

DPLR1\1021

Building Capacity for Coral Restoration: Contributing to Bermuda's Blue Infrastructure

Bermuda's reefs are categorised as high risk by the World Resources Institute due to their proximity to a high-density populated landmass and its associated coastal activities (WRI, 2004). Coastal development and boat traffic is an ongoing threat and directly impacts coral reefs mainly through destruction, removal of corals, and sedimentation (Smith et al., 2013). Active measures to address direct physical human-induced impact to preserve Bermuda's 400 km² reefs and their role as a nursery habitat, a coastal barrier and a tourism asset (Sarkis et al., 2013) are currently not implemented at scale. Yet, Bermuda's reefs are conducive to restoration as they are less vulnerable to climate change impacts (such as temperature-induced bleaching and disease proliferation) than those of the more southern Caribbean. Active coral restoration efforts in Bermuda were launched in 2016 by the Living Reefs Foundation (LRF), to address damage incurred by coastal development and vessel groundings. Through its signature project, the Coral Garden Initiative, the Foundation conducts comprehensive research on the production of genetically diverse corals, and engages residents and the tourism sector in participatory workshops and tours. Through research and outreach activities, the momentum for coral restoration in Bermuda is increasing. More recently, coral restoration has been included in Bermuda's Marine Spatial Plan (MSP) and Blue Economy Strategy. The Government's Department of Works & Engineering has expressed interest in incorporating coral planting on fringing reefs to strengthen the coastal barrier and protect the bridge link between the airport and 'mainland' Bermuda (the Causeway). Currently, boulders are placed within denuded coral reef patches for coastal protection, and replaced every 4 years as they erode. Planting corals on such boulders would counteract erosion and strengthen the coastal barrier over time, forming a 'Blue infrastructure'.

The project builds on LRF's work, specifically its home-grown stock of young corals and coral restoration experience. Its stock is sustainably sourced and originates from hatchery-reared larvae and microfragments rescued from storm damage for 6 boulder species and 1 branching; the stock is genetically diverse which increases its resilience to environmental factors. Evidence for successful restoration by LRF since 2016 is reflected in high growth rates measured for boulder species (5-20 cm²/year) and a survivorship of 85% over a 12 month period.

To expand the scope of restoration (< 800 m²) and target larger reef areas (5,000 m² and up), more accurate and comprehensive documentation and monitoring of the status of the reef and the performance of outplanted corals is required. Underwater photogrammetry is a state-of-the-art technology which produces accurate 3-D maps of the seabed, allowing repeat, high-resolution models for the continued assessment of young coral growth. In partnership with Tritonia Scientific Ltd., LRF will establish the computer infrastructure and train at least 3 LRF staff and 1 government officer in data collection and analysis to build capacity for future independent assessments of Bermuda's seabed.

A successful project will result in the outplanting and survivorship of 100 corals in the fringing reef parallel to the Causeway (Site1), and two underwater maps pre- and post-planting produced by newly trained Bermuda staff using new computer infrastructure. It will provide a new tool for scaling up coral restoration and assist the implementation of Bermuda's MSP, over the long-term.

Success within the scope of the project will be measured by:

- New computer infrastructure and additional skillset for the implementation of underwater photogrammetry in Bermuda by Bermudian staff
- A digital 3-D map of the Causeway reef critical to the bridge infrastructure
- Increased scale and accuracy of monitoring coral outplanting for restoration in Bermuda to areas covering greater than 5,000 m².
- Growth and survivorship of outplanted corals

CONTACT DETAILS

Title	Dr
Name	Samia
Surname	Sarkis
Website (Work)	[REDACTED]
Tel (Work)	[REDACTED]
Email (Work)	[REDACTED]
Address	[REDACTED]

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Building Capacity for Coral Restoration: Contributing to Bermuda's Blue Infrastructure

Section 1 - Project Title & Contact Details

Q1. Project Title

Building Capacity for Coral Restoration: Contributing to Bermuda's Blue Infrastructure

Q2. Please select whether you are applying as an organisation or as an individual (Guidance section 3 and Guidance Glossary)

Organisation

CONTACT DETAILS

Title	Dr
Name	Samia
Surname	Sarkis
Website (Work)	[REDACTED]
Tel (Work)	[REDACTED]
Email (Work)	[REDACTED]
Address	[REDACTED]

GMS ORGANISATION

Type	Organisation
Name	Living Reefs Foundation
Phone (Work)	[REDACTED]
Email (Work)	[REDACTED]
Website (Work)	[REDACTED]
Address	[REDACTED]

Section 2 - Overseas Territory(ies)

Q3. Overseas Territory (Guidance section 1.3):

Which UK Overseas Territory(ies) will your project be working in? Please note that in case of a non-permanent resident population you need to demonstrate a clear, meaningful, long-term link to the territory.

Bermuda

*** if you have indicated a territory group with an asterisk, please give detail on which territories you are working on here:**

No Response

In addition to the UKOT(s) you have indicated, will your project directly benefit any other UK OT(s) or country(ies)?

No

Section 3 - Project Partners

Q4. Project partners (Guidance section 3.2)

In this section, please give details of all the partners involved (including the Lead Partner) and provide a summary of their roles.

Project Leader name (Guidance section 3.1):	Samia Sarkis
Lead Partner name (if applying as an organisation; Guidance section 3.1):	Living Reefs Foundation
Lead Partner Website (if applicable):	www.livingreefs.org
Is the Lead Partner based in a UKOT where the project is working (Guidance section 3.1)?	<input checked="" type="radio"/> Yes
List other partners involved and where are they based (Guidance section 3.2):	Tritonia Scientific Ltd: Dunstaffange Marine Laboratories, Dunbeg Oban, Argyll, PA37 1QA, United Kingdom Tritonia Scientific Ltd. develops and uses advance 3D photogrammetry techniques, methodologies and innovation to deliver the most accurate and robust digital recreation of the real world. Tritonia's work has been used to inform management of Marine Protected Areas (MPAs) and research programmes investigating the impacts on, and the recovery of coral reef systems in Fiji, Philippines, Belize and the Indian Ocean. https://tritonascientific.co.uk/

Living Reefs Foundation (LRF) is responsible for the overall management and implementation of the project and provides the coral restoration scientific expertise. LRF's culture facilities to grow corals from microscopic larvae to 50 cm² colonies are:

- 1) A land-based hatchery for spawning, larval settlement and juvenile rearing,
 - 2) An ocean-based nursery of 10 coral garden pyramid-shaped frames for acclimating hatchery-produced corals to the natural environment.
- LRF is supported by the Government of Bermuda through an MoU to utilise the government-owned land-based hatchery, and the granting of permits for coral collection and restoration.

Specifically, LRF will:

- coordinate training, restoration, monitoring and evaluation activities between Tritonia Scientific and LRF scientists.
- engage the Bermuda Government through participatory planning and training activities
- ensure that the timetable is executed according to the timeline
- ensure the distribution of finances accordingly
- report to Darwin Plus Local in a timely manner
- implement coral restoration according to Best Practice protocols
- prepare communications documents
- share and disseminate findings from the project to Bermuda's public and private sector and to the Caribbean coral restoration and scientific network
- ensure the full training of at least three LRF scientists and at least one government officer in underwater photogrammetry for the production of marine maps.

Tritonia Scientific will:





- set-up LRF photogrammetry infrastructure
- provide field techniques and software training
- lead initial field surveys: Data collection and training
- remotely support LRF in postprocessing
- assist delivery of two 3-D maps for restoration site

Summary of roles and responsibilities of each partner in the project:

I confirm that all listed partners are aware of this application and have indicated support:

Checked

Attach a Cover Letter for your application (Guidance section 4.2).

-  [Cover letter LRF for Darwin Plus Grant Proposal 14.02.22](#)
-  14/02/2023
-  13:25:24
-  pdf 165.95 KB

Section 4 - Project Summary & Description

Q5. Project Summary (Guidance section 3.8)

Please provide a brief summary of your project. This may be used in communication activities and/or published online, if your application is successful.

Bermuda's Living Reefs Foundation (LRF) develops new techniques to preserve and restore damaged coral reefs by rearing young corals in its land-based hatchery and planting them on the reef. LRF plans to expand its well-tested restoration techniques by increasing its monitoring and evaluation capacity through georeferencing photogrammetry. Within 12 months, Bermuda will have 4 trained scientists (3 LRF; 1 government) and 3D computer modelling infrastructure. This contributes to safeguarding Bermuda's corals and their coastal protection role supported by the Government.

Q6. Description (Guidance section 2.1)

Please provide a description of your project, including:

- the overall objective
- the current situation and the problem the project is trying to address
- what success will look like and how you will measure it

Please be as specific as possible when describing the project, using quantified data and evidence where available. You may wish to consider: what are the specific threats to the environment that the project will attempt to address, and what should we know about these threats? What does your successful project look like? And how will you demonstrate whether and how your project has been successful?

Bermuda's reefs are categorised as high risk by the World Resources Institute due to their proximity to a high-density populated landmass and its associated coastal activities (WRI, 2004). Coastal development and boat traffic is an ongoing threat and directly impacts coral reefs mainly through destruction, removal of corals, and sedimentation (Smith et al., 2013). Active measures to address direct physical human-induced impact to preserve Bermuda's 400 km² reefs and their role as a nursery habitat, a coastal barrier and a tourism asset (Sarkis et al., 2013) are currently not implemented at scale. Yet, Bermuda's reefs are conducive to restoration as they are less vulnerable to climate change impacts (such as temperature-induced bleaching and disease proliferation) than those of the more southern Caribbean. Active coral restoration efforts in Bermuda were launched in 2016 by the Living Reefs Foundation (LRF), to address damage incurred by coastal development and vessel groundings. Through its signature project, the Coral Garden Initiative, the Foundation conducts comprehensive research on the production of genetically diverse corals, and engages residents and the tourism sector in participatory workshops and tours. Through research and outreach activities, the momentum for coral restoration in Bermuda is increasing. More recently, coral restoration has been included in Bermuda's Marine Spatial Plan (MSP) and Blue Economy Strategy. The Government's Department of Works & Engineering has expressed interest in incorporating coral planting on fringing reefs to strengthen the coastal barrier and protect the bridge link between the airport and 'mainland' Bermuda (the Causeway). Currently, boulders are placed within denuded coral reef patches for coastal protection, and replaced every 4 years as they erode. Planting corals on such boulders would counteract erosion and strengthen the coastal barrier over time, forming a 'Blue infrastructure'.

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genetically diverse which increases its resilience to environmental factors. Evidence for successful restoration by LRF since 2016 is reflected in high growth rates measured for boulder species (5-20 cm²/year) and a survivorship of 85% over a 12 month period.





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- Growth and survivorship of outplanted corals

(Optional) Please upload any additional and supporting materials or files (such as maps of project sites, etc) below. Maximum of 5 pages:

-
-  [Living Reefs Supporting Documentation](#)
 -  14/02/2023
 -  20:54:48
 -  pdf 930.09 KB

Section 5 - Project Outcome(s)

Q7. Project Outcome(s) (Guidance section 1.2)

Successful Darwin Plus Local projects must demonstrate measurable outcomes in at least one of the themes of Darwin Plus, either by the end of the project or soon after through a credible plan.

Please tick which theme(s) of Darwin Plus your project underpins:

Checked **Biodiversity: improving and conserving biodiversity, and slowing or reversing biodiversity loss and degradation;**

Unchecked **Climate change: responding to, mitigating and adapting to climate change and its effects on the natural environment and local communities;**

Unchecked **Environmental quality: improving the condition and protection of the natural environment**

Checked **Capability and capacity building: enhancing the capacity within OTs, including through community engagement and awareness, to support the environment in the short- and long-term.**

Please justify your selection.

In the long term, this project underpins all four themes by: Enhancing the biodiversity of corals and reef species dependent on coral habitat; contributing to the coastal protection role of corals and reducing climate change-associated storm impact; reducing sedimentation impact and improving environmental conditions by filling gaps in denuded reefs, and building capacity to scale up monitoring and evaluation of coral cover, damage and restoration.

Within 12 months, measurable outcomes in biodiversity and capacity building are:

- Increased number of corals for 4 species in defined area in Site 1(5000m2).
- Established digital mapping computer infrastructure
- 4 Bermuda trained staff





Section 6 - Project Timeline

Q8. Project timeline (Guidance section 2.2)

Please provide anticipated dates for the start and end of your planned project here. Please use the Darwin Plus Local Project Implementation Timetable Template (which can be downloaded below) to provide a list of the individual activities you have planned for this project, a brief description of what each activity entails, and the months in which the activities will be carried out. If the project involves only one activity (e.g. a purchase), please still provide project start and end dates (noting estimated times for procurement). Please note that your project will need to be completed by 31 March 2024.

Start date:	End date:	Duration (e.g. 3 months):
04 April 2023	31 March 2024	12 months

Please upload the completed Darwin Plus Local Project Implementation Timetable template with your proposed project activities below.

-  [LRF R1 DPlus Local Implementation Timetable 14.02.22](#)
-  14/02/2023
-  21:05:05
-  docx 44.76 KB

Section 7 - Costs

Q9. Costs (Guidance section 2.2 and please read the Finance Guidance)

Please provide a breakdown of costs to be funded through Darwin Plus Local (in GBP).

Are you seeking any matched funding for this project? (Please note that this is optional and there is no requirement to seek matched funding for Darwin Plus Local projects).

Yes

How much matched funding are you seeking and where from?

In-kind contributions by:

LRF volunteers certified SCUBA divers from the community to clean newly planted corals. 60 hours, [REDACTED]

LRF's Dr. S. Sarkis will also contribute 30 days of her time to assist in data collection and 3D image analyses, [REDACTED]

LRF's Corporate Secretary donates time for financial review, [REDACTED]

Tritonia Scientific Ltd will contribute [REDACTED] by providing their services below their normal costs (see attached letter).

Total matched in-kind funding: [REDACTED]

Budget line	Explanation	Cost in GBP
Staff costs:	<p>LRF's Dr. S. Sarkis: 1. project management, coordination, and timely preparation and delivery of reports.</p> <ul style="list-style-type: none">a. Order and document processing for equipment (Activity 1)b. Timely implementation of proposed planc. Liaise with and organise meetings/presentations to Bermuda's Government (Activities 2,9 &15)d. Final report and SOP writing, information sharing(Activities 13-17).e. Lead site selection and coral health assessment and outplanting (Activities 3 & 5).f. Organise and supervise all field activities, data collection training, analysis and map production (Activities 3, 5-8,10-12) . <p>LRF technicians (total: 2): Assist, participate and implement all field activities, data entry and analyses (Activities 3,5-8,10-12)</p>	[REDACTED]

LRF has a Memorandum of Understanding with the Department of Environment and Natural Resources (Bermuda Government) to utilise hatchery and office facilities, in support of its restoration work, and has no overhead costs for this.

Overhead costs cover shipping costs: These average 30% for larger and more specific equipment which is purchased overseas; these include:

Overhead costs: -Workstation and monitors for Agisoft Metashape providing the computational resource to reconstruct 3D models
-Data loggers to measure changes in Photosynthetically Active Radiation (PAR) and seawater chemistry, critical to coral growth.
-Surface GPS

Less specific equipment and materials, e.g. GoPROs will be purchased locally.

One Tritonia Scientific Ltd staff member (P. Schulz) will spend 2 weeks in Bermuda to set up the computer infrastructure and train Bermuda staff in implementing photogrammetry survey, data entry and analysis.

Travel & subsistence costs: Costs cover: Travel from Oban to Glasgow airport for P. Schulz, Tritonia Scientific Ltd staff member. This includes:
- One return flight Glasgow-Bermuda
-2-week room and board at the nearby Bermuda Institute of Ocean Sciences (3 meals a day)
- Transport from Oban to Glasgow airport (return)

Costs relate to expenses incurred by field work.
Boat time and fuel.
Collecting corals from the ocean-based nursery and outplanting at the study site (3 days).
Installation of Data loggers (1 day).
Site selection survey (1day)
Photogrammetric surveys (9 days)
Monitoring (17 days). Monitoring is conducted twice a month from May to October, and once a month from November to March.

Operating costs: SCUBA divers:
• Coral outplanting and photogrammetric surveys (4 divers; 2-tank dive). Total 13 days, 26 tanks
• Data logger installation and monthly monitoring (2 divers; one-tank dive). Total 18 days; 36 tanks.

There is no photogrammetry infrastructure in Bermuda at this time.

Hardware Photogrammetry Workstation - Computational resource required to process complex geometric 3D reconstruction with high-speed multicore CPU, sufficient RAM and GPU acceleration.

Subtotal: £ [REDACTED]

Capital equipment:

Image Analysis 3D Software - Photogrammetric software that generates accurate 3D spatial models from digital images. The output allows quantification of coral growth, changes in coverage, and species identification.

Subtotal: £ [REDACTED]

Image Data Collection - GoPro georeferenced stereo-system, provide a low-cost solution without compromising the generation and quality of models.

Subtotal: £ [REDACTED]

Light intensity, temperature, salinity are recorded at the restoration site using 2 submersible data loggers

Subtotal: £ [REDACTED]

Consultancy costs:

Tritonia Scientific staff P. Schulz is paid for her time to:

- Set up the computer infrastructure and stereo camera units for photogrammetry image analysis (Activity 4)
- Assist with pre-planning and site selection for GPS points (Activity 3)
- Leading the data collection and implementation of the first survey and training LRF and DENR staff (Activity 6)
- Training staff in data and image analysis using LRF's new computer infrastructure (Activity 7)
- Lead in final map production (Activity 11)

Fees for a 2-week on-site period and 6 days of remote assistance are covered by this grant.

Total:

This section provides more information on the budget to help evaluators understand how you will use the funds you are requesting. You do not need to list all costs, but please list and detail costs of more than £1,000 per item below, under the appropriate budget line.

Details of staff costs over £1,000 (if relevant)

High costs for Bermudan salaries are reduced by using field volunteers and in-kind contributions by LRF' principal investigator and corporate secretary.

The goal is for 3 LRF staff to acquire the know-how to ensure continuity in implementing the technology in Bermuda; the grant does not allow for the employment of 3 full time Bermudans, and maximum skillset is obtained by:

1. Optimising number of skilled technicians by training 2 part-time for the cost of 1 full time- [REDACTED] to implement 12-month project.
2. Dedicated project manager (PI S.Sarkis) with hands-on participation during 12-months project for 1 month salary [REDACTED]

Details of overhead costs over £1,000 (if relevant):

Not relevant

Details of travel and subsistence costs over £1,000 (if relevant):

Flights from Glasgow to Bermuda, which averages [REDACTED] return. Travel from Oban to Glasgow is estimated at [REDACTED].

LRF uses the available room and board at the Bermuda Institute of Ocean Sciences (BIOS) for student interns and visiting scientists regularly. It is conveniently close to LRF's hatchery and office (<2km). BIOS has a standard rate averaging [REDACTED]/week ([REDACTED]). This is the most cost effective; alternative options are hotels which are at full capacity and charge high peak rates during the spring months. For a 15 day stay, room and board is [REDACTED].

Details of operating costs over £1,000 (if relevant):

Boat usage fee and fuel average £120/trip. A total of 31 days of field work is estimated, amounting to [REDACTED].

Scuba tanks are re-filled by a commercial dive shop near Living Reefs' hatchery and cost [REDACTED]/refill. An estimated 62 refills are anticipated, amounting to [REDACTED].

Details of capital equipment costs over £1,000 (if relevant):

All capital equipment remains in Bermuda for use by LRF beyond the scope of this project.

Hardware Photogrammetry Workstation (██████):

- CPU (Intel Core i9 13900K 24-Core), 128GB RAM and 2 NVIDIA GeForce RTX3080-██████
- Monitors 24" (2)
- Keyboard/Mouse

Image Analysis and 3D Reconstruction Software (██████):

- Agisoft Methashape Pro ██████
- Adobe Photoshop

Image Collection (██████):

- GoPros 11, including underwater housing (2)-██████
- Batteries and charger
- SD Cards 128GB (4)
- Surface GPS + mount
- Underwater Markers 10-pack

Seawater quality (██████):

- HOBO Conductivity Data Logger-██████
- Odyssey submersible PAR Logger
- PAR wiper

Details of consultancy costs over £1,000 (if relevant):

Standard rates for Tritonia services (██████/day) are reduced to ██████/day for this project.

Photogrammetry field work training : ██████

Remote consultation postprocessing: ██████

There is currently no capacity in Bermuda to produce 3-D maps using photogrammetry. Overseas expertise is required to build this local capacity. The consultancy provides value for money by building long-term capacity through computer infrastructure and skillset at LRF, and the engagement of Bermuda government through participatory training activities. This additional capacity will enable scaling up and improving LRF's coral restoration monitoring and evaluation, and leverage additional funds to secure continuity in its application.

Details of other costs over £1,000 (if relevant)

N/A

If your project budget was prepared in another currency and converted to GBP, please provide the exchange rate, its source, and the date it was accessed:

Other currency:	Exchange rate:	Source of this exchange rate:	Date exchange rate accessed:
USD	1 USD=0.829 GBP	XE Currency Converter	12 February 2023

Darwin Plus Local has been created to build capacity and contribute to local economies in-territory.

What % of the total will be spent in the OTs? 

If less than 80% of the total project spend is to be spent within the OT(s), please explain why.

Not relevant

Section 8 - Local and National Priorities

Q10. Local and national priorities

Please explain how this project aligns with local and national priorities? You may wish to consider the project in the context of national environmental laws, objectives, strategies, territory specific agreements, action plans or policies.

By developing scalable restoration tools such as photogrammetry, this project aligns with Bermuda's national priorities of coral conservation and blue tourism.

Coral restoration is explicitly named in Bermuda's new Marine Spatial Plan under two key goals: 1. Conservation and restoration of damaged and/or denuded coral reefs, and 2. Prioritising coral restoration in areas vulnerable to storm damage. It is anticipated that the need for a large-scale monitoring and evaluation tool will increase in the near future. LRF's Coral Garden Initiative is also flagged in Bermuda's draft Blue Economy Strategy as a Blue Investment Project to support sustainable tourism.


The Department of Works & Engineering has expressed interest in optimising its strategy of protecting the Causeway from storm damage. In the long term, the Department is interested in assessing the cost-effectiveness of gradually integrating corals to the current man-made boulder barrier. By implementing a pilot scale photogrammetry analysis and assessing outplanted coral growth and survivorship at the Causeway site, this project will inform the Government on the potential of integrating corals for the purpose of coastal protection.


This project enables LRF to scale up its restoration programme independent of overseas expertise and assist Bermuda government in building its Blue infrastructure.


Will the project take place on Government owned land or water?


Yes

Please attach evidence that you have Government support i.e. Letter of Support.

 [Letter of support for Living Reefs Foundation](#)

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 16:34:49

 pdf 161.94 KB

Section 9 - Project Risks

Q11. Project Risks

Please demonstrate your consideration of any risks involved in this project and how you intend to

manage them. Depending on your project, you may wish to consider:

- Biosecurity risks – particularly for projects involving external equipment.
- Safeguarding risks – particularly for projects involving vulnerable groups such as children, older people or people with disabilities.

Risk	Mitigation
Injury and risk to life when SCUBA diving for research includes decompression sickness, environmental hazards (e.g. currents), exposure to elements, effect of pressure changes (barotrauma), marine life hazards, drowning, equipment failure or malfunctioning and other ocean users like boaters.	Dive planning involves full risk assessments, emergency action plan including transport and contact of emergency services. Boat is fully coded to Bermudian code of practice and VHF radios are onboard. First aid and oxygen kits will be accessible and regularly maintained and certified first-aid staff member will be present for all diving operations. Divers will be in pairs, maintaining close contact with buddy at all times, strict emergency action procedures will be in place for potential hazards encountered underwater. Changes in circumstances will be noted and assessed, that no further risks have arisen and the appropriate controls are in place.
Incomplete and/or geometric distorted 3D models, will reduce the data quality and cause inaccuracies in measurements for data analysis. These are mainly the results of poor and/or improper data gathering, lack of established scaling methodologies and insufficient subsurface georeferenced markers.	Performing dry-run trials will support appropriate data collection by: 1) Adapting suitable orientation and position of cameras 2) Refining and practicing appropriate swim pace and course 3) Demonstrating the required overlap coverage 3D models will be scaled with known distances between the cameras. The use of Ground Control Points (GCPs) will allow post-processing checks of scale and accuracy. Surface towed GPS tracker will be synced with cameras, embedding GPS location to data to improve model rendering. Subsurface markers will provide reference points. A contingency plan for repeat surveys should be made in case regions need to be repeated (Activity 6).

Loss of corals following outplanting; this would lead to low survivorship and misrepresent the coral growth potential at the study site. Potential reasons include: a. The attachment process of corals to the reef base (material used and preparation of reef base), b. Planted coral health, c. Planted coral origin.

LRF uses techniques tested onsite; it involves preparation of reef base area by removal of algae and any other encrusted organisms, and using rapid curing underwater marine epoxy dispensed with an applicator to avoid spreading in the water column and impacting surrounding corals. Loss of corals planted by LRF is <5%. Corals of poor health indicated by discolouration, paling, tissue loss are not outplanted. All corals used in the study originate from LRF's ocean-based nursery located in the same inshore body of water as the study site and are well acclimated to the site's natural conditions, optimising their quick adaptation.

Do you require more fields?

Yes

Risk

Mitigation

Poor buy-in from Bermuda's government.

The project directly addresses objectives identified in the national strategy developed since 2019, as part of the Bermuda's Ocean Prosperity Plan. Pre-planning with Bermuda Government started in June 2022 on the potential for integrating coral restoration in strengthening the coastal barrier, and for recovery of damaged/denuded reefs. The Bermuda Government's engagement is maintained by: 1. Including key officers in training sessions, and 2. Ensure that results are meaningful to the development of a long-term reef restoration and coastal protection strategy, through three planned meetings : 1. Within two weeks of commencement, 2. Six-months update, and 3. Post-project.

Loss of capacity due to staff turnover.

Bermuda offers more lucrative careers than the marine sciences to young people, and staff turnover is a possibility. This is mitigated by:1. The hands-on participation of LRF's Director of Coral Research and Development (S. Sarkis), who is also the founder and dedicated to LRF. She will ensure that the technical knowledge remains within the Foundation in the form of a guide outlining all steps (Activity #14). Sarkis has written two such practical guides for the UN. 2. The training and hands-on participation of two LRF technicians, rather than one. This ensures continuity in the implementation capacity during potential staff transition.

Repeat surveys miss the original area of survey or fail to repeat the same spatial coverage. Failure to produce replicable models to accurately measure changes in the outplanted coral colonies and to detect changes in the physical characteristics of the area.

The use of waypoints (coordinates) recorded by boat captains and LRF technicians to indicate the starting points for each underwater surveys. Sub-surface markers will be placed to mark and refer as bounding region of each site, to enable scuba diver surveyors to locate and navigate through the designated area. In addition, compass heading and transect line will be use in a pre-described survey plan, to minimise off-course transects. New members and/or volunteers will firstly need to be fully familiarized and trained with the techniques and areas prior conducting any subsequent surveys.

No Response

No Response

No Response

No Response

Section 10 - Terms & Conditions

Q12. Terms and conditions (Guidance section 3.10)

By applying for Darwin Plus Local you are adhering in full to the grant Terms and Conditions in full (available at: <https://dplus.darwininitiative.org.uk/apply> and as referenced in the Guidance at section 3.10). For information, the Terms and Conditions include requirements for all applicants to (amongst other requirements as per the full Terms and Conditions):

- Uphold a zero tolerance for inaction approach to tackling sexual exploitation, abuse, and harassment.
- Where appropriate, make all reasonable and adequate efforts to address gender inequality and other power imbalances.
- Notify all cases of fraud and theft (whether proven or suspected) relating to the project to the Grant Administrator as soon as they identified.

Please indicate you have read, and understood, and will adhere to the Terms and Conditions.

Checked

If your application is successful: If your project application is successful, the Fund Administrator (NIRAS) will ask you to provide some financial evidence for due diligence checks before you receive your project grant. (Please see section 3.3 of the Darwin Plus Local Finance Guidance). Please be ready to provide this evidence promptly.

Financial evidence for organisations: Year-end financial statements, the latest management accounts or audited accounts (if you have these).

Financial evidence for individuals: Proof of identity such as a passport, ID card or driving licence and solvency (such as bank statements) and a police check.

Section 11 - Certification

Certification

I certify that, to the best of my knowledge and belief, the statements made in this application are true and the information provided is correct.

Checked





I have the authority to submit an application on behalf of my organisation.

Checked

Name: Samia Sarkis

**Position in the organisation:
(if applicable)** Founder and Director of Coral Research and Development

Signature (please upload e-signature)

-  [Sarkis electronic signature](#)
-  14/02/2023
-  21:08:53
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Date: 14 February 2023

Section 12 - Submission Checklist

Checklist for submission

Check

I have read the Guidance documents, including the “Darwin Plus Local Guidance” and the “Darwin Plus Local Finance Guidance”.	Checked
If my proposed project takes place on public lands or water, I have uploaded a Letter of Support from Government.	Checked
I have uploaded a cover letter that details the information requested in the guidance (Guidance section 4.2 has information on what this cover letter should include).	Checked
I have read, and can meet, the current Terms and Conditions for this fund.	Checked
I have provided actual start and end dates for the project.	Checked
I have provided my summary budget based on UK government financial years i.e. 1 April – 31 March and in GBP in the application form.	Checked
I have uploaded my project implementation timetable using the specific template provided.	Checked
(If copying and pasting into Flexi-Grant) I have checked that all my responses have been successfully copied into the online application form.	Unchecked
The application has been signed by a suitably authorised individual (clear electronic or scanned signatures are acceptable).	Checked
I have checked the Darwin Plus website immediately prior to submission to ensure there are no late updates.	Checked
I have read and understood the Privacy Notice on the Darwin Plus website.	Checked

We would like to keep in touch!

Please check this box if you would be happy for the lead applicant (Flexi-Grant Account Holder) and project leader (if different) to be added to our mailing list. Through our mailing list we share updates on upcoming and current application rounds under Darwin Plus. We also provide occasional updates on other UK Government activities related to biodiversity conservation and share project news. You are free to unsubscribe at any time.

Checked

Data protection and use of personal data

Information supplied in the application form, including personal data, will be used by Defra as set out in the **Privacy Notice**, available from the [Forms and Guidance Portal](#).

This **Privacy Notice must be provided to all individuals** whose personal data is supplied in the application form. Some information may be used when publicising Darwin Plus including project details (usually title, lead partner, project leader, location, and total grant value).

Project Title:

Darwin Plus Local

Provide a **Project Implementation Timetable** that shows the key milestones in project activities. Complete the following table as appropriate to describe the intended workplan for your project. Projects are based on UK Financial Years (**1 April – 31 March** - therefore starts April 2023).

Please add/remove columns to reflect the length of your project. For each activity (add/remove rows as appropriate) indicate the number of months it will last, and shade only the months in which an activity will be carried out. The workplan can span multiple pages if necessary.

Activity #	Description (max 25 words)	No. of months	UK Financial Year 2023/24												
			Calendar Year 2023									Calendar Year 2024			
			Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
1. Order Equipment	Lead: S. Sarkis, LRF Assistance: P. Schulz, Tritonia Main items: Complete workstation infrastructure GoPro's Hero 11, Surface GPS Seawater data loggers (temperature, chemistry and PAR)	1													
2. Meeting 1: Project opening session with Bermuda Government: Department of Environment and Natural Resources (DENR) and Department of Works & Engineering	Organiser: S. Sarkis, LRF Agenda: -Confirm site selection and project logistics. -Confirm fieldwork training schedule and names of participating government officers.	1													

Project Title:

Activity #	Description (max 25 words)	No. of months	UK Financial Year 2023/24												
			Calendar Year 2023									Calendar Year 2024			
			Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
3. Site selection SCUBA assessment for coral planting designated area	<p>LRF lead S. Sarkis + 2 technicians: assess suitability for coral growth and survivorship.</p> <p>Tritonia, P. Schulz: assist pre-planning of sites and survey design.</p>	1													
4. Set up LRF's computer and camera units	<p>Tritonia, P. Schulz: set-up LRF's photogrammetry unit, assemble survey stereo camera system including surface GPS logger.</p>	1													
5. Outplanting corals and installation of water chemistry and light data loggers	<p>LRF, S. Sarkis +2 technicians: Assess coral health, transfer and photograph outplanted coral colony.</p> <p>Install data-loggers; CTD (conductivity/salinity, temperature, depth) and Photosynthetic Active Radiation (PAR-light).</p>	2													
6. Photogrammetry Field training and Data Collecting- Survey 1	<p>Tritonia, P. Schulz: conduct survey training and surveys.</p> <p>Trainees: LRF with 3 divers (S. Sarkis + 2 technicians). Bermuda government DENR at least 1 diver.</p>	1													

Project Title:

Activity #	Description (max 25 words)	No. of months	UK Financial Year 2023/24											
			Calendar Year 2023									Calendar Year 2024		
			Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
7. Photogrammetry Data analysis training	Tritonia, P. Schulz: on-site training to LRF staff for construction and analysis of 3D maps. Additionally, remotely assistance will be provided throughout the project.	4												
8. Monthly standard coral monitoring and water quality assessment	LRF technicians: Planted corals will be monitor twice a month; maintained free of algal fouling, photographed, and water parameters/samples will be taken.	10												
9. Meeting 2: Six-months review with Bermuda government: Department of Environment and Natural Resources (DENR) and Department of Works & Engineering	LRF Organiser S. Sarkis Agenda: -Update on project progress and next opportunity for further training for government officer(s).	1												
10. Photogrammetry Data Collection; Survey 2	LRF, S. Sarkis +2 technicians: Will conduct subsequent survey using techniques learnt from Tritonia Scientific. DENR (at least 1 diver) for training.	1												
11. Photogrammetry data analysis Survey 2 and map productions	LRF, 2 technicians: Data entry and analysis. Tritonia, P. Schulz: Provide remote assistance to LRF staff	2												

Project Title:

Activity #	Description (max 25 words)	No. of months	UK Financial Year 2023/24											
			Calendar Year 2023									Calendar Year 2024		
			Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
	to produce maps resulting from two surveys.													
12. Coral growth and survivorship analysis	LRF, 2 technicians: Monthly analysis of corals using standard ImageJ. Results will be examined against monthly seawater parameters, to aid review survivorship/growth of outplanted corals.	4												
13. Scientific report preparation	LRF, S. Sarkis: Preparation of report providing a summary, outcomes and results of the outplanted coral, which will include the 3D maps of the surveys.	2												
14. LRF manual on photogrammetry	LRF, S. Sarkis and Tritonia, P. Schulz: Production of a Standard Operating Procedures (SOP) for LRF's photogrammetry surveys, for future reference, training and guidance.	4												
15. Meeting 3: Post-mortem Communication brief to GOB	LRF, S. Sarkis: Preparation of brief to inform government of the project findings and how photogrammetry can be used and implement into Bermuda's surveying practices.	1												
16. Grant report	LRF, S. Sarkis: Production of the final report to Darwin Plus Local	2												

Project Title:

Activity #	Description (max 25 words)	No. of months	UK Financial Year 2023/24												
			Calendar Year 2023									Calendar Year 2024			
			Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
17. Information sharing	LRF is part of the Caribbean coral reef network; and will share information through online newsletters, Facebook and Instagram reaching out to Caribbean UKOTs.	1													