THE EAST COAST TASMANIAN ROCK LOBSTER FISHERY

Vulnerability to climate change impacts and adaptation response options

EXECUTIVE SUMMARY

A report to the Australian Government Department of Climate Change

The east coast Tasmanian rock lobster fishery – vulnerability to climate change impacts and adaptation response options (Executive summary)

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Largely as a function of the interdisciplinary nature of the research, this report represents a major contribution from all authors; the order of co-authors given here is alphabetical.

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Cover image: Rock Lobster (Bruce Miller)

An executive summary

This case study examines the potential impacts of climate change on the Tasmanian rock lobster fishery, and identifies several options and opportunities for adaptation.

Climate change is expected to have a significant impact on the Tasmanian rock lobster industry with declines in rock lobster biomass occurring initially in northern and north-eastern regions before eventually also potentially declining in the south. As water temperatures increase it is also expected that the range of a damaging sea urchin will be extended. The study found that the rock lobster fishery is reasonably well placed to adapt to the challenges of climate change but identified several possible measures that will assist with this adaptation including improved catch modelling, long-term monitoring, better risk assessment, and effective education and communication with the industry. Understanding the impacts of climate change on the Tasmanian rock lobster industry is important because this fishery is ideally placed to be an 'early warning signal' for Australian fisheries generally.

THE FISHERY

The Tasmanian rock lobster fishery is based on the harvest of the southern rock lobster around the state. It is a valuable industry to Tasmania, being the state's second most important wild harvest fishery with an estimated value of $72 million (at the first point of landing). The fishery provides employment for around 760 people in production, processing and distribution. Catching lobsters is also a cherished activity of many Tasmanians, and the fishery supports a thriving recreational sector.

However, climate change is expected to have a significant impact on the ocean environment around Tasmania, particularly on the east coast. Sea temperatures are rising, currents are changing and impacts are already being seen in species composition and ecosystems. These changes are expected to continue in the future, and will produce a range of flow-on impacts on ocean-based industries such as the rock lobster fishery.

At present, management policies for the fishery do not explicitly account for climate change. By understanding how climate change may affect the lobster fishery, managers and local communities are empowered to make better choices between available options. Recognition of the risks associated with climate change is a valuable first step towards better planning and more effective management.

LOBSTER GROWTH AND TEMPERATURE

Rock lobsters can live for 20 years or more. In Tasmania, lobsters grow slower in the cooler southern regions and faster in the warmer northern regions. Associated with these spatial patterns in growth is a difference in the size at maturity: larger sizes at maturity are associated with faster growth. Because of the uniform minimum legal size limit for harvest, the densities of lobsters are highest in regions of slower growth, with a considerable portion of the stock below the size limit for capture in southern regions. In south western regions, most females do not reach the legal size limit due to exceptionally slow growth.

THIS CASE STUDY

To explore the impacts of climate change, this case study examined existing information on the lobster fishery in four regions along the Tasmanian east coast. It investigated the connections between variables expected to alter with climate change (such as temperature and currents), with the biology of lobsters and the manner in which they are harvested (eg, catch composition and catch rates).

Using this information, the existing stock assessment model was modified to project forward and evaluate the likely exploitable biomass and egg production levels for two climate change scenarios – a mid-range scenario (IPCC emission scenario A1B) in the year 2030 and the same mid-range scenario plus a high range scenario (A1FI) in 2070.

This investigation brings together expertise from the biophysical, economic, social and governance disciplines. The report describes the potential impacts of climate change and explores different strategies for adaptation.

Combining information from surveys, expert knowledge and a workshop attended by industry representatives, resource managers, individual fishers, processors and quota holders, the investigation identified a range of potential actions that could be undertaken to minimise the threat of climate change to rock lobster stocks and the long-term viability of the industry.

WHY IS THIS CASE STUDY IMPORTANT?

The Tasmanian rock lobster fishery is ideally placed to be an 'early warning signal' for Australian fisheries generally. Being at the interface of the East Australian Current and southern ocean waters, it is experiencing climate warming faster than any other region in the southern hemisphere. Warming waters in this region have already resulted in altered species distributions and ecosystem impacts. Both industry and government are already considering management responses that take account of these changes making the fishery more responsive to climate related impacts. By building on this solid framework, including the new information provided in this report, this fishery will continue to be an example of adaptive planning and implementation that can provide valuable lessons for fisheries both nationally and internationally.

Image Credit: Bruce Miller

PROJECTED IMPACTS ON THE LOBSTER INDUSTRY

Specific impacts of climate change and their consequences for the Tasmanian rock lobster industry are likely to include:

- **Warmer waters by 2030:** Coastal waters off eastern Tasmania will warm to the equivalent of temperatures currently experienced further north in Tasmania or lower Victoria by 2030.
- **Even warmer by 2070:** The warming will be equivalent to the Victorian coast (mid-range scenario) or New South Wales coast (high scenario) by 2070. The associated low productivity and ecosystem function associated with these warmer water temperatures are also expected to move south. This may result in these areas being unable to support rock lobster populations of the same size as found today (section 4.3.1).
- **Long term declines in recruitment of lobsters:** Monitoring of catch rates of lobster larvae off eastern Tasmania show a long-term trend of decline. Under both the mid-range and high climate change scenarios, north-eastern and eastern regions of Tasmania are expected to experience continued declines in larval settlement (section 4.3.2).
- **Declines in lobster biomass:** Declines in rock lobster biomass are predicted to occur initially in northern and north-eastern regions, before eventually also declining in the south (section 4.3.3). Model projections indicated initial gains in biomass, through increased growth, although this would be followed by a reduction in biomass due to declines in recruitment. This pattern was consistent in all regions and for both climate change scenarios.
- **The spread of a second species of lobster:** Climate change may extend the range of a second lobster species into Tasmania (the eastern rock lobster). This was not considered in projections shown here as the species appears less productive than southern rock lobster and only trivial recruitment into Tasmania has been observed to date. Nevertheless, opportunities to target alternative species such as the eastern rock lobster may present themselves and should be carefully monitored.
- **The spread of a damaging sea urchin:** As the water temperature increases it is expected that the range of the sea urchin *Centrostephanus* will be extended. *Centrostephanus* is a rock-scraping grazer and large numbers of the sea urchin can significantly degrade ecosystems (producing so called urchin barrens) and reduce the quality of lobster habitat (section 4.3.7).
- **Using lobsters to control sea urchins:** The interaction between lobsters and *Centrostephanus* is a complex one because large lobsters eat sea urchins. Research is currently underway to determine the density of large lobster biomass that would be required to control sea urchin populations. Active management of the population of large lobsters will be necessary to enhance retention of increased numbers of large lobsters in coastal regions most at risk.
- **Impacts will vary between regions:** Impacts of climate change on the industry will be regional (as opposed to state-wide). The south-western regions are predicted to increase and/or maintain catches longer than other regions.

WHAT'S A LOBSTER WORTH?

The commercial rock lobster fishery has been an important component of the Tasmanian fishing industry for over 150 years, dating back to the 1800s.

The main determinant of total returns for a rock lobster fishing operation is the beach price which is largely determined by carapace size or weight and colouring. Processors prefer weights of 0.8 – 2 kilograms. The average weighted beach price in 2008 was around $42 per kilogram but reached in excess of $65 per kilogram during periods of high demand/low supply and favourable exchange rates.

UNCERTAINTIES

There are uncertainties in attempting to forecast future impacts of a complex system such as the lobster fishery. In particular, there is uncertainty surrounding the interplay of catchability and other fishery variables, and the possibility of ecosystem surprises:

- **Catch rates and stock size:** Lobsters become more active as the temperature increases, and as they become more active their catchability increases (therefore catch rates are expected to increase). However, this increase in catch rate is independent of changes in stock size predicted here (section 4.3.7). In stock assessments, catchability is normally assumed to be constant, or stationary through time, so any change would bias conclusions about the condition of the southern rock lobster stock. Other processes that may also bias conclusions by changing through time are growth rates, average recruitment and fishing efficiency.
- **Surprises:** There is the possibility of 'ecosystem surprises' and 'ecological thresholds' that may result in abrupt changes in ecosystem function, structure or quality, which may impact on rock lobster stocks (either positively or negatively). Sudden, unexpected shifts in ecosystem dynamics are a significant source of uncertainty for managers. Additionally, the impacts of ocean acidification are also unknown and these may be significant (section 4.3.7).

PERCEPTIONS OF CLIMATE CHANGE

As part of the vulnerability assessment, a risk perception study was conducted to gain some understanding of commercial fishers' perceptions of the potential impact of climate change on the industry. All respondents were male, with an average of 10–15 years experience in the industry. Of those interviewed, about 40 per cent did not perceive that climate change was a problem at all. Another 30–40 per cent felt that there was currently no consensus about the reality of climate change. These fishers noted that changes in climate did seem to be occurring, but were not convinced that it was human-induced, and that even if it was, considered it would not have a great impact on the industry.

Younger fishers were less sceptical and more positive about adaptation than fishers closer to retirement. For example, in this survey, 100 per cent of fishers 40 years or under believed climate change was a reality.

CAPACITY TO ADAPT

The Tasmanian rock lobster fishery is reasonably well placed to adapt to the challenges of climate change. Although fisheries management policies do not currently explicitly consider climate change, management is beginning to actively integrate the longer-term issues associated with climate change with the relatively shorter-term responses to current stock trends. In addition to this, active management of the stock in the shorter-term suggests the industry has the capacity to evolve and respond to longer-term trends even if the response to climate change is not explicitly managed.

This report identifies several possible measures and actions that may provide a constructive way forward for the rock lobster fishery:

- **Incorporate changes in lobster recruitment into catch modelling:** There is a need to include the impact of climate change on lobster recruitment into projection modelling used in setting the annual total allowable catch.
- **Establish a long-term lobster monitoring program:** Ongoing, long-term monitoring of lobster populations at specific sites (including unfished sites) will allow changes in lobster biology to be incorporated into fisheries management.

- **Develop regional management tools:** There will be a need to use spatial management tools rather than state-wide management tools to address issues arising from climate change. One issue where this is specifically required is in managing the potential impact of the sea urchin *Centrostephanus*. Different regional management regimes may, however, be perceived by recreational and commercial fishers as more complex or restrictive. Getting regional management accepted may be a significant challenge.
- **Redefine standard risk management:** Reponses to climate change should become part of standard risk management within the industry.
- **Develop longer-term priorities:** Management regimes may need to develop, and constantly re-evaluate, longer-term priorities. Flexibility in fishing across multiple species could be enhanced by reviewing management arrangements for allied fisheries simultaneously (e.g. fisheries with similar logistic requirements such as scallops, rock lobster, and giant crab), rather than a single species in isolation.
- **Make no-regrets adaptation a priority:** Identification of cost effective, 'no-regrets' adaptation measures should be a priority (i.e. those measures that would be beneficial under any future scenario). For example:
  - Measures that reduce the potential impact of the sea urchin *Centrostephanus*
  - Communication tools that improve relationships between commercial and recreational fishers over resource allocation issues
  - Utilising a multi-criteria analysis approach in the current fishery management to facilitate incorporation of climate change issues and challenges into 'core business'.

COMMUNICATING WITH FISHERS

Communication about climate change needs to be culturally appropriate and palatable to fishers, so that the issue of climate change will penetrate and be accepted within existing cultural norms. In this context it is important to engage with not only how communities identify vulnerability (in this case the quota, debt and succession), but how they engage with, and are able to act to respond to those threats.

Image Credit: Bruce Miller

Adaptation involves the interaction of a range of social, economic, cultural, ecological and policy factors. Building effective adaptation will require the development of frameworks and models that effectively integrate the various disciplinary approaches. Communication and education awareness for the fishing industry is essential in order to facilitate the implementation of the best strategies. A well-informed industry will be more proactive and will therefore more effectively manage the impacts of climate change, compared with an industry that ignores the threat or an industry that does not have access to sound information and tools for management of the fishery.

GAPS AND FUTURE ASSESSMENTS

One of the key reasons the east coast Tasmanian rock lobster fishery was selected as a case study for the NCVA was that, relative to most other fisheries, it is a comparatively well researched and data-rich system. Even so, this assessment was still limited by major gaps in knowledge. The study recommends that thorough vulnerability and adaptation assessments should be a high priority for all of Australia's major fisheries and critical marine ecosystems.

Key gaps that are readily apparent for the current case study include:

- **Impacts on lobster biology**: Full understanding of the impact of increased temperatures, ocean acidification and other climate change variables on rock lobster growth and recruitment
- **Responses by recreational and commercial fishers:** Clear understanding of the likely behavioural responses of users of the rock lobster resource to future climate-induced changes
- **Capacity to explore long-term adaptation:** There is a need to explore innovative institutional mechanisms for promoting long-term adaptation that accounts for intergenerational equity in resource utilisation. Decisions undertaken in the short term have the potential to impact on future generations of fishers.

Image Credit: Bridget Green

The report provides a baseline for future assessments. Further assessment should be able to evaluate a range of adaptation measures to provide government and industry with a blueprint to develop policy that is aimed at maximising the opportunities and minimising the harm associated with climate change.

What is needed is an integrated, multi-criteria decision framework for use in assessing different options aimed at adapting Tasmania's marine fisheries. This will require the development of appropriate objectives, criteria and weights based on input from a broad range of stakeholders. It should reflect the sector-specific characteristics identified in Chapter 6. While this would provide the capacity to develop medium- to long-term adaptation strategies, there is also an urgent need to identify, evaluate and implement no-regrets measures in the rock lobster fishery.

THE LOOMING PERIL OF THE URCHIN

By 2025, average temperatures along the entire east Tasmanian coast will likely reach a critical threshold that allows the sea urchin *Centrostephanus* to complete its larval life cycle in most years, therefore substantially increasing the risk of barrens forming. Once established, *Centrostephanus* denudes coastal reefs by overgrazing seaweeds and invertebrate fauna and forming persistent barrens. In the islands between NSW and Tasmania, *Centrostephanus* has already denuded approximately 50 per cent of shallow reefs and barren regions are increasing in north-eastern and eastern Tasmania. Experiments in Tasmania show that when sea urchins are removed, the seaweed cover and community structure recovers to that of ungrazed regions within 18 months. There is evidence to suggest that high densities of very large lobsters may be critical in preventing barrens formation.

Image Credit: Bruce Miller

THE EAST COAST TASMANIAN ROCK LOBSTER FISHERY COASTAL CLIMATE CHANGE CASE STUDY

The study of impacts on the Tasmanian rock lobster fishery is one of a number of case studies initiated as part of the National Coastal Vulnerability Assessment (NCVA). The case studies explore and illustrate different aspects of the coastal adaptation challenge in the context of a diverse range of climate change impacts and situations.

The Tasmanian case study report can be downloaded from: http://www.climatechange.gov.au

The report's title is:

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