Gap analysis of economic valuation studies completed in the Caribbean UK OTs

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1 Introduction

The sustainable development of small island states in the Caribbean is a permanent item of interest and concern for the international community. The viability, vulnerability and vitality of small island states have received a long-standing recognition as special challenges of these territories.

Small Island Developing States (SIDS) are characterized as having small but growing populations, limited resources, relative remoteness, susceptibility to natural disasters, vulnerability to external shocks, excessive dependence on imports, high energy and transportation costs, limited opportunities to create economies of scale and fragile environments (Easterly & Kraay, 2000). Despite these limitations, SIDS in the Caribbean perform well in economic, social, health and educational indicators, as well as in the flexibility of their decision-making processes (UNEP, 2006).

Given their unique characteristics, SIDS face impacts of global changes that differ from those on larger land-based countries. In the Caribbean, the typical effects of climate change include an increase in the temperature of the air and the sea surface, sea level rise, increase in ocean acidity, change in power, frequency and pattern of hurricanes, and increase in variability of rainfall and drought (Debrot & Butger, 2010). Thus, climate change has potential negative impacts on numerous ecosystems and diverse economic sectors all over the Caribbean region (Guillotreau et al., 2012). Studies on the consequences of climate change for the region estimate that this phenomenon can create costs that range between US$1 and 12 billion per year (Burke & Maidens, 2004).

Across the SIDS that form part of the United Kingdom Overseas Territories (UK OTs) in the Caribbean, persistent social, economic, environmental and institutional challenges for development undermine the resilience and prosperity of local economies. The limited economic diversification, stagnation in productivity and fragile institutional capacities, in addition to increasing financial, social and environmental pressures, are all symptoms of the vulnerabilities and risks in the UK OTs in the Caribbean.

To address the need for a systemic approach to create resilient ecosystems, the UK OTs in the Caribbean have developed the idea to integrate natural capital values into planning and policy making. Therefore, the Joint Nature Conservation Committee (JNCC) of the UK government initiated an assessment of natural capital research on these territories with the purpose of gaining understanding of the current state of development of this topic, building capacity to monitor environmental change, and integrating environmental evidence into economic policy making and infrastructure planning.

This report aims to provide additional insight into natural capital valuation studies in the Caribbean by assessing existing data gaps and research needs in the UK OTs. The analysis of available studies is primarily based on the framework to integrate ecosystem services into

governance proposed by Daily et al. (2009). This framework describes the links between threats, ecosystems, ecosystem services, values, and policy making, as presented in section 2 of this report. Section 3 presents an overview of the natural capital studies conducted in Caribbean UK OTs and explains the attributes considered in the gap analysis. Thereafter, a brief overview of the local context and the information provided by the available natural capital studies is presented in a separate section for each one of the five Caribbean UK OTs. Finally, section 9 identifies research gaps considering all the Caribbean UK OTs and section 10 presents recommendations based on the findings of the study.

2 Empirical Framework

The framework formulated by Daily et al. (2009) provides a structural approach to visualize the relationship between ecosystems, ecosystem services and governance. The framework connects the science of quantifying and monetizing ecosystem services with policy work for sustainable financing, investment decisions and advocacy. By focusing on key elements of the framework, this study provides insight into the required data and research to effectively incorporate natural capital in the governance of UK OTs in the Caribbean.

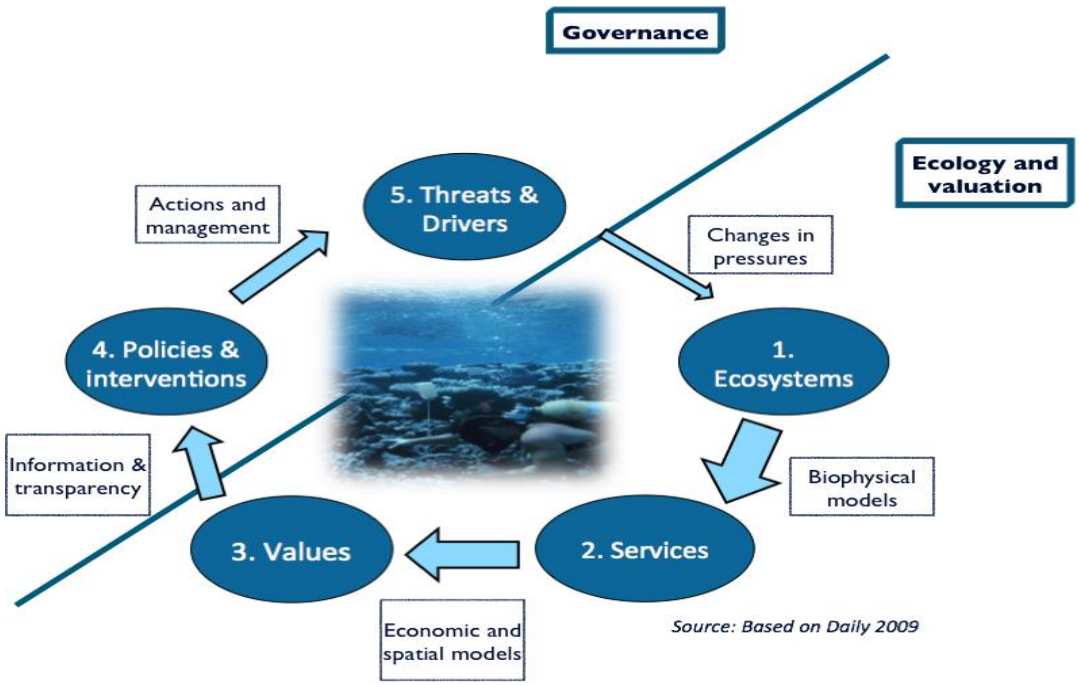

Figure 1 – Framework to integrate ecosystem services in governance (Daily et al., 2009)

The framework shown in Figure 1 depicts a continuous loop that includes ecosystems, ecosystem services, values, policies and interventions, and threats and drivers.

As shown in the framework, well-functioning ecosystems deliver ecosystem services, which can be defined as the benefits people obtain from ecosystems. According to the Economics of Ecosystems and Biodiversity (TEEB), ecosystem services can be classified in three categories: provisioning, regulating, and cultural services (De Groot et al., 2010). Provisioning services generate material outputs from ecosystems such as provisioning of water and timber. Regulating services deal with processes such as coastal erosion and changes in water flows, and with extreme events such as floods and storms. Cultural services relate to the non-material benefits of nature, including spiritual and recreational values.

These services can be socio-economically assessed through several techniques and methods (see Figure 2). The type of valuation method often depends on the service to be valued and the data available.

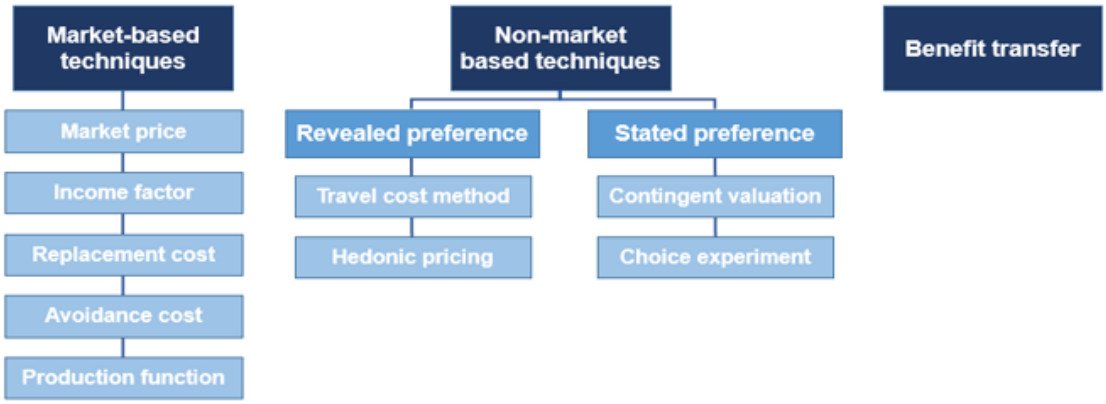

Figure 2 - Techniques to value ecosystem services

The results of ecosystem service assessments can contribute to improving management actions that deal with drivers of change and threats on ecosystems.

The values obtained through the techniques presented in Figure 2 provide information that can improve transparency in policies and interventions. Depending upon the governance context, possible applications of the value of ecosystem services include evidence-based policy making, sustainable financing strategies, investment decisions, of nature conservation advocacy, spatial planning and nature management.

Defining policies and interventions that account for the economic value of ecosystem services can ultimately create incentives to minimize threats and pressures on ecosystems, and promote their conservation and restoration, thereby preventing changes in natural capital stocks (Figure 1).

The analysis of data gaps and research needs presented in this report focuses on ecosystem services, valuation techniques and issues addressed in natural capital valuation studies completed in UK OTs in the Caribbean. Therefore, the subsequent sections of this report mainly describe the elements 2, 3, 4 and 5 of the framework presented in Figure 1. It is expected that this analysis will contribute to the understanding on how natural capital valuation studies can be improved to more effectively influence decision-making in the Caribbean UK OTs.

3 Relevant ecosystems and ecosystem services in the Caribbean

In order to guide the gap analysis, this section provides an overview of ecosystems and ecosystem services of common interest for natural capital studies in small island states in the Caribbean. Table 1 includes a list of services provided by marine and coastal ecosystems such as coral reefs, mangroves, beaches and seagrasses, and by terrestrial ecosystems such as forests and agricultural lands. The information presented in the table is based on the overview provided by Waite et al. (2014) and previous studies conducted by Wolfs Company in the Caribbean.

Table 1 – Overview of ecosystems and ecosystem services of common interest for natural capital valuation studies in the Caribbean

Ecosystem service	Coral Reefs	Mangroves	Beaches	Seagrasses	Forests	Agricultural lands
Provisioning services						
Fisheries	x	x		x		
Raw materials (e.g. forest products)		x			x	x
Medicinal resources	x	x			x	x
Water provision					x	
Regulating services						
Hazard protection	x	x			x	
Coastal protection	x					
Carbon sequestration		x		x	x	
Cultural services						
Tourism	x	x	x		x	x
Recreation	x	x	x		x	x
Culture, history and traditions	x	x	x	x	x	x
Non-use values	x	x	x	x	x	x

The list presented in Table 1 is not exhaustive, and hence, other ecosystems and ecosystem services may be considered important in the specific context of the territories under analysis.

4 Scope of the gap analysis

This section identifies natural capital valuation studies that have been completed in UK OTs in the Caribbean and introduces the specific aspects considered in the gap analysis.

4.1 Natural capital valuation studies in Caribbean UK OTs

The Caribbean UK OTs consist of Anguilla, Montserrat, Cayman Islands, British Virgin Islands, and Turks and Caicos Islands. In total, twelve natural capital valuation studies were identified in the Caribbean UK OTs (Table 2): four in Cayman Islands and two in each one of the other islands. Technical reports and complementary information was provided by local and international experts involved in each of the studies[1].

Table 2 - List of natural capital economic valuation studies conducted in Caribbean UK OTs

	Island	Title	Author	Year	Organizations involved	Commissioned by
1	Anguilla	*The tourism value of nature on Anguilla and the impact of beach erosion*	Koen Tieskens, Clint Lake, Sharmer Flemming, Pieter van Beukering, Luke Brander and Ron Janssen	2014	IVM VU University	Joint Nature Conservation Committee
2	Anguilla	*Valuation of Ecosystem Services of Anguilla - Report of the ANEA Workshop*	Ron Janssen	2015	EMU Environmental Services	Government of Anguilla

1 The following experts provided information or reports during the process: Stephen Mendes, Pieter van Beukering, Richard Waite, James Byrne, Karim Hodge, Alwyn Ponteen, Koen Tieskens, Ron Janssen, Katie Medcalf and Peter Edwards. Local experts of Cayman Islands, Turks and Caicos Islands and British Virgin Islands were not contacted since information was already available within Wolfs Company's members.

	Island	Title	Author	Year	Organizations involved	Commissioned by
3	British Virgin Islands	*Recreational Fishing in the British Virgin Islands: Current Status, Opportunities for Development and Constraints*	Colin P. Gillet, Rosemary Delayney and Hazel Oxenford	2007	Centre for Resource Management and Environmental Studies (CERMES) University of the West Indies, Faculty of Pure and Applied Sciences, Cave Hill Campus, Barbados	
4	British Virgin Islands	*The Tourism Value of Nature in the British Virgin Islands (BVI)*	Gala Sipos, Pieter van Beukering, Luke Brander, Ron Janssen and Koen Tieskens	2014	IVM VU University, Wolfs Company	Joint Nature Conservation Committee
5	Cayman Islands	*The Cayman Sharks and Dolphin Project*		2012	OTEP, Marine Conservation International, Save Our Seas Foundation	Department of Environment - Government of Cayman Islands
6	Cayman Islands	*The impact of invasive species on tourism - The case of lionfish in the Cayman Islands*	Pieter van Beukering, Roy Brouwer, Stijn Schep, Esther Wolfs, Luke Brander, Gina Ebanks-Petrie and Timothy Austin	2014	IVM VU University, Wolfs Company, Joint Nature Conservation Committee	Cayman Islands Government, Department of Environment
7	Cayman Islands	*The economics of expanding the Marine Protected Areas of the Cayman Islands - The cultural and recreational value of the Marine Environment to the Cayman Islands' residents*	Marleen Schutter, Francielle Lacle, Wouter Botzen, Pieter van Beukering and Esther Wolfs	2014	IVM VU University, Wolfs Company	Cayman Islands Government, Department of Environment

	Island	Title	Author	Year	Organizations involved	Commissioned by
8	Cayman Islands	*The Economics of Expanding Marine Protected Areas (MPAs) of the Cayman Islands*	Wolfs Company	2016	IVM VU University, Wolfs Company	Department of Environment - Government of Cayman Islands
9	Montserrat	*Value after the volcano: Economic valuation of Montserrat's Centre Hills*	Pieter van Beukering, Luke Brander, Desirée Immerzeel, Nicole Leotaud, Stephen Mendes, Arnout van Soesbergen, Claude Gerald and Carole McCauley	2008	OTEP, RSPB, Van Beukering Consulting, VU University Amsterdam, Montserrat Centre Hills Project	The Royal Society for the Protection of Birds (RSPB)
10	Montserrat	*Potential impact of invasive alien species on ecosystem services provided by a tropical forested ecosystem: a case study from Montserrat*	Kelvin S.-H. Peh, Andrew Balmford, Jennifer C. Birch, Claire Brown, Stuart H. M. Butchart, James Daley, Jeffrey Dawson, Gerard Grey, Francine M. R. Hughes, Stephen Mendes, James Millett, Alison J. Stattersfield, David H. L. Thomas, Matt Walpole and Richard B. Bradbury	2013		
11	Turks and Caicos Islands	*Economic Valuation of Environmental Resource Services in the Turks and Caicos Islands*	Crick Carleton - Chief Executive Nautilus Consultants Keith Lawrence - Environmental Economist Nautilus Consultants	2005		The Government of the Turks and Caicos Islands

	Island	Title	Author	Year	Organizations involved	Commissioned by
12	Turks and Caicos Islands	*TCI Sustainable Finance Project – Phase II Deliverable 1 - Tourism value of Nature in the Turks and Caicos Islands*	Wolfs Company	2016	Wolfs Company	Gulf and Caribbean Fisheries Institute

4.2 Attributes considered in the gap analysis

The gap analysis includes all the studies listed in Table 2. Each of these studies is analysed according to the following attributes: ecosystem services valued, valuation techniques applied, data used, and issues addressed.

The ecosystem services valued are classified in tourism, coastal protection, cultural value, recreational value, hazard protection, water provisioning, fisheries, carbon sequestration, amenity value, forest provisioning products and non-use values, amongst other services in the provisioning, regulating and cultural service categories.

The valuation techniques applied in each study are classified in market based, non-market based, and benefit transfer approaches. These include the market price, production function, income factor, avoided cost, replacement cost, hedonic pricing, travel cost, contingent valuation, choice experiment, and benefit transfer methods. Furthermore, the use of primary and secondary data, literature review and spatial data is also analyzed.

Finally, the issues addressed in each study are categorized in spatial planning, investment decisions, sustainable financing or advocacy issues. Studies that generate value maps or somehow contribute to spatial decisions are counted among the spatial planning studies. Studies that are specifically conducted to guide private or public investments are included in the category of investment decisions. Studies that develop financial plans or focus on financing mechanisms are considered in the sustainable financing type. And studies that provide information used for awareness raising are classified in the advocacy category.

All the information collected about the natural capital valuation studies is stored in an excel database, which is used to analyse the data gaps and research needs per island and to conduct comparisons between all the UK OTs considered in the study.

5 Anguilla

5.1 Local context

Anguilla is a UK OT (Table 3), composed of a main island and 22 offshore islands and cays located between the Caribbean Sea and the North Atlantic Ocean, east of Puerto Rico (CIA, 2016; Bettencourt & Imminga-Berends, 2015). Tourism is the major economic activity in Anguilla (Bettencourt & Imminga-Berends, 2015). In 2010, more than 118,000 tourists arrived in its territory, accounting for 56% of the islands' GDP, 41% of the direct employment and over 60% of the total employment (Bettencourt & Imminga-Berends, 2015). The growth of the tourism industry and the quick pace of investment activities are prompting concerns about assuring the conservation of the island's natural capital (Bettencourt & Imminga-Berends, 2015).

Table 3 – Geographic and socioeconomic context of Anguilla

Anguilla			
Land area (1)	100 km^2	Unemployment rate (2)	7.8%
Sea exclusive economic zone (EEZ) (1)	92,178 km^2	Percentage of people below the poverty line (1)	5.8%
Total population (1)	15,754 inhabitants	Illiteracy rate (1)	5%
Population density (1)	158 inhabitants/km^2		
GDP (total) (2)	US$311 million		
GDP (per capita) (2)	US$21,493		

(1) Bettencourt & Imminga-Berends (2015)

(2) UN Data (2016)

Anguilla has a large coral reef platform, coral sand beaches, limestone cliffs, low rock outcrops, an extensive barrier reef off the north coast, wetlands[2], mangroves, sand dunes and several salt ponds. The territory of Anguilla has a rich biodiversity, with several species listed in the IUCN red list (Bettencourt & Imminga-Berends, 2015). The interconnected biome provides shoreline protection against the natural hazards that often strike the island. Mangroves and beaches protect against storms, salt ponds against flooding, and dry scrub forest against erosion.

[2] Wetlands are important habitat for various seabirds, waterfowl and migratory shorebirds (Bettencourt & Imminga-Berends, 2015).

Unfortunately, ecosystems in Anguilla have been under threat over the last twenty years (Bettencourt & Imminga-Berends, 2015). Reef benthic habitats are in general in a poor state with low hard coral cover[3] and high levels of macro-algae (Bettencourt & Imminga-Berends, 2015). Lobsters and finfish catch have declined and the territory experiences fresh water scarcity (Bettencourt & Imminga-Berends, 2015). Drivers of change, such as tourism related activities and population growth in Anguilla, create pressures that include infrastructure development, sand mining, waste production and natural resource consumption.

Major threats, according to Anguilla's environmental officers, include the lack of consensus on the removal of vegetation, the filling of ponds for infrastructure development, and the scarce management of pesticide and herbicide use (Bettencourt & Imminga-Berends, 2015). Main environmental challenges faced by Anguilla are climate change (due to sea level rise), habitat degradation (due to infrastructure and economic development) and beach erosion (due to illegal mining for infrastructure development) (Bettencourt & Imminga-Berends, 2015).

In order to guarantee the protection of Anguilla's natural capital and its attractiveness as a tourist destination, seven marine protected areas[4] (MPAs) already exist in the territory. These areas were designed in 1982 but not managed until 1993 (Bettencourt & Imminga-Berends, 2015). Despite these management efforts, Anguilla is in need to develop solid instruments to ensure policy making that accounts for and integrates natural capital values. To be able to do so, natural capital valuation studies have to properly address critical ecosystems and consider the local context. To support and guide future research efforts, the next sub-section presents the results of the gap analysis of natural capital valuation studies completed in Anguilla.

5.2 Natural capital valuation studies

In Anguilla, the following two natural capital valuation studies have been identified and included in the analysis:

(1) The tourism value of nature on Anguilla and the impact of beach erosion (Tieskens et al, 2014): This study values ecosystem services (ES) based on the willingness to pay (WTP) of tourists. The tourism value of ecosystem services is estimated, through stated and revealed preference methods, at approximately 37 million USD per year and describes the white beaches surrounded by coral reefs as the most important asset for the local tourism.

[3] The mean percentage cover of hard coral dropped from 13.95% in 1990 to 4.1% in 2010

[4] Dog Island, Junks Hole, Little Bay, Prickly Pear Cays, Sandy Island, Shoal Bay/Island Harbour, and Sombrero Island Nature Reserve Marine Park

(2) Valuation of Ecosystem Services of Anguilla - Report of the ANEA Workshop (Janssen, 2015): This study presents a total economic valuation (TEV) and scenario analysis based on the ES in Anguilla. The services provided by beaches are valued at around 40 million USD per year and by coral reefs at approximately 5.1 million USD per year. Fisheries are valued at around 4.3 million USD per year, livestock at around 139 thousand USD per year, coastal protection at around 4.4 million USD per year, groundwater at around 1 million USD per year, and the TEV of the ecosystem services in the island at approximately 52.8 million USD per year. This study considers marine and coastal ecosystems, and agricultural lands.

6 British Virgin Islands

6.1 Local context

The British Virgin Islands (BVI) is a self-governing Caribbean UK OT comprised of approximately 60 islands, rocks and cays (Bremont, 2015). Only 16 of these islands are inhabited, being Tortola the largest and most populated one (Gillet et al., 2007). The BVI is adjacent to the U.S. Virgin Islands in the northern-eastern Caribbean Sea.

Table 4 – Geographic and socioeconomic context of the British Virgin Islands

British Virgin Islands			
Land area (1)	153 km^2	GDP (total) (3)	US$902 million
Sea exclusive economic zone (EEZ) (1)	80,117 km^2	GDP (per capita) (3)	US$30,502
Total population (1)	28,280 inhabitants	Unemployment rate (2)	3.1%
Population density (1)	185 inhabitants/km^2	Illiteracy rate (1)	2%
Population growth rate (2)	1.6% per year		

(1) Bettencourt & Imminga-Berends (2015)

(2) Bremont (2015)

(3) UN Data (2016)

Immigration has been one of the major causes of population growth in the BVI during the last decade (Table 4). Thus, 67% of the BVI labour force was comprised by foreigners in 2012 (Bremont, 2015). The government and the hotels and restaurants are the main employers in the BVI, as they respectively represent 33% and 20% of the labour force (Bremont, 2015). The unemployment rate in the BVI is one of the lowest in the Caribbean countries (Bremont, 2015; Table 4).

The two main industries of the BVI are the tourism (Bremont, 2015; Gillet et al., 2007) and the financial services (VP Bank, 2016), representing respectively 30.4% and 16.6% of the BVI's GDP (Bremont, 2015; Table 4). The tourism industry represents an important source of income in the territory and makes the economy of the BVI very tourism dependent (Bettencourt & Imminga-Berends, 2015). The islands offer a range of nature dependent tourist activities in their coral reefs and white beaches, and hosts almost one million tourists every year (Sipos et al., 2014).

The BVI habitats include mangroves, salt ponds, coral reefs, seagrass beds, sandy flats, moist and Caribbean dry forests, trenches and sea mounts. In these habitats, the BVI host a large diversity of

species, including endemic and endangered[5] ones (Bettencourt & Imminga-Berends, 2015). The BVI has around 51 designated protected areas: 19 national parks, 1 MPA, 14 fisheries protected areas, 20 bird sanctuaries, 1 forestry reserve and 6 water areas, but only 5 of these areas have management plans (Bettencourt & Imminga-Berends, 2015).

One quarter of the land area of BVI is made of forest, with approximately 550 ha of mangroves (75% in Anegada). The EEZ has 380 km^2 of coral reefs (Bettencourt & Imminga-Berends, 2015). While mangroves serve as shelter for boats during hurricanes, coral reefs are important tourist attractions.

With almost one million tourist every year, the tourism industry is a major driver of pressures on the natural capital of the BVI (Gillet et al., 2007). As the BVI has little interior land with significant mountainous area, most of the pressures occur in coastal areas (Bettencourt & Imminga-Berends, 2015). The consequences of the rampant tourism development include the degradation of mangroves for infrastructure development, beach erosion due to sand mining, eutrophication of near shore waters due to sedimentation and disturbance of marine habitats due to onshore development (Bettencourt & Imminga-Berends, 2015). The main challenges in the territory are halting environmental and habitat degradation, adapting to climate change and protecting endangered species.

As described by Gillet et al. (2007), the BVI faces an inconvenient paradox, since marine ecosystems suffer the impacts of tourism and at the same time sustain the tourism industry.

Therefore, considering natural capital and environmental aspects into policy making and spatial planning is an important aspect to promote a more sustainable tourism and avoid a decline in the services provided by local ecosystems.

6.2 Natural capital valuation studies

The gap analysis of natural capital valuation studies considers the two following studies conducted in the BVI:

(1) The Tourism Value of Nature in the British Virgin Islands (BVI) (Sipos et al., 2014): This study values ecosystem services through the WTP of tourists for management of marine ecosystems based on primary data collection. The study values ecosystem services to tourism in British Virgin Islands in around US$194 million per year. The study advocates for environmental protection

[5] 48 threatened species were identified in the British Virgin Islands in 2012 (Bettencourt & Imminga-Berends, 2015)

through highlighting the important contribution of the marine ecosystems to the tourism industry on the BVI. This study does not include spatial analysis.

(2) Recreational Fishing in the British Virgin Islands. Current Status, Opportunities for Development and Constraints (Gillet et al., 2007): This study examines the potential to develop recreational fishing industry in the British Virgin Islands. It analyzes the recreational fishing sector based on expenditure in the BVI. The results show that the total expenditure of anglers during one fishing season is around US$4.6 million and the total economic value of recreational fishing for the BVI economy is around US$2.6 million per year. The study supports investment decisions in diversifying the fishing industry. This study does not considers spatial analysis.

7 Cayman Islands

7.1 Local context

The Cayman Islands are a tectonically active Caribbean UK OT that consists of the following three islands: Grand Cayman, Cayman Brac and Little Cayman (Bettencourt & Imminga-Berends, 2015). The territory is a major offshore financial center and tourism attraction (Bettencourt & Imminga-Berends, 2015). According to figures from 2013, financial and insurance services represent around 42% the total GDP and the tourism industry around 25% (Schutter et al., 2014). In general, the Cayman Islands have a high standard of living and do not need to strictly rely on the British Government for budget (Bettencourt & Imminga-Berends, 2015). The GDP and GDP per capita of the Cayman Islands are the highest of all the Caribbean UK OTs (Trading Economics, 2016; Table 5).

Table 5 – Geographic and socioeconomic context of the Cayman Islands

Cayman Islands			
Land area (1)	262 km^2	GDP (total) (2)	US$3.48 billion
Sea exclusive economic zone (EEZ) (1)	119,137 km^2	GDP (per capita) (2)	US$57,827
Total population (1)	57,000 inhabitants	Unemployment rate (2)	5.6%
Population density (1)	210 inhabitants/km^2	Illiteracy rate (1)	0.3%

(1) Bettencourt & Imminga-Berends (2015)

(2) Trading economics (2016)

The Cayman Islands have the last large tracts of old-growth forest in all UK OCTs and the largest mangrove wetland remaining in the Caribbean, with the most significant forest areas within the Mastic region of Grand Cayman and the Bluff forest on Cayman Brac (Bettencourt & Imminga-Berends, 2015). The islands have lowland mangrove swamps, dry subtropical forests, wetlands, sea grass beds and coral reefs, which provide many ecosystem services to the islands and serve as habitat and breeding grounds for many animal species, including several endemic and endangered ones (Bettencourt & Imminga-Berends, 2015). The marine life in the Cayman Islands offers outstanding diving and snorkeling opportunities, which attract aboundant tourists each season (Schutter et al., 2014). Between July 2015 and June 2016 the Cayman Islands hosted 382,374 stay-over tourists and 1,603,112 cruise tourist (The Cayman Islands Department of Tourism, 2016).

However, the territory lacks freshwater and has beheld extinctions and large-scale coral bleaching incidents (Bettencourt & Imminga-Berends, 2015). The main pressures on natural capital in the Cayman Islands are caused by population and tourism growth, since these phenomena entail the use of natural resources, development of new urban areas, and generation waste and pollution.

The well-being of the inhabitants of the Cayman Islands is in many aspects dependent on natural capital and ecosystems services, particularly on coral reefs and mangroves wetlands. In order to protect the marine life and ecosystems of the islands, a system of marine protected areas (MPAs) was implemented by the Cayman Islands government in 1986 (Schutter et al., 2014). The valuation of the ecosystem services in the Cayman Islands can support the protection of vital environments, implementation of sustainable financing mechanisms for protected areas, and better-informed decision-making.

7.2 Natural capital valuation studies

The gap analysis of natural capital valuation studies considers four studies conducted in the Cayman Islands:

(1) The impact of invasive species on tourism - The case of lionfish in the Cayman Islands (Van Beukering et al., 2014): This study assesses the WTP of tourists to support the management of lionfish (invasive species). The results show that, in total, tourists are willing to contribute between US$8 million and US$26.3 million per year for the management of lionfish. Thus, the study provides useful information for advocacy of environmental protection and the development of sustainable financing mechanisms to manage lionfish.

(2) The economics of expanding the Marine Protected Areas of the Cayman Islands - The cultural and recreational value of the Marine Environment to the Cayman Islands' residents (Schutter et al., 2014): This thesis project values local cultural and recreational value of the marine environment to local residents through primary data collection. The total cultural and recreational value of the marine environment for local residents is estimated in the range between US$3.7 million to US$4.8 million per year. The study raises awareness on the importance of the natural capital to the inhabitants of the Cayman Islands.

(3) The Cayman Sharks and Dolphin Project (DoE, 2012): This study quantifies the economic value of sharks and dolphins in terms of their direct role in the tourism industry and their indirect value. The total economic value of sharks is estimated at between 80 million and US$130 million per year, and the total economic value of whales and dolphins is between US$26 million and US$50 million per year. The study advocates the protection of elasmobranch and cetacean populations and provides policy recommendations.

(4) The Economics of Expanding Marine Protected Areas (MPAs) of the Cayman Islands (Wolfs Company, 2016a): This ongoing study estimates the economic value of services obtained from marine and coastal ecosystems in the Cayman Islands. Preliminary results include the following ecosystem services: tourism value of nature (around US$163 million per year), carbon sequestration (about US$173,000 per year), coastal protection (approximately US$116 million per year), fisheries (around US$2.3 million per year), local recreational and cultural value (around US$5.6 million per year), and pharmaceutical value (around US$7.6 million per year). The study

uses spatial scenarios to analyse the benefits of expanding the marine protected areas on the Cayman Islands.

8 Montserrat

8.1 Local context

Montserrat is a volcanic mountainous island (Table 6), located between the islands of Nevis and Guadeloupe, 43 km south-west from Antigua (Bettencourt & Imminga-Berends, 2015). Montserrat no longer needed budgetary support from the UK by 1981. However, Hurricane Hugo in 1989 and the ongoing volcanic eruptions that started in 1995 made the island to require support to rebuild the local infrastructure (Bettencourt & Imminga-Berends, 2015).

Table 6 – Geographic and socioeconomic context of Montserrat

Montserrat			
Land area (1)	102 km^2	GDP (total) (2)	US$63 million
Sea exclusive economic zone (EEZ) (1)	7,582 km^2	GDP (per capita) (2)	US$12,384
Total population (1)	4,959 inhabitants	Unemployment rate (2)	5.6%
Population density (1)	113 inhabitants/km^2	Illiteracy rate (1)	4%

(1) Bettencourt & Imminga-Berends (2015)

(2) UN Data (2016)

The volcanic crisis severely affected Montserrat's economy with a massive disruption of agriculture and tourism, the latest being a thriving industry before 1995 (Bettencourt & Imminga-Berends, 2015). In 2012, the tourism contribution to GDP is estimated at only 2.75% (Bettencourt & Imminga-Berends, 2015). However, the tourism industry is still seen as extremely important for the island's redevelopment and it is considered a major private industry, bringing in between US$7 and 9 million per year since 2000 (McCauley, 2006; Bettencourt & Imminga-Berends, 2015). The construction industry has benefited from financial aid to construct safe zones and the airport, and agriculture has shifted in terms of the contribution of its sub-sectors. The contribution of crops to the agricultural sector decreased from 57% in 1995 to only 27% in 2005. The contribution of fishing, on the other hand, increased from 16% to 48% of the agricultural sector (McCauley & Mendes, 2006).

Volcanic activity disseminated between 45% and 60% of Montserrat's forest and resulted in the disposal of large amounts of sediments (airborne volcanic ash, debris runoff and ash) into the sea, severely affecting coral reefs (Bettencourt & Imminga-Berends, 2015; van Beukering et al., 2008). The hurricane season severely impacted sea grass beds, also contributing to the diminishment of marine life, especially the population of turtles.

Montserrat is known as the "Emerald Isle of the Caribbean" as it is one of the richest of all the UK OTs in terms of biodiversity (Bettencourt & Imminga-Berends, 2015). Montserrat has high

endemism, lush rainforest, black and silver-grey sand beaches, and eleven different vegetation types, namely: mangrove, thorny woodland, deciduous seasonal forest, semi-evergreen seasonal forest, tree fern break, littoral woodland, fumaroles vegetation, rain forest, palm break, lower montane rain forest and cloud forest or elfin woodland (Bettencourt & Imminga-Berends, 2015). The territory's marine habitats include a small patch of coral reefs, sea grass, sand and seabed sediment.

The protected areas in Montserrat include the Centre Hills Forest Reserve, the Silver Hills Forest Reserve and the Foxes Bay Bird Sanctuary (among other streams, ravines and steep lands). These areas cover about 11% of Montserrat's land and 30% of the volcano safe zone (Bettencourt & Imminga-Berends, 2015). After the volcanic eruptions, the Centre Hills Forest Reserve has the largest intact forest area in Montserrat (mostly secondary forest) (van Beukering et al., 2008).

Bettencourt & Imminga-Berends (2015) highlight that the only benefit from the volcanic eruptions is the barrier to sea level rise due to the accretion of beaches. Despite this, the main consequences of the eruptions are damages to the economy, biodiversity and ecosystems. Consequently, the volcano diminished the potential impact of any human activity on ecosystems and became the major threat to natural capital, arising pressures to forests, flora, fauna, coral reefs and other ecosystems present in the island. Other threats to endemic species are imposed by invasive alien species, such as feral pigs, goats, rats, sheep and cattle (Bettencourt & Imminga-Berends, 2015; van Beukering et al, 2008). Tourism can be considered a driver of pressures on natural capital only in the long term (van Beukering et al., 2008).

The need to reallocate population, build infrastructure and implement utilities and waste management systems to the Northern part of the island because of volcanic eruptions result in new pressures to ecosystems and forest areas due to land use change (van Beukering et al., 2008). Moreover, lack of financial resources prevent proper recruitment and training of environmental management staff in Montserrat (Bettencourt & Imminga-Berends, 2015). In order to promote the sustainable development and guarantee the ecosystem service provisioning in the island, it is clear that the island needs structured development plans that also take into account natural capital values.

8.2 Natural capital valuation studies

The gap analysis considers the following two natural capital valuation studies conducted in Montserrat:

(1) Value after the volcano: Economic valuation of Montserrat's Centre Hills (Van Beukering et al., 2008): This study assesses the value of the ecosystem services that are still provided by terrestrial ecosystems in Centre Hills after the main volcanic eruptions. The TEV of the Centre Hills ecosystem services is estimated at around 1.4 million USD per year. The study provides information on the economic importance of further conservation of the area and it is believed to

be a first step towards the design of sustainable financing plans to promote tourism and safeguard the quality and quantity of the ecosystem services provided by the forest in Centre Hills.

(2) Potential impact of invasive alien species on ecosystem services provided by a tropical forested ecosystem: a case study from Montserrat (Peh et al., 2013): This research applies a newly developed rapid assessment tool (TESSA – Toolkit for Ecosystem Service Site-based Assessments) to estimate the net impact of livestock control on carbon storage, nature-based tourism and wild goods harvested from terrestrial ecosystems in the Centre Hills. The overall net benefit generated from the annual flows of ecosystem services associated with livestock control in the reserve is estimated at around US$214,000 per year. The study supports the management of invasive species and investment decisions in relation to a feral livestock control programme.

9 Turks and Caicos Islands

9.1 Local context

The Turks and Caicos Islands (TCI) consist of two groups of islands separated by a deep-water channel north of Haiti, in the Bahamas (Statistical Office, 2015). The TCI is made of more than 40 islands, cays and sandbanks (Bettencourt & Imminga-Berends, 2015). There is continuous immigration to the islands with a yearly resident population growth of 5% (Bettencourt & Imminga-Berends, 2015; Table 7).

Table 7 – Geographic and socioeconomic context of the Turks and Caicos Islands

Turks and Caicos Islands			
Land area (1)	500 km^2	GDP (total) (2)	US$797 million
Sea exclusive economic zone (EEZ) (1)	154,068 km^2	GDP (per capita) (2)	US$23,615
Total population (1)	31,458 inhabitants	Unemployment rate (3)	12%
Population density (1)	63 inhabitants/km^2	Illiteracy rate (3)	2%
Population growth rate (1)	5%		

(1) Bettencourt & Imminga-Berends (2015)

(2) UN Data (2016)

(3) Statistical Office (2015)

More than one-third of the GDP in the TCI (Table 7) is aggregated by the tourism sector, as tourism represents the main economic activity of the territory (Statistical Office, 2015). The TCI ranks as the third country, out of 185 countries, in terms of the direct contribution of tourism to GDP (KPMG, 2015). Tourism has increased over the years and nowadays around one million tourists visit the TCI's territory every year (Wolfs Company, 2016b).

The financial services sector represents the second largest source of revenue after tourism, being followed by real estate development (Bettencourt & Imminga-Berends, 2015). Other key productive sectors in the TCI are fisheries, construction, wholesale and retail, transportation and storage, and communications (Bettencourt & Imminga-Berends, 2015; Statistical Office, 2015).

The TCI has a complex of different natural ecosystems that host a rich wildlife with more than 20 endemic plants, reptiles and insects (Bettencourt & Imminga-Berends, 2015). The natural capital of TCI supports fishing activities and the tourism industry. However, these ecosystems face many threats, such as the coastal developments, hurricanes, ship goundings, inappropriate waste disposal, lack of enforcement, beach erosion, deforestation, sand mining, fires, illegal fishing, alien species invasion, and consequences of climate change (Wolfs Company, 2015). The TCI's most important ecosystems include: coral reefs, mangroves and wetlands, salinas, sandy beaches and

dunes, sea grass beds, intertidal sand banks and mudflats, deep oceans, dry forest, and caves (Wolfs Company, 2015).

Threats to the TCI's natural capital are commonly driven by tourism development and population growth, which are highly dependent on the health of ecosystems. Thus, it is necessary for the decision-making to consider a balance between providing quality products and services to tourists and guaranteeing the preservation of natural capital (Statistical Office, 2015). The TCI has a total of 35 protected areas, which include 11 national parks, 11 nature reserves, 9 areas of historic interest and 4 designated sanctuaries (Wolfs Company, 2015). However, TCI's resources for environmental management and protection (mainly for marine protected areas) are scarce. As in other islands in the Caribbean, annual recurrent funds in the TCI are insufficient to cover staff positions, management activities, infrastructure and monitoring to ensure effective protection and sustainable use of natural resources (Wolfs Company, 2016b). Hence, natural capital valuation studies can guide the allocation of revenues and funds to environmental protection of important ecosystems and support decision-making and sustainable financing plans in the territory.

9.2 Natural capital valuation studies

The gap analysis considers on the following two natural capital valuation studies conducted in the TCI:

(1) Economic Valuation of Environmental Resource Services in the Turks and Caicos Islands (Carleton and Lawrence, 2005): This study values the coastal protection by coral reefs and conducts a rapid assessment of other marine and coastal ecosystem services for comparison purposes (e.g. tourism, recreational value, fisheries and amenity value). The value of the coral reefs for coastal protection in the TCI is estimated at around US$17 million per year. The total economic value of coral reefs is estimated at approximately US$47 million per year. The study supports the protection of coral reefs and aims to provide decision-makers with a realistic assessment of the impacts of their decisions.

(2) TCI Sustainable Finance Project (Phase II). Deliverable 1 - Tourism value of Nature in the Turks and Caicos Islands (Wolfs Company, 2016b): The tourism value of nature is estimated to demonstrate the contribution of marine ecosystem services to the economy of the TCI. This study is based on local secondary information and data from studies in other Caribbean islands. It does not use spatial data. The tourism value of marine ecosystems is determined, through benefit transfer, at around US$45.5 million per year. This study aims to support the allocation of government funding to the sustainable financing of the protected areas.

10 Gap analysis

This section compares the ecosystem services valued, valuation techniques applied, type of data used and issues addressed in the natural capital valuation studies identified in all the Caribbean UK OTs.

All natural capital valuation studies focus on marine and coastal ecosystems, except for those on Montserrat. Table 8 and Figure 3 3 present the ecosystems included in the available natural capital valuation studies in each of the UK OTs considered in this report. The majority of these studies analyze services obtained from coral reefs (9 studies) and beaches (7 studies). Mangroves and forests are represented in three and two studies, respectively. Ecosystem services derived from seagrass and agricultural lands are the least studied in the Caribbean UK OTs, being represented in one study each.

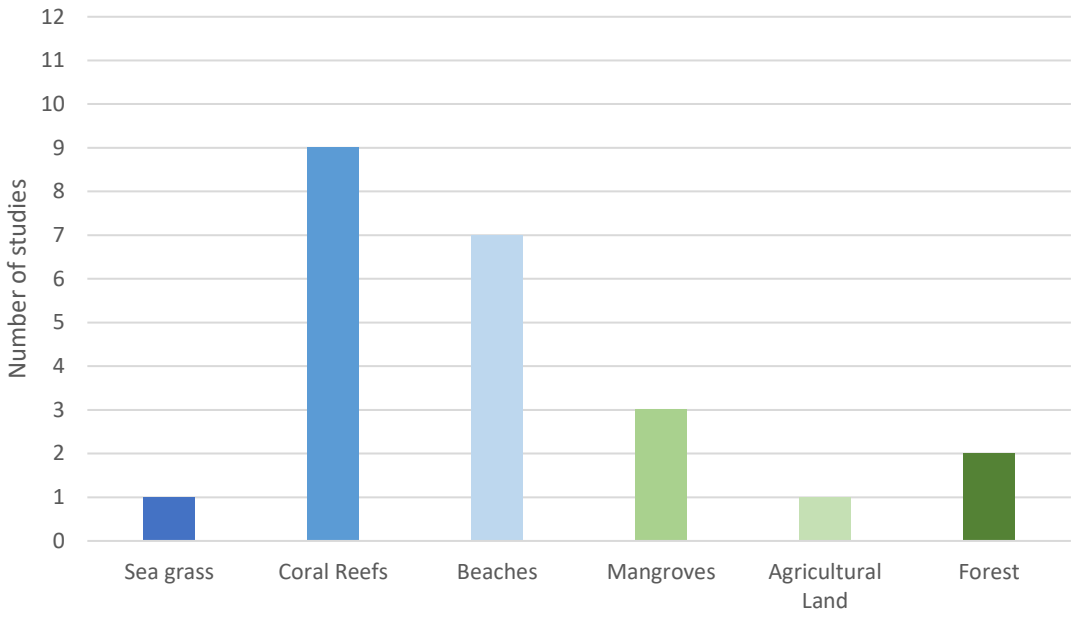

Figure 3 - Ecosystems considered in natural capital valuation studies in the Caribbean UK OTs

Ecosystem services obtained from coral reefs and beaches have been analyzed in all the UK OTs in the Caribbean. However, services from mangroves have been analyzed in Anguilla and the Cayman Islands, and from seagrass only in the Cayman Islands (Table 8).

The studies available in the Cayman Islands offer the best representation of different types of marine and coastal ecosystems. Terrestrial ecosystems, on the other hand, have only been included in the studies conducted in Montserrat and Anguilla (Table 8).

Table 8 - Summary of ecosystems considered in natural capital valuation studies in Caribbean UK OTs

Caribbean UK OT	Sea grass	Coral Reefs	Beaches	Mangroves	Agricultural land	Forest
Anguilla		x	x	x	x	
British Virgin Islands		x	x			
Cayman Islands	x	x	x	x		
Montserrat						x
Turks and Caicos Islands		x	x			

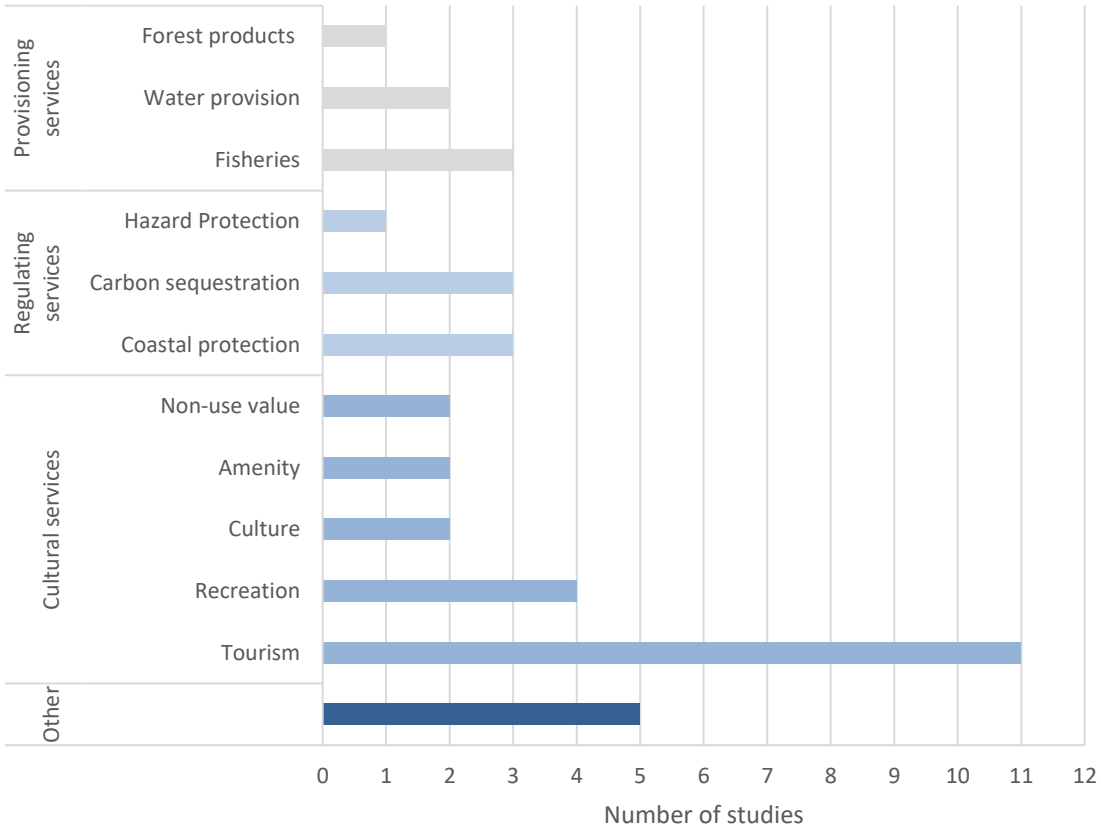

Figure 4 - Ecosystem services assessed in the analysed studies in Caribbean UK OTs

Figure 4 presents the number of studies that evaluate each type of ecosystem service in Caribbean UK OTs. This figure shows ecosystem services in the cultural, regulating and provisioning categories (De Groot et al., 2010). Ecosystem services in the category 'other' include biodiversity

(van Beukering et al., 2008), biological support (Wolfs Company, 2016a), livestock and existence value of coral reefs (Janssen, 2015).

Overall, tourism is the ecosystem service most frequently analysed in natural capital valuation studies in Caribbean UK OTs (only one study out of twelve did not determine the tourism value). As shown in Table 9, tourism has been assessed in all the Caribbean UK OTs. Other services that have been fairly considered in the studies in UK OTs include: recreation (Cayman Islands, Montserrat and Turks and Caicos Islands), coastal protection (Anguilla, Cayman Islands and Turks and Caicos Islands) and fisheries (Anguilla, Cayman Islands and Turks and Caicos Islands).

Forest products and hazard protection, on the other hand, are the least studied services in Caribbean UK OTs. Both services have been considered by one study in Montserrat (van Beukering et al., 2008), given their particular importance after the volcanic eruptions. Other ecosystem services with a low representation in existing studies include water provision, culture, amenity value and non-use values in general (Figure 4; Table 9).

Table 9 - Ecosystem services assessed in Caribbean UK OTs

Ecosystem service	Anguilla	BVI	Cayman Islands	Montserrat	TCI
Tourism	x	x	x	x	x
Recreation			x	x	x
Culture			x		
Coastal protection	x		x		x
Hazard Protection				x	
Fisheries	x		x		x
Water provision	x			x	
Carbon sequestration			x	x	
Amenity			x		x
Non-use value	x			x	
Forest products				x	
Other	x		x	x	x

In this report, the data used in natural capital valuation studies is classified as primary data, secondary data, literature review and spatial data (Table 10). Most of the studies use more than one type of data. Nine out of the twelve studies use primary data (75%), obtained mainly through surveys and interviews. Six studies use secondary data sources (50%), seven rely in literature review (58%) and four use spatial data (33%). The Turks and Caicos Islands is the only UK OT for which no primary data on natural capital have been collected.

The primary and secondary data categories were also divided into socio-economic and ecological data. In all the studies considered in this report, the ecological aspects are analyzed by using secondary data.

Table 10 - Summary of data used per Caribbean UK OTs

Caribbean UK OT	Primary Data	Secondary Data	Spatial Data	Literature Review
Anguilla	x	x	x	x
British Virgin Islands	x	x		
Cayman Islands	x	x	x	x
Montserrat	x	x	x	x
Turks and Caicos Islands		x	x	x

The studies analized in the UK OTs in the Caribbean apply a wide range of valuation techniques (Figure 5). Seven out of the twelve studies follow a market based approach (around 60%), five a revealed preference approach (approximately 40%), eight a stated preference approach (around 70%), and two a benefit transfer (around 20%). The majority of the studies use more than one valuation technique.

Although most of the studies conducted in Caribbean UK OTs collect primary data through stated preference techniques, these techniques are only used to estimate the value of nature for tourism (six studies) and recreation (three studies).

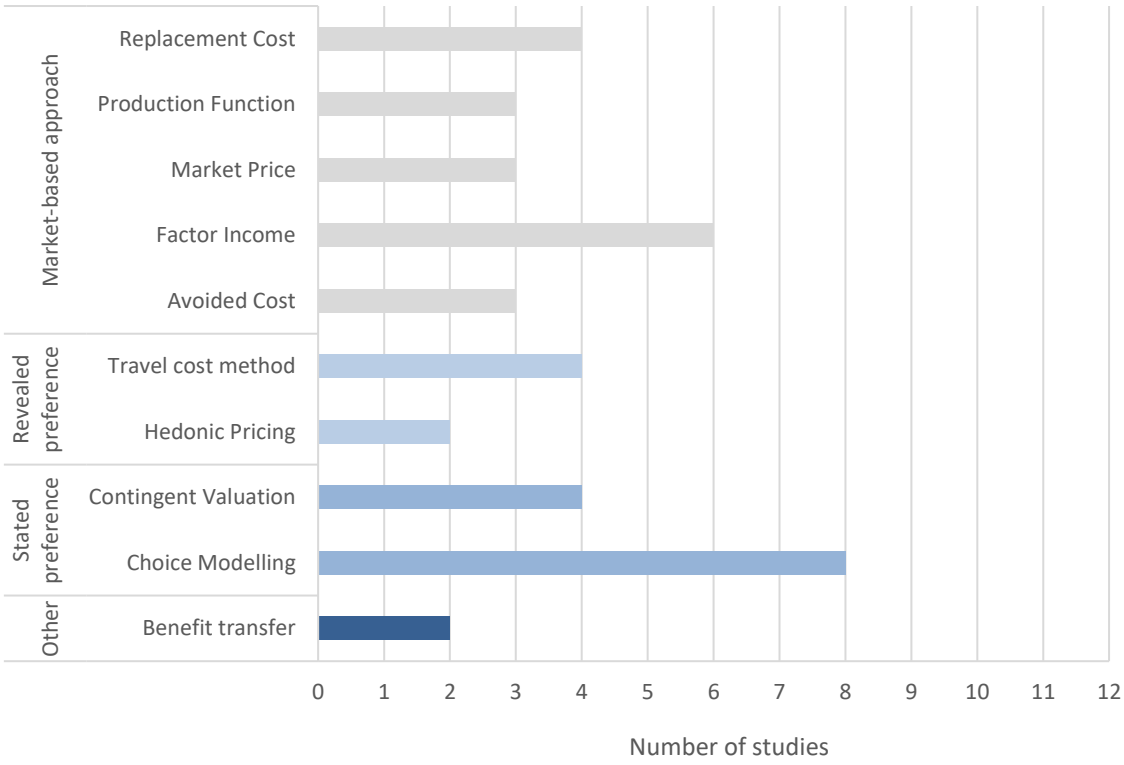

Figure 5 – Valuation techniques applied in the analyzed studies in Caribbean UK OTs

From twelve studies analyzed, five carry out a scenario analysis, two conduct a cost-benefit analysis and one includes value maps. The issues addressed by the valuation studies are classified in Spatial Planning, Investment Decisions, Sustainable Financing and Advocacy, according to the definitions presented in sub-section 4.2.

As shown in Table 11 andFigure 6, the majority of the studies in Caribbean UK OTs provides information to support the advocacy of nature management and conservation (10 out of 12 studies). Sustainable financing mechanisms, investment decisions and spatial planning are, on the other hand, explicitly addressed by only two studies each.

Natural capital studies as support for sustainable financing have been conducted in the Cayman Islands, Montserrat and TCI. Investment decisions have been considered in studies in the British Virgin Islands and Montserrat. Spatial planning, however, is only considered in studies in the Cayman Islands (Rable 11).

Table 11 – Summary of issues addressed in natural capital valuation studies per UK OT

Caribbean UK OT	Spatial planning	Investment decisions	Sustainable financing	Advocacy
Anguilla				x
British Virgin Islands		x		x
Cayman Islands	x		x	x
Montserrat		x	x	x
Turks and Caicos Islands			x	x

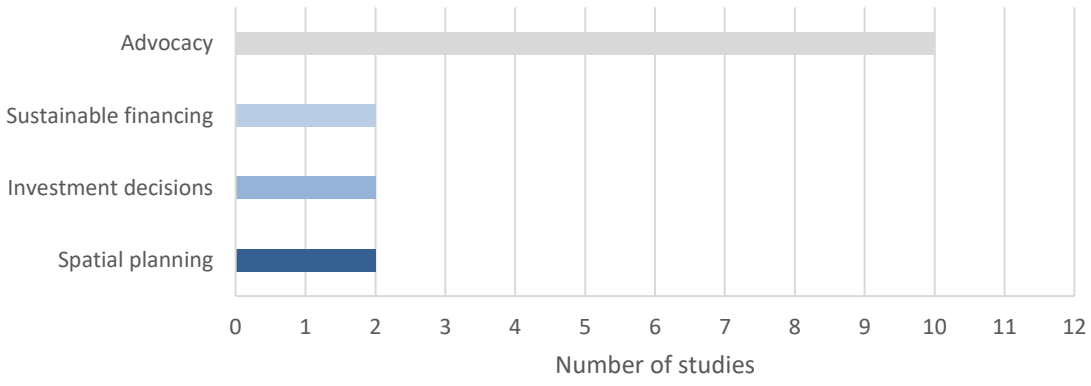

Figure 6 – Issues addressed by natural capital valuation studies in Caribbean UK OTs

11 Recommendations

This study aimed to provide insight into natural capital valuation studies conducted in UK OTs in the Caribbean. To achieve this goal, a gap analysis has been conducted. For each Caribbean UK OT, the studies available have been classified per type of ecosystem service assessed, valuation techniques used, type of data collected and main issues addressed. The results of this analysis have been subsequently compiled in order to provide an overview of data gaps and research needs in all the territories analyzed in the Caribbean.

11.1 Assessing relevant ecosystems and ecosystem services

The results of the gap analysis show that existing studies focus mainly on services provided by coral reefs and beaches. Other coastal ecosystems, such as mangroves and seagrass, have been rarely assessed, and terrestrial ecosystems are in general overlooked. Some of these ecosystem may play important roles as habitats, nursery areas, carbon pools and sources of raw materials.

The importance of the services provided by the least studied ecosystems in the UK OTs should be further investigated. Collaborative work between different UK OTs could help avoid relevant geographic areas and ecosystems to be ignored in future assessments. Stakeholder and expert consultation can furthermore help define priority ecosystems to conduct further natural capital research.

11.2 Using primary and spatial data

The increased use of primary and as well as spatially explicit data can increase the robustness of the results and thereby the impact that natural capital valuations may have in the local context. Several studies use primary data in the Caribbean UK OTs. However, these data are used to assess only a limited number of ecosystem services, such as tourism and recreation. Secondary spatial data are used as input in several natural capital valuations considered in this analysis, but in the majority of cases this does not lead to spatially explicitoutputs, i.e. maps.

In order to better inform policies and decision making, further efforts on primary data collection can help minimize uncertainties in the assessment of ecosystem services such as fisheries (socio economic and ecological data), cultural values (socio economic data) and carbon sequestration (ecological data). Primary data can also serve as the basis to develop spatial outputs that contribute to tackle specific challenges such as spatial planning, financial resource allocation, risk management and protected area planning.

Gaps in local data should be identified in early stages of future natural capital valuation studies. The analysis of local data gaps should be utilized to develop primary data collection plans. Given the costs involved in primary data collection, data collection plans should also be based on the prior selection of the most relevant ecosystem services to include in natural capital studies.

11.3 Addressing issues by value mapping and spatial analysis

Mapping ecosystem services and their values will assist us to set conservation priorities and eventually develop better informed integrated spatial planning and conservation areas. Even at the scale of small island states, ecosystem service value maps are essential to identify trade-offs and synergies between different ecosystem services and to reveal potential resource conflicts among beneficiaries of ecosystem services. In addition, spatial processed-based and hydrological models that simulate regulating ecosystem services, such as erosion prevention or water retention, reveal interlinkages across ecosystems. For instance, deforestation will cause erosion, which will affect the quality the coastal marine ecology.

For specific zoning questions spatially explitict decision support tools, such as a spatial multiple criteria analysis or cost-benefit analyses have proven their added value. Hotspots of ecosystem service value have been the basis for the expansion of marine or terrestrial protected areas in for example the Cayman Islands and Saba.

In order to better inform policies and decision making, further efforts in spatial analysis such as producing value maps is recommended. These spatial analysis will contribute to wise all-inclusive decion-making supporting resilient island economies.

11.4 Addressing research needs per territory

Despite the gaps identified above for all the UK OTs in the Caribbean, each of these territories has specific challenges in terms of natural capital research. To increase the local impact of natural capital studies on decision making, the gaps of information in each OT should be used as the basis for the scoping phase of future research projects. The importance of addressing each data gap is context specific and should be assessed in consultation with local stakeholders.

In Anguilla, seagrass and terrestrial ecosystems such as dry forests have not been considered in the studies available. Cultural and recreational services and the amenity value of ecosystems might be potentially interesting services to be included in subsequent research projects.

In the British Virgin Islands, seagrass, mangroves and terrestrial ecosystems have not been studied, and coral reefs have been partially considered in the assessment of the tourism value. A complete natural capital valuation study, considering the most relevant ecosystem services, as well as an updated study on the tourism value of nature, remain a research need in this territory.

In the Cayman Islands, research on the services provided by terrestrial ecosystems is required. Ecosystem services such us water provisioning and regulation, and the supply of products from terrestrial ecosystems could be relevant for future studies.

In Montserrat, further research should consider marine and coastal ecosystems. Cultural values of nature, fisheries, coastal protection, amongst other marine and coastal services can be relevant for next studies.

In the Turks and Caicos Islands, there is room for studying services from all different ecosystem types. A complete scoping of relevant ecosystem services in consultation with stakehodlers may be required. Next studies can include cultural values of nature, carbon sequestration and other services from marine and coastal ecosystems that are relevant in the local context. From terrestrial ecosystems, these studies could include the provision of freshwater and forest products, amongst others. Future research should also collect primary data in order to update the available figures on the tourism value of nature.

11.5 Stakeholder engagement

Further efforts can be devoted to evaluating the potential use of the results of natural capital valuation studies together with stakeholders and policy-makers, and thereby inform sustainable financing plans, policies and development strategies. The engagement with stakeholders during the research process can be extremely relevant to enhance the legitimacy of the results, strengthen the link between practical interests and the research goals, and increase the potential impact of natural capital studies on policy-making.

A lack of linkage between natural capital valuation studies and practical aims of governance can be observed in most of the Caribbean UK OTs. In order to assure the influence of natural capital valuation studies on environmental governance, it is important that the applications of the studies are coherent with governmental and private initiatives. Likewise, the follow up on how to implement the values obtained from natural capital valuation studies into investment decisions, sustainable financing, spatial planning and policy regulations should be clearly stated.

11.6 Standardization of procedures and sharing of experience

The Caribbean UK OTs lack a uniform and structural framework for data collection. This could enhance the comparative analysis of figures on natural capital value among the Caribbean UK OTs. Developing a general approach to collect data for the valuation of natural resources in the OTs is likely to facilitate the comprehension and use of the results.

Although several ecosystem services might share their degree of importance in different UK OTs, the geographical context can determine specific priorities. For example, while coastal protection is a relevant service in most of the territories, hazard protection related to volcanic eruptions is a relevant ecosystem service for Montserrat, but not for other Caribbean UK OTs. Standardization of procedures and techniques should therefore be flexible enough to allow researchers to account for both, similarities and differences. Sharing experiences and results of natural capital valuation studies between UK OTs can further contribute to this process.

References

Bettencourt, J. and Imminga-Berends, H. (2015). *Overseas Countries and Territories: Environmental Profiles.* Safège Consortium.

Bremont, M. (2015). *GHN Market Report: British Virgin Islands.* [Online] Available at: <https://www.alvarezandmarsal.com/sites/default/files/ghn-market_report-bvi-03-10-15.pdf>. Accessed on: November 15, 2016.

Burke, L., Maidens, J. (2004). *Reefs at Risk in the Caribbean*. World Resource Institute.

Carleton, C. and Lawrence, K. (2005). *Economic Valuation of Environmental Resource Services in the Turks and Caicos Islands.* Environmental Economist Nautilus Consultants.

CIA. (2016). *The world factbook.* [Online] Available at: <https://www.cia.gov/library/publications/the-world-factbook/geos/vi.html>. Accessed on: November 30, 2016.

Daily, G., Polasky, S., Goldstein, J., Kareiva, P., Mooney, H., Pejchar, L. et al. (2009). Ecosystem services in decision-making:. *Frontiers in Ecology and the Environment*, 7(1): 21–28.

Department of Environment (DoE) - Government of Cayman Islands. (2012). *The Cayman Sharks and Dolphin Project*.

Debrot, A.O. and R. Bugter, (2010). *Climate change effects on the biodiversity of the BES islands; Assessment of the possible consequences for the marine and terrestrial ecosystems of the Dutch Antilles and the options for adaptation measures.* Wageningen, Alterra, Alterra-report 2081; IMARES-report C118/10. 36 blz.

De Groot, R., Fisher, B., Cristie, M., Aronson, J., Braat, L., Haines-Young, R., . . . Ring, I. (2010). Integrating the ecological and economic dimensions in biodiversity and ecosystem service valuation. *The Economics of Ecosystems and Biodiversity (TEEB): Ecological and Economic Foundations,* 9-40. London: Earthscan.

Easterly, W. Kraay, A. (2000). *Small States, Small Problems? Income, Growth, and Volatility in Small States*. World Development Vol. 28, No. 11, pp. 2013-2027,2000.

Gillet, C. P., Delayney, R. and Oxenford, H. (2007). *Recreational Fishing in the British Virgin Islands:Current Status, Opportunities for Development and Constraints.* Centre for Resource Management and Environmental Studies (CERMES). University of the West Indies, Faculty of Pure and Applied Sciences, Cave Hill Campus, Barbados.

Guillotreau, P. Campling, L., Robinson, J. (2012). *Vulnerability of small island fishery economies to climate and institutional changes.* SciVerse Science Direct. Environmental Sustainability.

Janssen, R. (2015). *Valuation of Ecosystem Services of Anguilla*. EMU Environmental Services.

KPMG. (2015). *National Tourism Policy and Strategic Implementation Plan for the Turks and Caicos Islands.*

McCauley, C. (2006). *Residents' knowledge, attitudes, and behaviors pertaining to Montserrat's Centre Hills.*

McCauley, C. & Mendes, S. (2006). *Montserrat Centre Hills: Socioeconomic Assessment Report.*

Peh, K., Balmford, A., Birch, J., Brown, C., Butchart, S., Daley, J., Dawson, J., Gray, G., Hughes, F., Mendes, S., Millett, J., Stattersfield, A., Thomas, D., Walpole, M. and Bradbury, R. (2014). Potential impact of invasive alien species on ecosystem services provided by a tropical forested ecosystem: a case study from Montserrat. *Biological Invasions*, 17(1), pp.461-475.

Posner, S., McKenzie, E. and Ricketts, T. (2016). Policy impacts of ecosystem services knowledge. *Proceedings of the National Academy of Sciences*, 113(7), pp.1760-1765.

Schutter, M., Lacle, F., Botzen, W., van Beukering, P. and Wolfs, E. (2014). *The economics of expanding the Marine Protected Areas of the Cayman Islands - The cultural and recreational value of the Marine Environment to the Cayman Islands' residents*. Institute for Environmental Studies. Wolfs Company.

Sipos, G., van Beukering, P., Brander, L., Janssen, R. and Tieskens, K. (2014). *The Tourism Value of Nature in the British Virgin Islands (BVI).* Institute for Environmental Studies. Wolfs Company.

Statistical Office. (2015). *Turks and Caicos Islands Departing Survey,* South Base, Grand Turk, Turks & Caicos Islands: Department of Economic Planning & Statistics.

Tieskens, K., Lake, C., Flemming, S., van Beukering, P., Brander, L. and Janssen, R. (2014). *The tourism value of nature on Anguilla and the impact of beach erosion.* Institute for Environmental Studies.

The Cayman Islands Department of Tourism. (2016). *Bi-Annual Statistics Report: Jan-June 2016.*

Trading Economics. (2016). [Online] Available at: <http://www.tradingeconomics.com/>. Accessed on: November 30, 2016.

UN Data. (2016). *GDP.* [Online] Available at: <http://data.un.org/Default.aspx>. Accessed on: November 30, 2016.

United Nations Environment Programme (2006). Caribbean Environment Outlook. Special Edition for the Mauritius International Meeting for the 10-year Review of the Barbados Programme of Action for the Sustainable Development of Small Island Developing States. [Online] Available at: http://www.unep.org/PDF/SIDS/Caribbean_EO_final.pdf. Accessed on: December 29, 2016.

United Nations. (2016). *Exclusive Economic Zone.* [Online] Available at: <https://www.un.org/depts/los/convention_agreements/texts/unclos/part5.htm>. Accessed on: November 30, 2016.

van Beukering, P., Brander, L., Immerzeel, D., Leotaud, N., Mendes, S., van Soesbergen, A., Gerald, C. and McCauley, C. (2008). *Value after the volcano: Economic valuation of Montserrat's Centre Hills.* The Royal Society for the Protection of Birds (RSPB)

van Beukering, P., Brouwer,R., Schep, S., Wolfs,E., Brander, L., Ebanks-Petrie, G. and Austin, T. (2014). *The impact of invasive species on tourism - The case of lionfish in the Cayman Islands*. Institute for Environmental Studies. Wolfs Company. Joint Nature Conservation Committee.

VP Bank. (2016). *British Virgin Islands – the Economy.* [Online] Available at: <https://www.vpbank.vg/en_VG/827/Location-British-Virgin-Islands-Economic-profile.htm>. Accessed on: November 30, 2016.

Waite R., Burke, L., Gray, E., van Beukering, P., Brander, L., McKenzie, E., Pendleton, L., Schuhmann, P. and Tompkins, E. (2014). *Coastal Capital: Ecosystem Valuation for Decision Making in the Caribbean.* Washington, D.C.: World Resources Institute

Wolfs Company (2015). *TCI Sustainable Finance Project – Phase I. Report on phase I scoping the feasibility to implement a Sustainable Finance Mechanism based on the Tourism Value of the Natural Capital of the Turks and Caicos Islands*.

Wolfs Company (2016a). *The Economics of Expanding Marine Protected Areas (MPAs) of the Cayman Islands*. Institute for Environmental Studies.

Wolfs Company (2016b). *TCI Sustainable Finance Project – Phase II. Deliverable 1 - Tourism value of Nature in the Turks and Caicos Islands*.

Annexes

Annex 1 – Summary of indicators included in the local context of the Caribbean UK OTs

Caribbean UK Ots	GDP (USD)	GDP per capita (USD)	Unemployment rate (%)	Population	Inhab/km²	Land Area (km²)	EEZ (km²)	Iliteracy rate (%)	Main economic pillars
Anguilla	311,000,000	21,493	7.8%	15,754	158	100	92,178	5%	Tourism and Financial Services
British Virgin Islands	902,000,000	30,502	3.1%	28,280	185	153	80,117	2%	Tourism and Financial Services
Cayman Islands	3,480,000,000	54,827	5.6%	57,000	210	262	119,137	0.3%	Financial, Insurance and Tourism Services
Montserrat	63,000,000	12,384	5.6%	4,959	113	102	7,582	4%	Tourism and Construction Services
Turks and Caicos Islands	797,000,000	23,615	12%	31,458	63	500	154,068	2%	Tourism and Financial Services