PML | Plymouth Marine Laboratory

Marine Matters

Symposium at the European Parliament, Brussels, 6 March 2012

A Blueprint for Oceans and Coasts at the UN Conference on Sustainable Development (Rio+20, June 2012) Issues, Challenges and Solutions

Ocean Acidification

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UK Ocean Acidification Research Programme

EPOCA
European Project on Ocean Acidification

MedSeA

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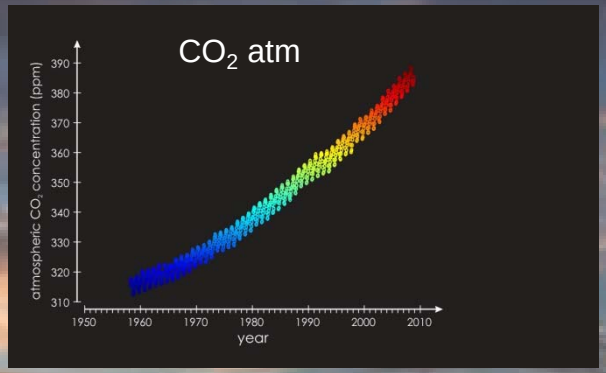
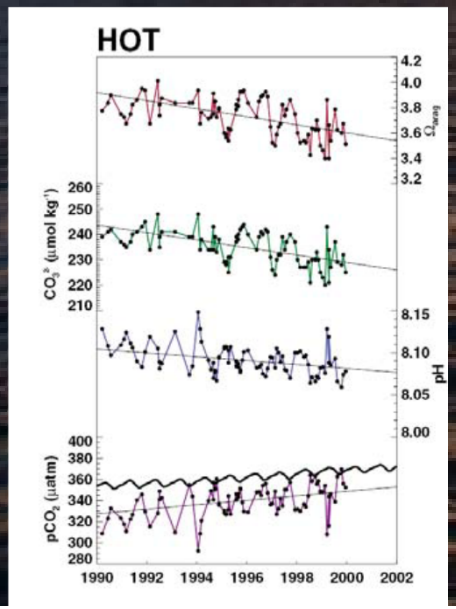
What is Ocean Acidification?

This is resulting in increased carbon dioxide (CO_2) in the atmosphere causing global warming



Mankind is burning fossil fuel

Oceans are vast and are taking up the CO_2

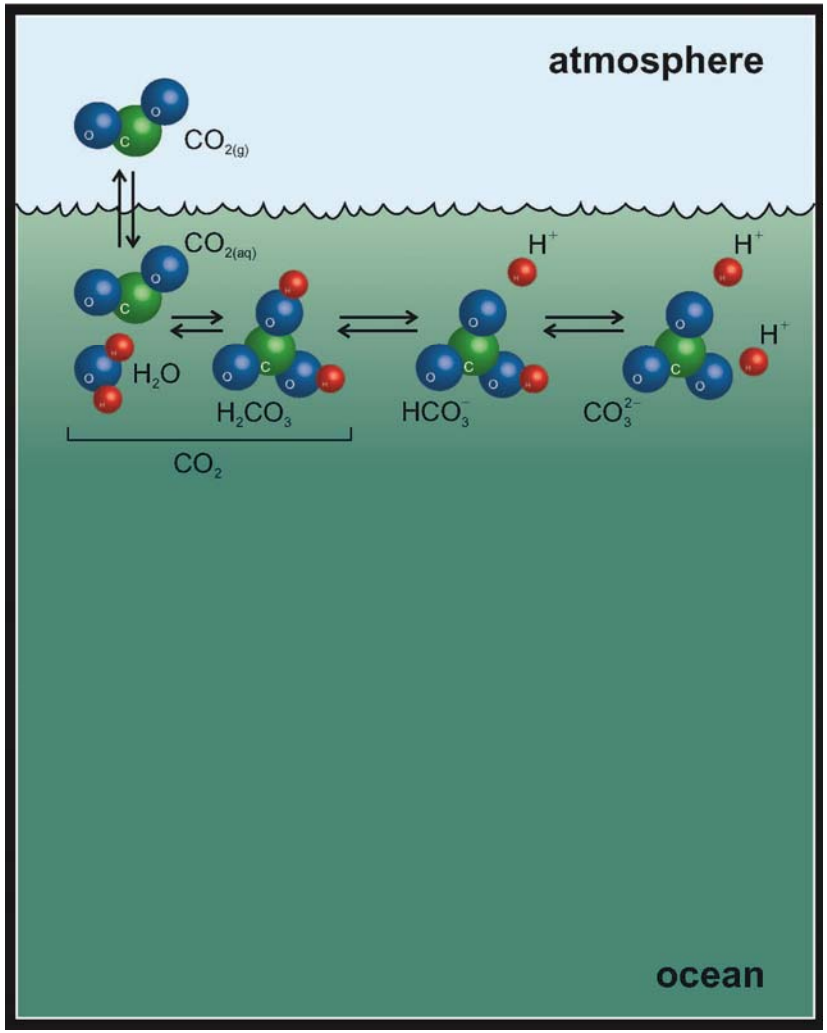


When CO_2 is added to water it becomes an acid…

…so the oceans are become more acidic, lowering the pH of seawater

..it is happening now and is measurable

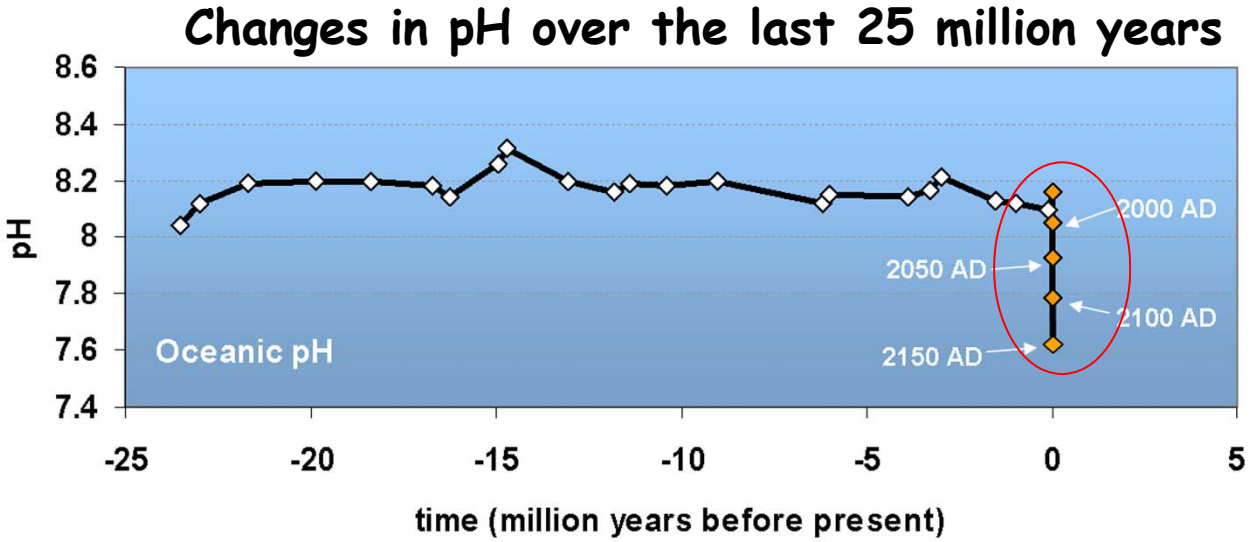
The root of the problem – CO_2 chemistry in seawater



- Oceans have already taken up 28% atmospheric CO_2 emissions
- Decrease in pH (increase in H+)
- Decrease in carbonate ions – key in controlling calcification of shells and skeletons

Ridgwell pers. Comm.

Oceans are Acidifying Fast …….

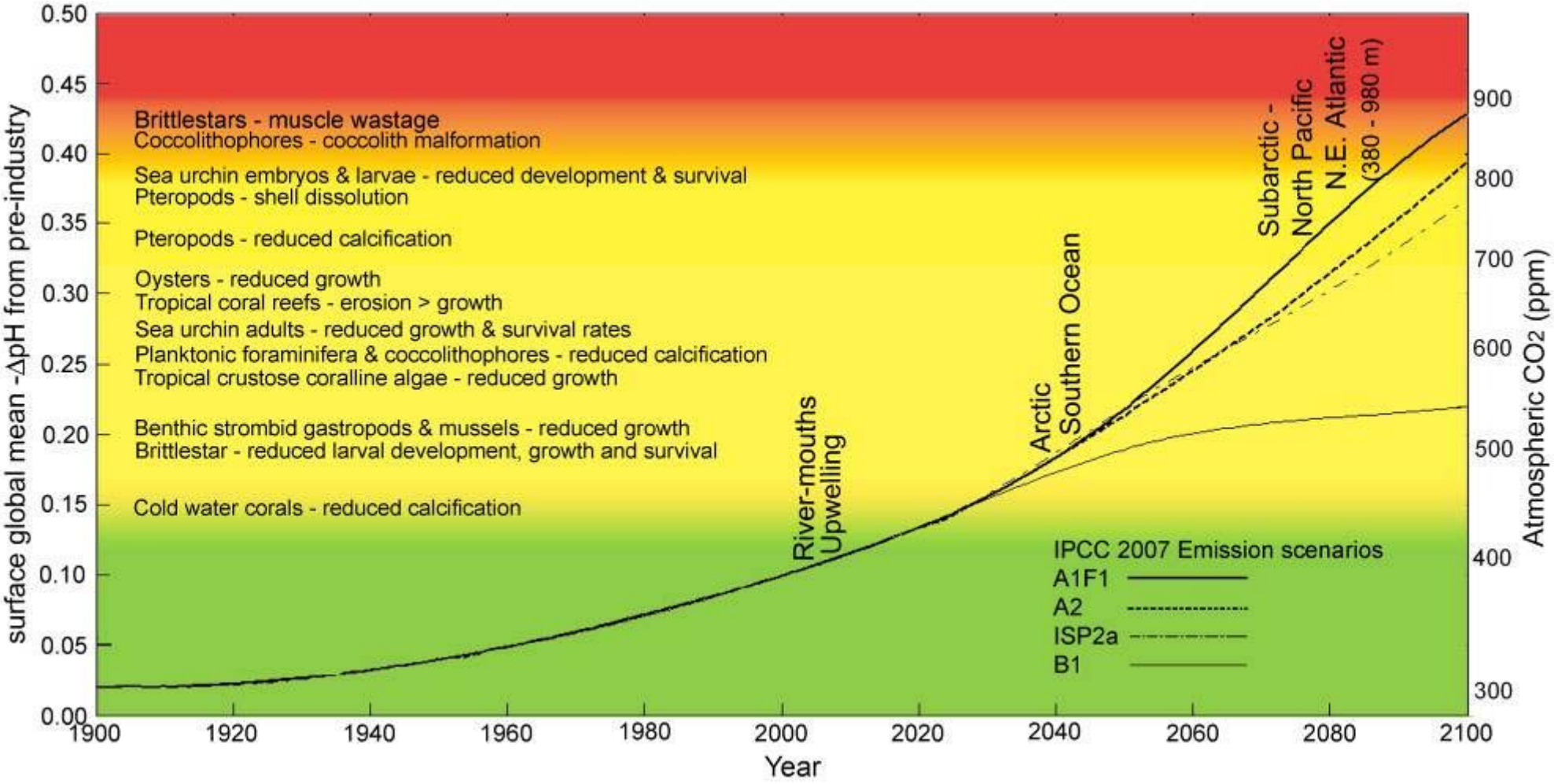


"Today is a rare event in the history of the World"

- **It is happening now, at a *speed* and to a level not experienced by marine organisms for about 60 million years**
- **Mass extinctions linked to previous ocean acidification events**
- **Takes 10,000's of years to recover**

Turley et al. 2006

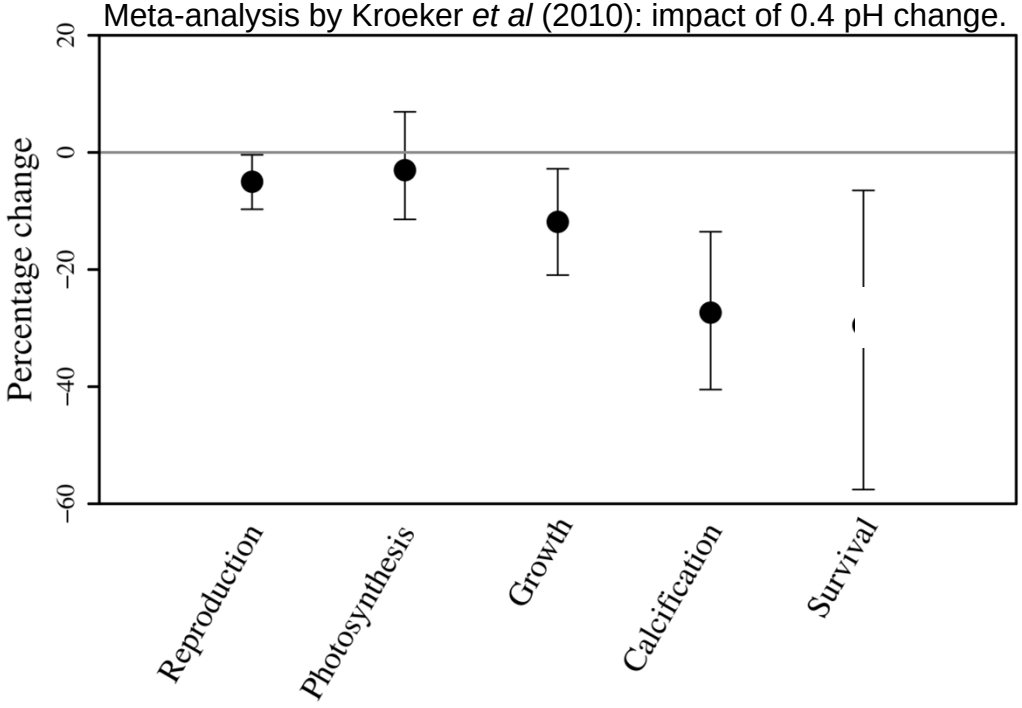
Mounting Evidence: that future CO_2 emissions could impact some marine organisms and ecosystems this century

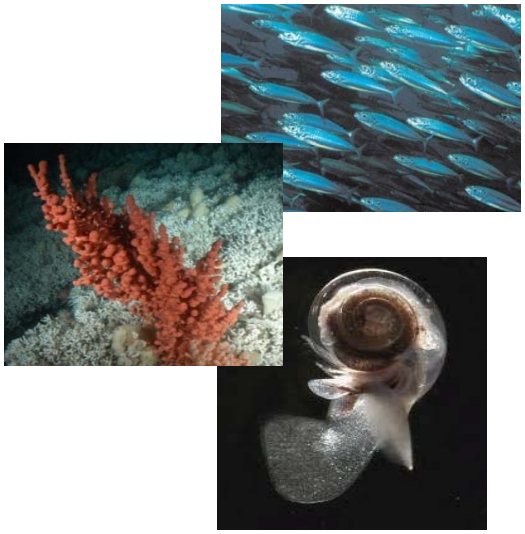


Turley et al. (2010)

Biological effects of ocean acidification …..

Meta-analysis by Kroeker *et al* (2010): impact of 0.4 pH change.





- 139 experiments significant reduction in survival, calcification, growth and reproduction in very many species

- But processes are not yet well-understood, variability is high and ecosystem effects (and their socio-economic impacts) are uncertain

Impact on invertebrates, many are food providing .....

ECHINODERMS

Abyssocucumis sp.
Amphiura filiformis
Arbarcia drufresnei
Arbarcia punctulata
Asterias rubens
Crossaster papposus
Cystechinus sp.
Denstraster excentricu
Echinocardium cordatu
Echinometra mathaei
Eucidaris tribuloides
Evechinus chloroticus
Heliocidaris erythrogra
Hemicentrotus pulche
Lytechinus pictus
Op
Op
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Pi
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Ps
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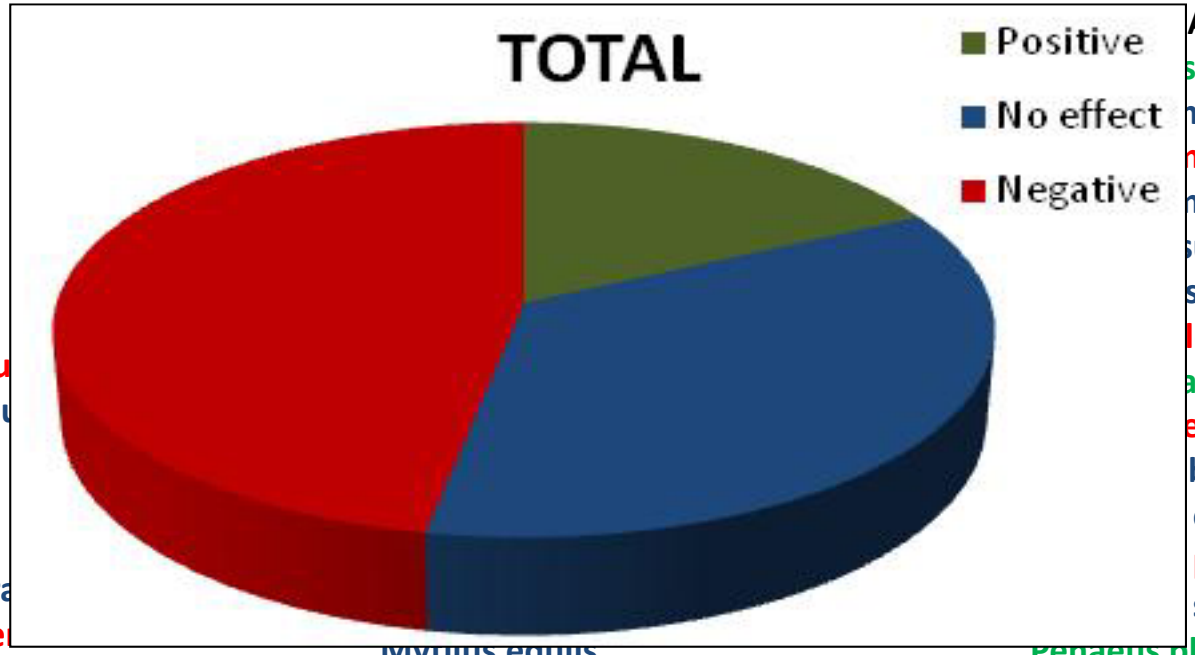
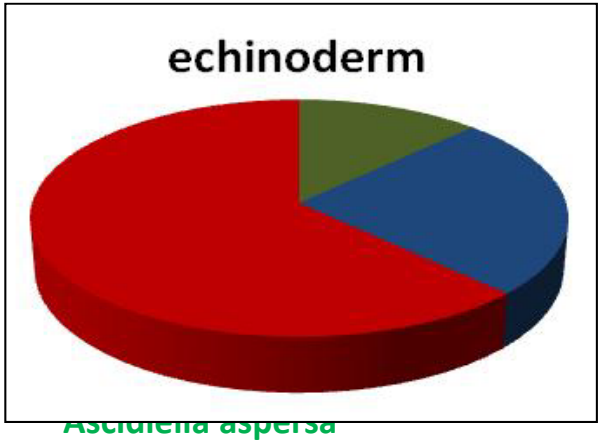
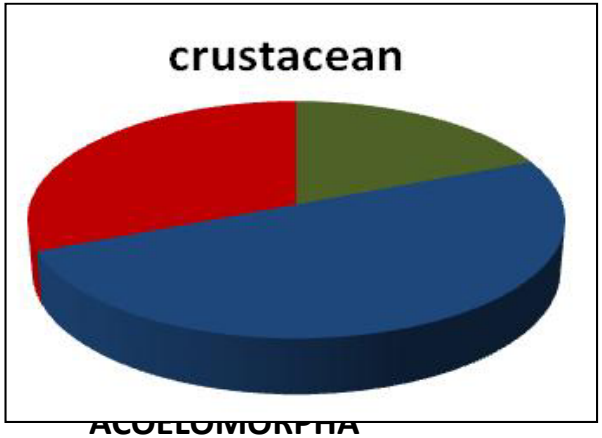






BRYOZOANS

Myriapora truncata

ANS

s sapidus
marus marinus
odestus
odestus
superba
s locusta
lodo
americanus
eus
ber
elegans
pacificus
serratus
Penaeus plebejus
Schizopera knabeni

Mytilus edulis
Nucella lamellosa

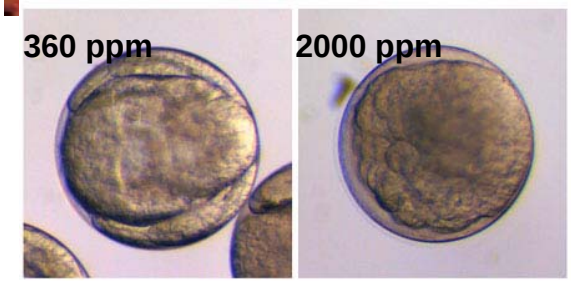
Ascidiella aspersa
Ciona intestinalis
Oikopleura dioicea

ACOELOMORPHA
Symsigatifera roscoffiensis

Dupont pers. comm.

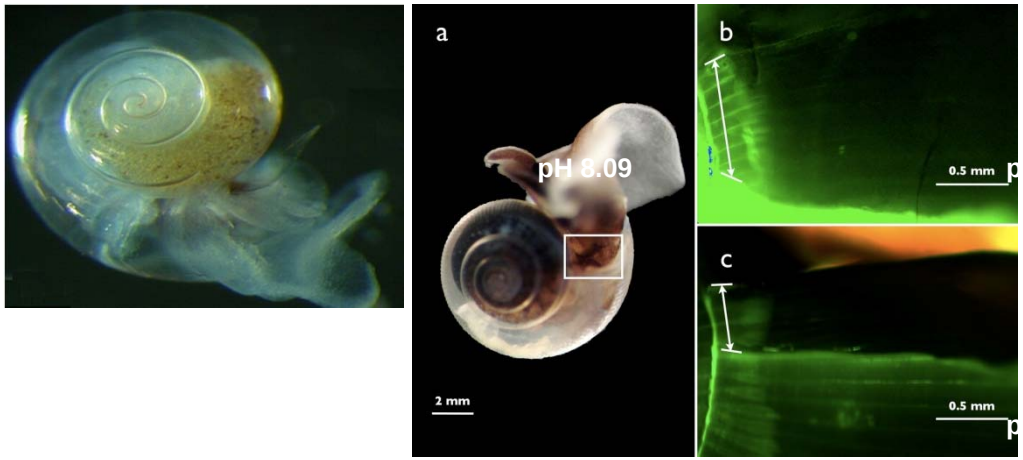
Key links in the food chain show vulnerability….

Krill embryo development

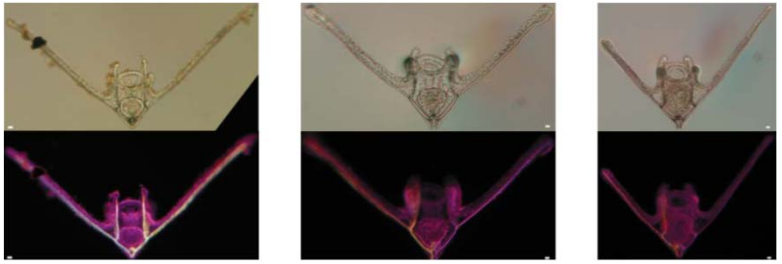


Kawaguchi et al. 2010

Pteropods shell growth



Arctic *Limacina helicina* stained with calcein. 30% reduction of the calcification rate at pH 7.8. Comeau et al. 2009



Brittlestar larval - 100% mortality in 7 days with a -0.2 pH.
Dupont et al. 2010

CO_2 seeps in coral reefs off Papua New Guinea

Ocean acidification leads to loss in diversity, structural complexity. No reef development at <7.8 pH.

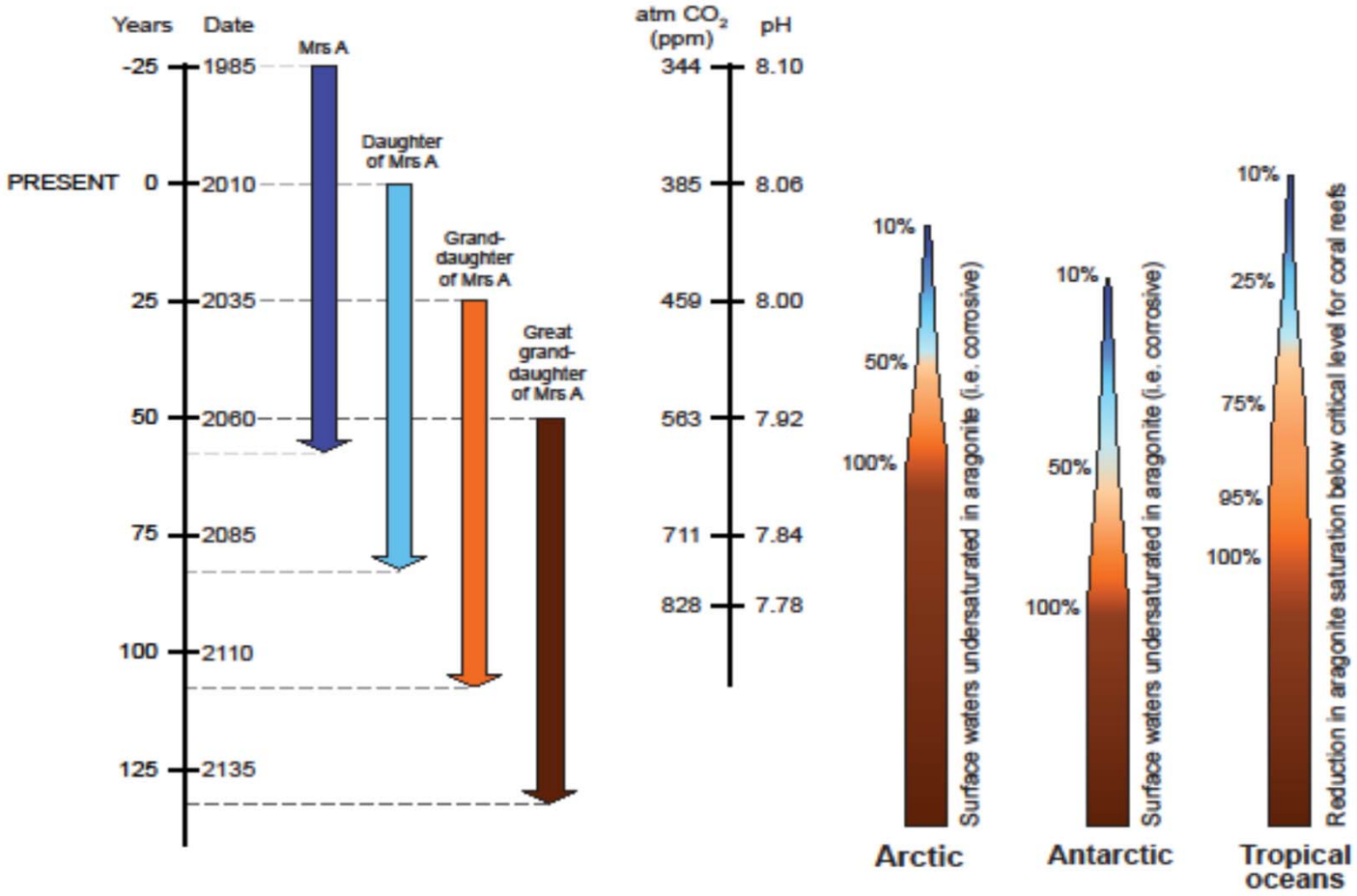
Today: pH 8.1 pH 7.9 pH 7.8

A vision of the future of coral reefs in a high CO_2 world?

Katharina Fabricius, Australian Institute of Marine Science

Potential Vulnerabilities in Relation to Human Life spans –

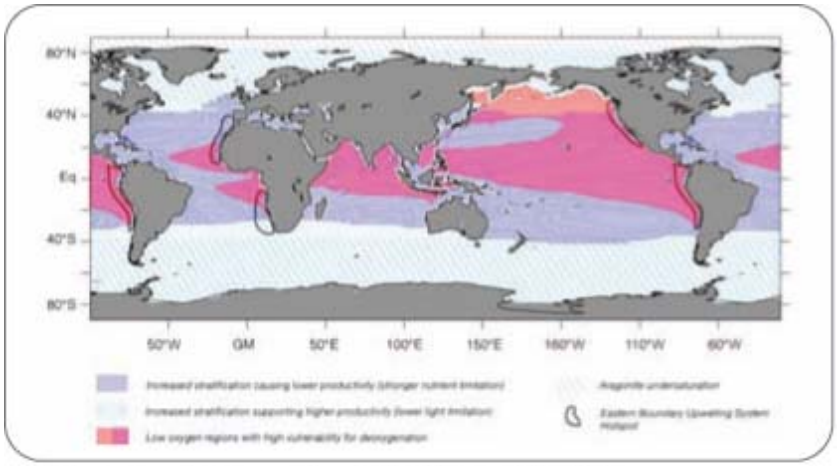
what it might mean to us and our children



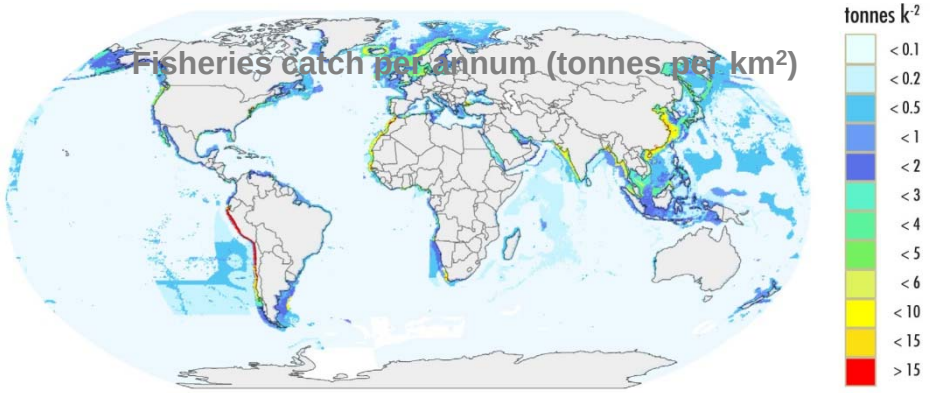
Turley and Boot (2011)

Multiple Stressors – Hotspots of Multiple Impacts

Acidification + Warming + Oxygen loss



Nicolas Gruber, Phil. Trans. R. Soc. A (2011) 369, 1980–1996



Data source: Sea Around Us project, (University of British Columbia, http://www.seaaroundus.org). Map designed by Dr. Reg Watson (http://ecomarres.com). Used with permission.

Change to biodiversity and ecosystems, and the goods and services they provide can be expected.

Important fisheries areas are vulnerable: upwellings, estuaries, polar waters, coastal waters and tropical coral reefs.

www.oceanunderstress.com

What can we do?

As major ocean change continues, governments will face increased pressure to adopt adaptive policy instruments at the local, national, and international levels

Global Action - the real fix:

- **Rapid and substantial cuts to CO_2 emissions**
- **Effective international planning and financing for adaptation**

Regional and Local Action - buying time to implement the global solution:

- **Determine vulnerabilities**
- **Reduce local sources**
- **Reduce other pressures**
- **Identify flexible and resistant species**
- **Explore other production options**