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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?



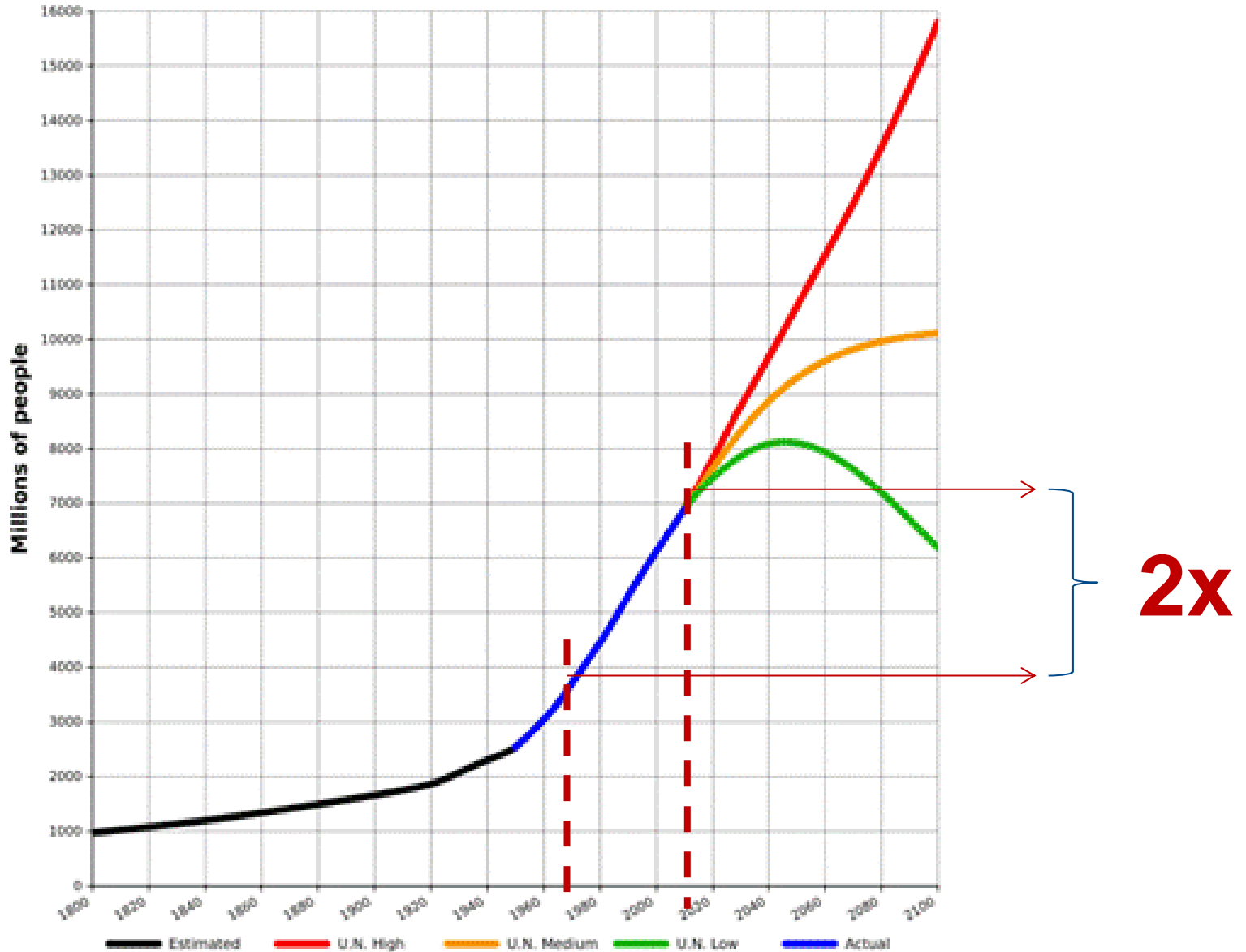
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Planet infected by humans





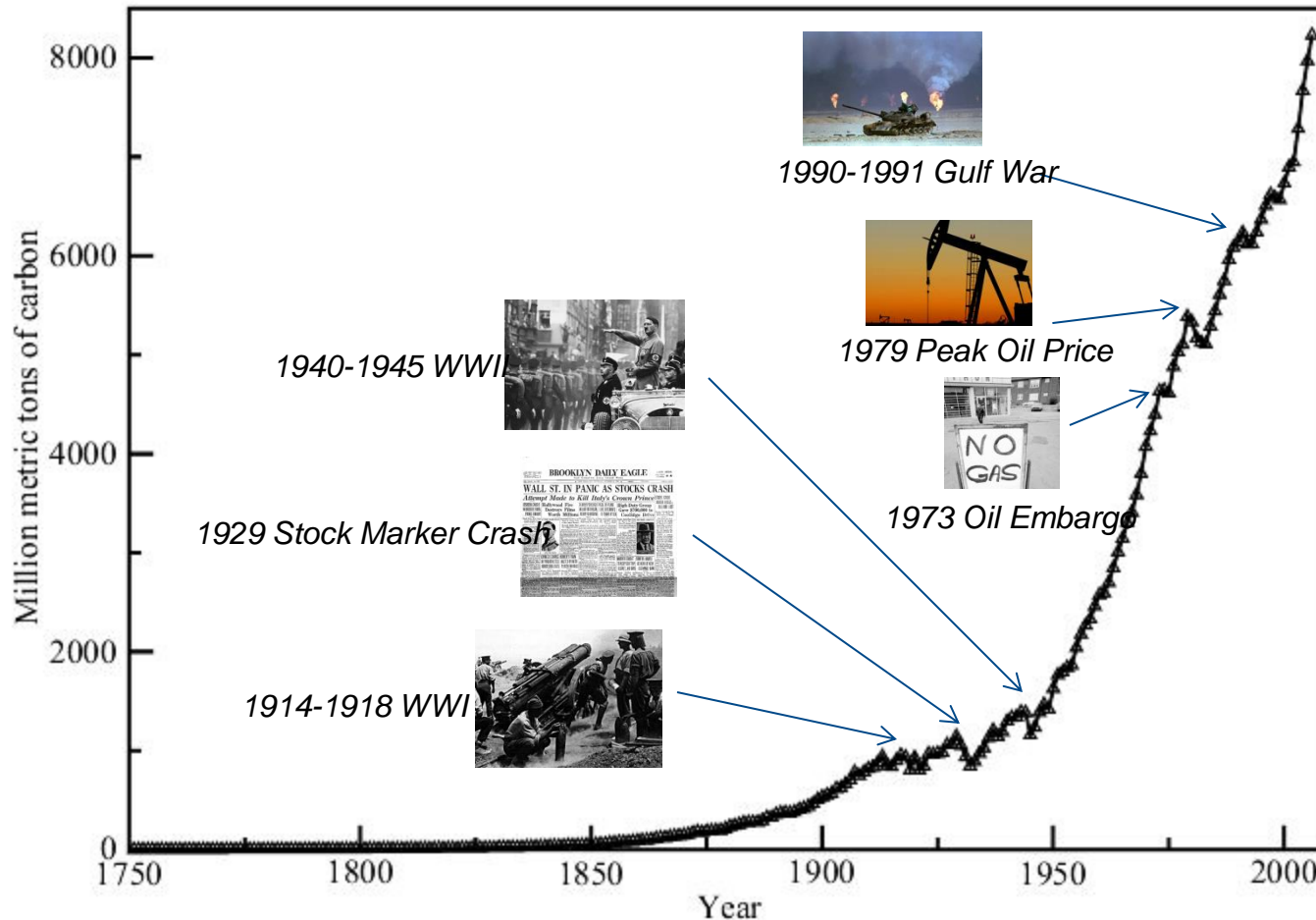
Cause: human demography





Energy = carbon dioxide (CO₂)

Global Fossil-Fuel CO₂ Emissions





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Symptoms

Global warming

Catastrophic events

Ice melting

Sea level rise

Hypoxia

Salinity changes

Ocean acidification





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)



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A problem of scale



GLOBAL challenges

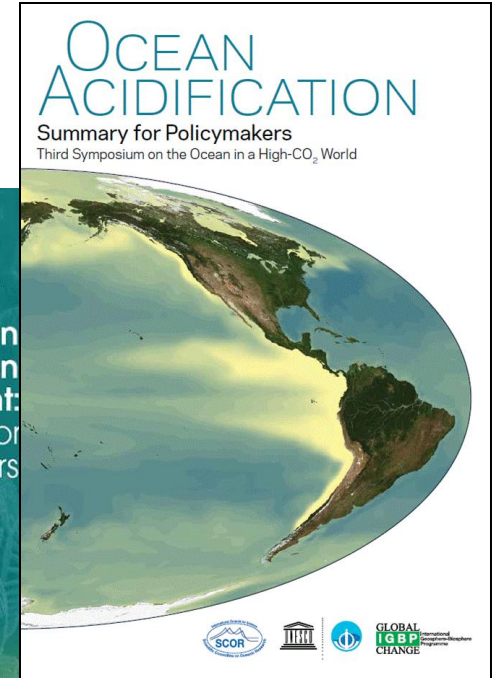
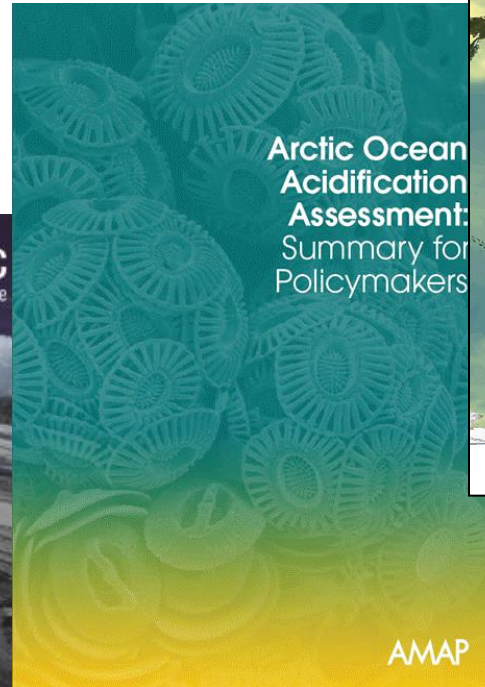
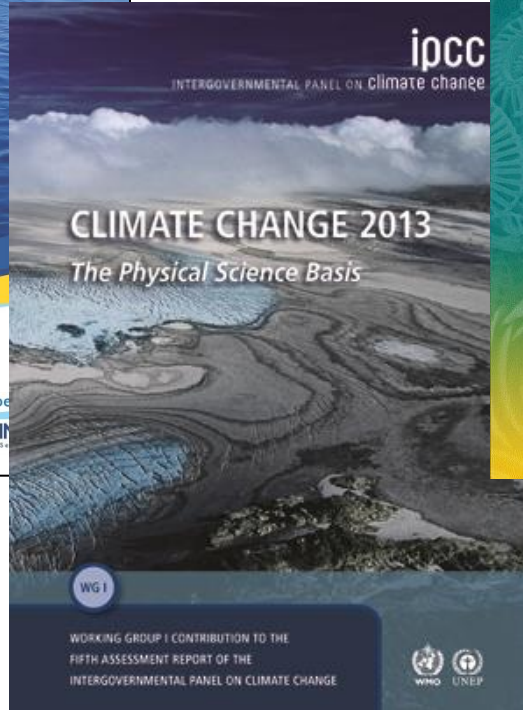
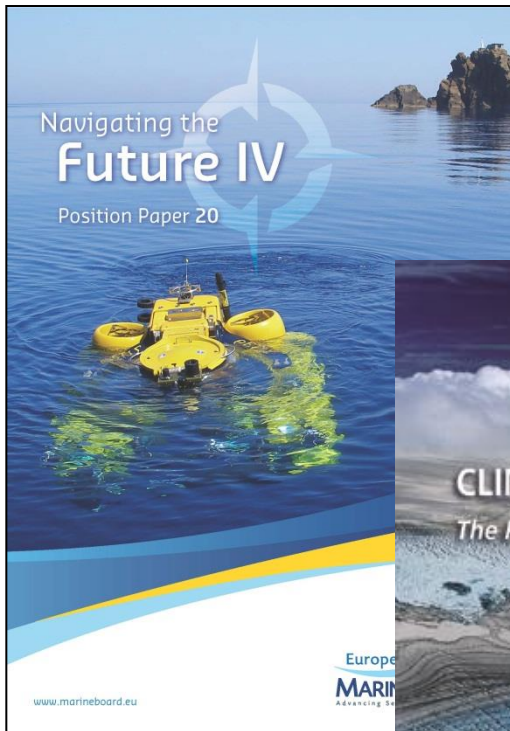
GLOBAL options: ↓ CO₂

GLOBAL/LOCAL data

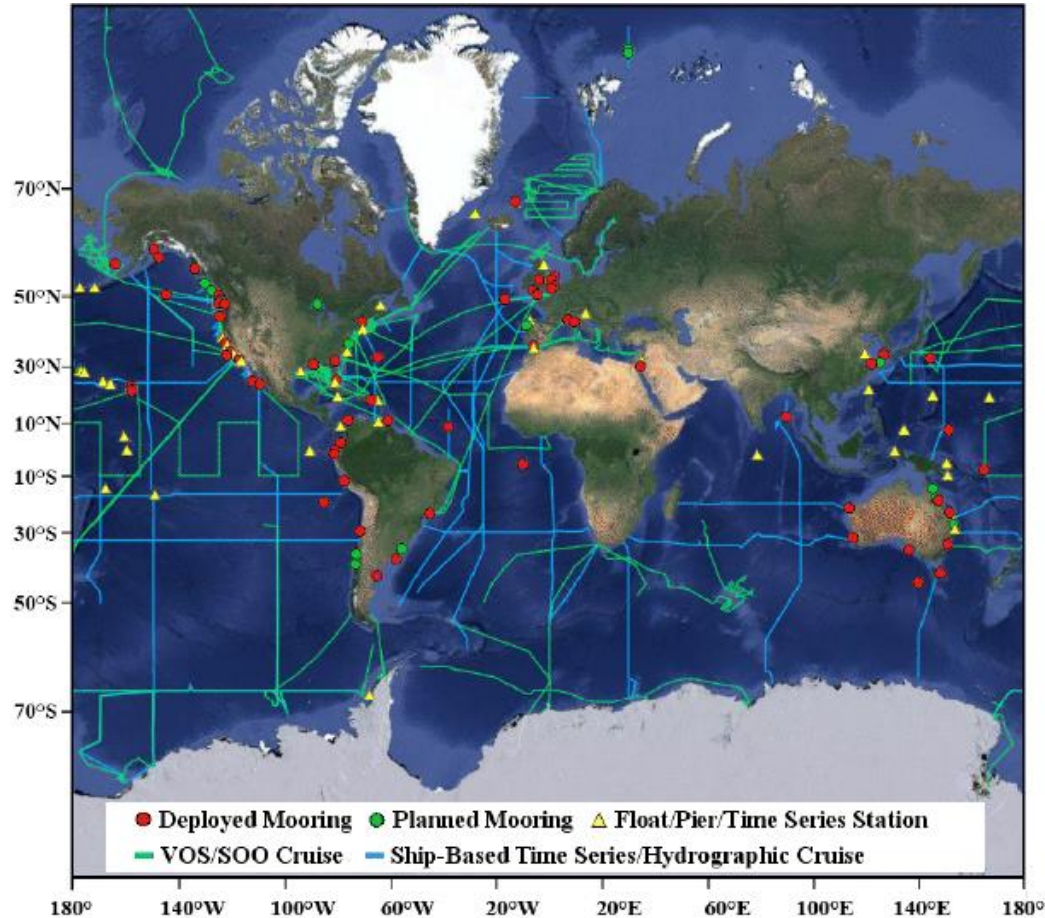


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Scientists are “virtually certain” that ocean acidification will lead to dramatic consequences



Global Observatory Network for ocean acidification



Existing: **red** Planned: **green**



Ocean Acidification
International
Coordination Centre

OA-ICC

Ocean Acidification International Coordination Centre (OA-ICC)

Communicating, promoting and facilitating global actions
in a changing ocean world

Lina Hansson
OA-ICC Project Officer

Michel Warnau
OA-ICC Programme Manager

IAEA Environment Laboratories
International Atomic Energy Agency
Principality of Monaco

[iaea.org/ocean-acidification](https://www.iaea.org/ocean-acidification)
[news-oceanacidification-icc.org](https://www.iaea.org/news-oceanacidification-icc.org)

©Lina Hansson

Mitigation: We know what to do



Demography




CO₂ emissions

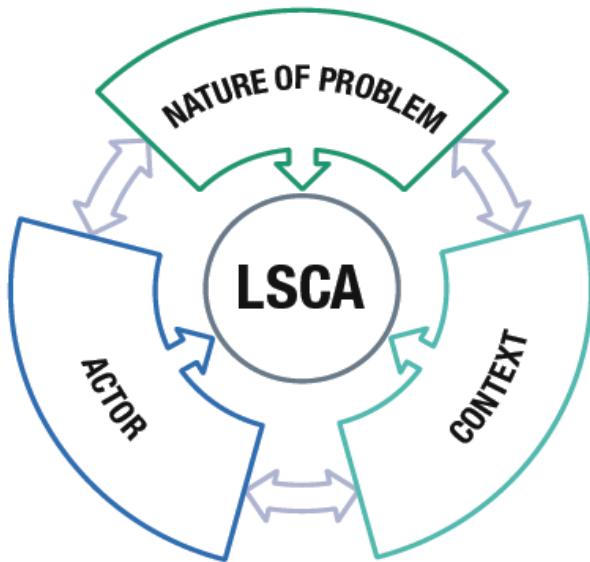
WHY NO MORE ACTIONS???

A man with short brown hair, wearing a red polo shirt, is smiling slightly. He is standing in front of a bookshelf filled with books and various items. The background is slightly blurred.

KEN CALDEIRA
on *Inquiring Minds*

“People have to sacrifice a little bit of their short term self interest to help the world be a better place for the long term. And how you get people to do that, I think, is the most important research that can be done.”

 @inquiringshow



Social dilemma:

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 failure to communicate



Tim Minchin

*The idea that (...) the science of anthropogenic global warming is controversial is a powerful indicator of the extent of our **failure to communicate.***



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A failure to communicate

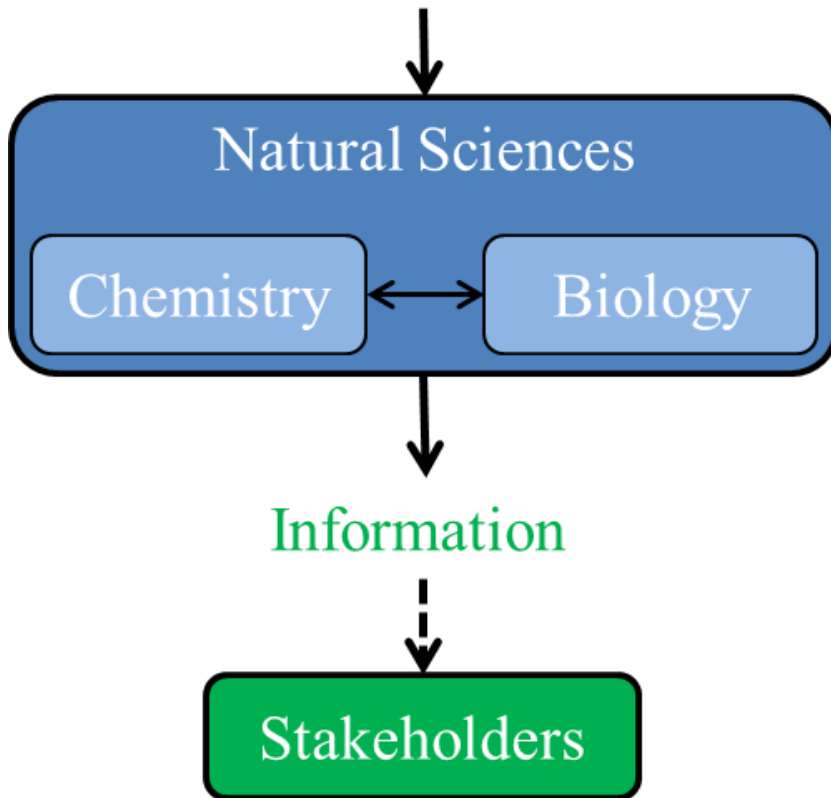
*Scientists are
sometime poor
communicators...*



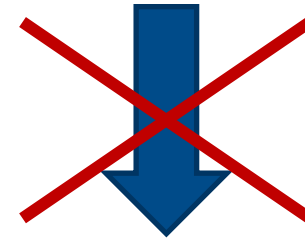
*... and
nerds*

A need for a new strategy

OCEAN ACIDIFICATION



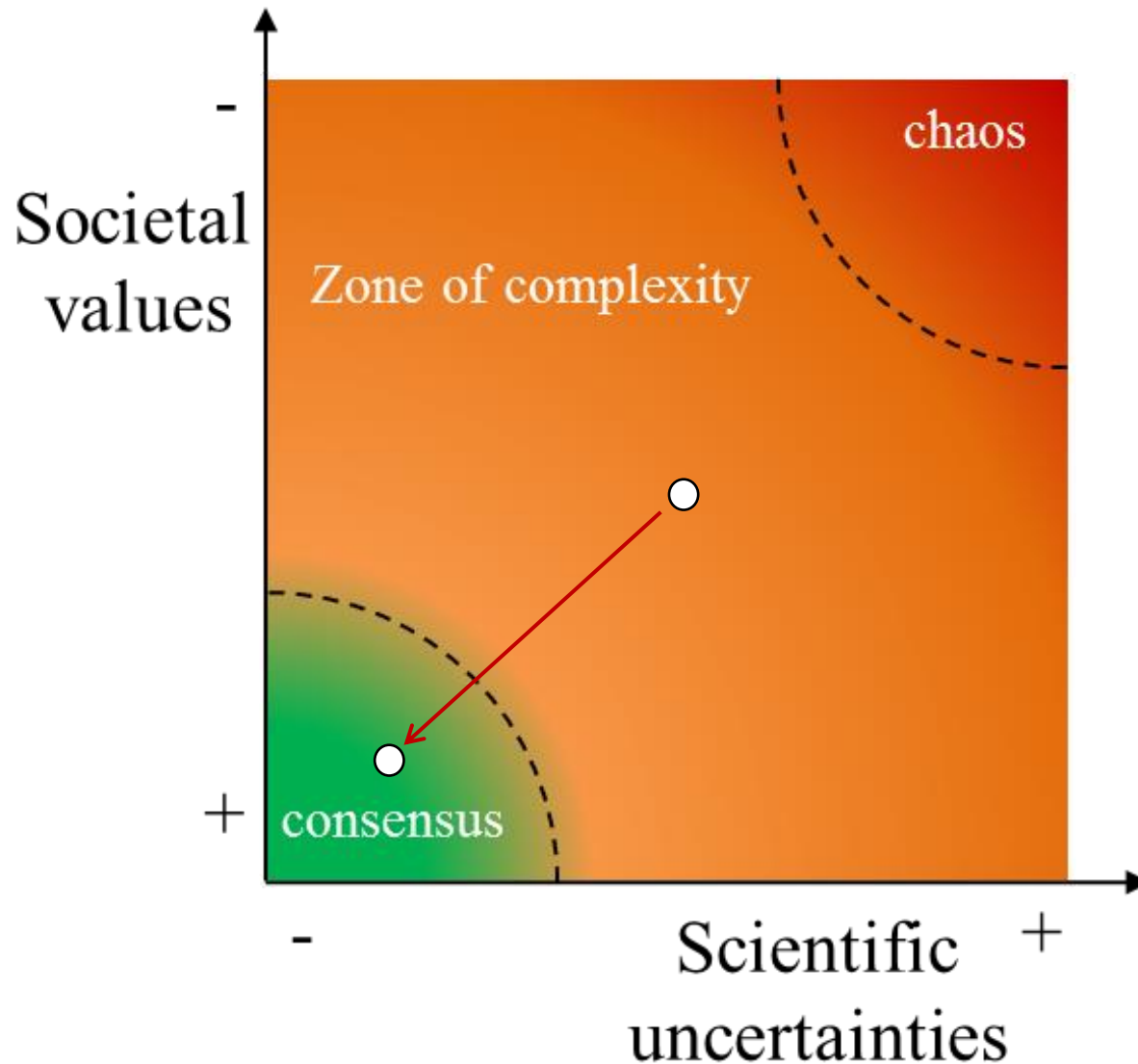
Information
[e.g. OA major threat]



Needed Change
[e.g. cut carbon dioxide emission]

Science supply paradigm

A science based on values





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Go local: Bohuslan, a seafood paradise



Hypothesis: By targetting values, we'll attract more attention





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Can you taste ocean acidification?

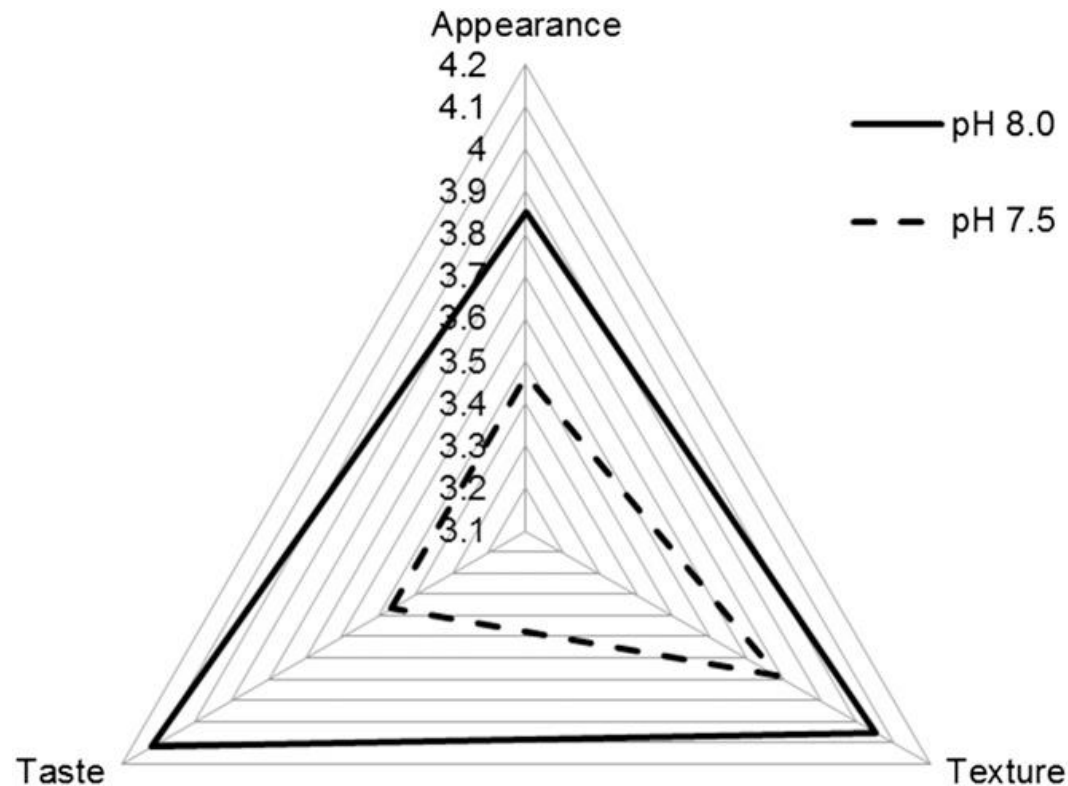




FIRST EVIDENCE OF ALTERED SENSORY QUALITY IN A SHELLFISH EXPOSED TO DECREASED pH RELEVANT TO OCEAN ACIDIFICATION

SAM DUPONT,^{1*} EMILIE HALL,² PIERO CALOSI^{2,3} AND BENGT LUNDVÉ⁴

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A timely press release

Ocean acidification can alter the taste of shrimps



Ocean acidification is often referred as the silent storm because you can't see it, you can't hear it, and you can't smell it, but our research suggests that you just may be able to taste it

COMPASS



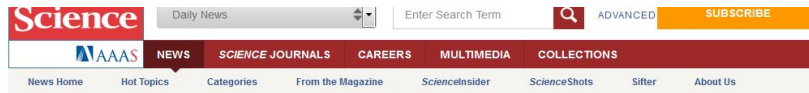
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Scientific impact



News > Climate > Less tasty shrimp, thanks to climate change

SCIENCESHOT



DEZIDOR/WIKIMEDIA/CREATIVE COMMONS

Less tasty shrimp, thanks to climate change

Tweet 203 Share 3.4k 8+1 17



By Puneet Kollipara | 19 December 2014 4:45 pm | 91 Comments

Climate change won't just harm marine life—it could also affect how it tastes. A new study finds that as oceans become more acidic—thanks



- ## Stimulate research:
- Chile
 - USA



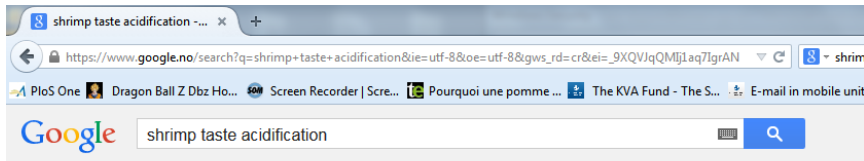
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A popular impact

Daily Mail Mail

LA VANGUARDIA

Los Angeles Times



Webben Videor Nyheter Bilder Kartor Fler ▼ Sökverktyg

Ungefär 87 100 resultat (0,39 sekunder)

Ocean acidification can alter the taste of shrimps - University ...
[science.gu.se/.../ocean-acidification-can-alter-the-t...](#) ▼ Översätt den här sidan
Ocean acidification can alter the taste of shrimps. News: Dec 29, 2014. A recent scientific study published in the Journal of Shellfish Research demonstrates that ...

Study shows rising ocean acidification likely to cause shrimp ...
[phys.org > Biology > Ecology](#) ▼ Översätt den här sidan
★★★★★ Betyg: 3,7 - 14 röster
23 dec. 2014 - All of the **shrimp** were cooked by professional chefs and fed to volunteer **shrimp** lovers who rated the **shrimp** on how well they tasted.

Ocean acidification affects the flavour of shellfish, study ...
[www.dailymail.co.uk/.../Climate-change-leave-pra...](#) ▼ Översätt den här sidan
22 dec. 2014 - Climate change will leave a sour taste in our mouths - literally: Study ...
Biologists put **shrimp** into tanks of sea water with pH 8 and pH 7.5 levels ...

Tasting Ocean Acidification | Ocean Currents
[blog.oceanconservancy.org/.../tasting-ocean-acidif...](#) ▼ Översätt den här sidan
15 jan. 2015 - Ocean acidification didn't affect texture at all, but it significantly hurt the **shrimps'** appearance and taste scores. **Shrimp** raised under regular ...

bad-tasting shrimp - Los Angeles Times
[www.latimes.com/.../la-fi-mh-badtastina-shrimo-2...](#) ▼ Översätt den här sidan

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作者: Sam Dupont 来源:《贝类研究杂志》 发布时间: 2015/1/8 14:41:19 选择字号:

气候变化让虾美味受损



气候变化不只会损害海洋生物的生活，还会影响它们的味道。一项新的研究发现，由于海洋会吸收二氧化碳，海洋酸度在不断增加，从而导致海虾味道变酸。研究人员把数百只中国毛虾（*Pandalus borealis*，如图）放入目前的酸度（pH值为8）或预设的2100年海洋酸度（pH值为7.6）的盛水容器中。水温为11摄氏度，这是海虾正常情况下可以适应的高温段。

Через сто лет креветки станут невкусными

текст: Анна Говорова/lfofx.ru

опубликовано 22 дек '14 17:52



Группа ученых из Великобритании, Канады и Швеции пришла к выводу, что в будущем (к 2100 году) креветки станут менее вкусными. Причиной ухудшения их вкусовых качеств, считают авторы, станет глобальное потепление климата и повышение уровня кислотности Мирового океана.



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You talk the talk, do you walk the walk?

This information attracts interests
but
Does it drive changes?



Havets Hus



(tested in Summer 2015)



A problem of scale



GLOBAL challenges

GLOBAL options: ↓ CO₂

GLOBAL/LOCAL data

LOCAL challenges

LOCAL options

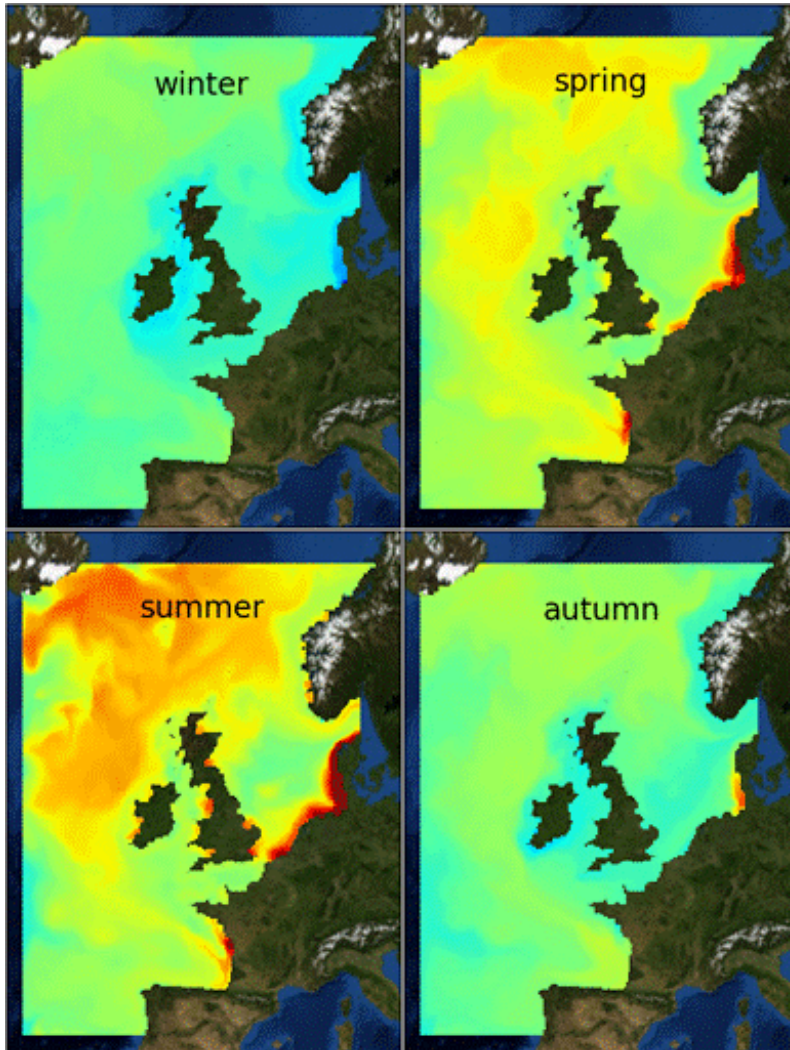
[management, adaptation, etc.]

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.*

Building the bride



GLOBAL options: ↓ CO₂

GLOBAL/LOCAL data



LOCAL challenges

LOCAL options

[management, adaptation, etc.]

LOCAL data



Re-evaluation of the literature to develop a mechanistic model (+ post-doc, WG)



Deadline:





Playing jenga with the ocean



Healthy ecosystem

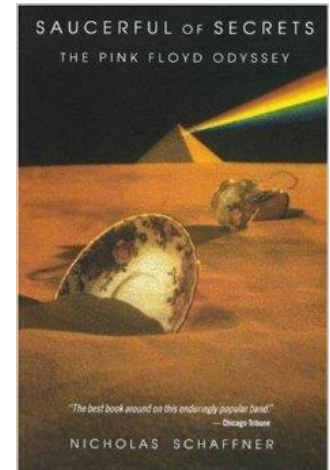


← Pressure
(e.g. OA)

← Exploitation

Adaptation: Buy some time

”I am still convinced that a lot of it was acid-based. It may have happened without, but it probably would have taken longer.”



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





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Success story



2005 crash of oyster industry

A viral story

THE SACRAMENTO BEE sacbee. **Oysters at Risk From Ocean Acidification, as Are Farmer Livelihoods | Commentary**
By Margaret Pilaro Barrette and Bob Rheault
Sept. 9, 2013, 4:16 p.m.

Viewpoints: Ocean acidification threatens California
By Terry S...
Special to **BOISE STATE PUBLIC RADIO**

NewScientist

ROLL CALL

W&T SEAFOOD

Ocean Acidification: Oysters as the New Canary in the Coal Mine
Posted by **Crystal Cun** on August 10, 2012

STORIAN

Ocean Acidification alters Pacific

Ocean Acidification Eats Oysters
Hits Home at Bill Dewey's Dabob Bay Farm

Oysters may struggle to build shells as carbon dioxide rises
Ocean acidification could hamper larvae's growth

Wednesday, March 13, 2013
by **MATT KETTMANN (CONTACT)**



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Policy response



Solution implemented

Monitoring / Research

Larval production in Hawaii

Treating water

Selection of resilient strains



Back into business



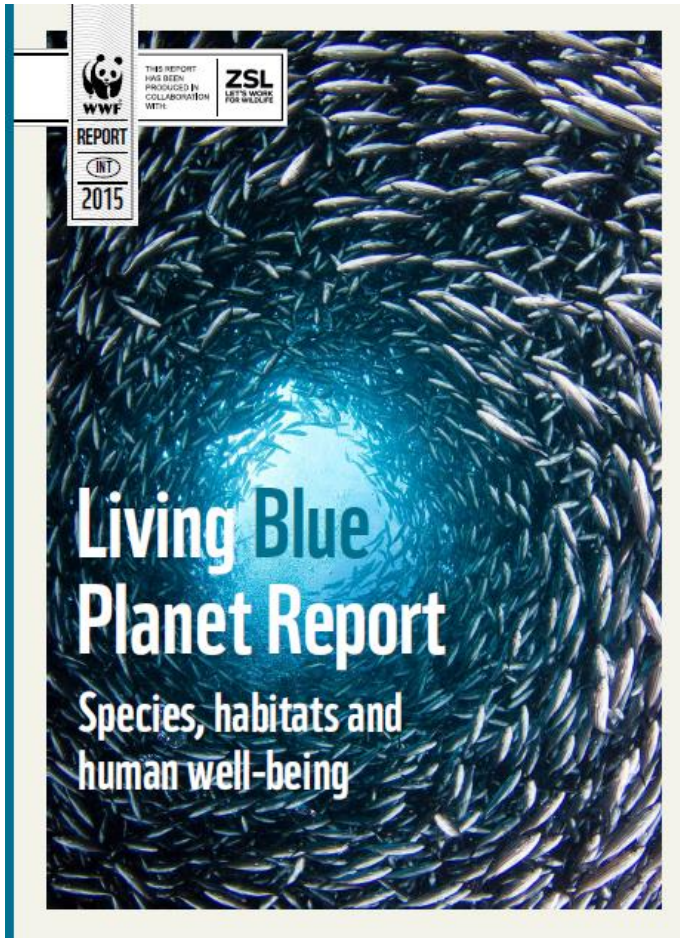
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It's not too late...





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 VERTEBRATE 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 TRILLION PLASTIC PIECES WEIGHING OVER 250,000 TONNES ARE IN THE SEA. OXYGEN-DEPLETED DEAD ZONES ARE GROWING AS A RESULT OF NUTRIENT RUN-OFF. THE OCEAN GENERATES ECONOMIC BENEFITS 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