

Course OA Does it work? Evaluation



Evaluation #1 (before)

Evaluation #2 (after)

Discussion

Dear Scientist,

We would like to employ you to assess the potential impact of global warming on our local population of mussels. Mussels are present all along our coast and a major economic resource for the country. Our population is located at the extreme southern distribution of the species (Cool Harbor, famous for his mussel soup). It is predicted that by the end of the century, the average annual temperature will increase by 2°C and we need to know how this could impact the survival of the adult mussels at Cool Harbor.

We have already employed two scientists but they had very different conclusions (see their reports below).

I am little confused by the conclusions of the two scientists. Can you please have a look at their conclusions and help us to understand which of the two scientists is correct?

Thanking you in advance



Report of Scientist #1

I have performed some experiments in the lab. I collected 20 mussels at Cool Harbor. I also measured the temperature at the Cool Harbor (20°C). Mussels were exposed in the lab to a temperature of 22°C for 2 weeks. At the end of the experiment, 5 mussels used in this experiment were dead, corresponding to a mortality of 25%.

We can then conclude that by the end of the century, mussels in the fjord will experience a 25% increased mortality.



Report of Scientist #2

I have conducted extensive measurements of temperature in the field. Large variations in temperature were observed between seasons (from a minimum temperature of 4°C in January to a maximum of 24°C in July, with an average temperature of 14°C) but also within a single day (for example, summertime temperatures can vary from 16° C at night to 23°C during the day). Moreover, some episodes of lower and higher temperatures can be experienced during unusually cold and warm days. As a consequence, mussels are already naturally experiencing temperature variations, and are thus acclimated to temperature changes.

In conclusion, we can predict that the mussels will be resistant to the small temperature increase expected by the end of this century with no or little impact on their mortality.



Sam Dupont

Researcher, Associate Professor University of Gothenburg 杜邦憲

Assistant Professor University of Hong Kong





The challenge of ocean acidification

what do we need to know?





Q1: Why do we need to study ocean acidification?

Q2: What is the cause of ocean acidification?

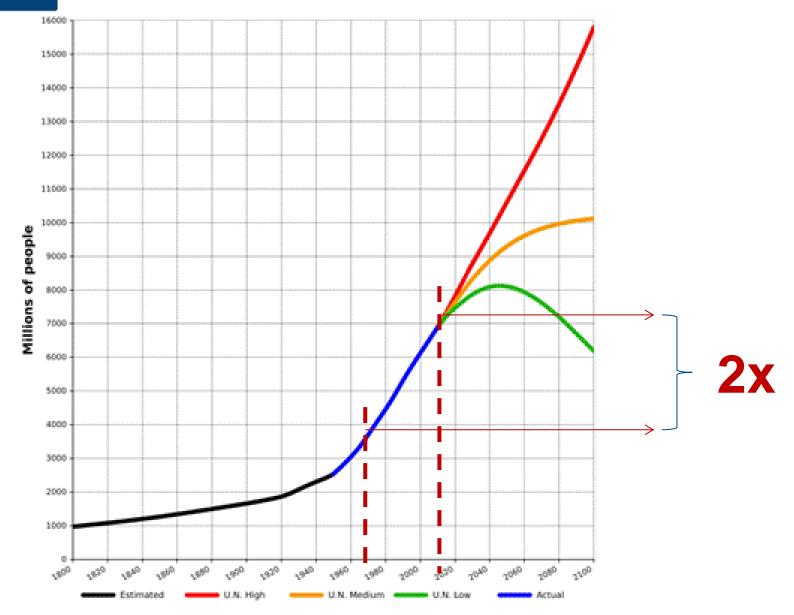


Planet infected by humans





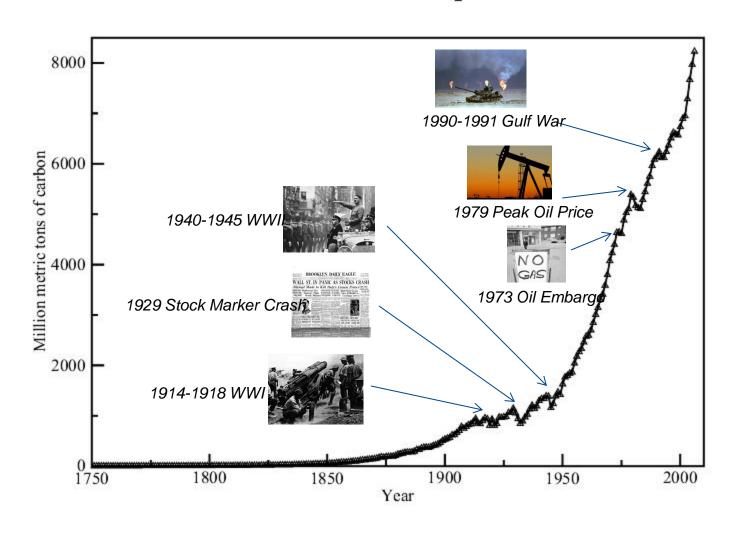
Cause: human demography





Energy = carbon dioxide (CO_2)

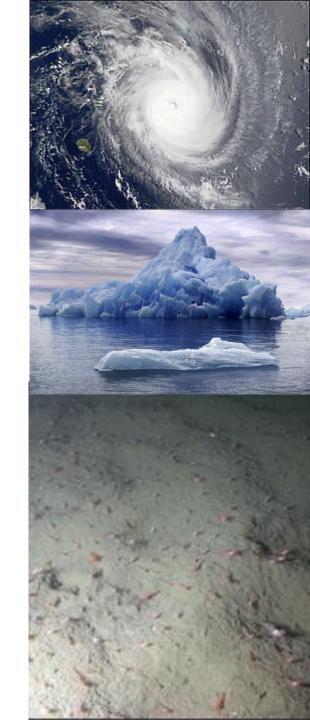
Global Fossil-Fuel CO, Emissions





Symptoms

Global warming Catastrophic events Ice melting Sea level rise Hypoxia Salinity changes Ocean acidification



Ocean acidification is chemistry... CO₂ ... not conjecture

$$CO_2 + H_2O \rightarrow H_2CO_3$$

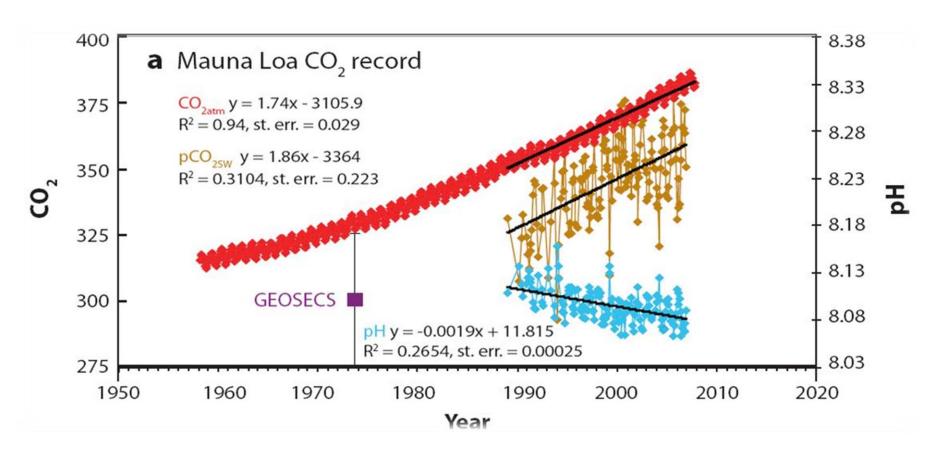
Carbon dioxide

Water

Carbonic acid

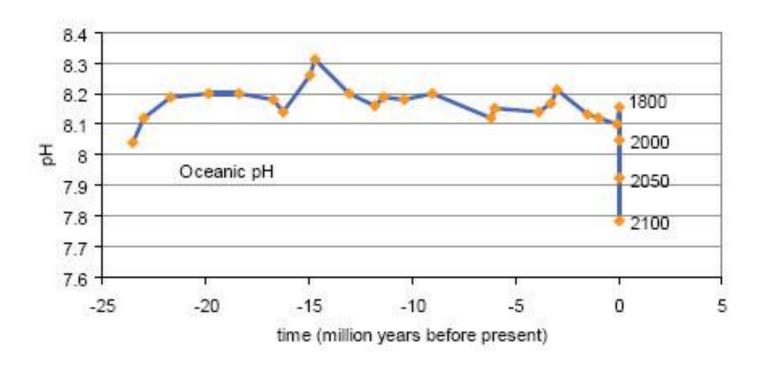


Ocean acidification is happening now





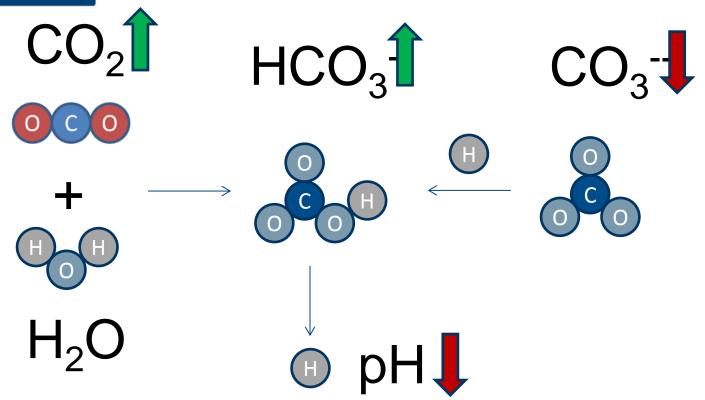
Fast and strong



Ocean 2x more acidic by 2100



A little bit more chemistry



Sea water more acidic

Sea water more corrosive Decreased carbonate Calcification? [CaCO₃]



POSITION Ocean acidification is a real, fast and directly related to our CO₂ emissions



Last ocean acidification event: the third extinction

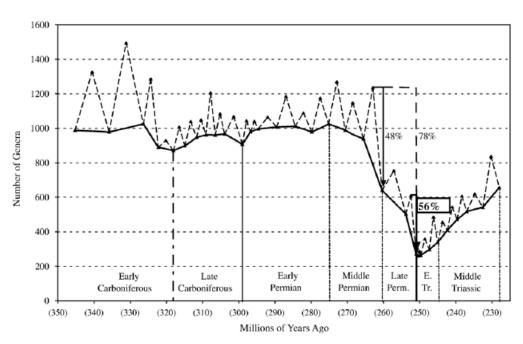
RESEARCH

REPORT

EARTH HISTORY

Ocean acidification and the Permo-Triassic mass extinction

M. O. Clarkson, 18 † S. A. Kasemann, 2 R. Wood, 1 T. M. Lenton, 3 S. J. Daines, 3 S. Richoz, 4 F. Ohnemueller, 2 A. Meixner, 2 S. W. Poulton, 5 E. T. Tipper 6



(Knoll et al. 2007)

Extinction of 92% of all marine species



Challenge marine ecosystems

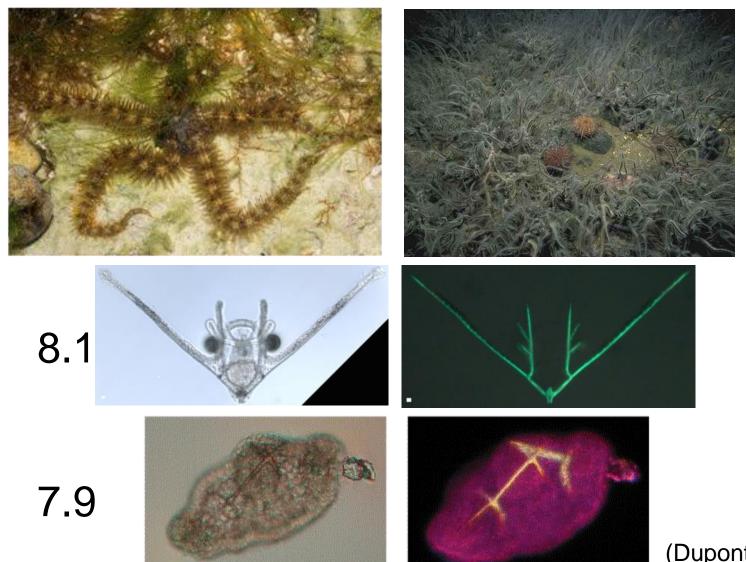


50% of marine animals threaten by ocean acidification

(Wittmann & Pörtner 2013)



Can lead to species extinction



(Dupont et al. 2008)



It is already happening



Impact aquaculture and industry



Q3: What can we do?

Q4: What do we need to address this challenge?



What can we do?



Fight?

Flight?

or nothing?

- NOTHING: Face to the consequences
- FIGHT: Mitigation Work on the cause (decrease CO₂)
- FLIGHT: Adaptation Work on the symptoms (buy some time)



A problem of scale



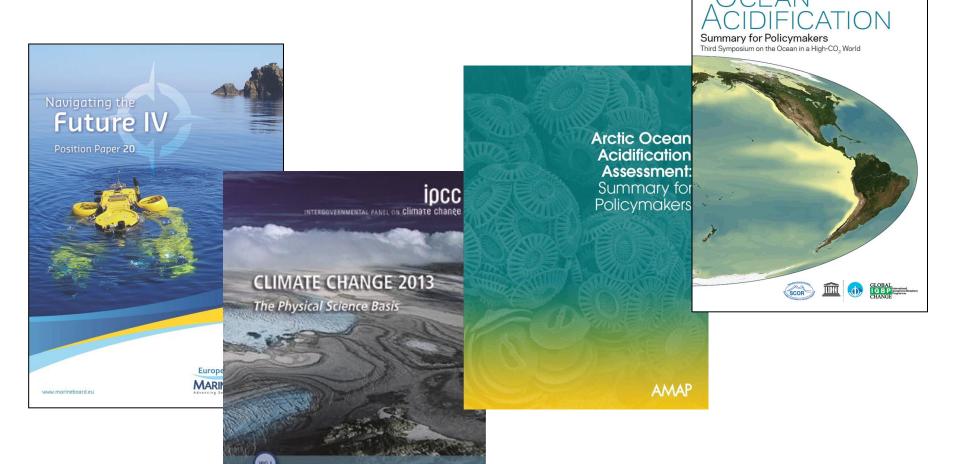
GLOBAL challenges

GLOBAL options: CO₂

GLOBAL/LOCAL data



Scientists are "virtually certain" that ocean acidification will lead to dramatic consequences



(a) (b)

WORKING GROUP I CONTRIBUTION TO THE FIFTH ASSESSMENT REPORT OF THE

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE



Mitigation: We know what to do



Demography



CO₂ emissions

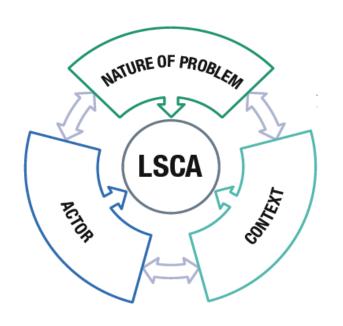
WHY NO MORE ACTIONS???





CENTRE FOR COLLECTIVE ACTION RESEARCH





Social dilemna:

Action, acceptance and compliance linked to psychological factors, values, beliefs, norms, policy-specific beliefs, freedom, fairness, effectiveness, personal outcome, trust and reciprocity, etc.

Need to be ocean literate



A problem of scale



GLOBAL challenges

GLOBAL options: **L** CO₂

GLOBAL/LOCAL data

LOCAL challenges

LOCAL options

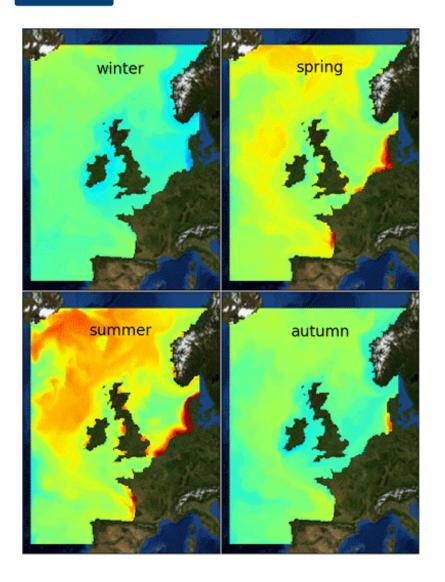
[management, adaptation, etc.]

LOCAL data





Projections



to better manage the future

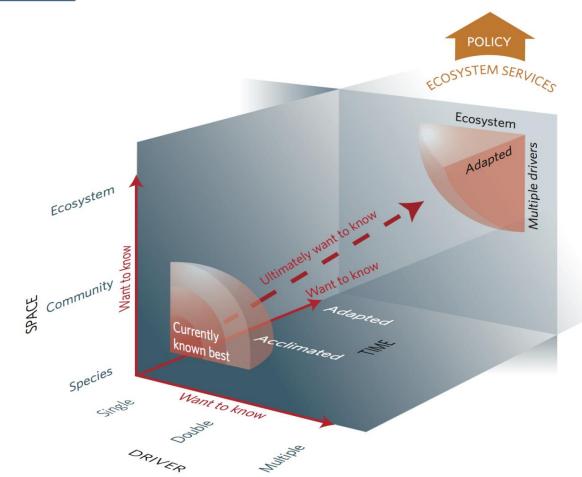


Biology is always the bottleneck

- Local scenarios
- Local variability
- Local stressors and other modulating factors
- Ecological interactions
- Evolution
- *Etc*.



Well, biology is complicated...



... and will always be limiting

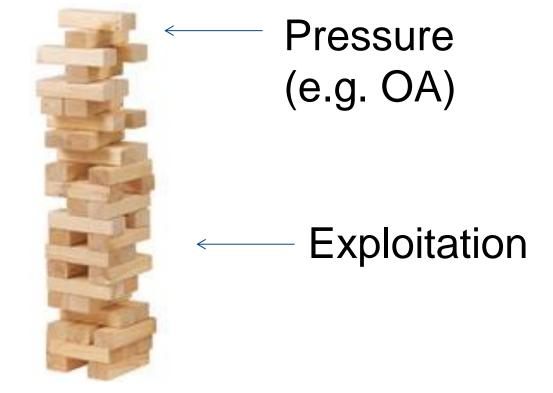
Riebesell and Gattuso (2015) Nature Climate Change



Playing jenga with the ocean



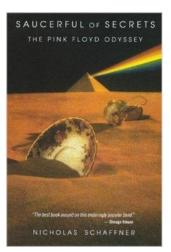
Healthy ecosystem





Adaptation: Buy some time

"I am still convinced that a lot of it was acidbased. It may have happened without, but it probably would have taken longer."



- Change practices (e.g. aquaculture)
- Make ecosystem more resilients (e.g. MPA)
- Decrease other sources of stress (e.g. pollution)
- Select resilient strains
- Protect hot spots
- etc.





Success story



2005 crash of oyster industry

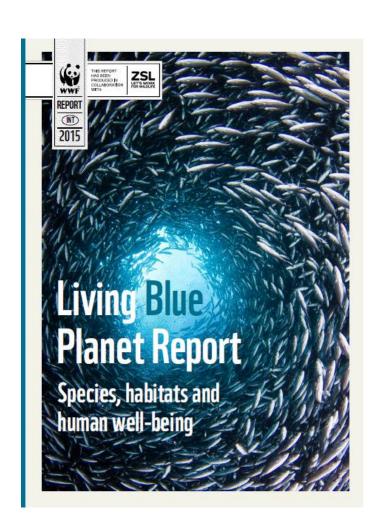


It's not too late...





But it's time



NEARLY 3 BILLION PEOPLE RELY ON FISH AS A MAJOR SOURCE OF **PROTEIN.** OVERALL, FISHERIES AND AQUACULTURE ASSURE THE LIVELIHOODS OF 10-12 PER CENT OF THE WORLD'S POPULATION. 60 PER CENT OF THE WORLD'S POPULATION LIVES WITHIN 100KM OF THE COAST. MARINE VERTERRATE POPULATIONS DECLINED 49 PER CENT BETWEEN 1970 AND 2012. POPULATIONS OF FISH SPECIES UTILIZED BY HUMANS HAVE FALLEN BY HALF, WITH SOME OF THE MOST IMPORTANT SPECIES EXPERIENCING EVEN GREATER DECLINES. AROUND ONE IN FOUR SPECIES OF SHARKS. RAYS AND SKATES IS NOW THREATENED WITH EXTINCTION. DUE PRIMARILY TO OVERFISHING. TROPICAL REEFS HAVE LOST MORE THAN HALF THEIR REEF-BUILDING CORALS OVER THE LAST 30 YEARS. WORLDWIDE, NEARLY 20 PER CENT OF MANGROVE COVER WAS LOST BETWEEN 1980 AND 2005. 29 PER CENT OF MARINE FISHERIES ARE OVERFISHED. IF CURRENT RATES OF TEMPERATURE RISE CONTINUE, THE OCEAN WILL BECOME TOO WARM FOR CORAL REEFS BY 2050. SEABED MINING LICENCES COVER 1.2 MILLION SQUARE KILOMETRES OF OCEAN FLOOR. MORE THAN 5 WORTH AT LEAST US\$2.5 TRILLION PER YEAR. JUST 3.4 PER CENT OF THE OCEAN IS PROTECTED. AND ONLY PART OF THIS IS EFFECTIVELY MANAGED. INCREASING MARINE PROTECTED AREA COVERAGE TO 30 PER CENT COULD GENERATE UP TO US\$920 BILLION BETWEEN 2015 AND 2050.



Q1: Why do we need to study ocean acidification?

Need solutions (mitigation, adaptation)

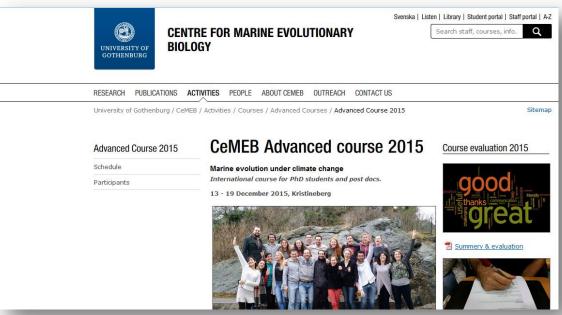
Need better information

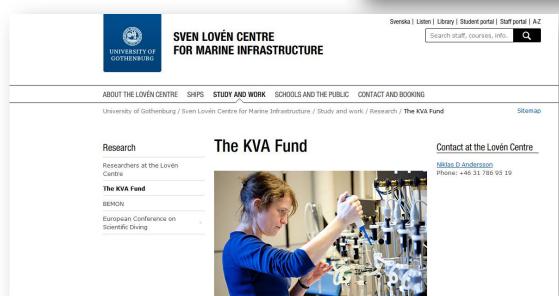
Think carefully of your question



Come and visit.....

5th edition: 16-22 October 2016





2017 call: August 2017



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18 incredible European destinations that haven't been discovered by tourists



"Sweden's west coast is home to quaint fishing villages and a bustling boating scene. Head to Fiskebäckskil to enjoy incredibly fresh seafood, charming walking paths, and cycling trails."