

For European_science_foundation, 28 Jan08



What is the relevance of ICES to this problem ?

The ICES perspective on Ocean Acidification

By Liam Fernand CEFAS (Lowestoft, UK)

What is ICES?

A science community of more than 1600 marine scientists from 20 member states and several affiliated countries

It has adopted the ecosystem approach to management (of fisheries)



The International Council for the Exploration of the Sea

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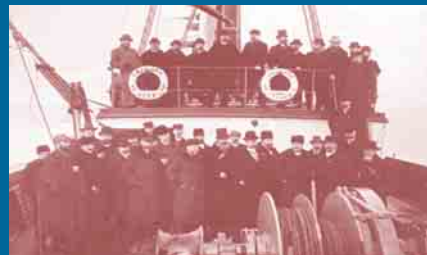


What does it do?

ICES promotes and coordinates marine **science** in the North Atlantic and produces unbiased **advice** to governments and commissions

ICES **Science** Committees

- Living Resources (i.e. survey groups)
- Resource Management
- Diadromous Fishes
- Marine Habitat
- Physical Oceanography
- Fishery Technology
- Baltic Sea Regional Committee



ICES **Advisory** Cttees.

- Fisheries Management (135 stocks)
- Ecosystems
- Marine Environment



What have they done so far?



ICES Workshop on the Significance of Changing Ocean CO₂ and pH in Shelf Sea Ecosystems (ICES WKCpH)
chairs Peter Brewer (MBARI) & Liam Fernand (CEFAS)
London 2-4th May

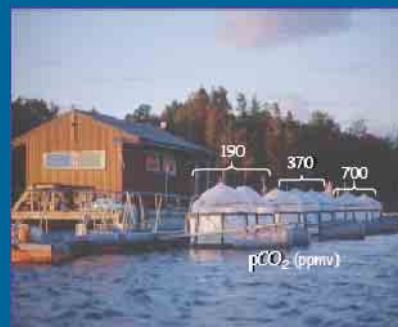
www.ices.dk/reports/occ/2007/WKCpH



Key recommendations:

Recommendations fall into the following categories

1. Experiments
2. Technology development
3. Modelling
4. Monitoring
5. Experimental protocol development and applications



Bergen facility



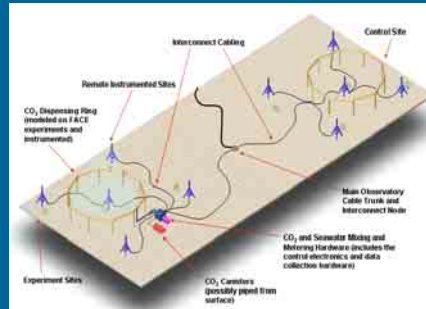
What to do: Part 1

Experiments need to;

- a) Address the issue of longterm change
- b) Identify key species or groups of species that are most likely to be affected.
- c) Include and be considered alongside other anthropogenic stresses.
- d) Be geographically diverse



(courtesy Steve Widdicombe PML)



What to do part 2

Modelling

For ecosystem - fisheries interaction, a joined-up approach is required, whereby models of higher trophic levels are coupled to physical and biogeochemical models.

Technological Development

Advances needed to convert lab experiments to field. As very different responses can be produced in the lab than in the wild. Such experimental strategies would include experiments in the ocean (FOCE) similar to those which occur on land (FACE).

Monitoring

There is an urgent need for the development of spatially and temporally highly resolved monitoring of atmospheric and surface water pCO₂, carbonate, alkalinity, pH over long periods of time in order to validate predictions and to provide the basis for macroecological analysis of the potential impacts of acidification for ecosystems.

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What to do part 3

Experimental protocol recommendations

There is a need to change permitting associated with experiments and the use of CO₂, at present it is banned by the London convention (despite the millions of tons being out gassed)

Protocols for the main chemical parameters, especially Dissolved Inorganic Carbon need to be adhered to and widely propagated (IOC, SCOR).

An experiment(s) need to be set up as an example of best practice, containing a suite of measurements with full access to reference documents.



courtesy F.Gazeau

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Issues relevant to fisheries

Respiratory Stress

Reduced pH limits oxygen-binding and transport by respiratory proteins, leading to reduced aerobic capacity.

Acidosis (reduced internal pH)

Disruption of acid/base balance impairs function and requires energy to restore or maintain optimal internal pH levels.

Reduced Calcification

Depression in carbonate saturation state increases the difficulty of carbonate deposition, with unknown metabolic consequences.

Metabolic Depression (Torpor)

Elevated CO₂, reduced pH, or both can cause some animals to enter a state of reduced metabolic rate and semi-hibernation.

Food Availability

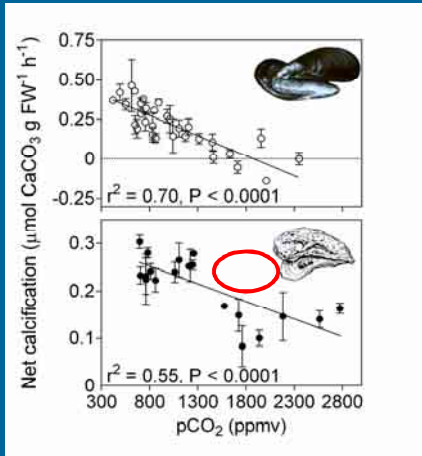
Appearance, abundance and quality of larval fish prey sources, such as phyto- and zooplankton, remain unknown (Edwards & Richardson 2004).

The gaps in knowledge that require addressing are extensive, but could focus on key target fishery species, particularly those that are heavily dependent on calcifying taxa as prey, e.g. pteropods.

Effects, are likely to be minor relative to the comparatively massive impacts of overexploitation over the last few decades?



Experiment on mussels (Frederic Gazeau)



- Decrease of calcification rates for the 2 species
 - Significant with $pCO_2 \uparrow$
 - Significant with $[CO_3^{2-}] \downarrow$
- Higher sensitivity of mussels
 - For a doubling pCO_2
 - 30% \downarrow of calcification for mussels
 - 15% \downarrow of calcification for oysters
- Dissolution of mussels shells for $pCO_2 > 1800$ ppmv

Gazeau et al., *Geophysical Research Letters* (2007) Vol. 34, L07603, doi:10.1029/2006GL028554

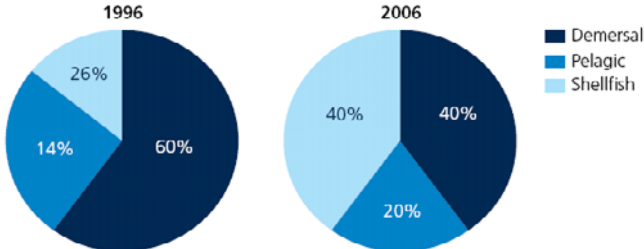


The changing UK picture

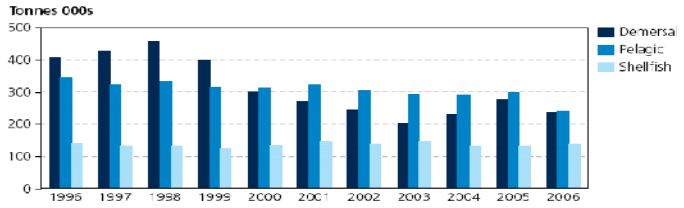
UK vessels landed 614 thousand tonnes of sea fish (including shellfish) in 2006, with a value of £610 million.

SeaFisheries 2006

Value of landings by UK vessels



UK vessels landing into the UK and abroad by species group





Increasing role of aquaculture?

EU aquaculture output is in the region of 1.4 million tonnes, value approaches € 2.8 billion .

This represents approximately 2.5% of total world aquaculture production by volume and 4.6% by value.

Leader in certain species: trout, sea bass, sea bream, European eel, turbot, and mussels.

Approximately 50% of aquaculture in EU (by weight) is shellfish.

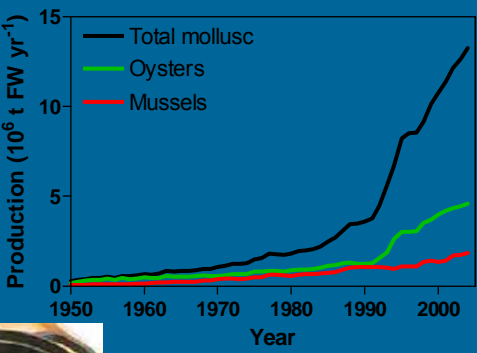
19% of the total volume of EU fishery production, and 30% by value.

Spain	
Blue mussel	294 826
Rainbow trout	30 810
Gilthead seabream	13 040
Seabass	4 513
Turbot	4 477



The future ?

There has been an increase in world wide the production of mariculture 5% yr⁻¹ for the last ten years, mostly in far China and East Asia. This total accounts for 15 – 20% of global aquaculture economic and a value of approx 10 billion ^{US\$}



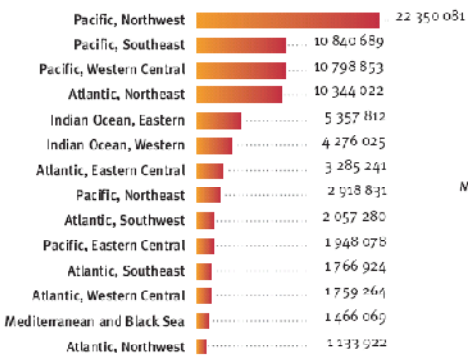
World wide shellfish production. Source FAO

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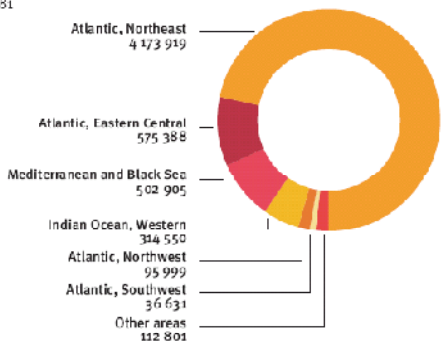


Total Catch

Total world catches by major fishing area (2003)
(volume in tonnes)



Total EU-25 catches by major fishing area (2003)
(volume in tonnes)

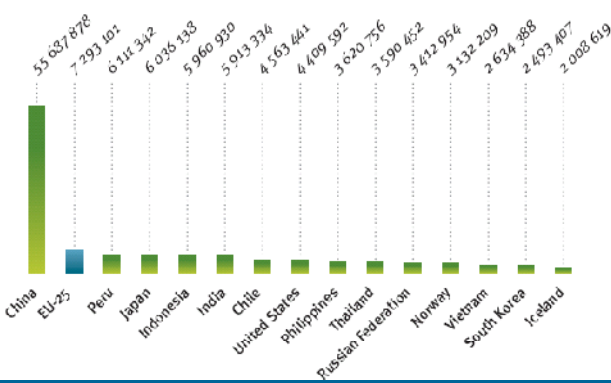


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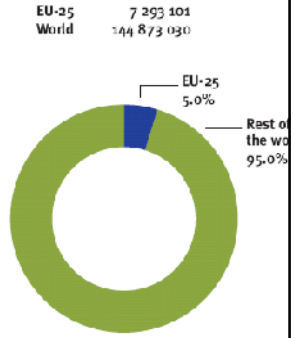


World wide total production : did anyone invite china?

Main world producers (2003)
(catches and aquaculture)
(volume in tonnes)



EU and the world (2003)
(catches and aquaculture)
(volume in tonnes)





What is ICES doing about it?

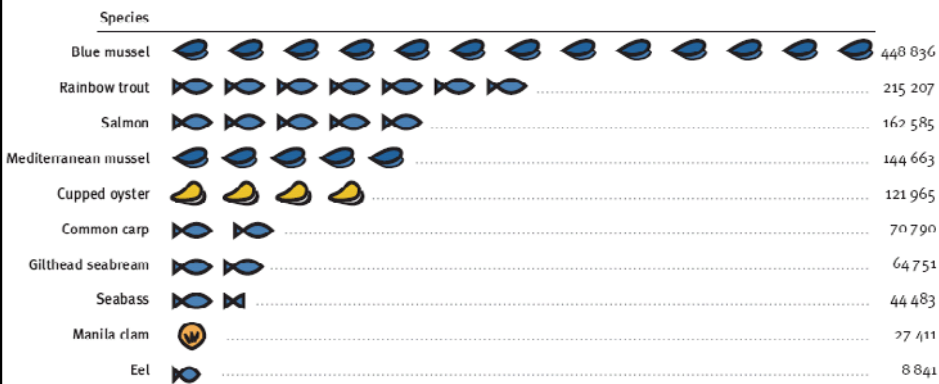
ICES has recognized this problem at advisory council level

It wishes to work with all other groups, PICES, IOC, SCOR, EU e.g. Gijon symposium

It wishes to encourage National Governments to work on the issues.



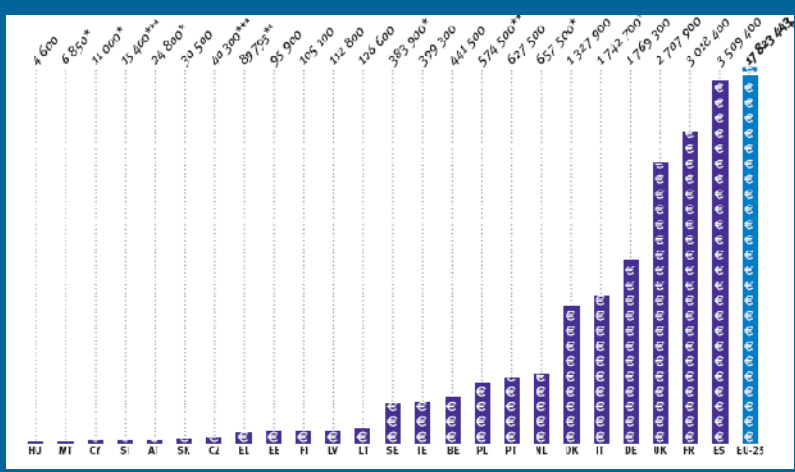
Top ten species produced in aquaculture in the European Union (2003) (volume in tonnes)



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Value of the output of the processing sector (2003) (in thousands of EUR)



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ICES Science is organized and promoted in an international network with

- > 130 Expert Groups
- 8 Science Committees, 3 Advisory Cttees.
- Annual Science Conference
- International Symposia
- High Profile Publications (ICES Journal of Marine Research, CRR, TIMES)

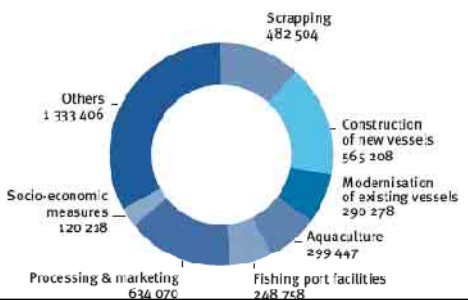
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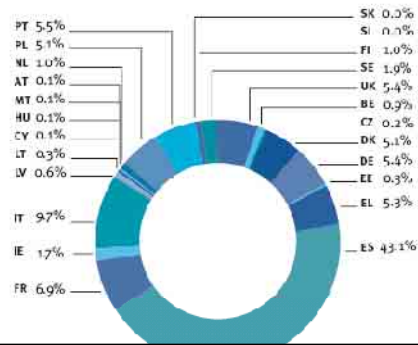
Community aid

To achieve the objectives of the Common Fisheries Policy (CFP) the European Union provides financial support to the fishing industry via the Financial Instrument for Fisheries Guidance (FIFG, 2000-2006). The FIFG provides assistance in areas such as fleet restructuring, small-scale fisheries, fishing ports facilities, sustainable aquaculture, and the processing and marketing of fisheries and aquaculture products. The overall budget allocation for the FIFG for the period 2000-2006 is now € 4.1 billion, including funds allocated to the new Member States which joined the EU on 1 May 2004. Starting in 2007 the FIFG will be replaced by the European Fisheries Fund (EFF) whose governing principles are designed to respond to the changing needs of European fisheries in the 21st century.

Distribution of FIFG allocations by area of assistance for the 2000-2006 programming period (in thousands of EUR)



Share of total EU structural aid by Member State (2000-2006 programming period)



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ICES science priorities



Science needed to implement the Ecosystem Approach to (Fisheries) Management (EAM):

- Understand ecosystem variability as related to physical and biological drivers (including living resources)
- Integrate fisheries science within the wider framework of marine science: new assessment tools and procedures (e.g. REGNS, WGRED, SGRECVAP)

Reduce uncertainty in the science underpinning the advice (e.g., in assessment data, ecosystem and environmental data)



Living resources

Observed changes

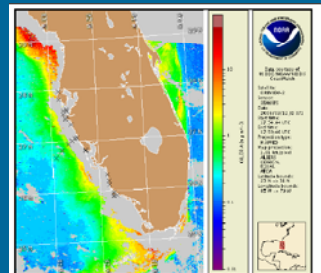
- Icelandic EEZ, 22 new warm-water species have been recorded, and formerly rare species have become more abundant since 1996
- Since 1990, plankton cycles have been strongly modified in the Iberian Sea
- Volume transport of warm Atlantic water into the Barents Sea increases plant production, which in turn affects cod recruitment positively



Working Groups

Products and possible contributions to GOOS

- ICES-IOC Working Group on Harmful Algal Bloom Developments (WGHABD)
- compile national reports on harmful algal blooms with a view to explore near-real-time status report options as well as forecasting tools like models
- Progress in the detection of harmful algal blooms and their dynamics by remote sensing techniques





Working Groups

Products and possible contributions to GOOS

- Working Group on Operational Oceanographic Products (WGOOP)
- make the environmental information in ICES available in a meaningful way
- to ensure the information is useful for near-time operational services
- WGOOP to interact with IOC/JCOMM/GOOS, especially EuroGOOS/ArcticGOOS



Actions

- ICES, in consultation with PICES,
- develops the science and technology bases necessary for operational service and products to observe ecosystem features
 - to complete the existing operational, physical oceanographical systems with the necessary ecosystem elements
 - as this will be required for future quality status and trend assessments and advice