New study uses satellites and field studies to improve coral reef restoration

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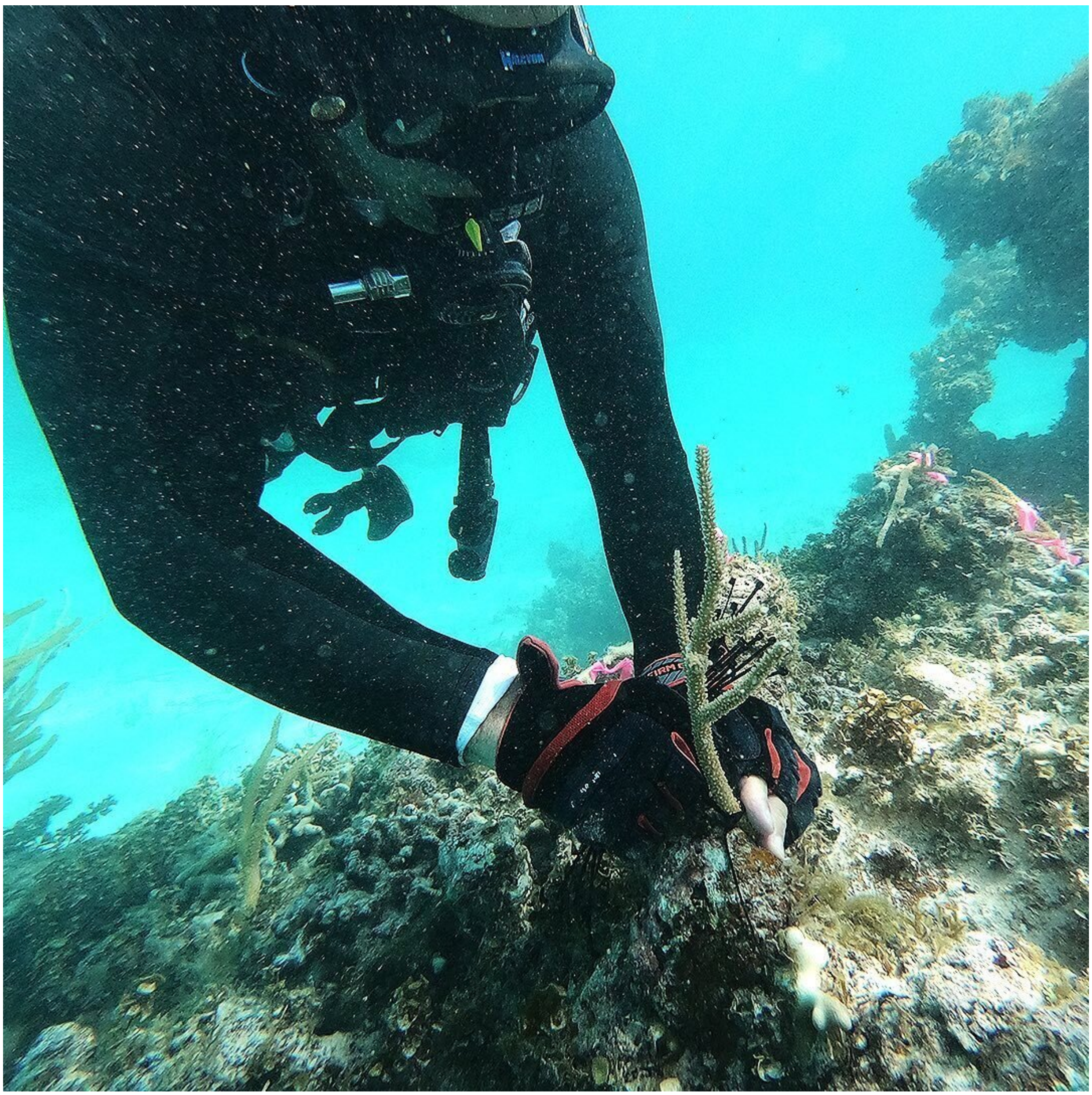

"Coral gardening" or "outplanting" has become a popular and promising solution for restoration. Credit: Arizona State University Center for Global Discovery and Conservation Science

Our planet's coral reef ecosystems are in peril from multiple threats. Anthropogenic CO_2 has sparked a rise in global average sea surface temperatures, pushing reef survival beyond its upper thermal limits. Coastal development from industry, aquaculture, and infrastructure generates sedimentation and increased turbidity in coastal waters, which raises particulate organic carbon (POC) levels. Additionally, sedimentation reduces photosynthetically active radiation (PAR), the much-needed sunlight soaked up by the symbiotic algae corals rely on for food.

With most of the world's reefs under stress, 'coral gardening' or 'outplanting' has become a popular and promising solution for restoration. Outplanting involves transplanting nursery-grown coral fragments onto degraded reefs. When successful, outplanting helps build coral biomass and restore reef function; but even with thousands of corals outplanted each year, the results are mixed. Newly settled corals are particularly vulnerable to stressors such as pollution, unfavorable light conditions, and temperature fluctuations. Therefore, identifying which stressors have the greatest bearing on coral health and survival is crucial for ensuring successful reef restoration.

A recent study published in *Restoration Ecology* by researchers from Arizona State University's Center for Global Discovery and Conservation Science (GDCS) found evidence that POC levels are one of the most important factors in determining coral outplant survival. This finding suggests that potential coral outplanting sites should be selected in areas where sedimentation levels are low, away from coastal development, or where coastal development is carefully managed for reef conservation.

"New restoration protocols can use remotely sensed data of multiple oceanographic variables to assess the environmental history of a site. This will help evaluate and optimize site selection and give their outplants the best chance of survival.," said Shawna Foo, lead author and postdoctoral researcher at GDCS.

The study was based on an analysis of coral outplanting projects worldwide between 1987 and 2019. The team assessed satellite-based data on multiple oceanographic variables including POC, PAR, salinity, sea surface temperature, and surface currents to quantify and assess each environmental driver's relative importance to and influence on coral outplant survival.

"Our results provide, for the first time, a clear set of conditions needed to maximize the success of coral restoration efforts. The findings are based on a vast global dataset and provide a critically needed compass to improving the performance of coral outplants in the future," said Greg Asner, co-author of the study and director of GDCS.

Notably, the researchers observed better survival rates for corals outplanted farther away from the coast than six kilometers. This finding has implications for many restoration projections which are often located near land for accessibility purposes, such as diving operations. The researchers also found better coral recovery in water deeper than six meters; corals outplanted in shallow waters showed elevated vulnerability to disturbance and bleaching. Overall, coral outplants had the greatest chance of survival in regions with stable PAR, lower levels of POC, minimal temperature anomalies, and increased water depth and distance away from land. The researchers note that finding restoration sites with all of these characteristics could pose a challenge in some areas, but a consideration of all drivers in combination will greatly help the chances of outplant survival.

More information: Shawna A. Foo et al, Impacts of remotely sensed environmental drivers on coral outplant survival, *Restoration Ecology* (2020). DOI: 10.1111/rec.13309

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