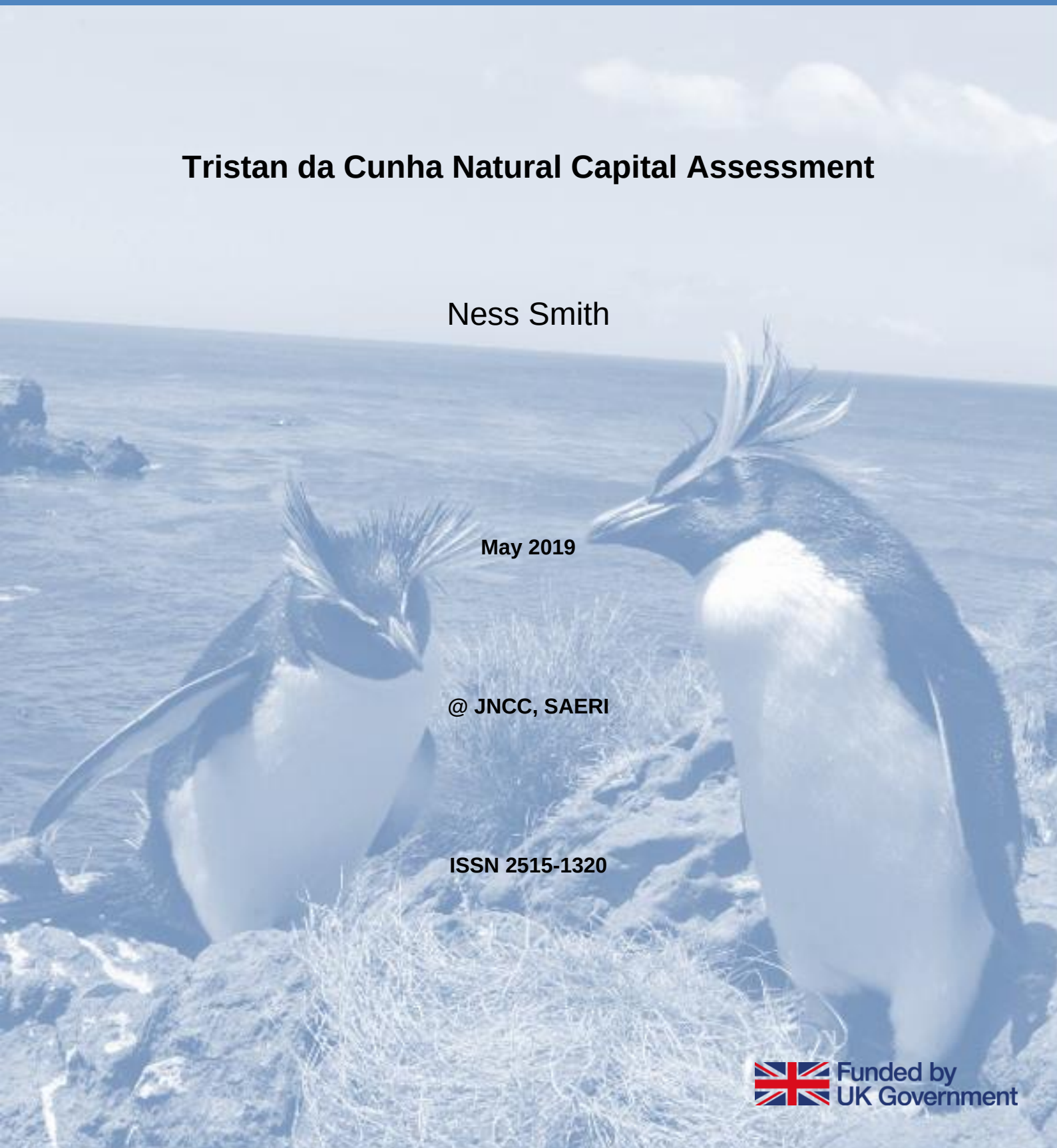
NATURAL CAPITAL IN THE UK'S OVERSEAS TERRITORIES
REPORT SERIES
SOUTH ATLANTIC REGION



Tristan da Cunha Natural Capital Assessment

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This report is compliant with the JNCC Evidence Quality Assurance Policy http://jncc.Defra.gov.uk/default.aspx?page=6675.

JNCC embarked on the 'Natural Capital in the Caribbean and South Atlantic Overseas Territories' project in late 2016. The project undertook an assessment of natural capital in 6 of the UK's Caribbean and South Atlantic Overseas Territories and built capacity to monitor environmental change and to integrate environmental evidence into economic policy making and infrastructure planning. The project was funded by the Conflict, Stability and Security Fund (CSSF).

A series of reports, one for each Territory involved in the project, as well as a final overarching report, summarise the results of the programme of work as a 'Natural Capital in the UK's Overseas Territories' Report Series. Additional reports produced during the lifetime of the project (e.g. workshop reports, scoping reports, interim reports) are to be published as part of a series of 'Supplementary Reports'.

contravention of its obligations under the Data Protection Act 1998 (or General Data Protection Regulation).

Summary

This report summarises processes and outputs from the South Atlantic Natural Capital Project on Tristan da Cunha. It provides a regional overview of the South Atlantic in section 2, whilst section 3 provides further context in terms of geography, governance, population, economy and environment of Tristan da Cunha. Section 4 provides an overview of project governance, stakeholder engagement and the overarching approach it took on Tristan da Cunha. Outputs from the assessment can be found in section 5 and cover;

- Soil erosion risk modelling
- Potential risks associated with the current waste management system
- Potential for tourism growth
- Cultural ecosystem services

In section 6 are suggestions for potential natural capital indicators whilst section 7 sets out conclusions and options for future work.

Contents

1 Introduction and background

1.1 Project overview

As small islands, the United Kingdom's inhabited Overseas Territories provide a home to approximately 250,000 people who are reliant on their natural environment, and the benefits that it provides, for their economic welfare and their security.

The Joint Nature Conservation Committee (JNCC) and its partners have pioneered the use of a natural capital approach in the Territories to provide better information on the benefits the natural environment generates to society. A natural capital approach addresses a wide range of issues relevant to enhancing economic security, building disaster resilience

JNCC is promoting the natural capital approach as providing a philosophy, a framework and processes to make a wide range of socio-economic and scientific data policy relevant. The JNCC and partner approach is participatory – with high level of engagement to ensure widest possible involvement in the OTs and to tailor work to individual OT priorities.

Supported by the CSSF programme in 2016 JNCC embarked on the '*Natural Capital in the Caribbean and South Atlantic Overseas Territories'* project. The work is part of a programme managed by the UK Government's Department for Environment, Food and Rural Affairs (Defra) to enhance economic security and build environmental resilience in the Territories.

The project undertook an assessment of natural capital in the majority of the UK's Caribbean and South Atlantic OTs and built capacity to monitor environmental change and to integrate environmental evidence into economic policy making and infrastructure planning.

The programme of work involved mapping and valuing the participating OTs natural capital assets through integrating ecological data, satellite data, Geographic Information Systems (GIS) and economic assessments.

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1.2 Definition of natural capital

A natural capital approach provides a way of understanding the relationship between human activity and the natural environment. It considers the natural environment as 'natural capital', assets that provide humans with benefits, also known as 'ecosystem goods and services'. In its work with the Overseas Territories JNCC has supported natural capital assessments that identify the various types of natural capital available to individual Territories, the ways in which the natural environment provides goods or services and who benefits. Where possible, natural capital accounts have been generated to set an economic value on these goods and services.

The natural capital approach is a unifying concept. It brings together data from a wide range of socio-economic and scientific data, adds value to existing data sets, identifies gaps in capacity and data and delivers policy relevant information to OT politicians and planners.

Natural capital assessments and accounting should be a routine part of economic and planning and policy making - it is not a one-off activity.

In the context of the JNCC led Overseas Territories work the programme was designed to:

- identify the priority natural capital assets associated with the terrestrial and marine natural environment, priorities for each participating Territory established through detailed, on-island, consultations;
- where practical, establish the estimated economic value for priority environmental assets;
- establish measurable attributes (natural capital metrics) to monitor changes in value through time;
- support integration of natural capital valuations into national mapping (GIS) to define the spatial distribution of these natural assets to promote the integration of the valuations into planning processes;
- tailor work to individual Territory priorities and policy objectives, recognising biogeographical differences and the availability of data to support analysis.

2 South Atlantic regional overview

The South Atlantic region is home to three UK Overseas Territories stretching across distinct geographical and ecological regions; St Helena, Ascension Island, Tristan da Cunha, the Falkland Islands and South Georgia & the South Sandwich Islands; the first three of which are classed as one territory but each has equal status.

Ranging from the tropical Ascension Island at 7°S to sub-Antarctic South Georgia at 54°S (Figure 1), the Territories nevertheless have a number of features in common. Their extremely remote nature means the region has a high degree of endemism with around 900 endemic species currently identified - over 50% of all known UK endemic species.[1] The region is widely recognised as being of high biodiversity importance and is home to regionally or globally important concentrations or assemblages of species. Ascension Island, for example supports the second largest green turtle rookery in the Atlantic whilst Gough Island, part of the Tristan da Cunha archipelago, has been described as, arguably, the most important seabird island in the world. The islands of Inaccessible and Gough are recognised as UNESCO World Heritage Sites[2].

[1] Regional ecosystem profile – South Atlantic Region. 2016. EU Outermost Regions and Overseas Countries and Territories, Maria Taylor, Tara Pelembe & Paul Brickle. BEST, Service contract 07.0307.2013/666363/SER/B2, European Commission, 209 p + 3 Appendices.
[2] https://whc.unesco.org/en/list/740

Figure 1: The South Atlantic UK Overseas Territories. Note South Georgia & the South Sandwich Islands were not assessed for the project.

Ascension Island, St Helena and Tristan da Cunha are all volcanic in origin and have small land masses[3]. The Falkland Islands, in contrast, is continental in origin[4] and has a land mass of over 12,000 km^2, much of which is uninhabited. All of the SAOTs have very large marine areas making up over 99% of the total area governed[5]. In the more southerly latitudes, these waters are highly prolific and provide valuable natural capital in the form of thriving fisheries. Compared to other regions, little is known about much of the South Atlantic Overseas Territories' (SAOTs) marine environments, although knowledge has increased significantly in the last few years.

Human population size for all the SAOTs is low, ranging from 250 on Tristan da Cunha to 4,534 on St Helena, and has varied little over the last several years. South Georgia & the South Sandwich Islands has no resident population other than a scientific research station which hosts up to 60 scientists in the summer months. All of the SAOTs are reliant on their natural capital across a number of economic sectors, including local food production, commercial agriculture, fishing and tourism. This is acknowledged through the numerous environmental ordinances and policies which the SAOTs have in place to protect and preserve species and ecosystems. All but the Falkland Islands are currently involved in the UK Overseas Territories Blue Belt programme[6].

[3] The geology of Saint Helena, Ascension Island and Tristan da Cunha Deposits Magazine - Issue 45 (2016) - Page 23.

[4] https://www.fig.gov.fk/minerals/geology/onshore-geology

[5] Regional ecosystem profile – South Atlantic Region. 2016. EU Outermost Regions and Overseas Countries and Territories, Maria Taylor, Tara Pelembe & Paul Brickle. BEST, Service contract 07.0307.2013/666363/SER/B2, European Commission, 209 p + 3 Appendices.

[6] Introducing the Blue Belt Programme. HM Government, 2017.

2.1 Tristan da Cunha

2.1.1 Geography

The Tristan da Cunha archipelago, consisting of the 'top islands' of Tristan, Nightingale and Inaccessible (and their islets), and Gough Island 410 km to the southeast of Tristan, are some of the most remote in the world, being separated from the nearest mainland by nearly 2,800 km of open ocean (Figure 2). The total land mass of all the islands covers just 178.3 km^2.

The islands are all volcanic in origin and vary in geological age and stage of erosion, with the oldest rocks dating back 18 million years. They lie to the east of the crest of the mid-Atlantic Ridge, close to its junction with the Walvis Ridge. The main group of islands are still volcanically active; an eruption on the main island of Tristan took place in 1961 which resulted in the entire community being evacuated and off the island for two years, and a submarine eruption took place near Nightingale as recently as 2004.

Around most of Tristan there are steep cliffs rising from the sea to around 500m. Above this is a less steep area known as The Base, and the summit cone, Queen Mary's Peak, rises steeply from this to 2,062 m. There are steep erosion gullies (or gulches) radiating downwards on all side and only four coastal plains, of which the Settlement Plain in the north west of the island is the largest[7] at approximately 5 km^2. The Settlement plain was formed by a massive collapse of The Base which was subsequently infilled by lava flows[8].

The archipelago's Exclusive Economic Zone (EEZ) covers 754,720 km^2. A very narrow shelf of shallow water surrounds the islands, which rise from a sea depth of about 3,500 m. Within the EEZ is a larger chain of volcanic seamounts that includes Isolda, McNish, RSA, Zenker, Sky Bank and one unnamed.

[7] Regional ecosystem profile – South Atlantic Region. 2016. EU Outermost Regions and Overseas Countries and Territories, Maria Taylor, Tara Pelembe & Paul Brickle. BEST, Service contract 07.0307.2013/666363/SER/B2, European Commission, 209 p + 3 Appendices.
[8] Hicks, A. Barclay, J., Mark, D.F. and Loughlin, S. (2012). Tristan da Cunha: Constraining eruptive behavior using the 40Ar/39AR dating technique. Geology 40(8), 723-726. doi:10.1130/G33059.1

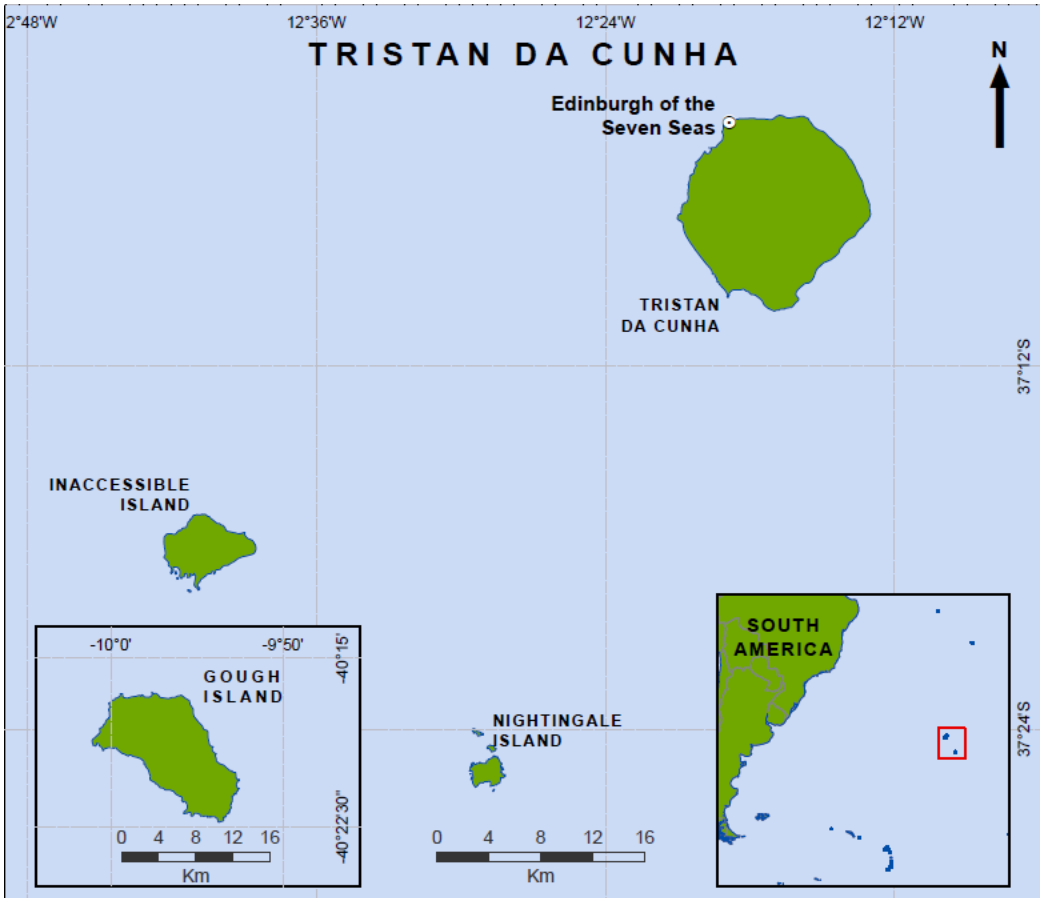

Figure 2: Location of Tristan da Cunha's three islands and its capital Edinburgh of the Seven Seas – also known as The Settlement.

2.1.2 Governance

St Helena, Ascension and Tristan da Cunha are considered as one Overseas Territory (OT) of the United Kingdom, but Tristan ceased to be termed a dependency of St Helena under a new ordinance in 2009. A Governor of St Helena, Ascension Island and Tristan da Cunha is appointed by the UK Government and lives on St Helena. The UK Government is represented on Tristan by a resident Administrator who is advised by the Island Council. The Council consists of eight elected and three appointed members; the elected member with the most votes is chosen as Chief Islander. Tristan da Cunha has its own legislation, but the law of St Helena generally applies with modifications to local circumstances[9]. The Government is the principal employer on Tristan, with a work force of approximately 140 spread across 11 departments.

2.1.3 Population

Tristan is the only inhabited island of the archipelago – with the exception of 6-8 expedition members manning the South African weather station on Gough. The first permanent settlement on Tristan was established in 1810 by three men who set up a trading station for passing ships, but this failed within a few years. In 1816 a small British garrison was established to deter any attempts to liberate Napoleon, exiled on 'nearby' St Helena in 1815. The garrison was quickly withdrawn in 1817, but Corporal William Glass, originally from Scotland, along with his wife and two other men decided to stay. The island has remained populated, with the exception of the 1961 evacuation, ever since. There were new arrivals to

[9] https://www.tristandc.com/government.php

grow the population over the early years, but it has fluctuated with geopolitical events. Today there are nine family names on the Island. The current population consists of 230 Islanders, and 10 expatriate workers and their families and visitors, all living in Edinburgh of the Seven Seas – generally just referred to as the 'village', or 'Settlement'. A further 26 resident Islanders are currently overseas[10]. There are approximately 120 private homes on the Island. The Island has an ageing population a low birth rate, and immigration is presently restricted to those that marry a resident Islander.

2.1.4 Economy

Tristan da Cunha's economy was based on traditional subsistence agriculture and fishing, which generated food for the consumption of the local population and it only started to move from a barter economy to a cash economy in 1942, when the Naval Station, located there during WWII, paid wages in cash. The commercial fishery for Tristan lobster began in 1949 which brought a significant change to the Island's economy.

The sole concession for the MSC-certified lobster fishery is held by a Cape Town fishing company, Ovenstone Agencies, which pay a percentage of the gross value of their annual lobster sales to Tristan da Cunha. Ovenstone operates vessels[11] for offshore rock lobster fishing, and owns the small fleet of dories for inshore fishing operated by the Islanders. There are 18 fishermen who are released from their 'day' jobs on declared fishing days[12]. There is a modern processing factory for the inshore fishery based on the island, which is also operated by Ovenstone and employs approximately twelve local staff, an expatriate manager and technician. On the days following a fishing day, a large proportion of the population work at the factory to help process the catch.

In addition to the fishery, the Island successfully sells collectable stamps and woollen souvenirs and has a small tourism industry, principally based around cruise calls, which added £50,000 to the economy in 2017/2018[13]. Scientific research and wildlife conservation have been attracting more funded projects to the island, and are a source of employment both for Islanders and outsiders[14]. Outside funding is usually needed to finance any capital construction on the island[15].

Today Islanders still grow their own crops – especially potatoes – rear cows for beef and milk, sheep for wool and mutton, as well as hens and ducks for eggs which make them relatively self-sufficient. There is a Government shop, or 'canteen' which imports a range of grocery products from the UK and, mainly, South Africa.

Due to its isolation and geography, Tristan is still, and is likely to remain, only accessible by ship. Essential passenger and cargo services are provided by Ovenstone as part of the lobster fishery concession. The journey takes approximately seven days.

[10] As of 07/05/19 - https://www.tristandc.com/population.php
[11] These vessels are equipped to fish and process the catch. There are referred to as freezer factory vessels. https://www.tristandc.com/newsfishingmsc.php.
[12] https://www.tristandc.com/economyfishing.php
[13] 2019 Acorn Tourism report for the NCA Project.
[14] Scott, S. (2017) A biophysical profile of the Tristan da Cunha archipelago. The Pew Charitable Trusts. Available at: https://bit.ly/2XnA6IL
[15] http://www.ribacompetitions.com/tristan/brief.html#background

2.1.5 Environment

The northern group of Islands have a mild-temperate, oceanic climate and sit near the belt of the 'roaring forties' - strong westerly winds found between 40-50°S which causes the weather to be highly changeable. Gough, being 350km to the south southeast, is more Sub-Antarctic. Tristan da Cunha's geographical isolation has resulted in a large number of endemic species evolving in both the terrestrial and marine environment. At least 287 plant taxa have been recorded, including 43 native ferns and clubmosses and 52 native flowering plants. Of these, 21 fern and clubmoss and 32 flowering plant taxa are considered to be endemic.

Vegetation is zoned by the geology / topography and altitude. The lower areas along the Settlement Plain would once have been dominated by tussock grasses, ferns and thickets of Island tree, but are now pasture land made up of non-native grasses. On some of the other low-lying plains this native vegetation persists. The Base above Sandy Point, and in the southern half of the island is dominated by fern bush, whilst between 600-750m the dwarf tree fern is dominant. From 750-900m low herbaceous vegetation dominates and above this zone are extensive mats of crowberry and moss. Above 1,500m the vegetation is very sparse. Many non-native plants have become established on Tristan. Some are considered invasive as they have become pests in the agriculture areas and gardens, others have become dominant in several natural habitats. For example, New Zealand Flax was introduced to Tristan as a thatching material and is still used as windbreaks[16].

The islands are most famous for their birdlife. There are seven species of breeding landbirds which are all endemic, and there are millions of pairs of breeding seabirds. Four species of seabirds - the Atlantic yellow-nosed albatross, Tristan albatross, Atlantic petrel and spectacled petrel - are endemic to the islands. Tristan da Cunha also hosts the largest population of northern rockhopper penguins. There are no native land mammals, reptiles, amphibians or freshwater fish on the islands and approximately 430 terrestrial invertebrate species have been recorded from all the islands.

The rocky intertidal and shallow subtidal regions down to 40 m depth are dominated by seaweeds, including dense kelp forests, with over 120 species, around a third of which are thought to be endemic to the Tristan islands. There are very few macroinvertebrates. Most of Tristan's EEZ consists of deep oceanic waters which is largely unstudied, but it is known to include seafans and cold water corals. Two species of seals – Sub-Antarctic fur seals and elephant seals, breed on the islands and five whale species, including Southern right whales and sperm whales, occur relatively frequently in Tristan's waters. Dusky dolphins are found around Gough, and short-beaked common dolphins are seen regularly offshore[17].

[16] Tristan da Cunha Government and RSPB (2012) Biodiversity Action Plan for the Tristan da Cunha Islands (2012-2016). Tristan Conservation Department, Edinburgh of the Seven Seas, Tristan da Cunha, South Atlantic.

[17] Scott, S. (2017) A biophysical profile of the Tristan da Cunha archipelago. The Pew Charitable Trusts. Available at: https://bit.ly/2XnA6IL

3 Project Governance, general approach and stakeholder engagement

3.1 Project governance

The South Atlantic Environmental Research Institute (SAERI) were tasked, under a memorandum of agreement with JNCC, to deliver the Natural Capital Project in the South Atlantic. The project was overseen by a Governance Group consisting of JNCC and SAERI, and a Technical Advisory Group consisting of leading natural capital academics and practitioners[18] . A Regional Cross-Territory Group, consisting of senior South Atlantic Overseas Territories (SAOTs) Government officials, was set up for high-level knowledge exchange and, where appropriate, Territory Advisory Groups were set up on each island. Given the limited staff resources available on Tristan, the Administrator acted as the main liaison for the project. A project manager, based at SAERI's office in the Falkland Islands, joined the project in July 2017. The project manager worked with the governance groups, PhD students, external academics/consultants and a SAERI GIS expert to deliver outputs (Figure 3).

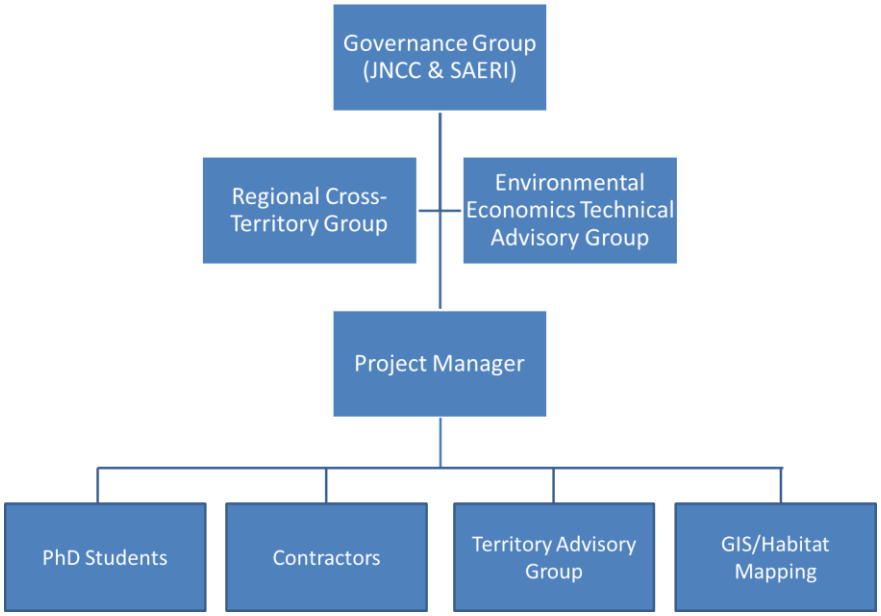

Figure 3: Governance structure of the South Atlantic Overseas Territories Natural Capital Assessment Project

3.2 General approach on Tristan da Cunha

With its small population, limited income, and relatively restricted economy, Tristan does not have the capacity or necessarily the requirement - to develop Natural Capital Accounts. The Government were interested in natural capital approaches but were more focused on the practical application than its principles. The priority was therefore to provide relevant examples which might be adapted for Tristan. The assessments identified resulted mainly in practical reports which could help Tristan in decision making, safety and wellbeing, and further developing its economy.

[18] Professor Georgina Mace, Professor Melanie Austen, Dr Pieter van Beukering, Nicholas Conner and Dr Emmanuelle Quillérou.

3.3 Stakeholder engagement

JNCC's approach to the wider Natural Capital Programme, and that therefore adopted by the South Atlantic Natural Capital Project, was to instigate high levels of engagement in the OTs, ensuring the widest possible involvement by Governments and other stakeholders, and to tailor work to individual OT priorities.

The project manager had several phone meetings with the Administrator and various heads of department during 2018 to introduce the South Atlantic Natural Capital Assessment Project and discuss how an NCA approach could help to inform environmental decision making on the island. From 8th – 29th November 2018 she met them in person on the island to give examples of work on other South Atlantic OTs, discuss the most important environmental benefits for Tristan Islanders and to prioritise what should be assessed within the project. During her time on Tristan, the project manager worked with the Administrator and other heads of department to identify relevant data and develop proposals further. The cultural ecosystem services assessment was scoped and a survey developed in collaboration with the Heads of Tourism and the Post Office.

Table 1: Consultees on Tristan da Cunha

Name	Organisation	Position
Sean Burns	UK FCO	Administrator
James Glass	TdC Government	Head of Fisheries
Trevor Glass	TdC Government	Head of Conservation
Iris Green	TdC Government	Head of Post Office
Dawn Repetto	TdC Government	Head of Tourism and Heritage
Robin Repetto	TdC Government	Head of PWD
Neil Swain	TdC Government	Head of Agriculture
Alasdair Wyllie	Independent consultant	Agricultural Advisor

Given the already high work demands on Government officers, a Territory Advisory Group was not set up on Tristan, but the project manager continued to liaise with the Administrator and relevant Heads of Government via telephone and email. All project outputs were reviewed by key stakeholders before being finalised.

4 Outputs

4.1 Cultural ecosystem services

4.1.1 Background

Tristan da Cunha has one of the most unique populations in the world with a strong cultural identity that dates back to its earliest settlers. The population is ageing, birth rates are falling and numbers on Island are starting to decline. The Island Council's strategic plan[19] sets out, under Lifestyle and Heritage objectives, a desire to 'preserve heritage, protecting against losing traditional customs' and also to 'address immigration issues'. Immigration is currently only allowed when an outsider marries an Islander. Satellite communication was introduced in 2003, bringing television to the Island, but internet connections only arrived on Tristan a few years ago. Islanders were keen to express to the 'outside world' how important their traditions

[19] Tristan da Cunha's Compass To Our Future

and way of life were to their health and wellbeing and a Cultural Ecosystem Services (CES) assessment was agreed to be a suitable way to formalise this.

CES are described by Fish et al.[20] as the *"contributions that ecosystems make to human well-being in terms of the identities they help frame, the experiences they help enable and the capabilities they help equip."* Building on concepts and methods developed as part of the UK National Ecosystem Assessment and its follow-on, the focus of this work was on developing an understanding of the many and diverse ways Islanders interpret and affiliate with the natural environment, and assign it significance.

4.1.2 Methods

The project manager worked with the Heads of Tourism and the Post Office to adapt the St Helena CES survey for Tristan. The survey set out to capture how Islanders interpret the natural environment in terms of its distinguishing qualities and characteristics, to capture the nature and diversity of cultural practices the natural environment enables, and support and assess the implications of these interactions for the well-being of people.

The survey incorporated a 'leisure' orientated view of the cultural ecosystem benefits arising from peoples' interactions with nature, but went beyond this to recognise the importance of work in cultural interactions with nature, which is of great importance on Tristan. Finally, to determine how interpretations of, and interactions with, the natural world varied across space, participative mapping was integrated into the survey.

Given the project manager was only on the island for one month, it was not possible to conduct face-to-face interviews. Questionnaires were therefore printed and distributed via Government Heads of Department, with instructions to return to the Administrator's office.

4.1.3 Results

Tristan Islanders are not often asked to complete questionnaires, so the return rate was always uncertain. Unfortunately only nine were returned, and experiential questions largely uncompleted, which did not allow for statistical analysis. Qualitative information allowed for some interpretation, but all results should be treated with caution.

The mountain featured prominently as a place that captured the essence of Tristan, and its naturalness, remoteness and wildlife were mentioned. Nightingale Island a source of food and somewhere to 'get away' from Tristan was also highlighted (Figure 3a). The potato patches were considered to be an important element of the natural heritage, emphasising the blurred lines between work and nature on the island (Figure 3b).

Again, the integral nature of work and leisure on Tristan is shown in Figure 4, where activities such as sheep shearing, hunting and feeding animals are listed alongside talking walks and watching wildlife as leisure activities. The patches, with its combination of camping huts, potato and vegetable patches, and leisure activities such as fishing is perhaps the place that best exemplifies how Islanders value the environment as a source of food, recreation, sociality, etc.

Although statistical analysis was not possible, a sense of tranquillity dominated in both work and leisure activities by all respondents who answered the 'experiential' questions.

[20] Fish, R., Church, A., & Winter, M. (2016b). Conceptualising cultural ecosystem services: a novel framework for research and critical engagement. Ecosystem Services, 21, 208-217.

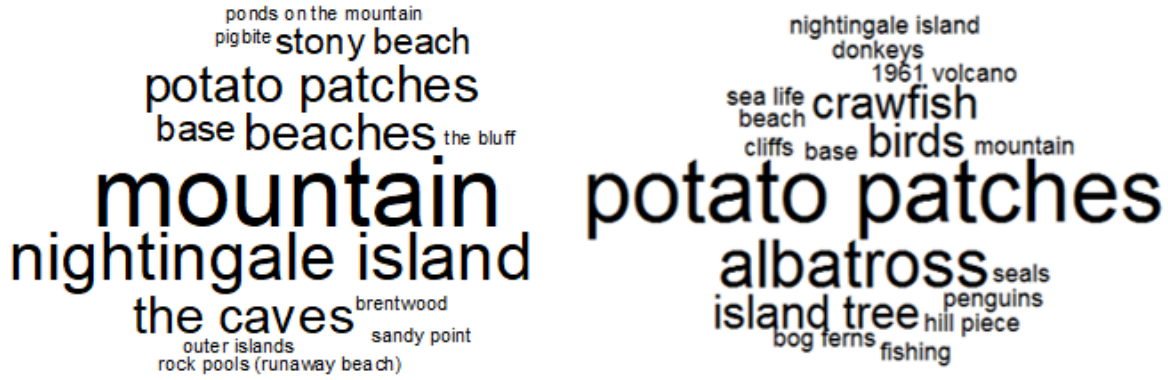

Figure 3. Places that capture a) the essence of the natural environment on Tristan and b) important elements of natural heritage

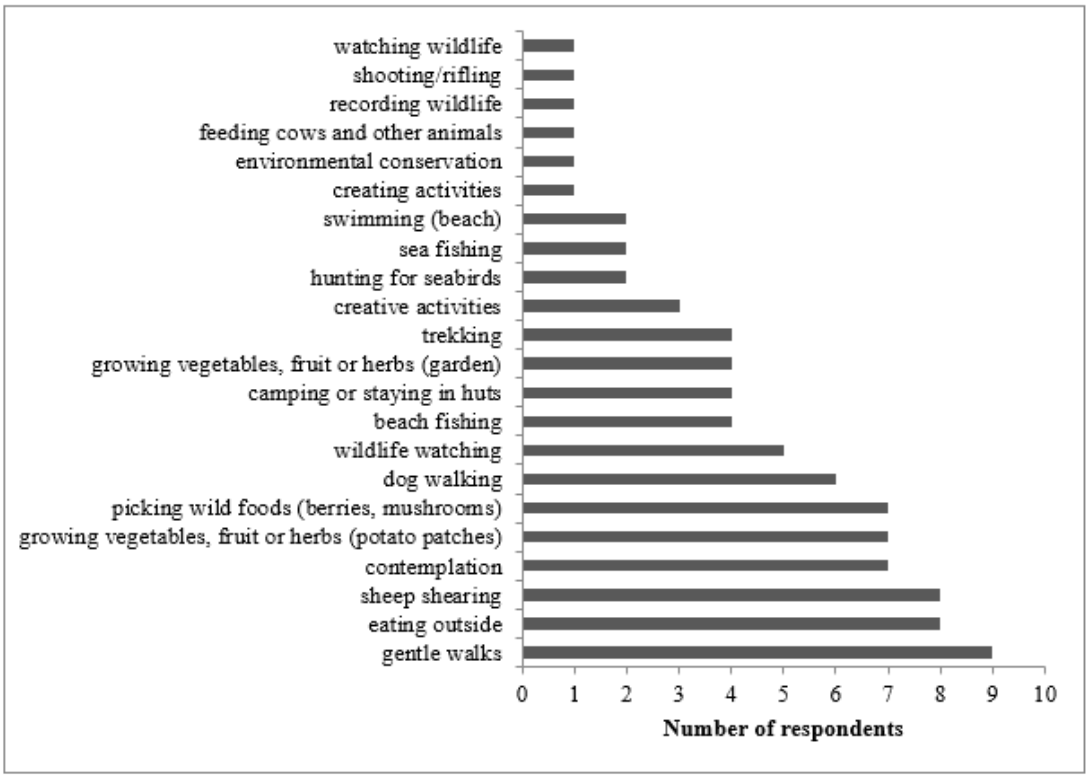

Figure 4. Outdoors leisure activities mentioned by respondents.

Given the limited habitation on the island, it is not surprising that most places of significance are in and around the Settlement Plain (Figure 5). Note that a lot of responses are not easily mapped, and are thus missing from the map below. Examples include “the Mountain” or “the Base”, which coincidentally are among the most iconic elements of the natural environment for respondents.

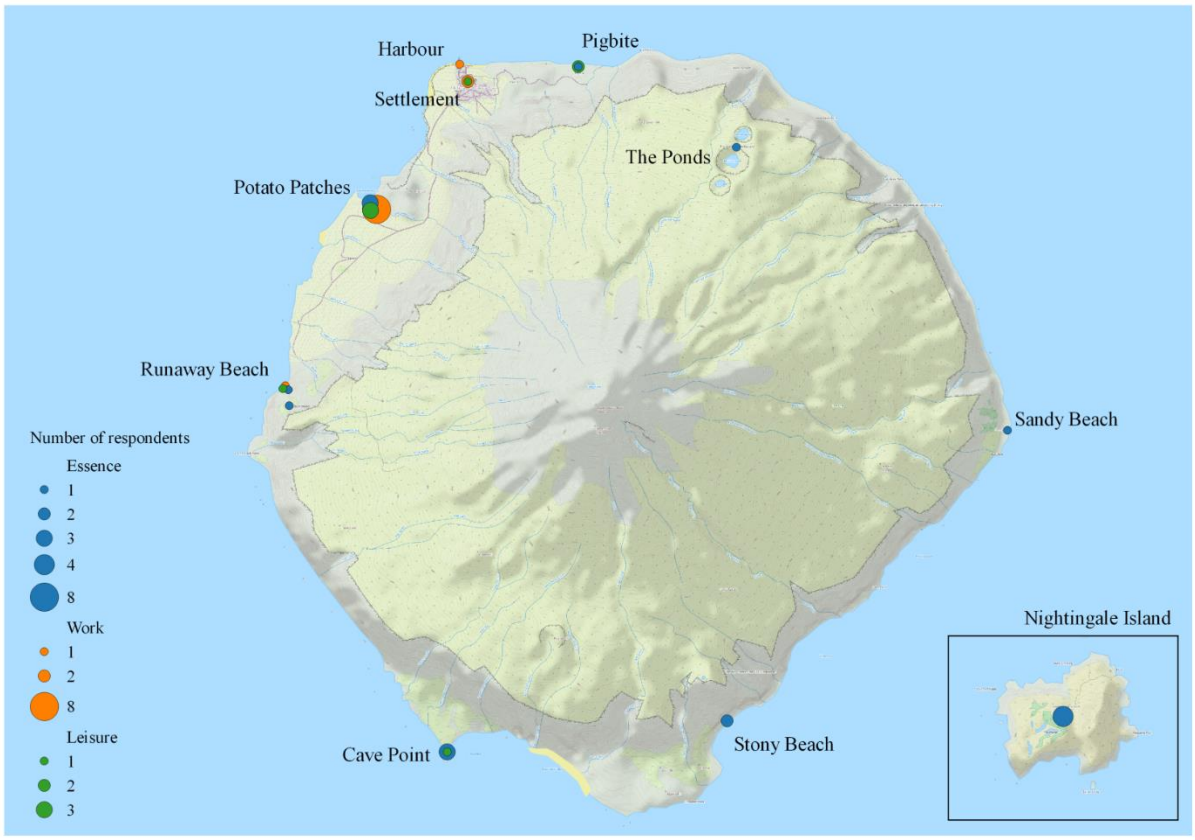

Figure 5: Combined map of iconic, leisure and work places. Background map by Open Street Map.

4.1.4 Conclusions

Although survey returns were low, the CES assessment is one of the few attempts to capture and document Tristan Islanders' intimate relationship with their islands and the multiple health and wellbeing benefits that they provide. It would be beneficial to repeat the questionnaire using face-to-face interview techniques which elicited more complete information on other South Atlantic islands. The report, nevertheless, provides useful evidence for Islanders should they seek external funding for work to protect and perpetuate their traditional lifestyle.

4.2 Soil erosion risk modelling

4.2.1 Background

Over the last few years, Tristan has suffered some major events of soil erosion which appear to be occurring with more frequency. These events have destroyed large areas of the pasture land upon which the inhabitants rely, and are a potential threat to water security and safety of the Settlement. The mechanism for this erosion is not clear, but it is thought[21] that that vegetation at the top of the cliffs (the edge of The Base) is becoming saturated and the water is seeping in between the soil and the unconsolidated layers of volcanic material, pooling until it reaches a sheer zone, causing the soil to slump. Tristan's Strategic Plan (2018) highlights the need to secure funding to assess these landslides. This assessment therefore set out to conduct an initial study to better understand the causes and risks of ongoing erosion through application of the SCIMAP soil erosion model, and identify future areas of funded work to enable mitigation measures to be put in place.

[21] Following discussions with Tristan Islanders, BGS and RSPB.

4.2.2 Methods

Using freely available data (Landsat and Sentinel-2), a time-series of images were obtained and processed. This enabled an investigation into vegetation changes / landform relationships at the top of the island, establishing a picture of the erosion mechanisms and risks.

SCIMAP is a fine sediment risk model that gives an indication of where the highest risk of sediment erosion risk occurs in a catchment. This is achieved by;

- Elevation (Digital Terrain Model (DTM))
- Precipitation (in mm/year)
- Erodibility (scored between 0 and 1, with 0 being least and 1 being most erodibility)

Topographic attributes were generated based on a high-resolution digital terrain model (WorldDEM) including aspect, slope and elevation. Four years' of precipitation data were supplied by the Tristan da Cunha Government to use in the erosion risk model and the UKCP18 global dataset - RCP8.5 – was used for climate change scenarios. Erodibility is calculated using vegetation cover, but the only existing map of Tristan was over ten years old; remote sensing methods were used to update this to provide the best data possible to feed into the erosion model (Figure 6).

The model was run under current conditions and climate change scenarios for 2050.

4.2.3 Results

Figure 6 shows a) the existing habitat for Tristan and b) the new habitat map created using remote sensing methods. This fed into the SCIMAP model and provides a significantly more detailed baseline for future environmental work on Tristan.

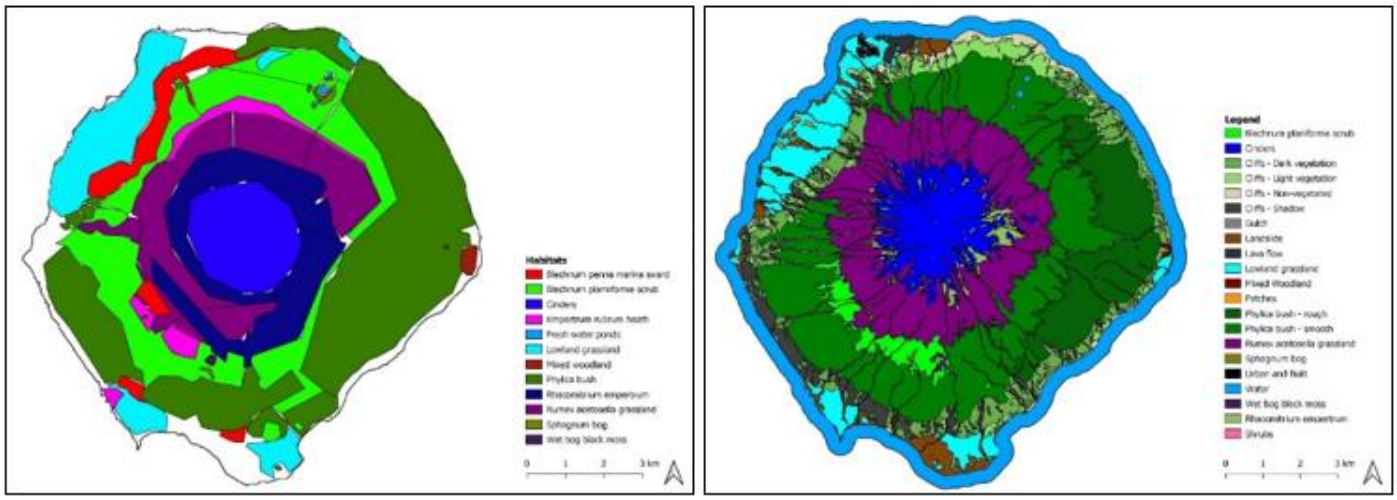

Figure 6: a) existing habitat map[22] and b) updated map of Tristan de Cunha.

[22] Tristan da Cunha Government and RSPB (2012) Biodiversity Action Plan for the Tristan da Cunha Islands (2012-2016). Tristan Conservation Department, Edinburgh of the Seven Seas, Tristan da Cunha, South Atlantic.

The SCIMAP soil erosion risk model shows a number of areas with soil erosion risk concentrated around the gulches and on the steep cliffs, with particular risk present where these interface with The Base (Figure 7). Areas with the highest erosion potential are both the steepest and those with least vegetation holding the slope together. The angle of slope is also a key factor

Figure 8 shows the island's water supply and associated infrastructure above the Settlement. It reveals both are sited within an erosion risk zone and therefore vulnerable to possible damage and disruption of the settlement's only water supply.

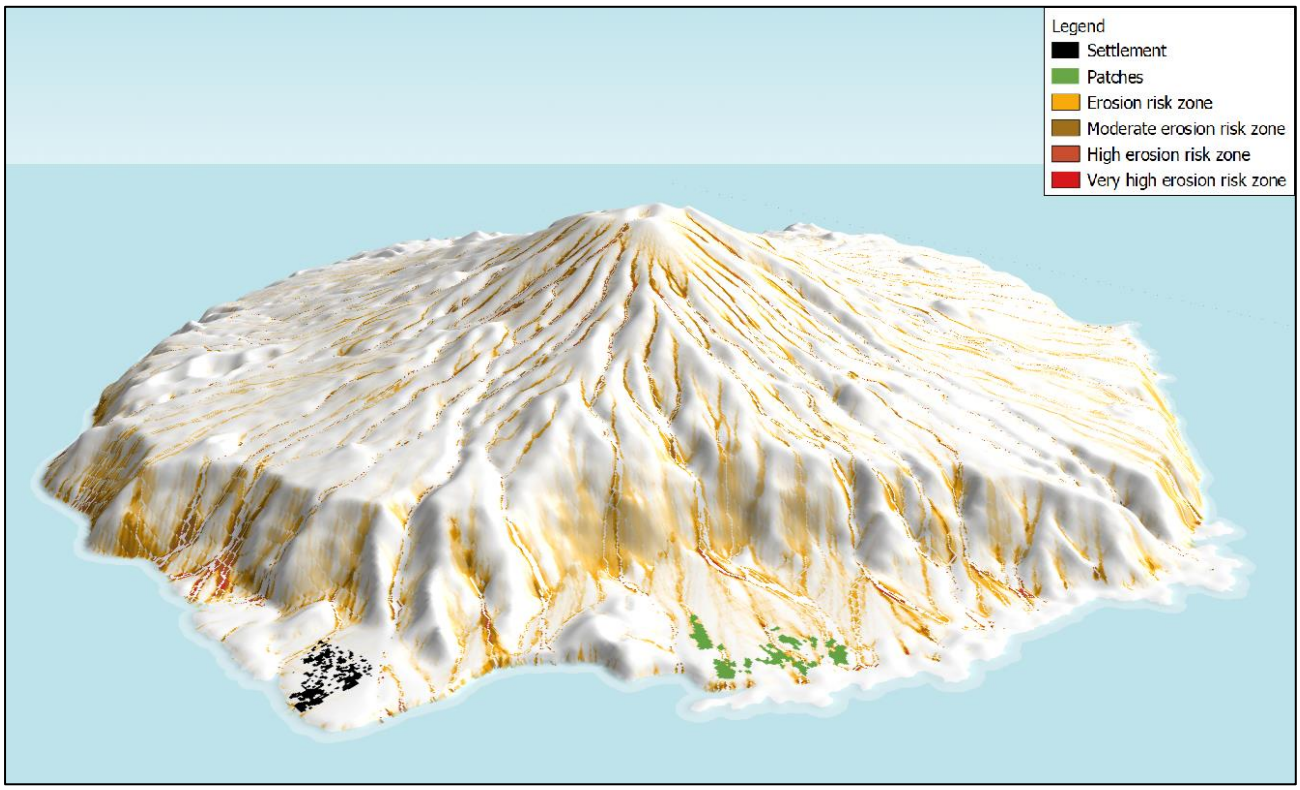

Figure 7: 3D representation of erosion risk (2020) along the Settlement plain. The erosion risk shows a boundary at the break of slope with the base and along the gulches.

The time-series analysis showed that the erosion risk is changing over time. This can result in both a positive, reduction in risk as the slumps vegetate over, or negative, increase in risk found on very steep areas with increasing rainfall.

No perceptible change was detected between the 2020 and 2050 scenario model runs, despite an increase in precipitation. This indicates that changes in vegetation extent effects risk to a greater extent and highlights the importance for ongoing monitoring.

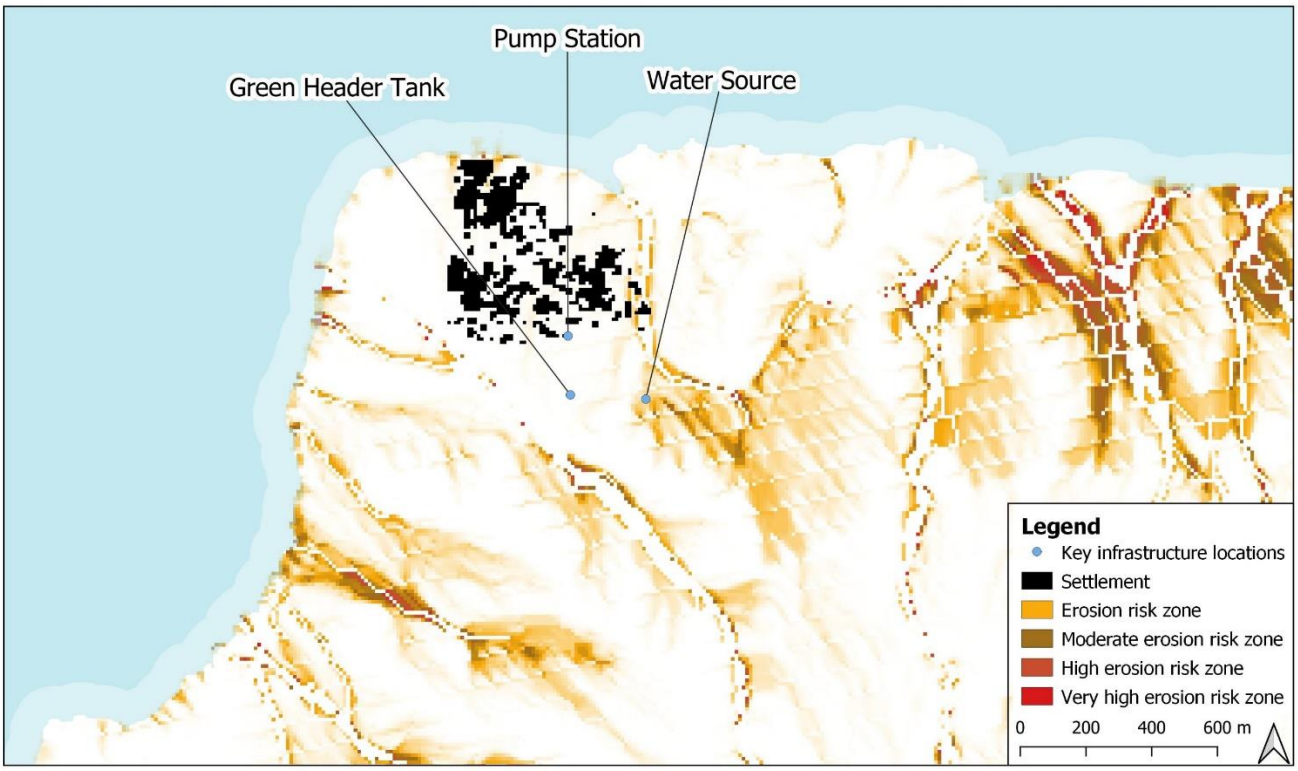

Figure 8: Erosion risk (2020) around the main water source and its infrastructural features

4.2.4 Conclusions

This assessment was, as far as we are aware, the first attempt to quantify erosion risk on Tristan da Cunha. It has shown that erosion risk is a very serious issue on the island, the Settlement Plain being key for the island's survival and at high risk from future erosion events. Erosion risk around the water supply is also a high concern. This report is a useful first step in understanding and mitigating these risks, but further work is necessary and should focus on:

- On-island verification of the erosion risk zones and models, with a full geological survey to confirm the main risk zones particularly on the Settlement Plain and where the water source for the settlement is located.
- The establishment of mitigation measures by an on-island survey.
- The re-run of remote sensing techniques on an annual or biannual basis to further establish and verify risk areas.
- The deployment of a network of weather stations to improve the understanding of rainfall intensity and distribution.

4.3 Waste management

4.3.1 Background

Although Tristan Islanders are still largely self-sufficient, growing their own crops and rearing animals, there is also a supermarket which imports groceries from the UK and, principally, South Africa. Products include flour, sugar, frozen bread, canned goods, and sodas in both cans and plastic bottles. This has inevitably led to an increase in household waste. All food waste such as peelings, leftovers etc., are fed to the Island's 700[23] chickens and ducks, so the bulk of household waste consists of packaging from imported food goods and broken

[23] As of April 2019.

hardware and electrical goods. Household waste is collected by a team of up to seven people, using a tractor and trailer, once a week and then taken to the Island 'landfill' dump which sits on the 1961 lava flow, 985m to the east of the Settlement where it is burned in the open. Hazardous and non-hazardous waste is not separated, and some hazardous waste does end up being burned. In addition, there are areas where large industrial machinery have been dumped throughout the lava flow over several decades.

During the initial consultation process it was requested that this assessment be focused on the potential reputational risk of not addressing the current waste management system on Tristan da Cunha. Initial research however revealed a wider set of interconnecting risks and the scope of the report was broadened to reflect this.

4.3.2 Methods

Using Google Scholar and Google search engines, an extensive literature review, of public attitudes to waste management and reputational risk was conducted. This covered news, environmental, political and business websites, grey literature and peer-review literature. Very little could be found on reputational risk to Governments as a result of not addressing waste management issues, but more so on risks to Businesses. The review however revealed a wider set of risks which Tristan da Cunha ***may*** be exposed to, including health, environmental, reputational and economic. Solutions that have been successful on other small islands were suggested.

4.3.3 Results

With the current waste management system on Tristan there are ***potential,*** interconnected, risks including health, environmental, reputational and economic. Important considerations associated with the confidence that can be attached to these potential risks actually occurring on Tristan were discussed.

Multiple health risks, including breathing problems, have been associated with open burning of waste[24] (research has focused on larger populations with higher quantities of waste). Prevailing westerly winds mean that emissions are largely blown away from the Settlement (Figure 9), but recommendations were made to ensure waste is not burnt in still conditions or when winds are in an easterly direction.

Environmental risks include pollution of farmland and water sources and increased risks of large, lightweight plastics and microplastics reaching the marine environment, where they could be ingested by, amongst other marine species, lobster. It was stressed that over 70% of plastics found in the marine environment around Tristan were thought to be from external sources.

Reputational risk largely stems from the outside perception of Tristan as being a pristine environment, which attracts researchers and visitors from around the world. Global public perception of the impacts of litter, and particularly marine litter, have risen. Recent research shows that searches of 'plastic recycling' rose by 55% following the BBC's Blue Planet II appeal in the final episode, alongside significant growth in searches for conservation charities[25]. Poor environmental performance has been shown to impact investment in, and profits, from business[26]. Economic risk is largely dependent on the potential health,

[24] International Solid Waste Association. Wasted health - the tragic case of dumpsites, 2015.
[25] https://resource.co/article/attenborough-effect-searches-plastic-recycling-rocket-after-blue-planet-ii-12334
[26] Risk unwrapped: plastic pollution as a material business risk. Client Earth report, July 2018.

environment and reputational risks described in previous sections, and if these do not occur then there is little or no economic risk.

Figure 9: Average wind direction for Tristan Island for 2016, overlaid on the Settlement a) and the location of the landfill dump (b).

4.3.4 Conclusions

Tristan Islanders are a resilient community who understand and live within their environment. Their waste management system has, however, fallen behind current best practice and it is suggested that it should be better managed to avoid a series of ***potential***, interconnected, risks. The report draws on a wide range of websites, peer-review and grey literature to provide an overview of these potential risks but **none can be proven without further, on the ground, research.** It is suggested, however that in parallel to, and/or independent of, any future research, steps are undertaken to implement a long-term strategy to improve waste management on the Island.

4.4 Tourism opportunities

4.4.1 Background

Tourism on Tristan is limited due to its remote location. There are several expedition cruise-calls a year where passengers are able to visit the islands for between 1-3 days, or are visited by islanders on-board if it is too rough to land. There were 918 cruise visitor arrivals in the 2017-2018 season, generating net revenue of over £50,000. A few visitors a year arrive on the regular passenger services, but cannot be guaranteed a berth until close to sailing. There are 11 guest houses on the Island, many of which are occupied by Technical Officers during their contracts. The Tourism Centre on Tristan hosts the Café da Cunha, a museum and a wide range of high quality gifts including items hand knitted on the Island. Excellent data and statistics are compiled by the Head of Tourism. The aim of this assessment was to explore new avenues to maximise profits from existing tourism levels, and the possibility of new opportunities including specialist expedition cruise-routes taking in the UK South Atlantic OT islands.

4.4.2 Methods

Working closely with the Head of Tourism, a four-part desk-based study was conducted. This involved in-depth discussions with cruise-ship operators and consisted of:
i) Conduct baseline research of the natural capital on Tristan, describing the tourism products available.
ii) Drawing on the findings of task i) and international tourism demand trends, conduct an assessment of demand for tourism to Tristan.
iii) Identify what is required in order to generate market demand, and create a successful and sustainable tourism industry within the existing limitations described above. Examples from other small, remote island communities will be given.
iv) Assess the potential economic impact of developing tourism on Tristan.

4.4.3 Results

Interviews with cruise operators currently including Tristan da Cunha in their itineraries report highly favourably about their experiences at the destination. They are made to feel very welcome, and visitors rate their experiences highly. The uncertainty of being able to disembark visitors due to sea conditions does not appear to detract from including Tristan in itineraries – the key factor is market demand. Many cruise operators report that one visit to Tristan da Cunha every year or every two years is as much as the market can support.

The expedition cruise sector is expanding rapidly, and there are 28 new expedition-style vessels scheduled for launch over the four years between June 2018 and June 2022. Virtually all of these new vessels are operated on a similar business model: *to go to very unique places, such as Antarctica and the Arctic, and charge a high ticket price while offering an exclusive and safe sense of adventure*[27].

Based on the expected growth of the expedition cruise market over the next five years, and with additional marketing from the Tristan da Cunha Government, it was anticipated that there could be an increase to 10 cruise ship visits per annum by 2024.Assuming an average of 200 passengers on each, a total of 2,000 visitors could be expected to visit the Islands. In addition to the income from immigration, additional expenditure could be generated from shopping, food and drinks, and tours.

Projected income in 2024 was calculated with the following assumptions:

- A review and refresh of Tristan da Cunha branded clothing is made, increasing average spend per visitor in the Island Gift Shop from £11 to £16 (additional £5 per person).
- Engagement with cruise companies to provide a 'Tristan Tea' (similar to those provided in the Falkland Islands) on the assumption it would be sold at £8 per passenger, and 60% of cruise ships would buy into it.
- On-island tour prices (and resulting income) are doubled, in line with international prices and potentially some (low key but effective) guide training.

The impact of these would be to increase net revenue from £50,000 to £135,000, an increase of 171%, and average net revenue per passenger increasing from £54 to £68 (Table 2).

[27] Cruise Industry News and personal communications

Table 2: Projected income from cruise-calls for 2024

Income Item	**2018**	**Projected: 2024**
Passengers	*918*	*2,000*
	£	£
Immigration	28,000	60,000
Venues (Shopping)	17,000	54,000
Refreshments (Food and Drink)	2,000	11,500
Overtime	9,500	21,000
Tours/Events	3,500	15,000
Miscellaneous	1,000	3,000
Total	61,000	164,000
Cost of Sales	11,000	29,000
Net Income	**50,000**	**135,000**
Net Income/Passenger (£)	**54**	**68**

4.4.4 Conclusions

Tristan da Cunha is expected to benefit from the significant growth of expedition cruise vessels and increased consumer interest in Antarctica over the next decade. Whilst being in a remote location, there is growing interest in off-the-beaten track destinations. The potential increase in income will require some changes on the Island in terms of operations and pricing. There were some concerns raised by the Head of Tourism; particularly around the provision of 'Tristan Teas' which will require significant labour from Islanders and the risk of a loss of money should passengers not be able to land. These are not insurmountable however and the report provides useful recommendations for exploiting the rise in expedition cruises.

5 Potential Indicators

The latest Biodiversity Action Plan for Tristan da Cunha[28] sets out 23 indicators under eight objectives. Indicators are useful tools for summarising and communicating broad trends. With small islands with limited resources, it is important that the process of collecting and analysing indicator data does not add a layer of additional input that will not be easily delivered. While some indicators will be territory-specific, it is also interesting and useful at a UK and EU level to be able to compare indicators across OTs.

Through this project, and the individual studies that have been undertaken there are some indicator 'quick wins' that have emerged. These are based on the concepts that, to ensure long term sustainability of the indicator, it will need to use data that is already being collected (or can be collected easily through minimum additions to additional data collection processes), and it will need to be easily replicable. Indicator options for the South Atlantic Overseas Territories that have emerged from the NCA project based on these principles, and enabling cross territory comparison, have been combined with a set of indicators being developed under the UK Government's 25 year plan[29] (Table 3). There is a scoping exercise being undertaken to see whether these indicators are applicable and/or able to be adapted to the UKOTs. For the South Atlantic, the indicators identified by this project were cross-referenced to the indicators emerging from the UK25YEP to explore any possible synergies.

[28] Tristan da Cunha Government and RSPB (2012) Biodiversity Action Plan for the Tristan da Cunha Islands (2012-2016). Tristan Conservation Department, Edinburgh of the Seven Seas, Tristan da Cunha, South Atlantic.

[29] https://www.gov.uk/government/consultations/25-year-environment-plan-measuring-progress

Table 3: Potential NCA indicators and synergies with UK25YEP indicators

					Potential Link back to UK 25YP indicators		
Potential Indicators from NCA project	**Falkland Islands**	**Tristan da Cunha**	**St Helena**	**Ascension Island**	**New No**	**Old No**	**Title**
Tourism: Annual visitors from cruise ships	x	x	x	x			
Tourism: Social media analysis	x	x	x	x			
Tourism: Stats – visitor numbers	x	x	x	x			
Cultural – 4 Qs from cultural survey on well-being (replicated for public Health)	x	x	x	x	F6	H16	Health and well-being benefits
Fisheries	x				D1	H18	Healthy Seas: fish and shellfish populations and functioning marine food webs
EO – Annual satellite image	x	x	x	x	N/A	N/A	N/A
Erosion	x	x	x	x			
Waste	x	x	x	x	H3	H34	Residual waste arising by type and sector

The scoping exercise also looked at the relevance of the UK25YEP to the UKOTs beyond this project, and suggest the following process is undertaken to establish this (Figure 10) where the starting point is the OT policy framework. On many of the islands this policy framework is established and indicators have already been identified. Synergies with the emerging UK25YEP indicators could then be easily established through matching existing OT indicators to UK2YEP ones via the step-by-step process outlined in Figure 10.

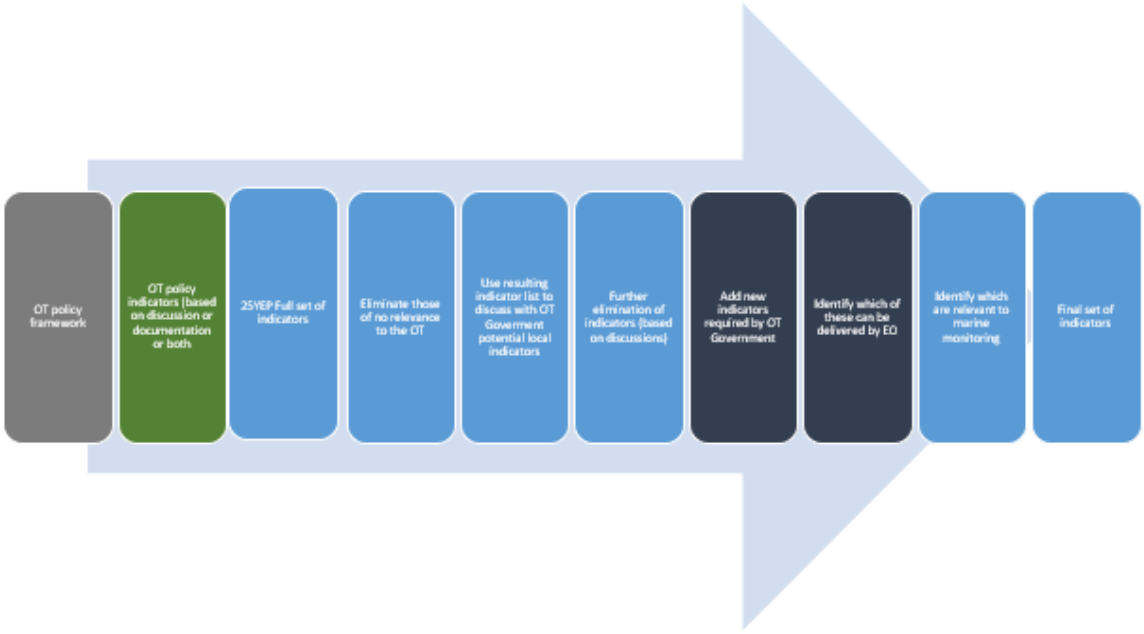

Figure 10: Proposed approach to developing UK2YEP indicators in the South Atlantic Overseas Territories.

It is suggested that:

- Building on the NCA work, data for the indicators identified through the project in table 3 continues to be collected, and the indicators continue to be measured on an annual cycle establishing progress against the baseline set during (or before in some cases) the project.
- As the UK2YEP indicator process progresses, this table is reviewed and updated. The process outlined in Figure 10 is followed step-by-step if wider more holistic overview of synergies between OT and UK25YEP indicators continues to be sought for the long term.

6 Conclusions and future options

Tristan da Cunha has a resilient community that maximises the benefits it can derive from its natural capital within the significant constraints of its isolation. The community faces a number of decisions about their future.

The Island's population is falling and current immigration policies are under review; this could affect traditional values and how Islanders benefit from their environment. It would be useful to re-run the cultural ecosystem services assessment with face-to-face interviews to provide a solid baseline to monitor potential change.

The erosion risk model has provided preliminary evidence which confirms the vulnerability of Tristan Islanders to landslides through natural erosion processes. There is an urgent need to conduct more detailed, on the ground, research to understand how these processes work and how the risks can be mitigated.

Although the risks associated with open burning of household waste cannot be proven on Tristan da Cunha without further research, it would seem prudent that measures are taken to make some simple changes to the current waste management system. These could include including avoiding burning waste on still days or during easterly winds, community clean-up days and continued education. Ideally. Funding for a small-scale incinerator should be sought.

Tourism is already a well-managed and profitable small scale industry for Tristan da Cunha. Due to its isolation tourism numbers will never be high, but the measures set out in the Tourism report – such as creating a Destination Cruise Manual tour operators – could help to capitalise on the growing expedition cruise market and the interest expressed by operators during the desk study.

Natural Capital in the UK's Overseas Territories Report Series: South Atlantic Region. *Tristan da Cunha Natural Capital Assessment*. Smith, N. May 2019. . ISSN 2515-1320.