Decadal re-survey of long-term lobster experimental sites to inform Centrostephanus control

Lead Agency: Institute for Marine and Antarctic Studies (IMAS)
Funding: $30,000
Start Date: 1 September 2019 End Date: 30 June 2021
Status: COMPLETED

Aims and Objectives:

The proposed project will re-survey baseline sites established during a previous Fisheries Research Development Corporation project (FRDC#2007/045) that investigated the effectiveness of rebuilding large lobsters to mitigate risk of urchin overgrazing.

Changes observed from 2008-2014 show decline in urchin abundance inside the dedicated no-take Fisheries Research Areas of Elephant Rock Research Reserve (ERRR) and North Bay Research Reserve (NBRR). From this prior research, the rebuilding of large predatory-capable lobster stocks within intact kelp beds (but containing incipient barrens) was, after 6 years, much more effective at reducing risk of barrens formation than was rebuilding of lobster stocks in an attempt to recover widespread barrens.

Given the research areas have remained in effect but have not been surveyed for the past 5 years, the re-survey of these experimental sites therefore presents an important opportunity to understand decadal trajectories in the capacity of large lobsters to mitigate the risk of sea urchin overgrazing.

The re-survey of these baseline sites constitutes highly cost-effective research to refine understanding of the effectiveness of lobster rebuilding strategies as an approach to control urchin overgrazing; thus, promoting sustainability of abalone stocks in eastern Tasmania.

Co-investment from IMAS will enable this objective to be achieved and will further enable a related objective regarding decadal trends in the ability of lobster stocks to be rebuilt on urchin barren grounds to be achieved, which will also contribute towards the overall effectiveness of 'east coast rock lobster stock rebuilding strategy' towards achieving ecological control of sea urchins.

Final Report:

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HIGHLIGHTS

1. Lobster populations can be rebuilt on extensive Centrostephanus barrens providing lobster fishing is relaxed, however rebuilt lobster populations on extensive barrens (following complete closure to lobster fishing) did not control urchin populations within 12-yrs to the point where kelp could recover (previous modelling indicates >50-yrs for any control by lobsters on extensive barrens).

2. Lobster populations can be rebuilt within kelp beds containing incipient barrens providing lobster fishing is relaxed, and following complete closure to lobster fishing, naturally high abundances of large lobsters can decrease urchin abundance and mitigate barrens expansion.

3. To minimize the risk of barrens formation, the rebuilding of large-sized and abundant lobster populations within largely intact kelp beds should be prioritised.

4. Alternative management interventions are required to rehabilitate extensive barrens in the near-term.

NON-TECHNICAL SUMMARY

Aims: We conducted two simultaneous long-term (12-year) experiments to assess the effectiveness of rebuilding large predatory lobster populations (≥140 mm carapace length) to:

1) Recover kelp beds on extensive Centrostephanus barrens.
2) Prevent barrens formation in largely intact kelp beds with incipient Centrostephanus barrens.

Approach: Rebuilding of lobster populations occurred within designated research areas closed to lobster fishing, i.e. lobster-rebuilding 'impact' sites, encompassing (1) extensive barrens, and (2) kelp beds with incipient barrens. Lobster-rebuilding 'impact' sites were closed to lobster fishing for 12-years following an initial accelerated rebuilding via translocation of ~1,000 large lobsters to each research area during the first year of closure to lobster fishing, representing the extreme case of possible lobster management options. For the extensive and incipient barrens experiments, monitoring of lobster, sea urchin and abalone populations, as well as barrens coverage, was performed 'Before' and 'After' lobster rebuilding for the 'Impact' and adjacent 'Control' sites open to fishing. An initial experimental set-up and intensive monitoring period of 3.5 years (from 2008 to 2011, i.e., FRDC Project #2007/045) indicated a rapid and encouraging decline in sea urchins inside at least one of the research areas (Johnson et al. 2013). This prompted continuation of the fisheries research areas for purposes of confirming early trends and to enable the effect of rebuilding lobster populations on urchin population dynamics to be established over a more ecologically meaningful timescale. Subsequently, given the ongoing nature of the fisheries research areas, an additional survey of the 'impact' and 'control' sites was achieved in 2014 and recently in 2020 (this project, funded by AIRF), enabling a 12-year assessment of the effectiveness of lobster rebuilding as a strategy for controlling Centrostephanus.

Results: We show that lobster population rebuilding, via closure of reefs to fishing, was achievable on both extensive and incipient urchin barrens reef. Notably, large resident lobsters (≥140mm carapace length) rapidly rebuilt such that after 3.5 years they were more numerous within closed areas than the ~1,000 large lobsters initially translocated to accelerate rebuilding. Relative to

control sites, the lobster-rebuilding increased urchin predation potential within the research areas, yet after 12 years, no effect of the lobster-rebuilding was detected on extensive barrens. In contrast, lobster-rebuilding within largely intact kelp beds with incipient barrens had a significant effect in reducing Centrostephanus abundance and cover of incipient barrens relative to control sites. For the incipient barrens experiment, the native sea urchin *Heliocidaris erythrogramma* was also significantly reduced by the lobster-rebuilding relative to control populations. Further demonstrating that lobster-rebuilding can mitigate barrens-formation, the number of incipient barrens in the lobster-rebuilding research area was largely stable through time, while the abundance of barrens approximately doubled at the control sites over 12-years. The size of individually monitored incipient barrens patches also more than doubled, on average, whereas incipient barrens within the research area remained stable.

Results show that lobster-rebuilding will be more effective in preventing overgrazing in the first instance compared to attempts to recover kelp beds once extensive urchin barrens have formed. Notably, despite seven-years of the East Coast Rock Lobster Rebuilding Strategy, we report very low lobster CPUE at the control sites open to fishing, suggesting that intense localized fishing is countering broader rebuilding efforts across the coast. Low CPUE at these sites was particularly striking for large size-classes of lobsters that are capable of preying upon the dominant size-classes of urchins on the reefs. Proactive management for local-scale resilience of kelp beds against overgrazing, by rebuilding natural size and abundance of predatory lobsters, will be far more effective than reactive attempts to restore natural predators once collapse to extensive barren grounds has occurred. For managing extensive barrens, rebuilding natural predators will be ineffective for restoring kelp beds in the near-term noting that previous modelling indicated >50-yrs may be required for predatory lobsters to reduce urchins to the point of kelp recovery on extensive barrens (Johnson et al 2013).

Key findings: In summary, this long-term research demonstrates that “An ounce of prevention is worth a ton of cure” when it comes to controlling destructive overgrazing by Centrostephanus. That is, the longer time series obtained through this latest survey extends and consolidates the trends detected in previous research (Johnson et al. 2013). Confirming early-signals from the initial research, the rebuilding of lobsters as a control strategy for sea urchins must prioritise the rebuilding of lobster populations within largely intact kelp beds, which show early signs of barrens formation, before it is too late. To recover kelp beds on extensive barrens, much larger and costly management interventions will be required to ‘re-set’ productive kelp beds (e.g., urchin harvesting, culling and/ or quickliming). Providing kelp beds can be ultimately restored on extensive barrens, management of restored areas must explicitly focus on maximizing natural predators to ensure resilient and sustainable kelp bed ecosystems are maintained into the future.