

The Boom and Bust of Coral Reef Accretion Potential Associated with Restoration and Coral Bleaching

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Coral reefs are critical habitats that support essential ecosystem services, such as shoreline protection and fisheries production, that are valued at >\$8.5 billion in south Florida alone. The persistence of reef habitats, and the ecosystem services they support, relies on the balance between the processes of reef growth (or “accretion”) and erosion. In the Florida Keys, where the subtropical climate has limited reef accretion for millennia, the impacts of recent coral-reef degradation have been especially severe. Erosion is now the dominant process on many of Florida’s reefs and the reef structure that took thousands of years to build is now rapidly eroding away. Because reef habitats serve as the structural foundation for the essential ecosystem services reefs provide to society, reviving the reef-accretion process is the most fundamental conservation challenge in coral-reef science. It is also a challenge that coral restoration is uniquely poised to address because coral outplanting directly enhances both coral cover and structural complexity; however, despite the potential for coral restoration to enhance the essential reef-accretion process *in theory*, few studies to date have quantified how restoration affects reef-accretion potential and reef structural complexity *in practice*. We addressed that important knowledge gap by conducting paired carbonate budget and structure-from-motion surveys at outplanted or “restored” and non-restored areas of eight offshore fore reefs and three inshore patch-reef sites in the Lower Florida Keys where Mote Marine Laboratory researchers have been outplanting corals since 2016. We found that in just 2–6 years, restoration reversed long-term declines in reef-accretion potential at offshore reefs where fast-growing *Acropora cervicornis* was outplanted, leading to a 16-fold increase in gross carbonate production and significant increases in structural complexity. Although there was no detectable impact of restoration at the inshore patch reefs where slower-growing massive corals were outplanted, those corals fared significantly better in the wake of the devastating 2023 mass coral-bleaching event. Whereas coral bleaching drove near-complete mortality of *A. cervicornis*, ~60% of massive coral outplants survived, demonstrating the importance of considering trade-offs between coral growth and survival to improve restoration efficacy. Although there remain important questions about whether and how restoration can meaningfully improve reef-scale ecosystem function in the face of future disturbances, our findings demonstrate its potential for rapid, localized reef accretion gains. Moreover, our carbonate-budget and structure-from-motion modeling approach provides a powerful tool for quantifying the impact of restoration on the essential reef-accretion function that could allow coral-reef managers to design restoration strategies that optimize functional outcomes in an uncertain future.