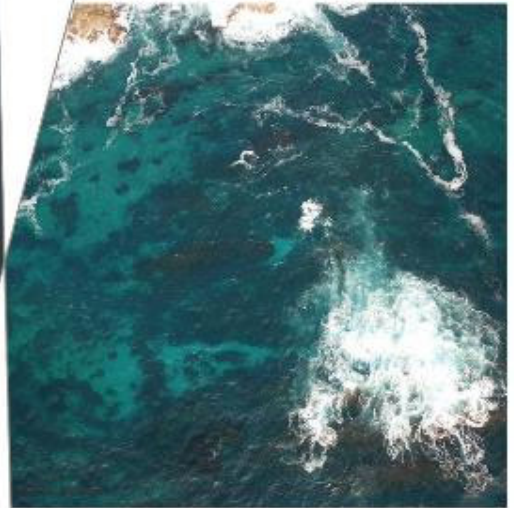


# The Urchin Plague - From Problem to Profit

End of Project Report

Stantec Job no. 304500721



Prepared for  
OceanWatch Australia

6 July 2022



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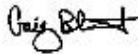
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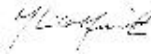
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Our report is based on information made available by the client. The validity and comprehensiveness of supplied information has not been independently verified and, for the purposes of this report, it is assumed that the information provided to Cardno is both complete and accurate. Whilst, to the best of our knowledge, the information contained in this report is accurate at the date of issue, changes may occur to the site conditions, the site context or the applicable planning framework. This report should not be used after any such changes without consulting the provider of the report or a suitably qualified person.

## Executive Summary

OceanWatch Australia Pty Ltd (OceanWatch), partnering with the Abalone Association of NSW, received funding from the National Landcare Program Smart Farms Small Grants for the ‘*The Urchin Plague - From Problem to Profit*’ project. This project joined a broader project that had been ongoing in NSW for roughly three decades, to assess the long-term cost and benefit of clearances of purple sea urchins (*Centrostephanus rodgersii*) to rehabilitate and return reef to abalone production for the fishery. Although the focus of urchin clearances has been on recovering abalone habitat it is noteworthy that partial clearances can improve the roe of the remaining urchins, thereby improving the urchin fishery, and increase the resilience of kelp communities to the potential effects of climate change. The broader project, which has included multiple funding sources as well as additional work in eastern Victoria, has been designed with a network of sites being prioritised for rehabilitation by clearing urchins.

Cardno now Stantec, was commissioned by OceanWatch to summarise the work done as part of the Smart Farms Small Grant (this report), including an assessment of the success of the project against its initial objectives, which were:

- > Rehabilitate 8 ha of urchin barrens through targeted urchin-culling, drawing on the support, skills and experience of commercial Abalone and Sea Urchin and Turban Shell (SUTS) divers. This was to include:
  - Culling 200,000 urchins
  - Determining whether significant regeneration of macroalgae ( $\geq 75\%$  coverage) occurred, and if there were a substantial increase in native biodiversity, including commercially important species such as abalone
  - Determining whether there was Improved roe quality of urchins remaining at the cull sites, hence supporting development of the sea urchin fishery.
- > Training NSW commercial Abalone and SUTS divers in an industry code of practice (CoP), delivered by OceanWatch in regional workshops, where:
  - Divers are recognised for completing training, with materials aligned to a unit of competency within the Seafood Industry Training Package
  - Marketing materials were developed
  - $\geq 75\%$  of the NSW Abalone divers (i.e. 28 divers) were engaged in the training.

Some additional work was also done as part of the project that was not included in the original proposal. This included:

- > The ‘Ultimate Urchin Challenge’, whose purpose was to:
  - Improve consumer awareness of urchins as a sustainably harvested product.
  - Increase consumer interest in urchin products.
  - Promote urchin project to the public, wider seafood industry and seafood retailers.
  - Highlight industry training practices/code of practice.

and

- > The ‘Restoration Through Harvest’ Symposium. This was a joint project led by UNSW, that OceanWatch contributed to financially, and participated in. The one-day Symposium brought together scientists, indigenous groups, abalone and sea urchin fishers, government managers, aquaculture specialists and entrepreneurs to discuss opportunities for the development of market-based approaches to control purple urchin populations and restore productive kelp forests.

Commercial Abalone and SUTS divers culled purple urchins at six sites, two more than had been proposed initially, and in up to three separate events at some of the sites. The target number of 200,000 urchins was exceeded and culling was sufficient to transform all sites from barrens to a benthic habitat dominated by macroalgae (more favorable to abalone) and to improve the roe quality and recovery of the remaining urchins to a level that is likely to be commercially viable for harvest by urchin divers.

OceanWatch worked closely with the Abalone Association of NSW to further develop the voluntary CoP for the NSW Abalone and SUTS fisheries. The CoP has been extended to include the Responsible Diver Training Program, which improves knowledge, awareness and professionalism in the sector and goes above and beyond requirements prescribed by state, national and international regulations. The sixteen divers and

deckhands that participated at workshops have been recognised for completing formal training by receiving formal certification, and were provided with a suite of marketing materials.

The 'Ultimate Urchin Challenge' and 'Restoration Through Harvest Symposium' both improved knowledge and interest in contemporary issues concerning NSW nearshore rocky reefs and their fishery products. The Ultimate Urchin Challenge was a step in changing the reputation of urchin products in the eyes of seafood consumers, given that urchins are somewhat 'undiscovered' by the wider public or have a reputation for being a difficult product to prepare and consume. At the Symposium, there was broad consensus that significant reductions of urchin barrrens through harvesting of purple urchin will have broad quadruple bottom line benefits (i.e. economic, environmental, social, cultural) to the NSW south coast community, and could serve as a model system for managing these rocky reef systems. An integrated, co-management approach including the various groups represented in the Symposium was recommended to oversee future urchin removals in dedicated sites, with rigorous monitoring of performance and benefits. This group continues to work together to identify sites, design a future program, and seek appropriate government permitting.

Although the OceanWatch project successfully met its objectives to cull at least 8 ha of barrrens, transforming them into diverse assemblages of macroalgae that will benefit the abalone and urchin fisheries, these areas will gradually return to the barrrens state after a few years without ongoing maintenance. This would likely be due to recruitment of juvenile urchins from other reefs or perhaps deeper water. Successful ongoing culling programs in other states address this issue by monitoring urchin abundance, so that maintenance culling can be done when required. To ensure a long-term benefit from the OceanWatch project (and broader culling generally) the industry needs to secure an arrangement whereby it has the resources to plan for and undertake ongoing monitoring and maintenance of cull sites in addition to initial culls. Suggestions that could potentially be incorporated into the broader culling program in NSW into the future include:

- > *Adding additional cull sites* – in addition to the maintenance of the six sites discussed in this report, consider economies of scale in adding more cull sites, in suitable areas, to the broader program.
- > *Continue to select areas for culling (and cull rates) that have mutual benefit to abalone, urchin divers, other stakeholders and the environment* – mutual agreement could best be obtained through stakeholder workshops and that considers the quadruple bottom line of economic, environmental, social and cultural issues.
- > *Leveraging the effects of east coast lows (ECLs)* - it is understood that ECLs in 2021 removed urchins from many barrrens thereby having a similar impact to culling in many areas. If the ECL had removed urchins in previously productive abalone areas then these areas could also be monitored and maintained and incorporated into the broader rehabilitation program. Industry should continue to look for similar opportunities after the occurrence of ECLs in the future, thereby avoiding potential costly and wasted culling effort – i.e. if ECLs have a similar effect to culling in areas that may have been proposed for targeting.
- > *Including opportunistic culling in the divers CoP* – Maintenance culling could potentially be done by abalone and SUTS divers when they are harvesting in previously culled areas, noting that this would need appropriate permitting.
- > *Partnering industry with researchers and other stakeholders* – Opportunities need to be explored as to how best to undertake culling for the mutual benefit of all stakeholders. This could also be done as part of a wider multi-state *program*, facilitated by a Marine Natural Resource Management group.

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# 1 Introduction

## 1.1 Background and Need

The purple urchin (also known as black urchin or long-spined urchin), *Centrostephanus rodgersii*, can clear and maintain areas of reef free from macroalgae, termed barrens or white rock, and in doing so, can reduce the productivity of abalone populations and other reef species dependent on macroalgal habitat. Its impact on reef habitats in Victoria and Tasmania has been particularly severe in the last few decades, and its spread south from a historical limit to NSW may be related to climate change (e.g. see FRDC 2009/070).

In NSW, large scale barrens have been present at least since 1928 (i.e. as seen in the oldest available aerial photographs) and possibly occur naturally. In 2003, approximately 50% of nearshore reef was measured as barrens (see FRDC 99/128). Although wave action in the shallows likely imposes physical limitations on the ability of urchins to establish densities sufficient to create a barren, the abalone divers and Glasby and Gibson (2020) have provided evidence that the shallow edges of barrens in NSW can still increase by large amounts in some places. Indeed, Glasby and Gibson (2020) estimated that there has been an overall increase in barrens in NSW in the last 30 years of ~20 m<sup>2</sup> per hectare per year, although at some sites they measured no change, or a reduction (Glasby and Gibson, 2020). When these increases occur at sites that were historically productive sites for collection of abalone, this is problematic, given there are limited numbers of productive abalone sites on the south coast of NSW that are accessible to divers.

Small-scale partial or full clearances of purple urchins, and translocation of abalone into cleared areas, has demonstrated the ability to recover abalone populations impacted by purple urchins (see FRDC 2014/22). Although the focus of purple urchin clearances is generally on recovering abalone it is worth noting that partial clearances also improve the roe of the remaining urchins, thereby improving the urchin fishery (Blount et al.; FRDC 99/128) and increase the cover and biomass of macroalgae. In eastern Victoria, a joint project between Industry and Government has seen commercial-scale removal of urchins from previously productive abalone reef and the consequent recovery of appropriate habitat for abalone. Fisheries Victoria released 'A Review of Rebuilding Options for the Victorian Abalone Fishery' that recommended investment in habitat rehabilitation through removal of urchins, and the translocation of abalone to recover productive populations. Such action is also a current management response for the NSW Abalone Fishery Management Strategy (see management response 2.2(f) *Continue to investigate the potential for, and effects of, restoring abalone populations through sea urchin harvesting in up to 1% of reef in water depths less than 20 m in NSW waters*). Pushing back the shallow edges of barrens at particular sites in NSW would increase production of abalone and urchin fisheries, and possibly other fisheries, and would also provide for extensions to kelp beds (thereby increasing resilience to these habitats to the effects of climate change).

## 1.2 The project

In early 2019, OceanWatch Australia Pty Ltd (OceanWatch), partnering with the Abalone Association of NSW, applied for funding from the National Landcare Program Smart Farms Small Grants Round 2 to cull urchins at some sites in NSW. The OceanWatch project joined a broader ongoing project in NSW, that has been running for three decades for assessing the long-term cost and benefit of urchin clearances to rehabilitate and return reef to abalone production for the fishery.

The broader project, which has included multiple funding sources as well as additional work in eastern Victoria, has been designed with a network of sites being prioritised for rehabilitation by clearing urchins. Its investigations have combined with other approaches needed to enhance recovery of abalone populations, particularly including translocation of abalone brood stock.

Cardno now Stantec (hereafter Stantec), was commissioned by OceanWatch to summarise the work done as part of the Smart Farms Small Grant (this report) including an assessment of the success of the project against its objectives.

### 1.2.1 Objectives

The initial objectives of the project were as follows:

- > Rehabilitate 8 ha of urchin barrens through targeted culling, drawing on the support, skills and experience of commercial abalone and SUTS divers. This was to include:
  - Culling 200,000 urchins

- Significant regeneration of macroalgae (75% coverage), and a substantial increase in native biodiversity, including commercially important species such as abalone
  - Improved roe quality of remaining urchins at the cull sites, supporting development of the sea urchin fishery.
- > Training NSW commercial Abalone and Sea Urchin and Turban Shell (SUTS) divers in an industry code of practice (CoP), delivered by OceanWatch in regional workshops, where:
- Divers are recognised for completing training, with materials aligned to a unit of competency within the Seafood Industry Training Package
  - Marketing materials are developed
  - 75% of the NSW Abalone/SUTS divers (i.e. 28 divers) are engaged in the training.

Some additional work was also done as part of the project that was not included in the original proposal. This included:

- > The 'Ultimate Urchin Challenge', whose purpose was to:
- Improve consumer awareness of urchin as a sustainably harvested product.
  - Increase consumer interest in urchin products.
  - Promote our project to the public, wider seafood industry and seafood retailers.
  - Highlight industry training practices/code of practice.

and

- > The 'Restoration Through Harvest' Symposium. This was a joint project led by UNSW, that OceanWatch contributed to financially, and participated in. The one-day Symposium brought together scientists, indigenous groups, abalone and sea urchin fishers, government managers, aquaculture specialists and entrepreneurs to discuss opportunities for the development of market-based approaches to control sea urchin populations and restore productive kelp forests.

## 2 Methods

### 2.1 Culling urchins

Initially, professional abalone divers interested in participating in the project met to discuss potential project sites and culling dates, and to nominate leaders to organise the work parties. Due to the fires in 2019/20 and loss of fishing infrastructure including processing sheds, a reduced number of leaders had to take a greater responsibility.

#### 2.1.1 Sites

Given the project was foremost a 'rehabilitation' project, sites were primarily chosen because divers had indicated that they had previously harvested abalone at those site when there was less barrens habitat, and hence offered a high chance of restoration success.

Site were also considered in terms of whether they were:

- > Readily accessible for culling (in this project), and for future maintenance and harvesting by urchin divers
- > Previously culled as part of FRDC project no. 2014-224 (in the case of Saltwater).

The proposal required at least four sites to be chosen on the far south coast of NSW but in total six sites were culled for this project. From north to south these included:

- > Blue Pools and the Brothers (Bermagui)
- > Baronda and Moon Bay (North of Tathra)
- > Saltwater and Disaster Bay (South of Eden) (**Figure 2-1i**).

Sites ranged in extent from <1 ha to up to 3.2 ha (**Figure 2-1ii**) and permission was granted from NSW Department of Primary Industries (Fisheries) for a permit for abalone divers to remove urchins from each of these areas.



### 2.1.2 Timing

Culling was proposed initially for spring, given it was anticipated that this would maximise the potential for colonisation of macroalgae following culls, with two five-hour-long culls (3 months apart) proposed for each site in each of 2019 and 2020. A final culling event and monitoring dive was proposed for each site for August 2021. To maximise effect, up to five divers per site were proposed for each culling event for a total of 100 diver days.

Given the challenges presented by Covid-19, compromises to the schedule were required and each site was culled at least once, and up to three times for some sites, by between two and five divers on each occasion. **Section 3.1.1** summarises effort at each site. OceanWatch staff were unable to travel during the period, limiting their ability to assist in the monitoring.

### 2.1.3 Technique

At each site, dive vessels were moored ~50 m apart. Teams of divers worked in particular areas within sites so that effort was spread evenly. Each diver had a sharp hand tool (knife or other pointed implement) (**Figure 2-2i**) which was used to penetrate the carapace of all urchins that were visible on the dive. Creating a hole in the carapace is an effective means of killing an urchin. The number of urchins culled during each event was estimated by multiplying cull rates (per diver per hour) by the number of divers and hours worked.

### 2.1.4 Monitoring changes to urchins and benthic habitat

Prior to culling, where possible, a drone was used to photograph the entire site from the air. GoPro underwater video was also taken at some sites and the overall percent cover of the site in macroalgae and barrens was estimated by the divers. A representative sample of between 10 and 20 urchins was cracked open at each site so that divers could estimate the quality and recovery of urchin roe generally (**Figure 2-2ii**). Where practicable, this process was repeated during each cull/monitoring event.

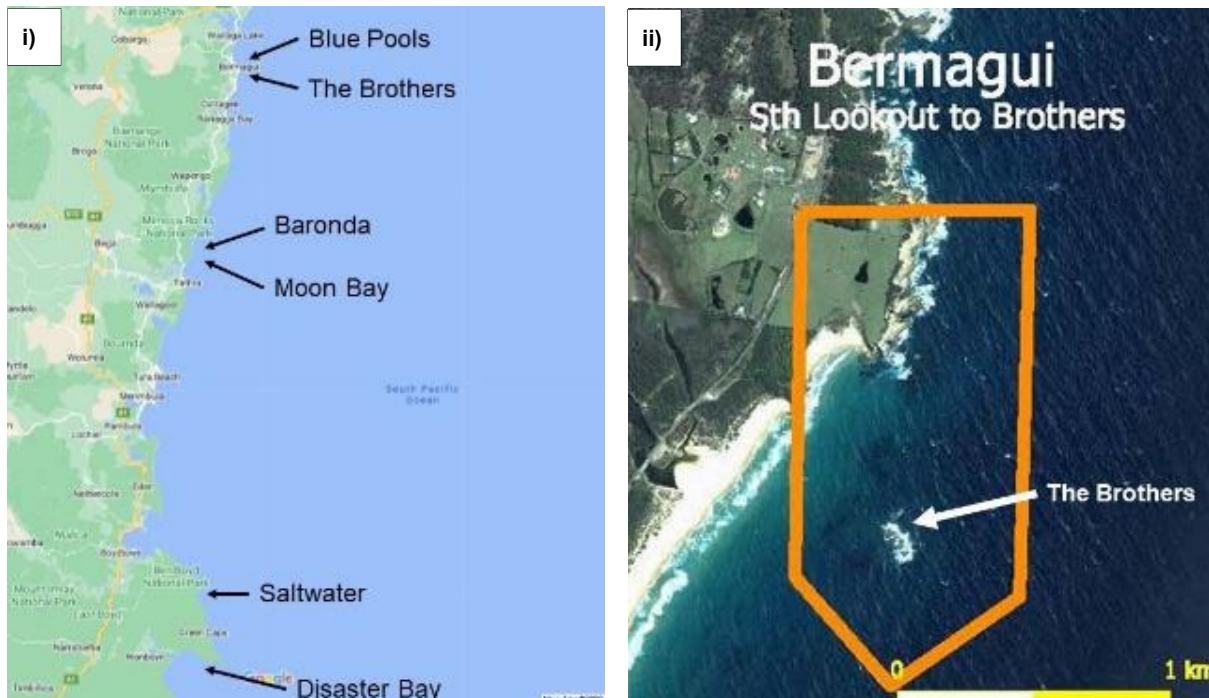


Figure 2-1 (i) Locations of sites and (ii) an example of one of the permit areas (i.e. The Brothers near Bermagui)

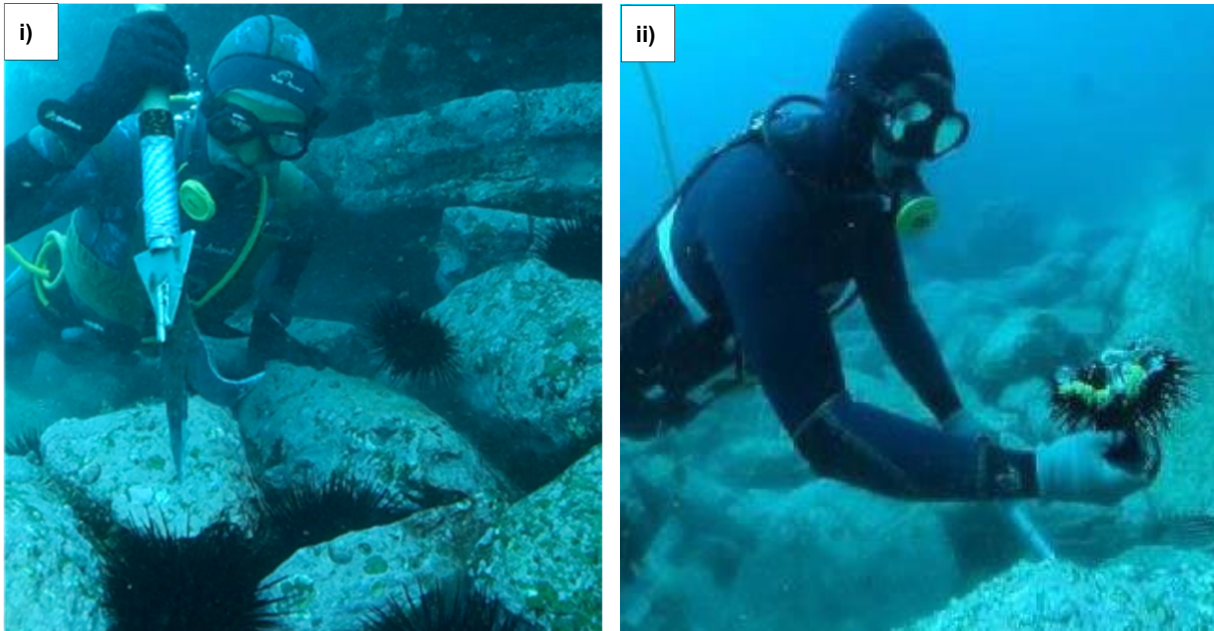


Figure 2-2 A diver (i) culling and (ii) checking the quality of urchin roe (Source: OceanWatch)

## 2.2 Extension of Abalone and SUTS Code of Practice

OceanWatch developed training materials for a ‘Responsible Diver Program’ modelled on its ‘Master Fishermen’ project. Materials included a one-day training program for divers in the NSW abalone and SUTS industry. Four online training workshops were undertaken and delivered by OceanWatch trainers, who are qualified to assess participating divers against a test of competency within a Seafood Industry Training Package.

Marketing materials were also developed and these included:

- > Videos
- > Written training material, and
- > Profiles and qualifications of individual fishermen on a Master Fisherman Website.

## 2.3 The Ultimate Urchin Challenge

In partnership with Sydney Fish Market, this event was held in May 2022. It involved bringing together the sea urchin industry, fisheries officers, media and some of NSW best chefs in a cooking challenge that would promote the sea urchin fishery. Chefs prepared dishes that included urchin roe and these were judged against each other.

## 2.4 The Urchin Symposium

The ‘Restoration Through Harvest’ Symposium was held in June 2021 in Narooma. Attendees included representatives from:

- > Yuin Nation Traditional Owners
- > Commercial and recreational fishers, including representatives from the Abalone Association of NSW, urchin fishers and businesses (e.g., Sea Urchin Harvest PTY LTD) and seaweed-focused businesses (e.g. Sea Health and South Coast Seaweeds)
- > Conservation groups and not-for-profits (e.g., the Nature Coast Marine Group, OceanWatch Australia)
- > Scientists, including from academic institutions, government, students and industry
- > Government (e.g., NSW DPI Fisheries)
- > Community stakeholders (e.g., ecotourism operators, local entrepreneurs in the marine space)

> Interested members of the general community.

There were 11 individual presentations by 17 speakers, of whom two travelled interstate to speak at the Symposium, as well as three virtual presentations from three states.

The progress and results of culling urchins was presented at the symposium along with the project video.

### 3 Results

#### 3.1 Culling urchins

##### 3.1.1 Effort

Estimated culling rates per diver were between 1,200 - 1,800 urchin per hour. Culling was done between 1 Dec 2019 and 19 Dec 2021, for a total of 47 diver days (i.e. the number of divers x the number of days dived) and for between two and five hours each day. Approximately 270,000 urchins were culled across ~10.4 ha at six sites, with the most being culled at the Blue Pools (104,000) and Saltwater (67,200) sites (**Table 3-1**). It is noted that culling had also been done previously at Saltwater and the Brothers at various times in 2017 and 2018 for FRDC 2014/224. **Figure 3-1** shows examples logger data (i.e. on one culling day) from divers at some sites in this project.

Table 3-1 Details of urchin culling

Site	Area (ha)	Date(s)	No. Divers (Diver Days)	Culling Time (hrs)	Culling Rate (urchins/hr)	No. urchins culled
Blue Pools (Bermagui)	2.0000	16.12.2019	6	6 divers x 4 hrs ea.	1,200 - 1,800/hr	40,400
	As above	05.09.2020	3	2 divers x 3.5 hrs ea., 1 divers x 4 hrs	1,200 - 1,800/hr	15,600
	As above	21.11.2020	2	2 divers x 4 hrs ea.	1,200 - 1,800/hr	48,000
The Brothers <sup>1</sup> (Bermagui)	3.2000	18.12.2020	7	7 divers x 4 hrs ea.	1,200 - 1,800/hr	6,000
Baronda (North of Tathra)	0.0386	01.12.2019	2	2 divers x 2 hrs ea.	1,200/hr	4,800
	0.2477	10.09.2020	5	5 divers x 4 hrs ea.	1,200 - 1,800/hr	33,600
	As above	14.09.2020	5	2 divers x 4 hrs ea.	1,200 - 1,500/hr	10,800
Moon Bay (North of Tathra)	0.6858	14.09.2020	4	4 divers x 4.5 hrs ea.	1,200/hr	21,600
Saltwater <sup>1</sup> (South of Eden)	2.2000	16.12.2019	2	1 diver x 4 hrs., 1 diver x 5 hrs.	1,800/hr	16,200
	As above	09.11.2020	3	4 divers x 4 hrs.	1,200 - 1,800/hr	17,400
	As above	20.12.2020	5	5 divers x 4 hrs.	1,200 - 1,800/hr	33,600
Disaster Bay (South of Green Cape)	2.0000	20.12.2020	1	1 divers x 4 hrs	1,800/hr	7,200
	As above	23.12.2020	1	1 divers x 4 hrs	1,800/hr	7,200
	As above	19.12.2021	1	1 divers x 4 hrs	1,800/hr	7,200
<b>Total</b>	<b>10.3721</b>		<b>47</b>	<b>178</b>		<b>269,600</b>

<sup>1</sup> Previous culling done at this site in 2017/2018 for FRDC 2014/224

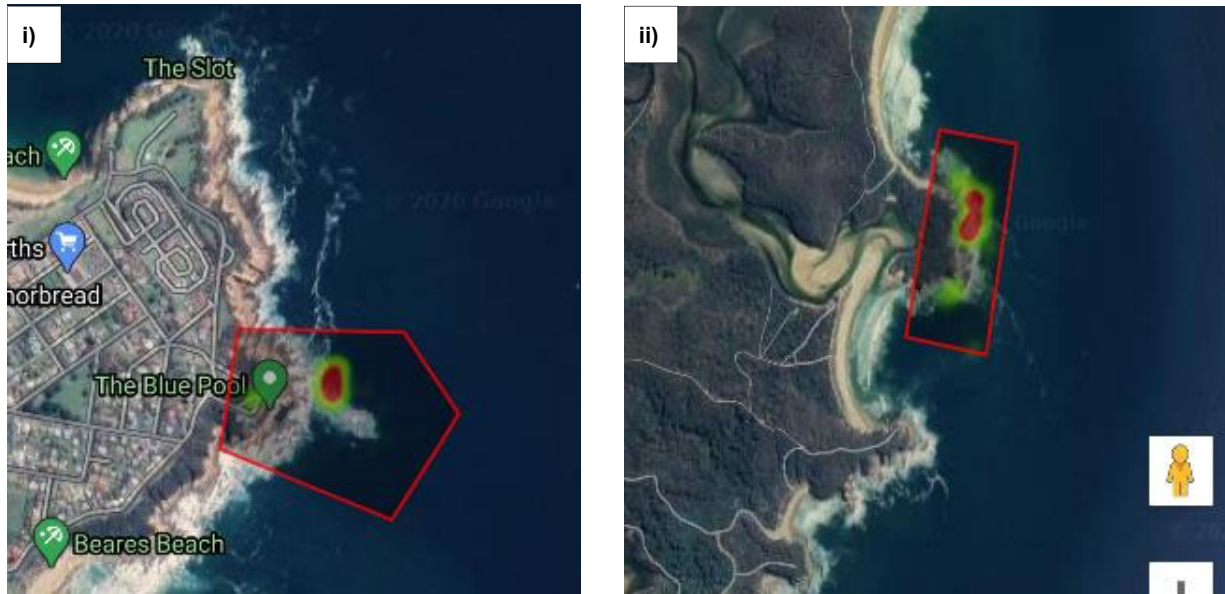


Figure 3-1 Example of culling effort by divers as determined from Succerfish loggers on cull days at (i) Blue Pools and (ii) Baronda (Source: OceanWatch)

### 3.1.2 Changes in urchins and benthic habitat

#### 3.1.2.1 *Urchins and roe*

The quality of urchin roe was generally poor in barrens prior to culling, with recovery (i.e. roe weight as a percentage of total urchin weight) at Blue Pools estimated at only 4% (**Table 3-2**). Roe quality improved at Blue Pools and Baronda after 9 months from the initial culls. At this time recovery had also increased marginally from 4 to 5% at the Blue Pools site, although it is noted that sampling was done at the start of the roe build-up season, rather than the middle or end of the period (i.e. late summer or autumn) when roe is generally largest in urchins everywhere (i.e. maturing). Improvement in quality and recovery of roe was also noted at Baronda, and at Saltwater where culling had been done for a previous project (FRDC 2014/224) in 2017/18 (**Table 3-2**).

Table 3-2 Roe quality at cull sites. ND = no data, arrow indicates an improvement

Site	Date(s) of Cull Event	Roe Quality	Roe Recovery (%)	Overall Change in Condition
Blue Pools (Bermagui)	16.12.2019	Poor	4	↑
	05.09.2020	Good	5	
	21.11.2020	Good	5	
The Brothers <sup>1</sup> (Bermagui)	18.12.2020	ND	ND	ND
Baronda (North of Tathra)	01.12.2019	Poor	ND	↑
	10.09.2020	Poor - Fair	ND	
	14.09.2020	ND	ND	
Moon Bay (North of Tathra)	14.09.2020	Fair	ND	ND
Saltwater <sup>1</sup> (South of Eden)	16.12.2019	Good	5	↑
	09.11.2020	Good	5-6	
	20.12.2020	Good	5-6	
Disaster Bay (South of Green Cape)	20.12.2020	ND	ND	ND
	23.12.2020	ND	ND	ND
	19.12.2021	ND	ND	ND

<sup>1</sup> Previous culling done at this site in 2017/2018 for FRDC 2014/224

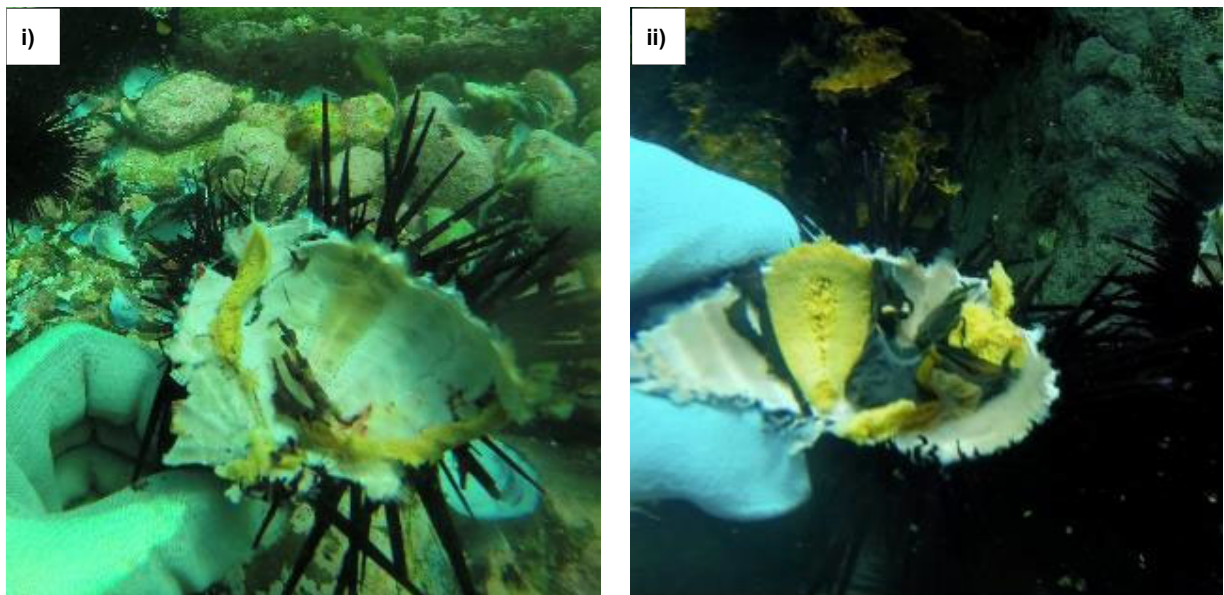


Figure 3-2 Example of roe quality at Saltwater before and after culling (Source: J Smythe)

### 3.1.2.2 Macroalgae

Prior to culling, the benthic habitat at all sites was mostly barrens due to high densities of urchins (e.g. see **Figure 3-3** for Blue Pools). That is, the reef was generally comprised of >70% barrens and macroalgae were scarce. The exceptions were Saltwater and the Brothers sites, where culling had been done previously in 2017/2018 for FRDC 2014/224 and only 50% of the reef was barrens. Nine months from the initial culling event at most sites there was a large increase in the percent cover of macroalgae (70% to 100%) and a corresponding decrease in the percent cover of barrens (to generally <30%) (see **Figure 3-4 i-v**). A further 12 months later, diver observations at Blue Pools indicated that macroalgal assemblages had become very diverse, dominating the reef, and only few areas of barrens could be found (**Figure 3-5**). Anecdotal information from divers indicated that similar transformations to benthic assemblages have occurred at all the cull sites.



Figure 3-3 Example of barrens habitat at a site prior to culling (Source: OceanWatch)

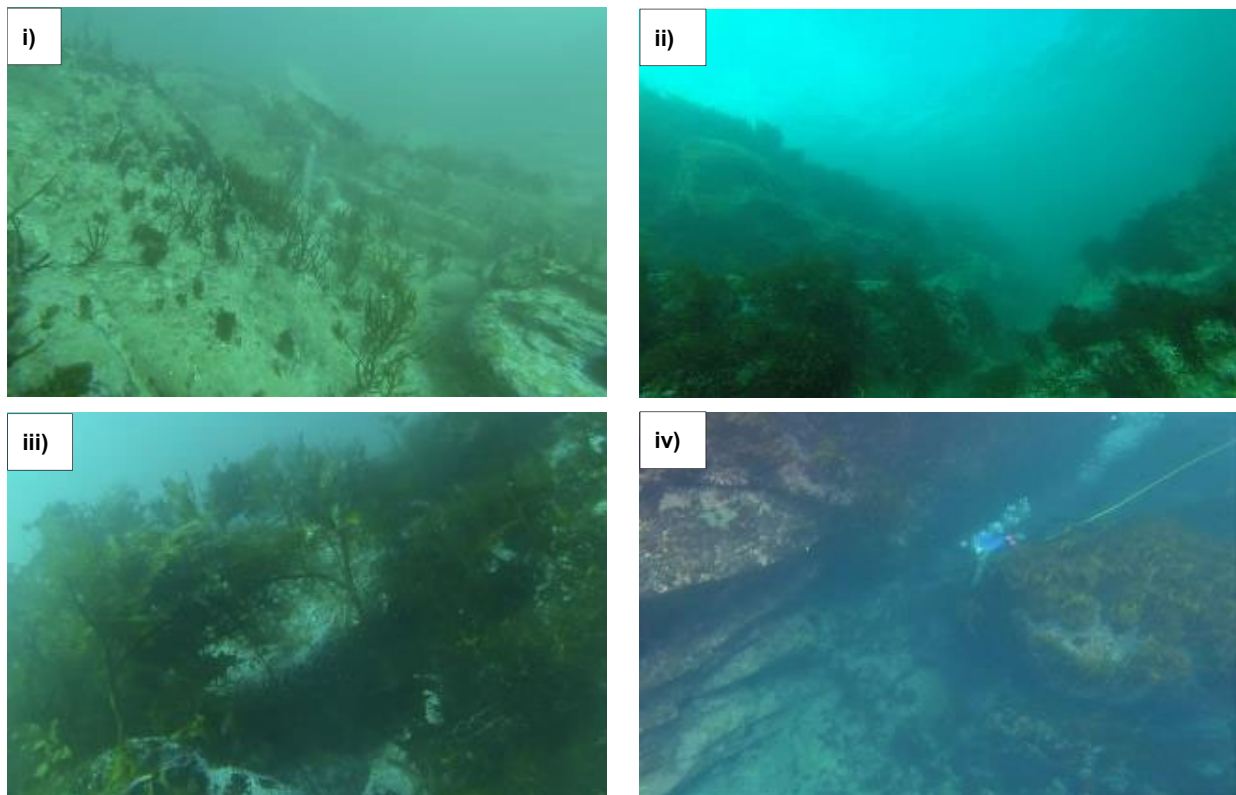


Figure 3-4 Example of weed growth six to twelve months after culling at (i - ii) Baronda (iii) Saltwater and (iv) Disaster Bay (Source: S Bunney/ J Smythe)



Figure 3-5 Example of macroalgal assemblage at a site (Blue Pools) two years after culling (Source: S Bunney)

### 3.1.2.3 Abalone and other species

Whilst not formally sampling abalone or other species, divers noted that more abalone were observed at cull sites once macroalgae colonised the sites (**Figure 3-6**). Divers also noted changes in assemblages of fish to be more like those in macroalgal-dominated areas.



Figure 3-6 Abalone seen at Baronda after culling (Source: J Smythe)



### 3.2 Extension of Abalone and SUTS Code of Practice

In total ,16 abalone/SUTS divers and deckhands completed the OceanWatch Responsible Diver Program, which included the following modules:

- > respect and social licence
- > indigenous and cultural fishing
- > best practice operations
- > sustainable best practice
- > environment and pollution
- > biology
- > threatened endangered and protected species
- > best practice handling
- > food safety and quality assurance
- > workplace health and safety
- > fisheries management, and
- > biosecurity and disease.

The training was aligned with a *Certificate II unit of competency* (i.e. participate in environmentally sustainable work practices). The divers who completed the program are now recognised through our OceanWatch Master Fisherman Program, and are profiled on the Master Fisherman website (<https://oceanwatchmasterfisherman.org.au/>), (e.g. <https://oceanwatchmasterfisherman.org.au/master-fishermen/stephen-bunney/>). Divers have been given a QR code that links to their profiles.

These are the two videos were developed through the program, that include a:

- > Industry video (<https://www.youtube.com/watch?v=QoUBI1MTfV4>), and
- > Community video (<https://www.oceanwatch.org.au/urchin-barrens/>).

### 3.3 The Ultimate Urchin Challenge

The Ultimate Urchin Challenge was well attended and a video of the event is in preparation. Some of the dishes prepared by the chefs are given in **Figure 3-7**.



Figure 3-7 Examples of chefs at work and dishes prepared for the Ultimate Urchin Challenge (Source: OceanWatch)

### 3.4 The Urchin Symposium

A report from the Symposium is given in **Appendix A**. It includes the day's agenda, a summary of presentations and conclusions.

An additional outcome of the symposium has been the continued collaboration between the attending groups through the formation of a steering committee. The committee continues to work together to seek opportunities to better manage sea urchin populations. The steering committee is made up of Academics (UNSW/SIMS/USYD), OceanWatch, Nature Coast Marine Group (community), NSW DPI officers, Traditional Owners, and representatives of the SUTS fishery and the NSW Abalone Association.

## 4 Discussion

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### 4.1 Assessment of project outcomes against objectives

Bushfires, as well as lockdowns for Covid-19 and safety concerns regarding social distancing, required some amendments from the proposed culling and monitoring schedule. Despite these challenges, divers managed to cull urchins at six sites, two more than planned, and in up to three separate events at some of the sites. The target number of 200,000 urchins was exceeded, and culling was sufficient to transform sites from barrens to a benthic habitat dominated by macroalgae, which is more favorable to abalone, and to improve the roe quality and recovery of the remaining urchins to a level that is likely to be commercially viable for harvest by urchin divers (**Table 4-1**).

An important outcome of this project has been for OceanWatch to work closely with the Abalone Association of NSW to further develop the voluntary Environmental Code of Practice for the NSW Abalone and SUTS fisheries. The CoP has been extended to include the Responsible Diver Training Program, which improves knowledge, awareness and professionalism in the sector and goes above and beyond requirements prescribed by state, national and international regulations. The sixteen divers that participated at workshops have been recognised for completing formal training by receiving certification, and they were provided with a package of marketing materials. A list of participating divers has been published online, so the community can identify and build trust with those that have completed formal training and are committed to environmental best practice. In promoting their product with the supply chain and end consumers divers can refer people to this online information. The broader community was informed about the training via local media releases, and via the OceanWatch newsletter and through video (see **Section 3.2**).

The 'Ultimate Urchin Challenge' and 'Restoration Through Harvest Symposium' were additional outcomes that weren't part of the original proposal and both have improved knowledge and interest in contemporary issues concerning NSW nearshore rocky reefs and their fishery products. The Ultimate Urchin Challenge was a step in changing the reputation of urchin products in the eyes of seafood consumers given that urchins are somewhat undiscovered by the wider public or have a reputation for being a difficult product to prepare and consume. With more than 50,000 followers on Facebook, and 11,000 on Instagram, Sydney Fish Market reaches a considerably large audience of seafood consumers. The event was, and will continue to be, promoted through social media posts, a video, and media releases and urchins will be promoted through brochures at retailers in Sydney Fish Market.

There was broad consensus from the Restoration Through Harvest Symposium that significant reductions of urchin barrens through harvesting of purple urchin will have broad quadruple bottom line benefits (i.e. economic, environmental, social, cultural) to the NSW south coast community, and could serve as a model system for managing these rocky reef systems. An integrated, co-management approach including the various groups represented in the symposium was recommended to oversee future urchin removals in dedicated sites, with rigorous monitoring of performance and benefits. This group continues to work together to identify sites, design a future program, and seek appropriate government permitting.

Despite having theoretical quadruple bottom line benefits (above) there are still many knowledge gaps regarding perceived benefits that could potentially be addressed with analysis, or top up, of existing data, including:

- > *Maintenance* - how often and how much effort is required to maintain macroalgal communities at cull sites?
- > *Costs versus benefits of culling* – what is the increase in production (\$) of abalone per hectare (and potentially other nearshore reef fisheries, e.g. rock lobster) at sites after culling, versus the effort to cull and maintain at site (\$) ? And what is the value of other perceived benefits (e.g. resilience of kelp to climate change etc)?
- > *Impacts to organisms that rely on barrens* – As indicated in **Section 1.1**, it is not clear how much barrens in NSW is natural versus created by fish down of predators or changes to climate. This has a bearing on how much culling in the future will actually be 'restoration' or 'eco-engineering' of benthic habitats, and hence how potential impacts should be assessed.

Table 4-1 Project outcomes

Objective	Achieved (Yes/No)	Comment
<b>Rehabilitation of 8 ha of urchin barrens through targeted culling</b>		
○ 8 ha (4 sites x 2 ha ea.)	Yes	The cull area of barrens at sites was variable but the total culled area was 10.4 ha. Six sites were culled.
○ Cull 200,000 urchins	Yes	270,000 urchins were culled.
○ Regeneration of macroalgae (75% coverage) and increases in abalone	Yes	Percent cover of macroalgae, after 9 months, was estimated to be up to 70% at some sites in Dec 2020 and near 100% at Blue Pools after two years. Anecdotal information from divers indicates greater occurrence of abalone at all sites.
○ Improved roe quality	Yes	Roe quality and recovery were improved at three of the six culling sites. Changes to roe were not formally monitored at the other sites but anecdotal information from divers indicates roe had improved.
<b>Training NSW commercial abalone and SUTS divers in an industry code of practice (CoP)</b>		
○ Divers are recognised for completing training	Yes	The training was aligned with a <i>Certificate II unit of competency</i> (i.e. participate in environmentally sustainable work practices).
○ Marketing materials are developed	Yes	Two videos and brochures were produced and fishermen are included in the Master Fisherman website.
○ Training of 28 divers	Partial	Sixteen divers were trained. The training modules are available for delivery to additional divers in the future.

## 4.2 Where to from here?

It is well known that the removal of purple urchins can transform benthic reef into macroalgal-dominated habitat to improve the roe in any urchins that remain (in terms of quality and recovery) and the consensus is that this would benefit SUTS and abalone fisheries. It is now also becoming recognised that this potentially increases the resilience of kelp and other macroalgal assemblages from the effects of climate change. In the last few decades, the continual formation of urchin barrens on Tasmania’s and Victoria’s east coasts poses the single largest threat to their rocky reefs and their and associated abalone and rock lobster fisheries. In NSW, given large extents of barrens have existed for at least 90 years, there is still debate (in this state) as to whether barrens are natural or not. Notwithstanding this, there is evidence of a net expansion of barrens in NSW in recent decades of around 20 m<sup>2</sup> hectare per year (Glasby and Gibson, 2020).

In south-eastern Australia, there has been a concerted effort by industry, researchers and funding agencies in recent decades to explore the various options for reducing abundances of urchins (and thereby reducing the expansion of barrens) to determine which would be the most efficient and effective. Options investigated have included:

- > Professional (dedicated) culling programs
- > Opportunistic culling (by abalone and SUTS divers)
- > Increasing catch and effort in the urchin fishery, and
- > Increasing the abundance of urchin predators (e.g. rock lobsters).

Although increasing the urchin fishery catch probably has the greatest potential to solve the problem, a slowly developing market has been a constraint. Events like the Ultimate Urchin Challenge may gradually improve the market but commercial culling is currently the best current option for modifying barrens even though its cost limits its scale (i.e. there is not only the cost of culling to transform a barren but also the cost of maintenance). Although barrens can quickly be transformed into a diverse assemblage of macroalgae, it

will gradually return to the barrens state (i.e. after a few years) without ongoing maintenance. Industry in other states has recognised this and the successful ongoing culling program in eastern Victoria whilst focusing its limited resources on culling small areas formerly known to be productive for abalone, also includes a plan for monitoring urchin abundance so that maintenance culling can be done when required.

There are four stages to a successful culling program:

1. Identifying sites for culling (that are likely to be productive for abalone and/or sea urchin)
2. Initial culling to transform barrens to macroalgae-dominated habitat
3. Monitor cull sites for increased urchin densities and incipient barrens
4. Maintenance of cull sites as required.

This OceanWatch project has been a mix of Stages 1 and 2 (i.e. at Blue Pools, Baronda, Moon Bay and Disaster Bay) and Stages 3 and 4 (i.e. maintenance at Saltwater and the Brothers, which had been culled previously as part of FRDC 2014/22), but the project did not include plans for Stages 3 and 4 at the newer cull sites. Although it is possible that sea urchin divers could regularly harvest in all of the culled areas in the future, and thereby negate the need for dedicated maintenance culling at any site, it is more likely that specific working parties (as per this project) will be needed at some point to prevent barrens reforming. Unless this work is done on an 'in-kind' basis, the costs are likely to be similar to the costs of the initial culls (i.e. Stage 2). The culling program in eastern Victoria estimates the cost of culling to be ~ \$10,000 per ha. By comparison the OceanWatch project model saw 10 ha culled over 26 months at a cost of around \$94,000 (i.e. \$31,000 cash provided to divers plus an in-kind contribution from industry of approximately \$63,000). This total of \$9,038 per ha for this program is comparable to the eastern Victorian program. On a per month basis, this equates to \$347 / ha for the 26 months (culling and simple monitoring included).

Although the OceanWatch project (this project) successfully met its objectives of culling at least 8 ha of barrens to restore previously productive abalone habitat and improved the roe in remaining urchins, the industry needs to find an arrangement whereby there can also be ongoing monitoring and maintenance of cull sites to ensure the long-term benefit of their work. Below are some suggestions that could potentially be incorporated into the broader culling program in NSW into the future:

- > *Adding additional cull sites* – in addition to the maintenance of the six sites discussed in this report, consider economies of scale in adding more cull sites, in suitable areas, to the broader program.
- > *Continue to select areas for culling (and cull rates) that have mutual benefit to abalone, urchin divers, other stakeholders and the environment* – mutual agreement could best be obtained through stakeholder workshops and that considers the quadruple bottom line of economic, environmental, social and cultural issues (see discussion of this in **Section 4.1**).
- > *Leveraging the effects of east coast lows (ECLs)* - it is understood that ECLs in 2021 removed urchins from many barrens thereby having a similar impact to culling in many areas. If the ECL had removed urchins in previously productive abalone areas then these areas could also be monitored and maintained and incorporated into the broader rehabilitation program. Industry should continue to look for similar opportunities after the occurrence of any ECLs in the future, thereby avoiding potential costly and wasted culling effort – i.e. if ECLs have a similar effect to culling in areas that may have been proposed for targeting.
- > *Including opportunistic culling in the divers CoP* – Maintenance culling could potentially be done by abalone and SUTS divers when they are harvesting in previously culled areas, noting that this would need appropriate permitting.
- > *Partnering industry with researchers and other stakeholders* – Opportunities need to be explored as to how best to undertake culling for the mutual benefit of all stakeholders. This could also be done as part of a wider multi-state program, facilitated by a Marine Natural Resource Management group.

### 4.3 Limitations of this Report

Given Stantec was commissioned at the end of the project to summarise the project's activities and findings we had no input into its methods or any other aspect of its governance. Stantec consulted with divers and other parties involved in the project to confirm all data provided to Stantec was complete and reported correctly. Given the project was foremost a 'rehabilitation' project, we have assumed that all of the culling sites had previously been barrens. It is worth noting that if the entire areas of sites had not always been barrens then this project would have involved a component of eco-engineering of natural habitat toward a 'preferred' macroalgal state in addition to rehabilitation. Historical aerial photos that could have confirmed that parts, or the entirety, of sites had existed as macroalgae several decades ago were not available to

Stantec. Hence, Stantec has taken the advice in good faith that the sites were 'rehabilitated' to a previously existing state.

## 5 References

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- Blount, C., Chick, R. C., and Worthington, D. G. (2017). Enhancement of an underexploited fishery - improving the yield and colour of roe in the sea urchin *Centrostephanus rodgersii* by reducing density or transplanting individuals. *Fish. Res.* 186, 586–597. doi: 10.1016/j.fishres.2016.08.022
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- FRDC Project no. 2009/070. *El-Nemo SE: risk assessment of impacts of climate change for key species in South Eastern Australia.*
- FRDC Project no. 2014/224. *Rebuilding abalone populations to limit impacts of the spread of urchins, abalone viral ganglioneuritis and theft.*
- Glasby and Gibson (2020). *Decadal dynamics of subtidal barrens habitat.* Marine Environmental Research, DOI: 10.1016/j.marenvres.2019.104869

# APPENDIX A



# Restoration Through Harvest Symposium: Linking urchin fisheries to kelp forest restoration

Thursday 17<sup>th</sup> June 2021  
Narooma Golf Club

## BACKGROUND

This Symposium brought together Indigenous Owners, fishers, conservationists, leading experts in coastal ecology and resource management and the general public to discuss approaches for management of endemic sea urchin populations and restoration of kelp forests in New South Wales.

Kelp forests are the biological engine of temperate shallow reef ecosystems in eastern Australia. They capture large amounts of carbon via photosynthesis and provide habitat and food for hundreds of species, including highly valued fishery species. One of the key biological interactions in kelp forests globally and in NSW is between herbivorous sea urchins and kelp. Urchin grazing can cause ecological phase shifts in which kelp forests are replaced by deforested reefs, commonly known as “barrens”, that can persist for decades, resulting in the loss of ecosystem services, high value species, and aesthetic and cultural value. However, barrens can also be productive systems, with for example in NSW urchin barrens hosting a diversity of fishes comparable to kelp dominated areas.

The endemic longspined sea urchin *Centrostephanus rodgersii* (Centro hereafter) creates extensive barrens habitat in some regions of the NSW coast. There is some disagreement as to whether such barrens in NSW are historically “natural” or a recent, human induced phenomenon linked to historical overfishing of urchin predators (see below). Notwithstanding this, in the lead up to this Symposium, it was clear that multiple groups of stakeholders from the NSW south coast perceive that a reduction of barrens and an increase in kelp forests were desirable from an environmental, economic and sociocultural perspective.

Multiple projects from NSW, Victoria and Tasmania show that removal of Centro, either through culling or harvesting, reduces barrens and leads to the re-establishment of algal-dominated habitat and associated biodiversity. Such urchin removal projects typically cost tens of thousands of dollars per hectare and are difficult to finance at large scales. However, the urchins can also be a valuable commodity, and there is a growing interest in synergistically combining commercial urchin harvest with the restoration of kelp ecosystems.

The removal of urchins and the return of these kelp forests potentially provides “quadruple bottom line” benefits to regional coastal communities – that is, synergistic economic, environmental, social and cultural benefits. Kelp supports high value fisheries such as abalone and rock lobster, along with rich ecosystems of fish, invertebrates, and other marine plants. Kelp forests that support nearshore abalone and lobster habitat have a strong cultural value for coastal communities and First Nations people and are a key part of healthy Australian marine environment. There is also growing commercial interest in kelp products for a variety of industries (food, cosmetics, health, fertiliser). Restoration of kelp forests also works to draw carbon

from the atmosphere and can help Australia work toward its international climate commitments. Barren habitats also provide a range of ecosystem services and therefore a transparent consideration of the costs, benefits and trade-offs need to be assessed in management interventions that may result in altering one habitat type to create another.

This Symposium brought together Indigenous Owners, fishers, conservationists and leading experts in coastal ecology and resource management from NSW, Victoria and Tasmania to discuss potential opportunities and actions to restore NSW kelp forests and associated abalone/ lobster fisheries through expanding the urchin industry on the NSW South Coast.

Such an approach aligns strongly with key policy priorities from the NSW Premier's Priorities to enhance the quality of life of the people of NSW.

Prior to the symposium, a steering committee was formed consisting of members from academia, commercial fishing, government, Traditional Owners and conservation organisations (See Appendix A). This committee collaborated in developing a program for the symposium that best facilitated discussion between the wider interest groups, and helped frame the symposium to address the following points:

- 1) What is the natural/healthy/desirable state of the system? Where is the evidence? What are the implications for urchin management?
- 2) How is urchin management currently done; who, what, where, why?
- 3) What is the nature, scale, and suite of management actions to achieve broad community, economic and environmental benefits through urchin removal?
- 4) How can we collaborate?
- 5) Implications for government

## **SUMMARY of the DAY**

### **Participation**

The Restoration Through Harvest Symposium was attended by 65 people (See Appendix D for photographs from the day).

Attendees included representatives from:

- Yuin Nation Traditional Owners
- Commercial and recreational fishers, including representatives from the Abalone Association of NSW, urchin fishers and businesses (e.g., Sea Urchin Harvest PTY LTD) and seaweed-focused businesses (e.g. Sea Health and South Coast Seaweeds)
- Conservation groups and not-for-profits (e.g., the Nature Coast Marine Group, OceanWatch Australia)
- Scientists, including from academic institutions, government, students and industry
- Government (e.g., NSW DPI Fisheries)

- Community stakeholders (e.g., ecotourism operators, local entrepreneurs in the marine space)
- Interested members of the general community

There were 11 individual presentations by 17 speakers, of whom two travelled interstate to speak at the Symposium. We facilitated an additional three virtual presentations from three states.

Presentations in the morning covered the following (See Appendix B including the program, Appendix C for a description of the talks and Appendix E for graphic summaries):

1. Kelp forest and urchin ecology and dynamics, including predicted impacts of climate change on these systems
2. Urchin barren data and trends
3. Traditional Owner perspectives on the issue and on NSW coastal management broadly
4. Conservation community perspectives on the issue
5. Case studies demonstrating the importance of the issue to commercial fishing
6. Case studies demonstrating the management of the issue in interstate contexts

The afternoon sessions consisted of breakout group discussions, grouped by area of interest, followed by a general discussion and conclusion sessions.

The distribution of symposium participants was:

<b>Attendee distribution (by breakout groups)</b>		<b>By speaker</b>
General & conservation community	20	1
Science and academia	15	5
Government	10	2
Abalone fishing	10	3
Urchin fishing	10	2
Traditional Owners	5	2

### **Media**

ABC journalist Keira Proust (ABC South East NSW) attended the Symposium and conducted interviews with Symposium organiser Associate Professor Adriana Vergés (UNSW Sydney, SIMS), Professor Peter Steinberg (UNSW Sydney, SIMS), Professor Maria Byrne (University of Sydney), Wally Stewart (Yuin Traditional Owner) and Bill Barker (Nature Coast Marine Group). This resulted in a news article being published. A/Prof Vergés also gave a radio interview with ABC South East Radio. Local Eurobodalla news site the Beagle Weekly published a story after a media release by the Nature Coast Marine Group. (NCMG). Bill Barker (NCMG) gave two radio interviews, with 2ST Nowra and PowerFM.

Articles:

<https://www.abc.net.au/news/2021-06-18/south-coast-sea-urchin-barren-concerns/100225040>

<https://www.beagleweekly.com.au/post/help-the-kelp-experts-meet-to-find-solutions-to-local-reef-health>

## **CONCLUSIONS and RECOMMENDATIONS**

Overall: There was broad consensus from the Symposium that significant reductions of urchin barrens through harvesting of Centro would have broad quadruple bottom line benefits – economic, environmental, social, cultural – to the NSW South coast community, and could serve as a model system for managing these rocky reef systems.

An integrated, co-management approach including the various groups represented in the symposium was recommended to oversee implementation of urchin removals in dedicated sites, with rigorous monitoring of performance and benefits. More detailed work is now needed to identify sites, design a program, and seek appropriate government permitting.

### More detailed comments:

- Stakeholder groups generally viewed the current state of the system as suboptimal to poor, relative to values they attributed to these habitats. The one exception to this consensus was the group of scientists, some of whom considered the state as “healthy”.
- All groups agreed that collectively we are at a mature stage in the consideration of these systems such that we can combine urchin fisheries (extraction) with conservation goals, which would in turn help meet other goals that follow from the reduction of barrens and regrowth of kelp.
- Key criteria for using harvesting/culling of urchins as a management method to facilitate kelp regrowth, with its associated benefits are:
  - Learn from existing programs (NSW, Tas, Vic) where appropriate.
  - Consider using natural control methods (predators) as well as harvesting.
  - There’s potential to combine urchin removals with kelp regeneration and restoration approaches, with associated benefits to seaweed-focused businesses that depend on kelp wrack
  - There needs to be a careful selection of sites (kelp/fringe/incipient barrens/barrens), which may depend on the overall objective and take into consideration ecological and/ or commercial outcomes as priorities, including to the abalone/ urchin and kelp fisheries

- Use marine parks to provide reference no-take sanctuary zones to re-establish predator species and monitor success of experiments in adjoining zones.
- Integration, cooperation and co-creation will be crucial for success, including:
  - Integration of Sea Country Planning and government plans with full recognition of cultural values, knowledge and rights (noting the pending Native Title Claim).
  - Integrating traditional cultural knowledge with research and management for co-management. A structure will be needed to coordinate interactions.
- There is a need to work together with government to develop management objectives, effective approaches to achieve these objectives, in line with the current permitting and regulatory framework for sites chosen for implementation.
- There is a need to be transparent about the costs/benefits and trade-offs associated with changes from one habitat type to another.
- There is a need for better understanding of current urchin fishing access for the different species (red urchins etc.)
- Funding: Need to develop a sustainable funding model that returns benefits to the NSW community, especially Traditional Owners, and others (not just industry). Issues include:
  - An urchin fishing subsidy in NSW? Do we need to have a discussion between states?
  - Is it appropriate to reduce red tape and licensing costs for urchin fisheries?
  - Need for funding for product development and R&D, e.g. CRCp (matching cash from industry)?
  - Should we create a CONSORTIUM that becomes eligible for funding?
  - Would there be value in uniting forces with VIC and TAS for some funding applications (e.g. for development of sub-optimal roe products? Or for a united communications/ PR strategy to increase uptake of urchin products nationally)
  - Should we develop a valuation approach to measure the non-commercial benefits of kelp restoration?

## **ACKNOWLEDGEMENTS**

*We acknowledge the Walbunja people of the Yuin nation, Traditional Custodians of the land on which this meeting took place, and pay our respects to their Elders past and present.*

*This project is supported by the NSW Office of the Chief Scientist & Engineer and OceanWatch Australia, through funding from the Australian Government's National Landcare Program.*

## Appendix A

### Steering committee members

<i>Associate Professor Adriana Vergés</i>	<i>UNSW Sydney; Sydney Institute of Marine Science</i>
<i>Professor Peter Steinberg</i>	<i>UNSW Sydney; Sydney Institute of Marine Science</i>
<i>Aaron Eger</i>	<i>UNSW Sydney</i>
<i>Clayton Mead</i>	<i>UNSW Sydney</i>
<i>Robert Chewying</i>	<i>NSW Aboriginal Fishing Rights Group; Yuin Nation Traditional Owner</i>
<i>Wally Stewart</i>	<i>NSW Aboriginal Fishing Rights Group; Yuin Nation Traditional Owner</i>
<i>Dr Natalie Moltschaniwskyj</i>	<i>NSW Department of Primary Industries</i>
<i>Simon Rowe</i>	<i>OceanWatch Australia</i>
<i>Siobhan Threlfall</i>	<i>OceanWatch Australia</i>
<i>Bill Barker</i>	<i>Nature Coast Marine Group</i>
<i>Professor Maria Byrne</i>	<i>University of Sydney</i>
<i>Dr Nathan Knott</i>	<i>NSW Department of Primary Industries</i>
<i>Chris Theodore</i>	<i>Sea Urchin Harvest PTY LTD</i>
<i>Rachael Theodore</i>	<i>Sea Urchin Harvest PTY LTD</i>
<i>Greg Finn</i>	<i>NSW Abalone Association</i>
<i>Stephen Bunney</i>	<i>NSW Abalone Association</i>

Appendix B

Symposium program

# Restoration Through Harvest Symposium: Linking urchin fisheries to kelp forest restoration

Thursday 17<sup>th</sup> June 2021  
Narooma Golf Club

The aim of this symposium is to bring together scientists, traditional owners, fishers, government managers, and other stakeholders to discuss opportunities for the development of market-based approaches to control sea urchin populations and restore productive kelp forests.

This project is supported by the NSW Office of the Chief Scientist & Engineer and OceanWatch Australia, through funding from the Australian Government's National Landcare Program.

We acknowledge the Walbunja people of the Yuin nation, Traditional Custodians of the land on which this meeting takes place, and pay our respects to their Elders past and present. We extend that respect to Aboriginal and Torres Strait Islander Peoples here today.



Office of the  
Chief Scientist  
& Engineer



National  
Landcare  
Program



Department of  
Primary Industries



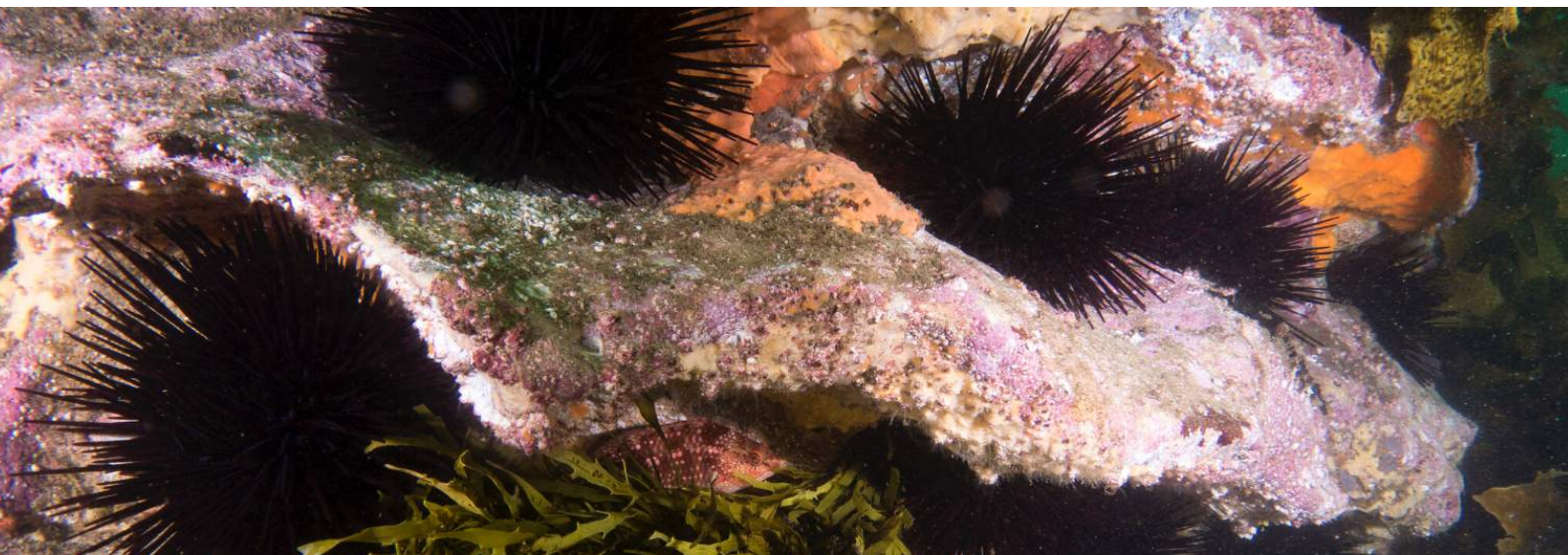
UNSW  
SYDNEY



underseaROV



THE UNIVERSITY OF  
SYDNEY





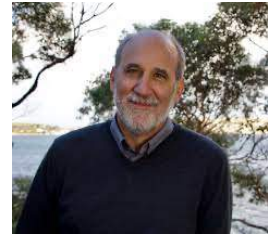
<b>Topic presentations</b>		
8:30	Welcome to Country	Wally Stewart
8:45	Symposium welcome	A/Prof Adriana Vergés (UNSW Sydney, Sydney Institute of Marine Science)
8:55	Scene-setting	Prof. Peter Steinberg (UNSW Sydney, Sydney Institute of Marine Science)
9:15	Importance of kelp forests and the role of urchin barrens in a healthy temperate reef	Dr. Craig Blount (Cardno) & Dr. Ziggy Marzinelli (University of Sydney, Sydney Institute of Marine Science)
9:35	50 years of habitat mapping and <i>Centrostephanus</i> research in southern NSW	Dr. Natalie Moltschanivskyj (NSW Department of Primary Industries)
9:55	Climate change: predicted impacts on resilience of kelp forests, urchins and abalone	Prof. Maria Byrne (University of Sydney) & Dr. Melinda Coleman (NSW Department of Primary Industries)
10:15	A South Coast conservation community perspective on kelp forests and urchin barrens	Bill Barker (Nature Coast Marine Group Inc)
10:35	Indigenous perspectives on past and present marine ecosystems & implications of Native Title	Robert Chewying & Wally Stewart
10:55	Wrap-up	Prof. Peter Steinberg
<b>11:00 – 11:25 Morning Tea (provided)</b>		
<b>Case study presentations</b>		
11:25	Introduction	Prof. Peter Steinberg
11:30	Historical overview of the NSW commercial urchin fishing industry	Greg Finn & John Smythe (NSW Abalone Association)
11:50	Challenges to Critical Habitat from Long-spine Purple Sea Urchins in the NSW commercial Abalone Fishery	Stephen Bunney (NSW Abalone Association)
12:10	Eastern zone Victoria <i>Centrostephanus</i> removals	John Minehan (Victoria Abalone Association)
12:30	Commercial perspectives on <i>Centrostephanus</i> harvesting in southern NSW and the value of a commercial sea urchin fishery	Chris & Rachael Theodore (Sea Urchin Harvest PTY LTD)
12:50	Early-warning signs, catastrophic overgrazing, and the incurable curse of too little, too late.	Dr. Scott Ling (University of Tasmania)
13:10	Diver control methods in Tasmania: an overview	Dr. John Keane (University of Tasmania)
13:30	Wrap-up	Prof. Peter Steinberg
<b>13:35 – 14:15 Lunch (provided)</b>		
14:15 – 14:45		Breakout discussions within stakeholder groups
14:45 – 15:45		Stakeholder groups summaries (10 min each)
<b>15:45 – 16:00 Afternoon Tea (provided)</b>		
16:00 – 17:00		Whole group discussion to answer key questions
17:00 – 17:30		Conclusions, recommendations and acknowledgements

## Speakers

### **Professor Peter Steinberg**

#### **UNSW Sydney, Sydney Institute of Marine Science**

Peter has 35+ years of experience in coastal ecology, kelp biology and ecology, the restoration and rehabilitation of coastal habitats, and the impacts of climate change. From 2009 -2020 he was the Director and CEO of the Sydney Institute of Marine Science (SIMS). He has been a Fulbright Scholar, a Queen Elizabeth II Fellow and CEO of a ASX listed biotechnology company. In 2017 he was awarded the Australian Marine Science Association's Silver Jubilee Award for outstanding contributions to marine science.



### **Associate Professor Adriana Vergés**

#### **UNSW Sydney, Sydney Institute of Marine Science**

Adriana is a marine ecologist based at UNSW Sydney, Australia. Her research investigates the ecological impacts of climate change in our oceans and develops hands-on restoration solutions to protect and conserve underwater forests and meadows. Adriana is one of the lead investigators behind Operation Crayweed, a project that is restoring missing seaweed forests along the Sydney coastline. This project was awarded a Green Globe Award for Impact by the New South Wales Government in 2017. More recently, Adriana launched Operation Posidonia, a collaborative project that is developing new citizen science initiatives to restore endangered seagrass meadows. Adriana is very passionate about communicating science to the wider public, especially through films and art. In 2019, she was awarded the UNSW Emerging Thought Leader Prize. Adriana obtained a PhD in Ecology in 2007 from the University of Barcelona.



### **Stephen Bunney**

#### **NSW Abalone Association**

Stephen is a commercial abalone diver with over 20 years of experience. He works with the New South Wales Abalone Association and is an active advocate for mitigation and rehabilitation of marine environments



### **Dr. Melinda Coleman**

#### **Principal Research Scientist and Adjunct Professor NSW Department of Primary Industries**

Melinda is a Principal Research Scientist with the Regional NSW Department of Primary Industries, working on managing and protecting kelp forests. Along with her research team, she was awarded a Green Globe Award for successfully restoring lost underwater forests in Sydney. Her research allows for 'future proof' management of threatened ecosystems despite future challenges brought on by climate change and anthropogenic factors. She is a global leader in kelp forest conservation and has contributed to several major international conferences as a keynote speaker, as well as having editorial positions with leading journals.



**Bill Barker****Nature Coast Marine Group Inc (NGMG)**

Bill has been active for the past 15 years in marine advocacy, education, public information and research on the NSW south coast. He was President of the NCMG from 2017 to 2019 and was a member of the Batemans Marine Park Advisory Committee from 2010 to 2019. As a SCUBA diver and snorkeller he has carried out hundreds of marine life surveys in the Batemans Marine Park area, mainly for the Reef Life Survey program.

**Chris & Rachael Theodore****Sea Urchin Harvest PTY LTD**

Chris and Rachael started Sea Urchin Harvest PTY LTD over a decade ago. They have a shared passion for the ocean, both being surfers and Chris having a background in commercial diving for abalone and urchins. They hail from the NSW South Coast where they are now raising their children. Chris has served witness to changes in the local marine environment due to increasing *Centrostephanus* populations over his 25-year abalone diving career. This was the driving force to start Sea Urchin Harvest Pty Ltd and bring back some balance to local reefs via a commercially viable sea urchin fishery. The Theodore's have built a business and a local market for sea urchin which they are proud to say is bringing back some balance to the reefs they know and love. They see export of NSW urchin as the next important step in this process.

**John Minehan****Victoria Abalone Association**

John has been a committee member of the Victorian Eastern Zone Abalone Industry Association and is heavily involved in research regarding the loss of abalone habitat due to sea urchin population growth. He joined a team of divers in the Marine Reef Restoration Project, collecting and harvesting sea urchins to control the population and rebuild abalone communities. He was awarded the Seafood Industry Victoria's Safety Award in 2017 for his work in establishing a safety plan for abalone diving.

**Gregory Finn****NSW Abalone Association**

Greg is an active member of the Abalone Association of NSW and the Commercial Fishing NSW Advisory Council and has spent many years involved in abalone fisheries. He began his career as a pearl diver and has since moved on to advocating for the abalone industry and working with shareholders to ensure the long-term sustainability of the species, particularly in response to domestic demand for sea urchin and abalone.

**Dr. Scott Ling****University of Tasmania**

Scott is a Senior Lecturer in marine ecology at the Institute for Marine and Antarctic Studies. His research focuses on how and why productive reef ecosystems collapse into impoverished low-value systems that can be difficult to reverse. He is interested in defining critical tipping-points and early-warning signs for reefs exposed to increasing, but ostensibly manageable, human stressors including overfishing, invasive species and urbanisation in combination with climate change. His research approach is founded on a strong understanding of natural history gained from extensive SCUBA-based surveys and critical field experiments to reveal key mechanisms driving reef ecosystems.



**Dr. John Keane**  
**University of Tasmania**

John is a Research Fellow at the Institute for Marine and Antarctic Studies, University of Tasmania. His key research fields are in wild fisheries, particularly small pelagic fish and commercial dive fisheries. John completed his undergraduate studies at the Australian Maritime College, winning the Captain Thomas Swanson and Raptis prizes for best performance in the Bachelor of Applied Science (Fisheries) degree program. After receiving first class honours, he moved to Hobart where he completed his PhD at the University of Tasmania on larval fish assemblages and their links with the East Australian Current. Since graduating he has been working at the University of Tasmania on numerous ARC and FRDC environmental and fisheries research projects.



**Professor Maria Byrne**  
**University of Sydney, Sydney Institute of Marine Science**

Maria is a Professor of Marine and Developmental Biology at the University of Sydney. For 12 years she was the director of One Tree Island Research Station on the Great Barrier Reef. This reef system has provided a platform for Maria's research on the biology and ecology of marine invertebrates that has largely involved echinoderms as model organisms. Her work on comparative evolutionary developmental biology and marine climate change has been funded by the Australian Research Council and other agencies for over 20 years. In recent years Prof Byrne's work has involved the quantification of the impacts of climate change stressors, ocean warming and ocean acidification on fundamental biological processes including growth, physiology, development and calcification.



**Robert Chewyng**

Robert is a Walbunja man from the Yuin nation and a member of the New South Wales Aboriginal Fishing Rights Group. He is a passionate member of the NSW Aboriginal Fishing Rights group and a community representative on the advisory board of the Jervis Bay Marine Park. Robert is also sits on the advisory board of the Aboriginal Fishing Advisory Council Expenditure Committee which provides advice to the Department of Primary Industries (DPI) NSW



**Dr. Ezequiel "Ziggy" Marzinelli**  
**University of Sydney, Sydney Institute of Marine Science**

Ziggy is a Senior Lecturer at The University of Sydney. Ziggy has over 15 years of experience in marine ecological research in Australia. Ziggy's research focuses on understanding the processes that generate, maintain and impact marine ecosystems, particularly kelp forests. He uses this information to develop solutions to environmental problems, for example via habitat restoration. Ziggy has published over 65 peer-reviewed scientific papers and book chapters.



**Wally Stewart**

Wally is a Walbunja man from the Yuin nation on the far south coast of NSW. Wally is also an applicant for the south coast native title claim and a member of NSW Aboriginal Fishing Rights Group. At present, Wally is employed part time by Katungul Aboriginal Medical Service as a Koori Connection Officer. In this position, Wally's role is to provide assistance to community members, case management, and linking community to services and providing community with support. A big part of Wally's role at Katungul AMS is also to design programs that create a healthy lifestyle for his community. You will see some of these programs in his presentation. Katungul AMS also has an agreement with Batemans Marine Park that allows Wally to mentor and provide support when Batemans Marine Park are providing training and delivering programs to community. One of Wally's position that he has held in the past was

his employment with NPWS as a Senior Field Supervisor in Byron bay on the north coast of NSW. In this position, Wally's role was to maintain parks and gardens, and provide a maintenance program for Cape Byron Marine park and Byron Bay Light house and manage staff. Wally was also a Member of the north coast whale disentanglement team and Incident Controller for Marine Mammal Standings. Wally has also held position as Aboriginal Liaison Officer for NSW Marine Parks and Batemans Marine Park. Wally volunteers his time working closely with AIASTIS, Wollongong Uni (Blue Economy) and Oxfam to build a foundation for economic development for his community. Wally's passion is Aboriginal fishing rights and is working towards building a sustainable healthy Yuin land and Sea Country. Wally believes if you have healthy land and Sea, you will have healthy Yuin people.



**Dr. Craig Blount  
Cardno**

Craig is a Senior Principal at Cardno and has 30 years of experience in environmental consulting and fisheries science. Craig has published in the fields of fisheries biology, marine ecology and fisheries enhancement. In recent years, he has been managing large-scale, multidisciplinary marine monitoring programs for assessing the potential effects of developments. Earlier in his career he spent many years studying abalone and sea urchin fisheries, their ecology and interactions in south-eastern Australia.



**Dr. Natalie Moltschaniwskyj  
NSW Department of Primary Industries**

Prof. Natalie Moltschaniwskyj has more than 25 years research experience in the field of marine ecology, with research expertise that includes community and population dynamics of invertebrate and vertebrate species. Her research in the area of marine science focuses on reproductive biology and ecology of molluscs (e.g. squid, mussels, oysters and abalone), working closely with both wild fishers and aquaculture. Currently Natalie is Director of Fisheries Research with NSW DPI.



## Appendix C

### Summary of Talks

Symposium welcome      A/Prof Adriana Vergés

Scene-setting      *Prof. Peter Steinberg*

Joining international expertise with intense local knowledge on the environment

- 1) What is the natural/healthy/desirable state of the system? Where is the evidence? What are the implications for urchin management
- 2) How is urchin management currently, who, what, where, why
- 3) What is the nature, scale, and suite of management actions to achieve these steps
- 4) How can we collaborate
- 5) Implications for government

1) Importance of kelp forests and the role of urchin barrens in a healthy temperate reef

*Dr. Craig Blount & Dr. Ziggy Marzinelli*

Eastern Australia has a reef system dominated by kelp forests comprised of *Ecklonia radiata*. These kelp forest ecosystems support many different species of marine life, including commercially important lobsters, abalone, and sea urchins. Urchin barrens are also a natural component of these ecosystem and are defined as areas with low kelp cover and high urchin abundance. Surveys have shown that kelp forests and sea urchins can support similar numbers of species but that kelp forests are essential for high value commercial species.

2) 50 years of habitat mapping and *Centrostephanus* research in southern NSW

*Dr. Natalie Moltschaniwskyj*

After collating 50 years of available habitat data (but not consulting with local Indigenous owners) there is evidence that sea urchin barrens occupy ~50% of the East Australian coast and that regionally this distribution has remained stable over 50 years. Because survey data was confined to the last 50 years and there may be historic changes which were not captured in this analysis. It is worth noting that there have been changes in the distribution of urchin barrens but these have confined to local scales.

3) Climate change: predicted impacts on resilience of kelp forests, urchins and abalone

*Prof. Maria Byrne & Dr. Melinda Coleman*

Climate change will continue to have multiple interactive effects on these marine ecosystems. As waters get warmer, we may see greater prevalence of disease, notably in abalone, different trophic interactions such as increased numbers of herbivorous fish, and more acidic waters which will negatively impact sea urchin and other CaCO<sub>3</sub> based species. Modelling suggests that these stressors will likely impact the South Coast by increasing kelp cover, decreasing urchin density, and harming abalone populations (until 2100).

4) A South Coast conservation community perspective on kelp forests and urchin barrens

*Bill Barker*

The South Coast has an active community that wants proper stewardship of its coastal environment. While marine systems are often out of sight, out of mind, they are extremely important for the South Coast community. This disconnect is perhaps because people are not informed about the threats facing south coast kelp forests. Further communication campaigns can help connect people to the ocean and direct that local stewardship to responsible ocean management.

5) Indigenous perspectives on past and present marine ecosystems & implications of Native Title

*Robert Chewing and Wally Stewart*

The Yuin people have lived on and care for their land since time immemorial. Historically, they have derived ~80% of their food from the sea and that connection has been broken by colonisation. Since colonisation, the Yuin people have not had authority to manage and care for their land and sea. This situation will change with the recognition of native title in 2022 and they would like to develop, in partnership, a sea-country plan that details the sustainable management of their territory.

### **Case study presentations**

Introduction Prof. Peter Steinberg

6) Early-warning signs, catastrophic overgrazing, and the incurable curse of too little, too late.

*Dr. Scott Ling*

Sea urchin barrens, mostly caused by the range expansion of *Centrostephanus* have increased from 9% to 47% in Eastern Tasmania in the last 50 years. A review of urchin control methods has shown that biological control with predators, volunteer urchin culls, and commercial sea urchin harvest, have not transformed barrens back to kelp forests. As a result, interest is now focused on dedicated culling efforts in the 0 – 18 meter range. These efforts work best when completed by trained, commercial sea urchin divers.

7) Diver control methods in Tasmania: an overview

*Dr. John Keane*

A sea urchin fishery has the potential to be a valuable industry for the state. The fishery can be managed for sustainable harvest, or can be designed to reduce the population to *Centrostephanus* to low numbers. Because not all urchins are desirable for fisheries, an incentive in the form of a per kilo subsidy was implemented for divers to remove all sea urchins from the sea floor from certain areas. Critically, this program also allowed for a commercial harvest. While in a trial phase, this approach has resulted in the shift of urchin barrens to kelp forests in some regions.

8) Historical overview of the NSW commercial urchin fishing industry

*John Smythe & Greg Finn*

There has been a commercial urchin fishing industry in NSW since the 1970s, often in partnership with abalone fishers/licenses. During this time, there has been a noted connection between sea urchin density, abalone stocks, and sea urchin roe quality. This link led to initial research which showed that by removing sea urchins, kelp forests were restored and the quality of sea urchin roe was improved. Expanding the industry further requires the expansion of the sea urchin market, potentially internationally.

9) Challenges to Critical Habitat from Long-spine Purple Sea Urchins in the NSW commercial Abalone Fishery

*Stephen Bunney*

The abalone fishery is supported by kelp forests and once spanned the whole NSW coastline, supporting a harvest of over 1,000 tons a year. The industry has since retracted to the South Coast as populations have declined. The industry believes the abalone decline is partly tied to increases in urchin populations which degrade abalone habitat. As a result, abalone divers are interested in “gardening” abalone reefs to remove sea urchins and allow kelp to regrow, while also respecting that it is an endemic species and part of a growing commercial fishery.

10) Eastern zone Victoria *Centrostephanus* removals

*John Minehan*

*Centrostephanus* populations are highest in Eastern Victoria where they have formed large urchin barrens and are associated with declined abalone catches. Using funds from the Eastern Victoria Abalone Association, the group worked to consistently cull sea urchins in the region. This effort has reduced the number of sea urchins and successfully restored tens of hectares of kelp habitat in Eastern Australia over the last 20 years. Subsequently, fishers are seeing increases in abalone numbers. A key element of their success was developing and following strict guidelines for urchin culling.

11) Commercial perspectives on *Centrostephanus* harvesting in southern NSW and the value of a commercial sea urchin fishery

*Chris & Rachael Theodore*

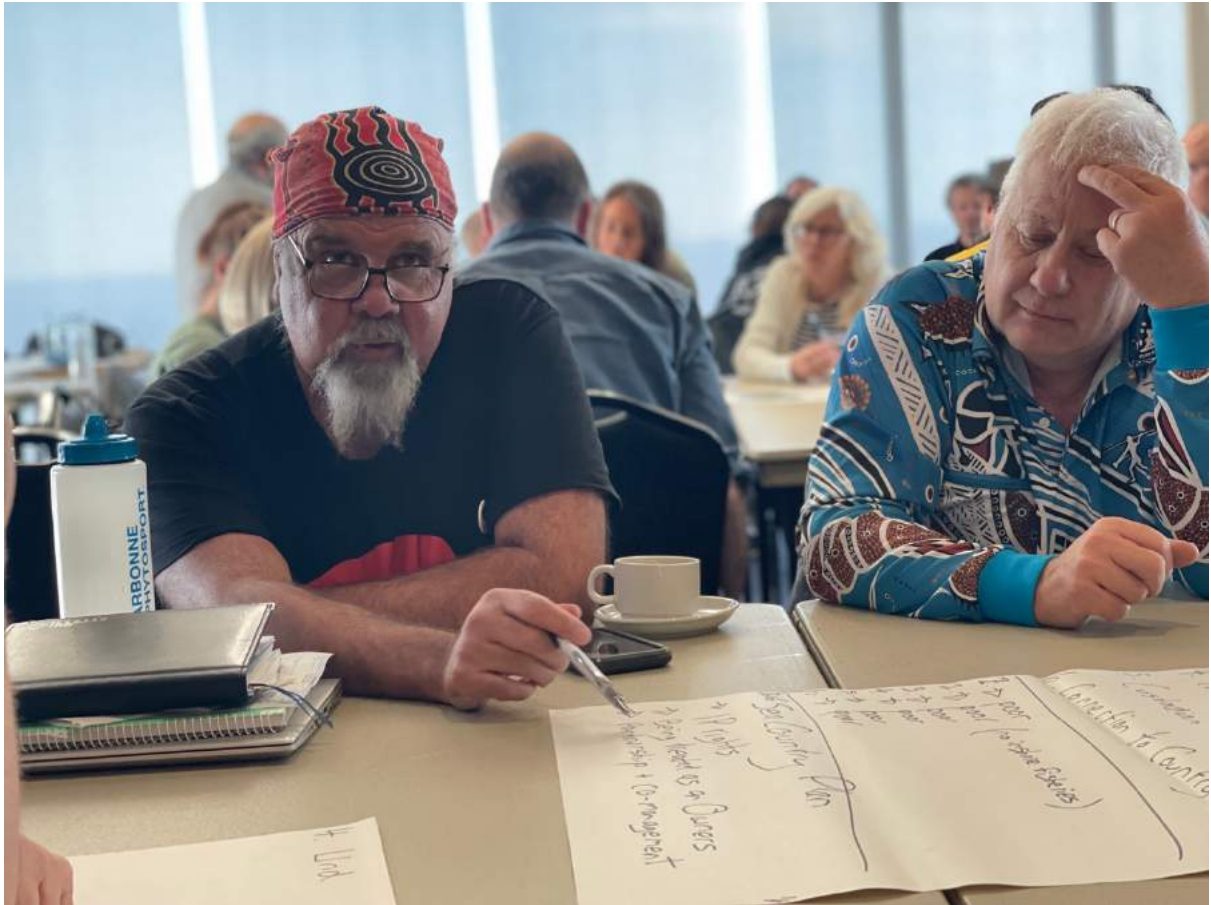
Sea urchins are a delicacy seafood item eaten around the globe. A sea urchin fishery can help create economic opportunities for rural areas while also training and upskilling local people. It is however, a significant investment that carries financial risks. As a result, we need to create an environment that encourages and rewards small businesses for taking that risk. Currently, the industry is interested in expanding the number of harvestable zones that it can work in, increasing its catch, and expanding to an export market.



Appendix D

Symposium photos









WE MUST RECOGNISE EARLY WARNING SIGNS

URCHIN BARRENS

4.5 TIMES INCREASE



50% OF TAS REEFS COULD BECOME URCHIN BARRENS (2005)

BARRENS ARE MOVING SHALLOWER

WHAT IS THE BASELINE?

WHAT DOES IT TAKE TO GET KEY HABITATS BACK?

RESTORATION THROUGH HARVEST SYMPOSIUM

EAT MORE URCHIN! LOCAL FOOD SOURCE PROVIDES JOBS



IF URCHIN FISHERIES CAN MAKE PROFIT, CONTROL OF POPULATIONS IS FEASIBLE



RESTORE MACRO ALGAE & UNDERFLORA

SUSTAINABLY

HARVEST FOR KINA & HIGH END ROE PROCESS

JAPAN EXPORT



TO INCREASE ABUNDANCE OF FAUNA



WE NEED TO RESTORE THE KELP CANOPY

THE ARE DIFFERENT BARREN TYPES

ECOSYSTEM COLLAPSE!

HARD TO COME BACK FROM

CULL URCHINS "TAKE-ALL HARVEST"

WHEN BARRENS

COALESCE

CAN RECOVER

INTEGRATIVE APPROACH

PLAGUE → POSSIBLE? → PROFIT

TIPPING POINT

2.2+ URCHINS PER M<sup>2</sup>

DYNAMIC SYSTEMS

RESTORE PREDATORS & HABITATS

SHELTER

MUTTON FISH

INCREASING CHALLENGES TO

ABALONE FISHERIES



CRITICAL

TOO LITTLE TOO LATE!



DON'T WAIT FOR COLLAPSE!

HARVEST URCHINS FOR ROE

ALL CONTROL METHODS ARE COSTLY & INTENSIVE

AN OUNCE OF PREVENTION IS WORTH A TON OF CURE

FOR ALL STAKEHOLDERS!

OXYGEN

NUTRIENTS & FOOD

CULL COLLABS & SHARED PERMITS

WE NEED TECH & R.O.Vs

INNOVATION

FISHERIES FUND URCHIN REMOVALS

TAKES PRESSURE OFF R&D BUDGETS



WHAT IS OUR COLLECTIVE VISION?

COLLABORATION

HOW CAN WE COMBINE OUR DATA SETS?

RESTORATION THROUGH HARVEST  
SYMPOSIUM

WHAT DO WE WANT TO GET BACK TO?

WHAT ARE THE KNOWLEDGE GAPS?

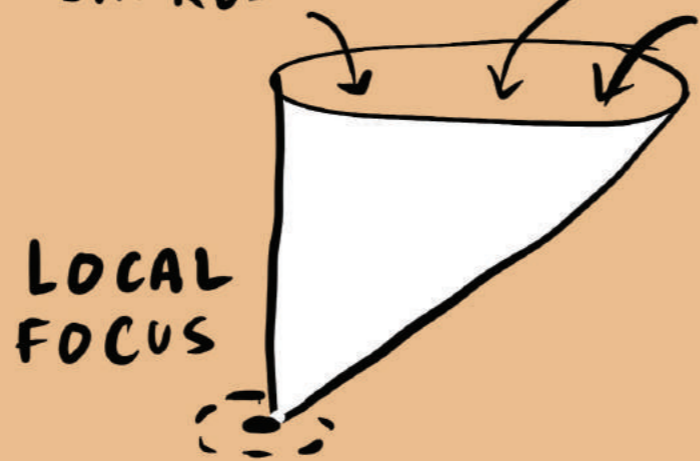
GLOBAL ISSUES



WHAT IS WORKING?

WHAT DO YOU VALUE ABOUT THESE HABITATS?

SHARED DATA SCIENTIFIC STORYTELLING  
KEY LEARNINGS



WHAT ARE THE

BARRIERS

URCHIN & KELP  
HABITATS  
SUBTIDAL ROCKY  
REEFS

WHAT DO YOU  
VALUE ABOUT  
THESE HABITATS

HOW DO YOU  
RATE THE HEALTH  
OF THESE  
SYSTEMS?

CARBON SEQUESTRATION  
TOURISM & PASSIVE RECREATION  
OUR LIVELIHOODS

CUSTODIANS & STEWARDSHIP

ECONOMIC ABUNDANCE

INTRINSIC BIODIVERSITY

ENDEMIC SPECIES

EMPLOYMENT OPPORTUNITIES

CONNECTION TO COUNTRY

OUR JOBS

PROVISION OF FOOD SOURCES

CULTURAL & SPIRITUAL

CENTURIES OF SYMBIOSIS WITH T.O.

BLUE ECONOMY

BENEFITS FOR HUMAN HEALTH

[KNOWLEDGE]

BEQUEST VALUES

wellbeing

DIVING, SURFING

Legacy

AESTHETICS

TROPICALISATION

POOR!

OUT OF BALANCE

ONLY SMALL AREAS OF OPPORTUNITY & HOPE

NOT OPTIMAL

VULNERABLE TO FUTURE CHANGE

DEPLETED

IN DECLINE

SUBOPTIMAL

DISCONNECTED

NEED MAINTENANCE MOSAIC

UNSTABLE

IN NEED OF RESTORATION

RAPID LOSS

BELOW 5/10!!

NEEDS FIXING

LONGER TERM THINKING

RESTORATION THROUGH HARVEST symposium

RECOGNITION

INTEGRATION

CO-CREATION

CO-INVEST?

INNOVATIVE APPROACHES

IMPROVE HARVESTING METHODS

NATIVE TITLE PIECE UP-FRONT!

"LIVING OFF OUR WATERS"

A SEA COUNTRY PLAN

INCORPORATING ABORIGINAL VALUES & I.P RIGHTS

MORE CITIZEN SCIENCE!

MORE FUNDING FOR RESEARCH

CONTINUOUS & SUSTAINABLE



ASSIST MAPPING & TRACKING

LEVERAGE TECHNOLOGY ADVANCEMENTS



RECOMMENDATIONS

TRAD OWNERS NOT STAKEHOLDERS

DIFFERENT STATES SAME RULES?\*

DIVERSE CROSS SECTION OF STAKEHOLDERS

IMPROVE DATA COHESION



SEAT AT THE TABLE INDIGENOUS REPRESENTATION

AUS-WIDE SUBSIDIES & LEGISLATION

NATIONAL APPROACH



PUT SCIENCE INTO RESTORATION

ADVISORY COMMITTEE

COLLABORATION



MEANINGFUL STRUCTURED CONVERSATIONS

GOVERNMENT STATEMENT

ADVOCACY

RESTORATION HONE RESEARCH

WE HAVE A PROBLEM!

WE SUPPORT SOLUTIONS!

FOLLOW UP!

HOLISTIC

WORKING GROUP FOR KELP RECOVERY & URCHIN MANAGEMENT

FISH, DON'T VOTE!



CO-MANAGEMENT & RESOURCE STRATEGIES WITH SUPPORT

NO TAKE ZONES

PRAGMATIC

LEARN FROM PAST LOOK BACK

ONGOING CONSULTATION & REVIEW

LOOPING BACK

[CONTROL]

MARINE SANCTUARIES

\* MAXIMUM SIZE LIMITS + REDUCE BAG LIMITS!

ANNUAL

RESTORATION THROUGH HARVEST

SYMPOSIUM

LONGER TERM THINKING

ENVIRONMENTAL & ECONOMIC

CLEAR GOAL SETTING

KELP HARVEST + URCHIN HARVEST + ABALONE FISHERIES

Catfish creative

#CATFISHCREATES