6.12. Summary of the PIs and other metrics and the formulae and data constraints underpinning their computation. In formula: *Cs* = species-specific catch; *E* = total daily effort; and *w* = catch weighting.

Metric use	Description	Formulae	Data constraints
Performance indicator			
CPUE	Commercial catch-per-unit effort (kg.hr^{-1})	$CPUE_{wp} = \frac{\Sigma_{i=1}^{n} wi(\frac{Csi}{Ei * wi})}{\Sigma_{i=1}^{n} wi}$	All records where: CPUE (total catch/total effort) was >66.66 kg.hr^{-1}; fishing effort was >8 hr.; fishing effort was <3 hr.; the reported catch of both species was zero; or the catch of the species for which CPUE was being estimated was <30% of the total catch were excluded. Minimum sample size: 10 records
Density$_{legal}$	Density of legal-sized abalone on surveys	$\text{Density}_{\text{Legal}} = \frac{\sum \text{Legal counted}}{\text{Total area surveyed}}$	>90% of survey completed Blacklip ≥130 mm SL defined as legal-sized Greenlip ≥145 mm SL defined as legal-sized
General assessment			
Proportion Grade 1 (greenlip)	Proportion Grade 1 greenlip abalone in commercial catch	$\text{PropG1} = \frac{\sum \text{Grade 1 Meats (kg)}}{\sum \text{Meats (kg)}}.$	All records where the total catch was >1% different from the sum of the three weight-grade categories were excluded; Records with zero catch were excluded. Minimum sample size: 10 records
Density$_{sublegal}$	Density of sublegal (i.e. those under the MLL) abalone on surveys	$\text{Density}_{\text{Pre-recruit}} = \frac{\sum \textit{Sublegal}}{\text{Total area surveyed}}$	>90% of survey completed Blacklip <130 mm SL defined as sublegal Greenlip <145 mm SL defined as sublegal

6.3 Quality Assurance

6.3.1 Research planning

The requirements of PIRSA Fisheries and Aquaculture were discussed in December 2012 and subsequently provided to representatives of the WZ abalone fishery to confirm their understanding of proposed deliverables. This ensures that the research undertaken and deliverables provided are consistent with the needs of PIRSA to meet their obligations under the *Fisheries Management Act 2007.*

6.3.2 Data collection

Commercial fishers are advised on the procedures and requirements for commercial catch sampling and completion of the required fishing logbook on a regular basis, usually at the commencement of each fishing season. The data provided by commercial fishers are checked by SARDI prior to acceptance and potential errors corrected through direct correspondence with individual commercial fishers. SARDI staff are trained to undertake FI data collection using the standardised method described in the SARDI Abalone Research Group Quality Assurance and Fishery-Independent Survey Manual.

6.3.3 Data entry, validation, storage and security

All logbook data are entered and validated according to the quality assurance protocols identified for the abalone fisheries in the SARDI Information Systems Quality Assurance and Data Integrity Report. The data are stored in an Oracle database, backed up daily, with access restricted to SARDI Information Systems staff. Copies of the database are provided to SARDI abalone researchers on request. All FI data are entered into Excel spreadsheets. A subset of the data (20%) is checked against the original data sheets in accordance with the Abalone Data Library Management Protocol. Once validated, data are uploaded to an Access database stored on the network drive in Port Lincoln. The database is regularly backed up to an external hard drive and to a web-based data storage system called Objective.

6.3.4 Data and statistical analyses

Data are extracted from the databases using established protocols. A subset (10%) of data extractions are checked to ensure extraction accuracy. This occurs in two ways. First, data are compared to those extracted previously. Second, the data extractions are undertaken by two SARDI researchers and subsequently compared. Most of the data are analysed using the open source software R. A subset (~10%) of the outputs from R are compared against estimates made in an alternative software package (e.g. Excel).

6.3.5 **Data interpretation and report writing**

The results, their interpretation and conclusions provided in the reports are discussed with peers, PIRSA and abalone licence holders. All co-authors review the report prior to the report being formally reviewed by two independent scientists at SARDI in accordance with the SARDI report review process. Following necessary revision, the report is reviewed by PIRSA to ensure it is consistent with their needs and objectives for the fishery.

6.4 Calendar year temporal patterns in low catch spatial assessment units – Greenlip and Blacklip

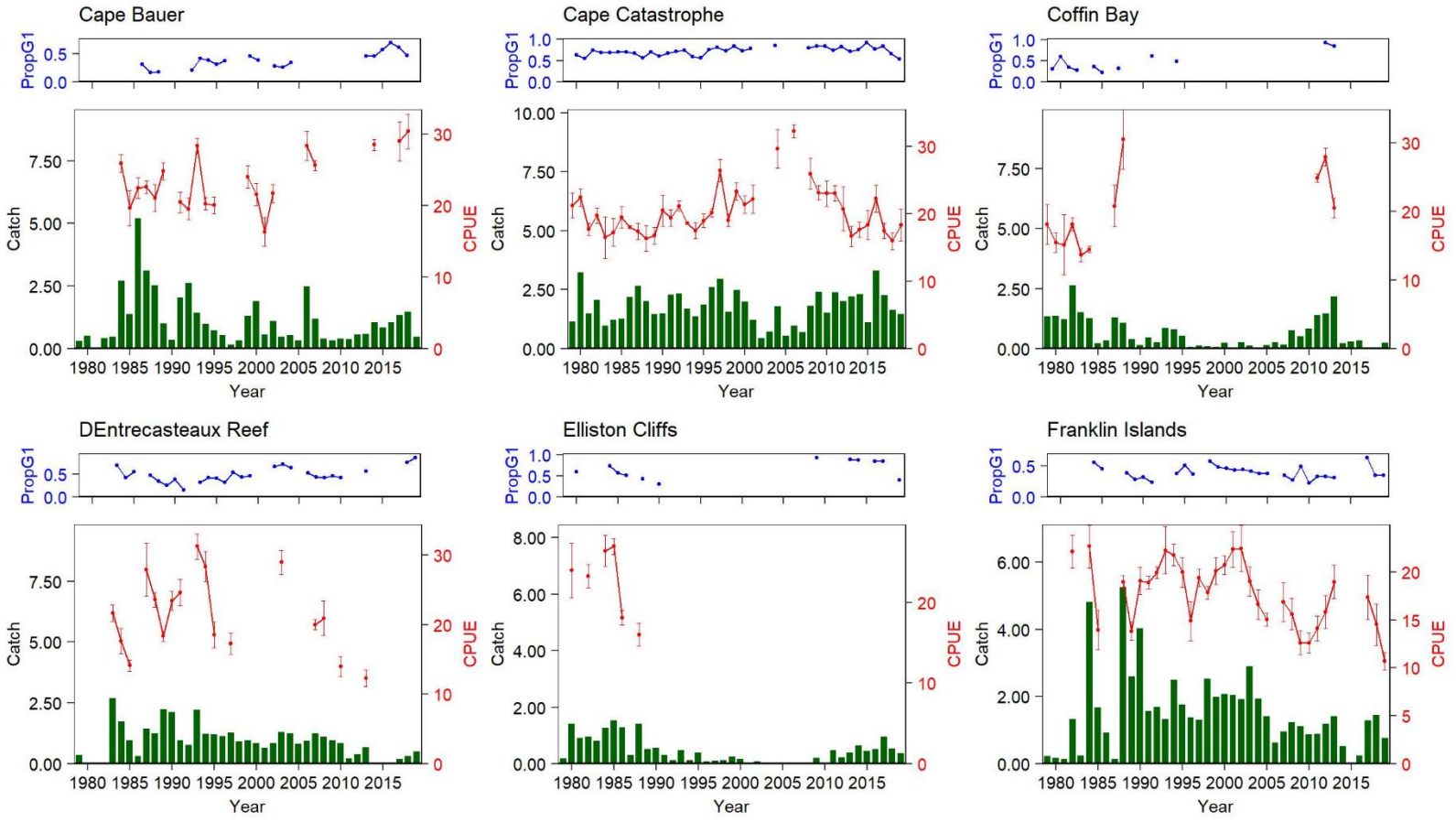

Figure 6.1. Catch (t, meat weight; green bars) of greenlip from low catch SAUs Cape Bauer, Cape Catastrophe, Coffin Bay, D'Entrecasteaux Reef, Elliston Cliffs and Frainklin Islands from 1979 to 2019. CPUE ± se (kg.hr^{-1}; solid red line) and PropG1 are shown in red and blue, respectively.

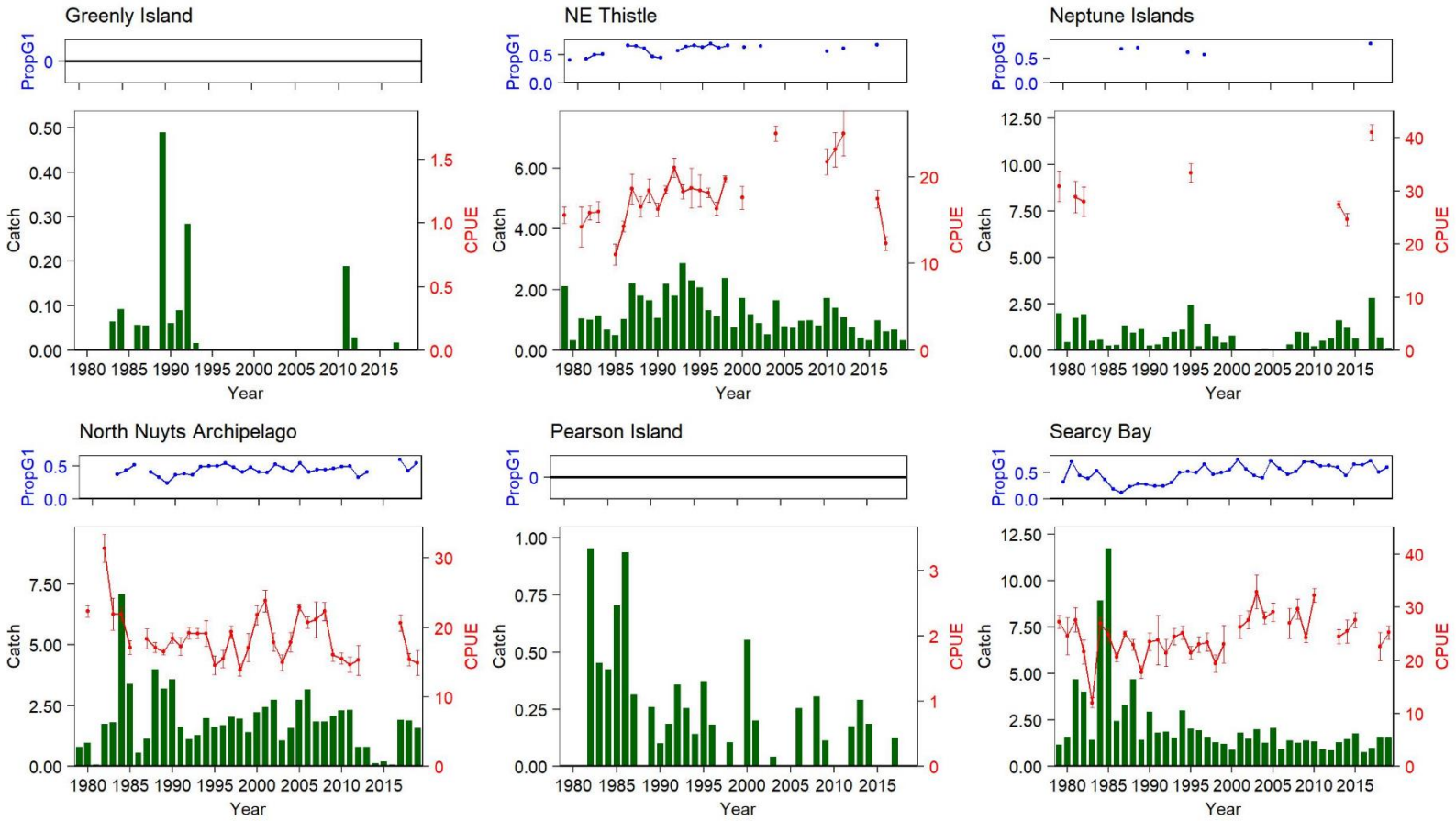

Figure 6.2. Catch (t, meat weight; green bars) of greenlip from low catch SAUs Greenly Island, NE Thistle, Neptune Islands, North Nuyts Archipelago, Pearson Island and Searcy Bay from 1979 to 2019. CPUE ± se (kg.hr^{-1}; solid red line) and PropG1 are shown in red and blue, respectively.

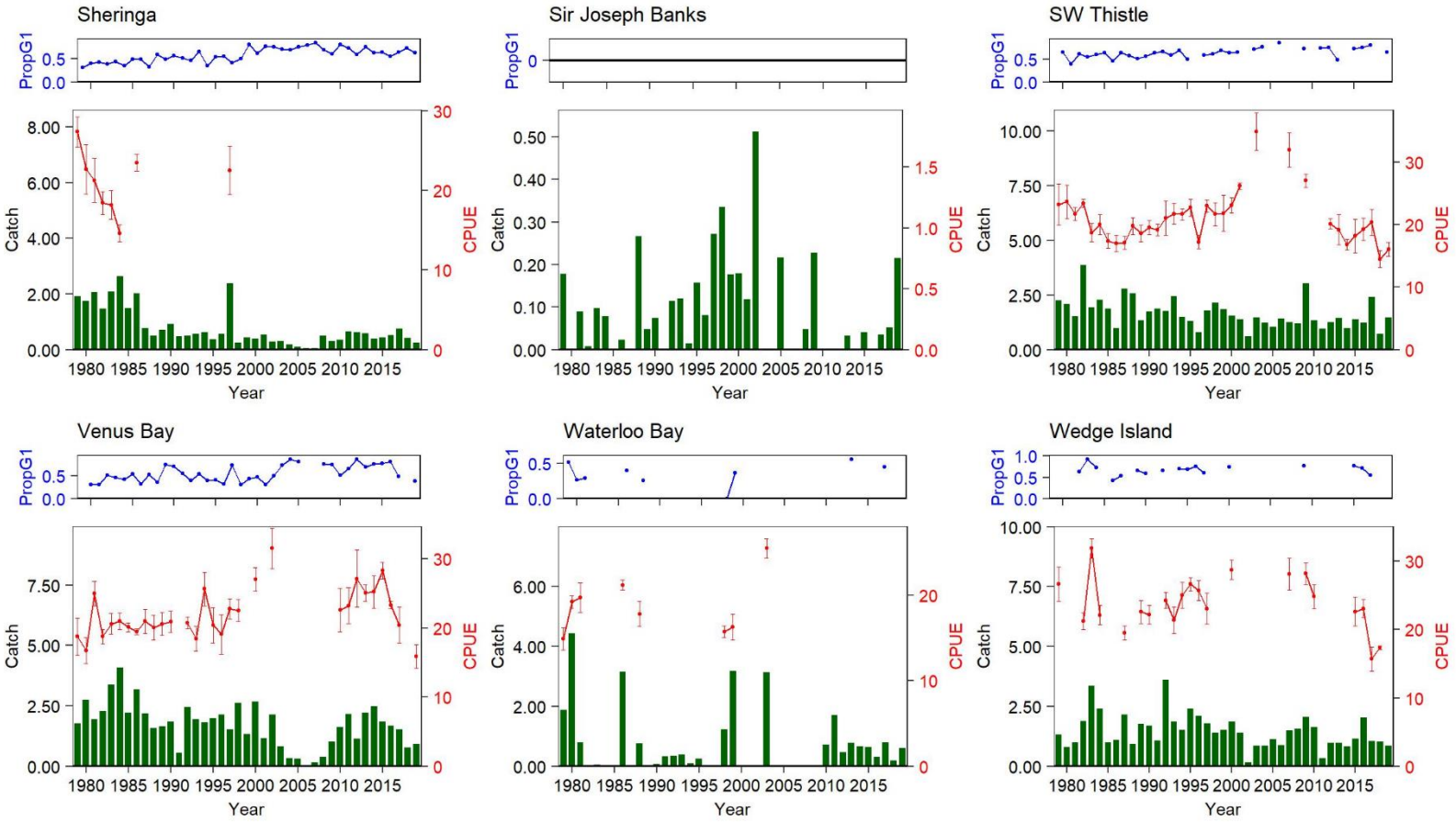

Figure 6.3. Catch (t, meat weight; green bars) of greenlip from low catch SAUs Sheringa, Sir Joseph Banks, SW Thistle, Venus Bay, Waterloo Bay and Wedge Island from 1979 to 2019. CPUE ± se (kg.hr^{-1}; solid red line) and PropG1 are shown in red and blue, respectively.

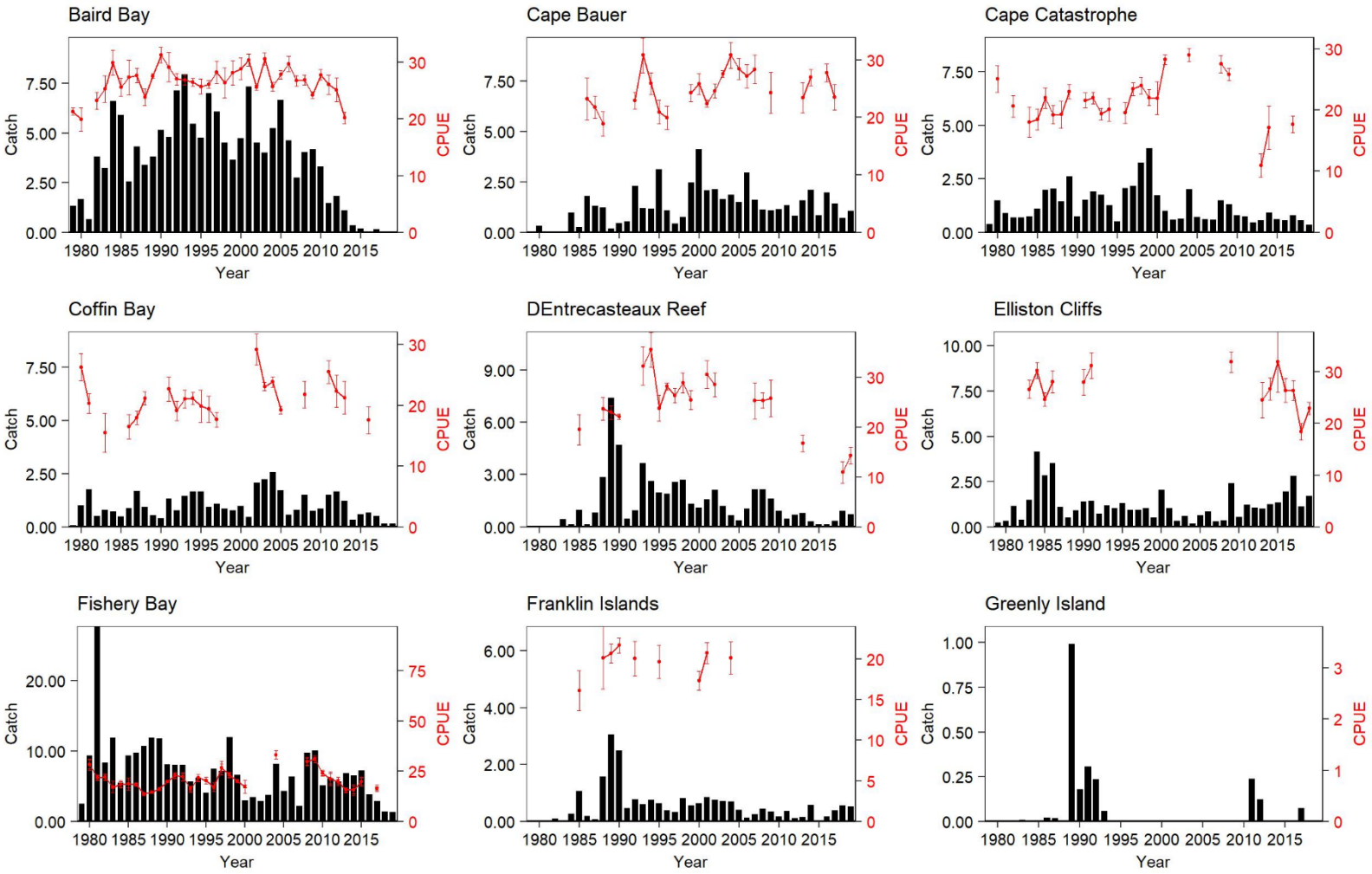

Figure 6.4. Catch (t, meat weight; green bars) and CPUE ± se (kg.hr^{-1}; solid red line) of blacklip from low catch SAUs Baird Bay, Cape Bauer, Cape Catastrophe, Coffin Bay, D'Entrcasteaux Reef, Elliston Cliffs, Fishery Bay, Franklin Islands and Greenly Island from 1979 to 2019.

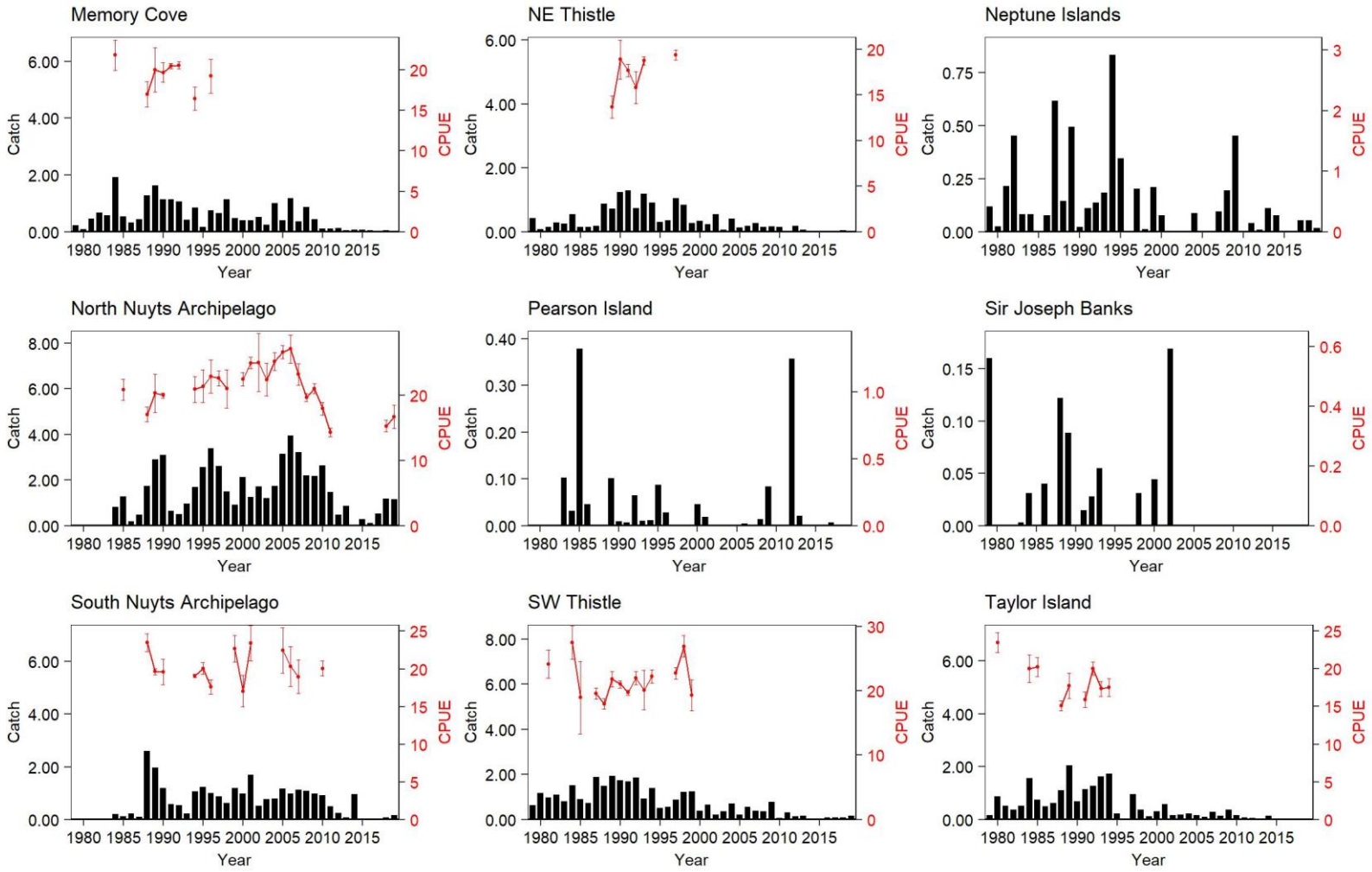

Figure 6.5. Catch (t, meat weight; green bars) and CPUE ± se (kg.hr^{-1}; solid red line) of blacklip from low catch SAUs Memory Cove, NE Thistle, Neptune Islands, North Nuyts Archipelago, Pearson Island, Sir Joseph Banks, South Nuyts Archipelago, SW Thistle and Taylor Island from 1979 to 2019.

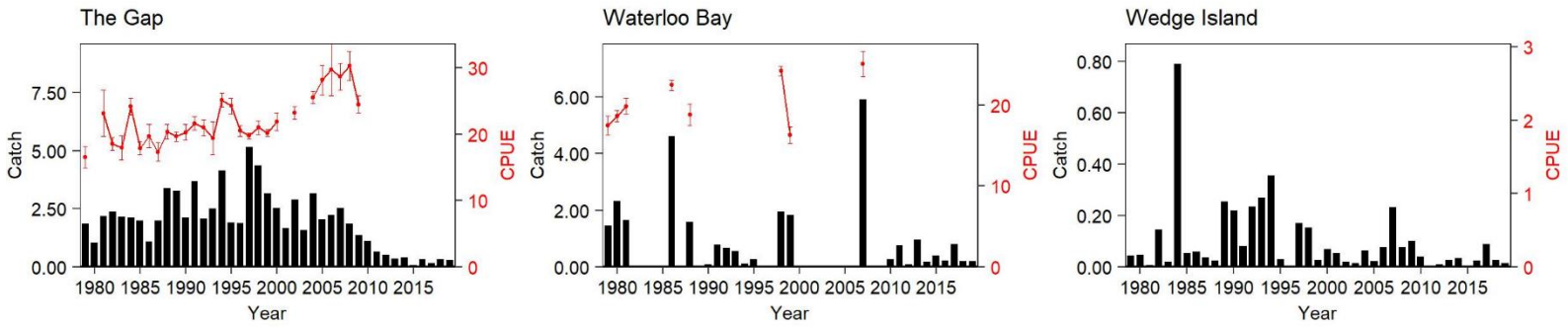

Figure 6.6. Catch (t, meat weight; green bars) and CPUE ± se (kg.hr^{-1}; solid red line) of blacklip from low catch SAUs The Gap, Waterloo Bay and Wedge Island from 1979 to 2019.

6.5 **Harvest strategy scoring – Greenlip**

Figure 6.7. Greenlip SAUs (indicated by plot names) showing performance indicators CPUE ± se (kg.hr^{-1}, red) and legal-sized mean density ± se (abalone.m^{-2}; olive green bars) from 1979 to 2019. Catch (t. meat weight; green bars) is also included for reference. Densities are from fishery-independent surveys from surveyed years. On relevant plots the green and red dashed lines and pale blue bands are the upper and lower limit reference points and target reference band from the harvest strategy performance indicators CPUE and legal density, respectively.

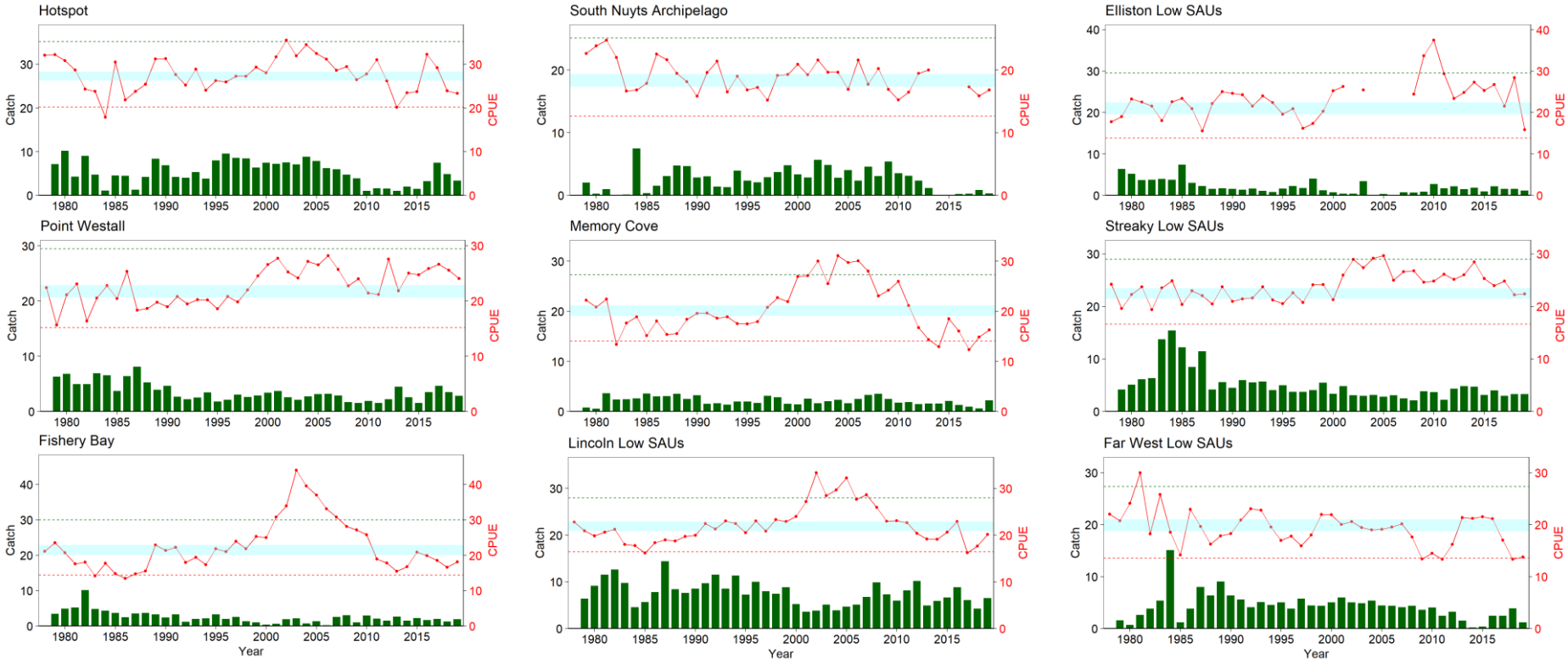

Figure 6.8. Greenlip SAUs (indicated by plot names) showing performance indicator CPUE ± se (kg.hr^{-1}, red) from 1979 to 2019. Catch (t. meat weight; green bars) is also included for reference. Densities are from fishery-independent surveys from surveyed years. On relevant plots the green and red dashed lines and pale blue bands are the upper and lower limit reference points and target reference band from the harvest strategy performance indicators CPUE and legal density, respectively.

6.6 **Harvest strategy scoring – Blacklip**

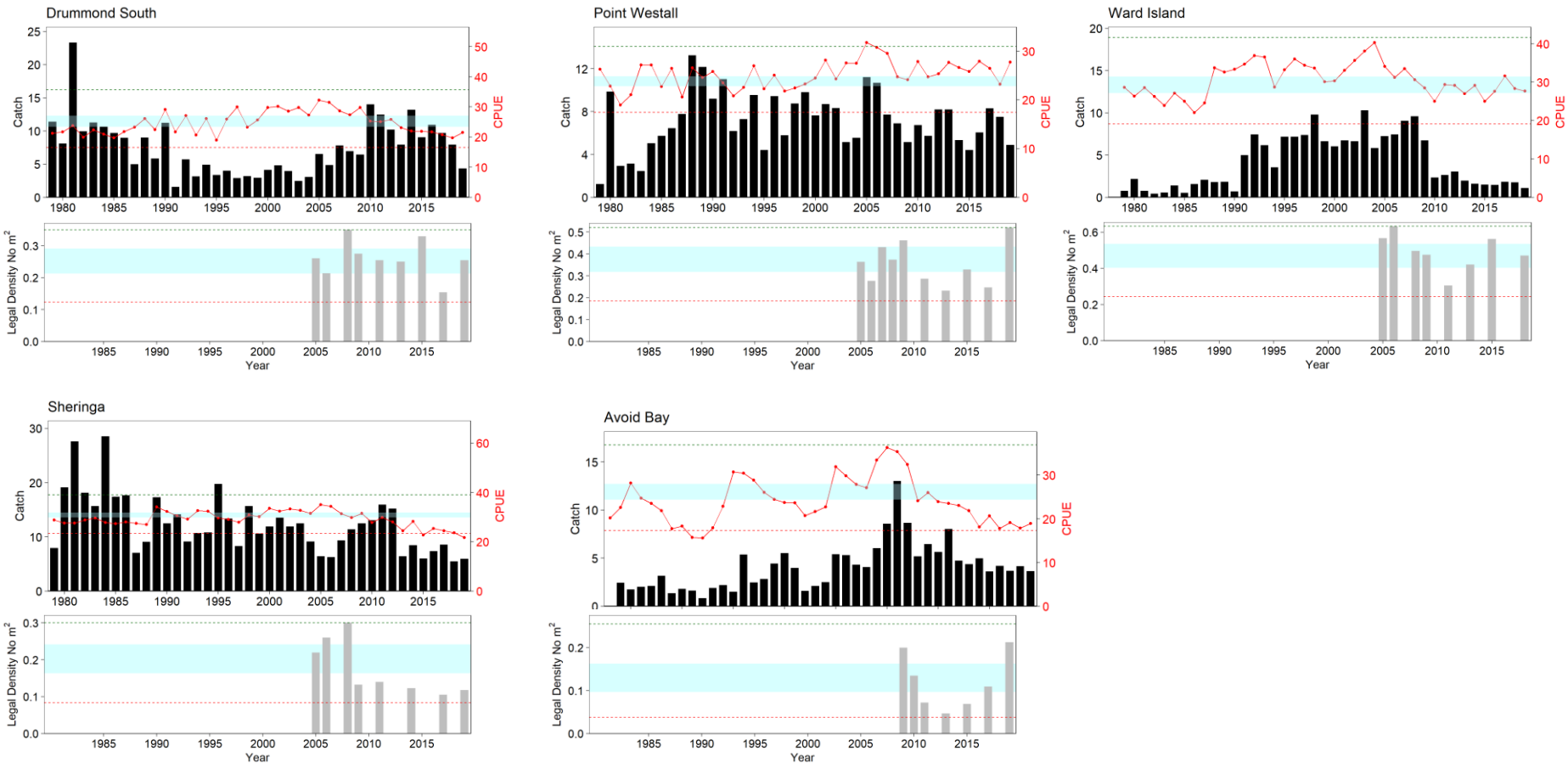

Figure 6.9. Blacklip SAUs (indicated by plot names) showing performance indicators CPUE ± se (kg.hr^{-1}, red) and legal-sized mean density ± se (abalone.m^{-2}; grey bars) from 1979 to 2019. Catch (t. meat weight; black bars) is also included for reference. Densities are from fishery-independent surveys from surveyed years. On relevant plots the green and red dashed lines and pale blue bands are the upper and lower limit reference points and target reference band from the harvest strategy performance indicators CPUE and legal density, respectively.

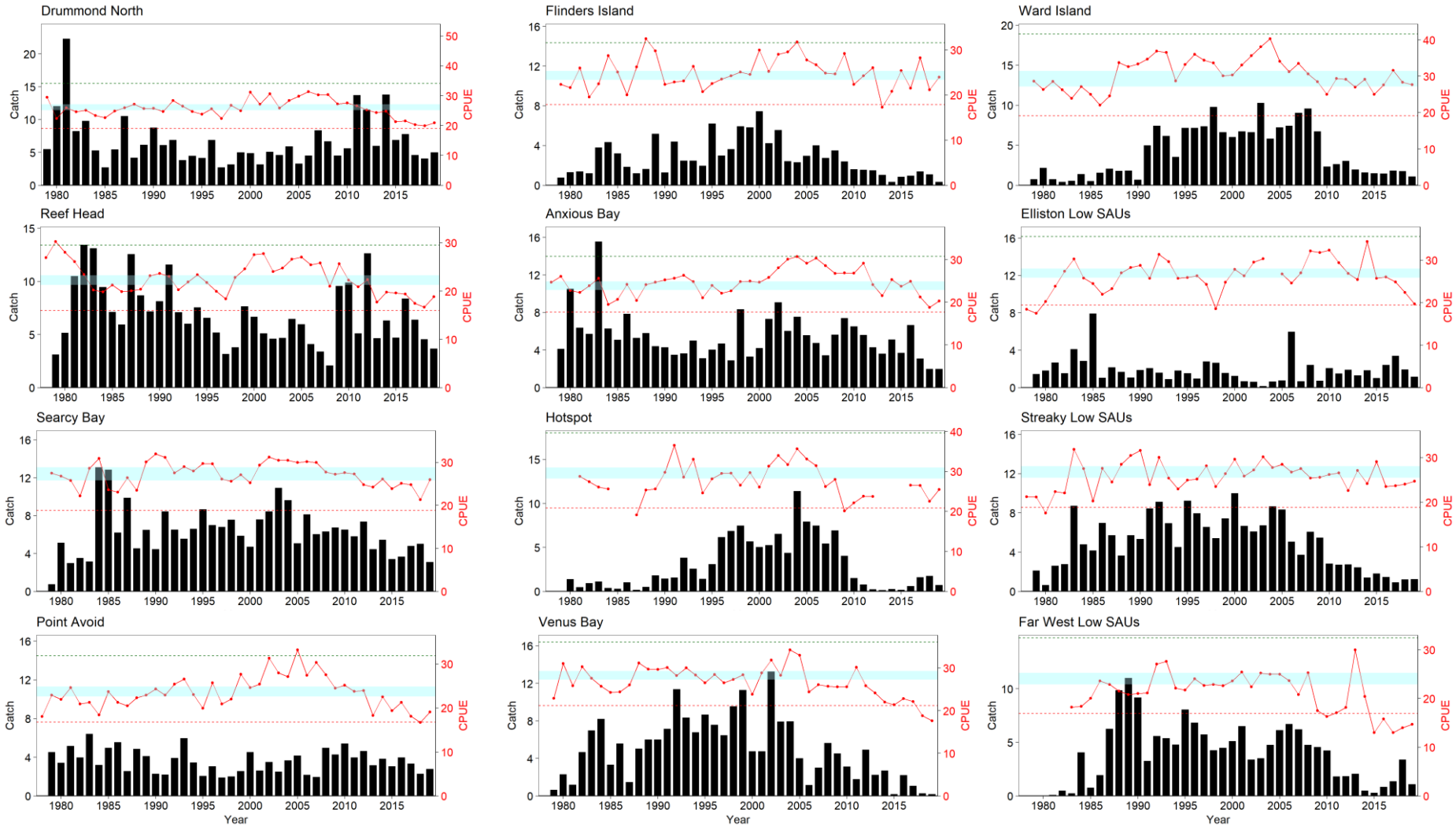

Figure 6.10. Blacklip SAUs (indicated by plot names) showing performance indicator CPUE ± se (kg.hr^{-1}, red) from 1979 to 2019. Catch (t. meat weight; black bars) is also included for reference. Densities are from fishery-independent surveys from surveyed years. On relevant plots the green and red dashed lines and pale blue bands are the upper and lower limit reference points and target reference band from the harvest strategy performance indicators CPUE and legal density, respectively.

6.7 **Summary tables**

Table 6.13. Calendar year greenlip catch (tons MW) from the Western Zone and SAUs, ordered alphabetically. Empty cells denote no catch.

Season	*Western Zone*	Anxious Bay	Avoid Bay	Baird Bay	Cape Bauer	Cape Catastrophe	Coffin Bay	DEntrecasteaux Reef	Drummond	Elliston Cliffs	Fishery Bay	Flinders Island	Franklin Islands	Greenly Island	Hotspot	Memory Cove	NE Thistle	Neptune Islands	North Nuyts	Pearson Island	Point Avoid	Point Westall	Reef Head	Searcy Bay	Sheringa	Sir Joseph Banks	South Nuyts	SW Thistle	Taylor Island	The Gap	Unassigned WZ	Venus Bay	Ward Island	Waterloo Bay	Wedge Island
1979	*138.1*	18.5	19.5	7.4	0.3	1.1	1.4	0.4	5.4	0.2	3.5	5.5	0.2		9.6	0.7	2.1	2.0	0.8		24.3	8.2	2.9	1.2	1.9	0.2	1.7	2.2	2.2	8.0		1.8	1.9	1.9	1.3
1980	*123.6*	14.6	9.2	3.6	0.5	3.2	1.4		5.8	1.4	3.8	10.5	0.2		7.0	0.5	0.3	0.4	1.0		18.4	5.6	7.3	1.6	1.8		0.6	2.1	2.6	7.2		2.7	5.2	4.4	0.8
1981	*108.1*	8.4	4.6	1.5	0.0	1.5	1.2		10.4	0.9	7.2	7.5	0.1		9.6	1.9	1.0	1.7	0.1		7.0	6.2	6.3	4.7	2.1	0.1		1.5	2.1	10.2		2.0	6.4	0.8	1.0
1982	*158.4*	9.5	16.8	9.4	0.4	2.1	2.6		10.4	1.0	6.4	6.9	1.3		4.6	2.8	1.0	1.9	1.7	1.0	22.1	6.4	13.7	4.0	1.5	0.0	1.0	3.9	4.1	13.3		2.3	4.6	0.0	1.9
1983	*157.6*	11.7	7.3	7.8	0.5	1.0	1.5	2.7	8.7	0.8	7.6	12.0	0.2	0.1	7.5	1.9	1.1	0.5	1.8	0.5	30.8	4.0	19.0	1.4	2.1	0.1	0.2	1.9	2.8	10.0	1.1	3.4	2.2	0.1	3.4
1984	*158.8*	15.9	6.2	7.4	2.7	1.2	1.3	1.7	6.8	1.3	3.6	13.1	4.8	0.1	3.9	3.1	0.7	0.6	7.1	0.4	14.4	8.2	8.4	8.9	2.6	0.1	6.1	2.3	10.9	4.9		4.1	3.6		2.4
1985	*91.5*	5.1	2.4	7.0	1.4	1.3	0.2	1.0	2.9	1.5	4.7	5.0	1.7		2.5	2.4	0.5	0.2	3.4	0.7	5.4	4.8	5.0	11.7	1.5	0.0	1.3	1.9	4.1	5.7	0.4	2.2	2.6		1.0
1986	*106.8*	9.3	6.2	4.4	5.2	2.2	0.4	0.3	3.4	1.3	3.1	5.8	0.9	0.1	4.3	3.9	1.0	0.3	0.6	0.9	10.7	3.1	5.4	2.4	2.0	0.0	0.6	1.0	9.6	7.6	0.4	3.2	3.0	3.2	1.1
1987	*104.5*	9.0	2.7	5.5	3.1	2.7	1.3	1.4	5.0	0.3	3.6	6.0	0.1	0.1	3.6	3.7	2.2	1.3	1.1	0.3	5.7	8.0	4.8	3.3	0.8		1.3	2.8	8.2	8.1	0.3	2.2	3.8	0.0	2.2
1988	*106.5*	9.6	4.2	4.7	2.5	2.0	1.1	1.3	1.5	1.4	3.6	4.6	5.3		0.8	3.1	1.8	0.9	4.0		7.9	6.8	2.9	4.7	0.5	0.3	6.8	2.6	6.9	7.8	0.1	1.6	3.9	0.8	0.9
1989	*82.5*	9.4	3.3	3.5	1.0	1.5	0.4	2.2	1.8	0.5	2.2	3.5	2.6	0.5	4.5	2.6	1.6	1.1	3.2	0.3	7.4	4.5	3.2	1.4	0.7	0.0	4.0	1.3	4.2	4.4		1.7	2.1	0.0	1.8
1990	*81.5*	5.7	2.1	5.2	0.4	1.5	0.1	2.1	0.8	0.6	3.1	6.3	4.0	0.1	8.1	3.2	1.1	0.2	3.6	0.1	2.9	4.7	2.1	2.9	0.9	0.1	3.3	1.8	2.7	6.8		1.8	1.3	0.1	1.7
1991	*74.3*	6.5	1.9	4.2	2.0	2.3	0.5	1.0	1.2	0.3	2.8	4.0	1.6	0.1	7.1	2.3	2.2	0.3	1.6	0.2	3.3	2.9	1.6	1.8	0.5	0.0	2.5	1.9	4.2	8.4		0.6	3.2	0.3	1.1
1992	*75.6*	6.0	3.8	4.1	2.6	2.3	0.3	0.8	1.2	0.1	2.8	6.6	1.7	0.3	4.3	1.4	1.8	0.7	1.1	0.4	1.8	3.5	2.0	1.9	0.5	0.1	2.4	1.8	2.2	6.8		2.4	4.1	0.4	3.6
1993	*74.4*	4.9	3.9	3.4	1.4	1.7	0.8	2.2	1.8	0.5	1.4	5.2	1.3	0.0	4.5	1.6	2.9	1.0	1.3	0.3	2.8	2.2	1.0	1.6	0.6	0.1	1.5	2.5	5.4	7.6	0.0	1.9	4.9	0.4	1.9
1994	*76.3*	5.4	5.0	3.8	1.0	1.4	0.8	1.2	0.7	0.1	2.2	7.1	2.5		4.7	1.5	2.3	1.1	2.0	0.1	2.7	2.5	1.4	3.0	0.6	0.0	1.9	1.5	4.9	8.7		1.8	2.6	0.1	1.5
1995	*75.8*	4.9	3.7	2.9	0.7	1.9	0.5	1.2	0.5	0.4	2.0	9.9	1.8		3.9	2.2	2.1	2.4	1.6	0.4	1.8	3.3	1.3	2.0	0.4	0.2	2.9	1.3	4.3	7.4		2.0	3.3	0.2	2.4
1996	*75.2*	6.2	3.7	5.5	0.5	2.6	0.1	1.1	1.1	0.1	3.2	7.6	1.4		9.3	1.6	1.3	0.2	1.7	0.2	0.9	1.6	1.7	1.9	0.6	0.1	2.5	0.8	3.3	6.4	0.0	2.1	3.8		2.1
1997	*75.7*	6.3	2.7	4.7	0.2	3.0	0.1	1.3	1.5	0.1	2.4	6.4	1.3		8.5	2.1	1.1	1.4	2.0		1.7	2.2	1.3	1.6	2.4	0.3	2.0	1.8	2.6	7.2		1.5	4.3		1.8
1998	*79.9*	6.1	1.4	5.0	0.3	1.6	0.1	0.9	0.6	0.1	2.0	8.3	2.5		8.3	2.6	2.4	0.8	2.0	0.1	0.7	2.8	0.9	1.3	0.2	0.3	2.9	2.1	3.1	10.1		2.6	5.0	1.2	1.4
1999	*82.6*	4.6	2.6	3.3	1.3	2.5	0.1	1.0	0.6	0.3	1.1	9.1	2.0		8.6	2.8	0.8	0.4	1.4		1.6	2.7	0.5	1.2	0.4	0.2	5.7	1.9	1.8	12.6	0.2	1.3	5.7	3.2	1.5
2000	*78.1*	3.9	2.1	2.8	1.9	2.0	0.2	0.8	1.4	0.2	1.0	12.7	2.1		6.4	1.4	1.7	0.8	2.2	0.6	1.7	2.8	2.9	0.9	0.4	0.2	3.5	1.6	2.1	9.0		2.7	4.3		1.9
2001	*77.4*	5.5	2.6	4.6	0.6	1.2	0.0	0.7	0.7	0.0	0.4	10.5	2.0		8.2	1.4	1.2		2.4	0.2	2.7	3.9	1.9	1.8	0.5	0.1	3.7	1.4	4.3	8.8	0.1	1.2	3.5		1.4
2002	*77.9*	8.6	3.1	3.4	1.1	0.4	0.3	0.8	2.2	0.1	0.9	10.6	1.9		6.4	2.5	0.9		2.7		2.5	3.3	0.9	1.5	0.3	0.5	3.6	0.6	3.8	8.0		2.1	4.7		0.2
2003	*82.5*	8.6	2.9	2.6	0.5	0.7	0.1	1.3	1.7	0.0	1.5	8.4	2.9		8.2	2.0	0.5		1.1	0.0	1.9	2.3	1.4	2.0	0.3		4.5	1.5	4.9	11.6	1.2	0.8	3.2	3.1	0.9
2004	*79.2*	8.7	5.6	3.3	0.5	1.8	0.1	1.3	0.4	0.0	2.1	5.9	1.9		6.6	2.7	1.6	0.1	1.6		1.5	2.3	0.9	1.3	0.2		4.8	1.2	2.6	9.9	3.5	0.3	5.7		0.9
2005	*77.6*	7.7	6.8	4.7	0.3	0.5	0.1	0.8	0.7	0.0	0.8	6.3	1.4		8.3	2.0	0.8		2.7		0.8	3.0	0.9	2.1	0.1	0.2	3.6	1.0	3.4	10.3	2.6	0.3	4.1		1.1
2006	*83.6*	9.9	11.0	4.0	2.5	1.0	0.3	0.9	0.4	0.0	1.3	7.2	0.6		7.8	1.6	0.7		3.2	0.3	2.1	2.8	1.4	0.9	0.1		2.8	1.4	1.5	9.3	2.6	0.1	5.3		0.9
2007	*82.2*	7.0	12.0	3.1	1.2	0.7	0.2	1.3	0.4		0.2	9.3	1.0		6.7	2.8	1.0	0.3	1.8		1.4	3.2	1.2	1.4	0.1		3.4	1.3	3.3	9.6	1.3	0.2	5.6		1.5
2008	*83.1*	7.5	13.1	2.7	0.4	1.8	0.8	1.1	1.7	0.0	2.6	4.9	1.2		5.5	3.2	1.0	1.0	1.8	0.3	2.0	2.6	0.8	1.3	0.5	0.0	4.4	1.2	3.9	7.8	0.4	0.4	5.5		1.6
2009	*82.6*	9.4	5.7	3.2	0.3	2.4	0.5	1.0	3.4	0.2	3.0	3.6	1.1		5.2	3.4	0.8	1.0	2.1	0.1	3.3	2.1	0.6	1.4	0.3	0.2	3.6	3.0	3.0	9.1	0.0	1.0	6.5		2.1
2010	*76.9*	12.7	3.7	1.7	0.4	1.5	0.8	0.8	2.8	0.0	1.4	3.2	0.9		3.5	1.9	1.7	0.2	2.3		6.4	1.0	4.9	1.3	0.4		5.1	1.3	2.9	6.8		1.6	3.2	0.7	1.6
2011	*74.8*	8.4	4.4	1.6	0.4	2.4	1.4	0.2	4.4	0.5	3.2	4.0	0.9	0.2	0.8	1.6	1.4	0.5	2.3		5.7	1.8	5.6	0.9	0.6		3.0	1.0	4.1	7.2		2.2	2.2	1.7	0.3
2012	*73.4*	8.2	6.4	2.9	0.6	2.0	1.5	0.4	6.2	0.2	1.5	3.7	1.2	0.0	1.6	1.8	1.1	0.6	0.8	0.2	4.4	1.5	2.6	0.9	0.6		2.7	1.3	6.8	6.0		1.1	3.3	0.5	1.0
2013	*72.4*	7.5	4.5	3.1	0.6	2.2	2.2	0.7	4.3	0.4	1.4	2.4	1.4		1.5	1.6	0.7	1.6	0.8	0.3	3.9	2.6	5.3	1.3	0.6	0.0	2.0	1.5	2.3	7.7		2.2	4.2	0.8	1.0
2014	*71.7*	6.5	3.9	3.8	1.0	2.3	0.2	0.0	6.4	0.6	3.1	3.6	0.5		1.3	1.7	0.4	1.2	0.1	0.2	4.2	4.2	3.6	1.5	0.4	0.0	0.8	1.0	3.1	8.9	0.1	2.5	3.0	0.7	0.8
2015	*68.9*	8.7	6.3	4.8	0.8	1.1	0.3	0.0	4.6	0.5	1.9	1.6			2.3	1.4	0.3	0.6	0.2		6.4	2.5	4.8	1.8	0.4	0.0		1.4	2.2	6.4		1.8	3.8	0.6	1.1
2016	*69.7*	6.9	4.8	4.7	1.0	3.3	0.4	0.0	4.0	0.5	1.9	4.5	0.2		1.6	1.9	1.0		0.1		5.8	1.8	4.1	0.8	0.5			1.2	3.6	7.7		1.7	3.3	0.3	2.0
2017	*72.6*	5.3	4.9	4.5	1.3	2.3	0.0	0.2	4.1	1.0	1.9	3.9	1.3	0.0	4.0	1.5	0.6	2.8	1.9	0.1	4.5	3.5	3.5	1.0	0.8	0.0	0.3	2.4	2.9	7.7		1.5	1.0	0.8	1.1
2018	*71.5*	4.7	6.6	3.3	1.5	1.6	0.0	0.3	2.6	0.5	1.8	4.6	1.5		6.5	0.7	0.7	0.7	1.9		4.7	4.8	4.3	1.6	0.4	0.1	0.5	0.7	2.6	4.8		0.8	5.5	0.2	1.0
2019	*66.1*	5.9	5.0	4.2	0.5	1.5	0.2	0.5	3.9	0.4	1.2	4.0	0.8		5.3	0.7	0.3	0.1	1.6		7.4	3.2	3.1	1.6	0.3	0.2	0.8	1.5	2.4	4.2		0.9	3.1	0.6	0.9

Table 6.14. Calendar year greenlip CPUE (kg.hr^{-1}) from the Western Zone and SAUs, ordered alphabetically. Empty cells denote no CPUE.

Season	Western Zone	Anxious Bay	Avoid Bay	Baird Bay	Cape Bauer	Cape Catastrophe	Coffin Bay	DEntrecasteaux Reef	Drummond	Elliston Cliffs	Fishery Bay	Flinders Island	Franklin Islands	Greenly Island	Hotspot	Memory Cove	NE Thistle	Neptune Islands	North Nuyts	Pearson Island	Point Avoid	Point Westall	Reef Head	Searcy Bay	Sheringa	Sir Joseph Banks	South Nuyts	SW Thistle	Taylors Island	The Gap	Unassigned WZ	Venus Bay	Ward Island	Waterloo Bay	Wedge Island
1979	*22.23*	22.1	23.2	22.6		21.3	18.2		17.9		21.1	24.7			33.3		15.6	30.9			22.2	19.8	20.8	27.3	27.4		22.9	23.2	16.3	17.9			32.2	14.9	26.7
1980	*21.2*	19.5	19.9	19.5		22.5	15.5		19.0	24.0	21.4	24.4			28.9				22.4		21.1	16.4	20.1	24.5	22.7			23.7	17.6	21.6			30.6	19.2	
1981	*22.2*	18.5	19.8	21.3		17.7	15.2		20.5		19.0	22.6			31.4	17.5	14.2	28.9			22.4	22.8	23.5	27.6	21.3			21.7	17.4	20.9		27.4	32.3	19.7	
1982	*21.93*	19.7	22.6	22.5		19.8	18.1		23.0	23.2	20.1	22.8	22.1		25.4	20.7	15.8	28.0	31.4		23.6	19.9	21.7	21.6	18.5			23.4	18.7	19.2		24.7	29.8		21.2
1983	*19.11*	20.9	18.4	21.9		16.5	13.7	21.6	18.6		15.3	20.2			23.9	13.2	16.0		21.9		20.1	14.5	17.7	12.0	18.2			18.7	14.8	18.0	23.5	20.6	25.8		31.8
1984	*20.11*	21.4	16.1	27.7	25.9	17.3	14.5	17.6	20.6	26.4	15.7	19.3	22.7		23.5	17.8			21.9		17.4	24.4	17.1	26.6	14.7		17.2	20.0	20.6	18.4		23.2	22.5		22.1
1985	*19.18*	18.0	16.0	25.1	19.7	19.5		14.1	15.1	26.9	16.3	21.8	14.0		24.8	18.2	11.0		17.1		19.1	20.7	18.1	24.7			15.5	17.4	16.9	17.4		20.3	23.1		
1986	*20.81*	21.6	21.0	22.4	22.4	18.0			17.6	18.1	16.0	22.6			30.1	15.8	14.3				22.5	22.7	24.6	20.5	23.5			17.0	20.3	17.4		20.3	29.4	21.1	
1987	*19.92*	22.3	17.6	26.1	22.6	17.4	20.8	27.9	18.7		13.7	19.5			21.8	16.6	18.6		18.4		19.6	23.0	18.3	25.0			25.7	17.1	18.8	17.5		21.8	23.7		19.5
1988	*19.25*	21.2	27.4	21.4	21.0	16.3	30.5	23.6	16.0	16.0	14.8	17.9	18.9			16.5	16.6		17.1		22.7	17.6	19.4	23.0			20.5	19.8	15.4	17.3		21.4	24.2	17.8	
1989	*20.23*	27.0	24.8	25.4	24.8	16.7		18.3	20.7		17.0	22.7	13.8		26.0	15.8	18.4		16.5		23.5	19.9	20.7	17.8			17.5	18.6	15.4	16.1		20.7	23.0		22.6
1990	*21.93*	25.4	24.7	27.5		20.5		23.4			23.3	23.8	19.1		31.4	17.7	16.2		18.5		19.5	19.2	22.3	23.7			16.7	19.6	17.5	21.0		23.5			22.2
1991	*22.41*	25.8	23.6	30.8	20.5	19.4		24.6			22.1	20.7	18.9		30.9	21.6	18.5		17.3		21.3	18.6	19.9	23.8			18.4	19.1	17.7	21.4		25.7	30.8		
1992	*22.86*	24.3	35.4	23.9	19.5	21.2			20.2		22.0	22.3	19.9		26.9	19.4	21.0		19.2		21.1	21.1	20.5	21.1			21.7	21.0	17.4	21.1		21.5	32.4		24.3
1993	*22.82*	27.3	33.8	25.5	28.4	18.6		31.3	22.1		17.5	21.1	22.3		24.7	18.5	18.3		19.2		23.0	18.5	18.0	24.5			19.5	21.8	19.9	21.5		20.7	29.4		21.4
1994	*23.43*	25.4	26.8	21.5	20.3	17.5		28.4			20.9	28.0	21.8		30.4	19.2	18.7		19.1		22.7	20.6		25.1			17.5	21.7	17.8	22.8		29.2	26.2		25.0
1995	*20.92*	22.7	26.6	22.2	20.1	19.0		18.5			17.6	22.4	20.0		23.9	16.6	18.4	33.4	14.6		17.3	20.0	19.8	21.2			18.6	22.7	16.5	20.5		21.0	25.0		26.6
1996	*21.31*	22.2	25.3	22.9		20.2			17.1		20.2	23.3	14.9		26.3	16.3	18.2		15.4		15.1	19.4	17.8	23.0			17.5	17.2	16.4	20.9		23.7	28.0		25.7
1997	*22.77*	26.7	23.0	22.5		26.4		17.3			24.2	23.5	19.4		26.4	19.9	16.3		19.4		21.2	18.9	18.6	23.4	22.6		16.7	23.0	18.6	20.6		23.5	32.6		23.1
1998	*22.41*	25.2	21.5	22.4		19.0					23.7	24.8	17.9		27.5	21.2	19.8		13.9			20.7	17.3	18.8			15.4	21.7	17.7	26.0		21.2	30.8	15.7	
1999	*23.45*	26.6	23.4	23.7	24.0	23.3					19.7	26.2	20.1		27.4	23.3			17.1		22.1	22.5					20.0	21.8	19.1	24.2		25.4	29.7	16.3	
2000	*24.93*	27.2	22.5	23.8	21.5	21.4			29.1			27.6	20.7		29.1	22.1	17.6		21.8		22.8	25.2	22.6				19.2	23.1	22.7	24.3		26.3	34.2		28.7
2001	*25.97*	31.3	27.2	27.7	16.3	22.2						27.7	22.4		28.6	26.9			23.8		27.8	26.8	28.6	27.0			19.3	26.2	21.0	25.9			29.8		
2002	*27.6*	30.6	29.8	25.2	21.7				42.0			32.1	22.5		31.4	27.1			17.9		30.7	26.9		27.6			19.7		24.0	27.1		30.9	31.1		
2003	*28.86*	34.8	33.1	28.6				29.0			32.3	31.4	19.0		35.2	27.6			15.0		33.6	26.5	24.7	32.9			21.9	34.9	26.9	28.4			37.0	25.4	
2004	*28.83*	35.7	37.7	27.5		29.7					45.1	29.0	16.6		32.0	28.9	25.0		17.9		27.9	24.9					20.4		26.1	29.7	27.8		40.6		
2005	*29.45*	31.3	38.9	30.4								31.5	15.0		34.4	30.2			22.9			26.9		29.1			18.0		27.0	31.8	29.9		37.0		
2006	*29.55*	33.0	40.3	29.4	28.4	32.2						30.3			32.7	29.4			20.8		30.6	27.2	34.3				16.9		21.3	28.8	28.8		34.7		
2007	*29.15*	36.4	38.8	29.9	25.6			20.0				28.7	16.9		31.3	30.1			21.1		27.0	27.9	26.1	27.0			19.0	32.0	26.4	28.8			31.8		28.1
2008	*27.63*	33.4	34.9	29.7		26.0		20.9	29.4		30.9	25.5	15.6		28.1	27.9			22.3		29.0	23.6		29.7			19.7		24.2	26.4			29.1		
2009	*24.44*	28.6	28.4	29.8		23.1			34.2		28.0	21.9	12.6		30.3	21.0			16.0		26.5	23.3		24.3			17.3	27.0	22.7	24.1			26.2		28.1
2010	*23.41*	25.5	24.4			23.0		14.0	30.5		25.0	22.5	12.6		25.3	26.7	21.8		15.5		29.0	26.1	24.7	32.3			17.3		24.0	22.2		30.3	24.8		24.8
2011	*23.44*	24.9	26.7			23.0	24.9		27.1		25.9	25.3	14.1			26.2	23.1		14.6		24.1	21.5	23.6				15.0		25.0	25.7		25.1	25.1		
2012	*23.42*	26.3	26.0	27.8		20.7	28.0		26.0		17.9	22.8	15.8		31.0	19.5	25.0		15.3		23.4	21.0	22.2				17.1	20.1	23.5	21.0		27.7	30.2		
2013	*22.33*	25.3	24.4	24.5		16.7	20.5	12.3	26.7		17.2	20.3	19.0			17.5		27.4			25.0	25.3	24.7	24.7			18.7	19.2	15.6	22.4		24.7	29.3		
2014	*20.15*	22.3	21.0	29.0	28.5	17.7			22.7		15.3	18.6			21.0	14.0		24.6			20.5	22.3	17.9	25.2				16.8	17.6	18.2		23.9	23.8		
2015	*22.76*	27.1	22.5	30.8		18.3			23.8		19.5	17.9			22.9	13.2					26.6	25.0	19.1	27.6				18.2	16.5	18.0		25.9	33.2		22.6
2016	*22.24*	22.4	25.4	31.4		22.3			23.7		20.7	22.0			25.4	18.4	17.4				22.4	24.9	20.6					19.3	19.2	19.0			23.7		23.0
2017	*21.18*	20.42	20.32	28.18	28.99	17.5			21.79		18.13	21.08	17.35		31.49	14.9	12.35	41.02	20.64		20.28	25.34	18.69					20.4	16.72	18.25		22.93			15.71
2018	*20.5*	20.7	21.06	24.18	30.38	15.97			21.13		18.58	24.77	14.53		29.16	12.46			15.38		18.14	26.86	19.95	22.62				14.51	14.01	14.93			28.76		17.34
2019	*19.7*	21.1	19.8	24.0		18.4			19.2		16.8	20.8	10.7		23.3	15.2			14.9		20.3	24.8	18.0	25.2			17.0	16.1	16.4	16.3		15.9	28.0		

Table 6.15. Calendar year greenlip PropG1 from the Western Zone and SAUs, ordered alphabetically. Empty cells denote no PropG1 estimate.

Season	*Western Zone*	Anxious Bay	Avoid Bay	Baird Bay	Cape Bauer	Cape Catastrophe	Coffin Bay	DEntrecasteaux Reef	Drummond	Elliston Cliffs	Fishery Bay	Flinders Island	Franklin Islands	Greenly Island	Hotspot	Memory Cove	NE Thistle	Neptune Islands	North Nuyts	Pearson Island	Point Avoid	Point Westall	Reef Head	Searcy Bay	Sheringa	Sir Joseph Banks	South Nuyts	SW Thistle	Taylors Island	The Gap	Unassigned WZ	Venus Bay	Ward Island	Waterloo Bay	Wedge Island
1979	*0.35*	0.24	0.30	0.47			0.30		0.21		0.47	0.29			0.43		0.41				0.23	0.34	0.39		0.31		0.44		0.28	0.52				0.51	
1980	*0.41*	0.40	0.48	0.33		0.63	0.59		0.31	0.59	0.66	0.39			0.25						0.30	0.36	0.44	0.33	0.40			0.65	0.52	0.63			0.57	0.26	
1981	*0.39*	0.30	0.28	0.51		0.55	0.35		0.30		0.52	0.31			0.56	0.43	0.43				0.25	0.36	0.29	0.71	0.43			0.39	0.33	0.45			0.70	0.29	
1982	*0.44*	0.38	0.43	0.32		0.74	0.28		0.32		0.50	0.27				0.65	0.50				0.36	0.28	0.37	0.45	0.39			0.61	0.54	0.62		0.73			0.63
1983	*0.44*	0.36	0.43	0.31		0.69		0.70	0.27		0.63	0.30			0.31	0.55	0.51		0.37		0.41	0.38	0.41	0.39	0.44			0.54	0.32	0.61	0.82	0.47			0.92
1984	*0.42*	0.35	0.38	0.42		0.68	0.37	0.43	0.40	0.73	0.71	0.39	0.55		0.18	0.49			0.44		0.39	0.45	0.33	0.54	0.35		0.28	0.59	0.46	0.50		0.45	0.23		0.73
1985	*0.48*	0.28	0.47	0.36		0.70	0.23	0.56	0.30	0.57	0.72	0.37	0.45		0.26	0.68			0.52		0.49	0.27	0.37	0.40	0.49		0.50	0.63	0.56	0.71		0.48	0.39		
1986	*0.45*	0.38	0.50	0.19	0.31	0.70			0.27	0.51	0.64	0.30			0.28	0.73	0.66				0.61	0.34	0.40	0.18	0.49			0.46	0.60	0.66		0.31	0.28	0.40	0.42
1987	*0.42*	0.19	0.38	0.17	0.17	0.68	0.32	0.48	0.26		0.57	0.48			0.20	0.67	0.66	0.69	0.41		0.45	0.16	0.21	0.13	0.34			0.63	0.56	0.64		0.38	0.33		0.54
1988	*0.40*	0.29	0.42	0.16	0.18	0.57		0.35	0.15	0.43	0.55	0.26	0.39			0.55	0.61		0.34		0.37	0.34	0.38	0.23	0.59		0.37	0.57	0.56	0.59		0.40	0.31	0.26	
1989	*0.40*	0.31	0.32	0.22		0.69		0.27	0.31		0.64	0.31	0.29		0.31	0.55	0.46	0.71	0.24		0.47	0.40	0.29	0.29	0.49		0.13	0.50	0.58	0.58		0.58	0.32		0.67
1990	*0.45*	0.30	0.36	0.30		0.61		0.39	0.09	0.31	0.69	0.47	0.32		0.49	0.61	0.44		0.37		0.37	0.28	0.30	0.29	0.57		0.52	0.56	0.48	0.60		0.65	0.59		0.59
1991	*0.46*	0.20	0.38	0.39		0.67	0.61	0.16	0.29		0.73	0.29	0.23		0.38	0.68			0.38		0.65	0.31	0.37	0.25	0.52		0.32	0.64	0.53	0.62		0.56	0.42		
1992	*0.44*	0.25	0.48	0.27	0.21	0.71			0.32		0.72	0.34			0.30	0.64	0.57		0.37		0.46	0.35	0.34	0.27	0.46		0.29	0.66	0.50	0.68		0.41	0.43		0.66
1993	*0.50*	0.28	0.64	0.30	0.41	0.74		0.33	0.49		0.60	0.37			0.36	0.53	0.64		0.49		0.60	0.42	0.36	0.28	0.65		0.48	0.58	0.58	0.63		0.49	0.47		
1994	*0.55*	0.31	0.63	0.32	0.38	0.59	0.48	0.43	0.48		0.80	0.52	0.38		0.57	0.58	0.66		0.50		0.65	0.38	0.64	0.52	0.36		0.42	0.69	0.50	0.66		0.42	0.63		0.70
1995	*0.52*	0.22	0.42	0.46	0.31	0.56		0.41	0.45		0.62	0.45	0.51		0.38	0.62	0.63	0.62	0.50		0.61	0.50	0.43	0.52	0.54		0.62	0.50	0.61	0.67		0.46	0.59		0.68
1996	*0.56*	0.32	0.33	0.42	0.38	0.75		0.33	0.63		0.83	0.58	0.37		0.58	0.69	0.69		0.55		0.47	0.31	0.40	0.51	0.55		0.58		0.57	0.65		0.44	0.64		0.76
1997	*0.57*	0.31	0.42	0.50		0.81		0.54	0.53		0.72	0.50			0.59	0.59	0.62	0.57	0.49		0.61	0.34	0.46	0.66	0.41		0.65	0.58	0.60	0.67		0.57	0.62		0.61
1998	*0.58*	0.33	0.55	0.38		0.72		0.44	0.61		0.79	0.58	0.57		0.61	0.68	0.66		0.41		0.65	0.38	0.54	0.54	0.51		0.57	0.61	0.61	0.78		0.36	0.63	0.00	
1999	*0.58*	0.45	0.54	0.46	0.46	0.83		0.47	0.63		0.83	0.55	0.48		0.46	0.59			0.48		0.63	0.47	0.52	0.57	0.80		0.57	0.68	0.47	0.72		0.43	0.60	0.37	
2000	*0.64*	0.42	0.70	0.40	0.38	0.73			0.69		0.95	0.57	0.46		0.48	0.82	0.64		0.42		0.72	0.51	0.69	0.56	0.62		0.62	0.64	0.73	0.79		0.50	0.78		0.75
2001	*0.61*	0.57	0.69	0.66		0.78			0.74			0.55	0.44		0.48				0.40		0.81	0.52	0.61	0.75	0.77		0.53	0.65	0.68	0.73		0.60	0.62		
2002	*0.60*	0.54	0.70	0.40	0.28			0.67	0.79		0.77	0.50	0.45		0.59	0.65	0.65		0.52		0.67	0.30	0.69	0.57	0.75		0.52		0.52	0.73		0.59	0.73		
2003	*0.61*	0.43	0.57	0.47	0.26			0.72	0.66		0.87	0.50	0.42		0.63	0.57			0.47		0.65	0.40	0.64	0.44	0.70		0.71	0.70	0.62	0.75	0.64	0.79	0.77		
2004	*0.58*	0.29	0.67	0.35	0.34	0.85		0.65	0.77		0.98	0.38	0.38		0.57	0.65			0.42		0.75	0.50	0.62	0.45	0.70		0.53	0.76	0.46	0.75	0.56	0.77	0.79		
2005	*0.67*	0.43	0.84	0.58					0.74			0.41	0.38		0.66				0.55		0.91	0.67	0.75	0.72	0.75		0.46		0.77	0.83	0.61	0.80	0.80		
2006	*0.67*	0.54	0.81	0.54				0.53	0.76			0.57			0.59				0.41		0.91	0.44	0.76	0.59	0.80		0.54	0.85		0.71	0.62		0.79		
2007	*0.64*	0.56	0.85	0.38				0.44	0.81			0.47	0.35		0.43				0.45		0.90	0.51	0.91	0.47	0.84		0.40		0.61	0.77	0.62	0.93	0.70		
2008	*0.59*	0.51	0.67	0.33		0.79		0.43	0.79		0.94	0.31	0.27		0.33	0.71			0.45		0.75	0.28	0.78	0.54	0.69		0.46		0.61	0.77		0.66	0.56		
2009	*0.64*	0.51	0.72	0.60		0.84		0.47	0.75	0.93	0.92	0.48	0.50		0.38	0.74			0.46		0.81	0.58	0.83	0.71	0.61		0.41	0.72	0.56	0.80		0.87	0.61		0.78
2010	*0.60*	0.53	0.69	0.50		0.83		0.42	0.80			0.38	0.23		0.26	0.82	0.56		0.49		0.84	0.60	0.72	0.71	0.80		0.41		0.58	0.65		0.64	0.50		
2011	*0.65*	0.55	0.71	0.44		0.74			0.62		0.82	0.60	0.34			0.77			0.50		0.74	0.60	0.74	0.70	0.73		0.40	0.73	0.75	0.79		0.62	0.48		
2012	*0.65*	0.61	0.79	0.63		0.82	0.93		0.61		0.83	0.48	0.33		0.27	0.74	0.61		0.33		0.84	0.50	0.71	0.64	0.59		0.37	0.75	0.63	0.79		0.86	0.52		
2013	*0.59*	0.56	0.64	0.49	0.46	0.71	0.84	0.56	0.50	0.88	0.82	0.50	0.31			0.66			0.41		0.73	0.61	0.67	0.62	0.76		0.45	0.48	0.54	0.70		0.66	0.48	0.56	
2014	*0.56*	0.50	0.62	0.52	0.45	0.75			0.56	0.87	0.72	0.44			0.19	0.68					0.71	0.55	0.53	0.47	0.63		0.47		0.46	0.63		0.89	0.45		
2015	*0.67*	0.55	0.74	0.65	0.57	0.92			0.71		0.86	0.51			0.43	0.73					0.71	0.58	0.62	0.67	0.64			0.72	0.63	0.74		0.80	0.79		0.77
2016	*0.66*	0.60	0.64	0.66	0.69	0.77			0.61	0.84		0.58			0.42	0.66	0.67				0.77	0.62	0.55	0.65	0.56			0.74	0.65	0.73		0.89	0.72		0.72
2017	*0.67*	0.47	0.66	0.73	0.61	0.83			0.59	0.84	0.79	0.71	0.63		0.70	0.67		0.79	0.60		0.75	0.73	0.38	0.73	0.64			0.80	0.65	0.79		0.92	0.79	0.45	0.55
2018	*0.64*	0.60	0.70	0.67	0.47	0.66		0.76	0.63			0.65	0.34		0.73				0.44		0.85	0.61	0.61	0.52	0.73				0.50	0.63			0.80		
2019	*0.61*	0.63	0.66	0.67		0.54		0.86	0.49	0.41		0.59	0.35		0.47				0.55		0.78	0.50	0.59	0.61	0.64			0.64	0.43	0.65		0.38	0.76		

Table 6.16. Calendar year blacklip catch (tons MW) from the Western Zone and SAUs, ordered alphabetically. Empty cells denote no catch.

Season	*Western Zone*	Anxious Bay	Avoid Bay	Baird Bay	Cape Bauer	Cape Catastrophe	Coffin Bay	DEntrecasteaux Rf	Drummond N	Drummond S	Elliston Cliffs	Fishery Bay	Flinders Island	Franklin Islands	Greenly Island	Hotspot	Memory Cove	NE Thistle	Neptune Islands	North Nuyts	Pearson Island	Point Avoid	Point Westall	Reef Head	Searcy Bay	Sheringa	Sir Joseph Banks	South Nuyts	SW Thistle	Taylors Island	The Gap	Unassigned WZ	Venus Bay	Ward Island	Waterloo Bay	Wedge Island
1979	*43.0*	2.1	3.2	1.3	0.0	0.4	0.1		6.2	9.9	0.3	0.6	0.2	0.0		0.1	0.2	0.4	0.1			3.4	2.2	1.1	0.7	5.3	0.2	0.0	0.6	0.2	1.9		0.7	0.2	1.4	0.0
1980	*71.4*	8.2	2.6	1.7	0.3	1.5	1.0		6.8	10.7	0.3	2.3	1.4			0.7	0.1	0.1	0.0			4.2	4.5	6.2	1.0	9.2			1.2	0.9	1.0		1.2	1.6	2.3	0.0
1981	*119.1*	8.2	1.1	0.7	0.0	0.9	1.8		16.0	15.8	1.2	6.9	2.0	0.0		1.0	0.5	0.2	0.2			4.7	8.3	4.6	5.8	29.6			1.0	0.5	2.2		2.5	1.9	1.7	0.0
1982	*102.0*	7.3	2.8	3.8	0.0	0.7	0.5		16.3	14.0	0.4	2.1	0.5	0.1		0.4	0.7	0.3	0.5	0.0		4.6	2.7	14.1	2.9	19.9			1.1	0.4	2.4		3.2	0.4	0.0	0.1
1983	*94.0*	6.3	2.5	3.3	0.0	0.7	0.8	0.4	8.5	12.2	1.5	3.0	1.1		0.0	0.9	0.6	0.3	0.1	0.1	0.1	6.1	1.8	15.9	2.5	17.7	0.0		0.8	0.5	2.1	0.0	4.1	0.3	0.0	0.0
1984	*117.0*	15.1	1.8	6.6	1.0	0.8	0.7	0.2	10.1	12.6	4.2	1.4	4.8	0.3		1.1	1.9	0.6	0.1	0.8	0.0	3.8	4.0	9.3	3.7	16.6	0.0	0.2	1.5	1.6	2.1		8.2	1.0		0.8
1985	*116.2*	5.8	1.6	5.9	0.3	1.1	0.5	1.0	2.6	7.9	2.8	2.3	3.7	1.1		0.6	0.5	0.2	0.0	1.3	0.4	2.4	6.7	7.6	19.8	28.3		0.1	0.9	0.8	2.0	0.7	6.2	1.2		0.1
1986	*100.2*	6.5	1.9	2.6	1.8	2.0	0.9	0.2	5.3	11.5	3.5	2.4	3.7	0.2	0.0	0.9	0.3	0.2	0.1	0.2	0.0	5.1	4.9	5.7	8.5	16.6	0.0	0.2	0.7	0.5	1.1	0.1	6.4	1.4	4.6	0.1
1987	*95.9*	5.8	1.0	4.3	1.3	2.0	1.7	0.8	10.1	8.7	1.1	2.7	0.9	0.1	0.0	0.2	0.4	0.2	0.6	0.5	0.0	4.8	8.9	12.4	6.2	13.1		0.1	1.9	0.6	2.0	1.2	1.5	0.7	0.0	0.0
1988	*84.4*	4.4	1.7	3.4	1.2	1.4	0.9	2.9	4.9	6.2	0.5	3.0	1.5	1.6		0.2	1.3	0.9	0.1	1.7		3.5	6.5	8.2	7.6	6.3	0.1	2.6	1.5	1.1	3.4	0.1	2.1	1.9	1.6	0.0
1989	*108.1*	5.7	2.6	3.8	0.2	2.6	0.5	7.4	5.9	8.8	0.9	3.0	2.0	3.1	1.0	0.6	1.6	0.7	0.5	2.9	0.1	4.4	12.0	6.1	4.1	10.5	0.1	2.0	1.9	2.1	3.3		5.7	2.0		0.3
1990	*108.8*	5.1	1.0	5.2	0.5	0.7	0.4	4.7	6.1	2.6	1.4	2.0	4.7	2.5	0.2	1.9	1.1	1.3	0.0	3.1	0.0	3.7	13.1	9.8	6.8	18.0	0.0	1.2	1.7	0.7	2.1		5.3	1.6	0.1	0.2
1991	*98.2*	3.1	2.3	4.8	0.6	1.5	1.3	0.5	8.8	10.8	1.4	2.0	2.4	0.5	0.3	1.3	1.1	1.3	0.1	0.6	0.0	2.5	8.6	8.8	5.4	12.8	0.0	0.6	1.7	1.2	3.7		6.1	1.1	0.8	0.1
1992	*100.2*	3.4	4.3	7.1	2.3	1.9	0.8	1.0	3.1	0.9	0.7	2.0	3.7	0.8	0.2	1.6	1.1	0.7	0.1	0.5	0.1	1.6	9.4	9.0	9.0	14.1	0.0	0.6	1.9	1.3	2.1		9.3	4.7	0.7	0.2
1993	*102.3*	4.0	2.5	8.0	1.2	1.8	1.5	3.7	7.1	6.6	1.2	1.4	2.0	0.6	0.1	4.0	0.4	1.2	0.2	1.0	0.0	4.5	7.8	6.9	5.3	5.6	0.1	0.2	0.9	1.6	2.5	0.1	10.3	7.4	0.6	0.3
1994	*104.1*	5.6	3.7	5.5	1.2	1.3	1.7	2.6	3.7	3.1	1.0	1.6	2.8	0.8		2.4	0.9	0.9	0.8	1.7	0.0	6.3	8.1	7.2	6.5	12.2	0.0	1.1	1.4	1.7	4.2		7.8	6.0	0.1	0.4
1995	*103.7*	2.5	4.6	4.8	3.1	0.5	1.7	2.0	5.0	5.4	1.3	1.0	3.6	0.6		1.5	0.2	0.3	0.3	2.6	0.1	4.0	8.2	7.1	7.1	17.3		1.2	0.5	0.2	1.9		9.5	5.0	0.3	0.0
1996	*92.6*	3.9	4.3	7.0	1.1	2.1	0.9	1.9	4.1	3.2	0.9	1.9	4.2	0.4		3.3	0.8	0.4		3.4	0.0	0.5	5.3	4.1	8.2	14.0		1.0	0.6	0.0	1.9	0.1	7.1	6.2		
1997	*104.9*	4.6	4.5	6.1	0.4	2.2	1.1	2.6	6.9	2.9	0.9	1.8	3.0	0.3		5.9	0.7	1.1	0.2	2.6		3.6	7.9	5.2	6.6	13.0		0.9	0.9	1.0	5.2		5.8	6.9		0.2
1998	*103.8*	3.5	2.4	4.5	0.8	3.3	0.9	2.7	2.8	2.9	1.0	3.0	4.4	0.8		6.8	1.2	0.8	0.0	1.5	0.0	2.0	9.0	4.0	8.2	11.6	0.0	0.6	1.2	0.4	4.4		9.2	7.7	1.9	0.2
1999	*102.3*	7.5	0.9	3.7	2.5	3.9	0.8	1.3	2.3	4.0	0.5	1.7	5.5	0.6		7.9	0.5	0.3	0.2	0.9		1.6	8.7	2.5	6.3	12.0		1.2	1.3	0.1	3.2	0.0	9.3	9.5	1.8	0.0
2000	*105.1*	3.5	3.2	4.7	4.1	1.7	1.0	1.1	6.3	3.1	2.0	0.8	6.4	0.6		5.8	0.4	0.4	0.1	2.1	0.0	3.4	8.2	8.6	6.2	10.3	0.0	1.0	0.4	0.3	2.5	0.0	9.8	6.8		0.1
2001	*104.8*	6.4	5.4	7.4	2.1	1.0	0.5	1.6	4.7	4.1	1.0	0.9	7.9	0.8		4.9	0.4	0.2		1.3	0.0	4.2	8.8	6.7	5.8	13.8		1.7	0.7	0.6	1.7	0.2	3.7	6.3		0.1
2002	*101.7*	7.3	5.5	4.5	2.1	0.6	2.1	2.1	3.0	5.0	0.3	0.7	4.9	0.8		5.1	0.5	0.6		1.7		3.2	8.6	4.2	6.0	12.7	0.2	0.5	0.2	0.2	2.9		9.2	6.9		0.0
2003	*101.5*	7.8	3.9	4.0	1.6	0.7	2.2	1.2	5.7	3.4	0.6	0.9	4.0	0.7		6.8	0.3	0.1		1.2		2.9	5.0	5.1	9.7	11.4		0.8	0.4	0.2	1.6	1.8	11.1	6.5		0.0
2004	*101.4*	5.4	4.9	5.3	1.9	2.0	2.6	0.7	2.9	2.6	0.2	2.0	2.1	0.7		4.3	1.0	0.4	0.1	1.7		3.6	5.4	4.5	9.8	12.1		0.8	0.7	0.2	3.2	3.4	6.8	9.8		0.1
2005	*102.4*	7.4	5.2	6.7	1.5	0.7	1.7	0.4	5.8	2.4	0.6	1.1	2.4	0.4		11.0	0.4	0.1		3.1		1.8	6.8	7.5	8.5	7.9		1.2	0.2	0.2	2.0	2.7	6.4	6.1		0.0
2006	*103.9*	5.5	8.6	4.6	3.0	0.6	0.6	1.0	3.8	6.7	0.9	1.6	3.0	0.1		8.2	1.2	0.2		3.9	0.0	4.2	11.4	5.1	4.9	6.5		1.0	0.6	0.1	2.2	3.2	3.4	7.8		0.1
2007	*103.7*	4.2	12.4	2.8	1.6	0.6	0.8	2.2	7.2	5.1	0.3	0.6	3.8	0.2		7.3	0.4	0.3	0.1	3.2		2.3	8.8	3.5	8.3	6.6		1.1	0.4	0.3	2.5	2.8	1.4	6.6	5.9	0.2
2008	*103.0*	3.7	9.9	4.0	1.1	1.5	1.5	2.2	5.6	7.2	0.4	2.4	2.8	0.5		5.4	0.9	0.1	0.2	2.2	0.0	3.2	8.5	3.3	6.2	12.0		1.1	0.4	0.1	1.9	0.1	5.1	9.6		0.1
2009	*102.3*	5.7	5.2	4.2	1.1	1.3	0.7	1.6	7.1	7.8	2.4	2.5	3.4	0.3		6.9	0.4	0.2	0.5	2.2	0.1	4.4	7.5	2.6	7.0	9.7		1.0	0.8	0.4	1.4	0.2	3.6	10.0		0.1
2010	*97.0*	7.9	6.6	3.3	1.1	0.8	0.9	0.9	4.7	7.9	0.5	1.3	2.5	0.2		4.2	0.1	0.2		2.7		5.4	4.2	11.0	6.4	12.0		0.9	0.1	0.2	1.1		4.1	5.8	0.3	0.0
2011	*94.1*	5.2	6.0	1.5	1.4	0.8	1.5	0.5	6.3	15.6	1.2	1.5	1.6	0.4	0.2	1.3	0.1	0.0	0.0	1.5		4.4	6.0	8.4	5.9	14.9		0.5	0.3	0.1	0.7		3.0	2.5	0.8	0.0
2012	*93.4*	5.7	7.5	1.8	0.8	0.5	1.7	0.7	14.7	10.2	1.1	1.4	1.5	0.1	0.1	0.8	0.1	0.2	0.0	0.5	0.4	3.4	5.5	9.0	5.8	14.3		0.3	0.1	0.1	0.5		1.8	2.7	0.1	0.0
2013	*89.0*	4.2	3.4	1.1	1.6	0.6	1.2	0.8	9.5	8.7	1.0	1.7	1.6	0.1		0.2	0.0	0.1	0.1	0.9	0.0	4.4	8.1	9.2	7.1	14.2		0.1	0.2	0.0	0.3		4.9	2.6	1.0	0.0
2014	*82.4*	5.0	6.4	0.4	2.1	0.9	0.3	0.3	11.2	12.8	1.3	1.6	1.0	0.6		0.1	0.1	0.0	0.1	0.0		3.9	8.8	5.2	4.9	8.8	0.0	1.0	0.1	0.1	0.4		2.8	2.0	0.2	0.0
2015	*65.8*	4.7	3.7	0.2	0.8	0.6	0.6	0.2	9.5	8.8	1.3	1.8	0.4			0.3	0.1		0.0	0.3		3.7	4.8	6.5	5.3	8.1	0.0		0.0	0.0	0.1		2.2	1.7	0.4	
2016	*66.7*	6.7	4.2	0.0	2.0	0.6	0.7	0.1	6.8	11.2	2.0	1.0	1.0	0.2		0.3	0.1	0.0		0.1		4.2	5.9	6.9	3.8	5.5			0.1	0.0	0.3		1.0	1.7	0.2	0.0
2017	*66.8*	3.8	4.0	0.2	1.4	0.8	0.5	0.3	7.5	10.5	2.8	0.7	0.8	0.4	0.1	0.5	0.0	0.0	0.1	0.5	0.0	2.8	5.9	6.9	3.4	8.8	0.0	0.0	0.1	0.0	0.2		1.5	1.2	0.8	0.1
2018	*57.0*	2.3	3.2	0.0	0.7	0.6	0.2	0.9	3.4	7.4	1.1	0.4	1.6	0.6		1.7	0.0	0.0	0.1	1.2		3.0	7.4	5.0	5.5	7.1		0.1	0.1	0.0	0.3		1.0	1.8	0.2	0.0
2019	*51.1*	1.7	3.6	0.1	1.1	0.4	0.2	0.7	4.3	8.2	1.7	0.3	0.9	0.5		1.8	0.0	0.0	0.0	1.2		2.5	6.7	3.9	4.1	4.2	0.0	0.2	0.2	0.0	0.3		0.3	1.7	0.2	0.0

Table 6.17. Calendar year blacklip CPUE (kg.hr^{-1}) from the Western Zone and SAUs, ordered by importance. Empty cells denote no CPUE estimate.

Season	*Western Zone*	Anxious Bay	Avoid Bay	Baird Bay	Cape Bauer	Cape Catastrophe	Coffin Bay	DEntrecasteaux Reef	Drummond N	Drummond S	Elliston Cliffs	Fishery Bay	Flinders Island	Franklin Islands	Greenly Island	Hotspot	Memory Cove	NE Thistle	Neptune Islands	North Nuyts	Pearson Island	Point Avoid	Point Westall	Reef Head	Searcy Bay	Sheringa	Sir Joseph Banks	South Nuyts	SW Thistle	Taylors Island	The Gap	Unassigned WZ	Venus Bay	Ward Island	Waterloo Bay	Wedge Island
1979	*22.7*	22.36	20.59	21.17					25.71	21.14												20.68	39.04	21.95		25.09					16.54				17.45	
1980	*24.7*	24.90	26.38	16.41		25.08	26.33		23.75	21.20		28.27										24.72	23.66	29.38		30.60				23.44			22.72	26.23	18.64	
1981	*23.8*	19.94	22.34				20.34		22.90	23.29		21.79	23.73									22.19	20.66	26.62	25.37	27.11			24.15		23.17		30.73	31.65	19.83	
1982	*25.2*	25.30	27.04	21.89		20.61			26.67	22.75		22.01										22.38	21.54	25.86	23.45	27.54					18.57		32.16			
1983	*23.2*	24.91	19.49	24.96			15.54		24.59	20.78	26.57	17.19	19.61									23.01	17.92	21.02	22.55	30.63					17.95		24.60			
1984	*24.2*	23.50	21.13	28.31		18.04			23.48	22.47	30.22	18.45	24.61				21.79					18.83	30.11	19.31	27.10	27.88			27.46	20.01	24.18		28.57	22.29		
1985	*23.6*	20.03	18.74	25.40		18.47		19.53	25.13	18.44	24.61	18.67	26.34	16.10						20.86		18.78	23.05	19.20	27.78	27.71			18.95	20.22	17.91		25.98			
1986	*23.9*	24.82	17.33	27.01	23.18	21.99	16.52		24.20	21.08	28.06	18.41	23.82									23.53	26.66	22.80	24.44	28.33					19.73		25.70	22.21	22.44	
1987	*22.5*	21.43	14.25	31.13	21.73	19.21	17.97		26.04	23.18		13.63	19.41									21.15	22.76	19.85	23.08	26.97			19.58		17.32		24.58			
1988	*22.4*	21.15	15.47	25.53	18.85	19.27	21.15	23.72	26.38	26.69		14.64	29.98	20.15			16.98			17.08		19.22	23.85	20.37	26.22	28.31		23.49	17.97	15.09	20.38		23.71	24.62	18.79	
1989	*23.7*	23.69	21.79	25.85		22.98		22.99	27.10	23.24		16.15	32.58	20.65			19.96	13.67		20.31		26.04	25.10	20.39	22.66	28.77		19.65	21.81	17.73	19.65		30.32	32.53		
1990	*25.9*	25.65	27.45	30.59				22.16	23.82	29.07	27.95	19.84	28.54	21.67		25.20	19.65	18.86		20.00		21.83	26.39	23.48	28.85	32.82		19.60	20.99		20.29		29.92	34.57		
1991	*26.3*	24.64	24.94	34.56		21.59	22.71		26.64	28.06	31.18	22.75	21.76			30.89	20.42	17.65				25.73	23.43	24.84	32.76	31.96			19.72	15.89	21.63		29.73			
1992	*25.8*	24.97	34.09	28.05	22.89	21.96	19.12		24.49	19.23		22.17	23.07	20.07		36.98	20.54	15.79				20.19	23.40	21.04	29.25	30.92			21.94	19.97	20.99		27.83	34.02		
1993	*25.8*	25.73	28.64	23.76	30.81	19.35	21.09	32.26	28.40	25.75		16.20	24.32			27.89		18.73				25.40	22.60	20.41	28.41	29.99			20.11	17.33	19.40		29.00	37.51		
1994	*26.0*	24.44	23.44	23.59	25.87	20.07	21.20	35.55	23.40	24.37		21.70	25.62			35.90	16.40			20.92		25.79	22.85	23.83	26.61	31.55		19.09	22.21	17.52	25.16		30.58	36.84		
1995	*25.6*	21.80	23.87	24.55	20.93		19.93	23.83	26.48	23.07		20.37	22.50	19.63		24.99				21.39		24.32	26.02	22.45	29.39	31.70		20.08			24.26		27.07	27.87		
1996	*24.7*	22.02	26.13	24.29	19.96	19.57	19.42	28.18	23.17	20.64		17.06	21.87			27.60	19.19			22.89			22.69	21.72	29.40	28.90		17.65			20.53		26.96	35.50		
1997	*26.0*	23.84	23.15	26.76		23.42	17.69	26.32	25.40	28.08		26.61	23.59			29.81		19.36		22.61		26.01	25.07	18.51	28.97	29.05			22.72		19.76		30.76	35.10		
1998	*25.2*	19.99	21.15	27.91		23.97		28.89	26.84	29.39		23.16	22.39			29.63				21.00		21.06	21.47	21.47	27.14	29.59			26.90		20.99		26.44	35.31	24.18	
1999	*25.6*	28.53		26.37	24.24	22.02		25.47	24.47	25.18		20.20	25.35			26.19						20.70	23.97	20.96	24.43	31.25		22.70	19.30		20.22		28.76	32.95	16.28	
2000	*26.1*	20.90	27.94	29.50	25.83	21.91			27.14	26.98		17.45	26.71	17.34		29.58				22.48		24.10	23.28	25.12	26.82	30.41		17.05			21.88		27.38	30.77		
2001	*28.4*	26.75	28.82	29.11	22.39	28.28		30.56	30.83	27.98			29.22	20.74		26.41				24.95		26.41	26.31	28.22	27.78	34.10		23.43					28.23	30.99		
2002	*28.3*	26.83	29.95	25.00	24.58		29.20	28.51	26.13	31.05			26.70			32.21				25.04		28.50	26.85	26.92	29.47	32.23					23.23		28.82	31.87		
2003	*29.8*	29.61	27.81	31.42	27.58		23.10		29.17	29.28			30.07			33.15				22.41		32.05	22.84	24.25	30.79	32.92						27.50	30.92	36.56		
2004	*29.4*	31.22	27.13	25.55	30.78	28.96	23.88		26.20	28.79		33.13	29.09	20.12		32.61				25.18		26.72	28.35	24.43	30.79	32.04					25.55	34.15	29.86	38.50		
2005	*30.2*	30.61	35.79	28.01	28.42		19.22		28.84	27.99			31.24			36.06				26.63		27.38	29.16	26.57	30.21	32.17		22.47			28.17	30.02	34.11	38.92		
2006	*31.2*	29.83	35.97	29.41	27.21				29.83	31.87			27.91			33.15				27.12		33.68	33.21	27.80	30.18	37.36		20.35			29.71	28.19	30.77	33.26		
2007	*29.1*	31.53	36.33	26.39	28.34			25.31	29.29	30.15			26.95			31.35				23.21		27.23	29.42	24.85	29.92	32.04		18.96			28.69	27.57	25.66	32.27	25.05	
2008	*28.5*	26.77	31.06	27.03		27.49	21.83	25.35	31.89	29.19		29.77	25.17			26.22				19.65		29.35	27.82	25.89	29.53	30.54					30.34		26.35	33.10		
2009	*27.0*	27.35	24.68	24.43	24.29	25.81		25.77	30.61	27.39	31.87	31.01	24.54			28.04				21.02		26.88	24.84	22.03	26.62	31.35					24.51		25.72	29.46		
2010	*26.2*	25.79	26.12	28.17					27.38	29.09		24.02	27.23			20.53				17.94		26.09	24.58	25.38	28.18	30.48		20.06					25.88	29.75		
2011	*25.6*	28.47	22.89				25.53		26.49	26.28		21.29	23.61			21.41				14.30		23.67	29.65	21.77	28.51	28.55							26.26	24.67		
2012	*24.8*	28.53	23.41				22.34		25.93	22.75		19.90	24.87									22.72	23.59	21.02	27.35	29.27							28.17	29.52		
2013	*24.6*	23.90	23.78		23.38	10.98	21.28	16.76	25.52	26.31	24.53	15.64	23.19									24.00	25.93	21.93	24.49	27.90							24.84	30.71		
2014	*23.0*	22.35	20.68		26.95	17.09			24.76	22.86	26.69	15.63	19.70									18.93	27.04	19.12	24.01	25.34							21.93	26.98		
2015	*22.8*	23.80	17.03						24.01	21.45	31.87	19.86										22.62	26.99	20.18	25.08	24.84							24.06	29.40		
2016	*22.4*	25.18	21.18		27.74		17.60		20.75	22.71	26.39		23.76									19.69	26.24	18.65	24.00	26.37								24.56		
2017	*22.2*	24.60	17.80		23.52	17.65			22.18	20.81	26.36	16.45										20.17	28.35	18.72	23.44	24.51							22.69	28.94		
2018	*21.08*	18.59	19.66					10.96	19.66	20.51	18.42		27.19			26.16				15.29		18.08	26.20	16.82	23.54	24.77								31.29		
2019	*20.6*	18.67	17.53					14.34	20.31	20.15	22.95					22.42				16.7		18.04	22.97	17.8	23.31	22.61								28.31		

Table 6.18. Annual zone score, score gradient, trend in zone score and status for blacklip and greenlip.

	Greenlip				Blacklip			
Year	Zone score	Score Gradient	Zonal trend	Status	Zone_score	Score Gradient	Zonal trend	Status
1993	4.99	0.01	5.00	Sustainable	5.19	-0.02	5.00	Sustainable
1994	4.48	-0.03	4.88	Depleting	4.82	0.00	5.00	Sustainable
1995	3.85	-0.07	4.21	Depleting	4.50	-0.04	4.79	Depleting
1996	4.63	-0.04	4.83	Depleting	4.92	-0.02	5.00	Sustainable
1997	4.43	0.01	5.00	Sustainable	4.37	-0.02	5.00	Sustainable
1998	5.05	0.08	5.83	Sustainable	4.72	0.00	5.00	Sustainable
1999	5.48	0.08	5.95	Sustainable	5.07	0.02	5.00	Sustainable
2000	6.62	0.15	7.07	Sustainable	5.62	0.08	5.96	Sustainable
2001	7.36	0.18	7.58	Sustainable	6.27	0.12	6.54	Sustainable
2002	8.41	0.19	7.69	Sustainable	6.65	0.11	6.46	Sustainable
2003	8.34	0.11	6.45	Sustainable	6.72	0.07	5.78	Sustainable
2004	8.55	0.05	5.45	Sustainable	7.10	0.05	5.34	Sustainable
2005	8.25	0.00	5.00	Sustainable	7.29	0.04	5.19	Sustainable
2006	7.69	-0.03	4.97	Sustainable	6.69	0.00	5.00	Sustainable
2007	6.94	-0.06	4.35	Sustainable	6.44	-0.04	4.78	Sustainable
2008	6.01	-0.09	3.98	Sustainable	5.65	-0.07	4.22	Sustainable
2009	5.08	-0.11	3.67	Sustainable	4.89	-0.09	4.02	Depleting
2010	4.97	-0.09	3.95	Depleting	4.37	-0.10	3.69	Depleting
2011	5.23	-0.03	4.84	Sustainable	4.25	-0.07	4.20	Depleting
2012	4.77	-0.01	5.00	Sustainable	3.92	-0.05	4.53	Depleting
2013	3.11	-0.12	3.45	Depleting	3.23	-0.08	4.16	Depleting
2014	4.37	-0.09	4.00	Depleting	4.18	-0.02	5.00	Sustainable
2015	4.81	0.03	5.02	Sustainable	3.19	-0.03	4.93	Depleting
2016	4.74	0.11	6.42	Sustainable	3.00	-0.04	4.70	Depleting
2017	3.36	-0.10	3.78	Depleting	2.47	-0.16	2.72	Depleting
2018	2.98	-0.16	2.84	Depleting	2.33	-0.07	4.20	Depleting
2019	3.34	-0.10	3.83	Depleting	3.33	0.03	5.04	Sustainable

6.8 Fishing for the live market

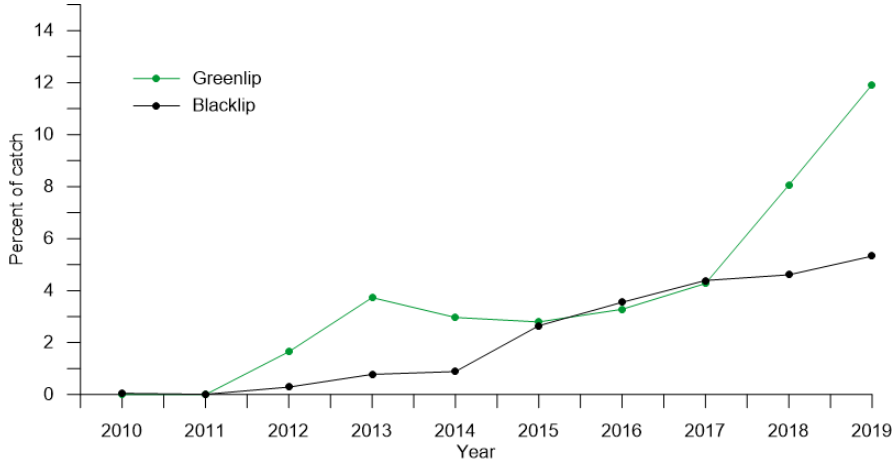

Figure 6.11. Percent of greenlip and blacklip (see legend) catch landed whole in the Western Zone from 2010 to 2019. Note BL landing excludes areas affected by *Perkinsus* near Port Lincoln and Baird Bay.

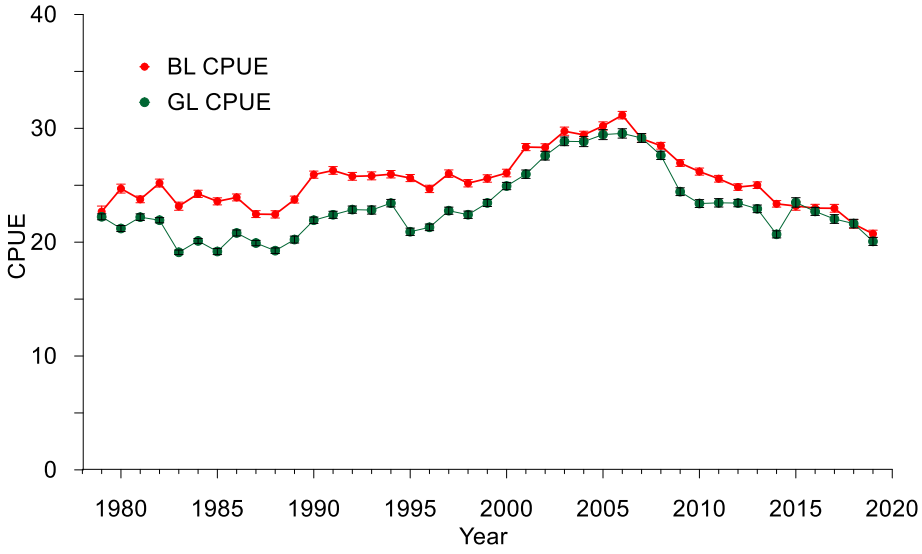

Figure 6.12. Western Zone greenlip and blacklip (see legend) CY CPUE ± se (kg.hr^{-1}) calculated from 1979 to 2019 with estimates from 2010 to 2019 excluding fishing days where catch was landed whole.