DPLR2\1025

Darwin Plus Local - Final Report (1)

Officer: Jessica Magnus

Section 1 - Darwin Plus Local Project Information (Essential)

Project Reference Number

DPL00052

Q1. Project Title

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

Overseas Territory(ies)

☑ Cayman Islands

Lead Organisation or Individual

Central Caribbean Marine Institue

Partner Organisation(s)

MarineGEO, University of Massachusettes Boston.

Value of Darwin Plus Local Grant Award

[redacted]

Project Start Date

01 October 2023

Project End Date

31 March 2024

Project Leader Name

Matthew L Doherty

Project Website/Twitter/Blog etc.

No Response

Report Author(s)

Matthew Doherty, Leah Harper, Leon Schlenger

Report Date

07 April 2024

Project Summary

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.

Project Outcomes

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;**
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.**

Section 2 - Project Outcomes (Essential)

On a scale of 1 (high – outcome substantially exceeded) to 5 (low – outcome substantially did not meet expectation), how successful do you think your project has been?

⦿ 3 - Outcome met expectation

Project outcomes and justification for rating above

Our initial research is beginning to reveal how sea cucumbers might influence coral reef ecosystems in the Caribbean, and their potential to enhance other efforts. Our findings indicate that sea cucumbers potentially play a significant role in reducing dry organic matter in the sediment (see sediment.pdf February results). We observed the median growth of Acropora corals, used commonly in restoration projects, higher when caged with sea cucumbers (see TLE.pdf). The impact might have been more pronounced if the sea cucumbers had remained within the experimental enclosures, with instances of sea cucumbers breaching the cages, echoing the findings of Grayson et al. (2022). While microbial analysis is ongoing, preliminary results of sediment excreted by sea cucumbers show no detectable DNA across multiple samples, suggesting a notable filtration effect. This finding,

especially in the context of sediment being a vector for coral disease (Studivan et al., 2018), underscores the potential importance of sea cucumbers in coral reef research and conservation strategies.

Supporting Evidence - file(s) upload

TLE
30/04/2024
09:15:35
pdf 163.42 KB

Sediments
30/04/2024
09:15:35
pdf 197.66 KB

DNA_concentrations
30/04/2024
09:15:35
pdf 19.46 KB

Supporting Evidence - links to published document/online materials

We aim to publish all results from this project in PeerJ. Analysis is still in progress due to the lag of extractions and sequencing. This will be shared with all relevant parties on submission.

Project Challenges

2023 marked a critical period for the coral reefs of Little Cayman, with a staggering 56% mortality rate of shallow water corals reported (Doherty et al., in press) and the near-total death of 95% of the Acropora coral nursery. This series of events forced us to reconsider the direction of our project. With the Acropora significantly impacted, we obtained permission from Darwin+ to shift our focus towards studying the microbial communities among the different treatments. Restrictions from the Department of Environment (DoE) limited our use to the remaining Acropora cervicornis instead of the initially planned Porites astreoides, resulting in only one fragment being available per treatment. As we prepared to analyse coral tissue, a plan was in place to collaborate with partners in the USA due to our lab's equipment limitations. However, an unexpected weather system devastated our project in Little Cayman, with conditions likened to those seen in hurricane years, including 15ft waves from un-forecast directions. Local advice had led us to believe our project site would be safe, yet the reality proved otherwise, prompting another revision of our project focus. Exploration of filtration processes of sea cucumbers as a new direction, analysing sediment and swab samples to understand and decipher Holothuroidea's ecosystem function. Despite these setbacks, the dedication and resilience of our staff allowed us to swiftly reestablish the project. Their hard work ensured that we could resume our research within days.

Lessons Learned

i) Reflecting on the entire endeavor, the project progressed smoothly, especially when considering the obstacles encountered. The unwavering dedication of our team and our strong mutual support made it possible to proceed positively. I was particularly impressed with our outreach efforts, including workshops for the younger demographic in the U.K., informative sessions for local stakeholders, and our active engagement on Instagram. We plan to share our data with the Department of Environment (DoE) and Darwin+ following thorough analysis and publication.

ii/iii) Weather conditions posed a significant challenge to our monitoring efforts. Contrary to expectations for calm seas on the island's north side during this season, we experienced a dramatic change in weather patterns, complicating our fieldwork.

iii/iv) Considering the difficulties posed by the weather, conducting the project at shallower depths might be a

viable strategy to enhance accessibility under adverse conditions. Although our nurseries were initially established at the current depth, a shallower location could facilitate more frequent monitoring, reduce effort, and offer the possibility to secure equipment and specimens should rough weather arise. This adjustment could potentially streamline our operations without compromising the project's integrity.

Section 3 - Project Finance (Essential)

Project Expenditure

Project Spend (indicative) since last Annual Report	2023/24 Grant (£)	2023/24 Total actual Darwin Plus Costs (£)	Variance %	Comments (please explain significant variances)
Staff Costs	[redacted]	[redacted]	[redacted]	MD yearly salary increase
Consultancy Costs	£0.00	£0.00	0	*No Response*
Overhead Costs	[redacted]	[redacted]	[redacted]	Overhead costs dropped due to overall project expenditure dropping.
Travel and Subsistence	[redacted]	[redacted]	[redacted]	*No Response*
Operating Costs	[redacted]	[redacted]	[redacted]	Funds were transferred from this allocation to "Other" for conducting DNA analyses. Donations for lab equipment further dropped cost. The number of boat days were significantly reduced due to unexpected and extended weather conditions.
Capital Items	£0.00	[redacted]	[redacted]	Muffle Furnace for dry organic matter analysis.
Others	[redacted]	[redacted]	[redacted]	*No Response*
Total	[redacted]	[redacted]	[redacted]	

Please provide a short narrative summary on project finances.

The project faced several setbacks caused by environmental factors during its implementation, prompting us to significantly revise and rethink our approach. We received approval from Darwin+ to reallocate funds to support genetic research, and we are immensely grateful for their support. Their flexibility has enabled us to advance the project despite a challenging few months. Gretchen Goodbody-Gringleys lab at CCMI, and Sarah Gignoux-Wolfsohns lab at UMASS donated a significant amount of lab equipment to the genetic portion of the project, further resulting in the much lower overall cost than anticipated.

Section 4 - Contribution of Project to Darwin Plus Programme Objectives

Please select up to **one** indicator that applies within **each group/indicator list (A, B, C, D)** and report your results for that indicator in the text box underneath. If you do not have relevant results to report for any of the indicators in a particular group, you can leave them blank.

Please also submit some form of evidence (above) to demonstrate any results you list below, where possible.

Group A: Capability and Capacity - Core Darwin Plus Standard Indicators (select one)

Checked	**DPLUS-A01: Number of people from key national and local stakeholder groups completing structured and relevant training.**
Checked	**DPLUS-A02: Number of secondments or placements completed by individuals of key local and national stakeholders.**
Checked	**DPLUS-A03: Number of local/national organisations with improved capability and capacity as a result of project.**
Checked	**DPLUS-A04: Number of people reporting that they are applying new capabilities (skills and knowledge) 6 (or more) months after training.**
Unchecked	**DPLUS-A05: Number of trainers trained reporting to have delivered further training by the end of the project.**

Group A Indicator Results

A01: 3 - Reef life survey training. A01/02: 2 DNA extraction and pcr training at UMASS. A03: 2, DoE and CCMI can use data to make and enhance project decisions. A03/A04: MD and JJ use RLS training for wholistic ecosystem monitoring, intergrating this training to MD's PhD, applicable in BOT's....

Group B: Policies, Practices and Management- Core Darwin Plus Standard Indicators (select one)

Unchecked	**DPLUS-B01: Number of new/improved habitat management plans available and endorsed.**
Unchecked	**DPLUS-B02: Number of new/improved species management plans available and endorsed.**
Unchecked	**DPLUS-B03: Number of new/improved community management plans available and endorsed.**
Unchecked	**DPLUS-B04: Number of new/improved sustainable enterprises/ community benefits management plans available and endorsed.**
Checked	**DPLUS-B05: Number of people with increased participation in local communities / local management organisations (i.e., participation in Governance/citizen engagement).**
Unchecked	**DPLUS-B06: Number of Local Stakeholders and Local Communities (people) with strengthened (recognised/clarified) tenure and/or rights.**

Group B Indicator Results

Global and local engagement through Reefs Go Live (Viewing rating pending; 27 different countries in 2021). Engagement with U.K schools (1271 pupils). Reef Lecture Series (46 local stakeholders). Social Media: Instagram (3,411 accounts reached, 310 likes), X (703 likes and views), Facebook (72 likes).

Group C: Evidence and Best Practices - Core Darwin Plus Standard Indicators (select one)

Unchecked	**DPLUS-C01: Number of best practice guides and knowledge products published and endorsed.**
Unchecked	**DPLUS-C02: Number of new conservation or species stock assessments published.**
Unchecked	**DPLUS-C03: New assessments of habitat conservation action needs published.**
Unchecked	**DPLUS-C04: New assessments of community use of biodiversity resources published.**
Unchecked	**DPLUS-C05: Number of projects contributing data, insights, and case studies to national Multilateral Environmental Agreements (MEAs) related reporting processes and calls for evidence.**

Group C Indicator Results

0

Group D: Sustainable Benefits to People, Biodiversity and Climate - Core Darwin Plus Standard Indicators (select one)

Unchecked	**DPLUS-D01 Hectares of habitat under sustainable management practices.**
Unchecked	**DPLUS-D02: Number of people whose disaster/climate resilience has been improved.**
Unchecked	**DPLUS-D03: Number of policies with biodiversity provisions that have been enacted or amended.**

Group D Indicator Results

0

Section 5 - Project Partnerships, Wider Impacts and Contributions

Project Partnerships

i) Leah Harper from MarineGEO contributed to the project's development and imparted training to CCMI in standardized survey methods, enabling application across other British Overseas Territories.
ii) The Department of Environment, with guidance from John Bothwell, provided essential advice on permitting processes and the initial setup of the project.
iii) The success of all partnerships can be attributed to the strong, pre-existing relationships among the collaborators.
iv) Critical advisement and support for the molecular aspects of the work were provided by Sarah Gignoux-Wolfsohn from Umass Lowell. This partnership, formed in response to the challenges posed by a marine heatwave and adverse weather conditions, was instrumental. Additionally, Matt Leray from the Smithsonian Tropical Research Institute offered valuable insights into various project elements.

Wider Impacts and Decision Making

I am confident in this project's potential to achieve some influence in decision making, largely through the dissemination of our findings through scientific publications. Several prominent projects have been in contact with the sea cuke team, setting the stage for future collaborations in the future. Currently, we are establishing the foundational understanding of Holothuroidea's ecosystem function within a Caribbean context, and are excited to lead in this vital area of research.

Sustainability and Legacy

Matt Doherty will transition as an associate of both Plymouth University and Smithsonian Tropical Research Institute and to complete his PhD. Leon Schlenger (intern) will return to Berlin to complete his master's degree on evolution and is currently considering a project focused on sea cucumbers. The dive equipment and cameras will be repurposed to support future efforts in education, conservation and research in key territories. All domes will be repurposed for future restoration research or activities.

Section 6 - Communications & Publicity

Exceptional Outcomes and Achievements

Darwin plus were fantastic to work with - We sincerely appreciate and value all feedback, interactions and fexibility during difficult moments. We would prefer if any figures/data previously shared were kept private until formal and peer reviewed analyses have taken place.

We had active engagement with U.K High schools, where students completed a coral reef and sea cucumber workshop for aspiring scientists and held a Q&A advising how to become successful within the field; this was also shared as a recording with a full school assembly. Active engagement with the Cayman Islands schools, local stakeholders, and international universities through presentations and lectures.

Photo, video or graphic to be used for publicity and communications.

Please upload at least one relevant and engaging image, video or graphic that you consent to be used alongside the above text in Defra, JNCC or NIRAS communications material.

Research Post (7)
30/04/2024
11:07:19
png 1.48 MB

Research Post (9)
30/04/2024
11:07:18
png 1.75 MB

Research Post (8)
30/04/2024
11:07:18
png 1009.92 KB

Research Post (6)
30/04/2024
11:07:18
png 1.47 MB

DPLUSSC4
30/04/2024
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jpg 555.24 KB

DPLUSSC2
30/04/2024
11:07:18
jpg 247.32 KB

DPLUSSC3
30/04/2024
11:07:18
jpg 281.18 KB

DPLUSSC1
30/04/2024
11:07:05
jpg 348.15 KB

Photo, video, and/or graphic captions and credits.

Research Post (9): Leon Schlenger performing part of the extraction process in Boston.
Research Post (8): Honley High School Huddersfield preparing their coral reefs posters.
Research Post (7): Matthew Doherty video calling Honeley High School in Huddersfield as part of their coral reefs workshop, organised by CCMI.
Research Post (6): Extraction team at UMASS Lowell.
DPLUSSC4: Matthew Doherty receiving cages to place out at the project start.
DPLUSSC3: Project species Holothuria mexicana.
DPLUSSC2: Leon Schlenger with project species (Holothuria mexicana).
DPLUSSC1: Matthew Doherty and Jack Johnson driving boat to project site.
Closed Cages: Picture of the cage set up.
Cages: Picture of the open control in the foreground, with a closed cage at the rear.

I agree for the Biodiversity Challenge Funds Secretariat, Administrator, and/or JNCC to publish the content of this section.

⦿ Yes, I agree for the BCFs Secretariat and/or JNCC to publish the content of this section.

Please list any accounts that you would like tagged in online posts here. This can include project pages, partners' pages or individuals' accounts for any of the following platforms: LinkedIn, Facebook, Twitter, or Instagram.

@reefresearch (instagram, facebook, x)
@marinegeo

Section 7 - Darwin Plus Contacts

Please tick here to confirm that you have read and acknowledge the BCF's Privacy Notice on how contact details will be used and stored and that you have sought agreement from anyone that you are sharing personal details with us on their behalf.

⦿ I confirm I have read the Privacy Notice and have consent to share the following contact details

Project Contact Details

Project Contact Name	Matthew Doherty
Role within Darwin Plus Project	Project manager
Email	[redacted]
Phone	[redacted]
Do you need further sections to provide additional contact details?	⦿ No