Chagos News

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Editorial

This is a very exciting time for the Chagos Conservation Trust! Professor Charles Sheppard, Dr John Turner and Dr Heather Koldeway have been given a Darwin Award by DEFRA to carry out research in Chagos over the next two and a half years. This will mean three expeditions – in February 2013, November 2013 and February 2014. The purpose of the work is to further inform the management of the Chagos marine reserve in particular and also to develop the baseline of information from as unspoilt a location in the Indian Ocean as possible to help with management in other marine reserves.

Being awarded this grant shows recognition of the important role that Chagos plays as a scientific baseline, and it is likely to become even more important for this purpose in the future as more scientists need to study a comparatively unspoilt reef ecosystem. This became very apparent during the expedition there during February 2012, because a lot of the research was using the fact that Chagos is unspoilt and so can be used to compare data from there with other locations globally.

Another big part of grant aided work is the Island Restoration Project, a description of which is given in this issue of *Chagos News* by Pete Carr. This is a tremendous project which will hopefully restore some islands to their pre-plantation days condition, with native hardwoods and hugely abundant seabird colonies.

Three more grants have been awarded recently too. One is from the FCO and concerns outreach to Chagossians and their descendants living in the UK. Much more on that in this issue by Xavier Hamon of ZSL. Secondly, another Darwin grant will progress research of turtles in Diego Garcia, awarded to Science Advisory Group member Professor Graeme Hays, and he will be working there with Dr Jeanne Mortimer who has worked in Chagos several times before, thanks to funding from the FCO. And thirdly an expedition to research pelagic and deeper regions will depart this November, led by Professor Jessica Meeuwig from the University of Western Australia. This work commenced in February's expedition, and has subsequently successfully trialled the new pelagic method off Australia. These results promise to be striking.

All in all, the science is advancing well. And on Tuesday 27 November there will be a conference on Chagos at the ZSL. This follows the very successful one in November last year at the Linnean Society, though at that one the room capacity was 100 people and so quite a few had to be turned away; this time the meeting room is larger.

We also have a new website which will be frequently updated with new information pertaining to Chagos. Did you follow the blog from the 2012 expedition? It had a wide readership and was syndicated to prestigious organisations like Scientific American. We hope that a daily blog will become a feature of future expeditions, as a way of drawing the CCT membership into the expedition.

CCT is also now employing two consultants to help out with all the extra work that is being done and needs to be done. Charley Cranmer is a fund raising specialist, and hopes to raise grants for particular important projects that CCT want to undertake in Chagos. Kate Longhurst is our communications and outreach consultant, and she will be undertaking many projects to help people understand the importance of the Chagos marine reserve. She is also helping with the production of *Chagos News* starting with this issue.

Anne Sheppard
Editor

The 2012 BIOT Expedition

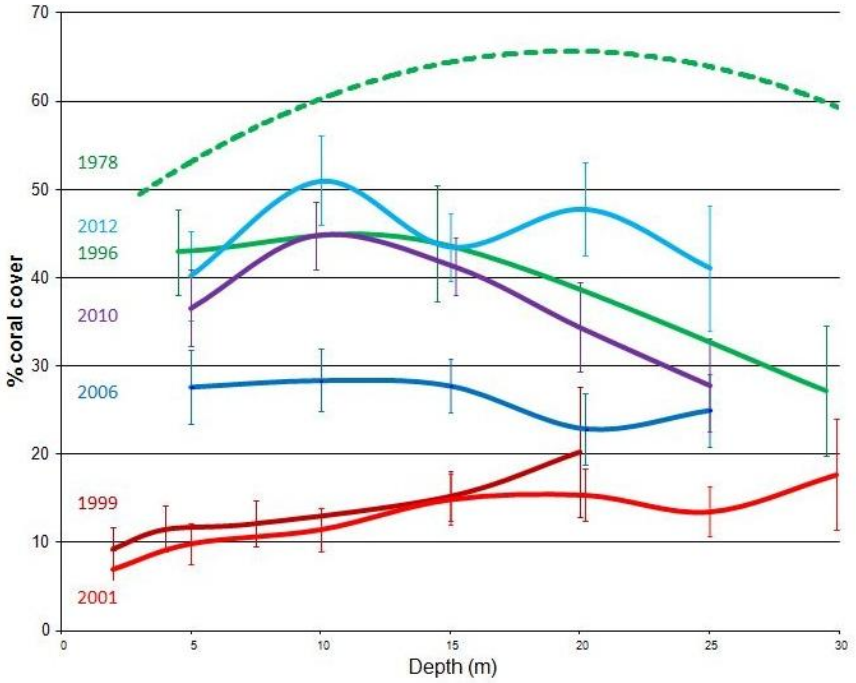
© Anne Sheppard

Using quadrats to survey the reef corals at 20m deep, surrounded by fish

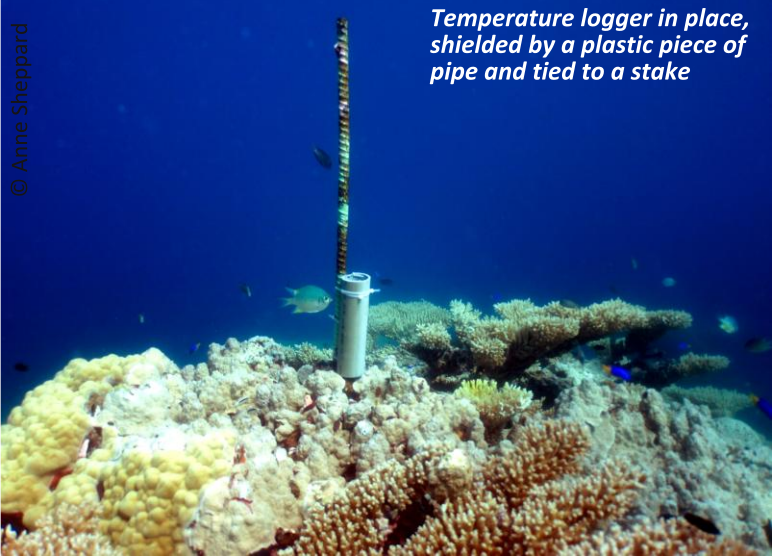
In February 2012 a team of scientists visited the Chagos for the first scientific expedition since the declaration of the Marine Protected Area in April 2010. Expedition Leader, Professor Charles Sheppard, introduces a series of reports on the work the team carried out.

The expedition in early 2012 pulled off some remarkable research, made some major discoveries (not all of them good unfortunately), conducted quite a lot more of what has now become routine monitoring work, and started one or two new lines of research as well. The next several pages amplify a lot of this, though of course, as is the case with all science, much still needs to be analyzed and worked up. Some of this has been briefly written up in an expedition report for BIOT on our return and this is available at www.chagos-trust.org/resources. The following is more my impressions several months on and focuses on my own observations at the time, leaving others to describe in greater and better detail their own parts later.

My own work starts with monitoring the reefs and their condition in broad terms, as has been the case almost every time I have visited the northern islands. To do this we count numbers of coral and soft coral colonies, numbers of interactions between colonies, and total coral cover at 5 m depth intervals down to our maximum depth of 25 m deep. The abundance of fish in several sites often made viewing the seabed complicated! We have seen a remarkable recovery (in terms of the amount of coral covering the reef at least) subsequent to the major devastation caused by the 1998 sea water warming. Below is a graph, an earlier version of which has been shown at presentations before, but here with the 2012 data added to it – the light blue line is 2012. Coral cover now exceeds that which existed in Chagos in 1996, in other words before the major warming wipe-out. But there is an interesting twist to this data. You can see on the line for 2012 the dip which occurs around 10 or 15 m deep in the live coral cover on the reefs, and I suspect this is because of quite severe storm damage done earlier this year. The officers and crew of the Marlin told us how, in fact, we were very lucky because severe bad weather had hampered their operations for weeks up to our arrival and had dissipated just in time for us, allowing us to do all the diving that we wanted. I suspect that these storms were the reason for the many broken table corals that we saw in these depths. Storms have long been known to be a major structuring force shaping the ecology of coral reefs, which build up islands (and indeed destroy islands on occasion) and most work in this respect has been done in the Caribbean. Yet in Chagos we can see the results of storms in this 2012 trace and I would guess that we have now reached some sort of equilibrium which is at least quasi-stable. We have to qualify all such statements of course with the



Coral cover to 25 m depth at 5 m depth intervals, at various dates up to the present 2012 is shown by the pale blue line (vertical lines are standard errors).



Temperature logger in place, shielded by a plastic piece of pipe and tied to a stake

observation that another major warming event could wreak havoc as it has done at least once before.

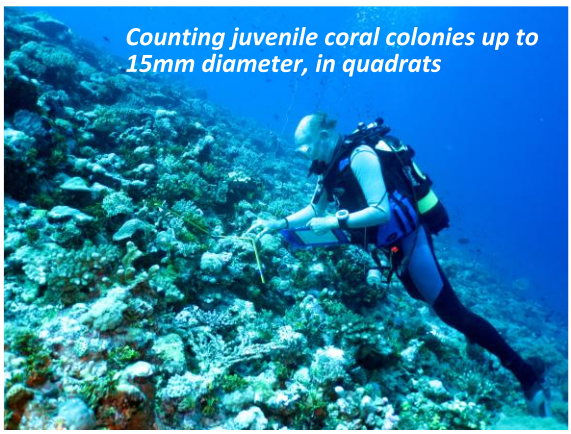
Water temperature is the key to this, more particularly increasing ocean temperature. Again in 2012 we recovered and replaced most of the underwater temperature recorders that have been located on several reefs throughout the archipelago, both in the lagoon and on seaward slopes of the atolls. The southernmost sites where we do this are on the seaward side of Diego Garcia, while the northernmost sites are in northwest of Peros Banhos atoll, with others deployed at several sites in between. These little instruments are fixed underwater on stakes, and are programmed to record the temperature at intervals of two hours. With the batteries they have in them, they can keep going for over two years. We have lost a couple in the past, and one or two have failed, although even the failures have yielded perhaps a year of data before the instrument ceased to function for some reason. Key to their successful operation and recovery lies in how we secure them, surrounded by a piece of plastic drain pipe in fact, which prevents grazing fish from chewing on them, for each is only a few inches across. It is always greatly satisfying firstly to find one and retrieve it, and secondly, when back on deck and attaching it to a laptop to download the data, seeing its faint red LED light winking at you which tells you that it is still working! To date we have had more or less continuous recordings from several sites since about 2006, and 10 more were deployed this time which should keep going until 2014. This is a huge amount of data which has already yielded some unexpected surprises including possible reasons why corals in Chagos have been able to resist high water temperature incursions in the way that they have.

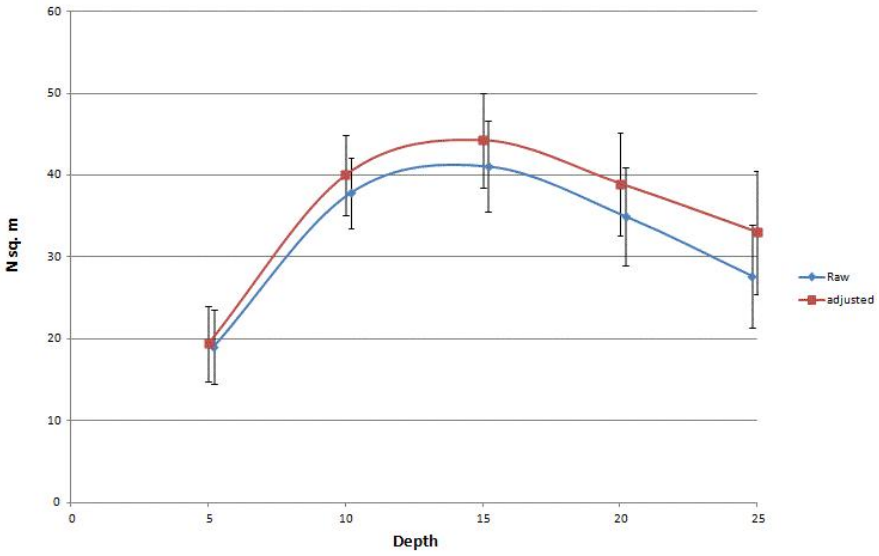
Connected with this we have a paleoclimate programme. Corals have growth rings in the same way that trees do, and various isotope ratios in each annual layer can tell us a great deal about climatic conditions, including temperature and rainfall, when that layer was being laid down by the living coral. This time we took cores from corals located beside several of the temperature loggers which will help to better calibrate the data. Coring is an interesting procedure because the source of the power for rotating the small drills at high speed is compressed air, and one core may require the air from three or more for diving cylinders, as the operator becomes almost invisible behind clouds of bubbles as the discharged air spins the drill bit.

One programme we began, or rather re-began, was counts of juvenile corals. Juveniles are of course the next generation of adults. We had looked at this in 2001 and again in 2006 but now I think we must have a regular programme to monitor this because the preliminary results we got, in Diego Garcia's seaward slopes only, show that the number of juvenile corals that exist is substantial. In fact Chagos is still one of the richest sites ever measured in this respect. The graph on the next page shows the number of juvenile corals >15mm across which changes with depth, taken on the seaward slopes where the military facility is located. All things being equal, we can assume that the next generation of corals is on track to maintaining the high abundance that we see in this archipelago.

Coral coring with compressed air drill, powered by air from spare diving tanks

We had a few interesting discoveries as well. We had discovered vast seagrass beds just south of Danger Island a couple of years ago but had not dived on them, merely looked at them while hanging over the side of a boat. This time we did dive on


Counting juvenile coral colonies up to 15mm diameter, in quadrats



The graph of juvenile coral number showing rise in abundance until 10-15 m depth, then a decline. The top (red) curve shows numbers per square metre substrate adjusted for non-available substrate (such as live adult corals).

them. Massive expanses of rich seagrass is not something we had until then associated with Chagos, and so now we wonder how much of the submerged Great Chagos Bank, and indeed other banks, is covered with this entirely different and richly productive ecosystem. Exploring those parts of Chagos that have never been visited (which is in fact over 90% of it) is something on the list of things to do.

work for a day to map its extent. So far it does not cover a very big area but, who knows what these coral predators will do and how they will expand? Many times in other parts of the world, plagues of crown of thorns starfish will simply disappear. Many times too they may remain with a constant but very patchy and episodic high presence. All we could do here was to record it and map its extent and see what happens on a

Part of the seagrass bed just south of Danger Island on the Great Chagos Bank

© Charles Sheppard

Crown of Thorns starfish feeding on Acropora coral - it strips the live tissues, leaving the white skeleton

© Charles Sheppard

Another discovery we made was not so welcome, and that was a plague outbreak of crown of thorns starfish off Eagle Island, also on the Great Chagos Bank. These feed voraciously on the living corals and can kill a reef, at least temporarily. We diverted

future visit. We did take the opportunity of collecting tissue from about 20 of them for a genetic analysis programme in Germany where others are examining the distribution of various forms of this animal. Collections were in fact

another of our roles: for genetic analyses of various kinds for institutions in several different countries.

I also had the pleasure of visiting the mangrove stand discovered two years ago but not visited since, in the north of Peros Banhos atoll. This again is an entirely different sort of habitat, but one with much urgent potential for restoration work because the coconuts will, if not controlled, relentlessly take over this habitat completely in due course as has happened on Eagle Island.

Chagos remains a magnificent place, and later articles will expand on this. It is the largest expanse of reefs which remain in very good condition in the world. There is a new management plan now which will help to guide and direct the work that is needed in the future, for the BIOT Administration to maintain the good condition that the marine habitats are in, and to guide the kinds of science programmes that we consider are needed for the better

understanding of the place. This Plan has just been placed on the FCO website, with a link to it on the CCT website.

Because of several successful grant applications, we now have several

funded expeditions ahead of us. For the first time ever, we have work mapped out for us stretching at least two years into the future; meaning a lot of tasks can be planned and done which will help us understand how the archipelago works both underwater and on land, with a view to helping BIOT Administration in the management of the area in the best possible way.

No expedition works without substantial input from a large number of people. The officers and crew of the Pacific Marlin were marvellously supportive, as always. The expedition doctor, Bob Long, was not given any medical crises to deal with, and worked tirelessly on deck and with the diving work. Pascaline Cote is a young woman with Chagossian ancestry who came along too, and with her tireless, enthusiastic and skilled support, she worked with several groups and contributed greatly to the expedition. It has given us great pleasure to learn that she has now successfully enrolled in a degree course in biology, so I very much hope that she will be visiting Chagos again in a professional capacity. And Pete Raines came along again too after arranging almost all the logistics before the expedition as well as during, and after it too. This is the unglamorous but essential component of any expedition, and again many, many thanks are due to Pete not least of which for the fact that he did much more than his fair share of many chores such as filling aqualungs which we, most ungratefully, then proceeded to empty again before each day was out.

Publication and publicising results are all an essential part of science.

© Charles Sheppard

The mangroves in the north of Peros Banhos. The palm trees are gradually shrinking the area available for mangroves, and the area needs conservation attention to encourage young mangroves to thrive.

Many will remember the day at the Linnean society last November where we had a conference on the science of Chagos to that point. This was successful and in fact we had to turn away people who wanted to come and see it because the Linnean rooms could hold only 100 people. This November we are repeating this with another meeting, held this time in the larger lecture theatre at ZSL in London. We hope to see many of you there.

Human Impacts on Hidden Coral Reef Biodiversity

Catherine Head,
University of Oxford and Zoological Society of London

After 21 days of hard work, great diving, and amazing new experiences on the Chagos 2012 Expedition, I headed back home with 5000 cryptofaunal samples from 55 dead coral heads from across the archipelago.

But to back-track a bit - my PhD research involves investigating the patterns of diversity and community structure of the reef cryptofauna, that is the small, often hidden, crabs, shrimp, gobies, and molluscs (to name but a few!) and how these contribute to reef functionality and resilience. The effects of human impacts on reef diversity are understood, to some degree, on elements of the reef community, particularly on the reef building corals themselves and on communities of fish, but there is little understanding of how such impacts affect the diversity of reef cryptofauna and the consequences of this on reef resilience.

To investigate this I assess cryptofauna species richness and abundance on dead coral heads across locations in the Indo-Pacific that represent a gradient of human impacted reefs. In order to assess reef health in Chagos, we carried out benthic photo transects at each site to measure benthic cover, which will be used alongside Dr Nick Graham's fish

The cryptofauna dive team: David Tickler, Pascaline Cote, Heather Koldewey, and Catherine Head


© Heather Koldewey

Catherine processing samples late into the night

barcoding on a sub-sample (the Caridea shrimp and snapping shrimp) of the cryptofauna, to build a phylogeny that will allow me to investigate the ecological and evolutionary processes shaping community structure.

biomass data as proxies for reef health. Our team's dives consisted of chiselling off two or three dead coral heads and bagging them for processing back on the boat and collecting the reef health data as described above, while occasionally popping our heads up from the coral heads to watch sharks and mantas passing by.

Once back from the dive, we spend the next few hours processing the coral heads. This involves a technique of freshwater flushing then sieving out the cryptofauna which inhabit these coral heads, and taking various measurements of the coral heads to account for habitat size and shape variations. All cryptofauna collected were recorded and preserved in ethanol for transport back to Oxford where I am now about one third of the way through identifying these species taxonomically. To date I have found many new species records for Chagos and have made some interesting findings, so look out for the publications! Soon I will start DNA

The Chagos archipelago is probably the closest to a true baseline for a healthy reef ecosystem that we have, and when you're there this becomes apparent from the huge shoals of fish, the size of the fish, the expanse of *Acropora* tables, and the regular sightings of top predators. That's not to say that Chagos reefs haven't been impacted by bleaching and other global impacts, which are arguably now impossible for any corner of the globe to escape, but the point is these reefs do not have to cope with local human impacts on a daily basis and are therefore able to bounce back from bleaching as was evident from the way these reefs recovered following the 1998 El Nino event. Chagos is therefore highly appropriate as the healthy reef site for my project that looks at biodiversity across a gradient of reef health. Over the next couple of years I will be collecting data from comparatively degraded locations across the Indo-Pacific, such as sites in Madagascar and the Philippines and this data will be compared to the Chagos cryptofauna diversity. In the meantime while I'm back in the lab analysing the data I'll allow my mind to wander just a little bit and relive the wonderful Chagos adventures and the archipelago's beautiful marine life!


© Catherine Head

Chiselling and bagging dead coral heads on a dive

Chagos 2012: A First Timer's Perspective

David Tickler, Bertorelli Foundation

I was delighted to be able to join the 2012 Chagos Expedition as diving officer, and as a keen diver and underwater photographer, the opportunity to be part of the research effort in the new marine reserve was almost too good to be true. However, it was with a certain amount of trepidation that I prepared for the trip – after all the Chagos is a long way from the nearest dive store, so there would be no popping out for spares if there was a kit failure. Fortunately for me, I had experienced help in the form of Charles Sheppard, Pete Raines and the other team members, and, after getting abundant advice by email, landed in Singapore excited to be getting underway, and with enough spares and tools to build a couple of new regulators if need be.

An aerial panorama...

From the outset it was obvious that it was going to be a fascinating place to work. As we flew in over Diego Garcia's East Plantation area (a site we would dive a few days later) we were treated to an aerial panorama of the bommie-strewn lagoon – a foretaste of what we would be exploring in the coming weeks. Like excited school children autograph hunting, the Chagos newbies coyly asked for the official BIOT crest stamp at immigration and then admired this new addition to

Illegally fished sharks awaiting disposal

our passports. The uniqueness of this visit was not lost on any of us.

The trip started on a sobering note, with our first morning involving a visit to the waste processing facility where the latest catch of illegally fished sharks was awaiting disposal. That the first sharks I saw in Chagos were piled in a rotting heap was a salutary reminder that its remoteness does not afford the reserve complete protection and the patrol effort there has an enormous task on its hands.

The first couple of days were devoted to setting up the *Pacific Marlin*, our generous hosts for the expedition, as a research vessel for the coming weeks of exploration and data gathering. Pete Raines led the transformation with military exactness and we soon had three inflatable boats set up on deck, a working pair of dive compressors on the forepeak, and dive gear, toolkits, and scientific equipment installed in the Marlin's deck hangar and ready to use.

From our first dives in Diego Garcia, the underwater life was stunning. Blown away by the abundance and health of the coral, and overall busyness of the reefs on our doorstep in DG, I was frequently told "If you think this is good, wait until we get up amongst the outer atolls". But it is worthwhile making the point that Diego Garcia – the 'developed' atoll with its naval base and airstrip – boasts reefs that would put most other marine parks in the shade. The strict measures in place mean that the immediate marine environment appears almost entirely unaffected by the presence of the base.

The stunning underwater life

That said, once we left the lagoon and began our slow circuit of the Great Chagos Bank and its outlying atolls, the scenery just got better and better and the sheer unspoiled-ness of the place was evident above and below the waterline.

As obvious as the physical beauty of the place was the enormous passion for its conservation that is shared by those involved in both the scientific and protection efforts. This came across both in the effort that was being put in, and also the willingness of all the team to get the non-scientists involved and to share their experience and knowledge. Pete Carr's 'extreme birdwatching' missions will not soon be forgotten by those of us who survived them.

Research volunteer Pascaline processing samples

This was my first involvement with marine biology at the coalface and it turns out that the key ingredient to ensure the success of an expedition of this kind is bucket loads of elbow grease. All the team were putting in long days (and nights) collecting and processing samples and data, and it was not long before both the expedition doctor and I, as well as the research volunteer Pascaline, were fully involved in the collection effort: when you only have three weeks in somewhere as unique and difficult to get to as Chagos every minute in the water counts. For someone for whom diving is normally centred around teaching or tourism, I found scientific diving to

be an interesting change of focus. It is very different diving when you spend 40 minutes staring at small squares of reef through a camera viewfinder and quadrat, so engrossed in getting it right that you have to be tapped on the shoulder because there's a manta flying over you. You have both the reward of getting useful work done, and the thrill of it being interrupted by the most marvellous distractions: like the day we were laying transect tapes in the lagoon inside Eagle Island when a sailfish swam by, or when, after a long day helping the Marlin crew haul BRUV (Baited Remote Underwater Video) units off the bottom, I dropped over the side with mask, fins and camera and blue water snorkelled with a dozen silvertip sharks. Every day had its signature moment.

The expedition team

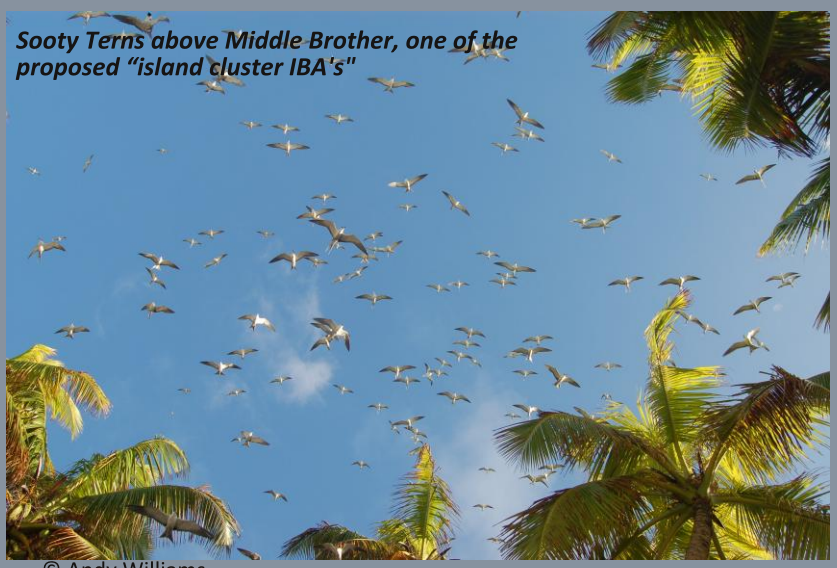
I have been so fortunate to have had the opportunity to have been part of the effort in the Chagos Marine Reserve, and to have worked with a team who were both great fun to be stuck on a boat with, and incredibly generous in sharing their time and knowledge. With their involvement and hard work the reserve can only be a success.

All images in this article by David Tickler
© Bertorelli Foundation

Terrestrial Aspects

Peter Carr, University of Warwick

As the expedition ornithologist and only dedicated terrestrial researcher on the expedition my prime role was to repeat the censuses of the internationally important seabird colonies that were conducted in 1996 (Symens, 1999), 2006 (McGowan, Broderick & Godley, 2008) and 2010 (Carr, in prep.). Secondary roles were to assess whether the present system of designation of IUCN classified Important Bird Areas (IBAs) (based upon specific islands) is the most conservation-efficient method and to further develop plans for enhancing the ecological value of some of the islands via restoration/rehabilitation involving managing invasive species. On all islands in the Chagos, rehabilitation would involve rat eradication and some form of habitat management, usually reducing the presence of coconut *Cocos nucifera*. The Breeding Seabirds: The counts from February 2012 have contributed to the understanding of the breeding phenology of seabirds in the Chagos. Fortunately the counts from scientific research expeditions in February/March 1996, 2006 and 2010 have now been supplemented by counts throughout the year between October 2008 and December 2010. These through year counts have proven invaluable from a conservation perspective. A clear picture is now emerging that the seabirds of the Chagos do not all breed annually and, to complicate their IBA status, do not use the same islands for breeding every breeding cycle.


Sooty Terns above Middle Brother, one of the proposed "island cluster IBA's"
© Andy Williams

The year round seabird counts have

revealed that the Red-footed Booby breeds continuously throughout the year with spikes in breeding triggered by as yet unknown reasons. Data also suggests the trigger is later on the southern atoll of Diego Garcia than in the northern atolls, with breeding spikes generally being about two months behind in the south.

© Pete Carr

A Sooty Tern chick heavily infested with parasitic ticks – possibly the cause of periodic desertions of islands classified as Important Bird Areas in the Chagos

The results from the 2012 expedition show this species is still expanding its breeding range in the Chagos, with a new small colony of 23 pairs being discovered on Petite Ile Mapou and at least two pairs breeding on native hardwoods at another new site on the eastern headland of the formerly inhabited Ile Diamant, both islands in the western half of Peros Banhos atoll which is not part of the strict nature reserve. A single pair was also recorded nesting on the Ile Lubine group of islands in the Egmont Islands atoll, another new island to be nested upon. Since the first comprehensive breeding seabird survey in 1996 (Symens, 1999) this species has colonised, (or more likely re-colonised) four islands in the Salomon Islands atoll, both island groups of the Egmont Islands atoll and now the northern islands of western Peros Banhos.

The Sooty Tern *Sterna fuscata* has been proven to breed in the Chagos at a less than annual cycle (Carr, in prep.). Fortunately, it was breeding in February 2012 with 155,500 breeding pairs found on four islands and a count of 48,000 pairs on Ile Longue in eastern Peros Banhos being the highest count ever for an individual island. What is now becoming clear is that some islands are deserted as breeding sites periodically. This phenomena has been recorded elsewhere (Feare, 1976) and it may be, as Feare postulates happens on Bird Island in the Seychelles, that parasitic ticks are the cause, infestations being noted in July 2009 on Ile Longue, an island not used for breeding in 2010. Another example of desertions and "island cluster" breeding is that in 2012, 32,000 breeding pairs were present on Middle Brother (one of the Three Brothers); but in July 2009 there were an estimated 10,000 pairs on each of the Three Brothers. Similar "island hopping breeding" has been noted from clusters of islands in eastern Peros Banhos for this species.

The Lesser Noddy *Anous tenuirostris* has also proved a challenging species to unravel its breeding phenology. This species has three epicentres of breeding in the Chagos based upon Nelson's Island, the Three Brothers and eastern Peros Banhos. In February 1996, the breeding at all three epicentres coincided, and resulted in a count of 43,275 breeding pairs (Symens, 1999). In 2006, the breeding epicentres were presumably asynchronous and resulted in a count of 2,682 breeding pairs and a cautious assumption that this species had catastrophically declined in the Chagos (McGowan, Broderick & Godley, 2008). Through-year counts between 2008 and 2010 have shown this species also breeds on a less than annual cycle and the three epicentres of breeding are not necessarily synchronised and, most important, that breeding numbers have remained relatively constant (taking in to consideration the vagaries of accurately counting a colonial arboreal-nesting seabird).

The Important Bird Areas: The conclusion drawn from analysing the breeding seabird data has been that classifying individual islands as IBAs based upon annual "spot-counts" does not necessarily do ecological justice to the island (Carr, 2011). The proposal now on the table is that clusters of islands (and possibly the surrounding and intervening seas)

© Andy Williams

Part of the Sooty Tern colony on Petite Coquillage. The colony on the Coquillages alternates between being on both or one or the other and numbers around 40-50,000 pairs

Ile Vache Marine: an eight hectare island that is likely to be the target of the next rat eradication project in the Chagos

should be classified as IBAs, e.g. the Eastern Peros Banhos island group (that includes all islands from Ile du Passe round to Vache Marine), taking in to consideration the shifting nature of the most populous breeder, Sooty Tern (Carr, in prep.).

Ecological restoration: In amongst the proposed cluster of islands' IBAs are islands of low ornithological importance. These are usually islands that were given over to the coconut *Cocos nucifera* plantation regime and are now infested by Black Rats *Rattus rattus* and dominated by a monoculture of unmanaged coconuts, both of which are strong deterrents to most terrestrial nesting seabirds. The long-term aspiration for these degraded islands is some form of ecological rehabilitation in order to improve their biomass and biodiversity, particularly for breeding seabirds and nesting sea turtles. The precedent has been set for attempts at ecological restoration in the Chagos with the 2006 rat eradication effort on the second largest land mass in the archipelago, that of Eagle Island (243.5 hectares). Sadly, this far-sighted and bold venture was unsuccessful (Daltry, Hillman & Meier, 2007).

Sights have now been set on removing rats from tiny Ile Vache Marine in eastern Peros Banhos. Set amongst six IBAs, it is hoped that a successful rat eradication project on this island will provide a further safe haven for breeding species. At eight hectares, with meticulous planning, financial backing and, most important, political will, this island is very feasible for a successful ecological restoration venture. It is hoped that preparations for this venture can be incorporated in to the proposed 2013 scientific research expedition in order to allow an attempt at rat eradication of Ile Vache Marine in either late 2013 or 2014.

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Quantifying fish behaviour, size at sex change and abundances in Chagos

Dr Nicholas Graham, ARC Centre of Excellence for Coral Reef Studies, James Cook University

The 2012 Chagos expedition was my third time to the archipelago, having participated in both the 2006 and 2010 expeditions. Whereas my earlier research in Chagos focused on reef fish diversity and biomass, in 2012 I also quantified some behavioural and life history characteristics and the fish fauna.

Flight initiation distance of reef fishes

With the help of Bob Long, our expedition doctor, I quantified the flight initiation distance (FID) of both parrotfishes and surgeonfishes at multiple sites around the archipelago. The flight initiation distance (FID) is the distance at which a predator (a human in this case) can approach an animal before it flees. The technique has been used in behavioural studies of animals

Bob Long approaching a fish, with a marker at hand ready to drop when the fish flees

David Tickler © Bertarelli Foundation

around the world, including birds, squirrels, antelope and fish. For fish, FID has been shown to vary predictably in response to fishing pressure and when comparing marine protected areas to fished areas. Specifically, fish can be approached much more closely when fishing pressure is light or they are within a protected area. Such behavioural changes have been shown to relate to how vulnerable fish are to being caught by fishers.

FID was quantified for parrotfishes and surgeonfishes at 12 sites around the northern atolls of Chagos. The data were collected at sites where reef fish biomass data were collected in 2010, which will allow the effects of predation risk to also be assessed when analyzing the data. The data will be compared to other locations in the Indo-Pacific (e.g. Philippines, Papua New Guinea and Vanuatu) where FID data have been collected in a range of fished and protected areas by my research group. It will be particularly interesting to see how this behavior varies in a large remote marine reserve such as Chagos, compared to the small reserves that are typical elsewhere for coral reefs. Initial results suggest the FID of fish in Chagos was between 40 and 65% less than recorded elsewhere using this technique, reflected how tame, or naïve, the fish are to humans as predators.

*A large school of initial phase greenthroat parrotfish (*Scarus prasiognathos*) feeding on the algae that grows on dead corals*

© Nick Graham

Size at sex change in parrotfishes

Some families of fish, such as parrotfishes, have a life history of sequential sex change. In parrotfishes the "initial phase" fish are females, with typically more drab coloration, whereas the "terminal phase" fish are males, and usually have much more vibrant coloration. Many species live in harems with a single male to a number of females. The size at which this sex change occurs can vary according to fishing pressure, and the influence of natural predators in the system. Size at sex change is an important variable as it has implications for the number of larval fish that can be produced, and the functions these important fish play on the reef.

The size at sex change of 17 species of parrotfishes was estimated across 16 sites in Chagos in 2012. Reef fish biomass, including predators, is also available for each of these sites. Again, similar data are available for a range of other locations across the Indo-Pacific which will allow the effects of fishing and local populations of predators to be assessed with regards to size at sex change in parrotfishes.

*A school of paddle tail snapper (*Lutjanus gibbus*) swimming up into the water column*

© Nick Graham

Biomass of reef fishes

I quantified reef fish biomass at 18 sites on seaward reefs of Salamons atoll, Peros Banhos atoll and the Great Chagos Bank in 2010, and found it to be exceptionally high. In 2012, the biomass of reef fishes was quantified at six sites around Diego Garcia using identical methods as those used in the northern atolls and

*A grey reef shark (*Carcharhinus amblyrhynchos*), the most common species of shark observed by divers in the waters of Chagos*

© Nick Graham

one additional site in the northern atolls. At each of the sites surveyed, four transect tapes were laid out at approximately 8m depth. Each transect was 50m long, and the fish species and an estimate of their body size were counted along a 5m wide belt of each transect. This body length estimate can be used to calculate the weight of each fish observed using well documented "length-weight" conversions.

Monitoring of shark populations

Documenting the number of sharks seen per scientific dive has been an ongoing activity in Chagos since the 1975 expedition. By 1996 population numbers had declined by ~90%, from around 4 sharks seen every dive to about 1 shark seen every second dive. The populations had not recovered by 2006. The data from 2012 suggest that around 1 shark was seen per dive, which may warrant cautious optimism that populations are showing a weak recovery. However, it will be important to continue monitoring the populations into the future to be sure about any recovery.

A Trainee Scientist's Perspective

Pascaline Cotte

Being given the rare opportunity of taking part on a Chagos Expedition is something I never thought would ever happen to me. I say this because I was unaware that any Chagos expeditions were happening. Growing up in the Chagossian community and being quite young, I was not conscious of the Chagossian environment, as I believe that it is an ignored topic within the community, until the recent declaration of the MPA.

I enjoyed the expedition from two perspectives, being a Chagossian and being a trainee scientist. Being of Chagossian descendant, it is a blessing to be back on the islands of my ancestors. Coming down in the plane and having an overall look at the great Chagos Bank I could begin to see why the Chagossians do not want to let go of their homeland. The shimmering turquoise water, the soft white beach and the lush green trees were just breathtaking. To finally see the famous landmarks such as the Barton Point plantation, the Catalina Wreck and setting foot on my grandfather's home island was very emotional for me.

As a marine biologist, being on such an expedition was already a big privilege: as a trainee scientist with not a lot of experience I cannot express how happy and grateful I was for the opportunity for taking part in it. I have only dived in Tobago before (editor's note – see Chagos News 37 www.chagos-trust.org/resources) and the experiences were amazing but Chagos was purely exceptional. For example, the visibility was so clear that at the end, we were all getting a bit fussy whenever it was not crystal clear.

The whole reef was just beautiful and very rich, rich in fishes and rich in corals. The only dive site I was saddened to look at was the one at Eagle Island. This particular dive site was covered with *Acropora* corals but most of them were dead already and it looked like there was an outbreak of Crown of Thorns a couple of weeks before. I was saddened because I wish that I could've done something to help somehow, but I suppose that it's just nature occurring.

The great Chagos bank is definitely the place to fall in love with the ocean whether ashore or underwater and it has definitely made me want even more to be a marine biologist than before.
I have learnt more than I imagined I would, from doing underwater transects to tying an eye splice rope knot. I have to be honest, it was not a walk in the park and there were difficulties, but at the end all turned out well. If I was given the chance to go back, I would definitely take it; just like I would encourage anyone to get involved in expeditions and conservation alike.

© Anne Sheppard

Surrounded by birds: Pascaline is amazed at the rich bird life on Middle Brother island

Resetting Baselines

Dr Heather Koldewey
Global Conservation Programmes Section Head, Zoological Society of London


Not yet a very old gnarley but in Chagos he has a very good chance of becoming one

© Anne Sheppard

Chagos taught me that I didn't know what the ocean should look like.

Through my job at the Zoological Society of London (ZSL), I'm one of those very privileged people to have had the opportunity to travel the world, and have worked from Mozambique to the Philippines in community-based marine conservation efforts.

In the Philippines, the areas I work are what can only be described as 'trashed' – blasted craters giving evidence of recent dynamite fishing, few tiny schooling fish, and if you're lucky, the flick of a tail as a small grouper scoots into a rocky crevice. Here, marine protected areas (MPAs) are about securing some hope for the future for poor and hungry communities with ever-decreasing options. And MPAs do work, protecting and restoring a diversity of coral reefs, but also recovering fish populations. Fishers there are fully engaged with MPA management, as they know the importance of such areas of ocean protection to secure their future, as well as that of the ocean, something I only wish was a more widely held view within UK fishing communities.

I knew Chagos was different. I'd seen the talks, read the articles, talked to the scientists, seen the data. I knew Chagos was special, hence my commitment and support for it becoming a no-take MPA and involvement in the CEN and CCT executive committee. But seeing it for real was quite another experience that a graph, a chart, or even an image could simply not prepare me for.


© Anne Sheppard

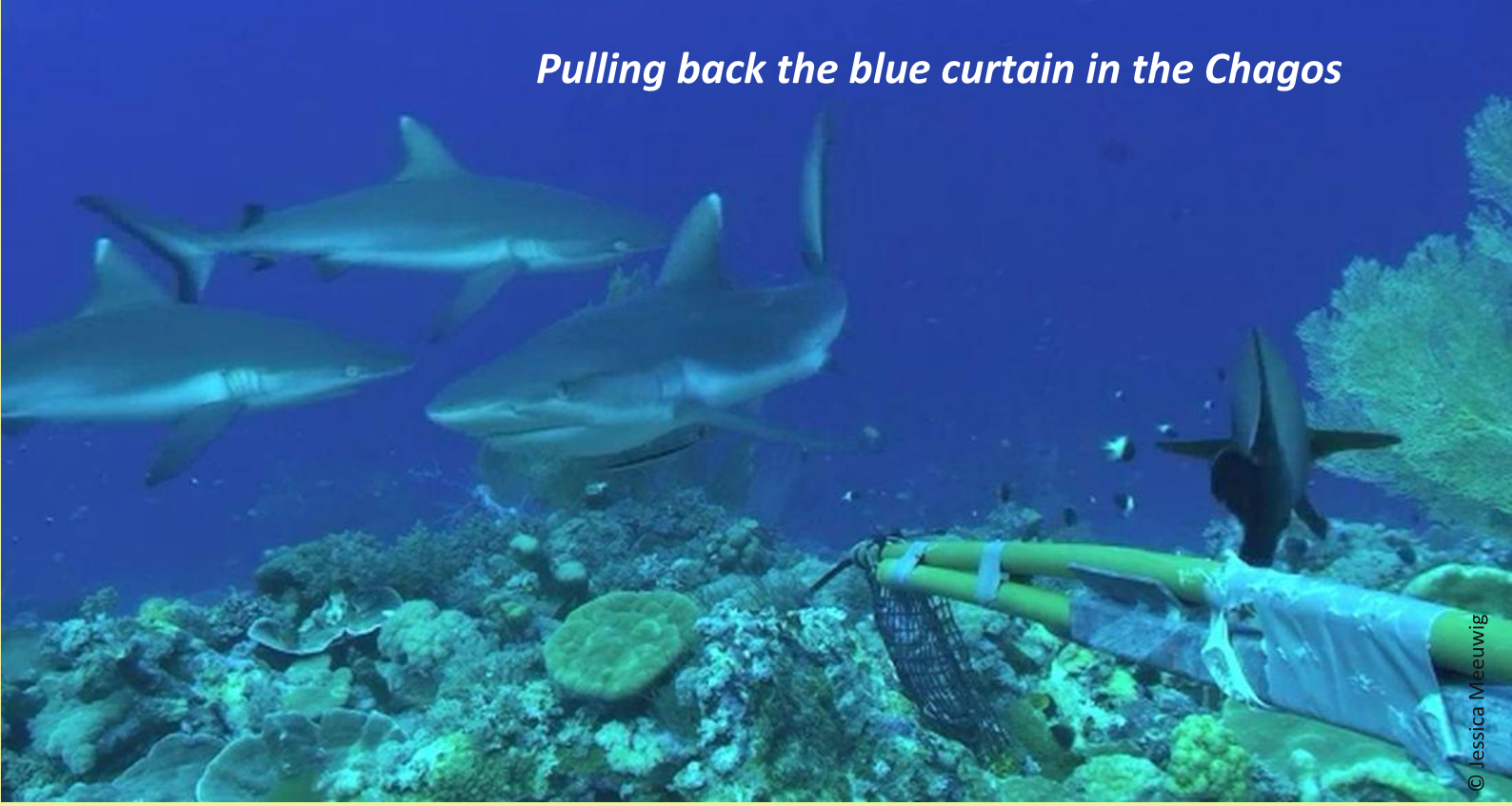
The turtles can be so tame that you need a macro lens to photograph them!

I was lucky enough to be one of the leaders for the C2012 Chagos expedition having been able to secure the core funding for the expedition through Project Ocean - ZSL's novel partnership with Selfridges' department store. Project Ocean transformed the London store for six weeks to promote sustainable seafood choices and the importance of MPAs – including an event on Chagos – and raised funds that supported the participation of half the scientists and support staff of the expedition.

Working closely with the legendary experience of Professor Charles Sheppard and extraordinary expedition skills of Pete Raines, we were fortunate to pull together a world class team of scientists prioritising the immediate research needs that would best inform a Chagos MPA management plan. For the first time, an integral member of the team was a trainee scientist who also represented the Chagossian community, a hugely positive step and one of the many successes of the expedition.

But back to my knowledge gap. Once in the water, I was unprepared for the sheer abundance of fish, the size and age of fish, and particularly the behaviour of those fish. For many years, I was curator of ZSL London Zoo's aquarium so I know what a gnarly old fish looks like and you just don't see them in the wild. Chagos was full of them. I have never had so many different kinds of fish swim towards me out of sheer curiosity – including lots of huge grouper that hung in the water column, something I hadn't seen before. To quote from *Finding Nemo* – "fish are friends not food" in Chagos. I could not believe the vast areas of stunning plate corals, any one of which would be a significant attraction in any dive site in the world. I experienced the sheer joy of seeing sharks on every dive – decimated in most of our oceans and even in trouble in Chagos. Most of all, I could not quite come to terms with what we have done almost everywhere else. Our oceans are in a desperate state and pressure from people is only increasing. Worringly, even those of us who are involved in ocean conservation are shifting our reference points, starting to consider mediocre, depleted reefs to be comparatively good. We have lost a sense of what our oceans should look like and could look like. Chagos was certainly the most beautiful place on Earth I have ever been to and being part of the expedition has further increased my resolve that this is a vital wilderness area of enormous significance that must be protected. And the graphs and charts say that too.

Pulling back the blue curtain in the Chagos



Professor Jessica Meeuwig and Dr Tom Bech Letessier
Centre for Marine Futures – Oceans Institute, University of Western Australia

Who lives below 15 m in the Chagos? This was the question that researchers from the University of Western Australia's Centre for Marine Futures, Oceans Institute sought to answer when they joined the February 2012 Expedition. The reef fish and shark populations of the Chagos Archipelago are thought to be in excellent condition and indeed, SCUBA-based research on the shallow reefs confirms this. As such, the Chagos Archipelago represents an important example of very healthy reef fish and relatively healthy shark communities that contributes to our global understanding of the impacts of human activities on reef ecosystems.

The fish and sharks associated with atoll reef and lagoon habitats below 15 m had yet to be surveyed. We deployed baited remote underwater video systems (BRUVS) (Figure 1) to document what species are present, how many there are, and the sizes of each individual. The team deployed the BRUVS at over 200 locations throughout the archipelago, including a newly discovered seamount, rising to approximately 60m from the ocean's surface.

While the over 200 hours of video imagery are still being analysed, initial impressions confirm that the deeper waters, like the shallows, support a rich and abundant fish and shark fauna. Large groupers, myriad sharks, dense schools of fusiliers and snappers populate the deeper reefs and lagoons (Figure 2). We were also able to sample the seamount, the first time that any of these have been observed in the archipelago. Surrounded by depths plunging to more than 500m, the seamount attracts roaming species such as silvertip sharks.

This survey is the first at these depths, effectively pulling back the blue curtain so that we can see what the fish and shark assemblages look like below depths where we can dive safely. The survey will help establish an ecological baseline in the Chagos that will help track changes through time following establishment of the world's largest no-take marine protected area and in the face of climate change. As a critical reference area for the Indian Ocean, the status of these deeper water fishes and sharks provide an important baseline when compared to areas remaining open to fishing.

Next step - completing the quantitative analysis of the video imagery so that we can provide a first baseline for these deeper habitats, demonstrating the importance of the Chagos Marine Reserve as a global reference area.

***BRUVS ready for deployment from the* Marlin**

Chagossian Community Environment Project

The ZSL Chagossian Outreach Team

CCT has teamed up with ZSL in a new initiative to work with Chagossian communities to raise awareness of environmental issues and provide opportunities in the field of conservation. Here, members of the project team introduce the work which they have been doing.

Crawley, East Croydon, Manchester, Mauritius ... Seychelles. The Chagossian community is represented around the world in many places. The majority of the Chagos Islands have been uninhabited for over 40 years now, and the rich wildlife of this environment both underwater and on the ground has been left untouched, essentially unspoiled. But what about Chagossians' knowledge and perception of the ocean, the reef and the plants and animals of the islands? They share a common heritage, passion for their homeland and a strong sense of community and after all this time, what of their traditional know-how and use of this environment has been passed on to current generations and what do they envisage for the future?

Times have changed and the rich Indian Ocean fish stocks have been over-exploited: shark poaching has become big business, the impacts global warming brings to the rest of the world have not ignored Chagos, and the archipelago now faces new environmental threats and challenges. What can the Chagossian community do so far from their homeland?

The vision of the new Chagossian Community Environment Project is firstly to raise awareness of these issues throughout the entire Chagossian community, first in the UK (2012), and hopefully in Seychelles and Mauritius in the years to come. Secondly, to train Chagossians in practical conservation, science and communication in line with the Zoological Society of London's (ZSL) commitment to global capacity building. ZSL and its partners CCT, Kew, Royal Society for the Protection of Birds (RSPB) and Coral Cay Conservation (CCC) hope to inspire and train future conservationists and environmentalists who could take part in upcoming expeditions, conservation projects and sustainable activities on Chagos' Islands and in their current countries of residence, whatever the future of their status.

Xavier Hamon, Chagos Environment Outreach Officer, says: *"This is a fantastic opportunity for environmental and conservation organisations to pro-actively work with Chagossians towards a better understanding of the fragile natural environment of Chagos and ways in which the Chagossian community can get directly involved in its preservation, for now and generations to come. Chagossians are best placed to talk about their home land and we want to support and train individuals so that they can take part in future expeditions and conservation projects in the UK and abroad"*.

Xavier Hamon, Chagos Environment Outreach Officer

Originally from France, Xavier has worked in community engagement at the Bat Conservation Trust over the last two years and specialised before that in agriculture and environment research and education.

Rudy Pothin, originally from Seychelles – where he worked at the Conservation unit for the Museum of Natural History - and who is of Chagossian descent, joining the project this year, says: *"This is an amazing opportunity for me to work on this project, realising I can make*

such a difference for both the conservation of Chagos and the Chagossians. That is where my family comes from and although I was not born there, it's "home". Coming from the Seychelles and knowing how amazingly beautiful, precious, fragile and rich the marine life is, helps to motivate me to do more for the conservation of the Chagos ecosystems. Everyone should work together for the conservation of what is the crown jewel of marine biodiversity on earth".


Rudy Pothin

Rebecca Short is also working on the project. Rebecca has a background in marine biology and conservation and is providing input into the science content of the project as well as a general co-ordination role: *"For a marine scientist the Chagos archipelago and its wildlife are like a dream to study. Anyone with a passion for the Indian Ocean and Chagos' role within it could not help but want to share the existing and new discoveries being made out there, especially with those most deeply connected to it. Central to the message our team wants to promote through this project is the notion that Chagos doesn't have to change: we don't have to lose what makes it so unique and appealing to both the scientific community and for Chagossians. We can and should make every effort to preserve this environment, for both human and natural heritage, whatever happens."*


Rebecca Short

The project is being managed by CCT member, Dr Heather Koldewey, who was part of the Chagos expedition team earlier this year and Sarah Thomas, ZSL's Head of Discovery and Learning.

The project is structured in multiple phases designed to allow everyone to get involved, from families just wishing to learn a bit more about their heritage to young people considering a career in conservation and indeed conservation of Chagos. A range of events and training are planned to this end:

Chagos Environment Family Days:
On Saturday 7th July, London Zoo hosted the Chagossian community of the South East of England at a flagship Chagos Environment Family Day. Family fun, arts & crafts and traditional activities were complemented by presentations from ZSL staff and a 'meet the expert' opportunity for those with a deeper interest in marine and terrestrial conservation. A Q&A session got people thinking and talking about what the Chagos Archipelago and surrounding marine life means to them and why it needs preserving. On the 21st July we took the family day on the road and visited the Chagossian community based in Manchester for a Chagos Environment Family Day at Manchester Museum.

Towards Future Conservationists:
Through the Chagos Environment Family Days and additional advertising, we are recruiting the enthusiastic, the promising and the passionate for a ten week training course. Over the course of the two fun days 47 people expressed an interest in joining up. Held over weekends the course will offer some of the fundamental knowledge and practical conservation skills necessary to kick-start a career in conservation, environmental management and other nature-based opportunities. With this project potentially feeding into existing schemes such as the ZSL EDGE fellowship programme, potential scholarships with project partners like Coral Cay Conservation, and increasing investment in initiatives like this, the team's aim is that those committed to their training could significantly further careers in their chosen path. In addition, it is hoped that Chagos


Learning about the life cycle of plankton at a family fun day

Signing up for the training course at a family fun day

expeditions in the coming years, akin to that in February 2012, will not only include Chagossians in their research teams but allow these new scientists/environmental professionals to participate in the planning and decision making required for development of conservation in Chagos itself.

All resources created during this project are being translated into French and made available through our website. We are also working on producing a film to showcase the opportunity this project could offer to other Chagossian communities around the world.

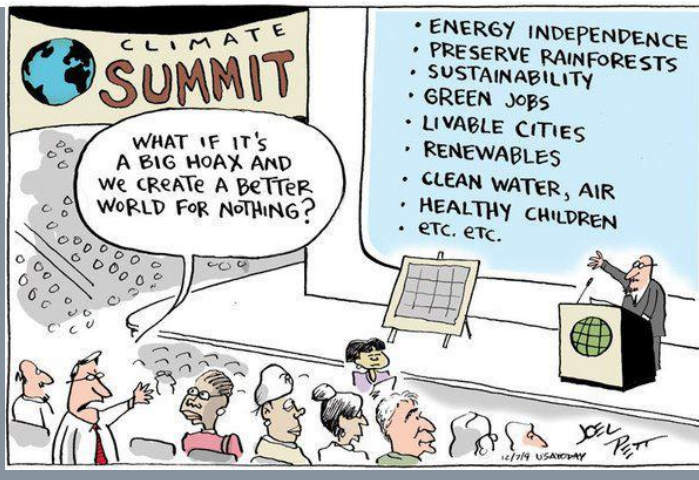
If you want to follow the progress of this project please visit: www.zsl.org/chagoscommunity. We will be posting details about up-coming events and resources (with French translation).

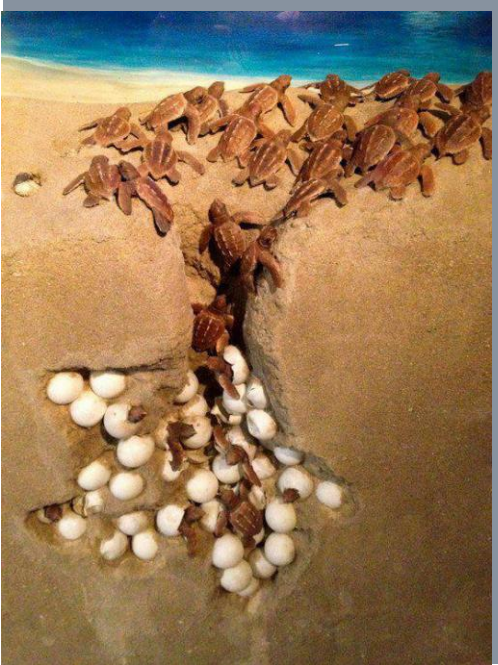
Please do get in touch with us if you want to know more about the project or if you feel you could add your contribution: Xavier.Hamon@zsl.org; Rudy.Pothin@zsl.org; Rebecca.Short@zsl.org or Kate.Longhurst@chagos-trust.org or call +44(0)7440 187756

TheSeaMonster

Anne Sheppard

TheSeaMonster is a fascinating blog with some of the most amazing photographs of the marine environment. It has guest blogs by marine scientists from around the world, and featured one by Charles Sheppard, the leader of the Chagos Expeditions, after the last expedition this year. You can read it at http://theseamonster.net/2012/03/charles-on-chagos and http://theseamonster.net/2012/03/charles-on-chagos-2





One of the writers for TheSeaMonster, marine biologist, writer and broadcaster Helen Scales attended the *Chagos Regagné* meeting at the Royal Geographical Society last year. Her report on that meeting can be read at http://theseamonster.net/2011/05/why-chagos-matters

The blog has many clever cartoons and interesting articles. One which caught my attention was about some little crabs and shrimp which live in corals and help them stay clean and healthy, see http://theseamonster.net/2012/06/corals-and-their-housekeeping-mutualists

It is also accessible through Facebook, where people can leave a comment about an article http://www.facebook.com/photo.php?fbid=371022659626122&set=a.2966450397207.71935.157201757674881&type=1&theater

Professor Charles Sheppard

One advantage of being a 'reviewer' for the Nobel prize-winning Intergovernmental Panel on Climate Change is that this draws your attention to numerous publications that may have escaped you, quite aside from the fact that you get to see drafts of reviews written by leading experts. Looking at IPCC work just drafted, I see that estimates of sea level rise have now been greatly increased over past estimates, as a consequence of the last 3-4 years of measurements and research. Today, estimates of sea level rise for this century range between 50 cm and 2 metres. Already in some parts of Asia it is rising by 1 cm per year. For sea level, like several other factors related to climate change, estimates are being revised to levels at or even above what we call 'worst case' scenarios of just a few years ago. Of course, global averages are just that: averages, and different parts of the world are responding differently and sometimes unpredictably .

With coral islands, we can add two other points. Firstly, they are protected by coral 'breakwaters' and if those die (for example from warming as happened in 1998) then much of the reef's breakwater effect is reduced – at least for a few years until they can grow again. Secondly, the middle of islands are generally at a lower elevation than their rims: almost all have raised rims that keep the sea at bay.

Now, the effect of sea level rise on coral islands is not like many people imagine – it is not a sort of small scale, slow motion tsunami. It is not even average sea level rise that matters anyway, but rather the high tides, especially high spring tides. What happens is that high tides may erode away the soft rock of these rims, so we see no change for year upon year until, one day, the next high tide broaches the rim, and the sea floods in, covering part of the land.

This point has now been reached in several parts of these islands. At several sites in Diego Garcia, this happened in March 2012; within a few minutes of each broach, water cascaded in like small rivers, here flooding the roadside grass to more than knee deep. It was fascinating to see coral reef fishes swimming over the grass and around the poles carrying electrical power to the south of the island. This group of four small lemon sharks joined in, swimming over the unfamiliar grass on their eternal quest for food, including inspecting my own wetsuit boots. This is not sea grass, but land grass. 'Croquet spoilers', someone called them, or 'Lawn Sharks' (you have to say that one aloud to get it).

But really it isn't amusing. This area, like several others, flooded repeatedly on several consecutive high tides, then neap tides came and no flooding would have happened, for a month at least. But it leaves salt behind which percolates down to fresh water tables, and even salt resistant shoreline grass can't take this kind of treatment for too long so that the longer term consequences may be more permanent. Here, on an expensive military facility, fortification against water incursions can be done, though it is costing millions. It is a different matter for the many coastal settlements in the rest of the tropical ocean. For more details and photos, see www.chagos-trust.org/resources/documents

Ships and Anchors in Diego Garcia

LCdr Jason W Schwarzkopf
MP SRON TWO, Chief Staff Officer, Diego Garcia

Lieutenant Commander Jason W Shwarzkopf examines the past damage done to reefs around Diego Garcia by the military base, and explains what steps have been carried out to prevent this in the future.

Diego Garcia is a strategically located island in the middle of the Indian Ocean and home to one of America's two remaining Maritime Prepositioning Squadrons. Far away, lush, and idyllic, the southernmost

Figure 1

island of the Chagos Archipelago is representative of the stereotypical island paradise that has inspired writers, adventurers, and travelers for centuries. Fresh sea-breezes, untouched by any continent for three thousand miles in all directions prevent the coral sand beaches and coconut tree forests from broiling in the equatorial sun. According to Prof. Charles Sheppard, British Indian Ocean Territories (BIOT) environmental advisor and foremost expert on Chagos ecology, the waters of the whole archipelago including Diego Garcia remain the most

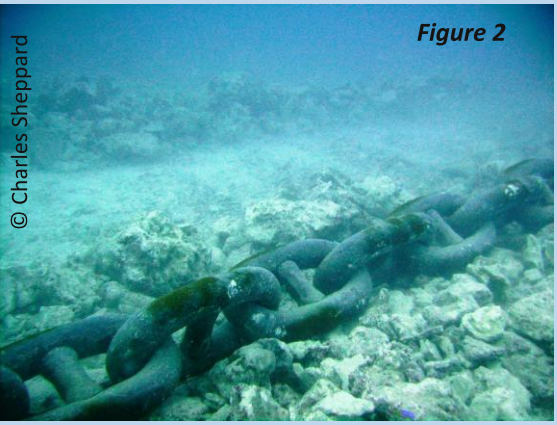


Figure 2

pristine environment in the world despite the sizable British and U.S. military footprint on Diego Garcia. This tropical jewel is constantly in some danger of suffering erosion for several reasons, some being climatic changes but also because portions of its reef were ground to dust in years past by years of anchoring (Figure 1). The damage inflicted upon the reef was grave, but was not irreparable provided action was taken.

The reef at Diego Garcia was slowly built by corals as the original volcano subsided over millions of years. Six thousand years ago, complicated changes in sea level meant that the present islands broached the surface of the Indian Ocean and life erupted in a green riot all over the island. Unlike the Philippines, Japan, or the Hawaiian Islands, the Chagos Archipelago, terminating in Diego Garcia, is generated and sustained by miniscule coral polyps, whose limestone skeletons entwine and ossify over the staggering intervals of geological time. In terms of lifespan, their importance to the ecosystem, and sheer mass, these coral polyps are analogous to the magnificent sequoias of the Pacific Northwest. Anchors and anchor chain dropped on these creatures fracture their connections with each other and with the 'roots' of the island- the calcified remains of previous polyps. The anchors can weigh three tons and each trails an average of four hundred feet of steel links back to the hawse on the ships above. Each link in the chain weighs a hundred pounds, and the motion of the cable as the ship pivots at anchor carves through the reef with all the delicacy of a chainsaw (Figure 2). In this fashion a ship at anchor in the lagoon can reduce an acre or more of reef to rubble in a day or less. Once areas of the formerly thriving reef have been reduced to dead rock, it is very difficult to regenerate, as the boulder-like remains of the dead reef form an inhospitable substrate for the next generation of polyps to settle upon. At any point in the past, ships anchored on living reef inexorably ground the coral underneath their anchors to dust, killing sections of the reef and preventing previously damaged areas from regenerating.

Any destruction of the reef is of concern to everyone, not just environmentalists or conservationists. In addition to providing a refuge of incredible biodiversity, the corals when alive also generate the sand which keeps much of the atoll of Diego Garcia above water. Through the natural abrasion of wave action and feeding habits of certain animals, the sand -

Figure 3

small pieces of aragonite - are washed up on the beaches of the lagoon in a gradual process that over short time periods become the thousands of tons of sand required to build and sustain the island. Without this constant construction, the island would swiftly (in a matter of a few decades, not centuries) vanish beneath the powerful breakers of the Indian Ocean. The island and its military facilities will be uninhabitable if further damage to the ailing reef prevents it from replenishing the sands at the required rate. Diego Garcia is concave when viewed from above. When the shallow lip that rings the shoreline is eroded away, large portions of the centre of the island will be immersed, rather than face a gradual, linear process of erosion. The erection of seawalls and breakwaters can then only delay the inevitable and even then at great cost; the solution has to come from the reef itself.

Back in 2008, Dr. Sheppard led a survey team of UK and US scientists and divers to conduct the largest-scale underwater inspection of the reefs in the lagoon of Diego Garcia in the history of the island (Figure 3).

Figure 4

The survey revealed the extent of damage done to sand-producing corals in the lagoon, as well as assessing the quantities of sand being produced and eroded on an annual basis. The most salient point the survey made was that the anchoring practices of the previous four decades had indeed impacted the delicate equilibrium attained over the previous 6,000 years, as had the large-scale coral die-off in the Indian Ocean in 1998. These factors so impacted sand production that by 2008 the northern beaches near Eclipse Point (nearest the lagoon entrance) saw a 3-meter erosion of the beach in a single year and some of this may have been attributable to lagoon sand loss (Figure 4).

Although it will take decades for any reefs damaged from any cause to completely recover their dazzling variety of species, if these reefs are given respite from the pounding of anchors and chain they do recover and have recovered quickly enough to maintain equilibrium of sand without the loss of additional real estate on the island (Figures 5 & 6). This year, island leadership—both British and U.S., re-evaluated the steps that have already been taken to minimize the amount of damage the ships in the lagoon inflict upon the reef. However, much more needs to be done to ensure the health of the reef and the physical integrity of the island.

The U.S. Navy maintains its proactive stance towards environmental stewardship of waterways from small inlet harbors to vast oceans around the world. As stewards of the environment and in accordance with U.S. Naval Regulations, the conservation and preservation of our oceanic environment is of paramount importance. The British Indian Ocean Territory Diego Garcia is no exception. Several initiatives are in progress to balance the strategic needs with maintaining the island's environment. While proposals, such as mooring buoys being re-installed in the lagoon, or the refurbishment of the pier on the southern end of the lagoon, are being considered, such options must remain viable to balance the Navy's need for a strategic forward presence and its deep commitment to environmental stewardship. The short term implementation costs could amount to potential long-term cost-savings for the U.S. Navy installation in Diego Garcia by foregoing the need for re-locating prepositioning ships. Additionally, the cost of installing the buoys is minimal compared to the expenses that have been incurred attempting to reclaim land that has already eroded, currently estimated at between $20-$40 million USD.

Less costly options include leaving the ships adrift at sea, anchoring the vessels in nearby banks (following survey to find suitable places), and moving the anchorages to less-damaging locations within the lagoon. After re-evaluating requirements for ships' anchorage locations versus the most fertile portions of the reef, Maritime Prepositioning Ships Squadron Two (in agreement with the British Representative and in concurrence with Prof. Sheppard's finding) a few years ago opted to reposition ships within Diego Garcia lagoon to negate the impact to sand-producing corals in the lagoon, and this is continuing. In addition to saving the reef and rebuilding the island naturally, these policies save millions being spent on beach reclamation in the short term and prevent the loss of an invaluable asset in the long term. The U.S. Navy continues to take proactive measures to mitigate damage to the coral atoll. Our focus on current mission readiness is first and foremost. Yet, we're committed to the future readiness of our joint forces, and as a gift to future generations, to preserve the reef on Diego Garcia.

Note: This article is not a commentary on US or DoD policy toward environmental agreements or intentions in the BIOT.

Figure 5

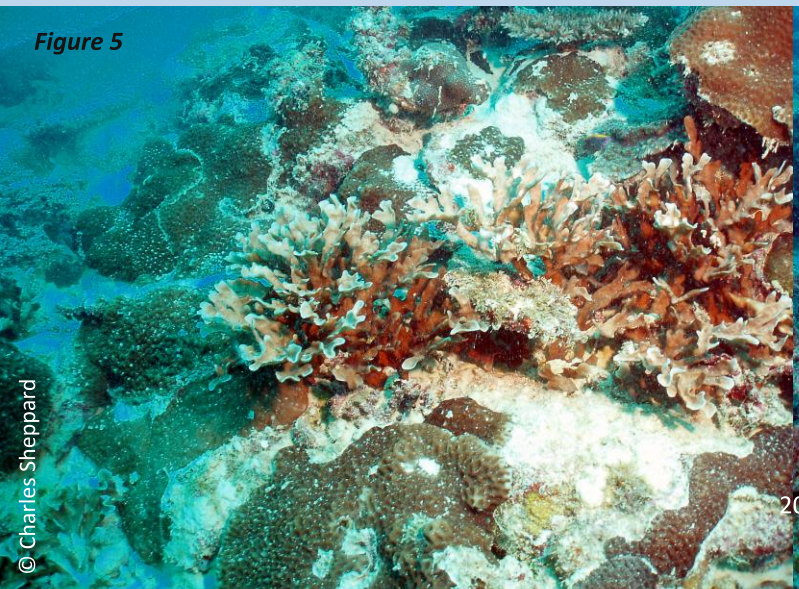
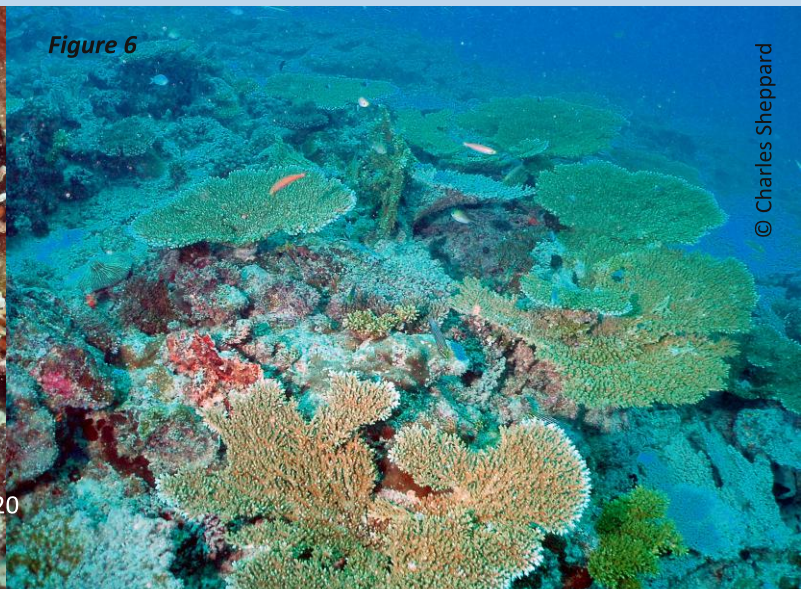


Figure 6



Update from the 12th International Coral Reef Symposium (ICRS)

Dr Sam Purkis, CCT-US

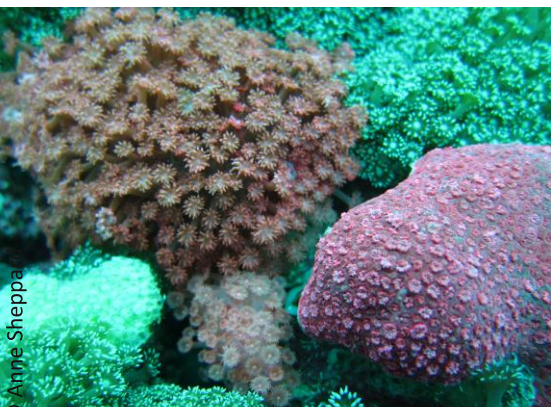
Like the Olympics, every four years the International Society for Reef Studies (ISRS) sanctions a major international scientific conference which provides the latest knowledge and leading edge technologies about coral reefs worldwide. In July 2012, the world's most renowned natural scientists, resource managers, conservationists, economists, educators and graduate students met in Cairns, Australia, to progress coral reef science, management and conservation. I was in attendance amongst 2,500 other delegates who had travelled to Cairns from some 80 countries to communicate their science and hear the latest advances from the international experts in coral reef studies.

A major theme of the ICRS was the study of the ecological, biological, and physical factors that determine coral reef resilience. Resilience is more than being able to recover from a major disturbance, surviving bleaching, or resisting bleaching. For a community to be resilient, it must also be able to continue to thrive, reproduce, and compete for space and resources. For example, coral communities that have experienced bleaching but not mortality may be weakened and less able to thrive, grow, and reproduce in the competitive reef environment. Chagos and the BIOT MPA was prominently featured in the work of many British scientists, Dr. Nick Graham (Senior Research Fellow, ARC Centre of Excellence for Coral Reef Studies), Alasdair Harris (Founder and Research Director, Blue Ventures), and Prof. John Turner (Senior Lecturer, Bangor University), among them. Particularly exciting was the report that Nick Graham provided on the high biomass of reef fish within the BIOT MPA, as compared to sites elsewhere in the Indian Ocean.

Arising out of the ICRS was a Consensus Statement on Climate Change and Coral Reefs which, at the time of writing, has been signed by more than 3,000 people. The Consensus Statement was drafted by a working group of eminent scientists, brought together under the auspices of The Center for Ocean Solutions, to address the topic of climate change impacts on coral reefs. There still remains time to sign the statement and I encourage you to do so online at: www.icrs2012.com/Consensus_Statement.htm

Bob Richmond, the current President of the International Society for Reef Studies, announced during the closing ceremony of ICRS 2012 that the 13th ICRS will take place in Hawaii in 2016. With the momentum that we have, Chagos and its fabulous reefs can be anticipated to again take center stage in Hawaii in four years time.

A link to the ICRS' news releases is www.icrs2012mediaportal.com



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CCT AGM

Our Annual General Meeting will be held on Tuesday 27th November 2012 at:
The Zoological Society of London, Regents Park, London NW1 4RY.

The meeting will be held in conjunction with a day long conference concerning the Chagos Archipelago. Full details will soon be available on our website.

In accordance with the Constitution, Members present at the Annual General Meeting will elect a Chairman, a Treasurer, the Secretary and members of the Executive Committee.

One third of the members of the Executive Committee must stand down each year, and this year the following are standing down:

- Pete Carr
- Rachel Jones
- Richard Martin
- Pete Raines
- John Turner

Nominations for office must be received by the Secretary at least seven days before the meeting.

Simon Hughes,
CCT Secretary

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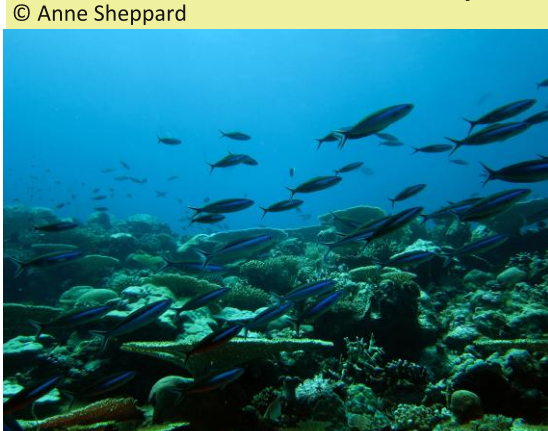

Welcome to new members of the CCT team

Simon Hughes, CCT Secretary

In July, the Chagos Conservation Trust was delighted to welcome Charley Cranmer and Kate Longhurst to our team. Charley and Kate are joining us thanks to a generous grant from Pew Charitable Trusts which has enabled us, for the first time, to engage dedicated professional services to further our charitable goals.

Charley Cranmer - Fundraiser
An experienced fundraiser, Charley has worked in the charity sector for several years, raising money for a variety of causes including overseas development, cancer patients, animals and the environment. A committed environmentalist since she was 16 years old, when she took part in her first campaign to save an ancient woodland, she is eager to bring her skills and experience to bear on behalf of CCT and Chagos.

Kate Longhurst - Communications and Outreach
Having worked in communications and outreach for both the Linnean Society of London and Coral Cay Conservation, Kate has tackled a range of challenges from website management to community engagement. She earned her Masters degree in conservation from University College London and is dedicated to the protection of the natural environment.

CCT Chairman, Alan Huckle, warmly welcomed the new additions to the team saying, "We are extremely pleased to be working with Charley and Kate at this time. We are looking forward to developing and expanding the work of CCT and they will play a key role in enabling us to do this."


Charley Cranmer


Kate Longhurst

Paul Caboche 1918-2012

Paul Caboche became known to readers of *Chagos News* in 2005 (CN 26) when we printed his memoir of life in the Chagos during the 1930s. That contact led to close and fruitful collaboration with CCT right up to a few weeks before his death in July. In 2006, recognizing his contribution to the study of the archipelago's history the Trust chose him as an honorary life member.

Paul's father managed the Salomon plantation from 1933 until his death there in 1952. Paul's connection with the Chagos began a year later when he hitched a ride aboard a sailing ship *Saint Gérant*. A few months later he found himself touring the archipelago aboard the *Diégo*. As war loomed he visited Chagos again as radio operator of the *Zambezia*, shortly afterwards finding himself posted to Diego Garcia as the Royal Navy's radio operator. His interest in radio had been acquired in his school days and encouraged by his father who got him to install a receiver and transmitter in Salomon in 1936. From those beginnings, Paul became a lifelong 'ham' with a call sign familiar to operators the world over.

Withdrawn from Diego Garcia in 1942 when the RAF set up its own radio station, Paul was recruited by SOE to provide radio communication with the Free French parties and in Vichy controlled Reunion; he also underwent training as a saboteur, to be deployed in the event of enemy invasion of Mauritius. After the war, he worked as an engineer in a number of Mauritian sugar estates, with at least two patents to his credit.

In retirement, spent in his villa on the shores of Baie du Tombeau, (rich in historical associations), the time he could spare from radio was used to study Mauritian and, especially, Chagos history; and he amassed an extensive archive of documents and a wide network of interlocutors. His capacious and extremely accurate memory enabled him to provide penetrating comments on every aspect of the history of the Chagos in the 20th century.

Widowed in the 1990s, Paul continued to enjoy the support and company of his four sons. The CCT joins them and many others in mourning his loss.

Nigel Webnan Smith

The Chagos Marine Reserve: Building on Success

The British Indian Ocean Territory (Chagos) is the world's largest effective marine reserve, and its marine fauna reflects this in its startling abundance. A public and scientific meeting on the archipelago is planned for Tuesday November 27th at the Zoological Society of London. This will both provide an update on the science of the archipelago as it rapidly develops, and will also have presentations on the ongoing Chagossian outreach and training programme, as well as on future scientific plans. The research expedition to the archipelago in 2012 has obtained some strikingly successful results and images of the sort that can only come from places such as this in today's over-exploited oceans. At this meeting you can see island and marine life with an abundance that is today very uncommon, along with the scientific meaning of it.

More information will soon be available at:
www.chagos-trust.org
For enquiries please contact:
kate.longhurst@chagos-trust.org

Chagos News is a private newsletter produced by the Chagos Conservation Trust; Registered Charity Number 1031561. The views expressed are those of individual contributors and are not necessarily those of the Charity or the Editor.

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