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<http://ceresproject.eu/>

**Climate Change and European Aquatic Resources**

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**Hull International Fisheries Institute**  
 HIFI

**CERES**

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**Noun: 1.** a pre-Roman goddess of agriculture, fertility and motherly relationships

.....advance a cause-and-effect understanding of how climate change will influence Europe's most important fish and shellfish resources **and the economic activities depending on them.**

.....provide tools and **develop adaptive strategies** allowing fisheries and aquaculture sectors and their governance to anticipate and prepare for adverse changes or future benefits of climate change.

Photo Credits: CERES Partners, International Fishing News, Fish&Fly Adventure fly Fishing, INCDDD 'Aqua Cross'

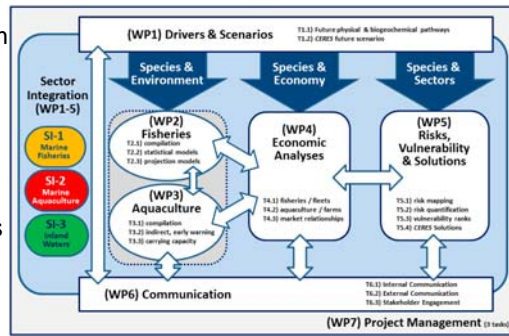
## CERES - Project description



### Objectives:

1. **Future projections** of key environmental variables
2. 'Scale up' to **consequences for fish populations and stocks**
3. Anticipate responses and assist in the **adaptation** of aquatic food production industries
4. Assess relative **exposure, sensitivity, vulnerability and adaptive capacity**
5. Consider **market-level responses** to changes (both positive and negative)
6. Formulate viable **adaptation strategies**
7. Effectively **communicate** findings

### CERES Workpackage (WP) Structure



## Partners



**CERES 'casts a wide net')**



**Fisheries**

- Mixed demersal fisheries
- Mixed pelagic fisheries
- Single species fisheries (bluefin tuna, etc.)

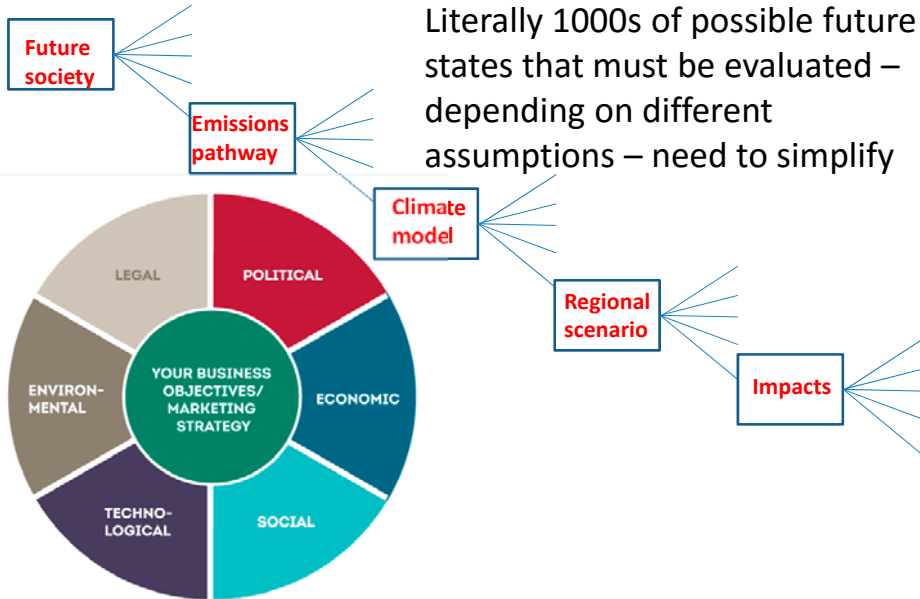
**Aquaculture**

8 key species / groups (shellfish and finfish)

Environment	Species	Rationale
Finfish		
Marine		
Atlantic salmon	<i>Salmo salar</i>	1.45 X10 <sup>6</sup> t FW y <sup>-1</sup> (Eurostat)
Gillthead bream	<i>Sparus aurata</i>	87463 t FW y <sup>-1</sup> (Eurostat)
European seabass	<i>Dicentrarchus labrax</i>	63981 t FW y <sup>-1</sup> (Eurostat)
Freshwater		
Carp*	<i>Cyprinus carpio</i>	70960 t FW y <sup>-1</sup> (Eurostat)
Rainbow trout*	<i>Oncorhynchus mykiss</i>	386458 t FW y <sup>-1</sup> (Eurostat) Proportion freshwater and marine?
Shellfish		
Oyster	<i>Crassostrea gigas</i>	89870 t FW y <sup>-1</sup> (flat oyster: 2750 t)
Mussel	<i>Mytilus edulis</i> and/or <i>Mytilus galloprovincialis</i>	156258 t (blue), 248937 t (Med)
Clam	<i>Venerupis philippinarum</i>	23779 t FW y <sup>-1</sup> Non-indigenous species, production is 80% of total clams

Species selected based on economic value, social / cultural value as well as knowledge of emerging species

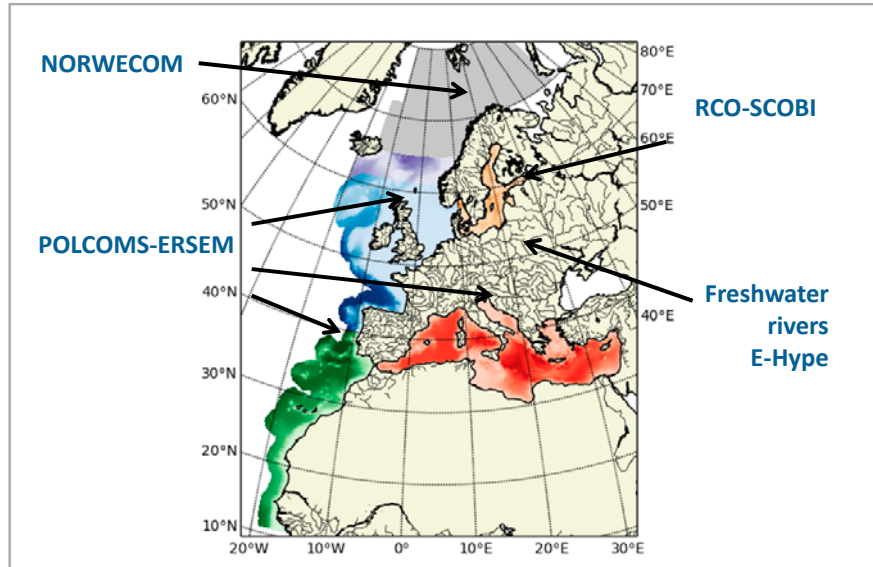
**Defining future scenarios**



Literally 1000s of possible future states that must be evaluated – depending on different assumptions – need to simplify

## Biogeochemical downscaling projections

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## State-of-the-art Biological Projection Models

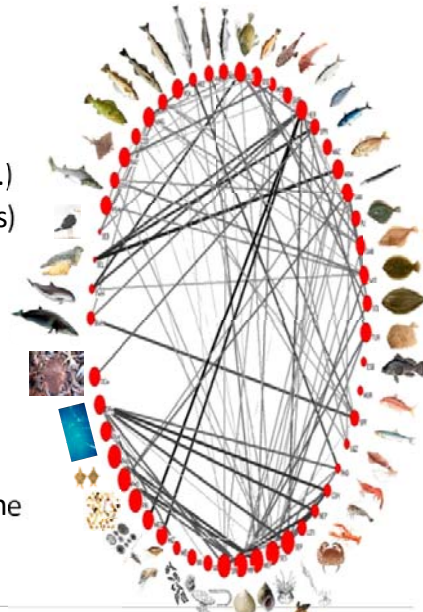
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### Fisheries

- single species (DBEM)
- Food web (Gadget, Aquatox, etc.)
- Whole system & sectors (Atlantis)

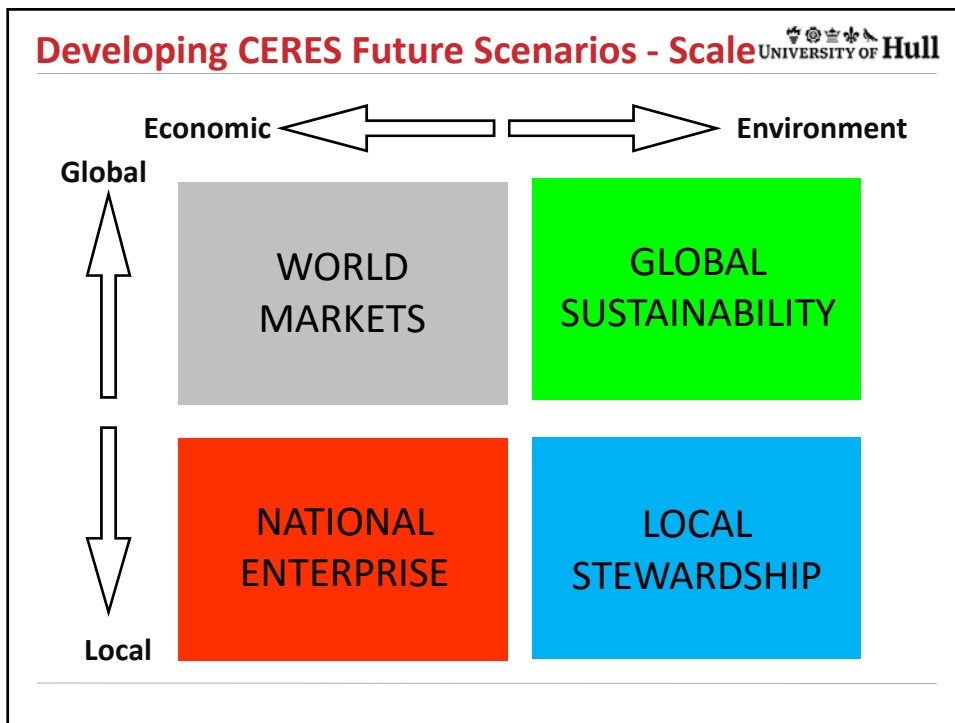
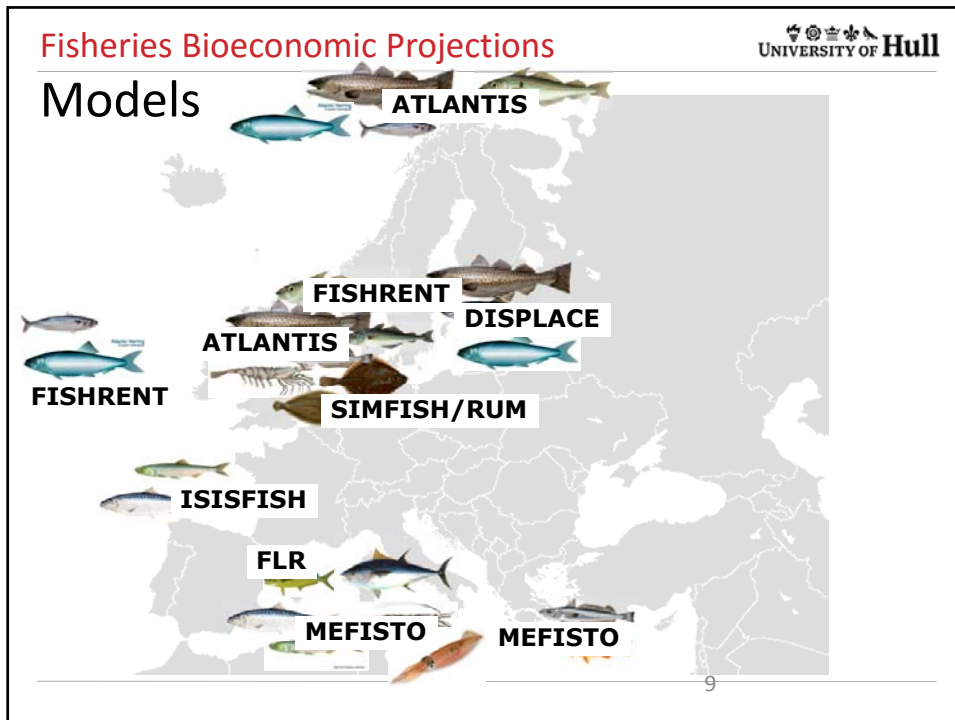
### Aquaculture

- FARM – Farm Aquaculture Resource Management
- ABC – Aquaculture, Biosecurity, and Carrying Capacity
- EcoWin – ecosystem effects at the system scale



North Sea food web in Atlantis





## Climate: risks and responses



## Risk analysis linked to responses

Stakeholder conceptual frameworks for risk assessment and management

Cause effect models

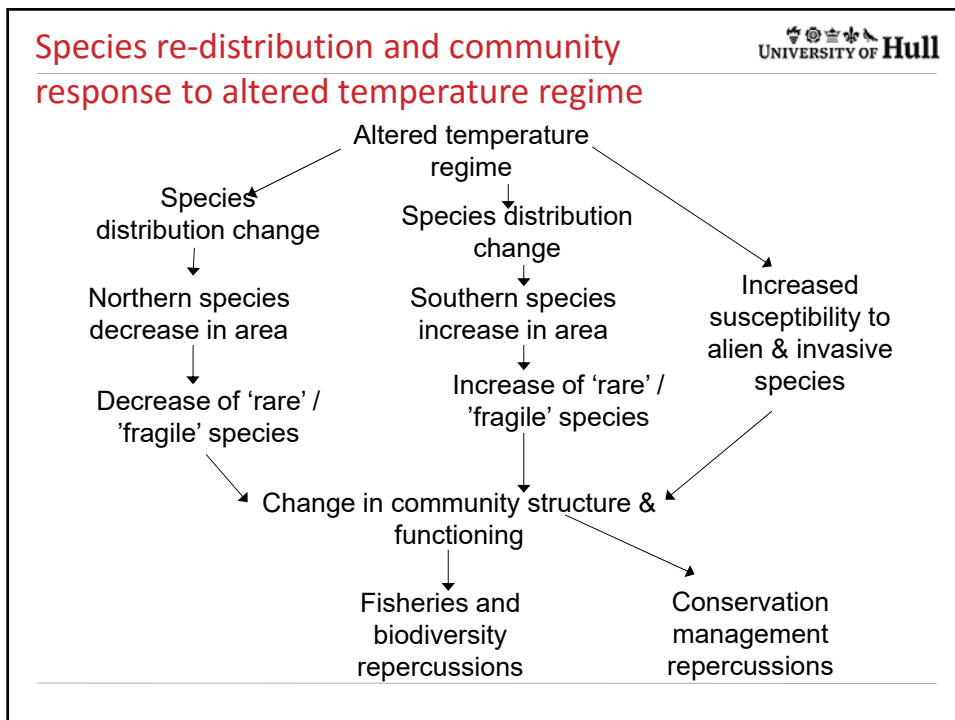
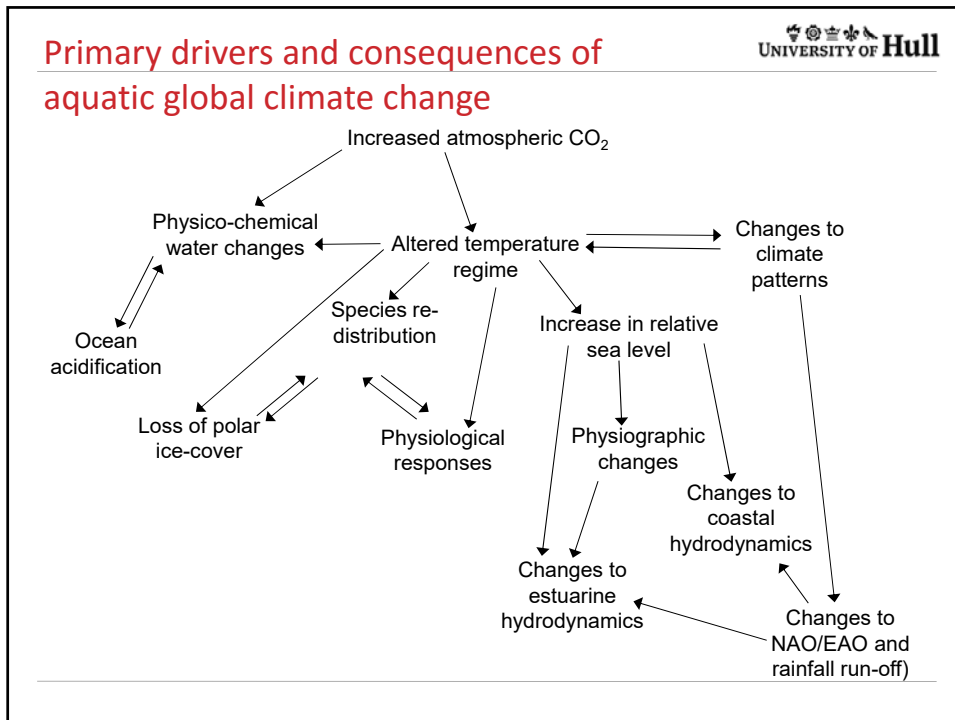
Quantitative risk assessments incorporating expert opinion and uncertainty

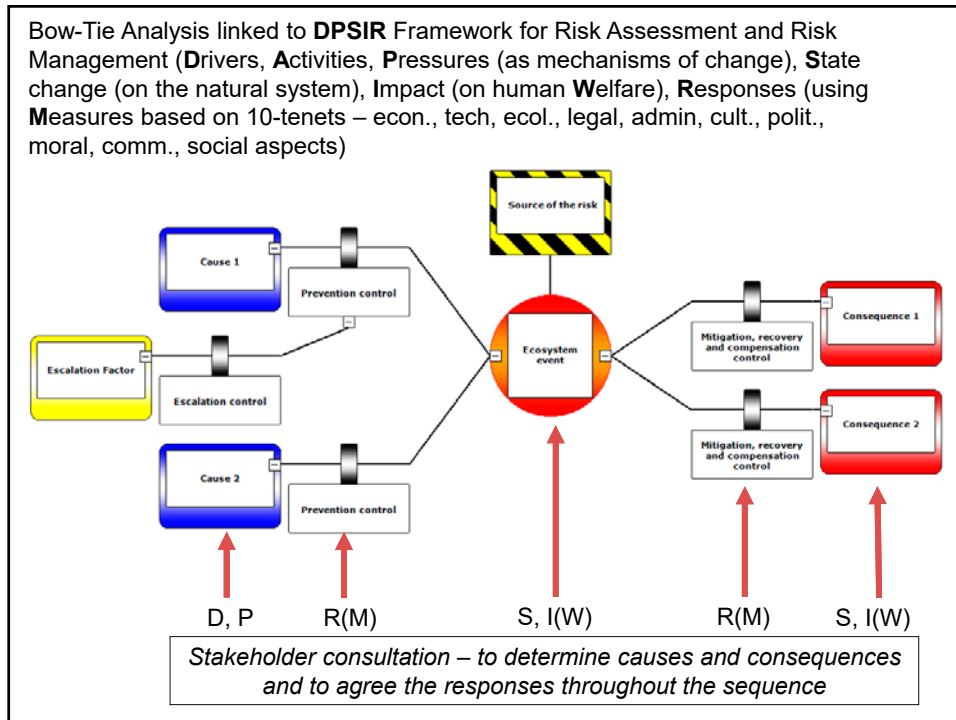
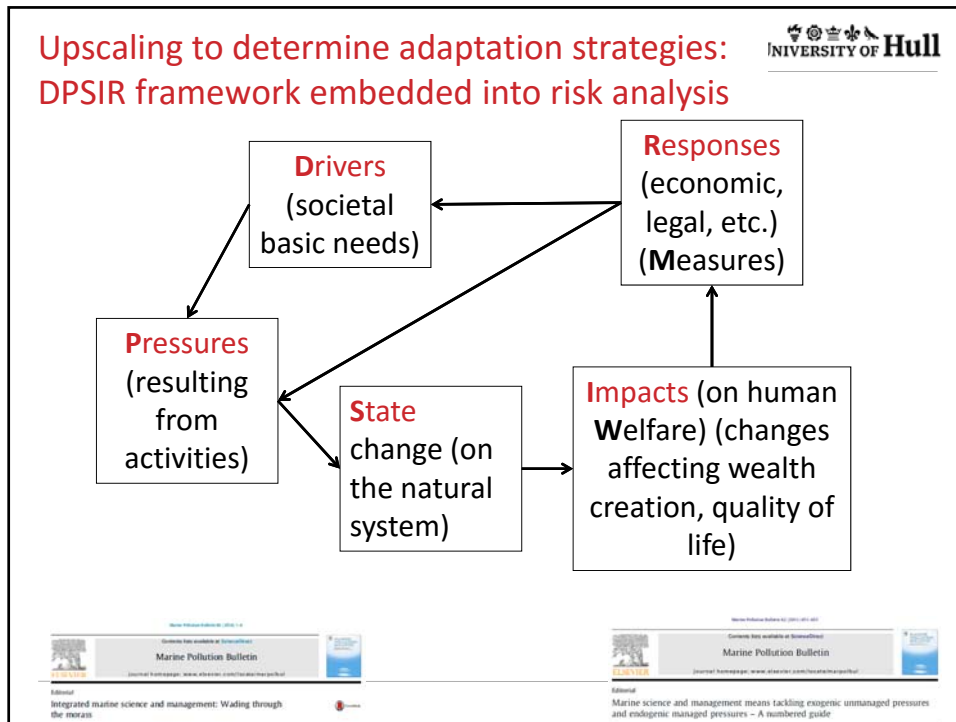
Bayesian belief networks

Vulnerabilities

DPSIR framework  
Bow-Tie analysis

Stakeholder responses and management (adaptation)









## Challenges:

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- Complex and changing governance regime
- Moving baselines
- **Unknown threats – cumulative and in-combination**
- **Conflicting hazards and pressures**
- Unknown opportunities – species, stocks, technologies
- **Conflicting stakeholder demands**
  - Blue growth demands vs. environmental protection demands
  - Ecologically sustainable development;
- Economic valuation of environmental factors
- Public and stakeholder participation.

