

TITLE: Operationalizing resilience for adaptive coral reef management under global environmental change

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ABSTRACT:

Cumulative pressures from global climate and ocean change combined with multiple regional and local-scale stressors pose fundamental challenges to coral reef managers worldwide. Understanding how cumulative stressors affect coral reef vulnerability is critical for successful reef conservation now and in the future. In this review, we present the case that strategically managing for increased ecological resilience (capacity for stress resistance and recovery) can reduce coral reef vulnerability (risk of net decline) up to a point. Specifically, we propose an operational framework for identifying effective management levers to enhance resilience and support management decisions that reduce reef vulnerability. Building on a system understanding of biological and ecological processes that drive resilience of coral reefs in different environmental and socio-economic settings, we present an Adaptive Resilience-Based management (ARBM) framework and suggest a set of guidelines for how and where resilience can be enhanced via management interventions. We argue that press-type stressors (pollution, sedimentation, overfishing, ocean warming and acidification) are key threats to coral reef resilience by affecting processes underpinning resistance and recovery, while pulse-type (acute) stressors (e.g. storms, bleaching events, crown-of-thorns starfish outbreaks) increase the demand for resilience. We apply the framework to a set of example problems for Caribbean and Indo-Pacific reefs. A combined strategy of active risk reduction and resilience support is needed, informed by key management objectives, knowledge of reef ecosystem processes and consideration of environmental and social drivers. As climate change and ocean acidification erode the resilience and increase the vulnerability of coral reefs globally, successful adaptive management of coral reefs will become increasingly difficult. Given limited resources, on-the-ground solutions are likely to focus increasingly on actions that support resilience at finer spatial scales, and that are tightly linked to ecosystem goods and services.

SOURCE: Global change biology

PDF URL: <https://onlinelibrary.wiley.com/doi/pdfdirect/10.1111/gcb.12700>

CITED BY COUNT: 205

PUBLICATION YEAR: 2014

TYPE: article

CONCEPTS: ['Coral reef', 'Reef', 'Resilience of coral reefs', 'Environmental resource management', 'Ocean acidification', 'Climate change', 'Environmental science', 'Adaptive capacity', 'Vulnerability (computing)', 'Ecology', 'Biology', 'Computer science', 'Computer security']