The Arctic Marine Climate Change Impact Fact Sheet – A draft project plan

Version 30th Sept. 2018 for PAME-2-2018

Project goals

- To leverage and synthesize factual information from the Arctic Council's work in a layman's format to communicate to decision makers and the public
- Each fact sheet should preferably consist of 4-8 pages
- Contribute to cross-working groups cooperation on common topics
- Contribute to the outreach aspect of the Arctic Council and ensuring close collaboration with the Arctic Council Secretariat
- At the 3rd PAME MPA workshop the experiences of the UK Marine Climate Change Impact Partnership's Annual Reporting Card whas presented.
- The UK experience would be useful for PAME since the Fact Sheet is likely to be similar to the UK's product

Main products

It is proposed that this project be developed in a stepwise approach by starting on the following activities/work packages:

1. Develop a template/outline for the factsheets based on the proposed structure

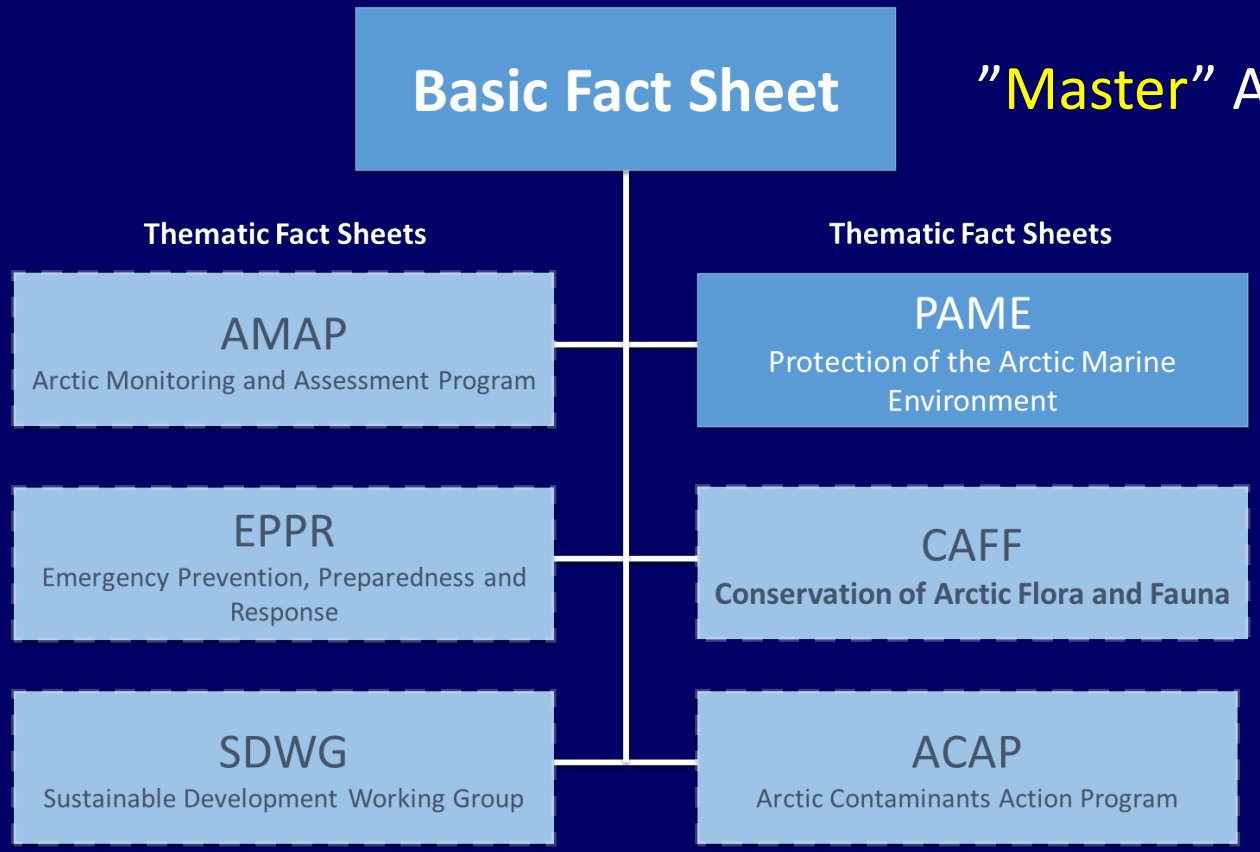
2. Develop a “master” Arctic Council fact sheet on Arctic climate change impacts

3. Develop the 1st thematic factsheet on Arctic climate change impacts on MPAs and indigenous people’s lives based on the “master” fact sheet.

4. The design and the desktop editing and publishing of the final products

Following are examples of possible thematic factsheets that could be developed in collaboration and coordination with Arctic Council working groups. All thematic factsheets would be based on the “master” template

Main products



”Master” Arctic Council fact sheet

PAME: Develop the 1st thematic factsheet on Arctic climate change impacts on MPAs and indigenous people’s lives

At the last PAME meeting (PAME-1-2018)

- It became obvious that recent AMAP and CAFF activities resonate well with this type of Fact Sheet, e.g. the CAFF's State of the Arctic Marine Biodiversity report, and AMAP's climate change impact assessments
- We also realised that this Fact Sheet could be a joint product used by the Arctic Council, produced by several or all of the working groups
- Representatives of AMAP and CAFF expressed their interests to be involved
- In June 2018 the AC Sec. expressed its interest to be involved, but this must be re-confirmed due to personnel changes at the AC Sec.

Steps taken prior to PAME-2-2018

- *PAME Secretariat facilitated discussion at the March Working Group Chairs' meeting regarding idea to develop fact sheet(s) and how to collaborate and coordinate across Working Groups*
- *Based on outcomes of the Working Group Chairs' meeting, PAME Project Proposer(s) to draft proposal in cooperation with other relevant Working Groups with the goal of developing a joint Working Group proposal to be made available in advance of Fall 2018 Working Group meetings*
- *Preliminary in-official discussions with AMAP at the Arctic Resilience Forum in August 2018*

Next steps

- *PAME Project Proposer(s) to update PAME on progress at PAME II-2018*
- *PAME Secretariat, in cooperation with other Working Group Secretariats, to coordinate submission and presentation of a joint proposal to Fall 2018 SAO Meeting*
- *PAME Secretariat to coordinate with other relevant Working Group Secretariats on the identification of potential funding opportunities and development of draft funding proposals, as appropriate*
- *National funding opportunities should be explored as soon as possible (FI and NO indicated that funding might be available depending on the outcome of PAME-2-2018*

Thanks!

Example extracts from the UK MCCI Cards

UK Marine Climate Change Impacts Partnership's Reporting Card

2015

www.mccip.org.uk/mbl

MCCIP Marine Climate Change Impacts Partnership

Marine climate change impacts

Implications for the implementation of marine biodiversity legislation

This Report Card looks at climate change and marine biodiversity legislation, with a focus on the legislation used to establish various types of marine protected areas.

Pink sea fan *Eunicella verrucosa* © Keith Hiscock

Key headlines

Climate change is rarely explicitly considered in marine biodiversity legislation, but mechanisms generally exist that could enable climate change issues to be addresse

The potential impacts of climate change on marine protected areas include feature being gained to or lost from sites and, in certain cases, the entire network.

Flexibility is required in responding to climate change impacts on marine protected areas so options such as designating new sites, abandoning old sites and revising management measures may all need to be considered.

With over 1,250 designated features in the UK marine protected area network, identi where and how these habitats and species are likely to be affected by climate chan will be a critical step in managing marine protected areas.

At the current stage of development for the Marine Strategy Framework Directive, further practical consideration of how climate change could affect targets for the achievement of Good Environmental Status is required.

How can marine protected areas and networks help address climate change?

Work in the United States by the National Oceanic and Atmospheric Administration (NOAA)* has identified that the long-term, site-based nature of marine protected areas provides a distinct advantage in addressing the impacts of climate change.

Marine protected areas do this by:

Providing a focal area where scientific monitoring can take place and the effectiveness of management measures can be assessed.

Water sampling 'rosette' being retrieved from the sea © Dave Sivyer. Crown Copyright.

Providing areas where non-climate stressors can be reduced, potentially leading to beneficial effects outside of the site, such as the protection of bordering habitats and enhanced production of marine species that "spillover" into outside areas.

Providing ecologically connected corridors for shifting species and habitats, with networks of marine protected areas facilitating the range shifts of populations.

Reducing risk and promoting resilience by encouraging as high levels of diversity as possible.

Acting as control areas or sentinel sites for the monitoring of climate change and other impacts, particularly where human activities are controlled and long-term monitoring is used to identify trends.

Protecting habitats that can help mitigate climate change impacts by storing carbon (e.g. salt marshes and seagrass beds).

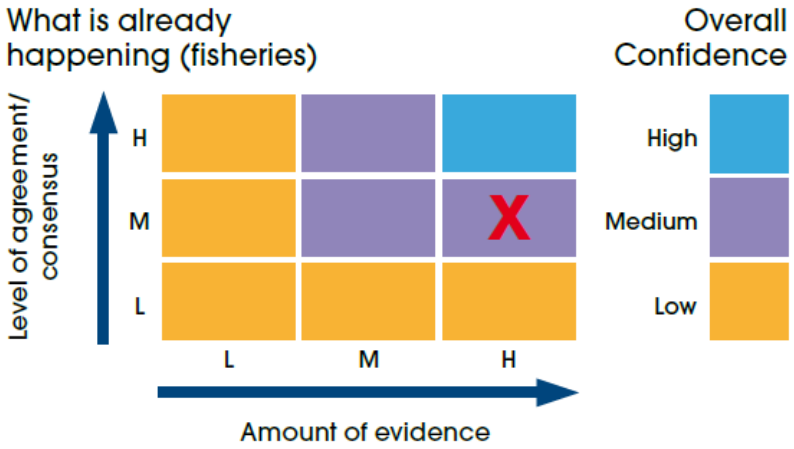
Utilising the involvement of stakeholders and local communities to promote public education on marine climate change impacts.

UK Marine Climate Change Impacts Partnership's Reporting Card

Confidence assessments

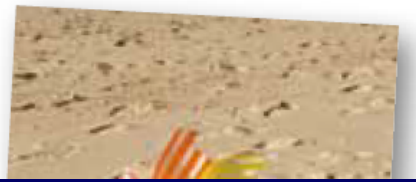
Contributing authors were asked to consider the level of confidence in the science for 'what is already happening' and 'what could happen in the future' for their specialist topics.

Authors were asked to mark an 'X' in the following grid to indicate the current level of confidence in the science, based on 'level of agreement / consensus' and the 'amount of evidence available' (see below for an example from the fisheries topic for 'what is already happening'):



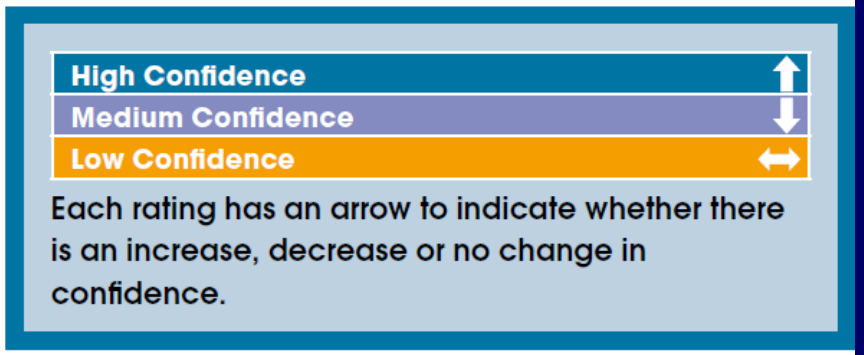
In each of the full, peer-reviewed topic submissions, a rationale is provided explaining why the authors have assigned a low, medium or high level of confidence.

It is important to note that the confidence assessments are for each topic taken as a whole rather than for the specific headlines included in this summary report card.



Changes in confidence since the 2007–2008 Annual Report Card

Changes in the overall level of confidence since the 2007–2008 Annual Report Card are shown as arrows within the confidence bars for each topic.



Confidence may go up or down due to new data and model outputs becoming available or through changes in understanding of the science.

The majority of confidence ratings have stayed the same since 2007–2008. However, nine have gone up, whilst six have gone down.

2009 MCCIP Ecosystem Linkages Report Card

The 2009 MCCIP Ecosystem Linkages Report Card looked at five key issues (CO_2 and ocean acidification, Arctic sea-ice loss, seabirds and food webs, non-native species, and coastal economies) to show how the interconnected nature of the marine ecosystem magnifies the many discrete impacts of climate change, documented in the MCCIP Annual Report Cards.

UK Marine Climate Change Impacts Partnership's Reporting Card

	WHAT IS ALREADY HAPPENING	WHAT COULD HAPPEN
Temperature (Air and Sea) *Marine Scotland; NOC; Cefas; IMGL; MOHC; PML; SAMS*	**High Confidence** ↔ • Marine air and sea surface temperatures have risen over the north-east Atlantic and UK waters in the last 25 years. • The largest increase in air temperature has been over the southern North Sea at a rate of around 0.6° C per decade. • The largest increases in sea surface temperature have occurred in the eastern English Channel and the southern North Sea at a rate of between 0.6 and 0.8° C per decade. • **Although temperatures are generally increasing, inter-annual variability is high. 2008 UK coastal sea surface temperatures were lower than the 2003–2007 mean.**	**Medium Confidence** ↓ • **Models project that temperatures will continue to rise in UK and north-eastern Atlantic waters up until at least the 2080s. However, in the next 10 years, natural oceanic and atmospheric variability make it difficult to predict whether temperatures will go up or down.**
Storms and Waves *ERI; NOC*	**Medium Confidence** ↓ • **Natural variability in wave climate is large and the role of anthropogenic influence is unclear.** • Increases in monthly mean and maximum wave height in the north-eastern Atlantic occurred between 1960 and 1990; however, this rise in wave height may be part of long-term natural variability. There has been no clear pattern since 1990.	**Low Confidence** ↔ • **There is no consensus on the future storm and wave climate for north-western Europe, since projected future storm track behaviour varies among atmospheric models.** • **Predictions of storm behaviour used by the UKCP09 wave model show storm tracks moving south, resulting in lower wave heights to the north of the UK and slightly larger wave heights in some southern regions, especially the south-west.**
Sea Level *NOC; MOHC*	**High Confidence** ↔ • Global sea level has risen at a mean rate of 1.8mm per year since 1955. From 1992 onwards a higher mean rate of 3mm per year has been observed. • **Sea-level rise measured over the UK is consistent with the observed global mean.**	**Medium Confidence** ↑ • Projections of change in the UK suggest a rise of between 12 and 76cm by 2095, compared to a 1980–1999 baseline. This approximately equates to rates of between 1.2 and 7.6 mm per year respectively. • Considering projected land movements, a greater rise in southern regions of the UK is likely relative to the north.
Ocean Acidification *PML; Bristol University; MBA*	**High Confidence** ↔ • The ocean is becoming more acidic as increasing amounts of atmospheric carbon dioxide (CO_2) are absorbed at the sea surface. Models and measurements suggest about a 30% decrease in surface pH (an increase in acidity) and a 16% decrease in carbonate ion concentrations since 1750. • **The rate of change in pH is faster than anything experienced in the last 55 million years and is causing concern for marine ecosystems and species.**	**Medium Confidence** ↔ • Oceans will continue to acidify with increasing CO_2 emissions. • Whilst we have high confidence that ocean acidification will continue, subsequent impacts on ecosystems are less well understood. • Future increases in ocean acidity may have major negative impacts on some shell and skeleton-forming organisms by 2100.
Atlantic Heat Conveyor *NOC; Cefas; MOHC; Reading University*	**Medium Confidence** ↑ • Daily observations of the Atlantic heat conveyor began in 2004, revealing substantial daily to seasonal variability. At present the record length is too short to determine inter-annual variability or longer-term trends. • **Observations and ocean models provide some evidence for recent slowing at some latitudes, during the 1990s and early 2000s. However, we do not yet have compelling evidence for a direct influence of changes in the Atlantic heat conveyor on climate in and around the North Atlantic over recent decades.**	**Medium Confidence** ↑ • It is very likely that the Atlantic heat conveyor will slow this century, with models predicting an average 25% reduction of pre-industrial strength.
Salinity *Marine Scotland; Cefas; IMGL; NOC; PML; SAMS*	**Medium Confidence** ↔ • The shelf sea and oceanic surface waters to the north and west of the UK have become relatively more saline since the 1970s. There are no clear trends in the shelf sea waters of the Irish Sea, southern North Sea and western Scotland. • **Salinity of the deep waters of the North Atlantic decreased between 1960–2000 but has been stable for the last decade.**	**Low Confidence** ↔ • **The salinity of shelf seas and oceanic surface waters may decrease slightly, though there are considerable uncertainties due to the influence of climate-driven changes in precipitation, evaporation, ocean circulation and ice-melt.**

UK Marine Climate Change Impacts Partnership's Reporting Card

by existing models.

Coastal Erosion
University of Plymouth

High Confidence ↔

- Coastal erosion is a complex process that has a variety of causes, with rising sea level being only one of them. Whereas climate change and relative sea-level rise are global and regional phenomena, respectively, coastal erosion is a local process.
- Currently, around 17% of the UK coastline experiences erosion (30% of the coastline in England; 23% in Wales; 20% in Northern Ireland; 12% in Scotland).
- Where the coast is protected by engineering structures (46% of England's coastline; 28% Wales'; 20% Northern Ireland's and 7% of Scotland's is protected by artificial structures), steepening of the intertidal profile and a narrowing of the intertidal zone resulting from rising sea levels commonly occurs.

Low Confidence ↔

- Both coastal erosion and steepening of intertidal profiles are expected to increase in the future, due to the effects of sea-level rise and changes to wave conditions.

Air-sea Exchanges of CO_2
PML; Cefas; UEA

Low Confidence NEW

- The ocean removes about one quarter of atmospheric CO_2 emissions from human activity.
- Some areas of the ocean absorb more CO_2 than others; some areas release CO_2 back to the atmosphere.
- The north-west European shelf seas are thought to be an area of CO_2 uptake.
- The efficiency of CO_2 uptake by some areas of the ocean, including the north-east Atlantic, may be decreasing.

Low Confidence NEW

- Increases in atmospheric CO_2 will drive an increase in the CO_2 content of the surface waters of the ocean. This is expected to increase the partial pressure of CO_2 to double its pre-industrial level by 2050.
- The proportion of CO_2 from anthropogenic emissions taken up by surface waters may decrease as sea surface temperature rises (reducing solubility) and CO_2 content increases (reducing buffering capacity). Other processes that affect CO_2 uptake are less well understood (e.g. stratification, upwelling, ocean circulation and primary production).

Air-sea Exchanges of Heat and Water
NOC

Low Confidence ↔

- The exchanges of heat and water between the ocean and the atmosphere play an important role in driving variability in the circulations of both the atmosphere and the ocean.
- An increase in ocean heat content has been identified, both globally and for the North Atlantic since 1960 (with an estimated upper limit of about 0.5 watts per square metre).

Low Confidence ↔

- Obtaining reliable predictions of future changes in the air-sea heat and freshwater fluxes in the UK marine environment is difficult as the anthropogenic signal is small and may be strongly influenced by changes due to natural variability in the climate system.

UK Marine Climate Change Impacts Partnership's Reporting Card

	WHAT IS ALREADY HAPPENING	WHAT COULD HAPPEN	CONFIDENCE
Plankton SAHFOS	• A 1000 km northward shift of warmer-water plankton, with a similar retreat of colder-water plankton, has been observed in the north-east Atlantic over the past 40 years as the seas around the UK have become warmer. • There is a correlation between plankton shifts and changes in various fish stocks.	• Continued increase in sea temperature and ocean acidification may exert a major influence on plankton variability, with implications for primary production and climate control.	MEDIUM
Fish MBA	• Abundances of some warm-water fish species (e.g. tuna, stingrays, triggerfish) have increased in southern UK waters during recent warming periods (1950s, 1980s – 2002), while declines were apparent during cooling episodes (1920s, 1960 – 1970s). Observations of rare fish migrants to UK waters cannot be directly attributed to climate change. • Cold-water species have retracted north in some regions (e.g. North Sea) but not in others.	• Continuing temperature rises are likely to further change fish distributions.	LOW
Marine mammals SMRU	• There is little useful information on the effects of climate change on marine mammals.	• There appear to be no special circumstances that suggest marine mammals around the UK should be severely affected. • Sea-level rise may affect current haul-out sites for seals, but the rate of change and creation of new sites may allow their populations to adapt. • As top predators in the food chain, marine mammals may be impacted by changes affecting the food chain that supports them.	LOW
Seabirds JNCC, CEH	• Poor breeding success, reduced survival and population declines of black-legged kittiwakes in recent years have been strongly linked to climate change, in particular to warmer winters and changes to their fish prey populations (e.g. sandeels). Evidence suggests other species may have been similarly affected.	• Further declines in some seabird populations are expected. • Anticipated sea-level rise may reduce available breeding habitat for shoreline-nesting species (e.g. terns). • Potential increased storminess could detrimentally affect cliff-nesting colonies of seabirds.	MEDIUM
Non-native species Cambridge University, SAHFOS	• New marine life is arriving into our waters both by migration and by human introduction. • The number of different non-native species is increasing in marine habitats and some are causing major ecological changes. • Distributions of non-native species are currently limited by water temperature. • Warmer UK waters over the last three decades are facilitating the establishment of some of these species.	• Future temperature increases could enable a wider range of species to invade and become established.	MEDIUM

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	WHAT IS ALREADY HAPPENING	WHAT COULD HAPPEN	CONFIDENCE
Intertidal species MBA, MECN	• Southern, warm-water species on rocky shores in the UK have increased in abundance and range with rising temperatures (e.g. purple acorn barnacle has extended its range by 170 km since the mid 1980s), whilst northern, cold-water species (e.g. common tortoiseshell limpet) have decreased in abundance.	• Continued extension and retraction of ranges with rising temperatures of southern and northern species respectively. • Some new species will become established whilst others will disappear from our shores.	MEDIUM
Seabed ecology University of Liverpool, MECN	• Climate processes such as sea temperature and waves can directly influence the abundance and species composition of seabed communities. • Localised effects through fishing impacts, habitat modification and contaminants are also important and make it difficult to assess the influence of climate change.	• Unknown.	LOW

UK Marine Climate Change Impacts Partnership's Reporting Card

Climate change: impacts on our vision for **commercially productive** seas

The impacts of climate change on the commercial services provided by our seas are expected to be significant. Sea-level rise, coastal flooding and storms and waves could affect ports, shipping and built structures. Fishing and fish farming will be impacted by temperature change and plankton availability. Rising temperatures should have some positive impacts on coastal tourism and marine recreation, whilst retreating Arctic sea ice may open up new (seasonal) shipping routes.

To access the full peer reviewed reports, go to: www.mccip.org.uk/arc/productive

Where headline messages under each topic are new for 2010-2011, they are highlighted in bold text. Arrows show change in confidence since the 2007-2008 MCCIP Annual Report Card. Where a topic is referred to in the 'regional snapshot' map, a map symbol appears.

	WHAT IS ALREADY HAPPENING	WHAT COULD HAPPEN
Shipping *DfT; University of Plymouth*	**Low Confidence** ↔ • **Retreating Arctic sea ice is increasing the accessibility of the 'Northern Sea Route' between Europe and Asia for a limited period of the year. In September 2009, two cargo ships symbolically utilised the 'Northern Sea Route'.**	**Low Confidence** ↔ • **Sea-level rise of the magnitude projected by UKCP09 will increase the vulnerability of port operations to flooding.** • Future changes to wind speed and storminess could lead to reduced loads, route changes and restrictions for some ships.
Tourism *Oxford University*	**Medium Confidence** ↓ • Climate change is increasing the frequency of months when conditions are more comfortable for tourists in north-west Europe than in the Mediterranean.	**Medium Confidence** ↑ • **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 watersport opportunities.** • **Increased visitor numbers could overwhelm small coastal communities with implications for energy, water and waste management and environmental degradation.** • **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.**
Built Structures *ABPMer; Cefas*	**Low Confidence** ↔ • **100-year analyses of both mean and significant wave heights are typically used to inform design criteria for offshore built structures such as oil installations. These studies reveal a high degree of natural variability in wave climate, which makes interpreting the impacts of climate change on offshore built structures very difficult.** • **There is limited published evidence that climate change has led to changes in operational practices of offshore installations.** • Sea-level rise has affected the planning of coastal structures.	**Low Confidence** ↔ • Continued sea-level rise, changes to significant wave heights and any change to storminess could have an adverse impact on built structures. • Any change in currents will affect structure erosion and patterns of scour both in coastal and offshore areas. • **Based on the UKCP09 projections only, built structures located in the southern North Sea and the Irish Sea and North Channel regions will be impacted the most by changes in winter significant wave height.**
Fisheries *Cefas; Strathclyde University; UEA*	**Medium Confidence** ↔ • **There is evidence that locations where high catches of cod, haddock, plaice and sole occur, have moved over the past 80-90 years. Climate change may be a factor but fishing and habitat modification have also had an important effect.** • **Shifting distributions of fish, partly as a result of climate**	**Low Confidence** ↔ • **The UK is expected to benefit from slightly (i.e. + 1–2% compared to present) higher fishery yields by 2050, although the Irish Sea and English Channel may see a reduction.** • **Models suggest that cod stocks in the Celtic and Irish Seas might disappear completely by 2100, while those in the North**

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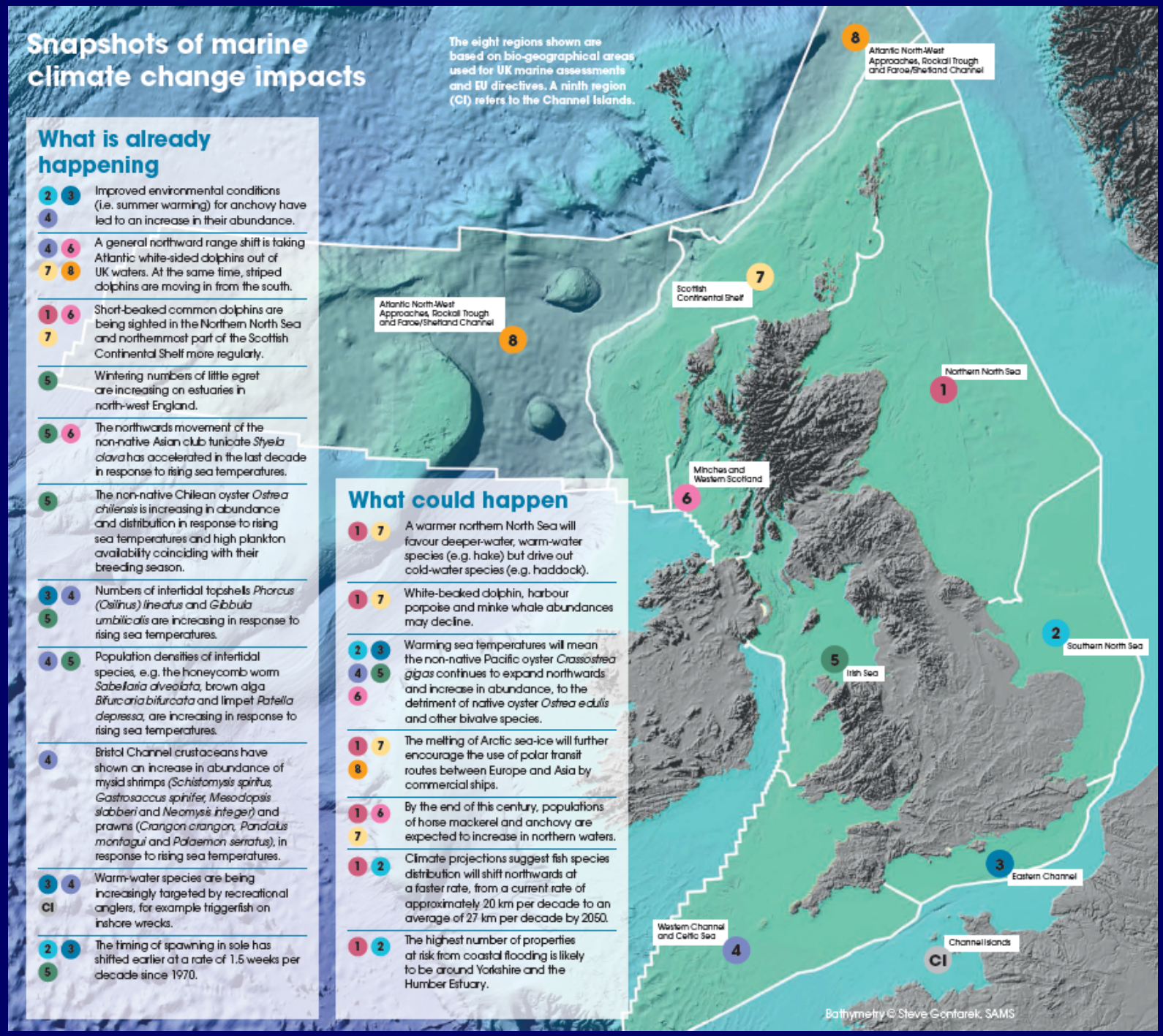

Thanks again!