Submission 059
Date received: 12/08/2011

Australian Government | Australian Institute of Marine Science
TOWNSVILLE | DARWIN | PERTH

12 August 2011

Ms J Norris,
Committee Secretary
House of Representatives
Standing Committee on Climate Change,
Environment and the Arts
PO Box 6021,
Parliament House
CANBERRA ACT 2600

Dear Ms Norris,

Thank you for your letter concerning the House of Representative's inquiry into Australia's Biodiversity in a Changing Climate. The Australian Institute of Marine Science (AIMS) welcomes the opportunity to provide a submission to this inquiry.

In this submission, AIMS presents the case that Australia's coral reefs are key examples of biologically diverse ecosystems of national and global importance. The Great Barrier Reef (GBR) in particular is a national icon and an important part of Australia's and the World's natural heritage. In recent years, the GBR has demonstrated vulnerability to climate change, made evident by two extensive coral bleaching events (since 1998) and Tropical Cyclone Yasi in February 2011.

If needed, AIMS would be keen to help in the development of a case study for Australia's coral reefs. The following is AIMS' submission to the Inquiry, structured according to the Terms of Reference.

1. Terrestrial, marine and freshwater biodiversity in Australia and its territories.

Australia is home to some of the World's most spectacular and diverse coral reefs including the Great Barrier Reef (GBR) and Ningaloo Reef. The GBR is the largest coral reef ecosystem on Earth (2200 km long) and Ningaloo is the largest fringing reef in the Southern Hemisphere. Functionally, the GBR and Ningaloo are the rainforests of Australia's marine environment; they are biologically richer than any other habitat (marine, terrestrial or freshwater) in Australia. Reef systems such as the GBR, Ningaloo and the reefs of Lord Howe Island are an important part of Australia's and the World's natural heritage, they have cultural value for Traditional Owners, and add significant revenue to the national economy. Australia has the second largest area of coral reef in the world, including a full range of reef types (inshore fringing reefs, mid-shelf and shelf edge reefs, oceanic atolls and deep submerged shoals). These reefs also span the full range of climatic conditions from temperate to tropical, and from arid to wet tropics. The value of the goods and services provided by Australia's coral reefs, represented mainly by tourism and fisheries, amount to more than $6 billion per year.

Coral reefs globally are significantly threatened by climate change and ocean acidification. The sensitivity of the GBR to climate change is now well documented by a growing body of scientific evidence and recent observations. Firstly, coral bleaching events due to periods of very high summer water temperatures have impacted coral populations on the GBR for a decade, and have now also recently influenced Ningaloo and Lord Howe (State of Environment Report, 2011). Secondly, three severe tropical cyclones in recent years (Larry in 2006, Hamish in 2009 and Yasi in 2011) have decimated large areas of the GBR. Thirdly, ocean acidification, which is a direct and indisputable chemical consequence of increasing CO_2 (the main greenhouse gas) concentrations in the atmosphere, impact on coral growth and physiology, thereby reducing a reef's ability to recover from

Townsville address: PMB No 3, Townsville MC, Qld 4810
Tel: (07) 4753 4444
Fax: (07) 4772 5852

Darwin address: PO Box No 41775, Casuarina NT 0811
Tel: (08) 8920 9240
Fax: (08) 8920 9222

Perth address: The UWA Oceans Institute (M096) 35 Stirling Highway, Crawley WA 6009
Tel: (08) 6369 4000
Fax: (08) 6488 4585

www.aims.gov.au

major disturbances such as bleaching and tropical cyclones. Also, ocean acidification has been demonstrated to upset the sensory physiology of larval reef fish, with implications for fish populations (Munday et al. 2010). The current upward track of CO_2 in the atmosphere means that the threat from ocean warming and acidification to Australia's coral reefs will grow significantly stronger over the coming decades. Predictions are indicating more intense coral bleaching events, more frequent severe cyclones and declining capacity for damage repair.

2. Connectivity between ecosystems and across landscapes that may contribute to biodiversity conservation

Connectivity between the terrestrial and marine environments is a fundamental issue for Australia's coral reefs and will increase in importance under climate change as weather events become more extreme. Recent examples of such extreme events are the Queensland flooding and Tropical Cyclone Yasi in 2011. Episodic run-off of freshwater, nutrients, sediments and pollutants all impact on coastal and nearshore regions of the GBR. Improved catchment management is the key remedy to reduce impacts from nutrient and pollutant run-off and the *Reef Water Quality Protection Plan 2009* and the *Reef Rescue Plan* are important Government initiatives in this regard. However, impacts of freshwater runoff on nearshore coral reefs are linked to meteorology and climate, and freshwater runoff is not under the control of local-scale management. Importantly, both the frequency and intensity of freshwater flooding events (Lough 2011) and the frequency of severe tropical cyclones (Walsh and Ryan, 2000), which also bring floods, are expected to increase under climate change. Further, as the CO_2 concentration in the atmosphere increases, the chemical connectivity between atmosphere and ocean grows stronger, increasing the threat of ocean acidification.

Connectivity across seascapes plays a critical role in the health of coral reefs and is a growing issue under climate change where multiple disturbances intensify. For example, climate-related disturbances such as coral bleaching and tropical cyclone impacts lead to ecosystem fragmentation, which increases the need for more intensified biodiversity conservation. Habitat degradation of one area may reduce the larval supply to other areas, thereby impairing rates of population replenishment and recovery. Shifts in temperature and wind regimes caused by climate change are also predicted to cause shifts in the character of the major boundary currents around Australia and alter patterns of larval dispersal and reef connectivity in as yet unpredicted ways (Climate Change Report Card 2010). Lastly, marine traffic between South East Asian and Australian ports are channels of connectivity for invasive species (e.g. in ballast water) and represents a biosecurity issue for Australian coral reefs and other marine habitats.

3. How climate change impacts on biodiversity may flow on to affect human communities and the economy

Climate change will likely have severe impacts on industries and communities linked to Australia's coral reefs. Groups most directly impacted are the tourism industry and commercial and recreational fisheries. Degradation of biodiversity at major tourism sites on the GBR and Ningaloo will erode these reef's goods and services, with negative consequences for Australian livelihoods. Climate change impacts are also expected to have flow-on effects to other related industries including hospitality, transportation and supporting service industries (GBR Outlook Report 2009). The impact on regional economies will be especially severe[1]. The enormous biological diversity of Australia's reefs represents a vast yet largely untapped source of novel biological compounds of economic and medical significance. Much of this potential resource could be lost if climate change results, as predicted, in a significant loss of biodiversity on coral reefs.

[1] The Great Barrier Reef (GBR) contributes just over $5 billion per annum to the national economy. If a total and permanent bleaching of the GBR were to occur today, then the costs are currently estimated at $37.7 billion with $16.3 billion for the Cairns area. Taken from *Valuing the effects of Great Barrier Reef Bleaching*, Oxford Economics and the Great Barrier Reef Foundation, Australia, August 2009. Also, the GBR supported 39,700 jobs within the GBR catchment area in 2006-07.

Ocean acidification from increased uptake of CO_2 from the atmosphere is predicted to gradually lower the ability of reef-building corals and shell-forming organisms to create and maintain structures. The GBR has broad value in terms of ecosystem services: it provides important biodiversity value, sustains significant fisheries, and serves as a wave barrier for Queensland's coastal communities. It is in Australia's interest that the GBR maintains these values in perpetuity. The medium to long-term consequences of ocean acidification are profound and a serious environmental and economic issue for Australia. A group of 50 marine scientists at a recent ocean acidification conference in Canberra, jointly organized and chaired by AIMS and CSIRO, came to the following conclusions:

- Global marine ecosystems including coral reefs are significantly threatened by ocean acidification, with implications for dependent communities globally.
- More facets of marine biology are threatened by ocean acidification than previously thought, with far-reaching implications for coral reef ecosystem function and the goods and services they provide.

4. Strategies to enhance climate change adaptation, including promoting resilience in ecosystems and human communities

The most effective way to secure a future for Australia's coral reefs and limit costly adaptation and mitigation measures in the face of climate change is to reduce global greenhouse gasses (especially CO_2) emissions. As the World is already committed to some level of climate change, a second important strategy is to enhance ecosystem resilience – i.e. promote the ability of the system to recover from disturbances. Key mechanisms for building reef ecosystem resilience is through intensified management of local-scale disturbances such as coastal developments, nutrient run-off and fishing pressures (Anthony et al. 2011). Enhanced ecosystem resilience through strategic management can effectively buy reefs time while atmospheric concentrations of CO_2 and other greenhouse gasses are reduced to safe levels.

Adaptation by human communities will become increasingly important as we enter further into an era of climate change and ocean acidification, but the necessity for expensive and radical adaptation and mitigation measures can be reduced by early curbing of CO_2 emissions. Useful adaptation and prevention strategies to address climate change are presented in *The Great Barrier Reef Climate Change Action Plan 2007 – 2012*. Key elements of the plan are to support (1) the adaptation of reef-dependent communities and industries, and (2) the resilience of the reef ecosystem.

The development of strategies for promoting the resilience of Australia's coral reefs is a high-priority research focus of the Australian Institute of Marine Science (AIMS). Here, AIMS works closely with reef managers and policy makers to develop plans for how ecosystems such as the GBR can be managed in the future to minimize its vulnerability to climate change and ocean acidification.

5. Mechanisms to promote the sustainable use of natural resources and ecosystem services in a changing climate

Effective and adaptive management strategies based on sound science are required to promote the sustainable use of natural resources and ecosystems in a changing climate. Several mechanisms are in place to promote the sustainable use of the GBR Marine Park, most importantly the GBRMP Zoning Plan 2003 (GBR Outlook Report 2009). The zoning plan is designed to protect the reef's biodiversity at multiple spatial scales, mainly via controls on fishing and shipping.

The challenges of sustainable use of coral reefs are greater in the neighbouring developing countries to Australia's North, specifically the Coral Triangle (www.cti-secretariat.net), where the livelihoods of more than 200 million people depend on reef resources. The climate change threat to coral reefs in the Coral Triangle has implications for food security in the region. Due to the human pressures on reefs in the Coral Triangle, these systems are more sensitive to climate change than well-managed reefs (Anthony and Maynard 2011). Australian marine science institutions such as AIMS are well

placed to assist in building capacity and improving the sustainable use and conservation of Coral Triangle reef resources.

6. An assessment of whether current governance arrangements are well placed to deal with the challenges of conserving biodiversity in a changing climate

Some arrangements are in place to conserve biodiversity under the current climate, and agencies such as the GBRMPA are actively seeking ways to better understand how to govern and manage the system under climate change and ocean acidification. However, as Australia's coral reef ecosystems enter into the uncharted territory of a rapidly changing climate, it is critical that science and management planning collaborate to proactively develop decision and planning support tools to maximise resilience and minimise vulnerability of reef ecosystems. A number of such collaborative projects between AIMS, GBRMPA and other Government departments are now underway for the GBR.

Beyond the GBR and Ningaloo, Australia has rich coral reef resources (for example to the North West) whose biodiversity and conservation value are still unaccounted for. Australia therefore may stand to lose more marine resources and wealth to climate change than estimated from threats to the GBR and Ningaloo alone.

For governance arrangements seeking to safeguard Australia's vast coral reef resources in a changing climate, the following elements must form part of the solution:

- Investment into science / management / policy partnerships with the objective to better understand ecosystem and biodiversity vulnerabilities and opportunities for management and policy to lower the risks to Australia's reef resources
- Effective uptake of recommendations from such partnerships into government policy – i.e. two-pronged strategies of reduced carbon emissions and local-scale conservation planning to enhance ecosystem resilience
- Broad communication of policy recommendations for raised public awareness of the climate change threat to marine resources and the ecological and societal implications of action versus inaction.

7. Mechanisms to enhance community engagement

The Australian community is currently confronted with a range of claims regarding the impact of climate change, ranging from the alarmist to the complacent. In order to ensure community support for, and engagement in, local and national efforts to reduce impacts and promote adaptation to climate change, the public must have access to consistent, impartial and authoritative information on climate change impacts based on careful observation and analysis. Research institutions such as AIMS will have a key role to play in providing this information and in promoting the maintenance and expansion of high calibre monitoring, research and analysis of climatic impacts on Australia's coral reefs.

Again, AIMS sincerely appreciates the opportunity to provide this submission and we would be enthusiastic about assisting the Committee develop a case study for Australia's coral reefs.

Yours sincerely,

Ian Poiner
CEO

References

- Anthony KRN, Maynard JA (2011) Coral reefs in the emergency room: continued carbon emissions will increase the need for intensive care. (Editorial) *Carbon Management,* 2: 215-218
- Anthony et al. (2011). Ocean warming and acidification will lower coral reef resilience. *Global Change Biology,* 17:1798-1808
- Climate Change Report Card
    - http://www.oceanclimatechange.org.au/content/index.php/site/welcome/
- Great Barrier Reef Outlook Report (2009).
    - http://www.gbrmpa.gov.au/outlook-for-the-reef/great-barrier-reef-outlook-report
- Great Barrier Reef Climate Change Action Plan (2007– 2012)
    - *www.gbrmpa.com.au/resources-and-publications/*
- Lough JM (2011) Great Barrier Reef coral luminescence reveals rainfall variability over northeastern Australia since the 17th century, *Paleoceanography*, 26, PA2201
- Munday PL et al. (2010) Replenishment of fish populations is threatened by ocean acidification. *PNAS*, 107: 12930-12934
- Reef Rescue Plan
    - http://www.nrm.gov.au/funding/2008/reef-rescue.html
- Reef Water Quality Protection Plan (2009)
    - http://www.reefplan.qld.gov.au/about/rwqpp.shtm
- State of Environment Report 2011 (in press) Australia's coral reefs in a changing ocean.
    - http://www.environment.gov.au/soe/2011/index.html
- Walsh KJE & Ryan BF (2000) Tropical cyclone intensity increase near Australia as a result of climate change. *Journal of Climate*, 13:3029-3036