Chagos News

The Periodical Newsletter of the Chagos Conservation Trust and Chagos Conservation Trust US

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Contents

Cover image: *Acropora* coral garden with green chromis shoal © Jon Slayer

Editorial

Rachel McCaffery, CCT Chair

As we wrap up another year it is time to reflect on what CCT has achieved and what the future holds for 2020 and beyond.

This has been an exciting year for CCT with the launch of our new strategic business plan, that will guide the organisation to 2022, and the beginning of our Healthy Islands, Healthy Reefs programme.

This ambitious programme aims to eradicate invasive black rats from the Chagos Archipelago, which in turn will enable seabirds to recolonise previously affected islands and provide vital nutrients to the recovering coral reefs that surround them.

Researcher Casey Benkwitt explains on P14 how new research shows us the important role seabirds play in helping coral reefs recover from, and build resilience to, climate change.

Currently we are working with a number of experts from around the world, in partnership with the British Indian Ocean Territory Administration, to determine the best way to eradicate the rats.

The timing of our programme couldn't be better with the volume of data coming from research occurring in the Chagos Archipelago at an all-time high. We've seen 10 expeditions visit the archipelago in 2019 through the Bertarelli Programme in Marine Science.

Involving nearly 100 scientists across 24 institutions from six countries, they have resulted in more than 20 scientific papers being published, which can be found on the Chagos Information Portal.

CCT recently participated in a workshop to look at research opportunities related to our Healthy Islands, Healthy Reefs programme. This collaborative working is vital as much of the current and future research is supporting and informing our programme.

In this issue of Chagos News we focus on the reefs and how recent coral bleaching events have affected not only the health of the reefs, but also the habitat structure across the whole archipelago as Daniel Bayley explains on P10.

But it's not all bad news.

Dr Catherine Head's work, P4, shows there is a glimmer of hope for future generations of Chagos Archipelago corals; and as we all work towards conserving this important place this is the news we especially enjoy reporting!

We also pay tribute to William Marsden who sadly passed away in October. William was a particularly hard-working Chairman who oversaw an important period of development for the Trust between 2002 and 2011.

From all at CCT we thank you for your support during 2019 and look forward to bringing you ever more positive news in 2020.

© Daniel Bayley/University College London

Recent coral bleaching in the Chagos Archipelago

Dr Catherine Head, ZSL & University of Oxford

In the Anthropocene era, the Chagos Archipelago is one of a handful of marine locations in the world that is exposed to very few direct human impacts.

Unfortunately, it is not immune to the global impacts of human-induced climate change.

One of the starkest examples of this was the 2015 and 2016 pan-tropical increase in sea surface temperatures (SSTs) as a result of an El Nino Southern Oscillation climatic event.

For the Chagos Archipelago reefs this led to a phenomenon known as coral bleaching, where the coral's symbiotic relationship with their symbiodinium (single-celled algae) breaks down as a result of biochemical processes triggered when the coral is under stress. The symbiodinium provide the coral host with the majority of its energy so unless temperatures recover back to their 'normal' threshold quickly, it can result in coral death.

Earlier this year we reported in the journal *Coral Reefs* on the impact of the 2015 and 2016 thermal event on the Chagos Archipelago reefs.

Sadly, the picture was less than rosy, with almost 70% of hard corals on shallow reefs dying as a result of SSTs remaining above average for over seven weeks in 2015, and for 17 weeks in 2016! This is the first time that such increases in SSTs have been recorded in two consecutive years in the Chagos Archipelago's waters, potentially indicating that the threat of climate change is ever increasing.

Interestingly, although the second thermal event lasted longer, a lower proportion of the surviving corals from the first event were killed.

The mechanism behind this is currently unknown, but it could be that the remaining corals are more resilient to higher

Chagos Archipelago's reefs in all their glory in 2013 © Catherine Head

temperatures, and their ability to endure and regenerate may be key to reefs surviving these acute rises in sea temperatures. This could provide some hope for the survival of the Chagos Archipelago's valuable reefs, which support so much of the marine world's biodiversity.

Some coral species suffered far more from the increases in SSTs than others. 86% of *Acropora* corals, previously the most abundant, perished. These are known to be the 'weedy' species on the reefs, growing quickly (for corals) but with little resilience to changes in the environment.

The abundance of *Porites* corals on the other hand was not significantly affected and they became the dominant corals after the *Acropora* die-off.

This shift in species composition may permanently change the landscape of the reefs, reducing the complexity of the reef landscape, which has been shown to have negative effects on the number and diversity of fish and other creatures.

Having said that, many juvenile *Acropora* corals can now be seen on the reefs giving hope that these reefs will recover.

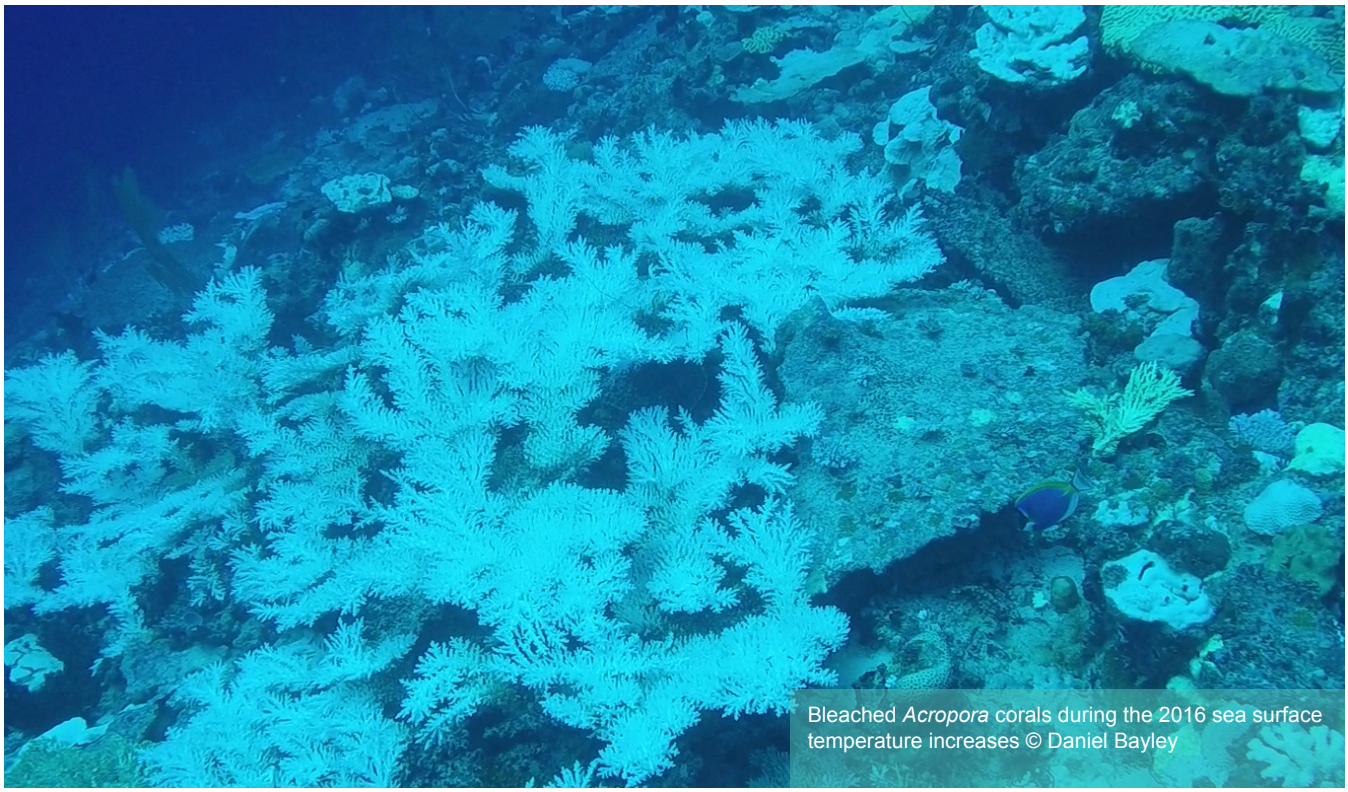
My work is now focusing on understanding where these juvenile corals are coming from – are they offspring of the few surviving *Acropora* colonies in the Chagos Archipelago, or are they from coral larvae that have travelled much further on the currents from other reefs in the Indian Ocean?

By understanding how connected coral larvae flow is we can better understand which reefs might be large sources of coral larvae and therefore a priority for protection.

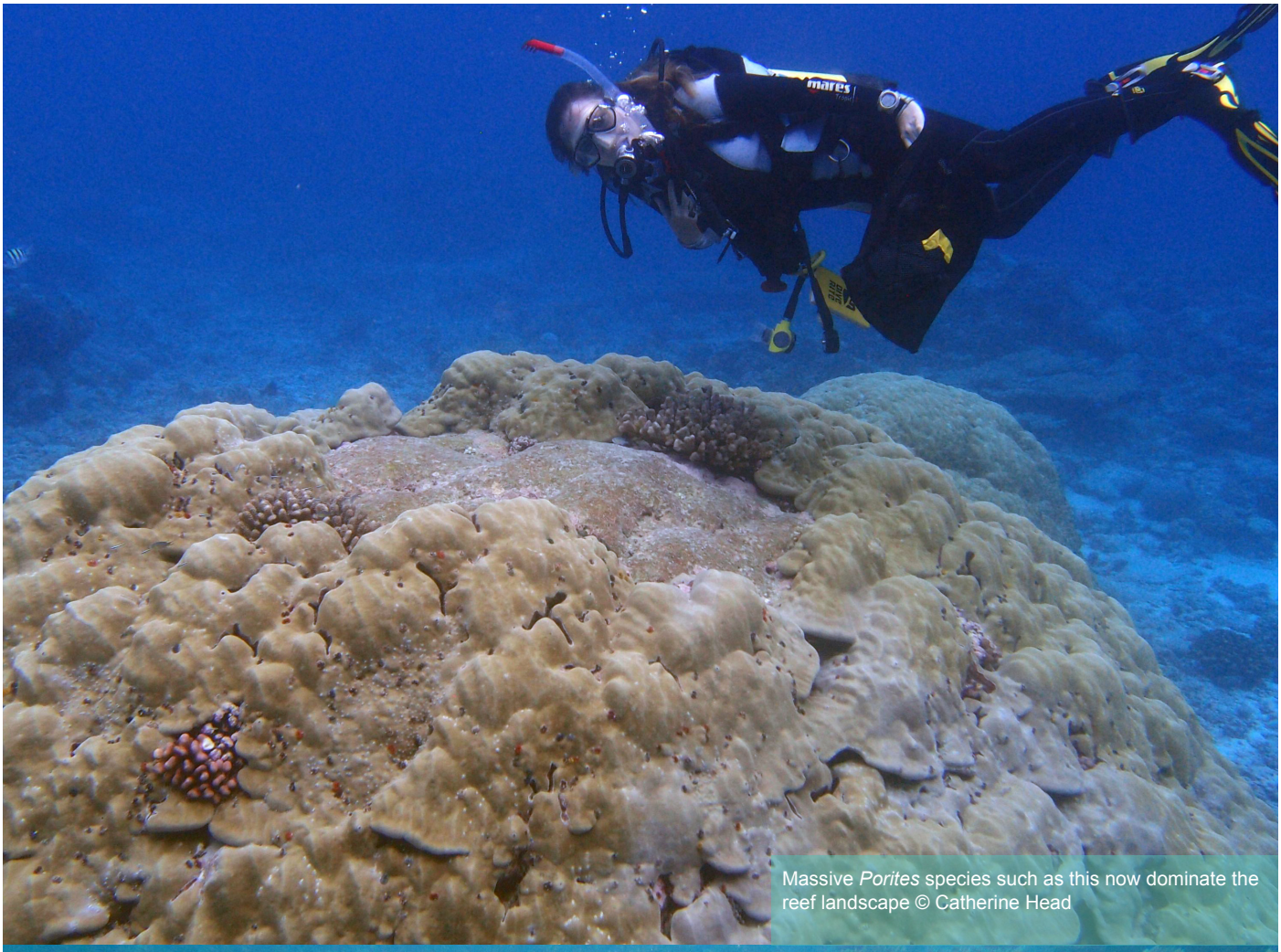
The Chagos Archipelago reefs have a history of high resilience, recovering from the last major thermal event in 1998, which resulted in similar levels of coral mortality, within approximately ten years.

This ability to recover is partly attributed to the remote and protected nature of the Chagos Archipelago, meaning it has to withstand fewer impacts from human-driven activities such as fishing and pollution.

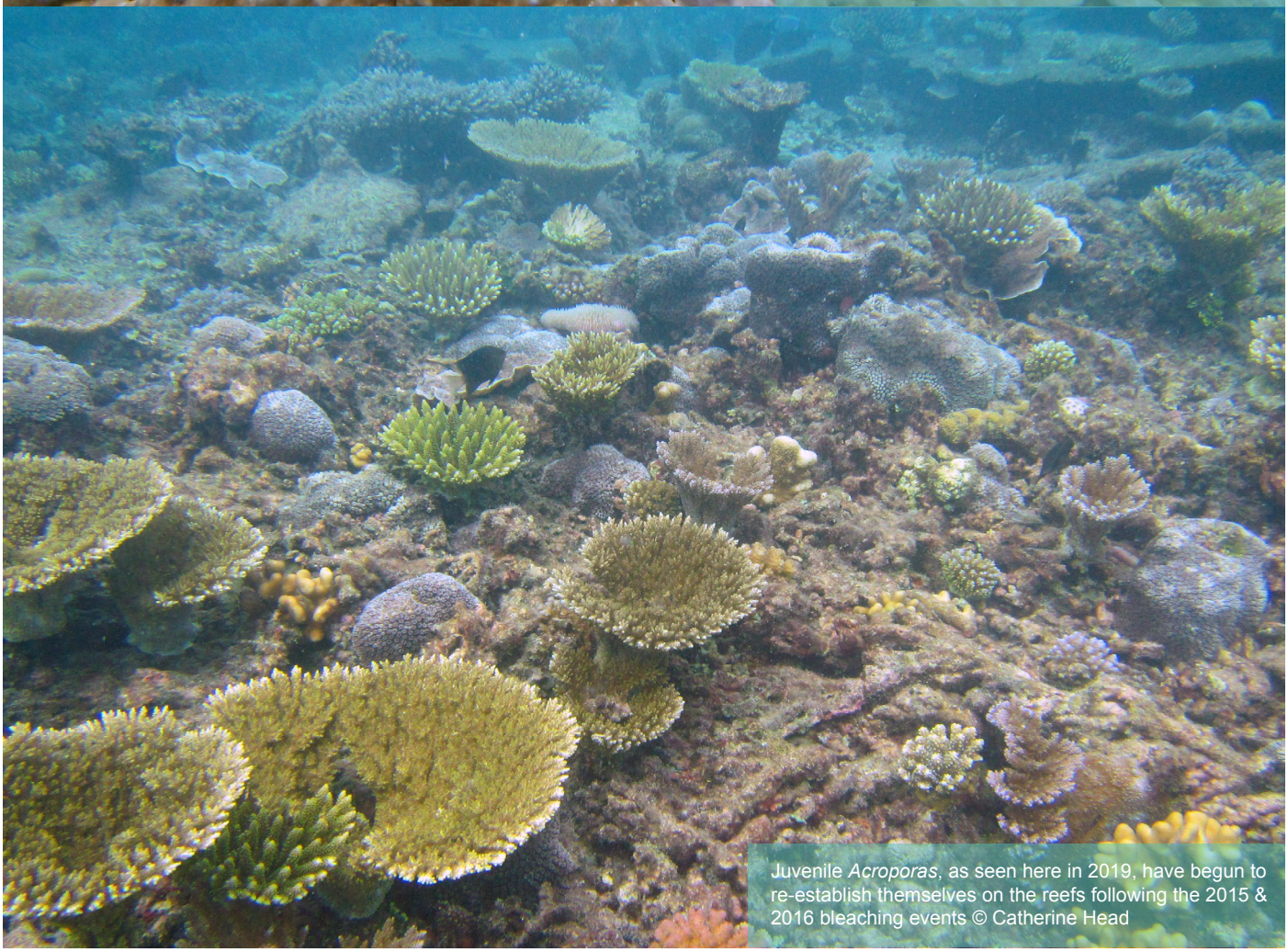
The big question now, with climate change increasing the frequency of these thermal events, is will the Chagos Archipelago reefs have enough time to recover before they are hit again?



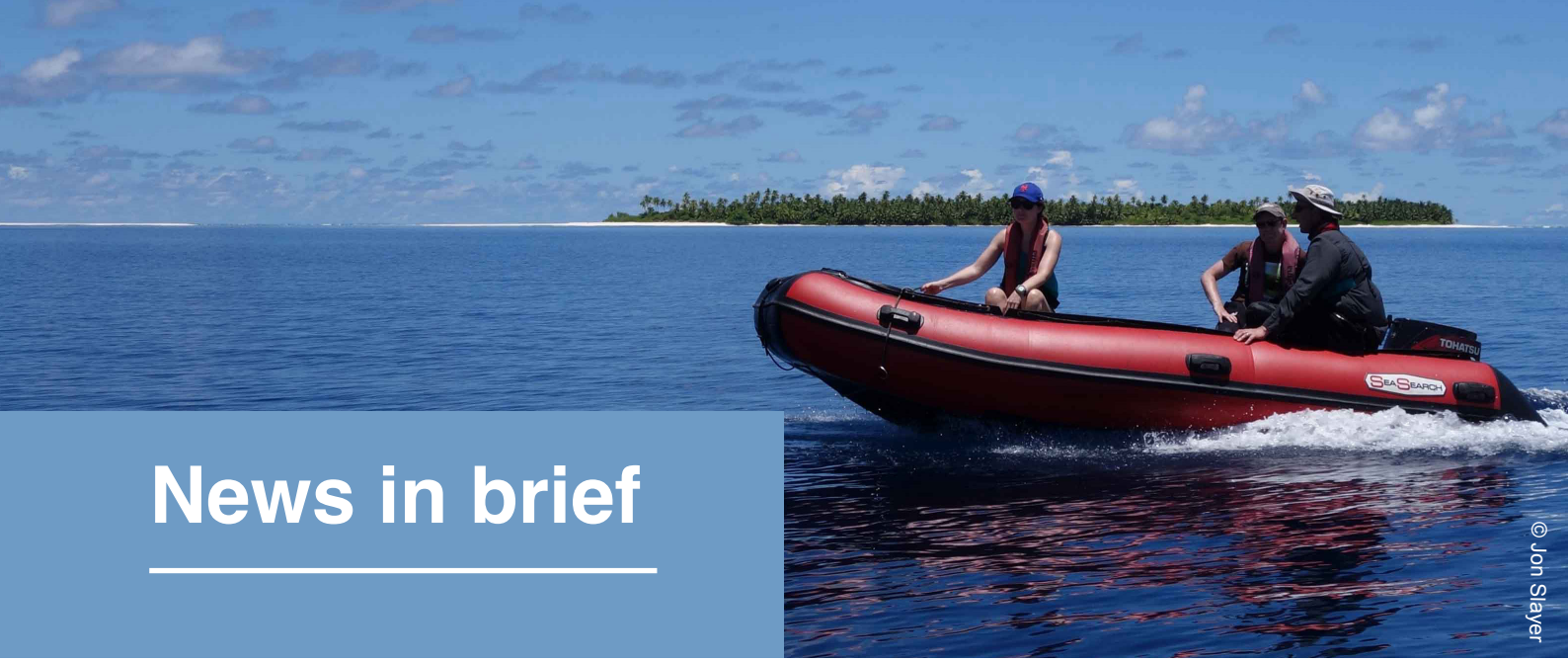
Bleached *Acropora* corals during the 2016 sea surface temperature increases © Daniel Bayley



Massive *Porites* species such as this now dominate the reef landscape © Catherine Head



Juvenile *Acroporas*, as seen here in 2019, have begun to re-establish themselves on the reefs following the 2015 & 2016 bleaching events © Catherine Head



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News in brief

© Blue Belt

Blue Belt Symposium

In July the University of Exeter hosted the first ever UK Overseas Territories Blue Belt Symposium, bringing together Territory and UK Governments, and international organisations, to discuss the opportunities and challenges in implementing the 'Blue Belt'.

The Blue Belt programme is an ambitious UK Government-led initiative that aims to provide long-term protection and sustainable management of more than four million square kilometres of ocean across the UK and the UK Overseas Territories.

Working in collaboration with the Territory Governments, and informed by overseas experts, the programme has established some of the world's largest marine protected areas across the Atlantic, Pacific, Indian and Southern Oceans.

Watch the video here


© Jon Slayer

Shark numbers plummet

Researchers have found that sharks are much rarer in habitats nearer large human populations and fish markets. The average body size of sharks also fell dramatically in these areas, where sharks are caught and killed intensively for their meat and fins.

"Human activity is now the biggest influence on sharks' distribution, overtaking every other ecological factor.

"Just 13% of the world's oceans can be considered 'wilderness' but sharks and other predators are much more common and significantly larger at distances greater than 1,250 kilometres from people.

"This suggests that large marine predators are generally unable to thrive near to people, and is another clear example of the impact of human overexploitation on our seas," says Dr Tom Letessier of ZSL's Institute of Zoology.

Read the full article here

Obituary

William Marsden, who died on 12 October, was a career diplomat who served as Chairman to Friends of the Chagos, and then the Chagos Conservation Trust (CCT), from October 2002 to July 2011.

He was a particularly hard-working Chairman who oversaw an important period of development for the Trust.

William served as Head of the East Africa Department in the FCO, and as Commissioner, BIOT (1985 to 1989).

In 1989 he left to become British Ambassador to Costa Rica and Nicaragua and he subsequently served–in his last FCO posting–as Ambassador to Argentina.

He took over as our Chairman in 2002 from Nigel Wenban-Smith and handed over the post in 2011 to Alan Huckle.

During his chairmanship he oversaw our evolution from Friends of the Chagos to CCT, the creation and successful running of the Chagos Environmental Network (CEN), the declaration of the Chagos Marine Protected Area, and the setting up of CCT-US.

William's wide-ranging contacts within and outside the FCO greatly facilitated these projects.

His drive was instrumental in turning these ideas to reality, building a wonderful structure on the firm foundations laid down by John Topp, our founder, and Charles Sheppard, our scientific and conservation lead.

Most of CCT's committee meetings were generously hosted in his London flat in Warwick Square, and benefited from his wine and Kaia's cucumber sandwiches.

We will always be grateful for his dynamic leadership and energy which helped to build a close-knit team, and fostered strong relationships between CCT and both Whitehall and the scientific community.

The changing face of coral reefs

Daniel Bayley, University College London

Coral reefs are home to roughly a quarter of all marine life. The reef organisms use the corals, algae, molluscs and sponges which make up the reef's structure for food and shelter.

The overall physical 3D complexity of the reef is an important indicator of both the resilience of the reef to disturbance and the diversity of associated animals such as fish.

Globally the 3D complexity of reefs is in decline, with large areas generally becoming flatter and more simplified in form, as multiple impacts such as land-based run-off, coastal development, destructive fishing and disease damage reefs.

Mixed with these pressures is an increase in the frequency and intensity of 'bleaching' events, whereby the seawater becomes unusually hot and triggers the stressing or death of organisms like corals.

In 2015 and 2016, the central Indian Ocean was severely damaged by two successive heating periods, part of a two-year global heating episode, which saw the mortality of over 70% of the shallow corals in the Chagos Archipelago.

Following the death of temperature-sensitive corals, the solid habitat structure created by their underlying carbonate skeletons is rapidly lost through physical and biological erosion, as the waves crash over the reef, and as the fish, sponges and clams bite and burrow their way into the dead coral structures.

Over the last five years we have been using an emerging image-based technology called 'Structure from Motion' photogrammetry (SfM) to create annual, large-scale 3D digital reconstructions of seaward and lagoonal reefs across the archipelago, in order to chart the changes to the reef physical structure.

SfM uses hundreds of overlapping camera images to find matching points, and computes the locations of those points in 3D space relative to one-another based on the positions of each camera shot.

This new technique allows us to record in detail the shape of the reef at marked locations each year, and to quantify the differences in the same patch of reef year on year.

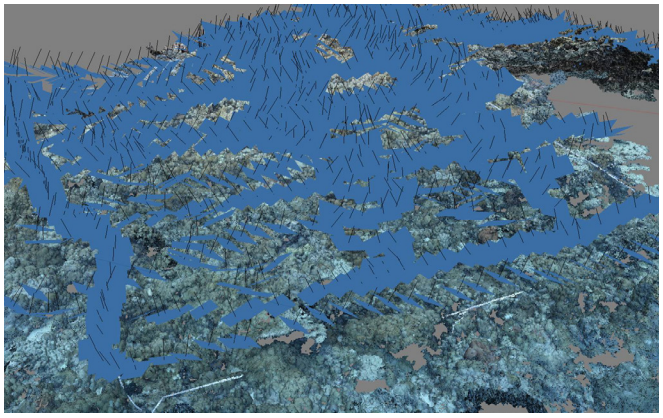

Figure 1. Example of a ~200 m2 reef surveyed in Salomon atoll using Structure from Motion, with the location and angle of each camera image used to construct the model shown in blue.

The models typically cover an area of between 100 and 600 metres squared, allowing us to see a large amount of change in terms of reef surface area, roughness, height and volume.

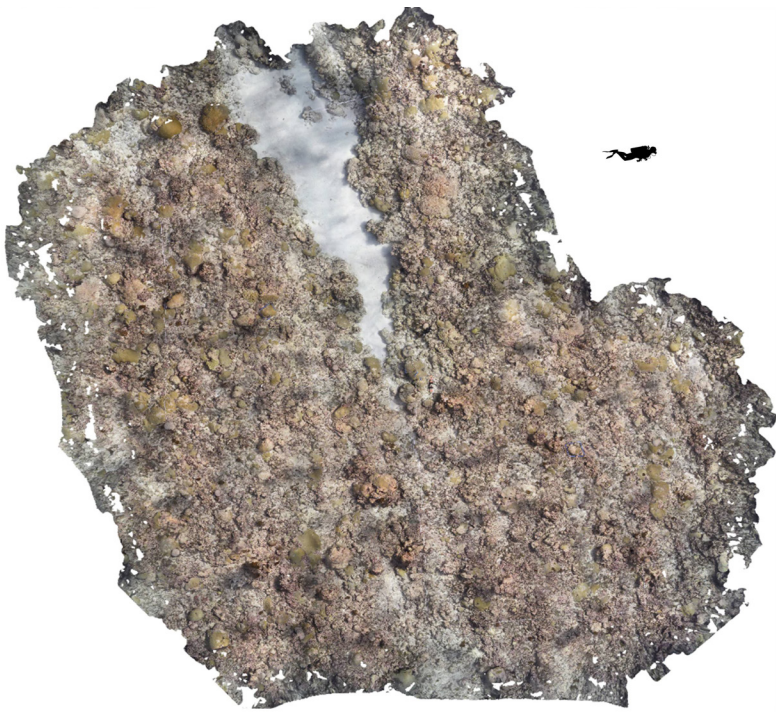

Figure 2. A large area of reef on Blenheim atoll, surveyed using SfM to create a ~600 m2 image-mosaic. This patch was surveyed in 2018, after the period of bleaching ending in 2016.

We found that across Salomon atoll, Peros Banhos atoll and the western Great Chagos Bank, the exposed seaward reefs have been heavily impacted post-bleaching and are now rapidly losing both their complexity of form and their volume of hard carbonate structure.

However, while the lagoons have also been damaged they appear, for now, to be broadly retaining their structure and volume through time.

The sites which have lost the greatest amount of structure are the seaward sites dominated by the plating *Acroporas* on moderate to highly exposed reefs.

These temperature-sensitive and relatively brittle species suffered heavy mortality and have rapidly been broken down into loose rubble, which is easily swept from the reef slopes.

Within the lagoons however, less coral mortality and loss of structure has occurred, thanks in part to the increased proportion of both robust temperature-tolerant species (such as *Porites*), and heterotrophic feeders such as *Goniopora*, which are not so reliant on their algae symbionts for nutrition.

The outlook for the shallow reefs of the Chagos Archipelago still remains uncertain, however preliminary surveys of the cooler mesophotic zone reefs past 30 metres depth, have found extensive areas of reef with up to 100% cover of scleractinian corals down to around 60 metres in the outer atolls.

Recruitment of new coral colonies has also continued in the shallows, and a number of individuals in our sites have established and are now 3-4 years old, giving some degree of hope for the future.

BIOTA briefing

BIOT conservation priorities

Preventing illegal fishing, eliminating rat infestations, improving waste management and tackling climate change are among BIOTA's redefined ongoing conservation priorities.

The list was recently drawn up in collaboration with scientific and conservation partners, including CCT. Read more about the priorities.

Prosecution of illegal fishing vessel

A Sri Lankan fishing vessel which was fishing illegally within the BIOT Marine Protected Area was recently intercepted, detained and prosecuted following a multi-agency response involving the BIOTA, supported by the Blue Belt programme, MRAG and the European Maritime Safety Agency.

At the final court hearing in August, the Master of the vessel pleaded guilty to all charges and was fined £15,000 for illegal fishing, £7,500 for the possession of illegal gear and ordered to pay £50 costs by the Magistrate. Find out more about the prosecution.

Chief Science Advisor's visit

Chief Science Advisor Mark Spalding visited the territory last month following the recent publication of his 2018 report. Along with BIOT's Environmental Officers he looked at the recent work to reduce the threat of invasive species, undertook reviews of sites at high risk of erosion and conducted snorkel surveys of the coral reefs around Diego Garcia.

Stamp and coin collections launched

To celebrate some of the territory's most spectacular fauna, new dragonflies and lizards of BIOT stamp collections and a beautiful new turtles commemorative coin series have been launched. Why not start collecting today!

Moving on

The Administration will be bidding farewell to Administrator Linsey Billing and Environment Officer Harri Morrall, who will be leaving in the New Year. We wish them the best of luck in their next adventures.

The British Indian Ocean Territory (BIOT) is one of 14 British Overseas Territories.

It is administered from London by the British Indian Ocean Territory Administration.

Can poo help protect coral reefs?

Casey Benkwitt, Lancaster University

As we approach Ile Longue, Peros Banhos atoll, we are met by a cacophony of sounds from seabirds filling the blue sky.

But what interests us most is the overwhelming smell - because it indicates that with a lot of poo comes a lot of seabirds.

Although we are coral reef ecologists, we are interested in seabirds (and their poo) because their excrement provides nutrients to nearby reefs, which in turn can increase the productivity and functioning of coral reef fishes.

Unfortunately, sights and smells such as these are rare around tropical islands. Rats, which feed on seabirds, have been introduced to nearly all island groups worldwide.

The result is stark differences between rat-free and rat-infested islands, even when they are in close proximity. For example, compared to Ile Longue, neighbouring Grande Ile Mapou is virtually silent due to the near absence of seabirds caused by rat predation.

These differences also extend below the water, since the lack of seabirds means that adjacent coral reefs do not reap the benefits of seabird poo.

Beyond introduced rats, reefs in the Chagos Archipelago must contend with other human stressors. Most notably climate change is threatening coral reefs by causing more frequent and severe marine heatwaves, which can lead to mass coral bleaching events, and ultimately, to coral death.

Thanks to support from the Bertarelli Foundation, we're working to uncover how these two stressors–invasive rats and climate change–interact to influence coral reefs.

One of the biggest questions is: Can seabirds help buffer coral reefs from the negative effects of climate change?

To find the answer, we're tracking coral and fish communities around rat-infested and rat-free islands in the wake of the 2015/2016 marine heatwave.

We found that coral cover declined by approximately 32% on shallow, lagoonal reefs between 2015 and 2018, regardless of the presence of seabirds.

But, even though seabirds did not reduce the magnitude of coral loss, there is still hope that they may promote quicker coral recovery in the coming years.

After the bleaching event, there was a huge increase in crustose coralline algae (CCA), only around rat-free islands. CCA provides critical habitat for baby corals, thus enhancing their success and potentially facilitating coral recovery.

In addition to helping baby corals, seabird nutrients may aid existing corals that survived the bleaching event.

A separate study based in the Pacific found that corals adjacent to a seabird colony grew four times faster than those around an island that lacks seabirds. We are currently monitoring more than 50 coral colonies to see if seabirds have the same benefits for coral growth in the Chagos Archipelago.

The fish communities around islands with seabirds provide even more hope for enhanced coral reef recovery.

Parrotfish play a key role on reefs by feeding on algae, thereby preventing it from overgrowing on the coral.

We recently found that the connection between parrotfish and birds goes beyond merely their name, as parrotfish around islands with seabirds grew approximately 22% faster than around rat-infested islands. Because larger parrotfish feed on more algae, these faster growth rates are another pathway by which coral reefs around islands with seabirds may fare better.

Ultimately, the bad news is that both introduced rats and climate change are stressors that affect coral reefs worldwide, even in remote protected areas like the Chagos Archipelago.

The good news is that eradicating rats is a relatively easy management strategy that may help buffer the effects of climate change on coral reefs.

At the very least, restoring natural pathways from seabird poo to reefs may help buy time for coral reefs while we work to find long-term solutions that address the more challenging problem of climate change.

The Chagos Archipelago is a rare haven of beautiful reefs, diverse wildlife and clean waters, located in the midst of the Indian Ocean. The Chagos Conservation Trust is the only UK charity dedicated to protecting it.

For more information please visit chagos-trust.org

If you would like to contribute to Chagos News please email chagosnews@chagos-trust.org

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