

Chagos News



The Periodical Newsletter of the Chagos Conservation Trust and the Chagos Conservation Trust US
No 43 DEC 2013

ISSN 2046 7222

Editorial

Chagos and CCT are stepping more confidently onto the international stage as an important area for conservation and scientific research. At the recent 3rd International Marine Protected Areas Congress (IMPAC3) in Marseilles, France and in the Big Ocean Managers meetings held immediately after it, it was clear to all that MPAs are critically important in our efforts to try to stave off the disastrous effects of the various chronic stresses that we are inflicting on ocean systems. And very large MPAs (VLMPAs) are of acute importance because they protect whole ecosystems.

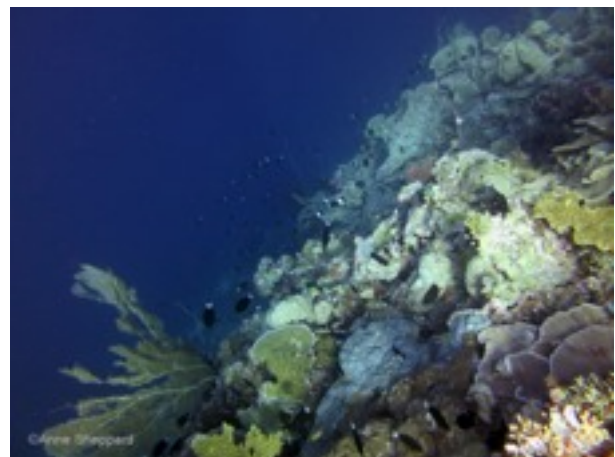
This is not news to most of us, yet there are still those who, because they want to exploit the ocean's resources in various ways, try to negate MPA benefits. One individual at the conference said that we should not have large MPAs because they only make the (tuna) fishermen angry and resentful so that they will not cooperate elsewhere! Industrial fishing's attempts to continue to ride roughshod over conservation work is looking increasingly foolish and being seen for the greed that it is!

There is also a lot of dodgy or delaying 'science' done by, or in the name of, the exploiters. I think there are parallels with research that tried to show that smoking had no harmful effects on human health back in the 1970s. Research on the beneficial effects of MPAs on the ocean's health is showing increasingly clearly that large, properly protected areas are not only good but *necessary*.

It is difficult not to think "I told you so" about governments and other agencies who do not listen to scientists' messages, which are the results of years of research and collaboration. The Philippines have recently announced that they will be planting a lot of mangrove forests to help protect coastlines from future cyclone damage. CCT trustee Dr Heather Koldewey has been proposing exactly that for some years.

CCT trustees, as members of the Big Ocean Network, have also been involved in the drawing up of the *Guidelines for the Design and Management of Large Scale Marine Protected Areas* which will be published next year by IUCN.

Anne Sheppard
Editor



Monitoring Megafauna in the Chagos Marine Reserve Workshop

Dr Matthew Gollock

Zoological Society of London



Between the 11th and 13th October 2013 an international team of 25 scientists and conservationists from 18 organisations and six countries met in Geneva to develop a co-ordinated approach to megafauna science within the Chagos Marine Reserve, as part of a workshop was jointly organised by the Zoological Society of London (ZSL) and hosted by the Bertarelli Foundation.

Previous to the workshop, discussions between ZSL, CCT and the Bertarelli Foundation highlighted the need for a co-ordinated approach to monitoring megafauna, after the Bertarelli Foundation initiated a pilot tagging programme, in collaboration with researchers at Stanford University and the University of Western Australia, in March 2013. This approach would ensure that research is developed to maximise the benefits to the species and habitats of Chagos and to establish the most effective means of information flow between researchers. Many of the species that were significantly affected by the commercial tuna fishery are classed as megafauna and, despite the reserve being created over three years ago, there has still been very little research being carried out on them due to logistical and financial constraints. As such, the organisations decided to bring together scientists and institutions that had experience and expertise of working in Chagos and/or on megafauna, to develop a science plan that would benefit the species, not only within the reserve, but in the wider Indian Ocean context and beyond.

The following organisations were invited to the workshop:

Australian Institute of Marine Science
Blue Marine Foundation
Chagos Conservation Trust
Ecole Polytechnique Fédérale de Lausanne
The Manta Trust
Oceana
Pew Environment Group
Save Our Seas Foundation
Stanford University
UK Government Foreign and Commonwealth Office
University College London
University of Bangor
University of St. Andrews
Swansea University
University of Warwick
University of Western Australia
Zoological Society of London

Over three days of presentations and discussions, participants agreed a vision, mission, values and nine key objectives related to monitoring megafauna in the context of wider research in the region. On the basis of these objectives, an outline five-year science plan was developed with the required infrastructure and immediate next steps identified. A strong collaboration was built during the workshop that will form the basis of a proposed collaborative consortium to develop and implement the plan. The success of the consortium was defined by a transparent and open approach to data- and skill-sharing, common methodologies and a simple, non-bureaucratic framework. This will encompass a complementary approach of five inter-dependent thematic areas:

Monitoring megafauna
Coastal and reef biology
Oceanography and 'ocean observation' of key processes
Conservation and management
Communications and outreach

Participants recognised the value of the Chagos Marine Protected Area in ocean conservation and as an opportunity to test the success of the large marine reserve paradigm. It became apparent that greater conservation and science gains were possible by developing the Chagos Archipelago as an 'ocean observatory' that could potentially connect with similar remote sites elsewhere. The Chagos Marine Protected Area was proposed as a 'hub' for a wide range of research that would benefit conservation and management with the broader vision to highlight the importance of Chagos in the context of the Indian Ocean and the global marine ecosystem.

Chagos 20/20: Protecting a Unique Environment in the Indian Ocean

Damien Clarkson
Director, Social Chic Agency

Just last year UNESCO reported that we discovered 2,000 species of new marine life, with more species being discovered in the last decade than ever before. Sadly, despite still not fully understanding the secrets of the oceans we continue to ruthlessly exploit them for financial gain. Overfishing, pollution, tourism and climate change have pushed our oceans to the tipping point. Our oceans are in the red zone, the sirens are going off but no one is coming...

On Monday 18th November I attended the Chagos Conversation Trust's 20/20 Conference, taking a retrospective look at the conservation of the Chagos Archipelago and gazing into what the next 20 years of conservation could look like.

Professor Charles Sheppard, who has led conservation in Chagos over the past 35 years, kicked off the conference by taking a look back at changes in Chagos' reef environment since he first visited the region. Charles has done more research in Chagos than any other scientist, and has led many expeditions to the archipelago since the first in 1978. He proceeded to outline the horrific El Nino related warming events in the Indian Ocean in the late 1990s. This caused decimation of coral reefs in the Indian Ocean, reducing them by about 90% in many places.

Chagos, however, proved to be exceptional in its ability to bounce back from warming events. While the nearby Seychelles stayed at heavily depleted levels of coral coverage, by 2006 Chagos had substantially recovered.

Charles attributes this in the main to the fact that Chagos remains relatively untouched by other anthropogenic environmental stresses such as overfishing, tourism and pollution. This is also reflected strongly in the huge levels of fish biomass in the region in comparison with other Indian Ocean locations. However he warned it doesn't take much exploitation of the fish population to trigger a dramatic drop in fish biomass levels. Sadly, in Chagos, the same as globally, there has been a lot of shark poaching. This has resulted in fewer sharks but the predator release has meant that the reef fish biomass has increased.

What struck me from Charles' talk is the uniqueness of the Chagos region. In a world where other reef environments are showing little signs of recovery, the abundance and strength of Chagos provides us with such an important learning environment.

The need to learn more about the region and keep conservation a priority is now being aided by smart technology solutions. Dr Elizabeth Widman of Warwick University spoke elegantly about the establishment of The Chagos Science Portal, a new project enabling researchers, governments and the general public to map and access new and existing data in an interactive database.



was fascinating to hear from Dr Jeanne Mortimer of the University of Florida about the abundance of Green and Hawksbill turtles that make the Chagos Archipelago their home and breeding area. She has done fantastic work in surveying 89% of the Chagos coastlines. The development of technology makes the task easier and they have recently started mapping the migration patterns of turtles from Chagos using satellite tags. Again the effects of climate change pose the greatest threat to the turtles. The temperature the sand where the turtle eggs are incubated determines the sex. Warmer conditions will mean fewer male turtles that could eventually lead to extinction.



Photo copyright Chagos Conservation Trust

Pete Carr gave a wonderful talk about the relationship between the number of birds on the Chagos islands and the trees that grow there. Basically, they don't like the monocultures of coconut that were planted there. But on islands which were too small for a plantation, and therefore native vegetation and no rats, the birds thrive in huge numbers. Islands where the native vegetation is being restored are starting to show large numbers of birds returning to live and breed.

My own experiences of diving set me on my path of conservation. Getting across the beauty of these places has to be a key ambition of conservation organisations. I accept not everyone is going to be able to travel around the world see these beautiful areas firsthand, but those of us with a desire to preserve nature must hold our government to with

regards to our overseas territories in exactly the same way as we do with our countryside here in the UK.

The afternoon saw Alistair Gammell talk about the campaign to create the Chagos Marine Protection Area. Many respected NGOs came together for the campaign to create the reserve and the order to create it was one of the last instructions given by David Miliband the Foreign Secretary on the eve of the 2010 general election.

Dr Daniel Wagner then talked about the rare and elusive deep water organism, black coral, from the Chagos Archipelago. When asked by a member of the audience about the impacts of the climate change he said that, not having a calcium skeleton acidification will not affect them, but it has been shown that as acidity increases these corals become stressed and start to develop diseases.

Climate Change was a recurring theme throughout the conference, with the speakers highlighting the clear threat it poses to the health of reefs and the marine life that inhabits them. The latest Intergovernmental Panel on Climate Change (IPCC) report indicated the temperature of the ocean is set to continue increasing and that the oceans are warming at a faster pace than suggested in the last IPCC report and at a faster rate than at any time in the past 10,000 years. This poses a grave threat to the reefs of the World and low lying coastal regions. The projections from the report put average sea level for the period of 2080-2100 at 45cm-82cm, higher than in 2007. Furthermore, as the extra CO₂ in the atmosphere finds its way into the ocean, increasing acidification also occurs.



Photo copyright Chagos Conservation Trust

As we approached the end of the day the focus turned to history and the future of the Chagos Archipelago. Nigel Wenban Smith gave a fascinating talk outlining poor historical conservation practices. We then heard from Rudy and Louis from ZSL talk about the continuing outreach programme to the Chagos community. The Chagos Ambassadors programme gives the Chagossian community a lot of information about conservation.

The day ended with a spectacular Chagos film by filmmaker George Duffield, who made the award winning film *The End of the Line* which has proved to be very influential in fisheries conservation work.

The conference provided me with a valuable insight into a region we hear so little about in the UK media. The beauty and uniqueness of Chagos has left me with a strong conviction that the

ongoing preservation of Chagos is vital; especially as other reef areas continue to degrade under the pressures of human exploitation and climate change.

After today I certainly will be making it a 2014 resolution to dust off my PADI open water diving licence and reconnect with the beauty of our marine environment.

Damien is a digital communications strategist and social media specialist with a track record of creating powerful campaigns that capture the imagination and inspire supporters to take action. Damien's career has so far included time working in the voluntary sector for major charities. He is a passionate about campaigning to protect the environment and is also a director of the climate change action campaigning group Climate Rush. You can connect with him on Twitter [@damiencarlson](https://twitter.com/damiencarlson) or email him at: damien@socialchicagency.com



What a Waste

Anne Sheppard
University of Warwick

Beach litter has always been pretty abundant on the Chagos islands. During the research expeditions there in the 1970s, the main items washed onto the beaches were rubber flip flops (mainly left-footed ones for some unfathomable reason, maybe the right-footed ones circulated in the opposite direction!) and glass fishing floats with their macramé web rope covering. We happily salvaged the latter treasures and, during the long expedition of 1978-79, we frequently had to salvage some of the flip flops too.

Over the years we have noticed a great change in the items being washed up. Not such a dramatic change in 1996, but by 2006, plastic items on these beautiful and remote beaches were abundant. On the last expedition in February 2013, a particular stretch of beach caught my attention with a profusion of plastic drinking water bottles. I counted 45 plastic water bottles on a 15 metre stretch of beach on the northern spit of sand on Ile du Coin, Peros Banhos. From the labels, most came from Indonesia.



Beach litter is one of the things that have been monitored in Chagos for many years. Prof Andrew Price has covered large areas of these atolls carrying out his rapid assessment surveys. <http://onlinelibrary.wiley.com/doi/10.1002/aqc.1029/abstract>

These show that Chagos beaches have more litter than most other Indian Ocean beaches. Perhaps this is because much of it is scavenged for use or recycling by the local people in other places, but another reason that so much litter ends up on the beaches of the uninhabited Chagos islands is part of what makes this archipelago so special to marine life – it is on the route of ocean currents which bring and take the larvae of many species across the Indian Ocean. It unfortunately also brings the waste plastic.

The issue of plastic in the environment is an increasing problem globally. It takes so long to break down that it will all be with us for a long time. And we keep adding to the pile. When, after some time, it seems to have decomposed, it has done no such thing. It just breaks down into smaller, plankton-sized bits of plastic that can be ingested by smaller creatures. <http://www.sciencedirect.com/science/article/pii/S0025326X11005133>. Many plankton feeders ingest it and even zooplankton in the ocean are killed by ingesting microscopic fragments of plastic which they cannot digest and so die of lack of food. On top of that, many persistent organic pollutants (POPs) adsorb onto the surface of the plastic fragments making them toxic too. <http://rstb.royalsocietypublishing.org/content/364/1526/2027.short>

The rapid assessment survey also found that there were much lower levels of beach litter on Chagos' inhabited southern atoll of Diego Garcia. This is due to a group of environmentally conscious personnel on the island who have regular a beach clean up (see Chagos News 39). They should be commended and must be pleased to see that their efforts have a noticeable effect.

The effect of plastic in the ocean is starkly illustrated in this tragic short film shot in Midway Island in the Pacific Ocean <http://www.youtube.com/watch?v=dtJFiIXp5Bo>. Please think carefully before you buy, and especially dispose of, plastic bottles. Drinking water bottles are commonly made of Polyethylene terephthalate, or PET. This can be identified by the numeral 1 inside the recyclable symbol. This material can be recycled if it is disposed of in the right place, and there is more demand for colourless



plastic waste for making into other things such as clothing, pillows, carpets and more PET bottles.

So, how can you help? The infographic here shows how much of a global problem water bottles are in the oceans. Buy yourself a re-usable bottle and carry it with you on journeys rather than buying a new bottle. If you have to buy one, please make sure that you recycle it.

M.A. Barlaz et. al. (2009). Transport and release of chemicals from plastics to the environment and to wildlife. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 364, pp 2027–2045

M.Cole, P.Lindeque, C.Halsband & T.S.Galloway (2011). Microplastics as contaminants in the marine environment: A review. *Marine Pollution Bulletin*, 62:12, pp 2588-2597

A.R.G.Price & A.Harris (2009) Decadal changes (1996–2006) in coastal ecosystems of the Chagos archipelago determined from rapid assessment. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 19:6, pp 637–644



Nelsons Island
photo Anne Sheppard



Big Ocean network convenes at meetings held in conjunction with the International Marine Protected Area Congress in Marseille

Dr Daniel Wagner

*Papahānaumokuākea Marine National Monument/
NOAA*

On October 21-26, 2013 Big Ocean managers and scientists gathered at a series of meetings held in conjunction with the Third International Marine Protected Area Congress (IMPAC3) in Marseille, France. IMPAC is one of the largest gatherings of marine conservation professionals from around the globe, and this third congress brought together over 1,200 marine specialists to propose solutions for the conservation and sustainable development of the world's oceans. Big Ocean had a very active participation at IMPAC3, organizing two half-day sessions on (1) the historical challenges and progress of large-scale MPAs, and (2) developing practical guidance for managing large-scale MPAs. Additionally, Big Ocean participated in a plenary debate at IMPAC3 that discussed whether size matters in marine conservation.

In addition to the events at IMPAC3, Big Ocean managers and scientists convened in Marseille at a number of events that were held independently of the congress. These included the 5th Big Ocean business meeting and a full-day writing workshop. During the business meeting, all seven of the current Big Ocean member sites (Great Barrier Reef Marine Park, Papahānaumokuākea Marine National Monument, Phoenix Islands Protected Area, Mariana Trench Marine National Monument, British Indian Ocean Territory Marine Protected Area, Motu Motiro Hiva Marine Park and Cook Islands Marine Park) provided updates on their most significant achievements in the last year, and discussed future collaborative projects for the network. In particular, Big Ocean is currently working with the International Union for the Conservation of Nature (IUCN) and the World Commission on Protected Areas (WCPA) to develop a publication that will provide practical guidelines on the design and management of large-scale MPAs. For this purpose, Big Ocean hosted a full-day writing workshop in Marseille, during which marine conservation professionals were engaged to provide a substantive review of the current draft of the guideline document.

“Big Ocean: a network of the world's large-scale marine managed areas” was established in 2010

with the aim of improving marine management efforts through sharing information, expertise and resources. Currently composed of the seven largest MPAs on the globe, Big Ocean sites encompass over 3.3 million km² of ocean ecosystems, an area that is over twice the size of the Gulf of Mexico. Representatives from the British Indian Ocean Territory have been active participants in all Big Ocean meetings since the inception of the network, and thereby helped improve marine management efforts around the globe.



Big Ocean managers and scientists gathered at their 5th business meeting in Marseille, France.



Participants of the Big Ocean writing workshop that reviewed the draft guidelines for the design and management of large-scale MPAs.

Chagos Conservation Trust - US Sponsors Scientist for 2014 BIOT Expedition

*Dr Sam Purkis
Nova University*

In the Spring of 2014 a team of scientists, jointly led by Drs John Turner and Heather Koldewey and Prof Charles Sheppard, will travel to the Chagos Archipelago to carry out ongoing scientific work in the world's largest marine reserve. Participating in this expedition will be a scientist, based in the United States, whose travel expenditures will be sponsored in full by a grant from the Chagos Conservation Trust US (CCT- US) thanks, in part, to a generous contribution from the Kayne Foundation (Suzanne and Ric Kayne).

The CCT- US was established in 2009 to aid the protection of the Chagos Archipelago coral atolls in the Indian Ocean by preservation of the natural diversity of plant and animal species through the prevention of environmental degradation and destruction. The mission of the CCT-US is to extend the goals of Chagos Conservation Trust (UK) to the United States by promoting conservation, science, education and historical research in relation to the Chagos Archipelago.

As part of this mission, the CCT- US aims to promote the role of US-based scientists in ongoing Chagos research. To realize this aim, we will

embark on a fundraising push to provide financial support to allow a US-based scientist to join scientific expeditions to Chagos. We will cover travel costs of the CCT-US Expedition Scholar who will be an outstanding scientist whose work will deliver meaningful and lasting insight into this Indian Ocean ecosystem.

Application notices were distributed through social media and environmental membership list links that are connected to targeted audiences consisting of trained professionals with the required skills to be a successful candidate. The funded candidate must be US-based and an active member of the CCT - US. Selection of the scholar will be made on the basis of creativity, motivation, productivity, and publication record. The successful candidate will be expected to remain involved and actively contributing to research in the Chagos after their month-long field visit to the British Indian Ocean Territory.

The deadline to submit (1) a curriculum vitae, (2) a short narrative on research interests and/or possible research projects, and (3) the names and contact information for three references was November 25, 2013. Currently submitted applicants are under review by the CCT- US Executive Committee. Full details of this scholarship opportunity are available on the CCT- US website behind the following link: <http://cctus.org/conservation-science/us-expedition-scholar/>.



The Chagos Marine Protected Area protects a huge area of sea floor and seamounts from trawling.

New Chagos reef exhibit at ZSL London Zoo

Rachel Jones

Zoological Society of London

A new 8,000 litre reef exhibit focusing on the Chagos Archipelago has opened at ZSL London Zoo. The habitat shows a mix of fish and invertebrates with a focus on species from the Indian Ocean. The stars of the show are a group of fairy wrasse (*Cirrhilabrus squamipinnis*¹) which are a fantastic combination of red and purple and are often seen displaying to each other by raising their striking dorsal fins. The exhibit also houses a varied collection of coral species all confiscated by UK customs under CITES legislation. The design of the 'reef' structure has been purposely created quite low in the tank to give the maximum amount of vertical space so the corals can achieve their full potential size which will take many years of slow growth. The habitat is in the early stages of breaking in and has a long way to go before it is fully mature but it will be worth keeping an eye on as it develops over the next few years into a beautiful and complex miniature reef environment.

1. **Randall, J.E. and A.R. Emery, 1983.** A new labrid fish of the genus *Cirrhilabrus* from the Chagos Archipelago, Indian Ocean. *J. Aquaricult. Aquat. Sci.* 3(2):21-24.



Siganus corallinus

Photo copyright ZSL



Zebrasoma desjardini

Photo copyright ZSL



Reef aquarium

Photo copyright ZSL



Cirrhilabrus rubrisquamis

Photo copyright ZSL

International Marine Protected Areas Congress 3rd International Conference

*Alistair Gammell
Pew Global Ocean Legacy*

The International Marine Protected Area Congress is held every four years, and the latest, the third, was held between 21st and 25th October in Marseille, France. With only seven years remaining to reach the target to protect 10% of the world's oceans by 2020 (it was originally by 2012, but that was missed!), 1,500 participants from 87 nations attended workshops and plenary sessions aimed at increasing the effectiveness of efforts to protect the oceans.

When the second Congress was held in Washington DC in 2009, the Chagos Reserve didn't exist. In Marseille however, it was heartening to see that in numerous PowerPoints and posters, Chagos was very definitely "on the map". What was even more heartening was not only the number of scientists that had visited the Chagos on scientific expeditions and who spoke highly of its exceptional values, but the number of scientists and others who wanted to visit.

The highlight on the congress as far as Chagos is concerned, was the premiere of a short film produced by George Duffield as a result of his visit to the archipelago as part of the Bertarelli sponsored scientific expedition to tag and study the movements of large predatory fish. The showing was well attended even though it was scheduled outside of the main event agenda. The managers of the marine protected area, the BIOT Government, attended.

A paper was presented which purported to show that FADs deliberately released by the fishing industry and allowed by them to drift into the Chagos reserve, had the effect of reducing its effectiveness by luring tuna to follow the FADs as they drifted out of the reserve. Assuming this is correct, how irresponsible is it of an industry to permit their equipment to damage conservation efforts and shouldn't they

be responsible for equipment they dump overboard and pay penalties if it subsequently causes damage? Of course it makes the case for large reserves, since smaller reserves could be more easily detrimentally affected by such activities, whereas the larger the reserve the less the impact is likely to be.

At the Congress a proposal to create an 834,000km² marine reserve in Pitcairn received considerable exposure, with two Pitcairners, Simon Young and Melva Warren Evans travelling to the Congress (probably no other delegate had travelled further to be there) and speaking passionately of their Island's wish to protect their waters.

At the congress, Mission Blue announced 50 new "hope spots". Chagos was already in the initial list of hope spots, but more information on this initiative can be found at <http://newswatch.nationalgeographic.com/2013/10/22/bold-plan-for-50-ocean-hope-spots-announced-at-impac-3/>

Following the congress a meeting of the "Big Ocean" network was held to exchange experience of managing the world's largest marine protected areas. Chagos was represented at this by Charles and Anne Sheppard.



Environment Training Course

Audrey Blancart

Zoological Society of London

Last year ZSL ran the first Chagos Environment Training Course with a team of twelve Chagos ambassadors from both the Manchester and Crawley communities. This year, we embarked upon a new intensive summer of learning and activities, with three themes: Marine conservation, Terrestrial ecology and Communication for conservation, where the eleven trainees could experience some wild outdoor adventures while building on conservation knowledge and skills. The course was set throughout the summer with a mixture of long weekends and various days away. It started at Sayers Croft where the two groups met before splitting again for a few modules.

Team building weekend

This weekend provided the trainees with an introduction to the training course. It also helped to explore the concept of being Chagossian and establish a baseline of the training content. The overall aim for the weekend was to create a team dynamic through various team building outdoor games such as high ropes, team building exercises and land restoration. The weekend also aimed to establish a group baseline of knowledge on coral ecology via an introductory documentary followed by a quiz. The overall weekend was a successful introduction to the training and its team players.

Habitat management

This session was about engaging the trainees in practical habitat management tasks and provided an introduction to the concepts that underpin them. It was also an introduction to problems caused by invasive species in an ecosystem. For this module, the group was split between Crawley and Manchester. The trainees explored the characteristic of a moss land at Risley Moss with the great support of Natural England. The site reflected some of the problems experienced on the Chagos islands in a UK setting, with invasive rhododendron and large areas of encroaching bracken which the trainees cut down before building a dam to assist as part of mini-moss

restoration project. During this time, the Crawley team spent a day at Hampstead Heath, with Justin and Grace from the ranger's team. They too learned about invasive species and their effects at the heath, such as Himalayan balsam and non-native Signal crayfish. They were introduced to the issue of invasive species that have to be managed carefully. They also got the chance to try out tree climbing.

Birds

This module expanded on previous learning about classification, identification, and monitoring and habitat management through ornithological activities, while applying this to Chagos-specific case studies. In Wales, the group of trainees was introduced to sea bird monitoring, with the help of Kathy, a wildlife professional and expert on the local area. From the sea cliffs at the RSPB reserve of South Stack, we explored the star species of the regions: choughs, guillemots and razorbills. A quick trip over to allow the trainees to catch the last few Sandwich terns of the season, rounded off by views of a small grey seal colony and a boat trip to Puffin Island to identify some more bird species.

Botany

Equipped with microscopes at the Ness Botanic Gardens, the trainees discovered plant anatomy. They had a guided tour around the gardens where they learnt about flower adaptations and pollination. The highlight of the day was discovering some of our everyday vegetables and fruits can be poisonous if consumed in large amounts. With interest, they also learned about the perfect condition and management needed to grow your own vegetable garden. They also learned the difference between growing plants in a tropical



environment compared to the UK. Aside from the beautiful flowers and varieties of trees in the garden they also learned about diseases that can affect trees and how to manage it both for the tree itself and also for the safety of the people visiting the garden. The trainees discovered how the Gardens manage their exhibits and learn about their conservation work.



Photo copyright ZSL

Marine

In this session, the marine specialist, Rebecca Short, engaged the trainees with information about Marine Protected Areas and fisheries practices, ending the session with a role play game where everyone represented a key stakeholder in marine industries. This was essential to the understanding of various challenges that NGOs, governments or fishers face every day. John Turner, from Bangor University, gave the trainees a taste of Chagos' pristine islands and marine wildlife before taking us to the sea shore for a real life biological survey. The trainees really enjoyed the adventures and identified many species.

The trainees ended their weekend in Wales with a try dive where they could experience their first feeling of being of diver.

Coral reefs

The purpose of this module was to develop a basic understanding of biological identification, classification and monitoring activities, as well as introducing the idea of ecological damage through looking at context-specific examples. Corals are always one that are very challenging to understand from the basic structure to the differentiating the species. At the Deep in Hull, the Manchester trainees were immersed with the activities planned and showed high curiosity for coral identification. They were able to identify the different walls within the corals, the types of coral, and even some species.

In Crawley, the day was spent at London Zoo Aquarium, with Rachel Jones. The group learnt about the different types of corals and their vital functions. They were introduced to the concept of climate change and how it's devastating impact on the world's coral reefs.

Communication and careers

In this session, we raised awareness of the pool of opportunities for skills development in conservation, going through local volunteering opportunities or bursaries available. We also build basic knowledge around social communication and event management.



Photo copyright ZSL

In Manchester, the trainees walked around Manchester Museum where they could talk to volunteers and understand how volunteering helps to develop a set of various transferable skills. They also had a short introduction to the living collection with Andrew Gray who was very engaging and gave the trainees an opportunity to do some frog and snake handling.

Anna also introduced us to communication and event management, before they had to go and create their own 'Chagos Event' as a group. This same session was delivered at London Zoo with the team from Crawley. We had a mix of different speakers from conservation, education and zoo backgrounds describing their careers.

Award ceremony

The nine weeks of the training course closed on an inspiring note. The Award evening ceremony was held in the historic site of Manchester Museum. Forty people were present, including the trainees and their families but also our project partners such as Bangor University (John Turner), Pew (Tania Paschen) and the BIOT Administration (Tom Moody). The event opened with a talk by ZSL

Education officer, Ana Pinto, followed by the story of her training by Lia Tallot, one of this year's trainee and Rudy Pothin, assistant ZSL outreach officer. John Turner then reminds us why the ecology of Chagos was crucial and part of an interdependent system. Heather Koldewey, ZSL, finally closed the event by awarding each trainee a certificate and a medal.

Advanced skills training

This year, a number of last year's trainees have been involved in advanced skills training – applying for bursaries to facilitate opportunities to further their skills in areas of their interest.

Following last year's course, Yannick Mandarin also participated in an expedition to the Chagos Archipelago. Aboard the Pacific Marlin, he was assisting researchers with bird monitoring activities as well as experiencing a full and varied scientific expedition.

Claudia Naraina and Cyndie Residu successfully applied for bursaries to complete their PADI Open Water SCUBA training, as well as to join Yannick on a challenging weekend with Ian Robinson of the RSPB, where they learnt the basics of chainsaw use, gaining a LANTRA CS30 qualification.



The new IPCC report on climate change, and what it might mean for reefs and islands of Chagos.

Professor Charles Sheppard
University of Warwick

A large publication by the Intergovernmental Panel on Climate Change (IPCC) was released a month or so ago, the fifth in the series and the first for about six years. The document published was the first of a group, with some more technical volumes to follow over the coming weeks. It does not present new research as such; rather it collates and interprets huge amounts of information from published sources, assembles them, and reports on the status of the world's climate and its effects on the world's habitats and regions. Furthermore, probably most importantly, it tries to predict where climate is heading over the next few decades, and some consequences. It is an enormous enterprise involving over a couple of thousand people to differing degrees, and a few years ago the Panel was awarded the Nobel Peace Prize for its efforts.

We know that coral reefs are one of the world's 'canaries in the cage' when it comes to climate change, meaning this tropical habitat is particularly vulnerable for several reasons. Furthermore, this habitat creates land like no other, such that several dozen nations of the world are made entirely of coral reef or have substantial portions of their land made by it. Many more gain protection from the breakwaters that reefs make as they grow up to the surface of the sea. I am particularly interested in this subject having helped with several elements of the story in a few countries. Here I summarise some of the key findings of the new IPCC report as they relate to oceans and to coral reefs, and then I relate this to the atolls and waters of the Chagos Archipelago.

In global terms, the upper ocean has warmed over the last 40 years. Strongest warming is, unsurprisingly found in the shallowest waters. This does a couple of things. Warming kills corals, and perhaps this will prove to be the most important or at least most immediate aspect of this story. Secondly, warming anything will make it expand, so that warming also increases sea levels as the ocean's water column expands. In fact, a substantial portion of sea level rise comes not from more melting water entering the world ocean, but simply by expansion of water that is already there.

Another factor is that the heat content of the oceans (as separate from temperature) has also increased. This is important to many global

weather patterns: ocean warming dominates the global energy change inventory to the extent that 93% of the increase in the Earth's heat energy is accounted for by the oceans, mostly the shallow portions. The importance of this includes expansions of and changes to the huge ocean sub-tropical gyres.

As a result, global sea level rise is accelerating: Over the last century it has averaged about 1.5 mm per year, but taking the last 25 years alone it has been over double this amount: about 3.2 mm per year. Forecasts are alarming to reefs and islands which are so close to sea level now: the new IPCC projects a further increase of the *rate* of rise later this century to over a centimeter per year or more – meaning up to half a metre or even one metre more by the end of this century, much of this happening well inside the lifetime of people now alive. Furthermore, the IPCC says, it is likely that the magnitude of extreme high sea level events has increased since 1970. It is, after all, not averages that do the damage but extreme events.

Acidification is another aspect. This happens when carbon dioxide dissolves in water, forming (initially at least but in a very complicated way) carbonic acid. Ocean acidification has become a well-researched area, with alarming forecasts of how much even a tiny amount of acidification will depress the growth of corals. Put simply, the skeletons of corals are limestone – an alkaline kind of rock – which is made by corals less effectively in seawater that is even slightly acidified.



Lagoon side of Eastern Diego Garcia, where the soil around an old tree has eroded away from its roots

Furthermore, the form of limestone that corals make is aragonite, the most susceptible of the various possible kinds.

So there are several aspects which all conspire to harm corals and reefs, but unfortunately there is more: some of us published a review earlier this year on synergies between harmful factors. Broadly, the harmful effects of one factor may be enhanced, or amplified, when acting in conjunction with others. That is not good news for reefs, unfortunately.

How will this relate to coral reefs, in particular to Chagos? Well, there are several aspects that are of immediate significance.



Photo Charles Sheppard

Ile on Peros Banhos atoll. In a few places, former, mature coconut trees have now ended up in the intertidal region.

First is continuing warming of surface ocean waters. (By surface layers, the IPCC often mean the upper few hundred metres. This is itself a complicated issue given the existence of marked thermoclines, but we can take it as including the shallow depths where corals grow.) Temperature kills corals, not smoothly but in spikes, or episodes, killing them in some years, in other years not. In a typical year and on a healthy reef, corals grow, and reefs grow too (not the same thing in fact, but they are related), and at the same time, bio-eroding animals and plants etch away at corals and at the more solid reef matrix, wearing it down. Growth of a reef is, if healthy, a tiny bit greater than erosion, which is why coral reefs and islands have developed over long periods of time. But if corals are killed, or damaged by sub-lethal bleaching only, growth is held up, while erosion continues all the time. Unfortunately it seems that

eroding and boring species don't seem to mind the warmer spells at all.

Thus reefs become eroded. We have studied this in the nearby Seychelles. Reefs are breakwaters that protect the islands: reduced breakwaters equals more wave energy striking the shores and eroding them away.

Secondly, and at the same time, is sea level rise. The global average for this is a little over 3 mm per year, and accelerating, and that for Chagos is now thought to be about the same. Chagos islands and reefs are not immune from this, as has been proposed by some in the past. So as sea levels rise, erosion of damaged reefs means their effect of protecting islands declines. Our work that I referred to in the nearby Seychelles showed us that the increased wave energy striking the shores has more to do with degrading reefs than it does with absolute sea level rise. This has not been examined in Chagos – it is one of many things that we simply have not had the opportunity or funding to do there yet.

It has been said by some that global averages don't apply to reefs and islands of Chagos (there are strong regional patterns across the world of course), but new and so far unpublished measurements show that in Chagos the sea level rise does mirror pretty closely the global average. Here too, projected rises are thought to be accelerating, and it is very likely that the frequency of extreme levels will increase by an order of magnitude or more by the end of this century – a huge amount.

The only thing at issue is the timing of it. I have watched erosion happen on several islands of Chagos over the last years. It is complicated. There is indeed one atoll, Egmont, where sand accumulations have actually joined up several islands leading to an apparent increase of land area (though other parts of that atoll have become very thin now as well). On the other hand, it is not too alarmist to say that atolls can submerge completely – Blenheim Reef in northeast Chagos is an atoll that was reported to have had three vegetated islets on it when first discovered, but it is now submerged – its islands washed away.

People have been confused by shoreline movement so let us distinguish between 'white sand' movement and 'brown earth' movement. All coral islands have pretty mobile shorelines, which ebb and flow seasonally, or perhaps on decadal timescales or longer. New sand that is washed up is white sand – freshly made from ground-up

corals for example. This is the kind that can accumulate in places, and later wash away - large banks of it can come and go. But brown earth is very 'old', its dark colour coming from humus developed over many decades - it is a thin topsoil, richer in dark organic matter. It is this that is becoming eroded in many places in Chagos - more of a one-way process. The erosion of some vegetated parts of Egmont's islands looks to be of brown earth.

Diego Garcia is an interesting case in point. Leaving aside the artificially landfilled western side where the military facility is, the eastern arm is also eroding away quite noticeably now. There was a paper published last year saying the rim of this island is increasing. I don't like to criticize authors, but that paper has been picked up and used in predictable and rather ill-informed resettlement arguments (not by the original authors I hasten to note). However, that paper was severely flawed, caused by the authors' comparing modern satellite images with a drawing of the atoll done in the late 1960s reproduced on a journal's page. That was quite inappropriate. So I obtained an aerial photo mosaic taken in 1965 and, comparing that with modern satellite images, confirmed what has been obvious to the eye on my annual visits to that atoll: far from expanding, Diego Garcia's land there is being eroded. (My note, in the same journal, will be posted on the chagos-trust.org website when I can sort out the copyright issue.) Diego Garcia's



Eastern Diego Garcia, lagoon shore, where old hardwood trees are becoming toppled as their soils are washed away.

eastern arm is getting eroded quite noticeably. In the military base area there is a shoreline 'hardening' programme, currently costing about many millions of dollars per year.

There is a third aspect too which will affect Chagos shores. As sea levels rise, so severe stormy events are likely to get yet more severe. This is of most interest to shipping, unsurprisingly, and is more marked in colder waters than the tropical Indian Ocean, at least so far. Chagos is too close to the equator for some events like cyclones, though it certainly can become brushed by their edges. Time will tell. But it is not, all in all, good news for these gorgeous islands, nor for their reefs, let alone the ability of the latter to support a thriving and rich ecosystem. Present evidence shows that those of Chagos are doing far better than almost all others in the Indian Ocean.

Despite the climate change deniers, and those who would like to deny aspects of it for Chagos (I would like to deny it also, but as a scientist I simply can't!), warming with its attendant harms to reef growth is said by the IPCC to be unequivocal. Many of the changes observed since the middle of the last century are unprecedented over time scales of centuries and even millennia. From our work on synergistic effects, I think that it is imperative to avoid any and all local factors, such as fishing, shoreline disturbance, sewage inputs and others, in order to as much time as possible for these reefs. This seems to delay degrading effects of climate change hopefully for a few decades.



Eastern Diego Garcia, lagoon shore, where a large navigation marker now abuts the beach with undercutting of its foundation.



Photo Charles Sheppard

The track in eastern Diego Garcia. It has had to be moved inland twice in the last few years.

What of the future then? It isn't good news. In global terms, some have said that we can manage the problem. Well, we don't really seem to be able to do so. We could perhaps all these impacts in theory, and scientists do know how to, but all over the world the pressures continue to stress reefs, coming from vested interests on one hand, to the immediate needs of starving people on the other.

Human influence on the marine climate system is clear, says the IPCC. We do not appear to know how to live in a sustainable or eco-friendly way, despite the claims of many to be able to do so. While reduction of carbon dioxide is probably the most critical aspect, this is beyond any ability of the governance of BIOT, or any small State. But let us not subscribe to the view that all is doom for reefs necessarily. It clearly looks that way on present trends, but those in Chagos have probably the best chance of any at present.



Photo Charles Sheppard

Shallow edge of Turtle Cove in Diego Garcia on an outgoing tide.