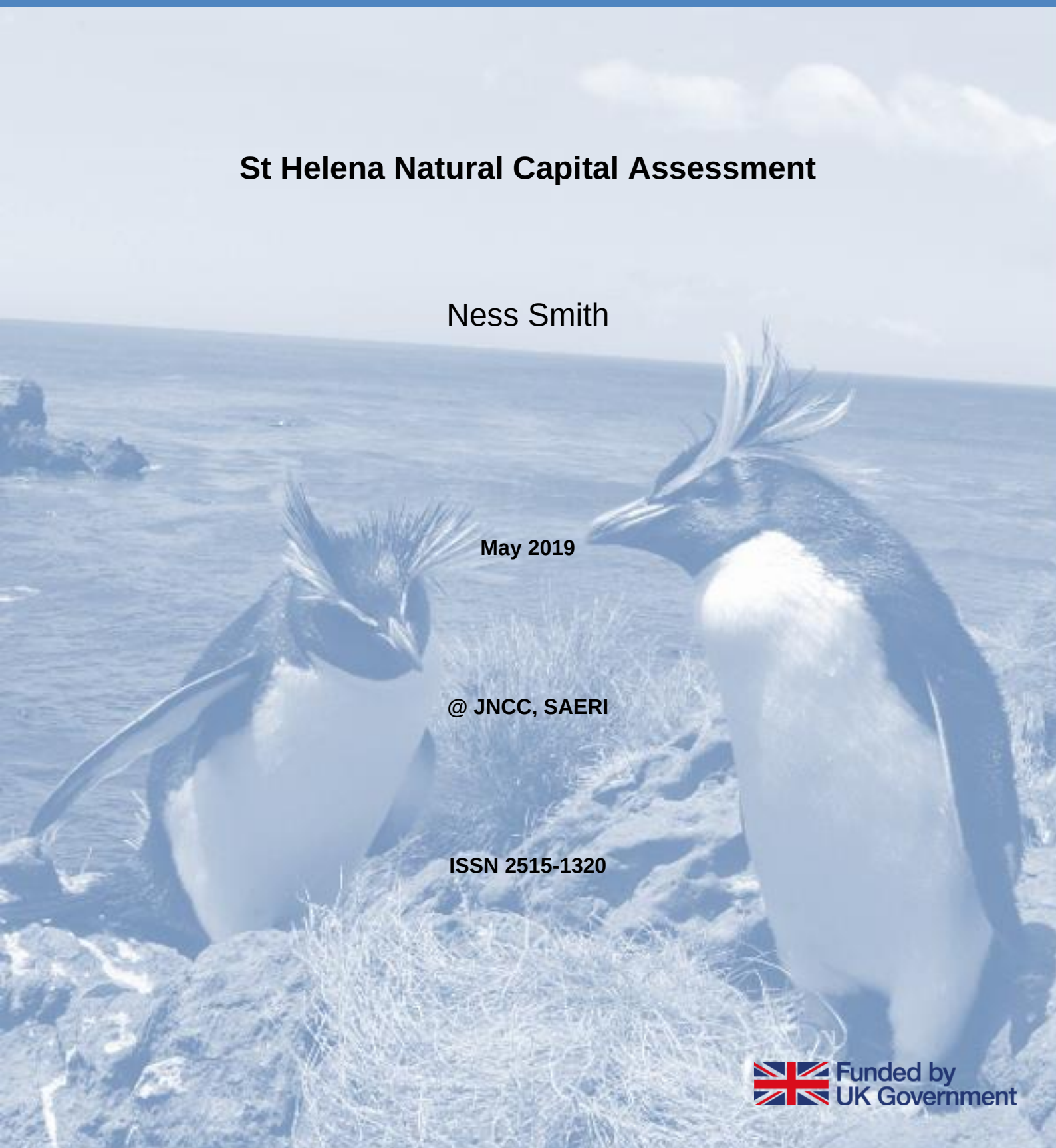

NATURAL CAPITAL IN THE UK'S OVERSEAS TERRITORIES REPORT SERIES SOUTH ATLANTIC REGION

St Helena 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.

Natural Capital in the UK's Overseas Territories Report Series South Atlantic Region

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'.

Summary

This report summarises processes and outputs from the South Atlantic Natural Capital Project on St Helena. 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 St Helena. Section 4 provides an overview of project governance, stakeholder engagement and the overarching approach it took on St Helena. Outputs from the assessment can be found in section 5 and cover;

- Land use modelling using Bayesian networks and QGIS
- Water security Cost Benefit Analysis
- Waste management Cost Benefit Analysis
- Constraints mapping for a new landfill site
- Cultural ecosystem services
- Social media mapping
- Marine tourism valuations
- Natural Capital Accounts

In section 6 are suggestions for potential natural capital indicators whilst section 7 sets out conclusions and options for further 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 an 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].

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

[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

[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

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 St Helena

3.1 Geography

St Helena is located at -15°56' latitude and -5°43' longitude lying roughly 2,900km from the coast of South America and 1,950km from the west coast of Africa (Figure 2). It is volcanic in origin and is the result of two separate eruptions from a volcanic hotspot starting around 15 million years ago[7]. It rises 4000m from the seabed, with only 5% above the surface. Its terrestrial area is122km^2 including the small offshore islands and stacks in the near shore waters.

The highest point on the island is Diana's Peak at 818 metres. It is rugged with small scattered plateaus and plains, with the largest area of level ground on the island being Prosperous Bay Plain in the eastern arid area. It is cut through with steep sided valleys (or gulches) that run down to sea level with the capital, Jamestown, sited within one such valley in the north west.

St Helena's EEZ is vastly larger than its terrestrial area, extending to 444,916km^2. With the exception of a narrow shallow shelf around the island, its waters are oceanic and contain a chain of seamounts formed as the Island moved away from the St Helena volcanic hotspot.

contract 07.0307.2013/666363/SER/B2, European Commission, 209 p + 3 Appendices.

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

[7] Claudia Adam, Valerie Vidal, Javier Escartín, 80-Myr history of buoyancy and volcanic fluxes along the trails of the Walvis and St. Helena hotspots (South Atlantic), Earth and Planetary Science Letters, Volume 261, Issues 3–4, 2007, Pages 432-442, ISSN 0012-821X, https://doi.org/10.1016/j.epsl.2007.07.005.

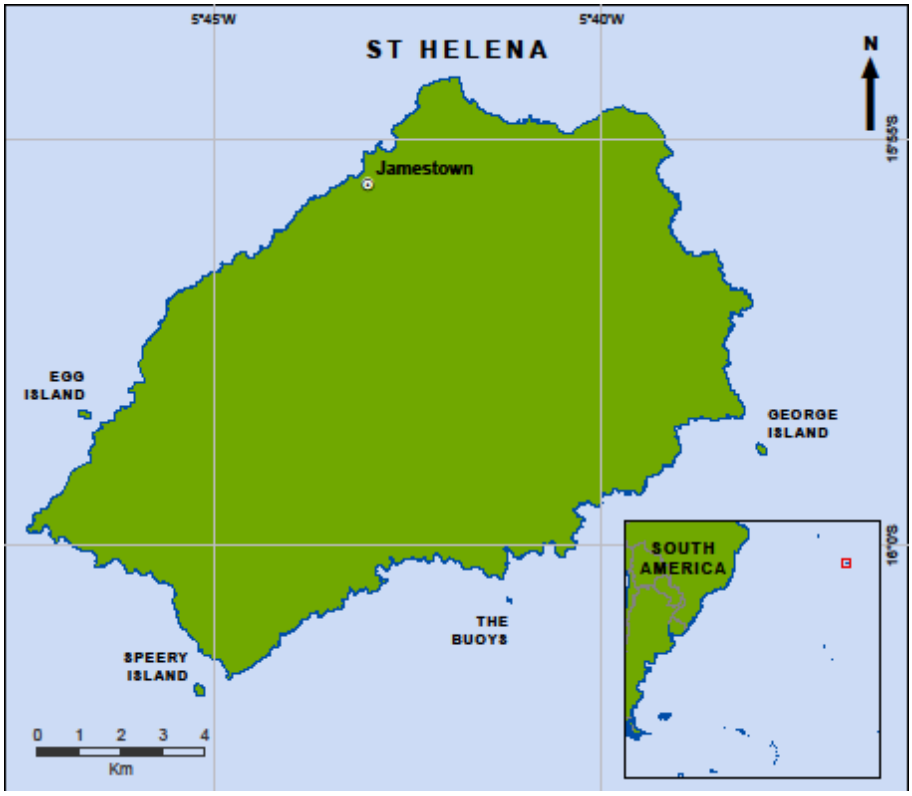

Figure 2: Location of St Helena and its capital, Jamestown.

3.2 Governance

St Helena, Ascension and Tristan da Cunha are considered as one Overseas Territory (OT) of the United Kingdom, and the latter two ceased to be termed dependencies 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 Governor presides over the Legislative Council on St Helena, but Defence and Foreign Affairs continue to be the responsibility of the United Kingdom.

St Helena has a body of twelve locally elected members who, along with a Speaker, and Deputy Speaker – neither of whom has a vote – and three Ex Officio Members (The Chief Secretary, Financial Secretary, and Attorney General – also with no vote) make up the Legislative Council. From within this council, five members are elected to sit on the Executive Council, along with the three Ex Officio Members, which advises the Governor in most areas of government policy (St Helena Government 2016b). Its legal system is based on English law but St Helena has the power to make its own legislation allowing the creation of Ordinances.

St Helena Government (SHG) constitutes the Islands' civil service and is headed up by a Chief Secretary and divided into seven Directorates which are supported by a number of specialist Directors[8].

3.3 Population

St Helena was first permanently colonised in 1659 but had been used since its discovery in 1502 as a source of food and water, with sailors importing livestock, vegetable and fruit trees

[8] http://www.sainthelena.gov.sh/constitution/

to the island. At the last full census in March 2016, the population of St Helena was 4,534 with a population density of 37.2 people/km^2, which is the highest density of all the South Atlantic territories.

Just under a quarter of people live in Jamestown with the remaining population distributed in settlements across the island. The population has always fluctuated in response to geopolitical events, but between 1987 and 2008 the population fell quite significantly due to a combination of a declining birth rate and increasing numbers of Islanders seeking employment overseas.

Table 1: Population of St Helena, 2016. Source, St Helena census 2016.

Household Population and dwellings by administrative district, 2016					
Administrative District	**Number of People**	**Number of Occupied Dwellings**	**Average (mean) household size**	**Area (sq miles)**	**Population Density (per sq mile)**
Jamestown	629	282	2.2	1.5	419
Half Tree Hollow	984	409	2.4	0.6	1640
St Pauls	843	363	2.3	4.4	192
Blue Hill	158	73	2.2	14.2	11
Sandy Bay	193	82	2.4	6.2	31
Levelwood	369	154	2.4	5.7	65
Longwood	790	319	2.5	12.9	61
Alarm Forest	383	163	2.3	2.1	182
Total	**4,349**	**1,845**	**2.4**	**47.6**	**91**

In 2002 St Helenians were reinstated with British Citizenship which added to the outward migration which had already started when many people moved to the Falkland Islands for work following the 1982 conflict. Many St Helenians work on Ascension Island, the Falkland Islands and in the UK. Since 2008 the population has shown steady growth, with people returning to the Island with the opening of the airport in 2017. According to the census in 2016 there were 416 non-St Helenians living on the Island, many working on short-term (2-3 year) contracts.

3.4 Economy

St Helena's economy is largely reliant on financial aid from the United Kingdom's (UK) Department for International Development (DFID), receiving £27.1m from them in 2018[9]. In 2017/18, £13.1m of local revenue was generated, £10.3m of that coming from Taxes and Customs duty. Pole and line caught tuna and coffee are St Helena's two main exports. SHG is one of the Islands' biggest employers, and unemployment is low; in 2016 there were 76 people unemployed and looking for work.

Tourism is now the biggest contributor to St Helena's economy. The difficultly in accessing the island kept tourist numbers low. To help stimulate the economy, DFID funded a new runway and airport for the Island, which opened to commercial flights in the autumn of 2017, following wind-shear problems on its initial launch in 2016. Visitors, including returning Islanders visiting friends and family, now total around 3,000 a year, with a steady year-on-year increase. Income from tourism was estimated at £3m in 2018.

[9] DFID Overseas Territories Profile: July 2018

St Helena has a long tradition of subsistence fishing, and began selling fishing licences to foreign-flagged tuna vessels in 1988; most of the tuna-fishing however was conducted in Ascension Island waters, and a number of attempts to establish a viable commercial fishery appear to have failed. Currently there is a one-by-one 'St Helena tuna' fishery and branding, in partnership with the International Pole and Line Foundation. All fish exports in 2017/18 totalled £291,000. There is a fish processing factory in Ruperts Valley, owned by SHG and run by the St Helena Fish Corporation (SHFC), which has been operating at a loss. SHG sought outside investment for the SHFC in July 2018, but this has not yet transpired.

Meat is produced on the island for local consumption in the form of pigs, cattle, sheep, goats and poultry. Production is sufficient to sustain the population and is supplemented by imported meat. Vegetables are also produced, and supplementary fresh fruit and vegetables are also imported. Honey production is important on the island as none can be imported due to biosecurity; it has potential for growth and export. Small scale coffee production is one of St Helena's best-known exports, amounting to £34,000 in 2017/18. It costs circa £60 for 100g in the UK. Mixed stands of forestry produce timber and firewood for local production, but none is exported[10].

3.5 Environment

St Helena's climate is moderated by the Benguela current and is classified as sub-tropical, maritime and mild. High variability exists across the island both laterally and in altitude, with a temperature decrease of 1.3°C for every 100m rise in elevation. Temperatures range from 20-28°C in summer months and 17-24°C for the remainder of the year. Winds are predominantly south-easterly trade winds, making the weather changeable, whilst rainfall is often very localised.

Due to its geological age and isolation, St Helena is home to 612 endemic species, which is almost a third of the endemic species in UK. Humans, along with the introduction of invasive mammals and plants over many centuries has drastically changed the islands flora and led to the extinction of many species, particularly birds and plants. Grazing mammals, left by early sailors, destroyed much of the native flora, and endemic trees were cut for timber and firewood, destroying much of the island's great forests.

Ecological zones on St Helena are mainly determined by altitude (UKOTs Online Herbarium 2011). At sea level a rocky, barren coastal zone extends almost all the way around the coast. Although it prefers grazed pasture land, 30% of the critically endangered St Helena plover (wirebird) population resides in this semi desert area. At slightly higher altitudes, areas of dry scrub species have developed; where once endemic species such as the St Helena ebony tree used to thrive, invasive species now dominate. Mid-altitude regions would once have been dominated by endemic gumwoods, now critically endangered, but are now occupied by a mixture of invasives including wild mango, African fountain grass, spoor and black olive trees. The upper mid-altitude belt, once dense with moist gumwood forests, is now dominated by pine, blackwoods and Eucalyptus trees, whilst understory species such as the black scale fern have been lost.

Cloud forest would have occupied most of the higher slopes across the island, but is now restricted to an area just 0.7km^2 on the two highest points on the island. This small patch alone hosts around 119 endemic species that are not even found anywhere else on the island, including three species of cabbage trees, lobelia, and the spiky woodlouse[11].

[10] http://www.sainthelena.gov.sh/statistics-data/external-trade10042019/

[11] Regional ecosystem profile – South Atlantic Region. 2016. EU Outermost Regions and Overseas Countries and Territories, Maria Taylor, Tara Pelembe & Paul Brickle. BEST, Service

St Helena's marine environment supports a diverse array of marine life, including many endemics. Nearly 780 marine species have been recorded, at least 50 of which are endemic species. Inshore habitats include large boulders and bedrock reefs; both white and volcanic sandy areas and regions covered in cobbles and maerl. There are no reef- building corals around St Helena, but there are ten species of octocoral including the endemic orange cup coral. Large schools of 'cunningfish' – the St Helena butterflyfish – dominate many inshore reefs, along with jacks, groupers and moray eels.

The surrounding ocean is important for migratory species including humpback whales and turtles, as well as resident populations of dolphins. Large aggregations of adult male and female whale sharks appear during the summer months, and it is thought that they are coming to St Helena to breed. Commercial fish species, particularly yellowfin and bigeye tuna are found within the EEZ, particularly around seamounts. Eight species of seabird, including red billed tropicbirds and Madeiran storm petrels, nest on the stacks and islands surrounding the main island[12].

SHG has a suite of ordinances to protect and manage both terrestrial and marine environments. Under the Land Development Control Plan, SHG has designated 23 National Conservation Areas (which includes built heritage), including Peaks National Park, and the entire marine EEZ was designated as a category VI (Sustainable Use) MPA in 2016.

4 Project Governance, general approach and stakeholder engagement

4.1 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[13]. 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. A member of the Legislative Council sat on the St Helena Territory Advisory Group and acted as an important conduit between wider stakeholders and the Council. 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).

[12] SHG Environment Management Division. St Helena Seabird Report, 2004-2011.
[13] Professor Georgina Mace, Professor Melanie Austen, Dr Pieter van Beukering, Nicholas Conner and Dr Emmanuelle Quillérou.

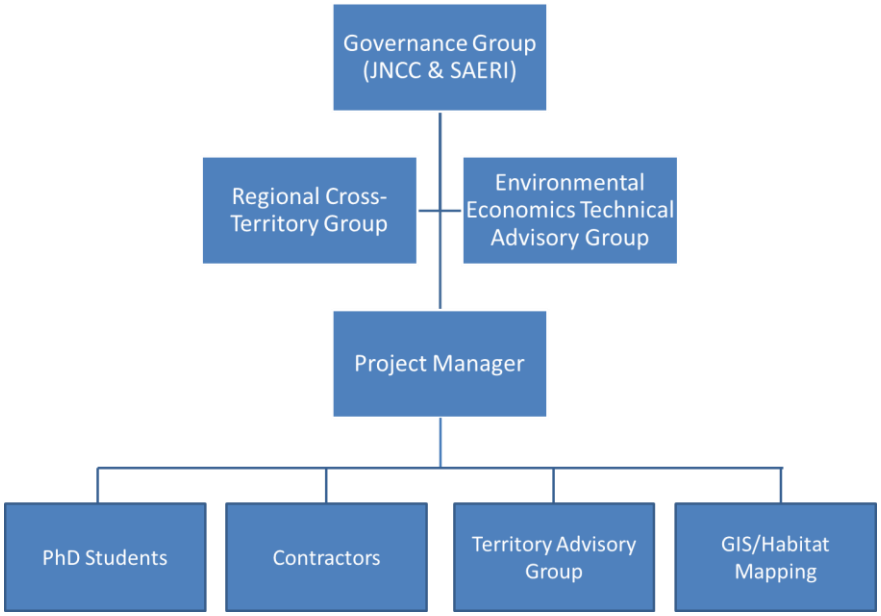

Figure 3: Governance structure of the South Atlantic Overseas Territories Natural Capital Assessment Project

4.2 General approach on St Helena

With just 122km^2 of land, much of which is not available for development due either to topography or statutory protection, multiple and conflicting land use emerged as a key issue during early stakeholder consultation. The main body of work on St Helena therefore focused on developing a land-use model to evaluate ecosystem services associated with current land uses, and the changes to these under a range of scenarios for St Helena's future (Figure 4). Further assessments which would either feed into the model or have wider policy application included two Cost Benefit Analyses, a cultural ecosystem services assessment and a survey to establish the willingness to pay for whale shark tourism. Funds to develop a series of Natural Capital Accounts, building on work already conducted, were secured and these were developed towards the end of the project.

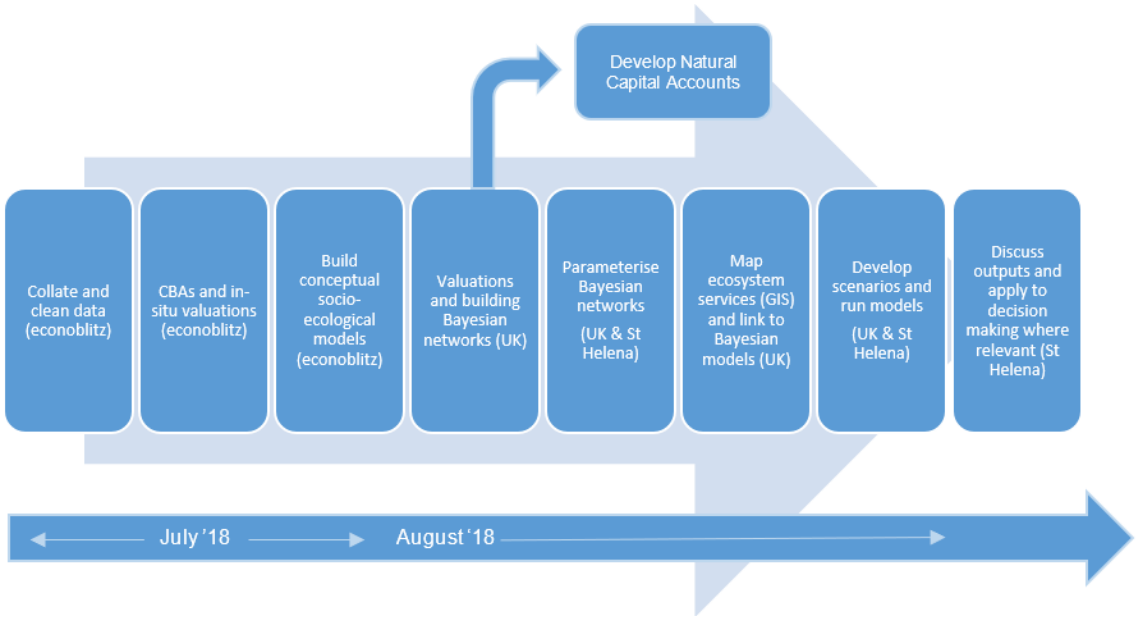

Figure 4: Key stages in the NCA process on St Helena.

4.3 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 team visited St Helena between 20th-27th January 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. A wide range of stakeholders including the Governor, Government officials as well as farmers, NGOs and utility providers were consulted. The project was presented at a full Legislative Council session. A full day workshop, attended by 25 people, was held on Friday 26th January where basic training in natural capital approaches was provided and participants identified, then prioritised through a sticky-dot voting system, what should be assessed within the project (Table 2).

Table 2: Outputs from scoping consultation, January 2018

Project/question	# Votes
Drought mitigation: **• Economic valuation of a reservoir in Fisher's Valley to increase water storage x 10, to safeguard against drought versus other options – desalination. EIA, pros and cons.**	12
What is the cultural and heritage value of St Helena? (combined)	11
Waste Management: **• Economic valuation of existing landfill to drive commitment to increase design life against construction of a new site – and where? (Recycling)**	11
What is the value of the forestry & agricultural estates in terms of food security and other benefits? (combined)	8
What is the value of the Peaks National Park from an ecosystem services perspective?	7
What is the value to the visitor of a well-managed natural environment? How much would visitors be willing to pay for nature's products?	7

A Territory Advisory Group was established and consulted on during development of a series of proposals for the assessment. The project manager visited the island again for a month in May/June 2018, and was hosted by SHG within the Governor's Office. During this time meetings with the Territory Advisory Group, individual stakeholders from Government departments, and elsewhere, took place to discuss assessments in more detail, identify suitable data to conduct the work and how these outputs might be applied in decision making, policy and planning. A public meeting was also held, which was attended by four members of the Legislative Council as well as members of the public.

The wider NCA team devised a two-week 'econoblitz' concept where a team of data specialists, economists and stakeholder engagement specialists would rapidly advance NCA work on the island through on island collaboration and a series of half-day workshops and with a small number of key stakeholders for each assessment. This took place in July 2018 but was reduced to just four days as flights to the Island were cancelled due to bad weather. Some workshops were conducted by skype and high levels of stakeholder input were still achieved.

A further two-week visit to St Helena took place in October/November 2018 to work with stakeholders to parameterise the Bayesian network/land-use model and to develop scenarios to feed into it (see section 5.1). The two scenario workshops were attended by senior representatives from SHG, including the Island Councillor with the Environment Portfolio, Chief Secretary and Head of ENRD, NGOs and other key stakeholders.

In March 2019 the project held a conference on St Helena to present outputs and facilitate cross-territory dialogue. The conference was attended by up to 120 people per day, including representatives from junior and senior schools, and was broadcast across the Island and worldwide. The NCA project team took this opportunity to meet with key stakeholders, focusing on how outputs from the project could be applied in decision making. Outputs were also presented to the Legislative Council. Consultations and training on Natural Capital Accounts were conducted at this time, but cut to just a few days, also due to postponed flights.

All project outputs were reviewed by key stakeholders before being finalised.

5 Outputs

5.1 Land use modelling using Bayesian networks and QGIS

5.1.1 Background

Land use planning is a major challenge on St Helena, where space is at a premium and there are multiple and competing uses of the land. Stakeholders were interested to understand the range of ecosystem services provided by the Peaks National Park, as well as those provided by the forestry and agricultural estates, and the sorts of trade-offs needed to balance these and other competing uses. Modelling, using a Bayesian network approach, was identified as a useful way to show the spatial distribution and level of ecosystem service provision of food production (crops, livestock, coffee and honey), timber, firewood, water supply, flood and erosion prevention, and recreation as well as to identify opportunity areas and changes in ecosystem service provision as a result. A Bayesian network was chosen specifically because it allows a wide range of qualitative and quantitative data to be integrated with stakeholder knowledge, and represents the links between different elements of natural capital and the ecosystem processes that contribute to ecosystem services.

5.1.2 Methods

An initial socio-ecological map was built through extensive stakeholder engagement and from this the Bayesian network (BN) was developed using the Netica software package[14]. The key input into the Bayesian network is the habitat map of St Helena[15], which was simplified to include the main natural and introduced habitats and important land uses. The model includes other natural capital assets including soil quality, slope, altitude, and precipitation. The spatial element of the BN analysis was undertaken in R using the 'bnspatial' package[16] (CEH and NERC, 2019). Pixel resolution of the input and output maps is 100 x 100m (i.e. 1 hectare). Scenarios were developed through two stakeholder workshops and fed back into the model (Figure 5) to identify a) areas for potential expansion of ecosystem services and b) changes in other ecosystem services as a result of land use change.

[14] Produced by the Norsys Software Corp https://www.norsys.com/netica.html. There are a number of BN software packages available. Netica was used initially as it has a relatively straightforward user interface.

[15] https://data.saeri.org/saeri_webgis/lizmap/www/index.php/view/map/?repository=01sh&project=saint_helena_web

[16] A further intermediate stage was required as Netica does not directly interface with R. Netica files were imported into another Bayesian networking package, GeNIe, then saved into a format readable by R. Future application of the approach, or amendments to the current model, could be achieved using a BN package readable by R (e.g. GeNIe, Hugin) or through suitable R packages (e.g. bnlearn)

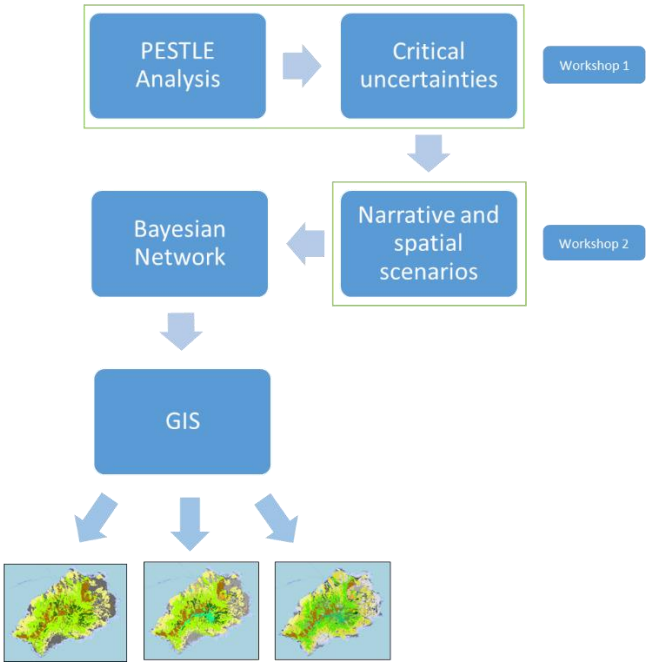

Figure 5: Scenario process feeding into the Bayesian Network, GIS and spatial outputs

5.1.3 Results

The provision of food, timber and firewood reflect the locations of those land uses, but are also enhanced or constrained by other aspects of natural capital (Figure 6). Each land use contributes to a wider range of ecosystem services. The potential for those ecosystem services depends on the intensity of land use and the characteristics of the where it occurs. For example, provision of clean water and flood risk reduction are higher where the land uses such as forestry are able to slow down the flow of water and where slope is not too high. Pollination relies on diverse habitats.

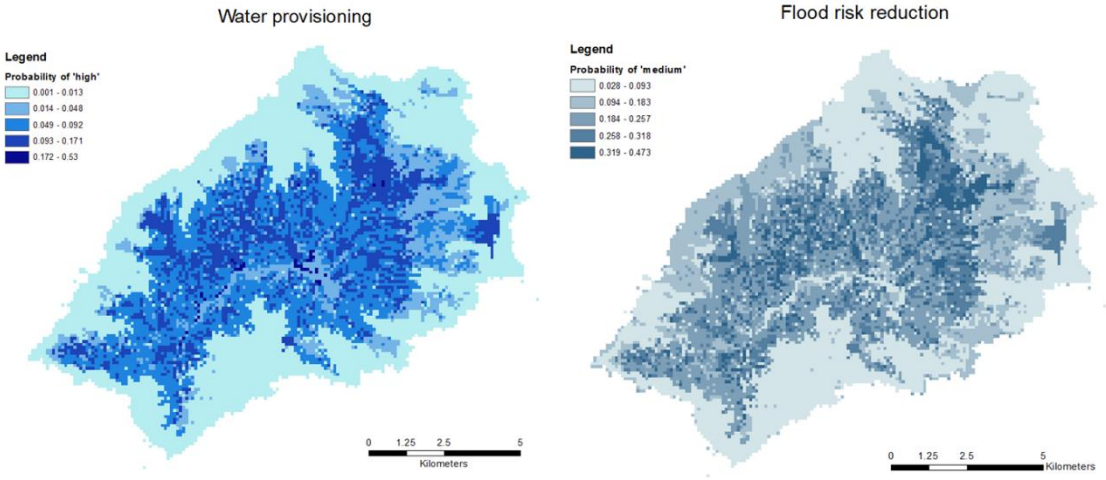

Figure 6: Examples of current ecosystem service provision outputs from the Bayesian network. Darker colours indicate greater service potential.

Scenarios applied to the model included: expansion of forestry for timber and fuel, expansion of horticulture, coffee and honey and removal of flax to replace with timber or native woodland. Opportunity areas for expansion were mapped (Figure 7) as well as the impacts these would have on other ecosystem services (Figure 8).

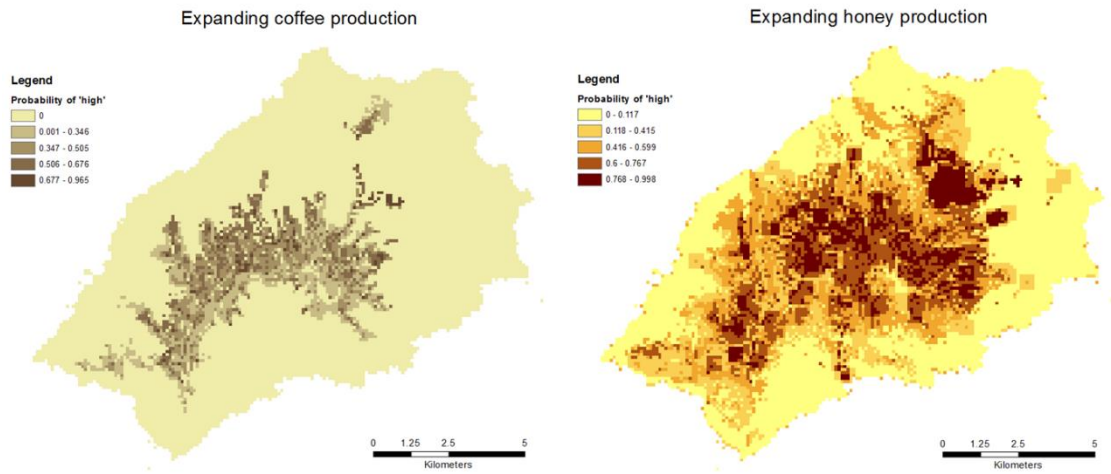

Figure 7: Examples of opportunity maps for future land use change

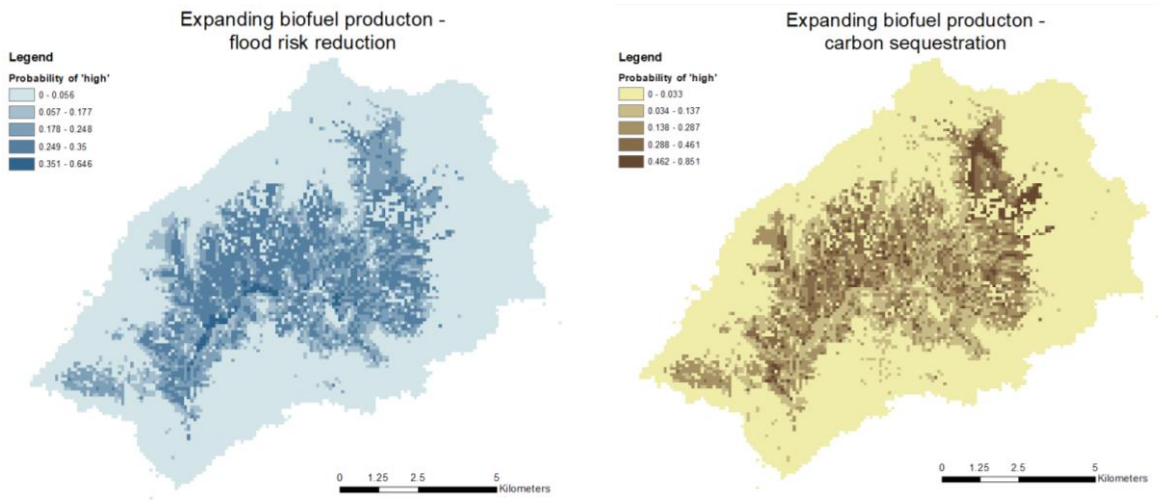

Figure 1: Expanding biofuel production; impacts on flood risk reduction and carbon sequestration.

5.1.4 Conclusions

The land use model, using Bayesian networks and QGIS, has helped stakeholders to think more about the interactions between ecosystems and the services they provide and brought different management sectors together to discuss a more integrated approach to land management. The outputs were well received by all stakeholders and multiple uses were identified across SHG. Primarily, it helps to fill a gap in evidence-based land use planning and will be used to inform the spatial application of the revised SHG Land Use Development Plan in the summer of 2019. A WebGIS version of the outputs, along with an interactive tool which will allow users to change land use within the model, has been developed. Further training and support in using these spatial tools will be required.

5.2 Water security Cost Benefit Analysis

5.2.1 Background

St Helena has suffered from a series of water shortages over the last few years, initially due to old infrastructure causing leakages, but also due to changing weather patterns and less rain. During these drought conditions, Connect St Helena had to truck water to individual

communities when their local reservoirs and boreholes were unable to meet their needs. Infrastructure has been improved significantly, but there is still a lack of storage capacity should the island experience one-two years without rainfall. Predictions of increasing tourism, following the commencement of flights from to St. Helena are expected to lead to more people on the island, and increased overall demand, thus the need for appropriate water management measures to manage supply and demand. The St Helena agricultural development strategy is also likely to lead to greater demand for water for irrigation and food processing.

One solution is to build a new reservoir at Fisher's Valley, which was identified as the only feasible site during a scoping study. The potential site was initially located within a candidate Ramsar wetland, but the footprint has now been moved further away. A pre-feasibility study, including construction costs, had already been undertaken. It was agreed to conduct a Cost Benefit Analysis (CBA) to estimate changes to the economic wellbeing of local and wider communities in response to different management approaches to water security, including the building of the new reservoir.

5.2.2 Methods

Cost Benefit analysis (CBA) involves estimating and comparing the costs and benefits of implementing a proposed project or management activity, with the costs and benefits of a 'base case', which represents a continuation of current conditions under which the proposed project/ policy is not implemented. In the case of a CBA for water security options, the Base Case would represent a continuation of the current approach to water collection, storage and supply (i.e. a 'business as usual' situation), The costs and benefits of alternative management options were then compared with the costs and benefits of the Base Case to identify any incremental differences between the base case and the alternative approaches.

Alternative approaches identified were: Construction of a new reservoir at Fishers Valley; construction of a desalination plant and; a package of mixed measures including the use of mist-capture devices. Technical, environmental and institutional aspects were considered for each alternative, along with risks and opportunities. Options with a positive net present value and a benefit cost ratio greater than one are considered feasible, with the option with the highest positive NPV and BCR being the most preferred. Discount rates of 4%, 7% and 10% were applied to each alternative.

5.2.3 Results

The proposed new reservoir at Fisher's Valley would ensure security of supply due to the large increase in overall capacity. However, the benefit-cost estimation was sensitive to the assumptions of how the benefits of the additional supply were valued (based on potential revenues). Given the water security objective of this option, valuing total capacity rather than just volume supplied would be reasonable (i.e. the full supply option in Table 3) and provides positive net benefits.

The desalination option, did not have positive net benefits except under assumptions of the lowest cost. Given the scale of current desalination plants, it is likely that any plant would be underutilised. Option 4 considered mixed approaches; these were analysed separately so they could either be used in combination or individually.

Restoration of native cloud forest habitats were also evaluated. Sansom et al. (2018) estimate that 16ha of cloud forest restoration could contribute an additional 33% to treated water supply. Based on the potential revenue of that water supply alone, restoration would incur a significant net loss. However, the CBA does not include the wider ecosystem service benefits of habitat restoration, in particular with respect to biodiversity, culture including tourism, and reduced flood and erosion damage.

Mist nets were found to have potentially the highest net benefits per unit of water collected, although this did vary considerably depending on assumption of net size and installation cost. Their use, however, is likely to be infeasible due to planning restrictions and existing land cover. It was also not possible within the scope of this analysis to determine the scale of mist net installation that could be applied on St Helena, and whether a meaningful contribution to water supply could be achieved.

Table 3: Present value and benefit/cost ratios of Fisher's Valley reservoir option. Costs and benefits over the life of a project are discounted to today's value and subtracted to give a net present value (NPV) and a benefit cost ratio (BCR). Options with a positive net present value and a benefit cost ratio greater than one are considered feasible, with the option with the highest positive NPV and BCR being the most preferred.

Present value	Discount rate		
	4%	7%	10%
Benefits (£)			
Full supply	5,737,061	3,954,632	2,825,992
50% supply	2,868,531	1,977,316	1,412,996
Costs (£)	3,666,652	3,666,652	3,666,652
Net benefit (£)			
Full supply	2,070,409	287,980	-840,660
50% supply	-798,122	-1,689,336	-2,253,656
Benefit-cost ratio			
Full supply	1.56	1.08	0.77
50% supply	0.78	0.54	0.39

5.2.4 Conclusions

The CBA has shown that in terms of water storage, and within the limits of the available data, constructing a new reservoir at Fishers Valley has positive net benefits. It also shows that a mixed approach, including mist nets and natural forest regeneration, could help to provide more water to keep supplies topped-up. Desalination, except under lowest cost assumptions did not have positive net benefits. This CBA can be used by Connect St Helena when considering an application to build a new reservoir and also highlights the importance of natural cloud forests in water provisioning on the island.

5.3 Waste management Cost Benefit Analysis

5.3.1 Background

At the present rate of waste disposal, the current landfill site at Horse Point (HPLS) will have a life of approximately ten more years before it will be full. Expected increases in visitor numbers and improved consumption associated with increasing standards of living, are expected to increase volumes of waste needing disposal. Once the capacity of the site has been reached, a new landfill site will need to be found and developed at a different location. Given the shortage of suitable sites, additional short-term and longer-term solutions are needed to defer the need for a new landfill site, while managing St. Helena's waste to prevent public health and environmental concerns. It was agreed to conduct a Cost Benefit Analysis (CBA) to estimate changes to the economic wellbeing of local and wider communities in response to different management approaches to waste management on the island.

5.3.2 Methods

Cost Benefit analysis (CBA) involves estimating and comparing the costs and benefits of implementing a proposed project or management activity, with the costs and benefits of a 'base case', which represents a continuation of current conditions under which the proposed project/ policy is not implemented. In the case of a CBA for waste management options, the Base Case would represent a continuation of the current approach to waste collection, treatment and disposal (i.e. a 'business as usual' situation). The costs and benefits of alternative management options were then compared with the costs and benefits of the Base Case to identify any incremental differences between the base case and the alternative approaches.

Alternative approaches identified were: A new landfill site at Donkey Plain; purchase and operation of an incinerator and; mixed measures of reuse, composting and recycling. Technical, environmental and institutional aspects were considered for each alternative, along with risks and opportunities. Costs and benefits over the life of a project are discounted to today's value and subtracted to give a net present value (NPV) and a benefit cost ratio (BCR). Options with a positive net present value and a benefit cost ratio greater than one are considered feasible, with the option with the highest positive NPV and BCR being the most preferred. Discount rates of 4%, 7% and 10% were applied to each alternative.

5.3.3 Results

The option to build an incinerator did not pass the benefit-cost test on its own merits, but the net costs did compare favourably with a new landfill option.

The reuse, composting and recycling option did have a positive net present value, indicating that this was the best option in economic terms (Table 4). The success of this option relies on reused materials (glass) and compost being acceptable and markets being available for exported recyclables and is particularly reliant on the value of recycled aluminium. This suggest that encouraging substitution of aluminium for other forms of packaging would be beneficial.

It might be expected that costs will increase as greater levels of separation are required (either before or after collection), the incidence of that cost will depend on the whether separation is by households and businesses or at waste management facilities. The ease of separation may also be an important driver of uptake by households and businesses. In turn, the 'quality' of separated wastes might impact on the marketability and acceptability of reused and recycled products, e.g. whether quality requirements are met.

The analysis only focused on the direct and indirect costs and benefits of the waste management operations. Each option may impose further costs on households in proximity to the associated waste facilities, e.g. due to noise, traffic, emissions. The incinerator option would also have higher greenhouse gas emissions due to the use of diesel fuel. The processing machinery used for the other options may be electrically driven offering the potential to use renewable energy, but these costs were not included in the analysis).

Table 4: Present value and benefit/cost ratios of reuse, composting and recycling options. Costs and benefits over the life of a project are discounted to today's value and subtracted to give a net present value (NPV) and a benefit cost ratio (BCR). Options with a positive net present value and a benefit cost ratio greater than one are considered feasible, with the option with the highest positive NPV and BCR being the most preferred.

Present values	Discount rate		
	4%	7%	10%
Benefits(£)			
1. Plastic baled and recycled	1,272,122	948,963	739,152
2. Plastic chipped and landfilled	1,131,913	844,372	657,686
Costs (£)			
1. Plastic baled and recycled	592,193	456,808	368,910
2. Plastic chipped and landfilled	572,176	462,761	391,723
Net present value (£)			
1. Plastic baled and recycled	679,929	492,154	370,242
2. Plastic chipped and landfilled	559,737	381,611	265,963
Benefit-cost ratio			
1. Plastic baled and recycled	2.15	2.08	2.00
2. Plastic chipped and landfilled	1.98	1.82	1.68

5.3.4 Conclusions

This CBA showed the clear economic benefits to SHG of advancing its reuse, composting and recycling strategies. Whilst a new landfill site, or other solution such as an incinerator, will be needed at some point in the future, efforts to conserve the lifespan of the current HPLS through 'zero waste' management policies was identified as the most economic option over the timescale of the CBA. SHG will use this CBA to help inform future decisions on the future of waste management on the island.

5.4 Constraints mapping for a new landfill site

5.4.1 Background

As part of the waste management CBA described in section 5.3, a constraints mapping exercise was conducted to help identify potential areas for a new landfill site, which was one of the alternative options to the business as usual situation.

5.4.2 Methods

Requirements for a new landfill site were identified and a minimum size for the site, to ensure it had an adequate life span, was set at greater than 10 hectares. Other requirements, or constraints, included both environmental and socio-economic factors, for example; a minimum distance from water sources, agricultural land, national conservation areas and urban areas and maximum steepness of slope.

Data were checked for availability and modified where appropriate. They were processed in QGIS to provide a series of vector data which were then converted to raster files. Cell size was equal to 10x10m. Raster files were clipped to the land mass of St Helena and combined. Combined raster files showed values ranging from 7 (not suitable, many constraints overlapping) to 0 (suitable, no constraints on the map). Finally, values were converted into a

qualitative scale of “suitable-unsuitable” and all potential sites over 9.9 hectares were extracted.

5.4.3 Results

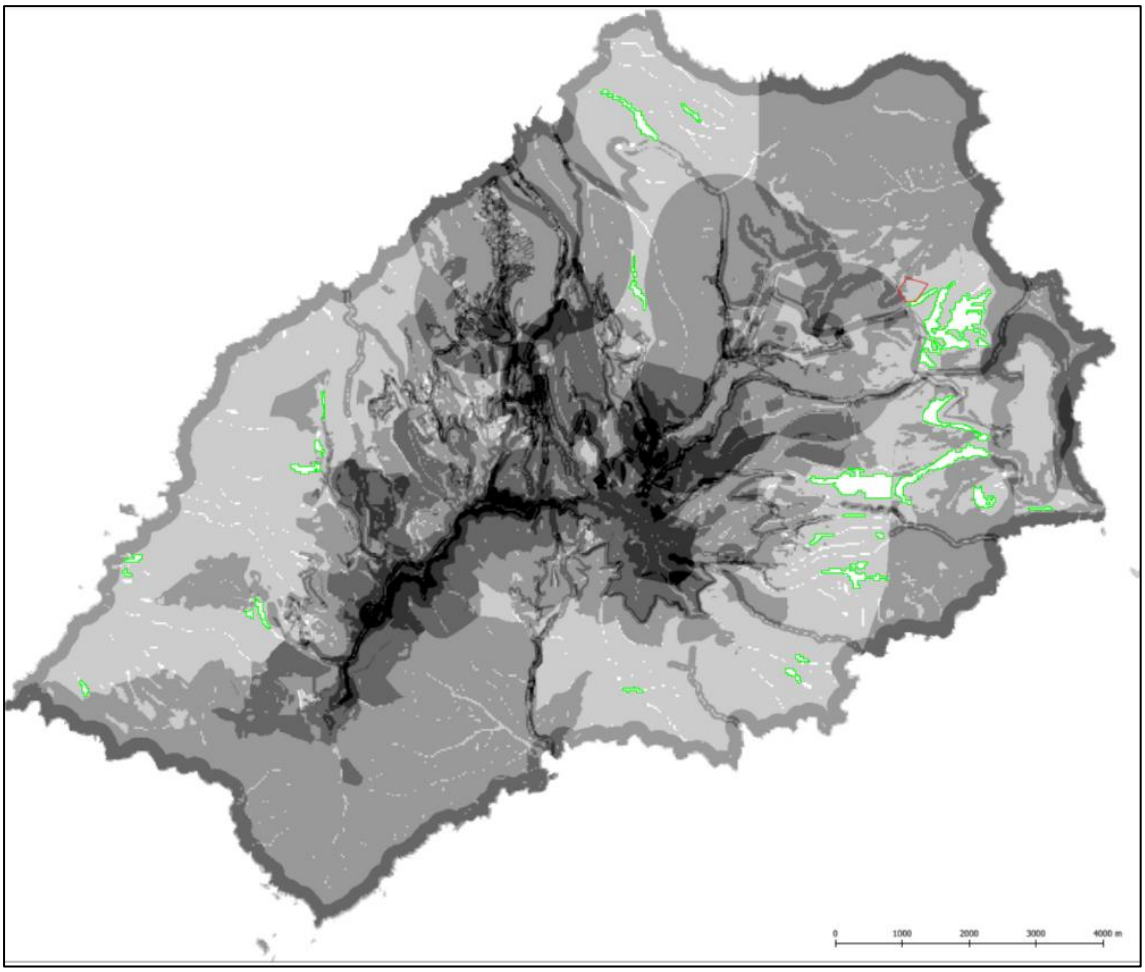

Figure 9: Final map showing suitable areas for a new land-fill site (outlined in green) based on given constraints.

5.4.4 Conclusions

Both data and map are a first iteration, and the analytical process described can be run again with different constraints criteria as and when new regulations, results from public consultation, or new data become available. SHG’s Environmental Risk Manager has used the constraints map to put forward the option of extending HPLS. Methods used in this analysis were shown to key stakeholders at SHG and great interest was shown in how constraints mapping could help improve evidence based land planning.

5.5 Cultural ecosystem services

5.5.1 Background

The St Helenian environment and its people have been shaped both by its isolation and its partial but constant connection to the outside world. St Helena is currently undergoing a period of change, with the opening of an airport in 2017, leading to higher visitor numbers, and the

planned arrival of a fibre optic cable presenting the prospect of high speed internet arriving in 2020. The island has an extraordinarily high level of endemic species yet, at the same time, has been extensively altered by human intervention. These juxtapositions have left St Helenians with a strong connection to their natural environment and heritage, which stakeholders were keen to document. Cultural Ecosystem Services (CES) are described by Fish et al. (2016) 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.

5.5.2 Methods

Interviews with a group of St Helenians were conducted to help design a survey to capture how St Helenians interpret the natural and built 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 as well as the built environment which is of great significance to St Helenians. The survey also set out to capture differences in CES as they relate to the different social identities of St Helenians . Finally, to determine how interpretations of, and interactions with, the natural world varied across space, participative mapping was integrated into the survey.

Surveys were conducted face-to-face and set out to achieve an equal distribution across administrative districts and social strata.

5.5.3 Results

In total 210 questionnaires were collected, which is approximately 5% of the Island's population. 80% of the sample were born on St Helena. People living on St Helena find the island beautiful, and strongly associated with notions of diversity and uniqueness. Diana's Peak, wirebirds and endemic flora were considered to be features of the environment that are important (Figure 10a), and Diana's Peak was also considered by most respondents to capture St Helena's 'essence'. A sizeable number of respondents also considered the slavery heritage of the island as very important.

Coastal and inland fortifications are the most important aspects of built heritage; High Knoll Fort being mentioned by 83 or 40% of respondents (Figure 10b). Interestingly, High Knoll Fort was also the place most frequently associated with negative feelings (38 respondents); not because it is disliked, but because it was felt it, along with other heritage sites, have been "neglected", are "falling down", or "need maintenance". Litter dropped by members of the public was also seen as a negative aspect of the environment.

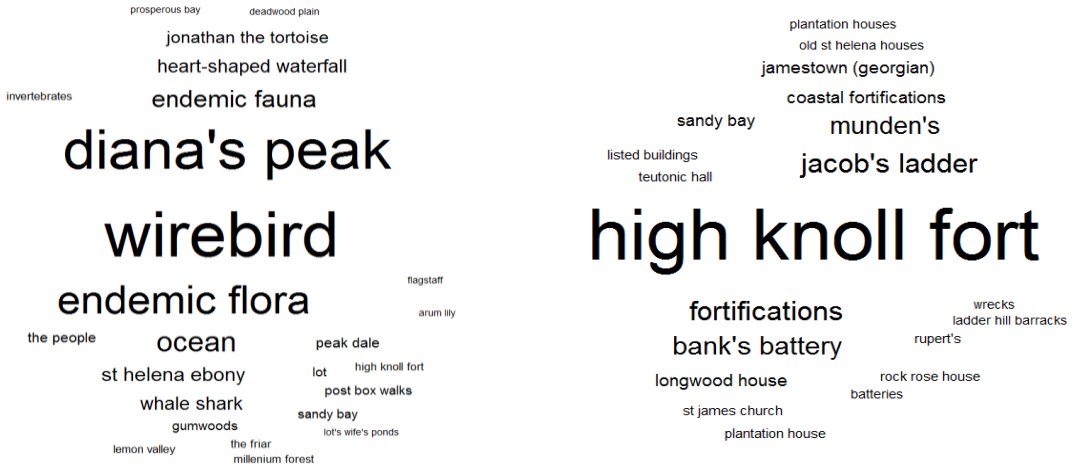

Figure 10: Important features of a) the St Helena environment and b) its heritage and built environment.

Figure 11 shows places mentioned by respondents as important to them in terms of ‘leisure’, ‘work’ and the ‘essence’ of the Islands. The most common work that brings people outside in St Helena appears to be nature or land surveying, including fauna and flora surveys, and marine surveys.). The most popular leisure activities, include creative activities (such as photography), foraging, trekking or long distance walking, gardening (including kitchen gardening), swimming in the sea, coastal fishing, contemplating, taking gentle walks, and eating outside.

Frequency of work and leisure outside appears to be related to negative and positive experiential well-being respectively, with respondents who are never or rarely working outside self-scoring higher on how anxious they were yesterday. Respondents who report higher levels of happiness are more active in general, as indicated by the higher percentages for almost all activities. More than half of the respondents who practice ecological restoration report lower levels of anxiety. Interestingly, the same hold for respondents who work in construction and maintenance.

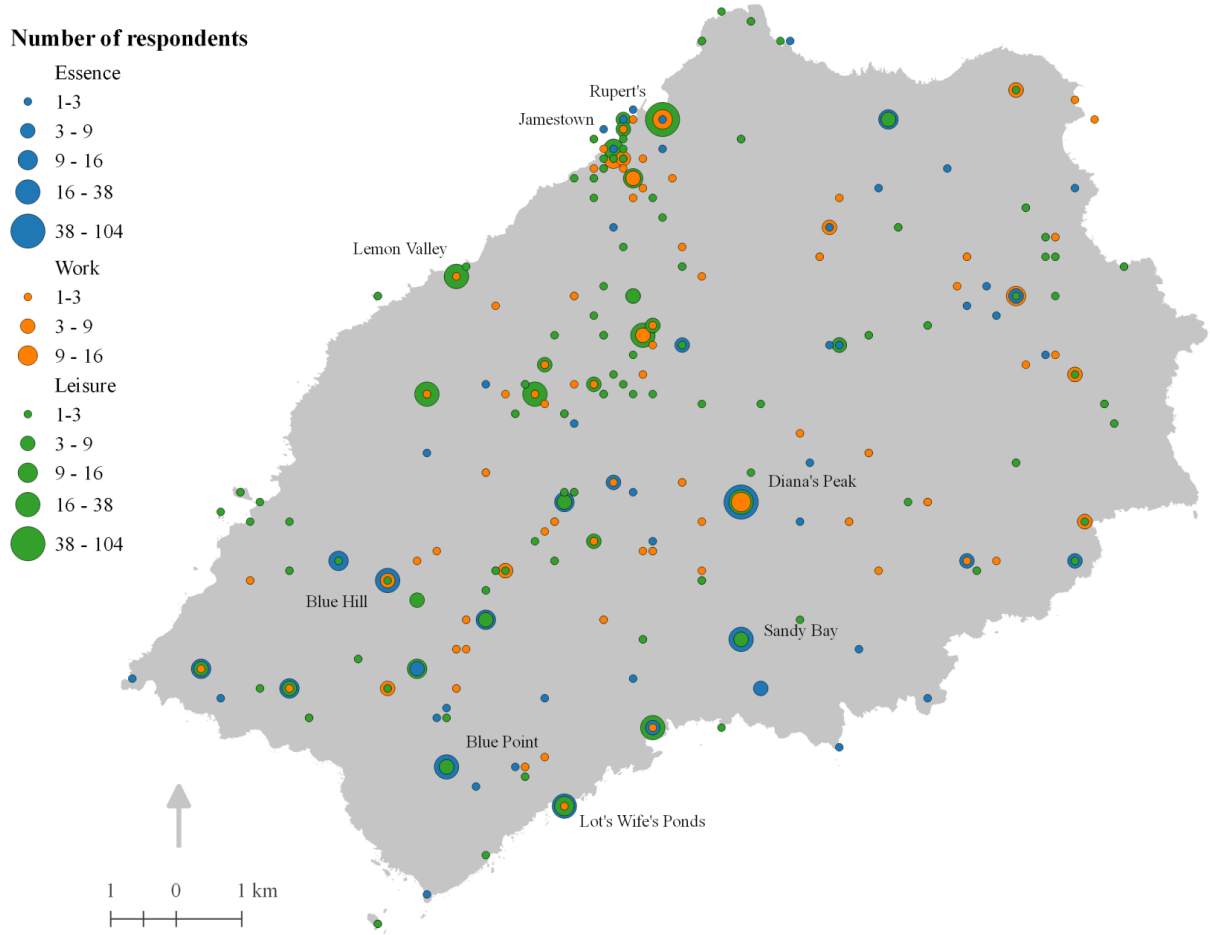

Figure 11. Combined map of places that capture the essence of the natural environment, and where Saint Helenians work and carry out leisure activities outdoors

5.5.4 Conclusions

This work fed into the Bayesian land use model described in section 5.1, which also helped to test the robustness of the model. It created great interest from stakeholders who could see multiple uses to underpin evidence based decision making. Findings on the benefits of spending time outdoors to subjective wellbeing could be used to inform public health strategies. In addition, this type of information can serve as baseline for future assessments for the state of natural capital in the Islands. Given that St Helena is likely to be embarking on a process of economic and social change, it is safe to assume that the way environmental spaces and cultural practices interact and the benefits this interaction produces are bound to evolve.

It can also be used to prioritise environmental spaces of cultural importance (e.g. High Knoll Fort) for protection or promotion. It also challenges traditional ways of managing and protecting nature, since places that are deemed exceptional or worthy of protection are not always the most distinctive in terms of wildlife or other environment-related features, but places that are made exceptional through – often historical – cultural practices and symbolism.

5.6 Social media mapping

5.6.1 Background

Cultural and built heritage were identified as being of particular importance during stakeholder consultations. The cultural ecosystem services survey outlined in section 5.5 was conducted to better understand the relationship that St Helenians and other residents have with their environment. Tourism is also an important ecosystem service and monetary values can be attributed to this; but what parts of the environment on St Helena are important to visitors? Traditional methods would require extensive surveys to determine this. Mapping natural, historical and built heritage values using social media content is a relatively recent methodology which uses photographs as a way to assign ‘significance’ or importance to the places they were taken.

5.6.2 Methods

Geolocated public photos uploaded onto Flickr and Instagram were accessed through their application programming interfaces (API). The image, along with its metadata (title, tags, latitude, longitude, user, and date taken were saved and analysed. Only photos that depicted the natural or built environment or historical heritage were retained. To assess mapping accuracy, photographic ‘hotspots’ were overlaid on satellite imagery to calculate the percentage of photographs depicting the area they were mapped on. It was decided not to analyse the Instagram dataset further due to issues with the way the photos are geolocated.

Photographs were mapped in three different ways. First of all as raw data; i.e. as points on the map based on where the photograph was taken. Secondly, as a continuous layer for further modelling, using kernel density estimation. Lastly, using a metric adapted by Wood et al (2013), data were converted to Photographic User Days (PUD). This last technique reduces user bias from the data set and represents *“the total number of days, across all users, that each person took at least one photograph within each site”.* Mapped data were divided into those that include natural, historical and built heritage, and those only including the natural environment.

5.6.3 Results

A total of 1020 photographs from Flickr, taken between 1st of December 2005 to 31st of July 2018, After filtering, this was reduced to 902 photographs initially and then down to 685 once photos not correctly geolocated had been removed.

Mapped photographs revealed that the majority of photographs are taken from the area around Jamestown, including the nearby sea and coast. Well known sites of historical and built heritage are also prominent, such as Napoleon's Tomb, Longwood House, or Plantation House; interestingly, many of these photos included the natural environment. As expected, in almost all cases photographs taken far from Jamestown, other settlements and sites of historical heritage depict the natural environment.

Mapping PUDs (Figure 12), similar, although more homogenous, patterns emerge. Jamestown still dominates the magnitude of PUD, however natural areas are equally represented. The mapping highlights that although some areas may be well known for their built or historical environment, they also contain areas of natural environment that are important to visitors. For example Longwood House and the area around High Knoll Fort remain the most photographed even when excluding photographs that depict only built or historical heritage.

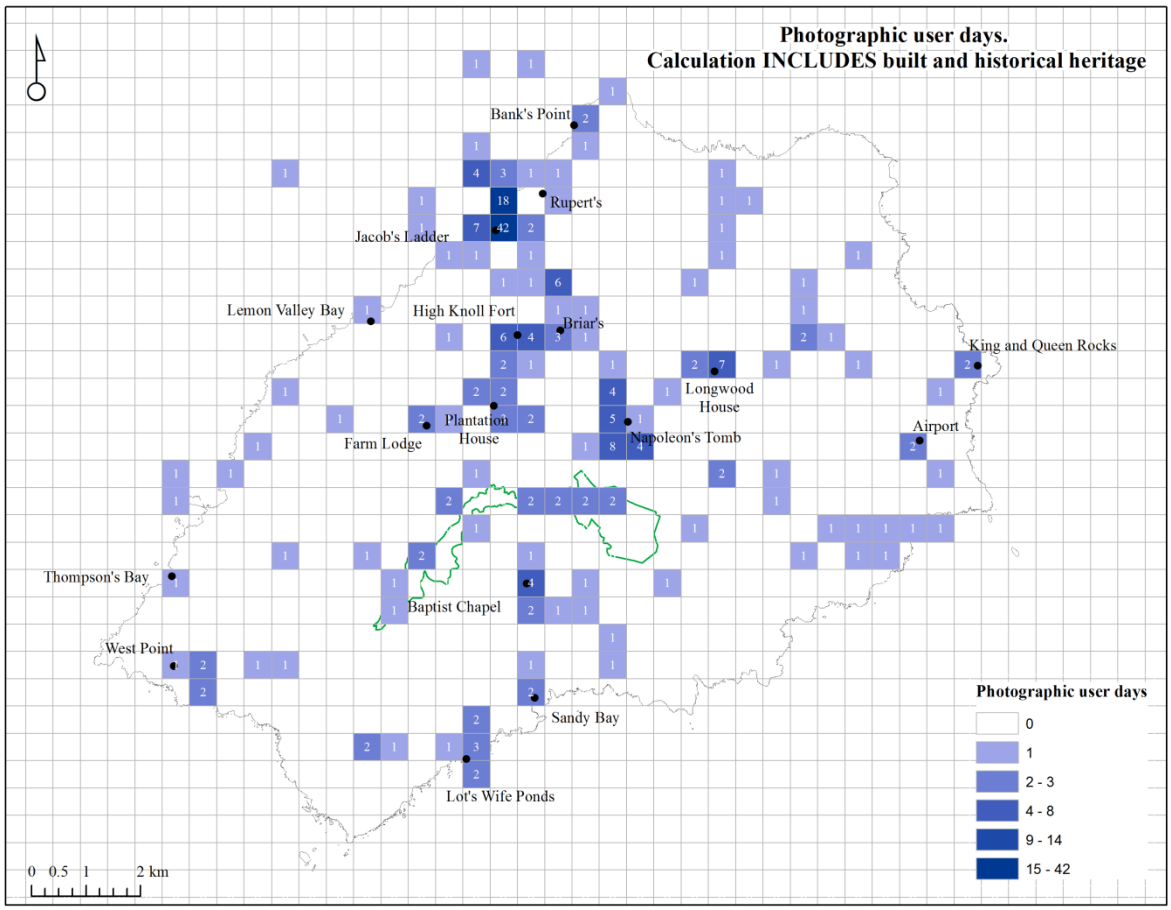

Figure 12. Total user days calculated for St Helena using Flickr photographs that depict the natural, historical or built heritage. Boundaries of Peaks National Park are in green.

5.6.4 Conclusions

Given the remoteness of St Helena, and its very limited home or mobile internet connection, part of the task was to gauge whether this type of internet-based methodology could be applied. The methodology appears to be feasible, although with some qualifications. Instagram did not prove suitable, but Flickr managed to capture both natural, historical and built heritage areas of interest in St Helena, and could be a valuable tool for mapping interest in the natural, historical or built environment in other areas of the South Atlantic with no or little internet connections – and beyond. With the new fibre optic cable bringing faster and cheaper internet to St Helena in 2020, this method could prove even more effective for long term monitoring of areas of importance and significance for visitors and, as more St Helenian's have access to mobile technologies, of those living on the island.

5.7 Marine tourism valuation

5.7.1 Background

St Helena's annual whale shark aggregation is, arguably, one of St Helena's greatest natural assets and there is already a growing market for snorkelling experiences with the sharks, which is only set to increase further. The characteristics of the aggregation, along with local accounts of mating behaviour, indicate that St Helena may be an important area in the breeding cycle of whale sharks (Clingham et al, 2016). As tourism increases, it is important to ensure that the already high standards of management are maintained, and that organisations and tour operators have a better understanding of how tourists relate to the marine environment as well as how much they are willing to pay for the experience of snorkelling with whale sharks. A willingness to pay survey, which included wider questions on attitudes to the marine environment, was conducted to provide evidence.

5.7.2 Methods

A questionnaire, designed to be completed by face-to-face interview, was written with a mixture of qualitative, tick-box and 10-point Likert scale questions (Appendix I) with additional areas for open responses to contextualize the quantitative data. The questionnaire was divided into three parts; pre and post-trip sections and a third section focused specifically on divers. This was administered during the peak whale shark tourism season on St Helena, between 15th January and 15th April 2019. Ideally, all respondents were interviewed before and after a whale shark snorkelling trip to understand how much the experience influenced their willingness to pay. People who hadn't booked a trip were also targeted. Interviewers aimed to capture approximately 40% of all tourists visiting the island, matching whatever number this equated to with an equal number of St Helena residents. Divers were targeted separately, with the aim of interviewing as many as possible. Data were analysed in 'R' and, as the data were not normally distributed non-parametric statistics were used to assess differences among and between groups.

5.7.3 Results

In total 154 surveys were completed. General knowledge of whale sharks was assessed, and of the 90 people who answered all five questions on their biology, 51 answered four out of five correctly whilst 39 did not (Figure 13)

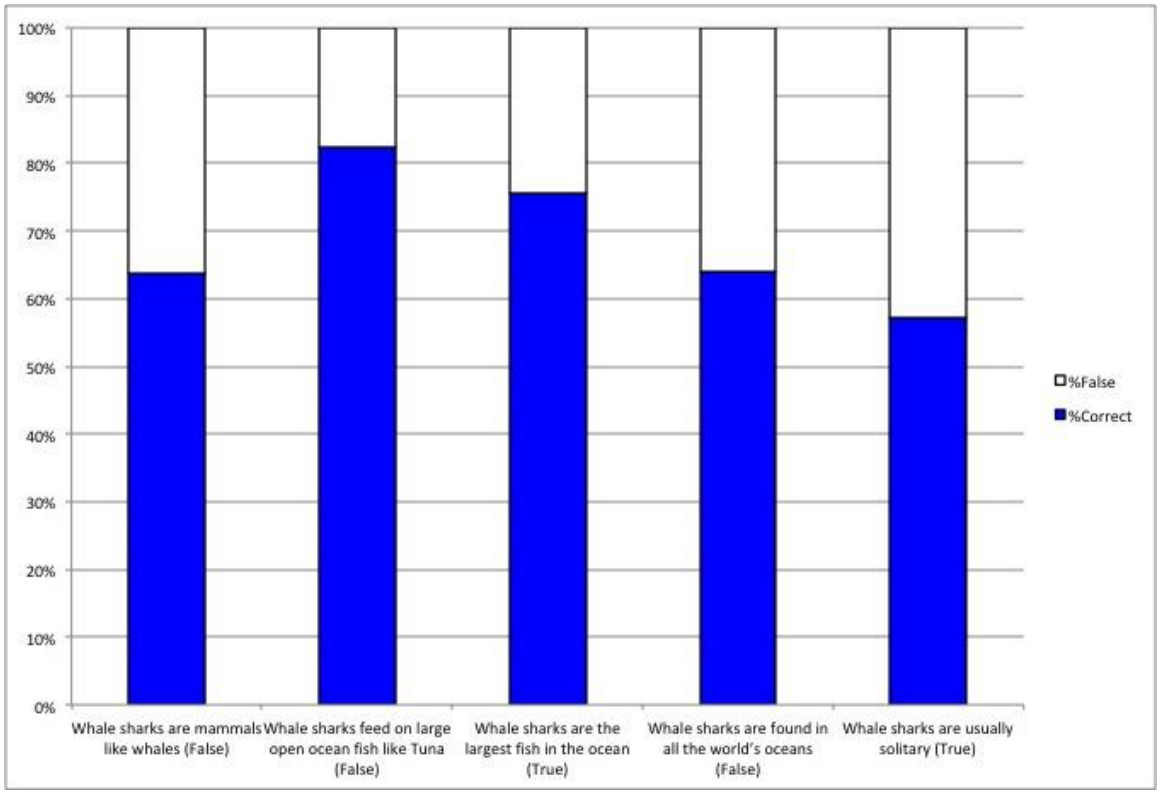

Figure 13: Participants' answers on baseline information about whale sharks.

The results of the opinion surveys showed strong agreement in several environmental themed statements but not such strong support for a protected area with no human activities allowed (Figure 14).

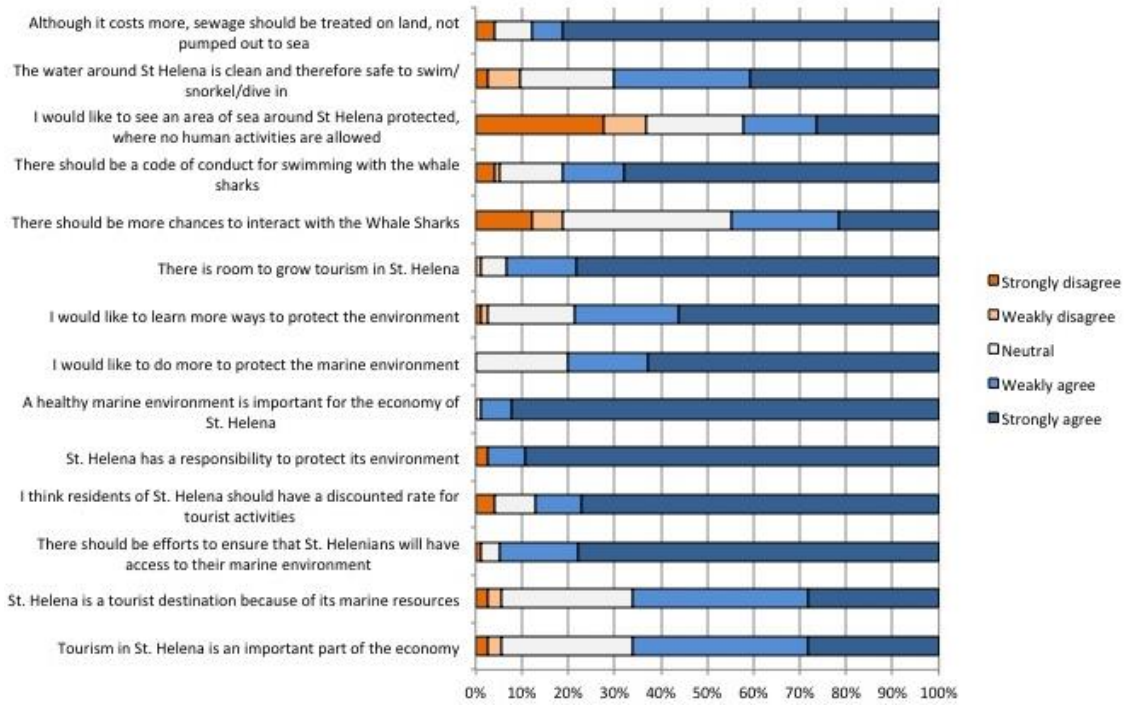

Figure 14: Participant's views on tourism, the marine environment and management.

People who came to St. Helena specifically to dive, did so to see underwater scenery (Likert 7.75), whale sharks17 (7.6), endemic species (7.5), to see wrecks (7.4) and to see manta rays (6.33), however the sample size for people responding here was relatively small (N=13).

Willingness To Pay to snorkel with whale sharks

The current whale shark excursion usually consists of 16 people on a boat with eight in the water at any time and typically costs £50. Overall the average value people are willing to pay for this status quo across all individuals responding is £6.50 more. People were willing to pay £7.90 (15.8% increase), more if the number in the boat was reduced to only eight people with significant differences based on income. If numbers were further reduced to eight people on the boat but only four in the water, willingness to pay was only £5 (10% more).

When asked if they would pay more if they knew money was going to community education and environmental programs, respondents were willing to pay an average of £12.32 more (Figure 15).

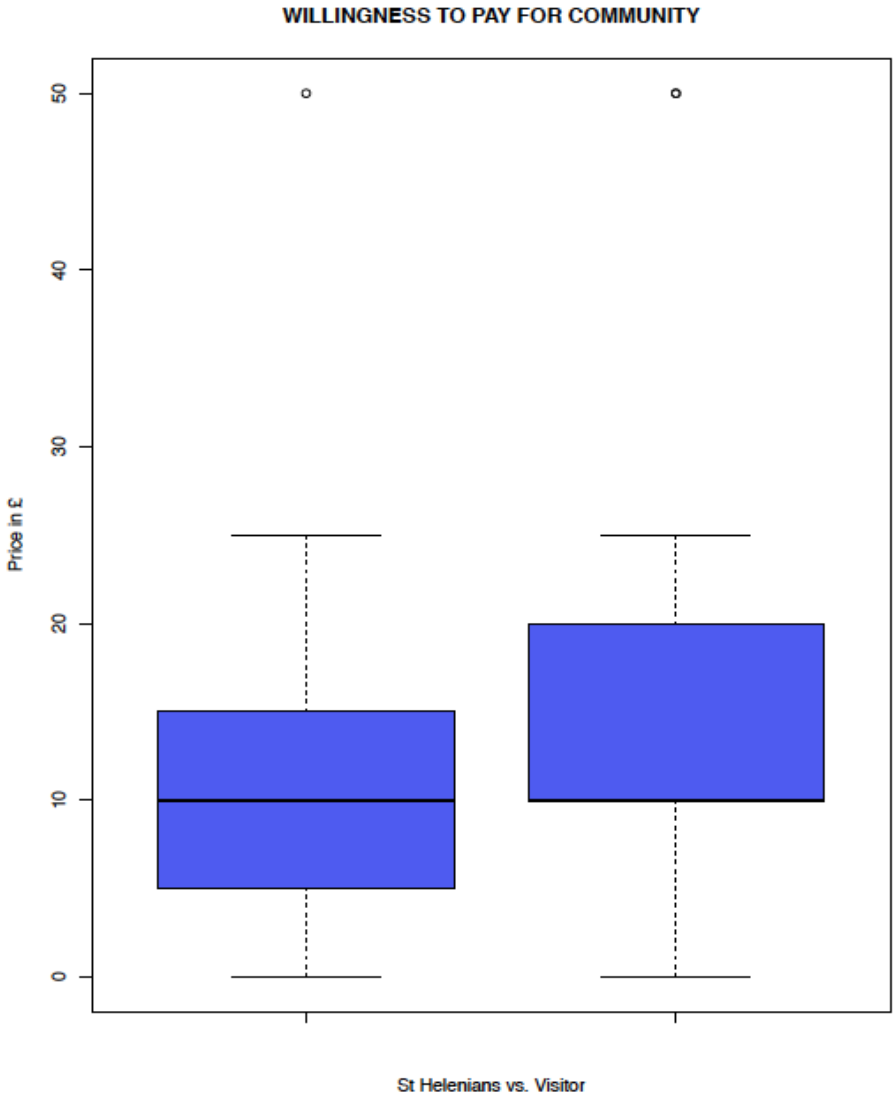

Figure 15: WTP for a contribution to community education and environmental programs

[17] Note that diving with whale sharks is not allowed under St Helena environmental policies.

People who have snorkeled before (N=79) were willing to pay on average a sum of £6.67 vs those who have never snorkeled (N=33) paying £5.14, which raised to £8.04 and £3.06 respectively for the eight on the boat and in the water scenario; although neither were statistically significant. Of high statistical significance, and perhaps unsurprisingly, those respondents who felt the whale shark tourism was not so well managed were willing to pay less than those who did; £1.30 versus £6.60.

5.7.4 Conclusions

Due to the timing of this assessment, its application has yet to be recorded. It is hoped that the St Helena National Trust and SHG's marine team will be able to hold a workshop to disseminate the results and discuss how findings can be built into tourism strategies, management and education. These data suggest a widespread favourable opinion of the marine environment, tourism and a desire to have a sustainable whale shark snorkelling industry as part of an integrated marine based tourism/management plan in St Helena. Moreover, those engaged in whale shark tourism are willing to pay more for the experience and even more for a more exclusive experience, however those supplemental costs are not enough to offset the loss of individuals on the tourism boats. This suggests that while there is a desire to have, and to pay for, an eco-friendly approach to tourism other methods than simply limiting the number of participants, or raising the prices should be explored.

5.8 Natural Capital Accounts

5.8.1 Background

The aim of this work was to establish a preliminary national "Natural Capital Account" (NCA) for St. Helena, which is a structured way to measure and monitor the benefits provided by the natural environment. Natural Capital Accounting uses the language of economics to understand the value of the environment. It's an approach used to measure the benefit of a nations' natural capital by building a series of accounts to provide data similar to other national accounts, such as GDP.

5.8.2 Methods

A preliminary search for datasets was conducted, with the main sources of data being:

- SHG GIS Office
- SHG Statistics Office
- SHG Environment and Natural Resources Directorate
- South Atlantic Environmental Research Institute (SAERI)
- JNCC

SHG's website[18] provided useful datasets for the physical and monetary flow for provisioning ecosystem services such as fish, meat and firewood production. The habitat map developed under the SHG-led Darwin Plus 052 project "Mapping St Helena's Biodiversity and Natural Environment" provided information on the extent and condition of St. Helena's habitats, soil productivity and erosion. Information from these datasets were included in the account's asset register, and they provided the foundation to calculate values for soil carbon storage and carbon sequestration.

[18] http://www.sainthelena.gov.sh/statistics/

The Natural Capital Accounts were built using three key questions:

5.9 What natural capital assets do we have?

A natural capital asset register was developed. This is an inventory that holds details of the stocks of natural capital assets within the geographical boundary of the country/territory. This asset register helps track trends in the extent and quality of habitats but does not give any information about their use or value.

What benefits do these assets provide?

A physical flow account was developed to show the expected flow of goods and services which are provided by the assets in the register. It provides information on the benefits provided by natural capital, with the flows measured in different physical units (e.g. number of recreational visits or visitors, weight of produce) so are not comparable in a common unit of value.

What is the value of these benefits?

A monetary account was developed which calculates two values; annual values of the flows of goods and services that are captured in the physical flow account, and asset values - which are the sum of the expected flows of discounted values over time. This account values benefits in a common metric, money, for ease of interpretation and comparison.

A series of score-cards, providing an easy to read summary for each ecosystem benefit, assessed was produced.

5.9.1 Results

A total annual value of £5.80 million was estimated for the modelled benefits for 2018. The 25-year assessment, conducted to determine the asset value of natural capital from each of these benefits based on the future value stream they will provide during this time period, was estimated at £89.54 million (Table 5). It is important to note the high degree of uncertainty is associated with the valuation of carbon storage and carbon sequestration and also that the unavailability of production data for agriculture lead to an underestimate of the total physical flow of natural capital.

Table 5. 2018 natural capital account results for St Helena

Benefit	Physical flow (Annual)	Monetary value (Annual)	Asset value (25yr)
Fisheries			£25.38 million
Agriculture			
Meat Production			
Forest Products			
Soil Carbon storage			
Carbon sequestration			
Tourism			
TOTAL		**£5.80 million**	**£89.54 million**

High uncertainty
Moderate uncertainty
Low uncertainty

Low uncertainty reflects confidence in the evidence to support decisions. High uncertainty reflects results that may be inaccurate by more than an order of magnitude. Some data may be marked as 'moderate' where the data used are themselves accurate, but do not provide a full measure of the services' value. All values in Pound Sterling.

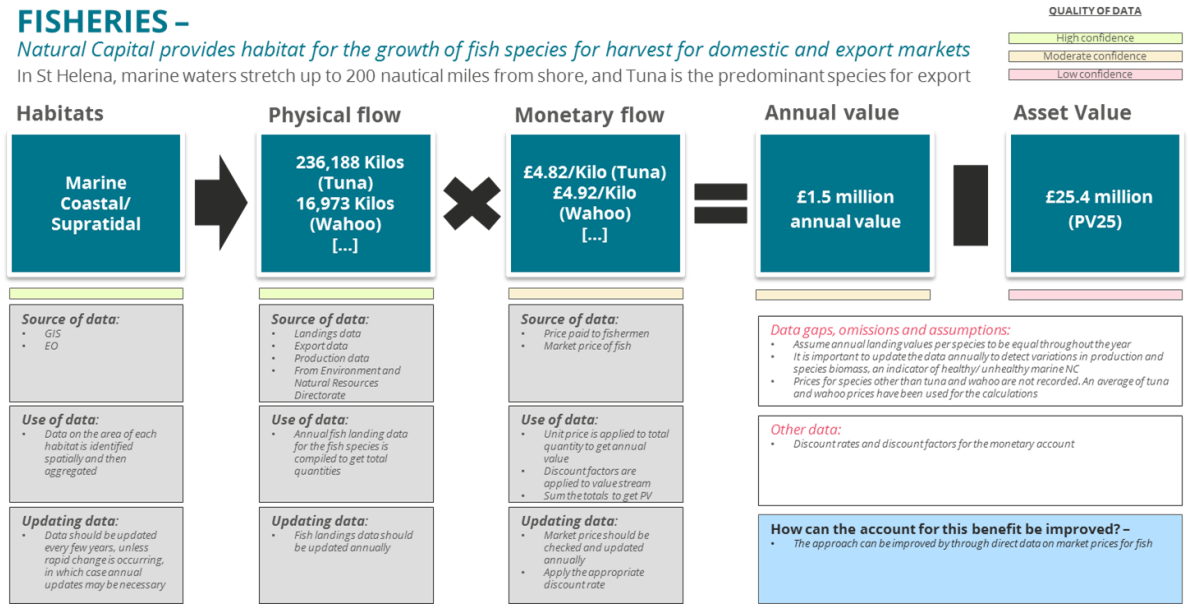

Figure 13: Score-card for fisheries benefits

5.9.2 Conclusions

The initial set of Natural Capital Accounts demonstrates what is feasible with available data and limited resource investment, highlights specific gaps, and helps identify what further data collection could be beneficial. As the accounts develop over time, they will hopefully feed in to the policy and planning process, and become a regularly consulted source of information. It is hoped that this will act as a foundation on which to build future iterations as new data and methods become available.

6 Potential Indicators

SHG has a set of key performance indicators which help track progress against its ten year plan. These sit under broad headings including environmental protection, and plants and wildlife. ENRD's Strategic Plan 2018-2021 does not include any indicators, but its National agriculture policy and implementation strategy 2014-2020 states that 'simple and reliable performance indicators will be developed' including 'hard indicators of agricultural production'. SHG's marine management plan include the ambition to use key seabird species as indicators of the status of the marine ecosystem, whilst an SHG-led DPLUS report sets out 27 potential indicators to monitor five marine ecosystem services[19].

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[20] (Table 6). 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.

[19] Rees S., Clingham E, Rodwell L., Glegg G., and Collins M. 2016. Marine Ecosystem Services of St Helena. Part 2: Ecosystem Service Valuations, Future Development Thresholds and Management. A report for the Environment and Natural Resources Directorate, St Helena Government by Marine Institute Plymouth University. pp 70

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

Table 6: 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 recommended the following process is undertaken to establish this (Figure 14) 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 14.

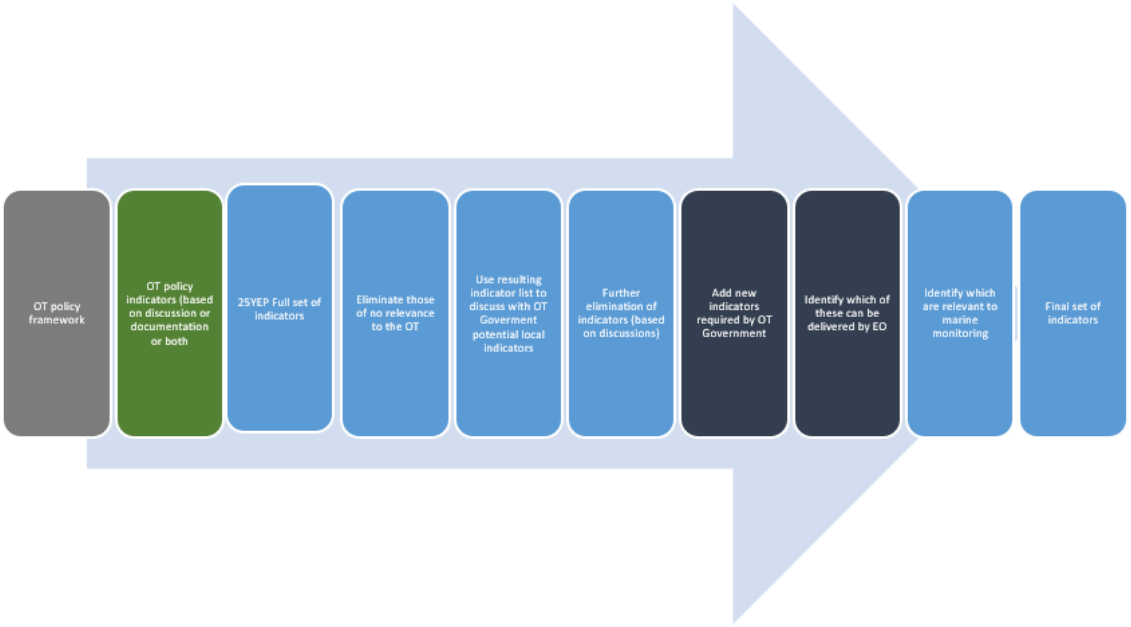

Figure 14: Proposed approach to developing UK25YEP indicators in the South Atlantic Overseas Territories.

It is suggested that:

- Building on the NCA work, data for the indicators identified through the project in table 6 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 14 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.

7 Conclusions and future options

St Helena, whilst still reliant on UK ODA, is starting to develop a thriving tourism industry and is anticipating the arrival of high speed internet in 2020. There are also ambitions to expand its agricultural outputs and export more coffee and potentially honey, and the population is growing once more as St Helenians return to the island following the opening of the airport in 2017. At the same time, the island has a set of challenging ambitions to preserve its threatened ecosystems and endemic species.

There are already multiple and conflicting land use pressures which impact on the island's natural capital, and these are only going to increase as the its economy develops.

The Natural Capital Project has shown that St Helena has a strong governance framework and high quality data to conduct natural capital assessments, but currently lacks the resources to bring this together. The land use model developed by the project is a useful planning tool which will help SHG in its ambitions to further develop evidenced-based planning and policy development. Data underpinning this tool – i.e. the St Helena habitat map – should ideally be updated and refined regularly using Earth Observation techniques to ensure it remains robust. It will be important to further build on-island capacity to manage, manipulate and interpret spatial data, to make full use of the project's outputs.

The Natural Capital Accounts have highlighted crucial data gaps, such as agricultural production, but provide a strong baseline to monitor changes in ecosystem service provision over time. It would be therefore be useful to update these on an annual basis and to use them in combination with UK25YEP indicators once developed.

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