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POLICY PERSPECTIVE

Coal, Cumulative Impacts, and the Great Barrier Reef

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Abstract

The Great Barrier Reef World Heritage Area, Australia, covers over 348,000 km^2 of tropical marine ecosystems of global significance. In July 2015, the World Heritage Committee called attention to the cumulative impacts of climate change, poor water quality, and coastal development on the region's outstanding universal value, but stopped short of inscribing the Great Barrier Reef on the List of World Heritage in Danger. Restoring the region's values is hindered by an environmental decision-making process that fails to incorporate cumulative impacts, including the climate change impacts of greenhouse gas emissions sourced from one of Australia's largest exports, thermal coal. We identify policy and processes that enable a more comprehensive consideration of the cumulative effects of coal mining by environmental decision-makers. Implementing cumulative impact assessment requires a collaborative and transparent program of planning and monitoring independent of Government and mine proponents that evaluates local, regional, and global impacts. The future of the Great Barrier Reef depends on transformational change in the cumulative assessment of Australian coal mines.

Introduction

The Great Barrier Reef World Heritage Area (the Reef) encompasses the world's most extensive coral-reef ecosystem, stretching over 2,300 km across an area almost the size of Germany. The Reef supports over half the world's hard coral species and mangrove diversity, one-third of the world's soft coral species, 23% of global seagrass diversity, and six of the world's seven species of marine turtles (GBRMPA 2014a). The global significance of the Reef was recognized in 1981 when it was inscribed on the World Heritage List for its outstanding universal value, meeting all four natural criteria: exceptional natural beauty, significant geomorphological features, significant ongoing ecological processes, and natural habitats for conserving biodiversity. The Reef also supports multiple indigenous, historic, aesthetic scientific, and social values, and contributed ~AUS$5.6 billion to the Australian economy from tourism, fishing, and other industries in 2011–2012 (GBRMPA 2014a).

There is overwhelming evidence that many of the values that collectively comprise the region's outstanding universal value have deteriorated since 1981 (GBRMPA 2014a; 2014b; Hughes *et al.* 2015). The Reef and its catchment (part of which is shown in Figure 1) are exposed, directly or indirectly, to diverse and extensive human activities, including agriculture, mining, ports, shipping, fishing, tourism, and urban and industrial development. The cumulative impact of all these activities, along with naturally occurring impacts such as cyclones and outbreaks of coral predators and disease, has caused an estimated loss of 50% of coral cover (De'ath *et al.* 2012), and significant declines in dugong (Marsh *et al.* 2007) and many seabird species (GBRMPA 2014a). Recent research indicates climate change is exerting negative effects on reef calcification, growth of massive corals, and the survival of corals in the region (De'ath *et al.* 2009; GBRMPA 2014a; Hughes *et al.* 2015).

In its 39th session in July 2015, the World Heritage Committee noted that the overall outlook for the Reef is poor, and that climate change, poor water quality, and coastal development (e.g., ports) are major threats to the region's habitats, species, and ecosystem processes (World Heritage Committee 2015). During the

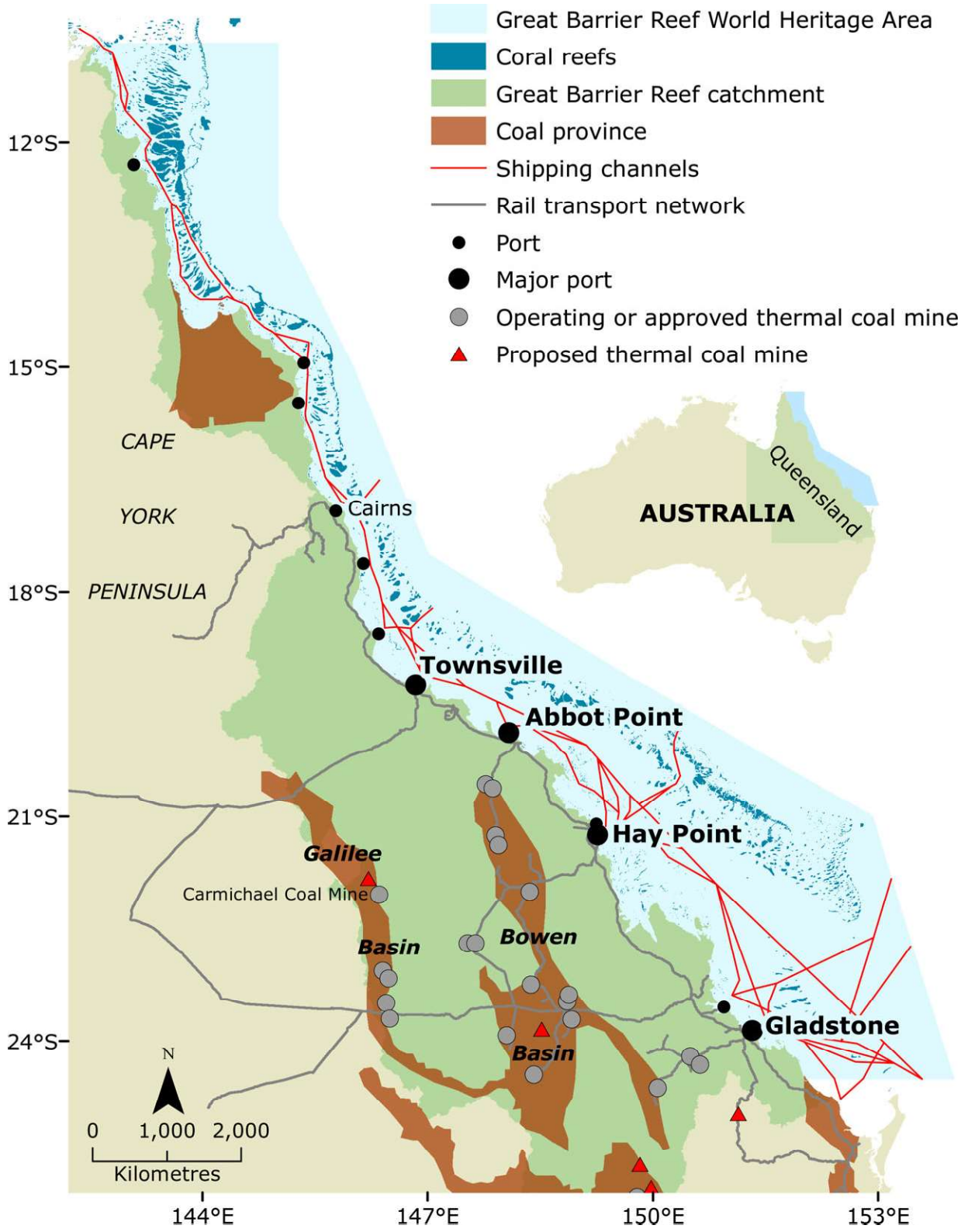

Figure 1 Distribution of coal basins, ports, and operating, approved and proposed thermal coal mines in the Great Barrier Reef World Heritage Area and its catchment in north Queensland, Australia. Data provided by: Australian Mines Atlas; Great Barrier Reef Marine Park Authority; and Queensland Department of State Development, Infrastructure and Planning.

Committee's deliberations, four countries specifically mentioned the cumulative impacts of these threats (Day 2015).

The committee decided in its July session not to inscribe the Reef on the List of World Heritage in Danger. Instead, it requested the Australian Government to demonstrate, within the next 18 months, how it will implement its long-term plan designed to restore the values for which the Reef was listed as World Heritage, and then to report again in 2019. However, the Australian Government's plan for restoring the Reef's values is likely to fail unless there is transformational change in the environmental decision-making process (Hughes *et al.* 2015). We show how current decision-making is promoting "death by a thousand cuts" of the Reef by failing to consider the cumulative impacts of all pressures, including developments in the Reef's coastal zone and catchments. Among these developments is the proposed extraction of one of the world's largest sources of greenhouse gas emissions—thermal coal.

Coal and the Reef

New developments at the Ports of Abbot Point, Gladstone, and Hay Point (Figure 1) are primarily driven by increasing demand from the coal and energy industries. In 2012, a reactive monitoring mission by the United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Centre and the International Union for Conservation of Nature (IUCN) found that the number and extent of new port developments presented "*a significant risk to the conservation*" of the World Heritage Area (Douvere & Badman 2012). Since then, the Australian and Queensland Governments have approved six new thermal coal mining developments,[1] which will require expansions of port infrastructure and dredging along the Reef's coastline.

The recently approved Carmichael Coal Mine in the Galilee Basin (Figure 1) is expected to produce 60 MTpa of thermal coal for energy production in India over its 60–90 year life span,[2] making it Australia's largest coal mine. New thermal coal mines in the Galilee Basin, including the Carmichael Coal Mine, propose to export their product via the Port of Abbot Point (Figure 1).

Environmental impact statements (EISs) assist the Queensland and Australian Governments to consider the impact of new coal mining proposals when deciding whether to approve them, and inform the development of appropriate conditions for environmental management and monitoring. EISs describe the current environment, predict the consequences of the proposed action (positive and negative), and identify how proponents intend to avoid, mitigate, or offset these consequences.

A draft EIS[3] for a new thermal coal mine is currently being assessed for the China Stone Coal Project, adjacent to the Carmichael Coal Mine (Figure 1) and equivalent in scale. Australia is the world's fifth largest producer of coal, generating AUS$16.7 billion in thermal coal export earnings from 194.59 million tons of product in the 2013–2014 financial year (BREE 2014). Australia's economic reserves of coal (thermal and metallurgical) have a CO_2 potential of 150 billion tons (Carbon Tracker and The Climate Institute 2013), or ~17% of the global carbon budget required to achieve an 80% chance of 2°C warming by 2050 (Carbon Tracker and Grantham Research Institute 2013). Global warming of 2°C and above, combined with increasing ocean acidification, is predicted to increase the frequency and severity of bleaching of coral reefs, leading to their widespread loss (Frieler *et al.* 2013; Pörtner *et al.* 2014).

The Queensland and Australian environmental assessment processes require coal mining EISs to report the cumulative impact of proposed developments and to assess whether there are significant impacts on World Heritage values. However, in practice, EISs report only the direct, local impacts of mining operations, and they do not consider the indirect impacts of the mines at a broader spatial or temporal scale. For example, the Carmichael Coal Mine EIS[4] did not identify impacts to the Reef from the expansion of the Port of Abbot Point, the increase in shipping traffic, or the greenhouse gas emissions of the exported coal product. Further, EISs in the Reef's catchment do not consider the impacts of successive developments over time or over the Reef's full extent (Grech *et al.* 2013), both of which are necessary to understand the incremental accumulation of impacts that have led to declines in World Heritage values. A new process is required to enable a more comprehensive consideration of the cumulative effects of coal mining by environmental decision-makers.

Assessing cumulative impact

Cumulative impact assessment (CIA) is an established process for systematically analyzing, evaluating, and predicting cumulative environmental change over time and across the spatial extent of the receiving environment (Spaling & Smit 1993). CIA requires information on: the relative magnitude and impact of pressures across the receiving environment; the spatiotemporal distribution of pressures and environmental features; and the additive, synergistic, or antagonistic interactions between multiple pressures (Grech *et al.* 2013; Judd *et al.* 2015). Interactions include pressures from one action (e.g., coal mining) in combination with past (e.g., pollution from land-based

activities such as mining), present (e.g., coastal development), and future (e.g., climate change) impacts. The scope of CIA must incorporate direct impacts (e.g., terrestrial habitat loss from an open-cut coal mine), indirect impacts (e.g., dredging at port to facilitate shipping of exported product), and consequential impacts (e.g., anchor damage from increased shipping) arising from all the proposed actions (GBRMPA 2014b).

The requirements of scope and scale necessitate CIA for thermal coal mining to incorporate impacts at the site of the mine, the railway, port, and shipping activities used to export coal, and the greenhouse emissions of exported coal (Grech *et al.* 2013). This must be assessed in conjunction with past, present, and future impacts from activities related or unrelated to mining at the spatial extent of the receiving environment, including the Reef and its catchment.

Barriers to comprehensive CIA

Implementing comprehensive CIAs at the appropriate scope and scale within EIS is challenged by (Grech *et al.* 2013): (1) the incremental approach to environmental assessment, where approval is often sought sequentially for small components of a larger project; (2) lack of capacity of proponents; and (3) limited sharing of information on proposed or planned developments due to commercial and competitive forces. An alternative approach to EIS is for government to lead a collaborative program of planning, permitting, monitoring, and management of cumulative impacts (Cardinale & Greig 2013), considering environmental, social, and economic consequences of thermal coal mining.

The appropriate governance structures exist to undertake comprehensive CIAs in Australia. Strategic assessments, provided under section 146 of the Commonwealth (Australian) *Environmental Protection and Biodiversity Conservation Act* 1999 (EPBC Act), evaluate the impacts of multiple actions or developments. The role of strategic assessments is to identify mechanisms to avoid, mitigate, and offset impacts at a much broader scale than can be observed through project-based assessments (i.e., EIS).

The response of the Australian Government to decisions of the World Heritage Committee over the years 2011–2014 included a comprehensive strategic assessment (GBRMPA 2014b) of the World Heritage Area and a framework for protecting and managing the Reef from 2015 to 2050 (*Reef 2050 Plan*; Commonwealth of Australia 2015). A key recommendation in the strategic assessment is "*to improve understanding and management of cumulative impacts from activities within and adjacent to the Region, and provide clearer guidance on how proponents and decision makers should address cumulative impacts in assessments*" (GBRMPA 2014b, Rec7).

Developing such an approach to address cumulative impacts is, however, inhibited by the *Reef 2050 Plan* (Commonwealth of Australia 2015), which is silent on the impact of greenhouse emissions from energy production and the effects of climate change more generally (AAS 2014). With the exception of water quality from the Reef's catchments, the *Reef 2050 Plan* also fails to provide the quantitative targets and explicit strategies (such as reducing the extent of dredging, coastal development, and unsustainable fishing) required to restore the values of the Reef to their condition when listed as World Heritage in 1981 (AAS 2014; Hughes *et al.* 2015). The *Reef 2050 Plan* relies heavily on qualitative and unmeasurable assurances, limiting its capacity to make a positive long-term contribution (AAS 2014). Continuing failure to meet the requirements of CIA will mean more EISs, leading to more piecemeal decisions that ignore the lengthy and extensive accumulation of impacts responsible for the decline in the Reef's values (Pressey *et al.* 2015).

Opportunities for comprehensive CIA

As a basis for targets and strategies, the links between energy production, coal mining, ports, shipping, and the integrity of the Reef can be quantified by a comprehensive strategic assessment of Queensland's thermal coal mining industry. There is a precedent: the Australian and New South Wales' Governments have a strategic assessment underway to assess the cumulative impacts of new and expanded coal mining on biodiversity in the Upper Hunter Valley.[5] A fundamental goal of such an assessment in Queensland should be world's best practice in CIA, in keeping with the global significance of the Reef.[6] Potential conflicts of interest of proponents and consultants (already evident in EISs; Grech *et al.* 2013) and the financial reliance of the State and Australian Governments on the coal industry should be circumvented by establishing an independent and technically informed CIA commission.

The role of an independent CIA commission would be to set the terms of reference, monitor and review the assessment's outputs, and facilitate public input by ensuring appropriate time frames and approaches to stakeholder consultation. The CIA commission should ensure an approach to strategic assessment that is informed by adequate data on environmental baselines and acceptable, ecologically informed thresholds. Baseline data define the state of biodiversity features of concern at some appropriate time before an action or development proceeds. Thresholds indicate breaking points at which

features undergo unacceptable change or irreversible consequences as a result of cumulative impact. Baselines and thresholds inform both impact predictions and mitigation strategies.

Current approaches to project-related baseline and monitoring programs are limited in their capacity to inform CIA because data are collected at inappropriate spatial and temporal scales (Grech *et al.* 2013). For example, the Carmichael Coal Mine EIS focused environmental monitoring primarily at the site of the proposed development (447 km^2), adjacent water bodies, and a 189 km rail line.

The collection of baseline and monitoring data to inform CIA would be improved by the development of integrated monitoring programs that are standardized across the Reef and its catchment (Hedge *et al.* 2013), implemented by third-party specialists, and funded by a levy on industry proponents (Bos *et al.* 2014). CIA monitoring programs could exploit industrialized research methodologies, such as metabolomics (e.g., Skelton *et al.* 2014), to provide near real-time, verifiable data that establish thresholds and causal links between key indicators and direct and indirect pressures, independent of proponents and consultants. Similar programs exist overseas: the Canadian Nuclear Safety Commission (CNSC) implemented an Independent Environmental Monitoring Program[7] to monitor environmental impacts at CNSC-regulated nuclear facilities.

The key requirements for thermal coal mining CIA have been put in place by Australian researchers (e.g., Franks *et al.* 2010) and national (e.g., CEAA 2014) and international agencies, including the World Bank (Cardinale & Greig 2013) and the European Union (Walker & Johnston 1999). Approaches to CIA range from simple checklists and matrices, through to system diagrams that identify cause-and-effect relationships, spatial overlay analysis, and detailed models that predict synergistic and antagonistic interactions between multiple and interacting pressures, species, habitats, and ecosystems (Walker & Johnston 1999; CEAA 2014). Even with inevitable uncertainties, methods such as Bayesian networks of cumulative impacts (e.g., Ban *et al.* 2014), linked to scenarios of future development, are powerful tools to guide decision-making with the best available data, models, and expert judgment.

Should the Reef have precedence over coal?

The coal industry is often viewed as a zero-sum game: current trading partners will source thermal coal from elsewhere if Australia does not supply it.[8,9] However, the reality is that each new Australian coal mine will contribute greenhouse gas emissions that exacerbate the risk of climate change generally, and climate-related impacts on the Reef specifically. Our view is that this risk, in combination with other pressures on the Reef, should be assessed and made explicit by the supplier. This view has wider traction in Australia, as reflected in a recent Federal Court[10] challenge to the Australian Government's approval of the Carmichael Coal Mine on the basis that it failed to consider the impact of greenhouse gas emissions of exported coal on the Reef. The Mackay Conservation Group was successful in its challenge because the Australian Environment Minister failed to take into account the conservation advice on two vulnerable species. The consideration of greenhouse gas emissions of exported coal in EIS remains unresolved, but is likely to be brought before the Federal Court again within 18 months. Regardless of this particular decision, the Australian Government must decide whether it should profit from actions that will damage the Reef, or allow an alternative supplier to profit from that damage.

The broader context for assessment of impacts from fossil-fuel emissions is that the United Nation's Framework Convention on Climate Change does not require signatory nations to account for emissions produced from exported goods. Our view is that stronger leadership is needed from the convention to reverse its present stance. Otherwise the full effects of any new supplies of fossil fuels will not be understood, even though, in aggregate, their impacts are likely to be serious. Reversing the convention's present stance could provide a catalyst for the consideration of the cumulative impact of greenhouse gas emissions of exported thermal coal in Australia and other regions.

Comprehensive CIA necessitates the evaluation of the social and economic impacts of thermal coal mining. Coal is Australia's second largest export earner, but the future of the AUS$16.5 billion Carmichael Coal Mine is uncertain because the global demand for coal in energy production is predicted to slow (IEA 2014). Construction at the mine site has suspended amid claims that the project is financially unviable (Buckley 2015), and the National Australia Bank (NAB) recently announced that it will not fund the mine's development because of increasing speculation over its future.[11] The Carmichael Coal Mine also faces another kind of financial pragmatism. Deutsche Bank, Citigroup, Morgan Stanley, HSBC, and other global lenders have declined to fund expansions at the Port of Abbot Point because of concerns about its impact on their international reputations.[12] CIA must expand to incorporate global drivers of energy production and financing to enable the comparison of the environmental, social, and economic costs and benefits associated with thermal coal mining.

The Australian and Queensland Governments have been jointly responsible for managing the Reef during the time when many of its values have declined (Hughes *et al.* 2015), expressing concern about such declines[13] but without implementing effective actions to reverse many of them. A transformational change in Australia's assessment of cumulative impacts is required, including the comprehensive assessment of the direct and indirect impacts of coal mining, if the Reef is not to suffer from the "tyranny of small decisions." As described by Odum (1982), this phenomenon involves a big decision arising post hoc from an accretion of small decisions, without the central question being addressed directly (in this case, how to maintain the values of the Reef) and without constraints or guidance from an effective high-level authority. It seems safe to say that no one set out to cause the present extensive damage to the Reef, but it has happened all the same.

In the case of the Reef, the tyranny of small decisions is imposed by the current EIS process that describes only single increments of decline, any one of which can be rationalized by decision-makers as posing acceptable environmental risks. The inadequacy of small, incremental decisions can be overcome by the rigorous, comprehensive CIA shown to be feasible elsewhere. For the Reef, however, effective environmental assessments will rely ultimately on the willingness of both governments to consider all cumulative impacts when making such assessments.

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