Resurvey of the Longspined Sea Urchin & barren grounds in Tasmania

Scott Ling, John Keane
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Climate driven range-extension

August 1945-2016

Temperature (°C)

Year


13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0

Kelp bed  Urchin barren

Late 1960’s  13 yrs
1978  16 yrs
Mid 1980s  13 yrs
20 yrs

EAC

5 yrs
11 yrs
18 yrs
Centrostephanus barrens
Centrostephanus behaviour
Dynamics of urchin overgrazing

Kelp collapse ≥2.2 urchins m⁻² (550 g m⁻²)

“An ounce of prevention is worth a ton of cure”

Recovery ≤0.4 urchins m⁻² (70 g m⁻²)

18 months
Resurvey of Longspined Sea Urchins & barren grounds

2001/02 vs 2016/17

- A total of 156 Dive & 156 Video Transects
- Sites spaced every ~20 km along open coast, at each site 3 sub-sites were surveyed with 4 transects surveyed at each sub-site
- Resurvey of existing sites = ‘Apples vs Apples’ comparison thru time
Resurvey of Longspined Sea Urchins & barren grounds

2001/02 vs 2016/17

Centrostephanus abundance
(mean no. urchins 5 m² ± SE)

East coast change:

x 1.75 increase

~1,200 urchins per ha

= 2,600 urchins per ha*

20 million individuals

* Crown-of-Thorns outbreak triggered at 15 starfish per ha

Dive survey (4-18 m depth)

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Resurvey of Longspined Sea Urchins & barren grounds
2001/02 vs 2016/17

Planar percent cover is sum of:
- Type I barrens = continuous
- Type II barrens => 40% cover
- Type III barrens = 20-40% cover
- Type IV barrens = <20% cover

Eastcoast only

- Eddystone (1)
- St. Helens (2)
- Fourmile (3)
- Bicheno (4)
- Wineglass (5)
- Schouten (6)
- Maria Is. (7)
- Forestier (8)
- Fortescue (9)
- Nubeena (10)
- South Bruny (11)
- Recherche (13)

Video survey (4-40 m depth)

Eastcoast change:
3.4% -> 15.2%
× 4.5 increase

Total = 1,726 ha barrens

Planar percent cover urchin barrens
(mean % reef ± SE)

- 2001/02
- 2016/17

<table>
<thead>
<tr>
<th>Location</th>
<th>2001/02</th>
<th>2016/17</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eddystone</td>
<td>178 ha</td>
<td>440 ha</td>
<td>x 2.5</td>
</tr>
<tr>
<td>St. Helens</td>
<td>86 ha</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fourmile</td>
<td>250 ha</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicheno</td>
<td>205 ha</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wineglass</td>
<td>188 ha</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schouten</td>
<td>304 ha</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maria Is.</td>
<td>47 ha</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forestier</td>
<td>25 ha</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Resurvey of Longspined Sea Urchins & barren grounds
2001/02 vs 2016/17
Resurvey of Longspined Sea Urchins & barren grounds

2001/02 vs 2016/17

Percentage of reef with barrens of any type
(mean % ± SE)

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<thead>
<tr>
<th>Location</th>
<th>2001/02</th>
<th>2016/17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eddystone (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>St. Helens (2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fourmile (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicheno (4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wineglass (5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schouten (6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maria Is. (7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forestier (8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fortescue (9)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Barren types:
- Type I barrens = continuous
- Type II barrens => 40% cover
- Type III barrens = 20-40% cover
- Type IV barrens = <20% cover

Eastcoast change:
9% -> 47% x 5.2 increase
Resurvey of Longspined Sea Urchins & barren grounds

2001/02 vs 2016/17

Distribution by depth

- **C. rodgersi abundance**
  - Mean number of individuals per 5 m² ± SE

- **Planar percent cover of urchin barrens**
  - Mean percent reef ± SE

**Eastcoast only**
- Eddystone (1)
- St. Helens (2)
- Fourmile (3)
- Bicheno (4)
- Wineglass (5)
- Schouten (6)
- Maria Is. (7)
- Forestier (8)
- Fortescue (9)

**Dive survey** (4-18 m depth)

**Video survey** (4-40 m depth)
Resurvey of the Longspined Sea Urchin & barren grounds
2001/02 vs 2016/17

Distribution by reef type & depth

Centrostephanus rodgersii density (mean individ. 5 m² ±SE)

- **a. Flat rock**
  - i.

- **b. Large Boulders**
  - i.

- **c. Small Boulders**
  - i.

Dive survey (4-18 m depth)
Resurvey of Longspined Sea Urchins & barren grounds

2001/02 vs 2016/17

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Dive survey (4-18 m depth)
Resurvey of Longspined Sea Urchins & barren grounds
2001/02 vs 2016/17

Re-survey summary:
• Significant increase over 15 years:
  ⇒ Urchins almost doubled (x 1.75 increase)
  ⇒ Barrens more than quadrupled (x 4.5 increase)

• Much of Eastcoast showing signs of grazing impact, some reefs approaching overgrazing tipping-point in coming years

• “Ounce of prevention worth ton of cure”
  => must act before it is too late, so where/ how should we act???
Resurvey of Longspined Sea Urchins & barren grounds

2001/02 vs 2016/17

Eastcoast only

Eddystone (1)
St. Helens (2)
Fourmille (3)
Dinas (1)

C. rodgersi density (mean max vel 5 m/d)

Depth category (m)

Percent cover bars (%)
Predators of Longspined Sea Urchins: Large lobsters >140 mm carapace

Nocturnal predators, can prey on large urchins when they emerge at night
Predators of Longspined Sea Urchins: Large wrasse >30cm
Blue Throat Wrasse

Daytime predators, can prey on small urchins when exposed
Predators of Longspined Sea Urchins: Large wrasse >30cm
Eastern Blue Grouper (NSW footage)

Daytime predators, can prey on large urchins in crevices; present in Tas
Predators of Longspined Sea Urchins: Large wrasse >30cm
Double header wrasse (Middleton Reef footage)
Predators of Longspined Sea Urchins: Large wrasse
Double header wrasse (Middleton Reef/ Lord Howe footage)
Fishing large predators = loss of kelp bed resilience

A. Fishing predators => loss of kelp bed resilience

B. Reversing fishing?

Rebuilding predators including human harvest & culling approaches => integrated approach

Kelp bed resilience

High kelp bed Resilience

Low kelp bed Resilience

Barrens resilience

Kelp

Barrens
State-dependent Integrated Pest Management (sIPM)

Effectiveness of control over a 5 yr period

<table>
<thead>
<tr>
<th>Control option</th>
<th>Prevention (kelp bed resilience)</th>
<th>Cure (recovery of barrens)</th>
<th>Depth range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Biological control - predation by enhancing large lobsters*</td>
<td>Yes</td>
<td>No</td>
<td>0 - 40m +</td>
</tr>
<tr>
<td>2 Biological control - predation by enhancing Blue Grouper</td>
<td>Yes</td>
<td>?</td>
<td>0 - 40m +</td>
</tr>
<tr>
<td>3 Abalone/ rec. divers culling urchins while fishing</td>
<td>Yes</td>
<td>No</td>
<td>0 - 18m</td>
</tr>
<tr>
<td>4 Harvesting of urchins+ ranching to improve marketability</td>
<td>Yes</td>
<td>No</td>
<td>0 - 18m</td>
</tr>
<tr>
<td>5 Dedicated urchin culling by commercial divers/ rec. divers</td>
<td>Yes</td>
<td>?</td>
<td>0 - 18m</td>
</tr>
<tr>
<td>6 Autonomous robotic culling</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>7 Quick-liming (diver/ ROV for deeper water)</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>8 Bio-tech control (triggering disease outbreak on barrens?)</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
</tbody>
</table>

*Translocation or lobster rebuilding would not affect trends in the re-survey because of timing.