



# Articulating futures: Community storylines and assisted ecosystem adaptation in the Great Barrier Reef

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## ABSTRACT

Public discourse about the Great Barrier Reef – a globally significant coral reef system stretching 2300 kilometres along the coast of northeast Australia – has become dominated by forecasts of its decline due to climate change. While a common and understandable response to fears about the Reef's imminent loss is advocacy for stronger action on climate change, there have also been increased calls for a shift toward resilience-based management supported by technological interventions to help coral ecosystems survive and adapt to inevitable temperature rises. This paper explores how local community perspectives are formed and expressed within this broader dialogue. Drawing on qualitative interviews with 80 people living and working in proximity to the Reef, we use composite narrative maps to illustrate how narratives of the Reef's imminent loss are used by communities to articulate alternative futures in the possibility of social change and in the ongoing efficacy of local protection and care. However, we also show how these narratives of loss can constrain the articulation of responses to technologically assisted adaptation, forcing the majority of participants into an uncomfortable moral binary between offering practical help to an imperilled Reef or allowing its imminent loss to catalyse social change. We reflect on what this might mean for fostering a productive and inclusive dialogue about assisted ecosystem adaptation in the Great Barrier Reef.

## 1. Introduction

In Indigenous contexts, to 'story' is a reflexive practice that explores and deepens awareness of the sacred connections between people and Country. Mediating reflection, balance and collective welfare, it is a practice long recognized as integral to Indigenous societies across time and space and to the construction of Traditional Ecological Knowledge (Iseke, 2013; Saiyed and Irwin, 2017; Wyld and Fredericks, 2015). The role that stories and narratives play shaping environmental imaginaries and practices in non-indigenous contexts is also well-recognized (Morris et al., 2019). More recently, however, environmental scholars have re-emphasized storytelling as a co-productive practice whereby multiple perspectives can be brought into dialogue and just and desirable responses to contemporary environmental problems articulated (Paschen and Ison, 2014; Veland et al., 2018; Wyborn et al., 2021).

In this paper, we focus on the stories being shared about the Great

Barrier Reef, a vibrant and diverse marine ecology stretching 2300 kilometres along the coast of northeast Australia. The Great Barrier Reef (shortened here at times to 'the Reef') holds profound significance for Reef Traditional Owners and is celebrated worldwide as a 'global nature superstar' (Foxwell-Norton and Lester, 2017, p. 569) for its outstanding aesthetic and ecological values. The last two decades, however, have seen an explosion of discourse about the vulnerability of the Reef to climate change. This has come as coral reefs worldwide have experienced successive and unprecedented mass bleaching events (National Oceanic and Atmospheric Administration, 2024) and reports from the Intergovernmental Panel on Climate Change have forecast the loss of 70–90 percent of tropical coral reefs worldwide even if average temperatures can be kept within 1.5 degrees of pre-industrial levels (Hoegh-Guldberg et al., 2018).

The likelihood of decline in the Great Barrier Reef has understandably triggered substantial concern (Marshall et al., 2019;

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Piggott-McKellar and McNamara, 2016) and various calls for action. Environmentalists, who have long known the Reef's power to 'engage public attention and mobilize political demand for action' (Konkes et al., 2021, p. 135) have been quick to use predictions of its impending loss to demand urgent mitigation of greenhouse gas emissions (Foxwell-Norton and Konkes, 2022; Konkes and Foxwell-Norton, 2021). Alerting broader communities to changes observed in the Reef since colonization, Reef Traditional Owners<sup>4</sup> have advocated for the amplification of their own voices, positioning care for Sea Country<sup>5</sup> as an enduring expression of the rights and responsibilities they share in and with the Reef (Grant, 2021; Rist et al., 2019). While differing perspectives have been expressed amongst coral scientists, many advocate the need to consider active strategies to build the ecological resilience of coral reefs (Shaver et al., 2022; Suggett et al., 2024). This has led to investments in research exploring novel technological interventions to protect the Great Barrier Reef from climate extremes, facilitate its recovery from disturbance, and accelerate its adaptation to rising temperatures (Anthony et al., 2020; Bay et al., 2023; McLeod et al., 2022).

As the Great Barrier Reef becomes a matter of substantial discussion and a touchstone for up-scaled assisted coral reef adaptation, this paper does not seek to arbitrate between perspectives regarding its future. Rather, our concern lies in examining whether there is adequate opportunity within the co-productive storytelling currently taking place for the articulation of multiple, diverse and alternative possibilities (Paschen and Ison, 2014; Veland et al., 2018; Dryzek, 2009). To explore this question, we draw on qualitative research in which people living and working in proximity to the Great Barrier Reef were invited to share their perspectives on its future and the prospect of technologically assisted adaptation. Using composite narrative maps, we aim first to trace the processes through which participants assemble nascent storylines about the Reef's future and the prospect of assisted adaptation, and second to critically examine how this assembly is situated in and shaped by broader stories and discourse about the Reef. As we highlight the dialectic connections between these personal and collective stories, our final aim is to consider what implications this has for effective dialogue and action for the Great Barrier Reef and other ecologies facing uncertain futures under climate change.

## 2. Shifting Reef storylines

Formed over millennia by the activities of billions of tiny coral polyps and their photosynthetic algal symbionts, the Great Barrier Reef is the world's largest coral reef system and a significant biological achievement. It is also an environment embedded in social and political processes, with meanings and possibilities shaped in the ways it is collectively storied. Stories – or character-based narrations of a struggle to overcome obstacles and achieve goals – are an important means of organizing social knowledge about the Reef and materially enacting its future (Morris et al., 2019). The enduring rights and responsibilities of over 70 First Nations are part of a story deeply embedded in the connections people have with Reef Sea Country (Whitehouse et al., 2014). Stories have also shaped the Reef post-European appropriation. Storied as a chattel for national development, for example, the Reef was subject to 'unprecedented exploitation' (Daley, 2014, p. 9), until a prospering tourist industry, sophisticated underwater photography, and an

increasingly influential conservation movement brought new stories celebrating the Reef's ecological value and demanding its protection (Elias, 2019; Lloyd, 2022).

The establishment of the Great Barrier Reef Marine Park in 1975 saw the regulation of economic activity within the Reef and a future focussed on the sustainable use of the region for public enjoyment, education, research, and recreational, economic and cultural activities; protection and management by interested parties including government, communities, Reef Traditional Owners, business, and industry; and helping Australia meet its international commitments and responsibilities. The Reef's listing on the World Heritage Register in 1981 solidified the Reef's aesthetic, ecological, and scientific importance at a global level, and the subsequent spatial planning and adaptive management processes undertaken as part of its protection have been ambitious (Day et al., 2019; Day, 2022). These have involved substantial participatory processes through which multiple attachments to and interests in the Reef have become evident (Day, 2017; Gurney et al., 2017). Within these frameworks, scientific knowledge and practice has come to play a prominent role determining the baseline ecological values and monitoring the effectiveness of this protection (Damiens et al., 2022).

The release of the *Reef 2050 Long-Term Sustainability Plan* in 2015 and the *Great Barrier Reef Blueprint for Climate Resilience and Adaptation* in 2017 signified two major additions to the Reef's storyline. The first is driven by an emphasis on the inherent, unique, and continuing rights and interests of Traditional Owners in the Reef (Commonwealth of Australia, 2023; Great Barrier Reef Marine Park Authority, 2024). Building on the imperative for co-management articulated in the *2050 Plan* and *Blueprint for Resilience*, Reef Traditional Owners speak of a future in which the Reef is managed as a biocultural landscape (Dale et al., 2018; Grant, 2021), or a landscape in which ecological and community wellbeing are not only interconnected but essentially one and the same (Jarvis et al., 2019). The success of management in a biocultural landscape, it follows, is measured as much by its contribution to Indigenous knowledge, heritage and self-determination as it is by metrics of ecosystem health such as coral cover, species abundance and water quality.

The second articulates the need to focus management activities on strengthening the resilience of the Great Barrier Reef relative to global environmental change. Proponents of resilience-based management in the Reef (and elsewhere) speak of a future in which rapidly escalating climate impacts demand anticipatory action to expand the protected area estate, improve habitat connectivity, reduce anthropogenic stressors and, critically, develop new strategies and tools for building adaptive capacity among human and ecological communities (McLeod et al., 2019; Westoby et al., 2020; Shaver et al., 2022; Suggett et al., 2024). In a world in which it is no longer possible to maintain ecosystems in a steady state or to shield them from external stressors, resilience-based management calls for increased dialogue about the goals of ecosystem management, better targeting of conventional management practices, and innovation to develop new options for ecosystem protection, restoration and adaptation. Options subject to active research and development include local-scale solar radiation management (through surface-level fogging and marine cloud brightening), stabilization of reef substrates, automated coral aquaculture and out-planting, genomic screening of corals used in restoration, and more (Butcherine et al., 2023; McLeod et al., 2022).

While debate over the feasibility and ethics of intervention to promote ecosystem resilience and adaptation is common among scientists working across a diversity of contexts (Vella et al., 2021), it is noted to be acute among those working on coral (Braverman, 2016). Critics of restoration and adaptation articulate a catastrophic storyline in which the loss of coral reefs, as we know them, is inevitable in the absence of deep and immediate cuts in greenhouse gas emissions (Braverman, 2016). In contrast with the resilience storyline – which positions local protection, restoration and adaptation activities as strategies to minimize losses and 'buy time' for global agreements on climate change to

<sup>4</sup> The term 'Reef Traditional Owner' is used throughout this manuscript in reference to people of Aboriginal and/or Torres Strait Islander descent with spiritual and cultural connections to areas within the Great Barrier Reef or who hold native title rights in relation to those areas (see [www2.gbrmpa.gov.au/learn/traditional-owners/reef-traditional-owners](http://www2.gbrmpa.gov.au/learn/traditional-owners/reef-traditional-owners)).

<sup>5</sup> Sea Country refers to any environment within the traditional estates of Aboriginal and/or Torres Strait Islander Peoples associated with the sea or saltwater and the cultural, social, and economic values they hold (Rist et al., 2019; Smyth, 2001; Smyth and Isherwood, 2016; Whitehouse et al., 2014).

take effect and for species to adapt to their changing environments – the catastrophic storyline positions these activities as offering, at best, small-scale and short-lived benefits and, at worst, a politically dangerous distraction from the task of ending the fossil fuel era (Braverman, 2017). Despite the polarized and emotive nature of these storylines both, importantly, rely on ecosystem and climate modelling to articulate narratives in which scientific expertise is foregrounded and used to identify strategies for shifting the trajectories of coral ecosystems under climate change from what is anticipated to something more desirable (Braverman, 2017). Both also narrate futures in which the window of opportunity for effective action is closing rapidly.

Ecosystem and climate models can be understood as a critical form of political discourse within ecological futures (Giddens, 1994; Lockie, 2014). This is not to suggest that models, the data on which they are based, or the forecasts they inform, are in some way fictitious, but to acknowledge their specific purpose and effect within collective dialogue. By bringing the future into the present, models and forecasts facilitate discussion and action to change that future (Giddens, 1994; Lockie, 2014). It is also to acknowledge the potential for unintended consequences, both good and bad. As the urgency of addressing climate risk forces reef scientists to ‘become spokespersons for their corals if they are to save them’ (Braverman, 2020, p. 21) those scientists are speaking about much more than coral. They are speaking about everything from marine park management and research priorities to energy transitions and global political economy. If Beck (2015) is right that anticipation of catastrophic global change contains within it the seed of social and economic transformation, then examination of the storylines circulating around coral reefs needs to be alive to multiple perspectives on the social and ecological futures these storylines make possible.

Braverman (2017, p. 13) argues that, in the case of coral, the storylines narrated by scientists have been ‘neutralized and prevented from having political effects.’ Whether this is true in a global sense is beyond the scope of this manuscript, but it begs the question as to how scientific knowledge and discourses are reflected in storylines circulating among broader communities with interests in the Great Barrier Reef, and what other forms of knowledge and experience influence these stories. As Jackson (2023b) notes, the futures anticipated by communities in Northern Australia (futures inclusive of multiple ecosystems) are influenced not only by science but by the politics of climate policy, the extent to which future climate impacts are perceived as locked in (and thus beyond action), peoples’ own experiences of loss and damage from climate events, and the affective or emotional experience of loss. While some residents are dumbfounded that scientific evidence in concert with exposure to ‘the visible manifestations of climate change’ is ‘not leading to rapid societal transformations’ (Jackson, 2023a, p. 93), others interpret cyclones, coral bleaching, and bushfires as evidence of natural variability, stop listening to science perceived as disconnected from their own experience, and/or give up on the possibility of arresting system collapse (Jackson, 2023b). Governance actors too, as Datta et al. (2024) demonstrate, articulate conflicting interpretations of climate risk and the appropriate policy and management responses.

In the translation of storylines into future-making action, neither all narratives nor all actors have equal influence (Datta et al., 2024). Yet there is an argument to be made that if publics are to support assisted adaptation (indeed, any novel technology or climate change response), the opportunity is needed for those same publics to engage with and contribute to the storylines in which adaptation technologies are embedded (Blue et al., 2022; Blue and Davidson, 2021). This may be less about asserting a singular authoritative narrative on the future than it is about allowing more voices to speak, different stories to be heard, diverse forms of authority to be exercised, and a richer set of values, knowledges and aspirations drawn into articulating the Reef’s future (Eriksen et al., 2015; van Kerkhoff et al., 2019; Wyborn et al., 2016). Numerous scholars have commented on the potential for more inclusive dialogue to reduce polarization and facilitate more coherent action on climate change (Louder and Wyborn, 2020; Milkoreit, 2017; Moezzi

et al., 2017; Paschen and Ison, 2014; Veland et al., 2018; Veland and Lynch, 2016); dialogue that is, in many respects, about enhancing collective capacity to negotiate potentially competing claims about what is ‘possible, plausible and desirable’ (Wyborn et al., 2020, p. 671).

However, understanding community perspectives on emerging technologies like assisted adaptation, and meaningfully drawing them into dialogue with scientific experts, government regulators, Traditional Owners and others is not entirely straightforward (Macnaghten, 2010). Asking communities to exercise authority in early discussions about the acceptability and feasibility of unfamiliar and novel technologies in contexts marked by socio-ecological complexity, rapid change, and uncertainty places heavy demands on them (Vella et al., 2021). In globally significant environments like the Great Barrier Reef, this is likely to take place in contexts where there is considerable public interest, diverse perspectives and established stories and discourses. Creative methods are needed to help communities participate in the generation of knowledge in circumstances where new perspectives are only just emerging, coherent and consistent positions on the best path forward may not yet be possible, and the consequences of decisions are not well understood (Macnaghten, 2021).

### 3. Research approach

Funded under Australia’s Reef Trust Partnership, the Reef Restoration and Adaptation Program (RRAP) is a multi-institutional research program exploring a range of scientific and technological strategies to assist the Great Barrier Reef survive, recover from and adapt to the impacts of climate change. Ongoing research, engagement and collaboration with Reef Traditional Owners<sup>6</sup> and other Reef communities is an explicit component of RRAP to allow the different perspectives on the prospective technologies to be understood and community interests and knowledge incorporated into the design and implementation of assisted adaptation technologies. Within this, the RRAP Regional Deep Dive is a qualitative research project that invites participants to discuss their connections with the Reef, their aspirations for its future and expectations for its management, and their views on restoration and adaptation.

Between late 2021 and early 2022, 70 face-to-face and semi-structured interviews were conducted with 80 participants mostly located in the regions around Cairns, Townsville, and Airlie Beach. Participants were recruited to the research due to their associations with four broad (and often overlapping) community sectors: Reef Traditional Owners, Livelihood users (e.g. tourism operators and commercial fishers), Institutional stakeholders (e.g. management authorities, scientists and engineers), and Civil Society representatives (e.g. members of reef restoration and conservation organizations and recreational users such as divers, photographers and anglers). Open ended questions encouraged participants to describe how they imagined the future of the Great Barrier Reef in coming decades and their views regarding the prospect of assisted adaptation. While some participants had experience and knowledge of RRAP and/or the options being explored, the majority had little or no familiarity. Where necessary, a brief and scripted outline explaining the goals of RRAP and the technologies being explored was given. Researchers were careful not to present a particular perspective on the issue, but encouraged participants to candidly raise issues and express thoughts, questions and concerns.

Interviews were transcribed verbatim. This research was approved by James Cook University’s Human Research Ethics Committee (Approval No. H8435) and followed protocols regarding informed consent and confidentiality.

<sup>6</sup> As rights-holders over the Great Barrier Reef, the authority and leadership of Reef Traditional Owners is also embedded in the governance arrangements underpinning the Reef Trust Partnership and central to RRAP research and implementation. Free, prior, and informed consent (FPIC) from Traditional Owners is a fundamental requirement of RRAP operations on Sea Country.

Although often associated with participatory methods such as citizen juries and community workshops, almost any social research method can contribute to the normative ideal of collective decision-making associated with deliberative democracy (Ercan et al., 2022). The Regional Deep Dive was deliberative in that interviews were both knowledge-producing and conducted within a larger research program that offered a range of opportunities for collaboration with other community members, scientists, and so on (Curato, 2012). Interviews were also intended to operationalise Dryzek's (2009) criteria for deliberative capacity; that is, to support dialogue that is authentic (noncoercive, meaningful and reciprocal), inclusive, and consequential. As Deep Dive participants were not statistically representative of the entire Reef community, the value of the study lies not in its generalizability beyond the research cohort but in capturing early dialogue with participants and their assembly of anticipatory storylines about the Reef, its future and the prospect of assisted adaptation (Paschen and Ison, 2014; Shepherd et al., 2018). This allowed researchers to closely examine these 'narratives in the making' (Chilvers and Kearnes, 2020; Lueg et al., 2020; Macnaghten, 2021) in order to support meaningful dialogue and public engagement.

To do this, researchers looked not just at the qualitative content of these anticipatory storylines (what was being claimed would happen in respect to the Reef) but how accounts were assembled to give claims effect, logic and plausibility. Specifically, researchers traced common patterns in their *employment* (the presumed logic that connects narrative themes and drives the momentum of the story), including *expository strategies* (how present circumstances are backgrounded in project a plausible future), and *narrative positioning* (the roles given to the various elements or characters in the story e.g. protagonists, antagonists, narrators), as well as the rhetorical strategies used to persuade and affect the listener (Berger, 1997).

Researchers sought to understand storylines as both an expression of participants' individual views, and also something 'resourced' (Macnaghten et al., 2019, p. 506) by broader collective discourse about the Reef and its future, and recurrent cultural metanarratives and imaginaries about technoscience and relationships between humanity and nature (Paschen and Ison, 2014). They paid attention to instances in which personal storylines aligned with these broader narratives and imaginaries, and to instances in which they were resisted and countered with alternative claims and visions (Lueg et al., 2020; McLean and Syed, 2016).

As they analysed participants' accounts, researchers created composite maps or diagrams to trace patterns in the way nascent perspectives were articulated. Presenting narratives in composite has proven helpful when connecting multi-faceted accounts in cohesive and impactful ways, when highlighting viewpoints and voices often overlooked in public discourse, and when disseminating complex narrative data while still providing anonymity to participants (Johnston et al., 2023; Willis, 2019). The composite narrative maps discussed here represent the anticipatory storylines shared by Deep Dive participants and serve as a useful and empirically based shorthand for understanding nascent community perspectives as part of broader research and decision-making around assisted adaptation in the Reef (Macnaghten, 2021).

#### 4. Results: Two community storylines

Analysis of the RRAP Regional Deep Dive interviews indicates two common community storylines about the future of the Great Barrier Reef. We outline the critical steps in the assembly of each storyline below, using composite narrative maps to show the flow and logic between narrative themes.

##### 4.1. Storyline 1: Probable loss-possible transformation-technological moderation

Observed in 62 of the interviews, this was the most common and more complex storyline. It is articulated in three steps: agreement with a probable future of precarity and loss, hopes for alternative possibilities in collective transformation, and technologically assisted adaptation as moderated loss and thwarted transformation.

###### 4.1.1. A probable future of decline and loss

When first asked to describe how they imagined the future of the Reef, the majority of Deep Dive participants did not initially express optimism. Instead, they expressed the belief that it was inevitable that the Reef would experience rapid ecological deterioration and loss. Three expository strategies, shown in Fig. 1 below, were used to provide context and substance to this anticipated future.

In the first expository strategy, participants aligned their responses with those claims already dominant in public discourse, listing multiple anthropogenic factors currently threatening the Reef and referring to existing scientific knowledge and management discourse to present its precarity as self-evident. The imminent impacts of climate change were framed as incontrovertible, with official climate reports and other forms of scientific authority often used as a rhetorical shorthand for the overwhelming consensus about its influence on the Reef's future. Other disruptions and pressures on the Reef, such as cyclones, crown-of-thorns starfish outbreaks, and pollution were more carefully elaborated to emphasize the multi-layered and compounding nature of the Reef's precarity. In the second, participants grounded their expectations of future decline with evocative firsthand accounts of an already distressed Reef. This included accounts of witnessing greater marine animal strandings, lowered numbers of fish and other marine animals, encounters with bleached coral, dwindling tourist revenue and growing public disenchantment with the Reef. With the third, participants expressed sorrow and frustration regarding the inability of human society to alter the Reef's trajectory despite its responsibility for, and knowledge of, its decline. This inability was attributed to the corrupting effect of economic and political interests which had eroded collective sense of responsibility, respect and care for the Reef and hamstrung any response to scientific warnings about climate change. Fossil fuel industries, populist governments, and entrenched inequalities resulting from a legacy of colonial dispossession were identified as key factors in this alienation.

###### 4.1.2. A possible future in collective transformation

While the first step in the assembly of the dominant storyline created a powerful and plausible basis for imagining the Great Barrier Reef's probable progression toward a worsening future, the majority of participants who articulated this storyline still found it deeply troubling. Only a couple of participants expressed giving into or being resigned to the probability of loss. Most described being unable to reconcile themselves to the Reef's probable future and feeling 'torn' or 'split' about the storyline they had created.

*I have two minds about it. I have my realistic one, and... my other mind is like "no, we will turn it around. We'll save what we can." You kind of forget that it's massive. When you get taken to a healthy reef, you're like "No way! There's no way this whole thing is going away" so I find it really hard to imagine how it looks like it's going to end up...I also try not to think too much about that because it's just not super helpful and it's really sad. Civil society representative.*

The majority of participants described holding onto reserves of faith and belief that things would turn out differently and used a second set of expository strategies to shift the storyline in a more hopeful direction. Shown in Fig. 2, these sought to unsettle the broader consensus about the probable decline and loss of the Reef by establishing the possibility that this future might not actually eventuate.

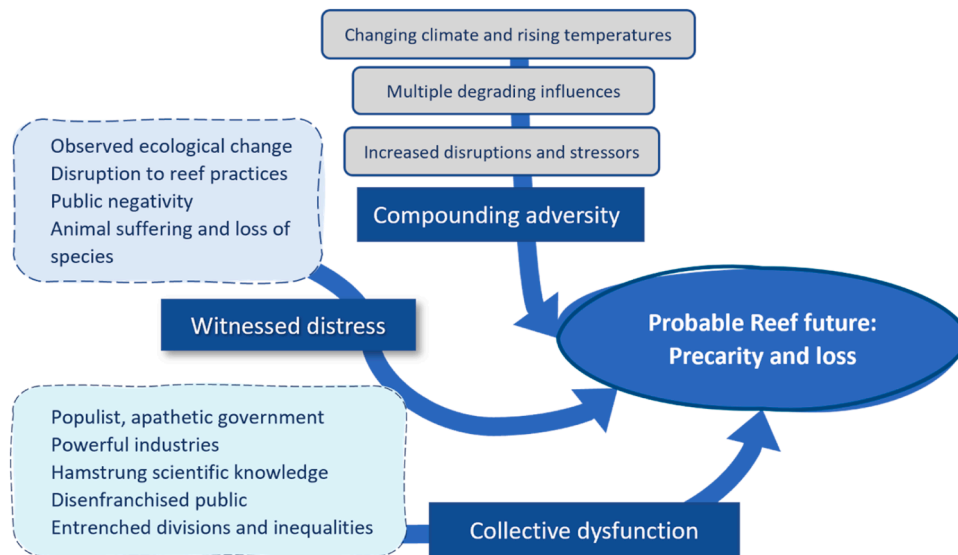


Fig. 1. Storyline 1: The articulation of a probable Reef future of increased precarity and loss.

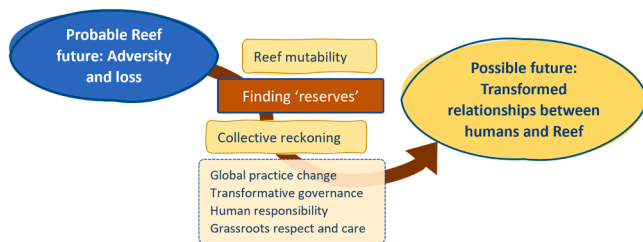


Fig. 2. Storyline 1: Unsettling probable loss and articulating possibilities for transformation.

First, participants identified the possibility that the Reef might not respond to anthropogenic threats in the ways it was predicted to. This included imagining ways the Reef might exhibit mutability against the impacts of climate change with some participants drawing on examples of ecological resilience and recovery in the aftermath of seemingly catastrophic disturbance, reasoning that the impacts of climate change would be unevenly distributed, and hoping that opportunities might remain for species and ecologies to survive and adapt. Second, participants speculated on the possibility that the Reef’s rapidly deteriorating circumstances might catalyse a collective reckoning, and a re-organization of human values, practices and ethics. Some used existing examples to imagine how the prospect of loss might galvanise a change in human behaviour:

*Look, it’s complicated, but the general trend according to the experts is that the Reef, particularly things like coral, is declining. Over the past 20 years it’s gone from poor to very poor and according to some people at the moment it’s either in danger or critical.... And that’s pretty sad, [but] I also say I’m an optimist and people can do amazing things, you only have to look at phasing out shopping bags from supermarkets, which we did very quickly. Institutional stakeholder.*

Others imagined how the fear of loss might alter existing political structures and systems, creating opportunities to more coherently address the escalating threats and precarity facing the Reef:

*I think the uncertainty in the Great Barrier Reef needs more than just science, it needs change of industries, it needs change of policies. Every aspect needs to come together, but science is probably the drive, and activism - as we do it - is getting inspiration out to industries and pressure*

*on the politics to back everything up that needs to happen. Civil society representative.*

As well as changed practices and political systems, participants also imagined how the Reef’s imminent loss might catalyse a broader ethical reckoning, and a transition towards more responsible, respectful and caring human-environment relationships:

*So yeah, [losing the Reef] would be a gross tragedy... but I would like to think there’s more here than that, you know?... and that that in itself can become [part of] the storytelling, what we did wrong, owning your mistakes, being transparent and authentic, you know? Livelihood user.*

4.1.3. Technologically assisted adaptation as moderated loss and thwarted transformation

When the prospect of human-assisted adaptation and technological interventions in the Great Barrier Reef was raised in discussions, it was incorporated into the dominant storyline in relation to both probable and possible futures. As a result, two conflicting outcomes were articulated as participants expressed their initial thoughts on technologically assisted adaptation in the Great Barrier Reef.

Fig. 3 below outlines how participants imagined conditional benefits in technologically assisted adaptation as they evaluated it against a probable future marked by profound and rapid ecological loss.

First, participants expressed practical reservations about whether technologically assisted adaptation could meaningfully alter the Reef’s trajectory towards loss and precarity, questioning whether it could be implemented at sufficient scale, whether coral would be amenable to

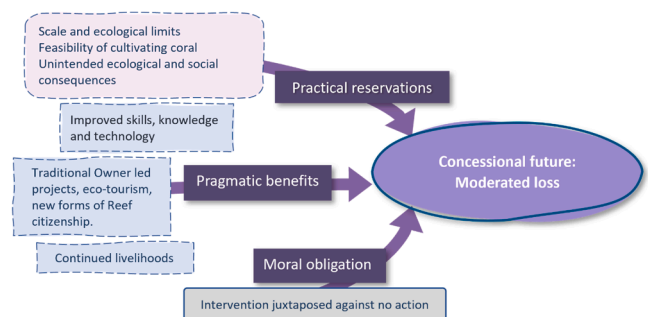


Fig. 3. Storyline 1: The prospect of technologically assisted adaptation articulated as moderated loss.

broad-scale interventions, and the possibility of unintended ecological consequences. Despite these reservations, they could still identify provisional and pragmatic benefits in seeking to preserve coral species in the face of loss, articulating the need to ‘buy time’ to implement other changes, maintain Reef livelihoods, foster leadership opportunities for Reef Traditional Owners, and build capacity and scientific knowledge regarding the management of the Reef. Moreover, they expressed a moral obligation to consider assisted adaptation in the face of probable loss, juxtaposing it against the prospect of doing or trying nothing to assist the Reef:

*Major social and political change obviously takes time, so having these other solutions that might .... actually have an effect is better than just sitting back and doing, well, nothing. Institutional stakeholder.*

*They have to do something and I'm glad that there's actually been an intervention, in a way, because otherwise we would have just sat here and watched the Reef slowly decline to nothing. Civil society representative.*

While participants acknowledged these pragmatic and moral imperatives, they also expressed uneasiness and grief when evaluating technologically assisted adaptation in relation to the future imagined possible in collective transformation. As outlined in Fig. 4, technologically assisted adaptation was articulated as being counteractive to this future.

First, participants articulated how, if feasible and effective, pragmatic technological action could ultimately serve to maintain the dysfunctional political systems and relationships they considered fundamental to the Reef's escalating precarity and loss. They imagined how the solutions offered by technological intervention might distract public attention away from systemic issues underlying the Reef's loss, keep populist politicians in office, and allow unsustainable industries and the use of fossil fuels to continue. Second, they expressed concerns about the relationships being fostered through technologically assisted adaptation, imagining Reef ecologies reduced to a selection of priority functions and values, and coral propagated *en masse* in laboratory-like settings. Assisted adaptation was framed as reflecting inequitable, instrumental relations and an ethic of human mastery over the Reef rather than the reconciliatory relationships participants imagined enacted through care, respect and responsibility:

*It's just like the audacity of humans to think "oh, it's just like a garden. We'll just water it, and just like plants and plants, and will be exactly the same as the Amazon rainforest". You're telling me that you are going to raise some old growth rainforest that took millions of years of complex interactions to build, and you're going to go and plant a monoculture of trees in a perfectly straight row and say, that's equivalent? Civil society representative.*

*There are scientists, governments of the world, out there searching space for another planet to live on. Why? Because we're about to kill this one? I'm no scientist and I'm no marine biologist. I'm just a Black man living in [place], working in [industry] and loving Mother Nature. We need to protect Mother Nature. Livelihood user.*

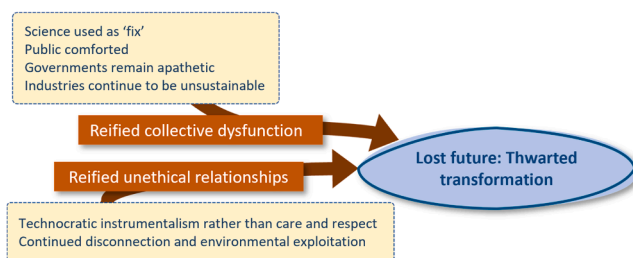


Fig. 4. Storyline 1: The prospect of technologically assisted adaptation articulated as thwarted transformation.

#### 4.2. Storyline 2: Contained balance-technological disruption

In the first and more dominant storyline, Deep Dive participants initially aligned with collective narratives and scientific forecasts about the Reef's likely decline. However, in doing so they created a narrative trajectory that provoked discomfort and sadness and ultimately led them to expand their storyline with the possibility of transformative collective change. The second and less dominant storyline - observed in 8 interviews - was assembled in an immediate, consistent and overt resistance to broader narratives about the Reef's imminent and probable decline. It is comprised of two steps: the articulation of a probable future of contained and continued balance in the Reef, and technologically assisted adaptation as interference and disruption of that balance.

##### 4.2.1. A probable future of contained balance

As outlined in Fig. 5 below, three expository strategies were used to articulate a Reef that was intrinsically self-sustaining, with a future that warranted little need for concern beyond ongoing local care and protection from excessive local pressures.

In the first strategy, participants positioned scientific forecasts and other public discourse about inevitable decline as distinct from local concerns and allied with political machinations far removed from the Reef. As they did, they devalued the integrity of these narratives by describing them as a strategy used by self-serving governments, media and scientific institutions to manipulate a naïve public and attract attention and funding.

*I get annoyed at hearing a few scientists with their 'doom and gloom' which is totally incorrect .... The government is throwing tens of millions of dollars at them. They've never had it so good and it is wrong for scientists to exaggerate or lie or whatever... because people and our silly government believe them...[and] the press love it - they don't want the truth. It spoils their story. Civil society representative.*

In the second strategy, participants used their firsthand experience, borne in substantial histories and direct on-going encounters with the Reef, to counter scientific forecasts of loss. In doing so, they elevated local vernacular knowledge as the more legitimate knowledge on which to plot trajectories of future change in the Reef and situated change in the Reef as an ongoing cycle of disruptive events and subsequent periods of recovery.

*I've been traveling down the Reef for, what, 20-odd years now and I've snorkelled in areas that I've seen go from unbelievable to shit, and fish stocks that have gone from crap to awesome. I've seen the entire process of the Reef generate, and [I've seen] climate turn it up, down, up and down. The corals will be resilient. They will change. It'll come back. Everyone says it won't, but it will. It'll regenerate ... without a doubt. So, I'm not concerned about the Reef, it's just our traffic and the damage from the little things like the anchoring, and the spearfishing and fishing. Livelihood user.*

As touched on in the last sentence of the quote above, in the third strategy participants framed any threats to the Reef as a discrete set of pressures and impacts caused by local human practices and direct interaction with the Reef. By framing change in the Reef as part of a



Fig. 5. Storyline 2: The articulation of a probable Reef future as ongoing, contained balance.

balanced cycle, and any problems experienced as contained and manageable, participants could then position local protection, care and respect as the primary practices on which to assure the Reef's future:

*The best future of the reef I think will look healthy, but it just all comes down to how far we're willing to go to sustain, manage it, keep it healthy.*  
Reef Traditional Owner.

#### 4.2.2. Technologically assisted adaptation as disruption

As participants discussed the prospect of assisted adaptation with researchers, they positioned it as an ally to exogenous interests and therefore an antagonist or a threat to the Reef's intrinsic stability and local community sovereignty over it. As shown in Fig. 6, distrust was expressed regarding the resources it had attracted and the scientific ambitions it served alongside fears of unforeseen ecological impacts and corrosive impacts on the authority of local knowledge, care and respect for the Reef.

## 5. Discussion

### 5.1. The generative possibilities of community counter-narratives

We have highlighted two storylines observed in interviews with communities living in proximity to the Great Barrier Reef as they discuss their perspectives on its future. Both treat public discourse and scientific forecasts of impending ecological decline and loss in the Reef as a culturally agreed metanarrative and a basis from which to dialectically assemble these perspectives (McLean and Syed, 2016). The first and more dominant storyline initially aligns with narratives of loss, using firsthand accounts and scientific reports and modelling to articulate a future marked by likely decline. However, storytellers are unable to fully resign to this future, and instead create a parallel possibility in which the Reef's escalating and much discussed precarity provokes a more coordinated global response to climate change and other anthropogenic problems (Randall, 2009). The second less common storyline plots a future contrary to scientific forecasts and broader public discourse, in which the Reef continues to follow its own innate cycles with the know-how, care and protection of local communities.

The centrality of the Reef's anticipated loss and decline in these storylines is further testimony to the ubiquity of looming catastrophe in the ways climate change is framed in contemporary environmental discourse (Louder and Wyborn, 2020; Paschen and Ison, 2014). However, resistance to the Reef's loss was equally critical in the formation of community storylines. As they talked, all participants (some of whom were scientists themselves) acknowledged the future predicted for the Reef but none narrated an unequivocal path toward that future. We argue it would be a mistake to reduce this resistance to either a lack of knowledge or a vain grasp at hope. Rather, these storylines demonstrate how communities use scientific forecasts and political discourse, not as monolithic 'statements of the future' (Yusoff and Gabrys, 2011, p. 518), but as narrative resources with which to express their own authority, ideas, and agency (Macnaghten et al., 2019; Veland et al., 2018).

This expansion of the 'normative horizons' (Beck, 2015, p. 78) of scientific discourse is exactly what Giddens (1994) and Lockie (2014) argue is the purpose and power of climate models and scenarios: not to

predict the future but to mobilise action and change. Against the prospect of unavoidable loss, research participants generated counter-narratives that recognised other agents and possibilities for the Reef (McLean and Syed, 2016; Paschen and Ison, 2014). One of these counter-narratives was formed around what Beck (2015, p. 78) calls 'the hidden emancipatory side effects of global risk' as participants recognised how bearing witness to the decline of an environmental icon like the Great Barrier Reef might catalyse political will and collective change at a global level. Another, however, was formed in a deep distrust of the catastrophic framing of the Reef, and how it devalues the enduring knowledge and stewardship embedded in the rights and custodianship of Reef Traditional Owners and in local management practices as ineffective in the context of global environmental change. Both storylines also recognised the manifold capacities embedded in the Great Barrier Reef itself: its ability to recover and evolve through disruption, to provoke global social action, and to heal and flourish in response to human care and protection.

### 5.2. Constraints on technological futures

As Louder and Wyborn (2020) argue, 'the very telling of a problem might constrain its solution' (p. 253). Once a metanarrative is culturally ubiquitous, all solutions tend to be framed with reference to it. While the prospect of loss and decline was critical to the ways participants articulated alternatives, constraints were evident in the dissonance and tension expressed in the first storyline as the majority of our participants formed nascent responses to the prospect of technologically assisted adaptation. Here, they initially aligned with broader scientific narratives about the likely decline and loss of the Reef and used them to form a plausible basis for their stories. Alternatives were found, not in negating the truth of impending loss, but in articulating the possibility that it might catalyse collective shock, grief, and, eventually, the willingness to coordinate action on a global level to address the social issues underpinning climate change (Beck, 2015). When the prospect of technologically assisted adaptation was raised, these participants admitted feeling morally obligated to consider any action that might feasibly grant the Reef a reprieve from the dire future they anticipated for it. At the same time, however, they expressed concern that pragmatic actions to build Reef resilience might compromise the collective reckoning they believed necessary to catalyse broader social change.

Here we see a subtle duality performed in the way science is articulated as a social and political actor in this storyline. While scientific forecasts of climate impacts on the Reef were accepted and incorporated within participants' hopeful counter-narratives around coordinated action to address climate change, the potential scientific and technological innovation behind novel interventions to increase Reef resilience evoked tension between the moral imperative to act and the possibility of undermining political and social change. The potential practical benefits that scientific interventions might have for coral, reef ecologies and human communities were storied as having potentially damaging political outcomes by reifying existing practices, distracting publics and serving as a metaphorical band-aid for systemic problems. In the second storyline there was no subtle duality, as no authority was given to scientific forecasts of the Reef's probable decline and no credence to the pragmatic imperative underpinning calls for technological intervention. The possibility that science might act to intervene in, as well as forecast, the Reef's future was storied as further confirmation of its alliance with exogenous interests contrary to the Reef's intrinsic resilience and to local knowledge and care.

### 5.3. Productive dialogue

By tracing the articulation of community responses to the prospect of assisted adaptation, our storylines demonstrate how these responses are mediated by existing cultural narratives and forms of knowledge. While these limit the possibilities envisioned for technologically-assisted

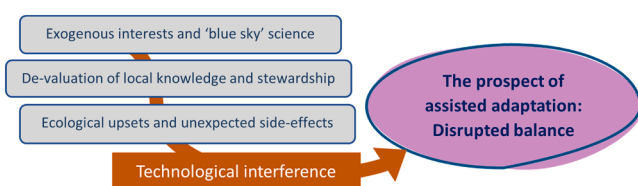


Fig. 6. Storyline 2: The prospect of assisted adaptation articulated as interference and disruption.

adaptation, the value of this understanding goes well beyond establishing community support for assisted adaptation. Building a nuanced understanding of the stories, assumptions and interests that shape different perspectives on the Reef's management fosters reflexivity as actors come together to discuss and plan for the Reef's future (Macnaghten et al., 2019). Our results show that perspectives on the Reef's future and responses to assisted adaptation are complex, emergent and fluid across interest groups, with even the scientists and Reef managers interviewed expressing both personal and more official views. Acknowledging this presents a fruitful base for inclusive future-forming dialogue with communities that goes beyond narratives of impending loss and urgency and the polarised solutions these render (Gergen, 2014; Wyborn et al., 2016).

How might a future be storied, imagined and enacted in which technological intervention, global action, and local practices of care happen in unison to mutually strengthen the prospects of the Great Barrier Reef? The storylines outlined in this paper highlight an existing capacity on the part of communities to engage in co-productive dialogue. Although it was not always easy or comfortable to contemplate the prospect of ecological decline and loss in the Great Barrier Reef, participants exercised skill, creativity and knowledge as they discussed the complexities and uncertainties involved in managing its future. Participants did not simply acquiesce to public discourse or scientific authority about the Reef's imminent loss but formed counter-narratives that expanded possibilities beyond the bounds of climate models and forecasts. However, the tensions and uncertainties observed around assisted adaptation indicate an area where a "collective vocabulary to render novel science and technology culturally meaningful" (Macnaghten, 2010, p. 512) is needed so that communities can engage more rigorously with its complexities and exert greater influence and agency in the possibilities that it might enable.

## 6. Conclusion

The changes observed in coral reefs worldwide and the scientific forecasts published by the International Panel on Climate Change (Hoegh-Guldberg et al., 2018) have generated a huge amount of discussion, investment and action in relation to the future of the Great Barrier Reef. Navigating a future for the Reef requires bringing multiple actors and diverse forms of authority into productive and inclusive dialogue. This requires skill, capacity and diplomacy, and it requires participants to willingly grapple with difficult problems, conflicting views and confronting solutions (Macnaghten et al., 2019). Tracing the formation and exchange of different stories about the Great Barrier Reef can be a valuable tool for making sense of, navigating and enacting its future (Veland et al., 2018).

In this paper, we have sought to highlight and enhance the voices and perspectives of local communities in this broader dialogue, tracing multiple and conflicting ways that scientific forecasts and broader public discourse about impending decline and loss are used to form views on the Great Barrier Reef's future and the appropriate actions to take in its management. Forecasts that emphasize looming precarity and loss have been highly effective in catalysing concern and discussion about the Great Barrier Reef but less effective, to date, in promoting a coherent narrative on the potential role of scientific and technological innovation. The results of this research illustrate that, as we navigate futures for ecologies affected by climate change, generative dialogue with affected communities is needed so that moral and pragmatic imperatives to actively build ecosystem resilience can be imagined, storied and enacted in ways that reinforce, rather than to compromise, desired momentum for social and economic change.

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## CRedit authorship contribution statement

**Gillian Paxton:** Writing – review & editing, Writing – original draft, Visualization, Validation, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Stewart Lockie:** Writing – review & editing, Writing – original draft, Visualization, Supervision, Resources, Methodology, Investigation, Funding acquisition, Conceptualization. **Vincent Backhaus:** Writing – review & editing, Writing – original draft.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Disclosure statement

The authors report there are no competing interests to declare.

## Data Availability

The data that has been used is confidential.

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