

Applicant: **Gore, Shannon**
Organisation: **Association of Reef Keepers**
Funding Sought: 

DPLR3\1077

The PAC Crisis in the BVI

Recent decades have witnessed the continuing loss of BVI coral reefs, following extreme climate events, increasing macroalgal blooms and the devastation wrought by Stony Coral Tissue Loss Disease. A novel phenomenon has now appeared which threatens to accelerate the decline of the remaining corals – an aggressive peyssonnelioid algal crust (PAC). We will investigate the potential for mitigation of this threat using a natural predator of PAC, the black sea urchin *Diadema antillarum*.

CONTACT DETAILS

Title Dr
Name Shannon
Surname Gore
Website (Work) [REDACTED]
Tel (Work) [REDACTED]
Email (Work) [REDACTED]
Address [REDACTED]

CONTACT DETAILS

Title Dr
Name Bryan
Surname Wilson
Website (Work) [REDACTED]
Tel (Fax) [REDACTED]
Email (Work) [REDACTED]
Address [REDACTED]

DPLR3\1077

The PAC Crisis in the BVI

Section 1 - Project Title & Contact Details

Q1. Project Title

The PAC Crisis in the BVI

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

Organisation

CONTACT DETAILS

Title	Dr
Name	Shannon
Surname	Gore
Website (Work)	[REDACTED]
Tel (Work)	[REDACTED]
Email (Work)	[REDACTED]
Address	[REDACTED]

CONTACT DETAILS

Title Dr
Name Bryan
Surname Wilson
Website (Work) [REDACTED]
Tel (Fax) [REDACTED]
Email (Work) [REDACTED]
Address [REDACTED]
 [REDACTED]
 [REDACTED]

GMS ORGANISATION

Type	Organisation
Name	Association of Reef Keepers
Phone (Work)	[REDACTED]
Email (Work)	[REDACTED]
Website	[REDACTED]
Address	[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.

British Virgin Islands (BVI)

*** 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:

Anguilla, Bermuda, Cayman Islands, Montserrat, Turks and Caicos Islands.

As these UKOTs are all either in the Caribbean or Western Atlantic, there is every likelihood that their reefs will be under threat from the spread of PAC, and therefore the knowledge gained during this project will directly benefit reef management agencies in these Territories.

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): Bryan Wilson

Lead Partner name (if applying as an organisation; Guidance section 3.1): Association of Reef Keepers

Lead Partner Website (if applicable): www.bviark.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: University of Oxford (UO), UK – Bryan Wilson
Commercial Dive Services (CDS), BVI – Chris Juredin
Beyond The Reef (BTR), BVI – Kendyl Berna

ARK: Shannon Gore (SG) is Managing Director of ARK and has been a marine biologist in the BVI for >20 years, and delivered two recent Darwin Plus Main projects in the BVI (DPLUS111 and DPLUS152). SG will administer the project in the BVI and assist BW with all SCUBA fieldwork.

UO: Bryan Wilson (BW) has been researching PAC in the USVI for seven years, with a number of publications in the field; he will coordinate project partners and facilitate project to completion. BW will also lead fieldwork and perform genomic analyses. BW successfully led and completed a recent Darwin Plus Local project (DPLR2_1028) in BIOT.





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

CDS: Chris Juredin (CJ) has >20 years' commercial diving experience in the Caribbean, running Commercial Dive Services in the BVI; CJ will provide his unparalleled experience of diving in the BVI, along with provision of diving boats and SCUBA equipment for fieldwork and oversee construction of grazing cages.

BTR: Kendyl Berna (KB) is Founder of BTR and works in close collaboration with CDS to promote ocean conservation and engage in reef monitoring in the BVI, and will assist with all SCUBA fieldwork, and create media content for science communication outreach.

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](#)
 29/11/2023
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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.

Recent decades have witnessed the continuing loss of BVI coral reefs, following extreme climate events, increasing macroalgal blooms and the devastation wrought by Stony Coral Tissue Loss Disease. A novel phenomenon has now appeared which threatens to accelerate the decline of the remaining corals – an aggressive peyssonnelioid algal crust (PAC). We will investigate the potential for mitigation of this threat using a natural predator of PAC, the black sea urchin *Diadema antillarum*.

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?

Caribbean reefs have been decimated by anthropogenic climate change (1), with extreme warming events (2) and increasingly frequent hurricanes (3) having led to mass bleaching and destruction of corals, respectively. More recently, the rapid and wide-ranging spread of Stony Coral Tissue Loss Disease (4) and macroalgal blooms (5) have further impacted already-diminished reef habitats.

The appearance of spatially-aggressive peyssonnelioid algal crusts (PAC) is a relatively novel phenomenon (6), their having historically existed at trivial abundances, but now commonly found on shallow coral reefs (< 3m depth), and 100% coverage at some sites (7). PAC overgrow live corals (6) (Fig. 1) and occupy vacant spaces on the reef after disturbances. More significantly, in a region already characterised by low rates of coral recruitment (8), PAC appear to repel coral larvae from settling (9), possibly due to their unique microbiome (10). PAC are also seemingly unaffected by ocean acidification (11), suggesting that they may dominate future reefscales in more

acidic oceanic waters.

It is thought that PAC, rarely grazed by herbivorous fish, are likely only significantly predated by the black sea urchin *Diadema antillarum*, after reports of grazed patches (12) in algal outgrowths. Additionally, a recent study suggested that halos in PAC around *Diadema* aggregates (Fig. 2) may also function as refuges for coral recruitment (7). However, as *Diadema* are undergoing a second mass die-off in the Caribbean (13) after briefly recovering from the initial collapse in the 1980s (14), it is unlikely that urchin populations at their current levels will create sufficient PAC-free patches for coral larvae to settle in and promote reef development. Additionally, extensive coral bleaching is already underway in the Caribbean (e.g. in St. John; P. J. Edmunds, personal communication) and will likely worsen with the upcoming El Niño, which will open up even greater opportunities for PAC to spread.

Based on this evidence, this proposal has been developed in response to the ongoing decline of coral reefs in the region, and more specifically, to the increase in cover and distribution of PAC (highlighted by our recent article [15]); unheeded, PAC will likely become the dominant organism on Caribbean reefs, replacing stony corals, and leading to a regional collapse in the ecosystem services (such as tourism, fishing, and coastal protection) which these reefs have historically provided. Preliminary surveys (by ARK and UO in July 2023) of a number of BVI reef sites (N=5) showed that PAC was present at every site, with benthic coverage up to 45% (B. Wilson, unpublished).

Our established team of researchers and local stakeholders offer the requisite scientific expertise (UO, ARK), and logistical support and robust local knowledge (CDS and BTR) to carry out a preliminary study for the long-term mitigation of the PAC threat, using the BVI as a proxy for the wider Caribbean region. We shall survey PAC and *Diadema* at reef sites around all of the major inhabited islands (Tortola, Virgin Gorda, Anegada and Jost Van Dyke). Cages (1m³; N=10) will be placed at sites with significant PAC benthic cover, and PAC grazing halos assessed over 14d in cages (N=5) each containing three collected *Diadema*, or cages (N=5) without urchins. Several *Diadema* (N=5) from cages will be euthanised and gut contents removed to confirm PAC grazing (using molecular diagnostic tools at UO). Monthly surveys of cages will record coral larval recruitment success. The ultimate outcome of this proposal will be proof of concept that aggregations of *Diadema* can have a significant grazing pressure on PAC and create potential refuges for coral recruits.


This project addresses all four Darwin Plus themes (Biodiversity, Climate change, Environmental quality, Capability and capacity building).


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?


This project is a preliminary study for a longer-term crisis management response to mitigate the spread of PAC – and the continuing loss of coral reefs - in the Caribbean. During the project, requisite infrastructure and skills will be developed to ensure that outcomes maybe sustained indefinitely by local stakeholders after the funding is finished; workshops on benthic surveys and using AI tools (for monitoring the spread of PAC), with training in sampling and molecular analyses will extend existing partner skillsets. With this knowledge, local stakeholders will continue to monitor PAC and *Diadema* populations over the twelve-months of the project, as well as assessing recruitment of coral larvae at cage sites. Partners will develop further funding proposals to support the full plan, e.g., Darwin Plus Main. KB will create media content to promote the project both locally and internationally, and project knowledge will be transferred to BVI Government and National Parks to assist their management of the Territory. Ultimately, the major change that we expect is successful proof-of-concept of biocontrol of PAC by *Diadema*. Should we be successful, the cutting-edge techniques trialled during this work could then also be shared with regional management agencies in the Caribbean.


(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:


 [References](#)


 29/11/2023


 22:55:34

 pdf 41.74 KB

 [Figures](#)

 29/11/2023

 22:46:26

 pdf 447.46 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 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 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;**

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 aligns primarily with themes of Biodiversity, Climate Change and Environmental Quality, by way of mitigating the spread of PAC - whose impact leads to a reduction in the diversity of coral-dominated reefs and which has been exacerbated by climate change; climate change has not only led to loss of corals but also to the freeing of vacant space on the benthos, which is then occupied by PAC. Training of local stakeholders in state-of-the-art reef monitoring techniques will enhance capacity for management of these habitats in the Territory.





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: [Darwin Plus website](#)) 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 2024 and be completed by 31 March 2025.

Start date:	End date:	Duration (e.g. 3 months):
01 April 2024	31 March 2025	12 months

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

-  [Workplan](#)
-  29/11/2023
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-  pdf 97.04 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?

Yes

How much matched funding are you seeking and where from?

Boat and crew hire, and all costs associated with ten days' SCUBA diving will be matched by funding from CDS (£19689)

Vehicle rental costs will be matched by ARK (£1775)

Budget line	Explanation	Cost in GBP
Staff costs:	NA	£0.00
Consultancy costs:	Production of media content for promotion of research and science communication outreach by KB (BYR)	██████████
Overhead costs:	ARK Overhead costs charged at 15% FEC ██████████	██████████

	Costs for Project Leader BW to travel to BVI for one month:	
	1 x Return KLM Flight Norwich-JFK (████████)	
	1 x Return Delta Flight JFK-STT (████████)	
	1 x Return KLM XS Baggage (████████)	
	1 x Return Delta XS Baggage (████████)	
	1 x Norwich Airport Development Fee (████████)	
Travel & subsistence costs:	1 x Return NYC AirTrain (████████)	████████
	1 x Return Ferry UVI-BVI (████████)	
	1 x Return Taxi STT-Cruz Bay (████████)	
	2 x Hotel one-night at JFK (████████)	
	1 x month's Accommodation BVI (████████)	
	1 x month's subsistence (██████/day) BVI (████████)	
	1 x BVI Entry Visa (██████)	
	1 x BVI Departure Visa (██████)	
Operating costs:	1 x HSE Diving Medical for BW (████████)	
	1 x DAN Insurance for BW (████████)	████████
	2 x Diving Kit Service (for BW and SG) (████████)	
	Fuel costs for ARK vehicle transportation (████████)	
Capital equipment:	Mesh cages for urchin caging experiments (████████)	████████
Other Costs	NA	£0.00
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)

NA

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

Direct and indirect costs (FEC) of ARK activities are charged at 15%.

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

As the British Virgin Islands are a high-end tourist resort location, accommodation and subsistence costs for BW within the region are therefore unavoidably high. However, we have scheduled his fieldwork to coincide with the off-peak season in the Caribbean (July) to reduce these costs as best we can.

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

NA

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

Whilst purchase of mesh cages used in commercial aquaria (N=10) for caging experiments would be > ██████████, CDS have stated that their construction costs for cages would be significantly less, at ██████████

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

In addition to her role assisting with SCUBA and fieldwork, KB is a documentary filmmaker, who will be employed on a consultancy basis, to also create high-production level media content to promote the project, and the threat of PAC to local and regional reefs.

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

NA

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:
<i>No Response</i>	<i>No Response</i>	<i>No Response</i>	<i>No Response</i>

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? 83

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.

- 1) Research in the BVI contributes to the UK's obligations to the Convention Of Biological Diversity (CBD),
- 2) This project addresses targets defined by Sustainable Development Goal 14 (Life Below Water), in particular Targets 14.2 (Protect and restore ecosystems) and 14.8 (Increase scientific knowledge, research and technology for ocean health).
- 3) The project aligns with DEFRA's "25 Year Environment Plan", specifically under "Thriving Plants and Wildlife", by "reversing the loss of marine biodiversity and, where practicable, restoring it"

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.

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
Scarcity of Diadema populations. Diadema are currently undergoing a disease epidemic in the Caribbean and there is a chance that wild populations might be increasingly difficult to find and sample.	Several project partners (ARK, CDS and BYR; SG, CJ and KB, respectively) have identified key sites in the BVI during SCUBA dives where Diadema populations are numerous and healthy.
<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: [Darwin Plus website](#) 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: [Darwin Plus website](#)).
- 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: Shannon Gore

Position in the organisation: (if applicable) Managing Director

Signature (please upload e-signature)

-  [Shannon blue Ink](#)
-  29/11/2023
-  23:03:50
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Date: 29 November 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
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).

