Darwin Plus: Final Report

To be completed with reference to the "Project Reporting Information Note":
(https://darwinplus.org.uk/resources/information-notes/).

It is expected that this report will be a **maximum of 20 pages** in length, excluding annexes.

Submission Deadline: no later than 3 months after agreed end date.

Submit to: BCF-Reports@niras.com including your project ref in the subject line.

Darwin Plus Project Information

Project reference	DPLUS113
Project title	CRACAB: Climate Resilience and Conservation of Ascension's Biodiversity
Territory(ies)	Ascension Island
Lead Partner	Ascension Island Government Conservation & Fisheries Directorate (AIGCFD)
Project partner(s)	University of Exeter French Institute for Agricultural Research (INRA)
Darwin Plus Grant value	£261,894
Start/end date of project	1st September 2020 – 31st March 2023
Project Leader name	Dr Diane Baum
Project website/Twitter/blog etc.	www.ascension-climate.org
Report author(s) and date	Sam Weber, Phil Lambdon & Diane Baum (June 2023)

1 Project Summary

The Earth's climate is changing at an unprecedented rate, threatening biodiversity and human well-being alike. Small oceanic islands are predicted to be highly vulnerable to climate change because of their size, isolation and relatively simple ecosystems. However, those same attributes also make small islands ideal microcosms in which to understand and manage its effects.

On Ascension Island, climate change is regarded as one of the principal threats to biodiversity, cutting across marine and terrestrial ecosystems. All but one of the 16 Species and Habitat Actions Plans prepared for the Island's Biodiversity Action Plan recognise climate change as a substantial threat; it is listed the Marine Protected Area (MPA) Management Plan as one of the few impacts that will continue to affect Ascension's marine environment following the designation of a large-scale MPA in September 2019; and it is identified as posing a significant risk of extinction in the island's Endemic Plant Restoration Plan. Yet, the likely impacts are rarely quantified.

Climate change is not an existential threat but a real and current problem facing Ascension's biodiversity, and managers need to treat it with the same impact assessment approach as other pressures. This project aimed to enable such a paradigm shift by providing outputs that allow quantitative measures of risk and impact that can be incorporated into Ascension's strategies and management plans, as well as exploring adaptation strategies to mitigate the most serious threats. This locally-specific information is vital to capture the attention of policy makers and galvanise action both on-island and globally. The adaptations trialled during the project will provide direct benefit to the species and ecosystems concerned and also benefit the AIGCFD staff and volunteers involved as they are able to take positive action to address climate change.

2 Project Partnerships

The project is led by the Ascension Island Government Conservation & Fisheries Directorate (AIGCFD) and was developed in response to priorities identified in conservation plans and strategies contributed to by numerous subject specialists over the past decade. The Project partnership built on a long-term collaboration between AIGCFD and the University of Exeter (UoE) and this relationship has continued to be productive over the duration of the project. In addition to leading research outputs on marine turtles, the UoE has provided project management support (including drafting of reports, change requests etc. and the maintenance of Project website). The original UoE Project Manager (Dr Weber) moved to a new permanent job role in Y2 of the project, but continued to provide in-kind supervisory and line-management support thereafter, meeting with the Project Leader on an approximately monthly basis to coordinate project activities. This report has been co-authored by teams from both AIG and UoE. The project has also developed a new collaboration with the French Institute for Agricultural Research (INRA) to support research on drought impacts affecting endemic plants. Unfortunately, the COVID-19 pandemic and ongoing repairs to the island's runway has continued to frustrate planned visits by INRA to Ascension Island during the lifetime of the project. Nevertheless, AIG has worked closely with the INRA team to develop contingency plans to ensure that at least some of the planned work can proceed in future (see Activity 2.1). In addition to formal partners, the project has also engaged with several external specialist contractors and collaborators to ensure that the climate change projections produced are robust and based on current international best practice. This includes the University of East Anglia's Climate Research Unit who led climate projections (Annexes 6 and 7), Plymouth Marine Laboratory, who led oceanographic projections (Annex 8), and researchers from Florida State University (Dr Mariana Fuentes) and IFREMER (Dr Jonathan Monsinjon) who assisted with model development for the marine turtle impact assessment (Annex 9). The Ascension Island community have been kept informed of the project through a public meeting, updates in the local press and via social media and the project website. The presence of structures associated with the beach shade trials and assisted migration sites elicited interest from members of the community and demonstrated in very tangible way the management actions necessary to aid climate change adaptation.

3 Project Achievements

3.1 Outputs

Output 1. *Ascension-specific predictions of future climate and ocean conditions produced and published.*

This output has been largely achieved as planned. A comprehensive climatic baseline for Ascension Island has now been published in the peer reviewed literature, incorporating more than 100 years of temperature and rainfall data (**Annex 6**). This observational series has been used to update the University of East Anglia's *ClimGen* climate projection tool and generate long-term projections of temperature and precipitation for Ascension Island under a range of emission scenarios (**Annex 7**). A comprehensive marine climate change assessment for the Ascension Island EEZ has also been completed, incorporating long-term projections for nine key ocean biophysical variables and a detailed analysis of the evolution of the Equatorial Atlantic Undercurrent, which plays a key role in driving the regional oceanography (**Annex 8**). A manuscript describing the results and their implications for ecosystem service provision in the Ascension Island Marine Protected Area has been submitted to the Journal of Geophysical Research (Biogeosciences) and is currently in revision following the first round of reviews (**Annex 8**).

Output 2. *Quantitative relationships between key habitats/species and climate variables established to allow greater detail on predicted impact of climate change on biodiversity.*

One of the principal goals of this output was to try and predict how climate change projections from Output 1 will affect Ascension Island's globally important green turtle nesting population (**Output 2.1**). This work benefitted from new collaborations with IFREMER and Florida State University which allowed us to replicate state-of-the-art modelling approaches described in Monsinjon et al. 2019. As a result, we now have detailed projections of how offspring sex ratio and hatching success are expected to change at

Ascension Island during the 21st century under a range of emissions scenarios (**Annex 9**), substantially exceeding our original indicator for this output.

Significant progress has also been made in predicting how sea level rise will affect future availability of marine turtle nesting habitat (**Outputs 2.2 & 2.3**). High resolution digital elevation models have now been generated for all of Ascension's main green turtle nesting beaches and a detailed analysis undertaken to predict future habitat loss at the Island's principal nesting site (Long Beach) by applying some widely used models of shoreline response to sea level rise (**Annex 10**). Results show up to 30% of current nesting area may be lost due to coastal retreat and a further 60% exposed to more frequent wave wash-over. However, our analysis also highlighted several important limitations with the models used in the previous studies that we replicated. In particular, none of the models account for landward beach migration which may mitigate many of the losses due to sea level rise (see **Annex 10** for details). While alternative models are available that explicitly account for this landward shift, they are more complex and require additional data inputs that are not currently available for Ascension Island. Rather than presenting policy makers with potentially misleading or inaccurate projections, we have therefore treated this analysis as a valuable scoping exercise and recommended a detailed set of priorities for further work (**Annex 10**).

The second focal taxa for this output was the critically-endangered Ascension Island spurge (*Euphorbia origanoides*), which occurs in arid coastal areas and may be increasingly impacted by drought-induced water stress as result of climate change. Following 2 years of continuous soil moisture monitoring, we now have a detailed understanding of the hydrological constraints on the survival of *E. origanoides*, which was lacking prior to the project (see **Annex 5.1** and Project Website). For example, this work has shown how strong groundwater pulses linked to rare, heavy rainfall events can cause significant replenishment of subsoil moisture reserves following extended periods of drought and are likely to be key to the survival of deep-rooted spurge (**Annex 5.1**). The detailed relationship between soil moisture and precipitation is an essential part of predicting responses of *Euphorbia origanoides* to future climate change. However, we have still yet to acquire the plant physiological data that will enable the final model to be developed. A planned research visit by partners at INRA to complete the necessary experimental work was repeatedly delayed, first by the COVID pandemic and subsequently by access issues and infrequent flights during repairs to Ascension's runway. Several alternatives were explored, including sending live plants to INRA laboratories in France, but these proved logistically and administratively unfeasible. AIG are now working with Brest Botanic Gardens to establish an *ex-situ* seed-grown stock in France which can be used for this study. While there is a good chance of completing this work after the end of the project, at present it has not been possible to produce a research paper as planned.

The final component of this output was to assess how current climate variability affects the reproductive success of the endemic Ascension Island frigatebird (*Fregata aquila*), and hence how projected oceanographic change from Output 1.3 might impact on an important marine indicator species. Using available nesting data from 2015–2020, we were able to show that breeding phenology in *F. aquila* is timed to coincide with a peak in food availability that follows an upwelling-induced pulse in primary production over the equator in the austral winter (see report on Project website). Years in which this peak was smaller or failed to coincide well with nesting tended to result in significantly reduced fledging success, which is significant given projected reductions in primary reduction in the Ascension MPA through climate change (Annex 8). While these findings are strongly suggestive of environmental coupling of breeding success in frigatebird, the relatively short timeseries and small numbers of years with high failure rates did not permit robust statistical tests. Consequently, more work is needed before this analysis is publishable. Monitoring of frigatebird breeding success is a core activity for AIGCFD so it will be straightforward to update the models developed here as new data becomes available.

Output 3. *Evidence-based adaptation actions trialled and those demonstrated to be successful are implemented through core AIGCFD workplans.*

Having developed local climate change projections and biodiversity impact assessments in Outputs 1 and 2, this output sought to trial a range of adaptation actions aimed at mitigating impacts on vulnerable species and habitats. Again, sea turtles and endemic plants were the main focal taxa considered. An experimental trial of artificial nest shading was carried out on two of the Island's main nesting beaches (**Output 3.1**) to assess its efficacy in reducing projected changes in hatching success and sex ratio (**Annex**

12). The study found that shading was capable of reducing nest temperatures by up to 1.2 ^{o}C, which resulted in improved hatching success and less female-biased sex ratios on some beaches, depending on their natural thermal regime (see **Annex 12** for details). However, scalability and issues associated with translocation into shaded hatcheries were identified as potential barriers. The results of this work have been submitted to the Wildlife Society Bulletin for publication (**Annex 12**). In addition to mitigating impacts of rising nest temperatures, this Output also sought to identify opportunities for mitigating habitat losses associated with sea level rise through proactive coastal planning policies (**Output 3.2**). However, as detailed in Output 2, while we were able to predict shoreline retreat in response to future sea level rise (Annex), the available modelling approaches did not permit for a robust assessment of landward beach migration, which is crucial for informing coastal planning. As such, this output remains a longer-term objective. A plan has been developed to collect the additional data needed to parameterise more complex shoreline evolution models (**Annex 10**).

The second component of this output sought to mitigate the effects of drought and water stress on endemic flora through trials of artificial shading and irrigation systems (**Output 3.1**), and assisted migration into climatically suitable niches (**Output 3.3**). Monitoring of soil moisture profiles informed an early decision to abandon artificial shading as an unsustainable and ineffective approach for conserving arid-zone flora such as the endemic Ascension Island spurge, allowing us to focus more time and project resource on more promising alternatives. In contrast, assisted migration of Ascension spurge into climate refugia has shown considerable promise as a climate change adaptation strategy (**Output 3.3**). Despite a few initial technical problems, we now have healthy Ascension spurge populations growing at three novel locations over a 17-month period (**Annex 5.4**). At the last rainy season, only one of these sites had been established for long enough for the plants to flower, seed and lay down sufficient seedbank for any progress in establishing self-sustaining population to be measured. Over 1200 seedlings were recorded at this site during the post-rain flush, which is comparable with densities wild sites where seed banks have built up over many years. In wild situations, mortality usually reduces numbers by 90-99% within weeks, and a comparable pattern was observed in the restoration. However, unlike previous rehabilitation attempts, a significant number of the wild-germinating population has survived to maturity and is now flowering and seeding (**Annex 5.5**). In the most recent survey, 98 wild-sown mature plants present and 96 'seedlings' were present. This study represents a rare test of assisted migration as a climate change mitigation strategy and demonstrates that it is a feasible conservation approach for *E. origanoides*.

Fog-harvesting passive irrigation systems have also yielded some encouraging results in rehabilitating drought-affected montane plant communities (**Annex 5.2**). Following some early design issues, the systems have been operating at 4 sites over a 12-month period and have harvested sufficient fog to keep them running continuously. Six-monthly monitoring of irrigated sites has revealed a 30% increase in bryophyte cover compared to un-irrigated control sites, including a 900% increase in lichen cover and a 600% increase in the abundance of species adjudged to be indicators of hyper-humid niches (**Annex 5.3**). The value of irrigation for rehabilitation is difficult to measure over a short timeframe because many species are slow growing. However, preliminary results offer hope that by creating moist conditions we can accelerate the recolonization of bryophytes and enhance the successional process that allows more diverse communities to develop. A final report from this output has not yet been produced because the benefits are not expected to be fully apparent for 1-2 more years. There are still lessons to be learned, and a better-informed report will be possible at a later stage. Passive irrigation trials established through CRACAB will be expanded and monitored over the next two years as part of a new Darwin-funded project (DPLUS159) seeking to develop better approaches for managing Ascension's upland endemic plants.

Passive irrigation of endemic plants and the maintenance and monitoring of assisted migration sites has been incorporated into AIGCFD workplans and the Green Mountain National Park Management Plan (pp. 29 & 36) which will ensure the continuity of the work (**Output 3.4**). While not deemed necessary or practical for large scale adoption, the potential future use of artificial turtle nest shading has also incorporated into the Beach Nature Reserves Management Plan (pp. 35 & 40).

Output 4. *Results of project and knowledge gained are widely shared to galvanise action on Ascension and encourage similar projects on other OTs and small islands.*

Throughout the project, efforts have been made to share key findings with the local community and with conservation scientists and practitioners working elsewhere. A website (**https://ascension-climate.org/**) was produced during Year 1 of the project and periodically populated with blogs and other content describing project activities (**Output 4.1**). A public meeting was held in Y2 of the project and attended by 40 Ascension residents to discuss climate change implications for Ascension explain project goals (**Output 4.2**). We had originally intended to produce a set of animated films of future scenarios as visual tools for stakeholder engagement. However, this did not take place, partly because some of the more visual elements of the work (e.g. sea level rise scenarios) require further refinement and partly because of a lack of clear responsibility for dissemination activities after the UoE project manager changed job roles in Y2. Although a replacement was appointed to deliver specific research aspects of the work (e.g. **Output 2.1**), they did not have the familiarity with project as a whole to fulfil wider project management functions. While the project may have failed to meet some of its dissemination targets, it has exceeded in other areas. For example, in the publication of findings in the peer reviewed literature. To date, one peer reviewed paper has been published (**Annex 6**), two are in the review or revision stage (**Annexes 8 and 12**) and a further one is awaiting submission (**Annex 9**).

3.2 Outcome

The project has broadly achieved its intended outcome of informing Ascension's response to climate change, reframing it from a nebulous threat to a local pressure with real impacts and solutions. We have completed the first long-term climate change projections for Ascension's marine and terrestrial environments (**Annex 6** & 7) both of which are essential for preparing evidence-based impact assessments. Using these projections, we have forecast likely impacts on sea turtles and nesting seabirds (Annexes 3 and 4), and trialled adaptation actions for mitigating some of these impacts on turtles and endemic flora (Annex 5 & 6), several of which have been adopted by AIGCFD on a longer-term basis (fulfilling **Outcome 0.2**). Local climate predictions have been incorporated into threat assessments in five different AIG management plans (see Section 3.1 and Annex 1 for links), and associated adaptation actions and monitoring protocols addressing the threat of climate change have been included in four of these (fulfilling **Outcome 0.1**), ensuring that progress made during the project is integrated into core AIG work plans.

The project cannot yet provide evidence of embedding climate change adaptation in higher level decision making on Ascension Island (**Outcome 0.3**). However, this indicator was based heavily on outputs of sea level rise (SLR) modelling and its implications for coastal land use (**Output 2.3**), as other management responses are not sufficiently controversial to warrant higher level political input. As described in Section 3.1 and Annex 10, while some predictions of green turtle habitat loss due to SLR have been made, we are not satisfied that the simple models used in the studies that we replicated are able to capture the complexities of shoreline retreat. It is important to stress that this represents a limitation in the field, rather than the current project, in which models of SLR impacts on sea turtles have not kept pace with a rapidly evolving literature on coastal geomorphology. There was not sufficient time, budget, or expertise to address these limitations in the lifetime of the project; however, a plan has been put in place to rectify this (Annex 10) and we are optimistic that indicator 0.3 will ultimately be achieved.

3.3 Monitoring of assumptions

Assumption 1: There is sufficient existing and available data to input into models.

This assumption has broadly held, with the exception of Outputs 1.2 (mapping of climatic zones) and 2.3 (modelling sea level rise impacts on marine turtle nesting habitats). As detailed in Section 3.1, the spatial coverage of available meteorological data for Ascension Island has proven to be too limited to comprehensively map fine-scale climatic variation. Alternative approaches were considered, including the creation of altitude-specific climate change projections using data from the few mid- and high-

altitude meteorological stations that temporally overlap with the lowland series. However, the coarse resolution of the Global Circulation Models used to produce climate change projections is unable to resolve elevational variation on Ascension Island (which is not recognised as land). With respect to Output 2.3, data availability was sufficient to run the models that we had originally planned (based on previous sea turtle studies), however these proved inadequate to capture the complexities of shoreline responses to sea level change. More sophisticated models were identified, but there was neither time nor budget to gather the additional data needed to parametrise these. Thus, while a preliminary report of findings has been submitted to AIG, we have plans to refine this before making specific policy recommendations.

Assumption 2: Observed relationships between climate variables and biological indicators are sufficiently robust to allow meaningful predictions

Comments: In the case of green turtles, the modelled relationship between temperature, sex ratio and hatching success proved robust and suitable for generating long-term predictions (**Annex 9**). For seabirds, relationships between fledging success and oceanographic conditions are less robust due to the relatively small number of years with sufficient monitoring data (5 years) combined with a comparatively noisy environmental signal (see report). A data audit at the planning stage indicated that 8-9 years of data would be available; however, earlier years in the time series (shortly after frigatebird recolonisation of the Ascension mainland) contained too few monitored nests to generate statistically robust estimates of annual fledging success. This output was always intended to be a scoping analysis and the findings are sufficiently interesting for this work to be continued in future as more monitoring data becomes available. In the case of endemic plants, while relationships between precipitation and soil moisture have proven robust (Annex 5.1), the unavoidable cancellation of a planned field visit by partners at INRA meant that the plant physiological data needed to generate predictions of water stress impacts on endemic flora could not be collected. As reported in sections 3.1 and 3.2, this assumption was monitored continuously and several contingency plans were explored but none of these proved practical within the lifetime of the project.

Assumption 3. At least some potential adaptation actions are shown to be effective and deliverable within available resources

Comments: This assumption held. All of the adaptation actions trialled proved to be deliverable and have demonstrated some success in mitigating predicted impacts of climate change (Section 3.1; Annexes 5 & 12).

Assumption 4. Outputs from the models and adaptation trials are sufficiently robust to warrant public interest

Comments: This assumption has broadly held. Participation in a public climate change meeting held in Y2 (40 people) was above average for Ascension Island, demonstrating that there is local interest in learning more about this global issue. The very visible presence of shade structures on the beach and passive irrigation systems on the mountain and at assisted migration sites also led to informal engagement between members of the public and AIGCFD staff. This provided an opportunity to discuss the threat climate change poses to Ascension's biodiversity and the positive interventions AIGCFD are taking through DPLUS113 to address it.

4 Contribution to Darwin Plus Programme Objectives

4.1 Project support to environmental and/or climate outcomes in the UKOTs

Climate change will have a profound impact on all aspects of Ascension's biodiversity and it is identified as the highest priority for Ascension's Conservation Department, cutting across both marine and terrestrial ecosystems. It is recognised as a major threat in all but one of the 16 Species and Habitat Actions Plans prepared for the island's priority species through Darwin grant 19026; listed in the MPA Management Plan produced by DPLUS063 as one of the few impacts that would continue to affect our seas once the MPA is designated; and is identified as posing a significant risk of extinction in the island's

Endemic Plant Restoration Plan. Until now, however, the threat has been framed in vague terms, with no Ascension-specific impact assessments or adaptation strategies.

While the project cannot yet claim to have fully embedded climate change adaptation into local policy and decision-making, demonstrable progress has been made. Through the work undertaken, Ascension Government now has access to robust, local projections of future changes in marine and terrestrial climate based on state-of-the-art global circulation models (Annexes 6-8), and we have already demonstrated how these can be applied to produce specific climate impact assessments for some of Ascension's most vulnerable species and habitats (Annexes 8-11) Crucially, rather than simply forecasting impact, the project has also sought to trial low-cost mitigation measures that may be practical in a small island setting (Annexes 5 & 12; Section 3.1), helping to meet the UK Government's obligations under the UNFCCC to cooperate in preparing for adaptation to the impacts of climate change. Knowledge and experience gained through the project have been used to update 5 different Ascension Island Government species and habitat management plans (Section 3.1 and Annex 1 for links), ensuring local continuity and lasting impact. Many of the key results are also either published or in the peer-review process (Annexes 6, 8, 9 & 12), ensuring that evidence and best practice is shared with the wider conservation community. Collectively, these actions leave Ascension Island better placed to anticipate the major consequences of climate change and implement adaptation measures to lessen its effect on protected habitats and species.

All of these outputs make important contributions to the Darwin Plus programme's dual objectives of conserving biodiversity and responding to climate change, in particular DPLUS standard indicators A03 & A07 (Government Departments with improved capability and understanding of biodiversity), B01 & B02 (species and habitat management plans improved), and C17 to C19 (peer-reviewed papers and technical reports published or submitted; see Annex 3 for details).

4.2 Gender equality and social inclusion

Climate change will affect everyone living on Ascension and so the problem is shared by all genders. While the project did not specifically raise or address any gender equality issues, it is notable that the current make-up of the AIGCFD is 77% female, including all senior management, meaning that the project has seen women taking a leading role in finding solutions. This is an important step on an island where two thirds of the population and a high proportion of senior managers are male.

Please quantify the proportion of women on the Project Board[1].	**50%**
Please quantify the proportion of project partners that are led by women, or which have a senior leadership team consisting of at least 50% women[2].	**100%**

5 Monitoring and evaluation

Internal M&E was the joint responsibility of the Project Leader (Diane Baum) and UoE Project Manager (Sam Weber), and was coordinated through quarterly meetings to monitor progress against logframe indicators, identify risks and adapt accordingly. The COVID-19 pandemic and the suspension of direct international flights to Ascension Island from the UK continued to disrupt planned fieldwork by overseas

[1] A Project Board has overall authority for the project, is accountable for its success or failure, and supports the senior project manager to successfully deliver the project.

[2] Partners that have formal governance role in the project, and a formal relationship with the project that may involve staff costs and/or budget management responsibilities.

partners and required continuous monitoring and adaptation. For some outputs (e.g. turtle nest shading experiments; Output 3.1), solutions were found that made use of a combination of on-island staff and remote analytical support, whereas for others (e.g. plant physiological studies; Output 2.1) no practical alternatives could be identified, despite considerable effort (see Section 3.1).

Several minor modifications to the project logframe were made as result of ongoing M&E. For example, continuous evaluation of soil moisture monitoring data collected as part of Activity 2.1 informed an early decision to abandon artificial shading of endemic plant populations as a climate change mitigation measure (Output 3.1) and invest more effort and project resource into assisted migration trials that stand a greater chance of success (Output 3.3). However, while the internal M&E process was generally quite nimble in responding to such challenges in the early stages of the project, the move the UoE Project Manager to a new permanent job role during Y2 inevitably impacted its responsiveness. For example, the assessment of sea level rise impacts on green turtle nesting habitats (Output 3.2) highlighted several deficiencies in available modelling approaches, but these analyses took place too late in the project for alternative solutions to be found. Reduced M&E coordination between UoE and AIG in the latter stages of the project are partly responsible for a failure to fully deliver this output and the associated Outcome-level indicator (Outcome 0.3). In practice, this was a difficult change to overcome. Although a replacement for the UoE Project Manager was appointed to undertake some of the analytical aspects of the role, they lacked the over-arching knowledge of Ascension Island and the project to assume all project management responsibilities. This left a gap in the project M&E structure which was difficult to fill. Despite this, the project was able to achieve most of its planned outputs, and a roadmap has been developed to work towards Outcome 0.3.

External M&E of project outputs has mainly come in the form of peer-review of manuscripts submitted to scientific journals. To date, one paper has been accepted for publication (Annex 6) and a second is in revision in response to constructive reviewer feedback (Annex 8). A third submitted paper is awaiting reviewer comments and a fourth is to be submitted shortly (Annexes 9 & 12), meaning further external evaluation of outputs will continue after the project concludes.

6 Actions taken in response to Annual Report reviews

Only one outstanding action point was raised at the last annual review, which was to present the revised Output 1.2. Our attempts to revise this output in response to limited data availability and our rationale for ultimately abandoning it are now fully explained in Section 3.3 and Annex 2 (logframe).

7 Lessons learnt

Many of the technical learnings from the project are described in detail in the annexed consultancy reports, submitted manuscripts and peer-reviewed publications and we do not attempt to summarise these again here. However, from an overall project management perspective, three important lessons can be summarised:

Firstly, the engagement of specialist consultants to deliver specific work packages has continued to be a productive model in a complex and rapidly evolving field. The consultants employed have worked efficiently to deliver Ascension-specific climate change forecasts on time and in accordance with the agreed terms of reference. In retrospect it would have been valuable to engage an additional consultant coastal geomorphologist to assist with sea level rise modelling, and we plan to pursue this in future.

Secondly, while the project has contributed a substantial amount of new knowledge, it is clear that the information presented in consultancy reports and publications is currently too complex for consumption by policy makers and the wider public on Ascension, which will limit their impact. We had originally planned to distil the key points from each work package into more accessible forms (e.g. infographics and animations) for dissemination locally; however the lack of clear responsibility for doing this after the UoE project manager moved to a new job role in Y2 meant that this did not happen. Ensuring that the results from the project are translated into more accessible forms remains a longer-term objective of AIGCFD.

Finally, adaptations to continuing COVID-related travel disruption in the early stages of the project have also helped to reinforce that, while site visits by overseas partners are desirable, considerable progress can nevertheless be achieved through remote collaborations. In the case of the marine turtle work, this has largely been possible thanks to the AIG Conservation Internship program, which has provided the local capacity needed to implement the work, combined with remote support from partners who already have extensive site knowledge. Future projects could look to capitalise further on remote collaborations between overseas technical experts – who possess specialist knowledge but are often time limited – and interns who are looking to gain career-relevant experience and are able to commit to longer periods of fieldwork.

8 Risk Management

No new risks were encountered during the reporting period.

9 Sustainability and Legacy

The legacy of the project has been secured in five main ways:

1. **Creation of new data assets held by Ascension Island Government**. Raw climate change projections for marine and terrestrial systems summarised in Annexes # and # are now held by AIGCFD and will enable Ascension-specific climate change impact assessments for a wide range of species and habitats as new data on environmental becomes available.
2. **Updated species and habitat management plans**. Local climate change predictions, threat assessments, monitoring protocols and adaptation actions produced by the CRACAB project have been incorporated into five different AIG species and habitat management plans. In most cases, updates involve a refocusing and rationalisation of existing management and monitoring effort rather than any additional burden, which will help to ensure long-term sustainability.
3. **Publication of findings in the peer-reviewed literature.** To date, three papers summarising project findings have either been published or submitted to peer-reviewed journals (Annexes 6, 8 & 12) and at least one more is pending submission (Annex 9). In most cases, associated raw datasets have also been made available in open-access online repositories. This will help to ensure that key project learnings and best practice are preserved in the scientific literature in perpetuity.
4. **Follow up projects that directly build on project outputs.** At least one follow-up project has already begun that extends passive irrigation trials initiated during the project (DPLUS159) and additional funding has been identified to resource more in-depth modelling of sea-level rise impacts on green turtle nesting habitats.
5. **Long-term partner collaborations.** Although UoE staff directly employed by the project will be re-assigned once funding ceases, this project extends a longstanding collaboration between AIGCFD and UoE on marine vertebrate research. The UoE supervisory team have given their time in kind to support project activities and will continue to do so after the project ends.

10 Darwin Plus Identity

Darwin Initiative funding was acknowledged in the recently-published paper in the International Journal of Climatology (https://rmets.onlinelibrary.wiley.com/doi/10.1002/joc.7314) and in papers submitted to the Journal of Geophysical Research (Annex 8) and Wildlife Society Bulletin (Annex 12). The Darwin logo also continues to be displayed prominently on the landing page of the project website (www.ascension-climate.org)

11 Safeguarding

No safeguarding issues or changes in the safeguarding policies of the lead and partner organisations have arisen in the past year of the project. All project team members have updated any mandatory safeguarding training as required by their employers.

Has your Safeguarding Policy been updated in the past 12 months?	No
Have any concerns been investigated in the past 12 months	No
Does your project have a Safeguarding focal point?	Diane Baum [redacted]
Has the focal point attended any formal training in the last 12 months?	No. Safeguarding training received in 2021/22. Training at a higher frequency than this is not possible in an Ascension context.
What proportion (and number) of project staff have received formal training on Safeguarding?	Past: 100% [3] Planned: 66% [2]
Has there been any lessons learnt or challenges on Safeguarding in the past 12 months? N/A	

12 Finance and administration

12.1 Project expenditure

Project spend (indicative) since last Annual Report	2022/23 Grant (£)	2022/23 Total actual Darwin Plus Costs (£)	Variance %	Comments (please explain significant variances)
Staff costs	[redacted]			
Consultancy costs				
Overhead Costs				
Travel and subsistence				
Operating Costs				
Capital items				
Others				
Audit costs				
TOTAL	**93,007**	**86,749**		

Staff employed (Name and position)	Cost (£)

[redacted]

12.2 Additional funds or in-kind contributions secured

[redacted]

[redacted]

12.3 Value for Money

The major costs involved in this project related to salary or consultancy costs and travel and subsistence, reflecting the need for external expertise and additional capacity to devise and initiate adaptation actions. Salaries were calculated on institutional pay scales commensurate with the level of experience required and are therefore in-line with local and national norms. A considerable amount of staff time (£84,695) has been provided in kind by project partners to deliver this project demonstrating the importance placed on this issue.

Travel and subsistence costs are high because the suspension of direct international flights from the UK to Ascension Island for the duration of the project necessitated long stays and multiple connecting flights. Most meetings between the partners have been conducted remotely, but we felt it was important that project staff have a knowledge of the island and that AIGCFD staff also have the opportunity to travel and disseminate the results of the project.

Annex 1 Project's full current logframe as presented in the application form (unless changes have been agreed)

Please insert your project's logframe (if your project has a logframe), including indicators, means of verification and assumptions. N.B. if your application's logframe is presented in a different format in your application, please transpose into the below template. Please feel free to contact BCF-Reports@niras.com if you have any questions regarding this.

Project summary	Measurable Indicators	Means of verification	Important Assumptions
Impact: A small island demonstrates leadership in tackling climate change by treating it as a current pressure and proactively introducing adaptation measures to protect the most vulnerable species and habitats.			
Outcome: Ascension's response to climate change is transformed through detailed, evidence-based predictions of impact that are used to galvanise action, prepare an adaptation response and focus monitoring effort.	0.1 By Q4 of Year 3 Ascension's Biodiversity Action Plan and protected area management plans will include the specific local threats of climate change, new monitoring protocols and proposed adaptation actions. 0.2 By Q2 of Year 2 Adaptation actions (including irrigation and shading) are initiated to reduce climate change impacts on priority species and habitats 0.3 By Q4 of Year 3 Results of project presented to the Ascension Island Council and Administrator to inform future policy on areas such as coastal land use.	0.1 Text of Biodiversity Strategy and protected areas management plans 0.2 Results of adaptation action trials 0.3 Minutes of Council meetings	It is possible to produce climate and oceanographic projections and receptor-response curves with sufficient levels of certainty to generate meaningful scenarios At least some potential adaptation actions are shown to be effective and deliverable within available resources
Outputs: **1.** Ascension-specific predictions of future climate and ocean conditions produced and published	1.1 By Q1 of Year 2 climate model for Ascension created capable of predicting temperature and rainfall changes with measured degree of certainty (Using methods developed by UEA in the Falklands through the EU Best funded TEFRA project) 1.2 By Q2 Year 2 Map of climatic zones on Ascension produced based on altitude, aspect and distance from sea 1.3 By Q2 of Year 2 Oceanographic model for Ascension EEZ produced	1.1 Climate model outputs made available on project website 1.2 Climate zone map made available on website 1.3 Oceanographic model outputs made available on project website	There is sufficient existing and available data to input into models

	predicting future changes in current and upwelling systems		
2. Quantitative relationships between key habitats/species and climate variables established to allow greater detail on predicted impact of climate change on biodiversity.	2.1 By Q2 of Year 3 Response curves relating temperature to green turtle sex ratios, and soil moisture content to stress levels in an endemic plant species (*Euphorbia origanoides*) produced from experimental data 2.2 By Q1 of Year 3 Digital terrain maps of turtle nesting beach produced 2.3 By Q2 of Year 3 Maps predicting future availability of turtle nesting habitat produced from swell height data collected adjacent to turtle nesting beaches combined with output 2. 2.4 By Q1 Year 2 Analysis of correlation between seabird productivity and ocean state variables completed and used to assess feasibility of using seabirds as indicators of ocean health.	2.1 Response curves published in peer-reviewed articles 2.2 Terrain models available on the project website 2.3 Maps of future turtle nesting habitat available on project website and published in peer-reviewed articles 2.4 Seabird productivity data and potential as indicators of ocean health published as a peer-reviewed article	Observed relationships between climate variables and biological indicators are sufficiently robust to allow meaningful predictions
3. Evidence-based adaptation actions trialled and those demonstrated to be successful are implemented through core AIGCFD workplans	3.1 By Q2 Year 3 Trials of turtle nest shading, endemic plant shading and fog-catching irrigation systems carried out 3.2 By Q3 Year 3 Digital terrain models of beaches presented to policy makers and planners to illustrate options for landward migration of beaches. 3.3 By Q2 Year 3 Identify sites on Ascension that have suitable climate conditions for *Euphorbia origanoides*. Transplant nursery grown stock to these areas and monitor success 3.4 By Q4 Year 3 Climate change adaptation measures shown to be successful are incorporated into AIGCFD management	3.1 Results of adaptation trials published in reports 3.2 Terrain models published on website and peer-reviewed article. Minutes of Council meetings. 3.3 Report and photographs of translocation programme 3.4 Reports and photographs of adaptation measures installed available on project website. Biodiversity Action Plan, MPA	At least some potential adaptation actions are shown to be effective and deliverable within available resources

	plans and implemented as part of core workplans.	Management Plan and Endemic Species Restoration Plan available on AIGCFD website	
4. Results of project and knowledge gained are widely shared to galvanise action on Ascension and encourage similar projects on other OTs and small islands	4.1 By Q4 Year 1 Create project website setting out scope of project and updated with project outputs 4.2 By Q4 Year 1 and Q4 Year 3 Hold public meetings on Ascension to initially outline the objectives of the project and later to showcase results of the project and illustrate climate scenarios for the island 4.3 By Q3 Year 3 Create animated films of future scenarios as visual tools for stakeholder engagement 4.4 By Q4 Year 3 Attend international conference to showcase how Ascension is addressing major threat to its biodiversity	4.1 Website available online 4.2 Photographs of public meetings and presentations distributed via project website 4.3 Films distributed online and at meetings and conferences 4.4 Conference proceedings and presentations available online	Outputs from the models and adaptation trials are sufficiently robust to warrant public interest

Activities.

Output 1.

1.1 Creation of climate model for Ascension capable of predicting temperature and rainfall changes with measured degree of certainty

1.2 Production of map showing climatic zones on Ascension based on altitude, aspect and distance from sea

1.3 Creation of oceanographic model for Ascension EEZ produced predicting future changes in current and upwelling systems

Output 2.

2.1 Production of response curves relating temperature to green turtle sex ratios, and soil moisture content to stress levels in an endemic plant species (*Euphorbia origanoides*) from experimental data

2.2 Production of digital terrain maps of turtle nesting beach

2.3 Production of maps predicting future availability of turtle nesting habitat produced from swell height data collected adjacent to turtle nesting beaches combined with output 2.2

2.4 Analysis of correlation between seabird productivity and ocean state variables completed and used to assess feasibility of using seabirds as indicators of ocean health.

Output 3.

3.1 Trials of turtle nest shading, endemic plant shading and fog-catching irrigation systems carried out

3.2 Digital terrain models of beaches presented to policy makers and planners to illustrate options for landward migration of beaches.

3.3 Sites on Ascension that have suitable climate conditions for *Euphorbia origanoides* identified. Transplant nursery grown stock to these areas and monitor success

3.4 Climate change adaptation measures shown to be successful incorporated into AIGCFD management plans and implemented as part of core workplans.

Output 4.

4.1 Creation of project website setting out scope of project and updated with project outputs

4.2 Public meetings held on Ascension to initially outline the objectives of the project and later to showcase results of the project and illustrate climate scenarios for the island

4.3 Creation of animated films of future scenarios as visual tools for stakeholder engagement

4.4 Presentation of results at international conference to showcase how Ascension is addressing major threat to its biodiversity

Annex 2 Report of progress and achievements against final project logframe for the life of the project (if your project has a logframe)

Project summary	Measurable Indicators	Progress and Achievements for the life of the project
Impact: A small island demonstrates leadership in tackling climate change by treating it as a current pressure and proactively introducing adaptation measures to protect the most vulnerable species and habitats.		Adapting to climate change represents a long-term challenge that cannot be fully addressed in a three-year project. However, the project has made important steps in framing climate change as a local threat through the creation of Ascension-specific forecasts of climate (Annex 6-7), oceanography (Annex 8), marine turtle reproductive output (Annex 9), and coastal habitat loss (Annex 10) under a range of emissions scenarios. Several adaptation actions aimed at mitigating these impacts have also been trialled and demonstrated tangible benefits for some of the most vulnerable species (Annexes 5 & 12). Follow up projects have already been initiated to build on this progress and further embed climate adaptation into local policy and planning.
Outcome Ascension's response to climate change is transformed through detailed, evidence-based predictions of impact that are used to galvanise action, prepare an adaptation response and focus monitoring effort.	**0.1** By Q4 of Year 3 Ascension's Biodiversity Action Plan and protected area management plans will include the specific local threats of climate change, new monitoring protocols and proposed adaptation actions.	**0.1** Local climate change predictions, threat assessments, monitoring protocols and adaptation actions produced by CRACAB project incorporated into the following Ascension Island management plans: Ascension Biodiversity Strategy and Action Plan p.20 (threat assessment); p.25 (climate smart management); p.50 (beach shading and assessment of barriers to beach migration); p.65 (passive irrigation and assisted migration endemic plants); p.50, 55, 62, 66 (monitoring) Beach Nature Reserves Management Plan p.18 (threat assessment); p35 (beach shading and assessment of barriers to beach migration); p.40 (monitoring) Letterbox Nature Reserve Management Plan p.19 (threat assessment); p.28 (assisted migration of E. origanoides); p.32 (monitoring) Wideawake Fairs Nature Reserves Management Plan p. 21 (threat assessment) Green Mountain National Park Management Plan p. 26 (threat assessment); p. 29 (endemic plant restoration plan); p.36 (monitoring)
	0.2 By Q2 of Year 2 Adaptation actions (including irrigation and shading) are	**0.2** Three climate change adaptation actions have been successfully trialled during the project and demonstrated success in mitigating climate stressors, including artificial shading of green turtle nests (Annex 12), irrigation of native plan

Project summary	Measurable Indicators	Progress and Achievements for the life of the project
	initiated to reduce climate change impacts on priority species and habitats	communities and translocation of critically endangered plants to climate refugia (Annex 5 & Section 3.1 for details).
	0.3 By Q4 of Year 3 Results of project presented to the Ascension Island Council and Administrator to inform future policy on areas such as coastal land use.	**0.3** No progress to report. This indicator was based heavily on presenting results of Output 2.3 (sea level rise impacts) and its implications for coastal land use planning, as other management actions are not sufficiently controversial to warrant higher level policy input. However, as explained in Section 3.1, projections of shoreline responses to sea level rise reported in Annex 10 are not considered to be sufficiently robust to guide policy at this stage. A plan has been developed to rectify this, building on learnings from the project, and we expect this outcome will ultimately be achieved.
Output 1. Ascension-specific predictions of future climate and ocean conditions produced and published	**1.1** By Q1 of Year 2 climate model for Ascension created capable of predicting temperature and rainfall changes with measured degree of certainty.	**1.1**. A long-term temperature and precipitation time series for Ascension Island has been compiled and published in the peer reviewed literature (see **Annex 6**). The observational dataset was used to update the University of East Anglia's ClimGen global climate model and Ascension-specific projections of monthly temperature and precipitation have been produced under 4 different emissions scenarios. Data are currently stored as projection files that have been transferred to Ascension Island Government; however, an example output is shown in **Annex 7**.
	1.2 By Q2 Year 2 Map of climatic zones on Ascension produced based on altitude, aspect and distance from sea.	**1.2** As detailed in the last Annual Report, this output could not be completed due to inadequate geographic coverage of available climate data on Ascension Island (see Section 3.1). The assumption regarding data availability was acknowledged in the original project application and unfortunately has not held.
	1.3 By Q2 of Year 2 oceanographic model for Ascension EEZ produced predicting future changes in current and upwelling systems	**1.3.** This output has been completed as planned. Long term projections of 9 oceanographic bulk properties (including pH, temperature, salinity and primary productivity) in the Ascension Island MPA have been produced under 4 different IPCC climate change scenarios, along with a detailed analysis of the evolution of the equatorial undercurrent, which plays a key role in driving the regional oceanography. The analysis indicates that the MPA will become warmer, more saline, more acidic, with less nutrients, less chlorophyll and less primary production by the mid-century, accompanied by a weakening of the AEU. A technical manuscript describing the results has been submitted for publication in the Journal of Geophysical Research and is currently in revision (see **Annex 8).**

Project summary	Measurable Indicators	Progress and Achievements for the life of the project
Activity 1.1 Creation of climate model for Ascension capable of predicting temperature and rainfall changes with measured degree of certainty.		This activity has been completed. Projections of temperature and rainfall at Ascension Island have been produced from 22 global circulation models in the IPCC CMIP5 ensemble using ClimGen. The variation in predictions across the individual ensemble members provides a measure of certainty.
Activity 1.2 Production of map showing climatic zones on Ascension based on altitude, aspect and distance from sea.		This activity could not be completed due to inadequate spatial coverage of meteorological data (see section 3.1).
Activity 1.3 Creation of oceanographic model for Ascension EEZ produced predicting future changes in current and upwelling systems.		Activity completed as planned. Results are reported in a technical manuscript that is in revision at the Journal of Geophysical Research (**Annex 8).**
Output 2. Quantitative relationships between key habitats/species and climate variables established to allow greater detail on predicted impact of climate change on biodiversity.	**2.1** By Q2 of Year 3 Response curves relating temperature to green turtle sex ratios, and soil moisture content to stress levels in an endemic plant species (*Euphorbia origanoides*) produced from experimental data. **2.2** By Q1 of Year 3 Digital terrain maps of turtle nesting beach produced.	**2.1** Long-term trends in green turtle sex ratio and hatching success have been projected under 4 different IPCC climate change scenarios, employing the most up-to-date modelling frameworks (**Annex 9**). Under the most pessimistic emissions scenarios, sex ratios are likely to shift from 67 to 85% female by 2100, while average hatching success is likely to decrease by approx. 14%. Results have been incorporated into a manuscript which will shortly be submitted to a peer-reviewed journal (see **Annex 9**). Soil moisture monitoring at endemic plant sites initiated during the project been for around 18 months and has provided valuable insights into local hydrology, in particular the importance of heavy rainfall events in recharging ground water reserves and sustaining plant communities dependent on deep roots to survive adversity (see Section 3.1 for details). However, the plant physiological data that will enable the final water stress response curve to be developed has not yet been collected. A planned visit by partners at INRA was cancelled due to the Covid 19 pandemic followed by prolonged repairs to Ascension's runway that have made the travel schedule unworkable. Collaborations established during the project mean there is a good chance of completing this work in future (see Section 3.1), but to date it has not been possible to produce a final research paper as planned. **2.2–2.3.** High resolution digital elevation models have been created for all major green turtle nesting beaches and a detailed analysis undertaken to predict changes in nesting habitat availability under 4 different IPCC sea level rise scenarios (see **Annex 10**). This analysis focussed specifically on Long Beach (Ascension's

Project summary	Measurable Indicators	Progress and Achievements for the life of the project
	2.3 By Q2 of Year 3 Maps predicting future availability of turtle nesting habitat produced from swell height data collected adjacent to turtle nesting beaches combined with output 2.	principal green turtle nesting site with >50% of nesting activity) to compare alternative models of shoreline response to sea level rise and highlight areas where further method development is needed to improve predictions across all sites (see Section 3.1 for details). Models suggest that up to 32% of current nesting area on Long Beah could be lost through sea level rise and associated shoreline retreat, with up to 60% of nesting area exposed to increased wave wash-over.
	2.4 By Q1 Year 2 Analysis of correlation between seabird productivity and ocean state variables completed and used to assess feasibility of using seabirds as indicators of ocean health.	Five years of nesting data for the endemic Ascension frigatebird (*Fregata aquila*) collated and analysed to explore relationships between breeding seasonality, fledging success and inter-annual variability in prey availability predicted from oceanographic models (see report on Project website). Results of this pilot study are suggestive of a trend that warrants further investigation, but ca. 5 years of additional monitoring data are probably needed for robust statistical tests.
Activity 2.1 Production of response curves relating temperature to green turtle sex ratios, and soil moisture content to stress levels in an endemic plant species (*Euphorbia origanoides*) from experimental data.		Response curves relating air temperature to green turtle sex ratios and embryo survival have been produced and used to generate long term projections of reproductive output under a range of climate change scenarios (Annex 9). Over 18 months of soil moisture monitoring conducted to characterise local hydrology in wild populations of *E. origanoides* (Annex 5.1).
Activity 2.2 Production of digital terrain maps of turtle nesting beaches.		Digital terrain maps produced for all key nesting beaches and a detailed analysis of future changes in nesting habitat availability undertaken for the Island's principal green turtle nesting site (Annex 10).
Activity 2.3 Production of maps predicting future availability of turtle nesting habitat produced from swell height data collected adjacent to turtle nesting beaches combined with output 2.2.		
Activity 2.4 Analysis of correlation between seabird productivity and ocean state variables completed and used to assess feasibility of using seabirds as indicators of ocean health.		See output 2.4 and report on Project website.
Output 3. Evidence-based adaptation actions trialled and those demonstrated to be successful are implemented through core AIGCFD workplans	**3.1** By Q2 Year 3 Trials of turtle nest shading, endemic plant shading and fog-catching irrigation systems carried out.	**3.1** An experimental trial of artificial nest shading was carried in Y3 and proved to be successful in reducing nest temperatures, improving hatching success, and producing less female-biased offspring sex ratios. However, the scalability of the method is unclear, and the trial indicated that nest relocation into shaded hatcheries may offset some of the benefits of shading. Results have been incorporated into a manuscript that is currently being reviewed for publication in the Wildlife Society Bulletin (see Annex 12).

Project summary	Measurable Indicators	Progress and Achievements for the life of the project
		Evaluation of soil moisture profiles informed a decision to abandon trials of endemic plant shading at an early stage, allowing us to focus on more sustainable approaches for conserving arid-zone flora (e.g. assisted migration; Output 3.3). In contrast, fog catching irrigation systems have now been operating in upland areas for approximately 1 year (Annex 5.2) and have shown encouraging results in rehabilitating bryophyte communities on degraded banks. Compared to control sites, abundance of lichen in irrigated plots increased by 900% and species adjudged to be indicators of hyper-humid niches increased by 592% (Annex 5.3). Bryophytes are slow-growing and it is expected to take a further 2-3 years before the final results of this trial can be analysed and reported. However, the continuation of this work has been integrated into a follow up Darwin Plus project (DPLUS159) which will build on the progress made here.
	3.2 By Q3 Year 3 Digital terrain models of beaches presented to policy makers and planners to illustrate options for landward migration of beaches.	**3.2** As detailed in Annex 10, although we have been able to predict future losses of green turtle nesting habitat under different sea level rise scenarios, the modelling approaches used do not currently permit confident predictions of landward beach migration, in part due to a lack of detailed knowledge of sediment budgets and backshore topography at Ascension Island. Therefore, rather than recommend specific management actions at this stage, we have instead outlined a set of priorities for future method development and have secured additional funding to allow this work to take place during the 2023/24 green turtle nesting season.
	3.3 By Q2 Year 3 Identify sites on Ascension that have suitable climate conditions for *Euphorbia origanoides*. Transplant nursery grown stock to these areas and monitor success	**3.3** Three climatologically suitable translocation sites have been identified and planted with nursery grown *E. origanoides*, all of which still have healthy populations surviving up to 17 months from the start date (Annex 5.4). At the last rainy season, only one site had been established sufficiently long for the plants to flower, seed and lay down sufficient seedbank for progress in establishing self-sustaining populations to be measured. However, initial results have been encouraging. Unlike previous rehabilitation attempts, a significant proportion of the wild-germinating population at this site has survived to maturity and is now flowering and seeding (Annex 5.5).
	3.4 By Q4 Year 3 Climate change adaptation measures shown to be	3.4 Passive irrigation of endemic plants and the maintenance and monitoring of assisted migration sites incorporated in AIGCFD workplans and Green Mountain

Project summary	Measurable Indicators	Progress and Achievements for the life of the project
	successful are incorporated into AIGCFD management plans and implemented as part of core workplans.	National Park Management Plan. The potential future use of beach shading is incorporated into the Beach Nature Reserves Management Plan.
Activity 3.1 Trials of turtle nest shading, endemic plant shading and fog-catching irrigation systems carried out.		Experimental shading trial completed and resulting manuscript submitted to a peer-reviewed journal (Annex 12). Fog-catching irrigation systems trialled over a 12 month period and impacts on native plant communities monitored (Annex 5.2-5.3)
Activity 3.2 Digital terrain models of beaches presented to policy makers and planners to illustrate options for landward migration of beaches.		Digital terrain models have been generated and results presented to AIG (Annex 10); however, available data and modelling approaches do not currently permit reliable estimates of landward beach migration. An action plan for future model development has been proposed and funding secured to implement parts of this in the coming green turtle nesting season.
Activity 3.3 Sites on Ascension that have suitable climate conditions for *Euphorbia origanoides* identified. Transplant nursery grown stock to these areas and monitor success		Three *E. origanoides* translocation sites established and monitored over a 17-month period to assess survival and recruitment (Annex 5.4 – 5.5)
Activity 3.4 Climate change adaptation measures shown to be successful incorporated into AIGCFD management plans and implemented as part of core workplans.		Passive irrigation of endemic plants established through CRACAB is continuing as part of the core AIGCFD workplan and is being expanded and monitored over the next two years as part of DPLUS159, which will produce a long-term endemic plant restoration plan. The *E. origanoides* assisted migration sites are being monitored and maintained by core AIGCFD staff. A review of the potential future use of beach shading is incorporated into the Beach Nature Reserves Management Plan and this action will be implemented if monitoring shows it is required.
Output 4. Results of project and knowledge gained are widely shared to galvanise action on Ascension and encourage similar projects on other OTs and small islands	4.1 By Q4 Year 1 Create project website setting out scope of project and updated with project outputs 4.2 By Q4 Year 1 and Q4 Year 3 Hold public meetings on Ascension to initially outline the objectives of the project and later to showcase results of the project and illustrate climate scenarios for the island 4.3 By Q3 Year 3 Create animated films of future scenarios as visual tools for stakeholder engagement	**4.1** Website completed as planned (www.ascension-climate.org) and periodically updated with project outputs **4.2** One public meeting held in Y1 of the project attended by 40 people to discuss climate change implications for Ascension and explain project goals. **4.3** This output was not completed. Animated films were originally intended to visualise impacts of projected sea level rise; however, further model development

Project summary	Measurable Indicators	Progress and Achievements for the life of the project
	4.4 By Q4 Year 3 Attend international conference to showcase how Ascension is addressing major threat to its biodiversity	and specialist input is needed before we can confidently forecast landward beach migration (see section 3.1 for details). **4.4** Results from marine-facing elements of the project presented at the 5th International Marine Protected Areas Congress (IMPAC5) in Vancouver Canada.
Activity 4.1. Creation of project website setting out scope of project and updated with project outputs		Website produced and population with project outputs. https://ascension-climate.org/
Activity 4.2. Public meetings held on Ascension to initially outline the objectives of the project and later to showcase results of the project and illustrate climate scenarios for the island.		One public meeting held in Y1 of the project attended by 40 people to discuss climate change implications for Ascension and explain project goals.
Activity 4.3. Creation of animated films of future scenarios as visual tools for stakeholder engagement		No progress during project lifetime but we intend to revisit this output once more advanced shoreline evolution models can be tested.
Activity 4.4. Presentation of results at international conference to showcase how Ascension is addressing major threat to its biodiversity		Results from marine-facing elements of the project presented at the 5th International Marine Protected Areas Congress (IMPAC5) in Vancouver Canada.

Annex 3 Standard Indicators

Table 1 Project Standard Indicators

DPLUS Indicator number	Name of indicator using original wording	Name of Indicator after adjusting wording to align with DPLUS Standard Indicators	Units	Disaggregation	Year 1 Total	Year 2 Total	Year 3 Total	Total to date	Total planned during the project
DPLUS-A03	By Q1 of Year 2 climate model for Ascension created capable of predicting temperature and rainfall changes with measured degree of certainty. By Q2 of Year 2 oceanographic model for Ascension EEZ produced predicting future changes in current and upwelling systems	Number of local organisations with improved capability to predict climate change impacts	Number of organisations	OT Government	0	1	1	1	1
DPLUS-B01	By Q4 of Year 3 Ascension's Biodiversity Action Plan and protected area management plans will include the specific local threats of climate change, new monitoring protocols and proposed adaptation actions.	Number of adopted Biodiversity Action Plans and Protected Area Management Plans including the specific local threats of climate change, new monitoring protocols and proposed adaptation actions.	Number	None	0	0	5	5	5
DPLUS-D01	By Q4 Year 3 Climate change adaptation measures shown to be successful are incorporated into AIGCFD management plans and implemented as part of core workplans.	Hectares of land under management that incorporates measures to address the local threat of climate change.	Area km2	Protected areas	0	0	20.56	20.56	20.56
DPLUS-C18	By Q1 of Year 2 climate model for Ascension created capable of predicting temperature and rainfall changes with measured degree of certainty.	Number of papers published in peer-reviewed journals	Number	Journal of Climatology	0	1	0	1	1

DPLUS Indicator number	Name of indicator using original wording	Name of Indicator after adjusting wording to align with DPLUS Standard Indicators	Units	Disaggregation	Year 1 Total	Year 2 Total	Year 3 Total	Total to date	Total planned during the project
DPLUS-C17	By Q2 Year 3 Trials of turtle nest shading, endemic plant shading and fog-catching irrigation systems carried out. By Q2 of Year 2 oceanographic model for Ascension EEZ produced predicting future changes in current and upwelling systems	Number of unique papers submitted to peer reviewed journals	Number	Wildlife Society Bulletin Journal of Geophysical Research			1 1	1 1	2
DPLUS-C19	By Q2 of Year 3 Maps predicting future availability of turtle nesting habitat produced from swell height data collected adjacent to turtle nesting beaches combined with output 2. By Q2 of Year 3 Response curves relating temperature to green turtle sex ratios produced from experimental data.	Number of other publications produced	Number	Technical reports to Ascension Government			2	2	2

Table 2 Publications

Title	**Type** (e.g. journals, manual, CDs)	**Detail** (authors, year)	**Gender of Lead Author**	**Nationality of Lead Author**	**Publishers** (name, city)	**Available from** (e.g. weblink or publisher if not available online)
The development of long temperature and precipitation series for Ascension Island.	Journal Article	Jones PD & Lister D (2021)	Male	British	International Journal of Climatology	https://rmets.onlinelibrary.wiley.com/doi/full/10.1002/joc.7314

Checklist for submission

	Check
Is the report less than 10MB? If so, please email to BCF-Reports@niras.com putting the project number in the Subject line.	X
Is your report more than 10MB? If so, please discuss with BCF-Reports@niras.com about the best way to deliver the report, putting the project number in the Subject line.	
If you are submitting photos for publicity purposes, **do these meet the outlined requirements (see section 10)?**	
Have you included means of verification? You should not submit every project document, but the main outputs and a selection of the others would strengthen the report.	X
Do you have hard copies of material you need to submit with the report? If so, please make this clear in the covering email and ensure all material is marked with the project number. However, we would expect that most material will now be electronic.	
If you are submitting photos for publicity purposes, do these meet the outlined requirements (see section 13)?	
Have you involved your partners in preparation of the report and named the main contributors	X
Have you completed the Project Expenditure table fully?	X
Do not include claim forms or other communications with this report.	