Fisheries

Western Zone Greelip Abalone (*Haliotis laevigata*) and Blacklip Abalone (*H. rubra*) Fishery in 2021-22

B. Stobart, K. Heldt and S. Mayfield

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SARDI
South Australian Research and Development Institute

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ABBREVIATIONS

AVG	Abalone Viral Ganglioneuritis
CPUE	Catch Per Unit Effort
FD	Fishery Dependent
FI	Fishery Independent
HS	Harvest Strategy
MDS	Multi-Dimensional Scaling
MLL	Minimum Legal Length
NFSRF	National Fishery Status Reporting Framework
PI	Performance indicator
PIRSA	Department of Primary Industries and Regions
PropG1	Proportion of Grade 1 (Greenlip Abalone in the catch)
SAAF	South Australian Abalone Fishery
SARDI	South Australian Research and Development Institute
SAU	Spatial Assessment Unit
TACC	Total Allowable Commercial Catch
WZ	Western Zone
WZAF	Western Zone Abalone Fishery
VCL	Voluntary catch limit

EXECUTIVE SUMMARY

This report assesses the status of the Greenlip Abalone (*Haliotis laevigata*) and Blacklip Abalone (*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 2021/22 financial year. The assessment includes application of the harvest strategy (HS) included in the Management Plan for the South Australian Commercial Abalone Fishery (PIRSA 2021) to determine stock status. The stock status from the HS is aligned with the National Fishery Status Reporting Framework (NFSRF; Piddocke et al. 2021). The HS uses financial year information to recommend a zonal catch for the following (calendar) quota year for the fishery. Unless otherwise stated, all years in this report refer to financial year and are indicated by the first year (e.g., 2021/22 financial year will be referred to as 2021).

Greenlip

During 2021, greenlip comprised 51% (47.4 t) of the combined abalone catch in the WZ, with total catches decreasing 41% since 2012 (79.8 t). The catch in 2021 was the lowest on record.

Application of the HS resulted in a zone score of 3.02. This was a decrease from 3.10 in 2020 and matches the value in 2018, the two being the lowest zone scores recorded. Together with the zone trend score of 5.00 (reflecting a stable trend), the zone score of 3.02 defines the stock status for greenlip in the WZ in 2021 as **'sustainable'**. A zone score of 3.02 translates to a recommended zonal catch of 43.23 t for the 2023 quota period, which is 2% below the TACC for 2022.

The HS greenlip status for 2020 and 2021, 'sustainable', reflects evidence that the long-term decline in harvestable biomass since 2003 has likely abated. This evidence includes (1) a relatively stable zone score, albeit at a low level, since 2017; (2) small, but consistent, increases in CPUE for the WZ and some SAUs between 2019 and 2021; (3) a high proportion of Grade 1 greenlip being harvested at many SAUs; and (4) relatively stable, but low density estimates of legal density from FIS at The Gap. In contrast, (1) FIS legal density estimates at Avoid and Anxious Bays show long-term declines, with 2021 estimates the lowest on record; and (2) CPUE for some SAUs remains at, or among, the lowest estimates on record.

Although the 'sustainable' status reflects stable biomass, the harvestable biomass of WZ greenlip is among the lowest on record. For abalone, low densities result in a high risk of recruitment impairment. For the WZ, there is strong evidence of recent low recruitment that may indicate some stocks are already recruitment impaired. For example, the current catch – the lowest on record – was harvested at a CPUE among the lowest recorded, demonstrating recent levels of recruitment

are substantially lower than those which supported previous, long-term, higher catches and catch rates. In addition, the density of greenlip at FIS sites is below that likely required for successful reproduction, with limited reproductive success also reflected in the density of sub-legal-sized greenlip in 2021 that was the lowest on record for both Anxious and Avoid Bays and amongst the lowest on record for The Gap. This indicates that recruitment is limited in these key SAUs, from which, collectively, 35% of the greenlip catch was obtained in 2021.

Blacklip

During 2021, blacklip comprised 49% (45.4 t) of the combined abalone catch in the WZ, with total catches decreasing 55% since 2012 (100.1 t).

Application of the HS resulted in a zone score of 3.10 and a zone trend score of 5.57 (reflecting an increasing trend), defining the stock status for blacklip in the WZ in 2021 as **'sustainable'**. This was the same stock status as 2019 and 2020. A zone score of 3.10 translates to a recommended zonal catch of 44.11 t for the 2023 calendar year quota period which is 1% above the TACC for 2022.

The blacklip status from the HS from 2019 to 2021 of 'sustainable' reflects evidence that the long-term decline in harvestable biomass since 2005 has likely abated and that stock recovery may have started. This evidence includes (1) an increase in zone score from 2.5 in 2018 to 3.1 in 2021; (2) small increases in CPUE for the WZ and some SAUs between 2018 and 2021; and (3) increasing estimates of legal density from FIS at Drummond South, Sheringa and Point Westall over the last three surveys. In contrast, there is no evidence of increases in legal density estimates from FIS at Avoid Bay, and CPUE for some SAUs remains at, or among, the lowest estimates on record.

However, the harvestable biomass of blacklip in the WZ is amongst the lowest on record and, as with greenlip, there is an associated, elevated risk of recruitment impairment. Notably, current catch is low and was harvested at a CPUE among the lowest recorded, demonstrating recent recruitment is likely lower than the levels that supported previous, long-term, higher catches and catch rates.

Conclusion

The 2021 HS outcome for both greenlip and blacklip is 'sustainable', with the low HS scores constraining recommended catches below the target catches for these fisheries (Greenlip target catch: 78 t; Blacklip target catch: 77 t). The recommended catch for greenlip in 2023 is 2% lower than the TACC for 2022, while that for blacklip is 1% higher than the TACC in 2022.

The persistent, current low biomass of greenlip, and the slow recovery from a similarly low biomass for blacklip, are likely due to a combination of overfishing and environmentally driven changes in productivity. Low biomass means that there is an associated risk of recruitment impairment for both species which requires careful consideration of future catch levels. These risks can be reduced through a combination of lower catches, higher size limits and both spatial and temporal restrictions on fishing to protect stocks at the highest risk (e.g. Greenlip Abalone in Anxious Bay, Flinders Island and The Gap, Blacklip Abalone in Reef Head, Avoid Bay Anxious Bay and Sheringa). Both stocks will require careful monitoring in future years.

Key summarised WZ blacklip and greenlip statistics: **Calendar year** - number of licences (No. licences); total allowable commercial catch (TACC); voluntary catch limit (VCL) and total commercial catch (TCC); **Financial year** - stock status from the harvest strategy (HS). tmw = tonnes meat weight.

Calendar year				Financial year	
Year	No licences	TACC (tmw)	VCL (tmw)	TCC (tmw)	HS Stock Status
BLACKLIP					
2019	22	58.6	53	51.08	Sustainable
2020	22	43.0	NA	40.39	Sustainable
2021	22	47.3	44.3	45.19	Sustainable
GREENLIP					
2019	22	73.01	66.4	66.05	Depleting
2020	22	51.0	NA	49.05	Sustainable
2021	22	48.9	NA	51.02	Sustainable

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 (*H. rubra*, hereafter referred to as blacklip) in the Western Zone (WZ) of the South Australian Abalone Fishery (SAAF; Figure 1.1) in the 2021/22 financial year. The level of reporting for the two species differs because species-specific 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 and Mayfield 2021). This report (1) assesses the status of each resource; (2) identifies the uncertainty associated with each assessment; and (3) documents future research needs for both species.

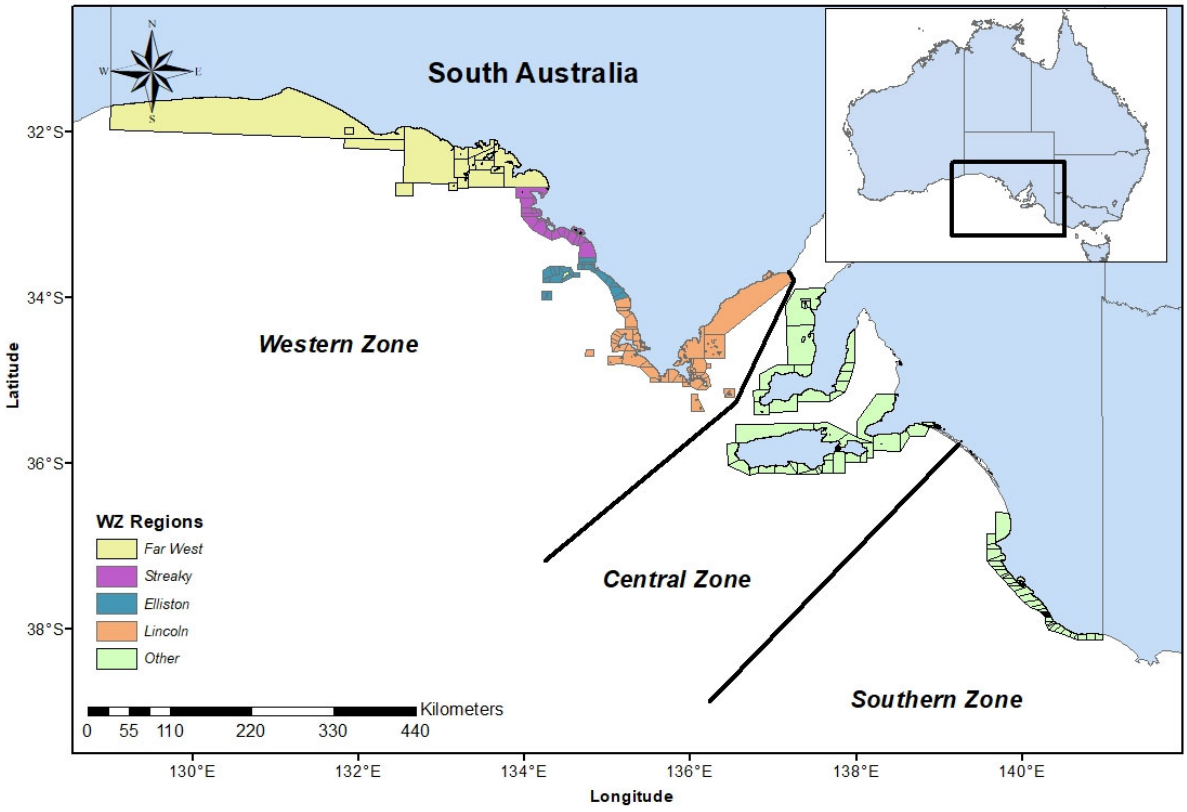

Figure 1.1. Fishing zones and mapcodes of the South Australian Abalone Fishery and regions of the WZ.

Data are presented for three spatial scales (Zone, Spatial assessment units (SAU), and Regions) and by financial year, as financial year is the time step specified by the harvest strategy (HS)

described in the Management Plan for the fishery (PIRSA 2021), noting the quota is set by calendar year. Thus, unless otherwise stated, information provided throughout this report is by financial year and referred to by the last year (e.g. 2021/22 financial year would bereferred to as 2021). The HS includes assignment of stock status consistent with the NFSRF (Table 1.1; Stewardson et al. 2018, Piddocke et al. 2021) 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

1.2 History and description of the fishery

1.2.1 Commercial fishery (calendar year)

A review of the management history of the SAAF since its inception in 1964 is provided by (Mayfield et al. 2012). The calendar year historical annual catch and quota (Figure 1.2) and listed major management milestones (Table 1.2) are provided for reference. Notably, prior to the introduction of quota, average annual greenlip catch from 1968 to 1973 was 215 t, almost double that during the following eleven years prior to the introduction of quota (128 t) and more than double that during the first decade post-quota (87 t). In contrast, the average catch for blacklip was 98 t from 1968 to 1973, a third less than in the eleven years prior to quota (63 t) and higher than during the first decade post-quota (102 t).

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 licences. These 35 licences remained in the fishery 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.

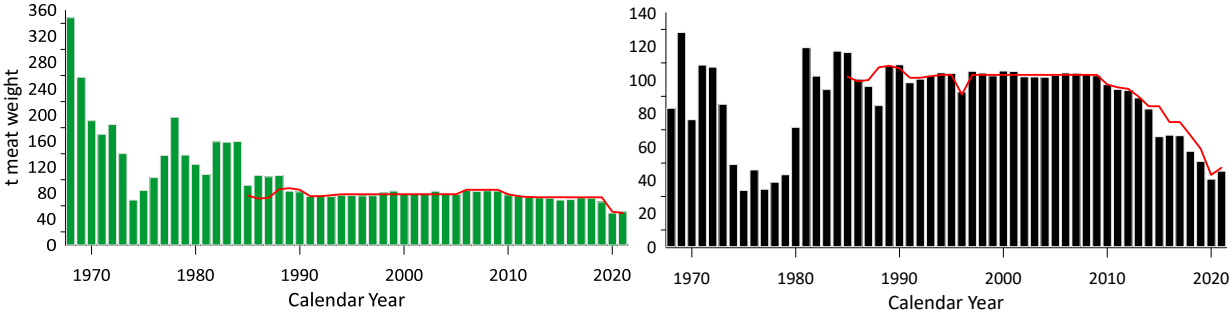

Figure 1.2. Western Zone catch (t, meat weight; bars) and total allowable commercial catch (red line) for greenlip (green bars) and blacklip (black bars) from the 1968 to 2021 **calendar years**.

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 (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.

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. A catch and effort logbook must be completed for each fishing day and submitted to SARDI Aquatic Sciences at the end of each month.

Since 1997, the WZ fishery has operated under the control of formal management plans (Zacharin 1997, Nobes et al. 2004, PIRSA 2012, PIRSA 2021). 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.

Calendar year	Milestone
1964	Fishery started
1970	More than 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 Voluntary closed season in Region B from October to February
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 to mapcodes constituting Searcy, Baird, Venus and Anxious Bays (see Figure 1.2).
2019	TACC in blacklip fishery decreased to 58.6 t; voluntary agreement to limit catch to 53.0 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.
2021	TACC in blacklip fishery increased to 47.3 t; voluntary agreement to limit catch to 44.3 t. WZAF closed to fishing from 1 October to 31 December. TACC in greenlip fishery decreased to 48.9 t. WZAF closed to fishing from 1 October to 31 December.
2022	TACC in blacklip fishery decreased to 43.5 t. WZAF closed to fishing from 1 August to 31 October. TACC in greenlip fishery decreased to 44.1 t. WZAF closed to fishing from 1 August to 31 October.

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

Management strategy	Western Zone management arrangements in the 2021 calendar year
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

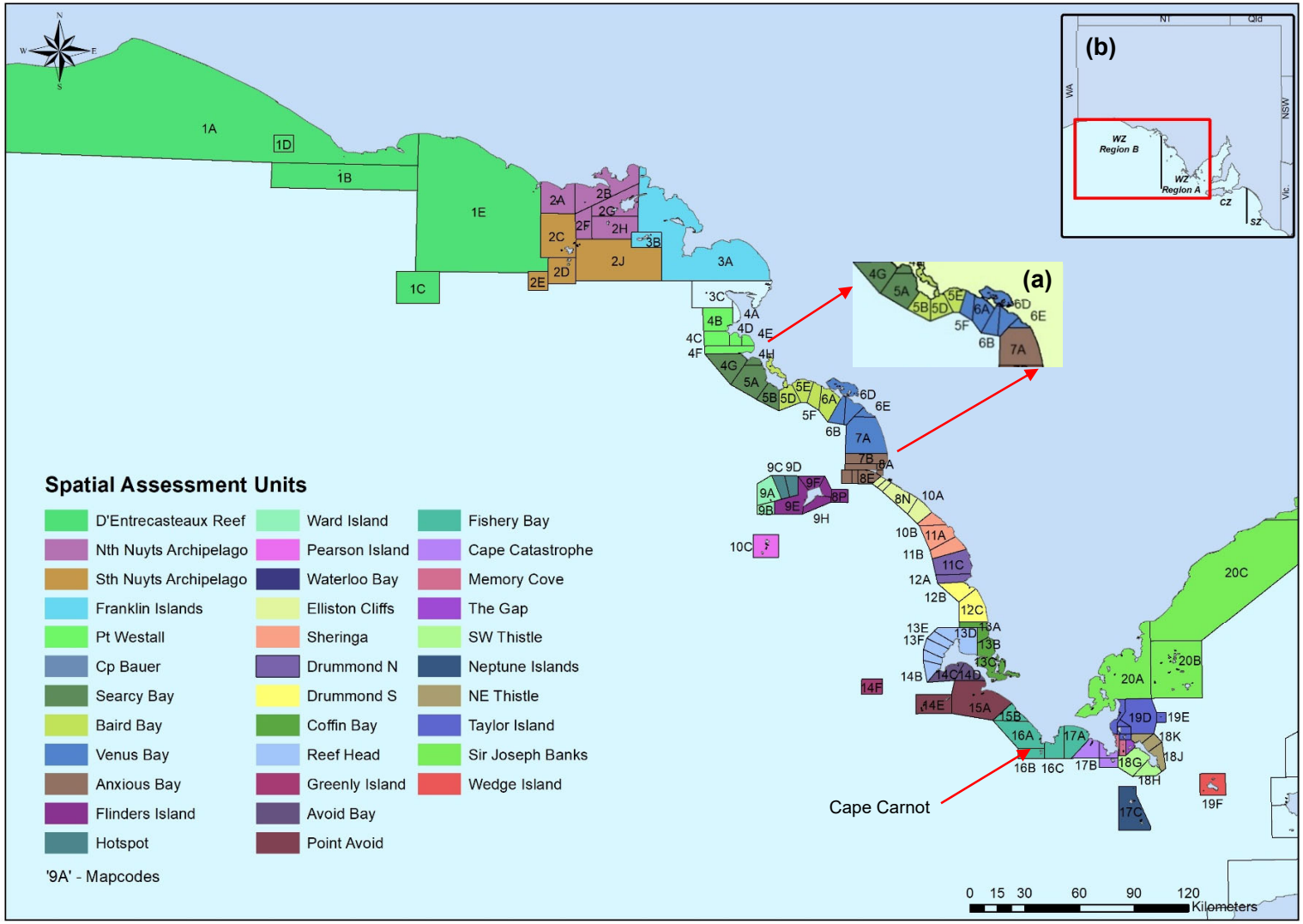

Figure 1.3. Spatial Assessment Units (SAUs) and map codes of the Western Zone South Australian Abalone Fishery. Inlay (a) shows old mapcode groupings for SAUs Searcy, Baird, Venus and Anxious Bays; inlay (b) shows old WZ region split.

1.2.2 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 2015). This equates to an estimated 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 2015), equating to 789 abalone.

1.3 Management Plan

The Management Plan for the SAAF (PIRSA 2021) 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*.

This report is directly relevant to the first goal of the Management Plan, 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 HS is described in the Management Plan and is the primary tool used to achieve the goal of sustainably harvesting the abalone resource and allocating stock status in accordance with the NFSRF (PIRSA 2021). The HS is consistent with the *National Guidelines to Develop Harvest Strategies* (Sloan et al. 2014) and the *South Australian HS Policy* (PIRSA 2015).

The HS provides a structured, species-specific, and spatially explicit, framework for decision making and includes assignment of stock status consistent with the NFSRF. 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 fishery independent surveys (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 SAU catches can be adjusted within a 10% range based on the information through harvest decision rules. The summed adjusted SAU catches inform setting of the TACC for the following season.

1.4 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 2016). Additional information on the biology of both species is also provided in Appendix 6.1. 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 the protozoan parasite *Perkinsus olensi* (Goggin and Lester 1995) and abalone viral ganglioneuritis (AVG; Mayfield et al. 2012a). *Perkinsus* is established in South Australia and negatively impacts three commercially harvested abalone species (Goggin and Lester 1995, Lester and Heyward 2005), but AVG has not been recorded in the State. Animals chronically infected with *Perkinsus* 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 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 (i.e. animals with lesions are present) 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 from 30 June 1968 to 30 June 2022. The FI data consist of density estimates and length frequency distributions from lead line surveys conducted periodically at selected SAUs.

Data were analysed at three spatial scales: (1) the WZ; (2) four regions of the WZ (termed Port Lincoln, Elliston, Streaky Bay and Far West); and (3) the SAUs and combined SAUs defined in the HS (see Figure 1.3 and PIRSA 2021). 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 by financial year and, where referred to and in figures, are described using their first year (e.g. 2020 refers to the 2020/21 financial year).

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 that fall into other groups.

Spatial and temporal analyses of annual CPUE and proportion of Grade 1 greenlip (PropG1; the largest grade category) were compared across financial 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 6.2, 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, the largest grade category where abalone weigh ≥230g meat weight, 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. For CPUE, where less than ten records are available for the year, the HS allows the estimation of CPUE by the inclusion of additional data from previous years (as described in the new HS, PIRSA 2021). These CPUE values can be identified in the plots as they lack error bars. Where there is a complete absence of CPUE data for a particular year CPUE is not estimated. For PropG1, the absence of data in any one year indicates fewer than 10 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).

2.1.3 Fishery-independent data

Greenlip abundance and size structure were obtained from SARDI FIS which are currently undertaken biennially. The FI output statistics include mean density (± se) of legal and sub-legal-sized greenlip and length-frequency distributions. In 2021, FI data were obtained for three SAUs – The Gap, Avoid Bay and Anxious Bay– and were estimated from 100m lead line surveys (McGarvey et al. 2008).

To improve the precision of the greenlip FIS at The Gap, the number of lead line transects was increased from 18 in 2009 and 2011 to 26 from 2013 onwards. The additional lead lines have now been incorporated into the FIS estimates used in the HS, with the two density values before 2013 hindcast based on the regression between the density using the original 18 lines from 2009 onwards against the new estimate using all 26 lines from 2013 onwards (i.e. comparison of the 5 years of density estimates using the alternative number of lead lines from 2013 to 2021). The use of parallel surveys to incorporate the new transects is considered ‘best practice’ and consistent with the approach used for other fisheries (e.g. blue crab; Beckman and Hooper 2019).

Length frequency distributions are shown in plots of number of greenlip by size bin. In order to aid the interpretation of the length-frequency distributions, the numbers are also converted to percentages and the percentage of large greenlip (LARGE) from FI survey length-frequency distributions is 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) is 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 and Mayfield 2021) and generally mirror those described above for greenlip. There were three differences between blacklip and greenlip performance indicators. First, there is no equivalent to the PropG1 secondary greenlip indicator to inform the blacklip assessment. Second, blacklip data for the Drummond SAU are split into Drummond North and Drummond South whereas for greenlip the data is reported for Drummond because there is insufficient data for greenlip to report Drummond North and Drummond South separately. Third, blacklip FI surveys use cross drops as opposed to the 100m lead lines used for greenlip (Stobart and Mayfield 2021).

2.3 Harvest Strategy – Greenlip and Blacklip

The HS is described in the Management Plan for the South Australian Commercial Abalone Fishery (PIRSA 2021). Briefly, the HS uses financial year FD and FI data. The FD data are used to estimate 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. Low-catch SAUs are combined by region to allow the determination of CPUE scores. Scores of the 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 (2021).

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 6.3.

3 RESULTS

3.1 Greenlip

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

Following very large catches in the 1970's (average 215 t.yr^{-1}; see Figure 1.2) and high catches in 1982 and 1983 (~ 170 t.yr^{-1}), total catches were relatively stable between 1988 and 2018, with catch ranging from a high of 87.4 t in 2005 to a low of 62.1 t in 2013 (Figure 3.1a). Catch then decreased 31% from 2018 (69.1 t) to 2021 (47.4 t), which was the lowest value on record. 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 1978 and 1997 (mean 21.4 kg.hr^{-1}), whereafter it increased to a peak of 29.8 kg.hr^{-1} in 2004 (Figure 3.1a), and then decreased 32% from 2005 to 2013 when it was among the lowest values on record (20.0 kg.hr^{-1}). Although CPUE increased 12% between 2013 and 2015, following this it continued to decline to 2018 when it was the fourth lowest value on record (19.6 kg.hr^{-1}). From 2018 there were small CPUE increases in each of three consecutive years, and in 2021 was 20.8 kg.hr^{-1} (Figure 3.1b). The proportion of Grade 1 greenlip in the commercial catch was the highest on record in 2021. The 2021 value for the combined trend of relative catch and CPUE was the lowest value on record, reflecting the relatively low catch and catch rate in 2021 (Figure 3.1c). While fishing effort in the >20m depth range has remained relatively stable for almost three decades (except for the slight increase in effort during 2015–2019), fishing in the 0-10m range has decreased from 2001 and increased in the 10-20m range (Figure 3.1d).

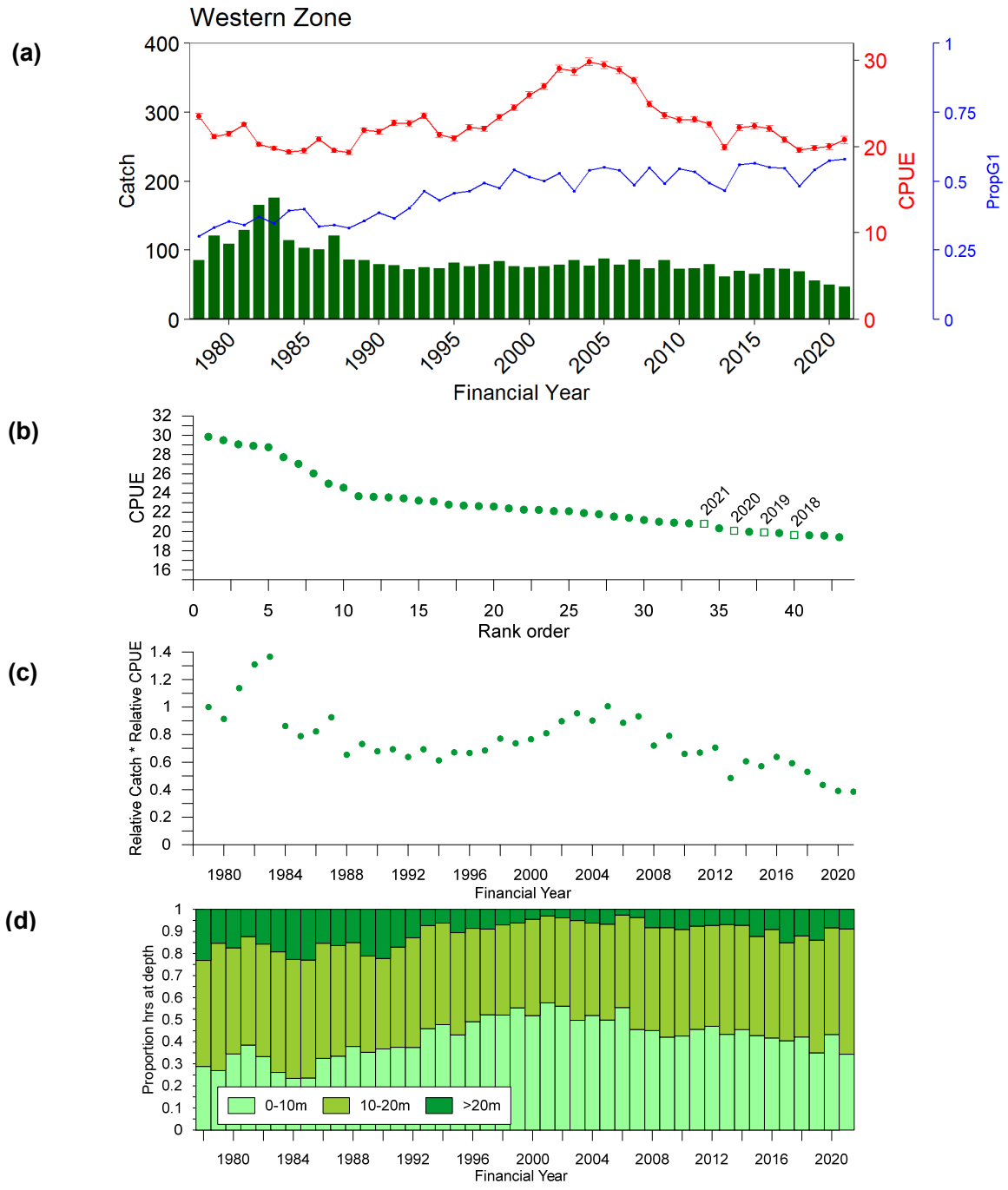

Figure 3.1. Greenlip **(a)** Catch (t, meat weight; green bars) from the Western Zone from 1978 to 2021. CPUE ± se (kg.hr^{-1}) and PropG1 are shown as solid red and blue lines, respectively. **(b)** Rank order of Western Zone greenlip CPUE. Last four years are marked with open square symbols. **(c)** Combined trend of relative catch and relative CPUE from the Western Zone from 1978 to 2021. **(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 Catch and CPUE within Regions of the WZ

The percent of catch harvested from the four regions was similar from the introduction of quota in 1984 to 2005, whereafter it mostly decreased in the Elliston region and generally increased in the Port Lincoln region between 2005 and 2021 (Figure 3.2a). Catch from the Streaky region increased from 2012 to 2013 and generally remained higher thereafter. During the same period catch from the Far West decreased and remained relatively stable at a low percentage between 2014 and 2021.

The CPUE in the Port Lincoln region was relatively stable from 1978 to 1999, whereafter it increased and, in 2005, reached a peak of 33.05 kg.hr^{-1} (Figure 3.2b). CPUE then declined from 2005 to 2017, with the 2017 value (17.8 kg.hr^{-1}) the lowest on record, but has subsequently increased 12% from 2017 to 2021 (20.0 kg.hr^{-1}). Similarly, the CPUE from the Elliston and Streaky Bay regions generally decreased from peaks in the mid-2000's, with CPUE from the Elliston region decreasing to the lowest value on record in 2021 (20.0 kg.hr^{-1}). CPUE in the Streaky Bay region decreased from the peak in 2005 to 2010, whereafter it increased to a second peak in 2014 (28.3 kg.hr^{-1}), subsequently decreasing consistently from 2014 to 2020, and then increased 13% between 2020 and 2021 when it was among the highest values recorded for this region. The Ceduna region CPUE was variable but relatively stable from 1987 to 2008, whereafter it increased to ~21 kg/hr^{-1} in 2013 and 2016 and had the lowest recorded values for this region in 2018 and 2019. CPUE was not estimable for this SAU in 2020 but increased 74% from 2019 (14.5 kg.hr^{-1}) to 2021 (25.3 kg.hr^{-1}) when it was the third highest value on record.

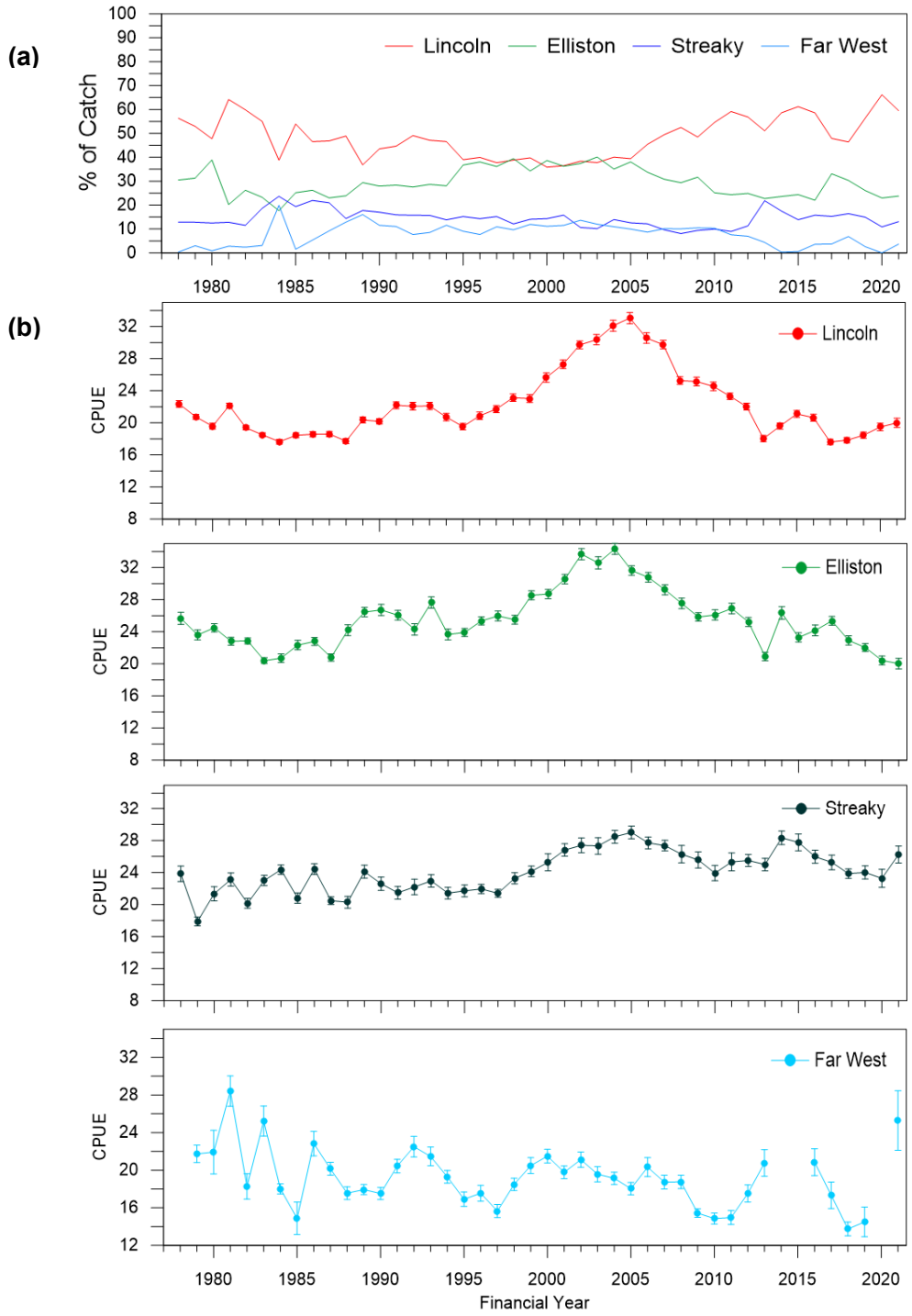

Figure 3.2. **(a)** Comparison between percent greenlip catch and **(b)** CPUE ± se (kg.hr^{-1}) at Western Zone regions (see legend) from the 1978 to 2021 financial years.

3.1.3 Distribution of catch among spatial assessment units

In 2021, the seven SAUs from which more than 5% of the total greenlip catch was harvested were Avoid Bay (19.1%), The Gap (9.7%), Point Avoid (8.2%), Anxious Bay (6.6%), Hotspot (5.7%), Point Westall (5.6%) and Drummond (5.1%). Cumulatively, these SAUs contributed 60% of the catch. This was similar but lower than the nine SAUs that exceeded 5% of the total greenlip catch in 2020 that represented 64% of the catch. The distribution of catch among SAUs was similar between 2020 and 2021, with the largest changes being increases at Avoid Bay (7.0 t; 14.0% to 9.0 t; 19.0%) and South Nuyts Archipelago (0.0 t; 0% to 1.4 t; 3.0%) and decreases at Memory Cove (2.1 t; 4.2% to 1.0 t; 2.0%), and SW Thistle (1.8 t; 3.6% to 0.8 t; 1.8%).

The MDS plot shows three groupings of years based on CLUSTER analysis (75% similarity) where the distribution of greenlip catch in SAUs within each group was similar (Figure 3.3). The longest period of similarity occurred when the catch contribution from SAUs was more diverse and lasted 20 years, primarily encompassing the 1990s and 2000s. During this period, the catch contribution was more evenly distributed among SAUs and generally changed less abruptly among years (Figure 3.4). Catch distribution from 2009 to 2016 was consistent with a separate cluster similar to the period 1981 to 1988, while recent catches from 2017 to 2021 were similarly distributed to those from 1978 to 1980 when catches from Point Avoid and Avoid Bay were higher.

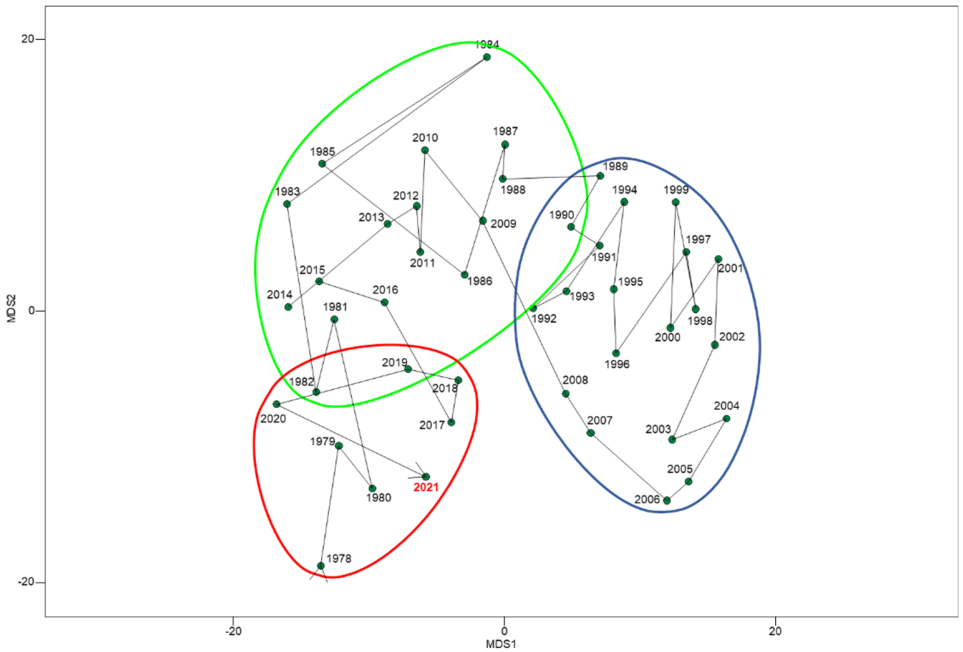

Figure 3.3. Multi-dimensional scaling (MDS) plot for SAUs showing similarity among years based on greenlip catch from the Western Zone from the 1978 to 2021 financial year. 2D stress = 0.24. coloured lines indicate numbered clusters with 75% similarity.

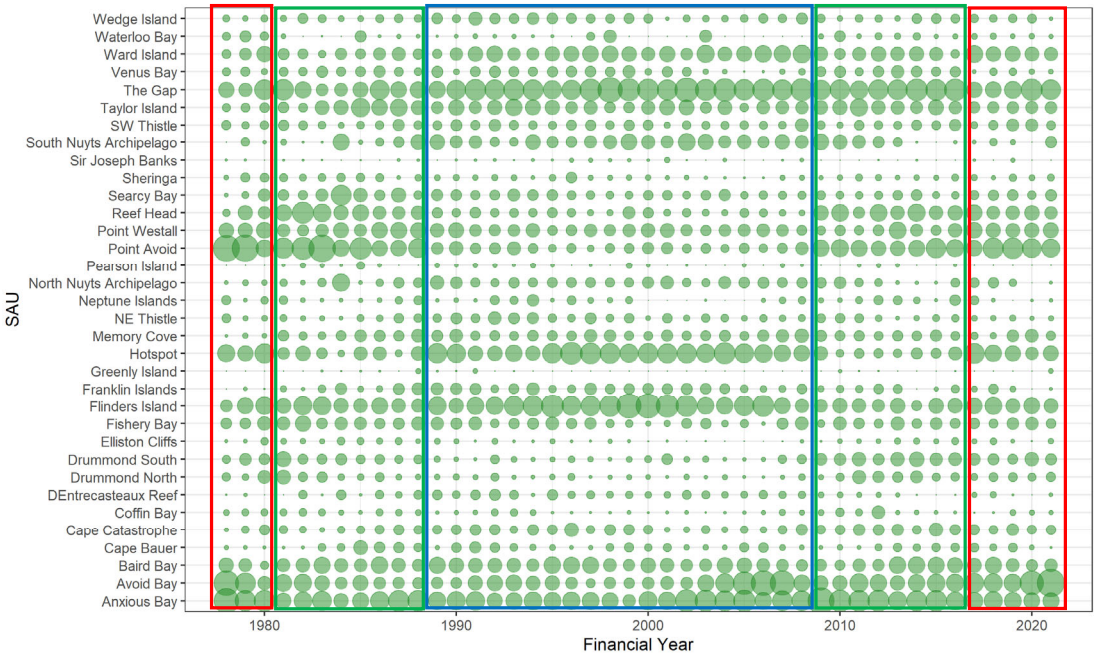

Figure 3.4. Bubble plot showing the spatial distribution of the greenlip catch (% of total catch) among the SAUs in the WZ from the 1978 to 2021 financial years. Coloured boxes represent clusters from the MDS in Figure 3.3.

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 one of the four amalgamated low catch SAUs (Figure 3.5). All three SAUs (The Gap, Anxious Bay and Avoid Bay) scored for legal density were below 5. The SAUs with a combined score below 5 contributed 69% of the 2021 financial year greenlip catch.

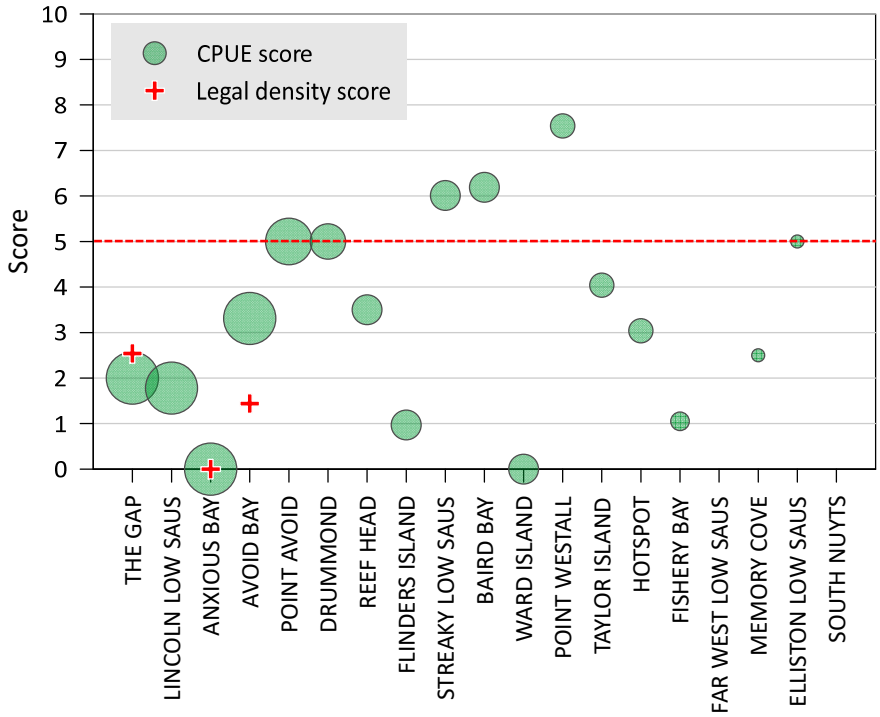

Figure 3.5. Greenlip SAU CPUE and legal density scores for the 2021 financial year (see legend). Bubble size for CPUE indicates % of WZ catch in the 2021 financial year. SAUs sorted left to right by decreasing catch contribution in 2021. Dashed red line shows target score of 5.

3.1.5 Temporal patterns in spatial assessment units

The Gap

With few exceptions, annual catches from The Gap have ranged between approximately 6 and 10 t.yr^{-1} (Figure 3.6 a). Catch almost halved between 2016 (8.9 t) and 2017 to 4.4 t and remained low thereafter. CPUE decreased between 1980 and 1988 (15.9 kg.hr^{-1}), whereafter it generally increased to a peak of 31.3 kg.hr^{-1} in 2004. Between 2004 and 2017, CPUE declined 53% to 14.7 kg.hr^{-1}, the lowest value on record and below the limit reference point of the HS. CPUE subsequently increased between 2017 and 2021 but remained below the target reference range in 2021 (18.6 kg.hr^{-1}). PropG1 increased substantially between 2018 and 2020 to the highest value on record, remaining relatively high in 2021 (Figure 3.6 a). In 2021, catch and CPUE were low relative to historic values, while PropG1 was amongst the highest on record (Figure 3.6 b).

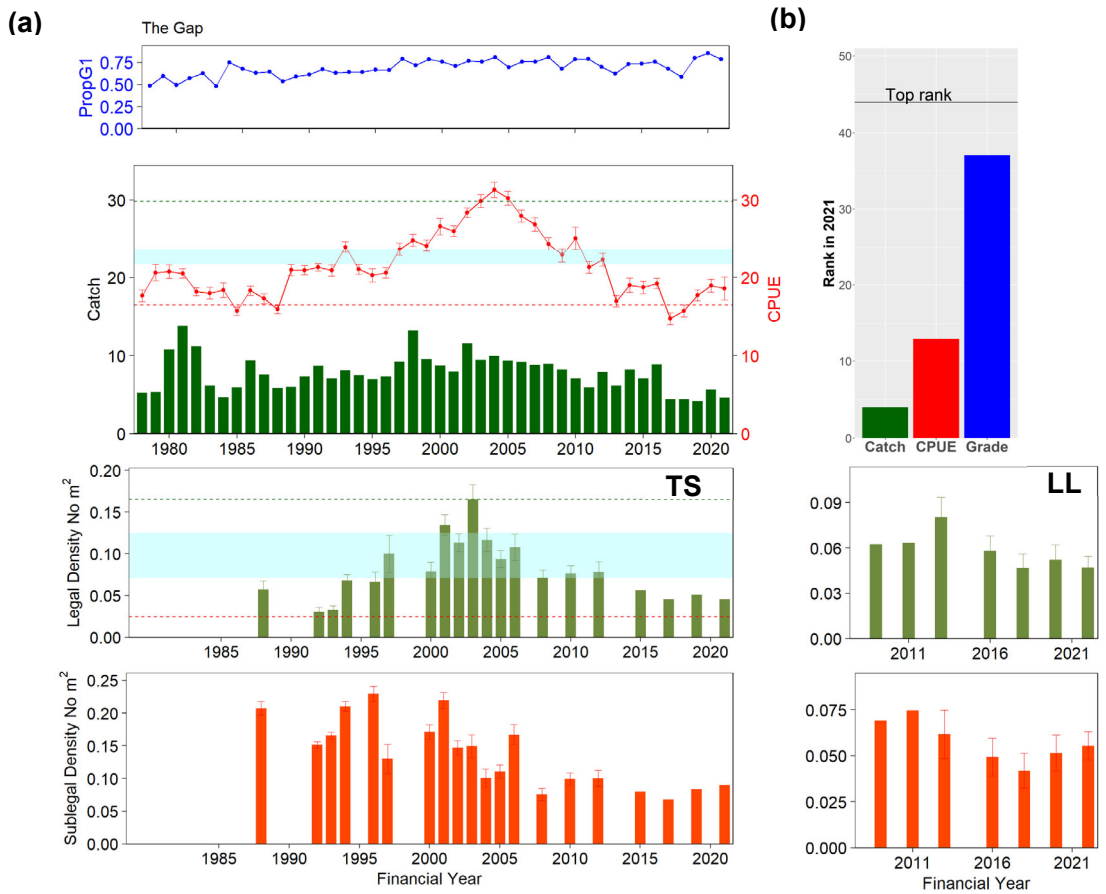

Figure 3.6. The Gap greenlip **(a)** Catch (t meat weight, green), CPUE ± se (kg.hr^{-1}, red), PropG1 (blue), legal-sized mean density ± se (abalone.m^{-2}; olive green) and sublegal-sized mean density ± se (abalone.m^{-2}; red bars) from 1978 to 2021. For HS performance indicators CPUE and legal-sized mean density, horizontal green and red dashed lines show the upper and limit reference points, respectively, and the target reference band is shaded light blue. Densities are from fishery-independent surveys from 1988 to 2021 in mapcode 18F. TS = timed swim, LL = Lead line (b) Rank of Catch, CPUE and PropG1 in 2021 relative to historic.

FI surveys at The Gap from timed swims (1988–2012) and conversion of the lead line densities to equivalent timed swim densities (2015–2021) indicate that the densities of legal-sized greenlip were lowest in the early 1990s, increased to the highest value on record in 2003 and subsequently declined to the fourth and third lowest values on record in 2019 and 2021, respectively (Figure 3.6 a). Legal density has remained below the target reference band from 2015 to 2021. The density of sub-legal-sized greenlip from timed swims (1988-2012) and conversion of the lead line densities to equivalent timed swim densities (2015–2021) was relatively high from 1988 to 2006 but has remained relatively low from 2008 to 2021. The decrease in legal density between 2012 and 2015 is also apparent in the length frequency distributions (Figure 3.7). However, the percentage of LARGE greenlip has been stable among years (range: 37–50%), with the highest percentage recorded in 2019. The percentage of SMALL greenlip has also remained relatively stable and ranged from the lowest recorded in 2002 (15%) to the highest value in 2021 (38%).

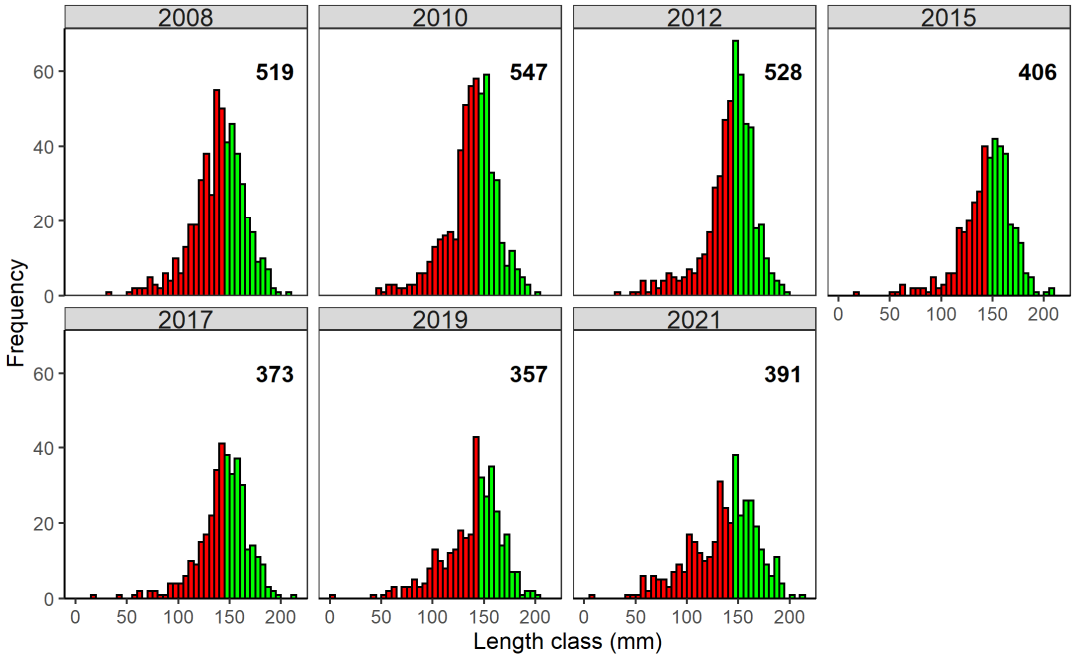

Figure 3.7. Legal (green bars) and sub-legal-sized (red bars) length-frequency distributions for greenlip observed on fishery-independent surveys from 2008 to 2021 in mapcode 18F. Length classes represent the upper length of each 5 mm bin. Bold numbers on plots are number measured.

Anxious Bay

The Anxious Bay catch has ranged from 4 to 16 t.yr^{-1} from 1978 to 2021, with exceptions in 1999 (2.9 t), 2020 (3.2 t) and 2021 (3.1 t; Figure 3.8a). CPUE generally increased from 1985 (18.2 kg.hr^{-1}), the lowest value on record, to a peak of 35.4 kg.hr^{-1} in 2003. However, CPUE has since decreased and, in 2021, was 18.4 kg.hr^{-1}, the second lowest value on record and below the limit reference point of the HS for this SAU. PropG1 in 2021 was the third highest value on record. Thus, in 2021, catch and CPUE were low compared to years since 1978, while PropG1 was high (Figure 3.8 b).

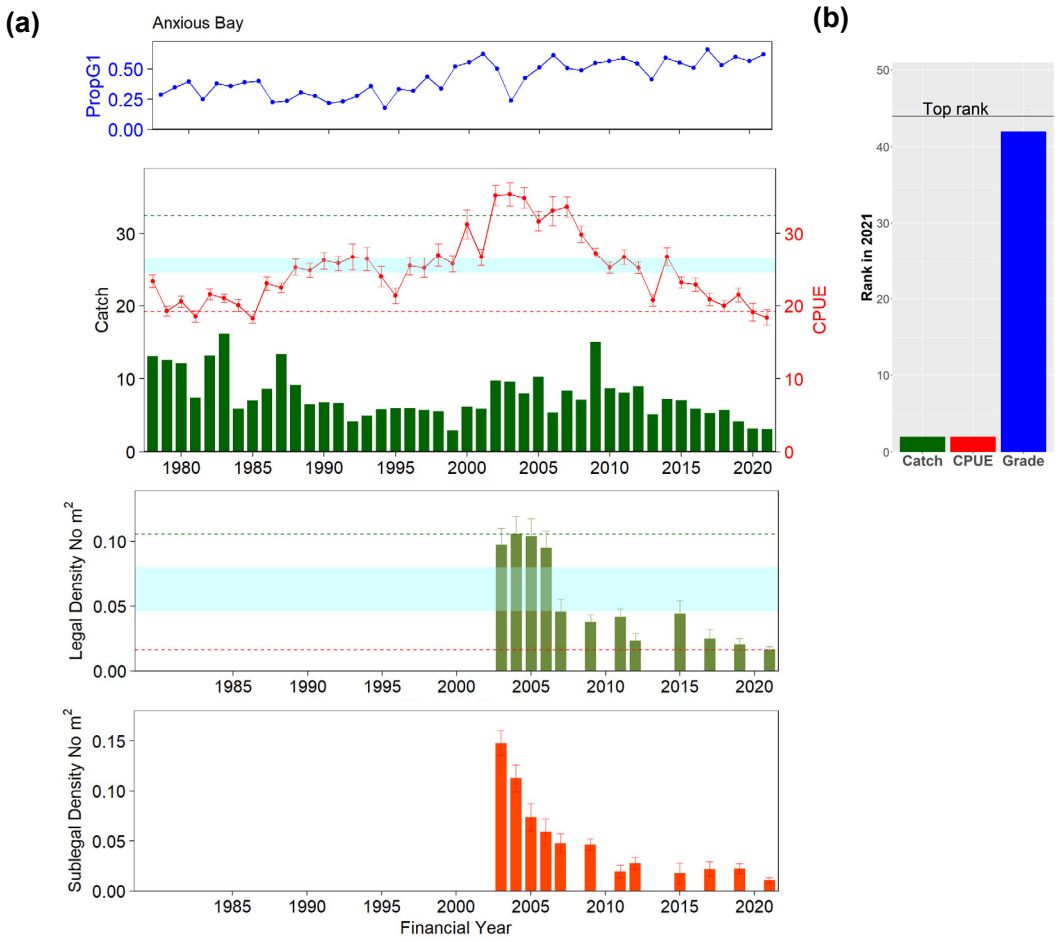

Figure 3.8. Anxious Bay greenlip **(a)** PropG1 (blue), Catch (t meat weight, green), CPUE ± se (kg.hr^{-1}, red), legal-sized mean density ± se (abalone.m^{-2}; olive green) and sublegal-sized mean density ± se (abalone.m^{-2}; red bars) from 1978 to 2021. For HS performance indicators CPUE and legal-sized mean density, horizontal green and red dashed lines show the upper and limit reference points, respectively, and the target reference band is shaded light blue. Densities are from LL fishery-independent surveys from 2003 to 2021 in mapcode 8A. **(b)** Rank of Catch, CPUE and PropG1 in 2021 relative to historic.

From FI surveys, the density of legal-sized greenlip halved between 2006 and 2007 and remained low in all subsequent survey years, including 2021, which was the lowest legal density on record (Figure 3.8a) and below the limit reference point of the HS. The density of sub-legal sized greenlip decreased consistently between 2003 and 2011, remaining at similarly low levels in all subsequent survey years and, in 2021, was the lowest value on record. The decrease in legal density from 2006 is also apparent in the length frequency distributions (Figure 3.9). The percentage of LARGE greenlip varied among years and ranged from 22% in 2007 to 58% in 2021. The percentage of SMALL greenlip was lowest in 2003 and 2012 (10%) and highest in 2021 (31%).

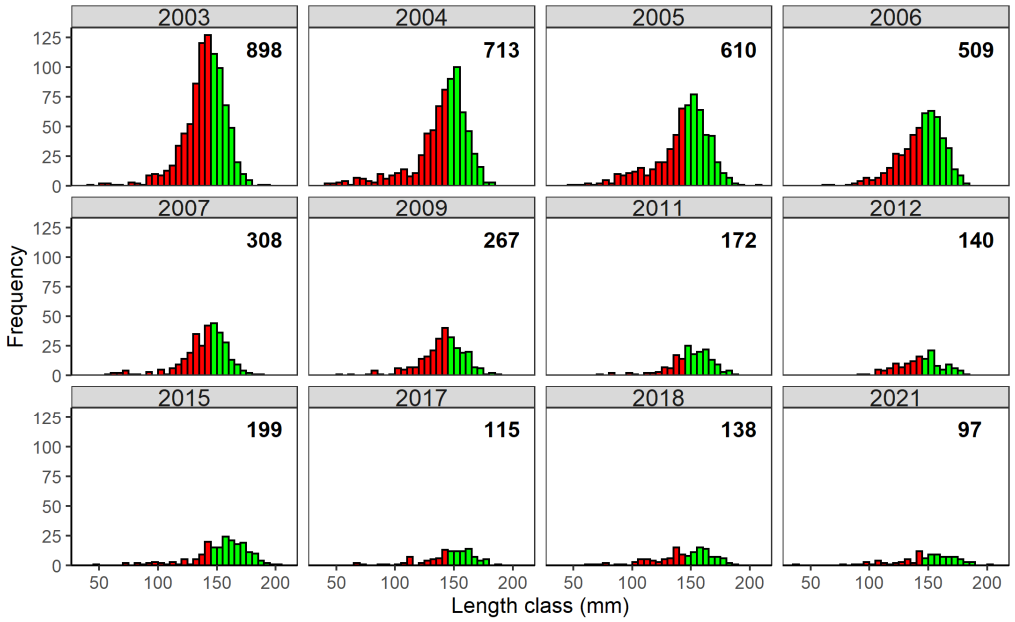

Figure 3.9. Legal (green bars) and sub-legal-sized (red bars) length-frequency distributions for greenlip observed on fishery-independent surveys from 2003 to 2021 in mapcode 8A. Length classes represent the upper length of each 5 mm bin. Bold numbers on plots are number measured.

Avoid Bay

Catch from Avoid Bay has generally ranged from 1 to 9 t.yr^{-1} with the exception of 1978, 1979, 1982 and 2005-2007 when catch ranged from 11 t in 2005 to 13 t in 1979 (Figure 3.10 a). In 2021, catch was 9t. CPUE has varied among years, but formed a distinct peak in 2005 (40.2 kg.hr^{-1}), whereafter CPUE generally decreased from 2005 to 2018 (19.0 kg.hr^{-1}) which was the lowest value since 1987, the fourth lowest value on record, and close to the lower limit reference point of the HS. CPUE has since increased and, in 2021, was 23.2 kg.hr^{-1}. PropG1 in the commercial catch increased substantially between 1995 and 2005 and was relatively high thereafter (Figure 3.10 a). In 2019, CPUE was in the mid-range of ranking, while catch and PropG1 were relatively high (Figure 3.10 b).

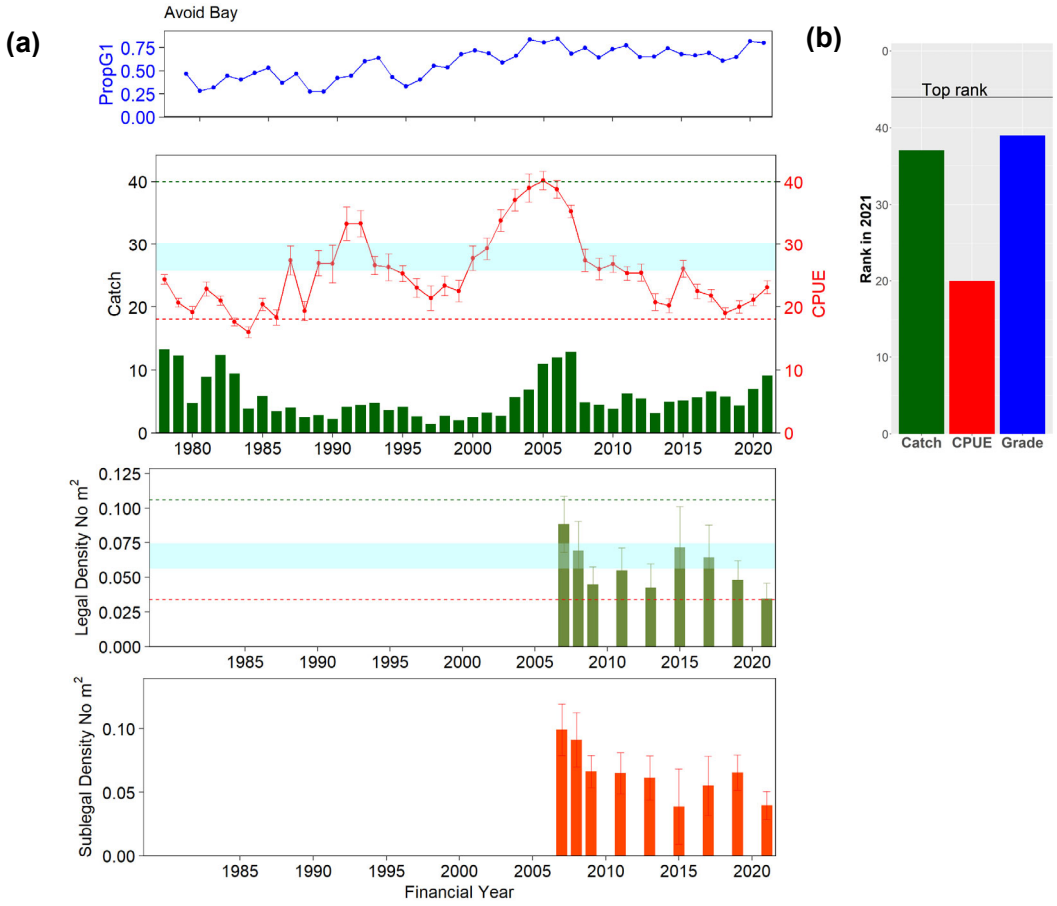

Figure 3.10. Avoid Bay greenlip **(a)** PropG1 (blue), Catch (t meat weight, green), CPUE ± se (kg.hr^{-1}, red), legal-sized mean density ± se (abalone.m^{-2}; olive green) and sublegal-sized mean density ± se (abalone.m^{-2}; red bars) from 1978 to 2021. For HS performance indicators CPUE and legal-sized mean density, horizontal green and red dashed lines show the upper and limit reference points, respectively, and the target reference band is shaded light blue. Densities are from LL fishery-independent surveys from 2007 to 2021 in mapcode 14D. **(b)** Rank of Catch, CPUE and PropG1 in 2021 relative to historic.

The abundance of legal-sized greenlip almost halved between 2007 and 2009, remained at a similarly low level between 2009 and 2013, and then increased to the second highest level in 2015. Legal-sized abundance has subsequently decreased consistently to the lowest value on record in 2021 and was at the lower limit of the HS (Figure 3.10 a). The density of sublegal-sized greenlip declined from 2007 to 2009, whereafter, except for lower values in 2015 and 2021, it has remained relatively stable. The reduction in legal density from 2007 is also apparent in the length frequency distributions (Figure 3.11). However, the percentage of LARGE greenlip was variable from 2007 to 2021 (range 30–51 %; Figure 3.11), as was the percentage of SMALL greenlip (12–39 %).

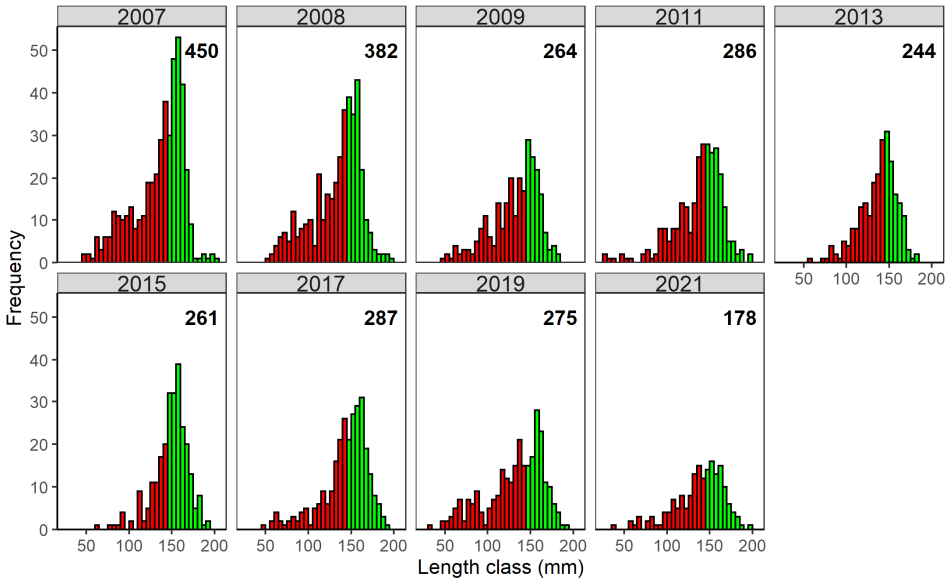

Figure 3.11. Legal (green bars) and sub-legal-sized (red bars) length-frequency distributions of greenlip observed on fishery-independent surveys from 2003 to 2021 in mapcode 14D. Length classes represent the upper length of each 5 mm bin. Bold numbers on plots are number measured.

Point Avoid

Catches from Point Avoid were relatively high in the 1980's and stable at a low value from 1989 to 2008 (~2 t.yr^{-1}). In 2009, catch increased to 6.0 t, whereafter it has remained relatively stable (Figure 3.12 a). CPUE has fluctuated among years, with a historic high in 2002 (33.7 kg.hr^{-1}). In 2021, CPUE was 20.9 kg.hr^{-1} and within the target reference range of the HS (Figure 3.12 a). PropG1 has been relatively high from 2005 to 2021. In 2021, catch and CPUE were in the mid-range of ranking, while grades were ranked high (Figure 3.12 b).

Drummond

Catch from Drummond was relatively high from 1979 to 1987, low from 1988 to 2008 (~1 t.yr^{-1}), and then increased and remained relatively high from 2009 to 2021 (~ 4 t.yr^{-1}; Figure 3.12 a). CPUE was relatively low between 1978 and 1989 (~20 kg.hr^{-1}), whereafter it increased to a maximum of 41 kg.hr^{-1} in 2001. CPUE has subsequently declined and, in 2021, was 22.6 kg.hr^{-1} and within the target reference range of the HS. PropG1 has increased from 2018 and, in 2021, was relatively high. In 2021, catch and CPUE were in the mid-range of ranking, while grades were ranked high (Figure 3.12 b).

Reef Head

Following relatively high catches from Reef Head throughout the 1980s, including very high catches in 1982 (18.8 t) and 1983 (14.2 t), catch was stable at less than 1.5 t.yr^{-1} between 1989 and 2008 (Figure 3.12 a). Catch increased eight-fold in 2009 and remained high until 2017, and then generally decreased to 1.8 t in 2021. CPUE was relatively stable from 1978 to 1998, whereafter CPUE increased, with a maximum of 32.2 kg.hr^{-1} in 2005. CPUE generally decreased from 2005 to a relatively low value in 2021 (17.7 kg.hr^{-1}). PropG1 was relatively low between 1978 and 1993, whereafter it increased to a historic high in 2006. PropG1 decreased from 2007 to 2016 whereafter it has increased and, in 2021 was relatively high and above the mid-point of ranked values. In 2021, catch and CPUE were below the mid-point of ranked catch values, while grades were above the mid-point of ranked catches (Figure 3.12 b).

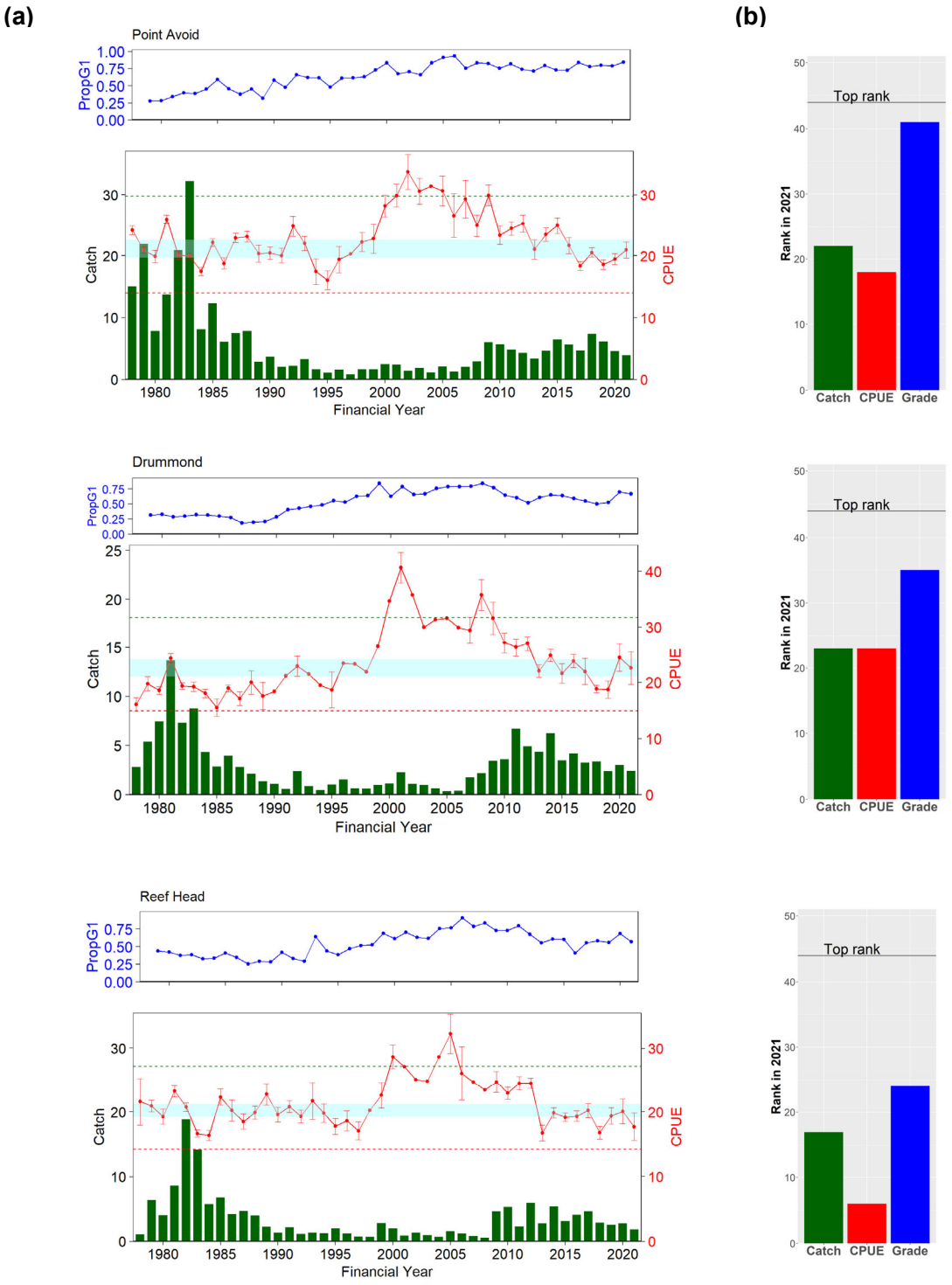

Figure 3.12. Point Avoid, Drummond and Reef Head greenlip **(a)** PropG1 (blue), Catch (t meat weight, green) and CPUE ± se (kg.hr^{-1}, red) from 1978 to 2021. For HS performance indicators CPUE and legal-sized mean density, horizontal green and red dashed lines show the upper and limit reference points, respectively, and the target reference band is shaded light blue. **(b)** Rank of Catch, CPUE and PropG1 in 2021 relative to historic.

Flinders Island

Catch from Flinders Island has been variable, with the highest catches recorded in the early 1980s and 2000s (Figure 3.13 a). Catch generally declined from the third highest value in 1999 (11.6 t) to 2021 (2.3 t), the second lowest value on record. CPUE declined in the early 1980s to the lowest value on record in 1987 (17.1 kg.hr^{-1}), whereafter it increased to the highest on record in 2001 (32 kg.hr^{-1}). From 2002, CPUE generally decreased and, in 2021, was 17.7 kg.hr^{-1}, the second lowest value on record. PropG1 was the highest value on record in 2017 and, while subsequently declining, it remains relatively high in value. Both catch and CPUE ranked low in 2021, while Prop G1 ranked relatively high (Figure 3.13 b).

Baird Bay

For the past 44 years, annual catches from Baird Bay have been relatively stable at approximately 3.6 t.yr^{-1} (Figure 3.13 a). However, catch was relatively low in 2021 (1.8 t). CPUE was variable among years, with four peaks that were greater than 30 kg.hr^{-1} occurring in 1990, 2005 and 2015 and 2020. CPUE in 2021 was relatively high (27.7 kg.hr^{-1}; Figure 3.13 b). PropG1 has fluctuated among years but progressively increased from 1988 and, in 2021, was among the highest values on record. In 2021, catch ranked amongst the lowest values recorded, whereas CPUE and PropG1 ranked high (Figure 3.13 a, b).

Ward Island

The annual catch from Ward Island has oscillated on a 5–6 year scale from approximately 1 t.yr^{-1} to 7 t.yr^{-1} (Figure 3.13 a). Catch decreased consistently from 2017 (5.3 t) to 2021 where it was relatively low (2.1 t). CPUE has fluctuated among years but generally increased from 1984 (22.1 kg.hr^{-1}) to a historic peak in 2003 (39.7 kg.hr^{-1}). CPUE then decreased consistently from 2003 to 2009, varied among years from 2009 to 2017, and again decreased consistently from 2017 to 2021. In 2021, CPUE was 20.2 kg.hr^{-1}, the lowest value on record and below the limit reference of the HS. PropG1 increased substantially from 2013 to 2014 (an 84% increase), whereafter it has remained high. In 2021, catch and CPUE values were low, while grades were above the mid-point of ranked catches (Figure 3.12 b).

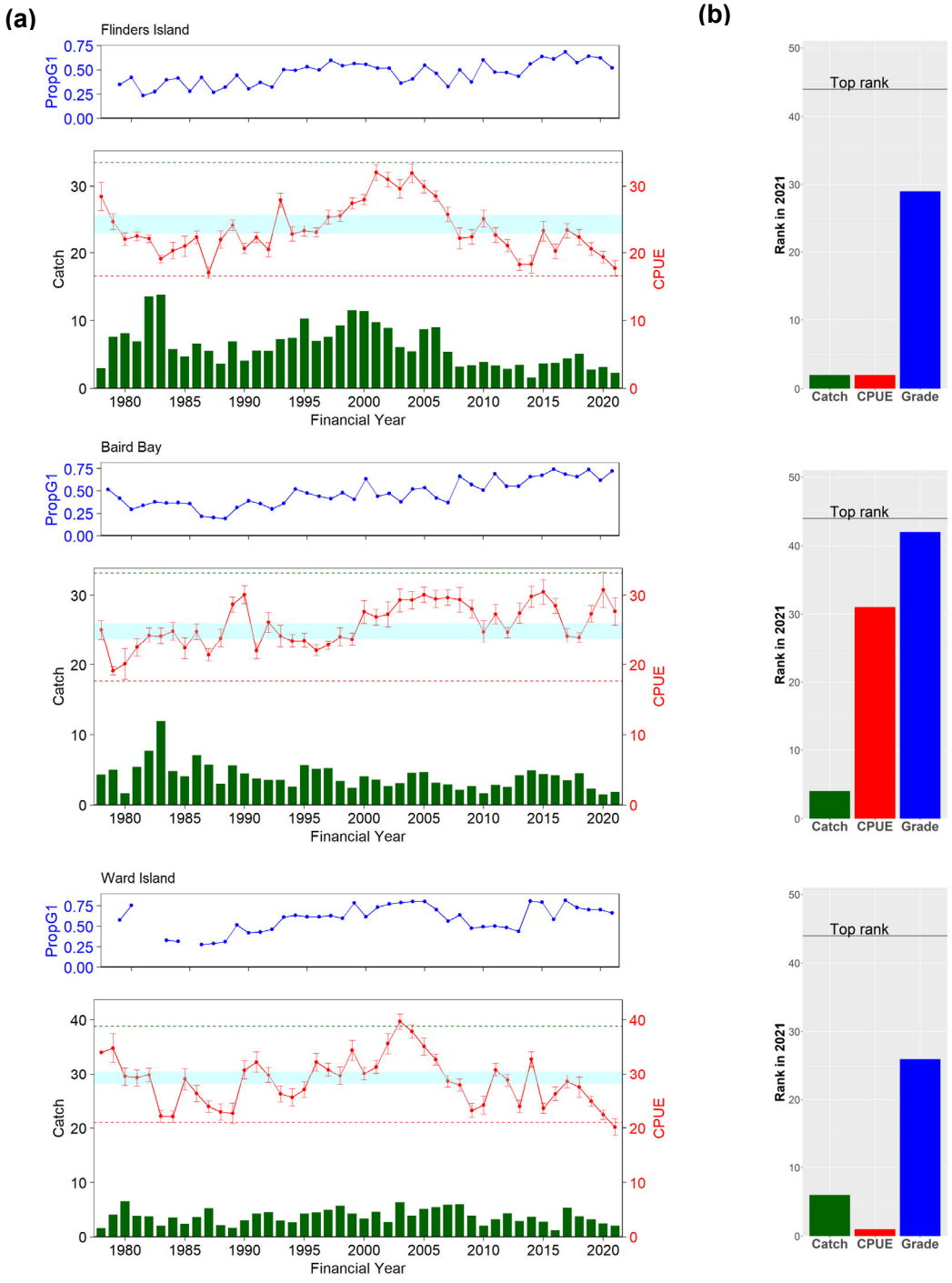

Figure 3.13. Flinders Island, Baird Bay and Ward Island greenlip **(a)** PropG1 (blue), Catch (t meat weight, green) and CPUE ± se (kg.hr^{-1}, red) from 1978 to 2021. For HS performance indicators CPUE and legal-sized mean density, horizontal green and red dashed lines show the upper and limit reference points, respectively, and the target reference band is shaded light blue. **(b)** Rank of Catch, CPUE and PropG1 in 2021 relative to historic.

Point Westall

Annual catches at Point Westall were initially high, but more than halved between 1987 and 1991, whereafter they remained relatively stable at about 2.7 t.yr^{-1} for 30 years (range 1.5 t in 2011 and 2015, 4.6 t in 2017; Figure 3.14 a). CPUE was variable from 1978 to 1987, followed by a period of relative stability in the early to mid-1990s. From 1997, CPUE increased to a maximum of 28.2 kg.hr^{-1} in 2006, whereafter it has oscillated at a relatively high value, and, in 2021, CPUE was relatively high (26.2 kg.hr^{-1}). PropG1 has remained relatively high from 2009 to 2021. Grade and CPUE both ranked high in 2021 and catch was relatively low (Figure 3.14 b).

Taylor Island

With the exception of a period of high catches from 1983 to 1987 (average 7.7 t), annual catch from Taylor Island remained relatively stable from 1988 to 2015 at about 3.5 t.yr^{-1} (Figure 3.14 a). However, catch decreased consistently from 2015 (3.7 t) to the third lowest value on record in 2021 (1.6 t). CPUE was relatively stable between 1978 and 1999, whereafter it increased to a historic high in 2004 (27.2 kg.hr^{-1}) and remained relatively high until 2011. CPUE then decreased by 43% between 2011 (24.0 kg.hr^{-1}) and 2017 (13.8 kg.hr^{-1}) whereafter it has increased and, in 2021, was 16.8 kg.hr^{-1}. PropG1 has fluctuated among years and, in 2021, was amongst the highest values on record. Catch and CPUE ranked low in 2021, while PropG1 ranked high (Figure 3.14 b).

Hotspot

The catch at Hotspot varied among years between 1978 and 1994, was generally higher and more stable between 1995 to 2005, whereafter it decreased consistently from 7.9 t in 2005 to the second lowest (1.0 t) in 2010 (Figure 3.14 a). Catch remained low between 2010 and 2015 (~1.5 t) but increased to 7.5 t in 2017, whereafter it decreased, and in 2021 was 2.8 t. CPUE was variable between 1978 and 1994 following which it increased to a peak in 2002 (35.5 kg.hr^{-1}). CPUE then generally declined except for a peak of 32.3 kg.hr^{-1} in 2016 and, in 2021, was relatively low and below the target reference band of the HS (23.9 kg.hr^{-1}). PropG1 increased 312% from the second lowest value on record in 2013 to the highest value on record in 2016, whereafter it decreased and in 2021 was relatively high. Catch and CPUE scored both ranked low in 2021 and grade ranked high (Figure 3.14 b).

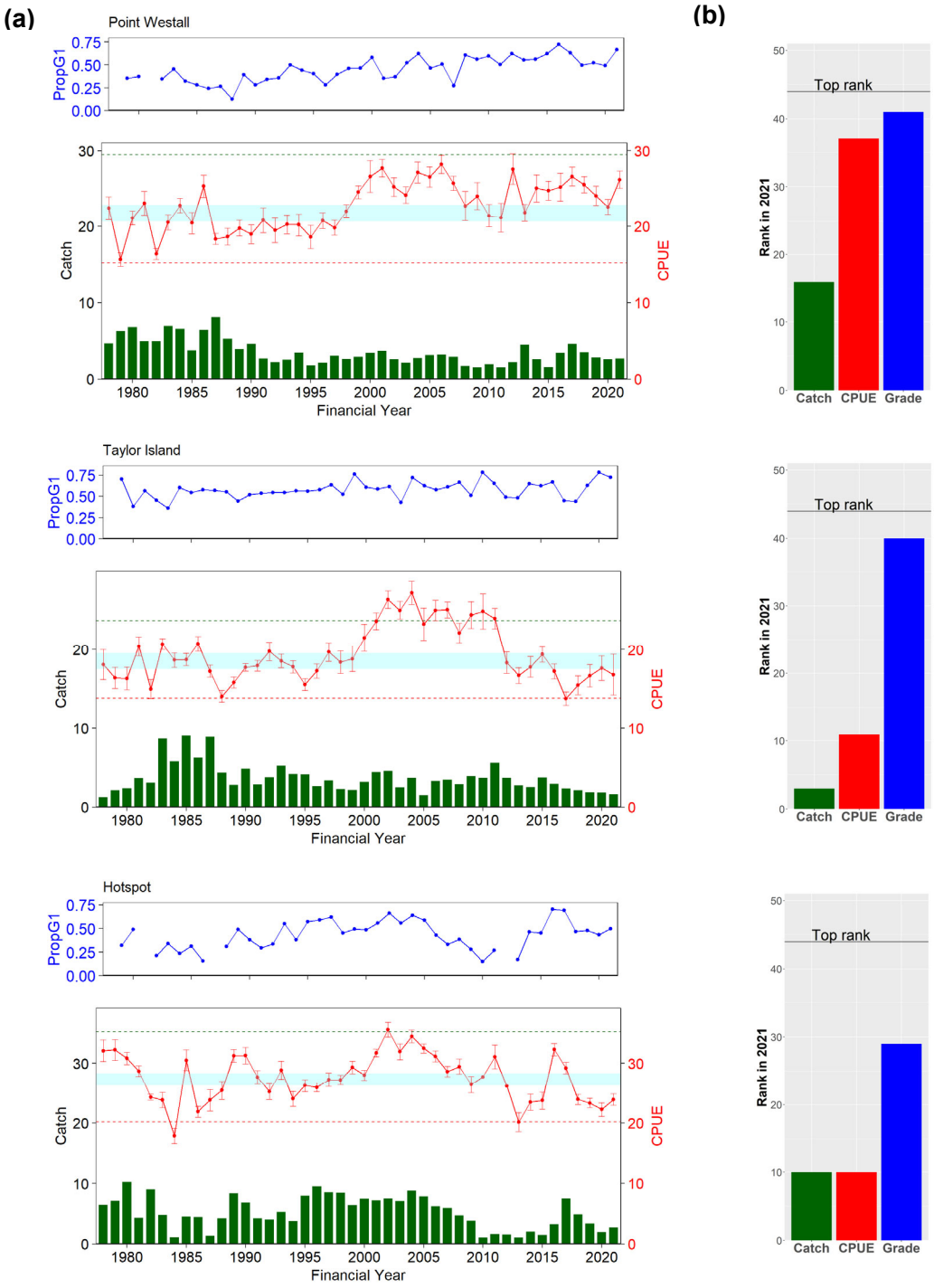

Figure 3.14. Point Westall, Taylor Island and Hotspot and greenlip **(a)** PropG1 (blue), Catch (t meat weight, green) and CPUE ± se (kg.hr^{-1}, red) from 1978 to 2021. For HS performance indicators CPUE and legal-sized mean density, horizontal green and red dashed lines show the upper and limit reference points, respectively, and the target reference band is shaded light blue. **(b)** Rank of Catch, CPUE and PropG1 in 2021 relative to historic.

Fishery Bay

With the exception of relatively high catches from Fishery Bay between 1980 to 1985, catch ranged between 0.2 t in 2006 and 3.7 t in 1988 (Figure 3.15 a). CPUE has varied among years with a low of 13.4 kg.hr^{-1} in 1986 and a high of 44.0 kg.hr^{-1} in 2003. In 2021, CPUE was relatively low (15.6 kg.hr^{-1}) and close to the limit reference point of the HS. PropG1 could not be estimated in 2020 and 2021. In 2021, both catch and CPUE ranked low relative to historic values (Figure 3.15 b).

Memory Cove

With few exceptions, annual catches from Memory Cove has ranged between 1.0 and 3.0 t.y^{-1} (Figure 3.15 a). CPUE was relatively stable between 1978 and 1996, whereafter it increased to a historic high in 2004 (31.1 kg.hr^{-1}) and remained relatively high until 2010. CPUE subsequently decreased to 12.9 kg.hr^{-1} in 2014 and remained relatively low thereafter with 16.6 kg.hr^{-1} in 2021. PropG1 was not estimable in 2021. Both catch and CPUE ranked low relative to historic values in 2021 (Figure 3.15 b).

South Nuyts Archipelago

Catch has been variable from the South Nuyts Archipelago and, with few exceptions, has been below 5 t.yr^{-1} (Figure 3.15 a). Catch decreased steadily from a high in 2009 to zero catch in 2015 subsequently increasing but remaining low. 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 2021, could not be estimated due to insufficient data, as was also the case for PropG1. Catch ranked below the mid-point of ranked catches (Figure 3.15 b)

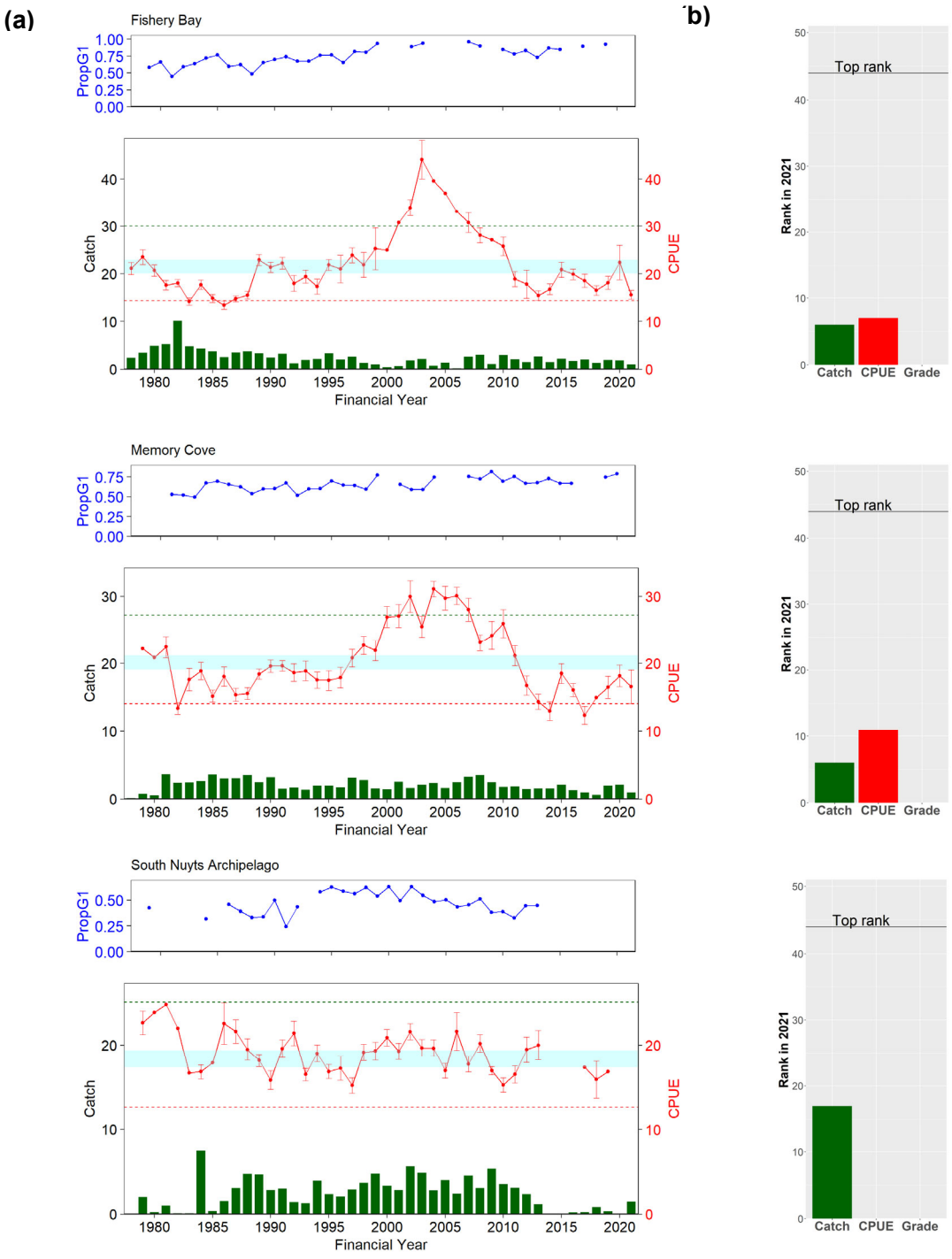

Figure 3.15. Calendar year Fishery Bay, Memory Cove and South Nuyts Archipelago greenlip **(a)** PropG1 (blue), Catch (t meat weight, green) and CPUE ± se (kg.hr^{-1}, red) from 1978 to 2021. For HS performance indicators CPUE and legal-sized mean density, horizontal green and red dashed lines show the upper and limit reference points, respectively, and the target reference band is shaded light blue. **(b)** Rank of Catch, CPUE and PropG1 in 2021 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 6.4, while the data pooled by regions is summarised and provided below.

Lincoln low SAUs

Catch has varied among years, ranging from 12.6 t in 1982 to the lowest value on record in 2021 (2.8 t; Figure 3.16a). CPUE decreased from 1978 to the lowest value on record in 1985 (16.2 $kg.hr^{-1}$), then increased to a peak of 33.3 $kg.hr^{-1}$ in 2002. Subsequently CPUE decreased to the second lowest value on record in 2017 (17.2 $kg.hr^{-1}$), remaining low thereafter and, in 2021, was (18.0 $kg.hr^{-1}$). PropG1 has been variable throughout the history of the fishery and, in 2021, ranked amongst the highest on record. Catch and CPUE in 2021 ranked low (Figure 3.16b).

Streaky low SAUs

With the exception of high values from 1983 to 1987, average catch was 4.2 t (Figure 3.16a). CPUE was relatively stable from 1978 to 2000, whereafter it increased to a peak in 2005 (29.7 $kg.hr^{-1}$). Subsequently, CPUE generally decreased to the lowest value on record in 2020 (18.8 $kg.hr^{-1}$), but increased 32% between 2020 and 2021 (24.6 $kg.hr^{-1}$). PropG1 increased 41% from 2020 to 2021 when it was the highest value on record. Catch in 2021 ranked low while CPUE and grade ranked high (Figure 3.16b).

Far West low SAUs

Catch was high in 1984 (15.1 t) from 1987 to 1990 low in 2021 (range 6.4 t to 9.1 t; Figure 3.16a, b). Catch remained relatively stable from 1991 to 2010 (~4.8 t) but in recent years, coincident with merging regions A and B, catch dropped to less than 2 t from 2013 and has since fluctuated at low levels. CPUE varied among years from the highest value in 1981 (30.0 $kg.hr^{-1}$) to 2019 (13.8 $kg.hr^{-1}$), the fourth lowest value on record, and could not be estimated for 2020 or 2021. PropG1 was stable from 1993 to 2010, whereafter it fluctuated and could not be estimated in 2021.

Elliston low SAUs

From 1979 to 1985 catch was ~5$t.yr^{-1}$, whereafter it has varied among years at a low value (average 1.5 $t.yr^{-1}$; Figure 3.16a). CPUE generally increased from 1978 to 2010, decreased to the second lowest value on record in 2019 (15.8 $kg.hr^{-}1$), but subsequently increased and, in 2021, was 21.6 $kg.hr^{-1}$ and within the target reference band of the HS. PropG1 was variable but relatively high from 1999 to 2021. Catch and CPUE ranked below the mid-point but Grade ranked high in 2021 (Figure 3.16 b).

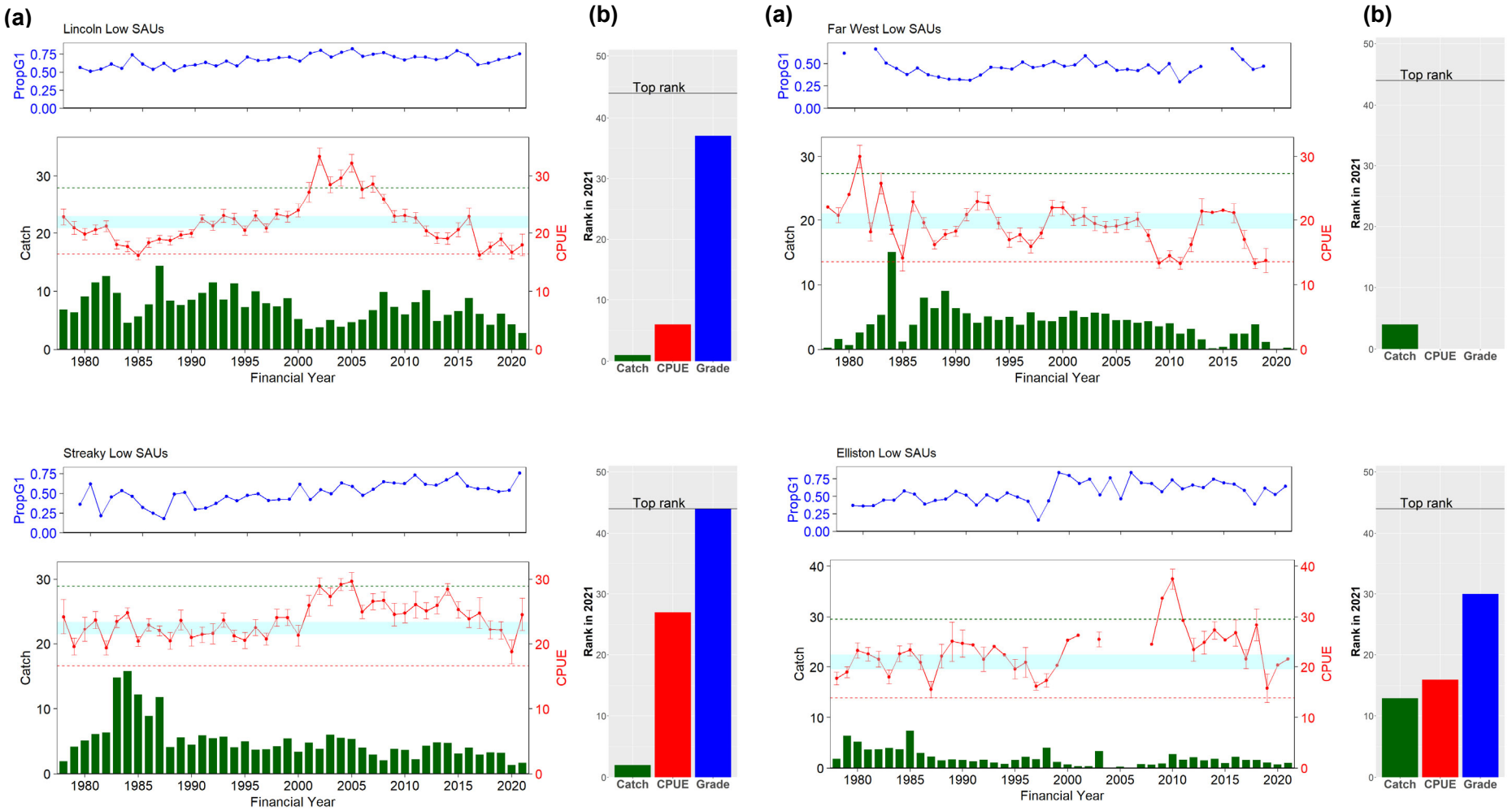

Figure 3.16. Lincoln, Streaky, Far West and , Elliston Low SAUs greenlip **(a)** PropG1 (blue), Catch (t meat weight, green) and CPUE ± se (kg.hr^{-1}, red) from 1978 to 2021. For HS performance indicators CPUE and legal-sized mean density, horizontal green and red dashed lines show the upper and limit reference points, respectively, and the target reference band is shaded light blue. **(b)** Rank of Catch, CPUE and PropG1 in 2021 relative to historic.

3.1.6 Harvest strategy – zone score and stock status

The catch-weighted zonal score for the 2021 financial year was 3.02 (Table 3.1, Figure 3.17). In combination with the zone trend score of 5.00 (Appendix 6.6, Table 6.18; reflecting a stable trend), these define the stock status for greenlip in the WZ in the 2021 financial year as 'sustainable' (Figure 3.18).

The zone score of 3.02 for 2021 translates to a recommended zonal catch of 43.23 t for the 2023 calendar year.

Table 3.1. Outcome of application of the harvest strategy described in the Management Plan for the South Australian Abalone Fishery to greenlip in the 2021 financial year. Combined score is half the sum of the CPUE and legal density scores.

SAU	CPUE	CPUE score	Legal density	Legal density score	Combined score	Catch proportion	Weighted SAU score
THE GAP	18.58	2.00	0.05	2.25	2.12	0.09	0.20
LINCOLN LOW SAUs	17.99	1.78			1.78	0.09	0.16
ANXIOUS BAY	18.40	0.00	0.02	0.00	0.00	0.09	0.00
AVOID BAY	23.15	3.31	0.03	1.44	2.37	0.09	0.21
POINT AVOID	20.92	5.00			5.00	0.08	0.39
DRUMMOND	22.57	5.00			5.00	0.06	0.30
REEF HEAD	17.72	3.50			3.50	0.05	0.19
FLINDERS ISLAND	17.75	0.97			0.97	0.05	0.05
STREAKY LOW SAUs	24.56	6.01			6.01	0.05	0.30
BAIRD BAY	27.68	6.19			6.19	0.05	0.30
WARD ISLAND	20.19	0.00			0.00	0.05	0.00
POINT WESTALL	26.20	7.54			7.54	0.04	0.33
TAYLOR ISLAND	16.79	4.04			4.04	0.04	0.17
HOTSPOT	23.91	3.04			3.04	0.04	0.13
FISHERY BAY	15.59	1.05			1.05	0.03	0.03
FAR WEST LOW SAUs					0.21	0.03	0.01
MEMORY COVE	16.57	2.50			2.50	0.02	0.06
ELLISTON LOW SAUs	21.56	5.00			5.00	0.02	0.12
SOUTH NUYTS					4.46	0.02	0.07
					Total Zone Score		***3.02***

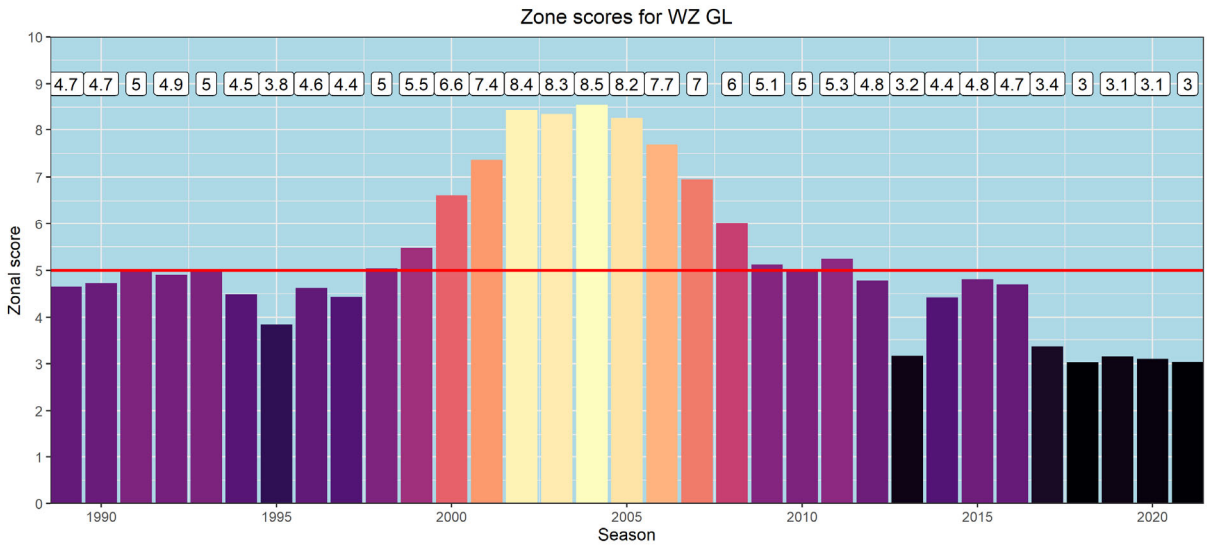

Figure 3.17. Zone score for greenlip from 1989 to 2021. Red line indicates target zone score of 5, numbers above bars are the zone score.

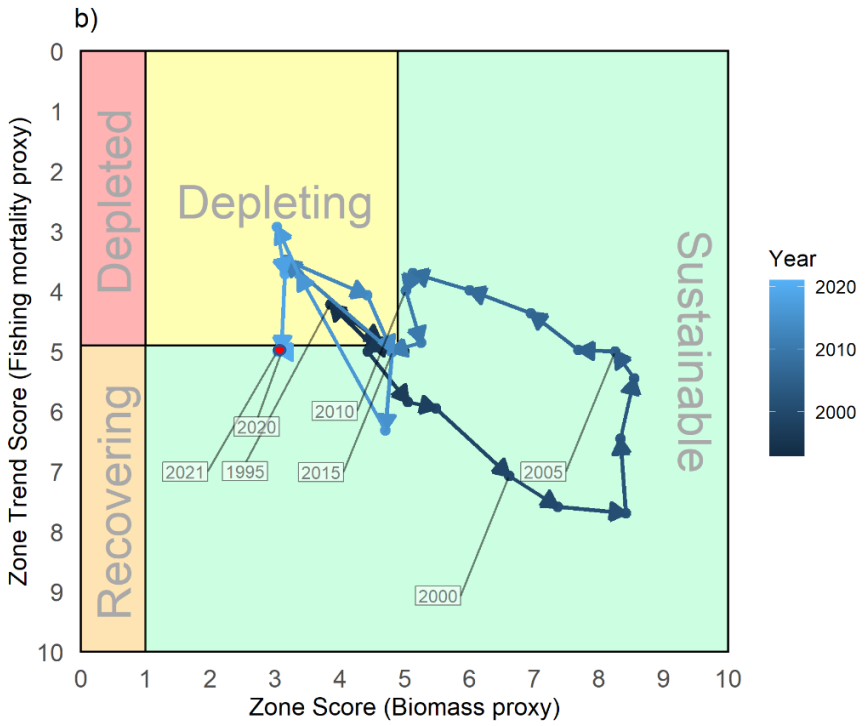

Figure 3.18. Phase plot showing the WZ changes in blacklip stock status from 1993 to 2021.

3.2 Blacklip

3.2.1 Western Zone

Total catches were relatively stable from the introduction of Region A quota in 1984 (98 t) to 2012, with catch ranging from 90.3 in 1994 to a high of 113.2 t in 1998 over this period (Figure 3.19 a). Subsequently, blacklip catch has reduced 55% between 2012 (100.7 t) and 2021 (45.4 t).

CPUE was generally stable over two periods: 1979 to 1988 (mean 23.8 kg.hr^{-1}) and 1989 to 1999 (mean 25.6 kg.hr^{-1}), after which it increased rapidly (20%) to a historic high in 2005 (30.7 kg.hr^{-1}; Figure 3.19 a). CPUE then declined 30% over 16 years between 2005 and 2021 (21.6 kg.hr^{-1}) and, in 2021, was the fourth lowest value on record, with values from 2017 to 2021 among the five lowest recorded (Figure 3.19 b). The 2021 value from the combined trend of relative catch and relative CPUE was also the second lowest value on record, with 2020 the lowest recorded (Figure 3.19 c). Fishing effort in the 0-10 depth range has observed small decreases over the last thirteen years, with corresponding small increases occurring in the 10-20m range (Figure 3.19 d)

3.2.2 Regions and spatial assessment units

The 2021 CPUE estimates for Port Lincoln, Elliston and Streaky Bay regions were the fifth, third and seventh lowest values on record, respectively (Figure 3.20). CPUE for the Far West was not estimable in 2020 or 2021, but values for the 2016 to 2019 were the four lowest recorded. CPUE in the Port Lincoln region was relatively stable from 1978 to 1999, whereafter it increased and, in 2006, reached a peak of 31.1 kg.hr^{-1} (Figure 3.20). CPUE then declined consistently from 2006 to 2018 and, in 2021, was 19.8 kg.hr^{-1}. Similarly, CPUE from the Elliston and Streaky Bay regions generally decreased from peaks in the mid-2000's, with CPUE from the Elliston region decreasing to the lowest value on record in 2019 (21.9 kg.hr^{-1}) and remaining low in 2021 (22.3 kg.hr^{-1}). CPUE in the Streaky Bay region decreased from the peak in 2005 to 2009, whereafter it remained relatively stable at a lower level from 2009 to 2021. The Far West region CPUE was relatively stable from 1986 to 2008, whereafter it varied considerably among years and remained low in recent years.

There were small changes in the distribution of annual catches among SAUs between 2020 and 2021. These included increases in catches from Venus Bay and Sheringa and a decrease in catch from Flinders Island (Figure 3.21). Eleven of the 12 SAUs scored for CPUE had values below 5, as did two of the four amalgamated low SAUs and two of the five SAUs scored for legal density (Figure 3.22). The only SAU with a CPUE score above a 5 was Point Westall (HS score = 5.72; Table 3.2).

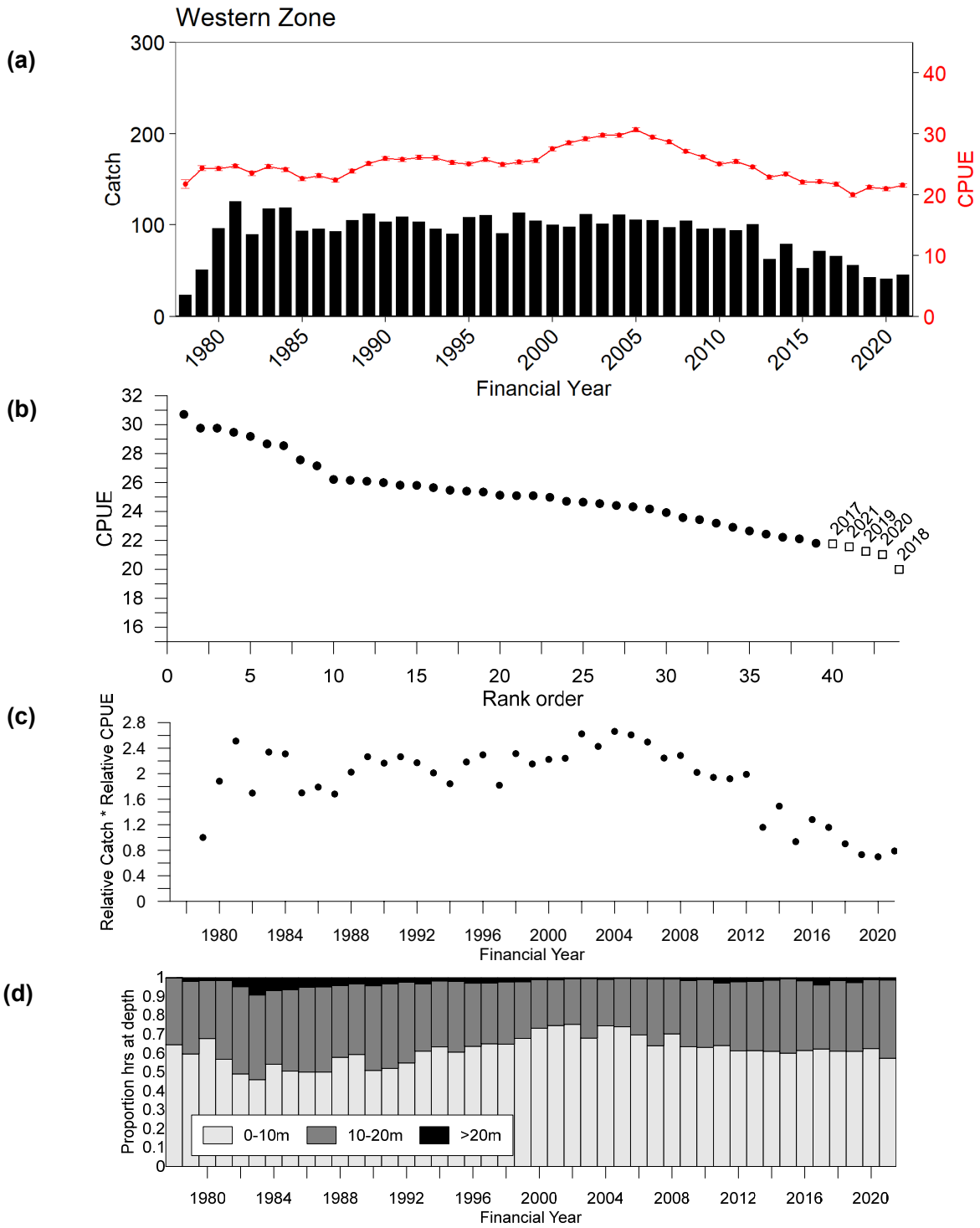

Figure 3.19. Blacklip - **(a)** Catch (t, meat weight; black bars) and CPUE ± se (kg.hr^{-1}; solid red line) from the Western Zone from 1978 to 2021. **(b)** Rank order of Western Zone CPUE (kg.hr^{-1}) from 1978 to 2021. Last five years are marked with open square symbols **(c)** Combined trend of relative catch and relative CPUE from the Western Zone from 1978 to 2021. **(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.

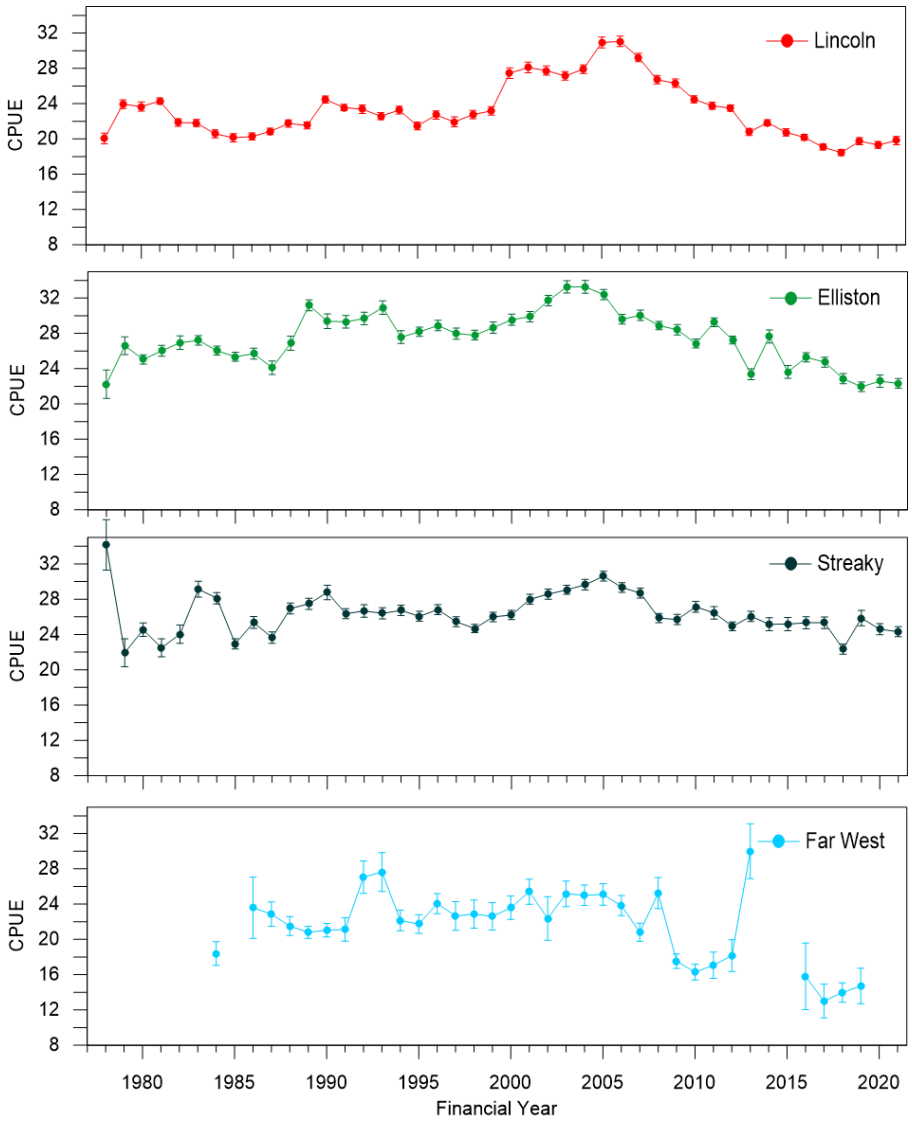

Figure 3.20. Comparison between CPUE ± se (kg.hr^{-1}) of blacklip at SAUs located near Port Lincoln, Elliston, Streaky Bay and Far West (see legend) from the Western Zone from 1978 to 2021.

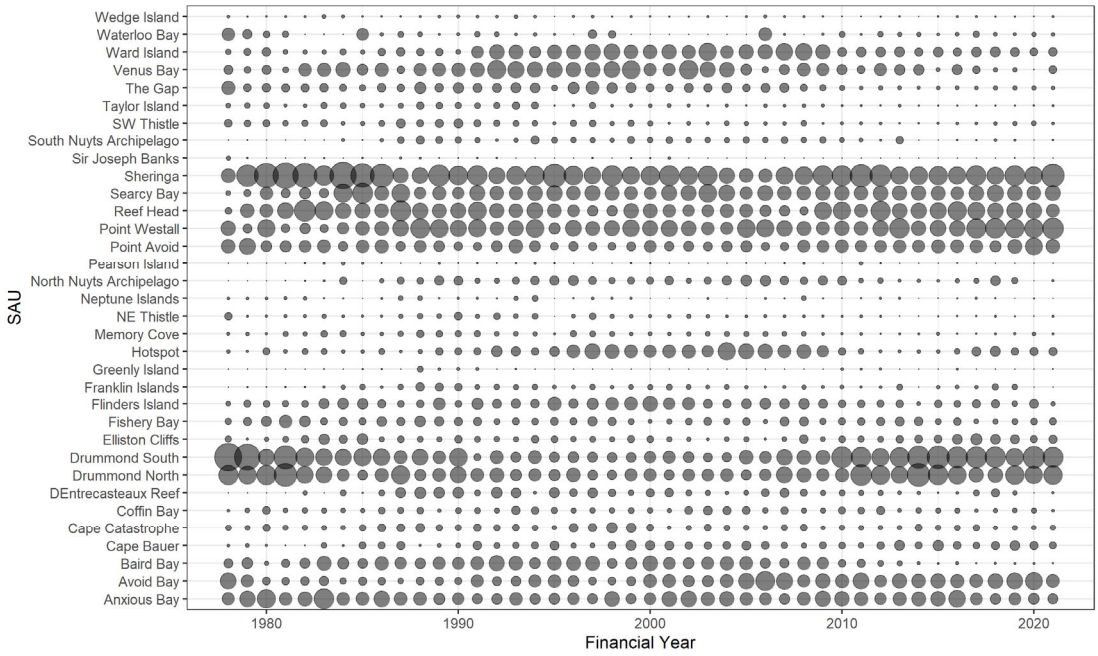

Figure 3.21. Bubble plot showing the spatial distribution of blacklip catch (% of total catch) among the SAUs in the WZ from 1978 to 2021 by financial year.

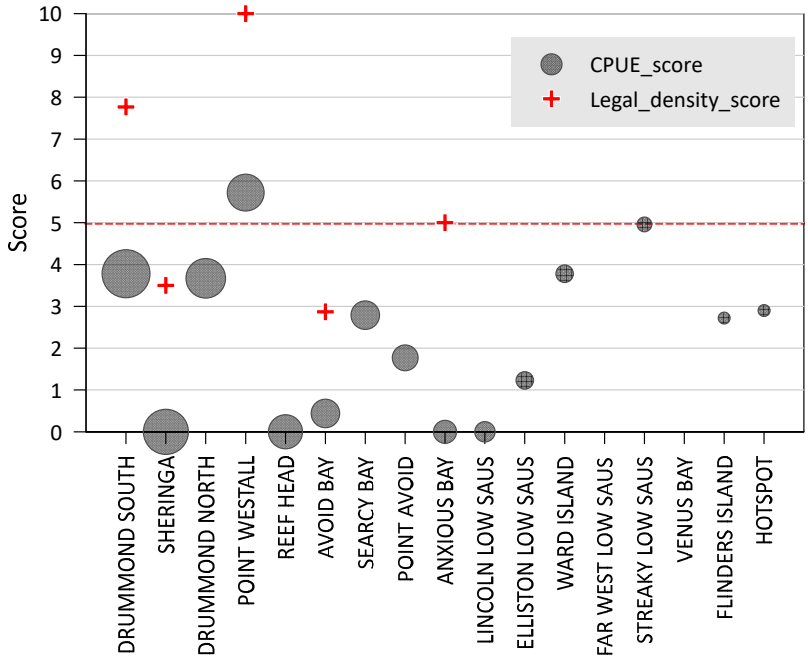

Figure 3.22 Blacklip SAU CPUE and legal density scores for the 2021 financial year (see legend). Bubble size for CPUE indicates % of WZ catch in the 2021 financial year. SAUs sorted left to right by decreasing catch contribution in 2021. Dashed red line shows target score of 5.

3.2.3 Harvest strategy – zone score, trend in zone score and stock status

The catch-weighted zonal score for the 2021 financial year was 3.10 (Table 3.2, Figure 3.23). In combination with the zone trend score of 5.57 (Appendix 6.6, Table 6.18; reflecting an increasing trend), these define the zonal stock status for blacklip in the WZ in the 2021 as **'sustainable'** (Figure 3.24)**.** The zone score of 3.10 for 2021 translates to a recommended zonal catch of 44.11 t for the 2023 calendar year.

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 2021 financial year. Combined score is half the sum of the CPUE and legal density scores.

SAU	CPUE	CPUE score	Legal density	Legal density score	Combined score	Catch proportion	Weighted SAU score
DRUMMOND SOUTH	21.76	3.78	0.36	7.77	5.78	0.14	0.81
SHERINGA	23.26	0.00	0.14	3.50	1.75	0.13	0.22
DRUMMOND NORTH	23.49	3.67			3.67	0.11	0.40
POINT WESTALL	25.70	5.72	0.42	10.00	7.86	0.10	0.80
REEF HEAD	15.39	0.00			0.00	0.09	0.00
SEARCY BAY	22.72	2.79			2.79	0.07	0.19
AVOID BAY	17.94	0.44	0.14	2.87	1.66	0.07	0.11
POINT AVOID	18.84	1.77			1.77	0.06	0.10
ANXIOUS BAY	17.61	0.00	0.29	5.00	2.50	0.05	0.14
LINCOLN LOW SAUs	15.66	0.00			0.00	0.04	0.00
ELLISTON LOW SAUs	21.02	1.23			1.23	0.03	0.03
WARD ISLAND	25.19	3.78			3.78	0.03	0.10
STREAKY LOW SAUs	25.44	4.96			4.96	0.02	0.12
VENUS BAY					0.00	0.02	0.00
FAR WEST LOW SAUs					0.00	0.02	0.00
FLINDERS ISLAND	20.86	2.72			2.72	0.01	0.04
HOTSPOT	25.14	2.90			2.90	0.01	0.04
					Total Zone Score		**3.10**

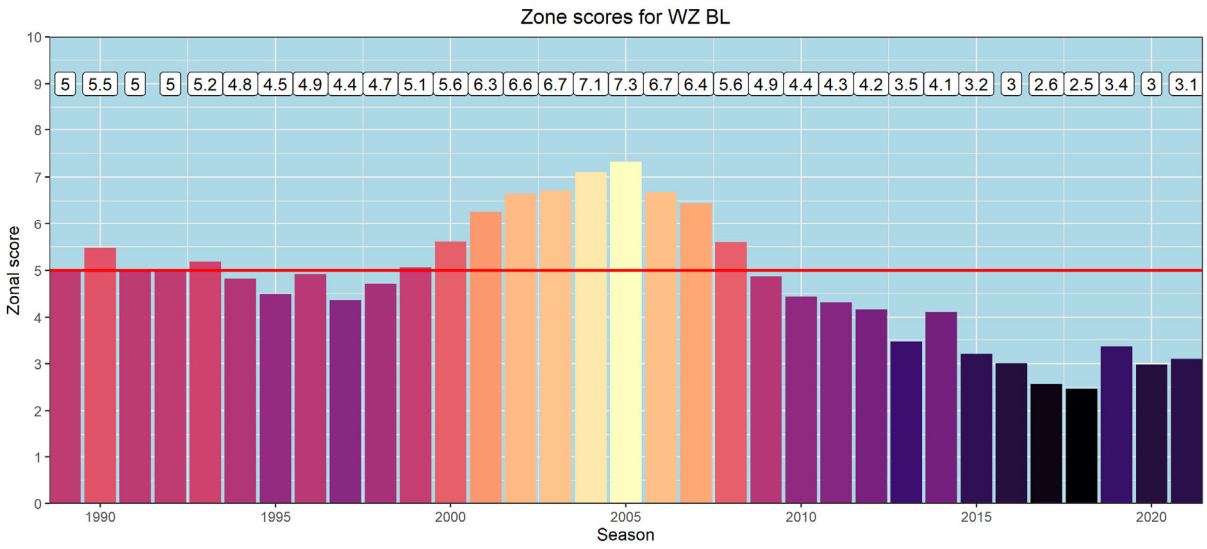

Figure 3.23. Zone score for blacklip from 1989 to 2021. Red line indicates target zone score of 5, numbers above bars are the zone score.

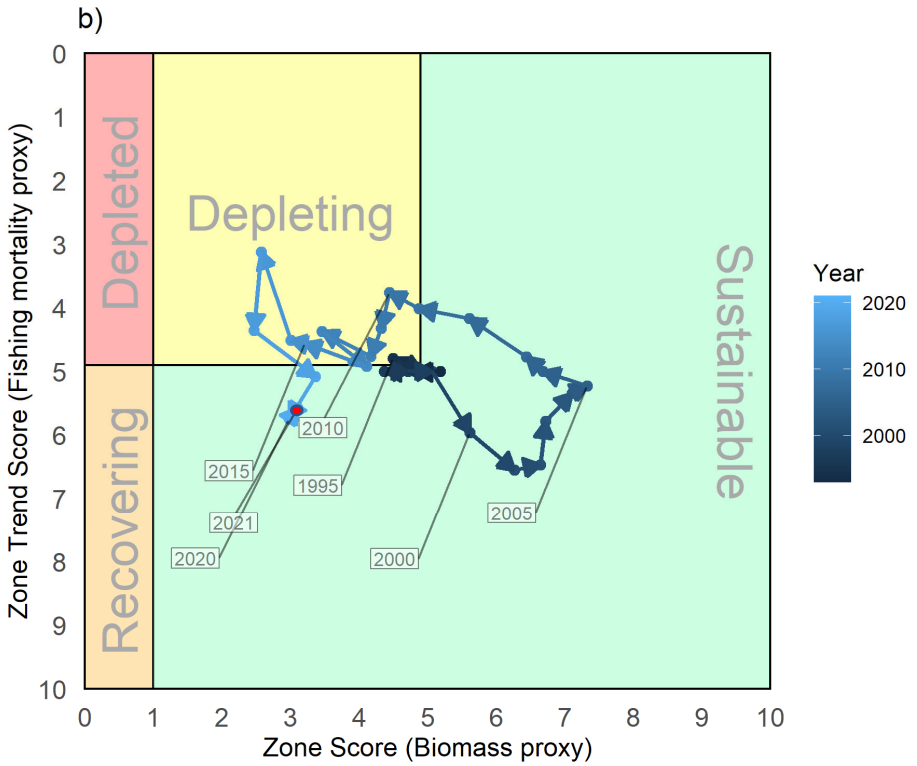

Figure 3.24. Phase plot showing the WZ blacklip stock status from 1993 to 2021.

4 DISCUSSION

4.1 Current status of greenlip and blacklip in the WZ

4.1.1 Uncertainties in assessment

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 represents relative abundance of the fishable stock and that it can detect changes in relative abundance of the stock (Tarbath et al. 2005). However, CPUE can be influenced by numerous factors unrelated to abalone abundance (Stobart et al. 2017a) and 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. 2017b). Second, there have been substantial changes in the distribution of catch among SAUs since 2011 that are difficult to interpret (Stobart et al. 2017a), and these also influence the estimates of CPUE. Third, except for greenlip at The Gap, the FIS are available for a relatively short time period and cover spatially discreet areas making comparison between FD and FIS-based measures of abundance difficult (Stobart et al. 2017a).

4.1.2 Greenlip

During the 2021 financial year, greenlip comprised 51% (47.4 t) of the combined abalone catch in the WZ, having decreased 41% from 2012 (79.8 t) to the lowest catch recorded. This 32t reduction to a catch of 47.4t in 2021 reflects lower TACC's, voluntary under-catch of the TACC, and the removal of one licence during the implementation of marine park sanctuary zones (see table 1.2). This decline in catch is analogous with many other abalone fisheries across southern Australia, which are currently characterised by ongoing low levels of catch and productivity (Burnell *et al.* 2022; Mundy and McAllister 2022; Piddocke *et al.* 2021).

Based on a weight of evidence approach, greenlip was classified as 'depleting' in 2014, 2017 and 2018 and 'sustainable' in the 2013, 2015 and 2016 calendar years under the NFSRF (Stobart et al. 2019). These statuses are also reflected in the retrospective outcomes of the HS, with the exception of 2013 which was 'depleting' under the new HS (Appendix 6.6, Table 6.18), suggesting that the HS may be responsive to early decreases in stock abundance (Stobart and Mayfield 2021). The change from a 'depleting' stock status in 2014 to 'sustainable' in 2015 and 2016 reflected improvement in stock abundance between 2014 and 2015 and a reduction in the risk of overfishing because there was a change to fishing greenlip in autumn rather than summer (Stobart and Mayfield 2016). While the change in fishing season improved catch rate and PropG1, it was not sufficient to arrest the decrease in abundance and harvestable biomass previously

observed in 2013 and 2014. Consequently, greenlip stocks were again classified as 'depleting' in 2017, 2018 and 2019. Evidence for the stock deterioration included ongoing CPUE declines in most fishing grounds including the surveyed SAUs of The Gap, Anxious Bay and Avoid Bay, and low legal and sub-legal densities from fishery independent surveys at The Gap and Anxious Bay (Stobart et al. 2018, Stobart et al. 2019, Stobart et al. 2020).

There was a subsequent change in classification from 'depleting' in 2019 to 'sustainable' in 2020 that was the result of the HS zone score stabilising at a low level from 2018 (Table 6.18) and the consequent increase in the zone trend score from 3.7 in 2019 to 5.0 in 2020. Evidence for the stabilisation included CPUE increasing in 61% of SAUs (63% of 2020 catch) between 2019 and 2020, including several high catch SAUs (e.g. The Gap). There were also increases in the overall WZ CPUE that were maintained between 2018 and 2020, and the PropG1 remained high at many SAUs.

The outcome of the HS for the 2021 financial year was also **'sustainable'** despite the zone score decreasing from 3.10 in 2020 to 3.02 in 2021. This is the fifth consecutive year in which the zone score has been less than 3.5. While the HS zone score had a small decrease between 2020 and 2021, the zonal trend score, and thus the classification, remained unchanged. The 2021 zone score of 3.02 translates to a recommended zonal catch of 43.23 t for the 2023 calendar year, representing a 0.35 t reduction from the recommended zonal catch of 43.65 t in 2022 (Stobart and Mayfield 2021) and is 2% lower than the TACC for 2022.

The HS greenlip status for 2021, 'sustainable', continues to reflect the evidence that the decline in harvestable biomass abated from 2018 onwards. In particular: (1) the small increases in the CPUE for the WZ in 2019 and 2020 continued in 2021; (2) CPUE increased or stabilised in a number of SAUs (e.g. stabilisation of CPUE at The Gap and increases at Avoid Bay and Point Westall); (3) the PropG1 remained high or had small increases at many SAUs, demonstrating that large greenlip, targeted due to their considerably higher value, were still available; and (4) the legal density estimates for The Gap remained relatively stable, albeit at a low level.

Despite the improvement in CPUE in 2020 and 2021 being accounted for in the HS, biomass remained historically low (zone scores of 3.10 and 3.02, respectively), with CPUE for some SAUs remaining at, or among, the lowest estimates on record despite lower catch. This was also reflected in the combined trend of relative catch and relative CPUE that was the lowest recorded for both years. The CPUE values were relatively low despite a 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) and 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/diver skill or technological differences; McCluskey and Lewison 2008, Heldt et al. 2021). Neither hyperstability, nor changes in effective fishing effort, have been quantified or accounted for in this assessment. Consequently, the harvestable biomass in 2020 and 2021 may be lower than indicated by the zone score. There is also no evidence that the lower CPUE is being driven by the recent increase in fishing abalone for the live market (Stobart et al. 2020, Stobart and Mayfield 2021) and the low biomass is also reflected in FIS-based legal density estimates in the three SAUs where FIS are conducted (The Gap, Avoid Bay and Anxious Bay). The latter show long-term declines in legal density at Avoid and Anxious Bays, with 2021 estimates the lowest on record, and relatively low legal density at The Gap over the past four surveys. Importantly, abalone reproductive success relies on high density and/or aggregations for successful reproduction, but the density at all three greenlip FIS sites is below that considered necessary for successful reproduction (0.3 abalone m^{-2}; Babcock and Keesing 1999). It is therefore likely that these sites are also recruitment impaired, as evidenced in the density of sub-legal-sized greenlip in 2021 that was the lowest on record for both Anxious and Avoid Bays and amongst the lowest on record for The Gap.

The ‘sustainable’ status in 2020 and 2021 reflects stable biomass, but it does not reflect the condition of the fishery in relation to historic catches or available biomass; indeed the harvestable biomass of WZ greenlip is currently among the lowest on record. The decline in biomass is likely to reflect a combination of overfishing and environmentally-driven changes in productivity, likely via reductions in recruitment, as evident for other fisheries across southern Australia (e.g. Rock Lobster; Linnane *et al.* 2010, 2019). While the HS is constraining catch to a relatively low level, for abalone, low densities result in a high risk of recruitment impairment. For the WZ, there is evidence of recent low recruitment that indicates some stocks are already recruitment impaired. For example, the current catch – the lowest on record – was harvested at a CPUE among the lowest recorded, demonstrating recent levels of recruitment are substantially lower than those which supported previous, long-term, higher catches and catch rates. In addition, the low density of sub-legal-sized greenlip in 2021 indicates that recruitment is low in these key SAUs, from which, collectively, 35% of the greenlip catch was obtained in 2021.

4.1.3 Blacklip

For 2021, blacklip comprised 49% (45.4 t) of the combined abalone catch in the WZ, having decreased 55% from 2012 (100.7 t). This 55 t reduction reflects lower TACCs, deliberate under-

catch of the TACCs, and the removal of one licence during the implementation of marine park sanctuary zones.

The outcome of the HS for the 2020 financial year was 'sustainable'. For 2021, the outcome remained '**sustainable**', reflecting a zone score increase from 3.0 in 2020 to 3.10 in 2021 with a zone trend score of 5.57 (increasing trend). The zone score of 3.10 for 2021 translates to a recommended zonal catch of 44.11 t for the 2023 calendar year which is 1% above that for 2022.

The status of blacklip stocks recently changed from 'depleting' in 2018 to 'sustainable' in 2019 as a result of the HS zone score increasing from 2.5 in 2018 to 3.4 in 2019 and the associated increase in the zone trend score to 5.1 in 2019 (also see Stobart and Mayfield 2021). The zonal trend score also remained above 5 in 2020 and 2021. The change of status in 2019 to 'sustainable' followed widespread deterioration in stock abundance and harvestable biomass that was most evident from 2012 onwards – reflected in nine years of a 'depleting' classification – followed by a modest improvement in stock abundance.

Despite the recent evidence of a small increase in CPUE and relatively high FIS legal density estimates for Drummond South and Point Westall, blacklip biomass remained low in 2021 (zone score of 3.10). Notably, the only SAUs maintaining relatively high catch rates were in the Streaky Bay region, and 71% of SAUs had decreases in catch rate between 2020 and 2021. In addition, SAUs with CPUE scores below a 5 in the HS (all except the Streaky Bay SAU) accounted for 85% of the blacklip catch in 2021. These low, and declining CPUEs, occurred despite very good weather conditions for fishing in 2021 that would have been expected to yield improved catch rates. As with greenlip, although the HS is constraining catch to a relatively low level, low densities result in a high risk of recruitment impairment. The low blacklip biomass is likely to reflect a combination of overfishing and environmentally-driven changes in productivity.

4.1.4 Conclusion

The 2021 HS outcome for both greenlip and blacklip is 'sustainable'. However, the HS scores for both species are among the lowest recorded, reflecting their low biomass. Although the low HS scores are constraining recommended catches below the target catches for these fisheries (Greenlip: 78 t; Blacklip: 77 t), the persistent, current low biomass of greenlip, and the slow recovery from a similarly low biomass for blacklip, means there is a current high risk of recruitment impairment for both species which requires careful consideration of future catch levels. These risks can be reduced through a combination of lower catches, higher size limits and both spatial and temporal restrictions on fishing to protect stocks at the highest risk (i.e. those with a CPUE

and/or FIS score ≤1) as is the case for Greenlip Abalone in Anxious Bay, at Flinders Island, Fishery Bay and The Gap, and for Blacklip Abalone in Reef Head, Avoid Bay, Anxious Bay and Sheringa.

The success of the HS relies on realistic zonal target catches paired with settings that deliver a recommended zonal catch that is adequately conservative to protect the fishery from further reductions to the greenlip stocks or to allow a continuation and timely recovery of the blacklip stocks. For example, assuming a continuation of the small increases in WZ CPUE observed for greenlip and blacklip over the past three years, it would take at least another 6 and 8 years, respectively, for the catch rates to reach those previously observed for these species in the 1990-2000 reference period (greenlip 22.9 $kg.hr^{-1}$ and blacklip 25.8 $kg.hr^{-1}$) used in the HS. Similarly, at the current rate of change in blacklip zone score, it would take 11 years to reach a zone score of 5. No upward trend in zone score is yet evident for greenlip. Given the risk, these stocks will require careful monitoring.

4.2 Future research needs

There are five high priority research needs for the WZ Abalone Fishery:

1) 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 translate to large increases in GVP. The first phase of a project to support production and release of hatchery-reared abalone for enhancement/aquaculture was finalised in 2022 (FRDC Project 2020/116), with an amendment to the project being sought for an experimental release of juvenile abalone.

2) Investigate the impact of, and factors leading to, the proliferation and spread of *Perkinsus olensi*. In response, an FRDC research project was initiated in January 2021 (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 2008) 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% (11 $t.yr^{-1}$) of blacklip catch to alternative fishing grounds (SARDI

unpublished), exacerbated quota reductions and likely cost the fishery in excess of AUD $10 million 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.

3) Identify and test a process to objectively obtain industry diver information that can be interpreted and used in the application of the 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.

4) 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 et al. 2018a; 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.

5) Establish and validate an index of recruitment for use as a leading indicator. 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; Mundy et al. 2018b).

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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) of 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) of 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 (Vainickis 2010). 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 is 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 (Bennett et al 2009). Following necessary revision, the report is reviewed by PIRSA to ensure it is consistent with their needs and objectives for the fishery.

6.4 Temporal patterns in low catch spatial assessment units – Blacklip and Greenlip

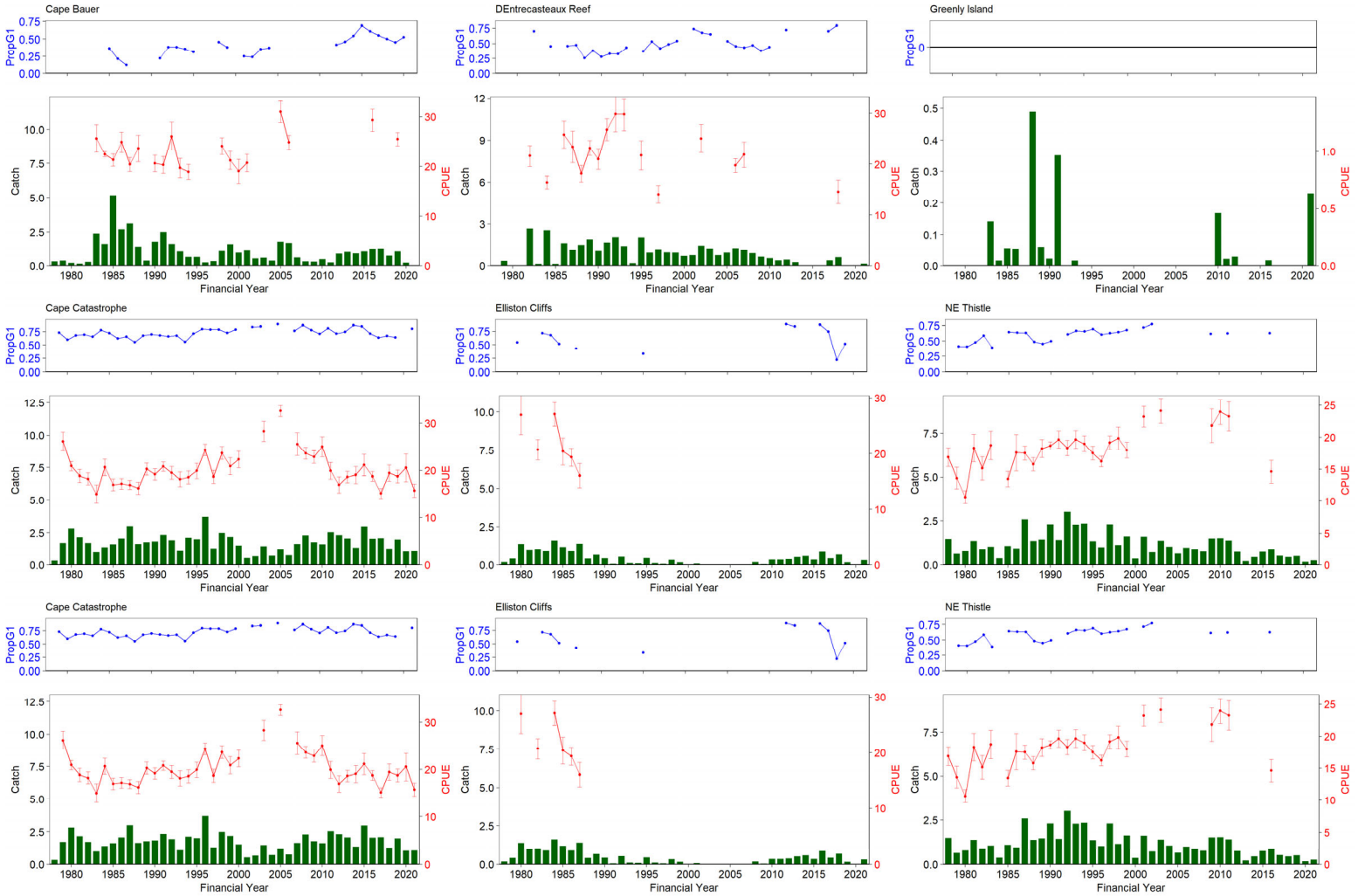

Figure 6.1. Greenlip low catch SAU's (indicated by plot names) showing Catch (t, meat weight, green bars), CPUE ± se (kg.hr^{-1}; solid red line) and PropG1 (solid blue line) from 1978 to 2021.

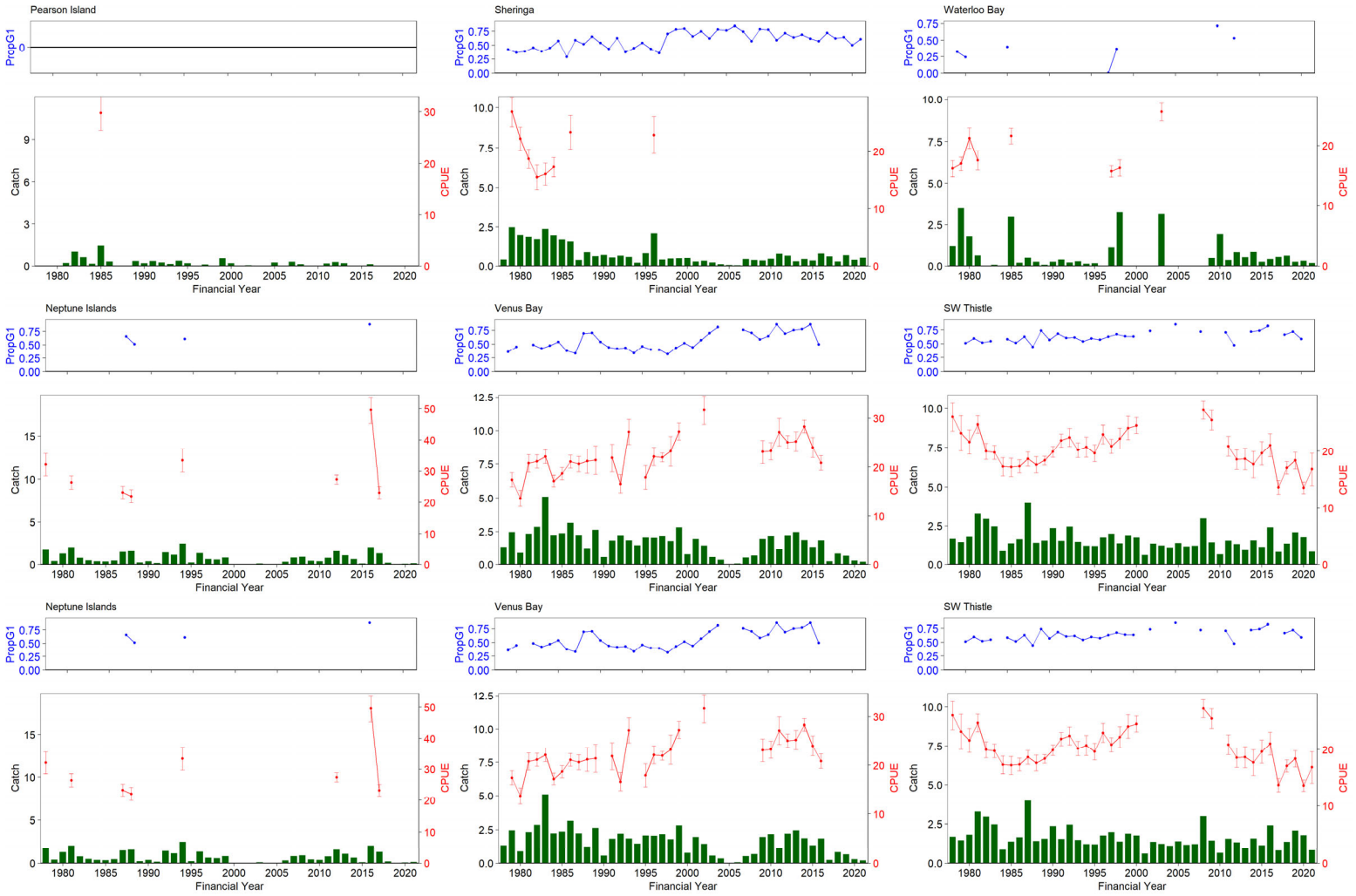

Figure 6.2. Greenlip low catch SAU's (indicated by plot names) showing Catch (t, meat weight, green bars), CPUE ± se (kg.hr^{-1}; solid red line) and PropG1 (solid blue line) from 1978 to 2021.

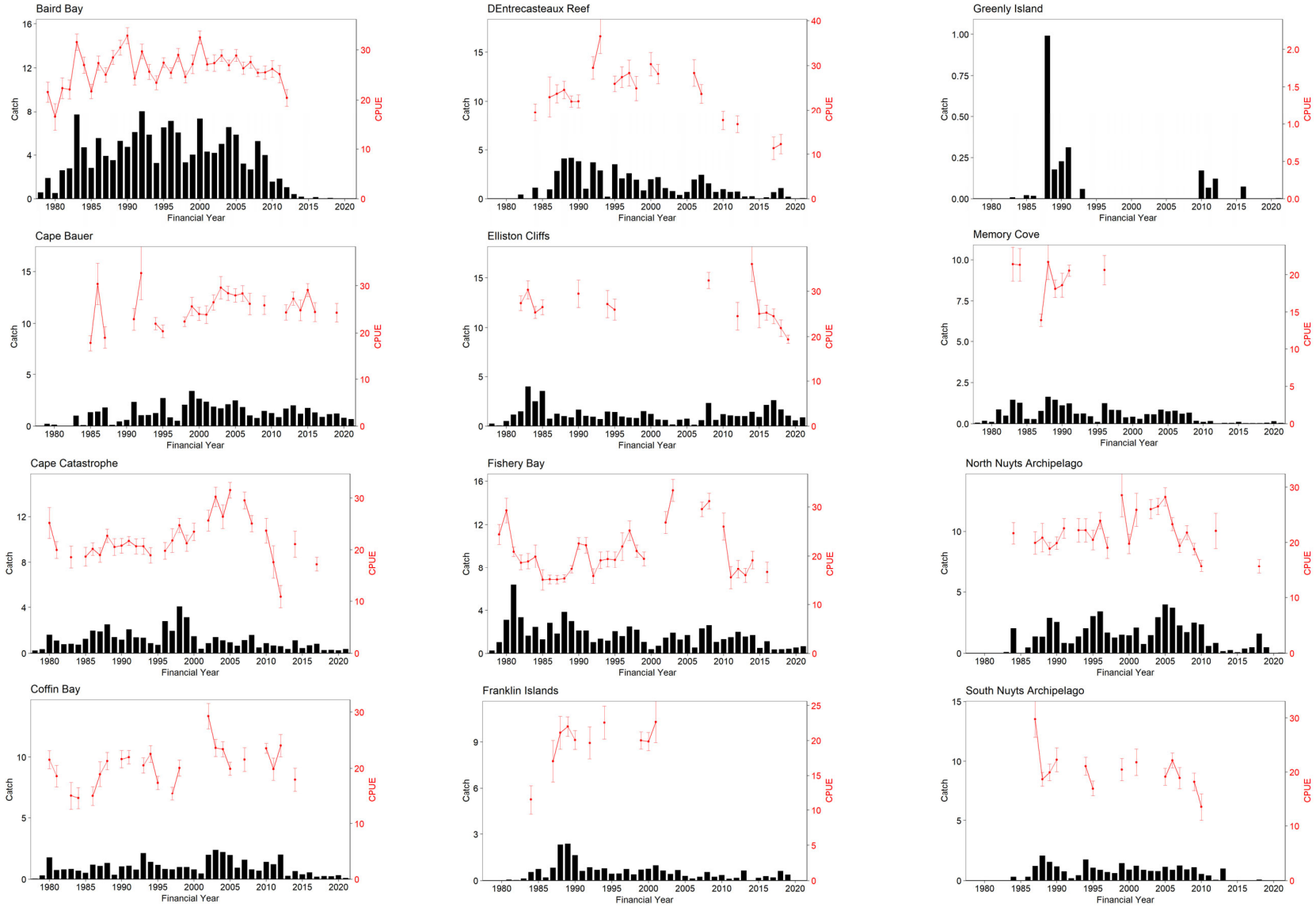

Figure 6.3. Blacklip low catch SAU's (indicated by plot names) showing Catch (t, meat weight, black bars) and CPUE ± se (kg.hr^{-1}; solid red line) from 1978 to 2021.

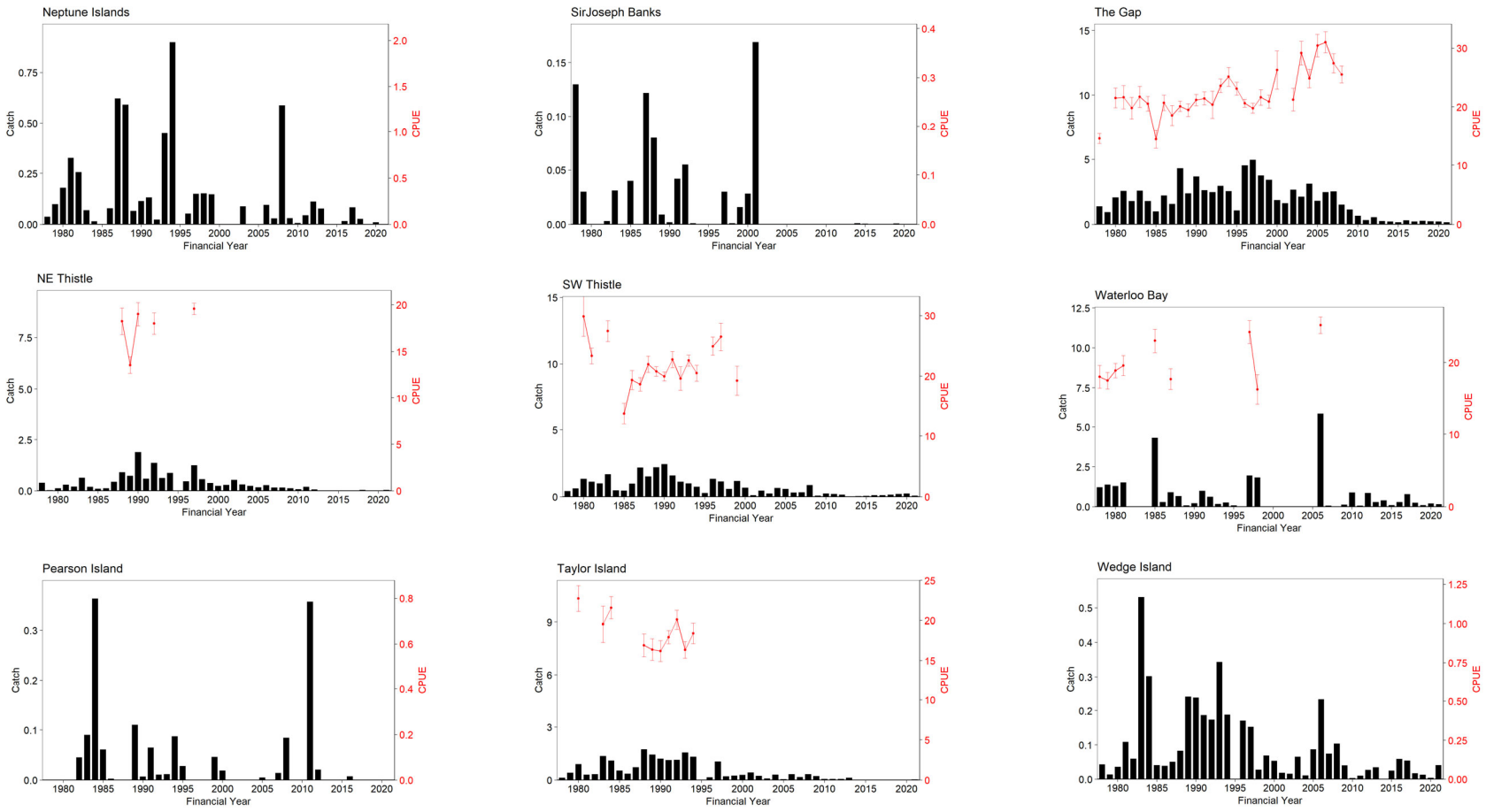

Figure 6.4. Blacklip low catch SAU's (indicated by plot names) showing Catch (t, meat weight, black bars) and CPUE ± se (kg.hr^{-1}; solid red line) from 1978 to 2021.

6.5 Harvest strategy scoring – Blacklip

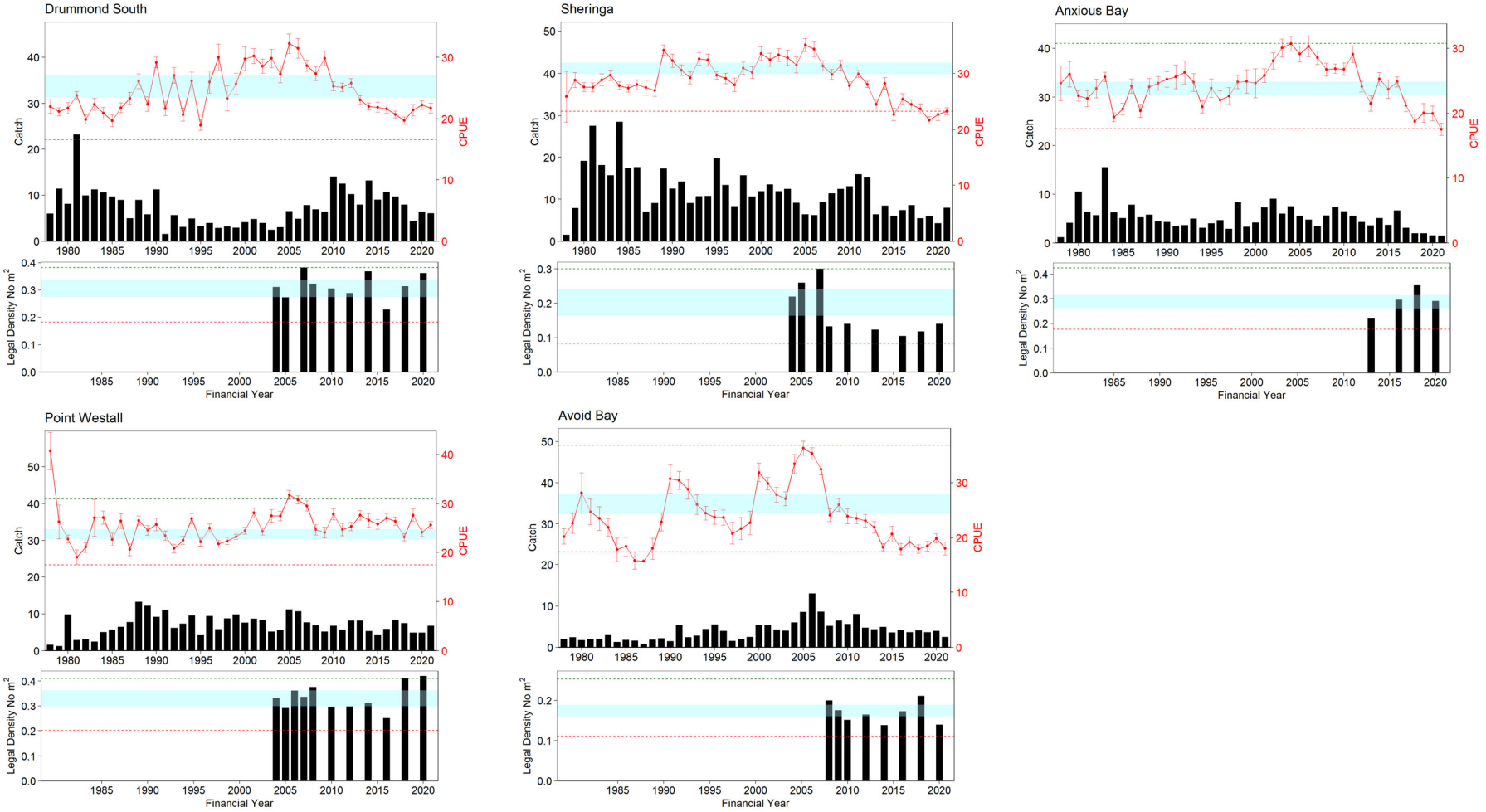

Figure 6.5. Blacklip SAUs (indicated by plot names) showing performance indicators CPUE ± se (kg.hr^{-1}, red) and legal-size mean density ± se (abalone.m^{-2}; black bars on density plots) from 1978 to 2021. Catch (t meat weight; black bars on CPUE plots) is also included for reference. Densities are 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.

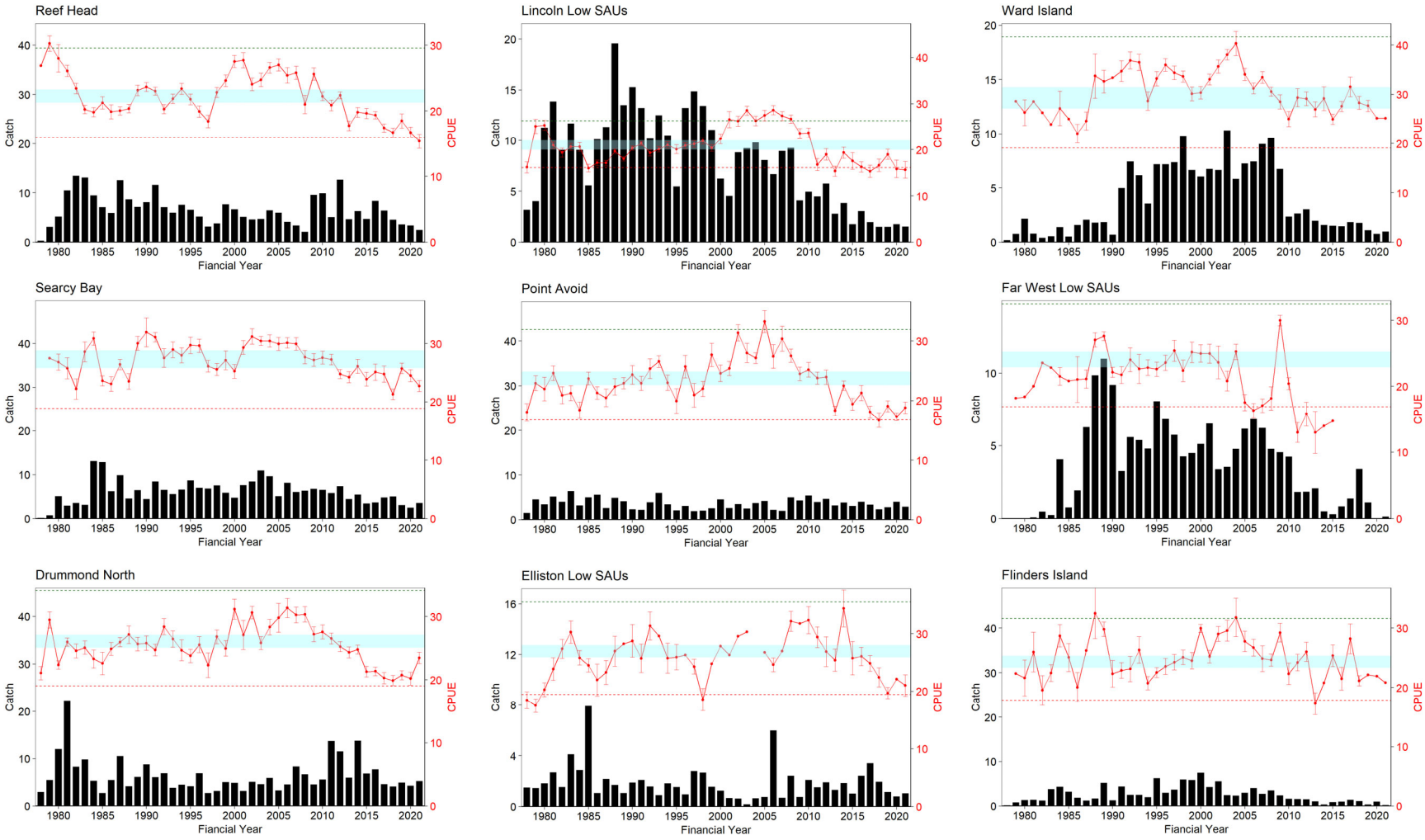

Figure 6.6. Blacklip SAUs (indicated by plot names) showing performance indicator CPUE ± se (kg.hr^{-1}, red) from 1978 to 2021. Catch (t meat weight; black bars) is also included for reference. The green and red dashed lines and pale blue bands are the upper and lower limit reference points and target reference band from the harvest strategy performance indicator CPUE.

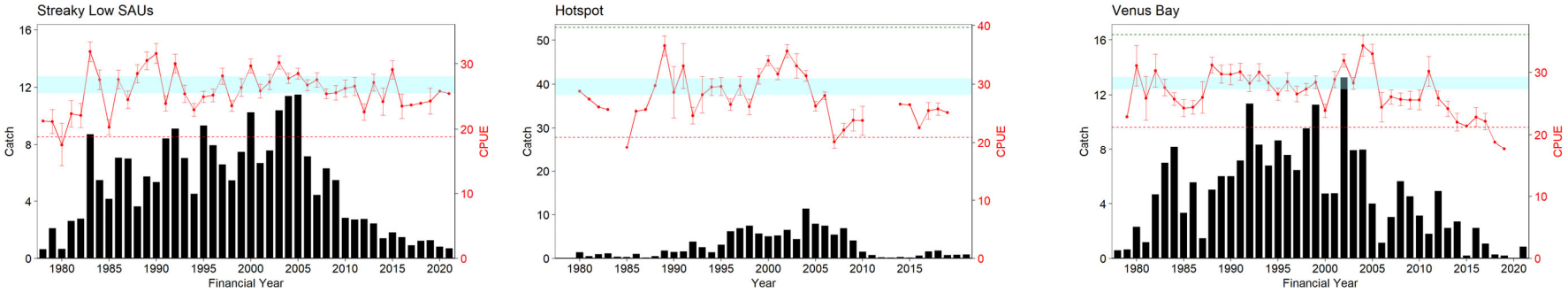

Figure 6.7. Blacklip SAUs (indicated by plot names) showing performance indicator CPUE ± se (kg.hr^{-1}, red) from 1978 to 2021. Catch (t meat weight; black bars) also included for reference. The green and red dashed lines and pale blue bands are the upper and lower limit reference points and target reference band from the harvest strategy performance indicator CPUE.

6.6 Summary tables

Table 6.13. Financial year blacklip catch (tons MW) from the Western Zone SAUs (ordered alphabetically Low SAU's at end). Empty cells denote no catch.

Financial Yr	Western Zone	Anxious Bay	Avoid Bay	Baird Bay	Cape Bauer	Cape Catastrophe	Coffin Bay	DEntrecasteaux Reef	Drummond North	Drummond South	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	LINCOLN LOW SAUS	ELLISTON LOW SAUS	STREAKY LOW SAUS	FAR WEST LOW SAUS
1978	23.6	1.2	2.0	0.6	0.0	0.2	0.0		3.0	6.0	0.3	0.3	0.1			0.1	0.1	0.4	0.0			1.5	1.6	0.3	0.1	1.6	0.1		0.4	0.1	1.4	0.0	0.6	0.2	1.2	0.0	3.2	1.5	0.6	0.0
1979	50.9	4.1	2.4	1.9	0.2	0.4	0.3		5.5	11.4	0.1	1.1	0.8	0.0		0.1	0.2	0.0	0.1			4.5	1.2	3.1	0.8	7.9	0.0	0.0	0.6	0.4	0.9	0.0	0.7	0.8	1.4	0.0	4.0	1.4	2.1	0.0
1980	96.1	10.5	1.7	0.5	0.1	1.6	1.8		12.0	8.1	0.5	3.1	1.3	0.0		1.4	0.1	0.1	0.2			3.4	9.9	5.2	5.1	19.1			1.3	0.9	2.1	0.0	2.3	2.2	1.3	0.0	11.3	1.8	0.7	0.0
1981	126.3	6.4	2.0	2.6	0.0	1.1	0.7		22.3	23.3	1.2	6.4	1.4	0.1		0.5	0.9	0.3	0.3	0.0		5.2	2.9	10.5	3.0	27.6			1.1	0.3	2.6	0.0	1.2	0.8	1.5	0.1	13.9	2.7	2.6	0.1
1982	89.4	5.7	2.1	2.8	0.0	0.8	0.8	0.4	8.3	10.0	1.5	3.4	1.2	0.0		0.9	0.5	0.2	0.3	0.0	0.0	4.0	3.1	13.5	3.5	18.1	0.0		1.0	0.3	1.8	0.0	4.7	0.4		0.1	9.1	1.5	2.8	0.5
1983	117.8	15.6	3.2	7.7	1.0	0.8	0.8		9.8	11.3	4.0	1.7	3.8	0.1	0.0	1.1	1.5	0.6	0.1	0.1	0.1	6.4	2.5	13.1	3.2	15.7	0.0		1.7	1.4	2.6	0.0	7.0	0.6	0.0	0.5	11.7	4.1	8.7	0.2
1984	118.8	6.3	1.3	4.7	0.1	0.7	0.7	1.1	5.3	10.7	2.5	2.5	4.3	0.6		0.4	1.3	0.2	0.0	2.0	0.4	3.2	5.0	9.5	13.1	28.5		0.3	0.5	1.1	1.8	0.7	8.2	1.4		0.3	9.1	2.9	5.5	4.1
1985	93.2	5.1	1.8	2.8	1.3	1.3	0.5	0.0	2.7	9.7	3.5	1.3	3.2	0.7	0.0	0.3	0.3	0.1	0.0	0.0	0.1	5.0	5.7	7.1	12.9	17.4	0.0	0.0	0.5	0.5	1.0	0.0	3.3	0.5	4.3	0.0	5.6	7.9	4.2	0.8
1986	95.9	7.8	1.6	5.5	1.4	2.0	1.2	1.0	5.5	9.0	0.8	2.8	1.9	0.2	0.0	1.0	0.3	0.1	0.1	0.5	0.0	5.5	6.5	5.9	6.2	17.6		0.3	1.0	0.4	2.2	0.1	5.6	1.6	0.3	0.0	10.1	1.1	7.1	1.9
1987	93.1	5.3	0.8	3.9	1.8	1.9	1.1	2.8	10.5	5.0	1.3	1.9	1.2	0.8		0.2	0.8	0.4	0.6	1.4		2.6	7.8	12.6	9.9	7.0	0.1	1.2	2.2	0.7	1.6	1.3	1.5	2.1	0.9	0.1	11.3	2.2	7.0	6.3
1988	105.1	5.8	1.9	3.5	0.1	2.5	1.3	4.1	4.2	9.0	1.0	3.9	1.7	2.3	1.0	0.5	1.6	0.9	0.6	1.3		4.9	13.2	8.7	4.6	9.1	0.1	2.1	1.5	1.7	4.3	0.0	5.0	1.8	0.7	0.1	19.6	1.7	3.6	9.9
1989	112.0	4.4	2.2	5.3	0.5	1.4	0.4	4.2	6.1	5.8	0.9	3.0	5.2	2.4	0.2	1.8	1.5	0.7	0.1	2.9	0.1	4.1	12.2	7.2	6.5	17.3	0.0	1.6	2.2	1.4	2.4	0.0	6.0	1.8	0.1	0.2	13.5	1.1	5.7	11.0
1990	103.5	4.3	1.5	4.7	0.6	1.2	1.0	3.8	8.8	11.2	1.7	2.1	1.3	1.6	0.2	1.5	1.1	1.9	0.1	2.5	0.0	2.3	9.2	8.1	4.5	12.5	0.0	1.2	2.4	1.2	3.7	0.0	6.0	0.7	0.2	0.2	15.3	1.9	5.3	9.2
1991	109.1	3.5	5.4	6.1	2.3	2.1	1.1	1.0	6.1	1.6	1.0	2.1	4.4	0.6	0.3	1.6	1.2	0.6	0.1	0.8	0.1	2.2	11.0	11.6	8.4	14.2	0.0	0.8	1.6	1.1	2.6	0.0	7.2	5.0	1.0	0.2	13.2	2.1	8.4	3.3
1992	103.1	3.6	2.5	8.1	1.1	1.4	0.8	3.7	6.9	5.7	0.9	1.0	2.5	0.9		3.8	0.6	1.4	0.0	0.8	0.0	3.9	6.2	7.1	6.5	9.1	0.1	0.2	1.1	1.1	2.5	0.0	11.4	7.4	0.6	0.2	10.2	1.6	9.1	5.6
1993	95.8	5.0	2.8	5.9	1.1	1.3	2.1	2.9	3.8	3.1	0.7	1.4	2.5	0.7	0.1	2.6	0.6	0.6	0.4	1.4	0.0	6.0	7.3	6.0	5.6	10.7	0.0	0.4	1.0	1.6	3.0	0.1	8.4	6.2	0.2	0.3	12.5	0.9	7.0	5.4
1994	90.3	3.1	4.4	3.3	1.3	0.9	1.4	0.2	4.5	4.9	1.5	1.2	2.0	0.8		1.4	0.5	0.9	0.9	2.0	0.1	3.4	9.6	7.6	6.6	10.8		1.8	0.8	1.3	2.5	0.0	6.8	3.6	0.3	0.2	10.5	1.8	4.5	4.8
1995	108.1	4.0	5.5	6.5	2.7	0.7	1.2	3.5	4.1	3.4	1.4	2.1	6.2	0.4		3.1	0.1			3.0	0.0	2.1	4.4	6.6	8.7	19.7		1.1	0.3	0.0	1.1	0.1	8.7	7.2	0.1		5.5	1.5	9.3	8.1
1996	110.5	4.7	4.0	7.1	0.8	2.8	0.8	2.1	6.9	4.0	1.0	1.6	3.0	0.5		6.2	1.2	0.5	0.1	3.4		3.1	9.4	5.2	7.0	13.4		0.9	1.3	0.2	4.5	0.0	7.6	7.2		0.2	13.2	1.0	8.0	6.8
1997	90.5	2.9	1.6	6.1	0.5	1.9	0.8	2.6	2.7	2.9	0.9	2.5	3.6	0.7		6.9	0.8	1.2	0.2	1.7	0.0	1.9	5.8	3.2	6.8	8.3	0.0	0.7	1.2	1.1	5.0	0.0	6.5	7.4	1.9	0.2	14.9	2.8	6.6	5.7
1998	113.2	8.3	2.1	3.3	2.1	4.1	1.0	2.0	3.2	3.2	0.8	2.2	5.9	0.4		7.5	0.8	0.6	0.2	1.3		2.0	8.7	3.8	7.6	15.7	0.0	0.6	0.6	0.2	3.8	0.0	9.6	9.8	1.8	0.0	13.4	2.7	5.5	4.3
1999	104.3	3.3	2.5	4.0	3.4	3.1	1.0	0.8	5.0	3.0	1.5	1.1	5.8	0.7		5.7	0.4	0.4	0.1	1.5	0.0	2.6	9.8	7.7	5.9	10.6	0.0	1.4	1.2	0.3	3.4	0.0	11.3	6.6		0.1	11.1	1.6	7.4	4.5
2000	100.2	4.2	5.4	7.3	2.7	1.5	0.8	2.0	4.9	4.1	1.2	0.4	7.5	0.8		5.0	0.4	0.2		1.5	0.0	4.5	7.6	6.7	4.7	11.9	0.0	0.9	0.7	0.3	1.9	0.3	4.8	6.0		0.1	6.3	1.2	10.3	5.1
2001	97.6	7.3	5.3	4.3	2.4	0.4	0.5	2.2	3.2	4.8	0.7	0.7	4.2	1.0		5.3	0.3	0.3		2.1		2.6	8.7	5.1	7.6	13.5	0.2	1.2	0.1	0.4	1.6	0.0	4.8	6.7		0.0	4.5	0.7	6.7	6.5
2002	111.7	9.1	4.3	4.2	1.9	0.9	2.0	1.1	5.1	4.0	0.6	1.5	5.6	0.6		6.5	0.6	0.5		0.8		3.5	8.3	4.6	8.5	11.9		0.9	0.5	0.2	2.7	1.5	13.3	6.6		0.0	8.8	0.6	7.6	3.4
2003	101.3	6.0	4.1	5.0	1.7	1.4	2.4	0.8	4.6	2.5	0.2	1.9	2.4	0.4		4.4	0.6	0.3	0.1	1.5		2.5	5.2	4.7	10.9	12.5		0.8	0.3	0.1	2.1	3.7	7.9	10.3		0.1	9.3	0.2	10.4	3.6
2004	111.2	7.5	6.0	6.6	2.1	1.1	2.2	0.4	5.9	3.1	0.6	1.3	2.3	0.7		11.4	0.9	0.2		2.9		3.7	5.6	6.5	9.6	9.1		0.8	0.7	0.3	3.1	2.7	8.0	5.8		0.0	9.8	0.6	11.4	4.8
2005	105.5	5.6	8.6	5.9	2.5	0.9	2.0	0.7	3.3	6.5	0.8	1.7	3.0	0.3		7.9	0.7	0.2		4.0	0.0	4.2	11.2	6.0	5.1	6.4		1.2	0.6	0.0	1.8	3.2	4.0	7.3		0.1	8.1	0.8	11.5	6.2
2006	105.2	4.8	13.0	3.2	1.8	0.7	0.9	2.0	4.5	4.9	0.1	0.6	4.0	0.1		7.5	0.8	0.3	0.1	3.7		2.2	10.7	4.1	8.1	6.2		0.9	0.3	0.3	2.5	2.2	1.1	7.4	5.8	0.2	6.7	6.0	7.1	6.8
2007	97.3	3.4	8.7	2.7	1.0	1.1	1.6	2.5	8.4	7.8	0.6	2.3	2.8	0.2		5.4	0.6	0.2	0.0	2.3	0.0	1.9	7.7	3.4	6.0	9.3		1.3	0.3	0.2	2.5	0.7	3.0	9.1	0.1	0.1	9.0	0.7	4.4	6.2
2008	104.5	5.6	5.2	5.3	0.8	1.6	0.8	1.6	6.7	7.0	2.3	2.6	3.5	0.5		6.9	0.7	0.2	0.6	1.7	0.1	5.0	6.9	2.1	6.3	11.4		0.9	0.9	0.3	1.5	0.2	5.7	9.6		0.1	9.3	2.4	6.3	4.8
2009	95.7	7.4	6.5	4.0	1.5	0.5	0.7	0.7	4.5	6.4	0.6	1.1	2.4	0.2		4.1	0.2	0.1	0.0	2.5		4.3	5.2	9.6	6.8	12.5		1.1	0.1	0.2	1.1	0.0	4.5	6.7	0.1	0.0	4.1	0.8	5.5	4.6
2010	96.1	6.5	5.6	1.6	1.3	0.9	1.4	1.0	5.6	14.0	1.2	1.3	1.6	0.4	0.2	1.5	0.1	0.1	0.0	2.4		5.4	6.7	9.9	6.5	13.1		0.6	0.2	0.1	0.7	0.0	3.1	2.3	0.9	0.0	4.9	2.1	2.8	4.2
2011	93.7	5.6	8.0	1.8	0.9	0.7	1.2	0.7	13.7	12.5	1.1	1.5	1.6	0.1	0.1	0.8	0.2	0.2	0.0	0.6	0.4	4.0	5.7	5.1	5.8	15.9		0.4	0.2	0.1	0.3	0.0	1.8	2.6	0.1	0.0	4.5	1.5	2.7	1.8
2012	100.7	4.3	4.7	1.1	1.7	0.6	2.0	0.7	11.5	10.2	1.0	2.0	1.5	0.2	0.1	0.2	0.0	0.1	0.1	0.8	0.0	4.6	8.2	12.7	7.4	15.2		0.1	0.2	0.1	0.6	0.0	4.9	3.0	0.9	0.0	5.8	1.9	2.7	1.8
2013	62.8	3.6	4.4	0.4	2.0	0.4	0.3	0.2	6.0	8.0	1.0	1.6	1.0	0.7		0.1	0.1	0.0	0.1	0.2		3.2	8.2	4.7	4.5	6.4		1.0	0.0	0.1	0.3	0.0	2.2	2.0	0.3	0.0	2.8	1.3	2.5	2.1
2014	79.0	5.1	5.0	0.2	1.2	1.1	0.7	0.2	13.8	13.2	1.5	1.7	0.4			0.3	0.1	0.0		0.3		3.8	5.3	6.3	5.5	8.5	0.0		0.0	0.0	0.2	0.0	2.7	1.6	0.4		3.8	1.9	1.4	0.5
2015	52.5	3.7	3.6	0.0	1.8	0.4	0.4	0.0	6.9	9.1	0.9	0.5	0.9	0.2		0.2	0.1	0.0	0.0	0.1		3.1	4.4	4.7	3.4	6.0	0.0		0.1	0.0	0.2	0.0	0.2	1.5	0.1	0.0	1.8	1.0	1.8	0.3
2016	71.6	6.6	4.2	0.2	1.3	0.7	0.6	0.1	7.7	10.7	2.1	1.1	1.0	0.3	0.1	0.6	0.0	0.0	0.0	0.4	0.0	4.0	5.9	8.4	3.7	7.4		0.0	0.1	0.0	0.3	0.0	2.2	1.5	0.3	0.1	3.0	2.4	1.5	0.8
2017	66.1	3.1	3.7	0.0	0.9	0.8	0.2	0.7	4.6	9.7	2.6	0.4	1.4	0.2		1.6	0.0	0.0	0.1	0.5		3.3	8.3	6.4	4.8	8.6	0.0	0.0	0.1	0.0	0.2	0.0	1.1	1.9	0.8	0.1	2.0	3.4	0.9	1.4
2018	56.0	2.0	4.1	0.1	1.2	0.3	0.3	1.1	4.1	8.0	1.7	0.4	1.1	0.6		1.8	0.0	0.0	0.0	1.6		2.3	7.5	4.6	5.0	5.4		0.1	0.2	0.0	0.3	0.0	0.3	1.8	0.2	0.0	1.5	1.9	1.2	3.4
2019	42.7	2.0	3.7	0.0	1.2	0.3	0.2	0.2	4.9	4.4	1.1	0.4	0.4	0.4		0.7	0.1	0.0		0.5		2.8	4.9	3.6	3.1	5.9	0.0	0.0	0.2	0.0	0.2	0.0	0.2	1.1	0.1	0.0	1.5	1.2	1.3	1.1
2020	41.2	1.6	4.0	0.0	0.8	0.3	0.3		4.3	6.4	0.6	0.5	1.0			0.8	0.2	0.0	0.0			4.0	4.9	3.4	2.5	4.3			0.2	0.0	0.2	0.0	0.0	0.8	0.2	0.0	1.8	0.8	0.8	0.0
2021	45.4	1.5	2.5	0.0	0.7	0.4	0.1	0.1	5.3	6.1	0.9	0.7	0.2	0.0	0.0	0.9	0.0	0.0		0.1		2.9	6.8	2.5	3.5	8.0	0.0	0.0	0.1	0.0	0.2	0.0	0.9	1.0	0.2	0.0	1.5	1.0	0.7	0.1

Table 6.14. Financial year blacklip CPUE (kg.hr-1) from the Western Zone SAUs (ordered alphabetically Low SAU's at end). Empty cells denote no catch or insufficient data to estimate CPUE.

Financial Yr	Western Zone	ANXIOUS BAY	AVOID BAY	BAIRD BAY	CAPE BAUER	CAPE CATASTROPHE	COFFIN BAY	DENTRECASTEAUX REEF	DRUMMOND NORTH	DRUMMOND SOUTH	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	VENUS BAY	WARD ISLAND	WATERLOO BAY	WEDGE ISLAND	LINCOLN LOW SAUS	ELLISTON LOW SAUS	STREAKY LOW SAUS	FAR WEST LOW SAUS
1978	21.8	24.7	20.2						21.1	22.0												18.1	40.7	26.9		25.9					14.5			18.0		16.2	18.4	21.2	
1979	24.4	26.0	22.6	21.6					29.5	21.2		48.8	22.4									22.9	26.3	30.3	27.5	28.8						22.9	28.6	17.5		25.1	17.5	21.2	18.2
1980	24.3	22.7	28.1	16.5		25.2	21.5		22.4	21.7		58.6	21.6			28.8						22.0	22.9	28.0	26.8	27.6			29.9	22.7	21.5	31.1	26.3	18.9		25.3	20.3	17.6	18.4
1981	24.7	22.3	24.7	22.4		20.0	18.6		26.0	23.8		41.8	26.0			27.5						24.6	19.0	26.1	25.8	27.5			23.4		21.7	25.8	28.5	19.6		21.0	23.9	22.4	20.0
1982	23.6	23.8	23.5	22.1					24.6	19.9	27.4	37.3	19.5			26.1						20.9	21.1	23.4	22.2	28.9					19.8	30.3	26.3			19.4	27.4	22.1	23.6
1983	24.6	25.6	21.9	31.6		18.5	15.0		25.1	22.4	30.3	37.8	22.5			25.6	21.4					21.3	27.1	20.2	28.6	29.7			27.4	19.5	21.7	27.6	23.9			20.6	30.3	31.9	22.9
1984	24.2	19.4	17.7	27.0			14.6	19.5	23.3	20.9	25.3	39.7	28.7	11.5			21.3			21.7		18.4	27.2	19.8	30.9	27.8				21.6	20.5	25.7	27.2			20.6	25.8	27.6	21.5
1985	22.7	20.7	18.3	21.7	17.7	18.7			22.6	19.7	26.5	30.1	25.1			19.1						23.7	22.7	21.3	23.6	27.4			13.7		14.4	24.3	25.0	23.0		16.0	24.5	20.3	20.8
1986	23.2	24.2	15.7	27.3	30.4	20.2	15.0	22.9	24.9	21.8		30.3	20.1			25.4						21.3	26.5	19.9	23.1	28.0			19.3		20.7	24.4	22.0			17.2	22.0	27.6	21.0
1987	22.4	20.4	15.6	25.0	19.0	19.0	18.9	23.7	26.0	23.3		30.2	26.2	17.1		25.6	13.9			19.9		20.5	20.6	20.0	26.4	27.5		29.7	18.6		18.5	26.0	24.6	17.7		17.1	23.3	24.5	21.1
1988	23.9	24.1	17.9	28.5		22.7	21.3	24.6	27.1	26.1		30.7	32.5	21.1		29.7	21.7	18.3		20.9		22.3	26.6	20.4	23.5	27.0		18.7	22.0	16.9	20.1	31.1	33.7			19.7	27.0	28.5	27.1
1989	25.1	24.7	22.9	30.5		20.5		22.0	25.7	22.4		34.6	29.8	22.0		36.6	18.1	13.6		18.9		22.9	24.6	23.2	30.1	34.2		20.0	20.8	16.4	19.5	29.7	32.6			18.0	28.3	30.5	27.6
1990	26.0	25.2	30.7	32.8		20.8	21.6	22.0	25.8	29.2	29.5	45.1	22.4	20.1		28.6	18.6	19.0		19.9		24.3	25.8	23.7	31.9	32.3		22.3	19.9	16.2	21.2	29.7	33.4			20.4	28.8	31.6	22.1
1991	25.8	25.6	30.4	24.3	22.9	21.7	22.0		24.7	21.7		44.5	22.9			33.1	20.5			22.6		22.9	23.5	23.0	31.1	30.6			22.8	17.9	21.5	30.1	34.7			21.4	25.7	23.9	21.7
1992	26.2	26.3	28.8	29.7	32.7	20.7		29.5	28.4	27.1		31.6	23.2	19.7		24.6		18.0				25.4	20.8	20.3	27.5	29.2			19.6	20.1	20.4	28.2	36.9			19.3	31.4	30.0	24.1
1993	26.1	24.8	26.0	25.6		20.7	20.5	36.5	26.5	20.7		38.3	26.3			28.2				22.2		26.6	22.6	21.9	29.0	32.6			22.6	16.3	23.6	30.0	36.5			20.1	29.6	25.4	22.7
1994	25.3	21.0	24.5	23.4	22.0	18.9	22.6		24.7	26.1	27.2	38.8	20.8	22.6		29.5				22.2		23.0	27.0	23.4	28.0	32.4		21.1	20.5	18.4	25.1	28.3	28.7			21.0	25.8	23.0	22.9
1995	25.1	23.9	23.7	27.5	20.4		17.4	25.9	23.8	19.0	26.0	38.5	22.5			29.6				20.5		20.0	22.3	21.8	29.7	29.7		16.9			23.1	26.5	33.2			20.1	26.0	24.9	22.6
1996	25.8	22.1	23.7	25.4		19.8		27.4	25.5	26.0		43.9	23.6			26.5	20.6			23.9		25.7	25.1	19.9	29.6	29.1			25.0		20.6	28.5	36.0			20.9	26.3	25.2	23.6
1997	25.0	22.7	20.7	29.0		21.8	15.4	28.3	22.3	30.0		50.4	24.3			29.7		19.6		19.0		21.0	21.8	18.4	26.1	28.0			26.5		19.8	26.5	34.4	24.2		21.3	24.3	28.1	25.4
1998	25.4	24.8	21.6	24.6	22.4	24.8	20.0	24.9	26.8	23.3		42.1	25.1			26.1						22.0	22.4	22.8	25.6	30.9					21.6	27.3	33.6	16.3		21.9	18.6	23.5	22.4
1999	25.7	24.9	22.7	27.1	25.6	21.3			25.0	25.7		38.9	24.5	20.0		31.3				28.5		27.7	23.3	24.6	27.1	30.2		20.5	19.2		20.9	28.4	30.1			20.4	24.8	26.4	25.2
2000	27.6	24.6	31.9	32.5	24.0	23.5		30.3	31.2	29.8			30.0	19.9		34.0				19.8		24.6	24.5	27.5	25.2	33.5					26.3	23.8	30.3			22.4	27.8	29.7	25.0
2001	28.5	25.8	29.8	27.1	23.9			28.1	27.1	30.2			25.2	22.7		31.7				25.9		25.4	28.1	27.7	29.3	32.5		21.8				28.9	33.0			26.6	26.3	25.8	25.0
2002	29.2	28.1	27.8	27.4	26.5	25.6	29.3		30.6	28.5		53.6	29.0			35.7						31.3	24.3	24.1	31.2	33.3					21.2	31.9	35.7			26.2	29.6	27.2	23.6
2003	29.8	30.1	27.1	28.9	29.6	30.2	23.6		25.8	29.8		66.7	29.6			33.1				26.0		28.0	27.6	24.8	30.5	32.8					29.2	28.3	38.0			28.5	30.4	30.2	20.8
2004	29.8	30.7	33.5	26.9	28.4	26.4	23.4		28.3	27.2			31.8			31.4				26.5		27.1	27.5	26.6	30.5	31.5					24.8	34.3	40.3			26.3		27.8	25.3
2005	30.7	29.1	36.3	28.9	28.0	31.5	19.9		29.8	32.2			27.8			26.2				28.2		33.2	31.8	27.0	29.9	35.1		19.1			30.4	33.0	34.1			27.5	26.8	28.5	17.5
2006	29.5	30.3	35.4	26.3	28.4			28.4	31.3	31.4			26.7			28.0				23.3		27.4	30.8	25.4	30.1	34.3		22.2			31.0	24.4	31.2	25.1		28.6	24.6	26.7	16.3
2007	28.7	28.6	32.4	27.6	26.2	29.6	21.5	23.7	30.2	28.6		59.0	24.9			20.1				19.4		30.4	29.6	25.8	30.0	31.3		18.9			27.4	26.1	33.5			27.3	27.0	27.5	17.1
2008	27.2	26.7	24.1	25.4		25.1			30.3	27.3	32.4	62.4	24.7			22.1				21.8		27.5	24.7	21.0	27.7	29.8					25.5	25.7	30.6			26.7	32.2	25.4	18.2
2009	26.2	26.9	26.0	25.5	25.9				27.2	29.8			29.2			23.8				18.8		24.5	24.1	25.6	27.2	31.4		18.2				25.6	28.5			23.6	31.8	25.6	30.0
2010	25.1	26.8	23.9	26.2		23.7	23.6	17.7	27.6	25.3		52.0	22.3			23.8				15.7		25.2	27.9	22.2	27.6	27.8		13.5				25.6	25.0			23.7	32.4	26.2	20.4
2011	25.5	29.1	23.5	25.2		17.6	19.8		26.5	25.1		31.1	24.2									23.8	24.7	20.9	27.3	29.9						30.2	29.3			16.8	29.4	26.6	13.0
2012	24.5	24.1	23.1	20.4	24.4	10.9	24.0	16.8	25.3	25.8	24.5	34.6	26.0							22.1		24.0	25.4	22.4	24.8	28.0						25.9	29.1			19.0	26.9	22.6	15.8
2013	22.9	21.5	21.9		27.3				24.4	23.1		32.0	17.3									18.3	27.7	17.7	24.2	24.5						24.2	27.0			15.4	25.4	27.1	13.0
2014	23.4	25.3	18.1		24.8	21.1	18.0		24.8	22.0	36.0	38.3	20.8			26.6						22.5	26.7	19.8	26.1	28.3						22.0	29.2			19.4	34.4	24.2	14.0
2015	22.1	23.7	20.6		29.1				21.3	21.9	25.1		25.4			26.5						19.4	25.8	19.6	23.9	22.7						21.4	25.0			17.6	25.8	29.1	14.7
2016	22.2	24.9	17.8		24.4				21.4	21.6	25.3	33.3	21.5			22.5						21.3	27.1	19.4	25.1	25.4						22.8	27.6			16.3	26.1	23.5	
2017	21.8	21.2	19.1			17.2		11.4	20.3	20.7	24.5		28.2			25.4						18.1	26.4	17.4	24.8	24.5						22.1	31.5			15.3	24.9	23.7	
2018	20.0	18.8	17.8					12.3	19.9	19.7	21.9		21.2			25.7				15.7		16.7	23.2	16.7	21.3	23.7						18.8	28.3			16.6	22.4	23.9	
2019	21.3	20.1	18.4		24.3				20.8	21.4	19.4		22.1			25.1						19.1	27.7	18.5	25.8	21.7						17.6	27.7			19.0	19.7	24.3	
2020	21.0	20.0	19.8						20.2	22.3			21.9									17.3	24.2	16.7	24.5	22.7							25.1			15.9	22.1	25.8	
2021	21.6	17.6	17.9						23.5	21.8			20.9									18.8	25.7	15.4	22.7	23.3							25.2			15.7	21.0	25.4	

Table 6.15. Financial year greenlip catch (tons MW) from the Western Zone SAUs (ordered alphabetically Low SAU's at end). Empty cells denote no catch.

Financial Yr	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	LINCOLN LOW SAUS	ELLISTON LOW SAUS	STREAKY LOW SAUS	FAR WEST LOW SAUS
1978	85.1	13.1	13.2	4.3	0.3	0.3	0.6	0.0	2.8	0.2	2.3	3.0			6.5	0.1	1.5	1.7	0.3		15.0	4.7	1.1	0.3	0.4	0.1		1.7	1.2	5.2		1.3	1.6	1.2	1.0	6.9	1.8	1.9	0.3
1979	120.9	12.6	12.3	5.0	0.4	1.7	1.3	0.3	5.4	0.4	3.4	7.6	0.4		7.1	0.8	0.6	0.4	0.9		21.9	6.3	6.4	1.3	2.5	0.1	2.0	1.5	2.1	5.4		2.5	4.1	3.5	0.7	6.4	6.4	4.2	1.6
1980	108.6	12.1	4.8	1.7	0.2	2.8	1.2		7.5	1.4	4.9	8.1	0.0		10.2	0.5	0.8	1.3	0.7		7.8	6.8	4.0	4.0	2.0		0.2	1.8	2.4	10.8		0.9	6.6	1.8	1.2	9.1	5.2	5.1	0.7
1981	128.9	7.4	8.9	5.4	0.2	2.2	1.4		13.7	1.0	5.2	6.9	1.0		4.3	3.7	1.4	2.1	1.6	0.2	13.7	4.9	8.6	3.6	1.9	0.1	1.0	3.3	3.6	13.8		2.3	3.8	0.6	1.1	11.5	3.7	6.1	2.6
1982	165.0	13.2	12.4	7.7	0.3	1.7	2.2	2.7	7.3	1.0	10.2	13.6	0.5		9.0	2.4	0.9	0.8	0.7	1.0	20.9	4.9	18.8	3.2	1.7	0.1	0.1	2.9	3.1	11.2		2.8	3.8		4.0	12.6	3.8	6.4	3.9
1983	176.3	16.2	9.4	12.0	2.4	1.0	2.0	0.1	8.8	0.9	4.8	13.8	2.4	0.1	4.7	2.5	1.0	0.5	2.8	0.6	32.2	6.9	14.2	6.3	2.4	0.1	0.1	2.5	8.7	6.2	1.1	5.1	2.1	0.1	2.6	9.7	3.9	14.8	5.4
1984	113.8	5.9	3.9	4.9	1.6	1.4	0.6	2.6	4.3	1.6	4.3	5.8	3.7	0.0	1.1	2.6	0.4	0.4	8.8	0.2	8.1	6.6	5.8	11.6	2.0		7.5	0.9	5.8	4.7	0.4	2.2	3.6		0.9	4.6	3.7	15.8	15.1
1985	103.3	7.0	5.8	4.1	5.2	1.6	0.3	0.1	2.9	1.2	3.7	4.7	0.8	0.1	4.5	3.6	1.1	0.4	0.3	1.5	12.3	3.7	6.7	4.7	1.7	0.0	0.4	1.4	9.0	5.9		2.4	2.4	3.0	0.8	5.7	7.4	12.2	1.2
1986	100.8	8.6	3.5	7.1	2.7	2.1	1.1	1.6	4.0	0.9	2.5	6.6	0.9	0.1	4.5	3.0	1.0	0.5	1.3	0.3	6.1	6.4	4.2	2.6	1.6		1.5	1.7	6.3	9.4	0.4	3.1	3.6	0.2	1.5	7.8	3.0	8.9	3.8
1987	120.9	13.4	4.0	5.7	3.1	3.0	1.1	1.1	2.8	1.4	3.5	5.5	3.7		1.3	3.0	2.6	1.5	3.2		7.5	8.1	4.7	6.1	0.4	0.2	3.1	4.0	8.9	7.6	0.4	2.2	5.2	0.5	2.0	14.4	2.3	11.8	8.0
1988	86.4	9.1	2.5	3.0	1.4	1.6	0.6	1.5	2.1	0.4	3.7	3.6	3.0	0.5	4.2	3.5	1.4	1.6	1.8		7.8	5.2	4.0	1.5	0.9	0.1	4.7	1.4	4.3	5.8		1.2	2.1	0.3	1.2	8.4	1.5	4.1	6.4
1989	85.5	6.5	2.8	5.6	0.4	1.8	0.2	1.9	1.3	0.7	3.3	6.9	3.1	0.1	8.4	2.5	1.5	0.2	4.0	0.4	2.9	3.9	2.3	2.6	0.6		4.7	1.6	2.8	6.0		2.6	1.7	0.1	2.3	7.6	1.7	5.6	9.1
1990	79.8	6.8	2.2	4.5	1.8	1.8	0.3	1.1	1.1	0.4	2.4	4.1	2.6	0.0	6.9	3.2	2.3	0.4	2.7	0.2	3.7	4.6	1.4	2.1	0.7	0.1	2.8	2.4	4.9	7.3		0.6	3.0	0.3	1.2	8.5	1.6	4.5	6.4
1991	77.9	6.6	4.1	3.8	2.5	2.3	0.4	1.7	0.6	0.1	3.3	5.6	2.3	0.4	4.2	1.5	1.4	0.2	1.6	0.4	2.0	2.7	2.2	1.6	0.5	0.1	3.0	1.6	2.8	8.7		1.8	4.3	0.4	3.4	9.7	1.3	5.9	5.6
1992	71.9	4.1	4.4	3.6	1.6	1.9	0.7	2.1	2.4	0.5	1.2	5.5	1.0		4.0	1.6	3.0	1.4	1.1	0.3	2.2	2.2	1.2	1.7	0.6	0.1	1.4	2.5	3.8	7.1		2.2	4.5	0.2	1.8	11.5	1.6	5.5	4.1
1993	75.2	5.0	4.8	3.6	1.1	1.1	1.0	1.4	0.9	0.1	2.0	7.2	1.7	0.0	5.3	1.4	2.3	1.1	2.0	0.1	3.2	2.5	1.3	2.8	0.6	0.0	1.3	1.5	5.3	8.1	0.0	1.9	3.0	0.3	1.6	8.6	1.1	5.7	5.1
1994	73.2	5.8	3.6	2.6	0.6	2.1	0.5	0.2	0.5	0.1	2.1	7.5	2.9		3.8	2.0	2.3	2.5	1.5	0.4	1.7	3.4	1.2	2.0	0.2	0.2	3.9	1.2	4.2	7.5		1.5	2.6	0.1	2.5	11.3	0.8	4.1	4.5
1995	81.8	6.0	4.1	5.7	0.6	2.0	0.1	2.1	1.0	0.4	3.3	10.3	1.0		8.0	2.0	1.4	0.2	2.0	0.2	1.1	1.8	2.0	2.2	0.8	0.1	2.4	1.2	4.1	7.0	0.0	2.1	4.3	0.2	2.2	7.2	1.6	5.0	5.0
1996	76.7	6.0	2.6	5.1	0.2	3.7	0.1	0.9	1.5	0.1	2.0	7.0	1.1		9.6	1.7	1.0	1.4	1.7		1.6	2.1	1.2	1.5	2.1	0.3	2.1	1.8	2.6	7.3		2.1	4.5		1.8	10.0	2.2	3.7	3.8
1997	79.3	5.7	1.5	5.2	0.3	1.3	0.1	1.2	0.7	0.1	2.5	7.6	2.6		8.6	3.1	2.3	0.6	1.9	0.1	0.8	3.1	0.7	1.3	0.4	0.3	2.9	2.0	3.4	9.3		2.2	5.0	1.2	1.4	8.0	1.7	3.8	5.8
1998	84.2	5.6	2.7	3.4	1.1	2.5	0.1	0.9	0.6	0.3	1.3	9.3	1.8		8.5	2.8	1.1	0.6	1.7		1.6	2.6	0.7	1.2	0.5	0.2	3.7	1.4	2.3	13.2	0.2	1.8	5.7	3.2	1.5	7.4	4.0	4.2	4.5
1999	76.9	2.9	2.0	2.4	1.6	2.2	0.2	0.9	1.0	0.2	1.0	11.6	2.0		6.4	1.5	1.6	0.8	1.5	0.6	1.6	2.9	2.9	1.0	0.5	0.2	4.8	1.9	2.2	9.6		2.8	4.3		1.9	8.8	1.2	5.5	4.4
2000	75.4	6.2	2.5	4.1	0.9	1.5	0.1	0.7	1.1	0.0	0.4	11.4	2.0		7.5	1.4	0.4		2.3	0.2	2.5	3.4	2.0	1.6	0.5	0.1	3.3	1.8	3.2	8.7	0.1	0.8	3.4		1.4	5.2	0.7	3.4	5.1
2001	76.8	5.9	3.2	3.6	1.1	0.5	0.1	0.7	2.3	0.1	0.6	9.8	2.0		7.2	2.5	1.6		3.2		2.4	3.7	0.9	1.7	0.3	0.5	2.8	0.6	4.5	8.0		2.0	4.6		0.2	3.6	0.4	4.8	6.0
2002	79.1	9.8	2.7	2.7	0.5	0.7	0.2	1.5	1.1	0.0	1.9	8.9	2.3		7.5	1.6	0.7		1.3	0.0	1.4	2.6	1.3	1.1	0.3	0.0	5.7	1.4	4.6	11.5	0.8	1.4	2.7		0.9	3.8	0.4	3.8	5.0
2003	85.1	9.6	5.7	3.1	0.6	1.5	0.0	1.3	1.0	0.0	2.2	6.1	2.3		7.1	2.1	1.4	0.1	1.3		1.8	2.1	0.9	1.8	0.2		4.9	1.3	2.5	9.4	3.9	0.6	6.4	3.1	0.9	5.1	3.4	6.0	5.7
2004	77.4	8.0	6.8	4.6	0.4	0.7	0.1	0.8	0.7	0.0	0.7	5.4	1.8		8.8	2.3	1.1		2.8		1.2	2.7	0.7	2.4	0.1	0.2	2.8	1.1	3.7	10.0	2.6	0.4	3.9		0.7	3.9	0.1	5.6	5.5
2005	87.4	10.2	11.0	4.7	1.8	1.2	0.2	0.9	0.3	0.0	1.3	8.7	1.2		7.9	1.6	0.6		2.3	0.3	2.1	3.1	1.6	1.0	0.1		4.0	1.4	1.5	9.3	2.6	0.0	5.1		1.2	4.7	0.3	5.4	4.5
2006	78.5	5.4	12.0	3.2	1.7	0.7	0.3	1.3	0.4		0.2	9.0	0.7		6.2	2.5	1.0	0.3	2.4		1.3	3.2	1.2	1.3	0.1		2.4	1.2	3.3	9.2	1.1	0.1	5.4		1.6	5.1	0.1	4.0	4.5
2007	86.2	8.4	12.8	2.9	0.6	1.6	0.8	1.1	1.8	0.0	2.6	5.4	1.0		5.9	3.3	0.9	0.8	2.0	0.3	2.0	2.9	0.8	1.3	0.4	0.0	4.6	1.2	3.5	8.8	0.5	0.5	5.9		1.4	6.8	0.8	3.0	4.1
2008	73.9	7.1	4.9	2.2	0.3	2.3	0.4	0.9	2.2	0.2	3.0	3.2	1.6		4.7	3.5	0.8	0.9	1.9	0.1	2.9	1.7	0.6	1.1	0.4	0.2	3.1	3.0	2.9	8.9	0.0	0.7	6.0		2.2	9.9	0.7	2.1	4.4
2009	85.6	15.1	4.4	2.7	0.3	1.8	0.6	0.6	3.4	0.0	1.1	3.4	0.8		3.9	2.5	1.5	0.4	2.2		6.0	1.5	4.6	1.6	0.3		5.4	1.4	3.9	8.2		2.0	3.9	0.5	1.5	7.3	0.9	3.8	3.6
2010	73.1	8.7	3.8	1.7	0.5	1.6	1.2	0.5	3.6	0.3	2.9	3.9	0.9	0.2	1.0	1.8	1.5	0.4	2.6		5.7	1.9	5.3	1.0	0.5		3.5	0.7	3.7	7.1		2.2	2.1	2.0	0.5	6.0	2.8	3.7	4.0
2011	73.9	8.1	6.3	2.9	0.2	2.5	0.8	0.4	6.7	0.3	2.1	3.3	0.9	0.0	1.6	1.8	1.4	0.8	1.2	0.2	4.8	1.5	2.3	0.9	0.8		3.1	1.6	5.6	5.9		1.1	3.2	0.4	1.0	8.2	1.7	2.2	2.5
2012	79.8	9.0	5.5	2.5	0.9	2.3	3.2	0.4	4.9	0.4	1.5	2.9	1.7	0.0	1.5	1.4	0.7	1.6	1.1	0.3	4.3	2.2	6.0	1.2	0.7	0.0	2.4	1.3	3.7	7.9		2.2	4.3	0.8	1.0	10.2	2.2	4.3	3.2
2013	62.1	5.2	3.1	4.2	1.0	2.1	0.3	0.2	4.4	0.5	2.7	3.5	1.1		1.0	1.6	0.2	1.1	0.2	0.2	3.3	4.5	2.8	1.4	0.3		1.2	0.9	2.7	6.2		2.4	2.9	0.5	0.4	4.9	1.5	4.8	1.5
2014	69.8	7.2	4.9	4.9	0.9	1.3	0.3	0.0	6.2	0.6	1.5	1.6			2.0	1.6	0.4	0.6	0.2		4.6	2.6	5.4	1.9	0.4	0.0	0.0	1.6	2.5	8.2	0.1	1.9	3.7	0.8	1.6	5.9	1.8	4.8	0.2
2015	65.2	7.1	5.1	4.4	1.0	3.0	0.2		3.5	0.3	2.2	3.6	0.2		1.5	2.1	0.7	0.1	0.1		6.5	1.5	3.1	0.7	0.3			1.1	3.7	7.1		1.3	2.8	0.3	1.4	6.6	0.9	3.1	0.4
2016	73.9	5.9	5.7	4.2	1.3	2.0	0.1	0.0	4.2	0.9	1.7	3.8	1.1	0.0	3.2	1.3	0.9	2.1	1.3	0.1	5.6	3.4	4.1	0.9	0.8		0.2	2.4	2.9	8.9		1.9	1.2	0.4	1.3	8.9	2.2	4.0	2.5
2017	72.8	5.3	6.6	3.5	1.3	2.1	0.0	0.4	3.3	0.4	2.0	4.4	0.5		7.5	0.9	0.5	1.3	1.5		4.7	4.6	4.6	1.4	0.6	0.1	0.2	0.8	2.3	4.4		0.2	5.3	0.5	1.2	6.1	1.6	3.0	2.5
2018	69.1	5.7	5.8	4.5	0.7	1.3	0.1	0.6	3.4	0.7	1.3	5.1	1.5		4.9	0.6	0.4	0.2	1.8		7.3	3.5	2.9	1.8	0.3		0.8	1.4	2.1	4.4		0.8	3.7	0.6	0.9	4.3	1.6	3.3	3.9
2019	55.9	4.1	4.4	2.3	1.0	2.0	0.4	0.0	2.4	0.2	1.9	2.8	0.4		3.4	2.0	0.5		0.7		6.1	2.8	2.6	1.6	0.7	0.2	0.3	2.1	1.9	4.2		0.7	3.2	0.3	1.0	6.2	1.1	3.3	1.2
2020	49.9	3.2	7.0	1.5	0.2	1.0	0.3		3.0	0.0	1.9	3.1			2.0	2.1	0.2	0.1			4.6	2.6	2.8	0.8	0.4			1.8	1.8	5.6		0.3	2.5	0.3	0.9	4.3	0.7	1.4	0.0
2021	47.4	3.1	9.0	1.8	0.0	1.1	0.2	0.1	2.4	0.3	1.0	2.3	0.1	0.2	2.8	1.0	0.3	0.1	0.1		3.9	2.7	1.8	1.5	0.5		1.4	0.8	1.6	4.6		0.2	2.1	0.2	0.1	2.8	1.0	1.7	0.3

Table 6.16. Financial year greenlip CPUE (kg.hr-1) from the Western Zone SAUs (ordered alphabetically Low SAU's at end). Empty cells denote no catch or insufficient data to estimate CPUE.

Financial Yr	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	VENUS BAY	WARD ISLAND	WATERLOO BAY	WEDGE ISLAND	LINCOLN LOW SAUS	ELLISTON LOW SAUS	STREAKY LOW SAUS	FAR WEST LOW SAUS
1978	23.5	23.4	24.4	25.1					16.1		21.1	28.5			32.1		16.9	32.1			24.1	22.4	21.6					26.0	18.1	17.7		34.0	16.2		22.8	17.7	24.2	22.0
1979	21.2	19.3	20.7	19.1		26.2	17.3		19.8		23.5	24.7			32.2	22.2	13.6				20.9	15.6	20.9	25.4	26.8		22.6	23.2	16.4	20.6	17.5	34.8	17.0		20.9	19.0	19.6	20.8
1980	21.6	20.6	19.1	20.1		20.9	14.0		18.6	26.9	20.7	22.0			30.8	20.8	10.6				19.9	21.1	19.3	26.6	22.2		23.9	21.6	16.3	20.7	13.7	29.6	21.2		19.8	23.2	22.3	24.1
1981	22.6	18.5	22.8	22.5		18.9	15.7		24.3		17.6	22.5			28.7	22.4	18.3	26.5	31.7		26.0	23.1	23.2	26.4	18.7		24.8	24.7	20.4	20.5	20.8	29.3	17.5	23.0	20.6	22.5	23.7	30.0
1982	20.3	21.6	21.0	24.3		18.3	18.8	21.6	19.4	20.7	18.1	22.1			24.3	13.4	15.1				20.1	16.4	20.7	17.9	15.5		22.0	20.0	14.9	18.2	21.1	29.8		29.1	21.2	21.5	19.4	18.2
1983	19.8	21.0	17.6	24.2	25.7	15.0	14.1		19.2		14.2	19.1	21.0		23.8	17.6	18.7		31.7		19.9	20.6	16.7	24.0	16.1		16.7	19.7	20.7	18.0	22.1	22.2		23.7	18.0	18.0	23.5	25.8
1984	19.4	20.1	16.0	24.9	22.5	20.7	13.2	16.4	18.0	27.1	17.7	20.3	20.4		17.9	18.9			18.5		17.5	22.8	16.4	27.1	17.3		16.8	17.3	18.6	18.4	17.2	22.1			17.7	22.6	24.9	18.5
1985	19.6	18.2	20.4	22.4	21.3	17.0			15.5	20.4	14.8	21.0	12.7		30.5	15.2	13.5			29.7	22.2	20.4	22.3	20.0			17.9	17.2	18.7	15.7	18.7	29.0	21.5		16.2	23.4	20.4	14.1
1986	20.9	23.1	18.3	24.8	25.0	17.2	21.8	25.8	19.0	19.4	13.4	22.3			21.9	18.0	17.6		17.5		18.8	25.3	20.3	24.9	23.3		22.5	17.3	20.7	18.3	21.1	26.4		19.6	18.4	20.9	23.0	23.0
1987	19.6	22.5	27.4	21.4	20.4	17.0	27.6	23.4	17.1	16.1	14.8	17.1	19.7		23.8	15.4	17.5	23.3	18.8		22.9	18.3	18.5	23.5			21.6	18.6	17.2	17.3	20.6	24.0		20.7	19.0	15.5	22.0	19.6
1988	19.4	25.3	19.4	23.9	23.7	16.3		18.2	20.0		15.5	22.0	16.1		25.5	15.6	15.8	22.1	15.8		23.1	18.6	19.9	16.9			19.5	17.6	14.0	15.9	21.2	23.0		24.0	18.7	22.1	20.5	16.2
1989	21.9	24.9	27.0	28.7		20.3		23.2	17.6		22.9	24.2	17.0		31.3	18.4	18.2		17.0		20.3	19.8	22.8	25.2			18.2	18.3	15.8	21.0	21.4	22.7		21.5	19.7	25.0	23.7	17.8
1990	21.8	26.2	26.9	30.1	20.6	19.2		21.0	18.4		21.4	20.7	17.5		31.3	19.6	18.7		18.5		20.5	18.9	19.6	22.2			15.8	19.9	17.7	20.9		30.8		23.4	19.9	24.6	21.0	18.3
1991	22.8	25.9	33.4	22.0	20.3	20.8		26.8	21.2		22.2	22.3	20.7		27.7	19.6	19.6		17.1		20.0	20.8	20.8	24.3			19.6	21.9	17.9	21.3	21.9	32.3		25.3	22.5	24.3	21.4	20.9
1992	22.7	26.7	33.4	26.1	26.1	19.5		29.9	22.9		18.0	20.5	19.3		25.3	18.6	18.3		20.5		24.8	19.5	19.3	24.6			21.4	22.4	19.8	20.9	16.7	29.8		20.0	21.3	21.5	21.6	23.0
1993	23.6	26.5	26.6	24.1	19.7	18.1		29.8	21.5		19.4	27.9	23.3		28.9	18.9	19.6		18.9		22.0	20.2	21.7	24.4			16.5	20.2	18.5	24.0	27.2	26.3		26.7	23.0	24.0	23.7	22.8
1994	21.4	24.0	26.3	23.4	18.9	18.6			19.5		17.3	22.8	20.6		24.1	17.5	19.0	33.4	16.5		17.4	20.2	19.8	21.6			19.0	20.7	17.8	21.0		25.6		25.2	22.5	22.3	21.2	19.5
1995	21.0	21.4	25.3	23.5		19.9		21.8	18.7		21.9	23.3	17.0		26.3	17.5	17.5		14.4		16.0	18.6	17.8	22.1			16.8	19.6	15.5	20.3	18.0	27.1		25.7	20.5	19.6	20.5	17.0
1996	22.3	25.5	23.0	22.1		24.4			23.4		21.0	23.1	14.6		26.0	17.9	16.2		19.0		19.4	20.8	18.6	25.8	22.8		17.2	22.9	17.3	20.6	22.2	32.3		23.1	23.0	20.9	22.6	17.8
1997	22.1	25.2	21.4	22.8		18.7		14.1	23.3		23.9	25.4	18.1		27.3	20.8	19.2		13.6		20.3	19.8	17.1	17.7			15.2	20.8	19.7	23.7	22.0	30.8	15.7		20.9	16.2	20.7	15.9
1998	23.5	27.0	23.4	24.0	24.2	23.7			21.9		21.9	25.6	18.6		27.2	22.7	19.8		16.0		22.2	22.0	20.2	23.8			19.2	22.2	18.4	24.9	23.2	29.7	16.3		23.3	17.3	24.1	18.0
1999	24.6	25.8	22.5	23.7	21.3	20.9			26.5		25.3	27.5	20.4		29.3	21.9	18.0		24.5		22.8	24.5	22.6				19.3	24.1	18.8	24.2	27.3	34.4		28.7	22.9	20.3	24.2	21.9
2000	26.0	31.2	27.8	27.6	19.1	22.4			34.7		25.0	28.0	20.7		28.0	26.9			22.3		28.2	26.6	28.6	26.4			20.9	24.5	21.5	26.6		30.1			24.0	25.3	21.3	21.9
2001	27.0	26.7	29.3	26.9	20.8				40.7		30.8	32.0	22.0		31.7	27.1	23.2		18.7		29.9	27.7	27.1	27.0			19.3		23.6	26.1		31.4			27.2	26.2	26.0	20.0
2002	29.1	35.2	33.9	27.3				25.1	35.8		34.0	31.0	20.3		35.5	30.0			17.7		33.7	25.2	25.1				21.6		26.4	28.4	31.7	35.6			33.3		29.0	20.6
2003	28.8	35.4	37.1	29.3		28.3			30.0		44.0	29.6	19.5		31.9	25.5	24.1		18.1		30.6	24.2	24.8	31.6			19.7		25.0	29.9		39.7	25.4		28.5	25.4	27.4	19.5
2004	29.8	34.9	39.0	29.3					31.3		39.6	31.9	16.4		34.5	31.1			20.1		31.4	27.2	28.6	29.8			19.6		27.2	31.3		37.9			29.7		29.2	19.0
2005	29.5	31.7	40.2	30.1	31.0	32.6			31.6		37.0	30.0	14.8		32.5	29.7			23.1		30.6	26.6	32.2				16.9		23.3	30.3		35.1			32.2		29.7	19.1
2006	28.9	33.1	38.8	29.5	24.9			19.7	29.9		33.1	28.5	16.7		31.2	30.1			20.9		26.6	28.2	26.1	25.6			21.6		25.0	28.0		32.7		27.5	27.7		25.0	19.5
2007	27.7	33.6	35.3	29.7		25.6		21.9	29.4		30.8	25.8	17.2		28.6	28.0			21.2		29.3	25.7	24.8	29.5			17.7		25.1	26.9		28.6			28.6		26.6	20.2
2008	25.0	29.9	27.4	29.3		23.7			35.8		28.1	22.1	15.3		29.4	23.1			19.5		24.9	22.7	23.4	27.3			20.2	27.2	22.1	24.4		27.9		28.2	26.0	24.4	26.8	17.6
2009	23.7	27.3	26.0	28.0		22.9			31.6		27.2	22.4	12.3		26.5	24.2	21.8		14.6		29.9	24.0	24.7	26.3			16.9	25.5	24.4	22.9	23.1	23.2		24.4	22.9	33.7	24.6	13.4
2010	23.1	25.3	26.8	24.8		25.1			27.1		25.8	25.2	12.3		27.8	26.0	23.9		15.2		23.3	21.4	22.9				15.2		24.9	25.1	23.3	24.2			23.0	37.5	24.8	14.5
2011	23.2	26.7	25.3	27.3		19.9			26.3		18.9	22.7	12.3		31.0	21.1	23.2		14.2		24.5	21.2	24.5				16.5	20.9	24.0	21.3	27.2	30.8			22.7	29.3	26.1	13.3
2012	22.6	25.2	25.5	24.7		17.0	23.0		26.9		17.8	21.0	17.0		26.2	16.7		27.4	17.2		25.2	27.6	24.5	24.1			19.5	18.5	18.3	22.3	25.1	28.8			20.4	23.4	25.2	16.2
2013	20.0	20.7	20.8	27.5		18.6			22.0		15.5	18.3	26.6		20.2	14.3			21.0		21.0	21.8	16.8	25.5			20.0	18.6	16.7	17.0	25.2	24.0			19.2	24.8	26.0	21.4
2014	22.2	26.8	20.2	29.8		19.1			24.9		16.8	18.3			23.5	12.9			23.4		25.1	19.9	27.4					17.7	17.8	19.0	28.4	32.8		21.7	19.1	27.3	28.5	21.2
2015	22.4	23.2	26.1	30.5		21.2			21.6		20.9	23.3			23.8	18.5			24.9		24.8	19.2						19.6	19.4	18.7	24.0	23.6		23.3	20.6	25.3	25.3	21.5
2016	22.1	22.9	22.5	28.5	29.3	18.7			23.8		19.9	20.2	18.8		32.3	16.1	14.6	49.6	23.5		21.6	25.2	19.4					21.1	17.2	19.2	20.9	26.3		20.3	22.9	26.7	23.9	21.2
2017	20.8	20.9	21.8	24.2		15.2			22.0		18.6	23.4			29.2	12.3		23.3	17.6		18.4	26.6	20.2	22.2			17.3	13.7	13.8	14.7		28.6		15.9	16.2	21.5	24.8	17.0
2018	19.6	20.0	19.0	23.9		19.5		14.6	18.8		16.6	22.3	13.0		23.9	15.0			13.3		20.5	25.5	16.8	25.1			15.9	17.1	15.4	15.7		27.5		16.3	17.6	28.4	22.2	13.3
2019	19.9	21.5	20.0	27.4	25.6	18.8			18.7		18.1	20.6			23.3	16.5			15.8		18.6	24.1	19.4	24.9			16.8	18.3	16.6	17.7		24.9			19.0	15.8	22.1	13.8
2020	20.1	19.1	21.1	30.8		20.6			24.5		22.4	19.4			22.3	18.2					19.4	22.6	20.1	19.2				13.6	17.6	18.9		22.4			16.7	20.3	18.8	
2021	20.8	18.4	23.2	27.7		15.8			22.6		15.6	17.7			23.9	16.6					20.9	26.2	17.7	28.0				16.8	16.8	18.6		20.2			18.0	21.6	24.6	

Table 6.17. Financial year greenlip PropG1 from the Western Zone SAUs (ordered alphabetically Low SAU's at end). Empty cells denote no catch or insufficient data to estimate PropG1.

Row Labels	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	VENUS BAY	WARD ISLAND	WATERLOO BAY	WEDGE ISLAND	LINCOLN LOW SAUS	ELLISTON LOW SAUS	STREAKY LOW SAUS	FAR WEST LOW SAUS
1978	0.36	0.29		0.52																									0.49									
1979	0.40	0.35	0.47	0.42		0.73	0.40		0.32		0.58	0.35			0.32		0.41				0.28	0.35	0.44	0.36	0.42		0.43		0.70	0.59	0.36	0.58	0.32		0.57	0.37	0.36	0.62
1980	0.42	0.40	0.28	0.30		0.60	0.41		0.33	0.54	0.66	0.42			0.49		0.41				0.28	0.37	0.42	0.67	0.37			0.51	0.38	0.49	0.45	0.76	0.24		0.51	0.36	0.62	
1981	0.41	0.25	0.32	0.34		0.68	0.30		0.29		0.45	0.24				0.53	0.48				0.34		0.37		0.39			0.60	0.57	0.57					0.54	0.37	0.22	
1982	0.44	0.38	0.45	0.38		0.69	0.31	0.70	0.30		0.59	0.28			0.21	0.52	0.59				0.40	0.35	0.38	0.42	0.46			0.52	0.45	0.63	0.48				0.86	0.61	0.45	0.45	0.66
1983	0.41	0.36	0.40	0.37		0.66	0.26		0.32	0.72	0.64	0.40			0.34	0.50	0.39		0.49		0.39	0.46	0.33	0.54	0.39			0.55	0.36	0.48	0.42	0.33		0.74	0.55	0.45	0.54	0.51
1984	0.47	0.39	0.48	0.37		0.78	0.55	0.45	0.31	0.68	0.72	0.41	0.53		0.24	0.67			0.42		0.45	0.32	0.34	0.46	0.45		0.32		0.60	0.75	0.47	0.31			0.74	0.58	0.46	0.45
1985	0.48	0.40	0.53	0.36	0.36	0.72			0.29	0.51	0.76	0.28			0.32	0.69	0.64				0.59	0.28	0.41	0.20	0.58			0.58	0.54	0.68	0.54		0.40		0.61	0.53	0.32	0.38
1986	0.40	0.22	0.37	0.22	0.21	0.63		0.46	0.28		0.60	0.42			0.16	0.66	0.64		0.44		0.46	0.24	0.35	0.14	0.29		0.46	0.52	0.58	0.63	0.37	0.28		0.45	0.54	0.39	0.25	0.45
1987	0.41	0.23	0.47	0.21	0.12	0.66	0.27	0.47	0.18	0.43	0.62	0.27	0.38			0.63	0.63	0.66	0.35		0.37	0.26	0.25	0.19	0.59		0.39	0.63	0.57	0.64	0.33	0.29		0.61	0.62	0.44	0.18	0.37
1988	0.40	0.30	0.27	0.19		0.55		0.26	0.19		0.48	0.33	0.44		0.31	0.54	0.49	0.51	0.37		0.45	0.13	0.29	0.26	0.52		0.33	0.45	0.55	0.53	0.69	0.31			0.52	0.46	0.49	0.35
1989	0.43	0.28	0.27	0.32		0.68		0.38	0.21		0.65	0.44	0.31		0.49	0.60	0.45		0.30		0.32	0.39	0.28	0.29	0.65		0.34	0.74	0.44	0.59	0.71	0.51		0.55	0.59	0.57	0.51	0.33
1990	0.46	0.22	0.42	0.39		0.70		0.28	0.29		0.70	0.31	0.27		0.38	0.60	0.49		0.37		0.58	0.28	0.42	0.24	0.54		0.50	0.57	0.52	0.61	0.54	0.42			0.60	0.52	0.30	0.32
1991	0.44	0.23	0.45	0.36	0.22	0.68	0.56	0.33	0.40		0.74	0.37	0.29		0.29	0.68			0.31		0.48	0.34	0.33	0.24	0.43		0.24	0.68	0.54	0.67	0.44	0.43		0.66	0.64	0.38	0.31	0.32
1992	0.48	0.28	0.60	0.30	0.38	0.66		0.33	0.43		0.67	0.32	0.33		0.34	0.52	0.61				0.66	0.36	0.30	0.31	0.63		0.43	0.61	0.55	0.63	0.42	0.46		0.61	0.59	0.52	0.37	0.37
1993	0.56	0.36	0.64	0.36	0.38	0.67	0.49	0.43	0.46		0.67	0.50	0.41		0.55	0.60	0.66		0.51		0.62	0.50	0.64	0.52	0.38			0.62	0.55	0.64	0.43	0.61			0.65	0.44	0.46	0.46
1994	0.52	0.18	0.43	0.52	0.36	0.56			0.48		0.76	0.49	0.41		0.38	0.60	0.66	0.61	0.51		0.62	0.44	0.44	0.48	0.45		0.58	0.54	0.57	0.64	0.34	0.63		0.62	0.58	0.55	0.41	0.45
1995	0.55	0.33	0.33	0.48	0.31	0.71		0.37	0.56	0.33	0.77	0.53	0.39		0.57	0.70	0.69		0.56		0.48	0.41	0.38	0.53	0.54		0.63	0.60	0.56	0.67	0.46	0.61		0.76	0.71	0.49	0.48	0.44
1996	0.56	0.32	0.41	0.44		0.80		0.53	0.53		0.65	0.50			0.59	0.65	0.60		0.51		0.61	0.28	0.47	0.62	0.43		0.59	0.58	0.58	0.66	0.40	0.61		0.61	0.66	0.43	0.49	0.52
1997	0.59	0.44	0.55	0.41		0.79		0.42	0.63		0.82	0.60	0.54		0.62	0.65	0.63		0.40		0.61	0.40	0.52	0.47	0.36		0.56	0.63	0.64	0.79	0.39	0.63	0.00		0.67	0.16	0.41	0.46
1998	0.57	0.34	0.54	0.48	0.46	0.79		0.48	0.64		0.81	0.54	0.49		0.45	0.60	0.64		0.46		0.63	0.46	0.52	0.56	0.70		0.62	0.67	0.52	0.72	0.32	0.60	0.37		0.70	0.43	0.42	0.48
1999	0.65	0.52	0.68	0.41	0.38	0.73		0.54	0.84		0.94	0.56	0.49		0.49	0.77	0.68				0.73	0.47	0.69	0.47	0.78		0.54	0.64	0.76	0.78	0.43	0.78		0.75	0.71	0.84	0.42	0.52
2000	0.62	0.56	0.72	0.64		0.79			0.62			0.56	0.56		0.49				0.41		0.83	0.58	0.61	0.78	0.80		0.63	0.63	0.61	0.76	0.52	0.62			0.65	0.80	0.61	0.47
2001	0.60	0.62	0.69	0.44	0.25			0.74	0.78			0.52	0.36		0.56	0.66	0.72		0.47		0.67	0.35	0.70	0.57	0.66		0.50		0.58	0.71	0.44	0.73			0.76	0.68	0.42	0.49
2002	0.63	0.50	0.59	0.48	0.24	0.84		0.68	0.66		0.89	0.52	0.51		0.66	0.59	0.77		0.57		0.71	0.37	0.63	0.51	0.75		0.63	0.74	0.62	0.77	0.57	0.77			0.80	0.75	0.55	0.59
2003	0.56	0.24	0.66	0.38	0.35	0.85		0.65	0.67		0.94	0.36	0.37		0.56	0.59			0.41		0.66	0.52	0.61	0.37	0.62		0.55		0.43	0.76	0.70	0.79			0.71	0.53	0.49	0.47
2004	0.65	0.43	0.84	0.52	0.37				0.76			0.41	0.41		0.64	0.75			0.53		0.83	0.62	0.75	0.64	0.78		0.49		0.72	0.81	0.81	0.80			0.77	0.77	0.63	0.52
2005	0.66	0.51	0.80	0.54		0.89		0.54	0.79			0.55	0.33		0.59				0.41		0.91	0.46	0.77	0.59	0.76		0.50	0.85	0.62	0.70		0.80			0.82	0.47	0.59	0.43
2006	0.65	0.62	0.85	0.42				0.45	0.78			0.46			0.43				0.44		0.93	0.51	0.91	0.56	0.84		0.44		0.58	0.76		0.70			0.72	0.84	0.47	0.44
2007	0.59	0.51	0.68	0.37		0.77		0.43	0.79		0.96	0.33	0.33		0.33	0.76			0.45		0.75	0.27	0.78	0.49	0.74		0.46		0.61	0.76	0.76	0.56			0.75	0.69	0.55	0.42
2008	0.66	0.49	0.75	0.66		0.87		0.47	0.84		0.90	0.50	0.41		0.38	0.73			0.55		0.83	0.61	0.84	0.68	0.57		0.51	0.72	0.67	0.81	0.70	0.64		0.77	0.77	0.68	0.65	0.49
2009	0.59	0.55	0.64	0.57		0.78		0.38	0.77			0.37	0.30		0.28	0.82	0.62		0.43		0.83	0.56	0.73	0.70	0.79		0.38		0.51	0.68	0.59	0.48			0.71	0.57	0.63	0.40
2010	0.65	0.56	0.73	0.51		0.71		0.44	0.64		0.84	0.60	0.31		0.15	0.69			0.56		0.76	0.60	0.72	0.65	0.78		0.39		0.78	0.79	0.65	0.50	0.72		0.67	0.73	0.62	0.50
2011	0.64	0.59	0.78	0.69		0.81	0.85		0.60		0.78	0.48	0.33		0.27	0.76	0.62		0.28		0.82	0.50	0.79	0.63	0.59		0.33	0.71	0.65	0.79	0.85	0.50			0.71	0.61	0.73	0.30
2012	0.59	0.55	0.65	0.55	0.41	0.71	0.88	0.72	0.52	0.88	0.83	0.47	0.29			0.67			0.42		0.74	0.63	0.67	0.63	0.72		0.45	0.48	0.49	0.70	0.69	0.49	0.53		0.71	0.66	0.62	0.40
2013	0.56	0.41	0.65	0.55	0.46	0.75			0.61	0.84	0.73	0.43	0.51		0.17	0.68					0.72	0.56	0.55	0.43	0.64		0.45		0.48	0.62	0.75	0.44			0.67	0.63	0.60	0.47
2014	0.67	0.60	0.74	0.66	0.55	0.87			0.65		0.87	0.56			0.46	0.73					0.79	0.56	0.61	0.64	0.69			0.72	0.65	0.73	0.77	0.81		0.67	0.70	0.75	0.67	
2015	0.68	0.55	0.68	0.68	0.69	0.85			0.63		0.85	0.64			0.45	0.67					0.73	0.62	0.60	0.65	0.62			0.74	0.62	0.74	0.85	0.79		0.87	0.80	0.69	0.75	
2016	0.66	0.51	0.67	0.74	0.61	0.71			0.59	0.87		0.61	0.66		0.70	0.67	0.63	0.88	0.68		0.73	0.73	0.41	0.75	0.57			0.82	0.67	0.76	0.50	0.58		0.50	0.74	0.68	0.59	0.67
2017	0.66	0.66	0.69	0.69	0.55	0.64		0.70	0.55	0.75	0.89	0.69	0.56		0.69				0.49		0.84	0.63	0.55	0.55	0.72				0.45	0.68		0.82		0.60	0.60	0.59	0.56	0.54
2018	0.58	0.53	0.61	0.66	0.50	0.67		0.79	0.50	0.22		0.58	0.28		0.47				0.43		0.78	0.50	0.58	0.57	0.62			0.67	0.44	0.59		0.73			0.62	0.39	0.56	0.44
2019	0.65	0.60	0.65	0.74	0.45	0.64			0.53	0.52	0.93	0.64			0.48	0.75			0.53		0.80	0.52	0.56	0.65	0.64			0.72	0.63	0.80		0.70			0.68	0.62	0.52	0.47
2020	0.69	0.57	0.82	0.62	0.53				0.69			0.62			0.43	0.79					0.79	0.49	0.68	0.60	0.50			0.59	0.78	0.85		0.70			0.70	0.53	0.54	
2021	0.70	0.62	0.80	0.72		0.80			0.67			0.52			0.50						0.84	0.67	0.57	0.75	0.61				0.73	0.78		0.66			0.75	0.64	0.76	

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

Year	Greenlip Zone score	Score Gradient	Zonal trend	Status	Blacklip 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	7.33	0.04	5.23	Sustainable
2006	7.69	-0.03	4.97	Sustainable	6.69	0.00	5.00	Sustainable
2007	6.95	-0.06	4.36	Sustainable	6.44	-0.04	4.77	Sustainable
2008	6.01	-0.09	3.98	Sustainable	5.61	-0.08	4.16	Sustainable
2009	5.12	-0.10	3.69	Sustainable	4.88	-0.09	4.01	Depleting
2010	5.02	-0.09	3.99	Sustainable	4.44	-0.10	3.76	Depleting
2011	5.25	-0.03	4.85	Sustainable	4.32	-0.07	4.32	Depleting
2012	4.79	-0.01	5.00	Sustainable	4.17	-0.04	4.76	Depleting
2013	3.16	-0.12	3.48	Depleting	3.46	-0.06	4.37	Depleting
2014	4.42	-0.08	4.06	Depleting	4.11	-0.03	4.91	Depleting
2015	4.81	0.03	5.00	Sustainable	3.21	-0.05	4.56	Depleting
2016	4.70	0.10	6.31	Sustainable	3.00	-0.05	4.51	Depleting
2017	3.36	-0.10	3.71	Depleting	2.57	-0.14	3.12	Depleting
2018	3.02	-0.15	2.93	Depleting	2.46	-0.06	4.35	Depleting
2019	3.15	-0.10	3.71	Depleting	3.36	0.03	5.08	Sustainable
2020	3.10	-0.01	5.00	Sustainable	2.98	0.07	5.75	Sustainable
2021	3.02	0.00	5.00	Sustainable	3.10	0.06	5.57	Sustainable