Understanding the drivers of coral reef recovery: A long-term study in the Pacific

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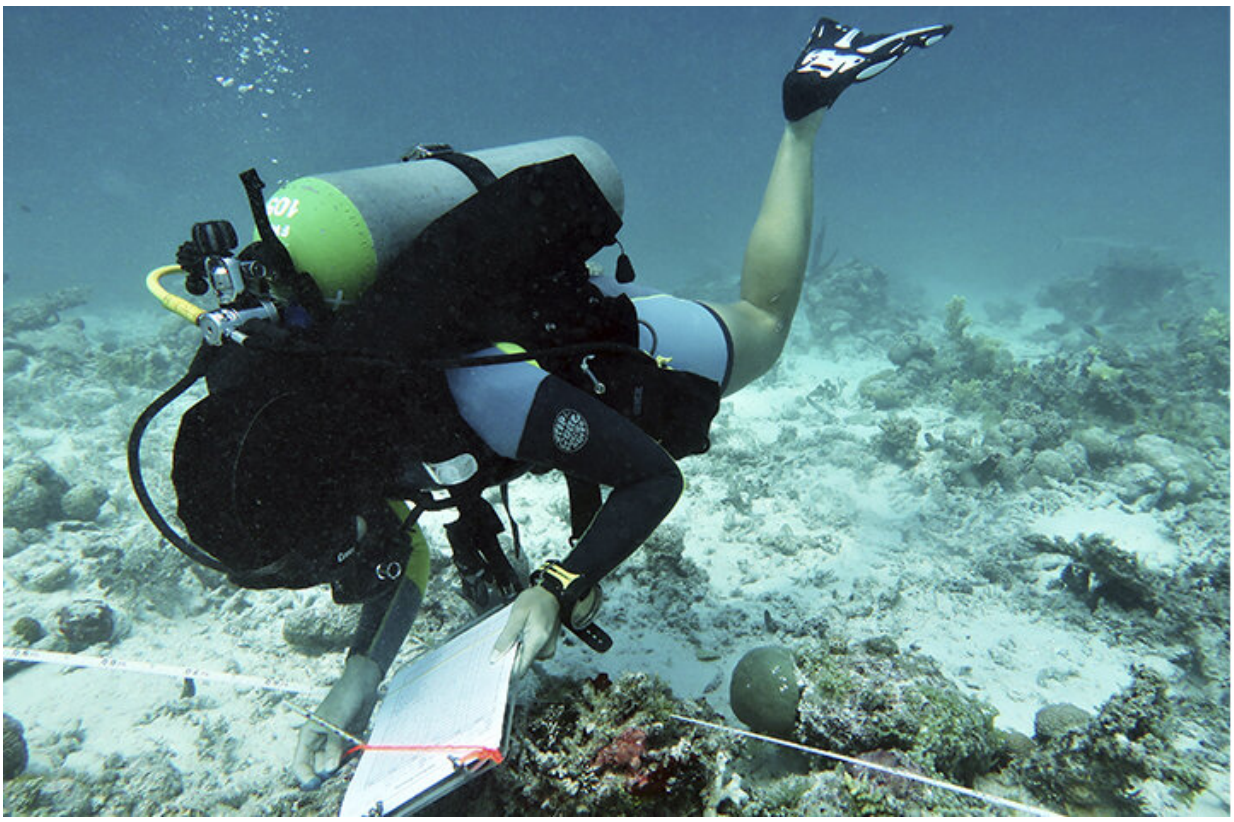

Researcher Marine Gouezo. Credit: Southern Cross University

New research on reef recovery shows corals need nine to 12 years to recover following large disturbance events such as mass bleaching and storm damage.

The findings are from Southern Cross University Ph.D. researcher Marine Gouezo, who works with the Palau International Coral Reef Center in the north Pacific. Her research entitled 'Drivers of recovery and reassembly of coral reef communities' is published today (20 February 2019) in the journal *Proceedings of the Royal Society B*.

While there have been previous studies on how some coral communities recover following disturbances, the uniqueness of Palau's long-term monitoring dataset is that some of these reefs were not impacted by any large-scale disturbances for a period of 14 years or longer since a mass bleaching event in 1998.

This allowed Ms Gouezo and co-authors to use long-term monitoring data collected over 15 years through the Palau International Coral Reef Center, to identify how reefs recover from destructive events. This is the first research of its kind in Palau, located about 800 kilometres (500 miles) southeast of the Philippines in the tropical North Pacific region.

"Coral reefs are declining worldwide as a direct result of human influences, but unlike many reefs around the world, Palau's reefs have been fortunate to experience over 14 years free from mass disturbance," said Ms Gouezo, who originates from France.

"After nine to 12 years we could even detect stability in coral-dominated states in certain habitats, something that is rare to document as the frequency of disturbances increases due to global climate change.

"Overall, fast coral recovery was observed at reefs that had good larval supply and connectivity, high survivorship of young corals, low coverage of fleshy algae, and high density of parrotfish. This study provides invaluable information to improve local management as the uncertainty of natural disturbance patterns increases."

Her primary supervisor, Southern Cross University's reef researcher and the founding Director of the Marine Ecology Research Centre Professor Peter Harrison, has pioneered coral reproduction projects on Australia's Great Barrier Reef and around the world.

"Marine's work is one of the few long-term monitoring research projects of coral recovery, and it shows how coral communities can reassemble and recover about a decade after major disturbance events," Professor Harrison said.

Ms Gouezo said while Palau was quite isolated in the Pacific and was a different system to the Great Barrier Reef, her research showed that high survivorship of young corals was imperative to recover damaged reef systems. She said her research, if applied to an Australian context, showed that maximizing the supply of coral larvae and connectivity through projects such as Professor Harrison's larval restoration on reefs in the Great Barrier Reef and in the Philippines were definitely a good option to help boost reef recovery in an area that had suffered multiple bleaching events and other disturbances.

This study was supported by The David & Lucile Packard Foundation, NOAA Coral Reef Conservation Program, NOAA Coastal Oceans Programs, Coral Reef Initiative Grant (US Department of Interior) and Southern Cross University's Marine Ecology Research Centre.

Destined for a career in coral conservation

With a name like 'Marine' and an insatiable passion for the ocean, it is no wonder Southern Cross University Ph.D. candidate Marine Gouezo is making waves in coral research worldwide.

A French national—who has studied marine science and conservation in Australia and New Zealand and worked as a researcher in

Madagascar—Ms Gouezo has now lived in the tiny country of Palau for five years, working for the Palau International Coral Reef Centre while conducting her Ph.D. research through Australia's Southern Cross University.

To an English-speaking person the name 'Marine' may sound unique, but Ms Gouezo says it's as common in French, as 'Marina' is in Italian and Spanish.

"My dad was into sailing from a very young age, and he always said that whenever he had a daughter he wanted to name her Marine – he was very passionate about the ocean," she said.

"I grew up swimming in the ocean and sailing, my parents really showed me to be close to nature which definitely helped shaped my path. When I had to decide what to study after high school I decided to give marine biology a try as I always wanted a job where I could travel overseas and be close to the ocean."

Marine feels she has always been destined to help protect the world's most precious coral reefs.

"I have a passion for coral reefs, and I really wanted to do my studies overseas to gain experience in different countries on different coral reefs, as they are very different depending on where you are in the world, so it's definitely been very helpful to travel a lot to compare the differences," she said.

Ms Gouezo said it was an honour to be published in London's prestigious *Proceedings of the Royal Society*, two and a half years into her Ph.D. candidature, and the same month as celebrating her 31st birthday. Her research draws on more than 14 years of long-term monitoring data collected by researchers and staff from the Palau International Coral

Reef Center.

"My Ph.D. is focusing on the whole process of coral reef recovery, especially after large-scale disturbances like mass beaching event or storm damage. My research specifically focuses on understanding processes and drivers that influence reef recovery, starting at the timing of coral spawning when larvae are released into the oceans, to studying the connectivity among reefs, to when baby corals settle on the reef and then grow into juvenile and adult corals – it's a long and complex process," she said.

"My findings detected some of the coral reef communities have been able to stabilize in certain habitats, and are even thriving in 'climax states'. We have calculated the recovery rates of different reefs, and have been able to analyze what drives faster recovery. Reefs that have good larval connectivity to each other are those that are either in close proximity or connected through currents, which enables more coral larvae to settle and develop into baby corals. Healthy reefs with high numbers of young corals also had really low cover of macro algae, and high density of parrotfish."

An international wildlife sanctuary in the Pacific

Palau is a group of islands located about 1600 kilometres (1000 miles) southwest of Guam. It became an independent state in 1994 after gaining its sovereignty from the USA.

Ms Gouezo works under the direction of Dr. Yimnang Golbuu, CEO of the Palau International Coral Reef Center, who is also a former Ph.D. student of Southern Cross University's Professor Peter Harrison. Through Dr. Golbuu's research and his work with the president of Palau, the country has become an international marine wildlife sanctuary in the middle of the Pacific.

Professor Peter Harrison, the founding Director of Southern Cross University's Marine Ecology Research Centre, said Ms Gouezo was an incredibly hard worker who had done a "brilliant job" collating a huge amount of information.

"One of the really interesting things about this research is it is one of the few long term research projects that clearly demonstrates how coral communities can reassemble and recover about a decade after major disturbance events, where large numbers of coral larvae arrive and settle to recreate the reef community quickly," Professor Harrison said.

"By extension this shows that if we can release the pressures off other reefs such as the Great Barrier Reef over decadal time scales, coral communities can recover to create a diverse and healthy reef environment. Through coral spawning coral reefs can recover, if we have enough time before the next disturbance—but the key issue is to quickly reduce greenhouse gas emissions otherwise increasing temperatures and recurrent mass bleaching events will continue to decimate corals and reef ecosystems and overwhelm their natural recovery capacity."

More information: Marine Gouezo et al. Drivers of recovery and reassembly of coral reef communities, *Proceedings of the Royal Society B: Biological Sciences* (2019). DOI: 10.1098/rspb.2018.2908

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