



# EXPERIMENTAL ESTIMATION OF PARAMETER VALUES TO DETERMINE EFFECTS OF CLIMATE CHANGE ON SHELLFISH PRODUCTION



## CERES

Climate change and European aquatic  
REsources

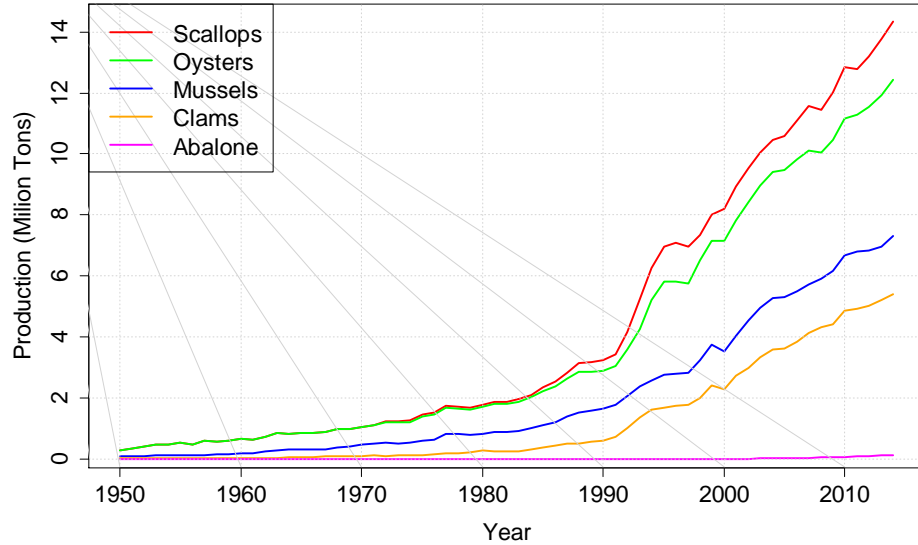


Pauline Kamermans & Camille Saurel



Aquaculture Europe, 17-20 October 2017  
Dubrovnik, Croatia

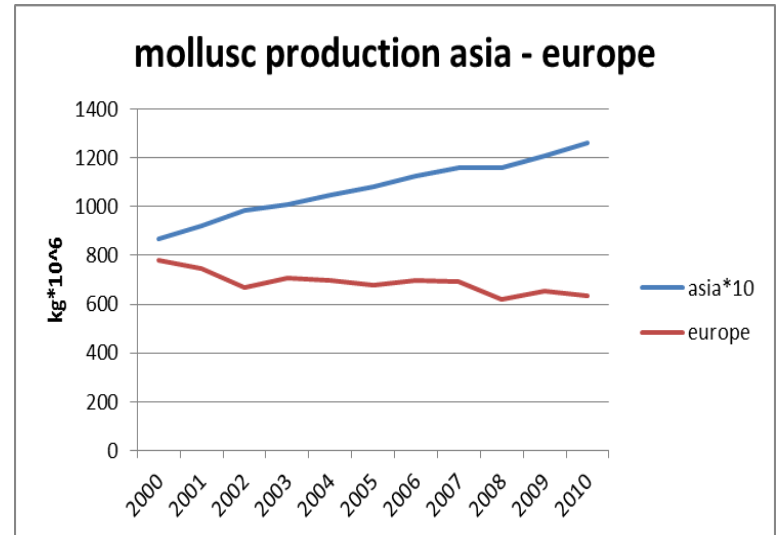
*This project receives funding  
from the European Union's  
Horizon 2020 research and  
innovation programme under  
grant agreement No 678193.*

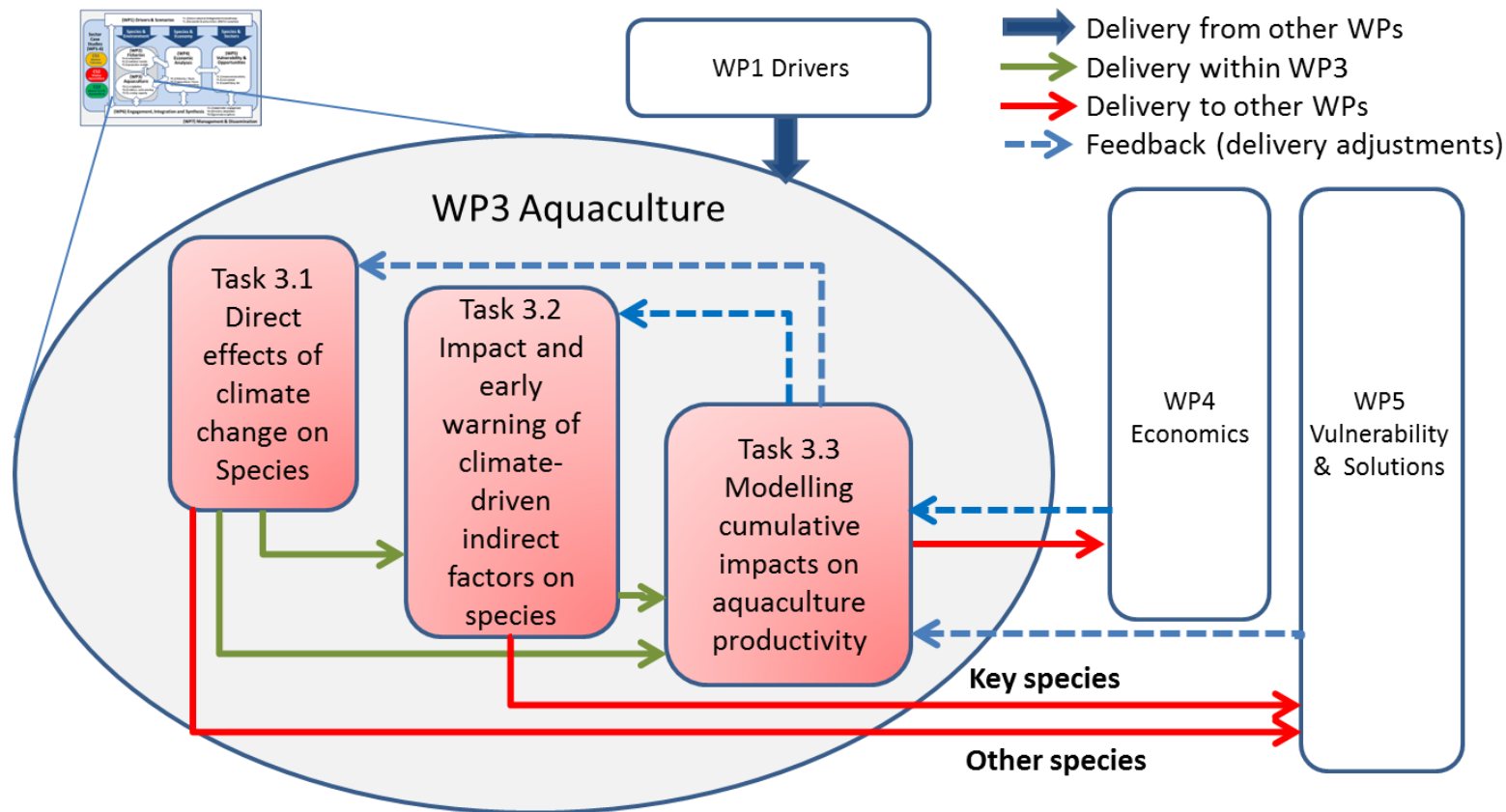


Need for adaptation to CC

Global production  
fast growth + 5 % per  
year

EU production declining





	Species group	Region	Species
→	SG10	North Sea	blue mussel
→	SG11	North Sea	blue mussel
	SG12	North Sea	Pacific oyster, European oyster
	SG13	Iberian Atlantic	manila clam, carpet shell
	SG14	Iberian Atlantic	Pacific oyster, Portugese oyster
	SG15	Mediterranean Sea	manila clam, carpet shell
→	SG16	Mediterranean Sea	Mediterranean mussel

mussels



oysters



clams

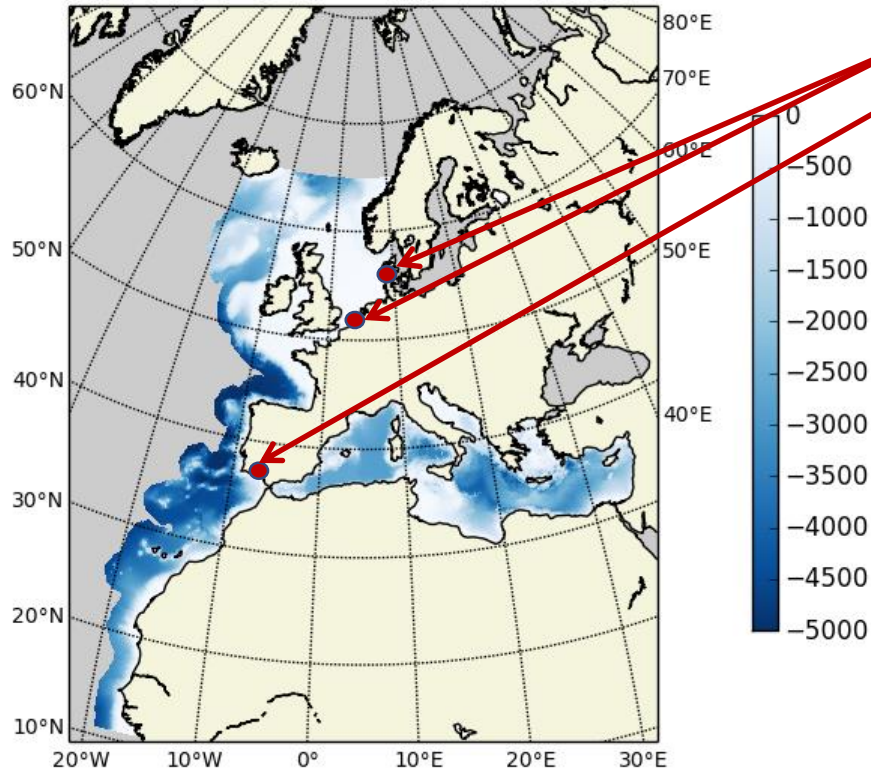


# CERES

Climate change and European aquatic RESources

# CC scenarios PML

GCOMS domains for CERES



Coastal areas in

North Sea (NL+DK)

Iberian Atlantic (PT)

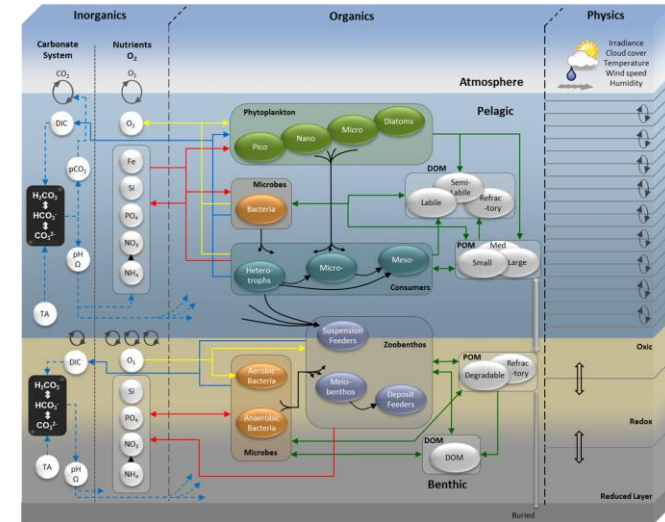
Temperature

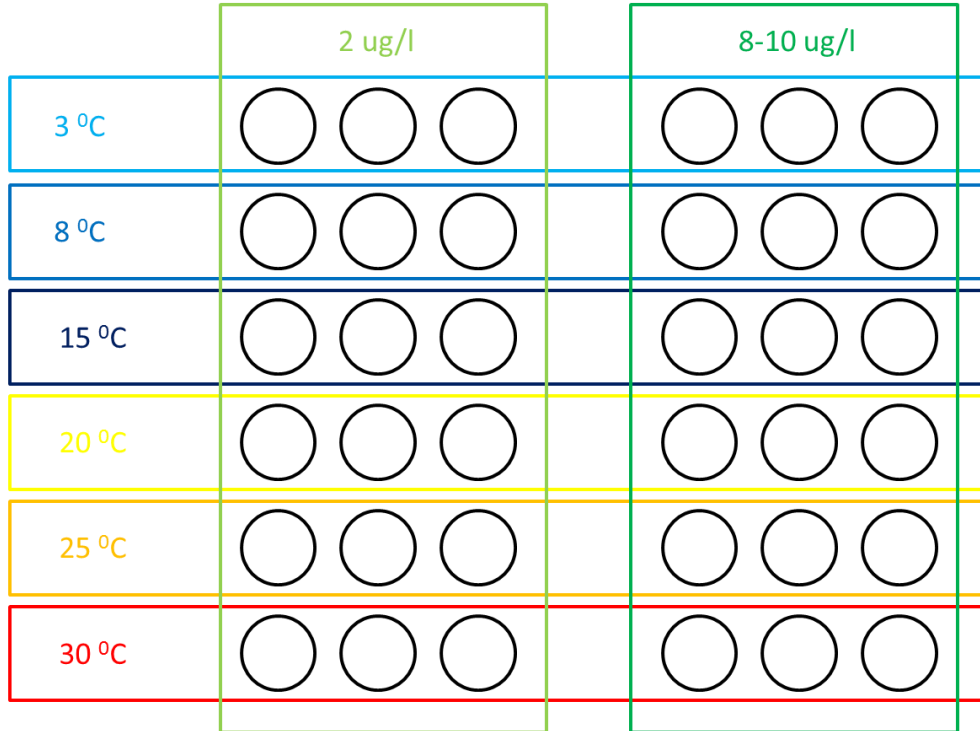
Salinity

Oxygen

pH

Phytoplankton chlorophyll





## Set-up

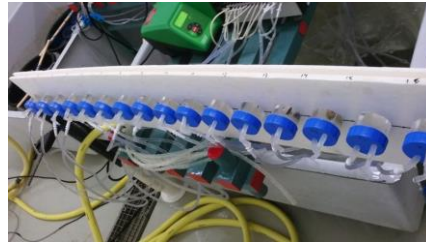
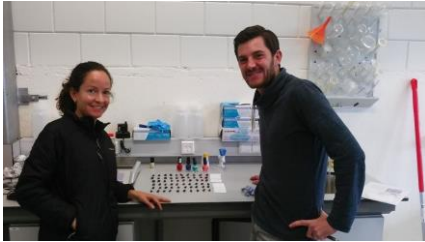
3 replicate tanks with 10 individuals per species and origin

species and origins:

*Mytilus edulis* (NL, DK)

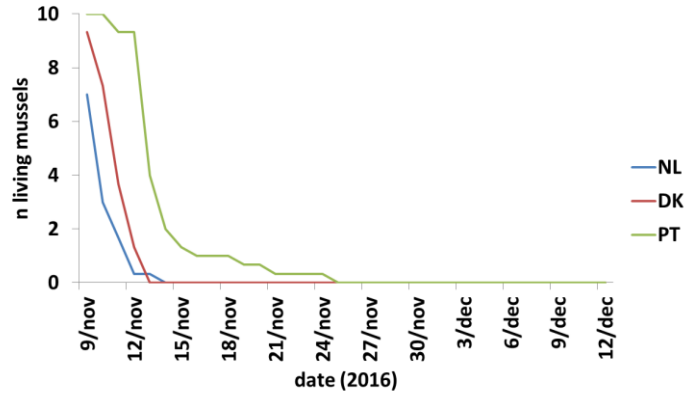
*Mytilus galloprovincialis* (PT)

1 size class: juvenile

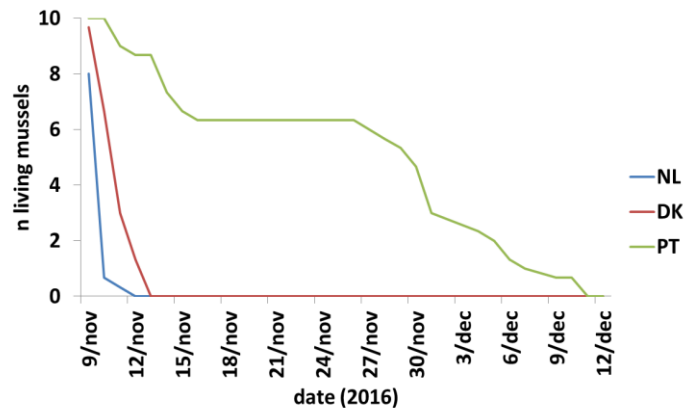


- Period treatment: ~35 days
- Conducted Nov - Dec 2016
- Salinity ~30 psu
- Individually marked shellfish
- Continuously fed
- Algae: *Isochrysis galbana* and *Skeletonema costatum*
- Growth rate and survival
- Clearance rate and oxygen consumption determined at the end

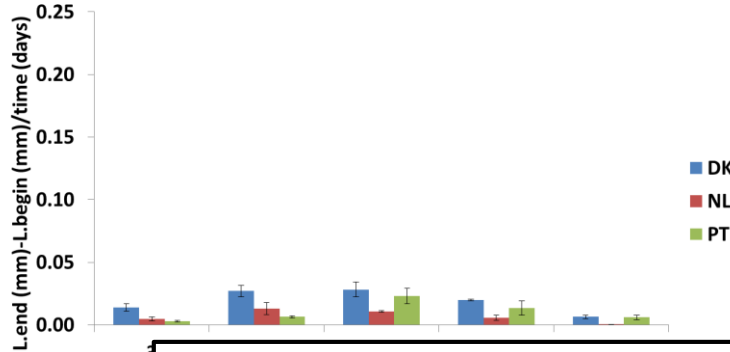
Survival mussels at 30 °C (2 µg)



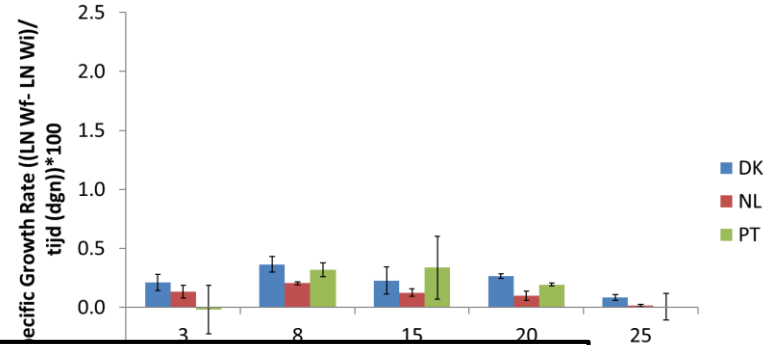
Survival mussels at 30 °C (10 µg)



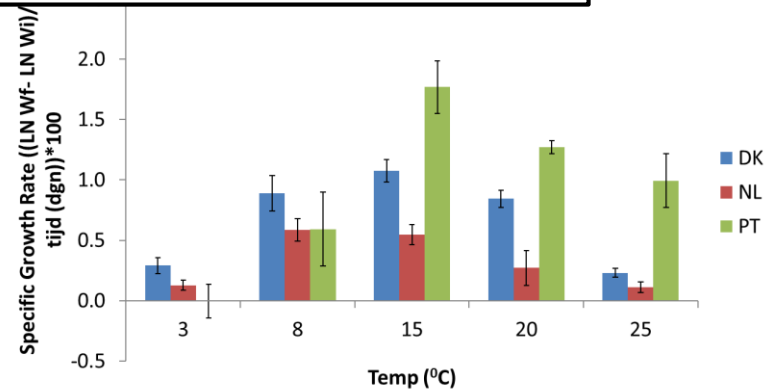
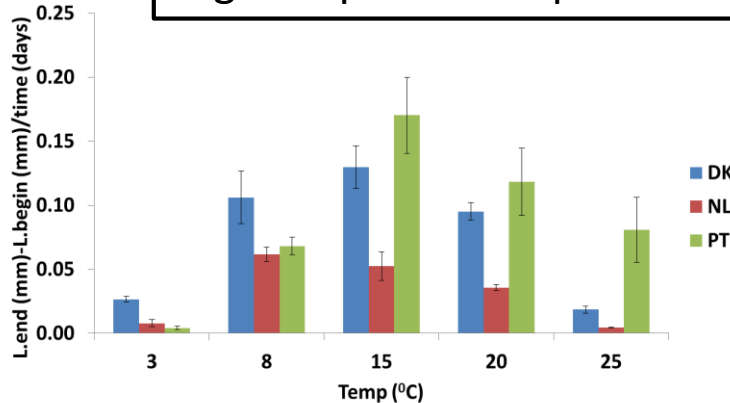
No survival of mussels at 30 °C  
Longest survival of Portuguese mussels at high food

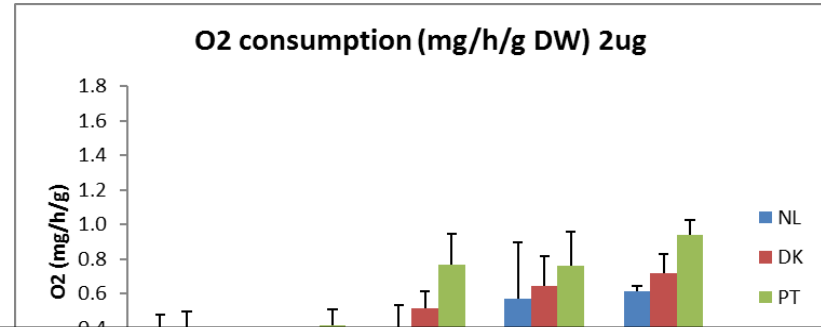
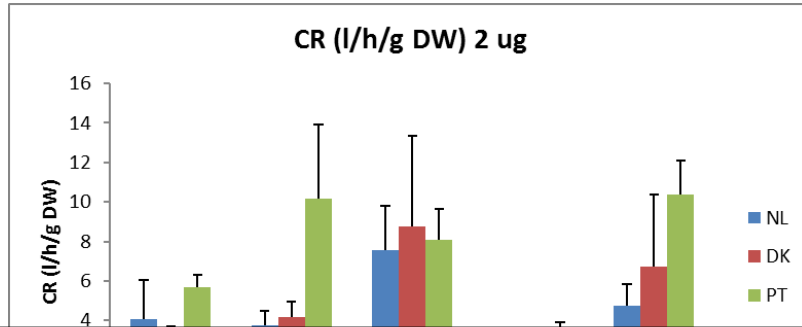
Shell growth in mm day<sup>-1</sup> mussels (2 µg)

Specific Growth Rate mosselen (2 µg)

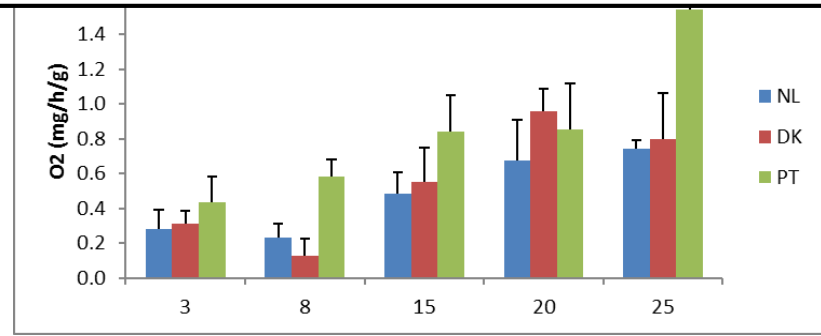
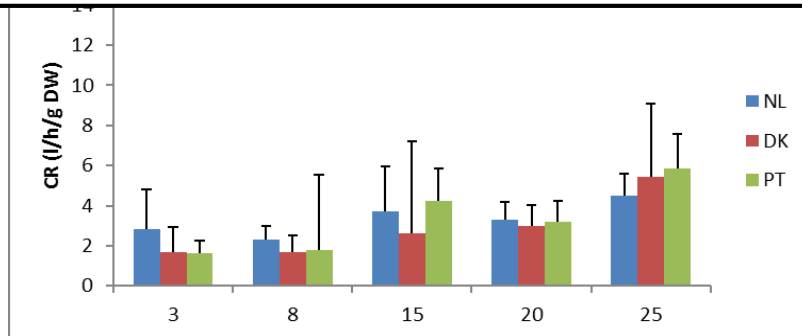


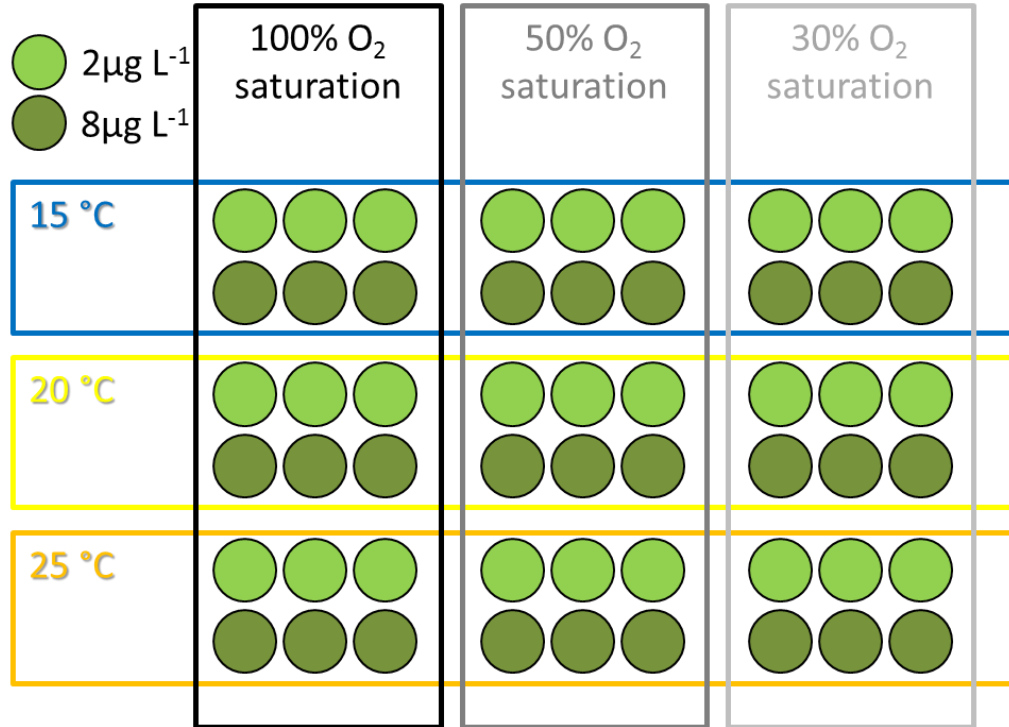
Significant effect of temperature and food on growth  
Higher optimal temperatures at high food conditions





Significant effect of temperature and food on clearance rate and oxygen consumption  
Lower clearance at high food conditions  
Increase in clearance rate with increase of temperature at high food  
Increase in oxygen consumption with increase of temperature





### Set-up

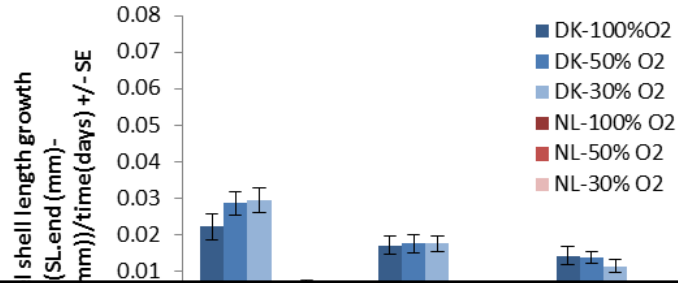
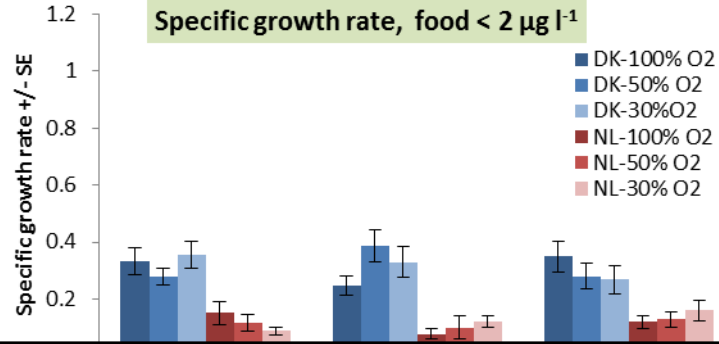
3 replicate tanks with 5 individuals per species, size class and origin

species and origins:  
*Mytilus edulis* (NL, DK)

4 size classes:  
Juvenile x2  
Adults x2



- Period treatment: ~20-30 days
- Conducted Nov - Dec 2016
- Salinity ~27 psu
- Individually marked shellfish
- Continuously fed
- Algae: *Rhodomonas salina*
- Growth rate and survival
- Clearance rate and oxygen consumption determined during the experiment

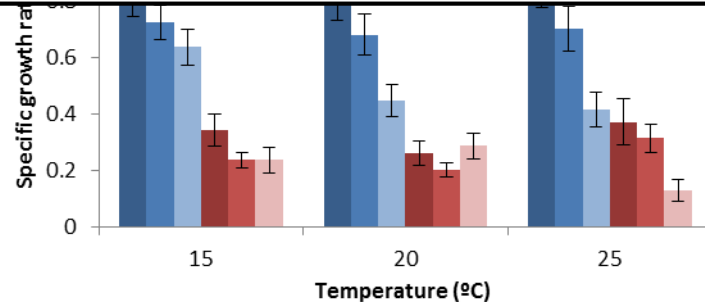
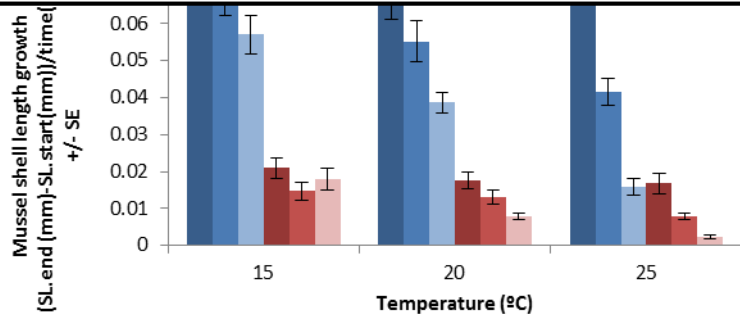
Shell growth mm d<sup>-1</sup>, food < 2 µg l<sup>-1</sup>Specific growth rate, food < 2 µg l<sup>-1</sup>

Significant effect of oxygen concentration and food on growth

Significant effect of interaction between temperature and oxygen concentration

Danish mussels significantly growing faster than Dutch mussels

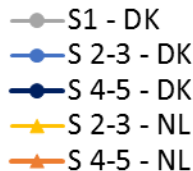
Higher optimal temperatures at high food conditions



**100% O<sub>2</sub>****Food > 5  $\mu\text{g L}^{-1}$** 

0.18

0.16

**50% O<sub>2</sub>****Food > 5  $\mu\text{g L}^{-1}$** 

0.18

0.16

**30% O<sub>2</sub>****Food > 5  $\mu\text{g L}^{-1}$** 

0.18

0.16

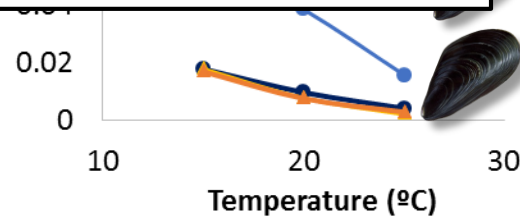
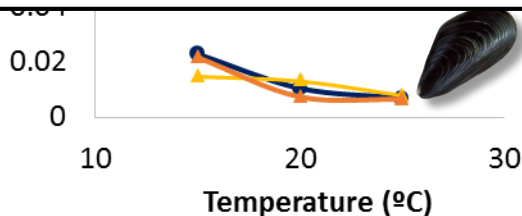
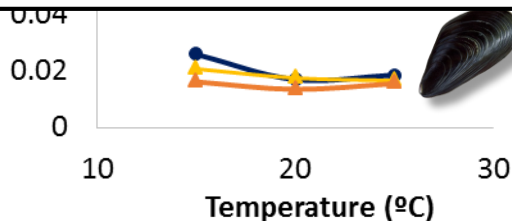


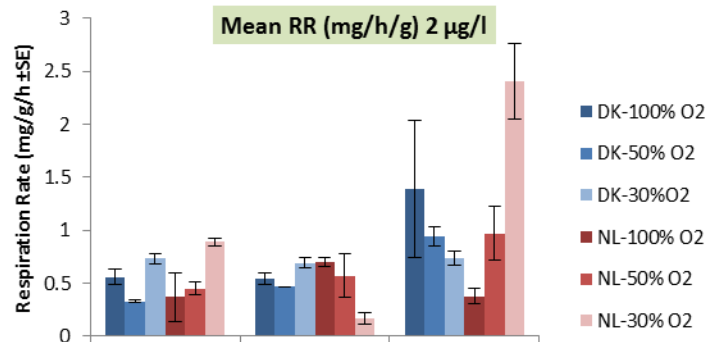
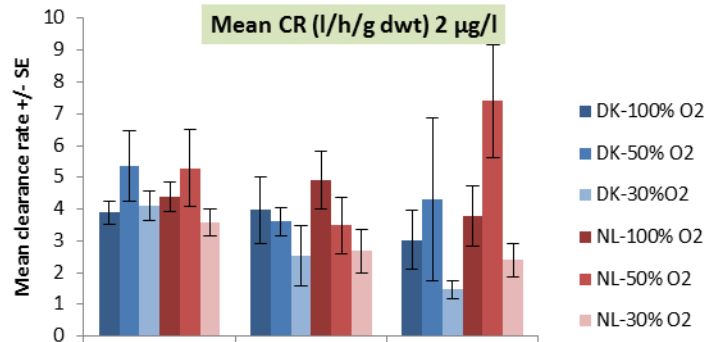
Significant effect of temperature on growth when oxygen concentration decreases

Growth curve is different between DK and NL:

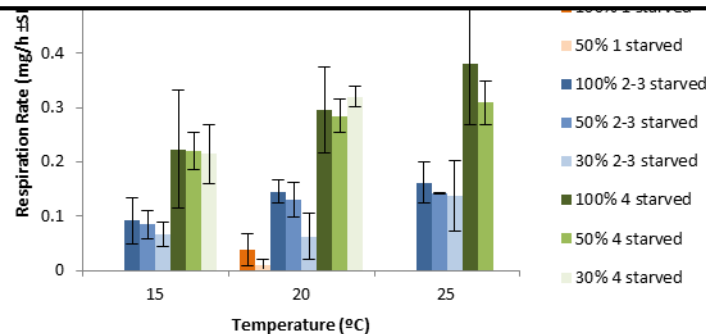
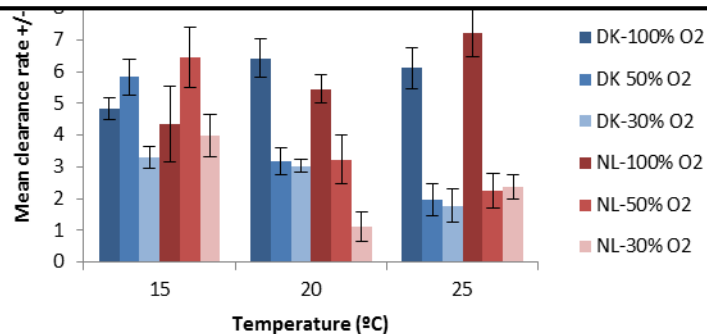
For the same experimental size: 2-3 cm, DK mussels are probably younger hence with faster growth.

At 4-5 cm, DK and NL have similar growth rates.

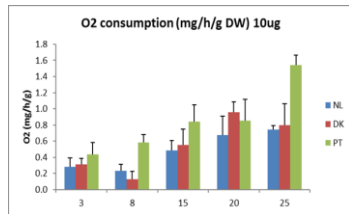
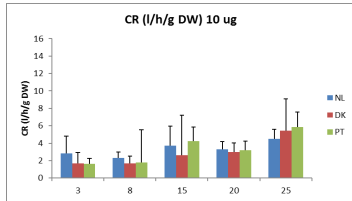
Growth mm day<sup>-1</sup>



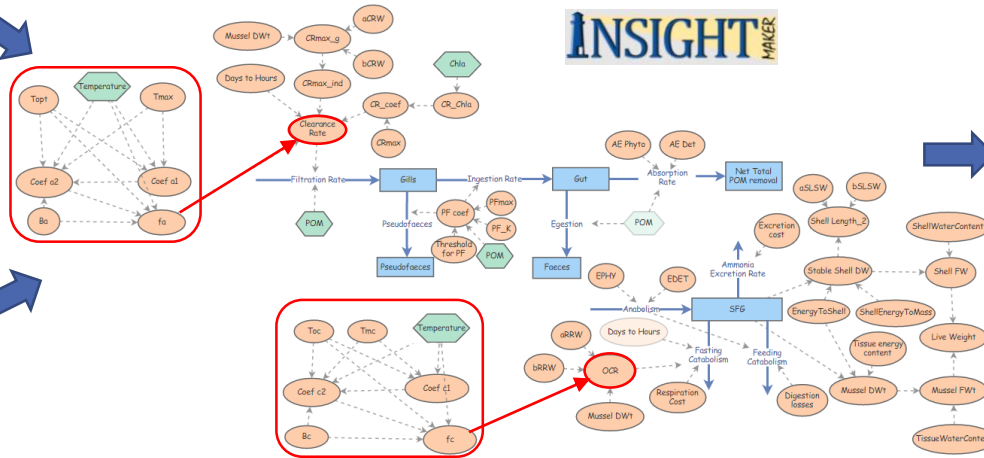
Significant effect of interaction high temperature and low oxygen concentration on reducing clearance rate and increasing oxygen consumption  
Increase in oxygen consumption with increase of temperature



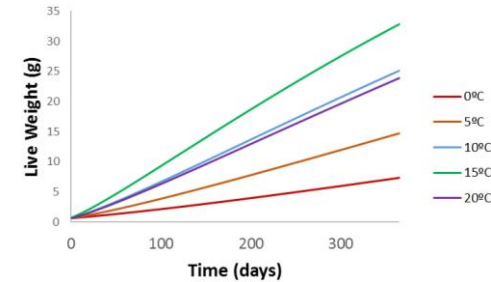
## Experimental results



## Bioenergetic individual mussel model



## Growth outputs of the model at different temperatures



Temperature effects on CR and oxygen consumption obtained from the CERES experiments will be used to calibrate and validate growth models



Thanks to Ainhoa Blanco, Alhambra Cubillo, Pim van Dalen, Ad van Gool, Johan Jol, Jack Perdon, Jeroen Wijsman, Kim Gregersen, Anita Hansen, Ásthildur Erlingsdóttir and Pascal Barreau for building the set-up, running the experiments and data processing.

*This project receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 678193.*

A wide-angle photograph of a coastal area with mountains in the background. In the foreground, there are several large, circular, green-netted structures floating in the blue water, likely part of a marine research or aquaculture setup. A small white boat is visible in the middle ground. Red buoys are scattered throughout the water.

Visit us:  
[ceresproject.eu](http://ceresproject.eu)

For further information  
please contact:

Thank you for your attention  
[pauline.kamermans@wur.nl](mailto:pauline.kamermans@wur.nl)