Center for Community-Based Resource Management (CBRM)

Natural Resources Institute, University of Manitoba

CBRM Database

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Case Study Name:	**Ecological States and the Resilience of Coral Reefs**		
Author:	Tim McClanahan, Nicholas Polumin, and Terry Done		
Document Type:	Paper in scientific journal		
Year:	2002		
Language:	English		
Document Location:	*Conservation Ecology* 6 (2):18		
Full Citation:	McClanahan, T., N. Polumin, and T. Done. 2002. Ecological states and the resilience of coral reefs. *Conservation Ecology* 6(2): 18		
Region:	Worldwide coral reefs, tropical latitudes		
Country:	n/a		
Ecosystem Type:	Coral reef, coastal marine		
Social Characteristics:	Coastal communities		
Scale of Study:	international		
Resource Type:	Invertebrates, fisheries, species conservation, habitat conservation		
Type of Initiative:	Research-driven project, other (intergovernmental to local)		
Community-Based Work:	Fisheries management, environmental health, ecosystem restoration		
Keywords:	Reef ecology, fisheries management, resilience, conservation, species diversity		
Summary:	**We review the evidence for multiple ecological states and the factors that create ecological resilience in coral reef ecosystems. There are natural differences among benthic communities along**		

	gradients of water temperature, light, nutrients, and organic matter associated with upwelling-downwelling and onshore-offshore systems. Along gradients from oligotrophy to eutrophy, plant-animal symbioses tend to decrease, and the abundance of algae and heterotrophic suspension feeders and the ratio of organic to inorganic carbon production tend to increase. Human influences such as fishing, increased organic matter and nutrients, sediments, warm water, and transportation of xenobiotics and diseases are common causes of a large number of recently reported ecological shifts. It is often the interaction of persistent and multiple synergistic disturbances that causes permanent ecological transitions, rather than the succession of individual short-term disturbances. For example, fishing can remove top-level predators, resulting in the ecological release of prey such as sea urchins and coral-eating invertebrates. When sea urchins are not common because of unsuitable habitat, recruitment limitations, and diseases, and when overfishing removes herbivorous fish, frondose brown algae can dominate. Terrigenous sediments carried onto reefs as a result of increased soil erosion largely promote the dominance of turf or articulated green algae. Elevated nutrients and organic matter can increase internal eroders of reef substratum and a mixture of filamentous algae. Local conservation actions that attempt to reduce fishing and terrestrial influences promote the high production of inorganic carbon that is necessary for reef growth. However, global climate change threatens to undermine such actions because of increased bleaching and mortality caused by warm-water anomalies, weakened coral skeletons caused by reduced aragonite availability in reef waters, and increased incidence of diseases in coral reef species. Consequently, many coral reefs, including those that are heavily managed, have experienced net losses in accumulated inorganic carbon in recent decades and appear likely to continue this trend in coming decades. Reefs urgently need to be managed with a view to strengthening their resilience to the increased frequency and intensity of these pressures. Ecological targets must include the restoration or maintenance of species diversity, keystone species, spatial heterogeneity, refugia, and connectivity. Achieving these goals will require unprecedented cooperative synergy between human organizations at all political levels, from intergovernmental to local.