

4-8-2016

Science-Based Policy Plan for Australia's Coral Reefs

David Booth
Australian Coral Reef Society Inc.

Lauren Nadler
James Cook University - Australia


Steve Doo
University of Sydney - Australia

Elizabeth Madin
Macquarie University - Australia

Sue-Ann Watson
James Cook University - Australia

Find out more information about [Nova Southeastern University](#) and the [Halmos College of Natural Sciences and Oceanography](#).

Follow this and additional works at: https://nsuworks.nova.edu/occ_facreports

 Part of the [Marine Biology Commons](#), and the [Oceanography and Atmospheric Sciences and Meteorology Commons](#)

NSUWorks Citation

David Booth, Lauren Nadler, Steve Doo, Elizabeth Madin, and Sue-Ann Watson. 2016. Science-Based Policy Plan for Australia's Coral Reefs : 1 -5. https://nsuworks.nova.edu/occ_facreports/132.

This Report is brought to you for free and open access by the Department of Marine and Environmental Sciences at NSUWorks. It has been accepted for inclusion in Marine & Environmental Sciences Faculty Reports by an authorized administrator of NSUWorks. For more information, please contact nsuworks@nova.edu.



Australian Coral Reef Society Inc.

A society promoting scientific study of Australian Coral Reefs

ACRS Correspondence

c/- Biological Sciences

The University of Queensland

St Lucia QLD 4072

(07) 3365 1686

austcoralreefsoc@gmail.com

Science-Based Policy Plan for Australia's Coral Reefs

8 April 2016

Summary: Australia's coral reefs are currently under threat from a range of short- and long-term stressors. The ability of corals to recover from acute disturbance events, such as bleaching, cyclones and crown-of-thorns seastars outbreaks, is greatly influenced by the multitude of stressors reefs are currently experiencing (1). Since healthy coral habitat is essential for the persistence of associated fish and invertebrate communities, as well as the industries that rely on them (2), all possible action must be taken to reduce stress factors to corals and associated organisms. Practical changes to current reef policies will reverse the decline in the health of Australia's coral reefs and increase the viability of all of the reef's associated industries.

Below is a list of issues that the **Australian Coral Reef Society** sees as the key stressors affecting the reef and future policy changes that could mitigate their effects.

- 1. Climate change:** The greatest and most pressing challenge currently facing the reefs of Australia is climate change, which affects the reef through warming sea surface temperatures, ocean acidification, increasing storm intensity and rising sea levels (3). Projected changes expected to occur in the first half of this century will have profound negative effects on the health and survival of reef organisms, including corals, invertebrates and fish species (4-8).

Suggested policy goals:

- Transition away from fossil fuels (e.g. reduce investment in coal mining infrastructure; no approval of new or expansion of existing coal mines or ports)
- Invest in renewable energy technology (e.g. via consumer rebates, R & D tax breaks)
- Establish rapid and ambitious government targets for reducing greenhouse gas emissions

- 2. Port development:** Port development leads to a range of impacts for coral reefs, primarily due to dredging for shipping channels, increased shipping activity and introduction of contaminants from

President: Prof David Booth; Tel: 02 9514 4053; Fax: 02 9514 4079; Email: david.booth@uts.edu.au

Vice-President: Dr Andrew Hoey; Tel: 0458 174 583; Fax: 02 9514 4079; Email: andrew.hoey1@jcu.edu.au

Hon Secretary: Dr O. Selma Klanten; Tel: 0417 341 941; Fax: 02 9514 4079; Email: osklanten@me.com

Hon Treasurer: Dr Jennifer Donelson; Tel: 0402 062 046; Fax: 02 9514 4079; Email: jennifermarie.donelson@uts.edu.au

materials that are in transit (9). Increased suspended sediment in the water from dredging and contaminants like coal can smother corals and cause deformities during development for a range of species (10).

Suggested policy goals:

- Stop development of new ports and expansion of existing ports
- Limit shipping channels through protected reefs, including the Great Barrier Reef Marine Park
- Minimise pollution from goods in transit, such as coal, lead, zinc, nickel and copper, by requiring sealed covers for all carriers of materials (e.g. ships, conveyor belts, trains and trucks)
- Institute a total ban on dumping of capital and maintenance dredge spoil at sea; require all dredge spoil be disposed of properly on land away from wetlands and waterways

- 3. Water quality:** As more coastal areas are cleared for agriculture, coastal development and roads, inshore coral reefs are increasingly exposed to high levels of nutrients, sediments and pollutants through land-based runoff that increase turbidity and reduce light availability (11). These changes have led to reductions in coral diversity and coverage on inshore reefs. Under these conditions, macroalgae communities often replace corals because algae grows well under high nutrient loads, while corals photosynthesise poorly under lowered light availability (12, 13).

Suggested policy goals:

- Manage fertilizer and pesticide use by the agricultural sector (reduce use, provide greater regulation and mandate records)
- Restore riparian zone (e.g. the marginal areas between land and rivers/streams) vegetation to capture runoff and reduce topsoil erosion before it reaches the ocean
- Reinstate vegetation management legislation in Queensland to minimise land clearing, particularly in the vulnerable Great Barrier Reef catchment
- Develop an ecosystem-based assessment protocol to determine nutrient reduction targets for specific catchment areas along all coastal reef areas, which would allow for flexible, site-specific nutrient reduction targets

- 4. Fisheries:** Australia's reefs have been well protected by marine reserves and fisheries regulations. Yet, evidence shows that where fishing occurs, there can be significant consequences for reef ecosystems. For instance, loss of top predators disrupts the equilibrium of the food chain, affecting the survival and behaviour of species lower in the ecosystem hierarchy (14-16). In addition, herbivorous (plant-eating) fish species help to keep seaweed growth in check, particularly following major disturbances (e.g. cyclones), which aids coral recovery through competition with these macroalgae for space on the reef (17-19). Designing fisheries regulations in line with ecosystem-based management principles has the potential to mitigate many of the negative effects of fisheries.

Suggested policy goals:

- Implement strict limits on the harvest of long-lived, slow-reproducing species (e.g. sharks) and set sustainable catch limits for top predators (e.g. coral trout) on Australia's coral reefs
- Ban fishing of herbivorous fishes to provide 'insurance' against future disturbances

- Increase spatial protection (e.g. increase no-take marine park zones) for fish in important life stages, including juvenile nursery grounds and spawning aggregation zones, which will likely increase fisheries yields

5. Crown-of-thorns seastars: Outbreaks of crown-of-thorns seastars (COTS) are one of the greatest contributors to coral loss on Australia’s coral reefs. COTS are voracious coral predators, with the capacity to consume 1 – 3 m² of coral per day (20). Given the slow-growing nature of corals, COTS outbreaks have led to rapid destruction of coral reefs on a local scale.

Suggested policy goals:

- Increase protection of known COTS predators (e.g. pufferfish, triggerfish)
- Develop an integrated management plan for the rapid detection and control of COTS outbreaks

6. Compliance and management: Compliance is essential for the effectiveness of marine management policies. Therefore, investment in infrastructure that promotes compliance and increases enforcement is essential for the success any new legislation (21).

Suggested policy goals:

- Increase the presence of patrol boats in marine protected areas (MPA) to increase enforcement and compliance of zoning regulations
- Implement an accessible information system for recreational and commercial fishers on zoning, particularly temporal closures
- Install additional moorings within marine parks to reduce anchor damage to vulnerable habitats and promote tourism

7. Beach erosion: Production of carbonate sands on coral reefs is vital to the maintenance of coral reef beaches. The majority of these coral reef sands are composed of the eroded skeletons of a range of species, including corals, molluscs and tiny foraminifera (22). As sea levels are currently rising, beach erosion has become a major concern on the islands of the Great Barrier Reef and beaches around the coast of Australia (11). A range of endangered species, including sea turtles and seabirds, rely on coastal habitat for nesting grounds.

Suggested policy goals:

- Implement policy changes to combat climate change and resultant sea level rise (see “Climate change” above)
- Protect beach habitat and areas of high sand production from sand-harvesting and limit destructive coastal development around them
- Reseed damaged beach habitat with living organisms from areas with high sand production to encourage a continued source of sand

8. Anthropogenic noise: Noise pollution from recreational boats, commercial vessels and container ships are often overlooked as a major stressor to marine habitats. Underwater noise has been shown to affect a wide range of marine species, notably marine mammals and fishes, which rely on acoustics for important processes like foraging, communication and navigation. Sound travels

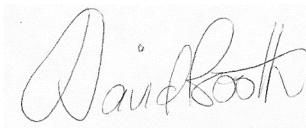
approximately four times faster in water than air due to pressure differences, and therefore noise pollution can often have far-ranging and unexpected impacts on marine communities (23-25).

Suggested policy goals:

- Implement quiet sanctuaries by incorporating noise into MPA spatial planning
- Create noise buffer zones for shipping lanes (e.g. position shipping lanes to maximise distance to coral reefs so that noise dissipates prior to reaching these habitats)
- Implement legislation requiring proper servicing of boat motors (e.g. engine mounts and mufflers to reduce vibrations and noise) to keep noise to a minimum

ACRS would be happy to provide additional information on the above as required.

Sincerely,



Professor David Booth
ACRS President

Acknowledgements:

ACRS thanks Miss Lauren Nadler (James Cook University), Mr Steve Doo (University of Sydney), Dr Elizabeth Madin (Macquarie University) and Dr Sue-Ann Watson (James Cook University) for their extensive contributions in preparing this document.

References:

1. Pisapia C & Pratchett MS (2014) Spatial Variation in Background Mortality among Dominant Coral Taxa on Australia's Great Barrier Reef. *PLoS One* 9:e100969.
2. Wilson SK, *et al.* (2010) Habitat degradation and fishing effects on the size structure of coral reef fish communities. *Ecol Appl* 20:442-451.
3. Hoegh-Guldberg O, *et al.* (2007) Coral Reefs Under Rapid Climate Change and Ocean Acidification. *Science* 318:1737-1742.
4. Munday PL, Jones GP, Pratchett MS, & Williams AJ (2008) Climate change and the future for coral reef fishes. *Fish Fish* 9:261-285.
5. Fabricius KE, De'ath G, Noonan S, & Uthicke S (2014) Ecological effects of ocean acidification and habitat complexity on reef-associated macroinvertebrate communities. *P Roy Soc Lond B Bio* 281:20132479.
6. Albright R, *et al.* (2016) Reversal of ocean acidification enhances net coral reef calcification. *Nature*. doi:10.1038/nature17155
7. Rummer JL, *et al.* (2014) Life on the edge: thermal optima for aerobic scope of equatorial reef fishes are close to current day temperatures. *Glob Chang Biol* 20:1055-1066.
8. Welch MJ, Watson S, Welsh JQ, McCormick MI, & Munday PL (2014) Effects of elevated CO₂ on fish behaviour undiminished by transgenerational acclimation. *Nat Clim Change* 4:1086-1089.
9. Grech A, *et al.* (2013) Guiding principles for the improved governance of port and shipping impacts in the Great Barrier Reef. *Mar Pollut Bull* 75:8-20.

10. Hess S, Wenger AS, Ainsworth TD, & Rummer JL (2015) Exposure of clownfish larvae to suspended sediment levels found on the Great Barrier Reef: Impacts on gill structure and microbiome. *Sci Rep* 5:10561.
11. Great Barrier Reef Marine Park Authority 2014. *Great Barrier Reef Outlook Report 2014*. GBRMPA, Townsville.
12. De'Ath G & Fabricius K (2010) Water quality as a regional driver of coral biodiversity and macroalgae on the Great Barrier Reef. *Ecol Appl* 20:840-850.
13. Fabricius K, De'ath G, McCook L, Turak E, & Williams DM (2005) Changes in algal, coral and fish assemblages along water quality gradients on the inshore Great Barrier Reef. *Mar Pollut Bull* 51:384-398.
14. del Mar Palacios M, Warren DT, & McCormick MI (2016) Sensory cues of a top-predator indirectly control a reef fish mesopredator. *Oikos* 125:201-209.
15. Boaden AE & Kingsford MJ (2015) Predators drive community structure in coral reef fish assemblages. *Ecosphere* 6:art46.
16. Madin EMP, Gaines SD, & Warner RR (2010) Field evidence for pervasive indirect effects of fishing on prey foraging behavior. *Ecology* 91:3563-3571.
17. Hughes TP, *et al.* (2007) Phase shifts, herbivory, and the resilience of coral reefs to climate change. *Curr Biol* 17:360-365.
18. Rasher DB, Hoey AS, & Hay ME (2013) Consumer diversity interacts with prey defenses to drive ecosystem function. *Ecology* 94:1347-1358.
19. Bellwood DR, Hoey AS, & Hughes TP (2012) Human activity selectively impacts the ecosystem roles of parrotfishes on coral reefs. *P Roy Soc Lond B Bio* 279(1733):1621-1629.
20. Pratchett MS, Cabelles CF, Rivera-Posada JA, & Sweatman HPA (2014) Limits to undersatnding and managing outbreaks of crown-of-thorns starfish (*Acanthaster* spp.). *Oceanography and Marine Biology: An Annual Review* 52:133-200.
21. McCook LJ, *et al.* (2010) Adaptive management of the Great Barrier Reef: a globally significant demonstration of the benefits of networks of marine reserves. *Proc Natl Acad Sci U S A* 107:18278-18285.
22. Hopley D (2011) *Encyclopedia of modern coral reefs : structure, form and process* (Springer, Dordrecht ; New York) pp xxvii, 1205 p.
23. Williams R, Erbe C, Ashe E, & Clark CW (2015) Quiet(er) marine protected areas. *Mar Pollut Bull* 100:154-161.
24. Simpson SD, *et al.* (2016) Anthropogenic noise increases fish mortality by predation. *Nat Comm* 7:10544.
25. Erbe, C. (2012). Effects of Underwater Noise on Marine Mammals. In A. N. Popper & A. Hawkins (Eds.), *The Effects of Noise on Aquatic Life* (pp. 17-22). New York, NY: Springer New York.