Chagos News

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

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Contents

Cover image: Chagos brain coral *Ctenella chagius* © Amelia Rose/University of Oxford

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Editorial

Dr Natasha Gibson, CCT Chair

By now, I'm sure all of you have watched David Attenborough's moving testament to environmental change and habitat destruction in his reflections on a Life on our Planet. "Scientist David", as my young son calls him, not only documented the natural world in stunning detail but implored all of us to care for it through small actions and large efforts.

And so, in the spirit of this citizen science, I've stepped up to the challenge of chairing CCT in this exciting time as it implements the Healthy Islands, Health Reefs programme.

I hope that my extensive experience in formulating and leading rehabilitation, biodiversity, clean energy, and sustainability programmes will benefit the Trust and its ambitions.

Next year will be an important milestone year for CCT with the launch of Healthy Islands, Healthy Reefs.

This is an ambitious 10-year programme to rewild the Chagos Archipelago, and is our contribution to the UN Decade on Ecosystem Restoration that aims to prevent, halt and reverse the degradation of ecosystems on every continent and in every ocean.

Our programme aims to eradicate invasive species and allow the reintroduction of seabirds and native vegetation, and so supports the UN's statement that "restoring oceans and coasts means reducing the pressure on those ecosystems so they can recover, both naturally and by re-seeding or transplanting key species".

The science of biodiversity monitoring has recently stepped up a gear with a new monitoring tool: environmental DNA analysis.

This is described in more detail on P16 by the scientists of NatureMetrics, who we hope to partner with on the Chagos Archipelago, but in basic terms the tool picks up traces of animals and plants from water, sediment, or soil.

This vastly increases the ability to determine what species are present in an area, to detect rare and elusive organisms, and is more cost effective as it relies on sample collection rather than direct observation of numbers.

These samples can be collected by anyone as it is a straightforward process, which is a bonus for CCT as we can ask any visiting scientific expedition, or even personnel based on Diego Garcia, to take these on our behalf.

Thank you again for your continued interest and support, especially through a difficult year due to the global pandemic, and all of us here at CCT look forward to updating you next year on the progress of Healthy Islands, Healthy Reefs.

Wishing you a safe and happy 2021!

Figure 1 © Amelia Rose/University of Oxford

The Story of the Lost Brain Coral

Dr Bryan Wilson, Department of Zoology, University of Oxford

As a child, I was entranced by the fantastical fictional tales of Conan Doyle's The Lost World, and later, by its real-life (and admittedly slightly less exotic but nonetheless enthralling) counterpart, the telling of Marjorie Courtney-Latimer's rediscovery of the long thought extinct coelacanth, amongst a rotting waste pile of landed fish on the docks of East London, South Africa in 1938.

In my frequent young flights of fancy, I often imagined myself some great explorer of old, pushing through dense undergrowth into a jungle clearing, only to see the merest flash of something disappearing into the thicket–the striped tail of a thylacine, the flecked breast of a Mauritius kestrel, or possibly even the comedically portly rump of a dodo.

And then the furious chase that followed (possibly more of a clumsy lunge in the case of the dodo). The capture! And the return home a hero, to share my discovery with the world and conserve the species for posterity and eventual reintroduction back into its jungle home.

Despite it being the 1980s, those dreams always seemed to be illuminated by Victorian flash photography, possibly in tribute to the tall tales of that time, who knows. Of course, that was some decades ago and whilst my dreams have become slightly jaded by the realisation of the hundreds of extinctions that have happened since my childhood, I have always held on to that same bookwormish fantasy. And then, several decades later, I finally took that flight of fancy...

Early in April 2019 and having only just joined the Bertarelli Program in Marine Science (BPMS) several months before, I found myself on their annual expedition to the British Indian Ocean Territory (BIOT), aboard the Patrol Vessel Grampian Frontier, forcing its way through an unseasonable Indian Ocean surge and chatting up on deck with Professor Charles Sheppard, a wonderful character known to many at CCT and in my romantic mind, a passionate marine scientist straight out of the rumpled pages of my copy of *The Lost World*.

As the warm winds tugged at our hair (well, certainly mine, at any rate), Charles was regaling me with glorious and nostalgic chronicles of his time diving in the Chagos Archipelago in the 1970s, and the tragic demise of one of its most iconic denizens, the Chagos brain coral (*Ctenella chagius*), an endemic to this region of the world.

As he eloquently described in his article for CCT several years ago ('The Chagos brain coral *Ctenella chagius*: falling into the red'; *Chagos News,* No. 52 July 2018), this beautiful hemispherical coral (Figure 1) was once one of the most common in the archipelago.

However, recent warming events in the Indian Ocean have disproportionately decimated its once abundant populations, such that on a previous expedition to BIOT in 2017, not a single live colony was found and there were fears that it had become extinct. Upon their return to the archipelago the following year however, a small number of diminished extant living fragments were discovered in the northern atolls of Salomon and Peros Banhos, and with it, the chance that the species was not lost to science after all.

After hearing this and forever being the optimist, I had on something of a whim included a permit for *Ctenella* when applying to the BIOT Administration to sample for a number of other more commonly-occurring coral species, on the off chance (nay, the inspired hope!) that I would stumble upon one on my upcoming dives.

As luck would have it, our expedition began in the south-west corner of Peros Banhos Atoll, surveying Ile du Coin, and as we sailed steadily northwards and clockwise in the coming days, my anticipation to dive the northern islands of the atoll grew.

On the third day's sail, the vessel arrived at Ile Diamant to anchor for a day or two, whilst we used the inflatable boats to survey the reefs of the islands nearby. At the seaward sites of Ile de la Passe and Ile Diamant, I continued to search for and sample the abundant *Acropora* and *Porites* species which form the focus of our research into reef health at Oxford, whilst always keeping half an eye out for *Ctenella*.

The occasional surge of hope was more often than not a false one, colonies of similar-looking brain corals *Goniastrea* and *Leptoria* easy to mistake at depth. That afternoon, buffeted by a slight swell, we skipped across the waves to anchor just off Moresby Island, named after the eighteenth century cartographer who surveyed these islands.

The site comprised a wide terrace at six metres depth, sloping down to 11 metres and then dropping off–it was a wonderful place, and with hindsight, one of my favourite on that expedition, with high coral cover and diversity. And yet also a challenging dive, the subsurface current increasing steadily throughout the hour underwater. Employing my usual survey tactic of heading upcurrent to begin and then drift-diving back to the anchor, my research associate (Amelia Rose) and I finned across the reef looking for corals to sample and tag.

And within the first ten minutes, we spotted our first glimpse of the enigmatic *Ctenella*, albeit a very pale and sorry-looking fragment, a small surviving part of what was once a much larger colony (Figure 2) and likely one of the specimens that Charles had spotted the year before. Six more similarly sorry-looking findings followed and I couldn't help but be slightly underwhelmed–and terribly sad.

The photos Charles had showed me were of pink-hued and beachball-sized giant underwater brains and these fragments were mere shadows of those. Still, where I could, I tagged the colonies and gently took thumbnail-sized tissue samples for which I'd so optimistically applied for a permit those months before, in the hope that some

contribution to the paucity of knowledge concerning this little coral could be made.

The six or seven weeks that followed our return to the UK were nervous ones–far too many times in my career have samples gone missing or spoiled during their inexorable progress home around the globe–the sensation heightened by the thoughts that given another unparalleled warming event in the central Indian Ocean, that these could be the last samples of this coral ever taken.

But arrive they did and in unspoiled condition, in a toughened-plastic trunk festooned with permits and airline stickers, where they were immediately transferred to the -80C freezer in our molecular lab at the University of Oxford's John Krebs Field Station for safekeeping.

So very little is known about *Ctenella,* and all that is comes from Charles' sterling work in recent decades, so almost anything that we learn will add to our knowledge of the coral.

Therefore, with the tissue samples I had collected, I fervently hoped I might be able to extract enough DNA to sequence its genome–and some months later, by incredible good fortune, I was lucky enough to be awarded a global research award to do just that by QIAGEN, one of the world's leading biotechnology companies. And as I write this, I have received the first results back, and am currently delving into the first ever genome data for this coral, hoping that the secrets of its enigmatic and tenuous existence might finally be revealed.

Buoyed up by last year's finding, in February of this year, I headed out once again on the annual BPMS expedition to BIOT, little knowing the global chaos that would soon ensue.

Arriving just before the main expedition team, our first week was to be based on the island of Diego Garcia (DG), assessing its feasibility to be an ecological study site representing the wider (and less easily accessible) archipelago.

It was hoped that we might find *Ctenella* around DG, but that was tempered by the very real expectation that was it was highly unlikely we would do so. Fortune however favours the brave, and only our second dive of the expedition, at the seaward side

Figure 2 © Bryan Wilson/University of Oxford

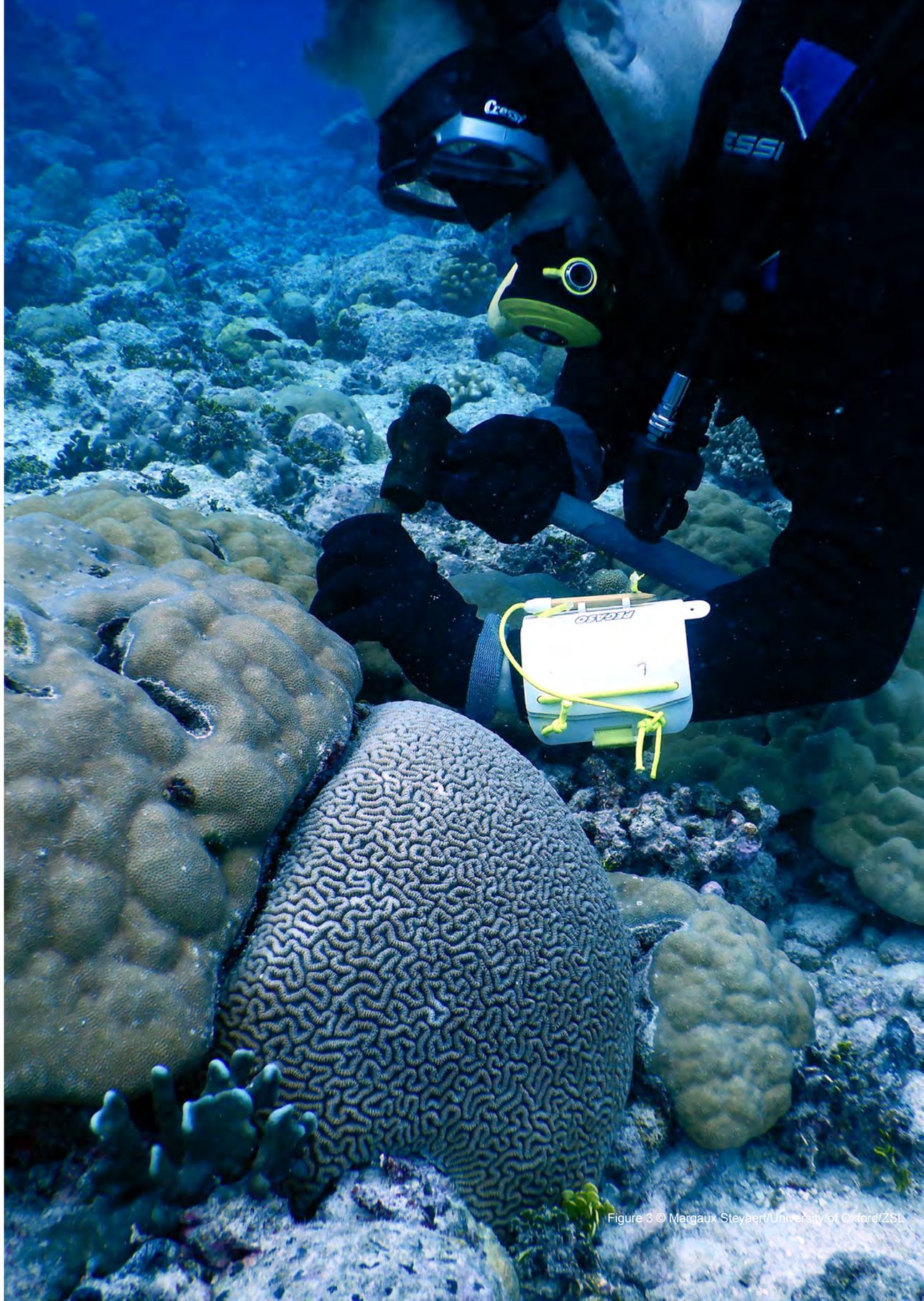


Figure 3 © Margaux Steyaert/University of Oxford/ZSL

of Barton Point at the northern end of the island, we dropped over the boat's side into a rough swell and literally on top of the largest *Ctenella* colony I had yet seen, a full and beautifully coloured hemisphere likely five to ten years old, an incredible sight to behold.

From one of the leading edges of the colony, I took a small tissue sample as before (Figure 3), whilst warily looking over my shoulder at a large grey reef shark lurking almost out of sight some thirty metres behind in the gloom (Figure 4).

My Reef0 team (comprising Margaux Steyaert and Vivian Cumbo) and I enthusiastically searched for more colonies in the tens of metres around this colony, but to no avail, and the earlier nascent joy of the dive soon ebbed away.

For this coral to survive and reproduce, teetering on the edge of extinction as it is, there needs be a biologically viable population of colonies within suitable spawning distance of each other and this sadly was not it.

Indeed, no further colonies were seen in the surveys around DG that week, nor in the coming days after the remaining members of the expedition joined us on the Grampian Frontier and we sailed northwards and up through the archipelago.

My sombre mood was exacerbated by distressing reports that were beginning to come in from around the globe that a novel coronavirus had taken hold in an increasing number of countries and that national borders were suddenly springing shut worldwide.

Two days before the expedition was summarily aborted and we were ordered to make for the Maldives with unseemly haste, the expedition team found themselves on what would unknowingly be one of our last dives in the Chagos Archipelago; Middle Brother Island, one of the Three Brothers in the centre of the Great Chagos Bank.

Margaux and I had just completed a survey of Middle Brother Lagoon, a wonderfully sandy and protected basin replete with large puppy-like grey nurse sharks, and close to our safe air limit for surfacing, were making our way back along a reef wall to the inflatable boats anchored nearby.

And there, in the shadows of the base of the wall, were two unmistakable colonies of *Ctenella* (Figure 5), dark-coloured and apparently healthy.

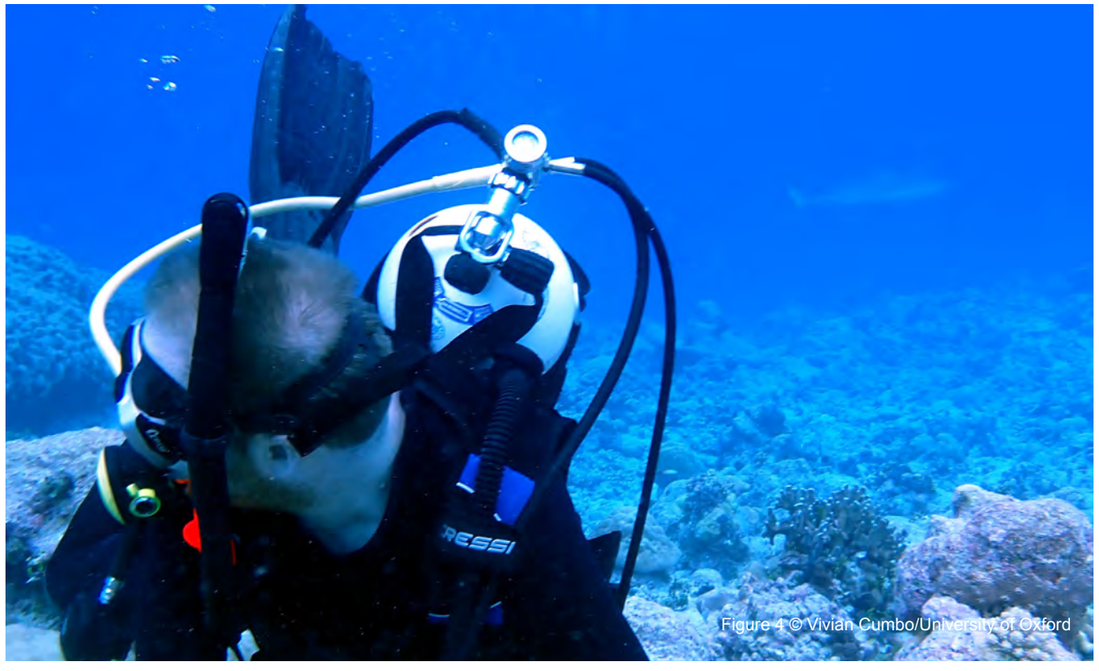


Figure 4 © Vivian Cumbo/University of Oxford

As my heart began to race, Margaux spotted another–and then two more several metres further along.

All in all we spotted some fifteen colonies in that hundred metre swim back to the boat, my depleted air supply diminishing faster still in the heady rush of my childlike excitement as we swam overhead just below the surface, in what to my mind was an Aladdin's Cave of *Ctenella* richer than any I could have imagined.

The very fact that this happened in the last minutes of our final dive here, low on air and knowing that we were steaming northwards the following day, unsure as to when we would next return, made the surface swim back that much more bittersweet.

J. L. B. Smith (the amateur ichthyologist who confirmed Marjorie Courtney-Latimer's Coelacanth discovery) once wrote of his feelings that momentous day, when he realised what lay before him: "Although I had come prepared, that first sight hit me like a white-hot blast and made me feel shaky and queer, my body tingled. I stood as if stricken to stone."[1]

And on what was my first dry St Patricks Day in decades, as our inflatable made its steady way back to the Grampian Frontier for a journey home to a suddenly uncertain world, I elatedly realised that I knew exactly how he felt that day in 1938. And that I'd been awaiting that feeling my entire life.

Where there was none before, there is real tangible hope now borne that this lagoon–and others unexplored in the archipelago–might offer a last stronghold for the species, a refugia for this critically endangered and iconic coral, especially given that these colonies would predate the recent warming events in the region.

Where we find viable populations, there exists a chance that the coral can be conserved and recovered, and whilst that chance might indeed be slight, as Charles so optimistically ended his 2018 article, "...we must still try!"

[1] Old Fourlegs: The Story of the Coelacanth by J.L.B. Smith. New York: Longmans, Green & Co., 1956

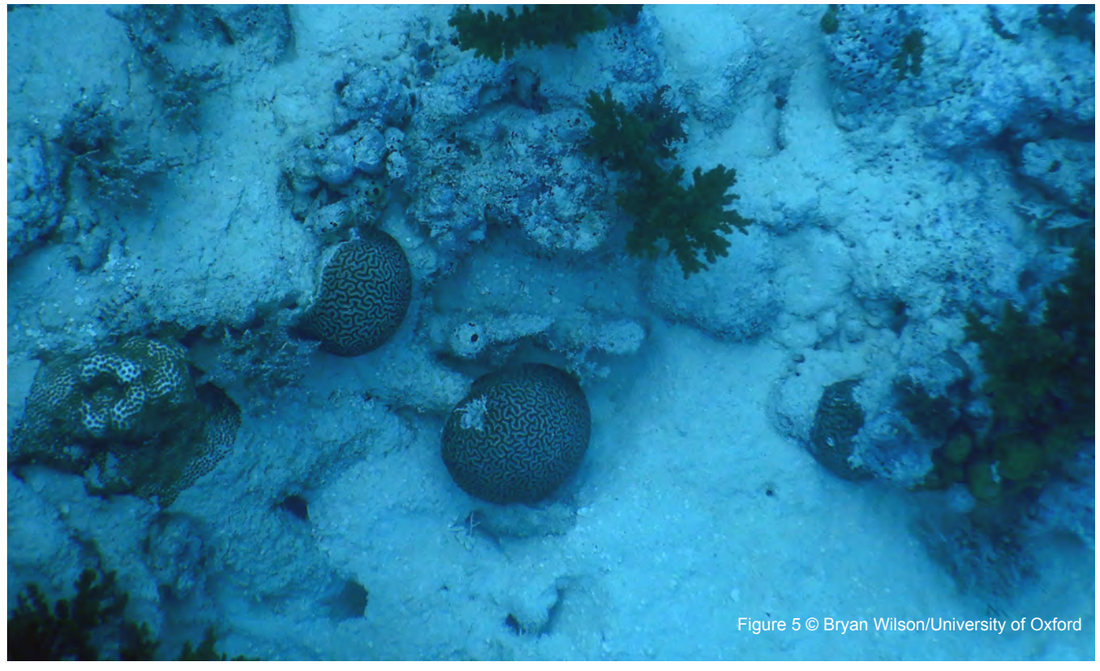
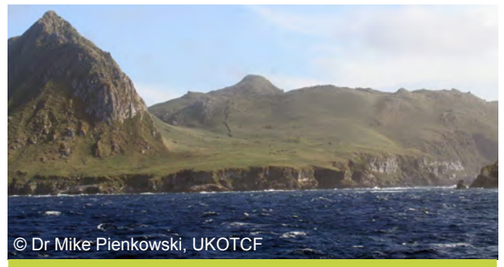


Figure 5 © Bryan Wilson/University of Oxford

News in brief



New marine protection

The government of Tristan da Cunha has announced it will extend its existing environmental protections to safeguard a huge diversity of wildlife, including penguins, whales, sharks and seals, by creating an almost 700,000 square kilometre marine reserve.

It will be the planet's fourth largest, the largest reserve in the Atlantic, and joins the UK government's Blue Belt programme that aims to create 4 million square kilometres of marine protection across Overseas Territories.

The Tristan da Cunha reserve will help protect 25 seabird species that breed on the archipelago and will become a no-take reserve, meaning no fishing or other potentially damaging activities will be permitted.

Read National Geographic's story here.

Future funding for corals

CCT was invited to participate in a high-level meeting to discuss The Global Fund for Coral Reefs.

The Fund seeks to raise and invest USD $500 million in coral reef conservation over the next 10 years through a coalition between United Nations agencies, financial institutions and private philanthropy sources.

It has the dual focus of facilitating the uptake of innovative financing mechanisms, including private market-based investments focused on coral reef conservation and restoration, and unlocking finance for coral reef-related climate adaptation through the Green Climate Fund, Adaptation Fund and multilateral development banks.

Find out more here.

Rats evicted from paradise

Palmyra had been an isolated and tranquil Pacific atoll until an invasion of black rats set its ecology hurtling down a different path.

Approximately 20,000 rats lived on Palmyra; a density around 10 times higher than in cooler climates thanks to the tropical environment.

To tackle the problem, Island Conservation carried out an island eradication programme. The situation on Palmyra shows that the Chagos Archipelago is not alone in battling with invasive species and coconut monoculture.

Read more here about the Palmyra eradication, and how CCT plans to adopt a similar approach for the 30 rat-infested islands in the Chagos Archipelago here.

Staying Connected for Conservation conference

The UK Overseas Territories Conservation Foundation has announced its online conference 'Staying Connected for Conservation in a Changed World', to be held over four days in March 2021.

The conference will cover subjects including engaging people, nature-based solutions for the UN Decade of Ecosystem Restoration, innovative approaches and capacity-building, and more.

The UK Overseas Territories Conservation Foundation has a long history in delivering conferences that provide a forum for government environmental bodies, NGOs and commercial organisations to discuss key conservation issues, highlight success stories, exchange ideas and forge partnerships.

For more information visit here.

A Decade in Review

Helen Pitman, Director, Chagos Conservation Trust

Scientists from the Bertarelli Programme in Marine Science have reviewed a decade of lessons from one of the world's largest marine reserves in recognition of the 10th anniversary of the designation of British Indian Ocean Territory Marine Protected Area (MPA).

Published in Marine Biology, 'A review of a decade of lessons from one of the worlds' largest MPAs: conservation gains and key challenges' looks at outcomes of the last 10 years of marine research in the British Indian Ocean Territory.

Over 70 scientists, including a number of past and current CCT trustees, collaborated in the review that highlights a number of success stories from the archipelago.

Marine research has been carried out in the Chagos Archipelago since the 1970s but there has been an explosion of scientific expeditions in recent years, primarily because of an increase in both access to the territory and investment in research.

Reef resilience

The Chagos Archipelago is famed for its coral reefs and is home to the world's largest atoll structure, the Great Chagos Bank. The review found that the MPA was a valuable reference site for understanding how coral communities react to climate change and that, despite being affected by climatic events such as the 2015 and 2016 coral bleaching events, the archipelago has not undergone the significant and continuing declines in health seen across other reefs in the Indian Ocean.

Scientists have determined that the lack of additional local threats such as overfishing and pollution sources, in addition to the remoteness of the archipelago, have also enabled the reefs to recover faster from the bleaching events than elsewhere in the Indian Ocean.

A sanctuary for turtles

Green and hawksbill turtle numbers have continued to increase since the MPA was established. Between 2011 and 2018 the estimated annual number of clutches of eggs for hawksbill turtles increased by up to five times, and for green turtles by up to nine times since 1996.

Satellite tracking has shown that after green turtles finish nesting in the archipelago they disperse across the Western Indian Ocean (WIO) to forage. Some individuals have ventured thousands of kilometres away to the waters of the Seychelles and mainland Africa.

This data is being used to inform marine spatial planning across the WIO and is an example of how research from the MPA can support important conservation actions, such as determining boundaries of protected areas in the Seychelles.

In addition to collecting census and tracking data, new foraging grounds in the form of seagrass meadows have been discovered, and it is hoped that future tracking will increase knowledge about the distribution of these important habitats across the whole WIO.

A key role for seabirds

The Chagos Archipelago is home to one million–or 5%–of the seabirds found across the WIO. It is estimated there are over 280,000 breeding pairs from 18 species, with sooty tern, lesser noddy and red-footed booby making up 96% of the birds found in the archipelago.

Red-footed boobies have been the subject of GPS tracking that has revealed adult birds fly long distances to feed in deep water. Some pass the Great Chagos Bank but stay within the MPA. One reason may be that the lack of fishing within the MPA results in a high availability of food and reduces threats from bycatch.

However, limitations on available breeding habitat due to the presences of invasive rats and some of the islands having previously been used for coconut plantations continues to restrict seabird numbers. Currently 95% of land is unavailable to seabirds and therefore without addressing this issue the MPA cannot reach its full potential of being a seabird sanctuary.

CCT's Healthy Islands, Healthy Reef programme will tackle this problem.

The above is a snapshot of the review that explores in detail the impact on pelagic wildlife, crypto fauna diversity, key ongoing threats and more. It is also only the beginning of a long-term commitment to scientific research and conservation action to support the Chagos Archipelago's marine environment.

Next Steps Towards a Rewilded Archipelago

Our large-scale island rewilding programme, Healthy Islands, Healthy Reefs, has moved into phase two: research and development.

The Healthy Islands, Healthy Reefs Research and Development Project will provide CCT with the urgently needed knowledge and capacity to deliver the rat eradication component of the wider programme.

Researching the gaps

The feasibility study highlighted a number of knowledge gaps that need to be filled and, once gathered, this data will inform the Healthy Islands, Healthy Reefs Operational Plan.

Questions over the presence or absence of rats and mice on a few islands, the amount of bait crabs take, and what specialist requirements are needed for mangroves, all need to be addressed.

It is vital to have this information to maximise the probability of successfully eradicating rats, which is key to rewilding the archipelago.

Investigating new technologies

We hope to look at which new technologies could help not only monitor newly rat-free islands to make sure there are no future invasions, but also to record the return of seabirds to these islands as a measure of success.

Using eDNA is one of these technologies as discussed on P16.

Building the team

Our ambitious programme requires a team that can ensure CCT has the expertise and funds to take it to the next phase.

Building our rewilding team is an important step in the development phase.

Financing the future and engaging the public

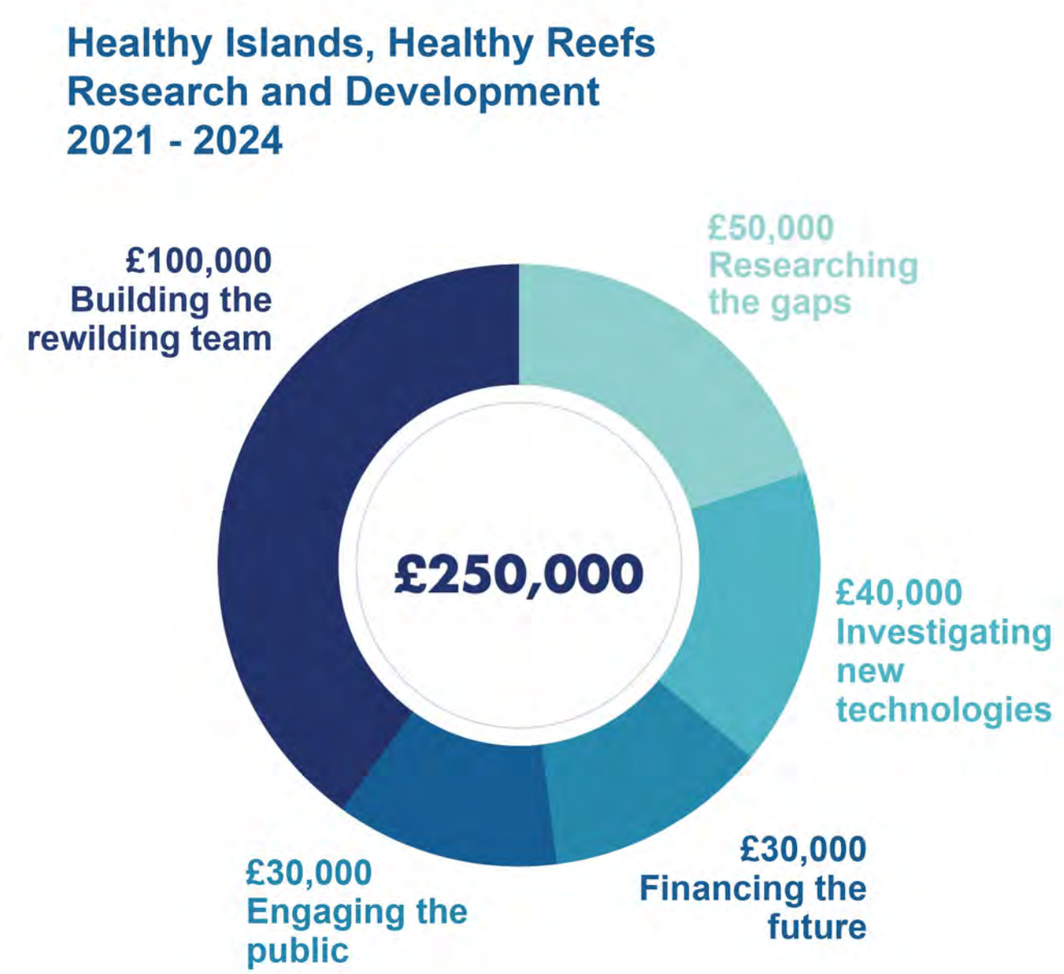
The rat eradication component alone is likely to cost approximately £4 million, therefore CCT needs to engage with the public about this important programme and ensure we can finance it into the future.

In 2021, CCT will launch its Healthy Islands, Healthy Reefs programme with a fundraising campaign to raise the funds required to start the research and development phase.

Together, with your support, we will secure the future of the Chagos Archipelago.

We're looking for donors and investors to make this vision a reality and secure the future of this unique and spectacular ecosystem.

To donate please visit our website here.



New Tools for Monitoring Biodiversity

Vere Ross-Gillespie, Regional Coordinator & Molly Czachur, Science Communications Manager, NatureMetrics

The British Indian Ocean Territory Marine Protected Area is famous for its size, yet at this scale the monitoring responsibilities present major logistical and financial challenges.

At NatureMetrics, we are helping CCT to establish new DNA-based biodiversity monitoring tools to increase the power of the data obtained and increase the pace at which it's collected.

CCT has been proactively seeking novel ways to monitor the islands of the Chagos Archipelago, namely due to 95% of the landmass being classed as degraded and conventional monitoring methods being time consuming and costly.

The degradation is mostly caused by habitat destruction and the presence of invasive rats, both resulting in a marked reduction of biodiversity. Without healthy seabird populations supplying nutrients, the coral reefs are less likely to thrive, and there are many more wildlife relationships that are being threatened as biodiversity is lost.

Conducting wide-scale spatial biodiversity surveys is a large undertaking, and doing them regularly adds another layer of costly considerations.

Biodiversity monitoring and field surveys for marine and terrestrial habitats typically require teams of specialists being deployed to remote locations, who then spend several weeks in the field gathering data using conventional monitoring techniques (e.g. dive transects, BRUV, tagging, rodent trapping, camera trapping, fish netting, bird transects etc.).

With a greater number of specialists needed in the field to identify and monitor a wide range of taxonomic groups, the health and safety risks to staff–as well as costs in terms of person days in the field–increase exponentially.

Biodiversity monitoring is hugely valuable, and we rely on the resulting data for managing our natural world. The scientific community has therefore set out to develop new ways to improve the speed at which we can collect biodiversity data, and improve the resolution at which we can detect different plants, animals and even microfauna.

Here at NatureMetrics, we're using a biomonitoring method called environmental DNA metabarcoding.

Environmental DNA, or eDNA, is the DNA that is left in the environment by living things. Similar to a crime scene where humans leave their DNA behind, animals do the same whenever they interact with their habitat–even in the air.

Whether it's a fish swimming amongst a coral reef, or an invasive rat foraging on land, all living things leave traces of their DNA in the environment. We capture this DNA, using the NatureMetrics filter pictured, and identify which animals are living where, and when.

We have had huge successes with using eDNA-based surveys for marine and terrestrial life. From fishes to dolphins and lizards to birds, we can capture biodiversity data for whole ecosystems just based on the DNA that the animals have left behind.

In coral reefs, it's possible to simply collect water samples from a boat and then send the samples back to the lab, where we can tell you what DNA has been found in your water sample.

This can describe coral reef health in a way that is objective, rapid and reliable, especially when there is limited time or financial resources. It's these inventories of whole vertebrate communities that allow us to start understanding what lives in a system, and how it changes over time.

Having learned about these DNA-based methods, CCT saw the potential in using these methods for wide-scale monitoring of the Chagos Archipelago and reached out to NatureMetrics for advice on monitoring firstly the presence of rats, and secondly the marine life in the Chagos Archipelago that is inextricably linked to the presence of seabird communities and rats.

Both types of data could be used to inform long-term monitoring of the impact of invasive species, as well as the success of eradication programmes and habitat restoration on the associated reef ecosystems of the islands.

By identifying the challenge and approaching NatureMetrics, CCT is now in a position to readily generate big datasets that can impact real-world solutions.

For more information on eDNA, metabarcoding and molecular techniques for biodiversity monitoring please visit the NatureMetrics website or e-mail their team directly - vere@naturemetrics.co.uk and molly@naturemetrics.co.uk.

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

CHAGOS CONSERVATION TRUST