

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	DPLUS133
Project title	Streamlining Ascension Island’s Marine Turtle Monitoring Programme for Long-Term Sustainability
Territory(ies)	Ascension Island
Lead Partner	University of Exeter
Project partner(s)	Ascension Island Government Conservation & Fisheries Directorate
Darwin Plus Grant value	£58,798
Start/end date of project	1 st August 2021 – 30 th September 2023
Project Leader name	Sam Weber
Project website/Twitter/blog etc.	Sam Weber
Report author(s) and date	Sam Weber (30 th January 2024).

1 Project Summary

Ascension Island supports the second largest nesting population of endangered green turtles in the Atlantic Ocean and the largest nesting colony of any marine turtle species in the UKOTs. The population has been monitored using standard methods since the 1970s which has documented its dramatic recovery from historical exploitation. As one of the longest-running initiatives of its kind, data from the Ascension Island Marine Turtle Monitoring Programme (AIMTMP) is used extensively for regional and global status assessments of this species. However, with exponential increases in numbers of nesting turtles in recent years, existing monitoring loads are becoming increasingly unsustainable for the local Government. Without action, there is a risk that monitoring will cease or be downgraded, with unknown implications for data veracity. This project aimed to streamline the AIMTMP to ensure its continuity whilst operating within local capacity constraints. To achieve this, a combination of simulation-based modelling and innovative statistical methods was used to develop monitoring protocols that offer the best compromise between efficiency and power to detect future trends. In addition, we also review new technologies that have the potential to deliver a step change in terms of automation and efficiency over longer timescales.

2 Project Partnerships

The project was developed as a collaboration between the University of Exeter and Ascension Island Government Conservation and Fisheries Department in response to a pressing need to streamline Ascension’s current marine turtle monitoring programme. Ascension Island Government identified the problem and worked with University of Exeter researchers to design a project that addressed local needs. AIG have continued to provide the Lead Partner with marine

turtle monitoring data, including effort data that can be used to assess the 'cost' and efficiency of current and future monitoring protocols (see Annex 5.1). The Project Leader spent 2-4 week periods on Ascension Island in Y1 and Y2 of the project which provided an opportunity to review project progress with managers in AIG and work alongside fieldworkers to understand current monitoring challenges. AIG and the University of Exeter have a longstanding collaboration on marine turtle monitoring on Ascension Island that dates back to 1998, so the current project marks the latest phase in a relationship that will undoubtedly be maintained after project completion.

In addition to its local objectives, the project also has the potential to learn from and contribute to a wider field of research on improving monitoring of large sea turtle populations. To facilitate this, in Y2 the project team hosted a workshop on '*Future technologies for large-scale monitoring of marine turtle nesting populations*' at the 41st International Seas Turtle Symposium, attended by >50 technical specialists and sea turtle conservationists (Annex 5.2 & 5.3). The workshop provided an opportunity to present project goals and collate experience, knowledge and perspectives on emerging technologies in marine turtle population monitoring from experts working at nesting colonies around the world.

3 Project Achievements

3.1 Outputs

The project had three core outputs, which have been largely completed as planned:

Output 1. *The status of the Ascension Island green turtle nesting population is updated and population estimates are made widely available.*

This output formed the starting point for simulating future population trajectories and monitoring designs (Output 2) - which was the core objective of the project - but also provided a valuable opportunity to update on the status Ascension Island green turtle population. The entire 45-year green turtle monitoring dataset has now been reanalysed using novel statistical methods to update the previous status assessment completed in 2012 (Annex 5.5). The results of the analysis have been deposited in the [State of the World's Turtles](#) online database, which is used for compiling regional and global status assessments, and archived locally in the Ascension Island Green Turtle Monitoring database as per original indicators (see Annex 5.4 & 5.5). Our original intention had been to publish an updated status assessment in the peer reviewed literature during the project to further increase accessibility of these population data. However, during the reanalysis, a decision was taken by both partners to postpone this formal assessment until the conclusion of the next 5-yearly full island census, currently ongoing for the 2023/24 nesting season. The rationale for this is somewhat technical and is linked to the methods used for estimating total nesting abundance on Ascension Island (see [Weber et al. 2014](#) for details). Due to the high monitoring burden (that this project addresses), annual green turtle monitoring on Ascension consists of nest counts conducted on 2-3 index beaches which are then scaled up to island totals based on the proportion of activity that occurs on these beaches during periodic (5-6 yearly) full island censuses. These full censuses are necessary to correct for the systematic redistribution of nesting activity around the island over time which would otherwise lead to biased estimates. Given that a full census had not been completed since 2017 (in part owing to the COVID pandemic) it was agreed that this should be allowed to occur before submitting finalised results to the peer reviewed literature.

Output 2. *The efficiency of alternative monitoring protocols is evaluated through simulation-based modelling.*

After applying 20 hypothetical sampling designs to 1000 simulated future nesting time series, two more streamlined monitoring protocols have been identified that require 26 – 63% less effort to implement than the current approach while achieving only minor losses in accuracy and precision

of annual population estimates, and no loss in statistical power to detect trends. Full details of the analysis and recommendations are provided in the accompanying technical report (Annex 5.1) submitted to Ascension Island Government. One of the recommended protocols (W6 2/7) was trialled during Y2 of the project and is now in routine use. Details of this protocol and the rationale for it have been updated in the Ascension Island Marine Turtle Monitoring Manual. Simulations suggest that further reductions in effort may also be possible without significantly compromising data quality and could be introduced in future if capacity becomes more limited.

Output 3. *Novel technologies that may one day supplement or replace existing monitoring methods are reviewed and assessed for suitability and field readiness.*

In addition to streamlining current monitoring protocols, the project also explored novel technologies that might one day replace existing, labour-intensive survey methods. This output took the form of a structured review of the peer-reviewed literature combined with an expert elicitation workshop organized at the 41st International Sea Turtle Symposium (Cartagena, 18-24th March 2023). The workshop entitled “*Future technologies for large-scale monitoring of marine turtle nesting populations*” was attended by 53 participants from approximately 20 countries and provided a forum to share expertise and ideas on what the future of marine turtle monitoring could look in some of the world’s largest nesting populations, including experiences of any new and emerging technologies not yet published in the scientific literature (Annex 5.1). This event substantially exceeded our original target of hosting an online workshop with representatives from four countries. In addition to planned activities, this Output also benefited from synergies with a subsequent Darwin Plus project (DPLUS) that provided funding for specific field trials of remote camera systems for marine turtle monitoring. The combined results of these activities are synthesised into a technology review and roadmap presented in the accompanying technical report (Annex 5.1). Overall, our review suggests that while advances in remote camera systems (including drones) and artificial intelligence are creating new opportunities for greater automation of marine turtle monitoring, none of these approaches are currently suitable to replace existing monitoring methods on Ascension Island, either because the necessary technologies are not available/affordable, or because they do not substantially reduce the overall monitoring burden (see Annex 5.1). However, recommendations for further method development and periodic reviews of technological innovations at other high density nesting sites are provided.

3.2 Outcome

Overall, the project has achieved its main intended outcome of streamlining the AIMTMP and ensuring the continuity of this globally important dataset as it adapts to as it adapts to shifting priorities and resource constraints in the Territory. Informed by the results of simulation-based models, Ascension Island Government have now adopted a more streamlined green turtle monitoring protocol that achieves comparable statistical power and accuracy to the original sampling design while requiring ca. 25% less effort to implement (**Outcome 0.1**; Annex 5.1). Importantly, because the revised protocol is based around the same core methods used by AIG since 2012, it can be implemented immediately, with no additional training or capacity building required, while longer term technology-driven solutions are explored. Although the methodology used for identifying has not yet been published in the peer-reviewed literature (**Outcome 0.2**), there are plans to do this in the longer term as the approach taken is likely to be of wider interest. As detailed in Section 5, this project was heavily impacted by an unforeseen change in employment status of the Project Leader, who moved to a permanent faculty position shortly after the project began, resulting in limited time to publish findings. Nevertheless, the core objective of alleviating monitoring burden on Ascension Island Government has been achieved and has provided confidence in the reliability of green turtle population data provided by the AIMTMP for underpinning local, regional, and global status assessments. We are grateful to the Darwin Initiative for the patience and extensions granted that allowed this important exercise to be completed.

3.3 Monitoring of assumptions

Three important assumptions were identified in the project log frame:

- *A reduced monitoring protocol can be identified that achieves an acceptable level of statistical power.*
- *Bayesian population models applied in other taxa are compatible with green turtle nesting data from Ascension Island.*
- *There is sufficient engagement in a planned monitoring workshop from the marine turtle research community.*

Thankfully, all of these assumptions held, as evidenced in Section 3.1 – 3.2.

4 Contribution to Darwin Plus Programme Objectives

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

As a result of this project, the Ascension Island Government Conservation and Fisheries Directorate have adopted a more streamlined marine turtle monitoring protocol that will enable them to divert limited resources from routine monitoring to practical conservation action, while still fulfilling their obligations under the Convention on Migratory Species (Article 5a) and Conventional on Biological Diversity (Article 7b) to monitor report on the status of the Island's iconic green turtle population. The revised sampling designs are shown to achieve a 26-63% reduction in monitoring effort for no or negligible loss in accuracy or power to detect long-term population trends. These outputs are well aligned with the objectives of the Darwin Plus Fund to strengthen institutional capability and capacity in the UKOTs (**standard indicator DI-03**) and evidence-based species management and monitoring plans (**standard indicators DI-C01 and DI-B02**). Downstream data users who rely upon regular population estimates from Ascension Island to track the global and regional status of the green turtle also stand to benefit from a sustainable monitoring programme that is based on a measurable level of uncertainty and statistical power. Updated green turtle population trends for the period 1978 – 2022 have been generated and made available via SWOT and the AIGMTMP database which will support local and regional conservation assessments and is fully consistent with Darwin Plus aims with regards to species evidence (**standard indicator DI-C02**).

4.2 Gender equality and social inclusion

This project primarily consisted of desk-based and analyses and reviews and did not raise or address any specific gender equality of social inclusion issues. However, we note that the project team and participants at the international workshop achieved a good gender balance, including women in senior leadership roles.

Please quantify the proportion of women on the Project Board ¹ .	66%
Please quantify the proportion of project partners that are led by women, or which	50%

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.

have a senior leadership team consisting of at least 50% women ² .	
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5 Monitoring and evaluation

The project has a simple structure, consisting of two partners, a small number of well-defined outputs and a clear pathway to impact which has greatly simplified the M&E process. M&E is primarily carried out by the Project Leader in consultation with Ascension Island Government (Director of Conservation & Fisheries) where appropriate. The Outcome and Output level indicators were clear, measurable and have been largely achieved, pending publication of the updated status assessment and simulation-based methodology in the peer-reviewed literature (see Annexes 2 and 5.1). As described in Section 3, publication of the project findings has been substantially delayed by the project leader and principal analyst at the University of Exeter moving to a permanent faculty position shortly after the project began. Although a replacement was appointed to deliver a range of projects previously led by Dr Weber, the current project required a specific skillset and knowledge of the Ascension Island monitoring dataset that was not easily filled. This change in staff capacity constituted the major M&E challenge encountered by the project and required several no-cost extensions and revisions of the project timeline in coordination with partners in Ascension Island Government. Given the urgency in reducing monitoring burden, an interim protocol was recommended and adopted by AIG in Y2 based preliminary modelling results, pending the completion of the final report. This interim protocol ultimately proved to be beneficial in informing the range of possible sampling designs considered in the final analysis, which were developed through consultation between project partners. The recommendations contained in the final technical report have now been internally evaluated and approved by project partners in AIG to ensure that they address the original needs and goals identified at the application stage, which represents the final stage of the current project M&E process. However, there will be opportunities for further external evaluation of our approach and findings when they are submitted for publication in the peer-reviewed literature in due course.

6 Actions taken in response to Annual Report reviews

Annual report reviews raised the following points which have been responded to as detailed below:

COMMENT: For Activity 1.2 could you please clarify the reason for delaying the updated status assessment for the Ascension Island green turtle population until the end of 2023/2024?

RESPONSE: A detailed justification for this delay is now provided in Section 3.1. We note that the publication of these historical data in the peer reviewed literature was not required to achieve our principal goal of streamlining future monitoring and that publication will follow at the conclusion of the 2023/24 nesting season once we can calibrate estimated totals generated during the project with the ongoing full island census.

COMMENT: Is there any acknowledgement of Darwin Plus funding associated to the data deposited on the World's Turtles online database (<https://www.seaturtlestatus.org/>)?

RESPONSE: Unfortunately, the SWOT metadata format does not accept specific funding information. However, data cannot be downloaded and reproduced from the database without the consent of the data provider, which provides the control point to ensure that funders and contributors are acknowledged in all downstream outputs.

COMMENT: Consider including in the M&L and lessons learnt sections examples of challenges and opportunities encountered by the project whilst (i) interacting with the international partners, (ii) during its internal process to check and validate models, (iii) on the format of the

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.

interaction for the exchange between data collectors in Ascension Island Government (AIG) and analysts at UoE, and on (iv) what are the procedures put in place to ensure that final outputs meet local needs.

RESPONSE: We have included specific examples of local evaluation of interim and final outputs and interactions between partners in Sections 2 (Project Partnerships) and 5 (M&E). Some reflections on the benefits of long-term international collaborations are also provided in Section 7 (Lessons Learned).

7 Lessons learnt

Two overarching lessons have been learned from the project that are of broader relevance to biodiversity conservation in the UKOTs:

1. Our simulation-based models suggest that many biodiversity monitoring protocols in the UKOTs, including the AIMTMP, are probably more intensive than is strictly necessary to achieve their stated objectives. Given that monitoring often competes for resources with management activities that contribute to species and habitat conservation and recovery, monitoring regimes should be regularly reviewed and updated to ensure that they are operating efficiently. The models developed in this project are quite specifically tailored for sea turtles; however, similar, simulation-based approaches could easily be applied in a wide range of contexts to optimise sampling designs and provide confidence in the data generated.
2. This project builds on a longstanding collaboration between Ascension Island Government and University of Exeter which predates the establishment of the Conservation Directorate in 2002. This familiarity, both with the datasets, local context, and between the individual team members involved, greatly facilitates communication and informal M&E between international partners and helps ensure outputs that are appropriate for local needs. Future Darwin projects should continue to recognise the value of building on past initiatives to consolidate long term benefits for biodiversity.

8 Risk Management

No significant risks were identified during the project other than the change in the employment status of the project leader described in Section 5 which resulted in several no-cost extensions being granted and delayed the completion and publication of the core analytical components of the project.

9 Sustainability and Legacy

Achieving a sustainable outcome goes to the core purpose of this project. The AIMTMP has been running continuously for 22 years and is a routine activity undertaken by AIG. However, it was becoming unsustainable to deliver in its current form. The more streamlined protocol developed and adopted through this project will form the basis for all future marine turtle monitoring on Ascension Island, ensuring the continuity of this important dataset as it adapts to shifting priorities and resource constraints in the Territory. The fact that the revised protocol is based on the same core methods used by AIG since 2012 means it can be implemented immediately with no need for additional for training and capacity building and with no discontinuities in the long-term population timeseries, while options for longer-term, technology-driven alternatives are explored.

While it is not possible to predict how local capacity might change in the longer-term, it is hoped that by rationalising the AIMTMP and demonstrating efficiency in achieving its monitoring objectives, the outputs from the project can maintain support for the programme through future changes in leadership at AIG. Indeed, results of our simulation-based models suggest that further efficiency savings can be made without significantly compromising data quality, providing managers with a range of options for responding to future capacity constraints. All statistical code

required to run simulations has been made openly available on GitHub (<https://github.com/sambweber/MoniTool/tree/main>), enabling further refinement and testing of monitoring protocols in future. We intend to publish these methods and code tools in the peer reviewed literature once they can be made generalisable, which will help to further consolidate the legacy of the project.

10 Darwin Plus Identity

This project was of a technical nature and provided limited need or opportunity for public engagement or promotional activities. Nevertheless, Darwin Plus support has been clearly acknowledged on the final technical report submitted to Ascension Island Government and on the introductory material and outputs relating to the ‘*Future technologies for large-scale monitoring of marine turtle nesting populations*’ workshop held at the International Sea Turtle Symposium in Colombia (see Annex 5.1). Darwin funding will also be acknowledged on any subsequent peer-reviewed papers that are published based on the findings or approaches developed during the project.

11 Safeguarding

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?	Yes (Dr Sam Weber, [REDACTED])
Has the focal point attended any formal training in the last 12 months?	Yes (Diversity and Inclusion in higher education, Feb 2022).
What proportion (and number) of project staff have received formal training on Safeguarding?	Past: 50 % (1) Planned: 0 %
Has there been any lessons learnt or challenges on Safeguarding in the past 12 months? Please ensure no sensitive data is included within responses.	

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]	[REDACTED]	0%	
Consultancy costs	[REDACTED]	[REDACTED]	2%	
Overhead Costs	[REDACTED]	[REDACTED]	2%	
Travel and subsistence	[REDACTED]	[REDACTED]		
Operating Costs	[REDACTED]	[REDACTED]		

Project spend (indicative) since last Annual Report	2022/23 Grant (£)	2022/23 Total actual Darwin Plus Costs (£)	Variance %	Comments (please explain significant variances)
Capital items				
Others				Outputs not ready for publication
TOTAL	£33,815.00	£31,289.76		

Staff employed (Name and position)	Cost (£)
Dr Richard Sherley – analytical support	
Professor Annette Broderick – project supervision and steering	
TOTAL	£2,716.00

Consultancy – description and breakdown of costs	Other items – cost (£)
Dr Liliana Colman – research fellow to replace Dr Sam Weber (following his move to a permanent faculty position at UoE) paid on consultancy basis as domiciled in Brazil	
TOTAL	

Capital items – description	Capital items – cost (£)
TOTAL	

Other items – description	Other items – cost (£)
TOTAL	

12.2 Additional funds or in-kind contributions secured

Source of funding for project lifetime	Total (£)

Ascension Island Government		
University of Exeter		
TOTAL		£51,082

Source of funding for additional work after project lifetime	Total (£)
TOTAL	

12.3 Value for Money

The bulk of the budget for this project comprises of salary and overhead costs for the team members involved in leading the analysis and were calculated on institutional pay scales commensurate with the level of experience required and estimated based on the minimum amount of time needed to complete an exercise of this nature. In practice, the complexity of the analysis and the need to develop code tools from scratch meant that substantially more time was ultimately allocated to this project than originally costed. To ensure value for money, all senior staff members in the University of Exeter and Ascension Island Government committed time and overheads in kind, resulting in significant matched funding that represented approximately half of the overall budget. The Project Leader also continued to give his time in kind after moving to a permanent faculty position at the University of Exeter to ensure the project reached a successful conclusion.

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

Project Summary	Measurable Indicators	Means of Verification	Important Assumptions
Impact: Ascension Island continues to generate reliable green turtle population estimates that contribute to global and regional status assessments while freeing up limiting resources for practical conservation action and applied research.			
Outcome: Ascension Island Government adopts a streamlined green turtle monitoring protocol that achieves clearly defined monitoring objectives while better reflecting local capacity constraints.	0.1. By the end of the project, a streamlined monitoring protocol is adopted by Ascension Island Government resulting in a reduction in total time allocated to monitoring. 0.2. Methodology used to rationalize the AIMTMP is published in the peer-reviewed literature.	0.1. Revised monitoring protocol incorporated into the Green Turtle Species Action Plan; green turtle nesting data and logs of person hours allocated to monitoring recorded in the AIG Marine Turtle Monitoring Database. 0.2 Published paper or in press manuscript.	0.1 Assumes that a reduced monitoring protocol can be identified that achieves an acceptable level of statistical power. Also assumes that Ascension Island Government is able to recruit conservation interns and thus has the capacity to trial the revised protocol in 2021/2022. To mitigate this risk we have included a specific budget to contribute to the T&S of interns during the 2021/2022 nesting season.
Outputs: 1. The status of the Ascension Island green turtle nesting population is updated and population estimates are made widely available.	1.1 By Q1 of Y2, a re-analysis of the 42-year nesting time series presenting up-to-date trends and population estimates is published in the peer-reviewed literature. 1.2 By Q1 of Y2, population data are submitted to the State of the World Turtles (SWOT) online repository.	1.1 Published paper or in press manuscript; updated nesting statistics are deposited in the Ascension Island Green Turtle Monitoring database. 1.2 Data are accessible via the SWOT website.	1.1-1.2 This output is based on established methods meaning there are no important assumptions.
2. The efficiency of alternative monitoring protocols is evaluated through simulation-based modelling.	2.1 By Q4 of Y2, at least six alternative monitoring designs are evaluated for resource efficiency versus statistical power to detect trends.	2.1 Report shared with Ascension Island Government; Published paper or in press manuscript	2.1 Assumes that Bayesian population models applied in other taxa are compatible with green turtle nesting data from Ascension Island.

<p>3. Novel technologies that may one day supplement or replace existing monitoring methods are reviewed and assessed for suitability and field readiness.</p>	<p>3.1 A desk-based literature review is shared with Ascension Island Government by Q4 of Y2.</p> <p>3.2 Remote workshop on future monitoring techniques for high density turtle nesting populations is held in Q4 of Y2 and attended by representatives from at least 4 globally-important colonies.</p>	<p>3.1 & 3.2: Technology Roadmap shared with Ascension Island Government and published on AIG website.</p>	<p>3.1 There are no important assumptions associated with this output.</p> <p>3.2 Assumes that there is sufficient engagement from the marine turtle research community and that invited participants can attend remotely. Initial expressions of interest have already been obtained from researchers working in India, USA, Australia and Costa Rica.</p>
<p>Activities</p> <p>1.1 Reanalyse all existing marine turtle monitoring data for Ascension Island using Bayesian state-space models.</p> <p>1.2 Prepare an updated status assessment for the Ascension Island Green Turtle for publication in the peer-reviewed literature.</p> <p>2.1 Using the current population estimate as a starting point, simulate future marine turtle nesting data assuming a range of long-term trends.</p> <p>2.2 Assess the power of alternative sampling regimes to detect simulated trends using Bayesian state-space models.</p> <p>2.3 Carry out a cost-benefit analysis of alternative monitoring protocols by comparing statistical power versus person-hours required to implement them.</p> <p>2.4 Gather data on person hours currently expended on green turtle monitoring under the existing protocol at different points in the nesting season.</p> <p>2.5 Report methodology used for streamlining the Ascension Island Marine Turtle Monitoring Programme for publication in the peer-reviewed literature.</p> <p>3.1 Undertake a structured literature review of new or emerging methods for marine turtle population monitoring.</p> <p>3.2 Host an online workshop/webinar focussing on the application of new technologies for monitoring high density turtle nesting populations.</p> <p>3.3 Collate findings and conclusions of (3.1) and (3.2) into a Technology Roadmap for the AIMTMP.</p>			

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	SMART Indicators	Progress and Achievements for the life of the project
<p>Impact</p> <p>Ascension Island continues to generate reliable green turtle population estimates that contribute to global and regional status assessments while freeing up limiting resources for practical conservation action and applied research.</p>		<p>Ascension Island Government is currently investing ~25% less effort in marine turtle monitoring, including breaks of up to 6 weeks per season to commit to habitat management and research, while not compromising the quality of population data generated. An updated status assessment and population estimate for the Ascension Island green turtle colony has been produced and shared with local and global databases, underpinned by a measurable level of statistical confidence.</p>
<p>Outcome Ascension Island Government adopts a streamlined green turtle monitoring protocol that achieves clearly defined monitoring objectives while better reflecting local capacity constraints.</p>	<p>0.1. By the end of the project, a streamlined monitoring protocol is adopted by Ascension Island Government resulting in a reduction in total time allocated to monitoring.</p> <p>0.2. Methodology used to rationalize the AIMTMP is published in the peer-reviewed literature.</p>	<p>0.1 Informed by the results of simulation-based models, Ascension Island Government has now adopted a more streamlined monitoring protocol that achieves comparable accuracy and statistical monitoring power to previous sampling designs, while reducing effort by approximately 26% (see Annex 5.1).</p> <p>0.2 Methodology used for streamlining the AIMTMP has not yet been published in the peer-review literature but is based around previously published work adapted for the Ascension context (see Annex 5.1). All code used to perform the simulations and analysis has been functionalised and published on GitHub to support future refinement and distribution of the toolset.</p>
<p>Output 1. The status of the Ascension Island green turtle nesting population is updated and population estimates are made widely available.</p>	<p>1.1 By Q1 of Y2, a re-analysis of the 42-year nesting time series presenting up-to-date trends and population estimates is published in the peer-reviewed literature.</p> <p>1.2 By Q1 of Y2, population data are submitted to the State of the</p>	<p>Green turtle nesting data for the period 1978-2022 has been analysed to generate an updated status assessment and results deposited in the SWOT online repository (Annex 5.4) and AIG Marine Turtle Monitoring Database (Annex 5.5). As detailed in Section 3, the project partners decided it would be more beneficial to delay formal publication of the updated status assessment until an overdue full island census can be completed in 2023/24. This is necessary to correct for any recent shifts in the distribution of nesting activity and would likely be requested at</p>

Project summary	SMART Indicators	Progress and Achievements for the life of the project
	World Turtles (SWOT) online repository.	peer review anyway. However, an interim status assessment containing the updated population trend has been provided to AIG as evidence of completion (Annex 5.5).
Activity 1.1 Reanalyse all existing marine turtle monitoring data for Ascension Island using Bayesian state-space models.		Re-analysis of monitoring data has been completed.
Activity 1.2. Prepare an updated status assessment for the Ascension Island Green Turtle for publication in the peer-reviewed literature.		Results of status assessment completed and reported to Ascension Island Government.
Output 2. The efficiency of alternative monitoring protocols is evaluated through simulation-based modelling.	2.1 By Q4 of Y2 , at least six alternative monitoring designs are evaluated for resource efficiency versus statistical power to detect trends.	Simulation-based modelling as been used to evaluate 20 hypothetical monitoring designs and recommend two more streamlined protocols that best optimise the trade-off between efficiency versus accuracy and statistical power to detect trends (Annex 5.1).
Activity 2.1. Using the current population estimate as a starting point, simulate future marine turtle nesting data assuming a range of long-term trends.		Using the current population estimate as a starting point, 10000 possible future marine turtle nesting timeseries were simulated, assuming underlying trends of 1–10% population decline per annum (Annex 5.1).
Activity 2.2. Assess the power of alternative sampling regimes to detect simulated trends using Bayesian state-space models.		Power of 20 alternative monitoring to detect simulated trends was compared, using observation errors estimated from Bayesian models fitted to annual nesting data (Annex 5.1)
Activity 2.3. Carry out a cost-benefit analysis of alternative monitoring protocols by comparing statistical power versus person-hours required to implement them.		Power, accuracy and precision of alternative monitoring protocols plotted against relative effort to identify the most parsimonious design (see Annex 5.1)
Activity 2.4. Gather data on person hours currently expended on green turtle monitoring under the existing protocol at different points in the nesting season.		Some data on person hours invested in monitoring collected and is directly correlated with the number of nesting activities occurring at a given point in the season. For computational ease, relative effort of different protocols was thus assessed from the proportion of total nesting activities that need to be counted in a given sampling design (see Annex 5.1).

Project summary	SMART Indicators	Progress and Achievements for the life of the project
Activity 2.5. Report methodology used for streamlining the Ascension Island Marine Turtle Monitoring Programme for publication in the peer-reviewed literature.		Detailed methodology is presented in the final technical report submitted to Ascension Island Government and will be prepared for publication in the peer-reviewed literature in due course (Annex 5.1)
<p>Output 3. Novel technologies that may one day supplement or replace existing monitoring methods are reviewed and assessed for suitability and field readiness.</p>	<p>3.1 A desk-based literature review is shared with Ascension Island Government by Q4 of Y2.</p> <p>3.2 Remote workshop on future monitoring techniques for high density turtle nesting populations is held in Q4 of Y2 and attended by representatives from at least 4 globally-important colonies.</p>	<p>3.1. A review of novel technologies that might supplement or replace current labour-intensive monitoring methods is included in the final technical report submitted to Ascension Island Government (Annex 5.1), including local experiences of direct field trials carried out through a concurrent Darwin Plus project (DPLUS174). The review shows that while thermal imaging drones and remote cameras have potential to contribute to marine turtle population censuses in some contexts, neither of these methods is sufficiently proven or labour-saving for immediate adoption at high density nesting sites like Ascension Island. Recommendations are included for future method development which should be carried out alongside more streamlined versions of existing monitoring approaches developed through Output 2.</p> <p>3.2. An in-person workshop on '<i>Future technologies for large-scale monitoring of marine turtle nesting populations</i>' was hosted at the 41st International Sea Turtle Symposium in Cartagena, Columbia in March 2023. The workshop was attended by >50 people from 20 countries, including researchers/managers working at major nesting populations in Costa Rica, Guinea Bissau & USA (see Annexes 5.1 - 5.3). The outcome of expert elicitation sessions from the workshop are incorporated into the "Technology Review" presented in the final technical report (Annex 5.1).</p>
3.1 Undertake a structured literature review of new or emerging methods for marine turtle population monitoring.		Structured literature search completed and incorporated into the Technology Review in the final technical report (see Annex 5.1).
3.2 Host an online workshop/webinar focussing on the application of new technologies for monitoring high density turtle nesting populations.		International workshop hosted in person at the 41 st International Sea Turtle Symposium (see Annex 5.1).

Project summary	SMART Indicators	Progress and Achievements for the life of the project
3.3 Collate findings and conclusions of (3.1) and (3.2) into a Technology Roadmap for the AIMTMP.		Technology Roadmap presented in the final technical report (Annex 5.1), combining results from the literature review, expert workshop, and local field trials on Ascension Island.

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
DI-A03	Ascension Island Government adopts a streamlined green turtle monitoring protocol that achieves clearly defined monitoring objectives while better reflecting local capacity constraints.	Number of local/national organisations with improved capability and capacity as a result of the project.	Organisations			1		1	1
DI-C01	An updated monitoring protocol is incorporated into the Ascension Island Marine Turtle Monitoring Manual that balances efficiency with measurable accuracy and power to detect trends.	Number of best practice guides and knowledge products published or endorsed	Number	Monitoring protocols		1		1	1
DI-C02	An updated population status assessment of the Ascension Island green turtle population is completed and data are submitted to the State of the World's Turtles online repository.	Number of new species stock assessments published		Fauna (local)	1			1	1
DI-C13	A workshop on future monitoring techniques for high density turtle nesting populations is held and attended by representatives from at least 4 globally-important colonies.	Number of webinar attendees.	Number	International		53		53	53

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)
Streamlining Ascension Island's Marine Turtle Monitoring Programme*	Technical report	Weber SB (2024)	Male	British	University of Exeter	Ascension Island Government Conservation & Fisheries Directorate

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.	