Chapter 6

Adapting to climate change: Measures to support fisheries, marine ecosystems and biodiversity

6.1 This chapter continues the report's consideration of responses to climate change by examining measures that can be taken by industry, government and scientific organisations. First, this chapter examines measures that can be considered within the fishing and aquaculture industries to ensure the sustainability of these industries in the face of climate change. Secondly, the chapter discusses the evidence received about rehabilitation work in the Great Barrier Reef. Finally, this chapter considers the evidence received relating to research into the effects of climate change on the marine environment.

Changes to fishing and aquaculture activities

6.2 In considering how climate change will affect fisheries and what can be done about it, the general view among witnesses is that the industry will need to adapt to any changes in conditions. In doing so, it is also apparent that there will be 'winners and losers'.[1] This section focuses on the more direct implications of climate change for marine fisheries, although it was noted that climate change could have wide-ranging implications for fishing and aquaculture industries, such as disruption to supply chains. Dr Alistair Hobday, CSIRO, provided the following evidence on this:

> Many fishing and aquaculture businesses also deliver product to market, and there may be impacts along the supply chain as a result of climate change. An example of one of those is if an extreme event disrupts a supply chain route like a road, a bridge or an airport and it is difficult to get those products through. So climate change will also increasingly have impacts on infrastructure that affects fisheries.[2]

6.3 Two of the key ways in which industry may adapt is by targeting different species—for wild fisheries, this would mean adjusting to any changes in distribution of species; for aquaculture species that are currently farmed in certain locations may need to be replaced by other species. Alternatively, breeding programs and other research may be possible to develop stock that is resilient in the face of changing conditions. In summary, it was suggested that '[w]e need to think outside the box a bit more'.[3] This section discusses this evidence.

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1 Professor Gustaaf Hallegraeff, Institute for Marine and Antarctic Studies (IMAS), *Committee Hansard*, 21 February 2017, p. 11.

2 Dr Alistair Hobday, Senior Principal Research Scientist, CSIRO, *Committee Hansard*, 17 March 2017, p. 2.

3 Professor Gustaaf Hallegraeff, IMAS, *Committee Hansard*, 21 February 2017, p. 11.

Relocating and changing target species

6.4 Witnesses suggested that industry could adjust by changing the species it targets. As noted in Chapter 4, warming waters in Tasmania may result in decreased productivity of the salmon aquaculture industry as salmon reach their upper thermal limit.[4] On this issue, Professor Gustaaf Hallegraeff referred to a report that examined the implications of climate change for salmon aquaculture, which suggested 'shifting to different species and looking at areas which had less fluctuation in water temperatures and remained cooler'.[5]

6.5 The committee was also informed of research that may change where salmon is farmed. Professor Stewart Frusher told the committee that as the coastal zone is expected to have 'a lot of issues with an increasing population', offshore and onshore locations for salmon aquaculture are being considered. Professor Frusher referred the committee to research being undertaken at the Institute for Marine and Antarctic Studies (IMAS) that is examining recirculated systems. The professor stated that the experimental aquaculture facility at IMAS:

> …is the first of its type to have cages large enough to hold large fish and to have sufficient cages to be able to do the replication in that work. Part of the research that has been undertaken there is to look at recirculation systems.[6]

6.6 Professor Hallegraeff also commented that, if in the future salmon 'is beyond its normal range of temperature tolerance, we should consider growing another fish'.[7]

6.7 Potential changes for the oyster industry were also noted. As Pacific Oyster Mortality Syndrome (POMS) is a disease that only affects the Pacific oyster, it was observed that the Sydney rock oyster could be introduced and cultivated in areas such as Tasmania that have been affected by POMS.[8] Parts of the oyster industry have also needed to adjust their infrastructure in response to changes in the marine environment. Mr Simon Rowe from OceanWatch Australia provided the following comments on these developments by referring to the New South Wales industry:

> The New South Wales oyster industry have noticed changes in level rise. They are stuck on their set infrastructure, so they are having to modify that, and there are other things along the lines of early warning systems for plumes and that sort of thing coming from downstream. They are starting to utilise some of those technological solutions in response to climate change. So they are aware of it and they are dealing with it slowly…It is a little bit unpredictable at times as to how it is going to affect their local area.

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4 See Department of Agriculture and Water Resources (DAWR), *Submission 18*, p. 4.

5 Professor Stewart Frusher, IMAS, *Committee Hansard*, 21 February 2017, p. 12.

6 Professor Stewart Frusher, IMAS, *Committee Hansard*, 21 February 2017, p. 12.

7 Professor Gustaaf Hallegraeff, IMAS, *Committee Hansard*, 21 February 2017, p. 11.

8 Professor Gustaaf Hallegraeff, IMAS, *Committee Hansard*, 21 February 2017, p. 11.

> They may start noticing some mortality or some changes and they may respond to those specifically, but I do not think they get up in the morning and think, 'I am going to change this today because of climate change.' It is very ad hoc.[9]

6.8 In discussing the ability of the fishing industry to adapt to climate change, it was emphasised that successful adaptation could enable the industry to take advantage of potential opportunities that climate change could create. Professor Hallegraeff stated:

> I would add that, again, adaptation is not necessarily something that is a bad thing. There are great opportunities, we believe, for climate change in fisheries, for instance. It just depends on whether or not the management framework is flexible enough to be able to deal with considerable changes. I am sure you have heard from New South Wales how much change is happening to the management of New South Wales fisheries at the moment, and the industry is going through a restructure. It is hard to work with an industry when the attention is elsewhere. But certainly there will be opportunities. That is the expectation that we see from research.[10]

Breeding programs to develop resilient stock and other responses

6.9 As noted above and in Chapter 4, increasing temperatures in Tasmania may result in decreased productivity in the Atlantic salmon industry. Despite this, the Fisheries Research and Development Corporation (FRDC) suggested that such an outcome could potentially be countered 'through selective breeding for a higher thermal tolerance'.[11]

6.10 Businesses can also adjust to climate change by reviewing and adjusting their planning. Dr Hobday explained:

> One example we might provide to an industry is: 'If you are going to experience an extreme event, what contingency plans would you have in place?' As any good business, they will have strategies for what they will do if they saw this or that event, and it might be harvesting your species over a longer period of the year, or it might mean diversifying your markets. The actual range of options that are available if you do that future planning is quite remarkable, and our challenge is to get industry, management and policy to really consider that spectrum.[12]

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9 Mr Simon Rowe, Program Manager, Environment, OceanWatch Australia, *Committee Hansard*, 16 March 2017, p. 44.

10 Ms Lowri Pryce, Executive Officer, OceanWatch Australia, *Committee Hansard*, 16 March 2017, p. 44.

11 Fisheries Research and Development Corporation (FRDC), *Submission 2*, p. 11.

12 Dr Alistair Hobday, CSIRO, *Committee Hansard*, 17 March 2017, p. 3.

6.11 Returning to the salmon industry in Tasmania, Dr Hobday stated:

> They understand climate is a risk to their future operation and one way you could manage that risk is with environmental information about the future. We have developed seasonal forecasts that can give some probability estimates of whether the upcoming conditions are going to be hotter than average or colder than average. They used those to, I think, manage their production schedules and also what they would be able to deliver to market, based on those environment conditions.[13]

Great Barrier Reef

6.12 The vulnerability of the Great Barrier Reef to climate change was discussed in Chapter 3. This section examines the various approaches underway and other approaches which could be considered to protect biodiversity and fisheries in the Great Barrier Reef.

6.13 Evidence received on how to address the health of the Great Barrier Reef went to:

- the need for global action to address human interference with the climate system; and
- local responses to enhance the resilience of the Reef, including research, management strategies and recovery efforts.

6.14 As noted earlier, this report does not focus on the need for global action on climate change. However, in the context of the Great Barrier Reef, the following comment provides an example of the points made by witnesses regarding the need for emissions reduction to protect the Reef:

> We would hope that they replace this target with a new target of 65 to 85 per cent reduction in greenhouse emissions based on 2005 levels by 2030, setting Australia on a pathway to meet a limiting 1.5 degrees, which may give us some reef in the future.[14]

6.15 The remaining paragraphs of this section focus on local responses to Reef rehabilitation, including the actions outlined in the *Reef 2050 Long-term Sustainability Plan*.

13 Dr Alistair Hobday, CSIRO, *Committee Hansard*, 17 March 2017, p. 9.

14 Mr Tony Fontes, Reef Campaigner, Australian Marine Conservation Society (AMCS), *Committee Hansard*, 30 August 2017, p. 27.

Current strategies and recovery efforts

6.16 The *Reef 2050 Long-term Sustainability Plan*, which was released by the Australian and Queensland Governments in March 2015, provides a framework for protecting and managing the Reef.[15] The Plan includes the following summary of programs intended to support the health of the Reef:

> The Australian Government is investing $200 million over five years to improve the resilience of the Reef, including supporting delivery of the Reef Water Quality Protection Plan. In particular, the new $40 million Reef Trust will fund water quality improvements, habitat restoration and species recovery, important for enhanced Reef health. In addition to maintaining its $35 million a year expenditure on water quality initiatives, the Queensland Government has committed an additional $100 million over five years towards water quality initiatives, scientific research and helping business transition to better environmental practices in the primary production and fishing industries.[16]

6.17 In addition to the $100 million committed by the Queensland Government for water quality and other initiatives, in June 2017 the Queensland Government announced a further commitment of $175 million ($35 million per year) over five years from 2017–18 for the Great Barrier Reef Water Quality Program.[17]

Regulation of activities in the Marine Park

6.18 One of matters addressed in the Reef 2050 Plan is sustainable fishing. The Great Barrier Reef Marine Park Authority (GBRMPA), which explained that it is supporting the Queensland Government to deliver its sustainable fisheries strategies, provided the following overview of how the sustainable fishing actions will support a more resilient Reef ecosystem:

> The strategy seeks to set sustainable catch limits to maintain targeted populations at around 60 per cent of pre-fishing levels. That's a more conservative target than typical in fisheries management. It also includes the introduction of satellite vessel monitoring systems on all commercial fishing vessels operating in the marine park to improve compliance, both

15 Department of the Environment and Energy, 'The Reef 2050 Plan', www.environment.gov.au/marine/gbr/long-term-sustainability-plan (accessed 18 October 2017).

16 Australian Government and Queensland Government, *Reef 2050 Long-Term Sustainability Plan*, March 2015, www.environment.gov.au/system/files/resources/d98b3e53-146b-4b9c-a84a-2a22454b9a83/files/reef-2050-long-term-sustainability-plan.pdf (accessed 18 October 2017), p. iii.

17 The Hon Steven Miles MP, 'Budget delivers record funding for environment', *Media Release*, 13 June 2017; Queensland Government, 'Budget highlights: Environment', https://budget.qld.gov.au/budget-highlights/environment/ (accessed 19 October 2017).

> with the zoning rules and also the fisheries rules. Both of these initiatives are critical contributions to the resilience of the marine park.[18]

6.19 The benefits of effective fisheries management were highlighted by the following evidence indicating how populations of fish species reefs recovered from cyclone damage:

> Two recent studies have indicated positive effects of protection from fishing on cyclone impacted reefs. Among reefs that were affected by [Tropical Cyclone] Hamish, the biomass of coral trout declined after the cyclone on reefs that were open to fishing, while there was no substantial change in biomass on reefs that were protected from fishing. A 12 year study of recovery of both benthic communities and fish communities on GBR reefs following disturbances found evidence that time to recovery following storms was 9% shorter for benthic communities and 18% shorter for fish communities on reefs that were closed to fishing compared with reefs where fishing was permitted.[19]

6.20 GBRMPA also explained that it is seeking to improve compliance with its zoning plan that regulates activities permitted in the Great Barrier Reef Marine Park:

> One of our key management tools is the zoning plan, which specifies the types of use allowed in different areas of the marine park. Fishing is prohibited in the marine national park zones, commonly referred to as 'green zones', which make up about 33 per cent of the park's 344,000 square kilometres. Together, ecologically sustainable fisheries and zoning contribute to enhancing the reef's resilience and that of the industries which depend on it to a range of threats, including climate change.[20]

Crown-of-thorns starfish management

6.21 As noted in Chapter 3, crown-of-thorns starfish outbreaks have been one of the major long-term causes of damage to the health of the Reef. Under the Reef 2050 Plan, efforts to reduce crown-of-thorns starfish outbreaks are focused on improving water quality and a targeted control program 'as needed'.[21] The Plan includes the following explanation regarding the scope of the control program:

> The Australian Government is…continuing a crown-of-thorns starfish control program, investing $10.5 million from 2012 to 2015 to protect high value reefs and increase knowledge of crown-of-thorns starfish biology. The program includes coordinating control activities, providing training for industry divers and community members, and undertaking industry

18 Dr David Wachenfeld, Director, Reef Recovery, Great Barrier Reef Marine Park Authority (GBRMPA), *Committee Hansard*, 30 August 2017, p. 46.

19 AIMS, *Submission 10*, p. 8.

20 Dr David Wachenfeld, GBRMPA, *Committee Hansard*, 30 August 2017, p. 46.

21 Australian Government and Queensland Government, *Reef 2050 Long-Term Sustainability Plan*, March 2015, p. 37.

> communication and awareness-raising activities. The aim is to maintain coral cover on targeted reefs at greater than the 20 per cent considered essential for reef health and resilience.[22]

6.22 Ms Hayley Morris, Executive Director, Morris Group, provided an example of control efforts. Ms Morris advised that crown-of-thorns starfish have been in 'plague numbers' in some areas, with 'up to 35,000 culled within reefs just off Orpheus Island in the last two months'.[23] Ms Morris added that there is research underway to enhance the effectiveness of culling efforts. Ms Morris advised that the Morris Group is funding a research project undertaken by James Cook University to support the eradication of crown of thorns starfish earlier in their lifecycles. Ms Morris explained:

> What they are trying to do is to have a detection program in place so that when the baby crown of thorns start to hatch an alert system goes off which allows organisations involved in the eradication project to get in there quickly before they become an issue that can really destroy the reef. Part of the issue is that if an outbreak happens it is almost too late and then the job becomes so much bigger because they are already spreading so fast. Whereas if you can get them at the early juvenile stage before an outbreak happens, an alert system helps to gives us the understanding of the conditions that make it right for outbreaks to happen. So that was $100,000 to James Cook University, and that project is in the early stages.[24]

6.23 However, others questioned the value of localised culling efforts for the overall health of the Reef. Dr Katharina Fabricius, Australian Institute of Marine Science (AIMS), stated that localised culling efforts are:

> …effective at a very small, local scale to keep available some spots that the tourist operators are visiting available. From an economic point of view, it is effective for those operators. From an ecological perspective, it is like killing flies in the outback. There are millions of crown-of-thorns starfish out there, and all the efforts that have been made to kill crown-of-thorns have reduced the number by maybe half a million starfish so far. With a single female producing 30 million eggs per spawning season, that reduction, through a lot of effort, in my mind is ecologically not important.[25]

22 *Reef 2050 Long-Term Sustainability Plan*, p. 25.

23 Ms Hayley Morris, Executive Director, Morris Group, *Committee Hansard*, 29 August 2017, p. 29.

24 Ms Hayley Morris, Morris Group, *Committee Hansard*, 29 August 2017, p. 31.

25 Dr Katharina Fabricius, Senior Principal Research Scientist, AIMS *Committee Hansard*, 30 August 2017, p. 38.

Work underway to account for recent developments

6.24 As significant coral bleaching events occurred since the release of the Reef 2050 Plan, GBRMPA advised that further work has been underway to account for these developments. GBRMPA noted that the Commonwealth and Queensland environment ministers recently announced their intention to bring forward the mid-term review of the Reef 2050 Plan. In addition, in May 2017 GBRMPA hosted a summit of 70 national and international experts in the use and management of coral reefs with the aim of developing a 'blueprint for protecting corals and coral reefs into the future'. The blueprint, which as at September 2017 was in development, will focus on '10 priority initiatives, including the need to accelerate global action on climate change, improve compliance with zoning and other rules and enhance crown-of-thorns starfish control'.[26]

Overall approach to building resilience of the Great Barrier Reef

6.25 As noted above, some stakeholders argued strongly for urgent action to address climate change by reducing emissions. For example, the Australian Marine Conservation Society's (AMCS's) overarching criticism of the Reef 2050 Plan is that it does not contain any actions to mitigate carbon emissions.[27] There was also debate about the effectiveness of localised recovery and resilience programs compared to action targeting carbon emissions.

6.26 Calls for changes to be made to the Reef 2050 Plan were made during this inquiry. Of particular note, in May 2017, the Reef 2050 Plan Independent Expert Panel announced that, in its view, when the mid-term review of the Plan takes place in 2018, the following changes should be made:

- climate change adaptation and mitigation actions should be included;
- the Plan should include 'a focus on a sustainable, functional Reef in the face of emerging cumulative impacts'; and
- there should be a 'greater emphasis on empowering local people and communities to deliver on-ground action that will benefit the Reef'.[28]

6.27 This section discusses some of the localised recovery projects drawn to the committee's attention and the evidence received about the success and limitations of such programs.

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26 Dr David Wachenfeld, GBRMPA, *Committee Hansard*, 30 August 2017, pp. 46–47, 49.

27 Mr Tony Fontes, Reef Campaigner, AMCS, *Committee Hansard*, 30 August 2017, p. 28.

28 Reef 2050 Plan Independent Expert Panel, Communiqué of seventh meeting, 5 May 2017, www.environment.gov.au/system/files/pages/abff0d5e-b94d-4495-b79b-90dc52274f69/files/expert-panel-communique-5may2017.pdf (accessed 15 November 2017).

6.28 The committee received evidence about specific assisted recovery projects and suggestions for such projects. The crown-of-thorns starfish management programs are one example. Another example was given by Professor Damien Burrows, who noted that in response to a cyclone, 'some teams went out to tip corals and move coral rubble off the beaches back into the water to create substrate for coral larvae to settle on'.[29] Professor Burrows argued that more of this type of work is required.[30]

6.29 Dr David Wachenfeld, GBRMPA, informed that committee that it is aware of research underway to improve coral recruitment rates by controlling the conditions in which coral spawn. Dr Wachenfeld referred to the spawning events during which corals synchronise their spawning to maximise fertilisation rates. Dr Wachenfeld explained that a few weeks after the spawning event, when the fertilised eggs have settled, the eggs turn into larvae and then 'a tiny little creature that goes down onto a coral reef and transforms into a new coral polyp'. Dr Wachenfeld advised that the research project involves collecting and maintaining the spawn in an aquarium 'so that much more of it survives than it would in the natural environment and then to put the spawn, at the right time, back onto the reef to deliver higher recruitment rates'. Dr Wachenfeld added:

> At the moment there have been some successful trials of this by an Australian scientist in the Philippines. We've just begun trials on the Great Barrier Reef. I should emphasise at the moment that this is a very small-scale endeavour. At the scale it is at the moment, it would be a site management tool. But the ambition, obviously, is to do the research to try to scale this up. This is really just one of the intervention and restoration tools that are being thought about and investigated.[31]

6.30 Localised resilience programs were also discussed. An example is an initiative to support the health of commercially significant reefs involving destratification. Sheriden Morris from the Reef and Rainforest Research Centre explained that the program involves technology developed by the Queensland University of Technology which can 'address localised climate impacts on coral reef systems'. Sheriden Morris stated:

> That technology is being widely used. Cairns Regional Council has adopted it into their dams for destratifying the water—for cold water pollution and for blue-green algae control. So it's already been built and used here in the tropics and we know that the mechanics of this are possible. The flow dynamics and modelling are currently being done; we've raised sufficient funds for those, and we are looking at running a pilot very shortly. We have put in a request for funds to help to run that pilot.

29 Professor Burrows explained that coral larvae prefer to settle on other coral.

30 Professor Damien Burrows, *Committee Hansard*, 30 August 2017, p. 23.

31 Dr David Wachenfeld, GBRMPA, *Committee Hansard*, 30 August 2017, pp. 51–52.

> We know that this will not save the entire Great Barrier Reef, but it will be able to be deployed at key tourism sites, which get about 120,000 visitors a year. This is about their only experience of the reef. We are fortunate: we have very, very clever scientists and we have clever engineers. We could, potentially, lead the way in protecting some of these zones. This is a very applied, very practical response, but only really for the tourist industry. It doesn't protect the GBR, but it will potentially provide a refugia for the tourist industry.[32]

6.31 As the above statement indicates, Sheriden Morris recognised that this technology is only a practical option to provide a refugia for small areas of the Reef. This point was reinforced by other witnesses; for example, Mr Tony Fontes from the AMCS noted that these projects 'might prop up a tourist operation' but otherwise were a 'tiny bandaid [that] is not going to make any difference at all in the long run'.[33] Dr Andrew Hoey from the Australian Research Council (ARC) Centre of Excellence for Coral Reef Studies similarly expressed scepticism about using pumped water. Dr Hoey stated that if such solutions work, and he is not convinced that they do, there is still a need to consider the interconnected nature of the Reef. Dr Hoey explained:

> The reef is obviously a complex system. So if you protect one, with a lot of the fish that you want to protect for fisheries, you're not going to be taking them from a tourism reef. They're interconnected between different reefs and different habitats. Some settle out of the plankton to inshore habitats before they move offshore. So it is not a matter of protecting one little spot. Even if we do those things, that's largely targeting the coral bleaching itself; it's not going to get those direct physiological effects that are impacting the fish, either.[34]

6.32 A counterargument, however, is that refugia work may help to ensure that some species of coral will survive that might not otherwise survive. Sheriden Morris stated:

> I know there are purists who disagree with this, but the concept around refugia is that, if, by some wonderful outcome, we do decarbonise the economy and if by 2050 we actually enable carbon to be stabilised around the atmosphere—if lots of things: if the Paris agreement's upheld and all those things happen, and by 2050 we stop below two degrees—refugia has a very, very special place, because this is what will save the complexity of the 330 species of corals, plus or minus a few, that we have. Otherwise, we will lose quite a large number of species…[T]he reality is that, if we want to keep some of those species, we're going to have to do something. We are locked in for 20 years of temperature increase, regardless of whether we decarbonise the economy tomorrow. So, with that in mind, do we look to

32 Sheriden Morris, Managing Director, Reef and Rainforest Research Centre, *Committee Hansard,* 29 August 2017, p. 2.

33 Mr Tony Fontes, Reef Campaigner, AMCS, *Committee Hansard,* 30 August 2017, p. 31.

34 Dr Andrew Hoey, Reef Ecologist, Australian Research Council (ARC) Centre of Excellence for Coral Reef Studies, James Cook University, *Committee Hansard,* 30 August 2017, pp. 4–5.

> protect some of the biodiversity or do we let it all just get slaughtered? The second point is: do we expose Australia's marine tourist industry—the 64,000 jobs and the $5 billion to $6 billion—when we have an opportunity to give it some protection?[35]

6.33 The committee also received evidence about assisted evolution with the aim of making corals more tolerant of higher temperatures. It was noted that some corals already have 'a pre-existing adaption capacity' that can help them adapt to changing conditions. Sheriden Morris stated:

> Corals also, remember, are old, like you inferred, and they can reach back into their back pocket for a pre-existing adaptation capacity. Not all corals but some corals have that existing adaptation capacity. Those that can adapt to these extreme events will be the ones that survive; those that can't access that adaptation capacity will be the ones that die. But, interestingly enough, it is not necessarily species wide. You'll have some corals—and you'll hear this over and over again—in a big patch of *Acropora* that have died and some that survive. So it's like high-speed evolution happening. But it's not really evolving; it's just pre-existing adaptation capacity.[36]

6.34 Differences between the degree of thermal tolerance within the Great Barrier Reef and the potential these differences present for assisted evolution efforts were noted. Dr Fabricius explained that the Reef 'has a greater thermal tolerance in the far north compared to the south', with evidence from the reefs in Papua New Guinea are also more tolerant of warmer waters. Dr Fabricius noted that currents are transporting larvae, which over time would support the growth of coral with a greater thermal tolerance in southern areas of the Reef. Dr Fabricius added that, potentially, research and rehabilitation work could assist this process. However, Dr Fabricius acknowledged that:

> …there are a lot of huge knowledge gaps and we are really just starting to dabble with ideas. And, yes, that won't be an easy thing. There certainly are very great challenges about scale. I don't believe in technology fixes. There will be no 3-D printing of our Great Barrier Reef and fish are happy again.[37]

6.35 Dr Janice Lough, Senior Principal Research Scientist, AIMS, also referred to assistant evolution research underway between AIMS and the University of Hawaii that is, at this time, 'just exploring the possibilities'. Dr Lough provided the following insights into the reasoning behind the project:

> …there are winners and losers when you have these major, say, thermal-stress events of reefs. You can look at a reef that has been bleached and

35 Sheriden Morris, Reef and Rainforest Research Centre, *Committee Hansard*, 29 August 2017, p. 3.

36 Sheriden Morris, Reef and Rainforest Research Centre, *Committee Hansard*, 29 August 2017, p. 4.

37 Dr Katharina Fabricius, AIMS, *Committee Hansard*, 30 August 2017, pp. 39–40.

> there is one coral that hasn't bleached. What are the attributes of those particular organisms that survive?
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> This is a complex project that is running over about five years, I think, that is examining: can we help the photosynthetic algae in the coral? They have very fast generation times. Maybe we can help them confer greater thermal tolerance on their hosts. There are a range of other activities that they are looking at.[38]

6.36 Despite the evidence received about the potential for assisted recovery and evolution and the willingness of scientific organisations to pursue further research in these areas, it was emphasised that such efforts:

> …are not seen by the scientists as an alternative for mitigating climate change, they are a strategy to give reefs time to adapt, but we still do need to achieve the objectives of the Paris Agreement…[39]

Further research and better utilisation and coordination of research efforts

6.37 The committee received a significant amount of evidence about the importance of further scientific research and the need to better utilise the results of research and the resources available for research.

6.38 The benefits of existing research programs were highlighted. In particular, the Integrated Marine Observing System (IMOS) was discussed. As noted in Chapter 2, funding for IMOS is provided by the Australian Government under the National Collaborative Research Infrastructure Strategy (NCRIS), with co-investment from other research partners supporting this core funding.

6.39 Concern shared by those involved in IMOS about the need to secure funding under the NCRIS for IMOS to continue is clear. For example, the University of Tasmania, as lead agency for managing IMOS, prepared a five year plan (2017–2022) designed to secure NCRIS funding. The five-year plan links IMOS to a range of government policies and research plans to 'make…the case for IMOS to be maintained as a world class research infrastructure'. As the document observes, although co-investment 'is essential to the functioning of IMOS as a whole', without the core investment provided by the Australian Government 'there will be no IMOS in which to co-invest'.[40]

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38 Dr Janice Lough, Senior Principal Research Scientist, AIMS, *Committee Hansard*, 30 August 2017, p. 39.

39 Dr David Wachenfeld, GBRMPA, *Committee Hansard*, 30 August 2017, p. 52.

40 University of Tasmania, *IMOS Five Year Plan (2017–22)*, http://imos.org.au/fileadmin/user_upload/shared/IMOS%20General/documents/IMOS/Plans___Reports/5_year_plan/IMOS-Five-Year-Plan-Final-23-09-16.pdf (accessed 14 November 2017), pp. 1, 31.

6.40 This issue was also raised during the March 2017 public hearings. Professor Iain Suthers from the Sydney Institute of Marine Science (SIMS), explained that the operators of IMOS 'now need to compete' for NCRIS funding. Professor Suthers noted that this uncertainty has implications for retaining staff:

> We expanded through the Kevin Rudd inspired NCRIS funding. That has now been contracted. That was about $18½ million per year to run the program. We have now cut and trimmed it down to about a $16 million-a-year request. That is what Tim Moltmann [Director, IMOS] has made to the NCRIS committee. That is still being assessed. They still do not know. Yet many of the people in the IMOS program, including the New South Wales IMOS, who have salaries that are dependent upon that are now looking over their shoulders for other jobs.
>
> So there is a great risk of losing that talent and that corporate knowledge, because these people are really specialists. They can move. They are very numerate. They can move into the banking sector, if they need to. But they love marine science; they love looking at climate—and we want to keep them. We had that signal 12, 18 months ago, but they are still now going through this NCRIS procedure to allocate the funds to these other capabilities.[41]

6.41 Professor Suthers added:

> IMOS is, without a shadow of a doubt, a stand-out. It has delivered for the public, for industry. We have quality-assured, quality-controlled data. It is being used, and how it is being used is being monitored and tracked. So I think that is a substantial feather in the cap for Australia. Even the US and Europe are looking at the way IMOS does business. I would hate to lose that.[42]

6.42 As part of the operational funding for 2017–2019 under the NCRIS, $29.5 million was allocated for IMOS.[43]

6.43 Another example of the need for funding to support long-term monitoring involves the Great Barrier Reef. As noted in Chapter 2, Professor David Booth referred to a team undertaking monitoring work on the Reef. Despite the existing scientific work, the need for further scientific research and funding for this research was emphasised. Professor Booth stated:

> …from a scientist's and ecologist's point of view, we just do not understand these natural systems well enough. I think long-term monitoring is so important but so underfunded. At the big end of town we have things like the IMOS—the integrated marine observing system—and AIMS's

41 Professor Iain Suthers, SIMS, *Committee Hansard*, 16 March 2017, p. 20.

42 Professor Iain Suthers, SIMS, *Committee Hansard*, 16 March 2017, p. 20.

43 Department of Education and Training, 'NCRIS Operational Funding 2017–2019', https://docs.education.gov.au/system/files/doc/other/ncris_projects_2017_funding_allocations.pdf (accessed 14 November 2017).

> long-term monitoring. They are great examples at the institutional level. There is smaller monitoring that we have done, but going for a quarter of a century that has been done on a shoestring. I think we need to build them to make them more secure.[44]

6.44 Professor Booth explained that, although the ARC provides grants that enable fisheries research with monitoring possible 'as a side issue', ARC funding cycles are for three year periods. Therefore, Professor Booth explained that ARC grants are not suitable for monitoring as three years of data 'is useless…[w]e know 25 years is not even enough'.[45] Professor Stewart Frusher, IMAS, also argued that there is a need for better coordination between state governments regarding secure funding to establish long-term data sets.[46]

6.45 Further examples of limited and short-term funding arrangements that do not enable the long-term monitoring necessary for analysing changes in the ocean environment were provided. Mr Simon Rowe from OceanWatch Australia stated:

> There was some money that was put aside to the NESP, the National Environmental Science Program—I think it was $142.5 million over six years—but that basically gets allocated towards priorities at the time. To respond to something like this calamity over this scale, I think they have available about $400,000, which they have under emerging priorities, which is quite a small amount. For those people who wanted to go out and act on this drama, it was very difficult to get some funds to go and start looking at the scale of the problem and what could be done about it.[47]

6.46 Gaps in monitoring are also evident. For example, in relation to the mangrove dieback in the Gulf of Carpentaria discussed in Chapter 3, the committee was advised that the dieback occurred in November 2015, however, the first report of dieback was not received by relevant experts until April 2016. Professor Burrows provided the following evidence regarding how he received initial reports of dieback and established that a large event had occurred:

> …in April 2016…we received an email from a fisherman in the Karumba area. He said, 'Guys, there's some dieback here. What do you reckon?' I remember that I was kayaking on the Ross River and I got a phone call. I was in the middle of kayaking and I was speaking to this fisherman: 'We'll have a look at it. But dieback is common. It does happen all the time. It's just one stand.' But we passed the photograph around to a few of our colleagues, and another colleague said, 'I'm going near Burketown; I'll have a look.' He said, 'I saw some dieback there as well, and the locals said it happened in November 2015, which is what the fisherman in Karumba said.' I said, 'That's interesting; they both said the same thing.' We passed

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44 Professor David Booth, *Committee Hansard*, 16 March 2017, p. 3.

45 Professor David Booth, *Committee Hansard*, 16 March 2017, p. 4.

46 Professor Stewart Frusher, IMAS, *Committee Hansard*, 21 February 2017, p. 7.

47 Mr Simon Rowe, OceanWatch Australia, *Committee Hansard*, 16 March 2017, p. 38.

> the word around to a few of our colleagues and said, 'Have you heard anything?' People from Borroloola in the Northern Territory said, 'Yes, we've got some dieback in our area too. It happened in about November 2015.' I thought, 'This is a coincidence; three different locations, all the locals saying it.' This was five months later.[48]

6.47 It was also argued that research efforts involving the marine environment could benefit from greater coordination. Mr Martin Exel, General Manager Environment and Policy, Austral Fisheries, commented on this by contrasting the coordination in meteorological matters with the various entities involved in marine research. Mr Exel stated:

> You have got the Bureau of Meteorology; they are doing a lot of work for us on the meteorological side of things but then, when you move into the oceanographic stuff, you have got IMOS here, you have got IMAS, you have got CSIRO—and everyone is vying for a little bit of pie. Setting up a single group where it could be said, 'You're responsible for looking at that marine side of things,' would help a great deal. I do not think it would be very expensive, personally.[49]

6.48 There were also suggestions that existing resources, such as the RV *Investigator*, need to be used more effectively. The vessel is capable of spending up to 300 days a year at sea;[50] however, evidence presented to the committee indicated that this capacity is not used in full. Professor Iain Suthers, SIMS, explained:

> One of the tools that we have that Australian taxpayers funded is the *Investigator*, this magnificent ship, 94 metres long, which is state of the art, and it is funded for only six months of the year. In the other six months, it is tied up at the wharf. You have marine scientists who are already funded and who have the expertise who are desperate to get to sea, even looking at perched sediment, which could cause a tsunami risk—unrelated to this issue—and yet we have this arcane formula to fund that vessel. It goes back, again, 20 years to the days of the Franklin and even before that. If I could make one plea: we already have the tool; we have the resource; can we just get it out there and operate it? It could help you with MH370 and all kinds of things.[51]

6.49 Witnesses representing CSIRO acknowledged that additional time on the *Investigator* would assist to gather 'higher resolution, more accurate information'. Dr Andreas Schiller from CSIRO, however, also highlighted practical issues with the process for obtaining use of the vessel. Dr Schiller provided the following evidence

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48 Professor Damien Burrows, *Committee Hansard*, 30 August 2017, p. 16.

49 Mr Martin Exel, General Manager Environment and Policy, Austral Fisheries, *Committee Hansard*, 21 February 2017, p. 24.

50 CSIRO, 'Research vessel: Investigator', www.csiro.au/en/Research/Facilities/Marine-National-Facility/RV-Investigator (accessed 30 October 2017).

51 Professor Iain Suthers, SIMS, *Committee Hansard*, 16 March 2017, p. 29.

that outlines the existing process and the difficulties researchers face in ensuring the time on the vessel suits their funding arrangements:

> Scientists write proposals to the national committee to seek time on that vessel. At the moment, you are having to write a proposal for two to three years ahead of time for allocation of time on that vessel. That can be problematic because you are granted time on the vessel but you have not yet got your other research project funded in order to support the ancillary work around that time. So aligning the vessel's scheduling with the time scale of other funding opportunities would be very advantageous. Sometimes we have the situation of a scientist obtaining the national facility time but their other grant that will pay for their people, the travel, the processing of samples and all of that fails, and they have to give back that time on the national facility because the timing of the proposals from group A and the national facility group do not line up.[52]

6.50 In response to a question taken on notice, however, CSIRO advised that there has been an increase in the number of days the *Investigator* is used for research. CSIRO explained:

> The *Investigator* is funded by the Australian Government to operate up to 180 days at sea per annum. In 2015/16 the ship delivered 248 research days at sea, through a combination of Australian Government funding and research charters. In 2016/17 with collaboration through a CSIRO/industry research partnership, the *Investigator* is planned to be at sea for an additional 19 days, and also a further 13 days for the Australian Hydrographic Service making an expected total of 204 research days at sea in 2016/17.[53]

6.51 Another area explored during this inquiry were the relationships between scientific organisations and industry. The report has previously referred to specific examples, such as the work involving CSIRO and the Tasmanian salmon industry. However, it was suggested that relationships between scientific bodies and industry need to be developed further. Ms Lowri Pryce, Executive Officer, OceanWatch Australia, remarked that knowledge is 'not being transferred effectively from the science community to the fishing and aquaculture sector'. Ms Pryce argued that the building of trusting relationships is required. Ms Pryce explained:

> It is difficult for a science community to engage with stakeholders who may be operating five kilometres offshore. They are not an easy stakeholder to wait around for. Communicating with on-water people—or saltwater people, as we call them—is somewhat of an expertise. That is the crucial link between science and them: somebody to translate as well as to extend. It is literally being on wharves and understanding how best to communicate. It is an acquired skill. It is an acquired skill that NRM is

52 Dr Andreas Schiller, Acting Director, Oceans and Atmosphere; Dr Alistair Hobday, Senior Principal Research Scientist, CSIRO, *Committee Hansard*, 17 March 2017, pp. 4–5.

53 CSIRO, Answers to questions on notice, 17 March 2017 (received 13 April 2017), p. 1.

> building. It is a skill OceanWatch has been flexing for the last 27 years. The capability is there. We have had the opportunity to extend information nationally from an environmental perspective through programs in the past—very successful, award-winning programs—and it is about giving us the opportunity to do what we do best as an NRM.[54]

6.52 The evidence received about privately commissioned research also demonstrates the need for further research, the limitations of existing government-supported research efforts and the relationship between scientists and industry. The committee was advised that Morris Group, which owns several tourism accommodation properties in north Queensland, is funding several research projects related to the health of the Great Barrier Reef. The first project supported by the Morris Group, which is in partnership with James Cook University and Earthwatch, operates on Orpheus Island and seeks to better understand how the Reef recovers following shocks such as cyclones and disease so as to improve understanding of what conditions are needed to support the Reef's recovery. The second project is a crown-of-thorns starfish early eradication project (this was discussed at paragraph 5.23). The third project is support to Great Barrier Reef Legacy, which is a not-for-profit 'research-educational institute'.[55] The support provided by Morris Group comprises $160,000 and the use of a vessel for research to search for and better understand corals that have survived bleaching events.[56]

54 Ms Lowri Pryce, OceanWatch Australia, *Committee Hansard*, 16 March 2017, p. 39.

55 Mr John Rumney, Managing Director, Great Barrier Reef Legacy, *Committee Hansard*, 29 August 2017, p. 38.

56 Ms Hayley Morris, Executive Director, Morris Group, *Committee Hansard*, 29 August 2017, p. 31; Ms Hayley Morris, Morris Group, *Submission 25*, p. 2.