

New data allows broad view of human influence on Pacific ecosystems

April 2 2015, by Kate M. Hanson

As man-made threats to coral reefs mount, and interest in conserving reef ecosystems grows, scientists have turned to studying extremely remote and uninhabited reefs in an effort to understand what coral reefs would be like in the absence of humans. A number of islands and atolls in the Pacific Ocean remain virtually untouched by human influence, situated hundreds of kilometers from the nearest human populations.

A study published today by scientists at the UH Mānoa School of Ocean and Earth Science and Technology (SOEST), the National Oceanic and Atmospheric Administration (NOAA), and the University of Victoria in the journal *PLOS ONE* draws on data from nearly 40 islands and atolls across the central and western Pacific, including 25 unpopulated islands, to investigate the relative influence of environmental variation and [human](#) presence on [reef fish](#) assemblages. The resulting message is sobering.

After accounting for environmental variation among the reefs, the team of scientists estimates that human presence is associated with large reductions in reef fish biomass compared to projections for an uninhabited state – 20% to 78% depletion at reefs in the Main Hawaiian islands, up to 69% depletion in the Mariana Archipelago and up to 56% depletion in American Samoa.

At the core of the study is an extensive dataset of fish abundance across the Pacific, gathered by divers conducting visual surveys of reefs during more than 2,000 hours of underwater observation at reef sites spanning

39 U.S. Pacific islands and atolls. The surveys were performed as part of NOAA's Pacific Reef Assessment and Monitoring Program, one of the world's largest coral reef monitoring efforts. The full dataset includes surveys of reef fish, coral habitat and satellite-derived measurements of oceanographic conditions at each reef location including sea surface temperature, wave energy and oceanic productivity.

"The great strength of the Pacific Reef Assessment and Monitoring Program is that the data are extremely comparable because it is gathered at all locations using the exact same methods, survey design and by a core survey team. This continuity in a dataset across such a large scale is unparalleled and allows us to really focus on the causes of differences among those locations," notes lead author Ivor Williams of NOAA's Coral Reef Ecosystem Division.

The data on oceanographic conditions and human population at each reef location were combined in models to investigate the influence of both environmental and human variables on reef fish abundance.

Fish higher up in the food web, like grouper, appear most susceptible to the influence of human presence. The sharpest declines in fish abundance were associated with relatively low human population densities, with continuing but more gradual fish declines seen on highly populous islands such as O'ahu and Guam.

The absence of humans from remote, uninhabited reef areas in the Pacific was not always associated with spectacular fish abundance. Reefs in the Northwest Hawaiian Islands, though extremely remote, had many fewer fish than uninhabited U.S. Line Islands situated close to the equator where regional and local upwelling bring nutrient-rich waters to the surface, enhancing phytoplankton production.

"The association between oceanic productivity and fish biomass that we

document for Pacific reefs is an important reminder that not all [coral reefs](#) have the same capacity to sustain high fish biomass. There is natural variability among reefs that is unrelated to their history of [human influence](#)," said Kate Hanson, a UH Mānoa postdoctoral fellow and a co-author on the study.

"Natural variability in fish communities amongst reefs implies that there is no single target for what a healthy reef should look like," notes Julia Baum, an assistant professor at the University of Victoria, Canada, and a study co-author. "However, the consistent declines in [fish abundance](#) with even low levels of human presence suggest that fully protected no-take zones will be necessary to maintain coral reef fish communities in their natural state."

More information: "Human, Oceanographic and Habitat Drivers of Central and Western Pacific Coral Reef Fish Assemblages." *PLOS ONE*, [DOI: 10.1371/journal.pone.0120516](https://doi.org/10.1371/journal.pone.0120516)

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