Chagos Scientific Research Expedition Outline

13th February – 7th March 2012

Overview

Between 13th February and 7th March 2012 a scientific research expedition will take place in the Chagos archipelago (British Indian Ocean Territory), supported and facilitated by the Foreign and Commonwealth Office and numerous other institutions. Twelve scientists and supporting team members will participate in the first full scientific expedition since the no-take marine protected area (MPA) was established in April 2010. Our research plans therefore prioritise the continuation of long-term monitoring programmes as well as establishing the best and most resource-efficient methods to monitor and manage the MPA. We believe our initiatives will assist BIOT in understanding and managing the world's largest fully no-take MPA, maintaining this extraordinarily rich area of marine and terrestrial biodiversity.

Itinerary

13 February:
Expedition team fly from Singapore to Diego Garcia

14-17 February:
Location: Diego Garcia
Purpose: Load equipment and supplies; test and commission equipment; briefings, equipment familiarisation and safety training; sorting and testing scientific equipment; undertaking scientific research on Diego Garcia.

18 February - 03 March:
Location: Northern atolls and Chagos Bank; provisionally Salomon Atoll (3 days), Peros Banhos Atoll (5 days), Great Chagos Bank (3 days), Egmont Atoll (3 days).
Purpose: Scientific research.

04-06 March:
Location: Diego Garcia
Purpose: Off-load equipment and decommission for on-site storage or re-export; debriefs; final research on Diego Garcia (if required).

Research Objectives

1. **Long-term monitoring of reef condition in the Indian Ocean (Charles Sheppard, Anne Sheppard, Pete Raines, Heather Koldewey)**

Our long-term reef monitoring programme has involved coral cover measurements since 1978, and then coral recovery assessments following the climate change mortality. The value of this routine, ongoing project has been to show that coral recovery patterns in Chagos are unmatched by other places in the world. Furthermore few places have coral cover data over such a long period and over such a significant time for coral reefs.

We will conduct repeat measurements at the same locations across Chagos to contribute to the longest time series of reef condition data in the Indian Ocean – this being valuable because a 'trajectory' yields far more information than does a one-off set of measurements. Now that recovery is complete - following the 1998 bleaching event – we will expand monitoring to measure juvenile coral recruitment.

2. **Monitoring fish and shark assemblages across the Chagossian shelf – (Jessica Meeuwig, Tom Letessier)**

We plan to deploy Baited Remote Underwater Video Cameras (BRUVS) in order to study the fish and shark assemblages of the coral reefs. The recent implementation of the MPA in Chagos means that there is an urgent need for robust monitoring, in order to (1) demonstrate the benefits of the MPA and

(2) evaluate any potential requests to reopen fisheries with the Chagos Exclusive Economic Zone. By using BRUVS, we are able to complement existing SCUBA visual surveys (VS), to extend the taxa sampled as well as the depth range over which sampling occurs.
Specifically we wish to explore:

a) How do the fish species assemblages vary with habitat and depth across the Chagossian shelf?
b) Is the variability in community composition, as determined by BRUVS sampling, low enough to provide sufficient power for long term monitoring of Chagos?
c) Do VS and BRUVS yield similar diversity patterns across habitat and depth? Are there habitats where either is more efficient?
d) Current depth ranges of many reef fish reported in the literature may be restricted by previously VS sampling. Does sampling with BRUVS extend known species vertical ranges significantly?
e) Top predators, including reef sharks, are depleted in fish communities from exploited reefs on shelf and coastal areas. Do near pristine reefs like those of Chagos hold a greater overall shark/large fish component because of the inaccessible conditions of the area?

3. Long-term monitoring of reef shark populations (Nick Graham)

We will continue the long-term monitoring dataset of shark populations that started in the 1970's using visual survey methods. This builds on findings published in a paper that reported a 90% decline in shark numbers from the 1970's to 2006 (Graham et al. 2010, *Aquatic Conservation*). In 2010 the shark numbers were slightly up from 2006, and a continuation of this monitoring is imperative to assessing the effects of the MPA status on reef shark population recovery.

4. Assessing the impacts of the recreational fishery around Diego Garcia on reef fish assemblages (Nick Graham, Heather Koldewey, Charles Sheppard)

This study will compare reef fish assemblages using underwater visual census between fished reefs in north east Diego Garcia to the RAMSAR protected reefs in north-west Diego Garcia. I will work with Charles Sheppard on this, who will be conducting similar surveys of corals. The information will be used to assess the need and design of a zoning plan.

5. Fish behaviour and life-history characteristics (Nick Graham)

We will assess some key fish behavioural and life history characteristics in this remote, unfished location. This will include, for example, the "flight initiation distance" of fish, which is an indication of the effects of fishing elsewhere in the world, size at sex change in parrotfishes, maximum attainable body size distributions, and foraging range size. Dr Graham's research group has similar data in more heavily fished and impacted locations across the Indo-Pacific, and also several smaller MPAs in these fished locations. Such information, in conjunction with data on fish abundance and biomass collected in Chagos in 2010 builds a picture of the uniqueness of this large marine wilderness area, and how much the ecological communities differ from fished locations and even the small MPAs that dot coastlines elsewhere. The information will also support the need for careful management of Chagos, and provide key reference points to measure other locations.

6. Human impacts on coral reef biodiversity (Catherine Head, Heather Koldewey)

Our understanding of the overall implications of human impacts on coral reefs for biodiversity of smaller species groups is extremely poor, in comparison with some groups such as reef-forming corals, fish and some bottom-dwelling invertebrate mega-fauna, despite making up the largest component of coral reef diversity.

This project focuses on assessment of the diversity of select groups of reef crypto-fauna and examines the relationship between these and reef-forming corals, fish and conspicuous mega-fauna on the relatively pristine reefs. To assess the number of small bottom-dwelling invertebrate species and their abundance at sites within the Chagos archipelago dead coral heads and coral rubble will be collected on exposed and sheltered sides of the reef slope. Samples will be analysed using a combination of morphological and molecular methods, including novel DNA barcoding methods. These

will be compared with the diversity of corals, fish and conspicuous megafauna, established using conventional survey methods.

The broader scope of this project involves biodiversity assessments over varying scales of human impacted reefs at locations across the Indian and Pacific Ocean enabling a trans Indian–Pacific Ocean biodiversity comparison to be made with the Chagos archipelago.

7. Long-term monitoring of bird populations (Pete Carr)

We will continue the long-term monitoring and research of the internationally important breeding seabird colonies on the ten designated and two proposed International Bird Areas (IBAs). The focus of the monitoring and research is to unravel the breeding phenology of the seabirds of BIOT in order to answer the following questions:

a) Is the present specific island designation for IBAs (as opposed to island clusters) the best long-term conservation management strategy for breeding seabirds in BIOT? (collaborative project with RSPB).
b) What triggers breeding of seabirds in BIOT? (Pete Carr thesis for MRES, supervised by Charles Sheppard).

8. Monitoring physical parameters on Chagos reefs (Charles Sheppard, Anne Sheppard)

We will continue the collection and replacement of currently deployed temperature loggers which have recorded a set of two-hourly sea temperature measurements taken at many depths and locations, some since early 2006. Analysis of these data is helping to determine what physical factors assist in maintaining the good condition of Chagos reefs. These results have all underpinned the moves which led to the proclamation of the Chagos MPA.

9. Management plan (Charles Sheppard, Heather Koldewey, Pete Carr, Pete Raines, Nick Graham)

We will use the opportunity of having a world-leading group of scientists – all of whom are also involved in marine management - to continue development of a newmanagement plan for BIOT. Over the course of the expedition will produce a revised draft of this management plan to submit to BIOT for review and consideration.

10. Species inventory (Heather Koldewey, Pete Carr, Anne Sheppard)

An updated species inventory will be compiled during the expedition that updates previous lists of fish and aquatic invertebrates, marine mammals, turtles and birds. Site localities and other biological parameters will be collected for Chagos endemics, particularly the Chagos brain coral, *Ctenella chagius* which is a priority species for ZSL's EDGE of existence programme.

11. Sample collection (Anne Sheppard)

Important, value-for-money aspects of previous expeditions have been collection of material for other research programmes in other parts of the world. On this expedition, we will be collecting minute quantities of holothurian tissue (sea cucumbers) for genetic (DNA) analysis by the University of Hawai'i to determine the recovery potential of the Chagos holothurian population following severe poaching; and similar echinoid samples for biogeographic distribution studies. Trace coral tissue samples will also be collected for global connectivity studies being conducted in several institutions. Drilled coral cores will also be collected as part of an ongoing study by Dr Miriam Pfeiffer from Aachen University, Germany, as part of the Indian Ocean climate analysis project.

12. Photo-documentation (Anne Sheppard, David Tickler)

We will continue to illustrate the recovery of the Chagos corals and the remarkable biodiversity of the area through underwater photography. We will also produce comprehensive photo-documentation of the expedition. The use of the BRUVS means we will also have a substantial collection of video imagery of fish assemblages.

Team Biographies

Professor Charles Sheppard (Expedition Leader)

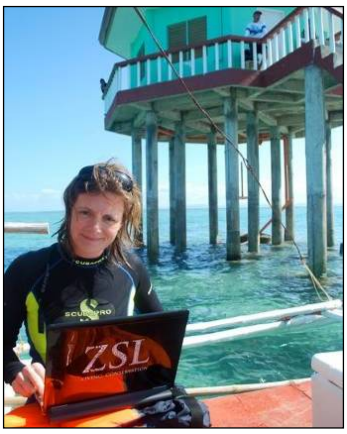
Charles has led several scientific research expeditions to the Chagos Archipelago. Following some early visits in the 1970s, expeditions he has organised since 1996 have involved over 100 scientists from numerous institutions, chosen to produce an integrated understanding of this archipelago. His own speciality is the condition of coral reefs, especially those around the world that have suffered from human impacts, which quickly led to recognition of the contrasting, remarkable and unique condition of the huge area of reefs in Chagos; Chagos has escaped most of the impacts that have affected most of the world.

He has contributed to, organised or led much of the work that has shown how Chagos reefs recovered extremely well from the climate change effects which killed so much of the Indian Ocean in 1998 and, with others including several research students, examined the repopulation of Chagos reefs to produce the exceptionally rich condition that exists today. Throughout he has attracted scientists of numerous, interlocking disciplines to produce the detailed synopsis and understanding that today underpins the scientific justification of the MPA. His own repeat measurements at the same locations at many dates has produced the longest time series of reef condition data in the Indian Ocean – this being valuable because a 'trajectory' yields far more information than does a one-off set of measurements. Various ancillary projects include a set of two-hourly sea temperature measurements taken at many depths and places by deployed instruments, in order to determine what physical factors also assist in maintaining the good condition of Chagos reefs. These results have all underpinned the moves which led to the proclamation of the Chagos MPA.

Pete Raines (Expedition Manager)

Pete Raines is a marine biologist and Chairman of Coral Cay Conservation (CCC), an organisation he founded in 1985. He has over 26 years of award-winning leadership and experience in coral reef conservation and is the author/co-author of over 300 scientific publications. He is an executive member of the Chagos Conservation Trust and Chagos Environment Network, and served as Expedition Manager on the Chagos 2010 Expedition. In 2004, Pete was awarded the MBE for services to the protection of biodiversity.

Dr Heather Koldewey (Chief Scientist)



Heather is Global Section Head of Conservation Programmes at the Zoological Society of London (ZSL). She has worked on community-managed MPAs in the Philippines for over 15 years through Project Seahorse as part of a wide portfolio of international marine and freshwater conservation projects. In addition, she has been involved in both research and conservation in Chagos, particularly on the benefits of large marine reserves for migratory species like tuna and sharks. She is an executive member of the Chagos Conservation Trust and Chagos Environment Network. She played a lead role in Project Ocean, a partnership between ZSL and Selfridges that raised awareness and funds for MPAs and generated funds to support this expedition.

Catherine Head (Scientist)

Catherine is a marine biologist and conservationist currently undertaking a PhD at the University of Oxford and Zoological Society of London (ZSL) on the effect of direct human activity on the biodiversity of coral reef ecosystems. Previous to this I have completed my BSc and MSc in Zoology from Royal Holloway University in 2003 and 2004 respectively. I then went on to work on a variety of coral reef conservation and research projects with Coral Cay Conservation in the Philippines and Tobago, and the Bermuda Ocean Institute in Bermuda. Most recently, I was Project Co-ordinator for the ZSL's EDGE Coral Reef Project where I developed and co-ordinated marine capacity building projects.

Professor Jessica Meeuwig (Scientist)

Jessica is the Director of the Centre for Marine Futures, University of Western Australia. Her main expertise is marine and fisheries conservation, and quantitative modelling. Her research group works across a range of taxa, from humpback whales to sharks to bony fish and includes some benthic ecology with key questions centring on how animals use habitat and the impacts of human activities on their ecology, population biology, energetics etc. Her group also has a strong interest in the development of video and image based sampling methods and maximising the power of information obtained from these methods. Jessica has worked as a marine ecologist in a wide range of temperate and tropical ecosystems and is a keen science communicator.

Dr. Tom Letessier (Scientist)

Tom is a Research Assistant Professor at the Centre for Marine Futures, University of Western Australia. His main expertise is in the meso- and basin-scale processes at the low-end of pelagic ecosystems. His PhD research focused mainly on the ecology of the model zooplankton order Euphausiacea. He has participated in several research cruises in the Atlantic and Indian Ocean and previously conducted SCUBA-based research on coral reefs on fish and coral taxonomy in the tropical Atlantic and Pacific Oceans.

Anne Sheppard (Scientist)

Anne is a Research Fellow at the University of Warwick and has participated in a number of expeditions to Chagos. She has co-authored several scientific publications arising from her work there. In addition, her many underwater photos taken on past expeditions have been made available to numerous organisations for educational purposes to promote the Chagos MPA, these being used in numerous websites, newspapers and magazines.

Dr. Nick Graham (Scientist)

Nick is a Senior Research Fellow at the ARC Centre of Excellence for Coral Reef Studies, James Cook University in Australia. His research focuses on large-scale ecological questions directly relevant to the management of coral reef ecosystems. He has assessed the longer-term impacts of coral bleaching and mortality of reef corals on fishes and identified the collapse of the reef structural matrix as a major driver of declines in a wide range of species and size classes. He has had an interest in the impacts of fishing and marine protection on reef

fish assemblages for some time and has worked on the time scales necessary for full recovery in No Take Areas and the effects of fishing and protection on predator-prey relationships and the overall size structuring of fish communities. More recently he has been assessing recovery dynamics of reefs from pulse disturbances, and is getting increasingly interested in methods of linking social-ecological systems for natural resource assessment and management in a changing climate. He has participated in two previous scientific expeditions to Chagos in 2006 and 2010.

Pete Carr (Scientist)

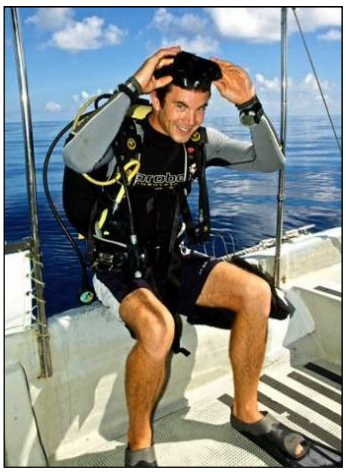
In conjunction with the RSPB, Peter has recently (2011) published Birds of BIOT, a book that summarises the avifauna of the Territory; he was also the author of the original paper that designated the ten IUCN categorised Important Bird Areas (IBAs) within BIOT. As a member of the Chagos 2010 Scientific Research Expedition he was co-responsible for terrestrial monitoring, focusing on ecological restoration priorities, Odonata distribution as well as seabird censuses. For the past three years he has spearheaded forest and wetland restoration work whilst working on Diego Garcia.

Pascaline Cotte (Dive Support Assistant)

Pascaline is 19 years old and of Chagossian descent. She's an outgoing person with a passion for nature and its beauty. Two years ago she had the chance to learn about marine conservation in Tobago through a Coral Cay Conservation scholarship. Her wish is to help keep the Chagos Islands as much of a paradise as it has always been.

Robert Long (Medical Officer)

Dr Long is board certified in both Family Medicine and Diving and Hyperbaric Medicine in both the US and Australia. He is currently working for a large oil company in Saudi Arabia in their primary care department. Previously he was the Medical Director for the Wesley Centre for Hyperbaric Medicine in Brisbane Australia. As an avid diver for over 35 years he has worked as the Diving Medical Officer for an Aquarius mission (NEEMO 2) and with the USS Monitor salvage operation. He enjoys triathlons and swimming in his free time.



David Tickler (Dive Technician)

David is a professional dive instructor and guide and has spent the last seven years working on charter and private vessels in various parts of the world, including Australia and Micronesia. As well as his diving qualifications, David has a Yachtmaster qualification and is a Diver Medic Technician. Prior to becoming a diving instructor he worked as an analyst for a bank in the UK, a think tank in Tokyo and a consulting firm in Sydney.

Acknowledgements

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