

Chagos News



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

Chagos is, as you might imagine, a great target for conspiracy theorists - with its isolation, military installation and Chagossian history. The internet is, of course, such an easy way for people to promulgate the most ridiculous and bizarre ideas, and a trawl through some of these is very amusing - but also worrying that people with no information about something can expound so freely on it and may be taken in by many others. It seems that some prefer to believe a good fairy tale than more mundane facts!

Some of these fantastical stories regarding Chagos are so outrageous that they are actually quite funny. For example after the 2004 tsunami there were reports that Diego Garcia a) had some sort of anti tsunami protection around it, ranging from a force field to a steel wall, b) knew about it in advance but didn't deign to tell the rest of the Indian Ocean countries and, c) was entirely washed away by the tsunami.

And these weren't even the most stupid ones - some involve aliens for example. Then there is the claim that the tragic missing Malaysian Airlines plane MH370 was forced to go to Diego Garcia by the CIA or, more recently, that it could have safely landed on Danger Is, Eagle Is or Nelsons Is. So many people tragically lost is no laughing matter, but the ideas of some idiots...!

Others, who have never been to Chagos, announce in confidant tones, about the place being radioactive as a result of the military being there, or covered in Agent Orange. They declare that the military have polluted the place and destroyed the natural resources of Diego Garcia. I guess that they know this by some sort of divination!

But the facts are unfortunately less interesting.



The 2004 tsunami did sweep over parts of some islands in the atolls, but because of the deep water and steep slopes surrounding the islands, it was not the disaster that it was elsewhere, although a whole batch of bird eggs were lost on one island inspected. An article describing the effects of the tsunami is in [Chagos News 25](#)

The truth about MH370 may never be known, but it certainly never landed in Diego Garcia - I was there at the time. No one has produced any evidence to show that the plane went to Diego Garcia but hey, who wants evidence to spoil a good story. And of course anyone who knows the islands would laugh at the idea that a large passenger plane (or even a small one) could ever land on one of the islands.

It is difficult to see how people who have never been to Diego Garcia and who are not in possession of any data can have any 'facts' about 'pollution' and 'damage to the ecosystem'. Detailed analyses of seawater for contaminants has revealed that it is the cleanest seawater on the planet. It has a healthy coral community (as far as warming from climate change allows) and, despite a recreational fishery and being outside the MPA, Diego Garcia has as high a fish biomass as the best managed marine protected area elsewhere in the Indian Ocean. The planet has been impacted everywhere by humans to some degree or another. Places which are inhabited are impacted more than those which are not - no one can question that. So, although the military presence there has had an impact, the *ecological* footprint of the military in Diego Garcia is mostly felt in and absorbed by the US and its allies in the East Indies. This is because virtually everything required to build and maintain the base originates there, and all inorganic waste is recycled back to industrialised points of origin. The impact on the atoll has long been minimal which is why Diego Garcia is the least polluted and least spoilt inhabited atoll in the world - shown by analyses of huge amounts of samples over many years. Sometimes the writers do have the data, but don't seem to understand it.

It is no secret that in the 1970s the military did remove coral rock from sections of the reef flat. They called them 'borrow pits', and you do wonder when they might be going to pay them back! Many places at that time were guilty of such environmentally stupid actions, this was

not too long after *Silent Spring* after all, but all actions which may affect the environment are now scrutinised for decades by the BIOT conservation advisor, along with a team permanently in place working for the US Navy. Charles Sheppard worked on this, succeeding the late John Topp who started so much of the present environmental work, and now his place is filled by Mark Spalding, who is carrying on giving that advice for BIOT.

It would be very unwise to think that any community, living entirely from the islands, would not have a significant impact on the atolls. The islands of Diego Garcia and the previously inhabited islands in the northern atolls were



heavily impacted in plantation days. But the saving grace for Diego Garcia is that the majority of the impact from the personnel is in the US.

There are definitely important discussions to be had about Chagos. It is important to stick to verified information and not spurious, unverified and, frankly, made up, 'facts'. Unfortunately I am quite sure that we will hear more wild claims being made in the future. Today though, the threats come from any lack of vigilance in conserving the archipelago, and from climate change. This year, for example, has seen a heavy bleaching event throughout the area and beyond, which is likely attributed to climate change.

We wait and see.

Anne Sheppard



There is a new exhibition on coral reefs at the Natural History Museum in London, and Chagos gets to play a small part in it, with many of the specimens being shown coming from there, as part of a collection made in the late 1970s and donated to the museum by Charles and Anne Sheppard. There is also an information board about the BIOT MPA.

The exhibition website is at <http://www.nhm.ac.uk/visit/exhibitions/coral-reefs-secret-cities-of-the-sea-exhibition.html> with an amusing video showing the theme of the exhibition is available at <https://www.youtube.com/watch?v=75zv2-ksPSg>

Our oceans are changing and coral reefs tell us how.

Coral reefs are home to almost a quarter of all marine species. In this new exhibition you will meet the inhabitants of these richly diverse habitats, and find out why reefs are so important and how their future is being secured.

Encounter 250 strange and beautiful specimens from our collections including the gigantic *Turbinaria* coral, the venomous blue-ringed octopus and coral collected by Charles Darwin.

Take a virtual reef dive, see live sea coral and fish in our aquarium and enjoy spectacular underwater photography.

Dr Ken Johnson, Museum coral reefs expert, explains the importance of corals:

'Coral reefs are not simply beautiful environments. They provide food, income and storm protection for many millions of people around the world.'

In partnership with:



Introduction to the exhibition

Coral reefs are home to almost a quarter of all marine species. In this exhibition you will meet the inhabitants of these richly diverse habitats, and find out why reefs are so important and how their future is being secured.

Encounter 200 strange and beautiful specimens from the Museum collections including the gigantic *Turbinaria* coral, the venomous blue-ringed octopus and coral collected by Charles Darwin.

Take a virtual reef dive, see live coral and fish in an aquarium and enjoy spectacular underwater photography.

Introduction for educators

The following ideas and printable resources have been developed to engage your students during their visit. The activities provide one aspect to consider while enjoying the exhibition as a whole. Students can work individually or in small groups.

Please take a general look at these resources before choosing which to use. Note that the activities differ in style but only the teachers' notes carry group recommendations. Therefore educators may use a mixture of activities within a class if they wish.

The resources include different ideas for pre-visit and post-visit activities, which are recommended to help students get the most out of their experience. Whatever the group, please discuss the activity instructions with students in class before their visit so they understand what to do.

Please bring clipboards and pencils, especially if students are likely to be drawing.

Our exhibition partners

For each activity we've included links to media from the Oceana Education programme of our exhibition partner, Catlin Group, which you can use before and after your visit.

For more Key Stage 2 and 3 resources and lesson plans on the subject of coral reefs, please follow these links:

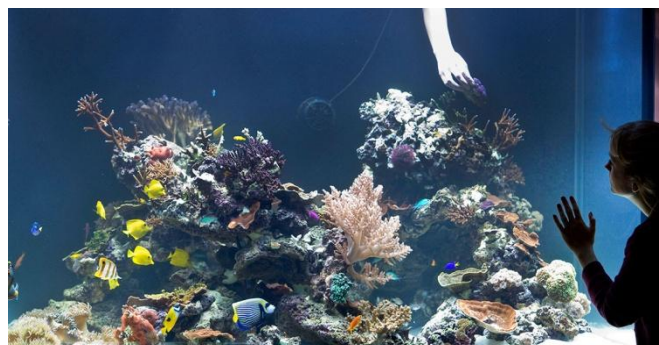
Resources for students aged 7-11

<http://oceana.digitalplanet.com/resources/collection/coral-reefs-7-11>

Resources for students aged 11-14

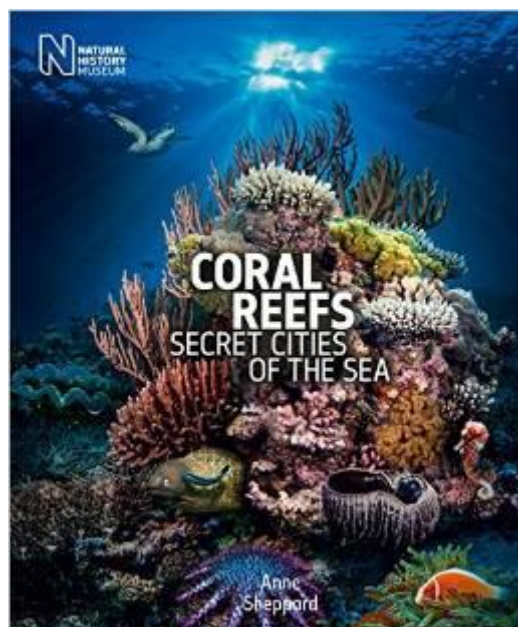
<http://oceana.digitalplanet.com/resources/channel/coral-oceans-11-14>

Also, there is a very useful schools teaching guide available to download in PDF format, with a lot of interesting ways to get more out of the exhibition. It is available to download at <http://www.nhm.ac.uk/content/dam/nhmwww/Schools/teaching-resources/corals-learning-guide.pdf>



The exhibition has one of the most beautiful coral reef aquaria and there is an online video of the making of the aquarium at <http://www.nhm.ac.uk/discover/coral-reefs-exhibition-aquarium.html>

The book to accompany the exhibition was written by CCT trustee Anne Sheppard, which also has a bit about Chagos in it. The book is £12.99 and is available in the museum shop or from Amazon at http://www.amazon.co.uk/Coral-Reefs-Secret-Cities-Sea/dp/0565093568/ref=sr_1_1?s=book&ie=UTF8&qid=1433681631&sr=1-1&keywords=coral+reefs+secret+cities+of+the+sea



Award of a grant to CCT

Charles Sheppard

We are delighted to record that we have been given a substantial grant from the John Ellerman Foundation towards developing our Chagos Information Portal – ChIP for short. ChIP was started a year ago with a grant of £20,000 from CCT, and that phase is now almost completed with the development of the core database structure, which will be made available very soon. The purpose of ChIP is to record in one place all scientific data or information on where it can be found (or as much as is possible) in one online site. It is not so much a website (despite being online) as a scientific database for scientists, managers and the general public. In the first year, much progress has been made in compiling a solid core of the information as well as the 'engine' to work it. The next stage is for volunteers to test that, and then release it.

This online relational database is eventually intended to store and provide a near-complete record of previous and current research in Chagos. It has dealt with the ongoing and past research projects there, while results of all future projects will be deposited by the researchers themselves. It will have a user friendly and interactive online Geographic Information System (GIS) which will have maps of Chagos with photos, video clips, and data tables and figures for all projects.

The reason this is needed is that in science, very often the sum of 2+2 can equal much more than 4, if researchers know about other people's results or have access to their data. When they do, they

can benefit from it and incorporate it into their own scientific planning and work. Thus ChIP was conceived. The wealth of data collected in the Chagos Archipelago over the past four decades is increasing fast, and currently is scattered in academic papers, government reports, unpublished data, and photo and video libraries of individual researchers. ChIP will inform scientific research and conservation, facilitate BIOTA's decision making about matters of environmental management in Chagos, and foster public stewardship. Every new expedition will add to the shared knowledge base to strengthen it. This is becoming especially important now, given the very welcome and necessary surge in scientific information that is becoming available for this area.

The John Ellerman Foundation has generously granted CCT over £80,000 to be spent over three years to hugely augment this start. It will allow improvement of many aspects and expansion from the present core and sometimes rather limited 'trial' material which forms the initial, working database in the system. It will permit the addition of very much more scientific information, including identification guides, coral trait data, reef 'sensitivity' details and maps, and much more physical, environmental and biological data. Importantly too, it will have an element for promulgating results in various fora. Furthermore, the integrated videos and photos will enable a much larger public to see what is developing in Chagos science, and this is important also for outreach purposes.

We are most grateful to the John Ellerman Foundation for their generosity.

Publications

Search

Seabirds

Source Type

- All
- Abstract
- Book
- Book Chapter
- Booklet
- Conference Paper
- Factsheet
- Journal Article
- Magazine Article
- Management Plan
- Monograph
- MSc Thesis
- Newsletter
- PhD Dissertation
- Scientific Report

From year

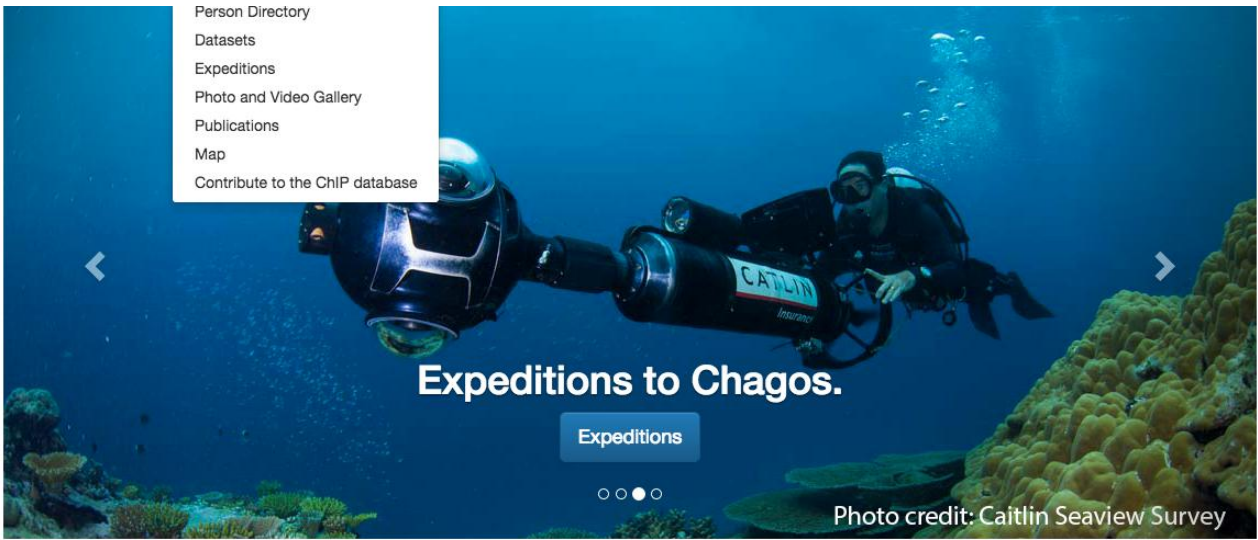
1998

To year

2010

		Authors
2007	<i>Microbacterium indicum</i> sp nov., isolated from a deep-sea sediment sample from the Chagos Trench, Indian Ocean	Myers, A.
2008	<i>Brevibacterium oceani</i> sp nov., isolated from deep-sea sediment of the Chagos Trench, Indian Ocean	Vogler, C., Benzie, J., Lessios, H., Barber, P. and Worheide, G.
2009	<i>Bhargavaea cecembensis</i> gen. nov., s. nov., isolated from the Chagos-Laccadive ridge system in the Indian Ocean	Shivaji, S., Ara, S., Begum, Z., Ruth, M., Singh, A. and Pinnaka, A.
1999	Breeding seabirds of the Chagos Archipelago	Shivaji, S., Bhadra, B., Rao, R., Chaturvedi, P., Pindi, P. and Raghukumar, G.
2008	Seabird populations of the Chagos Archipelago, Indian Ocean: an evaluation of IBA sites	Bhadra, B., Raghukumar, C., Pindi, P. and Shivaji, S.
1972	Birds seen at sea and on an island in the Cargados Carajos Shoals	Manorama, R., Pindi, P., Reddy, G. and Shivaji, S.
1969	Comment on the Little Green Heron of the Chagos Archipelago Indian Ocean <i>Butorides-Striatius-Javanicus</i> <i>Butorides-Striatius-Albolimbatus</i> validity	Symens, P.
2004	Seabirds on Agalega (Indian Ocean) – survival of boobies and frigate- birds into the 1870s, with comments on other species	McGowan, A., Broderick, A. and Godley, B.
1971	The Birds of the Chagos Group Indian Ocean	Pocklington, R., Willis, P. and Palmieri, M.

- Person Directory
- Datasets
- Expeditions
- Photo and Video Gallery
- Publications
- Map
- Contribute to the ChIP database



Expeditions to Chagos.

Expeditions



Photo credit: Caitlin Seaview Survey



The ChIP Project

Learn about the vision, mission, and aims of the ChIP project.

Chagos Images and Video Gallery »



Contribute to the Database

Help us grow this initiative by contributing documents, images, videos, gps points, maps, expeditions blogs, or anything else you feel could contribute to expanding scientific understanding and protection of the unique Chagos environment.

Chagos Publications »



Fund future ChIP expansions

Help us expand the ChIP project! We are currently looking for funders to support several key project that will help ChIP reach its full potential.

Chagos Expeditions »



Expedition Blog

Have you seen the online blog from this year's Darwin expedition? It gives a good account of some of the interesting things that happened and lots of great photos. You can see it at <http://chagos-trust.org/2015-darwin-science-expedition-0>

2015 Darwin Science Expedition Blog

[Jump to project background](#)

2015 Darwin Science Expedition

Follow the activities of the participants in the 2015 Darwin Science Expedition to Chagos in the daily blog below!



Chagos Archipelago - an invaluable scientific reference site

*Dr Benjamin Neal
University of Queensland*

In February this year, researchers from The University of Queensland extensively surveyed along more than 40 kilometres of the Chagos Archipelago, as part of the XL Catlin Seaview Survey, a global study to monitor the world's coral reefs.

A team using a motorised camera to map 29 extended photographic transects of shallow reefs captured around 20,000 high-definition panoramic images over the 13-day expedition. The imagery will allow researchers to develop an estimate of the range of coral cover and habitat types for the marine protected area as a whole.

An isolated outpost of coral health

The Chagos Archipelago is an invaluable scientific reference site for understanding the impacts of global factors such as climate change, primarily because it is one of the few sites in the world nearly completely free from the local human-caused effects of overfishing, sedimentation, eutrophication and other pollution.

UQ researchers observed a healthy reef system surrounded by virtually non-polluted waters, with abundant coral cover and diverse fish life, including a greater number of sharks than we have seen elsewhere, which are unfortunately nearly gone in so many reef ecosystems.

The imagery collected on this trip will contribute to the XL Catlin Global Reef Record, a free online standardised research tool and global database (www.globalreefrecord.org) which allows scientists and laypeople alike to remotely study reefs. It is expected that imagery for the sites surveyed in the Chagos will become available by September 2016.



Loading the equipment from the deck of the BIOT Patrol Vessel *Pacific Marlin*



Using the winch from the Pacific Marlin, the equipment is lowered gently into the RIB.

The next hurdle is getting the equipment from the RIB into the water.



Once in the water the huge cameras become much easier to handle.



With clear water, the extreme wide angle images show the reefs at their best.



Catlin Expedition Deep Coral Research

*Dr Paul Muir
Queensland Museum*

As part of the Chagos expedition, the XL Catlin Seaview Survey included researchers from Queensland Museum and UQ who focused on the coral fauna of the region. As the Chagos reef system is unique in so many ways it is an ideal “natural laboratory” for researchers looking at biodiversity, connectivity between reefs and the response of coral faunas to repeated mass bleaching events. Its remoteness, size, lack of direct human impacts and position between biogeographic areas are all unparalleled. In addition to these features, we were particularly interested in the deep reef or mesophotic zone from 30 to around 130 m depth. This reef zone is virtually undocumented but recent work on the Great Barrier Reef by ourselves and other

researchers indicates that the deep reef is far more extensive and contains far greater coral diversity than previously assumed. The mesophotic may also be particularly important for corals – it has been hypothesised that the zone may escape severe damage during catastrophic events such as mass bleaching and severe storms, thus providing a refuge and potential “seed bank” which could speed the recovery of shallow reef corals. The mesophotic corals of Chagos are virtually unknown, apart from work done by Sheppard in 1978-79 down to 64m, and we therefore planned a programme of targeted deep SCUBA diving and collecting with a robotic remote operated vehicle or ROV.

Frustratingly, this part of the expedition did not come to fruition: heavy weather stopped us deploying the ROV for much of the time while two key members of our

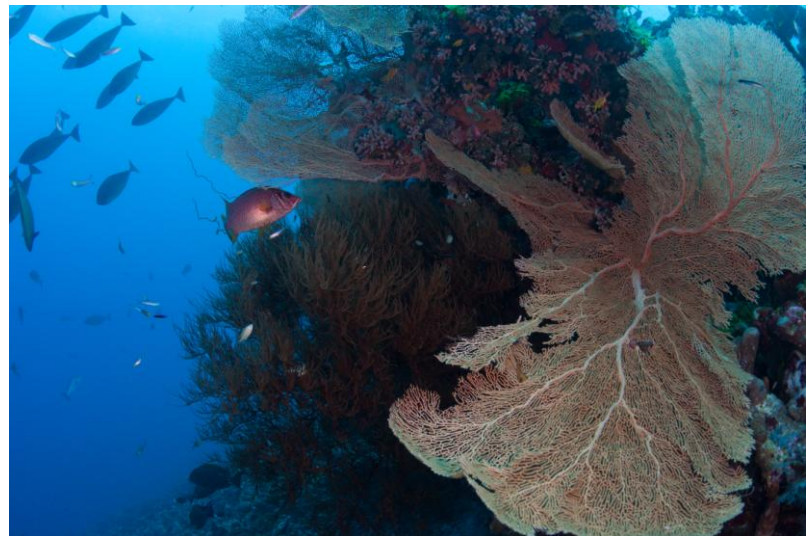


team had to withdraw from the expedition due to injury (not diving related!).



However, this setback had a silver lining – we were able to concentrate upon the “shallow reef” corals (ie <30 m depth) which turned out to be extremely unusual and more than enough to keep us from fretting! We were particularly interested in the genera *Acropora* and *Isopora* -the staghorn corals, the largest group of corals which dominate reefs of the Indo-Pacific, and are particularly susceptible to bleaching. The staghorns are very difficult to identify and the Queensland Museum specialises in this group, having taxonomic expertise and a large collection comprising of around 30,000 specimens from thousands of sites around the world.

We collected around 500 coral samples from Chagos during the expedition, paired with 500 genetics samples and a large database which includes several hundred detailed photographs. Over the coming months we will be analysing these samples and we hope to address questions such as how the staghorn coral fauna has responded to repeated bleaching events, have there been any loss of species, how does this system connect to corals in the Maldives and the rest of the Indian Ocean and are there any new species unique to Chagos? The coral samples will also become part of the Queensland Museum collection: a resource which is available to all coral researchers and a large, global database which has already formed the basis for some important studies in reef biology.



Hopefully one day we will get back to look at the mesophotic of the Chagos: an area which holds great promise in terms of research and perhaps the very future of the coral reefs of the region.

The Fishes of Chagos

Georgia Coward
Khaled bin Sultan Living Oceans Foundation

The Global Reef Expedition

In March and April of this year, the Khaled bin Sultan Living Oceans Foundation science team undertook two research missions in the Chagos Archipelago. This research is part of the Foundation's six year Global Reef Expedition (GRE), one of the world's largest coral reef studies that has enabled some of the most remote reefs on the planet to be surveyed. The team surveyed the coral communities, benthic structure and fish communities in 115 sites, with the research led by Chief Scientist, Dr Andrew Bruckner.

Of the 12 core survey scientists aboard the *M/Y Golden Shadow*, four of us were responsible for conducting the fish research. All reef fish were identified to species and their abundance and size was recorded along 30 x 4 m belt transects. Roving biodiversity surveys supplemented the quantitative transects to identify a full complement of species found in each location. This information allows us to quantify the biomass, diversity and density of fish populations in Chagos and assess the differences throughout the archipelago and between habitat types. The team undertook approximately 1,100 transects, identifying over 400 species of reef fish in 53 families.

The importance of this data

Globally, coral reefs provide food and shelter to 25% of the world's marine fish species. These fish play key roles in ecosystem functions. Herbivores, such as parrotfish (Scaridae) and surgeonfish (Acanthuridae), maintain the levels of algae on a reef. High levels of herbivory are necessary to prevent overgrowth and smothering of corals and maintain suitable habitat quality for settlement and growth of corals. Predators, including groupers (Serranidae) and snappers (Lutjanidae), help structure fish communities and maintain ecological balance between functional guilds. For example, an unsustainable increase in herbivore abundance could lead to high rates of bioerosion of coral and their increased susceptibility to other stressors.



KSLOF fish survey team for first Chagos mission (L-R: Badi Samaniego, Georgia Coward, Katie Lubarsky, Stefan Andrews). Photo Ken Marks



Steephead parrotfish (*Chlorurus strongylocephalus*) male and female, a common species and key herbivore recorded throughout Chagos fish surveys. Photos Chris Mirbach

Collecting this data on Chagos' reef fish populations is incredibly important for us to better understand both the role of marine protected areas (MPAs) and the fish community in an area with minimal fishing pressure. This data can provide us with a comparison of reef fish communities that have low direct anthropogenic impact.

Our initial thoughts

Biomass

The most notable observation throughout our research was the exceptionally high fish biomass. The biomass and large schools were an incredible sight to behold. At times it was hard to move due to the sheer number of fish, and counting them during transects was occasionally a daunting task. The general consensus amongst our team was that Chagos had the greatest biomass and largest schools of fishes recorded throughout the 15 countries we visited during the GRE.



Walls of fish made surveying challenging at times.

Photo Anderson Mayfield

These enormous schools of fish often exceeded 500 individuals, and were a common sight around Salomon Atoll, Victory Bank, Three Brothers and Peros Banhos. These schools frequently included, but were not limited to, greenthroat parrotfish (*Sarus prasiangathos*), yellowfin goatfish (*Mulloidichthys vanicolensis*), spotted unicornfish (*Naso brevirostris*), barred unicornfish (*Naso thynoides*), black snapper (*Macolor niger*) and humpback snapper (*Lutjanus gibbus*).



Hundreds of humpback snappers (*Lutjanus gibbus*) schooling around Three Brothers.

Photo Georgia Coward

Habitat and reef type

Fish assemblage definitely varied with habitat type and reef type. Overall diversity was greatest on the steeper slopes. Lagoonal sites acted as key nursery habitats for both predatory and herbivorous juveniles. Three species; slender emperor (*Lethrinus variegatus*), cigar wrasse (*Cheilio inermis*) and spottail coris (*Coris caudimacula*) were only associated with seagrass habitats. Seagrasses also supported unusually high densities of juvenile snappers, especially the humpback snapper (*L. gibbus*). Fringing, submerged and fore reef environments of Salomon Atoll, Victory Bank and Peros Banhos supported exceptionally high populations of herbivores.

The incredible grouper populations

The abundance, biomass and diversity of groupers (Family Serranidae, Subfamily Epinephelinae) were also noticeably higher in Chagos, and grouper made up a large proportion of the fish we recorded during each transect. Twenty-two species of grouper were recorded overall. Individuals from several commonly observed species, particularly the black-saddled grouper (*Plectropomus laevis*) and the brown-marbled grouper (*Epinephelus fuscoguttatus*) were frequently observed up to 90 cm in length. In Victory Bank one black-saddled grouper was recorded at a massive 190 cm total length.



Large black-saddled groupers (*Plectropomus laevis*).

Photo Stefan Andrews

Exciting and unusual fish species

During our dives we also recorded six species of shark, including two whale sharks (*Rhincodon typus*) and five ray species. One oceanic sunfish (*Mola mola*) was also seen during a survey in Salomon Atoll at 26m depth. The team was surprised by the low abundance of napoleon wrasse (*Cheilinus undulatus*). We think this could be due either to a lack of source populations, incorrect habitat type or a biogeographical barrier that prevents movement between the Maldives, where larger populations are recorded, and Chagos.



Whale shark (*Rhincodon typus*) seen in Peros Banhos.

Photo Andrew Bruckner

Overall thoughts

Chagos was an amazing location to visit during the GRE, and a rare opportunity to visit an environment with minimal human impact and it allowed us to see first-hand how effective an MPA can be, especially in terms of fish biomass.

Diving and surveying these sites and being surrounded by thousands of large and often inquisitive fish was something the KSLOF fish survey team will not forget!

Super Lucky

*Claudia Nariana
2015 Chagossian Scholar*

I spent many days during the Darwin Chagos 2015 science expedition on the islands, helping Pete Carr and enjoying learning about tropical terrestrial ecology from him. One day, while we were surveying the ocean shore of Ile Anglaise in Salomon Atoll, we came across a turtle which had become completely entangled in a discarded fish aggregating device (FAD). These FADs are set adrift by fishers to encourage fish to school under their apparent protection, the more sophisticated ones have transmitting devices on them so that they can be located again, and the sheltering school of fish can be swept up and caught. Unfortunately many of these FADs, especially the more primitively made ones, are not recovered and they can entangle and kill many sea creatures.

It was a hot day and the tide was going out when we came across the turtle washed up on the beach, entangled in the ropes of the FAD. It had obviously only fairly recently been washed up as it would have become dehydrated and died in a short time, maybe a couple of hours. It was so badly tangled up in the ropes of the device that it would never have managed to free itself. But it was still alive and Pete and I worked for some time to free it and then release it back into the cooling seawater. As we watched it swim off we reflected on how lucky it had been that we had come across it in time and also wondered how many less lucky turtles die in these FADs.

He was extraordinarily lucky! Almost no people walk on the islands of Chagos and the fact that we were walking by just at that time and were able to save him was super lucky. I felt super lucky too, to have this opportunity to save this beautiful creature. We hope that Super Lucky has a long and happy life!

On my way to release Super Lucky back into the ocean.

Photo Pete Carr



The turtle entangled in the netting of the FAD before we rescued him

Photo Pete Carr

Trekking Chagos

*Jon Slayer
CCT Media Consultant*

In February of this year an expedition that included a Google Trekker Street View team, consisting Elizabeth Widman and Jon Slayer, toured the northern atolls of the Chagos Archipelago. The intention was to obtain a good cross section of island habitats on the Trekker Street View camera so that visuals of the islands within the Chagos Marine Protected Area would be available for the public to see on Google Earth. These images would also have utility in mapping the islands, checking for invasive species and preparing for various terrestrial vegetation rehabilitation projects.



Widman

Although the weather was unusually poor for the duration of the two week expedition, over 20,000 360° panoramas were taken around 20 islands of the archipelago. These included a number of Important Bird Areas and the site of recent rat eradication and vegetation rehabilitation projects within the territory. Habitats captured included coconut monocultures left behind from coconut cultivation days, natural hardwood forests, grassland, mangrove swamps and rocky and sand beaches.

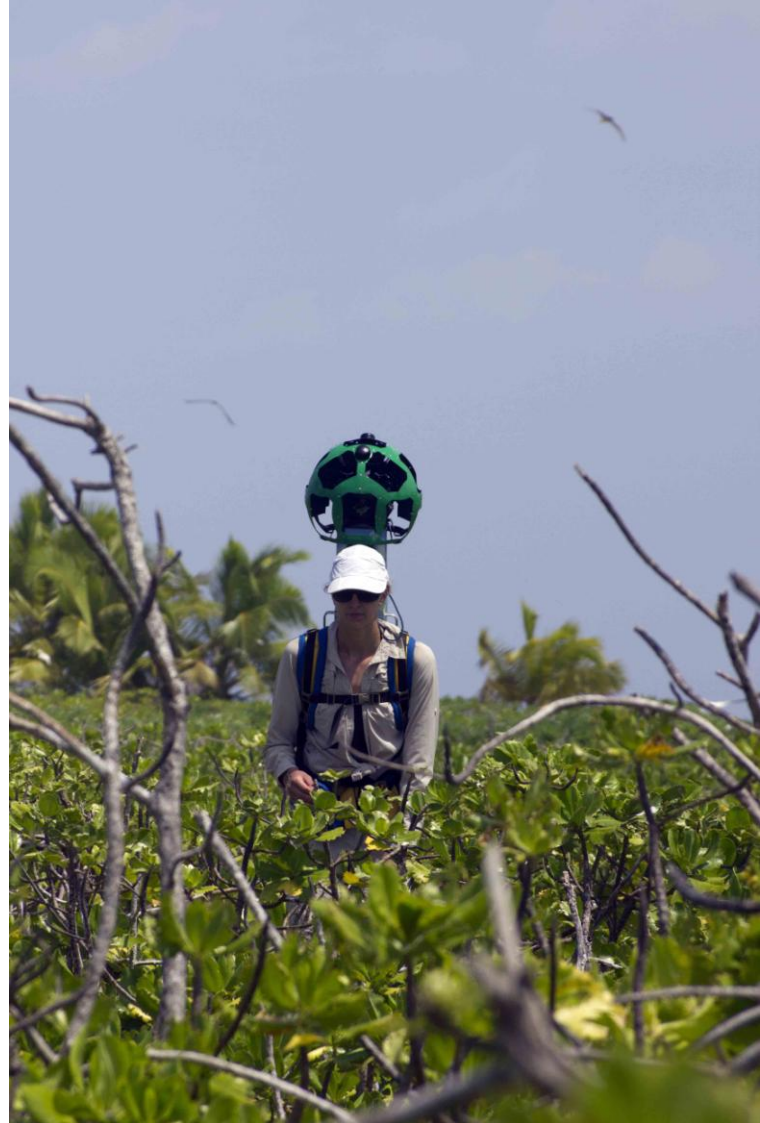
The journey around the islands was fascinating as we saw some of the very smallest islands of the atolls, such as Ile Poule and Coin du Mire that only take a few minutes to walk around, to Ile du Coin and Danger Island that took several hours to circumnavigate.

Swimming the Trekker camera ashore to Ile Petit Coquillage.
Photo Claudia Naraina



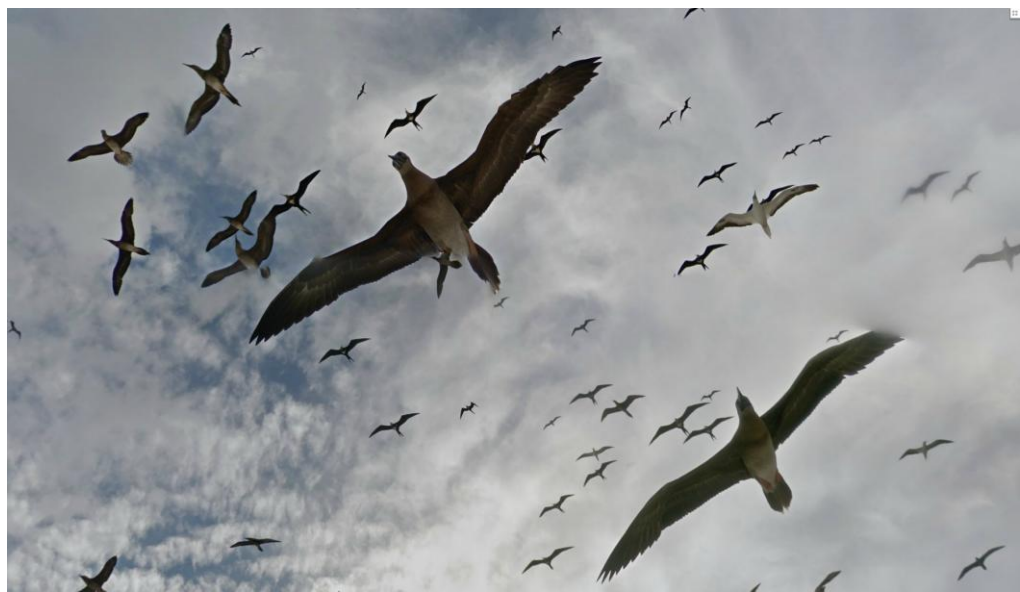
What was remarkable to record was the difference in bird life between those islands consisting of coconut monocultures and invasive rats, and those islands with native hardwood forests that were free of rats. Very few birds were to be seen on the former while clouds of curious birds hovered over us around the latter.

Also a pleasure to see were the myriad crabs that own these islands. With an absence of mammals (other than introduced rats where applicable) and terrestrial reptiles, crabs have taken over the ecosystem. Crabs on the beaches, crabs in the undergrowth and crabs up trees. Scavenging and hunting where elsewhere other animals would have taken on these roles.



The result of our explorations will firstly be a release on Google Earth of a series of Street View maps of 20 islands from the Great Chagos Bank, Peros Banhos and Salomon Atolls. Corresponding underwater Street Views taken by the Catlin Seaview Survey Shallow Teams will be released for three of the islands captured by the Trekker team. So you will be able to zoom in on Google Earth, walk the shores of Ile Vache Marine, Moresby Island or Nelson Island, then step off the beach and swim along the reefs all on your computer at home.

Flocks of birds overhead on Nelsons Island.



Thanks to all who assisted us in achieving this work, either through funding or direct assistance. It has taken a great deal of effort from various funders and administrators before our trip and from myself and Elizabeth many hours of tropically hot toil heaving the camera around these beautiful islands but we are really pleased with the results. We hope you enjoy walking along the stunning beaches and rocky shores of the archipelago, exploring through the coconut and hardwood forests and viewing the bird life in the trees and overhead! Look out for the release on Google Earth!



Walking round lots of hot sandy beaches Photo Claudia Naraina



Seawater temperatures in a Chagos lagoon

Charles Sheppard
University of Warwick

In the last issue of *Chagos News* I showed, using data from a couple of runs of the Diego Garcia tide gauge, that sea levels there were rising by an average of between about 5 to 6 mm per year at that site, a rate that might be increasing. This trend is highly significant both statistically and to the coral islands themselves. I showed a couple of temperature runs also, without much comment about that increasing trend. But this year we saw the start of a severe bleaching event, so water temperatures are becoming the centre of attention again.

We have reported before on some extraordinary results from ocean-facing reefs, where a cool thermocline rises to nearer the surface, causing plunges of temperature of 6-8 degrees, at a periodicity of 1-4 days, something which is still unexplained other than the obvious point that this is reflecting internal waves of some kind with very long wavelength. Furthermore, the shallowing thermoclines tended to occur during or towards the end of the March-April warm ocean temperature periods, thus probably bringing some respite to heat stressed corals. The loggers in the lagoons show this far less, and thus are likely to reflect any underlying trend with fewer complications.

We now have nine years of data from one site inside Peros Banhos lagoon, well flushed, and fairly near a major pass, so what of any long term, general trend? Ocean temperatures are well known to be rising – was this detected in atolls of the Chagos too? One logger is located on the side of a lagoon knoll whose slope extends to nearly 40 metres deep (Figure 1). With 2-hourly records, this particular trace has nearly 40,000 data points (Figure 4). Its line of best fit shows a rise of a little over 0.2 °C over the period March 2006 to March 2015, from about 28.3 at the start of the deployment, to

about 28.5 °C in March 2015. These numbers are those of the line of best fit, not of the peak temperatures that trigger coral bleaching of course. This graph is likely to be a good estimate of the *general* changes in temperature in this region – not of just the surface ‘skin’ of the ocean either, but of the substantial, surface body of water in which most of the reef-building corals live.



Fig 1. Location of the Peros Banhos lagoon logger at 15m depth. Image Google Earth

Nine years is not a long time span to measure such things – the variability about the line of best fit shows that. Longer traces with loggers would have been better of course, but we don't have them. The rising trend though is statistically highly significant. I showed before what this trend looked like to the time of writing, and this figure adds in the latest data – the present year when coral bleaching again has hit these Chagos reefs severely.

Curiously, the *average* temperature for the latest year is slightly less, because of a prolonged period of slightly cooler water during the Southeast Trades in 2014. It is important to note, however, that it is not average temperatures that causes the damage but the duration and magnitude of time at the higher temperatures; usually (but not always) these peaks occur in March or April, and this is evident from the

peaks in Figure 2. Whether corals then die after bleaching, or whether they recover, is not only a function of the high temperature itself and its duration, but also the steepness of the rise to that high point and the history of temperature at that location during the preceding few years during which corals may have become acclimated to heat to a greater or lesser degree.

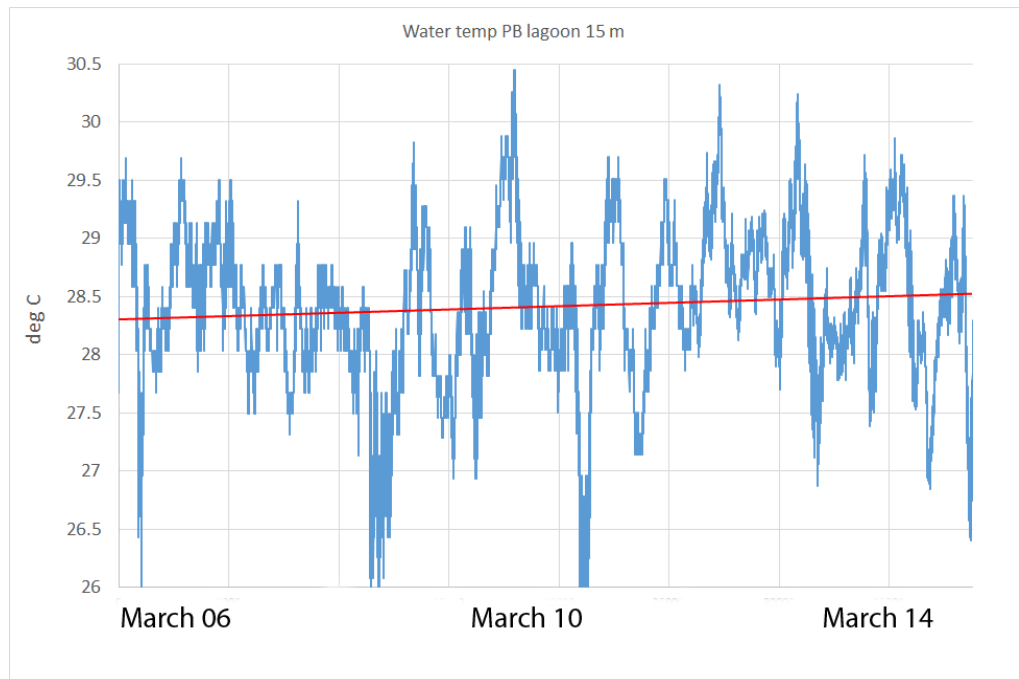


Fig 2. Excel plot of the water temperature from the loggers in Peros Banhos lagoon over the 8 year period. the line of best fit (red line) shows the relationship between averaged temperature and time.

Placing the loggers

Our seawater temperature measurements are obtained using little, affordable instruments that have a specified temperature precision of about 0.2 of a degree. This precision is not great, so several were initially tested in water baths both against each other and in a lab quality temperature controlled environment, and all tested were found to be accurate to considerably better than 0.1 degree, usually differing from each other by only a tenth of that. This testing and calibration was important because the intention from the outset was to collect data at each site over many years, requiring several changes of loggers as and when their batteries became low.

The way we place our loggers is important. These are being used more commonly around the world now, so it is worth noting how it is that we manage to get a good recovery of them – several users simply loose them after a few months, when they break free from their attachments. We recover most, even after being left for a long time. We place each in a piece of plastic pipe and tie those to stakes that are hammered into the reef, with the stakes being pushed first whenever possible through a plastic bag of dry cement which slowly hardens in a shape that conforms to the irregular reef surface. We recover them when we can, but that might not be more often than two or three years (Figure 3). The pipes are a few cm longer than the instruments in order to protect them from rasping and grazing fishes such as parrotfish, whose mouths would soon destroy them or the ties. We still lose some (Figure 4), but we have a recovery rate of over 75%, which is unmatched we think.



Fig 3. Swapping an old data logger for a new one.
Photo Charles Sheppard

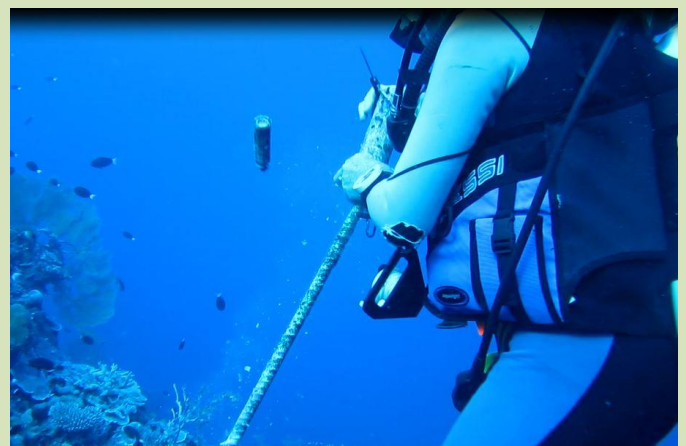


Fig 4. Sometimes the buoyant loggers escape!
Photo Anne Sheppard

The trend shown by this short data series indicates a rise here twice as fast as shown in other *global* trends. This may be important as it provides more good information about the Indian Ocean's tropical heat budget. Ocean warming is a complex issue: in the Pacific for example it appeared to have stabilized for the last few years, called a "warming hiatus" by many scientists. The reasons are complex, and the hiatus was temporary, and recent studies have shown warm water "seeping" from the Pacific into the Indian Ocean. This central Indian Ocean site of Chagos will be useful in such work on climate change and issues around global warming.



Coral bleaching has happened this year. Our expedition in March and April showed water temperatures almost everywhere exceeding 29 °C, and commonly well over 30 °C, to depths of over 20 metres on lagoon and ocean facing reefs. (For comparison, during the severely damaging warming episode of 1998 when most corals were killed, the temperature probably peaked at about 29.5 °C.) We suspected during the expedition that problematic conditions were developing for the reefs, and in fact on some reefs we did see several signs of stress in the form of a paling in the colour of corals, but only rarely any strong bleaching. Our visit this year lasted only up until mid-April but Dr Andrew Bruckner, a later observer on the Living Oceans Foundation research ship that followed us, reported that bleaching developed swiftly and was well underway by late April and May (Figures 5a-d).



But to learn whether that bleaching will lead to a mass mortality, or whether ocean cooling happens in time to permit the affected corals to recover, we will have to wait until a future visit.

Figures 5 a-d showing extensive bleaching in many species of coral.
Photo Andrew Bruckner



Snippets

The editor would like to draw your attention to two new papers just published in leading journals. First, in *Marine Ecology – Progress Series*, by Pippa Gravestock and Charles Sheppard: *Valuing the ecosystem services of the Chagos: a review of challenges and estimates*. The main author is in the finance business who now works on the economics of this and other Overseas Territories. This is part of a special collection of articles on economics of conservation, a much neglected area since it turns out, again and again, that maintaining biodiversity and productivity (i.e. conservation) pays. From this paper it seems that BIOT is one of the most important 'donors' to the Indian Ocean, thanks to its richness! An open access pdf of the paper can be downloaded at <http://www.int-res.com/abstracts/meps/v530/>

An important paper is due out soon in *Ecology*, the journal of the Ecological Society of America. It shows another major benefit of fully no-take MPAs. By Joleah B. Lamb, David H. Williamson, Garry R. Russ, and Bette L. Willis, it is called: *Protected areas mitigate diseases of reef-building corals by reducing damage from fishing*. They found a four-fold reduction in coral diseases in no-fishing areas. This is especially important now that there are worrying increases of coral diseases due to stress on reefs all around the world. It should be published soon. (doi: 10.1890/14-1952.1)

A quadcopter was flown over several islands and reef flats of the Chagos islands on the Darwin expedition this year. This is useful for obtaining various measures otherwise difficult if not impossible to obtain and some clips from the videos here show birds investigating the strange buzzing white thing in their airspace!



Left: Flying over Ile Moresby, Peros Banhos

Below left: Charles Sheppard with the quadcopter on Nelsons Is.
Right: Over the coconut palms of Ile Moresby.



To see the uploaded aerial videos, go to <https://www.youtube.com/watch?v=BAgP25LR2Ok&list=PLgYJmUc38e11i8QGZGLdBD-Sptqc9onVR>