

# Ocean Acidification – Connecting the Science to Policy

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## Second Symposium on the Ocean in a High-CO<sub>2</sub> World

- Scenarios of ocean acidification
- Impacts on benthic and pelagic calcifiers
- Ocean carbon system – past and present
- Effects of ocean acidification on nutrient and metal speciation
- Mechanisms of calcification
- Physiological effects: from microbes to fish
- Fisheries, food webs, and ecosystem impacts
- CO<sub>2</sub> disposal
- Adaptation and microevolution
- New concerns
- Biogeochemical consequences and feedbacks to the Earth system

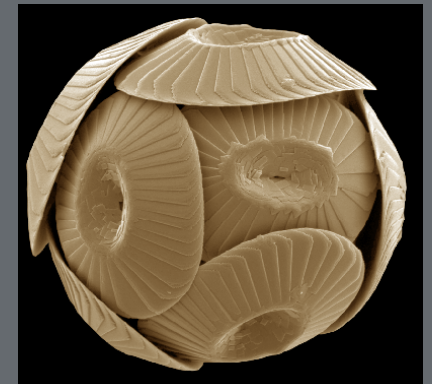


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- What does it all mean?
- What are the key messages?
- What needs to be done?



- Understanding what we need to know
- Making sure those that need to know get the message

# COMMUNICATION

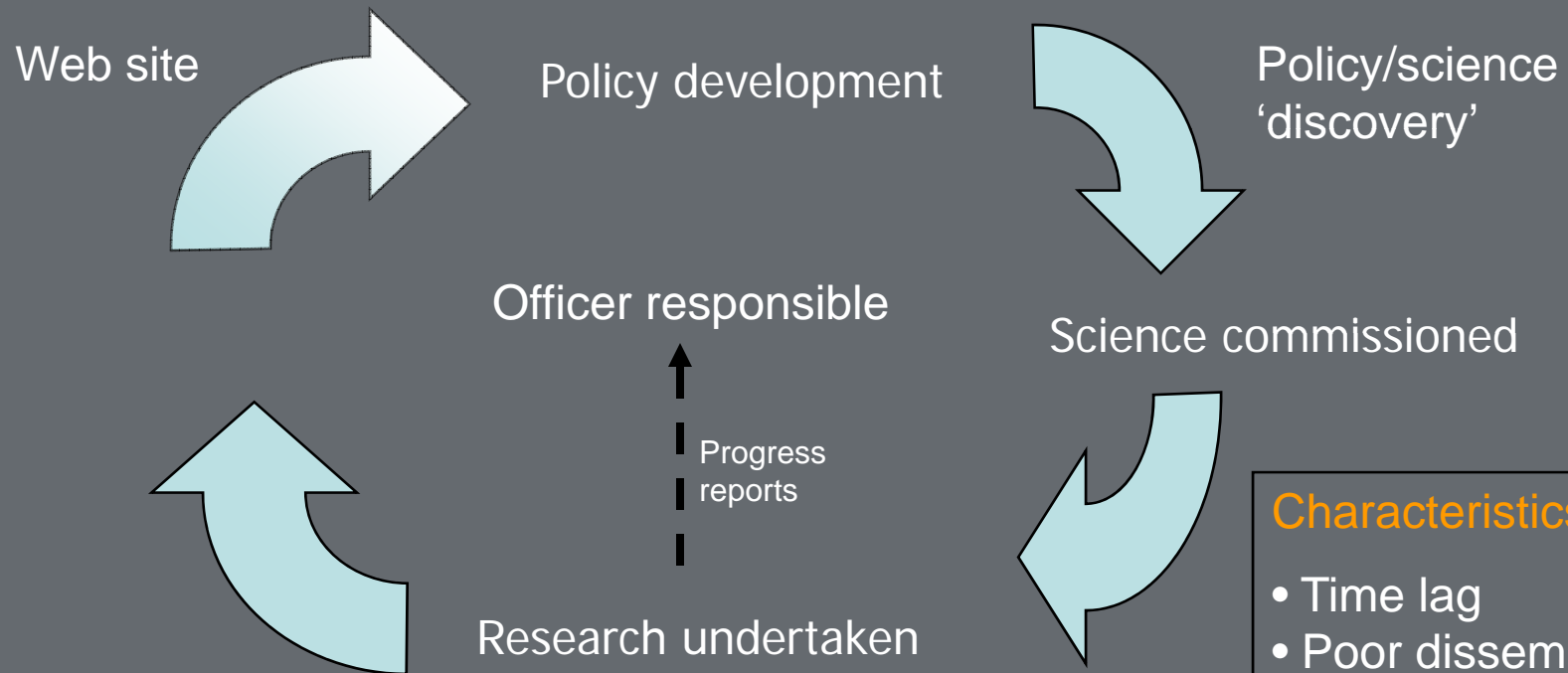


## Understanding what we need to know

- Scientific input: formulate (and answer) the scientific questions
- Advisory input: formulate the policy questions



## Policy-science links – poor practice



**Characteristics:**

- Time lag
- Poor dissemination
- Poor ownership
- Poor influencing
- Staff turnover



## Reference User Group

The concept was first applied to the EU COST-IMPACT programme (Costing the impact of demersal fisheries on the marine environment) to ensure the relevance, user-friendliness and outreach of the research.

The RUG concept has since been applied to other projects including IMCO<sub>2</sub> (The Implications of CO<sub>2</sub> in Marine Ecosystems) and most recently for the EPOCA Project (European Project on Ocean Acidification).



## Composition of RUG

The RUG should comprise a range of potential end users of the results of the research, typically from both commerce and government, with interests spread across relevant environmental, industry and conservation sectors **together** with the scientific community.



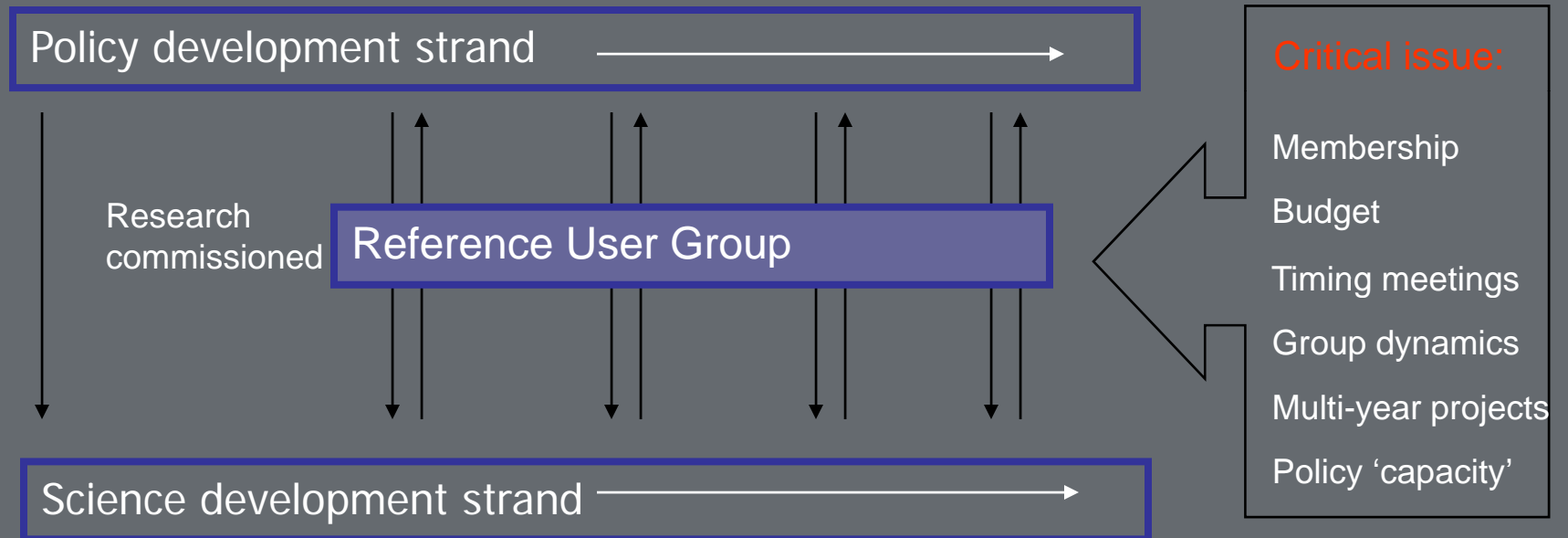
## Terms of Reference

- To advise on the types of data and analyses and products that will be most useful to managers, policy advisers, decision makers and politicians
- To advise on the format and nature of key messages arising from the research
- To advise on the dissemination procedures to ensure that the results from the research are disseminated to all potential end users of the information
- To feedback key science developments into their own sector/parent organisation



# The Reference User Group approach

## Policy-science links – better practice



# Making sure those that need to know get the message

MCCIP Marine Climate Change Impacts Partnership

## Marine climate change impacts

Annual Report Card 2006

We are observing large changes in our marine environment that are driven in part by climate change. This report card represents our first step in bringing together evidence from across the UK science community to help YOU understand and act upon the issues.

"I'm no longer sceptical. Now I do not have any doubt at all, I think climate change is the major challenge facing the world."  
*David Allenborough*

[www.mccip.org.uk/arc](http://www.mccip.org.uk/arc)

MCCIP Marine Climate Change Impacts Partnership

## Marine climate change impacts

Annual Report Card 2007-2008

The 2007 report card builds upon the evidence base presented in 2006, highlighting key developments and exploring new subject areas (coastal erosion, coastal habitats and air-sea exchanges of heat and freshwater). This year's report card brings together scientific understanding from a wider range of research institutes, providing an even more comprehensive assessment of UK marine climate change impacts and highlighting regional variations where possible.

"Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures"  
*Intergovernmental Panel on Climate Change (IPCC) 2007, Joint Nobel peace prize winners*

Here are just some of the new findings in the 2007-2008 card

- 2006 was the second warmest year in UK coastal waters since records began in 1870; seven of the ten warmest years have occurred in the last decade.
- Models predict fewer storms, but there will be a greater number of more severe storms.
- Coastal erosion is expected to increase. Currently, it affects 17% of the UK coastline.
- Warmer winters have been strongly linked to reduced breeding success and survival in some seabird populations.

www.mccip.org.uk/arc



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MCCIP ANNUAL REPORT CARD 2007-2008

## Introduction

As the evidence base continues to build, it is clear that marine climate change is having important impacts on the marine environment and the goods and services it provides. The information presented this year demonstrates the important knock-on effects that climate change can have through the food chain. For example, at the bottom, warming has led to plankton shifts, which have had an impact upon predators such as fish, which then affects seabirds.

Each topic includes a confidence rating for what is happening now and what could happen in the future:

**HIGH CONFIDENCE**   
**MEDIUM CONFIDENCE**   
**LOW CONFIDENCE** 

Where possible, regional impacts are highlighted.

The online version of this report card ([www.mccip.org.uk/ars](http://www.mccip.org.uk/ars)) is backed up with full peer-reviewed reports for each topic and includes a glossary of technical terms.

## Climate of the marine environment

Ocean climate is largely defined by its temperature, salinity, ocean circulation and the exchange of heat, water and gases (including CO<sub>2</sub>) with the atmosphere. The functioning of our marine ecosystem is highly dependent on changes to both ocean climate and

acidification, whilst storms and waves, sea-level rise and coastal erosion pose clear threats to human life, built structures and shipping.

The bold text (below and opposite) indicates new information for the 2007-2008 report.

### WHAT IS ALREADY HAPPENING

**Temperature (air and sea)**  
BADC; FRS;  
MOHC; NOCS;  
SAMR; UKCIP

#### **HIGH CONFIDENCE**

- Marine air and sea surface temperatures (SST) have been rising at a similar rate to land air temperature, but with strong regional variations. Since the 1980s the rate of rise has been about 0.3-0.6 °C per decade.
- Warming has been faster in the English Channel and southern North Sea than within Scottish continental shelf waters.**
- 2006 was the warmest-warmest year in UK coastal waters since records began in 1870; seven of the 10 warmest years have occurred in the last decade.**
- Recent warming is also evident in waters of the upper 1,000 m of the North Atlantic.

### WHAT COULD HAPPEN

#### **HIGH CONFIDENCE**

- Climate change models indicate that SST will continue to rise in all waters around the UK coast, with stronger warming in the south-east (-0.15-0.4 °C per decade in the southern North Sea) than the north-west (-0.05-0.2 °C per decade at Rockall).

## Acidification

PML

### **HIGH CONFIDENCE**

- The ocean is becoming more acidic as increasing atmospheric carbon dioxide (CO<sub>2</sub>) is absorbed at the sea surface. Models and measurements suggest that surface pH has decreased by 0.1 pH unit since 1750.
- The surface ocean has absorbed nearly half of the increased CO<sub>2</sub> emissions due to burning of fossil fuels over the last 250 years, thus reducing the amount remaining in the atmosphere.**

### **MEDIUM CONFIDENCE**

- Continued acidification will reduce the ability of the ocean to take up CO<sub>2</sub> from the atmosphere, which will have feedbacks to future climate change, further accelerating the accumulation of CO<sub>2</sub> in the atmosphere.**
- Future increases in ocean acidity will have major negative impacts on some shell/skeleton-forming organisms within this century.**



The screenshot shows the Marine Climate Change Impacts Partnership (MCCIP) website. At the top left is the MCCIP logo and name. To the right is a Google search bar with the URL www.mccip.org.uk. Below the logo is a navigation menu with buttons for Welcome, About MCCIP, Partners, News & events, Annual Report Card (highlighted), Science base, and Contact us. The main content area is titled 'Acidification' and includes a table of contents on the left. The table of contents lists various topics under the heading '2007-08', with 'Acidification' highlighted. The main text area is divided into two columns: 'WHAT IS ALREADY HAPPENING' and 'WHAT COULD HAPPEN'. The first column is labeled 'HIGH CONFIDENCE' and contains two bullet points about ocean acidification. The second column is labeled 'MEDIUM CONFIDENCE' and contains two bullet points about future impacts. Below the main text are several orange buttons with plus signs, each followed by a link: Executive summary, Full scientific review (with references), Confidence assessments, Knowledge gaps, Commercial impacts, and Authors. At the bottom of the page, there is a copyright notice: © Copyright MCCIP 2008 Last Modified: February 15, 2008.

**MCCIP** Marine Climate Change Impacts Partnership

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2007-08

- Introduction
- Marine environment
  - Temperature
  - Storms and waves
  - Sea level
  - Acidification**
  - Gulf Stream and Atlantic Heat Conveyor
  - Salinity
  - Shelf sea stratification and the spring bloom
  - Coastal erosion
  - Air-sea flux of heat and water
- Healthy and diverse marine ecosystem
- Clean and safe seas
- Commercially productive seas
- Further details
- List of Contributors
- Feedback and contacts
- Glossary
- Download PDF version (462 KB)
- Welsh version (PDF, 460 KB)

**Acidification**

PML

**WHAT IS ALREADY HAPPENING**

**HIGH CONFIDENCE**

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**WHAT COULD HAPPEN**

**MEDIUM CONFIDENCE**

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- Future increases in ocean acidity will have major negative impacts on some shell/skeleton-forming organisms within this century.

+ Executive summary

+ Full scientific review (with references)

+ Confidence assessments

+ Knowledge gaps

+ Commercial impacts

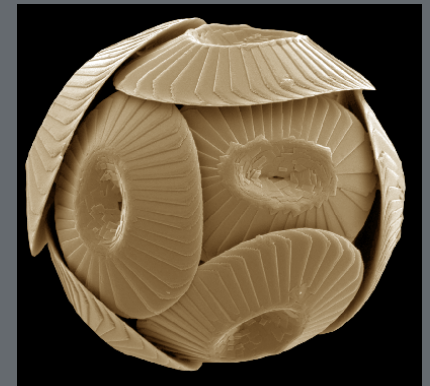
+ Authors

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## Planned outputs and outcomes from this meeting

- *‘The purpose of the meeting is to provide an interdisciplinary forum to assess what is known about ocean acidification and to identify priorities for future research.’*
- *Biogeosciences* special issue dedicated to the symposium entitled "The Ocean in the High-CO<sub>2</sub> World II".



## An additional output?

ARC-type document targeted at policy advisers and politicians around the world covering:

- What is happening; i.e. what do we know and how sure are we?
- What are the implications for politicians and decision makers?
- What needs to be done?



## Challenges for the future

- Making it the norm to establish links between science and policy ( the RUG concept)
- Maintaining the information flow in an accessible and credible format
- Achieving action that starts to address the implications of ocean acidification



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