

The Australian Coral Reef Society: the last 40 years of a century working with Australia's coral reefs

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ABSTRACT

On the 100-year anniversary of the Australian Coral Reef Society (ACRS), previously known as the Great Barrier Reef Committee (GBRC), we provide an overview of ACRS activities throughout its history, with a detailed account of key milestones in the last 40 years. We outline how the ACRS as promoted the protection and conservation of reefs, through expert advice, reviews, and submissions to enquiries. Examples are provided under the following themes: ACRS consultancy on zoning the Great Barrier Reef (GBR) Marine Park, marine protected area design, water quality on the GBR, port expansions along the Queensland coastline and environmental reform for the offshore oil and gas industry. We illustrate how scientists over recent decades have worked to better understand and encourage policy responses to the impacts of climate change on Australia's coral reefs. For a hundred years, the GBRC-ACRS has provided an avenue for Australian coral reef scientists, managers and conservationists to influence reef governance through policy. While these unique avenues for delivering timely and targeted expertise have helped to reduce proximate threats to reefs at local scales, their outcome in relation to climate change, arguably the largest threat to Australia's coral reefs, remains to be seen.

Keywords: Abbot Point, advocacy, coral bleaching, coral reef policy, Great Barrier Reef Committee, marine protected area, marine reserve, Montara oil spill, oil spill, reef conservation, Senate Inquiry, water quality.

Introduction

The Australian Coral Reef Society (ACRS), previously known as the Great Barrier Reef Committee (GBRC), was established in 1922 by the Royal Geographical Society of Australia. The history of the GBRC, from its inception until its disbandment sixty years later in 1982, was written in two parts by Professor Dorothy Hill,¹ who acted as committee secretary from 1946 to 1955. The ACRS was founded shortly thereafter as a continuation of the GBRC and has now operated for a further forty years. Several environmental historians have described the committee's operations in matters relating to science and management on the Great Barrier Reef (GBR) throughout this period.² Here, we update the existing historical record, drawing on archival records to provide an overview of the ACRS activities throughout its full one hundred year history, including a detailed elaboration on key milestones in the last forty years.

The GBRC transitioned to the ACRS at a time when three original committee objectives had been achieved: the establishment and transfer of Heron Island Research Station to the University of Queensland, the establishment of the Australian Institute of Marine Science (AIMS, est. 1972) and the establishment of the Great Barrier Reef Marine Park Authority (GBRMPA, est. 1975). The GBRC built, serviced and developed Heron Island Research Station in the 1950s to 1980s, then transferred ownership of the station and all its assets to the University of Queensland in 1982. The two substantial bodies formed by the Australian government took on responsibility for Australian marine science, and for science,

¹Hill (1984a, 1984b).

²Clare (1971). Wright (1977). Bowen and Bowen (2002). McCalman (2014).

management and conservation of the GBR Marine Park. AIMS would go on to act as the government's primary tropical marine research institute, expanding its operations around the Australian coastline from an initial base in Townsville.

The aim of the ACRS was outlined in its 1982 constitution as promoting the study, protection and conservation of Australia's coral reefs by bringing together academic researchers, reef managers and those with an interest in Australian reefs to exchange scientific information and share ideas on reef-related issues. The society's geographical scope grew to encompass all Australian coral reefs, from Western Australia and sites such as Cocos (Keeling) in the Indian Ocean to Lord Howe and the Coral Sea in the Pacific. This was a pivotal year in which the society began coordinating a growing body of members including universities, the GBRMPA, AIMS, several state government departments (for example, the Queensland Department of Agriculture and Fisheries, the Western Australian Department of Parks and Wildlife, the Marine Parks Office of Lord Howe Island), museums, research stations, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), environmental consultancies, non-governmental organisations, tourism operators and reef businesses.

The society began organising an annual conference in the 1980s to enable lively national and international debate about the science of Australia's coral reefs. In 1976, the society began providing financial assistance to support students enrolled in Australian universities to carry out their research and communicate their findings nationally and internationally. The first award recipients were Russell Reichelt, who later became chairman and chief executive of the GBRMPA (2007–18) and Anne M. Bothwell, whose work on coral population dynamics went on to inform coral restoration efforts. In the years in which no annual conference was held, as there was an International Coral Reef Symposium, ACRS provided funding to support students to attend these international meetings. Several award schemes, including the ACRS Medal, recognised exceptional scientific work and services to the Australian coral reef science community. The society published several books, including the widely used *Coral Reef Handbook* on the history, flora and fauna of Heron Island,³ and an edited volume on the biology, environment and management of the GBR.⁴

The society has an impressive history of scientific advocacy to secure the long-term future of Australian coral reefs, drawing on the expertise of its members to provide objective advice to policymakers. Fig. 1 and Supplementary Table S1 outline key developments in the science, protection and management of Australian coral reefs over the one hundred year lifetime of the GBRC and the ACRS. Here, we briefly summarize ACRS activities over the last forty years, in relation to selected themes.

³Mather and Bennett (1984).

⁴Hutchings and others (2019).

⁵Davies and others (1979).

The Capricorn-Bunker consultancy report: the science underpinning GBR zoning

One of the last major actions of the GBRC was to provide an account of past uses and impacts, with recommendations for future use and regulation in the Capricorn-Bunker Group, resulting in the report *Conservation and Use of the Capricorn and Bunker Groups of Islands and Coral Reefs* for the GBRMPA.⁵ This exercise was initiated by the Secretary of the Federal Department of Environment Australia, Dr Don McMichael, who had also been a member of the GBRC and was briefly chair of GBRMPA. The advisory project was undertaken in the mid-1970s and was reported in the GBRMPA annual reports 1977/8 and 1978/9, with all authors being members of the GBRC.

The report consolidated a plan for several state and federal government departments with direct responsibility for the islands, reefs and the waters that surround them. Values and recommended uses of the cays and reefs were summarised, with a focus on the vegetation, nesting turtles and birds, sites used for scientific research (Heron and One Tree Island) and established uses of cays, including camping, fishing, shell collecting and day visits. It emphasised the importance of the two research stations that had operated since 1951 (Heron Island) and 1966 (One Tree Island) to support research on the marine and terrestrial fauna and flora which, in turn, informed management plans. The importance of the region was noted for breeding birds and four species of turtles, two of which had major nesting sites in the waters around North West Island and Heron Island (Green turtles), and on Wreck Island and Masthead Island (Loggerhead turtles). Indeed, the turtle populations on North West and Heron Islands had formed the basis of turtle canning factories in the early 1900s and the mid-1920s respectively. Camping and day visits were permitted on some islands and unregulated impacts such as disposal of rubbish, anchoring, line fishing, removal of vegetation for barbecues and shell collecting needed to be addressed by the relevant agencies.

A zoning plan was developed for the Capricorn-Bunker region by the GBRMPA on the basis of this report, then declared in 1979. The consultancy work that the society carried out for the Capricorn-Bunker Group set an important precedent in opening up the zoning process to independent scientific advice. The GBRC-ACRS further advised the GBRMPA on three additional areas of the GBR: Lizard Island group to Innisfail, the inshore Townsville region, and the Swains, all of which are noted in the GBRMPA annual report for 1978/9. Later zoning plans were developed by the GBRMPA for the other sections of the GBR, some of which took several years from proclamation to tabling their

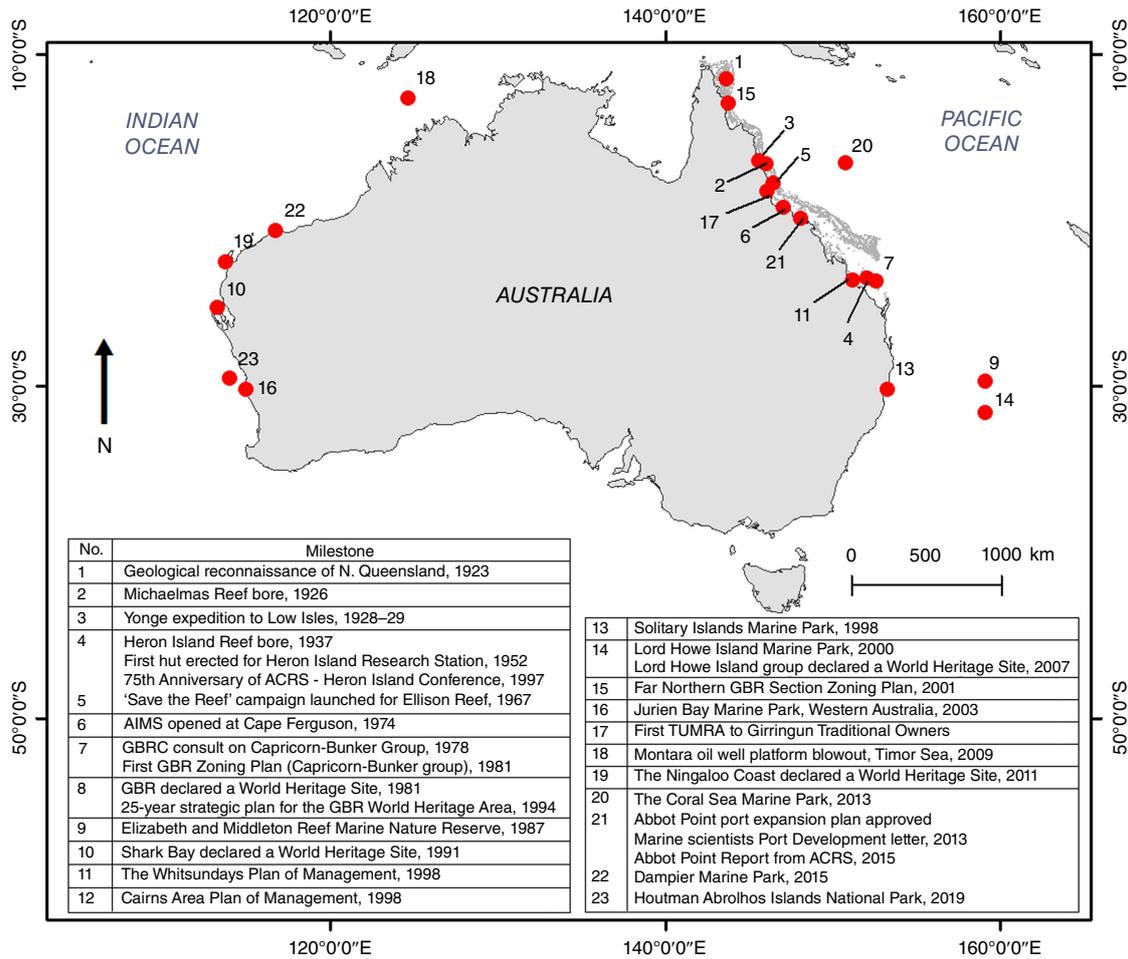


Fig. 1. Sites of activity for the Great Barrier Reef Committee—Australian Coral Reef Society, 1922–2022. Image credit: Sarah Hamylton.

zoning plans, including Cormorant Pass (1981), Cairns Section (1981–5), Far Northern Section (1983–6), Central Section (1983–7). All were released for public comment and a large part of the early work of the newly established ACRS was commenting on all of these.

As a general principle, the GBRC encouraged that existing usage be taken into account in marine park zoning. Subsequent workshops were held for user groups to incorporate recreational and commercial fishing, shipping lanes and military activities, initially for the Great Barrier Reef zoning, then later for all Australian marine parks, reflecting the critical importance of public ownership to the effective implementation of zoning plans. The participatory approach of developing zoning plans for multi-use marine parks became a widely followed model, both overseas and around Australia. The GBRMPA was the first organisation in the world to initiate the development of these multi-use parks and this achievement has been recognised through many national and international awards.

⁶Great Barrier Reef Marine Park Authority (2004).

Reform for the fishing industry in the far northern Great Barrier Reef through zoning

A single zoning plan for the entire GBR was later developed through what became known as the Representative Areas Program process (RAP), enacted in 2004.⁶ The GBRMPA relied heavily on advisory committees for developing the RAP, which focussed on fishing, tourism and water quality, and all of which included ACRS members. From 2000 to 2009, ACRS president Pat Hutchings was a member of the Resource Assessment Committee—Biodiversity and World Heritage, a committee of experts established by the chair of the GBRMPA, Virginia Chadwick, who met regularly to advise the GBRMPA.

The work of these committees coincided with a period of sustained focus (1990s–2010s) on the operations of fisheries, and drove reform of the Queensland fishing industry. Commercial fishing licence quotas were bought back in the far northern GBR under a A\$214 million structural adjustment

package, which represented a significant step toward reducing fishing pressure in an area that was highly valuable to the industry.⁷

Scientists and managers including Imogen Zethoven (WWF), John Tanzer (GBRMPA), Ian McPhail (GBRMPA) and Helene Marsh (James Cook University) raised concerns about destructive fishing with the Queensland Department of Environment and Primary Industries, including the impact of nets and traps entangling dugong, turtle, and sharks. Surveillance was expanded across the central and northern GBR, with the ACRS suggesting that increased boat and aerial patrols be supplemented with satellite transponders. In 1997, the Queensland state government allocated \$3 million to fit transponders to all fishing vessels within the GBRMP, beginning with trawlers then reef line fishers.⁸ In 1998, concerns were raised about the incidental drowning of dugongs in gill nets, and the use of these was banned from identified dugong feeding grounds in the far northern GBR.⁹ In 1999, the fitting of 'turtle excluder devices' to trawl nets was mandated, to prevent turtles being accidentally caught and drowned.

Designing Australia's marine parks

The society has advised on the design, size and placement of many Australian marine reserves, helping to account for physical, biological and socio-economic criteria by working with local state government departments in New South Wales, Western Australia, Queensland, and the Northern Territory to clearly specify and understand management objectives for an area. Advice spanned issues such as protecting a range of regionally representative habitats, prioritising a threatened or commercially valuable species and setting up frameworks to enable the success of biodiversity protection to be evaluated. Marine biologists, environmental managers and conservation scientists have commented as members or councillors of the ACRS on marine park management plans and audits across a broad range of geographical scales, including, for example, Jurien Bay Marine Park (1851 km²), Dampier Archipelago-Cape Preston marine reserve (2933 km²) and Rowley Shoals (400 km²), Abrolhos Island marine park (88 060 km²), and larger, networked parks across the GBR (344 000 km²), the Coral Sea Marine Park (989 836 km²) and the Great Kimberley Marine Park (74 469 km²) (Fig. 2).

All Australian states and territories identified the need to establish marine protected areas (MPAs) across marine ecosystems and habitats in the mid to late 1990s and the

National Representative System of Marine Protected Areas (NRSMPA) required each state and territory to develop their own multi-use Regional Marine Plan.¹⁰ As part of this process, conservation scientists have worked at the national scale to ensure that the design of the Australian Marine Parks Network includes a representative range of different coral reef environments and allows connections between protected reefs that facilitate larval transfer of juvenile corals and spill-over of fish stock between reefs.

At a time when the marine biodiversity in the Coral Sea was unknown, the ACRS commented on two draft plans of management for the Coringa-Herald and Lihou Reef National Nature Reserves, noting the unique geographic and genetic context of the Queensland Plateau, which acted as a major regional refuge for reef communities of the GBR and western Pacific during the previous Ice Age.¹¹ Momentum to establish a large offshore marine reserve in the Coral Sea began to build and, after a long standing campaign to 'Save the Coral Sea', the Coral Sea Marine Reserve was declared in December 2012 with an initial management plan to protect a single, large fully protected area of 502 626 km². This included twelve regions of coral reefs, shoals, cays and sea-mounts suggested by the ACRS on the basis of their important locations and the need to protect a complete range of marine habitats represented across such a large area.¹² This proposed reserve was later downgraded in January 2018 when a new Liberal government under the leadership of Malcolm Turnbull introduced a radically different Coral Sea management plan to parliament, replacing the single, large fully protected zone with several much smaller zones. Full protection had been cut by 53% to 238 400 km², with the expansion of a trawling zone from 4300 to 66 480 km². This protected area downgrade was the largest component of a national wind back in protection of more than 1 million km² or 31% of Australia's marine estate, the majority of which was opened up to industrial-scale fishing.

In a submission to the Australian Marine Parks Network (AMPN) Draft Management Plan, the ACRS noted that over the entire commonwealth marine estate, this represented the deepest cut to protected areas anywhere in the world, and such large losses and fragmentation of protected areas could potentially lead to collapse of these important ecosystems.¹³ No changes to the zoning plans were made, but the government funded researchers at James Cook University, including Dr Andrew Hoey who had authored the ACRS submission in his role as society president, to carry out a three-year investigation into the health of corals and fish communities in the Coral Sea. This revealed unique coral and reef fish

⁷Australian Coral Reef Society (1995).

⁸Australian Coral Reef Society (1997).

⁹Australian Coral Reef Society (1998).

¹⁰Grech and others (2015).

¹¹Australian Coral Reef Society (1999). Australian Coral Reef Society (2000a).

¹²Australian Coral Reef Society (2012a).

¹³Australian Coral Reef Society (2017).

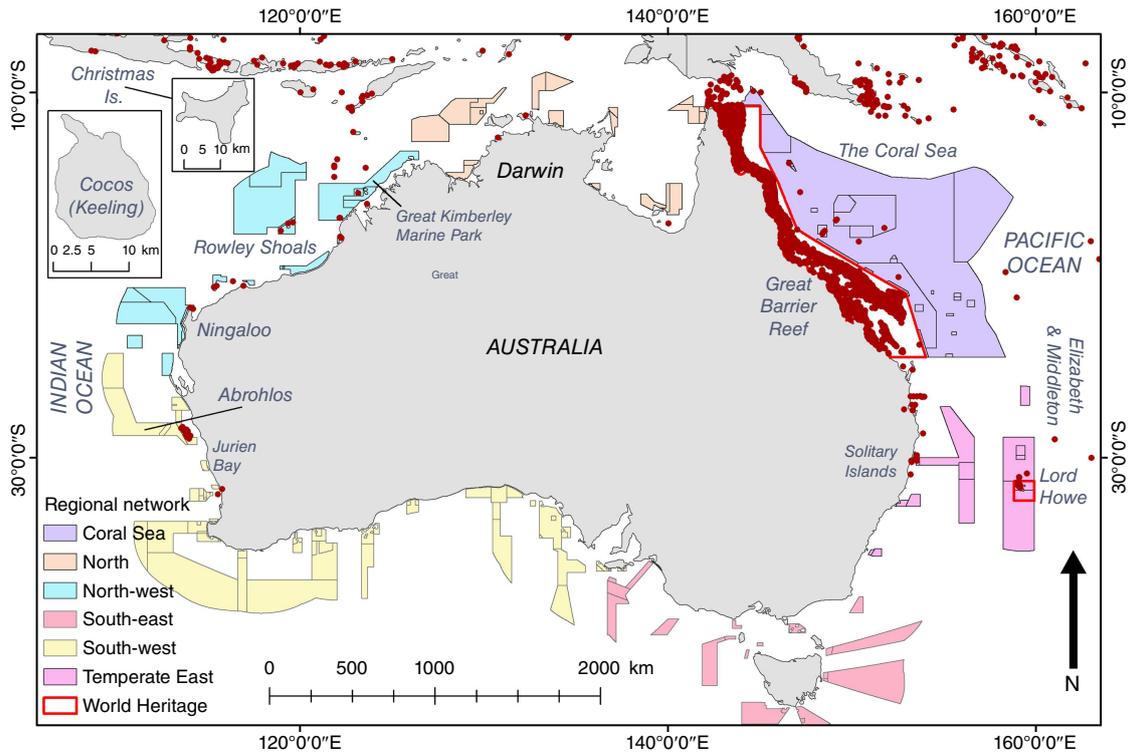


Fig. 2. Network of marine parks around Australia. The black outlines indicate parks that contain coral reefs and the red outlines indicate World Heritage sites. Image credit: Sarah Hamylton.

communities that are distinct from those of the adjacent GBR Marine Park and similar to temperate rocky reefs in the Tasman Sea to the south and New Caledonia, Vanuatu and the Solomon Islands to the east.¹⁴

The mix of tropical, subtropical and temperate marine species at the Solitary Islands in New South Wales has been the subject of several ACRS submissions since the Solitary Islands Marine Park was declared in 1998.¹⁵ One of the key challenges for managing the reefs in this area was a dearth of information on the subtropical reefs surrounding these rocky islands. The ACRS initially asserted the need for caution during the park's development until more information could support planning.¹⁶ The society went on to encourage an increase in the protected area coverage from 7 to 15%, with a later submission suggesting a further increase to 33% to reflect best practice elsewhere in the GBRMP.¹⁷ Such upward revisions reflected the availability of new information on regional marine biodiversity and marine conservation frameworks, which supported targeted replication across habitats, allowing the effectiveness of the zoning plan to be monitored, as legislation required. The society also

suggested that the plan explicitly account for the rights of the Gumbaynggirr and Yaegl Traditional Owners to collect shells and fish in the region.

Lord Howe Island was declared a World Heritage Area in 1982 because of its unique combination of tropical, subtropical and temperate biota, including many coral species at the southernmost limit of their existence. The ACRS commented on the design of Lord Howe Marine Park in 1999, 2000, 2007¹⁸ and then later as part of the broader Commonwealth marine reserve network proposal and draft Marine Bioregional Plan for the Temperate East Marine Region.¹⁹ The importance of the mesophotic benthic habitat on the drowned reefs on the Lord Howe shelf extending south to Ball's Pyramid was stressed. In the 2012 submission, the society president and professor in marine palaeoecology, John Pandolfi, drew attention to the sensitivity of the shelf to environmental degradation, which formed under Holocene climatic conditions different from today. The broader importance of this region, including the Elizabeth and Middleton Atolls to the north and the hotspots of marine and geomorphic biodiversity on the seamounts of Lord

¹⁴Hoey (2020).

¹⁵Australian Coral Reef Society (2000b).

¹⁶Australian Coral Reef Society (2000c).

¹⁷Australian Coral Reef Society (2010).

¹⁸Australian Coral Reef Society (2000d). Australian Coral Reef Society (2001).

¹⁹Australian Coral Reef Society (2012b).

Howe Rise and Norfolk Ridge was recognised through expansion of the marine parks over time.

Ningaloo Marine Park was initially established in 1987 and later expanded in 2004. An initial three-month consultation period for the Ningaloo Marine Park and Muiron Islands Marine Management Area received 5771 submissions. This included coordinated scientific advice from ACRS members working for the Australian Museum, the Australian Institute of Marine Science and several university research groups stressing the need to monitor undisturbed biodiversity inside and outside fishing sanctuaries and to protect a full range of habitats within protected areas.²⁰ ACRS president and benthic ecologist Dr Pat Hutchings from the Australian Museum emphasised the paucity of information on the undisturbed communities in and around Exmouth Gulf, particularly filter feeding communities on the inner reefs, many of which had been heavily fished and impacted by trawling. The need for a meaningful benchmark of biodiversity in soft sediment communities within and outside proposed fishing sanctuaries was raised for determining threats to existing communities, alongside potential for recovery and adequacy of their protection.

Hydrodynamic processes governing the circulation of seawater in and around Ningaloo were also identified as a critical knowledge gap relating to regional whale shark populations. One of the world's largest known seasonal aggregations of some 300 whale sharks occurs inside the Ningaloo Marine Park from March to June each year, where nutrient-rich waters upwell from the deep ocean within 10 km of the reef crest. The collaborative Ningaloo Research Program was established between state government departments, the CSIRO Wealth from Oceans Flagship Program, the Australian Institute of Marine Science and Western Australian universities, through which biologists and oceanographers worked to better understand spatial and temporal patterns in water temperature, nutrients and zooplankton that underpin whale shark aggregation and migration within the park, paving the way for the Ningaloo Coast to be declared a World Heritage Site in 2011.

The Great Kimberley Marine Park was declared in 2016 as the second largest marine park in Australia, affording protection for the remote Horizontal Falls and Montgomery, or Wooleejaaroo, Reef. Wooleejaaroo Reef is of great importance for the local Yawijibaya Traditional Owners, who have occupied this area for approximately 7000 years, sustainably harvesting dugongs, turtles, birds, fish, molluscs and crustaceans. The declaration of the marine park responded to regional momentum for protection, which peaked in 2015

when the ACRS partnered with the Western Australian Museum and the regional branch of CSIRO to release the Science Statement of Support for Developing a Great Kimberley Marine Park.²¹ The society advocated strongly for a network of strict no-take reserves, which would likely produce greater biodiversity outcomes than partially protected areas. It argued that the economic benefits of no-take reserves would exceed initial costs to fisheries, but that these benefits were predicated on adequate areas being protected.

Several common threads emerge across the many submissions regarding the design of protected areas around the Australian coastline. Many MPA plans around Australia have suffered a paucity of scientific evidence to support their recommendations. Notwithstanding the GBR and Ningaloo that have benefited from high levels of protection (>30% of the region protected) and recorded economic, social or biological benefits,²² many submissions for other no-take zones suggest insufficient overall coverage. This may reflect tensions between conservation needs and those of the local recreational and industrial fishing communities. Another commonly arising issue is a lack of representativeness and replication of protected habitats, particularly with respect to monitoring the effectiveness of protection in line with the requirements of the *Environment Protection and Biodiversity Conservation Act 1999*.

Water quality on the Great Barrier Reef

Declines to the health of inshore coral reefs were increasingly observed during the 1970s along the Great Barrier Reef coastline, with the balance of reef communities shifting away from reef-building corals toward macroalgae and soft corals. The Elevated Nutrients on Coral Reef Experiment, or ENCORE, was initiated by over twenty research groups, many of whom were ACRS members, to investigate how nutrients interact with corals at patch reefs near One Tree Island Research Station. Large scale nutrient loading experiments demonstrated the physiological and ecological changes that arise from eutrophication on reefs and revealed that the primary production of coral reefs is limited by inorganic nutrients, such as ammonium and phosphate.²³

The findings of ENCORE contributed to a growing awareness of links between coastal rainforest and wetlands loss, and impacts on inshore reef systems from floodwaters loaded with eroded sediments, fertilisers and chemicals that had run off the land of adjacent coastal farming catchments. Aerial photography revealed that flood plumes extended further offshore from catchments where the

²⁰Australian Coral Reef Society (2004).

²¹Australian Coral Reef Society (2015).

²²Babcock and others (2008). McCook and others (2010).

²³Koop and others (2001).



Fig. 3. Johnstone River flood plume on the central Great Barrier Reef. Image credit: Carol Honchin, supplied with kind permission by the Great Barrier Reef Marine Park Authority.

coastal rainforest had been cleared for farming (Fig. 3). Land use was affecting water quality as fine sediment and bacterial flocs known as marine snow were appearing on reefs adjacent to intensive agriculture. Flood plumes were reducing coral abundance and possibly also amplifying the reproductive success of *Acanthaster* (Crown of Thorns starfish), a subject on which the GBRC had been vocal in the 1960s–70s.²⁴ Water quality became a dominant concern relating to impacts on coral communities.

In 2003, the GBRMPA and the Queensland and commonwealth governments acted on advice and support from the World Wildlife Fund and the ACRS to establish the Reef Water Quality Protection Plan.²⁵ The goal of this plan was to ensure that by 2020 the quality of water entering the reef had no detrimental impact on the health and resilience of the GBR. Measures were set out to monitor water quality flowing into the reef from the major river catchments and coastal waters, targeting changes in fine sediment loads and excess nutrients from agricultural fertilisers and pesticides. A ‘Report Card’ was launched by the Australian and Queensland governments in 2009 to assess the results of all Reef 2050 Water Quality Improvement Plans.²⁶ To date, governments and industry have reduced pollutants by improving farming and grazing land use practices at regional and catchment levels, although the goal of no detrimental impact is yet to be met and coastal water quality remains ‘poor’.

Port expansions and the Queensland mining boom

The ACRS has evaluated the environmental implications of coastal development proposals, contributing substantially to commentary and policy decisions about port developments on the GBR coastline. The impact of dredging and dumping of dredged material on benthic communities, such as seagrasses and coral reefs has been a particular concern (Fig. 4).

Development proposals for tourism infrastructure and marinas have exposed corals to the impacts of dredging within the GBR marine park. However, it was the expansion of ports at Gladstone, Rockhampton, Mackay, Bowen and Hay during the Queensland mining boom (2010–12) that really pitted the environment against coal exports. The proposed expansion of Abbott Point coal terminal attracted significant media and public attention, prompting GBRMPA to develop a Port Strategy.

The ACRS stated in a response to the draft Queensland Ports Development Strategy that they did not support the expansion of shipping ports in Queensland, based on the evidence that this will have long-term detrimental effects on the GBR.²⁷ Their 2013 submission reiterated recommendations of no further port development and improved guardianship of the reef made by UNESCO in the wake of a 2012 reactive monitoring mission to the GBR World Heritage Area.

²⁴Hill (1984b).

²⁵The State of Queensland and Commonwealth of Australia (2003).

²⁶The Reef Water Quality Protection Plan Secretariat (2011).

²⁷Australian Coral Reef Society (2013a).



Fig. 4. *Brisbane*, a cutter suction dredge barge, dumping dredge material from the Port of Cairns in the Great Barrier Reef World Heritage site. Image credit: Xanthe Rivett, supplied with kind permission by WWF-Australia.



Fig. 5. A coal ship at Abbot Point terminal in Bowen, central Great Barrier Reef. Image credit: Jumbo Aerial Photography, supplied with kind permission by the Great Barrier Reef Marine Park Authority.

Approval was announced for plans to expand the Abbot Point coal port in northern Queensland, making it the largest coal port in the world (Fig. 5). The proposal included dumping millions of tonnes of dredge spoil into the ocean close to the port site. Amid mounting public pressure for this to be stopped and having approved the overall plan, GBRMPA had to decide whether or not to approve the specific component of the dredge dumping. Marine biologist and ACRS Councillor Dr Selina Ward drafted a letter that was

signed by approximately 280 marine scientists to the chair and CEO of GBRMPA, Russell Reichelt, explaining why this should not be approved.²⁸ This letter was sent to all members of the federal parliament and Queensland government and widely circulated to the media. Prior to this letter, the narrative had mostly been 'green groups opposed the expansion', but it changed to 'green groups and scientists oppose this expansion'. The issue generated enormous media attention as debate and protest continued around these and other port

²⁸Australian Coral Reef Society (2013b).

developments. The ACRS worked with Dr Jon Brodie, a water quality expert at James Cook University and long term ACRS member, to comment in several national and international news articles.²⁹

A 2013 report commissioned by the GBRMPA highlighted the potential for dredge material to migrate over larger areas and longer time scales than had previously been appreciated.³⁰ The large volumes of sediment proposed to be dredged would smother seafloor life and become remobilised to chronically impact nearby corals.

Water quality on the reef became an important topic in the 2015 Queensland election. The Newman Queensland government declared in 2014 that they would no longer allow the dredge spoil from Abbot Point to be dumped in the sea, instead it would be dumped adjacent to the coal port at Caley Wetland, home to tens of thousands of migratory birds. The issue attracted 79 000 submissions largely in opposition, including one from ACRS. The government lost the March 2015 election and the new ALP government released less controversial plans to dump the spoil on land near the port development instead.

The AIMS and the GBRMPA convened a nineteen-member expert panel to review the impacts of dredging, which were synthesised in a report that suggested a review of dredging policy in areas that had been designated for conservation.³¹ A single table presented by Dr Jon Brodie revealed the full extent of coastal engineering and dredging that would occur if all the planned proposals were approved. Most had not reached formal proposal stage, but included more coal loading terminals near Rockhampton, Mackay and Bowen.

Brodie's table provided a new perspective on the longer term, cumulative impacts across multiple projects, rather than individual dredging channel projects for which the *Environment Protection and Biodiversity Conservation Act 1999* and *Great Barrier Reef Marine Park Act 1975* provided a framework for assessing the environmental impacts of proposed activities. The total volume of material to be dredged was close to 100 million tonnes, which put the original Abbot Point proposal of 5 million tonnes into a different light. Armed with this cumulative picture of the impacts, and working with the port authorities and political leaders, GBRMPA proposed regulation amendments to the *Great Barrier Reef Marine Park Act 1975* to ban any disposal of dredged 'capital', that is, material associated with new ports inside the GBR Marine Park. This revoked the earlier approval for Abbot Point. The Minister for the Environment, Greg Hunt, approved and the change was enacted in federal parliament in 2015. The amendment was incorporated into the draft Reef

2050 Long-Term Sustainability Plan that same year, which planned reef management until 2050.³² ACRS noted that while the plan banned the disposal of capital dredge spoil within the GBR Marine Park, 80% of all dredge spoil dumping at the time had been conducted outside the GBRMP, but closer to shore within the World Heritage Area.³³ The Queensland government later banned dumping in this area as well.

Environmental reform for the offshore oil and gas industry

Since the 1970s, an extensive offshore oil and gas exploration and drilling industry has developed inside Australia's Exclusive Economic Zone, particularly off the northern and western coastline. This industry is regulated by the Australian government, which issues permits, leases and licences to oversee environmental management and oil well integrity. In the aftermath of several major spills from oil wells and ships close to fringing reefs around the Australian coastline, the ACRS investigated the impacts of these incidents and advised on industry regulation.

On 21 August 2009, a blowout occurred on PTTEP Australasia's oil well platform on the Montara Shelf between Australia and Indonesia. Crude oil flowed into the Timor Sea around 200 km off the Kimberley coastline for eleven weeks before the well could be capped (Fig. 6). The nearby Ashmore and Cartier Reefs, Scott and Seringopatom Reefs and Long Reef were impacted in what was Australia's biggest offshore petroleum industry oil spill. Scientists from the AIMS, CSIRO and the Australian Maritime Safety Authority surveyed the extent of the environmental damage, monitored the spread of the oil slick across the sea surface from satellite images³⁴ and created slick maps that were later used by Indonesian farmers to claim financial compensation for impacts on their seaweed crops.³⁵ Dispersant was sprayed from above to degrade the oil, which was contained and recovered via a boom operated by a pair of boats. This response was delayed because chemicals to disperse the oil and a replacement drill rig needed to be shipped from Singapore and Geelong, Victoria.

The ACRS president Professor Justin Marshall wrote to then Prime Minister Kevin Rudd on 9 September 2009, as well as the Minister for the Environment Peter Garrett and other state politicians to identify six major oil spills that had occurred in Western Australia since 1975 and call for the threat of pollution from oil and gas operations in remote northern Australia to be taken more seriously.³⁶ This added

²⁹Brodie (2013).

³⁰Great Barrier Reef Marine Park Authority (2013).

³¹McCook and others (2015).

³²Great Barrier Reef Marine Park Authority (2015).

³³Australian Coral Reef Society (2014a).

³⁴Australian Maritime Safety Authority (2010).

³⁵Prihandono and Esty Hayu Dewanty (2015).

³⁶Australian Coral Reef Society (2009).



Fig. 6. The Montara offshore oil platform and drilling rig in the Timor Sea off Western Australia, spewing uncontrolled oil and gas for 7–8 weeks after a blow out in August 2009. Image credit: Annabelle Sandes, supplied with kind permission by WWF-Australia.

to ongoing calls for an inquiry into the Montara spill and for an evaluation of the approval process for offshore oil and gas activities around the sensitive coral reefs of the region, including those in Cartier Island Marine Reserve, the Ashmore Reef National Nature Reserve, Hibernia Reef, Scott Reef, Rowley Shoals and the Kimberley and Pilbara coastlines.

As the incident occurred in a remote area, the ACRS drew on the expertise of staff of the AIMS, whose RV *Solander* research ship had operated off the northwest continental shelf for two years, and who could evaluate spill impacts on nearby reefs by comparing against recent ecological surveys as suitable historic baselines. This heralded a closer working relationship between ACRS and AIMS and the same year Dr James Gilmour of the Perth, Western Australian

branch of AIMS took up one of the inaugural corporate member positions on council.

The Montara Commission of Inquiry was launched two days after the well was capped, resulting in significant reform of Australia's offshore oil and gas industry. The lack of preparation that delayed spill management activities indicated a need for greater pre-emptive safety measures to protect sensitive coastal and offshore marine biodiversity. The ACRS worked with scientists from the AIMS and CSIRO to emphasise the need for a more comprehensive approval process for offshore petroleum drilling that involved independent scientific bodies and greater transparency in the environmental assessment of this industry. The National Offshore Petroleum Safety and Environmental Management Authority was established as an outcome of this inquiry to



Fig. 7. Bleached branching corals lose their colour and turn white. In the absence of recovery of their brown symbionts (*Symbiodinium*), they die and are overgrown by brown algae. Image credit: Lorna Parry, supplied with kind permission from Underwater Earth/XL Catlin Seaview Survey.

regulate Commonwealth Waters for safety, well integrity, environmental management and day-to-day petroleum operations. The authority also took on responsibility for monitoring the distribution and fate of spilled oil, as well as impacts on marine wildlife, shoreline ecology and fish catches in nearby coastal and offshore marine environments.

Climate change and Australia's coral reefs

The 1990s marked a turning point as the mass coral bleaching event of 1998 turned the focus of Australian coral reef scientists increasingly toward understanding the implications of climate change for coral reefs (Fig. 7, Supplementary Table S2). Coral reefs began bleaching throughout the globe in 1998 over twelve months of exceptionally warm conditions. On the GBR, 87% of inshore reefs and 28% of offshore reefs bleached³⁷ resulting in the mortality of between 5 and 10% of corals as a result of the extreme underwater heat waves.³⁸ In January 2002, reefs around the southern GBR, notably the Keppel Islands, saw mass bleaching and mortality among intertidal and shallow water corals. Mass coral bleaching on the scale seen in 1998 and 2002 did not subsequently happen in the GBR region for over a decade, then it hit with an unprecedented frequency and intensity in 2016, 2017, 2020 and 2022.

The issue of mass coral bleaching and mortality was discussed at the meeting of the International Coral Reef Symposium in Bali in 2000, which was attended by many members and councillors of the ACRS. ACRS president

Professor Ove Hoegh-Guldberg helped to launch the multi-disciplinary Coral Reef Targeted Research (CRTR) project funded by the World Bank's Global Environment Facility, with the University of Queensland as the executing agency, working alongside the Queensland government and the US National Oceanic and Atmospheric Administration (NOAA). This brought global experts from four centres for excellence: the Caribbean (Puerto Morales, Mexico), East Africa (Zanzibar), South-East Asia (University of the Philippines), and the Western Pacific (Heron Island). Heron Island Research Station on the southern GBR formed part of this global network, which developed world expertise on global change, reef connectivity, coral disease, remote sensing, reef modelling and coral bleaching during the five-year CRTR project.

Concerns about the growing threat of climate change also paved the way for a Tropical Marine Network (TMN) of six research stations along the GBR to be established to better access and understand the world's largest coral reef (Moreton Bay Research Station, Heron Island Research Station, One Tree Island Research Station, Orpheus Research Station, Lizard Island Research Station and Low Isles). In 2002, the Australian Federal Government's Systemic Infrastructure Scheme funded the TMN AU\$10.4 million to renovate, build and expand facilities for scientists and students from all over the world to study coral reefs of the GBR. Island research stations took on a crucial role as platforms from which on-site applied science could be carried out to understand coral reefs in the context of global change. As the impacts of climate change were increasingly observed

³⁷Berkelmans and Oliver (1999).

³⁸Hoegh-Guldberg (1999).



Fig. 8. The Free Ocean CO₂ Enrichment (FOCE) experiment to test the effects of ocean acidification at Heron Island. Image credit: David Kline.

along some of Western Australia's more remote coastlines, this consortium of reef island stations expanded to other areas of Australia, including the Kimberley Marine Research Station (Cygnet Bay, est. 2009) and the Coral Bay Research Station (Ningaloo, est. 2007). These research stations began reporting their activities and observations to a broader body of members through the annual ACRS newsletter. Avenues of research increasingly opened up to elucidate how warmer seas and acidifying oceans influence corals (Fig. 8).

Exceptionally warm seas brought five years of mass coral bleaching and mortality (2016–22) and scientists increasingly believed that most of the hard coral-dominated reefs on the GBR would be lost. The massive extent of coral mortality on the GBR in early 2016 was reported by the National Coral Bleaching Taskforce, led by Professor Terry Hughes from James Cook University's Australian Research Council Centre of Excellence for Coral Reef Studies and including several ACRS members and councillors, in several scientific papers, in leading journals *Science* and *Nature*. These studies linked the spatial footprint of bleaching to ocean warming,³⁹ tracked changes to coral community assemblages,⁴⁰ tracked how bleaching history or 'ecological memory' influences bleaching outcomes,⁴¹ and examined the follow-on effects for coral recruitment.⁴²

³⁹Hughes and others (2017).

⁴⁰Hughes and others (2018).

⁴¹Hughes and others (2019a).

⁴²Hughes and others (2019b).

⁴³Kim and others (2019)

⁴⁴Lachs and others (2021).

⁴⁵Australian Coral Reef Society (2016a).

⁴⁶Australian Coral Reef Society (2016b).

⁴⁷Australian Coral Reef Society (2016c).

Importantly, the footprint of this mass bleaching event extended well beyond tropical waters into subtropical coral communities such as the Solitary Islands Marine Park, driving high rates of immediate mortality of a subtropical endemic coral group in this region due to heat stress where,⁴³ post-bleaching, coral population density had declined by 51%.⁴⁴

The timely reporting throughout the multi-year event informed the reef managers, GBRMPA and Queensland National Parks and Wildlife Service, and federal government. This body of work meant that the true implications of bleaching were better understood by the scientific community. Council member Dr Andrew Hoey, who was also on the bleaching taskforce, wrote an ACRS media release titled 'Great Barrier Reef faces devastation without immediate action' to convey the news of the bleaching to the public and the international community.⁴⁵ In the federal election year, the ACRS incorporated the taskforce's observations into their evaluation of the different party's policy plans,⁴⁶ as well as a discussion note Advancing Climate Action in Queensland, ahead of the state election.⁴⁷

After two consecutive summers of global marine heat stress, 2015–16, GBRMPA convened the 2017 Reef Summit in Townsville, attended by several council members of ACRS, as well as marine park managers, Traditional Owners,

government agencies, research institutions, industry groups, reef users and other stakeholders. The summit produced GBRMPA's *Reef Blueprint for Resilience*, which unequivocally identified climate change driven by the burning of fossil fuels as the major threat to the reef.⁴⁸ In the face of the existential challenge posed by climate change, it became widely accepted that GBRMPA's old mission of protection and wise use was no longer enough to sustain the GBR. The blueprint canvassed available pathways to build resilience for the reef, highlighting the need to restore and maintain damaged ecosystems to build reef resilience through local actions, notably by investing in improving water quality.

The question of whether or not to intervene to aid reef recovery and bolster resilience by assisting natural processes, or actively restoring degraded reefs came to the forefront of discussions. In spite of reservations about ecological, socio-economic, cultural and ethical appropriateness of human intervention, a new research frontier emerged as scientists began exploring ways to 'buy time' for corals to survive the various manifestations of climate change. Novel restoration approaches were tested in laboratories and in the wild, including in-water reef rehabilitation and restoration, harvesting wild coral spawn slicks for restoration of degraded reefs and enhancing corals using assisted evolution. These increasingly became a focal point of support for student projects and a topic of lively discussion at annual ACRS conferences as viewpoints diverged on the promise of this new research direction.

As coral reef ecosystems exhibit complexity at all tiers of biological organisation, there was concern that manipulating one coral gene, trait or species may have unforeseen effects on broader reef ecosystems. When the GBRMPA drafted their intervention policy, the ACRS suggested an independent committee be established to review newly proposed innovations prior to implementation.⁴⁹ The ACRS statement on the GBRMPA intervention policy also recommended, in line with the precautionary principle, that it should be the responsibility of those proposing an intervention to establish that the proposed activity will not, or is very unlikely to, result in significant unintended and potentially harmful outcomes or side-effects to the GBR. Both suggestions were subsequently adopted. Despite this new focus of research activity, consensus remained within the scientific community that exploring the potential of active interventions should not shift focus away from the fundamental need to address climate change.

The link between the climate change driven impacts on the Australia's coral reefs and emissions of greenhouse gases had been clearly established by international bodies, such as the Intergovernmental Panel on Climate Change (IPCC), as well as through observations made over time by the AIMS

long-term monitoring program, the results of which have been consolidated in the GBRMPA *Outlook Reports*, which were launched in 2009⁵⁰ and subsequently released every five years. As it became increasingly clear that climate change outweighed other risks to the GBR, the question of whether or not the GBR should be added to the List of World Heritage in Danger arose.

The GBR was declared a UNESCO World Heritage site based on its Outstanding Universal Value to humanity in 1981, yet the declining state of the GBR combined with proposed port developments attracted public attention toward the risks associated with exporting fossil fuels. Concerned actors began to look for national and international levers for reform to encourage better environmental stewardship of the GBR, particularly to curb fossil fuel emissions. UNESCO's List of World Heritage in Danger identifies World Heritage sites facing major problems that threaten the characteristics for which they were initially designated as World Heritage, with the intention of bringing global attention to a threatened ecosystem to encourage action and mobilise assistance.⁵¹ The World Heritage Committee first considered the GBR for inclusion on the In-Danger list in 1997, and the question repeatedly arose to attract international media attention in the years that followed. The Australian government opposed and avoided a listing through political and industrial lobbying, as well as developing an integrated ports strategy, a water quality plan and a long-term sustainability plan. All of these plans designated substantial government funds for managing proximate threats, but failed to address climate change. The ACRS commented on each of these plans and released several statements highlighting the growing disconnect between Australian responsibilities for stewardship of the GBR and federal government's support of the fossil fuel industry. They noted that the investments and plans announced by the government for reef management placed the focus at the periphery, rather than the centre, of the problem. A 'broken-record' approach was taken across multiple statements to encourage urgent work on a credible national plan to achieve domestic greenhouse gas emissions reductions at a speed consistent with the survival of the GBR.

ACRS interaction with government and policy makers

Much of the advocacy work of the ACRS has involved interacting with state and federal government departments, politicians and policy makers to establish and design marine protected areas, develop reef management policy and alleviate climate change-related threats to Australia's coral

⁴⁸Great Barrier Reef Marine Park Authority (2017).

⁴⁹Australian Coral Reef Society (2020).

⁵⁰Great Barrier Reef Marine Park Authority (2009).

⁵¹Morrison and others (2020).

reefs. Interactions have occurred through formal channels established in response to a specific issue, such as royal commissions and senate inquiries, through policy guidance during election campaigns and through advocacy to reduce greenhouse gas emissions via open letters or statements, campaigns and ACRS council members visiting regional state government offices or federal offices in Canberra to discuss issues directly with politicians.

An approach termed ‘snorkel diplomacy’ by the national media describes the tendency for politician to interact with scientists during a visit to the reef that often precedes substantial reef policy decisions and financial commitments. Such visits afford an opportunity for politicians to directly experience the underwater environment through snorkelling or SCUBA diving. While the extent to which this experience influences policy decisions is unclear, these visits also provide extended and focussed periods of interaction between politicians and reef scientists.

Two episodes of snorkel diplomacy have resulted in substantial investments in GBR governance. In April 2018, His Royal Highness the Prince of Wales visited Lady Elliot Island on the southern GBR to meet leaders from technology, resources, energy, and property and infrastructure companies, as well as government and not-for-profit groups. This visit coincided with an announcement by the federal Minister for the Environment and Energy Josh Frydenberg of the Liberal government that they would award \$444 million to the Great Barrier Reef Foundation.⁵² This award was seen as controversial and later became the subject of a senate inquiry. In 2022, the largest ever environmental investment of \$1 billion was made by the Australian government, to be spent on water quality improvement, reef management and conservation, reef restoration and adaptation and strengthening partnerships and stewardship for the GBR. The funding announcement by the prime minister coincided with a nine-day visit by a panel of international scientists from the UNESCO and the International Union for the Conservation of Nature (IUCN), who were engaged in a monitoring mission requested by the World Heritage Committee as part of its deliberations over whether the GBR should be listed as ‘In-Danger’.⁵³ While such visits to the reef are clearly political publicity opportunities, they can establish meaningful links between scientists and politicians. The importance of the impression the reef may leave on those in a position to make high level policy decisions about its governance cannot be overstated (see [Box 1](#)).

The views of Australia’s coral reef scientists have shaped policies and legislation through expert panels, at royal

commissions and at senate inquiry hearings about pressing contemporary governance and management issues. Examples include:

- The 1970–4 Royal Commission into Petroleum Drilling on GBR, to which the GBRC made numerous submissions calling for the controlled exploitation of renewable resources and opposing any mining that adversely effected the reef; the commission ended in a moratorium on oil drilling within the GBR Marine Park,⁵⁴
- The 2009 Montara Commission of Inquiry, which was established in response to multiple letters from the society to Prime Minister Kevin Rudd and other politicians, at which the ACRS suggestions the offshore oil and gas industry activities near were taken up,
- The 2014 Senate Inquiry into the Management of the GBR, to which the ACRS advised on the adequacy of GBRMPA responses to a range of threats to the GBR,⁵⁵
- The 2018 Senate Inquiry into the Great Barrier Reef 2050 Partnership Program, which scrutinised the awarding process of the \$444 million to the Great Barrier Reef Foundation at which ACRS council member Dr Selina Ward presented a submission reporting on progress toward program objectives and administration of funds,⁵⁶ and
- The 2019 Senate Inquiry into the identification of leading practices in ensuring evidence-based regulation of farm practices that impact water quality outcomes in the GBR at which ACRS presented a submission prepared with the help of Dr Jon Brodie.⁵⁷

Findings from these inquiries have been consolidated into senate policy recommendations and scientific papers that have shaped legislative reform and influenced the environmental fate of Australia’s coral reefs.

As a member of Science & Technology Australia since 2013, the ACRS has attended the annual two-day Science Meets Parliament event, through which scientific bodies engage directly with parliamentarians. ACRS councillors have used this event to promote Australian coral reef research and highlight crucial issues facing the reef. In 2016, ACRS councillors met with the leader of the opposition Australian Labour Party, Hon. Bill Shorten to talk about threats facing Australia’s coral reefs and ways to improve reef health. ACRS president David Booth, secretary Selma Klanten and councillors Elizabeth Madin and Steve Doo held a meeting on 18 May 2016 with the Australian Labor Party Shadow Minister for Environment, Climate Change and Water, the Hon. Mark Butler, at the University of Technology Sydney. The

⁵²Lloyd (2018).

⁵³Grattan (2022).

⁵⁴Hill (1984b).

⁵⁵Australian Coral Reef Society (2014b).

⁵⁶Australian Coral Reef Society (2018).

⁵⁷Australian Coral Reef Society (2019).

Box 1. Diving the outer barrier with the prime minister: a World Heritage nomination on the horizon

The Great Barrier Reef was the first coral reef area in the world to be nominated as a World Heritage Site. The January 1981 nomination followed swiftly on the heels of a visit by Prime Minister Malcolm Fraser to the outer barrier. Fraser joined the Australian Museum's Pat Hutchings and Barry Goldman, Director of the Lizard Island Research Station on a dive trip to Cook's Passage, some 20 km northeast of Lizard Island.

As Pat recalled:

During one of my work trips to Lizard Island Research Station in June 1980, Dr Barry Goldman from the research station and I were heading to the outer reef to retrieve a CSIRO current meter that had snagged on some deep reefs in the channel at Cook's Passage. Prime Minister Malcolm Fraser, who was staying at the Lodge on the Resort side of the island at the time, expressed a desire to visit the outer barrier. At that time Lizard Island resort had no dive facilities, so Barry was asked if he could take the PM on a scuba dive. He agreed and the Resort provided their boat.

Pat boarded the resort boat, along with Fraser and his naval bodyguard, Barry, and Roy Caldwell, another coral reef biologist with dive experience.

After a quick dive down a mooring buoy to retrieve the gear at Cook's Passage, we took Fraser to the blue hole right next to Cook's Passage on the inner side of Carter Reef. It was a safe, shallow and sheltered site and the naval bodyguard came with us. Malcolm had received basic instruction and a briefing on the way out. He dived with an underwater Nikonos film camera and took many photos. We climbed out of the water and he seemed to have really enjoyed himself. He served me a gin and tonic from the bar aboard the resort boat.

Next day Fraser came down the beach with his camera as he was struggling to wind the film on. Barry took it into the darkroom and fixed it. I heard that he had those photos developed and passed them around at a Cabinet Meeting in Perth a few weeks later.

Fraser's trip to Lizard Island came at a time when the government were negotiating to nominate the GBR as a World Heritage Site. In April of the same year, he had visited the Great Barrier Reef Marine Park Authority in Townsville to discuss the nomination and when he left Lizard Island, he was heading for the nomination meeting with members of the World Heritage Committee in Cairns.

All of this happened at a time before David Attenborough-style nature documentaries, when the underwater beauty of the Reef was still not widely, publicly known. Perhaps the decision had already been made to protect the GBR, or perhaps seeing the reef first hand and taking those photos gave Fraser the conviction he needed to advocate for greater Reef protection, and to bring the other members of his cabinet on board with the nomination. We will never know, but at least he learned that the Australian Museum was in Sydney, not Canberra, and that it ran the Lizard Island Research Station!

councillors prepared a ministerial brief 'Science-Based Policy Plan for Australia's Coral Reefs' outlining the main threats to the GBR with corresponding policy goal suggestions.⁵⁸ They then prepared a further brief at Mark Butler's request, on the Benefits of Mangroves,⁵⁹ presented on 26 May 2016. Such meetings and briefs provide opportunities for the ACRS and reef community to build relationships with policy-makers and encourage the incorporation of evidence-based science into policy.

Lessons learned from a hundred years of coral reef science and protection

We conclude with an evaluation of what has, and what has not, been effective in achieving outcomes for Australia's coral reefs. Over the hundred-year lifetime of the GBRC—ACRS, attention has been focused on a range of threats to Australian reefs that have been perceived with

differing levels of importance over the years. Members and councillors of the ACRS have interacted with politicians through different avenues to influence reef governance. While such interactions have met with relative success in addressing proximate threats to Australian reefs, the same cannot be said for tackling the broader, global threat of climate change. We anticipate that this will continue to be the dominant threat to Australia's, and indeed the world's, coral reefs for years to come. While multi-use marine parks such as the GBR Marine Park are still well regarded as a good model for within-boundary protection of marine areas, management arrangements for most if not all such areas are increasingly compromised by the changing dynamics and scale of global atmospheric and marine heating.

The transition from the GBRC to the ACRS resulted in several important changes to the way that the society operated, and it is instructive to examine how the ACRS has functioned in relation to the themes expanded on, and milestones documented, here (Supplementary Tables S1, S2). The

⁵⁸Australian Coral Reef Society (2016c).

⁵⁹Australian Coral Reef Society (2016d).

society originally operated as a council of five experts in Queensland, but a growing body of members has increased the geographic reach and subject expertise of what has become a twenty-member council. A two-way relationship emerged through which ACRS reached out to members for expertise on specific subjects or geographic areas, while members also approached the ACRS to request submissions on specific issues, thereby benefiting from the authority of the combined expertise of a scientific society and the weight of a broader membership.

With the arrival of a suite of governmental and commonwealth institutions focussed on reef management science and policy (GBRMPA, AIMS, CSIRO), the ACRS has provided an avenue for employees of these organisations to contribute their expertise independent of their affiliation. For example, ACRS president Pat Hutchings represented the society on the Resource Assessment Committee as part of the GBR Representative Areas Programme from 2000 to 2009 at a time when she was employed by the Australian Museum, which itself was part of the NSW government and therefore poorly placed to provide timely comments from a publicly funded commonwealth agency. Without this arrangement, her input and expertise over nine years of serving on this committee would have required approval by the relevant state and federal ministers. In recognition of the importance of such avenues for institutional employees, and the need to diversify and collaborate with scientists who could provide expertise covering a broader geographic scope, the society updated its constitution in 2009 to specify that no less than two council positions shall be nominated from corporate members. These positions have been consistently occupied by employees of the CSIRO, AIMS and GBRMPA in the subsequent years.

At times, Australia's community of coral reef scientists have adopted diverse viewpoints that have required balanced representation by the ACRS by virtue of society membership. Divergent viewpoints often reflect cultural attitudes of the times, as was seen in the early 1970s when the GBRC advocated for controlled exploitation of renewable reef resources, noting an opposition to mining and oil-drilling until it could be shown that damage to the reefs faunal and floral ecology would not result.⁶⁰ This position was not a strong enough stance against exploitation for other organisations lobbying on behalf of the reef, such as the Wildlife Preservation Society of Queensland and the Australian Conservation Foundation, who also counted scientists among their members.

In more recent times, ACRS Council members with divergent opinions have written submissions together on the topics of the Reef 2050 Partnership Program with the Great Barrier Reef Foundation and the GBRMPA Intervention policy. While the manner in which the Great Barrier Reef Foundation was awarded government funding was a widely held concern, opinions diverged on the transparency and fairness with which the foundation subsequently invested in plans and

projects. Some called for wider consultation across academic as well as government and management institutions with reef expertise.

On the issue of reef interventions, while there was broad agreement about the desirability of interventions to aid reef recovery by bolstering resilience or actively restoring degraded reefs, opinions diverged on the priority that such measures should be afforded among the suite of threats facing Australian reefs that demand attention. In an effort to provide a balanced overview, ACRS submissions have intentionally outlined these competing perspectives.

The constitutional objective of protecting and studying Australia's coral reefs laid out in 1982 as the GBRC embarked on its new identity as the ACRS will remain for many years to come. As its geographic focus expanded beyond the GBR, the ACRS has worked alongside an expanding community of Traditional Owners, marine park authorities, state and federal government departments and, increasingly, a global community whose actions are determining outcomes for reefs. Yet the most devoted of ACRS members will only dive a tiny fraction of Australia's 50 000 km² of coral reef, extending from Cocos (Keeling) Atoll in the west across to Western Australia, Torres Strait, the use acronym GBR, the Coral Sea and out to Norfolk Island in the east. Regardless of whether these reefs are visited by scientists, the ACRS will remain committed to furthering our understanding of these rich marine ecosystems, and working toward their enduring health because of what we have come to understand that they are and, critically, what we are yet to discover they can be.

Supplementary material

Supplementary material is available [online](#).

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