

Impacts of climate change on tourism (and marine recreation)

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EXECUTIVE SUMMARY

The threat of climate change and the measures needed to both mitigate and adapt have been firmly embedded in UK legislation and policy. The Climate Change Risk Assessment (2012) undertook detailed analysis for over 100 potential impacts and provided a baseline that sets out how climate risks may manifest themselves in the absence of current and planned adaptation actions. The Marine Policy Statement (2011) provides a framework for marine planning across all UK waters and ensures the sustainable use of marine resources and strategic management of marine activities. Whilst these are welcome policy developments, there is still a great need for adaptation action within the tourism sector to address the most pressing threats and opportunities from climate change. Flooding and coastal erosion management could be devastating for tourism business but, at the same time, a warmer climate presents opportunities in terms of increased visitor numbers.

Visitor numbers to the UK are once again increasing and tourism is now worth nearly 9% of GDP. Water-based activities and contact with the natural world have seen the greatest increases in recent years. These, and other tourism activities, are strongly influenced by climate and weather.

Climate change is increasing the frequency of months when conditions are more comfortable for tourists in north-west Europe than in the Mediterranean. As a result, the tourism industry is expected to grow in the UK and especially along the coast. Warmer summers are expected to lead to an extended tourist season in the UK, especially at the coast, leading to increased revenues, new infrastructure, increased employment and enhanced water sport opportunities. Across the UK, coastal tourism and marine recreation is concentrated around different natural and man-made attractions. In southern England, there is preference for beach visits and sailing, in Wales tourists take part in adrenalin-filled water-based activities or more leisurely visits to National Parks and in Northern Ireland coastal tourism is focused around sea fishing.

However, the changing climate is already having negative impacts on the tourism industry. Relative sea level is rising resulting in increased coastal flooding, the loss of beaches and changes to other natural habitats. There has been a northward movement of important recreational angling fish species and changes in the populations of species important for wildlife watching such as harbour seals and seabirds.

Any increase in coastal flooding, erosion and extreme events would be expected to increase damage to coastal communities, tourist accommodation and transport links, whilst also posing an increased safety risk to marine recreation activities. To ensure sustainable development of the sector, it is essential that policy makers understand the direct and indirect impacts of climate change on both tourism infrastructure and tourists' perception. Changes in the marine climate have already affected the coastal environment which may affect the attractiveness to some tourists. Increasing sea temperatures are also expected to result in increases in temperature-sensitive marine pathogens that are potentially damaging to human health. A strengthening in the severity and frequency of extreme events will have an impact on ferry operations and other marine-based boating excursions.

Increased visitor numbers could overwhelm small coastal communities with implications for infrastructure, energy, water and waste management and environmental degradation. Understanding the carrying capacity of the tourist sites is also essential to manage the new flow of visitors and minimise the negative effect on the environment and the socioeconomics.

For the future sustainability of the tourism industry, it is vital that all stakeholders continue to adopt measures to mitigate and adapt to the challenges of climate change.

INTRODUCTION

Since the assessment in 2010, there have been a number of UK-based research, legislation and policy developments of relevance. The Climate Change Act 2008 created a framework for building the UK's ability to adapt to climate change. One of the Act's requirements was to produce the Climate Change Risk Assessment (CCRA) which was published in January 2012. Each country must now also develop a National Adaptation Programme (NAP) to address the most pressing climate change risks identified through the CCRA. Both the CCRA and the NAP must be reviewed and updated every five years.

The CCRA reviewed the evidence for over 700 potential impacts of climate change in a UK context and detailed analysis was undertaken for over 100 of these across 11 key sectors (Defra, 2012a). The climate change risks and opportunities are presented in terms of potential magnitude of risk, how magnitude varies over time and the overall confidence in the findings of the assessment. The work provides a baseline that sets out how climate risks may manifest themselves in the absence of current and planned adaptation actions. In response, the CCRA UK Government Report sets out the main priorities for adaptation in the UK under five themes¹ (HM Government, 2012).

The UK National Ecosystem Assessment (NEA), published in June 2011, provides an independent and comprehensive overview of the state and value of the UK's natural environment and ecosystem services. The total value of ecosystem services provided by the UK's coast is estimated at £48 billion, equivalent to 3.46% of Global National Income (GNI) (UK NEA, 2011). Tourism, leisure and coastal defence are the ecosystem services of greatest financial value but the relative importance of each differs according to location (ibid).

Charting Progress 2 is a comprehensive report on the state of the UK seas and describes progress since the publication of Charting Progress in 2005 (UK Marine Monitoring and Assessment Strategy (UKMMAS) Community, 2010). The report provides information on the extent to which human uses and pressures, such as climate change, are having an impact on the seas. Climate change has led to the average sea-level rise around the UK coast rising by about 14cm since the start of the 20th Century (UKMMAS Community, 2010). In addition, Charting Progress 2 is the first UK-wide assessment linking economic productivity with the pressure footprints on marine industries.

The Marine and Coastal Access Act 2009 requires the creation of Marine Conservation Zones (MCZ) - a new type of MPA to protect nationally important habitats and wildlife. The Act applies to inshore waters (from coast to 12 nautical miles (nm)) in England and Wales and in offshore waters (12nm to 200nm) all around the UK. There is also the

Marine (Scotland) Act 2010 and a proposed Northern Ireland Marine Bill. MCZs offer a flexible approach whereby the level of protection can be tailored for each site, from locations with minimal restriction through to highly protected areas from which all damaging activities are excluded. In England, Natural England and Joint Nature Conservation Committee (JNCC) have set up four regional MCZ Projects² that are tasked with bringing together stakeholders to recommend MCZs in English inshore waters and adjacent UK offshore waters.

In March 2011, the Marine Policy Statement was adopted jointly by the Secretary of State, Scottish Ministers, Welsh Ministers and the Department of the Environment Northern Ireland. The Marine Policy Statement provides a framework for marine planning across all UK waters and ensures the sustainable use of marine resources and strategic management of marine activities from renewable energy to nature conservation, and from fishing to recreation and tourism (HM Government, 2011a). The process of marine planning will achieve integration between different objectives and manage competing demands on the marine area through taking a spatial planning approach to management. Marine Plans will be based on a sound evidence base and will ensure that different and potentially competing activities can best be managed to the achievement of sustainable development. Appropriate marine planning will provide an important tool for meeting the long term challenges posed by climate change.

1. WHAT IS ALREADY HAPPENING?

Although affected by the global economic crisis, tourism remains one of the world's most valuable economic sectors. In 2011, there were 30.8 million overseas visits to the UK but, despite a few years of growth, it is yet to reach the previous high of 32.8 million visitors in 2007 (Office for National Statistics (ONS), 2012). In 2009, tourism was worth £115.4 billion to the UK economy, equivalent to 8.9% of total UK Gross Domestic Product (GDP) (Deloitte and Oxford Economics, 2010).

1.1 In coastal England: the Northern North Sea (part), Southern North-Sea, the Eastern English Channel and the Western English Channel

Tourism, in 2009, was worth £96.7bn to the English economy, equating to 8% of GDP (Deloitte and Oxford Economics, 2010). Tourism continues to be heavily concentrated in the London area (ONS, 2012). However, coastal attractions in England saw an overall increase in visitor numbers of 1% in 2011 (compared to 2010) and a gross revenue increase of 5% (Visit England, 2012). The breakdown across the country demonstrates more mixed fortunes. The east saw a four per cent increase in visitor numbers to coastal attractions whilst the south east and south west both saw a 2% increase (ibid). However, the north east experienced an 11% decline and the

¹Agriculture and forestry; Business, industries and services; Health and wellbeing; Natural environment; and Buildings and infrastructure.

²Net Gain (English part of North Sea, and offshore area); Balanced Seas (Eastern English Channel); Finding Sanctuary (South West England); and Irish Sea Conservation Zone (English and offshore parts of Irish Sea).

north west a 3% reduction (ibid). Despite that, between 2006 and 2009, nearly a quarter of all international tourist visits to the north east and the north west involved a visit to the coast with this figure increasing to 37% for the South East and 48% for the South West (Visit Britain, 2012).

Tourism on the English coasts traditionally mostly occurs during the summer months. In 2011/2012, 10% of the 2.73 billion visits by English residents to the natural environment were taken in coastal locations, including 153 million visits to a beach and 90 million visits to 'other coastline' (Natural England, 2012). The survey also found that the average duration of a visit to the natural environment was 1 hour, 58 minutes but 43% of visits to coastal locations and 32% of visits to 'other coastline' lasted three hours or more (ibid). In addition, recently there has been an increasing demand for experiences with the natural world. The north west of England had an 18% increase in the number of visitors to wildlife attractions in 2011 (compared to the previous year) (Visit England, 2012).

Coastal margins habitats have declined in total area by about 10% across the UK due to development, including tourism, and coastal squeeze (UK NEA, 2011). In low-lying coastal regions of England, 40 to 100 hectares of saltmarsh are being lost each year through coastal squeeze as human pressures restrict the landward migration of saltmarsh (UKMMAS Community, 2010).

The sea can provide a variety of tourism and recreational activities that will vary between areas including sailing, diving, sea angling, kayaking, surfing and wildlife experiences. Currently, little is known about the impact of marine climate change on coastal tourism and marine recreation in England. However, changes to the coastal environment have been noticed during the past few years. A general warming of the region and, in particular the sea surface temperature, allow the beaches and coastlines to become very attractive in summer. Coastal water temperature around the UK has increased by about 0.7°C in the last 30 years (Murphy *et al.*, 2009). However, sea-level rise, increase in wave height and storm surge have all enhanced coastal erosion and, as a result, more than 25% of the shore is being severely eroded. Fish and Moore (2005) suggest that cliff erosion and instability is increasing around the UK and that climate change is one of the primary drivers of this change. Extreme events have become more frequent with storms and floods becoming more common and more intense (Murphy *et al.*, 2009).

To date, climate change has had a relatively small impact on the UK's biodiversity and ecosystems although it has, for example, affected species ranges. There has been an observed northward movement of both exploited and non-exploited fish species in the North Sea which is attributed to climate change (UKMMAS Community, 2010).

Since 2005, there has been an increase in the population of grey seals in the northern and southern North Sea areas but for the Eastern and Western Channels the populations are stable but experiencing some problems (UKMMAS Community, 2010). The picture is more mixed for cetaceans and harbour seals. In the Northern Sea regions, harbour seal

numbers are declining. Across the four Charting Progress regions (Defra, 2005), the populations are stable but in the Eastern Channel there are many problems for the species (UKMMAS Community, 2010). Seals and cetaceans are popular species for wildlife-watching experiences. Any future changes in the populations will negatively affect this element of the tourism industry.

1.2 In the Irish Sea: coastal Wales, Isle of Man and coastal Northern Ireland

Wales

Tourism is a fundamental part of economic prosperity and job creation in Wales and, in 2009, the industry was worth £6.2bn to the economy or 13.3% of GDP (Deloitte and Oxford Economics, 2010). Beautiful landscapes and coastlines are the very foundation of the industry (Welsh Assembly Government, 2007). In 2011, Wales received 0.9 million international visitors (ONS, 2012) and between 2006 and 2009, 37% of international holiday tourists to Wales visited the coast with 31% participating in sports activities (Visit Britain, 2012).

In 2000, the Welsh Assembly Government, through the Welsh Tourist Board, launched a strategic initiative, repositioning Wales as a short-break activity tourism destination and promoting coastal activities (Wales Tourist Board, 2000). Activities in Wales include water sports such as surfing, diving and climbing as well as fishing and boating. This strategy has proved effective and tourism has increased (ONS, 2009). Over the same time, there have also been slight, but significant improvements in summer weather conditions (Jenkins *et al.*, 2007). In 2007, the Welsh Assembly Government then produced Sustainable Tourism which identified that managing and adapting to climate change will be critical to the future of sustainable tourism in Wales (Welsh Assembly Government, 2007).

The Welsh coastline and beaches are a major attraction. However, across the UK, about 3,000km (17% of the total length) of coastline is eroding (Ramsbottom *et al.*, 2012). As a result of climate change in Wales, coastal erosion and sea-level rises have been observed on 23% of the coasts (EUROSION, 2004) potentially having a negative affect on tourism. There has also been considerable loss of sand dune area due to agricultural land claim, forestry, golf courses and tourism (UK NEA, 2011). In addition, flooding is a greater threat in Wales than in the rest of the UK with 20% of the population and one in six properties at risk of coastal, river or some other form of flooding (Defra, 2012b).

The warmer summer months have allowed water sports activities such as surfing to develop extensively and Wales now has many of the UK's most popular surfing sites (e.g. <http://www.surfinginwales.co.uk>). The demand has increased and surf schools and tour operators have largely extended the season to almost six months of activity during the year. The Irish Sea is more sheltered than other coastal areas of the UK so seasonal differences in wave heights tend to be lower than other locations (Fealy *et al.*, 2006).

Isle of Man

Tourism makes a significant contribution to the island's economy. In 2010, there were 287,000 arrivals and a total visitor spend of £90 million (Isle of Man Government, 2012). A third of the island's visitors come from the north west of England (Isle of Man Treasury, 2010). The Isle of Man has a low population density with a largely undeveloped moorland landscape, rugged coastline and unspoilt beaches, that are very popular for outdoor and water sports. Tourism marketing efforts now emphasise the variety of cultural experiences, historical environments and natural landscapes to be found in close proximity (*ibid*). The Mission Statement for the islands tourism industry is "To grow the number of visitors and spend by promoting the attractiveness, events and activities that make the Isle of Man a desirable destination" with the strategic aim of being a year-round, distinctive and unique destination (*ibid*). Targeting those interested in outdoor sports is now a key priority of the tourism strategy. The choice of activities currently provided includes kayaking, sea and river fishing, sailing, "coasteering", windsurfing, mountain biking, diving and wildlife watching.

The Isle of Man has begun to target the timing of events at autumn and spring months to avoid simply displacing existing business during the peak summer months. Outdoor-based events include angling festivals, kayaking events, and the End to End Mountain Bike festival. The Isle of Man would also like to increase the number of cruise ships that visit the island.

Due to the location of the Isle of Man, the Irish Sea is the main factor to consider when dealing with climate of the island. Adverse marine climate change impacts can have a significant effect on the tourism sector. For example, the Douglas Promenade area is the most important area for tourist accommodation and many of its buildings are already susceptible to flooding from storm surges. However, the Isle of Man Tourism Visitor Economy Strategy (Isle of Man Government, 2012) does not include the impact of climate change on tourism infrastructure and attractions as an issue influencing the tourism sector. In addition, climate change is not perceived, by stakeholders, as the main issue to be concerned about even though specific problems, such as accommodation being susceptible to flooding, have been identified (Firth and Hutchins, 2006).

Northern Ireland

In 2011, there were approximately 12.4 million visits to Northern Ireland visitor attractions (both domestic and international) representing a 5.9% increase on 2010 (Department of Enterprise, Trade and Investment (DETINI), 2012). In 2009, tourism generated £1 billion for the economy (4.9% of GDP) (Deloitte and Oxford Economics, 2010). The coastline of Northern Ireland is characterized by stretches of cliff and rock, tidal inlets and sea loughs, as well as stretches of sandy beaches and dunes. The importance of coastal visitor attractions to tourism in Northern Ireland is demonstrated by the fact that there were more than half a million visits to the Giants Causeway Visitor Centre in 2011 (DETINI, 2012). However, 20% of the coastline is already

suffering from coastal erosion due to sea-level rise and high wave height (EUROSION, 2004).

Since the late 1800s, average temperatures have increased by 1.5°C and, following a fall in relative sea level as a result of isostatic rebound (1910 to 1957), there has been a slight rise in sea level (IPCC, 2007). Over the last century, there have also been alterations in precipitation patterns. In recent years, Northern Ireland has experienced an increase in the frequency and intensity of extreme events (Arkell *et al.*, 2007). As Ireland is dependent on sea and air transport for tourism, it is particularly vulnerable to bad weather in the form of strong winds or gales as tourists are unable to travel.

Tourism is a significant and important market and coastal activity and marine recreation include water sports, boating and yachting and, most importantly, fishing. Fishing for species including salmon, grilse, sea trout, brown trout and sonaghan, in and around Northern Ireland is a major recreational and economic activity (UK NEA, 2011). The unpolluted coastal waters make for an internationally recognized sea fishing sector which is also very popular among the Northern Ireland population.

Republic of Ireland

In 2011, there were 6.2 million overseas visitors to Ireland and, with the inclusion of the domestic holiday market, total tourism revenues were estimated at €5.5 billion (Fáilte Ireland, 2012a). The natural, unspoilt environment and dramatic coastlines are a unique selling point for Ireland. The country prides itself on its clean, green image and in 2010, 85% of visitors surveyed agreed that Ireland is a clean and environmentally green destination (Fáilte Ireland, 2010). Great Britain is Ireland's largest source market for tourism although between 2006 and 2011, the number of trips fell by 27% (Tourism Recovery Task Force, 2012). Following competitive analysis, four experience types were devised including 'getting active in nature' and 'awakening the senses'.

Ireland is not considered a "sun" spot so has to develop and trade on assets which make it unique to other destinations (Fáilte Ireland, 2012a). Not many tourists visit Ireland for a beach holiday but an increasing number are engaging in watersports such as surfing, sea kayaking and sailing. For example, the annual Great Island Kayak race takes place in December. In addition, an estimated, 107,000 overseas visitors engaged in angling while in Ireland in 2011 (Fáilte Ireland (2012b). There are number angling competitions and events throughout the year.

In 2007, 97% of bathing waters in Ireland complied with the minimum EU mandatory standards (Environmental Protection Agency (EPA), 2008). However, only 32% of those surveyed agreed that "the sea off the Irish coast is clean and safe to swim in" (Fáilte Ireland, 2012c).

1.3 In coastal Scotland: the West Coast, the Minch and the Northern North Sea

In 2010, there were 12.4 million domestic (from across the UK) and 2.4 million international trips in Scotland with a total spend of £4.1 billion (VisitScotland, 2012). Many people

visit Scotland for the diverse scenery, dramatic landscapes and natural history. However, the country does suffer from an adverse perception due to the inclement weather.

Coastal tourism is not one of the main segments of Scottish tourism (Viner and Agnew, 1999). The main visitor attractions continue to be the historical sites and museums, hill walking, water sports, golf and wildlife watching. However, of the 360 million visits to the outdoors in 2011 by adults in Scotland, 14% were to beaches and cliffs (TNS Research International, 2012). 41% of international visitors to Scotland, between 2006 and 2009, visited the coast with 37% undertaking sports activities (Visit Britain, 2012). Scotland offers a range of more extreme water-based adventure activities such as kayaking and surfing. These activities greatly depend on the quality of the coastal environment and are influenced by the coastal climate.

Fishing tourism has also always been very popular and is well renowned internationally. Scotland offers a varied sea fishing experience, an abundance of species (including cod, pollack, salmon, bass, skate) coupled with magnificent coastal scenery and the option to fish from both shore and boat.

Many people visit Scotland for wildlife watching both on land (birds) and at sea (whale-watching). Nature-based tourism in Scotland is estimated to provide £1.4 billion in income (Bryden *et al.*, 2010). Worryingly for Scottish tourism, Charting Progress 2 reports a deterioration in conditions for seabirds and, in some parts, a decrease in harbour seal populations (UKMMAS Community, 2010). Changes in the distribution of species could have a significant impact on this element of the tourism industry.

Scotland already experiences wide geographic variations in its climate and the scale of future climate impacts may also differ between Scottish regions. Scotland is the part of the UK where, to date, the annual mean temperature has increased less than in other parts of the country (Defra, 2005). Research has shown that the northern North Sea and the Scottish continental shelf have experienced significantly less warming than other coastal regions (Defra, 2005). Despite this, rising temperatures are already contributing to changes in the distribution of plankton and fish around Scotland, and the seabird populations that rely on them (Scottish Government, 2009). For example, the recent decline in seabird populations, such as black-legged kittiwakes, has been attributed to a change in the abundance of its main food source - the lesser sandeel (Scottish Natural Heritage, 2012).

Due to the large number of islands in the west and north of the UK, Scotland has a disproportionately long coastline (nearly 12,000km) and also about 54% of the inshore (12 nm) marine waters (UK NEA, 2011). Only 12% of the Scottish coasts have experienced coastal erosion (compared to 30% in England and 23% in Wales) (EUROSION, 2004).

2. WHAT COULD HAPPEN?

There are some factors, beyond climate change, that will affect tourism and recreation in marine areas. The high cost of fuel, increasing flight fares and reduced disposable income will

make travelling to and within the UK more expensive. For many, a holiday remains a 'protected purchase' but, in survey conducted in 2011, 42% of respondents reported they would be taking fewer holidays or short breaks in the following 12 months (VisitScotland, 2012). In addition, historically, the weather has not been a primary consideration for visitors to the UK as heritage, culture, the natural environment and visiting friends and family have been more important determinants (Baglee *et al.*, 2012).

2.1 In coastal England: the Northern North Sea (part), Southern North-Sea, the Eastern English Channel and the Western English Channel

Tourism is considered to be a highly climate-sensitive industry (Simpson *et al.*, 2008). As in most parts of the UK, rising summer temperatures and milder 'shoulder' seasons are an opportunity to increase tourism and open up new destinations for both foreign and domestic holiday makers. The tourist season will be extended although the summer will remain the busiest time. This will increase tourism revenue. As the tourism industry is largely dominated by Small and Medium Enterprises (SME) that have a relatively high adaptive capacity, the potential to exploit the opportunities are high (Baglee *et al.*, 2012).

Amelung and Viner (2006) projected a decline in the suitability of the Mediterranean for tourism during the summer and a parallel increase in the suitability for tourism in northern Europe. Visitors may be deterred by the projected uncomfortably high temperatures in southern Europe (Defra, 2012a) and, as a result, the UK may capture some of the European tourism market and there may also be a reduction in outbound tourism (Baglee *et al.*, 2012). There may also be a shift in the regional distribution of tourists as, by 2080, the south of England may have a reduced market share, whilst northern England, Scotland and Wales will have an increased market share (Hamilton and Tol, 2007).

Research using the UK Climate Projections 2009 (UKCP09) for the south west of England explored the likely impact of warming temperatures on tourism comfort in the 2020s and 2050s. Tourism Comfort Index (TCI) scores are projected to improve for the whole region for both the 2020s and 2050s with the greatest improvements for the months of June and September (South West Tourism, 2010). However, whilst more visitors could improve the economy and the employment, it could also mean increased congestion and pressure on natural resources and local infrastructure. The South West Tourism work on the TCI is one of a very limited number of studies and research addressing interactions between climate change and tourism is still in its infancy.

However, increased summer temperatures combined with increased periods spent outdoors may lead to an increased risk of skin cancer cases (HM Government, 2012). Coastal and marine tourism operators will need to be alert to the increased health risks associated with visitors being outside in hotter temperatures and take precautions to minimise any health impacts.

The main pressures on the marine environment and ecosystems are climate change and habitat damage and loss

from fishing (HM Government, 2010; Defra, 2011). UKCP09 projects that the UK shelf seas will be 1.5 to 4.0°C warmer by the end of the 21st century and that sea-level rise could range from 12 to 76cm (Murphy *et al.*, 2009). However, increased sea temperatures may lead to increased marine pathogens and harmful algae blooms with a consequent negative effect on human health. *Vibrio* marine pathogens cause nausea, cramps and headaches but are currently rare in the UK. There is currently no overall trend discernable for the microbiological quality of bathing waters (UKMMAS Community, 2010). However, *Vibrio* pathogens are sensitive to temperature and, as sea temperature rises, the number and severity of marine-acquired *Vibrio* infections is expected to increase (Baker-Austin *et al.*, 2010). There is currently no statutory requirement to monitor the incidence and prevalence of non-chlorea *Vibriosis* bacteria that are sensitive to environmental temperatures (HM Government, 2011a) meaning it hard to fully understand the impact on the tourism industry.

Whilst rising sea temperatures and sea-level rise will affect all regions, the threat of increasing coastal erosion and flooding is greatest in the south and east of England where the land is sinking (so relative rates of sea-level rise are greater) and where changes to the marine ecosystem associated with rising temperatures are most apparent (UKMMAS Community, 2010). One of the risks assessed by the CCRA was the monetary losses as a result of an increasing proportion of UK tourist assets at risk from flooding. Whilst this risk assessment also included river flooding, the projections are that there is a low risk of monetary losses for the 2020s but gradually increasing to medium risk for the 2050s and high risk for the 2080s (Baglee *et al.*, 2012).

Rising sea level will result in beach loss (see Table 1) and, particularly in the southern North Sea, may wash away coastal nesting habitat of ground-nesting seabirds such as terns. Any increase in storminess could also lead to nests being washed away during summer or to large-scale mortality during winter (UKMMAS Community, 2010).

Climate models suggest that seasonal mean and extreme wave heights will increase slightly to the south-west of the UK, reduce to the north, and experience little change in the North Sea (Murphy *et al.*, 2009). However, there is very low confidence in storm projections (UKMMAS Community, 2010). Sea-level rise may allow larger waves to hit the shore eroding or damaging coastal structures. In England, the Government expects to invest at least £2.1 billion on flooding and coastal erosion over the next four years (HM Government, 2012).

There have also been a number of policy developments in England with direct relevance for climate change and tourism and marine recreation. In August 2011, England's new biodiversity strategy (Biodiversity 2020: A Strategy for England's wildlife and ecosystem services) was published. It builds on both the National Ecosystem Assessment (UKNEA, 2011) and the Natural Environment White Paper (NEWP) (HM Government, 2011b). Outcome 2 of Biodiversity 2020 specifically relates to marine habitats, ecosystems and fisheries (see Box 1). The rationale behind the outcome is that climate change will add to the pressures from human activities and there is a need to ensure the resilience of biological communities through effective conservation measures (Defra, 2011). Currently, it is not possible to state with confidence whether seas are being used sustainably because it is not possible to assess the cumulative impacts of all activities such as fisheries and leisure and recreation. There also needs to be greater understanding of the value people place on the quality of the marine environment and of the interdependences between climate change and socio-economic drivers.

As well the value people place on the marine environment, there has been an increasing recognition of the value of a healthy natural environment to the economy and that we have been over-using many of our natural assets, including those from the marine environment. The NEWP committed to "creating a green economy in which economic growth and

Box 1. Outcome 2

Marine habitats, ecosystems and fisheries

Source: Defra (2011)

By 2020, we will have put in place measures so that biodiversity is maintained, further degradation has been halted and where possible, restoration is underway, helping deliver good environmental status and our vision of clean, healthy, safe, productive and biologically diverse oceans and seas. This will be underpinned by the following:

- 2A. By the end of 2016 in excess of 25% of English waters will be contained in a well-managed Marine Protected Area network that helps deliver ecological coherence by conserving representative marine habitats;
- 2B. By 2020 we will be managing and harvesting fish sustainably;
- 2C. By 2020 we will have marine plans in place covering the whole of England's marine area, ensuring the sustainable development of our seas, integrating economic growth, social need and ecosystem management.

Table 1: Protected beach loss (area km²). Source: Baglee *et al.* (2012)

	Lower scenario			Upper scenario		
	2020s	2050s	2080s	2020s	2050s	2080s
England	2 km ²	5 km ²	8 km ²	10 km ²	23 km ²	38 km ²
Wales	1 km ²	3 km ²	5 km ²	3 km ²	7 km ²	12 km ²
Scotland	0 km ²	1 km ²	2 km ²	2 km ²	5 km ²	10 km ²
Northern Ireland	0 km ²	0 km ²	0 km ²	0 km ²	1 km ²	1 km ²

the health of our natural resources sustain each other, and markets, business and Government better reflect the value of nature” (HM Government, 2011b). This commitment led to the creation of the independent Natural Capital Committee (NCC). The aim of the NCC is to:

- help the Government better understand how the state of the natural environment affects the performance of the economy and individual well-being; and
- advise the Government on how to ensure England’s ‘natural wealth’ is managed efficiently and sustainably.

The NCC, which will report directly to the Economic Affairs Committee (chaired by the Chancellor of the Exchequer), will produce an annual State of Natural Capital Report providing information on where natural capital is being used unsustainably, with the first report expected in spring 2013.

Recommendations to increase understanding of the potential impacts

Infrastructure, including roads, railways and buildings, located along the coast will become increasingly vulnerable to flooding and inundation events. A better characterization of infrastructures and attractions located within threatened areas should be undertaken to assess just how vulnerable these areas are and the severity of any potential impacts.

In addition, the impact of the predicted increase in tourism numbers needs to be assessed. Many coastal areas have traditionally welcomed tourists in relatively low numbers. Careful consideration is required to assess how these areas can best manage any increases in tourists. Further research is also required to understand and plan for the efficient use of energy and water and the development of appropriate waste management. If resources and natural capital are being degraded through over use, then any growth in tourism and related economic benefits cannot be sustained.

Whilst new risks and opportunities may emerge over the next 100 years as the climate changes are realised, there is still uncertainty related to when they will occur. As well as being proactive in implementing adaptation measures, there needs to be continued monitoring.

On land, the UKCP09 used 30-year time periods centred on 2020s, 2050s and 2080s and a range of emissions scenarios. However, although UKCP09 represented a significant advance from UKCIP02, for the marine environment, projections are only available for a medium emissions scenario and for the 2080s time period. This is as a result of lack of data, uncertainties over climate interactions and the inherent difficulty of modelling the marine environment. The predictions of future changes are largely hypothetical. Also, uncertainty remains over the magnitude and timing of climate change impacts especially at regional and local levels. However, if the tourism sector and others are to effectively adapt to future climate changes, the reliability and accuracy of the projections needs to be improved and enhanced and the links between climate change and impacts on marine ecosystems need to be better understood.

2.2 In the Irish Sea: coastal Wales, Isle of Man and coastal Northern Ireland

Wales

The Welsh Government’s Sustainable Tourism Framework highlights adapting to climate change as being of critical importance to the future of sustainable tourism in Wales (Welsh Assembly Government, 2007). Climate projections suggest Wales may experience increasing average temperatures throughout the year, an increase in average rainfall in winter, a decrease in average rainfall in summer and rising sea levels. As in other parts of the country, hotter summers may boost the tourism industry by attracting larger numbers of visitors both from the UK and abroad. However, the existing high level of threat from tidal and coastal flooding may increase further severely affecting tourism infrastructure. By the 2080s, total beach area loss due to increased coastal erosion and sea-level rise could be between 2 and 8% (Defra, 2012b). In addition, the opportunities for activities such as abseiling and climbing may be reduced due to the increasing precariousness of cliffs.

As in other parts of the UK, coastal tourism in Wales is highly dependent on the quality of the shore and sea environment. Wales is already a popular surfing destination and the warmer summer months may create the right conditions to increase water sports activities and related tourism. The extent and participation in watersports, especially those involving full immersion, is likely to increase under warmer conditions (Pinnegar *et al.*, 2012). However, as a result of sea temperature rise, marine ecosystems may be more vulnerable to harmful viruses and bacteria. This could be particularly significant for marine tourism and limit the ability to exploit the favourable temperature conditions.

Due to the concentration of major towns and cities in coastal areas, the Urban Heat Island effect may be less evident in Wales than in other parts of the UK. Visitors to these areas in the high summer will find conditions more comfortable and this could make these areas more attractive to tourists.

With an already high risk of flooding in Wales, future sea-level rise could exacerbate that risk. The financial implications for the tourism industry are directly linked to the number of tourist assets at risk of flooding (Baglee *et al.*, 2012). As tourist assets are concentrated in certain locations, such as along coastal areas, even localised flooding incidents or sea level rise could have a dramatic impact on the tourism industry.

There are still significant uncertainties over the precise scale and nature of climate change impacts on the unique and particularly vulnerable environments including designated coastal habitats. This should be addressed with some urgency. Future changes in wind patterns and directions are also particularly difficult to predict. However, any changes may increase exposure for certain coastlines but also generate recreational opportunities through enhanced conditions for windsurfing.

Isle of Man

The climate of the Isle of Man is significantly controlled by the surrounding marine climate. As conditions change in the Irish Sea, the Isle of Man is expected to get warmer, especially during the summer months. The tourism sector will benefit from an extended season and a more attractive overall climate for visitors. Potential issues resulting from an increase in visitor numbers and the potential impacts that climate change might have on tourism infrastructure have been identified (Firth and Hutchins, 2006). For example, the transportation system needs to be improved and the existing accommodation modified to increase protection against storm surge, floods and other extreme events.

The Isle of Man has many unspoilt beaches popular with visitors. Sea-level rise across the whole UK is predicted to result in a loss of 3 to 16km² of beach by the 2020s and 12 to 61 km² by the 2080s (Baglee *et al.*, 2012). However, the actual impact will vary regionally depending on geomorphological conditions. Any reduction in beach area will contribute to increased pressure for space on beaches where demand is already high which could result in overcrowding and, subsequently, dissuade visitors. Other, less vulnerable beaches could become more popular.

As fishing is a major tourist activity on the island, a warming sea and a warming climate may threaten the industry. Toxic algal blooms are already being monitored, as they are across the UK, and they are predicted to increase in number and severity in the forthcoming decades (Defra, 2005). This will endanger the marine life and especially shellfish which is important not only for the fishing industry but also for tourism.

The coastline of the Isle of Man is rich in marine life. The Irish Sea contains important populations of sea birds, fish and cetaceans including the bottlenose dolphin, grey seals and basking sharks. Diving and wildlife watching activities are prominent on the island and are responsible for a significant share of the tourism sector. The predicted increase in sea surface temperature is expected to have a serious impact on cetaceans and fish predators (Sea Watch Foundation, n.d). Smaller increases in temperature may have local impacts on the primary productivity of the Irish Sea and thus a local impact on potential food for cetaceans. A shift in plankton distribution and abundance will have implications for seals, dolphins and sharks in the area surrounding the Isle of Man which may have a knock-on impact for the popular wildlife-watching tourism operators.

Republic of Ireland

Climate change in Ireland is projected to result in warmer, drier summers, milder, wetting winters and rising sea levels. The summer and autumn are projected to warm much faster than winter and spring (Sweeney *et al.*, 2009). The temperate climate should be capable of absorbing the predicted changes in climate without resulting in unacceptable comfort levels for visitors. Warmer weather will make golf more attractive as an activity. But erosion of links courses due to rising sea levels and stormier conditions is already a significant

problem. Charter boat trips for angling, whale and bird watching, kayaking, sailing and cruising are all affected by poor weather conditions which may become worse in years to come.

Coastal flooding, caused by a combination of sea-level rise, storm surges and increased wave energy, and the resultant coastal erosion will be more widespread (Heritage Council and Fáilte Ireland, 2009). The cities and towns of Ireland are nearly all located by the coast, or on a large river, or both (Irish Academy of Engineering, 2009). Rising sea levels and more frequent and higher storm surges will expose Ireland's coastline to a greater risk of erosion and expose coastal defences to potential damage or collapse.

As changes to the climate affect the natural heritage, then they will also have implications for Ireland's tourism industry. For example, the Atlantic salmon is an important tourism resource and is likely to be greatly affected by a rise in water temperature (Heritage Council and Fáilte Ireland, 2009). In addition, seals may be affected by rising sea levels as their traditional haul out and breeding sites become flooded (*ibid*). However, more whales and dolphins are being sighted off the Irish coast and leatherback turtles are also predicted to become more frequent visitors.

A changing climate can also provide opportunities. However, a recent Fáilte Ireland publication on innovation in tourism (Fáilte Ireland, 2012d) does not mention climate change either as a reason to be innovative or as providing an opportunity to innovate activities and operations.

Northern Ireland

The weather in Northern Ireland is predicted to become warmer overall (between 1 and 3.5°C by the end of the 2080s), including milder autumns and winters, and, as a result, become more welcoming to international visitors (Murphy *et al.*, 2009). Warmer, drier summers and milder autumns and winters may extend the length of the traditional tourist seasons and make the country a more attractive destination providing new and additional opportunities for the industry.

Climate change might not create new risks but instead change the frequency and severity of the risks faced. Climate change may increase the vulnerability of coastal and marine environments. Extreme weather is predominant among potential risks related to climate change but other risks, such as increased coastal erosion, are increasing. An increased frequency in extreme events could cause disruption and reduce opportunity for transport affecting the transport of tourists (Baglee *et al.*, 2012).

Flooding (including coastal flooding) is possibly the single greatest climate change concern for businesses in Northern Ireland (Climate Northern Ireland, no date a). For the CCRA, it was not possible for the financial impact of flooding on tourism assets to be fully assessed (Baglee *et al.*, 2012), nor to calculate a response function for tourism assets at risk of flooding owing to a lack of detailed information on the location of the assets and the corresponding flood risk especially for Scotland and Northern Ireland (Ramsbottom *et al.*, 2012). However, flood frequency data indicates tourist

assets at risk of flooding on the coast could be inundated between three and five times more frequently by the 2080s if adaptation measures are not implemented (ibid).

Further sea-level rise could result in increased erosion and coastline retreat, impacting tourism and natural resources such as intertidal habitats. Beaches and tourist facilities may be at increasing risk. For example, beach area loss due to sea-level rise could be up to 100 ha by the 2080s (Defra, 2012c).

Fishing around the whole of the UK may be markedly different in years to come. There could be a very different mix of fishes including some species currently not native (UKMMAS Community, 2010). In addition, increased water temperatures can be lethal to fish such as salmon. However, there are no detailed predictions due to the complexity of the relationship between climate and distribution.

As many of the threats from climate change are closely linked and interrelated, they should not be considered in isolation or solely by Government. There is a need for coordinated adaptation plans and the inclusion of climate change risk assessments in business and emergency planning. To address the threats and build capacity, integrated coastal zone management will be increasingly important (Climate Northern Ireland, no date b).

Recommendations to increase understanding of the potential impacts

There has now been a Preliminary Flood Risk Assessment for Northern Ireland which suggests that 1,000 properties each year are at risk from coastal flooding (Climate Northern Ireland, no date b). However, to date, this information has not been translated into a strategy to help prepare the country and the coastal tourism sector to cope with the risks.

Compared to other countries, there is still a lack of data for Northern Ireland making it harder to predict the potential impacts of future climate change. As with other countries within the UK, there are now statutory requirements for climate change adaptation in Northern Ireland contained in the UK Climate Change Act 2008. The first Northern Ireland Adaptation Programme is currently being prepared by a Cross Departmental Working Group on Climate Change (Climate Northern Ireland, no date b). The aim is to address the risks identified in the CCRA by mainstreaming adaptation actions and building adaptive capacity across Government departments. It will then be essential that the SME that are so important to the economy in Northern Ireland, especially those in the tourism sector, are supported.

2.3 In coastal Scotland: the West Coast, the Minch and the Northern North Sea

Scotland is currently reviewing its natural tourism strategy. VisitScotland (2012) is keen that domestic tourism (from both Scottish and other UK markets) is further encouraged. However, as international visitors account for just 16% of trips to Scotland yet contribute 35% of the total visitor spend (VisitScotland, 2012), it is this segment of the market that should be further exploited. In addition, The Government Economic Strategy identifies seven growth sectors, based

Table 2: Changes to the Scottish climate by 2050 under a medium emissions scenario. Source: Murphy et al. (2009)

Region	Temperature	Precipitation
Eastern Scotland	2.3°C warmer	10% wetter
Northern Scotland	2.0°C warmer	12% wetter
Western Scotland	2.4°C warmer	15% wetter

on opportunities due to existing comparative advantages or through the potential to capitalise on unique natural assets, including sustainable tourism (Scottish Government, 2011a).

It is predicted that, over the coming decades, changes in climate will cause more frequent extreme weather events in Scotland (Murphy *et al.*, 2009). There will also be incremental changes which, though less obvious, will present adaptation challenges. The UK Climate Projections 2009 (UKCP09) suggest Scotland will get warmer, wetter winters and hotter, drier summers (see Table 2) (Murphy *et al.*, 2009). The UKCP09 also suggest that, over the next century, sea level around Scotland will rise due to both global heating and expansion of ocean water and melting ice sheets. However, in most of Scotland the land surface is actually rising due to post-glacial rebound. This is not happening rapidly enough to negate sea-level rise but it does reduce the absolute levels (Scottish Government, 2009).

The warmer summer temperatures may encourage more outdoor recreation and tourism and increases in sea temperature may increase coastal tourism. Water sports such as kayaking, canoeing, surfing and yachting are very likely to benefit from any increases in summer temperatures and the tourism season is likely to be extended by several months. However, sea-level rise and an increase in the intensity of storms will increase the risk of coastal flooding and threaten coastal habitats. Mudflats, saltmarsh, sand dunes and other coastal habitats are vulnerable to sea-level rise especially where there is no space for them to move inland (Scottish Natural Heritage, 2012). However, these habitats are important for natural coastal defence and their erosion will reduce their contribution and potentially result in an increase in coastal flooding. Coasts will be disproportionately affected by climate change, so more resources are required for adaptation on coasts (Scottish Government, 2011d).

Since the mid-1980s, sea temperature warming has been more pronounced in the Minches and Western Scotland (UKMMAS Community, 2010). These changes may lead to shifts in the location of fish stocks and increased sea temperatures may increase the risk of marine pathogens harmful to human health. The wetter weather and increase in extreme events may increase weathering of coastal paths impacting access (Scottish Natural Heritage, 2012). Although highly uncertain, the wave climate in winter may roughen and this could cause more frequent disruption to ferry services off north west Scotland and across the Irish Sea (Pinnegar *et al.*, 2012). The economic cost of adverse wave climate in the Western Isles of Scotland is currently about £10 million per annum (Woolf *et al.*, 2004).

The predicted increase in extreme events will have an impact on insurance companies which may have a knock-on impact on Small and Medium Enterprises (SME) (Scottish Government, 2011b). Globally, insurers have observed an upward trend in weather-related insured losses due to the increase in frequency and intensity of extreme weather events and the increasing economic cost associated with them (Climate Wise, 2012).

Vulnerability to climate variability is partly a function of the inherent capacity to adapt. To ensure effective, co-ordinated planning and ensure that Scotland is as resilient as possible to the future impacts of climate change the Government has produced Scotland's Climate Change Adaptation Framework (Scottish Government, 2009). The aim of the Framework is to improve understanding of the impacts; equip stakeholders with the skills and tools needed to adapt; and integrate adaptation into wider regulation and policy (ibid). In addition, sector-specific action plans have recently been produced. The Business and Industry sector Action Plan focuses on the seven key sectors highlighted in the Government Economic Strategy including tourism (Scottish Government, 2011b). Businesses need to be in a position to manage the risks and also ready to take advantage of new opportunities. It is fundamental that climate change is reflected in visitor and recreation management plans.

Like in England, there is a new framework for managing the seas provided by the Marine (Scotland) Act 2010. The Act includes the legal duty to develop a Marine Protected Area (MPA) network which can be adapted over time including flexibility on site boundaries. This will require a better understanding of ecosystems and the ecosystem services which underpin the socio-economic uses of the sea including how climate change and factors such as temperature rise will affect them (Scottish Government, 2011c). There will also need to be a periodic review of the MPA network in response to climate change (ibid).

Recommendations to increase understanding of the potential impacts

Warmer summer temperatures will benefit small coastal towns and islands in Northern Scotland bringing additional economic activity to these locations. Particular attention should be paid to the transport network which is mainly made up of ferry links and coastal roads. Increased risks of extreme weather events such as coastal flooding and landslides could cause damage and disruption to fragile island and remote communities who rely on inbound tourism. For example, the value of tourism in the Western Isles, which is mainly coastal in nature, is estimated at £50 million per annum (Taylor *et al.*, 2010).

The impact of climate change on both commercial and recreational fish stocks and fisheries is complex and still not fully understood. To support recreational fisheries, there needs to be long-term monitoring or water quality, sea temperatures and fish populations to assess environmental and fish population changes as a result of climate change.

Warming seas could also further alter the distribution of marine species of importance for marine wildlife watching

and angling. As these segments are so financially important to Scottish tourism, it is vital that particular attention is paid to further understanding the potential impacts.

3. KNOWLEDGE GAPS

In order to fully understand the impact of marine climate change on coastal tourism and marine recreation it is essential to address the following knowledge gaps:

a. As the summers become warmer and the winters milder, the UK will become a more attractive destination for tourists – both from Europe and domestically. Research using the UKCP09 and the Tourism Comfort Index (TCI) predict that the south west will be come 'ideal' for tourism during the summer months. However, this does not translate into a prediction for visitor numbers. Further research is required into visitors' preferences especially relating to the reasons for visiting certain locations and how these might change as the climate changes. This should also include assessment of the carrying capacity of sites as any increases in tourism could have a detrimental impact on existing infrastructure.

b. Climate change is predicted to increase coastal flooding and erosion through sea-level rise and an increase in extreme events. Tourism operations and infrastructure are often clustered in coastal locations. There needs to be more detailed vulnerability mapping of the potential impacts to identify where and how to target adaptation. This should then be followed by strategies with clear, deliverable actions.

c. There are inherent difficulties in modelling the marine environment and uncertainty remains over the magnitude and timing of climate change impacts. This, coupled with lack of understanding on the complex marine ecosystem interactions, means it is very hard to predict how marine ecosystem processes may react. Harmful marine pathogens, the northward migration of fish species and the changing distribution of marine species of importance for wildlife watching could all have a devastating impact on tourism. It is vital further attention is paid to understanding marine processes in the face of climate change.

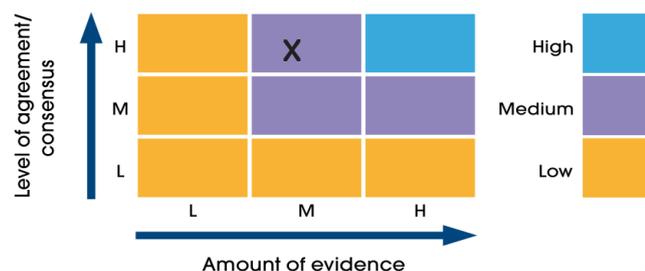
4. SOCIO-ECONOMIC IMPACTS

The paper already deals with socio economic and environmental impacts of climate change on tourism and marine recreation.

If the UK experiences milder, colder seasons and more reliable summers in line with the current predictions, the tourism season will be extended. This will provide increased opportunities for more year-round employment rather than the traditional seasonal work. However, increased coastal flooding and extreme events may deter visitors. Incremental change in climate that impact on species distribution will also have an impact on angling and wildlife-watching. These changes could result in significant costs for tourism operators. In addition, if marine and coastal tourism resources and natural capital are being degraded through over use and exploitation, then any growth in tourism and related economic benefits can not be sustained.

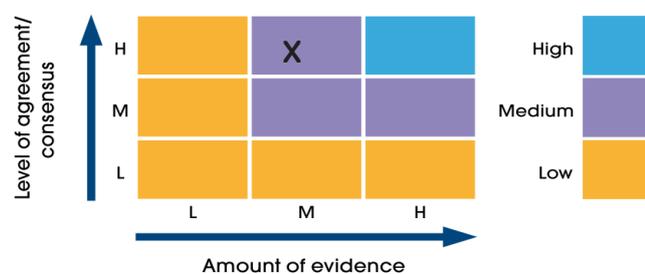
5. CONFIDENCE ASSESSMENT

What is already happening?



In the UK, research into the impact of climate change on coastal tourism and the impact on visitor numbers is still a relatively recent discipline. However, changes in the marine climate have been observed in a significant number of regions and countries. The relationship between climate change and the impacts on marine and coastal tourism is increasingly accepted by the scientific community and there is growing evidence of the general population shifting their tourism preferences in line with changes in climate.

What could happen?



Research into the effect of changes in the marine climate and the impacts on tourism is ongoing. Due to uncertainty in the climate predictions and even greater uncertainty in how tourists and the tourism sector will adapt to climate changes, it is not possible to explicitly predict how the tourism sector will be affected. However, several models, research and studies have all suggested similar impacts which have also started to be observed in some regions and countries of the UK. The UK is expected to have increased numbers of visitors due to the air and sea temperatures become more stable and reliable during the summer months.

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