



SEEING IS BELIEVING

UQ's Global Change Institute is creating a record of the world's coral reefs. Through their research and the publicity generated, they aim to impact policy on ocean management.

“Coral reefs are really quite extraordinary – supporting more than a million forms of life, and ensuring the livelihood of half a billion people worldwide – but in the past 30 years, around 40 per cent of them have disappeared. Getting to know our coral reefs is important to understanding how to save them.”

So says internationally recognised marine scientist and Director of UQ's Global Change Institute (GCI) Professor Ove Hoegh-Guldberg, who has made a life study of our oceans and marine life.

“With only a tiny fraction of the world's population ever having scuba dived, not many people have seen our beautiful ‘underwater cities’, nor have they been able to appreciate how the reefs are changing due to overfishing, pollution and warmer, more acidic water.

“We wanted to change that, to bring the reef to billions of people without them ever getting wet. In other words, a virtual diving experience that anyone can try at home through Google Maps Street View to see for themselves what is happening,” he says.

Because seeing is definitely believing: when people can view coral reefs in their lounge rooms at home, they are far more likely to engage in debate about the serious challenges facing our coastal ecosystems and help influence policymakers to take action to solve them.

With the help of collaborators from around the world, including government agencies, the World Wildlife Fund and a huge range of universities specialising in marine science, UQ researchers have worked with global partners including The Ocean Agency (Sydney), XL Catlin Group (London), National Oceanic and Atmospheric Administration (Washington DC), the International Union for Conservation of Nature (Switzerland), the Great Barrier Reef Foundation (Queensland) and Google to create the largest baseline record of the world's coral reefs.

Following very productive research collaborations with the Scripps Institution of Oceanography (University of California, San Diego) and the University of California, Berkeley Artificial Intelligence Research Center, the equipment being used has been dramatically boosted in its machine learning technologies and advanced (computer vision) image recognition capacity.

“The XL Catlin Seaview Survey approach is centred on high-definition imagery,” says Professor Hoegh-Guldberg.

“Using a purpose-built panoramic camera system on an underwater scooter, we take 360° images at three-second intervals of up to two kilometres per dive following the contours of the reef at a standard depth of 10 metres (+/- two metres). By standardising the survey depth we create a rigorous platform by which to compare the same coral communities across multiple sites and regions.

“Applying local knowledge and analysing factors such as environmental regimes (hurricanes, temperature changes, water colour), geomorphology (atolls, fringing reefs, barrier reefs), and anthropogenic influences (coastal development, fishing pressures), we can also interpret variable coral reef structures. Through geographical tags, we have amassed an unbiased documentation of coral reefs at particular points in time that can then be compared and contrasted later on.”

So far, the team has mapped in detail more than 1000 kilometres of reefs in 22 countries and has also compared reefs in Hawaii before (August 2015), during (November 2015) and after (June 2016) the recent global coral bleaching event.

Hawaii expedition leader and GCI scientist Dr Manuel Gonzalez-Rivero says he was shocked to see as much as half of the corals around Big Island and other sites in Maui dying as a result of the unusually hot conditions that year.

“One to two hundred-year-old colonies of the lobe coral and almost all of the Cauliflower coral gardens that dominated the reefs before were gone, with only one or two small colonies remaining.

“Local stressors such as sediment run-off is a critical problem for Hawaiian reefs, slowing and even preventing them from recovering from coral bleaching. We need to manage this problem now to help alleviate the long-term effect of climate change on these reefs.”

The XL Catlin Global Reef Record provides two main image-data products: 360° panoramas (created by scaling and stitching the fish-eye imagery), and quantitative analyses of the animals and plants living on the sea floor, using the percentage of reef cover as a guide. Both enable anyone from anywhere to actually see whether or not coral reefs are deteriorating over time.

“If we can demonstrate to people who live along coral coastlines the impact of their activities, and hence on their livelihoods, we may be able to encourage better practice and ultimately help save our precious coastal ecosystems,” says Professor Hoegh-Guldberg.

The technology used to gather this information is highly sophisticated and quick. After first manually annotating a random subset of obtained quadrats (one-metre square images of the reef) for each region using CoralNet tools, the team uses the data to train deep neural networks that map image patches to key benthic categories (types of underwater life). Automated image annotation methods are then used to process the remaining images in just 0.2 seconds each (compared with ten minutes for manual annotating).

The information gathered, however, plays an important role in conservation.

And highlighting the critical impacts of climate change on coral reefs through mechanisms like the XL Catlin Seaview Survey has had important influences on international agreements, such as the Paris Climate Agreement reached at the COP21 (Conference of the Parties) meeting of the United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement in December 2015. The resulting science-based targets on climate change are re-shaping our world in fundamental ways – with the agreement to keep average global warming below 2°C, which is vital if we are to preserve coral reefs for the future.

But the record is not just for scientists: it is for everyone – from policymakers to members of the public. The huge store of photos is an unprecedented source of data for scientists, reef managers and global decision makers, and is designed to be revealed to as many people in the world as possible: check it out at XL Catlin Global Reef Record: globalreefrecord.org/.

After all, as singer/songwriter Joni Mitchell once famously said, “you don’t know what you’ve got ‘til it’s gone”. By showing the world what lies within our oceans, the XL

Catlin Seaview Survey lets us know what what we’ve got. Our challenge for the future is to ensure it doesn’t go.

The more we can understand, the better able we will be to protect.

uq.edu.au/research/impact

Want to know more?

Enrol in the free UQx course *TROPIC101x Tropical Coastal Ecosystems* and develop the skills and knowledge you need to help preserve these habitats. Discover the incredible plants and animals that create these unique ecosystems, explore the challenges they face (such as overfishing, coastal pollution, ocean warming and acidification), and learn about techniques being used to tackle such problems. Lectures are delivered by leading experts, with many filmed on-site in the Great Barrier Reef. The course concludes with an innovative virtual ecology project, where you will have the option to take part in a citizen science project. It will be an exciting journey!

(Photo credit: XL Catlin Seaview Survey)

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Progress to date:

1998: Impacts of climate change (ocean acidification and rising ocean temperatures) predicted by Professor Ove Hoegh-Guldberg to lead to mass coral bleaching events

2010: Global Change Institute launched at UQ with one of its four goals being to research oceans globally to improve reef monitoring, management and protection

2012: Linking XL Catlin Group sponsorship with UQ ocean research, 150 kilometres of Australia’s Great Barrier Reef mapped

2013: 14 countries in the Caribbean mapped, generating 200,000 geo-referenced images by XL Catlin Seaview Survey

2014: 200+ kilometres of the Great Barrier Reef mapped or remapped after Tropical Cyclone Ita

2014: Five expeditions in four South East Asian countries, generating 100,000 geo-referenced images

2014: Australian Research Council Laureate Fellowship and Prince Albert II of Monaco’s Climate Award awarded to Professor Hoegh-Guldberg

2015: Eight key survey locations in the Maldives mapped, generating 30,000 geo-referenced images

2015: Chagos Archipelago coral reef ecosystem (virtually untouched by human activity) mapped, generating 27,000 geo-referenced images

2015/16: Three expeditions of Hawaii captured before, during and after the global bleaching event, generating 88,000 geo-referenced images

2016: Largest ever coral reef survey undertaken in Taiwan, generating 8000 geo-referenced images

2016: 1000+ kilometres of reefscape mapped across 22 countries, generating 600,000+ scientific images to date

2016: Maldives remapped after 2016 coral bleaching event [ADD MEDIA](#) [ADD HTML](#)

2016/17: Great Barrier Reef remapped after 2016 and 2017 coral bleaching events

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