Applicant: **Hertler, Heidi**
Organisation: **The School for Field Studies**
Funding Sought: **£50,000.00**

DPLR5\1060

Reef Restoration through Soundscapes: Biodiversity, Acoustic Cues, and Larval Recruitment

This study investigates how coral degradation affects biodiversity, acoustic cues, and larval recruitment on South Caicos reefs. We aim to demonstrate that as coral health declines, biodiversity and acoustic activity will decrease, weakening cues that guide larvae to suitable habitats. Furthermore, to test if soundscape loss impacts recruitment, a replay experiment will broadcast healthy reef sounds in degraded areas, assessing if acoustic cues can boost larval settlement. Results will guide restoration efforts by determining if acoustics can support coral recovery.

PRIMARY APPLICANT DETAILS

Title	Dr
Name	Heidi
Surname	Hertler
Website (Work)	https://fieldstudies.org/centers/tci/
Tel (Work)	[redacted]
Email (Work)	[redacted]
Address	[redacted]

DPLR5\1060

Reef Restoration through Soundscapes: Biodiversity, Acoustic Cues, and Larval Recruitment

Section 1 - Project Title & Contact Details

Q1. Project Title

Reef Restoration through Soundscapes: Biodiversity, Acoustic Cues, and Larval Recruitment

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

⦿ Organisation

PRIMARY APPLICANT DETAILS

Title	Dr
Name	Heidi
Surname	Hertler
Website (Work)	[redacted]
Tel (Work)	
Email (Work)	
Address	

GMS ORGANISATION

Type	**Organisation**
Name	The School for Field Studies
Phone	
Email	
Website	
Address	

Section 2 - Overseas Territory(ies)

Q3. Please state whether the same (or a similar) project proposal has previously been submitted (or you are planning to submit it) to the UK Government for funding. This includes through Darwin Plus Local, Defra's other Darwin Plus grant schemes or other UK Government funding mechanisms. Failure to share this information may result in the application being ineligible (see Guidance section 2.1.1).

⦿ No

Q4. Overseas Territory (Guidance section 1.3):

Which UK Overseas Territory(ies) will your project be working in?

☑ Turks and 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)?

⦿ No

Section 3 - Project Partners

Q5. Project partners (Guidance section 3.2)

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

Project Leader name: (Guidance section 3.1)	Dr. Heidi Hertler
Lead Organisation name: (if applying as an organisation; Guidance section 3.1)	The School for Field Studies
Lead Organisation Website (if applicable):	https://fieldstudies.org/center/tci/
Is the Lead Organisation based in a UKOT where the project is working? (Guidance section 3.1)	⦿ Yes
List other partners involved and where are they based:	Mikayla Carrier (Graduate Student), Dr. Bohnenstiehl, Dr. Eggleston based in Raleigh North Carolina at North Carolina State University

Summary of roles and responsibilities of each partner in the project:	This project involves a partnership between The School for Field Studies (SFS) and North Carolina State University (NCSU), each contributing vital expertise and resources to achieve the project objectives. The School for Field Studies brings specialized knowledge of the South Caicos reefs, including historical coral coverage data, which will inform the project's ecological assessments. They will provide essential logistical support, including room and board, boats, fuel, and dive equipment, as well as the expertise of trained dive staff for fieldwork. SFS staff and faculty will assist in deploying hydrophones, the audio-video array, and the larval plates and sound replay equipment. NCSU will contribute by assisting with the design and construction of the underwater speaker systems necessary for the proposed soundscape manipulation study. They will also provide a video-audio array, which will be used to identify and catalog species-specific sounds at no cost to this project. PhD student Mikayla Carrier will assist with fieldwork. Under the supervision of her advisors, Dr. Del Bohnenstiehl and David Eggleston, she will analyze the acoustic recordings and coral larval settlement data. The SFS and NCSU teams will collaborate to interpret and communicate these results.
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).

CoverLetter_Darwin
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Section 4 - Project Summary & Description

Q6. 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.

This study investigates how coral degradation affects biodiversity, acoustic cues, and larval recruitment on South Caicos reefs. We aim to demonstrate that as coral health declines, biodiversity and acoustic activity will decrease, weakening cues that guide larvae to suitable habitats. Furthermore, to test if soundscape loss impacts recruitment, a replay experiment will broadcast healthy reef sounds in degraded areas, assessing if acoustic cues can boost larval settlement. Results will guide restoration efforts by determining if acoustics can support coral recovery.

Q7a. 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?

Background: Coral reefs are vital ecosystems known for their biodiversity and economic value; however, they face significant environmental threats (Eakin et al., 2010; Heres et al., 2021). Corals reproduce through spawning, a synchronized process whereby eggs and sperm are released into the water column. Successful spawning leads to free-swimming larvae that actively select their settlement location in response to biochemical cues from crustose coralline algae and abiotic factors such as salinity, light, turbidity, and soundscape. Larvae that settle into suitable habitats may grow into new polyps (Munro et al., 1973; Szmant, 1986).

The reefs within Admiral Cockburn Land and Sea National Park near South Caicos Island have faced challenges from intense storms (2008, 2017, and 2022), coral disease (2019-2020) and bleaching (2023). These stressors, combined with extensive historical data on fish populations and benthic cover, provide a unique opportunity to study the effects of coral degradation and expand restoration strategies (Heres et al., 2021; Riegl et al., n.d.; Schelten et al., 2006; Steiner, 1999).

Overall objective: This project aims to develop strategies to reduce coral degradation and enhance ecosystem resilience in South Caicos by examining fish and invertebrate populations, reef soundscapes, and coral recruitment. The primary goals are to: (1) use long-term passive acoustic monitoring (PAM) to assess the presence and diversity of soniferous animals throughout the reef system and (2) determine the potential of enhancing larval recruitment using acoustic cues by establishing baseline differences in larval recruitment and soundscape characteristics across sites and assessing whether settlement can be enhanced by introducing health reef sounds into the environment.

Monitoring Soundscapes Across Diverse Reef Habitats: Hydrophones will be deployed at six sites with varying levels of live coral coverage. These sensors will record continuously at a rate of 48,000 kHz for eight months. Sites will be located on the south (protected MPA) and eastern (unprotected) side of South Caicos (supplemental figure 2). From the long-term recordings, sound pressure levels (SPL), acoustic spectra, and other soundscape metrics will be used to assess differences in the soundscape as a function of coral health.

Cataloging Species-Specific Sounds: An autonomous underwater camera system will be deployed with a small-aperture six-hydrophone array to locate biological sounds and capture simultaneous video. These data will expand our catalog of species-specific sounds for Caribbean reefs and establish their behavioral context (supplemental figure 3). This array, which uses red light for nighttime video, can be deployed for up to three days. Cataloging species-specific sounds will facilitate the development of machine learning-based call detection models that can streamline and improve PAM-based biodiversity assessments.

Assessing Sound as a Cue for Larval Settlement: To determine if the settlement on degraded reefs reflects the absence of suitable acoustic cues, an acoustic replay experiment will be conducted in a degraded reef and soundscape habitat, with the replayed sound taken from the healthiest reef. Experiments will be conducted during spawning periods (August and November), using broadband, low-frequency (fish-dominated) and high-frequency (invertebrate-dominated) sound files, and no sound controls (supplementary figure 3). Tiles will be placed 1, 5, 10, and 30 meters from the speakers (supplemental figure 4), with sites spaced > 500 meters apart. After the larvae are counted under a microscope, binomial tests will be used to evaluate if differences in the number of settled coral larvae are significant.

If successful, this project will measure the soundscape and biodiversity at six reef sites. These data establish a

baseline to assess the trajectory of ecosystem health and the impact of ongoing restoration efforts on these coral reef habitats. It will also provide an assessment of sound replay as a strategy for enhancing larval settlement in this ecosystem.

Q7b. 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?

This project will build a valuable database of reef sounds, with a particular focus on economically important species like groupers, snappers, and spiny lobsters, supporting both fisheries management and biodiversity monitoring efforts in South Caicos and the western tropical Atlantic region. Expanding the catalog of species-specific sounds creates a non-invasive method for tracking population health, benefiting the local economy and conservation strategies. To support widespread research and conservation, species-specific sound catalogs and detection software developed in this project will be made openly available to further aid biodiversity assessments across the region.

The hydrophones purchased through this grant will remain in the Turks and Caicos for long-term acoustic monitoring, giving insights into the evolution of coral reef health over time. This information is critical for understanding reef ecosystems' resilience in the face of ongoing environmental stressors.

Additionally, the acoustic replay experiments will test whether manipulating soundscapes can promote coral recruitment and assist in broader restoration efforts at degraded reefs, aligning with ongoing restoration projects around South Caicos. All sound replay equipment will remain in the Turks and Caicos. If successful, this approach could enhance local fish productivity by fostering healthier reef environments.

(Optional) Please upload any additional and supporting materials or files (such as maps of project sites, etc) below. Maximum of 5 sides of A4, and is combined as a single PDF:

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Section 5 - Project Outcome(s)

Q8. 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 with a clear focus on biodiversity and the natural environment, either by the end of the project or soon after through a credible plan.

Please note: Any proposals including research or monitoring are required to demonstrate a clear link to tangible outcomes for conservation of biodiversity and the natural environment. Please explain how any new research will be applied to drive environmental outcomes on the ground.

Please confirm that your project has a clear focus on biodiversity and the natural environment.

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

Please tick which additional theme(s) of Darwin Plus your project contributes to (if relevant):

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.**

Please justify your selection. Please use quantitative information where possible here.

The project's measurable outcomes focus on conserving and enhancing biodiversity in the Turks and Caicos Islands (TCI) reefs. By analyzing the link between coral health, biodiversity shifts, and acoustic cues, we will determine how soundscape impacts coral larval recruitment. Quantifying the response of larvae to sound in the natural environment will identify whether soundscape manipulation could be a viable mechanism to boost larval settlement and support reef recovery. Long-term, the project will provide researchers and managers with a species-specific sound catalog and monitoring tools, enhancing capacity for ongoing biodiversity assessments and informing protection strategies to benefit TCI's marine ecosystem.

Section 6 - Workplan

Q9. 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/how-to-apply/local-applications/**) 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 start after 1 April 2025 and be completed by 31 March 2026.**

Start date:	End date:	Duration (e.g. 3 months):
01 April 2025	31 March 2026	12 months

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

WorkPlan_DarwinGrant
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Section 7 - Costs

Q10. 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:	[redacted]	
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):

This project involves collaboration between the lead organization, the School for Field Studies, and partners at North Carolina State University (NCSU). Travel is necessary for NCSU researchers to assist with hydrophone deployment, video-audio array experiments, larval settlement, and sound replay studies. The most efficient route for travel involves round trips from Raleigh-Durham International Airport (RDU) to Providenciales International Airport (PLS) and taking either a ferry boat or an island hopper plane to arrive in South Caicos. School for Field Studies will provide room and board to the partner researchers.

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

No Response

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

The capital equipment requested for this project includes essential tools required to achieve the research objectives. Underwater speakers will broadcast reef soundscapes for the larval study, with buoys hosting solar panels and topside electronics. The hydrophones will continuously record biological sounds from six sites, with one additional instrument purchased as a spare. Since the School for Field Studies can support this project's operational and staff costs, we can allocate more than 10% of the total grant towards capital equipment. This instrumentation will remain in the Turks and Caicos following the project's end date to benefit research and restoration efforts.

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

No Response

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

The remaining funds will partially support travel and registration for a researcher to present findings at the Ocean Science Meeting in February 2026. Sharing the project's outcomes at an international venue will maximize its impact, foster collaborations, and enhance the visibility of innovative acoustics methods in reef restoration in the Caribbean.

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	0.7977	https://www.xe.com/currencyconverter/convert/?Amount=1&From=GBP&To=USD	20 November 2024

Darwin Plus Local has been created to build capacity and contribute to local economies in-territory (Guidance section 2.1.1 and section 1.8.4 of the Finance Guidance).

In-territory spend is defined in Darwin Plus Local as including funding spent on:

- **Equipment purchased in-territory;**

- **Equipment that cannot be acquired in-territory and is therefore purchased abroad, but will remain and be used in-territory beyond the life of the proposed Darwin Plus Local project;**
- **Training or skills that cannot be acquired in-territory and are therefore purchased abroad, but will be used in-territory beyond the life of the proposed Darwin Plus Local project;**
- **Time for consultants or staff based in-territory.**

In-territory spend does not include:

- **Time for consultants or staff who are based abroad, even if they travel to the OT to undertake the work;**
- **Shipping and import costs for equipment purchased abroad;**
- **Travel and subsistence costs where they incur spend outside the OT.**

What % of the total will be spent in-territory?	0

If less than 80% of the total project spend is to be spent in-territory, please explain why.

Equpment and expertise for this project is not available in TCI. Although funds will not be spent in TCI, all equipment purchased as part of the grant will remain in TCI. All work takes place in TCI.

Section 8 - Local and National Priorities

Q11. 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.

This project aligns with the mission and goals of the Turks and Caicos Islands Department of Environment and Coastal Resources (DECR), more specifically the goal to "protect and improve the environment and conserve and enhance biodiversity within the territorial boundaries of the Turks and Caicos Islands." Locally this project directly supports reef restoration efforts of the South Caicos Reef Restoration Consortium, a collaboration of stakeholders dedicated to restoring coral reefs around South Caicos. Finally, this project supports the Turks and Caicos National Physical Sustainability Development Plan (NPSDP), specifically the principles of "Resilience + Multi-Functionality" and "Nature as Beauty"

Will the project...

Take place on Government owned land or water?

⦿ Yes

Involve biocontrol, invasive alien species control or eradication?

⦿ No

Require permit(s) from Government departments for completion of activities?

⦿ Yes

If you have answered yes to any of the questions above, 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.

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Section 9 - Project Risks

Q12. 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.**
  For example, you should consider the ratio of vulnerable people or children to adults, ensuring there are appropriate background checks of all staff, and informing vulnerable groups and children of their right to safety and protection.

Risk	Mitigation
Diving and Boat Risks	To mitigate diving risks, all divers will follow dive safety protocols, maintain up-to-date certifications, and conduct regular equipment checks. At least one divemaster or dive instructor will be present on each deployment. Furthermore, we will have thorough emergency response plans, including on-site oxygen and medical evacuation strategies. All deployments will involve at least two divers, and backup deployment dates will be scheduled in case weather conditions delay fieldwork. Boat drivers hold US Coast Guard OUPV certificates. All staff are certified in CPR and first aid.
Equipment Failure and Environmental Risks	Regular maintenance and testing of equipment will be conducted before deployment, with backup instruments available for quick replacement. Deployments will include securing hydrophones to minimize damage risks, and data will be backed up after each retrieval. We will securely attach equipment and ensure comprehensive sanitation and cleaning before and after all deployments to mitigate the potential of lost equipment and disease transfer between sites.

Delayed Timeline	To address shipping and weather delays, we will order equipment as soon as funding is secured and include buffer time in the schedule. The baseline larval study equipment is readily accessible, and the audio-video array equipment is already on hand, allowing the project to begin promptly. Flexible fieldwork schedules are possible, as School for Field Studies researchers reside on the island year-round. Backup equipment will ensure continuity, and regularly

Do you require more fields?

⦿ No

Section 10 - Terms & Conditions

Q13. 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://darwinplus.org.uk/how-to-apply/local-applications/ **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, is addressing invasive alien species or includes activities requiring a permit, a Letter of support from OT Government.**
- **Project Workplan in the template provided for Darwin Plus Local (available at:** https://darwinplus.org.uk/how-to-apply/local-applications/**).**
- **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:	Heidi Hertler
Position in the organisation: (if applicable)	Center Director
Signature (please upload e-signature)	signature0001 22/11/2024 16:15:24 jpg 23.68 KB
Date:	22 November 2024

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 (found at:** https://darwinplus.org.uk/apply/local-applications/**) 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 (available at: https://darwinplus.org.uk/apply/local-applications/**).**	Checked
I have uploaded all supplementary documents if I have any.	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.

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).