

Darwin Plus: Overseas Territories Environment and Climate Fund Annual Report

To be completed with reference to the “Writing a Darwin Report” guidance:
(<http://www.darwininitiative.org.uk/resources-for-projects/reporting-forms>). It is expected that this report will be a **maximum** of 20 pages in length, excluding annexes)

Submission Deadline: 30th April 2020

Darwin Plus Project Information

Project reference	DPLUS089
Project title	Integrating genetic approaches into sub-Antarctic deep sea research and management
Territory(ies)	South Georgia and the South Sandwich Islands
Lead organisation	University of Essex (UoE)
Partner institutions	Cefas
Grant value	£278,231.00
Start/end dates of project	Start date : 1 st April 2019
Reporting period (e.g. Apr 2019-Mar 2020) and number (e.g. Annual Report 1, 2)	Annual Report 1, (April 2019 – March 2020)
Project Leader name	Michelle Taylor
Project website/blog/social media	NA
Report author(s) and date	Michelle Taylor and Rui Vieira

1. Project summary

South Georgia & South Sandwich Islands Marine Protected Area is one of the world’s largest protected areas, protecting vast deep-ocean areas that harbour diverse vulnerable marine ecosystems. Understanding if the MPA is a source or sink of juvenile benthic organisms, and its role regionally, is important for conservation management and only possible to groundtruth with genetic approaches. This project investigates deep-sea diversity and the genetic connectivity of habitat-forming organisms within the SGSSI MPA and across the wider South Atlantic region.

2. Project stakeholders/partners

Stakeholder 1 - Government of SGSSI (GSGSSI)

Cefas has consulted GSGSSI in the preparation of this proposal and they have endorsed this project, the outcomes of which will feed into SGSSI MPA research and monitoring plans through reports. Cefas is in

a strong position to do this as it regularly provides the GSGSSI with technical and scientific advice and support, including research and monitoring within the SGSSI MPA.

Stakeholder 2 - Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR)

Since 2012, Cefas have been providing the Foreign and Commonwealth Office (FCO) with technical and scientific advice in relation to the Antarctic fisheries managed internationally by CCAMLR. Cefas and UoE will be engaging with the GSGSSI by providing a report of project results. Cefas also heads the UK's scientific delegation to CCAMLR, with Dr Chris Darby serving as the UK Chief Scientist to CCAMLR, meaning this project will engage with CCAMLR through this route.

Regular meetings with GSGSSI have been held during year 1. Further updates will be given to relevant stakeholders at the end of year 2.

3. Project progress

3.1 Progress in carrying out project Activities

All the major outputs are long term goals and the above activities are steps towards their achievement. The project was approximately 1 month behind the planned activities when Covid-19 restrictions were imposed. This meant a cessation of all activities for this project. All of the planned work for the Mar-April (end of year 1) activities involved either 1. Travel (Dr Taylor was meant to be visiting Paris museum to collect more specimens) or 2. Laboratory work (Dr Etsebeth, technician, was meant to be undertaking the UCE work through this period). We were able to get back into the lab in mid-July. I requested extra finance from Darwin to support either 100% of the furlough costs of our technician or the 20% furlough (after I was able to convince the university to support official furlough). Neither was supported. I therefore will be requesting a 6-month no-cost extension to this project and many budget changes as staff costings are going to be over that originally planned. Some outputs will likely also not be possible in the long term as with the fixed budget and fewer samples they are not possible within the bounds of the time and finance available.

The outputs are:

1. Better informed management of SGSSI MPA with the provision of deep-sea connectivity information. This was always a longer-term goal i.e. 3rd year / end of project so is not yet complete but activities towards it are well underway (see below, 3.2).
2. Genetic data and species identification freely available.

Similar to the above, this is an end goal and activities are well underway.

3. Understanding the role of habitat heterogeneity in shaping deep benthic biodiversity.

Similar to the above, this is an end goal and activities are well underway.

4. Dissemination of information about deep-sea habitats around SGSSI and the wider sub-Antarctic.

Similar to the above, this is an end goal and activities are well underway.

3.2 Progress towards project Outputs

Outputs:

1. Better informed management of SGSSI MPA with the provision of deep-sea connectivity information.

Specific activities to achieve this output include:

- Hiring technician
- Meetings with BAS, Dr Barnes and Dr Collins, and Dr Downey, project collaborators.
- Collection of extra specimens from the South Georgia long line fishery
- Collection of extra specimens from the Smithsonian National Museum of Natural History in Washington DC however due to Covid-19 these have not been posted to us.
- Commencement of upscaling activities to improve efficiency of sample processing

This output is where the majority of our time for first year has been spent. After a one-month delay in hiring a technician, the project really started in earnest when Dr Kerry-Lee Etsebeth commenced as a technician in Nov 2019. Since then, up to the closure of our laboratory due to Covid-19 (Mar 2020), we made quick progress in laboratory research and sample collections. Dr Taylor visited the Smithsonian National Museum of Natural History in Washington DC to collect target species (*D. acanthina* and *T. viridis*) for population genomics in Feb 2020. The museum shut down soon afterwards and these specimens have not been posted to be used in the project (email received 18th Aug 2020 – the Smithsonian will likely not be sending out specimens until 2021). Dr Taylor was also not able to visit Paris museum for planned collections from there.

In the 4 months before the university closed due to Covid-19 (13th March) Dr Etsebeth managed to commence DNA extractions, test protocols, and purchase necessary equipment and consumables. All work ceased from 13th March > 6th July as the only project activities necessitated a laboratory and Dr Etsebeth was eventually furloughed. Since returning from Covid-19 lockdown on the 6th July the upscaling from individual samples to 96 plates of samples has been completed – this will dramatically speed up our sample processing. Due to Covid-19 shortages, getting the correct kits and consumables, as well as personnel shortages (the building has only 20 people in it, less than a tenth of the norm), getting lab work done has been difficult and is slowing our planned progress.

As we were doubtful that the extra specimens (from Smithsonian and Paris) will be available we have had to consider alternative ways to study connectivity. The only option was to push ahead with the samples we had in house/ in the UK and broaden the number of species if possible.

Our original two target species are the first two listed below. The ‘Total’ number is how many we have in house right now and can use. Days represent how many days of time it will take to do the remaining DNA extractions.

D. acanthina Total= 119; 48 DNA extractions to go (3 days)

T. viridis Total= 82; 35 extractions to go (3 days)

P. chilensis Total= 132; 119 extractions to go (7 days)

T. variabilis Total= 104 extractions to go (7 days)

T. brucei Total= 14 extractions to go (1 day)

T. vulpicauda Total= 265 extractions to go (12 days)

As studies of a single species in more detail (heavy sampling from a high number of locations) are not possible (the Paris and Smithsonian samples were key to this) we decided to expand the list of targets in an effort to understand a broader number of species at a wider scale (less sampling at fewer locations). Thus, we are now targeting 5 species (we believe *T. brucei* and *T. vulpicauda* are the same species but are verifying this genetically).

At present we feel this overall output is still possible but will not have the geographical range we had originally planned. Activities are also, realistically, around 6 months behind schedule.

A funded PhD has been secured by Cefas and University of Essex to model the connectivity of deep-sea octocorals around South Georgia and the Southern Ocean. This work does not require specimens. Oenone Scott will commence this mathematical modelling in Oct 2020. Results will be relevant to the project outputs and eventually the outcomes.

2. Genetic data and species identification freely available.

This was always a longer-term goal i.e. 3rd year / end of project so is not yet complete but activities towards it are well underway (see table in Annex 1).

3. Understanding the role of habitat heterogeneity in shaping deep benthic biodiversity.

The data acquired through the Blue Belt Programme RRS *Discovery* Expedition 99 in the South Sandwich Islands allowed the aims set under this Darwin Plus project to be addressed. The aim of the benthic sampling was to record the diversity and distribution of benthic communities along a latitudinal and depth gradient. All benthic material was preliminary identified on board and project team is collaborating with taxonomic experts, via the Natural History Museum, to help with species identification.

The Blue Belt Programme RRS *Discovery* Expedition 99 activities were permitted by the Government of South Georgia & the South Sandwich Islands through Restricted Activity Permit (RAP 2019/003), including sampling within the no take zones of the MPA.

A total of 12 trawl deployments were conducted, in 10 locations at different depths ranging from 182-843m, four using a benthic dredge, and eight using an Agassiz trawl. Of 12 trawls, 10 were considered valid; two were repeat trawls due to fouled gear. The Agassiz trawl is a benthic sampler designed to collect benthic invertebrates and is suitable for application in deep-water environments as the orientation of the gear as it lands on the seabed is not critical for successful specimen collection. The Agassiz trawl comprised 2m x 5mm inner and 40mm outer netting, wire sling bridle and a 5-tonne weak link in case of fouling. The benthic dredge construction was based on the “Hein” dredge design. This more robust sampler is intended for use on coarse sediments and areas of flat bedrock where damage to other towed gears would limit haul success. The benthic dredge comprised a 1m x 2m box frame with steel mesh top and base. The operation of both the Agassiz and dredge involved deployment from a stationary vessel. A 500m pennant wire was used (in water greater than 500m) and the sampler deployed to the seabed. Winch wire was paid out while the vessel manoeuvred to a location between 200m and 500m from the starting location. The gear was recovered to the stationary vessel using the winch wire and the catch assessed and processed accordingly. The position of the dredge and the Agassiz trawl deployments were determined using the vessel position (CRP) at the time of deployment and recovery.

Specimens were collected from the sampler (muddy samples were sieved over a 5mm mesh) and brought into a constant temperature environment (4°C) and stored in ambient (sea surface temperature) seawater. Individuals were sorted, counted and identified to the lowest possible taxonomic level, provided a unique identification code and ordered for processing. A representative image of each taxon was taken, and tissue subsamples, stored in both 100% ethanol and RNA later, were collected for subsequent genetic analysis. Specimens were sorted into major groups and remaining substratum and fixed in 4% formaldehyde. After 24 hours, specimens were transferred to 70% ethanol.

The epibenthic faunal dataset comprised of 541 samples, accounting for over 3,643 specimens belonging to 12 phyla, including: corals (Actiniaria, Alcyonacea, Hydrozoa, Pennatulacea, Scleractinia, Zoantharia), sponges (Desmospongiae), crinoids, sea stars, brittle stars and sea cucumbers, bryozoans, crustaceans (Amphipoda, Decapoda, Euphausiacea, Isopoda, Mysida, Pycnogonida), polychaetes and nematodes. In total, 81 preliminary taxa were recorded across the sampled areas; of these, 19 were provisionally identified to species level, belonging to 18 distinct families. The remaining taxa were identified to higher taxonomic levels, whilst seven taxa could only be identified to phylum level. Malacostraca and Anthozoa were the most diverse class comprising six and five taxa respectively.

Data analysis is ongoing and, where possible, it will be collated with available biodiversity datasets to allow to advance our understanding of deep-sea habitats from the Atlantic sector of Southern Ocean and contribute to investigate the distribution of benthic communities in the region.

4. Dissemination of information about deep-sea habitats around SGSSI and the wider sub-Antarctic.

Dr Taylor was invited for a lecture seminar at Cefas during year-1 to provide an overview and objectives of the project. The project team also attended the Deep-sea Biology Society Symposium and SCAR Open Science Conference.

Public lectures involving academic community and the wider audience are also planned but dependent on the Covid-19 evolution and further guidance from the Government.

The team is actively disseminating information about Antarctic deep-sea habitats via social media (e.g. Twitter) and it is expected to disseminate results to a wider audience during the course of years 2 and 3.

4.1 Progress towards the project Outcome

Overall project outcome:

A better understanding of the genetic connectivity of deep-sea coral communities across the SGSSI and sub-Antarctic region.

At present we feel confident that the overall outcome is still achievable however Covid-19 has meant major delays and a reduction in the scale of the analyses possible.

4.2 Monitoring of assumptions

Our original identified risks were:

- RSS *Discovery* survey work will be reviewed, and risk assessed as part of Cefas' HSEQ policy and UoE safety whilst working abroad policy to ensure the safety of staff at all times. A *standard operating procedure (SOP)* will be produced for the survey and the vessel will have safety checks undertaken by a qualified member of Cefas staff.
- Considerations regarding weather in the survey region will be monitored as part of the check list for off-shore operations. Other technical risks will be considered and where necessary, suitable mitigation put in place.

The *Discovery* expedition went ahead as planned and collected specimens for this project, weather did not unduly impact outputs.

Naturally, the project did not originally consider a global pandemic. This is now a major concern, and the team is liaising with all the stakeholders to mitigate the impacts on the project.

5. Project support to environmental and/or climate outcomes in the UKOTs

Project outputs will be shared with the UKOT Governments and CCAMLR at a later stage of the project. Such information will further enable GSGSSI in making informed decisions on vulnerability of local deep-sea benthic habitats and their protection. This project will also support UK government commitments under the Convention on Biological Diversity to establish "comprehensive, effectively managed and ecologically representative networks" of MPAs.

The outcomes of this project will feed directly to CCAMLR to better inform MPA designation and management processes and into wider regional management decisions, such as the SGSSI MPA 5-year review process through reports submitted to the government of SGSSI.

The project team has held regular meetings with GSGSSI during year 1 and first half of year 2. Further updates will be given to relevant stakeholders at the end of year 2, and a final report will be delivered at the end of year-3.

6. OPTIONAL: Consideration of gender equality issues

We have a balance of gender representation within this project.

7. Monitoring and evaluation

Please, refer to table of progress and achievements against Logical Framework, as shown in Annex 1.

As project activities increased from Nov 2019, we (Cefas and UoE) commenced more regular meeting with BAS and Dr Downey. Due to Covid-19, and the myriad of extra responsibilities all team members faced, those abruptly stopped. Now we have a technician back in the lab UoE communications about this project are daily, with monthly inputs from Cefas.

At the moment the link between the project activities and outcomes are minimal as there are no results to facilitate the necessary report writing, presentations, discussions etc. This will change in time as the analyses and results become available.

8. Lessons learnt

Starting internal administrative processes early is a lesson learnt.

And writing deadlines (such as the annual report!) into our electronic calendar is key. Future 6 month and annual dates are already listed in Dr Taylor's calendar now.

9. Actions taken in response to previous reviews (if applicable)

N/A

10. Other comments on progress not covered elsewhere

We asked for a change to the budget, moving travel finance, which was granted.

The logistical framework was improved after consultation with Darwin staff. A new framework was submitted in Oct 2019.

11. Sustainability and legacy

The project team liaised with the industry and GSGSSI to ensure an effective data collection programme until the end of the project, and revised existing protocols to target opportunistic sampling of corals onboard commercial fisheries vessels.

Specimens collected during the RRS *Discovery* expedition in the South Sandwich Islands (as part of the Blue Belt Programme) were donated to the Natural History Museum. The collected genetic material also included samples to the museum biobanking, forming the basis of future research, ensuring the good use and legacy of this Darwin Project.

As part of this research, an AIREs DTP proposal entitled “*Seascape genomics of Antarctic deep-sea corals*” have been successful and outputs will contribute to the legacy of the ongoing Darwin Plus project. This research will maximise the outputs and represented added value for money for the sought aims of the project. The selected candidate has been offered the studentship and is expected to start the PhD project in October 2020.

12. Darwin identity

Twitter was used to promote 1. The initiation of the grant and 2. Dr Taylor's visit to the Smithsonian to collect specimens.

So far there have been few other opportunities to undertake other promotion activities, but we expect this to change in the coming year, when more results are available for dissemination.

13. Safeguarding

UoE has a comprehensive safeguarding policy:

<https://www.essex.ac.uk/information/safeguarding/safeguarding-policy-and-guidance>

Safeguarding was top of our minds in recent months as we battled with online work, isolation at home, and returning to the laboratory (and the plethora of risk assessments that involved). We had regular meetings through this time and checked staff and student wellbeing very regularly.

As an Executive Agency of Defra, Cefas complies with UK Government safeguarding policies and the Equality Act 2010.

14. Project expenditure

Table 1: Project expenditure during the reporting period (1 April 2019 – 31 March 2020)

Project spend (indicative) in this financial year	2019/20 D+ Grant (£)	2019/20 Total actual D+ Costs (£)	Variance %	Comments (please explain significant variances)
Staff Costs				
Consultancy Costs				
Overhead Costs				
Travel & Subsistence				
Operating Costs				
Capital Items				
Others				

The overall underspend is minor. None of the above changes were discussed and agreed with Darwin as had Covid-19 not occurred the finance would have been spent. As Covid-19 occurred in the last 2 weeks of this financial year of grant expenditure we fell short of spending the finance we intended.

Annex 1: Report of progress and achievements against Logical Framework for Financial Year 2019-2020 – if applicable

Project summary	Measurable Indicators	Progress and Achievements April 2019 - March 2020	Actions required/planned for next period
Impact: To provide the GSGSSI and CCAMLR with new information on deep benthic ecosystems along the South Atlantic Antarctic Region allowing them to make informed decisions for the MPA review process.			
Outcome A better understanding of the genetic connectivity of deep-sea coral communities across the SGSSI and sub-Antarctic region.	0.1 Management considerations based on better informed science of genetic connectivity. 0.2 Better understanding of the biodiversity and community structure of sub-Antarctic deep-water ecosystems.	The indicators are: 0.1 Report to GSGSSI for 5-year MPA review process. 0.2 Working Group paper to CCAMLR with contributing information on biodiversity in the Atlantic Sector of the Convention Area. Neither are planned for year 1	Data collation for outputs 1 and 2 is required to undertake this outcome. Those will occur through year 2 which these two outcome finalised in year 3.
Output 1: Better informed management of SGSSI MPA with the provision of deep-sea connectivity information.	1.1 Samples collected, preserved, catalogued, and sent to the UK (year 1). 1.2 Genetic analysis conducted. 1.3 Make recommendations for management based on genetic information. 1.4 Genetic information is available for advice in the protection of vulnerable ecosystems.	This is the focus of our work in the year-1 of the project. Progress is being made against most activities (see below).	
1.1 Cefas to conduct a survey the on the RRS <i>Discovery</i> to examine the biodiversity and distribution of benthic invertebrate species around the South Sandwich Islands. Specimens catalogued and transported to the UK.		Activity completed.	This activity was successfully completed. The expedition report is under review and will be made available once published.
1.2.1 Specimens identified to highest possible level by taxonomy experts. 1.2.2 Research technician hired halfway through year 1 to undertake genetic laboratory work.		Activities 1.2.1 and 1.2.2 completed Activity 1.2.3 is well underway but have been delayed due to Covid-19	Activity 1.2.3 will continue into year 2. They were meant to finish in Nov 2019 however they will likely not finish until Feb 2020. We have provided the samples

Project summary	Measurable Indicators	Progress and Achievements April 2019 - March 2020	Actions required/planned for next period
<p>1.2.3 Specimens of target species have DNA extracted, quality controlled, UCE libraries prepared, DNA sequenced.</p> <p>1.2.4 Research assistant hired halfway through year 2 to undertake bioinformatics analyses.</p> <p>1.2.5 Connectivity of locations across SGSSI and wider sub-Antarctic analysed, and population structure investigated</p>		<p>1.2.4 We will be submitting a request to delay the hiring of the RA and push this activity later into year 2 or 3.</p> <p>Activity 1.2.5 not started yet – requires data from activity 1.2.3</p>	<p>database so you can see progress on each specimen.</p> <p>1.2.4 Complete change request form. Waiting for final budget reports and furlough finance to re-enter grant account.</p>
<p>1.3 Using the outputs of the wider project to inform the Government of South Georgia and the South Sandwich Islands (GSGSSI) MPA review process.</p>		<p>Activity not started, will commence in year 3 of the project</p>	<p>Original plans remain</p>
<p>1.4 Results written into a report to CCAMLR which can be built upon management processes and into wider regional management decisions.</p>		<p>Activity not started, will commence in year 3 of the project</p>	<p>Original plans remain</p>
<p>Output 2. Genetic data and species identification freely available.</p>	<p>2.1 Genetic data submitted to Genbank – a global repository of genetic data.</p> <p>2.2 Coral species identifications submitted to GBIF and therefore freely available</p> <p>2.3 New species descriptions submitted to WoRMS.</p>		
<p>2.1.1 Genetic data formatted for Genbank and species identification and metadata formatted for GBIF.</p> <p>2.1.2 Genetic data submitted to Genbank and species information to GBIF for quality control.</p>		<p>Activity not started, will commence in year 3 of the project</p>	<p>Original plans remain</p>
<p>2.2 Species records submitted to GBIF, WoRMS, OBIS and BODC.</p>		<p>Activity not planned until year 3 of the project</p>	<p>Original plans remain</p>
<p>2.3 New species descriptions written for peer-review publication (e.g. <i>Zootaxa</i>, <i>Polar Biology</i>) and submitted to WoRMS.</p>		<p>Activity not planned until year 3 of the project</p>	<p>Original plans remain</p>
<p>2.4 Analyse genetic connectivity data and diversity of vulnerable benthic marine organisms.</p>		<p>Activity not planned until year 3 of the project</p>	<p>Original plans remain</p>
<p>2.5 Provide recommendations to stakeholders to support the making of informed decisions about management of a network of Antarctic MPAs.</p>		<p>Activity not planned until year 3 of the project year 3</p>	<p>Original plans remain</p>

Project summary	Measurable Indicators	Progress and Achievements April 2019 - March 2020	Actions required/planned for next period
Output 3. Understanding the role of habitat heterogeneity in shaping deep benthic biodiversity.	3.1 Biodiversity report is acknowledged by GSGSSI and CCAMLR		
3.1 Collate deep sea biodiversity datasets from the Atlantic sector of Southern Ocean.		Activity 50% completed. We have not collected enough data to conduct the analysis. This activity is expected to be completed in year 2 of the project.	This activity is expected to be completed by the end of year 2.
3.2 Apply data analysis routines to available datasets and integrate outputs into reports to GSGSSI and CCAMLR.		Activity underway.	Original plans remain
3.3 Assess the effectiveness of the data collection programmes and reporting system.		Activity completed.	Integrate recommendations into reports to GSGSSI
3.4 Revise existing protocols for data collection. Collaborate with stakeholders to develop an effective data collection programme.		Activity completed	Integrate recommendations into reports to GSGSSI
3.5 Provide recommendations to stakeholders to support the GSGSSI 5-year MPA review process.		Activity not planned until year 3 of the project	Original plans remain
Output 4. Dissemination of information about deep-sea habitats around SGSSI and the wider sub-Antarctic.	4.1 Peer-review publications about the connectivity across areas of the SGSSI and wider sub-Antarctic region. 4.2 Peer-review publication on the deep-water biodiversity of the SGSSI region. 4.3 Donation of samples to the NHM. 4.4 Production of fact sheets about the biodiversity and pressures in the wider sub-Antarctic Atlantic region.		

Project summary	Measurable Indicators	Progress and Achievements April 2019 - March 2020	Actions required/planned for next period
4.1 Genomic connectivity publication written for submission to peer-review journal such as <i>Molecular Ecology</i> , <i>BMC Evolutionary Biology</i> etc.		Activity not started, will commence in years 2 and 3 of the project	Original plans remain
4.2 Diversity / biogeography of deep-sea biodiversity of the SGSSI region publication written for submission to peer review journals such as <i>Deep Sea Research I</i> , <i>Polar Biology</i> , <i>Marine Ecology Progress Series</i> .		Activity not started, will commence in year 3 of the project	Original plans remain
4.3 Donation of samples to the Natural History Museum and disseminate results to the wider audience.		Activity 50% completed. Further specimens will be donated if additional samples are collected.	Dissemination of results to a wider audience during the course of year-s 2 and 3.
4.4 Regular meetings with stakeholders (GSGSSI and UK's scientific delegation to CCAMLR) towards end of project to support project outcomes implementation and legacy.		Activity underway.	Regular meetings with GSGSSI have been held. Further updates to relevant stakeholders will be given at the end of year 2.
4.5 Report project outputs and provide recommendations to GSGSSI and UK's scientific delegation to CCAMLR.		Activity not started, will commence in year 3 of the project	Original plans remain
4.6 Attend scientific meetings (Deep Sea Biology Symposium, SCAR Open Science Conference) to showcase results.		Activity underway. Deep-sea Biology Society Symposium has been attended by Dr Taylor. SCAR Open Science Conference attended by Dr Vieira.	Results to be disseminated in 2021 at Deep-sea Biology Society Symposium and further meetings identified by the projected team, highly dependent on the Covid-19 evolution and advice from the UK gov.

Annex 2: Project’s full current logframe as presented in the application form (unless changes have been agreed) - if applicable

N.B. if your application’s logframe is presented in a different format in your application, please transpose into the below template. Please feel free to contact Darwin-Projects@ltsi.co.uk if you have any questions regarding this.

Project summary	Measurable Indicators	Means of verification	Important Assumptions
Impact: To provide the GSGSSI and CCAMLR with new information on deep benthic ecosystems along the South Atlantic Antarctic Region allowing them to make informed decisions for the MPA review process.			
Outcome: A better understanding of the genetic connectivity of deep-sea coral communities across the SGSSI and sub-Antarctic region.	0.1 Management considerations based on better informed science of genetic connectivity. 0.2 Better understanding of the biodiversity and community structure of sub-Antarctic deep-water ecosystems.	0.1 Report to GSGSSI for 5-year MPA review process. 0.2 Working Group paper to CCAMLR with contributing information on biodiversity in the Atlantic Sector of the Convention Area.	GSGSSI remains committed to the sustainable exploitation of marine resources and protection of vulnerable habitats. Suitable candidates for research assistant jobs are sourced.
Outputs: 1. Better informed management of SGSSI MPA with the provision of deep-sea connectivity information.	1.1 Samples collected, preserved, catalogued, and sent to the UK (year 1). 1.2 Genetic analysis conducted. 1.3 Make recommendations for management based on genetic information. 1.4 Genetic information is available for advice in the protection of vulnerable ecosystems.	1.1 Samples available for genetic analysis. 1.2 Genetic data available for bioinformatic analysis. 1.3 Report to GSGSSI about the connectivity of SGSSI benthic closed areas and other regional deep-sea areas. 1.4 Working Group paper to CCAMLR about the connectivity of deep-sea areas across the Atlantic Sector of the Convention Area.	Weather allows data collection. Samples arrive in UK in sufficiently good condition. Recommendations made to the stakeholders are considered by the policy-makers.

<p>2. Genetic data and species identification freely available.</p>	<p>2.1 Genetic data submitted to Genbank – a global repository of genetic data.</p> <p>2.2 Coral species identifications submitted to GBIF and therefore freely available.</p> <p>2.3 New species descriptions submitted to WoRMS.</p>	<p>2.1 Data made available online at: https://www.ncbi.nlm.nih.gov/genbank/</p> <p>2.2 Data made available at: https://www.gbif.org/</p> <p>2.3 Records made available on WoRMS database (http://www.marinespecies.org/)</p>	
<p>3. Understanding the role of habitat heterogeneity in shaping deep benthic biodiversity.</p>	<p>3.1 Biodiversity report is acknowledged by GSGSSI and CCAMLR</p>	<p>3.1 Meeting to inform the UK's scientific delegation to CCAMLR about project activities.</p> <p>3.2 Report delivered to GSGSSI and CCAMLR about deep benthic ecosystems in the Atlantic Sector of the Convention Area (end of yr 3).</p>	<p>A survey on the RRS <i>Discovery</i> to investigate the SGSSI benthic diversity was possible.</p> <p>Need for better understanding to support planned updates to the Fisheries Ordinance continues.</p>
<p>4. Dissemination of information about deep-sea habitats around SGSSI and the wider sub-Antarctic.</p>	<p>4.1 Peer-review publications about the connectivity across areas of the SGSSI and wider sub-Antarctic region.</p> <p>4.2 Peer-review publication on the deep-water biodiversity of the SGSSI region.</p> <p>4.3 Donation of samples to the NHM.</p>	<p>4.1 Publication prepared and ready to submit (end of yr 3). Once submitted tweets, news stories, and other outreach will be tracked to gauge impact (post-project).</p> <p>4.2 Open access peer-reviewed publication (yr 3 onwards).</p> <p>4.3 Collection of specimens available to the wider community (end of yr 3). Engagement with non-scientific community (e.g. “Science Uncovered”, European Researchers' Night) (throughout the project).</p>	

	4.4 Production of fact sheets about the biodiversity and pressures in the wider sub-Antarctic Atlantic region.	4.4 Fact sheets available to the stakeholders and wider public, including through the NHM.	
<p>Activities (each activity is numbered according to the Output that it will contribute towards, for example 1.1, 1.2 and 1.3 are contributing to Output 1)</p> <p>1. Better informed management of SGSSI MPA with the provision of deep-sea connectivity information</p> <p>1.1 Cefas to conduct a survey the on the RRS <i>Discovery</i> to examine the biodiversity and distribution of benthic invertebrate species around the South Sandwich Islands. Specimens catalogued and transported to the UK.</p> <p>1.2.1 Specimens identified to highest possible level by taxonomy experts.</p> <p>1.2.2 Research technician hired halfway through year 1 to undertake genetic laboratory work.</p> <p>1.2.3 Specimens of target species have DNA extracted, quality controlled, UCE libraries prepared, DNA sequenced.</p> <p>1.2.4 Research assistant hired halfway through year 2 to undertake bioinformatics analyses.</p> <p>1.2.5 Connectivity of locations across SGSSI and wider sub-Antarctic analysed, and population structure investigated.</p> <p>1.3 Using the outputs of the wider project to inform the Government of South Georgia and the South Sandwich Islands (GSGSSI) MPA review process.</p> <p>1.4 Results written into a report to CCAMLR which can be built upon management processes and into wider regional management decisions.</p> <p>2. Genetic data and species identification.</p> <p>2.1.1 Genetic data formatted for Genbank and species identification and metadata formatted for GBIF.</p> <p>2.1.2 Genetic data submitted to Genbank and species information to GBIF for quality control.</p> <p>2.2 Species records submitted to GBIF, WoRMS, OBIS and BODC.</p> <p>2.3 New species descriptions written for peer-review publication (e.g. <i>Zootaxa</i>, <i>Polar Biology</i>) and submitted to WoRMS.</p> <p>2.4 Analyse genetic connectivity data and diversity of vulnerable benthic marine organisms.</p> <p>2.5 Provide recommendations to stakeholders to support the making of informed decisions about management of a network of Antarctic MPAs.</p> <p>3. Understanding the role of habitat heterogeneity in shaping deep benthic biodiversity.</p> <p>3.1 Collate deep sea biodiversity datasets from the Atlantic sector of Southern Ocean.</p> <p>3.2 Apply data analysis routines to available datasets and integrate outputs into reports to GSGSSI and CCAMLR.</p> <p>3.3 Assess the effectiveness of the data collection programmes and reporting system.</p> <p>3.4 Revise existing protocols for data collection. Collaborate with stakeholders to develop an effective data collection programme.</p> <p>3.5 Provide recommendations to stakeholders to support the GSGSSI 5-year MPA review process.</p> <p>4. Dissemination of information about deep-sea habitats around SGSSI and the wider sub-Antarctic.</p> <p>4.1 Genomic connectivity publication written for submission to peer-review journal such as <i>Molecular Ecology</i>, <i>BMC Evolutionary Biology</i> etc.</p> <p>4.2 Diversity / biogeography of deep-sea biodiversity of the SGSSI region publication written for submission to peer review journals such as <i>Deep Sea Research I</i>, <i>Polar Biology</i>, <i>Marine Ecology Progress Series</i>.</p>			

- 4.3 Donation of samples to the Natural History Museum and disseminate results to the wider audience.
- 4.4 Regular meetings with stakeholders (GSGSSI and UK's scientific delegation to CCAMLR) towards end of project to support project outcomes implementation and legacy.
- 4.5 Report project outputs and provide recommendations to GSGSSI and UK's scientific delegation to CCAMLR.
- 4.6 Attend scientific meetings (Deep Sea Biology Symposium, SCAR Open Science Conference) to showcase results.

Annex 3 Onwards – supplementary material (optional but encouraged as evidence of project achievement)

Checklist for submission

	Check
Is the report less than 10MB? If so, please email to Darwin-Projects@ltsi.co.uk putting the project number in the Subject line.	Yes
Is your report more than 10MB? If so, please discuss with Darwin-Projects@ltsi.co.uk about the best way to deliver the report, putting the project number in the Subject line.	No
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.	No
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. However, we would expect that most material will now be electronic.	No
Have you involved your partners in preparation of the report and named the main contributors	Yes
Have you completed the Project Expenditure table fully?	Yes
Do not include claim forms or other communications with this report.	