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MARINE ECOSYSTEM SERVICES OF ST. HELENA PART 3: GUIDELINES TO SUPPORT THE FUTURE APPLICATION OF SOCIAL AND ECONOMIC ASSESSMENT METHODS TO INFORM MARINE MANAGEMENT AND PLANNING

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PART 3: GUIDELINES TO SUPPORT THE FUTURE APPLICATION OF SOCIAL AND ECONOMIC ASSESSMENT METHODS TO INFORM MARINE MANAGEMENT AND PLANNING

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1 Introduction

The St Helena Government recognises that the natural environment (the natural capital) of St Helena supports the well-being of the island residents and, if used sustainably, will provide the foundations for future economic growth (St Helena Government 2015). In September 2016 the entire 200nm Exclusive Fisheries Zone (EFZ) of St Helena was designated as an IUCN category VI "protected area with sustainable use of natural resources". The marine management plan for the 444,916km^2 Marine Protected Area (MPA) has also been formally adopted. The plan sets out management strategies for the marine environment that aim to protect marine biodiversity and ensure sustainable resource use. Working towards sustainable development in the marine environment demands that decision-making for marine management adequately integrates environmental, social and economic factors. As part of the Darwin Plus project, "The sustainable development and management of St Helena's fisheries and marine tourism" 2015-2017, an Ecosystem Service Assessment (ESA) was undertaken in two phases to provide an in-depth understanding of the links between the marine environment and the realisation of ecosystem service benefits

1.1 Summary of Phase 1

Established in the first phase of the ESA, the ecosystem services of commercial fisheries; recreation and culture, spiritual and tourism were considered by workshop participants to be at the highest risk of 'change' as the island economy develops (Fletcher, Rees et al. 2016).

In the first instance it was necessary to identify data that could be used as an indicator to assess value and change in ecosystem service benefits. Ecosystem Service (ES) indicators such as jobs, monetary values, well-being indices etc. can provide measures of ecosystem processes and ecosystem service benefits, allowing for the study of the linkages between ecological, social and economic systems and changes in relationships over time (Bohnke-Henrichs, Baulcomb et al. 2013, Hattam, Atkins et al. 2015). Indicators were selected based on knowledge of the secondary data sources that could accessed on St Helena (collected by the relevant agencies) and primary data that could be readily collected on a field trip to St Helena via questionnaire and interview (Annex I). The following ecosystem service indicators were identified along with the data source (Table 1).

Table 1 Ecosystem service indicators and data sources

Beneficial ecosystem service	ES Indicator	Data available from
Fisheries	Number of fishing vessels	Agriculture and Natural Resources Division (ANRD)
	Landings (weight and value)	Agriculture and Natural Resources Division (ANRD)
	Sales (weight and value)	Agriculture and Natural Resources Division (ANRD)
	Jobs	Agriculture and Natural Resources Division (ANRD)
Recreation and Culture	Number of Marine Tour Operators (MTO)	Questionnaire/Interview
	Jobs	Questionnaire/Interview
	Number of trips per year	Questionnaire/Interview
	Number of people on trips	Questionnaire/Interview
	Turnover (£)	Questionnaire/Interview
Cultural	Reported frequency of activity	Environmental Management Division (EMD)
Tourism	Number of passengers	Statistics Office, Corporate Policy and Planning Unit (CPPU)
	Type of passengers	Statistics Office, Corporate Policy and Planning Unit (CPPU)
	Expenditure	Statistics Office, Corporate Policy and Planning Unit (CPPU)
	Jobs	St Helena Tourist Office

1.2 Summary of Phase 2

In March 2016, primary and secondary data were collected to make a baseline assessment of the beneficial ecosystem services using both monetary and non-monetary assessment methods (Rees, Clingham et al. 2016). To establish how the ES indicators data had changed, time-series data was sought (where available) or local/expert opinion was utilised (summary results in **Error! Reference source not found.**).

To summarise the results, the fishing industry and the associated values are currently highly variable across years (see the long term variability in landings of Tuna 1977 – 2015 data in Annex VI (Rees, Clingham et al. 2016)). Presently the fishing economy supports a number of jobs in fishing, processing and sales (**Error! Reference source not found.**). Within this data time-series (for which socio- economic indicators can be linked over 5 years) there has been a decline in the value of fishing as an ecosystem service benefit which can be attributed to both ecological factors and market forces (Rees, Clingham et al. 2016). Tourism and recreation are currently the main growth areas with high values associated with seasonal wildlife watching trips (**Error! Reference source not found.**). The most valuable recreation activities are those directly associated with wildlife interactions e.g. scuba diving and swimming with whale sharks (*Rhincodon typus*) (**Error! Reference source not found.**). Sport fishing is also a high value market but is, as yet, under-developed on St Helena (**Error! Reference source not found.**). Any declines or loss in the marine species that underpin these activities will have a direct impact on associated values.

Tourism is an ecosystem service benefit which creates approximately £0.8million per annum in expenditure (**Error! Reference source not found.**). Positive knowledge and perceptions of the marine environment are essential to maintain these values. Negative knowledge or perceptions about the marine environment for example health scares (e.g. illness from sewage); safety issues (e.g. collisions at sea); collapse in fish stocks affecting food supply; and visual disturbance (e.g. litter) can potentially undermine these values (Rees, Clingham et al. 2016).

The most popular recreation activities, those that are associated with the local culture include a 'day out by the sea' and 'swimming'. There is a spiritual element to recreation activities that include simply 'looking at the sea' and gaining 'inspiration' from the sea (Rees, Clingham et al. 2016). Local residents reported a 'very high' frequency of activity associated with these activities. It must be considered that these interactions are invaluable as there is no means by which to accurately reflect the numerous health and wellbeing benefits of the interactions with the blue environment (Depledge and Bird 2009, Wheeler, White et al. 2012).

The purpose of this third phase is to provide:

- Guidelines on the collection of ES indicator data for the ESA;
- Guidelines on future data collection and reporting systems for the continued monitoring and assessment of the ES indicators with the relevant agencies; and
- Build capacity for ESA in St Helena.

Table 2 Summary table of ecosystem service indicators and associated monetary and non-monetary valuation metrics. The 'time series trend' shows if the data series has been positive (+), negative (-) or remained stable (+/-) over time for which data were available.

Beneficial ecosystem service	ES Indicator		Valuation metric	Time Series trend
Fisheries	**Total**	**Value (£)**	**£198,157[a]**	-
	Fishing vessels	Number	12	+/-
	Landings	Weight (kg)	251,572	-
		Purchase Value (£)	£152,000	-
	Sales	SHFC (£)	£25,157	-
		Local (kg)	68,720	+
		Local (£)	£179,000	+
		Export (kg)	116,000	-
		Export (£)	£146,000	-
	Jobs	At sea	34	+/-
		Processing	25	Curently downsizing
Recreation and Culture	**Total**	**Value (£)**	**£214,048[b]**	+
	MTOs	Number of operators	4	+
		In-use vessels	9	+
	Jobs	At sea and on land	7FT/7PT	+
	Scuba Diving	Trips per year	270	+
		Number of people on trips	3286	+
		Value (£)	£88,618	+
	Sport Fishing	Trips per year	52	+
		Number of people on trips	252	+
		Value (£)	£10,900	+
	Wildlife Interactions	Trips per year	311	+
		Number of people on trips	4009	+
		Value (£)	£58,645	+
	Wildlife Watching	Trips per year	199	+
		Number of people on trips	2037	+
		Value (£)	£40,645	+
	Scenic trips and island drop off/pick up	Trips per year	149	+
		Number of people on trips	746	+
		Value (£)	£15,240	+
Cultural	Fishing - rocks	Reported frequency of activity	Medium	No data available

Beneficial ecosystem service	ES Indicator		Valuation metric	Time Series trend
	Fishing - boat	Reported frequency of activity	Medium	No data available
	Water sports	Reported frequency of activity	Low	No data available
	Sailing	Reported frequency of activity	Low	No data available
	Swimming	Reported frequency of activity	High	No data available
	Spearfish	Reported frequency of activity	Low	No data available
	Day by sea	Reported frequency of activity	High	No data available
	Snorkelling	Reported frequency of activity	Low	No data available
Spiritual	Inspiration	Reported frequency of activity	Very High	No data available
	Looking at the Sea	Reported frequency of activity	Very high	No data available
Tourism	**Total**	**Value (£)**	**£853,802**[c]	+
	Cruise	Passenger numbers	2,633	+
	Cruise and Passenger Ships	Number	19	-
		Expenditure (£)	£113,025 [c1]	+/-
	Yachts	Number of vessels	178	+/-
		Number of Passengers	621	+/-
		Number of Passengers (stay longer than 3 days)	327	+/-
		Expenditure (£)	£104,357 [c2]	+
	Transit passengers	Number	138	+
		Expenditure (£)	£34,666 [c3]	+
	Tourist passengers	Number	754	+
		Expenditure (£)	£601,754 [c4]	+
	Jobs	Numbers employed in supporting sectors	146FT/63PT	

[a] Total value from sales minus purchases.

[b] The combined monetary value of each recreation activity. All values are presented in an aggregated format and are calculated from approximate values provided by the MTOs either as: charge per boat per day x number of trips per year; or (the number of trips per year x average number of people per trip) x cost per person. All values represent turnover and not profit.

[c] The combined value of expenditure across each of the tourism groups e.g. yachts, cruise and passenger ships. There may be double counting of values with recreation and cultural as the 'daily spend' may include trips taken with the MTOs.

[c1](No. of Persons * Landing Fee) + (No. of Persons * Estimated Spend)+ Cruise and passenger fee vessel[1] (harbour dues and pratique)

[c2] Yacht Fee[2] (Light dues + mooring x average length of stay) + Person Spend (number x daily spend x average length of stay) + (permit fee and additional spend for those here >72 hours)

[c3] Person Spend (number x daily spend x average length of stay)+ (1/3 Persons * Avg Spend Hotel Acc * Avg Length of Stay) + (2/3 Persons * stay on Ship transit fee)

[c4](No. of Persons * Landing Fee & Estimated Spend)+(1/3 Persons * Avg Spend Hotel Acc * Avg Length of Stay) +(2/3 Persons * Avg Spend on SC Acc * Avg length of Stay)

2 Indicators and Guidelines by Sector

2.1 Fisheries

2.1.1 Indicators

Indicators for fisheries that were used for the St Helena ESA are detailed in Table 3. These data are collected by ANRD for reporting purposes e.g. to ICAAT, St Helena State of the Island Report. Data reported to ANRD (aside from data linked to the export market) is centrally collated in a Microsoft Access database which can then be 'queried' to produce reports. Overall there is good indicator data available for assessing the ecosystem service benefit of fisheries against a range of monetary and non-monetary indicators (Table 3). In this ESA ANRD provided the reports for analysis.

Table 3 Table showing the Ecosystem Service Indicators for fisheries, the metric, the detail of the data, the reporting period and where the data are available from.

ES Indicator	Metric	Detail of data	Reporting period	Data available from
Weight of species landed	tonnes	Individual species	Monthly	ANRD
The value of species landed	£	Individual species	Monthly	ANRD
Earnings by skipper	£	Individual skipper	Monthly	ANRD
Crew employed	number	Individual skipper	Monthly	ANRD
Days fished	number	Individual skipper	Monthly	ANRD
Value of local fish sales	£	Individual species	Monthly	SHFC/ANRD
Weight of local fish sales	tonnes	Individual species	Monthly	SHFC/ANRD
Value of fish exports	£	Individual species	Monthly	SHFC/ANRD
Weight of fish exports	tonnes	Individual species tunas	Monthly	SHFC/ANRD
Fishing vessels	number	Skipper and boat name	? Annually	ANRD
Jobs	number	At sea and processing	? Annually	SHFC/ANRD

2.1.2 Guidelines

2.1.2.1 Identify a vision for the fishing industry that enables trade-offs to be identified and managed.

The ES indicators listed for fishing (Table 3) enable an overall valuation of the fishing resource from both a monetary and non-monetary perspective. An ESA that includes non-monetary indicators e.g. 'the number of crew employed', 'days fished' provides a holistic picture of the socio-economic interaction with the fish resource. Any future monitoring and assessment of the change in ES indicators will require local stakeholders to identify a vision for the fishing industry that enables trade-offs to be identified and managed appropriately. For example, the greatest proportion of the value of the annual catch has consistently come from inshore waters. The offshore fishery which opened up in 2014 now represents approximately one third of the value of the total landings.Is it more important, as the St Helena economy develops, that the earnings by skipper increases across the range of fishermen or linked to fishermen targeting a specific fishery/sector?

2.1.2.2 Create a data agreement protocol for 3rd Parties to avoid any misuse of the data.

The data collected for this study were requested from ANRD and are available at a fine scale (e.g. earnings per skipper.). These data are highly valuable for research to inform marine management and monitoring but are also highly sensitive as economic data linked to the individual can reveal aspects of well-being (e.g. income) that the individual concerned may not wish to share. It is essential that this level of data collection remains accessible for future research. It would therefore be advisable for ANRD to create a data agreement protocol for 3rd Parties to avoid any misuse of the data. This data agreement must as a minimum request:

- That only aggregated data be used in reporting (individuals must not be identifiable);
- That any data based on the individual are not discussed with third parties; and
- That the data are not to be passed on or shared without permission from ANRD.

2.1.2.3 Collection of additional data.

There is a range of additional data that would improve the ESA for St Helena fisheries these include:

- Tuna data (that combines weight and value) is aggregated at the point of landing, and combines yellowfin (*Thunnus albacares*), albacore (*Thunnus alalunga*) and bigeye tuna (*Thunnus obesus*) species. It would be useful to provide these data disaggregated;
- Weight and value have a category for 'other' and 'pet food' which represents a large proportion of catch it is unclear which species comprise this proportion of sales;
- SHFC data on bait and fuel sales;
- The operating costs of the SHFC and the processing plant;
- Accurate numbers of the number of crew per trip (including skipper) as the current data for the ES indicator for jobs represents the number of crew required to work a boat.

Crew members will often work on a number of different vessels throughout the year and not all vessels are at sea at the same time so the figures provided are considered to be an overestimate of the number of fishermen;

- Effort data that captures the number of lines and/or pots deployed per trip;
- Records of all species of bycatch and report the fate of bycatch (released alive, released dead, retained)(a proposed requirement under the new fisheries licence system); and
- Spatial data on fishing effort would enable marine managers to link effort, and value across a marine space. This would be particularly useful for the inshore fishery e.g. fishermen using static gear e.g. pots.

3 Recreation and Culture

3.1 Indicators

ES indicators for recreation and culture that were used for the St Helena ESA are detailed in Table 4Table 3. Data on the number of trips and income were originally provided by the St Helena Tourist Office. However, upon initial analysis of the data and review with staff from EMD, it was considered that these data did not capture the true level of recreation activity on St Helena.

Primary data on the economic value of the MTOs were gathered in March 2016 using a questionnaire designed to elicit a range of information on the number of people including (tourists and residents) taking part in a recreation activity and the expenditure on that activity (Annex 1). Data were collected via face to face interview with the MTOs. For reporting purposes all values were presented in an aggregated format and were calculated from approximate values provided by the MTOs either as: charge per boat per day x number of trips per year; or (the number of trips per year x average number of people per trip) x cost per person. All values represent turnover and not profit.

To assess the levels of cultural and spiritual interactions with the marine environment where there is minimal economic expenditure, a survey conducted in 2014 by EMD a total of 124 adults asked about the type and frequency of their use of the marine environment around St Helena (72% of those surveyed were Saints). Along with taking part in recreation activities many participants in the survey also stated that their main interaction with the sea was 'spiritual which involves 'Looking at the sea' and use the sea as a source of 'inspiration'. From the data it was possible to extract the frequency of recreation activity and the approximate number of trips per year.

Table 4 Table showing the Ecosystem Service Indicators for recreation and culture, the metric, the detail of the data, the reporting period and where the data are available from.

Beneficial ecosystem service	ES Indicator	Detail of Data	Reporting	Data available from
Recreation and Culture	Number of Marine Tour Operators (MTO)	Individual MTO	1 year 2015-2016	Questionnaire/Interview Also reporting to the Tourist Office though results not fit for ESA purpose.
	Jobs	Individual MTO	As above	Questionnaire/Interview Potentially collected via the Tourist Office
	Number of trips per year	Individual MTO	1 year 2015-2016	Questionnaire/Interview. Also reporting to the Tourist Office though results not fit for ESA purpose.
	Number of people on trips	Individual MTO	1 year 2015-2016	Questionnaire/Interview Also reporting to the Tourist Office though results not fit for ESA purpose..
	Turnover (£)	Individual MTO	1 year 2015-2016	Questionnaire/Interview
Cultural	Reported frequency of activity	Sample of 121 St Helena residents	1 year 2014	Environmental Management Division (EMD)

3.1.1 Guidelines

3.1.1.1 It is essential that ES values linked to tourism are monitored.

The ES indicators for recreation and cultural activity provided to the Tourist Office do not capture the full range of MTO activity on St Helena. Given the potential for economic growth in this area that is directly linked to the 'natural capital' it is essential that values linked to tourism are monitored. This may be done in two ways:

- MTO licensing that requires operators to compile (digital) logbooks on each trip to include the type of trip e.g. scuba diving, the number of people on trip and the charge per trip/per person.
- Annual data collection of the original 2016 questionnaire limited to questions 1-10 (Annex 1), following the questionnaire interview procedure included at the beginning of the questionnaire (Annex 1)

3.1.1.2 Create a data agreement protocol for 3rd Parties to avoid any misuse of the data.

Primary data from the MTOs are highly valuable for research to inform marine management and monitoring but is also highly sensitive as economic data linked to the individual can reveal aspects of well-being (e.g. income) that the individual concerned may not wish to share. It is essential that this level of data collection remains accessible for future research. It would therefore be advisable for EMD and/or the Tourist Office to create a data agreement protocol for 3rd parties to avoid any misuse of the data. This data agreement must as a minimum request:

- That only aggregated data be used in reporting (individuals must not be identifiable);
- That any data based on the individual are not discussed with third parties; and
- That the data are not to be passed on or shared without permission from EMD or the Tourist Office.

3.1.1.3 Schedule a repeat of the EMD study on the levels of cultural and spiritual interactions with the marine environment

The EMD study on the levels of cultural and spiritual interactions with the marine environment completed in 2014 reveals the close connection that Saints have with the marine environment. It would be useful to consider a repeat of this survey in 5 year intervals to determine any changes in cultural and spiritual association with the marine environment as the island economy develops.

3.1.1.4 Collection of additional data

There is a range of additional data that would improve the ESA for St Helena recreation and culture.

- The retail value of businesses linked to the MTOs to capture the value of sales e.g. diving equipment.
- A study to gather data on the subjective well-being of St Helena residents linked to the marine environment.
- Spatial data on diving frequency linked to dive sites (recreation hotspots see Rees et al (2010).
- Spatial maps of culturally significant areas to inform land and marine planning.

4 Tourism

4.1 Indicators

ES indicators for tourism that were used for the St Helena ESA are detailed in Table 4 Table 3.

Table 5 Table showing the Ecosystem Service Indicators for tourism, the metric, the detail of the data, the reporting period and where the data are available from.

Beneficial ecosystem service	Indicator	Detail of Data	Reporting	Data available from
Tourism	Number of passengers	Per passenger and tourist group	Annual	Statistics Office, Corporate Policy and Planning Unit (CPPU)
	Type of passengers	Per passenger and tourist group	Annual	Statistics Office, Corporate Policy and Planning Unit (CPPU)
	Expenditure	Averages (see table 6) per tourist group	Annual	Statistics Office, Corporate Policy and Planning Unit (CPPU) Port Management Department of St Helena Government
	Jobs	Per person	Annual	St Helena Tourist Office

Data on tourism were made available via the Statistics Office which is part of the Corporate Policy and Planning Unit (CPPU) of the St Helena Government. Data are collected by the statistics office on:

- Number of cruise passengers;
- Total yacht vessels;
- Total yacht passengers;
- Total transit passengers (arrive and leave on the same call of the RMS St Helena); and
- Total tourist passengers.

The expenditure of tourists on St Helena was calculated in the following format (Table 6) as per the State of the Island Report (St Helena Government 2015). Data on the numbers of vessels carrying passengers to St Helena was made available by the Port Management Department of St Helena Government. Data were separated into ships that carry passengers only (cruise and passenger ships) and ships that carry passengers and cargo to the island. Data for the jobs supported by the tourist industry were provided by the St Helena Tourist Office.

Table 6 Calculation formats for the expenditure of tourists on St Helena

Tourist group	Calculation
Cruise Ships	(No. of Persons * Landing Fee) + (No. of Persons * Estimated Spend)+ Cruise and passenger fee vessel[1] (harbour dues and pratique)
Yachts	Yacht Fee[2] (Light dues + mooring x average length of stay) + Person Spend (number x daily spend x average length of stay) + (permit fee and additional spend for those here >72 hours)
Transits	Person Spend (number x daily spend x average length of stay)+ (1/3 Persons * Avg Spend Hotel Acc * Avg Length of Stay) + (2/3 Persons * stay on Ship transit fee)
Tourists	(No. of Persons * Landing Fee & Estimated Spend)+ (1/3 Persons * Avg Spend Hotel Acc * Avg Length of Stay) + (2/3 Persons * Avg Spend on SC Acc * Avg length of Stay)
[1] Data on the harbour dues and pratique was made available from the Port Management Department of St Helena Government ships register. [2]The St Helena State of the Island report does not include the Yacht fee as this is paid directly to the Harbour office. It is included here as an expenditure that is linked to tourism.	

4.1.1 Guidelines

4.1.1.1 Formalise the collection of data from the Port Management Department of St Helena Government into an ESA.

All of the ES indicators listed for tourism (Table 5) provides an overall valuation of the tourism industry on St Helena. The majority of these data are already centrally collected by CCPU. The addition of harbour dues and pratique and the yacht fee which is available from the Port Management Department of St Helena Government adds to this analysis. These data are currently logged in paper format on the ships register. Data were transferred to an Excel spreadsheet by staff from EMD. It is recommended that these data are digitally created by the Port Management Department of St Helena Government and submitted to CPPU for inclusion in analysis.

4.1.1.2 Get feedback from Tourists on the 'state of the environment'

It remains important that tourism values continue to be included as an ecosystem service benefit from a healthy functioning marine ecosystem. Tourism is partly dependent on the same natural assets identified as the commercial, recreation and cultural ecosystem services. More broadly, tourism in St Helena relies on something less tangible, a perception or knowledge that the tourist is visiting somewhere with natural beauty, of which the marine environment is part of the package. Pressures on this perceptual knowledge are largely visible e.g. litter and pollution. As a minimum, feedback from tourists on their perception of the wider environment (including marine) can support sustainable environmental management. This data could be collected via digital technology installed at entry/exit points to the island.

4.1.1.3 Avoid double counting economic values linked to tourism

It would be possible to improve the analysis via an understanding of whether the estimated 'daily spend' includes 'excursions' associated with the natural environment, particularly the amount spent with the MTOs. If it is not included in the current 'daily spend' then this value can be added to the overall tourism expenditure and proportionately weighted to avoid possible to avoid 'double counting' the full value of directly associated recreation and cultural activities facilitated by the MTOs.

5 General Guidelines

5.1 Use a range of methods to capture ecological, economic and social values.

There are numerous ways to value the marine environment using monetary and non-monetary valuation methods. A full review of methods, relevant to MPAs was developed for the UK context in (Fletcher, Rees et al. 2014). Many of these methods are static and do not enable onward evaluation of the effectiveness and efficiency of a policy or management measure during and after implementation. Static valuations provide a 'snapshot' at a point in time. They are useful to influence decision-making and potentially raise the profile of ecosystem service benefits that may not have previously been considered in marine planning. They can also identify the trade-offs that may occur as the island economy develops.

The recent discussions, both in the literature and in practice, show that there is a need to matching the many different types of measures of ecosystem values to policy needs (Ban, Mills et al. 2013, Levin, Xepapadeas et al. 2013, Pendleton, Mongruel R et al. 2015). Valuation is sometimes, but not always, the needed metric of ecosystem service flow or capital. The full range of ecosystem value measures include ecological, economic and social values. The ESA employed in St Helena has combined stakeholder and expert knowledge to select the most relevant ES indicators and metrics to provide a baseline valuation (monetary and non-monetary) of the resource. It is imperative that these values are:

- Never added together to provide a Total Economic Value as this could lead to double counting of values across sectors;
- Always presented together (monetary and non-monetary ES indicator baseline values) as reliance on ES indicators that are amenable to economic valuation only can lead to the management of ecosystems that optimise the delivery of those economically valuable services at the expense of the rest (Robinson 2011); and
- Explicitly linked to the ecology of St Helena (the natural capital).

5.2 Set a future vision

Moving forward, these values can be used to shape future plans and policies in relation to the marine environment. The marine management plan for St Helena has set the future direction for sustainable development. Whilst there always remains a case for advocacy of the 'value' of marine biodiversity and the application of traditional economic valuation techniques to highlight how valuable an ecosystem service benefit may be, the implementation of the management plan and broader St Helena policy processes must now shift focus to establishing processes for evaluation of the ES indicators in order to measure outcomes and impacts in order to assess whether the anticipated benefits [of management] have been realised (HM Treasury, 2011).

In the second phase of this ESA project the St Helena stakeholders identified that they envisage a future where:

- The marine environment is valued;

- Marine management is integrated, effective with sufficient operational capacity and resources;
- The natural environment is managed holistically;
- Stock management (commercial and recreational) is underpinned by robust science;
- There is a thriving export and local market in fish products;
- Tourists are satisfied with their experience of the natural environment on St Helena; and
- Development is managed to support a quality over quantity product for both fisheries and tourism (Rees, Clingham et al. 2016).

In order for St Helena to achieve a desirable and sustainable future for all sectors each sector must develop a more refined vision including the identification of opportunities, constraints and trade-offs against ES indicators.

5.3 Set quantitative thresholds for sustainable development to inform management.

St Helena stakeholders identified a number of 'thresholds for sustainable use' identified as 'red flags' by workshop participants, signalling a warning that sustainable use is at risk of crossing over to unsustainable use. A full description of these thresholds can be found in Rees et al (2016). It recommended that these are prioritised as ES indicators for future evaluation. The summary table below (Table 7) provides a list of ES indicators that could be used to evaluate management measures against the threshold and whether there is currently data available to assess the status of the ES indicator.

Table 7 Ecosystem Service indicators that can be used to evaluate management measures against the threshold and if there is currently data available to assess the status of the ES indicator.

Threshold description	Ecosystem Service Indicator	Data currently collected
Decline in landings of grouper	Landings data (Commercial)	Y
	Landings data (Recreation)	N (?)
	Stock assessment	N
	Condition assessment of essential habitat	N
Decline in landings of longfin and skipjack	Landings data (Commercial)	Y
	Landings data (Recreation)	N (?)
	Stock assessment	Y (ICAAT level)
An increase in reported marine accidents	Records of accidents and near misses	N
A decline in economic values associated with fisheries	Landings data (kg and £)	Y
	Fishing vessels	Y
	Sales (local)	Y
	Sales (export)	Y
	Jobs	Y
A decline in economic values associated with recreation	Number of MTOs	Y
	Jobs	N
	Number of trips per year	Y
	Number of people on trips	Y
	Turnover	Y
A decline in economic values associated with tourism	Number of passengers	N
	Type of passengers	Y
	Expenditure	Y
	Jobs	Y
An increase in the deployment of Floating Aggregating Devices (FADs) by recreational fishermen	Number of devices	N
An increase in sales of fish through	Number of prosecutions or breaches of licence	N

Threshold description	Ecosystem Service Indicator	Data currently collected
the black market	Self-reported non-compliance	N
Dead areas of the sea related to sewage and nutrients	M^2 of dead areas (point and diffuse)	N
Decline in numbers of endemic species	Abundance of key species	Y
	Biomass of key species/habitats	Y
Damaged dive sites	Number of divers visiting each site	N
	Key species counts using control sites for comparison	N
	Number of breaches of diver code of conduct	N
Overfished sites	Abundance of key species	N
	Condition assessment of essential habitat	N
	Number of fishermen visiting each site (effort)	N
Persistent disturbance to vulnerable species	Observed breaches in codes of conduct	N
	Self-reported noncompliance with codes of conduct	N
Poor feedback on social media (eg. trip advisor) on recreation and tourism experiences.	Number of positive and negative posts on social media	N
Wildlife watching experiences are overcrowded	Number of people undertaking wildlife watching experiences	Y
	Observations of negative behavioral responses of key species to numbers of people	N
	Number of MTOs	Y
	Customer of feedback on wildlife watching experiences	N

5.4 Establish a process for the Evaluation of Ecosystem Service Indicators (Performance Management).

Evaluation frameworks provide a structure to the evaluation process. Applying an evaluation framework to assess impact is the systematic process of assessing the causal effects of a project policy or programme (Rosenbaum 2010, Gertler, Marintez et al. 2011). An evaluation framework provides evidence on if and how an intervention affects (or has an impact upon) variables of interest, allowing statistical or observational analysis of 'change' that underlies an intervention. Each evaluation framework needs to be tailored to the type of policy or management measure being considered and the types of questions it is hoped to answer (HM Treasury 2011). Evaluation of ES indicators within the continually evolving marine and coastal policy context of St Helena and in the broader South Atlantic region is vital to identify learning and good practice to support improved marine management (Carneiro 2013).

In the absence of rigorous experimental design (including control sites) which is almost impossible in the social and economic sciences, the evaluation of ES indicators needs to apply a confidence assessment approach in order to establish whether the observed changes in an ES indicator are the result of the local management measures or are being confounded by wider ecosystem and socio-economic effects (Rees, Ashley et al. 2016). For example the value of tuna landings on St Helena may increase over time but is this also linked to regional increases in quota, a decrease in IUU fishing, increased market price? Each ES indicator needs to be assessed for 'quality' to determine on a scale of 1-3 how well the ES indicator can describe localised effects of policy changes and/or marine management based on 'indicator quality' and 'agreement' of evidence (Figure 1).

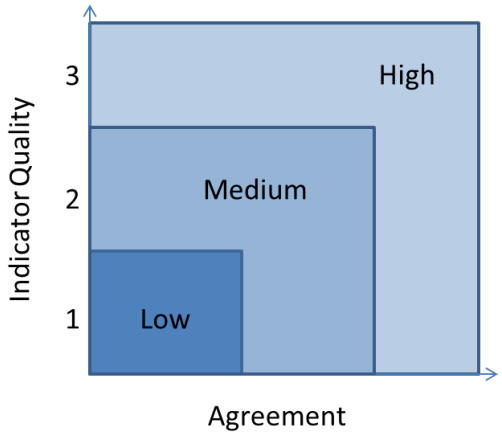

Figure 1 Criteria applied to provide a confidence rating for each indicator, based on each indicator's level of data quality and the agreement of the evidence provided to reflect the impact of management measures(Rees, Ashley et al. 2016)

For example: Data of the ES indicator for MTOs 'number of people on trips' show that this has increased over time. In terms of indicator quality the economic data from the MTOs is local and spatially explicit to the St Helena MPA therefore the indicator quality is a 3 (high). In terms of the agreement of evidence the number of visitors to the island has increased as has the number of MTOs operating over this time, St Helena Government have been promoting tourism, tourism

is also a globally increasing sector. Therefore there is 'high' agreement in the evidence that supports the reasons for the 'number of trips' increasing over time, signalling that there is overall a high degree in confidence that the ES indicator of 'number of people on trips' has increased due to local measures.

Similarly any confidence assessment linked to fisheries data will need to take into account regional factors such as Regional tuna data (fishing effort, weight and value) from ICAAT, data on export market prices, levels of Illegal, Unregulated and Unreported (IUU) in the region.

6 Future work and potential funding opportunities

Protected area management is typically challenging, complex, and can potentially touch upon numerous socially charged issues (Mascia, Claus et al. 2010), which, if ignored or compartmentalised, can result in the failure of the protected area to meet the objectives for which it was primarily designed (Christie 2004). Indeed, research shows that because MPAs are at the interface between social and ecological systems, short-term biological gains associated with designation may be compromised unless social issues, specifically notions of equity, are addressed in the planning and management process (Christie, McCay et al. 2003, Christie 2004, Klein, Chan et al. 2008, Norse 2010, Pollnac, Christie et al. 2010, Rosendo, Brown et al. 2011, Leleu, Alban et al. 2012, Rees, Attrill et al. 2013). Practical considerations, such as surveillance and enforcement, especially for remote and transboundary MPAs also present significant challenges.

There is a growing international interest the performance of MPAs to meet both ecological and socio-economic goals. The newly designated MPA St Helena provides a unique opportunity to expand from the baselines of 2016 and support improved marine management both locally and globally. A number of project funding sources target this theme:

- The Overseas Territories Environment and Climate Fund (Darwin Plus) https://www.gov.uk/guidance/darwin-plus-applying-for-projects-in-uk-overseas-territories
- Global Environment Facility https://www.thegef.org/about/funding
- Global Challenges Fund http://www.rcuk.ac.uk/funding/gcrf/
- Biodiversity and Ecosystem Services in Territories of European Overseas (BEST).

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8 Annex I

Questionnaire pre-amble and Consent

Please make the interviewee(s) aware of the following and provide copies of the information sheet and a reference copy of the consent form:

This questionnaire forms part of a study being carried out by …….

The questionnaire should last 20-45 min. Answers given will **remain confidential** and only anonymised and grouped data will be used in the analysis and reporting. By taking part in this survey you are consenting to your data being used as part of this study. You have the right to withdraw from this interview or to request your data is removed from the project at any time. You do not have to answer any individual question that you do not wish to answer.

The interview will be recorded and notes taken.

Ticking the following box indicates that you have read and understand the information provided above, that you willingly agree to participate and that you may withdraw your consent at any time and discontinue participation.

☐

Note to interviewer: There are several open questions in the questionnaire. At this point your role is to listen. Ask the question and listen to the answer. Try not to prompt the interviewee but do clarify or reflect the original question in your own words if needed. The idea is to get their opinion as it is framed in their mind rather than giving an answer related to the topics we want to hear. Try to remain impartial, nod and smile, but don't turn this part into a conversation. ***Make sure your recorder is on****. Please take detailed notes on the main points made by the interviewee.*

Questionnaire Marine Tour Operators

1. Business name:
2. Interviewee name:
3. How many years have you been running your business on St Helena?
4. Boat name(s)?

5. What services does your business provide? EMD break it down into wildlife interaction tours, wildlife viewing tours, dive tours. Courses or training, other services e.g. equipment hire.

Service	**Proportion of business (100%)**	**Boat name**	**Average price for this service per trip or per course**	**Approximate number of people buying this service last year**	**OR Number of trips last year**	**Average number of people per trip.**	**Increase or decrease from previous year.**
e.g Whale Shark Trip							
Other							

6. Client immigration status. What proportion of your customers are local, local contractor, or tourist and which are the most popular trips?

Local	**Local Contractor**	**Tourist**

7. How many staff were employed by your business last year (full-time)……. (part-time)…….
8. Is this more or less than the previous year?

9. Please can you indicate your annual turnover either as a figure……..or within one of these bands

Turnover	
0-10000	
11000 –20000	
21000-30000	
31000-40000	

41000-50000	
51000-60000	
61000-70000	
71000-80000	
80000-90000	
91000 - 100000	
Other?	

10. Please could you indicate your operating costs as a percentage of your turnover?

Marine species

11. Please identify which species you purposefully target and if there are any 'pressures' you can identify at the site with may affect either the site or the target species.

Target species	Predominant habitat (e.g. reef, sand, open ocean, seamount or wreck)	Dependent upon e.g. food sources	Pressures	Evidence

……..

Open Question: What do you need to ensure that your business has a long term future?