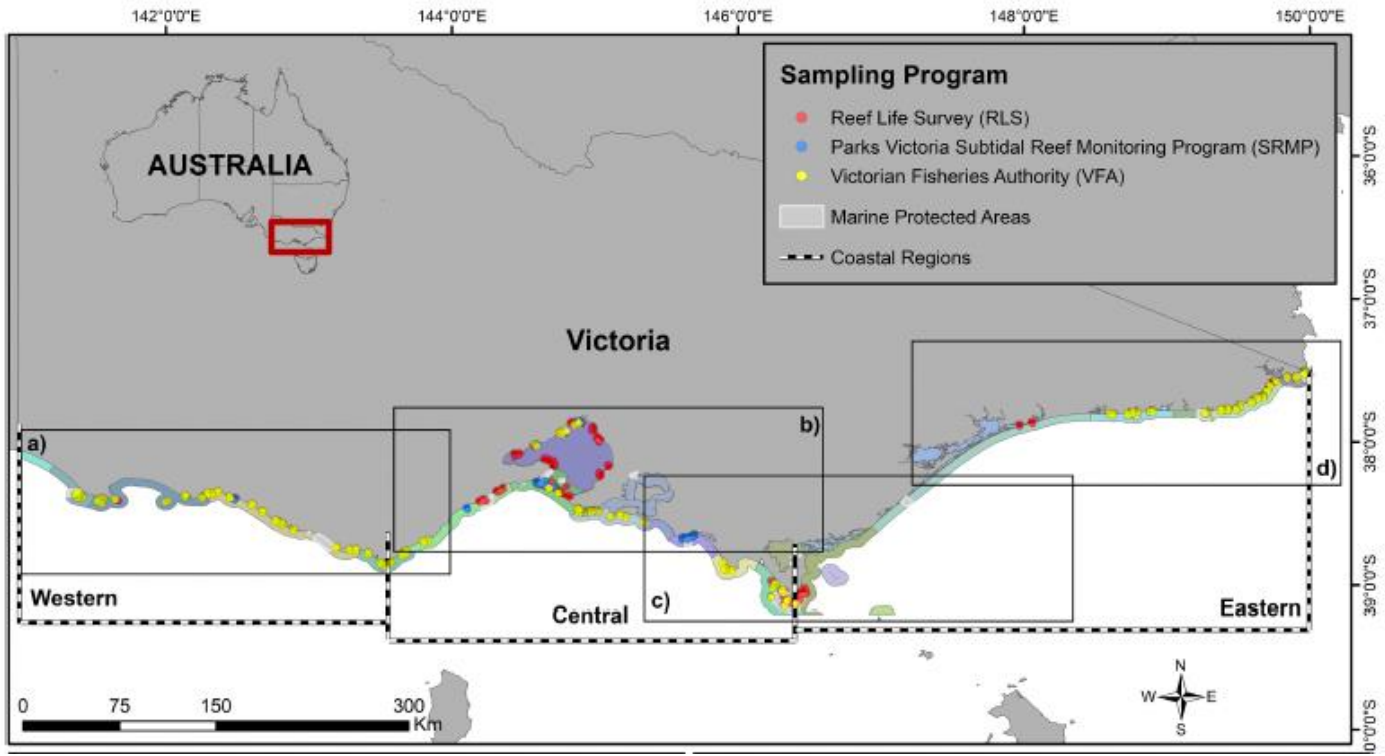
Socio-ecological challenges in managing overabundant urchins on temperate reefs

Stephen Swearer[1], Paul Carnell[2], Rebecca Morris[1], Tristan Graham[1], Fletcher Warren-Myers[1], Tim Dempster[1]

[1]University of Melbourne, [2]Deakin University

The Problem

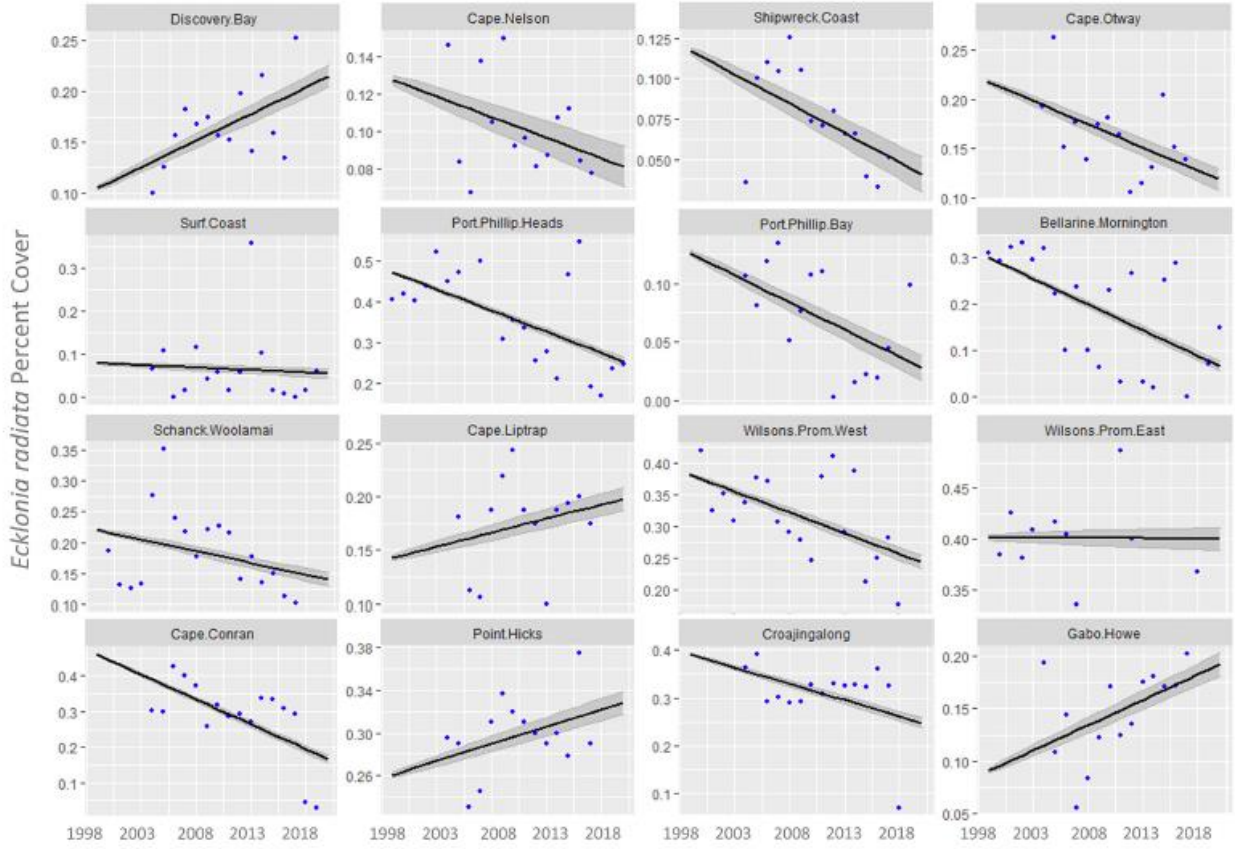
Widespread loss of canopy-forming macroalgae



Young et al. 2022 Diversity & Distributions

The Problem

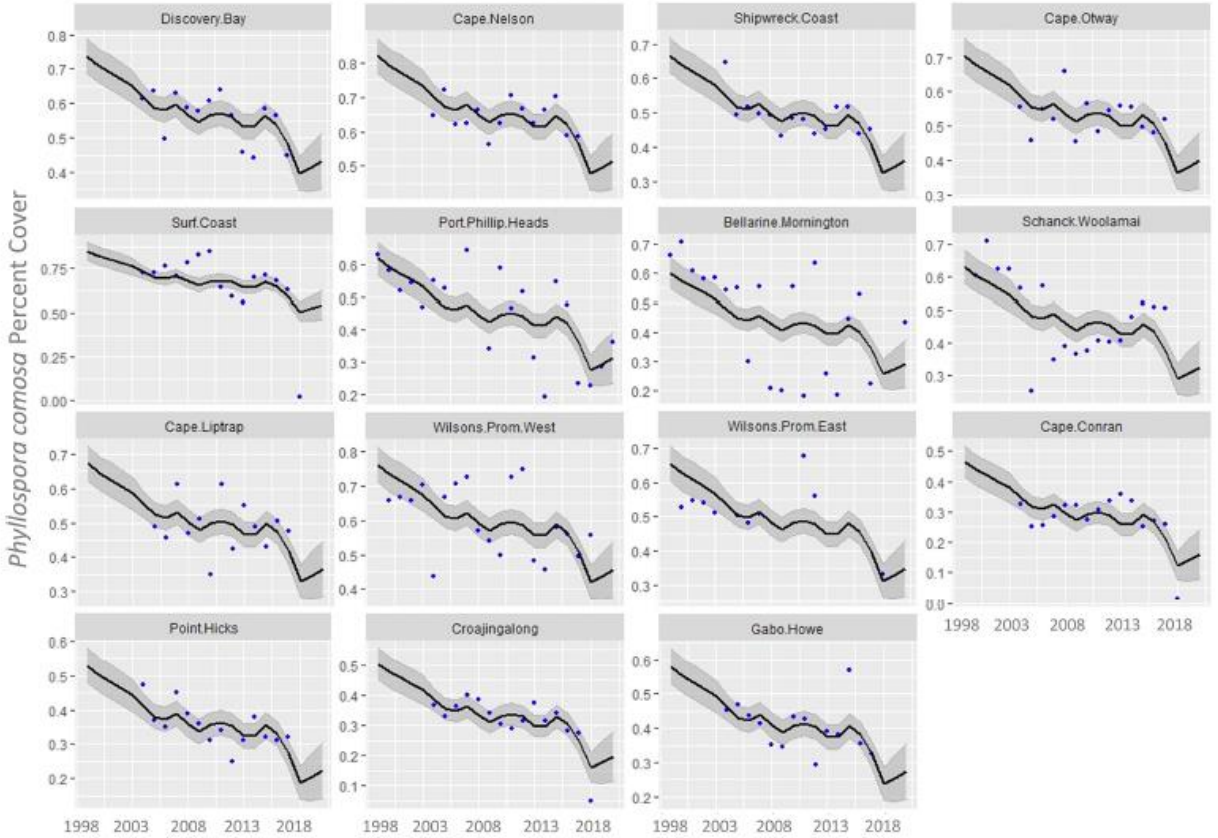
Ecklonia radiata



Young et al. 2022 Diversity & Distributions

The Problem

Phyllospora comosa



Young et al. 2022 Diversity & Distributions

The Cause?

The Reef Ecosystem Evaluation Framework: Managing for Resilience in Temperate Environments

July 2015

In partnership with:

UNIVERSITY of TASMANIA | IMAS INSTITUTE FOR MARINE & ANTARCTIC STUDIES

CRICOS 00586B

THE UNIVERSITY OF MELBOURNE

DEAKIN UNIVERSITY AUSTRALIA

Report produced by: Craig R. Johnson[1], Stephen E. Swearer[2], Scott D. Ling[1], Simon Reeves[1], Nina Kriegisch[1], Eric A. Treml[2], John R. Ford[2], Emily Fobert[2], Kerry P. Black[2], Kim Weston[3], and Craig D. H. Sherman[3]

1. Institute for Marine and Antarctic Studies (IMAS), University of Tasmania, IMAS Waterfront Building, 20 Castray Esplanade, Battery Point TAS 7004, Australia.

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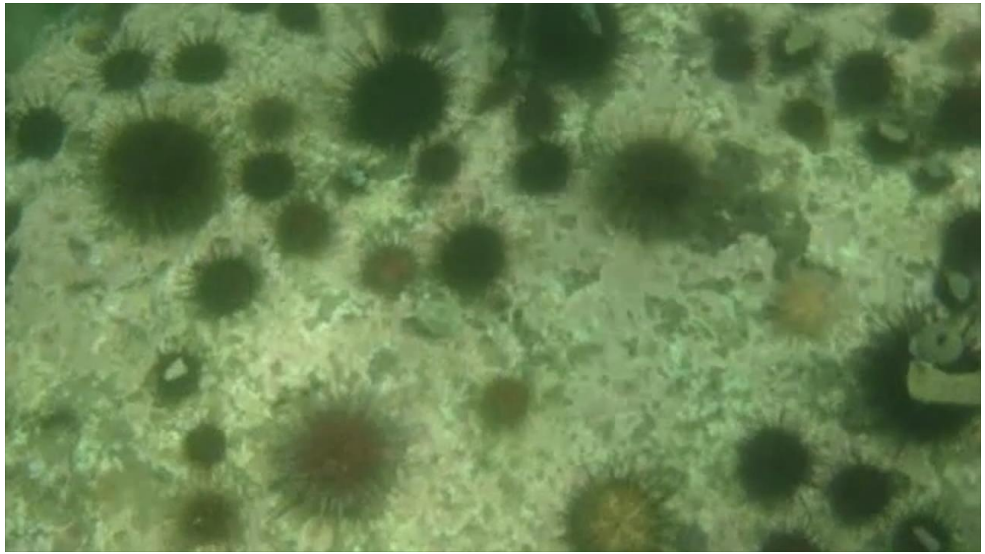
3. School of Life and Environmental Sciences, Deakin University, Geelong Waurn Ponds Campus, Pigdons Road, Geelong, VIC 3217, Australia.

2011 - 2015



S. Ling

The Cause – Overabundant Urchins

PLOS ONE

RESEARCH ARTICLE

Phase-Shift Dynamics of Sea Urchin Overgrazing on Nutrified Reefs

Nina Kriegisch*, Simon Reeves, Craig R. Johnson, Scott D. Ling

Journal of Experimental Marine Biology and Ecology 527 (2020) 151248

Contents lists available at ScienceDirect

Journal of Experimental Marine Biology and Ecology

journal homepage: www.elsevier.com/locate/jembe

Sea urchin control of macroalgal communities across a productivity gradient

N. Kriegisch, S.E. Reeves, C.R. Johnson, S.D. Ling*

Estuaries and Coasts (2019) 42:765–778
https://doi.org/10.1007/s12237-019-00525-1

Reconstructing Historical Marine Populations Reveals Major Decline of a Kelp Forest Ecosystem in Australia

Paul E. Carnell[1,2] · Michael J. Keough[1]

Oecologia (2018) 188:1239–1251
https://doi.org/10.1007/s00442-018-4275-3

GLOBAL CHANGE ECOLOGY – ORIGINAL RESEARCH

Oikos 125: 1273–1283, 2016
doi: 10.1111/oik.02502
Oikos © 2016 Nordic Society Oikos
Bonte. Accepted 18 November 2015

...ce to sediment-trapping turfs with decline of native ...hment of an exotic kelp

...h[1] · C. R. Johnson[1] · S. D. Ling[1]

Oecologia (2019) 190:665–677
https://doi.org/10.1007/s00442-019-04445-6

COMMUNITY ECOLOGY – ORIGINAL RESEARCH

Drift-kelp suppresses foraging movement of overgrazing sea urchins

N. Kriegisch[1] · S. E. Reeves[1] · ...

Journal of Experimental Marine Biology and Ecology 524 (2020) 151292

Contents lists available at ScienceDirect

Journal of Experimental Marine Biology and Ecology

journal homepage: www.elsevier.com/locate/jembe

...reduces resistance t... dominance

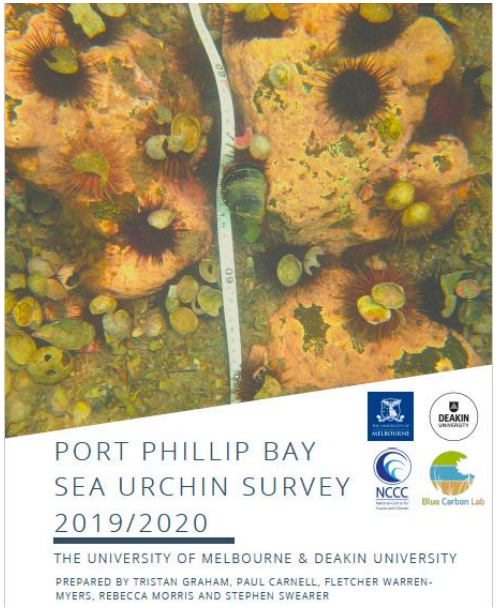
...raig R. Johnson | Scott D. Ling

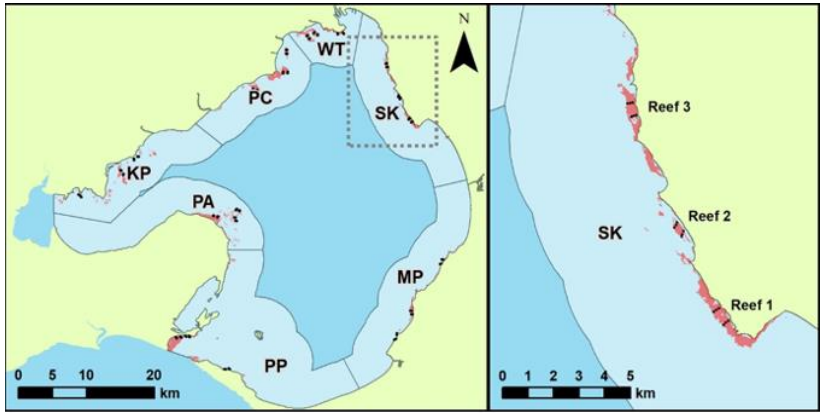
Octocoral barrier to grazing sea urchins allows macroalgal recovery on barrens ground

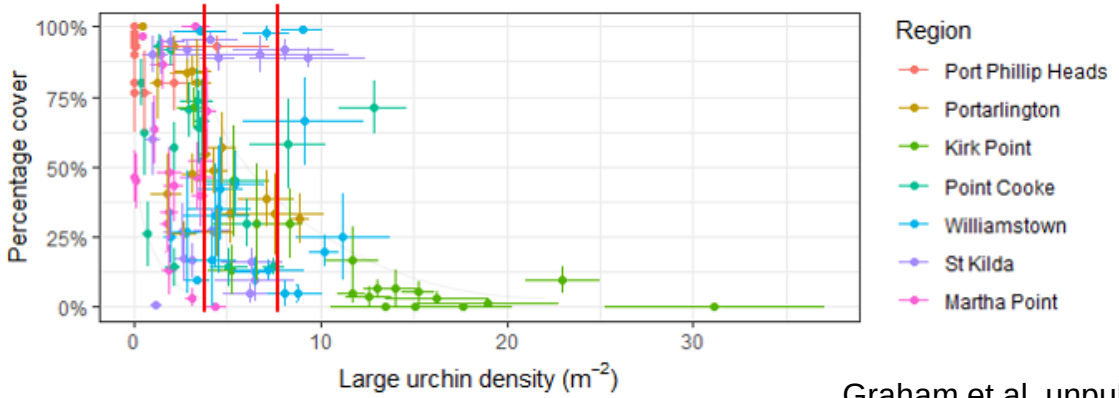
S.D. Ling*, S.E. Reeves, N. Kriegisch

Institute for Marine and Antarctic Studies, University of Tasmania, 20 Castray Esplanade, Battery Point, Tasmania 7004, Australia

The Cause – Overabundant Urchins

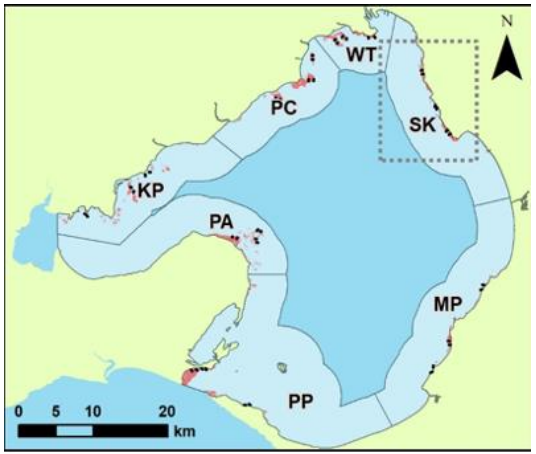


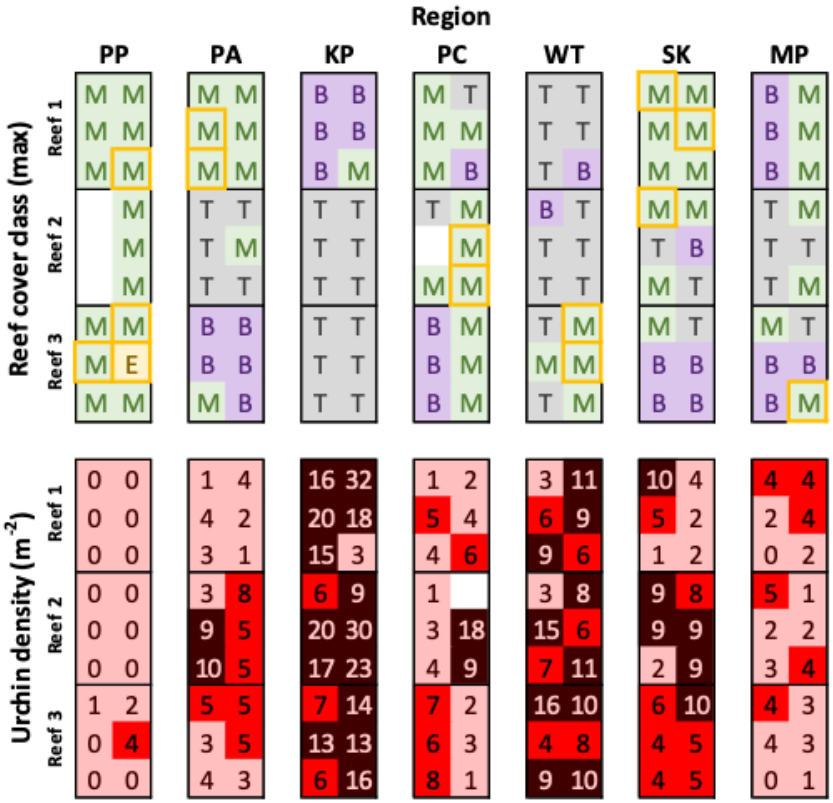




Graham et al. unpublished

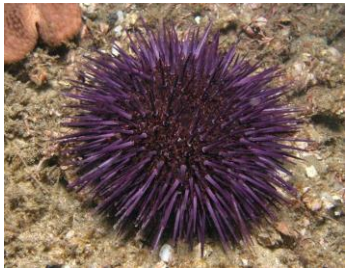
The Cause – Overabundant Urchins





Graham et al. unpublished

The Cause – Overabundant Urchins



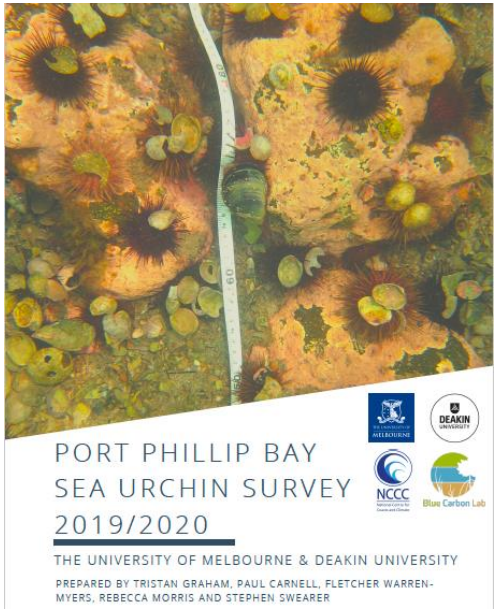
22 km^2 of reef habitat

~142 million urchins (80g urchin)

~11000 tons of urchins

Want ~5000 tons of remaining biomass

Target - ~75 million urchins removed



The Solutions

Natural

Human

The Solutions – Wild Harvest

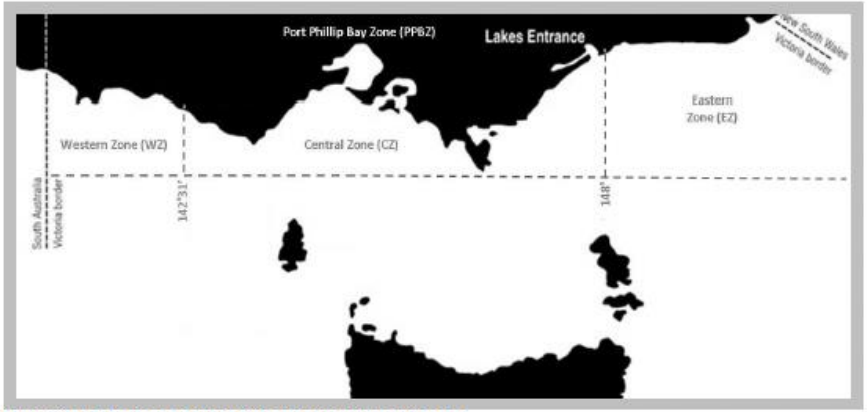


Figure 3. Map of sea urchin fishery management zones

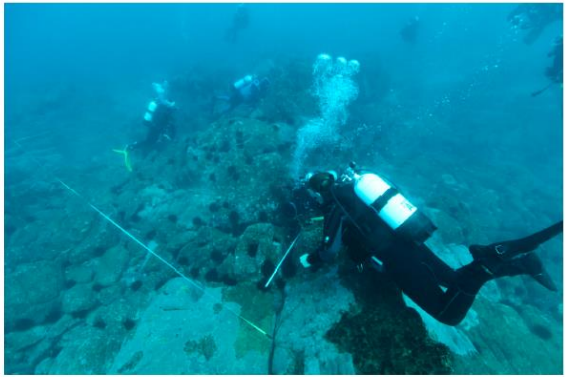
- Developing fishery since 1998
- Last stock assessment was in 2002 (3000 tons, ~25% of current estimates)
- Quota managed fishery. Only quota share holders can remove urchins from outside parks and sanctuaries
- Current fishery quota – 60 tons/yr
- Reef productivity and urchin processing are industry limitations
- Fishers don't harvest in barrens

The Solutions – Culling

Heliocidaris erythrogramma **(Purple Sea Urchin) Impact Management Plan for Point Cooke Marine Sanctuary**

Purple sea urchin *Heliocidaris erythrogramma* in urchin barrens, Point Cooke Marine Sanctuary

Centrostephanus rodgersii **(Black Spined Sea Urchin) Impact Management Plan for Beware Reef Marine Sanctuary**



Black Spined Sea Urchin, *Centrostephanus rodgersii*, at Beware Reef Marine Sanctuary.

Heliocidaris erythrogramma (Purple Sea Urchin) **Impact Management Plan for Nooramunga Marine and Coastal Park**

Heliocidaris overgrazing of *Posidonia* meadow, Sunday Is, Nooramunga M&CP, September 2014

The Solutions – Culling

Beware Reef Marine Sanctuary

- Long history of partnership between PV, citizen scientists, and fishers
- Recently switched to commercial divers ($20k for 25,000 culled)

The Solutions – Culling

Carnell et al. 2022

Cost-Benefit

- Benefit:Cost 1.91 – 6.71
- $6000 - $22000 per hectare
- $13 - $48 million to manage urchins in PPB

The Solutions – Aquaculture

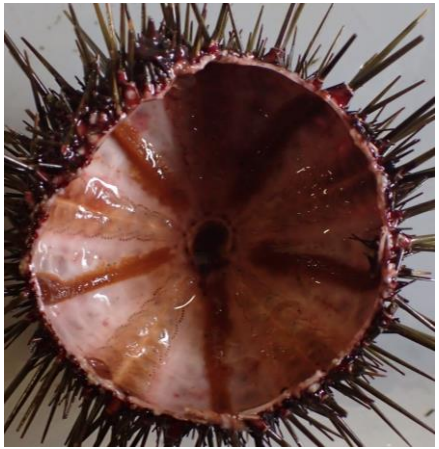
Solving key industry bottlenecks
for sea urchin roe enhancement

by Fletcher Warren-Myers, Stephen Swearer, David Francis, Giovanni Turchini and Tim Dempster
June 2021

AgriFutures Emerging Industries

Rationale

Urchins from barrens are an underutilised resource that could be turned into a valuable export commodity



Harvesting for roe enhancement is a potential cost-neutral way to control the overabundance of urchins

The Solutions – Aquaculture

Vol. 10: 345–361, 2018
https://doi.org/10.3354/aei00274
AQUACULTURE ENVIRONMENT INTERACTIONS
Aquacult Environ Interact
Published August 1

OPEN ACCESS

Barrens of gold: gonad conditioning of an overabundant sea urchin

Cassandra G. Pert[1,2,*], Stephen E. Swearer[2], Symon Dworjanyn[3], Nina Kriegisch[4], Giovanni M. Turchini[5], David S. Francis[5], Tim Dempster[1]

Received: 27 October 2020 | Revised: 31 January 2021 | Accepted: 4 February 2021
DOI: 10.1111/anu.13243

ORIGINAL ARTICLE

Aquaculture Nutrition WILEY

The balancing act: Protein, lipid and seaweed dietary levels to maximize gonad quantity in a wild-caught sea urchin

Fletcher Warren-Myers[1,2] | Giovanni Turchini[3] | Stephen E. Swearer[2] | David Francis[3] | Tim Dempster[1]

Contents lists available at ScienceDirect
Aquaculture
journal homepage: www.elsevier.com/locate/aquaculture

ELSEVIER

Stocking density and rearing environment affect external condition, gonad quantity and gonad grade in onshore sea urchin roe enhancement aquaculture

Fletcher Warren-Myers[a,b,*], Stephen E. Swearer[b], Kathy Overton[a], Tim Dempster[a]

Contents lists available at ScienceDirect
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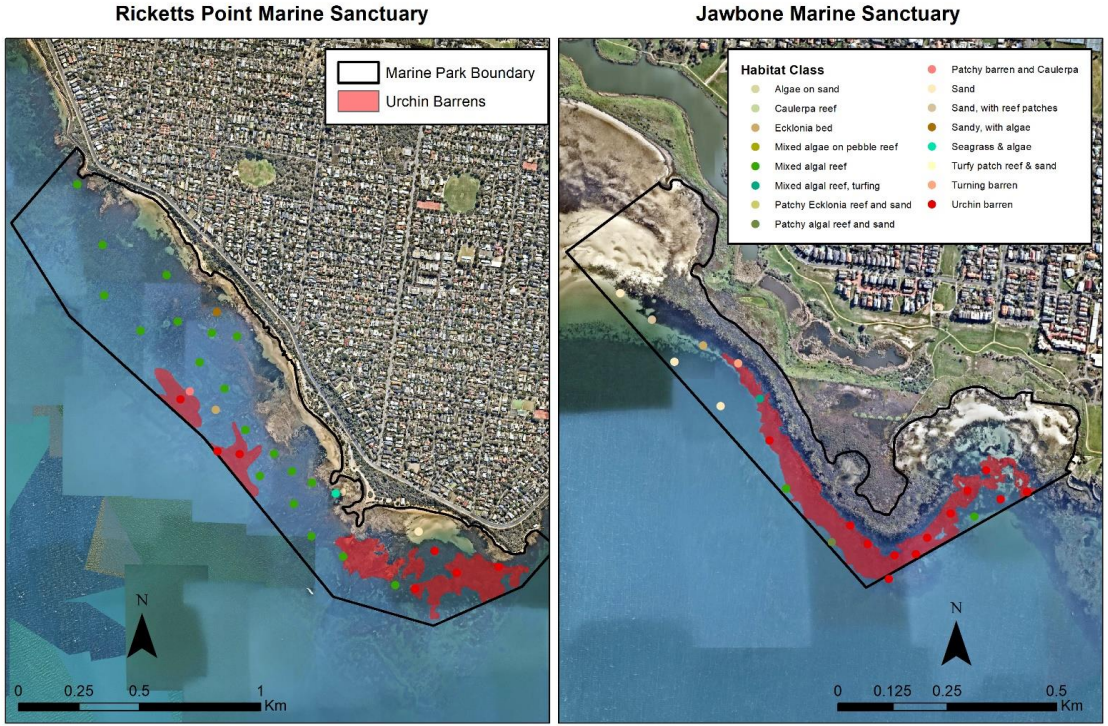
ELSEVIER

Algal supplements in formulated feeds: Effects on sea urchin gonad quality

Fletcher Warren-Myers[a,b,*], Stephen E. Swearer[b], David S. Francis[c], Giovanni M. Turchini[c], Kathy Overton[a], Tim Dempster[a,b]

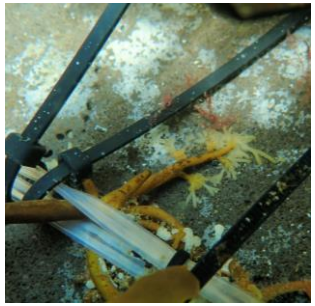
Next-Step Challenges

- Ongoing culling in MSs and MPs with commercial divers



Next-Step Challenges

- Active kelp restoration

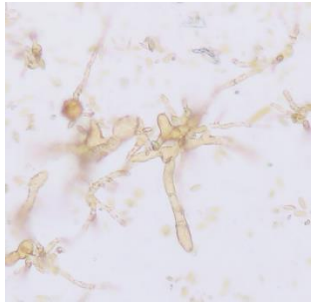


RESTORATION ECOLOGY
The Journal of the Society for Ecological Restoration
SER

RESEARCH ARTICLE

Identifying key factors for transplantation success in the restoration of kelp (*Ecklonia radiata*) beds

Tristan D. J. Graham[1,2], Rebecca L. Morris[1], Elisabeth M. A. Strain[1,3], Stephen E. Swearer[1]



RESTORATION ECOLOGY
The Journal of the Society for Ecological Restoration
SER

PRACTICAL ARTICLE

Optimizing the initial cultivation stages of kelp *Ecklonia radiata* for restoration

Sarucha Suebsanguan[1], Elisabeth M. A. Strain[1,2], Rebecca L. Morris[1], Stephen E. Swearer[1,3]

DEAKIN UNIVERSITY AUSTRALIA

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The Nature Conservancy Australia

SeaGen Aquaculture

Next-Step Challenges

- 5-ton industry-scale urchin roe conditioning trial

Next-Step Challenges

- Developing a marine spatial plan for urchin management and kelp restoration

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Victorian Fisheries Authority

Parks Victoria

Seafood Industry Victoria

yumbah aquaculture

Abalone Council Victoria

The University of Melbourne

Deakin University Australia

The Nature Conservancy Australia

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