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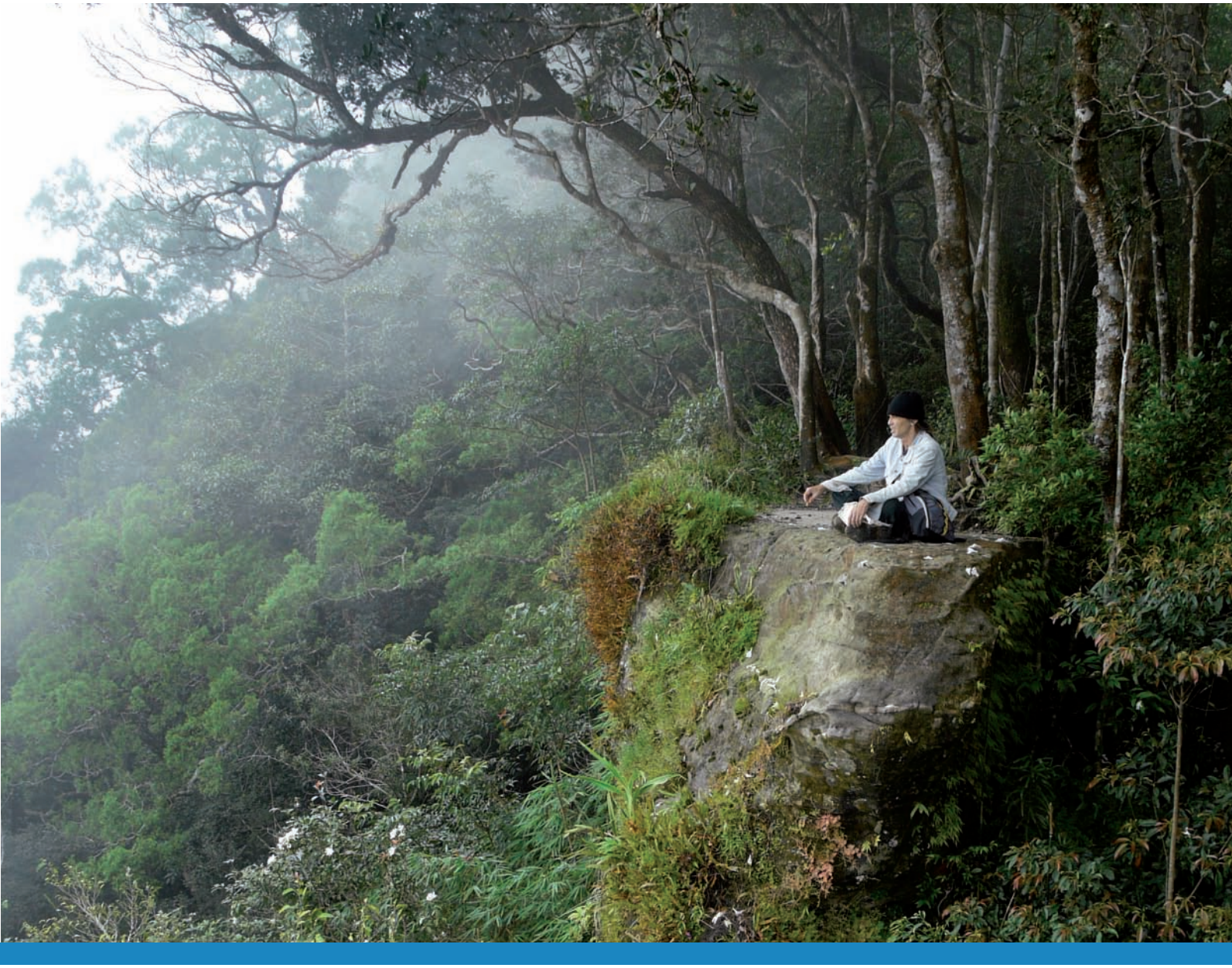
The Benefits of Natural World Heritage

Identifying and assessing ecosystem services and benefits provided by the world's most iconic natural places



BfN Federal Agency for Nature Conservation

UNEP WCMC

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Executive summary

The UNESCO World Heritage Convention celebrated its 40th anniversary in 2012 and continues to play a key role in the identification, conservation and promotion of the world's cultural and natural heritage of Outstanding Universal Value. As of May 2014, when the data was collected for this study, the 222 natural and mixed World Heritage sites covered 11% and 25% of terrestrial and marine protected areas respectively. Sites are inscribed on the World Heritage List because they have unique global values; however like all protected areas they also provide a range of locally, nationally and even globally important benefits that people depend on.

This study identifies and assesses the diversity of ecosystem services, and in turn the benefits that World Heritage sites can deliver to society and the economy through direct and indirect use or through inherent 'non-use' values. It also aims to increase awareness and understanding of the multiple services and benefits that ecosystems can provide as well as their contribution to the well-being of local, national and global communities.

Quantifying ecosystem services

Quantitative information was used to explore the distribution of two ecosystem services – carbon storage and water provision within the natural World Heritage network. Analysis for the pan-tropics estimated that natural World Heritage sites harbour a total of 5.7 billion tons of forest biomass at 10% tree cover threshold. The World Heritage network also contains higher forest biomass carbon density on average than the remaining protected area network in pan-tropical biomes, demonstrating its significant role in carbon storage and an important contribution to climate change mitigation.

Identifying the full range of benefits at global and site level

Each World Heritage site is unique and so too is the range of ecosystem services and benefits it delivers to people at different scales. This study presents the first global assessment of ecosystem services and benefits from all natural World Heritage sites based on the analysis of the data collected via the IUCN World Heritage Outlook – the first global assessment of all natural World Heritage sites. The analysis highlights that, collectively, the network supplies a wide range of benefits. The benefits most frequently identified at site level were 'recreation and tourism' (93% of all sites), 'aesthetic values related to beauty and scenery' (93%), 'resources for building knowledge' (92%), 'provision of jobs' (91%), 'contribution to education' (84%) and 'wilderness and iconic values' (84%). From the environmental services, water provision has the highest score with 66% of sites having been assessed as important for water quantity and/or quality. Carbon sequestration, soil stabilization and flood prevention were also identified as important ecosystem services provided by about half of all natural sites (52%, 48% and 45% respectively - with some 20% reported as data deficient for each service, meaning that potentially another 20% of sites could also be providing these services). The analysis indicates that some benefits, such as for example provision of medicinal resources or the presence of sacred plants and animal species, are much harder to determine due to a lack of data or knowledge. Significant regional differences have also been identified.

Case studies further highlight the variety of benefits provided by World Heritage sites, including water provision, prevention of floods, carbon sequestration, cultural and spiritual values, as well as opportunities for tourism, research and education and provisioning services.

Valuing the benefits

Valuing the benefits provided by natural World Heritage sites in monetary terms highlights their economic importance to decision-makers and investors. This study provides an introduction to a number of valuation approaches and draws on existing economic valuation studies that have been conducted in World Heritage sites. It highlights that most existing studies have looked at the ecosystem service values from tourism, as these values are visible in terms of tangible money flows in the local economy. Further investigation of the other services is warranted to get a clearer understanding of other important values from ecosystems. Economic valuation as tool in decision making should not be used alone. Decision-making processes should balance economic information and non-monetary values, such as the cultural and spiritual values, ascertained from engagement with experts and local stakeholders.

Ensuring continuous provision of benefits

This report also demonstrates that human activities are continuing to impact on the health of ecosystems contained within World Heritage sites. A decrease in the functioning of an ecosystem can have negative implications on the delivery of services and benefits. Identifying and assessing ecosystem services and benefits provided by natural World Heritage sites can therefore help raise awareness of the importance of conservation of these sites. The study concludes that by conserving World Heritage Sites, results are not limited only to the central task of the World Heritage Convention to protect "Outstanding Universal Value" but also extend to protecting healthy and intact ecosystems and natural features that provide benefits to global and local communities both for the present generation, and in the long term for generations to come.

Abbreviations and acronyms

BfN	Bundesamt für Naturshutz (Federal Agency for Nature Conservation)
CBD	Convention on Biological Diversity
CFRPA	Cape Floral Region Protected Areas
EEA	European Environment Agency
FAO	Food and Agriculture Organization
FGBPN	Fundação Grupo Boticário de Proteção à Natureza
GCBC	Greater Cederberg Biodiversity Corridor
GEF	Global Environment Facility
GHGs	Greenhouse gases
ICCA	Indigenous and Community Conserved Area
ICMBio	Instituto Chico Mendes de Conservação da Biodiversidade
IPBES	Intergovernmental Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
MA	Millennium Ecosystem Assessment
MAES	Mapping and Assessment of Ecosystem Services
NTFPs	Non-timber forest products
OECD	Organisation for Economic Co-operation and Development
OUV	Outstanding Universal Value
PA-BAT	Protected Areas Benefit Assessment Tool
TESSA	Toolkit for Ecosystem Service Site-based Assessment
TEEB	The Economics of Ecosystems and Biodiversity
TEV	Total Economic Value
UK NEA	UK National Ecosystem Assessment
UNDP	United Nations Development Programme
UNEP-WCMC	United Nations Environment Programme World Conservation Monitoring Centre
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
VCF	Vegetation Continuous Fields
WDPA	World Database on Protected Areas
WH	World Heritage

1. Introduction

1.1 Purpose, scope and structure of the study

The main purpose of this study is to increase awareness and understanding of the full range of direct and indirect benefits that local, national and global communities can receive from natural and mixed World Heritage (WH) sites. Examples of benefits, in addition to biodiversity conservation, include the prevention of floods, opportunities for tourism, cultural and spiritual values and the provision of food and water.
This report targets a wide range of audiences, including WH site managers, decision makers and the civil society. In particular, it can help inform management decisions which result in strategies to conserve healthy, functioning ecosystems within WH sites that support the delivery of multiple benefits to our societies and economies.

This study has four objectives:

i. **To assess specific ecosystem services (standing carbon and water provision) provided by natural World Heritage sites globally using spatial data.**
ii. **To explore the full range of benefits provided by natural World Heritage sites globally and at the site level.**
iii. **To value benefits in monetary terms (where appropriate) through compilation of existing case studies of economic valuation**
iv. **To examine the different governance models that can favour the delivery of ecosystem services and wider benefits.**

To achieve these aims the study uses the best available spatial data at the global scale as well as quantitative and qualitative information on benefits at the site level.

This report is divided into five chapters. Following this introduction (Chapter 1), Chapter 2 outlines the methodological framework for this study. Chapter 3 presents the results of the global analysis of key ecosystem services and benefits. Chapter 4 uses illustrative case studies from specific World Heritage sites to highlight (i) the range of benefits the World Heritage network provides, (ii) economic valuation studies that have been undertaken and the economic approaches used and (iii) the different governance models. Chapter 5 draws together some of the key messages from the study.

Funded by the German Federal Agency for Nature Conservation (Bundesamt für Naturschutz – BfN), the study was carried out by the International Union for Nature Conservation (IUCN) and the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC). This report accompanies the online benefits atlas hosted on the website of the IUCN World Heritage Outlook (http://worldheritageoutlook.iucn.org/), which presents the first global assessment of all natural World Heritage sites.

1.2 The World Heritage Convention and Outstanding Universal Value

The UNESCO World Heritage Convention celebrated its 40th anniversary in 2012 and continues to play a key role in the identification, conservation and promotion of the world's most outstanding cultural and natural sites. To date 190 countries have ratified the Convention and inscribed 962 sites in 157 countries on the UNESCO World Heritage List. As of May 2014, the 222 natural and mixed[1] World Heritage sites cover 11% and 25% of terrestrial and marine protected areas, respectively. Among these are 159 sites that have been recognized for their outstanding biodiversity values, including many of the most iconic natural areas in the world (Figure 1).

'Outstanding Universal Value' (OUV) is the key requirement for inscription of a site on the World Heritage List and means "cultural and/or natural significance which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity" (UNESCO 2013). To be deemed of OUV, a site must meet one or more of the ten World Heritage criteria, the corresponding conditions of integrity and/or authenticity (only cultural sites), and protection and management requirements (Figure 2). The four natural World Heritage criteria are listed below:

- ***(vii)*** *contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;*
- ***(viii)*** *be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features;*
- ***(ix)*** *be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals; or*
- ***(x)*** *contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of Outstanding Universal Value from the point of view of science or conservation.*

1.3 Ecosystem services, benefits and human well-being

Protected areas, such as natural World Heritage sites, are, for the most part, established in functioning and healthy natural

[1] *In this document reference to 'natural' World Heritage Sites includes both natural and mixed sites.*

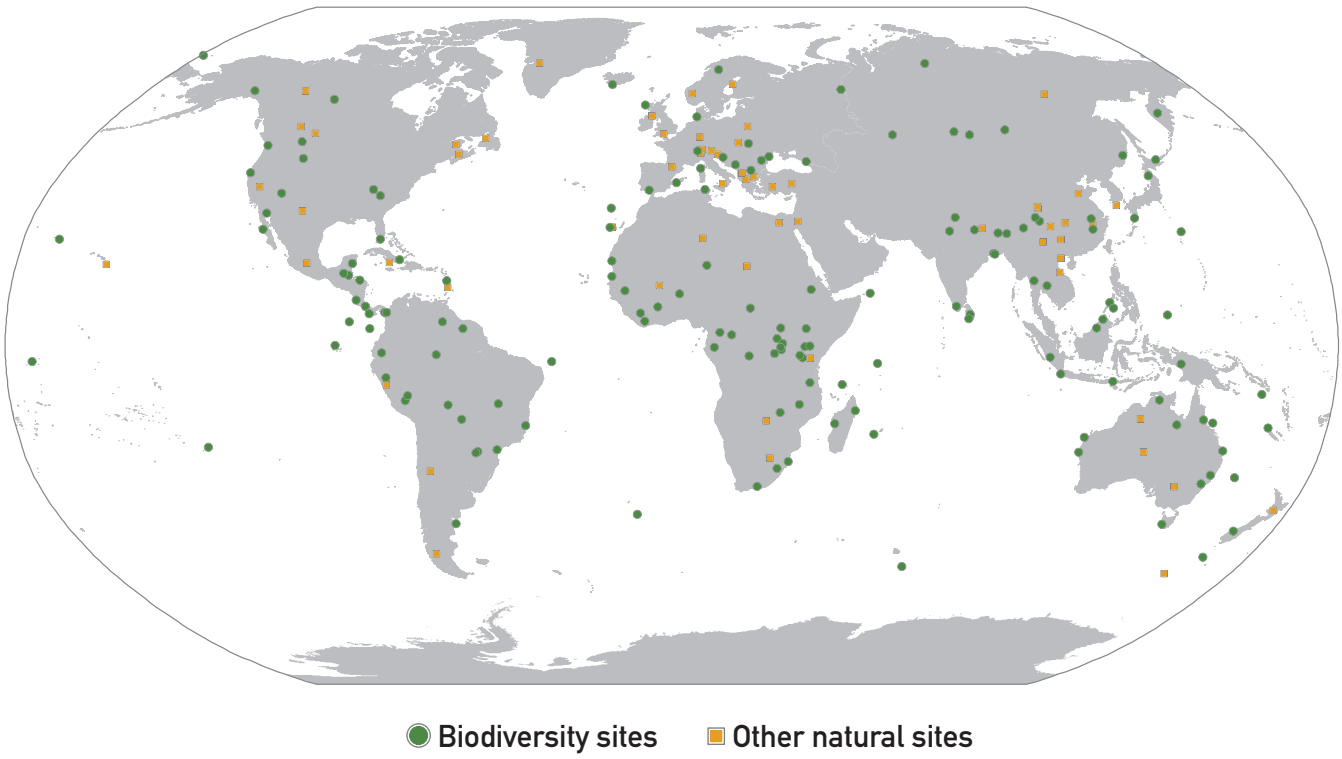


Figure 1. Global distribution of the 222 natural and mixed World Heritage properties. Green points indicate the 159 biodiversity sites inscribed under biodiversity criteria (ix) and/or (x). Amber squares indicate the natural and mixed World Heritage properties that are not inscribed under biodiversity criteria. For simplicity, all sites, including serial sites with multiple component parts, are represented as a single point or square on this map. Source: updated from (Bertzky et al., 2013).

ecosystems (Kettunen & ten Brink, 2013). Ecosystem functioning refers to a range of complex bio-physical processes associated with for example energy, water and nutrient cycling, trapping energy from the sun, and the building of soil. Ecosystem services can be described as the outputs of ecosystems from which people derive benefits (UK NEA, 2011)[2]. Cultural services, specifically, deliver benefits that are enjoyed through meaningful interaction of people with nature such as spiritual and religious experiences. Examples of ecosystem services include resources for subsistence, maintenance of the quantity and quality of water resources that can be used for drinking and irrigation, erosion control, and the maintenance of social and cultural values (UNESCO *et al.*, 2012).

In addition to being of Outstanding Universal Value and providing biodiversity and geoheritage conservation benefits, the value of other benefits that World Heritage sites can deliver is increasingly being recognised because of their contribution to the well-being of local communities and wider human society. In the context of protected areas, it has been acknowledged that the socio-economic benefits can contribute to five dimensions of well-being through direct and indirect use as well as non-use values (Kettunen & ten Brink, 2013; The World Bank, 2010). These can be valued in different ways and are discussed in more detail in Section 2. The five dimensions of well-being according to Kettunen & ten Brink (2013) have been considered in this study. They are:

- **Subsistence:** non-economic benefits that contribute to well-being, such as health, nutrition, clean water and shelter.
- **Economic:** benefits that provide the ability to earn an income, to consume and to have assets.
- **Cultural and spiritual:** pride in community and protected area, confidence, living culture, spiritual freedom, education.
- **Environmental services:** role in environmental stability and provision of natural resources.
- **Political:** relating to issues of governance and thus influence in decision-making processes.

Whilst this report provides an introduction into ecosystem services and benefits from World Heritage sites, a number of comprehensive guidance documents, tools and resources exist that help identify, assess and value ecosystem services and the wider benefits (**Box 1**).

1.4 Threats and management of sites

There is a need for a greater understanding, to inform decision making, of the linkages between ecosystem services and their relationship with human well-being as "no natural World Heritage site is immune from human influence or can be considered ecologically pristine" (Thorsell & Sigaty, 1998). As of May 2014, the time of preparation of this report, 8 % of

[2] *There is no universally agreed definition of ecosystem services (Haines-Young & Potschin, 2009)*

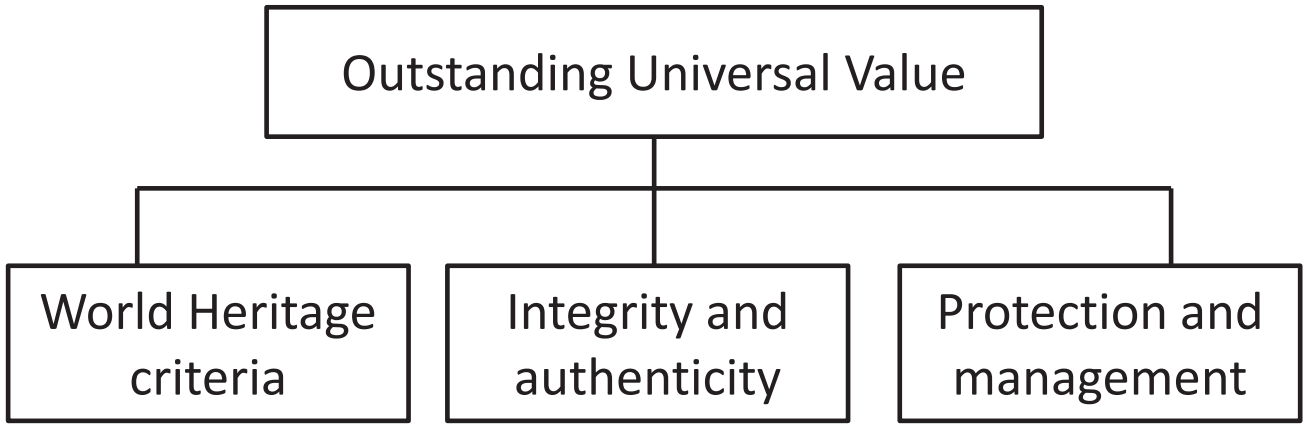


Figure 2. The World Heritage concept: To be deemed of Outstanding Universal Value (OUV), a site must meet one or more of the ten World Heritage criteria, the corresponding conditions of integrity and/or authenticity, and protection and management requirements. *Source:* (Bertzky *et al.*, 2013).

natural sites were inscribed on the 'List of World Heritage in Danger' and 25% were known to have serious conservation issues such as extractives industry operations, major infrastructure development, and commercial-scale poaching (IUCN, 2013). The new IUCN World Heritage Outlook now also provides information on the full range of threats and the most pressing conservation issues that are affecting each site. Threats from human or natural causes can degrade ecosystems, inhibit their functioning and in turn impact on the delivery of services and benefits, resulting in adverse impacts on development, poverty reduction and human well-being.

In terms of management of World Heritage sites, decisions should consider how the World Heritage network can positively benefit livelihoods, which can in turn contribute to poverty reduction (UNESCO *et al.*, 2012). This includes recognition of the wider benefits, such as job creation, that are not directly associated with an ecosystem service. Recognition of the economic benefits from World Heritage sites in terms of their contribution to local communities and regional and national economies can also be helpful to site managers and decision-makers. Increasing efforts to identify, understand and quantify the multiple benefits that World Heritage sites deliver can result in countries increasing their financial support for these sites (UNESCO *et al.*, 2012)

Box 1. Tools and guidance on identifying, assessing and valuing ecosystem services and wider benefits

Social and economic benefits of Protected Areas: An assessment guide – This book provides an introduction into the socio-economic benefits of Protected Areas and Protected Area networks, through step-by-step practical guidance on identifying, assessing a valuing the various ecosystem services and benefits from Protected Areas (Kettunen and ten Brink, 2013).

WWF Protected Areas Benefit Assessment Tool (PA-BAT) – The PA-BAT provides a methodology to assist protected area managers and authorities in the collation of information on the full range of current and potential benefits of individual protected areas (Dudley & Stolton, 2009). http://wwf.panda.org/?174401/PABAT

The Toolkit for Ecosystem Service Site-based Assessment (TESSA) – Piloted in Protected Areas, TESSA guides non-specialists through relatively accessible methods for identifying which ecosystem services may be important at a site, and for evaluating the magnitude of benefits that people obtain from them currently, compared with those expected under alternative land-use. http://www.birdlife.org/datazone/info/estoolkit

Integrated Valuation of Environmental Services and Tradeoffs (InVEST) – InVEST is a suite of software models used to map and value the goods and services from nature that sustain and fulfil human life. This tool enables decision makers to assess quantified trade-offs associated with alternative management choices and to identify areas where investment in natural capital can enhance human development and conservation. http://www.naturalcapitalproject.org/InVEST.html

World Heritage: Benefits beyond borders – This book offers a collection of case studies which provides a thorough understanding of World Heritage sites and their outstanding universal value in the context of sustainable development (UNESCO, 2012).

2. Conceptual and methodological framework for the study

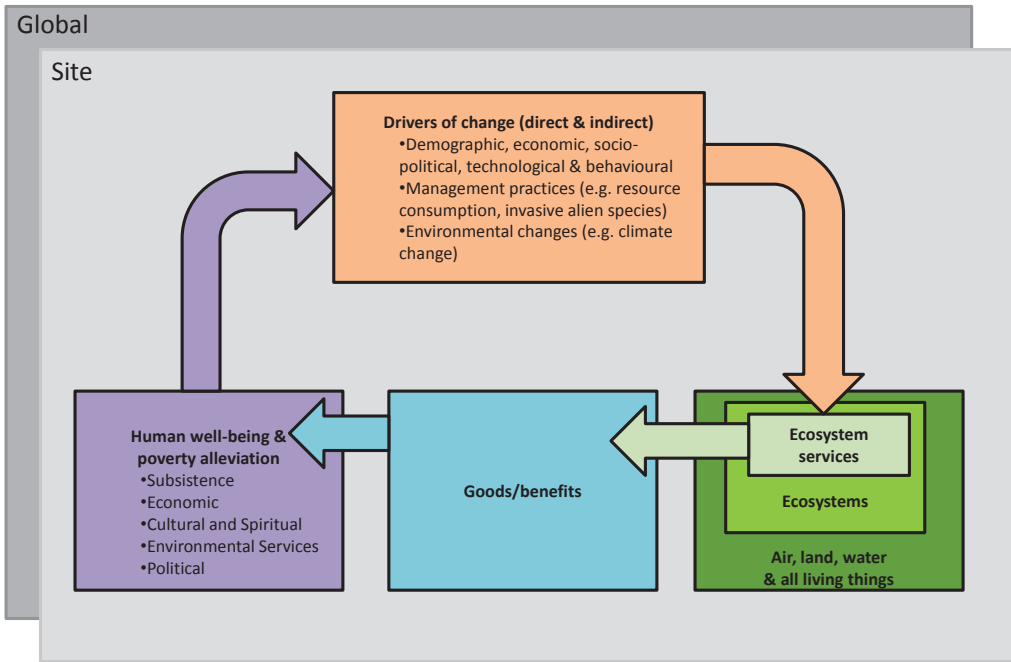


Figure 3. Conceptual framework for the analysis of ecosystem services and benefits provide by natural World Heritage sites at the global and site scales. *Source:* adapted from the UK National Ecosystem Assessment (UK NEA, 2011).

2.1 Conceptual framework

A number of ecosystem services frameworks exist in the scientific literature and in published assessments. For example, the Millennium Ecosystem Assessment (MA), UK National Ecosystem Assessment (UK NEA), The Economics of Ecosystems and Biodiversity (TEEB), Mapping and Assessment of Ecosystem Services (MAES)[3] and most recently, the framework from the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES)[4].

To frame this analysis of ecosystem services and wider benefits from natural World Heritage Sites the UK National Ecosystem Assessment (UK NEA, 2011) conceptual framework has been used. The framework was adapted because this is a global analysis but could equally be applied at the 'site' scale and allows for the considerable variation in the size and specific characteristics of individual World Heritage Sites.

The UK NEA framework illustrates the processes that link human societies and their well-being with the environment, while also emphasising the role of ecosystems in providing ecosystem services and benefits that bring improvements in well-being to people. It also builds on the conceptual and scientific advances, made by TEEB following the MA, in the economic valuation of ecosystem services to avoid the double counting of services by identifying 'goods' (the outcomes from ecosystem services that people value) (UK NEA, 2011). Ecosystem services deliver a range of goods that are of socio-economic value to people. These values can be broadly categorised as 'economic' (the monetary values) and 'welfare' values (includes social values that can be difficult to measure in monetary terms) (Kettunen & ten Brink, 2013). These values can be captured through the five dimensions of well-being (described in Section 1.3). People's perception of ecosystems and the values they provide influences choices such as how people use and manage an area, which in turn have implications on drivers of change (UK NEA, 2011). The conceptual framework also recognises that direct and indirect drivers of change (such as management practices) have an impact on ecosystems and their ability to deliver ecosystem services.

The World Heritage Convention uses the term 'benefits' as when a resource is being used to provide direct gains to stakeholders. Therefore, the terms goods and benefits will be used interchangeably to ensure compatibility with the benefits-focused terminology used by the World Heritage Convention.

2.2 Ecosystem services typology

There are a number of different ways to categorise ecosystem services depending on why you are considering them. This study uses the same typology as the Millennium Ecosystem Assessment (2005) which groups broad ecosystem services in four simple categories:

[3] *MAES is one of the key actions of the EU Biodiversity Strategy to 2020.*
[4] *This conceptual framework has not been used because it was developed after the start of the project.*

- **Supporting services** are those vital ecosystem processes that underpin a healthy and functioning ecosystem. Examples include primary production, water cycling and soil formation. Supporting services also underpin the delivery of other ecosystem services categorised below (outlined in brown in **Figure** 4).
- **Provisioning services** are the products obtained from ecosystems, including, for example, genetic resources, food and fibre, and fresh water (outlined in orange in **Figure** 4).
- **Regulating services** refers to the benefits obtained from the regulation of ecosystem processes, including, for example, the regulation of climate, water, and some human diseases (outlined in purple in **Figure** 4).
- **Cultural services** are the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experience, including, e.g. knowledge systems, social relations, and aesthetic values (outlined in green in **Figure** 4).

Figure 4 presents how ecosystem services could be classified for the analysis of natural World Heritage sites and provides further details of the framework introduced in Figure 3. Following the approach used in the UK NEA, final ecosystem services (those which directly contribute the benefits that are valued by people) have been distinguished from intermediate ecosystem services and ecosystem processes (those which underpin final services but are not directly linked to benefits). It is often the case that management practices focus on influencing the delivery of the former category rather than the latter (UK NEA, 2011).

In the context of ecosystem service valuation, three features of Figure 4 should be explained:

- **Separation of intermediate from final services is necessary to avoid double counting when valuing the benefits obtained from ecosystems.**
- **Recognition that not all of the value of a benefit will be derived from ecosystems and that some of the value should be attributed to human (capital) inputs such as manufacturing.**
- **Recognition that some benefits are not measurable through quantitative economic approaches but should still be considered when attempting to measure values in order to fully reflect actual or potential well-being (UK NEA, 2011).**

2.3 Methodology and datasets used in this study

This study used the best available spatial data at the global scale as well as quantitative and qualitative information on benefits at the site level.

2.3.1 Global geospatial analysis

The aim of this component of the study was to undertake a GIS based analysis to comprehensively measure specific ecosystem services quantitatively for all natural World Heritage sites. Despite numerous initiatives and efforts to map ecosystem services and benefits, amongst the seemingly abundant ecosystem services data, globally consistent, quantitative and spatially explicit data are still very limited (Egoh *et al.*, 2012; Larsen *et al.*, 2011; Naidoo *et al.*, 2008). In addition, they are very often not mapped to a scale that could be suitably applied to individual World Heritage sites or considered relevant under the World Heritage context (Egoh *et al.*, 2012 Appendix 1).

Following a review of the global data and consultation with data holders experts, two ecosystem services were identified as being suitable for a global analysis – carbon storage and water provision. Full details of the methodology and data used along with the limitations of the analyses are detailed in Section 3.2. A further limitation associated with data availability meant that this component of the study focused exclusively on terrestrial systems. Ecosystem services from marine systems are considered in other areas of the study, such as the global analysis of the Conservation Outlook Assessment data (Section 3.3) and the site level analyses (Section 4).

2.3.2 Data from the IUCN World Heritage Outlook

The IUCN World Heritage Outlook provides the first global assessment of natural World Heritage through Conservation Outlook Assessments. These assessments are a projection of the potential for a natural World Heritage site to conserve its values over time, based on a desk-based assessment of the current state and trend of values, the threats affecting those values and the effectiveness of protection and management (IUCN, 2012). The Conservation Outlook Assessments, compiled to standard formats for every single natural World Heritage site, also include one worksheet which focuses on understanding the benefits provided by each site. Based on the WWF Protected Areas Benefits Assessment Tool (Dudley & Stolton, 2009), the suite of potential benefits a site provides to human societies are categorised into eight broad benefit groups (Table 1).

Information from the benefits worksheet was available for 211 of the 228 natural World Heritage sites at the time this analysis was undertaken. It has been analysed and is presented for the first time in this study (Section 3.3). It provides an overview of the benefits provided by the World Heritage network, which could be used as a baseline for future analyses.

The benefits information, including an interactive map and search function, is also available online on the IUCN World Heritage Outlook website (http://worldheritageoutlook.iucn.org/).

2.3.3 Case studies

Publically available literature, complemented by expert knowledge of some sites, was used in the development of the case studies in the ecosystem services and governance sections (Sections 4.2 and 4.4 respectively). The case studies were selected to ensure that the World Heritage sites highlighted in this report were geographically balanced, as well as covering a range of terrestrial and marine ecosystems, and different sized sites.

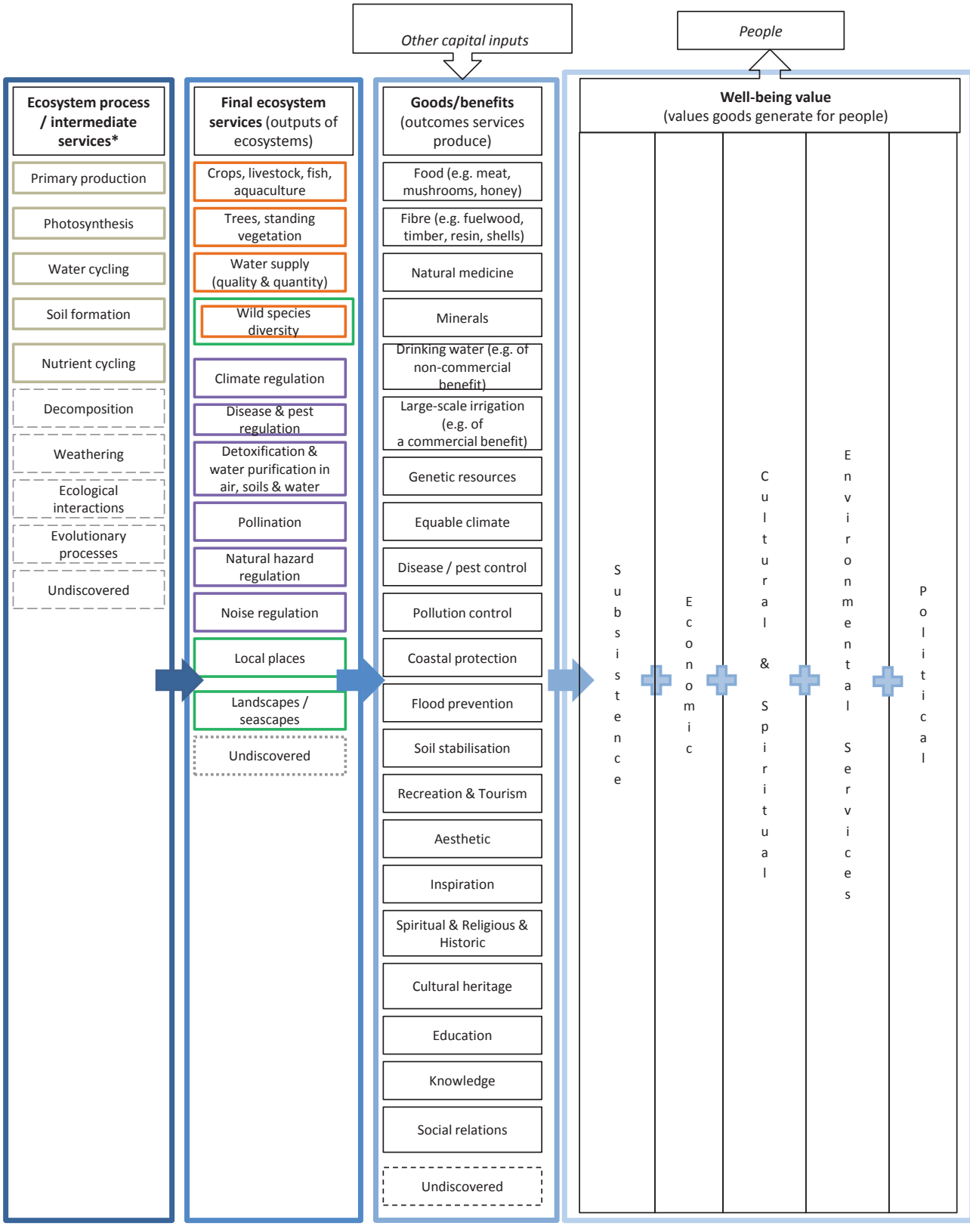


Figure 4. Ecosystem processes, services, goods/benefits and values from natural World Heritage sites. *Source:* adapted from the UK National Ecosystem Assessment (UK NEA, 2011). *Note some ecosystem services can be both intermediate and final services e.g. wild species diversity, pollination and climate regulation. In the figure they have been shown in the final position they occupy. Also note, the list of benefits is not exhaustive and will depend on the individual World Heritage site.

The case studies illustrated in the economic valuation section (Section 4.3) were based on existing analyses that have taken place within the site. There has not been a great deal of valuation work undertaken in World Heritage sites to date and therefore, whilst attempts were made to have balance across regions and ecosystems, some ecosystems are currently better covered in the available literature.

Table 1. List of benefits assessed in the IUCN Conservation Outlook Assessment

Broad level benefit groups	Benefits
Benefits related to food	Legal subsistence hunting of wild game
	Collection of wild plants and mushrooms
	Permissible fishing and/or contribution to fish stocks
	Traditional agriculture
	Livestock grazing and fodder collection
Values related to water	Non-commercial water use (drinking, cooking etc.)
	Commercial water use
Cultural and spiritual values	Cultural and historic values
	Wilderness and iconic values
	Sacred natural sites or landscapes
	Sacred plant or animal species
	Cultural identity and heritage values
Health and recreation values	Collection of medicinal resources for local use
	Recreation and tourism
	Aesthetic values related to beauty and scenery
Knowledge	Important resource for building knowledge
	Contribution to education
	Collection of genetic material
Environmental services	Carbon sequestration
	Soil stabilisation
	Coastal protection
	Flood prevention
	Water provision
	Pollination
Materials	Collection of timber, e.g. fuel wood
	Collection of other materials, e.g. coral, shells, rattan, minerals
Contribution to local economy	Provision of jobs
	Benefits from tourism

3. Global scale analysis of ecosystem services and benefits provided by World Heritage sites

3.1 Global spatial analysis

3.1.1 Carbon storage

Introduction

Forests play a vital role in regulating climate, and mitigating the effect of climate change, amongst many benefits they provide. The climate change mitigation role involves absorbing and retaining carbon that would otherwise be released into the atmosphere. If forests are removed for agricultural purposes, the soil organic carbon beneath may also become more exposed and more susceptible to oxidation (e.g. through aerobic microorganisms), thus also contributing to the release of carbon to the atmosphere (Ruddiman & William 2007).

Since the industrial revolution, anthropogenic activities have significantly altered the natural processes whereby carbon is released to or removed from the atmosphere (the carbon cycle). The increase of atmospheric carbon dioxide drives global climate change, affecting the global climate and local weather patterns. Carbon dioxide (CO2) emissions from land use change, mainly tropical forest loss, remains one of the dominant causes of the observed increase in atmospheric CO2 concentration (IPCC, 2013).

Natural World Heritage sites protect some of the most unique and outstanding natural wonders. As of 2013 UNESCO World Heritage Centre's Forest Programme recognises 107 forest World Heritage sites globally (http://whc.unesco.org/en/forests/) for in-situ conservation of forest biodiversity. They present a total area of 75 million hectares, over 13% of all IUCN category I to IV protected forests worldwide.

With the increased availability of earth observation data, notably the use of active remote sensing technology such as lidar (light detection and ranging), some recent scientific studies have estimated biomass carbon at high resolution in the pantropics (Baccini *et al.*, 2012; Saatchi *et al.*, 2011). This enables us to quantify the amount of forest biomass carbon within the natural World Heritage network, as an indicator of the ecosystem service of climate regulation.

Data and methodology

The pantropics region has been focus of some of the recent scientific studies which have estimated biomass carbon at high resolution (Baccini *et al.*, 2012; Saatchi *et al.*, 2011) and produced data that can be used for site level analysis at the scale of individual World Heritage sites. A pantropical carbon map combining above-ground and below-ground biomass at 30 arc-second resolution (Saatchi *et al.*, 2011) was used to assess the amount of forest biomass carbon within each natural World Heritage site in the region. This baseline carbon map was derived from a sophisticated model using ground inventory data as well as high resolution remotely sensed imagery, and represents a highly detailed account of forest biomass carbon in the tropical biomes. It is supported by a separate quality assurance layer which allows the quantification of accumulated uncertainty in defined geographic boundaries. We chose this data over a similar pantropical carbon map produced by another research group (Baccini *et al.*, 2012) because of its more complete geographical coverage in the pantropics. The map covers all tropical/subtropical biomes[5] (Olson *et al.*, 2001) in Africa, Americas and Asia (including Australia) (Figure 5).

Box 2: The pantropics region

The pantropics ('across the tropics') refers to a biogeographical extent that cover tropical regions of all major continents, i.e., in Africa, in Asia and in the Americas and include huge areas of the world's mega-diversity countries.

Tropical forests are the biologically richest ecosystems on Earth and there has been growing concerns about the impacts of anthropogenic pressures (Laurance et al., 2012). Containing some of the poorest countries and fastest growing economies, the pantropics region is often seen as the forefront of conflict between nature conservation and economic development. This is principally driven by the rise of demand for food and animal feed as the population grows. Increasingly, protected areas are becoming the final refugee for threatened species and ecological processes to sustain ever-declining biodiversity. In addition protected areas also host large quantities of biomass carbon and the continuing threat of deforestation presents a high potential for increased emission of carbon.

The boundaries of the natural World Heritage sites used in this analysis came from the World Database on Protected Areas (WDPA). At 130 sites the pantropical biome hosts more than half of all natural World Heritage sites[6].

To estimate the forest biomass carbon, forested area or forest extent in each World Heritage site was used to filter pixels considered to represent 'forests'. We used the percentage tree-cover data from the MODerate-resolution Imaging Spectroradiometer (MODIS) Vegetation Continuous Fields (VCF) collection (MOD44B), at 250 metre resolution. This continuous classification scheme of the VCF product reflects better than discrete classifications in representing the nature of heterogeneous land covers within individual pixels (DiMiceli *et al.*, 2011). Here, the term 'forest' refers to a percentage of

[5] *Tropical and Subtropical Moist Broadleaf Forests, Tropical and Subtropical Dry Broadleaf Forests, Tropical and Subtropical Coniferous Forests and Tropical and Subtropical Grasslands, savannas, and Shrublands*

[6] *At the time of this analysis, there are a total of 222 natural and mixed World Heritage sites*

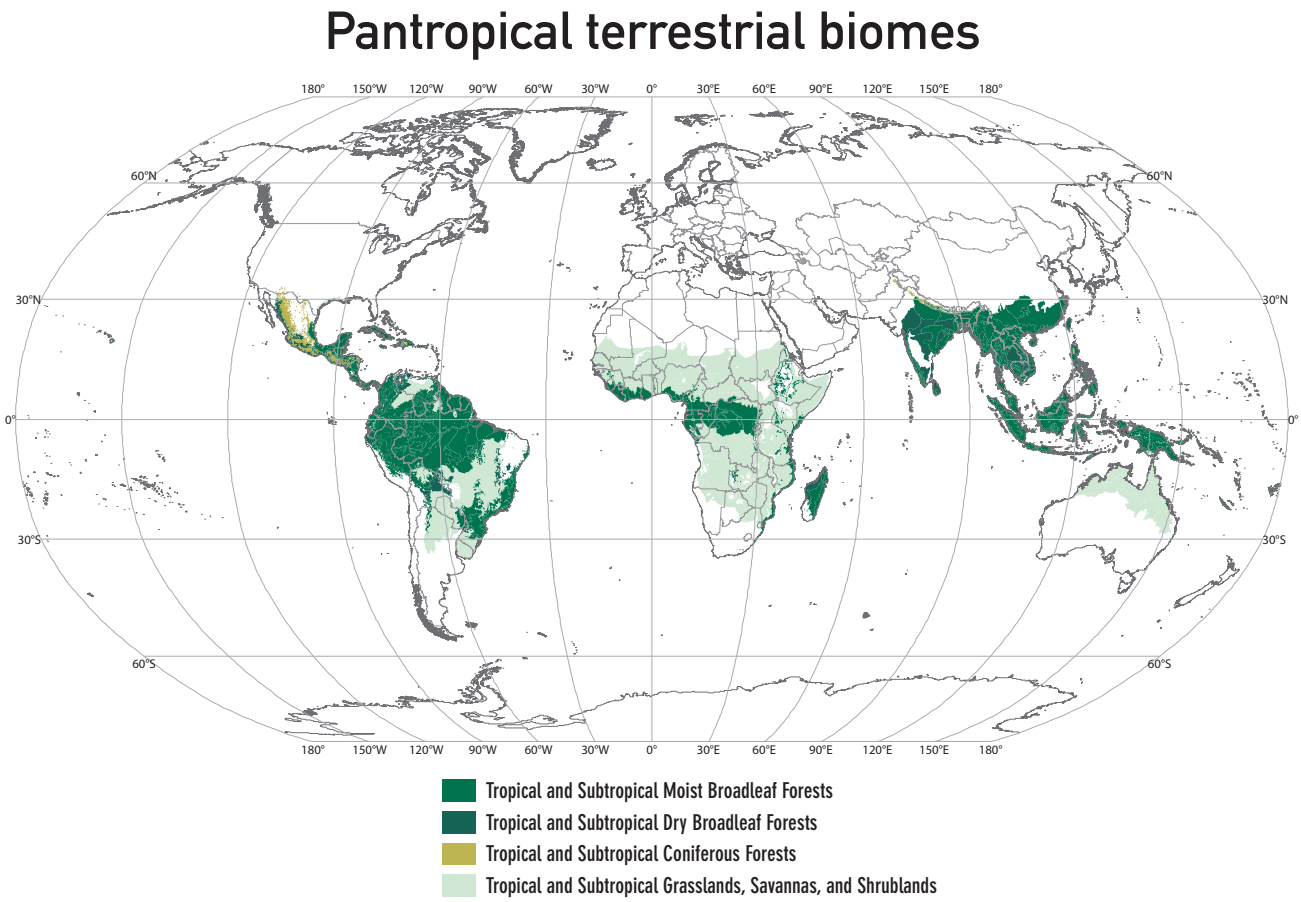


Figure 5. Pantropical terrestrial biomes

tree cover greater than a particular threshold (Saatchi *et al.* Supporting online materials) and should not be confused with a forest land use definition. Hence, for a range of definitions of 'forest pixels', we used fractional tree cover thresholds (at 10%, 25% and 30% tree cover respectively) to determine the forest extent within each World Heritage site. The range of thresholds reference the United Nations Framework Convention on Climate Change definition of forests used under the Kyoto Protocol (UNFCCC 2005): 10-30% tree crown cover.
The amount of forest biomass carbon was calculated by summing the total carbon for 'forest pixels' (eq 1):

$$\Omega = \sum_{i=1}^{N} \rho_i * c_i$$

where Ω denotes the total forest biomass carbon, ρ_i the carbon density (MgC/ha) of the *i*th pixel, c_i the cellsize (ha) of the ith pixel, and N the total number of forest pixels. The total relative uncertainty was estimated as follows (eq 2):

$$\sigma_{relative} = \frac{\sqrt{\sum_{i=1}^{N} (\rho_i * c_i * e_i)^2}}{\Omega}$$

where $\sigma_{relative}$ is the relative cumulative uncertainty, compared to the aggregated forest biomass carbon of the site, and e_i the uncertainty from the carbon uncertainty layer for the *i*th pixel (Saatchi *et al.* 2011, supporting information).

For each tree cover threshold, we calculated the total forest biomass carbon, forest area, and carbon density (the total forest biomass carbon divided by forest area) for each site and estimated uncertainties at the site level. In order to better understand the geographical distribution of forest biomass carbon in the tropics, we further divided the result by broad regions, i.e. Americas, Africa and Asia (including Australia).

To enable comparison, a similar approach was carried out for all nationally designated protected areas from WDPA (IUCN & UNEP-WCMC, 2014). The protected area polygons were first dissolved to avoid double counting, due to the effects of multiple IUCN management categories for some protected areas. Lastly, we also used the biome boundaries of the pantropics as additional input to provide a baseline reference to enable further examination.

Result

(i) Forest biomass carbon in natural World Heritage sites

It is estimated that World Heritage sites across the pantropical regions harbour a total of 5.7 billion tons of forest biomass

Table 2. Total forest biomass carbon in World Heritage sites in the pantropics, at 10% tree cover

	Total carbon (ton)	Forest area (km^2)	Density (ton/km^2)	Uncertainty (ton)	Relative uncertainty
Africa	1,713,446,437	150,617	11,376	5,786,431	0.34%
Americas	2,208,806,766	169,388	13,040	6,666,542	0.30%
Asia	1,792,490,002	121,587	14,742	7,225,983	0.40%
Total	5,714,743,205	441,591	12,941	19,678,956	0.34%

carbon at 10% tree cover threshold (**Table 2**); Americas WH forest sites host 39% of the total carbon at 2.2 billion tons compared to Africa and Asia with 1.7 billion tons (30%) and 1.8 billion tons (31%) respectively.

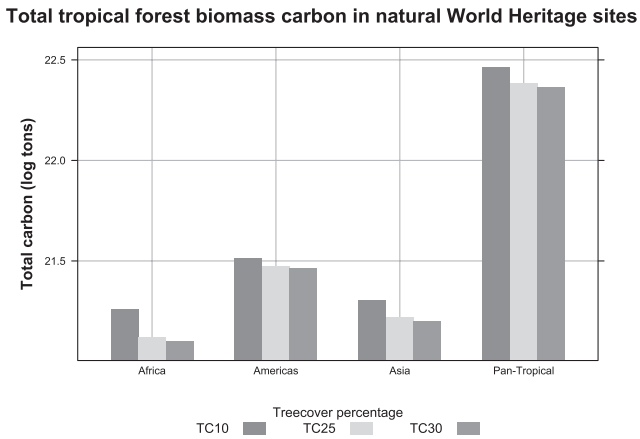


Figure 6. Forest areas in natural World Heritage sites in the pantropics at 10%, 25% and 30% tree cover (TC)

World Heritage sites in the pantropical Americas have the largest forest cover compared to Africa and Asia (Figure 6). When the tree cover threshold for 'forest' is increased, the number of pixels inside World Heritage sites defined as being 'forest' decreases in all three regions (as areas of low tree cover exist in each). In particular, there is a marked drop of forest area in Africa when compared using 10% tree cover and 25%, suggesting a significant portion of forest areas have a low percentage tree cover. For example, Selous Game Reserve has a total of 118 million tons of forest biomass carbon at 10% tree cover. This reduces by more than half to 51 million tons at 25% tree cover. This coincides with the widespread biome of Tropical and Subtropical Grassland, Savannah and Scrublands in Africa which has a low carbon density ratio.

In terms of carbon density in World Heritage sites across regions, Asia is estimated to have the highest figure, at 14,742 tons/ km2 at 10% tree cover threshold, followed by Americas and Africa. A similar pattern is observed at higher percentage tree covers (**Figure 7**). Noticeably in Africa, forest biomass density spikes from 11,376 tons/ km2 at 10% tree cover to 15,080 tons/ km2 at 25% tree cover. This may be explained by the exclusion of huge areas of low carbon density and low percentage tree coverage.

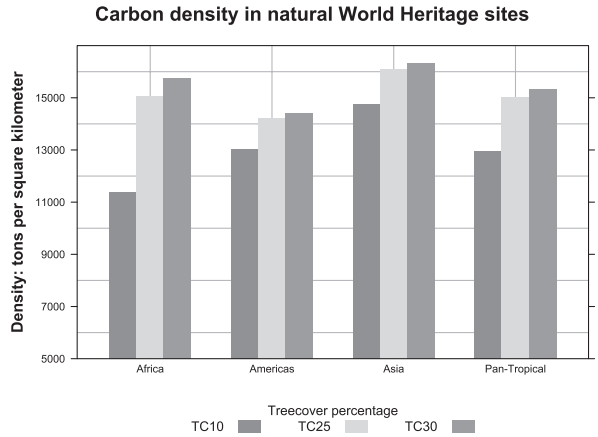


Figure 7. Forest biomass carbon density in natural World Heritage sites in the pantropics at 10%, 25% and 30% tree cover (TC)

At per site level, the distribution of total forest biomass carbon in the World Heritage network in the pantropics is uneven. Excluding sites having high relative uncertainty (in our case, we excluded using a value of 0.1, i.e. 10% uncertainty), we found Americas and Africa have more sites with higher total biomass carbon. For example, Central Amazon Conservation Complex (Brazil), the largest World Heritage site in the Amazon basin, also has the highest carbon stock of any tropical World Heritage site, with 676 million tons of carbon (MtC). Equally high on the list are Salonga National Park (Democratic Republic of the Congo; 633 MtC), Tropical Rainforest Heritage of Sumatra (Indonesia; 464 MtC) and Canaima National Park (Venezuela; 316 MtC). A total of 16 sites store more than 100 MtC (see Annex 2: Summary of forest biomass carbon in each World Heritage site).

To adjust the bias of total carbon due to size differences, we also examined the distribution of forest biomass carbon density. We found on average in the pantropics, World Heritage sites in Asia contain more carbon per square kilometre than Americas and Africa. The top three sites all have carbon densities above 20,000 tons/ km2 regardless of the tree cover threshold being used. These sites are Dja Faunal reserve (Cameroon), Puerto-Princesa Subterranean River (Philippines) and Gunung Mulu National Park (Malaysia) (see Annex 1).

(ii) Comparison with other protected areas and the pantropical biomes

Natural World Heritage sites capture just over 2% of the total forest biomass carbon in the pantropical biomes, which

Table 3. Total forest biomass carbon in pantropical biomes, at 10% tree cover

	Total carbon (ton)	Forest area (km^2)	Density (ton/km^2)	World Heritage total carbon (ton)	% biome carbon in World Heritage
Africa	57,498,328,438	7,826,312	7,347	1,713,446,437	2.98%
Americas	118,977,237,623	11,948,672	9,957	2,208,806,766	1.86%
Asia	78,436,972,627	6,780,299	11,568	1,792,490,002	2.29%
Total	254,912,538,688	26,555,282	9,599	5,714,743,205	2.24%

is estimated to contain 254.9 billion tons of carbon at 10% tree cover. Across all regions, this representation is very low (2.24%): World Heritage sites in Africa have a slight lead over those in Americas and Asia (2.98% over 1.86% and 2.29% respectively, Table 3). Likewise, at 10% tree cover, the protected areas network contains 66.8 billion tons of carbon, accounting for 26.21% of all forest biomass carbon in tropical biomes.

In terms of carbon per square kilometre, the World Heritage network exhibits on average a much higher forest biomass carbon density than the protected area network and the pantropical biomes (WH: 12,941, PA: 12,378, pantropics: 9,599 ton/km^2, Annex 1). It is also consistent across all three regions that World Heritage sites contain comparatively higher carbon density than biome average. These findings signal a major contribution of pantropical World Heritage sites in providing significant carbon stores. The wider protected area network in these biomes also supports above average forest biomass carbon, albeit slightly lower than World Heritage sites in density, indicating their designations contribute positively to conserving carbon storage in these regions (**Figure 8**).

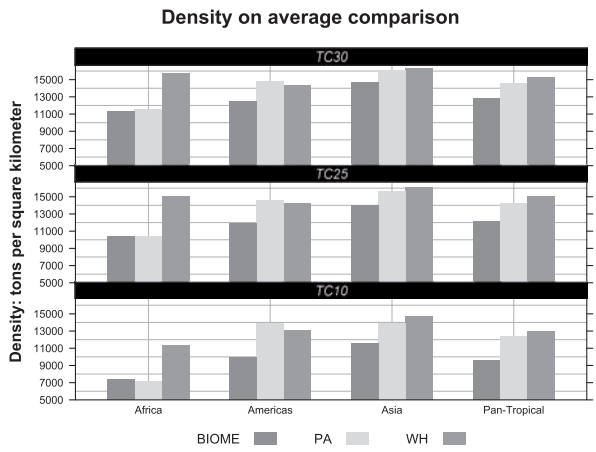


Figure 8. Comparison of average forest biomass carbon density of World Heritage sites (WH) against other protected areas (PA) and pantropical biomes

Discussion

This study represents a precise estimate of forest biomass carbon, in particular for World Heritage sites with larger forest areas. Thanks to the high resolution global carbon data and its uncertainty layer, we were able to estimate forest biomass carbon stocks for each World Heritage site in the pantropics, with quantified uncertainties or errors. The uncertainty analysis suggests the overall error is relatively small (Annex 2); as the size of the World Heritage site increases so do the number of forest pixels a site contains and the combined relative error reduces.

The analysis indicates that natural World Heritage sites in the pantropics host a significant amount of forest biomass carbon. However, the amount accounts for a small percentage in the pantropics as a whole. This reflects the nature of World Heritage sites as they are inscribed based on the Outstanding Universal Values (OUV), which by definition includes only areas that are deemed of OUV. Notwithstanding their limited geographical coverage, our findings suggest that these sites harbour carbon rich areas, supporting higher than average carbon density in all pantropical biomes in Africa, Americas and Asia.

Like other protected areas in the pantropical biomes, natural World Heritage sites are key to maintaining ever diminishing carbon sinks. Effective protection and management plans need to be in place to prevent the loss of carbon due to deforestation or forest degradation and, furthermore, to sustain the vital function of sequestration that these forest ecosystems provide.

This study also reveals several areas for additional research to improve our understanding of carbon storage in World Heritage sites, such as including other biomes beyond the pantropics. Globally consistent soil organic carbon data are increasingly available and may be used to assess comprehensive carbon stock. However, our study did not consider the inclusion of soil data. Available global soil organic carbon data were derived from extrapolating limited sample of soil profiles (as opposed to the largely observational and complete data for the forest biomass carbon) and the distributional data are not as accurate as they may appear to be (Scharlemann *et al.* , 2014). Combining data from very different processes may introduce additional errors and make the result inherently inconsistent.

Like any modelled output, the global forest biomass carbon map is also subject to errors. Direct observations such as variables derived from remote sensing (height, reflectance) and field measurement are used as input parameters to the model. While we are able to quantify systematic errors during this process, non-random errors may still be introduced and remain unaccounted for. For example, the use of generalised

pantropical allometric equations can be significantly biased, but this remains uncertain until universal type-specific and region-specific equations are available (Saatchi *et al.*, 2011).

3.1.2 Water provision

Introduction

Water is essential to life as no living organism can survive in the complete absence of water. However, water resources on Earth are finite; only 2.5% is freshwater and about two thirds of this is frozen, captured in glaciers and ice caps (Oki & Kanae, 2006). Necessary for human survival and economic development, water is also the 'life blood' of ecosystem functioning and is critical for sustaining healthy ecosystems, which deliver a wide range of services and benefits to people (UNEP, 2009). Key water-related services delivered by ecosystems, such as forests, mountains and freshwater systems, include the capture, storage, release and purification of water.

The provision of adequate and safe water is of major concern both nationally and internationally (World Bank, 2010). This is due to inefficient water use, an increasing human population and therefore growing demands for water as well as the impacts of climate change (World Bank, 2010).

The importance of protected areas for their role in protecting watersheds is increasing as concern over future water scarcity grows. A survey conducted in 2003 concluded that one third of the world's largest cities obtained a significant proportion of their drinking water directly from protected areas (World Bank, 2010). Examples of World Heritage sites highlighted in this study include Selous Game Reserve and Maloti-Drakensberg Park, which provide water to Dar es Salaam in Tanzania and Durban in South Africa respectively (World Bank/WWF, 2003). This survey also highlights that benefits arising from the provision of water can reach far beyond the boundary of a protected area and can contribute to human well-being and support the livelihoods of communities downstream through irrigation, industry and the generation of hydro-electricity. The term 'water tower' is widely used to express the importance of mountains in providing freshwater to adjacent areas downstream (Viviroli, 2007). Examples from the World Heritage network of mountains providing water to thousands or even millions of people include Morne Trois Tritons National Park (Dominica) (see section 4.2.1), Mount Kenya (Kenya) and the Sichuan Giant Panda Sanctuaries (China).

This analysis aims to provide a baseline overview of water provision in the global natural World Heritage network and a quantitative estimate for each site in order to better understand the dynamics in these systems and their distribution at a global scale. The potential implications of seasonality on the provision of water to people are considered using site-level examples.

Methodology

To model water provision for the natural World Heritage network, a simple water balance approach was adopted that assumes the storage of water is a constant, and its change is minimal over a long period of time in a closed system, in our context, World Heritage sites.

$$P = Q + ET + \Delta S$$

Where:
P is precipitation, *Q* is run-off, *ET* is evapotranspiration and *delta S* is the change in storage.

Global monthly precipitation data was obtained from WorldClim at 30 arc second resolution (~1 km), which typically represents an average over the period from 1950 to 2000 et. al, 2005). Then, monthly average precipitation for each World Heritage site was estimated by taking the average of all precipitation values within its boundary for each month. To examine seasonal variability of annual precipitation, a seasonality index was calculated using the formula below (Walsh & Lawler, 1981).

$$SI = \frac{1}{R}\sum_{n=1}^{12}\left|x_n - \frac{R}{12}\right|$$

Where:
R is the mean annual rainfall and Xn is the mean precipitation of month n. The index can range from 0, when precipitation for all months is equal, to a maximum of 1.83, when all precipitation is concentrated in a single month. According to Walsh and Lawler, an index value below 0.19 suggests a very equable distribution while a value above 1.20 indicates extreme imbalance where precipitation occurs only in 1-2 months.
Monthly long-term mean evapotranspiration (ET) data were derived by calculating the average ET for each month over the 12 year period (2000-2012), using MODIS Global Evapotranspiration Project data (MOD16), based on satellite remote sensing (Mu *et al*, 2011). To address the issue of missing values in this calculation, pixels having more than six years' absent values were excluded from this process, as they may introduce inconsistency and skew the result. Monthly ET of each World Heritage site was calculated using a similar approach to that of the precipitation by averaging all monthly ET pixels within each site boundary.

The baseline water balance was defined as the difference between precipitation and evapotranspiration assuming no change in storage over long time periods. For each World Heritage site, our methodology estimated the total amount of water, i.e. yield, going out of the World Heritage network and potentially accessible by people inside and outside the boundary.

The methodology offers a globally consistent approach to estimate water balance across large geographic regions and enables comparisons; however, it does not take into account local variables that may have an impact on precipitation, evapotranspiration or change in storage. The analysis only takes into account land areas and does not consider the marine components of some World Heritage sites.

Result

The World Heritage network hosts a large variety of landscapes, ranging from wet tropical rainforests to arid deserts and exhibits a distribution of water balance that covers both extremes (Figure 9). According to our analysis of 222 natural and mixed sites, 163 WH sites (excluding 29 sites due to insufficient precipitation or evapotranspiration data) provide positive water balance, with a yield of 638 mm on average per year. The large majority of these sites are found to be located in the tropical and sub-tropical regions. For example, Yakushima, off the southwest coast of Kyushu in Japan, has the highest net water yield in the World Heritage network, with a total of 2484 mm per year. This is due to the humid climate and a very high level of precipitation, in particular between May and August (Figure 10). Other high yield sites include Lorentz National Park (2336mm, Indonesia) and Rock Island Southern Lagoon (2302mm, Palau).

On the other end of the spectrum of water yield lies Tajik National Park in Tajikistan (**Figure 10**), where solar radiation (which drives evapotranspiration) is intense and precipitation is low throughout the year and uneven. The combination of high evapotranspiration rate and dry climate determines the negative water yield of this site, at -893 mm on average per year. Indicating the vegetation in this site is dependent on inflow from other systems or other sources, such as run-off from adjacent watersheds or groundwater, in order to balance the loss. A total of 30 sites are estimated to have a negative water balance, including Huascarán National Park (-607mm, Peru) and Garajonay National Park (-561mm, Spain).

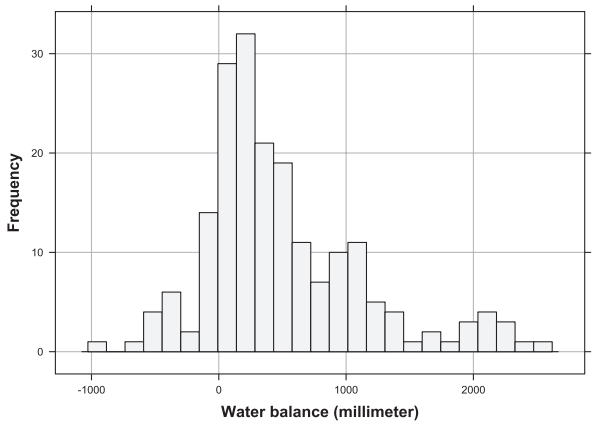


Figure 9. Distribution of water balance across natural World Heritage sites

The Seasonality Index distribution of the 209 World Heritage sites (13 data deficient sites, **Figure 11**) reveals a pattern where both very equable and concentrated precipitations are observed. The capacity in regulating the flow of water is an additional factor, in particular to sites where seasonal distribution of precipitation is imbalanced. Vegetation cover in these sites is likely to play a more significant role in retaining water and thus sustaining water supply in drier seasons. Keoladeo National Park in India (**Figure 12**), for instance, receives most of its rainfall in the monsoon season and the data shows a disproportionate amount of precipitation occurs mainly in July and August (more than 250mm) while other months see very little rainfall (most below 50mm) throughout the year. This is in contrast to Swiss Alps Jungfrau-Aletsch in Switzerland (**Figure 12**) where monthly precipitation remains highly consistent between 150mm and 200mm.

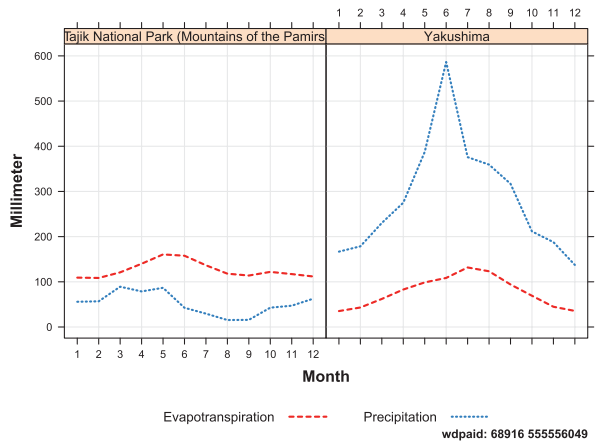


Figure 10. Comparison of water balance in Tajik National Park and Yakushima

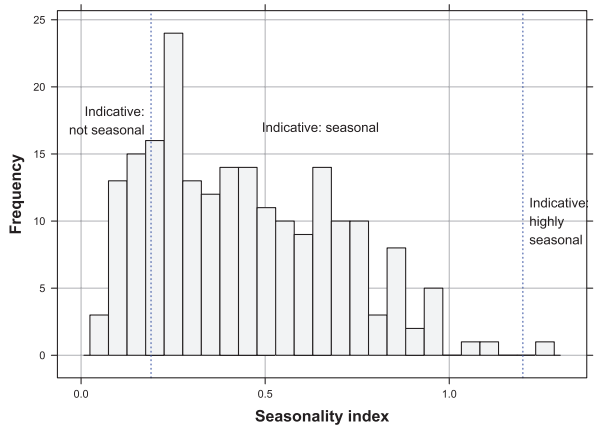


Figure 11. Distribution of the Seasonality Index across natural World Heritage sites

Since our methodology uses a mean ET value based on the time-period 2000-2012, any changes in ET response due to changes in vegetation in this period are not taken into account. Similarly, the long-term mean precipitation data does not take into account extreme events and seasonal and inter-annual variability which can have major impacts on vegetation and water production.

Discussion

This study represents an initial attempt to quantitatively estimate water yield and seasonality for all natural World Heritage sites using globally consistent data. This helps to estimate a baseline to understand potential provision as well as its variation throughout the year.

The results indicate a much varied distribution of water yield, reflecting distinctive geographies where sites of Outstanding

Universal Values are inscribed on the World Heritage List. Some sites generate significant amounts of water and serve as natural 'water towers', providing much needed water supplies to local communities (see some examples in **Box 3**). The potential human benefits arising from high water yield sites depends on their accessibility to people, both at the site and further downstream. For example, high water yield on an island with a low population will deliver little or no benefit to people. This reflects the case of Yakushima. On the other hand, a site may be indispensible if it is the sole source of water supply, regardless of how much water it actually generates (see Box 4). These aspects of benefits are inherently qualitative and site specific and are beyond the scope of this global study.

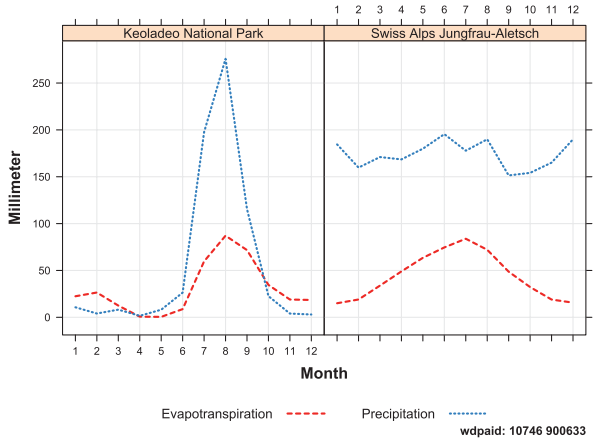


Figure 12. Comparison of water balance in Keoladeo National Park and Swiss Alps Jungfrau-Aletsch

Box 3: Examples of the importance of water provision from World Heritage sites

- A high yield site with an annual yield of 2115mm, Morne Trois Pitons National Park, provides 60% of the water supply to nearby communities outside of the boundary and other uses such as agriculture and hydroelectricity generation (details can be found in section 4.2.1).
- The Dong Phayayen-Khao Yai Forest Complex, with its high annual rainfall, acts as a critically important watershed for Thailand, draining into and feeding five of the country's major rivers: Nakhon Nayok river, Prachin Buri river, Lamta Khong river, Muak Lek river, and Mun river (UNESCO, 2013).
- In addition to supplying water to local communities, the water in Durmitor National Park has been bottled and sold as spring water since 2009. Revenues generated from water sales are estimated to be more than €112,000 (GEF/UNDP, 2011).

One point to note is that the baseline estimate provides a quantifiable metric and indicates the potential to be used. However the increase or decrease of water provision should not be interpreted as equivalent to the simple increase or decrease of such benefits, without considering other equally important services (see **Box 4**). For example, deforestation or significant loss of vegetation will most likely increase the surface run-off due to the reduction in evapotranspiration and the capacity to hold water in the soil, and this will accelerate the erosion of topsoil, reduce the buffer capacity to prevent floods and likely deteriorate water quality. Therefore a reduction in vegetation cover may result in an overall net loss of supporting and regulating services, which in turn may affect the healthy functioning of the ecosystem.

In addition, the provision of water should not be confused with actual run-off or accessible water as the model does not consider variations in environment at the site level. For example, precipitation may come in the form of snow in a cold environment and this converts to surface run-off only when temperature allows. Therefore, caution is needed to interpret results of sites located in cold climates or high latitude. For example, Huascarán National Park, as a site with negative water balance, is illustrative of how important it is to look at some of these sites in more detail as this is a high altitude site with very complex hydrology relying on glacier melt and consisting of Paramo vegetation which can retain water.

Box 4: Example of a World Heritage site with a small yet important water yield

The Laurisilva of Madeira is located along 35 km of the northern slopes of the island of Madeira in the Atlantic Ocean. It hosts the largest surviving laurel forest that was once widespread in Southern Europe some 15-40 million years ago.

The site has a limited annual water yield but highly seasonal precipitation (Figure 13). Water channels have been constructed by settlers even in modern days, to carry essential water supply from the forest following contours of the landscapes to the towns of the south and provide essential water supply for drinking, irrigation and hydro-power generation. Forests are key for the regulation of water flow and it is therefore imperative that this forest remains well protected for a sustained water supply to local communities.

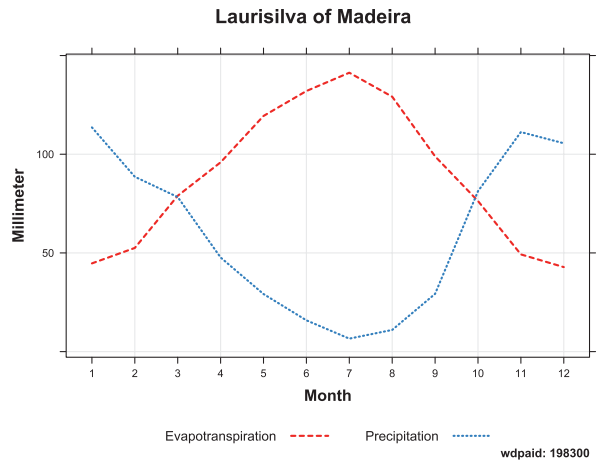


Figure 13. Water balance in Laurisilva of Madeira

Recognition of the watershed values of World Heritage sites is important in order to select appropriate management strategies and to consider the potential implications of management actions that may result some distance from the site boundary. The requirement of good management and strict protection of World Heritage sites usually ensure core and buffer areas are well protected, however, this may not be sufficient in watershed management as the source of impact may be far away from sites. For example, dams upstream or downstream may significantly alter the natural regulation of water flow.

This study highlights a number of areas for further research. For example much more work is needed to improve our understanding of the provision of water to beneficiaries. This requires data and models to map the spatial distribution of local communities or, in a wider context, target recipients, in order to link services to potential or realised benefits.

Further work is also required beyond the estimation of baseline water provision to understand other water-related benefits, unaccounted for in our study. For example, services like water purification, flood regulation, and cultural services (such as recreation and tourism). Data and models need to be developed to estimate these other water-related benefits, in particular for those that are qualitative and abstract in nature.

In addition, scenarios such as land cover change and climate change need to be taken into account to gain an understanding of potential changes. For instance, a change in the provision of water may have far reaching impact on the livelihood and well-being of local communities and such changes may be imminent due to rapid and usually unsustainable economic development. Therefore, future work would benefit from incorporating scenarios under which these ecosystem services are estimated. This will advance our knowledge of potential impacts of these changes on water-related ecosystem services in order to inform good decision-making.

3.2 Conservation Outlook Assessments

3.2.1 Methodology for analysing Conservation Outlook Assessments data

Using IUCN Conservation Outlook Assessment worksheets, site level information on the presence or absence of the supply of benefits by World Heritage sites has been assessed using expert opinion and analysed for the first time. The Conservation Outlook Assessment only considers legal use of natural resource and is not a cost/benefit assessment. Data for 211 of the 228 natural and mixed World Heritage sites was available, has been analysed and is presented below. Three analyses in total were conducted: a global assessment, examination of knowledge gaps and a brief investigation on drivers of change. In all of these analyses, results from individual sites have been aggregated to form the global perspective with the absolute number of responses being converted to percentages to aid the analysis of the responses. The online "benefits atlas" with full data for each WH site is available via the IUCN World Heritage Outlook website (http://worldheritageoutlook.iucn.org/).

For some sites it was also considered how five direct drivers of change (habitat change [e.g. land use change], pollution, overexploitation, climate change and invasive species) impact on the delivery of benefits and whether the impact was increasing of time. Data for other sites have also been collected, but only partially and require further completion and analysis.

3.2.2 Global assessment

The global analysis was undertaken at two levels of global aggregation, firstly at the broader benefit group (see first column of **Table 1**) and secondly in more detail by disaggregating these benefit groups into their component benefits (see second column of **Table 1**).

Figure 14 shows the reported presence of benefits aggregated to the global level, and to broad levels of benefits. Analysis at this broad level shows that the highest reported benefits were 'health and recreation values' (72% on average), 'knowledge' (65%) and 'contribution to the local economy' (65%). These results are perhaps unsurprising given the importance of World Heritage sites for tourism. 'Cultural and spiritual values' also scored fairly highly (56%), as some sites have strong cultural connections with local communities, traditional owners and custodians (Borges, 2011). Often World Heritage sites and protected areas are founded on sacred natural sites and their importance to indigenous and local people is proven crucial to equitable management and governance of World Heritage sites (Schaaf & Rossler, 2010; Verschuuren, 2014).

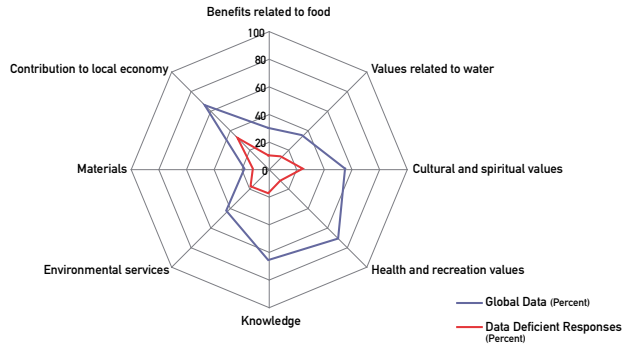


Figure 14. Responses aggregated by broad level of benefits at the global level (average percentage for a broader category).

By way of contrast, the lowest levels of responses were noted for values related to 'materials' (18%), 'food' (30%) and 'water provision' (35%). A possible explanation of this result is that in an effort to conserve the site, hunting and the collecting of plant resources are often forbidden, or greatly reduced therefore reducing access to these benefits. Perhaps surprisingly low (43%) is the reported provision of 'environmental services'. Given that this category includes many of the key regulating services that healthy ecosystems contribute to the delivery of, such as carbon sequestration, coastal protection and pollination, a higher response might have been expected.

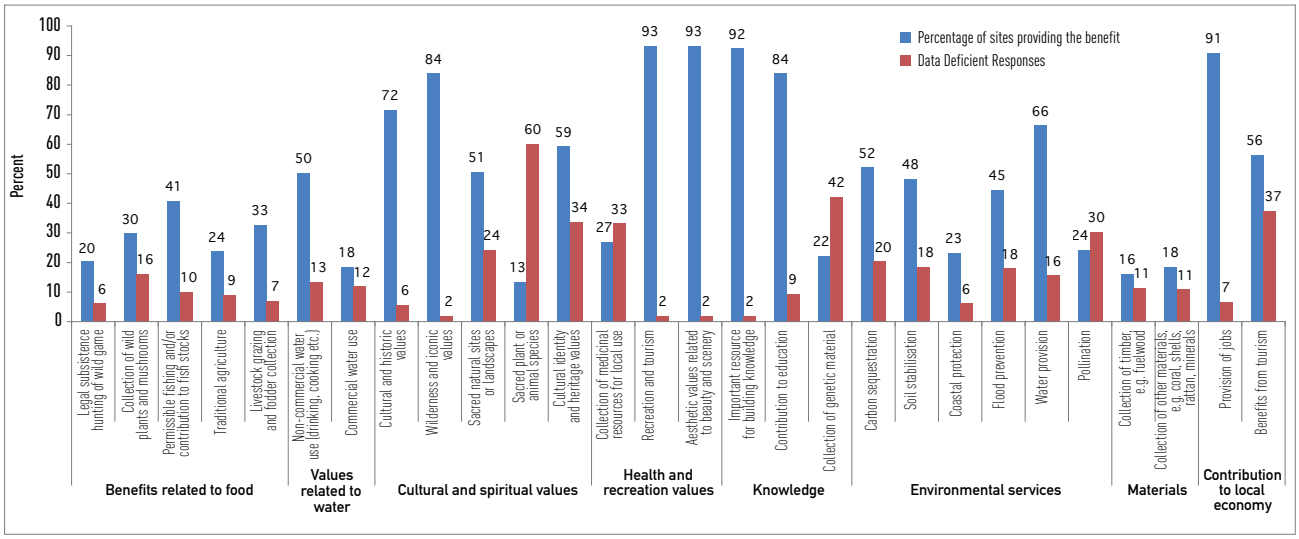


Figure 15. Presence (%) of different types of benefits from World Heritage sites (n = 211) and data deficient responses

A number of ecosystem service typologies exist, which can easily cause confusion; a possible reason for environmental services scoring lowly could be that the specific language and terms used in the Conservation Outlook Assessment (see Table 1) were not widely recognised or understood. An alternative method of collecting the data, such as through interviews may provide more detailed qualitative information of the values of benefits and would also allow the site assessor to ask questions for clarification if needed.

To help better understand the global overview of benefits provided, the broad benefits groups were disaggregated into their component benefits (**Figure 15**). Figure 15 illustrates that the benefits most frequently reported as present were 'recreation and tourism' (93% of all sites), 'aesthetic values related to beauty and scenery' (93%), 'resources for building knowledge' (92%), 'provision of jobs' (91%), 'contribution to education' (84%) and 'wilderness and iconic values' (84%). From the environmental services, water provision has the highest score with 66% of sites having been assessed as important for water quantity and/or quality. Carbon sequestration, soil stabilization and flood prevention were also identified as important ecosystem services provided by ca. half of all natural sites (52%, 48% and 45% respectively with ca. further 20% reported as data deficient meaning that these sites could be potentially providing these services as well, however further data is required).

Provision of these benefits was also compared between different regions. Consistent with the global results, 'recreation and tourism', 'aesthetic values related to beauty and scenery', 'resources for building knowledge', 'provision of jobs', 'contribution to education' and 'wilderness and iconic values' were most frequently reported as present in all regions. However, significant regional differences have been observed in the provision of some of the regulating services. For example, flood prevention showed the highest scores in South America, Mesoamerica and the Caribbean and Asia (77%, 76% and 60% respectively). Coastal protection appeared to be of high importance in Oceania and Mesoamerica and the Caribbean (50% and 65% respectively).
The presence/absence of benefits provides a very high level indication of the supply of benefits from the World Heritage network. However, it does not currently provide any insight into who receives the various benefits (i.e. the beneficiaries). This information is site dependant and so analysis at an aggregated global level may not be very valuable. Therefore a more comprehensive approach to collecting information at the site level through consultation with different stakeholders (e.g. local communities, park rangers, tourists) could constitute next steps in collecting this information and would provide greater insight into the whole range of values that the various stakeholders have.

3.2.3 Knowledge gaps

In addition to collecting information about the presence and absence of various benefits, information was collected about the benefits that site assessors' felt that they were unable to make a judgement because they lacked the data or knowledge to do so.

The greatest percentage of data deficient responses being reported for the benefits related to contribution to the local economy (specifically 'benefits from tourism' with 37% which can be explained by the fact that this particular benefit was only assessed as present if clear evidence was available of contribution of nature-based tourism to the local economy and in many cases this data was lacking), cultural and spiritual values (specifically 'sacred plant or animal species', 12%) and knowledge (specifically related to the 'collection of genetic material, 18%). In comparison benefits from 'recreation and tourism', 'aesthetic values related to the beauty and scenery', 'important resource for building knowledge' and 'provision of jobs' show little uncertainty due to data deficiency.

3.2.4 Drivers of change

In addition to the presence or absence of data collected to assess the benefits that World Heritage sites provide, further information was collected regarding the level of impact and trend of five direct drivers of change on the delivery of benefits within a total number of 74 sites across different regions:

- **Habitat (land use) change**
- **Overexploitation of resources**

- **Climate change**
- **Pollution**
- **Invasive species**

The classification of the drivers of change is based on that used in the UK NEA (2011).

In each of the sites the level of impact of these drivers on the provision of certain ecosystem services and benefits was assessed against four categories – low, moderate, high and very high. In each case it was it was also evaluated whether that impact was increasing, continuing or decreasing.

The results of the analysis are presented in the figures below (the numbers show the percentage of all cases where the impact of a particular driver of change on various ecosystem services and benefits was assessed across sites). **Figure 16** shows that overexploitation and habitat change (28% and 21% respectively) are the two drivers of change that were most frequently assessed as having high or very high level of impact on the provision of ecosystem services and benefits. **Figure 17** also shows that the level of impact from habitat change shows an increasing trend in many cases (49%).

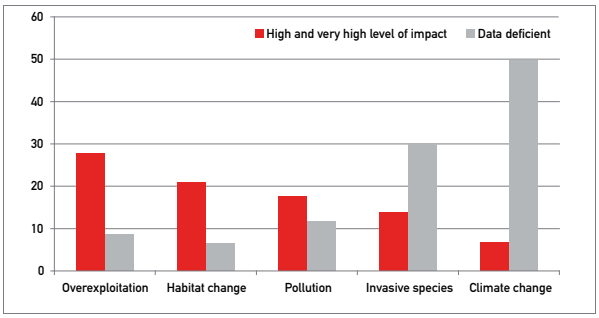


Figure 16. Level of impact of different drivers of change on the provision of ecosystem services and benefits

This analysis provides a very general global overview of different direct drivers of change affecting the provision of ecosystem services. Detailed analysis of complex interlinkages between the way ecosystems are being affected and the provision of benefits could provide a valuable source of information for decision-making; however, this can only be done at a site level and thus is far beyond the scope of this study.

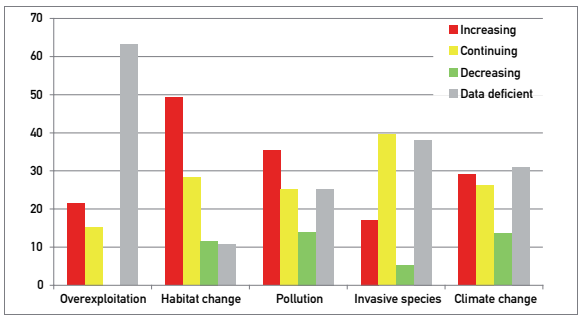


Figure 17. Trend in the extent that drivers of change are impacting on the provision of benefits

3.2.5 Conclusions

A number of conclusions can be distilled from the analysis of the Conservation Outlook Assessments benefits data. Firstly, that the World Heritage network delivers a wide variety of benefits and is most frequently associated with providing health and recreation values, knowledge, contributing to the local economy, and cultural and spiritual values. From the environmental services, water provision has the highest score with 66% of sites having been assessed as important for water quantity and/or quality. Carbon sequestration, soil stabilization and flood prevention were also identified as important ecosystem services provided by about half of all natural sites (52%, 48% and 45% respectively). However, these ecosystem services also had high numbers of 'data deficient' responses (about 20%) meaning that the figures could potentially be higher. This also indicates that for many sites our understanding of ecosystem services and benefits they provide is far from complete and this information can be used to identify future research needs. The analysis also indicates that some benefits, such as for example provision of medicinal resources or the presence of sacred plants and animal species, are much harder to determine due to a lack of data or knowledge. Significant regional differences have also been identified.

Site level assessment of benefits using the Conservation Outlook Assessment methodology provides useful baseline information for site managers, which can be used in future analyses to determine changes in the supply of benefits. The dataset could be further complemented in the future by using alternative methods or a mixture of methods, such as interviews and stakeholder consultations, to collect more detailed data.

Provision of ecosystem services and benefits is being affected by different factors. From the five drivers of change that this study looked at – habitat change, pollution, overexploitation of resources, climate change and invasive species – habitat change and overexploitation were most frequently assessed as having high or very high level of impact on the provision of ecosystem services and benefits (28% and 21% respectively). This study provides a very general global overview of different direct drivers of change affecting the provision of ecosystem services. However, this could be used as a framework for future work. More detailed site-level assessment of the most important direct drivers of change and how they may impact on the supply of key benefits could provide a valuable source of information for decision-making and help set priorities for management.

4. Site scale analysis: Case studies of ecosystem services and benefits, economic valuation and governance models

4.1 Introduction

This chapter uses case studies of specific World Heritage sites to illustrate the range of the ecosystem services and wider benefits that sites can deliver. It also introduces economic valuation methodologies and provides examples of valuation studies that have been undertaken in World Heritage sites. Lastly, it explores the various governance models that are being used within the World Heritage network and how they can contribute to the continued supply of ecosystem services and benefits.

4.2 Ecosystem services and benefits

World Heritage sites can support the delivery of a diverse variety of ecosystem services and benefits to society and the economy (see Figure 4 and Section 3.3). This section showcases only a small selection of these services and benefits and the values they provide to people in particular World Heritage sites, specifically: those values associated with water resources, climate regulation, cultural and spiritual, wilderness, ecotourism, knowledge and education and the provision of natural resources.

4.2.1 The value of water resources: Morne Trois Pitons National Park (Dominica)

Ecosystems provide a number of key ecosystem services related to the quantity and quality of water, as well as the purification, detoxification and the protection of water supplies. These water resources play a vital role in our lives, allowing us to meet our basic needs to drink, wash and farm, as well as to generate electricity, provide income and build our homes. Due to the scale at which water resources are generated and utilised, a wide range of groups from local populations to national and regional scales benefit from these services; in this case study a number of these services will be defined and their impacts on human well-being described through the examination of Morne Trois Pitons National Park.

Key Messages

- **World Heritage sites can provide water resources that significantly contribute towards human well-being through providing water to: allow basic subsistence needs to be met; increase agricultural production through permitting irrigation; and generate electricity through powering hydroelectric generators.**
- **Additionally, water resources can enhance tourism by water-based activities, thus indirectly allowing a population to generate an income from the water resources.**
- **These water resources have a wide range of beneficiaries that due to the transboundary nature of water resources can be from a local, regional, or even national level.**
- **Often the direct beneficiaries of these water services live outside the boundaries of the World Heritage site itself.**
- **Maintaining water-related services requires careful planning given the large size of watersheds and the many factors that can influence water quality.**

Location and World Heritage designation

The Morne Trois Pitons National Park is located on the southern end of the mountainous island of Dominica (UNEP-WCMC, 2011b). Dominica is one of the Windward Islands of the Caribbean and part of a submerged chain of volcanoes known as the Antillean chain (UNEP-WCMC, 2011b; UNESCO, 2014f) formed as part of ongoing subduction of the Caribbean continental plate under the North and South Atlantic tectonic plates.

Taking its name from the three-peaked basaltic remnants of a volcano rising over 1,400m (UNEP-WCMC, 2011b), Morne Trois Pitons national park covers approximately 6,900 Hectares (ha) (Edwards, 2011b). The landscape is dominated in terms of its physical attributes by steep mountain sides, deep incised valleys and glacis slopes (UNESCO, 2014f). The national park in addition to containing four of the islands seven mountain ranges, is also home to three lakes of regional importance, the Freshwater, Boeri and the Boiling Lake whose

water temperature is an average 95°C and which is the second largest such lake in the World (UNEP-WCMC, 2011b). Also of note is the locally named "Valley of Desolation" a large naturally formed amphitheatre where sulphurous fumaroles, steam vents, hot springs and mud pots bubble up through the ground (UNEP-WCMC, 2011b).

Designated a World Heritage site in 1997, under criteria (vii) and (x) (UNESCO, 2014h), the park is home to large, highly scenic, tracts of the most extensive almost undisturbed tropical forest in the Lesser Antilles and contains the headwaters of most of the major streams and rivers in the southern half of the island (UNEP-WCMC, 2011b).

Of the 72,000 strong population of Dominica, officially none live within the boundaries of the national park (Edwards, 2011b), although many indirectly benefit through the provisioning of water resources which will be discussed in due course.

Water resources

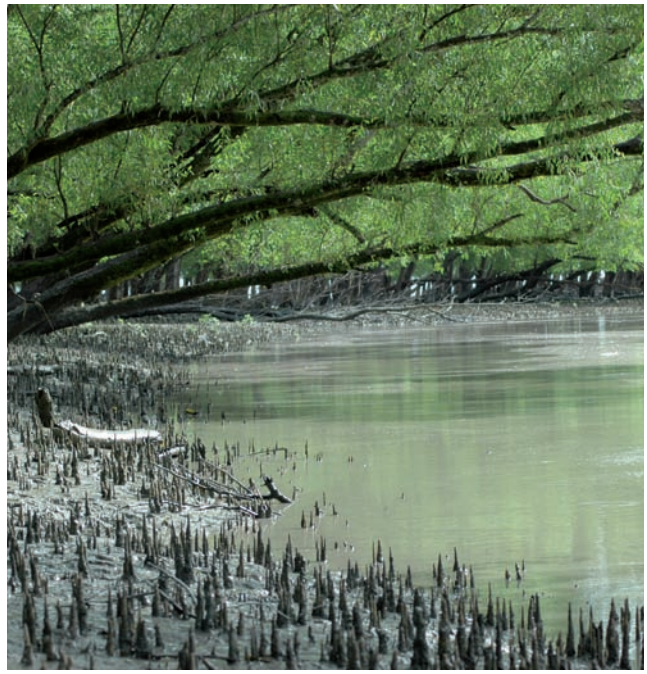
In terms of the water related benefits that the site contributes to, examination of literature has shown that the site contributes significantly to the providing and securing of water resources at local, regional and national scales due to the transboundary nature of these water resources.

The combination of topology, geology and climate has meant that the headwaters of most of the major streams and rivers in the southern half of the island are within the confines of the site. These resources are relied on in order to meet the potable water demands of the island as a whole, with it being estimated by Edwards, (2011) that 60% of Dominica's water supply demand is met by these waters. In addition to supplying basic needs in terms of potable drinking water, water resources are also utilised for cooking, bathing, fishing, washing, as well as farming and irrigation (Drigo, 2001).

In addition to meeting the water supply needs of the population, the water resources generated by the site are utilised by the Dominican Electricity Services (DOMLEC) to generate hydroelectricity. Three hydroelectric plants currently exist, all of which are located outside the boundaries of the national park on the Roseau River Watershed, but are driven directly from water collected in the national park (Edwards, 2011b). Together these hydroelectric sites generate 27 gigawatt hours (gwh) a year, accounting for an approximate 30% of Dominica's national production (DOMLEC, 2013).

Further to supplying potable water and a means to generate electricity, the water resources that the site provides also benefit the population through facilitating tourism (Edwards, 2011b). A number of the key tourist attractions in the site are water based from the boiling lake through to the numerous waterfalls and lakes. The presence of these tourist attractions, attracting over 84,000 visitors in 2009 (Edwards, 2011b) generates income through the sale of ecotourism passes, and the generation of jobs, for example as guides. In addition to tourism, the site is used recreationally by the local population. Swimming, for example, takes place in a number of locations - the Emerald Pool, Freshwater and Boeri Lakes and the numerous rivers (Edwards, 2011b).

4.2.2 Natural hazard regulation: Sundarbans National Park (India) and The Sundarbans (Bangladesh)



Regulating services can reduce people's exposure to natural hazards such as floods, fire and droughts. Sundarbans National Park and The Sundarbans World Heritage sites have been selected to highlight the important benefits that mangrove ecosystems deliver as a result of natural hazard regulation. Inhabiting estuaries and inter-tidal zones, mangroves provide vital ecological stability by delivering protection against erosion, providing buffer zones and reducing flooding– thereby contributing to coastal protection (Colette, 2007; FAO, 2014). It is anticipated that coastal zones, such as the Sundarbans, will become increasingly prone to natural disasters as the results of climate change intensify (Agrawala *et al.*, 2003). Increased exposure to natural hazards amplify the vulnerability of World Heritage Sites by increasing the chances that key ecosystems, listed for having Outstanding Universal Value, will be changed, degraded or destroyed (UNESCO *et al.*, 2010).

Key Messages

- **World Heritage sites can play an important role in mitigating the impacts of natural disasters (World Bank, 2010) through the delivery of regulating services which can reduce people's exposure to natural hazards such as floods, fire and drought (Millennium Ecosystem Assessment, 2005). Sites that conserve areas of mangroves are particularly important for their contribution to coastal protection and flood prevention.**
- **The increasing frequency of events, such as cyclones and storm surges, as a result of climate change highlights the urgent need to maintain healthy mangrove ecosystems for the continued delivery of benefits that local communities depend on and that contribute to human well-being.**

- **Evidence suggests that it is more cost effective to invest in risk prevention than to fund post-disaster recovery by preserving the delivery of disaster mitigating ecosystem services rather than attempting to recreate them once an ecosystem's capacity to provide these services has been reduced through degradation (UNESCO *et al.*, 2010).**

Location and World Heritage designation

Spanning 10,000km² along the coast of India and Bangladesh, the Sundarbans represent the largest expanse of contiguous mangrove forests in the world (Colette, 2007; Giri *et al.*, 2007; UNEP-WCMC, 2011d). This globally significant ecosystem is situated on the Bay of Bengal, within the delta of the Ganges, Brahmaputra, and Meghna rivers. A network of water courses intersect with a highly variable landscape, including sand bars, mud flats and mangrove islands (UNESCO, 2014i). Sixty percent of the area lies in Bangladesh with the remaining area in India. India's World Heritage site, Sundarbans National Park, was the first to be inscribed in 1987. The Sundarbans Reserved Forest in Bangladesh was also designated a RAMSAR site in 1992 in recognition of its significance as a wetland of international importance (Ramsar, 2013).

Inscribed on the World Heritage List under natural criteria (ix) and (x), the Sundarbans National Park and The Sundarbans represent a wetland ecosystem rich in biodiversity and is the only mangrove ecosystem left in the world to support the Bengal tiger (Panthera tigris tigris). Due to the unique niche their root systems provide, the mangrove forest offers nursery habitats to a wide variety of invertebrate and fish species (Kathiresan & Bingham, 2001). The area is also recognized for supporting important ecological processes, such as delta formation, tidal influence and plant colonization (UNEP-WCMC, 2011d).

Natural hazard regulation

The Sundarbans is situated in a region prone to a high incidence of cyclonic storms. Over the past two centuries the coastal areas and offshore islands of Bangladesh, which the majority of the Sundarbans belongs to, have been affected by 35 severe cyclones and storm surges (Akhand, 2003). In 2007 Cyclone Sidr hit Bangladesh causing the death of almost 3,500 people in Bangladesh and affecting millions of people along the coast (Dept. of Disaster Management - Ministry of Disaster Management and Relief, 2012; Mirza, 2010). According to the IPCC projections, the frequency of dramatic weather events will increase as temperatures and sea levels rise (Dasgupta *et al.*, 2007). Increasing the likelihood of flooding events, the Sundarbans region will become more vulnerable to cyclonic events (Agrawala *et al.*, 2003). The advanced warning system for cyclonic events has improved dramatically in recent years as a result of a government response (Paul, 2009) to Cyclone Gorky, which killed around 140,000 people in 1991. However, there are concerns that rising sea levels will compromise many of the current cyclone shelters (Karim & Mimura, 2008).

Extreme events impact ecological and human systems causing human suffering and economic losses thereby impacting human well-being. The region around the Sundarbans has one of the highest population densities in the world, as a result millions of people living throughout this complex landscape are currently benefiting from the coastal protection provided by these mangrove forests (Giri *et al.*, 2007).

Intact ecosystems are better able to deliver the ecosystem services they provide, such as flood mitigation, and to withstand hazardous events. A study comparing the protection provided by intact and cleared mangrove areas in Belize, found that intact mangrove areas provided more protection from storm events than their degraded counterparts (Granek & Ruttenberg, 2007). In addition, evidence suggests that it is more cost-effective to protect ecosystems that deliver key natural disaster mitigating ecosystem services than to recreate them artificially. The United Nations Development Programme (UNDP) has calculated the costs associated with building 2,200km of coastal embankments in the Sundarbans, which purportedly would provide an equivalent level of protection. It was estimated that US$294 million of capital investment and US$6 million for maintenance each year would be needed; an amount far greater than that currently spent on conserving this essential mangrove ecosystem (Colette, 2007). Consequently, it is more economical to invest in risk prevention, through the preservation of ecosystem services, than to fund post-disaster recovery (UNESCO *et al.*, 2010). Regardless of whether the number and strength of cyclones change as a result of climate change, "exposure of the region to the devastating effects of storms will increase if the mangroves cannot be conserved successfully" (Colette, 2007).

4.2.3 Climate regulation: Canadian Rocky Mountain Parks (Canada) and Ibiza, Biodiversity and Culture (Spain)

An important feedback loop exists between ecosystems and climate. While ecosystems regulate climate by influencing the mechanisms of water, energy and greenhouse gases (GHGs) exchange between land and the atmosphere, climate variation itself impacts the dynamics of ecosystem processes, determining the maintenance of their integrity

and capacity to provide goods and services for people (Bonan, 2008; Foley *et al*, 2003; Heimann & Reichstein, 2008; Millennium Ecosystem Assessment, 2005; World Bank, 2010). As such, climate regulation is important to ensure the normal functioning of the biosphere, which in turn will maintain the delivery of regulation services. The latest IPCC report states that "continued emissions of GHGs will cause further warming and changes in all components of the climate system" (IPCC, 2013). Under current climate change scenarios, protected areas are key to ensuring the provision of regulation services that can act both in terms of mitigation, by sequestering carbon and reducing deforestation; and in terms of adaptation to climate change, by ensuring the resilience of the ecosystems to extreme events is maintained and services such as climate regulation continue to be provided (World Bank, 2010).The two case studies –the Canadian Rocky Mountain Parks and Ibiza - have been selected to highlight the benefits ecosystems deliver through climate regulation in terrestrial and marine environments.

Key messages

- **World Heritage Sites that contain large tracts of forest can significantly contribute to the delivery of climate regulating services by ensuring that carbon stocks remain undisturbed.**
- **Coastal and aquatic ecosystems also play an important role in carbon sequestration by capturing significant amounts of 'blue carbon'.**
- **Regulation effects occur not only on a local scale, but taken together these sites can also impact the global climate system; therefore, World Heritage sites can be of particular importance for mitigating further impacts of climate change.**
- **Since the effects of climate change already occurring are likely to not be reduced even under best-case scenarios, it is important for areas that provide regulation services to be managed and have a protection status, given that they too are likely to suffer indirect consequences from a changing climate.**

4.2.3.1. Canadian Rocky Mountain Parks (Canada)

Location and World Heritage designation

With a total area of 230,684 km2, the Canadian Rocky Mountain Parks World Heritage Site is comprised of seven contiguous parks that straddle along a 400 km-long belt, between the British Columbia and Alberta borders (UNEP-WCMC, 2012a). A mosaic of mountain peaks, valleys, caves, glaciers, lakes and waterfalls compose the mountain landscape, as well as the presence of an important fossil record, and have led to its inscription under criteria (vii) and (viii) (UNESCO, 2014a). Although reserve status had already been attributed to the parks in 1887 under the Rocky Mountains Park Act, Jasper, Banff, Kootenay and Yoho National Parks were inscribed on the World Heritage List in 1984, and were joined by Mount Robson, Mount Assiniboine and Hanber Provincial Parks in 1990 (Parks Canada, 2009).

Climate regulation

Mountains are among one of the key ecosystems contributing to climate regulation services (Harrison *et al.*, 2010). A wide variety of unique habitats and features can occur in mountainous sites, such as heath and grasslands, forested areas, peatlands, glaciers and areas covered by snow. The Canadian Rocky Mountain Parks support the delivery of climate regulation services through carbon storage in forested areas and peatlands. Forests have an important role in the global carbon cycle by acting as carbon sinks. For example, globally Boreal Forests biomes have been estimated to store up to 380 Gt of carbon (World Bank, 2010). A study conducted in national parks across Canada (Sharma *et al.*, 2013) reported carbon stock densities being higher than those reported for reference forest areas with no protection status. Besides acting as a carbon sink, forests also play an important role in climate regulation by controlling the surface albedo (Betts, 2000; Sharma *et al.*, 2013). Similarly, snow and glaciers also contribute to reflecting solar radiation and regulating the climate.

Climate regulation occurs both on a local and global scale and the regulation services provided by the Canadian Rocky Mountain Parks will not only impact the local climate, but also have further effects on the global climate regime. In the face of global warming and climate change, this World Heritage Site will have an important role in local adaptation to climate change; for example, ensuring the conservation of the local fauna and flora, the storage and sink of carbon, by retaining water in glaciers and snow as well as ensuring constant and safe water supply to the lowlands for domestic and industrial use (Millennium Ecosystems Assessment, 2005). On a global scale, regulating effects will also be important to mitigate further impacts of climate change. The preservation of large forested areas will limit further CO2 emissions and increase CO2 sinks, being a key element in achieving climate mitigation objectives (Sharma *et al.*, 2013). With climate change being a global challenge, both mitigation or adaptation measures will have to be taken locally, and World Heritage sites are ideal locations for such actions to occur (UNESCO, 2007).

4.2.3.2. Ibiza, Biodiversity and Culture (Spain)

Christine Pergent Martini

Location and World Heritage designation

The World Heritage site "Ibiza, Biodiversity and Culture" is located in the Balearic Islands, Western Mediterranean. This site was inscribed on the World Heritage List in 1999 as a mixed site for both its cultural and natural values. The site provides an excellent example of the interaction between the marine and coastal ecosystems (UNEP-WCMC, 2011) and includes areas of salt marshes and seagrass meadows. The natural component of the World Heritage site is included in the Salinas de Ibiza y Formentera Nature Reserve. The site has also been declared a Special Protection Area (SPA) and is included in the EU Natura 2000 Network, and is a Zone of Special Protection of Birds.

The marine component of the site, with an area of 13 776 ha, includes the open sea between these islands up to limit of the 40 m depth. The main part of the underwater area in the Salinas de Ibiza y Formentera Nature Reserve is a vast underwater platform with sandy substrate, spreading between Ibiza and Formentera Islands. The area is characterized by dense and very well preserved coral reefs, dominated by *Cladocora caespitosa*, and *Posidonia oceanica* meadows. *Posidonia oceanica* is considered as an endangered species of the Mediterranean (e.g. Barcelona Convention – Annex II of the SPA/BD Protocol) (UNEP-MAP-RAC/SPA 1995).

Climate regulation

The literature provides sufficient evidence on the capacity of submerged aquatic vegetation to physically and chemically engineer their environment and to supply coastal protection services, a term applied to describe the benefits that human populations obtain from ecosystem functions (Millenium Ecosystem Assessment, 2005). Seagrasses are one such ecosystem and are known as ecological engineer species (Wright and Jones 2006). They provide important ecological services (Costanza *et al.* 1997) such as organic carbon production and export, nutrient cycling, sediment stabilization, enhanced biodiversity, and trophic transfers to adjacent habitats in tropical and temperate regions (Orth *et al.* 2006).

The *Posidonia* meadows play an important role in the dynamic and evolution of the coastal zone of the islands and the interaction between the marine and coastal ecosystems. The plant material produced in the meadows, supplies significant quantities of sediment and nutrients to the beach and associated dune system, particularly in regions where sediment production is of biogenic origin, as in the Balearic Islands (Marbà 2009).

Posidonia oceanica seagrass meadows can absorb and bury a significant portion of atmospheric CO2, helping to reduce greenhouse gases and regulate the planet's climate. This meadow acts as a long-term carbon sink which stores five times as much carbon for each kilometer of coastline as the average recorded for the Mediterranean.

Posidonia meadows produce an excess of organic carbon which can be stored in a specific structure, called "matte". Due to the slow decomposition, the organic fraction of the matte can be preserved for a long time, forming structures several meters thick (Mateo *et al.* 1997). Therefore the matte acts as a long-term carbon sink with the sequestration of carbon for several centuries or even thousands of years (Boudouresque *et al.* 1980; Mateo *et al.* 1997). Although several studies have highlighted the major role played by coastal vegetation (salt marshes, mangroves and seagrasses) in carbon sequestration, with more than 70 % of the 'blue carbon' stored (Nellemann *et al.* 2009), *P. oceanica* has the largest documented organic among seagrass species (Fourqurean *et al.* 2012; Serrano *et al.* 2012).

P. oceanica meadows of the Balearic Islands are particularly abundant (Diaz & Marbá, 2009). The P. oceanica meadows within the Ibiza World Heritage site constitute more than 70 % of the meadows of Ibiza and Formentera islands, and in comparison to the whole Balearic Islands, they have the highest ratio between surface of seagrasses and length of coastline. This area shows an exceptionally high carbon fixation rates (0.23 106 tC a-1 or 0.84 106 tCO2 a-1). The Balearic Islands' contribution to total national emissions of the greenhouse gases is 2.4 %. However, emissions per capita in the Balearic Islands are slightly higher than the national average and, since 1990, the population of the islands has increased by 45.3 % and has been accompanied by an increase in emissions per capita (Mac Cord and Mateo 2010). So it can be estimated that P. oceanica meadows surrounding the Islands offset 8.7 % of these emissions. The total stock accumulated equals 105 years of the Balearic Islands' CO2 emissions. The store of carbon sequestered beneath the meadows (matte) corresponds, for each kilometre of coastline, to an accumulation five times higher than the average recorded for the Mediterranean. On the global carbon market, this stock is valued at 4 billion euros, i.e. around 6 € m-2. These estimates confirm the outstanding role of Posidonia oceanica in the Balearic Islands as a carbon sink (Pergent *et al.* 2012).

4.2.4 Cultural and spiritual values: Golden Mountains of Altai (Russian Federation) and Laponian Area (Sweden)

Different cultures place values on natural features of the environment that have great meaning and importance for them and on which their survival as cultures depends. These values can be cultural but also spiritual. The later refer to the transcendent significance of nature that puts people in touch with a deeper reality greater than themselves, that gives meaning to their lives and motivates them to revere and care for the environment. In the case of protected areas that are or include sacred sites, these values are intimately related to the beliefs and practices of indigenous traditions and religions. Iconic natural features of many World Heritage sites, such as for example wilderness areas, also have spiritual significance for people as places of inspiration, symbols of identify, etc.

Key messages

- **Cultural and spiritual values of natural sites shape people's relationships not only in social and in a religious life but also with the landscapes they inhabit.**
- **The socio-cultural significance of sacred sites plays a pivotal role in the lives of local communities. Failing to recognise this socio-cultural and spiritual significance can exacerbate misunderstandings of ontological differences and jeopardize the management of these areas.**
- **Cultural values of wilderness refer to the strong attachment to wild nature and the aesthetic dimensions of wild emblematic landscapes and the experience of nature.**
- **The unimpaired character of nature in those World Heritage sites that are wilderness areas is important both for local people and for the global community; however, these untouched ecosystems also benefit human well-being by providing other important services.**

4.2.4.1. Golden Mountains of Altai (Russian Federation)

Bas Verschuuren

Location and World Heritage designation

The Altai mountains form the major mountain range in the south-western Siberia biogeographic region, covering a total area of 1,611,457 ha and boasting some 1,499 glaciers. Typical relief features of mountain peaks include the 4,605 m Mount Belukha, cirques and trough valleys with lake basins, morainal hills and ridges. They are also the source of some the greatest rivers such as the Ob which derives from the confluence of the Katun and Baya rivers and Lake Teletskoye which is the largest body of freshwater in south-western Siberia.

Golden Mountains of Altai have been inscribed on the World Heritage list in 1998 for their natural Outstanding Universal Value under criterion (x): "The Altai region represents an important and original centre of biodiversity of montane plant and animal species in northern Asia, a number of which are rare and endemic."(UNESCO, 2014c). This serial site comprises three component areas: Altaisky Zapovednik and its buffer zone around Lake Teletskoye; Katunsky Zapovednik and its buffer zone around Mount Belukha; and the Ukok Quiet Zone on the Ukok plateau (Klubnikin, Annett, Cherkasova *et al.*, 2000). Two of the areas are located along the borders with China and Mongolia where they become part of the greater Altai - a 2,100 km long transboundary stretch between the Russian Federation, China, Mongolia and Kazakhstan.

Cultural and spiritual values

In early history, the Altai was part of emerging and collapsing tribal unions, khanates, and the empires of the Scythians, Turks, Uigurs, Yenissey Kirgiz, Kidans, Mongols and Oitrats before it became part of the Russian Empire in the mid-18hundreds. The local populations of Altaisky, a Turkish-speaking people, have co-existed with nature for millennia and have a strong affinity with the natural environment as becomes evident through the expression of Altai worldview and wisdom named "Bilik" (Shodoev, 2012). Bilik is part of one of the world's oldest living shamanistic traditions in which natural objects (plants, stones, stars and planets) are believed to be living beings endowed with the same functional organs as human beings. Accordingly, Mount Uch Enmek is traditionally called the 'navel' of the Earth. The Earth is believed to receive vital energy and knowledge through this navel in the same way as a foetus receives nourishment in the mother's womb (SNSI, 2013).

Cultural heritage is expressed in the many petroglyphs and archaeologically important burial mounts (Shodoev, 2012). In fact, many of the burial mounts are located within a declining zone of permafrost due to climate change. These frozen tombs are considered to contain cultural treasures unique to the world and have an elevated protection urgency (Tresilian, 2008). Most famous of all burial mounts is possibly that of the "Ice Maiden" that was excavated by scientists who despite much resistance of shaman, local people and even the wider public also removed the mummy and placed her in a museum in St. Petersburg (Dobson, 2010; Raygorodetsky, 2013).

Clearly, the cultural and spiritual values of the Altai are much more than a heritage of the past or services offered by a natural environment, they are central to the lives of many of the Altaians today. Here cultural and spiritual values, are deeply enshrined in the Altaian worldview that also shapes peoples relationships not only in social and in a religious life but also with the landscapes they inhabit (Posey, 1999).

4.2.4.2. Laponian Area (Sweden)

Florence Revelin

Location and World Heritage designation

The Laponian Area World Heritage Site covers a territory of 9,400 km2 in northern Sweden. Listed as a mixed site on the UNESCO World Heritage List in 1996 (criteria (iii), (v), (vii), (viii) and (ix)), the Laponian Area brings together several protected areas and comprises four national parks and two nature reserves, offering a great variety of natural landscapes reputed of exceptional beauty. Two of the site's National Parks count among the first established in Sweden and Europe (1909) and other component protected areas were established in the early second half of the twentieth century.

This old nature protection system has guaranteed a good state of conservation of the whole area over the years. Both its remoteness and its vast wild landscapes spared from industrial development have led to the region being deeply associated with wilderness values, from both an ecological and a cultural perspective (Dälström, 2003; Green, 2009; Revelin, 2013).

These various protected landscapes can be divided into two dominant landscapes types: an eastern lowland of Archaean geological origin, which comprises marshlands, many lakes, and mixed woodlands; and a western mountainous landscape with spectacular mountain scenery. This higher part comprises a thinly-vegetated mountainous landscape with steep valleys and powerful rivers. The area contains more than 100 peaks higher than 1800m and about 100 glaciers (IUCN, 1996). Snow-covered mountains border on large alpine lake areas,

contrasting with very active delta areas and marshlands. The vast mire complex of Sjaunja Nature Reserve - the largest in Europe outside Russia - is virtually impenetrable by human beings except during winter, allowing natural succession to continue unimpaired (IUCN, 1996).

Wilderness values

The major cultural value of Laponia's wilderness relates to its aesthetic dimension. Tourism and recreation are historically important in the area, starting around 150 years ago (Revelin, 2013). Nature and wilderness experience holds an important place in Scandinavian culture, as illustrated by the concept of "friluftsliv", valuing outdoor life and activities (Sandell & Sörlin, 2008). The dramatic and wild landscapes of the region became very reputed and attractive since the early 20th century, and especially important in national values. This is exemplified by the Swedish anthem, which celebrates the wild mountainous north: the "most beautiful land upon earth". Today, nature tourism and wilderness experience is a significant activity in the region. Five mountain stations and around 20 overnight cabins are situated inside or at the vicinity of the site. Some parts of the site have no tourist facilities at all, and require full autonomy. This is the case for Sarek National Park, especially valued for its inaccessibility and its full image of wilderness.

Free access to wilderness areas is highly valued culturally in the Swedish society (the so called 'everyman's right' - Allemansrätt) and entering protected areas of Laponia is free of charge. Some emblematic landscapes also have important values for locals, such as those of the Skierfe mountain which is both an impressive landscape attracting tourists and a Saami sacred place.

Because of the ancient Swedish customary right of "allemansrätt" everyone is allowed to harvest common plants (if not protected) everywhere in Sweden, including in protected areas. Wild food plant and mushroom collection is permitted in the Laponia site, seasonally providing both the locals and visitors with some subsistence daily food. This provisioning service is hardly assessable economically, but is very important culturally, notably because the Scandinavians are deeply attached to this tradition of free access to nature, making wild nature areas especially valued (Berry, 2011; Sandell & Sörlin, 2008).

Using wild food resources, and more broadly living from and in this subarctic and hostile environment, are part of the fundaments of an important and complex system of traditional ecological knowledge of the Saami indigenous people living in the area (Roué, 2012). This knowledge covers various areas from medicinal uses of plants (Dubois & Lang, 2013), to moving around and surviving within an arctic wild environment thanks to complex knowledge of snow (Roturier & Roué, 2009). Wilderness areas also provide important pasture resources for reindeer herding, which is an essential cultural and economic activity for the Saami. Based on a transhumance system, herders use the whole diversity of local ecosystem throughout different seasons, moving from forest and mires in winter to mountain pastures in summer.

4.2.5 Nature-based tourism: Wadi Al-Hitan (Egypt)

The wide range of benefits generated through cultural ecosystem services are complex, multidimensional and can contribute significantly to human well-being. While the cultural, spiritual and aesthetic aspects of ecosystem services play an essential role in human existence and quality of life, nature-based tourism also has the capacity to provide economic, educational and conservation benefits. With biodiversity and ecosystems in peril around the world, ecotourism is increasingly being embraced as a means of conserving protected areas. World Heritage Sites, by virtue of their globally recognized status, are often popular tourist destinations. While nature-based tourism is not always considered beneficial and potential negative impacts should also be taken into consideration when planning, the sustainable tourism initiative undertaken at Wadi Al-Hitan World Heritage Site provides an example of how nature-based tourism can be used to benefit both local communities and natural World Heritage Sites.

Key Messages

- **The benefits nature-based tourism can provide to World Heritage Sites has been explored in both conservation and development contexts, and has been recognized for its ability to generate funds, create awareness and encourage conservation efforts by providing education and promoting sustainable practices.**
- **Nature-based tourism initiatives can also facilitate local empowerment and encourage local communities to take responsibility for the long-term conservation of their natural assets.**
- **While it is important to recognize the benefits tourism can bring to the conservation of World Heritage Sites, it is equally important to acknowledge that this is not a one-size-fits-all approach and that negative impacts can result from mismanagement. Poorly managed tourism can compromise the integrity of a site, as well as its Outstanding Universal Value, and potentially create negative socio-cultural implications.**

Location and World Heritage designation

The Wadi Al-Hitan World Heritage Site, also known as the Valley of the Whales, is situated in Egypt's Western Desert and covers 20,000 ha. The site is located 150km southwest of Cairo and is part of, and managed under, the Wadi El-Rayan Protected Area (WRPA). Wadi Al-Hitan became a Special Protected Area within WRPA in 1997 and was awarded World Heritage Status in 2005. Identified as a site of Outstanding Universal Value under Criterion (viii), Wadi Al-Hitan has been recognized as the most important site in the world for demonstrating the pivotal evolutionary phase in which whales evolved from land-based mammals (UNEP-WCMC, 2011e). Emerging from a sediment depression that once represented a shallow bay in the Tethys Sea 40 million years ago, the fossils at Wadi Al-Hitan are distributed through three Eocene formations and provide a rich example of the fossil record through time. In addition to exemplary whale skeletons, the site has also revealed an abundant array of other life forms, including sea cows, turtles, crocodilians, marine invertebrates, and vegetation – such as ancient mangrove species.

Nature-based tourism

In 2005, the World Bank carried out a Country Environmental Analysis which identified Egypt's environmental problems as being closely linked with localized poverty. The same year the global Millennium Ecosystem Assessment highlighted linkages between human well-being and poverty reduction (Millennium Ecosystem Assessment, 2005). With this being said, ecotourism opportunities associated with the conservation of natural and cultural World Heritage Sites, providing that benefits are equitably shared, can foster community participation and support for conservation efforts through awareness building and education. In its recent evaluation report (2013), the Egyptian Italian Environmental Cooperation Programme approached the issue of poverty alleviation and the advancements made regarding quality of life. In assessing the impacts of the programme, the report concluded that projects, including those ongoing at Wadi Al-Hitan, enabled both natural and cultural World Heritage Sites to become community development assets. Benefits that ecotourism can provide to communities surrounding Wadi Al-Hitan include: job creation, local economy diversification, community awareness/education, and additional support operations. With increases in tourism, local beneficiaries can also develop their own small businesses – including handicraft production.

Although an earlier report (2007) produced by the Nature Conservation Sector of the Egyptian Environmental Affairs Agency found that local communities around the Wadi El-Rayan Protected Area had limited awareness of the benefits the protected area provided to their communities, Wadi Al-Hitan has been identified as a good example of how well planned tourism development can provide local benefits (Borges, Carbone *et al.*, 2011). Although small-scale, most of the services offered to site visitors are provided by local communities. In order to facilitate this, emphasis has been placed on capacity building so that local people can develop the skills they need to offer these services (Borges *et al.*, 2011).

Wadi Al-Hitan reflects a World Heritage site which has undergone a gradual transformation in regards to the conservation and management of its geological legacy. The increased prioritization of the site, along with internal restructuring and considerable improvements in regards to monitoring and ecotourism development were cultivated with a specific goal in mind – to establish the site as an example for other protected areas in Egypt. Although management work, in response to growing visitor numbers, had already begun at the site prior to its inscription, the strategies implemented as a result of World Heritage listing demonstrate concerted efforts to minimize damage to the site while improving the experiences of tourists. In receiving World Heritage status in 2005, a stronger emphasis was put on the conservation of Wadi Al-Hitan. This emphasis included more community involvement, improved infrastructure and interpretation materials, staff capacity building and increased governmental support.

4.2.6 Knowledge and Education: Sian Ka'an (Mexico)

Through living alongside an ecosystem, utilising its natural resources for food, fuel and medicines, indigenous populations come to understand how an ecosystem functions. Knowledge about the functioning of an ecosystem is valuable to both local and global communities, as it allows local communities to manage their resources in a sustainable manner, and provides opportunities to progress scientific knowledge. In this case study, we focus on Sian Ka'an to illustrate the benefits in terms of education and traditional ecological knowledge that can result from interacting with an ecosystem.

Key Messages

- **World Heritage sites can provide cultural benefits in the form of education and knowledge to both local and global communities.**

- **The traditional ecological knowledge accumulated by indigenous populations through interacting with an ecosystem can provide valuable information:**
  - **That allows indigenous populations to sustainably manage their natural resources.**
  - **That combined with scientific knowledge can be used to create effective management strategies.**
- **Often being locations of high biodiversity, World Heritage Sites are valuable in terms of the scientific knowledge that they could generate through scientific research.**

Location and World Heritage designation

Located on the Eastern coast of the Yucatan Peninsula in the State of Quintana Roo, Sian Ka´an, literally translating as "Where the sky is born" (UNEP-WCMC, 2011c) is one of Mexico's largest protected areas. Established in 1986 under UNESCO's Man and the Biosphere Program, the site was inscribed on the World Heritage List in 1987 under criteria (vii) and (x) (UNESCO, 2014g), and manages around 530, 000 hectares of marine, coastal and terrestrial ecosystems (UNEP-WCMC, 2011c).

Sian Ka'an supports an extremely diverse set of habitats including tropical forests, palm savannah, lagoons, sinkholes and swamps, extensive mangrove stands, sandy beaches and dunes and a large marine area bisected by part of the Mesoamerican Barrier Reef (UNEP-WCMC, 2011c). Particularly noteworthy are the "Cenotes", water-filled natural sinkholes isolated from each other, which have promoted rapid speciation, and resulted in a diverse set of terrestrial and aquatic invertebrate species (Kramer, 2002), and the "Petenes", which are tree islands emerging from the swamps. Sian Ka'an is home to a remarkably rich set of flora and fauna, (UNEP-WCMC, 2011c; UNESCO, 2014g), including the vulnerable West Indian Manatee (*Trichechus manatus*), and the Black-handed Spider Monkey (*Ateles geoffroyi*) (UNESCO, 2014g). In 2003, the region was further recognised by being designated as a Wetland of International Importance under the Ramsar Convention (The Ramsar Convention on Wetlands, 2013). Culturally, this site is also important with evidence of human settlements dating back around 2,300 years being found, along with 22 other archeologically important sites.

Knowledge building and education

The indigenous Mayan people have lived for a long time within the ecosystems of the Sian Ka'an landscape (Brown & Hay-Edie, 2013), with discoveries of human remains, ceramic pieces, and other artefacts having been dated up to 2,300 years old (CESiaK, 2014). Living alongside the biodiversity of the region has allowed these communities to develop ways of using the natural resources for food, medicine, clothing and shelter. This traditional ecological knowledge enables these populations to utilise the natural resources, and often also promotes sustainable use of these resources and conservation of the ecosystem to allow future use of the resource. This knowledge when combined with scientific knowledge is potentially extremely valuable, as it can help develop management strategies that protect the ecosystem, while simultaneously helping the indigenous populations to meet their needs.

The Community Management of Protected Areas initiative (COMPACT) is a project being undertaken in the World Heritage Site combining such knowledge. COMPACT advocates principles of empowerment and self-supported development in its aims to establish sustainable management strategies for Sian Ka'an (Brown & Hay-Edie, 2013). It relies heavily on participatory approaches with local stakeholders, to create management strategies, based on a combination of traditional ecological knowledge and scientific knowledge.

An example of such a strategy is the development of apiculture (bee keeping), which has helped maintain forest cover and improve the quality of life. Through financial support from COMPACT (Brown & Hay-Edie, 2013), a group of women have developed over 90 apitherapy products by combining honey with other products such as medicinal plants. COMPACT further supported this organisation by assisting them in obtaining an organic certification, allowing them to sell their products for a higher price. These are sold from a retail store and marketed at hotels and trade fairs nationally and internationally (Brown & Hay-Edie, 2013).

The Amigos de Sian Ka'an (ASK) is another such organisation. ASK have been operating in the World Heritage Site for the past 18 years where they have, and continue to, undertake work to help the Mayan culture survive by encouraging the use of traditional skills and development of economic activities, which help generate income but do not harm the environment. Examples include, embroidery, furniture carving, medicinal plant use and honey making (Amigos de Sian Ka'an, 2014).

As a biologically diverse site of outstanding natural beauty, sustainable tourism in Sian Ka'an is being backed by a number of organisations, including the Centro Ecologico Sian Ka'an (CESiaK), as a route to sustainably develop the region. Using local guides and their knowledge of the region (CESiaK, 2014) a number of tours venturing into the buffer regions of the World Heritage site have been organised. These ventures have increased average income, allowed the community to diversify its income sources and has promoted the inclusion of women in new enterprises (UNESCO, 2014b). As local communities have benefitted directly from activities related to careful management of natural and cultural resources; an additional positive impact has been an increasing awareness of the connections between these activities and protection of the Sian Ka'an biosphere, including its status as a World Heritage site.

The World Heritage Site also houses an education centre which aims to provide tourists with an understanding of the ecosystem, the traditional Mayan culture, and sustainability projects taking place. Additionally through partnerships with Universities students can get involved with the ongoing projects taking place (CESiaK, 2014).

4.2.7 The provision of natural resources: Gunung Mulu National Park (Malaysia) and the Great Barrier Reef (Australia)

Provisioning services are the material benefits that are directly obtained from an ecosystem. Protected areas, in addition to safeguarding regulating and supporting ecosystem services, can also provide provisioning services that can be directly utilised by local people. They can take a wide variety of forms, from fuelwood and timber for construction, to non-timber forest products (NTFPs) such as medicinal plants, and bush-meat. These provisioning services allow local populations to meet their basic subsistence needs, support their livelihoods, and to live their lives as they choose. These two case studies - the Gunung Mulu National Park and the Great Barrier Reef - illustrate the benefits derived from terrestrial and marine provisioning ecosystem services.

Key Messages

- **World Heritage sites can significantly benefit human well-being through the provisioning ecosystem services.**
- **These provisioning services can be used to meet a number of different stakeholders needs for example:**
  - **Indigenous peoples who rely on these services to meet their basic subsistence needs, support their livelihoods and underpin their way of life.**
  - **Recreational users who use the resource for recreational purposes, potentially generating an income for those who manage the resource.**
- **Conflicts between the conservation of a World Heritage Site and making use of its provisioning services need to be carefully resolved to ensure that a balance between conservation and sustainable use is reached.**
- **Once management strategies have been emplaced, ongoing monitoring is necessary to ensure that they are having the desired results, and that they can be adjusted if necessary.**

4.2.7.1. Gunung Mulu National Park (Malaysia)

Location and World Heritage designation

Located on the island of Borneo within the State of Sarawak, a combination of its rain-forest covered mountains, wild rivers contained within deeply-incised canyons, sheer limestone pinnacles, long cave passages and immense caves makes Gunung Mulu national park a site of incredible natural beauty. Geologically the landscape is fascinating, holding records of over 1.5million years of change (UNESCO, 2014e), and providing one of the world's finest examples of collapsed karst terrain in the world (UNEP-WCMC, 2011a), with over 295 km of caves and tunnels in addition to the Sarawak Chamber, the world's largest known cave chamber (Eavis, 2006).

Inscribed on the World Heritage List in 2000 (UNEP-WCMC, 2011a), Gunung Mulu National Park covers almost 53,000 ha (UNESCO, 2014e), is home to a large number of species endemic to the region, ranks near the top globally in terms of palm diversity, and features an extensive network of caves. These caves are home to millions of swiftlets and bats (UNEP-WCMC, 2011a), and provide a unique opportunity to study the origins of cave fauna.

The land adjacent to the national park is home to a number of tribes collectively referred to as the 'Orang Ulu' (Sarawak Tourism Board, 2012). One tribe, the Penan is of particular interest to this case study. While the majority of the tribe has settled outside the boundaries of the national park, a small nomadic group lives in the eastern regions of the site. To protect the livelihoods of these people, the national park upon its inauguration gave them the rights to gather plant resources and hunt pig and deer within the subsistence zones of the national park (UNEP-WCMC, 2011a).

Provisioning services: food security, materials and health

The various indigenous tribes of the region have lived within the ecosystems of Gunung Mulu for a long time, with archaeological expeditions finding human remains, and evidence of burial rituals almost identical to those used today dating back 3,000 years (UNEP-WCMC, 2011a). Living alongside the biodiversity of the region for so long has allowed these communities to evolve traditional knowledge allowing them to fully utilise the natural resources for food, medicine, clothing and shelter.

In acknowledgment of this heritage both Penan and Berawan indigenous people who live beside and within the boundaries of the site were given hunting and collecting privileges allowing them to hunt and harvest semi protected species, such as the wild boar, for subsistence consumption (UNEP-WCMC, 2011a). This use of natural resources for helping local communities is important not only for helping them meet requirements in terms of food, but also in terms of respecting the tribe's customs and way of life.

In addition to helping overcome food security issues, the

right to harvest timber and NTFPs from Gunung Mulu National park also contributes to the well-being of local populations by providing them with materials with which build and make the various items they need for day to day to life, traditional medicines, and goods. For example, a study conducted by Naming (Naming *et al*., 2008) found that the Penan communities of the Gunung Mulu region made use of a total of 490 different plants for a wide variety of uses. Of the plants identified by local communities, over half of the plants identified were used for medicinal purposes, with some examples of other uses including poisons, antidotes, insect repellents, ritual usage and food flavouring (Naming *et al*., 2008).

To recognise the different users of the site, the management plan defines various zones within the National Park (UNEP-WCMC, 2011a). Traditional zones have been set aside for use by the indigenous population in these areas where indigenous populations have the right to hunt and gather. High density zones include some of the more easily accessible caves for use in tourism and the buildings necessary for the management of the park. The final zone designated are the wilderness zones which cover approximately 90% (UNESCO, 2014e) of the National Park area, and which are not open to the general public. Strict rules are in place to ensure that high density areas have a minimal impact on the local fauna as possible (Anderson *et al*., 1982; UNEP-WCMC, 2011a).

4.2.7.2. Great Barrier Reef (Australia)

Location and World Heritage designation

The Great Barrier Reef, located along the North Eastern coast of Australia, is the largest coral reef ecosystem in the world and is thought to be around half a million years old. Consisting of more than 2,900 individual coral reefs and nearly 1000 individual islands and covering an area of approximately 34,870,000 ha, it is the single largest structure on Earth to have been created by living organisms. In addition to its reefs, the Great Barrier Reef also includes significant areas of mangroves, and sea grasses.

Inscribed on the World Heritage List in 1981, the Great Barrier Reef is the most biodiverse World Heritage Site in the world. It contains over half of the world's Mangrove diversity, in addition to a great diversity of sponges, anemones, marine worms, crustaceans, fish, corals and birds to name but a few. The waters also provide major feeding grounds for one of the world's largest populations of the threatened dugong. At least 30 species of whales and dolphins occur here, and it is a significant area for humpback whale calving.

The Great Barrier Reef property has a long relationship with humans, with evidence suggesting that Aboriginal occupation of the coast probably dates back to the earliest human occupation of Australia around 40,000 years ago. Today, over 70 coastal clan groups maintain strong cultural relationships with the area and a number of native claims to land within the World Heritage Site are officially recognised.

Provisioning services: Fisheries

The Great Barrier Reef is used by a wide range of people, for a wide range of uses. Focusing on in the provisioning services, carefully managed commercial, recreational, and charter fishing, helps generate a significant income for the coastal populations, with commercial fishing generating Aus $192.5 from 2010-11 (Deloitte Access Economics, 2013), with a further Aus $57.7 million being generated from recreational fishing in the same time period (Deloitte Access Economics, 2013). In compliance with management strategies a range of species including fish, sharks, crabs and prawns are targeted over a wide area to help reduce the pressure on any one area. To ensure that sound management decisions are made extensive monitoring schemes exist, and altogether make the Great Barrier Reef one of the most highly monitored UNESCO World Heritage Sites in the World (UNESCO, 2014d). Commercial fishing within the Great Barrier Reef is controlled through permits, licensing, quotas and strict rules about methods used enforced (Australian Government, 2003). One of the key features of the Management strategy has been to ensure that commercial fishing is spread out over a wide area so to ensure that no single area is subject to high fishing pressure (Great Barrier Reef Marine Park Authority, 2011a). Recreational fishers are also carefully managed and are subject to size and possession limits in addition to seasonal and spawning closures to protect fish numbers.

In addition to commercial and recreational fishing, for the Aboriginal communities that inhabit the Great Barrier Reef, the reef and the coasts of the Heritage Area are part of their living cultural landscape, where the natural features that they have lived alongside for 60,000 years (Great Barrier Reef Marine Park Authority, 2011b) are inextricably interwoven with their spiritual life, economic uses and social organisation, of which fishing contributes significantly to their income. To protect the rights of these people the Great Barrier Reef Marine Park Authority assists them register as Traditional Owners of part of the park which gives them not only the legal right to hunt, fish and gather within the designated site, but also the responsibility to manage it sustainably, with the help of the Reef Rescue Land and Sea Country Indigenous Partnerships Program (Great Barrier Reef Marine Park Authority, 2011c).

4.3 The economic valuation of ecosystem services at natural World Heritage sites

4.3.1 Economic values

Having identified the ecosystem services that a particular World Heritage site delivers, the next step can be to value the benefits they provide to people. As presented in Figure 18 of the conceptual framework, ecosystem services often require some other capital input to become goods or benefits from which people gain an improvement in their well-being. Ecosystem services will only have a potential value, rather than realized value, if there is no population present to benefit from these services. However, when valuing the benefits it is necessary to

tease apart the ecosystem contribution from the other capital inputs, which means having an understanding of the role of the ecosystem service in the process (as well as its magnitude).

Whilst it is possible to report the value that ecosystem services delivered by World Heritage sites have (for both local and global populations) in various quantitative and qualitative ways, it is sometimes useful, or even necessary, to do so in monetary terms. This is because ecosystems are often undervalued in decision-making as their role in providing valuable services is not recognized. Their relative importance can be highlighted using monetary figures. For example, a site manager may wish to raise awareness amongst budget holders in the national government about the key role that biodiversity is playing in attracting international tourists or, what could be even more important, when referring to other ecosystem services, such as for example flood prevention. The field of environmental economics has developed both a framework and a number of tools that can assist with this process. This chapter aims to introduce this framework and the tools, drawing out learning points from existing economic studies of World Heritage sites to inform future analyses.

The concept of total economic value (TEV) is a well-established framework for identifying the various values of natural assets, and divides these between 'use' values and 'non-use' values (**Figure 18**).

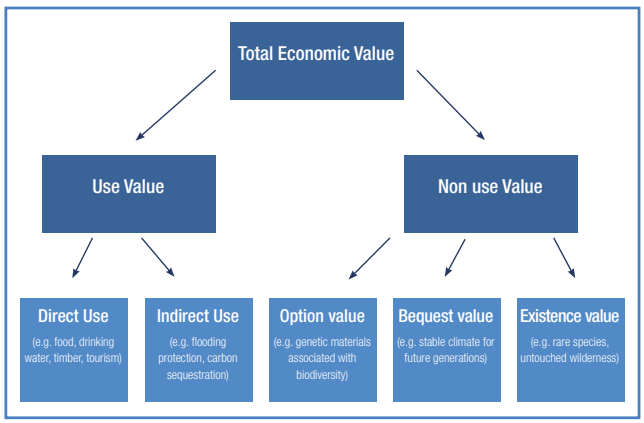


Figure 18. The Total Economic Value framework. *Source:* Munasinghe, 1993

(1) **Direct use values:** These are related to the consumptive (provisioning) and non-consumptive (cultural) benefits that people gain from natural assets.
(2) **Indirect use values:** These generally represent regulating ecosystem services and are non-market benefits, though efforts are increasingly being made to develop mechanisms that monetise their value (e.g. though Payments for Ecosystem Services, such as carbon markets).
(3) **Option values:** These represent potential use or non-use values in the future, when socio-economic, ecological or climatic conditions alter. Option values are sometimes included under use or non-use value headings, or as a distinct category of value.
(4) **Bequest values:** These arise from people knowing that future generations (rather than themselves personally) will be able to enjoy biodiversity.
(5) **Existence values:** These are related to the intangible benefits that people enjoy from the mere existence of nature.

4.3.2 Valuation methods for World Heritage sites

A number of economic methods have been used for valuing different aspects of the environment (e.g. Bateman *et al.* 2011, Pascual & Muradian 2010, Turner *et al.* 2010). The choice of analytical techniques depends on the audience and the scope of the study (i.e. which values need to be captured). The first decision to be made is whether an analysis will record only the tangible money values that appear in the economy (e.g. recorded as income, or investment), or whether it should also include non-market values (which influence overall well-being).

The subsequent choice of method may largely depend on resources/capacity to undertake the analysis and, allied to this, the availability of existing data. There is no one-size-fits-all approach for dealing with valuation questions, but for most of the methods there is a growing body of technical literature for best practice in performing them. Economic valuation methods can be broadly categorized as market-based, revealed preference, stated preference, and benefit-transfer methods (Pascual & Muradian 2010). These methods are discussed below:

Market-based

These methods are based on actual market data (quantities, prices, costs), which is relatively easy to obtain. They can normally only be applied to ecosystem services that have a direct link to market prices, such as tourism. Whilst prices can be used to calculate value, it is only a partial value, i.e. as it appears in the economy, since there will be some people who will value something above the actual price that they are paying for it. Costs of negative impacts can also be used as a way of identifying the value of ecosystem services. This 'cost of inaction' approach includes: damage costs of losing ecosystem services, replacement costs of substituting lost ecosystem services by other means, or mitigation costs of dealing with negative impacts on ecosystem services.

Revealed preference

These methods seek to reveal people's willingness-to-pay for maintaining ecosystem services (at the existing level). As in direct market valuation, they are also based on market data, but they focus on individual choices to understand people's preferences for ecosystem services. The two main methods are: Travel Cost (which calculates the value of ecosystem benefits from the time and travel costs people incur to visit a particular natural area, such as a World Heritage site), and Hedonic Pricing (which derives the implicit price for ecosystem benefits by modelling observable prices or costs using a set of explanatory variables relevant to the benefit).

Stated preference

These methods derive values for ecosystem services by identifying people's preferences in hypothetical market contexts. Their

main strength as opposed to the other approaches is that they can be designed for any ecosystem services context. The three main approaches are: Contingent Valuation (which is based on sample surveys asking people how much they would be willing to pay for an improvement in the environment, or accept as a compensation payment for the loss of ecosystem services), Choice Experiments (which use a sample of people who are asked to rank a number of hypothetical options of costs and ecosystem services), Group Valuation (which are participatory methods that infer social preferences from a group exercise).

Benefit transfer

The above methods all involve a degree of primary research (to different extents). Given the time and cost implications of new research and the growing body of valuation studies, increasing attention is being paid to benefit transfer methods (i.e. using a value estimated for one site at a similar site elsewhere). There are different ways of adjusting the transferred values to the study site specific conditions:

- **unit benefit transfers (simply takes the unit value of ecosystem services (e.g. per hectare or per person) from original studies as a reference value);**
- **adjusted unit transfer (adjusts the unit value by the characteristics of the new location, such as population (e.g. income) or ecosystem characteristics (e.g. tree coverage);**
- **value function transfer (applies parameters from an original study determining the importance of ecosystem characteristics in a value formula); and**
- **meta-analytic function transfer (where multiple studies are used to determine parameters for an aggregated formula).**

It should be noted that based on the growing number of valuation studies, The Economics of Ecosystems and Biodiversity (TEEB) initiative has created a database[7] of values to provide a quick starting point for applying benefit transfer methods (van der Ploeg *et al.* 2011).

4.3.3 Difficulties with monetary valuation

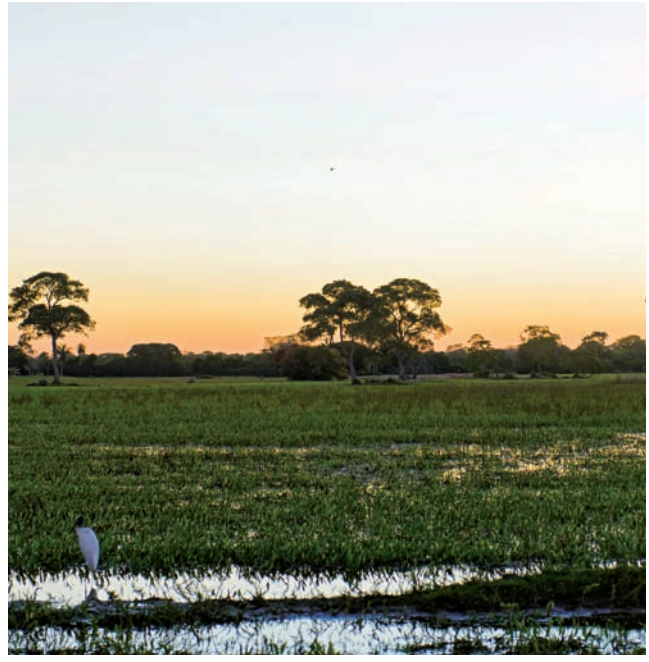
Whilst demonstrating the monetary values of the benefits delivered by World Heritage sites allows them to be considered alongside other financial benefits, there are some concerns about adopting this approach. These range from technical challenges (i.e. to derive sufficiently precise and robust values) to more fundamental ethical objections to putting monetary values on nature and especially World Heritage sites which have been designated for their outstanding value to humankind. The available valuation methods described above all have a number of shortcomings (see e.g. Zhang *et al.* 2005). There are also equity issues around the unequal distribution of income and the impact this has on monetary valuations. Other challenges result from the interconnectedness of different ecosystem services, non-linear spatial and temporal relationships between land management decisions in one place and benefits flows in another place, and tipping points whereby at a certain threshold a small change in land cover results in an abnormal and dramatic change in ecosystem services (Fisher *et al.*, 2008; Kosoy and Corbera, 2010; MA, 2005).

4.3.4 Case studies: economic studies of World Heritage sites

There have been a number of studies of World Heritage sites investigating local economic impacts (usually tourism), or the value of various ecosystem services associated with the site. Table 4 represents a sample of the existing economic studies of World Heritage sites, but it is by no means a comprehensive list. The studies are heavily skewed towards tourism values, which is to be expected since this is often the principal economic activity that takes place on most World Heritage sites as other uses are often non considered compatible with World Heritage status and therefore not permitted. The main economic analysis methods adopted are market price (i.e. visitor expenditure), contingent valuation, or travel cost. Some of the other studies are more qualitative in nature. For many World Heritage sites, there are no economic studies (publicly) available.

In addition to Table 4, six more detailed case studies (from existing studies) have been selected that are broad in terms of location and coverage, and are presented in the following section. They illustrate a variety of methods that have been used to estimate either the value of a wide range or of a limited subset of ecosystem services or benefits[8] delivered by a specific World Heritage site. In compiling these case studies effort has been made to draw out learning points from them to inform future economic analyses in World Heritage sites.

Pantanal Conservation Area (Brazil)



Introduction

Ecosystems and beneficiaries

The Pantanal Conservation Complex consists of a cluster of four protected areas, with a total area of 187,818 ha (UNESCO, 2014), and is located in western central Brazil. The site represents 1.3% of Brazil's Pantanal region, which is

[7] *http://www.fsd.nl/downloadattachment/80763/87522/TEEB%20database%20and%20Final%20report.zip*

[8] *Note that some of the studies have valued ecosystem services and/or benefits, not distinguishing between ecosystem services (both potential and realized) and benefits (i.e. that have required additional capital inputs).*

Table 4. A sample of the existing economic studies of World Heritage sites.

World Heritage site	Type of study	Values reported	References
Dorset Jurassic Coast	Semi-quantitative local economic impact study based on a survey (2008).	Public and private investment; and business attitudes.	Jurassic Coast 2009. An Economic, Social and Cultural Impact Study of the Jurassic Coast: A summary of findings.
Shiretoko	Exploration of ecosystem-based management of fisheries via policy analysis.	Some quantitative (administration) costs and the value of tourism and harvested fish.	Makino, M., Matsuda, H., Sakurai, Y. 2009. Expanding fisheries co-management to ecosystem-based management: A case in the Shiretoko World Natural Heritage area, Japan. Marine Policy 33, pp 207–214.
Serengeti National Park	Tourism studies, reporting figures for revenues from tourism expenditure.	Number of visitors, park fees, and total revenue. How revenues might be maximized.	Eagles, P.F.J., Wade, D. 2006. Tourism in Tanzania: Serengeti National Park. Bois et Forets des Tropiques, 290 (4), pp 73-80. Economics Research Associates 2007. Maximizing the Economy of the Serengeti National Park through Conservation. Project report prepared for Frankfurt Zoological Society, Frankfurt, Germany.
Wet Tropics of Queensland	Two main studies: one uses visitor expenditures from a survey; another uses Input:Output analysis.	Tourism study reports visitor data including local expenditure (economic contribution) and substitution. The Input:Output study reports output, value added, income, and jobs (all direct, indirect, total) associated with tourism expenditure as well as park management expenditure.	Prideaux, B. and Falco-Mammone,F. 2007. Economic Values of Tourism in the Wet Tropics World Heritage Area, Cooperative Research Centre for Tropical Rainforest Ecology and Management, James Cook University, Cairns. Gillespie Economics and BDA Group 2008. Economic Activity of Australia's World Heritage Areas. Report to the Department of the Environment, Water, Heritage and the Arts, Australia.
Djoudj National Bird Park	Reports on a contingent valuation survey of visitors carried out in 2003, and also includes data collected on visitor expenditure.	Estimates average willingness to pay and uses current park fees to generate consumer surplus value. Also reports expenditure by visitors.	Ly, O.K., J.T. Bishop, D. Moran and M. Dansohho. 2006. Estimating the Value of Ecotourism in the Djoudj National Bird Park in Senegal. IUCN, Gland, Switzerland, 34pp.
Belize Barrier Reef Reserve System	Two main studies exist which look at coastal protection, fisheries and tourism values. There is also a survey of local attitudes towards reef ecosystem services.	Reports 2010 values for lobster fisheries, recreation, and coastal protection, as well as 2025 projected values for each of these under three scenarios. The WRI study reports the economic contribution of tourism and fisheries from marine reserves in 2007. Some figures on local support.	Cooper, E., L. Burke and N. Bood. 2008. Coastal Capital: Economic Contribution of Coral Reefs and Mangroves to Belize. Washington DC: World Resources Institute. Clarke, C, S Rosado, A Rosenthal, K Arkema, M Canto, I Gillett, G Verutes, and S Wood. 2012. Coastal Zone Planning in Belize: a case study. Stanford, CA: Natural Capital Project. Diedrich, A. 2007. The impacts of tourism on coral reef conservation awareness and support in coastal communities in Belize. Coral Reefs (2007) 26, pp 985–996.
Great Barrier Reef	One study adopts the travel cost method. Reports for the Marine Park Authority use Input: Output analysis. A review paper examines previous studies.	Study provides consumer surplus values for visitors to the site (year 2000). The Input:Output analysis reports economic contribution figures (based on tourism and fishing). The review paper mentions various ecosystem service values.	Carr, L and Mendelsohn, R. (2003). Valuing coral reefs: A Travel Cost Analysis of the Great Barrier Reef. Ambio Vol. 32 No. 5, August 2003, Royal Swedish Academy of Sciences. Access Economics 2008. The economic contribution of GBRMP - Report 2006-2007. Access Economics PTY Ltd. For Great Barrier Reef Marine Park Authority, Australia. Natalie Stoeckl, Christina C. Hicks, Morena Mills, Katharina Fabricius, Michelle Esparon, Frederieke Kroon, Kamaljit Kaur, and Robert Costanza. 2011. The economic value of ecosystem services in the Great Barrier Reef: our state of knowledge in "Ecological Economics Reviews." Robert Costanza, Karin Limburg & Ida Kubiszewski, Eds. Ann. N.Y. Acad.Sci. 1219, pp 113–133.

World Heritage site	Type of study	Values reported	References
Península Valdés	Uses existing data to calculate tourism expenditure.	Reports direct, indirect and total tourist expenditure, as well as other information on local economic contributions.	Hoyt, E. and Iñíguez, M. 2008. The State of Whale Watching in Latin America. WDCS, Chippenham, UK; IFAW, Yarmouth Port, USA; and Global Ocean, London, 60pp.
Kakadu Natural Park	Conducts a contingent valuation survey of sample population.	Using willingness to pay figures it produces a national estimate of the value for preserving the Kakadu Conservation Zone.	Carson, R. T., Wilks, L., Imber, D. 1994. Valuing the Preservation of Australia's Kakadu Conservation Zone. Oxford Economic Papers, New Series, Vol. 46, Special Issue on Environmental Economics. (Oct., 1994), pp. 727-749.
Galapagos Islands	Studies have collated information on tourist expenditure. Another uses a model of the local economy.	Figures for tourist expenditure. Estimation of the value of tourism to the island's economy and how this has changed over time.	Edwards, S.F. 1991. The demand for Galapagos vacations: estimation and application to wilderness preservation. Coastal Management 19, pp 155-199. Taylor J. E., Hardner, J., Stewart, M. 2006. Ecotourism and Economic Growth in the Galapagos: An Island Economy-wide Analysis. Working Paper No. 06-001, August 2006. Department of Agricultural and Resource Economics University of California, Davis.
Western Ghats	One is a simple tourism study of the region. There is also a PhD thesis with a contingent valuation survey of urban residents.	Tourism-related figures. Aggregate willingness to pay for protection of biodiversity within a tiger reserve in the WH site.	Equations 2011. Tourism in Forest Areas of Western Ghats. Equations, Bangalore. Jyothis, S. 2002. Economics of biodiversity conservation: a case study of Western Ghats region, Kerala. PhD. Thesis, University of Mysore.
Komodo National Park	Conducts a contingent valuation survey of visitors to examine the effect of hypothetical rises in entrance fee on visitation and revenue generation.	Reports willingness to pay value and compares this with the management costs. Also examines the impact of a fee increase on the local economy.	Walpole, M.J., H.J. Goodwin and K.G.R. Ward 2001. Pricing policy for tourism in protected areas: lessons from Komodo National Park, Indonesia. Conservation Biology 15(1), pp 218-227.
Jiuzhaigou Valley	Conducts a contingent valuation survey of tourists.	Produces an estimate of site visitors' individual average and aggregate willingness to pay to access the site.	Xuewang, D., Jie, Z., Ruizhi, Z., Shi'en, Z., Min, L. 2011. Measuring recreational value of world heritage sites based on contingent valuation method: A case study of Jiuzhaigou. Chinese Geographical Science, vol. 21, no. 1, pp 119-128.
Yakushima	General reporting of the implementation of user fees to the site.	User fees and organizational approach.	Hiwasaki, L. 2004. Using Visitor Fees to Maintain Forests for Nature Tourism Activities in Yakushima Island, Kirishima-Yaku National Park. Research on Innovative and Strategic Policy Options: Good Practices Inventory. Asia-Pacific Environmental Innovation Strategies.
Kilimanjaro National Park	Report on tourism income and flows to local populations.	Share of tourism expenditure which is pro-poor, and how benefits could be further improved to local people.	Mitchell, J., Keane, J., Laidlaw, J. 2009. Making success work for the poor: Package tourism in Northern Tanzania, Final report. Overseas Development Institute.

one of the world's largest freshwater wetland ecosystems. Two major rivers flow from these headwaters. There is a high species abundance and diversity, including plants and birds, the latter attracting many tourists. Beneficiaries of the ecosystem therefore include these tourists (two-thirds of whom are from outside Brazil (Araújo & Bicalho, 2009)), as well as local cattle farmers and fishermen.

The local economy

The Pantanal is remote from the main centres of economic activity in Brazil; the nearest airport is located in the city of Cuiabá (around 100km away), which is the gateway to the region. Development in the Pantanal has been hindered by the cyclical hydrological regime: the Pantanal is an immense alluvial plain which becomes extensively flooded during the rainy season, temporarily storing a large volume of water (Swarts, 2000). Whilst cattle grazing is conducted in the Pantanal, it is sparsely populated, and in recent years many ranches have switched to tourist lodges due to the declining profitability of ranching and the growing tourism sector (Araújo & Bicalho, 2009). Sustainable economic activities based on use of the ecosystem have been identified (Dolabella, 2000) as:

- **cattle ranching**, which has been conducted largely in natural pastures for 200 years with minimal negative impact on the environment, and the Brazilian Association of Organic Producers now has a number of members in the area raising organic cattle;
- **tourism**, mainly nature-based or eco-tourism, is another important (over 250,000 tourists a year in the southern Pantanal (Araújo & Bicalho, 2009)), and growing, economic activity, though ideally further growth would be aligned with a strategic plan to minimize negative impacts;
- **sustainable fishing**, though this requires not focussing on a limited number of species.

Type of economic analysis undertaken

The main economic analysis relating to the Pantanal was published in 2000 (Seidl & Moraes, 2000) and is based on the values contained in Costanza *et al.*'s much-cited Nature paper (Costanza *et al*, 1997). The study focuses on Nhecolândia, which is the second largest of the eleven Pantanal sub-regions, comprising some 19.5% of the region (Silva *et al.*, 1998), though with a very small population (less than 2,000 inhabitants). The different biomes in the area were identified using satellite data and field plots were used to typify the general biophysical features of the categories. These were then assigned to one of four broad biome categories identified by Costanza *et al* (1997). The values of ecosystem services (simply transferring the per hectare/year values from the Costanza *et al.* study) were then weighted to appropriately reflect the amount of time and area spent providing services of a particular biome. For example, low-lying, flat grazing-lands were considered grasslands for two-thirds of the year and wetlands for one-third of the year. Note that these proportions, whilst considered typical for Nhecolândia, may not necessarily apply to other Pantanal sub-regions.

Main findings from the study

Table 5 shows the estimated annual value of a wide range of provisioning, regulating and cultural ecosystem services and benefits in Pantanal da Nhecolândia. The first column of values list those reported in the original study, the second are up-rated (by Consumer Prices Index inflation measure).

Ecosystem service categories	US$ (1994) per hectare per year	US$ (2013) per hectare per year
Water supply	1,977.11	3,108.41
Disturbance regulation	1,747.19	2,746.93
Waste treatment	505.05	794.04
Cultural	425.13	668.39
Water regulation	378.81	595.56
Nutrient cycling	185.06	290.95
Recreation/tourism	157.37	247.42
Habitat/refugia	105.88	166.46
Raw materials	75.05	117.99
Gas regulation	67.35	105.89
Erosion control	63.41	99.69
Food production	53.4	83.96
Climate regulation	44.76	70.37
Soil formation	22.37	35.17
Pollination	12.27	19.29
Biological control	11.29	17.75
Genetic resources	8.23	12.94
Total annual regional value	**5,839.72**	**9,181.21**

Table 5. Annual (per ha) values for ecosystem services and benefits in the Pantanal. Source: Seidl & Moraes, 2000

Together, water supply and disturbance regulation (flood control) contribute close to two-thirds of the total calculated value. This makes sense due to the hydrological importance of this site. Some values were not included in the above (e.g. non-use and educational). However, evidence suggests that these are also significant. For example, multilateral donors provide grants for conservation activity and a former ranch of almost 8,000 ha of protected area was purchased for scientific research.

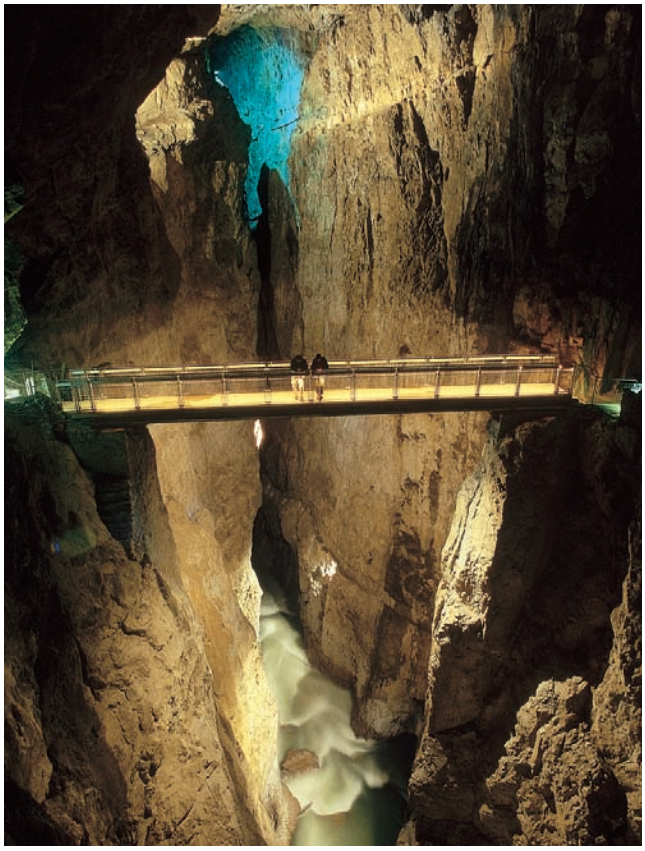
Cross-checking results with other studies of the area can be useful. For example, Shrestha *et al*, (2002) examined the recreational fishing value of the Pantanal using the travel cost method (see Section 4.3.2). It estimated that total social welfare ranged from US$35 million to US$56 million (1994 values). Recreational fishing was estimated to account for 80% of recreation at that time (Araújo & Bicalho, 2009). So, adjusting for this, results in an upper recreation value estimate of US$67 million (1994) for the whole of the Pantanal, which compares with around US$157 million in the above study (Table 5) just for Nhecolândia.

General conclusions from the case study

The approach (benefits transfer) is relatively simple but relies on the accuracy of the values being transferred to the new site. Some of the underlying studies used by Costanza *et al* (1997)

were relatively deficient. However, valuation databases of values for benefit transfer now exist containing a larger number of more recent studies and these could be utilised to derive more accurate valuations for a site (they could be further improved following the approaches outlined in the methodology section 4.3.2). However, this approach offers an option as a first approximation of (a somewhat hypothetical) total value for awareness-raising purposes. Applying the average total regional value per hectare from this study to the area of the Pantanal Conservation Area gives a 2013 total ecosystem service value of US$1,700 million per year. To put this figure into local context, it is greater than the value of Brazil's exports of fish (FAO, 2010) and fresh fruit (IBRAF, 2011) combined, whilst the entire Brazilian Ministry of Environment annual budget for the years 2010-2012 was US$ 1,718 million (INESC, 2014).

Škocjan Caves (Slovenia)



Introduction

Ecosystems and beneficiaries

The Škocjan Caves are located in the Kraski Landscape Park, Slovenia, and the World Heritage site extends over 413 ha (UNESCO, 2014). It includes four deep and picturesque chasms as well as the Mahorcic cave, which has several underground lakes and cascades. Habitats corresponding to the floras of Central Europe, the Mediterranean, Sub-Mediterranean, Ilyrian and Alpine, are all present, side by side, in the area. Large numbers of five species of wintering bat roost in the caves. Archaeological finds indicate that the site has been occupied for more than 10,000 years. The grotto system has been considered important since the first scientific studies were carried out in the 19th century (and is Europe's largest underground canyon). Whilst the total population in the area is only 400 people (present in three villages), around 100,000 people visit the Škocjan Caves each year. Local people are involved in the management of the World Heritage property.

The local economy

Despite having a very low local population, the park is very accessible. The caves are just 2km from the Ljubljana-Koper expressway, only 15km from Italy, and accessible by train (Slovenian Tourist Board, 2014). The park is considered the main tourism attraction in the area and provides opportunities for sustainable development. As such it attracts external investment for tourism infrastructure development, for example €1.4 million provided by the EU in 2013 (MEDT, 2013). Tourism-related income and employment includes working as a tour guide, local restaurants, the Škocjan Caves Information Centre, as well as provision of tourist accommodation (i.e. apartments as well as Bed & Breakfast in private dwellings) (Slovenian Tourist Board, 2014). According to the national authorities, fifteen years of the protected area has significantly contributed to local development (UNESCO, 2014, 2). Over the last decade visitor numbers have doubled and there are concerns that tourist carrying capacity could be exceeded on some days in the summer, especially during August (Jurinčič & Balažič, 2010). Therefore, measures to spread visitor numbers over less busy times of the year, or other areas within the park, will continue to be required (Jurinčič & Balažič, 2010).

Type of economic analysis undertaken

The study (Actum, 2011) of the Škocjan Caves Regional Park was carried out in 2011 and attempts to produce a monetary valuation estimate for the ecosystem services delivered by the park. As some ecosystem services originating in the park are delivered outside of the protected area, a buffer zone of activity was also included in the analysis. A workshop of experts and stakeholders was convened to identify the main ecosystem services being delivered at the site. Data on local salaries as well as visitor numbers was collated from existing studies. An additional survey of summer visitors (n=512) was implemented, in order to help determine future potential values if tourism was expanded by opening additional caves to visitors and marketing local products. Other data on economic activities was collected through interviews with local residents and other stakeholders. In order to establish the economic value of all of the ecosystem services provided by the park, a variety of economic techniques were used (mainly market prices, but also avoided damage cost, travel cost method, and a descriptive approach). Values for eight ecosystem services related to natural habitats were estimated (see **Table 6**).

Main findings from the study

Table 6 highlights the value of the main ecosystem services and benefits (in original 2011 € values as well as 2013 US$ values) delivered by the site.

The total value of ecosystem service provided by the Škocjan Caves Regional Park in 2011 is estimated at €12.85 million, of which tourism accounts for almost 90%. With a discount

rate of 5 %, the net present value over 30 years is estimated at around €216 million. Some estimates in the study could only be made descriptively, and others could not be calculated for various reasons (so the full benefits received by society are likely to be higher than the above figure). The study also estimated that if the tourism potential was further exploited then the 2011 value was estimated at €14.77 million, and net present value estimated at just over €253 million. This increase in value is largely derived from guided tours to additional caves as well as a new Tourist Information Centre. The importance of this tourism income can be clearly understood when considering that the average *per capita* income of rural households in Slovenia has been estimated at less than €4,000 a year (Möllers *et al*, 2008).

Ecosystem service categories	€ (2011) total current use value	US$ (2013) total current use
Recreation/tourism	10,993,764	15,498,081
Water supply	427,076	602,056
Cultural (education only)	100,540	141,733
Fibre/fuel	48,559	68,454
Food production	13,586	19,152
Climate regulation	4,720	6,654
Ornamental	2,610	3,679
Air quality	538	758

Table 6. Total value of ecosystem services and benefits from the Škocjan Caves. *Source:* Actum, 2011

General conclusions from the case study

The first point to note is the difficulty of using values for a wider area to indicate a value for a smaller protected area located within it (ideally a bespoke study is required). The approach used (mostly) existing data to derive current use values for ecosystem services based on market prices. The advantage of this is that existing data can be used without the need for new surveys, but this can only be an option in areas where data collection is relatively well developed. Whilst the full range of ecosystem services were explored in the study it was noted that for many ecosystem services it was not possible to estimate an accurate monetary value. Market prices also underestimate the total value to society. Thus the figures reported should be taken as a lower bound estimate. Nevertheless, even where market prices are of little use, awareness of the full value of the site can be increased, as evidenced by the approach the study adopted. This was done by engaging with stakeholders to identify ecosystem services and then attempting to quantify in a non-monetary way, or at least describe, the ecosystem services being delivered by the site. Such an approach – using market prices where available and a description where they are not – is attractive for site managers from a budgetary point of view since it avoids commissioning costly non-market valuation studies. 'Real' money figures also sometimes gain more traction with decision-makers than hypothetical economic valuation estimates. The risk, though, is that the figures subsequently used to demonstrate the value of ecosystem services are significant underestimates of true worth to society.

Doñana National Park (Spain)

Introduction

Ecosystems and beneficiaries

The Doñana National Park occupies the bank of the Guadalquivir River at its estuary with the Atlantic, and so major habitats consist of lagoons, marsh, dune fields, and woodland (UNESCO, 2014). The World Heritage site covers 54,252 ha. The site supports important populations of threatened species and is the most important wintering site for waterfowl in Spain (UNESCO, 2014). Whilst there has been a history of ecosystem conversion (drainage of over half the marshes for agriculture and destruction of over half the cork tree forests), use has also been made of the natural ecosystems, including for grazing cattle, fishing, hunting, harvesting of wetland vegetation and tourism (UNESCO, 2014). However, some of this activity is not sustainable and current issues include poaching, over-grazing and illegal exploitation of crayfish.

The local economy

Until 1930 the population of the area was small, and the wetland ecosystems were largely intact, supporting a small-scale subsistence economy (EEA, 2010). Over the following 50-60 years agriculture expanded in the area as a result of drainage and irrigation schemes, forest plantations were established to supply the production of wood and pulp, and urban development for coastal tourism occurred on the edge of the park (EEA, 2010). This has been offset by investment in the area, such as marsh restoration and habitat management schemes. In addition, the Doñana National Park and the Environment Department of the Andalusian Government have invested resources in efforts to control invasive species (€3.7 million over the last 20 years (EEA, 2010)). Funds have also been spent on research (e.g. the Spanish Geology and Mines Institute has invested €1.9 million over the last several years on research of the aquifer (EEA, 2010)).

Type of economic analysis undertaken

The approach adopted for the economic analysis of Doñana (EEA, 2010) involved the collation of existing studies. Depending on the ecosystem service concerned, the studies had used either market price or contingent valuation methods. The sources used included the Agriculture and Fisheries Statistics Yearbook of Andalusia, Annual Reports of Activities of Doñana National Park, as well as a small number of research papers.

Main findings from the study

The total value of the ecosystem services delivered by the site was estimated to be €570 million a year (for 2006), which equates to US$ 7,845 per ha a year (in 2013 values). To put this value of the site (€570 million) into local context, it is equivalent to one-third of the annual budget for the Spanish Ministry for Agriculture, Food and Environment, covering the whole country (SEPG, 2013). The most valuable marketed ecosystem services are food (agriculture followed by fisheries). As for the non-marketed ecosystem services, landscape beauty is valued more highly than the regulating services. Table 7 reports the original values as well as the 2013 US$ values for the main ecosystem services the study explored.

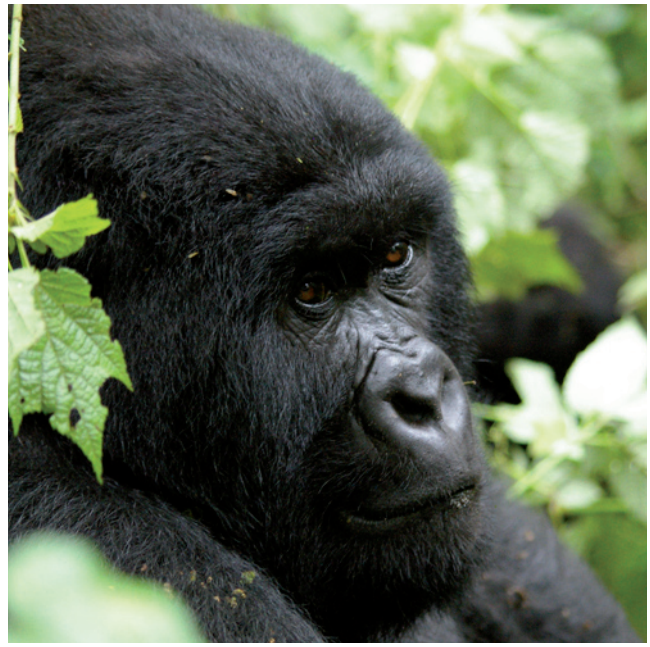
Ecosystem service categories	Total annual value (2006 € million)	Total annual value US$ (2013)
Food production -crops	240	363
Food production - cattle	69	104
Food production - crayfish	3	5
Food production - marine fisheries	11	17
Food production - estuary fisheries	13	20
Other provisioning	2	3
Cultural (aesthetic only)	86	130
Recreation/tourism	64	97
Regulating services	26	39

Table 7. Annual value of ecosystem services and benefits from the Doñana National Park. *Source:* EEA, 2010

General conclusions from the case study

The approach adopted here involves a review of existing literature to derive values for both marketed and non-marketed ecosystem services. As such it relies on the existence of reports and studies that have examined ecosystem services for that area. The approach is relatively simple and low-cost, but it is unlikely that relevant studies exist for most World Heritage sites. It also means that there will be unfilled gaps in the literature, where some ecosystem services are left unvalued. Further, such studies do not provide useful information on where ecosystem services are mutually incompatible, or how management might change to minimize trade-offs between ecosystem service provision. Nevertheless the current value of the existing use of ecosystem services at a site is still useful for raising awareness to decision makers of the importance of a site.

Virunga National Park (Democratic Republic of the Congo)



Introduction

Ecosystems and beneficiaries

The Virunga National Park lies in the north-east of the Democratic Republic of the Congo (DRC), on the border with Uganda and Rwanda. It covers an area of 790,000 ha and includes a wide range of habitats from savannahs and swamps to lava plains, tropical rainforest and snowfields (UNESCO, 2014). The wide diversity of habitats produces exceptional biodiversity. Some of the largest wild animal concentrations in Africa occur along the rivers of the park (UNESCO, 2014), but it is most famous for its mountain gorilla population.

The local economy

The area has seen over two decades of armed conflict, which (in addition to the loss of countless lives) has caused the collapse of public infrastructure and the economy, so that it is now one of the poorest areas on the planet (AfDB/OECD, 2008). Tourism disappears each time there is a break-down in stability due to a return of violence to the area. Plans were recently announced for oil and gas exploration in the park, which although it might bring some employment opportunities, could have an overall detrimental impact on the local population (WWF/Dalberg, 2013).

Type of economic analysis undertaken

The study for WWF (WWF/Dalberg, 2013) identified all ecosystem services to be included in each value category and a valuation technique for each factor (**Table 8**).

This is largely a desk-based approach, with very limited collation of data in the field. The study notes the limited time (12 weeks) available for the review of key documents and interviews with stakeholders. Data availability limited the ability to include an economic value for all factors (e.g. use of Non-Timber Forest Products and absorption of pollution by

the lake were not included). In addition to estimating current values the study also attempts to estimate the potential values if current challenges (such as security) are addressed.

Ecosystem Service	Technique
Fishery	Market price
Tourism	Travel Cost & Market price
Hydro-electric	Market price
Pharmacological use	Estimated royalties
Education	Grant values
Carbon	Market price (REDD+ value)
Water supply	Replacement cost
Erosion control	Restoration cost of forest

Table 8. List of ecosystem services and their value technique in the WWF study. *Source:* WWF/Dalberg, 2013

Main findings from the study

The current total value of the ecosystem services and benefits provided by the park (or at least of those where values were able to be calculated) is estimated to be almost US$ 49 million a year (see Table 9). This is more than the foreign aid that DRC receives each year from the UK, Norway, Sweden and Switzerland combined (USAID, 2014). The majority of this value is associated with food production (fisheries). These are all use values and there is potential to increase these almost ten-fold, mainly through development of tourism. The assumptions behind this implicitly suppose significant long-term investment in tourism infrastructure. It is also argued that non-use values (i.e. the value that people in other countries place on knowing that the mountain gorillas still exist) could increase (though they would not be realised in the DRC economy). The values are calculated based on a previous study (Hatfield & Malleret-King, 2007).

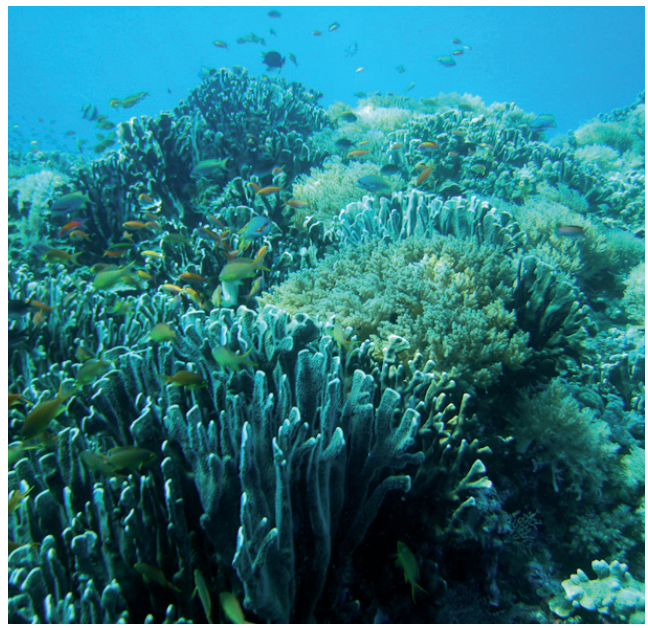
	Factors	Current value (US $million/year)	Potential value (US $million/year)
Direct use value	Fisheries	30	90
	Tourism	0	235
	Hydro-electirc power	5	10
	Other values (incl. pharmacological use, education & research)	5	10
Indirect value	Carbon sequestration and forest conservation	0	55
	Water supply	1	1
	Erosion control	6.9	7.8
Non-use value	Future use of park's resources	0	700
Total value		48.9	1,111.8

Table 9. Current and potential value of ecosystem services and benefits in Virunga National Park. *Source:* WWF/Dalberg, 2013

General conclusions from the case study

The approach uses a number of different techniques to value a range of ecosystem services. This involves undertaking some limited data collection to enable the calculations to be performed. Such data collection can be time-consuming depending on the local circumstances. The study could be further improved by undertaking an additional study of household use of Non-Timber Forest Products as these can be important for local livelihoods (though this would involve significant extra field work). In addition, where potential values under future scenarios are estimated, sensitivity analysis should be carried out to test the significance of key assumptions on the outcome (e.g. visitor numbers, carbon prices, fish-stock recovery rates).

Tubbataha Reefs Natural Park (Philippines)



Introduction

Ecosystems and beneficiaries

Tubbataha Reef Marine Park covers just over 130,000 ha, and is a unique example of an atoll reef with extensive lagoons and two coral islands (UNESCO, 2014). It is the only national marine park in the Philippines and is located in the bio-geographic centre of marine diversity in the world (with 441 fish species, 379 corals, 8 cetacean species as well as some globally threatened species of seabirds (UNESCO, 2014)). The site is located in a remote area without human habitation, but is a popular tourist destination (especially for diving) with visitors accessing the site on boats. In order to ensure the values of the property are maintained, tourism requires careful planning and management.

The local economy

With regard to fishing, Tubbataha is a no-take area, and the only activities allowed are tourism and research. There is some evidence that this has benefitted fish-stocks in adjacent fishing grounds (TEEBcase, 2011). The World Heritage site listing has helped the reef became a famous tourist destination and a number of boat operators directly benefit from this. For example: «*The inclusion of Tubbataha Reefs as a World Heritage Site is a very positive aspect in marketing to tourists, especially foreign, mainly European and American, divers. It gives the reefs a more important status compared to other areas, it is now a must-see destination.*» - Alex Floro, Dive Boat Operator working in Tubbataha (UNESCO, 2014). The park has capitalized on this through the collection of entry fees from the turn of the century, some of which is shared with local

communities (Subade, 2010). In order to determine the user fee a willingness-to-pay survey was conducted among divers and dive operators, which showed that the average diver was willing to pay US$ 41 per visit (Tongson and Dygico, 2004). In 2006 fee collections covered about 80% of the core park management costs (TEEBcase, 2011). External funding has also been forthcoming, with circa US$ 1 million (2013) being granted for conservation activities at the site between 2000-2003 (Subade, 2010).

Type of economic analysis undertaken

The Subade (2005) study assesses the willingness of people in the Philippines to pay towards the conservation of Tubbataha Reefs. In order to do this the contingent valuation method was used to find out how much residents in three nearby cities (Quezon City, Cebu City and Puerto Princesa) would contribute to a conservation trust fund for the park. The study followed the recommended procedures for undertaking a contingent valuation study: a) designing and pre-testing of the survey questionnaire (focus group discussions were conducted to determine what would be an acceptable payment mechanism), b) carrying out the main survey, c) estimating the willingness-to-pay, d) bid curve analysis (i.e. testing the estimation model), e) data aggregation, and f) final assessment. In such surveys it is important that respondents are made aware that payments are not hypothetical and may be collected at a future point by government agencies or other institutions (which was the case in this study). Two variants of data collection – personal interviews and self-administered surveys – were employed, and the dichotomous choice method of contingent valuation adopted (which involves presenting respondents with a value and asking them whether they would be willing to pay it or not). The total number of completed forms was 2,591.

Main findings from the study

The response rate for the self-administered questionnaires was fairly high at 79%, and 97% for the personal interview surveys. The study finds that 41% of all respondents would be willing to pay money to support conservation in the reserve. The main motives for a positive willingness to pay were: bequest value/motive (concern for future generations), existence value/motive (knowing that the Tubbataha Reefs were being well-protected), and altruistic value/motive. These are non-use values. However, a small number of respondents (between 9-14%) cited direct use values as their motivation for their "yes" to the willingness to pay question. The main reasons for non-willingness to pay found in this study were similar to other studies, namely limited income available, mistrust of the institutions managing the conservation funds, and the belief that conservation of the reef would take place anyway (without the respondent's contribution). The average willingness to pay values using the personal interviews were higher than the self-administered surveys (twice the value on average). For the household population of the three cities the aggregate willingness to pay per year (in 2002) is PHP 141-269 million (US$ 3.2-6.1 million in 2013), which is over ten times the core costs of running the park and more than required for an expanded conservation programme at the site (Subade, 2005).

General conclusions from the case study

The Subade (2005) study provides empirical evidence on non-use values for a World Heritage site in the developing country context. This is important since there is a mistaken impression that large non-use values are likely to be associated only with developed countries. If economic valuation is to be used for more than awareness-raising, then there is a two-part process: first, measure the economic value of natural assets to an identified population, and second, find ways to appropriate the value for use in securing those natural assets. Options for capturing values (i.e. collecting money) include taxes and voluntary donations. Studies such as this for the Tubbataha Reefs can be used to make the case with a national government for the introduction of a tax, or allocation from existing tax revenues. Since World Heritage sites are global goods the non-use values will extend beyond individual countries where the World Heritage site is located. This is sometimes demonstrated by international grants. A national source of funding is generally more secure than the use of tourism fees since external events can reduce visitor numbers. A final point to note from this study is that the estimated average willingness to pay significantly differed across the sample sites in the Philippines, thereby lending caution against benefit transfers of estimates from one place to another (at least without making careful adjustments). Although the city closest to the reefs (Puerto Princesa) had the highest willingness to pay, the second closest (Cebu) had the lowest (almost half the value of Puerto Princesa), and the furthest city (Quezon) was only around 15% lower than Puerto Princesa. If attempting to demonstrate the level of financial support a national population is willing to see government commit to funding World Heritage sites, then the benefit transfer approach is unlikely to be adequate. A large-scale contingent valuation survey, such as the one conducted in the Philippines, is to be preferred, ideally covering a weighted representative sample of the national population.

Lagoons of New Caledonia (France)

Nicolas Pascal

Introduction

Ecosystems and beneficiaries
The World Heritage site "Lagoons of New Caledonia: Reef Diversity and Associated Ecosystems" is located in the French Pacific Ocean archipelago of New Caledonia and consists of six marine clusters covering the total area of 1,574,300 ha. The site displays intact ecosystems, with healthy populations of top predators, and a large number and diversity of large fish (UNESCO, 2014k).

Local economy
Nearly 235 000 people have used or depended on one or more of the ecosystem services incorporated in the WHS, including:

- Fishermen of the commercial artisanal fishery (350 professionals)
- Local families for whom fishing in the coastal zones is a source of regular protein (2500 households) and non-regular revenues
- Blue tourism entrepreneurs (120 businesses, 400 jobs for 180 000 visitors a year) whose businesses depend directly on the underwater landscape quality
- Other related tourism businesses (1000 businesses and 1200 jobs) receiving the "blue" tourists.
- Real estate owners protected from coastal flooding (8800 households)

Type of economic analysis undertaken

The study by Pascal (2010) estimates the economic value of different ecosystem services (commercial, recreational and subsistence fishing; nature-based tourism; protection from flooding and research and education) by using different valuation methods, such as producer surplus assessment, avoided damages and travel cost method. In addition to existing data, survey with users and interviews with experts were undertaken to collect additional data.

Main findings from the study

Coral reefs and associated ecosystems (mangroves and seagrass beds) absorb the wave energy and prevent or minimise damages due to flooding during cyclones. It has been estimated that around 8 800 households benefit from this protection service in the WHS sites. The total value of damage that is avoided by the presence of ecosystems is in the order of € 32M. When applying the frequency of cyclones, this corresponds to an annual value of € 7M. This figure means that every year, coral reefs and associated ecosystems prevent coastal flooding which generates damage to residential buildings, hotel infrastructure and equipment to the order of € 7M. The ecosystem service of protection against coastal flooding represents approximately 12% of total services provided by the ecosystems incorporated in the WHS sites.

Fisheries linked to coastal ecosystems generate annually an added value of € 15.5M for the local economy, of which an estimated €5 million are from self-consumption, € 7.5M from the commercial fishery and €3M from the recreational fishery. The importance of the non-commercial fishing relative to commercial fishing (declared and undeclared) reflects the socio-cultural context of the fishing activities (both recreational and subsistence).

The added value of this ecosystem service represents approximately 27% of the total of the services produced by the ecosystems of the WHS. Around 350 fishermen derive income from this activity and more than 2500 households extract additional income and important proteins for their well-being. In volume, coastal catches represent more than two thirds of the annual consumption of fresh fish of the households of New Caledonia.

The service of underwater scenic beauty for «blue» tourism represents an added value of €8.4M for the local economy (15% of the total of the services produced by the ecosystems of the WHS). Each year, approximately 180 000 visitors (both tourists and residents) make use of coral reefs under various forms of recreation (diving, snorkelling, charters, day-tours, etc.). These activities, which are dependent on the health of the marine ecosystems incorporated in the WHS, have generated benefits for more than 120 companies and produced almost 400 jobs. The nautical sector (boats brokering, marina, maintenance, etc.) represents nearly 30% of the value of this service.

This ecosystem service reflects an important use of the lagoon by the residents and tourists. These users contribute to the financial health of the 120 hotels, 100 guesthouses and other 800 tourism companies. It is estimated that more than 1400 jobs are related to these uses.

This value is growing and has good potential if the positioning of the site and coral reefs of New Caledonia becomes consolidated in the competitive market of underwater tourism. As highlighted in the co-management plans of the WHS, there needs to be a sustainable development of tourism in terms of impacts on the environment. Among other things, the treatment of wastewater from hotels, control of sediment inputs, and carrying capacity regulation must be taken into account.

General conclusions from the study

The study presents a comprehensive valuation of the different ecosystem services provided by the site. The main services in economic terms are the biomass production from the commercial, subsistence and recreational fishery (€15.5 M/year) as well as the service of underwater scenic beauty for the 'blue' tourism (€8.4 M/year), followed by the protection against coastal flooding (€7 M/year). However, the study also mentions that many aspects of these services, particularly subsistence fishing cannot be reflected through the monetary approach:

- **It is an activity that is difficult to substitute, due to a low level of initial investment and minimal required training.**
- **It is a source of food and income for the women living in the tribes. The degree of dependence on the resource depends on the household and its proximity to urban**

centres. This aspect contributes to the continued presence of women in the villages, which has been recognized as a factor of social cohesion.

- **Fishing is a stable source of food and a protection against uncertainties of the future or other sectors (e.g. tourism).**

4.3.5 Overall conclusions and recommendations from monetary valuation case studies

Collectively, the case studies presented in this chapter offer a number of key lessons when considering conducting an economic valuation study in the context of a World Heritage site:

- There are a very limited number of studies that have attempted to estimate ecosystem services values of World Heritage sites beyond tourism. To a certain extent this is understandable since tourism is likely to generate the most economic activity taking place on most sites, and the values are visible in terms of tangible monetary flows in the local and international economy. However, there are more important values associated with the myriad of other ecosystem services that many World Heritage sites undoubtedly deliver. There is, therefore, an important task to address this, which interested parties may wish to take on. The case studies reviewed here present a number of possible ways forward with this work. In addition, there are a number of other economic approaches which have been used for valuing ecosystem services at particular locations, but not World Heritage sites, and the usefulness of these could be further explored.
- The benefits transfer approach has been used for some World Heritage sites and is straight forward and relatively quick to implement, but it relies on the accuracy of the values being transferred to the new site. Valuation databases of ecosystem service values for benefit transfer can be utilised to derive values for a World Heritage site. With additional effort they could be further improved by making relevant adjustments. The approach offers an option as a first approximation of total value. This can be useful for awareness-raising purposes.
- Reporting current direct use values for ecosystem services in World Heritage sites based on market prices has the advantage that existing data can be used without the need for new surveys. However, this is only an option in areas where data collection is relatively well developed (otherwise data collection will need to be commissioned to enable the calculations to be performed, which can be time-consuming depending on the local circumstances). When using market price derived values, they should be taken as a lower-bound estimate. 'Real' money figures also sometimes gain more traction with decision-makers than hypothetical economic valuation estimates. The risk, though, is that the figures, if subsequently used to demonstrate a site's value on their own, are significant underestimates of true worth to society.
- As a general conclusion for the order in which World Heritage sites might undertake economic analyses the following could be useful:
  - **Firstly, World Heritage sites could adopt an approach of using market prices for tourism and other tangible use values (using already available data)**
  - **Then reviewing the literature for existing studies (up-rated to current values) where these have been conducted for other benefits**
  - **For remaining valuation gaps adopt benefit transfer**
  - **But, if a case is to be made for additional funding then a contingent valuation study (or similar) is the preferred option.**
- Often policy-makers are interested in the resulting change in value as a result of a change in activity (such as a proposed tourist accommodation development) rather than the current total value, as this can inform an investment appraisal or cost-benefit analysis. Such an analysis explores the proposed change scenario against the base-case, taking into account all of the associated additional costs and benefits to determine whether there is a net benefit associated with the change. Future values are brought back to a single present value (the net present value) by discounting future values at an appropriate rate (e.g. the interest rate).Whilst cost-benefit analysis attempts to monetize all of the relevant values, investment appraisal focuses on just the realizable financial sums. Therefore, investment appraisal may be of use to site managers when evaluating alternative options for expenditure on a number of different tourism-related infrastructure projects at their site, if they are unlikely to have wider impacts on the ecological functioning at the site.
- It may also be the case that a useful analysis could be conducted in terms of costs that are avoided by managing the site as a World Heritage area, and how additional benefits could be gained (or more costs avoided) where such sites are managed effectively and not put in danger. When assessing a *dynamic* rather than *static* state (i.e. future scenarios as opposed to the current situation), the aim may be to minimize trade-offs between overall ecosystem service provision, or at least minimize the reduction in core services important for the integrity of the World Heritage site. In such cases, a sound understanding of the ecological processes and the linkages to benefits is required before even attempting monetisation. The underlying assumptions should be clearly stated and their relevance for the findings should be tested using sensitivity analysis.

4.3.6 Caveats for the use of economics

Whilst monetary valuation can be useful for raising awareness of important values to those decision makers who may be unaware of the economic contribution that World Heritage sites can provide, it is a significant step to go beyond this to use economics as the basis for decision-making. It should be remembered that economics provides only one source

of information, ignoring many important issues. Further, in many cases, despite the economic tools available, it will not be possible for a monetary value to be placed on most ecosystem services (and even when they can, they may be very inaccurate). Thus, engaging with experts and stakeholders to identify ecosystem services and then attempting to quantify in a non-monetary way, assign importance to, or at least describe, the ecosystem services being delivered by the World Heritage site will be an essential exercise in creating a full understanding of the benefits delivered by World Heritage sites, including those that cannot and should not be measured in monetary terms.

4.4 Governance and management case studies

4.4.1 Introduction

As discussed in the previous chapters, natural World Heritage sites, and protected areas in general, are being increasingly impacted on by a number of factors which in turn affects the provision of ecosystem services and benefits by these sites. By preserving natural World Heritage sites for their Outstanding Universal Value, we preserve the health and intactness of the ecosystems they contain and therefore ensure the continuous provision of ecosystem services and benefits. Direct benefits that these sites provide to local communities, such as provision of jobs and education programmes, are also an important aspect that needs to considered and managed in an equitable way. This chapter looks at different governance types and management models that exist within World Heritage sites and at the ways each of them ensures protection of the sites and the benefits they provide.

The governance of protected areas, including World Heritage sites, can be understood as an important aspect of integrated ecosystem management that aids the conservation of biological and cultural diversity. Governance involves the institutions and processes used by right holders, duty bearers and other stakeholders to make and influence decisions and exercise authority and responsibility (Borrini-Feyerabend *et al.* 2013). Governance has also become an increasingly important concept and recently has been through a rapid evolution, especially in the area of protected areas[9] and World Heritage sites.

The IUCN Guidelines for Protected Area Categories now also recognize four different governance types, namely: government managed protected areas, co-managed protected areas, private protected areas, and indigenous and local community conserved areas (Dudley 2008). These governance types cover an even broader diversity of shared governance arrangements applied to protected area systems and individual sites alike.

Governance is also a contested concept that stems from a western and scientific tradition. Increasingly areas conserved by local and indigenous peoples are being recognised as protected areas. This also invites stakeholders and decision makers to rethink their understandings of governance in a cross-cultural context and in times of economic and environmental uncertainty.

4.4.2 Governance by government: Yellowstone National Park (USA)

Harvey Locke

Yellowstone is one of the most famous national parks in the world and a model of a protected area managed by a government body. Yellowstone's management system as it has evolved since 1872 is interesting not only for this important park but also as an archetype of how the management of national parks evolves over time.

Location and World Heritage designation

Yellowstone National Park is the world's first national park (though not the first protected area) and was in the initial group of the five first natural sites inscribed on the World Heritage List. It is a large park in the Rocky Mountains, square in shape, with most of its 900,000 ha area located in the State of Wyoming, USA, with small but significant edges in Idaho and Montana. World Heritage criteria (vii) through (x) are met in an exemplary fashion: beauty and natural phenomena including half of the world's geothermal features, a magnificent canyon, important stages of earth's history especially relating to volcanism, ecological and biological processes of major significance (including exceptionally abundant and observable wildlife which includes the full range of carnivores native to the system and diverse ungulate prey base), and natural habitat representative of biological diversity including montane Douglas fir savannahs and the headwaters of the longest undammed river in the United States. Yellowstone is both a global icon of the national park and an exemplar of the large national park which is an important land use in western North America.

[9] *The Convention on Biological Diversity (CBD) in its Programme of Work on Protected Areas' Element 2 on "Governance, Participation, Equity and Benefit-Sharing" aims at improving, diversifying, strengthening, assessing and building capacity on governance aspects of protected areas (See: http://www.cbd.int/protected/pow/learnmore/intro/#element2).*

Main ecosystem services provided by the site

Yellowstone NP is the headwaters for the two largest river systems of the western United States: the Missouri-Mississippi and the Snake-Columbia. The Snake River is the source of freshwater for domestic consumption and irrigation for the largest part of the Idaho potato industry which is the largest potato producing region in the US. The Missouri provides irrigation and freshwater for most of the state of Montana. The 1,114 km long Yellowstone River (which joins the Missouri) is the longest undammed river in the United States which provides vital natural processes for native fish and riparian species. Yellowstone Lake located entirely within the national park is the largest lake at high elevation (2,357 m) in North America and has exceptional water quality (www.nps.gov/yell/index.htm).

Carbon is stored in park soils and forests. The park is an important natural control for the study of climate change. Ecosystem production and carbon fluxes in the Yellowstone region over the next century will likely reflect complex relationships between climate, forest age structure, and disturbance-recovery patterns of the landscape, plus management policies for large grazing herbivores and their predators (Genovese, 2011). Recent increases in fire activity suggest climate warming and associated alterations to hydrology are already changing disturbance regimes (Kashian *et al.*, 2013).

Yellowstone is one of the premier ecotourism destinations in the western United States and draws visitors from around the world (3,188,030 visitors in 2013). Eighty-eight percent of visitors are American (2011). The international visitors' origins are 27% from Canada, 11% from the United Kingdom, 10% from France, 10% from Germany, Netherlands 9%, 7% from China and the rest from other parts of Europe. Most visitors come in summer (June, July and August). There are no day-use limits and lodging and campgrounds in the park can accommodate about 14,300 visitors during the summer. There is significant additional supply of lodging and camping facilities in the gateway communities located outside the park (Gardiner and West Yellowstone in Montana, and Cody and Jackson in Wyoming). For all its popularity the park still offers wilderness solitude on an extensive network of backcountry trails and the Thorofare area of the park is the wildest and most remote place from a road in the lower 48 States. In 2010 45,045 people camped in the park's wilderness (www.nature.nps.gov/stats/park.cfm; Kulesza *et al.*, 2012a).

There are eleven native fish species. Recreational fishing is a popular activity in the park and is now managed to support native species restoration. Anglers must keep non-native fish and native fish must be released. Yellowstone has three of the four known pure wild populations of native Westslope Cuttthroat Trout that remain in the US and there are reintroduction efforts underway. There is one lake-based population of Arctic grayling.

The direct economic benefits are associated with tourism and park jobs. The Park's 3, 188,030 visitors in 2013 spent $382,000, 000 in local and non-local spending which supported 5,300 jobs. Fifty one percent of the parks economic impact from ecotourism is realized in Montana and forty nine percent in Wyoming. There are 550 total park staff (in summer there are 850 positions) and the Park's annual operating budget is $34 million. In addition, the park combined with its relative proximity to airports and attractive communities has given rise to a significant amenities–based economy that has driven most of the job growth in the region for the last twenty years (Cullinane *et al.*, 2014).

Governance and management system

The Yellowstone National Park Act 1872 created the Park and dedicated it as a public park or pleasuring-ground for the benefit and enjoyment of the people and protected the scenic and geological wonders; the Yellowstone Game Protection Act of 1894 then protected the Park's wildlife (except dangerous animals which were protected in 1931); the Park then became managed for future generations by the newly created US National Park Service under the Organic Act of 1916. The overall effect is that first, Yellowstone like all US national parks must be maintained in unimpaired form for the use of future generations as well as those of our own time; second, it is set apart for the use, observation, health, pleasure, and inspiration of the people; and third, the national interest must dictate all decisions affecting public or private enterprise in the parks.

The National Park Service's Call to Action 2013 promotes large landscape conservation to support healthy ecosystems and cultural resources. There are also park specific rules and regulations designed to protect ecosystem services while allowing for visitor use (http://www.nps.gov/yell/parkmgmt/index.htm).

The Park's Yellowstone Centre for Resources was created in March 1993 to centralize the park's science and resource management functions. It monitors the Park's ecosystem vital signs including ecosystem drivers, environmental quality, native species, stressors and cultural resources and publishes the findings periodically and employs between 100-150 staff including seasonal, temporary and permanent employees (Yellowstone Center for Resources, 2013). Overall, there are 550 total park staff (in summer there are 850 positions).

The existing management system of the Yellowstone National Park has been efficient in protecting important natural processes and the flow of ecosystem services which results in significant benefits to local, regional and global beneficiaries. The site provides economic benefits in the range of half a billion dollars to its region and country and supports a robust amenities based-economy in adjacent areas. Through direct visitation it inspires over three million visitors a year and through its existence enriches the lives of the people of the United States and the entire world.

4.4.3 Indigenous Lands: Joint Management at Kakadu National Park (Australia)

Bas Verschuuren

The governance of ecosystem services and the benefits they provide involves an understanding of how ecosystems are linked to human well-being (Millenium Ecosystem Assessment, 2005). This becomes particularly apparent in the governance of Kakadu National Park where joint management between contemporary and culture-bound institutions involves a continuous process of defining and sharing responsibility for looking after the land and the ecosystem services and benefits is provides.

Location and World Heritage designation

Located in the remote Alligator Rivers Region of Western Arnhem Land in the Northern Territory Kakadu is Australia's largest National Park of almost 2 million ha. It was found in 1975 and in 1981 it became Australia's first inscribed World Heritage site with additional inscriptions in 1987 (stage 2), 1999 (stage 3) and another extension in 2011 (http://whc.unesco.org/en/list/147). Kakadu contains the largest diversity of ecosystems of all Australian protected areas including a part of the world's largest tropical savannas. These grass and woodlands are alternated with open forest, floodplains, tropical rivers, mangroves, tidal mudflats, coastal areas, monsoon forests and impressive escarpments of up to 330 meters high.

Kakadu is recognized as an outstanding example of the "combined works of nature and man" but with relatively little influence from western settlers (UNESCO 1972, p. 2). The first guiding principle of the Kakadu Plan of Management therefore is: "culture, country, sacred places and customary law are one, extend beyond the boundaries of Kakadu, and need to be protected and respected" (Kakadu Board of Management 2007, p. iv). Aboriginal people known as *Bininj* have lived in Kakadu for over 50,000 years and their rich rock art sites are part of the world's longest continued and living art tradition (Chaloupka 1993). Some 5,000 art sites have been recorded and a further 10,000 sites are thought to exist (Kakadu Factsheet undated). This art tradition reveals insights into hunting and gathering practices, social structure and ritual ceremonies of Kakadu's past and present Indigenous societies. It is complemented by songs, stories and ceremony which together are a manifestation of the dreamtime, a time in which the earth and all beings were created by ancestral or mythological ancestors such as the Rainbow Serpent *Bula*, Lightning Man *Namarrgon* and Earth Mother *Warramurrungundji*. The *Bininj* believe that these 'mythological' beings created the land, sea and everything in it and that they laid down the traditional law for Bininj people that still plays a role in every day management of Kakadu.

Main ecosystem services provided by the site

Kakadu National Park provides a range of ecosystem services to a diverse group of beneficiaries. These include supporting services in the form of nursery and habitat function necessary for the reproduction of commercially viable species such as the Baramundi (*Lates calcarifer*) and other fish that are favoured by sport anglers in the park (Palmer, 2004). The underground water basins recharge seasonally and provide water to communities over the dry season (Finlayson *et al*., 2005). Kakadu is also home to many different Aboriginal peoples whose livelihoods, languages, traditional knowledge and worldviews are intimately linked to the land and constitute an extraordinarily biocultural diversity (Hill, 2010).

Aboriginal peoples enjoy many different types of use such as hunting, gathering, the use of construction materials but also the use of medicinal, ornamental and genetic resources. However, what makes Kakadu truly unique are its cultural ecosystem services - not just its Aboriginal cultural heritage and art tradition with associated intangible spiritual and religious values but also its capacity for inspiration and recreation of the many visitors it receives annually. Knowledge generation and education functions are also important benefits provided by the site alongside its role as a natural laboratory for scientific research (deGroot *et al* 2008).

Governance and management system

Approximately 50 per cent of Kakadu National Park is Aboriginal land under the Aboriginal Land Rights (Northern Territory) Act 1976. Most of the remaining area of land is under claim by Aboriginal people. Title to Aboriginal land in the Park is held by Aboriginal Land Trusts that have leased their land to the Director of National Parks (under the Environment Protection and Biodiversity Conservation Act 1999) for the purpose of being managed in accordance with the park's management plan and relevant decisions of the Kakadu National Park Board of Management. A majority of Board members represent the park's Traditional Owners (BMT WBM, 2010). The Traditional Owners engaged in this arrangement because they felt that having their land managed as a national park would support them in looking after their land in the face of growing and competing pressures.

The joint management system of the Kakadu National Park showcases how 'joint management' can combine ancient but dynamic culture and

modern conservation practice. *Bininj* landowners have two leading responsibilities – looking after country *gunred* and looking after people *guhpleddi* (Gundjemjeihmi Aboriginal Corporation, 2014). Understanding and communicating these interests within the current framework of joint management is seen by some Aboriginal and state protected area managers as one of the largest challenges for the future conservation of Kakadu.

In an attempt to engage with broader society, the new management plan being developed for 2014-2024 will go through a period of public comment and consultation with Traditional Owners, allowing different perspectives to be included (Planning Steps, undated). The new plan aims to conserve natural and cultural values, protecting the interests of the park's traditional owners and it provides safe visitors experiences. It also sets out the development of partnerships between government, the private sector and traditional owners that provide new business opportunities for local Aboriginal people. Essentially some of these opportunities lay in land management itself. As the new plan also focuses on the importance of weed control and traditional fire management Indigenous Ranger group are increasingly being established and are taking on management tasks using traditional practices whilst guided by a solid management plan and thousands of years of traditional knowledge and experience.

4.4.4 Private protected areas: Salto Morato Natural Heritage Private Reserve (component of Atlantic Forest South-East Reserves World Heritage Site, Brazil)

Marina Cracco

Private governance comprises protected areas under individual, NGO or corporate control and ownership (Borrini-Feyerabend, 2013). In addition to nature conservation benefits, privately owned protected areas can provide other important benefits, such as tourism and recreation, education and knowledge building.

Location and World Heritage designation

Salto Morato Natural Heritage Private Reserve (SMNHPR[10]) shelters a 2,253 hectare-area of Atlantic Forest in Guaraqueçaba, state of Paraná, in Brazil (FGBPN, 2012). 1,716 hectares of SMNHPR are part of the 470,000 hectares large serial[11] Atlantic Forest South-East Reserves World Heritage Site. The entire World Heritage property is composed of 25 protected areas of different designations ranging from a private reserve, several state parks to national parks. SMNHPR was established in 1994 and open to the public in 1996 (FGBPN, 2011; FGBPN, 2011b). The Atlantic Forest South-East Reserves, including SMNHPR, was inscribed on the World Heritage List in 1999 under natural criteria (vii), (ix) and (x) (WHC, 2014). The main ecosystem in the area is the Atlantic Forest. SMNHPR is home to 650 species of plants, 58 mammals, 384 birds, 34 reptiles, 61 amphibians, and 55 fish species (FGBPN, 2011, FGBPN, 2011b).

Main ecosystem services provided by the site

The main ecosystem services that the site provides include regulating services (carbon sequestration and storage, local climate and air quality regulation, erosion prevention and soil fertility maintenance, water conservation and water regulation), supporting services (habitat for species, maintenance of genetic diversity), and cultural services (recreational and mental and physical health through its landscape, aesthetics and cultural appreciation, spiritual experience, and knowledge). The unique biodiversity of the area makes the site a hotspot for scientific research. In addition, the reserve is important for nature-based tourism at local and national level.

Salto Morato NHPR is one of the positive examples of developing scientific research in Brazil through partnership towards nature conservation (Cegana, 2005). Over 86 scientific studies have been completed in SMNHPR since 1996 (FGBPN, 2011). The reserve also hosts a meteorological station to record climatic data every 15 minutes and a research laboratory.

The reserve receives between 4,000 to 8,000 visitors per year (over 8,000 in 2012, 4,500 in 2011) in addition to researchers (FGBPN, 2011; FGBPN 2011b). Ecotourism services include access to interpretative trails for walks, bird watching, etc. In 2011, the majority (39%) of tourist were from the capital of the State and (34%) within the local municipality (FGBPN, 2011b and 2012).

Governance and management system

Salto Morato NHPR is a private reserve owned by the Boticário Group Foundation created by Group Boticario, a Brazilian Cosmetic Company. The reserve was created to complement both public and private efforts in the effective conservation of threatened species and ecosystems in the Atlantic Forest. The Nature Conservancy (TNC) was the partner in obtaining the area (FGBPN, 2011).

In Brazil, Natural Heritage Private Reserves belong to the category of sustainable use protected areas, or conservation units, and are established in perpetuity and voluntarily by the landowner. The owner is requested to include signage in and outside the area, ban

[10] RPPN for its acronym in Portuguese: Reserva Particular do Patrimônio Natural

[11] "A serial nomination is any nomination which consists of two or more unconnected areas. A single World Heritage nomination may contain a series of cultural and/or natural properties in different geographical locations, provided that they are related" (http://whc.unesco.org/archive/serial-noms.htm)

hunting, fishing and capture of animals, clearing of forests and fires in addition to other activities detrimental to the environment. The owner is also required to develop and follow a management plan and to present periodic reports with help of the institution in charge of the environment at the federal/national level (IBAMA), other environment institutions at the state level and NGOs. Fines are assigned by the authorities when obligations are not met (Wiedmann, 1997 in Cegana 2005). Within this type of reserves, the activities allowed include scientific research, tourism and recreation and environmental education as established in the management plan and legislation (ICMBio/MMA, 2012; Case Study in Borrini-Feyerabend, 2013). The environmental police at the state level responds to complaints from owners of NHPRs in cases of illegal hunting, etc. in their property. In the case of SMNHPR, an environmental police unit is hosted within the property. In addition, support in protected area management, from the National Confederation of NHPRs (CNRPPN) is given to those voluntarily registered (www.icmbio.gov.br).

Private reserves, among other governance types, can provide benefits and conservation at little cost to society (Hayes, 2006; SCBD, 2010, Kothari *et al.*, 2012 In Borrini-Feyeraben, 2013) and can serve as instruments to complement and strengthen the public system (Mesquita, 2004 in Teixeira and Silva, 2011). In many areas population growth and increasing demand for resources and environmental services coupled with scarce financial resources available for nature conservation are limiting the establishment of public protected areas (McNeely, 1984 in Teixeira and Silva, 2011) increasing the importance of the private sector in biodiversity conservation (Mesquita, 2004 in Teixeira and Silva 2011). In addition to nature conservation benefits, privately owned protected areas provide other important benefits, such as tourism and recreation, education and knowledge building.

4.4.5 A unique Community Conservation Area: Mount Athos (Greece)

Thymio Papayannis

[12] *Ratified by Legislative Decree 10/16.9.1926.*

Mount Athos World Heritage site provides a unique example a self-administered system with the management exercised by representatives of Holy Monasteries, who comprise the Holy Community.

Location and World Heritage designation

In 1988 the Athonite Peninsula in Northern Greece was inscribed on the World Heritage List both for its cultural and natural values. Jutting into the North Aegean, this mountainous peninsula of 33,400 ha – dominated by the conical peak of Mt Athos at 2300 m – hosts a variety of ecosystems with rich biodiversity and has been recently proclaimed a Natura 2000 area in its entirety. The peninsula also hosts 20 historic monasteries, some of them dating from the tenth century, and many smaller sacred facilities.

Main ecosystem services provided by the site

The sacred mountain of Athos has been a spiritual centre of Orthodox Christianity since the 10th century (UNESCO, 2014j). The harmonious coexistence of nature and man has been a constituent element and aim of monasticism from its origins. In addition to its cultural and spiritual values, the site also provides other important ecosystem services. The forests in the area have remained largely untouched because of their inaccessibility, and play an important role in nutrient cycling and water storage (Bhagwat, 2009). Mount Athos also offers significant nature conservation benefits by protecting rich flora and fauna, including endemic, rare and endangered species. Traditional agriculture and forest management practices testify to the harmonious century-long interaction of man and nature in Mt Athos could potentially serve as examples for sustainable agro-forestry management at a wider scale.

Governance and management system

The management of the Athonite Peninsula depends on its special privileged status of self-governance, as provided by Article 105 of the Hellenic Constitution, by the Constitutional Charter of Mount Athos[12], as well as by the European Communities Greek Accession Act of 1979 and the respective texts attached to it. More specifically, Article 105 of the Constitution and the Constitutional Charter of Mt Athos determine the institutional framework of organisation and operation of the site, protect its regime and prohibit any modification of the administrative system, of the number of monasteries and of their hierarchical order. Thus, the administration of Mt Athos is exercised by the 20 Holy Monasteries through their representatives, who constitute the Holy Community. The territory of Mount Athos may not be expropriated and belongs exclusively to its Monasteries, which also have total rights of ownership, possession and occupation of their monuments and heirlooms. All other institutions, clusters (*sketes*) and retreats (*hesychasteria*) are dependencies of the 20 Monasteries.

In 2010 a positive step was taken towards the preparation of a 'strategic framework for the conservation and management of the cultural and natural heritage of Mt Athos'. A team of experts and a general coordinator were appointed by the Holy

Community and a comprehensive preliminary report was prepared.

According to this report, the integrated management of the site should be regarded as a participatory process of cooperation between the monastic fraternities, the government services and UNESCO. The report reviewed the present situation and proposed ten principles on which the management process should be based. It was reviewed extensively by the Athonite institutions and was discussed in detail in two expert meetings organised in Thessaloniki, in January and in late August 2013 by the Ministry of Culture and the cooperation of the Holy Community, the second one with the contribution of UNESCO experts, and was broadly endorsed by the participants. As there were certain reservations among the 20 Holy Monasteries on the best way to proceed, the issue was debated by the Holy Community in late December 2013 and by the Double Session in May 2014. The decisions taken were to advance prudently, establishing a Working Group among representatives of the Athonite institutions and the State services to finalise the management study specifications and to raise funds for its commissioning and completion.

The unique status of self-governance of Mount Athos, combined with the traditional way of life of the resident monastic community, has largely protected the site from significant anthropic threats. The monastic community of Mt Athos, of approximately 2000 monks, is the zealous steward of a millenary, uninterrupted spiritual tradition, which it nurtures since Byzantine times with a considerable degree of autonomy within the State of Greece. The rich flora and fauna the Athonite Peninsula have been well conserved by careful management of the forests and traditional agricultural practices.

4.4.6 Co-management: Belize Barrier Reef Reserve System (Belize)

Marina Cracco

Shared governance of protected areas is based on mechanisms and processes which share authority and responsibility among several actors. In Belize, engagement of NGOs in co-management is quite common, including in the component protected areas that constitute the Belize Barrier Reef Reserve System World Heritage site.

Location and World Heritage designation

The Belize Barrier Reef Reserve System (BBRRS) is located in the Caribbean off the coast of Belize in Central America. It forms part of the Mesoamerican Barrier Reef, the second largest barrier reef in the world and the largest in the Northern Hemisphere. Its main ecosystems include fringing, barrier and atoll reefs types, mangrove forests, coasts and coastal lagoons, sand cays and estuaries. Inscribed as a World Heritage Site in 1996 under natural criteria *(vii), (ix) and (x)*, the reef illustrates evolutionary history of reef development. This is a serial World Heritage site encompassing seven protected areas with different legal status (from marine reserves and national parks to natural monuments).

Main ecosystem services provided by the site

The main ecosystem services derive from coral reefs, mangroves, sea grass beds, and coastal areas and cayes. These ecosystems provide nursery grounds for fisheries and areas for ecotourism (TEEB 2010; Cooper *et al*, 2009, Garcia-Salgado, 2006 In Neal *et al*. 2008l). Other benefits provided by the Belize Barrier Reserve System include mitigation of natural disasters through coastal protection (barrier) and climate change adaptation and mitigation (blue carbon sequestration) (Greiner *et al*., 2013).

Tourism revenues for 2006 were around $250 million. An estimated 80% of tourists visit a destination within the coastal zone. Tourism has increased from 90,000 visitors in 1991 to 900,000 in 2006 as a result of marketing Belize's pristine natural environment. Activities include scuba diving, snorkeling, kayaking, sports fishing and manatee watching. 60% of income is derived directly from coastal and marine activities (Neal *et al* 2008).

In 2007, the value of the reef and mangrove related fisheries, tourism and shoreline protection services, was estimated to be between $395 million and $559 million. Also, in terms of national employment, it is estimated that reef-related tourism employs 20 percent of national workforce (Wade 2012).

Governance and management system

Five components of the BBRRS are co-managed (see table 10 below) with NGOs. The Government of Belize formally agrees to share management of public protected areas with non-government organizations (NGOs) (or community-based organisations-CBOs) through a legally binding agreement that lays out guidance and responsibility of each party within the contract (Salas, 2008).

Belize Audubon Society (BAS), under formal agreement, is responsible for on-site management following a management plan, financial management (collecting and managing

Table 10. Management entities of component protected areas with BBRRS

Component	Size	Management entity/ies
Bacalar Chico National Park and Marine Reserve	10700 Ha	Co-management: Green Reef Environmental Institute and Fisheries Department (marine reserve) assisted by Green Venture for biodiversity assessments/monitoring
Blue Hole Natural Monument	4100 Ha	Co-management: Belize Audubon Society and Forest Department
Half Moon Caye Natural Monument	3900 Ha	Co-management: Belize Audubon Society and Forest Department
South Water Caye Marine Reserve	29800 Ha	Fisheries Department assisted by Smithsonian Institute for biodiversity information
Glovers Reef Marine Reserve	30800 Ha	Fisheries Department assisted by WCS for biodiversity monitoring information and activities
Laughing Bird Caye National Park	4300 Ha	Co-management: Southern Environmental Association with the Forestry Department
Sapodilla Cayes Marine Reserve	12700 Ha	Co-management: Southern Environmental Association with the Fisheries Department

Sources: http://www.fisheries.gov.bz/; http://www.forestdepartment.gov.bz/

fees, fundraising, managing income generating activities), coordinating all activities spanning across programmes, hiring all staff and temporary workers, etc. The Public Party is responsible for protected areas management unit, support (trainings, workshops), law enforcement (joint patrols, court prosecution), guidance on research proposals, etc. The Southern Environmental Association (SEA) in Laughing Bird Cayes National Park and Sapodillas Cayes Marine Reserve undertakes activities from law enforcement to community education and outreach and scientific research and monitoring (SEA, undated).

The Association of Protected Areas Management Organizations (APAMO) was formally established in 2007 to coordinate the activities of protected area management organizations. In addition, Advisory Committees, and more recently regional Coastal Advisory Committees, have been established for the coastal areas, cayes and atolls.

4.4.7 Biodiversity Stewardship: Cape Floral Region Protected Areas (South-Africa)

Jenifer Gouza

Often in order to effectively conserve biodiversity, conservation efforts must focus outside of formerly protected area. In South Africa, 80% of the country's most scarce and threatened habitats are privately owned. Biodiversity Stewardship provides this new and proactive approach to conservation.

Location and World Heritage designation

The Cape Floral Region Protected Areas World Heritage Site is located in the southwest corner of South Africa in the Western and Eastern Cape Provinces of the country. It was inscribed on the World Heritage List in 2004 and consists of eight clusters extending from 50km south of the City of Cape Town northwards 210km to the Cederberg and 450km northeast to the Swartberg. The 553,000 ha cluster of eight sites together form a representative sample of the eight phytogeographic centres of the Cape Floral Region.

The eight sites, their area size and the relevant Management Authorities are shown in Table 11 below.

Table 11. The eight clusters making up the Cape Floral Region.

Cluster	Area (ha)	Management Authority
Cape Peninsula National Park	17 000 ha	South African National Parks Board
Cederberg Wilderness Area	64 000 ha	CapeNature
Groot Winterhoek Wilderness Area	26 000 ha	CapeNature
Boland Mountain Complex	113 000 ha	CapeNature
De Hoop Nature Reserve	32 000 ha	CapeNature
Boosmansbos Wilderness Area	15 000 ha	CapeNature
Swartberg Complex	112 000 ha	CapeNature
Baviaanskloof Protected Area	174 000 ha	Eastern Cape Parks and Tourism Agency
Total area	**553 000 ha**	

Main ecosystem services provided by the site

The Cape Floral Protected Areas (CFRPA) WHS plays an important role in providing benefits and ecosystem services, most notably freshwater provisioning services.

The Groot Winterhoek and Boland Mountain Complex are key water source areas for the Western Cape and the protected areas in these mountains, which form part of the CFRPA WHS are vitally important to protecting freshwater resources. The Groot Winterhoek conservation area comprises of 30 608ha, of which 19 200ha was declared a wilderness area in 1985. The conservation area is particularly important for the conservation of mountain Fynbos and wildlife, as a source of clean water to the Cape Town metropolitan area and the West Coast. The Groot Winterhoek Wilderness area also forms the watershed area that feeds two catchment areas that support rural and urban areas.

Governance and management system

The CFRPA WHS is jointly managed by the following Conservation Agencies, i) The Eastern Cape parks and Tourism Agency, ii) the Western Cape Nature Conservation Board (CapeNature) and iii) The South African National Parks Board. The Governance platform for the management of the site is the Joint Management Committee.

A key aspect to consider with respect to World Heritage Sites is that of buffering of the site. In the context of the CFRPA WHS the term coined by Mr Guy Palmer from CapeNature, to refer to the various tools and mechanisms used to buffer the site, is buffering mechanisms. These mechanisms include planning tools and products, landscape initiatives, corridors, biodiversity stewardship, declared mountain catchment areas and UNESCO designated biosphere reserves.

These buffering mechanisms such as the biodiversity corridors are designed to mitigate and act as adaptation mechanism to anticipated climate change impacts. These buffering mechanisms therefore play a key role in supporting the World Heritage concept by further safeguarding the important biodiversity of the Cape Floral Region.

Biodiversity Stewardship

Stewardship refers to the wise use, management and protection of that which has been entrusted to you. Within the context of conservation, stewardship means wisely using natural resources that you have been entrusted with on your property, protecting important ecosystems, effectively managing alien invasive species and fires, and grazing or harvesting without damaging the veld/vegetation (CapeNature Stewardship Operational Procedures Manual updated version 2009).

The Biodiversity Stewardship Programme within CapeNature is aimed at engaging private landowners with conservation worthy land. Landowners voluntarily participate in biodiversity conservation by formally agreeing (through a biodiversity stewardship agreement) to secure the conservation status of their land to (i) protect important ecosystems; (ii) enable the more sustainable use of natural resources and (iii) effectively manage threats to natural systems and biodiversity. Incentives may be offered to the landowner.

A biodiversity stewardship agreement is a voluntary agreement that may be informal or legally binding, and which commits a landowner and a public conservation agency to mutually agreed conservation management objectives.

One of the component protected areas of the site - the Groot Winterhoek Wilderness area - forms the southern core of the Greater Cederberg Biodiversity Corridor (GCBC) and is the anchor site for the freshwater corridor in the GCBC. The Groot Winterhoek Freshwater Stewardship Corridor is aimed at linking the Cederberg and the Groot Winterhoek Wilderness areas through biodiversity stewardship and encouraging better land management with private landowners.

In 2009 CapeNature and WWF jointly implemented a project to support freshwater conservation within the Groot Winterhoek Freshwater corridor. The aim was to engage private landowners to support freshwater conservation and to secure priority areas through biodiversity stewardship.

This engagement resulted in the securing of almost 9000ha of land of which the Groot Winterhoek Protected Environment (PE) made up 4 368ha. The Groot Winterhoek PE borders the protected area and further supports with buffering the site. The signing up of another 4404ha as a contract nature reserve resulted in the securing of lowland wetlands at the foothills of the Groot Winterhoek Mountains.

Key buffering mechanisms that support the WHS, such as biodiversity stewardship also contribute to securing and supporting the ecological infrastructure (and the benefits and services that flow from it) associated with the site. The mitigation for the effects of Global Climate Change is continuously factored into the planning and implementation of all initiatives. These multiple protection layers and tools play a synergistic and complementary role to support persistence of the site.

4.4.8 Transboundary management of ecosystem services and benefits: The Wadden Sea (Denmark/Germany/the Netherlands)

Anja Domnick and Harald Marencic

Transboundary protected areas are a particularly important form of shared governance, involving two or more governments and other actors (Borrini-Feyerabend, 2013). These sites also face unique governance challenges.

Location and World Heritage designation

The Wadden Sea stretches for 500 km along the North Sea coast of the Netherlands, Germany and Denmark, and was inscribed on World Heritage List for its outstanding universal geological, ecological and biodiversity values. This large World Heritage site encompasses a multitude of transitional zones between land, the sea and freshwater environment, and is rich in species specially adapted to the demanding environmental conditions (UNESCO, 2014l).

Main ecosystem service provided by the site

The Wadden Sea plays an important role as a tourist destination and thus has a significant impact for the regional economy. Many regions are entirely dependent on tourism. Every year millions of tourists are drawn to the Wadden Sea coast. 50 million overnight guests and 30 – 40 million day visitors per year are attracted to experience this natural wonder. Tourism is one of the major sources of income in the region with a turnover over 5 billion € per year.

Nature conservation and recreation coexist well in the Wadden Sea, mainly due to long-term policies, comprehensive protection and management schemes.

Governance and management system

Almost the entire Wadden Sea is managed under a nature conservation regime with natural processes undisturbed throughout most of the area. Since 1978, the three countries have been cooperating successfully together to protect the entire Wadden Sea as an ecological entity as laid down in the Joint Declaration. The trilateral Wadden Sea Plan together with the Trilateral Monitoring and Assessment Programme is the framework for policy, management, monitoring, research, communication and education. The World Heritage status of the site underlines the fact that the Wadden Sea has to be protected and managed as one ecological entity.

However, as the area is a popular tourist destination for many generations, there is a risk that increased tourism may have negative impacts and that protection and conservation of the World Heritage Wadden Sea could be harmed by new touristic developments.

Responding to these challenges the transnational project "PROWAD", funded by the EU via the Interreg IV B North Sea Program, plays an essential role in enabling and facilitating countervailing strategies. It uses a combination of knowledge and information tools, procedural advice and practical support, and capacity building and training to strengthen cross-sector relations between stakeholders across local, regional, national and transnational levels to answer the question: How can sustainable tourism be guided into safe ways to minimize the environmental impact that may come with touristic activities in the World Heritage Wadden Sea area.

The development of the Sustainable Tourism Development Strategy for the entire Wadden Sea was commissioned in 2010. The strategy foresees multi-level involvement and collaboration among different sectors (such as tourism and private business sector, ministries, nature agencies, national parks and NGOs) to create effective solutions. The strategy outlines the true potential that exists for nature-based tourism in the Wadden Sea and how, by supporting and protecting the 'Outstanding Universal Value' of the site, the provision of social, economic and environmental benefits can be ensured at local and regional levels.

5. Conclusions

Sites are inscribed on the World Heritage List because of their Outstanding Universal value; however like all protected areas WH sites also have a range of locally, nationally and even globally important values and benefits. Each World Heritage site is unique in the collection of ecosystem services and benefits it delivers to people at different scales. This report presents the first attempt to identify the full range of these benefits at global and site level and to quantify their extent.

At global scale, among other benefits, World Heritage sites provide a significant carbon sink and therefore contribute to climate change mitigation. The report shows that World Heritage sites across the pantropical regions harbour a total of 5.7 billion tons of forest biomass carbon. In terms of carbon per square kilometre, the World Heritage network exhibits on average a much higher forest biomass carbon density than the protected area network and the pantropical biomes (WH: 12,941, PA: 12,378, pantropics: 9,599 ton/km^2). These findings signal a major contribution of pantropical World Heritage sites in providing significant carbon stores.

At local scale, the protection of the ecosystems contained in the World Heritage site generates benefits local communities within and outside the boundaries of the sites. These direct and indirect benefits contribute to the well-being of people in a number of different ways, for example, through the provision of resources for subsistence and the less tangible cultural and spiritual values of nature that give meaning to people. In many cases, the protection of the ecosystems contained in the World Heritage site generates benefits outside the boundaries of the sites. For example, protection of the forest within the watershed of the Morne Trois Pitons National Park provides 60% of the water supply to communities living outside the boundaries in Dominica.

The analysis of the data collected through the IUCN World Heritage Outlook showed that the World Heritage network delivers a wide variety of benefits and is most frequently associated with providing health and recreation values, knowledge, contributing to the local economy, and cultural and spiritual values. From the environmental services, water provision has the highest score with 66% of sites having been assessed as important for water quantity and/or quality. Carbon sequestration, soil stabilization and flood prevention were also identified as important ecosystem services provided by about half of all natural sites (52%, 48% and 45% respectively). However, these ecosystem services also had high numbers of 'data deficient' responses (about 20%) meaning that the figures could potentially be higher.

For many sites our understanding of ecosystem services and benefits they provide is far from complete and some benefits, such as for example provision of medicinal resources or the presence of sacred plants and animal species, are much harder to determine due to a lack of data or knowledge. The information on knowledge gaps compiled in this report can be used to identify future research needs.

Different factors are continuing to impact on the provision of ecosystem services and benefits. From the five drivers of change that this study looked at – habitat change, pollution, overexploitation of resources, climate change and invasive species – habitat change and overexploitation were most frequently assessed as having high or very high level of impact on the provision of ecosystem services and benefits (28% and 21% respectively).

Ecosystems are often undervalued in decision making as their role in providing valuable services is not recognised. Valuing the benefits in monetary terms can highlight their relative importance and can be helpful in raising awareness amongst budget holders. This study highlights that a number of valuation approaches exist (such as the benefits transfer approach) and have been applied to World Heritage sites, although mostly in the context of ecosystem services values from tourism. However, it should be borne in mind that the various monetary valuation approaches are not without problems in terms of their accuracy. A further question arises as to their ethical validity.

Decision making processes should balance economic information and non-monetary values such as the cultural and spiritual benefits ascertained from engagement with experts and local stakeholders. The socio-cultural values of landscapes and the spiritual significance of sacred natural sites often play a pivotal role in the lives of local communities and need to be taken integrated into the management of the sites.

As benefits are site specific, site managers should consider possible trade-offs and/or synergies between the supply of the different ecosystem services and benefits, especially as some benefits are more tangible than others and because of the complex interlinkages between ecosystem services. Having a clear idea of the key ecosystem services/benefits a site provides and to whom (local, regional or global communities) is therefore vital for informed decision making and to assess the possible implications of management actions.

Conservation of World Heritage Sites for their Outstanding Universal Value ensures protection of healthy and intact ecosystems and natural features they contain and therefore the provision benefits to global and local communities.

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