

DPLR2\1025

Unveiling the Unrecognized: Sea Cucumbers' Role in Coral Reef Health

Sea cucumbers (class Holothuroidea) are under studied deposit feeders and bioturbators on the Caribbean seafloor, exerting a significant role in the health and function of coral reef ecosystems (Williamson et al., 2016). This study proposes to investigate the bottom-up influence sea cucumbers have on coral health in the face of climate change, and to improve the health and resilience of critically endangered coral (*Acropora cervicornis*) outplants in Little Cayman by co-locating corals with the common sea cucumber *Holothuria mexicana*.

Type	Organisation
Name	Central Caribbean Marine Institute
Phone (Work)	+ [REDACTED]
Email (Work)	[REDACTED]
Website	[REDACTED]
Address	[REDACTED]
	[REDACTED]
	[REDACTED]
	[REDACTED]
	[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.

Cayman Islands

*** 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): Matt Doherty

Lead Partner name (if applying as an organisation; Guidance section 3.1): Central Caribbean Marine Institute

Lead Partner Website (if applicable): www.reefresearch.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):

Leah Harper - Smithsonian institution, United States.

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

Central Caribbean Marine Institute will facilitate the research.

Leah Harper will deliver expertise in terms of identification, disease, and laboratory based work.

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](#)
- 22/06/2023
- 07:04:28
- pdf 29.14 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.

Sea cucumbers (class Holothuroidea) are under studied deposit feeders and bioturbators on the Caribbean seafloor, exerting a significant role in the health and function of coral reef ecosystems (Williamson et al., 2016). This study proposes to investigate the bottom-up influence sea cucumbers have on coral health in the face of climate change, and to improve the health and resilience of critically endangered coral (*Acropora cervicornis*) outplants in Little Cayman by co-locating corals with the common sea cucumber *Holothuria mexicana*.

Q6a. Description (Guidance section 2.1 and 6)

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?

The overall objective of this project is to assess the functional role of sea cucumbers in coral reef ecosystems. We aim to understand the impact of sea cucumbers on the health and growth of coral colonies and their potential contribution to the ecosystem in the face of climate change. Coral disease prevalence has risen in recent years, partly attributed to warming oceans from climate change (Burke et al., 2023). In the Caribbean, coral disease outbreaks have contributed to reef flattening, compromising corals' ability to render ecosystem services, such as habitat provision for fish and shoreline protection from storms. Sea cucumbers represent an important group of organisms that have the potential to ameliorate coral fitness through ecosystem processes such as detritivory and bioturbation (Williamson et al, 2016). Sea cucumbers excrete higher levels of calcium carbonate than they ingest, which is a crucial mineral in coral growth. Because they remove detritus and pathogens from sediments, sea cucumbers also may enhance corals' resistance and resilience to disease and bleaching (Grayson et al, 2021). This is a pilot project gathering initial evidence of the role of sea cucumbers as disease mitigation and their potential as a tool for coral restoration.

The work proposed here will leverage the existing *Acropora cervicornis* restoration program led by CCMI, which began in 2011 and has successfully outplanted over 1 km² of corals. Experimental treatments will center around 9 *Acropora* "spiders" supporting established outplants of (number) *A. cervicornis* fragments of known genotypes (photo, fig 1). Each spider will be haphazardly assigned a treatment: enclosure (sea cucumbers caged inside with the corals), exclosure (cage surrounding corals excluding sea cucumbers and other bioturbators), and control (open plots exposed to natural levels of bioturbation, fig 2).

First, we will test sea cucumbers' ability to remove organic matter from the surface layer of sediment. We will compare the difference in dry weight and ash-free dry weight from surface-layer sediment samples collected within enclosures, exclosures, and control plots to determine sea cucumbers' relative efficiency in consuming organic matter.. Additionally, we will assess the impact of sea cucumbers on the disease resistance, disease resilience, bleaching resistance and growth rates of *A. cervicornis*. Experiments will be conducted over a 90-day period, with coral assessments conducted every 14 days. By comparing coral health and growth outcomes between enclosure and exclosure treatments, we will determine the extent to which sea cucumbers contribute to enhancing corals' growth and resistance to bleaching and disease.

In addition to our controlled experiment and restoration effort, we will also quantify the density and diversity of sea cucumbers and other bioturbators and detritivores, such as queen conch, hermit crabs, and parrotfish across habitat types around the Cayman Islands using the globally standardised Reef Life Survey protocol. This will allow us to compare the abundances of these organisms in the Cayman Islands to other locations in the Caribbean and worldwide, and potentially link bioturbator and detritivore density to coral health in other UKOT's.

Overall, our project aims to understand the functional role of sea cucumbers in removing and recycling organic matter and their potential impact on coral growth and health, and to test the feasibility of co-locating sea cucumbers with outplanted corals to enhance restoration success. By conducting assessments and monitoring above mentioned parameters, we will contribute to the knowledge of coral reef ecosystems and potentially provide insights for effective conservation and restoration efforts utilizing handbooks and webinars.

Q6b. Long-term sustainability (Guidance section 2.1 and 6)

Please describe the long-term benefits of the project and the change it will bring about. How will the outcomes of the project be sustained after the funding is finished?

The project's long-term benefits include enhanced understanding of sea cucumbers' functional role in coral reef ecosystems, improved coral reef management based on valuable insights, potential bioremediation of coral disease and bleaching among CCMI's A. cervicornis outplants, and the potential development of new conservation and restoration strategies which may increase success post transplantation. To sustain the project's outcomes, knowledge dissemination through scientific publications, outreach activities, and collaborations with local communities, conservation organizations, and government agencies, including that of other UKOT's, are essential. Long-term monitoring programs should also be established, including ongoing monitoring of marine animal communities using protocols that are inclusive of sea cucumbers and other bioturbators, such as Reef Life Survey. Using the information gained through this study to generate a monitoring program allowing us to track changes over time and inform adaptive management strategies.

In summary, the project aims to assess the initial role of sea cucumbers in coral reef ecosystems, contribute to coral reef management decisions, mitigate coral disease, promote sustainable practices, and develop conservation and restoration strategies. To ensure long-term sustainability, knowledge dissemination, collaboration, and long-term monitoring are crucial.

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

-
- [Cucumber references](#)
 - 26/06/2023
 - 19:33:18
 - pdf 87.46 KB

-
- [Darwin Local cucumber Budget](#)
 - 26/06/2023
 - 19:05:07
 - xlsx 32.6 KB

-
- [Sea Cucumber Schematic](#)
 - 22/06/2023
 - 06:37:41
 - pptx 232.26 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 contributes to:

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

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

Checked **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. Please use quantitative information where possible here.

The project aims to test the viability of sea cucumbers of disease mitigation and growth in the critically endangered species of *A. cervicornis*. Grayson et al., (2022) demonstrated that exclusion of sea cucumbers increase surface pigmentation indicative of increased microbe sand microalgae (Purcell et al. 2016) and reduce corals' defence mechanism against a common heat-activated bleaching pathogen by ~52%. The findings of the project will contribute to the understanding of how sea cucumbers can support coral reef resilience and inform management by delivering outreach via webinars and restoration handbooks.

Section 6 - Workplan

Q8. Workplan (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 Workplan (available at: <https://darwinplus.org.uk/apply>) 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 must be completed by 31 March 2024.

Start date:	End date:	Duration (e.g. 3 months):
01 October 2023	31 March 2024	6 months

Please upload the completed Darwin Plus Local Project Workplan with your proposed project activities here

- [R2-DPlus-Local-Project-Workplan-FINAL_md](#)
- 26/06/2023
- 18:47:56
- docx 29.53 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:		
Consultancy costs:		
Overhead costs:		
Travel & subsistence costs:		
Operating costs:		
Capital equipment:		
Other Costs		
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)

No Response

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

No Response

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

No Response

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

No Response

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

No Response

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

No Response

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

No Response

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:
No Response	No Response	No Response	No Response

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.

No Response

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 proposed project aligns with both local and national priorities concerning environmental conservation. At the local level, protecting and preserving coral reef ecosystems is a priority due to their ecological and economic significance. By investigating the relationship between sea cucumbers and coral reef health, the project contributes to the preservation and conservation of these vital ecosystems. It provides valuable knowledge that can inform local conservation efforts and help develop targeted management strategies. The project also aligns with specific strategies or action plans established by the Cayman Islands government. For instance, the potential for sea cucumbers in disease mitigation, part of a larger marine conservation strategy.

In summary, the project's alignment with local and national priorities lies in its contribution to coral reef preservation and conservation, addressing environmental concerns, supporting evidence-based decision-making, and potentially informing the development or refinement of policies and strategies for marine ecosystem conservation. By shedding light on the relationship between sea cucumbers and coral reef health, the project offers insights that can benefit both local communities and national environmental conservation efforts.

Will the project take place on Government owned land or water or involve biocontrol, invasive alien species control or eradication?

Yes

Please attach evidence that you have Government support for this project i.e. a Letter of Support. Applications which indicate that they do not take place on Government land or water, but which propose work that appears to the reviewers would be difficult/impossible to carry out without working on government land or waters may be ineligible if no Letter of Support is provided.

- [DOE CCMI Sea Cucumbers Support Letter @ win June 2023](#)
- 26/06/2023
- 17:30:03
- pdf 150.42 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. Please note the importance of health and safety and environmental risk assessment in the design of your project. If there is any possibility that your project may have negative impacts on the environment or human health, it is important that you provide a comprehensive analysis of potential environmental and human health risks, and the prevention measures you will take to ensure the work does not cause harm.

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
Diving accidents	All divers will be AAUS scientific diver qualified and standard will be followed strictly at all times
<i>No Response</i>	<i>No Response</i>
<i>No Response</i>	<i>No Response</i>

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

Supporting documents list (please have these ready to attach with application)

- Cover Letter of no more than two A4 pages. (Guidance section: 4.2 has information on what this cover letter should include).
- If the project takes place on public land or water or is addressing invasive alien species, a Letter of support from OT Government.
- Project Workplan in the template provided for Darwin Plus Local (available at: <https://darwinplus.org.uk/apply>).
- Map and additional information (optional) maximum five additional pages.

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: Matt Doherty

Position in the organisation: (if applicable) Research technician

Signature (please upload e-signature)

- [signature](#)
- 22/06/2023
- 07:31:34
- png 6.09KB

Date: June 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 or is addressing alien invasive species, 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 my project that fit this Round.	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 workplan 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).

Project Title:

Darwin Plus Local

Provide a **Project Workplan** that shows the key milestones in project activities. Complete the following table as appropriate to describe the intended workplan for your project. Round 2 is for a **maximum of six months** with activities starting from 1 October 2023 and all projects must be completed by 31 March 2024.

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 Years 2023/24					
			Calendar Year 2023			Calendar Year 2024		
			Oct	Nov	Dec	Jan	Feb	Mar
1	Initial population surveys	1	x					
2	Building domes and fragmenting	2	x	x				
3	Restoration health monitoring, sea cucumbers put into domes and monitored bi-weekly four 4 months	4		x	x	x	x	
4	Detritivory measurements	2			x	x		
5	Lab work	1					x	
6	Education and outreach	2					x	x
7	Project analysis	2					x	x