Tropical Water Quality Hub

National Environmental Science Programme

Project 4.6 Recommendations to maintain functioning of the Great Barrier Reef

Project Summary

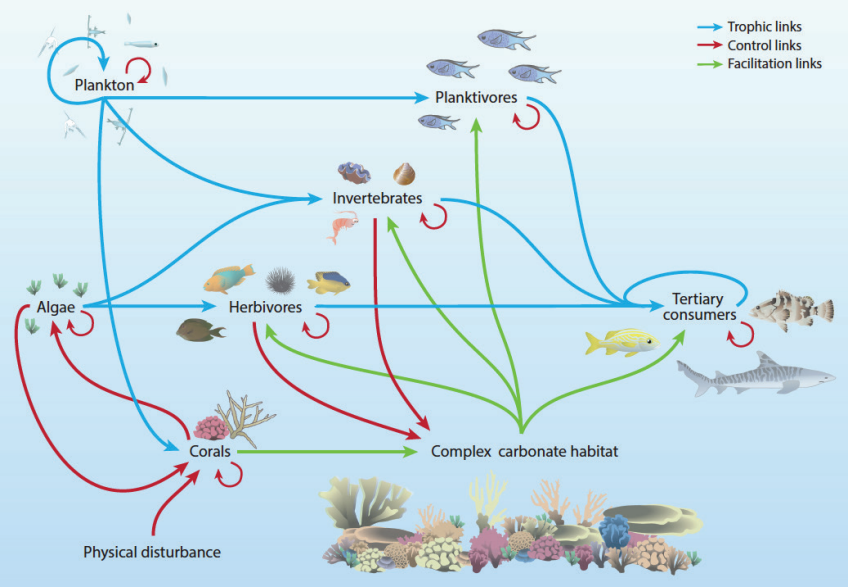
The Great Barrier Reef (GBR) is experiencing increased environmental stress, which threatens its functioning. Yet a subset of species is often disproportionately important in maintaining a functioning ecosystem. This project harnesses Queensland's breadth of reef expertise to deliver timely recommendations on what can be done to strengthen and protect key supportive species. Specifically we ask which species – or functional groups of species – drive processes that maintain a healthy reef. We provide scientific consensus in support of (1) species of particular functional importance, (2) areas of outstanding value and/or threat, (3) recommendations for enhanced and targeted protection, and (4) informed scenarios for what's at stake and the consequences of not taking further action. We also suggest collaboration with citizen science organisations to help monitor the status of priority species.

Problem

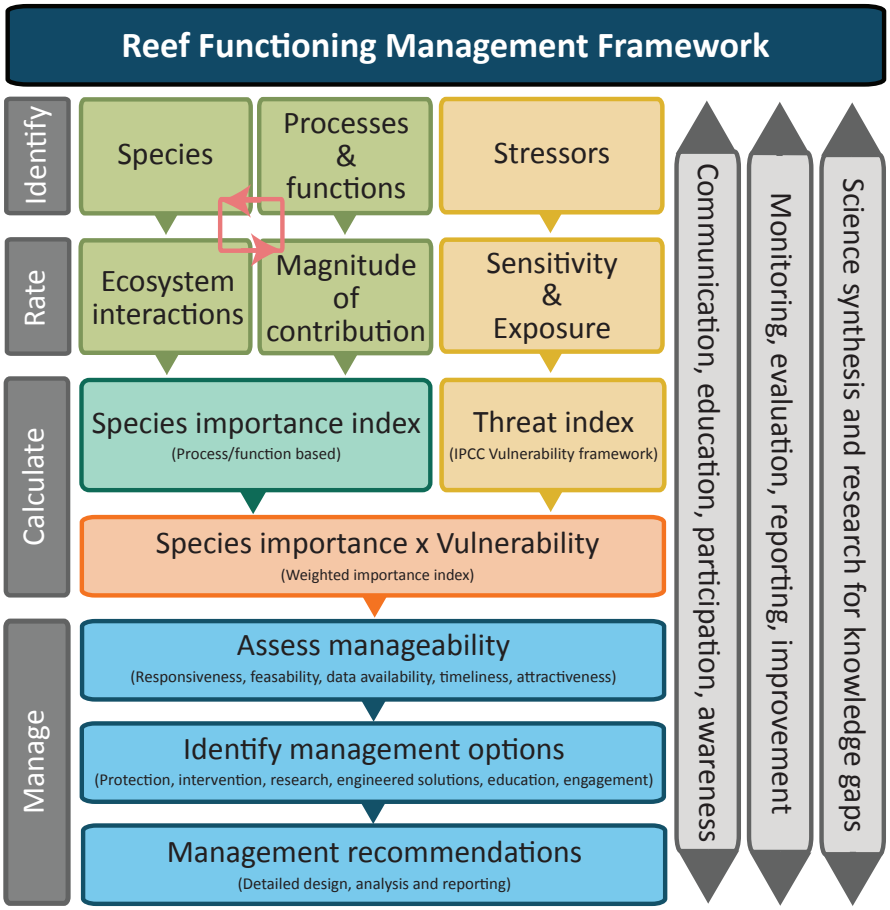
Climate change exacerbates local stressors on coral reefs and threatens the very functioning of the Great Barrier Reef. We can think of a functioning ecosystem as one that resembles its natural state and is able to support key ecosystem goods and services such as maintaining biodiversity, productive fisheries and coastal protection from storms. While authorities employ a diversity of approaches to manage the reef, it is important to ask whether key functions are adequately protected.

How Research Addresses Problem

1) Identifying key species (or functional groups of species) that drive functioning coral reefs.
2) Describing the threats (local or global) facing these species, ranking their vulnerabilities.
3) Proposing management actions to reduce the impacts of said threats (e.g. species protection, harvest controls, etc.).
4) Generating scenarios for "what's at stake": how will ecosystems change if these species are allowed to decline and how will that affect stakeholders?
5) Identifying critical knowledge gaps, recommending priority research questions.
6) Recommending actions for citizen science groups such that data can be acquired to support the monitoring of priority species.



Simplified schematic of key trophic and habitat linkages among major coral reef taxa. Functionally important species are those essential to the maintenance and/or facilitation of these links (Harborne et al. 2017; Ann. Rev. Mar. Sci.).



The Reef Functioning Management Framework provides a stepwise method to assess coral reef species based on their (1) functional importance, (2) vulnerability to threats, and (3) manageability, working towards effective targeted management of species essential to maintaining ecosystem functioning in a future ocean.

While healthy and productive ecosystems typically require high overall biodiversity, many studies highlight the critical importance of a small subset of species. Biodiversity conservation – which is often based on habitat protection – therefore needs to complement its strategy with specific provisions for key species. For example, the rezoning of the GBR in 2004 was motivated, in part, by a requirement to protect marine biodiversity. Implementation of the zoning plan continues to have multiple benefits, but these might be augmented with additional management provisions targeted at a small, but critically important, subset of species. This is becoming increasingly important to determine given the strengthening impacts of global (e.g. climate change, ocean acidification) and local (e.g. fisheries, water quality) stressors.

Coral reefs are complex ecosystems with a great diversity of players including microbes, algae, corals, sponges, invertebrates and fishes. Collectively, these species are the reef's life support system, maintaining critical functions such as calcification, bioerosion, primary production, herbivory, predation and nutrient cycling. Corals are major contributors to calcification and reef building, however some species contribute disproportionately to coral recovery and coverage (e.g. *Acropora*), while others contribute more to rates of reef building (e.g. *Turbinaria*). Beyond corals, microbial processes underpin many ecosystem processes, mobile invertebrates (e.g. crabs, molluscs) are a key driver of fisheries productivity (tertiary production), planktivorous fishes capture nutrients in upwelling zones, some herbivorous fishes are more important in controlling fouling seaweeds, and so on. Determining species of particular functional importance is essential for maintaining ecosystem functioning on the GBR in a future ocean.

Further information

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