A coral reef in Kalpitiya

Unravelling the mystery of corals

The trail of clues brings Cybulski all the way to Sri Lanka

—By—
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Jonathan Cybulski hopes to find answers as to why the coral ecosystem is changing with time, and what, if possible can reverse the bleaching of coral reefs, by mapping the story of the coral ecosystems through time, by studying human history, the historical interaction of humans with ecosystems and fossilised evidence.

Through these methods, he was able to discover a link between the coral mining industry and the loss in ecosystem structure of corals over time.

The bar reef in Kalpitiya and the Hikkaduwa reef had similar coral colour in 1998. Following a massive bleaching event that year, they died off. Subsequently, the bar reef recovered much better while the reef in Hikkaduwa, in the area where most coral mining takes place, did not. This phenomenon, according to *National Geographic* Young Explorer, Jonathan Cybulski, holds answers on corals' ability to recover. His research began in Hong Kong, but the trail of clues brought him all the way to Sri Lanka.

"Something is happening here that I need to figure out. I will try to figure the baseline, whether the present Sri Lankan reefs are different in these two sites and whether coral mining has impacted the ecosystems ability to recover," he said at a *National Geographic* Society session in Colombo recently.

This process of finding answers involves historical ecology, the intersection of humans in the ecosystem and what they leave in time.

Ethno-archaelogy project

Cybulski's research focused on Hong Kong's coral ecosystems and how they changed through time, due to external influences. It was after meeting a Sri Lankan scientist that Cybulski came up with an idea to carry out an ethno-archaelogy project in Sri Lanka, to understand what the lime production industry in Sri Lanka indicates about corals that existed during the period production was taking place.

Ethno-archaelogy is the process of looking at a modern civilisation to infer questions on civilisations in the past.

Through basic research, Cybulski found Sri Lankan coral reefs are subject to similar impacts, due to multiple stresses, as those in Hong Kong. He hopes the Sri Lankan perspective will provide an insight into the effects of the lime industry in Hong Kong.

"These two industries are quite similar, technology has not changed that much in about 1000 years, although, in Sri Lanka, harvesting of corals happened more recently, since there are existing calcium carbonate deposits," he says.

'Archaeo-ecology,' Cybulski coins his way of delving into the past to discover the true reasons for degradation of coral reefs. This involves looking at areas that have been investigated for archaeological interests, and is tied with anthropology, which studies human history, Cybulski says.

"This involves looking at things through a different lens, through an ecosystem story, since humans cannot exist without the ecosystem. Even if an excavation is carried out, there are human bones and pottery, that is linked to their surrounding ecosystem at the time," he says.

Cybulski insists archaeo-ecology is a new way of looking at the ecosystem in a way that makes it possible to discover the full story of what took place in the past.

He uses three major tools to understand this process, archaeo-ecology, paleoecology and historical ecology.

Paleoecology is looking at an ecosystem through time, via the clues left behind by that ecosystem. These include fossils and sub fossil sediments naturally left behind, which could be collected and analysed.

Historical ecology is a subset of paleoecology, which looks into the human-ecosystem interaction and what clues humans leave through maps, data or records, that can be used to deduce what has taken place in the past.

"At present, corals around the world are in a state of degradation, with coral ecosystems dying out. The coral reefs in the world are sick," Cybulski says, and a lot of this, according to him, is connected to human beings.

What is the natural state of corals?

Showing a picture of a coral reef taken at a remote location in the Pacific, near Micronesia, where no fish, turtles, sea urchins or algae are visible, he says it is important to find out why.

"One question is whether this is the natural state of these corals. If not, what is the natural state and what changes it? If we understand what changes it, we can start working backwards and learn how to conserve the corals," he says.

In ecology, there exists a phenomenon, referred to as the shifting baseline phenomenon. According to this, each generation has a different idea of what an ecosystem should be. When ecosystems are not documented there needs to be a way to check how it was in the past, Cybulski says. This is where his three tools come in to play.

Cybulski collects his paleo-ecological data from cores of corals, extracted from coral reefs by jamming a metal pipe into a coral reef. He says that a pristine coral reef dies as time passes and forms sediments made of calcium carbonate skeletons of the corals. Then, another pristine coral reef will grow on top of it, where the process of dying and forming sediments takes place, repeatedly.

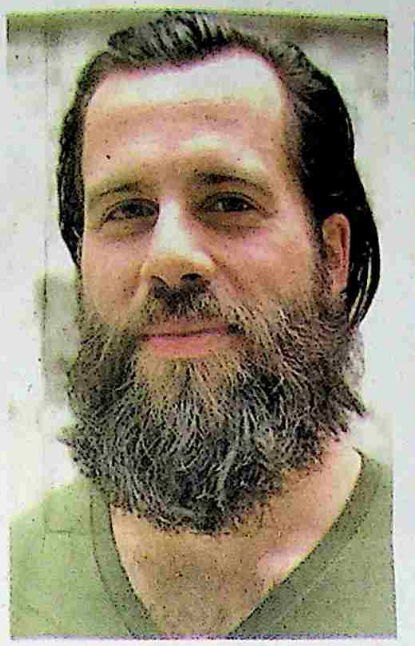
"This gives rise to a stratification where coral layers at the bottom are older and those at the top are much younger. A coral core extracted from this reef will contain different layers of deposits formed at different times, which can then be analysed at the lab," he says.

While maintaining the stratification, corals are separated into different segments, based on different methodologies and dated using carbon and uranium dating mechanisms. According to Cybulski, each species of coral calcify its skeletons slightly differently, leaving a thumb print in time to indicate which particular species existed at each location.

This enables comparison with the species currently present at the same location.

Loss in ecosystem structure

These coral cores also contain evidence from the existing ecosystem, like sea urchin spines and fish teeth, which can provide DNA to piece together what was actually taking place at the time. While conducting his research on Hong Kong's coral ecosystems, by analysing species' data, Cybulski found that these ecosystems have lost diversity over time. He used data collected from the past several thousand years and observed that the ecosystems have completely shifted during the past 3000 years.



Jonathan Cybulski

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A coral reef in the Tung Ping Chau Marine Park in Hong Kong

"I deal with two morphologically (physical structure and what that physical structure does to the ecosystem) different types of corals. One is the branching corals that appear antler like, the other is massive corals that appear as big rocks," he says. Branching corals grow very fast, are ecosystem engineers and remain important habitat builders to fish.

Massive corals on the other hand are slow growing and do not provide much surface area for fish.

Through historical data from his cores, Cybulski arrived at the conclusion that most of the corals on reefs that persist for millions of years are branching corals. However, when overlaying the modern data, a shift was observed, where massive corals dominate the coral reefs in Hong Kong.

"This is not only a loss in diversity, but also a loss in ecosystem structure, completely changing the way the ecosystem was performing," he says. Since massive corals are slow growing, they are more resilient to change. Therefore, when there are temperature changes, pollution fluxes and decreases in light in the water due to sediments, the impact on branching corals are greater, while massive corals sustain through time, Cybulski says.

This is where Cybulski's concept of archaeo-ecology comes in, to see why these changes are taking place. While looking for answers to the changes observed in Hong Kong, he came across lime kiln structures that can be found all over Hong Kong, the legacy of a booming industry that existed in the region from the 1500s. These kilns were used to produce lime, a building material, from Calcium carbonate. However, there was no Calcium carbonate geology in Hong Kong.

Skeletons on sites

After researching on the subject, Cybulski found coral skeletons on these sites, an indication corals were removed from the ecosystem for production, for hundreds of years. From one of the sites, he found a chunk of dismembered coral which was pushed to a side by the workers and eventually buried. After digging out and analysing this rock segment he was able to find sub fossil remains, which could be analysed to see what existed during the period.

Since data is collected from a human perspective in human archaeology, Cybulski notes that l the coral parts creates a bias, as the preferred type of coral they were harvesting is not known. "If they were randomly grabbing corals we will have a good idea about biodiversity, but if they were gathering corals from 10 metres into the waters or gathering only massive corals, this doesn't provide a good picture of what that ecosystem was in the past," he says. This is where he hopes his research in Sri Lanka will help establish the true impact of coral mining on coral ecosystems.

Cybulski notes that gold standard in paleoecology is to set a baseline in the past, to help come up with conservation guidelines - and from a conservation stand point, recovery remains important.

Pix: *National Geographic*