UK Ocean Acidification Research Programme

Benthic Acidification

In-situ characterisation of habitats adjoining cold-water coral reefs using a Sediment Profile Imagery (SPI) camera

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Background

- To date, views expressed on the potential impact of ocean acidification range from wholesale degradation of marine ecosystems through to no discernable impact with minimal consequences.

- Constraining this range of predictions is necessary to support with scientific evidence for sustainable management and marine policy.

Who's afraid of acid in the ocean? Not me

We keep being told this is a natural disaster – but scientists must come clean. It isn't

Matt Ridley

Today in Beijing an alliance of scientists called Oceans United will present the UN with a request for $5 billion a year to be spent on monitoring the oceans. High among their concerns is ocean acidification.

As global warming loses traction on the public imagination, environmental pressure groups have been cranking the engine on this "other carbon dioxide problem". "Time is running out", wrote two activists recently in *Scientific American*, "to limit acidification before it irreparably harms the food chain on which the world's oceans — and people — depend." The fear is that acidification stops shellfish, plankton, lobsters and crabs building their protective shel

The trouble is, a shoal of scientific papers points to the conclusion that this scare is faulty biochemical reasoning exaggerated extrapolation.

We have been here before: acid rain was the scare of the science correspondent of Th Economist, I wrote: "Forests beginning to die at a catastro One year ago, West Germa estimated that 8 per cent of were in trouble. Now 34 per that forests are in trouble is indisputable." Experts told Germany's conifers would 1990 and the Ministry of the said all forests would be gone by 2002.

Bunk. Acid rain did not kill forests. It did not even damage them. Forests thrived in Germany, Scandinavia and North America during the 1980s and 1990s, despite acid rain. I was a gullible idiot not to question the conventional wisdom I was being fed by those with vested interests in alarm.

Talking of vested interests, the European Project on Ocean Acidification is now a consortium of more than 100 scientists from 27 institutes and 9 countries. This summer it funded 35 scientists to spend six weeks in the Arctic studying the problem, "assisted" by the Greenpeace ship *Esperanza*. Think how little incentive the scientists would have to say: "Sorry, lads, we realise it is not much of an issue after all."

Start with a few facts. The oceans are not acid but alkaline, with an average pH of about 8.25 (0-7 being acid, 7-14 being alkaline). But they vary both in

Carbon dioxide emissions actually seem to help plankton in the oceans

Enough numbers. Try chemistry. The scary reasoning rests on the argument that lower pH will mean less dissolved carbonate in the water. But a

Studies of oyster sperm, cuttlefish eggs, juvenile sea stars, coral polyps and krill all point to the same conclusion: damage only occurs when carbon dioxide reaches ludicrous levels that are not expected for many centuries, if at all.

When I voiced some of these doubts in my latest book, I was accused of cherry-picking studies. So let's look at a "meta-analysis", a summary of relevant published studies. Iris Hendriks and Carlos Duarte, of the Spanish Council for Scientific Research, found that in 372 studies of 44 different marine species "there was no significant mean effect" from lower pH. They concluded that marine life is "more resistant to ocean acidification than suggested by pessimistic predictions" and that it "may not be the widespread problem conjured into the 21st century".

I had assumed the evidence for damage from ocean acidification must be strong because that is what the media kept saying. I am amazed by

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Ocean acidification rates pose disaster for marine life, major study shows

Report launched from leading marine scientists at Copenhagen summit shows seas absorbing dangerous levels of CO2

Interactive: Ocean acidification around the world

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Severin Carrell
guardian.co.uk, Thursday 10 December 2009 10.52 GMT
Article history

Thousands of glassfish, on the edge of the coral reef near Sharm el-Sheikh, Egypt. Photograph: Tarik Tinazay/AFP/Getty Images

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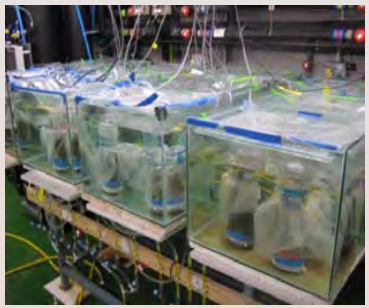
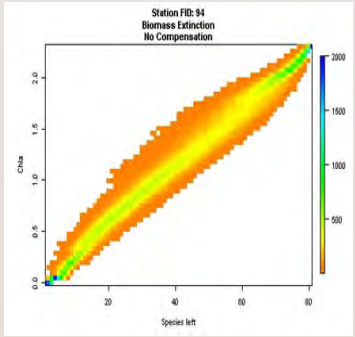
UKOA Programme

- July 2010-2013
- Wide range of scientists (PML, Cefas, SAMS, NOC)
- Experiments, large scale observations, modelling
- Funded by NERC/Defra/DECC
- Aims to characterise different benthic species and habitats to understand changes in function resulting from ocean acidification





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Lophelia pertusa habitats

- Cold water corals reefs are long-lived and structurally complex
- They support many species, provide essential fish habitats
- In many areas have been damaged by trawling (Koslow et al. 2001)

Why are these habitats important?

- These are considered vulnerable and have conservation importance
- Scleractinian species producing skeletal frameworks


Changing oceans 2012

We need to understand Ocean acidification effects

- There is a need to understand the function
- Long-term experiments
- *Insitu* observations

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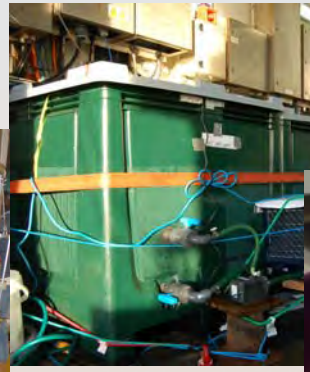
JC073 Expedition

- Full science crew, 11 institutions (Denmark, Germany, Spain, UK, USA)
- 5 sites visited
- 181 activity stations
- First visual surveys Hebrides Terrace Seamount (JNCC)



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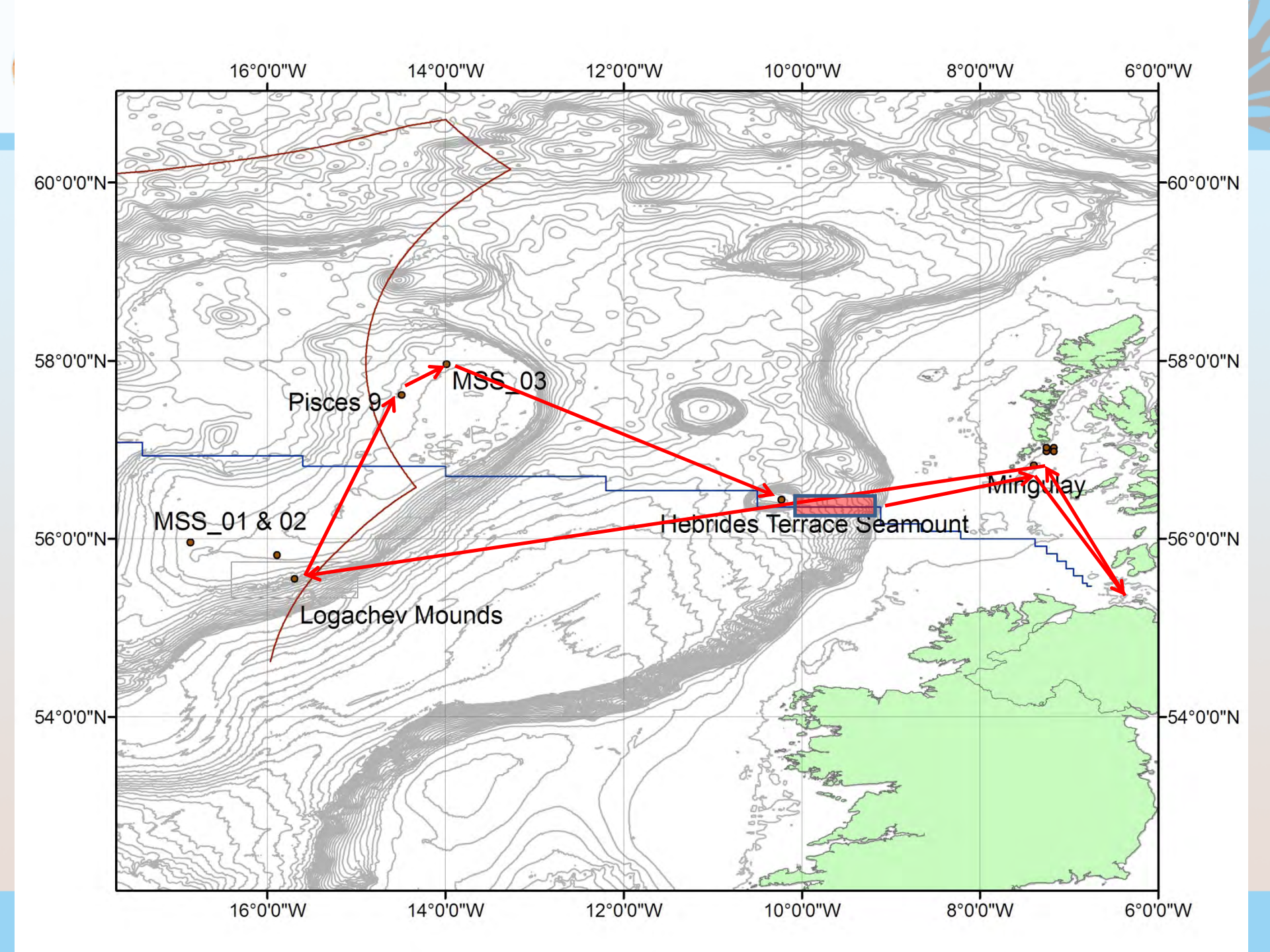
16°0'0"W
14°0'0"W
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8°0'0"W
6°0'0"W
60°0'0"N
58°0'0"N
56°0'0"N
54°0'0"N
Pisces 9
MSS_03
MSS_01 & 02
Logachev Mounds
Hebrides Terrace Seamount
Mingulay

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Sediment Profile Imagery (SPI) Camera

Images collect vertical section of the seabed and examples of the parameter that are measured can be seen below:

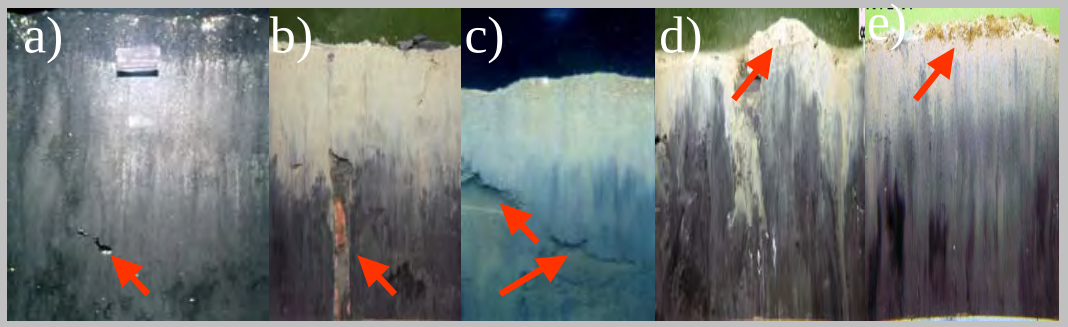

Figure: SPI images illustrating the following features: a) gas void, b) polychaete, c) burrows formation, d) pit mound and different sediment types and e) microalgal mat.

Advantages of this technique:

- Fast return of information
- Effective monitoring tool can cover rapidly large areas of the seabed
- The information can be easily communicated to non-specialists
- Robust technique for seabed systems
- SPI survey can be complemented with grab/corers samples

Birchenough et al (2012a) Ecological Indicators,
Birchenough et al. (2012b)Biogeochemistry,
Birchenough et al. (2006) Journal of Marine Systems.

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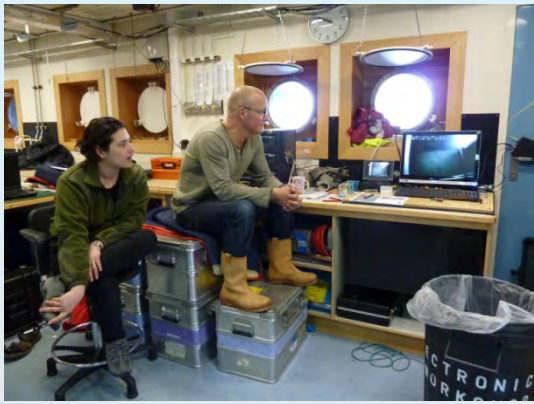
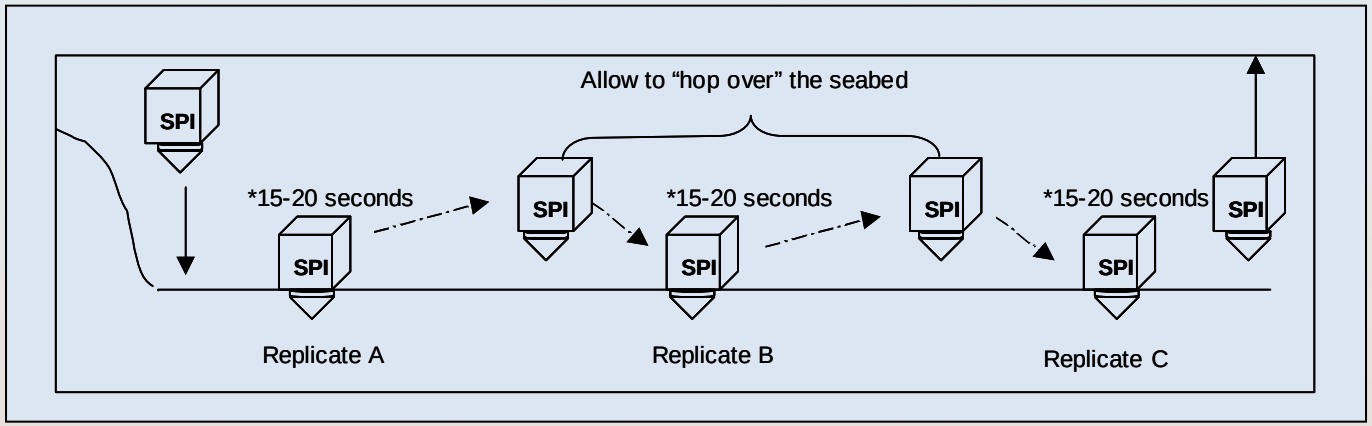
Methods

•Transects inside and outside the reef areas with video and SPI

•Each transect was 1.5-2 km= 56 hours =~400 images
•5 replicates were collected at each dip
•Sites: Mingulay, (200-250m) Banana reef (250-300m) and Logachev mounds (500-1200m)





1.5-2km

X-X-X-X-X X-X-X-X-X X-X-X-X-X X-X-X-X-X

300m 300m 300m

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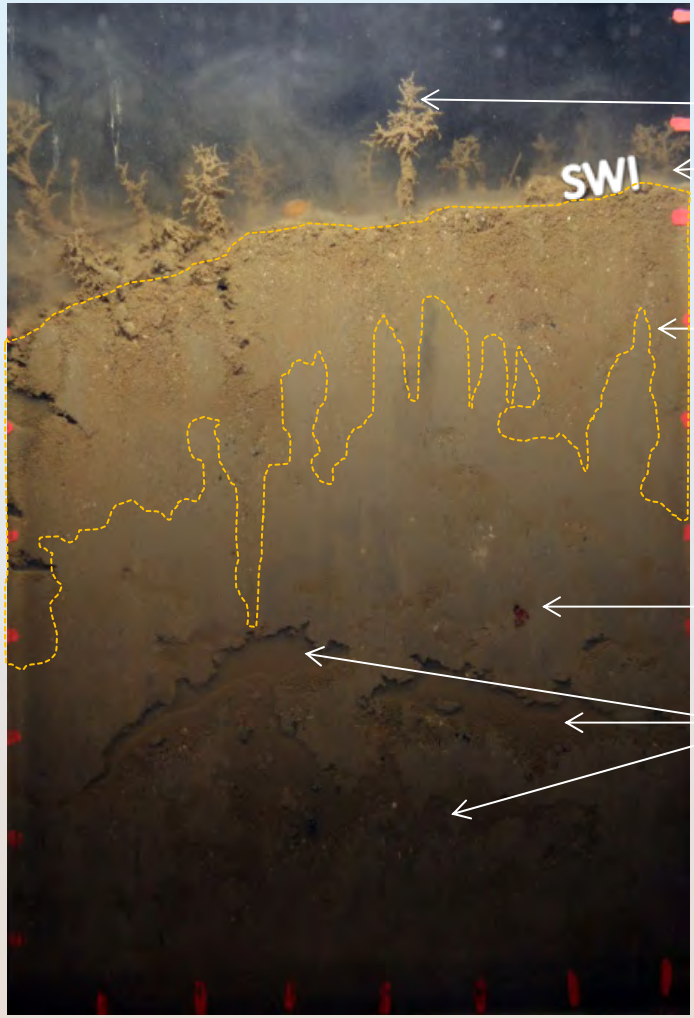
Image analysis



Surface fauna (*Lanice conchilega)*

sediment water interface

aRPD-apparent Redox Discontinuity layer

Deep burrowing infauna

Burrows

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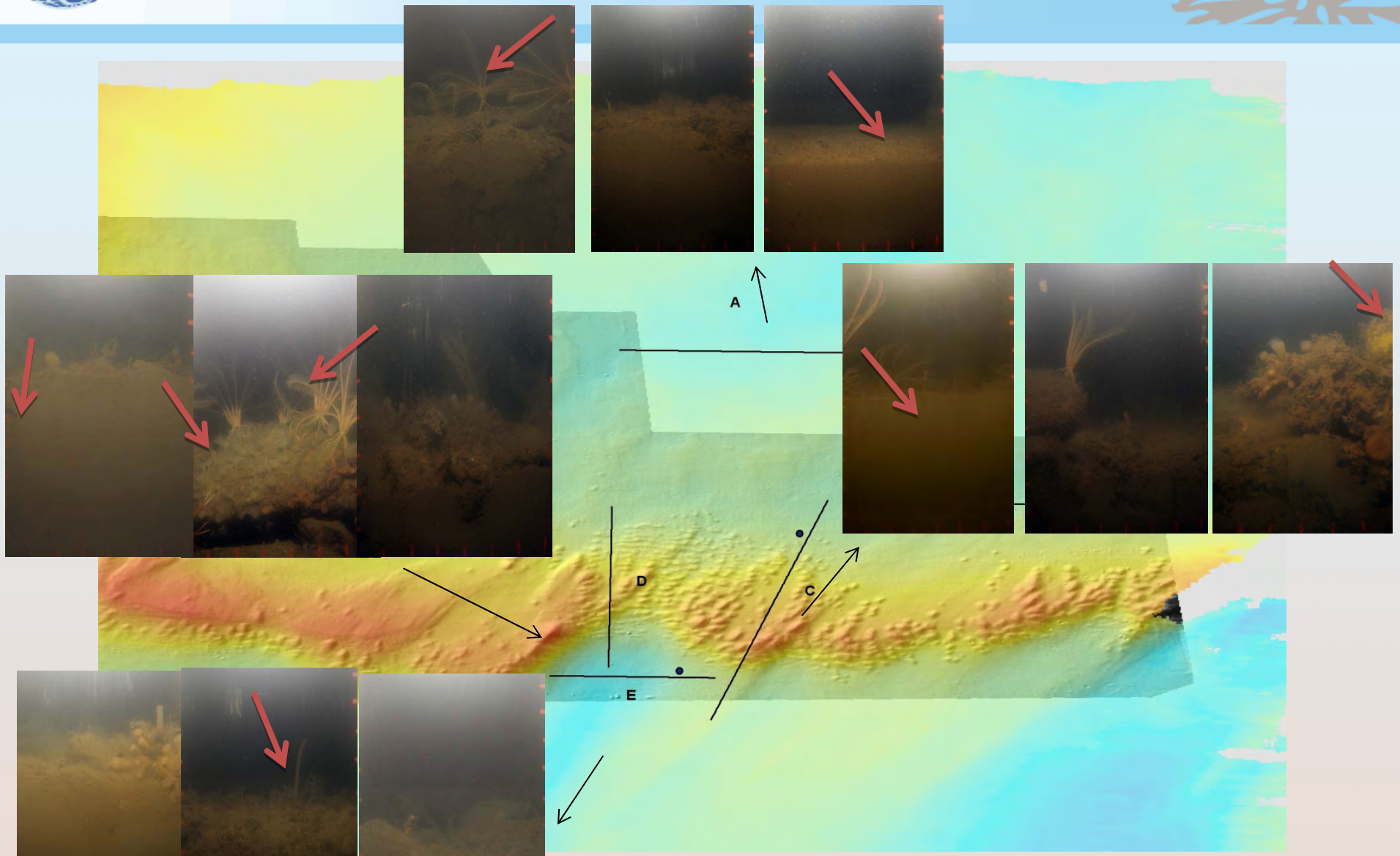
Mingulay reef complex



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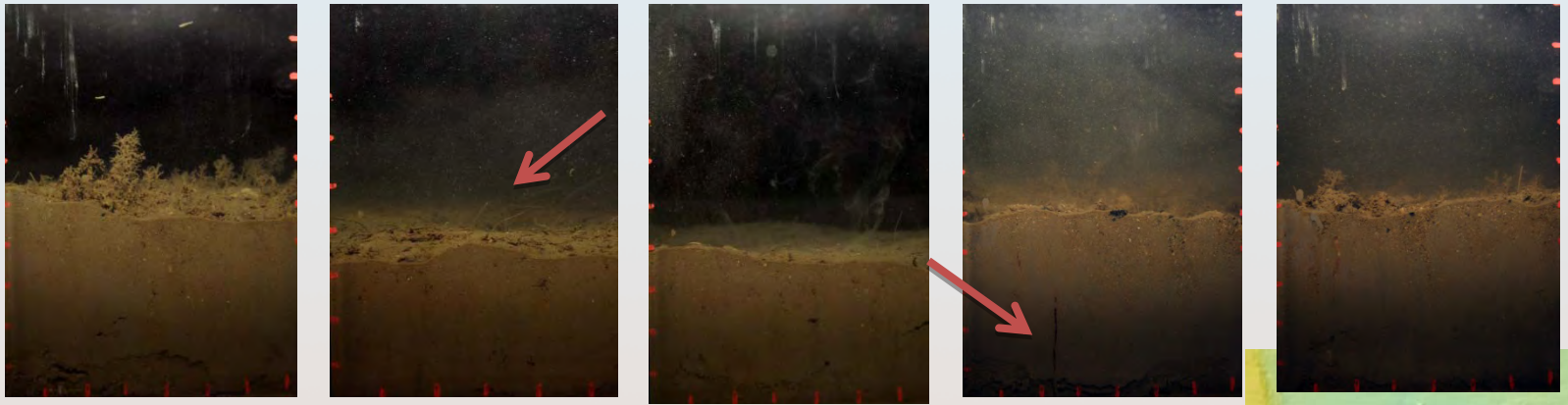
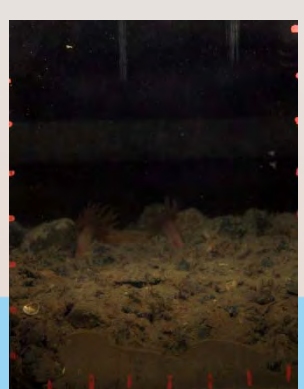
Banana Reef

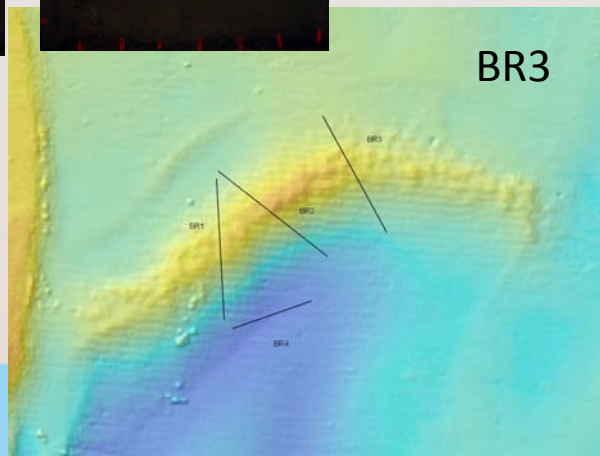
BR1



BR4



BR3



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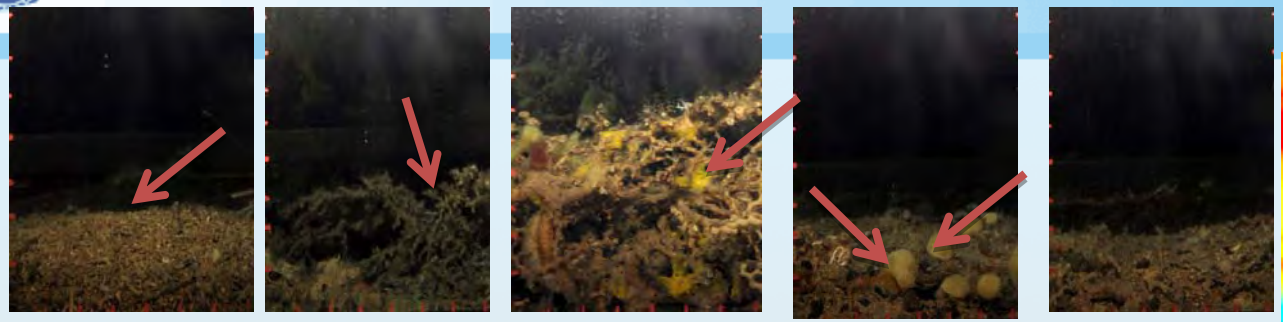
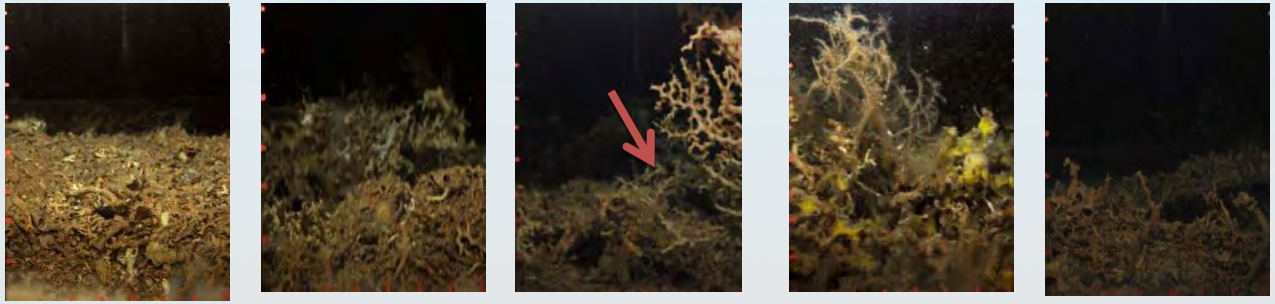
Logachev Mounds

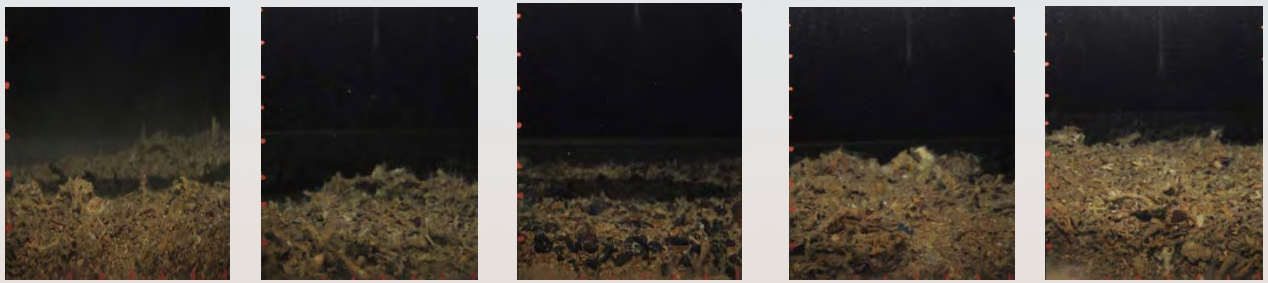
LG1



LG5



LG3



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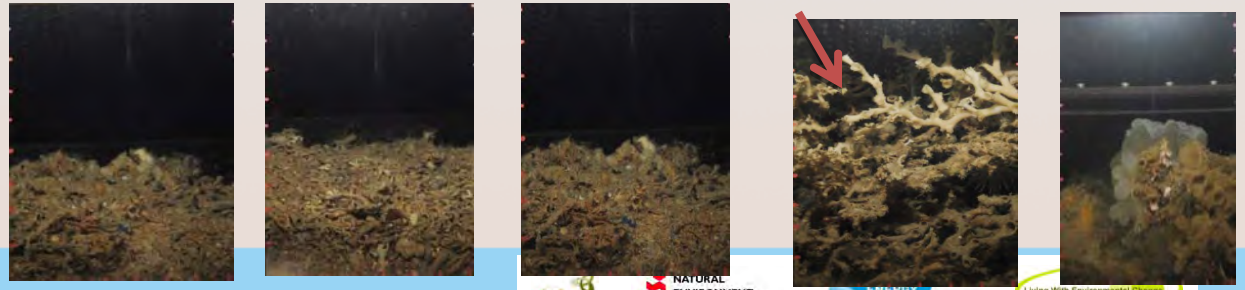

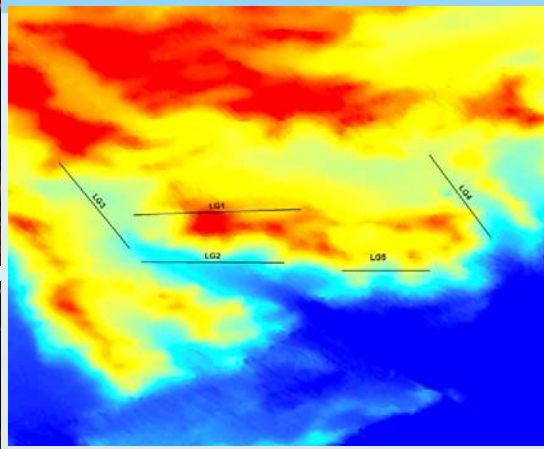

•Giant carbonate mounds (bioherms) in the Rockall Trough

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Study sites

Areas	Depth (m)	Sediment type	surface	Penetration	aRPD (cms)	burrows	Fauna
MRC	200-250	soft muds also stony areas (closer to the reef)	small polychaete tubes	Good	2-4 cm	distinct areas (~2cm)	Crinoids (*Leptometra* sp.), sponges (*Mycale macilenta*) and soft corals
BR	250-300	soft muds also stony areas (closer to the reef)	*Lanice conchilega* tubes	Good	4-6cm	deep burrows (6-8cm)	*Nephrops norvergicus* ** video , tubes and burrowing polychaetes, actinia and stony corals (*Caryoplyllia* spp.)
LM	500-1200	coral fragments, layers of coral rubble	rubble, framework/ attached fauna	limited (layered deposits)	------	------	Blue sponge (*Hymedesmia paupertas*), squat lobsters (*Munida* sp.). Coral *Madrepora oculata*, yellow sponge *Mycale macilenta*, the white sponge *Aphrocallistes bocagei*, cup sponges *Phakellia* sp. and some hydrocorals such as *Pliobothrus symmetricus*

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Summary

- First time that SPI was deployed at these sites
- This survey has helped to characterise habitats in the vicinity of *Lophelia pertusa* reefs
- Fast coverage over large areas
- This survey will help to scale-up experiments
- Evidence of burrows (bioturbation) and infauna presence (tubes and in sediments)
- aRPD layers varied at the sites
- Data sets will contribute as baseline information

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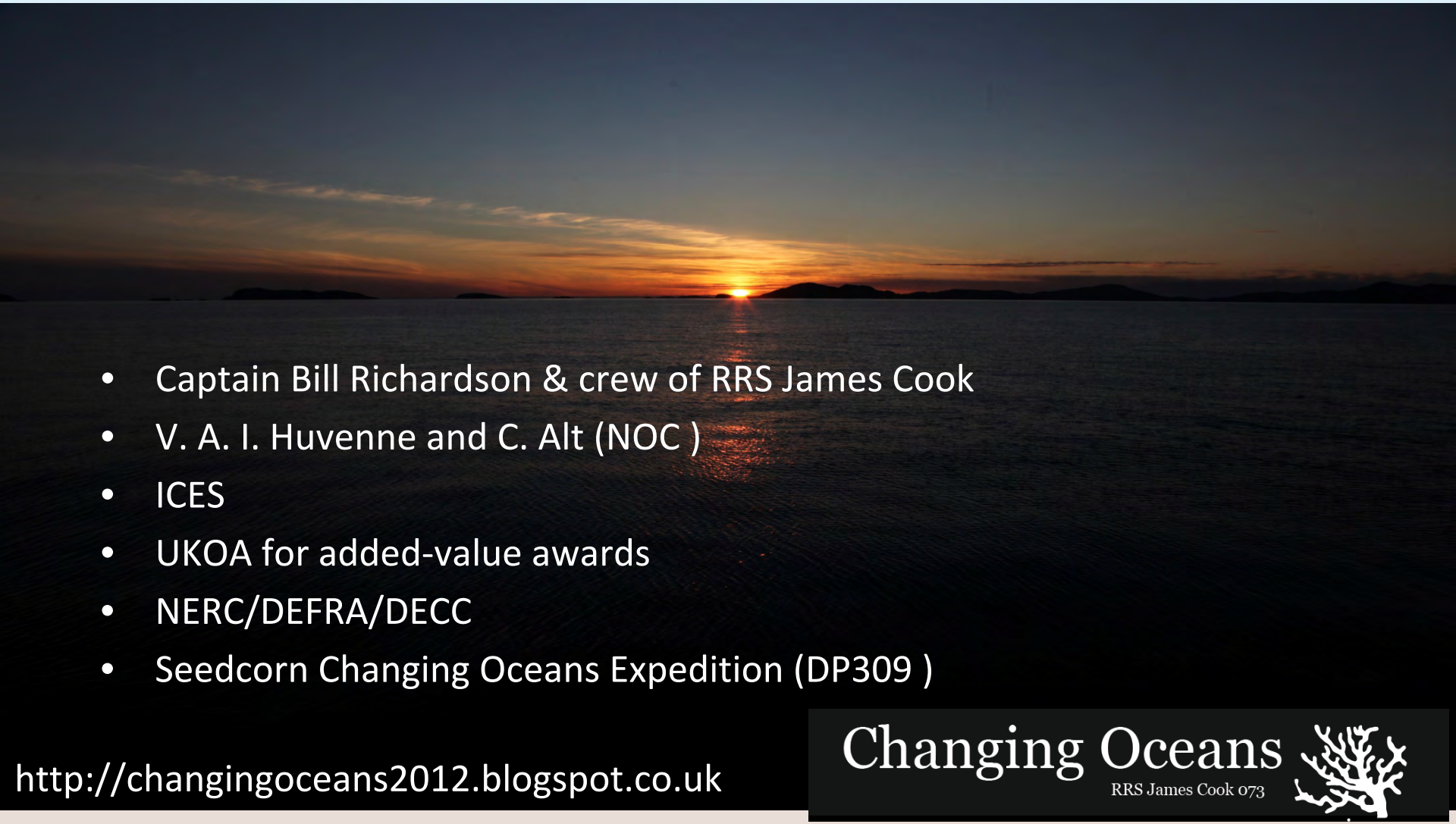
Acknowledgments



- Captain Bill Richardson & crew of RRS James Cook
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- NERC/DEFRA/DECC
- Seedcorn Changing Oceans Expedition (DP309)

http://changingoceans2012.blogspot.co.uk

Changing Oceans
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Thank you
Questions?