Establishing an Industry Recovery Strategy for Area 3 of the Western Australian Abalone Managed Fishery

Basia Lamb and Peter Rickerby

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Researcher Contact Details

Name:	Southern Seafood Producers (WA) Association
Address:	PO Box 1160
	Booragoon WA 6954
Phone:	0457 575 725
Fax:	
Email:	eo@sspwa.org.au

FRDC Contact Details

Address:	25 Geils Court
	Deakin ACT 2600
Phone:	02 6285 0400
Fax:	02 6285 0499
Email:	frdc@frdc.com.au
Web:	www.frdc.com.au

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Abbreviations

AIAWA – Abalone Industry Association of Western Australia

AMM – Annual Management Meeting

AVG – Abalone Viral Ganglioneuritis

CAES – Catch and Effort Statistics

CEO – Chief Executive Officer

CPUE – Catch Per Unit Effort

CSIRO – Commonwealth Scientific and Industrial Research Organisation

DPIRD – Department of Primary Industries and Regional Development

FIS – Fishery-Independent Survey

FRDC – Fisheries Research and Development Corporation

FRMA – Fish Resources Management Act 1994

GPS – Global Positioning System

LRL – Limit Reference Level

MFL – Managed Fishery Licence

MSC – Marine Stewardship Council

PRI – Point of Recruitment Impairment

SCPUE – Standardised Catch Per Unit Effort

SMU – Spatial Management Unit

SSPWA – Southern Seafood Producers (WA) Association

TACC – Total Allowable Commercial Catch

TC – Target Catch

VFA – Victorian Fisheries Authority

WA – Western Australia

WADA – Western Abalone Divers Association

WAFIC – Western Australian Fishing Industry Council

WZ – Western Abalone Zone of the Victorian Abalone Fishery

Executive Summary

The Southern Seafood Producers (Western Australia) Association in conjunction with the Abalone Industry Association of Western Australia hosted a two-day workshop (the workshop) at the Swan Yacht Club in East Fremantle on the 12th and 13th of June 2019. The aim of the workshop was to establish an industry recovery strategy for Area 3 of the Western Australian Abalone Managed Fishery. The workshop was chaired by Harry Peeters, Executive Officer of the Western Abalone Divers Association with presentations from Duncan Worthington and Craig Fox (Chair of Western Abalone Divers Association). The Western Abalone Divers Association representatives' presentations were to inform Area 3 authorisations holders, divers, Department of Primary Industries and Regional Development staff and other attendees of their experience in the Western Zone of the Victorian Abalone Fishery after the Abalone Viral Ganglioneuritis virus had severely impacted the Western Zone fishery and gain an understanding of how they established and continue to rehabilitate their stocks. The Western Abalone Divers Association representatives experience and knowledge were drawn upon to guide the Area 3 authorisation holders in sound decision making, and allowed the commencement of a formal industry process to recover the stocks after the marine heatwave in 2010/11 followed by several years of above-average water temperatures in 2011/12 and 2012/13. Many authorisation holders believe these factors impacted recruitment levels, successful spawning events and stock densities. Earlier reductions in Total Allowable Commercial Catch following these events may have prevented some depletion of stocks in Area 3 in the subsequent years, however the impacts were unknown at the time.

The two-day workshop was held to progress a formal industry-driven recovery strategy to compliment current Department of Primary Industries and Regional Development recovery work. The aim of the workshop was for industry participants to gain an understanding of how Western Abalone Divers Association had implemented new technologies to monitor fishing effort and catch more accurately. Specifically, understanding how the use of data loggers, dive loggers, measuring boards and GoPro's, and how data generated by these could be used to produce heat maps for fishing effort, catch rates, dive times and other tools were of key interest to workshop participants. Such metrics and tools were able to be used in conjunction with data gathered by the Victorian Fisheries Authority to guide determination of annual Total Allowable Commercial Catch. The Total Allowable Commercial Catch comprises the combined Target Catches for small spatial areas, termed reef codes, which together form a Spatial Management Unit.

Area 3 abalone authorisation holders are taking steps towards implementation of a recovery strategy using improved monitoring technologies, employment of an independent Executive Officer and Data Co-ordinator, and Target Catches quota setting process similar to the Western Abalone Divers Association approach. It will need to be tailored to suit the Area 3 Abalone Fishery in Western Australia to suit its unique characteristics, legislation, and harvest strategies.

The Western Australian Abalone Managed Fishery became Marine Stewardship Council certified in April 2017 and is required to work within the parameters of the Marine Stewardship Council and the Department of Primary Industry and Regional Developments legislation and harvest strategy. The Area 3 fishery has implemented a trial of a new system called 'paddocks' where a specific authorisation holder has been granted sole access to a specific area since 2016. This trial has been successful *prima facie*, however, will require robust scientific validation.

The motions, resolutions and action items that emanated from the workshop have initiated change in the Area 3 abalone fishery. A listing of the outcomes can be found within the 'Outcomes' section of the report. Independent facilitation in the form of an Executive Officer and Data Co-ordinator has been assigned. This in combination with a 70% majority required for any motion or decision to be passed has been a major factor in progressing industry action. Authorisation holders have agreed to contribute $5.00 per unit held of Greenlip and Brownlip Abalone to progress the outcomes of the workshop. Further funding will be sought to implement a long-term recovery strategy in the Area 3 Abalone fishery and to implement and maintain the outcomes and recommendations from the two-day workshops.

Keywords: Abalone Diver Data, Co-Management, Greenlip Abalone, Brownlip Abalone, Certification.

Introduction

Nationally, the Australian wild abalone resource has been experiencing unprecedented pressure from fishing, environmental change and disease. In Western Australia, the abalone resource has also been particularly impacted by the warm water event experienced in 2011 and above average temperature over the subsequent years. These heatwave events have severely affected the biomass of abalone within Western Australia, with a notable decline in stocks within the Kalbarri region (Strain et al. 2019a). The biological characteristics of abalone, such as slow growth and sporadic recruitment, necessitate intervention to build resilience in the stocks and ensure the regeneration of biomass and sustainability of the resource.

Greenlip Abalone in Area 3 (Appendix 1) of the WA Abalone Managed Fishery long-term sustainability is currently challenged by these pressures, having undergone a long-term decline in stock indicators, and recently further impacted by the WA warm-water events. Stock indicators are the measurable sustainability parameters set to aid in the determination of the performance of an aquatic resource. In response to declining stock indicators, substantial reductions in TACC have been enacted over recent years, including a closure of the Augusta sub-area (Appendix 2) for the 2019/20 season. Urgent attention is required to commence the recovery of the Greenlip Abalone resource, and a strategic approach is being developed.

The Southern Seafood Producers (WA) Association (SSPWA) through FRDC Project *2018-212: Establishing an industry recovery strategy for Area 3 of the WA Abalone Managed Fishery* enlisted key members of the Victorian Western Zone (WZ) Abalone Fishery to provide guidance on the industry-led action that promoted the implementation of a recovery strategy of the fishable resource in WZ Victoria. The Victorian WZ appear to be rehabilitating the resource following impacts from the Abalone Viral Ganglioneuritis (AVG) disease, which included loss of significant fishable biomass. The WZ Abalone Fishery have implemented a series of stages/actions as part of a strategic recovery plan, most of which can be transferable to the WA Area 3 Abalone Fishery, such as the development of small scale spatial management which enabled the development of high resolution catch and effort data, to aid in developing conservative management actions.

In conjunction with the industry recovery strategy, the Area 3 fishery will continue to trial a paddock system that has been in place since 2016, which aims to eliminate competitive fishing through exclusive area rights. In the current trial, authorisation holders agreed to give sole access to the Mason Bay and West Beach area (Appendix 3) in the Hopetoun sub-area (Appendix 2) to owner/operators George and Steve Beres. This is considered a successful venture by the Beres family, as they have sole guardianship over the management of the stocks within the area and thus have implemented strategies to ensure that the stock status in their paddock remains positive. Considering the current observed outcomes of the trial, the stakeholders within the fishery aim to extend the trial to encompass the entire Area 3 fishery. The trial at the Beres' paddock is underway with an agreed 5-year term, an additional 5 years may be granted should the trial prove successful. Initial anecdotal indications are positive.

The Area 3 Fishery until recently had eight traditional full authorisation (900 Greenlip units and 100 Brownlip units) for Greenlip and Brownlip Abalone in Area 3, however some of these have been split across several Managed Fishery Licence's (MFL's) and hold different level of entitlement, some with joint owners. Area 3 Authorisations Holders had been attempting to implement similar initiatives in recent years, through countless meetings both with facilitation and without, although ultimately industry could not come to an agreed position that was followed to fruition. The facilitation industry sought was successful at the time of the meetings, however ultimately failed as it was left to authorisation holders to drive the changes agreed at the meetings which led to internal conflict. Independent facilitation was required to drive the changes industry sought, although due to the current state of the fishery, it was increasingly difficult to implement independent facilitation in a financially viable way.

The workshop held on the 12th and 13th of June was independently facilitated through the use of financial resources provided by the Fisheries Research and Development Corporation (FRDC), during which an agreed position was formed requiring a 70% majority vote for any decision to be formalised. The independent facilitation and a percentage majority vote were crucial steps for Area 3 to obtain the outcomes required to develop and adhere to an industry recovery strategy.

Stock declines in Area 3 have impacted the scale of the fleet, with some operators unable to remain financially viable. The aim of the industry recovery strategy is to allow for the stocks to recover, while maintaining as much economic infrastructure and skills as possible rather than a complete closure of the fishery. A complete closure would necessitate operators to seek alternate streams of income until the closure was lifted, which represents a risk to the fishery though potential loss of critical infrastructure, skills, and knowledge.

Objective

The Objective of the project was to:

- Establish an industry recovery strategy for the Western Australian Area 3 Abalone Fishery based on the approach used, and knowledge gained, by the Victorian Western Zone Abalone Fishery post-Abalone Viral Ganglioneuritis.

Workshop

The two-day workshop was held at the Swan Yacht Club, Fremantle on the 12th and 13th of June 2019. The workshop was facilitated by Harry Peeters, Executive Officer of WADA. This workshop provided a forum for WADA attendees to present on their experiences from the implementation of a recovery strategy of the Victorian WZ Fishery post-AVG. The workshop was successful in generating a series of outcomes for industry participation in the recovery of Area 3.

The major topics covered over the workshop (Appendix 4) included several presentations and reviews of the experience in the Victorian Western Zone, a review of the current status of the Area 3 Fishery, current management framework, strategic options for Area 3, divers' observations and data collection options, and suggestions for who would develop and lead the industry recovery strategy. This document will outline the current status of the Greenlip Abalone Resource within Area 3, the agreed measures to be taken by industry to promote the rehabilitation, and a timing guideline for monitoring and assessment.

Attendees

The first morning of the workshop was attended by representatives from both WADA and SSPWA, invited observers and all Area 3 authorisation holders. DPIRD staff from the Management and Science divisions joined the workshop in the afternoon of the first day. Nominated operators and divers were invited to attend the second day of the workshop, joining the WADA representatives, observers, SSPWA staff, authorisation holders and DPIRD staff.

Wednesday 12th June Attendees (Appendix 5)

Thursday 13th June Attendees (Appendix 5)

Review of the experience in the Victorian Western Zone Fishery

The Victorian Western Zone Abalone Fishery peak body, WADA, appointed Harry Peeters as the Executive Officer in 2002. From 2002 to 2006 WADA implemented numerous changes before the AVG Virus in June 2006 that decimated stocks.

These changes included:

- Annual TACC setting workshops from 2003;
- Installation of data loggers, dive loggers and measuring boards on all abalone vessels in 2004;
- Trialling various size limits between 120 mm and 135 mm
- Quota reductions from 278 tonnes to 220 tonnes.
- Size limit formally legislated increasing from 120 mm to 130 mm in 2014

When the effects of the AVG Virus of 2006 first became apparent, the WZ progressively closed half of the fishery to commercial harvest. Subsequently, most of the WZ abalone fishery was closed in 2007 (Appendix 6) due to the severe stock impacts the AVG virus had caused. In contrast, areas such as Julia Bank, Julia Percy Island and Discovery Bay were not impacted by AVG and remained open to fishing. It was estimated 90% of the total biomass was lost from areas impacted by the virus. This was despite the issuing of VFA permits to allow fishing of the lesser affected non-traditional areas of abalone previously mentioned.

In 2009 the authorisation holders contributed $40,000 towards a rehabilitation workshop, and to engage Duncan Worthington and Keith Sainsbury to support data collection to inform additional strategic management arrangements. In conjunction with these measures, WADA applied for a FRDC funded project to conduct an estimate of the abalone biomass within the WZ post AVG (FRDC 2008-007). This biomass estimates and regular monitoring, were crucial for determining a realistic and conservative TACC when the fishery reopened.

Closure of parts of the WZ lasted up to five years. To ensure knowledge and key skills were retained for the rebuilding phase, divers were retained and kept fishing open sections. Since the reopening of the WZ in Victoria, owners and divers shared all data collected via data loggers/measuring boards, dive loggers, daily diver observations (via Fisherweb) and video footage with VFA's Management and Scientific teams. This integrated data reporting was integral to securing long term benefits for industry including a $70,000 grant to conduct a collaborative stock assessment with Commonwealth Scientific and Industrial Research Organisation (CSIRO) (FRDC 2012-236) in 2017, and now to routinely manage the annual stock assessment report and TACC setting.

Since the reopening of the fishery, the WZ have implemented a structured fishing plan including 35 separate reef codes across the four SMUs (called sub-areas in the WA Abalone Managed Fishery). These reef codes have an individual target catch amount set and are monitored throughout the season. Target catch amounts when combined for all reef codes never exceed the TACC for the entire SMU. Once the target catch for the reef code is reached, that reef system is closed until the next season. A series of heat maps (Appendix 9) for catch rates, effort and dive times are lately being generated using data collected with new-to-the-fishery technology.

The WZ now conducts a TACC setting workshop annually with an independent chair. Those in attendance include WADA representatives, owners, divers, independent scientists, and VFA scientists and managers. WADA's data and dive logger information, and VFA data (FIS and CPUE) combined with diver observations and Go-Pro footage inform determination of the total TACC and identify an appropriate target catch amount for each reef system.

Individual data collected with GPS positions are only reviewed by the Executive Officer to ensure operator privacy, while combined data from loggers is used in stock assessment and TACC setting. Owners play a very small part in the TACC setting process and are informed of the status of the fishery

via the Executive Officer throughout the year and are also invited to attend one of the three to four workshops held per annum. These workshops are held to discuss all available data about the fishery, and particularly the spatial information about catch rates and effort, to advise better management.

The combination of fine-scale (reef code system) and diverse data-driven management enable responsive decision-making within the fishery. This strategy enables, for example, closure of any reef system within several days once it has either reached target catch or catch rates have fallen below an acceptable level. Such real-time monitoring is far more effective than annual reviews for preventing ongoing damage to one or many reefs systems within a fishery.

Current Status and Management Framework of the Area 3 Fishery

The TACC is set annually in accordance with the Harvest Strategy for the Abalone Resource of Western Australia (DoF, 2017). This publication ensures transparency while clearly stating the objectives, performance indicators, reference levels and harvest control rules for the Abalone Managed Fishery. Before the TACC advice is sent to the Chief Executive Officer of DPIRD (CEO) (or a delegate) for their final decision, industry is consulted for feedback via TACC recommendation forms, on the TACC setting for next season. Consultation is undertaken by a number of methods. Firstly, a questionnaire, with all relevant information, is sent to all licence holders, and where possible divers, asking for their recommendations for the next TACC. This is to be completed and returned to DPIRD prior to the Annual Management Meeting (AMM). Secondly, discussions are held between DPIRD, licence holders, and divers at either the AMM or a separate quota-setting meeting. The feedback provided by industry and all other relevant information is collated by DPIRD, then sent to the CEO as advice. The CEO then makes their determination under the Management Plan for the next seasons TACC.

DPIRD is currently developing a Recovery Strategy for Area 3 Greenlip Abalone Resource separate to this paper. This Recovery Strategy is required by DPIRD to return the stock to target levels and also forms part of a Marine Stewardship Council (MSC) certification condition. Consultation regarding this recovery strategy with all Area 3 licence holders and where possible, divers, will be completed in 2020. Any outcomes from the workshop held, this document, or subsequent strategies will have to fall within the parameters of both the Harvest and Recovery Strategy of DPIRD.

Stock Status – The Abalone Area 3 Fishery utilise the performance indicator of standardised catch per unit effort (SCPUE) over a 3-year rolling average, which is informed by commercial catch statistics. Other measures are utilised to further inform decision making, such as fisheries-independent sampling. The most recent data presented at the Marine Stewardship Council 2nd Annual Audit in August 2019 (Strain et al, 2019b) for the WA Abalone Resource showed that the Greenlip abalone performance indicator had been in decline since 2011. An earlier decline was observed between 2000 and 2005, followed by a slight improvement until 2010. No such improvement has been experienced since, with the most severe decline experienced in the Augusta sub-area. The SCPUE now sits below the Limit Reference Level (LRL) (Appendix 8), despite marked decreases in the TACC since 2016/17 (Strain et al, 2019b). Since the 2016/17 season, the TACC has declined from 25.6 tonne to 4 tonnes for the current 2019/20 season. See Appendix 8 for Area 3 Greenlip Standardised Catch Per Unit Effort (SCPUE) with Reference Lines and Harvest Control Rule.

Refer to: www.fish.wa.gov.au/Documents/wamsc_reports/wamsc_report_no_8_addendum_2.pdf

DPIRD has expressed serious concerns about the state of the Area 3 Greenlip Abalone stocks over the past several years. Causes for concern include; 1) the trend of declining SCPUE, 2) three consecutive years of decline in primary indicators to beneath the LRL, 3) the subsequent triggering of the Harvest Control Rule to reduce the TACC to between 0 and 50% of the long-term sustainable harvest level (Strain et al, 2019b). At the 2019 Management Meeting, DPIRD advised a closure to the Augusta sub-area. This was enacted voluntarily by licence holders while the legislation was drafted under the

Management Plan, which came into place on 5 July 2019. Additionally, DPIRD announced a reduction in the TACC of Greenlip Abalone from 8 to 4 tonnes for Area 3. These changes were implemented, noting industry has taken a further voluntary reduction to 3.2 tonnes of Greenlip Abalone for the 2019/20 season as an outcome of the workshop in June 2019.

Recent Management Changes

One recent management change for Area 3 has been to increase the legal-size limit from 140 mm to 150 mm. This was driven by industry and supported in legislation by DPIRD and implemented in October 2018. Average meat weights have increased since increasing the legal-size limit. However, it is unclear whether the increase was caused by the change in size limit, or to the overall quota reductions of recent years. The MSC Certification has also seen the implementation to the harvest strategy (DOF, 2017).

Since 2015, several voluntary catch reductions have been implemented for Greenlip Abalone, either prior to or during the season, as follow:

- 2015/16 season reduction from 32 tonne to 25.6 tonne;
- 2016/17 and 17/18 seasons; a majority of licence holders agreed to reduce the total catch in each season by 6.39 tonnes and 7.65 tonnes, respectively; and
- 2019/20 season reduction from 4 tonne to 3.2 tonne.

Marine Stewardship Council (MSC) Certification

The WA abalone fishery is the first abalone fishery in the world to become MSC certified in April 2017 (Hart et al 2017). The WA abalone fishery has undergone two surveillance audits by the Conformity Assessment Bodies, SCS Global in 2018 and Bio.Inspecta in 2019. The surveillance audits are conducted to monitor the progress of conditions placed on the fishery to ensure continued Certification. The Fishery has several conditions placed on the Greenlip and Brownlip Abalone stocks after the 1st surveillance audit in 2018 which were Conditions 1, 2 and 3 (Damue and Morrison 2018) with further Conditions 4, 5, 6 and 7 (Daume and Hartmann 2019) added after the 2nd surveillance audit in 2019

Technological Advancement

The advancement of certain data collection technologies has enabled the increase in implementation of viable and accessible devices. The WZ Authorisation Holders utilised Boat Based Measuring Global Positioning System (GPS) Data Loggers (e.g. Succorfish and Scielex). These loggers are specifically designed to collect the GPS position of a vessel every minute and allow for the collection of length-based data in conjunction with that GPS location. The WZ also implemented the use of Dive Loggers (e.g. Succorfish) designed to record the logged GPS point of each diver whilst submerged. Used in conjunction, these loggers track the spatial and temporal movements of each diver, to effectively calculate diver effort, range, and related metrics. Perhaps most importantly, the combined use of the GPS loggers provides the fine scale spatial data essential for interpretation of abalone stocks. The WZ operators additionally utilise an underwater videography capability using Go-Pros for visual validation of stock assessments and anecdotal statements. Each of these technologies have been proven successful by use within the WZ and will be implemented within Area 3.

Beres Paddock Experiment

The paddock experiment implemented in 2016 gave exclusive access to owner/operators George and Steve Beres. Under this arrangement no other divers were permitted to enter the areas of West Beach and Masons Bay. These areas run from Point Ann to Hopetoun Jetty and from 15-mile breaker east of Hopetoun to Starvation Bay Point (Appendix 3). Giving the Beres' sole access removed competition from the area, prevented annual re-fishing of the reef systems and gave them total control over the potential harvest independent from outside influences. The Beres Family have on their own volition implemented a rotation policy, fishing reef systems once every two years, and have taken catches well

below their annual TACC allocation since they began. This form of management should be considered by owners on the extension of the trial program, as the results from diver observations are extremely positive and it is highly possible that the biomass within these areas is significantly higher than all other comparable areas.

Re-fishing of reef systems is one of the major risks within an abalone fishery, as divers can unknowingly fish a reef that has already been fished. This results in further depletion of the biomass and breeding stocks than would have occurred without diver overlap.

The in-built competitive nature of the abalone fishery is predictably detrimental, as necessarily competitive divers must seek to attain the highest catches and the most effective catch rate. The need to complete quota prior to other divers within the fishery is directly related to the subsequent opportunity to gain further quota as available. Under this scenario, the abalone biomass of reef systems suffers as divers see little opportunity or incentive to leave sufficient breeding biomass behind. Given that size limits are implemented across an entire fishery, it can be hypothesised that the most targeted reef systems will ultimately feel the greatest impacts. Less targeted areas may then hold more mature abalone for longer, increasing the chances of a successful spawning event before they are harvested.

Having sole harvesting rights of a paddock enabled the Beres Family to strategically harvest individual reefs, while avoiding overlapping fishing effort. Even with limited technological improvements, they have observed stabilisation in available biomass, and increased catch rates and meat weights. These changes are attributable to the more conservative fishing practices the Beres Family have been able to implement within their paddocks.

The preliminary success observed by the Beres' test paddock provides a promising potential management template for future projects within Area 3. There is potential to compare the Beres' paddock experiment with the proposed industry recovery strategy for variation in relative biomass increase compared with the previous fishing management strategy. If it becomes apparent that the paddock system, in conjunction with the new technology being implemented within the Area 3 fishery (outlined in section titled 'Technological Advancement'), is showing results above and beyond that of the industry recovery strategy alone, then industry would consider implementing paddocks across the entire Area 3 fishery.

Outcomes

1. Strategic Plan Outcome for the Area 3 fishery

Step 1: Collation of Industry Data Time Series

Step 1 Aim: To initiate industry collection of data on the Area 3 Greenlip Abalone Resource to ensure an adequate understanding of the current biomass and potential rates of recovery.

Throughout the duration of the Area 3 Abalone Resource Workshop, one key message taken from the Victorian experience was that the collation of data alone would be insufficient to recover the Greenlip Abalone Resource. However, where collected data informs decision-making, resource recovery can be facilitated effectively and meaningfully.

The collation of thorough and detailed fine-scale spatial data to determine the current status of the Greenlip Abalone Resource was unanimously agreed upon. Four key methods are used to obtain necessary data. The first of these are the use of Boat and Measuring GPS Data Loggers (e.g. Succorfish and Scielex). These loggers are specifically designed to collect the GPS position of the boat every minute, and when an abalone length is measured. The second are the Dive Loggers (e.g. Succorfish)

designed to record which logged GPS point the diver is in the water. Used together, these loggers track the spatial and temporal movements of each diver, to effectively calculate diver effort, range, and related metrics. Perhaps most importantly, the combined use of the GPS loggers provides the fine scale spatial data essential for interpretation of abalone stocks. The third data collection method is the Diver Observation Survey, where each diver can input their daily observations while diving. This includes reef condition for qualitative assessment of the abalone resource and reef system health. The fourth is the utilisation of underwater videography using Go-Pros for visual validation of stock assessment. Collected data is managed by a team comprising an Executive Officer and a Data Co-ordinator to ensure the confidentiality and integrity of the exercise.

The collation and analysis of data using these four collection methods was unanimously agreed as the first stage of the industry recovery strategy (Table 1). Authorisation Holders have voluntarily agreed to a financial commitment of $5.00 per fishing unit per annum to fund the procurement of the necessary equipment and the engagement of an independent Executive Officer and Data Co-ordinator

In addition to utilising the four data collection tools to inform decision making, the WADA representatives ensured that diver input was attained throughout the Victorian experience. The Authorisation Holders at the Area 3 Abalone Resource Workshop agreed that prior to the TACC Meeting held in late January of each year, a meeting will be scheduled for diver input to be collated by the Executive Officer and Data Co-ordinator.

Actions taken under Step 1:

- The collection of funds as per the $5.00 per unit financial commitment
- The appointment of facilitator (Executive Officer) and a Data Co-ordinator
- Signatories to a waiver that allows the release the individual diver's historical and future catch data collected by DPIRD to an entity (Data Co-ordinator) for the purpose of assessment and monitoring.
- The purchase of relative data collection tools for each operation.
- A Working Group established to investigate the possibility of utilising the results of the DPIRD Fisheye Program for current catch returns to be used alongside Data Loggers and Dive Loggers.
- FishEye training facilitated for all divers by DPIRD, to ensure timely catch data is available.

Step 2: Establishment and Management of Fine Scale Areas

Step 2 Aim: To establish a fine scale management system to aid the recovery of the Area 3 Greenlip Abalone Resource.

During the Area 3 Abalone Resource Workshop, WADA representatives provided advice for implementation of a finer-scale management network that will provide more data at scales consistent management needs. In Victoria, the reef code system is used. There, each demarcated reef is designated a code, and the data collected via the Data and Dive Loggers is applied to it. This allows for specific voluntary management arrangements to be implemented to individual reefs. In Western Australia, DPIRD utilise grid reference blocks which are 10 x 10 nautical miles for the purposes of monitoring. Until the mid-1980's larger 60 x 60 nautical mile Catch and Effort Statistics (CAES) blocks were used for monitoring. Area 3 data will be applied to grid reference blocks, until such a time as a formal reef code system or similar can be developed.

The WADA representatives use established reef codes individually set TC allocated to them annually. This is implemented on a voluntary basis by owners and divers. The aim of this approach is to reduce incidences of overharvest at heavily targeted locations. Planned targets provide clarity around changes in area productivity, with trends assisting predictive capacity for following years. For example, if a reef code does not reach its catch target, performance of the code receives greater scrutiny in the annual TACC setting and catch planning workshop for the following year.

Actions taken under Step 2:

- Establish the TC for each grid reference block based on DPIRD's historical catch data and analysis from the four data collection tools.
- Establish a fine scale management arrangement (such as reef codes) that will be practicable for the Area 3 Greenlip Abalone Fishery to be utilised once formalised. The data collected by DPIRD and the data collection tools will help inform this process.

Step 3: Initiate Industry Recovery Strategy

Step 3 Aim: To mitigate further depletion to the Area 3 Greenlip Abalone Resource, initiate recovery and ensure continuity of data collection throughout the period.

Timeframe for Stock Recovery:

As outlined in the MSC Assessment Report (Hart et al. 2017), the one generation cycle for Greenlip Abalone is approximately 7-8 years. Utilising the MSC principle for stock recovery, the applicable timeframe for recovery is 2 x the generation cycle: approximately 14-16 years. These timeframes are also utilised in DPIRD's Recovery Strategy for Area 3 Greenlip Abalone. This will provide a generic timeframe for the Executive Officer to model against when considering stock recovery.

Voluntary Industry Action:

Stakeholders agreed that urgent action was required to initiate the recovery of the Area 3 Greenlip Abalone Resource in the short term. During the Workshop, Authorisation Holders and Divers agreed to a voluntary reduction of the 4 tonne TACC for the 2019/20 season to 3.2 tonnes (400 kilograms per licence), with a structured division of catch across each specific sub-area, as outlined below.

- Augusta Sub-Area: Closed (advised and implemented by DPIRD)
- Windy Harbour Sub-Area: 1.45 tonnes
- Albany Sub-Area: 0.65 tonnes
- Hopetoun Sub-Area: Beres Paddock at 0.625 tonnes and the remaining area at 0.475 tonnes

All fishing activity undertaken during the 2019/20 season and beyond is to be monitored utilising the four tools outlined in Step 1.

Actions taken under Step 3:

- The establishment of a voluntary reduction in catch for the 2019/20 season to 3.2 tonnes (400 kilograms per licence).
- Industry to ensure monitoring equipment is utilised throughout the process.

Step 4: Ongoing Industry Fishing Arrangements

During the 2020/21 season, the Area 3 stakeholders will begin implementing an industry structured fishing program utilising the Strategic options in steps 1, 2 and 3 which will be developed and overseen by the Executive office and Data Co-ordinator in consultation with industry and DPIRD. This will be in line with the Harvest Strategy for the WA Abalone Resource and the 2020/21 Area 3 TACC. Additionally, any other required management arrangements will be discussed with industry and DPIRD ensuring any arrangements or changes are within the bounds of the Harvest and Recovery Strategy, *Fisheries Resource Management Act 1994* (FRMA) and MSC Certification.

Table 1. Proposed timing for monitoring, assessment, reviews and actions to be taken during the Greenlip Abalone recovery period.

	Step 1: Collation of Data Time Series					Step 2: Establishment and Management of Fine Scale Areas		Step 3: Initiate Recovery		Step 4: Ongoing Fishing Arrangements		
	Fund Collection	Appointment of Facilitators	Data Release Waiver	Working Group Establishment	Fisheye Training	Establish TC for grid reference blocks	Fine Scale Management Implementation	Voluntary Reduction in Catch	Utilisation of monitoring equipment	Structured Fishing Program	Review of Data Collected	Review of Fine Scale Management Arrangements
2019	X	X	X	X	X	X		X	X	X	X	X
2020	X		X	X	X	X	X		X	X	X	
2021	X		X				X		X	X	X	X
2022	X		X				X		X	X	X	
2023	X		X				X		X	X	X	X
2024	X		X				X		X	X	X	
2025	X		X				X		X	X	X	X
2026	X		x				X		X	X	X	

Discussion about who will develop and lead the industry recovery strategy

The Area 3 Industry recovery strategy will be managed by the independent Executive Officer and a Data Co-ordinator. They will analyse the data collected by the four discussed methods (Data Loggers, Dive Loggers, Diver Observation Surveys and Go-Pros), and deliver each TC based on the status of each reef code. This process precludes authorisation holders and diver interests, to ensure that the stock is monitored and managed to the highest standard. The Area 3 stakeholders agreed to the appointment of an independent Executive Officer and Data Co-ordinator to analyse and manage the resource by establishing TC via grid reference blocks until a finer scale reef code system can be implemented.

The control of the funds for the project will be handled by the Western Australian Fishing Industry Council (WAFIC) to ensure an independent process is maintained.

In line with the agreed Harvest Strategy for the WA Abalone Resource, research advice is provided by DPIRD on the Area 3 TACC to industry in late December. Prior to the Annual Management Meeting held in late January each year, the independent Executive Officer will organise workshops with divers and owners to discuss and agree to an industry recommendation on the Area 3 TACC. These recommendations will be provided to DPIRD at the Annual Management Meeting.

Once DPIRD's TACC advice is released in late December, a Workshop will be held, attended by divers and owners, with the aim of producing an industry recommendation on the TACC. Attendees of the present workshop (this study) resolved that prior to the Management Meeting held in late January, a meeting will be scheduled for diver input to be collated in preparation each year.

For confidentiality reasons, authorisation holders and diver names have been removed to ensure anonymity.

The following Motions were unanimously agreed to during the meeting:

Motion 1: An authorisation holder motioned that the Area 3 Licence Holders agree to a $5.00 per unit financial commitment to fund the procurement of the necessary equipment and the arrangement of an independent facilitator of the recovery process, to be charged on an annual basis. The funds are to be held in an agreed account prior to their collection. The Motion was seconded. The Motion was passed unanimously.

Motion 2: An authorisation holder motioned that all Area 3 Licence Holders commit to the installation of data loggers by the end of June 2019. The Motion was seconded. The Motion was passed unanimously.

Motion 3: An authorisation holder motioned that after consideration of the insight provided by the divers, the Licence Holders agreed that industry will restrict the 2019 catch to 400 kilograms per licence (3,200 kilograms total) to promote recovery. The Motion was seconded. The Motion was passed unanimously.

The following resolutions were agreed to during the meeting:

Resolution 1: Prior to the AMM held in late January, a meeting will be scheduled for diver input to be collated each year.

Resolution 2: Every diver will be equipped with GoPro's by the relevant Licence Holder.

The following Action Items were drafted during the meeting:

Item	Action	Charge	Outcome
1	Industry request that a Working Group be established to discuss and develop the necessary linkages that are required to utilise the Fisheye Program, Data Loggers and Dive Loggers.	Industry and DPIRD	
2	Licence Holders who have Data Loggers in place are to send Duncan Worthington (WADA Scientific Advisor) the data that has been collected to date to understand the compatibility.	Industry/WADA	
3	The Department will provide the SSPWA with an example of a waiver to release the individually collected Departmental data to an entity for the purpose of stock assessment and monitoring.	DPIRD/SSPWA	
4	The Department will investigate amending the scale of data utilised for FishEye reporting as Licence Holder uptake increases.	DPIRD	
5	As offered by DPIRD, Industry will arrange FishEye training to be facilitated for all divers by the Department.	DPIRD/Industry	
6	Industry are to extend an offer to Departmental Staff to experience the fishery in an operational capacity to strengthen understanding.	Industry	
7	Industry to investigate the hiring of a facilitator to co-ordinate the data collection, collation and analysis.	Industry	
8	Industry will consider a national storage repository of data collected through loggers to be raised with the ACA.	Industry	

9	EO of the Area 3 Abalone Fishery will apply for funding to monitor the Beres' Paddock Experiment.	Area 3 EO	
10	The Department will investigate the possibility of implementing sub-zonal quotas for this current season.	DPIRD	

2. National Approach – Outcome from the Recovery Program for the Area 3 fishery

The outcome from this workshop was the development of a framework for recovery management which could be applied to Area 3, or more broadly to any abalone fishery in Australia. It is important to caution that in development or application of any management framework, specific needs must be considered and adapted to as dictated by variables including species harvested, breeding cycles, biomass, geographical location, marine environment, State legislation, licence conditions, or the size of the fishery.

Step 1 – Active engagement and collaboration by all stakeholders

In order to implement any management changes to an abalone fishery all stakeholders must be on board including owners, divers and deckhands, government managers and scientists. There may be more parties to consider (e.g. Marine Stewardship Council in the case of WA). All parties concerned must be willing to undertake the following, or risk the failure of the industry recovery strategy:

a) Actively engage in the process;
b) Be prepared to make conservative and difficult decisions;
c) Work together through differences of opinion; and
d) Be willing to share data with necessary parties.

Step 2 – Set a percentage of votes required for decision making

Decision making within authorisation holder groups can at times be a fraught process, as each fishery has authorisation holders with varying unit holdings which can create an imbalance of voting power. It is important to establish a process of decision making at the initial stages of the strategy implementation, as not all decisions will garner 100% agreement. Consideration must be given to establish a percentile of unit holding support for motions to be passed. This percentage must be tailored to the specific fishery until holding composition to ensure that no one party can block any motion. Within Area 3, a 70% rule was implemented to prevent any one party from holding the ability to veto motions.

Step 3 – Independent facilitation and overseeing required

Independent facilitation is a necessary requirement to co-ordinate the communication process, from mediating meetings, ensuring motions are implemented and hold custodianship of the data collected. When industry is left to undertake these processes without support, it is destined for derailment. Most abalone fisheries do not experience high turnover of licence sales, so most abalone authorisation holders are established members of the industry. Due to the low turnover of authorisation holdings, abalone industry members develop personal histories and differences of opinion that can become obstacles in the recovery process. These obstacles can be avoided through the implementation of independent facilitators, able to guide the process and ensure that lines of communication remain open.

The appointment of independent facilitators also ensures that the sensitive data collected can be managed securely and without bias.

Step 4 – Set highly conservative TACCs for commencement

When implementing a recovery strategy, it is important to regard conservative decision making as the key to resource rebuilding. The first management tool that can be utilised almost immediately is to

establish catch reductions (legislated or voluntary) to levels that prevent further stock decline. The level of catch reduction must be considered on a case by case basis, although it is important to note that the level that will be required will be far lower than most authorisation holders would prefer. Leaving sufficient biomass is one of the most crucial steps for any abalone fishery to stabilise and initiate recovery. A highly conservative TACC should be set until such a time as reef codes with TC allocated are developed, which will allow for the resource management on the smallest possible scale.

Step 5 – Data collection combined with diver observations

The data collection should begin as soon as possible for a recovery strategy. Methods of data collection include GPS boat loggers, dive loggers, measuring boards and diver observations. Data needs include number of abalone taken, kilograms landed, and total dive times from grid reference blocks, sub-areas or general locations in real time. The catch data must be collated weekly for regular status updates on the TC for each assigned block or reef code so that it can be quickly closed once TC limits are reached. Delayed collection inhibits capacity to reach informed and responsible decisions necessary for recovery strategy development.

As the data is collected continuously and in real time, management decisions can be adaptive and precise to ensure reef system biomass is adequately protected. This strategy avoids the pitfalls of localised depletions caused by heavy fishing pressure at preferred reefs.

Step 6 – Set an appropriate size limit

Establishing appropriate size limits within a fishery is a key strategy to employ, especially where regulatory structure applies a single size limit across large spatial scales, as for Area 3. Ultimately, a size limit that is tailored to small scale spatial areas through careful monitoring of productivity may be the best possible outcome, however this is likely to be unachievable or legally enforceable through most legislative and regulatory frameworks. Establishing ‘gentlemen’s agreements’ within industry can be effective for short periods, but generally disintegrate over time. It is recommended that a larger size limit and conservative TACC be set as a preliminary action to boost biomass. The size limit in Area 3 was increased in the legislation from 140 mm to 150 mm prior to the workshop.

Step 7 – Electronic Reporting

To aid real-time management, data collected through boat and dive loggers should ultimately be collected through electronic daily catch reporting. The processing of paper based daily catch reporting can take weeks. Should the fishery be utilising boat and dive loggers with weekly updates, then daily electronic reporting of catches should be implemented to further streamline the data collection process.

Step 8 – Holistic step implementation is key

The combination of the aforementioned steps will culminate in the adoption of a recovery strategy. While taking small parts of this framework and applying it may give small benefits, the undertaking of the collective process will lead to an optimal outcome. The omission of any of the recommended changes leaves the process open to ineffectiveness. It is however important to ensure that this strategy is adapted to suit the abalone fishery in question, with any suggested modifications to the plan to be reviewed in the most strenuous fashion. Additional action can also be considered.

Step 9 – Prevent change avoidance

Most people are averse to change and will resist it. It is important to ensure consistency, so once decisions have been implemented, ensure that all possible avenues of review are undertaken prior to amending those decisions.

Other Steps to consider

- Divers who are unwilling to adhere to the new way of operating will harm the fishery, it does not matter if they are the most skilled or longest standing diver within the fishery, every participant must be involved. Measures to ensure compliance may need to be developed and adopted.

- Implement a blanket code of conduct for meetings to ensure that all matters are heard and considered fairly and professionally.

Results, Discussion and Conclusion

The outcome of this workshop was the development of a set of strategic options and agreed actions for an Area 3 Abalone Fishery Industry Recovery Strategy. These broadly included:

1. Implementation of standard data collection methods including data loggers, dive loggers, measuring boards and Go-Pros
2. Engagement of an Independent Executive Officer and Data Co-ordinator Officer to oversee data handling, assist in intercommunication between stakeholders in the fishery, and manage financial matters such as funding applications and equipment purchase
3. Moving towards real-time data reporting to enable adaptive management
4. Moving towards a more effective division of management units
5. Assessment of the paddock system trial for potential application more broadly in Area 3

While there are many similarities between the Victorian WZ and Area 3 in WA, there will be a need to tailor this industry recovery strategy specifically to the latter to accommodate species and environmental differences. The industry recovery strategy will need to be regularly reviewed to ensure it is promoting the recovery of the abalone resource. This will take place over years, given the slow growth rates of abalone. There is also an opportunity to explore other fishing methods, such as the paddocks system currently being trailed in Area 3, to further assist recovery of the fishery.

Implications and Recommendations

The impact of the outcomes generated from hosting the workshop in June 2019 have been encouraging. By hosting the workshop and formulating an agreed pathway to implement an industry recovery strategy, industry stakeholders have a greater understanding and reinforced stewardship over the processes outlined. The formal motions and recommendations made during the workshop will be the guiding agreement to implement the recovery process and an extension of the Paddock Trials.

It is recommended that, further to this FRDC Project, that industry ensure that the resolutions, motions and action items are followed through, dependent on the relevance as the implementation of the recovery strategy progresses. It is acknowledged that some arrangements may be improved upon, or some deemed redundant moving forward, however, it is critical that the authorisation holders continue to pursue the implementation of the recovery strategy and extension of the Paddock Trial.

Further development

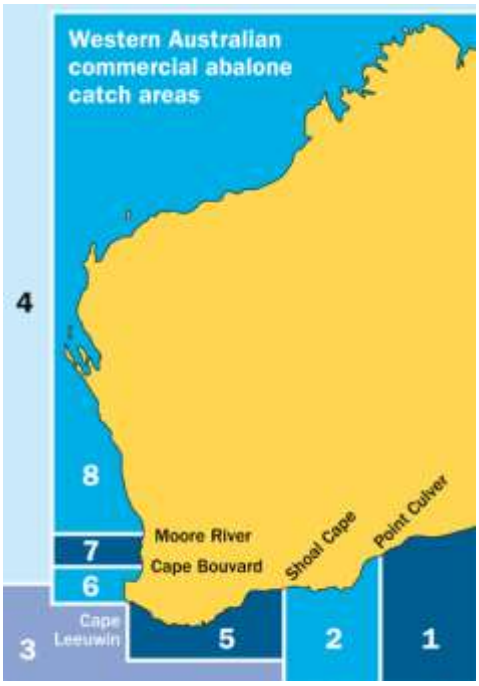
This Project has provisioned a template and an agreed resolve from industry to endeavour on the outlined pathway to recovering the resource. It does not implement or provide the means of implementing the proposed template. Further ongoing engagement between industry and DPIRD will also aid in the development of a fit for purpose recovery strategy that aligns with regulatory needs.

Extension and Adoption

This is an information and technology transfer project, whereby outcomes from FRDC funded projects to recover the WZ Abalone Fishery were to be communicated to the stakeholders of the Area 3 Abalone Fishery. The project outputs, which include this summary report from the workshop will be circulated through the AIAWA to its constituents, Area 3 authorisation holders and divers, DPIRD and other interested parties which include WADA Representatives. This report will also be shared with the Abalone Council of Australia. The appointment of the Executive Officer and Data Co-ordinator will ensure that the outcomes from the Project are followed through in a prompt and thorough manner, guaranteeing that any obstacles are quickly dealt with to ensure the program can be completed.

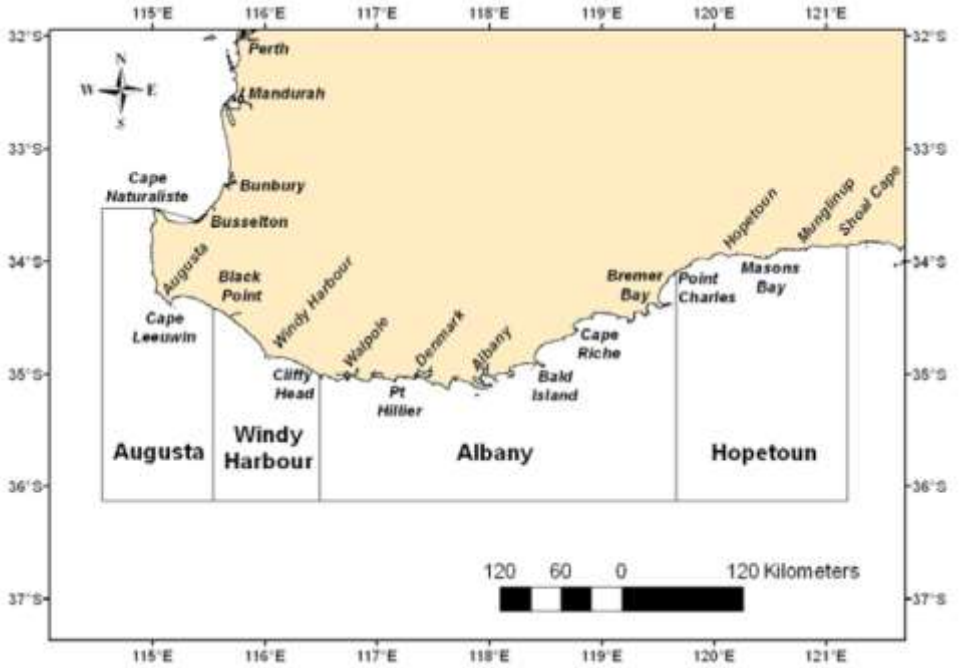
Appendices

Appendix 1 – WA Abalone Fishery



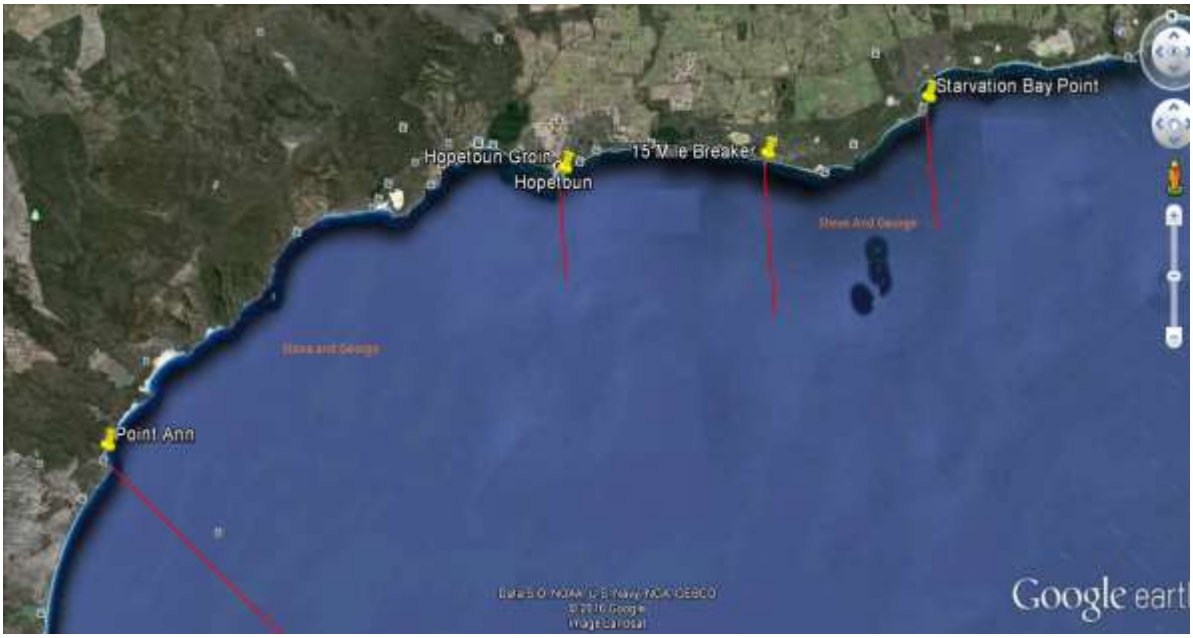
https://www.fish.wa.gov.au/Species/Abalone/Pages/Abalone-Management.aspx

Appendix 2 – Sub Areas of the Area 3 Abalone Fishery



Hart et al. (2013)

Appendix 3 – Beres Paddocks



Google Maps – Peter Rickerby

Appendix 4 – Workshop Agenda

Abalone Managed Fishery Area 3

GREENLIP RECOVERY STRATEGY MEETING

12 and 13 June 2019

Swan Yacht Club

Riverside Road, Preston Point, East Fremantle

AGENDA

- ***Wednesday 12 June 2019***

9am: workshop with Area 3 owners only

- Recap on current status and management framework of the Area 3 fishery
- Review of past experience in Vic Western Zone fishery
- Consideration of strategic options for Area 3 fishery
- Discussion about who will develop and lead the industry recovery plan

1pm: workshop with Area 3 owners and WA Fisheries managers and science team

- Extended discussion on current status and management framework of the fishery
- Presentation about Vic Western Zone experience from research
- Presentation about Vic Western Zone experience from owner and diver
- Consideration of strategic options for Area 3 fishery, recovery plan and timeline.

- ***Thursday 13 June 2019***

9am: workshop with Area 3 owners, WA Fisheries and divers

- Discussion on current status and management framework of the fishery
- Presentation about Vic Western Zone experience from research
- Presentation about Vic Western Zone experience from owner and diver
- Consideration of strategic options for Area 3 fishery, particularly involving divers

1pm: workshop with Area 3 owners, WA Fisheries and divers

- Presentation of Victorian Diver Observation data collection and App
- Development with divers of proposed data collection options
- Discussion with divers about their observations and thoughts
- Summary of outcomes and timeline

Appendix 5 – Workshop Meeting Summary

2018-212

Establishing an industry recovery strategy for the Area 3 Zone of the WA Abalone Managed Fishery

12 and 13 June 2019

Swan Yacht Club

Riverside Road, Preston Point, East Fremantle

Workshop Summary

- ***Wednesday 12 June 2019***

Dr Harry Peeters opened the Workshop at 9:10 am and welcomed Area 3 Authorisation/Licence Holders (Owners) to the event.

Attendees:

Name:	Association:
Harry Peeters	WADA
Duncan Worthington	WADA
Craig Fox	WADA
Peter Rickerby	Authorisation Holder
Jenny Rickerby	Authorisation Holder
John South	Authorisation Holder
John Lashmar	Authorisation Holder
Steve Beres	Authorisation Holder
George Beres	Authorisation Holder
Nathan Adams	Authorisation Holder
Chloe Clauson	Authorisation Holder
Kerry Rowe	Observer
Mark Harrison	Observer
Basia Littlejohn	SSPWA
Don Nicholls	SSPWA
Rhiannon Jones	DPIRD
Nick Caputi	DPIRD
Lachlan Strain	DPIRD

Introduction: The WADA Experience

Duncan Worthington and Harry Peeters commenced the workshop by providing an overview of the current arrangements for the Western Abalone Divers Association and what plan was implemented after the decline in stocks post AVG virus. Duncan provided the Victorian Area Catch Summary that he is charged with distributing to industry members each Monday (Appendix 6). The summary detailed the weekly catch for each reef code, with the TACC and Target Catches included for reference. Harry advised that the Fishery manages its take to the Target Catch threshold for each reef code, rather than the agreed TACC. Harry noted the importance of electronic reporting and the use of mobile updates every 24 hours to allow for transparent and active resource management.

Harry Peeters Experience: Appointed WADA Executive Officer in 2002, with previous experience as a police officer.

Duncan Worthington Experience: Worked within the Department in New South Wales, however quickly transitioned to working with industry. In 2009 he was appointed within WADA and charged with data collation and analysis.

Craig Fox Experience: Commenced as a Deckhand and Rock Lobster Fisherman and invested in the Abalone Industry post AVG. Currently works as an Owner Diver.

Kerry Rowe Experience: Long time Licence Holder in both Western Australia and Victoria, and has influenced WADA to continue on a trajectory that has led to the successful rehabilitation of the resource post AVG.

Harry provided a timeline of the process post AVG Virus:

- 2003: The inaugural Diver/Owner TACC Setting Workshop was held.
- 2004: The Owners resolved to install loggers on every vessel, ultimately $74,000 was spent to ensure industry wide data collection.
- 2004: Focus was still being placed on size limit increases; however, it was becoming clear that this was not aiding the recovery of the resource as the industry would have hoped.
- 2003 to 2005: The industry reduced the TACC from 278 tonnes to 220.
- June 2006: AVG Virus hit the Abalone Fishery in Victoria and reduced the productivity of the reef to 10-20%. All year classes were affected.
- 2006: Owners expressed the dire need for the Department to complete stock surveys, however the Department seemed unwilling to quantify the loss due to the potential legalities. Half of the Zone was immediately closed, with a 120mm size limit set.
- 2007: The whole Zone was closed, and the Department provided permits to fish in non-traditional areas.
- 2009: Owners raised $40,000 to gather experts on Abalone rehabilitation together for a Workshop. As a result, Duncan Worthington and Keith Sainsbury were hired to conduct the necessary data analysis and impose relevant management arrangements. An FRDC Project was conducted to estimate the Abalone biomass post AVG.

An authorisation holder entered the meeting at 9:31 am.

Harry Peters advised that the AVG Virus caused two bankruptcies with one close to succumbing. The Divers also faced financial hardship, with a natural rationalisation from 14 Divers to 6. Harry stressed the need for Owners in Area 3 to consider the potential growth in licence value, rather than the loss of income due to the necessary management arrangements over the following years.

An authorisation holder stated that the focus should be around gaining a higher value for the product.

An authorisation holder enquired as to whether there were any areas after the rehabilitation process started that showed stunted Abalone growth, to which Craig advised that since the rehabilitation process was enacted, there has been no noticeable stunting. The fishery implemented a program whereby a red bin is isolated on deck for undersized abalone for the purpose of translocation. This allowed for the divers to restock sparse areas as daily operations were underway.

The Area 3 Experience

Harry Peeters requested that industry provide an overview of the current scenario and how it had occurred.

An authorisation holder stated that the coupling of the industry overfishing and the heat wave event that occurred in 2011 have had an impact that the industry has struggled to rectify. He advised that several factors had led to the situation becoming further aggravated. The Departments three year rolling average

is a reactive model rather than a predictive model and has led to a complacency within the industry, alongside the setting of size limits that weren't effective.

An authorisation holder advised that the decline commenced the day the Fishery opened and stated that the use of Catch Per Unit Effort (CPUE) is not functional as a monitoring device as the Fishery's effort is evolutionary. He advised that the lack of leadership and decision making has been detrimental, leading to an increase in conflict within the fishery. He stated that the Fishery holds a highly negative and emotion driven culture which needs to end.

An authorisation holder stated that the perpetual nature of a lack of investment due to difficult financial times has been detrimental to the Fishery's development.

Harry Peeters stated that the industry must decide to end the division and bring a constructive approach to the rehabilitation of the resource. He stated that it was vital that the industry appoint a leader who is independent and willing to make the difficult decisions as required. Owners agreed that the appointment of an independent decision maker (Executive Officer) should occur.

An authorisation holder queried how WADA are funded, to which Harry advised that it was through a voluntary industry levy facilitated through the Department.

An authorisation holder queried whether someone with industry experience is required to undertake the Executive Officer role, to which Harry advised that it was not necessary. Craig Fox advised that the appointed person must be respected by industry and not afraid to call out nonsense. Their leadership coupled with relevant and accurate scientific data is the necessary combination for rehabilitation of the resource.

An authorisation holder advised that there had been resistance from some Divers when asked to use the Data Loggers, to which Harry Peeters advised that the Owners need to outline that the Divers Job Description now involves the continued use of Data Loggers, and should the Divers refuse, it would mean a review of performance and potentially a termination of employment. He advised that it should not be an optional arrangement.

An authorisation holder stated that historically, Divers in WA have been young, competitive and were generally the Owner-Diver arrangement. Any TACC decreases were offset with an increase in price. He indicated that this had shifted to Owners utilising farming and other enterprise to offset the costs of the business, which has in turn caused a loss of interest as the other enterprises have become more profitable.

Duncan Worthington advised that the change begins with the implementation of loggers and the gathering of data. Until Owners understand what changes have occurred to the biomass, they cannot proceed with confidence. Duncan stated that Divers must be involved and take ownership of the rehabilitation of the biomass. Harry Peeters stated that within the Victorian Fishery there are five well paid Divers who are respected as members of the community.

Harry Peeters queried the Department's plans for the re-opening of the fishery, to which the owners advised that the Departmental Surveys would inform the decision to reopen. Harry advised that structured fishing surveys need to be conducted by industry, rather than just the Departmental surveys.

The Meeting adjourned for a break at 10:33 am and recommenced at 10:58 am.

Craig Fox – Presentation on WADA

Craig Fox provided a presentation on the work that WADA has undertaken since the AVG Virus 12 years ago.

A video was presented to show the level of stock recovery since the AVG virus. The video was able to be taken as all divers are equipped with Go-Pro's.

Craig provided information on the individual depth logger, which measures a range of factors that allow for the correct CPUE measurement in a near real time environment. He advised that the Succorfish brand was ideal as it uploads the data to the cloud for effective storage. He advised that heat maps of the catch rates can be generated using this technology. Each year, three to four workshops are held with divers, one of which the owners are invited to discuss the catch rates and effort that are being applied within the

fishery. He highlighted the highly reactive nature of the Fishery due to the consistent stream of data available for Duncan's analysis. The individual depth logger is utilised in tandem with the Diver Observation App that was developed through a social scientist. Harry Peeters advised that the App will be made available for the Area 3 Abalone Fishery to utilise free of charge.

Craig Fox stated that collaboration was not easy, however it has proven to be extremely worthwhile. He advised that the sharing of industry collected data with the Department's Management and Scientific team has guided the industry into its first year of self-management. The Department has allocated $70,000 to WADA to conduct its own industry stock assessment.

Harry Peeters expressed his cynicism around fishery independent surveys (FIS) and stated that NSW no longer conduct FIS, with Victoria and South Australia considering alternatives to FIS's. Duncan Worthington stated that there are methods of conducting the data collection in a more practical and cost-effective way when compared to the FIS's, with the use of Data and Dive Loggers providing a means of application.

An authorisation holder advised that DPIRD will push for FishEye to be utilised, and there needs to be a discussion about how all the data collectors interact together.

Action Item: Industry request that a Working Group be established to discuss and develop the necessary linkages that are required to utilise the Fisheye Program, Data Loggers and Dive Loggers.

Harry Peeters suggested that as a start, the Area 3 Owners should invest the approximate $6,000 into purchasing the necessary data and dive loggers per diver.

Duncan Worthington suggested that a structured fishing program be implemented over the next three years. A structured fishing program incorporates the allocation of a series of GPS plots whereby divers have one hour to take up to 100kg, which would provide an idea of the current CPUE in those areas.

Duncan Worthington agreed to look at the data that has been collected to date to understand the ongoing compatibility.

Action Item: Licence Holders who have Data Loggers in place are to send Duncan Worthington the data that has been collected to date to understand the compatibility.

Duncan Worthington noted the need for a central depository for all data collated, perhaps the Abalone Council Australia.

Action Item: Industry will consider a national storage repository of data collected through loggers to be raised with the ACA.

An authorisation holder stated that it was his belief that the Abalone Area 3 stocks will not recover in two seasons and that the most effective means of ensuring recovery would be to close the whole area, which would prevent further localised depletion. Harry Peeters stated that the Western Zone in Victoria was closed for five years, however all Divers remained employed during that period. This was to ensure that the knowledge and skill was retained during the rebuilding phase.

Harry Peeters suggested that industry consider an area wide closure for two years, with the introduction of structured fishing after 12 months, from July to October. Different size limits will be introduced for the various areas. An authorisation holder suggested that structured fishing surveys should be occurring immediately to estimate the starting biomass, however Harry advised that it would make very little difference, bar the retention of Abalone on the seabed.

Duncan Worthington suggested that the structured fishing should occur with a no take rule, utilising transects or cameras. Harry Peeters agreed that visual images of the bottom are powerful tools.

Kerry Rowe expressed the need for the Department to manage the Zone to a finer scale, utilising reef codes or CAES Blocks to determine the biomass of each area and the targets for each block. An authorisation holder suggested that four blocks would be easy to manage under the arrangement.

Action Item: The Department will investigate amending the scale of data utilised for FishEye reporting as Licence Holder uptake increases.

Harry Peeters advised the Owners that they would need to sign a data release form so that an agreed entity can utilise the data for the purpose of stock assessment and monitoring.

Harry Peeters suggested that industry seek funding from the FRDC to fund the conduction of structured fishing surveys to assess the Area 3 Greenlip Abalone biomass. The FRDC funding may take between three to six months to be approved, however if the cost is under $90,000, Director Patrick Hone may sign off on the project without delay. An authorisation holder expressed that he was not comfortable with requesting funds from other entities to pay for the rehabilitation of the stock that he believes has been affected by Owner actions. Duncan Worthington advised that the FRDC would expect an in-kind contribution from Owners. Owners would also need to invest in the logging devices as their own cash contributions.

Industry and WADA representatives agreed that leadership was vital, and that there needs to be an independent Executive Officer appointed to take carriage of the set-up process.

Action Item: Industry to investigate the hiring of a facilitator to co-ordinate the data collection, collation and analysis. Funding will be investigated.

The Meeting agreed to the following:

- 2019: No take year with structured fishing surveys and filming.
- 2020: Structured small conservative fishing surveys with take.
- 2021: Advise on further action dependant on survey outcomes.

The meeting was adjourned at 12:55 pm for Lunch and recommenced at 1:49 pm.

1pm: workshop with Area 3 owners and WA Fisheries managers and science team

Harry Peeters welcomed the Department of Primary Industries and Regional Development (DPIRD) staff to the Meeting.

Harry Peters requested that each Departmental staff member provide an overview of the current scenario and where they believe the fisheries management is heading.

Rhiannon Jones advised that a meeting was held in the previous months whereby industry agreed to implement a voluntary closure for the Augusta Sub-Area, with a move to solidify the closure within the legislation which will be in force until at least the end of this current season, potentially longer. The TACC for Area 3 has been set at 4 tonnes.

Lachlan Strain advised that he had just completed the previous seasons stock assessment which is to be sent to the Marine Stewardship Council for the Audit occurring in August. He advised the following:

- Most of the stock indicators have decreased;
- Meat weights have increased;
- Catch rates have decreased; and
- Fishery Independent Survey showed an increase in juveniles and juvenile recruitment; however, the levels are still considered very low.

Lachlan advised that the paddock trial undertaken by the Beres Owners was showing promising results and the Department would support industry should they wish to move to the similar arrangement.

Harry Peeters queried how the Department would base the decision to reopen the Augusta closure, to which Rhiannon advised that Fishery Independent Surveys have been and will continue to be undertaken.

Harry Peeters advised the Department Staff of the agreements/actions made by industry thus far. He advised the Department that the industry will be signing a waiver to release the individually collected Departmental data to an entity for the purpose of stock assessment and monitoring. He requested that Rhiannon provide examples of the waiver to start the process.

Action Item: The Department will provide the SSPWA with an example of a waiver to release the individually collected Departmental data to an entity for the purpose of stock assessment and monitoring.

Harry Peeters advised that the industry wished to utilise small structured fishing surveys to help inform the decision to re-open the Augusta Sub-Area. Lachlan Strain stated that he nor the Department were averse to the idea and would be willing to work with industry around the fishing survey implementation.

Lachlan Strain advised that the Department is currently developing a Recovery Strategy, however it is only in the drafting stage. Kerry Rowe advised Lachlan that industry wish to manage to smaller spatial units, to which Lachlan stated that the research division already has the capacity to provide that information. Rhiannon stated that under the Management Plan, management to smaller spatial areas would be difficult given the current Plan already have a number of areas and species, however there was no barrier to industry implementing finer spatial catches via a Memorandum of Understanding. Rhiannon advised that the Department are currently aiming to reduce red tape and empower fisheries to strive for co-management.

Duncan Worthington produced a slide of the Departments scientific data, noting that there had been a significant catch rate reduction, however there was no change in the recruit density. Lachlan advised that within the 155mm and above size class there had been a decline, not momentous however it had occurred. Lachlan stated that he was in favour of structured fishing surveys, however expressed caution on the rate in which the surveys are undertaken. Lachlan stated that the scientific data is structured through a Weight of Evidence approach, to which Duncan advised that the Department had not included with weighting of each data set.

Kerry Rowe advised Lachlan that the industry was considering the implementation of Data Loggers and questioned how comfortable the Department was when using industry supplied data. Lachlan advised that technically catch data is industry data and therefore he had no qualms about using data from industry run loggers. He did however stress the fact that it would take some time for anyone to gain confidence, as the data time series must be developed.

Duncan Worthington provided a presentation on the events that took place within the Western Zone. Duncan stressed that although spatial data is key, the real driver for rehabilitating stock is utilising conservative decisions which Owners and Divers are required to contribute to. Duncan stated that the sharing of data was critical during the rebuilding stage of the Western Zones process. He strongly advised industry to ensure that divers be informed and involved and through the utilisation of the Data and Dive Loggers and the structured fishing program, the Fishery in Victoria had now recovered to a Fishery that can sustain a TACC of 70 tonnes. He provided an overview of the structured fishing program utilised within the Western Zone and the outcomes of the program.

Duncan provided an overview of FisherWeb, the online platform used to provide industry with 24-hour updates on the catch status.

Rhiannon advised that FishEye is equipped to provide a similar service.

Lachlan Strain advised that although the plan looks and sounds effective unless all Owners are on board the plan will not eventuate. He advised that the Department would be hesitant to legislate the proposed changes until a commitment is seen. Harry Peeters stated that it was important for the Owners to understand that the Department supports the actions that are going to be undertaken, as there is a financial cost involved in the implementation. Lachlan advised that the support is there, however there would be a need to employ an external entity to process the logger data and other finer details that must be considered.

Harry Peeters stated that industry had decided to commit a substantial amount of funding to implement the gear requirements. When considering the potential loss of MSC Certification, he queried whether the Department would consider providing a grant for the implementation of the industry recovery plan. Nick Caputi advised that the current budget constraints, it was unlikely that the Department would be able to aid financially in this process. Rhiannon advised that she would investigate other means of funding, potentially Royalties for Regions or through the regional development branch of the Department.

Rhiannon Jones offered organise training for the Divers in the use of FishEye, to be hosted in the regions as required.

Action Item: As offered by DPIRD, Industry will arrange FishEye training to be facilitated for all divers by the Department.

Harry Peeters advised that he would endeavour to seek a suitable person to be employed within the Executive Officer role and aimed to organise funding the following day. He stated that Owners would need to provide financial commitment, potentially $30,000 of funding for the first year. Harry questioned whether the Southern Seafood Producers Association WA would have the capacity and willingness to undertake the Executive Officer role, to which Don Nicholls advised that the Management Committee were due to meet on 18 June 2019, advice on SSPWA's stance would be provided after the meeting.

Nick Caputi stated that the undertaking of the data collection was complementary to what research the Department already undertook.

Duncan Worthington advised that the cost of the data analysis would be dependent on the level of involvement, however $10,000 may cover the first year of work.

The meeting briefly discussed the involvement of the Divers at the workshop the following day.

The meeting was closed at 4:40 pm.

- ***Thursday 13 June 2019***

Dr Harry Peeters opened the Workshop at 9:12 am and welcomed Department Staff, Area 3 Authorisation Holders and Divers to the event.

Attendees:

Name:	Association:
Harry Peeters	WADA
Duncan Worthington	WADA
Craig Fox	WADA
Peter Rickerby	Authorisation Holder
Jenny Rickerby	Authorisation Holder
John South	Authorisation Holder
John Lashmar	Authorisation Holder
Steve Beres	Authorisation Holder
George Beres	Authorisation Holder
Nathan Adams	Authorisation Holder
Chloe Clauson	Authorisation Holder
Kerry Rowe	Observer
Mark Harrison	Observer
Ian Clare	Diver
Wayne Marshal	Diver
Joel Veitch	Diver
Joel Day	Diver

Basia Littlejohn	SSPWA
Don Nicholls	SSPWA
Rhiannon Jones	DPIRD
Nick Caputi	DPIRD
Anthony Hart	DPIRD

Harry Peeters provided a recap for the Divers regarding the proceedings of the previous day. He stressed the importance of Diver input into the management of the Fishery and stated that he encourages more weighting to be placed on Diver opinion and anecdotal data.

Craig Fox – Presentation on WADA

Craig Fox provided his presentation for the Divers benefit. He advised that due to the AVG Virus, almost 90% of the abalone biomass was lost, however the rebuilding of the stock has proven successful and achievable. Craig provided the video taken of the seabed to visualise the rate of recovery and advised the Divers that the expectation is that all Divers in Victoria's Western Zone are expected to utilise the Go-Pro's and provide a short presentation each year on the areas in which they worked. A diver stated his support for utilisation of Go-Pros and advised that the Divers had a video program in place previously, however due to funding constraints the program was concluded.

A brief discussion on the differences between Data Loggers ensued, and it was noted that the Area 3 Data Loggers purchased may not be the most streamline version, however they have a greater capacity for data collection. It was noted that the spring-loaded Victorian Data Logger may have inefficiencies when considering the measurement of broken shelled abalone.

Harry Peeters advised that since the implementation of the Data Logger program in Victoria, the rate of vessel interactions conducted by Compliance Officers has decreased dramatically. Rhiannon Jones advised that the Department were open to discuss the use of Data Loggers for reporting purposes, however the implementation time would be substantial as legislative amendments would be required. Craig Fox suggested that Divers and Owners invite Compliance Officers aboard to experience their operation and to build the necessary trust and understanding to move forward. Rhiannon expressed her support and willingness to be involved.

Action Item: Industry are to extend an offer to Departmental Staff to experience the fishery in an operational capacity to strengthen understanding.

Craig Fox continued his presentation with an overview of the history of the Western Zone. He provided an overview of the Depth Loggers utilised to eliminate CPUE falsification, to which a diver expressed his support. The data recovered from the Depth Loggers was only reviewed by the designated Executive Officer to ensure operator privacy. The CPUE and catch records collated via Data and Dive Loggers allows the Executive Officer to provide guidance on how well or poor individual reef codes are throughout the season. The Workshops hosted by the Executive Officer are attended by the Divers, with the Owners being almost completely separated from the quota setting process. WADA has additionally implemented a Diver Observation Application for Divers to complete should they feel it necessary. Kerry Rowe identified that the combination of the systems was critical to the success of the program.

Craig Fox identified the changes in technology regarding the Depth Loggers, noting that the Succorfish is considered one of the most user-friendly technologies available. He advised that the Succorfish logs the position of the Diver via the cloud, and should there be no phone signal available, it can transition to satellite and continue to store data. The cost was estimated at $1,000.00 per unit. Craig additionally mentioned that due to its VMS like nature, the Logger can alert the skipper of the vessel transecting over any Marine Park boundaries. The Logger is also able to act as a means of vessel tracking should a vessel become distressed, as each ping is approximately every 15 seconds. Duncan provided an example of dive events and the data collated.

Duncan Worthington provided the Catch Plan for the Western Zone. He explained that within the four Western Zone areas, there were 35 individual reef codes. A TACC was set, however industry sets a target catch for each reef code which is monitored as the season progresses.

Craig Fox advised that the Western Zone implemented a Red Bin system for the translocation of small Abalone to underdeveloped areas during harvesting operations. An authorisation holder advised that currently any small Abalone that are chipped are eaten immediately by stingrays. He stated that a Red Bin system would be highly beneficial for the Area 3 operation to avoid the unnecessary increase in predatory take. It was noted that to implement the Red Bin system, the shucking of abalone on board vessels would need to cease.

The Meeting adjourned for a break at 10:53 am and recommenced at 11:21 am.

Duncan Worthington – Presentation on Area 3

Duncan Worthington reiterated the importance of conservative decision making in the rehabilitation of the biomass and utilising the necessary technologies for monitoring.

Duncan presented the information available to him from DPIRD. He advised that the Department could not release the entirety of the information due to privacy concerns. He provided an overview of the Western Zones current catches via FisherWeb, whereby all Divers and Owners can keep track of what has been taken within each reef code. Rhiannon Jones advised that FishEye is currently online for the Abalone fishery and is able to be to provide similar details at a broader spatial scale as FisherWeb.

An authorisation holder stated that the series of systems shown over the course of the Workshop must be implemented, however he stated that all Owners must have the same intent to co-operate, and that Divers must genuinely support the process. Harry Peeters advised that all within the Area must work on the basis of good faith.

An authorisation holder enquired at the cost of implementing the series of systems demonstrated within the Workshop. Duncan Worthington advised the meeting that the cost of employing an Executive Officer to lead the program would be approximately $30,000.00 p/a and the cost to employ a Data Co-Ordinator would be approximately $10,000.00 p/a. Harry Peeters advised that the Data Loggers were approximately $6,000.00 per unit, and Dive Loggers were $1,300.00 per diver.

An authorisation holder motioned that the Area 3 Licence Holders agree to a $5.00 per unit financial commitment to fund the procurement of the necessary equipment and the arrangement of an independent facilitator of the recovery process, to be charged on an annual basis. The funds are to be held in an agreed account prior to their collection. The Motion was seconded. The Motion was passed unanimously.

The Meeting adjourned for a break at 12:20 pm and recommenced at 1:08 pm.

Harry Peeters recommenced the meeting and advised that over the course of the break, he had scouted for potential candidates for the Executive Officer and Data Co-Ordinator positions. He advised that Angus Callander of the Industry Consultation Unit and Basia Littlejohn of both the SSPWA and Industry Consultation Unit would be suitable for the roles. It was agreed amongst meeting attendees that Angus and Basia were to be considered. It was agreed that Harry Peeters and Duncan Worthington would discuss the situation with Angus and Basia outside of the meeting. Harry Peeters suggested that Angus's first project would be to apply for funding to monitor the Beres Paddock Experiment as a point of urgency.

Action Item: Angus Callander as EO of the Area 3 Abalone Fishery will apply for funding to monitor the Beres Paddock Experiment as a point of urgency.

An authorisation holder motioned that all Area 3 Licence Holders commit to the installation of data loggers by the end of June 2019. The Motion was seconded. The Motion was passed unanimously.

Duncan Worthington requested that the Area 3 Owners put him in touch with the maker of their current Data Loggers to compare the useability. He also requested that all data collated from here onwards be

sent to him for analysis. He suggested that Angus Callander, Basia Littlejohn, Lachlan Strain, Rhiannon Jones and Anthony Hart are to meet to establish a Working Group to implement the recovery plan.

Harry Peeters queried whether the Department held the capacity to set sub-zonal quota to be implemented for the coming season, to which Rhiannon Jones stated that she would investigate the options available.

Action Item: The Department will investigate the possibility of implementing sub-zonal quotas for this current season.

The meeting agreed that the implementation of the sub-zonal management part of the recovery plan needs to be completed voluntarily, to which Rhiannon Jones agreed that it would be in the Owners best interests to not require this part of the plan to be legislated.

A diver queried how the sub-areas or reef codes would be divided, as he was concerned about travel due to the part time nature of his work. Craig Fox understood the disadvantages, however he stated that travel would need to become the new normal. He stated an alternative arrangement to sub-areas was to set a 300kg limit per diver, however this would prove less effective.

Harry Peeters advised that the distribution of catch amongst each area was the first key step and suggested that the Divers participate in a workshop with Duncan Worthington to provide an outline of their thoughts.

Harry Peeters excused Department Staff and Divers from the room. The Owners held a closed-door workshop. An Authorisation Holder left the meeting at 2:40pm.

An authorisation holder motioned that after consideration of the insight provided by the divers, the Licence Holders agreed that industry will restrict the 2019 catch to 400 kilograms per licence (3,200 kilograms total) to promote recovery. The Motion was seconded. The Motion was passed unanimously.

Harry Peeters advised that he notify the Department of the voluntary agreement. The agreement was committed to on the basis that Diver input will be sought well in advance of the TACC setting process commencing. Once the Harvest Strategy and the Departments TACC advice is released in late December, a Workshop will be held whereby divers and owners will be in attendance, and a decision on the TACC is to be made prior to the Management Meeting in late January.

The meeting resolved that prior to the TACC Meeting held in late January, a meeting will be scheduled for diver input to be collated each year.

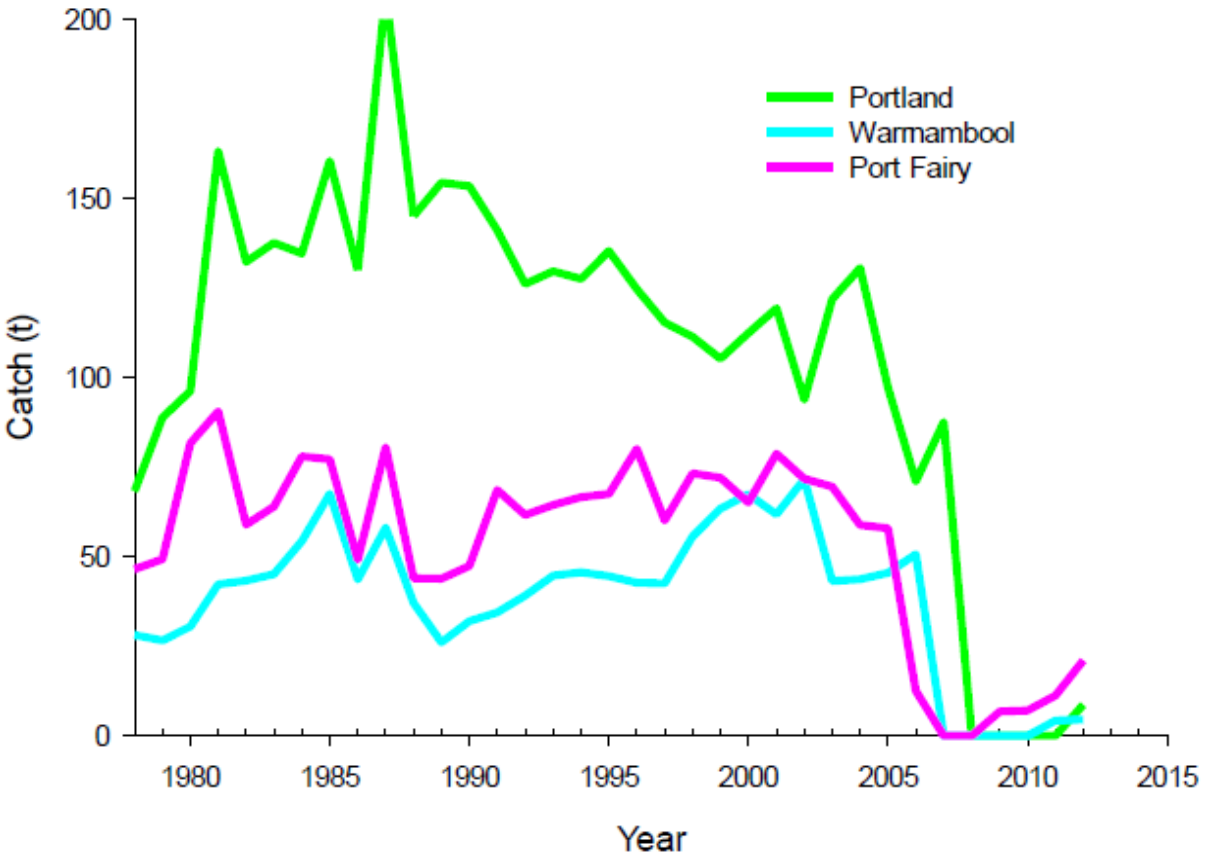
The meeting resolved that every diver will be equipped with GoPro’s by the relevant Licence Holder.

An authorisation holder stated that there must be an acknowledgement of the extreme risk posed by poaching and requested that the Department increase surveillance during the recovery period. Rhiannon Jones advised that Compliance officers are aware of the prohibition and regular routine surveillance was being conducted accordingly.

In closing, Kerry Rowe thanked Harry Peeters, Duncan Worthington and Craig Fox for their attendance and assistance throughout the process.

The meeting was closed at 4:20pm.

Appendix 6 – WZ Catch Graph Showing Closures in 2007



WADA

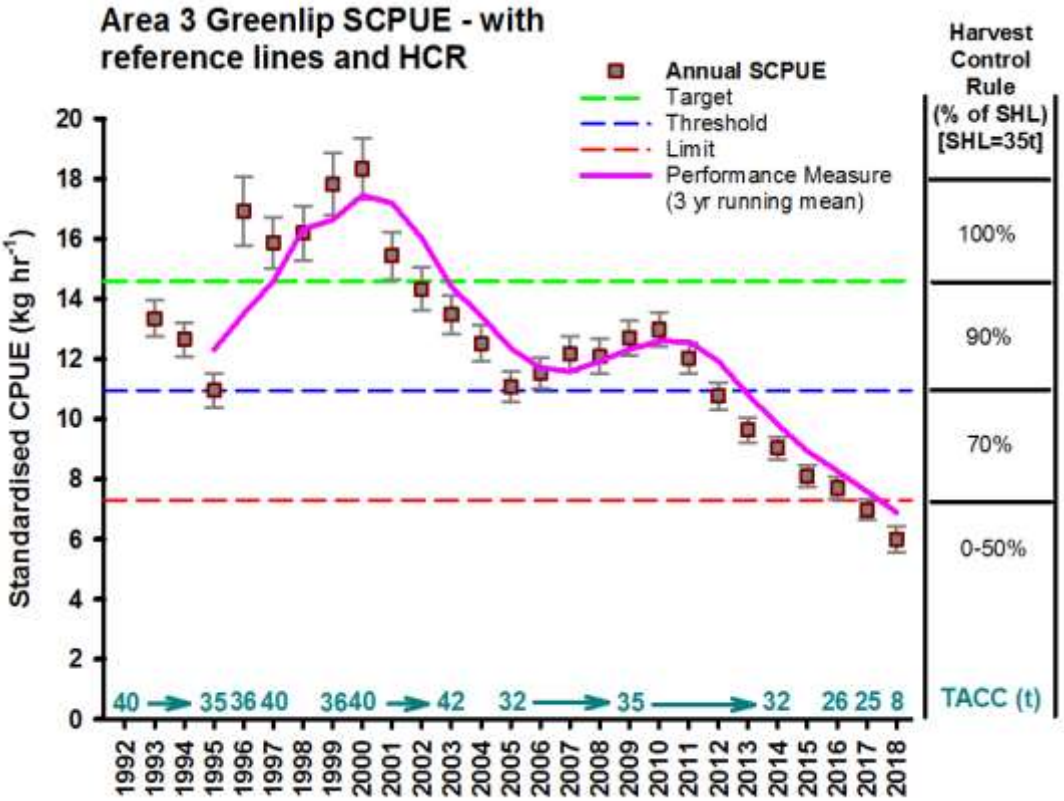
Appendix 7 – WZ Catch Summary Released Every Monday

Blacklip Abalone Western Zone TAC Catch Breakdown by Reefcode and Spatial Management Unit Generated Monday, June 3, 2019

							Quota			Triggers		
SMU	Reef	Status	Name	Catch(t)	Lower Limit	Lower Threshold	Target	Threshold	Limit	Target	Threshold	Limit
Portland	1.01	Below Limit	Discovery Bay	0.0	2.9	3.6	4.2	4.8	5.5			
	1.02	Below Limit	Whites	0.5	1.0	1.2	1.4	1.6	1.8			
	1.03	Below Limit	Water Springs	0.3	2.5	3.0	3.5	4.0	4.6			
	1.04	Below Limit	Blowholes	0.0	2.5	3.0	3.5	4.0	4.6			
	1.05	Below Limit	The Tits	0.7	2.5	3.0	3.5	4.0	4.6			
	1.06	Below Limit	South Bridgewater	1.4	2.8	3.4	4.0	4.6	5.2			
	1.07	No Allocation	Seal Caves	0.0	0.0	0.0	0.0	0.0	0.0			
	1.08	No Allocation	Horseshoe	0.0	0.0	0.0	0.0	0.0	0.0			
	2.01	No Allocation	Murrells	0.0	0.0	0.0	0.0	0.0	0.0			
	2.02	Below Limit	Jones Bay	0.0	2.2	2.7	3.2	3.7	4.2			
	2.03	Below Limit	Outside Nelson	0.0	4.6	5.5	6.5	7.5	8.5			
	2.04	Below Limit	Devils Kitchen	0.0	1.3	1.5	1.8	2.1	2.3			
	2.05	No Allocation	Inside Nelson	0.0	0.0	0.0	0.0	0.0	0.0			
	2.06	No Allocation	Killer Waves	0.0	0.0	0.0	0.0	0.0	0.0			
	2.07	No Allocation	Yellow Rock	0.0	0.0	0.0	0.0	0.0	0.0			
	2.08	No Allocation	Cape Grant	0.0	0.0	0.0	0.0	0.0	0.0			
	2.09	No Allocation	Passage	0.0	0.0	0.0	0.0	0.0	0.0			
	2.10	Below Limit	Lawrence Rocks	0.0	0.8	1.0	1.2	1.4	1.6			
	2.11	No Allocation	Blacknose	0.0	0.0	0.0	0.0	0.0	0.0			
	2.12	No Allocation	Hospital Reef	0.0	0.0	0.0	0.0	0.0	0.0			
	2.13	No Allocation	Dutton Way	0.0	0.0	0.0	0.0	0.0	0.0			
	2.14	No Allocation	Julia Bank	0.0	0.0	0.0	0.0	0.0	0.0			
	2.16	No Allocation	Minerva Reef	0.0	0.0	0.0	0.0	0.0	0.0			
	SMU Total	**Below Limit**		**2.9**	**23.0**	**27.9**	**32.8**	**37.7**	**42.6**			
Port Fairy	2.15	Below Limit	Yambuck	0.0	1.0	1.2	1.4	1.6	1.8			
	3.05	Below Limit	The Crags	1.5	6.7	8.1	9.5	10.9	12.4			
	3.06	Below Limit	Burnet's	0.1	2.1	2.6	3.0	3.5	3.9			
	3.07	Below Limit	Water Tower	1.2	3.5	4.3	5.0	5.8	6.5			
	3.08	Below Limit	Lighthouse Reef	0.8	2.5	3.0	3.5	4.0	4.6			
	SMU Total	**Below Limit**		**3.7**	**15.7**	**19.0**	**22.4**	**25.8**	**29.1**			
Julia Percy Island	3.01	Below Limit	Julia Percy North	0.0	0.6	0.8	0.9	1.0	1.2			
	3.02	Below Limit	JP - North East Reef	0.3	0.4	0.5	0.6	0.7	0.8			
	3.03	Below Limit	JP - East Side	0.0	0.4	0.5	0.6	0.7	0.8			
	3.04	Below Limit	JP - Prop Bay	0.0	2.7	3.3	3.9	4.5	5.1			
	SMU Total	**Below Limit**		**0.3**	**4.2**	**5.1**	**6.0**	**6.9**	**7.8**			
Warrnambool	3.09	Below Limit	Mills	0.5	1.4	1.7	2.0	2.3	2.6			
	3.10	On Target	Killarney	2.7	2.1	2.6	3.0	3.5	3.9			
	3.11	Below Limit	The Cutting	0.1	1.4	1.7	2.0	2.3	2.6			
	3.12	Below Limit	Thunder Point	1.1	2.5	3.0	3.5	4.0	4.6			
	3.13	No Allocation	Lady Bay	0.1	0.0	0.0	0.0	0.0	0.0			
	3.14	Over Threshold	Levys Point	1.8	1.1	1.3	1.5	1.7	2.0	28 Apr	28 Apr	
	SMU Total	**Below Limit**		**6.4**	**8.4**	**10.2**	**12.0**	**13.8**	**15.6**			
Zone Total				**13.3**			**73.2**					

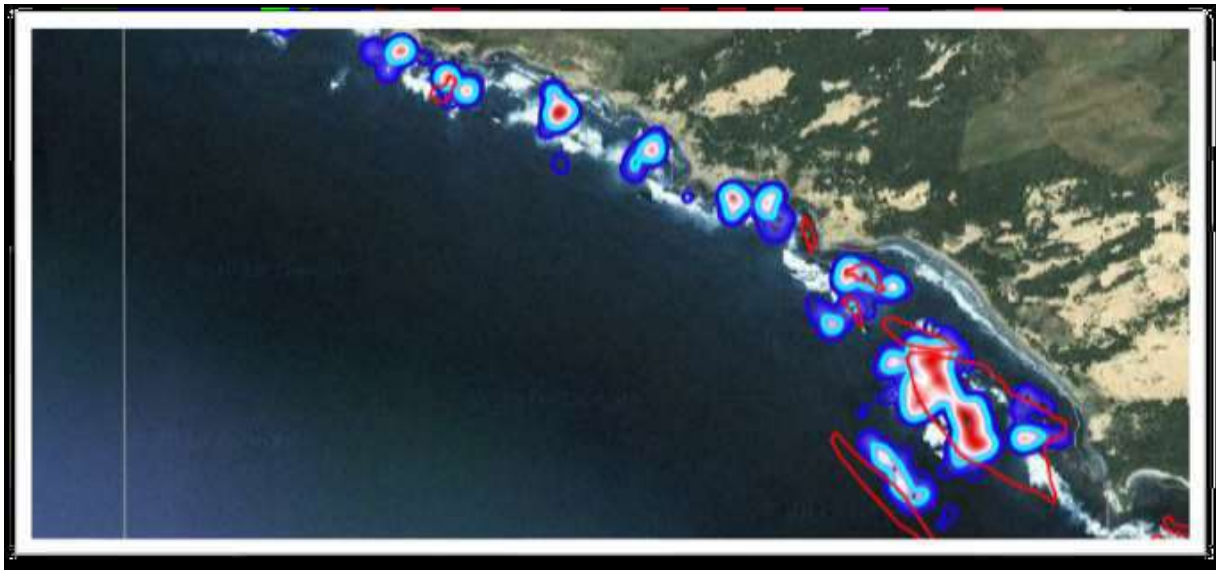
WADA

Appendix 8 - Area 3 Greenlip SCPUE with Reference Lines and Harvest Control Rule.

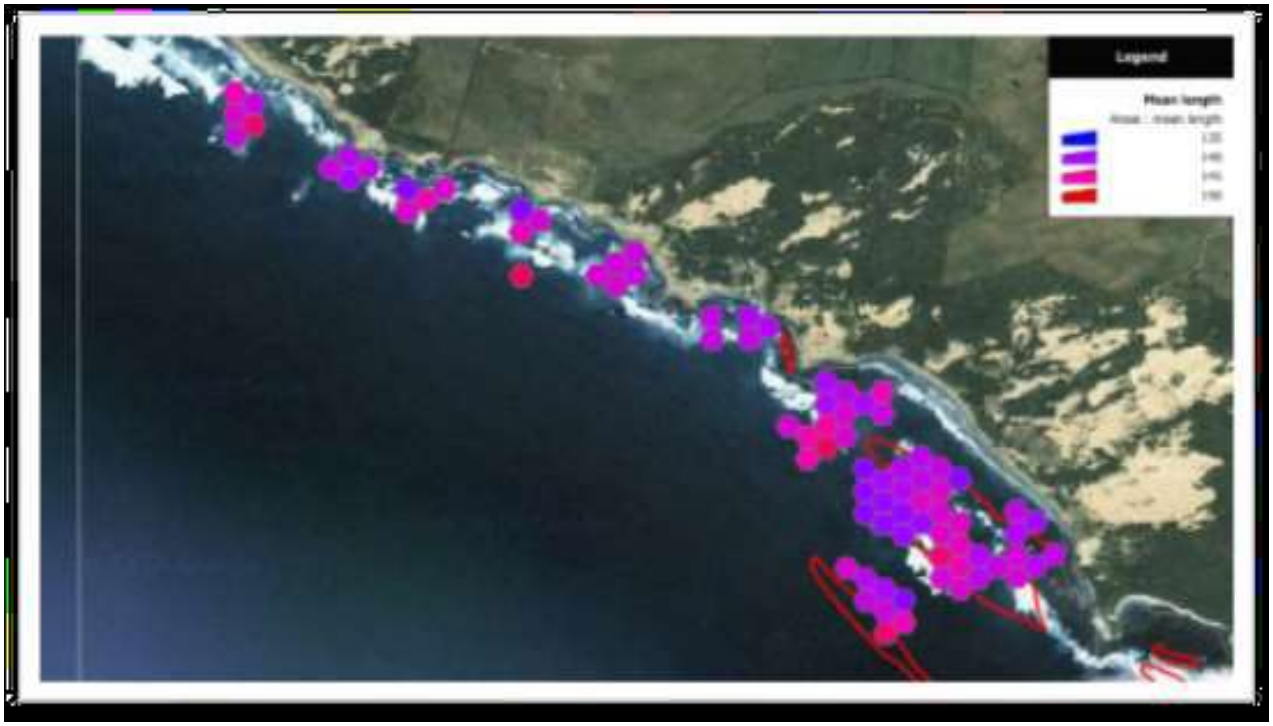


Strain et al. (2019b)

Appendix 9 – Heat Maps Generated



Effort Heat Map - WADA



Dive Length Heat Map – WADA

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