

Turning the tide: Innovative research reveals path to restoring Hawaiʻi's coral reefs

New study uncovers insights into coral decline — including too many sea urchins — and identifies key threshold for successful restoration

By Sandy Keaton Leander, ASU News
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Hawaiʻi's coral reefs are essential to the islands' communities and economy, but they are struggling against climate change, coastal pollution, overtourism and overfishing. However, a new Arizona State University study, conducted with Hawaiian cultural practitioners, offers a ray of hope by identifying a critical threshold for successful reef restoration efforts.

This latest research, published May 28 in [PLOS One](#), focuses on Hʻaunau Bay. It provides a crucial piece of the puzzle, revealing the significant impact of an increasing number of sea urchins on the reef's structure.

While urchins are a natural part of Hawaiian reefs, an overabundance of one species of urchin is thought to be caused by a combination of recent ocean warming, heavy tourism and overfishing. Fish that eat these urchins such as triggerfish, parrotfish and rays are in low abundance in Hʻaunau Bay. As a tourism hot spot, these predators are scared away on a day-to-day basis by swimmers. Overfishing in the area also puts pressure on predators that eat the urchins.

The result is an increase in urchin density to the highest levels ever measured on a reef in Hawaiʻi. This explosion of the urchin population is dismantling the reef through bioerosion as they grind away on coral skeletons, particularly in areas weakened by marine heat waves in 2015 and 2019. Bioerosion poses a significant threat to the reef's ability to grow coral fast enough to keep pace with rising sea levels.

Using a combination of underwater measurements and high-resolution spectroscopy from the ASU [Global Airborne Observatory](#), the team discovered an important threshold: Maintaining approximately 26% live coral cover would allow the reef to outpace the destructive effects of the

urchins and sea-level rise.

"This 26% target gives our restoration team a clear goal," said [Greg Asner](#), senior author of the study and director of the [Center for Global Discovery and Conservation Science](#) in the [Julie Ann Wrigley Global Futures Laboratory](#). "We are actively growing and planting coral in the H?naunau Bay to boost these numbers and push the reef toward a healthier state. If we can increase live coral cover above 26%, this may give these reefs a fighting chance to grow and thrive."

The average net carbonate production — how reefs build their physical structure — in H?naunau Bay is significantly lower than healthier reefs, and the vertical reef accumulation rate isn't keeping pace with the current rate of sea-level rise.

"The reefs cannot keep up with erosion without the help of those natural predators, and these reefs are essential to protecting the islands they surround," former ASU student and first author [Kelly van Woesik](#) said. "Without action taken now, we risk allowing these reefs to erode past the point of no return."

And while the high densities of sea urchins are concerning, this knowledge informs targeted management strategies to support the reef's recovery. The study not only identifies a critical challenge, it also provides a pathway toward a solution. Control of overtourism, reduction in chemical pollution, and education on overfishing are essential to bringing the urchins back into balance. The 26% live coral cover threshold empowers restoration efforts with a measurable objective, offering hope for the future of H?naunau Bay and other struggling reefs in Hawai'i.

"Armed with the scientific knowledge, our team can push forward with coral rescue and recovery, alongside efforts to reduce overtourism and pollution," said [Jeana Kelekolio](#), a Hawaiian lineal descendent of H?naunau, ASU outreach coordinator and a cultural advisor for ??ko?ako?a, a collaborative effort that fuses state-of-the-art science with the cultural knowledge of Hawai'i's community partners. "This is a great pathway for bringing back our beloved reef that we all depend upon."

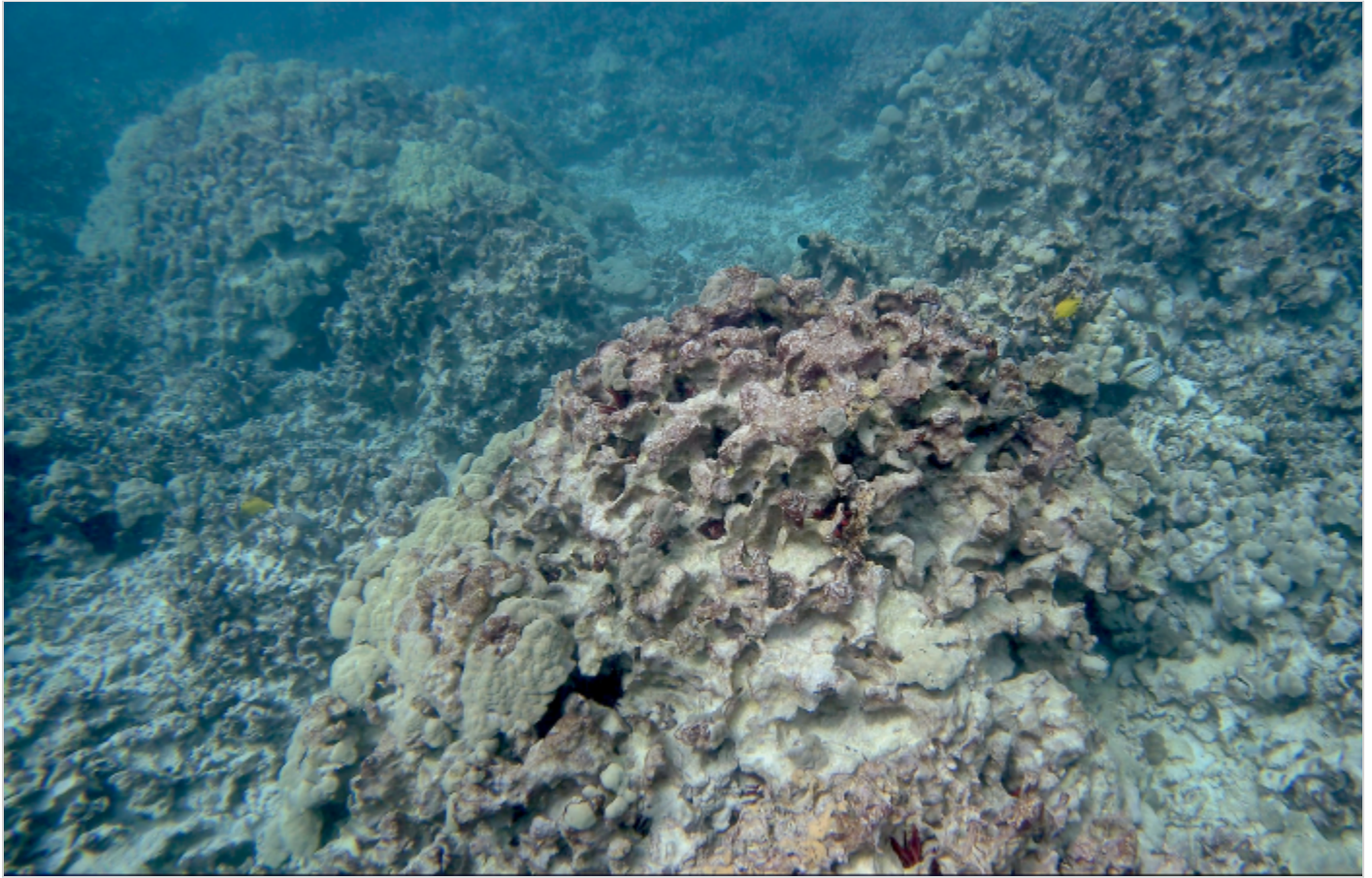
Asner's ASU research team, including co-author and School of Ocean Futures Assistant Professor [Jiwei Li](#), partnered with the state of Hawai'i and local communities through the ??ko?ako?a program, which takes a multipronged approach, tackling challenges from land-based pollution to climate change-related coral bleaching.

"The key is understanding what's out of balance," said Asner, also a professor with the [ASU School of Ocean Futures](#) in the College of Global Futures. "We need to identify the specific problems affecting each reef and develop tailored strategies to restore that balance."

The ??ko?ako?a partnership is supported by private donations, the state of Hawai'i and ASU.

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Main image



An overabundance of one species of sea urchin is dismantling the coral reef in Hanaunau Bay, Hawaii, through bioerosion (live and dead large corals shown here). But a new ASU study shows how much live coral cover would allow the reef to outpace the urchins and sea-level rise in order to thrive. Researchers are growing and planting coral to boost the Hanaunau Bay reef to a healthier state. Photo courtesy of Greg Asner

Text image(s)



A high density of *Echinometra mathaei* sea urchins is dismantling the reef in Hanaunau Bay through bioerosion. Photo courtesy of Greg Asner