Darwin Initiative
Overseas Territories Challenge Fund
Final Report

This report should be completed and submitted within a month of agreed end date of project

Darwin Ref Number	*EIDCF012*
Darwin Project Title	*Assessing Ascension Islands Shallow Marine Biodiversity*
Country (ies)	*Ascension Island/Falkland Islands/UK*
Award holding Organisation	*Shallow Marine Surveys Group (SMSG)*
Partner Organisations	*Ascension Island Government (AIG), South Atlantic Environmental Research Institute (SAERI), Falkland Islands Government Fisheries Department (FIFD), British Forces South Atlantic Islands (BIFSAI), British Antarctic Survey (BAS), National Museums of Northern Ireland (NMNI), University of Aberdeen (UoA) and Ascension Island Dive Club (AIDC)*
Grant Value	*£* XXX
Start/end date	*1st June 2012 – 30th June 2013*
Author(s), date	*Dr Paul Brickle; Dr Judith Brown; Dr Paul Brewin; Dr Wetjens Dimmlich; Dr Alexander Arkhipkin; Dr Vladimir Laptikovsky; Dr Prof. Frithjof Küpper; Dr Kostas Tsiamis; Prof. Pieter van West; Dr Simon Morley; Prof. Peter Wirtz; Dr Martin Collins; Lt. Col.Simon Browning; Sarah Browning 15th July 2013*

1. Challenge Fund Background

Ascension Island harbours globally important marine biodiversity, potentially representing a unique assemblage of western and eastern Atlantic flora and fauna. Previous marine biodiversity projects have focused primarily on turtles and seabirds (Darwin, RSPB and OTEP funded) lacking detailed inventories for marine invertebrates, ichthyofauna, corals and algae. Habitat inventories and mapping are urgently needed to manage coastal zones. In 2012 AIG and the University of Exeter (UoE) were awarded a Darwin grant to develop the first National Biodiversity Action Plan for Ascension Island, integrating all available information on the spatial distribution of biodiversity and threats. However, with the exception of seabirds and marine turtles, the BAP project has a predominantly terrestrial focus, in large part due to the current paucity of baseline scientific data for marine species that is needed to inform the development of Species Action Plans.

The results from the present survey will enable the production of faunal and floral species inventories, habitat descriptions and maps, a field guide to marine invertebrates, algae and fish, a report on the status of marine endemics, and a report on the potential impacts of climate change. These will inform Ascension Island Government of how they can fit their shallow marine environment into future biodiversity strategies and form CBD targets.

The other main objective of the Challenge Award was to provide an opportunity to formulate a full application to Darwin+ to address further gaps highlighted in marine biodiversity knowledge around Ascension Island.

2. Challenge Fund Activities

The Shallow Marine Surveys Group, in partnership with the South Atlantic Environmental Research Institute and a team of international scientists, in conjunction with AIG staff, addressed some of these issues by generating a great deal of much needed baseline data, thus creating scope for future marine biodiversity conservation and management actions and projects on the Island. The group trained local divers and Conservation Professionals from Ascension and St Helena in sampling protocols such that the collection of baseline data and monitoring of key marine flora and fauna can continue.

Stage One of the work, conducted by BAS included a meta-analysis of existing information on Ascension marine biodiversity to establish literature and a georeferenced database. These data will be linked to globally important open access databases such as the Open Biogeographic Information System (OBIS). At this stage Dr Wetjens Dimmlich set up and expedition blog (www.smsg-falklands.org/blog) so those interested could follow the progress of the group. This proved to be extremely popular on island and within the scientific community.

Stage Two and Stage Three of the work comprised two surveys where SMSG/SAERI assembled a team of 24 local and international ecologists, taxonomists and divers for the first survey and 12 ecologists and divers for the second survey. Many of the team had worked successfully together previously as project partners in the Falkland Islands and South Georgia. Two members of the team (Simon and Sarah Browning) were allocated the responsibility for logistic coordination this was key to success as their primary focus was on moving people and equipment in support of the project. Both working for the Ministry of Defence (British Forces South Atlantic Islands), one a senior logistics officer, was a direct benefit to the project for their understanding of the military supply chain, which ensured the seamless movement of equipment and people. Preplanning started approximately three months prior to both the main expedition in August 2012 and the follow up visit in May 2013. Key at the initial planning phase was to identify equipment and stores that could not be procured or obtained in the Falklands or Ascension Island such as: ethanol, camera spares, water proof paper, additional transact reels, writing boards and specimen containers. The early ordering of equipment allowed for contingency if it could not be transported via air it would have to be transported by ship in order to be in situ in Ascension ahead of each visit.

Freight from the Falklands was booked on the South Atlantic air-bridge through Mount Pleasant Military Base in the Falklands. The expedition had to be self-contained so the freight included diving cylinders, dive equipment and weights, SLR cameras, housings, strobes and medical oxygen as there are no facilities to hire equipment on Ascension. The civilian diving club in Ascension were able to offer compressed air and boats for transit to the dive sites. Seats on the air bridge had to be booked well in advance due to the limited number of places available for civilian passengers. Accommodation on Ascension Island is very limited particularly for large groups so early booking were essential. The first visit comprised a mix of Government housing and Military accommodation, while access to the military base was not available on the second visit so hotel accommodation was utilized. The Ascension Island Conservation department was able to offer office space for kit storage, specimen and data processing. Daily planning meetings were held to ensure everyone was in the right place at the right times with transport coordinated to undertake the tasks. Hire cars were booked in advance as vehicle availability is limited and the demand is high with 4x4 pickups at a premium. The pickups were essential for carrying diving and other equipment to the survey locations. Well planned and delivered logistic support proved to be critical to the success of the project; forward planning, provisioning and an understanding of the limitations of air-freight capacity was essential.

All the kit waiting in the store at Mount Pleasant for transport by RAF flight to Ascension Island

The basis of **Stage Two**, conducted in September 2012, was an ambitious three week (21 day) expedition to the Island to survey the intertidal and sub-tidal zones down to 30m depth. We adapted successful protocols from our previous work, (quantitative photo-quadrats, collections, macro-photography) and employed established methods specific to coral reef habitats (Underwater Visual Census and quadrat photography) which are proven to be statistically robust and comparative across similar studies carried out in other reef habitats globally. A member of the expedition from BAS also conducted thermal tolerance experiments to assess the temperature sensitivity of shallow water marine invertebrates at Ascension Island to evaluate their long term sensitivity to climate warming. Two of the group, phycololgists, from the University of Aberdeen and the Hellenic Centre for Marine Science assessed and captured as much of Ascension's diversity in terms of seaweeds (macroalgae) as possible during this expedition. Due to a clash of timing with other, similar work in Greece in August, they arrived after the rest of the group on the 3rd of September, but stayed on for nine days longer than the other team members in order to complete their tasks.

Sally lightfoot - *Grapsus adscensionis*

Further objectives for **Stage Two** included examining hard structures from fish (otoliths) and molluscs (shells) to determine age and growth patterns between and within species and also to look for patterns that could be monitored for climate change

Other studies included an investigation of biology of the Sally lightfoot crab, *Grapsus adscensionis*, which were carried out around English Bay and Turtle pond areas, as well as a single sample was taken at Catherine Bay.

Octopus behaviour (*Octopus vulgaris*) was also examined particularly with regards to its diet spectrum. Divers, after completing, surveys off English Bay monitored a couple of octopus dens and noted and identified discard shells.

Settlement plate in English Bay

Intertidal surveys were conducted to examine zonation and to examined the diversity of some of the more permanent rock pools.

The Group also deployed settlement plates with attached temperature loggers. The settlement plates are being monitored so recruitment and growth of encrusting organisms can be examined over the coming years. The plates are also useful for monitoring for potential invasive species. Very little grows (algae) on the surface of rocks at Ascension as the black trigger fish will eat almost anything that is exposed. The panels, therefore, needed to be fixed to a solid surface that would stop trigger fish getting access to the underside of the plates.

The second survey, **Stage Three**, was conducted in May/June 2013. This survey was not planned originally. We had unexpectedly made a significant saving on airfares for those members of the expedition travelling from the Falkland Islands. Our collaboration and partnership with the BFSAI meant that project members travelling to the Ascension Island from the Falkland Islands were only charged a concessionary rate on the Airbridge Charter that services Ascension Island and the Falkland Islands. This resulted in a £6,042 saving. This was unexpected and will therefore allow for a follow up trip in May 2013 if agreed by the Darwin Initiative.

Our team of 12 started to arrive on the 24th May. Lt. Col. Simon Browning and Sarah Browning arrived first with our freight. Elizabeth Clingham and Judith and Steve Brown arrived from St Helena on the Tuesday 28th. The rest of the team arrived on the 31st May from a cold and blustery Falkland Islands. The objective of this ten day survey was to build on the first by targeting the intertidal quantitatively, revisiting sites surveyed before to examine the community structure of different habitats on temporal scales and to visit sites and areas not surveyed previously.

Samples from each survey have been distributed taxonomic specialists for further examination and confirmation. This work is yielding great results including many new geographical records and some new species.

The work was very successful and surpassed expectations but was not without problems. The initial couple of days on the first survey were somewhat confused due to the number of scientists and the diversity of work needed to be completed. Regular planning meetings and a central data repository were quickly established which resulted in smooth operation. The diving conditions were great on the whole but the south coast remains un-surveyed due its exposure to the prevailing wind and current. This area still remains un-surveyed by the group and indeed by any previous survey. During the second survey (**Stage Three**) the Ascension Island Dive club's compressor broke down and a SMSG portable compressor had to be flown up.

3. Outcome & Impact of Challenge Fund

During the two surveys (**Stage Two and Three**) a total of 202 sampling events were conducted comprising a mixture of quantitative SCUBA surveys involving belt transects for fish and mobile fauna and quadrat photography for sessile fauna. Intertidal surveys and collections and subtidal collections were also carried out. Oceanographic surveys were conducted around the island. The marine environment is visually dominated by fish, particularly by one species, the black trigger fish (*Melichthys niger*). The reefs are completely grazed and predated by fish to such an extent that a significant component of the biodiversity remains hidden to avoid this pressure. A primary goal was to catalogue such "cryptic" species; we found a surprisingly high cryptic diversity that has been particularly poorly documented in the past. Of particular significance are the set of day vs night dive surveys that were carried out where community comparisons are likely to reveal for the first time the importance of cryptic reef species. The surveys yielded many new geographical records and likely candidates for new species.

Black trigger fish – a critical species, ecologically

Abundance and diversity

The collections made during our expedition not only confirmed that Ascension Island's shallow water fauna has eastern AND western origin but also allowed a more detailed analysis. Numerous invertebrate and fish species not yet recorded for the area were encountered. The majority of these have western Atlantic origin.

Biogeography and Biodiversity

A total of 129 shore fish species is now known from Ascension Island. Eleven of them (8.5%) appear to be endemic to the island and a further 16 species (12.4 %) appear to be shared endemics with Saint Helena Island. Four more species appear to be shared endemics of Ascension Island, Saint Helena Island and the Saint Paul's Rocks. Nine shallow water fish species are only known from the eastern Atlantic and Ascension Island. Twenty-four shallow water fish species are only known from the western Atlantic and Ascension Island, i.e. the western component is more than twice the size of the eastern component. Some genetic studies already exist; they indicate that western Atlantic species originate from the area of Brazil rather than from the Caribbean.

Similarly, the common fire worm turned out to be the western Atlantic *Hermodice carunculata* and not its eastern Atlantic sister species *H. nigrolineata* (B. Yanez in prep.). Two of the four zoanthids (Anthozoa, Zoantharia) collected have only been recorded in the western Atlantic and Ascension Island (Reimer et al. in prep). The Opisthobranchia, Scleractinia, Polyplacophora, Antipatharia and Decapoda collected are still being analysed.

Until today, only a few collections have been made of Ascension seaweeds. One of our aims was to update the knowledge of the island's marine flora, focusing on green, brown and red macroalgae. Our collections yielded extensive herbarium and silicagel material as well as underwater photos of selected species in the form of a field-guide. The seaweed flora of Ascension Island was investigated during a 2 week-period time in September 2012. Several rocky sites were chosen along the Island's shores, some of which had served as study sites in previous studies, in various coastal habitats, including rock pools (e.g. Catherine Point, Collyer Point, Shelly Beach), blow-hole areas (e.g. Catherine Point), Turtle Ponds (Georgetown), midlittoral rocks, beach rocks (e.g. Pillar Bay, Collyer Point, Clarkes Beach), outfall channels from power stations (Derby wreck), sublittoral rocks (e.g. English Bay, Comfortless Cove, Soudan Bay, Derby wreck, Horseshoe Reef, Red Rock Cave, reef west of Georgetown).

Seaweeds were collected by snorkelling and scuba-diving, from the surface down to 38 m depth. Underwater macrophotographs were taken using an Olympus PTWC-01 camera with PTDP-EP05 housing. Samples were studied in the laboratory of the Conservation Centre, using stereomicroscopes, where numerous herbarium specimens and silicagel samples for DNA bar-coding were made. Species were identified down to the lowest possible taxonomic level. Collections were supplemented by in situ collections of substratum samples for incubation under suitable culture conditions in the laboratory, which were subsequently monitored for algal outgrowth (collaboration with Akira F. Peters, Roscoff) for preparing unialgal isolates, enabling unparalleled microscopic and molecular studies in the laboratory afterwards.

Around 85 seaweed species were found, including 16 green, 18 brown and 51 red representatives, excluding the calcareous red algae that are still under investigation. Among them 39 taxa are new for the Ascension flora, of which *Corallophila cinnabarina*, *Erythrocladia violacea* and *Erythrotrichia bertholdii* are new for the tropical Atlantic Ocean. In addition, 7 species belonging to the genera *Acrochaetium*, *Aglaothamnion*, *Champia*, *Dasya*, *Dictyota*, *Polysiphonia* and *Rhodymenia* were given under their generic names as identification to species level requires more material collected.

Seaweed vegetation varied depending on the habitat examined. Well protected rock pools and blow-holes (Catherine point, Collyer point) hosted the most diverse and abundant seaweed communities, such as *Chnoospora minima*, *Codium taylorii*, *Colpomenia sinuosa*, *Levringia brasiliensis* and *Valonia ventricosa*. This macroalgal richness is likely correlated with the limited presence of grazers, such as the blackfish, inside the rock pools. On the contrary, sublittoral environments down to 30 m depth were poor in terms of macroscopic seaweeds, excluding the calcareous ones. In this case, only a few seaweeds, with diminutive and repent habit creating turf-like mats, could be found, due to the strong grazing pressure. These included *Dictyota* sp., *Gelidium pusillum*, *Lobophora variegata*, *Neomeris annulata* and *Wrangelia argus*. However, in crevices where access to the blackfish was restricted, more conspicuous algae could be met, such as *Padina gymnospora* and *Cladophora* spp. On the other hand, calcareous red algae (coralline red algae) actually dominated the sublittoral zone of much of Ascension's seabed ecosystem, covering large surfaces and constituting structuring elements to the seabed communities and landscape. Due to their solid calcium carbonate skeleton, they are unpalatable to grazers, and they somewhat fulfil the reef-building role that corals play in many other tropical marine areas around the world. They either form loose piles on the seabed (maerl - rhodoliths), or tower-like, reef-forming structures. Plenty of cyanophytes can be found on these formations, which apparently are not preferred by the blackfish. Midlittoral rocky habitats, exposed to high hydrodynamism, hosted several seaweeds, such as *Asteronema breviarticulatum*, *Chaetomorpha antennina*, *Ectocarpus* spp. and *Palisada perforata*. In a few sites (Collyer Point, Clarkes Beach), where extensive beach rocks formations are met in the exposed midlittoral zone, characteristic luxuriant clumps of seaweeds develop, including some large seaweeds such as *Sargassum* spp. and *Acanthophora ramulosa*, which were absent elsewhere around the Island. The Georgetown Turtle Ponds were quite poor in seaweeds, in contrast to what a previous study in the 1980s had reported, where only a few cyanobacteria and *Padina* specimens were found. An outfall channel from a power station was investigated near the Darby Wreck, where a number of *Ulva* and *Cladophora* species were found to occur in significant biomass, indicating a local enrichment of the water nutrients. Moreover, abundant populations of the green fleshy alga *Bryopsis plumosa* were encountered at the Darby Wreck, dominating swallow rocks and boulders. This species was never recorded before in the island and its massive presence at this specific site could be related with either an introduction event or to an outcome of a seasonal effect in the seaweed's life cycle.

Finally, a significant collection of substratum samples (fragments of sea shells, sand, coralline red algae) in sterile tubes was made. These samples will be incubated under suitable culture conditions in the laboratory. By experience, this approach captures a number of taxa usually inaccessible or unavailable during the fieldwork. As a result it is anticipated that the number of identified species will get longer.

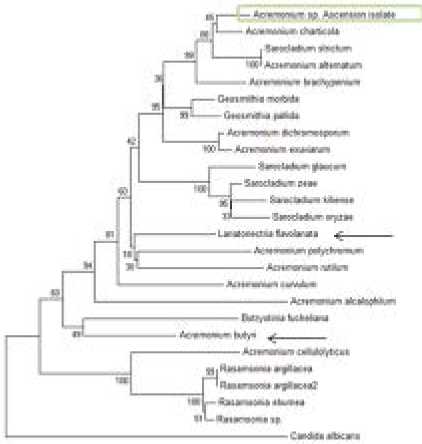
New species

The project has turned up number likely of new species from invertebrates to lichens. The first is novel lichen from saltwater vents of Whale Point. This work is being progressed by Kyle Fletcher, Stedson Stroud, Frithjof Küpper and Pieter van West.

In the Stage Two survey two suspected moss samples were collected from the saltwater vents of Whale Point on Ascension Island. However after molecular analysis it was discovered that these "moss" samples had been incorrectly identified. In the first instance a species of *Dilabifilum*; a little studied filamentous green algal genus, was identified through molecular work after sequencing its SSUrRNA. The lack of extensive studies on *Dilabifilum* have resulted in some conflicting opinions about the distribution of this species, with some sources claiming it only to be localised in Europe despite morphological reports on the identification of this alga from as far away as Japan and Antarctica. A source of this conflict may be due to the uncertainty about defining characteristics of this species with very little molecular work being done on *Dilabifilum*. This finding on Ascension Island could potentially be the first molecular confirmation of *Dilabifilum* species away from European waters. It would be of interest to investigate other areas of Ascension Island to see if it is has a foothold on the island. Unfortunately no morphological work has been carried out as of yet as axenic cultures are still in production so a comparison of previous morphological studies mentioned has yet to commence.

The second sample of misidentified moss revealed a potentially new species of lichen. Formed from the delicate mutualistic relationship between Fungi and Algae these organisms are notoriously hard to study and even harder to grow. Currently we have been unable to isolate the photobiont (algae) from the lichen, via the common technique of spreading a suspension of the lichen cells (a suspension of algal and fungal cells) on a low nutrition (i.e. Bold's Basal Media) media plate as it seems to be a particularly slow growing species of green algae allowing the fungus to invade any plates before algal colonies appear. However we have been able to successfully isolate the mycobiont of this relationship and are happy to report not only a new record but also potentially a novel lichen forming *Acremonium* species. Although these fungi are quite common, with at least 100 species belonging to this genus, only three have been reported to be associated with algae and forming a lichen. Unfortunately only two of these species *Acremonium rhabdosporum* and *Acremonium lichenicola* have been molecularly characterised. Therefore we will also need to characterise the third known lichen forming species *Acremonium pedatum* before we can confirm that the isolate from Ascension Island is a new species.

Macroscopic image of the novel lichen isolated from the salt vent at Whale Point, Ascension Island. The *Acremonium* hyphae are clearly visible on top of the green lichen and growing out of the colony. Scale bar represents 2mm

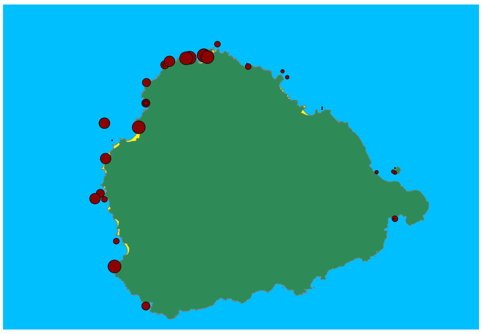


A reduced ITS *Acremonium* species tree showing the location of the potentially new lichen forming *Acremonium* sp. isolated from Ascension Island. As ITS sequences for the other lichen forming species are not available at present these have not been mapped, however on an 18S tree (seen in *Summerbell* et al 2011) the lichen forming fungi of this genus are seen to branch close to *Lanatonectria flavolanata* (*A. rhabdosporum*) & *A. butyri* (*A. lichenicola*) (Both arrowed). Unfortunately no molecular work is available for *A. pedatum* so the placement of this species cannot be confirmed

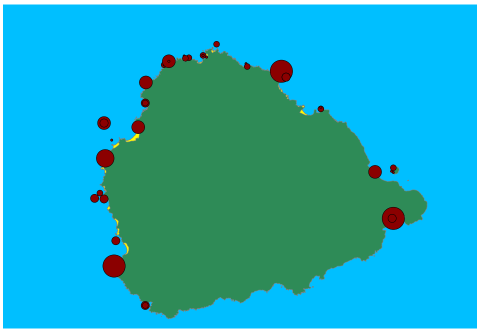
Marine and Fisheries Ecology

Underwater Visual Census (UVC) surveys were conducted to generate baseline data and assess the community structure and abundance of fish fauna over different habitats by recording abundance of both fish and marine invertebrates. Habitat inventories and mapping are needed to facilitate the management of coastal zones by establishing the current distribution and abundance so as to measure any changes over time. Survey methodology involved three divers per team – two counters and a cameraman. The counters recorded all invertebrates and benthic fish species in a 1mx50m belt (with each counter recording for one side of a tape measure). The counters then returned down the same 50m tape counting all the larger fish species within a 5mx50m belt.

The cameraman followed behind taking photographs of 0.25m^2 quadrats of the seabed every 2m which will be analysed with special software to estimate density and % area cover to examine biodiversity and community structure quantitatively. 82 UVS surveys were completed over the two trips to Ascension and sites were distributed as far as weather would allow. Unfortunately the conditions were never favourable to survey the southerly shore however both the westerly and northerly shores had good coverage. A range of habitats were surveyed including sand, cobbles, large boulder and bedrock sites and various depths were surveyed at each location – ranging from 2m to 25m. The second survey allowed the team to revisit sites surveyed before to examine the community structure of different habitats on temporal scales. Creolefish were the most abundant species during the August survey, then blackfish, Apollo damselfish and yellowtail damselfish. Of the invertebrates Diadem longspine urchins (*Diadema antillarum ascensionis*) were the most common followed by the shorter spined black urchin (*Echinometra lucunter*) - which is more abundant in shallower waters. In June there were much fewer creolefish, however yellowtail damselfish and Ascension wrasse juveniles were significantly more abundant than in August. Survey data also provided information on several commercial species e.g. the rock hind *Epinephelus adscensionis*. Results showed location differences in abundance of adults with a lower abundance in the more accessible areas which may be attributable to fishing pressure or habitat suitability. In contrast, juvenile rock hind densities were much higher in the sheltered areas with the greatest abundances found in the northern and western parts of the island which might be a reflection of the Island's oceanography allowing larvae and juveniles to be retained in greater numbers.

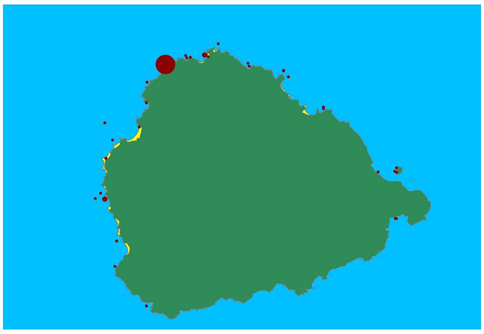


Relative density of juvenile rock hind



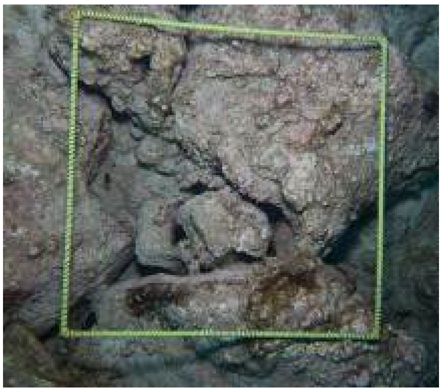
Relative density of adult rock hind

These surveys have also allowed us provide baseline data on endemic species inhabiting the coasts of Ascension Island. For example the white hawkfish, according to Lubbock (1980), are generally observed among finger-like projections of corraline algae on rocks at 3-10 m depth, but also seen in rock crevices and on scattered rubble to 25 m depth. During our survey in August/September they were found from 3 to 27 m and their densities varied between 0 and 39 individuals/200m^2. There was a general pattern of decreasing density with increasing survey depth. One survey, not following this pattern at 12 m, had a density of 39 individuals/200m^2! Hawkfish were associated with boulder on bedrock environments and not found on or near cobble, maerl or sandy environments. They were distributed around the Island in boulder habitats without apparent pattern except for a significantly higher density at White Rock.



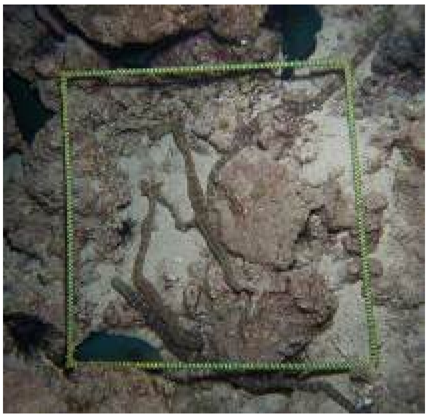
Relative density of white hawkfish

White hawkfish



Day quadrat

Surveys like these are important as the provide baseline data for this endemic species. Future surveys at different times of the year will shed some light on their biology, lifecycle and will make a direct comparison to our survey conducted in August/September and in May/June. It is important that future work be concentrated at estimating its abundance in temporal and spatial scales, describing and mapping its habitats and biology in order to inform a rigours species action plan for this important species.



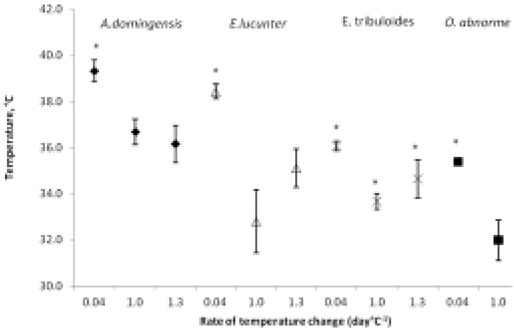
Night quadrat

To get a complete species list as well as conducting surveys in a variety of habitats and during different seasons it was also important to compare species found during the day and at night when a varying array of animals are present. To quantify the difference in species diversity and abundance day night comparison surveys were conducted both during the August survey and again in June. The survey method was adapted slightly (to compensate for reduced visibility at night) and involved three transects each 1m x 50m survey all along the rocky reef just off Wigan Pier. During the early afternoon the first set of transects were competed – leaving the tape measures in situ with activated glow sticks on each end. These were then repeated once darkness fell. Yellow banded sea cucumbers, shrimps and anemones are a few of the species which were only present during the night transects, whereas sand tilefish, Ascension wrasse, redlip blennies and sergeant major were all seen only during the day. Comparison of this data allows us to better understand species composition and different activity patterns of the Ascension marine fauna.

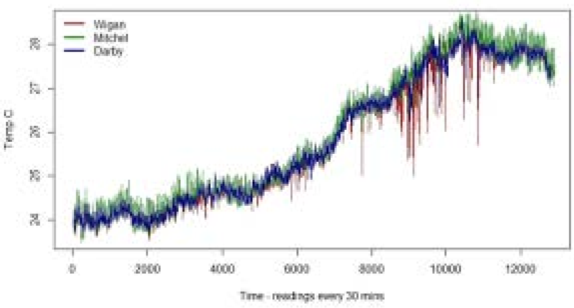
Climate Change

To assess the temperature sensitivity of shallow water marine invertebrates at Ascension Island, two sea urchins (*Echinomerta lucunter* and *Eucidaris tribuloides*), one brittlestar (*Ophiostigma abnorme*) and one bivalve (*Acar domingensis*) were collected from 3-9m at Wigan Pier, English Bay. Upper temperature limits were tested at three rates of temperature change, 0.04, 1.0 and 1.3day°C, to assess their long term sensitivity to climate warming.

At the fastest rates of change the bivalve, *A. domingensis*, was the most temperature tolerant (39.0°C) and the brittlestar, *O abnorme*, the least (35.6°C). At the slowest rate of temperature change all temperature limits were lower, with the bivalve again the most tolerant (36.2°C) and the brittlestar the least tolerant (31.1°C). With seawater temperatures reaching up to 29°C in May and June (Fig. left) the brittlestar only has a safety margin of 2°C over the warmest seawater temperatures, making them very vulnerable to any further warming. During May and June daily temperatures can vary by up to 3°C (Fig. right) and the urchin, *E. tribuloides*, showed the first signs that Ascension Island marine invertebrates have the plasticity to rapidly acclimate their physiology to increasing temperatures. Further research is required to test if this plasticity will give Ascension marine invertebrates an improved ability to cope with predicted climate change.



Upper temperature limits of four shallow water marine ectotherms at different rates of temperature change



Temperature records for Wigan Pier, Mitchel's Bay and the Darby Bay, 4 Sept 2012 to 3 June 2013

Additionally, climate studies in Ascension Island using biological markers were investigated. Two types of biological climate recorders in the marine environment were used, namely otoliths of coastal species of fish and shells of the intertidal oyster *Saccostrea cucullata*. These will also be used for age and growth studies and will feed into fisheries management strategies for future work.

More than 20 species of coastal fish were sampled from several locations around the Island. The sagittal otoliths were removed and placed in 95% ethanol for further processing in the Fisheries Department laboratory in the Falkland Islands. The standard transversal sectioning of the otoliths was performed using the diamond low speed saw Buehler Isomet. The otolith microstructure was examined under zoom microscope Olympus SZX12.

Growth increments were quite clear in all fish species studied. It was found that almost all medium size and large fishes were suitable for climate studies as they had long life cycles. The best resolution of growth increments was observed in ocean surgeon fish *Acanthurus bahianus* with oldest fish being 18 years of age. The most abundant black trigger fish *Melichthys niger* had high growth rates attaining maximum sizes at age of 10-12 years. Grouper *Epinephelus adsensionis* were 12-14 years old at 50-55 cm fork length. Surprisingly, large specimens of yellowfin tuna *Thunnus albacares* were up to 24 years old (at 260 cm FL), that should be taken into account when dealing with management of their stocks. The next step will be the dendrochronological analysis of the width of growth increments with dating 'uncommon' years of either fast or slow growth rates. Comparisons of growth rates and life spans of the same species inhabiting waters around Ascension Island and St Helena will give further indications about registering of macro-scale climate change in Tropical eastern Atlantic.

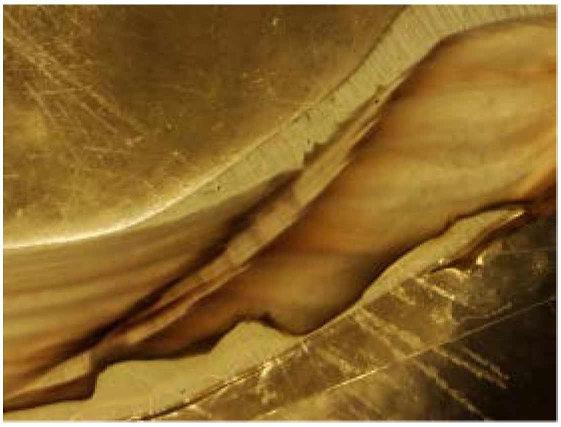
Annual growth increments in ocean surgeon fish *Acanthurus bahianus*

Annual growth increments in grouper (rockhind) *Epinephelus adsensionis*

Annual growth increments in yellowfin tuna *Thunnus albacares*

Length-frequency structure of oysters *Saccostrea cucullata* were studied in various bays of Ascension Island subjected to different oceanographic conditions and wave stress. The upper valve was used for measurements of weight, length and width. To estimate the age and growth of oysters, their valves were cut with the Buehler Isomat™ Precision saw to prepare thin cuts for each individual and then polished on the grinder. The sections were cut through the adductor muscle scar from the hinge to the shell edge to reveal annual growth increments at the scar.

Length of the oysters varied from 23 mm to 92 mm with ages ranging from 1+ year to 11+ year. Two modes were revealed (at age of 6 years and 10 years) both for age-at-length and age-at-weight data. The results of this study suggest that the populations of *Saccostrea cucullata* consisted of fast and slow growing animals. Further studies are needed to reveal possible phenotypic and genetic differences between these two groups of oysters in Ascension Island waters.



Annual growth increments in oyster *Saccostrea cucullata*

Oceanography

Setting

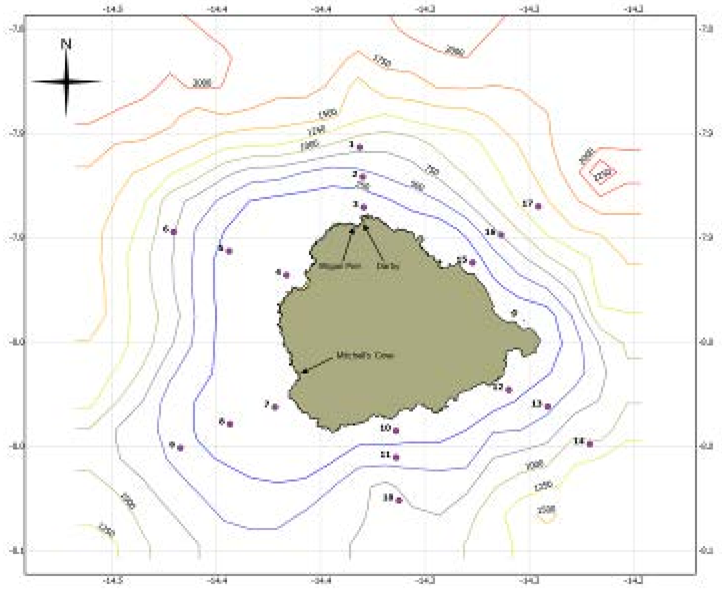
Ascension Island is situated within so called Tropical Surface Waters (TSW) of the southern central equatorial Atlantic. TSW extends down to approximately 50m depth; below this temperature declines rapidly from typically 27^{o}C to 15^{o}C across a sharp thermocline, marking the upper boundary of South Atlantic Central Water (SACW) down to 500m. Antarctic Intermediate Water (AAIW) lies below this down to 1200m, and Antarctic Bottom Water is found to the sea floor. The flow field around Ascension Island is predominantly westward along the southern band of the South Equatorial Current flow field (SSEC), fed in part by the Benguela Current and Angola Gyre off the coast of west Africa. South of Ascension at approximately 10^{o}S is the Southern Equatorial Counter Current (SECC) flowing eastward. The relative northward or southward positions of these currents vary seasonally. Both the SSEC and SECC are detectable down to 1200m.

Ascension Survey Stage 3

Oceanography was examined in two ways. To examine the regional oceanographic situation, we carried out a synoptic oceanographic survey in June 2013; stations are shown the figure below.

All stations were sampled during one day aboard the *Wide Awake* using a Valeport CTD profiler. Conductivity, temperature and pressure data were processed using the ‘oce’ package in R (version 3.0.1). Interpolation of temperature, and derived salinity and density was done in GRASS (version 6.2.4) using the regular spline tension algorithm.

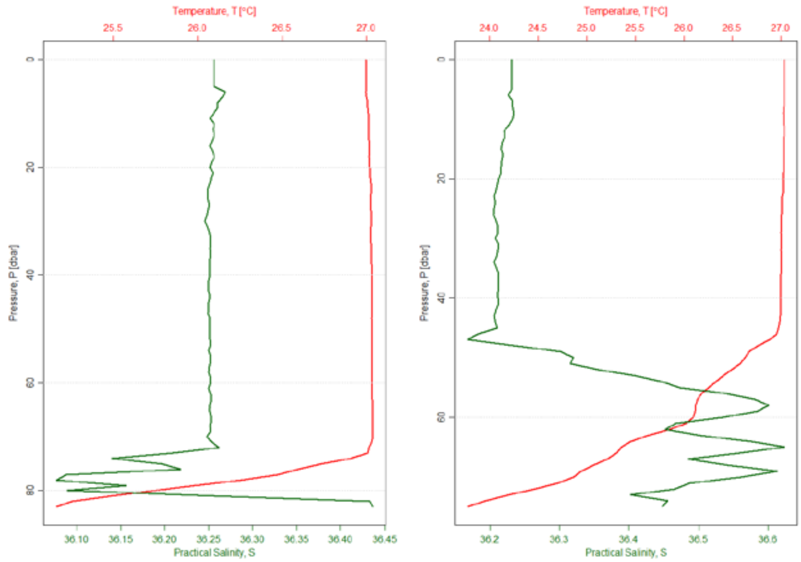
To examine fine temporal and spatial scale variability, we deployed three TidbiT 2 temperature loggers (Hobo-Onset) at Wigan Pier, on the wreck of the Darby in English Bay, and at Mitchell’s Cove. Loggers were initially deployed on the first expedition in Sept 2012, and set to record at 30 min intervals. In June 2013, loggers were retrieved, downloaded, and re-deployed. Preliminary spectral analysis was done in R (version 3.0.1) using the ‘stl’ seasonal decomposition function for time series data.



Ascension Island bathymetry (m), CTD stations, and locations of temperature loggers

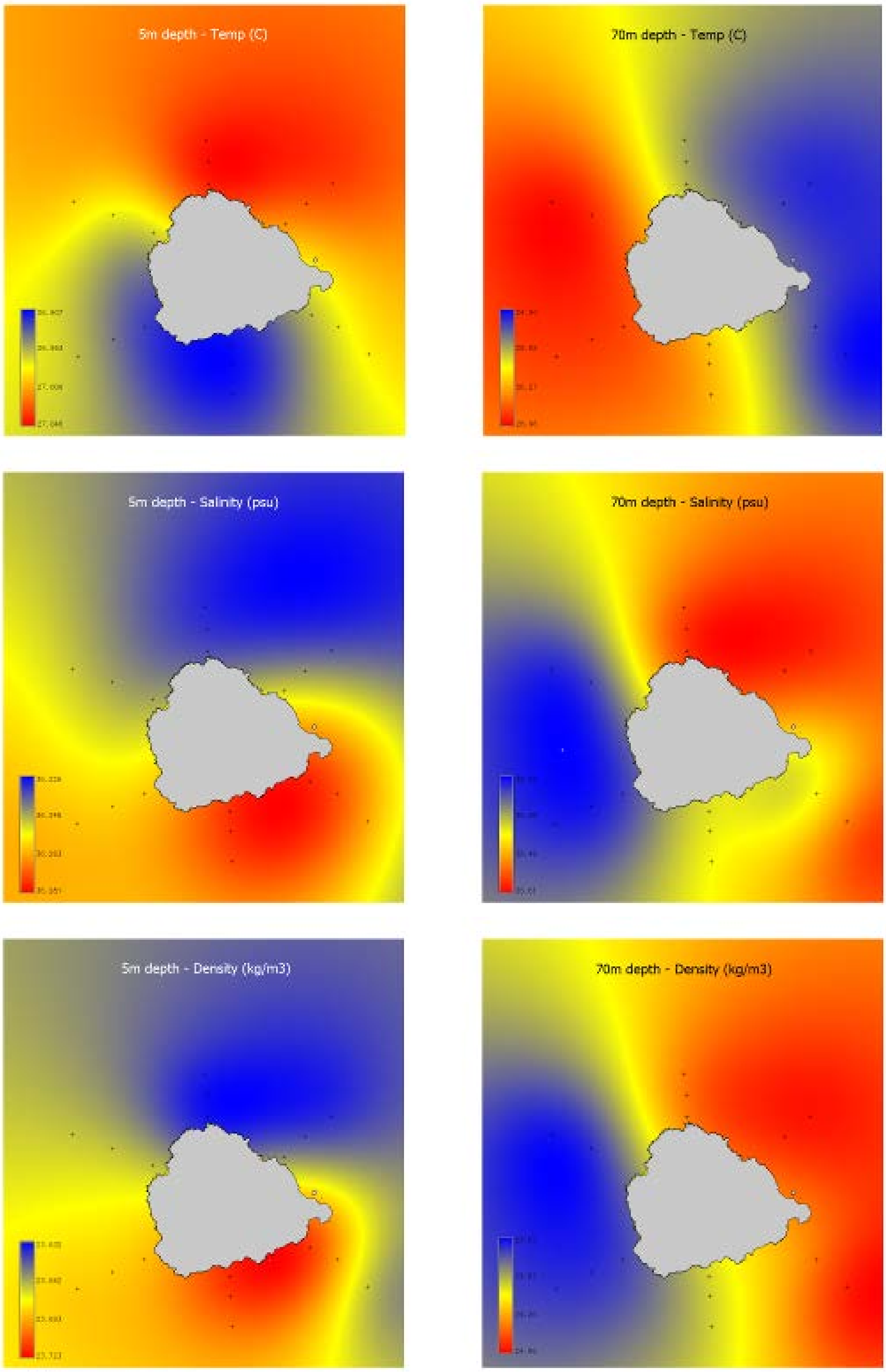
Preliminary Results

Oceanographic profiles show a clear East-West gradient in temperature and salinity, and significantly, a difference in the depth of the upper thermocline, being deeper in the west (approx. 70m depth) and relatively shallow in the east (approx. 50m depth).



Temperature and salinity profiles at Station 6 (left plot, western station) and station 17 (right plot, eastern station)

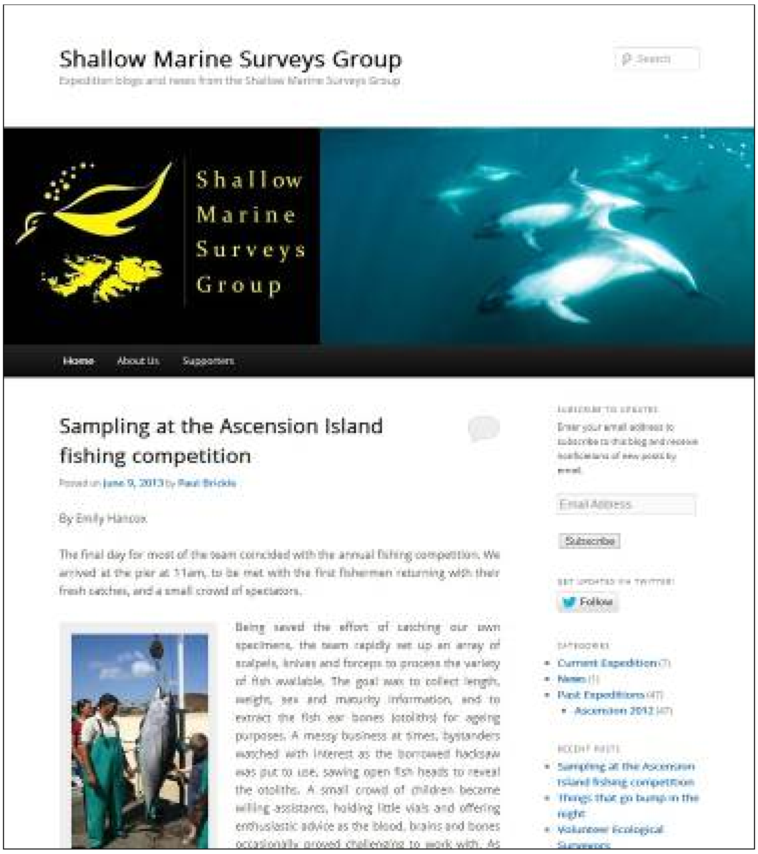
Similarly, interpolated views across the survey areas show distinct east-west gradients. At the 5m horizon, temperature, salinity and density showed very narrow ranges of spatial variability. However, below the thermocline at 70m depth, wide spatial variability was observed, particularly in the temperature gradient which varied by over 2 ^{o}C.



Interpolation of oceanographic data throughout the survey area at the 5m depth strata (left plots) and 70m depth strata (right plots)

Media, Field guide and Popular Press

The activities both above and below water, of the SMSG team during the Ascension Island expedition was fully documented,. The expedition web blog was created in June 2012, several months prior to travel to Ascension. To date, the site (at www.smsg-falklands.org/blog/) has been viewed over 10,000 times, maintaining a consistent rate of daily visits. Fifty-five updates have been posted by many members of the team, and updates continue to be posted as the team follow up on the work carried out at Ascension.



The front page of the SMSG expedition blog. Readers can follow the activities of the team which are presented in an easy to read style, accompanied by many informative and eye-catching images.

In addition to providing updates on the daily activities of the team, the site also presents a full photographic record of species recorded during the surveys. Readers are able to follow the posts through subscription by email or Twitter.

This online species record complements a traditional guide book to the marine life of Ascension Island. This guide book, currently under design, is scheduled for completion and publication in 2014 and, through hundreds of images, sourced from almost 20,000 recorded by the team, will represent the best available visual record of marine life at Ascension Island.

As further work is conducted by the Shallow Marine Surveys Group and its partners in Ascension Island and elsewhere, these undertakings will be added to the online record. We hope that presenting the group's activities in this visually appealing style and promoting the support of the many organisations which help to make these scientific expeditions possible will help encourage and advance the growth of scientific knowledge throughout this relatively unexplored region of the globe.

As well as the use of multimedia the group give public talks to the school and community. This created a great deal of community support.

Report to AIG

The wealth of data generated provides a baseline of species diversity, habitat preference and species abundance, allowing us a greater understanding of the Ascension marine ecosystem. This in turn can be used to generate management advice for inshore species and habitats including species of commercial interest.

We are preparing a full report to AIG, which will be copied to the Darwin Initiative, and will include a detailed account of our activities and will report faunal and floral species inventories, habitat descriptions and maps, a field guide to marine invertebrates, algae and fish, a report on the status of marine endemics, and a report on the potential impacts of climate change.

Development of a full Darwin Proposal

In terms of marine biodiversity the limitations of the current project included the limited time periods the surveys were conducted in, two discrete periods in August/September 2012 and May/June 2013, and the restricted bathymetric range due to conservative diving limits. Therefore the barriers to understanding the marine biodiversity of Ascension Island include the lack of surveys in temporal and bathymetric scales. Additionally the exposed southern coast was not sampled during either of the surveys because of difficult diving conditions. Furthermore Ascension Island is extremely data poor with respect to fisheries and oceanography. The Challenge Award has allowed us to develop ideas for a full Darwin Award that will fill the near shore biodiversity gaps deliver a better understanding of off shore biodiversity and near shore and offshore fisheries. A concept note has been commented on by AIG and our partner organisations and we intend to submit an application for the September 2013 round.

4. Lessons

There was a trade-off between the number of scientists and what could be achieved on the two surveys. Our multidisciplinary team managed to achieve a great deal in a short period of time on island. We struck the right balance with partners that had worked well together in the past and experts in different fields. Seeking agreement with museums and collaborators that samples received would be worked up in a timely fashion prior to sending on this valuable material ensured that samples were turned around in good time. Many of these experiences will be carried onto the full award if successful.

Due to the isolated nature of the Island adaptability, modification and being able to repair gear in situ was key. Many of the team were incredibly resourceful and were able make and adapt sampling gear as we needed it.

One important lesson was making sure that large team was organised from the start. This was an issue for the first couple of days during the first survey. Twenty scientists with different interests wanting to sample all at once was somewhat chaotic at first. As such, we quickly established correct systems, databases and data protocols were in place, and these lessons will be taken to the next project.

5. Project Expenditure

Item	**Budget for whole project***	**Actual Expenditure**	**Variance** as a %**	**Comments**
Travel Costs	XXX	XXX	+22%	See note 1
Subsistence costs	XXX	XXX	-38%	See note 2
Overhead costs	XXX	XXX		
Operating Costs	XXX	XXX	+7%	
Capital Costs	XXX	XXX	+21%	See note 3
Other	XXX	XXX	+100%	See note 4
Salaries (specify by individual) Oli Hogg BAS	XXX	XXX	-33%	See note 5
TOTAL	XXX	XXX	-0.4%	

* please indicate which document you refer to if other than your project application or annual grant offer letter

** please explain any variance of +/- >10%

Notes
The project made a saving of £6,042 due to a saving in flights and accommodation as a result of the collaboration with representatives of British Forces South Atlantic Islands. A number of the group were also provided with free housing in George Town contributing to the significant saving in accommodation costs. A further unexpected saving was made with Oliver Hogg (British Antarctic Survey) only being able work for 1 of 1.5 months budgeted. SMSG requested for an approval to amend the budget on the 31st January 2013 in order utilise the remainder of the budget for a second survey which added great value to the overall project.

These variances were unexpected and the savings were only apparent after not long before the first survey.

Note 1 – Travel Expenses.
The total for the first survey was £7,069 which was a saving of £1,042. With the revised budget a further £3,335 was utilised for the second survey.

Note 2 – Subsistence Costs
A number of the team were provided with AIG accommodation without charge resulting in a significant under spend during the first survey. This coupled with reduces costs in military accommodation resulted in the unexpected variance.

Note 3 – Capital Costs
This was due to extra spent on sampling bottle to augment what the group had in store.

Note 4 - Salary
An unexpected saving was made with Oliver Hogg (British Antarctic Survey) only being able work for 1 of 1.5 months budgeted.

6. Other comments not covered elsewhere

- Any comments not captured under previous headings.

Darwin Challenge Fund Reporting Guidelines

All Darwin projects are required to report on the work they have undertaken with Darwin funds and this offers you the opportunity to report on your achievements and lessons learnt and on any other issues you would like to raise. You report should show how you have progressed against the activities outlined in your application, or clearly explain any changes and the reasons why these changes were necessary.

You are expected to prepare the report in conjunction with your partners and you are expected to submit a Final Report within 1 month of completion of the agreed dates for the award (max 6 pages excluding annexes).

We will acknowledge and read all reports submitted, but will only contact you about your report if there are specific concerns.

If you have any additional queries about reporting, please feel free to email or call on 0131 440 5181.

Checklist for submission

	Check
Is the report less than 5MB? If so, please email to Darwin-Projects@ltsi.co.uk putting the project reference number in the Subject line.	✓
Is your report more than 5MB? If so, please advise Darwin-Projects@ltsi.co.uk that the report will be send by post on CD, putting the project reference number in the Subject line.	
Have you included means of verification? You need not submit every project document, but the main outputs and a selection of the others would strengthen the report.	✓
Do you have hard copies of material you want to submit with the report? If so, please make this clear in the covering email and ensure all material is marked with the project number.	
Have you involved your partners in preparation of the report and named the main contributors	✓
Have you completed the Project Expenditure table fully?	✓
Do not include claim forms or other communications with this report.	