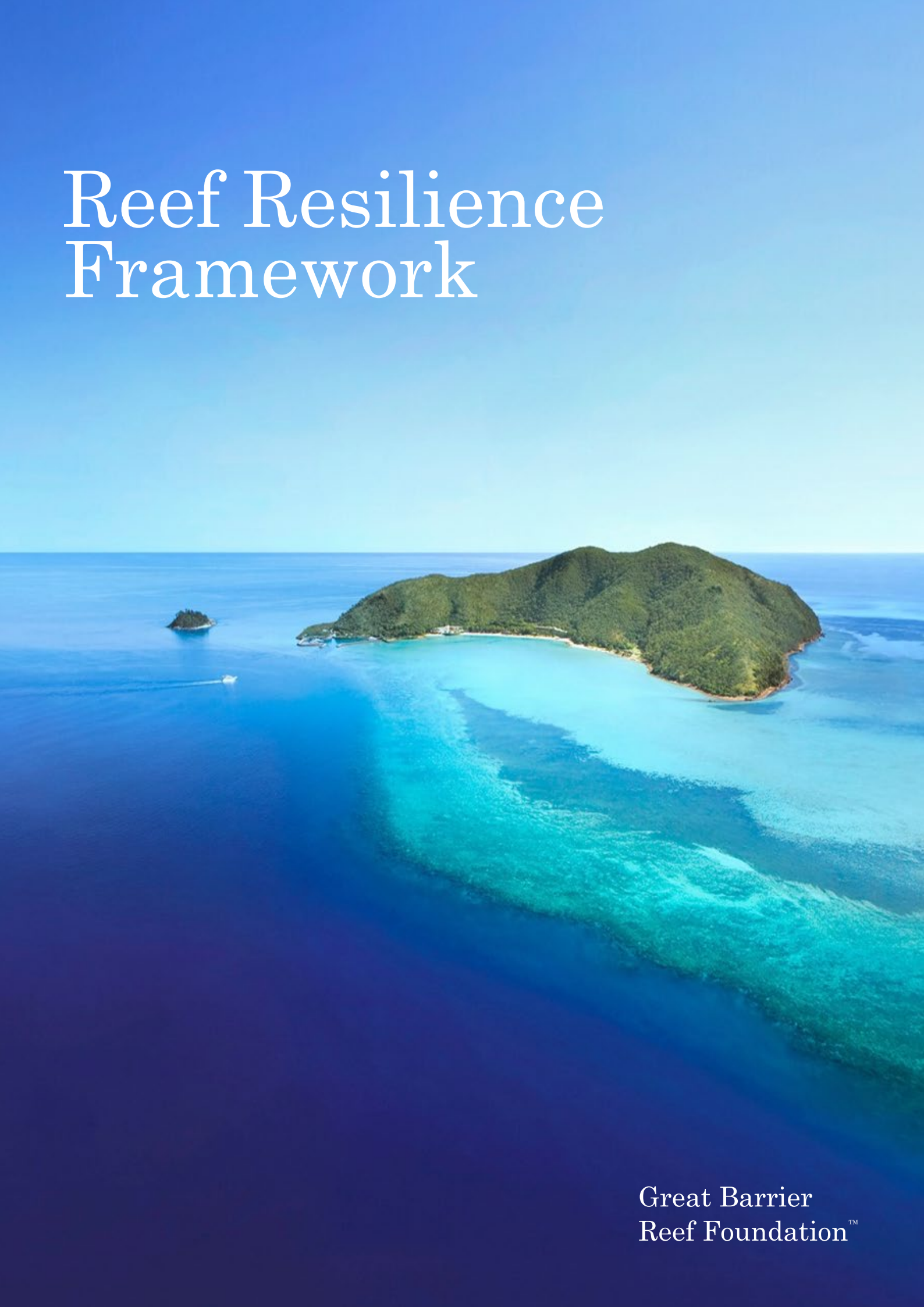
Reef Resilience Framework



Great Barrier Reef Foundation™

The Reef Resilience Framework has been produced by the Great Barrier Reef Foundation in partnership with AECOM and Reef Ecologic.

The Reef Resilience Framework has been developed in direct response to the coral conservation and management community who have advised that we must do more, act now and seek innovation from beyond the coral reef domain. We are taking a fresh approach, combining proven resilience-building models with site specific coral reef expertise to develop the first fully integrated and transferable model for institutionalising resilience-based management for coral reefs and the communities they support.

Building resilience is the new imperative for coral reef management. This Framework responds to this need.

Date	Version	Comment
23-Mar-2018	Draft	Draft for review
25-May-2018	Final draft	Final draft
03-Sep-2018	Version 1.0	Version 1.0 for use at pilot sites

Contents

1 Reef Resilience: An Introduction

Coral reefs are critically important ecosystems. They support 25% of all marine life and provide essential goods and services to around one billion people, including many of the world's most vulnerable. However, coral reefs are at risk on a global scale, with an estimated 75% of all coral reefs under threat from the combination of local stresses and changing climatic conditions. It is therefore imperative that global warming is limited in line with the Paris Agreement, in conjunction with reducing stresses on coral reefs at a local scale.

With business as usual approaches failing to have the impact needed to sustain coral reefs and the livelihoods they support into the future, new approaches that are matched to the scale and the urgency of the challenges faced are urgently needed. While tackling climate change must continue to be the highest priority, there is also an urgent need to restore and maintain the natural resilience of coral reefs if they are to have the best chance of coping with the change ahead.

The Reef Resilience Framework has been developed to assist reef communities and managers to better understand the current state of resilience of their reef and communities, identify strengths and weaknesses, prioritise action, and evaluate success with regards to addressing resilience challenges. The Framework looks holistically at coral reefs, the communities that depend on them, and the governance arrangements that influence them as an integrated system which must be understood together.

Our vision of reef resilience

For the purpose of the Reef Resilience Framework (the Framework), **reef resilience** is:

The capacity of reef ecosystems and the individuals, businesses and communities that depend upon them to survive, adapt and recover from the stresses and shocks that they experience.

Stresses are influences that gradually but persistently weaken reef systems and communities. Stresses which affect both reef ecosystems and communities can reduce the ability of both systems to function normally, and recover after shocks. Stresses may also increase the vulnerability of either system to shocks. Examples of stresses include agricultural runoff, over fishing, and chronic food or water shortages.

Shocks are sudden, short-term events that disrupt or damage reef ecosystems and communities. Examples of shocks include cyclones, coral bleaching, or oil spills.

Reef ecosystems include corals and the reef structures that they create, as well as the immense diversity of species that they support. They also include associated species and habitats, such as seagrasses, mangroves, islands and adjacent coastal systems.

In the context of coral reef systems, communities and governance refer to the entities or individuals that can be expected to be significantly affected by the reef ecosystem and whose actions can be expected to affect the ability of the reef ecosystem to provide the full range of ecosystem services.

Communities may include individuals, Indigenous Peoples and Traditional Owners, community groups, businesses, industry, and institutions such as government agencies and non-governmental organisations (NGOs).

Governance includes the organisational arrangements and cultures that influence reef ecosystems and communities, and the interactions between them.

Examples of reef ecosystems, communities and governance arrangements

Reef ecosystem: corals, fishes, seagrasses, mangroves, islands etc.

Communities: residents, Indigenous Peoples, Traditional Owner groups, tourism operators, farmers, fishers, etc.

Governance: marine park management authorities, Traditional Owner groups, government organisations, community groups, peak industry bodies, businesses and their culture, policies, practices, rules and regulations.

Image: Fitzroy Island, Great Barrier Reef.
Source: FNQ Magazine

While catchments and many activities on land are not directly captured in the Framework's definition of reef resilience, they are important considerations as they can be important influences on reef resilience and as sources of stresses and shocks.

The Framework's use of reef resilience aligns with the current best practice thinking on resilience-based reef management and provides a simple vision of resilience which resonates with the needs and interests of reef managers and communities. The vision of reef resilience has been developed with reference to the definition of resilience adopted by The Nature Conservancy Reef Resilience Network and Toolkit[1] for reef resilience, and the urban resilience definition and framework adopted by the 100 Resilient Cities initiative pioneered by the Rockefeller Foundation[2].

In the context of this Framework, resilience is not specific to any particular shock or stress. Rather, it highlights the importance of general resilience, which is important for coping with a wide range of possible future shocks. In using the Framework it is important to acknowledge that resilience is aspirational: it is acknowledged that it is increasingly difficult for reef ecosystems, individuals and communities to survive adapt or recover as climate change abatement efforts slow or fall short of globally agreed targets. However, it is hoped that this vision of reef resilience creates hope, inspires action and enables reef communities to understand and prepare for future change.

Stresses in reef ecosystems: Agricultural Runoff in the Great Barrier Reef

The Great Barrier Reef catchment area covers 423,000 square kilometres. Agriculture is a prominent use of the catchment with cattle grazing, sugarcane farming, horticulture, cotton growing and grain farming making up the area's agricultural industries. Nutrients from farm fertilisers, particularly nitrogen, enter the Great Barrier Reef in runoff from agricultural lands during major flood events.

High levels of nutrients encourage growth of algae (seaweeds and phytoplankton), and can change the mix of animals and plants found along inshore reefs. Nitrogen is also linked to outbreaks of the crown-of-thorns starfish[3]. Herbicides from farm runoff are also a concern due to their potential impact on a range of marine species such as corals, sea-grass and macro-algae.

Excessive use of farm fertilisers and herbicides therefore acts as a stress to the reef system that can exacerbate other stresses such as crown-of-thorns starfish outbreaks and amplify the impact of shock events like coral bleaching. This illustrates the importance of considering the interactions among shocks and stresses for reef management.

Image: *Agricultural runoff in Far North Queensland, Great Barrier Reef.*

Source: *STR/AFP/Getty Images*

The need for reef resilience

Coral reefs are at risk on a global scale, with an estimated 75% of all coral reefs under threat from the combination of local stresses and changing climatic conditions.

Around the world there are programs and initiatives that are tackling parts of the problems facing coral reefs and their vulnerable communities, but many of these are small-scale, under-resourced, uncoordinated and short-lived. Many of these programs are achieving great local results, but they are insufficient to deal with the scale and urgency of the problem and are missing the opportunity for greater impact that could be achieved through greater empowerment of local communities, broader collaboration with other global sites, and the effective and timely sharing of successes and failures.

> *"All World Heritage Marine sites urgently require a comprehensive and sustained program of action aimed at building resilience to give them their best chance to survive in the long-term."*
>
> *The Future of the World Heritage Convention for Marine Conservation, UNESCO World Heritage Marine Centre, September 2016*

Faced with a crisis that exceeds modern experience it is clear that business-as-usual approaches for managing coral reefs are no longer sufficient, and new approaches that are matched to the scale and the urgency of the challenges faced are urgently needed.

> *"While the Great Barrier Reef has changed over decades, the accelerating change over the last two years raises particularly important questions about our current approach to management. We are entering a new paradigm of marine park management that will require greater innovation to support resilience of the Reef. Management and decision-making needs to be forward-looking, responsive and flexible to address the rapidly changing landscape of risk. Importantly, innovation, adaptability and resilience need to be institutionalised through adoption of a resilience-based management approach."*
>
> *Great Barrier Reef Marine Park Authority (GBRMPA) Resilience Summit Background Document, May 2017*

Building resilience is the new imperative for reef management. This Reef Resilience Framework enables coral reef managers, communities and other influencers to more efficiently identify opportunities and design effective strategies for building holistic reef resilience and giving coral reefs and the people who depend upon them the best chance of coping with climate change.

2 The Reef Resilience Framework

The Framework has been developed to assist reef communities and managers to better understand the current state of resilience of their reef and communities, identify vulnerabilities and opportunities, prioritise action and evaluate success with regards to addressing resilience challenges. Through a focus on maintaining or improving community wellbeing, sustaining provision of ecosystem services, and an understanding of the role of governance arrangements in supporting these outcomes, the Framework provides a basis for successful resilience-building programs.

The Framework provides a structure for understanding reef resilience through three layers of increasing detail – Dimensions, Attributes and Indicators.

Dimensions

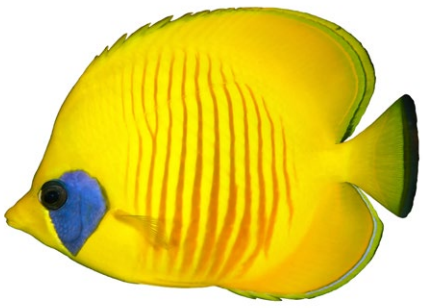
The entry-point to the Framework begins with three Dimensions that together, at a high level, describe the broader, inter-connected coral reef system which includes the reef ecosystem, the community that depends upon it, and the governance arrangement that determine how they interact. The three Dimensions – Ecosystem, Community, and Governance - together show the breadth of the Framework and reef resilience. The Dimensions serve as pragmatic categories for the Attributes and there are significant linkages and inter-dependencies between Dimensions and their Attributes. The Framework can be used to clarify and understand the interdependencies and interactions supporting desirable reef outcomes such as the: provision of ecosystem services; fostering of those reef ecosystem services which support community wellbeing; and, governance and maintenance of sustainable interactions between the reef ecosystem and the community.

Attributes

Attributes are the components of each Dimension that are most critical to conferring resilience when that Dimension faces chronic problems (stress) or sudden catastrophes (shock). Attributes have been constructed in order to fit into the statement “if we have more/better [insert attribute] the reef would be more resilient” or, ‘if we found a reef ecosystem or community with less/worse [insert attribute] we would expect the reef to be less resilient’).

Indicators

Indicators are characteristics of the reef system (features, processes) that can be measured or estimated (and potentially tracked through time) to provide an overall assessment of system resilience. They enable a more granular understanding of the overall status of system resilience and its key sources. In combination, the indicators provide the operational underpinnings for implementing resilience-based management.



The Reef Resilience Framework diagram in Figure 1 shows the Dimensions and Attributes.

Figure 1 The Reef Resilience Framework – Dimensions and Attributes

Dimensions

The Dimensions underpinning reef resilience include Ecosystem, Community and Governance. Table 1 provides a description for each of the three Dimensions.

Table 1 Reef Resilience Framework – Dimensions

Dimension	Description
Ecosystem	The Ecosystem dimension encompasses the reef ecosystem which includes corals and the reef structures that they create, as well as the immense diversity of species that they support. The reef ecosystem also includes associated species and habitats, such as seagrasses, mangroves, islands and adjacent coastal systems. The composition and condition of the ecosystem reflects its overall health and its resilience. A resilient reef ecosystem is more able to sustain delivery of important ecosystem services to communities despite exposure to shocks and stresses. Reef resilience is the capacity of the ecosystem to absorb shocks or stresses and adapt to change while retaining essentially the same function and structure.
Community	The Community dimension considers community to include businesses, Indigenous Peoples and Traditional Owners, members of the public, and institutions such as government agencies and Non-Governmental Organisations (NGOs). Communities have direct and indirect impacts upon the reef ecosystem, hold managerial responsibility for reefs or a level of dependency upon reef ecosystems for their wellbeing and livelihoods, or may have a personal connection to reefs. Evidence shows that resilient communities are better equipped to cope with change and uncertainty, take proactive measures to secure their future, and are better able to support reef resilience.
Governance	The Governance dimension considers the organisational arrangements and cultures that influence reef ecosystems and communities and the interactions between them. Governance includes policies, practices, rules and regulations that establish responsibilities and accountabilities for communities in relation to the reef system. These are usually established and implemented by organisations, such as marine park management authorities, Traditional Owner groups, government organisations, community groups, peak industry bodies, and businesses etc. The ability of these organisations to support the resilience of the ecosystem and community and to learn and adapt in the face of uncertainty determines their contribution to overall system resilience.

Attributes

The Attributes describe the components of the reef and community system that are most critical to conferring resilience to that system. Table 2 provides descriptions for each.

Table 2 Reef Resilience Framework – Attributes

Dimension	Attribute	Description
Ecosystem	Habitat condition	Areas of the reef ecosystem that are in poor condition due to current or historical exposure to chronic stresses (such as land-based sources of pollution, overfishing and coastal development), or a history of impacts from past shocks, can be more susceptible to future shocks.
	Biodiversity	Some species and some individual members of those species have a greater intrinsic ability to resist or tolerate shocks and stresses. Higher biodiversity can also confer resilience by increasing the chance that some species/ individuals will be present that are more able to resist or tolerate shocks and stresses. Reef areas with higher proportions of resistant individuals/species, or higher biodiversity in general, are likely to be more resilient.
	Recovery processes	The ability of a reef area to recover after a damaging event is strongly influenced by a range of ecological processes that support recovery. Processes such as larval dispersal between reefs (connectivity) and plant matter consumption (herbivory) can be especially important to effective recovery after damage from a shock event, thus playing a key role in ecosystem resilience.
	Seascape diversity	Seascapes that are composed of a diversity of habitat types are more likely to provide refuge during a shock event. By providing a larger range of ecological and physical features, heterogeneous seascapes are also more likely to contain groupings of species that are more tolerant and resistant to shocks and stresses. The presence of refuge areas and tolerant species groupings can significantly improve overall ecosystem resilience.

Dimension	Attribute	Description
Community	Knowledge & stewardship	Communities with a culture of valuing and respecting knowledge in all its forms and a history of innovation and revitalisation of traditional practices are better able to cope with disruption and adapt to change. The existence of mechanisms and practices of knowledge-sharing and innovation contributes to resilience. Communities that are informed, engaged and empowered to care for their reef resources are more aware of resilience challenges and more likely to support reef management. This creates the personal agency and resource buffers that increase resilience to future shocks and stresses.
	Resources & livelihoods	Communities with the social and economic resources needed for jobs, volunteering, and recreational activities can access a diversity of livelihood options and retain financial buffers. Community livelihoods are supported by accessible and affordable social and economic infrastructure. The strength of dependency on single sourced reef-based livelihoods influences the ability of a community to absorb or bounce back from declines in ecosystem services.
	Networks & relationships	The strength, accessibility and extent of networks and relationships within a community support community wellbeing. The strength of relationships is determined by the degree of trust, social diversity, mutual respect and recognition of rights and knowledge across all community members. Strong networks and relationships make a community more resilient to shocks and stresses and better able to work together to overcome challenges.
	Health & culture	The overall state of human health is critical for wellbeing and the ability of people to cope with shocks and stresses, irrespective of their resilience in other dimensions. Cultural connections are an essential component of personal wellbeing. Communities with better health and cultural connections or practices are better able to manage their impacts on reef ecosystems.

Dimension	Attribute	Description
Governance	Rules & regulation	Governance arrangements establish and maintain the rules and regulations that grant rights and enable sustainable use of reef resources. Governance systems that respect traditional rights, reflect contemporary values and are adequately resourced will contribute to resilience. Successful mechanisms for risk reduction and resilience also rely upon effective and efficient regulatory systems, which have been incrementally improved over time and are supported by legal and administrative frameworks at the local level.
	Representation & inclusion	Governance processes and arrangements that are inclusive and representative are more likely to be seen as legitimate and respected by the community. This fosters a better understanding of the causes and symptoms of resilience challenges. Decision-making that includes the diversity of stakeholders and incorporates their knowledge and values is more likely to effectively balance trade-offs and less likely to be thwarted by disruptions or widespread non-compliance.
	Leadership & management	Management of reefs is a complex task, made even more challenging by the rates of change and uncertainties ahead. Governance arrangements are flexible and adaptive to support the resilience of reefs and the communities that depend upon them. Governance arrangements clearly allocate roles and responsibilities while demonstrating leadership.
	Accountability & equity	Governance arrangements are in place to hold organisations accountable while pursuing just distributions of benefits and involuntary risks to enhance the adaptive capacity of vulnerable groups and society as a whole. Governance arrangements ensure equitable rights and access to resources and opportunities contribute to system resilience.

Indicators

While some may choose to use the Framework as a stakeholder engagement tool or decision-making framework, for communities that seek a quantitative or qualitative assessment of reef system resilience, they may consider developing place based indicators that map to the Framework. These Indicators can be used to describe the status of each of the reef Dimensions, or to provide detail of the resilience status of each of the system Attributes as described in the Framework.

A suite of example indicators has been developed. These are crafted as indicator statements, such that evidence or opinion to support the statements indicates high resilience. In contrast, evidence or opinion that is contrary to the statement indicates low resilience. Indicator statements are customisable to respond to each reef's site specific context, availability of information, and the capacity of the reef and community. These Indicators can then also provide a structure for developing quantitative metrics and targets that can be used for monitoring changes in resilience over time.

Indicators should be selected based on the appropriateness to a particular context. Key considerations when choosing or refining indicators for use at a particular site or for a particular issue include: focus areas; availability of data; and, relevance and types of shocks and stresses most pertinent.

Indicators should be able to be easily assessed or measured by managers and stakeholders, and to be communicated in terms that are easy for local decision makers to understand and use. Indicators should be selected by communities to help identify and prioritise activities to improve resilience.

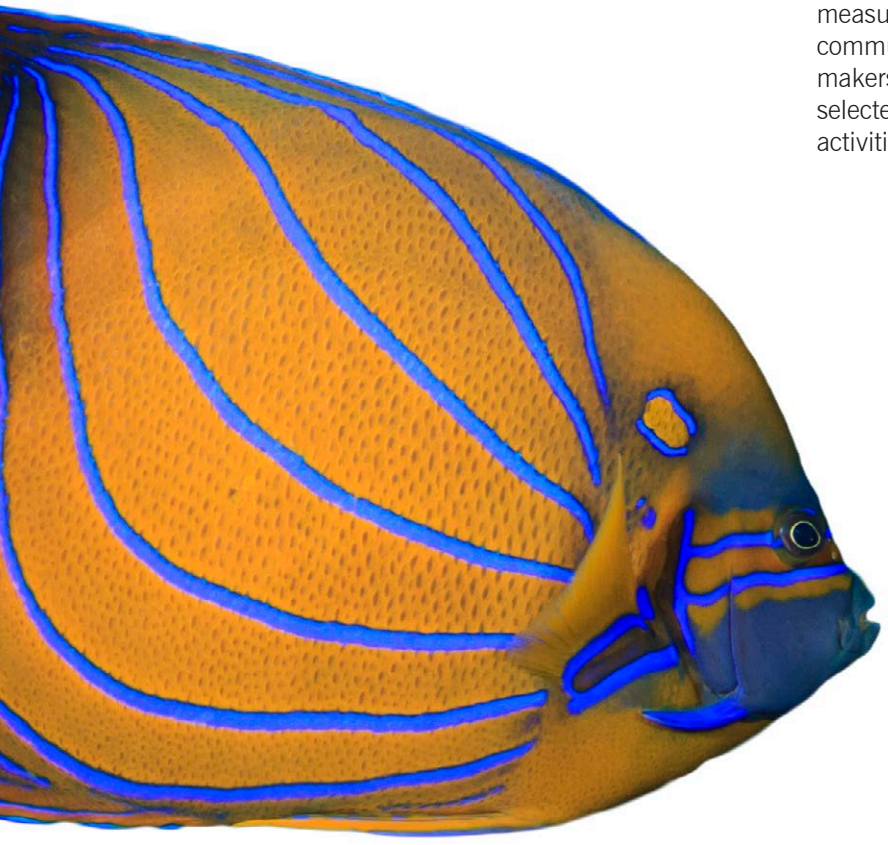


Figure 2 provides an example of suitable Indicators.

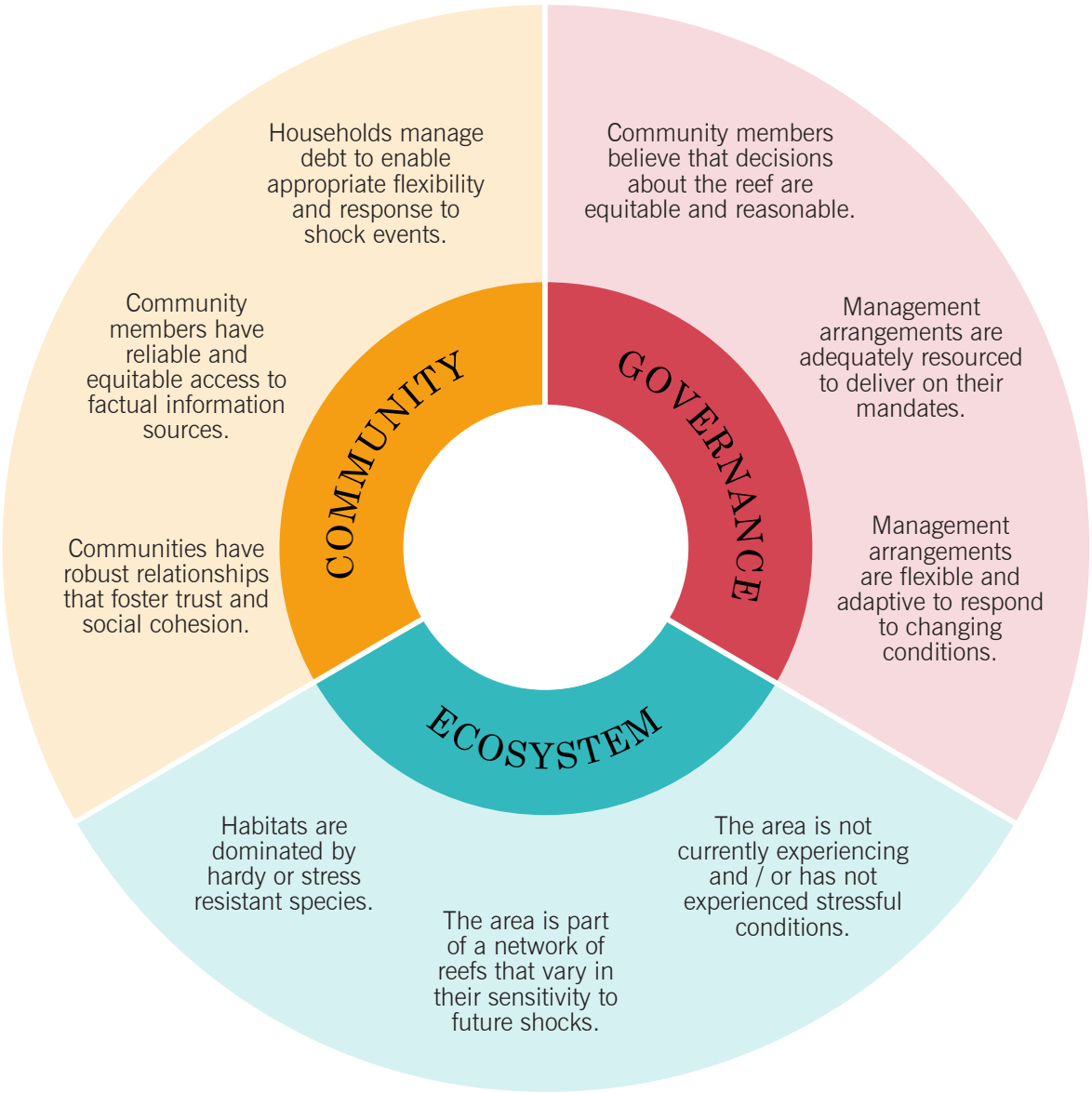


Figure 2 The Reef Resilience Framework – Example pilot Indicators

3 Developing and using the Reef Resilience Framework

The Framework has been developed to assist reef communities and managers to better understand the current state of resilience of their reef and communities, identify vulnerabilities and opportunities, prioritise action and evaluate success with regards to addressing resilience challenges.

Implementing the Framework

The Framework aims to bridge theory and practice, and integrates the best available research and practical experience to create a simple and useable model for understanding and building resilient reef systems. The Framework provides a clear and visual way of understanding and communicating resilience to the full range of relevant stakeholders and communities associated with coral reef systems.

The Framework can be used to support the development of reef resilience assessments to influence decision making, planning and the development of actions to improve reef resilience. In particular, this Framework moves beyond current management practices to develop an integrated understanding of reef resilience — one that assists with evaluating the interdependencies between reef ecosystems, the communities that depend on them, and the organisations that govern them.

The Framework provides a structure for identifying and prioritising local actions to deliver improvements in system-wide resilience. This process puts people at the centre of efforts to secure a better future for their coral reefs, establishing a model for operationalising resilience-based management that can be tailored to local conditions anywhere, and move beyond purely conservation based actions.

Figure 3 shows how the Framework has the potential to inform an understanding of the challenges facing the reef, and prioritisation and design of actions.

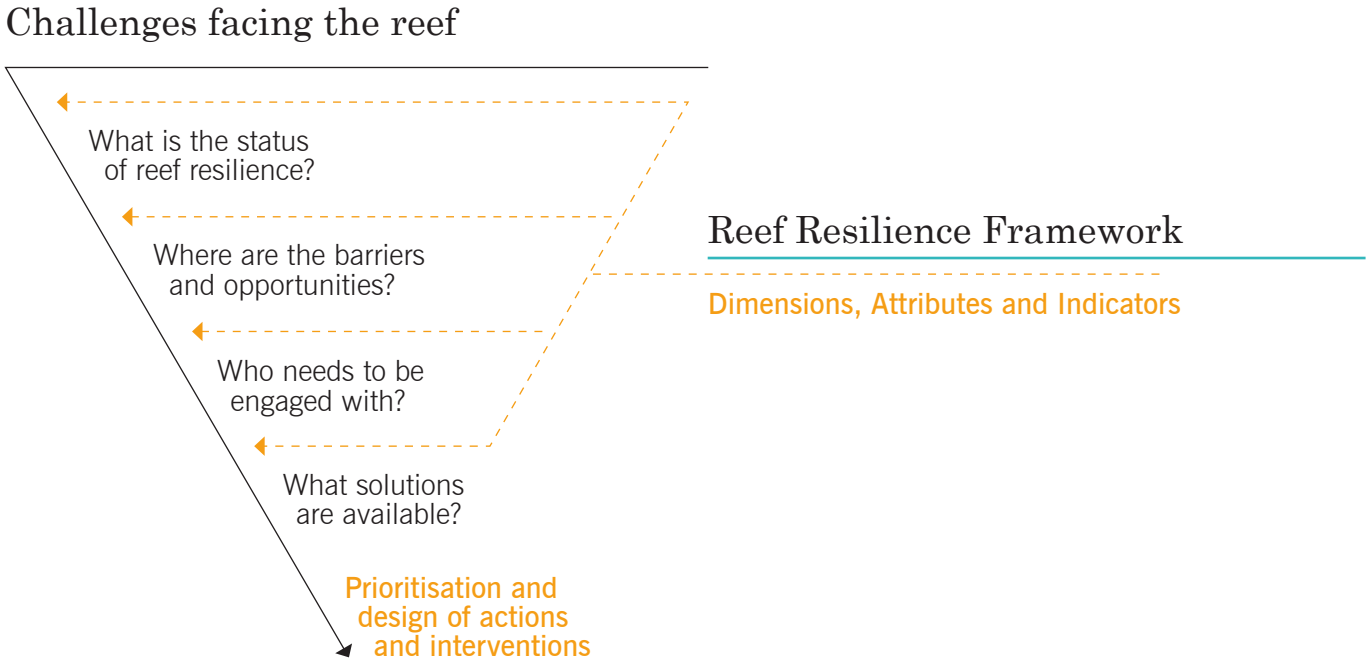


Figure 3 Implementing the Reef Resilience Framework

Table 3 summarises how the Framework supports users to achieve resilience outcomes and provides guidance as to how it can be used to guide decision making, planning and action.

Table 3 Reef Resilience Framework – Implementation

The Framework supports users to…	The Framework enables this by providing…	The Framework is implemented by …
…engage with a broad range of stakeholders	…a filter for identifying stakeholders	• Developing a stakeholder identification and mapping tool, using the Framework as the structuring framework • Using the Framework to review and revise stakeholder maps and to facilitate broadening of the engagement approach at each site
… evaluate the resilience challenges facing reefs and reef dependent communities	…a clear and consistent analytical structure	• Using the Framework as the structure for an initial site diagnosis, identifying resilience challenges and opportunities
…identify new ways of building reef and community resilience through new partnerships	…an integrated, broader conceptualisation of the challenges facing reefs and reef dependent communities	• Using the site diagnosis, alongside the Framework, to identify new resilience building partnerships
…identify and design resilience building initiatives that when implemented will deliver co-benefits and long term resilience dividends	…a clear and robust set of resilience indicators for initiative identification and development	• Using the Framework to develop a process to identify and prioritise initiatives through a workshop approach and tool • Assisting sites to increase the resilience value of their initiatives, using the Framework as an analytical framework
…accelerate action in building reef and reef dependent community resilience	…a readily accessible set of criteria for resilience investment	• Prominently communicating the Framework, advocating its use and supporting partners to integrate it into their own decision making processes
…provide a common language for collaboration and integration around resilience	…a clear and consistent definition and scope for reef resilience	• Broadly communicating an integrated view of resilience, and encouraging others to adopt and customise it for their own context

The Framework has been developed specifically for coral reefs, and coral reef dependent communities, although elements are likely to be applicable to other ecological systems and their surrounding communities. The Framework has been underpinned by peer-reviewed research and ongoing discussions with experts, and it is anticipated that ongoing input from thought leaders from relevant research areas and academies will continue to provide important guidance in verifying and operationalising the Framework.

Users of the Framework

The Framework is intended to be used by anyone working to address resilience in coral reefs and reef dependent communities.

The Framework supports these users as follows:

Communities

Helps communities to communicate and better understand their challenges, preferences, values and roles in building resilience.

Organisations

Helps organisations to better understand how their activities impact the reef and their role in building reef resilience.

Reef managers

Provides a new way of understanding and communicating reef and community challenges, especially in the context of major drivers like climate change. With future iteration/ development following pilot testing, the Framework will become a valuable and robust framework for managing reef resilience.

Centring people in resilience building - Reef Stewardship program, Southern Belize

The Toledo Institute for Development and Environment (TIDE) is one of the leading conservation non-governmental organisations in Belize.

TIDE works in partnership with the Government of Belize as reef managers to co-manage the Port Honduras Marine Reserve and protected areas in the Maya Mountain Marine Corridor.

TIDE is engaging with local communities and organisations such as fishers, Indigenous community groups, farmers, logging concessionaires, tour guides and school children through a number of innovative programs.

One of these is the Reef Stewardship Schools program, inspired by the successful and long-running Reef Guardians Program in the Great Barrier Reef. The program aims to inspire students and teachers - and through them their communities and local environmental agencies – to create awareness, understanding and appreciation for the reef and its connected ecosystems, while fostering stewardship and a community culture of custodianship for reef protection.

Image: Belize Reef Stewardship Schools.
Source: TIDE

Reef resilience - boundaries of influence

Boundaries of influence are likely to be different for each reef based on scale, complexity and the most important resilience challenges and opportunities.

When assessing reef resilience, defining systemic and geographic boundaries is useful to ensure that the Framework can be implemented in a focused and clear manner. The spatial scale of a resilience assessment, in the context of using the Framework, may initially be primarily determined using existing governance boundaries but should also consider how communities identify the area they depend on for survival and livelihoods. Spatial boundaries may also need to accommodate the drivers and influences that affect system resilience, such as the land uses or activities occurring in catchments which directly impact reef ecosystems.

Elements which are likely to be included within the sphere of influence:

- The reef ecosystem.
- The catchment that impacts the reef ecosystem e.g. terrestrial land uses and activities.
- Indigenous Peoples and/or Traditional Owner groups with formal or informal access or tenure rights over the reef.
- Reef dependent communities and organisations.
- Communities, organisations, and activities with a significant, direct, local impact upon the reef.
- Organisations with direct managerial responsibilities or influence over the reef and their agreed site boundaries e.g. World Heritage site boundaries.

Additional elements to consider:

- Indigenous Peoples and/or Traditional Owner groups with formal or informal access or tenure rights over surrounding marine systems or within land based catchments leading to the reef.
- Communities, organisations and activities with significant indirect local or regional impacts upon the reef (e.g. extractive industries, agriculture).
- Organisations and communities with an indirect interest or association upon the reef, or indirect managerial responsibilities or influence over the reef.

Developing the Framework - the process to date

The Great Barrier Reef Foundation (GBRF) is the lead charity dedicated to protecting the Great Barrier Reef through funding solutions grounded in science, technology, engineering and on-ground action to ensure their long-term conservation. Following on from participation at The Future of the World Heritage Convention for Marine Conservation (September 2016), the development of the Framework was initiated by the GBRF in 2017 based on an identified need and consultation with GBRF partners and projects.

The development of the Framework has been guided by learnings on reef resilience through direct engagement, literature review, on ground experience, and other global programs addressing resilience. Global leaders in urban and natural system resilience were consulted during the development of the Framework, with inputs collated from over 35 organisations over a series of workshops and expert consultations between November 2017 and May 2018.

The Framework has been informed by learnings from the Reef Resilience Network, the UNESCO World Heritage Convention, and 100 Resilient Cities Pioneered by the Rockefeller Foundation (100RC), with insights from other resilience initiatives such as the Great Barrier Reef Marine Park Authority's Climate Change Action Plan, The Nature Conservancy / National Oceanic and Atmospheric Administration Local Actions for Global Coral Reef Conservation Program, and the Thames 2100 Plan and Resilience Innovation Exchanges, amongst others.

In particular, the Framework builds on work done by the Reef Resilience Network established by The Nature Conservancy who developed the Reef Resilience Toolkit in partnership with many key organisations.

Reef Resilience Network

The Reef Resilience Network connects marine resource managers with information, experts, resources, and skill-building opportunities to accelerate and leverage solutions for improved conservation and restoration of coral reefs and reef fisheries around the world.

The Network is a partnership led by The Nature Conservancy (TNC) that is comprised of more than 1,350 members, and supported by dozens of partners and TNC staff, as well as over 100 global experts in coral reefs, fisheries, climate change, communication, and more who serve as trainers, advisors, and content reviewers. The Network strengthens members' ability to effectively manage coral reefs threatened by warming seas, bleaching, coastal development, pollution, overfishing, and changes in ocean chemistry.

For 15 years, the Network has played a critical role in transforming scientific and theoretical information about reefs into operational knowledge, tools, and guidance for resource managers: the government, non-governmental organisations, and community leaders tasked with managing reefs and the services they provide. The Network has provided training to 4,120 Managers and practitioners online and/or in-person. Over 50 projects have been launched with funding support by the Network, and over 150,000 people access the Reef Resilience Network Reef Resilience Toolkit annually.

100 Resilient Cities Pioneered by the Rockefeller Foundation

100 Resilient Cities (100RC) is working with 100 cities worldwide to develop resilience strategies. The main objective of the 100RC resilience strategy process is to trigger action, investment and support within city government and from outside groups.

100RC's work to date has established itself as an innovative, impactful initiative helping cities prepare for an uncertain future. In 4 years, the 100RC initiative has led to the implementation of 37 resilience strategies, with nearly 1,900 concrete actions and initiatives. Partners have pledged over US$230M million, while over US$620 million in funding has been leveraged from national, philanthropic and private sources to implement resilience actions.

Through 100RC, cities receive financial and logistical guidance for establishing a new position in city government, a Chief Resilience Officer (CRO), who will lead the city's resilience efforts; technical support to develop a holistic resilience strategy that reflects each city's distinct needs; access to an innovative platform of private sector and non-governmental organisation services to support strategy development and implementation; and inclusion in the 100 Resilient Cities Network to share knowledge and best practices with other member cities. 100RC was created by the Rockefeller Foundation on the Foundation's centennial in 2013.

PIONEERED BY THE ROCKEFELLER FOUNDATION
100 RESILIENT CITIES

UNESCO World Heritage Convention

World Heritage Sites are cultural and/or natural sites of 'Outstanding Universal Value', which are important across countries and generations. The United Nations Educational, Scientific and Cultural Organisation (UNESCO) seek to protect and preserve such sites through the 'Convention Concerning the Protection of the World Cultural and Natural Heritage'[4] (the World Heritage Convention).

UNESCO recognises the overwhelming threat posed by climate change to World Heritage properties, especially those containing coral reefs. Reducing greenhouse gas emissions is an urgent priority for protecting the future of coral reef World Heritage Areas. Additionally, UNESCO has underscored the need to develop guidance and support for World Heritage site managers and their communities to build resilience in the face of climate change.

Outstanding Universal Value is considered to transcend national boundaries and to be of importance for future generations. World Heritage status is a high accolade that brings with it responsibilities and international scrutiny. The global significance of World Heritage sites provides additional impetus to focus resilience-building efforts at these locations. Through their importance and profile, World Heritage sites can also serve to showcase resilience-building approaches.

UNESCO
PATRIMONIO MUNDIAL · WORLD HERITAGE · PATRIMOINE MONDIAL

4 Framework Project Team

The Framework has been led by the Great Barrier Reef Foundation (GBRF), in partnership with AECOM and Reef Ecologic and financial support from BHP.

The Great Barrier Reef Foundation

A charity organisation which leads the collaboration of business, science, government and philanthropy – groups who would not otherwise come together – for the benefit of coral reefs. The Great Barrier Reef Foundation (GBRF) champions real solutions to the threats facing coral reefs by delivering meaningful outcomes to protect and restore them.

GBRF has a well-established and proven track-record in managing large and complex multi-stakeholder projects focused on the scientific research, conservation, on-ground actions and decision support tools. GBRF has built strong relationships with key coral reef stakeholders in Australia and internationally, through formal partnerships with reef management agencies, support of community and Indigenous programs, funding of science and conservation projects and participation and membership of global networks.

Great Barrier
Reef Foundation™

AECOM

A global multidisciplinary company working with clients and communities to develop and implement innovative solutions to the world's most complex challenges. Their mission is to positively impact lives, transform communities and make the world a better place.

AECOM is currently working across a number of major programs to help develop, implement and facilitate ideas and tools to build community and ecosystem resilience.

AECOM

Reef Ecologic

Reef Ecologic have over 20 years of experience working with researchers and marine ecosystem managers in Australia, the Caribbean, Pacific and Indian Ocean regions. Reef Ecologic combines innovative science with practical actions to help managers and policymakers address the major issues affecting marine systems. Reef Ecologic has an extensive track record in collaborative approaches to applied research, management advice, policy development and capacity-building.

Reef Ecologic
For a better planet

5 Acknowledgements

GBRF in collaboration with AECOM and Reef Ecologic would like to thank their partners for their time and support in the development of the Framework:

100 Resilient Cities (100RC) pioneered by the Rockefeller Foundation

Adaptive Change Advisors

Australian Institute of Marine Science (AIMS)

Bloomberg Philanthropies

Columbia University

Commonwealth Scientific and Industrial Research Organisation (CSIRO)

EcoAdvisors

Global Island Partnership

Great Barrier Reef Marine Park Authority (GBRMPA)

International River Foundation

James Cook University

Marine Ecosystem Policy Advisors

National Oceanic and Atmospheric Administration (NOAA)

New York Museum of Natural History

Ocean Collectiv

Philanthropy Associates

Queensland Parks and Wildlife Service (QPWS)

Resilient Melbourne, City of Melbourne

The Nature Conservancy (TNC)

University of Queensland

University of Rhode Island

Western Australia Department of Biodiversity, Conservation and Attractions (DBCA)

Wildlife Conservation Society (WCS)

Glossary

Term	Definition
Attributes	The components of a reef, community and governance system most critical to conferring resilience to that system.
Community	Includes individuals, Indigenous Peoples and Traditional Owners, community groups, businesses, industry, and institutions such as government agencies and non-governmental organisations (NGOs).
Dimensions	The three Dimensions – Ecosystem, Community, and Governance - that together, at a high level, describe the broader, inter-connected coral reef system which includes the reef ecosystem, the community that depends upon it, and the governance arrangement that determine how they interact.
Ecosystem services	The sources of benefits that individuals and communities gain from coral reefs, which can be divided into three main categories: provisioning, regulating, and socio-cultural.
Governance	Includes the organisational arrangements and cultures that influence the reef ecosystems and communities and the interactions between them. Governance includes policies, practices, rules and regulations that establish responsibilities and accountabilities for individuals and organisations in relation to the reef system. These are usually established and implemented by organisations, such as marine park management authorities, Traditional Owner groups, government organisations, community groups, peak industry bodies, businesses
Indicators	Characteristics to be developed to support the application of the Framework by providing a place-based quantitative or semi-quantitative assessment of reef system resilience.
Reef ecosystem	Include corals and the reef structures that they create, as well as the immense diversity of species that they support. Reef ecosystems also include associated species and habitats, such as seagrasses, mangroves, islands and adjacent coastal systems.
Reef manager	Reef managers are individuals and organisations (government or non-government) that have formal responsibility for the protection and management of a coral reef system.
Reef resilience	The capacity of reef ecosystems and the individuals, businesses and communities that depend upon them to survive, adapt and recover from the stresses and shocks that they experience.
Reef Resilience Framework	A Framework developed to assist reef communities and managers to better understand the current state of resilience of their reef and communities, identify strengths and weaknesses, prioritise action, and evaluate success with regards to addressing resilience challenges.
Shocks	Influences that gradually but persistently weaken reef systems and communities. Stresses which affect both reef ecosystems and communities can reduce the ability of both systems to function normally, and recover after shocks. Stresses may also increase the vulnerability of either system to shocks. Examples of stresses include agricultural runoff, over fishing, and chronic food or water shortages.
Stresses	Sudden, short-term events that disrupt or damage reef ecosystems and communities. Examples of shocks include cyclones, coral bleaching, or oil spills.

References

[1] The Nature Conservancy (TNC), Reef Resilience Network and Toolkit. Retrieved from http://www.reefresilience.org/ on 11/05/2018.

[2] 100 Resilient Cities pioneered by the Rockefeller Foundation, Resilience Framework. Retrieved from http://100resilientcities.org/resources/#section-1 on 11/05/2018.

[3] Fabricius, K.E., Okaji, K. & De'ath, G. (2010) Three lines of evidence to link outbreaks of the crown-of-thorns seastar Acanthaster planci to the release of larval food limitation Coral Reefs Vol 29 Issue 3 pp 593-605.

[4] United Nations Educational, Scientific and Cultural Organisation (UNESCO), World Heritage Convention (WHC). Retrieved from http://whc.unesco.org/en/conventiontext/ on 11/05/2018.

Image credits:

FNQ Magazine, Fitzroy Island, Great Barrier Reef. Retrieved from https://fnqmagazine.com/fitzroy-island/ on 11/05/2018.

STR/AFP/Getty Images, Agricultural runoff in Far North Queensland, Great Barrier Reef, The Guardian. Retrieved from https://www.theguardian.com/environment/2015/jan/20/more-than-17bn-needed-to-improve-water-quality-on-great-barrier-reef on 11/05/2018.

Toledo Institute for Development and Environment (TIDE), Belize Reef Stewardship Schools. Retrieved from http://www.tidebelize.org/ on 11/05/2018.