

Chagos Archipelago Vava II Expedition, March 20-April 1, 2016

Expedition Report



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Acknowledgements

This expedition was made possible through support from the Bertarelli Foundation, for which we are grateful. The research was made possible thanks to permits and logistical support from the Foreign and Commonwealth Office. We are grateful for the thorough logistical assistance provided by the British Indian Ocean Territory Administration, the Brit Rep office, and environmental officer Helen Stevens. We thank the captain, chief engineer, and crew of the Vava and Vava II for excellent support in our scientific activities.

How to cite this report:

Letessier T B, Esteban N, Carr P, Schallert R, Head C, Nicoll M (2016). *Chagos Archipelago Consortium Vava II Expedition – Leg 1*. March 20st to 1st of April Scientific Report to The Bertarelli Foundation and the Foreign and Commonwealth Office.

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Executive summary

This expedition on board the Vava and Vava II from the 20/03 to the 1/04 2016, provided a unique occasion to support six scientists focusing on flagship species and habitats within the British Indian Ocean Territory or Chagos Archipelago. The primary purpose was to survey the mid-water fish and reef sharks, sea turtles, sea birds, and coral reefs around the Archipelago.

1. Mid-water Baited Remote Underwater Video Systems (BRUVS) were deployed in the nearshore (<50-200 m) to survey the mid-water fishes and sharks. Deployment revealed a rich and diverse mid-water community of sharks and fishes, with spatial trends that were possibly related to illegal fishing activities. First time mid-water BRUVS deployments on Benares Shoal provided a rare record of a scalloped hammerhead shark.
2. Over half of the islands of the archipelago were surveyed for turtle nesting activities and beach habitat via aerial surveys (30 islands) and coastal surveys (28 islands), providing the most complete nesting data record since surveys in 1999. The survey results demonstrated that significant numbers of turtles were nesting in March/April, outside the peak nesting season in October/November. Turtle satellite tracking data were used to validate existence of a foraging green turtle population on the Great Chagos Bank, revealed an extensive seagrass meadows of *Thalassodendron ciliatum*. Seagrass samples were preserved in preparation for the first peer-reviewed publication on seagrass in the Chagos Archipelago and to contribute to a regional seagrass health assessment of the Indo-Pacific.
3. Breeding seabird distribution and population data were collected from across the Archipelago. We documented an expanding breeding range of both the Red-footed and Brown Booby in Peros Bahnos Atoll. In addition, we tested the deployment of tail-mounted GPS loggers and leg-mounted Geolocators on both species of Booby, and conducted the first ever tracking of a seabird in the Archipelago; with a breeding Red-footed booby making a remarkable 425km, 38 hour foraging trip.
4. The Archipelago's coral reefs were surveyed at multiple locations to establish their health and to record any occurrence of bleaching this year. So far no bleaching is evident this year although reefs have varying levels of coral health following last year's bleaching event. Even at degraded sites the number of coral juveniles is high suggesting good recovery is possible. Deeper reefs as revealed by a first ever ROV deployment were in good conditions.
5. Shark and fish tagging activities are reported as part of the main tagging report for the Vava II leg 2 April trip.

1. Mid-water fish and sharks

1.1 Introduction

The population status and potential recovery of large mobile and predatory fish and sharks species inside the Chagos Archipelago is the subject of an ongoing pelagic research programme. Many species of tuna and oceanic sharks have experienced worrisome declines as a result of industrial long-lining and purse seining fisheries. These fisheries operated within the BIOT EEZ up until the designation of the marine protected area in 2010, thereby allowing for the potential recovery of these species to occur since then.

Management issues in the context of the BIOT EEZ and the wider Indian Ocean are thus being addressed by answering key questions regarding the distribution of these species in space and time. Questions being addressed include:

1. What is the effect of bathymetry and oceanographic variability on the locations of 'hotspots' throughout the marine protected area?
2. What is the seasonal variation of habitat-use within the area.
3. What is the recovery of species over time?

Understanding the influence of the coral reefs, atolls and seamounts on the mid-water fish and shark populations is thus of critical importance in assessing the influence and efficiency of the marine reserve. This trip enabled an assessment of the mid-water habitats near the coral reef of the main atolls and near Swart seamount.

1.2 Results and discussion

Mid-water stereo Baited Remote Underwater Video Systems (BRUVS, n = 18) were deployed on 6 occasions, at 5 different locations throughout the archipelago (See Fig. 1, at Salomon atoll, Egmont atoll, Swart seamount, Nelson Island, and on Benares shoal). On each occasion the BRUVs were streamed from a rescue craft, along 200 m of rope. Each BRUVS were situated 50 metres from its neighbour on the line, and suspended at 10 meters from a surface buoy, with the vessel located at the end of the 200 m. The typical deployment time was around 90 minutes. Each rig was baited with approximately 1.5 kg of squid. During deployment the vessel manoeuvred to maintain the rigs as close to stationary as possible.

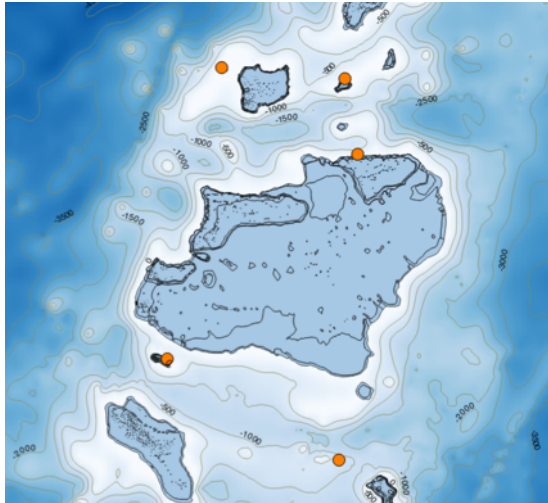


Fig. 1. Mid-water BRUVS sampling locations in the Chagos Archipelago in vicinity of coral reef

Based upon a short review of the footage it was apparent that sharks were present at each location, with typically one or two sharks being observed simultaneously on each deployment (Fig. 2). Notable exceptions to this were at Swart Seamount, in the south-east corner of the archipelago, and on Benares Shoal, in the north-west, where more than 2 individuals and 2 species were the norm at each deployment. The videographic material collected will now be analysed and will be combined analytically with results from previous expeditions. The data provide a valuable contribution to the ongoing assessment of the reserve, and provide rare records of the under-sampled intermediate habitat between the reefs and the open ocean.



Fig. 2. Records of mid-water sharks (Top panes – hammerhead and silvertips), and fishes (Bottom panes – barracuda school, and carangids and forage fish schools)

2. Sea turtles

2.1 Introduction

Sea turtles are a flagship species for the Chagos Archipelago Marine Reserve and baseline surveys have indicated significant nesting populations of hawksbill and green turtles across the archipelago. To date, the majority of surveys of both nesting and resident (foraging) populations have taken place on Diego Garcia, with information for outer islands relying on opportunistic surveys by Fisheries Officers. Satellite tagging of green turtles from Diego Garcia in 2012 and 2015 has revealed, for the first time, that a foraging green turtle population exists along the 20-30 m depth contour of South-East Great Chagos Bank, 200 km from land that has not been surveyed previously.

The expedition provided an opportunity to survey turtle nesting population in the outer atolls in a scientifically robust manner, determined by track counts on beaches and surveys of available nesting habitat. Temperature loggers were deployed in sand at nesting depths to contribute to monitoring of hatchling sex ratio. In-water surveys (snorkel/SCUBA) around islands were conducted to assess foraging turtle numbers (male:female ratio). Finally, surveys were conducted to validate habitat type corresponding to different habitat uses (day-, night-time) to provide critical information on foraging green turtle habitats, as well as collect information relevant to this remote habitat.

2.2 Results and discussion

Many more surveys were achieved than anticipated due to collaboration with the science team and crew as well as excellent provision of helicopter and boat support (Table 1).

Table 1. Overview of turtle surveys completed during the Expedition. Turtle nesting and nesting habitat surveys were carried out on all islands surveyed (aerial and foot). Figures in brackets indicate surveys by Pete Carr, Malcolm Nicoll & Catherine Head.

Site	Islands surveyed (aerial)	Islands surveyed (by foot)	Seagrass surveys (SCUBA)	In-water survey	Incubation temperature monitoring
Peros Banhos atoll	17	15(+5)	-	1	-
Salomon atoll	11	2(+1)	-	-	-
Egmont atoll	2	1	-	-	6
Great Chagos Bank	-	3 (+1)	3	1	-

- a) Turtle nesting population and habitat surveys: 28 islands were surveyed by foot, more than 50% of all islands. This number will increase with surveys planned by the crew in the following expedition. This complete assessment of nesting populations will contribute to a planned publication on the importance of nesting turtles in the Chagos Archipelago. Evidence of turtle nesting (tracks and/or body pits excavated during nesting) was observed on each atoll visited. As expected, the majority of turtles nesting during the previous weeks were greens, as green turtles nest year round. Interestingly, a hawksbill track was observed, as this is out of normal nesting season.

In terms of nesting turtle numbers, the most important atolls (specifying the top five islands in terms of body pit data) are Egmont Islands (295 nests), Chagos Bank (Danger Island (169) and Nelson's Island (38)), Peros Banhos (Unnamed Island (39) and Ile Finon (12)) and Salomon Islands. Recent nesting had occurred in Peros Banhos (1 hawksbill, 15 green, 1 unidentified), Chagos Bank (7 green) and Egmont Islands (2 green).

- b) Validation of foraging habitat: three sites were surveyed: one shoal previously identified in a reefal expedition in 2010, two sites identified by satellite tracking (Fig. 3). Surveys revealed extensive monospecific seagrass meadows populated by *Thalassodendron ciliatum* at depths of 12-27 m. Samples were taken for museum cataloguing, as the first collection of seagrass in the Chagos Archipelago, and for Carbon:Nitrogen:Phosphate ratio analysis (to provide baseline from a pristine habitat). Sites were surveyed by underwater video (BRUV) for fish diversity as part of a wider research program exploring the value of seagrass for fish ecology.

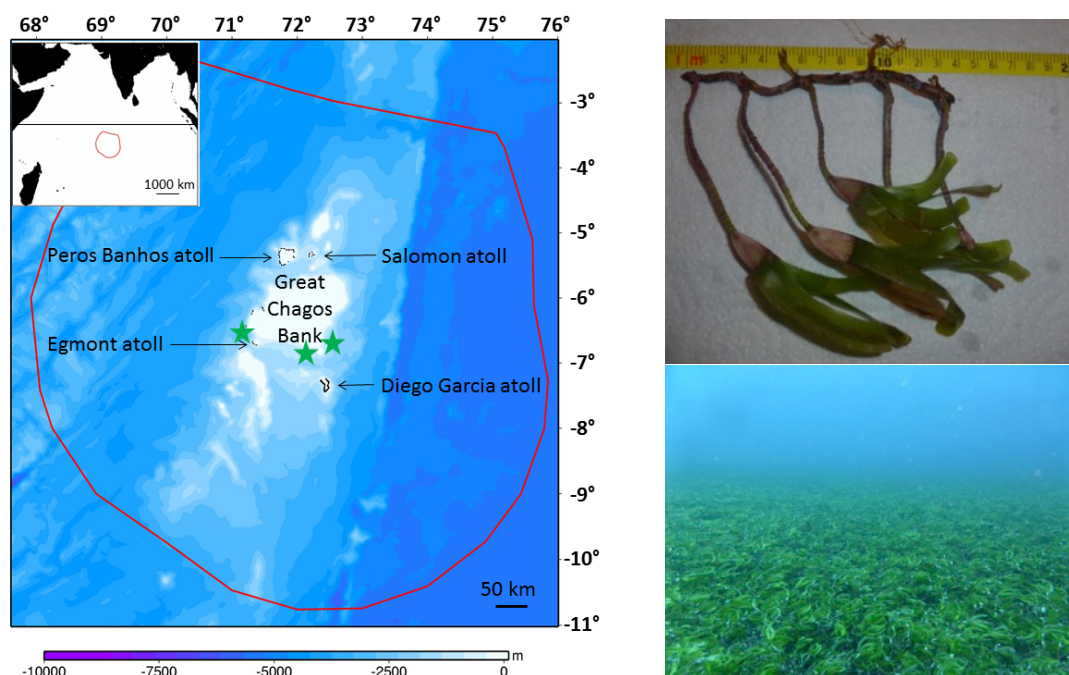


Fig. 3. Three sites sampled for seagrass are highlighted with green stars: Site 1 (S Danger Island), Site 2 (SE Chagos Bank-West) and Site 3 (SE Chagos Bank-East). Site 1 is 120 km west of site 3, 94 km west of site 2. Sites 2 & 3 are 30 km apart. Extensive *Thalassodendron ciliatum* meadows were found.

Incubation temperature monitoring: 6 temperature loggers (Gemini Tinytag TGP-4017) were placed at a range of turtle nesting depths in shaded and unshaded positions on Egmont Atoll. This will complete incubation temperature monitoring on each atoll.

Foraging turtle populations: 13 turtles were observed at 6 locations. Increased survey effort would be more useful during peak nesting season (potentially October-November). An injured immature hawksbill (CCL 33.1 cm) was observed close to Ile Fouquet.

3. Seabirds

3.1 Introduction

The importance of seabirds as crucial indicators of marine ecosystem health is becoming increasingly recognised. In the western Indian Ocean (WIO) the breeding seabird population is estimated at ~19 million individuals (30 species), consumes 150,000-500,000 tonnes of biomass each breeding season, which is equivalent to the annual tuna and billfish landings in the region. However, our understanding of seabirds' status, distribution and ecology in the Chagos Archipelago is limited, which undermines any assessment of how the marine protected area supports seabird populations in the WIO. We propose resolving this situation through generating novel information associated with three objectives:

1. To establish the status, distribution and trends of breeding seabirds in Chagos;
2. To identify and understand environmental drivers of critical foraging grounds for breeding seabirds within and outside the MPA;
3. To establish how non-breeding seabirds, from within and outside Chagos, utilise the MPA in relation to their at-sea distribution in the WIO.

On the Vava II trip we planned to collect additional data to supplement existing long-term monitoring data, to enable us to achieve objective (i) and identify suitable seabird 'study' colonies and tagging methodologies to achieve objective (ii). Data are already available, through established regional collaborations, to answer objective (iii).

3.2 Results and discussion

While in the Chagos Archipelago we surveyed 24 islands for breeding seabird populations. We found breeding populations of 10 species of seabird (see Appendix Table A1) on 24 islands. Of particular note were: the large (>10,000) Sooty Tern colonies on Ile Longue (Peros Bahnos) and South Brother on the Great Chagos Bank; and the first ever record of breeding Brown Booby on Ile Parasol and Red-footed Booby on Grand Soeur (Peros Bahnos).

In order to be confident that we will represent how seabirds, throughout the Archipelago, utilise the MPA we identified the following sets of 'study' breeding colonies across the Archipelago for Red-footed, Brown and Masked Booby: Parasol, Longue, Grand Bois Mangué and Petit Bois Mangué in the North; North Brother, Middle Brother, Resurgent and South Brother in the central west. In the south the plan is to use Diego Garcia. In addition to this we identified two back-up options in Danger and Nelson's islands.

Our plan is to use two types of tracking devices; tail-mounted GPS loggers for short-term breeding season movements and leg-mounted Geolocators for long-term non-breeding season movements. As none of our study species had been tracked in the Chagos Archipelago before we needed to explore the feasibility of deploying these two types of tags. We tested our bird capture and deployment methods on both Red-footed and Brown Booby, which will be the most frequently, tagged species and found that our methods were suitable. As a final test we deployed a single GPS logger on the tail of a breeding Red-footed Booby on Ile Parasol, which we recovered four days later. The resulting location information showed that the bird made a 425km trip over 38 hours to the west of Peros Bahnos (see Fig. 4). This is the first time a seabird in the Chagos Archipelago has ever been tracked and demonstrates that our proposed approach is valid.



Fig. 4. Red-Footed booby track from Ile Parasol, Peros Bahnos. The northern part of the track is the outward path and the southern part of the track the return.

4. Coral reef health

4.1 Introduction

Coral reefs in the Chagos Archipelago are known to be some of the most healthy and resilient in the world. This is largely attributed to the lack of direct human impacts on the reef e.g. fishing and pollution, resulting in reefs being able to 'bounce back' quickly from global climate change impacts, such as increases in sea surface temperature. Coral bleaching is the corals' stress response to increases in sea surface temperature, and is the visible sign that the coral cells have expelled their single-celled symbionts called zooxanthellae. The zooxanthellae provide the coral with energy through photosynthesis, therefore when they are expelled the coral loses a major food source, and hence this bleaching can result in mortality if the coral does not recover their zooxanthellae from the water column. The Chagos Archipelago has in the past suffered from coral bleaching on mass, most severely in 1998 and 2005, and has made quick and full recovery. Bleaching was also reported in the archipelago last year but we had not had the opportunity to return and assess the damage. This year high levels of coral bleaching are predicted at the time of the expedition because of the steady increases in sea surface temperatures caused by the El Nino climate pattern and exacerbated by global climate change.

The aims of this trip are:

1. To assess the health of the reef building corals, which are the architects of the reef, post last year's coral bleaching.
2. To record the occurrence of coral bleaching on both shallow (<30m) and mesophotic reefs (>30m) using a remotely operated vehicle (ROV).

To do this we use video transects on shallow reefs, which can be analysed for coral health metrics, and at deeper depths (>30m) we trialled the remotely operated vehicle (ROV) to record the occurrence of reef species and its health.

4.2 Results and discussion

In total we completed 27 reef surveys across 9 sites at Peros Banhos atoll, Salomon atoll, Three Brothers Islands, Victory Bank, and Nelson Island. We also successfully tested the ROV at Ile de Passe in Salomon and Ile Fouquet in Peros Banhos, for use on April's science expedition. This presents the first records of reefs below 30 meters from the Archipelago. Video footage will now be analysed to establish metrics such as percentage of live coral cover, percentage of coral with disease and with bleaching, which are standard ways of assessing reef health. This will allow us to establish the health of the reef pre- and post- this year's predicted bleaching event and the reef's potential rate of recovery.

Initial impressions from these surveys are that northern Peros Banhos, Three Brothers, and Nelson's reefs have degraded since our last surveys (April 2015), mainly due to mortality of table corals (*Acropora* species) which dominate these sites. In addition there has also been significant mortality of branching corals, which are often the most susceptible to coral bleaching, indicating that last year's bleaching maybe the main cause of coral die off at these sites. On a positive note the number of juvenile corals at these sites is high (Fig. 5) suggesting the potential for good recovery, as was the case following the 1998 and 2005 bleaching events. Moreover, deeper reefs appear to be in good conditions, based upon a preliminary review (Fig. 6).



Fig. 5. Example of the high number of coral juveniles at even degraded reefs suggesting high potential for recovery.

In comparison the reefs at Victory Bank and Southern Peros Banhos are healthy reefs with good live coral cover and abundant fish life. At these sites coral communities are not dominated by table corals, but by boulder corals, such as *Porites* species, and soft corals. *Porites* species are known to be less susceptible to coral bleaching and so perhaps survived much of last year's bleaching. The National Oceanic and Atmospheric Administration (NOAA) http://coralreefwatch.noaa.gov/vs/gauges/chagos_archipelago.php now put the Chagos Archipelago in Alert category 2 (the highest alert category) for bleaching this year, meaning that coral bleaching is imminent. We will continue to monitor this and many other aspects of coral health in the next April expedition.

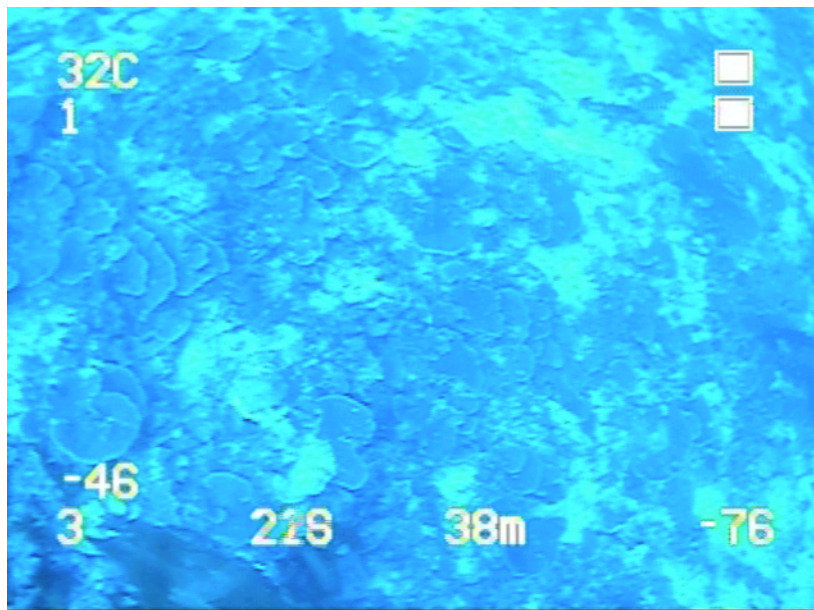


Fig. 6. An example of the footage from the ROV at 38m depth showing many healthy plate corals, suggesting reefs at deeper depths might offer refuge from coral bleaching for species dependent on the reef such as reef fish.

Appendix

Table A1. Islands visited; their legal status and breeding seabirds observed.

Atoll	Island	Legal designation	Seabird Species	Rat presence
Peros Bahnos	Ile Parasol	SNR	Lesser & Common Noddy Common white (fairy) Tern Sooty tern Red-footed Booby Brown Booby	NO
Peros Bahnos	Ile Longue	SNR	Lesser & Common Noddy Common white (fairy) Tern Sooty tern Red-footed Booby Brown Booby	NO
Peros Bahnos	Grande Ile Bois Mangué	SNR	Lesser & Common Noddy Common white (fairy) Tern Red-footed Booby	NO
Peros Bahnos	Petite Ile Bois Mangué	SNR	Lesser Noddy Common white (fairy) Tern Red-footed Booby	NO
Peros Bahnos	St. Brandon	SNR	Black-naped Tern	NO
Peros Bahnos	Morsby		Common Noddy Common white (fairy) Tern Red-footed Booby Lesser & Greater Frigate birds	YES
Peros Bahnos	Coin du mire	SNR	Masked Booby	NO
Peros Bahnos	Grande Ile Coquillage	SNR	Common Noddy Common white (fairy) Tern Red-footed Booby Brown Booby Lesser & Greater Frigate Birds	NO
Peros Bahnos	Petite Ile Coquillage	SNR	Lesser & Common Noddy Common white (fairy) Tern Red-footed Booby Sooty Tern	NO
Peros Bahnos	Manon	None	Common Noddy Common white (fairy) Tern Red-footed Booby	?
Peros Bahnos	Un-named (Burtle)	None	Common Noddy Common white (fairy) Tern	?
Peros Bahnos	Vert	None	Common Noddy Common white (fairy) Tern	?

Peros Bahnos	Finon	None	Common Noddy Common white (fairy) Tern	?
Peros Bahnos	Petite Soeur	None	Common Noddy Common white (fairy) Tern	YES
Peros Bahnos	Grande Soeur	None	Common Noddy Common white (fairy) Tern Red-footed Booby	YES
Salomon	Mapou	None	Common Noddy Common white (fairy) Tern Lesser Noddy Red-footed Booby	NO
Salomon	Ile de la Passe	None	Common Noddy Common white (fairy) Tern Lesser Noddy Red-footed Booby Brown Booby	?
Great Chagos Bank	South Brother	SNR	Lesser & Common Noddy Common white (fairy) Tern Sooty Tern Red-footed Booby	NO
Great Chagos Bank	Resurgent	SNR	Masked Booby	NO
Great Chagos Bank	Danger	SNR	Lesser & Common Noddy Common white (fairy) Tern Sooty tern Red-footed Booby Brown Booby	NO
Great Chagos Bank	Nelsons	SNR	Lesser & Common Noddy Common white (fairy) Tern Red-footed Booby Brown Booby Lesser & Greater Frigate birds	NO
Egmont	Sipaille	None	None	YES
Egmont	Ile Lubine	None	None	YES
Egmont	Iles des Rats	None	None	YES

Notes: SNR – Strict Nature Reserve.