Title: Targeted Conservation - Maximising the Great Barrier Reef's resilience to human-induced threats

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Target Audience: This brief is written for the attention of the Australian and Queensland Governments, who directly determine the policies and priorities of the Great Barrier Reef Marine Park Authority, Commonwealth Department of Sustainability, Environment, Water, Population and Communities, and other relevant institutions responsible for the conservation of the Great Barrier Reef. Through the Reef Trust, the Australian and Queensland Governments, alongside private investors, are also responsible for financing conservation and environmental restoration projects in the Great Barrier Reef Marine Park.

Targeted Conservation

Maximising the Great Barrier Reef's resilience to human-induced threats

Division of Global Sustainable Development.

University of Warwick.

2019.

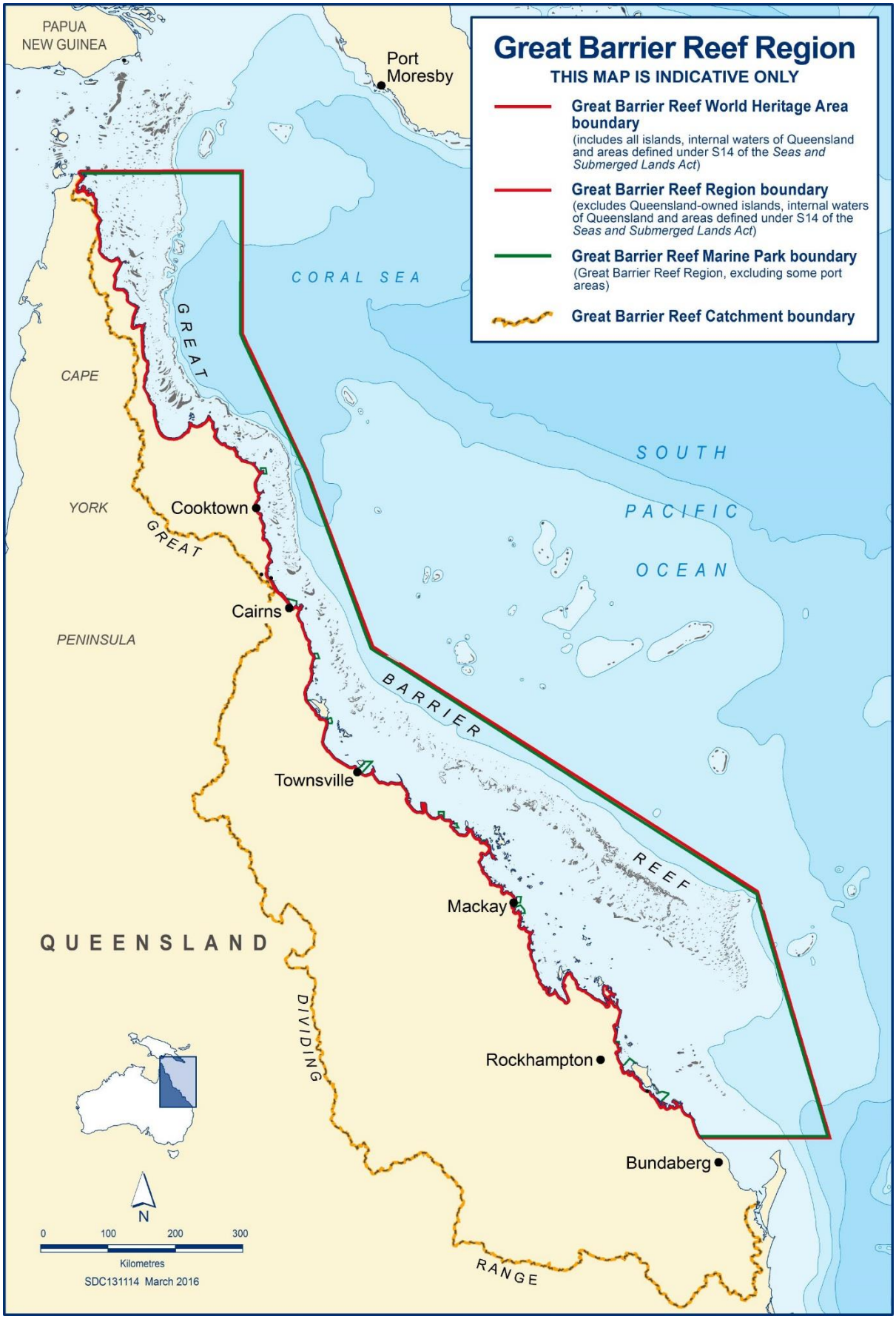

Figure 1: Map showing the boundaries of the Great Barrier Reef Marine Park and Catchment Area (Commonwealth of Australia, 2018a)

Marine Biodiversity Loss

Managing threats to the Great Barrier Reef

Executive Summary

The Great Barrier Reef (GBR) is suffering from significant biodiversity loss which threatens not only the reef itself, but also the continued prosperity of the Australian people. The GBR is currently protected by the GBR Marine Park Authority, however the current conservation strategies being implemented within the GBR Marine Park are inadequate. The Australian and Queensland Governments must re-establish the emphasis on conservation within the GBR, with a focus on protecting species that are crucial to the reef's ecosystem. In addition, the number and size of marine protected areas within the GBR Marine Park must be increased alongside improved management of terrestrial pollutants.

Threats to the Great Barrier Reef

The Great Barrier Reef (GBR) is the world's largest coral reef system, spanning over 2000 kilometres of Australia's North-East coast. Designated a UNESCO World Heritage Site, the GBR provides numerous supporting, provisioning, regulating and cultural services for more than one million people who live within its catchment area (see Figure 1). A valuable natural resource, the GBR is valued at AUS$64 billion and is estimated to contribute AUS$6.4 billion to the Australian economy from commercial and consumer activities (Oxford Economics, 2017, p. 14). However, the true value of the GBR to the Commonwealth of Australia, is much higher when its numerous ecosystem services (see Figure 2) are also considered (Stoeckl et al., 2011).

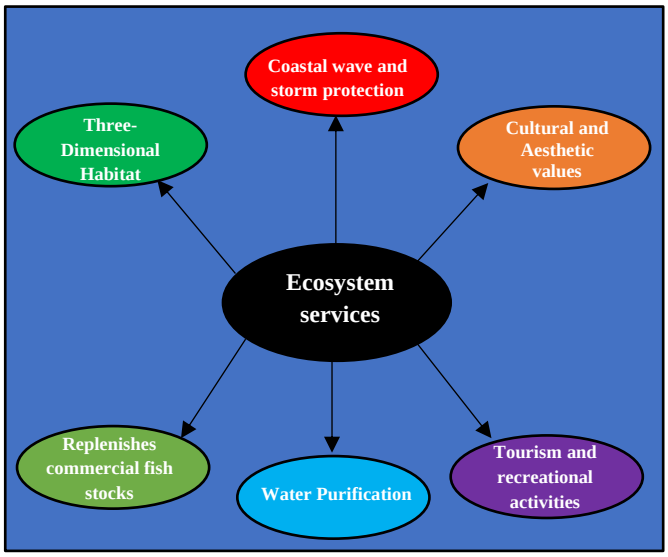

Figure 2: Ecosystem services provided by the GBR (Kennedy et al., 2013; Bellwood et al., 2004)

Despite its immense value, the GBR is suffering from significant biodiversity loss driven by human-induced pressures (see Figure 4). A business-as-usual approach from the Australian and Queensland Governments risks undermining the GBRs integrity and may lead to serious and potentially irreparable damage to an important reef system in the

near-future. Coral bleaching along the entire GBR could reduce the value of its services by at least AUS$38 billion and reduce the Australian economy by AUS$2.1 billion each year (Oxford Economics, 2017). Such an event risks destabilising the entire region and threatens the continued prosperity of the Australian people. (De Valck & Rolfe, 2018).

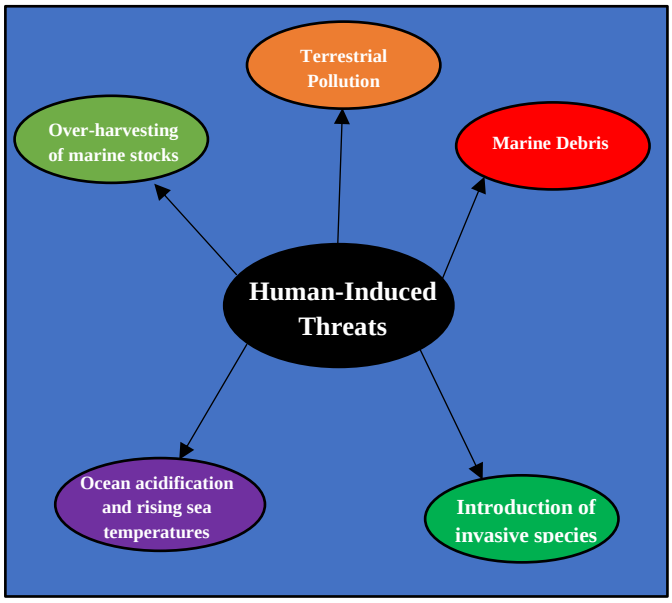

Figure 4:Human-Induced Pressures Threatening the GBR (Kennedy et al., 2013; Bellwood et al., 2004; Marshall et al., 2010)

Biodiversity loss is one of nine 'planetary boundaries' which describe the limits for human-induced environmental damage, before such damage becomes irreversible (Rockstrom et al., 2009). Biodiversity loss is significant because it reduces the resilience of Earth systems to local- and global-scale processes such as coral bleaching and climate change (see Figure 3). 'Biodiversity' consists of two separate parameters, genetic and functional diversity. Genetic diversity describes the potential for life to continue existing in the future. Low genetic diversity within a population indicates that it will be more susceptible to sudden environmental changes (Mace et al., 2014). Functional diversity describes the range, distribution and abundance of functions that organisms provide within an ecosystem. Ecosystems with high functional biodiversity tend to possess more resilience against sudden and significant environmental pressures (Mace et al., 2014).

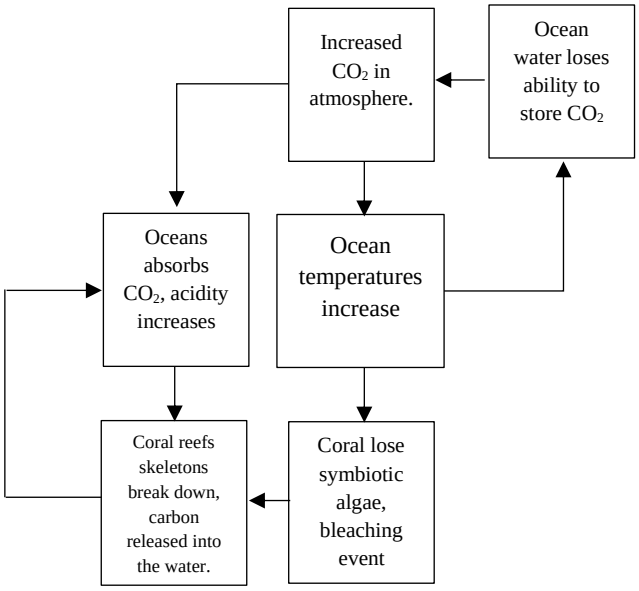

Figure 3: Flowchart showing relationship between coral biodiversity loss and climate change (Kinsey & Hopley, 1990; WMO, 2010)

Governance on the Great Barrier Reef

In 1975, the GBR Marine Park Act (Commonwealth of Australia, 2017) established a marine protected area (MPA) maintained by the GBR Marine Park Authority and Queensland Government. The GBR Marine Park Authority became responsible for protecting and conserving the reef and policing the 5% of the park allocated as a no-fishing zone (Bellwood et al., 2004). In 2004, this no-fishing zone (or 'no-take' zone) was extended to cover an additional 28% of the park (Hughes, Day & Brodie, 2015).

Whilst that has provided some protection to fisheries, it has done little to protect the GBR from most other human-induced pressures, including climate change.

The boundaries of the GBR Marine Park (see Figure 1) extend up to the coastal low-water mark and there are numerous exclusions to the park boundaries in port areas and enclosed waters along the Queensland coastline (King, Alexander & Brodie, 2012). This means that the GBR Marine Park Authority has no jurisdiction in major coastal developments that directly affect conservation efforts on the GBR.

The GBR Marine Park can be split into two distinct management regions: the developed urban coast (southern two-thirds) and the more remote Cape York region (northern one-third). The northern region has a smaller population, and as a result stresses on the GBR are much lower than in the more urbanised south. Whist northern reefs appear to be thriving, the continuation of urban and port development in the south has had an adverse effect on reef, seagrass and mangrove ecosystems (Grech, Coles & Marsh, 2011).

In addition to increased urban development, mismanagement of agriculture and livestock within the GBR catchment area, has led to a four-fold increase in sediment, nutrient and pesticide deposition into the GBR lagoon since European settlement in the 19th Century. This has provided additional pressure on an already delicate system (Hughes, Day & Brodie, 2015).

The GBR World Heritage Area

Not to be confused with the GBR Marine Park, the GBR World Heritage Area is the site officially recognised by UNESCO, and is managed by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC). Its boundaries extend to the high-water mark along the Queensland coastline and incorporate 3000 coral reefs, extensive seagrass meadows, mangrove forests, soft bottom communities and open water ecosystems.

Figure 5: The GBR World Heritage Area (King, Alexander & Brodie, 2012).

Terrestrial Pollutants

Nutrient Runoff – Nitrogen and Phosphorus runoff from fertilisers commonly leads to eutrophication, toxic algae blooms and hypoxia in coastal areas. In the case of the GBR it has also encouraged outbreaks of reef destroying Crown of Thorn Starfish.

Sediment Deposition – Deforestation destabilises soil which is then eroded away during precipitation events. Soil deposition in the GBR has decreased coral recruitment and increased seagrass mortality.

Pesticide Runoff – Overuse of pesticides can cause them to leach into groundwater, rivers and lakes. Pesticides cause the dieback of mangroves and expulsion of zooxanthellae (symbiotic algae in coral) causing bleaching events. Nearly a third of the GBR is now exposed to pesticides used in agricultural activity.

Figure 6: Terrestrial Pollutants (Álvarez-Romero et al., 2013; Waterhouse et al., 2011)

The Australian Government responded to rising levels of terrestrial pollutants (see Figure 6) entering the GBR Lagoon, by developing the Reef Water Quality Protection Plan (Commonwealth of Australia, 2018b). From this plan, the Australian Government initiated the 'Reef Rescue' Program in 2008, which provided financial incentives to farmers to adopt improved management practises (King, Alexander & Brodie, 2012). The Queensland Government also initiated the 'Reef Protection Package' which included new obligations and restrictions for sugarcane growers and beef cattle graziers within the GBR catchment area (King, Alexander & Brodie, 2012). Despite these measures, the responsiveness of the current regulatory system in Australia has been criticized for its lack of impact, due to the long timeframe that is takes to review potentially harmful chemicals (King, Alexander & Brodie, 2012).

In terms of management in the GBR Marine Park, current government policy is focused on generating sustainable wealth from the region rather than protecting it from human activity (Hughes, Day & Brodie, 2015). The current long-term plan for the GBR, articulated in the Reef 2050 Long-Term Sustainability Plan (Commonwealth of Australia, 2015) released in March 2015, requires significant alterations if the GBR is to be managed sustainably in the long-term. Currently, the plan prioritises the exportation of coal and coal seam gas for economic gain over adequately protecting the integrity of the GBR. It is the view of this brief that this practise is economically unsustainable (given the current global shift away from carbon-based energy production) and is counterproductive in terms of conservation within the GBR Marine Park.

Restoring Biodiversity on the Great Barrier Reef

This brief recommends that the Australian and Queensland Governments implement the following ten-point action plan:

1. **Develop and introduce new quantitative measures to assess the health of the GBR.**
   Such measures would help inform management decisions which maintain biodiversity and ecosystem functionality across the entire GBR system and not just a network of protected areas (Game et al., 2008). This brief suggests using the 'Marine Carbonate Budget' (Kennedy et al., 2013) as an appropriate measure to accomplish such a task.
2. **Identify sections of the GBR which are most at risk from environmental pressures.**
   This brief suggests using 'Spatially Explicit Assessments' (Grech, Coles & Marsh, 2011) to combine quantitative data with systematically collected expert opinions to identify 'at-risk' sites within the GBR. The aim of this assessment technique is to provide managers with the information they require to make informed and effective decisions for

minimal investment. Broad-scale assessments like this also aid management policies across jurisdictions, providing the opportunity to produce a cohesive and well-functioning plan (Grech, Coles & Marsh, 2011).

3. **Re-evaluate the boundaries of the GBR Marine Park.**
   This brief proposes that the GBR Marine Park boundaries be altered to mirror those of the GBR World Heritage Area (see Figure 5). This will give the GBR Marine Park Authority more influence over terrestrial activities that threaten the health of the GBR system (King, Alexander & Brodie, 2012).
4. **Reassess the effectiveness of current 'no-take zones' within the GBR Marine Park.**
   Considerations should be made to establish new no-take zones and enlarge previously established ones. Successful MPAs require no-take zones that are large, actively managed, strictly enforced and given enough time to build resilience (Edgar et al., 2014). No-take zones cannot prevent the decline of reef systems from large scale disturbances (such as increasing ocean temperatures), but they do provide the capacity for coral to recover more rapidly, increasing their overall resilience to environmental pressures (Williamson et al., 2013).
5. **Re-establish the former emphasis on conservation within the GBR Marine Park.**
   Conservation within the GBR should focus on protecting species, such as the herbivorous Parrotfish, which provide crucial ecosystem functions (Kennedy et al., 2013; Bellwood et al., 2004). Chronic exploitation of herbivorous fish can lead to a dramatic increase of microalgae which suppress the recruitment and survival of coral beds and introduce significant environmental stressors to reef systems (Game et al., 2008).
6. **Establish a less risk-averse conservation strategy with the GBR Marine Park.**
   The goal of conservation within the GBR Marine Park should be to maximise the overall number of healthy reefs, rather than aiming for one 'very-healthy' reef per region (Game et al., 2008). This is the most effective strategy for maintaining biodiversity and functionality across the whole of the GBR. This brief suggests that the number of healthy reefs within the GBR can be maximised by:
   - Protecting higher-risk reefs within low-risk areas
   - Protecting lower-risk reefs in high-risk areas (Game et al., 2008).

7. **Target conservation efforts within the GBR Marine Park to the southern two-thirds of the GBR catchment**

   This brief suggests focusing additional conservation efforts on the southern region to reduce stresses on the GBR within this area. Furthermore, economic development in Northern Australia should continue to be limited and closely managed to maintain gains in water quality within the region (Dale et al, 2016).

8. **Reduce terrestrial pollution entering the GBR.**

   The GBR Marine Park Authority should work with other Pacific nations and Australian institutions to curb the amount of terrestrial pollution entering the GBR lagoon. Pollutants of the greatest concern should be identified within the GBR catchment area and an understanding of the source of such pollutants be established (Waterhouse et al., 2011). Similar management in Honduras, Guatemala and Belize has been very successful (King, Alexander & Brodie, 2012). The WWF worked with major agricultural producers and chemical companies in the countries to introduce 'Best Management Strategies' which, under field test conditions, have showed reduced levels of terrestrial pollution (King, Alexander & Brodie, 2012).

9. **Invest in monitoring equipment and techniques to track and identify the flows of terrestrial pollutants into the GBR.**

   Understanding terrestrial pollution pathways can help target interventions and mobilise public and political support. This brief recommends using 'Earth Observation' techniques (satellite imagery) to map river plumes and other flows of terrestrial pollution into the GBR lagoon. Investment in this free data source could lead to benefits worth AUS$55 million a year (Bouma, Kuik & Dekker, 2011).

10. **Modify national and state regulatory systems for terrestrial pollutants.**

    This brief recommends that the Commonwealth of Australia adopts a regulatory system modelled on that of the European Union. Within the EU, substances must be proven safe in terms of human health and the environment in order to acquire authorisation for use in industry. Authorisations have an expiry date, meaning that substances must be re-evaluated at regular intervals, for example every 5 years. Adopting this regulatory model would allow the Australian system to prevent the most damaging substances from entering the GBR (King, Alexander & Brodie, 2012).

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