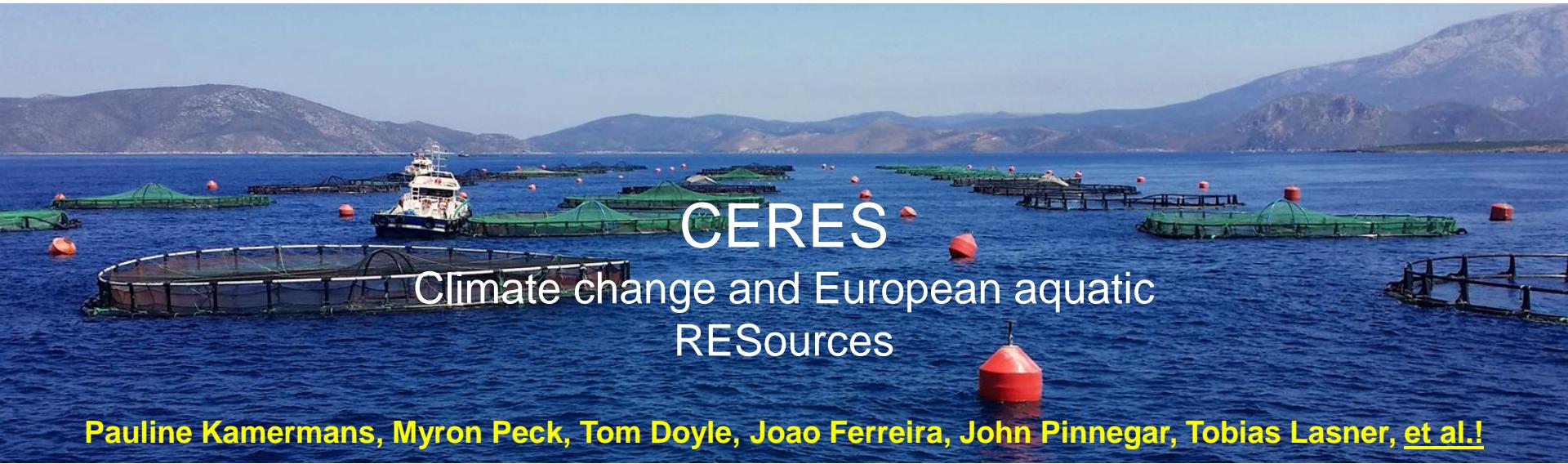
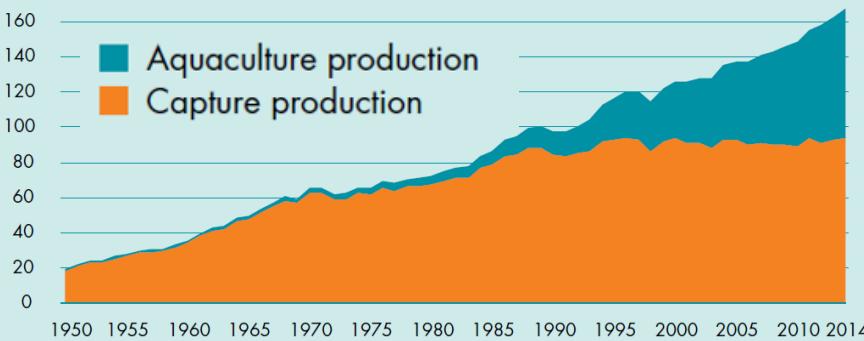




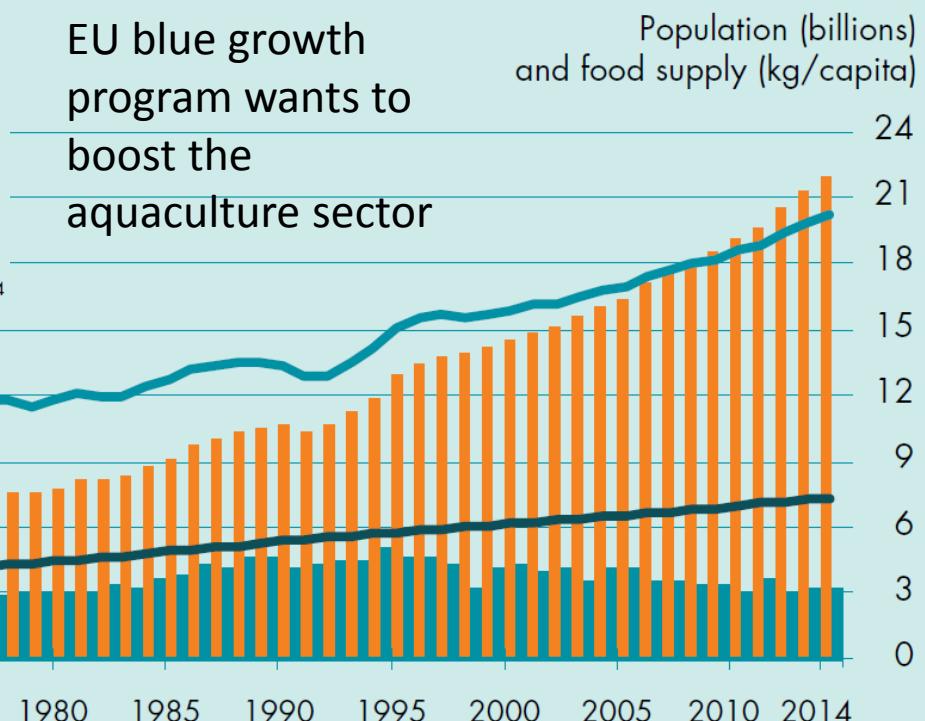
Risks and Opportunities of Climate Change to the European Aquaculture Industry: The CERES Approach



Pauline Kamermans, Myron Peck, Tom Doyle, Joao Ferreira, John Pinnegar, Tobias Lasner, et al.!



EU blue growth program wants to boost the aquaculture sector

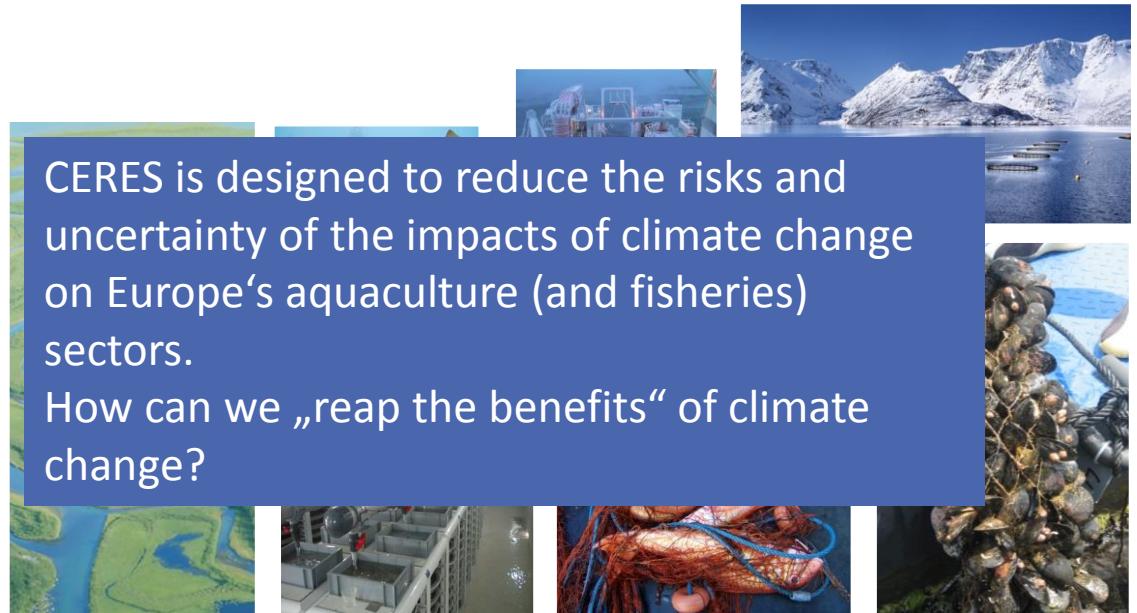


Food
Non-food uses

Population
Food supply



**2016 – 2020
5.6 million €
26 partners
12 nations**



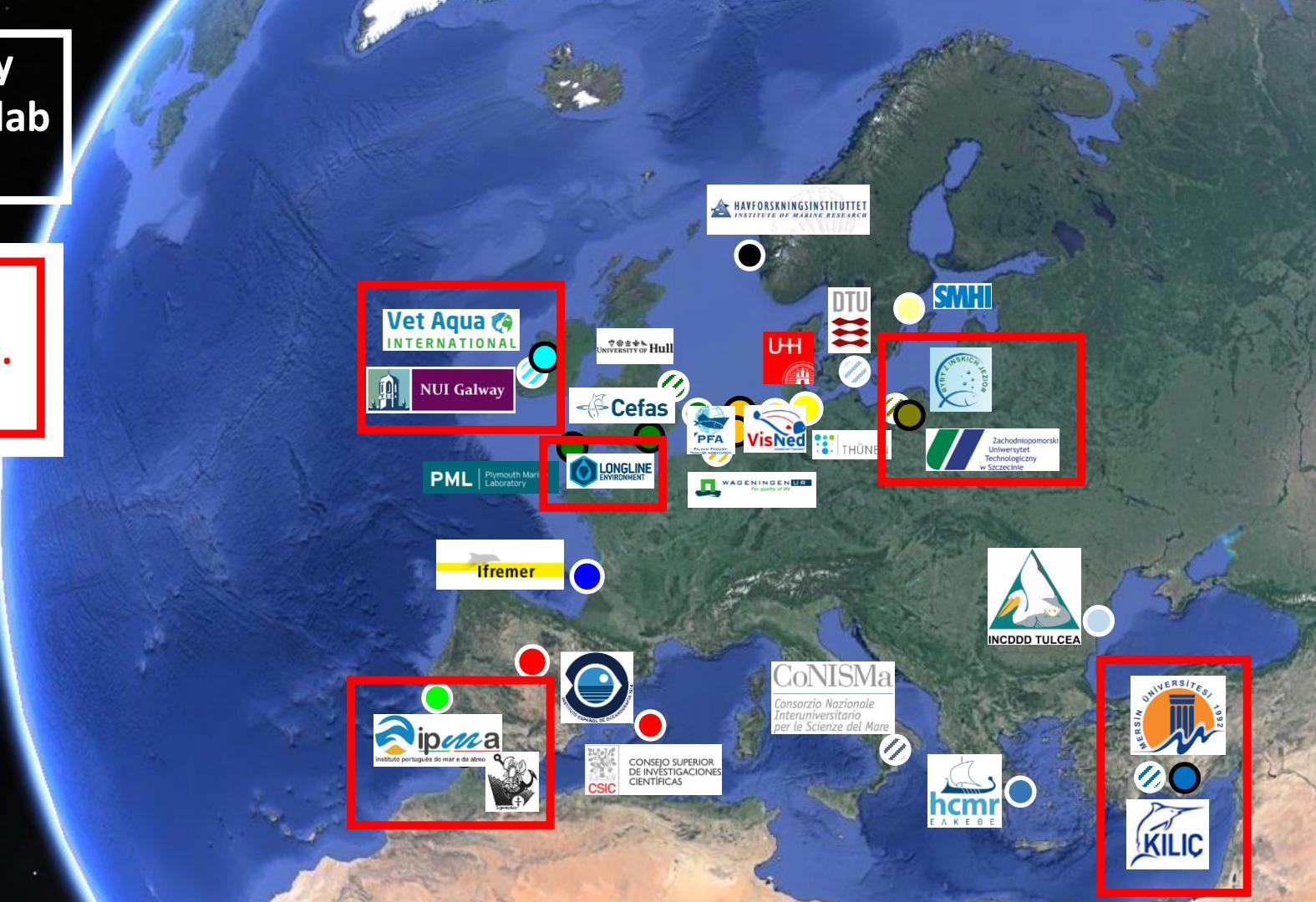
CERES is designed to reduce the risks and uncertainty of the impacts of climate change on Europe's aquaculture (and fisheries) sectors.

How can we „reap the benefits“ of climate change?



University
National lab
Industry

Uni/Lab & Aquaculture. Industry (5)





University
National lab
Industry

Uni/Lab &
Aquaculture.
Industry



SGR
Sagremarisco L^{da}
Mussels



CoNISMa
Consorzio Nazionale
Interuniversitario
per le Scienze del Mare





University
National lab
Industry

Uni/Lab &
Aquaculture.
Industry



Kılıç
Trout, Seabass,
Seabream,
Meagre





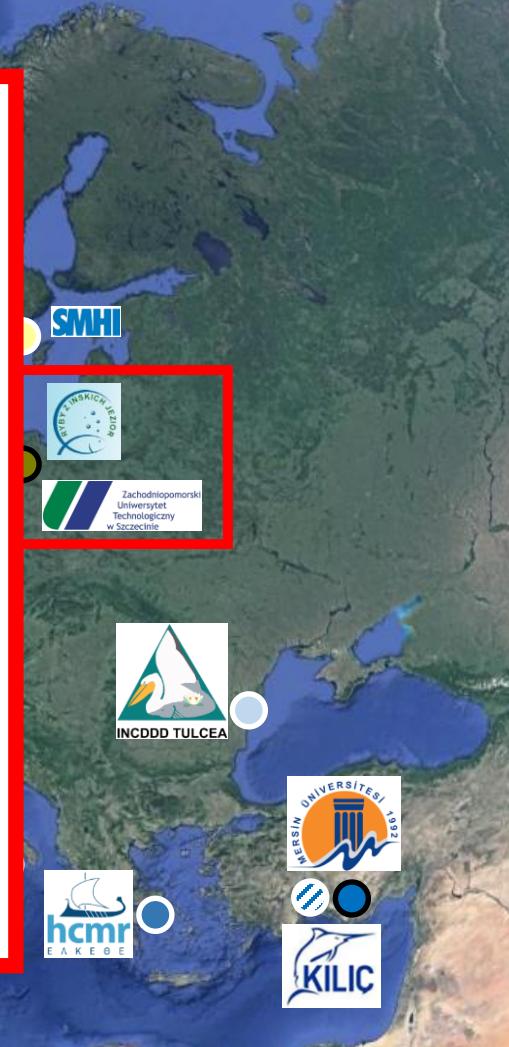
University
National lab
Industry

Uni/Lab &
Aquaculture.
Industry



ICR
Inskie Centrum
Rybactwa Spolka

Carp, Whitefish,
Pikeperch...





University
National lab
Industry

Uni/Lab &
Aquaculture.
Industry



Vet Aqua
Fish Vet
Group (FVG)



Target species (Europe's most valuable)

Salmon
Salmo salar



Trout
Oncorhynchus mykiss

Seabass
Dicentrarchus labrax



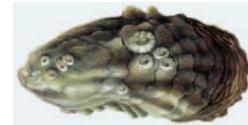
Carp
Cyprinus carpio

Sea bream
Sparus aurata



Blue mussel
Mytilus edulis

Cupped oyster
Crassostrea gigas

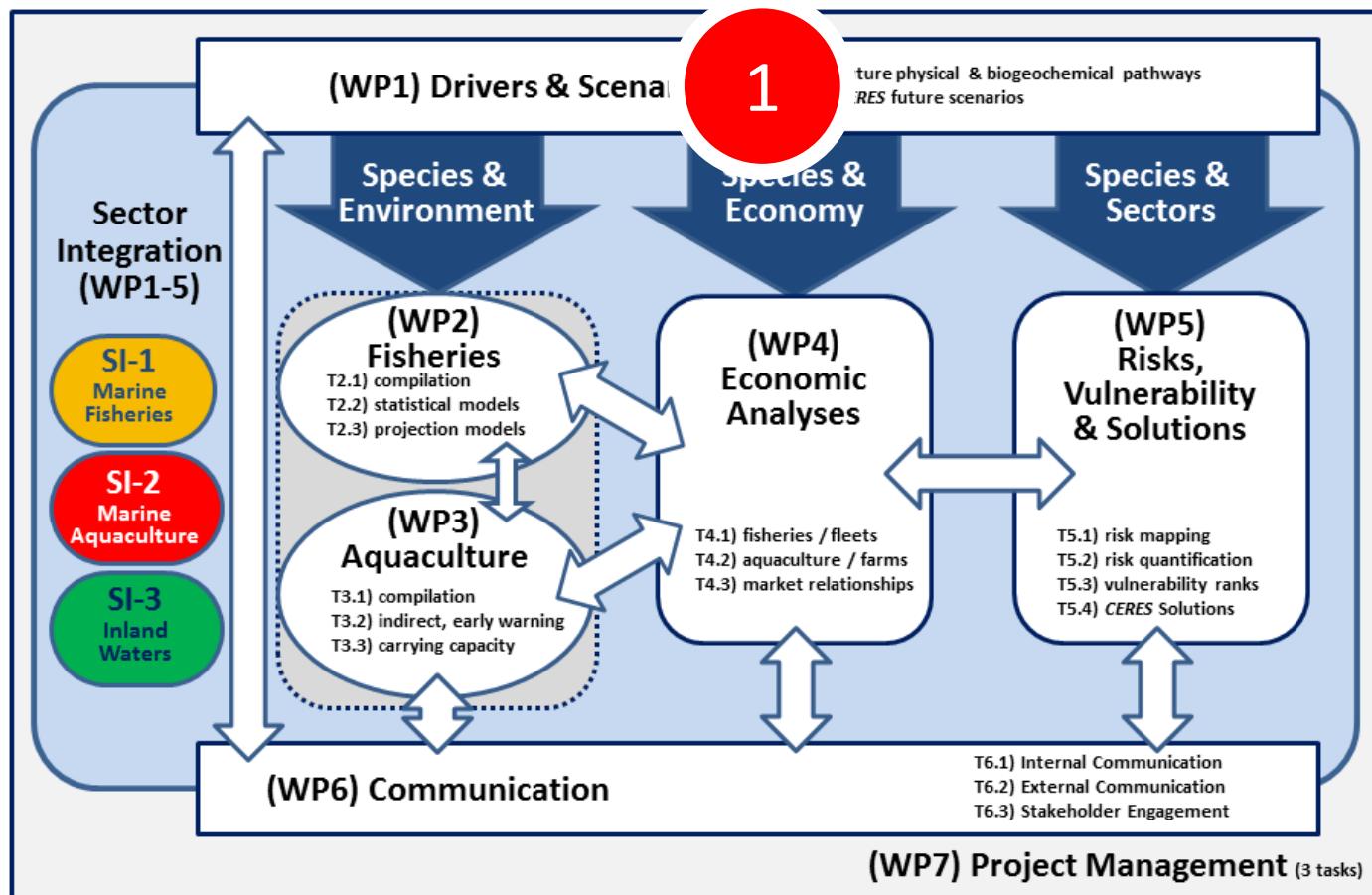


Mediterranean mussel
Mytilus galloprovincialis

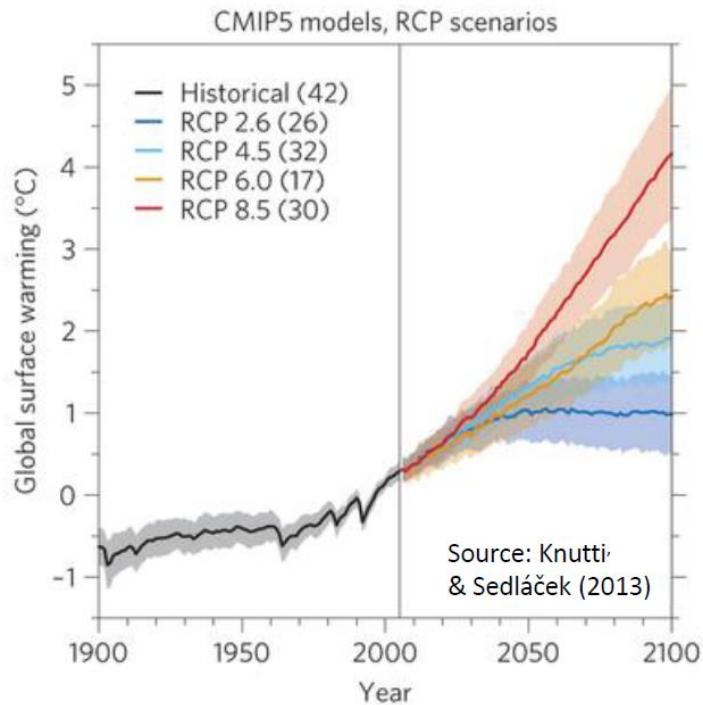


European clam
Ruditapes decussatus

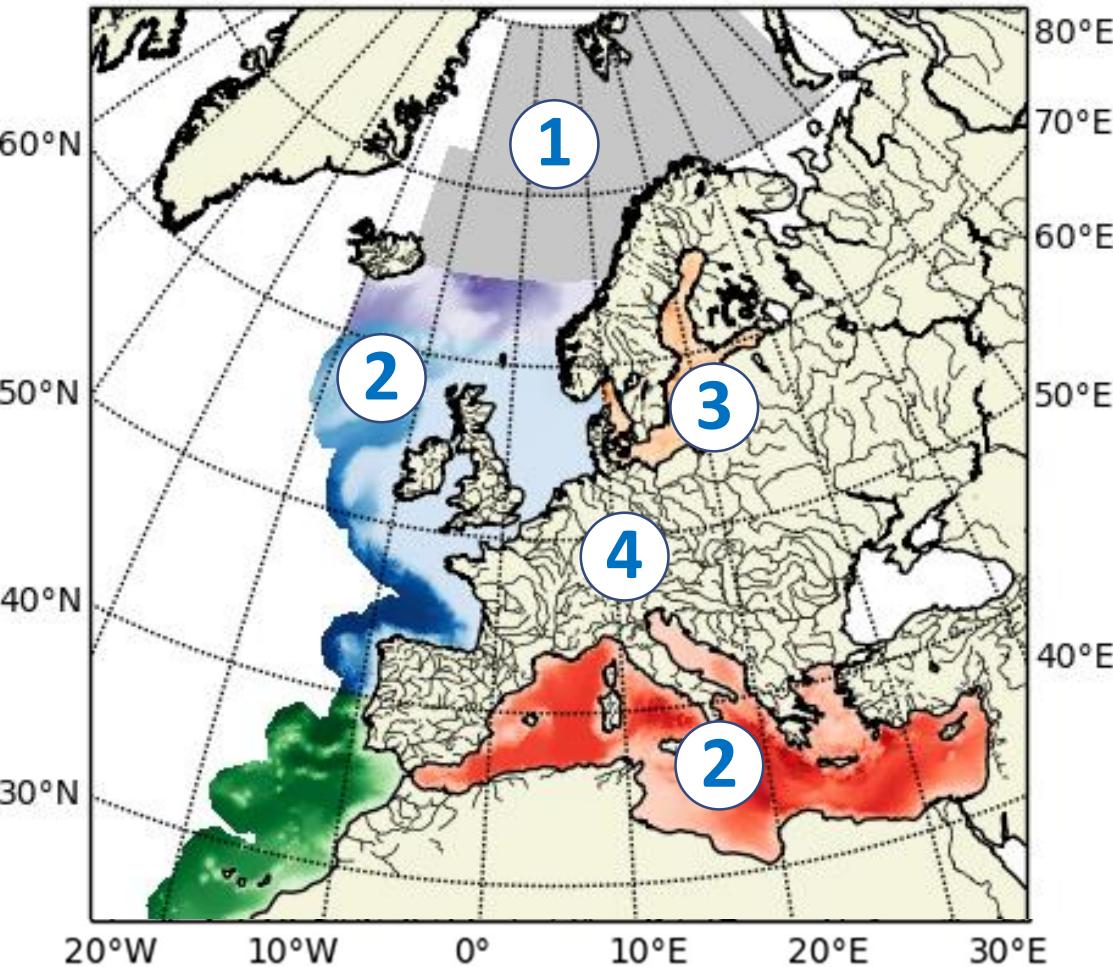
Future physical and socio-political drivers



Physical / biogeochemical projections



Regional Concentration Pathways
4.5 & 8.5 to 2100





The image shows the front cover of the CERES report. It features a yellow vertical bar on the left with the text "www.ceresproject.eu". The main title "CERES" is at the top in large blue letters. Below it is the project logo, which includes a stylized globe with blue and yellow patterns. The subtitle "Climate change and European aquatic RESources" is in a smaller blue font. The main heading "Socio-political scenarios for the fishery and aquaculture sectors in Europe" is in bold blue text. A short descriptive paragraph follows, mentioning short-, medium-, and long-term developments in governance, social, technological, and economic drivers. Three small images of fishing boats are at the bottom.

Socio-political scenarios for the fishery and aquaculture sectors in Europe

Short-, medium- and long term developments in governance, social, technological and economic drivers may be just as important to fisheries and aquaculture as climate driven changes in habitats and species.

Here we propose a suite of exploratory, future socio-political scenarios that will be used throughout the CERES project in modelling exercises and serve as the basis for discussions or engagement with the wider stakeholder community.

www.ceresproject.eu



The image displays several pages from the CERES report arranged in a staggered, overlapping fashion. The top page is titled "Why do we need scenarios?" and discusses the need for scenarios to understand the future context of climate change. Below it is a page titled "IPCC Scenarios" which lists four scenarios: Shared Socioeconomic Pathways (SSPs) 1.0, 2.0, 3.0, and 4.0. The next page down is titled "The four CERES Socio-political scenarios" and provides a detailed description of the four CERES scenarios: Visionary, Robust, Flexible, and Sustainable. This is followed by a page on "Demand for fish and seafood in Europe (EU-27)" which includes a chart showing projected demand from 2010 to 2050. The following page is titled "What could it mean for European Aquaculture?" and discusses the implications for aquaculture. The final visible page is titled "CERES Partners" and lists the project partners. A small note at the bottom of the page states: "Please note that the document is subject to change. Including an update released in the TECNOLÓGICAS Y MEDIOAMBIENTALES (CSIC) of Valencia, December 11, 2016, concerning the project's name and acronym. Please refer to the document 'Nota declarativa sobre el cambio del nombre del proyecto'." A URL "https://ceresproject.eu/wp-content/uploads/2016/11/CERES-report.pdf" is also present.

Why do we need scenarios?

IPCC Scenarios

The four CERES Socio-political scenarios

Demand for fish and seafood in Europe (EU-27)

What could it mean for European Aquaculture?

CERES Partners

Further Information:

Source documents

Your Feedback

https://ceresproject.eu/wp-content/uploads/2016/11/CERES-report.pdf

Produced 6 months after project started

Contrasting future trajectories...

B1 (Global Sustainability) world

RCP 4.5 and SSP1

A2 (National Enterprise) world

RCP 8.5 and SSP3

B2/A1B (Local Stewardship) world

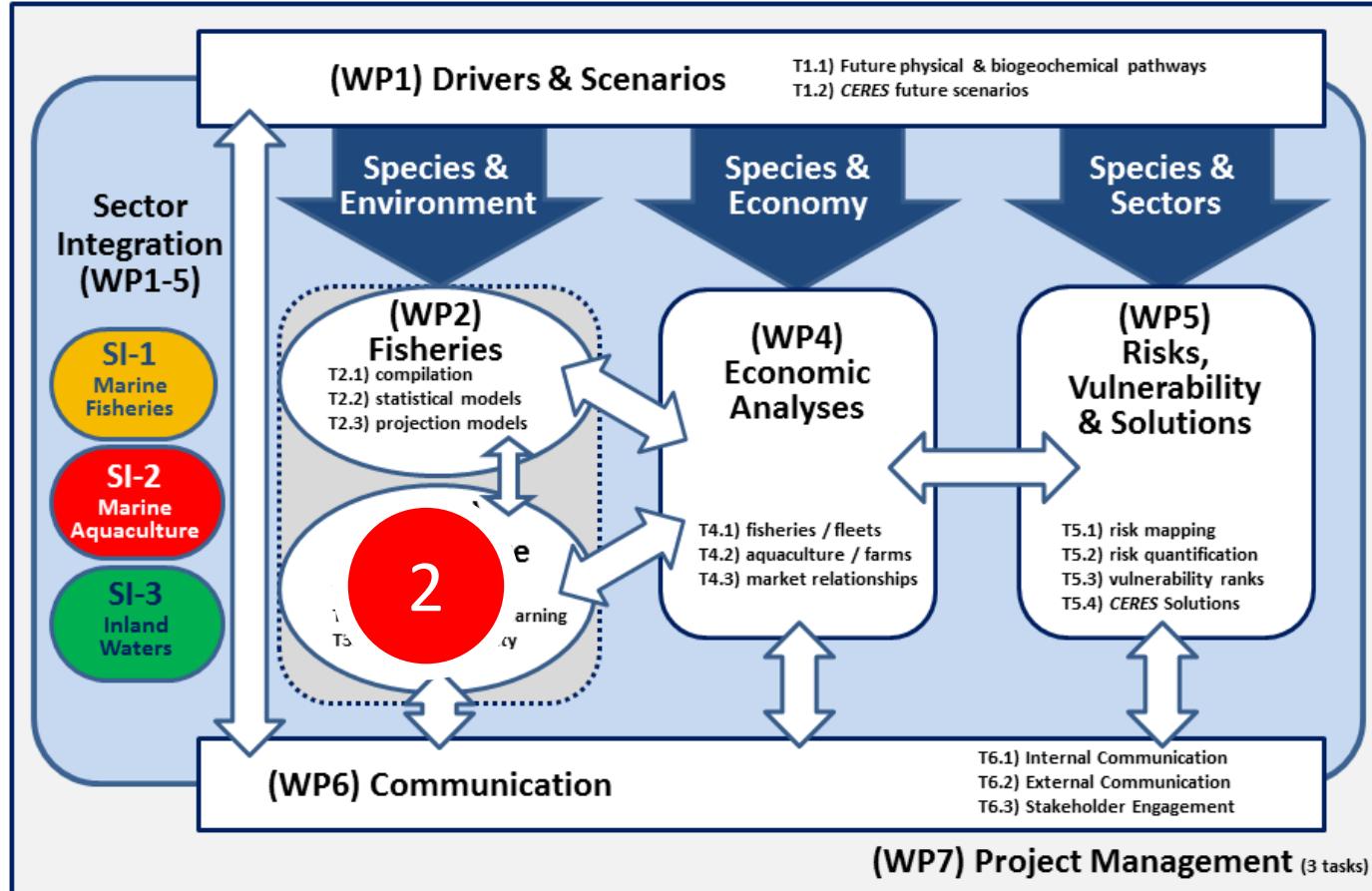
RCP 6.0 and SSP2

A1F1 (World Markets) world

RCP 8.5 and SSP5

World Markets – RCP 8.5 and SSP5 (A1F1)

- Huge expansion of offshore fish farming
- Luxury product vs anonymous fish protein
- *Pangasius* dominated aquaculture markets
- Extensive use of cheap immigrant labour
- Big businesses strive for value-for-money
- Frequent fish kills due to pathogens & jellyfish
- Global trading of aquaculture products
- Technology/automation important
- Low seafood prices, low energy prices



Task 1: Literature review

(Ignacio Catalan CSIC – et al.)

(Gap analysis... ~500 studies on species
fish & shellfish in European waters)



The monster tables....

Effects	Stage	Number of studies
Temperature	<i>eggs</i>	41
	<i>larvae</i>	74
	<i>juvenile</i>	65
	<i>adults</i>	94
Salinity	<i>eggs</i>	11
	<i>larvae</i>	26
	<i>juvenile</i>	5
	<i>adults</i>	15
Acidification	<i>eggs</i>	3
	<i>larvae</i>	3
	<i>juvenile</i>	0
	<i>adults</i>	1
Oxygen	<i>eggs</i>	0
	<i>larvae</i>	3
	<i>juvenile</i>	2
	<i>adults</i>	6
Temp. x Acid.	<i>eggs</i>	0
	<i>larvae</i>	0
	<i>juvenile</i>	0
	<i>adults</i>	0
Temp. x Oxygen	<i>eggs</i>	0
	<i>larvae</i>	2
	<i>juvenile</i>	3
	<i>adults</i>	11
Temp. x Acid.	<i>eggs</i>	0
	<i>larvae</i>	0
	<i>juvenile</i>	0
	<i>adults</i>	0
Temp. x Oxygen x Salinity	<i>eggs</i>	0
	<i>larvae</i>	0
	<i>juvenile</i>	0
	<i>adults</i>	1

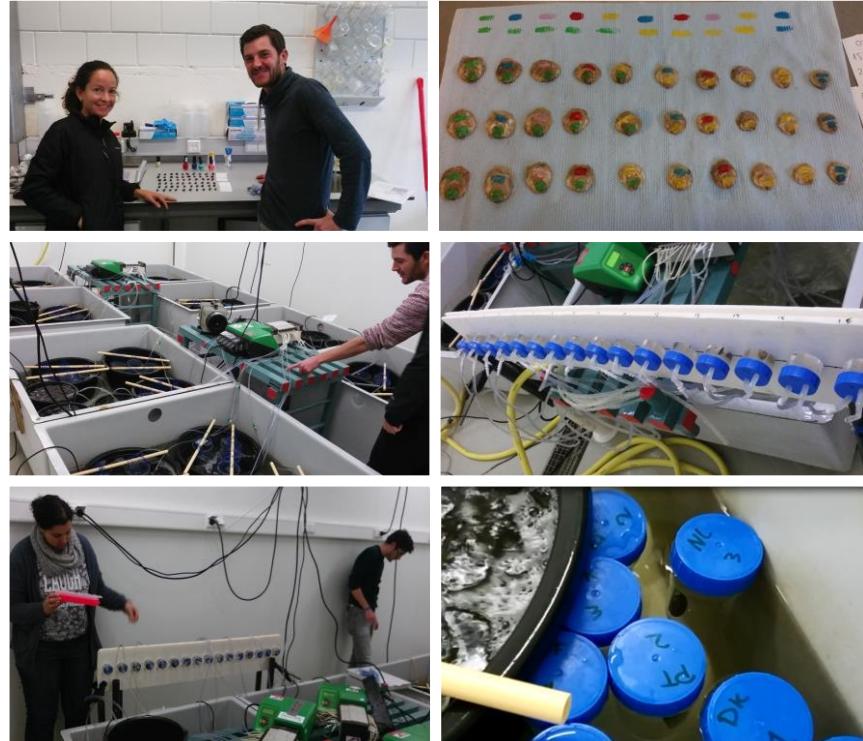
Task 1: Fill gaps (direct effects of CC)

(Pauline Kamermans – WMR)

35-day Common garden experiment
(growth, feeding, metabolism)

	Low food	High food
3 °C	○ ○ ○	○ ○ ○
8 °C	○ ○ ○	○ ○ ○
15 °C	○ ○ ○	○ ○ ○
20 °C	○ ○ ○	○ ○ ○
25 °C	○ ○ ○	○ ○ ○
30 °C	○ ○ ○	○ ○ ○

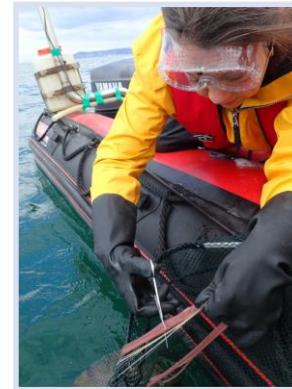
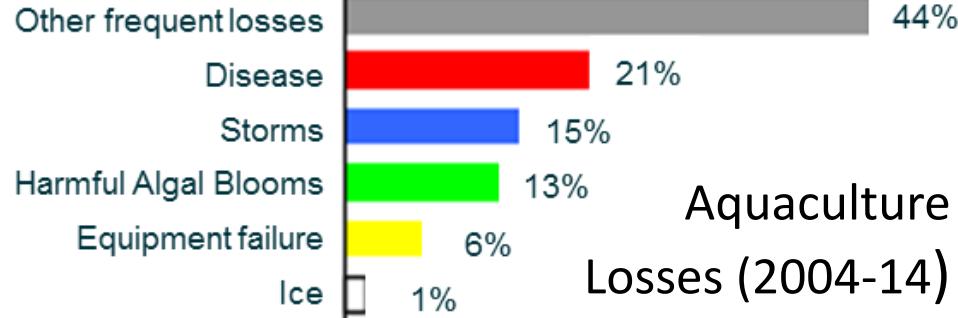
Mytilus edulis (NL, DK)
Mytilus galloprovincialis (PT)



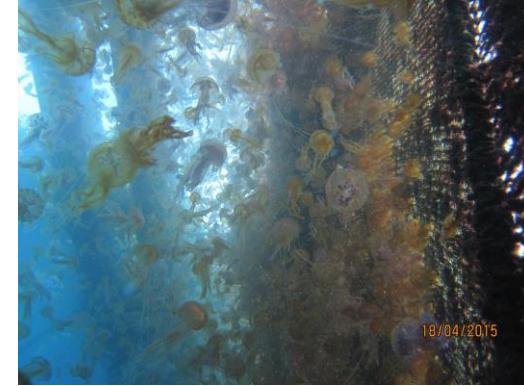
Pauline Kamermans (WMR)

Task 2: Indirect Effects (Jellyfish, disease, HABs)

(Tom Doyle - NUIG)



removing tentacles to extract venom



CERES Climate-ready business solutions...

Jellyfish outbreaks
Pathogens / illness
Harmful algal bloom



extracted cnidae for exposure



Protection from bubble curtain



Damage from jellyfish stings

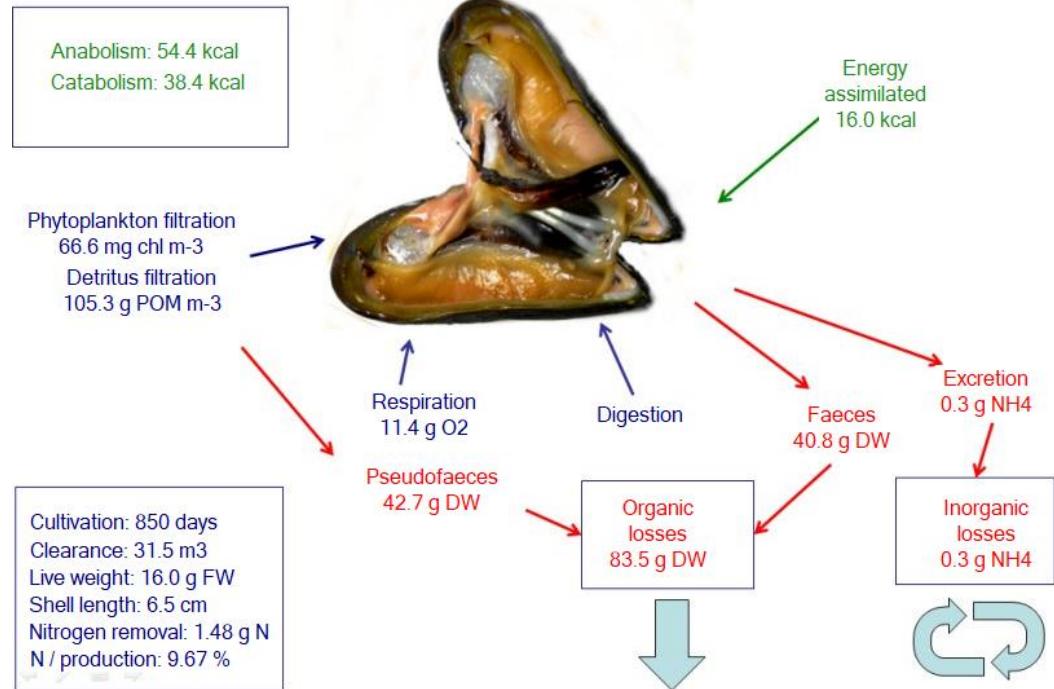
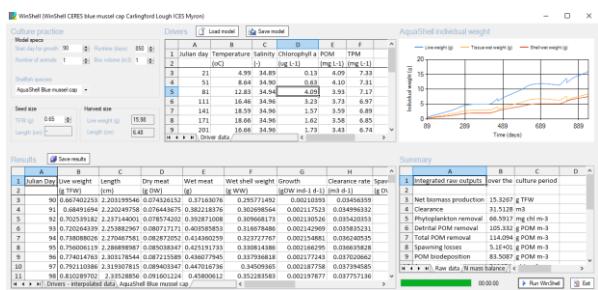
Task 3: Modeling biological impacts

(Joao Ferreira – LLE)

Carlingford Lough



WinShell

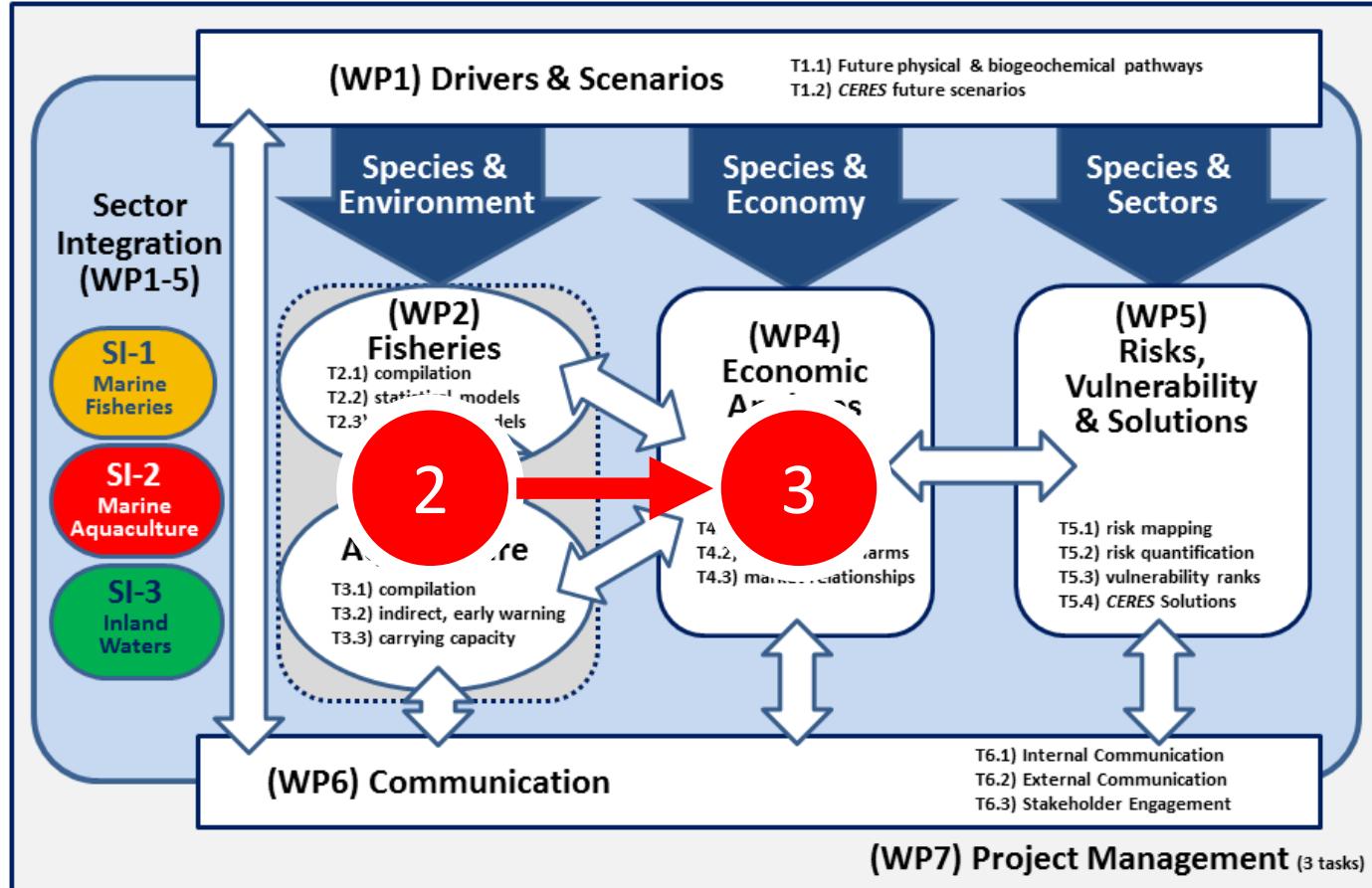


Task 3: Modeling biological impacts
(Joao Ferreira – LLE)

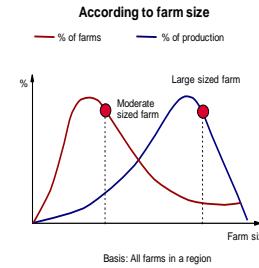
Parameter	Standard model	Scenario 1 +2°C	Scenario 2 -0.5 mg chl m ⁻³	Scenario 3 +0.5 mg chl m ⁻³
End-point biomass (g live weight)	16.0	16.2	11.5	23.7
End-point length (cm)	6.5	6.5	5.7	7.3
Clearance (m ³)	31.5	31.3	25.8	41.6
Phytoplankton removal (mg chl m ⁻³)	66.6	64.9	43.8	104.5
Detrital POM removal (g POM m ⁻³)	105.3	104.7	88.0	136.0
Net nitrogen removal (g N)	1.5	1.5	1.2	1.8

Growth and environmental services such as water clearance appear to be more sensitive to indirect effects of climate change, such as primary production shifts, than to direct effects, such as water temperature changes.

Economic Analyses (regional to national)



Statistics available to determine
>> important regions
>> farm sizes and distribution



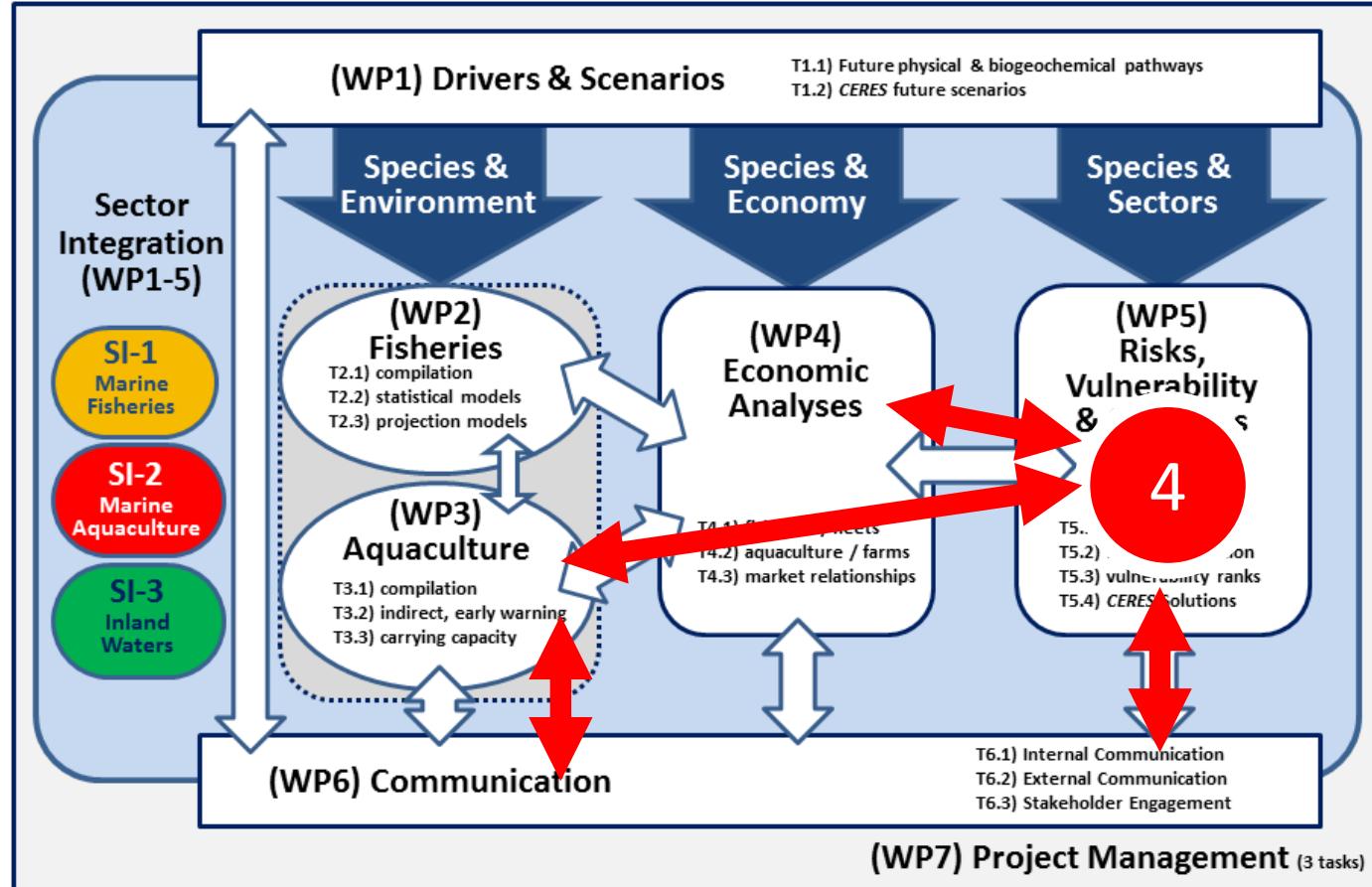
Typical Farm Approach

Focus groups of producers and advisors to
>> define prevailing production systems
>> collect data in a standardised way



Expertise of researchers + advisors + farmers
>> Production system knowledge
>> Explore adjustments to changes in work conditions (e.g. Climate Change)





Carp Breeders Słok k/Bielchatowa, Poland



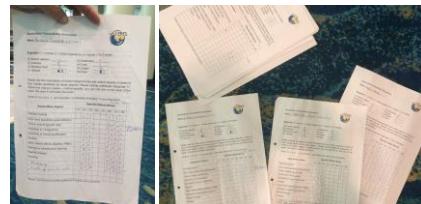
Trout farmers Hamburg, Germany



Sea bass & bream farmers Muğla Turkey



Regional Stakeholder Engagement – do what works!



expert ranking of sensitivity

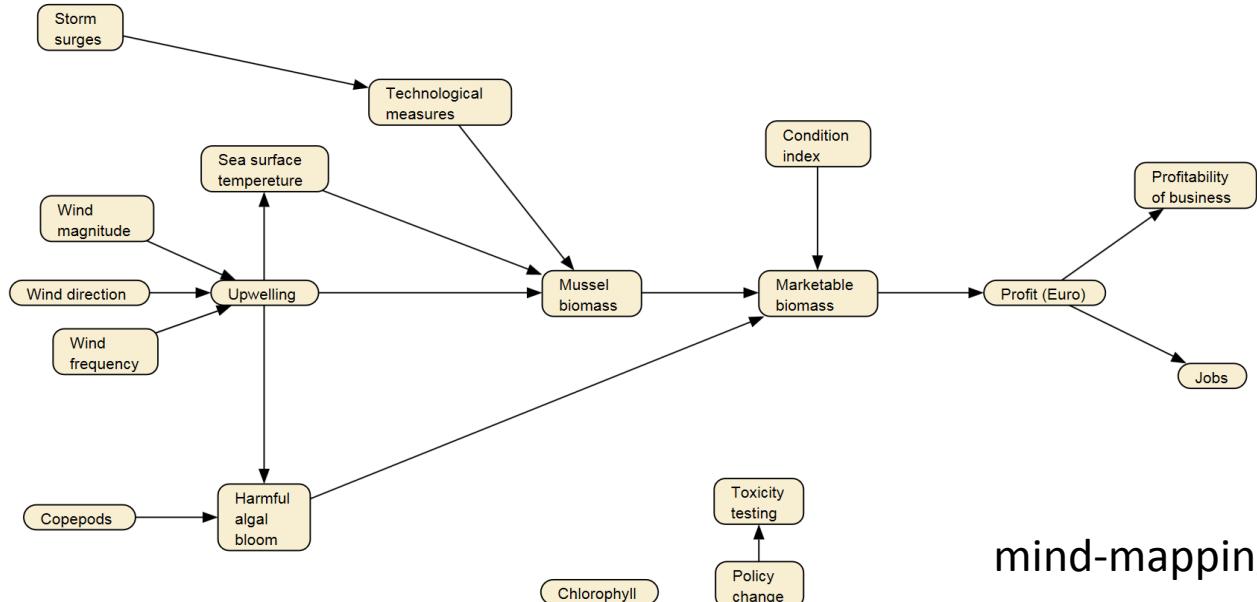


Scenario glossy



Online Questionnaire

This project receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 645391 CERES Climate Change and European Aquatic Resources



CERES

Climate change and European aquatic RESources

Thank you! – Get involved –!



www.ceresproject.eu

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