Epic ocean voyages of coral larvae revealed

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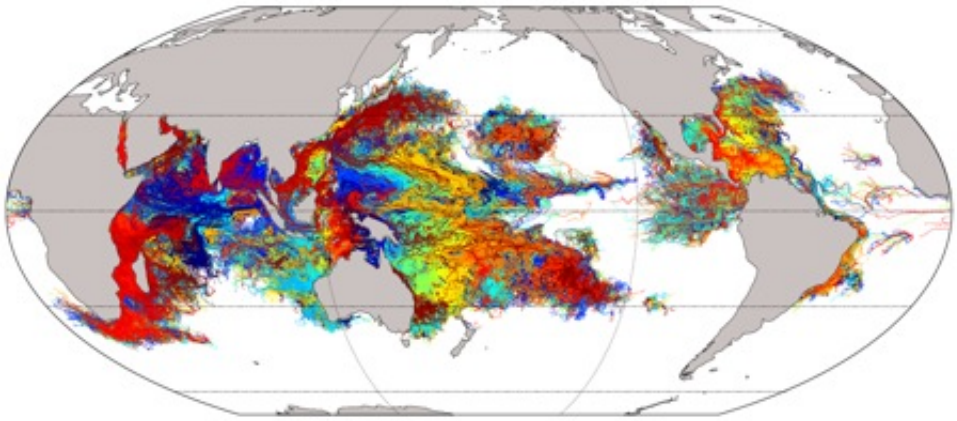

The pathways traveled by >14 million modeled coral larval over a one-year period using the Connectivity Modeling System developed by Dr. Claire Paris at the University of Miami. Note the empty no-man's-land that larvae have difficulty breaching -- this is the East Pacific Dispersal Barrier. Credit: S. Wood/Univ. of Bristol

A new computer simulation conducted at the University of Bristol (UB) and University of Miami (UM) Rosenstiel School of Marine & Atmospheric Science has revealed the epic, ocean-spanning journeys travelled by millimetre-sized coral larvae through the world's seas.

The study, published in *Global Ecology and Biogeography*, is the first to recreate the oceanic paths along which corals disperse globally, and will eventually aid predictions of how coral reef distributions may shift with climate change.

Coral reefs are under increasing threat from the combined pressures of human activity, natural disturbances and climate change. It has been suggested that coral may respond to these changing conditions by shifting to more favourable refuges, but their ability to do this will depend on the ocean currents.

Sally Wood, a Ph.D. candidate at UB, explains: "Dispersal is an extremely important process for corals. As they are attached to the seafloor as adults, the only way they can escape harmful conditions or replenish damaged reefs is by releasing their young to the mercy of the ocean currents."

Where these intrepid explorers end up is therefore an important question for coral reef conservation. However, tracking the movement of such tiny larvae in the vast oceans is an impossible task. "This is where computer simulation comes in," adds Wood.

Collaborating across the pond, Wood used the Connectivity Modeling System (CMS) developed by Dr. Claire Paris, associate professor of Applied Marine Physics at UM to identify the billions of paths taken. This larval migration model had been tested in a previous study against the reef-building coral Montastraea annularis in the Caribbean, where consensus between modeled estimates of genetic structure were found.

"Simulating an unprecedented number of mass spawning events from all known shallow reefs in the global ocean proved essential to identifying critical long dispersal distance events that promote the establishment of new coral colonies. What we found using the CMS are rare long distance dispersers that are thought to contribute to species persistence in isolated coral reefs, and to geographic range shifts during environmental changes," said Paris.

Some of the results yielded by the team were surprising. While the

majority of simulated larvae settled close to home, others travelled as far as 9,000 km., almost the entire width of the Pacific Ocean. When considered over multiple generations, this means that corals are able to cross entire ocean basins, using islands and coastlines as 'stepping stones.' However, a few places proved too distant for all but the hardiest of larvae: Coral in the tropical eastern Pacific are almost entirely cut off from those on islands of the central Pacific by a daunting 5000 km of open ocean. Geographically isolated reefs such as these may be particularly vulnerable, as they are not stocked with external recruits as frequently.

The model captured the start of the coral larvae's journey to its survival, and further work is ongoing to complete the story. Even after overcoming the trials of the open ocean, coral larvae arriving at a suitable location must first negotiate a 'wall of mouths' to settle on the reef face, and then compete fiercely for the space to thrive and grow.

More information: 'Modeling dispersal and connectivity of broadcast spawning corals at the global scale', by S. Wood, C.B. Paris, A. Ridgwell, & E.J. Hendy. *Global Ecology and Biogeography* (2013).

Provided by University of Miami