Initial results on long-term effects of OA and warming on cold-water corals and coralline algae

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+ update on JC073 'Changing Oceans Expedition'

UK Ocean Acidification Research Programme

HERIOT WATT UNIVERSITY

Cold water corals and maerl

Lophelia pertusa
(the most common UK coral)

- Scleractinia – framework forming
  - Complex habitats

- Global distribution from 40 – 3000m

Lithothamnion glaciale **(maerl or rhodolith)**

- Performs a crucial role within marine ecosystems

- High-Mg Calcite

UKOA-BIOACID collaboration
Began Sept 2011 (JAGO sub cruise)
AVA award


mares

Aims:

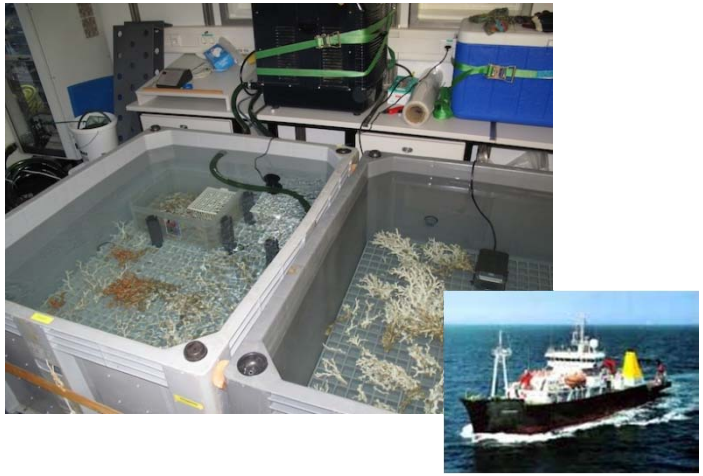
- What are the long-term effects of increased CO_2 and temperature upon cold water corals and maerl?
  -Single and combined effects

- Will acclimation occur?
  - To what extent?
  - Over what timescales?

- What will happen to protein expression (maerl)

Methods – impacts of OA and warming

- ***Short term*** experiments on RSS Discovery (<u>21 days</u>)
  - 380 and 750ppm CO_2 (pre-mixed gas bubbling)
  - Slow/ fast 3˚ C temperature shift – shock vs. acclimation



- ***Long term*** at Heriot-Watt University (<u>18 months</u>)
  - Gas mixing system (380, 750 and 1000ppm CO_2)
  - Two temperatures 9˚ C, 12˚ C

Methods – impacts of OA and warming

- **Collection** of maerl by scuba in Loch Sween, Scotland
- November 2011
- Depth 7m
- Thalli size; 4-6 cm diameter
  - 380ppm, 750ppm
  - 12˚ C, 16˚ C
  - 28 days

collection

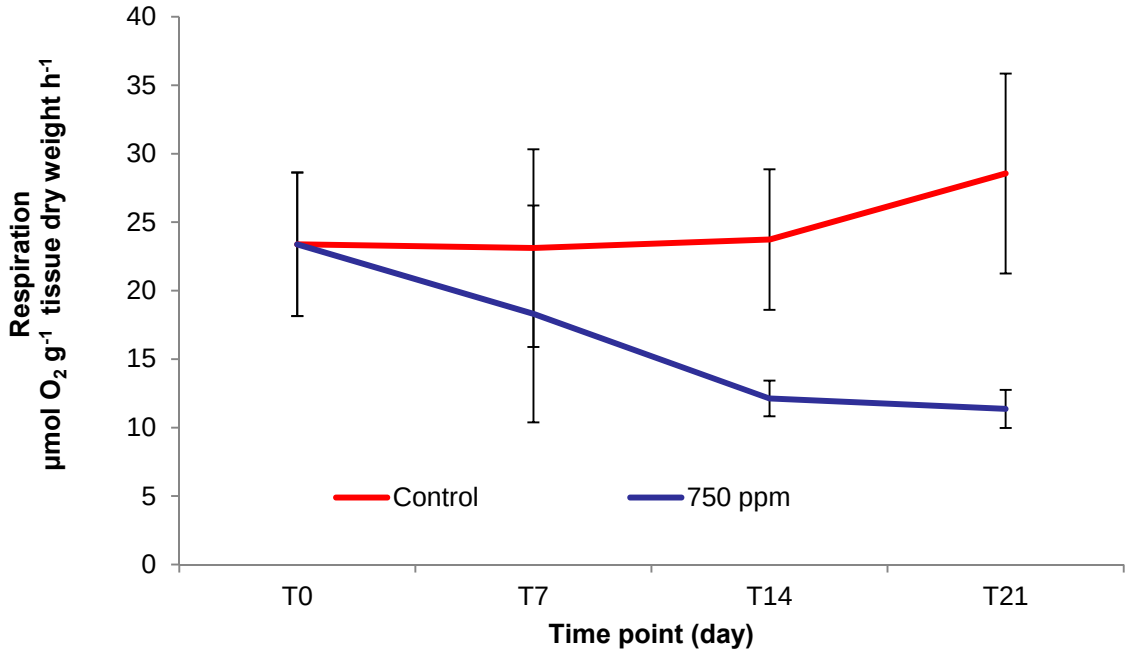
sorting

laboratory

Results & Discussion: Short term

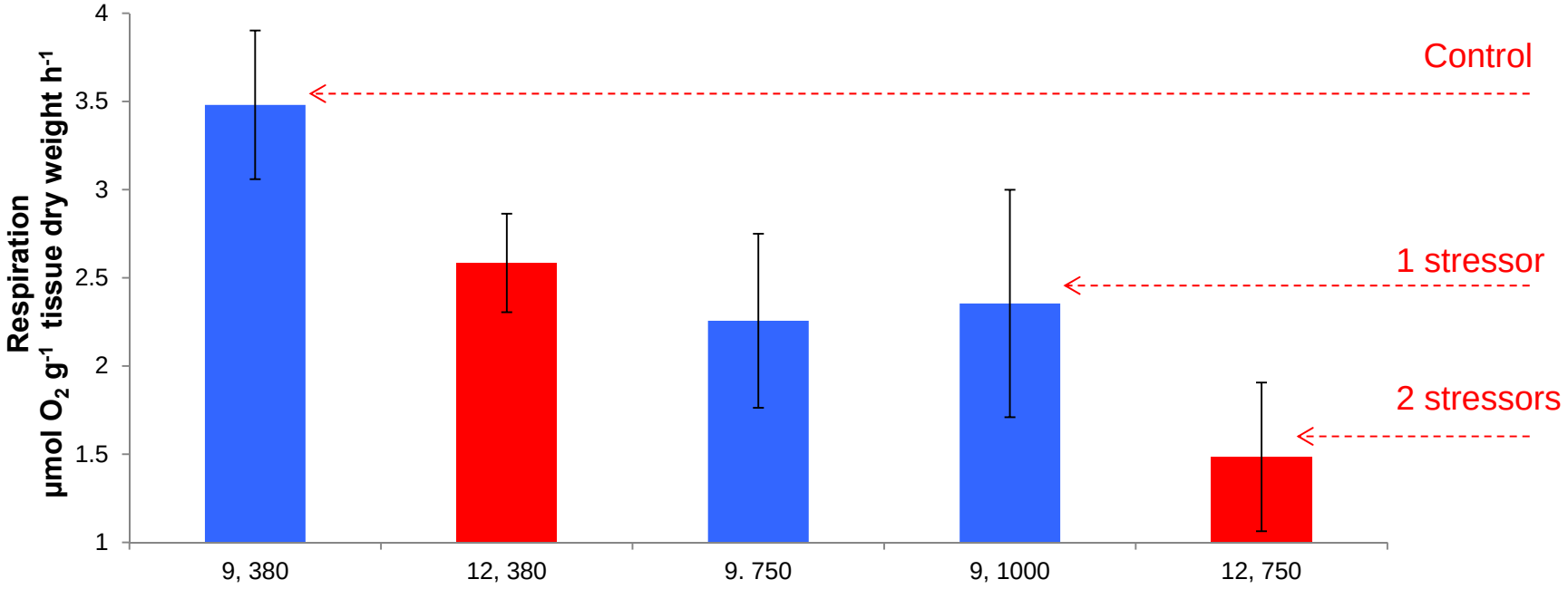
- *Ocean Acidification – respiration*

  - *L. pertusa* respiration decreased in acidified conditions (750ppm) over 21 days compared to present day conditions
  - Only different after 2 weeks
  - No change in calcification rate over this time (alk. anom.)



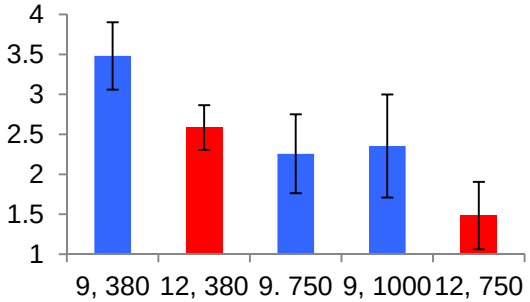
Results & Discussion: Long Term

- At 3 months:
  - Control has highest respiration rate
  - Corals at elevated CO_2 OR temperature had reduced respiration rates
  - Corals at elevated CO_2 AND temperature had reduced respiration rates



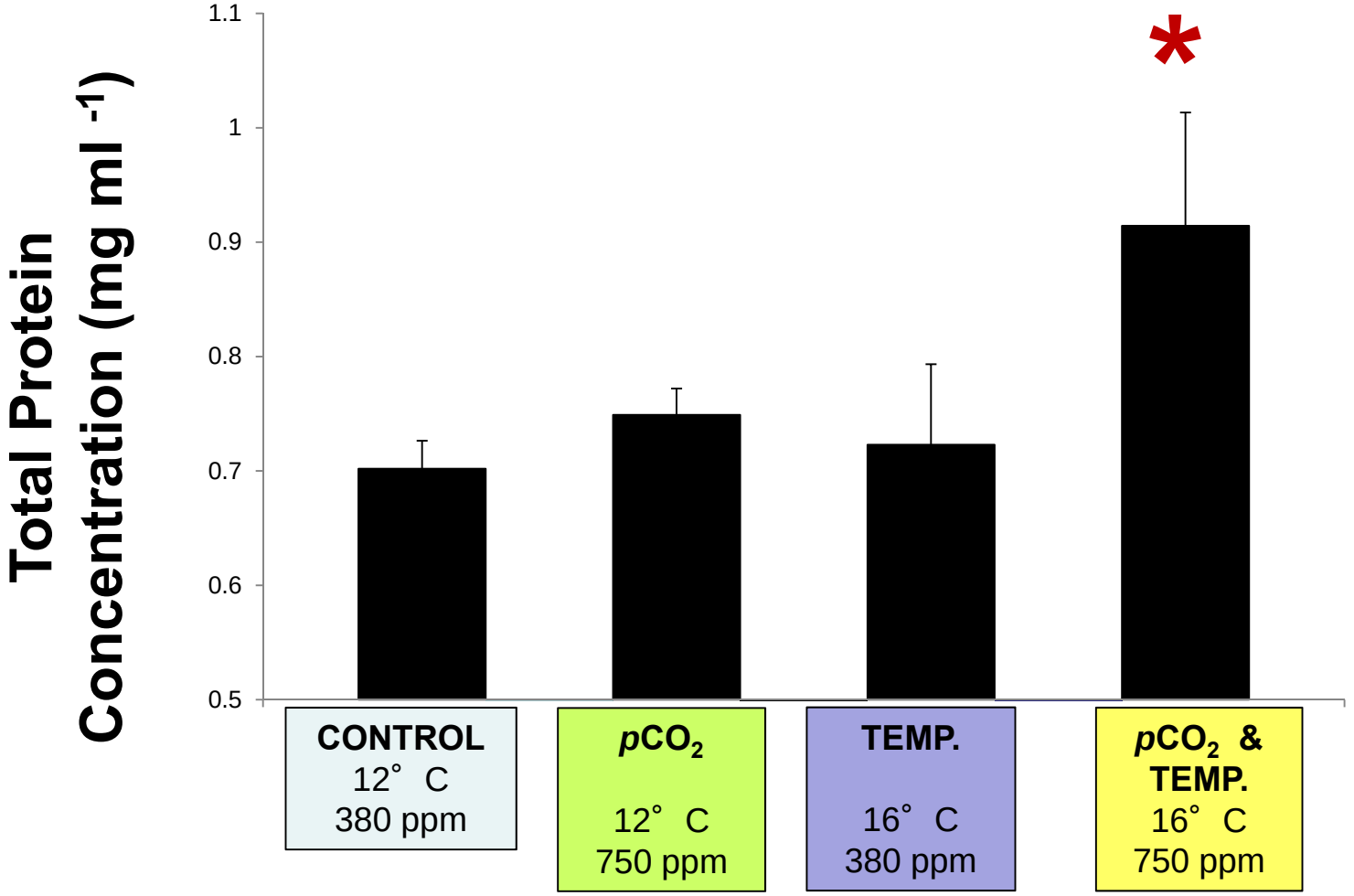
Results & Discussion: Long Term

- No significant difference between 750ppm and control. **Differs from short term experiment**
    - Acclimated compared to short term
    - No difference between:
        - 750 and 1000ppm OR temperature



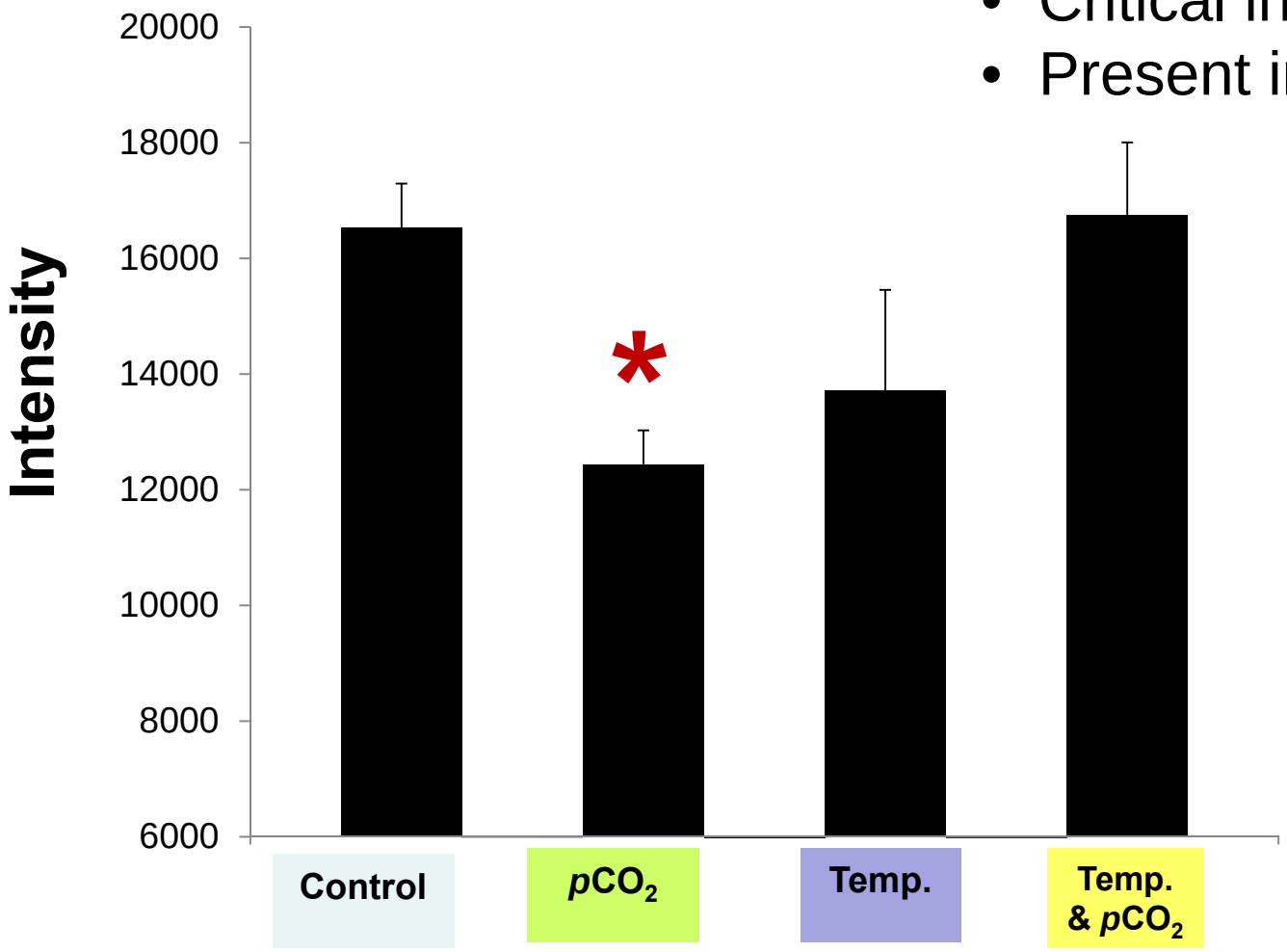
- **Combined** increase in CO_2 and temperature
    - Significant reduction in respiration
        - 6 months (non-normalised) look similar
    - Significantly lower net growth at 3 months
        - Net growth (buoyant weight):
            - 12˚ C 750ppm = 0.5%
            - 9˚ C 380ppm = 2.0%

Results: Total protein concentration



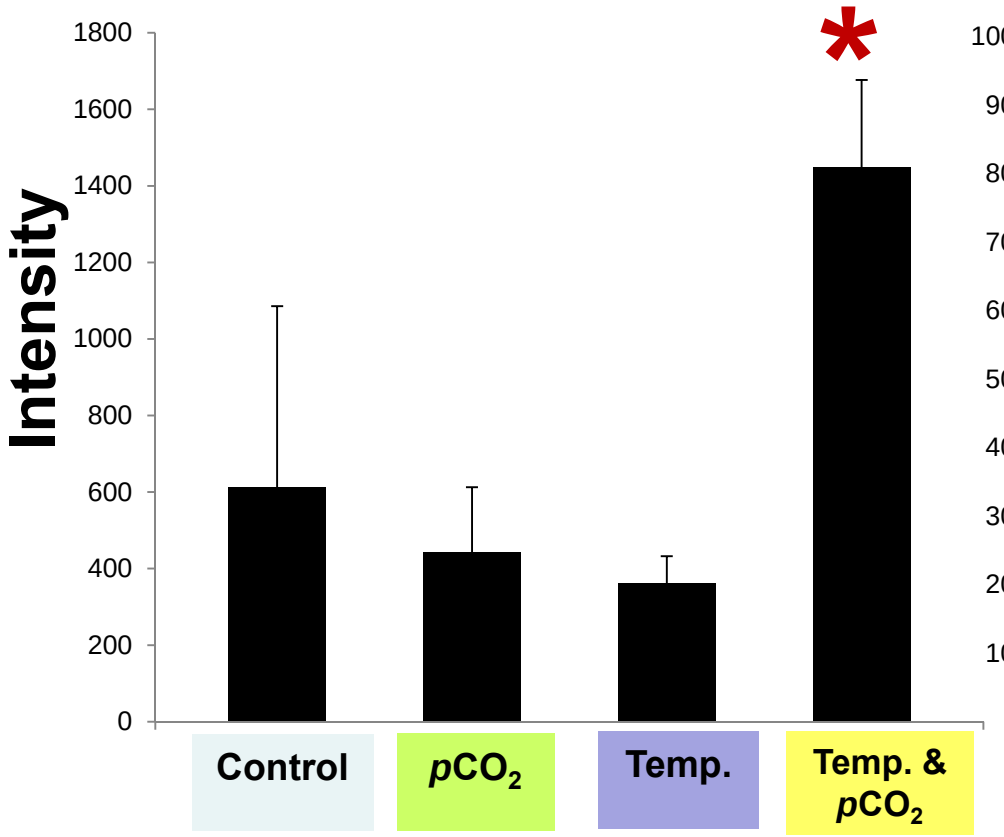
Results:Phycoerythrin

- Red light harvesting protein
- Critical in photosynthesis
- Present in most red algae

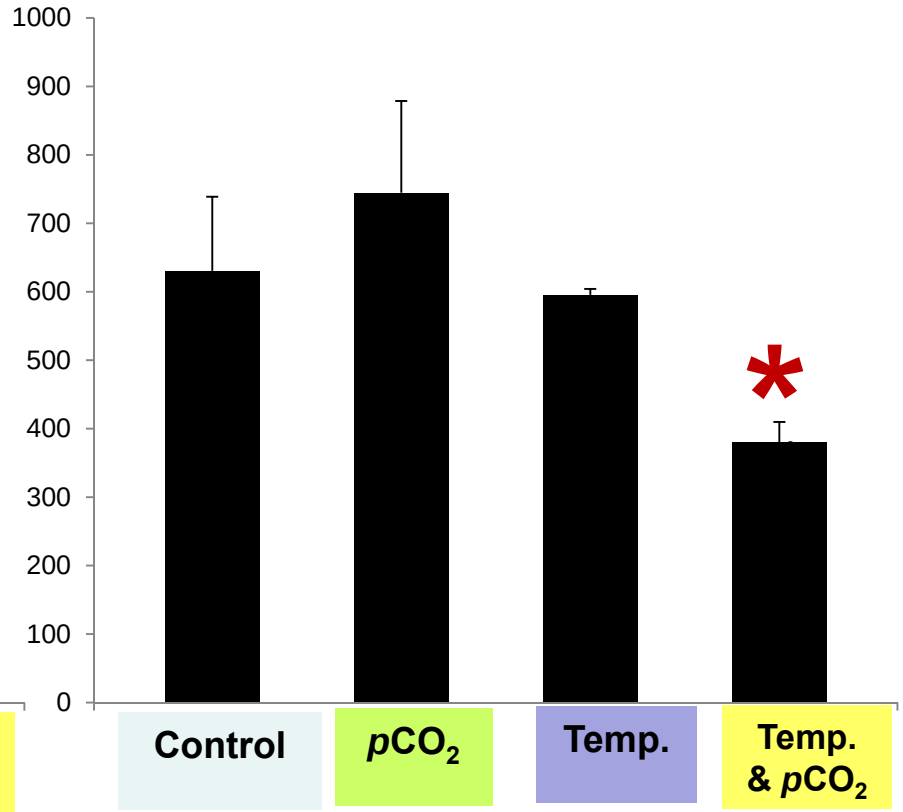


Results: Combined effects

Protein (h)



Protein (d)




Conclusions:

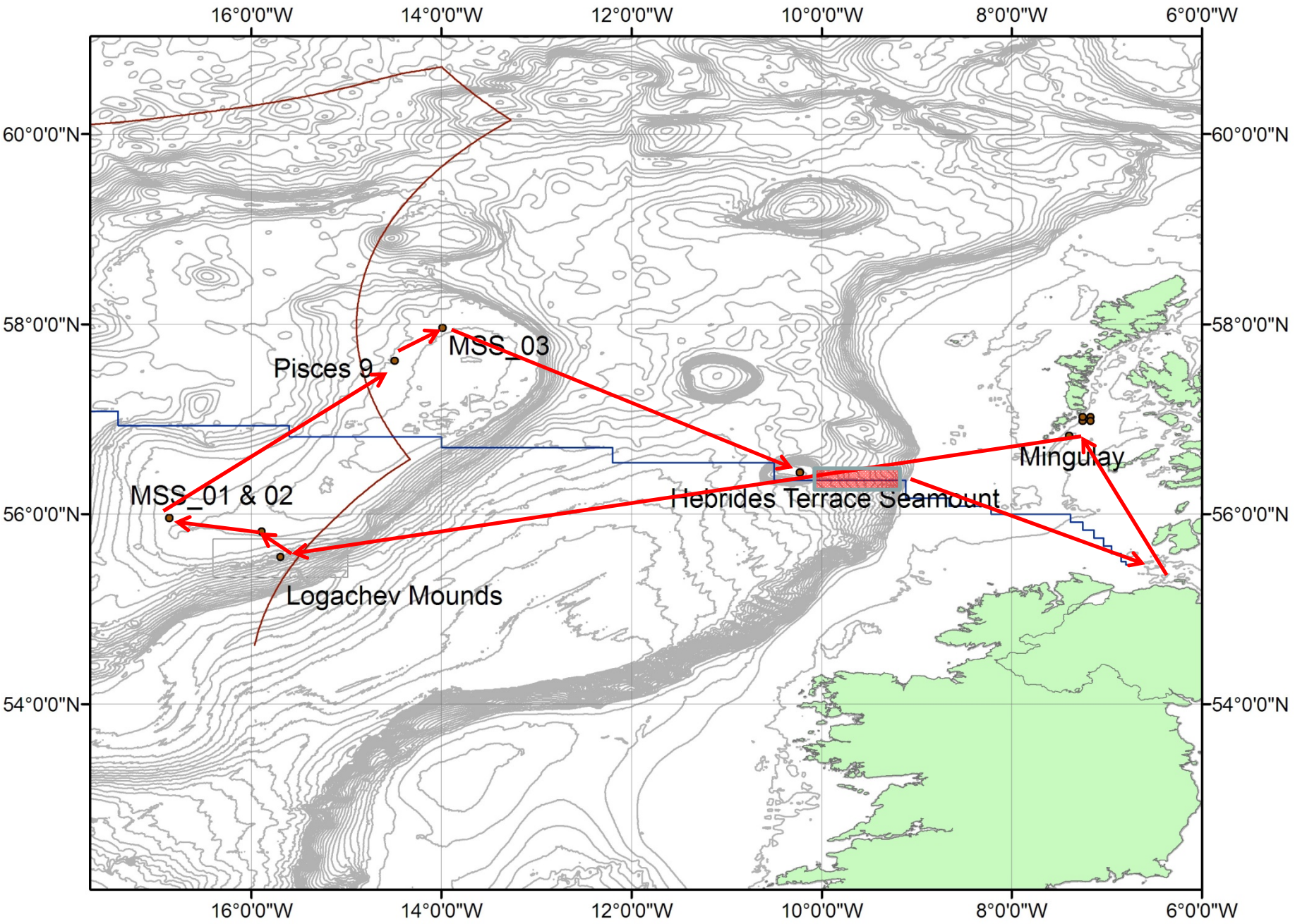
- ***Ocean Acidification***
  - Significant effects in short term, but acclimation occurs by T + 3 months (in terms of respiration). (Coral)
  - Varied response in protein expression (Maerl)

- ***Temperature***
  - Impact on respiration not significant at T+ 3 months. (Coral)
  - Varied response in protein expression (Maerl)

- ***Combined effect (most likely scenario)***
  - Significant reduction in respiration rate and growth rate compared to controls at T+3 months (Coral)
  - Temperature and pCO_2 have a synergistic effect on total protein concentration (Maerl)

JC073 ‘Changing Oceans Expedition’

- 17 May – 15 June 2012
- ROV from Irish Marine Institute (Holland 1)
- Participants from UKOA & BIOACID
- Added-value award supporting international researchers (Denmark, Germany, Spain, USA)
- Added-value award supporting increased outreach (School children & BBC visit at sea; Dynamic Earth workshops)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14°0'0"W
12°0'0"W
10°0'0"W
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

Activities at sea

Activity	Total Time (h)	Days
Mob	120	5.0
Transit	133	5.5
CTD	37	1.5
ROV*	251	10.4
MBES Hellisay	6	0.3
MBES/MVP/ADCP	81	3.4
SPI camera	16	0.7
Box coring	53	2.2
Gravity coring	22	0.9
SAPS	22	0.9
Moorings	6	0.3
Recovering ROV gear/samples	18	0.8
Contingency	66	2.7

*includes time recovering samples/equipment to surface

Changing Oceans

RRS James Cook 073

37 days to go

The team are busy preparing for the upcoming cruise, so further updates will be coming soon!

Posted by Laura on Tuesday, April 10, 2012

The countdown is on.....

In 2 months and 3 days time, 21 scientists and 11 technicians will be heading off on a mission. Onboard the RSS James Cook, these scientists and crew are heading out into the north Atlantic in search of corals, deep in the dark realms of the ocean.

What is the Changing Oceans Expedition?

On 17th May 2012, the RRS James Cook will set sail from Glasgow, heading into the North Atlantic with 21 scientists on board. Find out more about what these scientists will be doing here.

Latest News via Lophelia.org

- New case study on http://t.co/NWEhCfVl - learn about the cold-water corals of the Azores about 9 hours ago
- Video summary of 5th International Deep Sea Coral Symposium - current knowledge and developments http://t.co/sEypKnSJ about 12 hours ago

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Thanks to:

- NERC
- DEFRA
- DECC
- RSS *Discovery* participants and crew
- JC073 team
- National Marine Facilities
- Heriot-Watt University Environment & Climate Change theme
- Our Dynamic Earth

Changing Oceans Expedition blog

www.changingoceans2012.blogspot.co.uk/