Applicant: **Zimmermann, Alizee**
Organisation: **Turks and Caicos Reef Fund**
Funding Sought: **£46,558.00**

DPLR1\1088

Uncovering the genetic diversity of Caribbean coral rubble beds

Anthropogenic pressure is accelerating the destruction of marine ecosystems and coral rubble beds are increasing in size as a result. Despite being created of dead skeletons, the ecosystem maintains a high biodiversity including all major marine phyla. The variety of organisms present in Caribbean coral rubble beds is not currently known. Using a combination of physical collection, morphological identification and genetic analysis is the most accurate way of creating the first biodiversity inventory for Caribbean coral rubble beds.

CONTACT DETAILS

Title Ms
Name Alizee
Surname Zimmermann
Organisation Turks and Caicos Reef Fund
Website
Tel
Email
Address

CONTACT DETAILS

Title Ms
Name Alizee
Surname Zimmerman
Website (Work) **Www.tcreef.org (http://Www.**
Tel (Work)
Email (Work)
Address

CONTACT DETAILS

Title Ms
Name Michelle
Surname Taylor
Website (Work) **Www.seebeneaththesea.co.u k (http://Www.seebeneaththesea.co.uk)**
Tel (Mobile)
Email (Work)
Address

DPLR1\1088

Uncovering the genetic diversity of Caribbean coral rubble beds

Section 1 - Project Title & Contact Details

Q1. Project Title

Uncovering the genetic diversity of Caribbean coral rubble beds

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

⦿ Organisation

CONTACT DETAILS

Title	Ms
Name	Alizee
Surname	Zimmermann
Organisation	Turks and Caicos Reef Fund
Website	[redacted]
Tel	[redacted]
Email	[redacted]
Address	[redacted]

CONTACT DETAILS

Title	Ms
Name	Alizee
Surname	Zimmerman
Website (Work)	Www.tcreef.org
Tel (Work)	[redacted]
Email (Work)	[redacted]
Address	[redacted]

CONTACT DETAILS

Title	Ms
Name	Michelle
Surname	Taylor
Website (Work)	Www.seebeneaththesea.co.uk
Tel (Mobile)	[redacted]
Email (Work)	[redacted]
Address	[redacted]

GMS ORGANISATION

Type	**Organisation**
Name	Turks and Caicos Reef Fund
Phone	[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.

☑ Turks & Caicos Islands (TCI)

*** 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)?

⦿ Yes

Please list these below and describe how they will benefit:

All Caribbean UKOTs (Anguilla, Bermuda, BVI, Cayman Islands, and Montserrat) will benefit from the project due to the similarity of ecosystems found across the Caribbean region. Uncovering the biodiversity

present in the specified ecosystem in TCI will provide an understanding of the diversity in coral rubble beds throughout the region. Although there may be differences across the region, this project will provide an invaluable baseline of data for the entire Caribbean.

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):	Michelle Taylor
Lead Partner name (if applying as an organisation; Guidance section 3.1):	Alizee Zimmermann, Turks and Caicos Reef Fund
Lead Partner Website (if applicable):	Www.threefold.org
Is the Lead Partner based in a UKOT where the project is working (Guidance section 3.1)?	⊙ Yes
List other partners involved and where are they based (Guidance section 3.2):	Ms. Michelle Taylor, University of Aberdeen Dr. Kara Layton, University of Aberdeen
Summary of roles and responsibilities of each partner in the project:	Ms. Zimmermann is the lead partner and is responsible for all on-island logistics as well as overseeing the project. She is the executive director of the Turks and Caicos Reef Fund and has extensive experience in organising scientific research projects. Ms. Taylor is a Caribbean coral rubble bed researcher with experience surveying the ecosystem in TCI. She will help train staff on the laboratory equipment and is responsible for the field collection of samples. She is a certified SCUBA diving instructor and scientific diver with almost 2000 dives and will be responsible for all dive and field safety. Dr. Layton is a genetics researcher who will provide guidance in setting up the on-island laboratory as well as training TC Reef Fund staff and volunteers on the use of the equipment. She has been involved in selecting the most appropriate equipment for DNA extraction given the cost and size constraints.

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).

darwin cover letter tcrf letterhead
14/02/2023
22:34:09
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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.

Anthropogenic pressure is accelerating the destruction of marine ecosystems and coral rubble beds are increasing in size as a result. Despite being created of dead skeletons, the ecosystem maintains a high biodiversity including all major marine phyla. The variety of organisms present in Caribbean coral rubble beds is not currently known. Using a combination of physical collection, morphological identification and genetic analysis is the most accurate way of creating the first biodiversity inventory for Caribbean coral rubble beds.

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?

Coral rubble beds are ecosystems comprising coral rubble, where rubble is defined as chemically or mechanically abraded components of frame-building or reef rock larger than sand particles. Rubble is produced through natural processes such as storms, earthquakes, bioerosion, and wave disturbance, and anthropogenic events such as ship groundings, anchor damage, climate change-induced bleaching and subsequent mortality, or dynamite fishing. These local (e.g. eutrophication, biodiversity loss, pollution, and destructive fishing) and global (e.g. climate change and ocean acidification) factors are responsible for the loss of 1–2% of coral reef abundance per year in the Western Pacific; similar loss occurs in the Caribbean. Although coral rubble beds are much less structurally complex than live coral reefs, the presence of

interstitial spaces in the rubble provide heterogeneity and rugosity in the system, allowing a great diversity of marine organisms to inhabit the ecosystem. Climate change and its subsequent effects on coral reefs will only increase the abundance and scale of coral rubble beds globally, creating an urgent need to understand the ecosystem function and diversity and for future conservation.
As well as the other pressures our tropical coral reefs are currently facing, coral reefs in the Caribbean have recently been under threat from a new disease, stony coral tissue loss disease (SCTLD), which can result in coral death and additional coral rubble being added to rubble beds. In Turks and Caicos Islands, SCTLD reduced live coral cover by 62% in one year after it was first detected in 2019. In their search for turf and macroalgae, parrotfish (Scaridae), and other reef bioeroders, preferentially target dead corals, further dismantling the reef complex and increasing the size of nearby rubble beds. As a newly emerged disease the long-term consequences of SCTLD are not known, but it can be hypothesised that coral rubble quantities will increase as a result.
Coral rubble beds not only provide shelter and protection but are incredibly diverse, providing essential habitat for cryptic marine invertebrate species. Over 365 species of sponges, tunicates and bryozoans have been found under rubble in the Netherland Antilles; more recently, a new coral rubble-dwelling crab species was discovered in Guam. In Okinawa, Japan, specimens of crustaceans, flatworms, roundworms, echinoderms, segmented worms, and molluscs were found in coral rubble beds, however wider diversity research in the Caribbean is lacking. Caribbean coral rubble ecosystems have the potential to harbour vast numbers of species, but current data and biodiversity inventories are lacking, hence their true significance remains unknown.
The most pressing issue for this habitat is the current lack of data. A pilot study was run by Ms. Taylor and supported by the International Coral Reef Society and the Genetics Society collected data in Summer 2022. The methods were successful and the variety of organisms collected prove the diversity in the Caribbean is extensive. Collection of further specimens in Summer 2023 will exponentially increase our knowledge of the ecosystem and provide DNA barcodes to the global reference library.
The overall objective of this project is to create the first biodiversity inventory of Caribbean coral rubble beds, including taxonomic, morphological, and genetic data. This will be achieved by documenting and characterising the organisms inhabiting the ecosystem through underwater surveying and collection. This curation can be shared globally through the open-source database, Barcode of Life System, allowing researchers to access the data and increase transparency of the research. The success of this project will be in the creation and publication of DNA barcodes for organisms found in TCI coral rubble beds and in the use of that data to protect other rubble habitats in the region and around the globe.

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

darwin plus local - additional information
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pdf 509.61 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**
Unchecked	**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.

Once the biodiversity of the ecosystem has been established through this project, conservation plans can be made. Researchers are not able to inform policy without data, which is why this project is so important. Using genetics as a way to determine biodiversity is labour and cost intensive to begin with, however once the DNA barcodes of the organisms are obtained less invasive, quicker, and cheaper methods (such as environmental DNA) can be used to monitor the habitat. The investment now is essential to detect organisms before they are made extinct by humans.

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):
01 May 2023	31 March 2024	11 months

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

r1-dplus-local-implementation-timetable-template
14/02/2023
21:36:52
pdf 129.58 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).

⦿ No

Budget line	Explanation	Cost in GBP
Staff costs:	Staff involved in the project are having their salary covered by their employers to ensure funds are dedicated towards data collection and analysis.	£0.00
Overhead costs:	Electricity for laboratory equipment ([redacted] for 8 weeks)	[redacted]0
Travel & subsistence costs:	[redacted]- Travel for 2 researchers from the U.K. to TCI [redacted]), 6 weeks of accommodation on Providenciales [redacted], 6 weeks living costs[redacted]), car hire for travel around island to dive sites ([redacted] [redacted]- Travel for Dr. Kara Layton and 2 weeks living costs during laboratory set up and training [redacted] [redacted] for 4 researchers (2 local TCI researchers, 2 U.K. researchers) to travel to Grand Turk and South Caicos for additional data collection sites. [redacted]- accommodation in Grand Turk and South Caicos [redacted]	[redacted]

Operating costs:	[redacted] - Boat costs to allow researchers to reach dive sites around TCI [redacted] to cover captain, fuel, and boat maintenance). [redacted] - DNA extraction kits ([redacted] required). [redacted] - Laboratory consumables (ethanol, micropipette tips, quantification kits, gloves, etc). [redacted] - DNA barcoding of collected specimens run by the University of Guelph. Each plate of 95 specimens is [redacted]. A total of 10 plates of specimens are expected to be collected. [redacted] - Shipping of samples to University of Guelph, Canada (preservation in ethanol and the presence of biological samples requires specialised shipping)	[redacted]
Capital equipment:	[redacted] - Set up of an on-island genetics laboratory requires the purchase of a centrifuge ([redacted], vortex mixer [redacted] incubator [redacted], spark-proof freezer ([redacted], fluorometer ([redacted]) and micropipette set ([redacted] [redacted] - Shipping of equipment to TCI [redacted]	[redacted]
Consultancy costs:	N/a	£0.00
Total:		[redacted]

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)

No Response

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

No Response

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

Travel from the U.K. is required for Dr. Layton, Ms. Taylor and a research assistant to set up the laboratory and collect samples. Accommodation on island is expensive and renting a small house is most cost effective. TC Reef Fund does not currently have a vehicle and personal vehicles are not large enough to carry personnel and equipment around the island to sites and the marina, so visiting researchers must hire a car for the duration of their stay. Local researchers are unfortunately not qualified enough for the research but will be trained during the project.

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

Boat use is required to access the sites where coral rubble is found. Specimen collection needs to take place outside of the MPAs of TCI (as detailed in the research permit), which requires a greater distance to travel for suitable sites. TC Reef Fund owns a boat so only needs to cover the cost of a captain, fuel, and maintenance costs for this project. Multiple days of data collection is necessary to build the genetic database of organisms found in the ecosystem.

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

Laboratory equipment is essential for this project and can be used in the future for other DNA projects, allowing the TC Reef Fund to have autonomy over future genetic research on island. A centrifuge, incubator, vortex mixer, micropipette set, fluorometer, and spark-proof freezer are the minimum required to run DNA extraction on site and quantify the DNA present before shipping the samples for DNA barcoding. Reducing reliance on other laboratories allows TC Reef Fund to reduce ongoing costs for research, both for this project and other genetics projects.
Quotes attached in additional information document

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

No Response

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

Costs listed under operating costs, but since the DNA barcoding is outsourced it really belongs under other. Other is not an option for costs above.

DNA barcoding is labour intensive and is only conducted in well-equipped laboratories. There is not the possibility to conduct this work on island, so outsourcing is necessary. The University of Guelph is a partner in the BioScan project which is currently attempting to collect DNA barcodes for all animals on Earth. Dr. Layton and Ms. Taylor are involved in the project so the collaboration is already established.

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:
US$; CAD$	[redacted]	Bank of England	06 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?	53

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

A key component of this project is to set up an on-island laboratory to be used not just for this project but to allow TCI to expand their genetic research capabilities. All equipment for the laboratory must be purchased and shipped from the United Kingdom, United States, or Canada because of the lack of specialised research equipment available on island. Laboratory consumables and DNA extraction kits must also be purchased overseas and shipped in. The island does not have the means to DNA barcode specimens currently, and whilst setting up a laboratory with those capabilities is possible, it is extremely expensive and requires extensive training. Outsourcing this small section of the project is most cost and labour effective.
Setting up a laboratory, and training on the equipment, requires an experienced researcher. Dr. Layton has over a decade of experience with the equipment and has previously worked in the Caribbean, making her the perfect collaborator for this project. Once trained, TC Reef Fund staff can train additional researchers and interns who work with the organisation, allowing the continuation of genetics research.

All other expenses will contribute to local economies.

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.

The Turks and Caicos Islands (TCI) are fundamentally linked to their natural environment. As a small island nation, the associated assets of the environment are essential to the people of TCI. The marine environment provides coastal protection from storms, provides nutrition through fisheries, and attracts tourists from around the globe to its beautiful beaches and reefs. A 2018 JNCC report showed that tourism had an annual monetary value of over [redacted]. The report also showed that agriculture, fisheries, and local cultural services had only [redacted] value collectively. The value of tourism to the islands is indisputable and protecting the marine environmental is essential to keep that revenue. Including coral rubble beds in marine protected areas will increase interest in the habitat, especially to SCUBA divers interested in seeing rare, cryptic species, and will further boast the economy of TCI.

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.

research permit_taloraberdeen_coralrubble_2022-06-07-27
14/02/2023
21:50:44
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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

Field collection of specimens involving boat travel and SCUBA diving	Only certified and experienced divers will be involved in collection of specimens. All divers will have independent dive insurance covering hyperbaric treatment if required. Ms. Taylor will be personally supervising divers in the water with dive briefings given prior to getting in the water for each dive. The traditional buddy system will be employed, where no diver is alone underwater, and each buddy team must return to the surface with no less than ¼ of their air remaining. Experienced boat captains will be used and rolling risk assessments regarding weather conditions will be used.
No Response	*No Response*
No Response	*No Response*

Do you require more fields?

⊙ No

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:	Alizee Zimmermann
Position in the organisation: (if applicable)	Executive Director
Signature (please upload e-signature)	B8606A8F-890B-456C-AC4D-B285770806EE 14/02/2023 22:34:43 jpg 99.92 KB
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.	Checked
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.

Unchecked

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).

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
	Site location planning, equipment purchasing and shipping, logistics and planning for data collection.	3												
	Field collection of specimens	2												
	Set up of on-island laboratory	1												
	DNA extraction of collected specimens	2												
	DNA barcoding of collected specimens (carried out in Canada)	3												
	Analysis of genetic data	3												
	Report writing	2												